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Magnitude and Associated Factors of Delayed Long Bone Fracture Fixation With Surgical Implant Generation Network Nail in Tibebe Ghion Specialized Hospital, 2021gc, Ethiopia

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DEPARTMENT OF ORTHOPEDICS AND TRAUMA SURGERY

MAGNITUDE AND ASSOCIATED FACTORS OF DELAYED LONG BONE FRACTURE FIXATION WITH SURGICAL IMPLANT GENERATION NETWORK NAIL IN TIBEBE GHION SPECIALIZED HOSPITAL, 2021GC, ETHIOPIA

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A RESEARCH THESIS SUBMITTED TO BAHIRDAR UNIVERSITY, COLLEGE OF MEDICINE AND HEALTH SCIENCES, DEPARTMENT OF ORTHOPEDICS & TRAUMA SURGERY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR SPECIALTY CERTIFICATE TRAINING IN ORTHOPEDIC AND TRAUMA SURGERY

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	Study design	Cross sectional study
	Study project	Magnitude of Delayed fracture Fixation with Surgical Implant Generation Network Nail and associated factors among Patients with long bone
	Study area	TGSH, department of orthopedic and Trauma surgery

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.

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Acronyms and Abbreviations

AIS……..…..Abbreviated Injury Scale

ARDS …… Acute Respiratory Distress Syndrome

BDU …….Bahir Dar University

CI……..…….Confidence Interval

CPP……Cerebral Perfusion Pressure

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

FES……..…… Fat Embolism Syndrome

GC…….... Gregorian calendar

GCS…….. ……Glasgow Coma Scale

GP……General Practitioner

ICP…….Intracranial Pressure

ICU……...Intensive Care Unit

IMN …….Intramedullary Nail

ISS…… ……..… Injury Severity Score

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

OR……..……Odds Ratio

OR……..Operation Room

PE…….....Pulmonary Embolism

PI……...Principal Investigator

RTA …….Road Traffic Accident

SIGN……...Surgical Implant Generation Network

SOSD……..…SIGN Online Surgical Database

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

TBI ……..…….Traumatic Brain Injury

TGSH……..……Tibebe Gion Specialized Hospital

WHO…….…..….. World Health Organization

VTE……..…Venous Thromboembolism

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ABSTRACT

Introduction: The Magnitude of delayed long bone fracture fixation was variable in deferent setups; it reached 67.7% to 81 %. The reasons mentioned were shortage of operating theater slot, increased age, sever associated injury, and comorbidities. In our setup, both the magnitude and associated factors for long bone fracture definitive fixation with intramedullary Nail were not studied.

Objective: To assess magnitude and associated factors of delayed long bone fracture fixation with Intramedullary Nail in Tibebe Gion specialized hospital from January 13/2019-January 16/ 2021GC.

.**Method:** The study was conducted using a cross –sectional study and 290 patients were selected from patients admitted and operated at Tibebe Gion specialized hospital using SIGN nail from January1/2019GC to January 13/2021GC and registered on SIGN online database. The Data was collected from SIGN Online Surgical Database and patient's chart and entered into Epi-Info version 7.2 and analyzed with the Statistical Package for Social Science (SPSS) version 26. To describe the study population, descriptive statistics were used. Binary logistic regression was used to assess the influence of independent factors on the dependent variable. The final association was presented using Adjusted Odds ratio (AOR) with 95 % confidence interval (CI) and P value < 0.05 level of significance as cut of point.

Results: The magnitude of delayed long bone fracture fixation was 64.1% (95% CI: 59-69.7). The mentioned reasons for were lack of operating time (52%), medical conditions/comorbid (16.7%), sever associated injury(9.8%) , lack of SIGN nail implant (2%), lack of blood (1.5%), lack of Fund (1%) and others(17.2%) like, contaminated open fracture , delayed antibiotics initiation etc. Time from injury to debridement [AOR: 7.934, 95% CI (1.314, 47.898)], Severity of open fracture (GustiloAnderson open fracture classification) [AOR: 2.891, 95% CI (1.037, 8.060)], were significantly associated with Delayed long bone fracture definitive fixation with SIGN nail.

Conclusion and Recommendation: The magnitude of delayed long bone fracture definitive fixation in Tibebe Gion Specialized Hospital was high. Time from injury to debridement and irrigation, severity of injury (GA classification), and sever associated injury were factors significantly associated with delayed long bone fracture definitive fixations. Therefore, intervention should ensure for patients with open long bone fracture to have early debridement and irrigation and definitive fixation.

Key words; delayed fixation, long bone fracture, SIGN, Reasons for delayed long bone fixation

1. Introduction

1.1. Background

Long bones are longer than they are wide and these includes femur, tibia, fibula, humerus, ulna, radius, metacarpals, metatarsals, and phalanges(1).

Fractures are common and are a major social and financial burden in many countries. The incidence of adult fracture is said to be 1,351/100,000/yr in high income countries(2). Overall estimated incidence of musculoskeletal injuries in LMICS range from 779 to 1574 per 100,000 person-year(3). In 2016 deaths after trauma were 34, 959, which is more than death with HIV. The commonest cases of musculoskeletal trauma in Ethiopia are fall, mechanical force and transport injuries(4). A study on 422 x-ray proven fractures in Tikur Anbessa Hospital in six month time showed lower extremity fracture are the commonest fractures, and among them Femur was commonest followed by Tibia(5).

Long bone fracture of can be classified as open and closed fracture. An open fracture is defined as an injury where the fracture and the fracture hematoma communicate with the external environment, and or to the gastrointestinal tract or genitourinary tract through a traumatic defect in the surrounding soft tissues and overlying skin(2). Even though there are other classifications system of open fractures, Gustilo-Anderson classification is widely used; which is based on wound size, degree of contamination, and the degree of energy that caused the fracture(6). Type I fractures have a skin laceration of less than 1 cm and caused by low energy injury trauma. Type II fractures have a laceration size ranging between 1 cm and 10 cm. Type III fractures have a laceration size greater than 10 cm, extensive soft tissue injury , High energy injury, segmental osseous defect, extensive contamination & those patients who present to health facility greater than 8 hours from injury. It has three subtypes; Type IIIA the wound can be closed or re-approximated. It also includes any wound size with heavy contamination with or without segmental and/or comminuted fracture patterns, which signifies high energy injury. Type IIIB fractures have lacerations greater than 10 cm, but the wound cannot be re-approximated and require tissue flap for closure. Type IIIC fractures are open wounds with an associated vascular injury requiring repair for limb salvage(6).

The Management options for long bone fracture (Femur, tibia) are Intramedullary Nail (IMN), plate and screw, and External fixation(2,6–8). Over the years intramedullary nailing has become the standard treatment of lower limb long-bone diaphyseal and selected metaphyseal fractures

providing sufficient stability with limited soft-tissue dissection(9). Early Locked Intramedullary nails are safe or use in nailing procedures for closed and open fracture (types I, II, and IIIA open fractures) with initiating immediate intravenous antibiotic coverage depending on the wound type, followed by urgent debridement and irrigation , and fixation. Because types IIIB and IIIC are complex fractures with increased complications and adverse advents, in most of cases temporary external fixation may be prudent until a medically stable patient and wound allowed and then later may be change to IMN(2,6–8).

Despite recognition that patients with long bone fractures benefit from early definitive fixation with in 24hrs of admission, the degree to which this is achieved is unknown. Possible reasons to delay definitive fixation (>24hrs) at patient level are ongoing hemodynamic instability, coagulopathy, and fluctuations in cerebral perfusion, sever associated injuries like Severe thoracoabdominal injury and serve head injury, noncommercial insurance, comorbidities (like chronic renal failure, bleeding disorder including chronic anticoagulation etc.) and increasing age. At the hospital level, differences in processes of care predominantly driven by physician decision-making, institutional bureaucracy, lack of appropriate equipment(10,11). Shortage of operating time, and increased prevalence of polytrauma that should be stabilized before the surgical intervention could be also some of the reasons for delaying fixation(12).

Even though Intramedullary nailing is the standard treatment of lower limb long-bone diaphyseal and selected metaphyseal fractures (9), the cost of these implants makes them inaccessible for many patients in low-income and middle-income countries (LMIC) especially people who visit the public institution(13). Lewis G. Zirkle Jr. MD formed Surgical Implant Generation Network (SIGN) in 1999GC, with a vision of creating equality of fracture care throughout the world. The SIGN nailing system was specifically designed for use in resource-limited settings and does not require intraoperative fluoroscopy, power instrumentation, or specialized operating tables, equipment that is not universally available in the developing world(13). After doing procedures, and on follow up time SIGN surgeons report their patient's data to SIGN Online Surgical Database (SOSD (13,14).)

The SIGN Online Surgical Database (SOSD) is a database where prospectively collected data entered by surgeons at all SIGN sites worldwide. Data collected and entered into the SOSD at the time of admission and initial operative intervention include preoperative x-rays, Gustilo and Anderson open fracture type (if applicable), fracture location, time from injury to intravenous

antibiotic administration, and time from injury to initial surgical debridement, time of Fixation, reason for delay surgery if surgery not done early with in 24hours . Data collected at the time of intramedullary nailing include surgical reduction technique (open or closed), nail insertion technique (antegrade or retrograde), time from injury to nailing, time from injury to skin closure, and total duration of intravenous antibiotics. Postoperative x-rays are obtained immediately after surgery, and follow-up x-rays are generally obtained at all postoperative outpatient visits. Clinical follow-up data collected in the SOSD include weight-bearing status, ability to kneel, presence or absence of deep infection, and need for repeat surgery(15).

Since January 2008, it has become possible to achieve interlocking nail insertion in Ethiopia, because of SIGN by providing training and equipment, inter locking intramedullary nails with interlocking screws (Sign nails)(16). Bahirdar University, also get the this implant with free since 2014GC and still in use for long bone fracture fixation(17).

1.2. Statement of the problem

Study in surgical emergency department of Tikur Anbessa University Hospital Addis Abeba showed that upper and lower limbs were injured in almost equal proportions 3555 (49.7%) and 3113 (43.5%) respectively, while only 413 (5.8%) had more than one limb involved. The leg (below knee) was the commonest limb site injured 1602 (22.2%) (18). other study done on common types and pattern of bone fractures among road traffic injury victims seen in public hospitals of Addis Ababa showed that musculoskeletal injuries commonly affected the lower limbs (33.6%) and upper limbs (11.5%). Tibia (33.3%) and Femur (20.2%) fracture are common lower limb fractures(19).

Regarding open fracture, extrapolating from European studies, about 4% of all fractures are open or about 250,000 open fractures annually in United States. Other studies noted that open fractures occur at a rate of 11.5 per 100,000 persons per year (6). Because one third of the tibial surface is subcutaneous and lack soft tissue coverage throughout most of its length, open fractures are more common in the tibia than in any other major long bone (6,8,20). In Ethiopia; studies showed that this open fracture is higher than western. More than 20% of all adult fractures presenting to TASH were open fracture, and a considerable number (35%) of these occurs on the tibia. According to Gustilo- Anderson open fracture classification, 50% of the fracture was Gustilo grade III (33.3- IIIA, 13.9% - IIIB, and 2.7% was IIIC), followed by grade II (27.7%) and grade I (22.3%) respectively(21). In another study Among all open fractures,

more than two-third, 214 (71.1%) were Gustilo grade III (Gustilo-IIIA: 166 (55.1%), Gustilo – IIIB: 30 (10%) and Gustilo- IIIC: 18 (6%)) followed by Gustilo II (17.6 %(12). Prospective descriptive-analytical study done in Addis Abeba three hospitals (Black lion, Saint Paul and Yordanos) with femoral and/or unstable tibial fracture and treated using SIGN nail from January 2008 to January 2010 revealed the prevalence of Open fractures to be 12.2%(16).

The Magnitude of delayed long bone fracture fixation was variable in deferent setups. Prospective observational study done on incidence and causes of delay for treatment for long bone fracture of lower limb in Bharati Hospital Dhanakawadi, Pune, Maharashtra, India showed delayed long fracture fixation was 81.1% (22). other study done in Ibadan, Nigeria, departments of Orthopedics and Trauma, Child Oral Health, University College Hospital showed delay in 50% of cases (23). In Ethiopia, it is not well studied. However, a prospective observational study on open long bone fracture at Tikur Anbessa and Hawassa University Hospitals showed that only 32.5% of patients with open long bone fracture get initial surgical intervention within the first 24 hours of admission. Whereas more than two-thirds of patients (67.7%) get operated on after waiting for more than 24 hours after hospital presentation, and 40 patients (13.3%) were operated on after 48 hours in-hospital stay(12).

Patients treated at centers in which delayed fixation was most common were at significantly greater risk of PE and required longer hospital stay(10). Patients treated at trauma centers in the highest quartile of delayed fixation were at significantly higher risk of PE (mean PE rate 2.6% versus 1.3%; RR 2.0; 95% CI 1.2–3.2). Trauma centers most likely to perform delayed fixation also had significantly longer lengths of stay (median 7 days versus 6 days; RR 1.15; 95% CI 1.12– 1.19) (10). While decision-making in patients with severe multiple-system injuries is complex, early definitive care is feasible and safe in the majority of patients (24). For this reason, surgical fixation within 24 hours is conditionally recommended in current practice management guidelines (25). While evidence is strong that definitive fixation within 24 hours is both feasible(24) and associated with improved outcomes(26).

Study showed that if proper debridement and irrigation done early with 24 hrs. of injury, most of open long bone fracture can be safely fixed with SIGN nail(2,6,8). Despite recognition that patients with long bone fractures benefit from early definitive fixation with in 24hrs of admission, the degree to which this is achieved is unknown(12).

There are limited studies done to show the reasons of delance of long bone fracture fixation. A retrospective cohort study of done in United States trauma centers show that; increasing age, black race (OR 1.21; 95% CI 1.08–1.35), noncommercial insurance (OR 1.15; 95% CI 1.05–1.26), and comorbidities were significant predictors of Patient factors associated with delayed fixation. Chronic renal failure (OR 2.35; 95% CI 1.55–3.56) and bleeding disorders (including chronic anticoagulation) (OR 1.61; 95% CI 1.36–1.92) were the comorbid conditions most predictive of delayed surgery. These findings represent the strong influence of comorbidity on clinical decision making in this patient population and the additional time required to coordinate surgical treatment in medically-complex patients. Hemorrhage control and correction of coagulopathy are other common reasons for postponing the treatment of orthopedic injuries, with the goal of minimizing occult hypoperfusion(11). Severe abdominal injury, early transfusion, and early thoracic or abdominal surgery, shock or decreased Glasgow coma scale (GCS) in the ED, and need for early neurosurgery were also significantly associated with delayed fixation(10). Other study prospective observational study done in Bharati Hospital Dhanakawadi, Pune, Maharashtra, India showed that medical condition (55%) and financial reasons(31.7%), were the most common reasons followed by infrastructure issue(unit system /non availability of implant (14.3%) and had plan of surgery(22). In Ethiopia, observational study on open long bone fracture showed that Lack of proper prioritization of open fracture, shortage of operating time and resources, and increased prevalence of polytrauma that should be stabilized before the surgical intervention could be some of the reasons for delance (12). This study done only on open long bone fractures and not specifies whether debridement and irrigation only or including IMN Fixation were done for the patients.

There is no study done on the magnitude of delayed long bone fracture with SIGN and associated factors in Ethiopia. So, this study will try to find the magnitude as well as possible factor for delay. It also fills the existing gap of literature and used as baseline study in our hospital for future other studies.

1.3. Significance of the Study

Patients with long bone fracture are benefited from early definitive fixation. It decrease morbidity like complication related to prolonged immobilization, and decrease extra cost/charge, shorten hospital length of stay which itself make beds available for other waiting trauma patients for bed, aid early mobilization of the injured limb make early functional recovery and early

return to work. Determining the magnitude of delayed long bone fracture fixation IMN (SIGN nail the only available IMN in our setup) and possible reasons for delay can improve the quality of care give to our patients. Studies on magnitudes of delayed long bone fracture fixation and associated factors are limited and most are in western countries. There is no study in this topic in our setup. This research will not only try to fill the gap of lack of studies done in our setup on this topic but also can aid for other hospitals in Ethiopia as well as other LMICs which face similar challenges from the delay of treating patients. And this may also aid for policy makers, multilateral donors in university, service providers and thereby solve the problems for the delay of long bone fracture and also patients to get timely appropriate care. As this is the first study in our setup it also will be used as a baseline for other future studies.

1.4. Literature Reviews

Magnitude of delayed long bone fracture fixation

The Magnitude of delayed long bone fracture fixation was variable in deferent setups. Prospective observational study done on incidence and causes of delay for treatment for long bone fracture of lower limb in Bharati Hospital Dhanakawadi, Pune, Maharashtra, India showed delayed long fracture fixation was 81.1% (22). other study done in Ibadan, Nigeria, departments of Orthopedics and Trauma, Child Oral Health, University College Hospital showed delay in 50% of cases (23)

In Ethiopia, it is not well studied. However, a prospective observational study on open long bone fracture at Tikur Anbessa and Hawassa University Hospitals showed that only 32.5% of patients with open long bone fracture get initial surgical intervention within the first 24 hours of admission. Whereas more than two-thirds of patients (67.7%) get operated on after waiting for more than 24 hours after hospital presentation, and 40 patients (13.3%) were operated on after 48 hours in-hospital stay(12).

Factors associated with timing of fixation

A retrospective cohort study of done in United States trauma centers show that patient related factors; specifically, increasing age, black race (OR 1.21; 95% CI 1.08–1.35), noncommercial insurance (OR 1.15; 95% CI 1.05–1.26), and comorbidities were significant predictors for delayed fixation. Chronic renal failure (OR 2.35; 95% CI 1.55–3.56) and bleeding disorders (including chronic anticoagulation) (OR 1.61; 95% CI 1.36–1.92) were the comorbid conditions

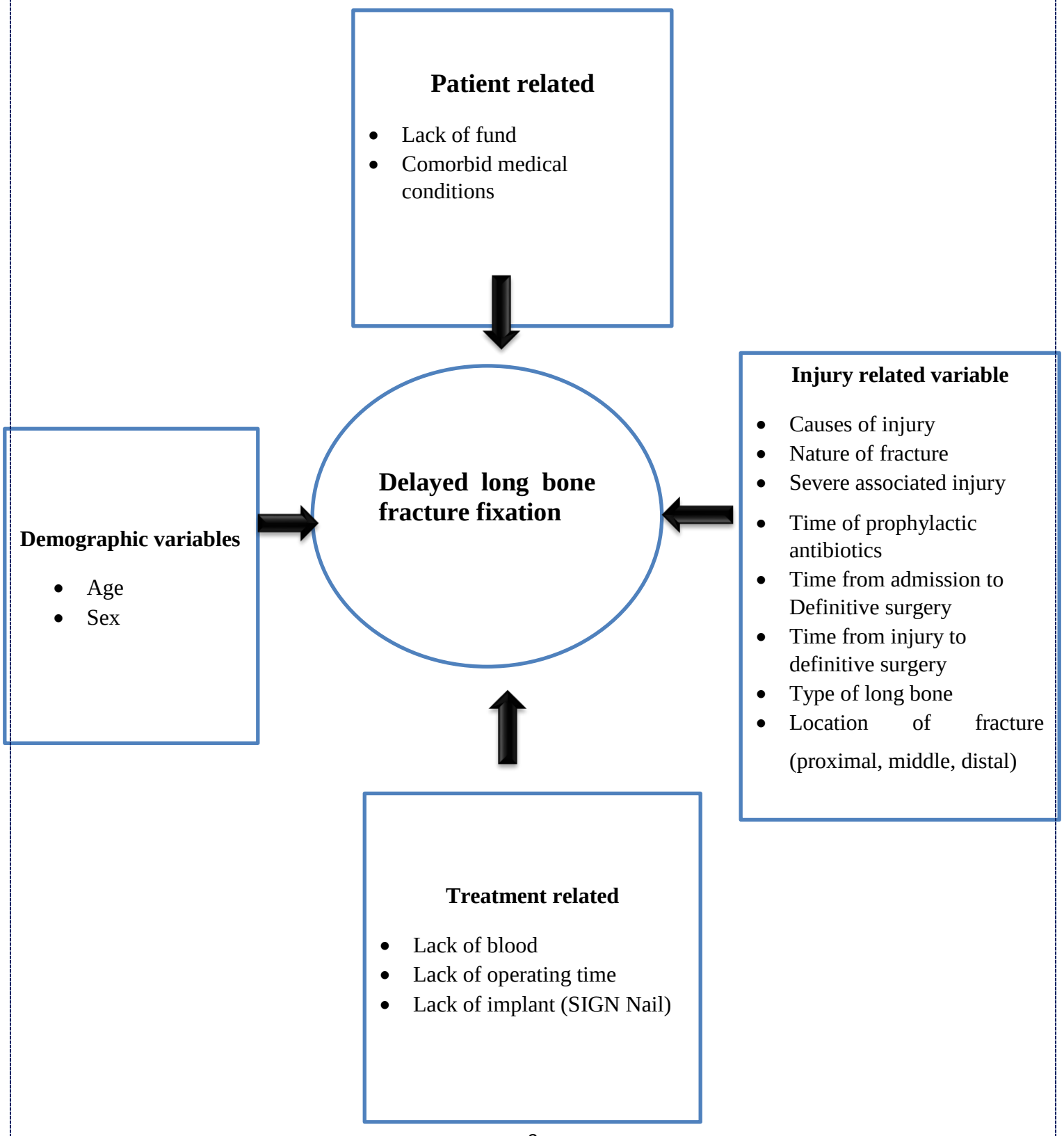
most predictive of delayed surgery(10). Severe abdominal injury, early transfusion, and early thoracic or abdominal surgery, shock or decreased Glasgow coma scale (GCS) in the ED, and need for early neurosurgery were also significantly associated with delayed. At the hospital level, differences in processes of care predominantly driven by physician decision-making, institutional policies, or allocation of resources are also likely to influence the timing of fixation, independent of patient factors (10). Conversely, high-energy mechanisms of injury (motor vehicle or motorcycle crash and pedestrian injury) and open femur fractures (OR 0.50; 95% CI 0.44–0.58) were strongly associated with early fixation (10). Earlier study also showed that Hemorrhage control and correction of coagulopathy are other common reasons for postponing the treatment of orthopedic injuries, with the goal of minimizing occult hypoperfusion(11).

Prospective observational study done in Bharati Hospital Dhanakawadi, Pune, Maharashtra, India showed that medical condition (55%) and financial reasons(31.7%), were the most common reasons followed by infrastructure issue(unit system /non availability of implant (14.3%) and had plan of surgery(22)

In Ethiopia there is no well specific study on reason for delayed long bone fracture fixation with SIGN Nail but A prospective observational study at Tikur Anbessa and Hawassa University Hospitals study showed that open fracture cases are not get early even primary surgical intervention . It could be due to various factors. Lack of proper prioritization of open fracture, shortage of operating time and resources, and increased prevalence of polytrauma that should be stabilized before the surgical intervention could be some of the reasons(12).

There is limitation of literatures to show the magnitude and associated factors of delayed long bone fracture fixation with IMN (SIGN nail). Most above evidences showed the benefits of early fixation over delayed fixation, and also showed possible associated factors for delayed fixation. Even this few researches done in developed world. In LMICs including Ethiopia, which are mostly using SIGN Nail implant for long bone fixation, there is lacking of study done on this specific area, so this research is important. It will help to determine the magnitude of the delayed long bone fracture fixation with SIGN Nail and associated factors and based on the finding recommendation can also draw for our setup higher officially and policymaker, and used as reference for future research.

Figure 1. Conceptual framework



2. Objective:

2.1. General objective:

- To assess magnitude and associated factors of delayed long bone fracture fixation with Surgical Implant Generation Network Nail

2.2. Specific objective:

- To determine magnitude of delayed long bone fracture Fixation with Surgical Implant Generation Network
- To identify associated factors for delayed long bone fracture fixation with Surgical Implant Generation Network Nail

3. Methods and Materials

3.1. Study Design and Period

Cross sectional study design was used on patients admitted at TGSH with diagnosis of long bone fracture and with SIGN intramedullary Nail reviewed and analyzed from March/ 2022- June/ 2022GC

3.2. Study Area

The study was conducted at TGSH which found 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 tertiary teaching hospital of Bahir Dar university college of medicine and health science under Bahir Dar University. The hospital started giving service in January 2019 G.C and it is the largest hospital in the city. Currently, the hospital is delivering different clinical services to the region. The hospital provides obstetrics, pediatrics, internal medicine, ophthalmology, general surgery, gynecology, ENT (ear, nose, and throat) and orthopedic surgery services. A wide range of procedures are performed. Electively and the emergency caseload are high with a large volume of trauma. The study was done among trauma cases who visited at TGSH with diagnosis of Long bone fracture

3.3. Source Population

All Patients admitted with diagnosis of long bone fracture in the orthopedic surgery department and operated with SIGN nails at TGSH from Jan 13/2019 to January 16/2021GC

3.4. Study population

Selected patients admitted with diagnosed to have long bone (femur, tibia and Humerus) fracture and operated with SIGN intramedullary nail at TGSH from January 13/2019 to January 16 /2021 G.C

3.5. Eligibility criteria

3.5.1. Inclusion criteria

- Patients with long bone fractures admitted and fixed with SIGN Nail implant and whose operation note and other detail data is found from SIGN online surgical database or patient record chart

3.5.2. Exclusion criteria

- Patients who has incomplete or double recorded data on SIGN databases or patient record chart
- Patients who had done revision surgery

3.6. Sample size and Sampling technique

The sample size was calculated using Epi info 7 software versions with the population survey feature and with the assumption of 95% confidence interval (CI) & 50% expected frequency (because of lack of specific data on the prevalence of delayed fracture Fixation with Surgical Implant Generation Network Nail and associated factors). The population size from SOSD on the study period is 306, which gave a sample size of 170 and to increase the yield, and decrease errors all cases who were fulfill the inclusion criteria which are 290 were studied.

3.7. Study Variables

3.7.1. Dependent Variables:

- Delayed long bone fracture fixation using SIGN Nail

3.7.2. Independent Variables

- Age
- Sex
- Place/residence
- Mechanism of injury
- Associated injury
- Severity of injury (Gustilo Anderson classification)
- Bone involved
- Location of fracture (proximal, middle, distal)
- Timing of Prophylactic antibiotics
- Time from admission to definitive fixation

3.8. Operational Definitions

- Delayed long bone fixation: definitive surgical operation to fix of long bone done after splint, traction or external fixation; usually after 24 hours (24,25)
- Delayed antibiotic prophylaxis: antibiotic prophylaxis not given in 3 hours of injury(2,8)

3.9. Data Collection Tools and Data Collection Procedure

Data was collected from SIGN online Surgical Database by two data trained collectors from June 15 to June 30/ 2022GC. Data collection format prepared on Epi-info version7

3.10. Data quality assurance, processing and analysis

The Data was collected from SIGN Online Surgical Database and patient's chart and entered into Epi-Info version 7.2 with giving each case a unique code then imported to the Statistical Package for Social Science (SPSS) version 26 and analyzed. To describe the study population, Descriptive statistics like Frequency, percentage and, cross tabulation were used to describe the variables. Binary logistic regression was used to assess the influence of independent factors on the dependent variable. The final association was presented using Adjusted Odds ratio (AOR) with 95 % confidence interval (CI) and P value < 0.05 level of significance as cut of point. Graphs, charts and tables were used for data presentation and dissemination

3.11. Ethical considerations

Ethical clearance was obtained from the IRB of BDU research ethics committee. The data extracted from SIGN data base was used for the study and every data was kept confidential by securing personal information in passwords.

4. Result

From a total of 306 admitted patients and operated with intramedullary Nail between January 13, 2019G.C to January 16, 2021G.C in TGSH , Bahir Dar, 290 patients were studied. Among this a total of 16 patients weren't eligible for this study; 8 of them have incomplete data, and 4 patients had revision surgery admitted as elective case, 2 patients come late after managed with traditional bone setters and 2 of them were double reported.

4.1. Patient-related characteristics

Among the 290 patients, 233(80.3%) were male. The mean± SD of age for the study cases was 32.9±0.808 years; the minimum-maximum age range among cases studied was studied was 12-83 years. Femur bone fracture seen more common than Tibia and Humerus bone fractures. The Right side of the body was involved more common compared to the left side (table 1.

Table 1 Distribution of potential patient related characteristics long bone fracture patients TGSH, Bahirdar, Amhara Region , Ethiopia, January 2019- January 2021GC(N=290)

Variable	**Category**	**Number/ Percent (%)**
Age (yrs)	Mean ± SD	32.9±0.808
	Median	30.00
	Mode	30
	Minimum	12
	Maximum	83
Gender	Male	233 (80.3%)
	Female	57 (19.7%)

Side of the Limb	Right	162 (55.9%)
	Left	128 (44.1%)
Type of Bone	Femur	181 (62.4%)
	Tibia	102 (35.2%)
	Humerus	7(2.4%)

Table 2 : Frequency distribution of gender vs age relationship of study in TGSH , Hahir Dar, Amhara Region, Ethiopia, Jan 2019-jan 2021

		Sex		
		Male	Female	Total
Age	10-25	79	14	93
	26-40	105	26	131
	41-55	28	11	39
	> 55	21	6	27
Total		233	57	290

4.2. Injury-related characteristics

Commonly fractured sites were in the Middle and Distal aspects of the bone. Among the study subjects, 56.6%% were closed fracture, 43.4% were open fracture. The most frequent mechanism of injury was road traffic accidents (51.4%), followed by fall down accident (15.5%) and bullet injury (14.1%). The rest were others (19%) like stick injury, etc.

Table 3 Distribution of injury related characteristics of patient with long bone fracture at TGHS, Bahir Dar, Amhara Region, Ethiopia, Jan 2019-jJan 2021GC (N= 290)

Variable	**Category**	**Number/ Percent (%)**
Location bone fracture	Proximal	62 (21.4.0%)
	Middle	145(50%)
	Distal	83 (28.6%)

Nature of fracture	Closed	164 (56.6%)
	Open	126 (43.4%)
Open fracture based of Gustilo Anderson (GA)classification (N=126)	GA I	14 (11.1%)
	GA II	30 (23.8%)
	GA IIIA	79 (62.7%)
	GA IIIB	3 (2.4%)
	GA IIIC	0 (0%)
Causes of fracture	Road Traffic accident / Motor vehicle accident	149(51.4%)
	Bullet/blast	41 (14.1%)
	Fall down accident	45 (15.5%)
	Others	55 (19%)

4.3. Occurrence of Delayed Fixation and related characteristics

The magnitude of delayed long bone fracture definitive fixation with SIGN Nail was 64.1% with 95%CI (59% -69.7%). The delance of definitive fixation related to mechanism of injury was 48.4% for RTA, 16.1% for bullet/blast injury, 15.6% for fall down accident, and 19.9% for other causes like stick injury. Related to type of bone, Femur fracture was 66.1% followed by tibia fracture 31.2%. Related to nature of fracture most delayed fixation was closed fracture (59.1%).

Table 4 Occurrence of Delayed long bone fracture Fixation and related characteristics of patient at TGHS, Bahir Dar, Amhara Region, Ethiopia, Jan 2019-jJan 2021GC (N= 290)

Variable	**Category**	**Number/percent %**
Delayed Surgery (>24hrs from admission) (N= 290)	Yes	186 (64.1%)

	No	104 (35.9%)
Age	10-25yrs	59 (31.7%)
	26-40yrs	79 (42.5%)
	41-55yrs	24 (12.9%)
	>55yrs	24(12.9%)
Gender	Male	154 (82.8%)
	Female	32 (17.2%)
Causes of Fracture	Road Traffic accident / Motor vehicle accident	90 (48.4%)
	Bullet/blast	30 (16.1%)
	Fall down accident	29 (15.6%)
	Others	37(19.9%)
Nature of fracture	Closed fracture	110 (59.1%)
	Open Fracture	76(40.9%)
Open fracture severity (Gustilo Anderen classification) (N= 76)	GA I	5 (6.6%)
	GA II	18 (23.7%)
	GA IIIA	50 (65.8%)

	GA IIIB	3 (2.43.9%)
	GA IIIC	N=0 (0%)
Fractured bone	Femur	123 (66.1%)
	Tibia	58(31.2%)
	Humerus	5 (2.7%)
Location of fracture	Proximal	46 (24.7%)
	Middle	85 (45.7%)
	Distal	55 (29.6%)
Sever associated injury	Yes	32 (17.2%)
	No	154 (82.8 %)

4.4. Occurrence of delayed long bone fixation and related factors

There was delay in definitive fixation long bone fracture with SIGN nail which is 64.1 %(186/290) i.e not operated within 24hrs of admission. The Mentioned reasons were lack of operating time (52%), medical conditions/comorbid (16.7%), sever associated injury(9.8%) , lack of SIGN nail implant (2%), lack of blood (1.5%), lack of Fund (1%) and others(17.2%) like, contaminated open fracture , delayed antibiotics initiation etc.

4.5. Factors associated with delayed long bone fracture fixation

Predictors for the occurrence of delayed long bone fracture definitive fixation were assessed using bi variable and multi variable binary logistic regression analysis to identify competent variables and assess presence or absence of association between the dependent and independent variables. A total of 5 variables which have p value <0.25 were selected from results of bivariable binary logistic regression analysis and entered to multi variable binary logistic regression analysis model.

In bivariate analysis variables with a p-value ≤ 0.25 with 95% CI such as Sex, Age, lack of operative time, sever associated injury, nature of fracture, time from injury to debridement, Gustilo Aderson open fracture classification (severity of injury in open fracture) and location of fracture in the bivariate analysis were included to the final multivariable logistic regression model. Variables like time from injury to debridement, Severity of open fracture (GustiloAnderson open fracture classification), were significantly associated with delayed long bone fracture definitive fixation with SIGN nail p-value < 0.05 with 95% Confidence Interval.

Table 5:- Multivariable Binary Logistic Regression analysis of factor associated with delayed long bone fracture definitive fixation with SIGN nail , TGSH, Bahirdar, Amhara Region, Ethiopia, Jan 2019-2021GC

Variables	Category	Delayed long bone Fixation		COR (95%CI)	AOR (95%)
		No	Yes		
Sex	Male	79	154	1	
	Female	25	32	0.657(0.364-1184)	0.710(0.236-2.138)
Age	<=55	101	162	1	
	>55	3	24	4.98(0.059-0.683)	0.166(0.007-4.150)
Sever associated injury	No	95	154	1	
	Yes	9	32	2.19(0.208-0.997)	**4.264(1.15-19.231)**
Nature of fracture	Closed	53	110	1	
	Open	51	76	0.78(0.443-1.164)	
Time from injury to debridement (in	<=24hrs	49	60	1	
	>24hrs	2	16	6.533(1.432-29.802)	**7.934(1.31**

hours)					**4-47.898)**
Gustillo Anderson Open fracture classification	GA Type I and II	21	23	1	
	GA Type III(sever injury)	29	53	1.669(0.792-3.515)	**2.891(1.037-8.060)**
Location of fracture	Proximal	16	46	1	
	Middle	60	85	0.493(0.255-0.951)	0.292(0.084-1.019)
	Distal	28	55	0.683(0.330-1.416)	2.891(1.037-8.060)

1.00= Reference category, P-value <0.05 , COR= Crud odds Ratio; AOR=Adjusted odds Ratio

5. Discussion

The study assessed the magnitude and associated factors of delayed long bone fracture definitive fixation with Surgical Implant Generation Network (SIGN) Nail at Tibebe Gion Specialized Hospital. The finding showed the overall occurrence of delayed long bone fracture fixation with SIGN was 64.1% [95% CI: 59.0 - 69.7]. It was lower than a prospective observational study done in Bharati Hospital Dhanakawadi, Pune, Maharashtra, India which was 81.1% (60/74), which could be by smaller sample size in this study (22). However, it was comparable to a study done in Ibadan, Nigeria, departments of Orthopaedics and Trauma, Child Oral Health, University College Hospital which was 50%(23).

It also consistence with finding of observational study done at two Ethiopian tertiary hospitals (Addis Ababa Black Lion specialized hospital and Hawassa comprehensive specialized hospital) , which was 67.7%(12). The possible justification for similarity of the result could be the patient load and other infrastructure issue similarity on those institutions

Regarding the reasons of delayed surgery of long bone fracture, a prospective observational study done in Bharati Hospital Dhanakawadi, Pune, Maharashtra, India showed that medical

condition (55%) and financial reasons(31.7%), were the most common reasons followed by infrastructure issue(unit system /non availability of implant (14.3%) and had plan of surgery(22). In this study the most common reasons for delay for long bone fracture fixation were lack of operating time (52%) and medical conditions/comorbid (16.7%) followed by sever associated injury (9.8%), lack of SIGN nail implant (2%), lack of blood (1.5%), lack of Fund (1%) and others (17.2%)(like, contaminated open fracture, delayed antibiotics initiation delayed debridement and irrigation etc) which were consistent finding with a prospective observational study done Ibadan, Nigeria, departments of Orthopedics and Trauma, Child Oral Health, University College(23), and in two Ethiopian tertiary hospitals (Addis Ababa Black Lion specialized hospital and Hawassa comprehensive specialized hospital (12).

A retrospective cohort study of done in United States trauma centers showed that patient related factors; specifically, increasing age, black race (OR 1.21; 95% CI 1.08–1.35), noncommercial insurance (OR 1.15; 95% CI 1.05–1.26), and comorbidities were significant predictors (10). In this study those variable were not associated for delayed fixation. This could be variability of Socio-demographic Characteristics between those study populations.

The study finding about associated factors showed that patients with diagnosis of long bone fracture (Gustillo Anderson Type III (server injury)) were 2.891 times more likely delay their definitive fixation than diagnosed with GA type I and II. Patients who take time from injury to Debridement more than 24 hours were 7.934 times more likely to delay their definitive fixation than those got their debridement within 24 hours. This finding was consistent to most recent literatures which is recommended to postpose definitive fixation if the patient was not get debridement and irrigation with in 24hours((7,8,27–29).

Patients with long bone fracture with severe associated injury are 4.264 times more likely to delay their definitive fixation than without associated injury. This finding was consistence to most literatures which give priority for other life and limb treating injuries before performing definitive fixation(6–8,10,25,30–34). A retrospective cohort study of done in United States trauma centers showed that Severe abdominal injury, early transfusion, and early thoracic or abdominal surgery, shock or decreased Glasgow coma scale (GCS) in the ED, and need for early neurosurgery were also significantly associated with delayed. In the same study , high-energy mechanisms of injury (motor vehicle or motorcycle crash and pedestrian injury) and open femur

fractures (OR 0.50; 95% CI 0.44–0.58) were strongly associated with early fixation (10). In this study mechanism of trauma, type of bone were not associated with delayed fixation

This study was based on secondary data with those variable related to delayed long bone fracture fixation need further study

6. Strength and Limitations of the Study

6.1. Strength

- The patient data was filled on the check list format during patient management then after fixation all the data was filled on the SOSD by experts in the area make the filled data credibility

6.2. Limitations

- It is a single-center study and the results have limited generalizability
- Being a retrospective study and use of secondary data

7. Conclusion

The magnitude of delayed long bone fracture definitive fixation in Tibebe Gion Specialized Hospital was high. Time from injury to debridement, severity of injury (GA classification), and sever associated injury were factors significantly associated with delayed long bone fracture definitive fixations.

8. Recommendations

- **For Department of Orthopedics and Trauma Surgery, Bahirdar University**
  - Give emphasis for patients with open long bone fracture to have early debridement and irrigation and definitive fixation.
- **For Ministry of Health and Regional Health bureau**
  - Measures to tackle Road traffic accidents should be taken with collaboration with other stockholders
- **For Researchers**
  - This is a good study area and can be done in a prospective and multi-center manner to increase the validity and help in the formation of protocols.

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