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Prevalence And Its Associated Factors Of Pin Site Infection Among Patients Treated With Extrenal Fixation In At Tibebe Ghion Specialized Hospital, Bahir Dar, Ethiopia

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BAHIR DAR UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCES

SCHOOL OF MEDICINE

DEPARTMENT OF ORTHOPAEDICS & TRAUMA SURGERY

PREVALENCE AND ITS ASSOCIATED FACTORS OF PIN SITE INFECTION AMONG PATIENTS TREATED WITH EXTRENAL FIXATION IN AT TIBEBE GHION SPECIALIZED HOSPITAL, BAHIR DAR, ETHIOPIA

By: ASEFA CHUKALA HAWAS (ORTHOPEDICS AND TRAUMA FOUTH YEAR RESIDENT)

THE RESEARCH TO BE SUBMITTED TO DEPARTMENT OF ORTHOPEDIC, COLLEGE OF MEDICINE AND HEALTH SCIENCES, BAHIR DAR UNIVERSITY, FOR THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR SPECIALTY IN ORTHOPEDIC AND TRAUMA SURGER

AUGUST, 2023

BAHIRDAR, ETHIPIA

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Study	Study design	A retrospective cross sectional study design
	Study project	Prevalence and its associated factors with pin site infection and associated risk factor with external fixation

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 proposal, have been fully acknowledged.

Principal investigator (PI)

Name_____

Signature_____

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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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Acknowledgement

First, I would like to thank BDU, department of orthopedic surgery for giving me this golden opportunity to practice research. Secondly, my gratitude goes to my advisors, Dr. Biruk Ferede (consultant orthopedic surgeon, Asst. professor of Orthopedics) & Mrs. Tsion Adebabay (public health officer, Master of public health), who had given me a good deal of their time and skill in providing me guidance and advice to prepare this proposal.

Abstract

Background; Pin site infection after treatment with EX FIX complicates significant proportion of cases. Studies show varying rates of occurrence of pin site infection the associated treatments, functional disability, prolonged pain, and lost wages can lead to substantial psychosocial impairment, economic burden to the patient, and stress on the health care system. A number of potential factors have been identified to increase rate of pin site infection, including old age, male gender, tobacco smoking, diabetes, high-energy fracture and time of intervention

Methods and materials; The study will be conducted using a retrospective cross-sectional study in patients who were admitted and operated with external fixation who fulfill the inclusion criteria and were on follow up in TGSH orthopedics department referral clinic from September 1,2020 to September 30/2023. Patients with external fixation will be reviewed and patients with pin site infection will be analyzed in particular. Simple binary variable regression analysis will be used to analyze the association between variables. The data will be analyzed using SPSS software and the results will be presented in tables and pie chart.

Result; A total of 170 of 179 patients (94.9%) were included: 161 males and 10 females with the Average age of 32.89 +-13.168 years. The estimated prevalence of PSI was 44.4% Results of

Binary logistic regression showed that timing of starting antibiotics from injury (AOR =2.064; 95%CI 1.007 – 3.996) and Time of surgery done from injury (AOR = 3.839; 95% CI 2.007 – 7.342) was significantly associated with PTI.

Conclusion; The overall prevalence of PTI is comparable with study done in Sulaimani Hospitals in Iraq (1).

The independent risk factors for PTI were time surgery from time of injury and delayed use of prophylactic antibiotics from time of injury

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Acronyms

BDU …………………... Bahirdar University

DM ……………………. Diabetes Mellitus

IRB …………………... Institutional Review Board

ORC …………...……... Orthopedic Referral Clinic

PI ……………………... Principal Investigator

PVD …………………. Peripheral Vascular Disease

SPSS...,,,,,,,,,,,,,,,,,,,,,,,,,,,, Statistical Package for the Social

SSI ……………………. Surgical Site Infection

TGSH ………………. Tibebe Ghion Specialized Hospital

EX FIX ………………... External fixation

IM ………………….…... Intramedullary

PTI …………………...Pin tract infection

2. Introduction

2.1 Background

External fixation has become a key tool in the orthopedic surgeon's modern armamentarium, being used both in traumatology and reconstructive surgery. The key advantage of this method is that the implant assembly called the external fixator device is located outside the body and is connected to the bone via transcutaneous pins or wires. External fixators were first applied to treat comminuted fractures, open fractures and bone loss, but its applications broadened in subsequent years, notably after Lazarovs' development of distraction orthogenesis (1),

External fixation is currently also used to correct congenital and acquired deformities, mobilize stiff joints and heal infected nonunion. However, external fixation is associated with high rates of morbidity, especially when a prolonged application is necessary (2), pin-tract infection which is defined as an episode of pain or inflammation at a pin site, accompanied by a discharge which was either positive on bacterial culture or responded to a course of antibiotics being one of the most common complication in patient treated with external fixation with incidence ranging from 1 to 100% (4; 5) , among this around 90 % of it a minor infection (CO 1–3) and at least develop once during the observation time (6).This great discrepancy in reported incidences of PTI is partly due to the lack of a uniform definition and classification system for the determination and quantification of this type of infection in addition to this patients factors, fractures factors, external fixator factors and surgeons experience also contribute (7) .

There is currently a lack of clear evidence and consensus on the pathogenesis of PTI, and many apparently contradictory hypotheses have been described. Numerous author (8; 9; 10) Clasper et al. (11) also incriminated fluid accumulation around the pin–bone interface as a cause of PTI. This description of the development of PTI has been disputed by other authors (12) who believe that it is a pathophysiological misconception to consider that pin loosening results from PTI. An unstable fixator will create a mechanically unfavorable environment for optimal bone healing and lead to deleterious instability at the fixator pin–bone interface, there by producing pin tract irritation and then infection (12) Bacterial colonization of pin and biofilm production Pin or wire colonization by bacteria starts during surgery or in the early postoperative period and has been

described as occurring in steps (13). Immediately after insertion of the wire or pin, plasma proteins rapidly coat the surface of the fixation pin implant (14).Membrane proteins and polysaccharides subsequently allow the bacteria to bind firmly to the proteins on the device surfaces. Finally, certain bacterial species secrete a protective exopolysaccharide layer the biofilm which renders them resistant to antibiotics (15; 16).

Staphylococcus epidermidis, S. auras and Escherichia coli are the three most common infective agents of external fixation constructs (17), Staphylococci are recognized as the most frequent causes of biofilm associated infections. Their exceptional status among biofilm-associated pathogens is due to the fact that staphylococci are frequent commensal bacteria on human skin and mucus. They are thus among the most likely germs to infect any medical device that penetrates these surfaces, such as those being inserted during surgery (18). Similarly, and like many other Gram-negative microorganisms, E. coli also has the capacity to form biofilm structures in vivo and in vitro (19).

PTI classification

Based on clinical symptoms, such as erythema and pain, Clint et al. (20) Described a simple approach that classifies pin sites as ‘‘good’’, ‘‘bad’’ or ‘‘ugly’’. Similarly, Santy et al. (21) Established criteria for describing pin sites as ‘‘calm’’, ‘‘irritated’’ or ‘‘infected’’ that take into account patients’ and clinicians’ observations. Other authors have graded the severity of the pin infection according to the presence of purulent discharge, skin erythema and radiological evidence of wire or half-pin loosening (22).Checketts et al. (23) Reported a classification system for PTI consisting of three grades of minor infections and three grades of major infections. This system considers clinical features and radiological evidence of osteolysis, with the significant difference between the two groups being that the external fixation has to be abandoned in major infections (Table 1). A last classification, described by Saleh and Scott, tries to grade the PTI according to therapeutic response to different treatments; however, as this system is retrospective in nature, it cannot be used as a predictive tool.

Table 2 ; Checketts – Otter burn grading system for level of pin site infection

Grade	Appearance	Treatment
	Minor infection	
1	Slight redness, little discharge	Improved pin site care
2	Redness of skin, discharge, pain and tenderness in the soft tissue	Improved pin site care, oral antibiotics
3	Grade 2 but not improved with antibiotics	Affected pin or pins resited and external fixation continued
	Major infection	
4	Severe soft tissue infection involving several pins, sometimes with associated loosening of the pin	External fixation must be abandoned
5	Grade 4 but also involvement of the bone; also visible in radiographs	External fixation must be abandoned
6	The infection occurs after fixation removal. The pin track heals initially but will break down and discharge at intervals	Curettage of the pin track

2.2 Statement of the problem

No research done in this specific area in TGSH even in Ethiopia beside there is many cases of pin site infection encounter our daily activity however, the prevalence of pin site infection not known in TGSH

One study done in university of Nairobi Nairobi-Kenya show that Incidence of pin tract infection was 87.7% (64 of 73 patients). Staphylococcus aureus (30.2%) and coagulase negative staphylococci (16.3%) were the commonest causative organisms (24)

Other study done was retrospective cross-sectional review that carried out in Sulaimani Hospitals (Iraq) through duration period of ten years from first of February, 2010 to 31st of January, 2020 on 87 patients with bone fractures managed by external fixation show that incidence of PTI was 34.9 %

It is a serious and difficult-to-treat complication once occurred with high associated morbidity and mortality. It causes delayed fracture healing, limb function loss, amputation and associated socioeconomic dependency. It also contributes to prolonged recovery, delayed discharge and increasing costs to both patients and the health care provider and society It is the most common and challenging complication, especially in open fractures occurring in up to 100% in severe forms. Septic complications need an early and aggressive approach with radical eradication of the septic focus. Unless an acute and minor infection which will be treated with minor surgical procedures and antibiotics giving a chance to leave ex-fix in situ, most chronic infections usually demand prolonged, complex, multiple and multi-stage reconstructive measures of bones and soft tissues, including implant removal which has devastating psychological, social and economic cost of the patients, family and the community at large (12; 24)

2.3 Significance of the study

External fixation is used as definitive management in TGSH and in Ethiopia in general more often than developed countries. Unfortunately, many cases pin site infection are observed when EX FIX is used as definitive management and the true incidence is not studied in our country and major factors not identified. Determination of incidence of pin site infection and associated factors in TGSH will help orthopedic surgery department to assess its practice and if any corrective measure is necessary. The study aspires to support or provide evidence if the trend of

using EX FIX as definitive treatment should continue or changed to internal fixation options. This will show the hospital and the country at large the need to avail material of internal fixation adequately and the expansion of other related specialties, like plastic surgeries for early soft tissue reconstructions to enable internal fixation practiced better in trauma patients.

2.4 Literature review

2.4.1 Prevalence of pin site infection in patient treated with external fixation

Pin infection is one in every of maximum not unusual hardship of external fixation. Left untreated, PTI will progress unavoidably, cause mechanical pin loosening, and in the end motive instability of the external fixator pin – bone assemble (3)

A retrospective go sectional review that accomplished in Sulaimani Hospitals (Sulaimani, Shar, and Shoresh teaching hospitals) via duration period of ten years from first of February, 2010 to 31st of January, 2020.The take a look at populace was all patients with bone fractures controlled by means of outside fixation during take a look at durational. Eighty-seven fractured patients had been enrolled with suggest age of (30 years) and range of 14- sixty-five years; 19.5% of patients were at age institution of much less than 20 years, forty.2% of them have been at age institution 20-29 years, 16.1% of them have been at age institution 30-39 years, 10.3% of them have been at age institution forty-49 years and 1. Eight% of them had been at age of fifty years and greater. The male to girl ratio became 2. Five:1. The diseased bones of studied sufferers were generally disbursed as followings; tibia (54%), femur (23%), humerus (21. Nine%) and foot fracture (1.2%). Demanding bone defect represented 77% of fractures and gap non-union represented 23% of fracture The procedure of remedy used changed into specially bone delivery (96.6%), accompanied by fibula protibial (2.3%) and arthrodiastasis (1.1%). The external fixation types used have been commonly Hybrid external fixation (82.8%) and traditional outside fixation (17.2%). The postoperative complications in step with Paley category encountered in 26.4% of fractured patients; hassle changed into pronounced in 60.9% of complex sufferers and obstacle in 39.1% of them. The occurrence of pin tract infection for fractured patients changed into (34.9%). The infective microorganisms for pin tract infection had been staphylococcus auras (50%), staphylococcus epidermidis (36.7%) and E. Coli (thirteen.3%). Checketts Otter burn category of pin tract infection changed into categorized into; G1 (36.7%), G2 (23.3%) and G3 (forty%). No sizeable variations have been determined among patients with pin tract infection and sufferers

and not using a pin tract infection regarding age (p=0.1) and gender (p=0.8). There has been a quite vast association among femoral fractures and better incidence of pin tract infection (p<zero.001) 73.7% of femoral fractures had pin tract infection. A surprisingly considerable association became determined between inflamed hole non-union fractures and better occurrence of pin tract contamination (p<zero.001), 70% of infected hole non-union fractures had pin tract contamination. A distinctly giant affiliation became found among presence of postoperative headaches and higher incidence of pin tract contamination (p<zero.001), ninety. Nine% of postoperatively complex patients had pin tract infection (1).

There may be unmarried-center potential evaluation of pin web site infections in 39 traumas, limb deformity, and bone contamination sufferers handled with external ring fixation take a look at performed at department of Orthopedic surgical treatment, Aarhus college medical institution. This observe show that from 39 sufferers 36 patients (ninety-two. Five %) in this cohort evolved a pin website contamination in keeping with the CO classification. Of these 16 patients (41 %) have been most effective graded as CO 1, wherein contamination became resolved in 7 of the sufferers with extended pin website care. In 12 of the patients (31 %), the highest CO grade sign up was CO 2, in 6 of the sufferers (15.5 %) CO 3, in 1 affected person (2.5 %) CO 5, and in 1 patient (Five %) no CO grade became suggested (6)

There is a prospective pass-sectional test, with consecutive sampling of patients which conducted on the orthopedic wards and clinics of Kenyatta national hospital (KNH). KNH is a metropolitan, tertiary referral and coaching health center in Nairobi, patients (73) was recruited into the have a look at and observed up for six weeks. The incidence of pin tract infection after uniplanar fixation of open fractures in KNH is excessive (87.7%). Most of these infections are minor involving smooth tissues best. Staphylococcus aureus and coagulase negative staphylococci are the main causative agents of pin tract contamination accounting for almost half of the cases of infection (24).

2.4.2 Associate factor with pin site infection in patient treated with external fixation

There were no considerable differences among the groups with regard to age, gender, nutritional popularity or cause for external fixation. The threat of pin-site infection is lower if interest is paid to warding off thermal harm and neighborhood formation of hematoma throughout surgery and if after care includes the usage of an alcoholic antiseptic and occlusive pressure dressing (5)

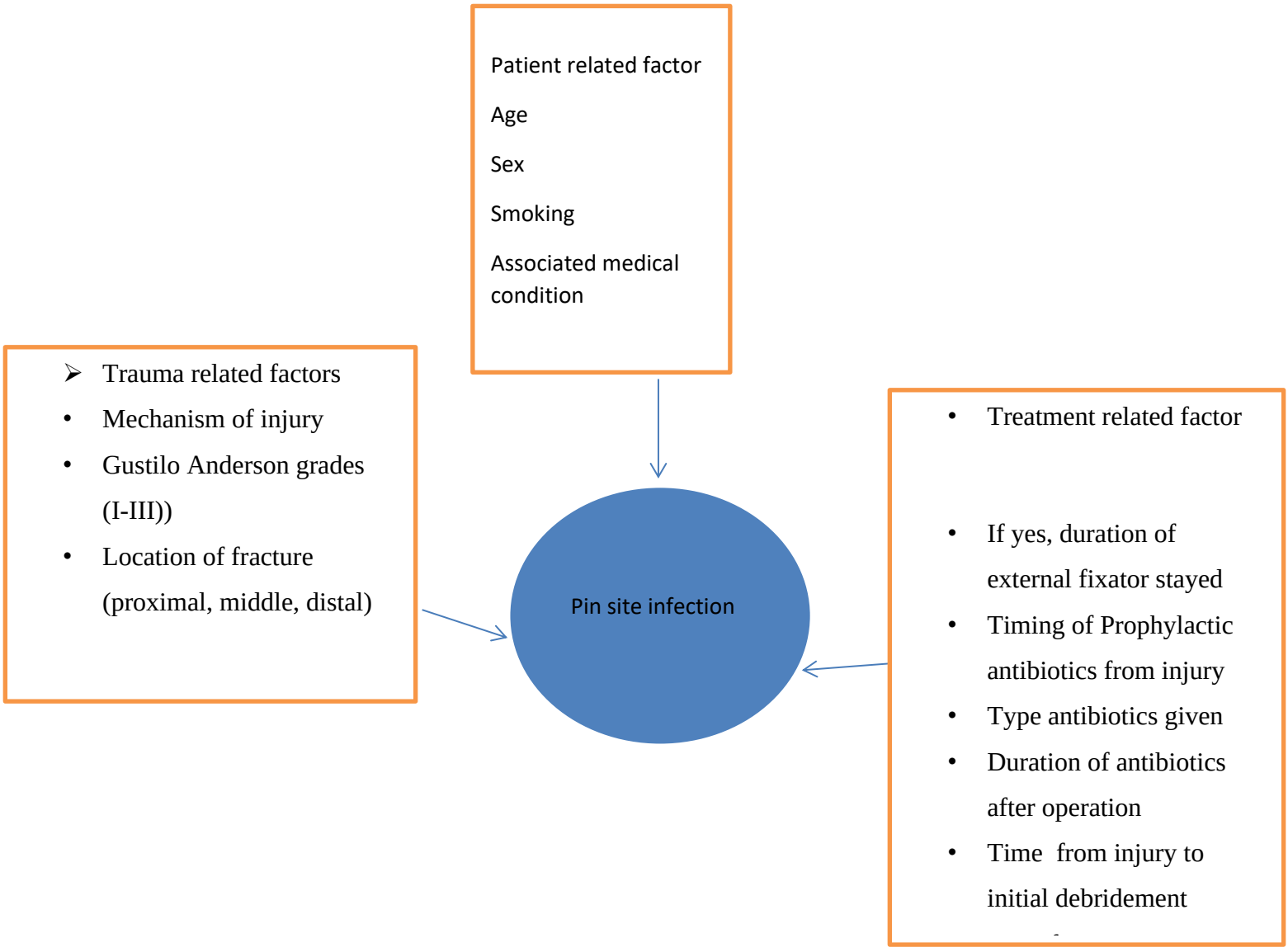
A twelve months prospective cohort examine was carried out at the Toking coaching health center in Lomé Togo. All trauma sufferers dealt with through outside fixation at some points of this era have been blanketed inside the examine. There have been 50 sufferers with 52 fractures who underwent outside fixation assessment of those pins after operation discovered pin tract infections round 152 pins. The occurrence fee of pin tract infections become fifty-nine.1%. Consistent with Checketts' scoring device for pin tract contamination, there had been 93 pins scored grade 1, 32 pins grade 2, 15 grade three, 8 pins grade four and 4 pins grade 5. No pin scored grade 6. In keeping with fracture sites requiring outside fixation, the incidence price of pin tract contamination turned into forty.6% for distal radius fractures, 57. Five% for tibia fractures, and 87. Five% for femur fractures. The prevalence improved from 20. Five% in closed fractures to 75.9% in open fractures. While the pins have been inserted manually, the occurrence fee turned into 35.5%. Analysis recognized 3 danger factors for pin tract infections: femur fractures (OR: thirteen. Sixty-one; 95% CI: 6. Sixty-nine-27. Sixty-eight; p< 0.001), open fractures (OR: 2. Sixty-seven; 95% CI: 1.34-5.33; p= zero.1/2), and when pins were inserted with electricity (OR: three.47; 95% CI: 1.51-7. Ninety-five; p= zero.003). (25)

Potential observes executed by way of involving 412 patients handled with external fixation to evaluate impact of prophylactic oral antibiotic on pin web page infection. This observe indicates that no distinction among people who took prophylactic oral antibiotics and manage within the occurrence, timing, or severity of pin infection so does no longer help using prophylactic oral antibiotics in healthful patients (26).

Descriptive observe changed into carried out in the course of months of Jan-Feb 2005 in selected wards of Nehru hospital PGIMER, Chandigarh. Total 50 sufferers with fifty-four outside skeletal fixators and 321 pin web sites had been studied. Findings of the examine found out that people who smoke had higher pin web page contamination rate i.e., 80% (16/20) in comparison to nonsmokers (fifty-three.3%). It was discovered statistically significant ($p < 0.05$). Consequently,

it's miles recommended that each orthopedic nurse want to put in force smoking cessation and meticulous pin website care practices for sufferers with external skeletal fixation (27)

Figure 1 ; Conceptual framework



3. Objective

3.1 General objective

To assess prevalence pin site infection and its associated factors among patients treated with external fixation at Tibebe Ghion Specialized Referral Hospital from September 1/2020 to September 30/2023

3.2 Specific objective

To assess prevalence of pin site infection among patients treated with external fixation at TGSH Hospital from September 1, 2020 to September 30/2022

To identify its associated factor affecting prevalence of pin site infection among patients treated with external fixation in TGSH from September 1, 2020 to September 30/2022

4. Methods and materials

4.1 Study area

This study conducted in the department of orthopedics & trauma surgery in TGSH.TGSH is one of the biggest specialized university hospitals in Amhara region and in the country at large. It started working in 2011 E.C /2018 G.C and rests on an area of 10000sq. M to primarily give service at a balanced cost to over 2000 people per day. The hospital has more than 500 beds in all its wards and over 67 beds in orthopedics and trauma surgery ward. Currently there are 7 general orthopedic surgeons, 2 pediatric orthopedic surgeon, 2 Arthroplasty and trauma surgeon and 1 trauma and sport surgeon. The department started postgraduate program since 2007 and it graduate 4 batches with total of 25 orthopedic surgeons so far. Currently there are 28 residents attending their specialty training in orthopedic surgery. The department has its own major operation room with two operating tables and major operations are done 5 days in a week on elective base and daily for emergency cases. The study will be conducted on patients treated with EX FIX and followed in hospital at ORC

4.2 Study Design

Hospital based a cross-sectional study design used to conduct the study on patients admitted to TGSH from September 1, 2020 to September 30, 2022 with the diagnosis of long bone fractures and operated with treated by external fixation will be reviewed and analyzed

4.3 Study period

The study will be conducted from July 22, 1 2022– August 12, 2023 G.C

4.4 Source population

All Patients who admitted and treated with external fixation in the orthopedic surgery department at TGSH from September 1/2020 to September 30, 2022 G.C

4.5 Study population

All Patients admitted and treated with external fixation at TGSH from September 1/2020 to September, 2022 G.C in Orthopedic surgery department who fulfilled the inclusion criteria listed.

4.5 Inclusion criteria

Patients treated with external fixation and admitted to the orthopedic surgery ward

Patients whose operations are fully documented on the chart

Whose follow up status is clearly known (clearly documented on follow up database or chart)

4.6 Exclusion criteria

Patients who have chronic osteomyelitis

Patients whose final result is not known (went against medical advice, lost from any form of follow up or referred.

4.7 **Sampling technique**

All patients admitted to TGSH and managed with EX- FIX from September 1, 2020 to September 30, 2022 fulfilling the inclusion criteria will be studied by reviewing their charts from hospital records

4.8 Sample size

There is no specific data on the prevalence and associated factors of pin site infection after external fixation in Ethiopia. One study done in university of Nairobi, Nairobi-Kenya show that Incidence of pin tract infection was 87.7% (64 of 73 patients)..

The minimum number of samples required for this study will be determined by using single population proportion formula.

$$n = \frac{(z_{\alpha/2})^2 \cdot pq}{d^2}$$

Where: n= minimum sample size required for the study

Z= standard normal distribution (Z=1.96), CI of 95% = 0.05

P= prevalence of surgical site infection is ; Hence; p=87.7 %(0.877) will be used

q = 0.133

d=Absolute precision or tolerable margin of error= 5 % (0.05)

Sample size : $n = \frac{Z^2 \mathrm{p}(1-\mathrm{p})}{d^2} = \frac{1.96^2 \mathrm{x} 0.877(0.133)}{(0.05)^2} = 179$

4.9 Data collection procedures

Data collection format containing variables will be prepared Data collection format containing variables will be prepared. Data collected from hospital records

4.10 Study variables

4.10.1 Dependent variables

Pin site infection after EX FIX

4.10.2 Independent variables

- Age
- Sex
- Place /residence
- Occupation
- Educational status
- Mechanism of injury
- Type of fracture (Open, closed)
    - ✓ Open (Gustilo Anderson grades (I-III))
- Type of long bone fracture (humerus, femur, tibia)
- Location of fracture (proximal, middle, distal)
- Timing of Prophylactic antibiotics from injury
- Time from injury to initial debridement
- Time from injury to definitive surgery
- Treatment
- Medical illness
- Smoking

4.11 Operational Definitions

- Pin site infection: pin-tract infection which is defined as an episode of pain or inflammation at a pin site, accompanied by a discharge which was either positive on bacterial culture or responded to a course of antibiotic.
- External fixation: a surgical method of immobilizing bones by placing pins which are secured together outside of the skin using a series of clamps and rods known as the external frame.
- Time to debridement: irrigation and debridement's done within 24 hours documented by the operating surgeon.
- Time to prophylactic antibiotics: prophylactic antibiotics given 3hours after injury for open fractures and within 30 minutes to 1hour of operation for closed fractures documented on chart
- Type of open fracture classified (Gustilo Anderson)((3)) in
- Type I----wound < 1 cm
- Type II ----wound 1-10cm
- Type IIIA …
    - 10 cm, high energy
    - adequate tissue for coverage
    - includes segmental / comminuted fractures even if wound <10c
    - farm injuries are automatically Gustilo III
- Type IIIB
- extensive periosteal stripping and requires free soft tissue transfer
- Type IIIC
- vascular injury requiring vascular repair
- followed up: A patient at least having one follow up is considered to have a follow up

4.12 Data quality assurance

Pre-test did on (5%) of sample size. Based on the finding of the pre-test, the data collecting format will be revised. Data collected from SOSD is highly reliable since it will be done by medical doctors who have real-time experience of treating orthopedic patients, and they are also familiar with data filling to the SOSD. The data collectors will be given two days refreshment training and also supervised closely and the filled format will be checked by the principal investigator for completeness and errors will be identified and corrected

4.12 Data processing and analysis

The collected data entered the SPSS software version 27 by the principal investigator. Frequency and cross tabulation was used to summarize descriptive statistics. Means and percentage used for numerical variables. Cross tabulation and Simple binary logistic regression analysis used to analyze the association between variables. Graphs, charts and tables used as appropriate for data presentation and dissemination. A P value of < 0.05 will be used as the criterion for statistical significance and OR with 95% confidence interval will be used to indicate the strength of association

4.13 Ethical clearance

Ethical clearance was obtained from the IRB of CMHS research ethics committee with protocol number 617/2022. Then this ethical clearance and cooperation letter was sent for TGSH to obtain consent to perform data collection. Confidentiality of patients was kept. The information found in the patient chart was kept secured or confidential and the information was used only for this study purpose.

4.14 Dissemination

The finding of the study was presented and submitted to department of Orthopedic Surgery, school of medicine, CMHS, and BDU, as one of the partial fulfillments of specialty certificates. The finding of the study would be shared with ARHB, ESOT, and other concerned bodies. For broader dissemination, the manuscript would be submitted to one of the peer-reviewed journals for publication.

5. Results

5.1 Socio demographic characteristics of study participants

Out of 179 patients treated with external fixation, 171 included in the study which gives a response rate of 94.9%. Among these 161 males and 10 females with the mean age of 29.83 + - 10.105 years. About 90(52.6%) participants were married and 72(42.1%) had secondary education level. (Table 3).

Table 3: sociodemographic characteristics of patients treated with external fixation at TGSH, Bahir Dar, Ethiopia,2023

Variable	Minimum	Maximum	Mean	St. Deviation
Age of participant	16	70	32.89	13.268

Variable	Category	Frequency	Percent
Sex	Male	161	94.2
	Female	10	5.8
Marital status	Single	81	47.4
	Married	90	52.6
Educational level	uneducated	81	47.4
	=< grade 8	16	9.4
	9 – 12	72	42.1
	diploma	2	1.2
Residency	Urban	74	43.3
	Rural	97	56.7
Smoking cigarette	yes	40	23.4
	no	141	76.6
Occupation	Farmer	71	41.5
	military	86	50.3
	merchant	14	8.2

5.1 Mechanism of injury, fracture pattern and treatment approach.

The leading cause of the injuries was bullet injury 117(68.4%). Mainly involve tibia fracture 83(48,5%). Open group IIIA fractures topped the list with 55.6% of total fractures followed by open grade IIIB fractures in 44.4% of cases. The study had no cases of open grade I, II and IIIC (table 5) The diseased bones of studied patients were commonly distributed as followings; tibia (48.5%), femur (19.9%), humerus (21.6%) ankle (7%) and forearm fracture (2.9%).

The external fixation types used were mostly Uniplanar external fixation. From 171 patients 76 case developed pin site infection which gave prevalence of 44.4 %. The treatment used was mainly oral antibiotic and pin site care (90.7%) followed by debridement oral antibiotic and pin site care (9.3%) (table4)

5.3 Associated factors

In comparison of Patient who took antibiotics after 6 hours of injury develop infection about 2.064 times than who took antibiotics before 6 hours (AOR =2.064; 95%CI 1.007 - 3.966) and those who operated after 12hr of injury develop infection about 3.839 times than those who operated before 12hr (AOR = 3.839 ; 95%CI 2.007 – 7.342).among patient smoking cigarette (40) about 24(60%) developed PSI but in nonsmoker (131) only 39.6% this show that those smoker higher risk to develop PTI But on binary logistic analysis this observation was statistically insignificant.

About 69(90.7%) of patients who developed pin site infection were managed by oral antibiotic and pin site care. (Table 4 & 5)

Lists of the operative and clinical factors for participants given in table 4 showing that frequency in count and percentage. Result of Binary logistic regression analysis of characteristics of study displayed in the table 4.

Table 4. Frequency Distribution of *Clinical and operative characteristics of participants*

Variable	Category	Frequency	Percent
Mechanism of injury	RTA	41	24%
	Bullet injury	115	67.3%
	FDA	9	5.3%
	Stick injury	6	3.5%
Timing of presentation	Less than 6 hour	95	55.6%
	>=6 hour	76	44.4%
Time from injury to surgery	<12	90	52.6%
	>= 12	81	47.4%
Duration of external fixation	10 week	19	11.1%
	12 week	76	44.4%
	16 week	56	32.7%
	>16 week	20	11.7%
Type of fracture	open	171	100%
	Closed	-	-
Grade of open fracture	IIIA	95	55.6%
	IIIB	76	44.4%
Prophylaxis antibiotic given	Yes	171	100%
	NO	-	-
Location of external fixation Is infection developing	Tibia	81	47.4%
	femur	36	20.6%
	humerus	39	22.6%
	ankle	11	6.4%
	forearm	5	2.9%
	Yes	74	43.3%
	NO	97	56.7%
Treatment given	Antibiotic	-	-
	Antibiotic & pine site care	69	90.7%

	Debridement, antibiotic and pin site care	7	9.3

Table 5 : Factors associated with pin site infection among trated with external fixation at TGSH in 2023

variables	Category	Pin site infection		COR (95%CI)	AOR (95%CI)	P-Value
		yes	no			
Time of antibiotic given	Less than 6 hours	27	52	1	1	
	Greater or equal to 6 hours	49	43	2.195(1.195-4.078) *	2.064(1.074-3.966) **	0.03
Time of surgery	<12hours	26	64	1	1	
	>=12 hours	50	31	3.97(2.095 - 7.523) *	3.839(2.007-7.342) **	0.001

*-P-Value significant at <0.25 ** p value significant at < 0.05

6. Discussion

The mean age in this study was 32.89 years with 88.2% of our patient were younger than 40 years of age. In contrary, in other studies the mean age was more than 40 years [23, 32]. This finding suggests that the mechanism in our study less related with osteoporosis. In our study 93.2 % of patients was males with only 10 female patients were involved. Similar pattern was also reported in other studies[22, 33]. This is because most common mechanism is bullet injury and males were more likely to engage themselves to such trauma events. In our study area male are armed unlike females. However the mechanism of injury in other studies showed RTA is the most common mechanism followed by fall down accident and bullet injury is rare and situational [15] Bullet injury was a leading cause of injury accounted for 67.3%, which is against study done in Addis Ababa, Ethiopia that Road traffic accident count as 75 % which was coincides with worldwide studies (28)

In this study open group IIIA fractures top on the list with 55.6% of total fractures followed by open grade IIIB fractures in 44.4% of cases and had no cases of open grade I, II and IIIC fracture or bone lengthening, deformity correction and bone gap management unlike other study reported as traumatic bone gap topped the list with 77% of total fractures followed by gap nonunion in 24% of cases. (1).unlike other study in which bone lengthening and deformity correction are an indication for external fixation but in this study indication for external fixation open fracture (1)

The incidence of PTI in the present study was 44,4 %, which is below with the reported in study done in Nairobi ,Kenya incidence of 87.7% (8) ,higher than study done Sulaimani Hospitals, Iraq (34.9%) (1).in this study infection rate is a little bit higher infection rate among surgery done ideal setup(2), probably due to delayed antibiotics administration and delay surgery after injury.

As regards to studied factors that contribute to PTI four factors were significantly associated with occurrence of PTI. There is a significant relationship at final model between development Pin site infection with type of fracture, time of surgery from injury and timing of antibiotic given

from injury. The use of anti-microbial prophylaxis in orthopedic surgery is important as it helps to minimize or eradicate endogenous microbes and prevent PTI. Timing of antimicrobial prophylaxis is extremely important as it is related to the rate of SSI. In open fractures, the infection risk is profoundly increased when the administration of prophylactic antibiotics is delayed for more than 6 hr. The above explanation given by (28) is confirmed by this survey as patients who got antibiotics after 6 hours developed SSI higher than who got less than 6 hours. (28).

7. Strength and Limitation

7.1. Strength

It is the first study in Ethiopia

7.2. Limitation

In this study able to identify the areas that need to be addressed to further reduce the prevalence of PTI in our hospital. But this study had some limitations. It is limited in that we studied small size of participants. Hospital documentation still manual recorded and difficult to get fully information

8. CONCLUSIONS

The prevalence of pin tract infection among fractured patients after external fixation is (44.4%) that is within international range. Most of them treated minor and with po antibiotic and pin site care (90.7%). The common risk factors of pin tract infection are time of from injury to prophylaxis antibiotic given and time of surgery from time of injury. Our study urged the orthopedic surgeons to be aware for risk factors of pin tract infection.

9. Recommendations

To TibebeGhion Specialized Hospital

A. Development of awareness for hospital health professionals for early initiation of antibiotic for open Fractures femur fracture.
B. Orthopedic surgeons should be aware of PSI and its complication to prevent suffering of patient on hospital stay and morbidity

To Federal Ministry of Health and Regional Health Office

A. It is better to develop treatment and prophylaxis's guideline for patients with PTI after management of open fracture by external fixation

To Health Educators and Researchers

It is a potential area to do further prospective study with large scale data since there is no published study on prevalence of PTI and associated factors in patient with open fracture managed with external fixation

10. Bibliography

1. **Barawi, Dr. Barzan N.M. Sharif Prof. Dr. Omer Ali Rafiq.** Incidence and Infective Microorganism of Pin Tract Infection. Sulaimani U : s.n., 2021, Vol. Vol. 07.

2. **GA, Ilizarov.** The tension-stress effect on the genesis andthe Genesis and Growth of Tissues: Part II. The Influence of the Rate and Frequency of Distraction. , Kurgan, USSR : The Academician, USSR Academy of Sciences and the, . 1989. pp. 263–285.

3. **D, . Paley.** Problems, obstacles, and complications of limblengthening by the Ilizarov technique. maryland : pubmed, 1989, pp. 81 -104.

4. **Pusater, Dimitri Ceroni Catherine Grumetz Odile Desvachez2 Sophie.** *From prevention of pin-tract infection to treatmentof osteomyelitis during paediatric external fixation.* Geneva : Springerlink.com, 2016. pp. 605–612. Vol. 10.

5. **R. Davies, N. Holt, S. Nayagam.** The care of pin sites with external fixation. octomber 1, 2005, Vol. 87, 5.

6. **Mats Bue, Arnar Óskar Bjarnason, Jan Duedal Rölfing, Karina Larsen1.** Prospective evaluation of pin site infections in 39 patients treated with external ring fixation. april 7, 2021, Vol. 6, pp. 135–140.

7. **J. J. Jauregui, N. Bor,R. ThakralS. C. Standard,D. Paley ,J. E. Herzenberg.** Life- and limb-threatening infections following the use of an external fixator. 2015, Vols. 97-B:1296–1300.

8. **Antoci V, Ono CM, Antoci V, Jr., Raney EM.** Pin-tract tinfection during limb lengthening using external fixation. 2008, Vol. 37.

9. **Battle J, Carmichael KD.** Incidence of pin track infectionsin children’s fractures treated with Kirschner wire fixation. 2007, Vol. 27, 2, pp. 154–157.

10. **. Blum AL, BongioVanni JC, Morgan SJ, Flierl MA, dos Reis FB.** Complications associated with distraction osteogenesis fornfected nonunion of the femoral shaft in the presence of a bone defect. Vol. 92, 4, pp. 565–570.

11. **Clasper JC, Cannon LB, Stapley SA, Taylor VM, Watkins PE.** Fluid accumulation and the rapid spread of bacteria in the pathogenesis of external fixator pin track infection. Injury. 2001, Vol. 32, 5, pp. 377–381.

12. **Ferreira N, Marais LC.** Prevention and management of external fixator pin track sepsis. Strateg Trauma Limb Reconstr. 2012, Vol. 7, 2, pp. :67–72.

13. **Ariza J, Euba G, Murillo O.** Orthopedic device-related infection. [ed.] pubmed. 2008, Vol. 26, 6, pp. 380–390.

14. **Holt J, Hertzberg B, Weinhold P, Storm W, Schoenfisch M,Dahners L.** Decreasing bacterial colonization of externalfixation pins through nitric oxide release coatings. 2011, Vol. 25, 7, pp. 432–437.

15. **Donlan RM, Costerton JW.** Biofilms: survival mechanisms of clinically relevant microorganisms. 2001, Vol. 15, 2.

16. **hoyle BD, Costerton JW.** Bacterial resistance to antibiotics: the role of biofilms. 1991, Vol. 37.

17. **Charville GW, Hetrick EM, Geer CB, Schoenfisch.** reduced bacterial adhesion to fibrinogen-coated substrates vianitric oxide release. 2008, Vol. 29, 30, pp. 4039–4044.

18. Vuong C, Otto M (2002) Staphylococcus epidermidis infections. 2002, Vol. 4, 4, pp. 481–489.

19. **Probert HM, Gibson GR.** Bacterial biofilms in the human gastrointestinal tract 23–27. 2002, Vol. 3, 2.

20. **Clint SA, Eastwood DM, Chasseaud M, Calder PR, Marsh DR.** The ‘‘Good, Bad and Ugly’’ pin site grading system: Areliable and memorable method for documenting and monitoring ring fixator pin sites. Injury. 2010, Vol. 41, 2, pp. 147–150.

21. **Santy J, Vincent M, Duffield B.** The principles of caring or patients with Ilizarov external fixation. 2009, Vol. 23, 26, pp. 50–55.

22. **Chan CK, Saw A, Kwan MK, Karina R.** Diluted povidone-iodine versus saline for dressing metal–skin interfaces in externa flixation. 2009, Vol. 17, 1, pp. 19–22.

23. **Checketts RGMA, Otterburn M.** Pin track infection and the principles of pin site care. In: DeBastiani AGAA, Goldberg DE(eds) Orthofix external fixation in trauma and orthopedics. New York : s.n., 2000. pp. 97–103.

24. **R M Mohammed, E O Atinga,, F C Sitati.** Pin Tract Infection after Uniplanar External Fixation of Open Fractures at a National, Teaching and Referral Hospital. 2017, Vol. vol 22, 1.

25. **A Abalo, ,K Tomta,G Ayouba.** Incidence and risk factors for pin tract infection in external fixation of fractures. 2010, Vol. 8.

26. **Austin T. Fragomen, MD & Andy O. Miller, MD & Barry D. Brause.** Prophylactic Postoperative Antibiotics May Not Reduce Pin Site Infections After External Fixation. December 7, 2016, Vol. 13, pp. :165–170.

27. **Suresh K. Sharma*, Jogindra Vati, Indarjit Wali, Ramesh Sen.** The effect of smoking on pin site infection rateamong patients with external skeletal fixation. April 2008, Vols. , Vol-4, 2.

28. **utaa, abola k.** Open fractures and the incidence of infection in the surgical debridement 6 hours after trauma. 1, 2013, Vol. 10.

29. **Lee WS, Cheung WH, Qin L, Tang N.** Age associated decrease of type IIA/B human skeletal muscle fibers. 2006, Vol. 450, pp. 231–237.

30. **McKenzie JC, Rogero RG, Khawam S, et al.** Incidence and Risk Factors for Pin Site Infection of Exposed Kirschner Wires Following Elective Forefoot Surgery. 2019;40(10), Vol. 40, 10, pp. 1154-1159.

31. **Nikolas H. Kazmers, corresponding author Austin T. Fragomen,and S. Robert Rozbruch.** Prevention of pin site infection in external fixation: a review of the literature. may 12, 2016, Vol. 11, 2, pp. 75–85.

32. **Cristhopher Stoffel, Bruno Eltz, Mauro José Salles.** Role of coatings and materials of external fixation pins on the rates. November 18, , 2021, Vol. Volume 12, Issue 11, pp. 920-930.

11. Annexes

10.1 Consent form

Title of the Research Project: Incidence and associated risk factors for pin site infection treat with external fixation in in Tibebe Ghion Specialized Referral Hospital, Bahir Dar, Ethiopia

Name of Investigator: Asefa Chukala (MD, orthopedic Surgery Resident)

Name of the Organization: Bahir Dar University, College of Medicine and Health Sciences.

Name of the Sponsor: Bahir Dar University

Introduction: this information sheet is prepared for Bahir Dar University, college of medicine and health sciences administration to make concerned offices clear about the purpose of research, data collection procedures and get permission to conduct the research.

Purpose of the Research Project: To assess the incidence of pin site infection in patients who treat using EX.FIX.

Procedure: In order to achieve the above objective, information necessary for the study will be collected from medical records and the patients.

Risk and /or Discomfort: Since the study will be conducted by taking appropriate information from medical chart and patient without intervention it will not inflict any harm on the patients.

The name or any other identifying information will not be recorded on the questionnaire and all information taken from the chart will be kept strictly confidential and in a safe place. The information extracted will be kept secured. After the data will be entered in to the computer it will be locked with password. The information retrieved will only be used for the study purpose.

Table 6 Data collection format

no	Questions	Responses					
1	Card No						
2	Age						
3	Sex						
4	Ethnicity	Amhara	Agew	Tigaru	Gumuz	other	
5	Marital status	single	married	Divorced	Widowed		
6	Residence	Rural	Urban				
7	Religion	Orthodox	Muslim	Protestant	Other		
8	Educational status	Uneducated	<grade8	Grade 8 -12	Diploma	degree	
9	Occupation	Farmer	Military	Govrt employe	Merchant	other	
10	Mechanism injury	Bullet injury	RTA	FDA	Stitch injury		
11	Indication for external fixation	Trauma	Pathologic #	Deformity correction	Lengthening		other
12	Location external fixation	tibia	femur	humerus	forearm	ankle	other
13	Gustilo-Anderson grade	I	II	III A	III B	III C	
14	Prophylactic antibiotic given	Yes	No				
15	If yes for #7, time from injury to antibiotic administration(hours)	=< 6	>6hr				

16	Time from injury to surgery(hours)	<24	>24				
17	Any medical condition	Yes	No				
18	Smoking	Yes	No				
19	Is there any infection	Yes	No				
20	If yes for #14 where	Pin site	Another site				
21	Treatment given	Oral antibiotic	Pin site care	Debridement	Oral antibiotic and pin site care	All	