2020-01

Treatment outcome of Open Knee Joint Injury and Associated factors Among Trauma Patients Visiting Tibebeghion Specialized Hospital, Bahir Dar, North West Ethiopia, 2020

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TREATMENT OUTCOME OF OPEN KNEE JOINT INJURY AND ASSOCIATED FACTORS AMONG TRAUMA PATIENTS VISITING TIBEBEGHION SPECIALIZED HOSPITAL, BAHIR DAR, NORTH WEST ETHIOPIA, 2020

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A THESIS SUBMITTED TO DEPARTMENT OF ORTHOPEDICS AND TRAUMATOLOGY, SCHOOL OF MEDICINE, COLLEGE OF MEDICINE AND HEALTH SCIENCES, BAHIRDAR UNIVERST FOR PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE IN SPECIALITY OF ORTHOPEDICS AND TRAUMATOLOGY

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TITLE OF PROJECT	OUTCOME OF OPEN KNEE JOINT INJURY AND ASSOCIATED FACTORS AMON TRAUMA PATIENTS VISITING TIBEBEGHION SPECIALIZED HOSPITAL ,BAHIRDAR,NORTH WEST ETHIOPIA
DURATION OF PROJECT	THREE MONTHS
STUDY AREA	TIBEBEGHION SPECIALIZED HOSPITAL ,BAHIRDAR ,NORTH WEST ETHIOPIA
TOTAL COST OF PROJECT	25,200 ETB

Declaration

I under the 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.

Acknowledgement

First, I would like to thank BDU department of orthopedics and Traumatology for giving golden opportunity for training and sponsoring of my research paper. Secondly, my gratitude went to my advisers Dr Biniam Biresaw and Gebeyaw Wudie, who had given me their time and skill in providing advice to develop this thesis.

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Acronyms and Abbreviations

ARHB-- Amhara Regional Health Bureaus

ESOT -- Ethiopian Society of Orthopedics

IRB----- Institutional Board Review

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Abstract

Background: Open knee joint injury is a deep traumatic laceration violating the joint capsule. It commonly occurred in males and the commonest causes are road traffic accidents and gunshot injuries. Associated injuries like periarticular fractures are common and lead to poor outcomes. Open knee joint injury needs urgent surgical debridement to prevent risk of septic arthritis and limitation of movement to the knee joint.

Objective: To asses' treatment outcomes and associated factors of open knee joint injury among trauma patients visiting TibebeGhion specialized Hospital, North West Ethiopia, 2020

Methods: Institutional based retrospective cohort study was done by reviewing medical records of patients treated for open knee joint injury from January 2019 to July 2020. A total of 43 patient's medical records was reviewed as study sample size giving 86% response rate. Data was entered and exported by using Epi Data manager version 4.4.1 and was analyzed by using, SPSS version 25. Findings were presented by using tables and texts. Chi-squared test was conducted and p value less than 0.05 were considered significant.

Results: Fourteen (32.5%) of this study participants had developed either infection, limited range of motion to the joint on follow-up due to open knee joint injury. Majority of the injuries (58.1%) were caused by road traffic accident. Presence of associated injury to the joint, wound size, time of wound closure, need for redebridement and diagnosis method showed significant association with poor outcome. From the diagnosed infection 90% was septic arthritis. On follow up 8 patients (18.6%) developed limited range of motion to the knee joint.

Conclusion: The rate of complication as one outcome among open knee injury patient in the study area was significantly higher. Presence of associated injury, wound size, time of wound closure, need for redebridemnt and diagnosis method were showed significant association with complication outcome. Routine public education campaigns should be conducted to create awareness about road traffic accidents and treating open knee joint injuries on emergent bases should be continued.

Key words Trauma, open knee Joint, injury, Ethiopia

1 Introduction

1.1 Background

Soft tissue injuries around the joint represent a spectrum of injuries ranging from superficial abrasions to open fracture dislocations(1). Open joint injury is defined as a deep traumatic laceration that violates the joint capsule. It is also called traumatic arthrotomy (2). Recognizing open joint injury is very important because it contaminates the joint by making it contagious to the skin(3). While open joint injuries occurred in any joint, the knee is the most frequently involved joint due to its anatomical structure and exposure to external forces (4, 5).

Anatomically the knee joint capsule extends superiorly approximately 3 cm to 4 cm proximal to the superior pole of the patella, posteriorly to the level of distal femur physical scars and to the articular surface of the tibial plateau, and anteriorly it lies directly under the patellar tendon(1). The Joint capsule is also confluent with the undersurface of the surrounding medial and lateral retinaculum (3).

Open knee joint injuries are classified by Collins and Temple (5). This classification is important to identify variables associated with infection and outcomes. Type I injury is single capsular perforation or laceration without extensive soft tissue injury. Type II injury is single or multiple capsular perforations with extensive soft tissue injury. Type III injury is open peri-articular fractures with extension through the adjacent articular surface. Type IV injury is characterized by open dislocation or associated with nerve or vascular injury requiring repair (5).

1.2 Statement of the problem

Global adolescent knee injury prevalence ranges between 10% and 25%, with more recent studies reporting higher percentages(6). Open knee joint injuries account accounts 51% to 91% of all other extremity open joint injuries .In contrast to this the ankle joint accounts 1.5% to 10% and the hip joint involved in only 1% to 7% of lower extremity open joint injuries(1). They are more commonly occurred in males and the mean age reported in different articles is in the third decade (4, 7).

Causes of open knee joint injuries depend on the setting of injury, whether it is in combat injuries or civilian setting. Common causes include gunshot injuries, motor vehicle accidents and lacerations. The incidence of trauma due to gunshot injuries and stab injuries is increasing in the civilian population, open knee joint injuries are also increasing (1).

Open knee joint injuries will have severe complications if they are not properly diagnosed and treated.it is associated with substantial risk of joint infection and pyoarthrosis (7). There are also cases with vascular injury which end up in above knee amputation (8, 9) .Factors contributing for these complications include extent of osseous and soft tissue injury , size of the wound ,degree of contamination, delay in antibiotics administration and surgical management (7, 10) . Open knee joint injuries may have concomitant periarticular fractures which range from 24% to 55% and may lead to poor outcome(8, 11). Clinical indicators of an open knee joint injury like grossly visible joint surface, intra-articular foreign body or air on x-ray are the most rapid method of diagnosis (8).

Since these open knee joint injuries commonly occur in the adult working population, complications from the improper treatment approach will have a significant socioeconomic burden in the community beyond the individual level. Knee surgery is often used as a measure of injury severity, but it is also an indication of the economic costs of knee injuries and the capacity of the individual to pay for treatment(6).

Open knee joint injuries due to war related injuries have been studied, but there is little information regarding those in the civilian population. As the incidence of trauma due to gunshot injuries and stab injuries is increasing in the civilian population, open knee joint injuries are also increasing (1) .

1.3 Justification of the study

Open knee joint injuries are very common orthopedic cases worldwide. Although some studies are done in other countries regarding open knee joint injuries most of them focused on diagnostic modalities rather than outcome and associated factors. In our country, even though these injuries are very common no local study done regarding open knee joint injury. Although these injuries are traditionally treated on emergent basis with antibiotics and open surgical debridement, there are no evidences regarding the success of the treatment and associated factors.

1.4 significance of the study

Gaining insight regarding outcome and associated factors of open knee joint injury was valuable for clinicians and researchers. Being the first study in the country the data and the results is beneficial for future interventions .Patients will also benefit as we will use evidence based approach for treatment of this problem. In our setup, we encountered many patients with open knee joint injuries and this study will help to assess and modify our treatment approach based on the results.

2. Literature Review

2.1 Overview of open knee joint injuries

Wounds violating joint capsule can result in various complications, so periarticular wounds are common concern for orthopedic surgeons (12). Regarding the mechanism of injury road traffic accidents and gunshot wounds are the main cause of injury followed by falls (5). Recent study about the profile of patients with open knee joint injury also demonstrated that 42.5% of cases were due to gunshot wounds and 52.5% patients had associated periarticular fracture(12). The main stay of treatment of open knee joint injury is urgent surgical debridement and irrigation. Early initiation of Intravenous antibiotics is also one of the most important treatment components of open knee joint injury (13).

2.2 Outcomes of open knee joint injuries

A prospective study was conducted by Marvel and Marshal to evaluate functional outcome of traumatic arthrotomies using 121 open knees from the United States army medical records. They demonstrated that sixteen failures of which seven of them under went delayed surgical debridement(7). Collins and Temple also evaluated knee pain at the seventh month of injury and found that patients with class IA injuries reported only mild pain while those with Class IV injuries had higher rate of pain and severe impairment. Of their open knee joint injuries they reported 11.8% rate of infection and 9% of vascular injury which resulted in amputation in 1% cases(5). Recent study done by Nguyen et al argued that low velocity intra-articular gunshot wounds can be treated non -operatively .They reported that of 24 patients with low velocity gunshot wounds none of the developed infection(14)

2.3 Factors associated with open knee joint injuries

Open knee joint injuries frequently occurred in men with younger age group (4, 5). On the contrary a meta-analysis reported that Females and adolescents appear to be more at an increased risk of sustaining a knee injury compared with males(6). A prospective study was conducted by Marvel and Marshal to evaluate functional outcome of traumatic arthrotomies using 121 open knees from United States reported that delayed surgical debridement, larger

wound size, severe articular cartilage injury and delayed initiation of active range of motion were associated with poor outcomes (7). According to Collins and Temple evaluation of knee pain at the seventh month of injury, the extent of osseous and soft tissue injury were the main factors affecting the outcome(5). In other study which evaluated joint range of motion at two months from the initial injury found that only 8% patients with associated fracture of the knee had flexion more than 90 degree. So they concluded that the type and extent of fracture and degree of soft tissue loss were determinant factors of the outcome (4). The cross-sections of tibial and femoral epiphyses revealed bone bruises due to compression and avulsion and the percentage of victims with knee injuries increased to 80% in the group of lateral impact(15).

2.4 Conceptual Frame Work

This conceptual framework was developed by referring different literatures (4, 5, 14).

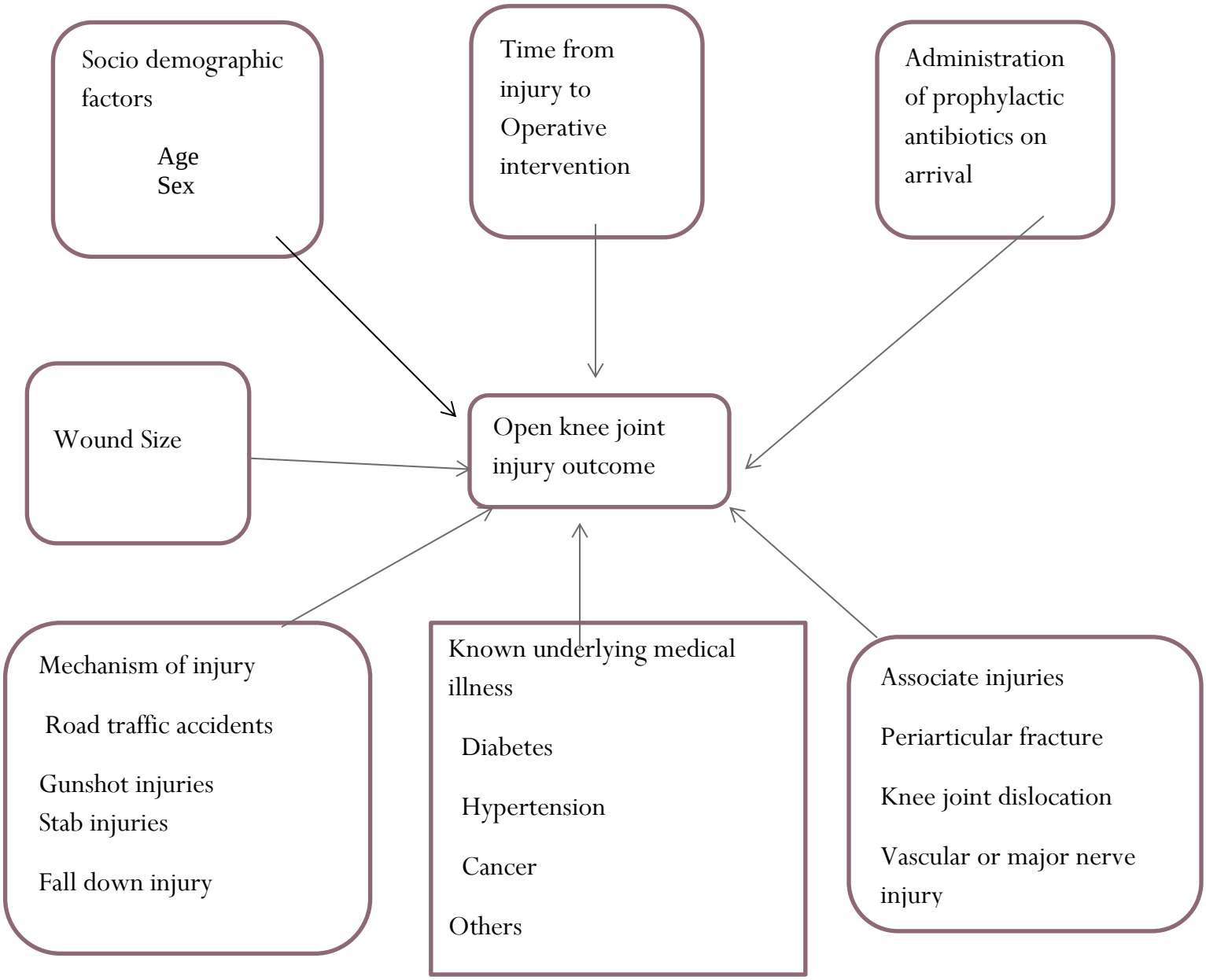

Figure 1: Conceptual Framework depicting the relationship between the outcome and associated factors.

Source: Developed by reading different literature as cited above

3. Objectives

3.1General objective

To assess treatment outcome and associated factors among patients with open knee joint injury treated in Tibebe Ghion Specialized Hospital Bhirdar Ethiopia, 2020.

3.2 Specific objectives

To determine the treatment outcome of patients treated for open knee joint injury.

To identify factors associated with open knee joint injury with Poor outcome.

4. Methods and materials

4.1 Study area and period

The study was conducted from august to September 2020 in Bahir Dar Tibebe Ghion specialized hospital. Bahirdar is the capital city of Amhara regional state located 565 km north-west of the capital Addis Ababa. TGSH is a teaching referral hospital currently teaching in eight specialty fields and serves more than five million people in the catchment area. Department of orthopedics has 60 beds for inpatient and operations are done four days in a week for elective cases and daily for emergency cases.

4.2 Study design

A retrospective cohort study was conducted, by reviewing chart documents of patients treated for open knee joint injury in Tibebe Ghion specialized hospital from January 2019 to July 2020.

4.3 Population

4.3.1 Source Population

All patients with diagnosis of open knee joint injury in TGSH hospital

4.3.2 Study population

Patients who were treated for open knee joint injury in TGSH hospital from January 2019 to July 2020.

4.4 Inclusion and exclusion criteria `

4.4.1 Inclusion criteria

Patients with open knee joint injury

Patients with complete medical record

Patients who had follow-up for at least three months postoperatively or those with known outcome before three months.

4.4.2 Exclusion criteria

Patients who discontinue follow up without known outcome

4.5 Sample size and Sampling technique

4.5.1 Sample size Determination

All 50 patients treated for open knee injury during the study period were sampled .

4.5.2 Sampling technique and procedure

We sampled all patients treated for open knee joint injury as survey as long as they fulfill inclusion and exclusion criteria. The patients' card number recorded in registration book was taken and Charts was reviewed.

4.5.3 Data collection tools and procedure

Data collection was done using a well-designed check list accomplished by reviewing patients' medical records. Main outcome measurements can be measured by, Knee range of motion, functional limitations and complications. Our study now measured complication as outcome. Data was collected by two trained general practitioners after being trained ahead of data collection. The data collectors were given training about research objective, the questioner, how to review charts, and how to fill the data to assure the quality of the data. The researcher followed the data collection process.

4.6 Study variables

4.6.1 Independent variables

Sociodemograpic factors: Age, Sex,

Baseline clinical variables: Mechanism of injury, time from injury to surgery, associated injury to the knee joint, wound size and known underlying medical illness

Management approach: Rebridement, time of wound closure and administration of prophylaxis antibiotics on arrival

4.6.2 **Dependent variables**

Outcome of open knee joint injury (poor outcome or good outcome)

4.7 Data processing and analysis

Data was entered and exported by using Epi Data manager version 4.4.1 and was analyzed by using, SPSS version 25. Findings were presented by using graphs, tables and texts. Chi-squared test was conducted and p value less than 0.05 were considered significant. The mean and percentage was used for nominal variables. Findings were presented by using tables and texts.

4.8 Operational definitions and definition of terms

A patient was considered having poor outcome of open knee joint injury when He/She had developed one of the complications like, infection, limb loss, limited range of motion to the knee joint or death due to open knee joint injury

A patient was considered having superficial infection is when the infection is above the joint capsule.

A patient was considered having Septic arthritis is when the infection involves joint cavity

A patient was considered having good outcome, when the patient attains his pre-injury activity without developing complications.

4.9 Data quality assurance

Data collection form was properly designed and data collectors were well trained and supervised by the investigator. Tool pre-testing was done to ensure that they are clear with the content and technique of gathering the data. Every data sheet was checked and evaluated after collection for its completeness.

4.10 Ethical clearance

Ethical clearance was obtained from IRB of BDU ethical committee. Because the study done is retrospective chart review, informed consent from the patients is not possible but appropriate consent was taken from the responsible body. However confidentiality was maintained when handling each case files.

4.11 Dissemination of results

The result of the study was presented as a partial fulfillment of specialty certificate in the department of orthopedics, BDU and it will also be disseminated to TibebeGhion specialized hospital, ARHB .It will also be presented to ESOT and will be published in peer review journals.

5. Results

Forty three known open knee joint injury patients were included in this study. Seven respondents were not considered for the analysis because of missing of data for outcome variable. The result includes socio demographic characteristics, diagnosis methods, treatments outcome, and complication of open knee injury.

5.1 Baseline Characteristics of study participants

Out of 43 respondents 36 (83.7%) were males. The age of the respondents ranges from 5-65 years. The mean (±SD) age of the respondents was found to be 30.28 (±14.5) years. Epilepsy and hypertension was reported from two different respondents as underling medical illness (see table 1 below). The major cause of injury is road traffic accident (58.1). Other injuries caused by axe, stick, machine and the like together covers 11.6%. The wound size ranges from 1cm*1cm (9.3%) to 15*20cm (2.3%). In terms of wound area almost half of (51.2%) the wounds area were more than $10cm^{2.}$ (See table 1 below)

Table 1: Characteristics of open knee joint injury patients in TGSH, October 2020

Variable	Category	Total	
		Number	Present
Sex	Male	36	36 (83.7%)
	Female	7	16.3
Age	30 and Above	24	55.8%
	Below 30	19	44.4%
Underling medical illness	Yes	2	4.6 %
	No	41	95.4%
Knee joint injured	Right	31	72.1%
	Left	11	25.6%
	Both	1	2.3%
Mechanism of injury	Road traffic accident	25	58.1%
	Gunshot injury	6	14%
	Fall down injury	7	16.3%
	Other	5	11.6%
Diagnosis method	Physical examination alone	17	39.5%
	Saline load test	26	60.5%
Presence of associated injury	Yes	14	37.5%
	No	29	62.5%
Diagnosis of associated injury to the joint	Peri-articular fractures	12	27.9%
	Major neuro-vascular injury	1	2.3%
	Others (tendon and ligament injury)	1	2.3%
Wound size	Less than $5cm^2$	16	37.2%
	5-10 cm^2	8	18.78%
	More than $10cm^2$	19	44.1%

5.2 Management approach for open knee joint injury

For all respondents intravenous prophylaxis antibiotics were administered immediately on arrival. Concerning the total time spent from injury to surgery most of them (81.4%) undergo surgery on the first day of trauma. But except one respondent all of them get surgical treatment within 72 hour starting from injury occurrence. Regarding to wound closure timing nearly half (53.3%) of the respondents' got wound closure on the first operation. Sixteen patients (37.2%) had need debridement as management options. These patients got debridement treatment with

different frequency ranging from one time (20.9%) to more than three times (2.3%) (See table 2 below)

Table 2: management approach for open knee joint injury patients in TGSH, October 2020

Variable	Category	Total	
		Number	Present
Intravenous prophylaxis Administration	Yes	43	100%
Total time from injury to surgery	On the first day	35	81.4%
	Within the first 72 hrs.	5	11.6%
	Up to a week	2	4.7%
	more than one week	1	2.3%
Time of wound closure done	On the first operation	20	46.5%
	Another operative procedure required	18	41.8%
	Bed side closure	5	11.6%
Redebriedemnt done	Yes	16	37.2%
	No	27	62.8%
Redebriedemnt frequency	Once	9	56.3%
	Two times	2	12.5%
	Three times	4	25%
	More than three	1	6.3%

5.3 complication of open knee joint injury

Fourteen (32.5%) of this study subjects had developed either infection or limited range of motion on follow-up due to open knee injury. From patients diagnosed with infection 90% of them developed septic arthritis while the remaining had superficial infection above the joint capsule. Eight patients (18.6%) developed limited range of motion of the knee joint at the end of on follow up. Of these patients four of them developed limited range of motion without infection while the remaining four patients with limited range of motion also developed infection concomitantly. Other complications like limb loss or amputation or death didn't report on this study

Table 3: complication as one outcome for open knee joint injury patients in TGSH, October 2020

Variable	Category	Total	
		Number	Present
Was infection diagnosed	Yes	10	23.2%
	No	33	76.8%
Type of infection	septic arthritis (deep infection)	9	90%
	superficial wound infection	1	10%
Limited knee range of motion	Yes	8	18.6%
	No	39	81.4%
Limb loss (amputation) and death			
	No	43	100%
Total complication outcome	Either limited range of motion or infection	14	32.5
Death	No	43	100%

5. 4 Association between complication and other variables

By running chi-squared test we have seen some variables have significant association with complication of open knee point injury. Presence of associated injury and the size of the wound had showed significant association with complications. Similarly the time of wound closure, need for redebridement and diagnosis method showed significant association with these complications. (See table five below).

Table 4: chi-squared association between different variables and complication of open knee joint injury in TGSH, October 2020

Variable	Category	Outcome ends up with Presence of complication		Pearson chi-square	P value
		Yes	No		
Presence of associated injury	Yes	10	4	12.25	0.000*
	No	4	25		
Time of wound closure done	On the first operation	2	18	8.66	0.03
	Another operative procedure required	11	7		
	Bedside closure	1	4		
Diagnosis method	Physical examination	10	7	8..83	0.003
	Saline load test	4	22		
Wound area	Below $10cm^2$	4	20	4.26	0.039
	$10cm^2$and above	10	9		
Sex	Male	9	27	0.78	0.058
	Female	5	2		
Age	Below 30	5	14	0.604	0.43
	Above 30	9	15		
Underling medical illness	Yes	2	0	4.34	0.1
	No	12	29		
Was Rebridement done	Yes	11	5	15.2	0.000*
	No	3	24		

NB. * =P value<0.001, cm^2= centimeter square, TGSH= Tibebe-Ghion specialized hospital

6. Discussion

Fourteen (32.5%) of this study subjects had developed either infection or limitation of knee range of motion on follow-up due to open knee injury. But here our finding is higher than study conducted by Collins DN, Temple SD in 1989 about the profile of patients with open knee joint injury showed that 11.8 % patients developed infection (5). The possible reason for this complication rate difference might be caused by difference in severity of injury and higher incidence of associated injury in our cases. Here our study showed 23.2% infection rate dominantly septic arthritis is in line with study reported that open knee joint injury was associated with substantial risk of joint infection and pyoarthrosis (7). Study done by Konda SR showed vascular injury associated with open knee joint injury may resulted in above knee amputation (8, 9) but in our study patient with vascular injury didn't end up in amputation which could be explained with the difference in degree of the vascular involvement.

Regarding the mechanism of injury our study showed that road traffic accidents (58.1%) and gunshot wounds (14%) are the main cause of injury. This is in line with study conducted by Collins DN, Temple SD in 1989 (5, 12)) which demonstrated similar mechanism for open knee joint injuries in civilian settings.. The main stay of treatment of open knee joint injury is urgent surgical debridement and irrigation. Our study supports the idea that early initiation of Intravenous antibiotics is also one of the most important treatment components of open knee joint injury (13).

Our study showed that the size of the wound has relationship with complication. This finding is supported by study conducted by Marvel and Marshal in United States (7). The possible reason for the association between wound size and high complication rate is scientifically sound and common. The larger the wound size will be, the more likely the high degree of initial injury causing extensive soft tissue damage tissue which in turn leading to high chance of complication.

Presence of associated injury like periarticular fractures and ligamentous injuries also showed significant association with complications. This is similar with the study done by Collins DN, Temple SD (5) which demonstrated patients with low grade injuries reportedly has lower

complication rate while those with articular surface comminution or meniscoligamentous disruption had higher rate of infection and severe impairment. This can be explained by the severity of initial soft tissue injury, multiple interventions required for the reconstruction and fixation of the associated injury which makes the wound prone for infection and other complications. Another point our study reported is the timing of wound closure has an association with open knee joint injury complication rate, This could be due to the more the wound remain opened it will be exposed to the environment which has high risk of infection. Diagnosis method also showed association with complications which might be indirectly related with the size of the wound. Those wounds with larger size would likely diagnose easily with physical examination by observation only. In addition the above variables redebridement had also association with complications that may be due to the fact that infected wounds required repeated redebridement.

Strength and Limitations

Strength

Being the first study in the country can be considered as the strength of this study

Limitations

The study findings can't be generalized to the population as the sample sizes are too small.

7: CONCLUSION and RECOMMANDATION

7.1 Conclusion

The rate of complication as poor outcome among open knee injury patients in the study area was significantly higher as compared to results of other studies. Majority injuries are caused by road traffic accidents and gun shot injuries which is similar with other studies. Presence of associated injury to the joint, wound size, time of wound closure ,need for redebridement and diagnosis method showed significant association with complications which is in line with other studies and scientifically plausible.

7.2 Recommendation

For federal ministry of health and Regional health office

- Since the rate of complication as one outcome among open knee injury patient in the study area was significantly higher so that emphasis should be given to this problem
- Measures to tackle road traffic accident should get enough emphasis as it is the leading cause of open knee injuries
- Routine public education campaigns should be conducted to create awareness about and complication risk reduction

For Tibebe-Ghion Specialized Hospital

- More attention should be given to patients with open knee joint injury and they should be treated as orthopedic emergency as the complication rate is significant.
- Orthopedic surgeons should aware their patients about the possible complication of open knee joint injury and prevention methods ,

For Researchers

We recommend other researchers to conduct prospective cohort study to identify causal relationship between Open knee joint complication and the risk factors

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9. Annex

Annexes I Questionaries'

BDU College of medicine and health sciences department of orthopedics and traumatology.

Data collection check list for a study about open knee joint injury, outcome and associated factors, which was done by reviewing medical records of patients.

1 Card no

2 Patient ages -------

3 Sex A. Male B. Female

4 Did the patient have known underlying medical illness?

4.1 if yes mention

5 Which knee joint is injured?

A left side B. Right side C. Both

6 What was the mechanism of injury?

a. Road traffic accident
b. gunshot injury
c. fall down injury
d. stab injury
e. Other(mention it)----------

7 What was the size of the wound on physical examination in Cm?

8 How was diagnosis of open knee injury made?

a. Based on physical examination finding(visible joint surface)

B. by using saline load test

C by using CT scan

9. Was intravenous prophylaxis antibiotics administered immediately on arrival?

A. Yes B. No

10. What was the total time from injury to surgery?

A. On the first day C. Within the first 72 hrs.

B. Up to a week D. more than one week

11 .Wound closure timing

A immediately B. on the second operation

12. Was there associated injury which is diagnosed before or during intra operative procedure?

A yes b no

12.1 If yes, what was the associated injury?

A per articular fracture (tibia plateau, patellar fracture, distal femur fracture)

B. knee joint dislocation

C major neuron vascular injury

D other (Mention it) ----------

13 When was wound closure done?

A on the first operation B. Another operative procedure required

14 Was Redebriedemnt done?(if no go to Question No 17)

A yes B. no

14.1 If yes how many times?

15. Was infection diagnosed? 15*20 on the left and 5*8 on the right

A yes B. No

16. If yes what type of infection?

A. superficial wound infection

B. septic arthritis (deep infection)

17. Did the patient have residual limping on follow up?

A yes B. No

18. Did the patient lose his limb (amputation) due to this injury?

A yes B. No

19. Did the patient lost his life due to this injury?

A yes B. No

Signature _____