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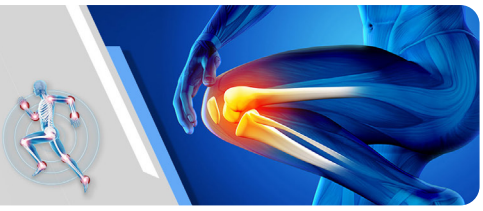

Prevalence, Patterns and Associated Factors of Acute Tibia Plateau Fractures among Adults with Tibia Fractures in Uganda

Benjamin Costantine Mfaume[1*], Expeditho Mtisi[2], Samuel Bugeza[3], Patric Sali[1], Abdirizak Sheikdon[1], Emusugut Michael[1], Waiswa Gonzaga[1], Tonny Mutanda[1]

Abstract

Background: The Tibia plateau makes up one of the most critical load bearing articular surface in the human body. An injury to this vital anatomic region affects knee alignment, stability and ultimately impairs functional mobility. Tibia Plateau fractures are associated with poor outcomes and more significant late complications if not well managed.

Objective: To determine the prevalence, patterns and associated factors of Tibia Plateau fractures (TPFs) among adults with tibia fractures seen at Mulago National Referral Hospital using Computerized tomography.

Methods: This was a cross sectional study which assessed tibia plateau fractures using computerized tomography. The prevalence of tibia plateau fractures was determined as a proportion of tibia plateau fractures among all tibia fractures enrolled in the study. The patterns were determined as a proportion of a particular pattern among tibia plateau fractures. For factors associated with TPFs, we performed a Fisher's exact test and factors with P-values less than 0.2 at bivariate were considered to have an independent association with tibia plateau fractures.

Results: 283 participants with tibia fractures were enrolled, 40 had tibia plateau fractures resulting in a prevalence of 14.1% (95% CI; 10.5 to 18.7). In this study 75% of the injuries involved the right tibia and 57.5% were closed injuries. Majority of tibia plateau fractures were classified as Schatzker VI at 60.0%. The most common column classification was medial accounting for 40% while the lateral and posterior Columns were equally distributed by 30.0% each. Sex of participant was found to have an independent association with TPFs.

Conclusion: Tibia plateau fractures are common injuries with a high prevalence in our setting. Road traffic accidents were the most common mechanism of injury affecting mainly motorcyclists and pedestrians. Shatzker VI and medial column is the most common fracture pattern in our setting.

Keywords: Prevalence; Patterns; Tibia Plateau Fractures; Injury; Accident; Schatzker classification

Introduction

The tibia plateau makes one of the most critical loading and bearing areas in human body. Its injury affects knee alignment, stability and motion [1]. On a global scale tibia plateau fractures make 1% of all fractures and 8% of such fractures in the elderly [1,2]. The annual incidence of tibia plateau fractures

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is 10.3-13.3 per 100,000 people [3,4]. A retrospective study done in Asia specifically China on showed evidence that electric-bike accidents caused about 32.42% of all tibia plateau injuries, and 39.62% of these were due to high-energy injuries [5]. Other countries have reported about 355 patients with tibia plateau fractures among 576,364 patients admitted in the hospital in a period between 2005 and 2010 [4]. In East African countries, a prevalence of about 9% has been reported. A study showed that of the 199 tibia fractures, 17 patients had tibia plateau fractures [6].

It has been postulated globally that isolated injuries to the lateral plateau account for 55% to 70% of tibia plateau fractures, in comparison with 10% to 25% isolated medial plateau fractures and 10% to 30% bicondylar lesions [1,2]. Estimated 1% to 3% of tibia plateau fractures are open injuries [2]. From a research done in Mulago hospital of Uganda, motorcyclists accidents accounted for 22.0% of all long bone fractures in 2018 and tibia fractures were the highest at 68.4% of all long bone fractures [7].

Classifying TPFs injuries is a key in setting priority goals for better management outcomes. The Schatzker classification is a radiological system that divides tibia plateau fractures into six types. This is the most adaptable system used in classifying these injuries and it helps distinguish them by causation and guides surgeons on appropriate management [8]. It can also give an idea of associated injuries of vital intra articular structures, and this is an advantage in resource limited settings [9]. The use of CT compliments precision with diagnosis already made using this classification.

CT scan also provides more details on the presence of associated injuries like widening of TP which has been seen to be associated with higher incidence of soft tissue injury at about 83%, medial meniscal injury occurred when depression or widening detected as more than 8mm [10].

The intra and inter observer agreement inclusive of clinical judgment showed that 81% of all TPF cases needed CT-scan [11]. Management of tibia plateau fractures by the dictates of Schatzker classification has proven to improve patient surgical outcomes greatly [2]. Poorly aligned knee reduction post TPF resulted into adverse outcome witnessed by early osteoarthritis, chronic pain, stiffness and early need for TKA [10]. Tibia plateau fractures are associated with very poor morbidity outcomes and late complications [12], if not adequately attended to, and yet not much information is available in Uganda at MNRH where a high prevalence of fractures in lower limb was found to be in tibias by one of the studies [7]. Results from a pilot study in Mulago hospital over a period of 4 months in 2019 showed that of 298 tibia fractures, 8% were TPFs. These were assessed using X-ray only since CT scan was not yet prioritized. Patients between 30 to 60 years have been largely found to be affected with tibia plateau fractures. Other factors contributing to injuries were alcohol intoxication and drug abuse [13-16]. Sex was associated with musculoskeletal injuries where a study found that 75% were males whose cause 87% was motor traffic accident. Motorcycle rider, passengers and pedestrians have largely been affected by TPFs [6] however no study in Uganda has been done to asses for these factors among patients with TPFs. Therefore this study set out to determine the prevalence, patterns and associated factors of Tibia Plateau fractures (TPFs) among adults with tibia fractures seen at Mulago National Referral Hospital using Computerized tomography.

Methods

Study design and setting

This was a cross-sectional study conducted between May to November 2020 at Mulago National referral hospital (MNRH). The hospital is a national referral and teaching hospital for Makerere University with a bed capacity of about 1500 beds and an annual in-patient turnover in excess of 140,000 patients. The study was carried out in the accident and emergency unit, orthopedic outpatient clinics and the orthopedic wards. The Accident and Emergency Department has a surgical casualty area, an operation theatre, a radiology unit which provides x-ray and ultrasound scan services, emergency laboratory, a pharmacy, a plaster room, an emergency surgical ward for patient's admission and a resuscitation area for critically injured patients. Here patients are triaged and there after reviewed by the orthopedic surgical team and consultants who plan to manage patients definitively. The orthopedic outpatient unit is similar to the Accident and Emergence department. The facility receives about 50-60 trauma patients per day from within and outside Uganda. All methods were performed in accordance with relevant guidelines and regulations. Ethical approval and consent waiver for this study were obtained from the Ethics committee of The School of Medicine Research Committee (SOMREC), College of Health Sciences at Makerere University with clearance number REC REF-2020-107.

Study population

All adult patients above 18 years of age presenting to the accident and emergency unit, orthopedic outpatient clinics and inpatient orthopedic wards with tibia fractures with one month of injury from May to November 2020 were consecutively included in the study. Patients with pathological fractures and those who were unconscious with low Glasgow coma score that remain so throughout the study time were excluded from the study.

Sample size estimation

The required sample size was achieved by using Kish Leslie 1965 formula.

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N= $\frac{Z^2_{\alpha/2} * pq}{d^2}$ where p was the proportion of patients with tibia fractures, q was the proportion without tibia fractures, but with tibia fracture d was the error = 0.05 and Zα is the value at 95% level of confidence =1.96.

Using the study of Clelland et al. [6,17] done in Kilimanjaro region in Tanzania, the prevalence of tibia fractures was 20%. Therefore, p= 0.2, q=0.8

N= $\frac{1.96x1.96* 0.2x0.8}{0.05^2}$ = 246 participants

Study procedure

All adult patients with tibia fractures presenting at the Accident and Emergency Department, trauma wards and outpatient clinics; were considered for the study. Patients with tibia fractures were clinically examined for the signs, symptoms and radiological evidence of tibia fracture. Patients were asked to consent for the study and sent for appropriate x-ray investigations. Patients with TPFs were given a questionnaire and sent for CT-scan paid by a principal investigator. Principal investigator was provided with a special radiology reader which helped to classify TPFs by Schatzker classification and three column classification. A Radiologist oriented and familiar with Schatzker classification and column confirmed the classification after reading the CT scans.

Data collection and analysis

All data was collected by the principal investigator (PI) with the help of trained research assistants using a pre-test questionnaire with mostly closed ended questions and a few open-ended questions. The tool comprises of two parts; the first part had demographic characteristics of participants while the second part assessed the patterns of TPFs.

Independent variables included; Age, gender, education level of a participant and occupation

Associated factors collected included; Mechanism of injury and role of a participant

The dependent variable was patterns of Tibia plateau fractures.

Collected data was checked for completeness before the participant left the interview room. Data was coded and entered into the electronic Epi Data Version 4.2.0.0. The database was rechecked to ensure accuracy and completeness of the data during entry. The cleaned data was then exported to Stata Version 15 for analysis.

Descriptive statistics

Data was summarized into means and standard deviation or median and interquartile range depending on the distribution. Prevalence of TPFs was expressed as a proportion of participants with TPFs divided by all patients with tibia fractures enrolled into the study. Patterns of tibia plateau fractures were summarized as a proportion of a particular pattern among patients with tibia plateau fractures. In pattern classification CT scan was used as the imaging modality in classifying tibia plateau fractures. To determine the factors associated with TPFs among patients with tibia plateau fractures in MNRH. Bivariate analysis was done using a Fisher's exact test for all the independent variables with TPFs. Variables with a P-value < 0.2 were considered for to have an independent association with TPFs. Multivariate analysis was not done because of the few numbers of the patients with TPFs obtained in the study.

Results

Socio-demographic characteristics of study participants

This study recruited 283 patients with tibia fractures over a period of six months, from April 2020 to November 2020. Of the 283 patients with tibia fractures, 40 had Tibia plateau fractures resulting into a prevalence of 14.1% (95% CI; 10.5 to 18.7). Majority of the participants, 37 (92.5%) were males and mainly between 28-37 years of age, 14 (35%) as shown in Table 1.

Bivariate analysis of socio-demographic characteristics with tibia plateau fractures

At bivariate analysis, only sex had an independent association with tibia plateau fracture patterns since it had a P-value less than 0.2. Age, occupation, carrier and education had no association with tibia plateau fractures as showed in the Table 2 below.

Table 3 shows the side of the limb involved, 30 (75%) of the 40 participants with tibia plateau fractures were right tibia fractures while 10 (25.0%) were left sided. Based on

Table 1: Socio-demographic characteristics of patients with tibia plateau fractures of patients attended in orthopedic clinics in MNRH.

Variable	Frequency (N=40)	Percentage
Sex		
Male	37	92.5
Female	3	7.5
Career		
Professional	18	45
Non professional	22	55
Education		
Primary	10	25
Secondary	19	47.5
Tertiary	11	27.5
Age groups		
18-27	6	15
28-37	14	35
38-47	12	30
>47	8	20
Mean age (standard deviation)	**37 (9.7)**	

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Table 2: Table showing the bivariate analysis of socio-demographic characteristics with patterns of tibia plateau fractures.

Variable	SC I (n=2)	SC II (n=2)	SC III (n=1)	SC IV (n=5)	SC V (n=6)	SC VI (n=24)	P-value**
Sex							
Female	0	0	0	0	3 (50)	0	0.019
Male	2 (100)	2 (100)	1(100)	5 (100)	3 (50)	24 (100)	
Occupation							
Formal	1 (50)	0	0	1 (20)	4 (66.7)	12 (50)	0.513
Informal	1 (50)	2 (100)	1 (100)	4 (80)	2 (33.3)	12 (50)	
Education							
Primary	1 (50)	1 (50)	0	2 (40)	3 (50)	3 (12.5)	0.238
Secondary	0	1(50)	1(100)	3 (60)	2 (33.3)	12 (50)	
Tertiary	1(50)	0	0	0	1 (16.7)	9 (37.5)	
Age groups							
18-27	0	1 (50)	0	2 (40)	0	3 (12.5)	0.541
28-37	2 (100)	1 (50)	0	2 (40)	2 (33.3)	7 (29.2)	
38-47	0	0	0	1 (20)	3 (50)	8 (33.3)	
>47	0	0	1 (100)	0	1 (16.7)	6 (25)	
** Fisher's exact test							

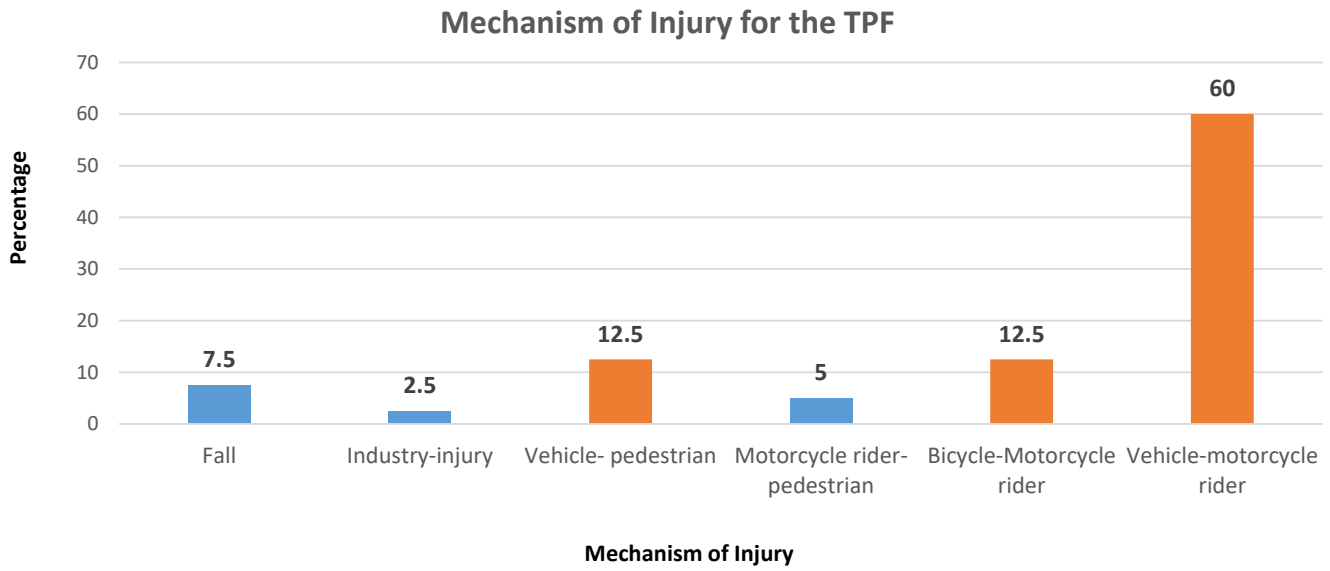

Figure 1: The bar graph showing the mechanism of Injury of the patients with TPFS.

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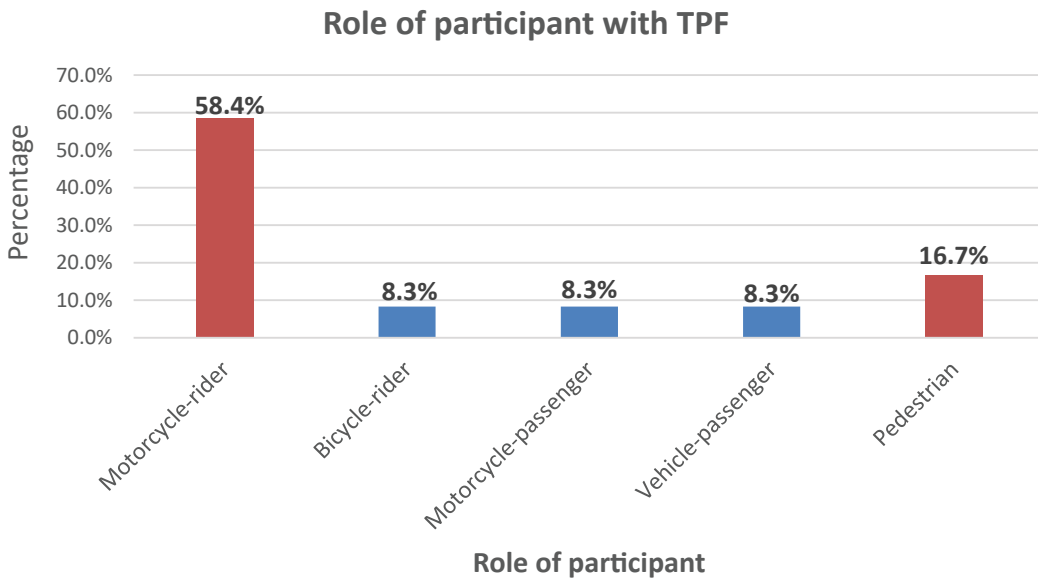

Figure 2: A bar graph showing role of participant.

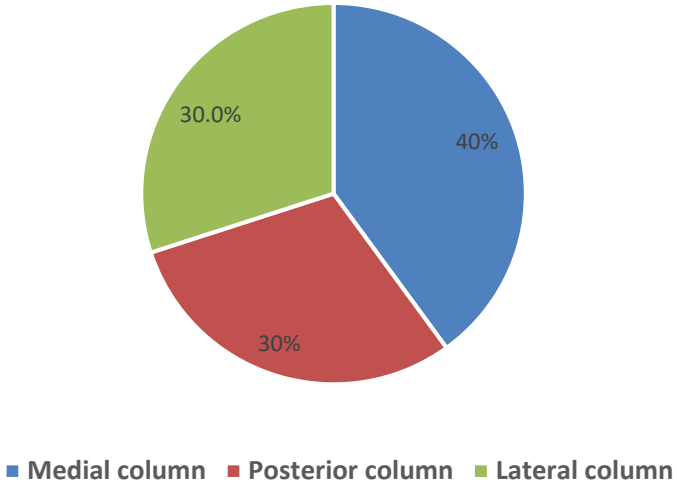

Figure 3: A pie chart showing the three column fracture classification.

the nature of injury, majority 21(57.5%) of the patients had closed injuries. In this study, majority, 24 (60%) had SCVI, followed by SCV where 6 (15%) of the participants had this Schatzker classification. The classification with the least number of participants was type III with 1 (2.5%) participant. In this study, majority 24 (60%) were vehicle-motorcycle rider accidents, bicycle-motorcycle accidents and vehicle pedestrian accidents were each 5 (15.5%). The least were falls 3 (7.5%), refer Figure 1. Our findings show that the most affected participants were motorcycle riders, 21 (58.4%) followed by pedestrians 6 (16.7%) with others being equally affected, refer Figure 2. The majority 16 (40.0%) involved the medial column while lateral and posterior columns were equal each having 12 (30%) of the participants, refer Figure 3.

At bivariate analysis, nature of injury, limb involvement, mechanism of injury and role of participant had no independent association with tibia plateau fracture patterns since their P-values were more than 0.2 as showed in the Table 3 below.

Discussion

In this study, we observed a prevalence of 14.1% which is slightly higher than what has been observed in Denmark where the incidence of 10.3% over a period of 5 years was observed.

The slight difference between Uganda and Denmark may be because of differences in MOI where RTA especially by motorcycle accidents are uncommon in developed countries but common in developing countries like Uganda. [4].

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Table 3: Table showing the bivariate analysis of factors associated with tibia plateau fractures.

Variable	SC I (n=2)	SC II (n=2)	SC III (n=1)	SC IV (n=5)	SC V (n=6)	SC VI (n=24)	P-value**
MOI							
Vehicle/motorist	1 (50)	0	1 (100)	4 (80)	4 (66.7)	14 (58.3)	0.286
Motorist/motorist	0	1 (50)	0	0	0	4 (16.7)	
Motorist /pedestrian	0	1 (50)	0	1 (20)	2 (33.3)	3 (12.5)	
Fall/industry	1 (50)	0	0	0	0	3 (12.5)	
Role							
Victim	1 (50)	0	0	0	0	3 (12.5)	0.213
Passenger	1 (50)	0	0	0	3 (50)	2 (8.3)	
Rider	0	1 (50)	1 (100)	3 (60)	2 (33.3)	17 (70.8)	
Pedestrian	0	1 (50)	0	2 (40)	1 (16.7)	2 (8.3)	
Drivers	0	0	0	0	0		
Nature of injury							
Open injury	1 (50)	2 (100)	0	2 (40)	4 (66.7)	14 (58.3)	0.729
Closed injury	1 (50)	0	1 (100)	3 (60)	2 (33.3)	10 (41.7)	
Limb involvement							
Right sided	1 (50)	1 (50)	1 (100)	4 (80)	5 (83.3)	18 (75)	0.798
Left sided	1 (50)	1 (50)	0	1 (20)	1 (16.7)	6 (25)	
** Fisher's exact test							

A study in Tanzania observed a prevalence of 9.0% over one year which is lesser than our findings of 14.1% observed in the study. We observed a higher prevalence because RTA was the leading cause of injury in our study compared to falls observed in Tanzania [6]. In this study, males were the most affected by tibia plateau fractures accounting for 92.5% of the total injuries. A study from Nigeria with a similar setting like Uganda also observed a common trend where the gender ratio of males to females was 6:1 [14]. The findings are slightly similar to a study in Brazil that observed more males with TPFs compared to female [13]. In addition, another study from China found that 71.1% of the participants with TPFs were males and only 28.9% were females [15]. This is because the most common mechanism of injuries in these studies were due to motorbike injuries and skiing activities which are more common among men than females.

According to our findings, individuals between 28 and 37 years were the most affected age group. Our findings are similar to a study in China which found that 71% of patients aged between 30 to 60 years. This is similar to our setting where young adults above 30 years are commonly motorcycle riders like the findings in Brazil [13]. Another study from Nigeria observed a high incidence of TPFs to be commonly among individuals between 30 to 40 years. This study is similar to our findings because the MOI was similar in both countries. In the previous study, most injuries were due to RTA as is the case in our setting [14]. In this study, over 55% of the participants with TPFs had non-professional occupation and 45% had formal occupation. This is similar to a study in China that observed more casual laborers with informal occupation and had sustained TPFs [16].

Based on mechanism of injury, 60% were due to vehicle-motorcycle accidents. Findings in this study are similar to what was observed that over 71% of the injuries are as a result of road traffic injuries [13] which resulted into SC VI fractures. It was observed in this study that 58.4% of the participants who sustained vehicle/motorcycle injuries got SC VI fractures. In addition, the previous study by Albuquerque also observed a high prevalence of SC VI fractures [13,17]. All the participants who suffered this injury were builders and all had SC VI fractures. The pattern in terms of column was not specific, some had injuries involving the medial column, and others involved the lateral column while others had posterior column fracture injury [17].

According to role of participant, 58.4% were motorcycle riders followed by pedestrians accounting for 16.7% of the injuries. Findings in our study are similar to a study that showed that 47.2% were motorcycle riders, 33.8% were passengers while 19% were pedestrians [14]. In another study, majority of the injuries were due to motor traffic accidents and over 42% being due to motorcycle accidents [17]. In this study, passengers contributed 15% of all the injuries. The findings are similar to a study from Nigeria that showed that passengers were the second largely affected individuals with TPFs accounting for 33% of the injuries in that study

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[14]. Pedestrians accounts for 16.7% of the participants in our research.

A similar study in Tanzania that looked at 166 participants with TPFs observed that about 21% of the participants were pedestrians. Pedestrians in Tanzania stood in third position among those involved in RTA [17]. As per our findings, over 60% of the participants in our study with SC VI fracture patterns further confirms what Gebel discovered that many individuals who get involved in RTAs result into severe injuries and poor outcomes of early post traumatic arthritis, limited knee motion, mal- union, non-union, persistent pain, change of motion and other complications [18] which could be explained by the severe form of fracture pattern.

This is however on the contrary to a study that was done in Switzerland which found that majority over 57% of the TPFs were SC I, II and III and only 35% were SC VI. The difference is because of different MOI where in Uganda the high energy injury due to RTA was the most common cause compared to winter sports in Europe [18]. In this study, the findings are different to a study in Shanghai China which observed that right TPFs were more by 58.2% compared to 41.8% left sided tibia plateau fractures [15]. The study is also contrary to a study in Brazil that showed that majority of the TPFs were left sided about 53.6% [13]. The difference in the findings could be due to the difference in the mechanism of injury, in the former study most of the injuries were due to falls from a height yet in the present study, majority of injuries were due to motorcycle/vehicle crushes.

The other difference might be due to difference on the side of driving in Uganda as opposed to other countries where people drive on the left side. Findings from this study are different to a study done by Egol et al. [2] noted that 1% to 3% of the TPFs were open in nature and over 97% were closed injuries. This is because majority of the injuries were due to sports accidents and in our present study, road traffic accidents were the most common especially vehicle-motorcycle accidents which resulted into closed injuries. This is however in contrary to what other studies which found that open injuries are the most common. A study done in Tanzania indicated that 72% of TPFs were open while 20% were closed injuries. The reason for above nature of injury could be because in the previous study, the second largest common cause of injury was falls from high heights that resulted into open fractures [17].

Sex was not associated with occurrence of TPFs. This could be explained by the fact that we had small numbers and our study was not powered enough to get statistical significance. Our findings are similar to a study that found age of participant not to be significantly associated with tibia plateau fractures [19]. Sex had an independent association with tibia plateau fractures however a multivariate analysis was not performed because this study had only three females which made the study less powered to detect a meaningful difference.

Findings are similar to a retrospective study that assessed 693 men and 327 females with TPFs for a period of four years and didn't find a significant difference in terms of gender [20]. Findings from Brazil and China found a higher incidence of TPFs among men compared to women but didn't get a statistically significant difference [21]. The study in China that looked at 29 cases of TPFs found that 71.1% were men and 28.9% were women [15]. In this study men have higher percentage of 92.5%. This finding is similar to the study done in Kilimanjaro on 1016 patients admitted in the orthopedic unit, 199 had TPFs of which 78% were men and the most common cause of injury was motor traffic accidents [17].

Level of education was not associated with occurrence of TPFs. This can be explained by the fact that Uganda is a low income country where majority of the citizens are secondary dropouts and are casual laborers. In addition resources from Uganda National Bureau of statistics in 2012 indicate that 59.1% of Ugandans are secondary school drop outs and are involved in casual jobs including riding bodabodas to earn a living. Another study mentioned that patients with road motor traffic accidents, 33.9% of the participants had attained secondary level education and one of the key contributors to the accidents in Kampala was poor knowledge on traffic rules [22]. In addition, occupation was not associated with TPFs. This could be explained by the fact that 1.5% of Ugandans who do not have professional jobs are usually engaged in boda boda riding as reported by Uganda Bureau of statistics 2016.

The main strength of this study is that this was the first study in Uganda to look at TPFs in our setting which provides baseline knowledge on the prevalence, patterns of TPFs as well as their associated factors. However, this study was limited by availability of computed tomography in Mulago hospital which is on and off at most of the times especially the total closure at night. The study target population may not be representative of the general Ugandan population since it does not receive all the injured patients although it is a national referral hospital of the country.

Conclusion

The study observed a high prevalence of TPFs of 14.1% in a period of only six months. Most of participants were young men aged between 28 to 37 years with SCVI pattern which is a due to high energy injury, mainly due to RTA affecting motorcycle riders and pedestrians. Closed injuries were the most common and male sex showing an independent association with TPFs. We therefore recommend the use of CT as a diagnostic tool to classify TPFs since SC VI were the most common fracture pattern.

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Declarations

Ethical approval and consent to participate

All methods were performed in accordance with relevant guidelines and regulations. Ethical approval and consent waiver for this study were obtained from the Ethics committee of The School of Medicine Research Committee (SOMREC), College of Health Sciences at Makerere University with clearance number REC REF-2020-107. The study tools were kept under lock and key only accessible to the research team to ensure that there was no breach of confidentiality

Consent for publication

Not applicable

Availability of data and materials

Participants did not provide their approval for the sharing of their information. However, for researchers who meet the requirements for access to confidential data, data are available at Mulago Hospital, Department of Orthopedics, Makerere University (pr.chs@)mak.ac.ug)

Competing interests

The authors declare no potential conflicts of interest with respect to research, authorship and/or publication of this article

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Data curation: Benjamin, Waiswa Gonzaga, Samuel Bugeza

Formal analysis: Expeditho Mtisi Benjamin Costantine Mfaume

Writing – original draft: Benjamin Costantine Mfaume

Writing – Review and Editing: Benjamin Costantine Mfaume, Expeditho Mtisi, Patric Sali, Abdirizak Sheikdon, Emusugut Michael Samuel Buzega

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