ORIGINAL RESEARCH

Epidemiology of Open Tibia fractures presenting to a tertiary referral centre in Southern Malawi: a retrospective study

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Abstract

Background

Road traffic accidents in Malawi have increased in recent years resulting in a high incidence of trauma seen in the hospitals as well as a high prevalence of musculoskeletal impairment in the community. Open fractures are a common consequence of road traffic accidents and the tibia is the most common long bone open fracture.

Objective

Epidemiology of open tibia fractures at the largest tertiary level hospital in Malawi and incidence of infections of open fractures managed at the institution.

Methodology

This was a retrospective study of consecutive open tibia fracture patients seen and admitted to Queen Elizabeth Central Hospital's (QECH) orthopedic department from 1st January 2019 to 31st December 2019. Patients with life-threatening head, chest, or abdominal injuries were excluded as management takes priority over any limb-threatening injury.

Results

There were 72 open tibia fractures screened, and 60 of these met our entry criteria; 6 patients did not, while 6 patient files were missing. The median age of patients was 36 years, IQR (27-44.75) with Males making up 82%(n=49) of open fractures. Most of the open tibia fractures were caused by road traffic accidents 63%(n=38), followed by assaults 18%(n=11), falls 17%(n=10), and industrial accidents 2%(n=1). 26.7% (n=16) of open tibia fractures developed an infection. We found that patients' average length of stay was 16. 9(IQR 9.5-31.25) days. Most of the injuries (68.3%, n=41) were moderate to high energy injuries being Gustilo et al. grade II and III open tibia fractures.

Conclusion

This study identified that open tibia fractures were common in our hospital and that were often high energy injuries requiring an extended hospital stay to manage. The infection rate noted was higher than that reported on average in lower- and middle-income countries. There is a need to do more robust prospective studies in the area to gather more information.

Introduction and Background

Malawi is a country in South-East Africa with a high road traffic mortality rate of 31 per 100,000 people per year[1,2]. There is a high incidence of trauma seen in Malawian hospitals and a high prevalence of musculoskeletal impairment in the community[3,4,5,6].

An open fracture is a broken bone with a wound that communicates with the fracture site[7]. The tibia is the most common location of long bone open fractures[8,9,10]. Road traffic accidents have increased in recent years, and open fractures are common following accidents[10,11]. These fractures are known to result in high rates of infections, non-unions and amputations. A systematic review by Schade et al. looking at open fractures in lower-middle-income countries found that 18% developed infections and 15% resulted in amputations[12].

Overall, infections are the most common complications of open fractures and can result in prolonged hospital admissions[13,14]. Open fractures are therefore a public health concern.

In Malawi, fracture care is mainly provided at district and central hospitals. The country has 14 specialist orthopedic surgeons who operate at central hospitals and 107 non-physician orthopaedic clinical officers who are stationed throughout the country's district hospitals to provide primary orthopaedic care. This cadre of non-physician orthopaedic care providers undergo 18 months of formal training on the basics of orthopaedics, including open fracture debridement and external fixation[15]. Queen Elizabeth Central Hospital, located in Blantyre, is the country's largest tertiary level health facility with 1350 beds and has 4 of the countries 12 specialist orthopaedic surgeons.

There is a paucity of literature on the burden of open fractures in the country. This study aimed to investigate the burden of open tibia fractures at the largest tertiary level hospital in Malawi and offer a snapshot of the epidemiology,

https://dx.doi.org/10.4314/mmj.v34i2.7

burden and rate of infections of open fractures managed at this institution.

Methodology

This was a retrospective study of consecutive open tibia shaft fracture (distal to tibia tuberosity and at least 5 cm above the ankle joint) patients seen and admitted to Queen Elizabeth Central Hospital's (QECH) orthopaedic department from 1st January 2019 to 31st December 2019. The orthopedic department has the policy to admit all open tibia fractures for management.

All adult and pediatric patients who presented with open tibia shaft fractures to QECH from 1st January 2019 to 31st December 2019 had their medical notes and discharge summaries reviewed as part of this study. Data was collected from April 2020 to the end of May 2020.

The number of patients managed in the year of the study was extracted from the orthopaedic data registry and ward registers by the study team. Patient files were subsequently reviewed, relevant data extracted and recorded on case reporting forms. To ensure the accuracy of the data collected, we looked through the discharge letters as well.

All Patients with life-threatening head, chest, or abdominal injuries were excluded. The management of these severe injuries takes priority over any limb-threatening injury, resulting in significant delays to the management of their associated open fractures. Including these patients would confound findings of outcome of timing to theatre and length of stay.

The database and data analysis was done using a combination of Microsoft Excel Software (Microsoft Corporation, Redmond, WA) and IBM SPSS statistics 23. Descriptive analysis was done in order to come up with the relevant demographics of our study population. Fisher's exact test was used to test the association between infection and Gustilo-Anderson grade, p-values < 0.05 were considered statistically significant.

The research was granted approval by the College of Medicine Research and Ethics Committee (COMREC) on the 21st of April 2020 and assigned the COMREC approval number U.02/20/2929. Being a retrospective cohort study, consent was not sought from individual participants to collect routinely collected clinical data. Data collected was anonymised with research numbers, and no information including patient identifiers was collected.

For this study, infection was defined as the presence of pus, purulent ooze, stitch abscess, cellulitis, or wound breakdown. If one or more of these features were present, it was recorded as an infection. The grading of fractures was assessed according to the Gustilo-Anderson classification of open fractures by the operating surgeon (either senior orthopedic clinical officers (more than ten years of experience) or orthopaedic surgeons)[16]. All patients received intravenous broad-spectrum antibiotics (Ceftriaxone doses between 1g to 2 g) as soon as the diagnosis of an open fracture was made. The management followed the Malawi Orthopaedic Association guidelines and standards for open fracture management[17,32].

Results

During the 12-month study period, QECH treated 72 open tibia fractures. 60 of these patients met our entry criteria, a further 6 patients did not, as they had life-threatening injuries that excluded them, and a total of 6 patient files were missing.

The median age of patients was 36 years, IQR (27-44.75) and males accounted for 81.2% (n=49) and females 18.8% of open fractures. The open fractures were predominantly in the 20-49 age bracket, which made up 73.3% (n=44) of the admissions, while those over 60 accounted for only 3.4%(n=2) of open fractures (Figure 1).

76.7%(n=46) of the open fractures occurred within Blantyre district the catchment area of the central hospital with only 23.3% (n=14) being referrals from other districts within the southern region of Malawi. The most common mechanism of injury was road traffic accidents with 63.3%(n=38), followed by assaults, 18.3%(n=11), falls 16.7% (n=10) and industrial accidents 1.6% (n=1).

Most of the injuries (68.3%, n=41) were Gustilo-Anderson grade II to III open fractures which are moderate to high energy injuries (II=33.3%(n=20); IIIA =13.3%(n=8); IIIB = 21.7%(n=13) and IIIC =0%(n=0)). Gustilo-Anderson grade I made up 31.2%(n=19) of the injuries.

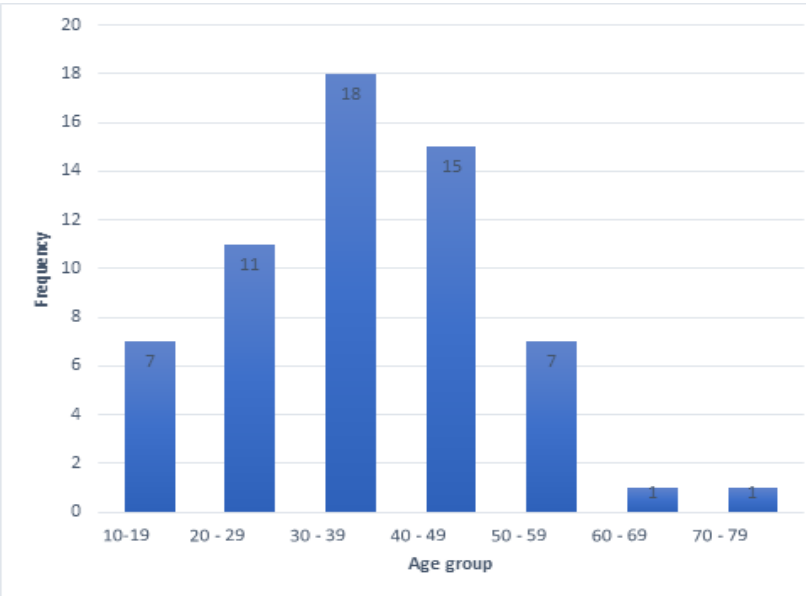

Figure 1. Age distribution

In the study, 56 of the patients had their debridements more than 6 hours after injury, only 1 had theirs within 6 hours, and 3 of the open fractures had not been not debrided. The infection rate of all open tibia fractures was 26.7%(n=16).

There were no infections in the Gustilo-Anderson grade I. Gustilo-Anderson grade II had 31% of infections (n=31), and 68.75%(n=11) of the infections were in Gustilo-Anderson grade III. Using Fisher's exact test, there was a statistically significant association (p-value <0.001) between the Gustilo-Anderson class and infection (Table 1).

We found that patients overall median length of stay was 16. 9(IQR 9.5-31.25) days. According to each Gustilo-Anderson grade, the median length of stay was Gustilo I: 10 days (IQR 6-15), Gustilo II; 27.3 days (IQR 12-29), Gustilo III; 30 days (IQR 18-70.5).

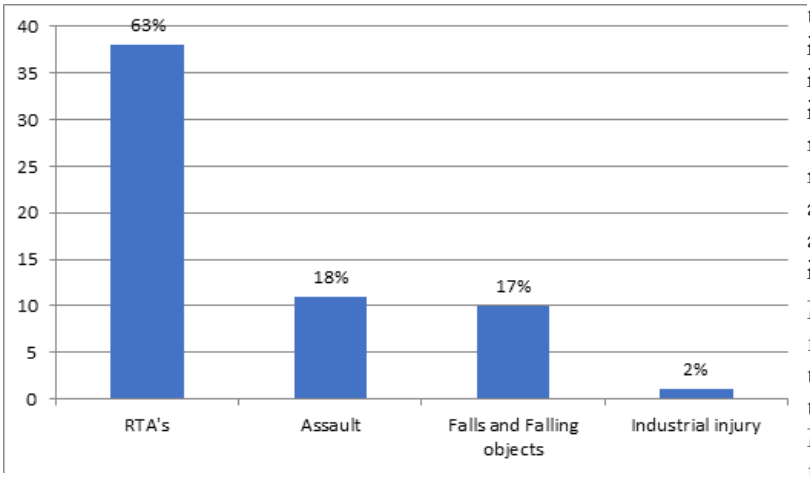

Figure 2. Mechanism of injury in open tibia fractures

Table 1. Gustilo-Anderson grading of fractures and number of infections

Gustilo-Anderson grade	Patient frequency (%)	Number of patients that developed infection (%)
I	19(31.2)	0(0)
II	20(33.3)	5(31)
IIIA	8(13.3)	5(31.25)
IIIB	13(21.7)	6(37.5)
IIIC	0(0)	0(0)
Total	60(100)	16(100)

There was no statistically significant association (p-value 0.059) between the Gustilo-Anderson class and length of stay.

Discussion

Open tibia fractures are a common presentation at our hospital. The average age of patients with open tibia fractures was 36 years and this is similar to what other hospital-based studies done in Africa in low-and-middle-income countries (LMICs) have found[18,19,20]. The 20-49 age group accounted for 73.3% of all open fractures admitted to the hospital. This age group consists of the most economically active individuals within society and this likely has negative repercussions on the country's developing economy through direct and indirect costs when the average length of stay in the hospital of these patients (typically around 16.9 days, IQR 9.5-31.25) is taken into account[21]. Only 3.4% of open fractures occurred in those over 60 years old. A probable reason for this finding might be that most people over the age of 60 in Malawi are considered to live a sedentary lifestyle and are unlikely to be frequent road users, where the majority of these open fractures are sustained. We must also consider the possibility that those over the age of 60 are likely to die from their injuries before being admitted to the hospital due to their diminished physiological reserves.

Road traffic accidents are the leading cause of open tibia fractures (64%), accounting for up to two-thirds of the open tibia fractures encountered at the hospital. Alassiri S et al. 2018 and Tekin AC et al. 2016 as well as numerous other authors have also found road traffic accidents to be a leading cause of lower extremity injury[18,19,20,24,26,27]. Locally, this highlights findings found in a study by Banza et al. 2018 in Lilongwe and echoes calls for improved road safety measures, including awareness within the country and improvement of trauma care[6,11]. Costa Rica, for instance, has, under its new road safety plans, started building new road infrastructure designed to protect road users by including pedestrian bridges, cycle tracks, protective railings and pavements along dangerous portions of roads. New and better road signs and traffic lights are also being installed[28]. Malawi could consider adopting some of these measures to better protect its road users.

Males made up 82% of the patients with open tibia fractures during the period. This is a similar finding to that of a study done by Alassiri S et al. 2018 on open tibia fractures[26] and several other injury studies[18-23]. Most households in Malawi are headed by men; the fact that this group is disproportionately affected has potentially adverse effects on the income of a family[29]. Odatuwa-Omagbemi et al. has suggested that men are more likely to suffer an open fracture due to being breadwinners[26]. Men are more likely to be out on the roads either as pedestrians or motor vehicle occupants trying to source money to feed their families.

64.5% of open tibia fractures overall were Gustilo-Anderson grade I and II injuries and these are fractures which usually do not require complex operative reduction and internal fixation or soft tissue reconstructions due to their low to moderate energy mechanism. Potentially, a majority of these injuries could be managed at secondary level (district) hospitals, thus reducing the burden of work on an already overburdened musculoskeletal service at the central hospital. Queen Elizabeth Central Hospital as a tertiary level institution is likely managing cases that could easily be managed at a secondary level hospital. Ideally, less severe cases should be filtered out by secondary level hospitals. One way of decongesting the central hospital is to ensure better education for orthopaedic clinical officers, who handle the bulk of orthopaedic cases in Malawi, and making sure a feedback mechanism exists on the appropriateness of referred cases[27]. In September 2019, Malawi adopted "MOA guidelines for the management of open tibia fractures", which help guide clinicians involved in the management of fractures on referrals and management[28]. Hopefully, this will result in improvements on the ground.

It is interesting to note that there were no Gustilo-Anderson grade IIIC open fractures (severe open fractures with vascular injuries) in the period under study. This could be a result of patients dying on roadsides due to severe haemorrhage or patients never being referred from the districts following amputation of the affected limb for lack of expertise to manage vascular injuries at this level of the health care system.

The overall infection rate was 26.7%, higher than the 18% infection rate that has been reported in the literature for lower-middle-income countries[12]. This observed difference could be the result of a lack of agreement between the studies in the definition of what constitutes an infection and this is potentially an area that needs to be examined more closely in future research in order to standardise results. The majority of the infected cases in our study(68.8%) were Gustilo-Anderson grade III fractures similar to what Alassiri S et al. 2018 found in their research[26]. High rates of infection in grade III open fractures are not surprising given the

extensive soft tissue damage and high contamination level associated with these high energy injuries.

The average length of stay of patients regardless of grade was 16.9 days, which was significantly lower than the average noted by a systematic review by Schade et al. were the average length of stay was 54 days[12]. Although this was within the range from the studies from the review a possible reason for the discrepancy between our finding and the averaget from the review is that the majority of studies analysed for the review were from higher-income countries who were likely able to keep patients in the hospital longer than would be possible in lower-income countries where there is an aggressive push to discharge patients because of limitations in staff and resources. In-patient care is reserved only for the most severe of cases. In a further analysis of the paper, it is also noted that 87% of their fractures were Gustilo-Anderson grade III (GA grade III) open fractures, compared to only 35% being GA grade III fractures in our study. GA grade III fractures tend to require more extended periods of hospitalisation because of multiple surgical procedures and infections. These fractures often require repeated debridements and muscle flaps. This is consistent with findings from a study by Hoekstra H et al. 2017[24]. Various reports have also confirmed that infection rates in GA grade III open fractures are far higher than that observed in grade I and II open fractures; it is likely a large proportion of their patients developed infection and had to have an extended stay in the hospital[18-23]. Hoekstra et al. has gone on to note that increased length of stay in hospitals drives up costs and results in a more considerable hospital burden[24].

It must, however, be mentioned that being a retrospective study, information was gathered from the patient files and, as a result, this study suffers from most of the inherent limitations found in retrospective studies. Most notably there is a limitation in the accuracy and completeness of the information extracted from the patient records. The fact that some of the patients' files could not be traced and lack of inclusion of patients with multiple severe injuries is also a cause of concern, skewing the picture of our results. There could also be issues with selection and misclassification bias. Misclassification bias as a result of interobserver difference of Gustilo-Anderson classification by clinicians where for instance some grade I injuries are classified as closed fractures.

This research serves as a starting point for further studies with more superior study designs to give more robust levels of evidence and include longer-term outcomes such as function or quality of life, as well as complications such as non-unions and osteomyelitis. Researchers intending to do prospective studies would do well to carry out more extensive analysis of open tibia fracture outcomes from different treatment modalities and better characterize infections in this group of patients. More studies on injury epidemiology in Malawi should be encouraged to fully understand the incidence and analyse the risk factors for musculoskeletal trauma in the country. Malawi and other LMICs on the continent need to consider investing more resources in the treatment and prevention of open fractures due to the resulting effects on the economy and impairment in function of patients following these lower limb injuries[34,35]. A study done in Malawi by Raqcuel et al. noted that limited mobility in patients with lower limb injuries resulted in unplanned long-term disruptions in work, personal financial loss, household economic hardship, psychological distress, and poor perceptions of health and quality of life[34].

Conclusion

In this institution, open tibia fractures were common, often due to high energy and required a prolonged hospitalization. Infection rates were high (especially in Gustilo-Anderson grade III) and, therefore, it is imperative to treat this group of fractures aggressively and early. Our findings showed most open tibia fractures had delayed or no debridement, management here could be improved to reduce infection rates and length of stay in hospital.

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