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Original Article

Epidemiology of inpatient tibia fractures in Singapore – A single centre experience

Joshua Decruz*, Rex Premchand Antony Rex, Suheal Ali Khan

Department of Orthopaedic Surgery, Khoo Teck Puat Hospital, Singapore

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ABSTRACT

Purpose: There are no previous epidemiological studies to represent the trends of tibia fractures in the urban setting. The purpose of our study was to provide unique epidemiological information on the incidence of tibia fractures requiring admission in the urban population of Singapore.

Methods: This is a retrospective review of clinical and radiological records encompassing three years period from 2012 to 2014 in a tertiary hospital in Northern Singapore, which covers an adult population of 550,000. Clinical information included demographics, mechanism of injury, and Gustillo-Anderson classification. Radiological records were evaluated by two of the authors and fractures were classified using the AO classification after consensus was reached.

Results: There were 214 cases of tibia fractures with a population incidence of 13 in 100,000. Among the tibia fractures, 47% were diaphyseal, 43% proximal and 10% distal. Majority of patients were males with a male to female ratio of 3 to 1. The mean age of females was 64 years while that of males was 40 years. The commonest mechanism of injury was road traffic accident, which contributed to 42% of cases, with motorcyclists making up 78% of all road traffic accidents. Compound fractures made up 23% of all fractures, most of which were Gustillo-Anderson type III; 69% of patients underwent surgical intervention.

Conclusion: The incidence of tibia fractures is 13/100,000 with a male-to-female ratio of 3:1. This incidence is lower than other studies, but the proportion of open fractures were surprisingly high at 23%. Distribution of fractures was unimodal with a peak in younger men and older women. This may signify a component of fragility among tibia fractures, especially proximal and distal fractures, which peaks above the age of 80 years old.

Introduction

Although tibia fractures contribute to only 3.8% of all adult fractures, the tibia diaphyseal fracture is the commonest long bone fracture.[1] Considering the socioeconomic impact of tibia fractures, it is no surprise that there are significant number of studies done on these fractures.[2]

Epidemiology of tibia shaft fractures and proximal tibia fractures has been addressed in a number of studies, while there have been fewer publications on the epidemiology of distal tibia fractures. The incidence of tibia shaft fractures has been reported with variation over the years and there are notable differences between different countries and cultures.

Previous studies have provided an insight on the epidemiology of such fractures in heterogeneous populations of urban and rural backgrounds.[1] With urbanisation rising exponentially worldwide, it would be interesting to identify the epidemiology of tibia fractures in an exclusively urban background. As a city-state, Singapore has completely urbanised infrastructures, and the epidemiology of tibia fractures in Singapore would be able to represent the typical incidence and trends that may be seen in other metropolitan cities with an exclusively urban environment.

There were no previous epidemiological studies for the Singapore population in view of the relatively low incidence of such fractures. Khoo Teck Puat Hospital (KTPH) serves the North and Northeastern part of Singapore with a significant number of patients from the neighboring country of Malaysia. It is the primary trauma centre for road traffic accidents (RTAs) occurring on two

* Corresponding author.
E-mail address: joshuadecruz@gmail.com (J. Decruz).
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major expressways and the northern check-point which is one of the busiest in the world.[3]

The purpose of this study was to provide epidemiological information on the incidence of inpatient tibia fractures in the urban population of Singapore and identify the patient demographics, mechanism of trauma and trends in fracture classification.

Methods

A population-based epidemiological study of all patients admitted with tibia fractures was carried out over a three-year period from 2012 to 2014. This study was conducted in KTPH in Northern Singapore, which is the closest hospital to the Northern border and receives close to 50,000 foreign vehicles per day.[3] KTPH is the only hospital in the north and northeastern region serving an average adult population of 550,000.[4,5] There were two fellowship trained trauma surgeons serving in KTPH throughout the duration of this study.

Retrospective review of the clinical and radiological records of the patients was conducted in early 2016. Clinical information regarding age, gender, residency status, cause of injury, and open or closed fractures was obtained from the Medical Records Office. The mechanism of injury were classified into RTAs, industrial accidents, falls from standing height, falls from height or steps, sports injuries, direct trauma and bicycle injuries. Information on conservative or operative management was included. Recurrent admissions were recorded to prevent repetition of data.

All fractures were classified using the Arbeitsgemeinschaft für Osteosynthesefragen (AO) classification. The classification was based on preoperative radiographs and computed tomography (CT) scans when available. A junior and a senior orthopaedic residents were tasked to read the radiographs and scans and come to a consensus regarding the classification. Open fractures were classified using the Gustilo-Anderson classification intraoperatively.

Results

Incidence of all tibia fractures was 13 in 100,000 persons per annum, with tibialdiaphyseal fractures having the highest incidence at 6.1 in 100,000 persons per annum. Proximal tibia fractures were close behind at 5.6 in 100,000 persons per annum. The number of cases based on the anatomical location of tibia fractures is as shown in Fig. 1. The average age of males were 40.1 years and for females the mean age was 64.1 years, while the mean age of the entire cohort was 46.3 years. Male to female ratio was approximately 3 to 1. Non-resident foreigners made up 32.7% of the patients.

The most common cause of tibia fractures was RTAs at 41.6%, of which the majority was motorcyclists at 78%. The next most common causes were fall from standing height at 27.1% and fall from height or steps at 9.3% (Fig. 2).

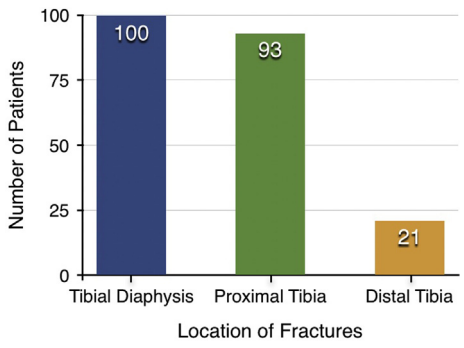

Fig. 1. Anatomical distribution of tibia fractures.

The proportion of open fractures was 22.9%, of which, 57.1% were caused by RTAs. Industrial accidents contributed to 16.1% of open fractures (Fig. 3). Majority (87.8%) of patients with open fracture were males. Gustillo-Anderson Type III was the commonest type of open fractures, however, the incidence of neurovascular compromise in Type III C was only 2% among all fractures (Fig. 4). More than two thirds of open fractures were at the tibial diaphysis, while the incidence of open fractures in the proximal and distal tibias was similar.

Among proximal tibia fracture patients, AO Class 41B1 was the most common with 23 cases, closely followed by B3 with 20 cases (Fig. 5). The average age of proximal tibia fracture patients was 50.4 years. Diaphyseal fractures had the youngest cohort with the mean age of 40.7 years, and AO Class A1 as the commonest fracture configuration (Fig. 6). The distal tibia group had equal number patients with AO Class A1, A3 and C3 fractures. These three AO classes formed 71.4% of distal tibia fractures (Fig. 7). The most common cause for proximal tibia and tibialdiaphyseal fractures were RTAs. However, for distal tibia fractures, fall from standing height was the common cause, followed by fall from height or stairs. It is notable that patients with distal tibia fracture were the oldest with the mean age of 55 years and an equal male:female ratio of 1:1.

The incidence of all tibia fractures was the highest between 30 and 39 years old with 30.7 in 100,000 persons per annum (Fig. 8). There was a unimodal distribution where the incidence was higher in younger men and older women. Analyses of proximal and distal tibia fractures showed a unimodal distribution where incidence increased with age. Whereas, diaphyseal fractures showed a decreasing incidence with age.

Majority of the cases were managed surgically at 68.7%, while 1.4% discharged against medical advice. The mean age of the surgical group was 40.6 years old while non-surgical group had the average age of 60.3 years (Fig. 9).

Discussion

This study aimed to provide a general overview of tibia fractures in the unique urban population of Singapore, as there were no baseline epidemiological studies done. The most notable finding from this study in comparison with studies from other countries is that there is a relatively low incidence of tibia fractures in Singapore. The incidence of tibialdiaphyseal fractures was 6.1 in 100,000 persons per annum. This was much lower than the 8.1–37 in 100,000 person per annum in countries like Finland, Sweden, Denmark and United Kingdom.[1,6–8] The incidence of proximal tibia fractures was 5.6 in 100,000 persons per annum in comparison to the 10.3–13.3 in international studies.[1,8,9] Distal tibia fractures had the lowest incidence and this was similar to Court-Brown's study.[1]

A comparison of RTA rate and fatalities between United Kingdom and Singapore revealed quite similar figures. The accident rate in Singapore was 74.3 per 10,000 vehicles, while in the United Kingdom, the rate was 65.5 per 10,000 vehicles.[10,11] We hypothesize that this difference could be contributed to the low travelling speeds in the urban environment of Singapore in comparison to the higher speeds seen in the United Kingdom, which has a more extensive motorway network. In view of this study focusing solely on inpatient admissions, the incidence could be under represented. However, decision was made not to use data from outpatient source as diagnoses by Emergency or General Physicians may lead to overestimation of certain fractures.

This study showed that RTAs were the commonest cause for tibialdiaphyseal fractures, with fall from standing height being the

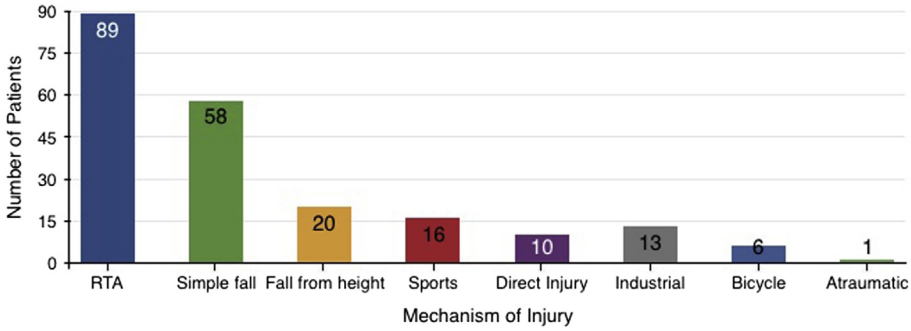

Fig. 2. Causes of tibia fractures.

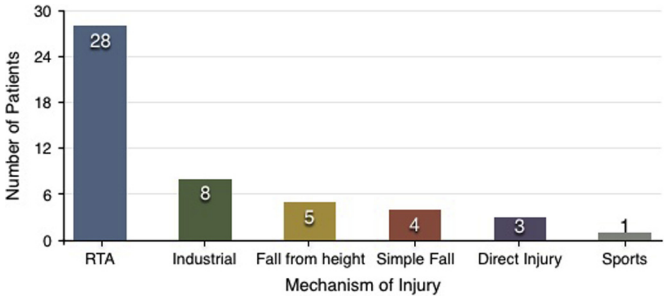

Fig. 3. Causes of open tibia fractures.

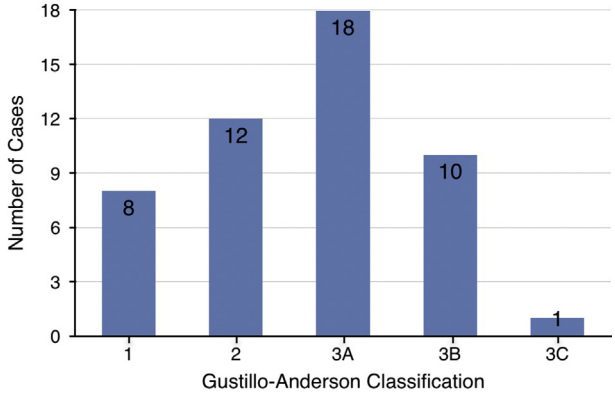

Fig. 4. Open fracture cases based on Gustillo-Anderson classification.

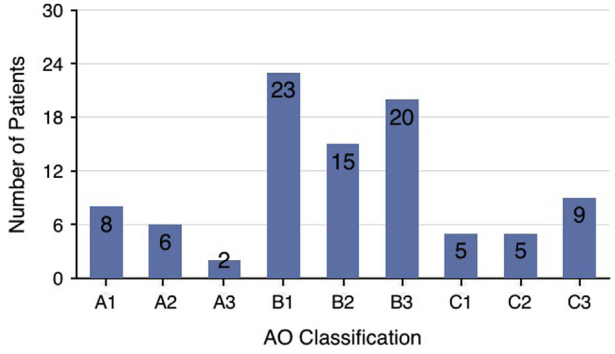

Fig. 5. Proximal tibia fractures based on AO classification.

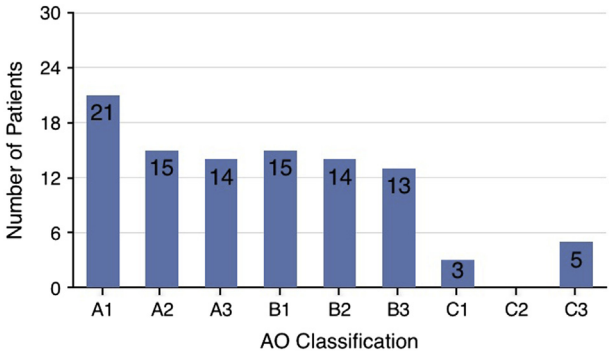

Fig. 6. Tibialdiaphyseal fractures based on AO classification.

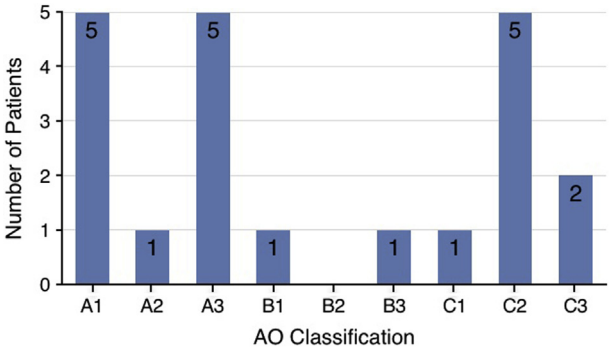

Fig. 7. Distal tibia fractures based on AO classification.

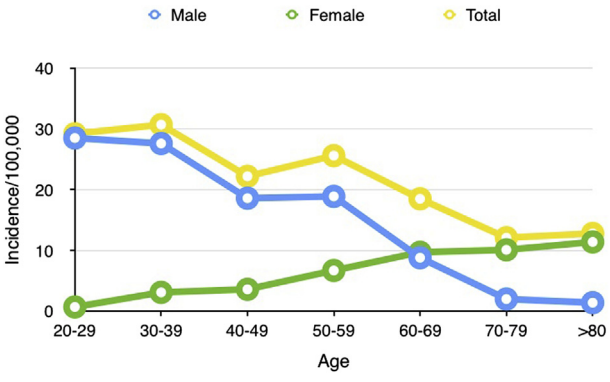

Fig. 8. Incidence of tibia fractures vs. age.

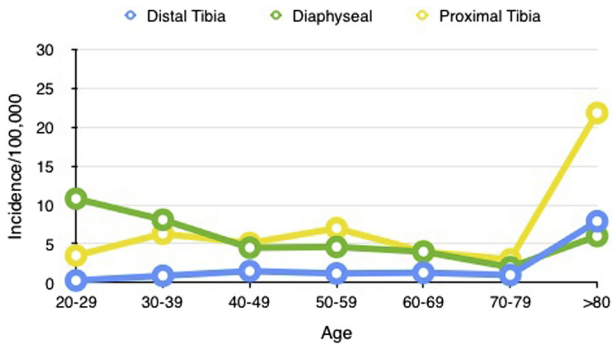

Fig. 9. Comparison of incidence vs. age in different anatomical distribution.

next most common cause. This contrasted the studies done by Weiss et al.[6] and Larsen et al.[7] which showed that sports and walking or falls on same level were the commonest causes. This could be because the trauma centre in this study was situated close to one of the busiest international borders where 50,000 foreign vehicles travel in and out of the country on a daily basis. Nevertheless, the commonest cause for open fractures is RTAs and this was shown in other studies.

In diaphyseal fractures, the rate of open injuries was 33.7%. This was much higher than the 12% stated in the Weiss paper. This, may once again, be explained by the lower rate of RTAs as a mechanism in the Swedish group, at 21% in comparison with the 37% in our study. The rate of surgical treatment of tibia diaphyseal fractures was also much higher at 84%, as could be expected from higher energy mechanisms, in comparison with the 58% in the Swedish study. AO Class A1 was the commonest fracture configuration and was also reflected in other studies.[6]

In recent studies on proximal tibia fractures in Denmark and Brazil, the AO Class B3 was the commonest configuration, followed by AO Class C3.[9,12] This contrasted our study where B1 was the most common class. However, AO Class B3 followed closely as the 2nd commonest type. Only 50.5% of proximal tibia fracture patients required surgery and this was much lower in comparison to the study by Elsoe et al.[9] which stated 92.1% were treated surgically. This was interesting because the average age of patients with such fractures in our study was 49.3 years old, and this was younger than the 52.6 years old mean age in the Danish study.

The distribution of tibia fractures showed a unimodal peak in young men and older women. This was similar to the Type C distribution as described by Court-Brown and Caesar. This may suggest that tibia fractures may also be a type of fragility fracture.[1] With an ageing population, especially in metropolitan cities worldwide, we should expect to see more tibia fractures, and particularly so, since our study showed that proximal and distal fractures peak after the age of 80 years old.

There was a concern in other centers in view of low incidence of tibia fractures in ratio to the number of surgeons. Two fellowship trained trauma surgeons handled these 214 cases of tibia over the course of three years and this amounted to more than 35 cases a year for each surgeon. Despite Singapore being small city-state, there was no apparent need to have centralized specialised services for tibial fractures and there were no signs that training of residents were compromised.

In conclusion, the incidence of inpatient tibia fractures in our study is 13/100,000 with a male-to-female ratio of 3:1. This incidence was lower than other studies in literature and this was likely due to the exclusive urban environment that the institution is located in. However, the percentage of open fractures was surprisingly high, possibly due to the number of RTAs involving motorcyclist. Incidence of tibia fractures was higher in younger men and older women as seen in previous studies. This unimodal distribution may signify a component of fragility among tibia fractures, especially when proximal and distal tibia fractures peaks above the age of 80 years old. An understanding of epidemiology allows the health care managers to better plan and allocate resources.

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Ethical statement

This study was conducted in accordance with the ethical standards of the responsible committee and with the ethical principles of the 1975 Declaration of Helsinki and was approved by our institutional ethics review board. (The NHG DSRB reference number for this study is 2017/00052).

Conflicts of interest

The authors did not receive benefits or grants in any form from a commercial party related directly or indirectly to the subject of the article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cjtee.2019.01.004.

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