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Original article

Tibial shaft fracture: A large-scale study defining the injured population and associated injuries☆

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ABSTRACT

This is the first large-scale study to define the injured population and examine associated injuries for patients with tibial shaft fractures. Patients over 18 years of age in the National Trauma Data Bank (NTDB) who presented with tibial shaft fractures during 2011 and 2012 were identified. Modified Charlson Comorbidity Index (CCI), mechanism of injury (MOI), injury severity score (ISS), and specific associated injuries were described. Multivariate logistic regression was used to identify predictors of mortality.

A total of 19,312 males and 8394 females who had sustained tibial shaft factures were identified. The age distribution was bimodal with peaks at around 20 and 50 years of age. The median CCI for these age groups increased with increasing age. The median ISS was in the 0–9 range for all age groups. Falls were common in the older age groups, while motor vehicle accidents were more common in the younger age groups.

Overall, 59.6% of tibial shaft fracture patients had at least one associated injury (58.2% of patients had at least one other bony fracture, and 16.7% of patients had at least one internal organ injury). Inhospital mortality was more associated with the presence of an associated injury (chi-squared = 268.3) than age (chi-squared = 86.0) or CCI (chi-squared = 0.2).

Overall, the patient population sustaining tibial shaft fractures and their associated injuries were characterized. The importance of such associated injuries is underscored by the fact that mortality was more associated with associated injuries than patient age or comorbidities.

1. Introduction

Tibial shaft fractures occur with an incidence of 16.9/100,000/year.[1] They are associated with significant short- and long-term morbidities,[2] ranging from acute compartment syndrome to chronic leg and knee pain.[3] Furthermore, tibial shaft fractures in working-age adults have been shown to have a significant financial impact, both in terms of direct medical costs and lost productivity.[4]

As with other orthopaedic injuries, several studies have characterized patients with tibial shaft injuries in terms of age, gender, mechanism of injury (MOI) and fracture type. One such study by Larsen et al. found that men have a higher frequency of fractures while participating in sports activities, while women have a higher frequency while walking and during indoor activities.[1] Another study by Court-Brown and McBirnie found that the majority of tibial shaft fractures were caused by falls from height and road-traffic accidents.[5] However, both of these studies

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may be limited by their population sizes (both under 600) or regional factors (both done at single institutions).

In the orthopaedic trauma assessment, it is helpful to know the likelihood of associated injuries in order to optimize evaluations and ensure appropriate management. For example, in the setting of a calcaneus fracture, the strong association with vertebral column injury is often considered.[6] Similarly, with open clavicle fractures, pulmonary and cranial injuries are important to suspect and recognize early.[7] Although a few studies have examined injuries associated with tibial shaft fractures such as ankle, posterior malleolus, and ligamentous injuries,[8–11] no previous study has characterized overall bony and internal organ injuries that are associated with tibial shaft fractures.

The aim of the present study is to use a large, national sample of adult trauma patients with tibial shaft fractures in order to characterize the patient population, comorbidity burden (modified Charlson Comorbidity Index [CCI]), MOI, injury severity score (ISS), and specific associated injuries for adult patients with tibial shaft fractures. It is believed that a better understanding of such variables would help health care providers optimize patient evaluation and management.

2. Methods

2.1. Patient cohort

The National Trauma Data Bank Research Data Set (NTDB RDS) was used to identify patients for this study. This database is compiled from several hundreds of trauma centers around the US and contains administrative and registrar-abstracted data on over five million cases.[12] Data files are processed through a validation phase to ensure reliability and consistency of the data used for research.[12]

The inclusion criteria for patients in this study were: (1) hospital admission during years 2011 and 2012, (2) over 18 years of age, and (3) an International Classification of Disease, 9th Revision code for tibial shaft fracture (823.20, 823.22, 823.30, 823.32). A waiver was issued for this study by our institution's Human Investigations Committee.

2.2. Patient characteristics

Age was directly abstracted from the database. After evaluation of the age distribution, subsequent analyses were done with age groups defined based on clusters in the population (18–39 years, 40–64 years, 65+ years).

The following comorbidities were directly extracted from the database: hypertension, alcoholism, diabetes, respiratory disease, obesity, congestive heart failure, coronary artery disease, prior cerebrovascular accident, liver disease, functionally dependent status, cancer, renal disease dementia, and peripheral vascular disease. From these patient characteristics, a modified CCI[13] that has been shown to have comparable predictive value to the original CCI was calculated.[14] Modified CCI was computed based on an algorithm previously described by an earlier study by Samuel et al.[15]

2.3. Injury characteristics

ISS is an overall assessment of body trauma severity based on the Abbreviated Injury Scale.[16] This is a variable that was directly abstracted from the NTDB RDS data set.

The categorizations for MOI were "fall", motor vehicle accident ("MVA"), or "other". Patients with a fall mechanism of injury were determined based on the following ICD-9 e-code ranges: 880.00–889.99, 833.00–835.99, 844.7, 881, 882, 917.5, 957.00–957.99, 968.1, 987.00–987.99. Patients with an MVA mechanism of injury were determined based on the following ICD-9 e-code ranges: 800–826, 829–830, 840–845, 958.5, and 988.5. Patients included in this MVA category were involved in accidents as motor vehicle drivers/passengers, motorcyclists, bicyclists, or pedestrians. All other e-codes were counted as "other".

For associated injuries, ICD-9 diagnosis codes that were used to identify associated bony and internal organ injuries. It is important to note that based on this data set, it could not be distinguished whether proximal and distal tibia associated injuries were contiguous (extensions of the same fracture line) or indicative of segmental injuries. Thus, these were not included as "associated

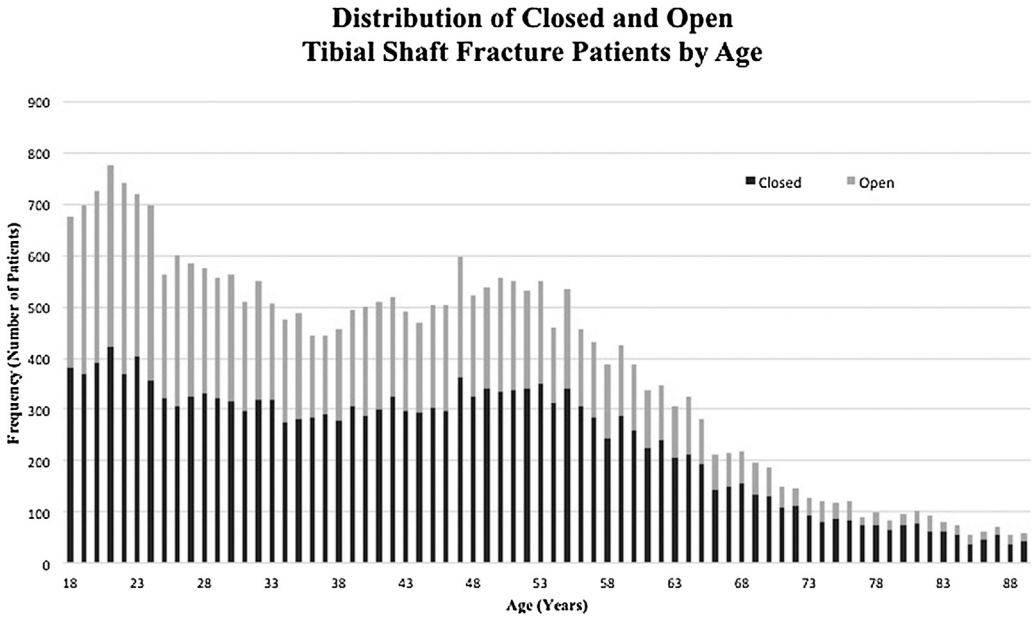

Fig. 1. Distribution of open and closed tibial shaft fracture patients by age.

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