

## Original Article

# Epidemiological study of ankle fractures

Jorge Mitsuo Mizusaki<sup>1</sup> , Sérgio Damião Santos Prata<sup>1</sup> , Marco Antonio Giglioni Rizzo<sup>1</sup> ,  
Luiz Augusto Sampaio Gonzaga Filho<sup>1</sup> , Leandro Pessoa Carneiro<sup>1</sup> 

1. Hospital Santa Marcelina, São Paulo, SP, Brazil.

## Abstract

**Objective:** To evaluate the epidemiological characteristics of patients with fractures in the ankle region.

**Methods:** This prospective, observational, descriptive, and epidemiological study included ankle fractures treated at our service from March 1, 2017 to March 1, 2018. Data were obtained from 150 patients through a detailed questionnaire.

**Results:** The sample, which included 61.33% men, aged mainly between 20 to 30 years; 46.68% were of mixed race, and 41.33% had only completed elementary school. A total of 33.66% of the ankle fractures occurred in the afternoon. According to the Weber classification system, 46.66% were type B fractures.

**Conclusion:** Ankle fractures were more common in men of working age, and were mostly closed fractures in the right lower limb.

**Level of Evidence IV; Prognostic Studies; Case Series.**

**Keywords:** Ankle fractures/epidemiology; Ankle injuries/epidemiology; Fractures, bone/epidemiology; Surveys and questionnaires.

## Introduction

Ten percent of all fractures in the human body occur in the ankle, which ranks second behind the hip in lower limb fractures. These values are similar in trauma referral hospitals in a number of states in Brazil: one study from Bahia found that 8.97% of all fractures from motorcycle accidents were in the ankle and/or foot, representing 27.05% of trauma-related orthopedic surgeries<sup>(1)</sup>. The peak incidence of ankle fractures is in younger men and older women. Characteristically, these are low-energy injuries, mostly caused by simple falls or sports accidents<sup>(2-4)</sup>.

A classification system developed by Danis and modified by Weber describes the injury based on the location of the fracture in the lateral malleolus. Fractures can be classified as type A, B or C (a fracture below, at the same level as, or above the syndesmosis, respectively). This system remains popular and has shown substantial inter- and intraobserver reliability<sup>(5)</sup>. Lindsjö<sup>(6)</sup> commented that “even an exhausted doctor, on an emergency call at four o'clock in the morning, should be able to apply [this system], without making too

many mistakes”. An alternative classification system based on the mechanism of trauma was proposed by Ashurst and Bromer in 1922 and expanded by Lauge-Hansen in 1950 after cadaver studies<sup>(7,8)</sup>.

Traditionally, these fractures have been treated with plaster casts. However, when to use surgical or conservative treatment has been widely discussed in recent decades<sup>(9,10)</sup>. Several studies<sup>(11-14)</sup> have found unsatisfactory results in 17 to 24% of cases, regardless of the follow-up time, even in Weber type B fractures, which have a good prognosis<sup>(15-17)</sup>. Other studies have found incomplete recovery up to 2 years after surgery<sup>(14-16)</sup>. Better quality materials and professional improvement has encouraged surgical treatment for these fractures, especially the more complex ones. However, provided that it is correctly indicated, non-surgical treatment for Weber type B fractures is still viable.

The lack of Brazilian studies on ankle fracture epidemiology encouraged the development of a study with a more detailed analysis.

Study performed at the Hospital Santa Marcelina, São Paulo, SP, Brazil.

**Correspondence:** Sérgio Damião Santos Prata. Rua Santa Marcelina, 177, Vila Carmosina - 08270-070, São Paulo, SP, Brazil. **E-mail:** [sergioprata@yahoo.com](mailto:sergioprata@yahoo.com).

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## Methods

This study was registered in Plataforma Brasil and was approved by the institutional ethics committee. This prospective, observational, descriptive, and epidemiological study included ankle fractures treated at our service from March 2017 to March 2018. A total of 150 patients were evaluated.

The data were obtained through a detailed questionnaire applied at the time of hospital discharge; each patient was interviewed in person. The analyzed variables included age, profession, sex, ethnicity, marital status, education, means of emergency transportation, time and day of the week of the trauma, the mechanism of trauma, fracture type and location, affected limb, Weber and Lauge-Hansen classification, treatment type, associated injuries, prescribed medications, and hospital length of stay.

## Results

Of the 150 evaluated fractures, 50 (33.66%) occurred in the afternoon (Table 1). A total of 70 patients (46.68%) were of mixed race, 60 (40%) had completed high school, and 80 (53.33%) were married.

The sample was 61.34% men (92 patients), average age 20 to 30 years old.

The most common mechanism of injury (Table 2) was a fall from standing height (sports, walking, getting out of a car, dancing), which occurred in 51.42% of the patients, half of whom were women, whose mean age was 46.22 years old. The second most common mechanism was falling down stairs, which occurred in 20% of the patients, 85.71% of whom were women, whose mean age was 48.35 years. The third most common mechanism was being run over by a vehicle, which occurred in 10% of the patients, all of whom were men, whose mean age was 41.42 years. This was followed by car accidents, which occurred in 7.15% of the patients, all of whom were men, whose mean age of 30.8 years. The next most common mechanism was direct trauma to the fibula, which occurred in 4.28% of the patients, all of whom were men, whose mean age was 32.33 years. Falls from heights occurred in 7.15% of the patients, all of whom were men, whose mean age was 43.8 years. Most of the patients (102, 68%) arrived at the emergency department by their own means, and the highest incidence of trauma occurred on Sunday (32 patients, 21.34%).

The fracture occurred on right side in 83 patients (55.34%). Lateral malleolus fractures occurred in 67 patients (44.67%) (Table 3). The fractures were closed in 130 patients (86.66%) and open in 20 patients (13.34%). A concomitant skin lesion occurred in 42 patients (28%), and no medications were prescribed for 116 patients (77.33%).

The most frequent fracture type was Weber type B (Table 4), occurring in 70 patients (46.66%). Surgery was performed in 86 patients (57.33%), with the most common technique being internal fixation with plates and screws. A total of 43 patients (28.67%) were hospitalized, with a length of stay ranging from 4 to 7 days. All fractures healed without delayed consolidation or pseudarthrosis.

**Table 1.** Fractures according to the time of day they occurred

Time of the Trauma	Patients	%
Morning (6:00 am - 12:00 pm)	38	25.33%
Afternoon (12:00 pm - 6:00 pm)	50	33%
Evening (6:00 pm - 12:00 am)	48	32.00%
Night (12:00 am - 6:00 am)	14	9.34%

**Table 2.** Fractures according to treatment type

Treatment Type	Patients	%
Conservative	38	25.34%
External Fixation	10	6.67%
Surgical with Screws	16	10.66%
Surgical with Screws + Plates	86	57.33%

**Table 3.** Fracture location

Trauma Location	Patients	%
Lateral Malleolus	67	44.67%
Medial Malleolus	15	10%
Bimalleolar	58	38.66%
Trimalleolar	10	6.67%

**Table 4.** Fractures according to Weber classification

Weber Type	Patients	%
A	48	32%
B	70	46.66%
C	32	21.34%

## Discussion

The incidence of ankle fractures, their social impact, and the lack of Brazilian epidemiological studies motivated this study. The study objectives were completed without data collection problems or errors in questionnaire application.

A total of 150 patients were treated between March 1, 2017 and March 1, 2018. All patients provided written informed consent.

The incidence of ankle fractures in men was 61.34% (92 patients) and 38.66% in women (58 patients), including a total of 86.66% closed fractures and 13.34% open fractures. The literature diverges somewhat from these results: White and Bugler<sup>(16)</sup> reported that open fractures are rare, accounting for only 2% of all ankle fractures. This disagreement can be explained by the fact that the hospital's region has a significant number of motorcycle accidents, which increases the number of serious fractures and, therefore, increases the rate of bone exposure.

In addition, a study by the Hospital do Servidor Público Municipal de São Paulo found a higher incidence of ankle fractures in older women, hypothesizing that postmenopausal osteoporosis was an important associated factor<sup>(19)</sup>.

The mean age in our sample was 45 years at the time of the injury, which is higher than that of the mean age of individuals who suffer isolated ankle sprains<sup>(20)</sup>. The distribution of ankle fractures was bimodal, with peak incidences in younger men and older women – an interval of 50 years between peaks<sup>(18)</sup>. The most affected general age group in our study was young adults between 20 and 30 years old, with a mean age of 28 years in men and 41 years in women, which differs from the literature. However, because the hospital's region is predominantly low income, motorcycles (and thus motorcycle accidents) are more common since it is a less expensive means of transportation.

Characteristically, ankle fractures are low-energy injuries, mostly caused by simple falls or sports accidents. Even exposed ankle fractures, which have a higher incidence in older women, are generally caused by simple falls rather than high-impact trauma<sup>(18)</sup>. In our sample, falls from standing height (sports, walking, getting out of the car, dancing) were the most common type (51.42%). Another finding was that more fractures occurred in the afternoon (33.3%) and on Sunday (21.34%), which follows, since it is a day of rest and leisure, with many people participating in sports.

A significant number of patients (22.67%) reported using alcohol and/or illicit drugs prior to the trauma, which was similar the number reported in other studies (20%)<sup>(20)</sup>. The fact that the highest incidence of fractures in our study was on Saturday and Sunday may also be related to the substance use. However, toxicological tests were not performed to determine the extent of this relationship.

There was a slight predominance of mixed-race patients (46.68%), which is directly related to the demographics of the hospital's region. Most patients were also married (53.33%) and their education level was consistent with their age group. The most common education level was high school. A total of 6.67% patients were illiterate, which was slightly higher than the São Paulo state average (4.3%)<sup>(19)</sup>.

Since most fractures are due to low-energy trauma and do not have major clinical repercussions, the majority of our patients arrived at the emergency room by their own means (68%). However, all patients with open fractures arrived at the hospital by ambulance, demonstrating that emergency services were used for more serious victims, which confirms their importance and the need for efficiency.

The most frequent Weber classification was type B (46.66%), followed by type A (32%) and type C (21.34%), which agrees with the literature (38% type A, 52% type B, and 10% type C)<sup>(19)</sup> and demonstrates substantial interobserver reliability of this system.

One divergence with the literature was our Lauge-Hansen classification results. The proportions of supination-adduction, supination-external rotation, and pronation fractures in our sample were 32%, 28%, and 40% respectively. However, the most common injury pattern in the literature is supination-external rotation (60%), followed by supination-adduction (20%), and pronation (20%)<sup>(19)</sup>.

Fractures are also classified as unimalleolar, bimalleolar, or trimalleolar based on the combined fractures of the lateral, medial, and posterior tibial malleolus. As the number of fractures increases, the prognosis worsens. The fractures in our sample were: lateral malleolus (44.67%), bimalleolar (38.66%), medial malleolus (10%), and trimalleolar (6.67%), which corroborates the literature in that most fractures occur in the lateral malleolus.

The vast literature on ankle fractures is replete with small heterogeneous case series reporting the outcomes of a confusing variety of treatment strategies and using disparate outcome assessments. Satisfactory results can be obtained from different types of treatment, and the indiscriminate use of surgery does not necessarily improve results, in addition to the fact that it exposes patients to additional complications. In our study, 74.66% of the patients underwent surgery, and 86 underwent osteosynthesis surgery with plates and screws. Only 25.34% were treated conservatively, which shows our service's clear preference for surgical treatment.


The patients in our sample remained hospitalized for up to 7 days, which was consistent with the literature. Our sample size is indicative of the large number of these fractures in tertiary hospitals. Orthopedists should be aware of the epidemiology of these injuries. The brief period of data collection prevented analysis of other outcomes. New studies with longer follow-up and/or including other institutions, could add new conclusions about other aspects of this type of trauma.

## Conclusion

The ankle fractures in our sample occurred predominantly in patients aged between 20 and 30 years. Other relevant epidemiological factors included demographic variables, such as mixed race, being married, and having a high school education level, as well as injury characteristics, such as fractures on the right side and injury occurrence in the afternoon and on Sundays. Falling from standing height was the most common trauma mechanism, with open fractures occurring in 28% of the cases, being the most common associated injury. Weber type B fractures were the most frequent type, and internal fixation with plates and screws was the most frequent treatment.

This prospective epidemiological study identified the characteristics of patients with ankle fractures, the characteristics of the fractures, and the type of treatment, demonstrating the importance of in-depth studies on this topic to facilitate faster patient recovery and return to daily activities, since most are young and economically active.

In addition, the results also demonstrate that a more detailed epidemiological understanding can facilitate the development of preventive and educational measures to reduce the incidence of vehicle accidents, which figured prominently in our study population.

**Authors' contributions:** Each author contributed individually and significantly to the development of this article: SDSP \*(<https://orcid.org/0000-0001-5957-527X>) conceived and planned the activities that led to the study, participated in the review process; JMM \*(<https://orcid.org/0000-0001-6039-4599>) data collection, interpreted the results of the study, statistical analysis, wrote the article; MAGR \*(<https://orcid.org/0000-0002-7424-9074>) performed the surgeries, survey of medical records, participated in the review process; LASGF \*(<https://orcid.org/0000-0002-5765-2304>) wrote the article, bibliographic review, clinical examination, statistical analysis; LPC \*(<https://orcid.org/0000-0001-6106-0101>) data collection, formatting of the article, participated in the review process. All authors read and approved the final manuscript. \*ORCID (Open Researcher and Contributor ID) 

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