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Original Article

Epidemiological study of posterior malleolus fractures

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Abstract

Objective: Perform an epidemiological analysis of patients who suffered ankle fractures, including the posterior malleolus.

Methods: Data were collected from 123 consecutive patients who suffered ankle fractures affecting the posterior malleolus between October 2021 and November 2023 in one institution. Skeletally immature patients or patients with incomplete radiological exams were excluded, including a final sample of 100 patients. The parameters analyzed were sex, age, side, comorbidities, mechanism of trauma, and associated injuries. In addition, fractures were evaluated according to Danis-Weber and Bartoníček classifications.

Results: Posterior malleolus fractures were more present in females on the right side and in the 5th decade of life, and comorbidities were observed in 46% of patients. The most frequent trauma mechanism was ankle sprain at ground level, and the main associated injury was tibial shaft fracture. The most frequent posterior malleolus fractures were Bartoníček type 2 and fibular fractures, Danis-Weber type B.

Conclusion: Posterior malleolus fractures occurred predominantly in females in the 5th decade of life, after ankle sprains, Bartoníček type 2. Hypertension was the most prevalent comorbidity, and the most common associated fracture was transindesmal fractures of the fibula (Danis-Weber B).

Level of evidence IV, Therapeutic studies, Case series.

Keywords: Epidemiology; Ankle fractures.

Introduction

Ankle fractures are the fifth most common fracture in adults, with an incidence of approximately 1,000 cases per 1 million people per year[1]. Posterior malleolus fracture (PMF) is still a topic of discussion, with divergences in the literature from its epidemiology to treatment. The increased use of computed tomography (CT) in diagnosing ankle fractures has enhanced the diagnosis of PMF and provided a deeper understanding of fracture patterns and their management[2].

Isolated PMFs are rare and are commonly associated with other ankle injuries, such as fractures of the medial and lateral malleolus[3]. The involvement of the posterior malleolus (PM) is considered a factor of worse prognosis in these fractures, which can evolve with serious complications such as chronic pain, joint stiffness, and, ultimately, post-traumatic osteoarthritis[1].

Epidemiological studies on fractures contribute to the organization of trauma services and the development of effective strategies for prevention and treatment[4]. Epidemiological studies of PMF are scarce and contradictory, with a wide variation in incidence between studies[5]. Previous studies describe a frequency of 7% to 44% of PM involvement in ankle fractures[6]. As a result, the epidemiological profile of PMF remains visibly incomplete.

The objective of this study is to perform an epidemiological analysis of patients who suffered ankle fractures, including the posterior malleolus, expanding the current concepts present in the literature.

Methods

This is a cross-sectional epidemiological study in which data were collected from 123 consecutive patients who suffered ankle fractures affecting the PM between October 2021 and November 2023 in one institution. Skeletally immature patients or patients with incomplete radiological exams were excluded, including a final sample of 100 patients.

Study performed at the Santa Helena Hospital, Brasília, DF, Brazil.

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The parameters analyzed were sex, age, side, comorbidities, mechanism of trauma, and associated injuries. Fractures were evaluated according to Danis-Weber[7,8] and Bartoníček et al.[9] classifications regarding the fracture pattern of the lateral malleolus and posterior malleolus, respectively. The model proposed by Danis-Weber divides fibular fractures into A (infrasyndesmal), B (transsyndesmal), and C (suprasyndesmal). The model proposed by Bartoníček classifies PMF into type 1 (extrafibular notch fragment), type 2 (posterolateral fragment extending into the fibular notch), type 3 (posteromedial two-part fragment involving the medial malleolus), type 4 (large posterolateral triangular fragment) and type 5 (irregular, osteoporotic fragments, not classifiable in the previous types).

Information on the physical examination, surgery details, procedure complexity, and rehabilitation protocol was not available in the database.

The calculated descriptive statistics were means and standard deviation (SD) for continuous variables and frequency and percentages for discrete variables. All statistical analyses were performed using Excel 2021 spreadsheet.

Results

The majority of the 100 patients evaluated were female (68%), with a male-to-female ratio of 0.47. The mean age was 50.4 years (± 49.5), affecting mainly patients in the 5th decade of life, with the right side being affected in 58% of cases (Table 1).

In the sample, 46% had comorbidities, the most prevalent being hypertension (43.5%), psychiatric disorders (28.2%), dyslipidemia (23.9%) and Diabetes Mellitus (17.3%). The most frequent trauma mechanism was a ground-level sprain (63%), followed by falling down stairs (18%). Associated injuries were found in only 8% of cases, the most common being tibial shaft fracture in three cases (Tables 2 and 3).

Regarding the Danis-Weber classification, type B was the most prevalent (68%), followed by type C (25%). According to Bartoníček classification, type 2 was the most prevalent in 52% of cases, followed by type 3 in 29% of cases (Figures 1 and 2).

Discussion

Several studies reveal that ankle fractures involving the MP are frequent and are associated with worse clinical outcomes. However, studies investigating their epidemiological profile are still scarce[9,10-13]. In our study, the epidemiological evaluation of PMF was performed, and its main findings were the predominance of females, a mean age of 50.4 years, and comorbidities in 46% of patients. The most frequent trauma mechanism was ankle sprain at ground level, and the main associated injury was tibial shaft fracture. Finally, there was a higher prevalence of Danis-Weber type B in lateral malleolus fractures and Bartoníček type 2 in PMF.

The results of our study align with previous studies regarding the sex and age group most commonly affected. A predominance of females was observed, representing 68% of the sample, with a proportion of 0.47 among men and women, especially in the 5th decade of life. A recent epidemiological study by Li et al.[5], including 472 patients with PMF, also showed a higher predominance of females (53.4% of patients) and a peak incidence between 50-59 years. This higher prevalence in females is also observed when analyzing ankle fractures as a whole, with or without MP involvement. A previous study, including over 50,000 ankle fractures, showed that most ankle fractures affect women, corresponding to 61% of cases[12]. Another study also described a higher involvement of females and an association with the advancement of the age group[13]. Since older women have a higher incidence of osteopenia and osteoporosis, we can infer from the data presented that PMF may be related to bone fragility.

Table 1. Variables analyzed and their respective percentages

Variables	N = 100
Sex (M/F)	32 (32%) / 68 (68%)
Age	50.4 (± 49.5)
Side (R/L)	58% / 42%
Comorbidity (Yes/No)	54% / 46%
Associated injuries (Yes/No)	8% / 92%

Table 2. Comorbidities

Comorbidities	n (%)
Hypertension	20
Psychiatric disorders	13
Dyslipidemia	11
Diabetes	8
Hypothyroidism	5
Heart disease	5
Obesity	4
Intestinal cancer	2
Osteoporosis	2
Asthma	2
Migraine	2
Fibromyalgia	2
Others	8

Table 3. Trauma mechanism

Mechanism	n (%)
Ankle sprain at ground level	63
Fall down stairs	18
Sports	8
Motorcycle fall	4
Fall from height	3
Others	4

Comorbidities, especially in older patients, can impact the choice of PMF treatment and the results obtained[14]. A significant percentage of patients included in the study had associated comorbidities (46%). Cardiovascular diseases represent the majority of them, present in 36% of patients, followed by psychiatric diseases that had great relevance, affecting 13% of patients. Although mental illness was not directly associated with higher complication rates, Simske et al.[15] showed that patients with mental illness associated with ankle fractures had lower functionality and higher levels of postoperative pain. Diabetes was present in 8% of the cases evaluated, being a pathology known to be associated with increased rates of complications during the treatment of an ankle fracture[16]. Obesity was present in 4% of cases despite a relatively low incidence; a previous study[17] demonstrated a higher chance of obese patients suffering an ankle fracture, especially more unstable fractures, types B and C of Danis-Weber. The high number of patients with comorbidities observed in the study highlights the need for a careful preoperative evaluation and careful postoperative follow-up since these patients may have higher rates of complications, especially in severe fractures such as trimalleolar fractures.

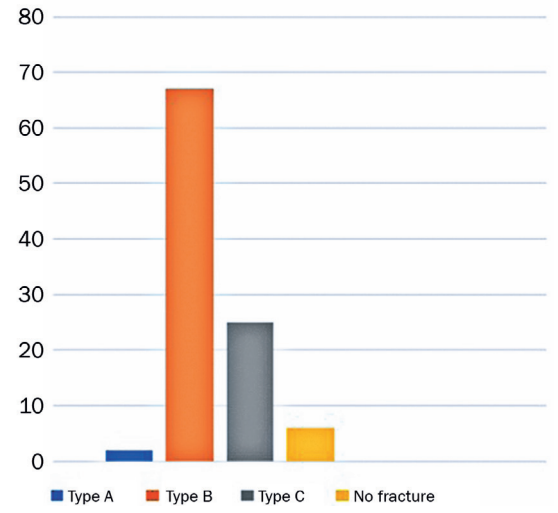

Figure 1. Distribution of peroneal fractures, according to the Danis-Weber classification.

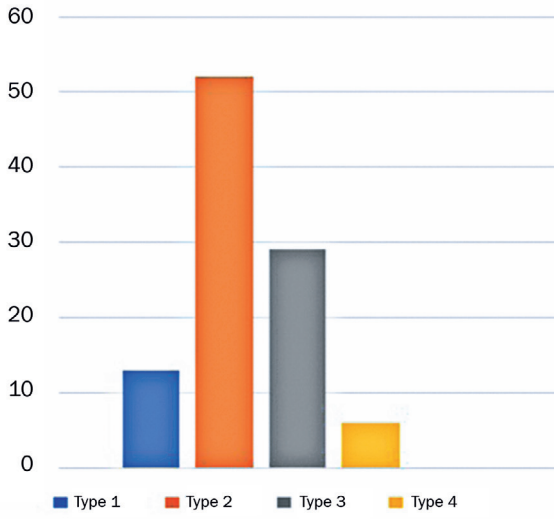

Figure 2. Distribution of posterior malleolus fractures, according to Bartoníček classification.

Approximately 20% of ankle fractures are secondary to injuries with external rotation of the talus, often involving the posterior malleolus. In our study, it was observed that in 63% of cases, PMF was due to a sprain that occurred at ground level, followed by 18% of cases caused by falling down stairs. Li et al.[5] presented similar results, with sprain being the main mechanism of PMF trauma, accounting for 86.5% of the cases. These data are similar to those found in ankle fractures in general, in which falls at ground level are the main trauma mechanism[12,18]. In addition, only 8% of the patients in our study had associated injuries, the most common being the diaphyseal fracture of the ipsilateral tibia (4% of the cases). Previous studies show this association, often emphasizing that associated injuries are underdiagnosed, partly due to the lack of TC evaluation[19]. These data reinforce the need for a complete radiological analysis to diagnose PMF, allowing for a more appropriate treatment.

Isolated PMFs are rare and are commonly associated with other ankle injuries, such as fractures of the medial and lateral malleolus. To better characterize PMF, the lateral malleolus fractures were classified using the Danis-Weber classification. The majority of cases were type B (68%) and C (25%), a statistical result similar to that presented by Bartoníček et al.[9]. Interestingly, we observed a few cases (6%) without an associated fibula fracture, as well as a single instance of a type A fracture. Regarding the Bartoníček classification, it was possible to classify all cases between types 1 to 4. Types 2 and 3 were the most frequent, representing 52% and 29% of cases, respectively. These statistics are similar to those obtained by Rammelt et al.[3] in their initial study, with 141 cases (Type 2 (52%), type 3 (28%), type 4 (9%) and type 1 (8%)), but with discrepancy between the frequencies of types 4 and 1. In the study by Li et al.[5], which used the classification proposed by Haraguchi et al.[20], the authors presented an incidence of 78.2% of posterolateral fractures (equivalent to Bartoníček's type 2), 10.4% of fractures with medial extension (equivalent to Bartoníček's type 3) and 11.4% of fractures with small extra-incisural fragment (equivalent to Bartoníček's type 1). These results are statistically similar to the pre-existing epidemiological data, but considering the relatively small sample, the previous literature, and the variations observed, larger studies are needed to consolidate this information.

Our study has numerous limitations, many of which are intrinsically related to the study design. Among them, we highlight that this is a single-center study, the sample size is small, and there is a lack of evaluation of the treatment

and prognosis of fractures. Further studies analyzing these aspects will certainly expand the knowledge about PMF.

Conclusion

Posterior malleolus fractures occurred predominantly in females on the right side and in the 5th decade of life, and the comorbidities were observed in 46% of patients. The most frequent trauma mechanism was ankle sprain at ground level, and the main associated injury was tibial shaft fracture. The most frequent PMF was posterolateral with involvement of the fibular notch (Bartoníček type 2) the most common associated fracture was transindesmal fractures of the fibula (Danis-Weber B).

Authors' contributions: Each author contributed individually and significantly to the development of this article: SPO *(https://orcid.org/0000-0002-5649-8122) Conceived and planned the activities that led to the study; BASA *(https://orcid.org/0000-0001-5269-9106) Interpreted the results of the study, participated in the review process; HM *(https://orcid.org/0000-0001-7527-969X) Participated in the review process. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID).

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