



Original Article

Epidemiological study on calcaneus fractures in a tertiary hospital[☆]



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ABSTRACT

Objective: To analyze the epidemiology and characteristics of patients with calcaneus fractures.

Methods: This is a retrospective revision of patients with calcaneus fractures hospitalized in the Institute of Orthopedics and Traumatology of this institution between 2006 and 2010. Data such as age, gender, laterality, trauma mechanism, type of fracture, associated injuries, compound fractures, and time from injury to surgery were analyzed.

Results: The analysis of 52 patients showed that men were more commonly affected than women, at a ratio of 5.5:1. Bilateral fractures were observed in ten cases, resulting in a total of 62 calcaneus fractures. A fall from a height was the most frequent trauma mechanism (75%), followed by motorcycle accidents (11.5%) and automobile accidents (9.6%). The most frequent fractures were intra-articular, with 47 cases. Compound fractures were observed in 15 patients (28.9%). Non-surgical management was adopted for 11 patients while 41 patients underwent surgery. The mean time between trauma and the definitive treatment was 7.8 days (range: 0–21 days), and 58.5% of cases were treated within seven days.

Conclusion: Patients with calcaneus fractures, most commonly young men, were admitted to a high complexity care hospital, victims of a fall from a height with associated injuries. The great severity of these fractures is characterized by the high prevalence of bilateral (19.2%) and compound fractures (28.9%) in this population group.

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Estudo epidemiológico das fraturas do calcâneo em um hospital terciário

R E S U M O

Palavras-chave:
Fraturas ósseas
Calcâneo
Epidemiologia

Objetivo: Analisar a epidemiologia e as características das lesões e dos pacientes com fraturas do calcâneo.

Métodos: Revisão retrospectiva dos pacientes com fraturas do calcâneo internados de 2006 a 2010, no Instituto de Ortopedia e Traumatologia dessa instituição. Foram analisados parâmetros como idade, gênero, lateralidade, mecanismo de trauma, tipo de fratura, lesões associadas, exposição e tempo decorrido até o tratamento cirúrgico.

Resultados: Foram encontrados 52 pacientes com fratura do calcâneo, dez casos bilaterais (19,2%), total de 62 calcâneos fraturados, com predomínio do gênero masculino, na relação 5,5:1. A média de idade foi de 36,8 anos. O mecanismo de trauma mais frequente foi a queda de altura (75,0% dos casos), seguido por acidentes de motocicleta (11,5%) e acidentes de automóvel (9,6%). Fraturas intra-articulares foram mais frequentes, com 47 casos. Quinze pacientes apresentaram fraturas expostas (28,9%). Dos 52 pacientes com fratura do calcâneo, 11 foram tratados conservadoramente e 41, cirurgicamente. O tempo médio entre o trauma e o tratamento cirúrgico definitivo foi de 7,8 dias, variou de 0 a 21 dias, com a maioria dentro dos primeiros sete dias (58,5%).

Conclusão: Pacientes com fraturas do calcâneo atendidos em um hospital voltado para o atendimento de alta complexidade foram na maioria jovens, do sexo masculino, que sofreram queda de altura e com algum tipo de lesão associada. Os índices elevados de bilateralidade (19,2%) e de exposição da fratura (28,9%) caracterizam a maior gravidade dessas fraturas nesse grupo populacional.

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Introduction

Calcaneal fractures are uncommon, accounting for approximately 2% of the total number of fractures.¹⁻³ However, they are the most common fractures of the tarsus (60%).¹ They are frequently associated with high-energy axial trauma, mainly due to falls from a height and automobile accidents.^{1,2,4,5} The high energy of the trauma is correlated with soft tissue involvement, and combined lesions are found in 50% of cases⁶; other fractures of the lower limbs and lumbar spine fractures (10%) are the most frequent associations.^{7,8}

Intra-articular fractures account for 70% of the cases; these are the most challenging and present the worst outcomes.¹ Studies conducted in the United States indicate that these fractures usually affect young adults between 21 and 45 years old (90% of cases).^{5,7,9}

The diagnosis is confirmed by lateral and anteroposterior view foot radiographs and Harris view (axial) calcaneal radiographs.⁴ In cases of intra-articular fractures, computed tomography is indicated for a better understanding of the injury.^{4,9}

Treatment is based on the characteristics of the fracture and associated injuries, as well as on the local soft tissue conditions.^{7,10} Re-establishment of the normal anatomy is correlated with the good functional outcome.^{10,11} Conservative treatment is usually indicated for extra-articular injuries or in those with small intra-articular involvement, with little or no deviation. The presence of severe joint involvement,

significant deviation, and compound lesions are indications for surgery.¹⁰

A search in the SciELO and LILACS databases and in the journals *Acta Ortopédica* and *Revista Brasileira de Ortopedia*, using the terms “fracture” and “calcaneus,” as well as a search on PubMed using the terms “calcaneus,” “fractures,” and “Brazil” failed to retrieve studies in Portuguese on the epidemiology of calcaneal fractures.

This study is aimed at evaluating the epidemiology of calcaneal fractures in hospitalized patients treated from 2006 to 2010 in a tertiary orthopedic and traumatology hospital, considering that the knowledge of characteristics, patterns, and frequency of the fractures is useful for adequate treatment and prevention.

Patients and methods

A retrospective review was carried out by collecting data from the medical records and imaging studies of patients with calcaneal fractures attended to at a tertiary orthopedic and traumatology hospital from 2006 to 2010. The study assessed parameters such as age, gender, laterality, trauma mechanism, type of fracture, associated injuries, the presence of compound fractures, and time elapsed until surgical treatment. The study included all patients admitted to this hospital with a diagnosis of calcaneus fracture. Patients whose data were incomplete (identification, diagnosis, and post-treatment radiographic images, or irregularities in the

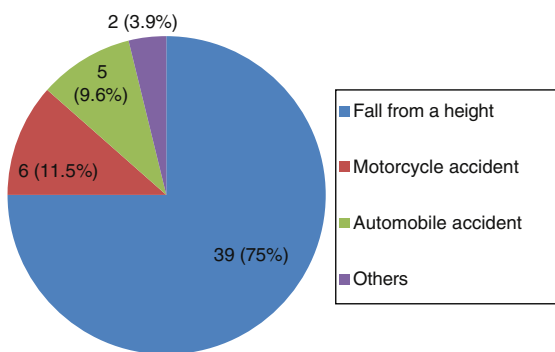


Fig. 1 – Trauma mechanism.

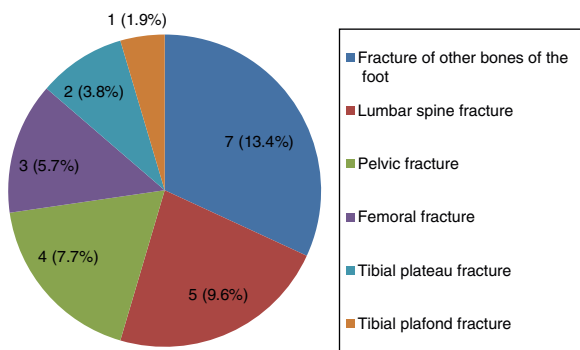


Fig. 2 – Associated fractures.

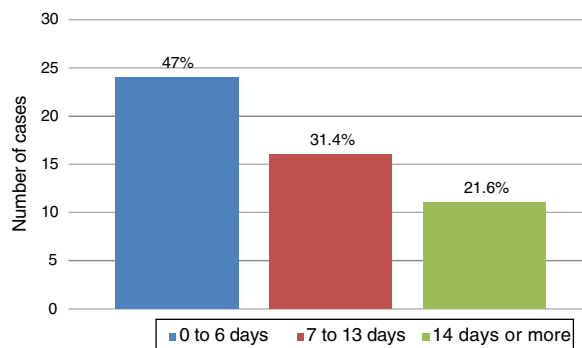


Fig. 3 – Time elapsed between trauma and definitive surgical treatment.

description of the procedure and the time interval from the diagnosis to the procedure) were excluded.

The present study was approved by the Research Ethics Committee under No. 06577712.8.0000.0068.

Results

The study retrieved 52 patients with calcaneus fractures: 44 men and eight women (5.5:1). The mean age was 36.8 years, ranging from 16 to 70 years. Of the 52 patients, ten presented bilateral fractures (19.2%), comprising a total of 62 calcaneal fractures. In 31 cases, the right side was affected (50%) and in 31 cases, the left side (50%).

The most frequent trauma mechanism was a fall from a height (39 cases; 75.0%), followed by motorcycle accidents (six cases; 11.5%) and automobile accidents (five cases; 9.6%; Fig. 1).

Intra-articular fractures were the most common, observed in 47 cases (75.8%); of these, 14 were comminuted (29.8%). Extra-articular fractures were observed in 15 cases (24.2%).

Twenty five patients presented associated fractures (48.0%): seven cases of other foot bones (13.4%), five of the lumbar spine (9.6%), four of the pelvis (7.7%), three in the femur (5.7%), two of the tibial plateau (3.8%), and one of the tibial plafond (1.9%; Fig. 2). Non-orthopedic injuries were observed in five cases (9.6%): two had hepatic contusions (3.8%), two had facial fractures (3.8%), and one presented hemopneumoperitoneum (1.9%).

Fifteen patients presented compound fractures (28.9%). Six were classified as Gustilo type II (40% of the compound fractures), six as type IIIA (40%), and three as type IIIB (20%).

Of the 62 cases of calcaneal fracture, 11 were treated conservatively (17.8%) and 51 underwent surgery (82.2%). The mean time between trauma and definitive surgical treatment was 7.8 days, ranging from 0 to 21. The definitive procedure was performed within the first six days in 24 cases (47%). Sixteen cases were treated during the second week (seven to 13 days; 31.4%), and 11 cases, in the third week (after 14 days, 21.6%; Fig. 3).

Discussion

A total of 62 cases of calcaneal fractures were observed between 2006 and 2010, averaging 12.4 per year. As the present study was conducted in a tertiary orthopedics and traumatology hospital that treats over 2900 accident & emergency cases per month, this type of injury is clearly uncommon when compared with other fractures. Due to this fact, together with the complex anatomy of that bone, the treatment of calcaneal injuries requires a long surgical training.

Most fractures occurred in young male patients (84.6%), with a mean age of 36.8 years, similar to that observed in the literature.^{5,7,12} Considering that most patients with calcaneal fractures require one year to achieve complete functional recovery and that only 46% will present excellent functional results after five years,¹³ the preferential involvement of a young and economically active population brings serious consequences to public health. Furthermore, this fact highlights the need for correct treatment in order to avoid or delay late complications with potential incapacitating sequelae that require new surgical treatments. The predominance of the young male population may be related to the greater exposure of this age group to occupational hazards and traffic accidents.

A fall from a height was the most prevalent trauma mechanism (75.0%), followed by motorcycle accidents (11.5%) and automobile accidents (9.6%). While studies differ regarding the most frequent mechanism of injury, these are the most quoted.^{7,9,12,14} Similar to the present study, Mitchell et al.¹² observed that over 70% of the cases of this injury were due to a fall from a height.¹² In turn, Bohl et al.¹⁴ found data slightly different from those presented in this study: 49% of their cases

were due to traffic accidents (37% automobile accidents and 8% motorcycle accidents), and only 43% of their cases were due to a fall from a height.

In the present study, no laterality predominance was observed (1:1), and bilateral fractures were found in 19.2%, unlike the literature, which indicates rates of bilaterality ranging from 3% to 8%.^{7,12} As the studies suggest, bilateral calcaneal fractures tend to present greater Böhler angle decrease and higher rates of complications, associated injuries, and worse outcomes when compared with unilateral lesions.^{15,16} The higher prevalence of bilateral fractures found in this study may be related to the fact that this medical service is a hospital focused on high-complexity trauma care.

The high prevalence of compound fractures (28.9%) contrasts with that found in the literature, which presents rates of up to 10.0%.^{13,17} Of the 15 cases of compound fractures in the present study, five (33.3%) were related to traffic accidents (four cases of motorcycle accidents and one case of an automobile accident). Considering only calcaneal fractures resulting from motorcycle accidents (six cases), four were compound (66.7%). This fact is worrisome, as the rate of infection in compound calcaneal fractures ranges from 7.7% to 39.0%.¹⁸ Compound calcaneal fractures require additional surgeries in 41% of the cases,¹⁹ presenting an osteomyelitis rate of up to 19% and an amputation rate of 5.2%.²⁰

A total of 25 patients presented associated injuries (48%); this large number reflects the high energy of the trauma suffered by the patients. Among these cases, fractures in other bones of the foot were the most common, being observed in seven cases. Lumbar spine fractures, classically described as commonly associated injuries, were observed in 9.6% of all cases, a rate similar to that presented in other studies.^{7,8} Data on associated injuries are divergent among the studies; some show high prevalence,¹⁴ while others show figures with little significance.¹² When present, these injuries were lower limb fractures, especially in other bones of the foot and leg, followed by vertebral fractures.^{12,14}

The mean time elapsed for the surgical treatment was 7.8 days, and most cases were treated in the first week after the trauma (47.0%). Factors such as associated injuries, the general condition of the patient, and local soft tissue conditions affected the time elapsed until definitive surgical treatment. It is worth mentioning that 11 cases (26.8%) could only undergo surgery during the third week; such a long waiting time does not allow the use of minimally invasive procedures, as consolidation of the cancellous bone fragments is advanced, hindering proper fracture reduction.

Epidemiological studies are useful for understanding the frequency, distribution, and characteristics of fractures, representing a basis for prevention and more appropriate treatment. A limitation of the present study is the fact that it included patients from a high-complexity care hospital in a large city, with a controlled flow of patients; therefore, the present data cannot be extrapolated to all of Brazil.

Conclusion

Patients with calcaneal fractures treated at a high-complexity hospital were mostly young men who had suffered falls from

a height and had some type of associated injury. However, the high rate of bilaterality (19.2%) and compound fractures (28.9%), indicate the great seriousness of these fractures in this population group.

Conflicts of interest

The authors declare no conflicts of interest.

REFERENCES

- Dhillon MS, Bali K, Prabhakar S. Controversies in calcaneus fracture management: a systematic review of the literature. *Musculoskelet Surg.* 2011;95(3):171-81.
- Bruce J, Sutherland A. Surgical versus conservative interventions for displaced intra-articular calcaneal fractures. *Cochrane Database Syst Rev.* 2013;(1). CD008628.
- Veltman ES, Doornberg JN, Stufkens SA, Luitse JS, van den Bekerom MP. Long-term outcomes of 1,730 calcaneal fractures: systematic review of the literature. *J Foot Ankle Surg.* 2013;52(4):486-90.
- Palmersheim K, Hines B, Olsen BL. Calcaneal fractures: update on current treatments. *Clin Podiatr Med Surg.* 2012;29(2):205-20.
- Pelliccioni AA, Bittar CK, Zabeu JL. Surgical treatment of intraarticular calcaneous fractures of Sanders' types II and III. Systematic review. *Acta Ortop Bras.* 2012;20(1):39-42.
- Medeiros CM, Henao JE, Rohenkohl C, Hirata LM, Baruffi NA, Klein Junior A, et al. Functional evaluation of surgically-treated intra-articular fractures of the calcaneus. *Rev Bras Ortop.* 2008;43(11-12):482-9.
- Worsham JR, Elliott MR, Harris AM. Open calcaneus fractures and associated injuries. *J Foot Ankle Surg.* 2016;55(1):68-71.
- Stapleton JJ, Zgonis T. Surgical treatment of intra-articular calcaneal fractures. *Clin Podiatr Med Surg.* 2014;31(4):539-46.
- Maskill JD, Bohay DR, Anderson JG. Calcaneus fractures: a review article. *Foot Ankle Clin.* 2005;10(3):463-89.
- Sharr PJ, Mangupli MM, Winson IG, Buckley RE. Current management options for displaced intra-articular calcaneal fractures: non-operative. ORIF, minimally invasive reduction and fixation or primary ORIF and subtalar arthrodesis. A contemporary review. *Foot Ankle Surg.* 2016;22(1):1-8.
- Zhang W, Chen E, Xue D, Yin H, Pan Z. Risk factors for wound complications of closed calcaneal fractures after surgery: a systematic review and meta-analysis. *Scand J Trauma Resusc Emerg Med.* 2015;23:18.
- Mitchell MJ, McKinley JC, Robinson CM. The epidemiology of calcaneal fractures. *Foot.* 2009;19(4):197-200.
- Zwipp H, Rammelt S, Barthel S. Calcaneal fractures – open reduction and internal fixation (ORIF). *Injury.* 2004;35(2):46-54.
- Bohl DD, Ondeck NT, Samuel AM, Diaz-Collado PJ, Nelson SJ, Basques BA, et al. Demographics mechanisms of injury, and concurrent injuries associated with calcaneus fractures: a study of 14 516 patients in the American College of Surgeons National Trauma Data Bank. *Foot Ankle Spec.* 2016, pii:1938640016679703 [Epub ahead of print].
- Dooley P, Buckley R, Tough S, McCormack B, Pate G, Leighton R, et al. Bilateral calcaneal fractures: operative versus nonoperative treatment. *Foot Ankle Int.* 2004; 25(2):47-52.
- Zeman J, Matejka J, Matejka T, Salasek M, Zeman P, Nepras P. Open reduction and plate fixation (ORIF LCP) for treatment of

- bilateral calcaneal fractures. *Acta Chir Orthop Traumatol Cech.* 2013;80(2):142-7.
17. Heier KA, Infante AF, Walling AK, Sanders RW. Open fractures of the calcaneus: soft-tissue injury determines outcome. *J Bone Jt Surg Am.* 2003;85-A(12):2276-82.
 18. Richter M, Kwon JY, Digiovanni CW. Foot injuries. In: *Skeletal trauma: basic science, management and reconstruction.* 5th ed. Philadelphia: Mosby Elsevier; 2014. p. 2251-387.
 19. Beltran MJ, Collinge CA. Outcomes of high-grade open calcaneus fractures managed with open reduction via the medial wound and percutaneous screw fixation. *J Orthop Trauma.* 2012;26(11):662-70.
 20. Wiersema B, Brokaw D, Weber T, Psradellis T, Panero C, Weber C, et al. Complications associated with open calcaneus fractures. *Foot Ankle Int.* 2011;32(11):1052-7.