

Original Article

Epidemiological profile of orthopedic foot and ankle surgeries before and after the COVID-19 pandemic

Thaís Assad Araújo¹, Antônio Manuel Pinto Júnior¹, Bruna Sanches Bezerra¹, Giuliana Pereira Gomes², Isadora Pereira Gomes¹, José Henrique São João Peres³, Leticia Zaccaria Prates de Oliveira¹, Pedro Henrique Vieira Partata⁴, Danilo Ryuko Cândido Nishikawa⁵, Rui dos Santos Barroco¹

1. Serviço de Ortopedia e Traumatologia, Hospital Mário Covas, Santo André, São Paulo, Brazil.
2. Serviço de Ortopedia e Traumatologia da Universidade de Taubaté - UNITAU, Taubaté, São Paulo, Brazil.
3. Serviço de Ortopedia e Traumatologia da Santa Casa de Ourinhos, Ourinhos, São Paulo, Brazil.
4. Serviço de Ortopedia e Traumatologia do Hospital Municipal Antônio Giglio, Osasco, São Paulo, Brazil.
5. Departamento de Cirurgia Ortopédica, Hospital Alemão Oswaldo Cruz, São Paulo, SP, Brazil.

Abstract

Objective: To analyze the epidemiological profile of orthopedic foot and ankle surgeries, comparing the volume and distribution of procedures performed in the pre- and post-COVID-19 pandemic.

Methods: This is an observational, retrospective, and descriptive study, with a quantitative approach, based on the analysis of institutional records of orthopedic foot and ankle surgeries performed between 2017 and 2023. The data were grouped into two periods: pre-pandemic (2017–2019) and post-pandemic (2021–2023), excluding 2020 because elective procedures were suspended following the World Health Organization's announcement of the COVID-19 pandemic.

Results: A total of 742 orthopedic foot and ankle surgeries were analyzed. Of the total, 649 procedures (87.4%) occurred in the pre-pandemic period and 93 (12.5%) in the post-pandemic period, corresponding to an 85.7% reduction in surgical volume. There was a sharp drop in 2021, followed by a partial recovery in 2022. Fractures remained the main surgical indication in both periods, while elective procedures, especially corrections of forefoot deformities, showed a disproportionate reduction in the post-pandemic period.

Conclusion: The COVID-19 pandemic significantly reduced orthopedic foot and ankle surgeries, with surgical activity remaining lower in the post-pandemic period than in the pre-pandemic period.

Level of Evidence IV; Retrospective observational study.

Keywords: Foot injuries; Ankle injuries; Orthopedic surgery; COVID-19.

Introduction

Orthopedic conditions affecting the foot and ankle are a major cause of morbidity, functional limitations, and socio-economic impact, as this anatomical region is fundamental to ambulation and an individual's autonomy. Fractures, structural deformities, ligament injuries, and degenerative pathologies are among the main indications of specialized care, often requiring surgical intervention. Recent studies reinforce that ankle fractures remain among the most

prevalent musculoskeletal injuries in hospital services, with a high care burden⁽¹⁾.

In addition to traumatic conditions, elective foot and ankle surgeries, such as corrections of hallux valgus, arthrosis, and forefoot deformities, have a high prevalence and direct impact on quality of life. Contemporary evidence shows that these conditions are associated with population aging, increased life expectancy, and greater demand for procedures aimed at functional improvement and pain relief. Recent reviews

Study performed at the Hospital Mário Covas, Santo André, SP, Brazil.

Correspondence: Rui dos Santos Barroco. Rua Dr. Henrique Calderazzo, 321, Bairro Paraíso, 09190-610/615, Santo André, SP, Brazil. **E-mail:** ruibarroco@uol.com.br

Conflicts of interest: none. **Source of funding:** none. **Date received:** January 20, 2026. **Date accepted:** March 27, 2026.



highlight the relevance of these surgeries in the context of modern orthopedics and their growing demand within health systems⁽²⁾.

The organization of health services plays a decisive role in timely access to specialized orthopedic surgeries. Under regular conditions, there is a balanced coexistence between urgent and elective procedures. However, health crisis situations can significantly alter this pattern. The COVID-19 pandemic has imposed unprecedented challenges on health systems worldwide, resulting in the suspension or postponement of elective surgeries and the prioritization of emergency care⁽³⁾.

In orthopedics, several studies published after the onset of the pandemic showed a significant reduction in surgical volume, including foot and ankle procedures. Recent literature indicates that, although trauma surgeries were partially maintained, there was a sharp drop in elective procedures, with a direct impact on the epidemiological profile of surgeries performed during this period⁽⁴⁾.

Even after easing the restrictive measures, the recovery of surgical activity was gradual and heterogeneous. More recent studies indicate that the deferral of elective surgeries and the reorganization of care flows continued to affect procedure volumes in the years following the pandemic's critical phase. Comparative analysis between pre- and post-pandemic periods has been widely used as a methodological strategy to assess the lasting effects of COVID-19 on specialized orthopedic care⁽⁵⁾.

Given this context, the objective of this study is to analyze the epidemiological profile of orthopedic foot and ankle surgeries performed in a reference hospital, comparing the volume and distribution of procedures in the pre-pandemic (2017–2019) and post-pandemic (2021–2023) periods, to evaluate the impact of the COVID-19 pandemic on specialized surgical activity.

Methods

This is an observational, retrospective, and descriptive study with a quantitative approach, whose objective was to analyze the epidemiological profile of orthopedic foot and ankle surgeries performed in a reference hospital, comparing the pre- and post-COVID-19 pandemic periods.

The study population consisted of all patients undergoing orthopedic foot and ankle surgical procedures between January 2017 and December 2023. For analytical purposes, the data were grouped into two distinct periods: pre-pandemic (2017–2019) and post-pandemic (2021–2023), excluding 2020 because elective procedures were suspended following the World Health Organization's announcement of the COVID-19 pandemic⁽⁶⁾. The period corresponding to the return of face-to-face activities in São Paulo was defined as the post-pandemic period⁽⁷⁾.

The variables analyzed included the absolute number of surgeries per year, the total procedure volume per period, and the distribution of the main surgical indications, with an

emphasis on fractures and elective procedures. Data analysis was performed descriptively, by calculating absolute and relative frequencies, annual means, and percentage variations. For the comparison between the pre- and post-pandemic periods, absolute and relative differences in surgical volume were analyzed without applying inferential statistical tests.

The results were presented using tables and graphs, designed to show the temporal distribution and the comparison between the periods analyzed. The study followed the ethical principles of research with secondary data, ensuring the anonymity of information and the confidentiality of records, and that individual patient identification is not necessary.

Results

A total of 742 orthopedic foot and ankle surgeries were analyzed over the study period. Of this total, 649 procedures (87.4%) were performed in the pre-pandemic period (2017–2019), while only 93 procedures (12.5%) were performed in the post-pandemic period (2021–2023). The direct comparison between the periods showed an absolute reduction of 556 surgeries, corresponding to an 85.7% decrease in surgical volume in the post-pandemic period, indicating a significant reduction in orthopedic foot and ankle surgical activity (Figure 1).

During the pre-pandemic period, a high and stable surgical volume was observed, with all care capacity in use. In contrast, the post-pandemic period showed a marked reduction in surgical activity, with only 23 procedures performed in 2021, followed by a slight recovery in subsequent years, still far below pre-pandemic levels.

The annual distribution of surgeries by procedure type showed a predominance of trauma surgeries throughout

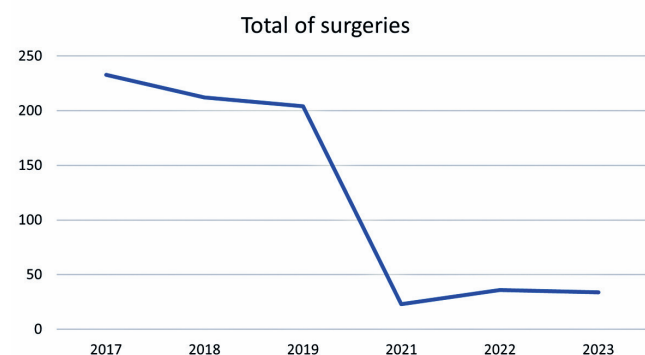


Figure 1. Number of surgeries per year: showing a significant reduction in surgical procedures, with stabilization in the post-pandemic period.

Note: Annual distribution of orthopedic foot and ankle surgeries between 2017 and 2023, showing a marked reduction in surgical volume in the post-pandemic period, with a more pronounced drop in 2021 and partial recovery in subsequent years.

the period analyzed. As shown in Figure 2, osteosyntheses accounted for the highest proportion of procedures across all years, with only slight variation between the pre- and post-pandemic periods. On the other hand, elective surgeries, especially hallux valgus corrections, showed a marked reduction in the post-pandemic period, with a more evident decrease in 2021 and partial recovery in subsequent years. Therefore, there was a change in the percentage composition of procedures, with a relative increase in the participation of trauma surgeries compared with electives in the post-pandemic period.

Regarding the epidemiological profile of surgical indications, foot and ankle fractures remained the main cause of intervention throughout the analyzed period, with less marked variation over the years, as shown in Figure 2. In contrast, elective surgeries, especially those aimed at correcting forefoot deformities, such as hallux valgus, showed a significant drop in the post-pandemic period, with a more pronounced reduction in 2021 and only partial recovery in subsequent years. This behavior shows a differentiated impact of the pandemic across procedure types, reflecting the prioritization of urgent cases and reduced assistance due to the restrictions imposed during the period.

Discussion

The results of this study demonstrate a significant reduction in orthopedic foot and ankle surgeries in the post-pandemic period, when comparing annual procedure means across the periods analyzed. This finding aligns with international evidence indicating that the COVID-19 pandemic was a determining factor in the reorganization of health services, with the prolonged suspension of elective surgeries and the prioritization of urgent cases, especially in orthopedics⁽⁸⁾.

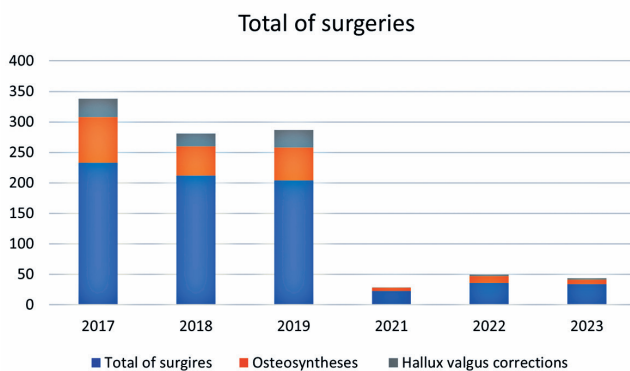


Figure 2. Surgeries analyzed per year, with emphasis on osteosyntheses and hallux valgus corrections.

Note: Annual distribution of orthopedic foot and ankle surgeries according to the type of procedure, highlighting the predominance of osteosyntheses over the period and the more pronounced reduction of elective surgeries, especially hallux valgus corrections, in the post-pandemic period.

The abrupt reduction observed in 2021 reflects the immediate impact of sanitary restrictions and the reallocation of hospital resources to face COVID-19. Multicenter studies have shown that, during the pandemic critical phase, orthopedic services operated with severely reduced capacity, maintaining predominantly trauma-related surgeries, while elective procedures were largely postponed⁽⁴⁾. This scenario is consistent with the profile observed in this study, in which fractures remained the primary surgical indication in the post-pandemic period.

The temporal analysis shows that even in 2023, the recovery in surgical volume was only partial, remaining far from pre-pandemic levels. This finding corroborates recent studies indicating a slow and heterogeneous recovery of orthopedic surgical activity, influenced by reduced demand, structural limitations, and the reorganization of care flows⁽⁹⁾. The persistence of this impact suggests that the effects of the pandemic extended beyond the health emergency period, prolonging access to specialized care.

Another relevant observation was the more pronounced reduction in elective surgeries, especially those aimed at correcting forefoot deformities, such as hallux valgus, as shown in Figure 2. These procedures showed a significant drop in the post-pandemic period, in contrast to trauma surgeries, which remained relatively stable throughout the period analyzed. This behavior suggests a differentiated impact of the pandemic according to the nature of the procedure, reflecting the prioritization of urgent cases and the temporary suspension of elective surgeries. This finding aligns with studies of the foot and ankle area, which demonstrate a greater impact on elective procedures during and after the pandemic, associated with both direct interruption and an increase in waiting lists, with clinical repercussions for patients previously indicated for surgery⁽¹⁰⁾.

The maintenance of the predominance of fractures as the main surgical indication throughout the period analyzed reinforces the unavoidable nature of orthopedic trauma, even in contexts of health crisis. Recent evidence indicates that, although there was an overall reduction in traumatic visits during periods of confinement, foot and ankle fractures continued to require surgical intervention, especially those associated with instability or significant functional impairment⁽¹¹⁾.


From a health management perspective, the findings of this study highlight the importance of planning strategies to mitigate surgical complications in the post-pandemic period. Recent literature emphasizes the need to reorganize surgical schedules, expand operative capacity, and define clinical and functional criteria for prioritizing elective surgeries to reduce the prolonged impact on patients' quality of life and on health systems⁽¹²⁾.

Finally, this study contributes to understanding the impact of the COVID-19 pandemic on specialized foot and ankle orthopedics in a Brazilian hospital setting, reinforcing international evidence and highlighting the relevance of

comparative epidemiological analyses to support clinical and managerial decisions. The comparison between pre- and post-pandemic periods allows us to identify not only the magnitude of the reduction in care but also the persistent challenges to the full resumption of specialized surgical services.

Conclusion

The findings of the study confirm the hypothesis that the COVID-19 pandemic significantly affected orthopedic foot and ankle surgical activity, as evidenced by a significant reduction in procedure volume in the post-pandemic period compared with the pre-pandemic period.

Authors' contributions: Each author contributed individually and significantly to the development of this article: TAA *(<https://orcid.org/0000-0002-3008-7>) Data collection, and participated in the review process; AMPJ *(<https://orcid.org/0009-0003-7549-1932>) Conceived and planned the activities that led to the study, data collection, statistical analysis, wrote the article, and participated in the review process; BSB *(<https://orcid.org/0000-0002-5382-5271>) Survey of the medical records, interpreted the results of the study, and participated in the review process; GPG *(<https://orcid.org/0009-0008-0728-9800>) Bibliographic review, data collection, interpreted the results of the study, and participated in the review process; IPG *(<https://orcid.org/0009-0009-8517-3448>) Survey of the medical records, data collection, formatting of the article, and participated in the review process; JHSJP *(<https://orcid.org/0009-0003-0543-230>) Interpreted the results of the study, and participated in the review process; LZPO *(<https://orcid.org/0000-0001-5849-5841>) Interpreted the results of the study, participated in the review process, and formatting of the article; PHVP *(<https://orcid.org/0009-0009-1529-0585>) Statistical analysis, bibliographic review, interpreted the results of the study, and participated in the review process; RSB *(<https://orcid.org/0000-0002-2870-2261>), and DRCN *(<https://orcid.org/0000-0003-0227-2440>) Conceived and planned the activities that led to the study, supervised all stages of the study, interpreted the results of the study, and coordinated the review process. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID ).

References

- Hansen R, Shibuya N, Jupiter DC. An updated epidemiology of foot and ankle fractures in the United States: complications, mechanisms, and risk factors. *J Foot Ankle Surg.* 2022;61(5):1034-8.
- Coelho RA. Innovative approaches in the treatment of foot and ankle injuries. *J Foot Ankle.* 2024;18(3):332-7.
- COVIDSurg Collaborative. Elective surgery cancellations due to the COVID-19 pandemic: global predictive modelling to inform surgical recovery plans. *Br J Surg.* 2020;107(11):1440-9.
- Blum P, Putzer D, Liebensteiner MC, Dammerer D. Impact of the COVID-19 pandemic on orthopaedic and trauma surgery: a systematic review of the current literature. *In Vivo.* 2021;35(3):1337-43.
- Howlett NC, Wood RM. Modeling the recovery of elective waiting lists following COVID-19: scenario projections for England. *Value Health.* 2022;25(11):1805-13.
- World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19-11 March 2020 [Internet]. Geneva: World Health Organization; 2020 [cited 2026 Mar 19]. Available from: <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-11-march-2020>
- Prefeitura de São Paulo. Retomada das atividades presenciais nos estabelecimentos de ensino [Internet]. São Paulo: Prefeitura de São Paulo; 2021 [cited 2026 Mar 19]. Available from: <https://prefeitura.sp.gov.br>.
- Petrone B, Iturriaga CR, Mauri T, Sgaglione N. COVID-19 and orthopaedics: recovery after the pandemic surge. *Arthrosc Sports Med Rehabil.* 2020;2(5):e677-82.
- Anoushiravani A, Kalyanasundaram G, Kuna M, Murasko M, Carroll J, Mulligan M. Effect of coronavirus disease 2019 (COVID-19) on orthopaedic surgical volume. *J Hosp Manag Health Policy.* 2023;7:16.
- Mascio A, Greco T, Comisi C, Cinelli V, De Gasperis N, Candelli M, et al. Foot and ankle trauma: epidemiology before, during, and post COVID-19 pandemic in a level I trauma center: a 5-year experience and data analysis. *J Clin Med.* 2024;13(24):7585.
- Ghoshal S, Stovall N, King AH, Miller AS, Harris MB, Succi MD. Orthopedic surgery volume trends during the COVID-19 pandemic and postvaccination era: implications for healthcare planning. *J Arthroplasty.* 2024;39(8):1959-66.
- Momtaz D, Ghali A, Gonuguntla R, Kotzur T, Ahmad F, Arce A, et al. Impact of COVID-19 on elective orthopaedic surgery outcomes during the peak of the pandemic: an uptick of complications-an analysis of the ACS-NSQIP. *J Am Acad Orthop Surg Glob Res Rev.* 2023;7(2):e22.00276.