Advantages of a Multidisciplinary Team in the Treatment of Bone and Joint Infections

Vantagens de uma Equipa Multidisciplinar no Tratamento das Infeções Osteoarticulares

Ricardo Sousa[1,2*]; Miguel Araújo Abreu[2,3*]

1. Orthopedic Department, ULS Santo António, Porto, Portugal
2. Hospital Lusíadas, Porto, Portugal
3. Infectious Diseases Department, ULS Santo António, Porto, Portugal

* Porto Bone and Joint Infection Group (GRIP)

https://doi.org/10.82189/spot.60

ABSTRACT

Bone and joint infections represent a significant source of morbidity and mortality, often termed a "silent epidemic." While native infections, such as septic arthritis and osteomyelitis, still persist, surgical site infections related to orthopedic implants have gained particular prominence due to their growing prevalence and complexity. These infections not only lead to substantial patient morbidity and mortality but also create a significant burden on healthcare resources through prolonged hospital stays, multiple surgeries and extended antibiotic therapy.

We advocate for the adoption of a multidisciplinary approach in treating bone and joint infections, drawing on the experiences of an existing multidisciplinary team. The integration of orthopedic surgeons, infectious disease specialists, internal medicine professionals and microbiologists enables a more comprehensive diagnostic and therapeutic approach, offering tailored surgical and antibiotic strategies based on the specific infection and the patient's overall circumstances.

Based on existing international examples and the experience of the authors, this paper proposes the establishment of a structured multidisciplinary approach in the Portuguese setting to optimize patient care and healthcare resources use.

Keywords: Arthritis, Infectious/drug therapy; Arthritis, Infectious/therapy; Clinical Decision-Making; Patient Care Team

RESUMO

As infeções osteoarticulares representam uma importante causa de morbilidade e mortalidade, sendo frequentemente descritas como uma "epidemia silenciosa". Embora infeções nativas, como a artrite séptica e a osteomielite, continuem a ocorrer, as infeções do local cirúrgico associadas a implantes ortopédicos têm assumido particular relevância devido à sua crescente prevalência e complexidade. Estas infeções não só acarretam um impacto significativo na morbilidade e mortalidade dos doentes, como também impõem uma carga substancial aos sistemas de saúde, através de internamentos prolongados, múltiplas intervenções cirúrgicas e terapêuticas antibióticas prolongadas.

Autor Correspondente/Corresponding Author: Ricardo Sousa [geral@ricardosousaortopedia.pt], Largo do Prof Abel Salazar, 4099-001 Porto, Portugal

Recebido/Received: 2024/10/11 **Aceite/Accepted:** 2025/07/16 **Publicado online/Published online:** 2025/09/27 **Publicado / Published:** 2026/11/03

© Author(s) (or their employer(s)) and Orthopedic SPOT 2025. Re-use permitted under CC BY-NC. No commercial re-use.
© Autor (es) (ou seu (s) empregador (es)) Orthopedic SPOT 2025. Reutilização permitida de acordo com CC BY-NC. Nenhuma reutilização comercial.

Defendemos a adoção de uma abordagem multidisciplinar no tratamento das infeções osteoarticulares, extrapolando na base na experiência de uma equipa multidisciplinar existente. A colaboração entre cirurgiões ortopédicos, infeciologistas, internistas e microbiologistas permite uma abordagem diagnóstica e terapêutica mais abrangente, com estratégias cirúrgicas e antibióticas adaptadas ao tipo de infeção e ao contexto clínico de cada doente.
Com base em exemplos internacionais e na experiência dos autores, este artigo propõe a implementação de uma abordagem multidisciplinar estruturada no contexto português, com o objetivo de otimizar os cuidados prestados aos doentes e a utilização dos recursos de saúde.

Palavras-chave: Artrite Infecciosa/tratamento; Artrite Infecciosa/tratamento farmacológico; Equipa de Cuidados ao Doente; Tomada de Decisão Clínica

INTRODUCTION

Bone and joint infections are currently responsible for enormous morbidity and even mortality, constituting what could be called a silent epidemic. Although native infections (e.g. septic arthritis and osteomyelitis) continue to exist, post-surgical infections associated with orthopedic implants of various kinds are particularly important due to their high prevalence and complexity.

Today, there is a growing global trend in the number of arthroplasties performed, inevitably leading to an increase in periprosthetic infections, which account for more than 40% of all bone and joint infections.[1,2] The aging demographic trend also leads to a significant rise in complex fractures in elderly patients, generating an increasing number of infections related to the surgical treatment of these fractures.[1,3]

The impact of this disease is gigantic and multifaceted. First, it causes great morbidity for patients and significantly increases mortality, which exceeds 20% at five years.[4,5] Moreover, the complex treatment involves prolonged hospitalizations, multiple surgeries, extended antibiotic therapy, etc. which significantly affects hospital resource availability and leads to significant socio-economic impact.[6-8]

In Portugal, the treatment of these patients is typically carried out autonomously by the responsible surgeon or with assistance from colleagues within the same specialty and institution. Interdisciplinary cooperation is less common, and inter-hospital referrals are even rarer. As a result, these patients are often treated by medical teams with limited training, who never truly acquire the desired experience and knowledge. This article aims to share our experience as a multidisciplinary team and to encourage a joint reflection on possible future pathway in our community.

THE CONCEPT OF A MULTIDISCIPLINARY TEAM

The concept of a group of doctors with different skill sets coming together to make better decisions about patients and/or complex pathologies is certainly not revolutionary. The paradigmatic example of this approach is group consultations in Oncology, which have proven so successful that they are now an essential part of the standard of care in cancer treatment, including in Orthopedics.[9]

The need for this type of approach has also become evident in the context of bone and joint infections.[10-13] On one hand, these infections tend to occur in medically fragile patients, such as the elderly or those with multiple co-morbidities. On the other hand, the diagnosis is often complex and depends on the combined interpretation of clinical, imaging, and laboratory information.[14,15] Treatment is also very demanding and frequently requires major surgeries and prolonged antibiotic therapies.

Naturally, the composition of the team may vary according to different realities and institutional specificities. However, since the vast majority of these patients require surgical treatment, Orthopedics is indispensable and should, therefore, lead the process. It is also often necessary to involve surgeons capable of addressing associated soft tissue defects (i.e., Orthoplastic or Plastic Surgery).[11-13, 16-18]

Infectious Disease is another essential specialty. The long periods of antibiotic therapy often required, multi-resistant bacteria, fungi, and other difficult-to-treat microorganisms, as well as the need to select drugs with anti-biofilm activity or integrate and properly interpret laboratory data, require someone dedicated to this area.[12,16,19]

The reliability of the information depends heavily on the expertise of the microbiologist and laboratory staff, who must be trained in appropriate methodologies—some of which

may involve advanced technologies like implant sonication for biofilm analysis or molecular biology techniques.

The participation of Internal Medicine in the co-management of these complex patients is also crucial. Their systematic participation in decision-making within multidisciplinary teams is significantly more important than occasional involvement. It is essential to emphasize that, despite the evident optimization of antibiotic therapy resulting from this approach, the required multidisciplinary interaction goes far beyond "antimicrobial stewardship programs".[20] However, we clearly see the integration of members from infection prevention and control programs (PPCIRA) as an added value.

It is true teamwork, where surgical possibilities influence and are influenced by antibiotic therapies, which in turn must consider the "orthopedic scenario" and the expected outcome. Moreover, these decisions are made considering the specific microbiological context of the infection, which occurs in a patient with its own specific medical comorbidities that may further influence treatment options.

THE ADVANTAGES OF THIS APPROACH

The benefit of teamwork is so intuitive that it almost seems redundant to defend the many and different advantages that the convergence of various medical specialties, each with distinct viewpoints and sensitivities, brings.

Although ubiquitous, infection is a complication that, fortunately, affects only a small percentage of patients undergoing orthopedic procedures. If, instead of each doctor treating their own complications in an *ad hoc* manner, a multidisciplinary team dedicated to treating this pathology were to exist, much more favorable conditions would be created.

First and foremost, this dedication fosters motivation to acquire knowledge and accumulate clinical experience. Combined with ongoing clinical research that this concentration permits and encourages, conditions are created for the establishment of institutional protocols that enable not only a more structured and evidence-based approach but also the dissemination of norms and recommendations to improve care by other professionals. Naturally, all this translates into better clinical outcomes.[12,21-25] In addition to the clinical advantages, there are obvious indirect socioeconomic gains and even direct economic and resource savings for the health systems (Table 1).

Tabela 1. Comparative Studies Illustrating the Advantages of a Multidisciplinary Approach to Bone and Joint Infections

Author	Year	Country of Origin	Patient Population
Ntalos *et al.*	2019	Germany	Periprosthetic hip infections (n=46) Significantly shorter hospital stay, fewer surgeries, and fewer antibiotics used.
Biddle *et al.*	2021	United Kingdom	Periprosthetic knee and/or hip infections (n=58) Significantly better infection eradication rates.
Ferguson *et al.*	2021	United Kingdom	Various types of osteomyelitis undergoing surgery (n=25,006) Better outcomes in specialized units: fewer surgeries, shorter hospital stays, lower mortality, and fewer amputations.
Ntalos *et al.*	2021	Germany	Vertebral spondylodiscitis (n=361) Significantly shorter antibiotic therapy duration, different surgical strategy with better results.
Vuorinen *et al.*	2021	Finland	Periprosthetic knee and/or hip infections (n=154) Significantly fewer surgeries and shorter hospital stays in specialized centers.

HOW OTHER EUROPEAN COUNTRIES ARE ORGANIZED

Given the wide variability in healthcare structuring across different European countries, it is not surprising that there are also very different models of treatment delivery for these patients. Although the reality that exists in Portugal is still the most prevalent form of organization, there is a continuum of differentiation in the care provided to patients with bone and joint infections.

The embryonic structure consists of the creation of multidisciplinary teams specifically dedicated to treating this pathology within a few institutions in the country. This has been the reality for many years in much of Western Europe. In competitive healthcare systems such as Switzerland or Germany, this situation persists to this day. It is up to the patients themselves to take the initiative to seek out the institution most qualified to solve their problem, which may (or may not) happen with greater or lesser ease of access.

In other countries with more centralized healthcare systems, such as Spain[26] and England,[18] institutions with dedicated and specialized multidisciplinary teams that meet a set of predetermined requirements can apply for official recognition as a specialized center. However, the lack of legal obligation for patient referral and the absence of funding incentives for

institutions mean that the network primarily operates through the awareness and education of the medical community itself.

There are also examples where this organizational capacity evolves into networked structures, allowing smaller hospitals to collaborate with more specialized centers, thus standardizing procedures and offering patients the best possible treatment, as is the case in the Netherlands.[11] The most sophisticated form of organization example comes from France, where, since 2008, as part of a government initiative, a national network of reference centers has been created. Each of these coordinates 'corresponding centers' associated with them.[10] There is a legal obligation for complex bone and joint infections to be discussed with the respective CRIOAc (Centre de Référence des Infections Ostéoarticulaires Complexes), which decides on the best course of treatment to offer. This may include assuming the treatment of the patient if deemed the most appropriate. Specific funding conditions have been created for these centers.[10] The results of this policy have been overwhelmingly positive.

PORTO BONE AND JOINT INFECTION GROUP OF PORTO (GRIP): A MULTIDISCIPLINARY TEAM EXPERIENCE IN PORTUGAL

A few years ago, we took the first step by creating a multidisciplinary group that includes not only Orthopedics and Infectious Diseases, but also Internal Medicine and Microbiology, meeting weekly and regularly involving other medical specialties. This activity includes not only the direct responsibility for treating as many bone and joint infection cases as possible but also supporting diagnostic and therapeutic decisions in all remaining cases within the institution, as well as an increasing number of collaborations and consultations for colleagues from other institutions seeking our help.

This volume of work allows us not only to accumulate experience and contribute with significant case series for international collaborations[27-30] but also to consistently reflect on and demonstrate that evidence-based strategies lead to higher success rates.[21,25,31-33]

Furthermore, there has been a constant concern for developing institutional guidelines and clinical research projects that have allowed the dissemination of best practices beyond the group. Several examples demonstrate this, including: a) within the field of native joint septic arthritis, such as the empirical antibiotic therapy recommendations currently in force at our institution[34] or active participation in the development of European guidelines[35]; b) in optimizing preoperative prophylaxis for prosthetic replacement surgery[36-39]; c) in the diagnosis of periprosthetic infections, either through optimizing recommended microbiological study methods[22,40] properly interpreting available biomarkers,[41,42] or actively participating in the latest two global definitions of periprosthetic infection[14,43] and their validation.[44,45]

A POSSIBLE PATH FOR THE FUTURE

Reflecting on our experience, Fig. 1 illustrates what we believe to be a well-adjusted proposal for providing care to these patients in Portugal.

Naturally, the overall volume of bone and joint infections is too large to imagine that all infections could ever be treated in reference centers. There is a first level of intervention, particularly for acute infections requiring urgent treatment, which must always remain the responsibility of the general orthopedic surgeon who first encounters the patient. Naturally, in a second phase, communication with more specialized support can be advantageous, especially for optimizing antibiotic therapy.

Chronic infections, however, should always be treated by multidisciplinary teams whenever possible, as the more indolent nature of these infections allows for calm and deliberate decision-making, optimizing the chances of treatment success. Ideally, in more complex cases, interaction with reference centers allows for the development of medical and surgical intervention plans based on the best available evidence and expertise, which may or may not be implemented in the patient's original institution.

As in countries where these services are well-organized, reference centers should not only aid less experienced centers but also be able to identify and absorb the treatment of the most challenging cases, such as those with previous treatment failures, requiring complex surgical reconstructions, or needing specialized resources that are not available in all hospitals.

The implementation of this or another similar framework obviously depends on logistical and/or financial limitations inherent to the specific context. The approach to achieving this will undoubtedly differ between the National Health System and the growing private healthcare sector in Portugal, but it will certainly benefit all stakeholders, as evidenced by the available literature. It is urgent to begin this discussion!

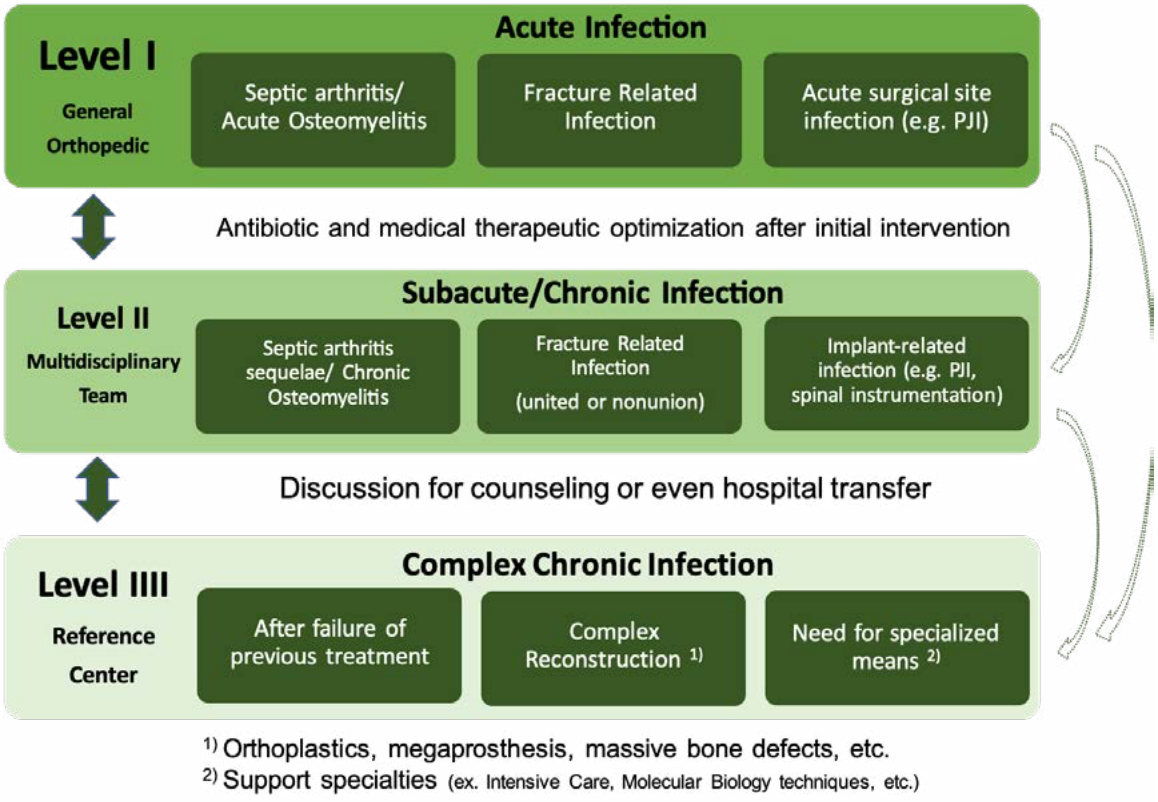


Figure 1. Proposed stratification for the care of patients with bone and joint infections in Portugal

Responsabilidades Éticas

Conflitos de Interesse: Os autores declaram a inexistência de conflitos de interesse.

Apoio Financeiro: Este trabalho não recebeu qualquer subsídio, bolsa ou financiamento.

Proveniência e Revisão por Pares: Não solicitado; revisão externa por pares.

Ethical Disclosures

Conflicts of Interest: The authors have no conflicts of interest to declare.

Financial Support: This work has not received any contribution grant or scholarship.

Provenance and Peer Review: Not commissioned; externally peer-reviewed.

Declaração de Contribuição

Todos os autores contribuíram de forma idêntica para a concepção, elaboração e revisão do manuscrito. Todos aprovaram a versão a ser publicada.

Contributorship Statement

All authors contributed equally to the conception, drafting, and revision of the manuscript. All authors approved the final version to be published.

References

1. Lemaignen A, Bernard L, Marmor S, Ferry T, Grammatico-Guillon L, Astagneau P, et al. Epidemiology of complex bone and joint infections in France using a national registry: The CRIOAc network. J Infect. 2021;82:199-206. doi: 10.1016/j.jinf.2020.12.010.
2. Markus Rupp, Edmund Lau, Steven M Kurtz, Alt V. Projections of Primary TKA and THA in Germany From 2016 Through 2040. Clin Orthop Related Res. 2020; 478:1622-33.
3. Court-Brown CM, Duckworth AD, Clement ND, McQueen MM. Fractures in older adults. A view of the future? Injury. 2018;49:2161-6.
4. Lum ZC, Natsuhara KM, Shelton TJ, Giordani M, Pereira GC, Meehan JP. Mortality During Total Knee Periprosthetic Joint Infection. J Arthroplasty. 2018 ;33:3783-8.
5. Natsuhara KM, Shelton TJ, Meehan JP, Lum ZC. Mortality During Total Hip Periprosthetic Joint Infection. J Arthroplasty. 2019;34:S337-S42.
6. Premkumar A, Kolin DA, Farley KX, Wilson JM, McLawhorn AS, Cross MB, et al. Projected Economic Burden of Periprosthetic Joint Infection of the Hip and Knee in the United States. J Arthroplasty. 2021;36:1484-9 e3.
7. Sousa A, Carvalho A, Pereira C, Reis E, Santos AC, Abreu M, et al. Economic Impact of Prosthetic Joint Infection - an Evaluation Within the Portuguese National Health System. J Bone Jt Infect Jun. 2018;3:197-202.
8. Iliaens J, Onsea J, Hoekstra H, Nijs S, Peetermans WE, Metsemakers WJ. Fracture-related infection in long bone fractures: A comprehensive analysis of the economic impact and influence on quality of life. Injury. 2021;52:3344-9.
9. Specchia ML, Frisicale EM, Carini E, Di Pilla A, Cappa D, Barbara A, et al. The impact of tumor board on cancer care: evidence from an umbrella review. BMC Health Serv Res. 2020;20:73.
10. Ferry T, Seng P, Mainard D, Jenny JY, Laurent F, Senneville E, et al. The CRIOAc healthcare network in France: A nationwide Health Ministry program to improve the management of bone and joint infection. Orthop Traumatol Surg Res. 2019;105:185-90.
11. Zijlstra WP, Ploegmakers JJ, Kampinga GA, Toren-Wielema ML, Ettema HB, Knobben BAS, et al. A protocol for periprosthetic joint

infections from the Northern Infection Network for Joint Arthroplasty (NINJA) in the Netherlands. Arthroplasty. 2022;4:19.

12. Carlson VR, Dekeyser GJ, Certain L, Pupaibool J, Gililland JM, Anderson LA. Clinical Experience With a Coordinated Multidisciplinary Approach to Treating Prosthetic Joint Infection. Arthroplast Today. 2020;6:360-2.
13. Sambri A, Fiore M, Tedeschi S, De Paolis M. The Need for Multidisciplinarity in Modern Medicine: An Insight into Orthopaedic Infections. Microorganisms. 2022:31;10.
14. McNally M, Sousa R, Wouthuyzen-Bakker M, Chen AF, Soriano A, Vogely HC, et al. The EBJIS definition of periprosthetic joint infection. Bone Joint J. 2021;103-B:18-25.
15. Metsemakers WJ, Morgenstern M, McNally MA, Moriarty TF, McFadyen I, Scarborough M, et al. Fracture-related infection: A consensus on definition from an international expert group. Injury. 2018;49:505-10.
16. Jenkins N, Hughes H. How I do it.... How infection doctors approach the PJI MDT. Knee. 2020;27:1994-7.
17. Laurent E, Lemaignen A, Gras G, Druon J, Fevre K, Abgueguen P, et al. Multidisciplinary team meeting for complex bone and joint infections diagnosis: The PHICTOS study. Rev Epidemiol Sante Publique. 2019;67:149-54.
18. England N. 2013/14 NHS Standard contract for bone and joint infection service specification (adult) section b part 1 - service specifications. 2013 [14 Jan 2023]; Available from: https://www.england.nhs.uk/wp-content/uploads/2017/04/b07-bone-joint-infec.pdf.
19. Ferreira L, Pos E, Nogueira DR, Ferreira FP, Sousa R, Abreu MA. Antibiotics with antibiofilm activity - rifampicin and beyond. Front Microbiol. 2024;15:1435720. doi: 10.3389/fmicb.2024.1435720.
20. Bauer S, Bouldouyre MA, Oufella A, Palmari P, Bakir R, Fabreguettes A, et al. Impact of a multidisciplinary staff meeting on the quality of antibiotherapy prescription for bone and joint infections in orthopedic surgery. Med Mal Infect. 2012;42:603-7.
21. Santos Silva M, Sousa A, Rodrigues C, Serrano P, Sousa R. Determinants of sucess in the treatment of prosthesic joint infection with debridement, antibiotics and implant retention. Acta Orthop Belgica. 2021;87 e-supplement 1:123-9.
22. Sousa R, Carvalho A, Santos AC, Abreu MA. Optimal microbiological sampling for the diagnosis of osteoarticular infection. EFORT Open Rev. 2021;6:390-8.
23. Bose D, Kugan R, Stubbs D, McNally M. Management of infected nonunion of the long bones by a multidisciplinary team. Bone Joint J. 2015;97-B:814-7.
24. Akgun D, Muller M, Perka C, Winkler T. High cure rate of periprosthetic hip joint infection with multidisciplinary team approach using standardized two-stage exchange. J Orthop Surg Res. 2019;14:78.
25. Dias Carvalho A, Ribau A, Soares D, Santos AC, Abreu M, Sousa R. Combined antibiotic therapy spacers either commercial or handmade are superior to monotherapy - a microbiological analysis at the second stage of revision. J Bone Jt Infect. 2021;6:305-12.
26. Sanidad Md. [26. Tratamientos de las infecciones osteoarticulares resistentes H]. [updated 26/09/202114/01/2023]; Available from: https://www.mscbs.gob.es/profesionales/CentrosDeReferencia/docs/Fesp/ Fesp26.pdf.
27. van Sloten M, Gomez-Junyent J, Ferry T, Rossi N, Petersdorf S, Lange J, et al. Should all patients with a culture-negative periprosthetic joint infection be treated with antibiotics? : a multicentre observational study. Bone JointJ. 2022;104-B:183-8.
28. Shohat N, Goswami K, Tan TL, Yayac M, Soriano A, Sousa R, et al. 2020 Frank Stinchfield Award: Identifying who will fail following irrigation and debridement for prosthetic joint infection. Bone Joint J. 2020;102-B:11-9.
29. Lowik CA, Parvizi J, Jutte PC, Zijlstra WP, Knobben BA, Xu C, et al. Debridement, antibiotics and implant retention is a viable treatment option for early periprosthetic joint infection presenting more than four weeks after index arthroplasty. Clin Infect Dis. 2020;71:630-6. doi: 10.1093/cid/ciz867.
30. Beldman M, Lowik C, Soriano A, Albiach L, Zijlstra WP, Knobben BAS, et al. If, when, and how to use rifampin in acute staphylococcal periprosthetic joint infections, a multicentre observational study. Clin Infect Dis. 2021;73:1634-41. doi: 10.1093/cid/ciab426. Erratum in: Clin Infect Dis. 2022;74:1890. doi: 10.1093/cid/ciac149.
31. Barros LH, Barbosa TA, Esteves J, Abreu M, Soares D, Sousa R. Early Debridement, antibiotics and implant retention (DAIR) in patients with suspected acute infection after hip or knee arthroplasty - safe, effective and without negative functional impact. J Bone Jt Infect. 2019;4:300-5.
32. Sousa R, Silva M, Sousa A, Esteves J, Neves P, Seabra-Lopes J, et al. Tratamento de Infeções Protésicas com Desbridamento e Preservação do Implante – resultados da aplicação prospetiva de um protocolo pré-estabelecido. Rev Port Ortop Traumatol. 2017;25:16-27.
33. Sousa R, Esteves J, Sousa A, Silva M, Ramos J, Lopes S, et al. Tratamento de Infeções Protésicas com Cirurgia de Revisão a Dois Tempos - resultados de um estudo prospetivo com abordagem protocolada. Rev Port Ortop Trauma. 2017;25.
34. Cipriano A, Santos FV, Dias R, Carvalho A, Reis E, Pereira C, et al. Adult Native Joint Septic Arthritis: A Nine-Year Retrospective Analysis in a Portuguese University Hospital. Acta Med Port. 2021;34:826-32. doi: 10.20344/amp.12998.
35. Ravn C, Neyt J, Benito N, Abreu MA, Achermann Y, Bozhkova S, et al. Guideline for management of septic arthritis in native joints (SANJO). J Bone Jt Infect. 2023;8:29-37.
36. Ribau AI, Collins JE, Chen AF, Sousa RJ. Is Preoperative Staphylococcus aureus Screening and Decolonization Effective at Reducing Surgical Site Infection in Patients Undergoing Orthopedic Surgery? A Systematic Review and Meta-Analysis With a Special Focus on Elective Total Joint Arthroplasty. J Arthroplasty. 2021;36:752-66 e6.
37. Sousa RJ, Abreu MA, Wouthuyzen-Bakker M, Soriano AV. Is Routine Urinary Screening Indicated Prior To Elective Total Joint Arthroplasty? A Systematic Review and Meta-Analysis. J Arthroplasty. 2019;34:1523-30. doi: 10.1016/j.arth.2019.03.034.
38. Sousa R, Barreira P, Leite P, Santos AC, Ramos MH, Oliveira A. Preoperative Staphylococcus aureus Screening/Decolonization Protocol Before Total Joint Arthroplasty-Results of a Small Prospective Randomized Trial. J Arthroplasty. 2016;31:234-9.
39. Sousa R, Munoz-Mahamud E, Quayle J, Dias da Costa L, Casals C, Scott P, et al. Is asymptomatic bacteriuria a risk factor for prosthetic joint infection? Clin Infect Dis. 2014 ;59:41-7. doi: 10.1093/cid/ciu235.
40. Neves P, Fonte H, Barreira P, Pinto A, Santos AC, Araújo Abreu M, et al. Adequate Microbiological Intraoperative Investigation in Prosthetic Joint Infections - reflexions on our experience with an emphasis on implant sonication. Rev Port Ortop Traumatol. 2020;28:207-17.
41. Vale JS, Castelo FS, Barros BS, Ribau AC, Carvalho AD, Sousa RJ. Synovial Fluid Biomarkers for the Diagnosis of Periprosthetic Joint Infection-A Systematic Review and Meta-Analysis of Their Diagnostic Accuracy According to Different Definitions. J Arthroplasty. 2023;38:2731-2738.e3. doi: 10.1016/j.arth.2023.06.017.
42. Diniz SE, Ribau A, Vinha A, Oliveira JC, Abreu MA, Sousa R. Simple and inexpensive synovial fluid biomarkers for the diagnosis of prosthetic joint infection according to the new EBJIS definition. J Bone Jt Infect. 2023;8:109-18.
43. Shohat N, Bauer T, Buttaro M, Budhiparama N, Cashman J, Della Valle CJ, et al. Hip and Knee Section, What is the Definition of a Periprosthetic Joint Infection (PJI) of the Knee and the Hip? Can the Same Criteria be Used for Both Joints?: Proceedings of International Consensus on Orthopedic Infections. J Arthroplasty. 2019;34:S325-S7.
44. Sousa R, Ribau A, Alfaro P, Burch MA, Ploegmakers J, McNally M, et al. The European Bone and Joint Infection Society definition of periprosthetic joint infection is meaningful in clinical practice: a multicentric validation study with comparison with previous definitions. Acta Orthop. 2023;94:8-18.
45. McNally M, Sigmund I, Hotchen A, Sousa R. Making the diagnosis in prosthetic joint infection: a European view. EFORT Open Rev. 2023;8:253-63.