G96: Should implant associated orthopedic infections be treated in specialized centers?

Juan D Lizcano, Efrain Diaz-Borjon, Ruben Alejandro Morales, Jesse Wolfstadt, Phillippe Boisrenault, Panayiotis J. Papagelopoulos, Tulio Campos, Brian A Klatt, Angela Hewlett, Carlos Higuera-Rueda.

Response/Recommendation:
Treating implant-associated orthopedic infections in specialized centers with a dedicated multidisciplinary services could potentially lead to improved clinical outcomes, antibiotic therapy compliance and lower reinfection rates

Level of Evidence: Limited

Delegate Vote:

Rationale:

While the incidence of hip and knee periprosthetic joint infection (PJI) remains stable, its prevalence continues to rise due to the increasing volume of primary procedures being performed [1–3]. For this reason, adopting new strategies to improve and streamline infection control and quality of life outcomes is imperative. Due to the high disease burden and treatment failure rates, patients often require comprehensive and specialized medical treatment, similar to oncology patients [4–8]. Consequently, various referral centers for PJI have transitioned to centralized patient care through a multidisciplinary approach, aiming to become specialized centers for PJI treatment. While there is no universal definition for these specialized centers, they are typically characterized by the following elements: 1) available surgeon and nursing staff specialized in PJI cases, 2) at least one infectious disease (ID) specialist and plastic surgeon (PS), 3) multidisciplinary meetings, academic discussions and case conferences, 4) combined orthopedic and ID clinics, 5) standardized antibiotic protocols, 6) elective surgery with fast-track protocols, 7) communication with smaller centers, and 8) patient-reported outcomes collection [9]. We performed a literature review and found that 11/289 articles matched the previous description for specialized centers.

An example of specialized centers are the network of referral centers for bone and joint infections (BJI) used to treat osteomyelitis and septic arthritis [10]. Besnard et al. described a reduction of failure rates 42.9% to 11.8% ($p = 0.03$) of arthroscopic treatment of septic knee and shoulder arthritis, after the implementation of a BJI center with a multidisciplinary team of orthopedic surgeons and ID specialists [11]. However, the use of multidisciplinary teams extends beyond the management of osteomyelitis and native septic arthritis, proving equally valuable in the treatment of implant-associated orthopedic infections. Vuorinen et al described the outcomes of PJI patients at a single hospital after the implementation of a multidisciplinary team with ID and PS specialists. They reported a 36.2% ($p=0.004$) decrease in two-stage procedures, 46.8% ($p<0.001$) increase in DAIR procedures, and an increase in DAIR success rates from 55.6% to 85.2% ($p=0.077$) [12]. One way to ensure a multidisciplinary approach is through weekly conferences with physicians from other surgical and non-surgical specialties involved in patient care. Bidle et al. explored the effect of implementing multidisciplinary weekly meetings with ID

specialists and microbiologists. They found that in the post-intervention cohort, the mean time to microbiology advice decreased by 5 days ($p<0.001$) and failure rates decreased from 41.4% to 3.45% ($p<0.001$) [13]. These findings align with the ones reported by Ntalos et al. who found that holding a weekly infection conference with a pathologist and microbiologist to discuss operative treatment and postoperative course, led to a decrease in the mean length of stay (62±43 days vs 29±14 days, $p<0.001$) as well and decreased number of surgical procedures (5.1±4.3 vs 1.8 ±1, $p<0.001$) and mean number of antibiotics administered (4.2±2 vs 2.8±1.2, $p=0.008$) [14]. Likewise, Bauer et al found that a weekly meeting with ID specialist, microbiologist and pharmacist led to a more accurate antibiotic therapy selection and length, based on antibiogram results ($p<0.005$), but no significant differences in reinfection rates (pre-intervention 25% vs 18% post-intervention, $p=0.75$) [15].

Moreover, combined orthopedics and ID clinics could help centralize patient care, decreasing treatment fragmentation. In the study by Carlson et. al, implementing a combined ID and arthroplasty clinic led to a decrease in the incidence of missed ID appointments from 40.6% (3/32) to 25% (3/24) [16]. In a similar study, Karczewski et al studied the impact in patient outcomes after establishing an interdisciplinary service specialized in PJI, composed by an orthopedic, microbiology and pathology teams. They found that, using a standardized treatment protocol, a significant decrease in the time between staged procedures (66.6 vs 80.7 days, $p<0.001$) and reinfection rates (3.1% vs 10.4%, $p = 0.048$) was achieved [17]. One relevant benefit of a PJI referral center is the prevention of treatment fragmentation, which has been associated with worse postoperative outcomes. Garceau et al. compared the outcomes of two-stage exchange arthroplasty procedures who had both surgeries performed at one center to patients explanted at a general orthopedic hospital and transferred to a specialized center during the interstage period for reimplantation. They found that patients who received continued care had lower rates of recurrent infection (53.6% vs 13.4%; $p < 0.001$), and soft tissue complications (31.3 vs 14.3%; $p = 0.030$) compared to their counterparts[18]. Of note, the aforementioned studies represent retrospective cohorts with a before-after design, rather than a prospective comparative design, which limits the generalizability of their findings. Although the use of regional and national hospital networks for treating PJI appears promising (**Table 1**), the current literature consists primarily of descriptive studies without any comparison groups for reference. [19–22].

The low number of studies surrounding this topic could be explained by the lack of a standardized definition for specialized centers, as many institutions might have a dedicated BJI or PJI units. Anticipating the increase in PJI-related scientific literature, we encourage researchers to describe the institution characteristics and interdisciplinary collaborations, to achieve a more objective measurement of the impact of specialized centers for PJI.

Conclusion: Treating implant-associated orthopedic infections in specialized centers with a dedicated PJI service could potentially lead to improved clinical outcomes, antibiotic therapy compliance and lower reinfection rates.

References:

1. American Joint Replacement Registry (AJRR). *2023 Anual Report*. American Academy of Orthopaedic Surgeons (AAOS); :1-121. Accessed July 23, 2024. https://connect.registryapps.net/2023-ajrr-annual-report

2. Sharkey PF, Lichstein PM, Shen C, Tokarski AT, Parvizi J. Why Are Total Knee Arthroplasties Failing Today—Has Anything Changed After 10 Years? *The Journal of Arthroplasty*. 2014;29(9):1774-1778. doi:10.1016/j.arth.2013.07.024

3. Sloan M, Premkumar A, Sheth NP. Projected Volume of Primary Total Joint Arthroplasty in the U.S., 2014 to 2030. *J Bone Joint Surg Am*. 2018;100(17):1455-1460. doi:10.2106/JBJS.17.01617

4. Chao R, Rothenberger SD, Plate JF, Klatt BA, Shah NB, Urish KL. Treatment Failure Rates Significantly Decrease at One and Five Years After Debridement, Antibiotics, and Implant Retention for Acute Periprosthetic Joint Infection in Total Knee Arthroplasty: A 10 Year Cohort Study. *The Journal of Arthroplasty*. Published online November 2024:S0883540324009112. doi:10.1016/j.arth.2024.08.048

5. Sutton `Ryan, Lizcano JD, Fraval A, Wiafe B, Courtney PM, Brown S. Comparable Results of Single and Two-Stage Exchange for Select Periprosthetic Hip and Knee Infection. *J Am Acad Orthop Surg*. Published online May 29, 2024. doi:10.5435/JAAOS-D-24-00013

6. Xu Y, Huang TB, Schuetz MA, Choong PFM. Mortality, patient-reported outcome measures, and the health economic burden of prosthetic joint infection. *EFORT Open Rev*. 2023;8(9):690-697. doi:10.1530/EOR-23-0078

7. Xu C, Goswami K, Li WT, et al. Is Treatment of Periprosthetic Joint Infection Improving Over Time? *The Journal of Arthroplasty*. 2020;35(6):1696-1702.e1. doi:10.1016/j.arth.2020.01.080

8. Dietz MJ, Springer BD, Barnes PD, et al. Best Practices for Centers of Excellence in Addressing Periprosthetic Joint Infection: *Journal of the American Academy of Orthopaedic Surgeons*. 2015;23:S12-S17. doi:10.5435/JAAOS-D-14-00380

9. Lizcano JD, Dietz MJ, Fehring TK, Mont MA, Higuera-Rueda CA. Specialized Centers for Treating Periprosthetic Joint Infections: Is It About Time? *The Journal of Arthroplasty*. 2024;39(12):2893-2897. doi:10.1016/j.arth.2024.09.021

10. Ferguson J, Alexander M, Bruce S, O'Connell M, Beecroft S, McNally M. A retrospective cohort study comparing clinical outcomes and healthcare resource utilisation in patients undergoing surgery for osteomyelitis in England: a case for reorganising orthopaedic infection services. *J Bone Joint Infect*. 2021;6(5):151-163. doi:10.5194/jbji-6-151-2021

11. Besnard M, Babusiaux D, Garaud P, et al. Impact of setting up a bone and joint infection referral center on arthroscopic treatment of septic arthritis of the knee and shoulder: Retrospective study. *Orthopaedics & Traumatology: Surgery & Research*. 2018;104(8):1265-1269. doi:10.1016/j.otsr.2018.08.006

12. Vuorinen M, Mäkinen T, Rantasalo M, Huotari K. Effect of a multidisciplinary team on the treatment of hip and knee prosthetic joint infections: a single-centre study of 154 infections. *Infectious Diseases*. 2021;53(9):700-706. doi:10.1080/23744235.2021.1925341

13. Biddle M, Kennedy JW, Wright PM, Ritchie ND, Meek RMD, Rooney BP. Improving outcomes in acute and chronic periprosthetic hip and knee joint infection with a multidisciplinary approach. *Bone & Joint Open*. 2021;2(7):509-514. doi:10.1302/2633-1462.27.BJO-2021-0064.R1

14. Ntalos D, Berger-Groch J, Rohde H, et al. Implementation of a multidisciplinary infections conference affects the treatment plan in prosthetic joint infections of the hip: a retrospective study. *Arch Orthop Trauma Surg*. 2019;139(4):467-473. doi:10.1007/s00402-018-3079-6

15. Bauer S, Bouldouyre MA, Oufella A, et al. Impact of a multidisciplinary staff meeting on the quality of antibiotherapy prescription for bone and joint infections in orthopedic surgery. *Médecine et Maladies Infectieuses*. 2012;42(12):603-607. doi:10.1016/j.medmal.2012.09.005

16. Carlson VR, Dekeyser GJ, Certain L, Pupaibool J, Gililland JM, Anderson LA. Clinical Experience With a Coordinated Multidisciplinary Approach to Treating Prosthetic Joint Infection. *Arthroplasty Today*. 2020;6(3):360-362. doi:10.1016/j.artd.2020.05.003

17. Karczewski D, Winkler T, Renz N, et al. A standardized interdisciplinary algorithm for the treatment of prosthetic joint infections: outcome in a centralized and specialized department. *The Bone & Joint Journal*. 2019;101-B(2):132-139. doi:10.1302/0301-620X.101B2.BJJ-2018-1056.R1

18. Garceau S, Warschawski Y, Dahduli O, Alshaygy I, Wolfstadt J, Backstein D. The effect of patient institutional transfer during the interstage period of two-stage treatment for prosthetic knee infection. *The Bone & Joint Journal*. 2019;101-B(9):1087-1092. doi:10.1302/0301-620X.101B9.BJJ-2019-0279.R1

19. Kamp MC, Van RWTM, Janssen L, Van MC (Marieke). First results of a uniform regional treatment protocol and registration for acute prosthetic join infection in the South-East of the Netherlands. *J Bone Joint Infect*. 2019;4(3):133-139. doi:10.7150/jbji.33039

20. Zijlstra WP, Ploegmakers JJW, Kampinga GA, et al. A protocol for periprosthetic joint infections from the Northern Infection Network for Joint Arthroplasty (NINJA) in the Netherlands. *Arthroplasty*. 2022;4(1):19. doi:10.1186/s42836-022-00116-9

21. Ferry T, Seng P, Mainard D, et al. The CRIOAc healthcare network in France: A nationwide Health Ministry program to improve the management of bone and joint infection. *Orthopaedics & Traumatology: Surgery & Research*. 2019;105(1):185-190. doi:10.1016/j.otsr.2018.09.016

22. Dombrowky A, Jolissaint J, Posey SL, et al. Regional Periprosthetic Joint Infection Centers: The Time Has Come for a Paradigm Change in the Treatment of Periprosthetic Joint

Infection. *The Journal of Arthroplasty*. Published online July 31, 2024. doi:10.1016/j.arth.2024.07.034

Table 1. Regional and national hospital networks for treating PJI

Author	Year	Country	Intervention	Population	Results/Outcomes
Kamp [18]	2019	Netherlands	Combined diagnostic and treatment protocol for acute PJI (DAIR) in nine regional hospitals.	Patients undergoing DAIR for acute PJI N=236	87% Success rate at one year and 3% mortality within the first year. Better adherence to regional protocol over time.
Zijlstra [19]	2022	Netherlands	Northern Infection Network for Joint Arthroplasty (NINJA). Development of mutual diagnostic and treatment protocol for PJI across four hospitals.	N/A	Descriptive study describing the treatment protocol used in such centers.
Ferry [20]	2019	France	Bone and joint infections national network. 9 main centers (CRIOAcs) and 15 corresponding centers.	N/A	Study describes the characteristics of a national BJI network, which has allowed for the creation of PJI-focused academic programs and research.
Dombrowsky [21]	2024	USA	Regional referral center for the treatment of PJI.	Chronic PJI patients referred from external institution undergoing two-stage exchange. N=182	3.9% one-year mortality rate. 90% of the patients were successfully reimplanted. Patients referred >90 days after the diagnosis of chronic PJI have higher failure rates.