

# Clinical Faceoff

## Clinical Faceoff: One- Versus Two-Stage Exchange Arthroplasty for Prosthetic Joint Infections

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The treatment of chronic prosthetic joint infections (PJI) remains controversial. In

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North America, the preferred surgical treatment is the two-stage exchange arthroplasty. However, in Europe, the single-stage approach is favored.

For this *Clinical Faceoff*, I have invited experts who represent different viewpoints of these two philosophies. Daniel Kendoff MD, and Thorsten Gehrke MD, practice one-stage exchange arthroplasty at the HELIOS ENDO-Klinik Hamburg in Germany. The proponents of two-stage surgery are both past presidents of the North American Musculoskeletal Infection Society. Elie Berbari MD, is an infectious disease specialist at the Mayo Clinic in Rochester, Minnesota, USA, and Arvind Nana MD, is an orthopaedic surgeon at University of North Texas Health Science Center in Fort Worth, Texas, USA. To explore this controversy, we will begin by exploring one-stage reconstruction.

**Montri Wongworawat MD:** *What are the advantages of single-stage direct exchange for PJI?*

**Daniel Kendoff MD and Thorsten Gehrke MD:** The two-staged exchange for PJI has become the gold standard worldwide; but based on the first implementation of mixing antibiotics into

bone cement by Professor Buchholz in the 1970s, the ENDO-Klinik uses a single-stage exchange approach for PJI in more than 85% of all our infected cases. The major potential advantage of a cemented one-stage exchange concept is the need for only one operative procedure. This offers decreased cumulative perioperative risk, decreased functional impairment, financial benefits, shorter hospital stay, and shorter systemic antibiotic administration. However, diligent removal of all hardware, cement and cement stopper, and aggressive debridement of all affected soft tissues is mandatory for this technique. Since neither spacer placement nor immobilization is required in the one-stage scenario, patients experience improved outcomes.

**Dr. Wongworawat:** *Drs. Berbari and Nana, with the advantages offered by the one-stage exchange, why perform two-stage reconstruction?*

**Elie Berbari MD and Arvind Nana MD:** One-stage exchange surgery for PJI caused by a low virulence organism in patients with a healthy soft tissue envelope has been offered as a more cost-effective therapeutic approach when compared with two-stage exchange [9]. This procedure is felt to positively

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“modulate” the local immune response so that it is not overwhelmed by any residual infection, and is the preferred approach for PJI in some European orthopaedic centers. This strategy is associated with a 73% to 100% success rate [10, 11]. These data are derived from single-center retrospective cohorts [10], and these studies often lack sufficient followup or a standardized definition of treatment failure. In addition, an important element of the one-stage revision in many of these studies is the use of antimicrobial-loaded cemented reconstruction at the time of reimplantation. The use of cementless revision implants in one-stage surgery might be associated with an increase in the risk of infection recurrence. Given the lack of randomized clinical trials and experience with one-stage exchange surgery, we believe two-stage reconstruction will continue to be the preferred treatment for PJI management in this country.

**Dr. Wongworawat:** *What do you think about the concerns raised by Drs. Nana and Berbari regarding the lack of randomized clinical trials and sufficient followup to determine recurrence risk? Are these real concerns?*

**Drs. Kendoff and Gehrke:** Indeed, the overall number of studies evaluating the one-stage exchange is relatively low. Although so far, there have been no prospective studies comparing the two approaches to prove superiority, there is evidence that the one-stage exchange

has slightly better success when compared with two-stage exchange, as seen in the register from Norway with more than 700 patients [4]; there even are data the United States describing successful results with one-stage surgery [3]. However, we agree that more one-stage surgeries are performed in Europe. Our experience has not confirmed the idea that reinfection occurs in the setting of cemented implants. The keys remain extensive and complete débridement of the osseous bed. A strict philosophy of avoiding cemented revision implants presents an understandable but subjective reason against the one-stage procedure in the United States.

**Drs. Berbari and Nana:** Issues related to the use of cemented or cementless prosthesis are complex. Some might be related to the preference and experience of the surgeon, transactional versus total cost, presence of bone loss, and the ability to revise, repair, or salvage the prosthesis in the future. Several studies have reported on the excellent long-term outcome of cementless implants [1, 5, 6]. We particularly recommend cemented long stems in patients with limited bone loss, and in older patients. However, patients with infected revisions tend to be younger and have significant bone loss, and deformity often is present in infected revision surgery. Modern cementless implants allow more options in these difficult femoral reconstructions.

**Dr. Wongworawat:** *What other factors play into decision-making and surgeon choice, and where is the evidence leading us?*

**Drs. Kendoff and Gehrke:** There seems to be more and more clinical evidence from the United States showing a relative lower success rates (< 75%) in terms of infection control in multidrug-resistant and culture-negative PJI, especially in the knee [7, 8]. Furthermore one current report from the United States describes a high risk of associated mortality (7%) in the two-stage approach for PJI of the hip, with many deaths occurring even before the point of reimplantation [2].

**Drs. Berbari and Nana:** There are inherent advantages and disadvantages to single-stage and two-stage approaches to PJI [9]. Furthermore with either approach, it is fair to assume that consistent and reproducible 95% success of treatment will not be achieved anytime soon. Although we often focus on infection eradication and on the type of reconstructive procedure, social and patient characteristics have affected decision making. The Internet, direct-to-consumer marketing, surgeon perception, geographic proximity to referral centers and to family, and the legal environment all affect patients' choices. Perceived and actual risk exposure, payment method, training, and legal implications can alter the options that a surgeon may present to a patient.

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**Dr. Wongworawat:** *How do we chart the future direction beyond geographic preferences for optimal treatment of PJI?*

**Drs. Kendoff and Gehrke:** Limited surgical experience of cementing in general is an understandable but subjective reason against a one-stage procedure. A general limitation based on geographic preferences between Europe and the United States might be overcome by collaborative prospective comparative studies between the continents.

**Drs. Berbari and Nana:** We agree with Drs. Kendoff and Gehrke that large, multicenter studies are needed to evaluate outcomes and assess optimal strategies for management of patients with PJI. The use of multicenter randomized clinical trials and prospective, multicenter, observational cohorts is warranted. Education and training associated with optimal use of single-stage exchange are needed in the United States to achieve acceptance of this strategy.

**Dr. Wongworawat:** Success or failure of treatment often is analyzed by the outcome of infection arrest. However, a more comprehensive approach would include evaluation of other possible outcomes. Such a study was published by Wolf et al. in 2011, using Markov expected-utility decision analysis to compare single- and two-stage revision THA infections [12]. Thorough analysis involved evaluating outcome utilities,

such as avoidance of recovery between operations, lower infection rate, and decreased risk of death. While analysis of pooled data sets showed that two-stage exchange gave a greater chance of infection control, it also produced a higher probability of death. In this theoretical model, primary exchange arthroplasty was favored over two-stage reconstruction. Higher-level studies are needed to improve our understanding, as Wolf et al. remind us that outcomes research may need to be more comprehensive than simply evaluating infection arrest. Other utility parameters, risks, and benefits should be studied in any future randomized controlled trials.

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