

HK59: Are there any absolute contraindications to performing one stage exchange arthroplasty for patients with chronic periprosthetic joint infection (PJI)?

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Response/Recommendation:

No. We do not feel that there are any absolute contraindications to one-stage exchange arthroplasty. However, relative contraindications may include signs of systemic sepsis, severely immunocompromised status, and extensive soft tissue defects that compromise primary wound closure.

Level of Evidence: Low

Delegate Vote:

Rationale:

The reasonable indications and contraindications for one-stage exchange arthroplasty have long been at the center of debate, particularly as recent evidence increasingly supports its comparable infection control rates to two-stage revision, along with the benefits of reduced patient morbidity, improved functional outcomes, and lower costs [1-3]. Since Professor Buchholz first introduced the concept of one-stage exchange arthroplasty in 1981[4], strict patient selection has consistently been regarded as a critical prerequisite for achieving excellent outcomes [5]. According to the 2018 International Consensus Meeting (ICM) on orthopedic infections, "In patients with signs of systemic sepsis, extensive comorbidities, infection with resistant organisms, culture-negative infections, and poor soft tissue coverage, one-stage exchange arthroplasty may not be a good option." This recommendation received a 93% agreement rate, reflecting a high level of consensus [6]. Following a thorough search of articles published after 2018 that explicitly outlined contraindications for one-stage revision, we identified that systemic sepsis and poor soft tissue coverage, though not directly supported by clinical studies, have been widely acknowledged across regions based on the inherent "2-in-1" characteristics of one-stage exchange arthroplasty (Table 1). In contrast, the other three factors—extensive comorbidities, culture-negative infections and infection with resistant organisms—have been subject to validation or questioned by various studies over the past few years.

Conducting randomized controlled trials (RCTs) to evaluate contraindications for one-stage exchange arthroplasty is inherently challenging due to practical and ethical constraints. Therefore, most studies are retrospective with mid-term follow-up. Despite their limitations, they provide valuable insights, and our conclusions are derived from a combination of these studies and systematic reviews that synthesize the available evidence.

The overall health status of the host is a crucial factor in determining the success of treating PJI. Ji et al. [15] reported a small series of 17 immunocompromised patients who underwent one-stage revision, achieving infection eradication in only 8 cases (47%) over a mean follow-up of 68 months. Both patients with recurrent infections exhibited severe immunosuppression with extensive comorbidities. Similarly, Wolf et al. [16] found poor infection eradication rates for one-stage revision in compromised patients (McPherson type B + C), with eradication rates of 33% compared to 95%

for two-stage revision. Comparable outcomes were observed in patients with significant local soft tissue and bone compromise (McPherson Grade 3), with eradication rates of 0% for one-stage versus 95% for two-stage revision. Although the ENDO-Klinik team recently reported that the MSIS stage of host status and limb status were not significantly associated with re-infection after repeated one-stage revisions [17,18], it is important to interpret these findings cautiously. The MSIS classification may perform more reliably for first-time revisions for infection, whereas in cases where the infection has not been controlled, there is an inherent selection bias towards sicker patients. These "fragile" patients often have a limited life expectancy and lower functional demands for their limbs. Therefore, the goals of PJI treatment in such patients may prioritize their preferences and focus more on disease control rather than complete eradication.

Identifying the pathogen preoperatively is critical for the success of one-stage exchange arthroplasty. However, in some highly specialized hospitals where a tried, effective PJI management protocol has been established with comprehensive antibiotic options, the traditional contraindication of "culture-negative PJI" appears to be less absolute. Van den Kieboom J et al. [19] compared the outcomes of 105 patients with chronic culture-negative PJI and found no significant differences in treatment failure rates for reinfection between one-stage and two-stage revision (16.7% vs. 20%) (Table 2). Ji et al. [20] reported a 90.2% infection control rate in 51 culture-negative PJI patients after one-stage revision, with a mean follow-up of 4.4 years, showing no significant difference from culture-positive patients. Similarly, Greenfield BJ et al. [21] found no significant difference in reinfection rates between patients with identified pathogens (3.6%) and those without (9.1%) after one-stage hip revision. Another study from Charite Hospital has confirmed these findings, noting no significant differences in demographics between culture-negative and culture-positive PJI patients, with only one culture-positive reinfection after a 2-year follow-up [9]. The ENDO-Klinik team, pioneers of one-stage revision, reported a 90.9% infection control rate in 22 culture-negative patients after one-stage revision with a 3.6-year follow-up, concluding that "the absence of pre-operative pathogen detection may not be a contraindication to one-stage revision in selected patients." [22]

Antibiotic-resistant organisms represent another critical consideration for one-stage revision. Interestingly, only the 2018 ICM included resistant organisms as a contraindication, while major one-stage revision centers worldwide do not consider it a contraindication (Table 1). A meta-analysis of 1,856 PJI cases from 44 cohorts found MRSA in 20% of one-stage patients versus 10% in two-stage. Reinfection rates per 1,000 person-years were lower for one-stage (16.8) than two-stage (32.3) [23]. The longest follow-up study on one-stage revision reported that 49.5% of patients had antibiotic-resistant pathogens. With a minimum follow-up of 10 years, the infection-free survival rate was 94% [24]. Similarly, Ji et al. [25] evaluated 126 patients undergoing one-stage revision with broad inclusion criteria, including 17% infected with MRSA or MRSE, achieving an average 5-year infection control rate of 89.2%.

Taken together, it is important to recognize that not all situations of poor outcomes following one-stage revision should be regarded as contraindications. Certain conditions, such as fungal, *Enterococcus faecium* infections or patients with infected megaprotheses yield suboptimal results regardless of whether a one-stage or two-stage revision is performed. The decision to perform one-stage revision should be based on a comprehensive assessment of the surgeon's experience, hospital resources, and patient-specific factors. While contraindications for one-stage revision do exist, there are no "absolute" contraindications, as the concept of "absolute" cannot be definitively proven in many unique clinical scenarios.

Table 1 Contraindications for one-stage revision published after 2018

Institutes	The time of publish	Contraindications
Endo-Klinik Hamburg, Germany [7]	2024	-Unknown pathogen -Severe soft tissue defects -concurrent sepsis
First Affiliated Hospital of Xinjiang Medical University, China [8]	2022	-Active systemic infection -Infection involving neurovascular bundles and peripheral vascular disease -Severe Immunocompromised host -Severe soft tissue defects
Universitätsmedizin Berlin, Germany [9]	2023	-Severe soft tissue defects -Severe bone defects -Multiple prior revisions for PJI -Concurrent sepsis
University College of London Hospital, United Kingdom [10]	2018	-Unknown pathogen -Concurrent sepsis -Severe immunocompromised host
Hospital of Buenos Aires, Argentina, Buenos Aires, Argentina [11]	2021	-≥1prior revisions for PJI -Antibiotic resistant organism -Sinus tract -Unknown pathogen
2018 ICM[6]	2019	-Systemic sepsis -Extensive comorbidities -Infection with resistant organisms -Unknown pathogen -Severe soft tissue defects
RCT in United States[12]	2023	-Unknown pathogen -Severe soft tissue defects -Immunosuppressed patients
Rothman Orthopaedic Institute, United State [13]	2024	- Severe soft tissue defects -Had PJI history -Extensive bone loss requiring endoprosthesis

RCT in Denmark[14]	2021	-Severe soft tissue defects -Major bone loss -Concurrent sepsis -Malignant disease with less than 2 years life expectancy -Re-infection after previous two-stage procedure -Bilateral knee infection
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RCT: randomised controlled trial; NA: not available

Table 2: The results from studies published in the past 5 years regarding one-stage revision for culture-negative PJI

Publish year	Comparative group	Number of patients	Follow up time (years)	Infection control rate
2020[20]	Culture negative vs Culture positive	51	4.4	Culture negative: 90.2% vs Culture positive: 94.3%
2021[19]	one-stage vs two-stage for culture negative PJI	105	4.2	one-stage: 83.3% vs two-stage : 80.0%
2021[21]	Culture negative vs Culture positive	77	6	Culture negative: 90.29% vs Culture positive: 96.4%
2022[22]	Culture negative vs Culture positive	30	2	Culture negative:100% vs Culture positive: 96.7%
2023[23]	None	22	3.6	90.90%

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