Treatment Failure Rates Decrease Significantly at Approximately One Year Following Two-Stage Exchange Arthroplasty for Periprosthetic Joint Infection

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INTRODUCTION: Two-stage exchange arthroplasty is the preferred treatment for chronic periprosthetic joint infection (PJI) following total knee arthroplasty (TKA). However, the optimal follow-up period to capture treatment failures remains undefined. Variability in failure definitions complicates interpretation of outcomes, with recent efforts by the Musculoskeletal Infection Society (MSIS) establishing standardized tiered criteria. The optimal follow-up duration is an important clinical element to inform the design of future prospective studies and clinical trials. Moreover, this helps to establish expectations for patients at clinical visits regarding their anticipated clinical course. This study aimed to identify temporal breakpoints in treatment failure following two-stage exchange and to determine a clinically meaningful postoperative monitoring period.

METHODS: We retrospectively evaluated 148 patients (77 female, 71 male) from 16 hospitals who underwent two-stage exchange for chronic TKA PJI (2015–2022). Failures were defined using MSIS Outcome Reporting Tool (Tier 3 or 4). Two models were examined: "Tier 1 failure" (reoperation or prolonged suppressive antibiotics) and "Tier 1+2 failure" (reoperation only). Bayesian regression with Monte Carlo Markov Chain simulation modeled cumulative failure as piecewise functions, identifying statistically significant breakpoints. Single- and double-breakpoint models were compared using deviance information criteria and Bayes factors.

RESULTS: Overall failure rates were 25% at 1 year, 31.1% at 3 years, and 33.1% at 5 years. For Tier 1 failure, a single breakpoint at 1.20 years (95% CI, 1.03-1.47) was associated with a 441% higher failure rate before this mark ($P < 0.001$). A two-breakpoint model identified inflection points at 1.11 and 2.42 years, with failure rates more than seven times higher before 1.11 years compared to after 2.42 years. For Tier 1+2 failure, a single breakpoint was detected at 0.73 years (95% CI, 0.62-1.06), with a nearly tenfold higher failure rate before this point ($P < 0.001$). Single-breakpoint models demonstrated superior fit compared to double-breakpoint models.

DISCUSSION: In this study, most treatment failures for two stage exchange arthroplasties were clustered within the first postoperative year, regardless of failure definition. Additional breakpoints beyond two years were less robust, with limited incremental failure after this period. These findings suggest that close monitoring during the first year captures most clinically relevant failures following two-stage exchange arthroplasty, and that one-year follow-up may be sufficient for prospective studies, clinical trial design, and patient counseling.

SIGNIFICANCE/CLINICAL RELEVANCE: Two-stage exchange arthroplasty for chronic TKA PJI demonstrates the highest risk of failure early, approximately within the first postoperative year after treatment. A standardized follow-up period of one year is both clinically meaningful and practical, with the potential to inform future surveillance protocols, clinical trial design, and resource allocation.

Figure 1. Graphs demonstrating the single breakpoint model (A) and double breakpoint model (B) for Tier 1 Failure.

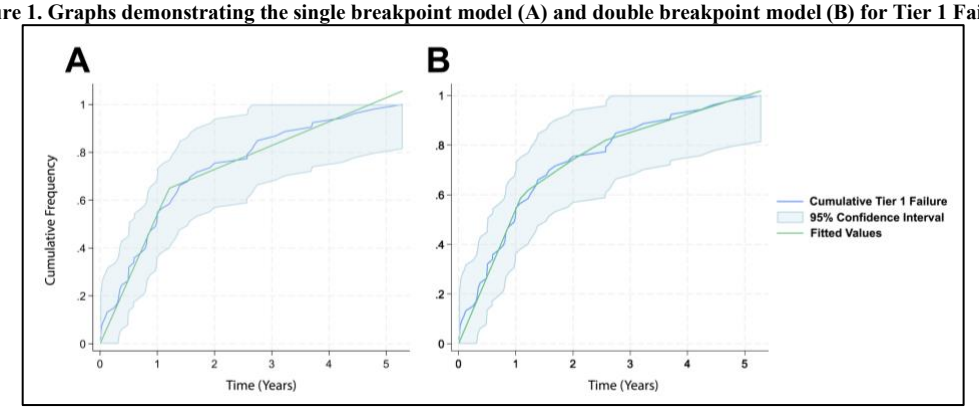

Figure 2. Graphs demonstrating the single breakpoint model (A) and double breakpoint model (B) for Tier 1+2 Failure.