Why Revisions Fail? Risk Factors and Predictors of Reoperation Following Revision Megaprosthetic Reconstruction for Tumors Around the Knee

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Significance & Hypothesis:

Megaprosthetic reconstruction following tumor resection around the knee is prone to a variety of complications. With improved survival rates, patients commonly outlive their implants, resulting in an increased number of revision procedures. However, the survival of the revision implants, particularly the predictors of subsequent reoperation, are not well established. It is hypothesized that initial and revision failure mechanisms predict the risk of reoperation and influence the patient's outcomes.

Innovation:

This study is the first to analyze revisions at multiple time points using event-level analysis stratified based on the reason for initial revision, enabling characterization of revision risk over time and evaluation of risk factors for reoperation following index revision for megaprostheses around the knee performed for oncologic indications.

Approach:

A retrospective study from a longitudinally maintained institutional megaprosthesis database (2004–2025) identified 64 patients who underwent revision of a prior rotating-hinge megaprosthetic reconstruction for tumors around the knee. Patients were stratified by index reconstruction: distal femoral replacement (DFR, n=38), proximal tibial replacement (PTR, n=15), and total femoral replacement (TFR, n=11). Demographic, oncological, and implant data were collected. Indications for index and subsequent revisions were classified based on Henderson classification. The primary outcome was reoperation. Kaplan-Meier survival analysis and univariate Cox proportional hazards regression were used to identify predictors of re-revision, and DFR data were analyzed at the episode level. Reoperation-free survival was compared using the log-rank test, and cumulative incidence of re-revision was estimated with the Aalen-Johansen method with death and amputation as a competing risk. PTR and TFR cohorts were analyzed descriptively due to limited sample size.

Results:

Among 38 DFR patients (mean age 42±21 years, 53% male), 19 (50%) experienced re-revision at a median follow-up of 2.9 years. Seven patients (18.4%) ultimately underwent amputation. Univariate analysis identified BMI (HR 1.08 per kg/m², 95% CI 1.00–1.16, p=0.040), stem diameter (HR 1.63 per mm, 95% CI 1.15–2.30, p=0.006), and Henderson classification (log-rank p=0.031) as significant predictors of index re-revision. Episode-level analysis of 48 DFR episodes with known Henderson classification demonstrated that infection (n=23) was associated with significantly worse failure-free survival compared to mechanical failures (Type 2–3, n=21; p=0.001), with median time to re-revision of 5 months and 24 months, respectively (p=0.038). The one-year cumulative incidence of re-revision was 47.2% for infection and 15.2% for mechanical failures. In the TFR cohort, among initial failures secondary to infection, 83% (5/6) underwent a subsequent revision. The PTR cohort demonstrated a 40% (6/15) primary re-revision rate, with infection accounting for only 20% of index failures. Across all cohorts, infection was the most common indication for re-revision (71%) regardless of the initial indication.

Discussion & Impact:

Periprosthetic infection at any revision stage represents a high-risk group, associated with accelerated implant failure and increased revision burden, and requires careful management and close follow-up. The predominance of infection as the subsequent indication across all classifications suggests that each revision may compound infection risk. Lastly, patient and implant characteristics, including BMI and stem diameter, may contribute to initial revision failure.

Figures/Tables:

Figure 1: Kaplan-Meier curve for re-revision by Henderson type at index revision (DFR).

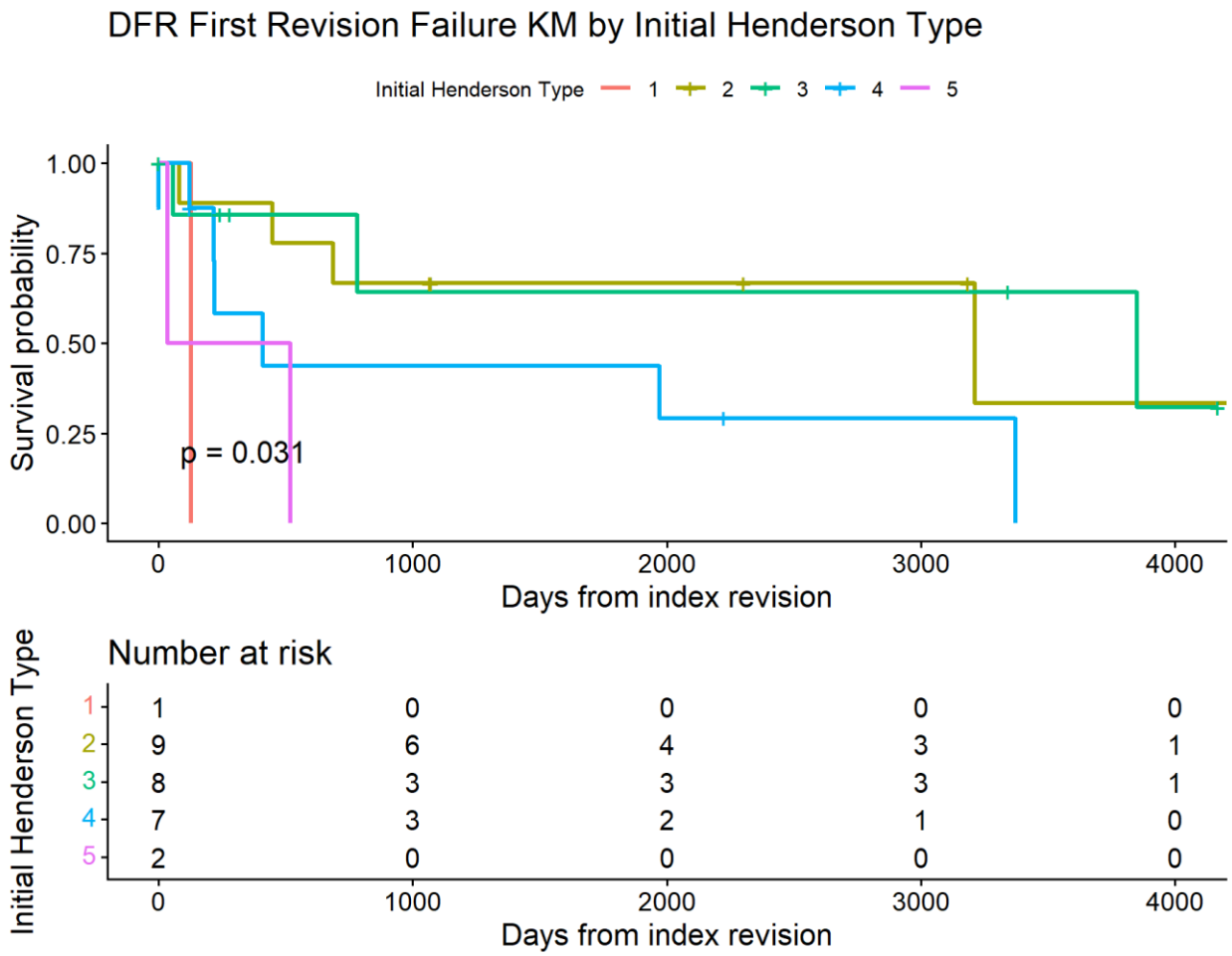

Figure 2: Kaplan-Meier failure-free survival by Henderson classification at each revision episode: Infection (Type 4) vs Mechanical (Type 2–3)

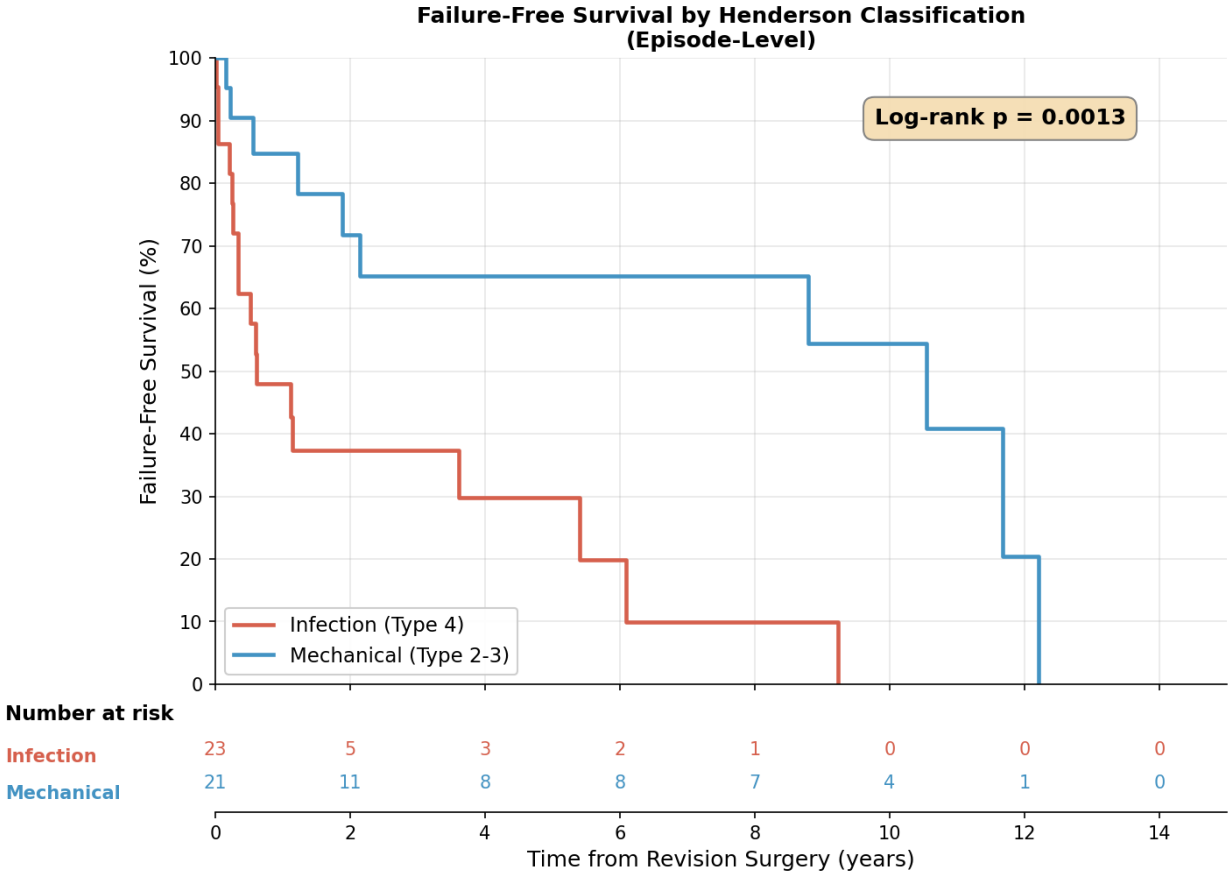

Figure 3: Failure mode transitions between consecutive revisions (n=31 transitions with known Henderson classification at both stages)