Cemented Proximal Tibial Replacements Provide Durable Mid-Term Survival but High Long-Term Failure: A 45-Year Experience

Autreen Golzar, Trevor Lloyd, Christopher D Hamad, Thomas Olson, Min Wook Joo, Michael Fice, Soroush Shahamatdar, Nicholas M Bernthal

INTRODUCTION:

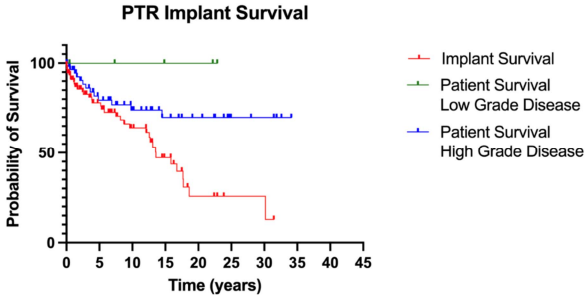
Endoprosthetic proximal tibial replacement (PTR) is a complex limb-salvage procedure requiring extensor mechanism reconstruction and soft tissue coverage. Implant survivorship for oncologic PTR remains generally acceptable in the short to mid-term but significantly declines with extended follow up. Soft tissue complications, particularly extensor mechanism failure, are more frequent in the proximal tibia due to the challenging anatomy and limited soft tissue envelope. Despite the increasing use of PTR and improvements in implant design, long-term outcomes remain poorly characterized due to historically small cohorts and limited follow-up. Moreover, there is a paucity of data evaluating how specific reconstructive techniques, particularly extensor mechanism strategies, impact both implant survival and functional outcomes. We present a 45-year single-institution experience with cemented PTRs to evaluate implant survivorship, characterize failure modes, and identify surgical factors associated with long-term function and mechanical failure.

METHODS:

We retrospectively reviewed 92 cemented PTRs from 1980 to 2023 at a single academic center. Patients who underwent combined distal femur replacement and PTRs were excluded. Tumors were staged using Enneking criteria (11 low-grade, 59 high-grade); patients with metastatic disease were excluded. Data were collected prospectively from operative reports and follow-up examinations. Kaplan–Meier methods estimated implant survival, using any revision surgery as the endpoint. Patients without failure were censored at last follow-up or death. Failures were classified using the Henderson failure mode system.

RESULTS: Overall implant survival at 5, 10, 15, 20, and 30 years was 79.6%, 64.1%, 47.2%, 25.7%, and 12.8%, respectively. The most common failure modes were aseptic loosening (14.1%), followed by structural failure (9.8%), Type 5 (6.5%), infection (4.3%), and soft-tissue failure (2.2%). Patients reconstructed with direct patellar tendon-to-implant fixation followed by gastrocnemius flap coverage had significantly less extensor lag than those reconstructed with flap-first fixation and tendon-to-flap suturing (3.9° vs. 16.5°, p = 0.040).

DISCUSSION AND CONCLUSION: Cemented PTRs offer acceptable mid- to long-term survivorship, although outcomes decline after 15 years with patients often requiring a revision within their lifetime. Direct tendon-to-implant fixation with overlying flap coverage significantly improves extensor lag. Further multi-institutional studies are warranted to validate technique-based differences in outcomes and develop strategies to improve both durability and function in this challenging population.



Complication	PTR (n = 92)
Soft Tissue Failure (Type 1)	2/92(2.2%)
Aseptic Loosening (Type 2)	13/92(14.1%)
Mechanical Failure (Type 3)	9/92(9.8%)
Infection (Type 4)	4/92(4.3%)
Tumor Recurrence (Type 5)	6/92(6.5%)