

Title: Salvage of the Limb Salvage: Revision of a Tumor Prostheses for Malignant Processes of the Knee

Authors: Matthew Houdek, Benjamin Wilke, Cody Wyles, Peter Rose, Michael Taunton, Franklin Sim

Institution: Department of Orthopedic Surgery, Mayo Clinic, Rochester, MN

Background: Endoprosthetic or custom prosthetic replacement is an option for reconstruction of the distal femur and proximal tibia to restore a functional extremity and achieve limb salvage. Although these prostheses are commonly used, failures still occur as patients are living longer and longer following treatment, however there is a paucity of data concerning the outcomes of revision surgery.

Purpose: The purpose of this study was to examine a consecutive series of revision knee arthroplasties where an endoprosthetic or custom distal femoral and/or proximal tibial replacements was used to reconstruct a tumor defect following extirpation of a malignant process to evaluate 1) overall patient and implant survival, 2) need for reoperation, 3) postoperative complications including infection and 4) patient function.

Methods: Using our institutions total joint registry we identified 7,358 knees undergoing a revision total knee arthroplasty 1969-2013. We excluded all patients that did not previously have an endoprosthesis placed for a malignant process, leaving a cohort of 70 knees. Kaplan-Meier survival outcomes and Hazard ratios were assessed for overall survival, reoperation, infection, and revision. Knee Society Score (KSS) and Knee Society Function Score (KSS-f) Scores were used to evaluate patient reported outcome. Mean age was 42 years (range 14-78) at the time of the surgery with 48% being male. The most common pathology was osteosarcoma (n=48, 69%). All surviving patients had 1-year follow-up with a mean follow-up of 6 yrs (1-18 yrs). The mean time to death was 8 yrs (range 2 mos -18 yrs). An endoprosthetic component was used in 80% and a custom distal femoral and/or proximal tibial replacement was used in 20% of patients.

Results: The mean 5-, 10-, and 15-year overall survival was 90%, 77%, and 46% (Fig. 1). In regards to survival of the implant, the 5-, 10-, 15-, and 20-year overall survival was 72%, 42%, and 42% (Fig. 1). There was no difference in implant survival between endoprosthetic or custom implants ($P=0.17$). The mean time to re-revision, reoperation for any cause, and postoperative infection was 4, 3 and 1 year. Hazard ratios showed an increased risk for revision and reoperation in males and those with a postoperative complication including dislocation and infection (Table 1). Likewise wound complications significantly increased the risk of infection (Table 1). Amputation occurred in 3 patients, with an overall limb salvage of 96%. Postoperative complications included periprosthetic fracture (n=10, 14%), component loosening (n=7, 10%), arthrofibrosis (n=7, 10%), delayed healing (n=6, 9%), hematoma (n=4, 6%), and dislocation (n=3, 4%). Following surgery, patients had a significant improvement in both the mean KSS (52 vs 87, $P=0.0001$) and KSS-f (41 vs 70, $P=0.0001$).

Discussion: With limited options to reconstruct the knee following tumor extirpation, the use of custom and endoprosthetic implants is common. Even with advances in implant design and surgical technique, in this series failure of these implants was common, with a majority of patients out-living their implants and requiring a re-revision surgery by 10-years post-revision. Males undergoing a revision procedure should be cautioned on their increased risk of failure and need for re-revision. Although there was a high rate of re-revision, the overall limb salvage rate was high and patient function significantly improved, as such we recommend revising failed tumor prostheses.

Table 1: Hazard Ratios for Rerevision, Reoperation and Postoperative Infection for Endoprosthetic Reconstruction for Malignant Processes of the Proximal Femur

Preoperative Factors	Revision THA (95% CI)	p Value	Reoperation (95% CI)	p Value	Infection (95% CI)	p Value
Male Gender	4.01 (1.68-10.56)	0.001	3.46 (1.56-8.23)	0.002	1.64 (0.43-6.65)	0.45
Age ≤40	1.55 (0.67-3.68)	0.29	1.66 (0.77-3.72)	0.19	0.76 (0.18-2.89)	0.69
Dislocation	8.58 (1.91-28.32)	0.008	5.20 (1.19-16.03)	0.03	-	-
Hematoma	1.11 (0.17-3.80)	0.88	1.30 (0.20-4.40)	0.72	1.80 (0.09-9.93)	0.60
Delayed Healing	1.88 (0.54-5.03)	0.28	3.02 (1.00-7.44)	0.04	5.83 (1.23-22.17)	0.02
Periprosthetic Fracture	0.62 (0.14-1.83)	0.42	1.62 (0.59-3.82)	0.31	-	-
Component Loosening	2.60 (0.99-6.14)	0.05	2.46 (0.96-5.61)	0.05	-	-
Arthrofibrosis	0.62 (0.09-2.13)	0.49	0.48 (0.07-1.61)	0.26	-	-
Infection	16.08 (4.93-52.38)	<0.0001	14.48 (5.06-41.60)	<0.0001	-	-

Figure 1:

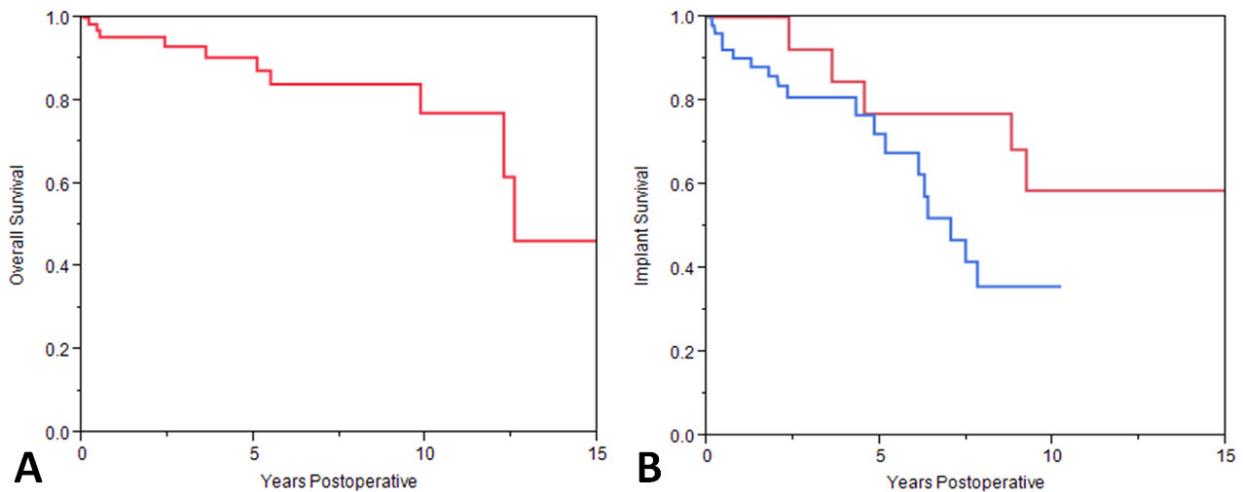


Figure 1: Overall- (A) and revision-free (B) survival following endoprosthetic or custom implant reconstruction for a revision of a endoprosthesis or custom implant performed for limb salvage for a malignant process of the distal femur or proximal tibia. Patients frequently need a re-revision procedure, and there was no difference between the use of a endoprosthesis (blue) or custom implant (red) for the revision procedure.