

Title: Salvage of the Limb Salvage: Revision of a Tumor Prosthesis for Malignant Processes of the Proximal Femur

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 proximal femoral replacement is an option for reconstruction of the proximal femur to restore a functional extremity and achieve limb salvage. Although these prostheses are commonly used, failures occur as patients are living 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 hip arthroplasties where an endoprosthetic or custom proximal femoral replacement 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 13,616 hips undergoing a revision hip arthroplasty 1969-2013. We excluded all patients that did not previously have an endoprosthesis or custom proximal femoral replacement placed for a malignant process, leaving a cohort of 40 hips. Kaplan-Meier survival outcomes and Hazard ratios were assessed for overall survival, reoperation, infection, and revision. Hip Society Scores (HSS) were used to evaluate patient reported outcome. Mean age was 55 years (range 14-85) at the time of the surgery with 58% being male. The most common pathology was metastatic disease (n=14, 35%) and chondrosarcoma (n=12, 30%). All surviving patients had 1-year follow-up with a mean follow-up of 6 yrs (1-21 yrs). The mean time to death was 4 yrs (range 1 week - 21 yrs). A custom proximal femoral replacement was used in 55% and an endoprosthetic replacement was used in 45% of patients for the revision prosthesis.

Results: The mean 5-, 10-, and 15-year overall survival was 55%, 46%, and 36% (Fig. 1). In regards to survival of the implant, the 5-, 10-, 15-year overall survival was 84%, 84%, and 74% (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 8, 6 and 1 year. There is was no analyzed factor which increased risk for revision, reoperation or postoperative infection (Table 1). Amputation occurred in 1 patient for tumor recurrence, for an overall limb salvage rate of 98%. Postoperative complications included periprosthetic fracture (n=7, 18%), dislocation (n=7, 18%), component loosening (n=7, 10%), sciatic nerve palsy (n=3, 7.5%), component loosening (n=3, 7.5%) and infection (n=3, 7.5%). Following surgery, patients had a significant improvement in the mean HSS (43 vs 74, $P=0.0001$).

Discussion: The results of this study show that patients typically succumb to their disease prior to implant failure. Following surgery patients experience a significant increase in functional mobility, as well as pain relief. Although proximal femoral replacements have historically had a high rate of failure, revision of these prostheses should be performed as overall there was a high limb salvage rate and patient function significantly improved following the revision of a tumor prosthesis.

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	1.47 (0.35-7.18)	0.59	1.49 (0.44-5.81)	0.52	2.04 (0.19-44.13)	0.55
Age ≤60	1.88 (0.43-12.94)	0.41	2.67 (0.67-17.70)	0.17	-	-
Obesity	3.61 (0.42-30.66)	0.21	2.47 (0.32-15.19)	0.34	-	-
Dislocation	3.30 (0.81-14.09)	0.09	3.03 (0.86-10.20)	0.08	2.18 (0.10-22.98)	0.54
Delayed Healing	-	-	3.54 (0.18-20.88)	0.31	7.85 (0.36-82.56)	0.15
Component Loosening	5.10 (0.96-24.12)	0.05	2.70 (0.56-10.19)	0.19	-	-
Infection	2.80 (0.14-19.35)	0.40	1.74 (0.09-10.37)	0.62	-	-

Figure 1:

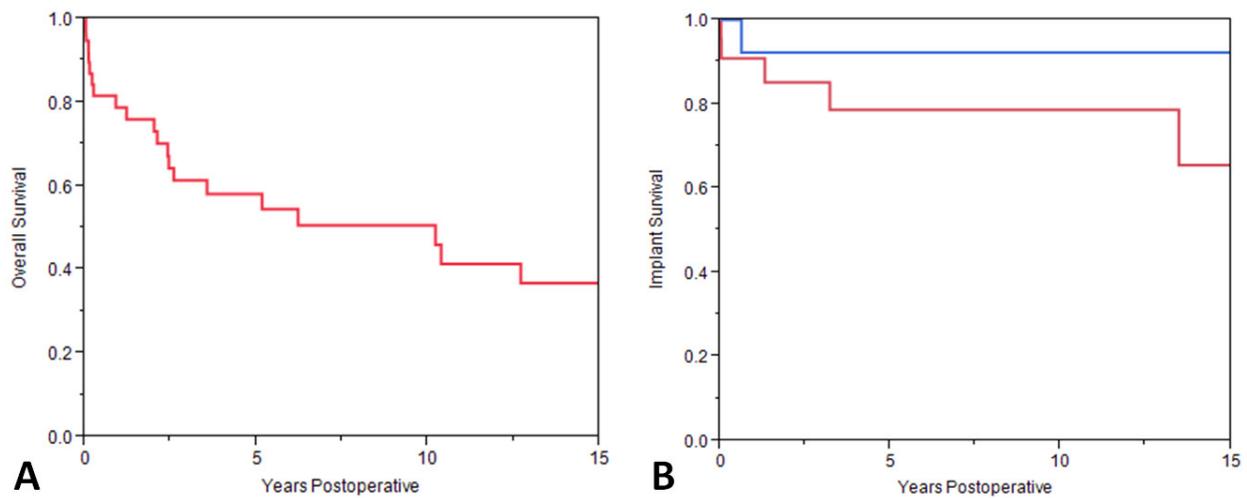


Figure 1: Overall- (A) and revision-free (B) survival following endoprosthetic or custom implant reconstruction for a revision of a endoprosthesis or custom implant performed for limb salvage for a malignant process of the proximal femur. Patients frequently succumb to their disease process prior to needed an additional revision procedure. There was no difference between the use of a endoprosthesis (blue) or custom implant (red) for the revision procedure.