A Nine-Year Experience with a New Fully Cemented, Hybrid, Splined, Porous-Coated Stem in Oncologic Reconstruction

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Significance & Hypothesis: The evolution of limb salvage techniques and technologies has prompted widespread development of modular implants with enhanced fixation and versatility. Despite the proliferation of new implant designs, outcomes data for many novel stems in oncologic reconstruction remain limited. We hypothesized that a fully cemented, straight-tapered, 120 mm, splined modular stem with a hybrid osseointegrative surface coating would demonstrate favorable early survivorship and complication profiles across multiple reconstruction types.

Innovation: This study presents the first institutional outcomes for oncologic reconstruction using a hybrid non-taper stem combining full cementation with a porous osseointegrative surface coating and splined geometry. To our knowledge, no prior study has reported clinical and survivorship outcomes for this specific implant design across distal femoral, proximal femoral, and proximal tibial reconstructions.

Approach (Materials & Methods): We retrospectively reviewed 53 patients who underwent oncologic reconstruction with the between 2016 and 2024. Reconstruction sites included distal femur (n=23), proximal femur (n=21), and proximal tibia (n=9). The mean age was 43.8 ± 24.5 years; 49.1% were female. The most common diagnoses were osteosarcoma (35.8%), metastatic carcinoma (26.4%), and giant cell tumor (5.7%). Neoadjuvant chemotherapy was administered in 52.8% and adjuvant chemotherapy in 66.0%. The mean resection length was 13.1 ± 5.2 cm. Ninety-six percent of procedures were primary reconstructions. The mean follow-up was 4.7 years. Kaplan-Meier analysis estimated implant and patient survival. Complications were classified per Henderson criteria.

Results: At 5 years, implant survival was 79.6% (95% CI: 70.2–89.0%), and patient survival was 64.0% (95% CI: 52.3–75.7%) (log-rank p = 0.025; HR = 0.33, 95% CI: 0.14–0.80). Implant failure occurred in 5 patients (9.4%): 1 structural failure (Type 3), 3 infections (Type 4), and 1 local recurrence (Type 5). No Type 1 or 2 failures were observed. Thirteen patients (24.5%) experienced at least one complication, with infection being the most common (11.3%).

Discussion & Impact: This hybrid non-taper stem demonstrated favorable early performance, with low complication rates and consistent function across DFR, PFR, and PTRs. While implant survivorship declined beyond 5 years in some cases, outcomes remain appropriate for oncologic indications. However, limited sample size, few failure events, and incomplete long-term follow-up reduce power to assess late implant durability, and the implant survival curve may evolve with continued observation. Ongoing surveillance and longitudinal studies are necessary to evaluate long-term outcomes and guide refinements in patient selection and implant design.

Figure 1. Kaplan-Meier survival curves for implant and patient survival following oncologic reconstruction

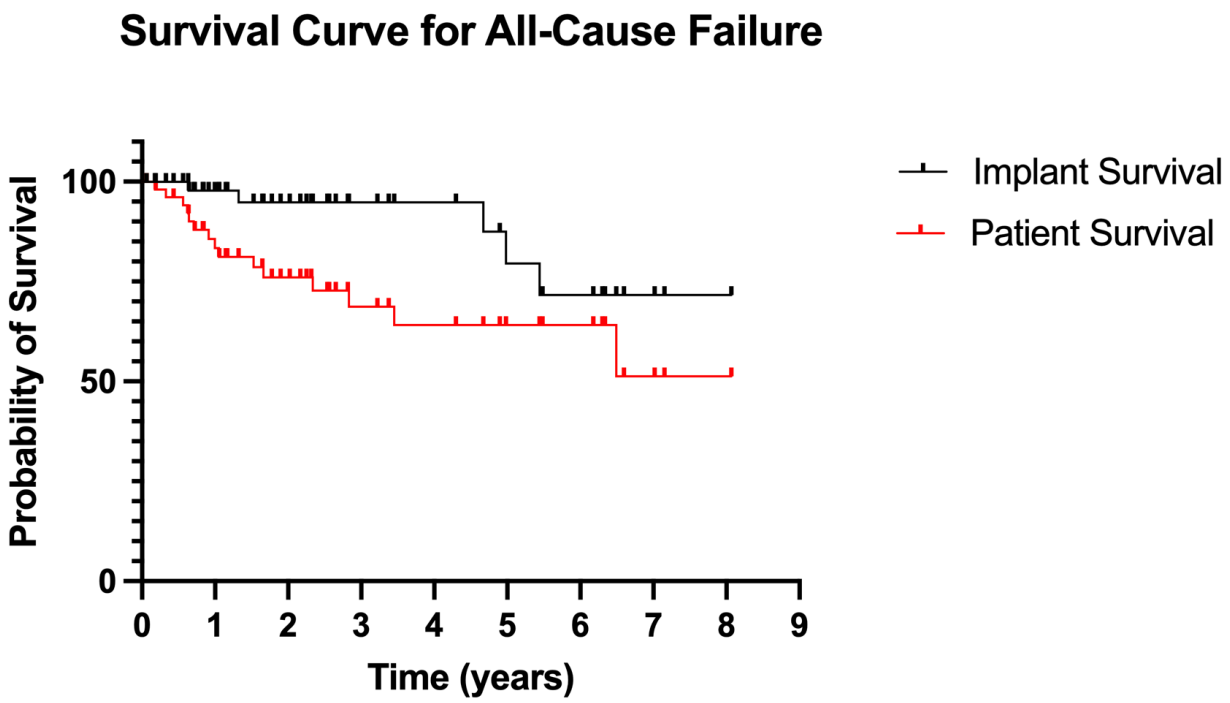

Table 1. Patient Demographics and Clinical Characteristics (N = 53)

Characteristic	Value
Age, mean (SD), y	43.4 (24.2)
Median (IQR)	43.8 (18.0-66.5)
Sex, No. (%)	
Male	27 (50.9)
Female	26 (49.1)
BMI, mean (SD)[a]	25.1 (5.8)
Reconstruction site, No. (%)	
Distal femur	23 (43.4)
Proximal femur	21 (39.6)
Proximal tibia	9 (17.0)
Primary procedure, No. (%)	51 (96.2)
Primary diagnosis, No. (%)	
Osteosarcoma	19 (35.8)
Metastatic carcinoma	14 (26.4)
Giant cell tumor	3 (5.7)
Chondrosarcoma	3 (5.7)
Myeloma/plasmacytoma	3 (5.7)
Sarcoma (soft tissue/radiation-associated)	2 (3.8)
Other	6 (11.3)
Stem width, No. (%)	
9-10 mm	3 (5.7)

11 mm	36 (67.9)
12 mm	9 (17.0)
13-14 mm	5 (9.4)
Resection length, mean (SD), cm	13.1 (5.2)
Median (IQR)	13.0 (10.0-17.0)
Neoadjuvant chemotherapy, No. (%)	28 (52.8)
Neoadjuvant radiotherapy, No. (%)	9 (17.0)
Adjuvant chemotherapy, No. (%)	35 (66.0)
Adjuvant radiotherapy, No. (%)[b]	8 (15.4)
Follow-up, mean (SD), mo	24.4 (23.2)
Median (IQR)	17.2 (5.9-37.5)
Status at last follow-up, No. (%)	
Continuously disease-free	12 (22.6)
Alive with disease	14 (26.4)
Dead of disease	16 (30.2)
Lost to follow-up	11 (20.8)

[a] Available for 19 of 53 patients (35.8%).
[b] Available for 52 of 53 patients.

Table 2. Complications and Implant Failure by Henderson Classification

Classification	Description	No. (%)
Implant failure (Henderson)		5 (9.4)
Type 3	Structural failure	1 (1.9)
Type 4	Infection	3 (5.7)
Type 5	Tumor progression	1 (1.9)
Type 1	Soft tissue failure	0
Type 2	Aseptic loosening	0
All complications		13 (24.5)
Infection	PJI, wound infection	6 (11.3)
Disease progression	Recurrence, metastasis, positive margins	4 (7.5)
Wound dehiscence		1 (1.9)
Periprosthetic fracture		1 (1.9)
Stiffness		1 (1.9)
Pulmonary embolism		1 (1.9)
Time to implant failure		Median (range)
		2.7 (0.3-59.0) mo

Complication categories are not mutually exclusive. Henderson Type 1 (soft tissue failure) and Type 2 (aseptic loosening) were not observed.