Durability of Proximal Femur Replacements: A Forty Year Experience

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INTRODUCTION:

Proximal femoral replacements (PFRs) are an effective surgical option for the treatment of primary and metastatic tumors causing large bony defects. Increased interest in acetabular wear and the rarity of these indications has made the understanding of the durability of these implants and their mechanisms of failure crucial.

METHODS:

All patients undergoing a primary or revision PFR for an oncologic diagnosis at a single institution between 1982-2020 were reviewed. This study utilized the validated Henderson Failure Classification and characterized the failures as soft tissue failures (type 1), aseptic loosening (type 2), structural failures (type 3), infection (type 4) or tumor progression (type 5). Statistical significance was defined as $p < 0.05$ using an unpaired t-test or chi square, where applicable.

RESULTS:

132 PFRs performed on 124 patients were included, including 122 primary and 10 revision PFRs. Average age at time of first surgery was 47.32 years (range: 6.3–85.5) for patients undergoing primary PFR and 40.4 years (range: 17.3–60.1) for patients undergoing revision (Table 1). Chondrosarcoma and metastatic disease (each 27/122; 22.1%) were the most common diagnoses for primary reconstruction followed by osteosarcoma (21/122; 17.2%).

11 out of 122 primary PFRs (9.0%) failed at a mean time of 111.49 months, while 3 out of 10 revision PFRs (30.0%) failed at a mean time of 120.51 months (Table 2). There was an infection rate of 2.5% (3/122) for primary PFRs and 10% (1/10) for revision PFRs. Mean follow-up time for primary PFRs was 62.03 months and mean follow-up time for revision PFRs was 143.89 months. Segment/resection length was not significantly associated with primary or revision PFR failures (p=0.381 and 0. 274, respectively). Stem length was also not significantly associated with primary or revision PFR failures (p=0.797 and 0.826, respectively).

DISCUSSION AND CONCLUSION:

Neither stem length nor resection length was correlated with PFR failure. This is perhaps due to the stem location of PFRs being more distal and not being subjected to a higher magnitude of muscular deforming forces and subsequent intramedullary movement over time compared to the more proximal stems of distal femoral replacements. The rate of infection for PFRs was also relatively low in this dataset, possibly due to the meticulous soft tissue reconstruction using the muscles of the hip for implant coverage. The current study represents one of the largest available on PFRs over a 40-year study period and highlights the remarkable durability of these implants.

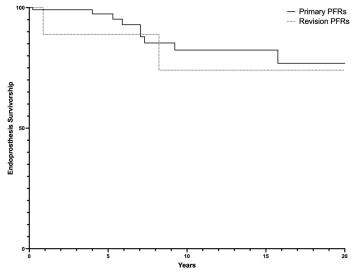

Figure 1: Implant survival curve of primary PFRs to revision PFRs demonstrating that PFRs remain a durable reconstruction option for this patient population.

Table 1: Demographic and Implant Measurement Data

Primary PFR		**Total (N = 122)**	**Non-Failure (N = 111)**	**Primary Failure (N = 11)**	**P-Value**
Age (years)	Mean ± SD	47.32 ± 22.19	48.32 ± 22.29	37.27 ± 19.26	0.116
	Range	6.29 - 85.48	6.29 - 85.48	8.11 - 73.24	
Gender	Male (%)	45.90	45.95	45.46	0.975
	Female (%)	54.10	54.05	54.55	
Follow-Up (months)	**Mean ± SD**	**62.03 ± 72.71**	**56.88 ± 71.74**	**111.49 ± 69.61**	**0.018**
	Median	**31.76**	**24.48**	**86.24**	
Segment length (mm)	Mean ± SD	188.85 ± 109.39	183.71 ± 111.57	217.25 ± 88.95	0.381
	Median	175	170	220.00	
Stem length (mm)	Mean ± SD	132.35 ± 30.54	132.26 ± 31.36	132.57 ± 24.16	0.797
	Median	127	127	127.00	
Revision PFR		**Total (N = 10)**	**Non-Failure (N = 7)**	**Revision Failure (N = 3)**	**P-Value**
Age (years)	Mean ± SD	40.40 ± 16.44	38.46 ± 17.15	44.93 ± 17.04	0.600
	Range	17.33 - 60.12	17.33 - 58.41	26.51 - 60.12	
Gender	Male (%)	40.0	28.57	66.67	0.260
	Female (%)	60.0	71.43	33.33	
Follow-Up (months)	Mean ± SD	143.89 ± 81.23	155.57 ± 69.00	120.51 ± 115.15	0.577
	Median	183.48	184.53	110.7	
Segment length (mm)	Mean ± SD	196.67 ± 110	166.67 ± 115.53	256.67 ± 83.27	0.274
	Median	150	120	230	
Stem length (mm)	Mean ± SD	123.89 ± 28.19	125.5 ± 29.63	120.67 ± 31.01	0.826
	Median	127	127	120	

Table 2: Types of Proximal Femur Replacement Failures

	Type of Failure	**Incidence of Failure**	**Time to Failure**	**Incidence of Subsequent Failure**
		N (%)	***Mean ± SD (Months)***	***N (%)***
Primary	Aseptic loosening	3/122 (2.45)	53.55 ± 8.77	1/3 (33.33)
	Structural failure	4/122 (7.38)	149.87 ± 86.39	3/4 (75.00)
	Infection	3/122 (2.45)	32.66 ± 45.23	2/3 (66.67)
	Tumor progression	1/122 (0.82)	87.78	0/1 (0)
	Total	**11/122 (9.02)**	**111.49 ± 88.18**	**6/11 (54.54)**
Revision	Soft-tissue failure	0/10 (0)	N/A	N/A
	Aseptic loosening	1/10 (10)	110.70	0/1 (0)
	Infection	1/10 (10)	10.59	0/1 (0)
	Tumor progression	0/10 (0)	N/A	N/A
	Total	**3/10 (30)**	**120.51 ± 115.15**	**0/3 (0)**