

Early Failures Utilizing the Photodynamic Bone Stabilization System in Pathologic and Impending Fractures



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Introduction

Impending and complete pathologic fractures often necessitate surgical fixation. Traditional orthopedic implants are commonly used, achieving clinically acceptable outcomes, but their metallic composition can impair radiographic evaluation and affect radiation treatments. Recognition of these concerns led to the development of radiolucent implants such as the minimally invasive Photodynamic Bone Stabilization System (PBSS), featuring a light cured polymer contained within an inflatable balloon catheter.

Failures due to Progression of Disease

Renal Cell Carcinoma Distal Humeral Fracture



Renal Cell Carcinoma Distal Humeral Lesion Revision with a Locking Compression Plate



Materials and Methods

Two participating hospitals in one healthcare system reviewed cases utilizing the PBSS implant. 23 patients with 27 impending or pathologic fractures in the proximal radius or humerus from metastatic carcinoma, myeloma, lymphoma, and melanoma were identified. Clinical charts and imaging were reviewed to determine the status of the implant at final follow-up as well as complications. A Chi squared test was utilized for nominal variables with a t test for continuous variables for analysis.

Table 1		Full Series		Intact Implant		Broken Implant		Statistical Analysis
		n (27)	%	n (19)	%	n(8)	%	Student T Test (p)
Age	Average and range	62.9 (40-80)		63.4 (40-78)		65.3 (60-80)		0.63
Follow up (avg)	Average (days) and range	231.5 (17-948)		205.9 (33 - 948)		261.5 (17-823)		0.65
	Died of Disease	12 (n=23)		8 (n=16)		5 (n=7)		
Chi Squared								
Gender	Male	8	34.8	7	43.8	1	14.3	0.17
	Female	15	65.2	9	56.3	6	85.7	
Etiology	Myeloma	12	44.4	10	52.6	2	25	0.18
	Renal Cell Carcinoma	5	18.5	3	15.8	2	25	0.57
	Breast Carcinoma	4	14.8	2	10.5	2	25	0.33
	Lung Carcinoma	3	11.1	2	10.5	1	12.5	0.88
	Lymphoma	1	3.7	1	5.3	0	0	NA
	Cholangiocarcinoma	1	3.7	0	0.0	1	12.5	NA
Melanoma	1	3.7	1	5.3	0	0	NA	
Indication	Pathologic Fracture	17	63.0	12	63.2	5	62.5	0.97
	Impending Fracture	10	37.0	7	36.8	3	37.5	
Location	Surgical Neck	4	14.8	3	15.8	1 ^{NS}	12.5	0.44
	Proximal Humeral Shaft	12	44.4	10	52.6	2 ^N	25	0.19
	Distal Humeral Shaft	9	33.3	4	21.1	5^A	62.5	0.03
	Proximal Radius	2	7.4	2	10.5	0	0	NA
		n (23)						
Chemo	Yes	18	78.3	12	75	6	85.7	0.57
	No	5	21.7	4	25	1	14.3	
Radiation	Yes	20	74.1	13	68.4	7	87.5	0.3
	No	7	25.9	6	31.6	1	12.5	

^{NS} Chart documented trauma as a reason near time of failure.
^N One ORIF done for implant fracture and another patient had repeat surgery for screw removal.
^A Two varus malunions noted though only 1 implant broke on follow up imaging.
^R One ORIF done for periprosthetic fracture though no breakage of the implant was observed.
^A Two required Repeat ORIF.

Results

11 of the 23 patients remained alive with disease at time of analysis. 8 of 27 (30%) implants failed. 5 of 23 (22%) patients required repeat surgery due to complications including 3 revision ORIF cases, one ORIF for a periprosthetic fracture, and one screw removal. 5 of the 9 cases (56%) (p=0.03) with lesions in the distal humeral shaft developed breakage of their implant by final follow-up compared to 3 of 18 cases (17% p=0.03) elsewhere in the humerus; no failures were seen in the radius. 5 patients were noted to have progression of disease on follow up radiographs with 4 failures in patients with progression.

Discussion

The PBSS implants potentially allow improved surveillance of fracture healing and tumor recurrence along with decreased scattering of radiation during treatment. Unfortunately, there may be a higher rate of mechanical failures, particularly for lesions involving the distal humerus. This may be due to decreased cross sectional area of the implant in this region as compared to the metaphyseal and proximal regions. Further research should be considered to evaluate the utilization and indications for this minimally invasive system.

Mechanical Failure

Implant Fracture in a Proximal Humeral Lesion from Breast Cancer



Conclusions

The Photodynamic Bone Stabilization System offers some unique theoretical advantages to metallic implants. However, this is eclipsed by the high failure rate seen with impending and pathologic fractures. There was an overall failure rate of 30% and a distal humeral failure rate of greater than 50%. Given the sample size, these values may even be an underestimation. Caution should be utilized when this implant is chosen for a pathologic or impending fracture.