Rate of Secondary Procedures following Minimally Invasive Stabilization of Pelvic Metastatic Disease

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INTRODUCTION: Bone is one of the most frequent locations for metastatic disease, particularly for primary tumors of the prostate, breast, lung, kidney, and thyroid. Osseous involvement typically leads to significant morbidity for patients through pain, lack of mobility, and pathologic fracture risk. The pelvis is one of the most common osseous locations for metastatic disease and presents significant management challenges. Patients with osseous metastases to the pelvis are treated with a variety of multidisciplinary therapies depending on provider preference and individual patient factors, and surgical intervention options vary widely among institutions. One newer option for surgical management is minimally invasive stabilization of the pelvis using screws and cement, with or without ablation and radiation therapy. This technique, which utilizes a collaborative approach between orthopaedic oncology and interventional radiology, has been shown to markedly improve pain and function and facilitate early initiation of other local and systemic therapies while minimizing the morbidity associated with more traditional reconstruction techniques such as the Harrington procedure and its variations. Despite significant improvements in pain and function in many patients treated with minimally invasive stabilization, we have noted several patients who have subsequently required additional procedures including total hip arthroplasty, largely secondary to disease progression or articular collapse. As systemic therapies improve, patients are living longer with metastatic disease, and understanding the need for secondary procedures in this patient population will be critical. The purpose of this study is to evaluate and characterize secondary procedures following initial minimally invasive intervention for pelvic metastatic disease.

METHODS: This study involved a retrospective analysis of 108 patients (ages 17-86, average = 63.69 years) who have undergone percutaneous stabilization of pelvic metastatic disease since the technique's inception at our institution in 2011. Inclusion criteria included patients with a minimum of one year of follow up or documentation of completion of orthopaedic surgery and interventional radiology care prior to one year of follow up. The most common primary malignancies included multiple myeloma (16), breast cancer (15), lung cancer (14), and renal cancer (13). Patients were evaluated for the rate of secondary pelvic operations and total hip arthroplasty following initial minimally invasive pelvic stabilization. This data was further analyzed to identify the location and type of secondary surgery as well as patient and tumor factors that may impact the need for secondary surgeries, such as radiation therapy, ablation at the time of initial stabilization, and the type of primary malignancy. The resultant data was then analyzed using Fisher's Exact Test and T-test analysis to evaluate the effect of these potential secondary factors.

RESULTS: Forty-two of the 108 patients met inclusion criteria. Thirty-two patients passed away within one year of surgery, while 34 patients were either lost to follow up, did not have one year of follow-up data available, or did not have a primary malignancy. Of the remaining 42 patients, 18 (42.9%) ultimately required a secondary pelvic procedure. Twelve of these 18 (66.7%) secondary procedures were ipsilateral to the site of initial stabilization. Six of the 42 patients (14.3%) underwent total hip arthroplasty postoperatively, while 13 (31.0%) underwent another type of procedure, nine of which involved additional fixation of the pelvis, often to treat further progression of metastatic disease. One patient required a total hip arthroplasty in addition to second fixation and stabilization. Of note, 16/18 (88.9%) patients who required secondary procedures were treated with pelvic radiation prior to the secondary procedure, compared to 16/24 (66.7%) patients who did not require a secondary procedure ($p = 0.15$). Additionally, 8/18 (44.4%) patients requiring a secondary procedure underwent some form of ablation at the time of initial pelvic stabilization, compared to 9/24 (37.5%) patients who did not require a secondary procedure ($p = 0.75$). Somewhat surprisingly, type of primary malignancy was not correlated with the need for a secondary procedure ($p = 0.54$), with the most common diagnoses of secondary procedure patients being multiple myeloma (3), breast cancer (3), lung cancer (2), and renal cancer (2).

DISCUSSION AND CONCLUSION: Stabilization of the pelvis is critical for management of pelvic metastatic disease to minimize overall patient morbidity. Minimally invasive pelvic stabilization with screw fixation and cement augmentation provides excellent initial pain relief and stability for patients as demonstrated in the literature and our patient cohort. The results of this study demonstrate a need for additional minimally invasive procedures for many patients who live beyond a year with metastatic disease, with a relatively low need for more invasive total hip arthroplasty (14.3%). Most of the secondary procedures in our study were ultimately performed for progression of metastatic disease and not due to hip joint degenerative disease, highlighting the fact that hip arthroplasty is often not immediately necessary for management of pelvic metastases. In total, 57.1% of patients ultimately did not require any additional pelvic surgery for management of metastatic disease. With our limited patient numbers, the need for secondary procedures was not found to be significantly influenced by radiation therapy, ablation therapy, or the type of primary malignancy. While this minimally invasive stabilization technique minimizes overall morbidity and provides significant pain relief while allowing patients to continue to

receive critical systemic therapy for management of their primary malignancy, patients who live for an extended period of time may ultimately require additional procedures.