CLINICAL STUDY

Safety and Efficacy of Minimally Invasive Acetabular Stabilization for Periacetabular Metastatic Disease with Thermal Ablation and Augmented Screw Fixation

Michael P. Hartung, MD, Sean M. Tutton, MD, Eric J. Hohenwalter, MD, David M. King, MD, and John C. Neilson, MD

ABSTRACT

Purpose: To evaluate minimally invasive acetabular stabilization (MIAS) with thermal ablation and augmented screw fixation for impending or minimally displaced fractures of the acetabulum secondary to metastatic disease.

Materials and Methods: Between February 2011 and July 2014, 13 consecutive patients underwent thermal ablation, percutaneous screw fixation, and polymethyl methacrylate augmentation for impending or nondisplaced fractures of the acetabulum secondary to metastatic disease. Functional outcomes were evaluated before and after the procedure using the Musculoskeletal Tumor Society (MSTS) scoring system. Complications, hospital length of stay, and eligibility for chemotherapy and radiation therapy were assessed.

Results: All procedures were technically successful with no major periprocedural complications. The mean total MSTS score improved from 23% ± 11 before MIAS to 51% ± 21 after MIAS ($P < .05$). The mean MSTS pain scores improved from 0% (all) to 32% ± 22 after MIAS ($P < .05$). The mean MSTS walking ability score improved from 22% ± 19 to 55% ± 26 after MIAS ($P < .05$). Two complications occurred; a patient had a minimally displaced fracture of the superior pubic ramus at the site of repair but remained ambulatory, and septic arthritis was diagnosed in another patient 12 months after repair. The average length of hospital stay was 2 days ± 3.6; six patients were discharged within 24 hours of the procedure. All patients were eligible for chemotherapy and radiation therapy immediately after the procedure.

Conclusions: MIAS is feasible, improves pain and mobility, and offers a minimally invasive alternative to open surgical reconstruction.

ABBREVIATIONS

MIAS = minimally invasive acetabular stabilization, MSTS = Musculoskeletal Tumor Society, PMMA = polymethyl methacrylate

Every year, metastatic bone disease is diagnosed in > 100,000 patients in the United States, with a median survival ranging from months to several years depending on the primary tumor (1,2). The pelvis is the second most commonly involved site after the vertebral column (3). Painful bony destruction of the pelvis can result in impending or pathologic fracture of the acetabulum, which decreases function, mobility, and quality of life. Treatment options include medical and radiation therapy, percutaneous interventional procedures, and surgical reconstruction (4). Patients with smaller lesions benefit from pain management with bisphosphonates, narcotics, and radiation therapy (5). Radiofrequency ablation and cryoablation provide pain relief for patients who respond poorly to medical therapy (6–8). Percutaneous cementoplasty (osteoplasty) can be performed alone or in addition to thermal ablation and may relieve pain and provide support to the weakened bone (9–12).

From the Division of Vascular and Interventional Radiology (M.P.H., S.M.T., E.J.H.) and Department of Orthopedic Surgery (D.M.K., J.C.N.), Medical College of Wisconsin, 9200 W. Wisconsin Ave., Milwaukee, WI 53226. Received January 22, 2015; final revision received January 17, 2016; accepted January 19, 2016. Address correspondence to S.M.T.; E-mail: stutton@mcw.edu

S.M.T. is a paid consultant for Benvenue Medical, Inc (Santa Clara, California). None of the other authors have identified a conflict of interest.

From the SIR 2014 Annual Meeting.

Figures E1 and E2 and Table E1 are available online at *www.jvir.org*.

J Vasc Interv Radiol 2016; XX:▮▮▮–▮▮▮

http://dx.doi.org/10.1016/j.jvir.2016.01.142

Surgical reconstruction with total hip arthroplasty is indicated for patients with lesions compromising the structural integrity of the acetabulum and resulting in pathologic fractures, provided that the patients are surgical candidates and predicted to survive > 3 months (4). However, surgery is highly morbid, and many patients already debilitated by cancer are incapable of surviving surgery or making a meaningful recovery. Surgery traditionally involves a Harrington-type reconstruction of the acetabulum, which improves functional outcomes in carefully selected patients but can result in high rates of postoperative infection and hardware failure, a long recovery, and significant delays in radiation therapy and chemotherapy (13–15). Previous published reports of percutaneous cementation of acetabular lesions primarily addressed contained defects limited to Harrington class I–II lesions without pathologic fracture (9,10).

The purpose of this study was to evaluate minimally invasive acetabular stabilization (MIAS) with thermal ablation and augmented screw fixation for impending or minimally displaced fractures (Harrington I–III lesions) secondary to metastatic disease. This procedure can be performed in patients who are unable to tolerate complex open surgical reconstruction. The approach is intended to decrease tissue disruption and allow patients to undergo earlier chemotherapy and radiation therapy after the procedure.

MATERIALS AND METHODS

After obtaining institutional review board approval, we performed a retrospective review of 13 consecutive patients with a mean age of 58 years ± 11 (range, 43–82 y) who underwent thermal ablation, percutaneous cementation, and screw fixation of metastatic acetabular lesions between February 2011 and July 2014. **Table 1** summarizes the demographic data for the study cohort in chronologic order. Indication for procedure, narcotic use, prior radiation therapy, and inpatient versus outpatient status at the time of the procedure were assessed. Imaging performed before the procedure was evaluated, and the acetabular lesions were categorized using the Harrington classification (I–III) (13), which classifies acetabular metastatic disease based on the extent of osteolysis and the open surgical technique needed to obtain a secure arthroplasty.

Inclusion criteria were impending or minimally displaced (< 5 mm) pathologic fracture, decreased mobility, and pain with weight bearing. MIAS was considered based on the metastatic disease burden and expected morbidity from open acetabular reconstruction with total hip arthroplasty, the desire to avoid delays in chemotherapy and radiation therapy, and the preference for rapid return to function. Each patient was discussed at a multidisciplinary tumor board that included interventional

Table 1. Data for 13 Patients Who Underwent MIAS

Patient No.	Age (y)/Sex	Primary Tumor	Harrington Class	Ablation Procedure/Additional Procedures	Total MSTS, Before/After*	Walking Ability, Before/After†	Pain, Before/After†	Time to Evaluation (d)
1	54/F	Renal cell	III	RF/embolization, femur RF and ORIF, sacroplasty	13/33	0/2	0/1	16
2	53/F	Esophageal	III	Cryo/femur ORIF, iliac osteoplasty	10/20	0/1	0/1	32
3	64/F	Leiomyosarcoma	III	Cryo/femur ORIF	10/27	0/2	0/1	24
4	45/F	Melanoma	I	Cryo/embolization	47/67	2/4	0/1	23
5	60/M	Breast	I	Cryo/iliac osteoplasty	33/77	3/4	0/4	50
6	67/F	Lung	III	RF/femur ORIF	23/27	1/1	0/1	19
7	55/M	Esophageal	II	MW/none	23/80	2/5	0/1	19
8	75/F	Lung	II	RF/none	20/50	1/3	0/1	18
9	43/F	Leiomyosarcoma	II	RF/none	40/80	2/4	0/1	17
10	57/F	Adrenocortical	II	RF/hip radiation before procedure	10/40	0/2	0/2	8
11	57/M	Renal cell	III	RF/none	27/47	1/2	0/1	61
12	46/F	Rectal adenocarcinoma	II	RF/none	23/70	1/4	0/4	10
13	82/M	Synovial sarcoma	III	RF/none	23/50	1/2	0/2	22

Cryo = cryoablation; F = female; M = male; MIAS = minimally invasive acetabular stabilization; MSTS = Musculoskeletal Tumor Society; MW = microwave ablation; ORIF = open reduction internal fixation; RF = radiofrequency ablation.

*Total MSTS score is presented as a percentage of normal function, with 100% indicating normal function.

†Walking ability and pain scores range from 0 (worst) to 5 (best).