MR appearance of skeletal neoplasms following cryotherapy

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Abstract. Cryotherapy is an increasingly popular mode of therapy adjunctive to surgical curettage in the treatment of certain skeletal neoplasms, such as giant cell tumors or chondrosarcomas. The magnetic resonance (MR) findings following cryotherapy have not been previously reported. We reviewed the MR findings in seven patients with skeletal neoplasms following curettage and cryotherapy. In six cases we found a zone of varying thickness extending beyond the surgical margins, corresponding to an area of cryoinjury to medullary bone. This zone displayed low signal intensity on T1-weighted images and high signal intensity on T2-weighted images, consistent with the presence of marrow edema. This zone of edema almost certainly reflects underlying thermal osteonecrosis. This zone may vary in size and intensity over time as the area of cryoinjury evolves or resolves. MR is currently the imaging procedure of choice for follow-up of most musculoskeletal neoplasms. Knowledge of the MR findings following cryotherapy should help prevent confusion during the interpretation of follow-up MR examinations.

Key words: Magnetic resonance imaging – Neoplasms – Musculoskeletal neoplasms – Cryotherapy – Chondrosarcoma – Giant cell tumor of bone

Cryotherapy is an increasingly popular mode of therapy adjunctive to surgical curettage in the treatment of certain skeletal neoplasms, such as giant cell tumors and low grade chondrosarcomas [9]. Cryotherapy is used following curettage to induce peripheral necrosis of both the bony wall of the curettage cavity and of any residual tumor cells, thereby decreasing the chance of local recurrence. Magnetic resonance (MR) is currently the imaging procedure of choice for the post-treatment follow-up of most musculoskeletal neoplasms. The MR findings following cryotherapy of skeletal neoplasms have not been previously reported.

Materials and methods

At the time of this study, 12 patients with musculoskeletal neoplasms had been treated with curettage and intraoperative cryotherapy at our institution. Four of these patients had no postoperative MR examination at the time of this retrospective study and were excluded from consideration. Of the eight subjects who had postoperative MR examinations, one further subject was excluded from the study because severe metal artifacts from an intramedullary nail precluded any useful images.

The study population consisted of three men and four women, of ages ranging from 28 to 55 years (average 42 years). Three patients were treated for giant cell tumor and four had low-grade chondrosarcomas. Three lesions were located in the femur, three in the tibia, and one in the humerus.

All patients were scanned with a General Electric Signa MR unit with a field strength of 1.5 tesla. These scans were performed between 7 and 633 days following cryotherapy (median 56 days). The lesions were scanned in coronal, sagittal, or axial planes. No particular scanning planes were consistently used among all seven patients. Short TR spin echo sequences (TR = 600–800 ms, TE = 20–25 ms) were obtained in three patients. Long TR asymmetric spin echo sequences (TR = 2000 ms, TE = 30 ms and 80 ms) were obtained in all seven patients. Short T1 inversion recovery (STIR) sequences (TR/TE/TI = 2000/40–43/120–130) were obtained in five patients. All scans were done with a slice thickness of 5 mm, a field of view of 16–28 cm, a matrix size of either 256 x 256 or 256 x 128, and 1–2 excitations.

The scans in this study were reviewed by the authors without blinding with respect to the diagnosis or previous therapy.

Cryotherapy was performed following curettage in all seven patients. The cryogen used in all patients was liquid nitrogen, and it was applied by spraying into the curettage site. Three freeze-thaw cycles were used, and a thermocouple was used in some of the cases to monitor the temperature of the adjacent soft tissue. Following cryotherapy, bone graft or polymethylmethacrylate cement was used to fill the curettage site in five cases.

Only one patient in this series has undergone subsequent reoperation and biopsy of the cryotherapy site.

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Fig. 2. A T1-weighted (TR/TE = 800/20 ms) sagittal image of the left knee, 7 days after curettage and cryotherapy of a low-grade chondrosarcoma. The curettage cavity is filled with polymethylmethacrylate cement (c). The cavity is bounded anteriorly by a subtle concentric zone of inhomogeneous signal intensity (arrows). This zone measures 6-7 mm in thickness and may represent the very early findings of thermal injury. The area of low signal intensity immediately posterior to the cement represents a postoperative seroma (s).

B-D Sagittal images of the left knee 95 days after curettage and cryotherapy of the tumor. The curettage cavity is filled with polymethylmethacrylate cement (c). The cavity is now surrounded by a 7- to 8-mm zone of decreased intensity consistent