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# MR image-guided interstitial brachytherapy for recurrent endometrial carcinoma

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## Introduction

Magnetic resonance imaging (MRI) has been reported to be superior to any other modality in imaging the normal anatomy of the female pelvis, including the bladder and rectum, and in delineating tumors of the vagina, uterus, and uterine cervix. In patients with advanced or deeply infiltrating tumors, the specific signal intensities of gynecologic tissue allow for the distinct separation of tumor or normal tissue on the images. CT does not clearly delineate tumor tissue from the uterine, parametrial, or normal tissues.

The magnetic resonance therapy (MRT) unit at the Brigham and Women's Hospital (BWH) is a 0.5 Tesla open interventional unit (Signa SP GE medical systems) consisting of two short cylindrical magnets. Between these two components, there is a 56-cm gap, which provides full and direct access to the patient during imaging and enables placement of brachytherapy radiation treatment applicators. There is a 30-cm diameter imaging volume at the center of the gap, which obtains high-quality images similar to those obtained in standard systems at the same field strength. Other than this unique "open" configuration, there are no differences from conventional MRI systems.

Recurrent endometrial cancer presenting at the vaginal apex may be cured with appropriate therapy, including external beam radiation followed by interstitial brachytherapy. Gynecologic interstitial brachytherapy requires the insertion of needles into the tumor mass, followed by temporary afterloading radiation treatments. However, the proximity of the vaginal apical tumor mass to adjacent critical structures including the bladder and rectum results in a high potential risk of complications. We hypothesize that MR-guidance during the insertion of the needles is both feasible and effective, providing adequate tumor coverage with improved sparing of the adjacent normal tissues.

## Materials and Methods

All patients enrolled in this trial underwent a hysterectomy at the time of initial diagnosis of endometrial cancer, and suffered from a recurrence at the vaginal apex. A diagnostic MR image was obtained at the time of initial presentation to BWH and was evaluated by the radiologist and the radiation oncologist to determine the tumor volume, extent and 3D relationships to adjacent structures, along with the length and number of needles required at the time of implantation. The patient was brought to the MRT operating room and general anesthesia initiated. MR images including fast recovery, fast spin echo tri-planar T2-weighted, T1-weighted axial spin echo, fat-suppressed axial T2-weighted fast recovery, and fast spin echo sequences were obtained in all cases. During the MRI, interstitial catheters were spaced approximately 1 cm apart and inserted through a Syed template into the perineum in order to encompass the MR visualized areas of tumor.

## Results

From February to August 2004, four patients with recurrent endometrial cancer underwent gynecologic interstitial implantation as part of an IRB-approved prospective trial. All patients were successfully imaged and image guidance was adequate in all cases to allow needle placement. The mean age was 71.5 years (range, 59-88). Case 1 had a tumor measuring 3.75 x 3.5 x 3.2 cm adjacent to the right ureter; 13 catheters were successfully placed without puncturing the ureter or bladder. Case 2 had a mid-vaginal tumor measuring 2 x 2 x 1 cm that extended superiorly to the rectosigmoidal flexure; 11 catheters were inserted and the rectal wall was not penetrated. Upon completion of insertion, a 7-mm gap was identified between the rectosigmoidal flexure and the vaginal apex. Case 3 had a mass infiltrating the rectovaginal septum; 12 catheters were inserted with no evidence of rectal insertion. Case 4 had a 5.7 x 4.9 x 4.3 cm mass extending antero-superiorly from the vaginal apex pressing against the bladder anteriorly and the rectosigmoidal flexure posteriorly; 24 catheters were placed. The pubic arch caused significant interference with insertion into the most anterior aspects of the tumor; however, MR guidance allowed for careful placement of the needles around the pubic arch. Four catheters did penetrate the posterior edge of the bladder wall; however, the tumor was fully covered by the radiation treatment.

**Conclusions**

Magnetic-resonance guided interstitial implantation in gynecologic tumors is feasible in an MRT unit. This technique allows the operator to perform real-time image-guided gynecologic brachytherapy.

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