AbstractID: 9284 Title: The imaging and dosimetric capabilities of a novel CT/MR-suitable, anatomically adaptive, shielded HDR/PDR intracavitary brachytherapy applicator for the treatment of cervical cancer

Purpose: To design and investigate the imaging and dosimetric capabilities of a novel, CT/MR-suitable, anatomically adaptive, shielded cervical HDR/PDR brachytherapy applicator.

Method and Materials: An applicator was constructed featuring an inter-colpostat shield that can translate/rotate about the colpostat's long-axis. Artifact-free CT imaging was achieved using a "step-and-shoot" technique; pausing the scanner midway through the scan and moving the shield out of the beam's path. Artifact-free MRI imaging was achieved by utilizing MRI-compatible ovoid components and pulse-sequences that minimize susceptibility artifacts. The applicator's imaging capabilities were demonstrated acquiring images using phantoms that positioned the novel and Fletcher-Williamson ICBT applicators in clinically-applicable geometries for both modalities. Artifacts were qualitatively compared. To evaluate any dosimetric advantages, Monte-Carlo models of the novel and FW applicators were first validated. Anatomies of patients that have undergone ICBT for cervical disease were modeled using Monte-Carlo and spatially registered with models of both applicators using SolidWorks; a CAD software suite. Equivalent, clinically-applicable ^{192}Ir loadings were simulated for both applicators using Monte-Carlo techniques. The novel applicator shield's rotation and translation was adjusted for each dwell position in order to minimize dose to the rectum and superimposed for comparison to equivalent FW treatments. Rectal dose (rate and absolute) volume histograms were determined for both applicators and compared.

Results: Using a "step-and-shoot" CT scanning method and MR compliant materials and optimal pulse-sequences, images of the novel applicator were artifact-free using both modalities. Additionally, for the patient case presented, there is a 26% and 13% reduction of d90 and d50, respectively, and a 13% reduction in overall absolute dose to the rectum when compared to equivalent Fletcher-Williamson ICBT treatments.

Conclusion: A novel ICBT applicator can be imaged using CT/MR without artifact and reduce dose to the rectum compared to the current state-of-the-art, FW ICBT applicator.

Conflict-of-Interest: Work partially supported by Nucletron Corp.