

AbstractID: 3604 Title: 3D Monte Carlo-Based Treatment Planning Evaluation of Intracavitary HDR Balloon Catheter Brachytherapy

Purpose: To evaluate the dosimetric effects of missing tissue and tissue heterogeneities on intracavitary HDR balloon-catheter brachytherapy using a novel 3D Monte Carlo-based treatment planning study.

Method and Materials: The PTRAN Monte Carlo (MC) photon transport code is used to generate 3D calculations of the doses arising from an HDR ^{192}Ir source in; Anatomy-based MC simulations modeling the dosimetric effects of missing tissue beyond the skin surface and tissue heterogeneities (such as air pockets) adjacent to the balloon catheter (Mammosite); and in a large water phantom representing those calculations achievable with a conventional 3D brachytherapy RTPS. Each MC simulation employs a track length estimator scoring method in a 3D grid, with 2mm resolution in a 12cmx11cmx8cm volume, scoring 8×10^6 primary photon histories. The dose matrices from all MC simulation are registered (in the external beam module of a commercial RTPS) to a single, modeled patient CT, which is identical in location, scale, and shape to the patient volume described in the anatomy-based MC simulations. Several target volumes (e.g. a 1cm margin on the Mammosite balloon) and a skin-surface contour, are created. Dose-volume histograms (DVH's) are computed for each volume, per each plan. Comparisons of the resultant DVH's quantify the dosimetric errors expected from routine clinical planning of Mammosite applications.

Results: The missing tissue beyond the skin surface reduces target coverage by 1.5-3.5% and skin doses by 8-20%, when compared to calculations achievable with conventional 3D brachytherapy treatment planning systems. A 10cc airpocket neighboring the Mammosite balloon reduces doses to adjacent tissues <0.5%.

Conclusion: A detailed 3D Monte Carlo-based brachytherapy RTP study of the dose prediction errors in balloon catheter HDR applications shows that the missing tissue beyond the skin surface reduces skin doses by as much as 20% and target coverage by as much as 3.5%.