AbstractID: 7264 Title: Comparison of HDR Brachytherapy Optimization using Physical Dose and Biological Response Models

Purpose: Comparison of optimized HDR treatment plans using biological and physical objective functions.

Methods and Materials: For a gynecological cancer case, treatment plans were generated using physical and biological optimization models. Optimization was done using adaptive simulated annealing. The target and critical structure volumes were determined from CT images. Target volumes were planned to receive 80Gy using a uniform external beam dose of 0 or 45Gy. The physical model objective function uses a least square fitting. The biological model objective function uses EUD to maximize the target and minimize critical structures dose. Plan evaluation is done by comparing the isodose distribution and calculating tumor control probability (TCP), normal tissue complication probability (NTCP), equivalent uniform dose (EUD), coverage index (CI), homogeneity index (HI), and overdose index (OI).

Results: The physical model produced excellent dose uniformity and target coverage. The biological model was able to increase EUD to the target, lower EUD to the rectum and sigmoid, but increased EUD to the bladder. When external beam dose is added, the differences in EUD were in the same direction, but smaller. The biological plan was less uniform (lower HI and higher OI) with the same CI as the physical model, but when an external beam was added, CI was the same, HI became smaller, and OI was larger compared to the physical model. TCP was larger for the biological model. NTCP are zero for plans without external beam dose. When external beam dose was added, TCP and NTCP increased for both plans. TCP became higher for the physical model and NTCP followed the same trend as the EUD calculations.

Conclusion: The biological model is able to spare dose to critical structures, but has less homogeneity and greater overdose than the physical model. When an external beam dose is included, plans look almost identical.