AbstractID: 12655 Title: Emission guided radiation therapy system: a feasibility study

Purpose:

To evaluate the feasibility of a combined PET-Linac system for real-time guidance of radiation therapy for tumors that move due to respiration.

Method and Materials:

We are developing a treatment system that will simultaneously deliver radiation during PET acquisition. A method to compensate for respiratory motion will be to deliver radiation beam-lets along individual PET lines-of-response (LOR's) as they are detected. The system involves rotating a radiation source and PET detectors on a gantry while dynamically controlling a binary multi-leaf collimator to deliver the beam-let responses in a 2D helical mode. Simulations were conducted using GATE to model 300 seconds of PET list-mode acquisition of a 'hot' 3 cm diameter tumor exhibiting 3.7 second periodic 2 cm peak-to-peak motion in a 'warm' background. A 5 cm planning target volume (PTV) was used as a filter to reject LOR's that did not intersect this volume. LOR's that intersected the PTV and whose timestamps were within a 500 ms cutoff window were responded to. A voxel-based Monte Carlo simulation package was used to model the resultant dose distributions comparing the emission guided (EGRT) method with uniform coverage of the PTV.

Results:

Composite dose volume histograms were calculated using 10 phases of the motion cycle. Dose to the non-tumor volume was normalized to the same mean value for both scenarios. The EGRT approach exhibited a non-uniform dose distribution to the tumor compared to uniform PTV coverage. However, even with the non-uniformity, there was a 30% relative increase in minimum dose to the tumor volume for the EGRT approach.

Conclusion:

Although non-uniform dose delivery to the tumor volume needs to be addressed, the feasibility of using PET to guide radiation delivery in real-time has been demonstrated.

Conflict of Interest:

SRM and ASN are co-founders of a company commercializing emission guided radiation therapy.