

**Purpose:** To evaluate an emission guided radiation therapy (EGRT) system's ability to deliver dose to a moving PET-avid target.

**Methods:** We are developing a treatment system that will simultaneously deliver radiation during PET acquisition. Due to PET's slow imaging time, a method to compensate for motion will be to deliver radiation beam-lets along individual PET lines-of-response (LOR's) as they are detected. The EGRT system involves rotating a linac and PET detectors on a closed ring gantry while dynamically controlling a binary multi-leaf collimator for helical delivery. A cylindrical phantom and six spherical inserts were filled with FDG to achieve an 8:1 target-to-background ratio. The phantom was mounted onto a motion stage programmed with a free breathing trajectory acquired from a human subject using an external marker. This trajectory was translated into a purely superior/inferior (z) motion path for the stage and used as ground truth. A planning target volume (PTV) was defined around the largest sphere's motion path. LOR data were acquired in list-mode from a GE Discovery system and used as input to a voxel monte carlo simulation of radiation dose delivered by the EGRT system with an average lag time of 250 ms. The EGRT method was compared to uniform irradiation of the PTV.

**Results:** The EGRT approach exhibited a non-uniform dose distribution to the tumor. However, for this specific case there was a 30% relative increase in dose to 50% of the tumor volume for the EGRT approach with both methods normalized to have the same integral dose to the phantom.

**Conclusions:** We have shown that a target exhibiting free breathing motion can be tracked and treated using individual PET emissions to guide delivery. There is dose peaking at the center of a uniform PET-avid volume. This is the first EGRT feasibility demonstration with experimental data.

**Funding Support, Disclosures, and Conflict of Interest:**

SRM and ASN are stockholders of RefleXion Medical.