AbstractID: 7726 Title: Preliminary experimental study for tumor position tracking during radiotherapy using positron emission markers

Purpose: To experimentally evaluate the feasibility of tumor position tracking using positron emission markers for external beam radiation therapy.

Method and Materials: Clinical PET imaging is known to be limited by its low spatial resolution of approximately 4-10 mm. However, if the geometry of the source is known, the position of the sources can be determined with sub-millimeter accuracy. We propose to apply this concept for real-time tumor position tracking during radiotherapy. For pulmonary and abdominal tumors, delivering accurate radiation therapy is limited by the motion of the tumor as the patient breathes. By implanting positron emission markers into tumor, and using pairs of position-sensitive detectors to track the resulting annihilation gamma rays, the position of the tumor can be tracked in real-time with high accuracy. Positron emission based technique will deliver a lower radiation dose to normal tissue than x-ray fluoroscopy, and the smaller size of the positron emission markers reduces risk to the patient during implantation. The concept and simulation study has been previously published (T. Xu et.al, Med. Phys. 33(7) p2598). In this feasibility study, the technique was evaluated using a clinical PET system (CTI ECAT). A Ge-68 Linear source was used to simulate a point source in 2D slices during conventional 2D acquisition. The Ge-68 source was put at 3 locations and the data were combined to simulate multiple (3) markers.

Results: Three point sources were successfully localized using proposed technique. The localization precision ranges from 4 mm down to 0.2 mm when the number of coincident events used increases from 100 to 4100. The precession reaches 0.77 mm with only about 200 events from three point sources.

Conclusion: The study has shown that multiple positron emission markers can be localized with sub-millimeter precision, which is sufficient for tumor localization during radiotherapy.