AbstractID: 9463 Title: Developing Contrast Enhanced Biodegradable Markers to Enhance Image Guided Radiation Therapy

Purpose: Surgical markers implanted during the removal of tumors prior to radiation treatment are used to guide radiation therapy. Current markers are permanent and frequently difficult to image. Our purpose is to develop and analyze contrast enhanced bioabsorbable polymer markers which are detectable in both planning CT images and the delivery verification images from Electronic Portal Imaging Devices (EPID), *MegaVoltage Computed Tomography (MVCT), and Cone-beam CT (CBCT)*.

Methods and Materials: We created bioabsorbable, radio-opaque surgical markers formed into either small cylinders or as a quick-setting injectable liquid that solidifies. Contrast agent ($BaSO_4$) was blended with PLGA (poly lactic-co-glycolic acid) polymer, a bioabsorbable polymer approved for surgical usage. Percent composition of $BaSO_4$ was varied to optimize imaging visibility. Four blends of PLGA cylindrical polymer markers with 5%, 10%, 20%, and 25% loading densities of $BaSO_4$ were made for preliminary measurements. Markers were imaged with EPID, CBCT, CT, and MVCT in various phantoms for image quality analysis. The injectable formulation was made by dissolving the PLGA in N-methyl pyrrolidone (NMP), a low-toxicity, organic solvent at concentrations ranging from 20-40% PLG. To study degradation rates polymer implants with $BaSO_4$ contrast were implanted into 10% gelatin phantoms. CT scans were acquired periodically over 5 weeks to monitor marker stability. Final candidate blends were implanted in rats for testing imaging, biocompatibility, and material stability.

Results: Results show biodegradable polymer can be blended with contrast, producing markers which can be imaged with CBCT, MVCT, EPID, and CT modalities. Markers are stable and biocompatible in test animals.

Conclusions: The blends of 20 - 25% $BaSO_4$ additive bioabsorbable markers were visible in all imaging modalities and therapy sites tested. In vivo animal testing demonstrated stability and biocompatibility. Contrast enhanced markers show great promise and further investigations should be pursued, especially with the increased emphasis on partial breast treatments.