Public Abstract

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Title:DEVELOPMENT OF INSTRUMENTATION AND TECHNIQUES FOR PRECLINICAL IMAGE GUIDED MICROIRRADIATION

Radiation therapy accounts for more than half of cancer treatments in the US, and in order to provide the most effective treatment to patients, new developments are implemented each year. Before a novel radiation therapy device or technique can be used to treat patients in the clinic, it must first undergo testing. One of the most effective testing methods is preclinical small animal testing, because the testing environment provides a large sample population on which treatment variations can be tested for efficacy and possible side effects. To improve the effectiveness of preclinical testing, the devices and methods used on small animals should closely resemble those used in the clinic. These include irradiators, fractionation schedules, repeatability methods, and results characterization. Results characterization will provide a translational pathway between the preclinical and clinical environments of a small animal irradiation and human treatments to account for variation in treatment beams and subject size between preclinical and clinical irradiations.

The Biomedical Physics Laboratory at Washington University in St. Louis, with whom I was working, developed a preclinical small animal image guided microirradiator, the microIGRT, and we characterized the device using clinical methods, such as those used for machine acceptance and quality assurance. In order to provide treatment verification and subject positioning repeatability, we designed, developed, and characterized a micro electronic portal imaging device (microEPID), similar to the portal devices used on clinical linear accelerators. Using the microIGRT and the microEPID, we developed treatments for small animal brain, lung, liver, and spinal tumors using clinical treatment planning methodologies translated to preclinical small animal models. We characterized the treatment results with several metrics and compared these to clinical treatments. The metrics were compared, side by side, and conclusions were drawn for the efficacy of the small animal treatment to establish the first steps for a pathway to translate preclinical results to clinical trials. Considering the difficulties of dosimetry for small fields commonly used in small animal irradiations, we also designed and developed a fiber scintillating microdosimeter. This dosimeter allowed for more accurate orthovoltage beam characterization, thus improving treatment planning and translational treatments.