

AbstractID: 10938 Title: Implementation of an Image-Guided System for Conformal Small Animal Irradiation: Characterization, QA, and Workflow

Purpose: To implement a custom built system for image-guided conformal pre-clinical irradiation.

Method and Materials: The system consists of variable kVp x-ray tube (5-225 kVp), mounted on a rotating gantry with a flat-panel detector (detector element size: 0.4 mm). Animal positioning is achieved through a three-dimensional translational stage. Dosimetric characterization of the system was performed for two beam qualities: 100 kVp, HVL 2.8 mm Al, and 225 kVp, HVL 0.9 mm Cu. Winston-Lutz tests were performed to evaluate isocentricity. In-house software was designed to support fluoroscopic and cone-beam CT (CBCT) imaging, and static and arc treatment using preset treatment protocols. These tools allow high throughput image-guided set-up and treatment of animals. The overall workflow was characterized by hidden-targets tests, including localization and dosimetric accuracy.

Results: The absolute output of the x-ray tube was verified by 3rd party TLD measurements. Output and energy agreed with calibration to within 2% upon monthly quality assurance tests. Flexmaps repeated over 8 months were consistent within ± 0.1 mm. Winston-Lutz tests revealed a residual system flex of ± 0.5 mm and ± 0.1 mm in the cone and fan directions, respectively. Target localization accuracy in repeated tests using both fluoroscopic and CBCT imaging was sub-millimeter. CBCT images were reconstructed with 0.2 mm isotropic voxels. This system has been in use for small animal irradiations for 10 months, during which time over 600 animal irradiations have been performed.

Conclusion: Image-guided conformal irradiation systems provide an important tool for translational research in radiation oncology. This system recapitulates the clinical tools for radiation oncology, and provides a versatile and easy-to-use platform for conformal image-guided treatment of small animals.

Conflict of Interest: Some of the co-authors are inventors of this system, and may financially benefit through its successful commercialization by Precision X-Ray, Inc.