AbstractID: 8355 Title: Design of the Washington University Small Animal Conformal Micro Irradiator

Purpose: To design a conformal small animal micro radiation therapy (microRT) instrument, consisting of a cone beam microCT subsystem for submillimeter low dose structural imaging and image guided radiotherapy and an orthovoltage conformal micro irradiator with high radiation dose rate for high throughput conformal irradiation
Method and Materials: The microCT subsystem is based on an 80kVp micro-focus x-ray source with 75x75 um^2 focal spot and a flat panel amorphous silicon detector with 1024x1024 pixels. The microRT subsystem design utilizes a 320kVp orthovoltage source with dual focus spots (0.4x0.4 mm^2 at 800W and 1x1 mm^2 at 1800 W). The orthovoltage beam is collimated using two orthogonal jaws and exchangeable apertures. The resolution of the cone-beam micro CT and the therapy beam spatial precision was determined using a numerical model. The microCT radiation dose, the orthovoltage source spectral output, and dose rate were evaluated using a mouse digital phantom (MOBY) and a pencil beam algorithm.
Results: microCT reconstructed tomographic data with a resolution of 125 μm is achievable using 128 projections and a maximum radiation dose of 2cGy. Automatic animal positioning and handling is performed within a precision of 100 μm. The treatment beam can be aimed at different latitude and longitude angles in steps of 2 arc min. and translated at 50μm steps (x,y,z). The beam cross section can be modulated with submillimeter precision using steps of 50μm. A radiation dose rate of 40 Gy/min is delivered when the system is operated at an average half-value layer of 4.6 mm Cu and a maximum beam penumbra of 0.35 mm.
Conclusion: We designed and numerically evaluated the performance of a microRT system integrated with a microCT for conformal radiotherapy of murine animal models.

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