Purpose: To extend the capabilities of a micro-CT to perform conformal image-guided small animal radiotherapy with minimal system modifications.
Methods: A GE eXplore CT 120 preclinical imaging system, with an upgraded x-ray generator (140kVp, 50 kW), was recently installed at our institution. We have constructed an in-bore collimator that allows delivery of off-axis rectangular fields, equivalent to a pair of independent orthogonal jaws. All measurements were performed using the large focal spot (1.0 mm) at 140 kVp, 50 mA, 25 ms pulse duration, with 220 ms between pulses. The half value layer (HVL) was determined in aluminum. The dose rate at isocenter of an un-collimated field was measured in a 20 mm diameter PMMA phantom with 0.6 cc ion chamber. EBT2 radiochromic film was calibrated against the ion chamber up to 8 Gy. Square beam profiles (5 x 5, 10 x 10, 20 x 20 and 30 x 30 mm) were measured using EBT2 film on the surface of a 40 x 40 x 19 mm polystyrene block, with the surface placed at isocenter. Films were scanned on a flatbed scanner (Epson 1000XL) and converted to dose using a fitted calibration curve.
Results: The first and second HVL was determined to be 7.1±0.3 and 10.2±0.2 mmAl respectively. The dose rate of an un-collimated field was measured at 29.4±0.1 cGy/min, including beam off time. The beam profiles showed the fields were reasonably flat and symmetric, with flatness values ranging from 1.4% to 5.0% and symmetry from 0.4% to 6.5%. The beam penumbra was very sharp, with values from 0.4 to 0.7 mm, due to the in-bore collimation.
Conclusion: The initial performance of this micro-CT scanner and in-bore collimator shows potential for conformal radiotherapy for small animals including rats without significant structural modification of the micro-CT.