AbstractID: 5825 Title: An Image-guided Irradiator for Pre-clinical Radiation Therapy Studies

Purpose:
The development of IMRT has increased the community's reliance upon dose-volume constraints for normal tissue avoidance and the development of SBRT has increased the consideration of alternate fraction schedules. The lack of clinical data for supporting these changes in practice places additional pressure on the development of realistic animal models for fractionation and normal tissue dose-volume studies. In support of these efforts, the construction of an image-guided radiation therapy unit for small animals has been initiated. The current status of this development and its design elements are described.

Method and Materials:
The system is comprised of a decommissioned radiation therapy simulator (Nucletron – Simulix) adapted to support a flat-panel detector (Perkin Elmer, RID1640) and a 225kVp x-ray tube (GE Siefert 225, f.s.=0.4-3mm). The pulsed radiographic exposures (200-600) collected over 360 degrees are reconstructed using a filtered back-projection cone-beam CT method. Soft-tissue visibility and geometric targeting of the system components have been assessed. EGSnrc Monte Carlo simulations were performed to assist in the design of the optimal treatment geometry for rodent and rabbit models. The simulations for 225 kVp x-rays (1 cm diam circular field size) have been considered to achieve high dose rate, small penumbra, and acceptable clearance during arc-based delivery.

Results:
The cone-beam CT imaging system generates soft-tissue images of rodents with sub-mm resolution. Monte Carlo results demonstrate penumbral performance (d90-50) of the system with a 3mm focal spot and reduced collimator-object distance will be under 1mm. A radial dose gradient can be established from 360 degree arc approach (9%/mm from D90-d50) for small field sizes.

Conclusion:
The development of a cone-beam CT guided radiation therapy unit with sub-mm resolution and high 3D dose gradients is progressing. Initial simulations and imaging system development suggests that precisely located spherical dose distributions can be delivered with such a system.