

AbstractID: 11908 Title: Development and Application of a Pre-clinical Stereotactic Irradiator

With the advent of advanced image-guidance technologies, stereotactic body radiation therapy (SBRT), the application of an ablative dose of radiation given in one or few fractions and delivered with high accuracy, has emerged as a promising modality in the treatment of cancer. Despite this success, there is remains room in optimizing delivery and understanding response. In this regard, pre-clinical studies can be very beneficial in systematically evaluating response and predicting and validating clinical protocols. We describe the development and application of a small animal irradiator, which provides high accuracy in target localization and radiation delivery in a manner that mimics clinical SBRT delivery. The essential characteristics of the irradiator include: a high dose rate (≥ 10 Gy/min), allowing high dose delivery in a clinically-relevant time frame; precise target localization (≤ 1 mm) to optimize irradiation to a tumor with respect to normal tissue sparing; and small radiation fields (1 to 10 mm) needed to implement the technology in small animals. The irradiator is based on a commercial X-ray device (XRAD 320, Precision X-ray, Inc.). The system can be operated at low energies (20-30 kVp) for high contrast imaging (essential for precise localization), and at high energies (≥ 250 kVp) for therapeutic delivery. Radiation beam parameters, including energy specification (characterized by the half-value layer - HVL), depth dose characteristics, and off-axis profiles, have been determined through direct measurement. We describe the application of the device in a number of subcutaneous tumor, orthotopic tumor, and normal tissue models developed at our institution. Finally, the development of a next-generation irradiator is also discussed.