AbstractID: 4546 Title: Radiological Dependence of Electronic Brachytherapy Simulation on Input Parameters

Purpose: In comparison to ^{125}I or ^{192}Ir, characterization of dose rate distributions from electronic brachytherapy is subject to the additional challenge of unforeseen photon energy spectra. Towards simulating photon energy spectra and resultant dose rate distribution, Monte Carlo investigators first generate electrons which bombard the x-ray tube anode and subsequently create photons via bremsstrahlung. Modeling techniques for this endeavor are largely unexplored. Therefore, sensitivities of spectra and dose rate distributions were assessed through varying modeling parameters for the Xoft Axxent x-ray source. **Materials & Methods**: MCNP5 was used to simulate photon spectra and dose rate distributions, with comparisons to experimental measurements (PTW model 34013 chamber in liquid water) for $1<r\leq 7$ cm and $0^\circ\leq \theta \leq 150^\circ$ with simulations covering $0.3 \leq r\leq 15$ cm and all available angles. The following source modeling parameters were evaluated for impact on in-water spectra and dose: electron beam radius (R), electron beam annularity (R') like a doughnut, and anode film thickness (t). Since simulations of electron:photon transport are inefficient in comparison to Monte Carlo modeling of radionuclides, MCNP variance reduction techniques such as cell importances (IMP), electron cutoff energies (PHYS:E), high-energy biasing of bremsstrahlung spectrum (BBREM), and bremsstrahlung photon multiplicity (BNUM) were assessed. **Results**: Due to the complex anode shape, $F(r,\theta)$ was highly-dependent on R, varying a factor of 2 when changing R from 0 to 0.084 cm. This effect was more pronounced when varying R' due to less radial volume averaging. Through comparison with experimental measurements, the optimal electron beam shape had the largest spot size which could fit within the anode and no annularity; it was a uniform pencil beam. Altering MCNP variance reduction techniques did not significantly alter results, but greatly hastened simulation efficiency. **Conflict of Interest**: Research was sponsored in part by Xoft, Inc.