AbstractID: 10848 Title: Benchmark investigation of MCNP5, EGSnrc, and PENELOPE Monte Carlo codes for calculating the emitted photon spectrum from an electronic brachytherapy source

Purpose: To perform a benchmark investigation of three general-purpose Monte Carlo codes used to calculate the emitted photon spectrum from the Xoft Axxent® electronic brachytherapy source. **Method and Materials:** Three different Monte Carlo codes, MCNP5, EGSnrc, and PENELOPE were benchmarked for parameters relevant to simulation of the Axxent® source. The tested parameters were electron backscatter from a high atomic number slab, electron impact ionization and bremsstrahlung production in tungsten, and yttrium fluorescent photon production. A full model of the Axxent® source was constructed in each code, and the differences in the emitted photon spectra were explained based on the results of the simple benchmarks. **Results:** The three electron transport algorithms in MCNP5 produced up to 48% differences in electron backscatter, but the best agreement with EGSnrc, PENELOPE, and experimental data was with the ITS-style energy indexing. The choice of electron transport cutoff energy in PENELOPE had a large effect on the number of backscattered electrons, but less of an effect on the total backscattered energy. Bremsstrahlung production in tungsten was in good agreement for all three codes, but large differences in the production of tungsten L-shell fluorescent photons were observed. The yttrium Kα fluorescent photon production in MCNP5 was 35% low compared to PENELOPE when executed with full photon/electron transport, but it was within 3% of PENELOPE when executed using photon transport only. The simulation results for the full model of the Axxent® source were consistent with the results from the individual benchmarks, with significant differences in the tungsten L-shell fluorescent photons and yttrium fluorescent photons. **Conclusion:** The three Monte Carlo codes produced differences in the calculated photon spectrum for the Axxent® source, and these differences will have an effect on the corrections applied for air-kerma strength measurements. **Conflict of Interest:** This study was funded in part by Xoft, Inc.