AbstractID: 6865 Title: Development of a fluence benchmark for clinical electron beams

Purpose: A fluence benchmark for clinical electron beams with application to validation of the electron beam model of a commercial radiotherapy treatment planning system

Method and Materials: A fluence benchmark for the 6-21 MeV electron beams of a clinical linear accelerator was determined for 40x40 large field. Measurements were done on a clinical accelerator that is not used to treat patients, allowing us to disassemble the accelerator and directly measure critical geometrical details and to operate the accelerator outside the normal operating range to help ascertain source and geometry details. Therefore, source and geometry in the simulation was adjusted within more restrictive limits than previous studies to match simulation results to measured central axis depth dose curves, cross-plane and in-plane profiles at the depth of maximum dose, d_{max}, and in the bremsstrahlung tail. Parallel to this process, a series of measurements were made on the same linac to commission a commercial planning system. The fluence calculated with the commercial beam model was validated with the fluence benchmark.

Results: Agreement between measured and simulated depth-dose curves upstream of the fall-off region and depth-ionization curves in and beyond the fall-off region was excellent: within 1%/0.5 mm. The dose profiles matched within 1% in the high-dose regions of the electron field and within 2 mm at the field edge. The current benchmarks approach the goal of within 1% in fluence, given 100% on the central axis, and 2 mm in position. The electron energy distributions of the 6 electron beams calculated with the commercial beam model closely matched the benchmark.

Conclusion: A high accuracy, highly detailed fluence benchmark for clinical electron beams is developed and proved to be useful for validation of the electron beam model of a commercial planning system to the accuracy required for dose calculation in radiotherapy.

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