AbstractID: 7455 Title: Commissioning of the Pinnacle³ electron beam MC dose calculation algorithm for patient-specific treatment planning

Purpose: To report on the commissioning of the Pinnacle^3 Monte Carlo (MC) electron dose algorithm and to compare MC and pencil beam (PB) dose calculations for complex electron beam clinical treatment plans.
Method and Materials: The Pinnacle^3 (Philips Radiation Oncology Systems) MC dose algorithm consists of primary electron and contaminant photon sources which parameterize particle transport through the jaws and electron applicator. Five electron applicators ranging in size from 5x5 to 25x25 were modeled for a 9 MeV electron beam from a Siemens (Primus) linac. A combination of auto-modeling scripts and iterative adjustment were used to modify various parameters in the model in order to produce the best agreement with measured depth and profile doses. Parameters included the electron spectrum, the contribution from contamination photons and the in-air scattering beyond the applicators. The commissioned MC beam model was subsequently used to calculate dose distributions for two patients treated with superficial lesions in highly irregular anatomies involving the ear and face.
Results: The agreement between MC calculations and measurements was on average within 2%/2 mm for all applicator sizes. Larger differences were noted for the 25x25 applicator particularly in the beam horns; similar discrepancies were found for the PB beam model. Significant dose differences (particularly above the 90% dose level) were observed between MC and PB calculations in one plan. Relative to MC, the PB algorithm over-estimated monitor units by 6% and 3% for the two cases. Timing values were 6.0 and 76.3 minutes for the 9 MeV, 5x5 and 15x15 applicator plans respectively for 1.0% uncertainty averaged over 4 mm cubic voxels with dose>50%dose$_{max}$.
Conclusion: The large differences between MC and PB dose algorithms in complex, electron-only patient treatment plans provide justification for the need for well-commissioned MC electron beam algorithms in routine treatment planning.
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