AbstractID: 14149 Title: Comparing computational phantoms and whole-body patient CT images for secondary cancer risk estimation

Purpose: To check the sensitivity of anatomy detailing on the quantification of second cancer risk in pediatric patients treated with passively scattered protons.

Method and Materials: Clinical radiation treatment plans for medulloblastoma were analyzed and representative beams were selected for conversion to a Monte Carlo system for dose calculations in Geant4. Phase space files, separately for primary protons and treatment head generated neutrons, were generated at the exit of the beam-shaping aperture using the detailed model of the MGH treatment nozzle for 4 circular fields: center of brain, superior-, mid- and inferior-spine; range (90-90%) of 11 cm, modulation width of 5 cm, aperture diameters of 3 and 9 cm (higher and lower neutron contributions, respectively). Anonymized whole-body patient CT data from pediatric patients treated with protons were incorporated into Geant4 simulation code. Three sets of age-dependent pediatric whole body fully-segmented phantoms developed at the University of Florida were incorporated as well: the UF-B series, the new ICRP-compliant series and a patient-adjusted 'hybrid' phantom. To calculate organ equivalent doses, radiation weighting factors were used. Results for organ equivalent doses were compared between different anatomical representations. The number of particles generated in the phase space files varied 1.4–9 million.

Results: The results on organ doses show a discrepancy of 40-70% for out-of-the-field organs close to the beam, and up to a factor of five for organs further away. The latter is partially due poor statistics in dose scoring.

Conclusion: Fully-segmented whole body computational phantoms are indispensable for risk analysis where organ doses through the full patient body are needed but rarely available due to lack of CT or segmentation. The error of using voxelized and non-stylized phantoms instead of patient specific anatomy is lower than in current risk models, hence they are suitable for estimating the organ doses.

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