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TU-F-CAMPUS-T-05: Replacement Computational Phantoms to Estimate Dose in Out-Of-Field Organs and Tissues

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Abstract

Purpose:

To estimate the absorbed dose in organs and tissues at risk for radiogenic cancer for children receiving photon radiotherapy for localized brain tumors (LBTs) by supplementing their missing body anatomies with those of replacement computational phantoms. Applied beyond the extent of the RT Images collected by computed tomography simulation, these phantoms included RT Image and RT Structure Set objects that encompassed sufficient extents and contours for dosimetric calculations.

Method:

Nine children, aged 2 to 14 years, who received three-dimensional conformal radiotherapy for low-grade LBTs, were randomly selected for this study under Institutional-Review-Board protocol. Because the extents of their RT Images were cranial only, they were matched for size and sex with patients from a previous study with larger extents and for whom contours of organs at risk for radiogenic cancer had already been delineated. Rigid fusion was performed between the patients' data and those of the replacement computational phantoms using commercial software. In-field dose was calculated with a clinically-commissioned treatment planning system, and out-of-field dose was estimated with an analytical model.

Results:

Averaged over all nine children and normalized for a therapeutic dose of 54 Gy prescribed to the PTV, where the PTV is the GTV, the highest mean organ doses were 3.27, 2.41, 1.07, 1.02, 0.24, and 0.24 Gy in the non-tumor remainder, red bone marrow,

thyroid, skin, breasts, and lungs, respectively. The mean organ doses ranged by a factor of 3 between the smallest and largest children.

Conclusion:

For children receiving photon radiotherapy for LBTs, we found their doses in organs at risk for second cancer to be non-negligible, especially in the non-tumor remainder, red bone marrow, thyroid, skin, breasts, and lungs. This study demonstrated the feasibility for patient dosimetry studies to augment missing patient anatomy by applying size- and sex-matched replacement computational phantoms with pre-contoured organs.

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