AbstractID: 7742 Title: Uncertainties in Superficial Dose from Helical Tomotherapy Delivery due to Target Localization Errors

Purpose: To quantitate shallow-depth dose calculation accuracy for IMRT breast treatment plans created with Tomotherapy system and to estimate the dose errors caused by setup errors.

Methods: A cylindrical solid water phantom with radiochromic film was used for this purpose. The split phantom can hold a film in coronal or sagittal planes. A 5cm thick PTV was contoured by extending it to the surface of the phantom. A plan was optimized to treat the superficial PTV while limiting the dose to the surrounding critical structures. To evaluate the setup uncertainties multiple phantom plans were generated by shifting the phantom 5, 10 and 20 mm to right and up (7, 14, and 28mm distance) and simulated doses were compared against the measured doses. The 3D dose matrices from TPS for no-shift and shifted phantom plans were exported in DICOM and were analyzed in MatLab. Doses from eleven transverse slices were analyzed to estimate the dose differences in the shifted phantom plans. Shifted phantom plan dose distributions were transposed back onto the patient PTV and computed dose difference histograms (DDHs) in the PTV volume.
Results: The planning system overestimated the shallow-depth dose by as much as 14%, but was smaller than 3% at depths greater than 5mm. PTV DDHs for no and 7 mm shifts showed <5% dose differences, while for 14 mm, the dose differences were ≤10% and were very large for the 28 mm shift.

Conclusion: Tomotherapy planning system computes the shallow-depth dose within 14% accuracy at 1.0 mm and better than 3% for depths greater than 5mm. Setup errors ≤7mm showed negligible dose errors, consistent with the use of image-guided therapy. Large shifts were required to induce large dose errors in the PTV.

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