AbstractID: 3763 Title: Comparison of Monte Carlo and Convolution/Superposition Calculation Methods: Quantification of the Dose Prediction Errors Arising from Tissue Heterogeneities.

Purpose: To investigate the extent of the dose prediction error (DPE) due to tissue heterogeneities in superposition/convolution (SC) based dose calculations by comparisons with Monte Carlo (MC) calculations for head-and-neck IMRT treatment plans.

Materials and Methods: A retrospective investigation is performed for ten Head-and-Neck IMRT patients. Dose calculations are performed with SC and MC algorithms. For both algorithms, the intensity modulation generated by the dynamic multi-leaf collimator (DMLC) is incorporated into the dose calculation via a transmission matrix generated by determining the ratio of incident and transmitted energy fluence through the DMLC using a MC algorithm. Plans were compared based upon the criteria used during the IMRT optimization: GTV D_{98}, CTV D_{95}, Nodal volume D_{90}, Cord D_{02}, and Parotid D_{50}. As the same transmission matrix is used for both methods and the SC and MC algorithms subsequent dose differences are attributed to handling of the tissue heterogeneities by the SC algorithm.

Results: The GTV D_{98} and CTV D_{95} local doses agree within ±3.2% for the SC and MC calculations. Differences are within ±1.8% for the D_{90} of the nodal target volume. The cord and the brainstem D_{02} doses differ by <±3.5% and <±2.5% of the local dose respectively. The Parotid D_{50} shows the greatest variations, with local differences up to 5.8%. The observed deviations do not show systematic under- or over-estimate of the dose by SC.

Conclusions: When identical transmission matrices are used, the DPE of the SC method, using the MC method as a references, is <±3.2% for the target structures. For the critical structures, DPEs as high as 6% of the local dose were observed, which corresponds to <3% if normalized to the prescription dose. (Supported by NIH-1R01CA98524)