AbstractID: 11437 Title: Investigation of Dose Accuracy in XiO Superposition Convolution Algorithm Calculation When Lower-Jaw is Replaced with MLC

Purpose: To investigate the dose delivery accuracy using Linacs with MLCs as lower-jaws planned with the CMS-XiO superposition convolution dose calculation algorithms.

Method and Materials: Siemens Primus accelerators with multi-leaf collimators as lower jaws and Varian Trilogy accelerators with tertiary collimators were used in this study. Delivered dose were measured with a calibrated 0.125 cc ion chamber in a $30x30x15$ cm^3 solid water phantom for a series of specially-designed T-shaped MLC fields with different field-aperture-opening ratios (FAOR) and several clinically used 3DCRT MLC-blocked fields were compared with dose calculations using the XiO superposition convolution method, Clarkson and hand calculations with combined or separate collimator scatter and phantom scatter factors. Several block-equivalent-square (BES) values, including XiO convolution back-projected-BES, Clarkson BES, geometrically-estimated BES, were utilized in the hand-calculations to compare as independent checks. Monte Carlo simulations were performed to verify the dose calculation and to study the sources of scattering contribution.

Results: Up to 8.0% discrepancies were found between XiO superposition convolution calculation and measurements for the Siemens accelerator while good agreement (within 1.0%) was obtained for the Varian accelerator for various FAOR. An average 1.8% difference between Siemens and Varian Linacs was noted with the FAOR >1/3, possibly resulted from the "imaginary" lower jaws in the XiO convolution algorithm for Siemens. Monte Carlo simulations confirmed these results. Hand calculations using a combined collimator scatter and phantom scatter factor with a XiO back-projected-BES can estimate the delivered dose accurately (0.12% of measured values) including extreme cases for Siemens (FAOR<1/3).

Conclusions: A 1.8% correction should be applied to Linacs that use MLCs to replace a pair of jaws in the XiO superposition convolution algorithm when FAOR is >1/3. For FAOR <1/3, the XiO superposition convolution should not be used while hand calculations can be used by combined collimator scatter factors with XiO back-projected-BES.