AbstractID: 13058 Title: Effects of the MLC characteristics on IMRT dose distribution

Purpose: The purpose of this study is to investigate the characteristics of the Multi-leaf collimator (MLC) including the leaf thickness, leakage and the tongue-and-groove structure and their effects on the dose distribution of intensity-modulated radiation therapy (IMRT) and patient-specific IMRT quality assurance (QA).

Methods: Monte Carlo dose calculations were performed based on intensity maps that were built from the actual deliverable IMRT leaf sequences with and without considering the characteristics of MLC using our in-house Monte Carlo software. Intensity maps with a fine resolution ($0.1 \times 0.1 \text{mm}^2$ pixel size) were used for IMRT dose calculation. The mean dose of the treatment target and the voxel doses in high dose regions of 7 IMRT plans generated by different treatment planning systems for Varian 21EX and Siemens Primus linear accelerators were used for comparison and evaluation.

Results: The MLC leaf thickness, leakage and the tongue-and-groove structure can change the mean dose by up to 4.5%, 5.6% and 5.3%, respectively, when these factors are considered separately. They also cause significant uncertainties in the voxel doses with standard deviations of up to 0.7%, 2.1% and 1.3%, respectively. The fudge factors applied in treatment planning systems (TPS) can only compensate the mean dose change partially because the effects are different for individual IMRT plans. The uncorrected mean dose change and the voxel dose uncertainties are shown as the difference between the TPS calculation and measurements in measurement-based IMRT QA.

Conclusions: It is concluded that the MLC characteristics can affect the mean target dose and cause significant uncertainties in individual voxel doses. The dose uncertainties caused by MLC characteristics are a major source of dose discrepancies for measurement-based IMRT QA because they are not fully considered in the TPS.