AbstractID: 11089 Title: Study of systemic and random errors on VMAT and IMRT plan quality and deliver accuracy

Purpose: During the delivery of volumetric modulated arc therapy (VMAT), random errors exist in both the MLC leaf positions and the gantry angle. In this work, we investigated the impact of such random errors on VMAT plan quality and delivery accuracy. The impact of system calibration errors was also examined. For comparison purposes, we performed a similar study on step-and-shoot IMRT plans.

Material and Method: VMAT plans for three treatment sites (prostate, pancreas and head-&-neck) were created using a home-grown arc sequencer. Next, random and systematic leaf position errors were introduced into these plans with the random errors sampled from Gaussian distributions of varying widths ranging from 1 to 3mm. Two types of systematic errors, including MLC bank shifts in the same direction (Type I: leaf gap unchanged) and MLC bank shifts in opposite directions (Type II: leaf gap increase/decrease). The plan quality variations were compared in the Pinnacle^3 planning system. Plans with systematic errors were verified using the MatriXX ion chamber array with gamma evaluation criteria of 3%/3mm.

Results: The plan degradation observed for VMAT plans was slightly less as compared to that for fixed-field IMRT plans when random errors up to 3mm to the leaf positions were introduced. With type I systematic errors of 3mm on leaf positions, the average standard deviation of PTV dose increased by 10.2%. This value increased to 18.4% for the corresponding fixed-field IMRT plans. A larger impact on the IMRT plans was also observed when type II systematic errors were introduced. The above results were confirmed by plan verification measurements with higher gamma passing rates for VMAT plans when systematic errors were applied.

Conclusion: The VMAT delivery technique has better tolerance to random and systematic errors in gantry angle and MLC leaf position errors as compared with step-and-shoot IMRT.

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