Purpose: VMAT has received considerable attention due to its ability to provide improved plan quality and delivery efficiency relative to fixed field IMRT. A key component of VMAT treatment planning is the need to restrict the leaf motion from one control point to the next. In this work, we studied the dependency between restriction on leaf motion and the plan quality, delivery accuracy and efficiency for VMAT.

Material and Methods: The leaf motion constraint is the maximum distance one MLC leaf can move between adjacent control points within an arc with a unit of mm per degree of gantry rotation. Three cases with different sites were planed for VMAT treatment using a variety of leaf motion constraints. Final dose calculation for each plan was done with 2-degree control point spacing. All VMAT plans were delivered on an Elekta Synergy linac with PreciseBeam VMAT® control system, and were verified using IBA MatriXX system. A 2%/2mm passing criteria was used in Gamma Evaluation.

Results: The as-optimized VMAT DVHs looks very similar for different leaf motion constraints. The final dose, however, reveals degradation in plan quality with increasing leaf motion. Such degradation is most pronounced for the Head-Neck case. Best plan quality was obtained with 2~3mm/degree leaf motion for Head-Neck and prostate cases, and 3~5mm/degree for pancreas case. The delivery time increases monotonically with the increase of leaf motion and can be 2~3 times different. In terms of delivery accuracy, plans with more leaf motion tend to have lower gamma passing rate (93% for 2mm/deg and 71% for 20mm/deg for the Head-Neck case). We recommend a 3mm leaf-motion constrain for creating VMAT plans.

Conclusion: The leaf motion constraint in VMAT planning is a critical parameter and has to be considered to ensure plan quality, deliver accuracy and efficiency.

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