AbstractID: 13753 Title: Comparison of techniques to simulate VMAT for matching delivery to dose calculation

Purpose: To simplify the dose calculation process, dynamic delivery techniques such as VMAT are typically approximated using static fields for the dose calculation. A number of techniques have been employed for VMAT dose calculations and delivery. In this work, we have evaluated these different techniques in terms of the accuracy and the agreement between planned and delivered doses.

Materials and Methods: Dose calculations for VMAT include static field and Monte-Carlo simulations. Different methods of setting the control points (CPs) during DICOM export, including MU redistribution, CP insertion, and CP reposition, were tested for dose calculations using static fields. The exported VMAT plans were delivered using the Elekta PreciseBeam® VMAT linac control system. The delivery results were measured using an IBA MatriXX system and were compared with the calculation data to test the delivery accuracy.

Results: Using static fields for dose calculation and MU redistribution for VMAT delivery can lead to significant discrepancy between the calculation and delivery. The passing rate of the gamma analysis with 3%/3mm criteria can be as low as 67% when tested using an extreme case. The CP insertion and CP reposition methods can improve the agreement between the planned and measured doses. However, MLC leaf motion between adjacent CPs needs to be limited when static fields are used for VMAT dose calculation. Using Monte-Carlo dose calculation to simulate the dynamic delivery of VMAT provides excellent agreement between the dose calculations and deliveries regardless of the amount of MLC leaf motion used in the plan with an average gamma analysis passing rate of 98.1% for the 5 selected VMAT plans.

Conclusions: Using static fields to simulate VMAT works well as long as CP setting for delivery is handled properly. Monte-Carlo simulation has a clear advantage in simulating dynamic VMAT delivery.

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