Method for optimizing MLC beam model parameters in RayStation® for VMAT deliveries

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INTRODUCTION

- Dose calculations for VMAT deliveries are sensitive to small changes in MLC beam model parameters that are considered difficult to assess with IMRT QA phantoms [1]
- While film and OSLDs can be used for end-to-end testing of clinical plans, this work utilized multiple calibrated ionization chambers with measurement uncertainty <1.5%.
- In RayStation® beam models, leaf tip width (LTW) is used to account for x-ray transmission through the rounded end of a multileaf collimator (MLC)
- Tongue-and-groove width (TGW) accounts for transmission along exposed leaf sides in an MLC-defined aperture
- In this work, LTW and TGW values were varied to optimize agreement between TPS calculations and ionization chamber measurements for representative VMAT plans

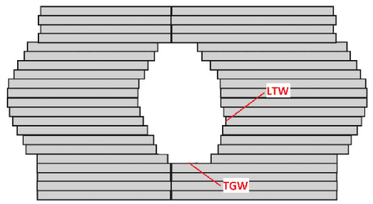

Fig. 1. LTW and TGW parameters in RayStation®

METHODS

- Analysis was performed for 6, 10, and 15 MV beams with an institutional Varian TrueBeam™ beam model in RayStation® v7
- LTW and TGW values were varied 0.00-1.00 cm and 0.00-0.25 cm, respectively, while all other model parameters remained fixed
- VMAT test plans included three anatomy-based plans (unilateral neck, chest wall, lung) and four geometry-based plans (off-axis target, C-shape, small and large cylinders) from TG-119 [2]
- Average dose was calculated for ROIs corresponding to ionization chambers placed within a cylindrical Solid Water® phantom
- TPS dose was compared to measurements using calibrated A1SL chambers at six positions within the high dose region. Corrections were made for accelerator output measured same-day following the TG-51 protocol [3]

RESULTS

- Fig. 2 shows percent difference between ionization chamber measurements and RayStation® calculations averaged over all plans as a function of LTW for each beam energy
- Fig. 3 shows corresponding data as a function of TGW for the same VMAT test plans
- Percent difference was found to trend linearly (dashed line) with larger calculated doses resulting from increasing LTW and decreasing TGW
- Point-wise disagreements up to 9.2% and 19.4% were observed for variations in LTW and TGW, respectively
- Optimized LTW and TGW parameter values for each beam energy ranged from 0.33-0.36 cm and 0.00-0.08 cm, respectively

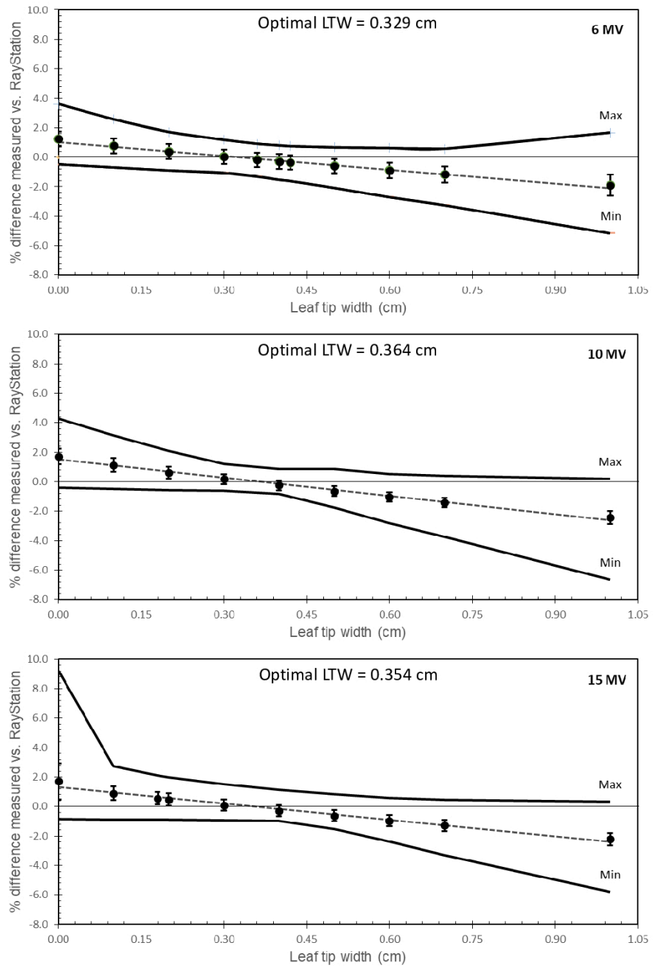

Fig. 2. Measured vs. calculated dose as a function of LTW for 6, 10, and 15 MV beams

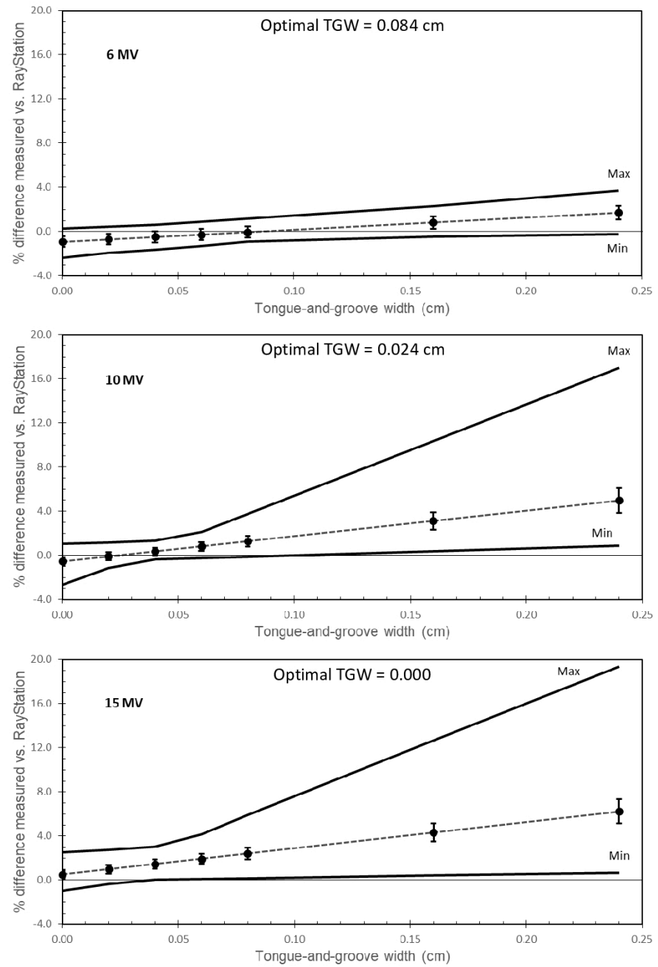

Fig. 3. Measured vs. calculated dose as a function of TGW for 6, 10, and 15 MV beams

CONCLUSIONS

- Based on results from a suite of VMAT test plans, the parameters LTW and TGW were optimized with high precision (±0.01 cm)
- Parameter values reported in this work should not necessarily be considered typical since they are specific to the beam model, treatment machine, and chosen test plans
- Nevertheless, the methods shown in this work can be used by other clinics to assess various parameters when creating a beam model for dynamic delivery in any treatment planning system

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CONFLICT OF INTEREST

The authors have no relevant conflicts of interest to disclose for this work.

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