Impact of the MLC leaf-tip model: **TPS dose calculation deficiencies and IROC-H phantom failures**

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PURPOSE

Radiotherapy treatment planning system (TPS) dose calculation is sensitive to MLC modeling, especially when treating with IMRT / VMAT. AAPM recommendations such as TG-119 and MPPG-5a suggest that patient-specific IMRT QA can be used to detect modelling errors.

We investigate the dosimetric impact of two MLC model parameters (leaf-tip width and leaf-tip offset) in a commercial TPS. We also assess the detectability of introduced errors and the relationship with IROC-H head-and-neck phantom failures.

METHODS

Commissioning

- Elekta Agility MLC was commissioned clinically in RayStation v.6
- 9 IMRT/VMAT plans optimized to treat the IROC-H H/N phantom
- All plans were re-calculated on 27 different MLC beam models varying:
- MLC leaf-tip width: represents region of partial transmission
- MLC leaf-tip offset: represents shift of MLC from nominal position
- Clinical model: MLC leaf-tip width = 4.5 mm, MLC leaf-tip offset = -0.5 mm



TLD: PTV2

the phantom is shown.

Figure 1: MLC leaf-tip width, which represents a region of partial transmission, and MLC leaf-tip offset, which represents a shift of the MLC from the nominal position.

Evaluation

- TLD doses measured and compared between clinical model and MLC-shifted models
- Physical doses from IROC-H H/N phantom for one plan (7-field IMRT)
- TPS calculated doses for all other plans.
- Plan-specific QA and ROC analysis performed with ArcCheck (3%/3mm)
- "Failing" plan is one that fails IROC-H criteria (7% dose difference in TLD)

CONCLUSIONS

Small changes in the MLC leaf-tip offset can cause large changes in the calculated dose for IMRT and VMAT plans that are difficult to identify through standard IMRT QA methods. These errors were only detectable through external validation. These results may, in part, explain the reported high failure rate of IROC-H phantom tests.



TLD	loitial	Final
	IIIIIdi	FINAL
PTV1 - center	-7%	-4%
PTV1 - periphery	-9%	-3%
PTV2	-4%	-2%
Spinal cord	-4%	+2%
Table 1 : Percent diffe	erence between TLD dos by the TPS	se measured by IROC-H

