TPS commissioning for IMRT/VMAT

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Background and Objective

The study describes the methodology for Monaco TPS beam model validation on two Infinity linear accelerators for IMRT/VMAT techniques.

Methods

One of the two linear accelerators was taken as a reference and the second one was matched in terms of PDDs and profiles for different field sizes and depths in a water tank using gamma analysis. For MLC calibration verification, a 3 abutted field was measured and analyzed with a 2D matrix array. An offset was applied to produce a best fit for both MLCs. After that, the ExpressQA package provided by Elekta was performed to fine-tune MLC parameters by comparing TPS calculated dose distributions with those measured at the linear accelerator.

For IMRT/VMAT verification, AAPM TG119 test cases were used. DICOM images from the AAPM website with structures sets were imported into Monaco 5.11 TPS. Planning was done for Prostate, Head and Neck, Multi Target and C-Shape for both IMRT and VMAT techniques following recommendations set in TG119 report. All treatment plans were created using 7-9 beams for IMRT and 1-2 arcs for VMAT for energy 6MV. For point dose measurement, IBA FC-65G (0.65cc) ionization chamber in a RW3 phantom was used at CAX. For planar dose measurement, a 2D array (IBA Matrixx) positioned in a MultiCube phantom set to the isocenter. Planned and measured planar dose distributions were compared using gamma index criteria of 3%/2mm as recommended by AAPM TG218. For IMRT plans, gantry was kept at zero angle. IMRT and VMAT plans were delivered on both machines and a comparison was made.

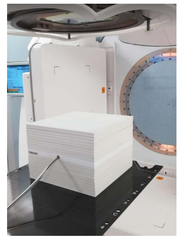

Fig1. Setup of phantom for 1point dose measurement

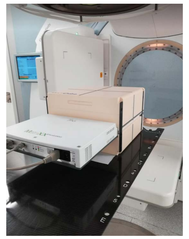

Fig2. Setup of phantom for planer dose measurement

Results

The 3 abutted field profiles of the two machines showed a good match with gamma index of 99.6% using 2%/2mm criteria.

All plans reached the goals as per TG119 reports. In term of point dose measurement, an average difference of 0.1%, 0.4% was observed for IMRT and VMAT respectively. For planer dose distribution, the mean gamma index values were 98.9% and 98.6% using 3%/2mm criteria with a mean confidence limit of 1.8 (i.e., 98.2% passing) and 3.9 (i.e., 96.1% passing) for IMRT and VMAT delivery on both linear accelerators respectively.

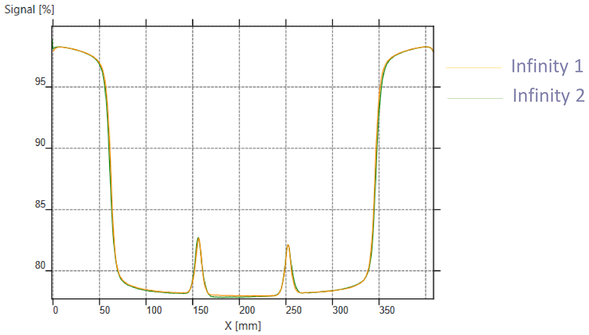

Fig3. 3 abutted field profiles

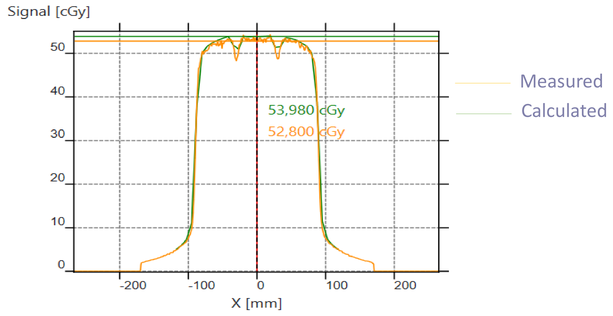

Fig4. 3 abutted field profiles

Tests	1 point dose diff% (CAX)		Planer dose 3%-2mm (%)	
	IMRT	VMAT	IMRT	VMAT
MultiTarget	-0,65	-0,71	99,23	100
Prostate	2,02	-0,85	98,44	100
H&N	1,19	0,95	98,70	97,6
Forme C	3,76	-1,71	98,98	97,6

Tab1. 1pt dose and planer dose results for each test independently

Conclusions

The two Infinity linear accelerators were measured included MLC parameters fine-tuning and the results showed good agreement between measured and TPS calculated dose distributions for IMRT/VMAT delivery techniques.

References

[1] Monaco Technical Reference, Post Modeling Adjustment of MLC Parameters,LRMMON0003/4.0, 2014.

[2] Nainggolan et al."Dosimetric Evaluation of Volumetric Modulated Arc Therapy (VMAT) and Intensity Modulated Radiotherapy (IMRT) Using AAPM TG 119 Protocol." Journal of biomedical physics & engineering vol. 9,4 395-408. 1 Aug. 2019.