were taken in a motorized water phantom using small detectors (Razor stereotactic diode and PFD, IBA Dosimetry). In addition, MLC transmission was measured using a Farmer ion chamber. MLC model parameters (transmission, offset, leaf tip width, tongue-and-groove) were optimized to maximize the agreement between measurements and calculations. Model assessment was performed using a set of highly intensity-modulated MLC geometrical patterns, designed to enhance tongue-and-groove, transmission and offset/leaf-tip effects. For those fields, planar dosimetry was carried out with GafChromic EBT3 films. Clinical validation was performed evaluating TG-119 cases along with 25 DMLC and 10 VMAT clinical plans. Plan-specific quality assurance was performed with a 2D-array (MatriXX, IBA Dosimetry) and gamma-index metric was used to assess the agreement between planned and measured dose distributions. A 2%/2mm criterion was used with both local (LN) and global (GN) normalization.

Results: Optimized MLC parameters were: transmission 0.018, position-offset 0.04cm, tongue-and-groove 0.05cm, leaf tip width 0.3cm. Average and standard deviation (SD) values of gamma index pass-rates were: for geometrical patterns: 92.8%, SD=5.1%(LN); 95.5%, SD=2.5%(GN). For TG-119 plans: 97.1%, SD=4.4%(LN); 99.7%, SD=0.7%(GN). For DMLC clinical plans: 97.0%, SD=3.7% (LN); 98.8%, SD=2.6%(GN). For VMAT plans 90.1%, SD=4.0% (LN); 96.5%, SD=2.1% (GN). Critical regions dominated by tongue-and-groove and rounded-leaf-tip effect showed a very good agreement between measurements and calculations (see Fig.1).

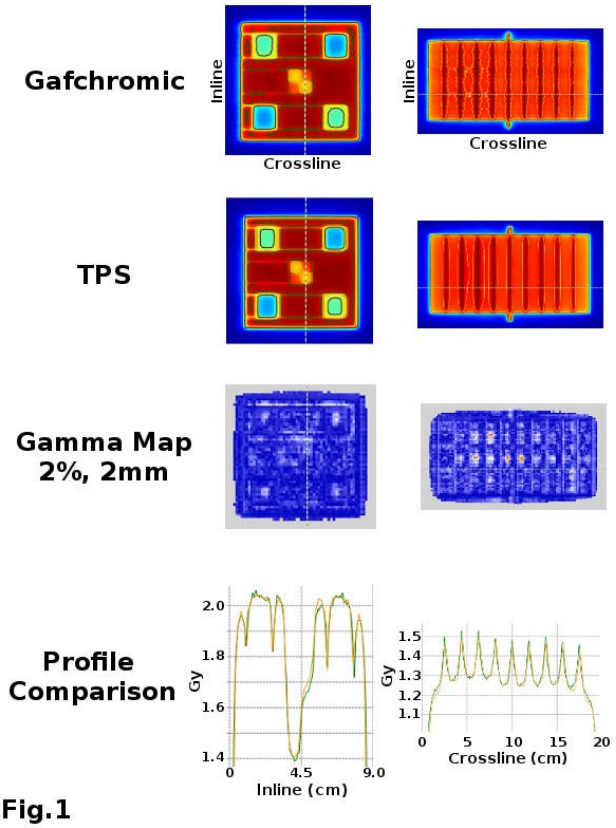

Fig.1

Conclusion: Results demonstrate the followed procedure leads to a proper optimization of the MLC model in RayStation, leading to clinically acceptable gamma index pass-rates. The needed additional measurements can be easily integrated as a subset of the standard measurements required for the commissioning of the RayStation TPS.

PO-0807

3D and 4D dose calculations for tumour-tracking irradiation of lung/liver tumours using gimbaled linac

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Purpose or Objective: To compare dose-volume metrics calculated with the four-dimensional (4D) Monte Carlo (MC) and three-dimensional (3D) dose evaluation systems in dynamic tumor tracking (DTT) irradiation for lung or liver tumors.

Material and Methods: Twenty patients with lung tumors and 15 patients with liver tumors who underwent DTT irradiation using a gimbal-mounted linac were enrolled in this study. During computed tomography (CT) simulation, 4DCT under free breathing and exhale breath-hold CT were performed. Planning target volume (PTV) for DTT was calculated using the gross tumor volume (GTV) delineated on a reference CT scan (exhale phase in the 4DCT or exhale breath-hold CT) by adding asymmetric margins to compensate for possible errors due to the DTT. The 6 to 9 non-coplanar ports of the 6-MV X-ray were set to each PTV. Doses were calculated for the reference CT using a commercially available treatment planning system (TPS). At the same time, 4DMC dose evaluation was performed for 10 respiratory phases of 4DCT using an in-house dose calculation system based on the MC algorithm, considering the gimbal rotation. The doses calculated for 10 phases were accumulated using deformable image registration software for the lung tumor patients, whereas mean values of the dose-volume metrics were evaluated for the liver tumor patients. The difference between the doses calculated with 4DMC (4D doses) and those calculated for the reference CT scan with TPS (3D doses) were investigated for the following dose-volume metrics: the percentage of dose that covers 95% of the GTV (GTV D95), the max dose received by the spinal cord (Cord max), the percentage of lung volume that received more than 20 Gy and 5 Gy irradiation (Lung V20 and Lung V5, respectively) in patients with lung tumors, and the mean dose and percentage of liver volume that received more than 20 Gy irradiation (Liver mean and Liver V20, respectively) in patients with liver tumors.

Results: The mean values of the dose-volume metrics for the 4D doses were as follows: 94.1% (range, 83.8–99.7%) GTV D95, 9.7 Gy (range, 1.8–22.0 Gy) Cord max, 4.9% (range, 1.9–13.7%) Lung V20, 19.2% (range, 7.2–30.7%) Lung V5, 10.0 Gy (range, 5.2–15.2) Liver mean,15.5% (range, 8.2–27.7%) Liver V20 The mean differences in the dose-volume metrics for the 3D and the 4D doses were as follows: 0.5% (range, -7.4–4.8%) GTV D95, 0.1 Gy (range, -2.5–1.8 Gy) Cord max, 0.1% (range, -0.8–1.4%) Lung V20, 0.3% (range, -1.6–2.1%) Lung V5, 0.1 Gy (range, -1.6–1.1 Gy) Liver mean, and -1.0% (range, -1.7–3.1%) Liver V20. There were no statistical significant differences in these dose-volume metrics evaluated by paired t-test.

Conclusion: The 3D doses calculated with TPS for the target tumor and organs at risk were almost equal to those calculated with 4DMC. 3D dose could be used as a substitution for 4DMC calculation. However, the dose to the spinal cord was underestimated by a maximum of 2.5 Gy.

PO-0808

Validation of a clinical peripheral photon dose model: prostate IMRT irradiation of Alderson phantom

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