Contribution ID: **21** Type: **Oral**

Validation of a 6 MV flattening filter free phase space of a C-arm linear accelerator for a Monte Carlo framework

Friday, 1 December 2023 15:30 (10 minutes)

Purpose: To validate a 6 MV flattening filter free (FFF) phase space, determined in previous works, of a TrueBeam system for a Monte Carlo (MC) dose calculation framework.
Methods: The 6 MV FFF phase space, scored at the end of the patient-independent part (above the secondary collimator jaws), is used to calculate MC dose distributions inside a water phantom for square, rectangular, off-axis and MLC collimated fields and two volumetric modulated arc therapy (VMAT) plans consisting of 4 and 6 arcs, respectively. The dose distributions of the open fields were measured inside a water bath using a Semiflex 3D and a microDiamond detector (PTW, Freiburg, DE). The depth dose (DD) curves, X-profiles and Y-profiles of the absolute dose distributions were compared using a 1D gamma analysis, with a 1% (global), 1 mm criterion. The dose distributions of the VMAT plans were measured using radiochromic films and compared to the MC calculated dose distributions using a 2D gamma analysis, with a 3% (global), 2 mm criterion and a 20% low-dose threshold.
Results: The gamma passing rate between the (Semiflex 3D) measured and MC calculated dose distributions averaged at 92% (56%-94%) for DD curves, 98% (27.27%-100%) for X-profiles and 96% (27.3%-100%) for Y-profiles for all depths. The disagreement being mainly in the build-up region of the DD curves, where the calculated dose is lower than the measured dose. Comparing measurements performed with the microDiamond detector and the MC calculated DDs, the gamma passing rate averaged at 99.9% (99.35%-100%) for PDDs, 96% (76.36%-100%) for X-profiles and 95 % (74.1%-100%) for Y-profiles for all depths. For the VMAT plans, the gamma passing rates between the measured and MC calculated dose distributions were 95% for the 4 arcs case and 99% for the 6 arcs case.
Conclusion: A phase space for a 6 MV FFF photon beam of a TrueBeam system was successfully validated for open and intensity-modulated fields.

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Session Classification: Session VI

Track Classification: Radiation Therapy