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Accuracy of an Eclipse treatment planning system for SRS

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Introduction: The Royal Hospital in Muscat, Oman, obtained a Varian TrueBeam ver 2.5 SRT linac in 2016. 6 MV and 6 FFF photon beams were commissioned on an Eclipse treatment planning system (Ver 13.7) using dosimetric data ranging from 40x40 cm2 to 4x4 cm2 as recommended by the vendor. Although a dedicated iPlan treatment planning system is routinely used for stereotactic radio-surgery (SRS) planning, we wanted to investigate the feasibility of using Eclipse treatment planning system in dosimetry of treatment fields typically used in SRS treatments with dimensions smaller than those recommended by the vendor.

Materials and methods: PDDs, OARs and output factors were measured for 6 MV and 6 FFF photon beams using a pinpoint chamber for 3x3, 2x2 and 1x1 cm2 fields. Separate beams were configured in the planning system with one being configured with beam data containing the vendor recommended dosimetric data (fields between 40x40 and 4x4) and the other with dosimetric data for the small fields in addition to vendors recommended dosimetric data. To test the performance of the Eclipse treatment planning system we first compared PDDs of 3x3, 2x2 and 1x1 cm2 field sizes to measurements. In addition, VMAT plans for single and multiple SRS type lesions were optimized and calculated. The optimized plans were then recalculated in a standard 30x30x15 cm3 QA Solid Water phantom. Using a small thimble ionization chamber, measured and calculated doses within the QA phantom were compared.

Results:
Measured PDDs for 6 MV and 6FFF beams were compared to Eclipse calculated PDDs for beam configured with small fields dosimetric data. The calculated PDDs for depths 5 and 10 cm and 3x3 cm2 field size were less than 0.2% from measurements,however, for the 2x2 cm2 field size the discrepancy increased to 2.0%.
Moreover, plans optimized and calculated with 6 MV beam configured with small field dosimetric data, the calculated and measured doses in the QA phantom were in closer agreement with one another in comparison to plans optimized with 6 MV beam configured without including small fields dosimetric data. We also noticed that the agreement between calculated and measured doses improved when jaw-tracking is disabled in plan optimization.

Conclusion: It is important to include dosimetric data for small fields in treatment planning beam data when planning to treat small lesions. To further reduce discrepancies between calculation and measurements, we recommend using fixed-jaws positions when optimizing plans for small lesions.

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