Comparison of XVMC Monte Carlo dose calculations with Eclipse AAA calculations for RapidArc plans

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Abstract

Purpose: The agreement between the AAA and XVMC algorithm in the treatment planning for RapidArc is investigated. While the majority of the radiation field is blocked by the MLC system, multiple small dose islands with MLC opened only slightly can be observed in one control point. This raises questions on how accurate the clinically used AAA algorithm in Eclipse is able to calculate RapidArc dose distributions. The fast Monte Carlo Code XVMC was used as a benchmark to test the AAA algorithm.

Methods: RadpidArc plans of 25 patients were calculated with AAA and XVMC. The patient cohort consisted of 4 different cancer sites (H&N, upper abdominal, lung, prostate). Dose distributions and PTV and OAR coverage were compared looking at the PTV mean dose D_{mean}, the volume $V_{95\%}$ of the PTV receiving 95% of the prescribed dose, the dose $D_{95\%}$ delivered to 95% of the PTV Volume, the percentage PTV mean dose with respect to the prescribed dose $D_{mean/prescr}$ and OAR mean dose.

Results: The recalculation of RapidArc plans yielded good agreement of both calculation algorithms for treatment plans of all four cancer sites. PTV mean dose differences of AAA and XVMC were found to be in between -0.11% and 4.89% of the prescribed dose. The mean dose difference found was 0.48±0.77 Gy. Local dose differences were found when comparing dose distributions in regions of big mass density differences and in high dose regions. One head and neck plan and one prostate plan revealed significant differences in PTV coverage (ΔD_{mean}=3.25 Gy) and OAR mean dose (prostate mean dose -13.71 Gy) respectively.

Conclusions: The vast majority of treatment plans calculated with the AAA algorithm were found to agree within the expected and acceptable tolerances compared to XVMC results. Nevertheless in some cases dose differences were observed that could be of clinical significance.