

Development of an Independent 3-Step Patient Specific QA Program for a Single Isocenter Multiple Brain Metastases Treatment Technique

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Abstract

Objectives: HyperArc (HA) is a special VMAT technique that enables the simultaneous irradiation of multiple brain mets on a Varian TrueBeam linac with a single isocenter and planning performed using the Eclipse treatment planning system. It is challenging to perform patient specific QA on such modulated HA plans due to the small sizes of the brain metastases and the current limitations in existing detectors and phantoms. We have devised a 3-step patient specific QA process that includes three independent QA checks. The checks include a portal imaging delivery and analysis with Varian PDIP, an independent dose calculation with Mobius 3D and a 3D film gamma analysis with Gafchromic film.

Methods: Varian TrueBeam 2.7, Eclipse 15.5 treatment planning system, with a HA planning license. A radiation oncologist approved HA treatment plan is exported to Mobius 3D in the first step. A 3D gamma analysis is performed by the Mobius 3D software according to our specified tolerances. The second step involves the creation and delivery of a portal dosimetry plan to the EPID and a subsequent PDIP analysis of the delivered fluence. Currently we compute the percent difference in the CU (Calibrated Unit) between TPS calculated plan, and the delivered plan. The third step consists of the creation and delivery of a QA plan to a plastic water phantom, which has Gafchromic film placed at desired depths corresponding to the depths of the various brain metastases being analyzed in the plan. A complete 3D gamma analysis of the film is then performed using a film analysis software.

Results: Mobius gamma analysis is performed using the 2%/2mm and 2%/1.5mm criteria. Our test plans indicated a passing rate of at least 97 and 98% respectively. A percent CU difference is computed using PDIP, which is well within a 5 % tolerance range. Gafchromic film dosimetry is performed with a commercial film dosimetry analysis software. A gamma pass rate of at least 97% is observed for our test plans.

Conclusion: Due to the small size of the multiple brain metastases routine patient specific QA using diode arrays especially for sub millimeter metastases becomes challenging mainly as the size of the metastases can be smaller than the spacing between the diodes of the array. Our 3-step approach alleviates this issue, while still providing a reliable and robust pre-treatment patient specific QA process.

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Abstract

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