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Abstract

Dosimetric validation for an automatic brain metastases planning element based on single isocenter dynamic conformal arcs

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Categories: Medical Physics, Radiation Oncology
Keywords: stereotactic body radiotherapy, brain metastases

How to cite this abstract
Liu H, Li J, Pappas E, et al. (June 16, 2016) Dosimetric validation for an automatic brain metastases planning element based on single isocenter dynamic conformal arcs. Cureus 8(6): a45

Abstract

Objectives: To validate the calculated absolute dose and dose distribution from a new commercial planning software dedicated for treating multiple brain metastases using a single setup isocenter and multiple non-coplanar dynamic conformal arcs technique.

Methods: Three types of measurements were performed to validate the planning software: 1, dual micro ion chambers were used with acrylic phantom to measure the absolute dose; 2, three dimensional cylindrical phantom with dual diode array was used to evaluate 2D dose distribution and Gamma Index (GI) passing rate for four different plans; and 3, three dimensional pseudo-in-vivo patient specific phantom filled with Vinyl-pyrrolidone polymer gels was used to evaluate the accuracy of 3D dose distribution and radiation delivery.

Results: Micro chamber measurement of two targets of 1.2 cc and 0.9 cc showed that the percentage differences of the absolute dose at both targets are less than 1%. Averaged GI passing rate of four different plans measured with diode array phantom is above 98%, using a gamma analysis criteria of 3% dose difference, 1 mm distance to agreement (DTA), and 10% low dose threshold. 3D gel phantom measurement results demonstrated a 3D displacement of nine targets of 0.7 ± 0.4 mm (range 0.2~1.1 mm). By the use of selected axial slices that encompass each one of the nine targets, the GI passing rate is 98.7% (5% dose difference, 2mm DTA, and 10% low dose threshold). Measured D95, the minimum dose that covers 95% of the target volume, of the nine targets is 0.7% less than the calculated D95.

Conclusions: Three different types of dosimetric verification methods were used and proved the dose calculation of the new automatic brain metastases planning (ABMP) element is clinical acceptable. The 3D pseudo-in-vivo patient specific gel phantom test also served as an end-to-end test for validating not only the dose calculation, but the treatment delivery accuracy as well.

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Published 06/16/2016