Cureus

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Abstract

Successful automation of high quality single-isocenter VMAT SRS treatment planning on a linear accelerator

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Categories: Medical Physics, Radiation Oncology
Keywords: stereotactic radiosurgery, single isocenter, multiple metastases, intracranial, volumetric modulated arc therapy (vmat)

How to cite this abstract
Thomas E M, Ollila S T, Popple R, et al. (June 16, 2016) Successful automation of high quality single-isocenter VMAT SRS treatment planning on a linear accelerator. Cureus 8(6): a60

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Objectives: One of the more challenging scenarios in radiation treatment planning is inverse optimization of single isocenter linac-based SRS for multiple metastases. Subtle variations in treatment planning parameters can lead to large differences in plan quality. Institutions without a dedicated multidisciplinary team may either, not plan these cases optimally, or choose to avoid SRS for these cases altogether, in favor of less complex but more cognitively harmful WBRT. We present results of the first semi-automated templated approach to single-isocenter intracranial VMAT SRS for multiple mets. Our hypothesis was that an approach designed to encompass planning techniques that enforce optimal plan quality in terms of conformity, steep gradient, and normal tissue spill could reliably produce high quality plans and increase planning efficiency, especially for the less experienced planner.

Methods: A 5-arc geometry was templated within the Eclipse treatment planning system based on a previously published successful approach. A customized normal tissue optimizer was designed to automatically generate the steepest gradient possible. Five multiple metastasis cases (n_min = 3, n_max=12) of varying target sizes and distributions that had been planned on TrueBeam STx were re-planned with the semi-automated approach. Conformity, moderate isodose spill (V12Gy for single fx, V18Gy for five fx plans), and low dose spill were compared between the manually and semi-automated planned cases.

Results: The templated planning procedure was able to consistently meet or exceed the high plan quality of five previously optimized cases in key metrics of plan quality with a large reduction in plan setup time. Plan conformity, plan V12/V18, and mean brain dose in templated plans were each within 5% of their manually planned counterparts.

Conclusions: Complex and time-consuming aspects of single-isocenter multiple metastasis SRS treatment planning were successfully automated in a versatile, template-based approach. This approach was able to replicate plan quality normally requiring concentric shell tuning structures and much more extensive planner involvement . We expect that this work can significantly increase facility access to multi-met treatment planning and significantly reduce planning time requirements.

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Published 06/16/2016