

On the quantification and development of strategies for minimizing the inherent geometric and dosimetric uncertainties of single isocenter multiple brain metastases Stereotactic Radiosurgery

Introduction: Stereotactic radiosurgery (SRS) is an effective treatment for patients with multiple brain metastases (MBM) since it improves outcomes and reduces toxicity when it replaces whole-brain radiation therapy (WBRT). Single-isocenter SRS can be less time consuming in comparison to the use of multiple isocenters for each brain metastasis, however, this technique can be more sensitive to geometric and dosimetric errors, depending on the isocenter distance from the target volume.

Objective: The present study aims to the determination, analysis and quantification of the inherent dosimetric and geometric uncertainties in the single-isocenter multiple brain metastasis stereotactic radiosurgery and the consecutive development of strategies for their minimization, through End-to-End quality assurance procedures.

Methods and Materials: Linear accelerators with characteristics that enable the implementation of single-isocenter multiple brain metastases radiosurgery will be used. The uncertainties' minimization strategies will be evaluated through patient-specific quality assurance procedures, with the use of anthropomorphic phantoms (pseudopatients). The geometric uncertainties will be quantified with mechanical quality assurance tests of the isocenter, the gantry rotation and the treatment couch shifts, while dosimetric uncertainties will be measured through ion chambers, films and polymer gels. For the data analysis, the Matlab software will be used.

Expected Results: With the systematic study and the quantification of the single-isocenter multiple brain metastases radiosurgery inherent uncertainties, the following are expected:

- The development of quality assurance procedures for a) commissioning/training and b) periodic End-to-End QA.
- The development of a proposed margin strategy.
- A proposed use of number of isocenters.
- The optimization of patient specific pre-treatment plan verification procedure.