

Purpose: The Trilogy® MX (Varian Medical Systems) supports simultaneous motion of the couch, gantry and collimator during volumetric modulated arc therapy (VMAT). This study investigates the feasibility and potential advantages of treating CNS tumors using VMAT with such capabilities.

Method and Materials: To guide the selection of couch, gantry and collimator trajectories, a score function estimates the geometric overlap between tumor and organs at risk (OAR) for each couch/gantry combination. An initial set of beam trajectory candidates includes couch and gantry combinations, that correspond to minima found in a search of the overlap score map excluding zones of collision and long beam paths through the patient. This set is clustered into multiple continuous arcs subject to mechanical limitations. Following determination of couch/gantry trajectories, a principal component analysis finds the collimator angle at each beam orientation that minimizes residual tumor-OAR overlap. A purpose-developed VMAT optimization algorithm determines the optimal MLC position and MU for control points within each arc. A planning study of seven CNS patients compared trajectory VMAT with dynamic gantry, leaf, couch and collimator motion (Tra-VMAT), standard non-coplanar VMAT (Std-VMAT, no couch/collimator motion within subarcs), and non-coplanar IMRT plans.

Results: Tra-VMAT yields improved tumor dose conformality, lowered maximum dose to optic nerve, brainstem and chiasm, by 6%, 1.8%, 0.9%, 1.3%, respectively, relative to Std-VMAT. Tra-VMAT also yields higher PTV minimum dose, reduced maximum dose to chiasm, optic nerve, and cochlea, and reduced cochlea mean dose, by 4.4%, 1.5%, 6.4%, 10.2%, 8.9%, respectively, relative to IMRT. Tra-VMAT average beam-on time is comparable to Std-VMAT, but significantly (42%) less compared to IMRT.

Conclusion: Optimized couch/collimator trajectories can be integrated with VMAT. Trajectory VMAT, with improved mechanical flexibility, results in better dosimetric properties and improved treatment efficiency in the treatment of CNS tumors.

Conflict of Interest: Sponsored by Varian Medical System