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Abstract

Conformal Arc Informed VMAT for Multiple Brain Metastases Radiosurgery

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Objectives Linear accelerator based radiosurgery is often performed using either dynamic conformal arcs or VMAT. For multiple brain metastases, multifocal conformal arc techniques can struggle to deliver the desired dose and high conformity for all targets simultaneously. While VMAT can achieve better coverage and conformity, it can result in highly modulated, non-intuitive MLC trajectories. The complex MLC trajectories can often struggle with blocking between targets and may leave MLC gaps between targets. Our purpose is to develop a technique for multiple brain metastases that combines the intuitive MLC trajectories of dynamic conformal arcs with the flexibility of VMAT. Methods A Conformal Arc Informed VMAT (CAVMAT) planning technique was developed in which conformal arcs are assigned subgroups of targets to maximize blocking between targets. Arc weights are optimized to achieve desired dose per target while minimizing the variation in MU per arc. The optimized conformal arc plan then serves as the starting point in a VMAT inverse optimization to fine tune the dose to each target and optimize conformity. Eight multiple brain metastases cases - originally planned with VMAT - were replanned with CAVMAT. The following metrics of plan quality were used to compare the VMAT plans with the CAVMAT plans: volume of healthy brain receiving 6Gy, 12Gy, and 16Gy, conformity index, and total number of monitor units. Results For the CAVMAT plans, the average decrease in V6Gy, V12Gy, and V16Gy was 3±11%
(range: 16% lower to 18% higher), 7±3% (range 12% lower to 4% lower), and 6%±5% (range 14% lower to 1% lower), respectively. The number of monitor units changed little on average (0.6±21% increase), but varied widely by plan (to 42% lower to 22% higher) compared to VMAT plans, beam on time has an average difference of 1% compared to VMAT plans. The conformity index was 1.27±0.12 for CAVMAT compared to 1.22±0.12 for VMAT. Conclusions The CAVMAT planning technique provides smaller low dose spill to normal brain tissue compared to VMAT, with comparable conformity, monitor units, and treatment times. Future work will focus on automation and further investigation of the consequence of target size.

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