AbstractID: 3471 Title: The development and testing of a prototype three-dimensional wedge for whole brain radiation therapy

Purpose: Whole brain radiation therapy (WBRT) is the standard treatment for >2 brain metastases, and often used in conjunction with stereotactic radiotherapy for 1-2 metastases. The use of open fields (conventionally used for WBRT) leads to higher doses to the brain periphery with lower doses near the brain center. These dose variations potentially compromise treatment efficacy and translate to increased side effects. The goal of this research was to design and construct a 3D 'Brain Wedge' to compensate dose heterogeneities in WBRT.

Method and Materials: Radiation transport theory was invoked to calculate the desired shape of a wedge to achieve a uniform dose distribution at the sagittal plane for an ellipsoid irradiated medium. A wedge was machined based on the calculation results. Three ellipsoid phantoms, representing the mean and ± two standard deviations from the mean cranial size were constructed, representing 95% of the adult population. Film was placed at the sagittal plane for each of the three phantoms and irradiated with 6MV photons, with the wedge in place. Optical density to dose calibrations were conducted following IMRT quality assurance procedures, for 6 MV photon beams.

Results: The calculations yielded a smooth 3D wedge design to account for the missing tissue at the peripheral areas of the brain. Isodose plots for the three phantoms demonstrated the feasibility of this wedge to create a homogeneous distribution with similar results observed for the three phantom sizes, indicating that a single wedge may be sufficient to cover 95% of the adult population.

Conclusion: A 3D wedge has been developed based on transport theory with the aim of creating a uniform mid-plane sagittal dose distribution for WBRT. A prototype wedge was machined and experimentally validated.

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