AbstractID: 5530 Title: Patterns of brain tumor recurrence predicted from DTI tractography

Purpose: Approximately 170,000 new cases of brain metastases and 17,000 cases of primary brain cancer are diagnosed in the United States each year. Stereotactic Radiotherapy (SRT) is fast becoming the method of choice for treatment of non-superficial brain lesions. SRT treatment plans of malignant and metastatic brain tumors typically incorporate a 2 cm margin to account for microscopic tumor spread, however, distant and/or recurrent tumors sometimes occur. Our hypothesis is that paths of elevated water diffusion may provide a preferred route for transport or migration of cancer cells through an unknown mechanism. If our hypothesis is correct then future SRT treatment would be modified to provide elongated treatment margins along the paths of elevated water diffusion leading from the primary tumor site; thereby reducing the incidence of recurrence and improving clinical outcomes.

Method and Materials: MR diffusion tensor imaging datasets were acquired in patient subjects treated with SRT of malignant and/or metastatic brain tumors. DTI was performed using an EPI sequence on a 1.5T clinical GE scanner with 20 serial axial images of voxel dimensions 0.976×0.976×6 mm; TR 10s; TE 89.4 ms; 25 diffusion gradient directions plus 3 reference (b=0) scans. Following SRT, patients were given repeated MRI follow-ups at regular intervals to identify early tumor recurrence. When recurrent tumors were detected, DTIstudio and FSL software was used to compute paths of preferred water diffusion through the primary tumor site and the site of recurrence.

Results: There exists an apparent correlation between patterns of recurrence in the brain and paths of elevated diffusion leading from the primary brain tumor.

Conclusions: Our preliminary results on a small number of patient datasets suggest that this hypothesis is correct and further investigation is warranted. Future work will employ a more sophisticated fiber analysis on additional patient images and verification with animal models.