AbstractID: 6892 Title: Quantification of Global Changes in Normal Appearing Brain Tissue of Cerebral Tumor Patients during Early-Delayed Phase after Radiation Therapy

Purpose: Radiation therapy (RT) affects the central nervous system manifesting in neurological complications. The aim was to quantitatively assess early-delayed changes in normal-appearing brain tissue (NAT) ensuing RT using diffusion tensor imaging (DTI). We hypothesize that there are diffuse changes in NAT with degradation in structural integrity due to radiation.

Methods: Twenty-five patients with cerebral tumor (17 men, 8 women, median age 60 years) participated in IRB approved clinical MRI studies. Temporal changes in NAT were studied pre-RT, 3- and 6-weeks during RT, and post RT at ten-, and 19-weeks from start of RT. RT doses ranged from 50 to 81Gy.

The DTI indices of fractional anisotropy (FA), mean diffusivity <D>, eigen-diffusivities parallel ($\lambda_{\|}$) and perpendicular ($\lambda_{\perp}$) to axonal fibers, of water diffusion were calculated on a voxel-by-voxel basis from DTI. Normal brain tissue, excluding tumor and cerbero-spinal-fluid was categorized into two volumes of interest, either ipsilateral or contralateral to tumor hemisphere. Temporal changes in DTI indices were expressed as percentages. For example, percent change in FA during third week of RT is expressed as $= 100*[(FA_{t=3week} - FA_{t=Pre-RT})/ FA_{t=Pre-RT}]$.

Results: There were significant changes in DTI indices after completion of RT in both the ipsilateral and contralateral NAT. Post RT at 19-weeks, there was 10% increase in $\lambda_{\|}$, 15% increase in $\lambda_{\perp}$, 13% increase in <D>, and 13% decrease in FA. The $\lambda_{\perp}$ increase was 1.5 times that of $\lambda_{\|}$. Magnitude of change was higher in ipsilateral compared to contralateral, with ipsilateral changes assuming significance earlier. However, contralateral changes tended to approach those of ipsilateral at 19-weeks.

Conclusions: Significant and gradual increases in eigen-diffusivities indicate degradation of structural integrity. Changes in ipsilateral and contralateral hemispheres during and post RT signify diffuse bilateral structural degradation. Spatio-temporal radioresponses noted herein emphasize minimizing dose to critical CNS structures and pathways.