Abstract ID: 18990  Title: Lung Deformations and Airway Stenosis with Distal Atelectasis in Patients Treated with Stereotactic Body Radiation Therapy for Lung Tumors

Purpose: To investigate the possibility to use lung deformations to differentiate between radiation-induced fibrosis and potential airway stenosis with distal atelectasis in patients treated with stereotactic body radiation therapy (SBRT) for lung tumors.

Methods: Planning and follow-ups CT scans were reviewed for 46 patients who received lung SBRT treatment at our institution between 2002 and 2009, in 3 or 5 fractions, and a median total dose of 54Gy (range, 30-60). Vector lung tissue displacements were studied for patterns of parenchymal deformation only in patients with follow-up CT scans > 6 months. Planning CT lung surface contours were matched to the follow-up scans and at least 50 anatomical landmarks inside the lung (vessel or airway branches) were identified on both scans to guide the deformation of the lung structure. Parenchyma displacements maps for the whole lung were interpolated from the landmark deformations and analyzed to identify tissue migrations towards the observed hyperdense region consistent with distal atelectasis.

Results: Out of 46, only 24 patients demonstrated lung density changes with sufficient follow-up time and image quality. Fifteen patients (62%) displayed converging deformation patterns and their average Hounsfield Unit change for the hyperdense region was 344HU and significantly higher than for the other patients (247HU, p = 0.03) supporting an alternate consolidation mechanism. The mean maximum dose to proximal airways was 38Gy for the converging pattern group versus 20Gy (p = 0.003) and a maximum likelihood Probit fit yielded TD50 = 24Gy, m = 0.56. The mean minimum dose to the hyperdense region was 15Gy versus 18Gy (p = 0.23).

Conclusions: A correlation between converging deformation patterns and lung density changes was observed suggesting the possibility of an additional mechanism for lung density increase in addition to fibrosis. Correlations between converging patterns and dose to proximal airways also suggest a 24Gy dose-threshold effect.