AbstractID: 11523 Title: Quantification of Ventilation Imaging from Clinical 4DCT Datasets for Selective Avoidance IMRT in Non-Small cell Lung Cancer.

Purpose: To determine a clinically appropriate ventilation level for selective avoidance IMRT using clinical 4D CT data sets and a small-deformation inverse-consistent linear-elastic (SICLE) registration algorithm

Materials/Methods: Using SICLE, the maximum inhalation and expiration phases of 4D CT datasets from 6 NSCLC patients were registered. After registration, smoothing was applied to the input images to account for registration error. A correction was applied to the voxels in the inhalation image to account for lung tissue mass discrepancy due to lung inflation. The ventilation was calculated voxel by voxel as a local volume change, $\Delta V/Vex = 1000\ (HU_{in} - HU_{ex})/(HU_{ex}(1000 + HU_{in}))$, where HU_{ex} and HU_{in} are the Hounsfield units associated with the expiration and inhalation images, respectively. After this, an additional smoothing filter and a cumulative distribution function were applied to aid segmentation and normalize the data between 0% and 100%. Ventilation volumes were quantified as a function of normalized ventilation level, which can be used as a threshold for delineation of ventilation subregions.

Results: Using the inhalation image registered to the expiration image, consistent ventilation images were calculated. The ventilation levels of 90%, 80%, 70%, 60%, and 50% were studied as it was determined that ventilation levels below 50% would not be beneficial as this region would include almost the entirety of the lungs. An exponential relationship between ventilation level and ventilation-competent volume at a given percentage ventilation was observed. Quantified ventilation data and charts demonstrating these relationships were generated.

Conclusions: In selective avoidance IMRT for NSCLC, it is critical to determine the optimal ventilation level to segment within a normal lung region, which would then be used as an avoidance structure in functional image guided IMRT. Our study shows that a 70% ventilation level is promising to be implemented into selective avoidance IMRT techniques for NSCLC.