AbstractID: 9204 Title: Using Small-Deformation Linear-Elastic Registration to Quantifying Ventilation-Competent Lung Imaging from Clinical 4DCT Datasets: Toward Selective Avoidance IMRT for Locally Advanced Non-Small-Cell Lung Cancer.

Purpose: To verify the feasibility of a small-deformation inverse-consistent linear-elastic (SICLE) registration algorithm in quantifying ventilation-competent sublung images from 4D CT datasets.

Materials/Methods: SICLE, a deformable image registration algorithm developed at the University of Iowa, was utilized to register the 100% inhalation and 100% exhalation phases of the lung which were extracted from clinical 4D CT datasets. The SICLE method performs inverse consistent image registration in which the forward and reverse transformations are estimated jointly while minimizing the inverse consistency error. After deformable registration, ventilation was calculated using the equation $\Delta V/V_{ex} = 1000\ (HU_{in} - HU_{ex})/(HU_{ex}(1000 + HU_{in}))$ on voxels of the inhalation and exhalation images, where HU is in Hounsfield Units and $\Delta V/V_{ex}$ is the change in regional volume divided by the local volume.

Results: SICLE was found to be efficient and consistent in deformable image registering lung CT image datasets with different phases. 3D ventilation images were quantified and given in coronal, transverse, and sagittal view. Quantitative ventilation in a given region of interest was also determined. Ventilation-competent sublung regions were constructed with different functionality levels of 90, 70, 50, and 30%.

Conclusions: Utilizing a small-deformation inverse-consistent linear-elastic registration algorithm, it was feasible to quantify ventilation competent subregions from clinical 4D CT datasets. Given the availability of 4D CT technology, this study opens a pathway to integrate functional lung information into radiotherapy for locally advanced non-small-cell lung cancer.