PURPOSE: A method has been proposed to calculate ventilation maps from 4DCT images. Weekly 4DCT data were acquired for lung cancer patients undergoing radiation therapy. The purpose of our work was to use ventilation maps calculated from weekly 4DCT data to study how lung function changed throughout radiation therapy
METHODS: Spatial registration and a density-changed based model were used to compute weekly ventilation maps for 6 patients. We quantitatively analyzed the data by defining regions of interest (ROIs) according to dose and lung lobe and by tracking the weekly ventilation of each ROI throughout treatment. The slope of the linear fit to the weekly ventilation data was used to evaluate change in lung function throughout treatment. The dose ROI ventilation data were used to study how function changed throughout treatment as a function of dose. The lung lobe ROI ventilation data were used to investigate the impact of tumor reduction on ventilation change throughout treatment.
RESULTS: We found that 3 patients had an increase in weekly ventilation as a function of dose and 3 patients had no change or a slight decrease in ventilation as a function of dose. When the tumor volume in a lobe was visibly reduced, ventilation increased, and when the tumor volume was not visibly reduced, the ventilation distribution did not change. The average slope of the group of lobes that contained tumors that shrank was 1.18 (indicating an increase in ventilation), while the average slope of the group that contained tumors that did not shrink was -0.31 ($p = 0.013$).
CONCLUSIONS: We did not find a consistent pattern of ventilation change as a function of dose. The weekly lobe ventilation data indicated that when tumor volume shrinks, ventilation increases, and when the thoracic anatomy is not visibly changed, ventilation is likely to remain unchanged.