Purpose: 4DCT can be used to measure pulmonary function change following radiation therapy for adaptive treatment planning. The purpose of this study is to analyze the effects of the measurement variation and compare the planned radiation dose and pulmonary function change due to radiation not measurement variation.

Methods: Two 4DCT data sets before RT scanned with thirty minutes break and one 4DCT data set acquired 5 months after RT from one patient were used in this study. Tissue volume and vesselness preserving image registration algorithm was applied to register the maximum inhalation image to the maximum exhalation image for the calculation of local lung expansion as a measurement of regional pulmonary function (PF). The pulmonary function changes (PFC) before RT and after RT were calculated via the PF ratio between two 4DCT scans. The radiation induced pulmonary function change (RI-PFC) is calculated from PFC after RT by filtering measurement variation calculated in PFC before RT. We compared the RI-PFC with planned radiation dose at the contralteral/ipsilateral lung, and the upper/lower lobes of the ipsilateral lung.

Results: Significant measurement difference is found between lobes in the same ipsilateral lung. For the contralateral lung in the RI-PFC region, the average radiation dose is 2.5 Gy and the average PFC value is 1.10. For the ipsilateral lung in the RI-PFC region, left upper lobe shows the average ration dose as 59.1 Gy with average PFC value 0.9, and the left lower lobe shows the average ration dose as with 2.5 Gy the average PFC value 1.14.

Conclusions: We described a technique that uses 4DCT, image registration and biomechanical analysis to measure regional pulmonary function change. We compared the radiation induced pulmonary function change to the planned radiation dose distribution and examined the differences in different lungs, and at the lobar level.

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