

**Purpose:** A novel ventilation imaging method based on 4D-CT has been applied to functional radiotherapy planning and assessing radiation-induced ventilation changes. Understanding of its reproducibility is a prerequisite for such applications, however it has not been studied to date. The purpose of this study is to develop a method for validating 4D-CT ventilation imaging through characterizing its reproducibility and show preliminary results.

**Methods:** 4D-CT ventilation images were created for three patients from repeat 4D-CT scans at different time points, including two pre-treatment (pre-RT1 and pre-RT2), one mid-treatment (mid-RT) and/or one post-treatment (post-RT). The reference (pre-RT1) was compared with pre-RT2 to quantify the temporal change in the absence of therapeutic intervention. Pre-RT1 was also compared with mid-RT and/or post-RT to quantify the temporal change in the presence of therapeutic intervention. Finally, the Spearman's voxel-based correlations between pre-RT1 and pre-RT2 were compared to those between pre-RT1 and mid-RT or post-RT to investigate the hypothesis: the temporal change in the absence of therapeutic intervention is smaller than that in the presence of therapeutic intervention.

**Results:** Differences between the temporal changes in the absence and presence of therapeutic intervention were inconsistent. Regions of both agreement and disagreement were identified throughout the lung between pre-RT1 and pre-RT2, mid-RT or post-RT. The correlations with pre-RT2 (absence) (range, 0.41-0.64) were slightly higher than or comparable to those with mid-RT or post-RT (presence) (range, 0.42-0.62). In general, the ventilation variations between pre-RT1 and pre-RT2 increased with increasing respiratory variations during the 4D-CT acquisition.

**Conclusions:** Preliminary results from a 3-patient study suggest inconsistent differences between the temporal changes of 4D-CT ventilation in the absence and presence of therapeutic intervention. Respiratory variations have been found to contribute to deteriorate the reproducibility. Ongoing studies focus on investigating more patients and spatial characteristics of the temporal changes.

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