Purpose: Respiratory signal for 4DCT is typically extracted using an external respiratory positioning management device (RPM) which is often inconvenient and time consuming. The efficiency of 4DCT imaging could be substantially improved if anatomical body could be used as respiratory surrogate. The purpose of this study is to compare similarity of 4DCT sorted using respiratory signals extracted from anatomical surrogate (AS) to those extracted from RPM.

Methods: 4DCT data of 31 cancer patients (15 male, 16 female, 67.0 mean age, 17 lung cancers, 14 abdominal cancers) were retrospectively analyzed. Respiratory signals/phases were derived from AS (body area of axial CT image) using pre-sorted CT images and compared to those from RPM. The correlation coefficient (r) and absolute phase difference (|d|) between the two were calculated. Image quality of 4DCT reconstructed using the two methods (4DCTAS and 4DCTRPM) was scored (1 to 5, 1 is the best) for comparison.

Results: The mean correlation coefficients were 0.92±0.05, 0.90±0.06, and 0.94±0.03, and mean absolute phase differences were 11.40±4.62%, 13.83±4.56%, and 8.45±2.56 for all patients, the lung cancer patients, and the abdominal cancer patients, respectively. The match between AS- and RPM-derived phases was significantly better for the abdominal cancer patients than for the lung cancer patients (p-value=0.04 and 0.001 for comparisons in r and |d| respectively. The phase difference was the greatest near the diaphragm in the lung cancer patients. No slice-location dependency for phase difference was observed in the abdominal cancer patients. The 4DCTRPM slightly outperformed the 4DCTAS in image quality evaluation: mean scores were 2.5±0.6 and 3.1±0.8 (p-value=0.02) respectively for the lung cancer patients, and were 2.6±0.7 and 2.8±0.9 (p-value=0.59) respectively for the abdominal cancer patients.

Conclusions: Anatomical surrogate for 4DCT sorting is comparable to RPM. Its performance is better for abdominal cancer patients than for lung cancer patients.