JULY 12–16
2020 VIRTUAL
JOINT AAPM | COMP MEETING
EASTERN TIME [GMT-4]

Evaluation On Dosimetric Effects of Irregular Motion During 4DCT Scanning Using a Self-Developed Lung Phantom

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INTRODUCTION

Radiotherapy treatments are based on density and geometric information acquired from patient CT scans. Generally, the breathing patterns of lung cancer patients are very complex, exhibiting considerable diversity even within the same patient. It should be noted that intrafraction variability in motion is significantly larger than interfraction motion variability.

For mobile targets, 4DCT is a standard procedure for incorporating tumor motion in treatment planning. However, 4DCT cannot directly address the intrafractional motion problem. Therefore, there is an urgent need to evaluate dosimetric effects caused by irregular motion systematically when patient received a stereotactic radiotherapy treatment.

AIM

The aim of this work is to evaluate the dosimetric effects of irregular motion during 4DCT scanning using a self-developed lung phantom.

METHOD

To measure the effects of irregular intrafraction variability in motion, a realistic deformable lung phantom is required. Figure 1 shows the self-developed lung phantom. The motion amplitude lengths and periods of the phantom can be configured by the control system respectively.

In the configuration of the phantom motion, the motion amplitude lengths ranged from 10 mm to 25 mm and the frequencies of the platform were set at 3 s/cycle to 5 s/cycle. A GE CT scanner was used for the 4DCT scans.

RESULTS

The measured motion period in figure 2 is exactly consistent with the set value in the control system.

Volume discrepancies increase with increasing irregular intrafractional motion.

The target exceeded 5% volumetric differences for the breath patterns of higher amplitude motion and constant respiratory cycle. Finally, irregular intrafractional motion will degrade the dose distribution seriously.

Fig1. Self-developed lung phantom associated with GE CT.

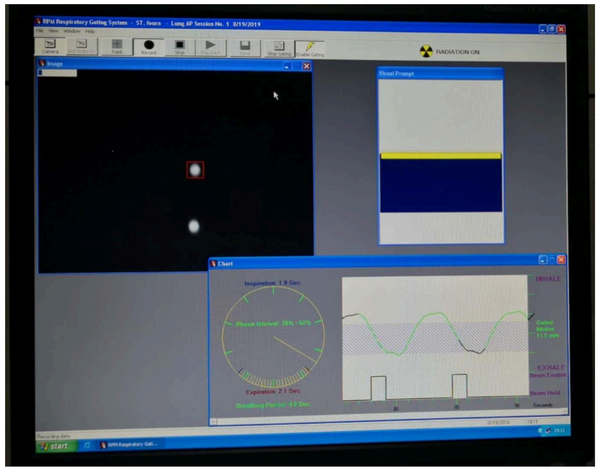

Fig2. Motion period of the control system test.

CONCLUSIONS

4DCT is sensitive to deviations in the respiratory pattern and intrafractional breathing motion might cause unwanted deviations between the planned and the delivered dose distributions for patients with poor pulmonary function. Knowledge of the disadvantages of dosimetric effects enables individualized optimisation of the radiotherapy treatment.

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ACKNOWLEDGEMENTS

We would like to express our deep appreciation for the cooperation and support from our colleagues in the physics group of radiotherapy department of Shanghai Pulmonary Hospital.

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