

Contour Comparison of Internal Target Volume between 4DCT, CBCT, and 4DCBCT for Stereotactic Body Radiation Therapy (SBRT) of the Lung

Parag Sevak ¹, Indrin J. Chetty ², Karen Snyder ², Eric Laugeman ¹, Chang Liu ¹, Munther Ajlouni ²

1. Radiation Oncology, Henry Ford Health System 2. Radiation Oncology, Henry Ford Health System, Detroit, USA

✉ **Corresponding author:** Parag Sevak, psevak1@hfhs.org

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Abstract

Objectives: Simulation 4DCT scans are often used in treatment of lung tumors to help develop an internal target volume to take into account patient specific tumor motion. Prior to treatment, the use of cone beam CT (CBCT) scans for SBRT of the lung is standard for patients prior to treatment to aid in positioning and alignment. 4DCBCTs can evaluate tumor motion prior to treatment, however they require more time and resources. We sought to characterize the differences in between contours for each modality.

Methods: 4DCBCTs were acquired before each fraction for 5 Lung SBRT patients to assess tumor motion before treatment. A 4DCBCT was acquired with a full trajectory with a gantry speed of 3 deg/sec, and a total of 1800 projections. The Varian RPM device was used to bin the projections into 10 phases and reconstructed with filtered backprojection. An ITV was contoured on each of the 10 phases at each fraction delivered and the ITV the union of the contours on each phase. The ITV was also drawn on the average CBCT used for the patient localization. The dice coefficient, hausdorff distance, and center of mass were used for comparison of the ITV contoured on the maximum intensity projection generated from 4DCT, Average CBCT, and 4DCBCT.

Results: Contour comparison means over 4 fractions were obtained. Initial results have shown that similar dice coefficient (similarity of the two contours) between the average CBCT and 4DCBCT ITV (0.75 ± 0.12), 4DCT to average CBCT (0.76 ± 0.09), and 4DCT to 4DCBCT (0.73 ± 0.05). Hausdorff distance was similar between average CBCT and 4DCBCT ITV, 4DCT to average CBCT, and 4DCT to 4DCBCT (6.05 ± 1.39 , 5.08 ± 2.16 , 6.41 ± 1.67 respectively). Mean center of mass was also similar between average CBCT and 4DCBCT ITV, 4DCT to average CBCT, and 4DCT to 4DCBCT (1.32 ± 0.39 , 2.02 ± 1.14 , 2.48 ± 1.3).

Conclusions: We found similar dice coefficient, center of mass, and hausdorff distances. While 4DCBCT has the ability to assess tumor motion prior to treatment delivery, further evaluation of the potential benefits will require further investigation. Due to 4DCBCT image quality and treatment related changes, the use of 4DCBCT for ITV delineation should be further analyzed before clinic implementation.

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Abstract

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