

Daily 4DCBCT Dose Accumulation for Lung SBRT Patients

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Abstract

Objectives: To investigate the differences between planned dose and actual dose calculated on daily 4D cone-beam CT (4DCBCT) for lung cancer patients treated with stereotactic body radiotherapy (SBRT).

Methods: For four patients, an internal target volume (ITV) was drawn on the maximum intensity projection calculated from a 4DCT simulation. A 3D treatment plan (12-14Gy x 4 fractions) was planned on the average CT. Before each fraction, 4DCBCTs were acquired with the Varian RPM device to assess tumor motion before treatment. A 4DCBCT ITV was created using the union of physician drawn ITVs on each of the ten phases. An ITV was contoured on the average CBCT as well (avgCBCT ITV). Using the online registration, the treatment plans were calculated on the average CBCT as well as on each phase of the 4DCBCT which were then summed. Dose to 95% and 99% of the avgCBCT ITV and 4DCBCT ITV (D95% and D99%, respectively) for each fraction was compared to the same metrics of the treatment planning ITV.

Results: The mean D99% and D95% difference between the 4DCBCT ITV and the treatment planning ITV for four patients was -7.3% (range: -4.2% to -11.9%) and -2.4% (0.4% to -3.9%), respectively. The 4DCBCT ITV coverage was worse than the avgCBCT ITV coverage for all patients. The mean D99% and D95% difference between the 4DCBCT ITV and the avgCBCT ITV was -8.9% (range: -4.5% to -17.9%) and -4.5% (-1.4% to -8.9%), respectively. On average, the avgCBCT ITV coverage was better than the planned ITV coverage, although for one patient, each fraction delivered resulted in worse coverage than planned.

Conclusions: Even though the accumulated dose calculated on 3DCBCT was comparable to planning dose calculated on the average CT, the accumulated 4D planning dose on the 4DCBCT was less than the 3D dose on both average CT and 3DCBCT for all the patients. Daily 4DCBCT has the potential to accurately assess the actual delivered dose to the moving tumor.

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