

Purpose: To model the probability of normal lung tissue density change and obtain dose-response curves restricted to observed change areas for patients with lung tumors who received stereotactic body radiation therapy (SBRT).

Methods: 129 follow-up CT scans for 36 patients who received SBRT between 2003 and 2009 with a maximum of 5 fractions and a median total dose of 54 Gy (range, 30-60) were analyzed. RT-induced lung density changes were evaluated after fusion of planning CT scans with post-RT follow-up scans corresponding to interval periods of approximately 3, 6, 12, 18, and 24 months after treatment. Each follow-up scan was manually reviewed and areas of visible density change were contoured. Scans were divided into regions receiving specific 10Gy dose-bins. Voxel density changes belonging to contoured areas were averaged over each dose-bin to obtain dose-response curves (DRC). The occurrence of visible density change depending on the maximum dose to the tumor was also chosen as an end point to model the normal tissue complication probability (NTCP).

Results: With an analysis restricted to area of visible change, the density change magnitude appeared to not depend much on the dose bin. The average density increase was smaller at 3 month (214HU), peaked at 6 months (322HU) and slightly decays thereafter without totally vanishing (300HU). This observed trend was similar using rigid or deformable registration. The maximum target dose for a 50% complication probability for changes >200HU was 80Gy according to the NTCP model.

Conclusion: Although local correlations between dose and density increase have been reported for conventional and SBRT lung treatments, our analysis revealed a relatively uniform and stronger density response, while temporal density changes followed a previously reported density change trend (Palma 2010, IJROBP). These discrepancies were likely due to the restriction of the analysis to areas with actual density increase.