

# Heterogeneous dose prescription for early stage lung cancer stereotactic body radiation therapy: Implications on dose gradient

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## Background

Rapid dose fall-off in the normal tissues surrounding a lung SBRT target is critical to avoid significant toxicity. This study aims to explore the relationship between tumor dose prescription and steepness of dose gradient for lung SBRT plans.

## Methods

This study is based on 20 4DCT simulation scans of patients with stage I non-small cell lung cancer, previously treated by SBRT to 60 Gy in 5 fractions. For each simulation CT, three plans, each consisting of 11 beams (9 equally-spaced beams with entry over the ipsilateral hemithorax + 2 non-coplanar beams), were generated for static-gantry IMRT delivery technique. The prescribed dose (PD) was consistent with the clinically delivered plan, with 95% of the PTV exposed to 60 Gy. We varied stipulations for dose heterogeneity within the target (homogenous plans - maximum dose approximating 120% of PD; moderately heterogeneous plans - maximum dose approximating 135% of PD, and extremely heterogeneous plans - maximum dose approximating 150% of PD). For each of the 60 plans, the mean distance per 10% change in isodose from the 100% to 50% isodose line was calculated.

## Results

We found that increasing target dose heterogeneity related to steeper dose gradients. The mean maximum dose was:

- 121.5 6.5% of PD for the homogeneous plans
- 137.3 6.3% of PD for the moderately heterogeneous plans
- 156.4 5.9% of PD for the extremely heterogeneous plans

The mean distance per 10% change in isodose line was:

- 2.71 0.3 mm in homogeneous plans
- 2.64 0.3mm in moderately heterogeneous plans
- 2.59 0.3 mm in extremely heterogeneous plans
- $p < 0.001$  for all comparisons

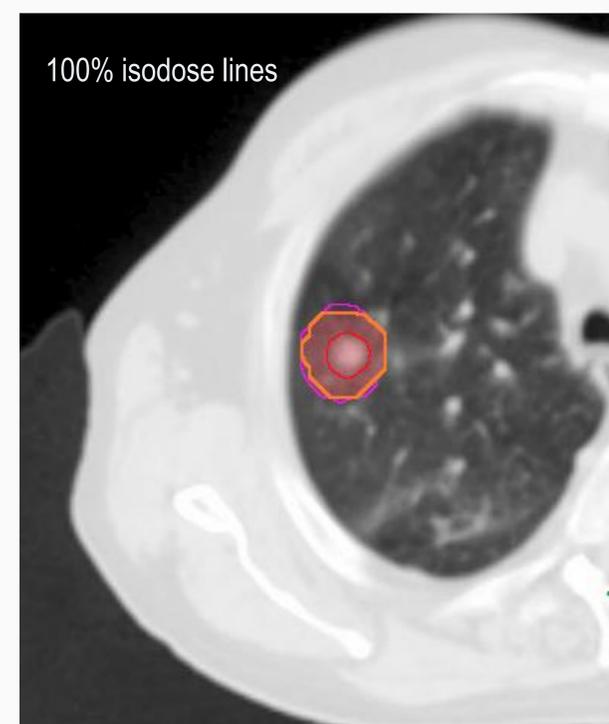
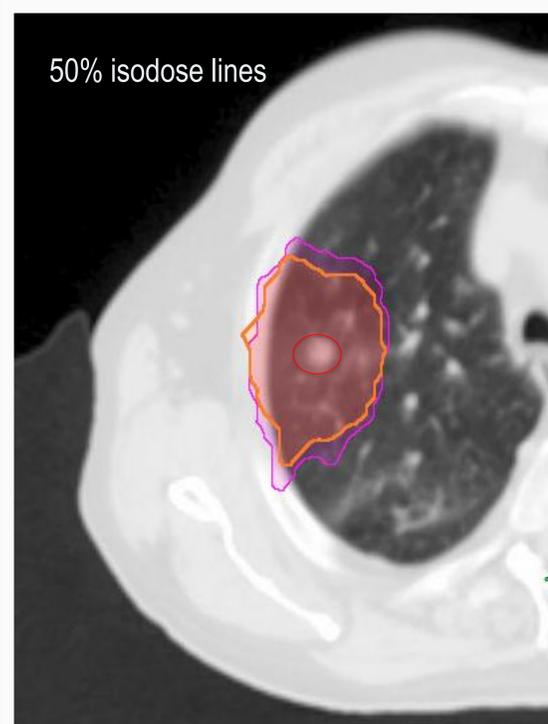


Figure 1. Representative examples comparing 50% and 100% isodose lines for a homogenous plan (purple volume, max dose of 115% of PD) and an extremely heterogenous plan (orange volume, max dose of 148% of PD) for the same patient. The ITV is contoured in red.

## Conclusions

Heterogeneous dose prescription for lung SBRT achieved steeper dose gradients outside the target volume. This benefit may further improve the already low SBRT-related complication rates, and the inherent increase in Equivalent Uniform Dose (EUD) may yield advantages with respect to local tumor control.

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