Adaptive Planning of Lung Stereotactic Body Radiation Therapy Patients Based on Target Excursion and Deformation

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INTRODUCTION

For Lung cancer patients treated with Stereotactic Body Radiotherapy (SBRT), 5 mm margins are usually added to CTV to account for breathing motion, setup error and tumor deformation

AIM

The primary objective of this study is to validate and derive adaptive margins for patients undergoing SBRT for lung cancer using implanted anchored electromagnetic transponders.

METHOD

For each patient, a 10-phase 4DCT scans were acquired. Anchored beacon transponders were used to track tumor position and gate treatment delivery. All initial plans utilized a uniform 5 mm CTV to PTV margins, and treatment gating limit was set to 5 mm. The prescription was 1000 cGy per fraction to a total of 5000 cGy. Patient's target motion and inter-transponders distances were measured daily. Treatment motion preset limits and target deformation were used to calculate new margins.

Retrospectively, patients were re-planned to use calculated margins. The mean CTV, PTV, normal tissue toxicity were evaluated. Two tailed T-test was used to determine if average inter-fraction target deformation differed significantly for each patient and between patients. A p-value of <0.05 considered significant.

RESULTS

Average intrafraction target motions were 2.9 ±1.72 mm, 7.85 ±2.75, and 4.63±0.08 mm in the left/right, superior/inferior, and anterior/posterior directions respectively. Average target deformation was 1.17 ±1.1 mm for all patients. Calculated margins based on treatment motion limit and target deformation was 6.17 ± 2.34 mm in all direction. With the implementation of these revised plans based on these data, 100% of the CTV, and 95% of PTV were encompassed by the prescription dose. For a single patient, inter-fraction tumor deformation does not change significantly (p=0.997). Tumor deformation does change significantly from patient to patient (p=0.976).

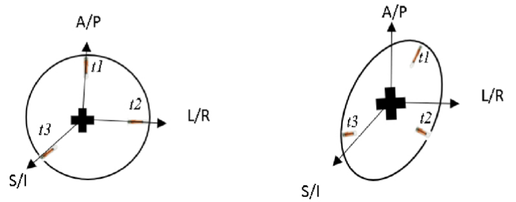

Figure 1 Illustration of tumor deformation

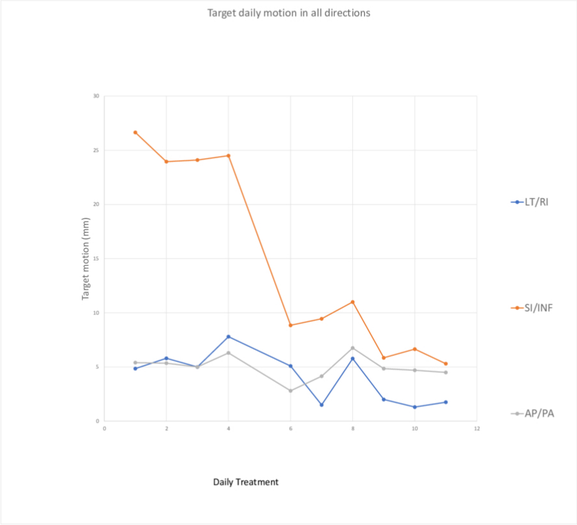

Figure 2 Daily Target Motion

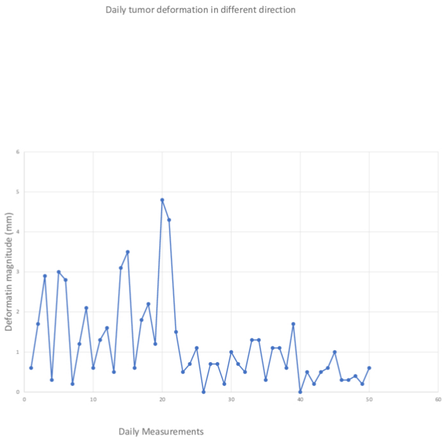

Figure 3 Daily Target Deformation

CONCLUSIONS

Implanted transponder beacons during lung SBRT can provide useful information on tumor deformation and can be used to calculate new PTV margins to adapt the plan and keep normal tissue toxicity within tolerance. Because inter-fraction tumor deformation does not change significantly, revised margins after first fraction provides a reasonable estimate for the remaining fractions.

CONTACT INFORMATION

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