AbstractID: 3592 Title: A Computational Analysis of Lung Damage from 3D, IMRT, and Helical Tomotherapy

Purpose:
It is well known that the lungs are extremely sensitive to radiation damage. Based on low-dose tolerance models, the argument has been made that delivering small doses from multiple gantry angles may actually cause more lung damage than delivering large doses from fewer gantry angles. The purpose of this work is to calculate the percent reduction in lung function for several existing lung models and treatment delivery techniques.

Method and Materials:
Conformal APPA, non-coplanar 3D conformal, and helical tomotherapy plans were created for 15 lung patients. All plans used the same beam energy, the PTV, and prescribed dose. The percent reduction in lung function was calculated by multiplying the DVH doses by a dose response function. Three published models were used: 1.) Lung function reduces linearly at 1% per Gy (*Linear*), 2. Lung function reduces to 0% at the threshold dose of 13 Gy (*Delta13*), and 3.) Lung function decreases to 0% at the threshold dose of 36 Gy (*Delta36*).

Results:
The linear model yielded the least difference in lung function reduction between the three delivery techniques, with a mean difference of 3 percent (*range 1-7%)*. The delta13 model clearly favors APPA treatment delivery, with the exception of targets smaller than 50cc. If the threshold for lung damage is greater than 20 Gy, then the conformal techniques overtake APPA in providing the least lung damage. A delta36 model greatly favors highly conformal rotation delivery techniques, such as tomotherapy.

Conclusion:
Although the model for lung damage is unknown, several conclusions can be draw on the appropriateness of delivery techniques. If the threshold for damage is at very low doses, then techniques that spread the dose are less advantageous. However, if the threshold is greater than 20 Gy, or is linear, then conformal techniques provide the best lung sparing.