AbstractID: 8715 Title: Dose calculation accuracy of a commercial treatment planning system for phantom geometries with varied lung densites

Purpose:
The purpose of this study was to investigate the dose calculation accuracy of a commercial treatment planning system for various water-lung phantom geometries; specifically, the effects of lung density, chest-wall thickness and a 3-field beam configuration.

Method and Materials:
A comparison was made between collapsed cone convolution (CCC) calculations and DOSXYZnrc Monte Carlo (MC) simulations for: (1) a homogeneous phantom (ρ = 1.00, 0.500, 0.250 and 0.125 $g \cdot cm^{-3}$), (2) a slab phantom with varied chest-wall thicknesses (d_{chest} = 1.5, 2.25 and 3.0 cm) and lung densities and (3) a 15x15x15 cm^3 box of lung surrounded by a 2.25 cm layer of water. We use ρ_{lung} = 0.400, 0.150 and 0.250 $g \cdot cm^{-3}$ to simulate full exhalation, inhalation and mean lung density respectively. For the homogeneous and slab phantoms one 6MV 10x10 cm^2 field incident on a 50x50x25 cm^3 phantom at SSD = 100 cm was simulated. For the box phantom a 3-field beam configuration was used to simulate a basic lung treatment.

Results:
For the homogeneous phantom at, ρ_{lung} = 0.125 $g \cdot cm^{-3}$, the CCC results were systematically 5% high. The slab phantom results showed that past d = 3.0 cm the accuracy of the CCC calculations were dependent on lung density and independent of chest-wall thickness. The percent difference was as high as 4% for ρ_{lung} = 0.150 $g \cdot cm^{-3}$. The 3-field box simulations revealed an increased difference with decreasing lung density. Percent differences were as high as 8%, 4%, and 2% for the ρ_{lung} = 0.150, 0.250, and 0.400 $g \cdot cm^{-3}$ phantoms.

Conclusion:
For the homogeneous phantom simulations, the percent difference increased with decreasing density. Dose accuracy was found to be invariant with respect to chest-wall thickness. From the 3-field box configuration, we found the total percent difference increased with the number of fields.