Purpose: The internal target volume (ITV) accounts for uncertainties in tumor position and shape and is defined from images acquired with 4DCT. In this work, the locations of gold fiducial markers implanted in lung tumors of seven patients are used to represent tumor motion and investigate the role of the CT scanner geometry and scan duration on ITV definition.

Methods: All of the simulations are geometric simulations performed in MATLAB (The Mathworks, Nattick, MA) and variations in image reconstruction are not considered. The CT scanner geometries simulated include a 4-slice CT scanner (with an axial field of view of 10 mm) and an 'ideal' CT scanner geometry that covers all potential tumor positions in the same bed position (axial field of view of 100 mm). The scan durations were varied from 6 seconds per bed position to 30 seconds per bed position. For all of the simulations, the tumor was modeled as a sphere of diameter 25 mm. The ITVs were compared by calculating the mean ITV for each patient and scan parameters.

Results: For all of the patients, the mean ITV increased as the scan duration increased. The maximum increase in mean ITV was 25%.

Conclusions: This work highlights the potential benefit of modified CT protocols to determine the ITV. One example of a modified protocol would be to increase the scan duration (to decrease ITV uncertainties) while decreasing the mA of the scanner (to avoid giving extra radiation dose). The largest factor influencing the ITV is the scan duration (and not the scanner geometry).