Purpose: To investigate the impact of interfractional tumor motion on dose delivery of gated lung SBRT.

Methods: 4DCT scan for five lung patient was performed without breathing control at simulation and prior to each treatment. Gated treatment plans were performed on the end-exhale (50% phase) simulation CT with a 30% duty cycle. ITV was created by combining the GTVs at 40%, 50% and 60% phases. PTV was created by adding a 5 mm uniform margin to the ITV. All plans were normalized such that 60 Gy (3 fractions) was prescribed to the 85% isodose line.

To calculate the accumulated dose over the treatment course, the original plan parameters were copied to the 40%, 50% and 60% CTs obtained prior to each treatment. In order to eliminate the effect of setup error to dose delivery, treatment isocenters at each fraction were determined by aligning the tumors on the slow CTs obtained prior to each treatment to that on the slow simulation CT. Doses recalculated on the 40% and 60% CTs at each fraction were warped through deformable CT image registration to their corresponding 50% CT to compose the 4D dose at that fraction. Those fractional 4D doses were warped to the 50% simulation CT to compose the accumulated 4D dose over the treatment course.

Results: The minimum tumor doses over the treatment course were 59.9, 45.1, 68.9, 41.9 and 47.8 Gy respectively. Tumor V60s were 99.7, 92.2, 100, 97.2 and 93.0% respectively. The corresponding mean lung doses were 3.8, 6.4, 3.7, 4.4 and 3.7 Gy respectively.

Conclusions: Change in tumor motion pattern over the treatment course results in tumor underdosing. Tight margins are normally used in lung SBRT. Therefore monitoring of the reproducibility of interfractional tumor motion is critical to the success of dose delivery.