Purpose: To verify the SBRT plans on CMS Xio treatment planning system using the Monte Carlo simulation and investigate the related issues.

Methods: The SBRT plans with 6 MV were originally made on CMS Xio treatment planning system with superposition algorithm. The same patient's CT, beam geometry and MUs were used in the Monte Carlo simulation (MC) on MCSIM. MCSIM is an EGS4-based MC dose calculation system for photon and electron beams. The Monte Carlo plans were compared with the Xio plans to verify Xio superposition algorithm for SBRT. The electron disequilibrium was particularly investigated by comparing the DVHs for a 2-mm thick peel of the GTV. Then, the beam energy was changed from 6 MV to 10 MV for MC to test energy effect on SBRT dosimetry.

Results: Six SBRT lung plans created on CMS Xio and delivered on Varian 21 EX linac were included in this study. The tumor GTV ranged from 1.4 cc to 11 cc and the dose ranged from 1950 cGy to 5400 cGy. The comparisons were made in terms of DVHs, mean doses, minimal doses, and maximal doses for GTV. The results showed all the dose values of Xio plans agreed with MC to within 2% with only two exceptions. The dose distribution in the peel of GTV followed the same pattern as the whole GTV. This indicated the Xio superposition algorithm has well accounted for electron disequilibrium. The 10-MV beams had both hot and cold spots from DVH comparison. This may be due to the larger build-up for 10-MV beams.

Conclusions: The Xio superposition algorithm has adequately accounted for electron disequilibrium in dose calculation and can perform accurate dose calculation for SBRT. Compared to high energy beams, 6 MV is preferable in terms of the GTV coverage and dose homogeneity.