Purpose: To quantify the dose differences between cone-beam CT (CBCT) and conventional CT (CT) using dose calculation with pencil beam convolution (PBC) and analytical anisotropic algorithm (AAA).
Methods: CBCT obtained from a kV on-board imager integrated with a Varian Trilogy linear accelerator was used for dose calculation. CBCT and CT images for 8 lungs, 1 lumbar spine, and 1 liver cancer patients were used in this study. The clinical treatment plans were initially calculated on conventional CT and then transferred to CBCT. The PBC and AAA algorithms in Eclipse treatment planning system were used for dose calculation. All clinical and physical parameters including structures, beams and leaf sequences from the initial plan were preserved on CBCT. The differences between two-dimensional dose distributions from CT and CBCT were calculated using PBC and AAA. The gamma analysis was used to evaluate the dose distributions with tolerance criteria (3%, 3mm).
Results: The average dose calculated on CBCT was higher in nearly 67% and 90% of the patients than that calculated on CT using PBC and AAA, respectively. The average of the mean percentage dose difference (MPDD) between dose distribution from CT and CBCT from all patients in the different planes (139 cases) was 0.5% and 1.8% using PBC and AAA algorithms, respectively. The MPDD ranged from -13.2% to 7.9% using PBC and from -13.9% to 9.9% using AAA. The gamma analysis with tolerance criteria using AAA had lower passing rates (84%) than PBC.
Conclusion: The discrepancies in dose between CBCT and CT were the largest in lung patients because of large variations in CBCT and CT numbers. AAA showed larger deviations of CBCT dose calculations from CT than PBC. The dose calculated on CBCT was generally higher on CBCT than CT. The AAA accounts more for image artifacts inherent to CBCT than PBC.