AbstractID: 12709 Title: Dose and image quality evaluation for partial and full-angle kilovoltage cone-beam CT protocols

Purpose: To assess imaging dose of partial and full-angle CBCT scan protocols, and to evaluate their image quality.

Method and Materials: The CTDI of the six new CBCT protocols for Varian OBI were obtained by ion chamber (IC) measurements and Monte Carlo (MC) simulations: standard-dose-head, low-dose-head, high-quality-head, pelvis, pelvis-spotlight, and low-dose-thorax. Various CTDI values were calculated by (1) the conventional weighted CTDI ($CTDI_w$) calculation and (2) Bakalyar's method ($CTDI_{wb}$). The MC simulations were performed to obtain the $CTDI_w$ and $CTDI_{wb}$, as well as from (3) central slice averaging ($CTDI_{2D}$) and (4) volume averaging ($CTDI_{3D}$) techniques. Image quality of the new protocols was evaluated testing HU verification/uniformity, spatial linearity/resolution, and contrast resolution.

Results: The $CTDI_w$ were found as 6.0, 3.2, 29.0, 25.4, 23.8, and 7.7 mGy for the new protocols respectively. The $CTDI_w$ and $CTDI_{wb}$ differed within +3% between IC and MC. Method (2) results were within ±12% of Method (1). In MC simulations, the $CTDI_w$ and $CTDI_{wb}$ were comparable to the $CTDI_{2D}$ and $CTDI_{3D}$ with the differences ranging from -4.3% to 20.6%. $CTDI_w$ of the new protocols were lower (1.8~14 times) than the old protocols respectively. In the image quality analyses, all the protocols except low dose head and low dose thorax protocols were within the tolerance in the HU verification test. All the protocols passed the spatial linearity/resolution and HU uniformity tests. Only high quality head and pelvis scan protocols passed the contrast resolution test.

Conclusion: $CTDI_w$ of the new CBCT protocols has been significantly reduced compared to the old protocols. The new scan protocols resulted in lower radiation dose with acceptable image quality. HU inaccuracy in CBCT images from low-dose-head and low-dose-thorax protocols can render incorrect dose results. When a high soft-tissue contrast data is desired, high quality head or pelvis scan protocol is recommended.

Conflict of Interest: