AbstractID: 12714 Title: A method to estimate cone-beam CT dose index and cone-beam dose length product

Purpose: To characterize the cone-beam CTDI (CBCTDI) and cone-beam dose length product (CBDLP) by Monte Carlo (MC) technique.

Method and Materials: An extended CT head phantom (60cm long) and an extended CT body phantom (90cm long) were created in our BEAMnrc/EGSnrc MC system to accurately model the CBCTDI. The CBCTDI is equivalent to CTDI except normalized with the actual beam width. Before the simulations, the beam width of a Varian OBI system was measured with radiochromic films. The MC model of the OBI x-ray tube was used to acquire the phase space files of the full-fan and half-fan cone beams. Then, DOSXYZnrc user code simulated a total of twenty CBCT scans with the beam widths from 2cm to 13.6cm for the CT head phantom and from 2.2cm to 15.4cm for the CT body phantom. After the simulations, CBCT dose profiles at center and peripheries were extracted and integrated (dose profile integral, DPI) to calculate the CBCTDI per each beam width. The weighted CBCTDI ($_w$CBCTDI) was calculated from DPI values by using 1/3 and 2/3 weighting equation and mean $_w$CBCTDI was derived. Finally the CBDLP for each beam width was compared to each weighted DPI ($_w$DPI) value. We also investigated the accuracy of the CBCTDI using the Dixon's point dose method.

Results: Mean $_w$CBCTDI was found as 8.590±0.010 cGy for head and 4.518±0.004 cGy for body scan. The CBDLP and $_w$DPI was close within 0.3%. We also found that the point dose method can estimate the CBCTDI within 3% difference comparing to the DPI integration method.

Conclusion: We proposed the CBCTDI and CBDLP concepts in CBCT dosimetry, validated the applicability of CBCTDI as a dose index for CBCT scan and demonstrated a clinically feasible to estimate the CBDLP using the point dose method.

Conflict of Interest (only if applicable): None