Purpose: To quantify the variation in CT number generated by the Simulix Evolution CBCT with changes in scan length and phantom thickness.

Methods: Three phantoms were used in this study: CIRS Model 610 AAPM CT Phantom, Gammex 467 Tissue Characterization Phantom, and Catphan 600 phantom. The AAPM Phantom was used to assess the variation of HU with phantom thickness. Scans were acquired with two field size settings (full- and half-beam) with and without a 3.5 cm thick ring. The Catphan and Gammex phantoms were used to assess the Simulix's capability of producing a consistent CT-to-ED conversion table with different scan lengths, ranging from 1 cm (very thin) to 20 cm (clinical use). The data were also compared to data acquired with our in-house CT Sim (GE HiLite LightSpeed 16 slice).

Results: The AAPM phantom scans with and without the ring yielded an average difference in HU of 145 HU (full-beam) and 74 HU (half-beam) for each of five inserts. The HU for Cortical Bone (SB3) [largest Gammex electron density insert; 1.69] ranged from 923 to 1170 HU for the 4 cm and 1 cm scan lengths, respectively. The HU for Teflon [largest Catphan electron density insert; 1.867] ranged from 657 to 951 for the 20 cm and 1 cm scan lengths, respectively. The HU for air in Catphan ranged from -749 to -905, and the HU for LDPE [electron density 0.944] ranged from -82 to -42, for the 20 cm and 1 cm scan lengths, respectively.

Conclusions: Results show a large variability in the calculated CT number with differences in phantom thickness, as evidenced by the results with the AAPM phantom. In addition, there appears to be a dependence on scan length, attributed to increased scatter contribution. Further tests will be done to evaluate the appropriateness of the use of the Simulix CBCT unit for heterogeneity corrected external beam treatment planning.

Funding Support, Disclosures, and Conflict of Interest:

The author has received no funding during the course of this research.