AbstractID: 12899 Title: Dosimetric Characterization of a Dedicated Breast Computed Tomography Clinical Prototype System

Purpose: To determine the radiation dosimetry characteristics of a dedicated breast computed tomography (BCT) clinical prototype system.

Method and Materials: The relevant parameters of the BCT system were replicated in a Monte Carlo simulation program based on the Geant4 toolkit. To model the system's x-ray spectrum, empirical measurements of exposure under varying conditions and of the first half-value layer were performed. To validate the Monte Carlo program, the exposures at the five insert positions of a standard head CT phantom while undergoing both a scout image and a full BCT scan were estimated, and the results compared to empirically measured values. The average glandular dose (AGD) was characterized for simulated homogeneous semi-ellipsoidal breasts of varying sizes and glandular fractions. In all cases, the AGD was normalized to the exposure measured with a CT ionization chamber in air located at the isocenter.

Results: The modeled x-ray spectrum was able to predict the empirically measured x-ray exposures after varying thicknesses of aluminum to within 9.4%, while the exposure distribution at the inserts of the standard head CT phantom were estimated to within 11.5%. The normalized AGD to the homogeneous breasts varied from 2.51 mGy/R to 5.21 mGy/R, depending on breast size and glandular fraction. For an average breast, for which the system automatically sets the tube current at 100 mA, the AGD would be 7.55 mGy.

Conclusion: The glandular dose from this BCT system was characterized for a range of breast sizes and compositions, and was found to result in similar values compared to typical multi-view diagnostic mammographic examinations but higher values than a standard two-view screening mammography examination. Further studies including the variation between mean glandular dose to homogeneous breasts and actual glandular dose to breasts with real tissue distribution are ongoing.