AbstractID: 4608 Title: Monte Carlo calculation of the organ and effective doses for pediatric patients under helical CT exams

Purpose: As it gains more popularity as a diagnostic modality, helical multi-slice CT can potentially impose a significant patient dose especially to pediatric populations. Even though simple acryl phantoms have been used to estimate relative radiation risks to the patient, very few studies have investigated accurate age-dependent organ absorbed doses. This study was intended to assess individual organ dose as well as the effective dose under typical CT exams using realistic tomographic phantoms of pediatric patients.

Method and Materials: Five ORNL stylized phantoms and five realistic UF tomographic phantoms of pediatric patients were prepared for the use with MCNPX general Monte Carlo code. A FORTRAN subroutine was written to explicitly simulate the helical motion of the multi-slice CT x-ray source. Ion chamber measurements provided the normalization factors for the Monte Carlo simulation results. Three tube voltages (80 kVp, 100 kVp, and 120 kVp), two collimated beam thicknesses (12 mm and 24 mm), and two filter (head filter and body filter) combinations were simulated for each of the ten phantoms.

Results: The study data showed that the effective dose increased on average 110% when the tube voltage changed from 80 kVp to 100 kVp at the same tube current setting, while the 120 kVp imposed on average 53.8% higher dose than the 100 kVp tube settings in the CAP CT exams. The ORNL phantoms and the UF phantoms showed distinctive dosimetric characteristics under chest and abdomen CT exams. The cause of these differences is explained by the unrealistic torso thicknesses of the ORNL stylized phantoms. Individual organ equivalent doses are also calculated and compared between the two types of phantoms.

Conclusion: Detailed organ doses and effective doses were calculated for pediatric patients under helical CT using various anthropomorphic computational phantoms and Monte Carlo code.