Head Radiation Dose from Pediatric CT Examination on Single and 64-slice CT

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Introduction:

The pediatric computed tomography (CT) scans have increased worldwide, contributing to higher population radiation dose. Technique diversification in pediatrics exams and different CT technologies of multi detectors computed tomography (MDCT) has led a wide range of exposure levels making difficulty the optimization of doses at pediatric clinical application.

Objectives:

The objective of this study was compare the dose length product (DLP) in the cranial, in the eyes and in the thyroid, simulating pediatric head exam undergoing CT singles slice and in MDCT 64, using clinical protocol. Forty thermoluminescent dosimeters (TLD100) were evenly distributed on surface of the head phantom along the sagittal axis.

Methods:

To single slice CT, Tomoscan AV-Philips equipment, 20 TLDs were exposed to scatter radiation and, 20 were exposed to primary radiation performed by 120kV, 300mAs, and slice thickness/spacing of 3/5mm and 5/7mm in the anatomic position equivalent of the supratentorial and posterior fossa regions, respectively.

To MDCT, Brilliance 64-Philips, the TLDs was exposed to 120 kV, 400 to 359 mAs modulation, and slice/spacing of 2/1 mm to all head surface, and it was used a phantom of dose pediatric (16 cm of diameter) for simulation child's cranium.

The TLDs were calibrated for 120kV X-ray over the acrylic phantom. TL measurements were performed on Harshaw 4000 system.

Results:

To single slice CT the dose were calculated based on previous study, by mean linear TL density for the region exposed to secondary radiation defined by position (p):

- To secondary X-ray:

$0.3 \leq p \leq 6$ cm; $\rho(p) = 7.9(4)x10^{-2} + 7(5)x10^{-5}p^{4.5(4)}$ cm^{-1} (Eq 1);

- To primary X-Ray to posterior fossa region:

$6.0 < p \leq 9.6$ cm; $\rho(p) = 30(8)x10^{-1} + 47(10)x10^{-3}p$ cm^{-1} (Eq 2)

- To exposed for the supratentorial region:

$9.6 \leq p \leq 12.3$ cm; $\rho(p) = 0,87(7) - 0,007(7)p$ cm^{-1} (Eq 3)

To MDCT the dose was estimated to 12 cm, 2.5 cm to eyes, 5 cm to thyroid based on TLD response as function of phantom length.

To the single slice CT equipment, the DLP to the cranium, eyes and thyroid were 1133(331) mGy, 39(15) mGy and 6,5(2.5) mGy, respectively.

At exams with MDCT equipment the DLP to the cranium, eyes and thyroid were 1647(82) mGy, 339(17) mGy and 404(20) mGy, respectively

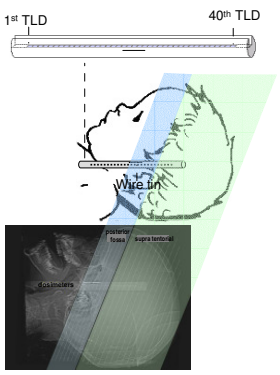

Figure 1: Ilustration of pediatric exposition in single–slice CT, angulated.

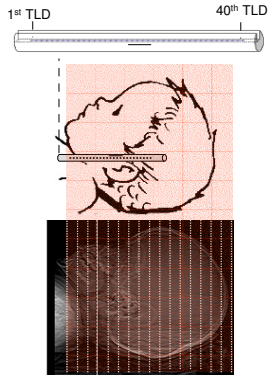

Figure 2: Ilustration of exposition in multi-slice CT.

Figure 3 shows the date calculated for the distribution of radiation in cranium second the equation 1, 2 and 3, the experimental results for CT single-slice and multi-slice, respectively.

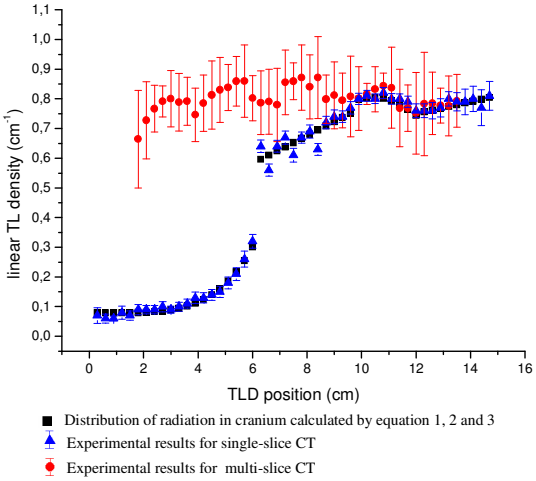

Figure 3: Linear density calculated for radiation in cranium using equation 1, 2 and 3, the experimental results for CT single-slice and multi-slice ,

Discussion and Conclusions:

These results show that the doses are superior using MDCT. The results for the eyes exposure might be able to induce cataracts since lens opacities can be induced as low as 100 mGy. The clinical protocol adopted in the MDCT generated high levels of thyroid doses not detected at single slice exams.

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