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RADIOCHROMIC FILM CALIBRATION FOR DOSIMETRY IN CHEST CT SCANS

Álvaro M. L. Gómez[1] and Arnaldo P. Mourão[1,2]

[1] Departamento de Engenharia Nuclear – UFMG

[2] Centro de Engenharia Biomédica – CEFET-MG

Sumary

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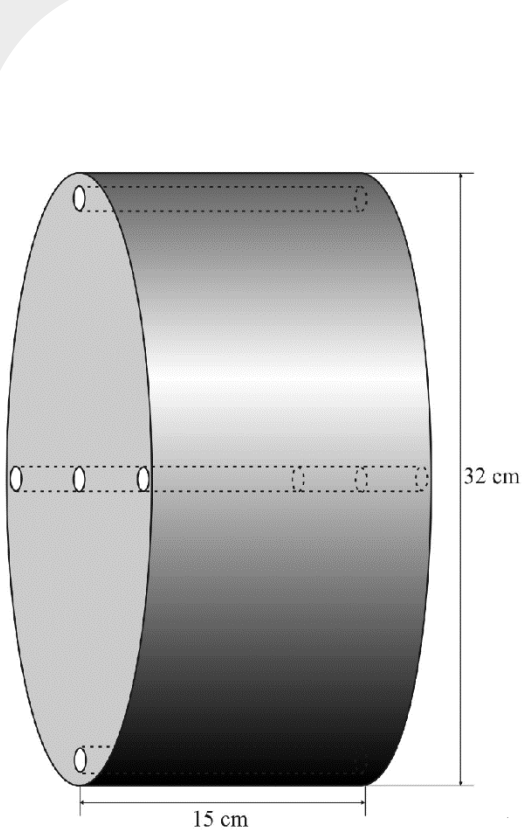
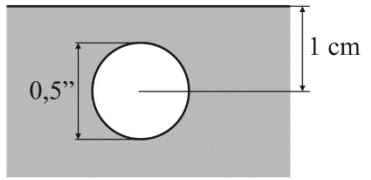
Introduction

- The versatility and speed with which diagnostic images are obtained by computed tomography (CT) .
- The increasing number of approved procedures in the unified health system (SUS) in Brazil means a high probability of impact on public health .
- The development of techniques to optimize the processes of acquiring images is very important for the handling of the acquisition parameters, iterative image acquisition methods, simulation, etc.
- Dosimetry studies allow obtaining results that refer to the amount of energy that the patient might be getting in some specific regions of the body especially those which are considered with greater sensitivity to ionizing radiation.
- Radiochromic films were developed to record the interaction of energy that came from different directions and so obtain maps of air Kerma profiles from a proportional response to darkening about the amount of energy recorded.

Materials and Methods



Five openings of ½". One central and four peripheral are lagged 90°



Position of peripheral opening

Materials and Methods

Radiochromic film strips
GAFCHROMIC XR-AQ2

Ionization chamber ACCU-RADCAL GOLD 10X6-3

Toshiba Asteion CT scanner

The phantom was positioned in the isocenter of the gantry

The radiochromic film strips have been inserted into rods of PMMA into openings "12" and “central”.

The scans were made in the helical mode of 10 cm in length in the central region of the phantom with voltages of 120 and 135 kV

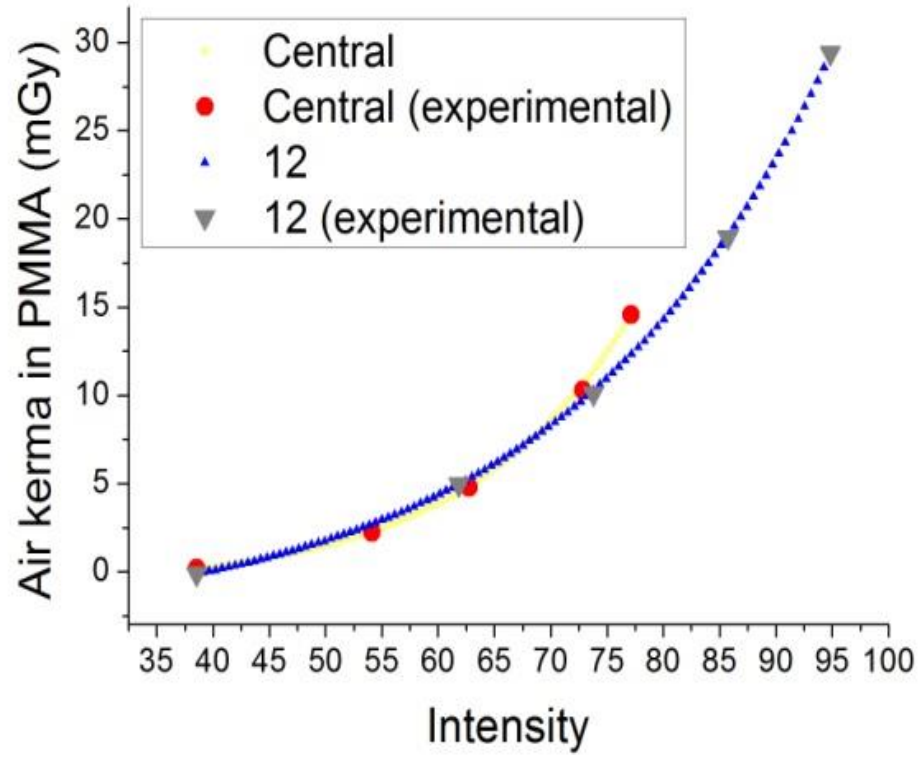
To air kerma in PMMA measurements, the ionization chamber was placed in “central” and “12” openings of the phantom and the central slice of 10 mm was irradiated several times. It was obtained five air Kerma values in each position.

Data collect

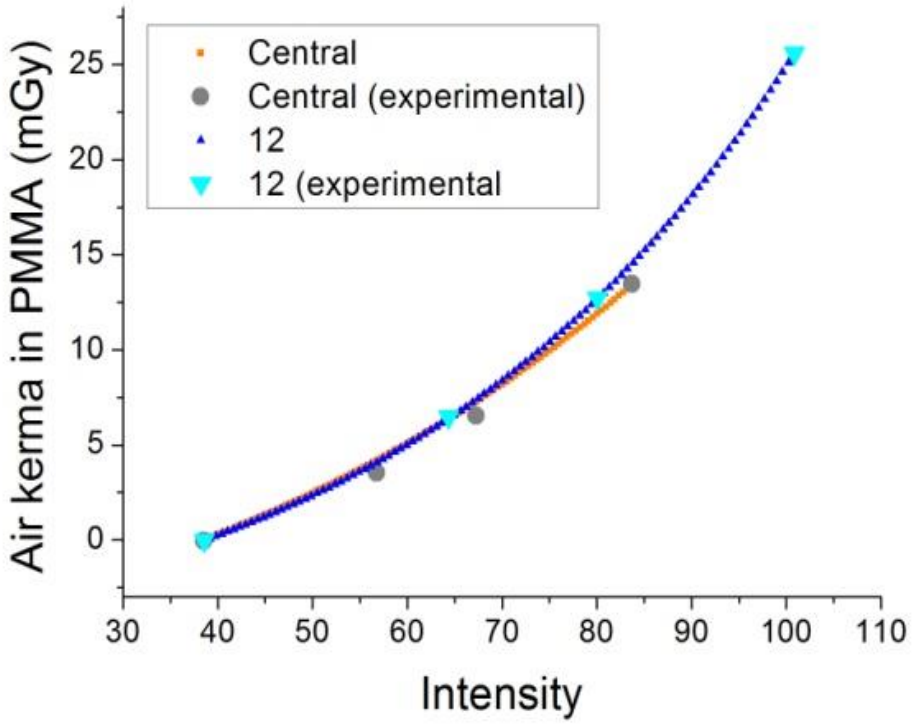
The films were scanned with a resolution of 300 ppi in JPG format. The images were processed using ImageJ software.
Intensity values in grayscale to unexposed films were treated as Background (BG) and considered as zero miligrays

Results

- Calibration curves were constructed for each voltage used in feeding the X-ray tube for the reason that one of the properties of radiochromic films is that they have energy dependency. Fig. 1 shows the curves of air Kerma in the PMMA obtained for each position in the phantom.



(a)



(b)

Figure 1: Calibration curves for calculates and experimental data at positions "Central" and "12" of radiochromic films for a voltage of 120 kV (a) and (b) 135 kV.

From the values of air Kerma in the PMMA obtained experimentally, mathematical curves that allow you to describe the behavior of radiochromic films when exposed to radiation to conditions described here. The mathematical models follow the expression:

$$y=A*e^{(x/B)} - C$$

Table1. Values For the parameters *A*, *B* and C for calibration curves

	120 kV		135 kV	
	CENTRAL	**12**	**CENTRAL**	**12**
A	0.078	0.614	2.022	3.077
B	14.585	23.870	37.177	42.374
C	0.926	3.210	5.759	7.661

Table 2. Air Kerma in mGy measured and calculates values to 120 kV

Central			12		
Measured	**Calculated**	**Error**	**Measured**	**Calculated**	**Error**
0.000	0.172	-0.2	0.000	-0.125	0.1
2.465	2.243	0.2	4.859	4.954	-0.1
4.931	4.780	0.1	9.718	10.085	-0.4
9.861	10.268	-0.4	19.436	18.957	0.5
14.792	14.589	0.2	29.153	29.380	-0.2

Table 3. Air Kerma in mGy measured and calculates values to 135 kV

Central			12		
Measured	**Calculated**	**Error**	**Measured**	**Calculated**	**Error**
0.000	-0.059	0.06	0.000	-0.022	0.02
3.357	3.558	-0.2	6.394	6.463	-0.07
6.713	6.540	0.2	12.789	12.730	0.06
13.427	13.457	-0.03	25.578	25.590	-0.01

Conclusion

- Mathematical models obtained from experimental curves may be used for calibration of the radiochromic film as absorbed dose measurement devices in adult chest phantom CT scans for the optimization of protocols image acquisition.

Acknowledgements

CAPES

FAPEMIG

AGNUS DEI
CLÍNICA MÉDICA

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Thank you!