DOSIMETRIC EVALUATION OF $CaSO_4$:Dy; LiF:Mg,Ti AND LiF:Mg,Ti MICRODOSIMETERS USING WATER PHANTOM FOR DOSIMETRY IN CLINICAL 6 MV PHOTON BEAMS

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Introduction: With the advent and advances in the use of nuclear technology for diagnostic and therapeutic purposes has emerged a major concern related to the detection and evaluation of radiation dose to the environmental control and personal evaluation. It is essential to ensure the radiation safety of the population: workers (occupationally exposed individuals), pacients and individuals of the public (Oberhofer and Kron, 1979) . The main objective of dosimetry in radiotherapy since the appearance of this mode of treatment was to determine with greater precision and accuracy possible the absorbed dose delivered to the tumor through the calibration of the radiation beam and dosimetry for routine quality control, both the machine and therapy treatment (Metcalfe et al, 2007). This study aimed to evaluate the performance of the thermoluminescent dosimeters of $CaSO_4$:Dy, produced at IPEN, LiF:Mg,Ti and LiF:Mg,Ti microdosimeters to be applied in clinical dosimetry of photon beams using water phantom.

Materials and Methods:

Dosimetric materials:

- 200 $CaSO_4$:Dy TL Dosimeters;
- 200 LiF:Mg,Ti (TLD-100)
- 105 of microLiF:Mg,Ti (TLD-100).

Equipments:

- Cubic water phantom 30 x 30 x 30 cm^3 filled with distilled water;
- Furnace Vulcan model 3-550 PD;
- TL reader Harshaw model 3500.

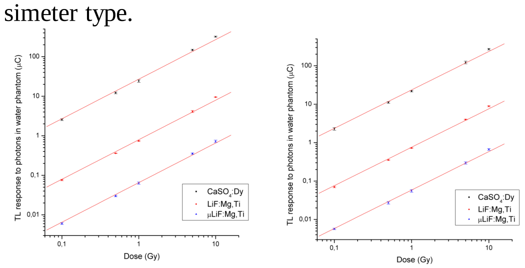
Irradiation systems:

- Linear accelerator VARIAN model Clinac 2100 C of the Hospital das Clínicas da Universidade de São Paulo (HC-FMUSP);
- Linear accelerators VARIAN model Clinac 2100 C and model 23EX of the Hospital Albert Einstein.
- Cobalt-60 gamma source from Laboratory of Dosimetric Materials /IPEN with activity 0,656 GBq on 09/12/2008.

The dosimeters were selected according to their sensitivities and were divided into the groups. An initial dose response curve was obtained using a ^{60}Co gamma source. For the positioning of dosimeters in the water phantom they were packed in plastic material and positioned at the build-up thickness. The TL responses were evaluated and dose-response curves of each dosimeter type and its sensitivities were obtained to the radiation doses: 0.1, 0.5, 1.0; 5.0 and 10.0 Gy. Each presented value represents the average of 10 TL responses and the error bars the standard deviation of the mean.

Results:

Figure 1 presents the dose response curves: (a) to 6 MV photons using a water phantom from (HC-FMUSP) and (b) to 6 MV photons using water phantom from Hospital Albert Einstein, respectively. Figure 2 presents the average sensitivity of each dosimeter type.



(a) (b)

Figure 1: (a) Dose response curve to photon (6 MV) in water phantom (HC-FMUSP); (b) Dose response curve to photons (6 MV) in water phantom (Hospital Albert Einstein).

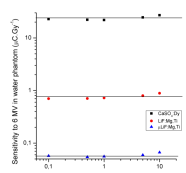


Figure 2: Average sensitivity of the TLDs to 6 MV photons using a water phantom.

Conclusion and Discussion:

The dose-response curves presents linear behaviour in the photon dose range from 0.1 to 10 Gy. $CaSO_4$:Dy dosimeters presents TL sensitivity about 30 and 400 times greater than LiF:Mg,Ti and microLiF:Mg,Ti dosimeters respectively.

The $CaSO_4$:Dy pellets, developed and produced in commercial scale by the Laboratory of Dosimetric Materials/IPEN, can represent a cheaper alternative to the imported chips TLD-100 to be applied in clinical photon beams dosimetry.

References:

Metcalfe, P. and Kron, T. and Hoban, P. 2007. The physics of radiotherapy X-rays and electrons .

Oberhofer, M. and Scharmann, A. 1979. Applied Thermoluminescence dosimetry.