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SMALL FIELDS DOSIMETRY EMPLOYING THERMOLUMINESCENT DOSIMETERSIN THE CLINICAL APLICATION OF PHOTON BEAMS

Almeida, S B[(1)], Cunha, A P V[(2)], Sampaio, C C[(3)], Menegussi, G[(4)] and Campos, L L[(1)]

(1) Radiation Metrology Center, Instituto de Pesquisas Energéticas e Nucleares, Av. Prof. Lineu Prestes, 2242 – Cidade Universitária, São Paulo – SP, Brazil (sbipen@usp.br).
(2, 3,4) Radiation Therapy Department. Hospital das Clínicas de São Paulo – HC, Av. Dr. Enéas Carvalho de Aguiar, 255 - CerqueiraCésar, São Paulo - SP, 05403-000

Introduction: In radiotherapy, the new techniques have some difficulties such as: beam dosimetry, geometric characterization and the use of small radiation fields[(1)]. In some cases, the fields sizes are reduced due to the very small lesions, the simulations of the treatment in the planning have a very important role, therefore, they must be provided with data referring to these small fields. Dosimetry becomes quite complex, as the precision becomes quite contestable, especially when small fields are being used in low density regions[(2)].

Due to the absence of lateral electronic balance, determining the dose in the target volume in small field cases is quite difficult. Another problem for this type of dosimetry is the sharp dose gradient at the edges of the field. However, this fact requires that the choice of the radiation detector must be of a relevant size in the dosimetry of small fields, taking into account some parameters such as: high spatial resolution, density equivalent to water, linearity, reproducibility, regardless of energy and rate of dose[(3)].

Material and method: For this analysis LiF:Mg;Ti (3,15 mm in diameter, 0,9 mm in thickness) and µLiF:Mg;Ti (1 mm x 1 mm) dosimeters produced by Harshaw were used. The irradiation system was the Varian Clinac 6 EX with photon energies of 6MV, with the collimator Multi-leaf Brainlab M3 belonging to the Hospital das Clínicas de São Paulo - HC. In addition, for measurements solid water plates (SW) of 30x30x1cm³ dimension were used. The studied field sizes were 9,8x9,8cm^2, 5x5cm^2, 4x4cm^2, 3x3cm^2, 2x2cm^2, 1x1cm^{2}and 05x05 cm^2.

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Results: The dosimeters were selected with TL sensitivity between ±3%. The TL response presented non-significant variation. The dose response curves to photon beams of 6MV presented a linear behavior in the dose range studied (2Gy to 10Gy). Results obtained in simulated irradiations demonstrated the viability of using µLiF:Mg;Ti as dosimeter to dose evaluation of small photon fields with relatively low uncertainties for this type of application. Table 1 presents the result of TL response of the dosimeters for the studied fields.

Tabela 1. Field factor - TL response average.

Field size (cm^2)	**0,5 x 0,5**	**1 x 1**	**2 x 2**	**3 x 3**	**4 x 4**	**5 x 5**	**9,8 x 9,8**
Detector							
LiF:Mg;Ti	-	0,667	0,849	0,852	1,000	1,024	1,015
µLiF	0,637	0,626	0,703	0,874	1,000	1,004	1,010

Conclusions: The dosimetry of small fields is very complex and difficult due to the dimensions of the fields, however the LiF:Mg;Ti and µLiF dosimeters demonstrated an excellent viability for this type of application due to their dimensions being minimal and showing uncertainties below 3%.

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References:

1. Alfonso, R., Andreo, P., Capote, R., Huq, M. S., Kilby, W., Kjäll, P., ... & Ullrich, W. (2008). A new formalism for reference dosimetry of small and nonstandard fields. *Medical physics*, *35*(11), 5179-5186.

2. Whyte, R. I., Crownover, R., Murphy, M. J., Martin, D. P.,Rice, T. W., DeCamp Jr, M. M., ... & Le, Q. T. (2003).Stereotactic radiosurgery for lung tumors: preliminary report of a phase I trial. The Annals of thoracic surgery, 75(4),1097-1101.

3. Report. No. TRS-483 - Dosimetry of small static fields used in external photon beam radiotherapy: Summary of TRS-483, the IAEA-AAPM international Code of Practice for reference and relative dose determination (2018).