Analysis of the correction factor for the effect of the volumetric average using thermoluminescent dosimeters

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Abstract

Among the dosimetry complexities of making use of small fields, the volume average correction factor is an essential factor for analysis. This factor is defined as the ratio between the dose absorbed in water at the reference point of the water phantom in the absence of the detector and the average dose absorbed over the sensitive volume of the detector (still in the absence of the detector). This occurs because the detector has a significant volume, having the potential to influence dosimetry depending on the region that has a high dose gradient or the size of the field that is intended to be measured [1,2,3]. The objective of this work was to analyze the volumetric mean factor using TLDs (LiF:Mg,Ti; µLiF:Mg,Ti; $CaSO_4$:Dy). To develop the effect of the volumetric average, some parameters are necessary, such as: the dimensions of the dosimeters and the profiles of the radiation beam. Due to the geometry of the dosimeters or detector used, it is necessary to take into account the weight function, w(x,y)[2]. This parameter should approximate the dosimeter to a detector shape, such as: line, cylinder, cylinder with central electrode or a circular shape. In this work, the dosimeters were approximated to a detector with a circular shape like the diode, due to the face of the dosimeter facing the central beam of the linear accelerator. To be used the beam profiles were approximated to a Gaussian distribution that was obtained by the graphics program origin, in version 9.0. To calculate the volumetric average, a code developed by Cunha, 2019 using the Scilab software, version 6.0, was used. The fields analyzed were 2 x2 cm^2; 1 x 1 cm^2 and 0,5 x 0,5 cm^2. The results obtained demonstrated that the µLiF was the dosimeter that had the least influence on the fields, showing an influence of only 2% in the 0.5 x 0.5 cm^2 field, being considered the best detector for small field dosimetry. The LiF:Mg,Ti dosimeter showed a significant influence of 8% in the 1 x 1 cm^2 field. $CaSO_4$:Dy had an influence of 60% and is not recommended for use in fields smaller than 1 x 1 cm^2.

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References

[1] CUNHA, A. P. V. Implementação do formalismo para dosimetria de campos pequenos, TRS-483, e avaliação do impacto na radioterapia. Tese de Doutorado. Universidade de São Paulo, 2019. (doi.org/10.11606/T.5.2019.tde-23082019-082058).

[2] 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. (doi.org/10.1002/mp.13208).