First Latin-American Congress
on Solid State Dosimetry and Radiation Measurements
13-17 September, 2021

3D DOSE RECONSTRUCTION OF SMALL FIELDS IN A KILOVOLTOTAGE BEAM

SILVEIRA, M.A., PAVONI, J., and BAFFA, O.

Departmento de Física , FFCLRP, Universidade de São Paulo, 14040-901 Ribeirao Preto, SP, Brazil.
E - mail of corresponding author: matheus-silveira@usp.br, matsilver@hotmail.com

Introduction: New techniques of radiotherapy require spatial resolution and high precision. In this context, the conventional dosimeters, such as, ionization chamber and radiochromic films provide one dimensional and bidimensional information. However, gel dosimetry records tridimensional information of absorbed dose what is advantageous [1]. Gel dosimetry is based s in radiosensitive chemicals immersed in a matrix combined with an image technique to provide the 3D absorbed dose. Based on this technique, this work will provide a tridimensional dosimetry of a small field irradiated with 160 kV x-ray beam obtaining a percentage dose depth (PDD).

Materials and methods: The gel dosimeter used in this work is the Fricke-xylenol-orange(FXO) with formaldehyde and gelatin, prepared and packed in a 5 cm cylinder diameter and 10 cm tall.

The irradiation process was performed at our department with with a GE generator (TITAN type) producing a x-ray beam at 160 kV (10 mA), with intrinsic filtration of 0.8 mm Beryllium and 2 mm Aluminum, in a 2 cm diameter field. The irradiated planned max dose was 8Gy at the top of the cylinder.

The determination of the 3D dose map associated to the attenuation coefficient was performed in our in-house cone-beam optical-CT based on the convergent light source. The acquired transmission image had (800 x 600) pixles with 0.3 x 0.3mm² of effective pixel size, and the reconstructed image of the PDD profile was done with a resolution of (512 x 512) pixels with the same pixel size. To minimize noise and artifacts on the reconstruction process we used the *simultaneous iterative reconstruction technique* combined with *total variation denoising* algorithms (SIRT-TV) with 25 iterations and regularization parameter λ of 0.01. The final reconstructed image of the 2 cm diameter field is in the axial axis and the PDD profile was extracted from the coronal plane, to visualize the dose depth along the cylinder.

Results: The results presented in figure 1 show a dose reconstruction map at max dose of 8Gy for the axial axis (A), and along the entire vertical length in coronal axis(B) and the PDD profile in (C).

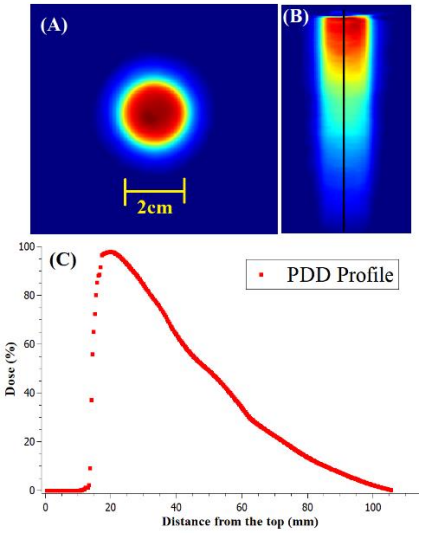

Figure 1: (A) Reconstructed image of axial axis at max dose of 8 Gy. (B) Reconstructed image of coronal axis. (C)Normalized percentage dose profile normalized to max dose of 8Gy

In this evaluated profile, it was possible to verify the whole PDD mapping, 100% to 0% of dose at central axis. A small fluctuation was found at the central region, that could be explained by the imperfections along the cylinder wall, a non optimized vessel for this volume of dosimeter. However, the 3D dose determination was not compromised.

Conclusions: The determination of the dose maps presented in figure 1 provide the 3D absorbed dose for the small field of the 2cm diameter irradiated with 160kV beam, this information is not possible to be visualized using the conventional dosimeters, therefore the gel dosimetry in this context will complete the whole dosimetry in a irradiation process.

References:

1. Baldock C., De Deene Y., Doran S., Ibbott G., Jirasek A., Lepage M., McAuley K. B., Oldham M. and Schreiner L. J., Polymer gel dosimetry, Phys. Med. Biol. 55 (2010) R1–R63

Partial financial support: CAPES, Finance Code 001, CNPq and FAPESP