Characterization of a 3D Prototyping Semi-Automated Filter Holder System for RQR and RQA radiation qualities

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Introduction

Dosimetry in diagnostic radiology and radiation protection is a critical aspect to ensure the accuracy standards and security. Characterization of radiation measurement systems, such as the semi-automated filter holder system for RQR and RQA, is essential to ensure the accuracy of measurements. In addition, quality control of dosimetry equipment, such as the patient dose calibrator (PDC), is crucial to ensure reliable results. In this study, we propose the use of spectrometry and ionization chamber for the characterization of the 3D prototyping semi-automated filter holder system.

Methods

The semi-automated filter holder system was assembled following international standards. The characterization will be performed using an X-ray spectrometer and an ionization chamber, following the procedures recommended by international standards. Tests for the quality control program will be performed.

Results

The results showed that the system meets the requirements of the international standards TRS457 and IEC 61267, with good energy response, stability, uniformity, and linearity. The use of spectrometry and ionization chamber was effective in determining these parameters. The spectra characterization allowed the establishment of an adequate quality control, with precise and reliable measurements.

Conclusions

The semi-automated filter holder system for RQR and RQA was characterized using spectrometry and ionization chamber, and a quality control program was established. The results indicate that the system is suitable for dosimetry measurements. Additionally, Monte Carlo simulation will be used for validation of the calibration method.

Monte Carlo Simulation of GRID collimators

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Introduction

GRID therapy uses collimators to obtain non-uniform spatial radiation patterns, generating dose peaks and valleys in the target volume. Based on it, favorable conditions to preserve healthy tissues are desirable. As the radiobiological mechanisms are not fully understood, the development of experimental setups for studies is a goal. Therefore, the aim of this work was to study different materials for the construction of GRID collimators to be used in radiobiological studies.

Methods

Monte Carlo Simulation with the PENELOPE v.2014 was used to obtain the dose distributions of cylindrical collimators with 5 cm in diameter and 3.5 cm thick. The collimators have a 3 mm open field and an open/blocked field ratio of 1:1. Aluminum, brass and lead were used to simulate the collimators and water to simulate a phantom. The dose distributions were used to obtain dose profiles and the valley-to-peak ratio - the peak-dose, referring to the dose in the unblocked beam path, and a valley dose referring to the dose of the blocked areas. Matlab® was used to analyze the dose distributions and profiles. A 100 kVp beam spectrum generated with SpekCalc was used to simulate.

Results

The ratio between the theoretical value and the full width at half maximum for the blocked filed for aluminum, lead, and brass, obtained by considering only the primary photons and the collimator transmissions, are 0.11, 0.09 and 0.10, respectively. The valley-to-peak ratio obtained using the simulations for the aluminum, lead and brass collimators were 0.23, 0.08, and 0.10, respectively. The difference between the theoretical and simulated values are due to the scattering inside the collimators and in the phantom, the transmission by the collimator being larger for the lighter material.

Conclusions

The results showed that lead and brass produced the highest degree of spatial fractionation, and are more suitable for the experimental setup of a GRID irradiation system for radiobiology studies.