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Introduction

In principle, induced radioactivity can be produced at all accelerators capable of liberating neutrons and other hadrons [1, 2]. When the accelerated beam strikes a nucleus, it converts it into a different nuclide, which may be radioactive.

In the last years, a lot of work has been done on the measurements of photoneutrons by different techniques from linear accelerators [3-6]. In addition, some of the investigators identified the typical radionuclides produced in the treatment room by the activation from the air [7-9].

Aim of this work

The aim of this work is to calculate the neutron fluence using Monte Carlo simulation, Geant4 code, as a function of the neutron energy, in and out side the treatment room to estimate the equivalent dose to patients.

Materials and Method

We developed a photon beam model for Varian 2100C (Varian Medical Systems) for Monte Carlo dose calculation purposes using last version of Geant4. A schematic of geometrical model of Clinac 2100C simulated with Geant4 are shown in Fig. 1. Calculations of photoneutrons were carried out for the most part at the machine isocenter.

The ambient dose equivalent using closed jaws, at point A and x-ray modes 20, 18, 15 and 10 MV , was found 1.79, 1.60, 0.62, and 0.02 mSv Gy$^{-1}$ respectively. The mean energy of neutrons were 0.48, 0.44, 0.40, and 0.16 MeV at 20, 18, 15, and 10 MV respectively.

The mass energy-absorption coefficient ($\mu_{en}/\rho$) used in above equation 1 is available in the database from medical linear accelerators, Med. Phys. 32, 2899-2910 (2005).

Results

The ambient dose equivalent using closed jaws, at point A and x-ray modes 20, 18, 15 and 10 MV, was found 1.79, 1.60, 0.62, and 0.02 mSv Gy$^{-1}$ respectively. The mean energy of neutrons were 0.48, 0.44, 0.40, and 0.16 MeV at 20, 18, 15, and 10 MV respectively.

Conclusions

The total dose present in this study from neutron received by patients treated with 20 MV present 1.79 mSv Gy$^{-1}$ in isocenter, and this can represent a risk for healthy tissues and contribute to secondary malignancy insurgence.

The annual dose received by workers was found in the range between 0.6 to 1.96 mSv, which represent very low dose according to the exposure limits recommended by International Commission on Radiological Protection (ICRP) and International Atomic Energy Agency (IAEA).

Literature cited

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