

THE NEUTRON DOSE CONVERSION COEFFICIENTS CALCULATION FOR HUMAN TOOTH ENAMEL IN ANTROPOMORPHIC PHANTOM

Khailov, Artem¹; Ivannikov, Alexander¹; Skvortsov, Valeri¹; Stepanenko, Valeri¹; Tsyb, Anatoli¹; Hoshi, Masaharu²

1 Medical Radiological Research Center, Obninsk, Russia, ivannikov@mrrc.obninsk.ru

2 Institute of Radiation Biology and Medicine at Hiroshima University, Hiroshima, Japan, mhoshi@hiroshima-u.ac.jp

To provide a dose reconstruction in human body tissues in case of accidental overexposure, prior knowledge of relationship between the dose measured by EPR spectroscopy in tooth enamel and organ or whole body doses is needed. To achieve this purpose the Monte Carlo simulation code MCNP4B was used to calculate the neutron and photon transport in mathematical adult men anthropomorphic heterogeneous phantom with newly defined dental region.

Dose response of tooth enamel to neutrons in vitro is known to be weak. At irradiation in the phantom, secondary photons ($E\gamma = 2.23$ MeV) produced mainly in reaction of radiation capture on hydrogen of soft tissues contribute to dose formation. Consequently, in this work separate calculations of neutron and secondary photon doses in enamel were made.

The calculated conversion coefficients that relate the neutron and secondary photon dose absorbed in enamel (molars and pre-molars only) to neutron fluence are shown in Fig.1a and Fig.1b respectively for different geometry of irradiation. Notations of the irradiation geometry are: AP (antero-posterior), PA (postero-anterior), LLAT (left lateral), RLAT (right lateral) and ISO (isotropic). At neutron energies below 10 keV the main contribution to the absorbed dose is given by the secondary photons. At higher energies dose in enamel due to neutrons strongly increases and neutrons give the main contribution. The doses strongly depend on the irradiation geometry.

The data presented provide the basis for connection between EPR signal in enamel and the standard operational quantities for neutron doses in different organs defined in ICRP Publication 74 (1996). To make such connection the energy dependences of tooth enamel EPR signal responses to neutron and photon are in need, which should be taken from calibration experiments.

Figure 1.

