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Investigation of eye lens dose operational quantity Hp(3) in kilovoltage energies

The use of radiation in medical imaging has been increasing during the past decades. Based on the new annual dose limit recommended by the ICRP, eye lens dosimetry should be considered important in occupational monitoring. In this study, the important challenges in eye lens dosimetry were investigated using Monte Carlo simulation. For this purpose, the human eye was completely simulated using MCNP Monte Carlo code, the sensitive part of the lens, i.e. the germinative zone was also considered in the simulations. To investigate the effect of the lens depth on the dose delivered to the lens, different eye anatomies like normal, myopia, hyperopia were simulated. The scattered X-ray spectrum received by the eye of the staff, after scattering from the patient was obtained, and the dose from the scattered photons in different parts of the eye lens was calculated. For measurement of Hp(3), 3mm of tissue-equivalent material is usually suggested to be used for covering the dosimeter. The X-ray attenuation of different thicknesses of tissue and plexiglass was compared in order to find the thickness of plexiglass which is equivalent to 3mm eye tissue. Finally, the results of the simulations show that the previously-suggested protocols for the measurement of Hp(3) can be used with small uncertainties. The result indicates that the dose received by the lens is not much affected by the thickness and the depth of the lens. In the next step, the effect of cylindrical, and slab phantom for calibration was investigated. The percentage differences between the lens dose for normal, myopia, and hyperopia eyes are less than 2%. Therefore, it was concluded that the different eye anatomy has no significant effect on the lens dose. The cylindrical phantom was suggested for calibration, instead of the slab phantom. 3mm plexiglass was equivalent to 3mm eye tissue, therefore the 3mm plexiglass was suggested to cover the personal dosimeter.

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