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Challenges of the eye lens dosimetry using thermoluminescence dosimetry

Eye lens cataract is one of the earliest biological effects of radiation since the discovery of X-rays. According to the 2011 update of the International Commission on Radiological Protection (ICRP), the dose to the eye lens in occupational exposure in planned exposure was reduced significantly compared to the previous dose limit (1,2). Therefore, measurement of lens dose has been the subject of different investigations during the last decade. In this study, the common method used in our department, for the measurement of Hp (3) operational quantity using thermoluminescence dosimeters, has been verified. In this investigation, the effect of TLD location, and the thickness of material covering the dosimeters was investigated. For this purpose, two phantoms were used, one of them was on the bed to provide the scattering condition as the patient, and the second Phantom, the Alderson Rando phantom was located at the position of the cardiologists in angiography. Several TLD-100 cubical chips were installed at different places on the face of the phantom, like eyebrows, cheeks, forehead, and temples. Currently, the Hp(3) monitoring methods suggest that the dosimeters should be located at the edge of the eye, near the temples. However, the results of our investigation showed that this place may introduce significant uncertainties to the measurement. Based on our measurements, the best locations with the results near the central part of the eye is on both eyebrows, or on the cheek. The results also indicate that 3mm plexiglass should cover the TLD, the dosimetry experiences about 10% uncertainty for 80 kVp X-rays scattered from the patient phantom, and reaching the staff eye. Finally, the currently used protocol used in our department was revised, and based on the new protocol, TLDs are inserted inside cubical plexiglass containers, and put on the middle of right, and left eyebrows in order to reduce the uncertainties in eye dosimetry.

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