Development of Geant4 simulation code for eye plaques using detailed eye models

Min Cheol Han1, Donghyeok Choi1, Hojae Kim2, Dong Wook Kim1, Kyung Hwan Chang1, Jihun Kim1, Su Chul Han1, Kwangwoo Park1, Ho Jin Kim1, Hegin Han3, and Jin Sung Kim1*

1Department of Radiation Oncology, Yonsei University College of Medicine, Seoul, Republic of Korea
2Department of Radiation Oncology, Yonsei Cancer Center, Severance Hospital, Seoul, Republic of Korea
3Department of Nuclear Engineering, Hanyang University, Seoul, Republic of Korea
*E-mail: jinsung.kim@yuhs.ac

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Eye plaques are widely used methods in ocular brachytherapy to treat eye cancers such as uveal melanoma. In a clinical site, specific plans for eye plaque are established by using advanced treatment planning systems (TPSs). During the last 20 years, several studies have assessed the TPSs using Monte Carlo (MC) simulation, but the evaluation processes had used a simplified eye model, such as a sphere, and they have focused on the dose verifications for tumor and critical targets excluding radiosensitive layers. Recently, the International Commission on Radiological Protection (ICRP) and Hanyang University have released the detailed computational human phantoms, called mesh-type reference computational phantoms (MRCPs) and mesh-type reference Korean phantoms (MRKPs), respectively. The eye models included in MRCPs and MRKPs incorporated detailed radiosensitive structures required for effective dose calculations. In this study, we have developed a Geant4-based MC simulation code based on the detailed eye models extracted from the MRCPs and MRKPs. The developed code could successfully calculate doses not only for tumor and critical organs but also for radiosensitive regions. We expect that detailed information about the simulation code, its related results, and an application example comparing with a patient-specific eye plaque plan will be presented in our presentation on NAT2020 and in our full paper.

Fig. 1. Geant4-based eye plaque simulation using detailed eye model of MRCPs: (a) geometry visualization, and (b) screenshot of eye plaque simulation with ruthenium-106 source

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