Results on 2019 KREDOS inter-laboratory comparison of whole body dose reconstruction using Monte Carlo simulation

Min Chae Kim[1,2], Hyoungtaek Kim[1*], Yoomi Choi[1], Jungil Lee[1], Young-su Kim[2,3], Han Sung Kim[3], Wi-Ho Ha[3], Hanjin Lee[4], Hyungjoon Yu[4], and Chan Hyeong Kim[2]

[1]Korea Atomic Energy Research Institute, 989-111 Daedeok-daero, Yuseong-gu, Daejeon, 34057, Republic of Korea
[2]Department of Nuclear Engineering, Hanyang University, 222, Wangsimni-ro, Seongdong-gu, Seoul, 04763, Republic of Korea
[3]Korea Institute of Radiological and Medical Sciences, 75 Nowon-ro, Nowon-gu, Seoul, 01812, Republic of Korea
[4]Department of Radiological Emergency Preparedness, Korea Institute of Nuclear Safety, Daejeon, Republic of Korea
[*]E-mail: kht84@kaeri.re.kr

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An evaluation of a whole body dose is essential in an event of a radiation accident. To provide more reasonable body doses, a calculation using Monte-carlo based tools is in a spotlight in an accident dosimetry. In order to verify the applicability of the simulation technique in an real radiation accident scenario, an experiment was conducted in Korea Retrospective Dosimetry Network (KREDOS). Two physical human body phantoms facing a radiation isotope (Ir-192, ~32.99 Ci) were designed. One was located at a distance of 30 cm from the source to simulate a case of heterogeneous exposure. The other phantom was located 1 m away from the source to simulate a case of homogeneous exposure. The physical phantoms used in this experiment were male and female Computerized Imaging Reference Systems (CIRS) phantoms. The phantom near the source is a reference sized female phantom, with a dose rate of around 1.8 Sv/h on the abdomen and 0.25 Sv/h in the back recored using an electrophoretic deposition (EPD). In the case of the phantom located far away, which is a reference sized male phantom, a dose rate of 1.33 Sv/h was measured on the abdomen and 0.196 Sv/h on the back. The female and male phantoms were exposed for 2 and 7 hours, respectively, so both phantoms were expected to be exposed close to 1 Sv in an effective dose. In the present calculations, a mobile phone was used as a fortouitous dosimeter to estimate doses for the whole body as well as the phone itself. The dose conversion coefficients (DCC), a coefficient that converts a mobile phone dose to whole body dose, were calculated using the simulation results of all phones and the whole body doses. Sixteen mobile phones in total were placed on the two phantoms and a display glass of the mobile phones was applied as a detector in a Monte-carlo simulation to represent a dose given to a mobile phone. Mobile phones were placed in four different positions on each phatom (chest, hip, thigh, and waist) where a phone can be placed in real life. The shielding effect by a body was tested depending on the phone locations. The phones on the chest, hip, thigh, and waist were standing shape by the display glass facing to the outward. The phones on the right waist were 90˚ rotated from the standing shape facing sideways to compare the effects of the incident angle between phones on the left and right waist. A kind of proficiency test of the simulation results between different institutes were performed. Three institutes which were Korea Atomic Energy Research Institute (KAERI), Korea Institute of Radiological and Medical Sciences (KIRAMS), and Korea Institute of Nuclear Safety (KINS) were participated. All simulations were carried out using mesh-type reference computational phantoms (MRCPs) with Geant4 code. The results showed a good agreement within 5%.

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