3[rd] URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

Assessment of EMFs to human exposure from open MRI system

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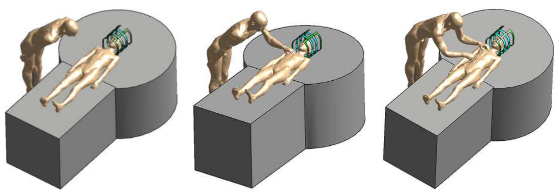
Recently, a medical device market such as a magnetic resonance imaging (MRI) system is outrageously growing. Open MRI system are widely used for patients with claustrophobia or companion animal. Because a patient assistance can have easy to access to patients or companion animal during a scanning in open MRI system, the patient assistant can set the patient's mind at rest by touching the patient's body while the MRI scans are running. Therefore, it is necessary to analyze the electromagnetic field (EMF) exposure of patient assistant during MRI scans. In this study, we investigated the numerical dosimetry for patient assistant exposure to EMFs from an RF head coil models of 0.3 Tesla and 1.2 Tesla open MRI system. The assessment of patient assistant for RF head coil model was calculated using the commercial electromagnetic simulation software, Sim4life with a finite difference time domain solver.
A commercially available RF head coil were referenced for the numerical computation of the dimension and types. Thelonious, the patient model, is a 11-year olde female model, which consisted with 75 different biological tissues. As the patient assistant, a posable adult model (Duke) was employed. Duke is 34-year-old male with 77 different tissues. Because Duke is a posable model, various poses were possible near the patients, allowing the exposure conditions to be examined at different poses of the patient assistant during the MRI scans. Three poses were defined using Duke model, which are representative scenarios. Scenario 1 is a posture in which the patient assistant is standing with bent waist forward next to the patient. Scenarios 2 is a posture in which the patient assistant' left hand is on the patient' chest. Finally, scenarios 3 is a posture in which the assistant's both hands are on the patient chest. Scenarios 3 creates an electrical current loop owing to the patient assistant's posture.
In this study, the input power with RF field(B1) of 2 μT was applied all SAR computations for each scenario. The spatial peak 1 g SARs of patient in 0.3 T system and 1.2 T system are 0.11 W/kg and 2.2 W/kg, respectively. Table 1 shown the spatial-averaged SARs in patient assistant. The SAR level of scenario 1 was relatively lower than those of scenarios 2 and 3 mainly because of the physical distance the coil model to the patient assistant and no electrical contact points between the patient and patient assistant. Scenario 3 produces higher SAR levels in the patient assistant than scenario 2, because the external magnetic fields, which was generated by the RF coils, is coupled to the closed induction loop formed by the arms of the patient assistant. SAR levels of the patient assistant in 1.2 T RF coil model produced at least 20 times than those in 0.3 T RF coil model. More careful attention is required if the field strength(B_0) of MRI system is increased.



Scenarios 1 Scenarios 2 Scenarios 3

Figure 1. Assessment scenarios

Table 1. Peak spatial-averaged SAR [W/kg] in patient assistant

Scenarios	0.3 T		1.2 T	
	1 g	10 g	1 g	10 g
1	0.0002	0.0001	0.0061	0.0038
2	0.0025	0.0013	0.1045	0.0556
3	0.0039	0.0018	0.1768	0.0937

Acknowledgements

This work was supported by the ICT R&D program of MSIT/IITP (2019-0-00102, A Study on Public Health and Safety in a Complex EMF Environment)