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Design of Low Field RF Coil for Open MRI System by Electric Dipole Radiation

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목적 : Dimensions of body RF coil composed of 4 rectangular loops for low field open MRI hav been optimized. The design result shows the field inhomogeneity of B1 field below 1.5 dB in the 25 cm DSV can be achieved.

대상 및 방법 : Our low field RF coil is composed of 4 rectangular strip loops that assumed to b located at both the bottom and top sides of permanent magnet. All the loops have identica dimensions and current amplitude. First, the inductance of a loop is calculated. Second, the current distribution on the coil strip is calculated by using finite difference time doma method (FDTD). It takes as much as 4 days in FDTD simulation for low frequency RF field That's why the electrical dipole radiation method is used for simulation. With the curren distribution obtained using the FDTD simulation, for various dimensional parameters th magnetic field has been calculated by electric dipole radiation method, where the curren elements are regarded as electric dipole radiation sources. The field pattern from electri dipole radiation is almost same as that from FDTD simulation. Also, it is same as that fro the result using the Viot-Savart equation, for far zone radiation term becomes zero and th B1 field amplitude of near one radiation is the same as the B field due to static current The field homogeneity is calculated in the 25 cm DSV.

결과 : The calculated magnetic inductance from a single strip loop of 15 cm×100 cm with 5 c wide strip is 1.31 μH, and the experimentally measured value by using a tuned RF coil i 1.4 μH. The measured field pattern from a single loop agrees to the simulation results. The current density along the longer side of the loop does not vary remarkably. It changes ver slowly along the stripe. But current density in a section of the stripe varies remarkably and does not depend on RF frequency. The current densities on the strip edges are about tw times of that on the middle. The current density on inner edge path of the loop is large than that on the outer edge path. The horizontal and vertical gaps between the loops do no shows monotonic behavior. But The longer the length of loop, the more homogeneous the field. The RF coil with 4 rectangular loops 15 cm×100 cm with 5 cm wide strip which a separated vertically 70 cm and horizontally 60 cm shows 1.2 dB field inhomogeneity in 2 cm DSV.

결론 : Electric dipole radiation method is very useful to optimize RF coil dimension in the case o low field MRI. It spares computational time and gives near and far zone fields. The propose low field body coil shows good homogeneity below 1.5 dB in 25cm DSV.