Development of a local RF shielding method for whole hand imaging

S. Handa[1], K. Taniguchi[1], K. Kose[1], and T. Haishi[2]

[1]Institute of Applied Physics, University of Tsukuba, Tsukuba, Ibaraki, Japan, [2]MRTechonology Inc., Tsukuba, Ibaraki, Japan

INTRODUCTION

In a human MRI system, the RF shielded room is required to prevent external noise. However, the RF shielded room limits the installation site and degrades openness of the MRI system. To overcome this problem, an alternative RF shielding method is required. In this study, we have developed a local RF shielding method for a whole hand MRI system.

MATERIALS AND METHODS

A compact whole hand MRI system with a permanent magnet (magnetic field: 0.3 T, gap width: 13 cm) was used in this study (Fig. 1) (1). A 14 turn solenoid RF coil with an oval aperture (7 cm width × 13 cm height) was developed. The local shielding method was developed using a conducting plate and a LC balun circuit. The RF coil was placed in an RF shielded box made of 100 μm thick copper sheets. The RF shielded box was connected to the conducting plate made of a 1-mm-thick copper plate and 0.5-mm-thick plastic sheet on a wooden block. The RF coil was split with three 100 pF chip capacitors to obtain a sharp resonance (Fig.3). Unloaded and loaded Q factors of the RF coil at the Larmor frequency were 260 and 160. The LC balun circuit was connected to the RF coil circuit to suppress undesired common mode noise and to be used to balance the RF coil circuit. External noise suppression performance of the LC balun and the conducting plate was evaluated using an artificial external noise. A 22 years old male subject sat on a chair in front of the magnet and inserted his hand into the RF coil for the evaluation. The artificial noise was emitted from a loop antenna (15 cm diameter, made of 3 turn 5D-2V coaxial cable) located 2 m apart from the magnet center and was connected to a signal generator (MG 3641A, ANRITSU Inc., Japan). The signal generator produced a frequency-modulated Gaussian noise signal at 12.57950 MHz. The artificial noise power spectra were obtained using fast Fourier transform from the received datasets.

RESULTS AND DISCUSSIONS

Figure 4 shows the measured power spectra of the artificial noise, when the conducting plate and the LC balun were used or not. In this figure, the conducting plate has about 20 dB noise suppressions. Furthermore, the combination of the LC balun and the conducting plate has about 40 dB noise suppression. Figures 5 and 6 show 2D coronal cross sections obtained from 3D datasets acquired with a gradient echo sequence (TR/TE = 40 ms/5 ms, matrix size: 512 × 256 × 32, voxel size: 0.4 mm × 0.8 mm × 1.6 mm), when the conducting plate and the LC balun were used or not, respectively. In Fig. 5, the artificial noise was drastically suppressed. This result has demonstrated that whole hand imaging is possible using the local RF shielding method instead of an RF shielded room.

In conclusion, we have developed a local RF shielding method and demonstrated its usefulness for whole hand imaging in the presence of external noise.

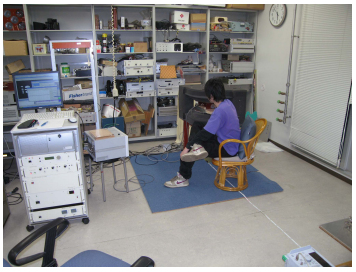

FIG. 1

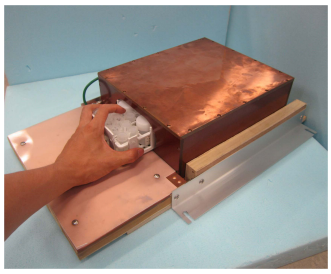

FIG.2

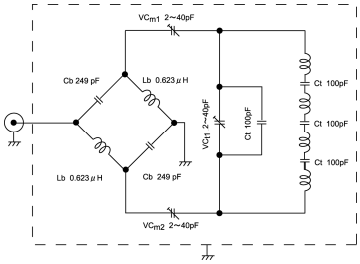

FIG.3

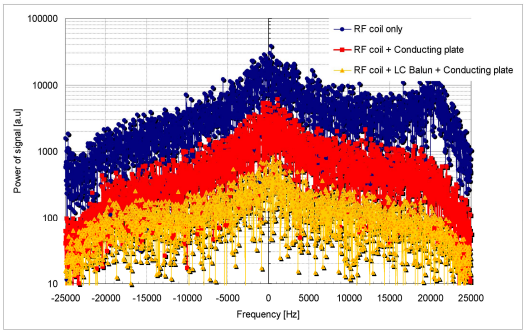

FIG. 4

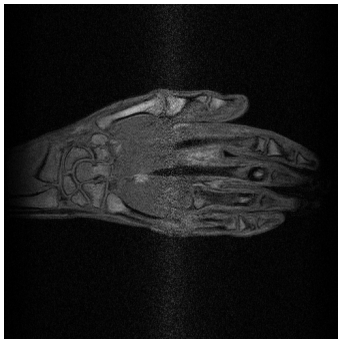

FIG. 5

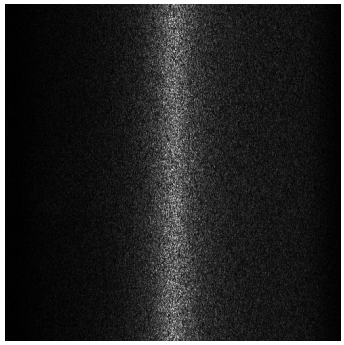

FIG. 6

References

[1] S. Handa et al, Proc 16th ISMRM, Tronto, 2008, submitted.