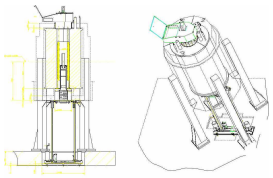
Control/Tracking Number: 02-M-244-ESMRMB
Activity: Scientific Paper (Methodology)
Topic (Complete): 206 Functional Imaging
Current Date/Time: 4/16/2002 2:17:06 AM

Functional MR imaging of the monkey brain in a novel vertical large-bore 7 Tesla setup

J. Pfeuffer[1], H. Merkle[2], N. K. Logothetis[1];
[1]Dep. of Neurophysiology, Max-Planck Inst f. Biol Cybernetics, Tuebingen, GERMANY,
[2]Laboratory of Functional and Molecular Imaging, NIH/NINDS, Bethesda, MD.

Introduction

Functional MRI in monkeys promises to build a bridge between brain research in humans and the large body of systems neuroscience work in animals [1]. Simultaneous fMRI and electrophysiology was recently used in the anesthetized monkey to elucidate the neural activity underlying the fMRI BOLD signal [2]. Here we present the first results from a novel high field (7T), large-bore (60cm) *vertical* MR system, in which MR imaging and electrophysiology can be performed in the awake trained monkey (*Macaca mulatta*). Upright positioning of the animal - being used over the last 50-years in all alert-monkey laboratories, was chosen for fMRI too, to minimize discomfort in the animals, expedite their training process, and ensure longer cooperation during the demanding psychophysical testing.



MR System and Setup

The 7 Tesla magnet has a 60-cm bore, an overall height of 6.40 m, and an empty weight of 80 tons. The system, extending over three floors, is quality shielded for low and high-frequencies to ensure noise-free electrophysiological recording of both local field and action potentials inside or outside the magnet bore. It is controlled by a four-channel BRUKER Biospec console. The 38-cm gradient insert achieves 80 mT/m in 130 µs. RF coils were custom-built [Merkle H et al., this meeting] similar to designs reported previously [2].

A prototype of primate chair was custom-designed and built to accommodate for the positioning of the electrophysiology assortments, the reward of the animal, the stimulus presentation, and the control of unwanted movement. The chair is driven into the magnet with a vertical transport system. All cables connecting the proximal end of the recording and monitoring devices to the main equipment were fed through a specialized filter panel at the lower end the chair.

Results

Initial MR imaging experiments were performed with spin echo, FLASH, and inversion-recovery sequences to determine T1, T2, and T2* values for gray, white matter and CSF. Functional echo-planar imaging provided robust activation with high t values >5 and percent changes >5%. The quality of the first anatomical and functional images acquired with this system promises the ultra-high resolution required to examine the local electrophysiological signal measured with microelectrodes in the context of the activation of small networks assessed in functional MR imaging.

References

1. Logothetis NK et al. [1999] Nature Neurosci 2(6):555-62.
2. Logothetis NK et al. [2001] Nature 412:150-157.
3. Logothetis NK et al. [2002] J Neurosci Meth in press.

Supported by the Max-Planck-Society.