ice Use Only

l #:

1993 Abstract Form for
Scientific Presentations
SOCIETY OF MAGNETIC
RESONANCE IN MEDICINE

.FTH ANNUAL SCIENTIFIC MEETING
NEW YORK HILTON & TOWERS
New York, NY, USA
August 14-20, 1993

er Oral Presentation but willing to present poster
er Poster but willing to make oral entation
er Only
Presentation Only
video required (available only for oral presentations)

: CATEGORIES
IORS SHOULD FILL IN BOTH A
ER AND A NUMERICAL CATE-
, IF APPROPRIATE

ING
CATEGORY [B] [13]
Clinical Observations
lodels
Nervous System—Brain
Nervous System—Spine and Other
Head and Neck
Cardiovascular (cardiac)
Chest/Pulmonary
Gastrointestinal
Genitourinary
Musculoskeletal/Sports Medicine
Vascular Imaging—Neuro
Vascular Imaging—Body
Non-proton Imaging
Breast
Functional Neuroimaging
Interventional MRI
Hematologic/Bone Marrow

:TROSCOPY
CATEGORY [ ] [ ]
Clinical Applications
Technique Development
Nervous System—Brain
Nervous System—Other
Cardiovascular (cardiac, vessels, etc.)
Gastrointestinal (liver, gut, etc.)
Kidneys and Pelvis
Musculoskeletal (including bone)
Tumor
Body Fluids (blood, plasma, urine, etc.)

HODOLOGY
CATEGORY [ ]
Angiography
Flow Quantification
Perfusion
Diffusion
Microscopy
Sequences/Pulse Design
Fast Scans
Gradient/RF Coils
Processing/Display Techniques
Contrast Mechanisms including Magnetization Transfer
Contrast Agents
Special Localization/Imaging
Quantitative Analysis
ESR
Bioeffects/Safety
Short T_2/Solids/Biomaterials
Multinuclear Spectroscopy

STRACT DEADLINE:
eived no later than **April 27, 1993.**
opyrights to accepted abstracts become the
erty of the SMRM. No proprietary
rmation may be withheld by authors.

IL TO:
SMRM
Twelfth Annual Meeting
1918 University Avenue, Suite 3C
Berkeley, CA 94704 USA

hors mailing abstracts from outside the should allow six weeks for mailing or d abstracts by express.

se type or print clearly the name and complete ling address of the first author.

ne Stephen M. Rao, Ph.D.
MCW Clinic at Froedtert
ress Neuropsychology Section
9200 W. Wisconsin Ave.
Milwaukee, WI 53226
untry U.S.A.

Somatotopic Mapping of the Primary Motor Cortex with Functional Magnetic Resonance Imaging

S.M. Rao,* J.R. Binder,* T.A. Hammeke,* L.M. Lisk,* P.A. Bandettini,† F.Z. Yetkin,** G.L. Morris,*
W.M. Mueller,‡ P.G. Antuono,* E.C. Wong,† V.M. Haughton,** and J.S. Hyde†
*Departments of *Neurology, **Radiology, and ‡Neurosurgery, and †Biophysics Research Institute, Medical College of Wisconsin, Milwaukee, WI.*

INTRODUCTION:

Recent functional MRI (FMRI) studies have demonstrated changes in signal intensity within the contralateral primary motor cortex during simple, self-paced, repetitive finger movements [1,2,3,4]. Most of our current knowledge of the somatotopic organization of the primary motor cortex in humans is derived from the electrophysiological stimulation studies of Penfield [5]. Curiously, only one PET study [6] has examined the somatotopic organization of the primary motor cortex. A replication of this work with FMRI is needed for three reasons: (a) the somatotopic organization of the motor cortex is well-defined and can serve as a validation of the FMRI technique, (b) results from electrical stimulation studies may differ from those derived from imaging studies of voluntary movements, and (c) *in vivo* functional mapping of the primary motor cortex with FMRI may be useful in evaluating patients with various cerebral disorders, particularly in the operating suite.

METHODS:

Six healthy right-handed subjects were imaged using a standard GE 1.5-T Signa scanner equipped with a 30.5 cm i.d. three-axis local gradient coil and an endcapped quadrature birdcage RF coil. A blipped gradient-echo echo-planar pulse sequence (TE = 40 ms; FOV = 24 cm; 64 x 64 matrix; 3.75 mm in-plane resolution) was used. Three contiguous coronal slices (10 mm slice thickness) were obtained through the primary motor cortex (subjects' heads were flexed 25° forward in the scanner relative to standard MR orientation).

During each task, 104 consecutive images (TR = 2 s) were obtained during 10 alternating baseline (rest) and activation periods of 10 s each. Activation tasks included simple, self-paced, repetitive movements of the right fingers (digits 2-5 in unison), toes, and elbow. In addition, subjects performed isometric contraction of the tongue to avoid motion artifact. Pixels demonstrating functional activity were identified by correlating raw MR signal intensity values with reference sine functions [4,7], using a cut-off value of $|r| \geq .50$ ($p < 2.7 \times 10^{-6}$) corresponding to the Bonferroni-adjusted alpha level required for multiple comparisons.

RESULTS:

In general, active pixels closely corresponded to the known somatotopic organization of the primary motor cortex (see Figure 1 for results from a representative subject). Toe movements produced signal changes within the interhemispheric fissure, while finger and elbow movements resulted in changes approximately two-thirds of the distance from the lateral fissure to the interhemispheric fissure. Elbow movements, however, did not produce the more lateral activity observed during finger movements. Tongue movements resulted in bilateral signal changes nearer the lateral fissure.

CONCLUSIONS:

Results of this preliminary study suggest that FMRI is capable of demonstrating the somatotopic organization of the primary motor cortex. In contrast to the present investigation, a PET study [6] was unable to distinguish arm from finger movements. The cortical areas activated by voluntary movements were generally similar in spatial topography to those derived from stimulation studies. Future studies are needed to directly correlate FMRI results with electrical stimulation findings derived from patients undergoing intraoperative cortical mapping.

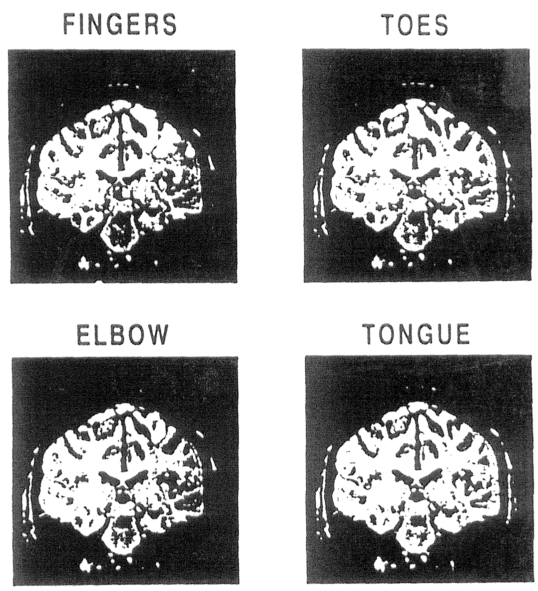

Figure 1

REFERENCES:

1. Bandettini P.A., Wong E.C., Hinks R.S., Tikofsky R.S., and Hyde J.S. *Magn. Reson. Med.*, 25, 390 (1992).
2. Kwong K.K., Belliveau J.W., Chesler D.A., Goldberg I.E., Weisskoff, R.M., et al. *PNAS* 89, 5672 (1992).
3. Kim S., Ashe J., Georgopoulos A.P., Merkle, H., Jutta M., et al. *J. Neurophysiol.* 69, 297 (1993).
4. Rao S.M., Binder J.R., Bandettini, P.A., Hammeke, T.A., Yetkin, F.Z., et al. *Neurology* (accepted for publication).
5. Penfield W. and Boldrey E. *Brain* 15, 389 (1938).
6. Grafton S.T., Woods R.P., Mazziotta J.C., and Phelps M.E. *J. Neurophysiol.* 66, 735 (1991).
7. Bandettini P.A., Jesmanowicz A., Wong E.C., and Hyde J.S. *Magn. Reson. Med.* (accepted for publication).