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Clinical Use of Functional Magnetic Resonance Imaging: Reflections on the New CPT Codes

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Functional magnetic resonance imaging (fMRI), a noninvasive method for mapping human brain function, was developed 15 years ago. This technique, based on the blood oxygen level dependent (BOLD) contrast, is sensitive to the localized hemodynamic changes that occur with increased neural activity. Over the first decade following this discovery, fMRI was used extensively to map brain activity evoked from sensory, motor, cognitive, and emotional tasks in healthy individuals. More recently, this technique has been applied to further our understanding of neurobehavioral disorders, such as Alzheimer's disease, epilepsy, brain tumors, stroke, traumatic brain injury, and multiple sclerosis.

fMRI has become widespread because it is relatively easy to perform, is reproducible, does not involve the use of exogenous contrast agents, can be performed with the majority of existing MR scanners, and yields superior temporal and spatial resolution relative to other functional imaging techniques (e.g., positron emission tomography). Not surprisingly, some clinicians have appreciated the potential of fMRI as a tool for diagnosis and management of patients. Several professional specialties have begun to apply fMRI techniques to patient care, including clinical neuropsychology, neurology, neuroradiology, neurosurgery, psychiatry, and rehabilitation. The best developed clinical application has involved the use of fMRI in the presurgical mapping of patients with brain tumors and epilepsy. The strength of clinical fMRI research in this area culminated in the approval of fMRI-specific CPT codes (see below), effective January 2007. One of the three approved fMRI codes was specifically designed for clinical neuropsychologists and physicians with education and training in the administration of neurofunctional tests.

The advent of CPT codes has raised concerns regarding the appropriate qualifications of clinical neuropsychologists applying fMRI in clinical practice. Regardless of the purpose of study, fMRI is technically challenging with regard to study design, image analysis, and interpretation of findings. The complex nature of this technique increases the risk of over-interpretation or misuse of data when individuals practice this technique without adequate training. To address this concern, Division 40 of the American Psychological Association published a position paper identifying the role of neuropsychologists in clinical fMRI (The Clinical Neuropsychologist, volume 18, 2004). The task force noted that clinical fMRI is a team effort; consequently, clinical neuropsychologists will typically collaborate with professionals with expertise in neuroradiology, neurosurgery, MR physics, and statistical image analysis.

Neuropsychologists have extensive training in the development of cognitive tasks and statistical analysis, recognizing the importance of reliability and validity. In clinical practice, neuropsychologists are trained to recognize confounds to assessment of human behavior, interpret findings of cognitive performances, and make appropriate recommendations for treatment. Given the basic, fundamental training in brain-behavior relationships and human behavior, the role of neuropsychology in fMRI is well supported.

This paper will first discuss the CPT codes and then provide possible models of education and training that will ensure that the clinical fMRI study is administered and interpreted by a qualified practitioner.

Clinical fMRI codes

A series of evaluation/procedural codes were presented to the American Medical Association (AMA) CPT Editorial Panel for consideration for use in billing for these procedures by psychologists and physicians. As of January 1, 2007, there exist three distinct CPT codes for billing related to the fMRI procedure, grouped as follows:

70554	Magnetic resonance imaging, brain, functional MRI; including test selection and administration of repetitive body part movement and/or visual stimulation, not requiring physician or psychologist administration. (Do not report 70554 when 96020 is performed).
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70555	Magnetic resonance imaging, brain, functional MRI; requiring physician or psychologist administration. (Do not report 70555 unless 96020 is performed).
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AND

96020	Neurofunctional testing selection and administration during non-invasive imaging functional brain mapping, with test administered entirely by a physician or psychologist, with review of test results and report. (For magnetic resonance functional MRI, brain, use 70555; Do not report 6020 with 96101-96103, 96116-96120; Do not report 96020 when 70554 is performed).
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A physician (typically a radiologist) bills using either the 70554 or 70555 code, and the neuropsychologist bills using the 96020 code. Code 70554 is billed alone for a simple study where the tests are typically administered by a technician. For complex studies, two bills are rendered. Code 70555 is billed in conjunction with 96020; the radiologist uses the former

code. Clinical neuropsychologists will use the 96020 code, which is applied to the mapping of cognitive functions beyond simple motor and sensory assessment (e.g., language, memory, cognition, higher-order movements, and perception). The minimal work necessary to bill for 96020 requires the administration of at least two tests with at least one task assessing a higher cognitive function such as, but not limited to, attention, memory, language, visuospatial function, executive functions, decision making, planning, judgment, orientation, complex movements, and psychomotor speed. In addition, the neuropsychologist is expected to select the fMRI scanner tests, instruct and practice the patient on the tests, administer and adapt the tests (if necessary), monitor test performance, score and interpret test performance, consult with referring and collaborating physicians on test findings, and generate a clinical report.

Education and training models for clinical fMRI

By virtue of their knowledge base and training in relevant areas, neuropsychologists are qualified and essential contributors to teams conducting fMRI in clinical settings. However, it is important to note that neuropsychologists interested in using fMRI in clinical settings are expected to have additional training in issues directly relevant to fMRI. At this time, there are no guidelines for formal training in the use of fMRI clinically but there are several areas key to further study before a neuropsychologist uses fMRI in this manner. Training in fMRI should include use and development of cognitive tasks appropriate for fMRI paradigms that would optimally evoke activation in brain regions and functional systems of interest. Neuropsychologists also require training in MR physics and image acquisition, to the extent that they understand the underlying principles related to the technique. It is also recommended that they receive training in statistical analysis of fMRI data, as this is directly related to interpretation of activation findings. To avoid misuse or overinterpretation of fMRI results, clinicians must recognize the limits associated with imaging and the specific paradigm applied.

Specialization within the field of clinical neuropsychology is often established with specific training in internship or post-doctoral residency programs, as well as continuing education courses or collaboration. With regard to training in clinical fMRI, no formal programs have been established, though systematic training experiences are becoming available at all stages of career development.

Graduate programs in neuropsychology typically offer coursework in neuroscience. If possible, individuals interested in fMRI are encouraged to take courses in MR physics, image acquisition, statistical analysis of fMRI data, and interpretation of imaging results. Formal coursework may be offered outside the neuropsychology program, but may be available as elective courses. Also, as students complete practicum training for neuropsychological assessment, training programs may also offer practicum training specific to clinical use of fMRI. Practicum training of this nature should include basic training in the multiple facets of fMRI, including acquisition, analysis, and interpretation. Graduate students interested in advancing their training in fMRI would benefit from directing their research interest in this area as well. Research in fMRI as a graduate student could allow for

supervised training of all phases of fMRI research which would provide a strong foundation for clinical application of fMRI.

Internship and postdoctoral programs could also offer training in fMRI and the clinical application of this technique. With general clinical training occurring at the internship level, there is likely less time to acquire specialized training in fMRI. However, post-doctoral training offers a unique opportunity to acquire knowledge necessary for clinical application of fMRI. Again, the range of training should include MR physics, study design, imaging acquisition, analysis, and interpretation. Postdoctoral training in a setting where direct supervision and hands-on experience in the application of fMRI is possible may be the most effective way to obtain training for this procedure.

Once practicing as a neuropsychologist, there is less opportunity to immerse oneself in the appropriate training for fMRI practice. There are a few programs in the United States that offer 2 or 3-day courses in fMRI specifically designed for neuropsychologists who are planning to participate in fMRI research and practice. While these courses provide some exposure to and basic knowledge relevant to this technique, additional longer-term collaboration with currently practicing fMRI clinicians would be important to enhance one's training. Sabbatical opportunities or extended collaboration with colleagues is often valuable in this context.

Summary

The recent advent of clinical fMRI provides a unique opportunity to improve patient care using a completely noninvasive, reliable, and sensitive functional imaging procedure. At the same time, there are challenges to ensure that practitioners are qualified to conduct clinical fMRI studies within currently approved areas of clinical practice (presurgical mapping). Most fMRI experts, however, anticipate that fMRI will eventually be demonstrated to have valid applications in other clinical areas (e.g., see this issue for early diagnosis of Alzheimer's disease and as a biomarker for response to various medical, surgical and behavioral interventions). How clinical neuropsychologists will keep pace with these emerging scientific and clinical developments will present a challenge for the field in the coming years. It is critical that neuropsychology and other related fields provide adequate training opportunities so that the quality of service delivery is commensurate with the complexity of this important technological advance.

Reference

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