

TITLE: Mapping Receptive Language with Magnetic Source Imaging and Electroconvulsive Stimulation

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Objective: To compare results of receptive language mapping obtained with electrical cortical stimulation to that of non-invasive magnetic source imaging (MSI).

Background: MSI has been established as a reliable method for lateralizing receptive language function. However the relationship between specific language sites using MSI activation and cortical mapping with electrical stimulation is not well understood.

Methods: Twenty-one patients (ages 4 – 52 years) who were candidates for epilepsy or brain tumor surgery were studied. MSI was performed using an auditory word recognition task with a 148 MEG channel whole head system and analyzed using the ECD model. Receptive language areas were defined by dipole clusters (at least 5 dipoles within a 1 cm range). Electroconvulsive stimulation (ECS) was performed using a surgically implanted subdural electrode array placed over the temporal lobe. The language protocol briefly tested automatic speech, naming, auditory comprehension, repetition and reading. Electrodes were labeled as positive language sites if stimulation of contiguous pairs interrupted a minimum of one language function from at least two directions. 3D MSI images and a 3D CT or MR scan after grid placement were fused into a set of hybrid images. Language sites from the two methods were considered concordant if they overlapped to within 1 cm or if MSI dipoles were deep on the same gyrus or sulcus. Sites without overlap were considered discordant. The degree of correlation was classified into one of three categories for each patient: 1) Complete concordance - all MSI language dipoles overlapped with ECS; 2) Partial concordance - some sites with either method did not meet criteria for concordance; 3) Discordance - no overlap of language sites.

Results: Temporal language regions were identified with ECS in 17/21 patients. The remaining four patients proceeded to surgery with the guidance of MSI alone. In the 17 patients with both MSI and ECS language data, 3/17 were completely concordant, while 14/17 patients were partially concordant. No cases with complete discordance were identified. MSI language activity sources were frequently found deep in the sulcus, while ECS identified function at the cortical surface. Surgical resection guided by both methods was able to spare not only the language cortex traditionally identified by electrical stimulation, but also the deep areas identified by MSI. No significant language deficits developed post-operatively in this group.

Conclusions/Relevance: MSI is a valuable tool for mapping receptive language function. MSI and ECS are complimentary methods, generating a more complete language map that minimizes potential postoperative deficit.