Speech-Language Tasks Administered Based on Cortical Location During an Awake Craniotomy

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Abstract
Direct cortical stimulation during awake craniotomies is used for mapping language in order to proceed with the greatest precision while ensuring preservation of critical language areas. Intraoperative mapping is typically conducted by having the patient produce route speech and name objects. However, no standardized tests or procedures are used during craniotomies; therefore, speech-language pathologists (SLPs) are unsure of the correct methods to use. PubMed, Web of Science, and CINAHL databases were searched to retrieve studies focused on language tasks including naming, reading, counting, and other verb tasks during awake craniotomies. The tasks were conducted when performing these tasks. We review the tasks reported, list the cortical and subcortical regions whose stimulation inhibited language, and consider the types of task that stimulated regions of the brain. We compiled the research and created a representation of a brain with the locations of stimulation based on task. We argue that particular types of tasks are better used for awake craniotomies serving particular locations in the brain. We discuss the clinical value of the tasks and the limitations of the procedure. We suggest future research towards a formalized approach to language mapping during awake surgery. Further research will answer clinicians’ questions as to how to map language with the greatest specificity intraoperatively.

Methods
- Research Question: In patients with brain pathologies undergoing awake craniotomies, does the type of language task influence what area of the brain is disrupted during direct cortical stimulation?
- Search Strategy: (awake AND neurosurgery OR surgeon OR surgery) AND language AND (auditory OR language) AND (auditory testing OR testing OR test OR tests OR task OR task OR assistance OR localization)) OR (cortical mapping) AND (brain OR cerebrum OR cerebral) AND (area OR location OR area OR region)
- Databases searched: PubMed, Web of Science, CINAHL
- Research Process: Title and Abstract Review → Full Article Review
  - Appraisal: 403 articles were narrowed down to 7 articles, including 2 Case Control studies, 4 Case series, and 1 Systematic review. These were appraised and results were compiled.

Types of Tasks
- Object Naming
  - Patient presented with line drawings of concrete objects and asked to name each drawing (typically from BNT).
- Counting
  - Patient must count from 0-10 continuously.
- Reading
  - Patient must correctly read a short sentence.
- Word Generation
  - For 20 seconds, the patient must come up with as many words as possible.
- Auditory Response Naming
  - Patient hears description of a concrete noun and must generate a label or descriptor.
- Word Discrimination
  - SLP reads aloud one or two syllable words or nonsense words (changing initial or final phonemes). Subject determines whether they heard a word or nonsense word by making a thumb movement.
- Symbol Identification
  - Patient is presented with a symbol (i.e. a stop sign) and must say its name or indicate which category it belongs to.
- Verb Tasks
  - Multiple types. Must produce the verb in a picture in the correct form, must complete a sentence with a left out word, must come up with a verb that can be done with objects in picture, patient must produce infinitive form of verb depicted in drawing.

Results
- Object naming stimulated most areas of the brain (parietal, temporal, and frontal lobes) (Brennan, 2007).
- Object naming more sensitive for testing language than counting (Brennan, 2007).
- IFOF—perform reading tasks and picture naming (Gil-Robles, 2013).
- Naming should include both living and nonliving objects (Papagano, 2011).
- Verb comprehension is a better assessment than object naming (Rofes, 2014).

Conclusions
There are a variety of speech-language tasks used to assess different areas of the brain. However, there is not one standard assessment used across patients mainly due to the variability of each brain as well as the difficulty of controlled testing of patients undergoing awake craniotomies.

Discussion
- Based on research, we compiled the individual tasks and their respective locations stimulated in the brain.
- We compiled a list of general locations, and suggested tasks for those specific locations.
- Important: Due to brain plasticity and variability, these are suggestions. Tasks should be individualized to each patient.
- The areas in the brain listed should be tested using the following tasks:

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<th>Task Associated Stimulations</th>
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References