EEG-Based Brain Computer Interface to Control FES: A Program Proposal
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INTRODUCTION

✓ Stroke is the leading cause of long-term disability in the US.
✓ Fifty percent of stroke survivors have some hemiparesis.
✓ The effectiveness of current treatment techniques has been questioned.
✓ A new intervention being considered is an electro-encephalogram (EEG) based brain computer interface (BCI).
✓ EEG-based BCI uses a person’s brain activity to control an electronic device- in this case, functional electrical stimulation (FES).
✓ Currently research is being done to test the effectiveness of an EEG-based BCI to control FES for treating hemiparesis after stroke.

OT TASK-ORIENTED APPROACH

✓ Contemporary model of motor behavior and learning
✓ Uses meaningful occupations as the means for change
✓ Views Client as an active participant in the therapy process
✓ Emphasizes the interdependence of person, environment, occupational performance, and role performance
This approach will be used to frame this intervention.

BCI IN THE CLINIC

Intended population
✓ Individuals who have experienced a stroke
✓ Ability to maintain high degree of concentration

Evaluation
✓ Canadian Occupational Performance Measure (COPM)
✓ Activity Card Sort (ACS)
✓ Specific measures of motor function as necessary
✓ Functional task(s) chosen to address in therapy
  Examples include:
  ✓ Sewing tasks
  ✓ Cooking tasks
  ✓ Feeding tasks

Session Preparation
✓ EEG cap
✓ FES electrode placement based on desired function

Session
Client told via computer screen one of four commands:
✓ Attempt to relax affected UE
✓ Attempt to carryout functional task with affected UE
✓ Imagine relaxing affected UE
✓ Imagine engaging in functional task with affected UE

If EEG signal surpasses a pre-determined threshold, FES is activated, stimulating the selected muscle(s).

By requiring a high degree of active engagement, it is believed that motor learning will occur as a result of BCI use.
Similarly, placing functional demands on the central nervous system (CNS) encourages lasting changes; cortical recovery should occur, ultimately improving occupational performance.

TERMINATION OF TREATMENT

Duration of treatment will vary with each client Treatment should cease when Client:
✓ Is satisfied
✓ Spontaneously, consistently uses effective strategies during occupations
✓ Reverts to inefficient movement patterns with removal of treatment
✓ Lacks improvement in spite of personal and environmental modifications being made

EXPECTED RESULTS

It is expected that BCI use will lead to cortical recovery and improved upper extremity (UE) functional use as measured by task performance and functional neuroimaging.

TRAINING

Provided by a team of OT, Neurologist, and Engineer
✓ OT: Scope of hemiparesis and its effect on ability to perform activities of daily living (ADLs).
✓ Neurologist: Functional and stroke neuroanatomy
✓ Engineer: Explanation of closed-loop system
✓ Team: Discussion of functional neuroimaging

REFERENCES


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