Neuroprosthetics and Spinal Cord Injuries

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ABSTRACT

Spinal Cord Injuries are life-changing injuries that effect thousands of people across the world. They are often difficult to treat due to the nature of the spinal cord and the complexities of the human nervous system. However, modern medicine and technology have advanced significantly over the past decade leading to the development of new treatments for SCIs. Neuroprosthetics are an exciting technology that has experienced significant growth in effectiveness over the years with its ability to restore motor function. The goal of this research project is to analyze the history and different types of Neuroprosthetic devices to determine if the devices are effective and if they could become an effective means of treatment for people with spinal cord injuries. Each group member will analyze medical journals and research papers to determine these facts. Our results should determine if these could become an effective means of treatment for people with Spinal Cord Injuries.

INTRODUCTION

- Spinal Cord Injuries (SCIs) refer to damage to the spinal cord from some physical trauma or degenerative disorder
- Neuroprosthetics refer to any device that can enhance the input or output of a neural system.
- Advances in Brain Machine Interfaces have allowed for the development of Neuroprosthetic Devices directly connected to the brain.
- These Devices could help restore motor function in individuals with SCIs or other injuries
- By extracting and relaying specific information from the Brain or Spinal Cord, BMIs can allow for people with SCIs to interact with their environment through an external device in a similar way to before an injury

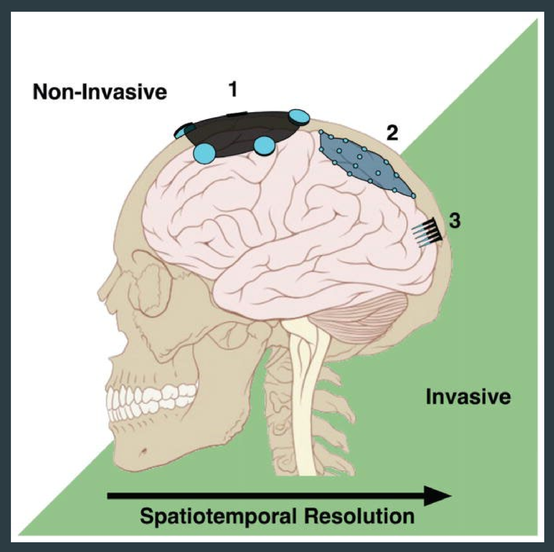

Figure 1. Invasive BMIs vs. Non-Invasive BMIs (Brain Machine Interfaces)

METHODS

- Online Research.
- Researched credible medical journals, articles, and papers that focused on BMIs and Neuroprosthetics

RESULTS

- Functional Electrical Stimulation (FES) has been used to control prosthetics in the past
- Systems such as the Freehand (Invasive) and the Sigmedics Parastep (Non-Invasive) have shown that FES can restore motor function
- Due to muscular tissue denervation from SCIs, these systems often require invasive surgeries and extensive training
- Typically, the more invasive a BMI is, the more accurate the readings for neural activity are. This means that more invasive BMIs are more effective at controlling prosthesis.

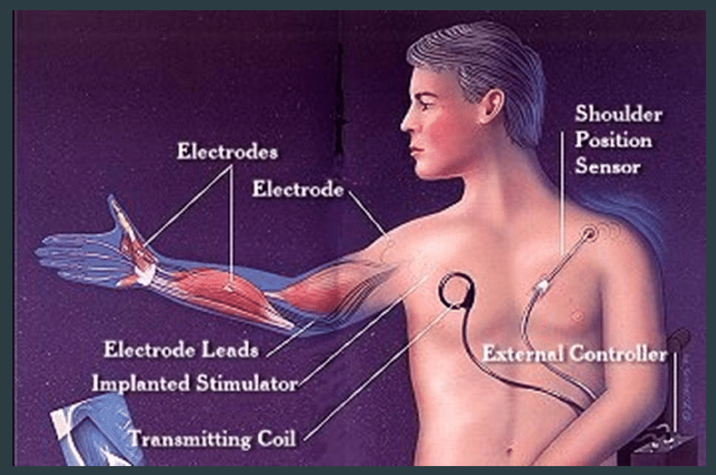

Figure 2. Major Components of the Freehand System, developed in Cleveland, Ohio

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DISCUSSION/FUTURE WORK

- The main drawbacks of BMI used for Neuroprosthetics are sustainability and control.
- Neuromorphic computing is the next step in improving these drawbacks
- Wireless BMI systems are expected to be developed through clinical trials in the next 5 years
- Latest Neuroprosthetic improvement is the BRAVO project

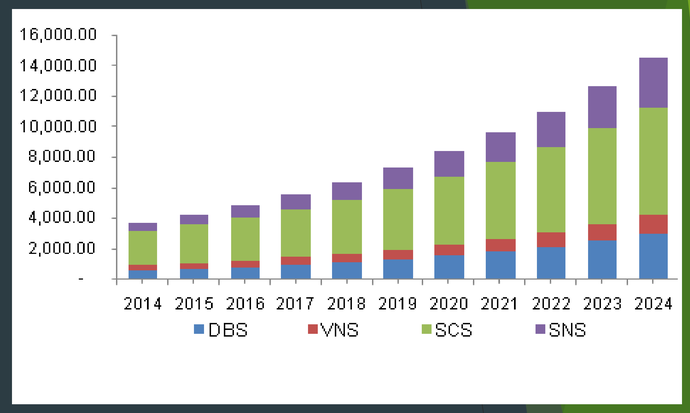

Figure 3. North America Neuroprosthetics Market, By Type, Spinal Cord Stimulation (SCS) Deep Brain Stimulation (DBS) Sacral Nerve Stimulator (SNS) Vagus Nerve Stimulators (VNS) 2014 - 2024 (USD Million)

CONCLUSIONS

- The market for Neuroprosthetics has increased significantly over the past ten years.
- With new technological advances in BMIs, Neuroprosthetic Devices could become an extremely effective form of treatment for SCIs.
- Still must overcome the problems of invasive surgery and overall comfort and natural feel for the user.

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