A Hybrid Electrochemical Microstimulator Implant for Denervated Muscles

Principal Investigator: COCKERHAM, KIMBERLY
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PUBLIC ABSTRACT

Facial nerve weakness is a medical disorder that causes the face on one side to droop and not move normally. The facial nerve is commonly damaged by trauma to the face, which was experienced by nearly a quarter of the troops involved in the recent Iraqi war. The nerve can also be injured during surgery involving the ear, face, or brain.

Existing medical devices use electrical stimulation alone to cause muscle contraction, but the level of electrical stimulus required to restore motion to the paralyzed facial muscles is painful. Our project will develop an implantable muscle stimulator combining low intensity electric stimulation with stimulation with a neurotransmitter, a substance that is used by nerves to stimulate muscle action in our body. This will restore motion to the paralyzed muscle in a painless, more natural manner. Our work will enlarge the understanding of the therapeutic use of neurotransmitters in the stimulation of muscle.

The first aim of this project will be to "fine tune" the exact level of electrical stimulation and stimulation with neurotransmitters that produces a natural appearing blink in an animal model of facial nerve weakness. The second aim will be to study the effectiveness an implantable device in an animal model of facial nerve damage. As the selected animals' eyelids are almost identical to human eyelids, performance of the microstimulator in animal testing will give us reliable feedback on how the device will perform in patients. The device will be made out of materials that are harmless to the body, enabling implantation. The knowledge gained from this testing will enable refinement of a series of prototype stimulators. The last aim will be to test the safety of the implant, which will be done by examining the animal after it has had the implant for 30 and 90 days.

This project addresses a common condition that currently has no satisfactory treatment for many patients. It provides an innovative solution, combining traditional electric stimulation for the production of muscle contraction with stimulation by neurotransmitters. This project will have direct clinical application. The data from this initial study will provide the basis for application to the Food and Drug Administration for approval and future clinical trials. We expect that the device will require a series of revisions and refinements addressing such areas as the proper balance between electric and neurotransmitter stimulation and refining the pump mechanism capable of rapid precise delivery of very small amounts of fluid. This stimulator will bring a new therapeutic option to patients suffering from facial nerve damage, the first of its kind, which will be able to restore blink action to the paralyzed eyelid and eventually motion to the rest of the face.