Deep Brain Stimulation to Treat Alzheimer's Disease

John Paquet III, *Biomedical Engineering, University of Rhode Island*
BME 181 First Presentation, March 4, 2013 <jp32012@gmail.com>

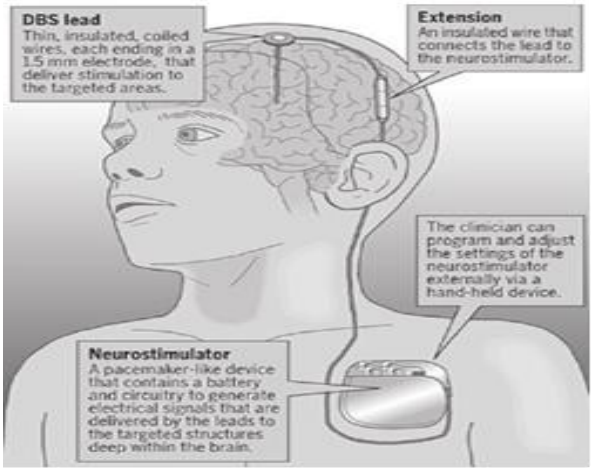
***Abstract*—Scientists hope that constant stimulation of parts of the brain involved in behavior, memory, and cognition by electrical impulses from a pacemaker will maintain brain function longer in Alzheimer's patients.**

I. Introduction

Alzheimer's disease (AD) affects about 5.4 million people in the US, is the sixth leading cause of death in the country, and is the only cause of death in the top ten that cannot be prevented, slowed, or cured by current drugs or methods. One out of every eight elderly Americans has AD, suffering from deterioration of cognition, behavior, and memory. Deep brain stimulation (DBS) may offer effective treatment for those suffering from this horrific disease. Although it would not be a cure, DBS has the potential to improve the quality of life for people with AD.

II. Methods

DBS consists of three major components: the lead, the neurostimulator, and the extension. During surgery, a tiny hole is drilled through the patient's skull to insert the lead into the target area of the brain. Next, the neurostimulator is inserted below the collarbone. Then, the surgeon creates a small opening behind the patient's ear and directs the extension beneath the skin of the head, neck, and shoulder. The device and wires cannot be seen from outside the body.



Target areas for the electrodes include the fornix, a memory center, the frontal lobes, a behavior and cognition center, and junctions of cognitive, behavior, and memory pathways. In the early stage of Alzheimer's, only some spots of the brain are destroyed. Much connectivity remains, but plaques block signals sent from one part of the brain to another part farther away. Thus, scientists are placing the electrodes at the intersections to determine if stimulation will revive those circuits.

III. Results

Although there has not yet been much testing for DBS on Alzheimer's patients, the initial results are uplifting. For instance, at Ohio State, a patient was asked to highlight specific shapes on a paper with many different figures drawn on it. In the first attempt, in which the neurostimulator was turned off, the patient was only able to find a couple of the shapes. However, after a period of constant stimulation, the patient was able to find thirty of the shapes. In another example, six patients in a pilot trial in Canada, after a year of continuous stimulation, showed improved memory and significantly more brain activity.

IV. Discussion

Although DBS is recognized as a safe and effective treatment for Parkinson's disease, dystonia, and other ailments, there are the risks of brain surgery and complications if parts of the DBS system move around or break. Also, dizziness and speech or vision issues, among other side effects, may occur; however, these could be reversible by adjusting the placement of the electrodes and changing the calibration, or the voltage and frequency at which the electrodes fire, via a hand-held device. Unfortunately, DBS treatment for Alzheimer's may cost between $50,000-100,000 for insurance, but this estimate could come down by the time treatment is ready to be applied outside of trials, which will be at least several years.

The current treatments for Alzheimer's that are in practice today have been frustratingly ineffective. DBS would potentially be able to help people with early-stage or mild AD, because much of the connectivity in the brain remains. With the number of Americans with AD expected to triple by 2050, the need for an effective treatment is greater now than ever, and deep brain stimulation may fill the gap.

References

[1] A.D.A.M. Medical Encyclopedia. U.S. National Library of Medicine, 26 Sept. 2011 <http://www.ncbi.nlm.nih.gov/pubmedhealth /PMH0001767/>
[2] Alzheimer's Association. 2012 Alzheimer's disease facts and figures. *Alzheimer's and Dementia: The Journal of the Alzheimer's Association*. March 2012; 8:131–168.
[3] CBSNews. CBS Interactive, 6 Dec. 2012 <http://www.cbsnews.com/video/watch/?id=50136498n>
[4] CBSNews. CBS Interactive, 21 Jan. 2013 <http://www.cbsnews.com/8301-204_162-57564987/electric-brain-stimulation-may-treat-alzheimers/>
[5] MedlinePlus Medical Encyclopedia. *U.S National Library of Medicine*. U.S. National Library of Medicine, 27 Feb. 2013 <http://www.nlm.nih.gov/medlineplus/ency/article/007453.htm>
[6] The Ohio State University Wexner Medical Center, 22 Jan. 2013 <http://medicalcenter.osu.edu/mediaroom/releases/ Pages/Ohio-State-Implants-First-Brain-Pacemaker-To-Treat-Alzheimer's.aspx>
[7] Wikipedia. Wikimedia Foundation, 03 Jan. 2013 http://en.wikipedia.org/wiki/Deep_brain_stimulation>
[8] CNS Diseases. 2013 <http://cnsdiseases.com/deep-brain-stimulation>