

Stimulation of the Vagus Nerve for Severe Tinnitus

Zachary Jacobson, *Biomedical Engineering, University of Rhode Island*
BME 281 Second Presentation, November 28, 2012 <mindzeyblind8@my.uri.edu>

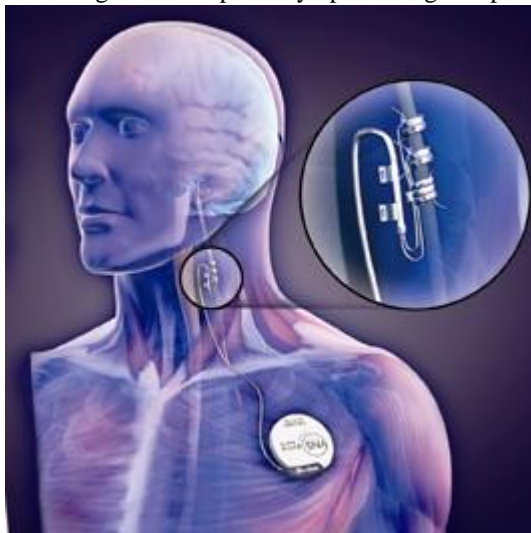
Abstract—For centuries man has experimented with relieving tinnitus by utilizing masking sounds, oils, and even white noise. In the past decade alone treatment for this condition has rapidly progressed with a better understanding of neural plasticity. Only in discussing current technology can we analyze the benefits of such therapies.

I. INTRODUCTION

Every year millions of people in the US are affected by tinnitus, or ringing of the ears without an external source. Of the fifty million affected, approximately 2 million remain unaffected by conventional treatment through drug therapy. Yearly, the US Veterans Administration alone spends almost \$1 billion for tinnitus treatments. For the millions whose condition is beyond the help of drugs and therapy very few possibilities for treatment exist. In the past doctors have tried to use white noise to mask the ringing. Today, therapies using electrodes to stimulate the Vagus Nerve have shown great promise is greatly reducing the effects of severe tinnitus in patients.

II. METHODS

Vagus Nerve stimulation has revolutionized treatment for tinnitus in the 21st century. By directly stimulating this nerve in conjunction with tonal arrangements doctor's are able to retrain the damaged neural pathways producing the phantom



tones. As the patient is subjected to a series of tones an implanted battery with electrodes simultaneously stimulates the vagus nerve leading into the auditory cortex. When this happens powerful neuromodulators such as acetylcholine and epinephrine are able to effectively reduce the intensity of the ringing. In recent years the need to implant batteries and electrodes into the neck to stimulate the Vagus Nerve had diminished thanks to the developments in microelectrodes and microtransponders. Currently, technological advances allow us to implant tiny semiconductor devices no bigger than a

grain of salt to sites of stimulation. Activation of said devices depend on an external source using radio waves, and in some cases near infrared light (FLAMES).

III. RESULTS

The result of Vagus Nerve stimulation varies from patient to patient. In most cases patients see, or more precisely hear, a tremendous difference after a month of treatment. Periods between treatment have been known to last between 2 to 6 months; and in some cases up to a year. Even still, there are cases in which the patients experiences no relief at all.

IV. DISCUSSION

In the end the question comes down to, "Is it worth it?". In many cases, sufferers of tinnitus experience lack of sleep which leads to behavioral problems. These in turn can lead to loss of personal and professional relationships. Some may also experience loss of appetite and low self-esteem. However, surgery or implantation of any kind should only be considered after less traumatizing means have been exhausted. It is also important to note that Vagus Nerve Stimulation, while FDA approved for treating depression, is not FDA approved for treating tinnitus and remains in clinical trials. Regular cost for the implantation procedure alone is \$20,000. Still, one cannot refute the progress of neural stimulation to correct this problem. In the future we can expect to see more great advances in this field such as the use of quantum dot semiconductors that can cross the blood brain barrier for ease of implantation and precise control of stimulation. Perhaps on that day the downfalls of current treatment will be obsolete.

References

- [1] "Brain Stimulation Therapies." *National Institute of Mental Health*. National Institute of Mental Health, 17 Nov. 2009. Web. 22 Apr. 2012. <<http://www.nimh.nih.gov/index.shtml>>.
- [2] Wikipedia: Tinnitus <en.wikipedia.org/wiki/tinnitus>.
- [3] "A Brief History of Neuromodulation." *International Neuromodulation Society*. International Neuromodulation Society, 2012. Web. 23 Apr. 2012. <<http://www.neuromodulation.com/about-neuromodulation>>.
- [4] Lozano, Andres M. "Harnessing Plasticity to Reset Dysfunctional Neurons." *The New England Journal of Medicine* 364.17 (2011): 1367-368. Print.