Deep Brain Stimulation (DBS)
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Abstract—Deep Brain Stimulation is a type of surgery that has
been used to treat various diseases by implanting electrodes in
the brain. While there are many obstacles that are still
encountered with this technology, it has been proven to be an
extremely helpful tool in alleviating symptoms of certain diseases.

I. INTRODUCTION

PARKINSON’s disease, dystonia, OCD, and tremors—these are all diseases that affect millions of people.
While there are many treatments from which to choose, an option for more extreme cases is Deep Brain
Stimulation (DBS). Electric currents were first used to cure various diseases in 50 AD, when Scribonius Largus used
electric torpedo fish to treat headaches [1]. Today, scientists have created pulse generators and electrodes that can be
implanted in people’s brains that send electric pulses to help alleviate symptoms of Parkinson’s, dystonia, OCD, and
tremors.

II. SURGERY

The first step to this highly complicated process is pre-operative planning, which determines the electrode placement.
The location is different for each patient, so the surgeon uses an MRI to determine the coordinate plane and the best
surgical route to where the electrodes will be placed (see Figure 1). This is usually done the morning before the surgery
[2].

The surgery is usually done with the patient awake. A hole is drilled into the skull, and a guide canula is put into the brain.
A Microdrive then puts the electrode(s) in the location determined by the MRI. The implanted pulse generator, or
IPG, is then put in the subclavicular region and is connected to the electrode(s). The surgery usually takes about 4.5 hours
for a unilateral implant, and 6 hours for a bilateral implant [2].

III. DBS PROGRAMMING

After the surgery is completed, the DBS has to be programmed. There are many variables that can be altered to
optimize results. Electrode polarity is one of them. Each electrode can be programed as either an anode and cathode, or
just a cathode. When an electrode can be both an anode and cathode, the field is more focused and narrow, whereas when
an electrode is just a cathode, it has a wider field with radial current diffusion [3]. The amplitude can also be changed,
although the voltage usually stays between 1 and 3.6 V. This is usually the variable that is changed the most. Pulse width is
also a variable, although it is usually not changed. It is only really moved if there are bad results at the maximum voltage
levels (>3.6V). The last variable is frequency, which is usually set between 2 and 185 Hz (although therapeutic effects are
usually only seen above 100 Hz). The standard Hz value is 130 [3]. These variables are manipulated until there is either a therapeutic
effect or a side effect [2]. Figure 2 is Medtronic’s 8840 N’Vision Clinician Programmer, which is used to change the
parameters [4].

IV. DISCUSSION

DBS Technology has advanced greatly, especially in the last 100 years, helping many people deal with the side effects
of different diseases. There is even research into the use of this technology to help treat various mental illnesses, such as
depression and anxiety. While the advances have been great, there is still a lot of work that needs to be done. There are
many side effects of the surgery and the DBS itself. Stroke, seizures, speech/balance problems, and headaches are just a few of the side effects [5]. Another downfall of this
technology is that scientists do not completely understand the neural passageways and physiological mechanisms of the
brain. The surgeons use the MRI to determine the best course of action, but it is not guaranteed to work for each person [2].
The process of programming the DBS also involves quite a bit of educated guessing. While there is much work that still
needs to be done with DBS, interest in this technology gives us hope that the process will be perfected.

REFERENCES
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