

DBS as a Form of Neuromodulation

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Starting in the 1940s, neurosurgery specialized in the destruction of portions of the brain including the thalamus and globus pallidus. Because of the relatively high risk of injury, the procedure was abandoned for use of the drug levodopa, the precursor of dopamine, a synaptic inhibitor.

Both of these methods of treatment resulted in a marked reduction in the number of unwanted motor tics. As a result, the therapies were used to treat Parkinson's Disease, and to a smaller extent, Tourette's Syndrome.

Eventually, with advances in technology and the commonality of cardiac pacemakers, researchers turned their attention to electrical stimulation of the brain. Using knowledge of old ablative procedures helpful in treating disease, researchers determined that electrical stimulation provides much the same result as destruction of the affected areas. Using more modern detection techniques such as SPECT and PET scans, researchers can pinpoint the areas responsible for the symptoms of these diseases.

Using this knowledge, implantation of an electrode lead in either the thalamus, the globus pallidus, or the subthalamic nucleus by means of a craniotomy. A second surgery is then performed to implant the pulse generator (IPG).

After successful implantation, the IPG must be calibrated to the individual. Calibration typically takes between a few weeks and a year.

Finally, the device can be used for its therapeutic purpose. It does this by delivering a small

current (0.86 to 6.4ma) via a 10s square pulse train consisting of individual 125Hz 60µs pulses.

The electrical stimulation actively blocks the ability of neurons to synapse, explaining the ability of DBS to alleviate the motor symptoms of Parkinson's Disease and Tourette's Syndrome.

Interestingly, DBS can also help fight depression and addiction, although the exact mechanisms are still unknown.

Overall, 75% of the motor symptoms associated with Tourette's, and 60% of the motor symptoms associated with Parkinson's. In addition, 50% of depressed patients were completely or almost completely cured.

Potential future improvements include a longer battery life, remote operation and monitoring, a smaller IPG, and a more cosmetic look.

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