

Best Brain Stimulation Treatment for Mental Illnesses

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Abstract—This paper compares the different treatments for mental illnesses that use brain stimulation to find the best treatment.

I. INTRODUCTION

BRAIN stimulation techniques have been around since the 1930's and have been an improving field for treatment of mental illnesses such as depression, as well as such neurological disorders as Parkinson's disease. There are three main types of stimulation: Electroconvulsive Therapy (ECT), Transcranial Magnetic Stimulation (TMS), and Deep Brain Stimulation (DBS). These brain stimulation techniques have all had vast improvements and generated sub treatments. Which of these treatments is the best option for curing these mental problems?

II. METHODS

ECT has been around since the 1930's and was formally known as Electroshock Therapy. The use of anesthesia and muscle relaxers has made this treatments less dangerous, as a patient is brought into a seizure using one or two electrodes placed on the scalp which provide stimulation for one minute. In recent studies, researchers have experimented with changing the size of electrodes, amplitude, and spacing to determine the most beneficial and safest treatment. Multiple sessions are needed for treatment.

TMS started its development in the late 1980's and early 1990's. This external treatment using magnetic pulses generated from an electromagnetic coil placed on the forehead to stimulate the area of brain thought to be involved with mood regulation. Pulses are applied over a course of a forty minute duration. Patients are conscious throughout the procedure. Depending on the patient, as few as one session or up to four sessions, spread a week apart, are needed to help cure their mental illness, mainly depression.



←(TMS)

DBS has been around almost as long as ECT. In the traditional forms of DBS, two electrodes are implanted in the brain, generally in the motor cortex, and is under constant stimulation, by pulse generators located in the chest, throughout treatment. This treatment is mainly used for Parkinson's disease, but has recently been used to combat treatment-resistant depression.

In a more recent sub field of DBS, called transcranial direct current stimulation tDCS, graduate students at Johns Hopkins School of Medicine have created a device, called the Stimband, which delivers current two inches deep into the motor cortexes from the scalp, for twenty minute increments per day.



←(TREMTEX Stimband)

III. RESULTS

ECT, when combined with other medications and performed under anesthesia and muscle relaxers, can be very effective with study that found an 86 percent remission rate of major depression in patients. It is used as a last ditch treatment only.

TMS has been shown in one study to have little to no effect in treating major depression, at least over a two week period, according to one study (shown below).

Table 2. Baseline and Week 2 Scores for Each Outcome Measure in 60 Patients With Major Depression*

| Measure | HFL-TMS Group (n = 20) | | LFR-TMS Group (n = 20) | | Sham Group (n = 20) | | F | P Value | η ² |
|-----------------|------------------------|-------------|------------------------|-------------|---------------------|------------|-----|---------|----------------|
| | Baseline | Week 2 | Baseline | Week 2 | Baseline | Weeks 2 | | | |
| MADRS score | 36.1 ± 7.5 | 30.8 ± 7.5 | 37.7 ± 8.4 | 32.2 ± 9.0 | 35.7 ± 8.1 | 35.4 ± 7.5 | 6.2 | .004 | 0.18 |
| BDI score | 33.1 ± 12.1 | 26.7 ± 11.9 | 35.0 ± 9.2 | 27.2 ± 10.8 | 32.3 ± 8.1 | 29.0 ± 8.7 | 5.1 | .03 | 0.08 |
| BPRS score | 20.8 ± 6.3 | 18.8 ± 6.3 | 22.1 ± 6.8 | 19.2 ± 5.9 | 21.4 ± 6.0 | 20.1 ± 5.2 | 1.0 | .38 | 0.03 |
| CORE score | 8.6 ± 3.6 | 6.6 ± 3.1 | 8.7 ± 3.3 | 6.6 ± 3.5 | 8.8 ± 5.5 | 7.6 ± 4.2 | 1.7 | .499 | 0.02 |
| GAF scale score | 43.0 ± 6.8 | 45.2 ± 7.1 | 43.5 ± 9.9 | 46.3 ± 8.5 | 42.7 ± 7.1 | 42.5 ± 6.8 | 2.6 | .08 | 0.08 |

Abbreviations: BDI, Beck Depression Inventory; BPRS, Brief Psychiatric Rating Scale; GAF, Global Assessment of Functioning; HFL-TMS, high-frequency left-sided transcranial magnetic stimulation; LFR-TMS, low-frequency right-sided TMS; MADRS, Montgomery-Asberg Depression Rating Scale.
 *Data are given as mean ± SD. F scores, P values, and effect sizes (η²) are presented for analysis of variance models for each variable.

DBS traditionally has been shown to only be slightly effective when treating Parkinson's, as symptoms will come back uncontrollably at a certain point. However, in one small study on depression, it was shown that four out of six patients went into complete remission from MDD.

The Stimband has been shown to bring Parkinson's symptoms to a halt in nonhumans if used twenty minutes daily, with so far no uncontrollable buildup of untreatable tremors like what happens with traditional DBS.

IV. DISCUSSION

As is a common connection between most of these forms of brain stimulators, they are to be used in extreme conditions after most options, including ECT, fail to correct the problem at hand. ECT is perhaps one of the most effective of these treatments, as it is used for multiple conditions, and is relatively effective and less dangerous now. TMS is relatively ineffective and definitely not the best option for a treatment. DBS is sadly by itself not a good cure for Parkinson's and has recently been studied for its benefits with people suffering from MDD. Its sub field of tDCS has been proven to work with Parkinson's. All in all, ECT is the most effective brain stimulation technique to date.

REFERENCES

- [1] Deng, Z.-D., Lisanby, S. H., & Peterchev, A. V. (2013). Controlling stimulation strength and focality in electroconvulsive therapy via current amplitude and electrode size and spacing: comparison with magnetic seizure therapy. *The Journal of ECT*, 29(4), 325–335.

- [2] National Alliance Against Mental Illness: ECT, TMS, and Other Brain Stimulation Therapies. <<https://www.nami.org/Learn-More/Treatment/ECT,-TMS-and-Other-Brain-Stimulation-Therapies>>
- [3] Johns Hopkins Center for Bioengineering Innovation and Design: Tremtex: <<http://cbid.bme.jhu.edu/innovations/design-project-gallery/2015-1/>>
- [4] National Institutes of Health: Brain Stimulation Therapies <<http://www.nimh.nih.gov/health/topics/brain-stimulation-therapies/brain-stimulation-therapies.shtml#Mayberg>>
- [5] Mayberg HS, Lozano AM, Voon V, McNeely HE, Seminowicz D, Hamani C, Schwalb JM, Kennedy SH. Deep brain stimulation for treatment-resistant depression. *Neuron*. 2005 Mar 3; 45(5):651-660.