

## Deep Brain Stimulation in Treatment of Mental Illness

\*Micki Kane \*1, Alexis Cygan 1, Costigliolia Clark1

Department of Neurovascular and Neuroimaging Research , Ethopia

\*Corresponding Author : Micki Kane, Department of Neurovascular and Neuroimaging Research , Ethopia

E-mail: Mickii@25 gmail.com

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### Abstract

Deep brain stimulation is a method that involves using an electric stimulus on a specific target in the brain with stereotaxic. It is a minimally invasive, safe, adjustable and reversible nerve involvement technology. At present, this technique is widely applied to treat movement disorders and has produced promising effects on mental symptoms, including combined anxiety and depression. Deep brain stimulation has therefore been employed as a novel treatment for depression, obsessive-compulsive disorder, habituation, Tourette's syndrome, presenile dementia, anorexia nervosa and other refractory mental illnesses. Many encouraging results have been reported. The aim of the present review was to briefly describe the mechanisms, target selection, side effects, ethical arguments and risks associated with deep brain stimulation. Although deep brain stimulation is a developing and promising treatment, a large amount of research is still required to determine its curative effect, and the selection of patients and targets must be subjected to strict ethical standards.

### Keywords

Deep Brain Stimulation, Mental Disorder, Psychotherapy, Target, Treatment.

### Introduction

Electric shock treatment (EST) is a psychotherapy that may be used alone or in combination with drug therapy, and has demonstrated positive curative effects in the treatment of mental disorders. However, there are a considerable number of patients, known as 'refractory' patients, who are immune to these clinical interventions and show little possibility of recovery. Refractory mental illnesses contribute greatly to disability worldwide; therefore identifying effective alternative therapies may make a huge difference for such patients.

Deep brain stimulation (DBS) is accomplished via a nerve stimulator implanted in the body and supplied by a battery source, commonly known as a brain pacemaker. Typically, a pulse generator supplied with a lithium battery is placed under the skin in the chest area, with one or two wires attaching it to an implanted electrode that is oriented to the target region for brain stimulation (inserted using the stereotaxic technique).

### Mechanisms of DBS

The neurobiological mechanisms by which DBS regulates brain function are not yet fully understood. The effect of DBS on the cerebral nuclei target region is either excitatory or inhibitory, depending on the properties of internuncial neurons and the afferent neurons in the target region. It has been proposed that high-frequency DBS may induce functional damage to areas surrounding the lesion, including closure of current-dependent ion channels and blocking of depolarization via exhaustion of the neurotransmitter. The mechanism by which this damage occurs is synapse inhibition and it is also known as neural activation in the stimulated region.

Many scholars conclude that the influence of DBS on the neurological network is more complicated than simply damaged surgery and that DBS therapy may affect the neuronal somas and the two-way activation function of axons.

Previous studies have reported that various neurotransmitters, including glutamic acid and dopamine, are released following DBS. Functional neuroimaging data also indicate that DBS alters the brain activity beyond the target area to a large extent, suggesting that DBS may have a sophisticated neural network control function.

### The side-effect of DBS

Approximately 80,000 individuals have undergone DBS treatment worldwide, with a reported mortality rate of 0–0.4%. The side effects associated with DBS are categorized as acute side effects of surgery and long-term side effects.

### Acute side effects of surgery

The acute side effects of surgery observed in large sample research studies include physical and mental side effects. Physical side effects include intracranial hemorrhage, which has a prevalence of 0.4–1.3% and irreversible brain damage, which has a prevalence of 0.8%. Furthermore, studies in patients who have undergone DBS have found that the prevalence of infection, epileptic seizure and cutaneous complications are 0.7, 1.5 and 25%, respectively.

One of the most harmful side effects of DBS is the risk of inducing psychiatric symptoms that differ from the therapy. Mental complications include transient aggressiveness, hypomania, mania, depression, anxiety, apathy and even suicide. The most common side effect is postoperative delirium (15.6%), followed by depression and hypomania. For DBS treatment of Parkinson's disease, for example, the most severe side effect is an increased suicide risk, particularly when the target region is in the subthalamic nucleus and globus pallidus internus (, with large sample research reporting a suicide risk of 0.16–0.32%. It is therefore necessary to highlight the suicide risk screening of patients undergoing DBS.



## Discussion

DBS has some advantages compared with destructive and disruptive surgical techniques; however, the treatment process is slow and still requires invasive surgery. The popularization and application of DBS technology is impeded by the duration limit of the battery, regulation of stimulation parameters, and selection of optimal target, patient selection criteria and ethical arguments. The exploitation of novel pharmacological agents and targets, more detailed local stimulation devices and extracranial neuromodulation devices within deeper brain structures (which are more effective than transcranial magnetic stimulation).

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