Deep brain stimulation indications

Deep brain stimulation is nowadays a frequently performed surgery in patients with movement disorders, intractable epilepsy, and severe psychiatric disorders.

Since its introduction in the late 1980s, chronic DBS has substantially expanded therapeutic options in movement disorders such as Parkinson’s disease, essential tremor, and dystonia [1] [2].

Its application is expanding to the treatment of other intractable neuropsychiatric disorders including depression and obsessive-compulsive disorder (OCD), Gilles de la Tourette syndrome, and addiction. Latest research suggests beneficial effects of DBS in Alzheimer disease (AD).

Evidence for the use of DBS to treat dementia is preliminary and limited. Fornix and nucleus basalis of Meynert DBS can influence activity in the pathologic neural circuits that underlie AD and Parkinson's disease dementia. Further investigation into the potential clinical effects of DBS for dementia is warranted [3].

Deep brain stimulation (DBS) has been used more recently, for dementias, depression, cognitive disorders, and epilepsy. Despite its wide use, DBS presents numerous challenges for both clinicians and engineers. One challenge is the design of novel, more efficient DBS therapies, which are hampered by the lack of complete understanding about the cellular mechanisms of therapeutic DBS. Another challenge is the existence of redundancy in clinical outcomes, that is, different DBS programs can result in similar clinical benefits but very little information (e.g., predictive models, longitudinal data, metrics, etc.) is available to select one program over another. Finally, there is high variability in patients' responses to DBS, which forces clinicians to carefully adjust the stimulation settings to each patient via lengthy programming sessions. Researchers in neural engineering and systems biology have been tackling these challenges over the past few years with the specific goal of developing novel DBS therapies, design methodologies, and computational tools that optimize the therapeutic effects of DBS in each patient. Furthermore, efforts are being made to automatically adapt the DBS treatment to the fluctuations of disease symptoms [4].

While the efficacy of deep brain stimulation (DBS) to treat various neurological disorders is undisputed, the surgical methods differ widely and the importance of intraoperative microelectrode recording (MER) or macrostimulation (MS) remains controversially debated [5].

Deep Brain Stimulation for Depression

Deep Brain Stimulation for Depression

Deep Brain Stimulation for Dystonia

Deep Brain Stimulation for Dystonia

Deep Brain Stimulation for Parkinson's disease

Deep brain stimulation for Parkinson's disease.

Deep Brain Stimulation for obsessive-compulsive disorder

Deep Brain Stimulation for obsessive-compulsive disorder

Deep Brain Stimulation for Alzheimer's disease

Deep Brain Stimulation for Alzheimer disease.

Deep Brain Stimulation for Post-Traumatic Stress Disorder

Deep Brain Stimulation for Post-Traumatic Stress Disorder.

Deep Brain Stimulation for chronic pain

Deep Brain Stimulation for chronic pain.

Deep brain stimulation for Meige’s syndrome

Deep brain stimulation for Meige’s syndrome.

Deep Brain Stimulation for tremor

Deep Brain Stimulation for tremor.

Deep Brain Stimulation for epilepsy

Deep Brain Stimulation for epilepsy. .

The Food and Drug Administration (FDA) approved Deep brain stimulation DBS as a treatment for essential tremor in 1997, for Parkinson's disease in 2002, dystonia in 2003, and obsessive-compulsive disorders, in 2009. DBS is also used in research studies to treat chronic pain, PTSD, and has been used to treat various affective disorders, including major depression; neither of these applications of DBS have yet been FDA-approved. While DBS has proven effective for some patients, potential for serious complications and side effects exists.

The degree of clinical improvement achieved by deep brain stimulation (DBS) is largely dependent on the accuracy of lead placement.

Though mechanisms underlying deep brain stimulation are still unclear, commonly accepted theories include a “functional inhibition” of neuronal cell bodies and the excitation of axonal projections near the electrodes.

It is becoming clear, however, that the paradoxical dissociation “local inhibition” and “distant excitation” is far more complex than initially thought. Despite an initial increase in neuronal activity following stimulation, cells are often unable to maintain normal ionic concentrations, particularly those of sodium and potassium.

Clinical outcome studies have shown that “asleep” DBS lead placement, performed using intraoperative imaging with stereotactic accuracy as the surgical endpoint, has motor outcomes comparable to traditional “awake” DBS using microelectrode recording (MER), but with shorter case times and improved speech fluency [6].

Over the years, the most suitable surgical candidates and targets for some of these conditions have been characterized and the benefits of DBS well demonstrated in double-blinded randomized trials [7]. [8].

DBS directly changes brain activity in a controlled manner, its effects are reversible (unlike those of lesioning techniques), and it is one of only a few neurosurgical methods that allow blinded studies.

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