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NON-INVASIVE BRAIN STIMULATION-ENHANCING TECHNIQUES

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Abstract: Brain activity may be modified safely and painlessly using non-invasive brain stimulation (NIBS) methods. Transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS) are two NIBS approaches that can be used to improve cognitiveand motor function, treat neurological andpsychiatric illnesses, and learn more about the anatomy and physiology of the brain. These methods alter the excitability and plasticity of neurons by introducing electrical currents or magnetic fields into certain brain areas. Though it is still in its infancy, NIBS has shown promising results in enhancing memory and learning in healthy people, lowering depressive symptoms, and restoring motor function in stroke patients. To completely comprehend the NIBS processes and maximize its therapeuticapplicability, additional study is necessary.

I. INTRODUCTION

The human brain is the most intricate organ in the body, controlling a wide range of activities like perception, cognition, movement, and emotion. One of the long-standing objectivesof neuroscience has been the development of safe, non-invasive methods for controlling brainactivity. Non-invasive brain stimulation (NIBS) approaches have become a potential means of controlling brain activity without the use of drugs or surgery in recent years.

For NIBS techniques like transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS) to function,they must apply electrical or magnetic fields to particular brain areas. This causes adjustments inneuronal activity, which affects cognitive and motor performance. These methods have the potential to boost cognitive function in healthy people as well as improve results in several neurological and mental illnesses.Despite NIBS's promise, there is still muchto learn about its fundamental workings and idealuses. The use of NIBS methods, including their physiological consequences, possible therapeutic uses, and cognitive enhancing properties, will be reviewed in this research. We will also discuss the present constraints of NIBSresearch and possible prospects for the discipline.

II. METHODOLOGY

Transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS)are two major categories into which NIBSmethods can be divided. While tDCS modifies brain activity using a constant, low-intensity electrical current, TMS induces electrical currentsin the brain using a rapidly varying magnetic field.Both methods can be used on particular parts of the brain and are non-invasive and painless. Several outcome measures, such as behavioral tests, physiological measurements, andimaging methods, are frequently used to evaluate the effects of NIBS. Behavioral tests can evaluate alterations in cognitive or motor function, such asaccuracy or response time. Changes in brain activity or muscle activity can be measured using physiological techniques like electromyography (EMG) or electroencephalography (EEG), respectively. Imaging methods like positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) can reveal changes in brain activity at the network level.

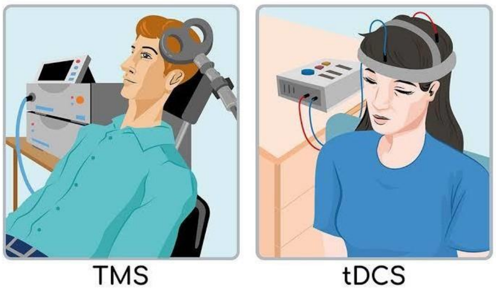

Fig 1: TMS and tDCS

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Numerous study designs, such as crossover designs, within-subject designs, and randomized controlled trials (RCTs) can be used to carry out NIBS studies. Due to its ability to account for confounding factors and provide comparisons between treatment and control groups, RCTs are regarded as the gold standard forassessing the effectiveness of NIBS therapies. As participants act as their controls, crossover designs can be used to evaluate the immediate effects ofNIBS interventions. Given that participantsreceive the intervention over the course of multiple sessions, within-subject designs can beused to evaluate the longer-term effects of NIBS interventions.

Another key factor in technique is the safety of NIBS therapies. Although NIBSmethods are typically regarded as safe, they canhave side effects like mild discomfort orheadaches. Although they are uncommon, adverse events can happen and need to be closelywatched during NIBS studies. To account for placebo effects and improve the validity of study findings, sham interventions—in which participants receive a placebo intervention that imitates the symptoms of NIBS without actuallystimulating them can be used.

III. CONCLUSION

Techniques for non-invasive brain stimulation (NIBS) have become a viable method for safely and non-invasively modifyingbrain activity. Transcranial magnetic stimulation(TMS) and transcranial direct current stimulation (tDCS), two NIBS approaches, can be used to treat neurological and psychiatricconditions, enhance cognitive and motorperformance, and study the physiology and function of the brain.

Although numerous studies have shown the effectiveness of NIBS interventions, there isstill much to learn about the underlying mechanisms of NIBS and the best applications for clinical and cognitive enhancement goals. Additionally, there are still some restrictions anddifficulties in NIBS research, including the needfor more standardized protocols and outcome measures and variations in each individual's response to stimulation.

However, NIBS interventions have a wide range of potential advantages, and the fieldis developing quickly. To completely comprehend the processes of NIBS-induced changes in brain function and to optimize the application of NIBS methods for therapeutic andcognitive enhancing objectives, furtherstudy is required.

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