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Transcranial direct current stimulation for the treatment of Obsessive-Compulsive Disorder – a narrative literature review

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Abstract

Introduction and Objective. Obsessive-compulsive disorder (OCD) is a chronic, often treatment-resistant condition involving dysfunction in the cortico-striato-thalamo-cortical (CSTC) circuit and neurotransmitter imbalances. Standard treatments, including SSRIs and cognitive-behavioral therapy (CBT), are insufficient for a substantial proportion of patients. Transcranial direct current stimulation (tDCS), a non-invasive, cost-effective neuromodulation technique, has emerged as a potential therapeutic option. The aim of the review is to critically evaluate current evidence on the efficacy, safety, and clinical utility of tDCS in OCD treatment, emphasizing optimal stimulation targets, parameters, therapeutic outcomes, and areas requiring further investigation.

Review Methods. A literature review was conducted using PubMed and Google Scholar databases (2020–2025), based on key words: 'transcranial direct current stimulation', 'obsessive-compulsive disorder', 'brain stimulation', 'efficacy', and 'neuromodulation'.

Brief description of the state of knowledge. Evidence suggests that stimulation of the pre-SMA, dlPFC, OFC, and ACC can significantly reduce OCD symptom severity. Meta-analyses report moderate short-term efficacy with a favourable safety profile. However, patient responses vary widely, and current studies use heterogeneous protocols with inconsistent outcome measures.

Summary. tDCS demonstrates promising short-term benefits and good tolerability in treating OCD, particularly when targeting cortico-striatal network hubs. However, lack of standardized protocols and limited long-term data constrain its clinical adoption. High-quality randomized trials with uniform methodologies are essential to validate its role as a reliable adjunctive treatment in OCD management.

Key words

obsessive-compulsive disorder, transcranial direct current stimulation, neuromodulation, efficacy, brain stimulation therapy

INTRODUCTION

Obsessive-compulsive disorder (OCD) is a complex, chronic neuropsychiatric condition that significantly impacts patients' daily functioning. It is a major global health challenge, with a lifetime prevalence estimated at 2% – 3% of the general population, often leading to severe disability and a high socio-economic burden. Its pathophysiology involves dysfunctions within the cortico-striato-thalamo-cortical (CSTC) circuit, as well as disturbances in serotonergic, dopaminergic, and glutamatergic neurotransmission. Despite the availability of established treatments, such as selective serotonin reuptake inhibitors (SSRIs) and cognitive-behavioural therapy (CBT), the substantial variability in therapeutic response, along with frequent comorbid depressive and anxiety symptoms, complicates the treatment process. As a result, increasing attention has been directed toward neuromodulatory approaches, including transcranial direct current stimulation (tDCS), as a non-invasive, safe, and potentially effective alternative for treatment-resistant OCD [1]. Approximately 40% of patients with OCD do not achieve satisfactory improvement following first-line standard treatments, prompting researchers to explore alternative therapeutic strategies. The disorder is characterized by a relatively well-understood neuroanatomical basis, which supports the development of non-invasive brain stimulation techniques, such as repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation [2]. However, treatment outcomes remain highly variable across individuals, largely due to patient-specific factors that influence intervention efficacy. In response to these challenges, increasing emphasis is being placed on the development of personalized therapeutic strategies. Recently, this direction has been reinforced by the FDA approval of a novel TMS protocol that utilizes individualized brain

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mapping via functional MRI (fMRI) and other modifications, demonstrating superior therapeutic efficacy compared to earlier, standardized approaches [3].

OBJECTIVE

The aim of this narrative review is to provide a comprehensive summary of the current knowledge regarding the use of tDCS in the treatment of OCD, with particular emphasis on mechanisms of action, a review of clinical studies assessing efficacy and safety, and existing research limitations. The review also aims to evaluate the clinical potential of tDCS as an adjunct or alternative to pharmacological and psychotherapeutic interventions in the management of treatment-resistant OCD.

DISCUSSION

Mechanism of action and technical parameters of tDCS. Neuromodulation, including transcranial direct current stimulation (tDCS), has gained popularity as an effective and safe method of psychiatric treatment, offering low cost, ease of use, and broad accessibility [4][5]. This non-invasive technique uses a weak direct current (typically 1–2 mA) that flows between electrodes placed on the scalp, modulating neuronal excitability. In contrast to transcranial magnetic stimulation (TMS), it does not directly induce action potentials.

In the treatment of neuropsychiatric disorders such as OCD, tDCS is typically applied in 20–30-minute sessions, once or twice daily. Usually, 10–20 sessions are administered over 5–10 days, which can be effective, although the outcomes remain variable [5]. Treatment protocols may differ in terms of duration and intensity of sessions, contributing to differences in therapeutic efficacy, and identifying a gold-standard protocol remains the subject of ongoing research (Fig. 1).

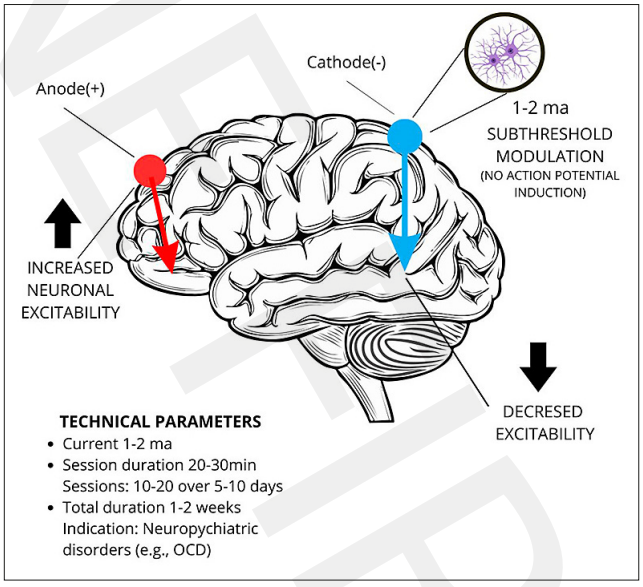

Figure 1. Schematic representation of transcranial direct current stimulation (tDCS). The anode increases neuronal excitability, whereas the cathode decreases it. Typical stimulation parameters are shown: current intensity of 1–2 mA, session duration of 20–30 minutes, and 10–20 sessions over 1–2 weeks

Neurobiological basis of OCD in the context of neuromodulation. The striatum, as a key component of the cortico-striato-thalamo-cortical (CSTC) loop, plays a critical role in the pathophysiology of OCD. fMRI studies demonstrate increased resting-state functional connectivity (RSFC) between its subregions and cortical structures, such as the supplementary motor area and the precuneus, as well as decreased dynamic functional connectivity (DFC) with emotion-regulating areas such as the orbitofrontal cortex. Altered DFC patterns correlate with symptom severity, supporting the hypothesis that striatal dysfunction is central to OCD mechanisms [6].

Clinical studies indicate that neuromodulation of targeted brain regions, including the dorsolateral prefrontal cortex (dlPFC) and the dorsomedial prefrontal cortex/anterior cingulate cortex (dmPFC/ACC), significantly reduces OCD symptom severity. Meta-analyses of randomized controlled trials have shown that excitatory rTMS over the left dlPFC and dmPFC/ACC, as well as inhibitory stimulation over the right dlPFC, is associated with significant clinical improvement compared to control groups. These findings support the role of these regions as viable targets for neuromodulatory interventions, including transcranial direct current stimulation [7].

The impact of tDCS on brain network connectivity in OCD has also been investigated, with a particular focus on the pre-supplementary motor area (pre-SMA). In a study of 43 patients with OCD, a single session of tDCS (or sham stimulation) was administered with electrodes placed over the right and left pre-SMA. Resting-state fMRI data were collected post-session, followed by effective connectivity (EC) and graph theory analyses. Active tDCS significantly enhanced local effective connectivity within the sensorimotor network (SMN).

There was an increase in recruitment, clustering coefficient, and local network efficiency within the SMN. No changes were observed in global brain connectivity. These findings suggest that even a single session of tDCS may modulate local network organization, particularly within the SMN. Targeting the pre-SMA with tDCS may be an effective approach to restoring network connectivity in this disorder [8].

One of the main features of OCD is impaired response inhibition as measured, for example, by the stop signal task (SST)[9]. There is evidence in healthy subjects that transcranial direct current stimulation of the pre-additive motor area leads to significant improvements in inhibitory performance [10]. It is noteworthy that a meta-analysis assessing the likelihood of brain activation in the context of braking performance in the Stroop task showed the involvement of a network including: right cingulate cortex, left dorsolateral prefrontal cortex, bilateral inferior frontal cortices, right superior frontal cortex, and temporal cortex[11].

Neuroimaging studies have also revealed increased activity in the orbitofrontal cortex (OFC) in patients with OCD, which is impaired with excessive anxiety and impulsivity[12].

According to a paper by Gajendra N Pardeshi et al., the medial prefrontal cortex (mPFC) is also an important brain area involved in the pathogenesis of OCD[13]. A meta-analysis of studies using resting-state functional imaging (resting-state fMRI) and voxel-based morphometry (VBM) confirmed the existence of both functional and structural abnormalities in the brains of patients with OCD. Increased functional activity was noted in the bilateral inferior frontal

gyrus (IFG), mPFC and ACC, as well as in the insula[14]. High-frequency deep magnetic stimulation (dTMS) targeting the mPFC and ACC has received approval from the FDA for the treatment of OCD disorders, which may inspire effective tDCS therapy targeting these brain structures[15].

A randomised, double-blind, placebo-controlled trial was conducted to clinically test the safety and efficacy of tDCS as adjunctive therapy to fluoxetine in OCD. Sixty adult patients were included in the study and randomly allocated 1:1 to either the experimental group (tDCS + fluoxetine) or the control group (fluoxetine + sham stimulation). The anodal electrode was placed over the left dlPFC and the cathodal electrode was placed over the right orbitofrontal cortex. A 2mA current for 20minutes was applied, 3 times a week for 8 weeks. In the control group, stimulation was simulated for 30 seconds only. It was shown that among those with moderate to severe OCD, there was no significant difference in OCD symptoms between those using tDCS in combination with fluoxetine therapy and those using fluoxetine alone ($p > 0.05$) [16]. However, the potential role of tDCS as an adjunctive therapy requires much more research and should be a point of interest for investigators.

Combining tDCS with neuroimaging, such as fMRI, may allow a more thorough understanding of the neural mechanisms behind behavioural effects, which may be useful in research, clinical practice, and in identifying brain circuits associated with symptom improvement[17].

Efficacy and safety of tDCS. A meta-analysis of ten 10 randomised controlled trials showed that tDCS could significantly reduce the severity of OCD symptoms in the acute phase, as confirmed by the Yale-Brown obsessive compulsive scale (Y-BOCS) scores (SMD = -0.56; 95% CI: -0.87 to -0.26). Moderate heterogeneity was observed ($I^2 = 49.85\%$), and sensitivity analysis confirmed the stability of the effect after excluding individual studies. However, potential publication bias was detected, confirmed by in tests by Egger and Begg, and by trim and fill analysis. Subgroup analysis revealed an effect of the geographic region on the results, and meta-regression showed that the age of participants could modify the efficacy of the treatment. The use of tDCS in the treatment of OCD is associated with an increased risk of some mild local side-effects, such as tingling, skin redness, burning, or neck pain. However, the overall safety profile remains comparable to sham stimulation, as the incidence of more severe symptoms, such as headaches, drowsiness, pruritus or sudden mood changes, did not differ significantly between groups [18].

In contrast, a meta-analysis by Le Yan et al., also from 2025, indicates that tDCS significantly reduces the severity of OCD symptom, as evidenced by a reduction in the Y-BOCS total score (SMD = -0.46; 95% CI: -0.84 to -0.07; $p = 0.02$; $I^2 = 39\%$). This effect was particularly pronounced in interventions with a duration of ≤ 20 days (SMD = -0.95; 95% CI: -1.80 to -0.10; $p = 0.03$), which may suggest the higher efficacy of shorter treatment protocols. In contrast, there were no significant differences between tDCS and sham stimulation in terms of reduction of depressive symptoms (RR = -0.21; 95% CI: -0.58 to 0.15; $p = 0.25$), or incidence of adverse effects (RR = 3.98; 95% CI: 0.04 to 374.99; $p = 0.55$), with the quality of evidence in both cases rated as moderate and very low, respectively[19]. In contrast, a 2024 study using high-resolution cathodal HD-tDCS over the right orbitofrontal cortex in patients with moderate to severe OCD, showed good tolerability and safety of this intervention. Although there was a significant reduction in obsessive-compulsive, depressive and anxiety symptoms in both the active and sham groups, the differences between groups did not reach the level of statistical significance. The response rate obtained (26.1% vs. 23.8%) does not confirm the clinical superiority of HD-tDCS over placebo in the short-term treatment of OCD, suggesting the need for further studies with other stimulation parameters or a longer duration of therapy[20].

The current study evaluated the safety and efficacy of transcranial direct current stimulation (tDCS) as adjunctive therapy to fluoxetine in adolescents with OCD who had not received prior pharmacological treatment. Participants were randomly assigned to an active or sham group and received 10 sessions of tDCS (20 minutes each) with a cathode on the supplementary motor area and an anode on the arm muscle. Both the active and sham groups received fluoxetine. Symptom severity was assessed using the CY-BOCS scale at the start of the study and at weeks 2, 6 and 12. Eighteen patients completed the study. In the active group, an accelerated reduction of OCD symptoms in the adolescents was demonstrated after only 2 weeks The use of tDCS as an early augmentation in OCD is still potentially feasible and requires studies on a larger population sample[21]. In the FEATSOCS study, the left orbitofrontal cortex (L-OFC) and supplementary motor area (SMA) were stimulated using the tDCS method.

The aim of the study was to compare the effects of L-OFC and SMA stimulation directly in the same sample of patients with OCD, as part of a randomised controlled trial. The greatest clinical effect was observed after L-OFC stimulation. The researchers emphasise the need for further research to determine optimal stimulation parameters, to understand the mechanisms of tDCS and to assess long-term efficacy [22]. tDCS therapy targeting the mPFC may be crucial for anxiety extinction, as it modulates functional connectivity between structures associated with anxiety regulation (mPFC, home-mode network, salience network), increases frontal pole connectivity with frontal cortices and decreases connectivity with the anterior insula, basal nuclei and salience network. In patients with OCD, active frontopolar tDCS accelerated learning of therapeutic safety during exposure and response prevention (ERP) – indicating a potential increase in the efficacy of exposure-based psychotherapy. These findings warrant further clinical trials on larger groups of patients to assess the efficacy of tDCS as a support for ERP therapy[23].

According to a 2021 randomised placebo-controlled trial, cathodal tDCS targeting SMA with an anode on the left shoulder muscle, resulted in a statistically significant reduction of OCD symptoms in patients refractory to pharmacological treatment. The magnitude of symptom reduction was moderate: a mean decrease in Y-BOCS score of 6.68 points was observed in the active tDCS group, compared to 2.84 points in the placebo group (effect: Cohen's $d = 0.62$, $p = 0.03$). Importantly, there were no significant differences between groups in the reduction of depressive and anxiety symptoms – the effect of tDCS was selective for OCD symptoms. Another study confirmed the good safety profile of tDCS, as both study groups reported only mild side-effects [24]. Although most research on tDCS in OCD has focused on the reduction of clinical symptoms,

Table 1. List of tDCS studies in OCD treatment

Study	Objective	Methodology	Key Findings	Outcome
Moshfeghinia R, et al. (2025) [18]	Systematic review and meta-analysis of tDCS efficacy and safety in OCD patients	Meta-analysis of randomized controlled trials (RCTs)	tDCS significantly reduces OCD symptoms (SMD = -0.56), with a favourable safety profile. No significant long-term effect observed.	Moderate efficacy in reducing OCD symptoms with good safety.
Yan L, Wang Y, Li M. (2025) [19]	Meta-analysis of tDCS for OCD treatment	Meta-analysis of RCTs	Short-term effectiveness of tDCS in reducing OCD severity (SMD = -0.46), more pronounced in shorter protocols (≤ 20 days). No significant effect on depressive symptoms.	Short-term efficacy with mixed results on depression reduction.
Wang Y, et al. (2024) [20]	Assess the effectiveness of high-definition tDCS (HD-tDCS) in OCD treatment	Randomized, double-blind, controlled trial of HD-tDCS	HD-tDCS reduces OCD symptoms but does not show significant superiority over sham. Treatment is well tolerated.	No significant clinical superiority compared to sham but good safety.
Agrawal A, et al. (2024) [21]	Pilot trial of tDCS as early augmentation in adolescent OCD	Pilot randomized controlled trial	tDCS significantly reduces OCD symptoms in adolescents with early treatment augmentation.	Positive results in adolescent OCD with early tDCS use.
Fineberg NA, et al. (2023) [22]	Feasibility, acceptability, and practicality of tDCS for OCD symptoms	Randomized controlled crossover trial (FEATSOCS study)	tDCS shows feasibility and acceptability in reducing OCD symptoms. Further optimization of protocols needed for effectiveness.	Feasible and acceptable, but requires protocol refinement.
Adams TG, et al. (2022) [23]	Investigate the effects of tDCS targeting the medial prefrontal cortex in OCD	Pilot studies on tDCS with fMRI analysis	tDCS modulates functional connectivity and improves safety learning, suggesting a potential role in OCD treatment.	Enhances safety learning and modulates brain connectivity.
Silva RMFD, et al. (2021) [24]	Assess the efficacy and safety of tDCS as add-on treatment for OCD	Randomized, sham-controlled trial	tDCS as an adjunct to traditional therapy significantly reduces OCD symptoms with mild side-effects.	Effective adjunctive treatment with a good safety profile.

Abbreviations: tDCS – Transcranial Direct Current Stimulation; **OCD** – Obsessive-Compulsive Disorder; **SMD** – Standardized Mean Difference; **RCT** – Randomized Controlled Trial; **HD-tDCS** – High-Definition Transcranial Direct Current Stimulation; **fMRI** – Functional Magnetic Resonance Imaging

its potential effects on neurocognitive function are also receiving increasing attention. Preliminary data from several small studies suggest that tDCS can improve response inhibition, executive control, attention and working memory. These effects were noted after stimulation of various areas, including the dlPFC, pre-SMA and OFC. Although these results are promising, their interpretation is limited by the small number of participants, the lack of a placebo group in some of the studies, and the considerable heterogeneity of the protocols. Further randomised controlled trials are needed to assess whether tDCS can provide sustained and clinically relevant cognitive benefits in patients with OCD [25] (Tab. 1).

Augmentation of psychotherapy with tDCS – data beyond OCD. Neuromodulation is not a replacement for psychotherapy – Cognitive Behavioural Therapy (CBT) remains the gold standard for treating OCD, especially when combined with ERP therapy. In the case of deep brain stimulation (DBS), efficacy better predicts nerve fibre connectivity rather than specific anatomical locations, which may translate into future research on personalising tDCS. Neuromodulation should be considered as an augmentation, especially in refractory OCD cases[26].

Currently, there are not many studies involving tDCS as an adjunctive therapy in the treatment of OCD, but this combination of therapeutic tools is able to produce satisfactory results in other cases, which should inspire researchers for further research into the treatment of OCD.

Results of a 2025 randomised controlled trial show a greater reduction in social anxiety disorder (SAD) symptoms among a group of 13 patients undergoing CBT+tDCS, compared to 12 patients undergoing tDCS alone and 12 patients undergoing CBT and sham tDCS. In conclusion, the combined CBT+tDCS intervention showed superior efficacy in reducing SAD symptoms [27].

Another pilot study from 2025 assessed the potential psychosocial and therapeutic effects of combining tDCS with CBT in patients diagnosed with major depression (MDD) and who had not previously received treatment. At week 12 of treatment, those receiving active tDCS achieved greater reductions in depressive symptoms and improvements in sleep quality than the sham group. Many participants experienced full remission of symptoms, confirmed by low scores on the BDI and MADRS scales. Preliminary results suggest that combining tDCS with CBT may increase the effectiveness of depression treatment and prolong its effects [28]. The feasibility of a protocol to use tDCS+CBT for the treatment of negative symptoms in 5 adolescents at high risk of psychosis was also recently investigated, and the results of this study are promising. The protocol is feasible for these adolescents, which outlines the future of further research in this direction [29].

Variability in response and the need to personalise therapy. The efficacy of 3 different tDCS protocols in patients with OCD was compared to determine which one was most effective in alleviating symptoms. Forty patients were allocated to 4 groups (3 intervention and 1 control). A 5-day tDCS protocol (2 mA, 15 minutes, twice a day) was used, with different electrode arrangements – all with the anode over the right cerebellum (O2) and the cathode over, respectively: pre-SMA (group 1), left OFC (group 2), left cerebellum (group 3). Two of the 3 tDCS protocols significantly reduced OCD symptoms ($p < 0.001$). The best effects were achieved with anode over O2 (right cerebellum) and cathode over pre-SMA or left OFC. O2 stimulation was more effective than O1 (left cerebellum) stimulation. In conclusion, different electrode arrangements affect differently the efficacy of tDCS in the treatment of OCD. The study points to the combination of pre-SMA or OFC with O2 as promising stimulation targets [30].

A narrative review and CONSORT evaluation from 2024 indicates that many studies do not report compliance with the intervention protocol or provide a sufficiently long follow-up period, which may mask delayed therapeutic effects. Lack of standardisation and inconsistent reporting significantly

hinder comparisons of results and limit the ability to conduct reliable meta-analyses. High-quality, well-controlled studies with clearly defined protocols, longer follow-up and better reporting of technical details of interventions are needed [31]. Despite the growing number of studies investigating the use of tDCS in the treatment of OCD, response to therapy remains highly variable between patients. Currently, there are no clearly defined predictive factors for the effectiveness of this method. However, it seems reasonable that future research should include an analysis of clinical features (e.g. age, disease duration, symptom profile) and individual neurobiological characteristics that may influence the response to stimulation. A better understanding of these variables may, in the future, allow for personalisation of therapy and improved efficacy. The variability of technical parameters used in tDCS studies significantly hinders comparisons of results and limits the ability to draw clear clinical conclusions. Standardisation of basic elements of the protocol – such as electrode location, current intensity, duration and number of sessions – is a necessary step towards improving the quality of the studies and the effectiveness of the therapy (Fig. 2).

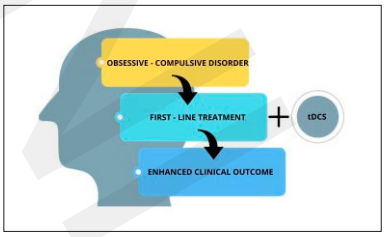

Figure 2. The use of tDCS as an adjunctive method to first-line treatment in obsessive-compulsive disorder (OCD), aimed at improving clinical outcomes

Limitations of the study. The available evidence suggests that transcranial direct current stimulation may serve as an adjunctive treatment for obsessive-compulsive disorder. However, the current state of knowledge does not yet allow it to be considered a stand-alone treatment. Existing studies do not indicate a consistent therapeutic effect. Nevertheless, following a review of the literature, it can be concluded that tDCS may be beneficial in selected patients, under specific stimulation conditions, and potentially in combination with behavioural interventions targeted at the disorder in question.

The results of the meta-analysis should be interpreted with caution. The most recent meta-analyses indicate a small to moderate clinical improvement. However, the certainty of this effect is limited by small sample sizes, heterogeneity in stimulation protocols, varying criteria for treatment-resistant OCD, short follow-up periods, and potential publication bias. These results warrant further research but do not justify definitive claims regarding efficacy. At present, tDCS should be regarded as an experimental or novel adjunctive strategy, particularly in the case of treatment-resistant OCD.

CONCLUSIONS

Transcranial direct current stimulation stands out as a compelling neuromodulatory candidate for treatment-resistant obsessive-compulsive disorder. Its therapeutic rationale targets the cortico-striato-thalamo-cortical (CSTC) network the circuit driving OCD pathology. Evidence from fMRI, functional connectivity studies, and meta-analyses supports the potential of stimulating the pre-SMA, dlPFC, OFC, and ACC. While meta-analyses of randomized trials show that tDCS can reduce Y-BOCS scores particularly through short-term protocols of 10–20 sessions actual clinical outcomes remain notably inconsistent. However, the current evidence base is limited by small sample sizes, protocol heterogeneity, and short follow-up periods, which substantially constrain the generalizability of findings. Despite these limitations, some data also point to improved cognitive performance in specific patient cohorts.

Safety is well-documented, with adverse effects typically limited to mild, transient local reactions. However, the high degree of inter-individual variability in treatment response is a significant hurdle. The current literature rarely accounts for critical patient-specific predictors, like symptom subtypes, age, illness duration, or baseline neuronal activity patterns. Furthermore, the lack of a 'gold standard' for electrode placement, current intensity, and session frequency, makes it difficult to compare results across trials or establish a clear clinical routine.

There is a clear potential for tDCS as an adjunct to psychotherapy, specifically for enhancing exposure and response prevention (ERP) and anxiety modulation. Preliminary findings suggest that tDCS might accelerate therapeutic gains or improve their sustainability, providing a path for combined protocols with CBT in treatment-resistant cases. Despite these promising signals, tDCS is not yet ready for routine use in psychiatric practice. Moving forward, the focus must shift to large-scale, rigorous trials that prioritize personalized intervention strategies and long-term follow-up to confirm clinical utility (Tab. 2, Tab. 3).

Table 2. Overview of tDCS Therapy in OCD Treatment

Aspect	Details
Purpose of tDCS Therapy in OCD	Reduction of OCD symptom severity, especially in treatment-resistant cases (SSRI, CBT).
Main Neurobiological Targets	Modulation of functional-structural brain areas (e.g., pre-SMA, dlPFC, OFC, ACC) within the CSTC network.
tDCS Parameters	Frequency: 10–20 sessions, duration: 20–30 minutes, current intensity: 1–2 mA, once or twice a day.
Efficacy of tDCS in OCD Treatment	Moderate short-term efficacy, particularly when applied to CSTC network regions.
Targeted Brain Areas	Pre-SMA, dlPFC, OFC, ACC.
Safety of tDCS	Favourable safety profile; most reported side-effects are tingling, skin redness, headaches.
tDCS Combined with Other Therapies	tDCS as an adjunct to CBT in treatment-resistant OCD cases; preliminary data suggest improved therapeutic outcomes.
tDCS Combined with Other Therapies	tDCS as an adjunct to CBT in treatment-resistant OCD cases; preliminary data suggest improved therapeutic outcomes.

Abbreviations: tDCS – Transcranial Direct Current Stimulation; **OCD** – Obsessive-Compulsive Disorder; **SSRI** – Selective Serotonin Reuptake Inhibitors; **CBT** – Cognitive Behavioural Therapy; **CSTC** – Cortico-Striato-Thalamo-Cortical; **Pre-SMA** – Pre-Supplementary Motor Area; **dlPFC** – Dorsolateral Prefrontal Cortex; **OFC** – Orbitofrontal Cortex; **ACC** – Anterior Cingulate Cortex

Table 3. Clinical positioning of tDCS relative to other neuromodulation approaches in OCD

Neuro-modulation approach	Invasive-ness	Evidence and current clinical status in OCD	Main advantages	Main limitations	Position of tDCS relative to this method
tDCS	Non-invasive	Investigational/experimental. Evidence remains limited by small samples, heterogeneous protocols, short follow-up, and inconsistent stimulation parameters. No established gold-standard protocol is available.	Low cost, easy to administer, generally well tolerated, minimal equipment requirements, potential for repeated or adjunctive use with CBT/ERP or pharmacotherapy	Lower spatial focality than TMS, variable response, uncertain durability of effects, lack of standardized electrode montage, intensity, number of sessions, and maintenance protocols	tDCS may be best conceptualized as a promising adjunctive or experimental neuromodulatory strategy, particularly attractive where accessibility, tolerability, and combination with psychotherapy are priorities
rTMS	Non-invasive	More clinically developed than tDCS. Several randomized controlled trials and meta-analyses support symptom reduction in OCD although protocols and outcomes remain heterogeneous	Better focality and stronger neuromodulatory effect than tDCS; established infrastructure in psychiatry; non-invasive; does not require anaesthesia	More expensive than tDCS, less portable, requires specialized equipment and trained staff, possible discomfort, rare seizure risk	Compared with rTMS, tDCS is less established and probably less focal, but it is cheaper, simpler, more scalable, and may be easier to combine with psychotherapy sessions
Deep TMS	Non-invasive	Currently the most clinically established non-invasive stimulation option specifically cleared for OCD in the United States	Deeper cortical penetration than conventional rTMS; standardized commercial protocol; regulatory clearance for OCD; clinically available in some settings	High cost, limited availability, requires dedicated device and trained personnel, protocol often involves frequent clinic visits; not all patients respond	tDCS does not yet have the regulatory or evidence status of dTMS, but its practical advantages include lower cost, portability, and easier implementation in research or adjunctive psychotherapy protocols
DBS	Invasive neurosurgical procedure	Reserved for severe, chronic, highly treatment-resistant OCD.	Can produce substantial and durable improvement in carefully selected refractory patients; adjustable and continuous stimulation; directly targets pathological circuits	Requires brain surgery, risk of infection/haemorrhage/ hardware complications, high cost, need for long-term programming and monitoring, ethical and accessibility concerns	tDCS is far less invasive and safer, but also likely less potent. It should not be viewed as a substitute for DBS in extreme refractory OCD, but as an earlier, lower-risk adjunctive strategy before considering invasive approaches

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