neurocare

transcranial Direct Current-Stimulation tDCS

Application

neurocare

Digital therapeutic techniques can help patients with a range of psychiatric disorders and neuro-rehabilitation problems like recovery from stroke and chronic pain. By measuring and modulating brain activity, neuromodulation has the potential to offer faster and longer-lasting outcomes than standard treatments, all with no to very minimal side-effects.

neurocare offers a range of neuromodulation-based solutions to help you achieve better results in your therapeutic practice. We can support you with technology, equipment, advanced training, and further information. We also offer specific information to help your patients, your staff and further business advice.

Your clinical practice will benefit from neurocare's proven treatment protocols giving you, the practitioner, the ability to personalise for your individual patients and offer a more sustainable solution in mental health and rehabilitation. Seeking training, advice or partnership with neurocare will help your practice be at forefront of innovative health solutions, delivered professionally and following best practice.

Content

Imprint

neurocare group AG
Albert-Einstein-Str. 3, 98693 Ilmenau, Germany
Tel: +48 (3677) 68 979 0
e-mail: info@neurocaregroup.com • web: www.neurocaregroup.com
Administrative office: Rindermarkt 7 • 80331 Munich • Germany

Neuromodulation with tDCS?

Transcranial Direct Current Stimulation (tDCS) is a non-invasive, well-tolerated neurostimulation treatment. In practice, tDCS involves attaching an anode and cathode electrode to the head producing a weak electrical current that is applied to the brain. Several studies have shown positive effects on a range of conditions.

tDCS equipment is easy to use, and the treatment is painless and safe. When combined with other therapies, tDCS can enhance their positive effects. Depending on the voltage, duration, polarity, and location of the electrodes, the applied current has an inhibiting or stimulating effect.

tDCS modifies the resting membrane potential, either promoting or inhibiting the transmission of information. This allows the therapist to modulate neuronal excitability and activity levels.

A complimentary therapy

Depending on the indication and the disorder, combining conventional therapy with tDCS may enhance treatment outcomes. In stroke patients, tDCS is recommended in addition to motor, speech, and cognitive training. For patients suffering from depression, tDCS can be used in combination with psychotherapy or medication.

tDCS is typically applied in specialist clinics, outpatient rehabilitation facilities, by doctors and therapists. If you are interested in incorporating tDCS in your practice or clinic, neurocare can assist in both technology and training solutions for you or your team.

Depression

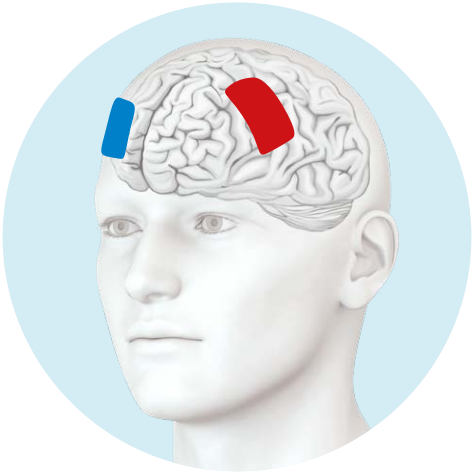
Several studies have demonstrated that depression often goes hand in hand with asymmetric activity of neuron populations in the prefrontal cortex. In the left hemisphere (dorsolateral prefrontal cortex, DLPFC), decreased neuronal activity has been observed.

tDCS can compensate for that deficit with anodal left side treatment. Within just a few sessions, cognitive performance improves. Research shows antidepressant effects generally after 2 to 3 weeks of treatment.

tDCS can be used to complement other conventional therapies such as medication or psychotherapy.

A **Evidence = Level A (definitely effective)**

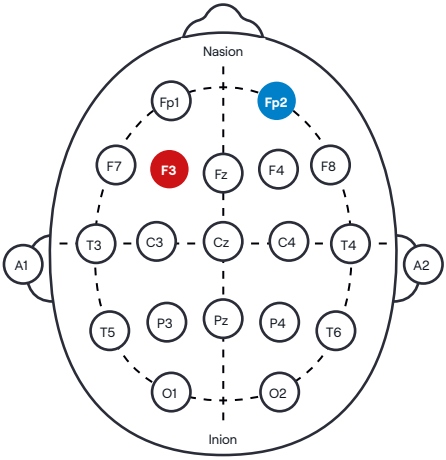
scope	10 – 15 sessions
duration	20 – 30 minutes
stim. intensity	2 mA
efficacy	●●●●●



Suitable electrode positions with evidence level A:

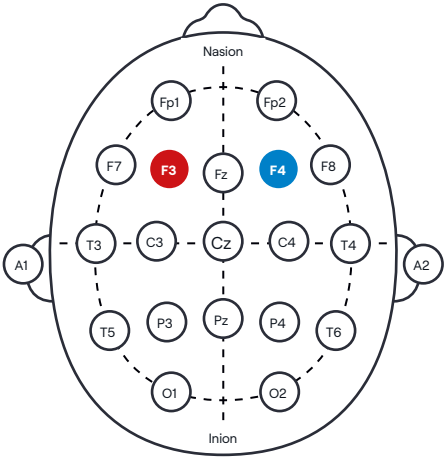
- **anode**
  left DLPFC (F3)
- **cathode**
  right supraorbital (FP2)

Source: Lefaucheur JP et al. 2017, Aust S et al. 2015



- **anode**
  left DLPFC (F3)
- **cathode**
  or right DLPFC (F4)

source: Brunoni AR et al. 2013



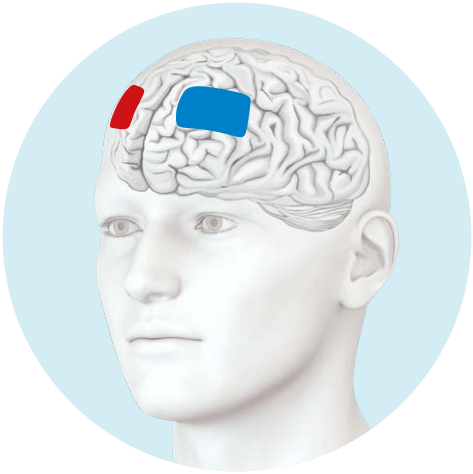
Addictive disorders

Addictive disorders are often challenging to treat. Studies show people with addiction suffer from disturbed cognitive control in relation to both cravings and the consumption of addictive substances. This disorder of cognitive control is reflected in a change in DLPFC activity. By stimulating the DLPFC, risk-taking behaviours and addiction can be eased. As a consequence, cravings are reduced.

B Evidence = Level B (probably effective)

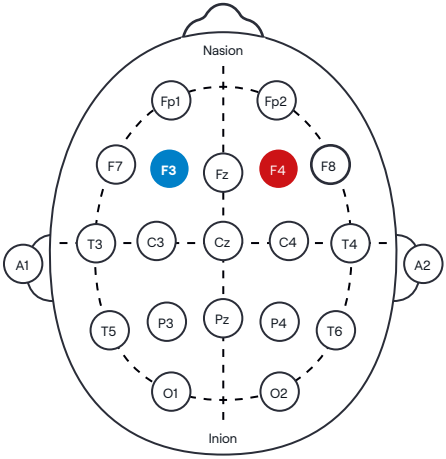
scope	5 – 10 sessions
duration	20 – 30 minutes
stim. intensity	2 mA
efficacy	●●●●○

source: Lefaucheur JP et al. 2017, Klauss J et al. 2018, Coles AS et al. 2018, Batista E et al. 2015



anode
right DLPFC (F4)

cathode
left DLPFC (F3)



Pain

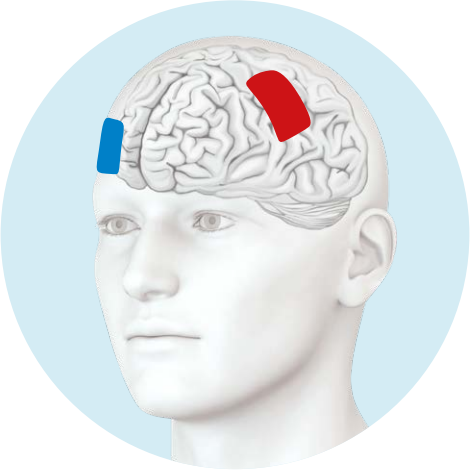
tDCS can reduce perceived pain. In several studies, patients suffering from fibromyalgia, migraines, chronic, postoperative, or neuropatic pain reported improvements after tDCS treatment with anodic stimulation over the motor cortex (M1). Improvement in symptoms were noticeable within relatively few sessions and remained after treatment.

B **Evidence = Level B (probably effectiv) in:**

- neuropathic pain
- fibromyalgia
- migraine
- postoperative pain

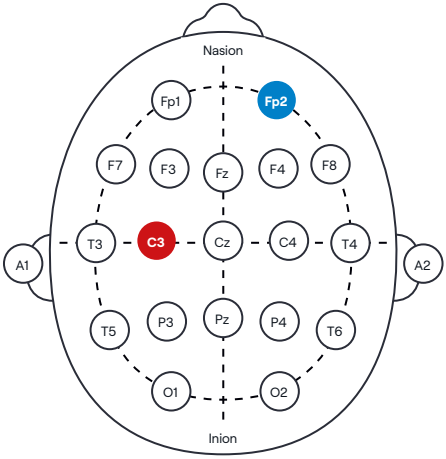
scope	5 – 20 sessions
duration	20 minutes
stim. intensity	1 – 2 mA
efficacy	●●●●○

source: Lefaucheur JP et al. 2017, Przeklasa-Muszynska A et al. 2017, Silva AF et al. 2017



anode
left hemisphere (motor cortex; C3) or contralateral (C4) to the side of the body experiencing pain

cathode
right supraorbital (Fp2) or Fp1 (depending on side of pain)



Motor disorders

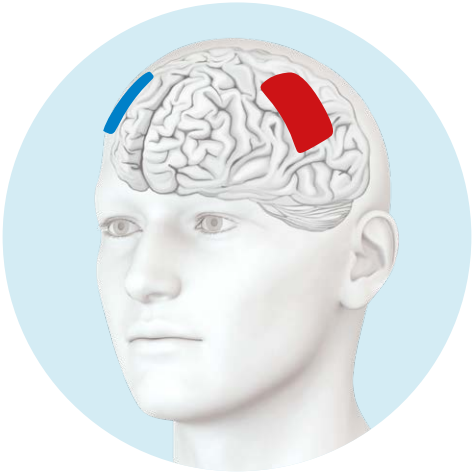
Strokes often lead to loss or disruption of motor areas of one hemisphere of the brain. This damaged hemisphere can no longer control the movement of contralateral limbs. The undamaged hemisphere tries to compensate for the deficits of the other hemisphere through increased activity. In the long term, the dominance of the undamaged hemisphere impairs the regeneration of the damaged hemisphere.

tDCS can inhibit the activity of the undamaged hemisphere and increase the activity of the damaged hemisphere. The aim is to restore the balance of the control processes in both hemispheres. Combining tDCS with conventional therapies, such as physiotherapeutic treatments, enables more targeted, unilateral movements.

B **Evidence = Level B (probably effective) for the combination of tDCS with motor training in the subacute or chronic phase**

This recommendation applies to all three electrode positions on the right side:

scope	1 – 5 session
duration	20 – 30 minutes
stim. intensity	1 – 2 mA
efficacy	●●●●○

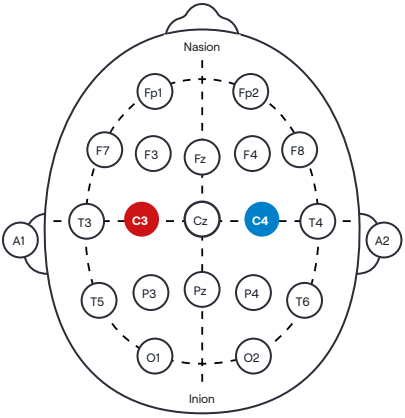


source: Fregni F et al. 2020

Here are possible electrode positions with level B evidence for motor disorders after stroke:

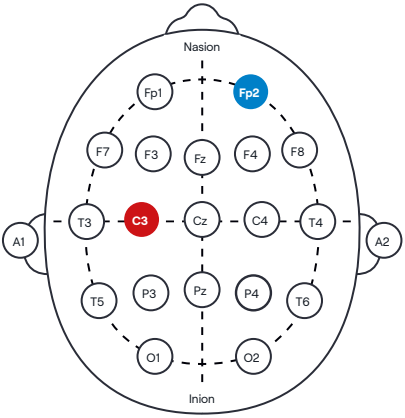
- **anode**
  same hemisphere as the lesion
  (C3 or C4, relevant for lesion)
- **cathode**
  contralateral to the lesion (C3/C4) or
  supraorbital

subacute: Andrade SM 2017
chronic: Bolognini N 2011, Lindenberg R 2012



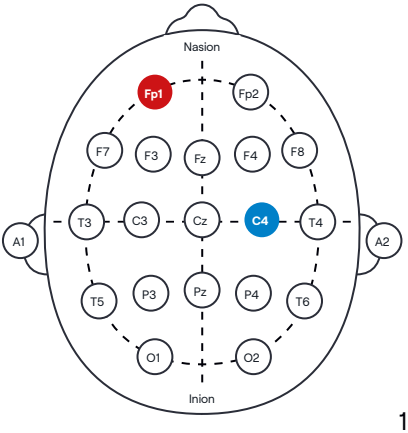
- **anode**
  same hemisphere as the lesion
  (C3 or C4, relevant for lesion)
- **cathode**
  supraorbital in heathy hemisphere
  (Fp2 or Fp1)

subacure: Andrade SM 2017, Khedr EM 2013
chronical: Rocha S 2016, Ilic NV 2016



- **anode**
  supraorbital in the hemisphere of the lesion
  (Fp1 or Fp2, relevant for lesion)
- **cathode**
  motor cortex in healthy hemisphere
  (C4 or C3)

subacure: Andrade SM 2017, Kim DY 2010
chronical: Nair DG 2011, Felice 2016



Cognitive deficites

Memory and cortival activity

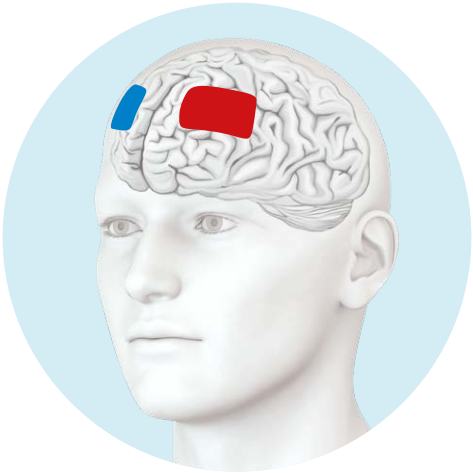
Patients with neurological disorders often suffer from impaired cognitive performance. While disturbances of attention and memory are prominent, executive functions or spatial-perceptive functions are also often impaired. Such disorders may be caused by brain damage or imbalances in neurochemical transmitters. Serious impairments may require that the patient needs daily care and support.

Combining tDCS with cognitive therapies like computer-assisted therapies can improve attention and memory faster and more effectively. The application of anodic stimulation over the DLPFC together with conventional therapies may significantly increase functional outcomes. Through additional transcranial modulation of damaged or intact brain areas, synaptic connections can be more easily established or strengthened.

C Evidence = Level C (possibly effective)

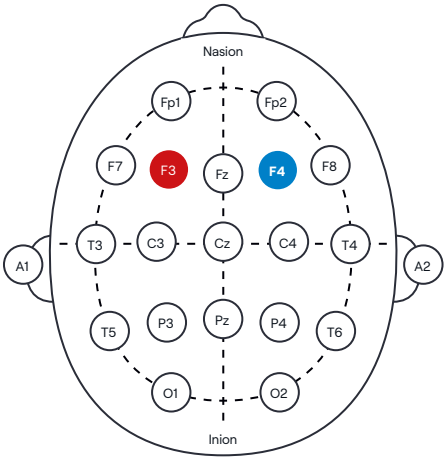
scope	10 – 20 session
duration	20 minutes
stim. intentiy	1 – 2 mA
efficacy	●●●○○

source: Lefaucheur JP et al. 2017, Ruf SP et al. 2017, Mattioli F et al. 2016, Sacco K et al. 2016



anode
left DLPFC (F3)

cathode
right supraorbital (Fp2)
or right DLPFC (F4)



Dysphagia

Medical professionals estimate that 50 % of all patients experience acute difficulty in swallowing after a stroke, known as dysphagia. Approximately 25 % suffer from chronic dysphagia. In treating dysphagia, the goal is to regain the ability to eat orally and to reduce the risk for aspiration.

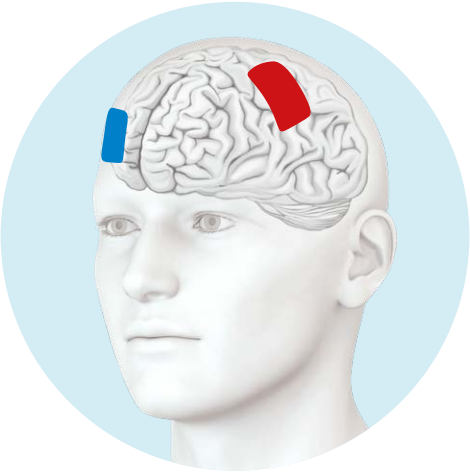
To achieve that, transcranial direct current stimulation (tDCS) can be applied concurrently to swallowing therapy.

Stimulation of the pharyngeal motor cortex during simultaneous swallowing therapy can improve the outcome of the treatment. Using tDCS to exogenously activate the involved network structures of swallowing at the same time as the patient has swallowing therapy can lead to long-term improvement.

C Evidence = Level C (possibly effective)

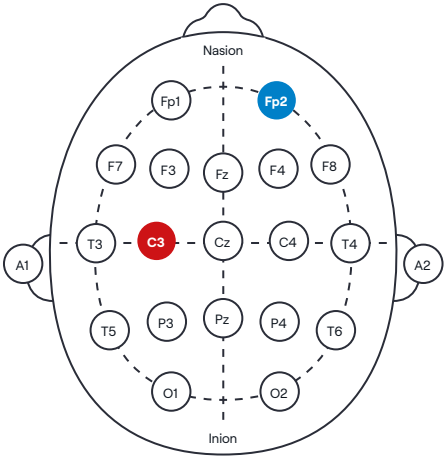
scope	5 – 10 sessions
duration	20 minutes
stim. intensity	1 mA
Efficacy	●●●○○

source: Suntrup-Krueger S et al. 2018, Suntrup S et al. 20136



anode
contralesional: from Cz 3,5 cm lateral and 1 cm anterior: ~C3 oder C4 (for cerebral infarction: ~C4)

cathode
Fp1/Fp2 (contralateral to anode)



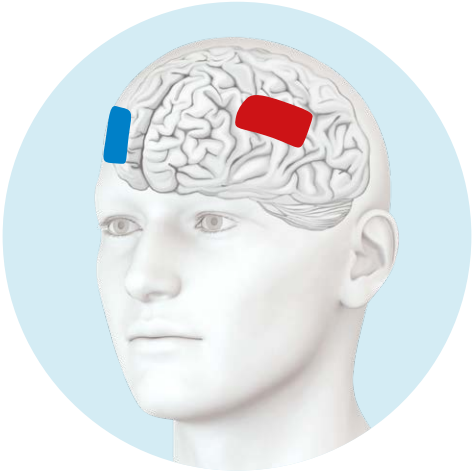
Aphasia

Stroke sufferers may experience disturbance of speech production or comprehension, called aphasia. For some patients, the ability to communicate is so severely impaired that any targeted communication becomes difficult to achieve.

tDCS treatment above the affected speech centre (left temporal lobe, Broca area) can improve speech production. Recent studies have shown sustainable improvements through anodic tDCS over the motor cortex (M1). Results improve if tDCS is combined with speech therapy.

C **Evidence = Level C (possibly effective)**

scope	10 – 15 sessions (Speech training should be conducted during or after each stimulation.)
duration	20 minutes
stim. intensity	1 – 2 mA
efficacy	●●●○○

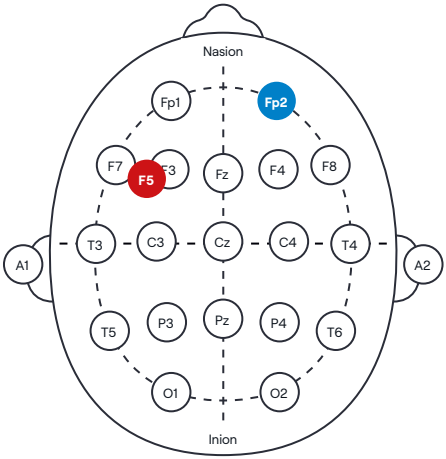


Possible electrode positions with evidence level C for aphasia:

anode
Broca area (F5)

cathode
right supraorbital (Fp2)

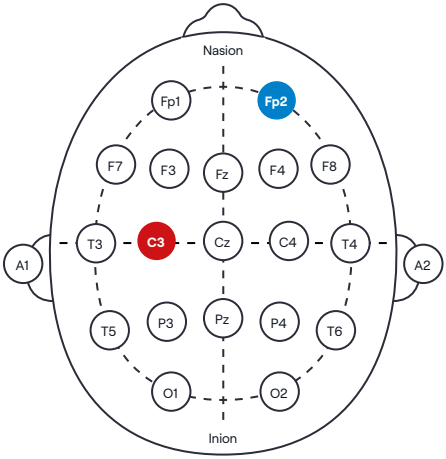
source: Fregni F et al., 2020, Lefaucheur JP et al. 2017, Marangolo et al. 2014



anode
M1 (C3)

cathode
right supraorbital (Fp2)

source: Darkow R und Flöel A 2018, Meinzer M et al. 2016



Auditory hallucinations in schizophrenia

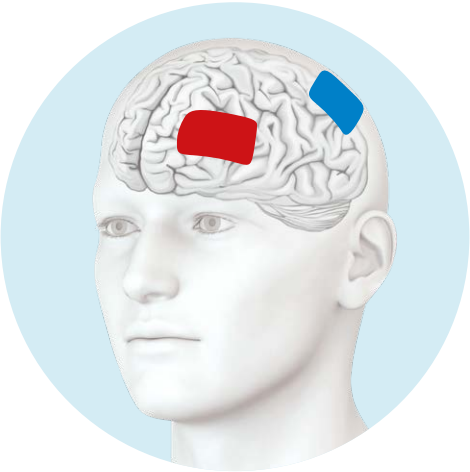
Experts estimate that between 50 and 70 % of patients with schizophrenia experience acoustic hallucinations. By using tDCS, clinicians can initiate synaptic structural modifications and reinforce them for the long term. This helps synchronise the activity of the brain's hemispheres and regulates excitation states of the Wernicke area.

The application of tDCS can reduce hallucinations within a relatively small number of sessions. After a longer period of treatment, lasting effects can be achieved.

B **Evidence = Level B (probably effective)**

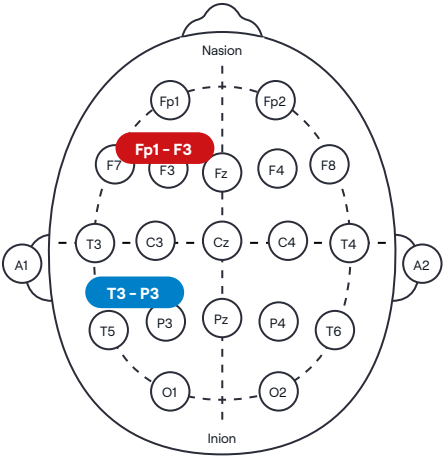
scope	10 sessions
duration	20 minutes
stim. intensity	2 mA
efficacy	●●●●○

source: Fregni F et al. 2020, Lefaucheur JP et al. 2017, Brunelin J et al. 2012



anode
between Fp1 and F3

cathode
at the transition between left temporal and parietal lope (between P3 und T3)



Safety and side effects

Risks and side effects:
tDCS is a promising method to modulate neuroplastic processes. Studies on safety and side effects have shown clear results: tDCS is well tolerated and has few side effects. Individual patients report mild fatigue, in rarer cases nausea or headaches.

Contraindications

No application:

- in conjunction with a defibrillator
- in conjunction with a cardiac pacemaker
- in conjunction with a brain stimulator
- in patients with implants (intracranial metals, e. g. plates, screws, etc.)
- in patients with open skull
- in patients after skull trepanation

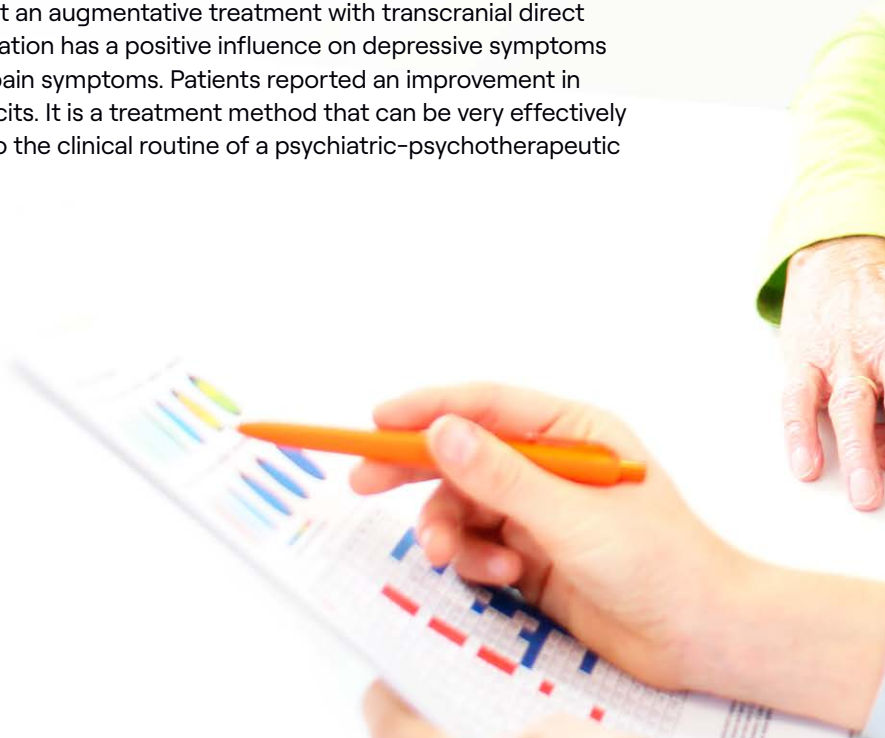
Testimonial of Dr. Hetzel

Psychiatric-psychotherapeutic practice, Alléstraße, Schwäbisch Gmünd, Germany

"We mainly treat depressive patients with transcranial direct current stimulation over the left prefrontal cortex in combination with behavioural therapy and/or antidepressant drug treatment. We also treat patients with chronic pain symptoms and post-stroke conditions with cognitive deficits.

We have treated over 100 patients to date. In principle, a treatment series of 15 sessions of 30 minutes was performed on consecutive days. No side effects were observed.

I can state that an augmentative treatment with transcranial direct current stimulation has a positive influence on depressive symptoms as well as on pain symptoms. Patients reported an improvement in cognitive deficits. It is a treatment method that can be very effectively integrated into the clinical routine of a psychiatric-psychotherapeutic practice."



Testimonial of Dr Schmidt-Staub

tDCS in the specialist practice for neurology, psychiatry, and psychotherapy, Hannover, Germany

”We’ve been offering treatments with various neuro-physiologically oriented methods since 2014, including tDCS, rTMS, and neurofeedback. These methods have proven to be good alternatives or supplements for complex psychosomatic and psychiatric-neurological clinical conditions. In the meantime, we have specialised in therapy-resistant cases that have not or only insufficiently responded to the previous guideline-oriented therapy.

We regularly use tDCS in the treatment of depressive episodes, anxiety disorders, and pain management. We have had particularly good outcomes with fibromyalgia patients and chronic pain patients.

We select the appropriate stimulation sites according to scientific protocols from double-blind studies. We achieve very good clinical results especially in the dorsolateral prefrontal cortex (DLPFC) and the sensorimotor cortex. In the case of positive response after 5 to 10 days, we usually work with daily applications over 15 sessions (3 weeks). In complex cases, interval therapy with the same stimulations every 3 months has also proved successful, which has led to good results in the long term.

In addition to the usual 2-electrode procedures, we have also had good outcomes by using neurorehabilitation during the therapy of hemispastic patients with bi-cathodal stimulation (4 electrodes by splitter cable) over the sensorimotor cortex. In addition to improvements in spasticity, there were also good motor improvements after lesions that had occurred further in the past (in one case of stroke as long as 5 years ago). Moreover, we achieved cognitive improvements and, in the case of left-lateral lesions, positive effects on word-finding and speech flow.

tDCS therapy is also a very good option for patients who do not wish to take drug treatments or for whom medication-free methods are more appropriate from a medical point of view. There are several options for application. For example, after extensive assessment of the causes, even slight cognitive disorders can be modulated.

The different procedures complement each other in their application. By now, tDCS has become an integral part of our therapeutic approach due to its good efficacy and simple handling.

It is a treatment method that can be very well integrated into the clinical routine of a psychiatric-psychotherapeutic practice."

Sources of literature

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For information, advice or to register online:

neurocare group AG
academy@neurocaregroup.com
Tel.: +49 (3677) 68 979 0

www.neurocaregroup.com

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Contact and information:

neurocare group AG
info@neurocaregroup.com
+49 (89) 3564 767 0

www.neurocaregroup.com