Transcranial direct current stimulation
Application
We are here for you

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neurocare helps people by providing sustainable therapies for mental disorders, chronic pain and rehabilitation. As a specialist in non-invasive neuromodulation, neurocare offers the technology, training and clinical expertise for safe and well-researched therapies. By measuring and modulating brain activity, significant and lasting improvements in symptoms and quality of life can be achieved.

The interventions can improve the outcome of standard therapies and can also help when other therapies fail or are not feasible.
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Neuromodulation with tDCS?

Transcranial direct current stimulation (tDCS) is a non-invasive, well tolerated treatment method. A weak electrical direct current acts on the brain through two electrodes attached to the head. Studies show positive effects in a range of indications.

tDCS is easy to use, painless and safe. In combination with other therapies, tDCS can enhance their positive effects. Depending on the voltage, duration, polarity and location of the electrodes, the applied current can have an inhibiting or stimulating effect. tDCS modifies the resting membrane potential and the transmission of information is either promoted or inhibited. Neuronal excitability and activity levels can be modulated in this way.

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. In depression, tDCS can be used in combination with psychotherapy or pharmacotherapy. 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, please contact us to learn more about technology and training solutions.
Depression

Studies have demonstrated that in depression there is often asymmetric activity of neuron populations in the prefrontal cortex. In the left hemisphere (dorsolateral prefrontal cortex, DLPFC) decreased neuronal activity has been observed. This can be compensated with anodal left side tDCS. Improvement in cognitive performance is observed in relatively few sessions. Studies show antidepressant effects are generally noticed after 2 to 3 weeks of treatment.

tDCS can be used in parallel to or complimentary to other conventional therapies (e.g. pharmacotherapy or psychotherapy).

Level of evidence = Level A (definitely effective)
Suitable electrode positions with evidence level A:

- **Anode:**
  - left DLPFC (F3)

- **Cathode:**
  - right supraorbital (FP2)

Addictive Disorders

Addictive disorders are known to be challenging to treat. Studies observe there is disturbed cognitive control in relation to 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 and addiction can be alleviated which is found to reduce craving.

Level of evidence = Level B (probably effective)
Scope: 5 – 10 sessions
Duration: 20 – 30 minutes
Stim. intensity: 2 mA
Efficacy: ★★★★★☆

Anode: right DLPFC (F4)
Cathode: left DLPFC (F3)

Pain

In studies of patients with fibromyalgia, migraine, chronic, postoperative or neuropathic pain, tDCS treatment with anodic stimulation over the motor cortex (M1) is found to reduce perceived pain. In relatively few sessions, improvements have been observed which have persisted after treatment.

Level of evidence = Level B (probably effective), for:
- neuropathic pain
- fibromyalgia
- migraine
- postoperative pain
- **Anode:**
  left hemisphere (M1; C3) or contra-
  lateral (C4) to the side of the body
  experiencing pain

- **Cathode:**
  right supraorbital (Fp2) or Fp1
  (depending on side of pain)

**Scope:** 5 – 20 sessions
**Duration:** 20 minutes
**Stim. intensity:** 1 – 2 mA
**Efficacy:** ⭐⭐⭐⭐⭐

Source: Lefaucheur JP et al. 2017, Przeklasa-Muszyńska
A et al. 2017, Silva AF et al. 2017
Motor Disorders

A stroke often leads to the loss or disruption of motor areas of a hemisphere. As a result, the 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.

Level of 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 sessions
Duration: 20 – 30 minutes
Stim. intensity: 1 – 2 mA
Efficacy: ★★★★★☆☆☆☆☆

Source: Fregni F et al. 2020
Possible electrode positions with evidence level B for motor disorders after stroke:

- **Anode:**
  - same hemisphere of the lesion (C3 or C4, relevant for lesion)

- **Cathode:**
  - contralateral to lesion (C3/C4) or supraorbital

Subacute: Andrade SM et al. 2017

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- **Anode:**
  - same hemisphere of the lesion (C3 or C4, relevant for lesion)

- **Cathode:**
  - supraorbital in healthy hemisphere (Fp2 oder Fp1)


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- **Anode:**
  - supraorbital in hemisphere of lesion (Fp1 oder Fp2, relevant for lesion)

- **Kathode:**
  - motor cortex in healthy hemisphere (C4 oder C3)

Subacute: Andrade SM et al. 2017, Kim DY et al. 2010
Cognitive Deficits
Memory and cortical activity

Impaired cognitive performance is often observed in patients with neurological disorders. 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. The impairments can be such that the patient may require full-time or partial everyday life supports.

Combining tDCS with cognitive therapies (e.g. computer-assisted therapies) can improve attention and memory faster and more effectively. The application of anodic stimulation over the DLPFC in combination 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.

Level of evidence = Level C (possibly effective)
**Anode:**
left DLPFC (F3)

**Cathode:**
right supraorbital (Fp2)
or right DLPFC (F4)

Scope: 10 – 20 sessions
Duration: 20 minutes
Stim. intensity: 1 – 2 mA
Efficacy:

Cognitive Deficits
Learning and information processing

Cognitive deficits are symptoms of many psychiatric disorders. Affected are e.g. executive functions, working memory, attention and information processing. Deficits in learning, thinking and problem solving become visible in everyday life. These impairments represent a handicap for patients when it comes to finding their way back into working life. Even coping with the demands of everyday life can already overtax patients.

The combination of tDCS treatment with cognitive training can have a positive effect on the psychiatric rehabilitation process: The tDCS prepares the brain structures to induce neuroplastic changes. For cognitive training, a task should be chosen that is specifically targeted to the functional area.
With MyBrainTraining® a tool has been created that is specially tailored to the needs of psychiatric patients. Prof. Dr. Kawashima was able to show that MyBrainTraining® exercises lead to cortical activation. Regular training leads to significant cognitive and behavioural improvements in the patients’ everyday life (Moritz et al. 2015)
Cognitive deficits
Self-efficacy and performance

After the acute phase of treatment of a neurological or psychiatric disease, there is often the need for cognitive training. Cognitive training can be used as an adjunctive or essential element of therapy. The aim is on the one hand to increase cognitive performance and on the other hand to strengthen the patient’s activation and motivation.
All 30 exercises of MyBrainTraining® have a cortically stimulating effect. The exercises can improve performance in the areas of speed of information processing, attention and vigilance, verbal and visual learning, working memory as well as thinking and problem solving. If neuroplasticity is increased during training with tDCS, recovery can be improved.

During therapy, individual training plans are tailored to the cognitive and motivational needs of each patient. The software is auto-adaptive and adjusts itself to the individual performance of the patient. Thus, patients experience the training as motivating and perceive the subjective learning progress as positive. The training is suitable to accompany the entire therapy process from the in-patient stay to the out-patient therapy up to independent practice at home.

Test MyBrainTraining® free of charge and without obligation. Enquiries under: MBT@neuroCaregroup.com
Dysphagia

After a stroke, an estimated 50% of all patients experience acute difficulty in swallowing and 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. Transcranial direct current stimulation (tDCS) can therefore be applied concurrent to swallowing therapy.

Stimulation of the pharyngeal motor cortex during simultaneous swallowing therapy is seen to improve the outcome of treatment. Using tDCS to exogenously activate the involved network structures of swallowing in parallel to the endogenous excitation of swallowing therapy can lead to long-term improvement.

Level of evidence = Level C (possibly effective)
Anode:
contralesional: from Cz 3.5 cm lateral and 1 cm anterior: ~C3 or C4
(for cerebral infarction: ~C4)

Cathode:
Fp1/Fp2 (contralateral to anode)

Duration: 5 – 10 sessions
Duration: 20 minutes
Stim. intensity: 1 mA
Efficacy: ★★★★☆☆☆☆☆

Source: Suntrup-Krueger S et al. 2018,
Suntrup S et al. 2013
Aphasia

Sufferers of a stroke may experience disturbance of speech production or comprehension, called aphasia. The ability of the affected person to communicate can be so severely impaired that targeted communication can be difficult to achieve.

tDCS 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). A combination with speech therapy is indicated.

Level of evidence = Level C (possibly effective)
Possible electrode positions with evidence level C for aphasia:

**Anode:**
Broca-Areal (F5)

**Cathode:**
right supraorbital (Fp2)


**Anode:**
M1 (C3)

**Cathode:**
right supraorbital (Fp2)


**Recommendation for both montages:**

- **Scope:** 10 – 15 sessions
  (Speech training should be conducted during or after each stimulation.)
- **Duration:** 20 minutes
- **Stim. intensity:** 1 – 2 mA
- **Efficacy:** ★★★☆☆☆
Auditory Hallucinations in Schizophrenia

An estimated 50-70% of patients with schizophrenia experience acoustic hallucinations. By using tDCS, synaptic structural modifications can be initiated and reinforced for the long-term. The activity of the hemispheres can therefore be synchronised, regulating excitation states of the Wernicke area.

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

Level of evidence = Level B (probably effective)
**Anode:**
left DLPFC (F3) or supraorbital (Fp1)

**Cathode:**
at the transition between left temporal and parietal lobe (between P3 & T3)

Scope: 10 sessions
Duration: 20 minutes
Stim. intensity: 2 mA:
Efficacy ★★★★★☆☆☆☆☆

Safety and side effects

Risks and side effects

tDCS is considered a promising method to modulate neuroplastic processes. Studies on safety and side effects give a clear recommendation: tDCS is a well-tolerated method with 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.)
• for 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 behavioral therapy and/or antidepressant drug treatment. We also treat patients with chronic pain symptoms and post-stroke condition 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.

It can be stated that an augmentative treatment with transcranial direct current stimulation has a positive influence on the depressive symptoms as well as on the 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 neurophysiologically 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 very good outcomes with fibromyalgia patients and chronic pain patients in particular.

We select the appropriate stimulation sites according to scientific protocols from double-blind studies. We achieve very good clinical results especially in the area of 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 in neurorehabilitation with the therapy of hemispastics with bicathodal stimulation (4 electrodes by splitter cable) over the sensorimotor cortex. In addition to improvements in spasticity, there were also good motor improvements after lesions which had occurred longer ago (in the longest case of stroke 5 years ago), as well as 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, e.g. after extensive assessment of the causes, even slight cognitive disorders can be modulated. The different procedures complement each other in their application. tDCS has meanwhile 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."
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Technical data of the DC-STIMULATOR MOBILE

General information
• Stimulator: 71 x 94 x 15 mm (W x L x H), weight: 66 g
• storage module: 71 x 39 x 15 mm (W x L x H), weight: 42 g
• Programming device: 71 x 62 x 15 mm (W x L x H), weight: 46 g
• Charging device: 71 x 62 x 15 mm (W x L x H), weight: 46 g
• power consumption maximum 0.25 W
• power supply via integrated, rechargeable, leak-proof
• battery in memory module, charging via USB power supply
• continuous operating time approx. 90 min (depending on type of stimulation and battery condition)
• touch-protected electrode connection according to DIN 42802-2 (Ø 1.5 mm)
• graphic display (reflective), 1 key

Stimulation
• DC intensity -2,000...+2,000 µA
• deviation of DC current intensity from setpoint max. 2 % for |I| > 500 µA resp. maximum 10 µA
• offset current ±10 µA
• internal DAC resolution of signal generation 12 bit
• error of the quartz time base maximum 0.001 %.
• voltage limitation maximum ±16 V
• the maximum output current of 2 mA (tDCS) is not exceeded (maximum tolerance 2 %)
• the defined stimulation duration is not exceeded (maximum tolerance 1 %)
neuroConn

Next Stimulation
1mA tDCS 20
OK (CHANGE)
Learn how to apply tDCS

The neuroCademy offers one- and two-day advanced training in transcranial direct current stimulation:

• at neuroCademy training centres,
• in your own practice or institution,
• or as an online webinar

Please also visit our website for more information on our free info webinars

Learn how to use tDCS in several applications, understanding:

• how tDCS works and how it is applied,
• which therapies are possible according to current research,
• how to implement tDCS in your practice,
• how tDCS devices are used (including hands-on practice).

Online, self-placed learning

Enrole in a self-paced learning pathway for tDCS. You will gain access to expert learning modules covering the theory and foundations of tDCS, as well as technical demonstration videos and access to live lessons and Q&A sessions scheduled throughout the year. https://lms.neurocademy.com

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