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HDCkit

Portable & Programmable Modular DC Stimulator

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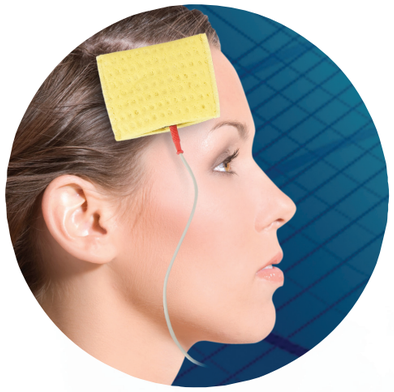
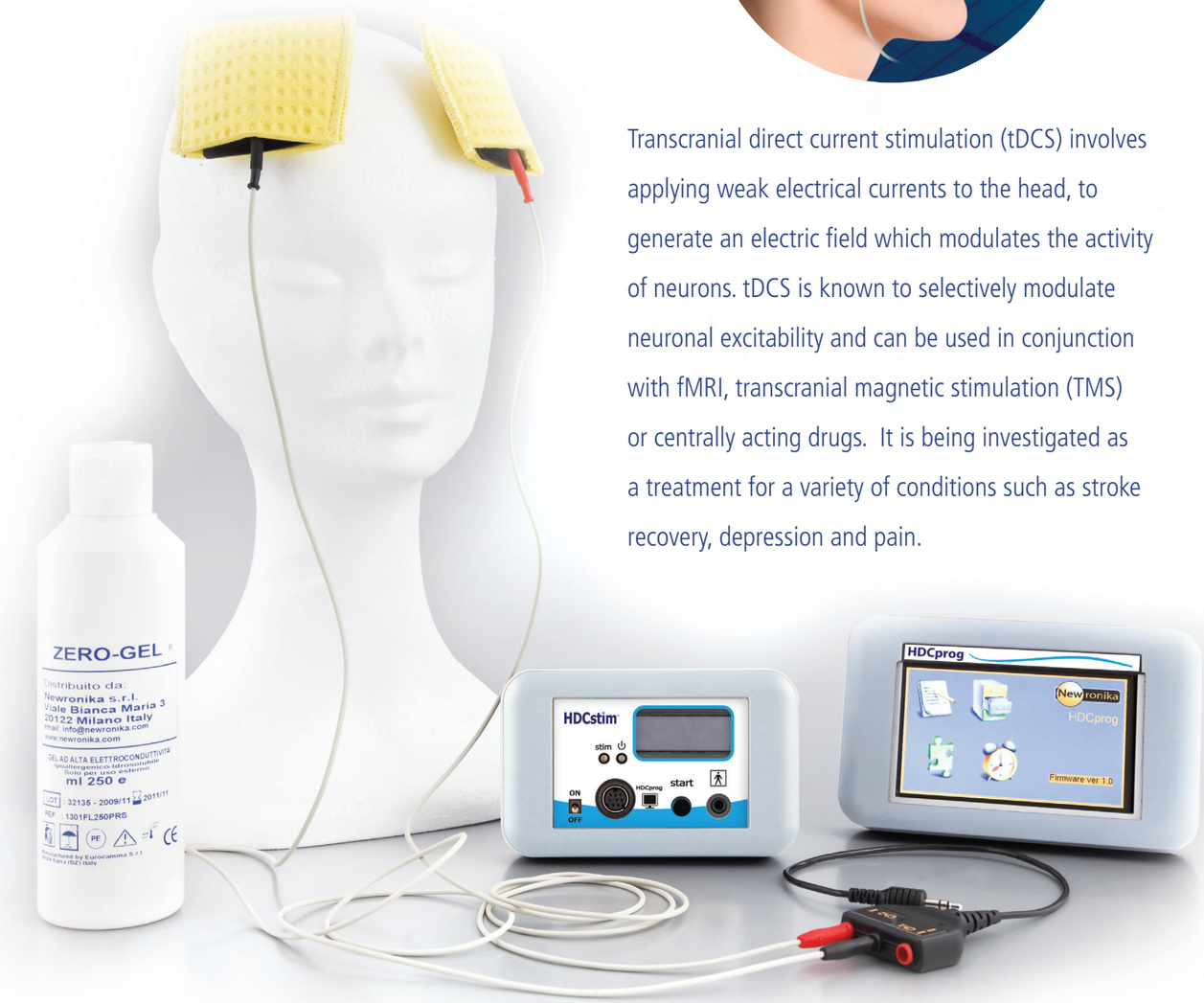
HDCkit

An introduction to tDCS (transcranial Direct Current Stimulation)





Transcranial direct current stimulation (tDCS) involves applying weak electrical currents to the head, to generate an electric field which modulates the activity of neurons. tDCS is known to selectively modulate neuronal excitability and can be used in conjunction with fMRI, transcranial magnetic stimulation (TMS) or centrally acting drugs. It is being investigated as a treatment for a variety of conditions such as stroke recovery, depression and pain.

Extensive neurophysiological experiments have shown evidence that Direct Current (DC) penetrates the brain to modify neuronal transmembrane potentials, thereby influencing brain excitability[1].

Animal studies suggest, that if cathodal stimulation - negative pole or electrode (cathode) is located near the cell body or dendrites - it decreases the resting membrane potential and therefore hyperpolarises neurones, whereas if anodal stimulation - positive pole or electrode (anode) is located near the cell body or dendrites - it causes depolarisation by increasing resting membrane potentials and spontaneous neuronal discharge rates[2].

Current research suggests that electrodes placed on the forehead could produce noticeable psychological changes that were dependent on the direction of the field.

Lang et al[3] claim that anodal polarisation of the motor cortex increased the motor response to TMS of the same area; reduction of this response was observed with cathodal polarisation, the effects of which seem to last for an appreciable amount of time after exposure. Investigators are currently testing the validity of these claims and the effects of tDCS on other brain areas and functions.

tDCS is now emerging as a major research tool in its own right and as a complimentary tool to conventional TMS.

- In studies of the visual system *Antal et al*[4] working with Professor Walter Paulus in Göttingen, have used tDCS to modulate visual cortex excitability measured using TMS, and to enhance visuomotor learning.
- In cognitive studies tDCS has been used to modulate learning and to study memory functions. These studies have stimulated V1, V5/MT, parietal cortex and prefrontal cortex[5].
- Studies applying tDCS to the motor cortex have revealed that tDCS can modulate motor cortex excitability (measured using TMS) for up to 90 minutes post stimulation[6]. Exploiting this long term change in brain sensitivity has allowed exploration of motor learning and plasticity.
- The long term effects of tDCS make it an effective tool to use in conjunction with centrally acting drugs and one study has shown that dopaminergic modulation combined with tDCS can enhance the effects of tDCS for up to 24 hours[7].
- The rehabilitation potential of tDCS remains to be explored but already, in rehabilitation following stroke, tDCS has been combined with measures of plasticity in double blind trials to give promising indications of a positive role for non invasive DC stimulation in rehabilitation[8].

References in this article are found on the back of this brochure

An introduction to the HDCkit

HDCkit is a cost-effective modular system for Direct Current (DC) stimulation, designed specifically for both research and clinical use. It consists of a stimulator (HDCstim), a programmer (HDCprog) and a set of electrodes (HDCel, which also has the option of a headcap).

There are many benefits in using a modular system such as the HDCkit:

- **The stimulator (HDCstim) and the programmer (HDCprog) are two separate units, minimising the risk of any misuse of the stimulator by the patient or subject, ensuring that applications or treatments are administered correctly everytime.**
- **The researcher or clinician using the HDCkit remains in complete control of how stimulations are administered.**
- **The researcher or clinician requires only one HDCprog to programme any number of stimulators (HDCstim).**
- **Researchers or clinicians can order additional HDCstims as and when required for studies or treatments.**
- **The HDCStim unit is portable, battery-operated and designed for home use by a subject or patient.**
- **The basic HDCkit package contains everything required to administer tDCS.**
- **The HDCkit is fully programmable and can run any number of applications or treatments within its parameters.**

HDCprog

The **HDCprog** is an easy-to-use touch-screen LCD programmer that, when connected to a HDCstim, allows a clinician or researcher to set tDCS treatments or protocols for their patients or subjects. By using the HDCprog, it is possible to define an entire treatment or application by setting the number of stimulations (maximum 99), the intensity (up to 1.5mA per channel), the duration (maximum 20min), and the minimum interval between two consecutive simulations (max 1168 hours).

Upon connecting it to a HDCStim after a treatment has been administered, the HDCprog allows the physician to check stimulation results through an easy to navigate stimulation report interface, allowing for an informed evaluation of applications administered so far. HDCprog is powered by an AC/DC adapter, which is certified for medical use.

HDCprog - Technical specifications

Monitor and user interface

Intended use	Touch-screen LCD to set HDCstim stimulation parameters
Display	480x272dot, 16bit colors Powering
Power supply	External power supply certified for medical use (HDCpower)
Maximum input voltage	5V
Maximum input current	500mA (DC)

Safety and certifications

Medical device class	Class IIa medical device (CE marked, Notified Body 0068).
Essential safety requirements	EN 60601-1, EN 60601-1-2, EN 60601-1-4
Isolation	Reinforced isolation class II between principal HDCprog part and HDCstim applied part through optoelectronic isolation

Dimensions

Case	15cm x 9cm x 2cm.

Program

Maximum number of stimulations	99. Step: 1 stimulation
Minimum time interval between two consecutive stimulations	168h. step: 1 hour
Minimum current intensity	500uA
Maximum current intensity	1500uA. Step: 1ua
Minimum stimulation duration	0min
Maximum stimulation duration	20min. Step: 1min

HDCpower - Technical specifications

System features

Intended use	AC/DC adapter certifiedfor medical use (FRIWO, DE, model MPP15 MED)
Type	commutation
Montage type	Insertion

Safety and certifications

Safety	IEC/UL (for further details contact the manufacturer)
Isolation	Class II

Dimensions

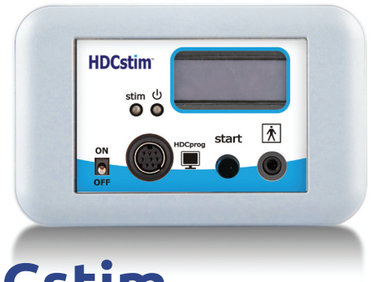
Case	8.75cm x 5.15cm x 3.4cm

Input

Maximum input voltage	240V AC
Minimum input voltage	100V AC
Input current	400mA

Output

Type	Fixed
Number of outputs	1
Voltage	5V
Current	2.4A
Nominal power	15W



HDCstim

The **HDCstim** is a battery supplied, programmable stimulator that is used to administer direct current (DC) stimulation. Designed for home use by a patient or subject, the HDCstim is only pre-programmable with a HDCprog and will not deviate from the treatment or protocol chosen by a researcher or clinician. The HDCstim delivers a finite number of prescribed stimulations with a selectable time interval between two consecutive stimulations. The HDCstim records all use and its outputs, for later retrieval on the HDCprog by researcher or clinician.
It is lightweight, highly portable and compact.

The HDCstim's ease of use ensures that the subject or patient can activate the pre-programmed stimulation as and when directed. Additional HDCstims can be ordered as and when required without the need to buy additional programmers, thereby getting the most out of a clinical budget or research grant.

HDCstim - Technical specifications

Intended use

Intended use	Portable and programmable direct current [DCI simulator.
Applied part	Type BF

Safety and certifications

Medical device class	Class IIa medical device (CE marked, Notified Body 0068).
Essential safety requirements	EN 60601-1, EN 60601-1-2, EN 60601-1-4

Dimensions

Case	11.5cm x 7cm x 2cm.

Power Supply

Type	Internal power supply.
Power	2 batteries tvpe AA/LR6 - 1.5V - KAA.
Secondary battery	Renata batteries CR2325. Nominal capacity: L90mAh

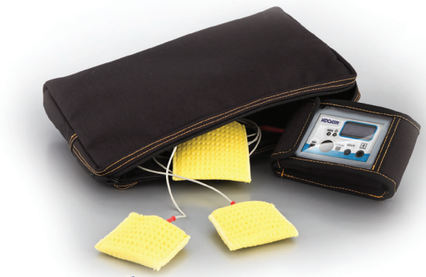
Stimulation

Types of stimulation	Monochannel stimulation (1 anode and 1 cathode) Bichannel anodal stimulation (2 anodes, 1 cathode) Sham stimulation
Maximum output current	1.5 mA per channel (1500 uA)*.
Minimum output currernt	0.5 mA per channel (500 uA)
Maximum output voltage	28 VDC** per channel
Currency generator accuracy	<0.1 mA**.
Mean impedance, check resolution	Mean impedance check resolution: +/- 2k0hm.
Current ramp	from 0 to 100% in 5 seconds.
Treatment duration	1 to 20 minutes with 1 minute resolution.

Real time system for administered treatment stability (through the measure of output current and voltage)

Maximum difference between administered and set current before stimulation stop	0.2mA
Maximum impedance variation before stimulation interruption	4k0hm***
Mean impedance check resolution	+/-2k0hm.

Specific tolerance is stated in the manuals.



HDCel

The HDCel is a set of accessories for the administration of DC stimulation from the HDCStim. HDCel is consists of a set of electrodes made from plant cellulose and conductive silicone, and are manufactured to ensure biocompatibility with the skin. Electrodes are safely connected to HDCStim through the cables provided, the connections of which are designed to minimise the risk of incorrect set-up by the patient or subject.

The HDCel set can also be provided in a cap format, that allows for precise anode and cathode positioning due to multiple points on the cap on which the electrodes can be attached and recorded.

HDCCel - Technical specifications

Electrodes

Intended use	Sponge electrodes for DC stimulation delivery
Material (external part)	Spontex Fiab Spa, vicchio (Fi) Italy, s/n PG970S and PG980S
Material (Internal part)	Conductive silicone Fiab Spa, vicchio (Fi) Italy, s/n PG970/2 and PG980/2

Safety and certifications

Medical device class	Accessory of Class IIa medical device (CE marked, Notified Body 0068).
Essential safety requirements	93/42/CEE Manufactured according to the procedures of FIAB quality systems ISO 13485

Dimensions

Small type	5cm x 5cm
Large type	6cm x 8.5cm

Connector cables

Active electrodes	Red cables (male connector, female electrode) - Female connection touch proof DIN 1.5 and banana connection 2mm. Fiab Spa, vicchio (Fi) Italy, s/n F9032D/M2EM
Reference electrodes	Black cables (female connector, male electrode) - Plastics One Inc USA, s/n 441222ATB028001

Accessory

High conductivity gel	ZERO GEL ml 250, EUROCAMINA S.r.l Egna Italy

tDCS Literature Review

Below is a list of academic papers, categorised by area, on the subject of **tDCS (Transcranial Direct Current Stimulation)**
Click on the titles to be taken to an abstract or an online copy of the full paper.

REVIEW & SAFETY

Technology insight: noninvasive brain stimulation in neurology-perspectives on the therapeutic potential of rTMS and tDCS
Nat. Clin. Pract. Neurol. 2007 Jul. 3(7): 383-93. Review
Fregni F, Pascual-Leone A.

Noninvasive human brain stimulation
Annual Rev. Biomed Eng. 2007; 9: 527-65
Wagner T, Valero-Cabre A, Pascual-Leone A.

The use of tDCS and CVS as methods of non-invasive brain stimulation
Brain Res Rev. 2007 Dec; 56 (2): 346-61. Epub 2007 Aug 28. Review.
Been G, Ngo TT, Miller SM, Fitzgerald PB

Transcranial direct current stimulation: State of the art 2008
Brain Stimul. 2008 Jul;1(3):206-23.
Nitsche MA, Cohen LG, Wassermann EM, Priori A, Lang N, Antal A, Paulus W, Hummel F, Boggio PS, Fregni F, Pascual-Leone A.

Brain polarization in humans: a reappraisal of an old tool for prolonged non-invasive modulation of brain excitability
Clin Neurophysiol. 2003 Apr;114(4):589-95
Priori A.

Physiological basis of transcranial Direct Current Stimulation
Neuroscientist. 2011 Feb;17(1):37-53.
Stagg CJ, Nitsche MA.

Cognitive, Mood, and Electroencephalographic Effects of Noninvasive Cortical Stimulation With Weak Electrical Currents
Journal of ECT 2010 Oct 5. [Epub ahead of print]
Tadini L, El-Nazer R, Brunoni AR, Williams J, Carvas M, Boggio P, Priori A, Pascual-Leone A, Fregni F.

Electrified minds: transcranial direct current stimulation (tDCS) and galvanic vestibular stimulation (GVS) as methods of non-invasive brain stimulation in neuropsychology - a review of current data and future implications
Neuropsychologia. 2010 Aug;48(10):2789-810.
Utz KS, Dimova V, Oppenländer K, Kerkhoff G.

Safety aspects of transcranial direct current stimulation concerning healthy subjects and patients
Brain Res Bull. 2007 May 30;72(4-6):208-14.
Poreisz C, Boros K, Antal A, Paulus W.

Sustained excitability elevations induced by transcranial DC motor cortex stimulation in humans
Neurology; 57: 1899-1901.
Nitsche Ma, Paulus W, 2001.

GABAergic modulation of DC stimulation-induced motor cortex excitability shifts in humans
The European Journal of Neuroscience; 19: 2720–2726 (2004)
Nitsche Ma, Liebetanz D, Schlitterlau A, Henschke U, Fricke K, Frommann K, Lang N, Henning S, Paulus W, Tergau F.

Consideration for safety in the use of extracranial stimulation for motor evoked potentials
Neurosurgery; 20: 143-147 (1987)
Agnew WF, Mccreery DB.

Excitability changes induced in the human motor cortex by weak transcranial direct current stimulation
J Physiol. 2000 Sep 15;527 Pt 3:633-9
Nitsche MA, Paulus W.

Transcranial Direct Current Stimulation: Estimation of the Electric Field and of the Current Density in an Anatomical Human Head Model
IEEE Trans Biomed Eng. 2011 Feb 17. [Epub ahead of print]
Parazzini M, Fiocchi S, Rossi E, Paglialonga A, Ravazzani P.

GENERAL RESEARCH ON tDCS

Shaping the effects of transcranial direct current stimulation of the human motor cortex
J Neurophysiology. 2007 Apr; 97 (4): 3109-17. Epub 2007 Jan 24.
Nitsche MA, Doemkes S, Karakose T, Antal A, Liebetanz D, Lang N, Tergau F, Paulus W.

Perception of comfort during transcranial DC stimulation: effect of NaCL soloution concentration applied to sponge electrodes
Clin Neurophysiology. 2007 May (5): 1166-70. Epub 2007 Feb 27
Dundas JE, Thickbroom GW, Mastaglia FL

Transcranial direct current stimulation: a computer-based human model study
Neuroimage. 2007 Apr 15;35(3): 1113-24. Epub 2007 Feb 4
Wagner T, Fregni F, Fecteau S, Grodzinsky A, Zahn M, Pascual-Leone A.

Timing-dependent modulation of associateive plasticity by general network excitability in the human motor cortex
J Neuroscience, 2007 Apr 4; 27 (14): 3807-12
Nitsche MA, Roth A, Kuo MF, Fischer AK, Liebetanz D, Lang N, Tergau F, Paulus W.

Safety aspects of transcranial direct current stimulation concerning healthy subjects and patients
Brain Res Bull. 2007 May 30; 72 (4-6): 208-14. Epub 2007 Jan 24
Poreisz C, Boros K, Antal A, Paulus W.

Boosting focally-induced brain plasticity by dopamine
Cereb. Cortex. 2008 Mar;18(3):648-51. Epub 2007 Jun 24
Kuo MF, Paulus W, Nitsche MA.

Focusing effect of acetylcholine on neuroplasticity in the human motor cortex
J Neuroscience. 2007 Dec 26; 27 (52): 14442-7
Kuo MF, Grosch J, Fregni F, Paulus W, Nitsche MA

ALS

Motor cortex abnormalities in amytrophic lateral sclerosis with transcranial direct-current stimulation
Muscle Nerve. 2007 May; 35 (5): 620-4
Quartarone A, Lang N, Rizzo V, Bagnato S, Morgante F, Sant'angelo A, Crupi D, Battaglia F, Messina C, Girlanda P

ALZHEIMER'S DISEASE

Temporal cortex DC stimulation enhances performance on a visual recognition memory task in Alzheimer's disease
J Neurol Neurosurg Psychiatry. 2008 Oct 31.
Boggio PS, Khoury LP, Martins DC, Martins OE, Macedo EC, Fregni F.

Transcranial direct current stimulation improves recognition memory in Alzheimer disease
Neurology. 2008 Aug 12;71(7):493-8.
Ferrucci R, Mameli F, Guidi I, Mrakic-Sposta S, Vergari M, Marceglia S, Cogiamanian F, Barbieri S, Scarpini E, Priori A.

ATAXIA

A novel approach for treating cerebella ataxias
Med Hypotheses. 2008 Feb 15; [Epub ahead of print] PMID: 18281160 [PubMed as supplied by publisher]
Manto M, Taib NO

DEPRESSION

Go-no-go task performance improvement after anodal transcranial DC stimulation of the left dorsolateral prefrontal cortex in major depression
J Affect Disord. 2007 Aug; 101 (1-3): 91-8. Epub 2006 Dec 12
Boggio PS, Bermpohl F, Vergara AO, Muniz AL, Nahas FH, Leme PB, Rigonatti SP, Fregni F.

Transcranial and deep brain stimulation approaches as treatment for depression
Clin EEG Neuroscience 2007 Apr; 38 (2): 105-15. Review
PMID: 17515176 [PubMed - indexed for MEDLINE] Rau A, Grossheinrich N, Palm U, Pogarell O, Padberg F.

Transcranial direct current stimulation: A new tool for the treatment of depression? Journal of Affective Disorders 2009, 117:137-145.
Abraham P. Arul-Anandam, Colleen Loo.

A randomized, double-blind clinical trial on the efficacy of cortical direct current stimulation for the treatment of major depression
Int J Neuropsychopharmacol. 2008
Boggio PS, Rigonatti SP, Ribeiro RB, Myczkowski ML, Nitsche MA, Pascual-Leone A, Fregni F.

Efficacy and Safety of Transcranial Direct Current Stimulation in Major Depression
Biol Psychiatry 2011. doi:10.1016/j.biopsych.2010.12.031.
Dell'Osso B., Priori A., Altamura A.C.

Transcranial direct stimulation and fluoxetine for the treatment of depression
Eur Psychiatry. 2008 Jan;23(1):74-6.
Rigonatti SP, Boggio PS, Myczkowski ML, Otta E, Fiquer JT, Ribeiro RB, Nitsche MA, Pascual-Leone A, Fregni F.

Transcranial Direct Current Stimulation In Severe, Drug Resistant Major Depression
Journal of Affective Disorders 2009. Nov-118 (1-3): 215-9.
Ferrucci R, Bortolomasi M, Vergari M, Tadini L, Salvoro B, Giacopuzzi M, Barbieri S, Priori A.

EATING DISORDERS / ALCOHOL ABUSE / CRAVING / DECEPTION

Activation of prefrontal cortex by transcranial direct current stimulation reduces appetite for risk during ambiguous decision making
J Neuroscience. 2007 Jun 6; 27 (23): 6212-8
Fecteau S, Pascual-Leone A, Zald DH, Liguori P, Theoret H, Boggio PS, Fregni F.

Transcranial direct current stimulation of the prefrontal cortex modulates the desire for specific foods
Appetite. 2007 Dec 23
Fregni F, Orsati F, Pedrosa W, Fecteau S, Tome FA, Nitsche MA, Mecca T, Macedo EC, Pascual-Leone A, Boggio PS

Cumulative priming effects of cortical stimulation on smoking cue-induced craving
Neurosci Lett. 2009 Sep 29;463(1):82-6.
Boggio PS, Liguori P, Sultani N, Rezende L, Fecteau S, Fregni F.

Prefrontal cortex modulation using transcranial DC stimulation reduces alcohol craving: a double-blind, sham-controlled study
Drug Alcohol Depend. 2008 Jan 1;92(1-3):55-60.
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Cortical stimulation of the prefrontal cortex with transcranial direct current stimulation reduces cue-provoked smoking craving: a randomized, sham-controlled study
J Clin Psychiatry. 2008 Jan;69(1):32-40.
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Transcranial direct current stimulation in the treatment of anorexia
Med Hypotheses (2010), doi:10.1016/j.mehy.2009.12.032
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EPILEPSY

Anticonvulsant effects of transcranial direct-current stimulation (tDCS) in the rat cortical ramp model of focal epilepsy
Epilepsia. 2006 Jul; 47(7): 1216-24
Liebetanz D, Klinker F, Hering D, Koch R, Nitsche MA, Potschka H, Löscher W, Paulus W, Tergau F.

MIGRAINE

Transcranial direct current stimulation reveals inhibitory deificiency in migraine
Cephalalgia. 2007 Jul; 27 (7): 833-9. Epub 2007 May 10
Chadaide Z, Artl S, Antal A, Nitsche MA, Lang N, Paulus W

MOTOR CORTEX/ STROKE

Improved isometric force endureance after transcranial direct current stimulation over the human motor cortical areas
Eur J Neuroscience 2007 Jul; 26 (1): 242-9
Cogiamanian F, Marceglia S, Adeline G, Beriberi S, Priori A.

Effects of transcranial direct current stimulation on the exciteability of the leg motor cortex
Exp Brain Res. 2007 Sep: 182 (2): 281-7. Epub 2007 Aug 24
Jeffery DT, Norton JA, Roy FD, Gorassini MA

Repeated sessions of noninvasive brain DC stimulation is associated with motor function improvement in stroke patients
Restor Neurol. Neuroscience. 2007; 25 (2): 123-9
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Short and long duration transcranial direct current stimulation (tDCS) over the human hand motor area
Exp Brain res. 2008 Feb; 185 (2): 279-86. Epub 2007 Oct 17
Furubayashi T, Terao Y, Arai N, Okabe S, Mochizuki H, Hanajima R, Hamada M, Yugeta A, Inomata-Terada S, Ugawa Y.

Improvement of spatial tactile acuity by transcranial direct current stimulation
Clin Neurophysiology. 2008 Jan 17; [Epub ahead of print]
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MOVEMENT DISORDERS

Noninvasive cortical stimulation with transcranial direct current stimulation in Parkinson's disease
Mov Disord. 2006 Oct; 21(10): 1693-702.
Fregni F, Boggio PS, Santos MC, Lima M, Vieira AL, Rigonatti SP, Silva MT, Barbosa ER, Nitsche MA, Pascual-Leone A.

Homeostatic-like plasticity of the primary motor hand area is impaired in focal hand dystonia
Brain. 2005 Aug;128(Pt 8):1943-50.
Quartarone A, Rizzo V, Bagnato S, Morgante F, Sant'Angelo A, Romano M, Crupi D, Girlanda P, Rothwell JC, Siebner HR.

Transcranial direct current stimulation in two patients with Tourette syndrome
Mov Disord. 2008 Sep 11.
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PAIN

Recent advances in the treatment of chronic pain with non-invasive brain stimulation techniques
Lancet Neurol. 2007 Feb; 6 (2): 188-91
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Site-specific effects of transcranial direct current stimulation on sleep and pain in fibromyalgia: a randomised, sham-controlled study
Pain Pract. 2007 Dec; 7 (4): 297-306. Epub 2007 Nov 6.
Rozenblatt S, Fregni F, Gimenez R, Wetzel T, Rigonatti SP, Tufik S, Boggio PS, Valle AC

Transcranial direct current stimulation over somatosensory cortex decreases experimentally induced acute pain perception
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Cathodal transcranial direct current stimulation of the visual cortex in the prophylactic treatment of migraine
Cephalalgia. 2011 Mar 11. [Epub ahead of print].
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A randomized, sham-controlled, proof of principle study of transcranial direct current stimulation for the treatment of pain in fibromyalgia
Arthritis Rheum. 2006 Dec;54(12):3988-98.
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A sham-controlled, phase II trial of transcranial direct current stimulation for the treatment of central pain in traumatic spinal cord injury
Pain. 2006 May;122(1-2):197-209.
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SOCIAL SCIENCE

Studying the Neurobiology of Social Interaction with Transcranial Direct Current Stimulation the Example of Punishing Unfairness
Cereb. Cortex. 2007 Dec 24; [Epub ahead of print]
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STROKE

Enhancing the working memory of stroke patients using tDCS
Am J Phys Med Rehabil. 2009 May;88(5):404-9.
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Transcranial direct current stimulation of the unaffected hemisphere in stroke patients
Neuroreport. 2005 Sep 28;16(14):1551-5.
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Improved naming after transcranial direct current stimulation in aphasia
J Neurol Neurosurg Psychiatry. 2008 Apr;79(4):451-3.
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Interhemispheric Competition After Stroke: Brain Stimulation to Enhance Recovery of Function of the Affected Hand
Neurorehabil Neural Repair 2009; 23; 641-56.
Nowak DA, Grefkes C, Ameli M and Fink GR.

Transcranial Direct Current Stimulation in Stroke Recovery
Arch Neurol 2008, 65 (12): 1571-76.
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WORKING MEMORY/ LANGUAGE

Time-dependent effect of transcranial direct current stimulation on the enhancement of working memory
NeuroReport. 2008 Jan 8; 19 (1): 43-7.
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VISUAL CORTEX / PARIETAL CORTEX

Bidirectional modulation of primary visual cortex excitability: a combined tDCS and rTMS study
Invest Ophthalmol Vis Sci. 2007 Dec; 48 (12): 5782-7
Lang N, Siebner HR, Chadaide Z, Boros K, Nitsche MA, Rothwell JC, Paulus W, Antal A.

Gender-specific modulation of short-term neuroplasticity in the visual cortex induced by transcranial direct current stimulation
Vis Neurosci. 2008 Jan-Feb; 25(1): 77-81
Chaieb L, Antal A, Paulus W.

Cathodal transcranial direct current stimulation over the parietal cortex modifies facial gender adaptation
Ideggyogy Sz. 2007 Nov 30; 60 911-12): 474-9
Varga ET, Elif K, Antal A, Zimmer M, Harza I, Paulus W, Kovacs G

Cathodal transcranial direct current stimulation on posterior parietal cortex disrupts visuo-spatial processing in the contralateral visual field
Exp Brain Res. 2008 Jan 15; [Epub ahead of print]
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