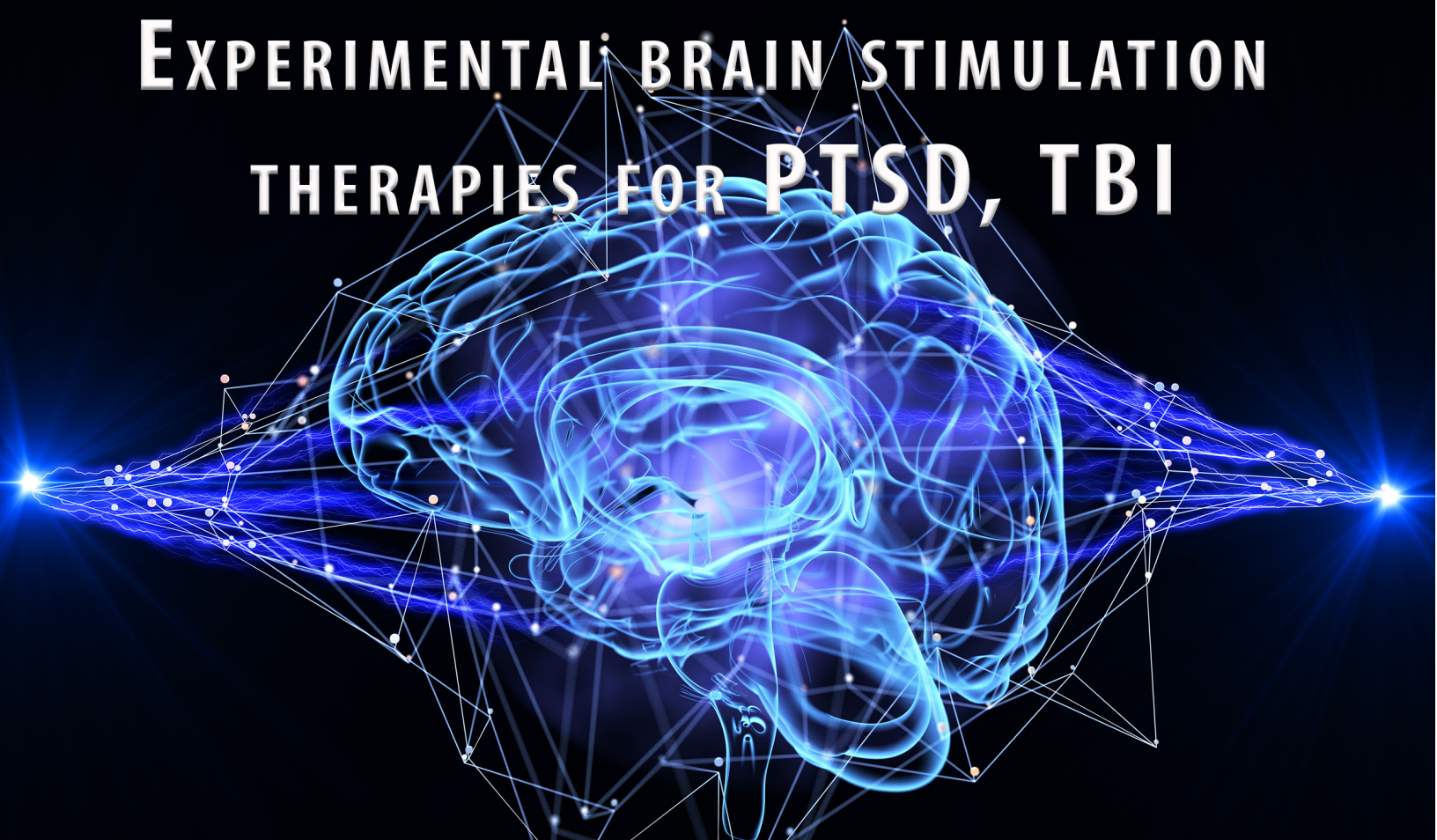
Experimental brain stimulation therapies for PTSD, TBI



In recent decades, multiple forms of brain stimulation have been tested to treat mental disorders that do not respond to other treatments. These therapies, most of which are non-invasive, involve activating or deactivating areas of the brain with electrical or magnetic stimulation. The Food and Drug Administration (FDA) has approved certain kinds of brain stimulation to treat such disorders as anxiety, depression, epilepsy, obsessive-compulsive disorder, Parkinson's disease, and insomnia. The FDA hasn't approved brain stimulation techniques for the treatment of traumatic brain injury (TBI) and PTSD. Here are some techniques that VA researchers are experimenting with to treat those two conditions:

Transcranial direct current stimulation (tDCS) or transcranial alternating current stimulation (tACS)

How it works: A small amount of electrical current is applied to the scalp via two or more electrodes—at least one positive and one negative. Placement of the electrodes is based on the desired outcome of the stimulation. Positive and negative electrical currents are transmitted to the brain, making brain cells more likely or less likely to be active.

Potential side effects: Most common are a tingling or itching sensation during stimulation and redness at the site of the electrodes. Headaches, a slightly metallic taste, and mood changes can also occur. The most severe is skin irritation or a small skin burn under the electrodes, but that is rare.

Example of VA clinical trial: Transcranial direct current stimulation may modulate extinction memory in posttraumatic stress disorder

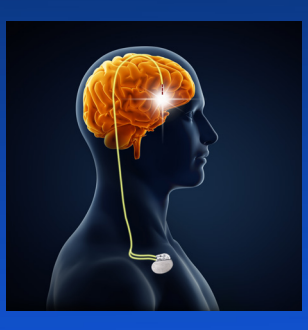
Transcutaneous vagus nerve stimulation (tVNS)

How it works: This works by electrical stimulation of the auricular branch of the vagus nerve, which stimulates the skin of the ear canal, as well as the tragus and auricle, two other parts of the ear. An electrode attached to a stimulator is placed in the ear. Typically, 30-second electrical pulses are sent about every five minutes from the stimulator to the vagus nerve, which transmits those signals to the brain. The procedure lasts about 20 minutes.

Potential side effects: Similar to those of tDCS/tACS, namely slight pain or a burning, tingling, or itching sensation under the electrodes

Example of VA clinical trial: Non-invasive Vagal Nerve Stimulation and Sleep

Deep brain stimulation (DBS)

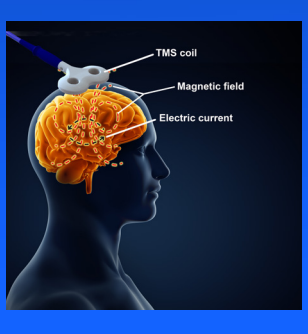


How it works: In this invasive technique, two electrodes are implanted in the brain and are controlled by a generator that is placed in the chest. The electrical stimulation is continuous, and its frequency and level are customized for the patient, who is fully sedated for part of the procedure.

Potential side effects: Lightheadedness, headache, and temporary pain and swelling are some of the more common side effects. The more severe ones include seizure, stroke, and excessive bleeding caused by damage to blood vessels, but they are rare.

Example of clinical trial in VA: Deep Brain Stimulation of the Amygdala for Combat Post-Traumatic Stress Disorder

Transcranial magnetic stimulation (TMS)

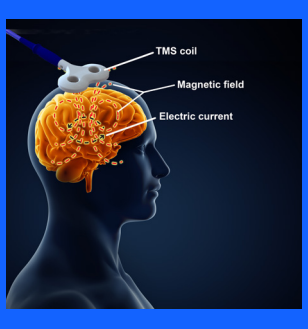


How it works: Large magnetic coils are positioned just above the scalp over the desired stimulation area. A TMS machine causes the coils to change direction, producing short magnetic pulses. These pulses produce an electric current in neurons in the brain through electromagnetic induction.

Potential Side Effects: Most common are facial twitching and scalp discomfort at the site of stimulation. Headache and lightheadedness can also occur. The most severe side effect is a seizure, which is rare.

Example of clinical trial: Transcranial Magnetic Stimulation (TMS) to Treat mTBI and PTSD

Repetitive transcranial magnetic stimulation (rTMS)

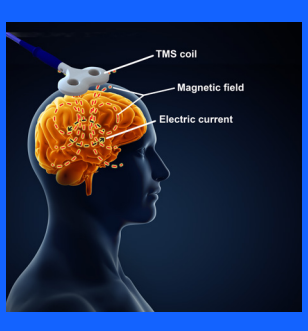


How it works: This procedure and TMS are very similar. But unlike TMS, the speed at which the magnetic coils change direction in rTMS increases to microseconds. This creates "repetitive" electromagnetic pulses that produce a stronger electric current in neurons. Due to the increase in strength, rTMS can produce changes in the brain that last longer than those induced by TMS.

Potential side effects: (Same as with TMS)

Example of VA clinical trial: Transcranial Magnetic Stimulation for Post-Traumatic Stress Disorder

Inhibitory or continuous theta burst TMS (iTBS or cTBS).



How it works: TBS, a relatively new form of transcranial magnetic stimulation, is patterned after rTMS. TBS has several advantages over rTMS, including its ability to deliver the same amount of electromagnetic pulses in a much shorter time frame, and its stimulation pattern that can affect key brain regions involved in PTSD. With TBS, treatment time can be reduced to 10 to 15 minutes, making the procedure much more tolerable for patients. Regular TMS can take 45 minutes for the same amount of stimulation.

Potential side effects: (Same as with TMS or rTMS)

Example of VA clinical trial: Theta-Burst Neuromodulation for PTSD (TBS)

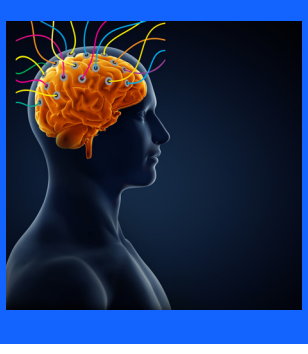
Transcranial light-emitting diodes (LEDs) or LED light therapy

How it works: Patients wear a helmet lined with light-emitting diodes, a device that allows a current to pass through. The diodes apply red and near-infrared light to the middle, front, and sides of the head. The light is painless and generates no heat. The LED therapy has been shown to increase blood flow to the brain and has an apparent effect on damaged brain cells, specifically their mitochondria, which are units within a cell that emit energy. A treatment takes about 30 minutes.

Potential side effects: The most common ones—headache, nausea, and irritability or agitation—are usually mild and short-lasting.

Example of VA clinical trial: LED Light Therapy to Improve Cognitive & Psychosocial Function in TBI-PTSD Veterans

Low-intensity, pulsed-based transcranial electrical stimulation (LIP-tES)



How it works: This procedure includes stimulation techniques such as IASIS, FENS, and LNS. Electrodes applied to the scalp deliver weak electrical currents, with the goal of reducing abnormal brain waves that can lead to TBI and PTSD symptoms.

Potential side effects: Similar to those of tDCS/tACS

Example of VA clinical trial: A pilot treatment study for mild traumatic brain injury: Neuroimaging changes detected by MEG after low-intensity pulse-based transcranial electrical stimulation.

Sources

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