

You patients may ask you about...

Transcranial Magnetic Stimulation or Neuromodulation for Depression

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In October 2008, the FDA approved the use of an “experimental investigative” treatment approach for major depression: transcranial magnetic stimulation (TMS). It has been approved in Canada since 2006. Unlike other and still experimental neuromodulation techniques such as *deep brain stimulation* and *vagus (vagal) nerve stimulation*, TMS does not necessitate surgery nor the implantation of electrical stimulators. No electrodes are used, either. It will also likely be perceived as less dramatic and frightening than ECT, which requires general anesthesia, a continuous oxygen supply, and applies electricity directly to the brain to induce 30-second seizures. Added to TMS’s appeal is the absence of antidepressant’s iatrogenic symptoms: weight gain, sedation, sexual dysfunction.

TMS uses *electromagnetic induction* to generate a weak electrical current through the insulating tissues of the scalp and skull with no or little discomfort. Housed inside the plastic casing is an 8-shaped ferromagnetic coil. When the device is powered on, electricity is directed to a large capacitor (also called a “condenser”), which stores an electrical charge. When the capacitor discharges, it produces an intermittent magnetic pulse in the coil similar in intensity to an MRI (1.5 -2 teslas). The magnetic field is constant during a MRI; during TMS, it lasts milliseconds, is focused and repeated. The coil is usually placed on the left side of the scalp, the site of the left dorsolateral prefrontal cortex. No actual contact with the skull is necessary. These rapid repetitive series of reversing magnetic fields passes unimpeded through skin and bone and generates a weak current to the area of the cerebral cortex and distally to other neurocircuits. The exact neuro-electromagnetic impacts are difficult to discern because the brain mass is not a uniform conductor of electricity. In theory, this process aims to stimulate brain neurons in regions that modulate mood, perhaps by potentiating sustained synaptic efficiency.

The outpatient procedure may involve 6 weeks of 2 or more daily sessions of 30-40 minutes. Generally, the patient is able to quickly resume everyday activities. The protocol is likely to change over time as clinical researchers refine the dosage and placement efficacy. We do not know at this juncture the durability of any improvements or whether periodic maintenance treatments might be advised to prevent relapse.

The FDA ruling applies only to adult patients whose major depression has not satisfactorily responded to at least one adequate antidepressant medication trial. Only a single TMS device has been approved so far, the NeuroStar, manufactured by Neuronetics Inc. To locate a nearby TMS provider, check out the Neuronetics website, www.NeuroStarTMS.com or call 877-600-7555.

The basic technology for using electromagnetic induction to create brain currents has only been around for a decade or so. The initial use was by neurologists who would use a single pulse to the primary motor cortex as a diagnostic aid in assessing the intactness of neuropath ways in patients who had a stroke, spinal cord injury, multiple sclerosis or motor neuron disease.

The research on human volunteers subjected to thousands of TMS pulses has shown little effect on the body. Animals studies similarly reveal no discernible structural effect on brain tissue. The most common side-effects are transient headaches, scalp discomfort at the site of stimulation, tingling, spasms or twitching of facial muscles, lightheadedness, and discomfort from noise during treatment. Early trials were associated with some risk for seizure but the protocol has been modified and the reported incidence has been significantly mitigated. In rare cases, TMS is also considered to be a risk for mania and temporary hearing loss. No cognitive effects have been reported and hearing thresholds were not observed to have changed. Further longitudinal data will

be needed, of course, to discern any adverse long-term effects.

Exclusions for TMS are those patients who have recurring migraines, are pregnant, a family history of a seizure disorder, had neurosurgery, have a metal plate implanted in the skull, had a stroke or have a pacemaker. Current research suggests that TMS may be less effective with those whose depression has lasted for 4 or more years, older patients, and those with psychotic features.

An estimated 5% drop-out of TMS attributable to side-effects, compared to about 15% who cease taking their antidepressant medication for the same reason.

O'Reardon (2007) reported a Penn State study of 301 medication-free patients with major depression at 23 sites in US, Australia and Canada, the largest use of TMS as a stand alone treatment. Participants were included who had not responded to prior medication treatment. They received either active or sham TMS for 4-6 weeks. Those in active treatment improved with reduced symptoms at twice the rate of those in the sham sessions.

In a more recent study, half of the patients in the TMS reported significant improvement with a third a complete remission by the end of a six-week course of treatment (Demitrack, 2009). Other studies using sham-controls and various dependent measures similarly reported improvement up to 6 weeks (but less of a response for the most part than bilateral or unilateral ECT. It is important to note that patients with severe depression and those with a Major Depressive episode are generally considered to have a reduced placebo-effect .

For a good overview of the TMS research, see Sheila Dowd et al., *Transcranial magnetic stimulation for depression*, **Current Psychiatry** Dec 2008, Vol.7, No.12. Less technical and patient friendly information may be found on the Mayo Clinic's website (www.mayoclinic.com/health/transcranial-magnetic-stimulation). A video of the procedure can be found on the Neurostar website.

*O'Reardon JP, Solvason HB, Janicak PG, et al. Efficacy and safety of transcranial magnetic stimulation in the acute treatment of major depression: a multi-site randomized controlled trial. **Biological Psychiatry** 2007; **62**, 1208-16.

Demitrack, MA, Thase, ME. Clinical significance of transcranial magnetic stimulation (TMS) in the treatment of pharmaco-resistant depression: synthesis of recent data. *Psychopharm Bull.* 2009, 42(2): 5-38.

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