



# Transcranial magnetic stimulation

## Overview

Transcranial magnetic stimulation (TMS) is a noninvasive procedure that uses magnetic fields to stimulate nerve cells in the brain to improve symptoms of depression. TMS is typically used when other depression treatments haven't been effective.

This treatment for depression involves delivering repetitive magnetic pulses, so it's called repetitive TMS or rTMS.

## How it works

During an rTMS session, an electromagnetic coil is placed against your scalp near your forehead. The electromagnet painlessly delivers a magnetic pulse that stimulates nerve cells in the region of your brain involved in mood control and depression. It's thought to activate regions of the brain that have decreased activity in depression.

Though the biology of why rTMS works isn't completely understood, the stimulation appears to impact how the brain is working, which in turn seems to ease depression symptoms and improve mood.

There are different ways to perform the procedure, and techniques may change as experts learn more about the most effective ways to perform treatments.

## Why it's done

Depression is a treatable condition, but for some people, standard treatments aren't effective. Repetitive TMS is typically used when standard treatments such as medications and talk therapy (psychotherapy) don't work.

## **Risks**

Repetitive TMS is a noninvasive form of brain stimulation used for depression. Unlike vagus nerve stimulation or deep brain stimulation, rTMS does not require surgery or implantation of electrodes. And, unlike electroconvulsive therapy (ECT), rTMS doesn't cause seizures or require sedation with anesthesia.

Generally, rTMS is considered safe and well-tolerated. However, it can cause some side effects.

## **Common side effects**

Side effects are generally mild to moderate and improve shortly after an individual session and decrease over time with additional sessions. They may include:

- Headache
- Scalp discomfort at the site of stimulation
- Tingling, spasms or twitching of facial muscles
- Lightheadedness

Your doctor can adjust the level of stimulation to reduce symptoms or may recommend that you take an over-the-counter pain medication before the procedure.

## **Uncommon side effects**

Serious side effects are rare. They may include:

- Seizures
- Mania, particularly in people with bipolar disorder
- Hearing loss if there is inadequate ear protection during treatment

More study is needed to determine whether rTMS may have any long-term side effects.

## **How you prepare**

Before having rTMS, you may need a:

- **Physical exam** and possibly lab tests or other tests
- **Psychiatric evaluation** to discuss your depression

These evaluations help make sure that rTMS is safe and a good option for you.

Tell your doctor or mental health provider if:

- **You're pregnant** or thinking of becoming pregnant.
- **You have any metal or implanted medical devices** in your body. In some cases, people with metal implants or devices can have rTMS. However, due to the strong magnetic field produced during rTMS, the procedure is not recommended for some people who have the following devices:
  - Aneurysm clips or coils
  - Stents
  - Implanted stimulators
  - Implanted vagus nerve or deep brain stimulators
  - Implanted electrical devices, such as pacemakers or medication pumps
  - Electrodes for monitoring brain activity
  - Cochlear implants for hearing
  - Any magnetic implants
  - Bullet fragments
  - Any other metal device or object implanted in your body
- **You're taking any medications**, including prescription or over-the-counter medications, herbal supplements, vitamins or other supplements, and the dosages.
- **You have a history of seizures** or a family history of epilepsy.
- **You have other mental health disorders**, such as substance misuse, bipolar disorder or psychosis.
- **You have brain damage from illness or injury**, such as a brain tumor, a stroke or a traumatic brain injury.
- **You have frequent or severe headaches.**

- **You have any other medical conditions.**
- **You've had prior treatment with rTMS**, and whether it was helpful in treating your depression.

## **Before your first appointment**

Repetitive TMS isn't invasive, doesn't require anesthesia and can be performed on an outpatient basis. You don't need to arrange for someone to drive you home after treatment — unless, for the first treatment, you prefer a driver until you get a sense of how you'll feel afterward.

Before considering treatment, check with your health insurance company to see whether rTMS is covered. Your policy may not cover it.

## **What you can expect**

Repetitive TMS is usually done in a doctor's office or clinic. It requires a series of treatment sessions to be effective.

Generally, sessions are carried out daily, five times a week for four to six weeks.

## **Your first treatment**

Before treatment begins, your doctor will need to identify the best place to put the magnets on your head and the best dose of magnetic energy for you. Your first appointment typically lasts about 60 minutes.

Most likely, during your first appointment:

- **You'll be taken to a treatment room**, asked to sit in a reclining chair and given earplugs to wear during the procedure.
- **An electromagnetic coil will be placed against your head** and switched off and on repeatedly to produce stimulating pulses. This results in a tapping or clicking sound that usually lasts for a few seconds, followed by a pause. You'll also feel a tapping sensation on your forehead. This part of the process is called mapping.
- **Your doctor will determine the amount of magnetic**

**energy needed** by increasing the magnetic dose until your fingers or hands twitch. Known as your motor threshold, this is used as a reference point in determining the right dose for you. During the course of treatment, the amount of stimulation can be changed, depending on your symptoms and side effects.

## **During each treatment**

Once the coil placement and dose are identified, you're ready to begin. Here's what to expect during each treatment:

- **You'll sit in a comfortable chair**, wearing ear plugs, with the magnetic coil placed against your head.
- **When the machine is turned on**, you'll hear clicking sounds and feel tapping on your forehead.
- **The procedure will last about 40 minutes**, and you'll remain awake and alert. You may feel some scalp discomfort during the treatment and for a short time afterward.

## **After each treatment**

You can return to your normal daily activities after your treatment. Typically, between treatments, you can expect to work and drive.

## **Results**

If rTMS works for you, your depression symptoms may improve or go away completely. Symptom relief may take a few weeks of treatment.

The effectiveness of rTMS may improve as researchers learn more about techniques, the number of stimulations required and the best sites on the brain to stimulate.

## **Ongoing treatment**

After completion of an rTMS treatment series, standard care for depression — such as medication and psychotherapy — may be recommended as ongoing treatment.

It's not yet known if maintenance rTMS sessions will benefit

your depression. This involves continuing treatment when you are symptom-free with the hope that it will prevent the return of symptoms.

However, if your depression improves with rTMS, and then later you have another episode of symptoms, your rTMS treatment can be repeated. This is called re-induction. Some insurance companies will cover re-induction.

If your symptoms improve with rTMS, discuss ongoing or maintenance treatment options for your depression with your doctor.

By Mayo Clinic Staff

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TMS is a non-invasive method of brain stimulation that relies on electromagnetic induction using an insulated coil placed over the scalp, focused on an area of the brain thought to play a role in mood regulation. The coil generates brief magnetic pulses, which pass easily and painlessly through the skull and into the brain. The pulses generated are of the same type and strength as those generated by magnetic resonance imaging (MRI) machines. When these pulses are administered in rapid succession, it is referred to as “repetitive TMS “ or “rTMS”, which can produce longer lasting changes in brain activity.

rTMS has been shown to be a safe and well-tolerated procedure that can be an effective treatment for patients with depression who have not benefitted from antidepressant medications or cannot tolerate antidepressant medications due to side-effects. TMS was FDA-cleared in 2008 and now is widely available at clinics and hospitals across the country.

When people think of treatment for brain disorders like depression, the first course of treatment that usually comes to mind is medication. But along with medication comes many unpleasant side effects and with each subsequent attempt at finding the most effective medication treatment plan the chances of remission decrease. Medication aims to stimulate the brain chemically, but the brain can also safely be stimulated electrically using magnetic fields with transcranial magnetic stimulation (TMS). You can learn about how TMS treatment works and how to choose between the two most common types – surface TMS and deep TMS.

## What is Transcranial Magnetic Stimulation (TMS)?

Transcranial magnetic stimulation (TMS) is a type of brain stimulation therapy that has been successful in treating a variety of brain disorders but is most commonly used for major depression. TMS is medication-free but can also be used in conjunction with antidepressants when used to treat depression. In the U.S., there are two main options for TMS – NeuroStar’s surface TMS and BrainsWay’s deep TMS.

TMS improves neurological functioning by stimulating activity in underactive regions of the brain that are contributing to a particular brain condition. Both types of TMS use magnetic energy pulses aimed at specific regions of the brain

believed to affect various brain disorders. Magnetic pulses going into your brain might sound scary, but actually they are the same type and strength as the magnetic pulses used in MRI machines and are considered very safe. These magnetic pulses pass through the skull and stimulate brain cells which can improve communication between different parts of the brain.

## Approved and promising uses for TMS

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In the U.S., TMS is FDA approved to treat major depressive disorder in adults. In many European countries it is approved for a multitude of other common brain conditions including:

- Anxiety
- Post-Traumatic Stress Disorder
- Stroke after-effects
- Bipolar depression
- Schizophrenia
- Parkinson's Disease
- Alzheimer's Disease
- Chronic pain
- Nicotine addiction

TMS has even shown promise in treating more conditions such as, tinnitus, fibromyalgia, Tourette syndrome, autism spectrum disorder, multiple sclerosis and more. Currently in the U.S. TMS is being used off-label to treat many more conditions than it is FDA approved for and the studies are showing promising results.