



**Pain Relief Foundation**

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## Transcranial Magnetic Stimulation

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### **What is transcranial magnetic stimulation (TMS)?**

TMS is a method that is used to pass a series of magnetic pulses through a coil of copper wire that is encased in plastic and held over the subject's head. This coil resembles a paddle or a large spoon and is held in place by the investigator. A magnetic field is generated in the coil by allowing an electric current to pass through the coil. The resulting magnetic field passes through the subject's scalp and skull and in turn generates a tiny current in the person's brain.

### **What is the purpose of TMS?**

TMS is used to activate certain brain areas that are linked to pain relief. Neurosurgeons in some centres implant electrodes to lie over the motor cortex to help to reduce pain caused by damage to nerve, spinal cord or brain. It is thought that low-intensity stimulation of the motor cortex activates leads to activation of other areas of the brain that are able to control pain. At the Pain Relief Foundation's Pain Research Institute we are researching the use of TMS with aiming to help a number of difficult-to-treat chronic pain conditions. In pain following spinal cord injury, amputation and stroke and similar conditions the uppermost layer of the brain, cortex, has undergone some changes which have led to the development of new circuits. These circuits do not have any useful purpose and may cause the pain to become chronic. These circuits may be maladaptive in that they maintain the symptoms. There is good reason to believe that such circuits can be changed back to normal. For example, regular mental imagery can revert such circuits back to normal or near-normal. TMS is aimed at inducing a similar positive change.

### **What happens during TMS?**

You will be seated comfortably and your head will be resting on a padded support. You will be asked

to wear a head tracker device, resembling a pair of large spectacles, from which an infrared beam is sent to an optical reader placed some feet away. Further infrared tracking is created by the operator touching your nose and ears with an infrared pen for landmarking purposes. The tracking information is passed on to the computer that already has your MRI scan uploaded. The computer can now calculate the coordinates of the brain area the operator intends to target. The method for this is similar to that used in Sat Nav devices. By moving the TMS coil the operator can send magnetic pulses into a pre-selected site in the brain and activate it within 2mm accuracy. There will be a clicking noise associated with the current passing in the coil, but the effect of the magnetic field and the induction of current in the brain are not painful. However, some discomfort may occur from the contraction of scalp muscles or the activation of nearby nerves.

If the target for the stimulation is in that part of the brain that controls movements of your hand or foot, we will measure the response by placing electrodes over 1-2 muscles. The electrodes are small (1 cm in diameter) plastic discs that stick to the skin and are painless. The operator will give you single TMS pulses that are strong enough to provoke a tiny muscle twitch on the foot or hand. When therapeutic TMS is given, the intensity is kept low and you will not experience any muscle twitching.

Therapeutic TMS is referred to as repetitive TMS (rTMS). This is because it is given in sets of 100 pulses given over 10 seconds. Up to 20 sets may be given in one session. The exact number of sets is determined individually.

### **Which painkillers are no longer recommended / available?**

You are likely to be offered 5 or 6 sessions, each lasting approximately 30 minutes. The first session will be longer because the preparation will take longer. The stimulation itself lasts between 10 and 20 minutes.

### *What can I expect from the treatment?*

This depends on the condition you have. If you are suffering from chronic pain you may expect pain relief 2-3 days after each session. The duration of benefit usually increases after each session. However, the effect is usually measured in days or weeks only. Because of this, you may be asked to practice mental imagery on a regular basis at home that mimics the effect of TMS. If you are being treated for arm weakness after stroke, you will be asked to do regular home exercises in the week between sessions.

### **Do I need to prepare for this treatment in any way?**

No preparations are needed. At your first visit we will assess your suitability for TMS. There are very few conditions that make you ineligible for TMS. You must be over 16, not be pregnant, not have a cardiac pacemaker, not wear a cochlear implant, and not have a brain or high spinal cord stimulator in place. If you have had epileptic fits ever, we can only perform TMS if your doctor agrees. The same applies to a history of drug or alcohol abuse, or if you have severe heart disease. If you are currently on central nervous system medications we will decide on a case by case basis whether it is advisable to offer you TMS.

### **Are there any safety concerns?**

TMS is generally considered safe but there are some safety issues you should know about. There are international guidelines that have been in force since 1998, upgraded in 2009, which we rigorously follow. Although not noisy, the TMS causes an artefact that mimics the effect of high volume noise on the ears and therefore you will be asked to wear earplugs. Any change in hearing is likely to be mild and virtually always transient. Some subjects feel a little dizzy or may have a slight headache afterwards but these very rarely require any treatment. Some patients have experienced and epileptic fit after TMS. Since guidelines have been in force, they have become very rare. A recent review reported only 2 cases of epileptic fit in thousands of sessions of TMS. We believe the risk exists but is very small. The operators have been trained to deal with a fit should it occur. It should be underlined that there is not one single report of a person in whom TMS triggered or caused epilepsy. The way we do TMS uses parameters that are among the safest.

Should an epileptic fit happen during TMS session you would be helped and monitored until you have completely recovered from it. It is very unlikely that you would need observation in the hospital. If you have a driving licence, you are by law required to inform DVLA. There is no strict advice available about what happens next, and DVLA will deal with each case on an individual basis. After having heard from their Medical Advisor, you may be asked to return your driving licence to DVLA. If you have a group 1 licence and you are asked to surrender it, you can get it back after 6 months, provided that you have been assessed by an appropriate specialist, and investigations such as an EEG or brain scan are normal.

### **Is TMS an approved treatment for chronic pain?**

No, the treatment is still considered experimental and only available for those who participate in research studies. TMS equipment is available in several laboratories and NHS hospitals but is not yet used as a routine treatment.

### **What is the current evidence that TMS is effective in chronic pain?**

In the last 5 years several research studies have been published that show that motor cortex rTMS is efficacious in controlling neuropathic pain and fibromyalgia. These studies have been conducted without the use of brain navigation; instead the investigators have relied on muscle responses triggered with single pulse TMS. It remains to be determined if brain navigation with its superior ability to target the magnetic pulses accurately has a greater effect on pain. Also, what is not known is how long pain relief is maintained in those who respond initially.

### **I have severe chronic pain. Are there alternative treatments available?**

Yes, and your doctor will be able to detail them. Alternative treatments include medication and neurosurgical procedures. Much of management of chronic pain is supervised by GPs. Your GP will determine if a referral to a specialist is likely to be helpful.

*I would like to take part in an ongoing research study. Where does the TMS treatment take place?*  
The research is conducted in the Pain Relief Foundation's Sensory-Motor Laboratory, located in the **Clinical Science Centre**, Lower Lane, Liverpool L9 7AL (next door to the Walton Centre

NHS Foundation Trust hospital). If you decide to take part, and your GP is agreeable, you will be sent an appointment for the treatment, and with the letter there are directions and other details enclosed.

### **Where can I get more information about TMS?**

The ELATA Foundation, a charity supporting research on the effect of TMS on depression, has an informative website at:  
[www.elata.org/index.shtml](http://www.elata.org/index.shtml).

Two Pain Relief Foundation's experts on TMS (Dr. Paul Sacco and Professor Nurmikko) will be able to ask any questions either via e mail ([psacco@liverpool.ac.uk](mailto:psacco@liverpool.ac.uk) ; [tjn@liverpool.ac.uk](mailto:tjn@liverpool.ac.uk) ) or by phone (0151 529 5820).

