THE ULTIMATE GUIDE TO TMS THERAPY [2020]

This is the complete guide to Transcranial Magnetic Stimulation therapy in 2020. In this guide you will learn all you need to know all about TMS therapy. Step by step! To simplify it, I divided this guide into chapters. I used questions and answers format to make it interactive. Let's start with a list of content then we will dive in.

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Chapter 1: Introduction To Clinical Depression

In the next chapter we will cover the fundamentals of TMS Therapy. First, you'll learn more about clinical depression. Then we will discuss a more "stubborn" form of depression called TRD or treatment resistant depression. Then you will learn about the current treatments available for depression. Then we will explain why TMS therapy provides hope for those suffering from treatment resistant depression.

What is clinical depression?
Depression is one of the worst disorders one could have. Unfortunately depression can't be diagnosed with a lab test or a brain scan. It is challenging to relate the silent suffering a depressed patient experiences on a daily basis. This adds more to the feeling of loneliness which is one of the symptoms of this disorder. The current DSM-V includes the following as criteria for major depressive disorder:

To diagnose a major depressive episode, the individual must be experiencing five or more symptoms during the same 2-week period and at least one of the symptoms should be either (1) depressed mood or (2) loss of interest or pleasure.

1. Depressed mood most of the day, nearly every day.
2. Markedly diminished interest or pleasure in all, or almost all, activities most of the day, nearly every day.
3. Significant weight loss when not dieting or weight gain, or decrease or increase in appetite nearly every day.
4. Decreased sleep or excessive sleep.
5. A slowing down of thought and a reduction of physical movement (observable by others, not merely subjective feelings of restlessness or being slowed down).
6. Fatigue or loss of energy nearly every day.
7. Feelings of worthlessness or excessive or inappropriate guilt nearly every day.
8. Diminished ability to think or concentrate, or indecisiveness, nearly every day.
9. Recurrent thoughts of death, recurrent suicidal ideation without a specific plan, or a suicide attempt or a specific plan for committing suicide.

Can depression and anxiety happen together?
Depression is commonly associated with other psychiatric disorders, particularly anxiety. This warranted a subtype or a specifier of depression referred to as Major Depressive Disorder with Anxious Distress Features.

Severity of Depression:

The severity of depression is broken down into mild, moderate, and severe. These quantifiers depend largely on the severity of symptoms and the functional impairment caused by depression. Functional impairment can be on one's social life (relationships, family..etc) or productivity (school, work.. etc).

How serious is depression?
Contrary to the general belief, depression has a significant impact on public health. According to the World Health Organization depression is the number one cause of disability in the world. {https://www.who.int/news-room/fact-sheets/detail/depression} Globally, more than 264 million people of all ages suffer from depression. Close to 800 000 people die due to suicide every year. Suicide is the second leading cause of death in 15-29-year-olds. Not only depression is a leading cause of disability worldwide but also it is a major contributor to the overall global burden of disease. There are interrelationships between depression and physical health. For example, cardiovascular disease can lead to depression, and depression can lead to worse outcomes of heart disease. The same can be said about diabetes, stroke, hypertension.. etc.

Is there a depression test?
Many depression tests had been developed over the years. The most commonly used are PHQ-9, MADRS, and HAM-D. Some of these tests are used for screening and some for follow up. Such tests are necessary to evaluate patients who could be candidates for TMS therapy.

Are women more likely to get depression than men?
Yes. Women are more likely than men to experience major depressive disorder. Women are also more likely to attempt suicide than men. That being said, men are more likely to die of suicide than women.

How to treat depression?
Mild depression is treated with psychotherapy or what is commonly referred to as talk therapy. Examples of effective psychotherapies include; Cognitive Behavioural Therapy (CBT), Interpersonal Therapy (IPT), Mindfulness-Based Cognitive Therapy (MBCT), and Acceptance and Commitment Therapy for Depression (ACT-D). Moderate to severe depression requires to be treated with psychotherapy as above in addition to medication antidepressants. Common antidepressants from the class of Selective Serotonin Reuptake Inhibitors or SSRIs are the first-line treatment. This includes medications like; Celexa, Lexapro, Paxil, Prozac, Zoloft. Other classes of medications include Serotonin and Norepinephrine reuptake Inhibitors or SNRIs like; Effexor, Pristiq, and Cymbalta. Some other antidepressants are used alone or in combination for augmentation with the above like; Wellbutrin, Remeron, Buspar. Also, we use mood stabilizers and antipsychotics for the reason of augmentation in some cases of severe depression like; Seroquel, Abilify, and Rexulti.

What are the side effects of antidepressant drugs?
The list is too long and some side effects are more common in a particular antidepressant than others. The most common side effects include stomach issues, diarrhea, dry mouth, headache,

dizziness, emotional numbness (feeling like a zombie), weight gain and sexual side effects. We found that weight gain and sexual side effects to be the most common reason for patients to stop taking their medications. This could result in the worsening of the depression either because of the side effects or because of discontinuing the medication.

How successful are antidepressants?
Unfortunately, antidepressants are not very successful. The success rate of antidepressants medications is about one in three. When combining medications and therapy together we may be able to get about half the patients better from the first attempt.

What happens to those who don't respond to the first attempt of antidepressants?
Those who don't respond to the first antidepressant can be tried on another. The chances of response drops significantly the more we try. To be more specific, it drops from 27% to 21% to 16% and finally to 6.9% by the fourth attempt. This means that about one-third of depressed patients are not going to respond to talk therapy and antidepressant medications. This is called Treatment Resident Depression.

What is Treatment Resident Depression or TRD?
The definition of TRD depends on the source. In clinical trials, failure of response to one antidepressant medication is considered Treatment Resistant Depression. By CMS criteria, failure of two antidepressants is considered Treatment Resistant Depression {https://www.cms.gov/Medicare/Coverage/DeterminationProcess/downloads/id105TA.pdf}. Lastly, some insurance companies rely on outdated guidelines from 2006 to claim their own criteria for treatment resistant depression to be the failure of 4 antidepressants.

How to treat Treatment Resistant Depression or TRD?
There are three major treatments that are currently available for TRD.

1. TMS or Transcranial Magnetic Stimulation. TMS is the most benign out of the three.
2. ECT or Electroconvulsive Therapy. Commonly referred to as shock therapy.
3. Esketamine. A derivative of the party drug; Ketamine.

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Chapter 2: The Basics Of TMS Therapy

What is Transcranial Magnetic Stimulation Therapy?
TMS or Transcranial Magnetic Stimulation is a new treatment for depression that uses pulsating magnates to stimulate parts of the brain believed to be responsible for depression. The activation of the brain cells requires the repetition of this magnetic pulse. Hence it is sometimes called repetitive Transcranial Magnetic Stimulation or rTMS. Transcranial Magnetic Stimulation

is a non-invasive outpatient treatment for depression. In TMS we use a magnetic pulse to stimulate areas of the brain connected to depression circuits.

Who qualifies for TMS Therapy?
TMS therapy qualifications are commonly set by insurance companies. Generally speaking insurances are finding the benefit of TMS therapy to be superior to medications. They are lowering the previously seen as very strict criteria to qualify for TMS. Below I listed the main 3 points of criteria:

Criteria #1
Diagnosis of severe depression in the current episode measured by a depression rating scale.

Criteria #2
Failure of medication antidepressants.

Some insurances require failure of 4 antidepressants: United, New Directions, Humana
Some insurances require failure of 2 antidepressants: Aetna, Cigna, Anthem, Medicare, Tricare

Criteria #3
Two Classes of antidepressants.

Some insurances require the antidepressants to be from 2 different classes. For example and SSRI like Prozac and an SNRI like Effexor

Criteria #4
Augmentation treatment

Some insurances require augmentation treatment. This means two antidepressants or an antidepressant with a mood stabilizer.

Criteria #5
Failure of psychotherapy.

How does Transcranial Magnetic Stimulation work?
A depressed brain is hypoactive in certain areas. TMS stimulates these certain areas of the brain. This will cause a cascade of brain circuits activation that results in certain brain circuits that used to be sleepy to wake up. Obviously, the science behind it is more complicated. This novel mechanism of action is referred to as neuroplasticity.

A magnetic coil is placed in contact with the patient’s forehead. The magnet painlessly delivers a magnetic pulse that stimulates nerve cells in the region of your brain involved in mood control and depression. More specifically, this area of the brain is called the Dorsolateral Prefrontal Cortex or DL-PFC. It's thought that the left DL-PFC is hypoactive in depressed patients and

activating this regain of the brain can result in the improvement of depressive symptoms and even complete recovery in many cases.

How is TMS Therapy Performed?
TMS therapy is performed in outpatient settings. There is no sedation required. There are no restrictions required before or after the treatment sessions. Patients can drive themselves after the TMS treatment session.

What should I expect during my TMS treatment?
During your first session, you will be seated on a comfortable chair in a very relaxing room. The TMS psychiatrist will perform your brain mapping and motor threshold determination. Mapping will specify the exact location to deliver the magnetic pulse. Also, mapping will specify the exact dosage (intensity) of the treatment required. Once that's done, you will be receiving your first TMS.

How do I spend my time during my treatment sessions?
It is advised that you stay awake during treatment sessions. Researchers are currently looking into the combination of cognitive behavioral therapy with TMS to augment the antidepressant effect. You are more than welcome to invite your therapist to come join you during your sessions. Also, there has been a boom in therapy apps on smartphones that could be helpful to invest your time in. Lastly, you will have access to a 65' 4K TV so you can watch your favorite channel, YouTube or Netflix. We recommend that you watch, read or listen to things that bring joy, happiness, and peace. Please avoid watching the news, action movies, thriller movies, or scary scenes.

What does TMS feel like?
There is a simple tapping sensation on the side of the head during TMS. Some patients describe it as a "woodpecker" sensation on the side of the head. Most get used to it in a matter of minutes. It becomes like ambient noise and patients don't notice it after a while. This is called habituation. Only about 5% of patients report discomfort of the head during the treatment.

What is Motor Threshold Determination or Mapping?
During your first session, you will be seated on a comfortable chair in a very relaxing room. The doctor will perform your brain mapping and motor threshold determination. This will specify the exact location to deliver the magnetic pulse. Also, it will specify the exact dosage (intensity of the magnetic pulse) for your treatments. To do this, the doctor will be giving one pulse at a time at the motor cortex until the spot that moves the patient's thumb is identified. A few more pulses will be delivered at different intensities until the best magnetic pulse intensity is identified. This is referred to as the Motor Threshold. The next step will be determining the treatment target which is measured as 5.5 cm anterior to the spot identified in the previous step. Once that's done, you will be receiving your first TMS for the duration based on your protocol. You will notice that your first TMS session is going to be longer than the following sessions. This is because of the time needed for the mapping.

Who performs Transcranial Magnetic Stimulation?
The first session for the motor threshold determination and brain mapping is performed by a psychiatrist trained in TMS Therapy. The following sessions are performed by a medical assistant directly trained and supervised by the psychiatrist.

How long does Transcranial Magnetic Stimulation take?
A TMS session could last anywhere from 3 minutes to 37 minutes. To be more specific,

- rTMS session takes 19 minutes with newer TMS devices and 37 minutes with older TMS devices
- dTMS session takes 20 minutes
- iTBS session takes 3 minutes or 9 minutes if doing SAINT accelerated TMS protocol

How many sessions TMS Therapy requires?
TMS therapy schedule could vary based on the indication and the protocol used. Generally it is between 20 to 36 sessions.

The typical schedule of TMS therapy for depression is 30 sessions. We follow that with 6 sessions of taper off. The schedule is usually as follows:

- One session a day, 5 days a week for 6 weeks.
- Then one session a day 3 days a week in week #1.
- Then one session a day 2 days a week in week #2.
- Then one session in week #3.

The typical schedule of accelerated TMS therapy for depression is 10 sessions a day for 5 days for a total of 50 sessions.

How long does the effect of Transcranial Magnetic Stimulation last for?
About two out of three patients will maintain their response or remission 6-12 months after TMS. About one third could see a return of depressive symptoms.

What is the indication to repeat TMS?
TMS can be repeated again if depression returns. Generally, we would want to see a response by a decrease of depression rating scale score of 50% to consider a second treatment course. The chances of response with the second TMS therapy course of treatment is very good (78% to 84%).

What is maintenance TMS?
Some patients may require maintenance TMS therapy after their initial or repeated treatment course. It can keep patients from relapsing again into depression after their initial treatment. Maintenance TMS therapy could be once a week for a while then once every two weeks.

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Chapter 3: The Indications For TMS Therapy

Though depression is the main indication for TMS therapy, there are many other uses for TMS therapy. Below I will walk you through most of the current TMS therapy uses, both FDA-cleared and off-label uses.

What is Transcranial Magnetic Stimulation used for?
TMS therapy is indicated for the treatment of Major Depressive Disorder in adult patients who have failed to receive satisfactory improvement from prior antidepressant medication in the current episode. Also recently TMS therapy got FDA-approval for treatment of OCD in adult patients who have failed to receive satisfactory improvement from prior treatments. TMS is used off label for many other psychiatric disorders like anxiety and PTSD.

When is Transcranial Magnetic Stimulation used?
TMS Therapy is used when talk therapy and antidepressant medications fail to achieve a satisfactory improvement in depressive symptoms. This means that as of 2020 TMS is reserved for severe cases of depression.

Does Transcranial Magnetic Stimulation work for depression?
Yes. In fact, It works better than any antidepressant for those suffering from Treatment Resistant Depression or TRD. About two out of three patients respond to TMS therapy. About one third will experience a remission of their depressive symptoms.

Does Transcranial Magnetic Stimulation work for anxiety?
Yes. We have plenty of data to support the effectiveness of TMS for anxiety treatment. That being said, TMS is not FDA-approved for anxiety. That is because the anxiety trials were not large enough. Low-frequency right-sided TMS therapy is used for anxiety.

Does TMS work for other psychiatric conditions?
The main ones now are Depression, Anxiety, OCD. The current focus is headed towards PTSD, ADHD, Bipolar, and Schizophrenia. Also, TMS there are data supporting the use of TMS for addiction like cocaine.

Does Transcranial Magnetic Stimulation work for OCD?
Yes. A particular type of TMS called Deep Transcranial Magnetic Stimulation is FDA approved for OCD. It is done using a machine called BrainWay with a particular H7 coil.

Does TMS Therapy work for Bipolar Disorder?
Bipolar Disorder is basically the combination of depression and mania. Many bipolar patients can experience long periods of severe depressive episodes. TMS can be used during severe depressive episodes that don't respond to medication treatment. That being said, there might be a risk of inducing a manic episode. Close monitoring is very important. The FDA recently in March 2020 granted a TMS device breakthrough designation for bipolar depression.

Does Transcranial Magnetic Stimulation work for Postpartum Depression?
Yes. TMS can be helpful in postpartum depression. There is no contraindication for TMS in the postpartum phase or with breastfeeding mothers.

Does Transcranial Magnetic Stimulation work for depression during pregnancy?
Depression could happen during pregnancy not only postpartum. That's why we are using a new terminology now for depression related to pregnancy as peripartum depression. The answer is yes. TMS can be used during pregnancy. The initial clinical trials for TMS excluded pregnant women, later trials looked into the safety and efficacy of TMS during pregnancy and no absolute contraindication was reported.

Does Transcranial Magnetic Stimulation work for PTSD?
Probably. There are many studies that investigated the use of TMS to treat PTSD. Most showed good results. Some used the same depression protocol of high frequency Left DL-PFC stimulation and others used a different protocol with low-frequency TMS to the right DL-PFC (commonly used for anxiety). That being said. TMS is not FDA-cleared for PTSD for the lack of a large enough randomized controlled trial.

Does Transcranial Magnetic Stimulation work for ADHD?
It is being studied. Some results are promising. It needs further investigation though.

Does Transcranial Magnetic Stimulation work for Autism?
Possibly. We have some data for the use of low frequency transcranial magnetic stimulation for the treatment of mild cases of Autism.

Does Transcranial Magnetic Stimulation work for Tinnitus?
Possibly. There was a study that was done at the VA that showed some promise in TMS for tinnitus. That being said, all patients should use earplugs for hearing protection. Exposure to chronic noise could cause hearing loss or tinnitus. This is different from the use of TMS to treat tinnitus which works on neuromodulation of the hearing centers of the brain.

Does TMS work for Smoking Cessation?
Yes. Preliminary data are currently being revealed proving the effect of TMS for smoking cessation. This will be huge as cigarette smoking is the number one preventable mortality cause

in the USA. Helping patients quitting smoking with TMS will open the door wide open for the general public acceptance of majestic therapy or neuromodulation.

Does TMS Therapy help with Fibromyalgia?
There are some data that support the use of TMS for fibromyalgia and central chronic pain. It is worth noting that Theta Burst Stimulation or iTBS seems to have more success for fibromyalgia and chronic pain.

Does TMS Therapy help with Migraine Headache?
There is a single pulse TMS device (eNeura) that has FDA-clearance for migraine headaches. It is different from the device we use for depression which is repetitive transcranial magnetic stimulation.

Can Repetitive Transcranial Magnetic Stimulation (rTMS) increase IQ?
It is certainly being evaluated for that. There had been a special interest in TMS for reasons of cognitive enhancement. Some trials are looking into performance enhancement with TMS among athletes and surgeons.

Any other indications for TMS?
TMS is evaluated for Insomnia, Chronic Pain, Fibromyalgia, Movement Disorders, Tinnitus. Also, there is a promise in the early stages of dementia.

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Chapter 4: The Effectiveness Of TMS Therapy

The success rate of TMS therapy is an important topic for anyone looking into TMS therapy for depression treatment. This is particularly true when we look at the high success rate reported in real-life clinical practices. You will learn the numbers of how successful TMS is. Please remember that TMS is a medical treatment. As you might have already guessed, there is nothing 100% in medicine. When you read that 58% of patients receiving TMS show a response, your mind might jump to ask about the 42% who did respond to the treatment. I would like you to keep the following points in your mind:

1. These numbers are our of randomized controlled trials to eliminate the effect of placebo to the best we could. Meaning the patients receiving the treatment wouldn't know whether they are receiving actual magnetic stimulation or just a machine that makes noise to make it sound as if they are receiving magnetic stimulation. This inherently will show a lower response rate when compared to open-label (actual real-life clinical practice).
2. Patients recruited in clinical trials usually have severe resistant depression. This means that the number of medication trials they had before is significantly high. Some are in the

20+ medication trials. That by itself tells you how severe and stubborn their depression is.

3. 58% is a great response rate when compared to antidepressants. To put it in perspective, The chances of improving with the first trial of a medication antidepressant is on 27%. By the fourth trial of antidepressants the chance of response plummets down to 6.9% only.
4. TMS therapy technology in evolving and improving. The reported success rate of 58% in 2007 and 67% in 2010 can be lower than what we have nowadays especially with navigated accelerated TMS success rate. The later being 90% in 2019.

Is Transcranial Magnetic Stimulation effective?
The short answer is, Yes. It is effective for the treatment of certain psychiatric disorders. Currently the evidence is most obvious in Depression, Anxiety, and OCD.

How effective is Transcranial Magnetic Stimulation?
All TMS therapy studies had shown a good success rate. The main pivotal randomized controlled trial that was submitted for FDA approval in 2007 showed that 58% of patients showed a response and 37% of patients had a remission after 30 treatment sessions of TMS. An NIH sponsored trial in 2010 showed a similar outcome. Many other randomized controlled trials replicated the same outcome. Nowadays, it is a given that TMS is effective for depression.

What is the success rate of TMS Therapy?
TMS research had shown great results. Especially when compared with the low success we have with medications. In randomized controlled trials the success rate ranges from ⅔ to ½ of patients receiving TMS. In open-label trials, when people know for fact that they are actually receiving the TMS therapy, the response rate is higher. It is worth mentioning that accelerated TMS therapy showed a 90% response rate in SAINT-TRD trial {https://www.biorxiv.org/content/10.1101/581280v3}. We at Florida TMS Clinic have achieved this high success rate with accelerated TMS {https://www.floridatmsclinic.com/accelerated-tms}.

Is Transcranial Magnetic Stimulation FDA-approved?
Currently, TMS therapy is FDA-cleared for two psychiatric disorders:

1. TMS therapy is indicated for the treatment of Major Depressive Disorder in adult patients who have failed to receive satisfactory improvement from prior antidepressant medication in the current episode. Also recently
2. TMS therapy also FDA-approval for the treatment of OCD in adult patients who have failed to receive satisfactory improvement from prior treatments.

If TMS treatment is so effective, why isn't it tried before medication?
Usually we would reserve a more expensive treatment option to be second-line treatment. That's why the initial trials for TMS (2007) included patients who failed one or more antidepressants. For this reason the FDA approved it for treatment resistant depression based on the data they had. This doesn't mean it won't work as a first-line treatment.

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Chapter 5: The Contraindications And Side Effects of TMS Therapy

This won't be a complete guide to TMS therapy without talking about the risks that could be associated with TMS. Obviously, just like anything in medicine, every treatment has its own benefits and risks. Knowing the pros and cons of TMS Therapy should help you make a better decision about choosing TMS over other depression treatment options.

What are the absolute contraindications for TMS?
The main absolute contraindication for TMS therapy is the presence of a movable ferromagnetic intracranially (inside the head). In other words if someone has a brain stent, clip or stimulator then they should not be receiving TMS therapy. There are other relative contraindications for TMS that will require further evaluation with the doctor before TMS therapy.

What are the relative contraindications for TMS?
The list of contraindications includes a history of seizure, head injury, brain surgery, any metal in the head (outside of mouth) such as shrapnel, surgical clips, or fragments. Implanted devices such as pacemakers. The presence of any of the above warrants further investigation and discussion with the doctor to evaluate the benefits vs the risks of TMS therapy.

Is Transcranial Magnetic Stimulation safe?
For the right patient the answer is; Yes. TMS is one of the safest treatments currently available for depression aside from talk therapy. TMS therapy has proven safety and efficacy in many clinical trials.

What are the negative side effects of TMS Therapy?
The most common side effect of TMS therapy is scalp irritation or discomfort. It is reported in about 5% of patients and it usually goes away after a few sessions. It can be avoided by starting the magnetic stimulation intensity low and going up slow.

Can TMS therapy cause seizures?
Yes. Though it is very rare, TMS therapy can induce a seizure. It is estimated to happen in 1/30,000 treatments. Considering that each patient is getting about 30 sessions. This is estimated to happen at the rate of 0.1%. That chance is one in a thousand. To put this in perspective, one of the antidepressants; Wellbutrin is estimated to cause seizures in 0.4% which is four in a thousand. In other words, some medications have more risk to induce seizures

than TMS. That being said, every patient undergoing TMS therapy should have a full evaluation by a TMS psychiatrist to screen for medical issues and current medications that could alter the risk of seizures.

Is Transcranial Magnetic Stimulation painful? Does TMS hurt?
For most patients the answer is; No. TMS doesn't hurt for the vast majority of people. Pain is subjective. About 5% of patients treated with TMS report head discomfort in the first 4-5 sessions. It mostly goes away as they get used to the treatment. A very small minority of patients could experience a tension headache. This usually goes away in 30 minutes to 2 hours. In some cases Tylenol or Ibuprofen can be helpful. It can be avoided by starting the magnetic stimulation intensity low and increasing gradually.

What does Transcranial Magnetic Stimulation feel like?
It simply feels like a woodpecker on the side of the head. As the patient is basically laying in a spa-like chair watching Netflix, most of the time this feeling disappears in the background after a few minutes.

Does TMS Therapy cause Migraine?
TMS could cause mild head discomfort in about 5% of patients. Rarely some patients could experience a headache. It is usually more of a tension-type of headache not a migraine headache. Also, there is a single pulse TMS device that is actually FDA-cleared for migraine headache treatment. See the section for TMS Therapy Uses above.

Does TMS Therapy cause hearing loss?
Constant exposure to loud noise could cause some hearing damage. It is highly recommended that patients wear earplugs during their TMS sessions to avoid hearing loss. In fact, we ask all of our patients to do so. Earplugs decrease the level of noise by about 30 dB which puts it in the safe range.

Does TMS Therapy cause brain damage?
No. TMS doesn't cause brain damage. This is assuming that all the screening measures are taken. Meaning there are no contraindications to the magnetic treatment. In other words, there are no ferromagnetic metals of stents in the brain.

Does TMS Therapy cause memory loss?
There is no clinical evidence that TMS causes memory loss. On the other hand, there is clinical evidence to the contrary. Many are looking into the use of TMS for cognitive enhancement and treatment of early dementia.

Does TMS Therapy cause insomnia?
Not directly. To the contrary, many patients report improvement in sleep after a few sessions. There are trials looking into using TMS for insomnia.

Does TMS Therapy cause lucid dreams?
Possibly. Some patients report lucid dreams especially in the first week of treatment. We don't have reports of nightmares though.

Can TMS Therapy be done with dental implants?
Yes. For the vast majority of cases, TMS therapy can be performed with dental implants. Please share with your TMS doctor where and what dental implants you have to discuss more and monitor.

Can TMS Therapy be done with a heart pacemaker?
Possibly but with extra care, TMS can be done with a cardiac pacemaker. It requires a very detailed evaluation. Coordination with the cardiologist and electrophysiologist to make sure the pacer and battery interrogated recently. We also would need to contact the manufacturer (Medtronic for example), depending on the model, they might recommend and send us a "shield".

Can TMS Therapy be done with a brain pacemaker?
No. TMS is contraindicated with brain pacemakers. Brain pacemakers are used for deep brain stimulation in some cases of refractory Parkinson's disease and respiratory depression.

Can you have TMS Therapy if you have a Spinal Cord Stimulator?
Yes, one can have TMS with a spinal stimulator. Assuming the stimulator in the thoracic or lumbar spine. i
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Chapter 6: TMS Therapy Protocols And Machines

Thanks to the advancement in Transcranial Magnetic Stimulation technology, TMS had evolved significantly throughout the years. It continues to improve in technology and protocols. In this chapter I will tell you about the history of TMS. How it evolved over the years, where are we today with the technology and what is coming for the future.

When Was TMS Invented?
Basically in 1985. The first attempts to make a clinical TMS machine were done in the UK. The first clinical TMS device was very basic and it was only made for single-pulse stimulation. It was designed to treat movement disorders and was used by neurologists then.

Who Invented TMS?

Dr. Anthony Barker from the UK. In 1985, Drs. Barker, Jalinous, and Freeston reported the first demonstration of TMS. Dr. Barker and colleagues produced twitching in a specific area of the hand in human volunteers by applying TMS to the motor cortex in the opposite hemisphere that controls the movement of that muscle. Dr. Barker is awarded for his discovery and recognized internationally {https://www.elsevier.com/about/press-releases/research-and-journals/dr.-anthony-t.-barker-wins-first-international-brain-stimulation-award} In the United States though, Dr. Mark George is the one to thank for bringing this medical technology to the United States. He is one of the pioneers to bring the use of TMS to behavioral science. He continues to be a leader in the field today {https://www.bbrfoundation.org/about/people/mark-s-george-md}

What is rTMS?

Repetitive Transcranial Magnetic Stimulation or rTMS is the traditional TMS as we know it today. It uses a figure of 8 coil (the coil has two donuts attached to each other which makes it look like the number 8). The coil is placed on a prespecified location of the head. The magnetic coils will deliver magnetic pulses on and off at specific intervals. The pulses are called “trains” and the intervals are called “Inter-train intervals”. A typical rTMS treatment session would consist of 75 trains each train lasting for 4 seconds. The breaks in between the trains (inter-train interval) could be set to 26 seconds or 11 seconds. This depends on the cooling system utilized. Older TMS machines take longer to cool and newer ones take less time to cool. This means that an rTMS session could last between 37 minutes to 19 minutes. Typically 30 sessions are required. Sometimes followed by 6 sessions for tapering off.

What is deep TMS or dTMS?

Deep Transcranial Magnetic Stimulation or dTMS is similar to rTMS in the general principle of magnetic stimulation but different in shape of the coil that delivers the treatments. While rTMS uses a figure-of-8 coil for a focal point of stimulation, dTMS uses an H shaped coil. This coil is housed in a spherical helmet that is placed on the patient head. The main goal is to deliver more magnetic stimulation deeper in the brain. dTMS is used for depression and OCD.

Which TMS is better rTMS or dTMS?

The answer is the following; both rTMS and dTMS are effective for the treatment of depression. dTMS is more proven for the treatment of OCD. That being said, the question of rTMS vs dTMS is difficult to answer. One has to consider that dTMS uses higher frequency and higher energy output than rTMS. This can make it less of an “apple to apple comparison”. What we know for fact is that both are effective for the treatment of depression.

What is iTBS?

Intermittent Theta Burst Stimulation or iTBS is delivered via a figure-of-8 coil just like rTMS. No helmet is needed. The duration of the treatment is much shorter though. Theta Burst Stimulation uses triplet pulses at a higher frequency to deliver unique, high energy frequency to stimulate the DL-PFC. This can be achieved with only 20 trains of stimulation each train lasting for 2 seconds with 8 seconds between trains. In other words, an iTBS session can be done in just

about 3 minutes. For this reason it is referred to as Express TMS or 3-minute TMS. iTBS is as effective as rTMS. This was proven in a large clinical trial called THREE-D. {https://pubmed.ncbi.nlm.nih.gov/29726344/}

Which TMS is better rTMS or iTBS?
When it comes to rTMS vs iTBS the answer is, they are both as effective. This is based on a large clinical trial called THREE-D {https://www.ncbi.nlm.nih.gov/pubmed/29726344} that showed a similar response rate and remission rate between the two TMS protocols.

What is Navigated TMS or nTMS?
Navigated Transcranial Magnetic Stimulation utilizes 3D spatial cameras to track the patient head positioning and the TMS coil. The software will calculate in real-time the movement of the patient's head and the TMS coil. The treater will be alerted if the coil is not positioned appropriately. This increases the precision of the coil placement.

Which TMS is better Naviagated TMS or Blind TMS?
In clinical research, there was no significant difference between the navigated vs non-navigated TMS. That being said, researchers are usually excellent at where they place the coil "blindly" without the use of 3D navigation guidance. In real life, you are the mercy of the work level of experience of the treater. In our practice, we notice that patients move on average 3 times per TMS session. This means that we detect and make adjustments to the coil placement frequently. Other TMS centers don't have a reliable method to detect movement and adjust accordingly. Which means the brain target can be missed.

What is Accelerated TMS or Accelerated iTBS?
This is a very exciting development in the field of neuromodulation. Accelerated TMS means the delivery of multiple sessions of TMS a day. This could be as many as 10 sessions a day. It shortens the total duration for the treatment to 5 days only. It might also be more effective than regular TMS. Accelerated TMS had shown a 90% remission rate {https://med.stanford.edu/news/all-news/2020/04/stanford-researchers-devise-treatment-that-relieved-depression-i.htm}. This is surprisingly good news. It could mean that we are one step closer towards fast and effective treatment for one of the most difficult disorders to treat.

Which TMS is better: regular daily TMS or accelerated TMS?
Accelerated TMS is very promising. Mainly because it cuts the time to achieve relief from depression significantly. We are talking about 5 days instead of 6 weeks. But not only that, the open-label trial that we have now shows better outcomes than any open-label trial investigating all other forms of TMS. 90% remission rate is as good as it gets in the world of psychiatry. That being said more research is needed to make the final call on which one is superior.

What are the FDA-cleared TMS machines available in the US?

Currently there are 7 FDA cleared manufacturers that have TMS machines available for clinical use in the United States. These are: NeuroStar, BrainsWay, MagStim, MagVenture, NexStim, Mag&More and CloudTMS.

I have written a detailed article explaining each of the TMS systems mentioned above. Please click here to read it.

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Chapter 7: TMS Therapy Alternatives

To be completely informed, you need to know about all the alternatives out there for TMS therapy. In this section I am not going to talk about classical antidepressants and talk therapy as these are alternatives to TMS therapy. We will only discuss the treatment options available for TRD or Treatment Resistant Depression.

What are the alternatives to TMS therapy?
There are three treatment options that are FDA-approved for treatment resistant depression:

1. ECT which is electroconvulsive therapy. AKA Shock Therapy.
2. TMS which is Transcranial Magnetic Stimulation
3. EsKetamine or Spravato.

Is Transcranial Magnetic Stimulation Shock Therapy?
The answer is absolutely not. There is a big confusion out there thinking that TMS is the same as shock therapy. TMS is not shock therapy. There is no shock at all in TMS. Shock therapy is ECT or Electroconvulsive Therapy. In ECT, an electrical shock is delivered to the brain to induce a therapeutic brain seizure. This is done in hospital settings and under sedation. This is not how TMS works. TMS basically uses what we know with Faraday's law of induction. We know that a magnetic field can induce a micro-electrical current. With a focused magnetic field we can activate the brain cells by inducing these micro-electrical currents. So basically TMS gives us most of the end results we want from ECT without the side effects that come from ECT.

How does TMS compare to ECT?
For starters, TMS is not shock therapy. So TMS doesn’t involve inducing a therapeutic seizure. Therefore TMS doesn’t require that we put the patient to sleep. So no sedation or anesthesia of any kind. TMS is done in an outpatient doctor’s office setting. No need for a hospital visit like ECT. Patients can drive into the clinic for TMS therapy and drive themselves back. While with ECT and because of the sedation, patients will need someone to drive them back. Memory loss is a common side effect with ECT. TMS doesn’t cause any memory loss or any cognitive

decline. To the contrary, there is evidence that TMS can improve memory and cognition. There is a growing interest in the preventive and therapeutic use of TMS for early dementia.

Which one is better: ECT or TMS?
It depends on what we are treating. For depression without psychosis, both TMS and ECT are effective. But for depression with psychotic features then ECT is better.

What are the main side effects of ECT?
Memory loss, cognitive decline, side effects relative to anesthesia and seizure.

What is Ketamine and S-ketamine?
Ketamine is a dissociative anesthetic that is used in anesthesia for humans (rarely nowadays and animals (veterinary medicine). It was a popular party drug in the 70s and 80s. It causes dissociation like feeling “K-Hole”. It primarily blocks NMDA receptors. IV ketamine had been used to treat TRD. Recently Esketamine (Spravato) received FDA approval for TRD.
How is Esketamine given?
Spravato or Esketamine is an intranasal spray administered under medical supervision. Patients need to be monitored in the medical office for 2 hours after the administration of Esketamine. It is given twice a week for 4 weeks then weekly thereafter.

What are the side effects of Ketamine and Esketamine?
Dissociation, nausea, and vomiting. Rare but high-risk side effects are cardiovascular, like hypertension and tachycardia.

Which one is better: TMS or Esketamine?
Almost always TMS. Basically, because it is more effective and much safer. Also TMS is more convenient as patients spend about 20 minutes per session while Spravato requires 2 hours hold in the medical office after the dose is given.

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Chapter 8: The Cost Of TMS Therapy

Is Transcranial Magnetic Stimulation covered by insurance?
Yes. TMS therapy is covered by most major insurances. This includes United Healthcare, Blue Cross Blue Shield, Aetna, Cigna, Humana, Magellan, and Tricare.

Is Transcranial Magnetic Stimulation covered by Medicare?
Yes. TMS is covered by all federal insurances. This includes Medicare, VA, Tricare, Federal Workers compensation etc.

Is Transcranial Magnetic Stimulation covered by Medicaid?

It depends on the state. In some states's Medicaid covers TMS. Others don't. The best thing to do is to contact a TMS clinic nearby. They can contact your insurance on your behalf to find out if TMS covered under your policy or not.

What billing codes do you use for TMS services?
There are three billing codes for TMS services that your doctor will report to your insurance for reimbursement.

CPT Code 90867
Therapeutic repetitive transcranial magnetic stimulation (TMS) treatment; initial, including cortical mapping, motor threshold determination, delivery, and management.
Should be reported only once in a treatment course.

CPT Code 90868
Therapeutic repetitive transcranial magnetic stimulation (TMS) treatment; subsequent delivery and management, per session.
Typically reported up to 35 times in a treatment course.

CPT Code 90869
Therapeutic repetitive transcranial magnetic stimulation (TMS) treatment; subsequent motor threshold re-determination with delivery and management.
Typically reported 1-2 times in a treatment course.
Should not be reported with CPT Codes 90867, 90868.

How many TMS sessions are covered by insurance?
Typically up to 36 sessions per treatment course.

How soon can I receive TMS re-treatment after a successful first course?
Your insurances would want to see that improvement after TMS lasted for at least 2 months. Insurances vary on how soon they would cover for TMS retreatment. Some will cover it again after 3 months some after 6 months and some require a year between treatment courses.

How much does Transcranial Magnetic Stimulation cost?
The average cost per remission for TMS therapy is $6,146. This is based on a cost analysis study done in 2019. {https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6742475/}

Most insurances cover most of the cost of TMS therapy. Sometimes patients might have deductibles to meet and copays. If paying for TMS privately then the cost largely depends on the private pay fee schedule of that particular clinic. Some clinics offer a discounted rate for prompt private pay. So always ask for it. If you want to see the average cost of TMS in your particular zip code then use this tool provided by Fair Health Consumer using the CPT codes provided above {https://www.fairhealthconsumer.org/}.

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Chapter 9: TMS Therapy Resources

Where can I learn more about TMS?
If you are a patient and you are looking for TMS information beyond what's provided in this TMS guide, then you probably need to look into resources intended for doctors. An example would be the Clinical TMS Society {https://www.clinicaltmssociety.org/}.

Where can I find TMS reviews and testimonials?
There are plenty of testimonials on our google page. For national reviews on TMS then TMS+You is a website and forum where people share their TMS stories. There is an excellent autobiography book written by Martha Rhodes call "3,000 Pulses Later" which I find very helpful. There are currently two TMS support groups on Facebook where people share their experiences. I like the Facebook group under the name "TMS Therapy Support and Information". I find the admin and members more genuine and interested in answering questions. I often answer questions myself there when appropriate.

Where can I find a TMS clinic near me?
If you live in the Tampa Bay area then we compiled a list of all the TMS clinics available in the area.