كلية المستقبل الجامعة
قسم الفيزياء الطبية
المرحلة الرابعة

Medical Physics

Neurophysics

Lecture 7

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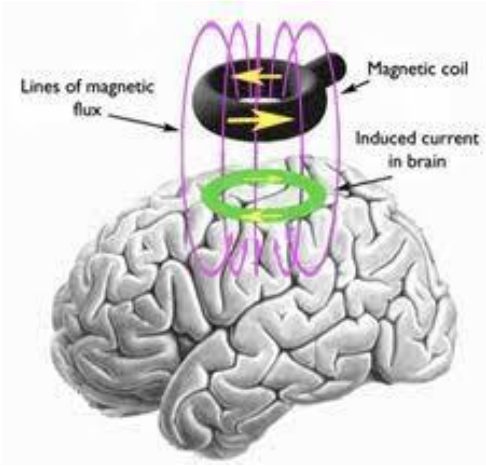
Neurological Disease Detection Devices:

Transcranial Magnetic Stimulation (TMS) :

TMS, which stands for 'transcranial magnetic stimulation', is a non-invasive method of stimulating the brain through applying a strong magnetic field to an individual's head. The electric field passes through the scalp and into the targeted brain region in order to induce action potentials .

TMS is generally considered a safe and painless method of non-invasive brain stimulation, and the technique has been used extensively in research and clinical applications since the 1980s .



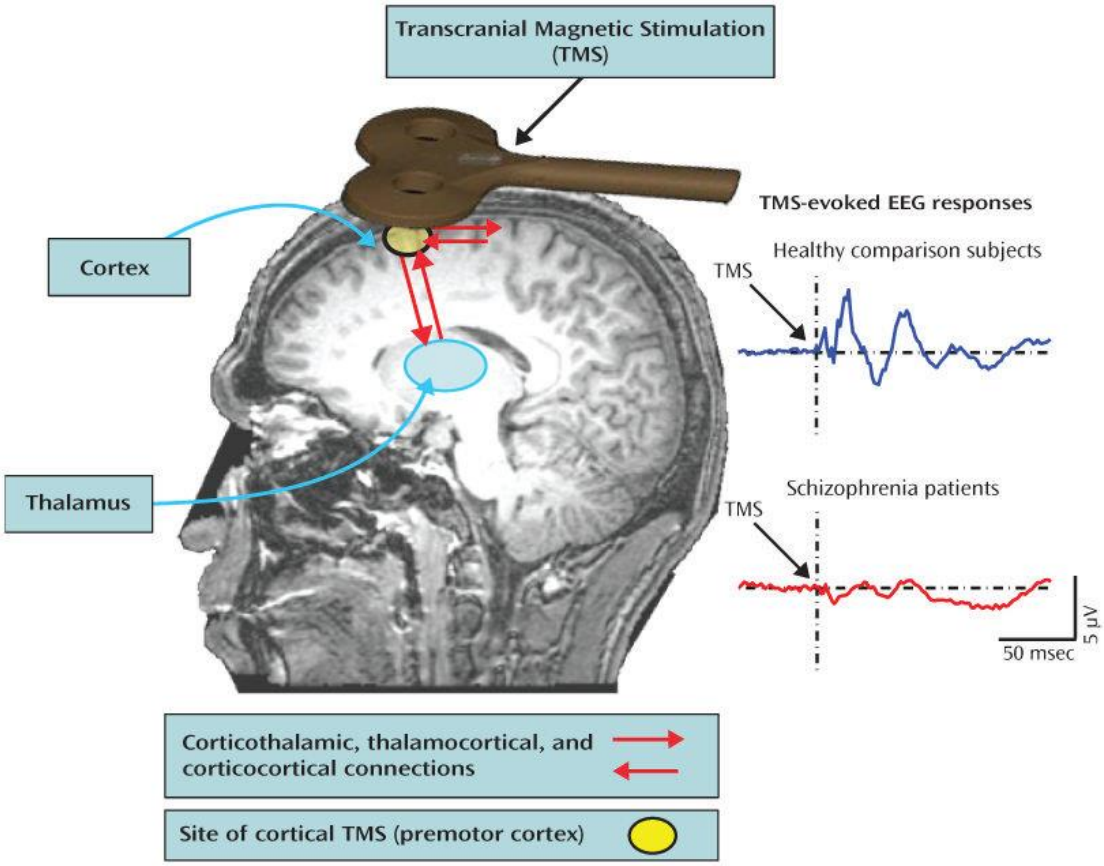
Transcranial magnetic stimulation (and repetitive transcranial magnetic stimulation (rTMS) in particular) are commonly used today in research exploring the technique’s effects on neurological diseases and conditions such as depression, Alzheimer's disease, Parkinson’s disease, migraine and more .

Types of TMS :

It is possible to deliver transcranial magnetic stimulation in a number of ways: from single-pulse TMS methods, up to complex quadripulse paradigms. Each different method of delivering TMS offers distinct advantages and disadvantages .

1- Single Pulse TMS :

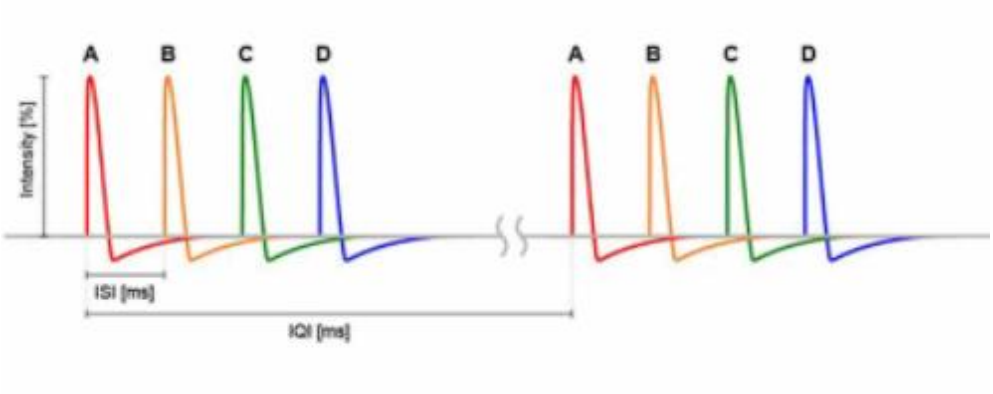
Single pulse TMS can be used to probe the chronometry of basic processes within the brain. can be delivered single pulses of TMS to the early visual cortex at specific intervals after a visual target .



2- Quadripulse Stimulation (QPS) :

Is a novel repetitive transcranial magnetic stimulation (rTMS) technique that can be used to increase or decrease cortical excitability1.

Four bursts of monophasic TMS, originating from four separate magnetic stimulators, are administered, with each QPS burst being separated by an inter-burst interval (IBI) of five seconds .



Uses of TMS :

The most robust and widely accepted use of TMS is in the measurement of the connections between the primary motor cortex and a muscle to evaluate damage in patients suffering from neurological diseases and conditions such as:

Stroke, multiple sclerosis, amyotrophic lateral sclerosis, movement disorders, motor neurone disease, migraine, and other injuries and disorders .

That affect the facial and cranial nerves and the spinal cord .

TMS Side Effects :

1- Headache .

2- Mild scalp discomfort at the stimulation site

3- Twitching or tingling of facial muscles

4- A feeling of lightheadedness

Mechanism of TMS :

Transcranial Magnetic Stimulation (TMS) can be used by neuroscientists to measure the activity and function of specific brain circuits in humans.

Through the placement of an electromagnetic coil on a patient's head, the TMS system can generate a very strong magnetic field that passes through the scalp and into the individual's targeted brain regions in order to induce action potentials in the subject .

Contraindications for TMS :

Although TMS is well tolerated by the vast majority of subjects, there are a number of important contraindications that should be considered. Transcranial magnetic stimulation should not be used in populations with:

1- Increased risk of, or susceptibility to, seizures .

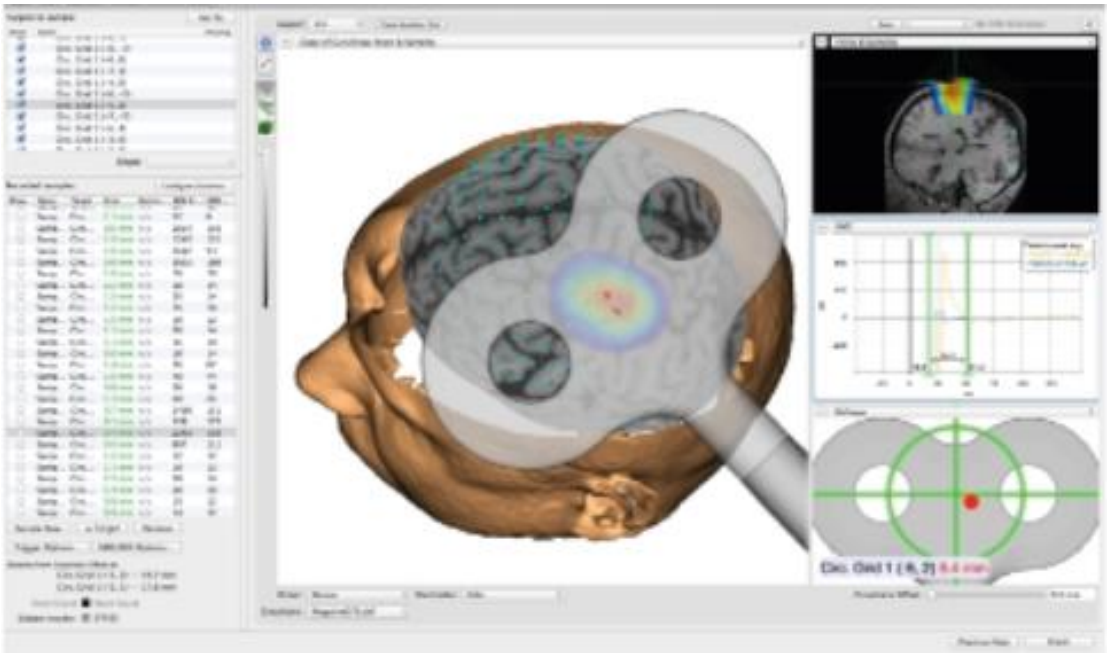
2- Implanted/internal metal hardware (surgical plates, screws, etc) .

3- Implanted medical electrical devices (cardiac pacemakers, medication pumps etc.)

Brainsight TMS Neuronavigation :

When using transcranial magnetic stimulation techniques, a researcher or clinician will generally need to target a very specific region of the brain.

While it is possible to target a brain region manually by using a direct reference on the subject's scalp, the effort of holding a - often fairly heavy - TMS coil for an extended period of time can cause the operator to gradually drift away from the intended site of stimulation .



To alleviate this, some researchers make use of digital neuronavigation systems - such as Brainsight TMS Neuronavigation - which allow the TMS coil's position relative to the patient's head to be tracked in real time.

Visual feedback delivered by the software can indicate immediately to the operator if they have moved away from their intended site of stimulation, and provides an easily-interpreted frame of reference to help them correct the positioning of the coil (**To correct brain region**) .