Determining motor threshold

Franziska Plessow, Ph.D.

Intensive Course in Transcranial Magnetic Stimulation,
06/21/2016
What are the learning objectives of this session?

1. What is motor threshold (MT)?
2. Why do we determine MT?
3. What types of MT can be determined?
4. What are the available methods to determine MT?
5. What are the key steps for determining resting MT with electromyography?

→ Hands-on practice
What is motor threshold (MT)?

- The minimum amount of machine output necessary to elicit a motor response in a participant or patient in at least 50% of all attempts.
- Represents membrane-related excitability of cortical axons.
- Depends on:
  - Inter- and intraindividual variance
  - Device (stimulator and coil)
  - Type of MT
  - Method of determination
  - Hemisphere stimulated
Why do we determine MT?

- Easy to observe
- Objective (e.g., phosphene threshold)
- Indicator of relative cortical excitability
- A way of calibrating and normalizing TMS coil output energy for inter- and intraindividual physiologic variability in experimental designs and therapeutic applications
- Determines dosage and safety limits
What types of MT can be determined?

Resting motor threshold (RMT) > Active motor threshold (AMT)
What are the available methods to determine MT?

- Visual inspection
- Electromyography (EMG)
RMT with EMG

- The minimum amount of machine output necessary to elicit a motor response in a participant or patient in at least 50% of all attempts

→ Minimum single-pulse stimulator output intensity resulting in motor evoked potentials (MEPs) of at least 50 μV peak-to-peak amplitude in ≥50% of n consecutive trials (≥5/10; Rossini-Rothwell method)

Determining motor threshold
What are the key steps for determining RMT with EMG?

1. Choosing an output target
2. Setting up and ensuring safety
3. Finding the “hot spot” (adjusting location)
4. Finding the MT (adjusting intensity)
1. Choosing an output target
1. Choosing an output target

Determining motor threshold
2. Setting up and ensuring safety
3. Finding the “hot spot”

≈5 cm lateral from the vertex

(Jaspers, 1958)
3. Finding the “hot spot”

≈5 cm lateral from the vertex

Determining motor threshold
3. Finding the “hot spot”
3. Finding the “hot spot”

1. Set intensity to 30% and deliver a couple of pulses
2. Go up in steps of 5% until MEPs are observed
3. Deliver several pulses to ensure a consistent response is evident (suprathreshold)
4. Test eight spots around the location of the MEP
3. Finding the “hot spot”

1. Set intensity to 30% and deliver a couple of pulses
2. Go up in steps of 5% until MEPs are observed
3. Deliver several pulses to ensure a consistent response is evident (suprathreshold)
4. Test eight spots around the location of the MEP
5. Repeat Step 4 until the individual’s “hot spot” is identified

Whatever you do, do it consistently.
4. Finding the MT

1. Record 10 MEPs
2. Progressively lower intensity until ≥5/10 runs show an MEP of ≥50 µV = MT (1-2%)
3. Continue until you have <5/10, then go one up again
4. Finding the MT

- Alternatives under time constraints:
  - $\geq 3/6$
  - Adaptive MT determination/Parameter estimation by sequential testing (PEST) with the TMS Motor Threshold Assessment Tool (clinicalresearcher.org)

- Trouble shooting:
  - No MEP detected (relaxation, AMT, silence period)
  - MEP latencies $> 150$ ms
  - Expectation
Thank you for your active participation and good luck for the rest of the week!

For further questions, contact me at any time:
Franziska Plessow
fplessow@mgh.harvard.edu