Determining motor threshold

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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 intensity** (% of maximum 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)
- Index of relative cortical excitability/reactivity
- 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

  → Rossini-Rothwell method:
  Minimum intensity to elicit motor evoked potentials (MEPs) of ≥ 50 μV peak-to-peak amplitude in ≥50% of consecutive trials (typically 10)

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
2. Setting up and ensuring safety

Determining motor threshold
Attaching EMG electrodes

Identify

Clean

Attach
3. Finding the “hot spot”

≈5 cm lateral from the vertex

(Jaspers, 1958)
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 5-10% until MEPs are observed
3. Deliver several pulses to ensure a consistent response is evident (suprathreshold)
4. Test four spots around the location of the MEP (north, east, south, west)
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 (1-2%) until ≥5/10 trials elicit an MEP of ≥50 μV (or visible twitch)
3. Always check 1 intensity lower
4. Finding the MT

- Alternatives under time constraints:
  - ≥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, silent period)
  - MEP latencies = 20-30 ms