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Title:

Effects of transcranial magnetic stimulation coil orientation and pulse width on short-latency afferent inhibition

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Abstract:

Purpose: We used a controllable pulse parameter transcranial magnetic stimulation (cTMS) device to assess whether adjusting pulse width and coil orientation would allow more selective stimulation of different neuronal populations.

Methods: Young healthy subjects participated in experiments involving single pulse stimulation over the hand motor area elicited by a cTMS device connected to a figure-of-eight coil. Experiment 1 (n=10) evaluated the effect of coil orientation (posterior-anterior, PA; anterior-posterior, AP) and pulse width (30, 60 and 120 μs) on the strength-duration curve, the input-output (IO) curve and the latency of the motor evoked potentials (MEPs) in the first dorsal interosseous muscle. Experiment 2 (n=12) evaluated the effect of coil orientations (PA, AP) and pulse width (30 and 120 μs) on short-latency afferent inhibition (SAI), tested with electrical median nerve stimulation at the wrist prior to TMS (inter-stimulus intervals: N20 latency +2 and +4 ms). All tests were completed during background contraction (~10% maximum).

Results: The mean strength-duration time constants were shorter for PA than AP directed currents when estimated using motor threshold data (231 vs. 294 μs; *t*-test, $p = 0.008$) and IO data (252 vs. 296 μs; *t*-test, $p < 0.001$). ANOVA revealed an interaction of pulse width and orientation on MEP latencies ($p = 0.001$), due mainly to the increase in latencies with short duration AP stimuli. A similar pulse width and orientation interaction was observed for SAI ($p = 0.011$), resulting from the stronger inhibition with AP stimuli of short duration.

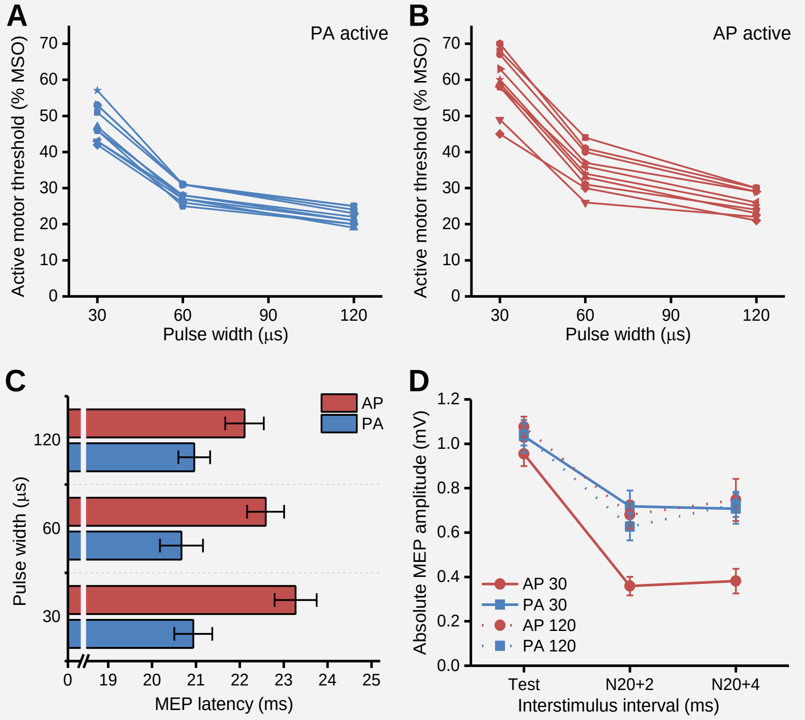

Figure 1. Effects of pulse orientation (posterior-anterior, PA, **A**; anterior-posterior, AP, **B**) and width (30 and 120 µs) on active motor threshold. Individual data shown. **C**, Effects of pulse orientation (posterior-anterior, PA; anterior-posterior, AP) and width (30 and 120 µs) motor evoked potential latencies. **D**, Effects of pulse orientation (posterior-anterior, PA; anterior-posterior, AP) and width (30 and 120 µs) on short-latency afferent inhibition. Test refers to unconditioned MEP, N20+2 and N20+4 refer to the intervals (ms) between electrical stimulation and transcranial magnetic stimulation.

Conclusion: PA and AP oriented pulses appear to activate neural populations with different time constants. The AP-sensitive neural populations that elicit the longest latency MEPs are more readily stimulated by short than by long duration pulses, and appear more sensitive to SAI. Manipulating pulse width may improve the selectivity of AP stimulation.