Reliability of the Motor Hand Area in the 10-20 and 10-5 Systems

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Introduction

- The C3 or C4 region in the 10-20 system is assumed to represent the motor hand area. Therefore, in the absence of transcranial magnetic stimulation (TMS) or neuronavigation systems, neuromodulation methods, such as anodal transcranial direct current stimulation (AtDCS), target the C3 or C4 region to influence the cortical excitability of the hand.
- The purpose of this study is to compare the peak-to-peak motor evoked potential (MEP) amplitudes of the right first dorsal interosseus (FDI) and abductor digiti minimi (ADM) muscles after single-pulse TMS at the C3, C1, and C3h regions in the 10-5 system (see Fig. 1).
- The general hypothesis of the study is that MEPs recorded at FDI from the C3 may differ from the C3h and C1 and thus not serve as the best approximation of the human hand area.

Methods

- Sixteen right-handed individuals participated in this study.
- After finding the FDI hotspots of the participants, each resting motor threshold (rMT) was determined.
- Using single-pulse TMS, MEPs at the C3, C3h, C1, and hotspots were measured fifteen times each in random order.

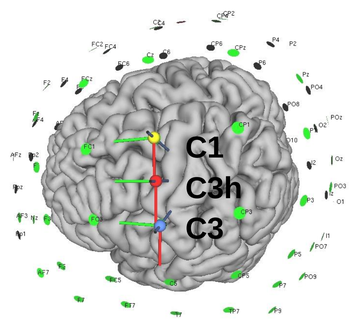

Fig. 1. Location of C1, C3h, and C3

Results

- The current findings revealed that MEPs were greatest at the C3h and C1, with both being larger than those recorded from the C3 region (see Fig. 2). This finding was expected based on Silva et al.'s (2021) recent MRI study.
- In the present study, individuals reported sensation around the left orbicularis oculi muscle (i.e., eye) instead of the FDI or ADM muscle after TMS at the C3.
- Although FDI and ADM representation areas overlap, MEPs of ADM tended to be more dorsal than those observed for FDI (see Fig. 3). This is in accordance with recent observations by Raffin et al. (2015).
- Moreover, the present data suggest that the FDI representation is more widely distributed than the ADM representation (see Fig. 3).

The **C3 region** in the 10-20 system is **not** the right **motor hand area.**

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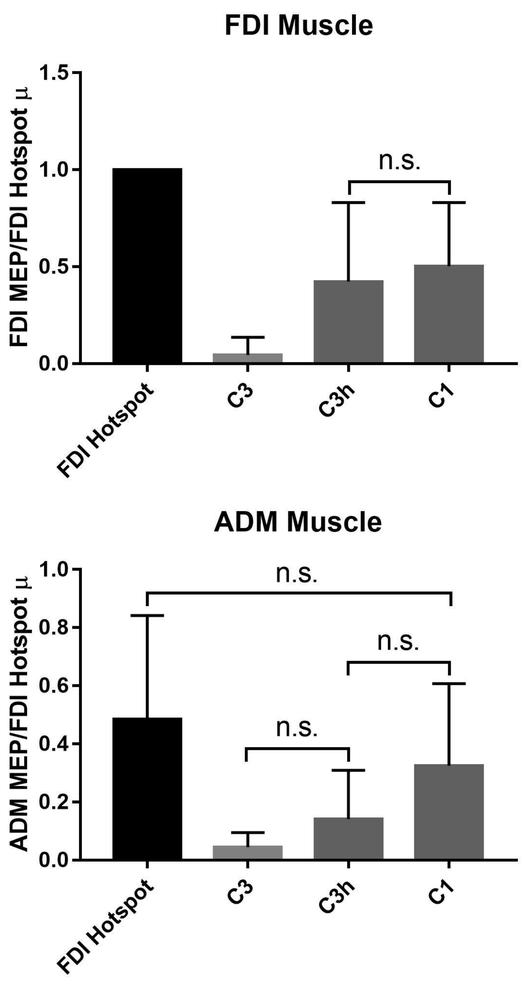

Fig. 2. MEPs at FDI and ADM from each region

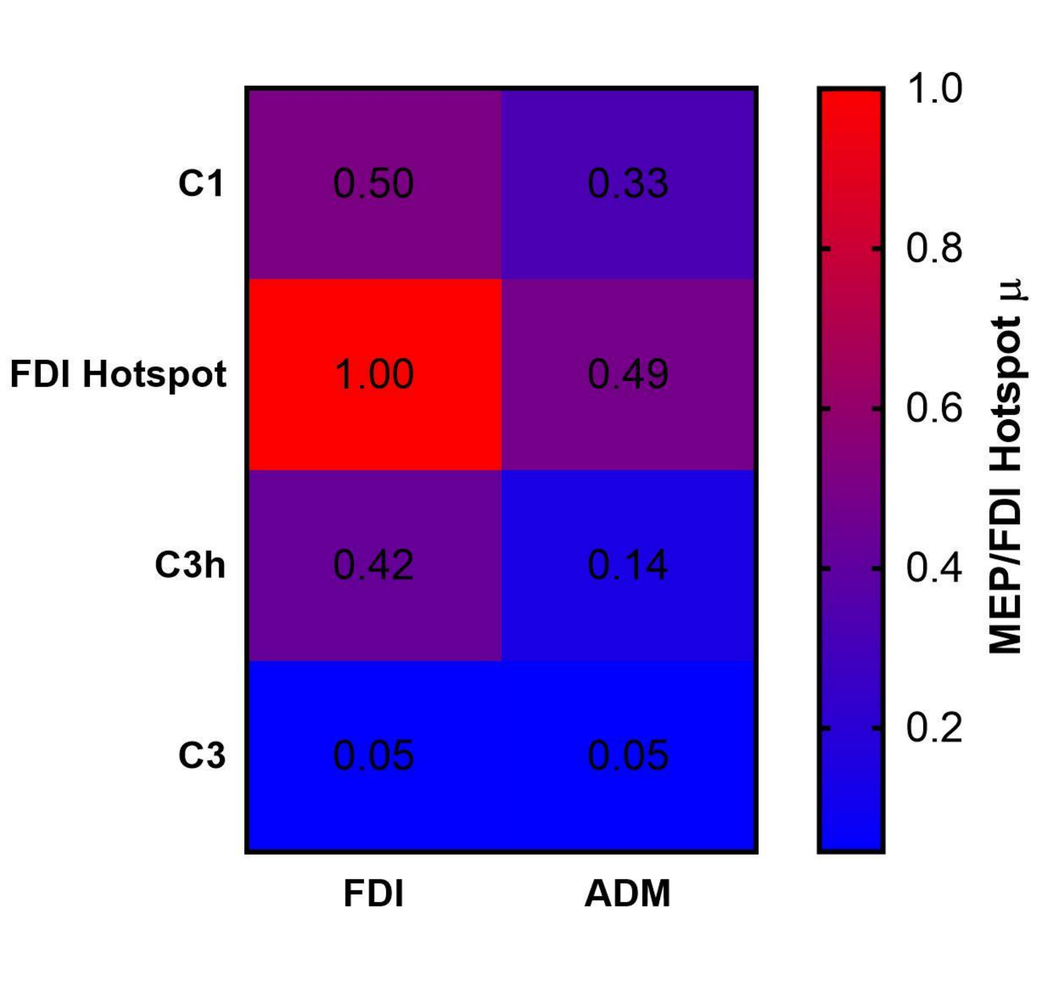

Fig. 3. MEP map based on MEPs at FDI and ADM from each region

Discussion

- Future efforts should compare the efficacy of neuromodulation of the hand when targeting these distinct neural regions (e.g., AtDCS at the C3 vs. AtDCS at the C3h vs. AtDCS at the C1).

Limitations

- Measurement error may have occurred when locating C1, C3h, and C3.
- The hotspot used may have been a local hotspot rather than a global hotspot.
- Sample size used herein is small.

References

- Raffin, E., Pellegrino, G., Di Lazzaro, V., Thielscher, A., & Siebner, H. R. (2015). Bringing transcranial mapping into shape: sulcus-aligned mapping captures motor somatotopy in human primary motor hand area. Neuroimage, 120, 164-175.
- Silva, L. M., Silva, K. M. S., Lira-Bandeira, W. G., Costa-Ribeiro, A. C., & Araújo-Neto, S. A. (2021). Localizing the primary motor cortex of the hand by the 10-5 and 10-20 systems for neurostimulation: an MRI study. Clinical EEG and Neuroscience, 52(6), 427-435.