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Introduction

- Our previous magnetoencephalographic (MEG) brain imaging in youth with cerebral palsy (CP) have shown altered sensorimotor beta cortical oscillations when controlling leg motor actions[1].
- Therapeutic trends have shifted from strength training to high-velocity power training, which have shown improvements in isokinetic strength, power production and mobility in youth with CP[2].
- The objective of this study was to utilize MEG brain imaging to examine the potential changes in sensorimotor cortical oscillations following power training.

Figure 1. Exemplary depiction of a participant completing the high-velocity power training on Total Gym ®

Methods

- 11 youth with CP (Age = 15.9 ± 1.1 yrs; GMFCS I-III) and 16 neurotypical controls (NT) (Age = 14.6 ± 0.8 yrs).
- 24 training sessions of high-velocity bilateral leg press power training were completed with a licensed physical therapist (Fig. 1).
- 1 repetition max and peak power production were used to assess muscular performance changes and 1-minute walk used to assess mobility changes.
- During MEG recordings, participants used their right leg to complete a goal-directed isometric target-matching task (Fig. 2).
- Advanced beamforming methods were subsequently used to image the strength of the sensorimotor beta oscillatory power.
- NTs only underwent the baseline MEG assessment.

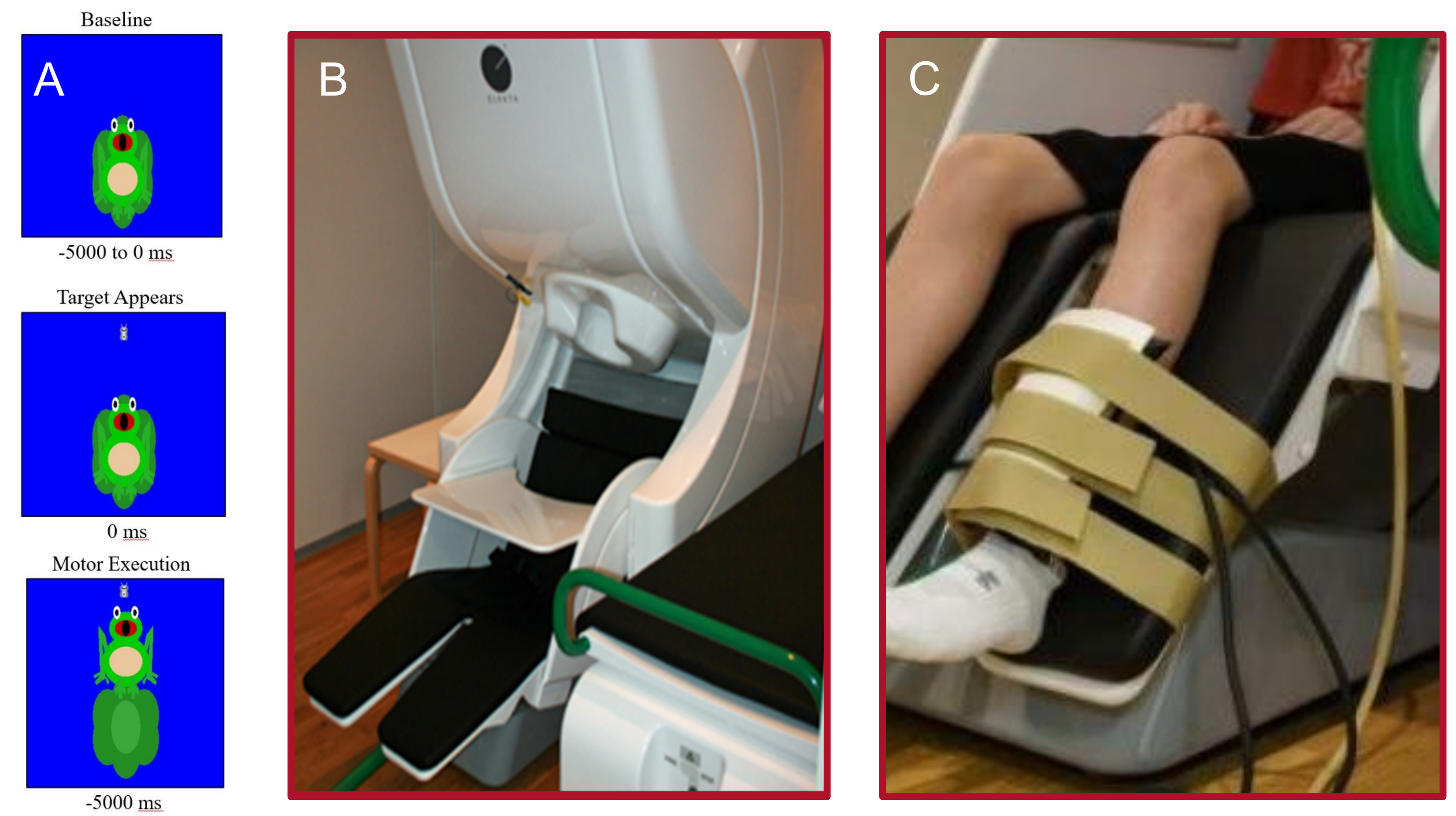

Figure 2. A. Depiction of the MEG experimental paradigm. Each trial was 10 s in length. Participants started the trial at rest for 5000 ms. Then, a target moth appeared, this promoted the participant to generate an isometric knee extension force that matched the force value. A successful match occurred when the moth that represented the target force was inside the frog's mouth for 300 ms. **B.** MEG device. **C.** Set up for isometric knee extension for MEG task.

Results

- Youth with CP increased their 1RM ($p < 0.01$), peak power production ($p = 0.04$), and 1-minute walk ($p = 0.02$) (Fig. 3).
- Beta sensorimotor cortical oscillations in the leg region were stronger in the youth with CP prior to training compared to NTs ($p = 0.04$) (Fig. 4).
- Youth with CP had a reduction in the strength of the beta oscillations after undergoing power training ($p = 0.02$) and the strength of the oscillations was not significantly different from the NTs after training ($p = 0.68$) (Fig. 4B).
- Peak power production after training was tightly linked with the strength of the post-therapy sensorimotor cortical oscillations ($r = 0.79$, $p = 0.03$).

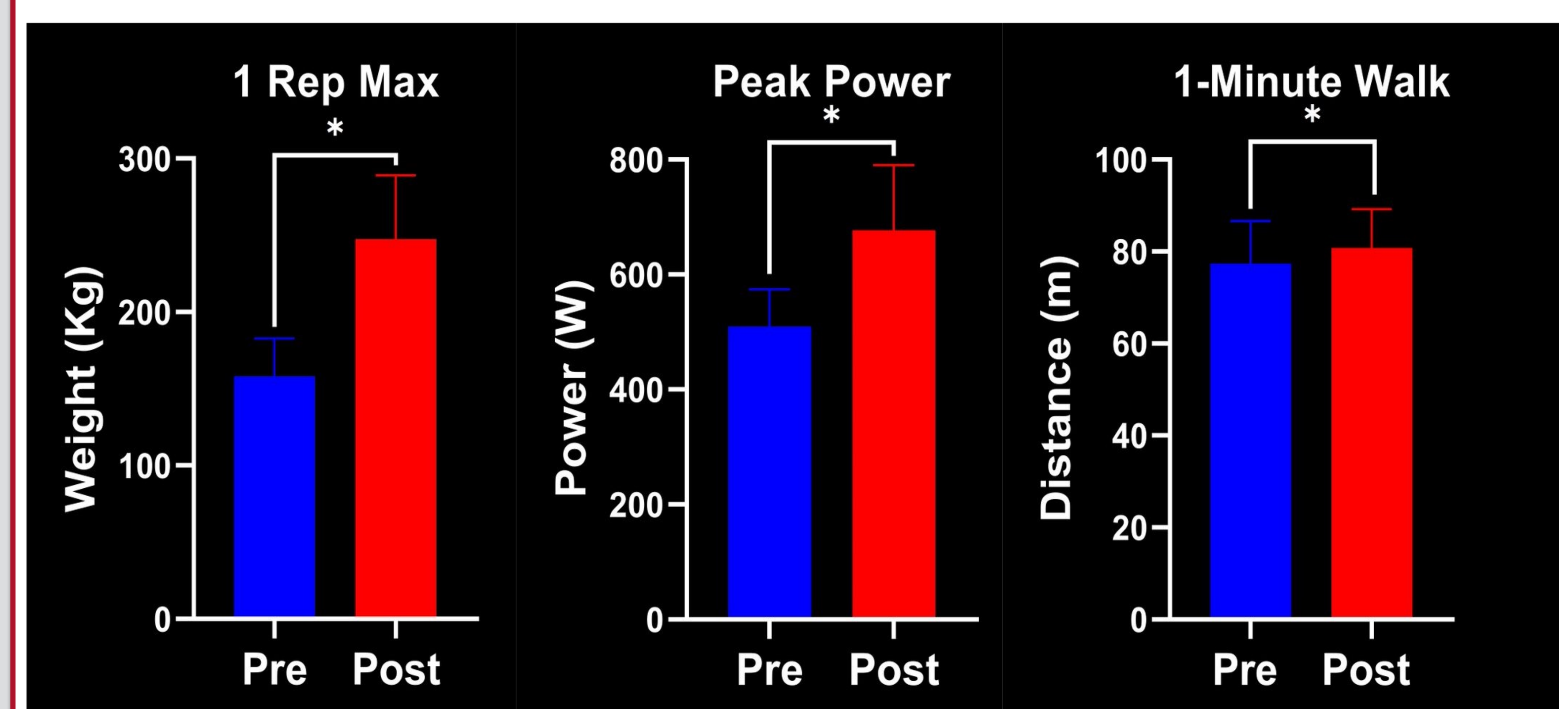

Figure 3. Clinical outcomes variables. As shown, the participants with CP had improvements in their 1-repmaximum, peak power production and 1-minute walk after power training. *p<0.5

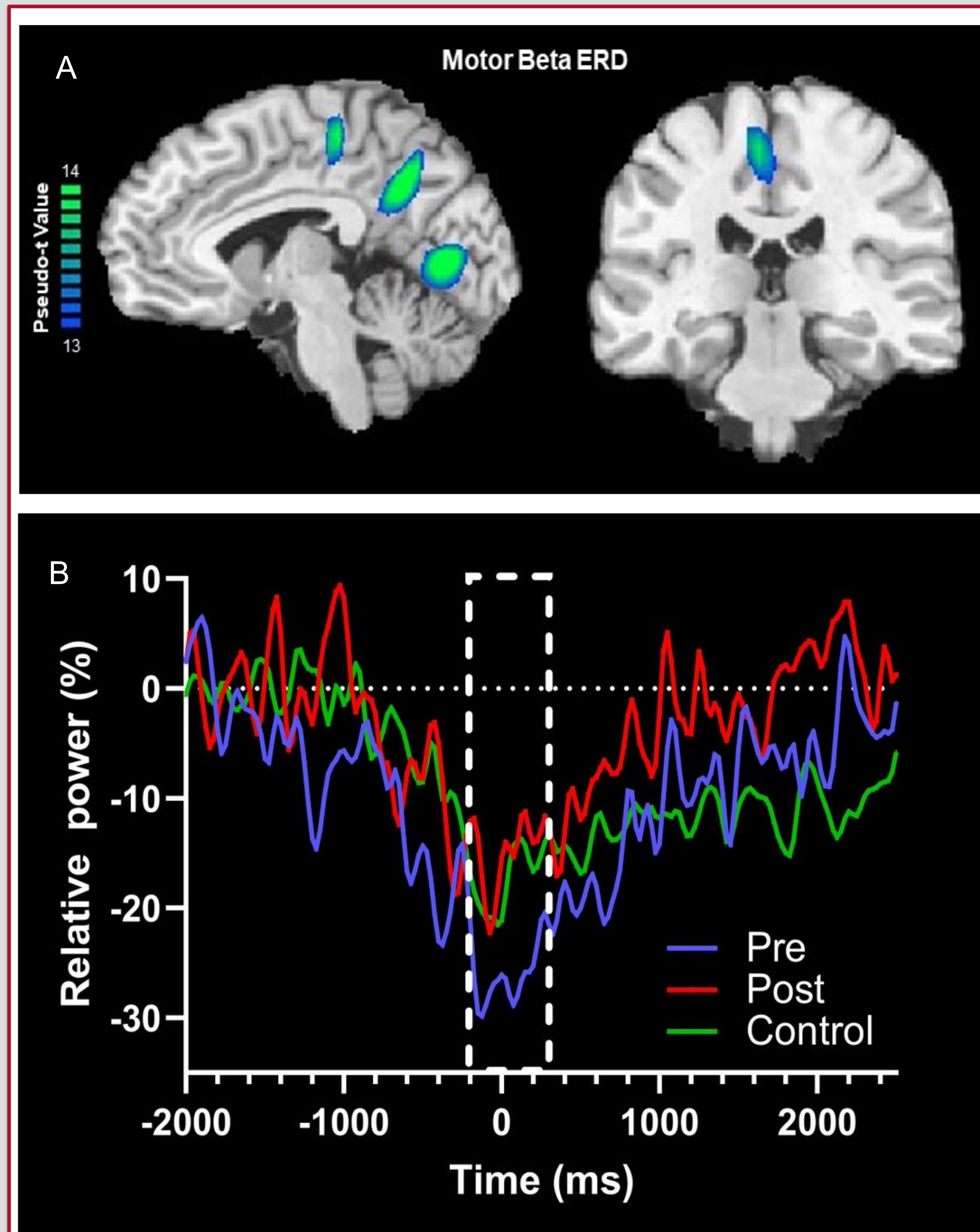

Figure 4. A. Group mean beamformer images for the beta oscillations. **B.** Time series of power at the peak voxel in the sensorimotor cortices. The onset of the isometric knee extension force is at time 0.0 ms. The white dashed box represents the region analyzed. As shown, the sensorimotor cortical activity after power training was weaker and similar to what was seen in the neurotypical controls.

Conclusions

- Power training appears to improve the neural generators that control the leg motor actions, and these neuroplastic changes partly contribute to improvements in the peak power production of youth with CP.
- Potentially, power training might provide the key therapeutic ingredients for complementary muscular and neurological plastic change.

References

1. Kurz, et al. (2020). *Ann Clin Transl Neurol*, 7(12), 2421-2432.
2. Moreau, et al. (2013). *Neurorehabil Neural Repair*, 27(4), 325-334.