Static magnetic stimulation over the visual cortex reduced visual reliance during postural control in individuals with perceived ankle instability

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Summary

This study aimed to investigate acute effects of transcranial static magnetic stimulation (tSMS) over the visual cortex on visual reliance in individuals with perceived ankle instability (PAI). Twenty-five participants with PAI randomly received tSMS or sham stimulation for 30 mins. Romberg ratio from a single-leg assessment was assessed before after the stimulation. The tSMS group increased Romberg ratio of time-to-boundary (TTB) standard deviation (SD) minima in anteroposterior (AP) and mediolateral (ML) directions compared with sham group. These findings indicate that a single tSMS session may reduce visual reliance during static postural control in individuals with PAI. (96 /150 words)

Introduction

Altered sensorimotor reorganization may contribute to diminished static postural control due to inflexible sensory reweighting in individuals with PAI [1]. Individuals with PAI heavily rely on visual cues for postural control [2]. Patients with lower extremity injuries exhibit increased visual cortical activation during a simple movement task, potentially reflecting greater reliance on visual cues for postural control. [3]. tSMS is a cost-effective non-invasive brain stimulation that reduces neural activity in specific areas including the visual cortex [4]. tSMS over the visual cortex may acutely reduce visual reliance by deactivating the visual cortex in individuals with PAI. However, no study has explored effectiveness of tSMS in reducing reliance on visual cues during static postural control in individuals with PAI. Therefore, this study aimed to investigate acute effects of tSMS over the visual cortex on visual reliance during static postural control in individuals with PAI.

Methods

This randomized, double-blind placebo-controlled study enrolled 25 participants with PAI. (M=12, F =13; Age = 21.5 ± 2.1 years; Height = 166.6 ± 7.3 cm; Mass = 59.0 ± 9.1 kg; #lateral ankle sprains = 4.4 ± 3.6 times; #giving ways = 3.4 ± 4.3 times; Cumberland ankle instability tool scores: 19.6 ± 3.9). Participants were randomly assigned to a tSMS (n = 12) or sham group (n = 13). During intervention, participants sat in an armchair while either a neodymium magnet (tSMS group) or an identical non-magnetic stainless-steel cylinder (sham group) was placed on the scalp over their visual cortex for 30 mins. Before and after the intervention, participants performed three trials of single-leg stance with eyes open and closed conditions on a force platform. The mean and SD of TTB minima were quantified in AP and ML directions. Romberg ratios were calculated by dividing the eyes-closed by the eyes-opened condition for the mean and SD of TTB minima to assess visual reliance during static postural control. A lower ratio represents increased reliance on visual information. Mann-Whitney U tests were used to analyze between-group differences in absolute change scores for each outcome measure. The effect size *r*, along with 95% confidence intervals (CI), was calculated for each comparison. Significance was set a priori at $P < 0.05$.

Results and Discussion

The tSMS group showed a significant increase in the Romberg ratio of TTB minima SD in the ML direction (median (IQR): tSMS = 0.74 (1.32), sham = -0.29 (1.27), $P = 0.012$, $r = 0.50$ 95%CI: 0.13 to 0.75) compared to the sham group, with large effect size. No significant between-group differences were observed in the Romberg ratio of TTB minima SD in the AP direction and TTB minima mean in both directions ($P > 0.05$).

These results indicate that a single session of tSMS reduces visual reliance during the single leg stance in individuals with PAI. Researchers have reported that tSMS over the visual cortex reduces cortical activity and influences visual cognition [4]. tSMS-induced reduction in visual processing may lead to decreased visual reliance during static postural control tasks. These findings may have important clinical implications regarding neuromodulation-based rehabilitation for sensorimotor dysfunction in patients with PAI. Further investigations should explore effects of repeated sessions of tSMS on sensorimotor function in individuals with PAI.

Conclusions

A single session of tSMS over the visual cortex acutely increased the Romberg ratio of TTB minima SD during a single-leg balance task in individuals with PAI. These findings suggest that tSMS applied to the visual cortex may acutely reduce visual reliance during static postural control in individuals with PAI. Future research is required to explore effectiveness of multiple sessions of tSMS for restoring optimal sensorimotor control in patients with PAI.

References

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