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EEG-based Motor Imagery Neurofeedback Enhance Mu Suppression during Motor Attempt in Stroke Patients

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Introduction: Neurofeedback using EEG-based event-related desynchronization (ERD) has shown potential in stroke rehabilitation [1]. However, its effects on ERD during actual motor attempts remain underexplored. This study investigates the impact of motor imagery-based neurofeedback on mu suppression in the sensorimotor cortex, aiming to inform its role in enhancing neuroplasticity and improving rehabilitation outcomes.

Material, Methods and Results: Fifteen patients with hemiplegia after subacute ischemic stroke participated in a randomized cross-over study. The study consisted of two experimental conditions: neurofeedback and sham. Each condition was divided into four sequential blocks: resting, grasp, resting, and intervention, followed by an additional block of resting and grasp. During resting sessions, participants fixated on a white cross on a black screen for 2 minutes without moving their upper limbs. In grasp sessions, they repeatedly opened and closed their affected hand at approximately 1 Hz for 3 minutes while maintaining fixation on the same cross. The neurofeedback intervention displayed a punching image of the impaired limb corresponding to imagined movement-induced mu suppression, while the sham condition used mu suppression data from other participants.

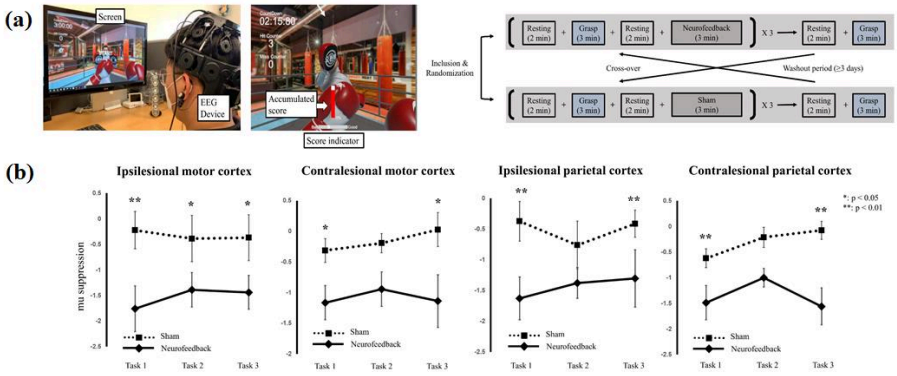

Figure 1: (a) Study design (b) *Mu suppression in the ipsilesional and contralesional cortex*

The neurofeedback intervention produced significant mu suppression in the bilateral motor and parietal cortices compared to the sham condition across repeated sessions ($p < 0.001$). During real grasping sessions following neurofeedback, progressive increases in mu suppression were observed in the ipsilesional motor cortex and bilateral parietal cortices compared to sessions after sham ($p < 0.05$). This effect was not present in the contralesional motor cortex.

Conclusion: Motor imagery-based neurofeedback effectively enhances mu suppression in the ipsilesional motor cortex and bilateral parietal cortices during motor execution in patients with subacute stroke. These results highlight the potential of motor imagery neurofeedback as an adjunctive therapeutic approach to improve motor-related cortical activity and support motor rehabilitation in stroke recovery.

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