Neurofeedback of Slow Cortical Potentials in children with Attention-Deficit/Hyperactivity Disorder (ADHD): a multicenter randomised trial controlling for unspecific effects

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Abstract

Background
Neurofeedback (NF) in children with ADHD has been investigated in a series of studies over the last years. Previous studies did not unanimously support NF as a treatment in ADHD. Most studies did not control for unspecific treatment effects and did not demonstrate that self-regulation took place. The present study examined the efficacy of NF in comparison to electromyographic feedback (EMG) to control for unspecific effects of the treatment, and assessed self-regulation of slow cortical potentials (SCP).

Methods
A total of 150 children aged 7 - 9 years diagnosed with ADHD (82% male; 43% medicated) were randomised to 25 sessions of feedback of slow cortical potentials (NF) or feedback of coordination of the supraspinatus muscles (EMG). The primary endpoint was the change in parents’ ratings of ADHD core symptoms four weeks after the end of treatment compared to pre-tests.

Results
Children in both groups showed reduced ADHD-core symptoms (NF – 0.3, 95% CI -0.42 / -0.18; EMG – 0.13, 95% CI -0.26 / -0.01). NF showed a significant superiority over EMG (treatment difference 0.17, 95% CI 0.02 / 0.3), p=0.02). This yielded an ES of d=0.57 without and 0.40 with Baseline observation carried forward (BOCF). The sensitivity analysis confirmed the primary result. Successful self-regulation of brain activity was observed only in NF. As a secondary result teachers reported no superior improvement from NF compared to EMG, but within-group analysis revealed effects of NF on the global ADHD score, inattention, and impulsivity. In contrast, EMG feedback did not result in changes despite more pronounced self-regulation learning.

Conclusions
Based on the primary parent-rated outcome NF proved to be superior to a semi-active EMG feedback treatment. The study supports the feasibility and efficacy of NF in a large sample of children with ADHD, based on both specific and unspecific effects.

Trial Register
Current controlled trials ISRCTN76187185, registered 5 February 2009.