

# Evidence-Based QEEG Neurofeedback Therapy: Clinical Outcomes in ADHD

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## Abstract

Neurofeedback studies to date have only used standardized protocols to try to demonstrate successful outcomes for ADHD and have often lacked the best control procedures with experimental designs. We examined patient specific protocols (non-standardized) with the use of age norm referenced performance measures along with eyes closed Z-scored QEEG variables to validate the outcomes achieved. Patient data was obtained from a private practice setting (mean age = 11.35, SD = 5.13; means FSIQ = 99.20, SD = 18.46). Derived age norm referenced EEG data and performance measures from the Integrated Visual and Auditory Continuous Performance Test (IVA/CPT) were collected at baseline and approximately every 5-10 hours in the course of therapy (mean hours = 21.06). A t-test for dependent samples was conducted for modality specific and non specific measures of attention and response control. Analyses were conducted on 1: patients that were off medication throughout (N= 41), 2: started on medication initially but later off medication in the course of treatment (N=3), and 3: on medication and never off medication (N=5). All 41 cases (100%) of cases with no medication intervention showed significant improvement on all performance measures examined ( $p < .0000001$  to  $p < .001$ ) and all demonstrated improved or normalized functioning for QEEG z-scores at their respective end points of treatment. Patients engaged in medications generally showed mixed results with analyses for overall measures showing no significant improvement. The results indicate that medications obfuscate optimized individual treatment. Medication versus non-medication brain localization factors by LORETA analyses are being examined.

## Introduction

Studies to date examining effectiveness of Neurofeedback Therapy for ADHD have utilized a singular protocol based on QEEG findings with limitations such as reduced recording sites or limited quantitative measures/site derived across populations of ADHD. While many of these studies have demonstrated good clinical outcome, the results have not been convincingly equal or more effective than medication treatment approaches. This study sought to examine treatment effectiveness of neurofeedback therapy without the benefit of medication.

## Subjects

The data was acquired by clinical retrospective examination of 57 patients ranging in age from 6 to 38 (mean = 11.35, SD = 5.13) all with at least one DSM-IV diagnosis that included any of the ADHD diagnoses (314.00, 314.01, 314.9). Total treatment hours varied between 5 to 102 (mean of 21.01, SD = 20.37). 41 cases never had medication at any point in treatment, 3 cases were identified as on medication at the start of treatment were discontinued medications in the course of treatment, and 5 cases were identified that remained on medication throughout the treatment period.

## Methods

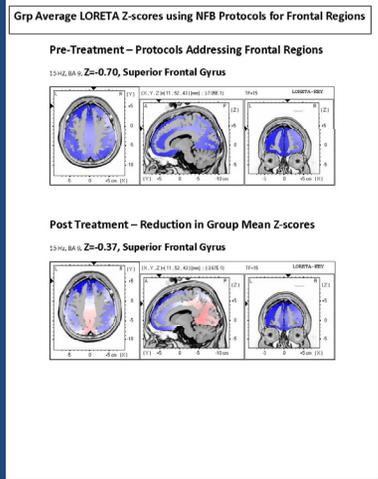
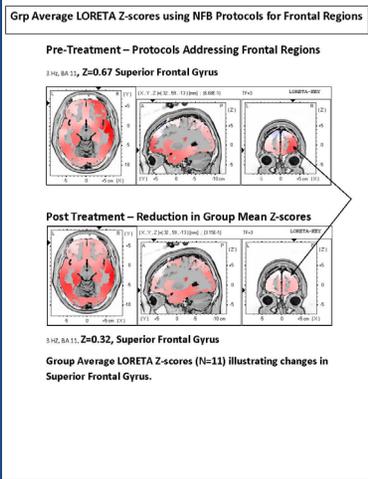
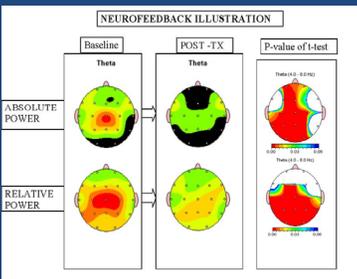
Amongst other tests, subjects were administered the Integrated Visual and Auditory Continuous Performance Test (IVA/CPT) and EEG was collected on a Cadwell Easy-2 system using 19 channels of the International 10-20 System which excluded Fpz, and Oz. All data was off-line reviewed for artifact removal and subjected for analyses using Neuroguide™. Measures for absolute power, relative power, power asymmetry, coherence, and phase lag were derived. NFB protocols were tailored to each patient depending on which measures were maximally deviant from normal across electrode sites.

## Results

The non-medication cases all showed significant improvement from pre-treatment to termination of treatment.



The analyses examining the groups using medications at any phase of their treatment showed no significant improvements in attention and response control performance.



Of 29 cases having pre and post qEEG in this sample, all showed some improvement in measures but only 20/29 = 69% showed significant improvements in their QEEG profiles compared to the on meds group (4/7 = 57%) and the transitioning off meds group (1/3 = 33%).

## Discussion

The preliminary analyses of these cases indicates that Neurofeedback Therapy is a potent methods to remediate ADHD symptoms as measured by objective performance and by qEEG Z-score measures as well as group average Z-score LORETA at maximal hyperactivity and hypoactivity regions of interest. Early case study analyses indicates that medication usage may hamper treatment outcome using Neurofeedback therapy suggesting that the therapy has optimal outcome if conducted once medications are discontinued. These preliminary analyses indicate that changes in brain function correspond to improvement in attention and response control performance with outcome effectiveness at least matching reported results of medication efficacy in the ADHD population, with no cases in this sample having any adverse reactions to neurofeedback therapy.