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COMPARISON OF TRADITIONAL THERAPY VERSUS NEURO FEEDBACK; ONE YEAR RETROSPECTIVE STUDY OF 50 PATIENTS

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ABSTRACT
Treatment for children with attention deficit/hyperactivity disorder (ADHD) today is predominantly pharmacological. Behavior therapy (BT) and non-pharmacological treatments such as neurofeedback (NF) are promising alternatives We tested 50 patients (25 control and 25 with neurofeedback) We tested the EEG after 10 sessions There was significant reduction of theta waves (P< 0.0001).

KEYWORDS: Treatment for children with attention deficit/hyperactivity disorder (ADHD) today is predominantly pharmacological.

INTRODUCTION

Attention deficit and hyperactivity disorder (ADHD) is mainly known for its mainstream behavioral symptoms of hyperactivity and inattention. However, other complications such as anxiety, depression, and conduct disorders have been recorded as secondary characteristics associated with ADHD (Meyer et al; Gutierrez et al). It is estimated that 50% to 90% of patients diagnosed with ADHD will experience these secondary characteristics (Spencer et al). Pharmaceuticals such as methylphenidate (MPH) and Amphetamine (AMP) are the two most widely used first line treatments in children, adolescents, and adults with ADHD for the past 60 plus years (Childress et al). While the response rates to these drugs are up to 71% with AMP and 68% in MPH (Childress et al), the side effect profile raises concern on the long-term health of children and adolescents. For example, loss of appetite has been well established as a common side effect of stimulants. A metanalysis review studied the use of MPH in children and adolescents illustrated, a significant decrease in the frequency of appetite of 30.3 %, 95% CI: 18.0-42.6 in patients on stimulant ADHD medication (Schneider et al). Several studies put forward that the development or increase in severity of tic could be linked to the use of ADHD stimulant treatments (Kaplan et al). Other adverse effects like, insomnia and psychiatric effects have been well recorded with the use of stimulant drugs. Although studies on the pharmaceutical (stimulants and non-stimulants) treatments of ADHD have shown significant efficacy treating the mainstream symptoms of ADHD, 45% of patients of the inattentive type and 10-30% of the combined type failed to respond to pharmaceutical therapy (Contreras et al; Monastra et al). Furthermore, it is difficult to use pharmaceuticals alone to aid in cognition, academic improvement and social skills that are needed in patients with ADHD (Monastra et al and Bennet et al). Most often combined treatment with behavioral therapies is required in order encompass these shortcomings. Research suggest that behavioral therapies enable patients to reinforce the psychosocial skills resulting in long term efficacy rather than short term as seen with pharmaceutical treatments alone (Monastra et al). For this reason, other treatment modalities have been encouraged for further investigation to find long term treatment options for children with ADHD. Such treatment models focus on redirecting the patient's attention by tracking their brain activity in accordance to images displayed on a screen. We will briefly discuss some of these models that have shown potential in the treatment of ADHD.

Hemoencephalography (HEG)

Hemoencephalography (HEG) is a neurofeedback technique that offers researchers with feedback regarding cerebral perfusion in the prefrontal cortex. There are two forms of HEG, one is near infrared spectroscopy (NIRS) and second is Passive infrared (pIR). Passive infrared consists of a sensor that detects light from the infrared spectrum that correlates to the levels of heat produced by the activity of brain region. The heat recorded is relative to the amount of sugar utilized in the respective to the metabolic activity within neurons. Near-infrared spectroscopy measures the neural activity in the brain by

detecting the absorption of the light according to the level of oxygenated and deoxygenated hemoglobin. In a pilot study NIRS neurofeedback was used as a treatment modality for children with ADHD. The study investigated children (N=27) ages 7-10 years with ADHD and exposed them to 12 sessions of near-infrared spectroscopy and 12 sessions in EEG group. In both groups attention task was conducted for the children at 4 weeks and 6 months after NIRS training. The study investigators found ADHD symptoms decreased significantly 4 weeks and 6 months after NIRS training and trend reduction in the EEG group (Marx et al). Although the small sample size is a limitation in this study, NIRS has shown to have promise in the treatment of ADHD and would necessitate further research.

Electromyography (EMG)

Another method of biofeedback used as a potential treatment for ADHD Is electromyographic biofeedback (EMG-BF) this method consists of placing electrode on subjects' muscles to produce a feedback signal in response to muscle activation. Although this method is not studied as extensively as EEG biofeedback, one randomized study investigated biofeedback treatments of tomographic neurofeedback and EMG-BF. The training consisted of a total of 36 training units where lessons were given 2-3 times per week over a period of twelve weeks. Found that both Tomographic NF and EMG-NF training suggested equivalent behavioral improvement in children with ADHD. whereas EMG-NF group demonstrated meaningful motor coordination and skills training in children with ADHD (Maurizio et al).

Electroencephalography (EEG)

One of the most prevalent and the one we investigate in this study is electroencephalogram (EEG) biofeedback therapy. EEG biofeedback is a series of brainwaves patterns that are classified based on their distinct frequency ranges. There are six wavelength patterns in total. Delta: 0.5-4Hz, Theta: 4-8 Hz, Alpha 8-13Hz, Sensorimotor (SMR): 12-15Hz, Beta: 15-35 Hz, Gamma: 35-50Hz. Out of the six different types, delta and theta are considered the slow activity wavelengths, they are linked to daydreaming and drowsiness. Whereas alpha represents a relaxed states without focus and Beta is associated with high alertness, concentration, and focus. Children with ADHD have increased levels of theta activity and decreased levels of beta wavelength activity (Alhambra et al) EEG therapy initially studied by Lubar and Shouse in 1976 (Arns et al). Lubar and Shouse studied different wavelengths activity of 16-20Hz (Beta) at the same time attempting to reduce cortical activity (theta 4-8 Hz) this led to a reduced impulsivity, hyperactivity, and enhanced attention span of the subjects under study (Monastra et al; Arns et al). These wave patterns are best analyzed using Quantitative electroencephalography (QEEG). QEEG neurometric imaging is the statistical analysis of the electrical activity of the brain. It is a brain mapping tool used to evaluate differences in brain function from a database of people of the same age and gender without difficulties. QEEG brain mapping and neurometric analysis enables the formulation of treatment options guided by the brain patterns associated with abnormal behaviors rather than relying solely on questionnaires or behavioral observations. QEEG is very useful in revealing the underlying abnormal brainwave patterns associated with ADD/ADHD. Research on the use of EEG neurotherapy in the treatment of ADD/ADHD has demonstrated efficacy and maintenance. Numerous research studies have shown that EEG neurotherapy is at least as effective in reducing ADD/ADHD symptoms as psychostimulant drugs and most studies have reported treatment success rates of between 70-80% for those children who show abnormal brainwaves.

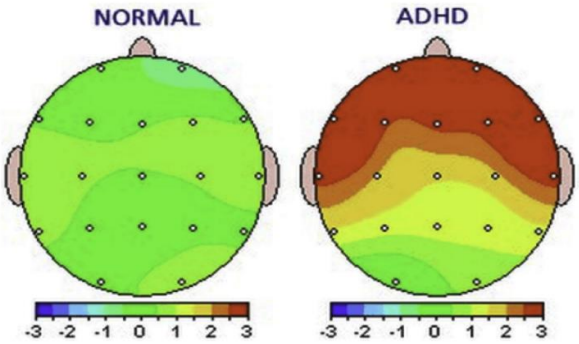

Figure 1: Brainwave activity of normal vs ADHD patient.

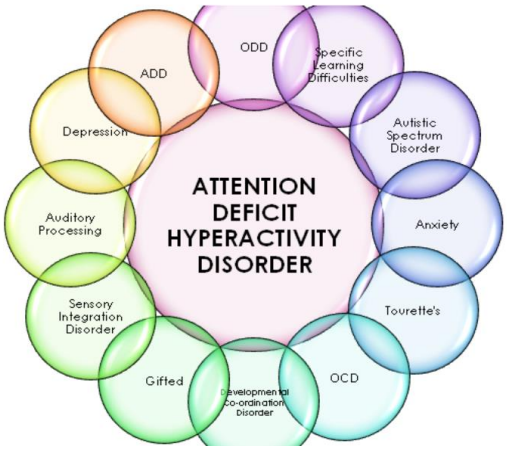

Figure 2: ADHD spectrum.

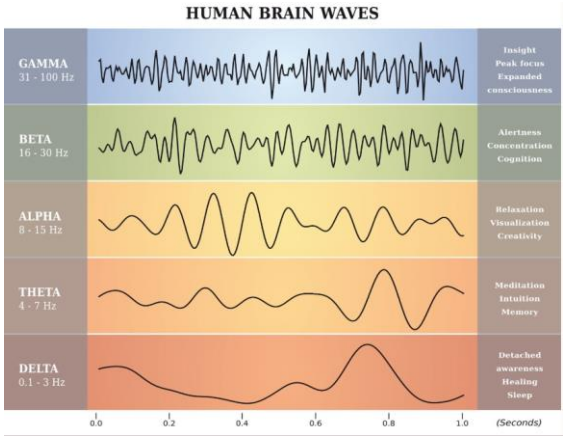

Figure 3: Brain wave types.

Study Design

Sensors are placed on the scalp to record brainwave patterns.

The computer converts the brainwaves into game-like displays or colorful images paired with sounds to give auditory feedback as well.

As the child controls what happens on the computer screen by changing his or her brainwave patterns in the direction desired, he or she learns to change his or her brain state. Basically, the child plays a computer game solely by controlling his or her level of concentration. Standard ADHD protocols that inhibit theta (4–8 Hz) and reinforce beta (13–20 Hz) or sensorimotor rhythm (SMR) (13–15 Hz over the motor strip) have been used extensively and are based on experience and research showing that excess theta or a high theta/beta ratio is typical for ADHD.

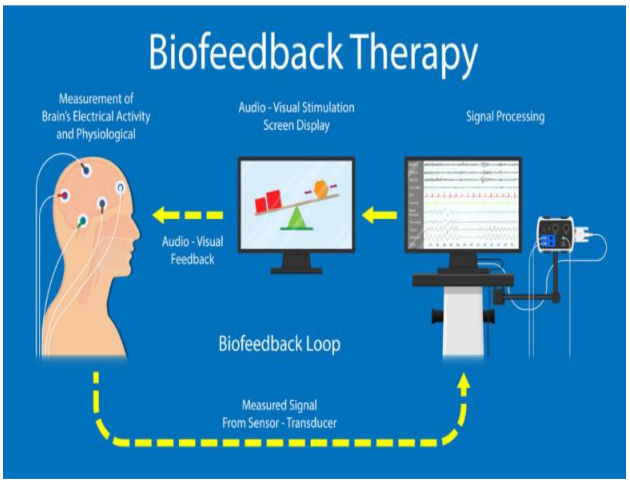

Figure 3: Biofeedback loop Mechanism.

RESULTS

Neurofeedback training aimed at enhancement of the "Focused Attention" and "40 Hz-centered gamma" indices in autism +ADHD was accompanied by improved in Hyperactivity and Irritability by the Aberrant Behavior Checklist (ABC) inventory. Achenbach's ASEBA showed improvements in Attention Problems/Deficits Scores and Conduct Behavior. SRS-2 showed improvements in T-score.

Self-regulation of prefrontal EEG measures of "Focused Attention" ("Inhibit All" protocol) and "40 Hz-centered Gamma" indices using protocol with DVD-control as a visual feedback along with auditory feedback was effective in maintaining interest and motivational engagement of children with autism spectrum disorder with co-occurring ADHD.

Ten 25 min. long sessions of neurofeedback were sufficient to achieve ability to control EEG parameters of interest as evidenced by increase of theta/beta ratio and gamma power targets during training sessions. During 20-25 min. of individual neurofeedback sessions, we found linear increase of electrodermal activity (SCL), decrease of heart rate and several heart rate variability (HRV) measures improvements.

CONCLUSION

As shown by the statistical data in our study, neurofeedback is effective treatment modality that provided additional benefit when compared to Traditional treatment in ADHD patients. We encourage further research regarding implementing this treatment modality in clinical setting to treat ADHD/ADD in children.

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