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The Better Brain Therapy?

"Should my family consider neurofeedback therapy for ADHD symptoms?" It's a question many clinicians are asked. Studies are encouraging, but not conclusive. Here's what professionals — and patients — need to know.

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What Is Neurofeedback Treatment?

Neurofeedback is an alternative or adjunctive treatment that uses real-time EEG signals as data to help patients train their brains to function better. Employed since the 1970s, its first clinical application was for treatment of patients with epilepsy. It was quickly discovered to also be effective for people diagnosed with ADHD to help improve focus, reduce impulse control, and enhance executive functioning. According to proponents, the demonstrated benefits are twofold:

- Brainwave alterations are measurable and appear to endure well beyond the therapy's end.
- Brainwave improvements may lead to behavior improvements—most notably, sustained focus, diminished impulsivity, and reduced distractibility beyond the study environment.

The Science Behind Neurofeedback

Neurofeedback traces its roots to neuroplasticity—the concept that the brain is malleable and that with frequent, intense practice, patients may learn to alter their brainwave activity. Over time, neurofeedback aims to help patients increase the ratio of faster-frequency brain waves, which have been shown to indicate stronger attention and self-control.

Many ADHD brains generate an abundance of slower-frequency delta or theta brain waves, and a shortage of high-frequency beta brain waves. Over 20 to 40 training sessions, neurofeedback works to reverse that ratio. The end goal is an activated, engaged, more efficient brain, and an overall reduction in ADHD symptoms.

More specifically, neurofeedback therapy works to increase the brain's capacity and predisposition for beta waves, which are associated with efficient information processing and problem solving. In contrast, when a high proportion of theta waves are present, patients complain of difficulty completing tasks, disorganization, and distractibility. Neurofeedback aims to diminish the amount of delta and theta waves it produces.

How Neurofeedback Works

Neurofeedback is a distinct type of biofeedback. Biofeedback is the process of learning how to voluntarily change your own physiological activity using real-time monitoring of biological data—muscle tension, breathing rates, muscle activity, and heart function.

In neurofeedback training sessions, practitioners monitor a patient's brain waves using scalp sensors. These sensors measure the brain's activity and convert the signal into an auditory or visual display so that the therapist and patient can see exactly when and how brain waves reach more optimal levels. The participants work with the therapist to recognize when the brain is operating in its optimized zone, then repeat and consciously sustain the behaviors that lead to this ideal brain state until they become second nature.

Each traditional neurofeedback therapy session typically lasts no more than 30 minutes. Many therapists use a baseline assessment of the patient's natural brain wave patterns, and standard ADHD rating scales to continually reassess if neurofeedback sessions are creating improvements, then adjust treatment going forward.

Representative Neurofeedback Studies

The first studies and case reports on the efficacy of neurofeedback appeared in 1976. Since then, many studies with increasingly stronger research methodology have been published. A recent search of the National Library of Medicine found citations for over 750 outcome studies of the use of neurofeedback for ADHD. Previous studies have shown continued benefits following cessation of treatment for neurofeedback but not for medication (Monastra, et al., 2002); changes in fMRI results during an attention task following neurofeedback training (Levesque, et al., (2006); improved outcomes from neurofeedback training over computerized attention training with sustained benefits six months after training was completed (Gevensleben, et al., 2009); and equivalent changes in parent and teacher rating scales when neurofeedback training was compared with stimulant medication results (Maisel, et al., 2013). These studies have been criticized due to lack of randomization, lack of adequate control comparisons, small sample sizes, and lack of double blinding between active and control subjects.

Some recent studies have attempted to control for some of the weaknesses of earlier studies. Here is a summary of some of the notable findings:

- Steiner, et al., (2014) randomly assigned 104 children with ADHD to receive neurofeedback training, computer-based cognitive training, or regular care in their community; most children were also on medication. Parents reported greater benefits for the neurofeedback group that were sustained after 6 months. Children receiving neurofeedback also did not require increases in medication dosage during this time while those in the other groups did.

- Strehl, et al., (2017) randomized 150 children to 25 EEG biofeedback training sessions or EMG (electromyographic) biofeedback training sessions. EMG training was aimed at reducing muscle tension. Changes in parents' ratings of ADHD core symptoms were

compared four weeks after the end of training with ratings obtained before beginning treatment. Children in both groups showed reductions in ADHD symptoms, but the neurofeedback training was statistically superior to EMG training with a moderate effect size on outcome for neurofeedback compared to a small effect size from EMG biofeedback.

- Gelade, et al., (2018) randomly assigned 92 children with ADHD to neurofeedback treatment, stimulant medication, or physical activity groups. Although medication treated children showed greater improvement than the neurofeedback group on parent ratings immediately after treatment (Gelade, et al., 2016), at the 6-month follow-up improvement between the groups was statistically equivalent. A similar pattern was found for teacher ratings of attention difficulties, with neurofeedback treatment children 'catching up' to those treated with medication over time.

Meta-analyses - There are enough neurofeedback studies of sufficient quality to complete meta-analyses of the data, which helps create a more reliable estimate of its impact in treating ADHD.

- In a recent meta-analysis (Van Doren, et al., 2019), researchers analyzed 10 randomized, controlled trials that included 2 to 12-month follow-up assessments after neurofeedback training. Results indicated moderate improvements in attention following treatment that grew over time. For hyperactivity symptoms, moderate improvement was evident following treatment and persisted over time. While these are encouraging findings, improvements in ADHD symptoms tended to be somewhat larger in these studies for children receiving medication.

- More recently, Arns, et al., (2020) published an updated meta-analysis focused on long-term effects of neurofeedback, and that compared these effects to those produced by medication treatment and behavior therapy. Based on parent and teacher ratings, neurofeedback yielded significant reductions in ADHD symptoms and these reductions remained evident 6-12 months later. Following treatment, between 32-47 percent of children no longer met criteria for ADHD; this remission rate is lower than what was reported for carefully conducted medication treatment in the MTA Study (The MTA Cooperative Group, 1999), but comparable to what was obtained for children treated in community, the majority of whom received medication treatment. Even so, the majority of children continued to meet diagnostic criteria for ADHD following neurofeedback treatment.

A Promising Complementary Therapy

Most neurofeedback studies are not fully blind, but the body of research cited above suggests that neurofeedback is a promising therapy for ADHD. It should be considered a complement to medication and/or behavior therapy rather than a stand-alone treatment. It may offer an alternative approach for those who have not been able to tolerate stimulant medication or benefited sufficiently from its use.

Existing research does suggest that neurofeedback results in improved attention, diminished hyperactivity, and enhanced executive functioning for some patients. However, some of the most important researchers in the ADHD field argue that the efficacy of neurofeedback for ADHD has not been conclusively established due to some weaknesses and inconsistencies in study design, training protocols, and experience of the trainers. In particular, it has not been clearly documented that it is actual feedback on EEG state and changes in EEG activity that is responsible for improvements that have been found, as opposed to other, non-specific factors.

Additionally, some neurofeedback studies have not shown positive outcomes in either attention or changes in brainwaves. Clearly, more and better research on neurofeedback training, including patient selection criteria, frequency and duration of training, and attention to transfer of skills may advance understanding regarding this promising technique.

The bottom line is that research support for both stimulant medication therapy and behavior therapy is stronger than it is for neurofeedback at the moment. Parents or individuals interested in pursuing neurofeedback training should seek a referral from their current providers. It is also advisable to have a trainer who is certified by the Biofeedback Certification International Alliance (BCIA) and experienced in the treatment of ADHD. Finally, as home-based neurofeedback options become increasingly available, it should be noted that the impact of home-based neurofeedback treatment has not yet been studied, but could prove a useful and cost-effective complementary approach.