The Effect of the BrainAdvantage Integrated HEG Neurotherapy System on Mild to Moderate Alzheimer's Disease

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ABSTRACT:

Premise: the integrated neurotherapy system works better than any other single modality to improve symptoms of mild to moderate Alzheimer's disease effectively, rapidly and relatively inexpensively, to improve and preserve the quality of life.

BACKGROUND:

Alzheimer's disease (AD) is an aggressive type of dementia. In the US, as many as 5.2 million people are currently living with AD including 250,000 under the age of 65. The Alzheimer's Association estimates every 70 seconds someone in America develops AD, and by 2050 they estimate that number will more than double to 1 every 33 seconds.[1]

Although it is referred to as a disease, dementia is really a syndrome and is identified by a pattern of symptoms which can be caused by any number of cerebral and extra cerebral diseases.[10] According to current diagnostic criteria the pattern is defined by changes of observable behavior on three different levels.

1. Patients perform significantly worse than their peers on cognitive testing including memory and at least one other area such as attention, language, temporal and spatial orientation, and executive functions (planning, organizing, problem solving, judgment) [11]

2. Patients have a reduced ability to carry out activities of daily living. More complex activities such as managing the bank account, organizing the household or arranging travel, are impaired first, while basic activities such as dressing, grooming, preparing simple meals, eating, or using the toilet are affected later [14]

3. In addition to impairments of cognition and activities of daily living, patients with dementia show significant alterations of personality (loss of interests, apathy), social conduct (indifference to others, tactlessness, aggressiveness, disinhibition) and emotional control (outbursts of anger, tearfulness and mood swings) [15]

Within the human brain there is a complex mix of chemical and electrical processes which allow us to speak, move, see, think, and remember.[17] This requires a vast communications network in the

brain that is made of billions of cells called neurons. To get messages through this network, an electrical charge travels to the end of the neuron resulting in the release of neurotransmitter chemicals along the myriad of pathways. Alzheimer's disease disrupts this intricate signaling system. This happens because of two abnormal structures in the brain that are created called amyloid plaques and neurofibrillary tangles. Plaques are made of beta amyloid, a toxic molecule that comes from a normal protein. Something causes enzymes to snip this protein. These beta amyloid fragments then clump together into damaging plaques.[2] Normally, tau, found in the neurofibrillary tangles, stabilizes the internal support structure of neurons, but in Alzheimer's the disease causes threads of tau to become entangled, killing the neuron by damaging critical parts of its transport system. As Alzheimer's disease progresses, more and more neurons die. The brain shrinks. Memory is lost.[3] New research from a Mount Sinai School of Medicine research team headed by Michelle Ehrlich, MD, Professor of Pediatrics, Neurology, and Genetics and Genomic Sciences, has focused on Amyloid-Beta (Abeta) oligomers in the brain which are floating clumps of amyloid. "These clumps are sited in research as the main component that impedes brain cell function in Alzheimer's patients." [2]

In 1986 Dr. David Snowdon, an epidemiologist and professor in Neurology at the University of Minnesota, embarked on an ongoing scientific study involving 678 Catholic nuns from the School Sisters of Notre Dame. The ongoing "Nun Study" has come to represent some of the world's most significant research on ageing and Alzheimer's disease. [4]

One of the primary questions the Nun Study attempted to answer was how pathology in the human brain relates to AD's symptoms. Today, it is known that although plaques and tangles are the two most important pathological features of Alzheimer's disease, they are not the only issue. The results from the Nun Study show that approximately one third of the sisters whose brains were found to be inundated with AD associated plagues and tangles at autopsy had shown no symptoms of dementia and scored normal results in all mental and physical tests while alive! The difference it seems is "Cognitive Reserve". [4]

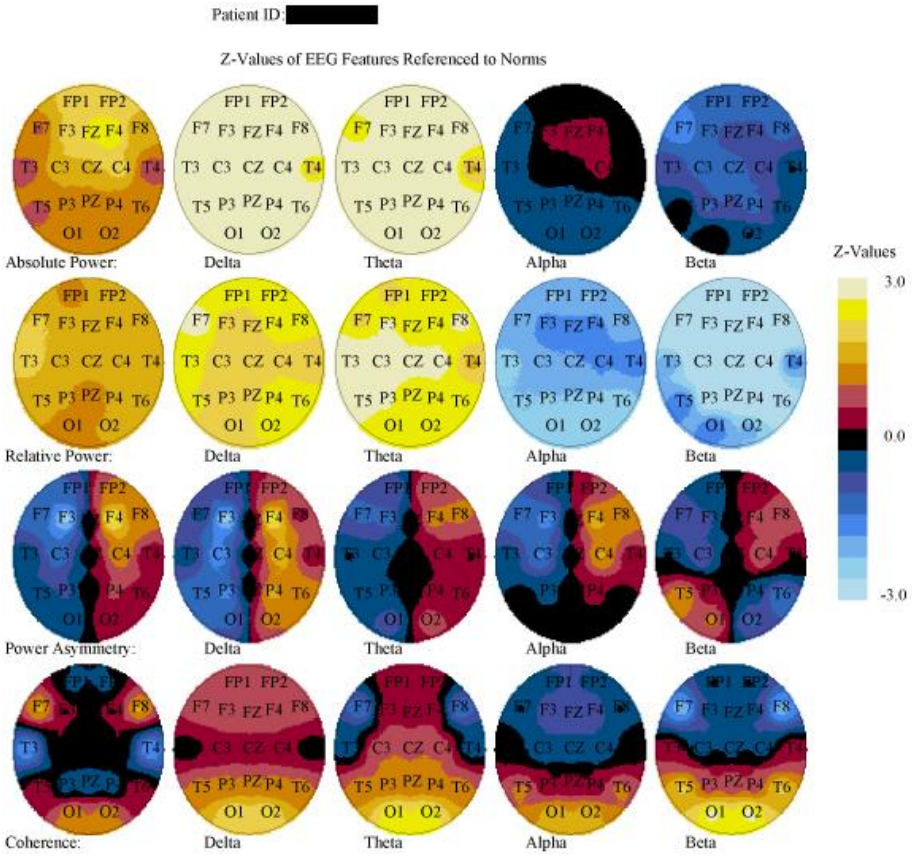
The theory behind Cognitive Reserve is that individuals with greater cognitive (thinking, learning and memory) skills are able to delay symptoms of AD despite underlying changes in the brain.[16] Therefore lifestyles including physical activities; intellectual pursuits and socializing are associated with slower cognitive decline in the healthy older set. There is also evidence from functional imaging studies that subjects engaging in such activities can clinically tolerate more AD pathology.[4] It is possible that training your brain and body creates more efficient cognitive function and therefore delays the onset of dementia. [5]

The purpose of this study was to determine whether an integrated neurofeedback system using Hemoencephalographic neurotherapy was effective in reducing the symptoms and/or progression of Alzheimer's disease allowing patients a better quality of life.

METHOD

The study included a single participant recruited through BrainAdvantage at The Arizona Center for Advanced Medicine. The patient was a 64 year old woman who had been diagnosed with depression, dementia, cerebral atrophy, and neurologic neglect syndrome. Her predominant symptoms prior to treatment were cortical blindness, which is the total or partial loss of vision in a normal-appearing eye caused by damage to the visual area in the brain's occipital cortex, loss of short term memory, depression, lack of affect and eye contact. Informed written consent was obtained from patient before study began.

The patient was evaluated using a QEEG (quantitative electroencephalogram) using the Lexicor NeuroSearch-24 Quantitative Electroencephalographic (qEEG) data acquisition system using 19 scalp electrodes placed according to the International 10-20 system. The QEEG showed decreased brain activity at Fp1, and Fpz. Also it indicated excessive Delta and Theta activity which reached statistical significance (two to four standard deviations above the mean). This was apparent in Absolute Power, while Theta was also above the norm by two standard deviations in Relative Power. A Power Asymmetry was apparent with greater power right frontally than at the left hemisphere in Delta, Theta and Alpha frequencies. Hypercoherence or excessive communication was exhibited at occipital sites indicating a lack of functional integrity at these areas. The participant's discriminate scores suggested the presence of Primary Degenerative Dementia.



.NIR HEG neurofeedback was used to provide oxygen baseline and utilization levels at Fp1, Fp2 and Fpz. The test showed low activity in all areas of frontal lobes.

Neuromotor skills testing using Interactive Metronome was used to determine brain/body function. Two tasks are evaluated. The first task was to clap to a beat heard through headphones. The second task was to clap to beat with headphones while additional sounds were added to show if she was on the beat, too fast or too slow.

Patient was unable to clap her hands or find her leg to clap hand-to-leg.

Observations of the patient at initial assessment showed the patient unable to walk unassisted without running into walls and windows. She didn't smile or speak to staff and appeared confused. Disorder duration, medication information and nutrition assessment were obtained by patient and/or husband self-report, medical reports when available and a comprehensive medical evaluation. Computerized testing could not be completed as the participant was unable to see the computer screen.

PROCEDURE

During the training period the patient completed a series of 20 sessions of integrated technologies. The first 10 sessions included 30 minutes (10 minutes each) of nIR HEG neurofeedback using a near infrared (nIR) HEG headband from Biocomp Research Institute and a Neurobics Pocket A3 neurofeedback unit using NIR HEG settings with BioExplorer software and custom training designs. The HEG headband sends pulses of red and infrared light through the skull to the cortex beneath. (The skull itself is not opaque but translucent). By measuring the amount of red compared to infrared light that is reflected back by the cortex to the headband sensor, the headband can indicate how much oxygen there is in the blood. An initial baseline was measured after 30 seconds and then a video flythrough was displayed on a computer screen. The display continued to move through the scenery as long as oxygen levels were maintained above baseline. When oxygen levels dropped below baseline the flythrough stopped. HEG neurofeedback was used at Fp1, Fp2 and Fpz using the 10-10 system of scalp landmark positions.

Patient also trained during each session using a DAVID Pal audio/visual entrainment device from Mind Alive. This device is programmable and uses a semi-sine wave, blue-tinted white-light eyeset and isochronic tones, binaural beats and chime to entrain brainwaves. Headphones and an incandescent eyeset with full field illumination-two square inches (13 square cm) per eye were used. Targeted frequencies were (L) 14 HZ, (R)18 HZ &10 HZ to improve mental functioning and memory.

The patient completed 50 sessions of auditory retraining using Advanced Brain Technology's The Listening Program. This therapy consists of psychoacoustically modified music which stimulates the vestibular system and the limbic system to improved auditory processing issues, reading, learning, communication and memory. Specific frequencies addressed in these sessions range from

20 Hz (low frequencies) to 20,000 Hz (high frequencies). The participants listened at home on Sennheiser 500 headphones on a condensed schedule of 1, 30-minute session, five days per week, for 10 weeks.

Neuromotor skills training using the BrainAdvantage Timing Trainer was completed for 20-minutes during each session to improve the patient's timing/rhythmicity by reducing the interval between the onset of a tone and patient's response.

During training the patient wore headphone and listened to a metronome set at 54 beats per minute. As she listened to the beat, she engaged in physical movements such as clapping hand-to-hand with a sensor on one palm. The objective was to match their physical movement to the beat (e.g., clap at the beat). The patient had feedback through an auditory system that provides tone specific stimuli to indicate whether the patient responded prior to, at, or past the regularly occurring auditory metronome beat. The accuracy of patient response to the metronome beat was provided in milliseconds (ms), with different tones indicating far from, close to, or at the metronome beat. A visual display of millisecond accuracy was presented on a computer screen. Initially the patient was assisted by the neurotherapist to complete clapping to the timed beat. As the sessions progressed she was able to complete this task on her own.

After 10 sessions, cognitive training was added as the patient was able to see the computer screen more clearly. Cognitive training using Advanced Brain Technology's BrainBuilder software was used approximately 20 minutes per session to practice brain speed, memory and recall.

After the tenth training sessions, the patient was reassessed using: the HEG neurofeedback oxygen baseline and utilization levels, and the Interactive Metronome for Neuromotor skills. After the twentieth session she another QEEG was completed as well as the HEG neurofeedback oxygen baseline and utilization levels, and the Advanced Brain Technologies' Brain Speed Test and the Interactive Metronome for neuromotor skills. Parent reports and self-reports were administered during all reassessments to identify changes in behavior and symptoms.

Data Acquisition

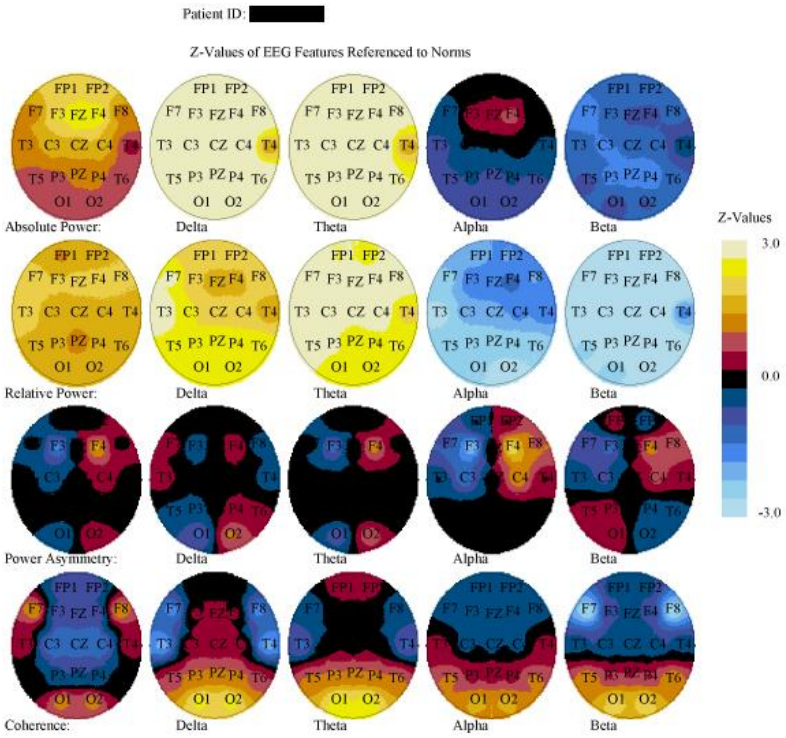
nIR HEG neurofeedback data were collected using BioExplorer's Bio Review program. This is an adjunct to the training program and provides graphs of performance for each session. Reports were also generated from Interactive Metronome giving information on the number of milliseconds by average the patient was off the beat and the number of times they hit on the beat. Also comparison reports could be generated to show improvement over time. The BrainBuilder cognitive software has a built-in database of progression and scores as the patients completed tasks. The QEEG data was acquired using the Lexicor NeuroSearch-24 Quantitative Electroencephalographic (qEEG) data acquisition system using 19 scalp electrodes placed according to the International 10-20 system.

Results

The patient made remarkable progress in 20 sessions. She showed marked improvements in

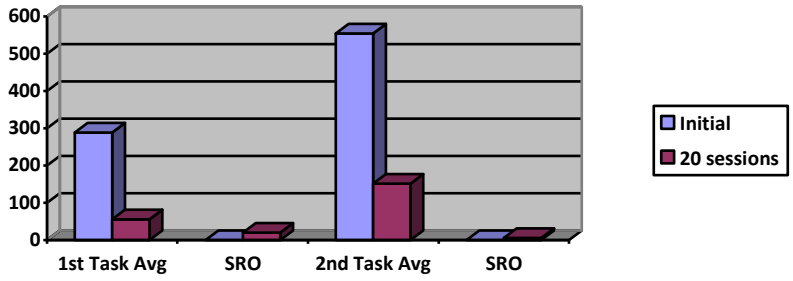
depression, memory and recall. She was much more "present" when she came to the office. She looked at the staff and spoke to them. She was laughing and happy. Her eyesight had improved and her husband was taking her out again as she didn't get lost as before. Her husband reported that she had sat down and written letters to members of her family, something she hadn't been able to do in years. He cried.

A post QEEG was done after approximately twenty treatments of the Brain Advantage System.



Although power Z-scores were similar as well as discriminate score findings, a noticeable improvement in Power Asymmetry was noted. That is, the hemispheres were more balanced in the Delta and Theta frequencies. The patient's behavior presented as more alert during this second visit. Additionally, Beta hypercoherence has improved occipitally.

Table 1 shows gains in HEG baseline and oxygen utilization.



The chart above shows improvement in neuromotor skills over 20 sessions. The 1st Task Average (Avg) is the number of milliseconds by average the patient is off the beat. SRO or Super Right On is the percentage right on the beat.

On the first task without additional sounds, the patient initially scored 289 ms off the target and was on the beat 13 percent of the time with assistance. On the initial second task with additional sounds, she was 554ms off the target and was on the beat 0 percent of the time. After 20 sessions the patient's task average score on the first task was 56 ms off the target and she was on the beat 21 percent of the time with no assistance. On the second task she was 152ms off the target and on the beat 6 percent of the time without assistance.

The patient also showed an improvement in Brain Speed scores over the last 10 sessions as she was unable to perform this task the first 10 sessions. Her scores rose from 424 to 625 an improvement of 32.16%.

HEG baselines and oxygen utilization also improved. See Table 1. After 20 sessions the oxygen baselines and utilization levels had increased substantially and she was able to keep the raised oxygen level up consistently over the 10 minutes per site.

Oxygen Baseline levels Pre		Oxygen Baseline Levels Post	Oxygen Utilization Pre	Oxygen Utilization Post	Gain in Baseline	Gain in Utilization
FP1	65	101	2.4%	9.8	**32.67%**	**75.51%**
Fp2	51	98	1.7	7.9	**47.99%**	**78.48%**
Fpz	**100**	**145**	**4.9**	**12.2**	**31.03%**	**59.84%**

CONCLUSION:

HEG neurofeedback, when combined with other technologies in an integrated program, is both effective and cost-effective for treating mild to moderate Alzheimer's disease without pharmaceutical medication.

While based on just single participant, the results of this study show a dramatic treatment effect with no harmful side effects to the participant. The participant and her family members all noted improvement in vision, memory and recall, depression. The BrainAdvantage System proved to be quick, easy and extremely helpful in giving this individual back the ability to live a higher quality life.

Anecdotal reports from participant as well as family members verified that there was a huge change in the patient's ability to think and act with clarity.

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