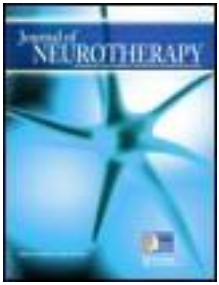

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Clinical Use of an Alpha Asymmetry Neurofeedback Protocol in the Treatment of Mood Disorders

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SCIENTIFIC ARTICLES

Clinical Use of an Alpha Asymmetry Neurofeedback Protocol in the Treatment of Mood Disorders: Follow-Up Study One to Five Years Post Therapy

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ABSTRACT. *Background:* This study reports on three of six patients who have completed an average of 27 neurofeedback sessions using a patented alpha asymmetry protocol for the treatment of depression.

Method: The follow-up data, from one to five years post therapy, were derived from a single session re-test using the same alpha asymmetry protocol and the Beck Depression Inventory.

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Results: The three patients originally diagnosed as having unipolar depression reached the training criteria for the non-depressed range by the end of their initial training, and they have maintained their normal scores for right hemisphere alpha asymmetry training over time. The follow-up Beck Depression Inventory scores were also within the normal range.

Discussion: This finding is contrary to the previously held demonstrations by Davidson and Henriques regarding the stability of decreased left anterior cortical activation in remitted depression. While some patients have reported mood changes with life's vicissitudes, none have experienced clinical depression since they have terminated therapy.

KEYWORDS. Affective disorders, biofeedback, electroencephalography, alpha asymmetry

BACKGROUND

Beginning in the spring of 1994 a small group of depressed patients agreed to try an experimental treatment for mood disorder (Baehr, Rosenfeld, Baehr, & Earnest, 1999; Baehr, Rosenfeld & Baehr, 1998; Rosenfeld, 2000). The rationale for this treatment stems from research which demonstrates that differences in frontal EEG asymmetry, characterized by an apparent left frontal hypoactivity, have been linked with depression, (Davidson, 1995; Davidson, 1998; Gotlib, Ranganath, & Rosenfeld, 1998; Harris, 1978; Hughes & John, 1999) and that this asymmetry may be modified using EEG biofeedback (Allen & Cavendar, 1996; Rosenfeld, Baehr, Baehr, Gotlib, & Ranganath, 1996). We reasoned that depressed persons might benefit from training to increase differences in activation in the right and left frontal cortices. We hypothesized that if this asymmetry training was successful, then tests designed to assess depression would reflect improvement in affect, and we hoped that the asymmetry changes would hold over time. Four of the six patients who participated in the original research were available for retesting. Two patients were unavailable for follow-up study. A third patient is currently in treatment and will be included in the discussion section. Longitudinal data was gathered for patients who had been out of therapy for one to five years.

METHOD

The following is a description of the procedures used to train patients to succeed on the alpha asymmetry protocol. Initially patients were trained to use diaphragmatic breathing exercises and autogenic suggestions such as "I feel quite relaxed" and "warmth is flowing down my arms into my hands and fingers" to promote relaxation and hand warming. Subjects were taught to meet a hand warming criteria of 90-95 degrees Fahrenheit. This technique serves to reduce artifact caused by muscle tension. The patients were also instructed to focus their thoughts on pleasant, unemotional imagery during EEG training sessions. They sat in a reclining chair with their feet up, and were encouraged to maintain a relaxed state, closing their eyes and moving as little as possible. The patients were seen once or twice a week for an hour-long session, which consisted of approximately 50% brainwave biofeedback followed by 50% psychotherapy. During biofeedback, F3 and F4, referenced to Cz were recorded.

We originally used the frontal asymmetry score as a measure of asymmetry, however it proved to be a variable index, which was influenced by occasionally high (or low) samples. In another study we found that an index based on the percentage of time the alpha asymmetry score (PTAA) was greater than zero, was a better discriminator of groups of depressed and normal persons than the more variable magnitude scores (Baehr, Rosenfeld, Baehr, & Earnest, 1998). We now regard 58% as the approximate cut off point for PTAA, which discriminates between the depressed and normal groups, with > 58% representing the non-depressed population. The asymmetry score is defined as (F4-F3)/(F4+F3), where F4 is the alpha magnitude at that right frontal location, and F3 is the magnitude at that left frontal side, both referenced to CZ. The EEG data was recorded on either a four-channel unit or on a NeuroSearch 24-channel unit (both by Lexicor Corp.). Fast Fourier transforms (FFTs) were derived on Blackman-Harris windowed analog signals over 1-sec epochs (Harris, 1978).

RESULTS

The expectations of this study were generally supported, as can be seen in the positive results reported in Table 1. The data in this table show the pre- and post-alpha asymmetry training measures of depression based on the Beck Depression Inventory (BDI; Beck, Ward,

TABLE 1. The Beck Depression Inventory (BDI) scores * and the Percent of Time Asymmetry Is Greater Than Zero (PTAA) Scores Are Shown for Three Subjects Before and Immediately After Termination of Therapy.

	BDI	BDI	BDI	PTAA	PTAA	PTAA
SUBJECT	Before Therapy	After Therapy	Follow-Up One to Five Years	Before Therapy	After Therapy	Follow-Up One to Five Years
Bob	31	3	3 (1 year)	48%	84%	86% (1 yr.)
Celia	40	4	4 (3 years)	57%	86%	66% (3 years)
Ann Rose	n/a	2	3 (5 years)	49%	69%	69% (5 years)

* BDI score < 9, and PTAA scores > 58 are in the non-depressed range.

Follow-Up Case Studies: Complete patient histories can be found in Baehr, E., Rosenfeld, J.P., Baehr, R., and Earnest, C. (1999).

Mendelson, Mock, & Erbaugh, 1961) and the frontal alpha asymmetry is greater than zero (PTTA), immediately following the termination of therapy, and one to five years post treatment. (A score of > 9 was used to identify the depressed group.)

Bob, 38-year-old male, Initial Diagnosis: Dysthymic Disorder (DSM IV: 300.4). Bob is a professional man. He sought therapy when his marriage was breaking up. His mood was depressed and irritable for most of the day, for more days than not. He frequently had problems with insomnia, and his self-esteem was poor. His condition was chronic, first appearing in his adolescence. Bob's father also suffered from Dysthymia.

Bob's PTAA score changed from an initial score of 48% to a score of 84% when he terminated therapy. His PTAA score was essentially the same (86%) one year after termination of therapy. His BDI score changed from an initial score of 21 to a score of 3 at the end of his 22 bi-weekly therapy sessions. His maintained his BDI score of 3 one year after terminating therapy. Bob reported that he was no longer depressed. Having been divorced, he was now beginning of a new relationship.

Celia, 36-year-old female, Initial Diagnosis: Major Depressive Disorder (DSM IV: 296.21). Celia is a single woman who is a teacher in a private school. She sought therapy eighteen months before beginning neurotherapy when she was experiencing symptoms of a major depression. Her mood was depressed for most of the day, nearly every day.

She was experiencing difficulty sleeping, felt a loss of energy, had feelings of worthlessness and had recurrent suicidal thoughts. Her father had symptoms of dysthymia.

Celia's PTAA score changed from an initial score of 57% to a post therapy score of 78% after 32 bi-weekly sessions. Two years after terminating neurotherapy, her score of 66% was still well within the normative range for non-depressed persons. Her follow-up BDI score of 4 was the same as when she terminated neurotherapy, and was significantly lower than her initial BDI of 40. Celia has remained in psychotherapy since ending her neurofeedback sessions. She has continued to experience personal growth and improvement in self-esteem. She was able to handle two disturbing life situations; her mother's illness and a recent downsizing at work, which resulted in loss of her job, without becoming clinically depressed. She has recently relocated to a city where she has found an excellent job and new relationships.

Ann Rose, 70-year-old female, Initial Diagnosis: Recurrent Major Depressive Disorder (DSM IV 296.32) Ann Rose is a semi-retired librarian. She was referred to therapy twelve years ago by a psychiatrist who had been treating her for major depressive episodes over a period of twenty-eight years. One of us (E.B.) saw her periodically when she was experiencing a major depressive episode, and she would typically stay in psychotherapy for a short period of time until her symptoms remitted. Her most recent (and last) episode occurred in spring of 1993. There was no precipitating event known to have caused this recurrence.

Ann Rose's PTAA score changed from an initial score of 49% to a post therapy PTAA score of 69% after thirty-four bi-weekly sessions. Five years after the termination of neurotherapy her PTAA score of 60% was still within the normative range. Her five-year follow-up BDI score of two was consistent with the non-depressed score of one she earned when she terminated therapy.

Ann Rose has maintained yearly contact with her therapist since ending neurotherapy. She has not experienced clinical depression in more than five years. This was the longest period of time she had gone without experiencing depressive episodes. She returned to see her therapist for brief psychotherapy while she was in the process of moving and relocating to another city for retirement. Although the move was a very positive one for her and her family, she experienced considerable stress in dealing with separation issues involved with severing relations and leaving the city she had lived in all of her life. She experienced anxiety about the change and some remorse; however, she did not become clinically depressed. In a recent conversation, a month after she

had moved, Ann Rose told her therapist that she was adjusting to her new environment, was happily engaging in classes and new activities.

DISCUSSION AND CONCLUSION

This study presents the first longitudinal data for persons who have undergone neurofeedback using the alpha asymmetry protocol for treatment of mood disorders. The results are very encouraging; three subjects normalized their PTAA scores by the end of their neurofeedback asymmetry training, and these subjects have maintained their non-depressed status one to five years after the end of treatment. BDI scores and the verbal reports of the patients are consistent with feelings of well-being. All of these patients were on medication when they started neurotherapy treatments. Celia had been taking 20 mg of Prozac for more than two years when she started neurotherapy. Ann Rose had been taking 20 mg of Paxil for one month prior to beginning neurotherapy. Bob started to take 50 mg of Zoloft shortly after beginning treatment. They all discontinued medication before the forth quarter of their treatment. None have reinstated medication.

One patient, Celia, continued in psychotherapy after completing her neurotherapy training. While this fact may confound the follow-up results, one must take into consideration that she was seen for 18 months in psychotherapy prior to the neurofeedback treatment, and she failed to show improvement in her mood. We have found that patients who are successful in modifying their alpha asymmetry patterns are not only less depressed, but are generally more amenable to psychotherapy.

One patient, Katy, is not included in the current study because she has continued her asymmetry training. She was initially diagnosed as having a bi-polar depression, and she did not achieve normative scores during her training. One possibility is that bi-polar depression may have a different brainwave signature than mono-polar depression. At the end of treatment her diagnosis was changed to Dysthymic. Since that time she has been stabilized on medication (a combination of Wellbutrin 500 mg and Methylphenidate hydrochloride, 10 mg) and is no longer depressed. She has normalized her asymmetry (PTAA score is 68%), and her current BDI score of 2 is well within the normal range. She has returned for additional asymmetry training with the goal of maintaining a positive asymmetry while reducing her medication.

This paper has presented longitudinal data from the first three patients who have been successfully treated for depression using an alpha

asymmetry protocol. The findings in this study are contrary to previous data regarding the stability of frontal asymmetry in depressed persons. Davidson (1998), and Henriques and Davidson (1991) found that decreased left anterior activation remains even when depression is remitted. This finding led them to hypothesize that "depressogenic" asymmetry patterns "may be a *state independent* marker that indexes risk for depression." While they discuss the need for longitudinal studies based on asymmetry patterns, they did not anticipate that EEG brainwave patterns might respond to the effects of operant conditioning, and that a change in frontal asymmetry might occur as a result of neurofeedback training. The significance of this study is the demonstration that frontal asymmetry patterns identified as a *state* or a *trait,* can be normalized in depressed persons and that changes which occur as a result of therapy can endure as long as five years. Long lasting change in frontal asymmetry may decrease vulnerability in some individuals who would be otherwise prone to chronic depression.

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