Obsessive Compulsive Disorder and the Efficacy of qEEG-Guided Neurofeedback Treatment: A Case Series

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Key Words
Neurofeedback
Obsessive Compulsive Disorder
Quantitative Electroencephalography

ABSTRACT

While neurofeedback (NF) has been extensively studied in the treatment of many disorders, there have been only three published reports, by D.C. Hammond, on its clinical effects in the treatment of obsessive compulsive disorder (OCD).. In this paper the efficacy of ctEEG-guided NE for subjects with OCD was studied as a case series. The goal was to examine the clinical course of the OCD symptoms and assess the efficacy of gEEG guided NE training on clinical outcome measures.

Thirty-six drug resistant subjects with OCD were assigned to 9-84 sessions of QEEG-guided NE treatment. Daily sessions lasted 60 minutes where 2 sessions with half-hour applications with a 30 minute rest given between sessions were conducted per day.

Thirty-three out of 36 subjects who received NF training showed clinical improvement according to the Yale-Brown obsessive-compulsive scale (Y-BOCS). The Minnesota multiphasic inventory (MMPI) was administered before and after treatment to 17 of the subjects. The MMPI results showed significant improvements not only in OCD measures, but all of the MMP1 scores showed a general decrease. Finally, according to the physicians' evaluation of the subjects using the clinical global impression scale (CGI), 33 of the 36 subjects were rated as improved.

Thirty-six of the subjects were followed for an average of 26 months after completing the study. According to follow-up interviews conducted with them and/or their famiiy members 19 of the subjects maintained the improvements in their OCD symptoms. This study provides good evidence for the efficacy of NF treatment in OCD. The results of this study encourage further controlled research in this area.

INTRODUCTION AND BACKGROUND

OCD is a debilitating psychiatric disorder. It is characterized by recurrent and persistent thoughts, impulses, images (obsessions) and/or repetitive behaviors, or mental acts that the person is dnven to perform, that are intrusive and inappropriate and cause marked anxiety or distress.' It is the fourth most common mental disorder and the tenth leading cause of disability in the world.

There are only 3 published reports!". on NF in the treatment of OCD. Currently, the most widespread treatment modalities for this disorder are pharmacological treatment with serotonin reuptake inhibitors (SR1s) with cognitive behavior therapy (CBT). Despite the proven efficacy of both SRIs and CBT, a substantial percentage of patients receive little benefit from these standard approaches.'

As effective as these treatments are, a response is usually con-%tiered an amelioration of the symptoms and not the remission of symptoms. After treatment persons suffering from this disorder may not all patients show a response to these treatments. While controlled trials with SRIs have demonstrated a selective efficacy in OCD, up to 40-60% of patients do not have a satisfactory outcome." The fact remains that a large fraction of patients without substantial response to standard treatment experience significant morbidity![8]

When investigating SRIs Ackerman and Greenland' found that a meta-analysis of 25 drug studies with OCD patients had modest improvement with domipramme. The average treatment effect on the Y-BOCS was 10.64 (uncorrected for placebo effects), which is a 1.33 standard deviation improvement. For fiuvoxamine, which is the most effective SSRI treatment for OCD, the mean Y-BOCS improvement was only 5,4 points. If the 10.64 average change of Ackerman and Greenland is used, patients scoring high on the Y-BOCS (20-30 points) will still have a mild to moderate range of symptoms (20-30 points) after drug treatment.

The efficacy and response to COT treatment is quite variable, and also may not be sustained in the long term, It is claimed that 76%-86% of patients who complete CBT treatment make improvements,"' On the other hand, intensive COT has been found to have a 75% remission rate.' O'Connor et al." found that either cognitive behavioral therapy or medication alone can help the patients to a certain level.

It is evident that other novel treatment methodologies may be needed. As an alternative treatment Rucklidge[12] introduced micronutnents to a patient who did not respond to medications and subsequently underwent CBT with a modest response. Micronutrients worked well with this patient. Ruckfidge concluded that many OCD patients are resistant to conventional treatments so alternative treatments should be introduced to patients and further research is needed on the mechanisms of micronutrients.

qEEG Findings and NF

Currently there is little evidence on the psychopathology of OCD. However, in order to apply NF treatment one needs to know which band to train and on which brain area to place the eleetrode. For this the gEEG method is quite successful in helping guide the practitioner in placement and band selection since some studies have been done in assessing the gEEG findings in OCD. One of the first qEEG studies conducted on OCD was done by Simpson et al:' In this study, patients' qEEG was recorded under symptom provocation (both live and imaginary). The results indicated that significarit EEG changes were elicited by live contaminants, but not imaginary ones, and that an increase in OCD symptoms showed an increase in posterior relative alpha activity (in comparison to anterior areas).

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PiiireepdeVioured **rig a grotv** classified as OC D. who shared the sews sairiploodalegy,cxjti ce staffed into 2 subgroups by qE.EG. One par teas characterized as harn) diffuse excessive alpha and emotive beta in frontal central and mid-teriporal areas, whereas the other glee!) was cnaractenzed by exar,srve theta activity, especially in the frontal anC posterior-temporal areas.Theta abnormalities have also been reported by Insel et al ." Jenike and Bnotman,,' Palla et al.." and Rockwell and Simons." Furthermore, Phchep et and Hansen et a1.[2,3] have been able to identify pathophysiological subgrouos within the OCD population who exhibit differences with regard to their response to serotonergic medications (responders vs. non-responders). Those patients with excess alpha relative power (with some frontal and central beta excess) were found to respond positively 82% of the time to serotonin mediated antidepressants, whereas, the second subtype with increased theta relative power (with some alpha minima) failed to improve 80% of the time with SRIs.

In a study conducted by Pogarell et authors found that patents who had high levels of obsessions had nigher absolute EEG power measures. especially in the faster frequencies (alpha2, betel), whereas patients with high compulsion scores had lower absolute EEG Power, This may be related to increased mental activity in obsessions as opposed to compulsions.

In a study conducted by Bum et al," decrease of the slow a-band power in OCD as compared to healthy subjects was observed. A significant negative correlation between the slow a-band power and me time to complete a neuropsychoogical test exploring executive functions was found: the more reduced the slow a-band power, the slower the performance on this test. Bolwig et found an excess in the alpha range witn sources in the corpus striatum, in the orbito-frontal and temporo-frontal regions in untreated OCD patents. This abnormality was seen to decrease following successful treatment with paroxetine. Finally, Tot et al,m found OCD patients to be characterized by increased slower frequencies and slow alpha frequencies, especially in the left fronto-temporal areas, when compared against age matched norms.

As can be seen, since gEEG findings tend to see OCD as a heterogeneous group who share the same symptoms, this may expain why current treatments are not effective in all patients, and the duration of positive effects are not long lasting, This may indicate that different modalities of treatment may be needed to efficiently treat these subgroups.

NF is an intervention aimed at training individuals to better regulate tie biological functioning of their own brain. This has generally involved the self-regulation of EEG rhythmic activity, traditionally referred to as EEG biofeedback, NF or neurotherapy. In NE training the subject is placed in front of a computer screen which displays the subjects digitized and analyzed brain electrical activity. The display can be either in the form of a complex video game type of displays, or in the form of simple bar graphs. The thresholds of the activities which are to be increased and/or decreased are set on the display. When the undesired activity decreases below the thresnold andice when the desired activity increases above the threshold a pleasant tone is heard through the attached headphones, and the display will change. In some systems, the subject can also earn points based on his/her performance providing additional feedback. As the sessions are repeated, the thresholds are gradually modified inhibiting the undesired activities and reinforcing tie desired activities thereby conditioning to endure these activities."

NF has been used successfully with ADHD/Learning epilepsy,"" anxiety.[3,4,6] mild head injuries" and even in autism.[4]" the treatment of OCD with NE. Therefore, seeing a need for more information in this area we decided to investigate tie efficacy of gEEG-guided NE in subjects with OCD as case series

MATERIALS AND METHODS

We studied 36 subjects ranging in age 18-59 years old. Inclusion criteria: Subjects were included from patients visiting the center who met DSM-IV diagnostic criteria for OCD. Subjects should have had received at least one treatment modality which was ineffective. Additionally, the subjects should not have any history of physical illness; the baseline laboratory tests (Hemogram, 812, 86, Folic Acid, THS and urine drug screening for illicit drugs) had to be normal. Exclusion Criteria: The presence of any other psychiatnc disorder, nistory of past or present drug abuse, head trauma with loss of consciousness, suicide risk and/or abnormal blood test results, All the subjects in the study used medication prior to the treatment. The mean total number of medications used in the past was 3,6 (±. 2.2). The mean duration of illness was 8.0 years (± 4,7y.). On inclusion all medications were discontinued and 34 patients were medication free at baseline and for the entire NF treatment duration. Only 1 patient received medication (chlornipramine) during NF treatment since it was necessary to manage her symptoms However, she was taking 2 medications at toe time of admission, It was discovered that another patient was self-medicating with bipehdline during the treatment phase. Evaluation measures included family history. QEEG data which was processed with the Nx-Link database, and the following ratings scales

The Yale-Brown obsessive compulsive scale (Y-BOCS) was designed to remedy the problems of existing rating scales by providing a specific measure on the severity of the symptoms of OCD that is not influenced by the type of obsessions or compulsions present. The scale is a clinician-rated, 10 item scale, eacn item rated 0 (no symptoms) to 4 (extreme symptoms) (total range 0 to 40). The scale rates obsession and compulsive components and provides subscores for each. A cut-off score of 16 is usually used for inclusion into OCD medication trials.' In this study subjects were rated before treatment, and after completion of treatment,

The clinical global impression (CGI) rating scale is a commonly used scale that measures symptom severity, treatment response and the efficacy of treatments r treatment studies of patients with mental disorders." In this study changes in the severity scale, pre- and post-treatment were assessed. The clinical global impression-severity scale (CGI-S) is a 7-point scale that requires the clinician to rate the severity of the subject's illness at the time of assessment, relative to the clinician's past experience with subjects who have the same diagnosis Considering the total clinical experience, a subject is assessed on the severity of the mental illness at the time of rating where: 1= normal, not at all ill: 2 = borderline mentally ill: 3 = mildly 4 = moderately ill; 5 = markedly ill: 6 = severely ill; and 7 = extremely

An MMPI was administered to all subjects before treatment and after completion of treatment, however, results were only available for 17 out of the 36 subjects. The MMPI, although developed as a tool to assess personality, lends itself to measuring changes in psychopathology. It is appropriate for assessing treatment outcomes in patient samples where Psychopathology is being evaluated, particularly if the emphasis is being placed on DSM-IV Axis I disorders." Since it is sensitive to psychopathology, as the illness recedes the pathological scores decrease (e.g., normalize). The MMPI is very difficult to fool, whereas the patient can more easily manage the doctor interview and the Y-BOCS rating thus affecting the CGI and Y-BOCS results. Since this is not a double blind

study the MMPI may provide a counterpoint to the bias of the doctor, All patients were interviewed by the center staff. Informed consent was obtained from all subjects, and independent investigations were conducted.

To determine the locations and bands to be used in NF treatment, gEEGs were recorded with a Lexicor Neurosearch-24 qEEG system (software version 3.10). All EEGs were recorded drug free. In order to ensure that all subjects were drug free, all medications were discontinued at screening, and the recordings were performed after a washout period equal to 7 half-fives of the medication they were taking prior to admission. For example, the half-life of chlornipramine is 35 hours so 7 half-lives (in days) would be equivalent to 7 x 35/24 = 10.21 days, therefore, the EEG would be recorded on the 12th day after cessation of medication. EEG signals were sampled at 128 samples per second per channel, Samples were analyzed with a normative neurometric approach using the Nx-Link database software (version 2,40), The NxLink database software is based on the work of E. Roy John and is a method of quantitiative EEG that provides a precise, reproducible estimate of the deviation of an individual record from normal. QEEGs were recorded and compared against the Nxlink database both before and after treatment as well as every 40 sessions, in order to reveal the divergence of the brain electrical activity from norms, in the form of 2- scores, and to guide the NF treatment protocols by training the areas that show deviations from normal, as determined by the comparisons to the Nxlink database. In Neurometnc QEEG analysis, all QEEG variables are calculated as Z-scores which is a score equal to the distance (deviation) from the norm in standard deviation units. The rationale behind this approach is that the subjects who normalize their QEEG Z- scores will benefit the most from NF.

When the baseline gEEG of this population was analyzed, excessive theta and/or alpha with **a** generalized distribution, especially in relative power was observed. In addition, the following findings were observed (Table 1). As can be seen, a little over half of the subjects showed increased relative alpha activity (in comparison to norms) and half of those with increased relative alpha power also showed increased coherence (hypercoherence) in the alpha band. Hypercoherence is said to be present in the EEG when two brain sites or areas are overly connected, as indicated by the two waveforms at these different sites being more similar in terms of morphology than an age-matched normal subject. Hypercoherence can be regarded as a kind of immaturity wherein cortical areas do not specialize and take on specific abilities

and thus appear overly similar to each other.**NF Treatment**

All the NF training was performed using Lexicor Biolex software (version 2.40). Each session was of 60 minutes duration, with 1 session per day. Electrodes were placed according to the International 10-20 System. Between 9 and 84 NF training sessions were completed, depending on the case. Treatment termination was based on the changes (a decrease) of symptoms in comparison to the pre-treatment complaints. The mean number of sessions was 50.2 (t 22,4 STD),

Electrode sites for training were selected based on the QEEG analysis (using the (Nx-Link database). The location of the deviant Z-scores is most important no matter what the EEG measure. A general rule is to link the patient's symptoms to deviant Z-scores located in regions of the scalp related to functional specialization in the brain and the patient's symptoms."" The importance of proper area and band selection was also shown by Moore° in a review of 2 OCD studies he conducted, where he found that pure alpha training did not produce any benefits. Moore concluded that the reason was that there were 2 OCD

Table I

Screening QEEG deviations from norms

Primary Finding		Secondary Finding	
Increased relative alpha power	20	Increased alpha coherence	10
Increased **relative** theta power	10	Increased theta coherence	3
Increased relative beta power	4		
Increased relative theta and beta power			
Increased relative alpha and beta power			

subgroups both of which would not have benefited from alpha training. The frontal and frontotemporal electrode sites were selected according to the subject's QEEG and also according to previous studies based on the frontal, prefrontal and fronto-temporal deviations from norm based on the QEEG recording of OCD patients. The most commonly used electrode sites were as follows (both bipolar and monopolar). In NF inhibit moans keeping the activity below a set threshold whereas reward means keeping the activity above a set threshold:

The frontal and centro-parietal-temporal electrode sites below were selected according to subjects QEEG and Broadmann Areas (BA) The criteria to shift from one site to another is the z-score values or based on the first author's clinical experience.

FP1-FP2: Theta or p-inhibit, a-inhibit, p(21-32)-inhibit

F3: Theta or (x-inhibit, a-inhibit, p(21-32)-inhibit or (1 3-32)-inhibit

FL Theta or a-inhibit, p(21-32)-inhibit, or N13-32)-inhibit

F4: Theta-inhibit, a-inhibit, 3(21-32)-inhibrt or (i(13-32)-inhibit

Fp1-1'4; Theta-inhibit, a-inhibit, p(21-32)-inhibit or p(13-32)-inhibit

The $Fp0_2$ site was helpful for the fear and anxiety problems. Fp° stands for Frontal Pole Orbital (pre-frontal) and 7' signifies the right side of the brain This site is outside the standard 10-20 system at the juncture of the right brow bone and top of the nose, in the inner corner of the eye socket.[6-2]

$Fp0_2$: Theta-reward, a-inhibit, p(21-32)-inhibit or a-reward. Theta-inhibit. p(21-32)-inhibit

Central-parietal area electrode sites were selected for procedural memory and brain area 24, the Anterior Cingulate for being the hub of the affective limbic system. Brain Area 40 representing cognitive reasoning, imagination was also used.

C4-P4: Theta-inhibit, a-inhibit, p(21-32)-inhibit or p(13-32)-inhibit or SMR-reward, Theta-nhibit, p(21-32)-inhibit

P4; Theta-inhibit, a-inhibit, p(21-32)-inhibit or (1(13-32)-inhibit

The sensory area was selected for sleep regulation. BA 24 Anterior Cingulate: Hub of affective limbic system.

Cz-G4: Delta-inhibit, Theta-inhibit, p(21-32)-inhibit

Coherence training was performed according to z-scores. Hyper coherence can be considered as a lack of differentiation of brain functions or as a decrease in "flexibility" of functioning.

FP1-FP2.

F3-F4, P3-P4: is coherence-inhibit, a-inhibit, p(21-32)-inhibit or p(13-32)-inhibit

Table 2

YBOCS results. Changes in the severity of illness based on the Yale Brown Obsessive Compulsive Scale

Al) Patients	Total Score		Obsession Subscale		Compulsion Subscale	
	Pre	Post	Pre	Post	Pre	Post
Mean	27,58	6.06	17.08	3.64	10.50	2.42
Standard Deviaton	9,65	10,36	5.73	5.66	9.37	5.26
Mean Difference (Post-Pre)		-21,53	.13.44		-8.08	
F(1,35)		134.77	129.63		31.06	
ri(1,35)		079	0.79		0.47	
Significance		P < 0.01	P < 0.01		P < 0.01	
Pure Subgroups			Obsessional Group (reponAg only obsessions will no complsionsl		Compulsion Group' (reporting only compulsions with no obsessions)	
			Pre	Post	Pre	Post
Mean			18.64	3,97	20.00	1.67
Standard Deviation			2.97	3.68	0	2.89
Mean Difference (Post-Pre)			-15.80		-18.33	
F(1,35)			193.9		226.63	
r(1 35)			0.93		0.99	
Significance			P <0.01		P < 0.01	
Mixed Subgroup reporting both obsessions and compuwans)	Total Score		Obsession Subscale		Compulsion Subscale	
			Pre	Post	Pre	Post
Mean	36.44	9,61	18.78	5.06	17.67	4.56
Standard Deviation	4,20	13.50	2.05	7.03	3.65	6.78
Mean Difference (Post-Pre)	-26.83		-13.72		-13.11	
F(1,35)	56.48		50,05		47.67	
if(1,35)	0.64		0.61		0.60	
Significance	P < 0.01		P<0,01		P<0.01	

For illustration purposes only, due to small N (3)

RESULTS

The study included 12 males and 24 females. The mean age for the group was 30.1y (±9.0y). For males the mean age was 25.8y (±5.2y) and for females was 32.3y (±9.8y). Twenty-six out of 36 had a family history of some sort of psychiatric illness. Since the inclusion was based on patients that came for treatment to the clinic, without any a priori selection criteria, more females than males were included.

The pre- and post-study results are shown in Table 2. As can be seen NF treatment reduced Y-BOCS total score from 27.58 (±9.65 std) (which is above the cut-off score of 16) to 6,06 (±1036), which corresponds to a reduction of 21,53 points A repeated measures ANOVA, where intra-subject effects were accounted for, was performed on the data and the overall change was found to be significant at the p<0.001 level (F(1,35) =134.77, 01,35) = 0.79). Tests were performed on the subscales separately and all were found to be significant at a p < 0.001 level of significance. One group reported only obsessive symptoms (N=15), one group only compulsion symptoms (N=3) and a th:rd group reported both symptoms (N=18). These were analyzed separately and all 3 groups reduced their scores significantly (p <0.01).

The results of the CGI pre- and post-treatment assessment along with the statistical analysis of the results (based on repeated measures ANOVA corrected for intra-subject variance) are given in Table 3,

According to the CGI results the decrease of the score of -4 points was found to be statistically significant at the p < 0.01 level (F(1,35) = 205.94. 11^2(1,35) = 0.85 The group (as a whole) was rated as being severely ill, whereas at the end of treatment they were rated as being borderline mentally ill showing a 4 point decrease in the severity of their illness.

Table 3

CGI Results. Changes in the clinical global impressions severity score

Severity	Pre	Post
Mean	6.22	2.03
Standard Devation	0.76	1.75
Mean Difference (Post-Pre)	-4.19	
F(1,35)	205.94	
)1^2(1,35)	0.85	
Significance	P < 0,01	

The MMPI was admiwstered to all sub,ects before and after treatment, however, results were only available for 17 out of the 36 subjects. Two scores were analyzed, the psychasthenia score and the depression score. The Pt scale was originally developed to measure the general symptomatic pattern labeled by Marks et al." as psychastnena not commonly used today, which is characterized by excessive doubts, compulsions, obsessions, and a rigid and perfectionist personality with unreasonable fear. Psychasthenia can be considered very close to modem OCD. The depression score was analyzed because it showed the highest value at 75 indicating a score greater than 2 standard deviations from the norm. The results of the changes before and after treatment are given in Figure 1.

As ths figure demonstrates, there is a general decrease in all the scores after NF treatment. The analyzed scores show a statistically significant decrease (Table 4). The depression score change of -17,88 was found to be significant at a p < 0,01 level as assessed by a repeated measures ANOVA taking into account the intra-subject

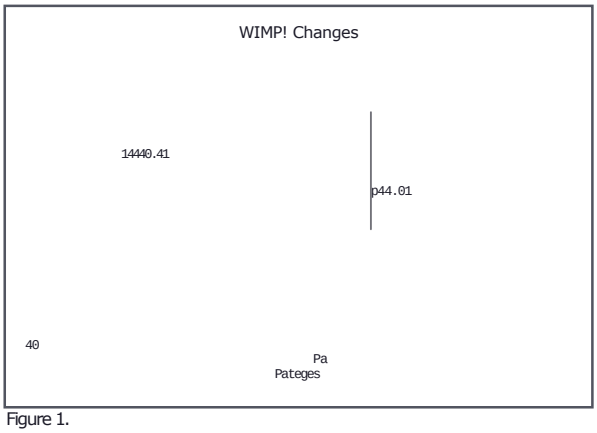

Figure 1.
Changes ·n Pi category scores before and after NF treatment.

Table 4
MMPI results. Changes in the severity of illness based on the Minnesota multiphasic inventory (MMPI)

	Depression Score		Psychasthenia Score	
	Pre	Post	Pre	Post
Count	17	17	17	17
Mean	74.76	56.88	72.06	56.65
Standard Deviation	11.78	10.37	8.17	10.85
Minimum	50	37	55	37
Median	78	55	73	60
Maximum	90	78	85	71
Mean Difference (Post-Pre)	-17,88		-15.41	
F(1,32)	27,07		19.42	
101,32)	0.64		0.55	
Significance	P < 0,01		P< 0,01	

variance (F(1,16) = 27.07, 01,16) = .64). The same was true for the psyr.tasthenia score which showed a change of -15,41 was also significant at the p < 001 level (F(1,16)=19,42. rj^2(1.16)=0.55). Also. as can be seen in Figure 1, there is a trend towards normalization of all scores from 1-2 standard deviations above the norm, (50 = normal, 60 = 1std, 70 = 2std) to within the norm (under 60).

Long-Term Follow-Up

Two years after the subjects completed their treatment they were followed-up by telephone and queried as to their disposition. The average time of contact after termination of treatment was 26 months, Of the 36 original patients, all were reached. Of these 19 remained symptom free or improved, 9 had developed mild symptoms which did not intelere with their daily functioning, and they did not feel the need to seek treatment, and 5 had relapsed. Of tie 2 patients who received medication during treatment, one was in the group that did not respond to treatment. The patient also did not respond to medication and was in the relapse group. The other patient who received medication responded well to NF treatment and remained improved and medication free

CONCLUSION AND DISCUSSION

The goal of this case series was to explore the effect of gEEG guided NF treatment in OCD, since very little information on this topc nas been published.

The main NF treatment strategy was to decrease hypercoherence brain areas where the subjects coherence value is higher than the corresponding norm) first, and then decrease individual activities that showed deviations from norm. Overall, the most common training sites were F3, Fz. F4 and the C4-P4 bipolar site.

The case study group assessed in this study showed improvement in all of the scales measured. The subjects reported improvement as measured by the Y-BOCS. The magnitude of the improvement was 21.53 points which was almost double the 10.64 point improvement seen in the average improvement with drug treatment by Ackerman and Greenland.' These changes were observed by the physician, in that the group was rated at being severely ·11 at the start of treatment and were rated as being borderline ill at the end of treatment. This change was also observed by psychological testing as seen in the MMPI results. Not only was there a significant improvement of the scales that were clinically relevant (above 701, but all scores showed a general normalization (e.g.. the group's values, after treatment are closer to the normal range than before treatment). Finally, when the subjects were fo.3owed-up 2 years after treatment, of those from tie original group that were contacted (36 out of the 36). 19 remained symptom free or improved, 9 had deveioped mild symptoms, and 5 nac relapsed. Therefore, for the malonty of this group of patients, NF treatment was not only effective, its effects lasted up to 26 months after cessation of treatment. These results are congruent with the results of long term follow-ups that have been done in other NF studies."""""""" The same long-term effect of NF is also seen in this study of OCD.

Only 1 subject received medication (chlomipramine) dunng the course of the study. This subject did not respond to either NF or medication treatment. A second subject who responded to NF was later found out to have been self-medicating with biperidine. At this juncture it cannot be determined whether the improvement is due to NF treatment, the medication or the combination of the two.

Another important factor that NF may be able to address is learned nelplessness, their inabiity to control their obsessions and compulsions, and the inability of their previous treatments in alleviating their condition reinforced their helplessness in overcoming this disorder. Learned helplessness is seen in people with pessimistic explanatory style — which sees negative events as permanent ("it will never change"). personal (Ifs my fault'), and pervasive ("I can't do anything correctly") — are most likely to suffer from learned helplessness and depression. [5ı] A common complaint verbalized by all of the subjects in this study was "Am I ever going to get better?', or 'Do I have to live with this illness the rest of my life and I should get used to it?" In some cases the fact that they had to get used to living with this illness was conveyed by tie physician that they sought treatment from, before coming to our center. Their inability to control their obsessions and compulsions, and the inability of their previous treatments in alleviating their condition reinforced their helplessness in overcoming this disorder. With NP treatment all subjects were actively engaged in their treatment since all of them complied with their schedule and training regimen. In this way the subject's own controi systems most probably came into play without any recommendations and/or promoting from the center staff, and they learned how to work tc overcome their disorder themselves.

The anatomical basis for OCD is complex and still under investigation although anterior cingulate cortex (ACC) abnormalities are being seen consistently in the pathophysiology of OCD.[65] The ACC can be divided into cognitive (dorsal) and emotional (ventral) components. The dorsa• part of the ACC is connected with the prefrontal cortex and

parietal cortex as well as the motor systems and frontal eye fields." The ventral part has connections to the amygdala, the nucleus acumens, the hypothalamus, and the anterior insula, It is involved in assessing the importance and relevance of emotional and motivational information, A number of SPECT studies report hyperfrontality (increased right and left anterior prefrontal cortex activity and increased anterior cingulate gyrus activity) and increased basal ganglia activity in obsessive compulsive disorder (0CD).% NF may be involved in helping in the proper self-regulation of these pathways.

The average length of treatment in our study was 1-2 months. This duration is less than seen with pharmacological treatment in OCD. According to the "Practice Guideline For The Treatment of Patients With Obsessive-Compulsive Disorder", prepared by the Work Group On Obsessive-Compulsive Disorder:

Most patients will not experience substantial improvement until 4-6 weeks after starting medication, and some who will ultimately respond will experience little improvement for as many as 10-12 weeks. Successful medication treatment should be continued for 1-2 years before considering a gradual taper by decrements of 10%•25% every 1-2 months while observing for symptom return or exacerbation.

When comparedlo 2 years of treatment, 1-2 months is favorable. Also when the previous treatment history of this group is taken into account we see that the mean of the total number of medications used in the past is 16 (± 2.2). and the mean of the duration of illness was 8,0 years (± 4.7y.). This group was able to be medication free and functioning within 2 months whereas they were suffering with their disorder for years, and taking numerous medications with little or no effect A

The goal of this study was to investigate the utility of NF as a treatment for OCD. Although the results were positive there are obvious ; limitations to this study. The male/female ratio was unbalanced; the treatment duration was not controlled showing variability in the number of sessions necessary for treatment, and the investigator and the patient were not blinded as to the treatment. It would be appropriate and usefui to investigate whether these results are replicable with better, more controlled study designs, since in this group of patients we were able to see results comparable to those seen after medication treatment.

DISCLOSURE AND CONFLICT OF INTEREST

T. Surmeli and A. Ertem have no conflicts of interest in relation to this article.

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