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Investigating the effect of adding neurofeedback to the choice treatment (cognitive behavioral therapy and medication) on obsessive beliefs and early maladaptive schemas in patients with obsessive-compulsive disorder

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Abstract

Introduction: This study aimed to investigate the effects of adding Neurofeedback Therapy (NFT) to taking medication (Selective Serotonin Reuptake Inhibitors: SSRIs) and Cognitive Behavioral Therapy (CBT) in patients with Obsessive-Compulsive Disorder (OCD) on Obsessive Beliefs (OBs) and Early Maladaptive Schemas (EMSs).

Materials and Methods: In this clinical trial conducted in Mashhad, Iran in 2019, 10 diagnosed OCD patients were selected using purposeful sampling. They were randomly assigned into equal two groups (group 1: NFT + SSRIs + CBT, group 2: SSRIs + CBT). They were evaluated using the Obsessive Beliefs Questionnaire (OBQ) and Young Schema Questionnaire-Short Form (YSQ) before intervention, on the 8th session, after treatment, and a two-month follow-up. Repeated-measures ANOVA tests were used for statistical analysis.

Results: There was a significant time \times intervention effect for all fifteen EMSs ($P < 0.05$) and three OBs ($P < 0.05$); however, significant time \times condition interaction has been seen for responsibility/threat estimation belief ($P < 0.05$) and abandonment, defectiveness/shame, enmeshment/undeveloped self, insufficient self-control/self-discipline, mistrust/abuse, subjugation, and social isolation/alienation, and unrelenting standards schemas ($P < 0.05$). We found no significant difference between treatment groups in EMSs and OBs.

Conclusion: The results showed that both treatment plans are effective in the reduction of obsessive beliefs and early maladaptive schemas; however, adding neurofeedback to standard therapy has not resulted in significant differences in reducing obsessive beliefs and early maladaptive schemas in patients with obsessive-compulsive disorder.

Keywords: Cognitive-behavioral therapy, Neurofeedback therapy, Obsessive-compulsive disorder, Selective serotonin reuptake inhibitors

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Introduction

Obsessive-Compulsive Disorder (OCD) is the fourth most prevalent psychiatric disorder with %1.3 lifetime prevalence (1,2). Mood (15%) and anxiety (14%) disorders are the most comorbidities of OCD (3).

Multiple biological and psychological factors cause OCD. OCD basis is abnormalities in a neural circuit (increased in basal ganglia activity), neurotransmitter dysfunction (imbalance in serotonergic and dopaminergic systems), and hyperactivity in the orbitofrontal-striatal circuit containing the orbitofrontal, cingulate gyrus, and subcortical structures including the hippocampus, basal ganglia, and amygdala (4,5).

The psychological etiology of OCD involves factors such as parenting, family dynamics, early life experiences, early maladaptive schemas, and obsessive beliefs. The Obsessive-Compulsive Cognition Working Group (OCCWG) suggests that OBs can contribute to OCD development and maintenance. OBs make normal intrusive thoughts seem unacceptable, harmful, or dangerous (6). OCCWG's OBs include Responsibility/Threat estimation (RESP/THREAT) for the responsibility of harm avoidance, Perfectionism/Certainty (PERF/CERT) involves high standards, a fear of making mistakes, tolerance for uncertainty, and the Importance/Control of thinking (IMP/CONT), which means thoughts are significant, representing one's actual wishes and sentiments. (7). Obsessive beliefs predicted all OCD aspects except contamination, and they are connected with subtype symptoms (8).

Some EMSs participate in OCD development and maintenance. EMSs are dysfunctional themes and patterns of emotions, imaginations, cognition, memories, and physiological sensations that arise from childhood trauma and are awakened by unpleasant life events (9). Several studies showed EMSs scores in OCD patients significantly higher than in the control group (10-12). Our previous study also showed that the mediating role of obsessive beliefs was significant concerning emotional deprivation, abandonment/instability, defectiveness/shame, and unrelenting standards with the severity of obsessive-compulsive symptoms (13).

Different treatments are employed for OCD due to its multiple origins. Exposure and Response Prevention (Ex/RP) and SSRIs are first-line OCD treatments. (14). Although

Ex/RP and SSRIs are highly effective for most patients and about 40-80% of patients respond well to treatment (15), they also have their limitations, such as partial response and high recurrence rate patients' refusal (16-18).

Previous studies reported that Perfectionism/Certainty and EMSs related to dependency and incompetence significantly mediated treatment response (19). Moreover, an improvement in EMSs during Ex/RP in OCD patients was a predictor of treatment outcomes (20). Therefore, it seems that complementary therapies are essential for these patients.

Given the inadequacies of current treatment, experts are exploring alternatives to improve it. Recently, neuropsychological therapies have been considered (21). Neurofeedback Therapy (NFT) alters, enhances, modulates, and boosts brain cell efficiency. Simple reinforcement will teach the brain to prolong regular brain wave patterns (22). Adding NFT to regular therapy significantly reduced OCD severity, obsessions, and compulsions (23,24). Adding neurofeedback to standard treatment was evaluated in our prior study. Neurofeedback dramatically improved treatment results like OCD severity and obsessions (25). To determine which component changes are responsible for the significant improvements in treatment results after introducing neurofeedback, our study examined if adding NFT, which focuses on symptom reduction, can also modulate underlying components such as OBs and EMSs.

Materials and Methods

The current research was approved by Shahid Beheshti University of Medical Sciences. The statistical population consisted of OCD patients. The samples were selected from those who were referred to a specialized psychological and psychiatric clinic in Mashhad, Iran, in 2019. About 30 outpatients were interviewed after an online invitation to participate in the study. Ten patients were selected purposefully and randomly assigned to NFT+CBT+SSRIs or CBT+SSRIs (five per group). The groups matched in terms of demographic factors such as age, gender, education, and socioeconomic status. This study followed ethical standards and required informed consent from all participants.

Inclusion criteria included receiving a primary diagnosis of OCD, being outpatient,

having at least eight weeks duration of medication and one year of OCD duration, 18-50 years old, and having a high school education. The exclusion criteria included concurrent psychotherapy or medication use, not accepting NFT or medication for OCD, having suicidal thoughts, or other psychiatric disorders, history of recent brain injury or surgery, pregnancy and lactation, and absence in five sessions.

Procedure: A blind psychiatrist made the diagnosis, but a psychotherapist specializing in neurotherapy provided treatment. Psychotherapy and neurotherapy were done at

a private clinic and Ibn-e-Sina Hospital in Mashhad, Iran. All patients take SSRIs prescribed by a psychiatrist (sertraline 100 mg, fluvoxamine 100 mg, or fluoxetine 40 mg (26) for at least eight weeks before the pre-test and continued throughout treatment. All patients underwent weekly Foa and Yadin's (27) fifteen 90-minute CBT sessions. Patients in the NFT group underwent thirty 45-minute sessions twice a week. NFT was delivered on two brain regions related to OCD abnormalities, C4 and Fz-Pz (28,29). Table 1 presents the details of therapy sessions. Data were analyzed by an independent analyzer after collection.

Table 1. The content of the interventions

Intervention	Content	
CBT	Evaluation session	Conduct the assessment Set initial treatment goals
	First and second sessions	Explain what OCD is and how it develops Provide a rationale for treatment (how Ex/RP is working) Sharing the treatment plan
	Middle sessions	Perform variations of Ex/RP based on a set hierarchy
	Final session	Reviewing what was learned in therapy Planning for possible problems in the future and ways to deal with it Planning to continue Ex/RP for minor residual symptoms or later symptoms arise
NFT	30 sessions twice a week lasted for 45 minutes	1. 10 minutes: Suppression of thalpa (6-10 Hz), Beta (18-22 Hz), Reinforcement of SMR (12-15 Hz) on C4 2. 20 minutes: Suppression of High Beta (18-30 Hz) on Fz-Pz

Research instruments

A) *The Structured Clinical Interview for DSM-IV Axis I and II Disorders (SCID)*: Psychiatrists utilize the SCID to diagnose patients using DSM-IV Axis I and II. Kappa coefficients of 0.71 for axis I and 0.84 for axis II indicate inter-rater reliability (30). This study used the Persian-translated and adapted SCID with 0.6 Kappa coefficient retest reliability (31).

B) *Obsessive Beliefs Questionnaire (OBQ)*: Three subscales of the 44-item self-report OBQ measure beliefs regarding RESP/THREAT, PERF/CERT, and IMP/CONT on a 7-point Likert scale (completely disagree to completely agree. Its internal stability was $\alpha = 0.80$ (7). Persian whole-test Cronbach's alpha is 0.92 (32)

C) *Young Schema Questionnaire-Short Form (YSQ)*: The YSQ-SF is a 75-item self-report measure that assesses 15 EMSs. Respondents

rank each character concern on a Likert scale from 1-6. EMSs severity increases with the score. The YSQ-SF has demonstrated adequate psychometric properties (33). Yalcin et al. found that the YSQ has a powerful predictive validity of psychological distress (34). The Cronbach's alpha coefficient of the Iranian version is between 0.76 and 0.90 for the subscales and 0.96 for the whole scale (35).

Demographics were analyzed employing the Exact Fisher, Shapiro-Wilk and Levene's approaches ensured distribution normality and variance equality. Repeated-measures ANOVA tests were used for statistical analysis.

Results

Based on the demographic data, the participants' mean age was 30.80 ± 6.01 years, and mean of OCD duration was 13.90 ± 5.21 years and the mean age of onset was $16.90 \pm$

3.07 years. 60% of participants were married, and 70% were women. EMSs and OBs scores were compared before, on session 8, post-treatment, and two-month follow-up using

repeated-measures ANOVA. Mean and standard deviation changes of OB and EMS during treatment are presented in Table 2.

Table 2. The descriptive findings of OBs and EMSs before, 8th session, after treatment, and follow-up

Variable	NFT+CBT+SSRIs				CBT+SSRIs			
	Before	8 th session	After	Follow-up	Before	8 th session	After	Follow-up
RESP/THREAT	81.20	64.20	32.60	30.60	71.80	60.00	47.60	47.20
	12.04	7.91	10.87	11.82	19.63	16.67	13.44	17.55
PERF/CERT	77.60	63.80	41.80	37.60	77.00	60.60	50.60	54.00
	12.97	14.25	13.00	23.30	13.47	6.80	5.81	15.37
IMP/CONT	57.80	44.00	24.20	24.60	51.40	41.80	32.40	31.80
	14.09	7.48	10.35	10.01	16.24	10.49	5.31	9.54
Ab	28.20	24.80	18.60	15.80	17.80	13.80	13.40	13.20
	2.68	3.11	7.40	7.19	7.46	7.72	7.66	9.78
DI	26.00	22.40	17.60	15.60	16.40	15.40	11.80	11.80
	4.30	7.36	8.14	8.44	6.38	8.35	8.28	8.87
DS	21.80	18.00	12.00	7.60	15.20	13.40	12.00	12.40
	6.64	5.33	4.84	2.07	6.76	6.14	6.96	10.16
ED	20.20	15.80	13.20	12.40	18.40	14.80	13.00	13.20
	8.92	7.98	7.08	6.30	7.12	8.70	9.82	10.03
EI	18.20	11.80	9.00	7.60	17.00	14.20	13.00	12.00
	7.66	1.78	2.54	2.79	7.31	7.46	7.00	5.52
EM	25.40	19.20	13.80	10.40	17.80	14.80	12.40	12.80
	6.69	6.76	6.37	3.57	6.90	7.15	5.63	9.65
EG	23.60	17.60	13.00	12.00	16.40	14.20	14.60	12.60
	5.31	5.85	4.12	5.52	4.33	5.67	6.46	3.91
Fa	26.40	22.80	16.40	15.00	15.80	14.00	10.80	13.00
	2.30	5.63	6.42	5.29	6.97	6.36	6.22	10.70
IS	27.40	23.20	19.20	14.60	18.80	16.60	14.60	15.20
	3.57	4.20	4.96	7.02	6.57	5.89	7.12	8.75
MA	19.00	14.40	8.80	8.00	15.00	13.80	12.20	13.20
	5.38	3.57	2.28	2.73	6.28	6.45	6.94	9.65
Sb	26.40	22.40	13.40	11.20	17.20	15.00	13.60	15.20
	3.91	6.87	5.12	3.96	3.42	3.87	4.50	7.79
SI	23.60	18.40	13.20	10.20	14.20	13.60	11.60	11.80
	4.03	3.84	3.56	3.34	5.54	6.06	7.23	9.12
SS	23.80	17.60	14.00	13.80	16.80	14.00	13.80	15.00
	5.06	4.15	6.78	7.22	1.09	2.34	2.7	7.07
US	20.60	15.80	12.00	11.00	18.00	15.80	15.20	15.00
	8.35	6.41	6.16	4.18	4.58	5.26	5.35	5.00
VH	24.20	20.60	13.80	10.80	18.80	15.00	12.40	11.80
	5.49	6.69	5.49	1.64	6.64	8.45	8.23	10.32

Responsibility/Threat estimation (RESP/THREAT), Perfectionism/Certainty (PERF/CERT), Importance/Control of thought (IMP/CONT), Abandonment (Ab), Dependence/Incompetence (DI), Defectiveness/Shame (DS), Emotional Deprivation (ED), Emotional Inhibition (EI), Enmeshment/Undeveloped Self (EM), Entitlement/Grandiosity (EG), Failure (Fa), Insufficient Self-control/Self-discipline (IS), Mistrust/Abuse (MA), Subjugation (Sb), Social Isolation/Alienation (SI), Self-Sacrifice (SS), Unrelenting Standards (US), Vulnerability to Harm or illness (VH).

Tables 3 and 4 provide the tests of within-subjects effects and tests of between-subjects effects for OBs and EMSs, respectively. Tables 3 and 4 show a significant time × intervention effect for all EMSs and 3 OBs observed;

however, significant time × condition interaction has been seen for RESP/THREAT belief and Ab, DS, EM, EG, IS, MA, Sb, SI, US schemas. There was no significant difference between groups on EMSs and OBs.

Table 3. Analysis of variance results for obsessive beliefs and time variables

Variable	Source	Type III Sum of Squares	DF	Mean Square	F	P	Partial Eta Squared	
RESP/THREAT	Within group	Time	3	3308.13	27.08	0.00	0.77	
		time * group	3	437.96	3.58	0.02	0.30	
		Error (time)	24	122.15				
	Between-group	Intercept	118374.40	1	118374.40	267.27	0.00	0.97
		Group	202.50	1	202.50	0.45	0.51	0.05
		Error	3543.10	8	442.88			
PERF/CERT	Within group	Time	3	2260.49	19.04	0.00	0.70	
		time * group	3	202.09	1.70	0.19	0.17	
		Error (time)	24	118.68				
	Between-group	Intercept	133980.62	1	133980.62	308.01	0.00	0.97
		Group	286.22	1	286.22	0.65	0.44	0.07
		Error	3479.90	8	434.98			
IMP/CONT	Within group	Time	3	1629.00	20.30	0.00	0.71	
		time * group	3	127.76	1.59	0.21	0.16	
		Error (time)	24	80.23				
	Between-group	Intercept	59290.00	1	59290.00	250.02	0.00	0.96
		Group	28.90	1	28.90	0.12	0.73	0.01
		Error	1897.10	8	237.13			

Responsibility/Threat estimation (RESP/THREAT), Perfectionism/Certainty (PERF/CERT), Importance/Control of thought (IMP/CONT)

Table 4. Analysis of variance results for early maladaptive schemas and time variables

Variable	Source	Type III Sum of Squares	DF	Mean Square	F	P	Partial Eta Squared	
Ab	Within group	Time	3	142.60	12.39	0.00	0.60	
		time * group	3	41.50	3.60	0.02	0.31	
		Error(time)	24	11.50				
	Between-group	Intercept	13249.60	1	13249.60	81.72	0.00	0.91
		group	532.90	1	532.90	3.28	0.10	0.29
		Error	1297.00	8	162.12			
DI	Within group	time	3	124.55	12.10	0.00	0.60	
		time * group	3	14.69	1.42	0.25	0.15	
		Error (time)	24	10.29				
	Between-group	Intercept	11730.62	1	11730.62	57.69	0.00	0.87
		group	429.02	1	429.02	2.11	0.18	0.20
		Error	1626.60	8	203.32			
DS	Within group	time	3	143.76	12.06	0.00	0.60	
		time * group	3	64.60	5.42	0.00	0.40	
		Error (time)	24	11.91				
	Between-group	Intercept	7896.10	1	7896.10	59.74	0.00	0.88
		group	25.60	1	25.60	0.19	0.67	0.02
		Error	1057.30	8	132.16			
ED	Within group	time	3	89.89	14.84	0.00	0.65	
		time * group	3	3.09	0.51	0.67	0.06	
		Error (time)	24	6.05				
	Between-group	Intercept	9150.62	1	9150.62	35.14	0.00	0.81
		group	3.02	1	3.02	.01	0.91	0.00
		Error	2083.10	8	260.38			
EI	Within group	time	3	102.76	8.67	0.00	0.52	
		time * group	3	13.46	1.13	0.35	0.12	
		Error (time)	24	11.84				
	Between-group	Intercept	7344.10	1	7344.10	74.51	0.00	0.90
		group	32.40	1	32.40	0.32	0.58	0.03
		Error	788.50	8	98.56			
EM	Within group	time	3	200.02	14.83	0.00	0.65	

		time * group	136.47	3	45.49	3.37	0.03	0.29
		Error (time)	323.70	24	13.48			
		Intercept	10017.22	1	10017.22	69.81	0.00	0.89
	Between-group	group	75.62	1	75.62	0.52	0.48	0.06
		Error	1147.90	8	143.48			
		time	335.40	3	111.80	15.83	0.00	0.66
	Within group	time * group	121.70	3	40.56	5.74	0.00	0.41
		Error (time)	169.40	24	7.05			
EG		Intercept	9610.00	1	9610.00	109.29	0.00	0.93
	Between group	group	44.10	1	44.10	0.50	0.49	0.05
		Error	703.40	8	87.92			
		time	391.27	3	130.42	9.25	0.00	0.53
	Within group	time * group	107.27	3	35.75	2.53	0.08	0.24
		Error (time)	338.20	24	14.09			
Fa		Intercept	11256.02	1	11256.02	85.22	0.00	0.91
	Between group	group	455.62	1	455.62	3.45	0.10	0.30
		Error	1056.60	8	132.07			
		time	384.80	3	128.26	14.41	0.00	0.64
	Within group	time * group	117.20	3	39.06	4.39	0.01	0.35
		Error(time)	213.50	24	8.89			
IS		Intercept	13987.60	1	13987.60	109.01	0.00	0.93
	Between group	group	230.40	1	230.40	1.79	0.21	0.18
		Error	1026.50	8	128.31			
		time	292.10	3	97.36	16.99	0.00	0.68
	Within-group	time * group	127.40	3	42.46	7.41	0.00	0.48
		Error (time)	137.50	24	5.72			
MA		Intercept	6812.10	1	6812.10	56.13	0.00	0.87
	Between group	group	10.00	1	10.00	0.08	0.78	0.01
		Error	970.90	8	121.36			
		time	524.60	3	174.86	10.48	0.00	0.56
	Within group	time * group	292.50	3	97.50	5.84	0.00	0.42
		Error (time)	400.40	24	16.68			
Sb		Intercept	11289.60	1	11289.60	201.24	0.00	0.96
	Between-group	group	96.10	1	96.10	1.71	0.22	0.17
		Error	448.80	8	56.10			
		time	382.47	3	127.49	16.36	0.00	0.67
	Within group	time * group	165.27	3	55.09	7.07	0.00	0.46
		Error(time)	187.00	24	7.79			
SI		Intercept	8497.22	1	8497.22	80.44	0.00	0.91
	Between-group	group	126.02	1	126.02	1.19	0.30	0.13
		Error	845.00	8	105.62			
		time	254.60	3	84.86	6.28	0.00	0.44
	Within group	time * group	101.00	3	33.66	2.49	0.08	0.23
		Error(time)	323.90	14	13.49			
SS		Intercept	10368.40	1	10368.40	166.39	0.00	0.95
	Between-group	group	57.60	1	57.60	0.92	0.36	0.10
		Error	498.50	8	62.31			
		time	243.67	3	81.22	13.50	0.00	0.62
	Within group	time * group	69.27	3	23.09	3.84	0.02	0.32
		Error(time)	144.30	24	6.01			
US		Intercept	9517.22	1	9517.22	81.75	0.00	0.91
	Between-group	Group	13.22	1	13.22	0.11	0.74	0.01
		Error	931.30	8	116.41			
		Time	639.67	3	213.22	16.69	0.00	0.67
	Within group	time * group	77.47	3	25.82	2.02	0.13	0.20
		Error(time)	306.60	24	12.77			
VH		Intercept	10144.22	1	10144.22	63.11	0.00	0.88
	Between-group	Group	81.22	1	81.22	0.50	0.49	0.05
		Error	1285.80	8	160.72			

Abandonment (Ab), Dependence/Incompetence (DI), Defectiveness/Shame (DS), Emotional Deprivation (ED), Emotional Inhibition (EI), Enmeshment/Undeveloped Self (EM), Entitlement/Grandiosity (EG), Failure (Fa), Insufficient Self-control/Self-discipline (IS), Mistrust/Abuse (MA), Subjugation (Sb), Social Isolation/Alienation (SI), Self-Sacrifice (SS), Unrelenting Standards (US), Vulnerability to Harm or illness (VH).

These data indicate that both treatment strategies reduced OBs and EMSs; however, adding neurofeedback therapy has not resulted in significant differences over the standard treatment group in reducing OBs and EMSs.

Discussion

We aimed to compare the effect of using NFT in addition to the choice treatment on reducing OBs and EMSs in patients with OCD. This study showed that both treatment conditions reduced the OBs and EMSs; however, treatment groups had no significant differences. According to a meta-analysis that has examined the effectiveness of different types of NFT on OCD in various studies, our research, which investigated changes in OBs and EMSs while utilizing NFT, was the first in this field (21).

Regarding our study, standard treatment (CBT+SSRIs) reduces OBs and EMSs. The conducted studies support our findings. For example, Diedrich et al. in a study that conducted CBT on 71 OCD patients, indicated that reductions in OBs partially mediated improvements in obsessive-compulsive symptoms over time (36). Also, Wilhelm et al. in a study aimed to identify mechanisms of change in OCD patients (n= 36), showed that perfectionism and certainty OBs and EMSs related to dependency and incompetence significantly improved treatment response (19). Another research indicated that all schema categories (except impaired limits) predicted increases in relationship-related OC symptoms through the mediation of intolerance of uncertainty (37), which remark the underlying role of OBs and EMSs in the development and maintenance of OCD.

Studies that examined the effectiveness of NFT on OCD were not concerned with its effect on OBs and EMSs (22,38,39). A recent systematic review mentioned that in various studies, NFT helped OCD patients; however, methodology, heterogeneity, and reporting bias were issued (24). An RTC showed that NFT that targets the aPFC- the same region that our study is focused on- can lessen OCD symptoms (40). Our study is the first in this field. We

found that adding NFT made no significant difference in reducing OBs and EMSs between the two groups. This finding is most likely due to the nature of NFT, which mostly causes cortical changes, and OB and EMS are more emotionally based and have subcortical processing.

The most surprising aspect of the results is a significant time × condition interaction difference between the two groups in RESP/THREAT belief and Ab, DS, EM, EG, IS, MA, Sb, SI, and US schemas. These results suggest that although there is no significant difference between groups, adding NFT can improve the time duration needed to achieve these changes.

This study has consequences for future procedures. Our results should be interpreted cautiously due to the limited sample size. Our findings need to be confirmed by larger research using coping-style questionnaires.

Since significant changes in the OB and EMS were observed in a shorter period in this study, it can be used in the treatment of people with severe OCD. Also, in people who need changes in a short time, it is recommended to use additional NFT along with standard therapy.

Conclusion

Our findings provided clear evidence that both treatment conditions can reduce the obsessive beliefs and early maladaptive schemas in patients with obsessive-compulsive disorder. In time × condition interaction in the group received extra neurofeedback therapy, a greater improvement was observed. It was also observed that the addition of neurofeedback therapy had no significant differences in reducing obsessive beliefs and early maladaptive schemas between groups.

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