

Mood and cognitive effects of Deep Brain Stimulation for Essential Tremor

Anthony Bishay, Alexander Lyons, Daniel Habib, Natasha Hughes, Helen Qian, Jessica Summers, Tyler Ball, Kaltra Dhima, Dario Englot, Sarah Bick

VANDERBILT UNIVERSITY
MEDICAL CENTER

INTRODUCTION

- Essential tremor (ET) is a prevalent movement disorder.
- ET patients also experience non-motor symptoms including anxiety, depression, and cognitive impairment.
- Deep brain stimulation (DBS) is an established treatment for severe medication-resistant ET, yet its impact on non-motor symptoms remains unclear.

OBJECTIVES

- To investigate the impact of ventral intermediate nucleus (VIM) DBS on anxiety, depression, and cognition in ET patients.

METHODS

- We performed a retrospective cohort study in ET patients who underwent neuropsychological testing before and after VIM DBS.
- Test measures included Beck Depression Inventory-II (BDI-II), Beck Anxiety Inventory (BAI), and tests measuring attention, working memory, executive function, language, memory, and visuospatial function.
- Cognitive test scores were converted to z-scores and averaged within cognitive domains.
- Pre-operative tremor scores were obtained using the Fahn-Tolosa-Marin (FTM) or Washington Heights Inwood Genetic Study of Essential Tremor (WHIGET) scales.
- Post operative tremor improvement was graded on a scale from 1-4, with 4 being excellent tremor control.

RESULTS

- 139 patients met inclusion criteria (**Table 1**).
- Postoperatively, BDI-II scores significantly improved (9.82 ± 6.77 preoperative vs. 8.29 ± 6.18 postoperative, $p < .001$), while BAI scores remained unchanged. While language and memory scores had a statistically significant decrease following DBS, the extent of change did not reach threshold for clinical meaningfulness (**Table 2**).
- No significant associations were found between tremor improvement and neuropsychological functions on multivariable regression (**Table 3**).

Depression showed statistical improvement following VIM DBS while language and memory were significantly worsened. However, the magnitudes of these changes were small and likely not clinically meaningful. Our results suggest that VIM DBS for ET is unlikely to cause adverse neuropsychological changes.

Table 1. Demographic and Clinical Characteristics

	Total Sample (N=139)
Demographics	
Age [Mean (SD)]	66.63 (10.22)
Female [n (%)]	74 (54.4%)
Race [n (%)]	
White	132 (97.1%)
Black	4 (2.9%)
Follow up duration (days) [Mean (SD)]	389.76 (383.45)
Motor Scores [M (SD)]	
Preoperative FTM (n=57)	Total: 50.58 (13.76) Left (L): 14.78 (5.29) Right (R): 15.52 (5.40)
Preoperative WHIGET (n=75)	Total: 28.92 (8.27) L: 13.23 (5.13) R: 15.69 (4.35)
Postoperative Tremor Improvement Ratings	3.51 (0.55)
Electrode Characteristics	
Laterality [n (%)]	
Bilateral	116 (85.3%)
Left	14 (10.3%)
Right	4 (2.9%)
Electrode AC/PC coordinates [Mean (SD)]	
X	L: 15.17 (4.31) R: -15.04 (4.81)
Y	L: 4.22 (1.80) R: 2.99 (1.94)
Z	L: 3.78 (3.41) R: 5.69 (3.18)

Table 2. Neurocognitive Changes Following DBS Surgery

	N	Pre-Operative	N	Post-Operative	p-value
Depression [Mean (SD)] BDI-II	126	9.93 (6.91)	126	8.47 (6.49)	$p < .001^*$
Anxiety [Mean (SD)] BAI	62	7.53 (6.93)	25	7.60 (5.06)	$p = .152$ $p = .249$
Attention and Working Memory (Z-Score)	135	-0.596	135	-0.671	
Speeded Color Naming	123	-0.750	132	-0.817	
Speeded Word Reading	121	-0.736	133	-0.828	
Speeded Visuomotor Sequencing	125	-0.539	122	-0.302	
Attention Span and Working Memory	132	-0.302	138	-0.531	
Executive Function (Z-Score)	139	-0.350	139	-0.460	$p = .028$
Speeded Visuomotor Set-Shifting	123	-0.554	119	-0.623	
Speeded Response Inhibition/Set-Shifting	123	-0.573	131	-0.811	
Language (Z-Score)	139	-0.204	139	-0.328	$p = .003^*$
Confrontation Naming	128	0.121	121	0.344	
Semantic Fluency	130	-0.563	137	-0.563	
Phonemic Fluency	133	-0.667	136	-0.865	
Memory (Z-Score)	130	-0.115	130	-0.452	$p < .001^*$
Word List Learning	130	-0.401	119	-0.439	
Word List Recall	130	0.098	130	-0.387	
Story Learning	122	-0.010	122	-0.173	
Story Recall	122	-0.037	120	-0.318	
Visuospatial (Z-Score)	131	0.059	131	-0.033	$p = .046$
Visual Angle Estimation	129	0.087	128	0.001	
Visual Detail Perception	132	0.050	131	-0.038	

*Significance set at $p < .007$

Table 3. Multivariable models predicting change in neuropsychological measures using tremor improvement ratings.

Multivariable Model					
	B	SE	β	t	p
BDI-II					
Tremor Improvement Ratings	0.523	1.835	0.046	0.285	.777
Age	-0.020	0.113	-0.030	-0.181	.858
Gender	-2.254	1.972	-0.190	-1.143	.260
ATTENTION AND WORKING MEMORY					
Tremor Improvement Ratings	0.332	0.169	0.283	1.971	.055
Gender	-0.171	0.187	-0.132	-0.918	.364
EXECUTIVE FUNCTION					
Tremor Improvement Ratings	0.377	0.173	0.311	2.185	.034
Gender	-0.079	0.190	-0.059	-0.417	.679
LANGUAGE					
Tremor Improvement Ratings	0.299	0.161	0.272	1.862	.069
Gender	-0.030	0.178	-0.024	-0.166	.869
MEMORY					
Tremor Improvement Ratings	0.315	0.219	0.221	1.439	.158
Gender	0.114	0.249	0.070	0.459	.649
VISUOSPATIAL					
Tremor Improvement Ratings	0.340	0.226	0.228	1.505	.140
Gender	0.072	0.255	0.043	0.282	.779

*Significance set at $p < .008$

