Deep Brain Stimulation in Obsessive Compulsive Disorder

Table Summarizing Clinical Research Studies

Studies used in this table were either double-blinded crossover trials and/or prospective trials with at least 10 participants; no retrospective case series or reviews are included.

First Author (Year)	Study Title	Country Funder(s)	Intervention Tested	Study Size	Inclusion Criteria, Patient Demographics	Trial Type	Findings
Investigational Brain Stimulation Target: Junction of Ventral Capsule and Ventral Striatum (VC/VS)							
Greenberg (2010)	Deep brain stimulation of the ventral internal capsule/ventral striatum for obsessive-compulsive disorder: worldwide experience	United States Belgium --- • Brain & Behavior Research Foundation • National Institute of Mental Health • Medtronic Inc.	Condition after Bilateral VC/VS Stimulation vs Condition before Implantation	26	• Adults (ages 22 - 59) • Severe OCD for at least 5 years • Failure of at least 3 months of traditional pharmacological and behavioral therapy • No previous or current psychotic, personality, or neurologic disorders • Not pregnant *Co-Morbid Conditions:* Major Depressive Disorder (22/26)	Prospective Cohort Study Performed with FDA Investigational Device Exemption Approvals Length: 31.4 ± 4.1 months (17 with >24 months)	• Significant improvement over first 3 months of stimulation with continued effect seen at 36 months (average of 38.5% improvement • Over time, there is an increase in the percentage of patients receiving benefit (61.5% with at least a 35% improvement of their OCD score at 36 months) • Improvement in concurrent *depression* (average of 43.2% improvement) • Improvement in concurrent *anxiety* (average of 52.6% improvement) • Improvement in overall daily function (average of 69.5% improvement) Major Adverse Events: • Intracranial hemorrhage (2/26) • Worsening of *depression* (3/26
Investigational Brain Stimulation Target: Nucleus Accumbens (NAcc)							
Huff (2010)	Unilateral deep brain stimulation of the nucleus accumbens in patients with treatment-resistant obsessive-compulsive disorder: Outcomes after one year	Germany --- • Cologne Fortune Program Grant • Medtronic Inc.	Condition with Right-sided NAcc Stimulation vs Condition without Stimulation vs Condition before Implantation	10	• Adults (ages 21 - 65) • Severe OCD for at least 5 years • Failure of 4 pharmaceutical and behavioral therapy treatment regimens, each lasting at least 10 weeks • No previous or current psychotic, personality, or neurologic disorders • No substance abuse • Not pregnant *Co-Morbid Conditions:* Major Depressive Disorder (6/10)	Double Blinded Crossover Study followed by a Prospective Cohort Study Approved by the Institutional Ethics Committee and in accordance with the Helsinki Declaration Length: 15 months (6 months blinded)	• Significant improvement seen at 12 months (average of 21.4%) • Slightly greater improvement with active stimulation (average OCD score 10.3% better) • 50% patients had at least a 25% improvement in their OCD score • Improvement in concurrent *depression* (average of 30.0% improvement) • Improvement in overall daily function (average of 45.1% improvement) • No significant improvement in *anxiety* or cognitive function Major Adverse Events: • Dysesthesia (1/10)
Denys (2010)	Deep brain stimulation of the nucleus accumbens for treatment-refractory	The Netherlands --- • Netherlands Organization	Condition with Bilateral NAcc Stimulation vs	16	• Adults (ages 18 - 65) • Disabling OCD for at least 5 years • Failure of 4	Prospective Cohort Study with a Double Blinded Crossover	• Significant improvement seen at 8 months (average of 46% improvement) • Persistent improvement seen at 21 months (average of 52% improvement) • Greater improvement with active stimulation (average OCD score 25% better)

First Author (Year)	Study Title	Country Funder(s)	Intervention Tested	Study Size	Inclusion Criteria, Patient Demographics	Trial Type	Findings
	obsessive-compulsive disorder	for Scientific Research • Medtronic Inc.	Condition without Stimulation vs Condition before Implantation		pharmaceutical and behavioral therapy treatment regimens, each lasting at least 12 weeks • No previous or current psychotic, personality, or neurologic disorders • No substance abuse *Co-Morbid Conditions:* Major Depressive Disorder (6/16)	Segment Registered in the International Control Trial Registry and approved by the Institutional Medical Ethics Review Committee Length: 21 months (1 month blinded)	• 56.3% of patients had at least a 35% improvement in their OCD score • Improvement in concurrent *depression* (average of 45.1% improvement) • Improvement in concurrent *anxiety* (average of 42.6% improvement) Major Adverse Events: • Increased libido (7/16) • Mild forgetfulness (5/16) • Word-finding problems (3/16)
Investigational Brain Stimulation Target: Subthalamic Nucleus (STN)							
Mallet (2019)	Long-term effects of subthalamic stimulation in obsessive-compulsive disorder: Follow-up of a randomized controlled trial	France --- • Programme Hospitalier de la Recherche Clinique Assistance Publique–Hôpitaux de Paris • Agence Nationale de la Recherche Program for Young Researchers	Condition at Condition at Inclusion in Bilateral STN Stimulation Randomized Controlled Trial vs. Condition after 46 months of Bilateral STN Stimulation	14 (12 at final assessment)	• Adults (ages 18-60) • Severe OCD for at least 5 years • Failure of 4 pharmaceutical and behavioral therapy treatment regimens • No previous or current psychotic, personality, or neurologic disorders • No substance abuse *Co-Morbid Conditions*: • Major Depressive Disorder (4/12)	Prospective Follow-up to Randomized Controlled Trial Approved by the Institutional Ethics Committee and in accordance with the Helsinki Declaration Study Length: 46 months	• Significant improvement at 46 months (45% median decrease in Y-BOCS scores) in responders at final assessment (11/12) • Significant and progressive improvement with time, concomitant with increased DBS voltage (scores at 46 mos. vs. 16 mos.) • Significant improvement in global functioning and social/family life • Significant positive relationship between symptoms at 46 months and age of onset Major Adverse Events • Hypomania and impulsivity (4/12) • Suicide attempt (3/12)
Mallet (2008)	Subthalamic nucleus stimulation in severe obsessive-compulsive disorder	France --- • Programme Hospitalier de la Recherche Clinique Assistance Publique–Hôpitaux de Paris • Agence Nationale de la Recherche Program for Young Researchers	Condition after Bilateral STN Stimulation vs Condition before Implantation	17	• Adults (ages 18-60) • Severe OCD for at least 5 years • Failure of 4 pharmaceutical and behavioral therapy treatment regimens • No previous or current psychotic, personality, or neurologic disorders • No substance abuse *Co-Morbid Conditions:* Major Depressive Disorder (6/17)	Double Blinded Crossover Study Approved by the Institutional Ethics Committee and in accordance with the Helsinki Declaration Length: 10 months (6 months blinded)	• Significant improvement seen with 3 months of stimulation (average of 36.7%) • Greater improvement with active stimulation (average OCD score 32.1% better) • Improvement in overall daily function (average of 33.3% improvement) • Greater improvement in function with active stimulation (average score 30.2% better) • No significant change in concurrent *anxiety* Major Adverse Events: • Intracranial hemorrhage (1/17) • Infection resulting in device removal (2/17)
Investigational Brain Stimulation Target: Bed Nucleus of the Stria Terminalis / Anterior Limbs of the Internal Capsule (BST/ALIC)							
Luyten (2016)	Electrical stimulation in the bed nucleus of the stria terminalis alleviates severe obsessive-compulsive disorder	Belgium -- • Research Foundation-Flanders (FWO) • Agency for Innovation by Science and Technology • Medtronic Inc.	Condition with BST/ALIC Stimulation at Last Follow-up (> 4 Years) vs. at 4 Years Post-Implantation vs. Condition Before Implantation	24	• Adults (ages 18-60) • Severe OCD of at least 5 years • Failure of at least 3 pharmaceutical and behavioral therapy treatment regimens • OCD (Y-BOCS) score at least 30/40; Global Assessment of Functioning score 45 or less • No previous or current psychotic, personality, or neurologic disorders • No substance abuse *Co-Morbid Conditions:* • Major Depressive Disorder • Anxiety Disorder	Double-blind, randomized crossover design with 4 year unblinded follow-up Approved by the Ethics Committees of the University Hospitals of Leuven and Antwerp Length: up to	• Significant improvement in OCD symptoms during blinded “on” phase of stimulation compared to before implantation (average of 42%); improvement in concurrent *anxiety* (average of 71%); *depression* (average of 54%), and global functions (30 points) • After 4 years, significant improvement in OCD symptoms (66%), concurrent *anxiety* (58%) and *depression* (67%), and global functioning (30 points) • Significant improvement at last follow-up (up to 14 years) in OCD symptoms (45%); concurrent *anxiety* (45%); concurrent *depression* (49%); and global functioning (30 points) • First clinical evidence for BST involvement with OCD; observations suggest BST may be better stimulation target compared to ALIC to reduce obsessions and compulsions • Chronic stimulation in BST/ALIC induced metabolic decreases in anterior cingulate, prefrontal, and orbitofrontal cortices • No stimulation-induced cognitive and memory

First Author (Year)	Study Title	Country Funder(s)	Intervention Tested	Study Size	Inclusion Criteria, Patient Demographics	Trial Type	Findings
						16 years (24 with >14 years) (6 months blinded)	impairment Major Adverse Events • Intracerebral hemorrhage (2/24) • Suicide attempts (4/24) • Seizures (tonic-clonic 2/24; absence/partial 3/24)

Updated in 2020 by Alicia Brown, first year medical student at Augusta University / University of Georgia Medical Partnership, under the supervision of International Neuromodulation Society (INS) member Marshall Bedder, MD, FRCPC, DABAPM, DABAM, FASAM, Clinical Associate Professor of Psychiatry & Health Behavior, Medical College of Georgia, Augusta University and INS Public Education and Website Manager Nancy Garcia. (Originally compiled during 2012-2013 by International Neuromodulation Society member Chengyuan Wu, MD, MSBmE, Thomas Jefferson University Hospital, Department of Neurosurgery and second-year medical student Lekhaj Daggubati, Drexel University School of Medicine.)

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