

# Deep Brain Stimulation in Tourette Syndrome

## Table Summarizing Clinical Research Studies

Studies used in this table were either double-blinded crossover trials and/or prospective trials or case series.

First Author (Year)	Study Title	Country Funder(s)	Intervention Tested	Study Size	Inclusion Criteria, Patient Demographics	Trial Type	Findings +/-
<b>Investigational Brain Stimulation Target: Centromedian Nucleus (CMT) / Parafascicular Complex (Pf) / Ventral Oral Nucleus (Voa) / Substantia Paraventricularis (Spv) of the Thalamus</b>							
Okun (2013)	<a href="#">A Trial of Scheduled Deep Brain Stimulation for Tourette Syndrome: Moving Away From Continuous Deep Brain Stimulation Paradigms</a>	United States --- • National Institutes of Health	Condition after Bilateral CMT Stimulation vs Condition without Stimulation vs Condition before Implantation	5	<ul style="list-style-type: none"> <li>• Adults (≥25 years old)</li> <li>• Severe disabling Tourette syndrome</li> <li>• No response to at least 4 drugs</li> <li>• No untreated mood disorder or psychosis</li> <li>• No severe medical conditions</li> <li>• No recent illicit drug use</li> <li>• No prior neurosurgical intervention</li> <li>• No neurological disorder</li> </ul>	Double Blinded Crossover Study followed by a Prospective Cohort Study  Approved by the Institutional Review Board  Length: 6 months	<ul style="list-style-type: none"> <li>• Significant improvement seen at 6 months (average of 18.6% improvement)</li> <li>• Improvement delayed in patients randomized to group with delayed stimulation</li> <li>• Immediate effect of scheduled stimulation was found to be comparable to the immediate effect of continuous stimulation</li> </ul> <p><u>Major Adverse Events:</u></p> <ul style="list-style-type: none"> <li>• None</li> </ul>
Porta (2012)	<a href="#">Deep brain stimulation for treatment of refractory Tourette syndrome: long-term follow-up</a>	Italy --- • Italian Tourette Syndrome Association • National Hospital Research Development Fund	Condition after Bilateral CM-Pf-Voa vs Condition before Implantation	18	<ul style="list-style-type: none"> <li>• Patients ages 17-47</li> <li>• Severe disabling Tourette syndrome</li> <li>• No response to at least 6 months medical treatment with at least 2 drugs</li> <li>• No severe medical conditions</li> </ul>	Prospective Cohort Study  Approved by the Institutional Ethical Standards Committee  Length: ≥ 5 years	<ul style="list-style-type: none"> <li>• Significant improvement seen at 36 months (average of 35.5% improvement)</li> <li>• 50% patients had at least a 35% improvement in their OCD score</li> <li>• Improvement in concurrent <i>depression</i> (average of 27.0% improvement)</li> <li>• Improvement in concurrent <i>anxiety</i> (average of 56.0% improvement)</li> <li>• Improvement in overall daily function (average of 32.0% improvement)</li> </ul> <p><u>Major Adverse Events:</u></p> <ul style="list-style-type: none"> <li>• Intracranial hemorrhage (1/8)</li> <li>• Discontinued stimulation due to lack of adequate therapeutic effects (2/8)</li> </ul>
Savica (2012)	<a href="#">Deep Brain Stimulation in Tourette syndrome: A Description of 3 Patients With Excellent Outcome</a>	United States --- • National Institutes of Health	Condition after Bilateral CMT-Pf Stimulation vs Condition before Implantation	3	<ul style="list-style-type: none"> <li>• Patients ages 17-35</li> <li>• Severe Tourette syndrome</li> <li>• No response to at least 5 drugs</li> <li>• No response to behavioral therapy</li> <li>• Stable ADHD</li> </ul>	Case Series  Approved by the Institutional Review Board  Length: 12 months	<ul style="list-style-type: none"> <li>• Significant improvement seen at 12 months (average of 70% improvement)</li> <li>• Some immediate improvement of tics</li> <li>• Concurrent psychiatric symptoms remained stable or slightly improved</li> </ul> <p><u>Major Adverse Events:</u></p> <ul style="list-style-type: none"> <li>• None</li> </ul>
Ackermans (2010)	<a href="#">Double-blind clinical trial of thalamic stimulation in patients with Tourette syndrome</a>	Belgium The Netherlands --- none mentioned	Condition after Bilateral CM-Vca-Spv vs Condition	6	<ul style="list-style-type: none"> <li>• Adults (≥25 years old)</li> <li>• Severe Tourette syndrome</li> <li>• No response to 3 month trials of at least 3 different</li> </ul>	Double Blinded Randomized Crossover Study	<ul style="list-style-type: none"> <li>• Blinded phase demonstrated significant improvement only in patients receiving stimulation (average of 37% more than those without stimulation)</li> <li>• Significant improvement seen at 12 months (average 49.2% improvement)</li> <li>• No effect on cognition</li> <li>• No significant improvement in concurrent ADHD,</li> </ul>

First Author (Year)	Study Title	Country Funder(s)	Intervention Tested	Study Size	Inclusion Criteria, Patient Demographics	Trial Type	Findings +/-
			without Stimulation vs Condition before Implantation		medications • No response to 10 sessions of behavioral therapy • No psychiatric disorder • No current substance use • No structural brain abnormalities	Approved by the Institutional Ethics Committee  Length: 12 months (3 month crossover)	OCD, Anxiety, or Depression  <u>Major Adverse Events:</u> • Brain hemorrhage (1/6) • Infection (1/6) • Decreased energy level (6/6) • Blurry or double vision (6/6)
Visser-Vandewalle (2003)	<a href="#">Chronic bilateral thalamic stimulation: a new therapeutic approach in intractable Tourette syndrome. Report of three cases</a>	Belgium The Netherlands --- none mentioned	Condition after Bilateral CMT-Pf Stimulation vs Condition before Implantation	3	• Patients ages 28-45 • Severe Tourette syndrome • No response to multiple medications • No response to behavioral therapy • No severe medical conditions	Case Series  Approved by the Institutional Ethics Committee  Length: 26.7± 28.9 months (range 8-60 months)	• Significant reduction in tics after long-term follow-up (average of 82%)  <u>Major Adverse Events:</u> • None  Side Effects: • Decreased energy level (3/3) • Increase Sexual Drive (1/3)
<b>Investigational Brain Stimulation Target: Globus Pallidus pars interna (GPI)</b>							
Cannon (2012)	<a href="#">Deep brain stimulation of anteromedial globus pallidus interna for severe Tourette's syndrome</a>	Australia --- • Medtronic, Inc. • New South Wales Institute of Psychiatry Training Fellowship • National Health and Medical Research Council of Australia Program	Condition after Bilateral GPI Stimulation vs Condition before Implantation	11	• Adults (≥18 years old) • Severe Disabling Tourette syndrome • No response to at least 3 drugs • No response to behavioral therapy	Prospective Cohort Study  Approved by the Institutional Review Board  Length: ≥3 months	• Significant improvement seen at 3 months (average of 49.6% improvement) • 54.5% had at least 50% improvement in their tic severity score • 92% reported improvement within 3 days of surgery  • Significant improvement in concurrent Depression (average of 60.2% improvement) • Significant improvement in concurrent OCD (average of 56.9% improvement)  <u>Major Adverse Events:</u> • Worsening tics (1/11) • Worsening Depression or Anxiety (2/11) • Hardware malfunction (3/11) • Infection (1/11)
<b>Multiple Stimulation Locations</b>							
Welter (2008)	<a href="#">Internal pallidal and thalamic stimulation in patients with Tourette syndrome</a>	France --- • National Institute of Health and Medical Research (INSERM) • University of Pierre and Marie Curie (Paris VI) • Assistance-Publique-Hôpitaux de Paris	Condition after Bilateral Gpi Stimulation vs Condition after Bilateral CM-Pf Stimulation vs Condition after Bilateral Stimulation of Gpi & CM-Pf vs Condition without Stimulation	3	• Adults (≥18 years old) • Severe Disabling Tourette syndrome • No response to at least 6 months medical treatment • No cognitive deficits • No psychosis	Controlled Double Blinded Randomized Crossover Study  Approved by INSERM and Institutional Ethics Committee  Length: 37.7± 20.4 months	• The most significant improvement was seen with Gpi stimulation (average of 78.3% improvement) • Significant improvement was seen with CM-Pf stimulation (average of 44.7% improvement) • Significant improvement was seen with stimulation of both (average of 59.7%) • In 2 patients, turning off stimulation resulted in return of symptoms nearly to baseline levels • No negative effect on cognition • Decrease in Depression and Anxiety with CM-Pf stimulation  <u>Major Adverse Events:</u> • Decreased energy level (3/3) • Numbness of face/arm (3/3) • Nausea/Vertigo (2/3) • Decreased libido (1/3)

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 Dagubati, Drexel University School of Medicine

**Additional references:**

1. Xu, W., Zhang, C., Deeb, W. *et al.* Deep brain stimulation for Tourette's syndrome. *Transl Neurodegener* 9, 4 (2020). <https://doi.org/10.1186>

**Please note:** *This information should not be used as a substitute for medical treatment and advice. Always consult a medical professional about any health-related questions or concerns.*

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