

## BACKGROUND

- ❖ Deep brain stimulation (DBS) of the globus pallidus interna (GPi) is a widely accepted treatment of Parkinson's disease (PD)<sup>1</sup> and dystonia.
- ❖ Recent reports have demonstrated the efficacy of GPi DBS in the treatment of treatment refractory Tourette Syndrome (TS)<sup>2,3</sup>.
- ❖ Prior to considering DBS, patients with TS should have failed therapy for tic suppression and psychiatric co-morbidities<sup>4</sup> with
  - Dopamine receptor blockers
  - Dopamine depletors
  - Other therapies
- ❖ These medications can cause drug induced parkinsonism (DIP) through reduced post-synaptic receptor blockade or presynaptic dopamine depletion<sup>5</sup>.
- ❖ We describe a case of malignant TS treated with adjunctive GPi DBS who developed acute recurrent symptoms of DIP after interruption of DBS therapy.

## CASE REPORT

- ❖ 21 year old right handed woman with long-standing history of TS first evaluated at our center in at age 14.
- ❖ Symptoms were refractory to multiple medication therapies used in combination:
  - Tetrabenazine 150mg/ day
  - Fluphenazine 3mg/ day,
  - Topiramate 225mg/day,
  - Clonidine & guanfacine
  - Baclofen, metaxalone, benzodiazepines
  - Methylphenidate
  - Multiple serotonin reuptake inhibitors
  - Botulinum toxin injections to vocal cords for coprolalia
- ❖ Symptoms included:
  - Self-injurious motor tics (whiplash tics, arm flailing, leg extension, punching and kicking walls, self-cutting).
  - Vocal tics: partial word repetition, loud sounds and coprolalia.
  - Obsessive compulsive behaviors (OCB)
  - Attention deficit and hyperactivity disorder (ADHD)
  - Depression
- ❖ Symptoms were complicated by mild, non-impairing parkinsonism (subtle bradykinesia and rigidity).
- ❖ Pre-operative medications included:
  - Tetrabenazine 112.5mg/day
  - Aripiprazole 4mg/day
  - Fluphenazine 3mg/day
- ❖ After consensus review<sup>4</sup> the patient underwent bilateral GPi DBS (3387 leads, Activa PC pulse generator, Medtronic, Minneapolis, MN) in February 2011.
  - pre-operative YGTSS= 89 (39 severity; 50 impairment)
- ❖ At 6month follow-up with stimulation (Table 1) there was reduction in YGTSS scores (Figure 1).
- ❖ Neuroleptic medications were reduced to:
  - Tetrabenazine 64.5mg/day
  - Aripiprazole 5mg/ day for depression
- ❖ Patient was intermittently compliant with medications due to psychosocial stressors, and rapidly re-initiated her regular neuroleptics.

## CASE REPORT (cont...)

- ❖ 14 months after implantation she experienced shock like pain over her abdominal pulse generator and was advised to discontinue stimulation due to concern for hardware malfunction.
- ❖ 6 days after discontinuation of stimulation, examination revealed marked parkinsonism (Video 1) with exacerbation of complex motor and vocal tics (clapping, head jerking, leg extension, hitting head with fist, coprolalia and other sounds
- ❖ Parkinsonism gradually improved with amplitude re-titration to final settings of 5.5V bilaterally (Video 2). (Figure 1)
- ❖ In the following days, a herpes zoster rash overlying battery side emerged, explaining her pain.

## RESULTS/ TABLES & FIGURES

Table 1: Optimized DBS settings

	Left GPi	Right GPi
Polarity	C+2-	C+ 10-
Amplitude (V)	5.5 V	5.5V
Pulse Width (µs)	110 µs	90 µs
Frequency (Hz)	150 Hz	150 Hz

Achieved over 7months of follow-up scheduled monthly.

Figure 1: YGTSS scores before and after stimulation

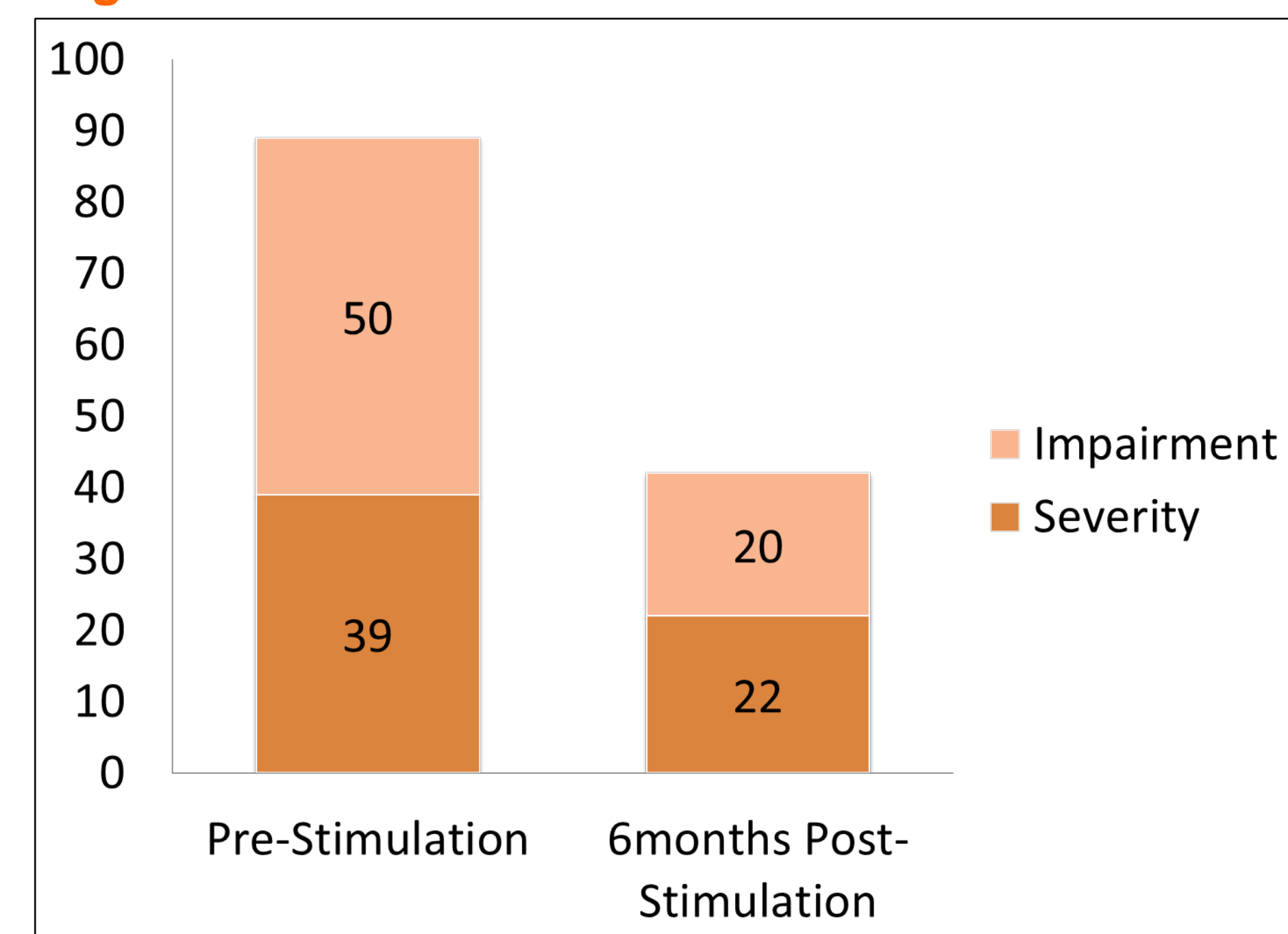
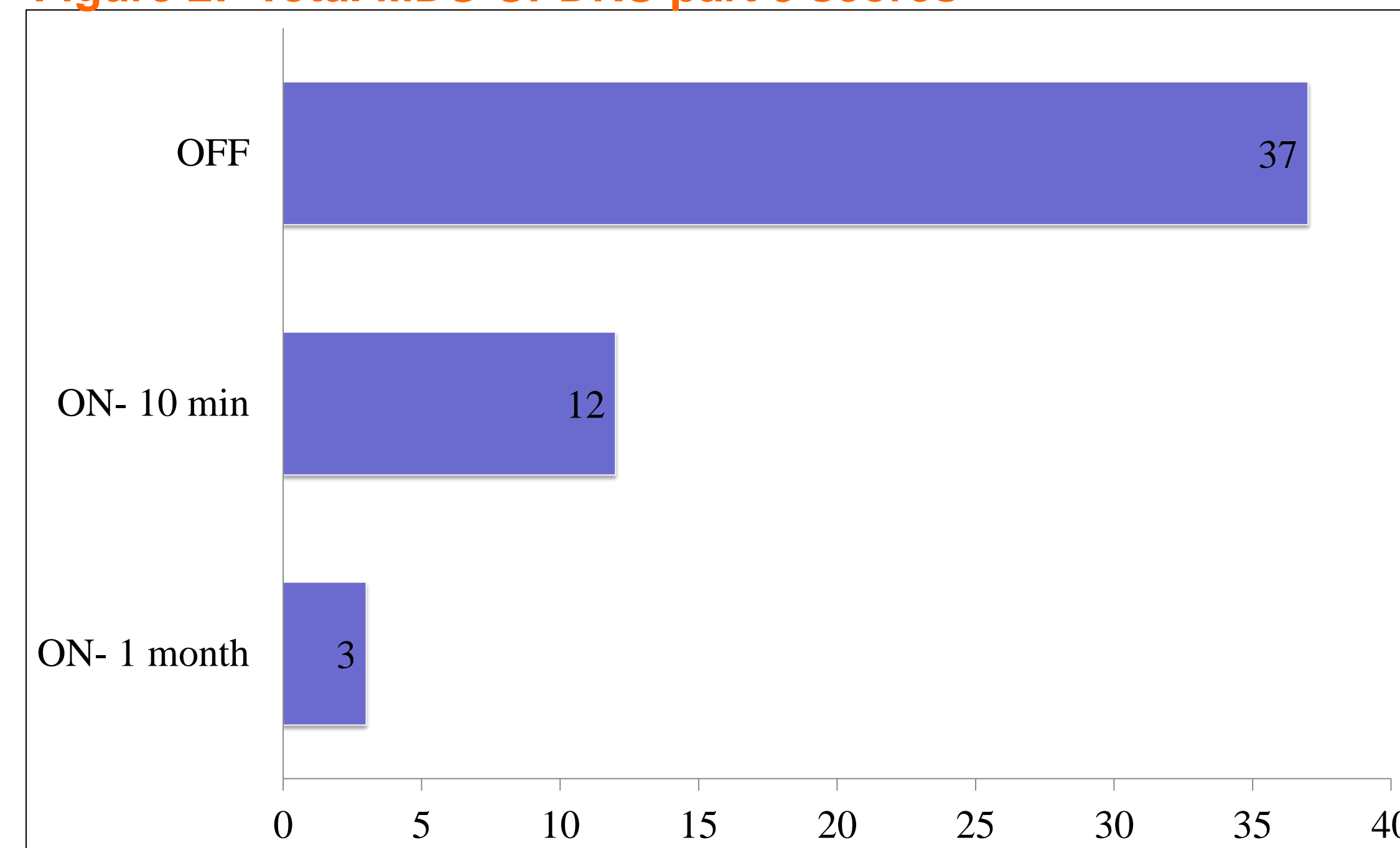


Figure 2: Total MDS-UPDRS part 3 scores



Measured DBS-OFF for 6 days, DBS ON for 10minutes and DBS ON for 1month.

## DISCUSSION

- ❖ Our case demonstrates simultaneous improvement in hyperkinetic (tic) and hypokinetic (parkinsonian) movements with GPi stimulation.
- ❖ To our knowledge this is the first case of DIP reported to improve with bilateral GPi DBS, though medication adjustment is the treatment of choice in typical cases of DIP
- ❖ Improvement of tics and Parkinson's disease (PD) with subthalamic nucleus (STN) DBS has previously been described<sup>6</sup>.
  - No known STN pathology has been described in TS.
- ❖ Pallidal DBS is a mainstay of PD and dystonia therapy and it is increasingly being considered for the management of other hyperkinetic movement disorders<sup>7</sup>.
  - There is irregular and reduced firing of GPi neurons in TS<sup>8</sup>.
  - There are increased oscillatory bursts and synchrony of GPi neurons in PD<sup>1</sup>.
- ❖ The observed simultaneous improvement of tics and parkinsonism supports theories that the beneficial effects of high frequency stimulation are attributable to normalization of firing patterns within the diseased nuclei<sup>1</sup>.
- ❖ GPi may be a uniquely suitable target to treat co-existing hyper- and hypo-kinetic disorders due to its down stream influence on thalamocortical pathways.

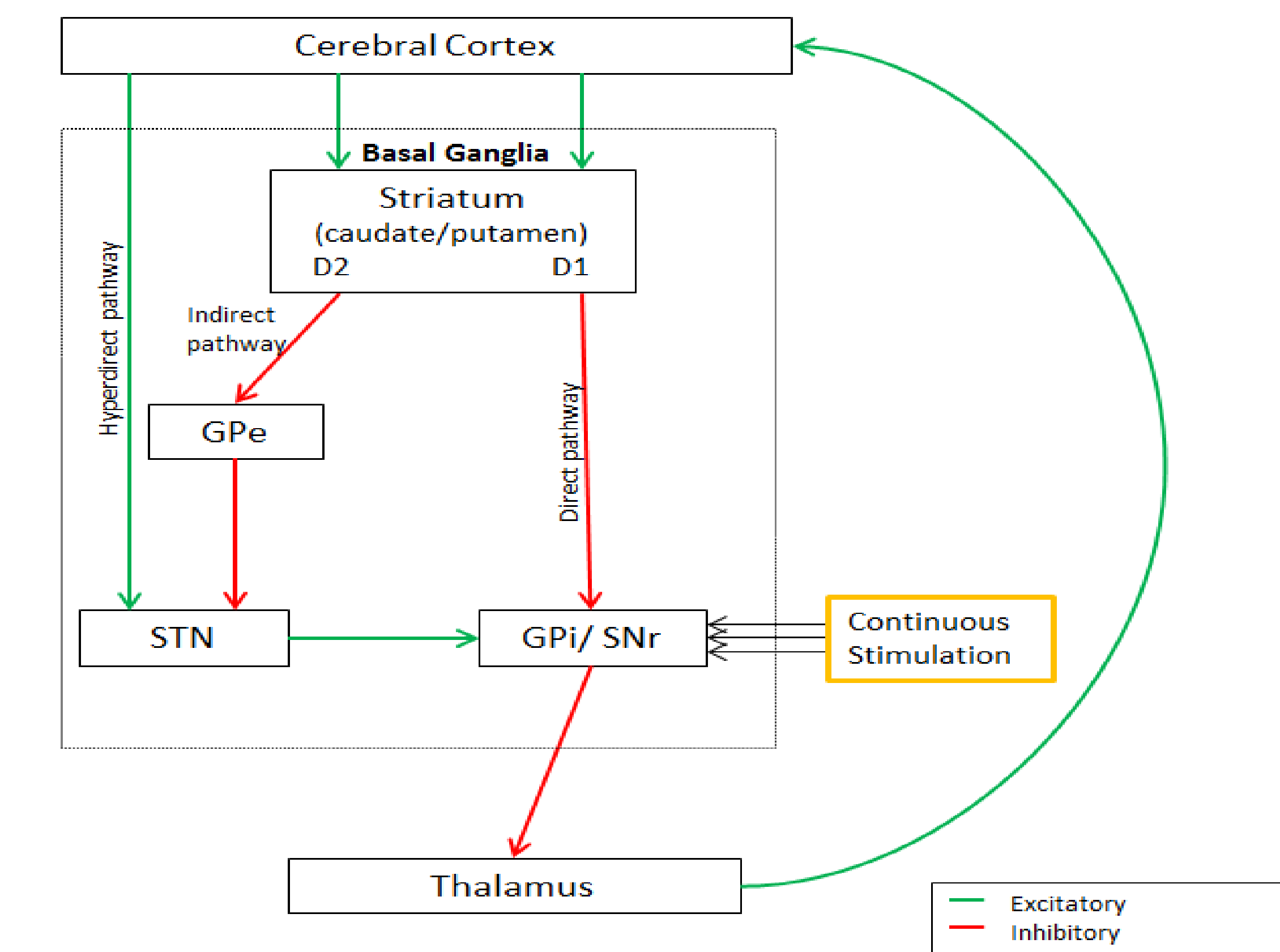


Figure 3: Basal Ganglia in Motor Control.

Imbalance in the hyperdirect, direct and indirect pathways result in abnormal movement disorders. Stimulation of the main output nucleus (GPi) may normalize over all motor function<sup>9</sup>.

Poster available for download.



## REFERENCES

1. Wichmann T, DeLong MR. Deep-Brain Stimulation for Basal Ganglia Disorders. *Basal ganglia* 2011;1:65-77.
2. Viswanathan A, Jimenez-Shahed J, Baizabal Carvallo JF, Jankovic J. Deep brain stimulation for Tourette syndrome: target selection. *Stereotactic and functional neurosurgery* 2012;90:213-224.
3. Poysky J, Jimenez-Shahed J. Patient selection and assessment recommendations for deep brain stimulation in Tourette syndrome. *Mov Disord* 2007;22:1366-1367; author reply 1367-1368.
4. Poysky J, Jimenez-Shahed J. Patient selection and assessment recommendations for deep brain stimulation in Tourette syndrome. *Movement disorders : official journal of the Movement Disorder Society* 2007;22:1366-1367; author reply 1367-1368.
5. Shin HW, Chung SJ. Drug-induced parkinsonism. *J Clin Neurol* 2012;8:15-21.
6. Martinez-Torres I, Hariz MI, Zrinzo L, Foltynie T, Limousin P. Improvement of tics after subthalamic nucleus deep brain stimulation. *Neurology* 2009;72:1787-1789.
7. Welter ML, Grabli D, Vidailhet M. Deep brain stimulation for hyperkinetic disorders: dystonia, tardive dyskinesia, and tics. *Current opinion in neurology* 2010;23:420-425.
8. Zhuang P, Hallett M, Zhang X, Li J, Zhang Y, Li Y. Neuronal activity in the globus pallidus internus in patients with tics. *Journal of neurology, neurosurgery, and psychiatry* 2009;80:1075-1081.
9. Fahn S, Jankovic J, Hallett M. *Principles and Practices of Movement Disorders*. 2011;2:38-40.

Video 1: Stimulation OFF



Video 2: Stimulation ON for 10 minutes

