

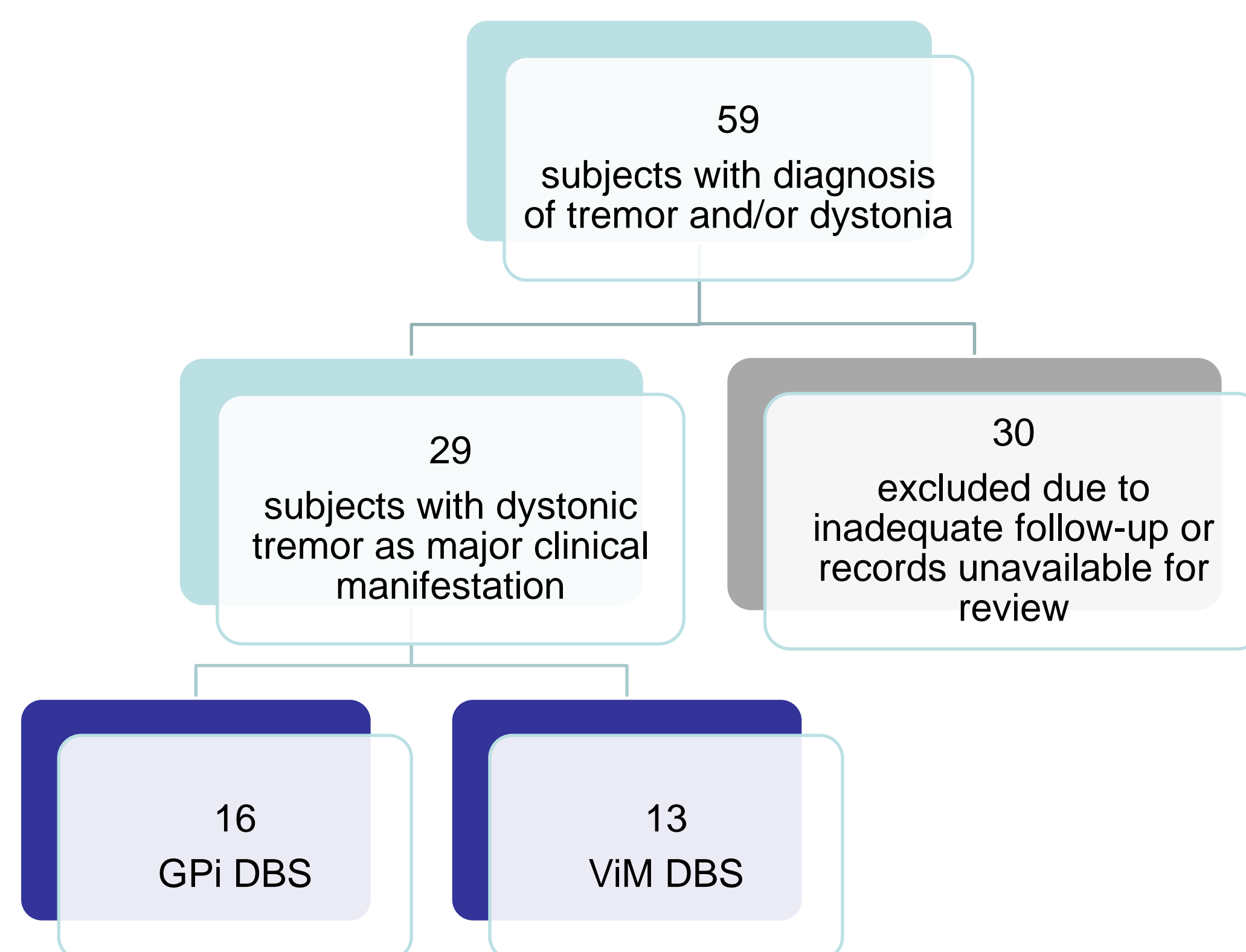
BACKGROUND

- ❖ Dystonia is characterized by sustained, repetitive, patterned contractions of opposing muscles groups which result in abnormal postures or twisting movements¹.
- ❖ Dystonia can be classified anatomically into either focal, segmental, multifocal, hemidystonia, or generalized dystonia. Features of dystonia can also include dystonic tremor (DT).
- ❖ DT has the following key characteristics²:
 - associated with a dystonic posture
 - irregular amplitudes and frequency (usually <7Hz)
 - postural-intentional tremor rather than resting tremor.
- ❖ Tremor associated with dystonia (DAT) is often used to describe dystonic tremor when present in a body region not affected by dystonia, with dystonia present elsewhere in the body³.
- ❖ Dystonia associated dystonic tremor (DADT) is a term used to describe dystonic tremor which is present in the same anatomical location as the dystonia.
- ❖ A few small case series have described the posterior subthalamic area⁴, the caudal zona incerta nucleus⁵, globus pallidus interna^{6,7,8}, and the ventral intermediate nucleus of the thalamus^{7,8,9,10} as potential surgical targets for the treatment of dystonic tremor. There is limited information in the scientific literature regarding DBS for the treatment of medication refractory dystonic tremor.
- ❖ **OBJECTIVE:** To describe the efficacy of thalamic (ViM) and pallidal (GPi) deep brain stimulation for the treatment of medication-refractory primary DT.

METHODS

- ❖ We retrospectively identified patients with a diagnosis of dystonia and/or tremor from our DBS database (subjects implanted between 1/1996-3/2013).
- ❖ Inclusion criteria:
 - clinical diagnosis of dystonia in whom a major disease manifestation is tremor
 - patients treated with ventral intermediate nucleus (ViM) thalamic or pallidal (GPi) deep brain stimulation for the treatment of dystonic symptoms.
- ❖ Exclusion criteria:
 - subjects with secondary dystonic tremor
- ❖ Demographic variables, age at onset of symptoms, anatomical distribution of tremor and dystonia, symptom duration at time of surgery, DBS-related variables, total duration of follow-up, medications used for tremor pre- and post-op were all recorded.
- ❖ Change in dystonia and tremor symptoms at the last clinic visit compared to baseline was rated on a scale of 0-2 (0= no improvement, 1= some improvement, 2= marked improvement) based on chart review.

Figure 1: Patients included in analysis



RESULTS

Table 1: Patient characteristics and DBS variables

	GPi group (n= 16)	ViM group (n= 13)
Avg. current age (in yrs)	57.3 ±16.1	68.8±9.4
Sex	9M, 7F	7M, 6F
Avg. age at symptom onset (yrs)	33.0 ±21.3	36.7 ±20.9
Avg. age at DBS implantation (yrs)	50.2 ±18.1	62.2 ±7.6
Avg. pre-operative symptom duration (yrs)	17.2 ±10.3	25.5 ±16.0
Avg. post-surgical follow-up (yrs)	3.1 ±2.8	3.6 ±3.7
Unilateral electrode placement	0	7**
Bilateral electrode placement	16	6

*One patient had ineffective bilateral GPi DBS followed by bilateral ViM DBS placement (GPi electrodes inactivated).
 **One patient had bilateral ViM DBS placement but has only right ViM active due to adverse stimulation events associated with left ViM.

Table 2: Anatomical distribution of dystonia and dystonic tremor

	GPi			ViM		
	Dystonia	Tremor	Dystonic tremor	Dystonia	Tremor	Dystonic tremor
Focal	6	15		3	11	
Head	6	9		2	3	TAD N=1
Arm/hand	0	6	DADT N=16	1	8	
Segmental	2	1		4	2	
Multifocal	2	0		1	0	DADT N=9
Hemi-body	0	0		1	0	
Generalized	6	0		1	0	Pure DT N=3
No dystonia	0	--		3	--	

Figure 2: Average improvement in tremor and dystonia symptoms

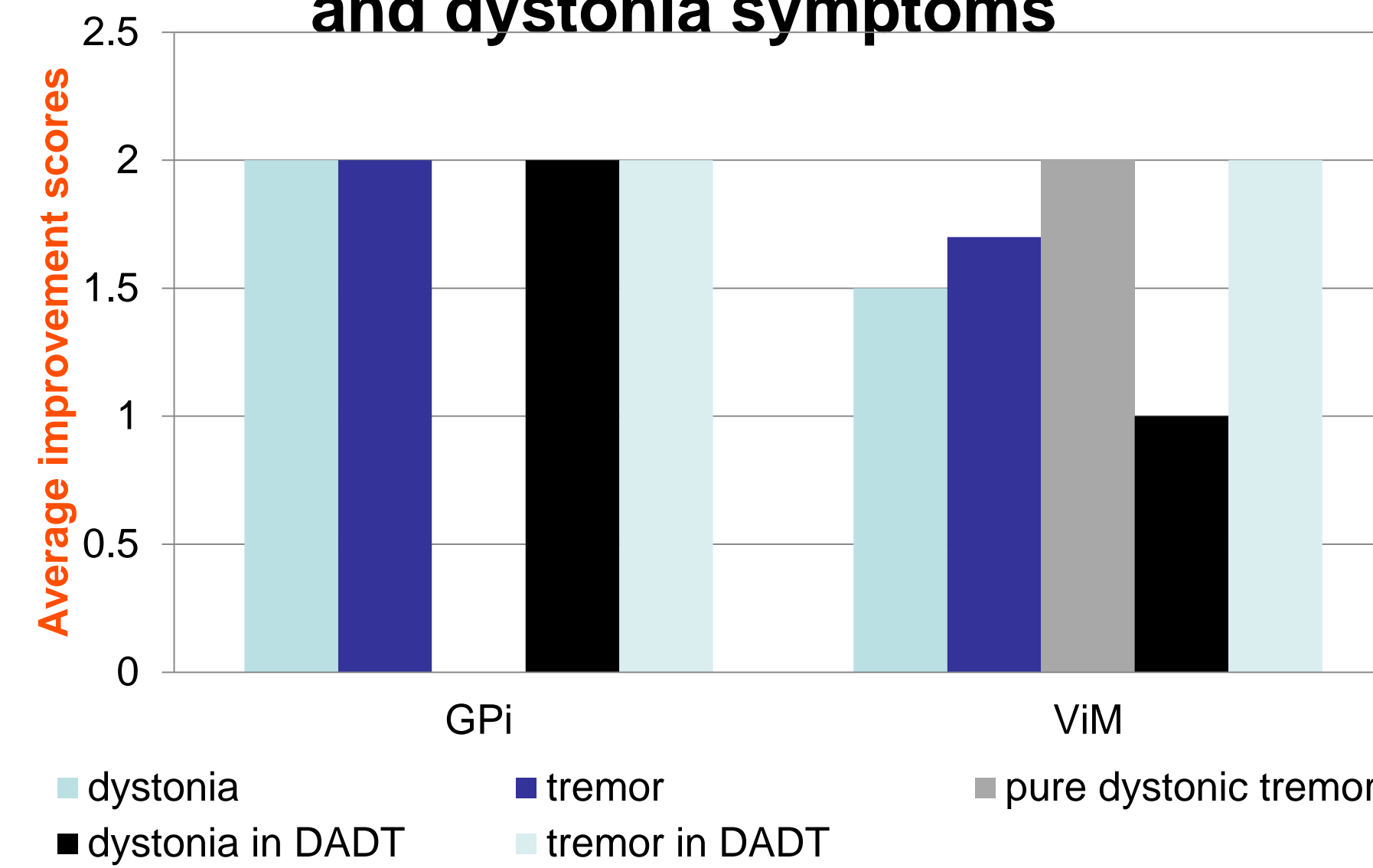


Figure 3: Improvement in dystonic tremor by phenotype

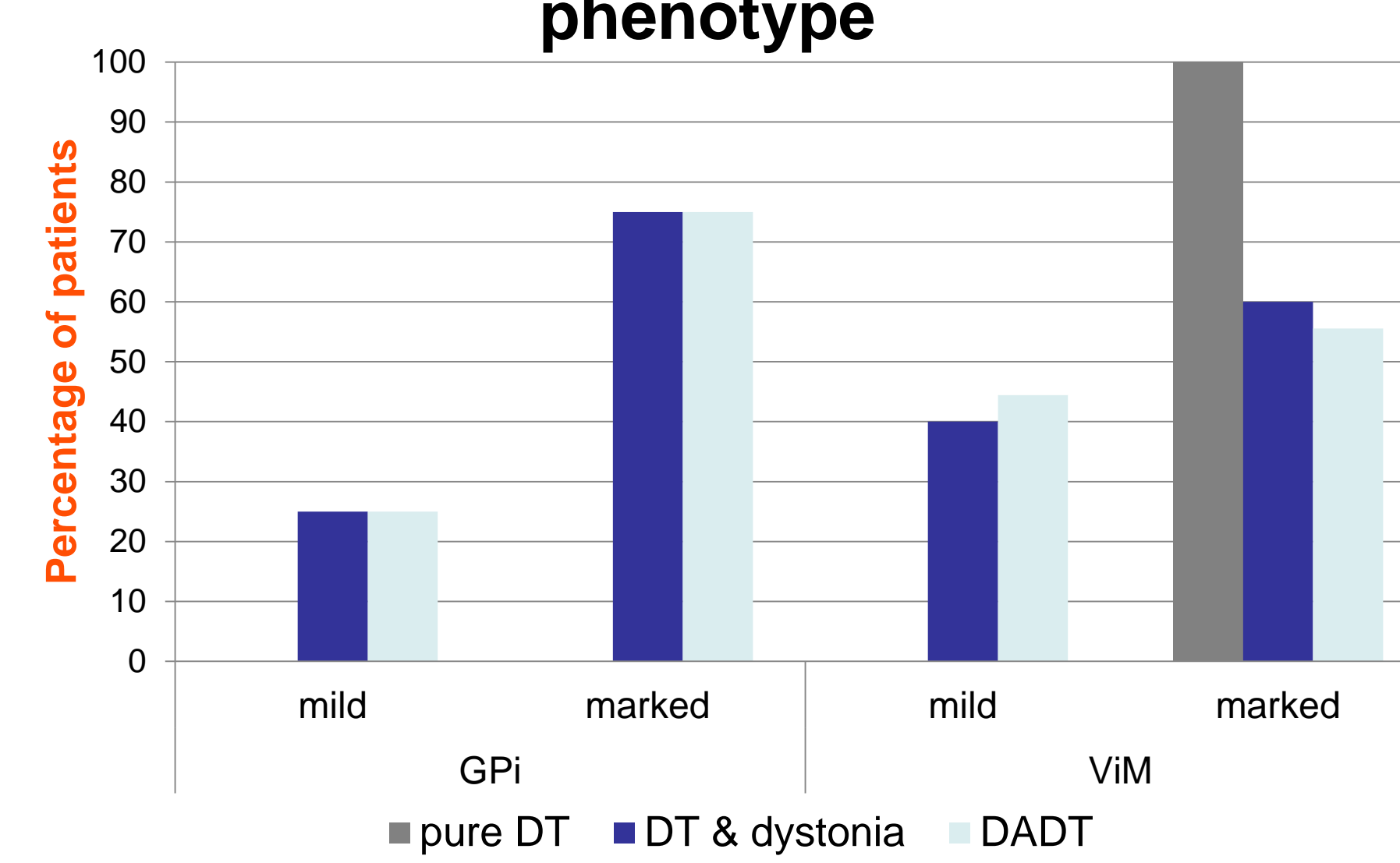
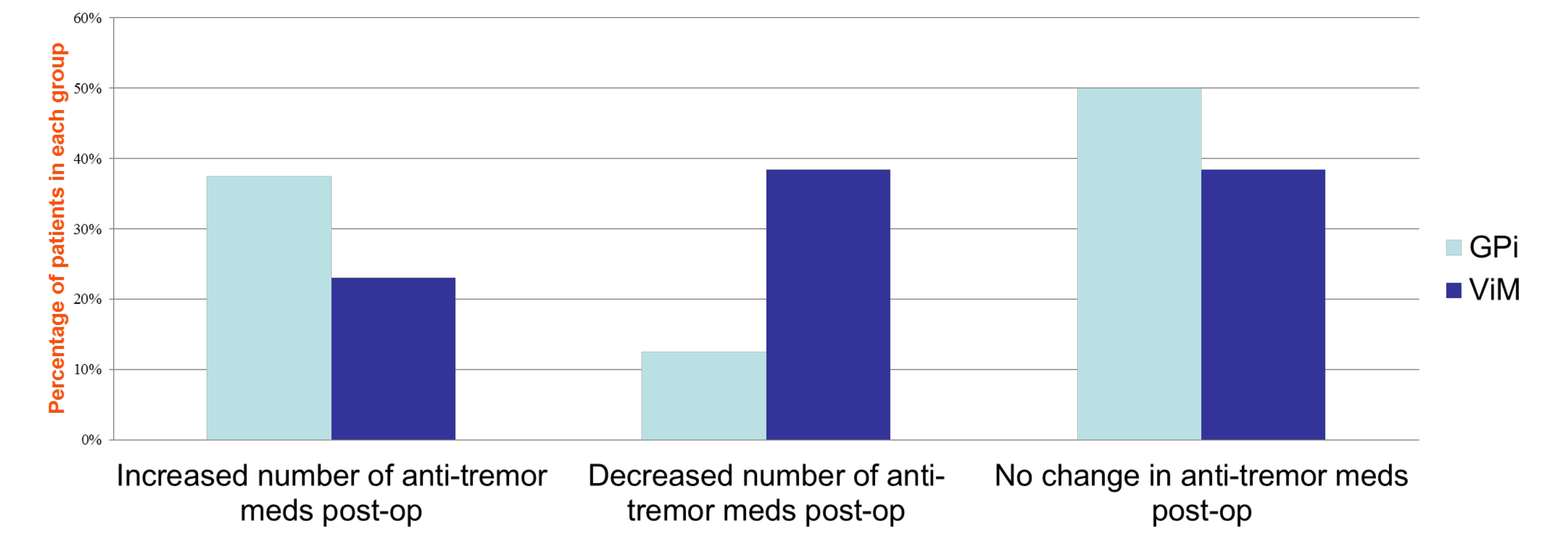


Table 3: DBS parameters (per electrode)

	GPi	ViM
Avg. amplitude (V)	3.7 ±1.2	3.4 ±0.8
Avg. pulse width (µsec)	138.8 ±47.3	154.7 ±26.8
Avg. frequency (Hz)	160.0 ±110.4	96.8 ±59.3

RESULTS – CONT.

Table 4: Change in tremor medications after DBS



DISCUSSION

- ❖ We found greater improvement in dystonia in the GPi group when compared to the ViM DBS group. Additionally, there was greater improvement in DT in those who underwent GPi DBS.
- ❖ Subgroups of DT may respond differently to DBS
 - Subjects with DADT were more likely to have undergone GPi DBS
 - Subjects with pure DT were all treated with ViM DBS
- ❖ There was greater improvement in subjects with DADT (whose dystonia and dystonic tremor presented at the same anatomical location) who were stimulated using GPi DBS
 - Since dystonic tremor is often observed along with dystonia, perhaps the improvement in this DT subtype can be linked to a corresponding improvement in dystonia in the pallidal DBS group.
- ❖ Three patients with pure DT were stimulated with ViM DBS group and all had marked improvement in tremor.
 - Previous authors⁸ have also suggested ViM DBS is the better target for patients with DT whose main phenotype is tremor. However, their cohort of patients did not include any patients with pure DT.
- ❖ There was only one patient with TAD in our cohort
- ❖ Our findings favor pallidal DBS for DT, which supports prior studies suggesting that the optimal surgical target for dystonia is the globus pallidus^{10, 11}. However, our finding in favor of pallidal DBS for DADT deviates from prior smaller studies suggesting thalamic DBS may be a better target.
 - However, a higher percentage of patients in the pallidal DBS group increased the number of anti-tremor medications post-operatively.
- ❖ Strengths of the study included:
 - Large patient cohort with primary dystonic tremor.
 - Similar baseline characteristics between both groups.
- ❖ Limitations to the study included:
 - Choice of DBS targets for implantation was not randomized and therefore could lead to selection bias.
 - A portion of cohort had limited follow-up information or records were unavailable for review.
- ❖ **CONCLUSION:** Prospective analysis evaluating the efficacy of thalamic and pallidal DBS for the treatment of medication-refractory primary dystonic tremor is currently ongoing.

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