Postoperative Follow-up Tremor and Dystonia Management and Long-term Considerations

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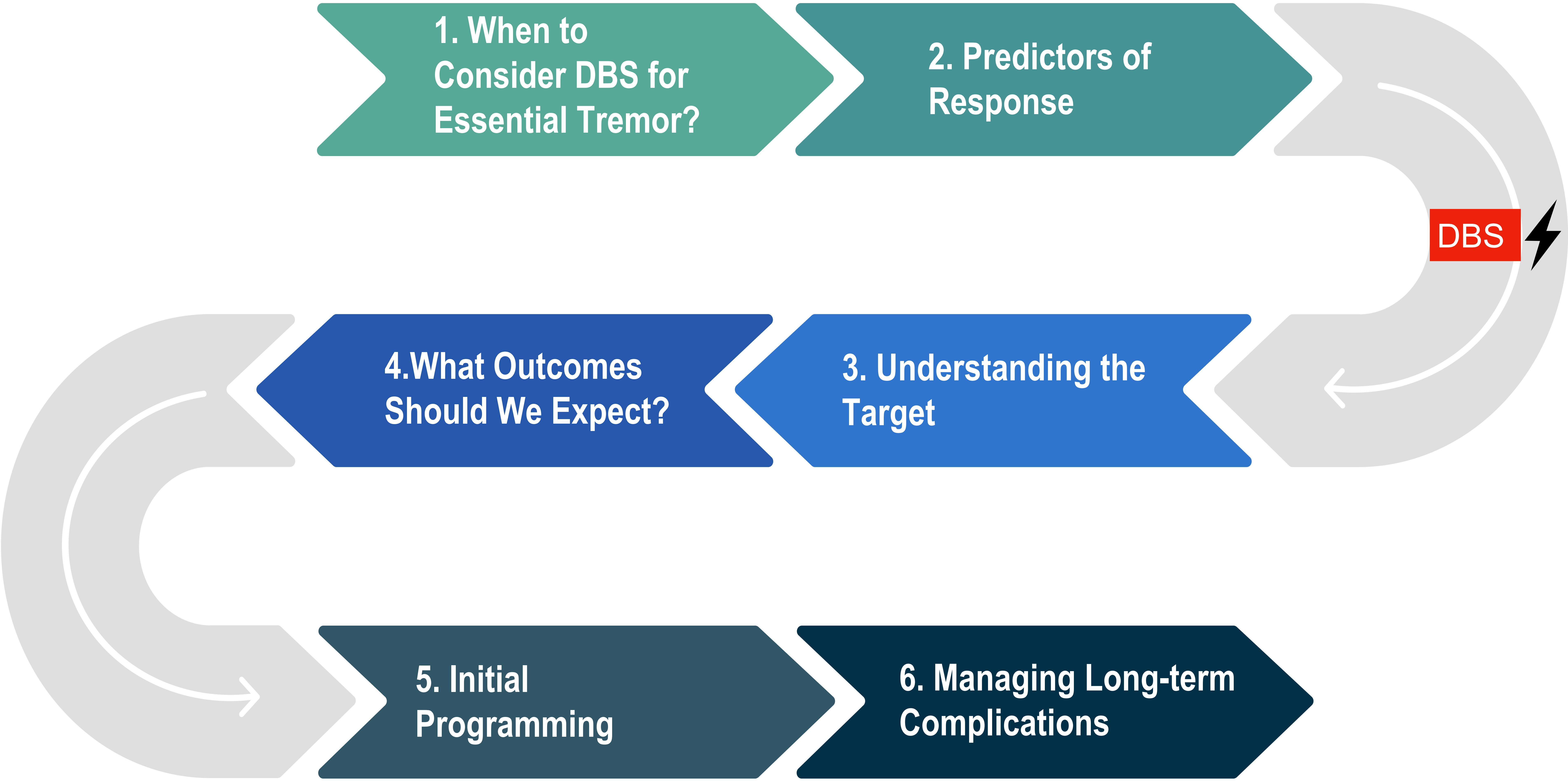
MDS-PAS 5th Neuromodulation School for Movement Disorders

DBS for Essential Tremor - Roadmap

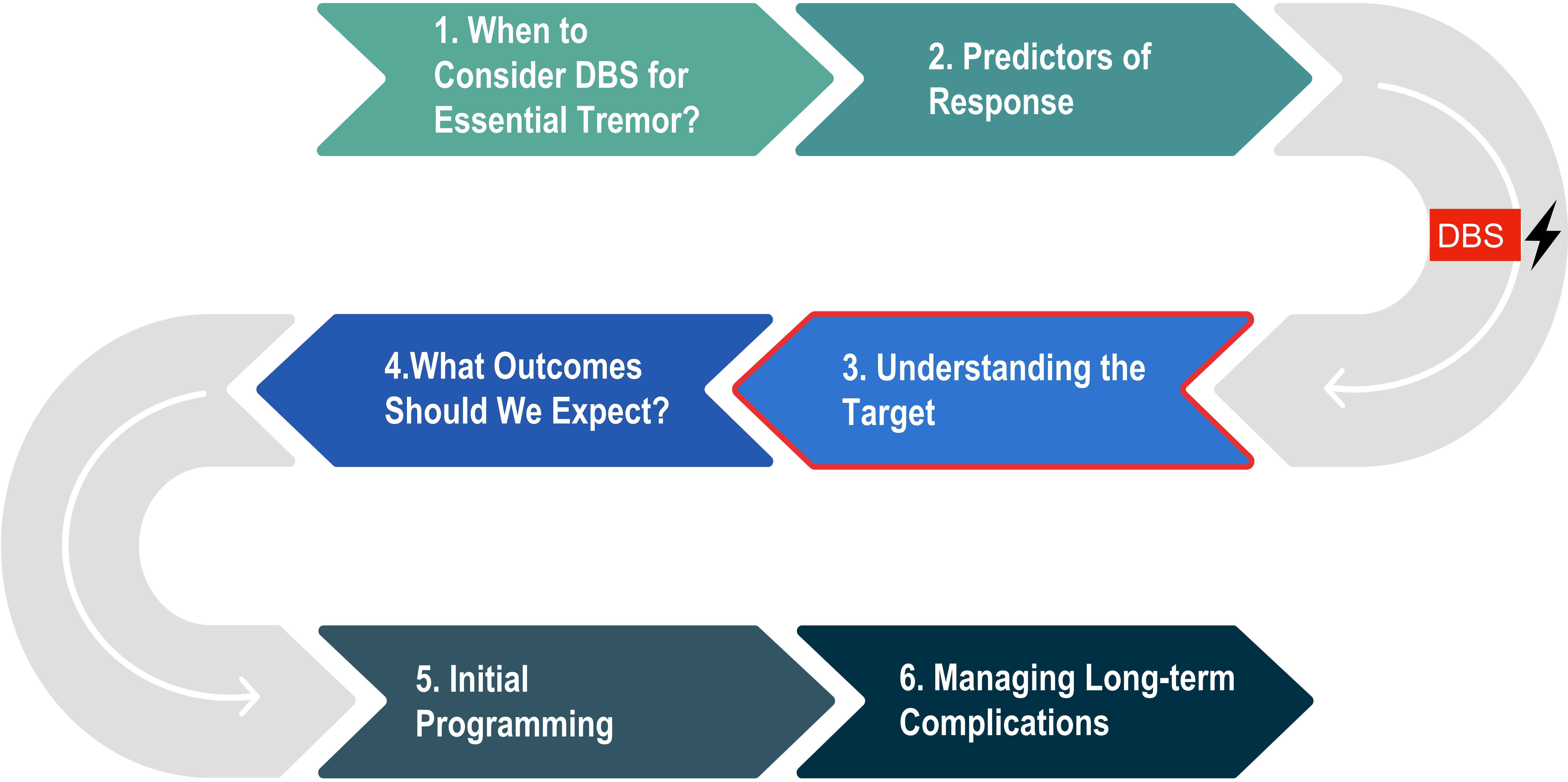


Predictors of response

Good response	Doesn't matter	Bad response
Distal (hands) and postural tremor	Alcohol response	Intentional tremor
High frequency	Medication response	Low- and variable frequency
Constant amplitude		Ataxia associated
		Older age

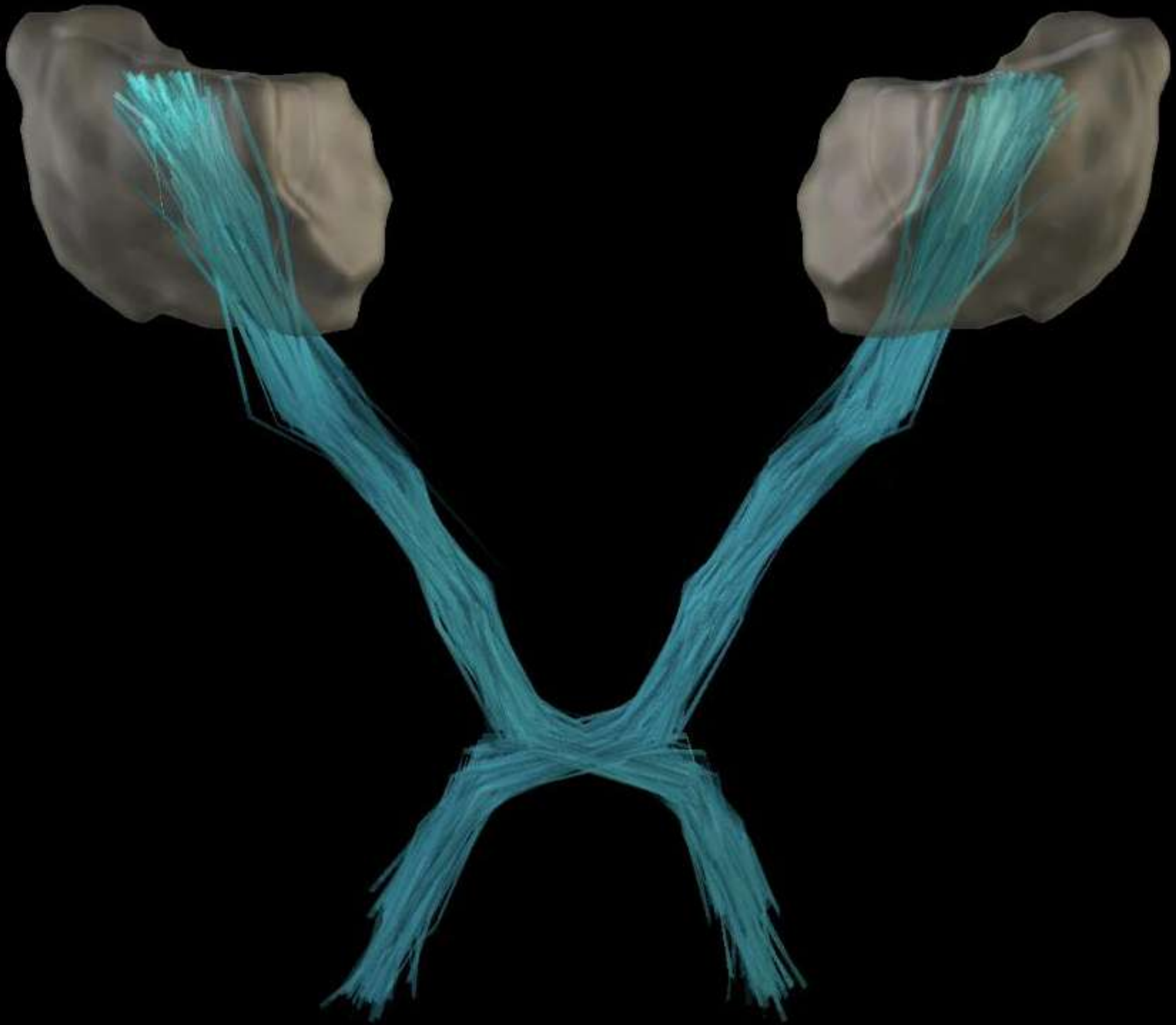
Fasano J Curr Clin Care 2018
Ferreira et al. Mov Disorders 2019

DBS for Essential Tremor - Roadmap




thalamus left
GPi right
RN right
RN left
GPi left

Posterior subthalamic area (PSA)



DBS of the PSA and the VIM in essential tremor

A randomized, double-blind, crossover trial

Michael T. Barbe, MD,* Paul Reker, MD,* Stefanie Hamacher, MS, Jeremy Franklin, PhD, Daria Kraus, PhD, Till A. Dembek, Johannes Becker, Julia K. Steffen, Niels Allert, MD, Jochen Wirths, MD, Haidar S. Dafsari, MD, Jürgen Voges, MD, Gereon R. Fink, MD, Veerle Visser-Vandewalle, MD, and Lars Timmermann, MD

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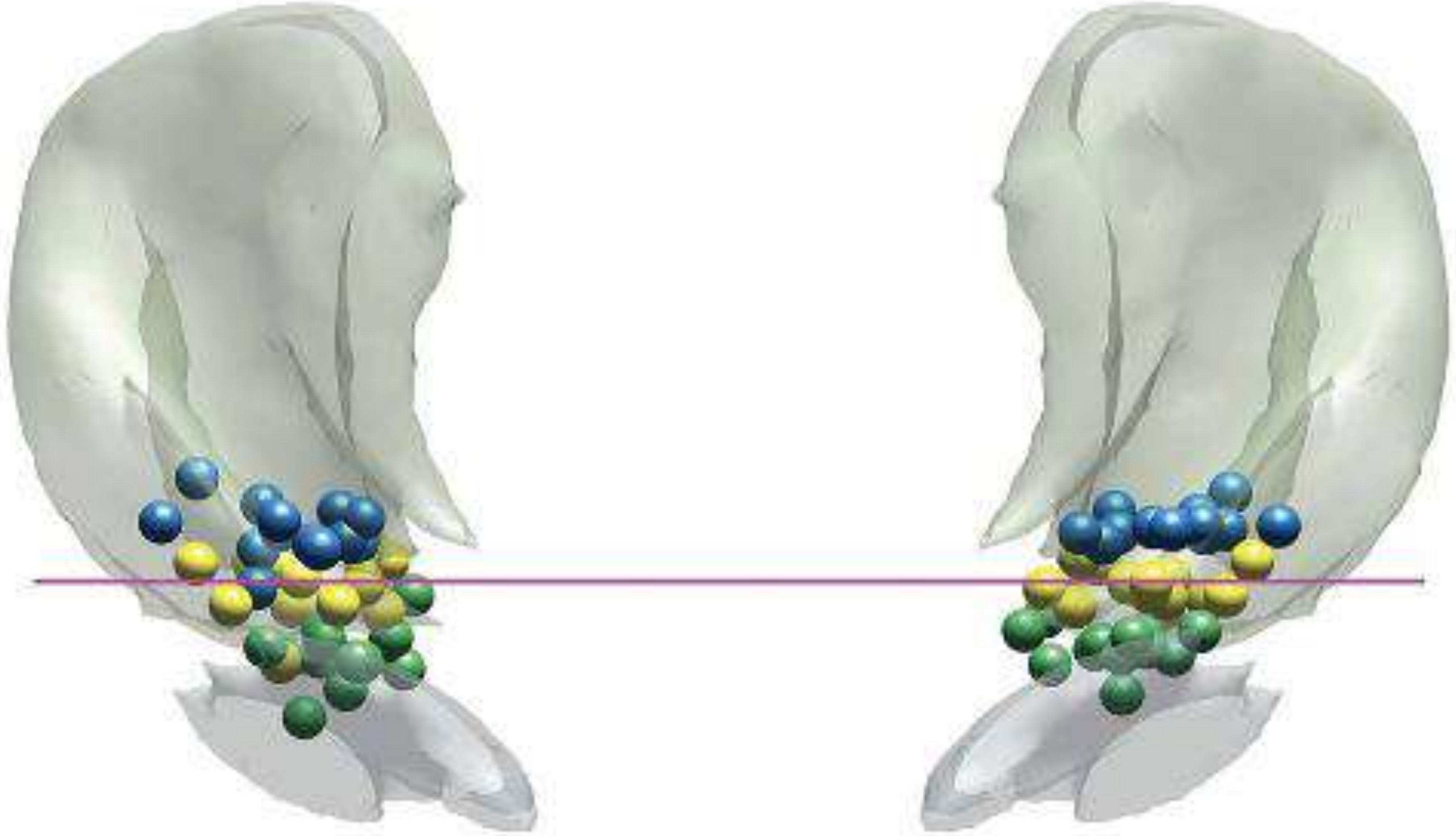
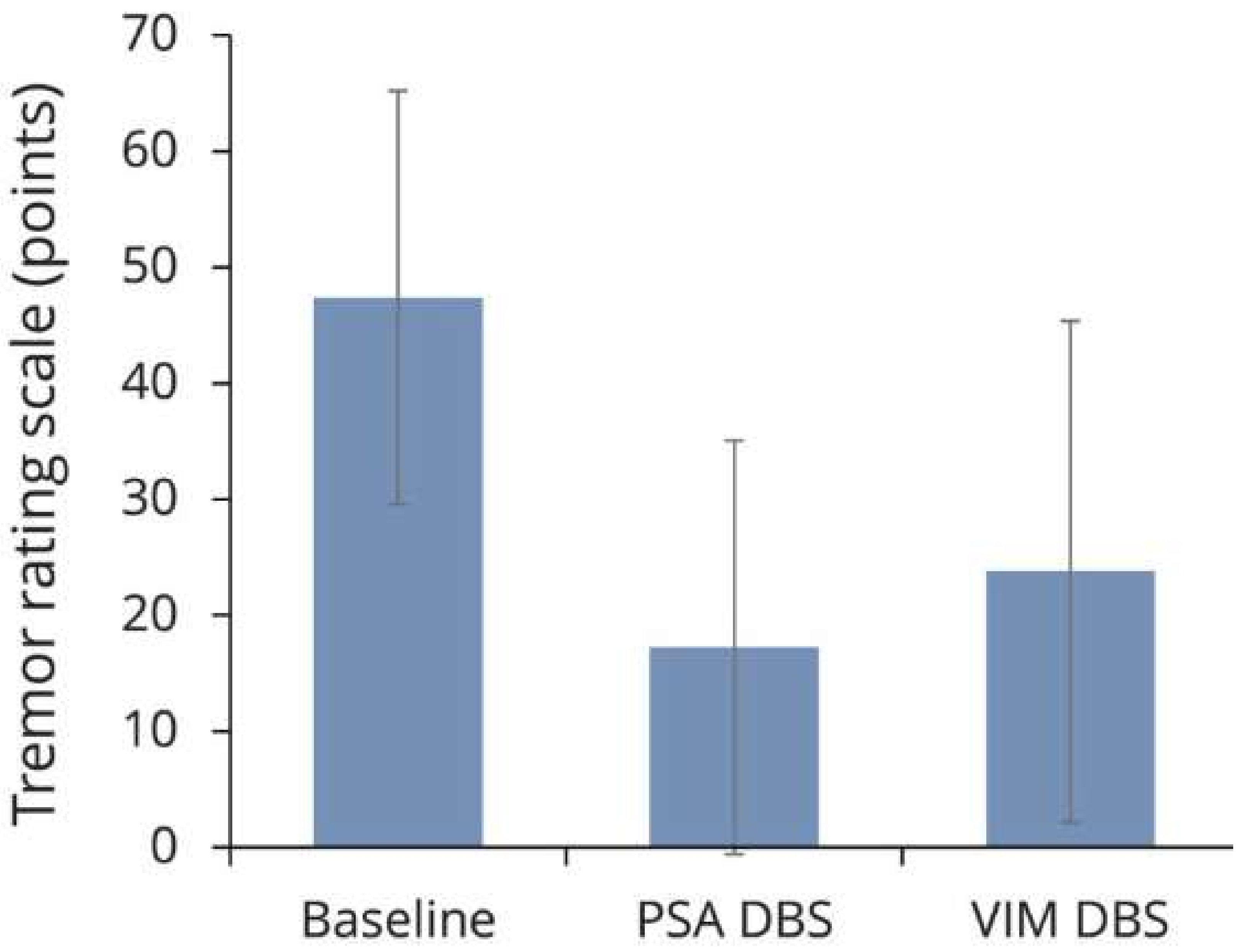
Neurology® 2018;0:1-8. doi:10.1212/WNL.0000000000005956





ANNALS of Neurology

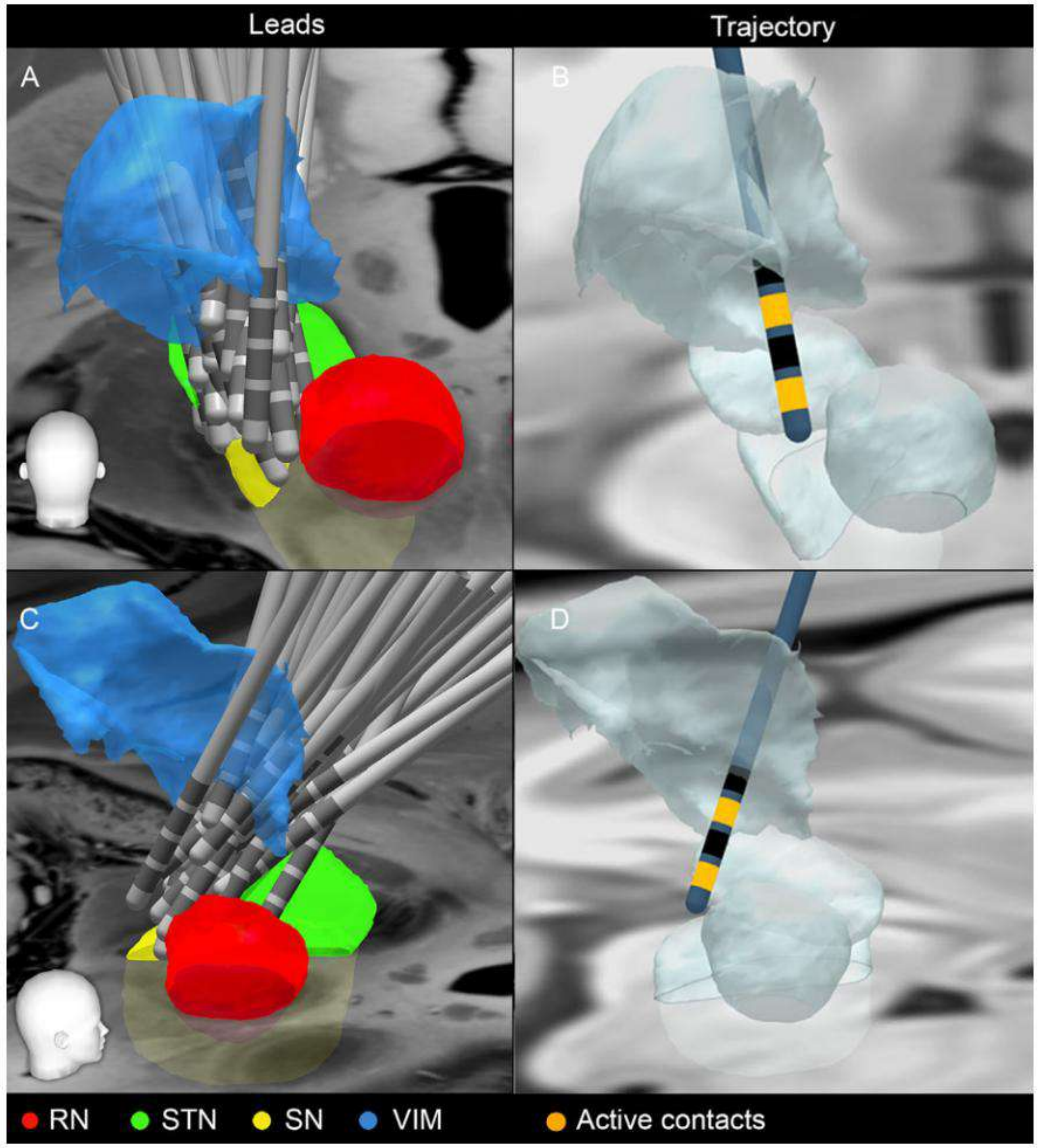
Deep Brain Stimulation for Arm Tremor: A Randomized Trial Comparing Two Targets

Nadja Kvernmo, MD,[1,2] Ane E. Konglund, MD, PhD,[3] Martin M. Reich, MD,[4,5]
Jonas Roothans, MSc,[5] Are H. Pripp, PhD,[6] Espen Dietrichs, MD, PhD,[1,2]
Jens Volkmann, MD, PhD,[4,7] and Inger Marie Skogseid, MD, PhD[1]

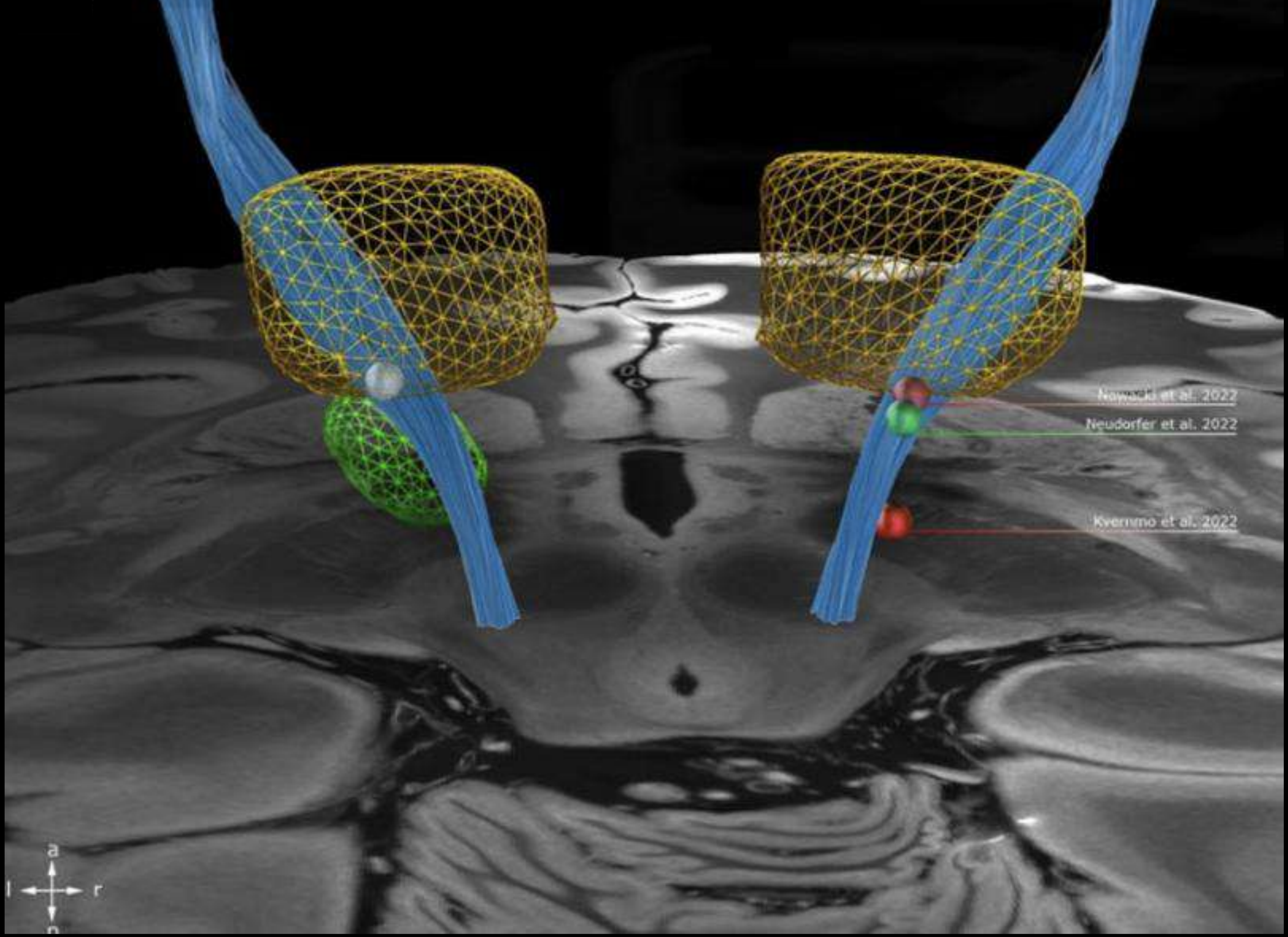
Different types of tremor

PSA = 78% improvement

VIM = 69% improvement



MNI coordinates X=13.63, Y=15.13 and Z=2.58 mm




Axial Vol MPRAGE ISO FGATIR
03/11/2025, 21:26:46
Perpendicular
Distance to Target: 0.00 mm
AC/PC COORDINATES
Axial
Locked
Sagittal
Coronal
COORDINATES
AC/PC
DICOM
Reference Point
PC
AC/PC Distance (mm)
27.98
Target
mm
%
Lateral Left
16.50
Anterior
7.00
Superior
1.50
Angulation (°)
Lateral Right
0.00
Anterior
0.00
Trajectory Length (mm)
Change Target
70.00
Edit AC/PC
Alerts
Data
Home
PEREZ, TOMAS MANUE...
1571203
Plan: Trajectory Final 2
Trajectory
Scroll
Zoom
Pan
Rotate
Center
Windowing
Locked
Trajectory 01
Measure
Point
Angle
Multiline
Margin
3.0 mm
Back
Done
BRAINLAB


Axial Vol MPRAGE ISO FGATIR
03/11/2025, 21:26:46
Perpendicular
Distance to Target: 0.00 mm
AC/PC COORDINATES
Axial
Locked
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Measure
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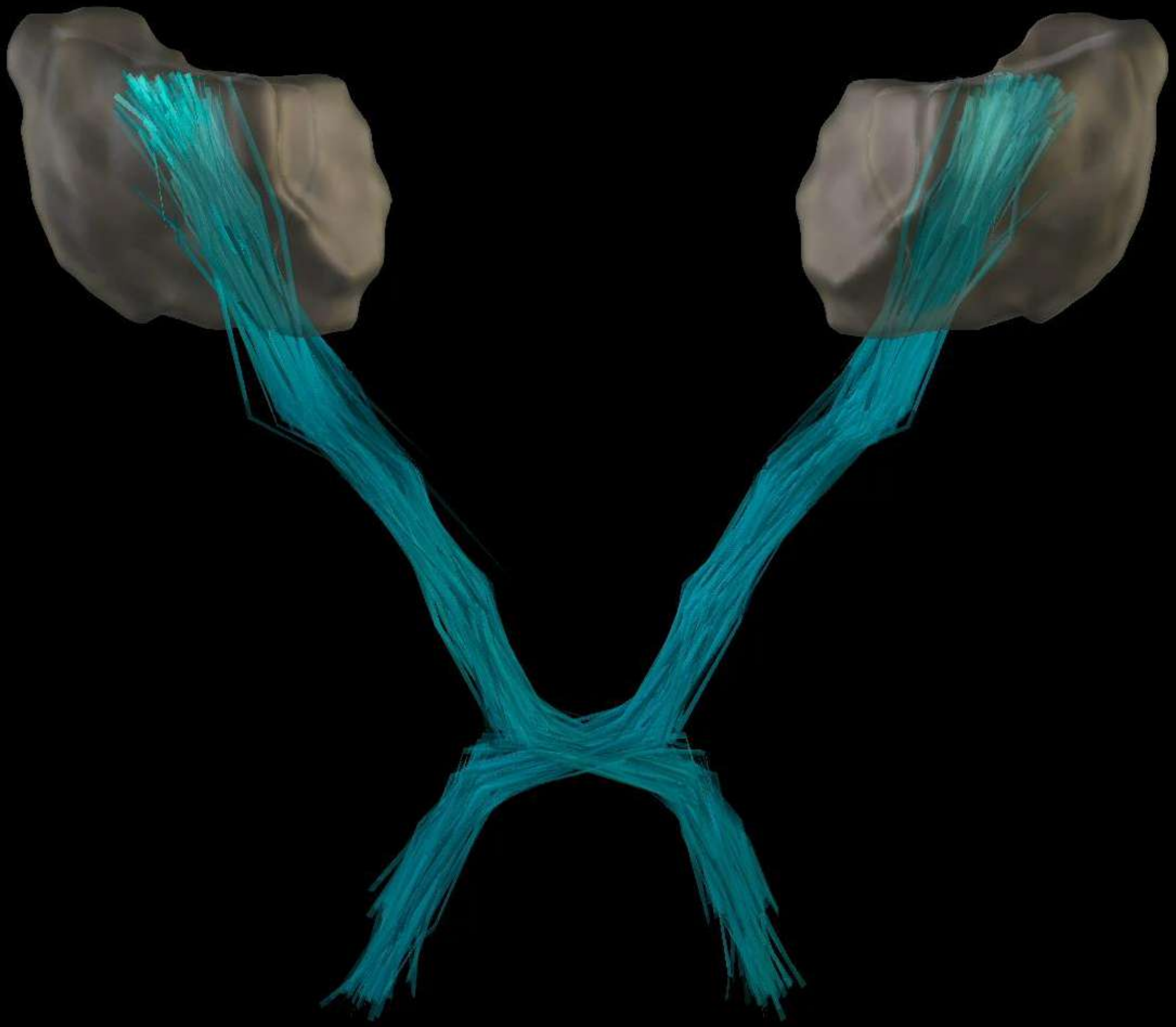
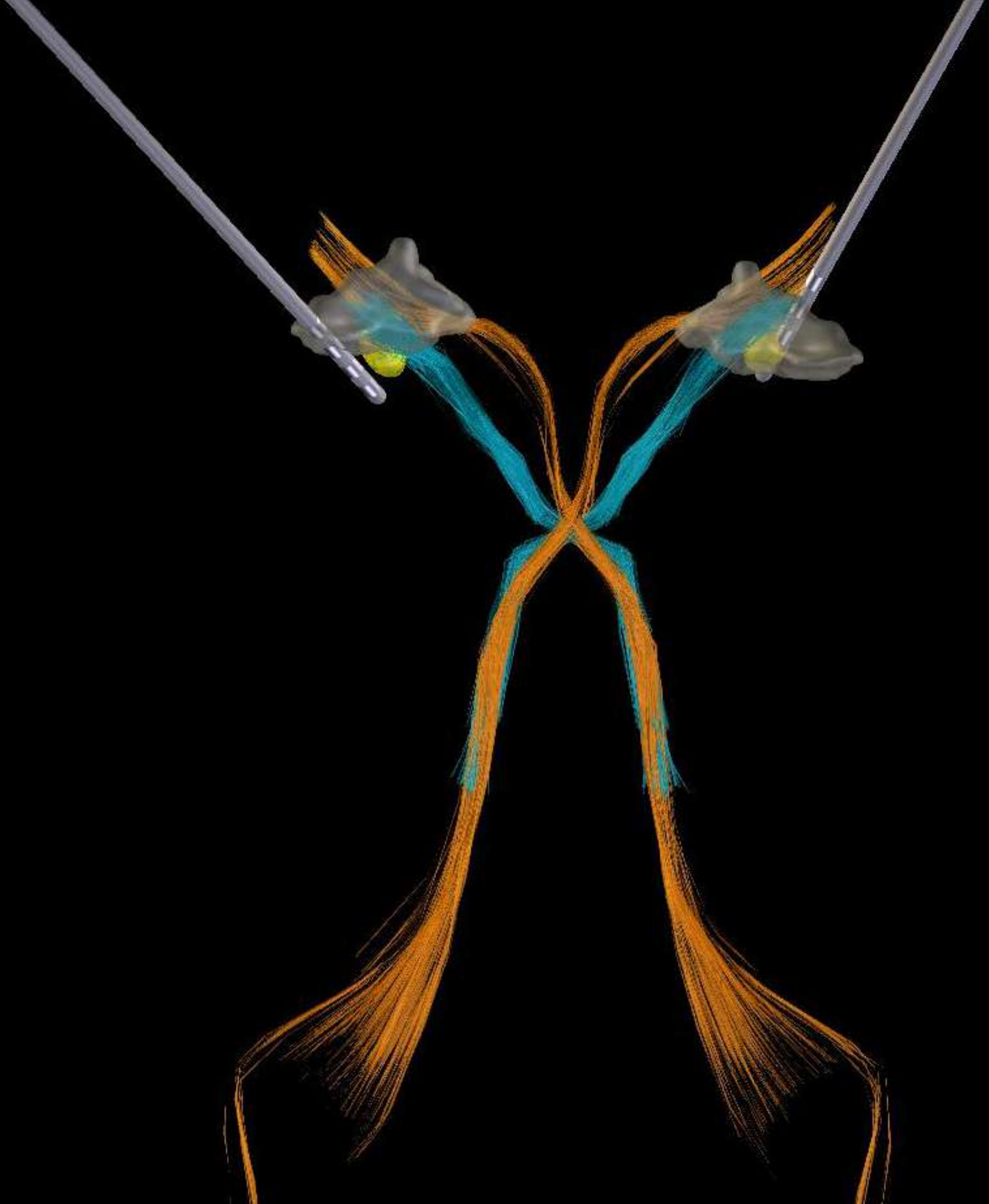
Multiline
Margin
3.0 mm
Back
Done
BRAINLAB

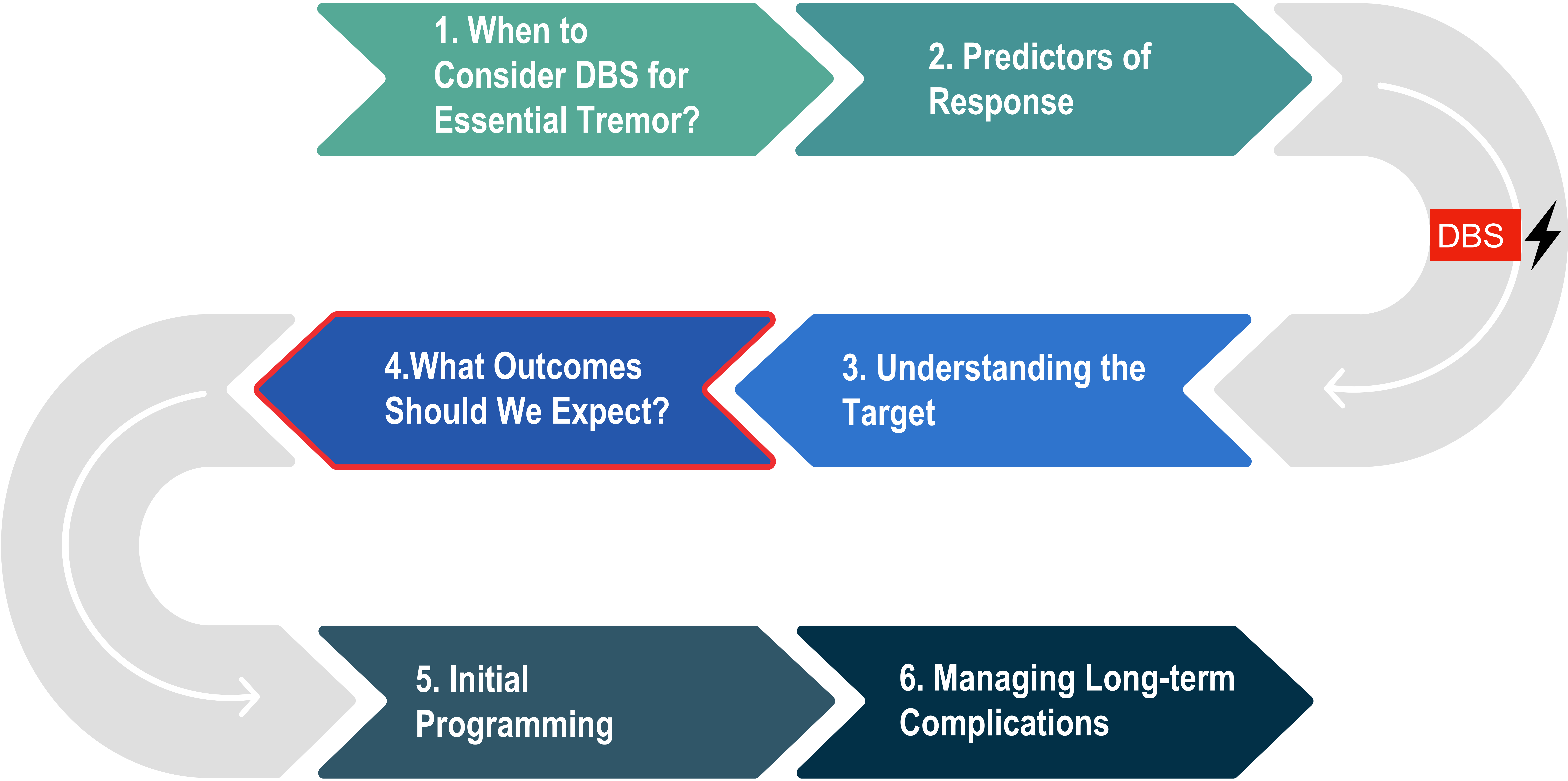
After Surgery: How Do We Know We Are on Target?






Better tremor control in the left hand

DBS for Essential Tremor - Roadmap



Clinical outcomes expected

1 year = 53-66%

6 months = 55-70%

Kremer et al.
J Clin Med 2021

Cury et al.
Neurology 2017

72 years old, essential tremor for 35 years

Disabling action tremor (Fahn-Tolosa-Marin Rating Scale 33/40)

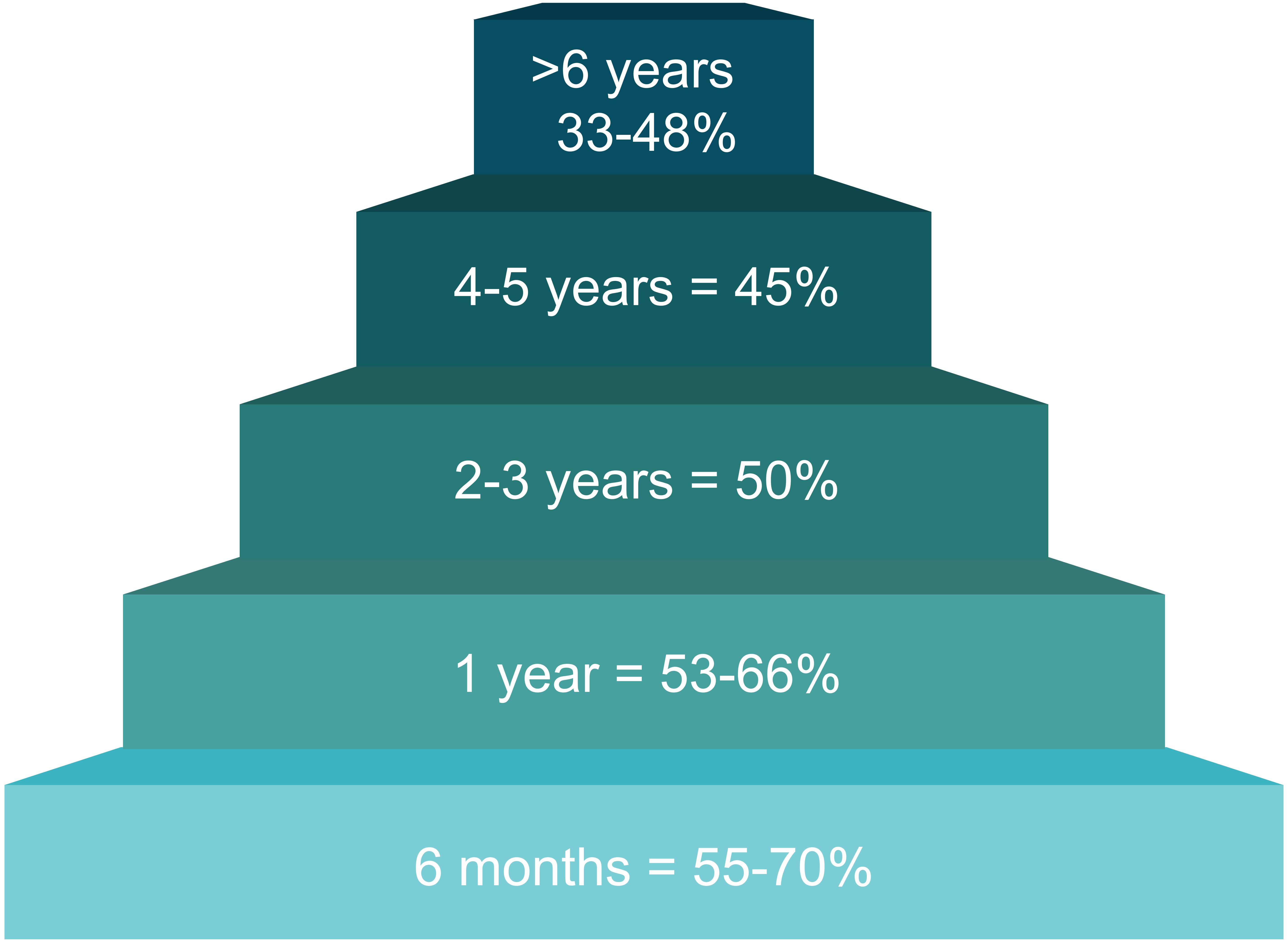
Off-stimulation

72 years old, essential tremor for 35 years

Disabling action tremor (Fahn-Tolosa-Marin Rating Scale 33/40)

On-stimulation

Clinical outcomes expected for VIM DBS



Kremer et al.
J Clin Med 2021

Cury et al.
Neurology 2017

Thalamic deep brain stimulation for tremor in Parkinson disease, essential tremor, and dystonia

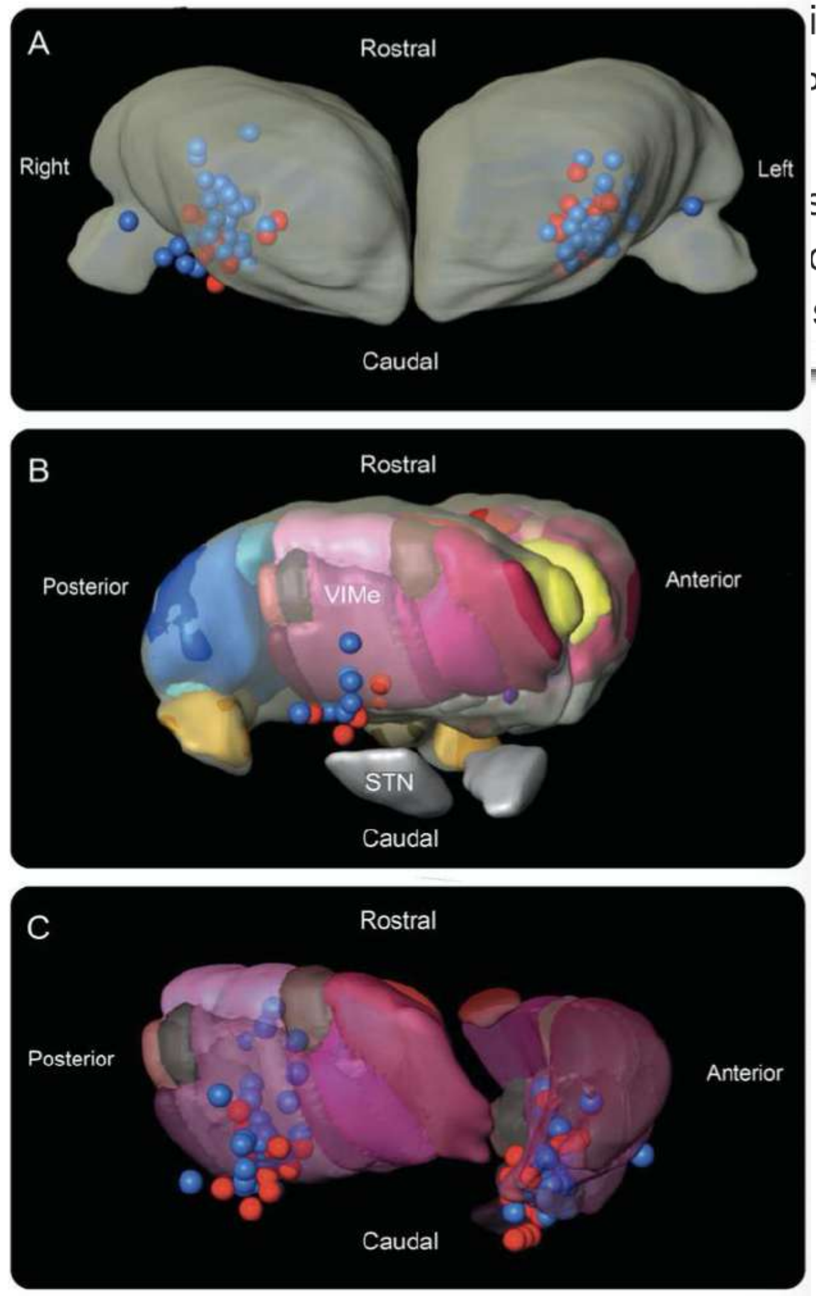
Rubens Gisbert Cury, MD, PhD
Valerie Fraix, MD, PhD
Anna Castrioto, MD, PhD
Maricely Ambar Pérez Fernández, MD
Paul Krack, MD, PhD
Stephan Chabardes, MD, PhD
Eric Seigneuret, MD
Eduardo Joaquim Lopes Alho, MD, PhD
Alim-Louis Benabid, MD, PhD
Elena Moro, MD, PhD

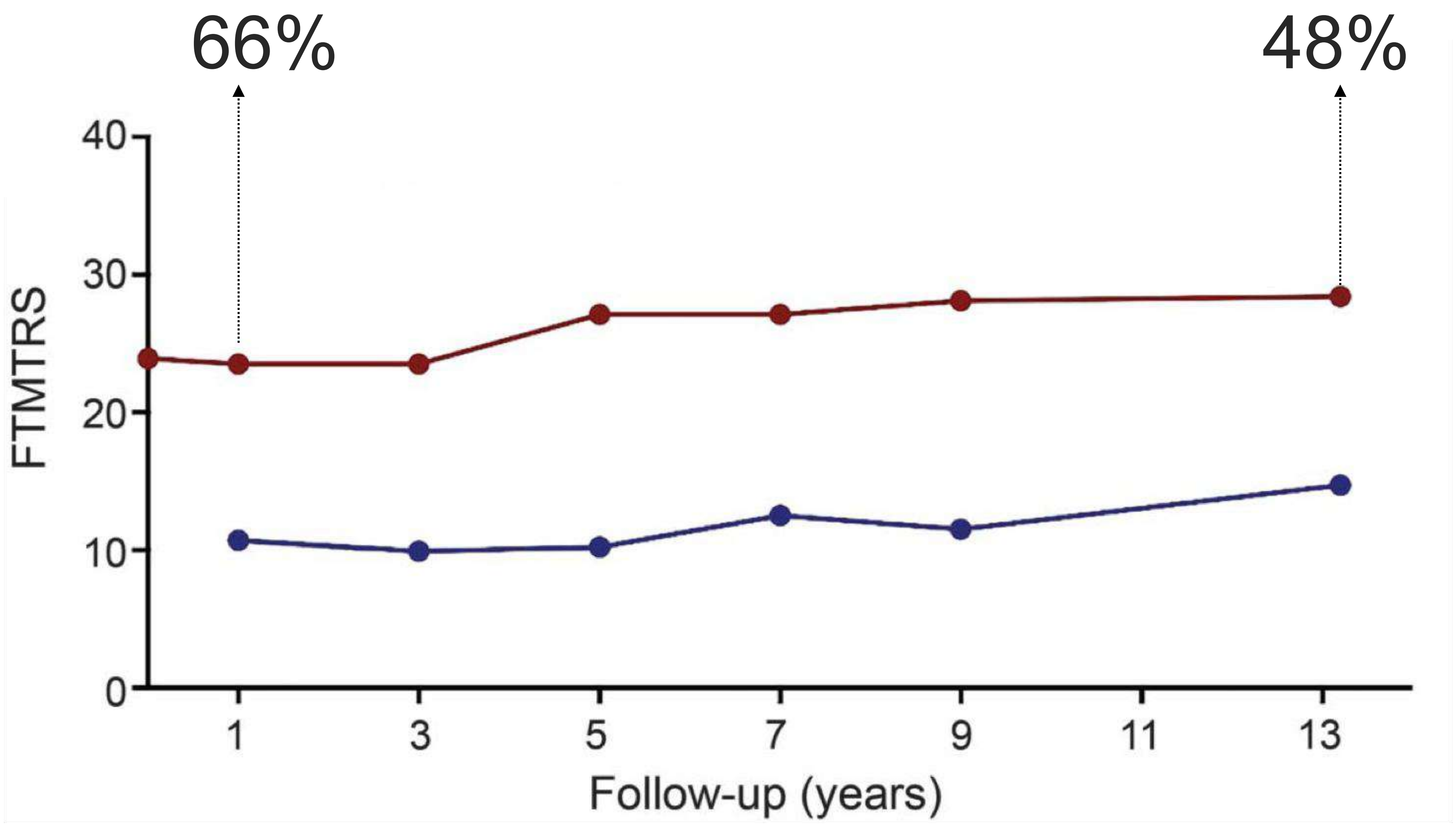
ABSTRACT

Objective: To report on the long-term outcomes of deep brain stimulation (DBS) of the thalamic ventral intermediate nucleus (VIM) in Parkinson disease (PD), essential tremor (ET), and dystonic tremor.

Methods: One hundred fifty-nine patients with PD, ET, and dystonia underwent VIM DBS due to refractory tremor at the Grenoble University Hospital. The primary outcome was a change in the tremor scores at 1 year after surgery and at the latest follow-up (21 years). Secondary outcomes included the relationship between tremor score reduction over time and the active contact position. Tremor scores (Unified Parkinson's Disease Rating Scale-III, items 20 and 21; Fahn, Tolosa, Marin Tremor R ive contacts were recorded.

Results: Ninety PD and ET had sustained improvement in tremor with and 66% at 1 year; 63% and 48% beyond 10 yea significant loss of stimulation benefit over time (p > oderate response at 1-year follow-up (41% tremor i stained after 5 years (30% improve-



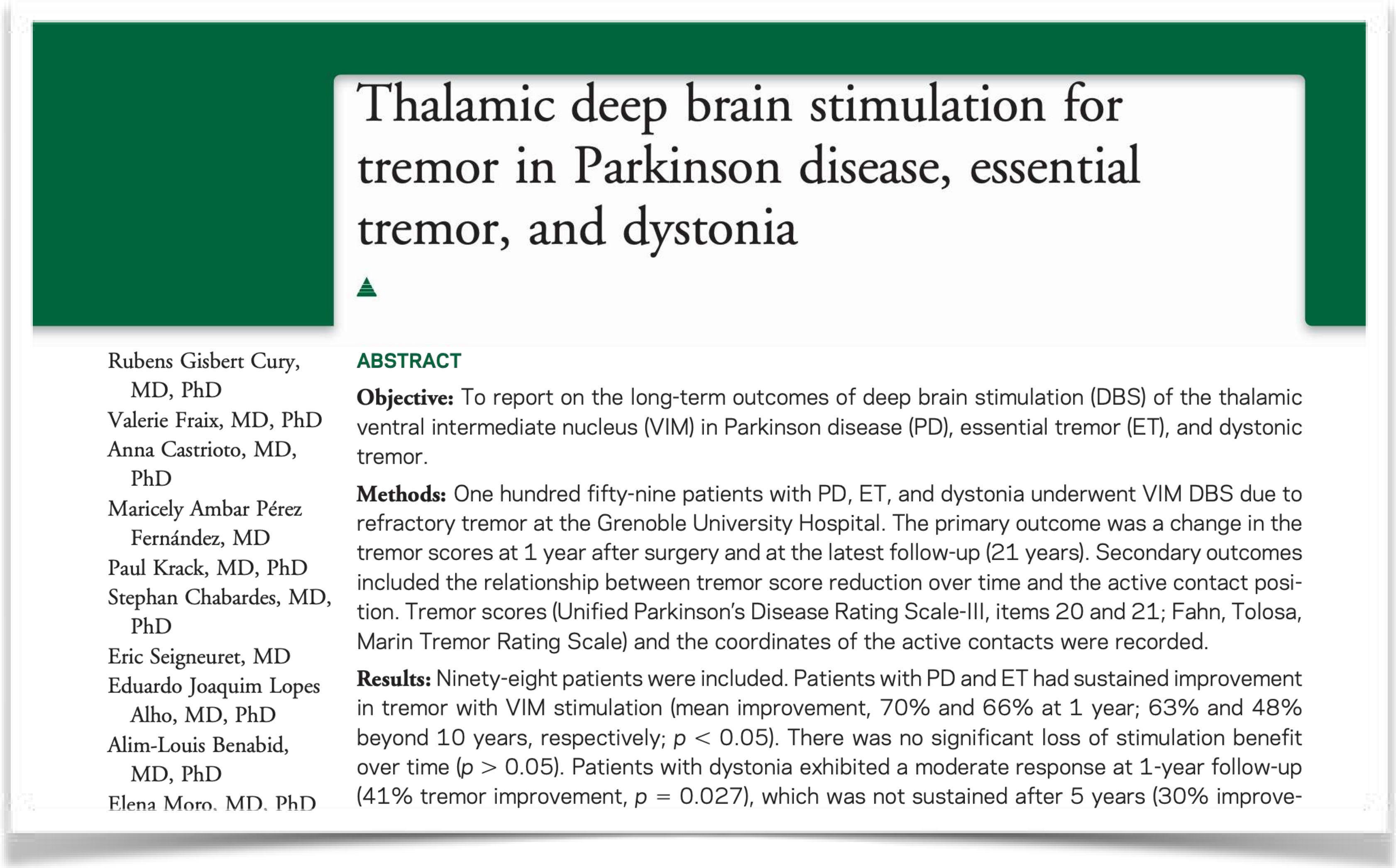


Cury et al. Neurology 2017

Long-term effect

Courtesy from Grenoble CHU

Should we consider DBS if the voice tremor is the most bothersome symptom in a paciente with ET?



Thalamic deep brain stimulation for tremor in Parkinson disease, essential tremor, and dystonia

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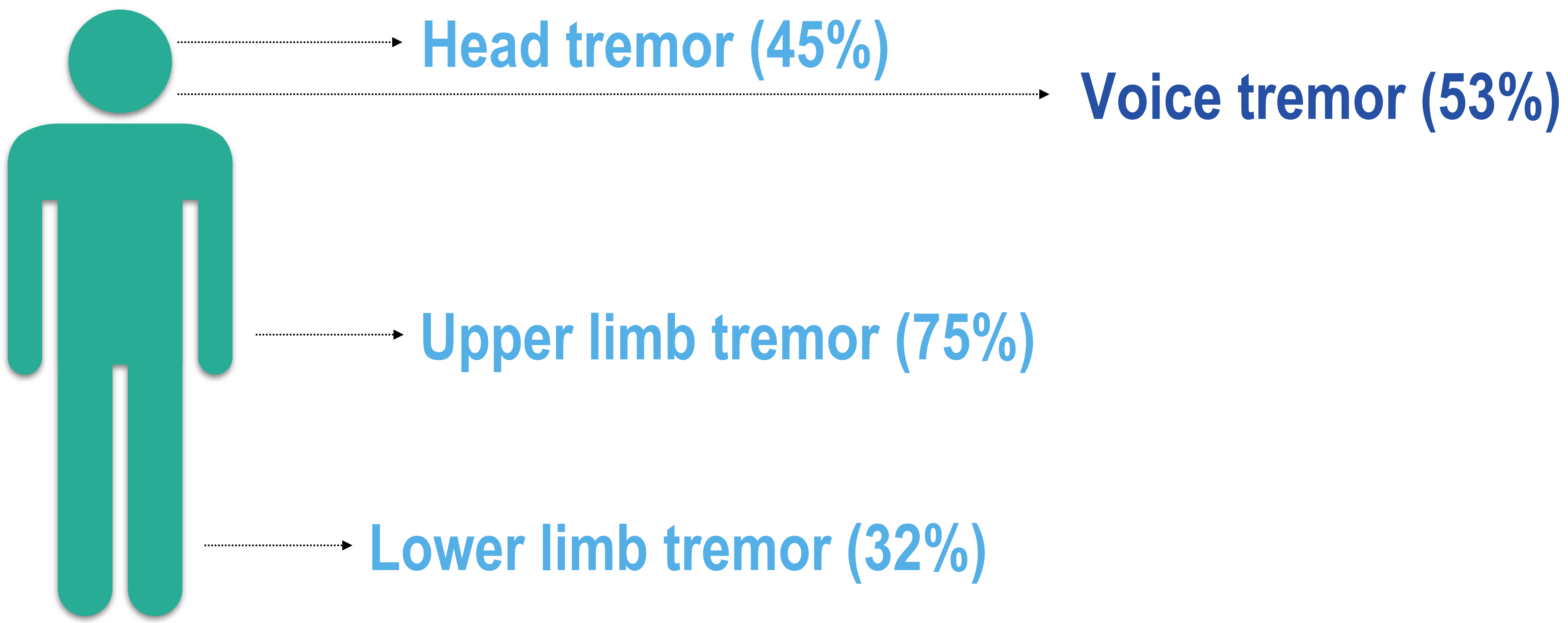
Results: Ninety-eight patients were included. Patients with PD and ET had sustained improvement in tremor with VIM stimulation (mean improvement, 70% and 66% at 1 year; 63% and 48% beyond 10 years, respectively; $p < 0.05$). There was no significant loss of stimulation benefit over time ($p > 0.05$). Patients with dystonia exhibited a moderate response at 1-year follow-up (41% tremor improvement, $p = 0.027$), which was not sustained after 5 years (30% improve-



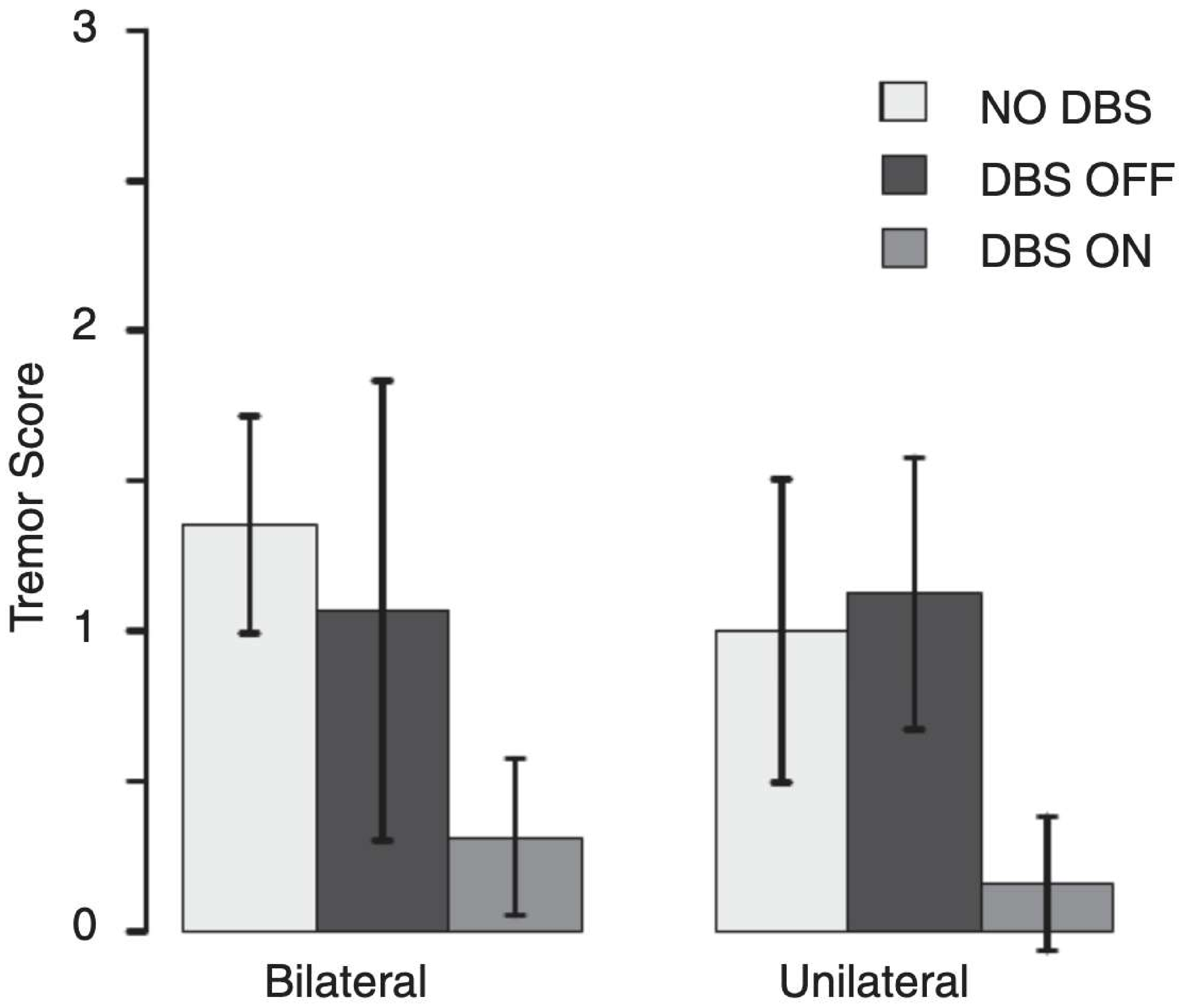
Cury et al. Neurology 2017

Thalamic Deep Brain Stimulation for Essential Tremor Also Reduces Voice Tremor

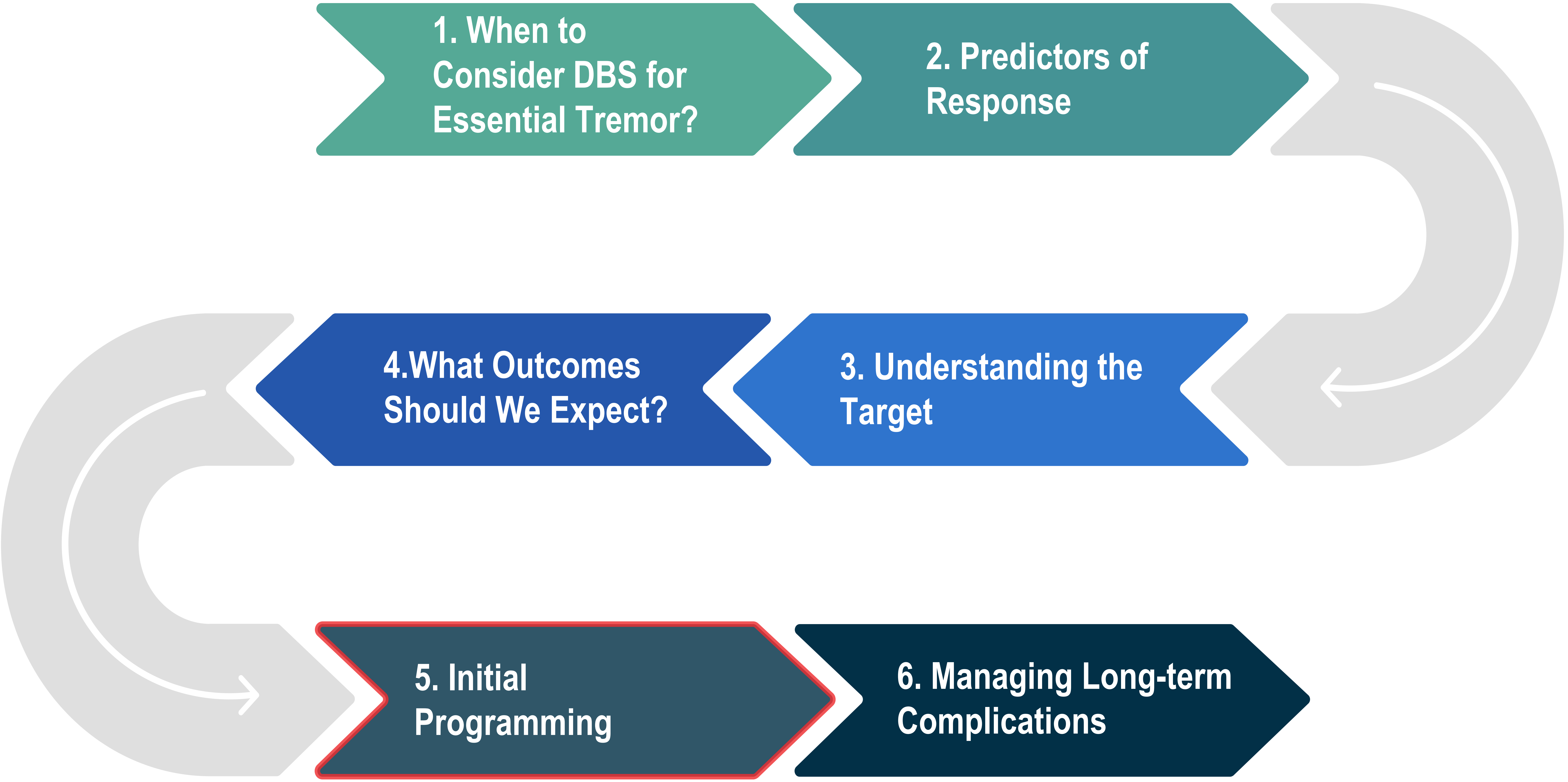
Bornali Kundu, MD, PhD*; Lauren Schrock, MD†; Tyler Davis, MD, PhD*;
Paul A. House, MD*

20 ptes (19/20 had voice improved)

Voice Tremor Score



DBS for Essential Tremor - Roadmap



Initial Programming

Parkinson's disease: start very slow

Essential tremor: start slow

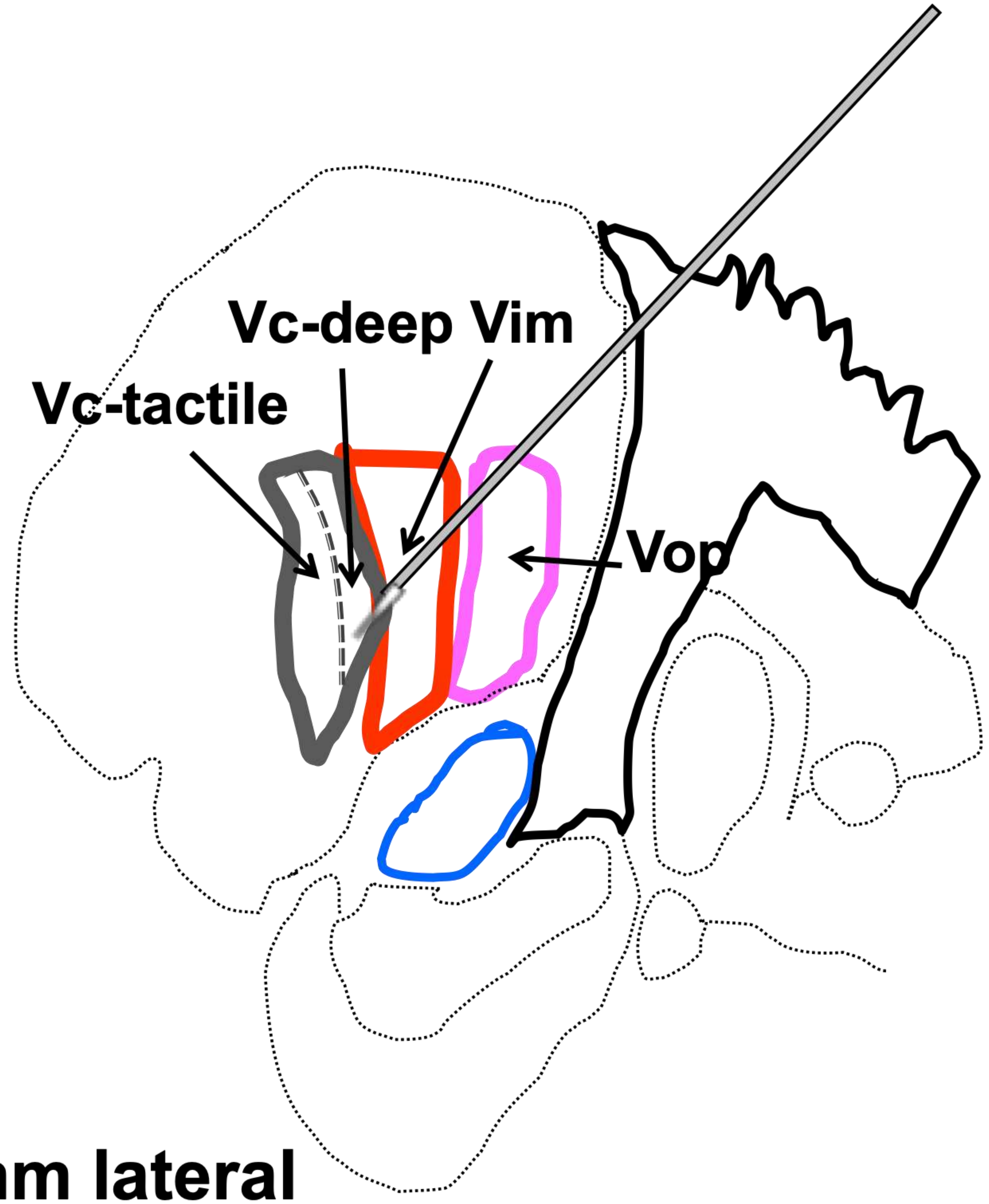
Dystonia: start moderate*

Sagittal plane

Dorsal

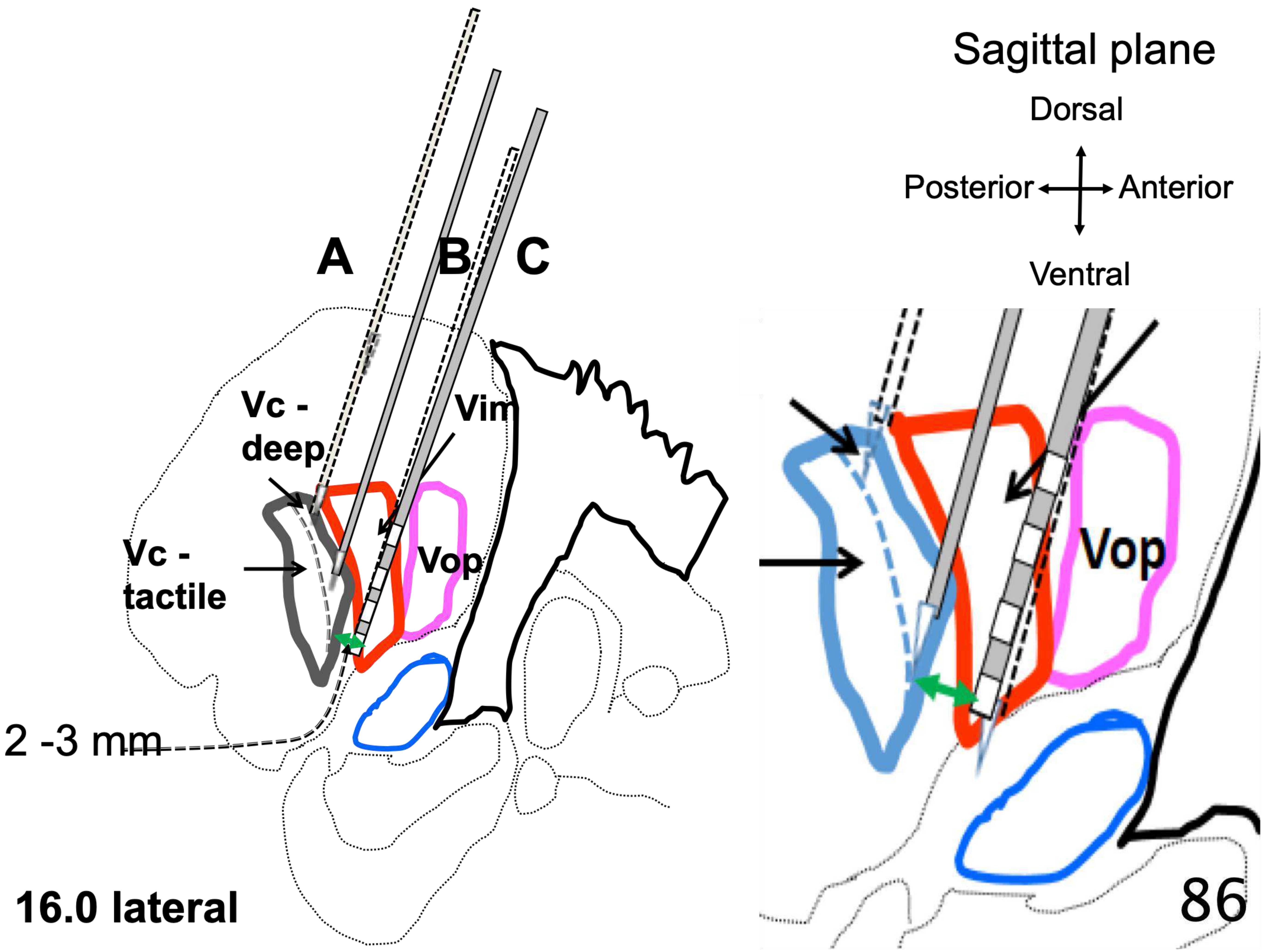
Posterior Anterior

Ventral



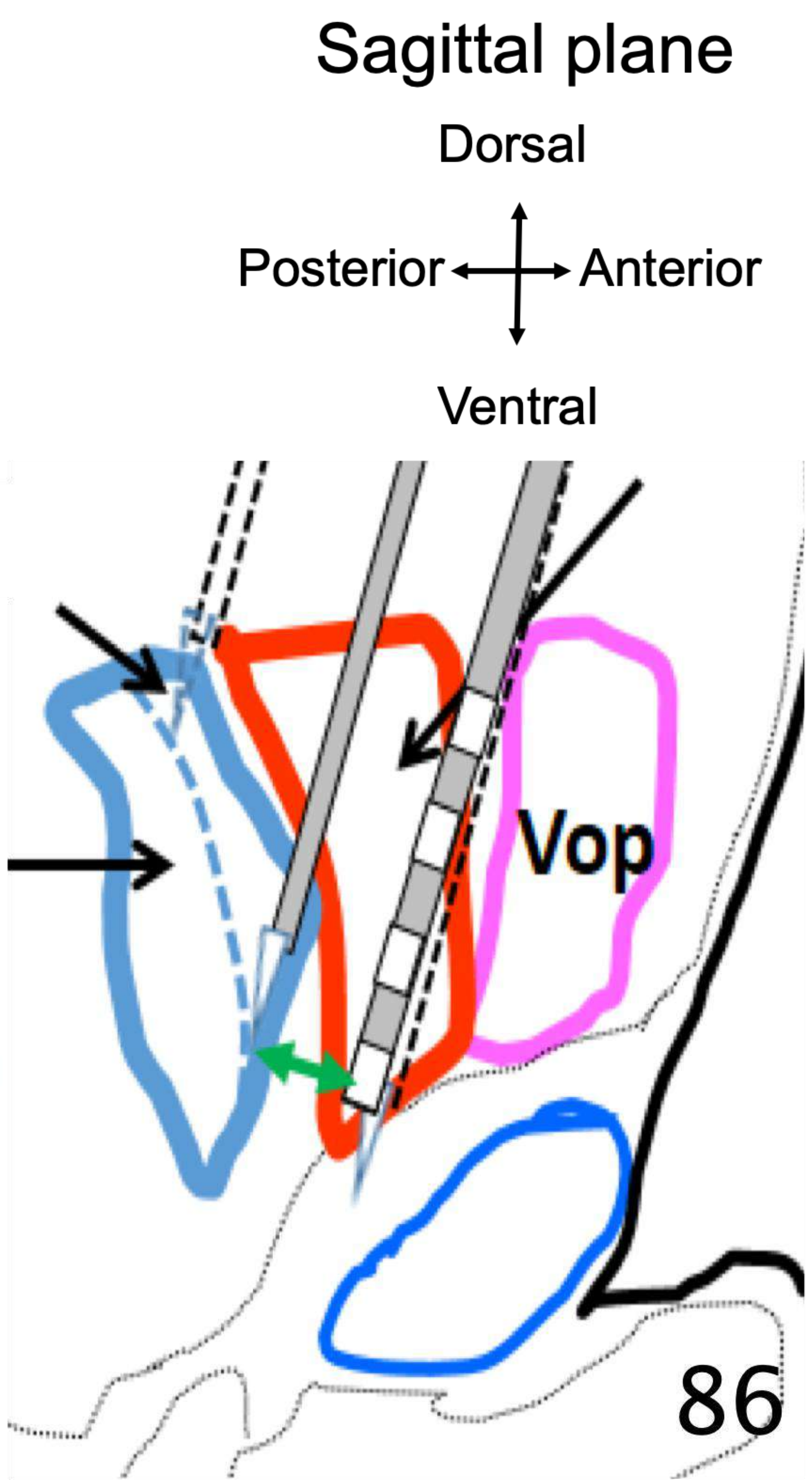
16.0 mm lateral

to the AC-PC line


A
B
C
Vc -
deep
Vim
Vc -
tactile
Vop
2 -3 mm
16.0 lateral
Sagittal plane
Dorsal
Posterior
Anterior
Ventral
Vop
86

Effects of stim in proximity of the VIM

Stimulation Related Observation or Side Effects	Related Anatomy	Relative to Vim
Tremor control	Middle of the Vim	Vim
Dysarthria	Medial aspect of Vim, centromedian nucleus, parafascicular nucleus	Medial
Dysarthria, contralateral muscular contraction	Posterior limb of the internal capsule	Lateral
Reduction of tremor at high amplitudes with no side effects	VOP or VOA	Anterior
Paresthesia, Ataxia, Slurred speech	Vc	Posterior
No benefit or adverse events	Dorsal aspect of the thalamus	Superior

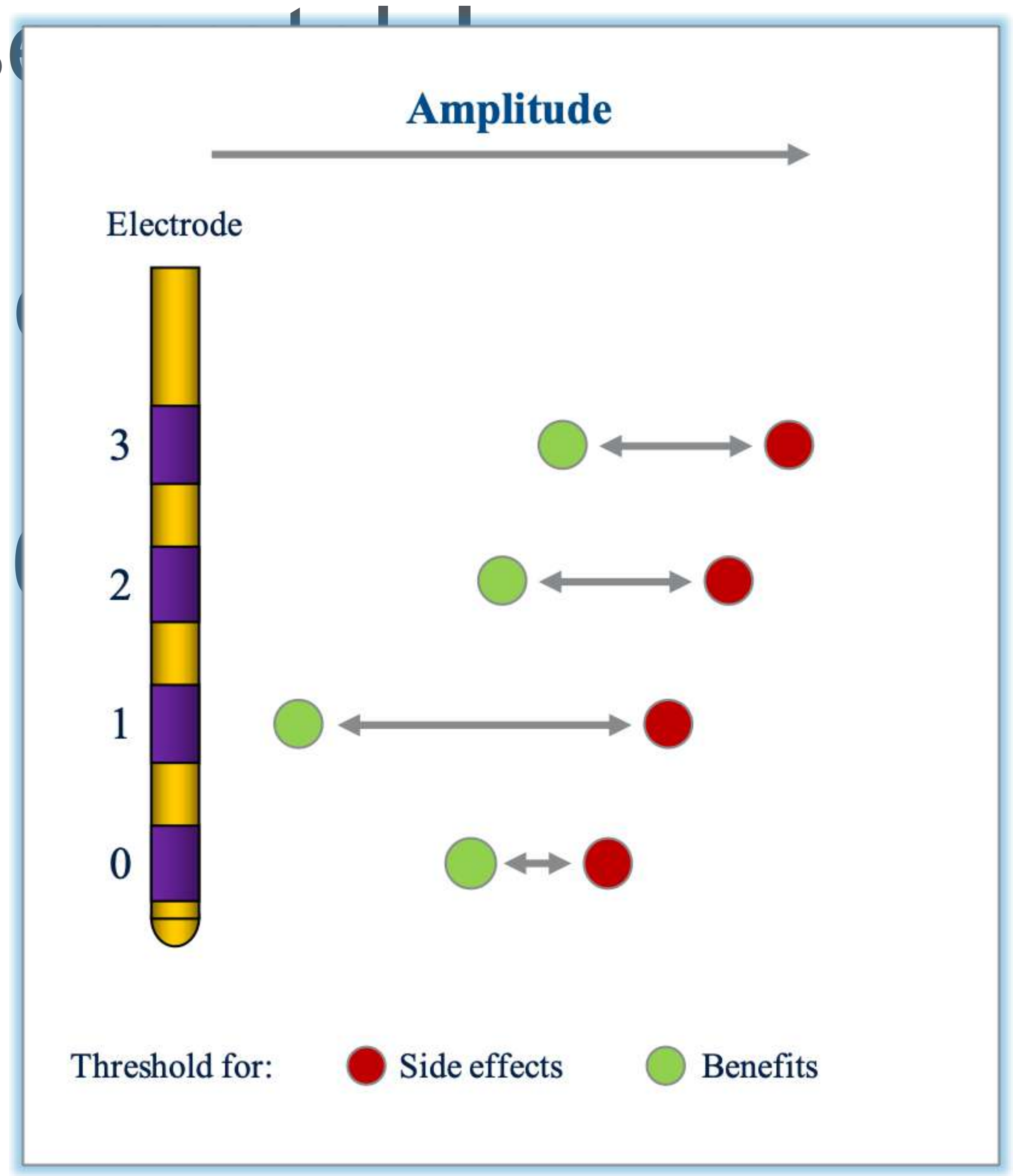


International Parkinson and Movement Disorder Society

General principles of Programming VIM DBS

- Monopolar review (define the therapeutic window)
- Teste each side se
- Usually the lower
- Start with 0.5mA/
- **Observe**:

- Postural tremor
- Kinetic tremor
- Gait



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General principles of Programming VIM DBS

Tremor response to polarity, voltage, pulsewidth and frequency of thalamic stimulation

Padraig E. O'Suilleabhain, MB, BCh; William Frawley, PhD; Cole Giller, MD, PhD; and Richard B. Dewey Jr., MD

Current

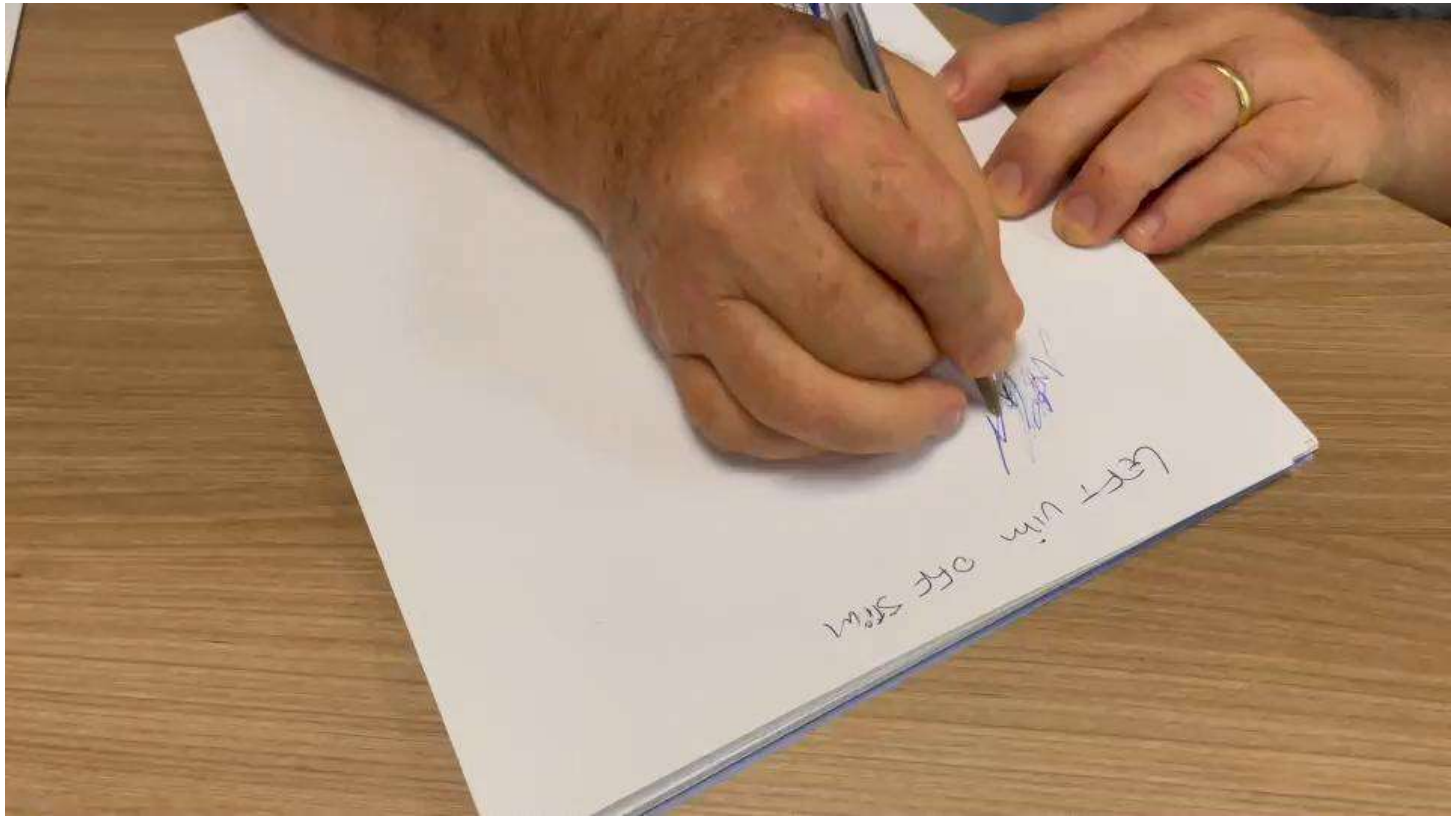
PW 120>90>60

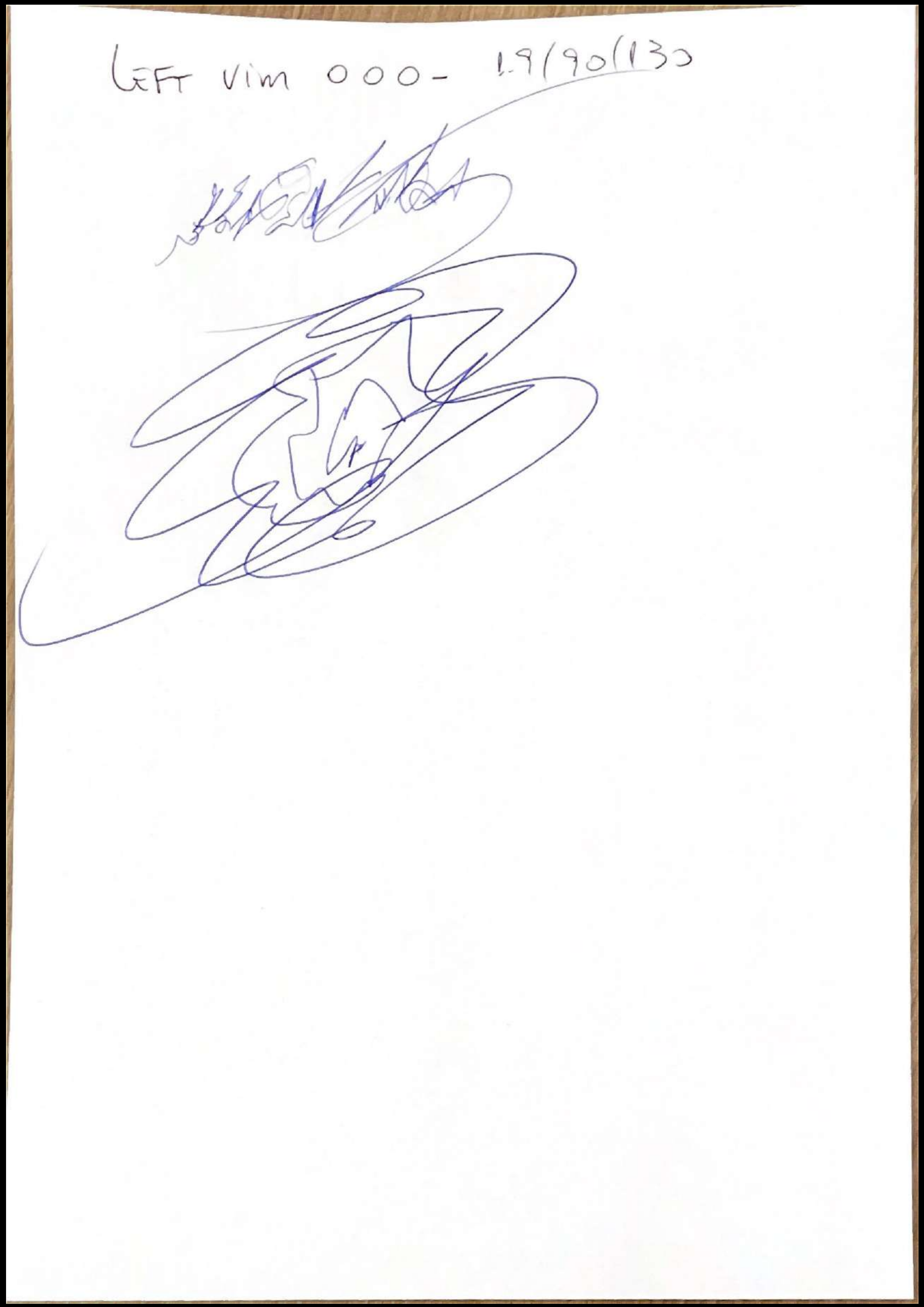
Fr 130=60=185

Follow the tendencies!

70 yo, Essential Tremor for 30 years

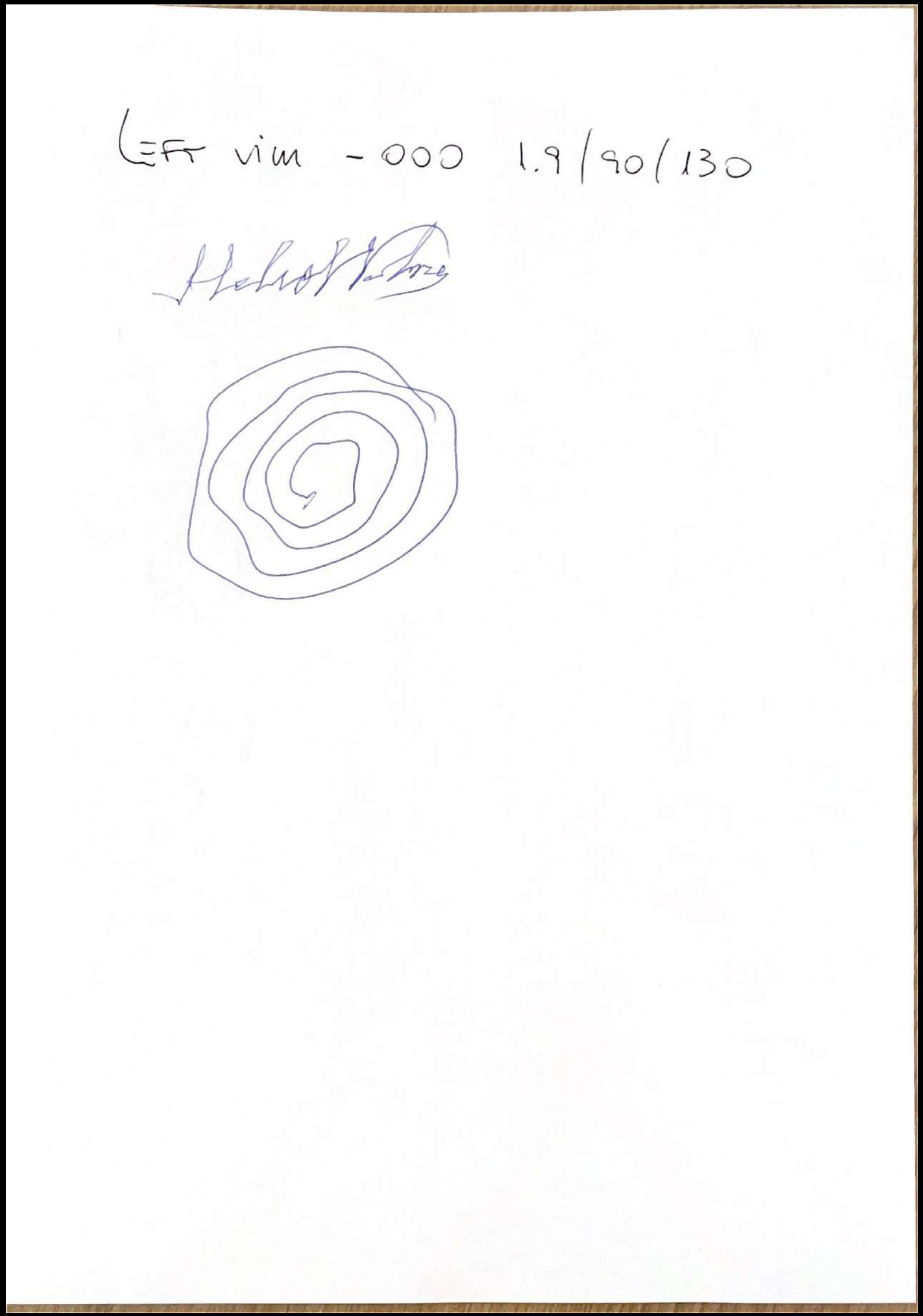
70 yo, Essential Tremor for 30 years




LEFT Vim 000- 1.9/90/130

LEFT VIM 00-0 1.9/90/130

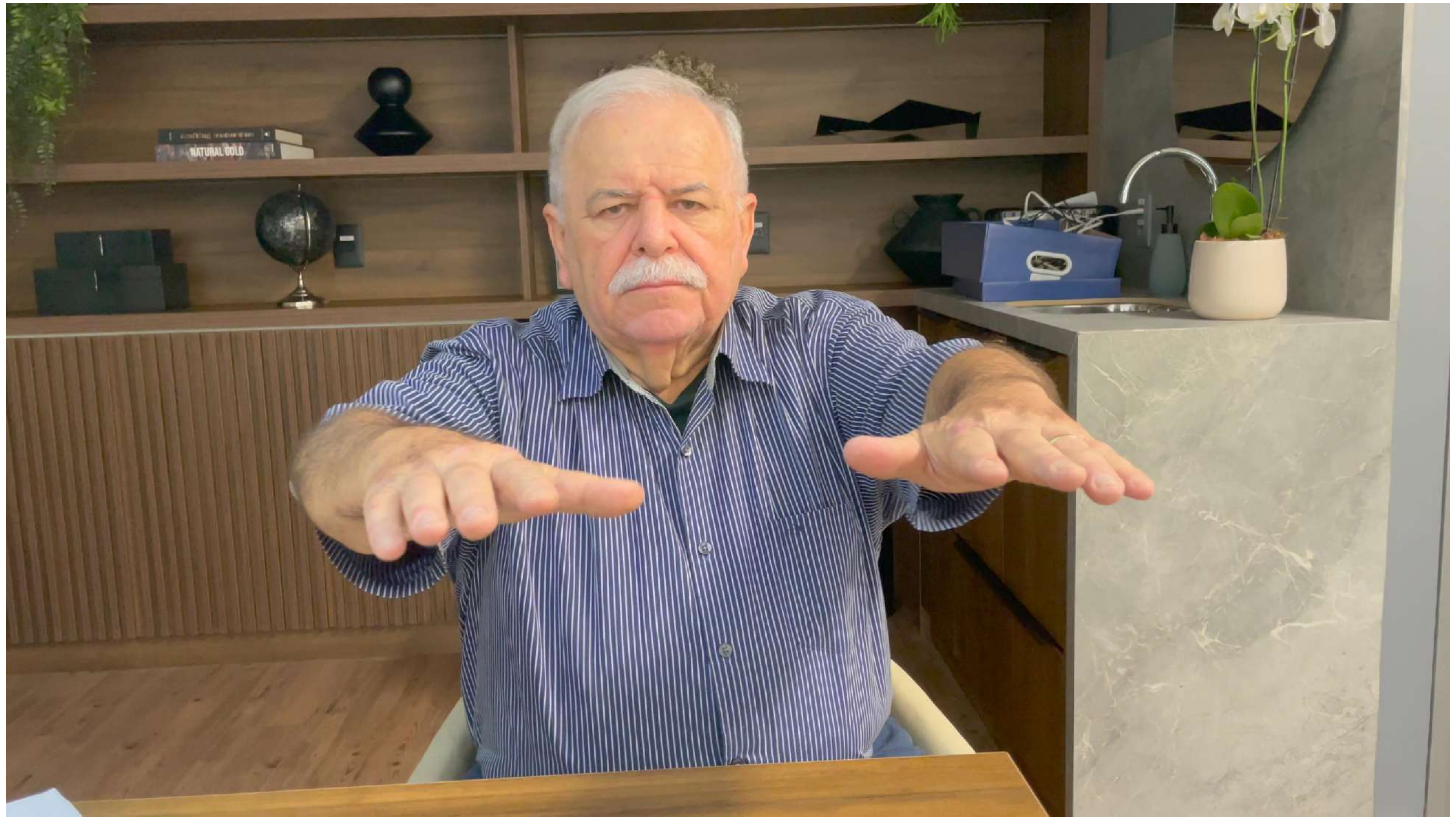
LEFT VIM 0-00 1.9/90/130


LEFT vim -000 1.9/90/130

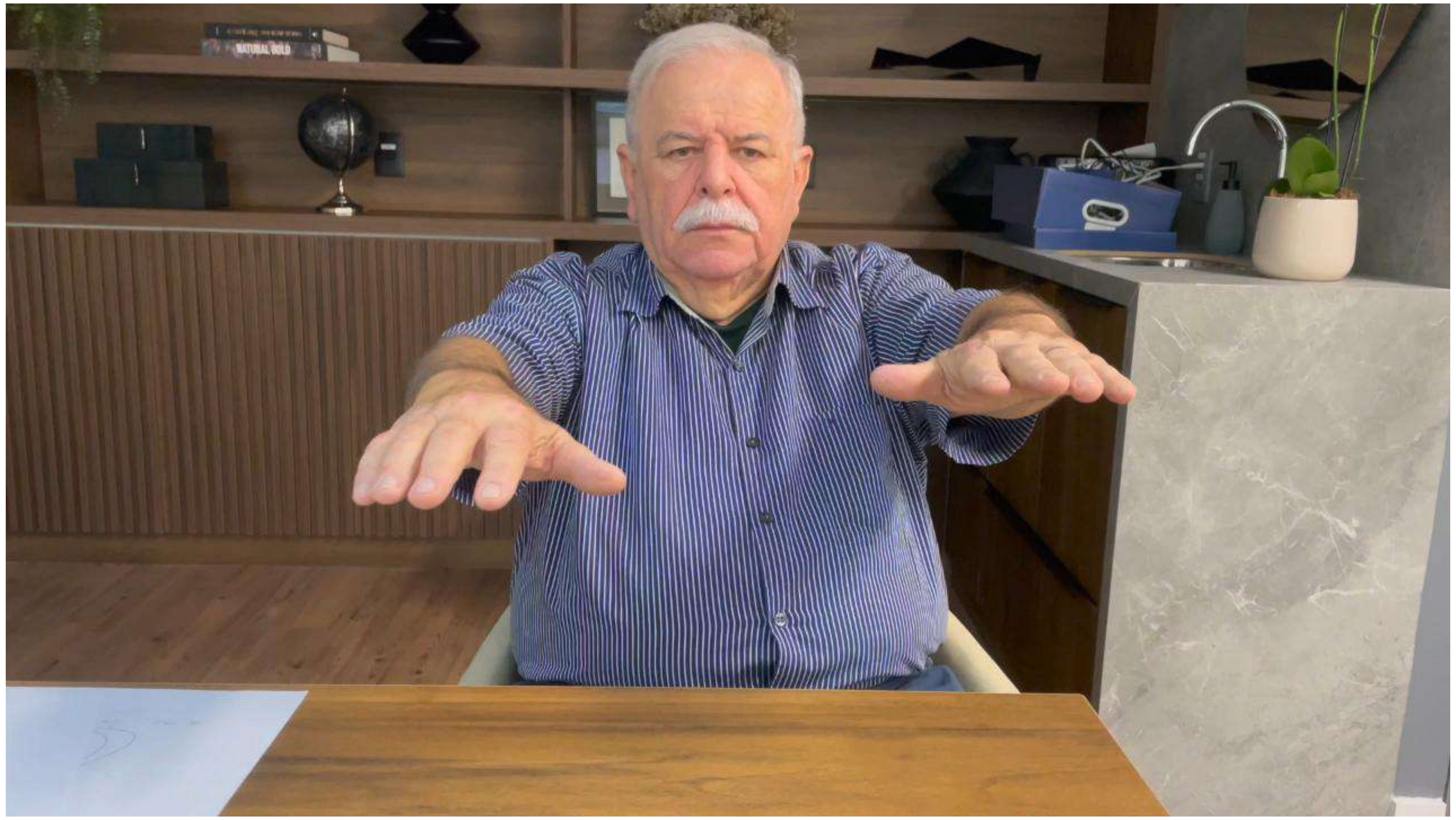
Cranial-caudal stimulation

NEUROMODULATION CENTER
MOVEMENT DISORDERS GROUP - UNIVERSITY OF SÃO PAULO

Off-stimulation



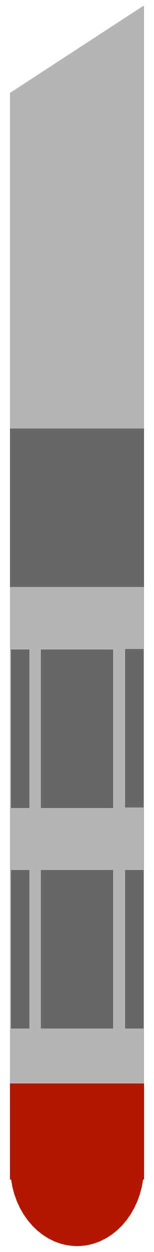
On-stimulation



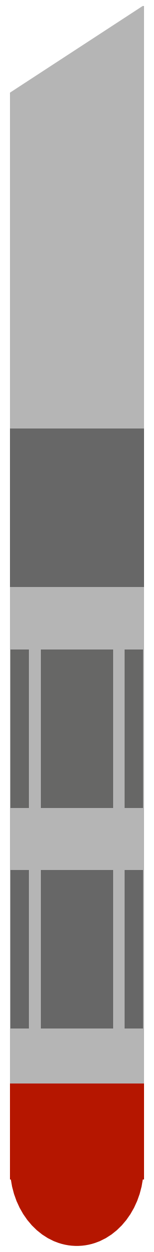
Program 1

Right electrode

0.5 mA; 60 µS; 130 Hz



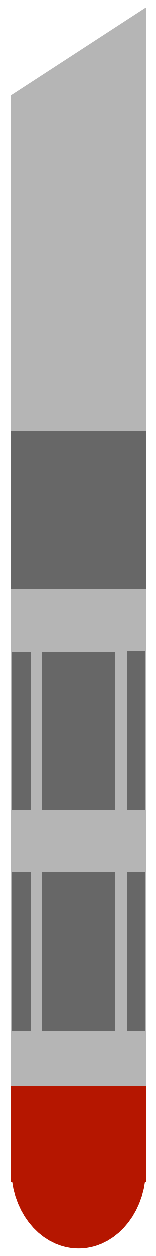
Left electrode



0.3 mA; 60 µS; 130 Hz

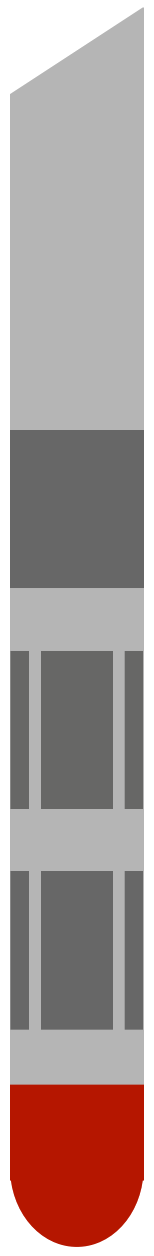
Program 2

Right electrode



0.7 mA; 60 μS; 130 Hz

Left electrode



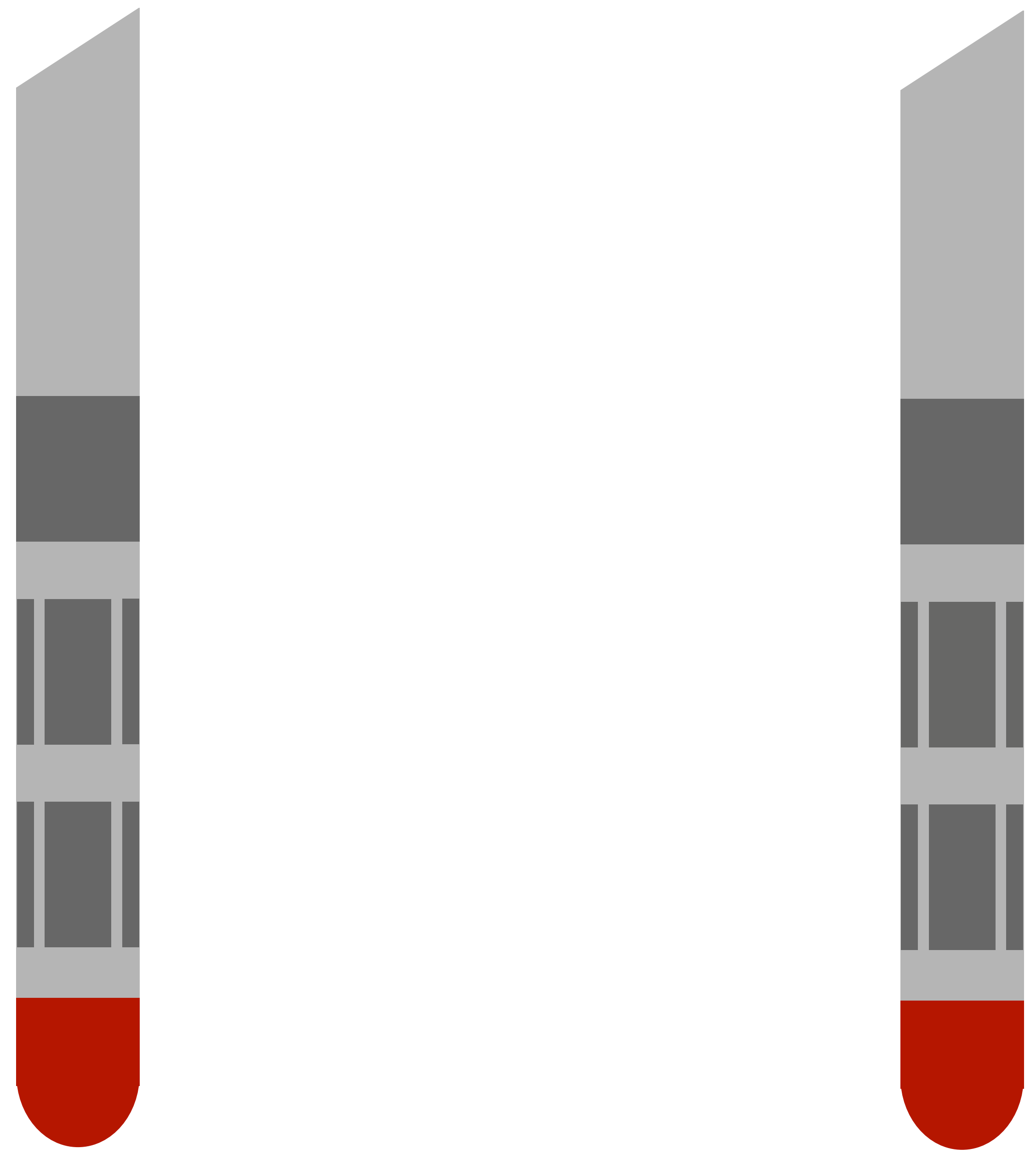
0.5 mA; 60 μS; 130 Hz

Program 3

Right electrode

Left electrode

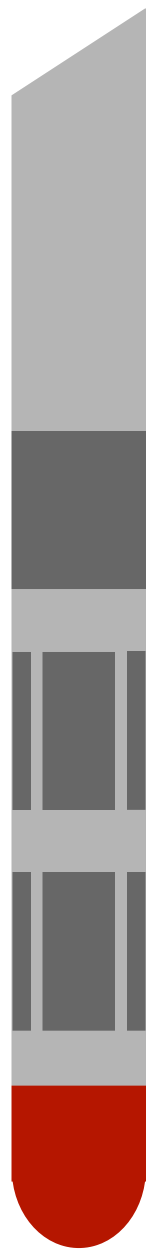
0.9 mA; 60 µS; 130 Hz



0.7 mA; 60 µS; 130 Hz

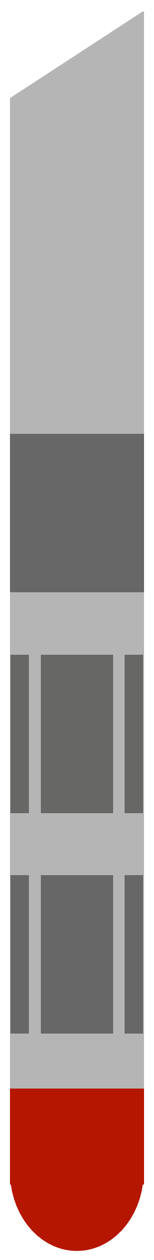
Program 4

Right electrode



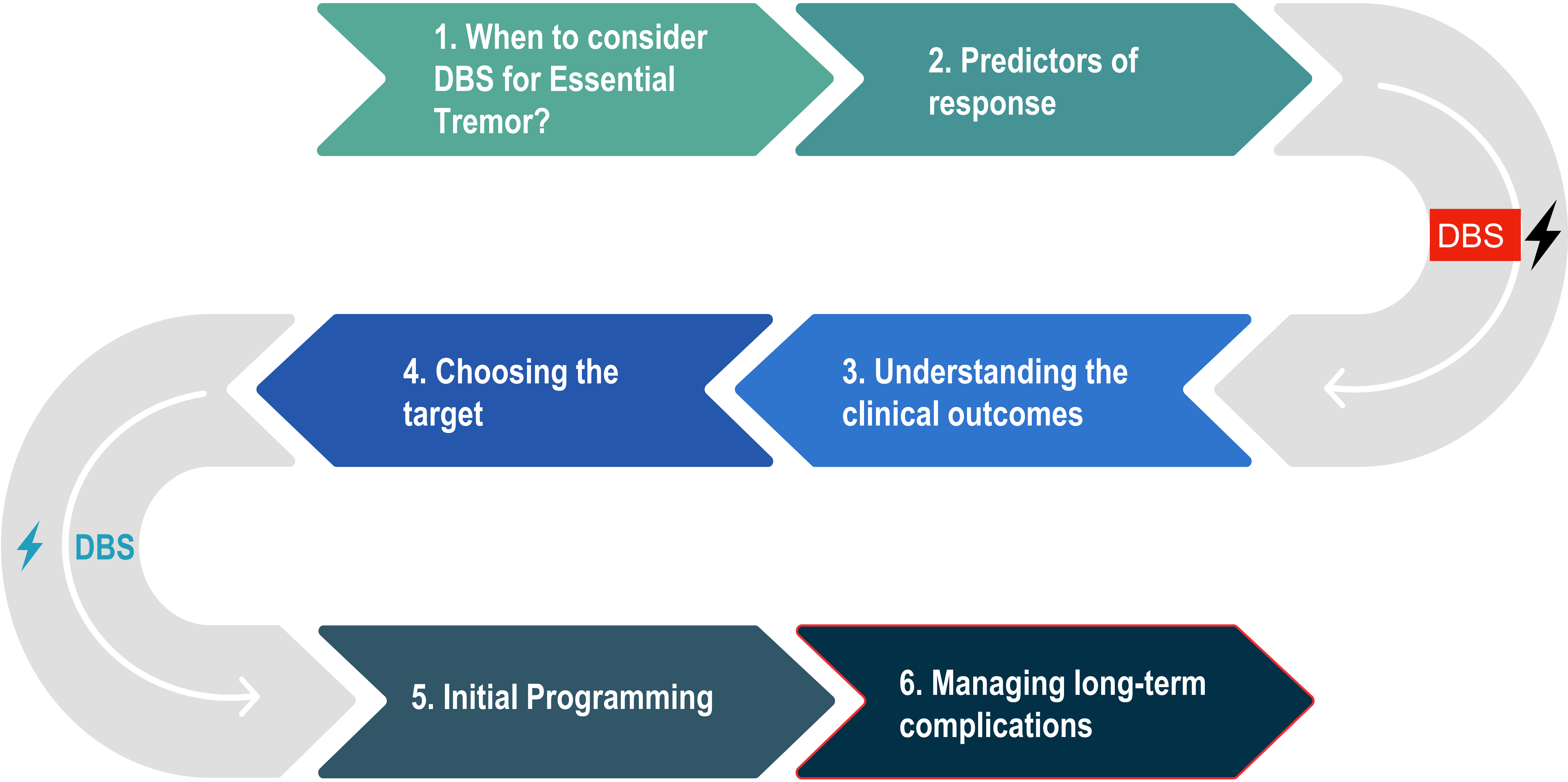
1.1 mA; 60 μS; 130 Hz

Left electrode



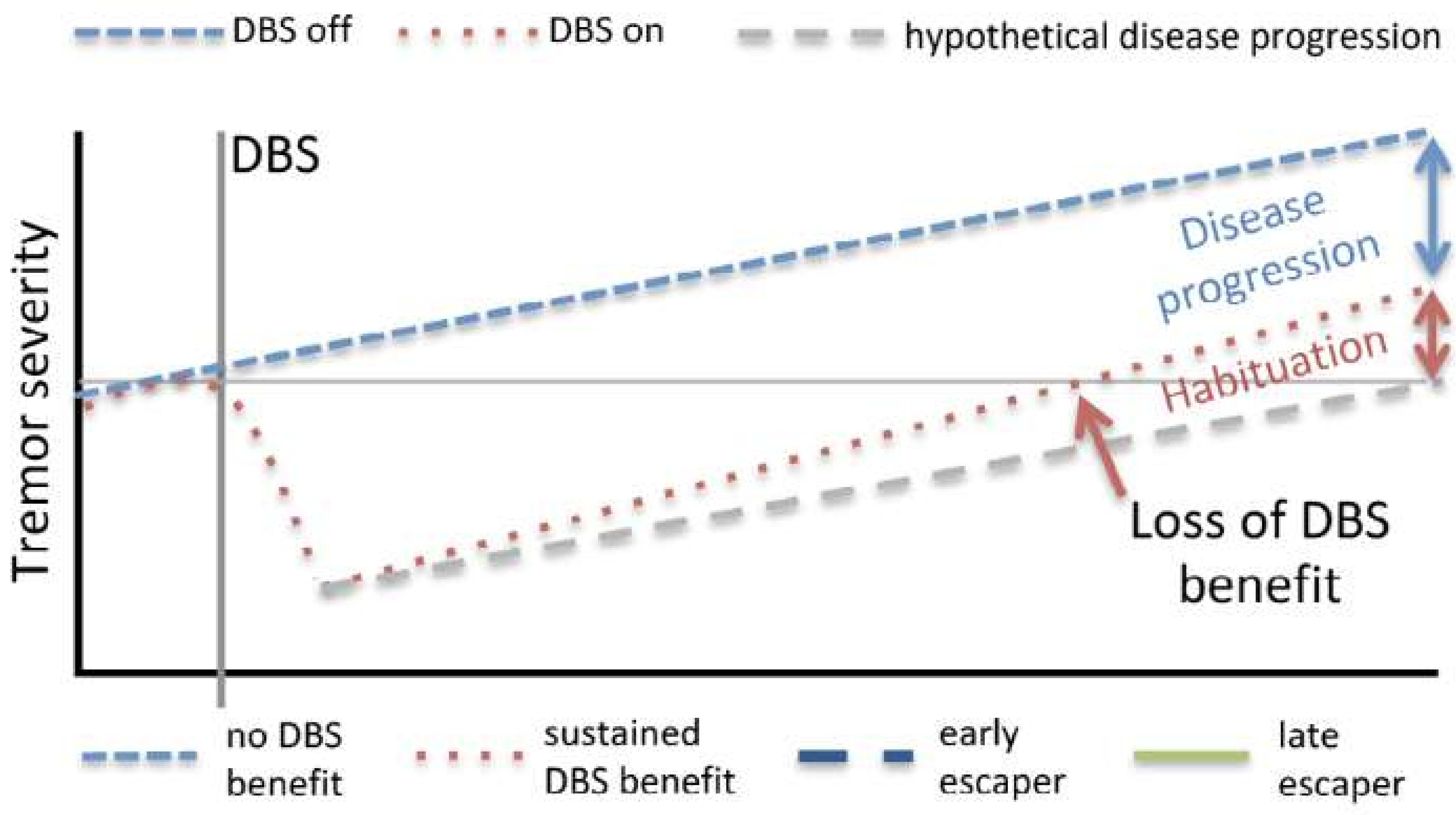
0.9 mA; 60 μS; 130 Hz

Roadmap



1. When to consider DBS for Essential Tremor?
2. Predictors of response
DBS
3. Understanding the clinical outcomes
4. Choosing the target
DBS
5. Initial Programming
6. Managing long-term complications

Habituation

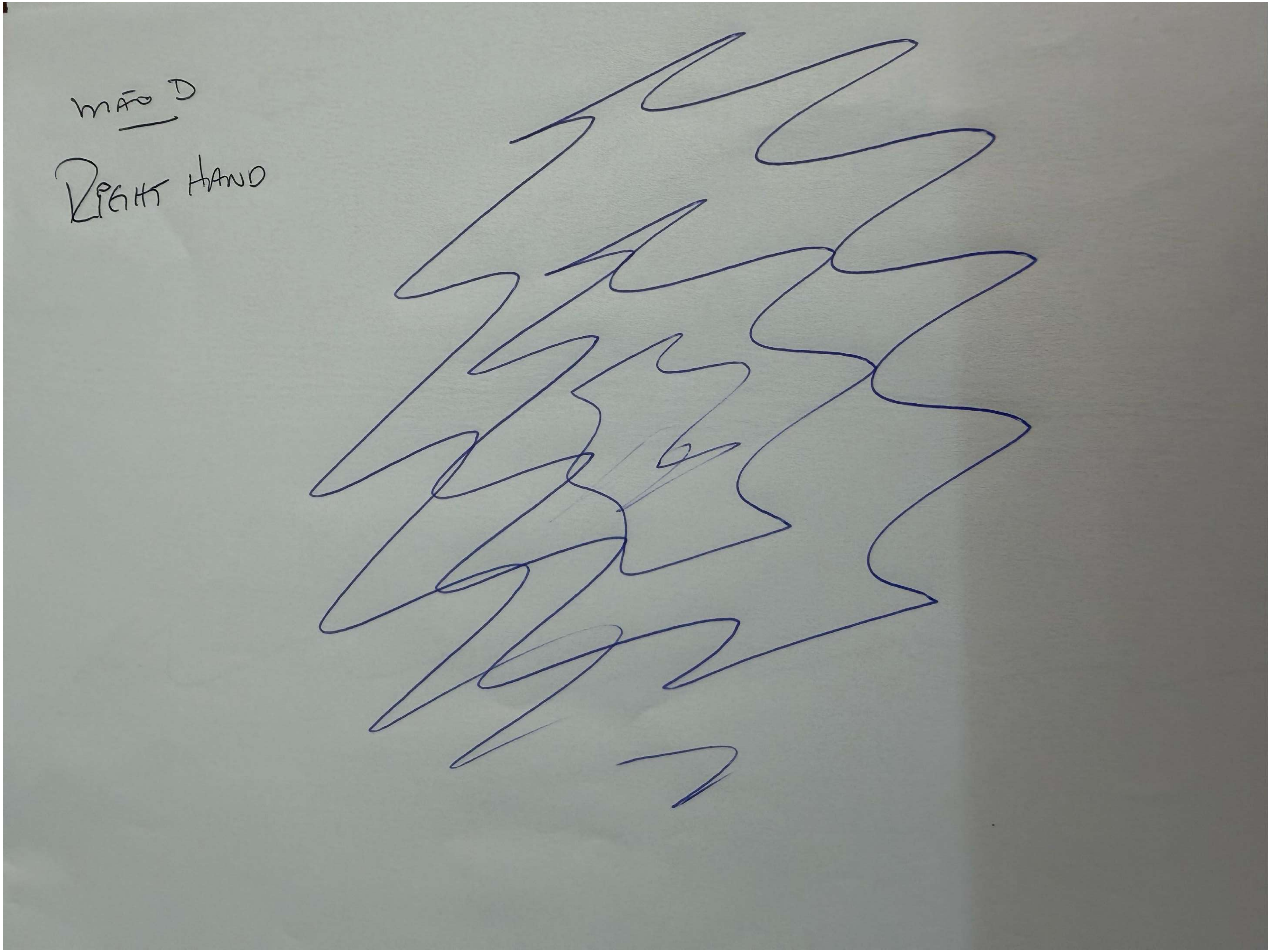


Fasano et al., 2019

International Parkinson and Movement Disorder Society


Off-stim


On-stim



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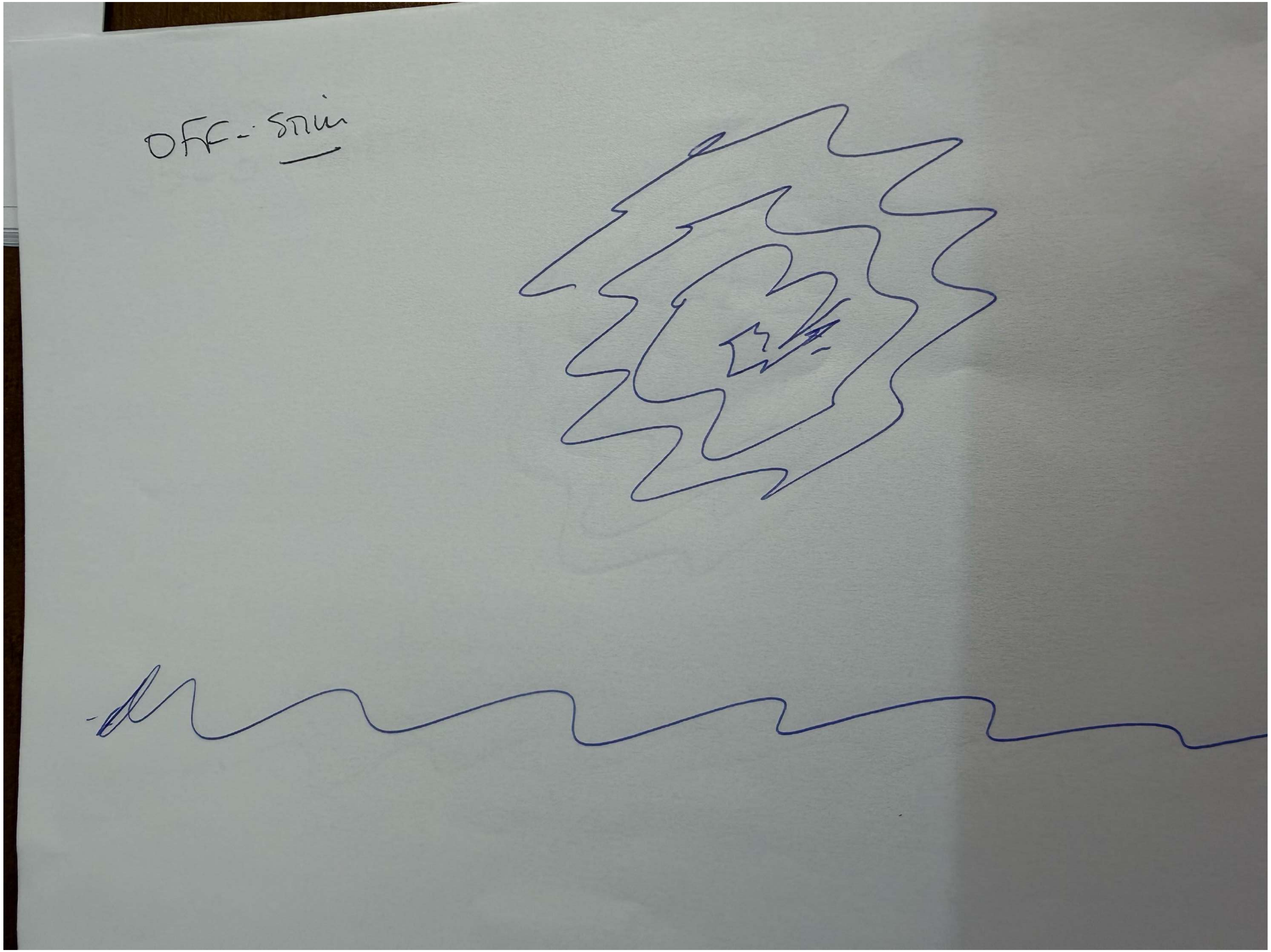
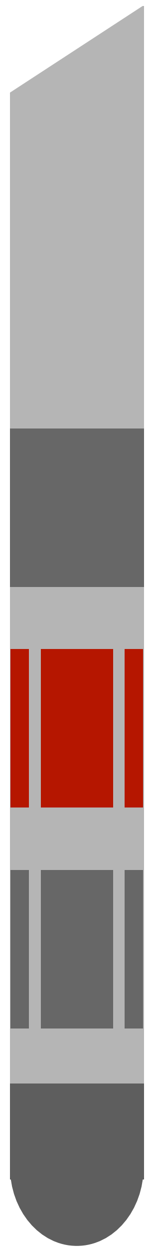
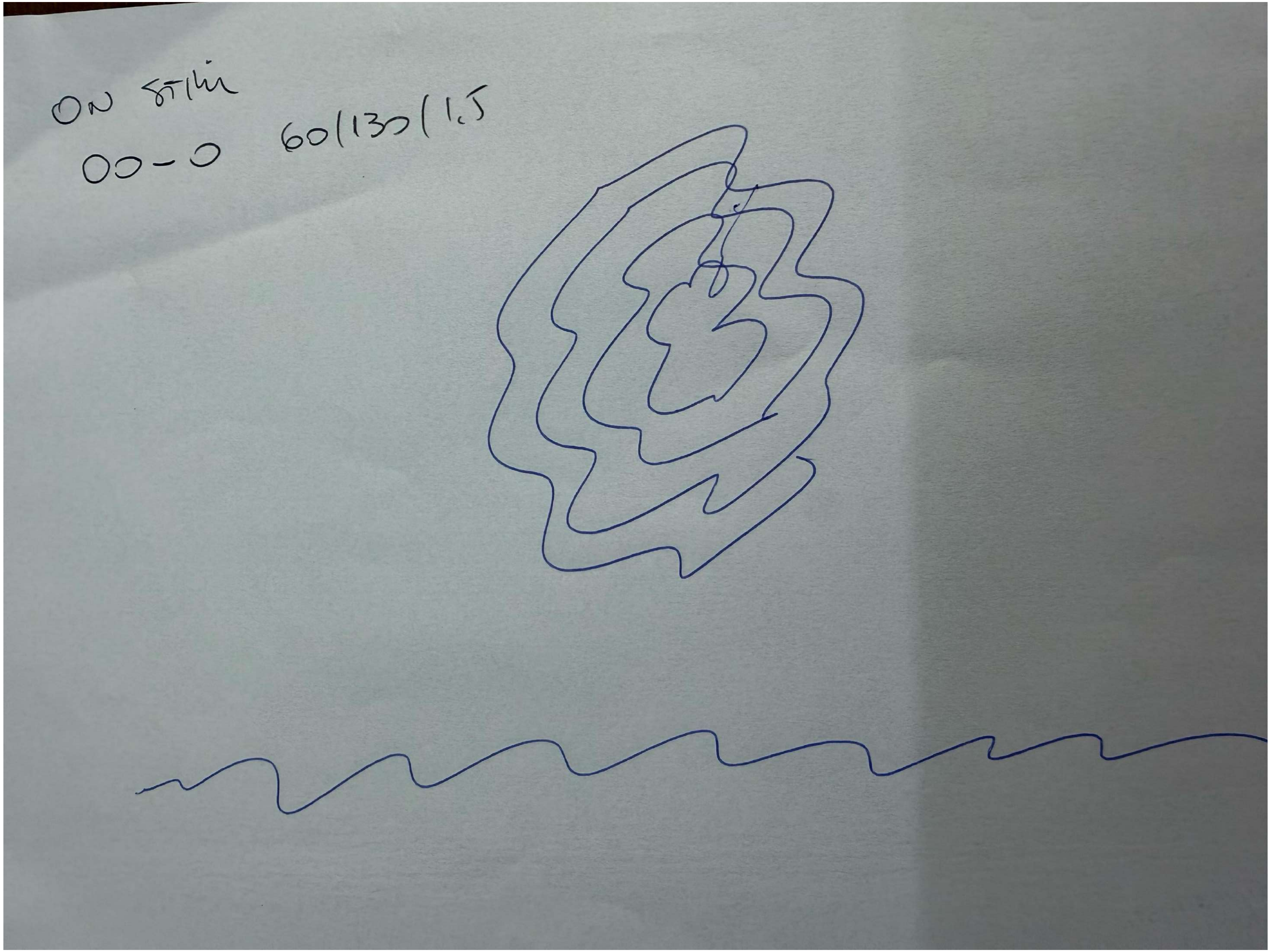
Movement Disorder Society



International Parkinson and
Movement Disorder Society

Left electrode





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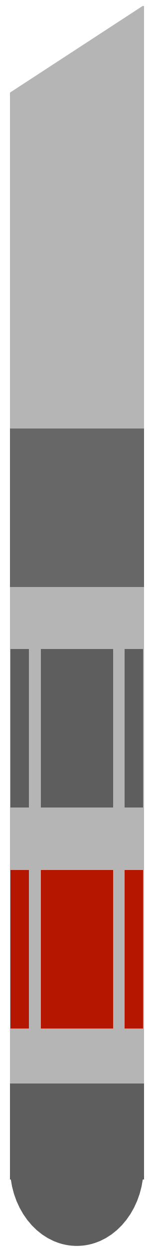
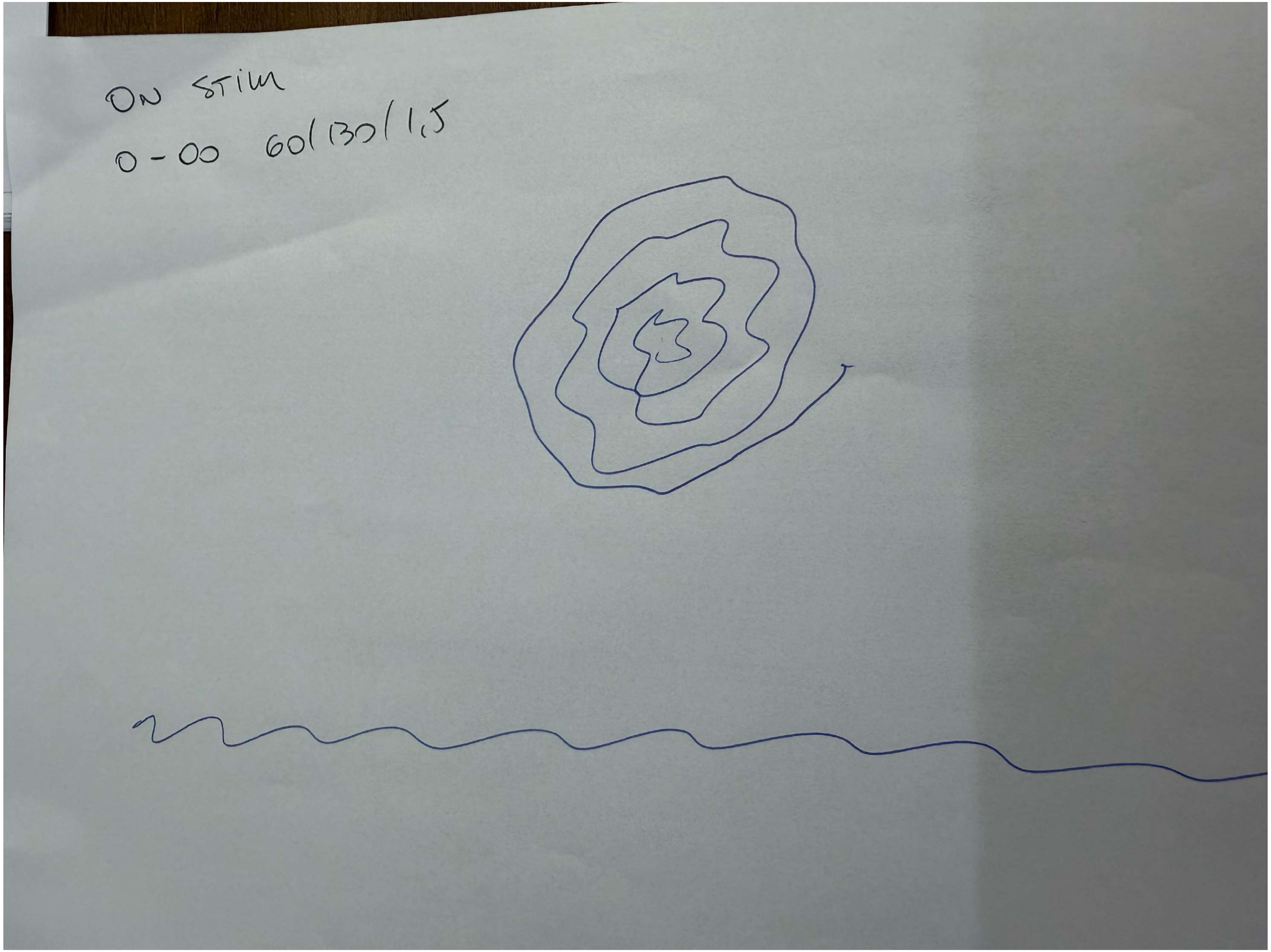
Left electrode





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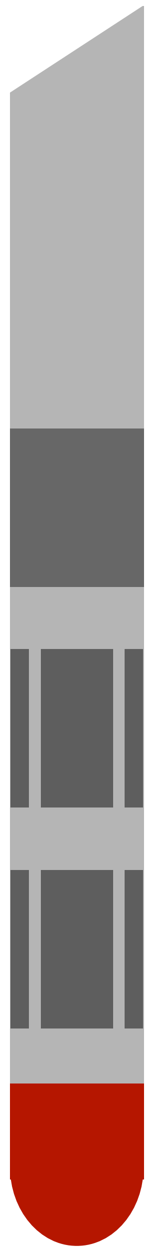
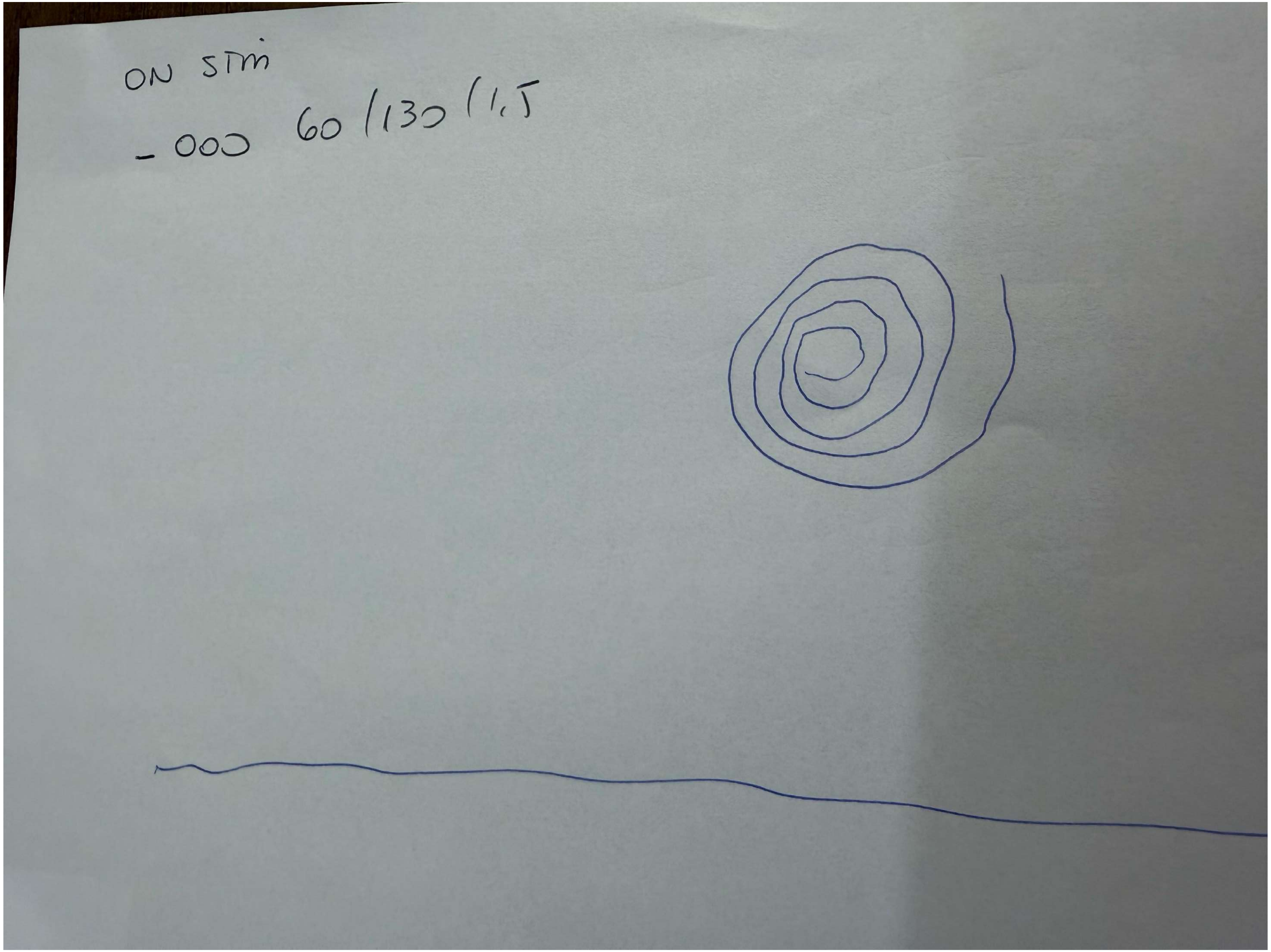
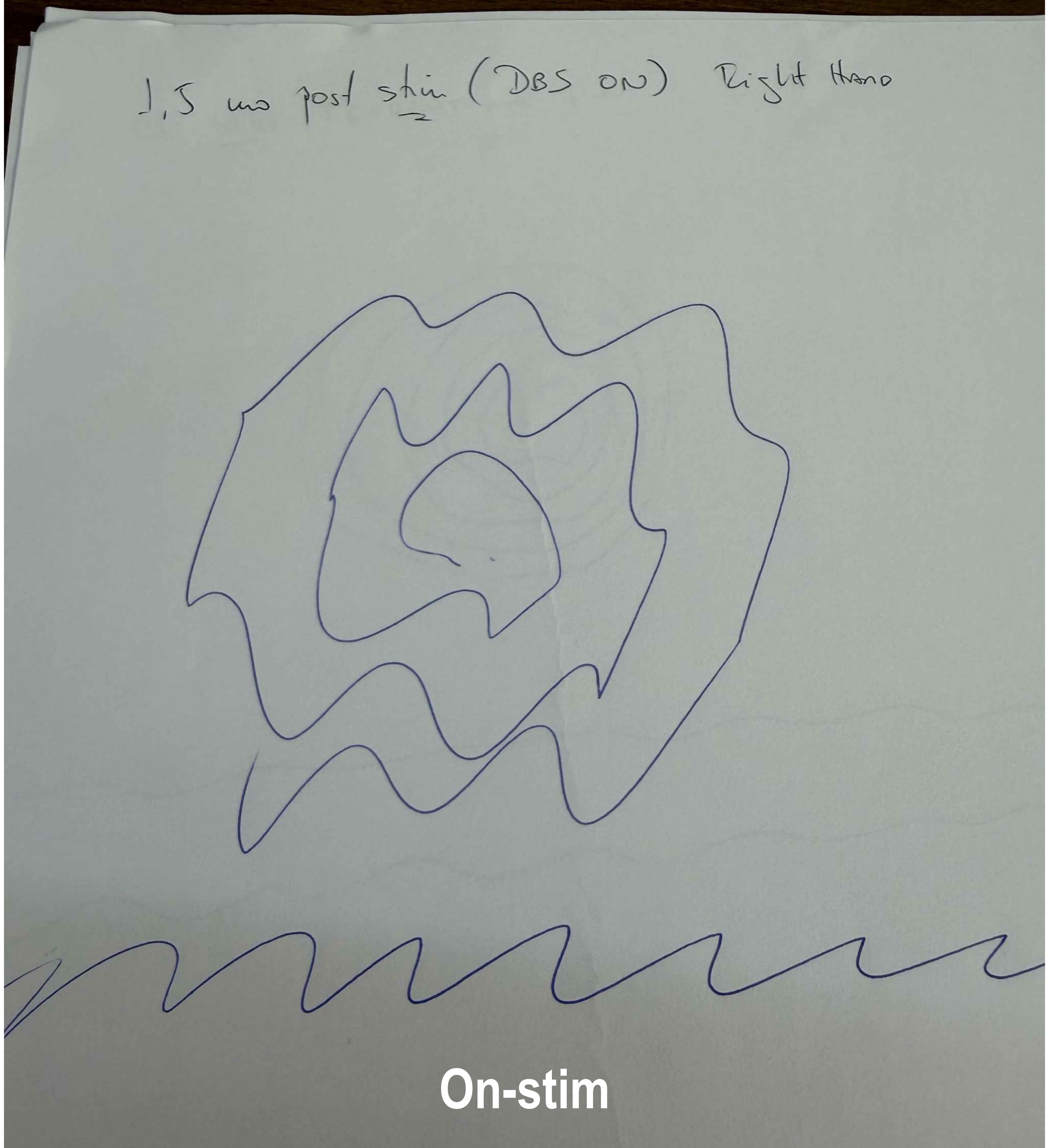
Left electrode





1 month later….



On-stim

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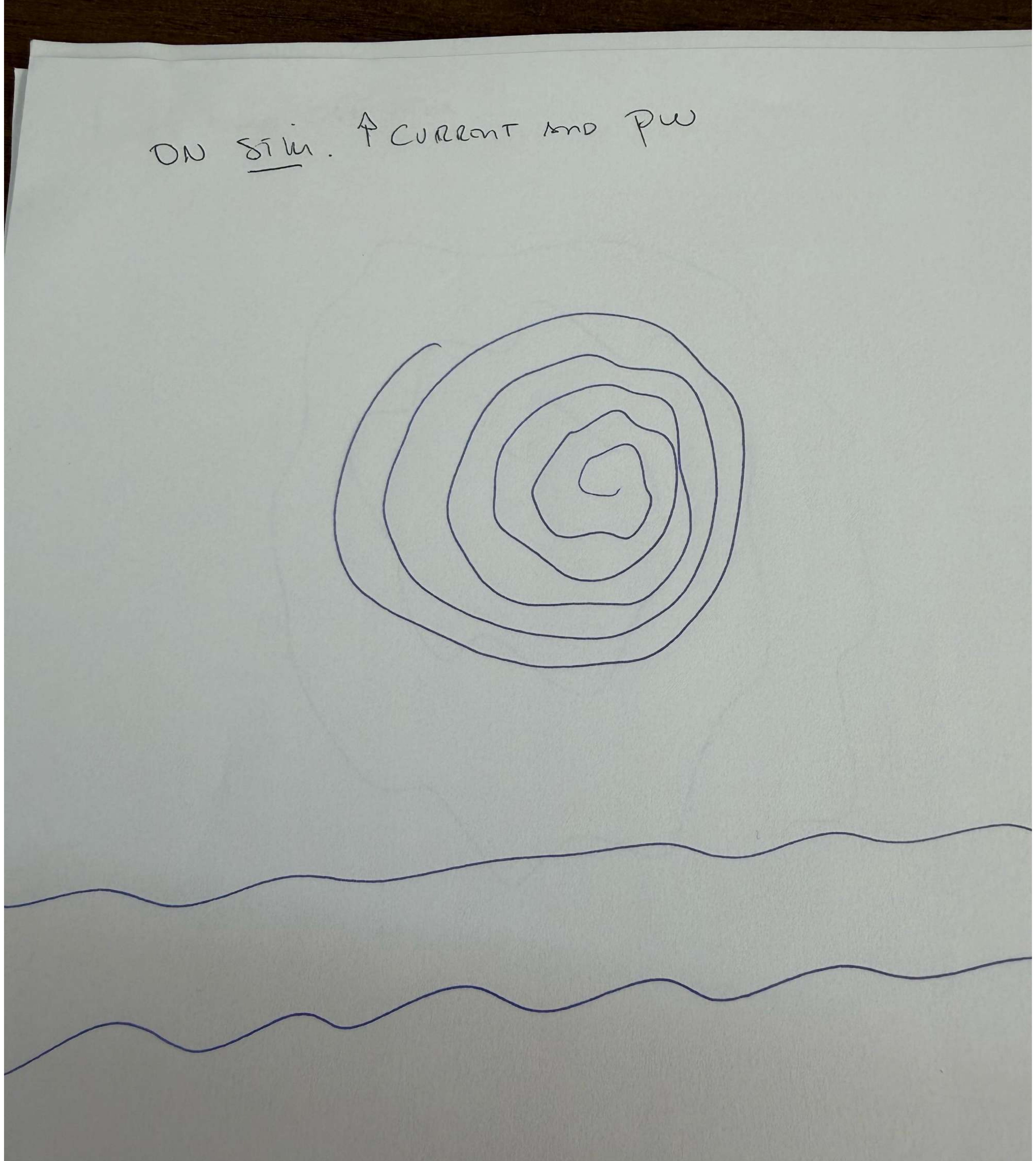
After parameters adjustments



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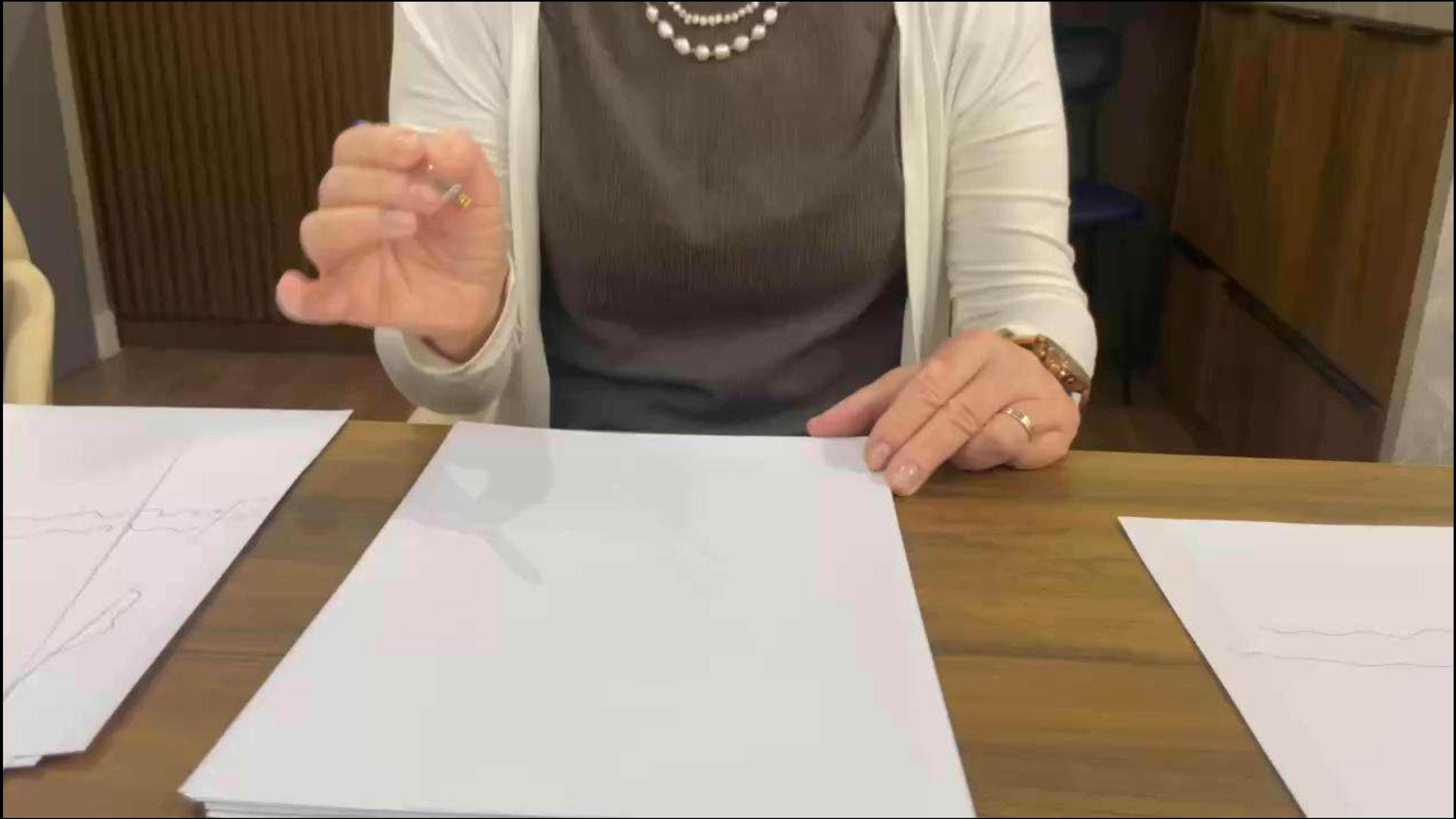


Polling!!

Are considered good approaches to avoid habituation, except:

a) DBS Holiday

b) Turn off the stimulation at nigh

c) Increase pulse width

d) Alterning settings

e) On-demand stimulation

Polling!!

Are considered good approaches to avoid habituation, except:

a) DBS Holiday

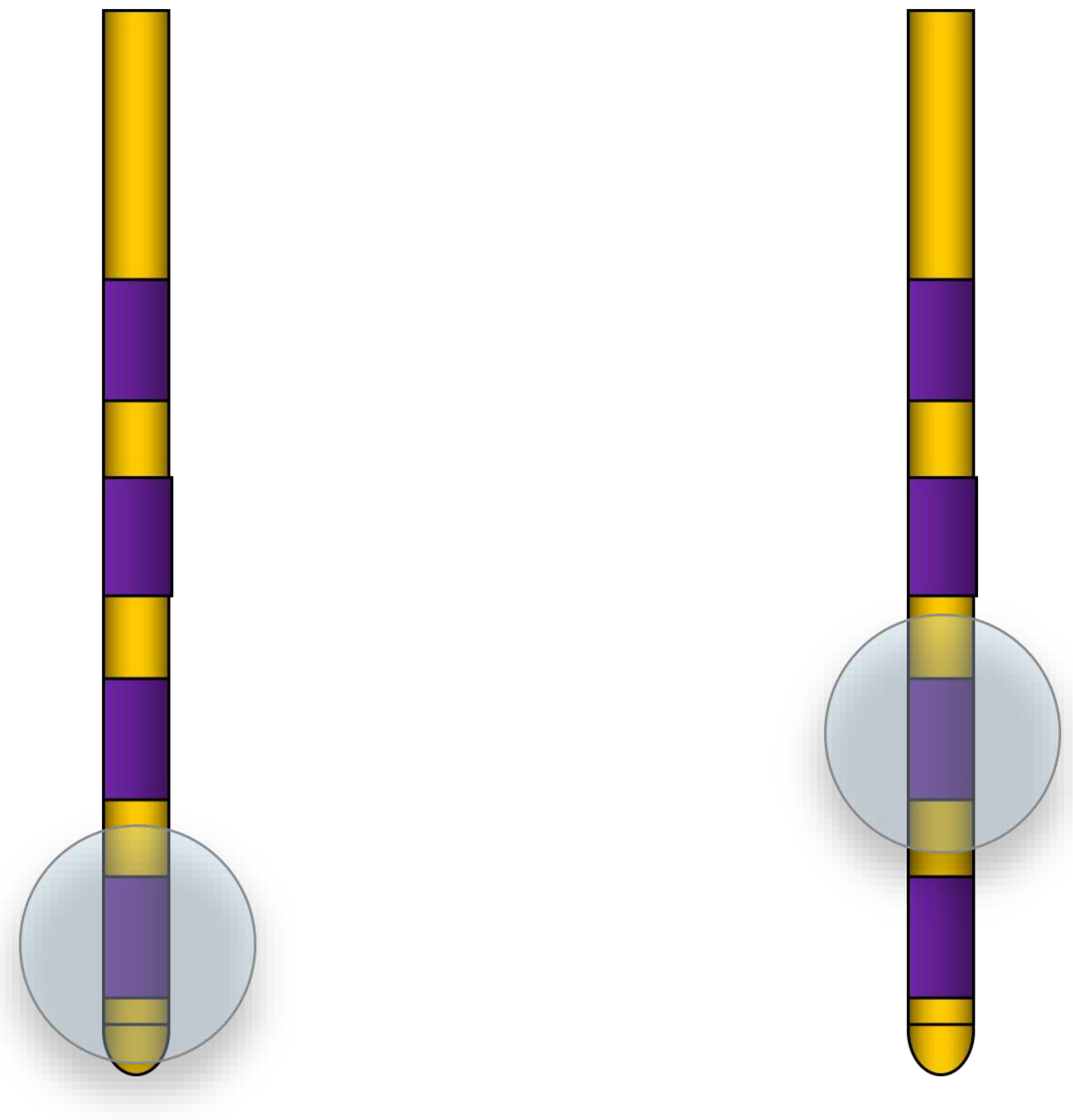
b) Turn off the stimulation at nigh

c) Increase pulse width

d) Alterning settings

e) On-demand stimulation

One strategy: alternate between two good cathodes



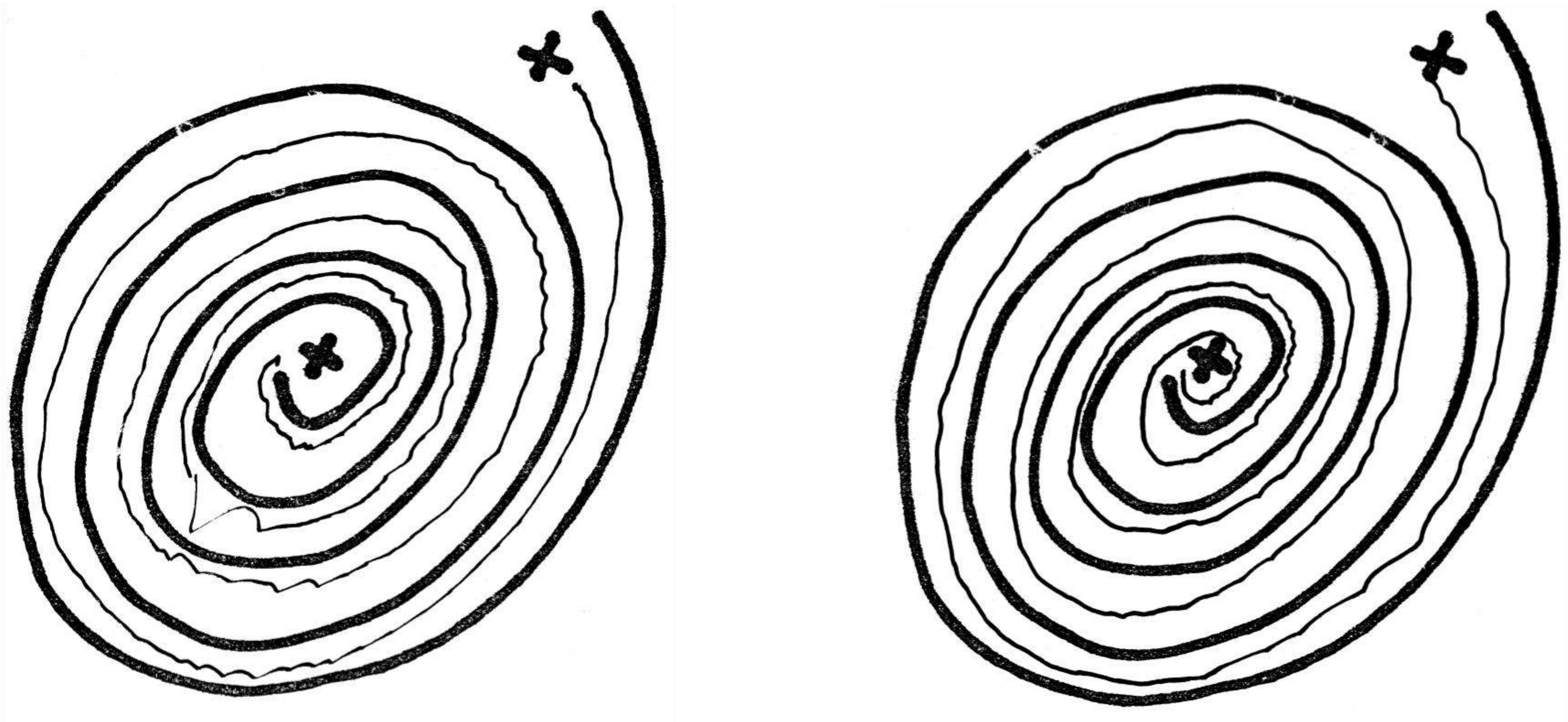
Turn-off DBS at night!

Turn-on DBS upon waking!

Strategies to avoid habituation = Holiday

Pedro J. Garcia Ruiz
Jesus Muñiz de Igneson
Oswaldo Lopez Ferro
Carmen Martin
Carlos Magariños Ascone

Deep brain stimulation holidays in essential tremor



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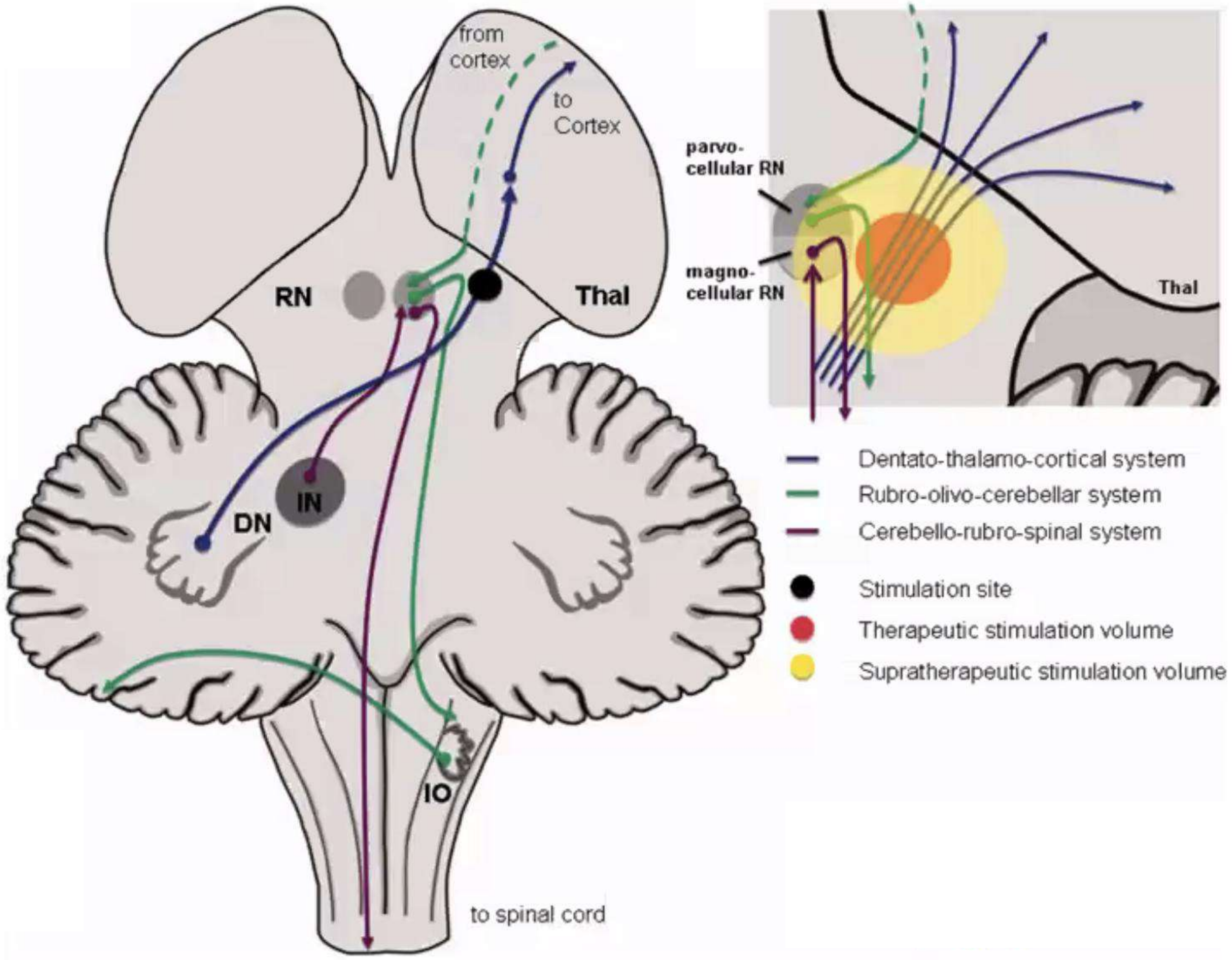
What about this???

Ataxia after DBS for Essential Tremor



Groppa et al., 2014

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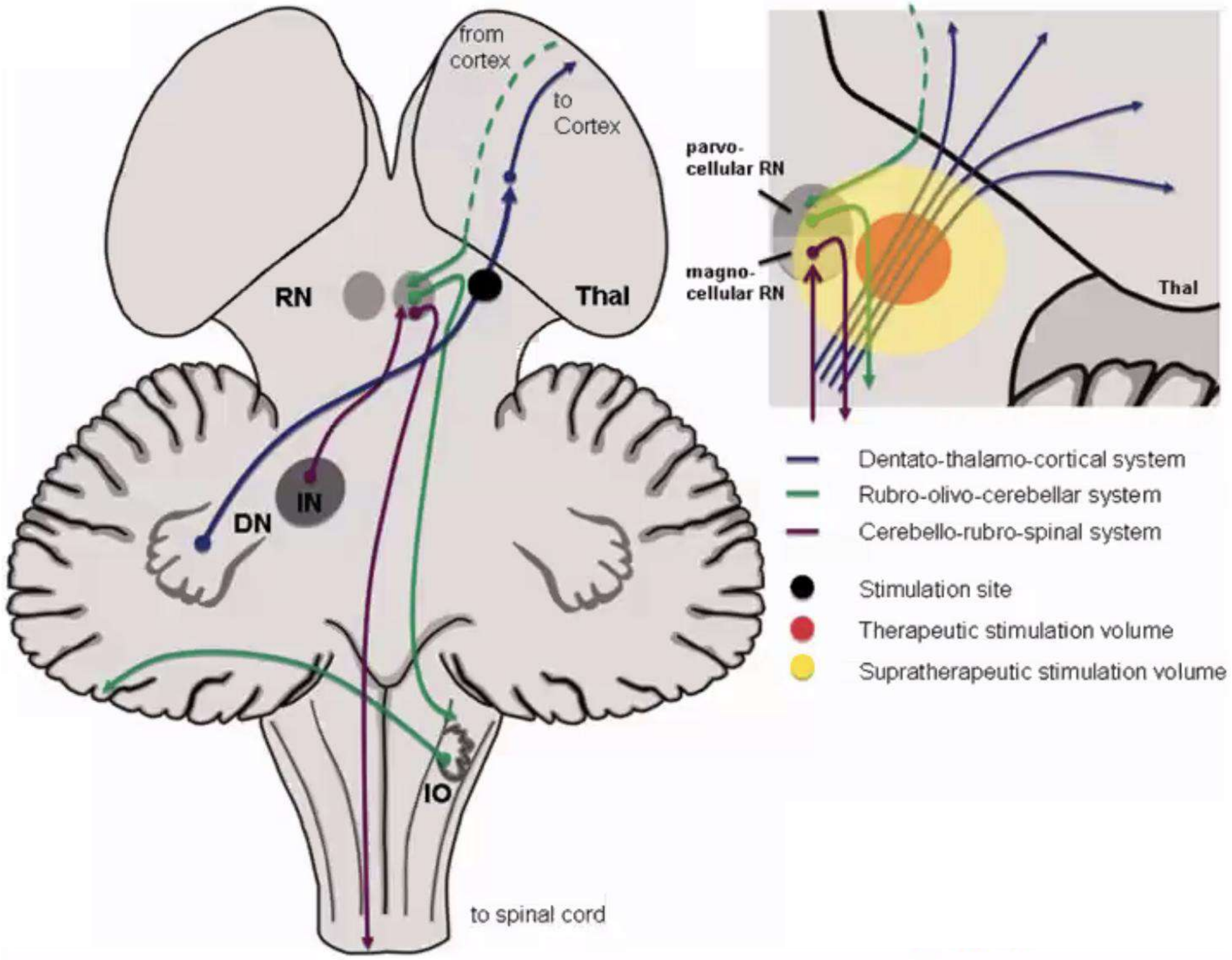
Ataxia after DBS for Essential Tremor

Tremor suppression

- Dentate thalamic tract

Speech & gait disturbances

- Rubral fibers



Groppa et al., 2014

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Ataxia after DBS for Essential Tremor = Shorten PW

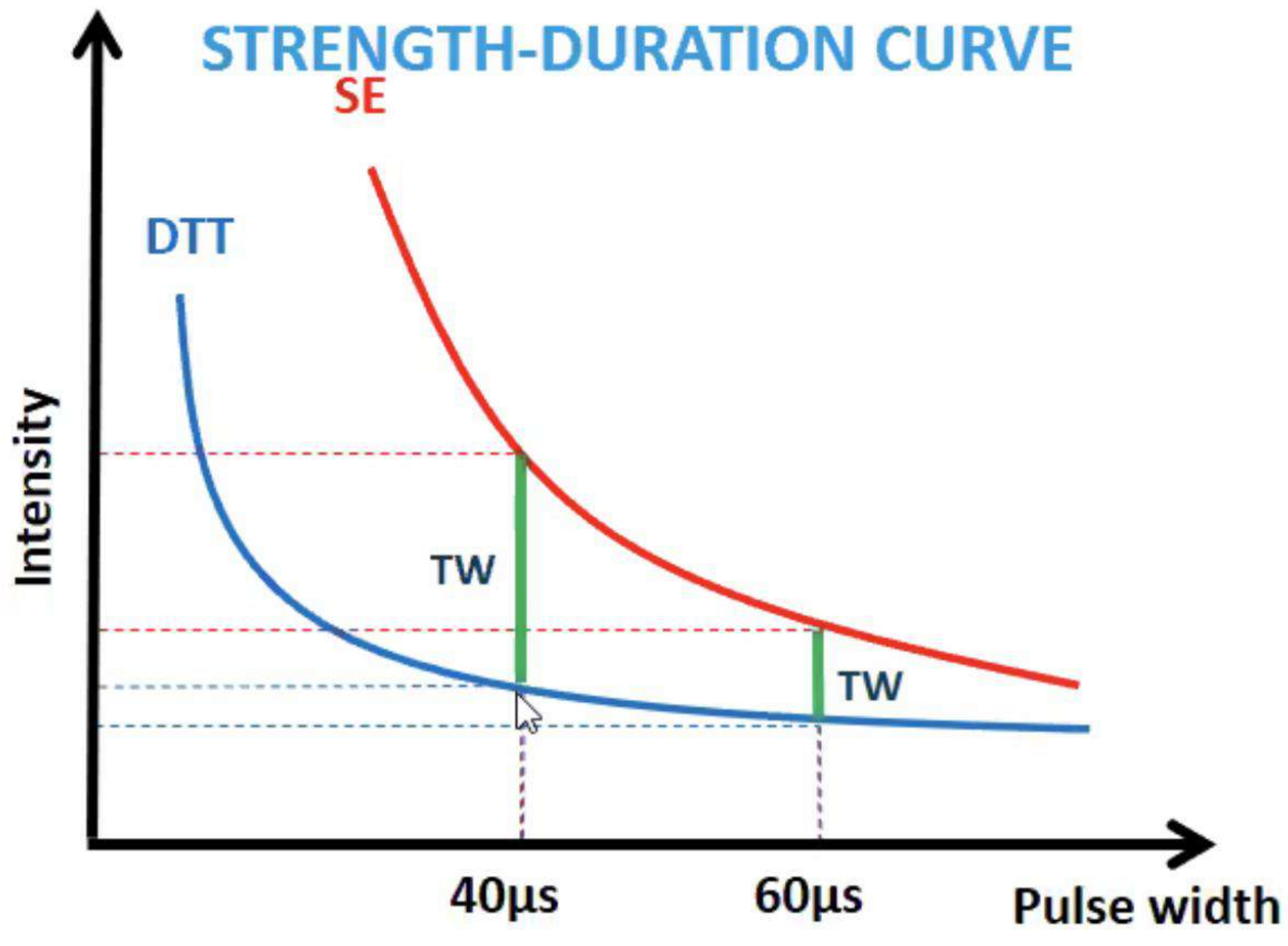
Chronaxie

Dentate thalamic tract (DTT)

~ 27µs

Rubral fibers (RF)

~ 57µs



Groppa et al., 2014

Ataxia after DBS for Essential Tremor = Shorten PW

Movement disorders

SHORT REPORT

Shorter pulse width reduces gait disturbances following deep brain stimulation for essential tremor

Daniel Kroneberg,[1] Siobhan Ewert,[1] Anne-Christiane Meyer,[1] Andrea A Kühn[1,2]

► Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/jnnp-2018-319427).

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ABSTRACT
Objective Gait disturbances are frequent side effects occurring during chronic thalamic deep brain stimulation (DBS) in patients with essential tremor (ET). Adapting stimulation settings to shorter pulse widths has been shown to reduce side effects of subthalamic DBS. Here, we assess how a reduction of pulse width changes gait performance of affected patients.
Methods Sensor-based gait assessment was performed to record spatiotemporal gait parameters in 10 healthy subjects (HS) and 7 patients with ET with gait disturbances following thalamic DBS. Patients were

gait disturbances and DBS-induced side effects[8] remains challenging.

Antidromic activation of the cerebellar nodule via the uncinate tract from the subthalamic area has been discussed as a possible mechanism inducing gait ataxia in patients with ET with thalamic DBS.[3] Previous studies had identified distinct electrophysiological properties of fibre tracts mediating tremor suppression and limb ataxia.[9–11] Based on differences in axon diameters and chronaxies, shortening pulse widths would allow a more selective activation of cerebellothalamic fibres, which mediate

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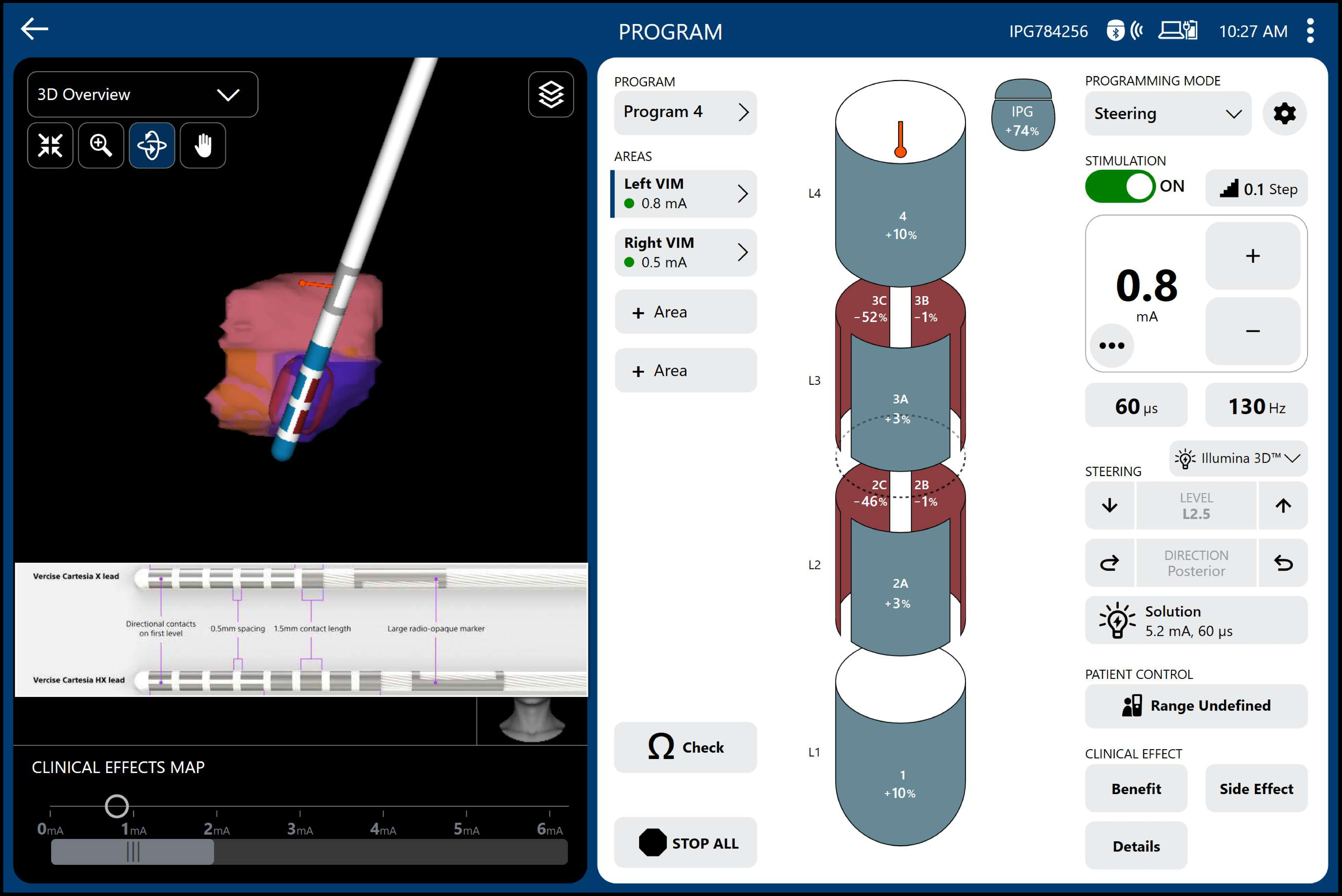


PROGRAM
IPG784256
10:27 AM
3D Overview
Vercise Cartesia X lead
Directional contacts on first level
0.5mm spacing
1.5mm contact length
Large radio-opaque marker
Vercise Cartesia HX lead
CLINICAL EFFECTS MAP
0mA
1mA
2mA
3mA
4mA
5mA
6mA
PROGRAM
Program 4
AREAS
Left VIM
0.8 mA
Right VIM
0.5 mA
+ Area
+ Area
Check
STOP ALL
L4
L3
L2
L1
4
+10%
3C
-52%
3B
-1%
3A
+3%
2C
-46%
2B
-1%
2A
+3%
1
+10%
IPG
+74%
PROGRAMMING MODE
Steering
STIMULATION
ON
0.1 Step
0.8
mA
+
−
60 μs
130 Hz
Illumina 3D™
STEERING
LEVEL
L2.5
DIRECTION
Posterior
Solution
5.2 mA, 60 μs
PATIENT CONTROL
Range Undefined
CLINICAL EFFECT
Benefit
Side Effect
Details

Managing ataxia after VIM/PSA DBS

1. Steer the current dorsally
2. Steer the current horizontally
3. Reduce current/ pw

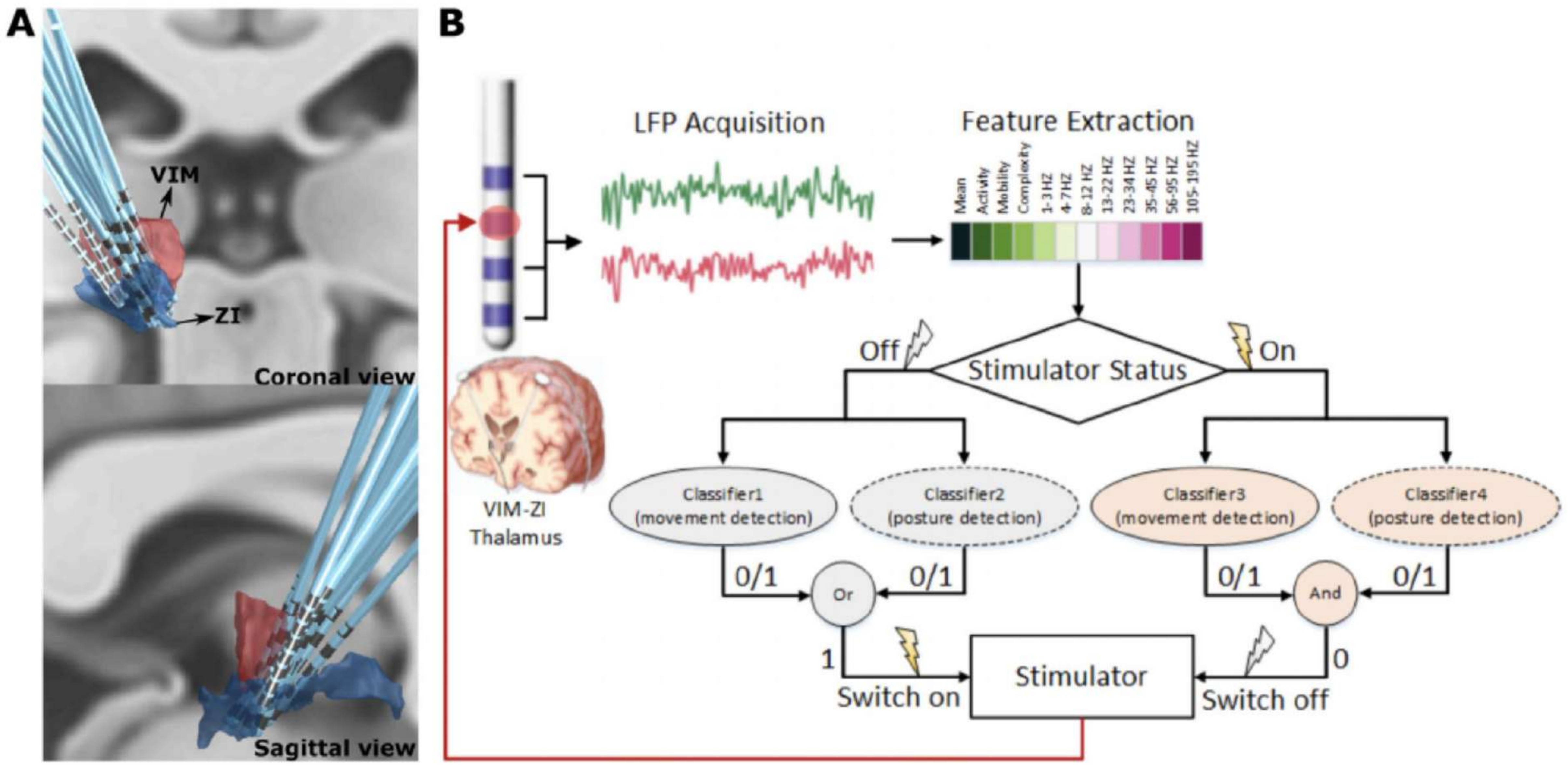
DBS: GROUP A

DBS: GROUP B (Walk)

RESEARCH ARTICLE

Closed-Loop Deep Brain Stimulation for Essential Tremor Based on Thalamic Local Field Potentials

Shenghong He, PhD,[1,2] Fahd Baig, MB, PhD,[1,2,3] Abteen Mostofi, MA, MBBS, PhD,[3] Alek Pogosyan, PhD,[1,2] Jean Debarros, PhD,[1,2] Alexander L. Green, MD, BSc, MBBS,[2] Tipu Z. Aziz, FMedSci,[2] Erlick Pereira, MA, MBBS, MD,[3] Peter Brown, MA, MBBS, MD, FMedSci,[1,2] and Huiling Tan, PhD[1,2*]



Teaching Deep Brain Stimulation to Walk
Today's lesson: we're teaching the DBS how to walk!
GOALS:
✓ Detect intention
✓ Recognize gait
✓ Adjust stimulation
✓ Improve walking
✓ Enhance life!
BRAIN SIGNALS (When walking)
CLOSED-LOOP ALGORITHM
DBS ADAPTS IN REAL TIME
= BETTER MOVEMENT!
MOVEMENT IS LIFE.
NEVER STOP TAKING STEPS FORWARD.
SCIENCE MEETS COMPASSION.
THE BRAIN CAN CHANGE. SO CAN TOMORROW.
NEUROSCIENCE
MOVEMENT DISORDERS
DEEP BRAIN STIMULATION
ADAPTIVE DBS
CLOSED-LOOP SYSTEMS
I TEACH BRAINS
TODAY'S GOAL: WALK BETTER. LIVE BETTER!
DBS
I'm ready to learn and move better every day!
BETTER STEPS BETTER LIFE!

HOT TOPIC

Teaching Deep Brain Stimulation to Walk

Rubens Gisbert Cury, MD, PhD,[1,2*] and Camila Aquino, MD, MSc, PhD[3]

Postoperative Follow-up Tremor and Dystonia Management and Long-term Considerations

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