Cleveland Clinic

RESTORE study
DBS for post-stroke rehab

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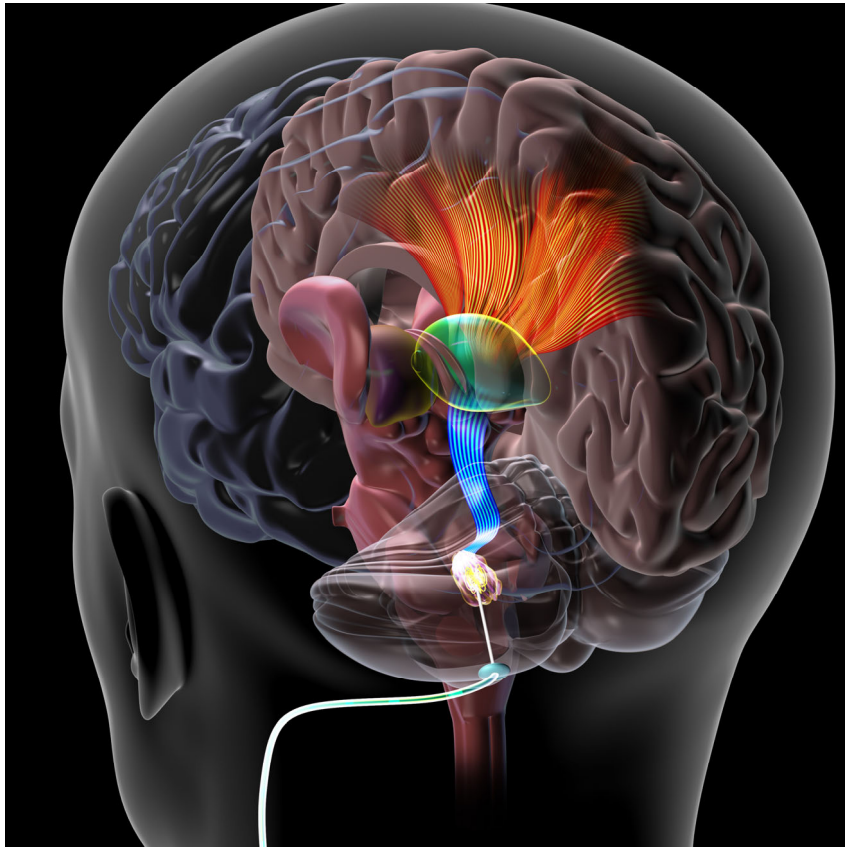
DBS of the dentatothalamocortical pathway



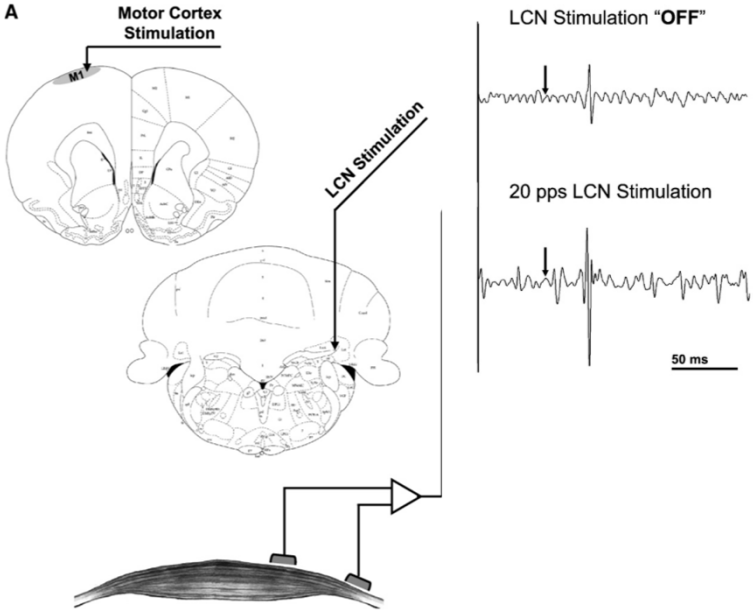
Stimulate a disynaptic excitatory pathway

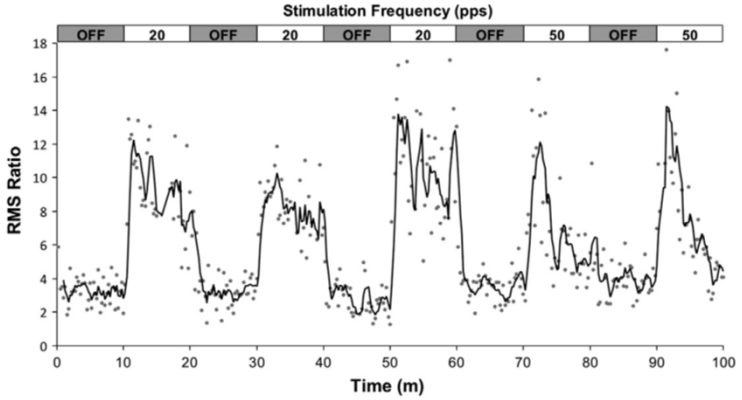
Perilesional excitability

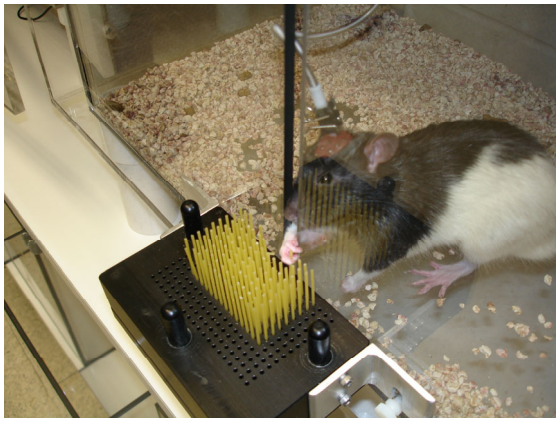
Improve outcomes with PT

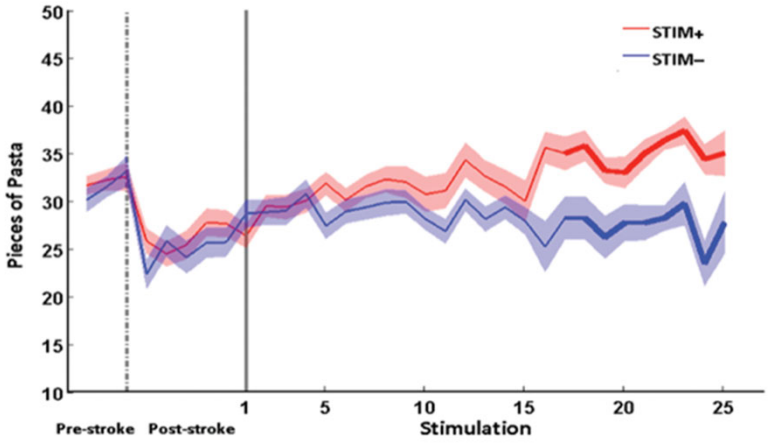
Target the node

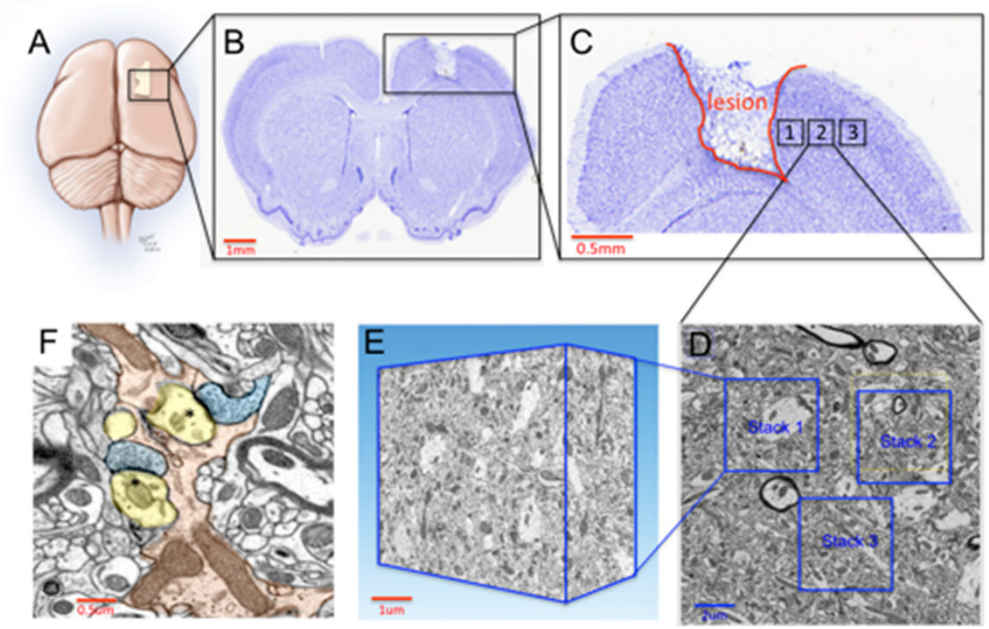
Cortical Excitability

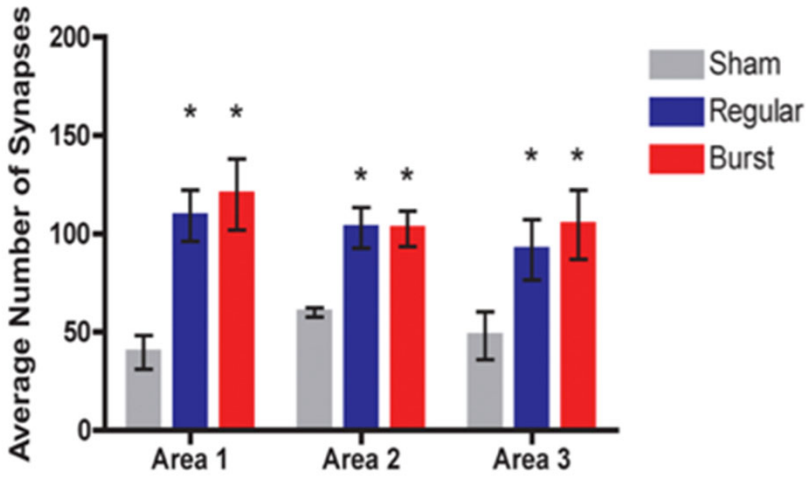


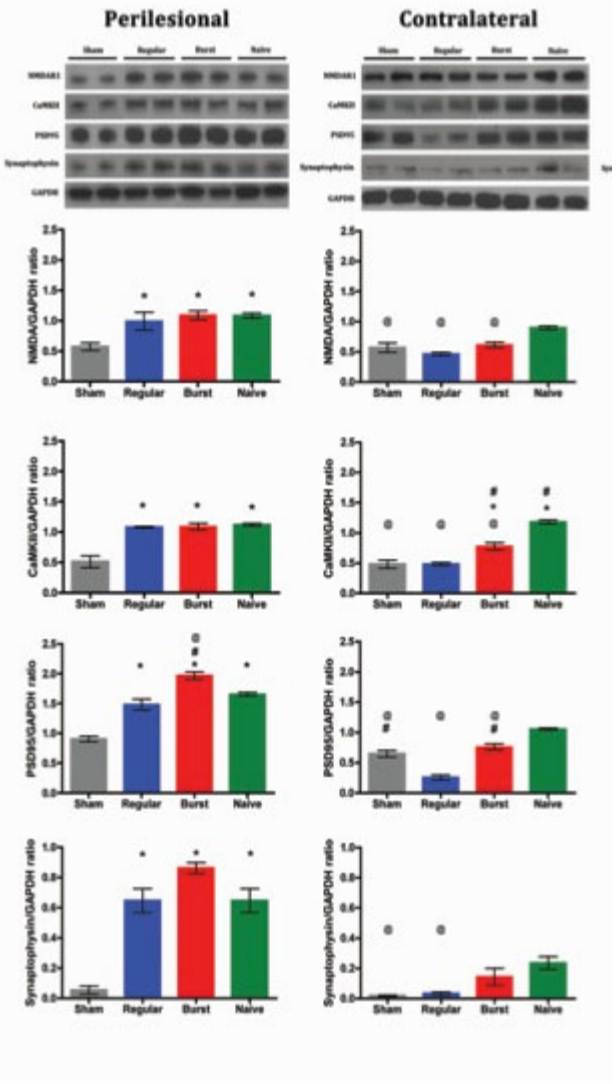




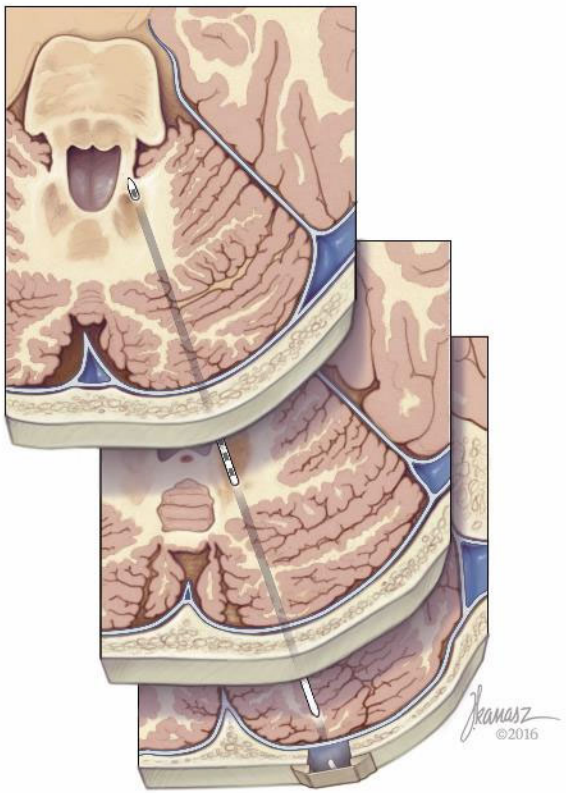



A
B
C
lesion
1
2
3
1mm
0.5mm
F
E
D
Stack 1
Stack 2
Stack 3
0.5um
1um


Average Number of Synapses
200
150
100
50
0
Area 1
Area 2
Area 3
Sham
Regular
Burst

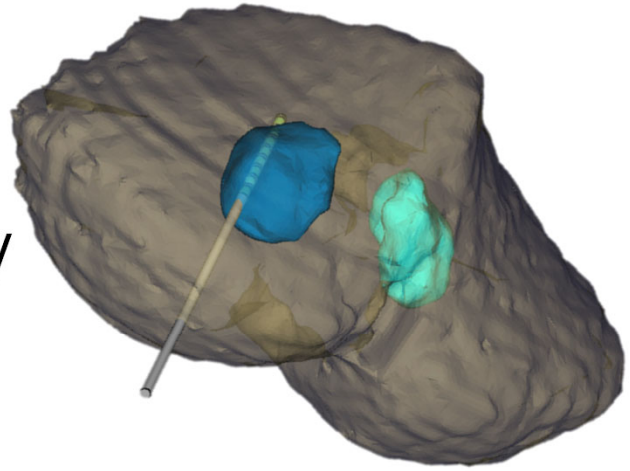

Perilesional
Contralateral
NMDA/GAPDH ratio
CaMKII/GAPDH ratio
PSD95/GAPDH ratio
Synaptophysin/GAPDH ratio
Sham
Regular
Burst
Naive

Human Translation: EDEN study

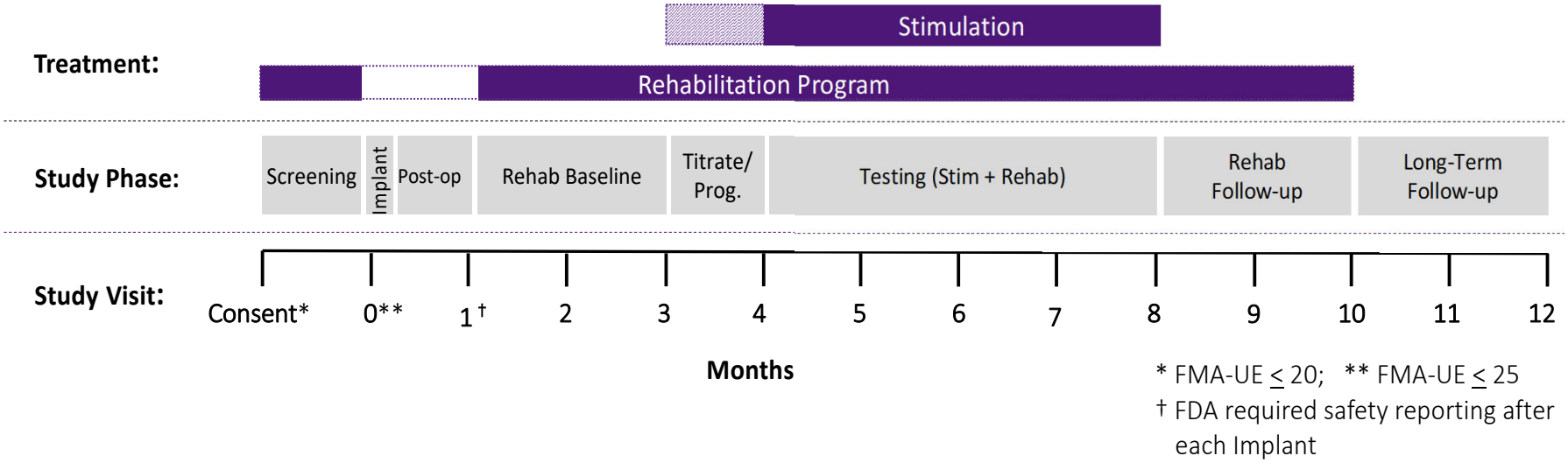


- Moderate to Severe hemiparesis
- 12-36 months post-stroke
- Unilateral MCA stroke

Human Translation: EDEN study



- 12 patient safety and feasibility study
- Open label, single arm

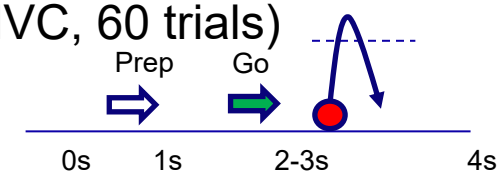


* FMA-UE ≤ 20; ** FMA-UE ≤ 25

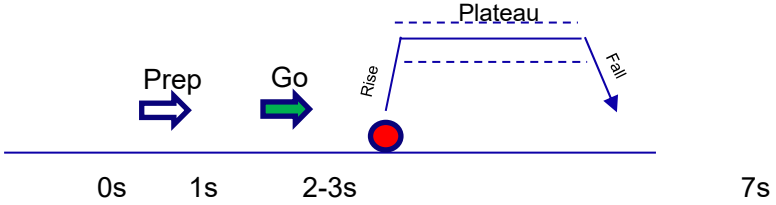
† FDA required safety reporting after each Implant

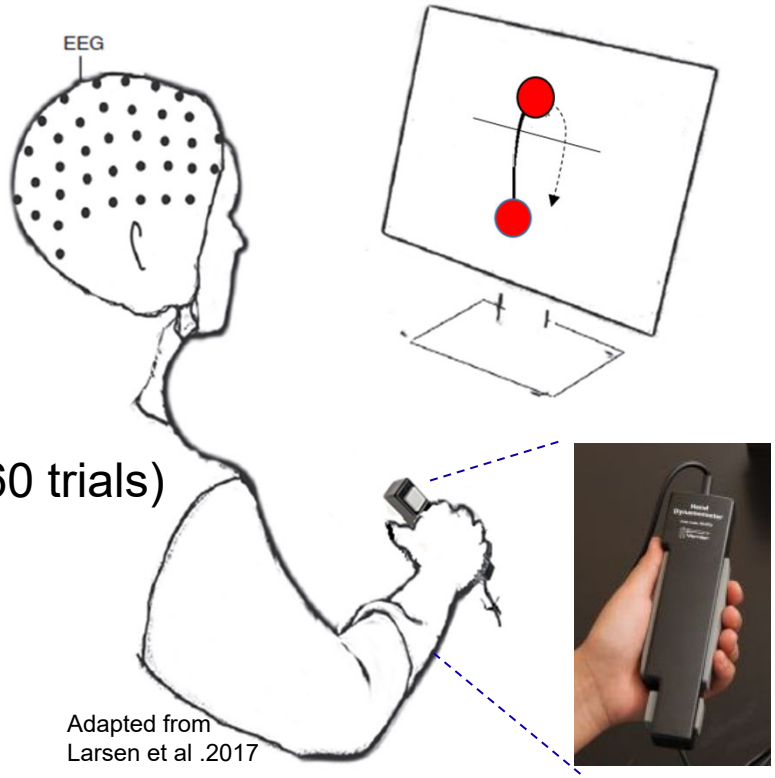
Visuomotor Tasks

Squeeze Task (effort 20% MVC, 60 trials)



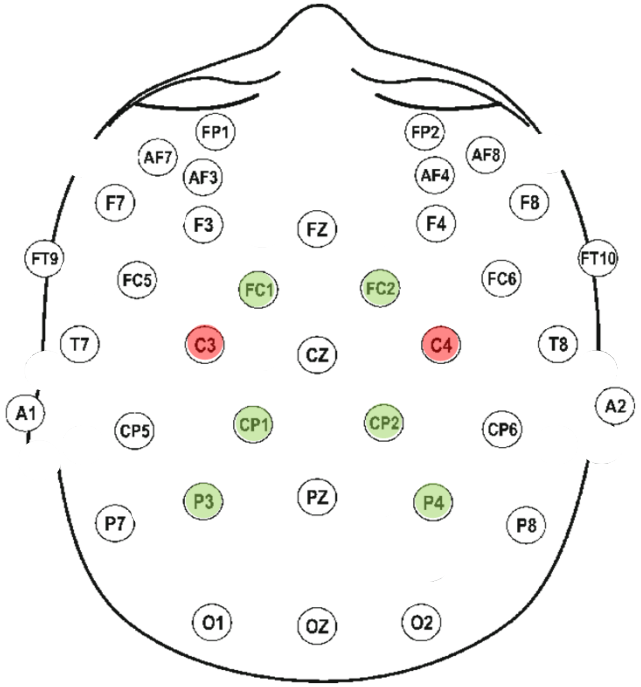
Squeeze and Hold Task (effort 20% MVC, 60 trials)

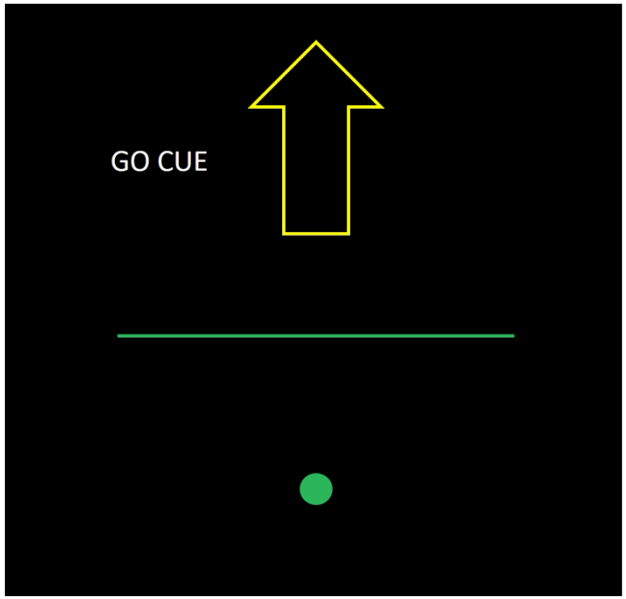




Adapted from Larsen et al .2017

Motor Tasks Electrophysiology



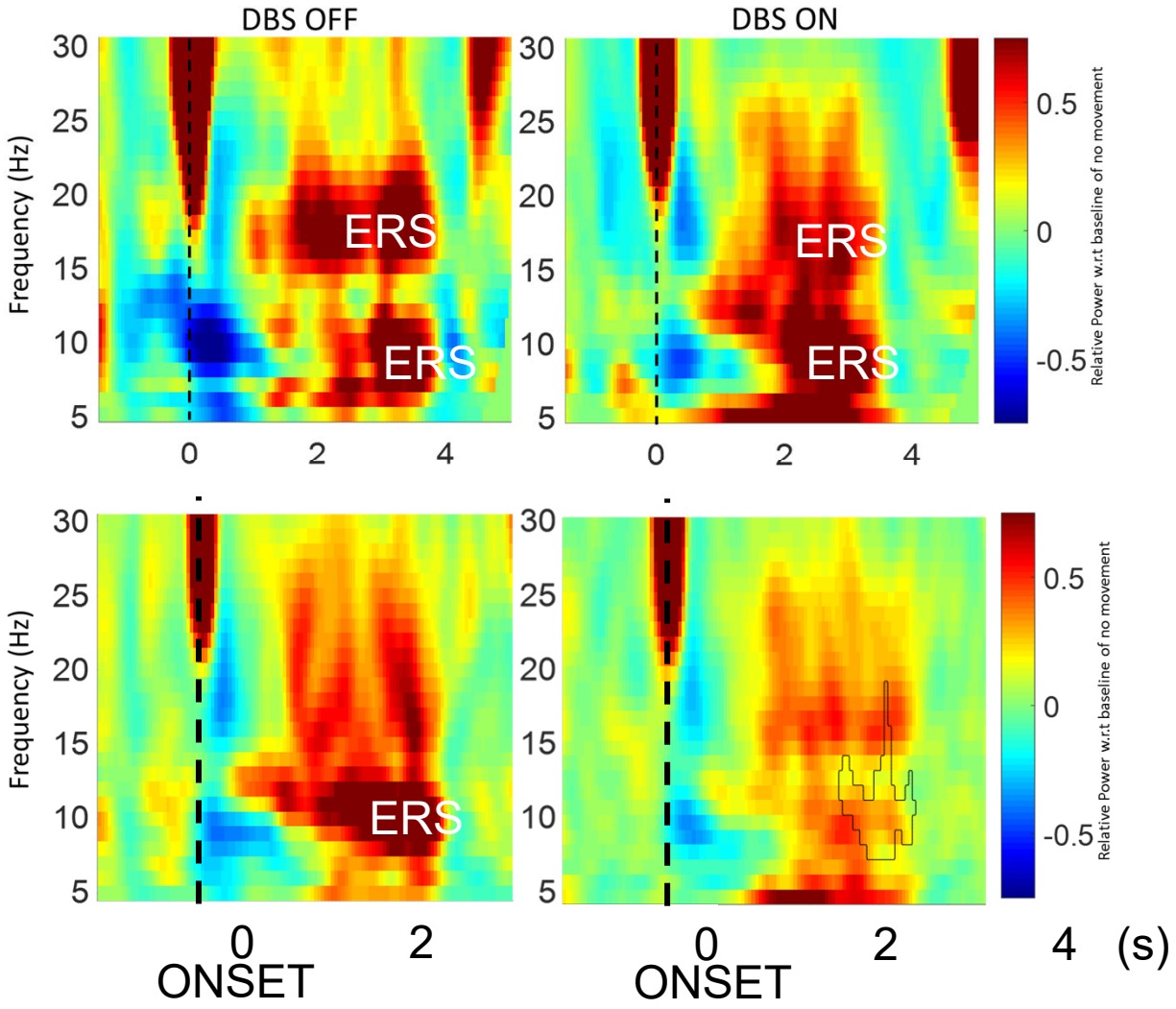


ERS – Squeeze task

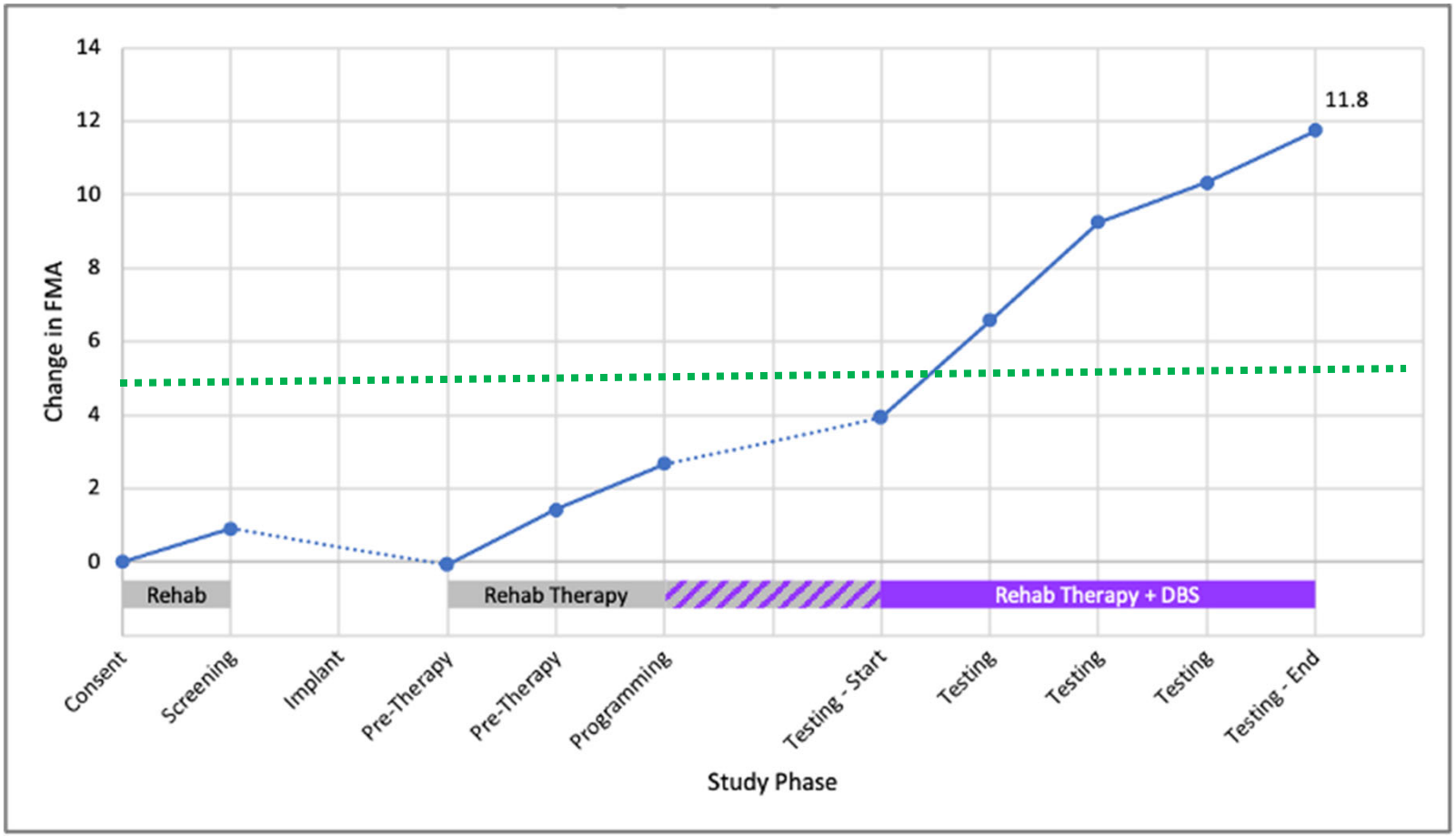
Patient-007,
EEG – CP1

DBS setting – 1
No significant difference
Between DBS OFF vs. ON

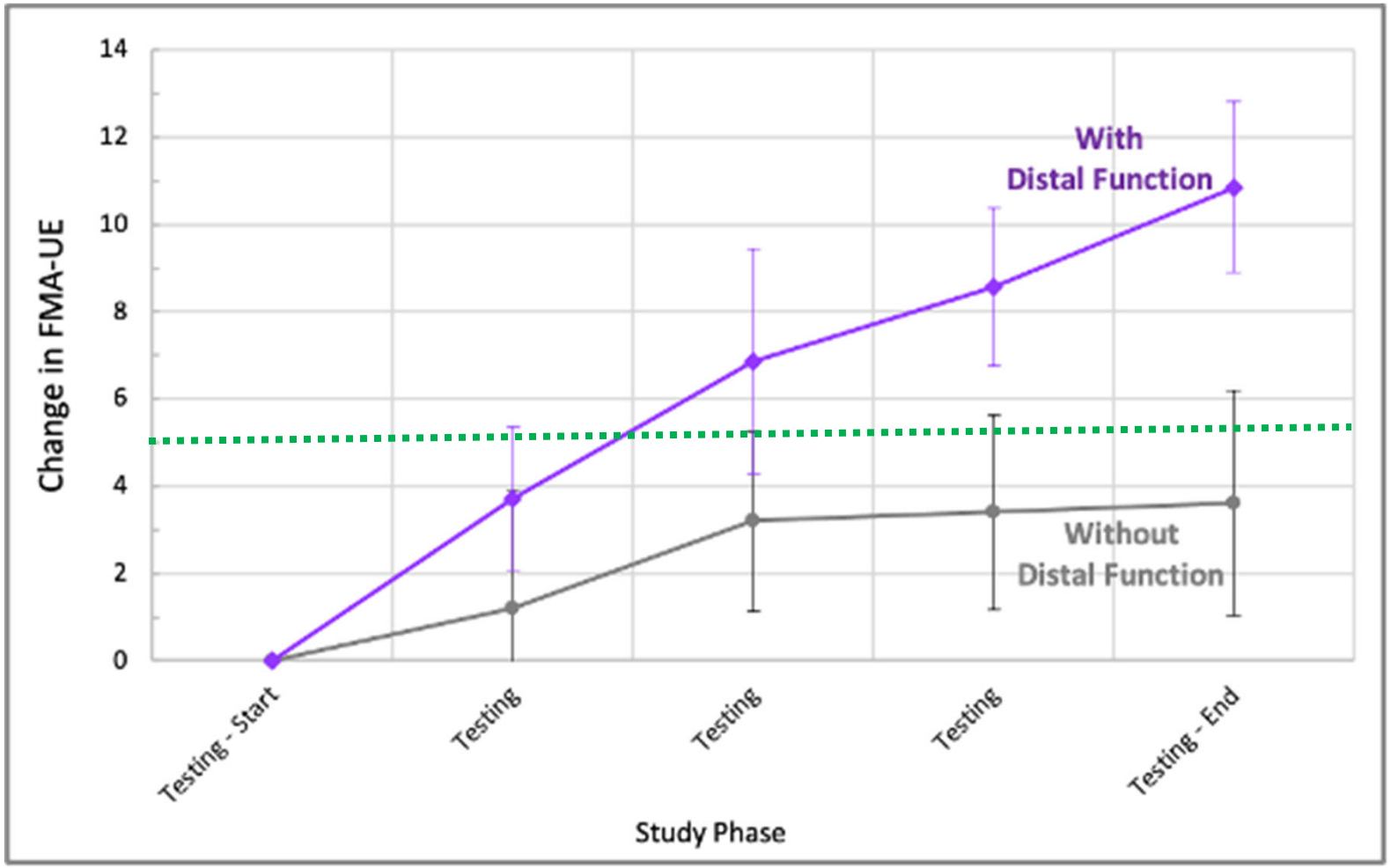
DBS setting – 2
Significant* difference
Between DBS OFF vs. ON
In Alpha band



Clinical data (n=12)



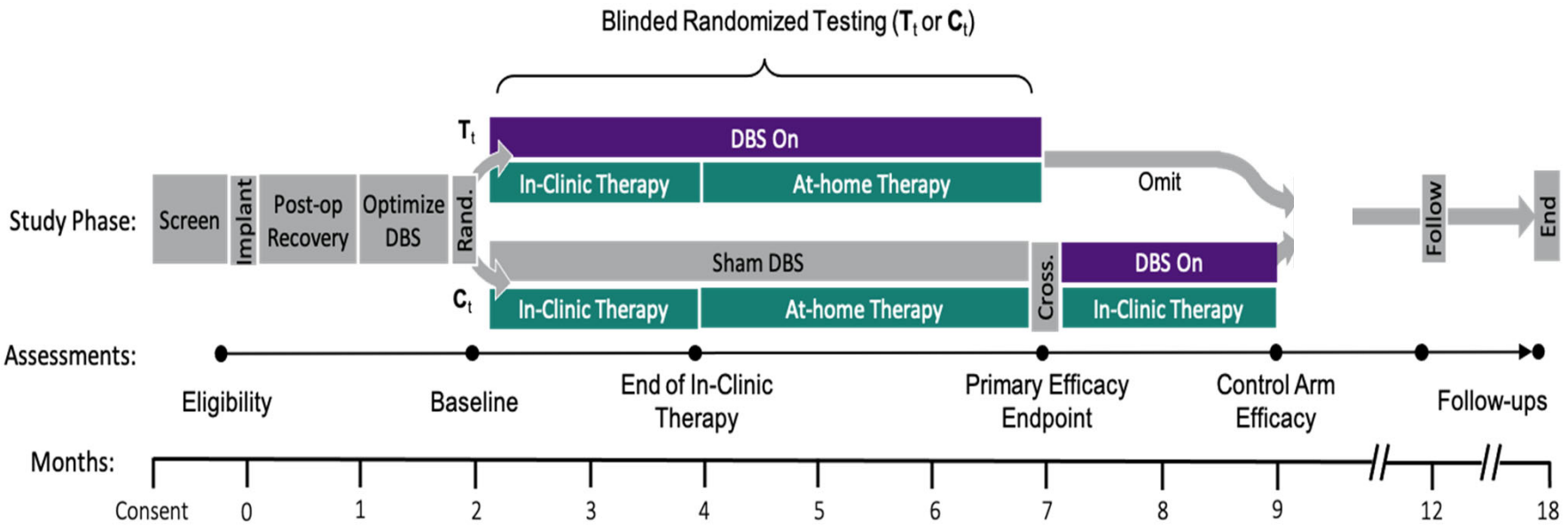
Clinical data (n=12)



Complications

- No major perioperative complications
- DBS-related nausea in first 3 patients
- Transient surgical site pain
- Transient chest redness related to prone position


400


Blinded Randomized Testing (T_t or C_t)
T_t
DBS On
In-Clinic Therapy
At-home Therapy
Omit
Study Phase:
Screen
Implant
Post-op Recovery
Optimize DBS
Rand.
Sham DBS
Cross.
DBS On
C_t
In-Clinic Therapy
At-home Therapy
In-Clinic Therapy
Follow
End
Assessments:
Eligibility
Baseline
End of In-Clinic Therapy
Primary Efficacy Endpoint
Control Arm Efficacy
Follow-ups
Months:
Consent
0
1
2
3
4
5
6
7
8
9
12
18

N=40