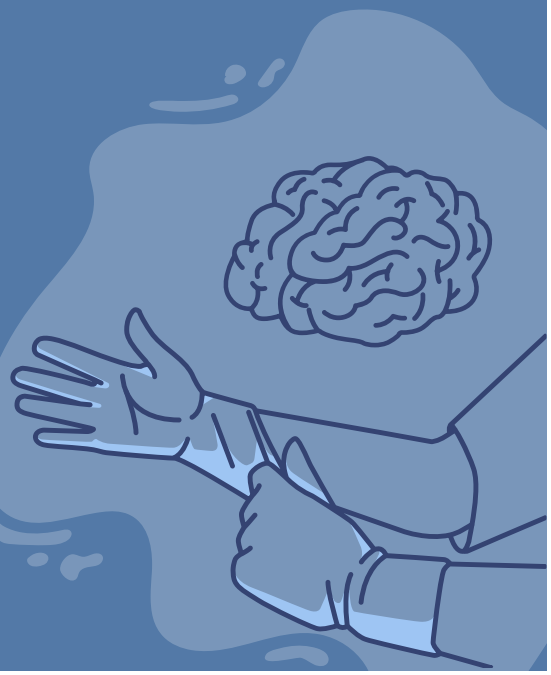
# DEEP BRAIN STIMULATION IN PARKINSON'S DISEASE

María Ruiz Izquierdo



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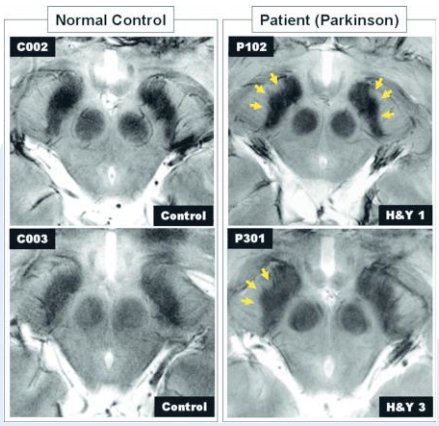
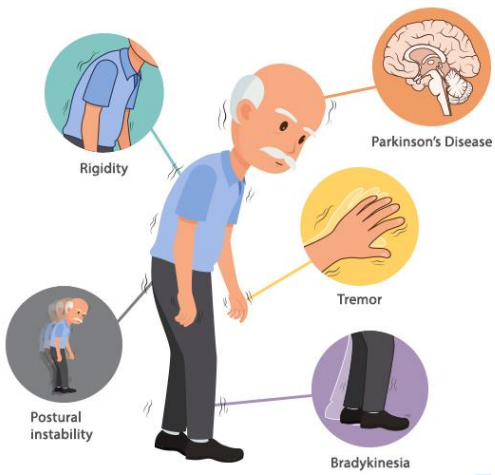
01

## PARKINSON'S DISEASE

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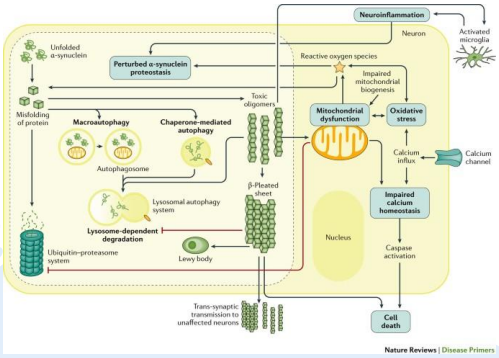


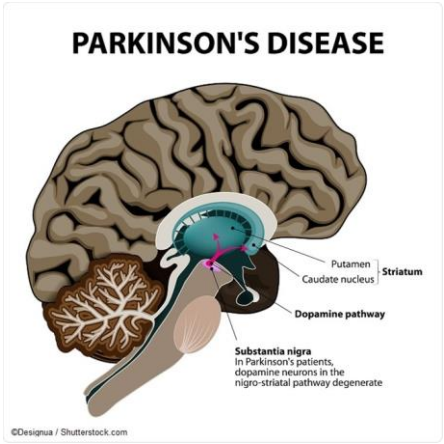


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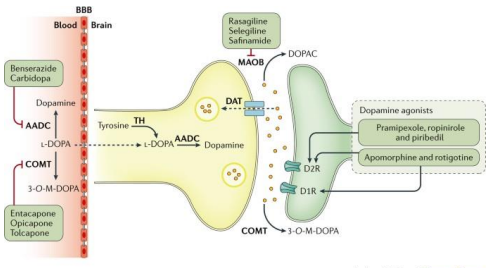
# PARKINSON'S DISEASE

TREATMENT APPROACHES:

- L-DOPA: dopamine
- L-DEPRENYL: monoamine oxidase
- FETAL CELLS: dopamine-secreting cells
- DESTROY FEEDBACK CIRCUITRY: surgical lesions
- DEEP BRAIN STIMULATION

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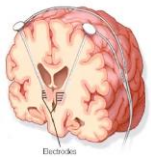
## DBS SYSTEM



- Platinum iridium wires
- Nickel alloy connectors
- Polyurethane sheath

- Insulated wire


- Active component
- Electric signal

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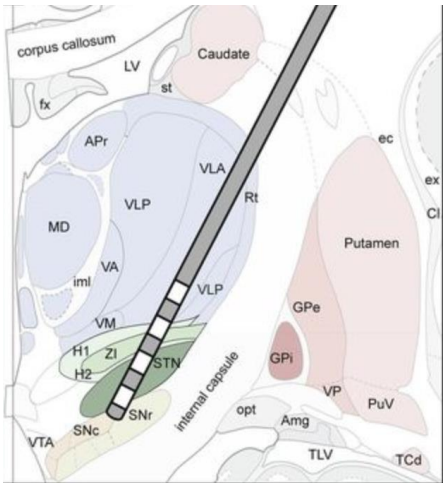
## SURGICAL PROCEDURE AND PATIENT SELECTION

Parkinson's Disease targets:
- Ventral intermediate nucleus (Vim): contralateral tremor
- Subthalamic nucleus (STN): motor symptoms and dyskinesias→better antiakinetic effect, reduction of medication and less stimulation energy
- Globus Pallidus (Gpi): motor symptoms and dyskinesias

Targeting techniques:
- MRI
- Ventriculography
- Microelectrode recording
- Intraoperative stimulation

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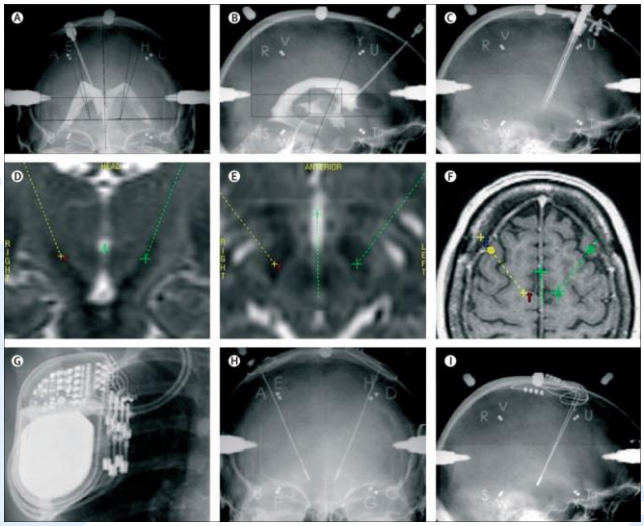

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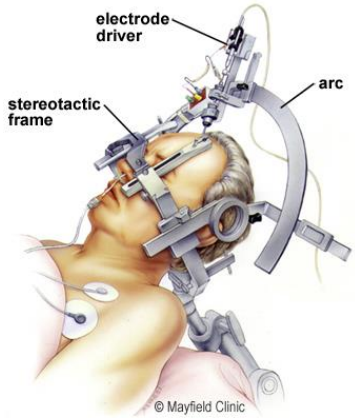
## SURGICAL PROCEDURE AND PATIENT SELECTION

IMPLANTATION
- Lead: local anaesthesia+ neurological assesment
- IPG: general anaesthesia, subclavicular area

PATIENT SELECTION
- Individual Risk-Benefit evaluation
- Advanced PD
- Young age
- Non-Levodopa-responsive motor symptoms
- No cognitive impairment
- Psychiatric disease
- Dementia

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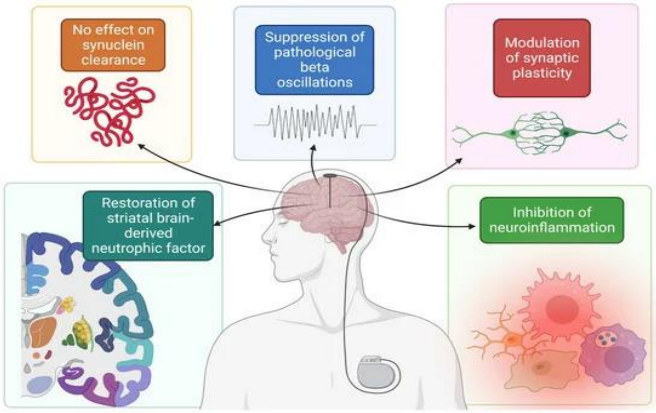
# DBS MECHANISM

Disrupt aberrant oscillatory activities

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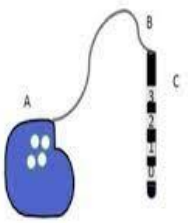
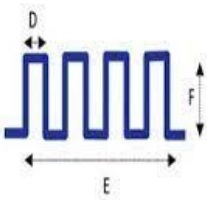
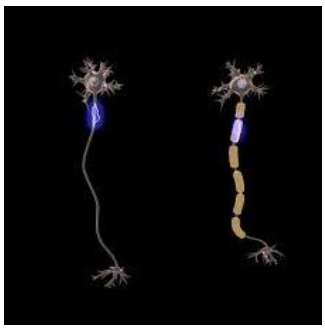
# DBS MECHANISM

FACTORS

- Stimulation parameters: amplitude, voltage, frequency and pulse
- Time
- Target cells: not homogeneous



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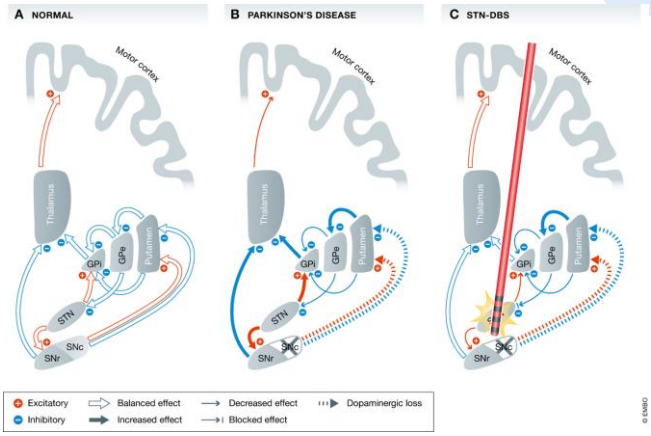
# DBS MECHANISM

EFFECTS
- Ionic level: reorganization of charges
- Cellular level: action potentials propagation

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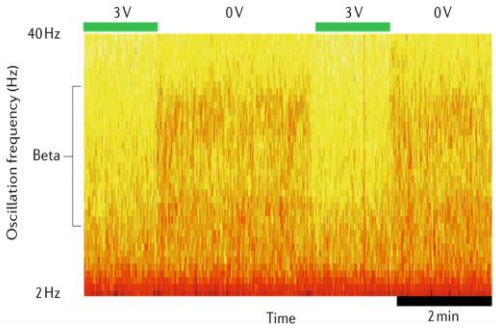
# DBS MECHANISM




- Beta oscillations: bradykinesia and rigidity
- High synchronization in basal ganglia, thalamus and motor regions
- →Selective filter

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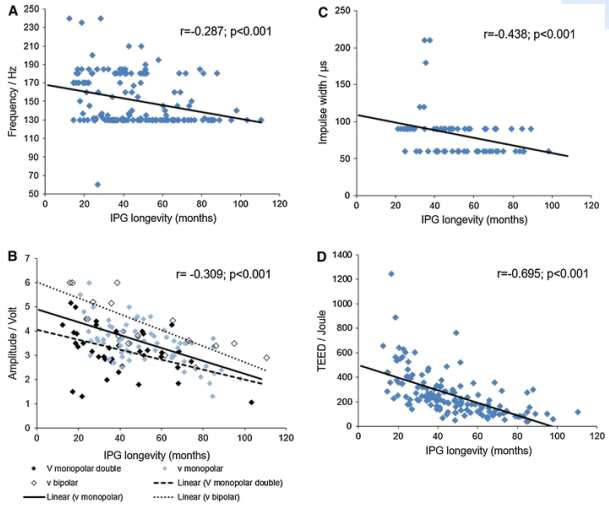
# 03

## LIMITATIONS

- Biocompatibility: interface electrode-tissue
- Size and weight of IPG
- Battery duration: stimulation parameters, hardware, lead placement and patient factors
- Recharging



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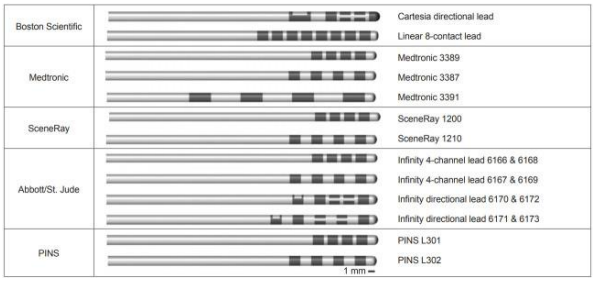
## MARKET

| Model | St. Jude (Abbott) Infinity 5 | St. Jude (Abbott) Infinity 7 | Boston Scientific Vercise PC | Boston Scientific Vercise Gevia | Boston Scientific Vercise Genus P8P16 |
|---|---|---|---|---|---|
| No. of channels | 2 | 2 | 2 | 2 | 1/2 |
| Weight (gram) | 49 | 58 | 55 | 28 | 58 |
| Size (mm) | 56×50×13 | 67×50×14 | 71×50×11 | 51×46×11 | 72×50×12 |
| RC | No | No | No | Yes | No |
| Freq. range (Hz) | 2–240 | 2–240 | 2–255 | 2–255 | 2–255 |
| Pulse width (µs) | 20–500 | 20–500 | 10–450 | 20–450 | 20–450 |
| TF | MSS | MSS | A | A | A |
| CF | CA | CA | MICC | MICC | MICC |
| Directional lead | Yes | Yes | Yes | Yes | Yes |
| MRI safety | C | C | U | C | C |
| LFP sensing | No | No | No | No | No |

| Model | Boston Scientific Vercise Genus R16 | Medtronic Activa PC | Medtronic Activa RC | Medtronic Activa SC | Medtronic Percept PC |
|---|---|---|---|---|---|
| No. of channels | 2 | 2 | 2 | 1 | 2 |
| Weight (gram) | 27 | 67 | 40 | 44 | 61 |
| Size (mm) | 52×46×11 | 65×49×15 | 54×54×9 | 55×60×11 | 68×51×12 |
| RC | Yes | No | Yes | No | No |
| Freq. range (Hz) | 2–255 | 2–250 | 2–250 | 3–250 | 2–250 |
| Pulse width (µs) | 20–450 | 60–450 | 60–450 | 60–450 | 20–450 |
| TF | A | IL | IL | IL | IL |
| CF | MICC | No | No | No | No* |
| Directional lead | Yes | No | No | No | No |
| MRI safety | C | C | C | C | C |
| LFP sensing | No | No | No | No | Yes |

TOTAL COST OF THE PROCEDURE: 30000$



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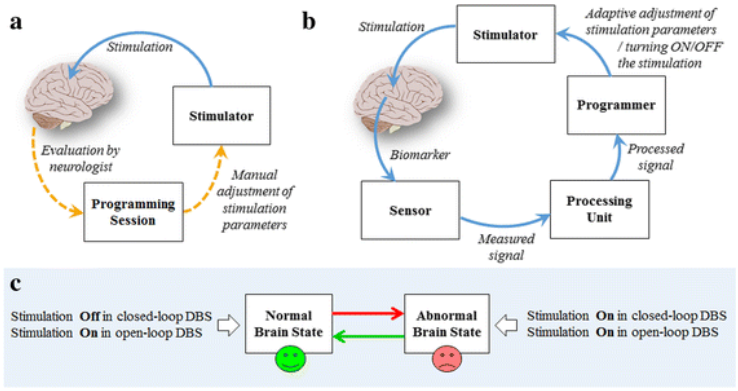
# IMPROVEMENTS

- Adaptive neuromodulation: feedback mechanism
- Optimization of electrode placement: High field MRI, difusion imaging and consecutive tractography
- Stimulation methods: current vs voltage and waveform

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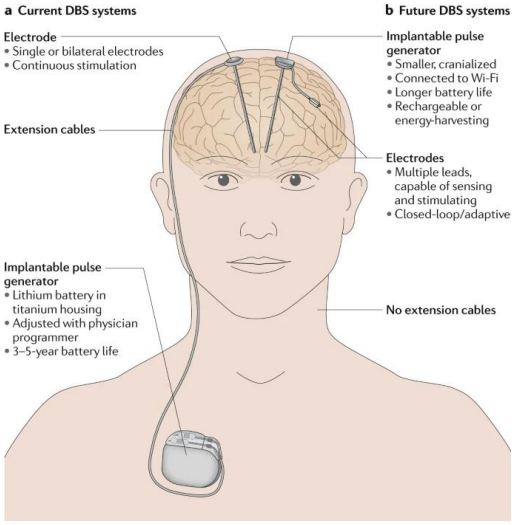
# CONCLUSION

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# THANK YOU FOR YOUR ATTENTION

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