



Enregistrements Stéréotaxiques & Stimulations Cérébrales à Haute Fréquence des Noyaux Gris Centraux

Dr Bernard Pidoux, MCU-PH

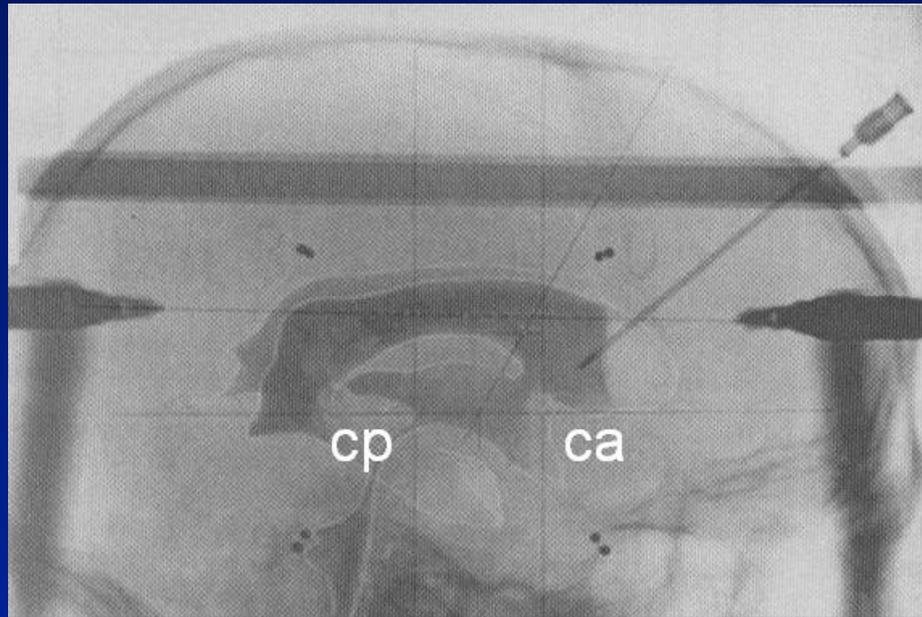
bernard.pidoux@upmc.fr

Le tremblement est un des signes cardinaux de la maladie de Parkinson.

Il peut être discret au début et devenir dans certains cas très invalidant, interférant avec les activités quotidiennes.

Dans les années 1960s, une intervention neurochirurgicale portant sur un noyau spécifique du thalamus, le Vim, avait la propriété de supprimer ces tremblements sans affecter les mouvements.

Cependant la thermo coagulation devait se limiter à ce noyau de petites dimensions sinon des déficits neurologiques pouvaient apparaître, surtout en cas d'intervention bilatérale.



Repérage du thalamus et des repères anatomiques
Commissure Postérieure (cp), Commissure Antérieure
(ca), troisième ventricule, l'aide de la
ventriculographie. Grille stéréotaxique.

Les autres symptômes de la maladie de Parkinson n'étaient pas corrigés par la chirurgie.

- On évitait le NST (hémiballisme).

- utilisation d'enregistrements par microélectrodes intra crâniennes pour confirmer la localisation des cibles.

TRAITEMENT DU TREMBLEMENT PARKINSONNIEN PAR STIMULATION CHRONIQUE DU NOYAU VENTRAL INTERMÉDAIRE DU THALAMUS

A.L. BENABID****, P. POLLAK*****, M. HOMMEL**, J.M. GAIO*****
J. DE ROUGEMONT*, J. PERRET**

* Service de Neurochirurgie, Hôpital A. Michallon, CHRU de Grenoble

** Clinique Neurologique, CHRU de Grenoble

*** Unité de Neurobiologie Préclinique, INSERM U 318, Faculté de Médecine de Grenoble.

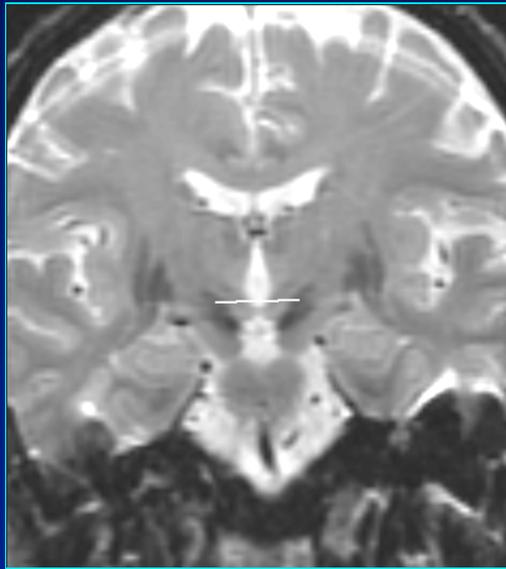
RÉSUMÉ

La thalamotomie stéréotaxique du noyau Ventral Intermédiaire (Vim) peut améliorer le tremblement parkinsonien sévère résistant aux médicaments. Afin de diminuer le nombre d'échecs et les effets indésirables, une stimulation chronique à haute fréquence (130 Hz) du noyau Vim a été effectuée chez 4 patients dont deux avaient déjà subi une thalamotomie de l'autre côté. Le tremblement a été supprimé chez tous les patients, au prix de paresthésies légères, avec un recul allant de 2 à 14 mois. Les effets aussi bien bénéfiques que secondaires ont été immédiatement supprimés à chaque arrêt de la stimulation. Ces résultats préliminaires sont encourageants, mais il convient d'apprécier la persistance de l'efficacité au long cours sur un plus grand nombre de cas.

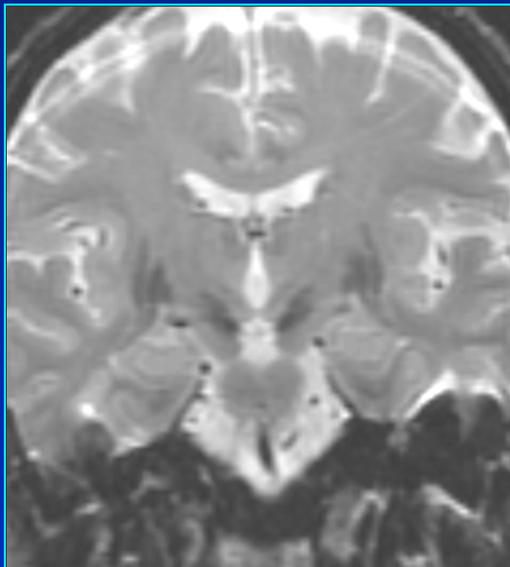
Treatment of parkinsonian tremor by chronic Vim-thalamic stimulation.

A.L. BENABID, P. POLLAK, M. HOMMEL, J.M. GAJO, J. DE ROUGEMONT, J. PERRET. *Rev. Neurol. (Paris)*, 1989, 145: 4, 320-323.

SUMMARY

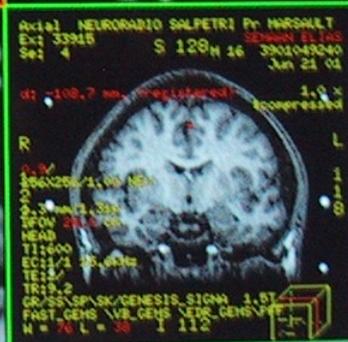
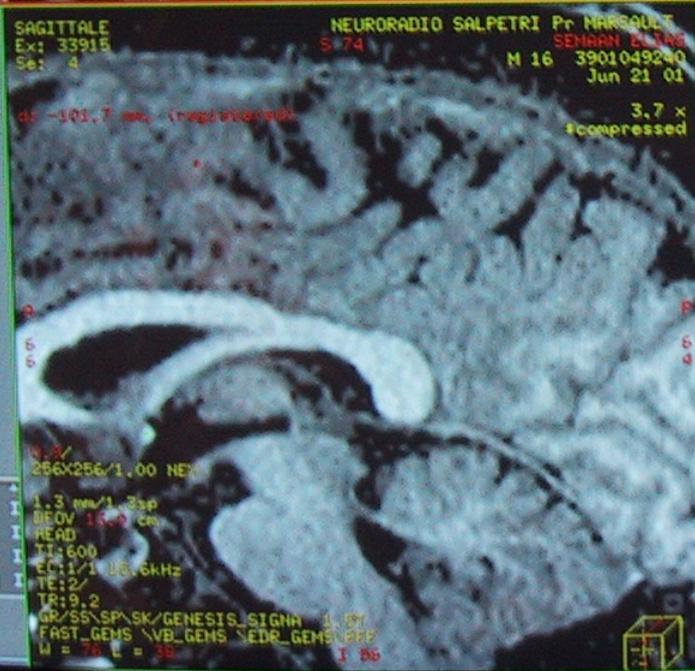


D/G : x



A/P : y





Stimolab

FILE HELP

FRAME BACK-UP

BIOPSY ATLAS

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TARGET

SIMULATION

TOOLS

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Fixation:

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Ycible: 111.0

Zcible: 57.6

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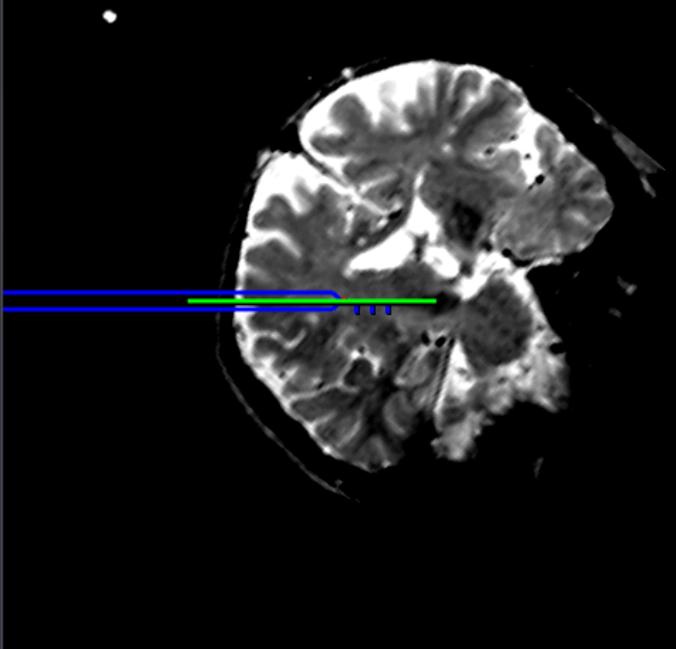
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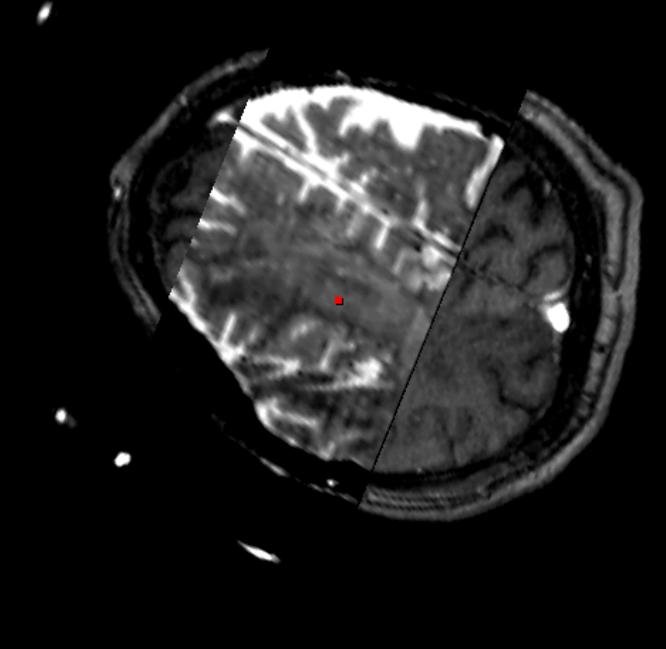
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8 | I |

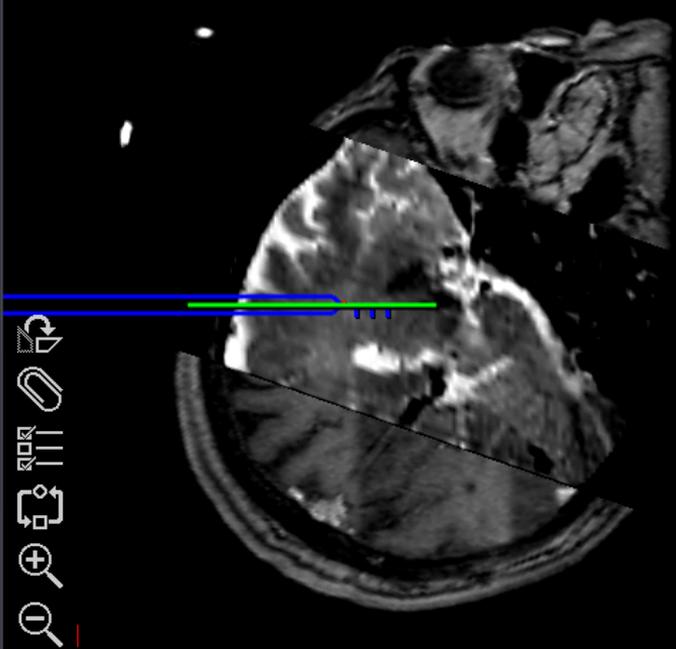
Traj. View 1



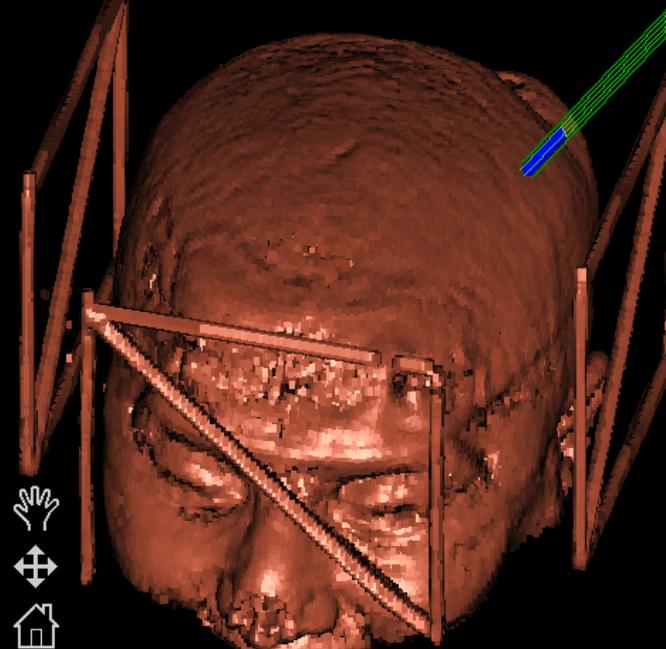
Probe's Eye



Traj. View 2



3D



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- Identify Frame
- Reformat Exam
- Planning
- Frame Settings

Select a plan and read the frame settings.

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50.7

Set Entry Set Target

31.3 mm to target
0.0 mm off plan

Frame Settings

Lat (x): +107.0 +/- (x)

A-P (y): +102.6 +/- (y)

Vert (z): +124.6

Ring: 110.7

Arc: 124.4

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Current Frame Coordinate

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Back Next



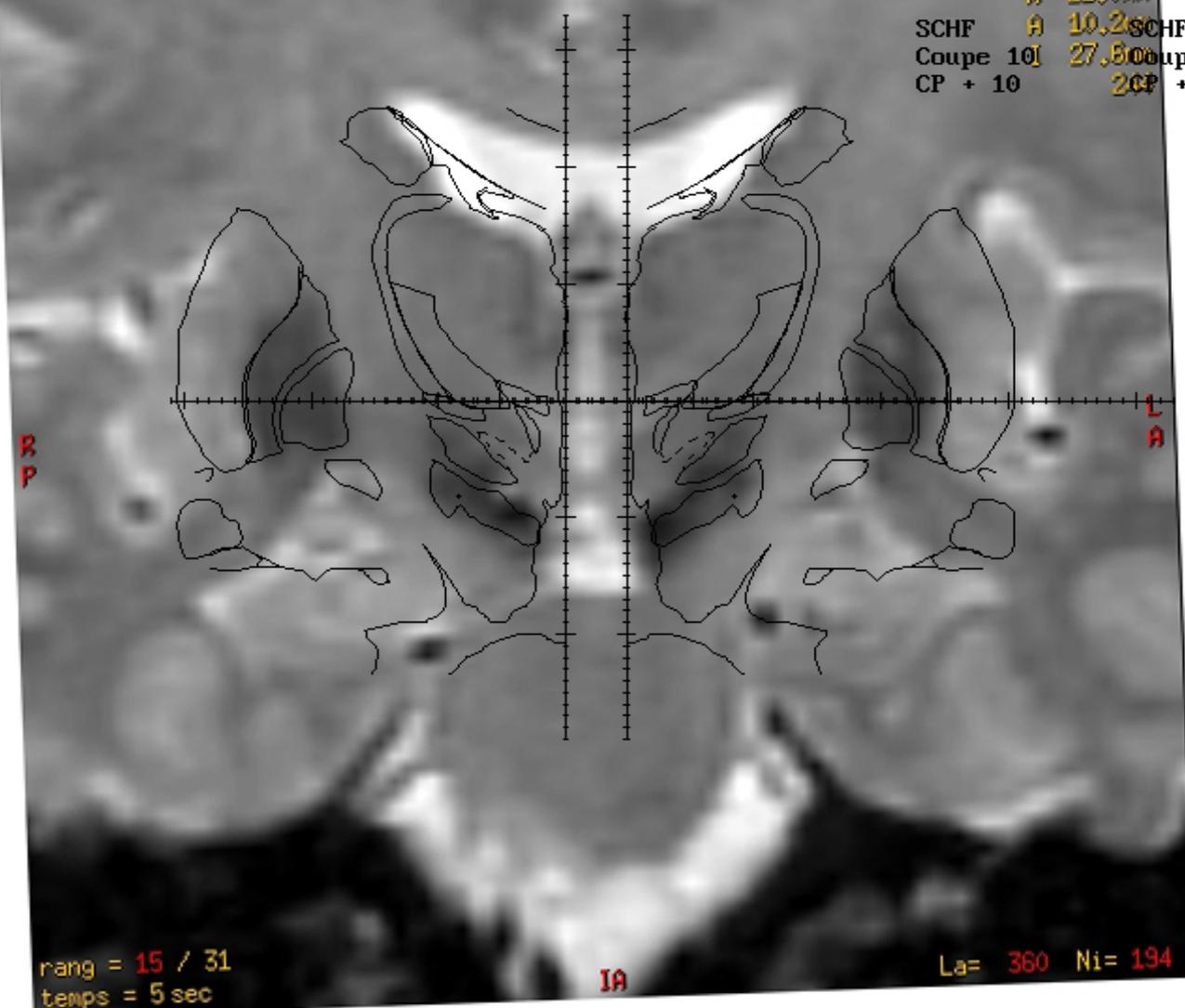
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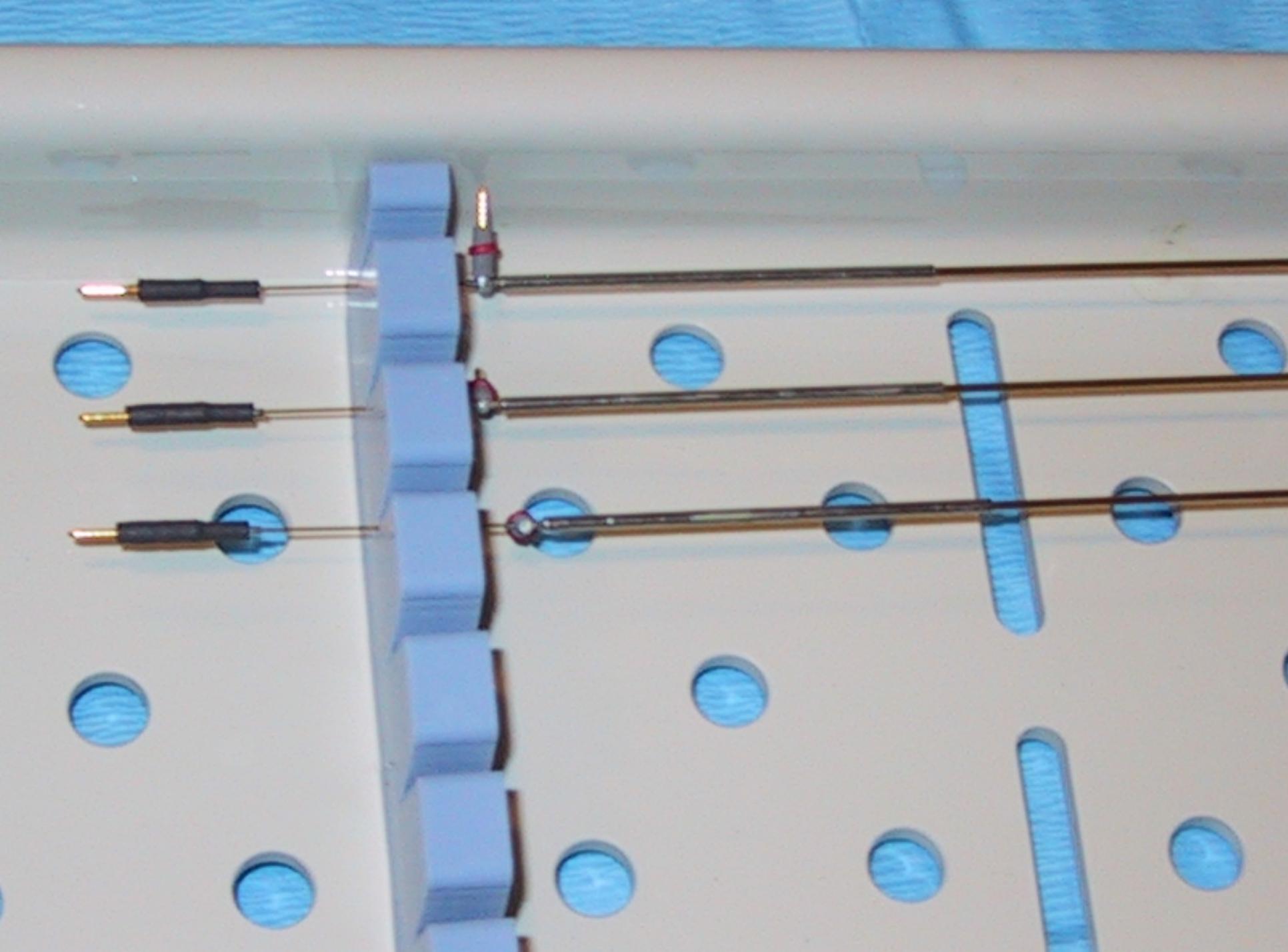
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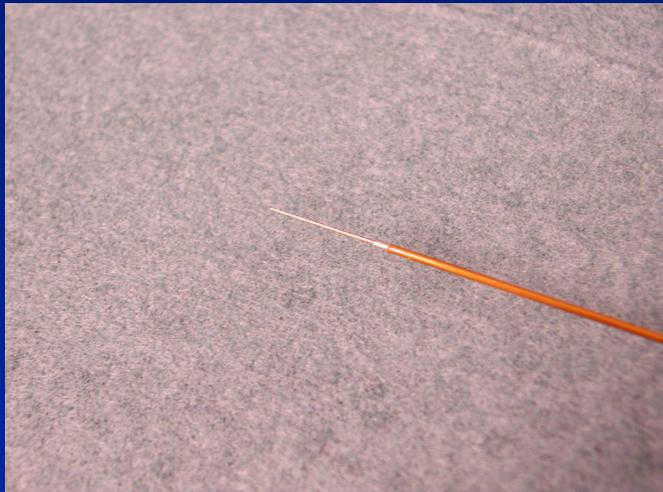
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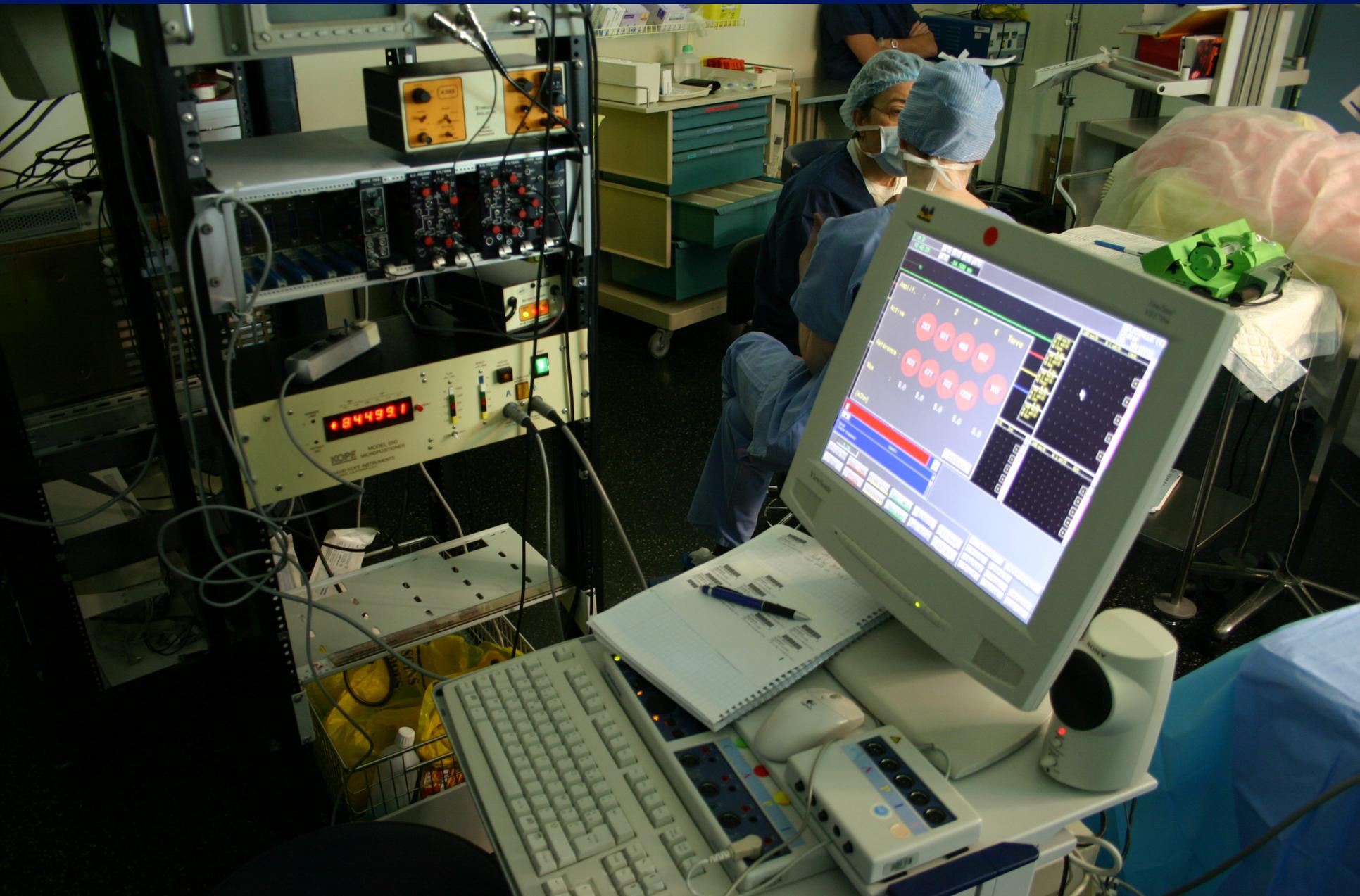
L'enregistrement par microélectrode

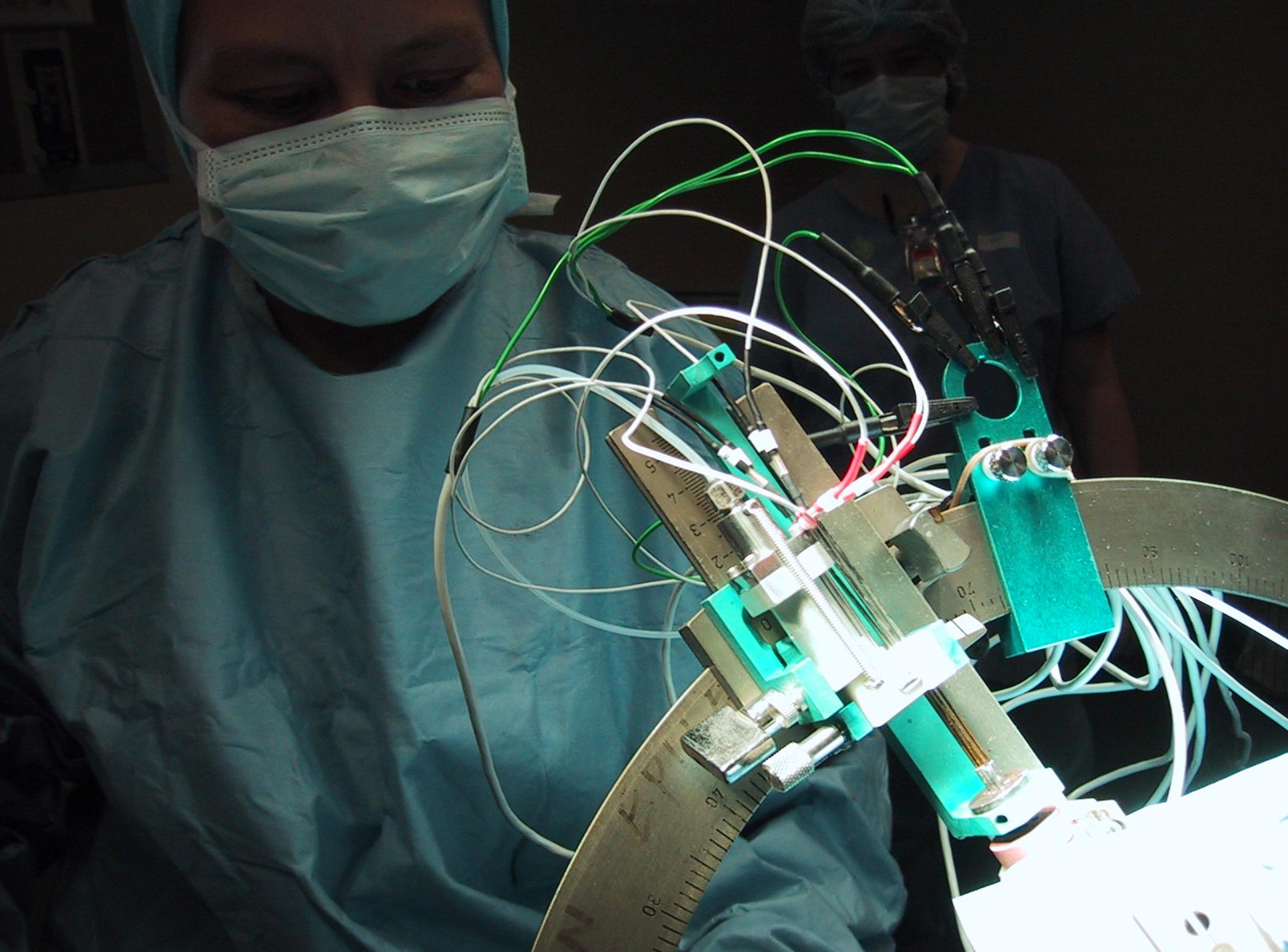
- est utile pour confirmer la localisation anatomique précise des noyaux cibles**
- vérifier qu'il n'y a pas d'erreurs instrumentales**
- définir la position exacte de la cible chirurgicale fonctionnelle**
- dont la stimulation entraînera la disparition des symptômes**

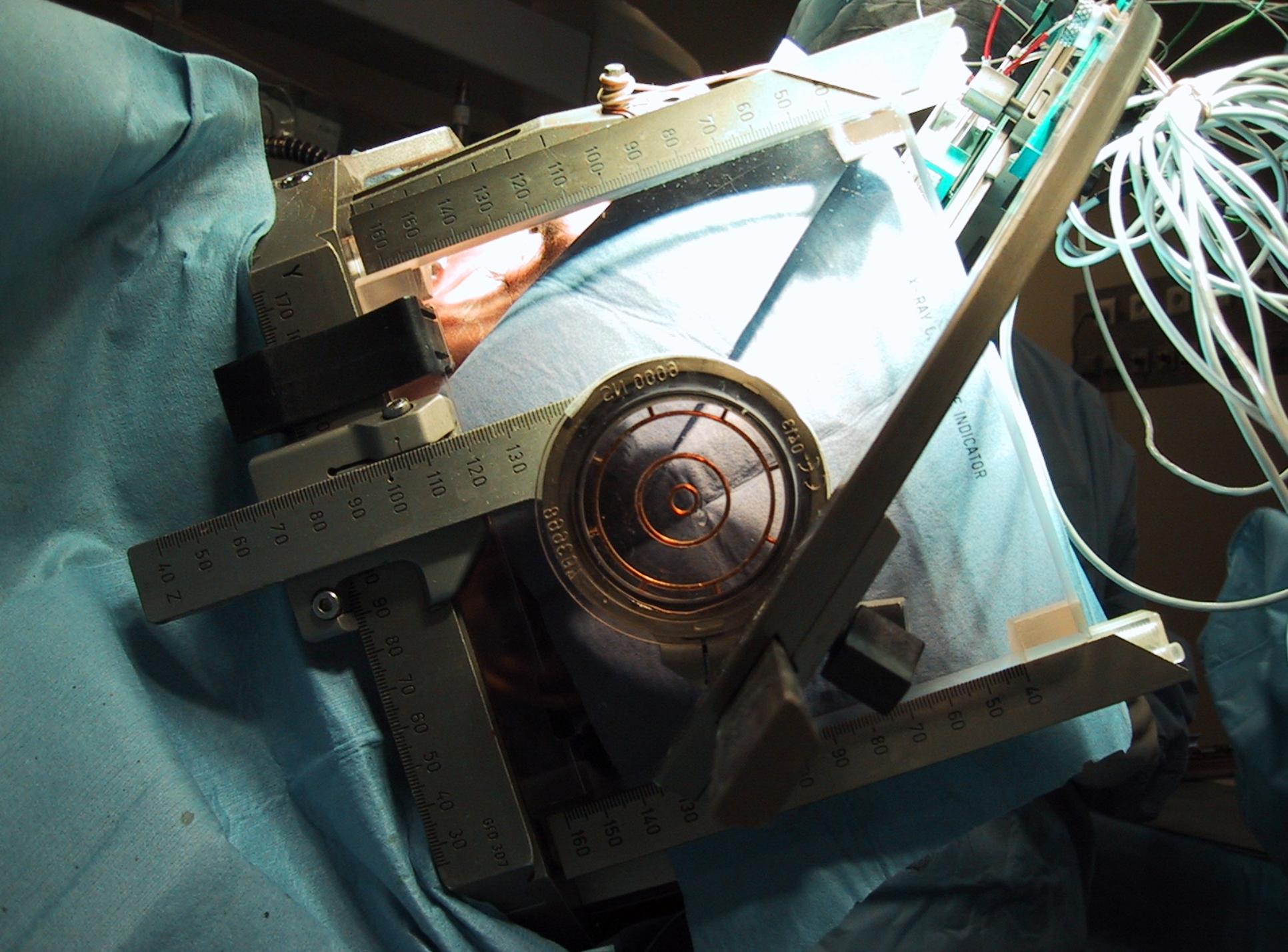












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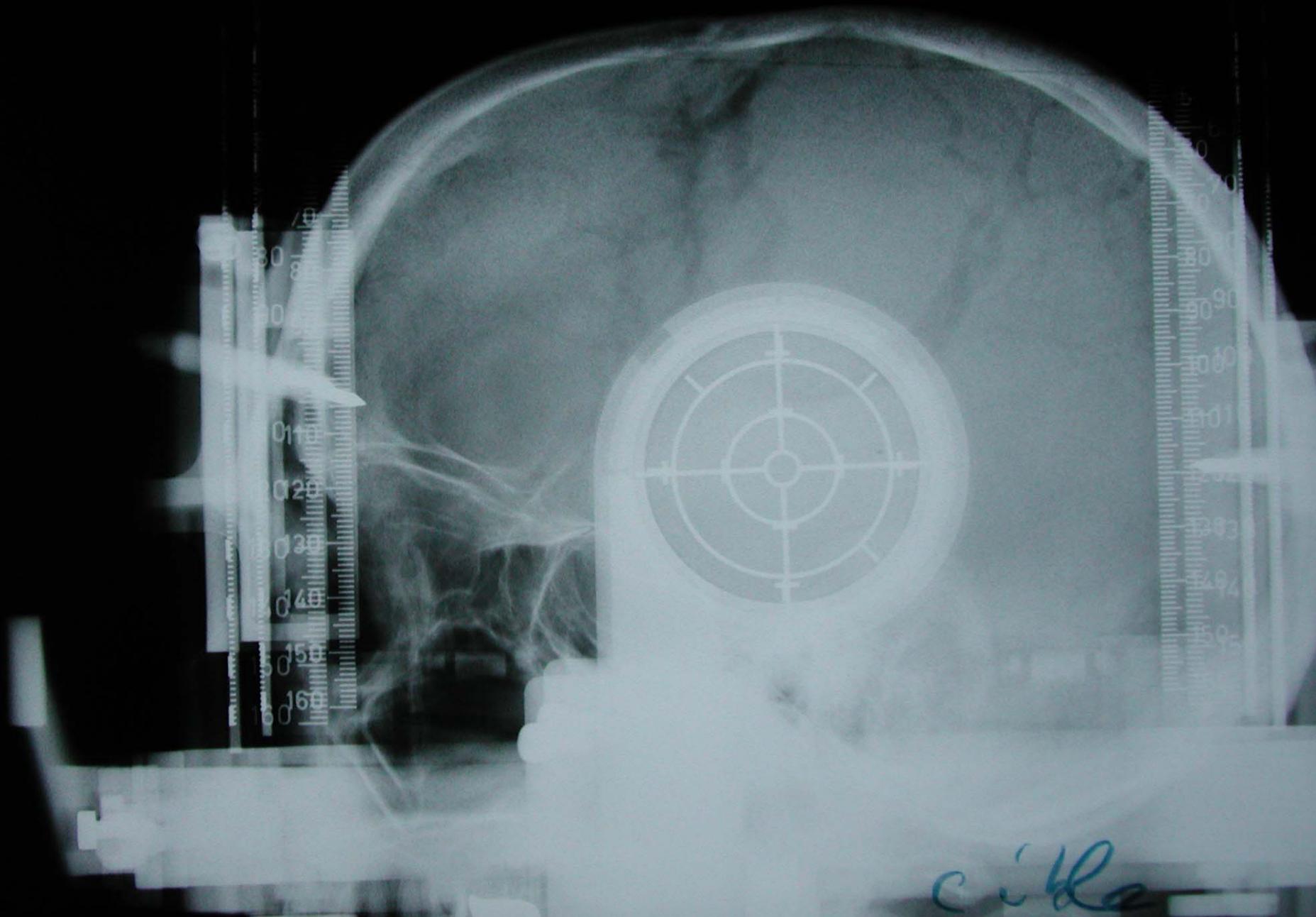
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0000 12 0000 0000 12 0000

90 80 70 60 50 40 30 20 10 0

160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

X-RAY C-ARM
INDICATOR



ciho

Ry u^og

2 = 121
= Plot ①

DELASALLE Didier -7_16 December_09h18_Profil.bio - 50%

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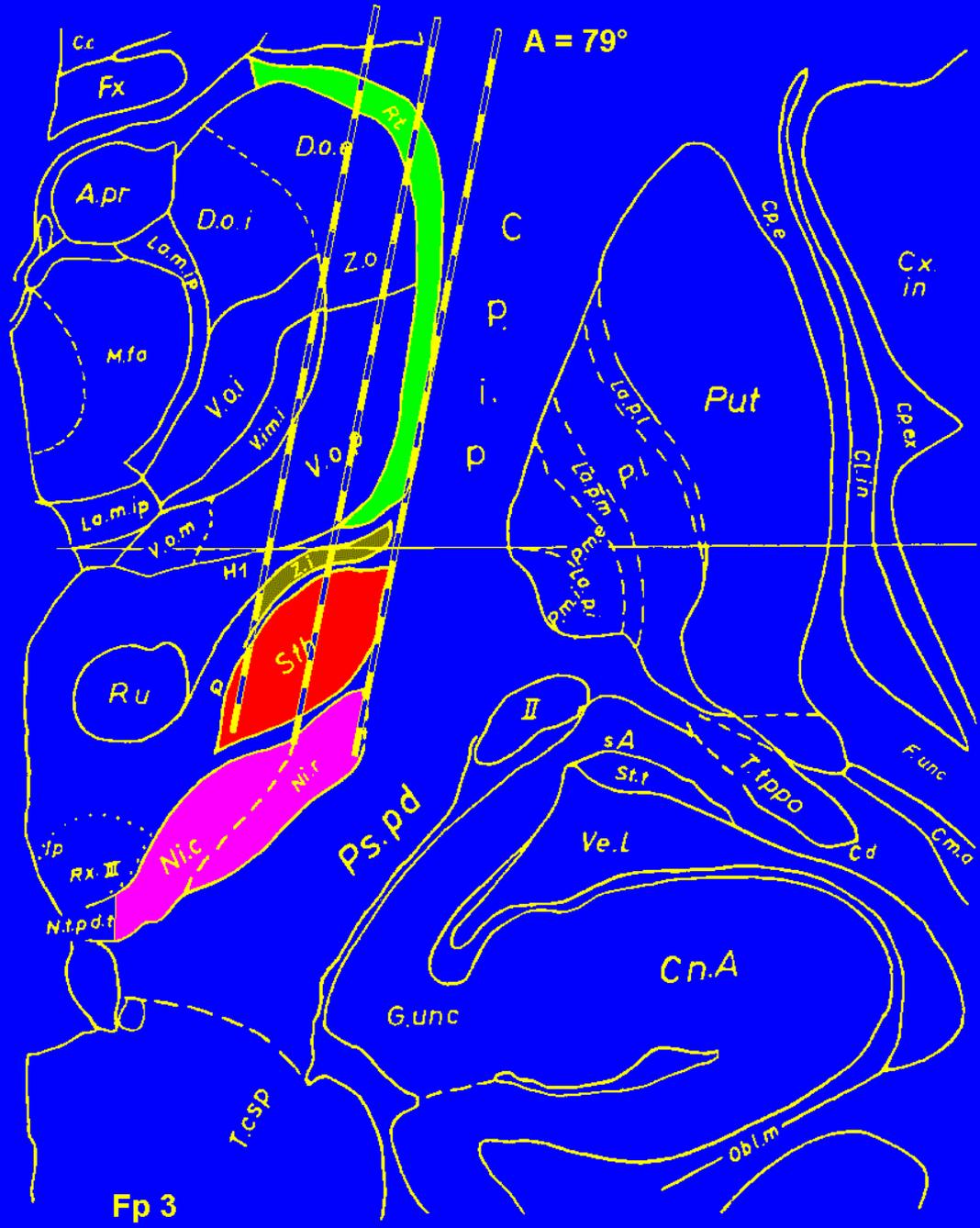


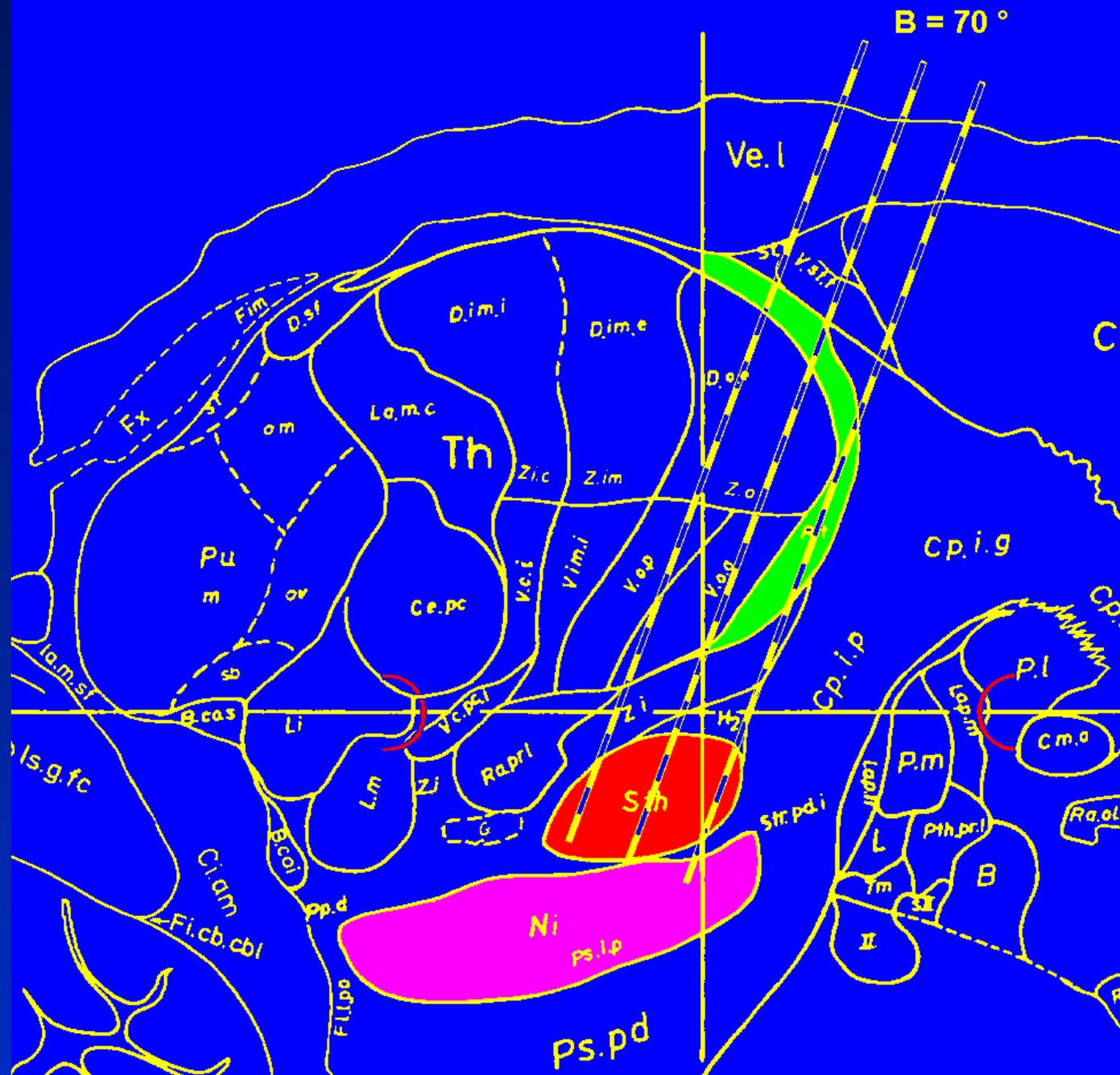
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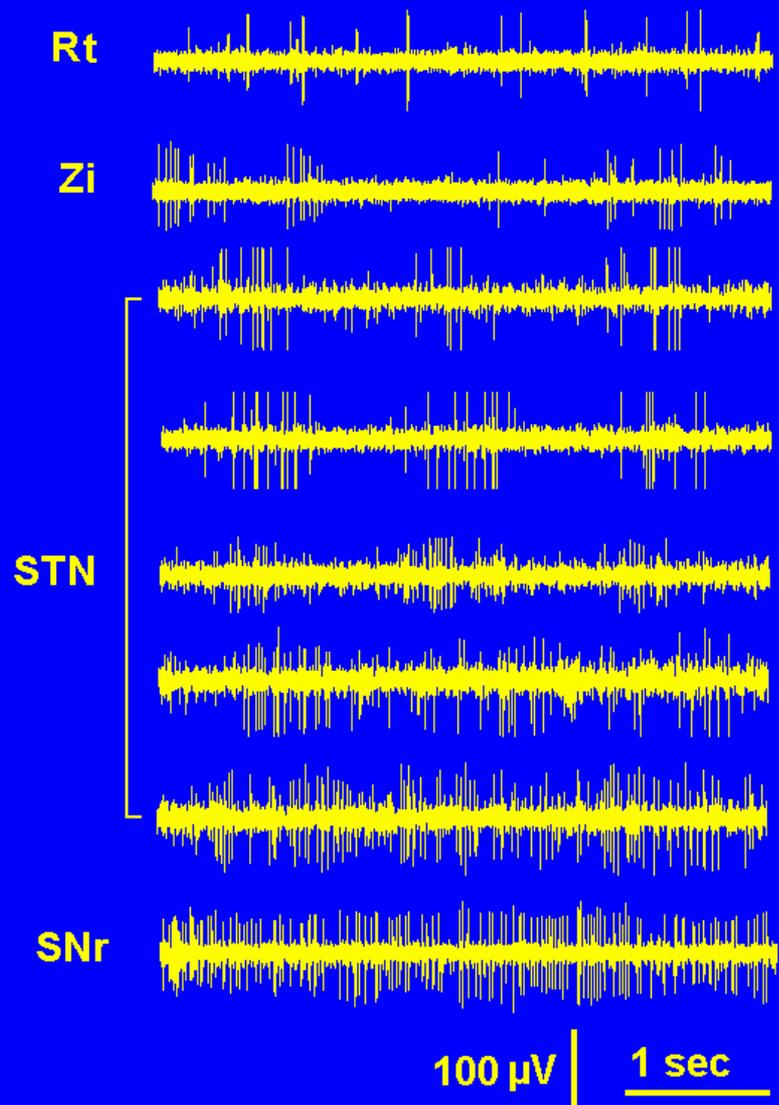
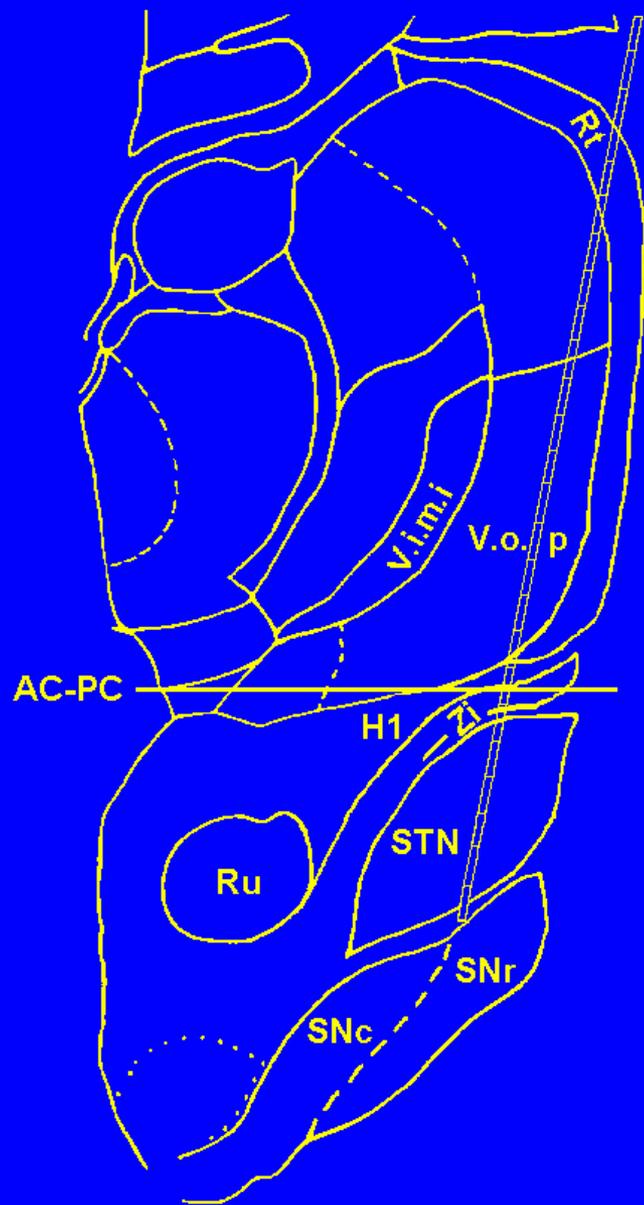
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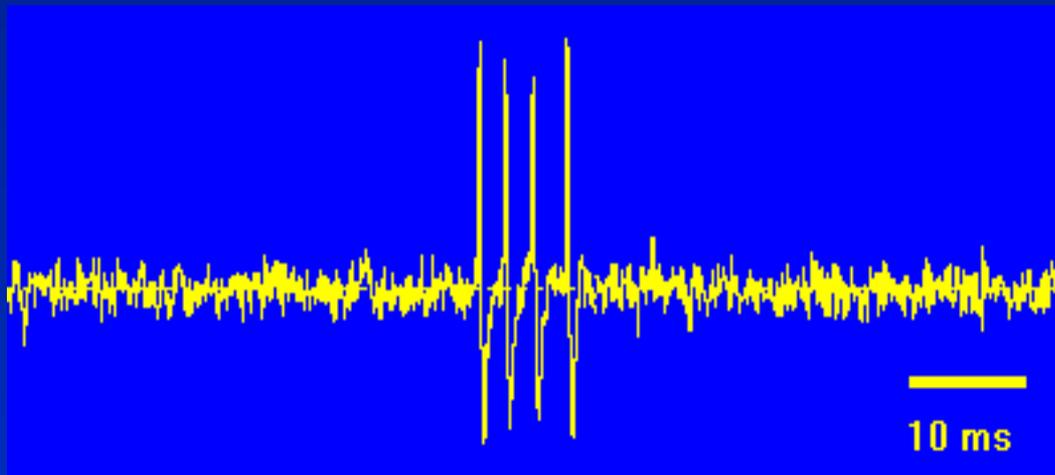
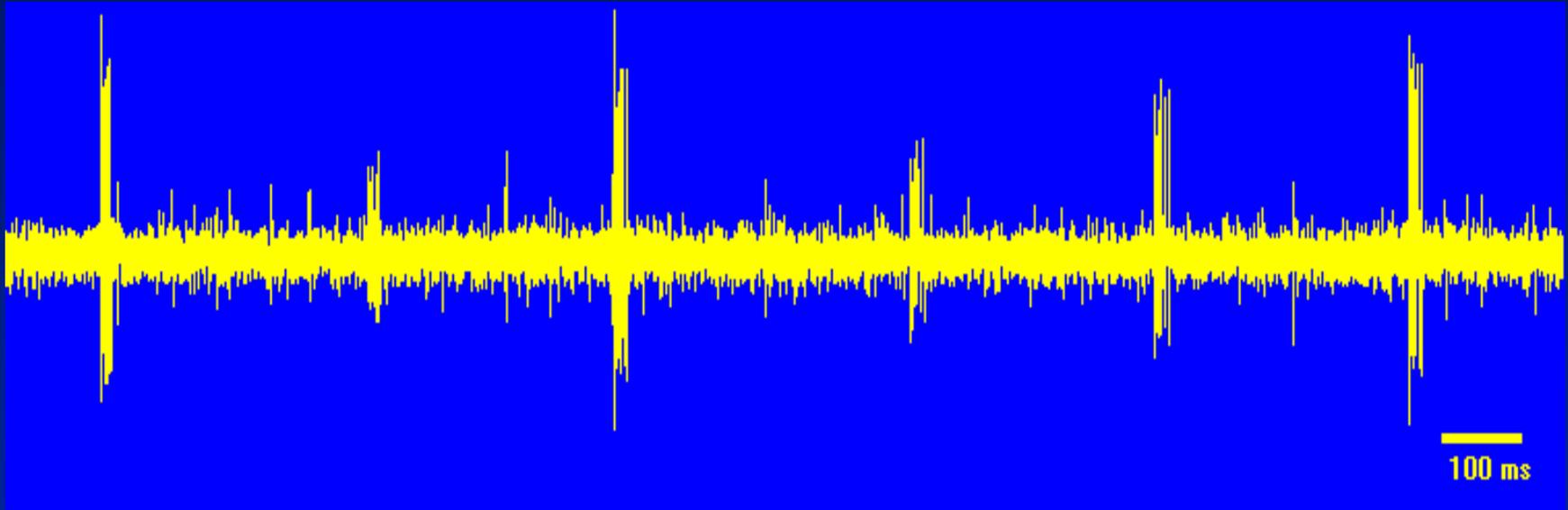
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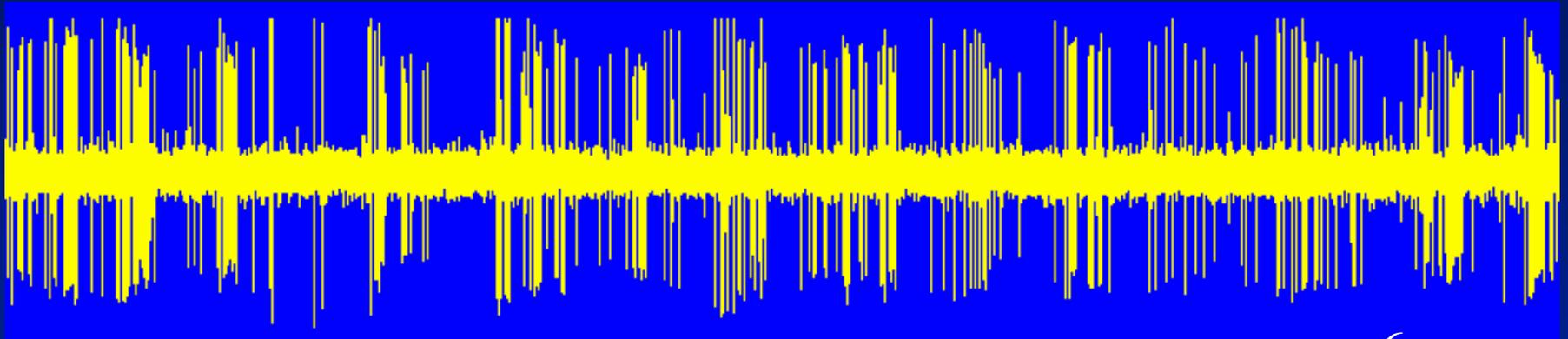
Thalamic reticular nucleus



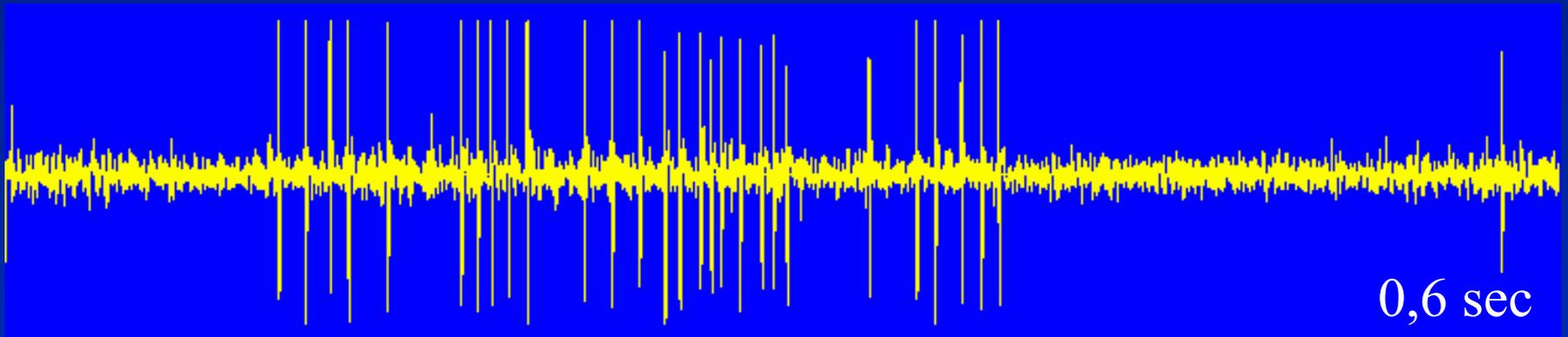
type B neurone
Raeva et al. 1991



Parkinson's Disease – Subthalamique Nucleus



6 sec

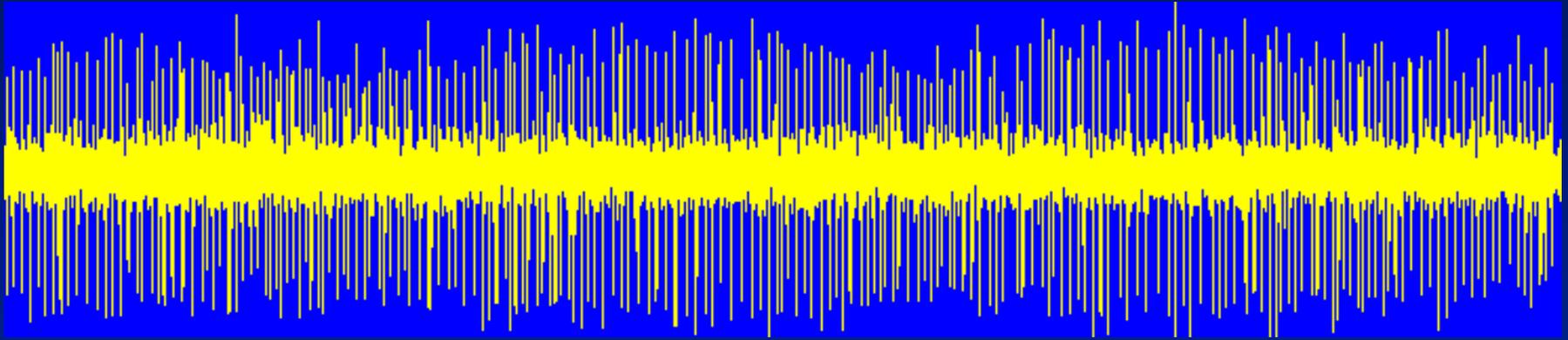


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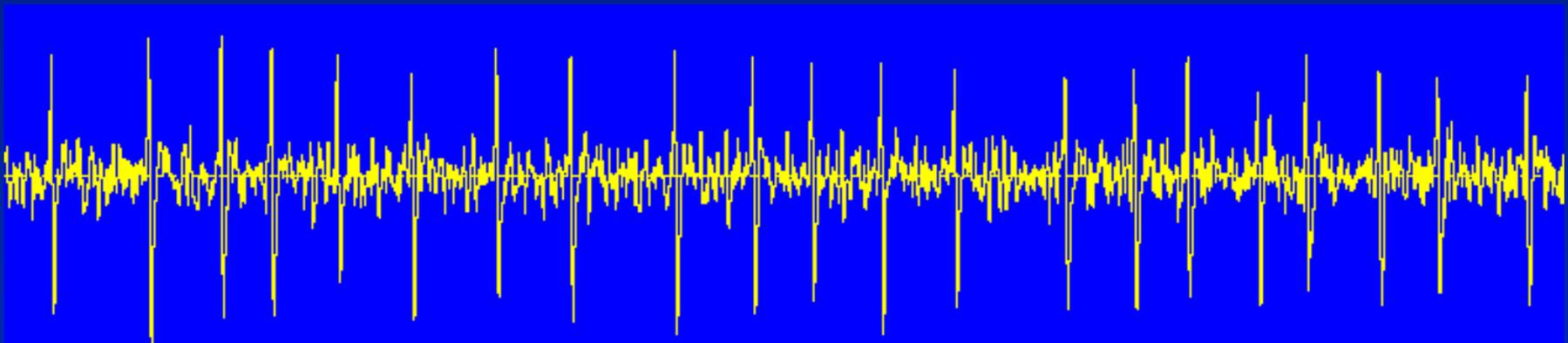
Single unit microelectrode recording



Parkinson : substantia nigra single unit activity



2 sec



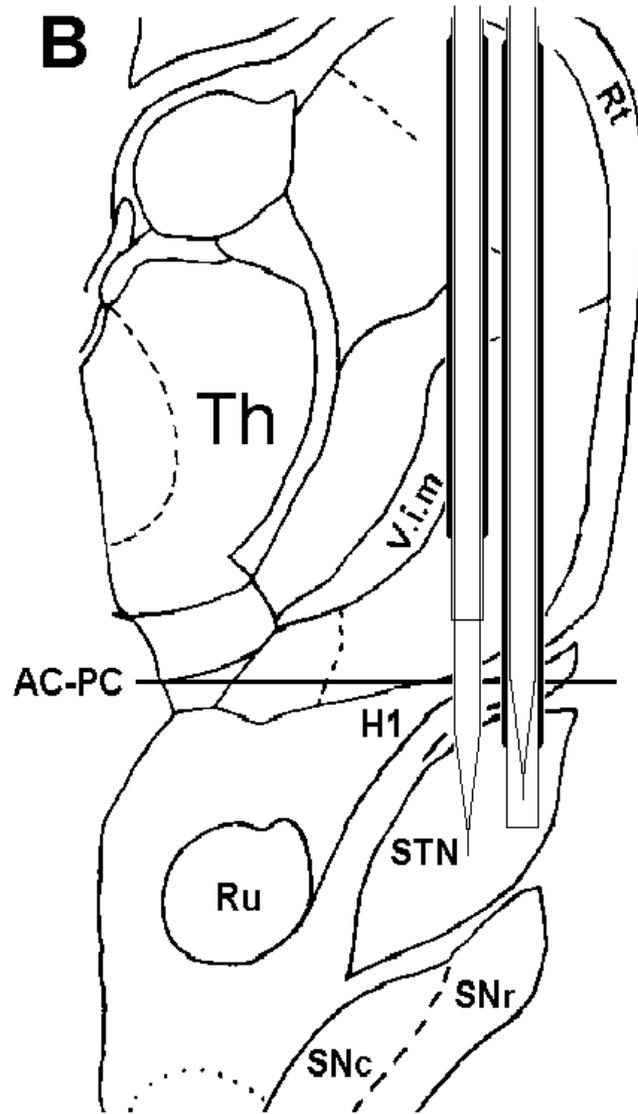
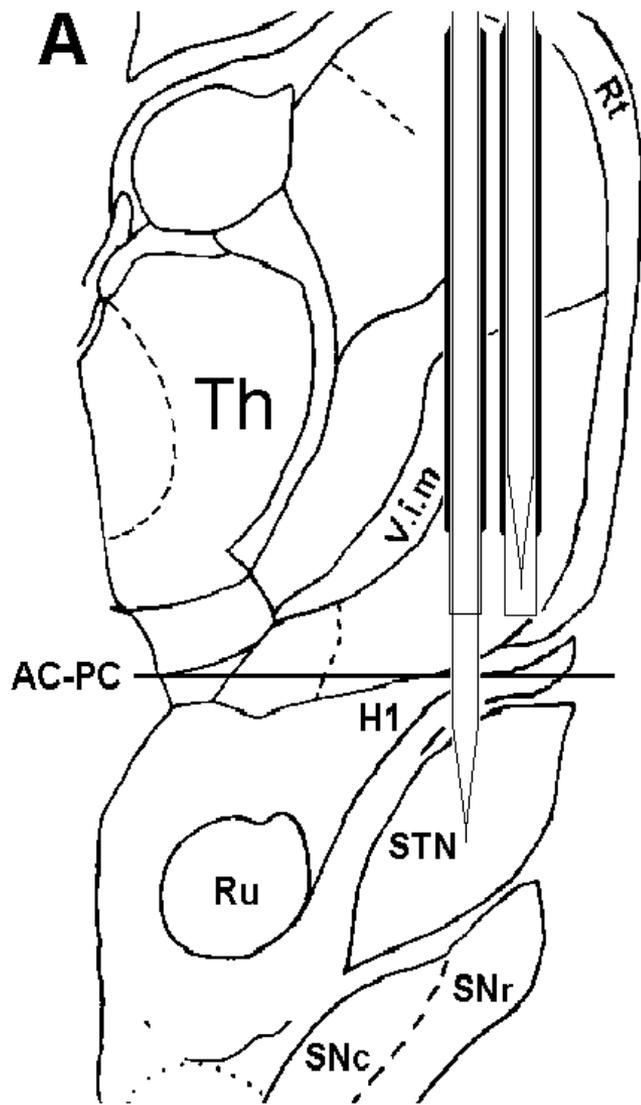
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La stimulation per opératoire à haute fréquence (135-185 Hz ; 2-3 mA ; 70-80 μ s)

- indique précisément la localisation de la cible fonctionnelle

- au niveau de laquelle la stimulation supprime rigidité, tremblement et akinésie



Stimulation-induced effects:

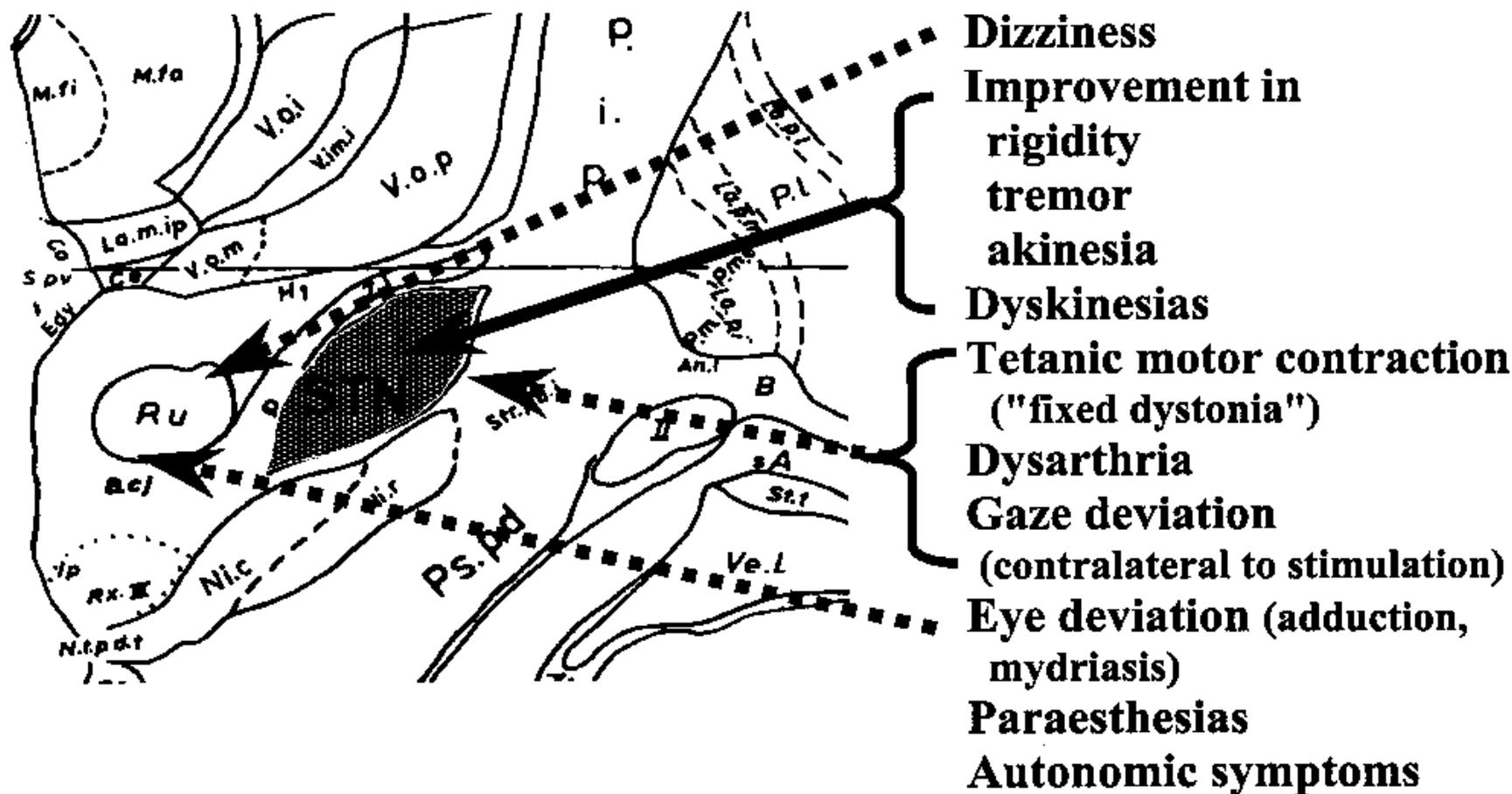


FIG. 2. Sites of stimulation-induced effects in the subthalamic nucleus region on a coronal view at 3 mm posterior to the mid-bicommissural line (from Schaltenbrand's atlas). STN, subthalamic nucleus. The site for paraesthesias is more posterior. The site for autonomic symptoms is more anterior.

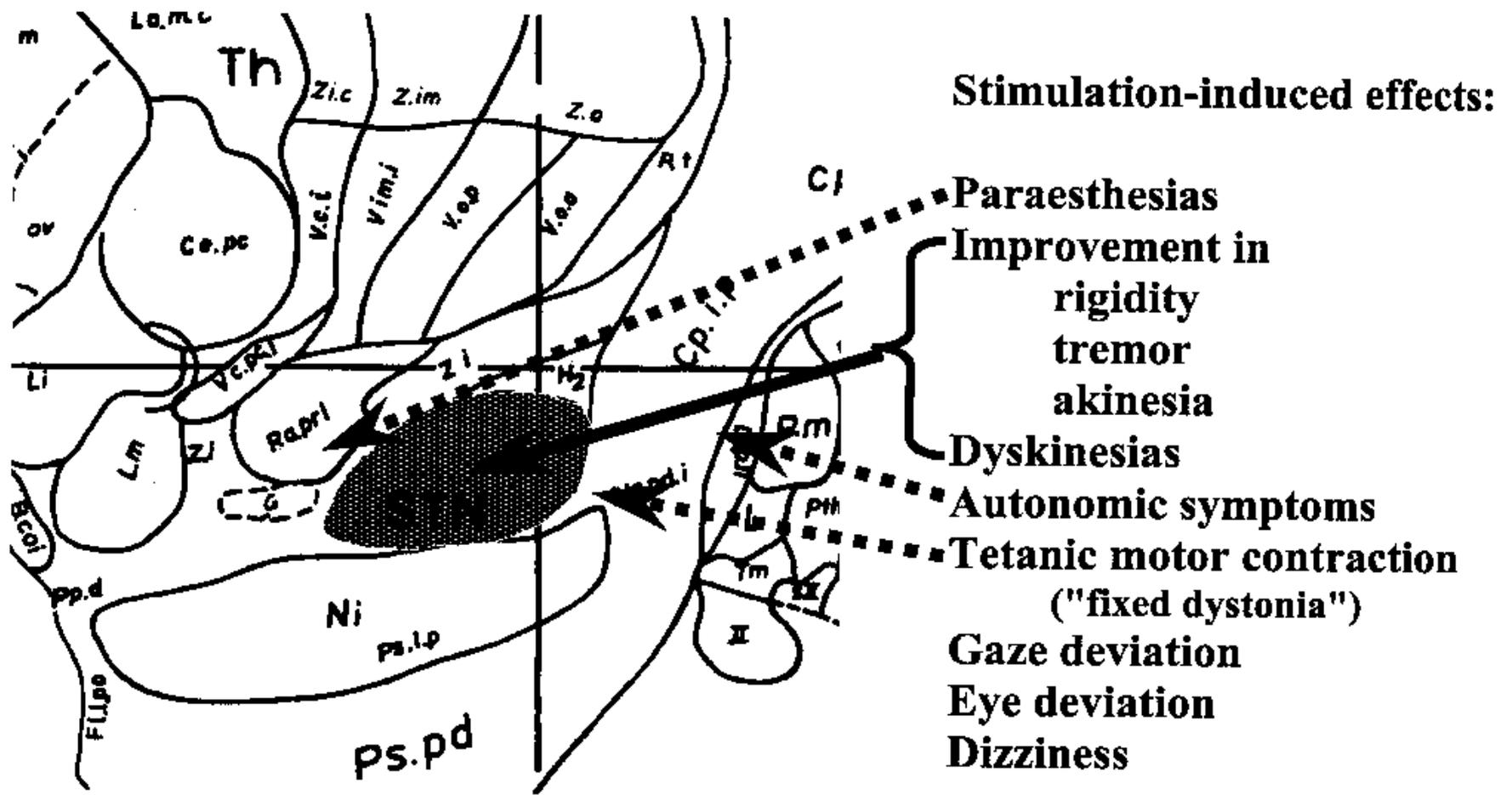
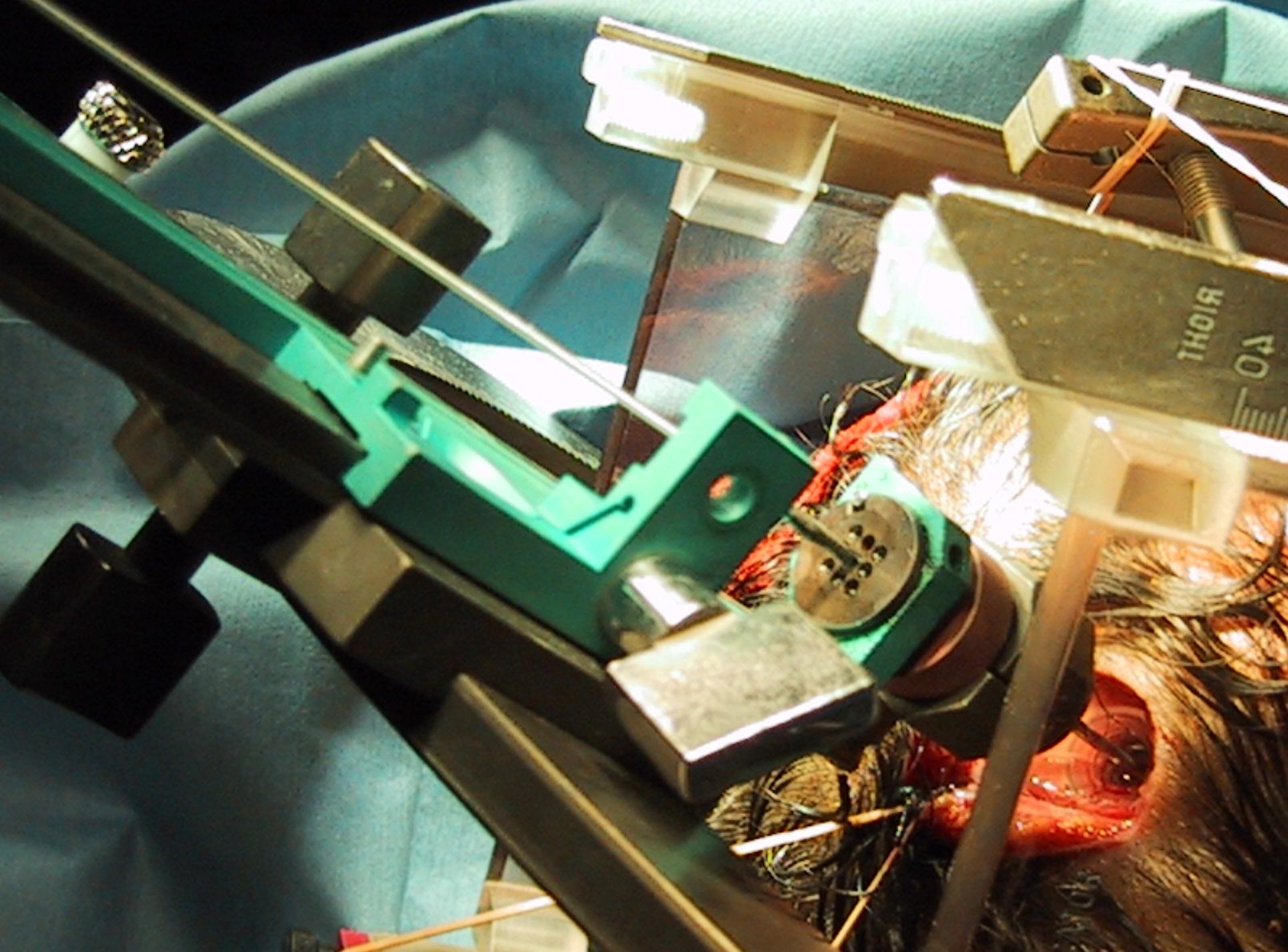


FIG. 1. Sites of stimulation-induced effects in the subthalamic nucleus region on a sagittal view at 12 mm of laterality (from Schaltenbrand's atlas) STN, subthalamic nucleus. The site for gaze deviation is imprecise. The sites for eye deviation and dizziness are more medial.

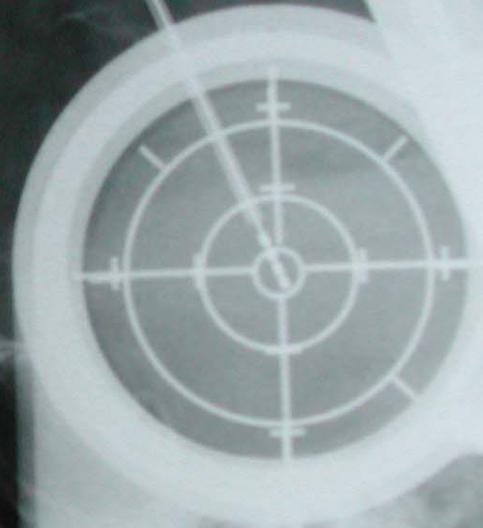


Ry u^og

2 = 121
= Plot ①

M1

Z = 120

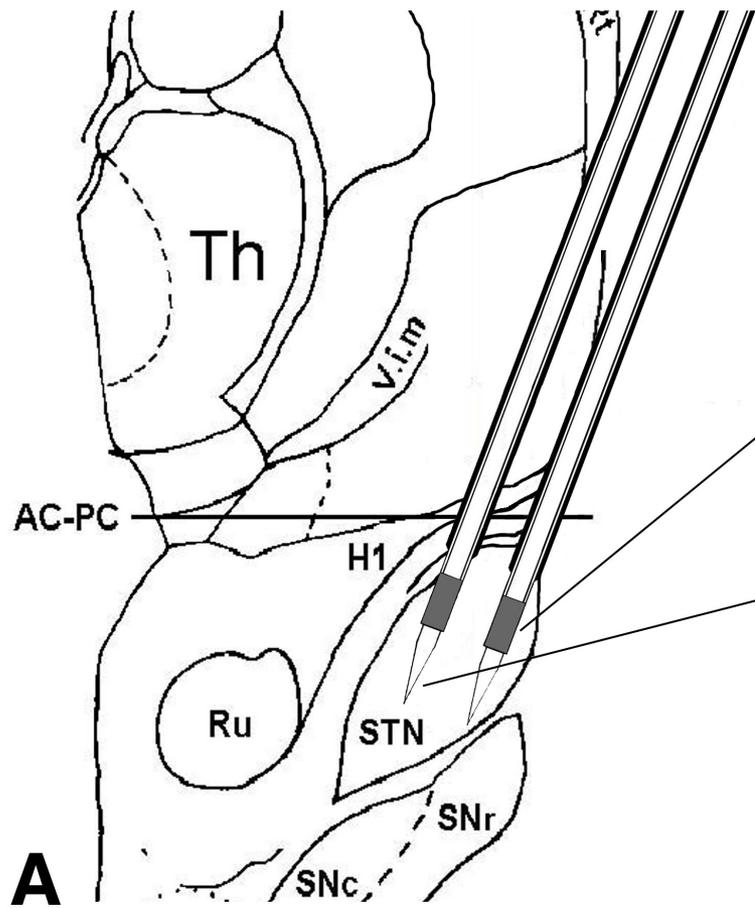


(12)

Z=119

Enregistrements
&
stimulations
per-opératoire

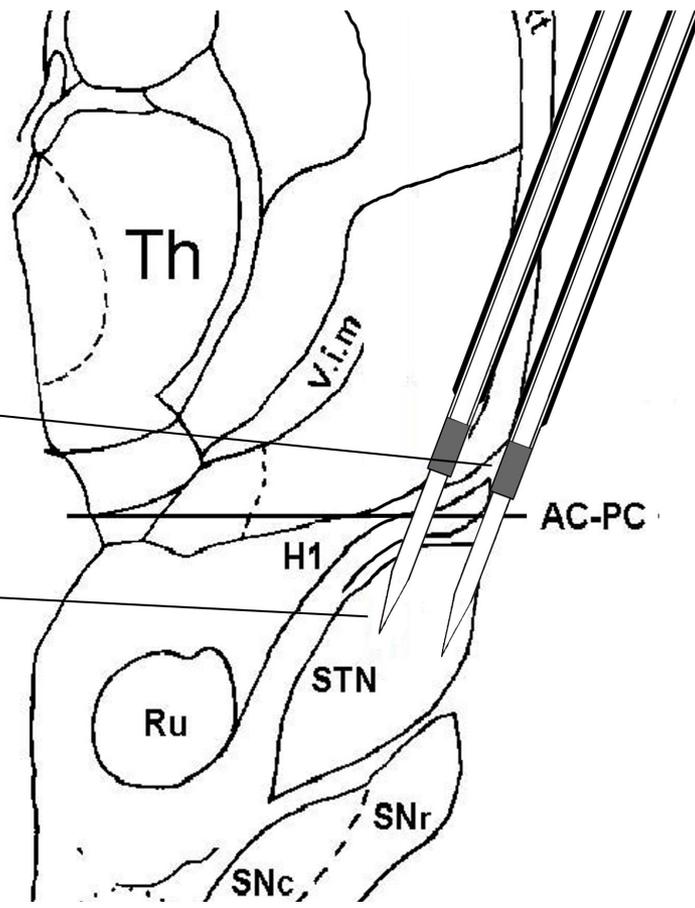
Video sequences



A

Stimulation

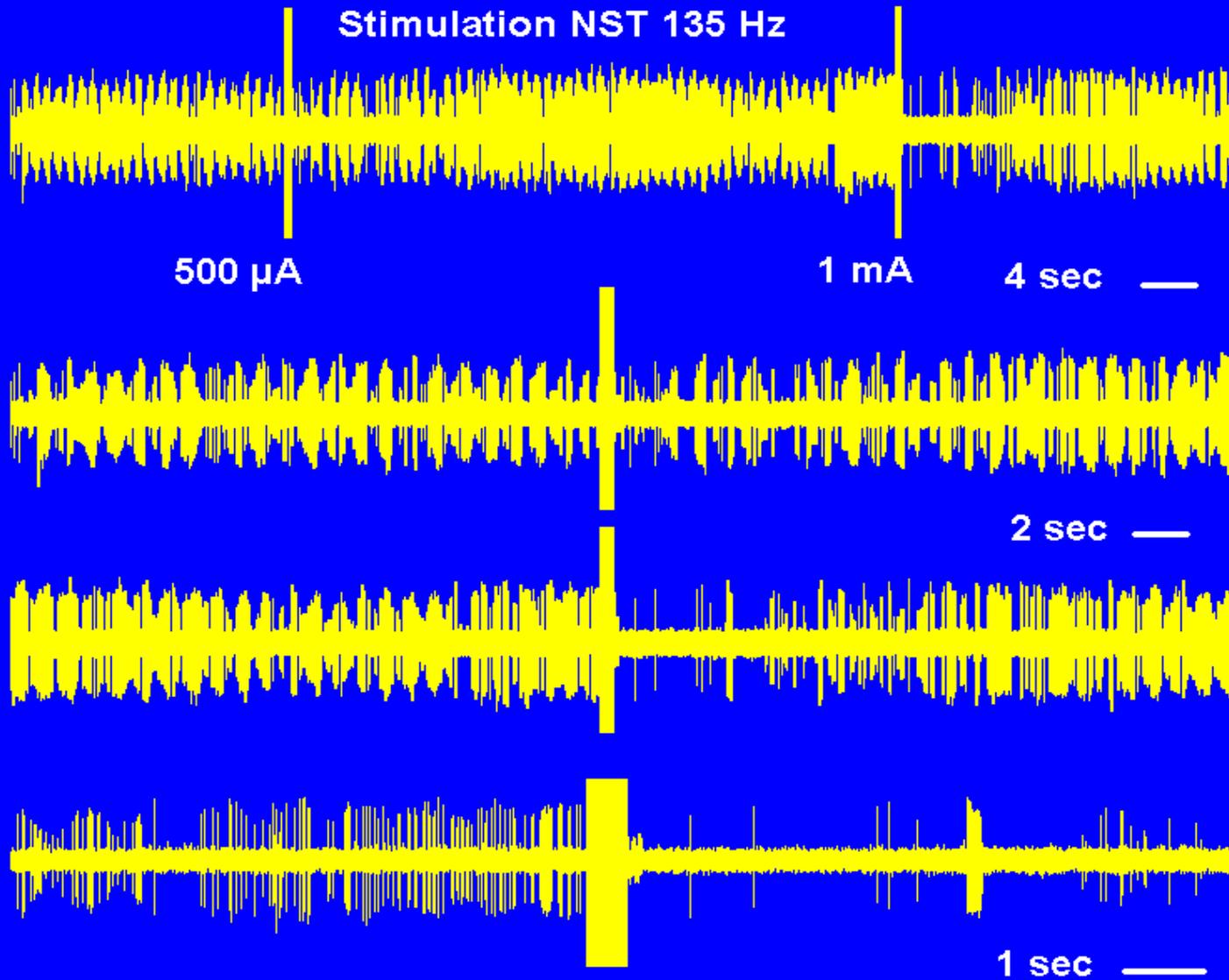
Recording



B

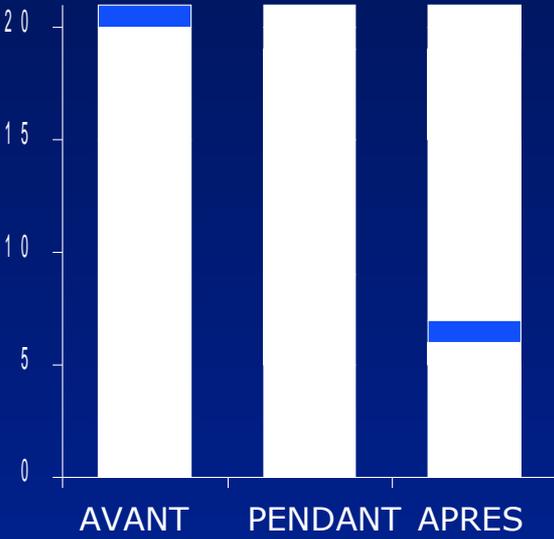
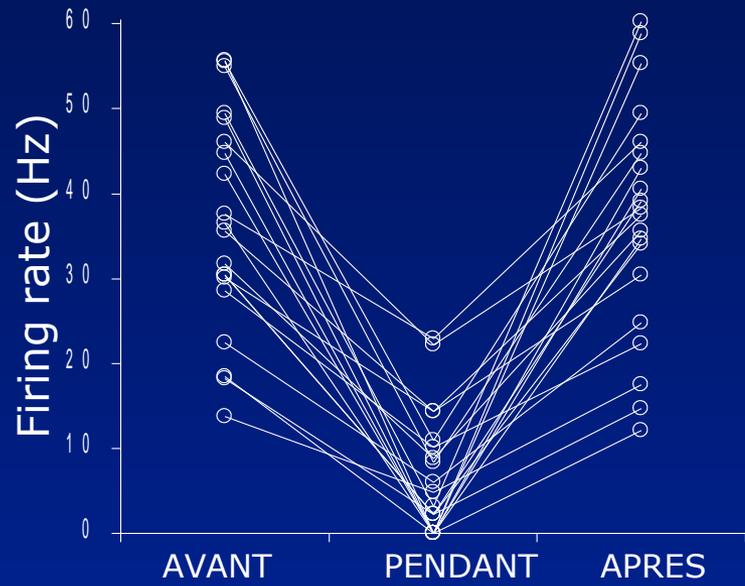
AC-PC

Stimulation NST 135 Hz



Stimulation HF homolatérale

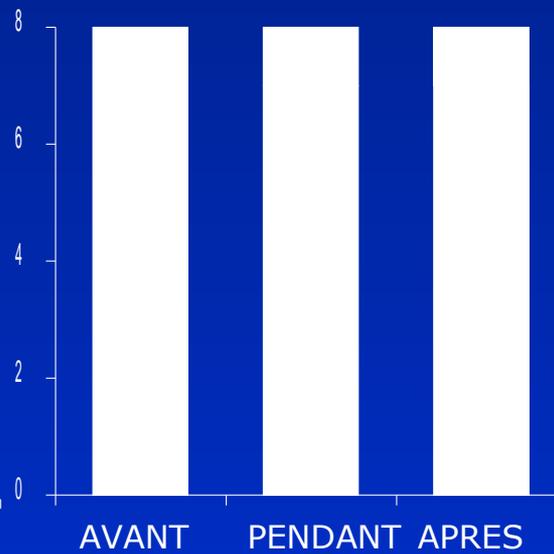
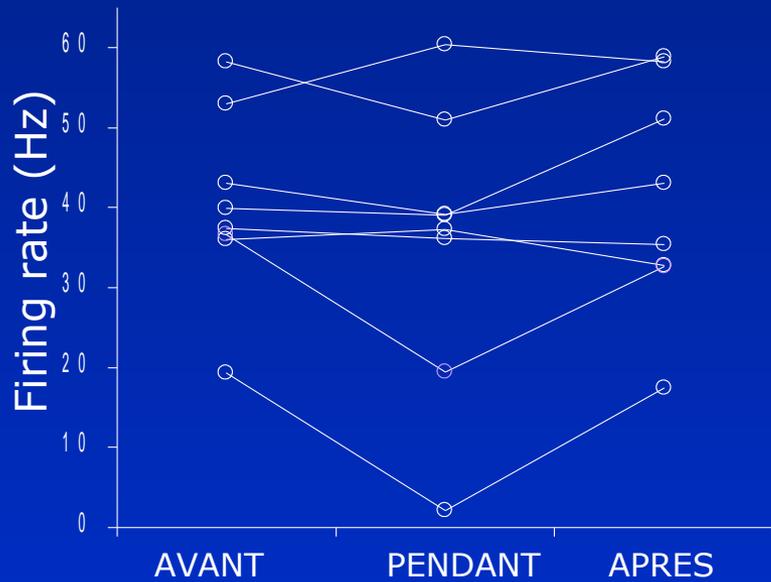
A



- IRREGULIER
- REGULIER
- BURSTING
- PAS D' ACTIVITE

Procedure 'Placebo'

B



A: STN single stim. 0.7 mA



B: STN double stim. 0.7 mA

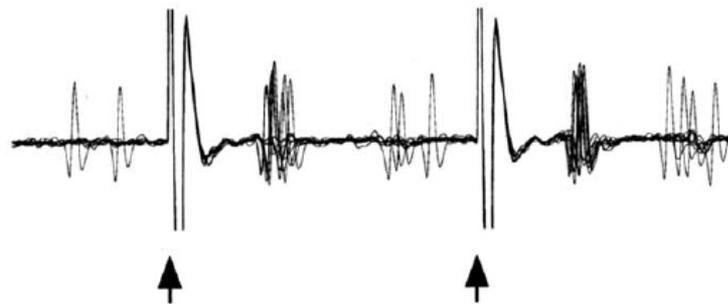
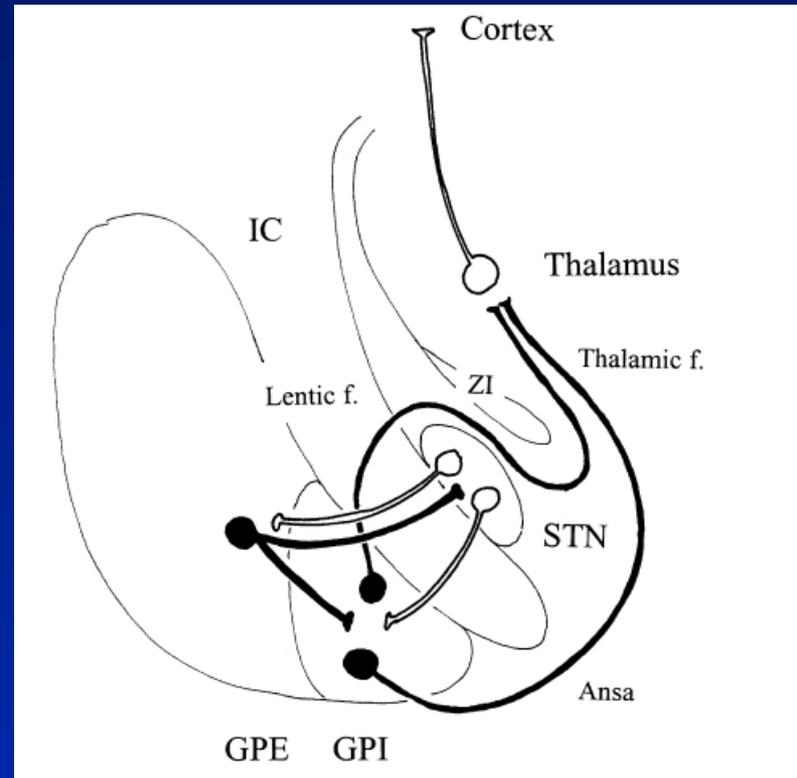


Figure 1. *A, B*, Responses of a GPe neuron to single stimulation (stim.; *A*) and double stimulation (stim.; *B*) of the STN. Ten overlapped traces show that single or double stimulation of the STN (marked by arrows) induced highly synchronized spiking ~ 3.5 ms after each stimulus. The second spikes following the initial short-latency spikes were also synchronized. Stimulus arti-

STN stim \rightarrow GPe recordings



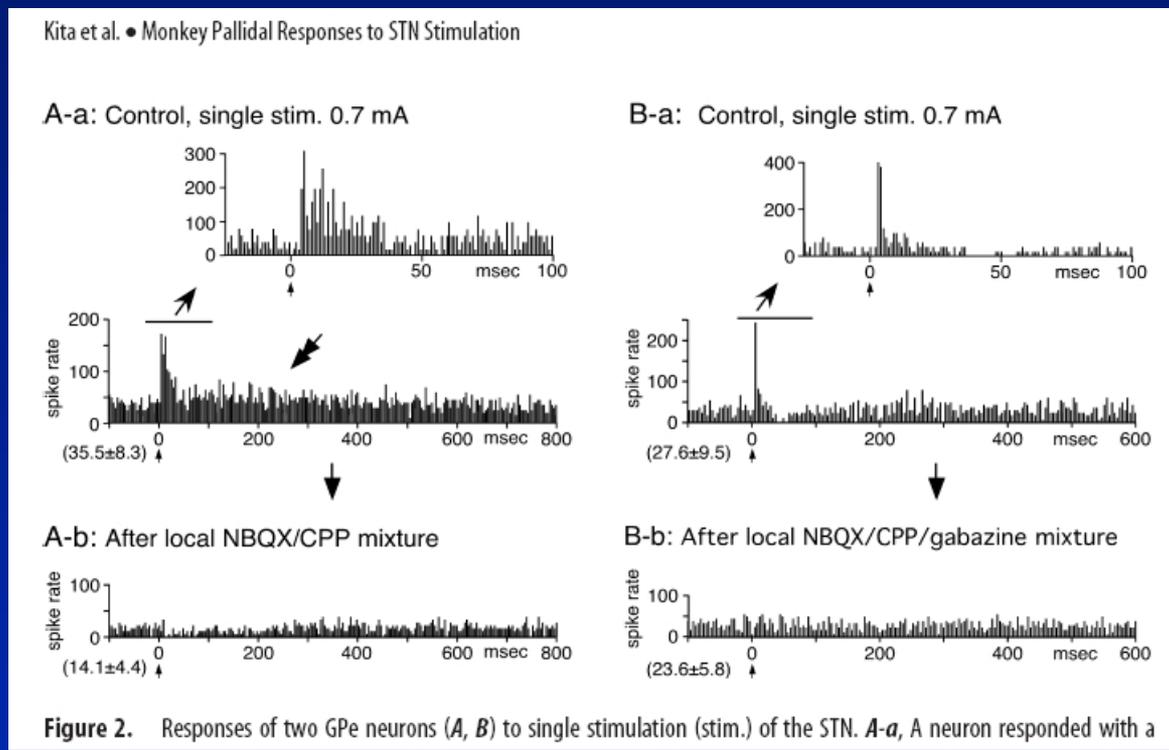
Kita H, Tachibana Y, Nambu A, Chiken S.

Balance of monosynaptic excitatory and disynaptic inhibitory response of the globus pallidus induced after stimulation of the subthalamic nucleus in the monkey. *J. Neurosci.* 2005; 21:8611-8619.

Single stimulus STN stimulation → GPe monosynaptic response (Glu)

Short latency excitation

GLU
blockers
blocks
STN-GPe
excitation →



Glu + GABA
blockers
←

Kita H, Tachibana Y, Nambu A, Chiken S.

Balance of monosynaptic excitatory and disynaptic inhibitory response of the globus pallidus induced after stimulation of the subthalamic nucleus in the monkey. *J. Neurosci.* 2005; 21:8611-8619.

STN - BHFS → GPi recordings : strong inhibition

Inhibition
during
BHFS →

Inhibition
suppressed
by GABA
blocker →

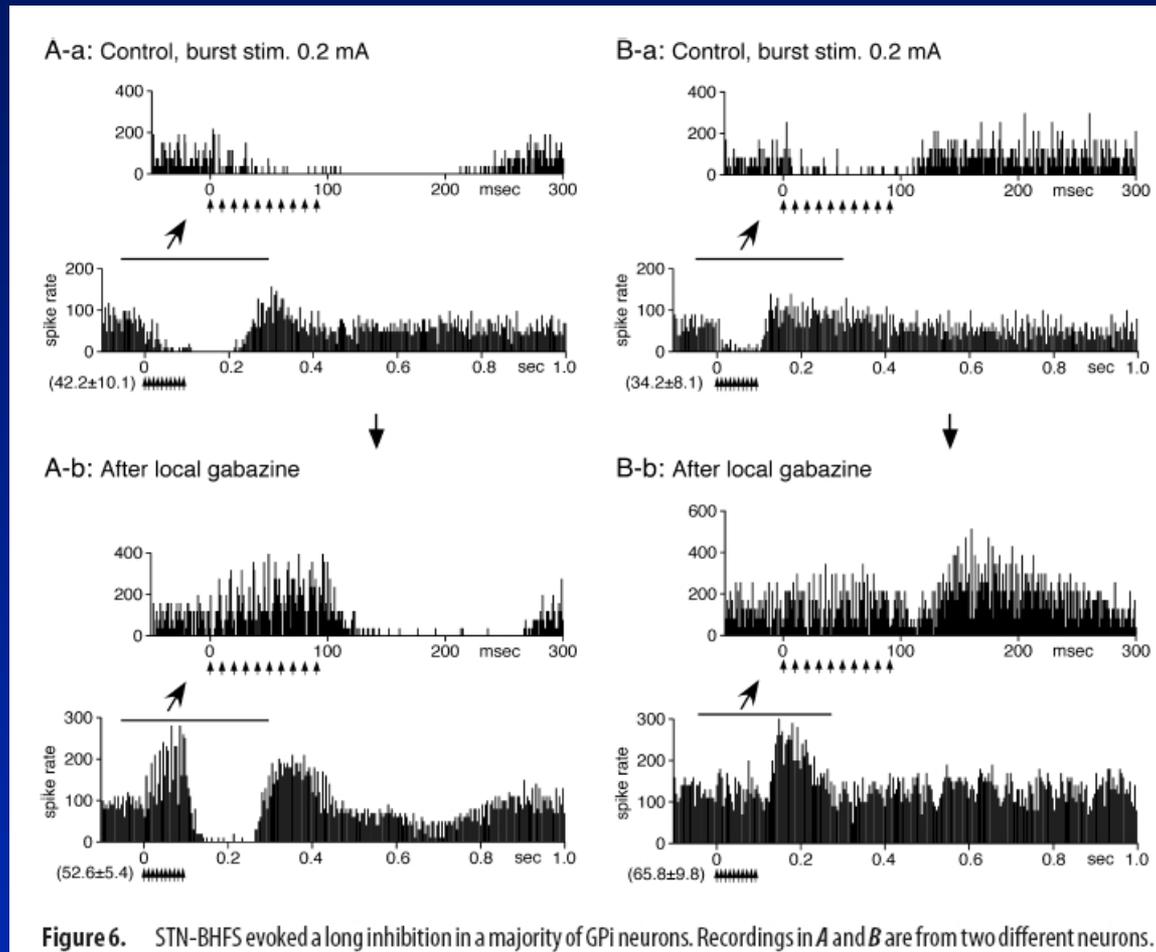


Figure 6. STN-BHFS evoked a long inhibition in a majority of GPi neurons. Recordings in *A* and *B* are from two different neurons.

Kita H, Tachibana Y, Nambu A, Chiken S.

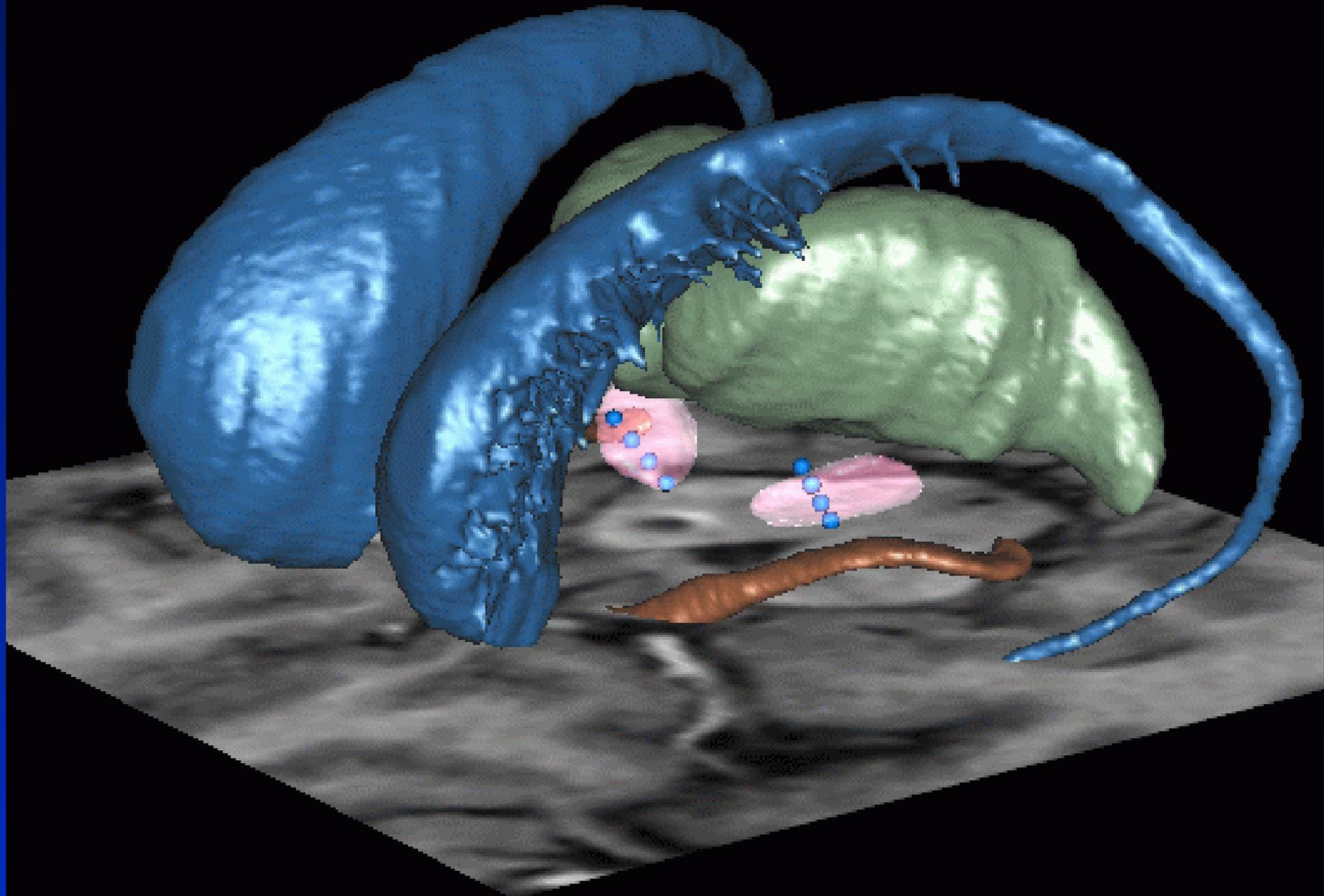
Balance of monosynaptic excitatory and disynaptic inhibitory response of the globus pallidus induced after stimulation of the subthalamic nucleus in the monkey. *J. Neurosci.* 2005; 21:8611-8619.

Corrélations entre l'électrophysiologie

et

l'histo-radiologie

Atlas histologique tridimensionnel
déformable (J. Yelnik, E. Bardinet et col.)



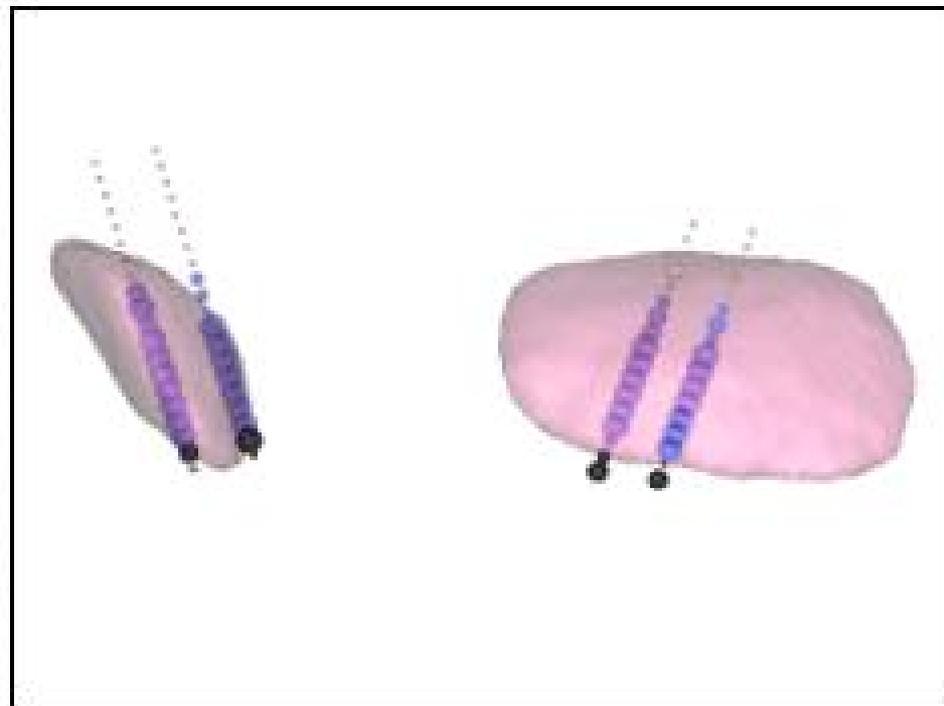
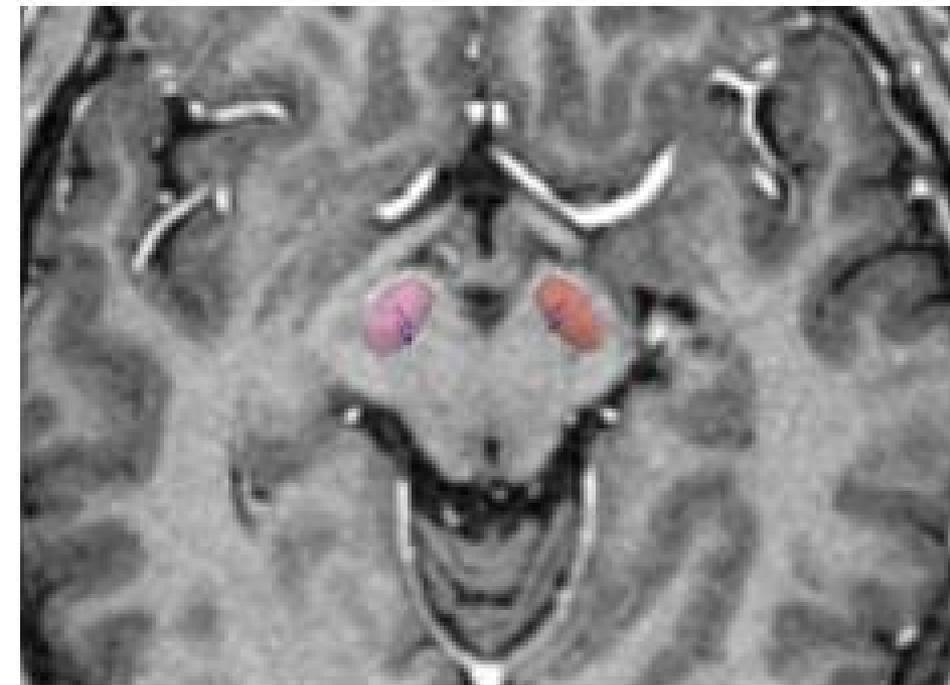


Fig.4. Confrontation of the atlas structures and electrophysiological per-operative recordings in the patient's pre-operative MRI. The blue spheres represent the recordings of two microelectrodes by hemisphere identified as being within the STN by the electrophysiologist. Interval distance between two successive spheres is 0.5 mm.



ASSISTANCE
PUBLIQUE HÔPITAUX
DE PARIS

Groupe Hospitalier Pitié-Salpêtrière



Département de neurophysiologie clinique et

Laboratoire de Physiologie

<http://www.physio.chups.jussieu.fr>

bernard.pidoux@upmc.fr