Auditorium André Malraux –Mercredi 22 novembre 2017

Thérapies Guidées par l'Image

Jean-Jacques Lemaire, MD, PhD, neurochirurgien

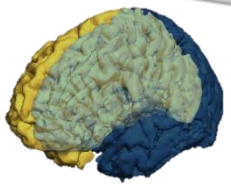
Resp. service de neurochirurgie et axe TECHMED, CHU
Resp. de l'axe TGI de l'Institut Pascal UMR CNRS UCA SIGMA

Clermont-Ferrand

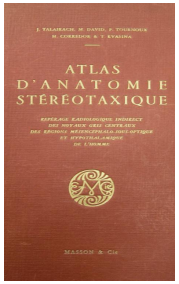
INSTITUT PASCAL
sciences de l'ingénierie et des systèmes

Laboratoire de recherche

UMR 6602 - UCA/CNRS/SIGMA

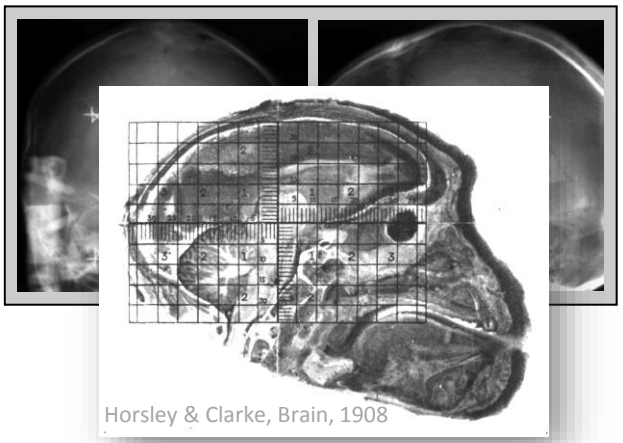


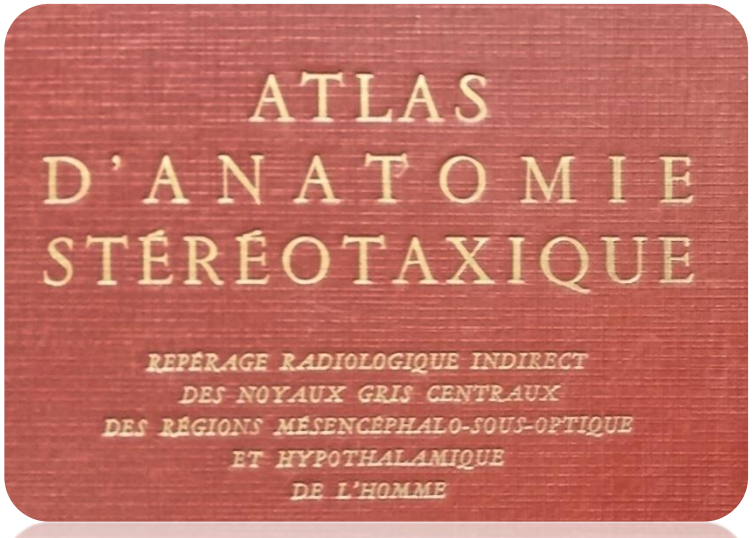
1- Le repérage dans le cerveau



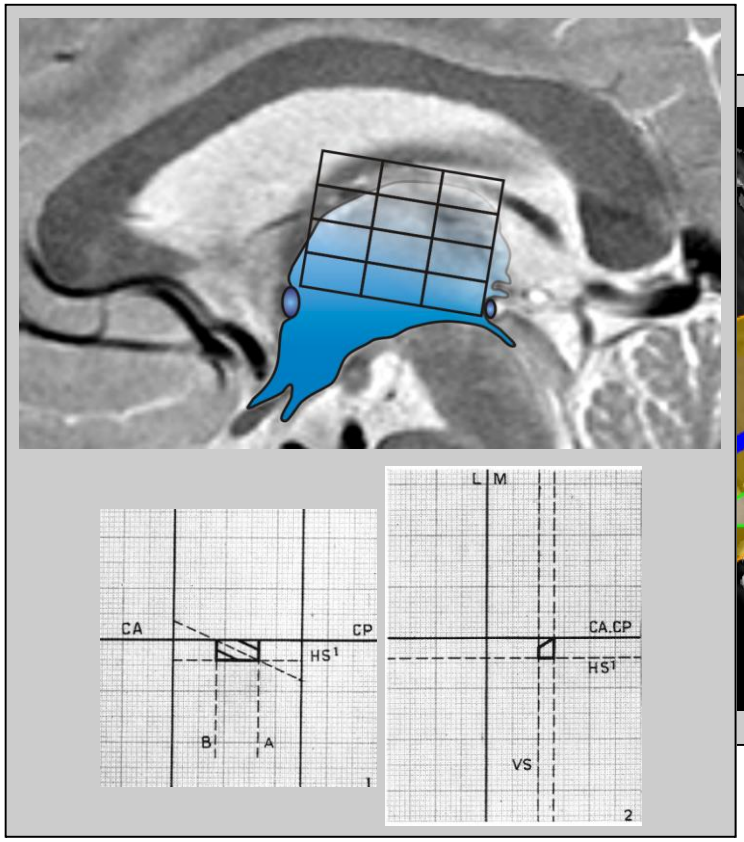
Méthode indirecte, la localisation n'est possible qu'avec l'aide de lignes de bases …

Talairach et al … 1957

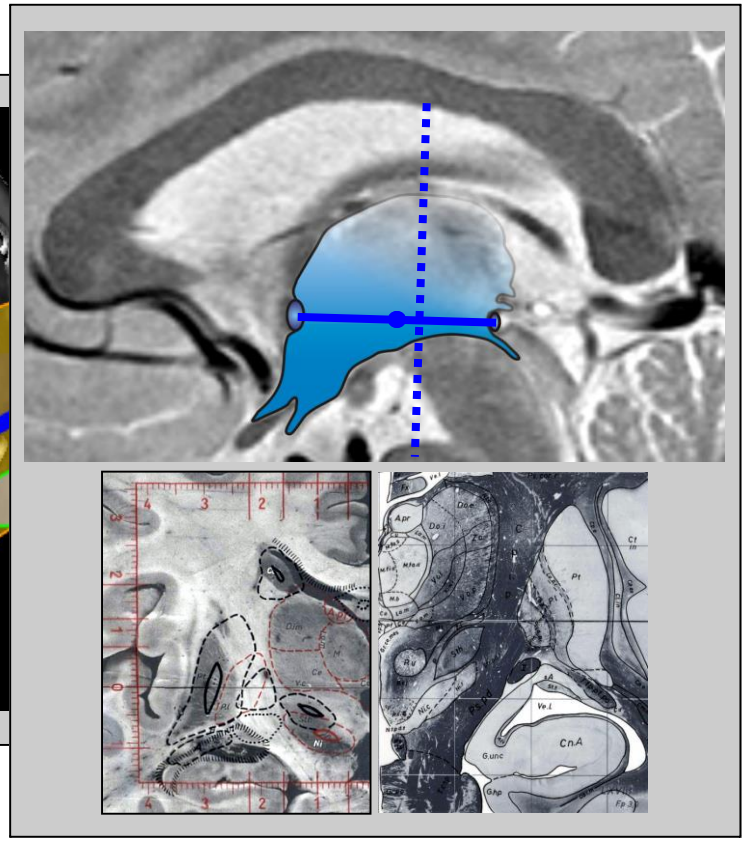

Horsley & Clarke, Brain, 1908



Le repérage de structures proches des ventricules
Direct : *la structure fait saillie e.g. corps mamillaire*
Indirect: *la distance entre le ventricule et la structure est connue (recherches anatomiques sur cadavre).*



Talairach et al. 1957



Schaltenbrand & Bailey, 1959

1a - Premiers pas du repérage directe en IRM

Acta Neurochir (Wien) (1999) 141: 759–766

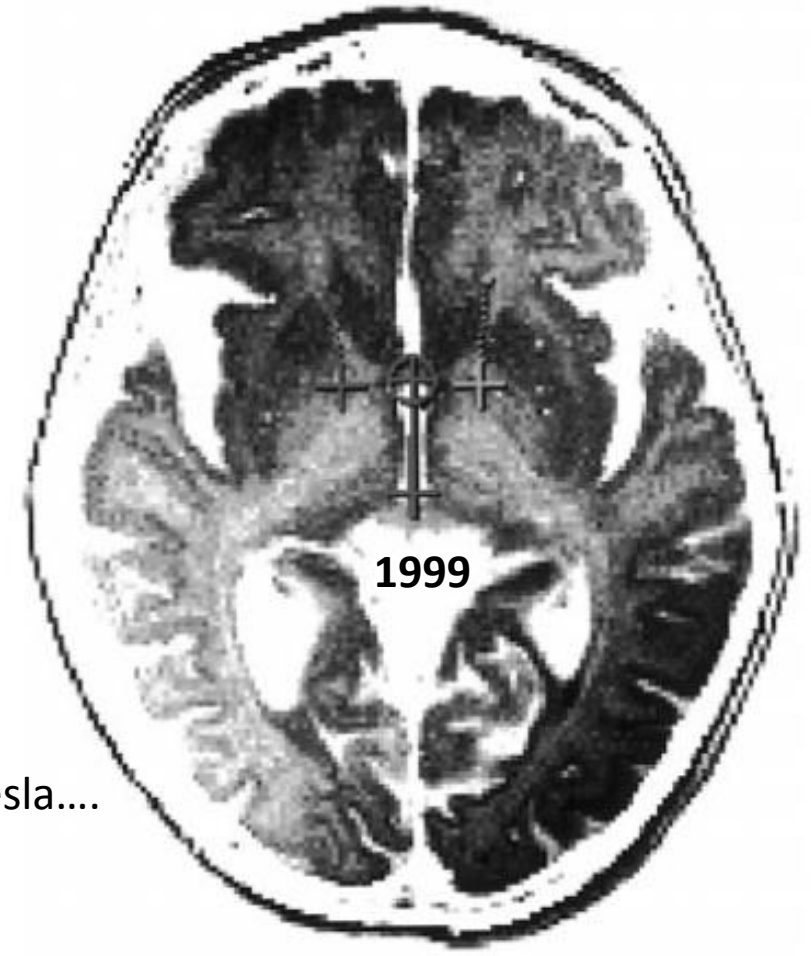
Acta Neurochirurgica

Printed in Austria

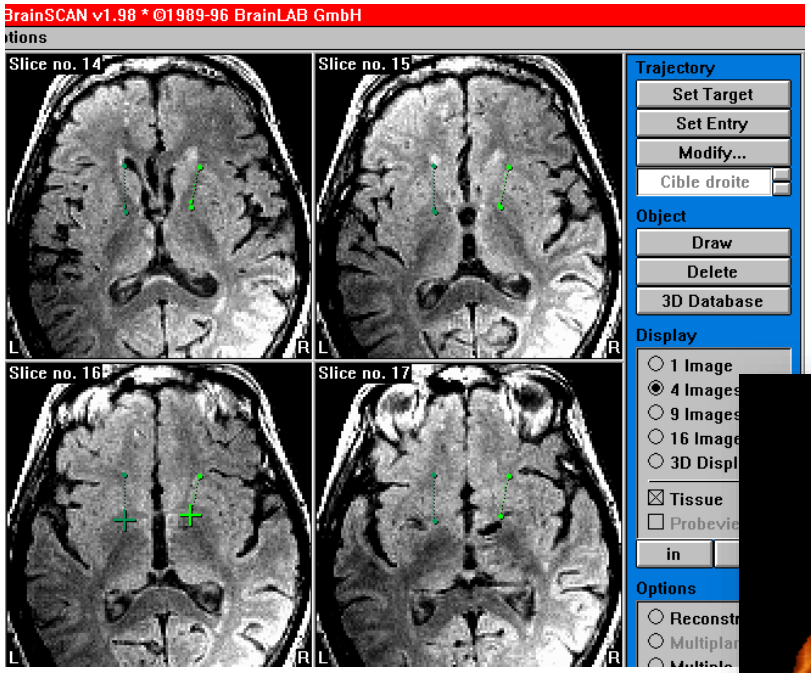
Direct Stereotactic MRI Location in the Globus Pallidus for Chronic Stimulation in Parkinson's Disease

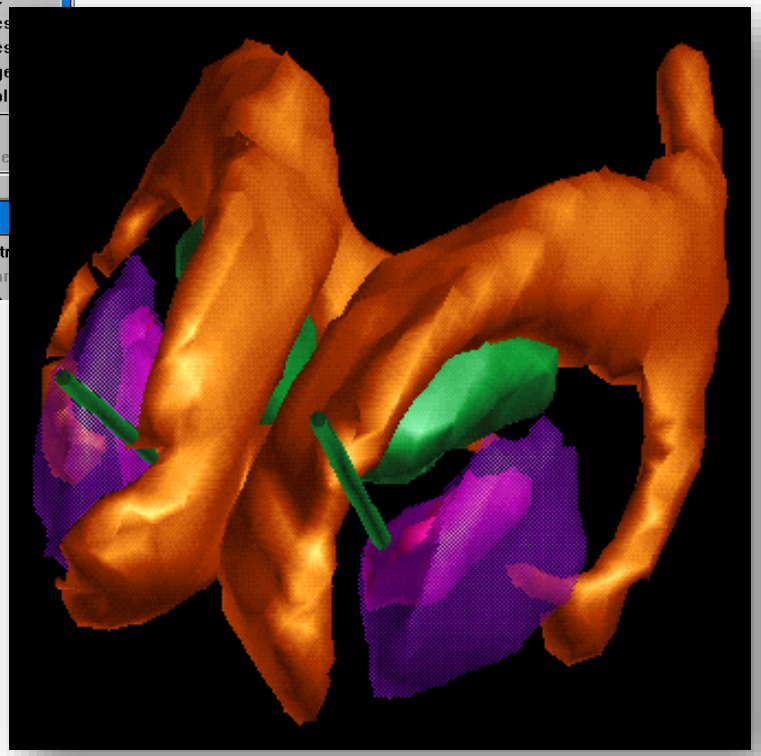
J. J. Lemaire[1,3], F. Durif[2], J. Y. Boire[3], B. Debilly[2], B. Irthum[1], and J. Chazal[1]

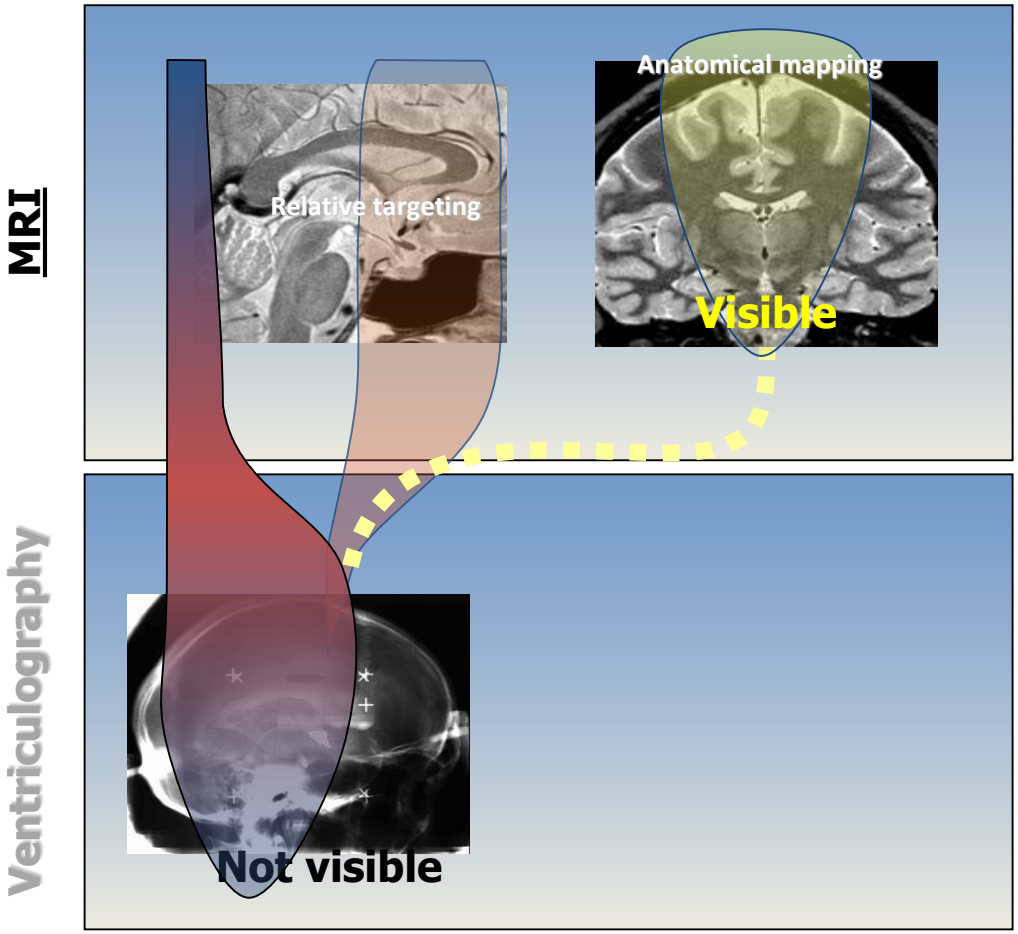
[1] Department of Neurosurgery, Chamalières, France
[2] Department of Neurology of the University Hospital, Clermont-Ferrand, France
[3] Medical Imaging Research Unit of the Faculty of Medicine, Clermont-Ferrand, France



1 Tesla….


BrainSCAN v1.98 * ©1989-96 BrainLAB GmbH
Slice no. 14
Slice no. 15
Slice no. 16
Slice no. 17
Trajectory
Set Target
Set Entry
Modify...
Cible droite
Object
Draw
Delete
3D Database
Display
1 Image
4 Images
9 Images
16 Image
3D Displ
Tissue
in
Options

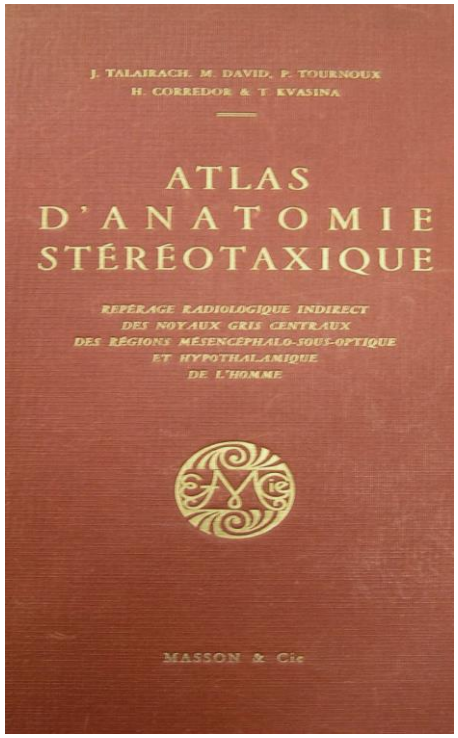



MRI
Relative targeting
Anatomical mapping
Visible
Ventriculography
Not visible

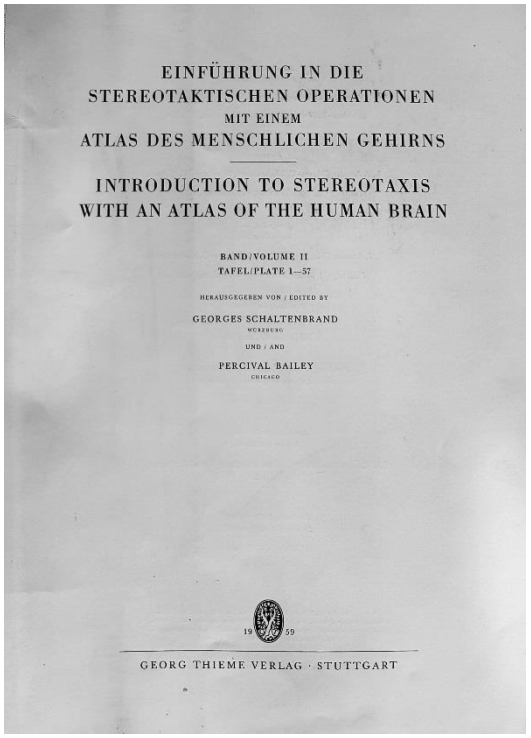
1-b Des connaissances théoriques à l'imagerie de coupe IRM

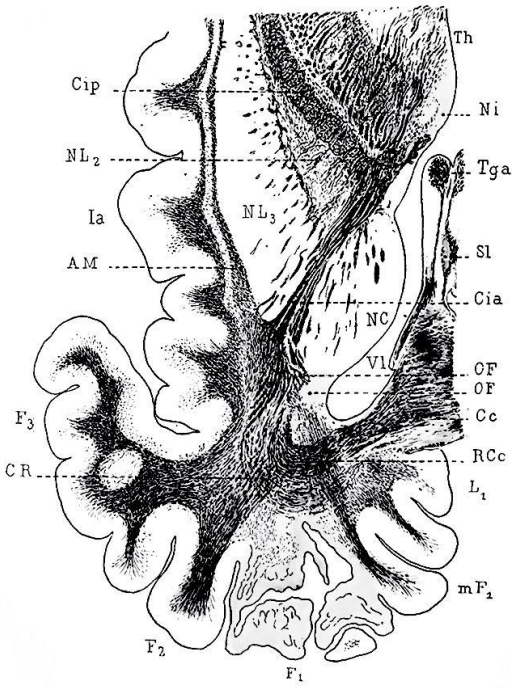
- Des Atlas

Talairach et al. 1957



Schaltenbrand & Bailey, 1959





Dejerine , 1901

AN ATLAS OF THE BASAL GANGLIA,
BRAIN STEM AND SPINAL CORD

Based on Myelin-stained Material

By
HENRY ALSOP RILEY, M.A., M.D.
Professor of Neurology and Neuroanatomy, Columbia University

THE WILLIAMS & WILKINS COMPANY
Baltimore
1943

Cytoarchitecture
of the Human Brain Stem

by

JERZY OLSZEWSKI
M.D. (Wilno), Dr. med. (Freiburg/Br.), Ph.D. (McGill)
Assistant Professor of Neuroanatomy, Department of Neurology and Neurosurgery, McGill University,
and Associate Neuroanatomist, Montreal Neurological Institute

and

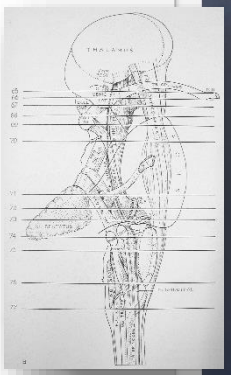
DONALD BAXTER
M.D., C.M. (Queen's), M.Sc. (McGill)
Research Fellow, Montreal Neurological Institute

with a foreword by

J. GODWIN GREENFIELD M.D.

19 S K 54

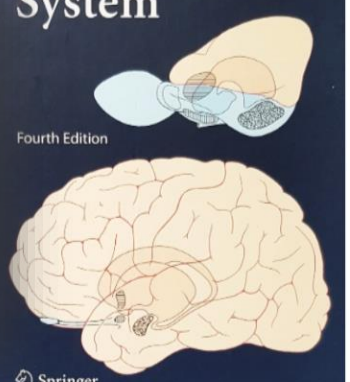
BASEL S. KARGER NEW YORK



Nieuwenhuys · Voogd · van Huijzen

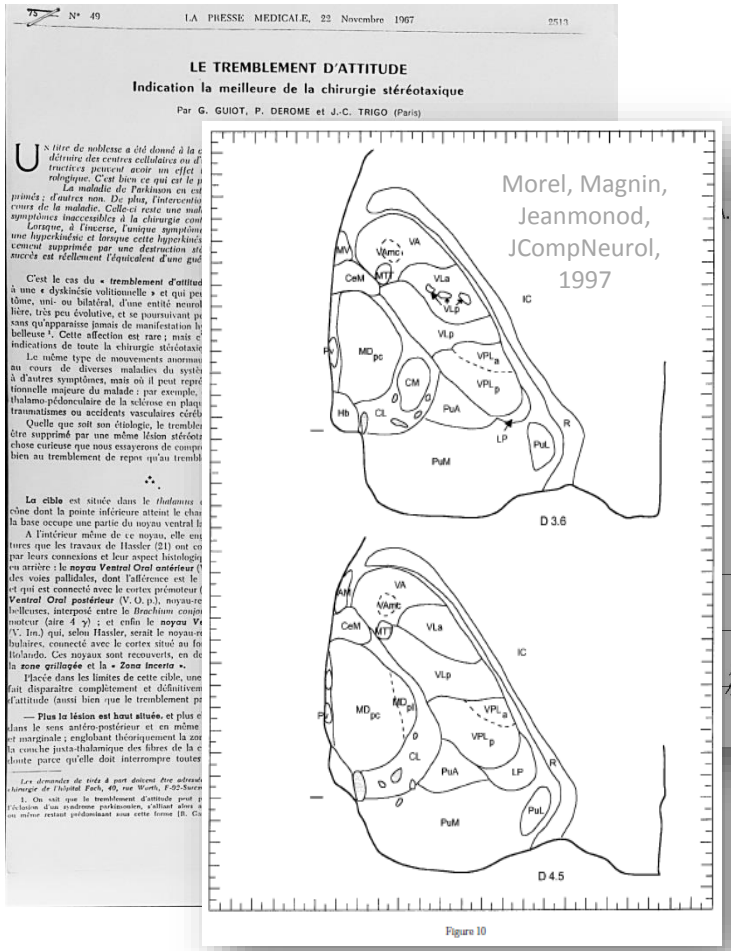
The Human Central Nervous System

Fourth Edition



Springer

Des articles…



N° 49 — LA PRESSE MEDICALE, 22 Novembre 1967 — 2513

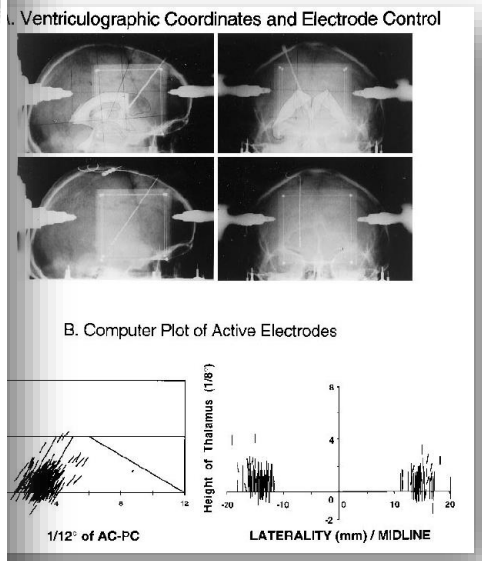
LE TREMBLEMENT D'ATTITUDE

Indication la meilleure de la chirurgie stéréotaxique

Par G. GUIOT, P. DEROME et J.-C. TRIGO (Paris)

Morel, Magnin, Jeanmonod, JCompNeurol, 1997

Figure 10



Benabid et al, Neurosurgery, 1996

Clinical studies

Evolution of a surgical technique for posteroventral pallidotomy using CT/MR fusion and intraoperative macrostimulation

J Cli Neuro, 1998

R. J. Cook[1,2] FRACS, G. Fracchia[1] MBBS BScMed, P. Hoban[1] PhD, R. Joffe[1,2] FRACP, D. O'Sullivan[3] FRACP

[1]Dalcross Private Hospital, Sydney, Australia
[2]Royal North Shore Hospital, Sydney, Australia
[3]St Vincents Hospital, Sydney, Australia

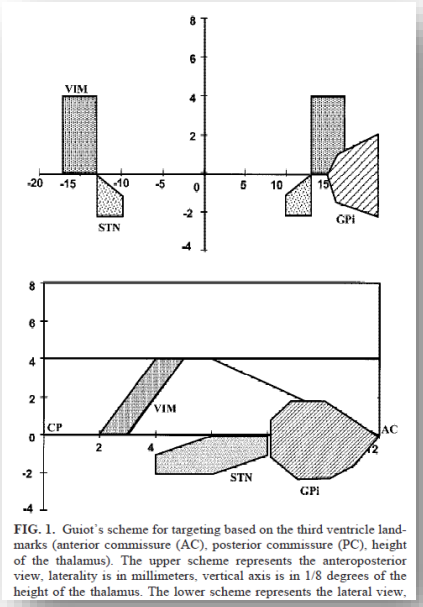
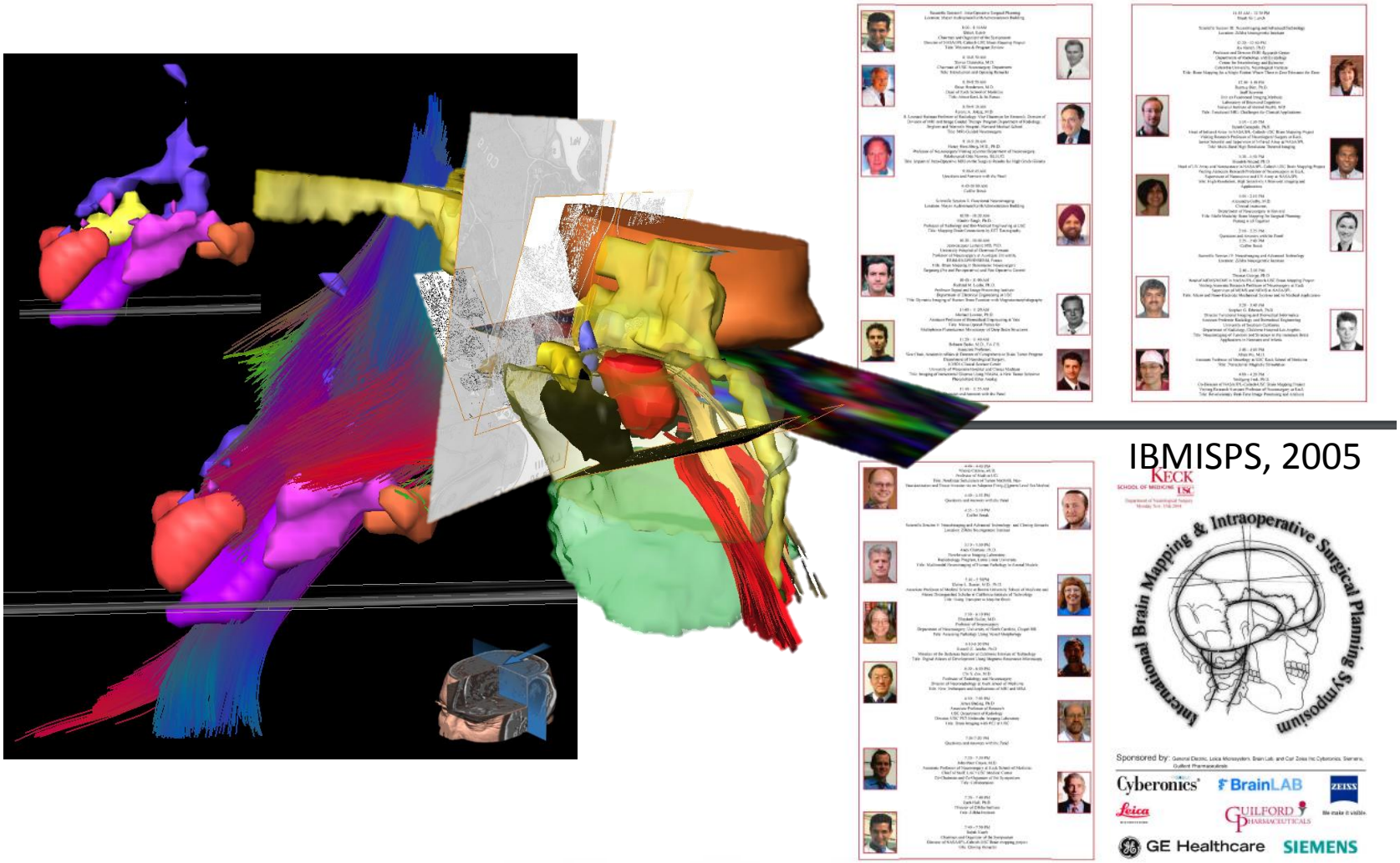


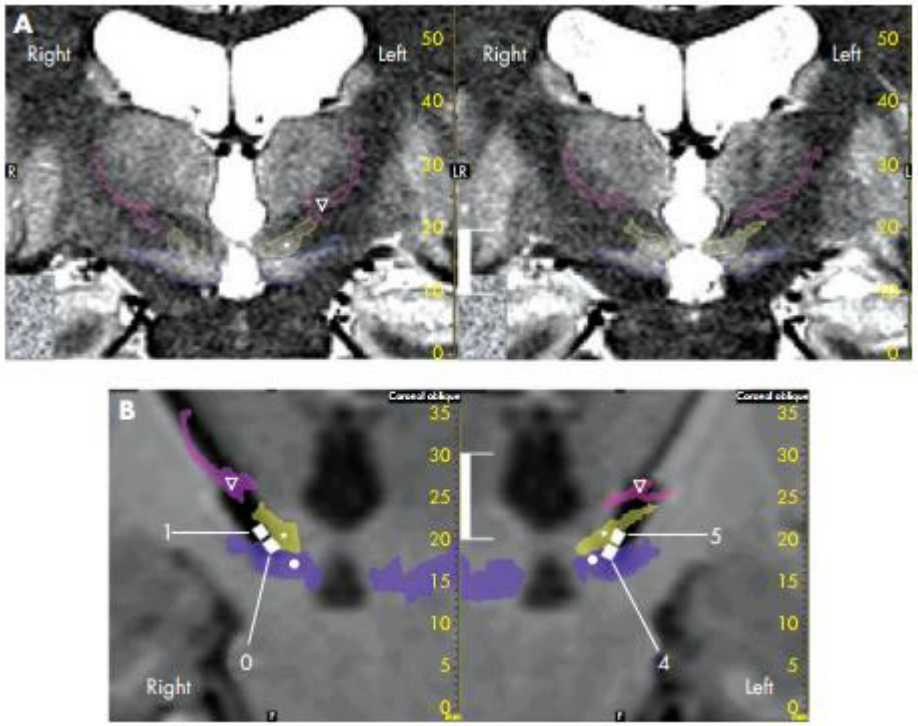
FIG. 1. Guiot's scheme for targeting based on the third ventricle landmarks (anterior commissure (AC), posterior commissure (PC), height of the thalamus). The upper scheme represents the anteroposterior view, laterality is in millimeters, vertical axis is in 1/8 degrees of the height of the thalamus. The lower scheme represents the lateral view.

Benabid et al, Mov Disord, 2002

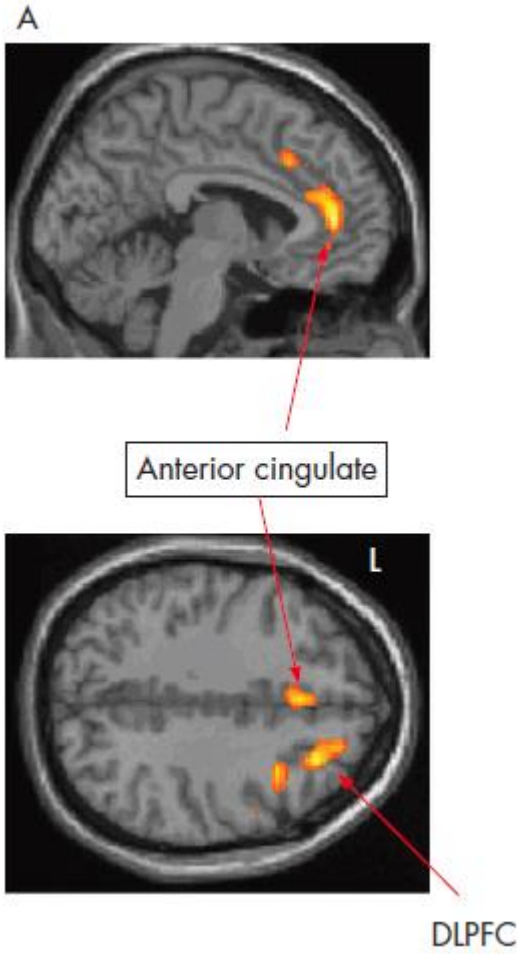
2 - De l’atlas à la cartographie



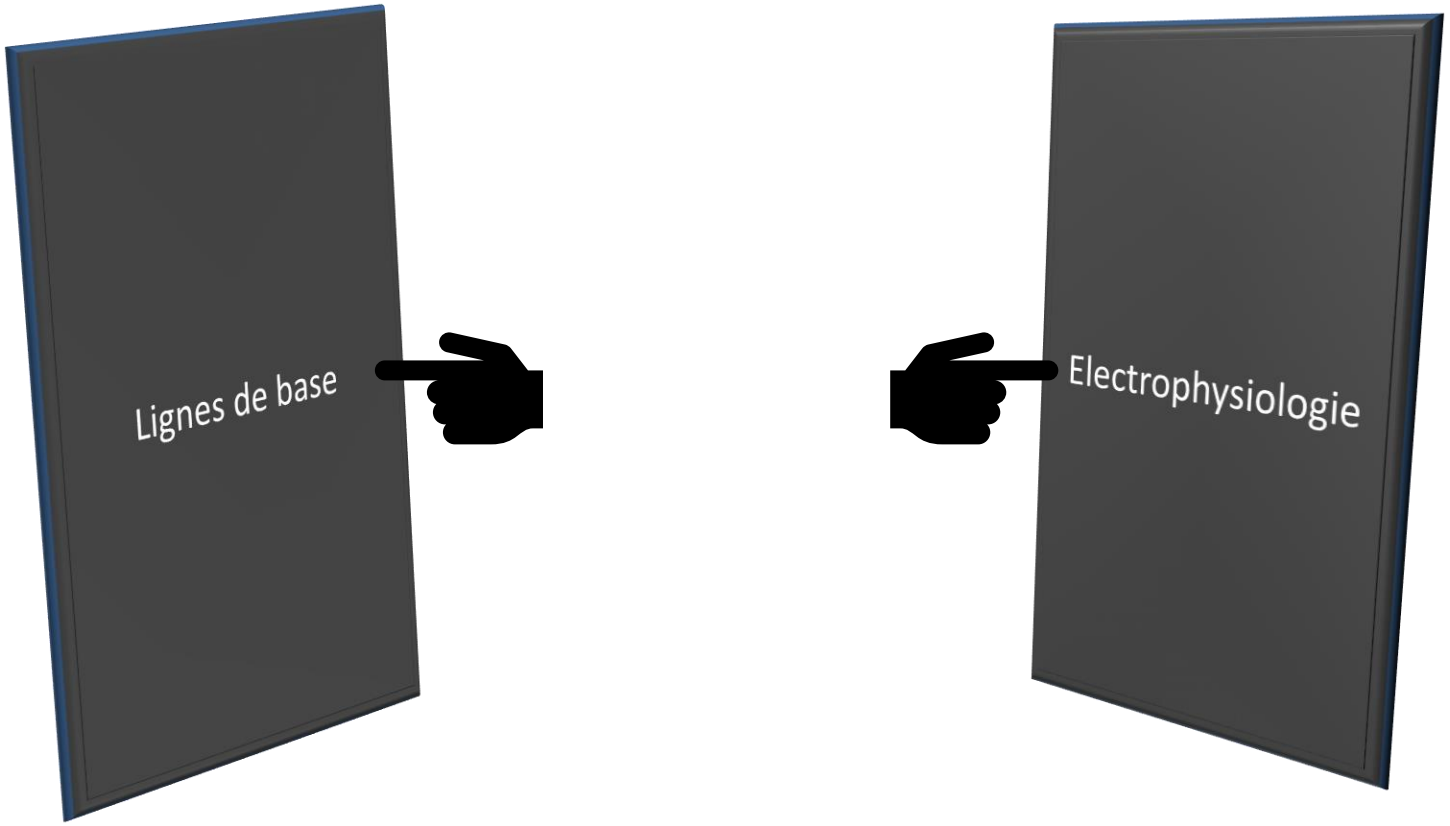
E.g. Comprendre l'hypomanie par la localisation



Ulla et al, JNNP, 2007

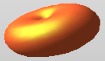


2a- Cartographie directe vs indirecte



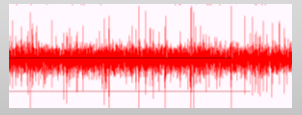
Apport de l'électrophysiologie (AG, AL…)

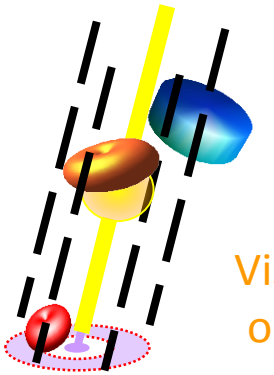
Cible anatomique



Cible clinique

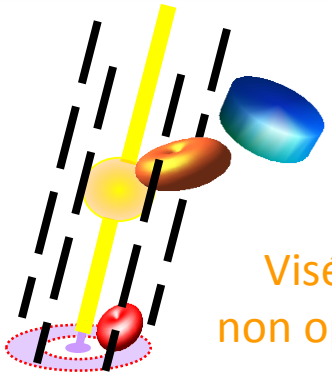
Cible électrophysiologique





Visée anatomique optimale=Directe

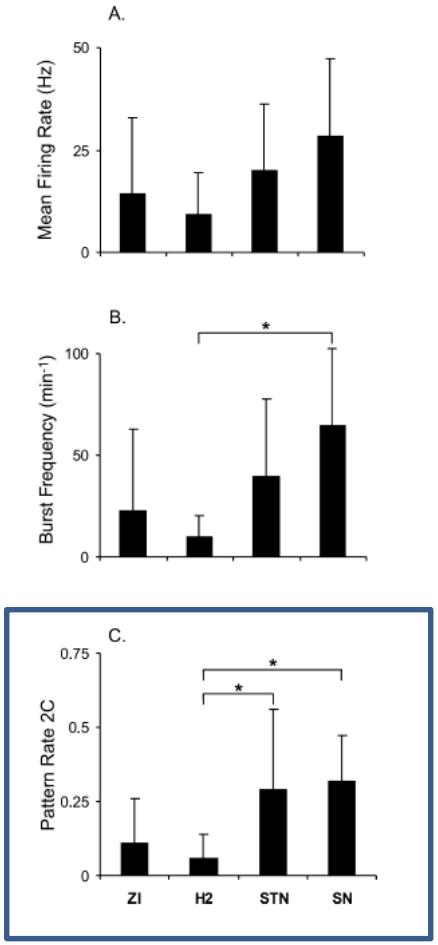
- Validation de trajectoire
- Optimisation **clinique / électrophysiologique**

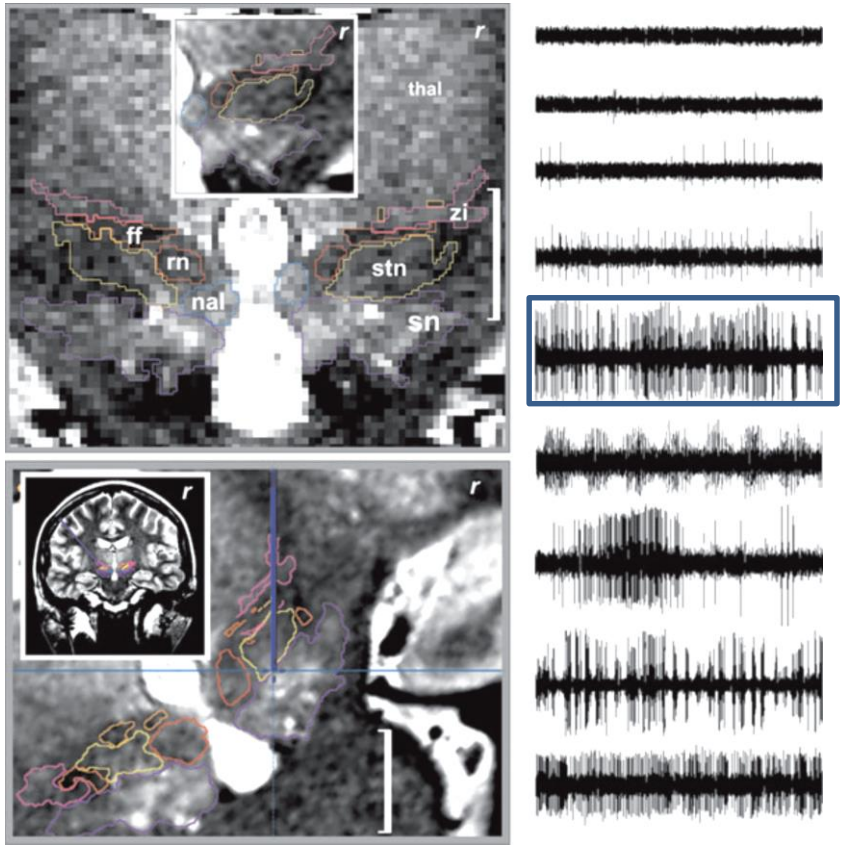


Visée anatomique non optimale=Indirecte

- Correction de **trajectoire**
- Détermination et optimisation de **cible clinique / électrophysiologique**

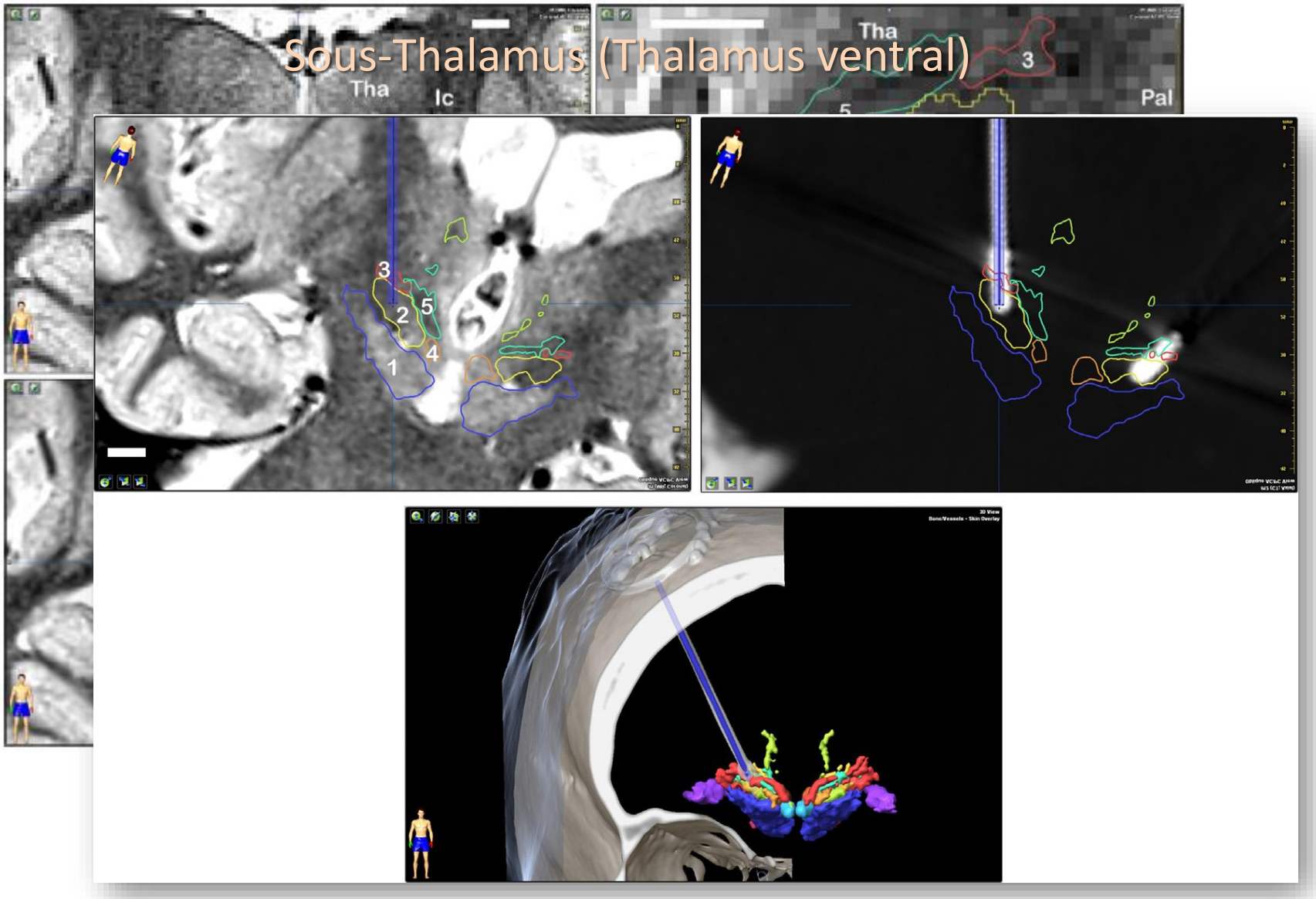
La cible anatomique est bien celle électrophysiologique (si connue)





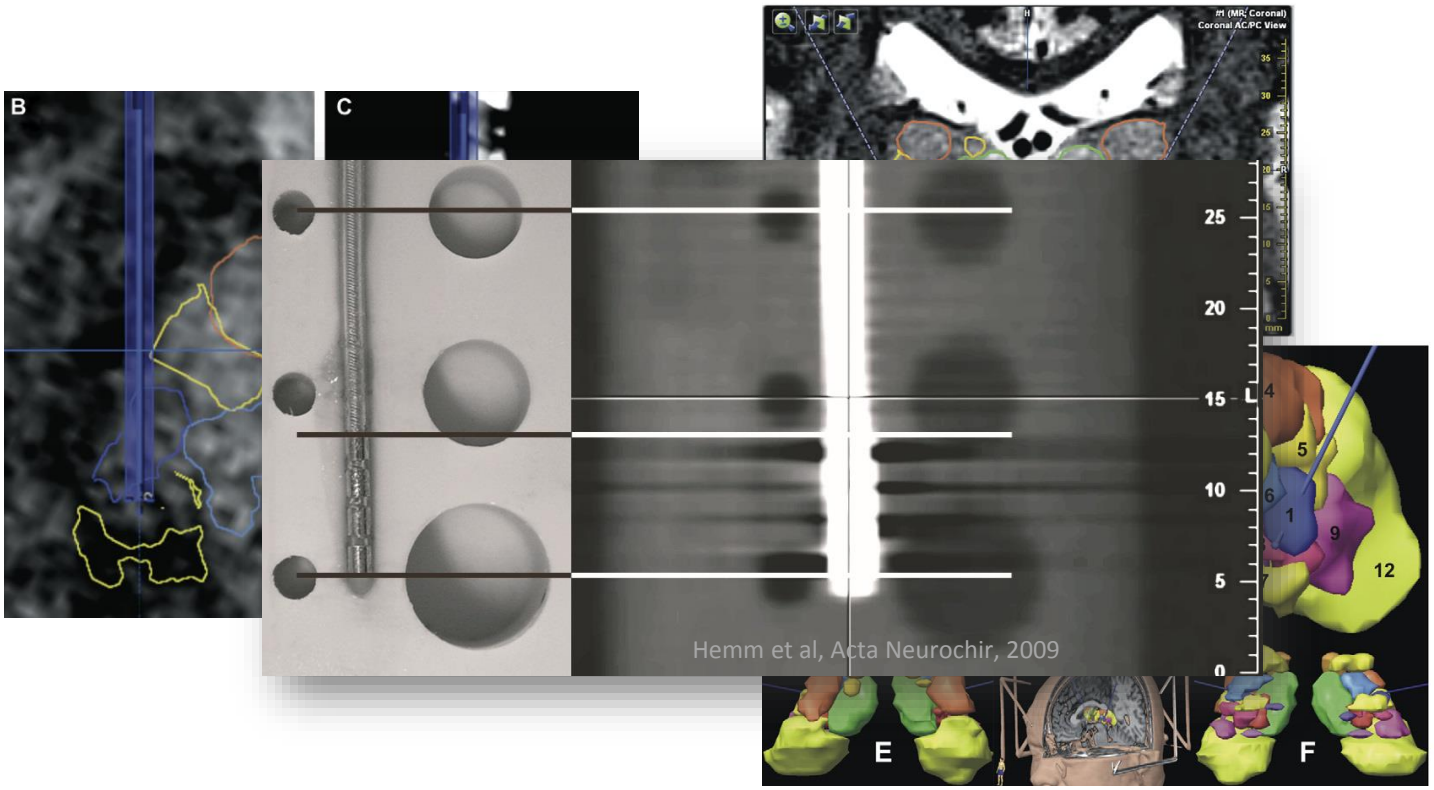
Coste et al, EJN, 2005

Sous-Thalamus (Thalamus ventral)



Zerroug et al, Neurochir, 2016

Des noyaux intra-thalamiques



Hemm et al, Acta Neurochir, 2009

Vassal et al, EJN, 2012

2b - Analyses structurelles (IRM) avancées pour cartographier le cerveau

Très haute résolution

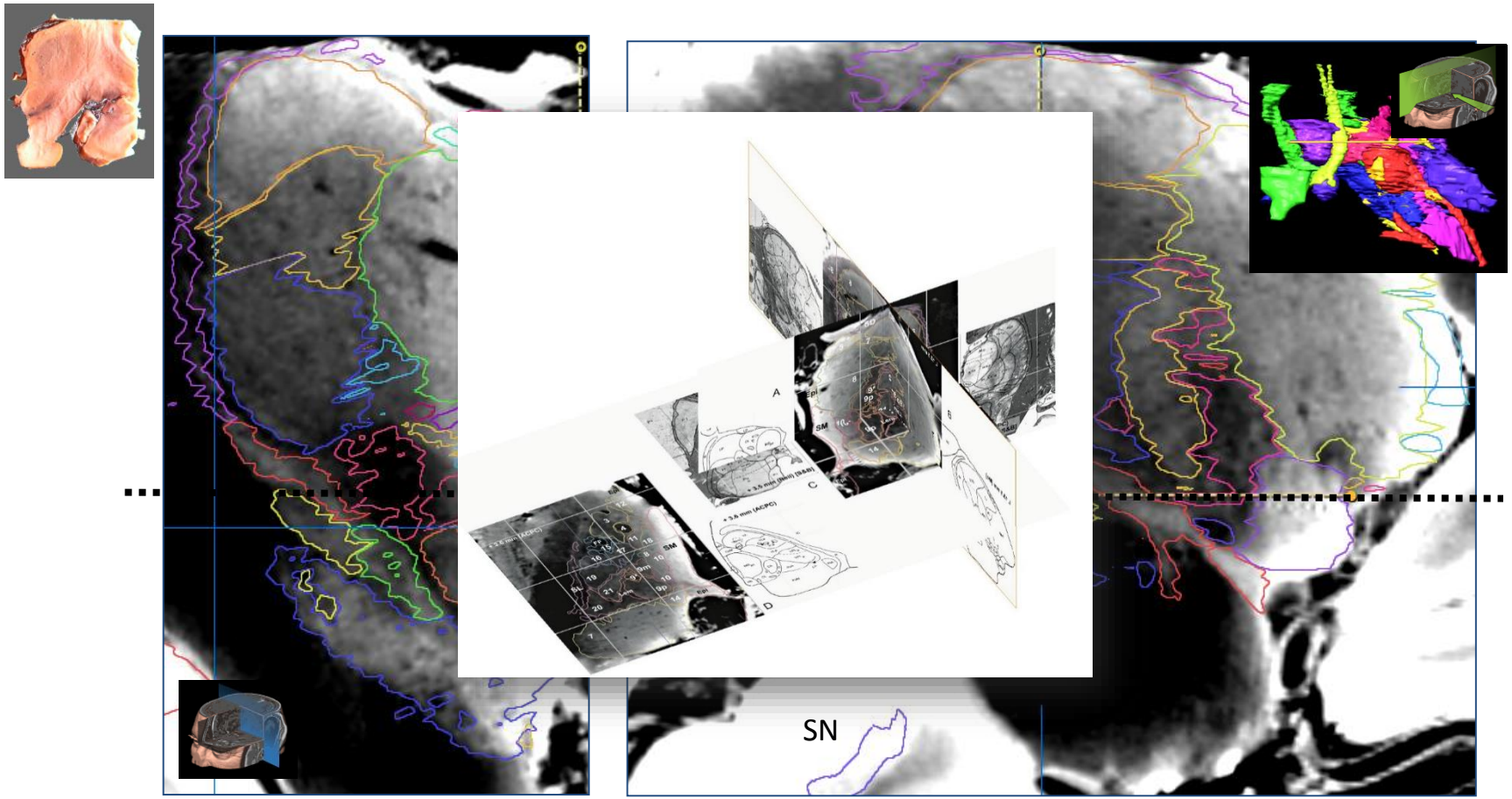
DTI tractographie

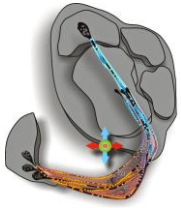
Confins…

Très haute résolution

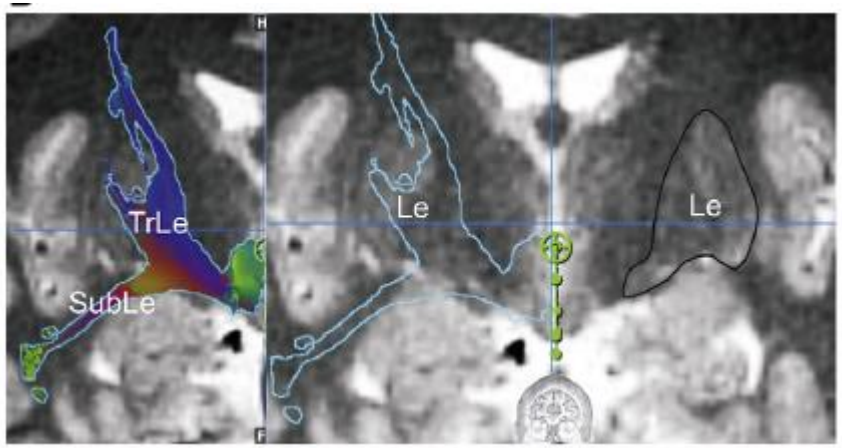
Atlas 4.7-Tesla

Neurosurgery, Brain 2010…..

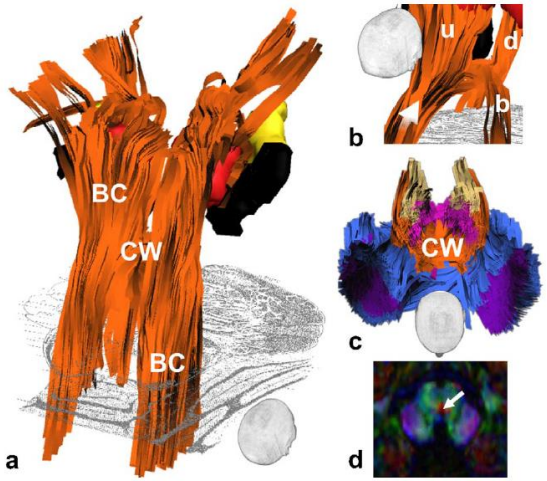




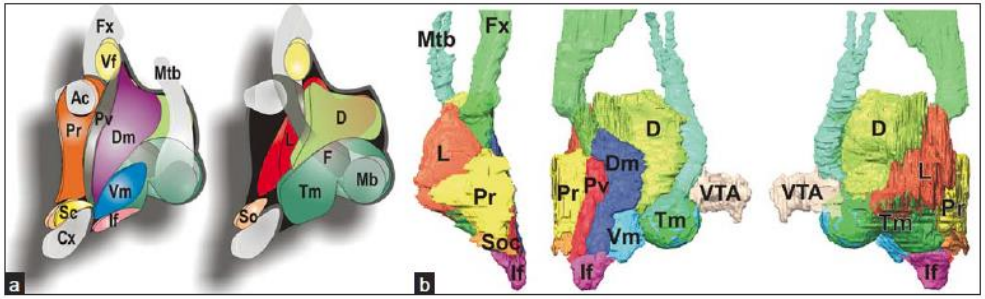
Tractographie et Confins



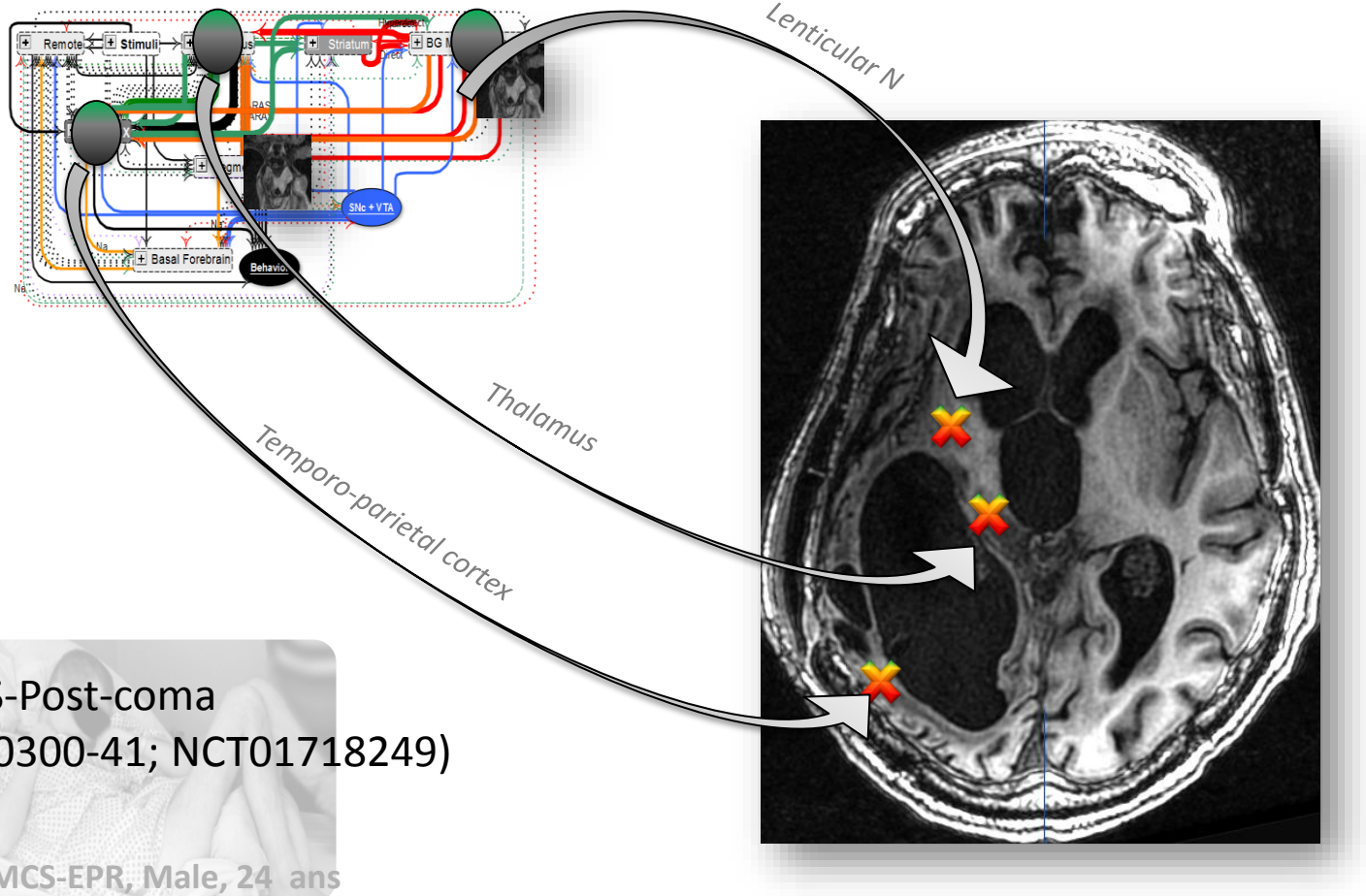
Lemaire et al, BR et SN 2011, neurosurgery 2016



Lemaire et al, Neurochir, 2011



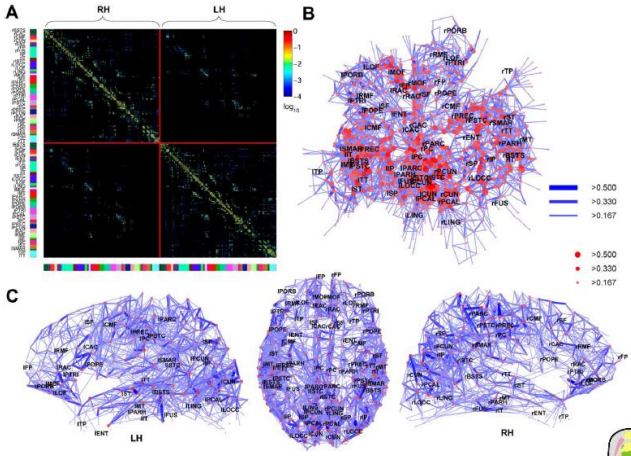
2c- Localiser une cible dans un cerveau remanié



Etude DBS-Post-coma
(2011-A00300-41; NCT01718249)

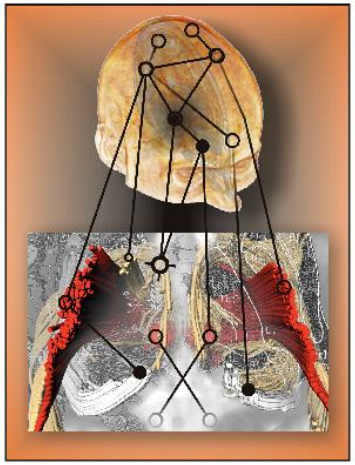
MCS-EPR, Male, 24 ans

3 - De la cartographie à la connectomique



Hagmann Plos Bio, 2008

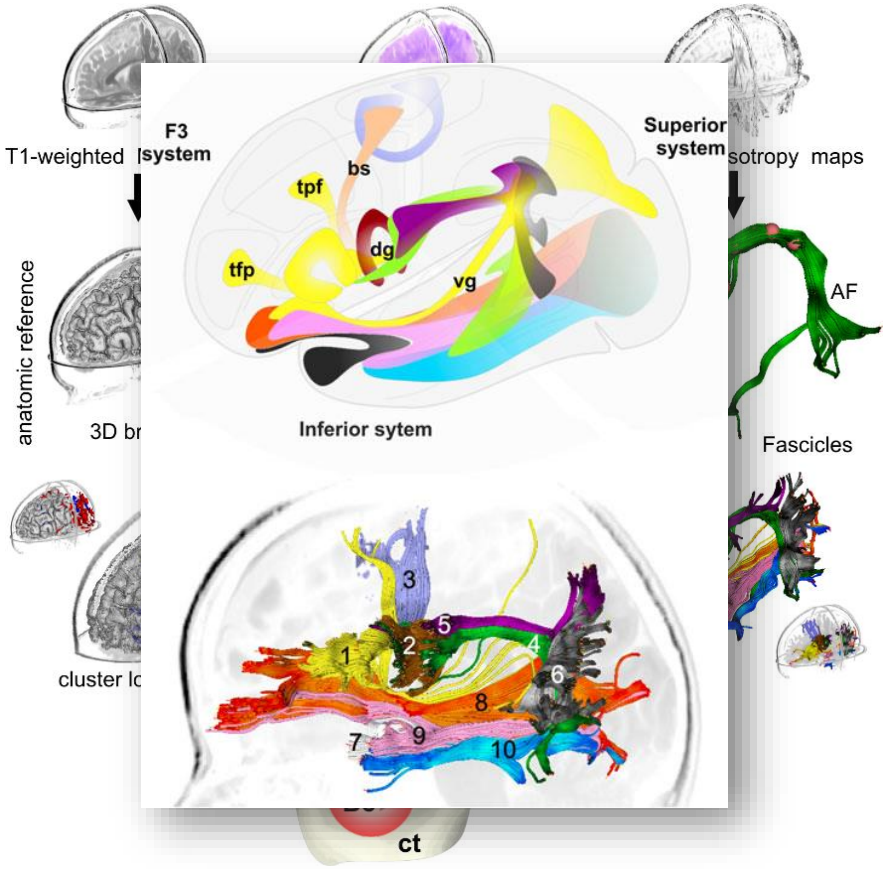
Clermont-Ferrand, France
September, 28 & 29, 2012



International Symposium
On
Deep Brain Connectomics

Under the Auspices
of

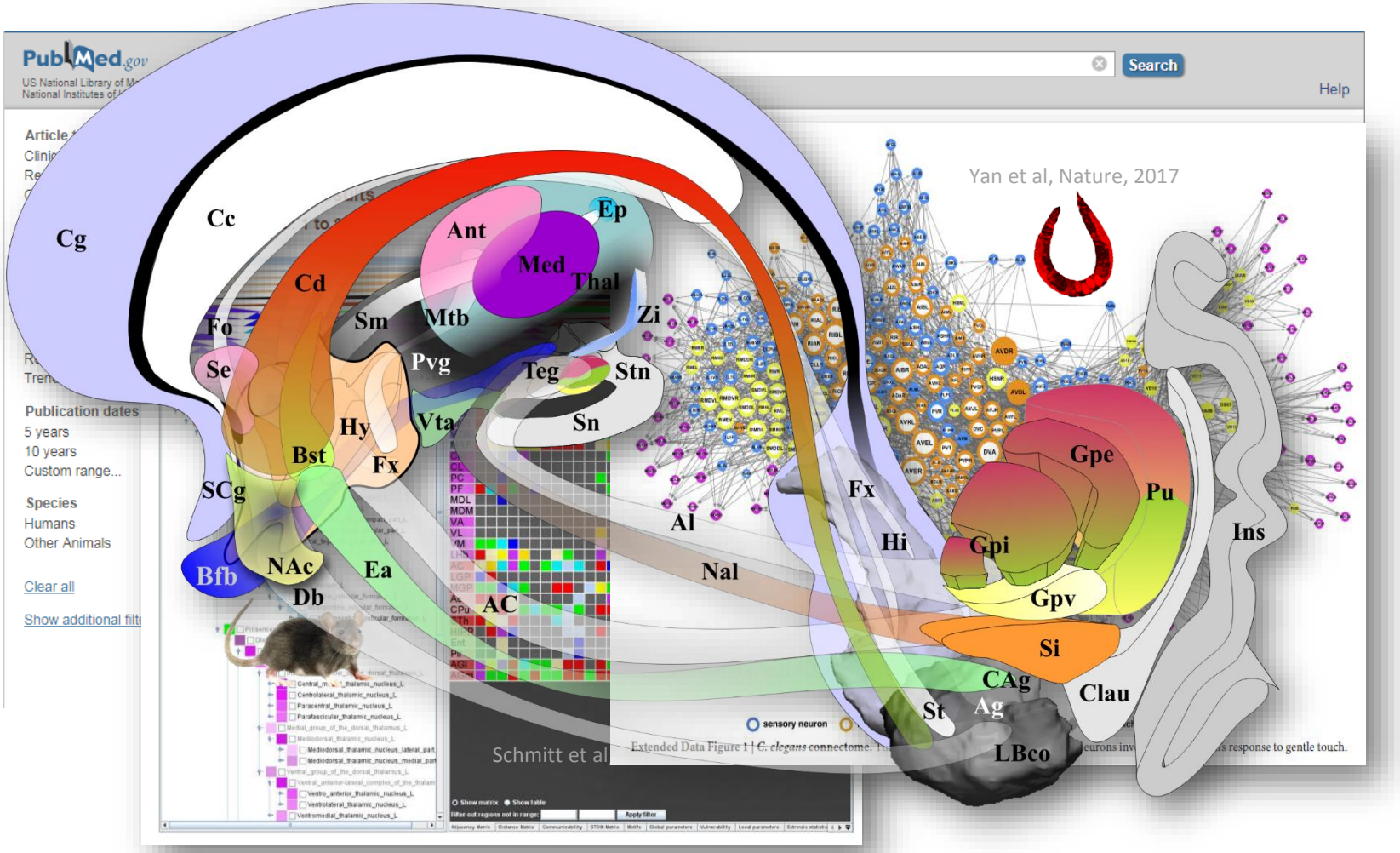
Connectomique fonctionnelle



Brain Topography 2012, PlosOne 2016

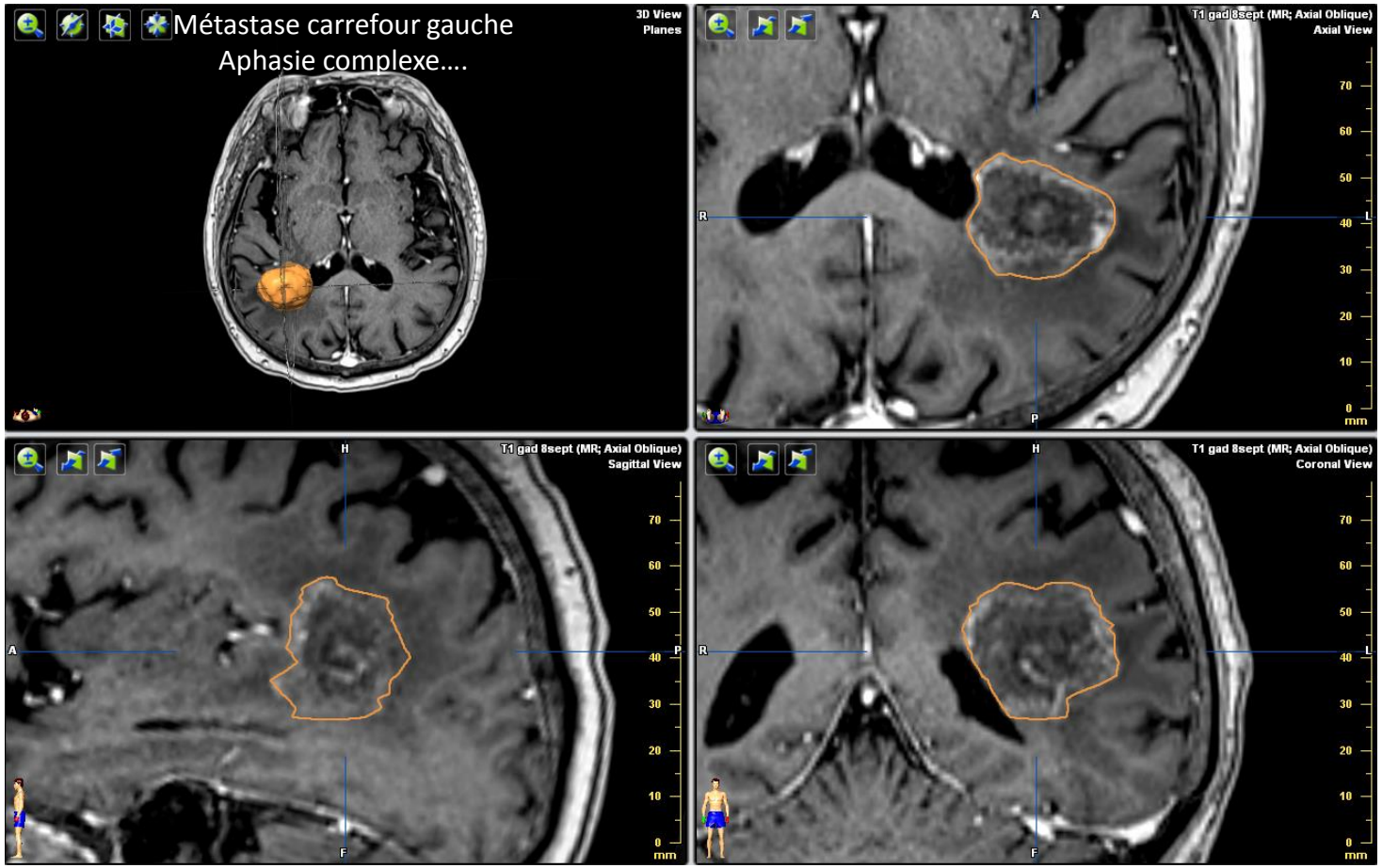
The unit of this functional connectome : the connection between a fascicle (f) and a BOLD cluster (Bc) within a cortical territory (ct), and named a **fascicle-cluster connection** (Fc); according to the Bold signal status (B+ or B-), Fc were positive (Fc+) or negative (Fc-)

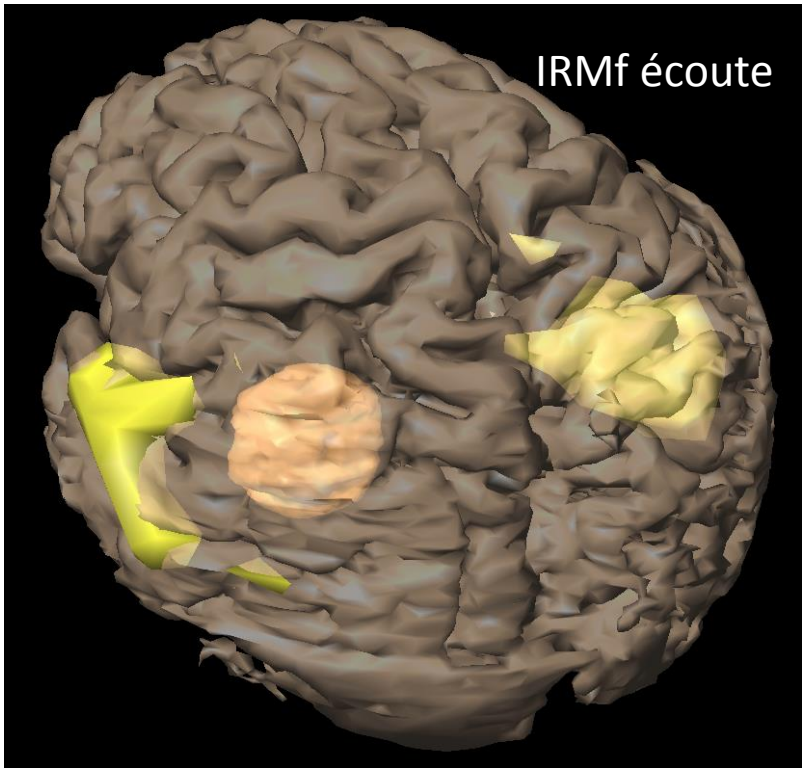
Connectomique (fonctionnelle)

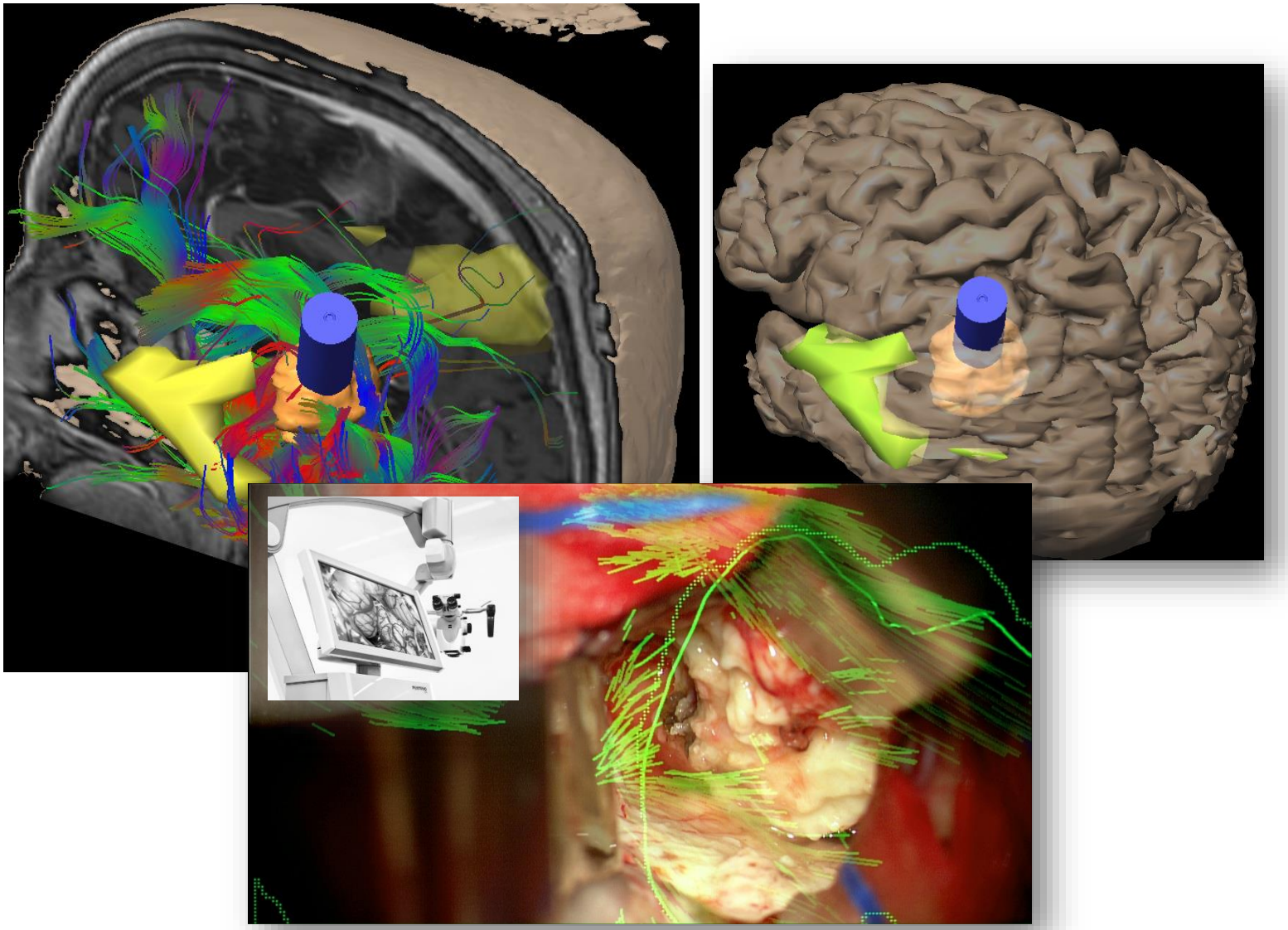


4 - Guidage en neuronavigation

« à ciel ouvert »




IRMf écoute



Thérapies Guidées par l'Image