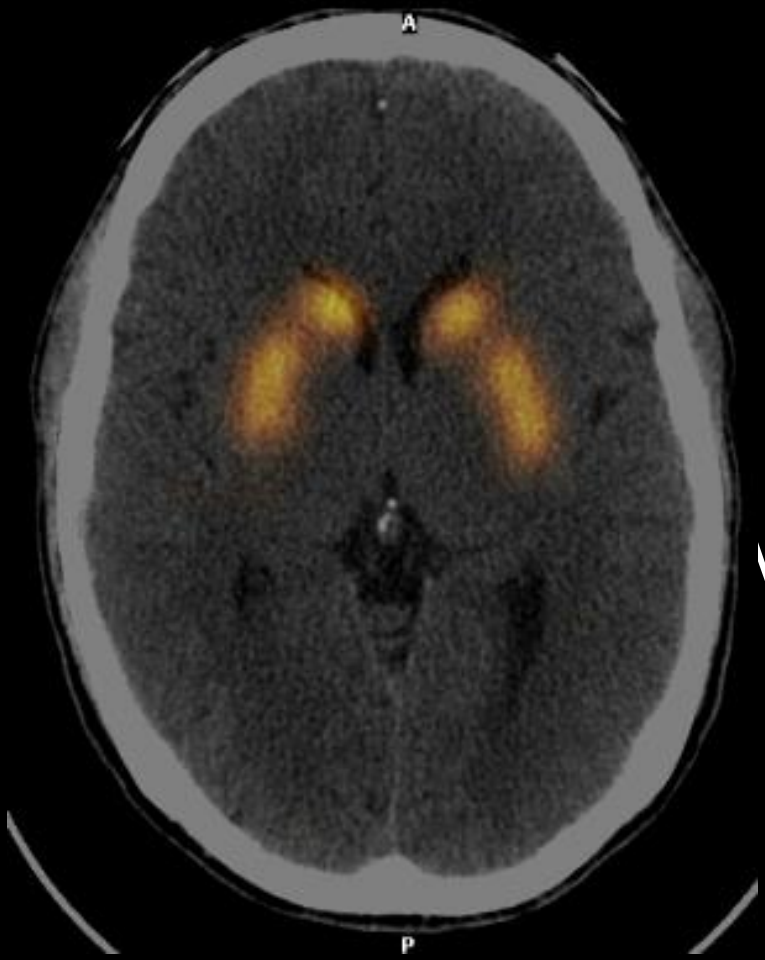
NIGRO-STRIATAL PATHWAY IMAGING DOPAMINE TRANSPORTER

^{123}I Ioflupane



Clinical Usefulness ..

How it works
Ioflupane examination recomandations
Visual & semi-quantitative analysis
Patients with normal imaging

Parkinson
Lewy Body Disease vs Alzheimer
Other Parkinson Plus pathologies

Financial Disclosures/ Conflict of Interest

As a MD

Honorarium from GE Healthcare ioflupane talks

Honorarium from GE Imaging systems 670 CZT

University Hospital administration

Research contract GE Imaging systems Ioflupane NDB

Financial contract with Siemens Ioflupane NDB

About IOFLUPANE ^{123} I SPECT (IFP)

select the false proposition

Image quality & analysis of IFP ^{123}I SPECT

select the false proposition

Parkinsonism and Ioflupane ^{123} I SPECT

select the false proposition

PARKINSON and PARKINSONISM

- 1-2% > 60 y 1 Million in the US (x 3 in 2050)
- annual medical costs US $23 billion annually (projection)

- diagn. clinical judgment on experienced neurologists

bradykinesia and tremor/rigidity /postural instability (2017)

- absence of absolute exclusion sign

Neurology® 2014;83:406-412

- often incorrect particularly at early stages of disease Adler

- traditional definition of parkinsonism : tip of iceberg
- Including Lewy body disease

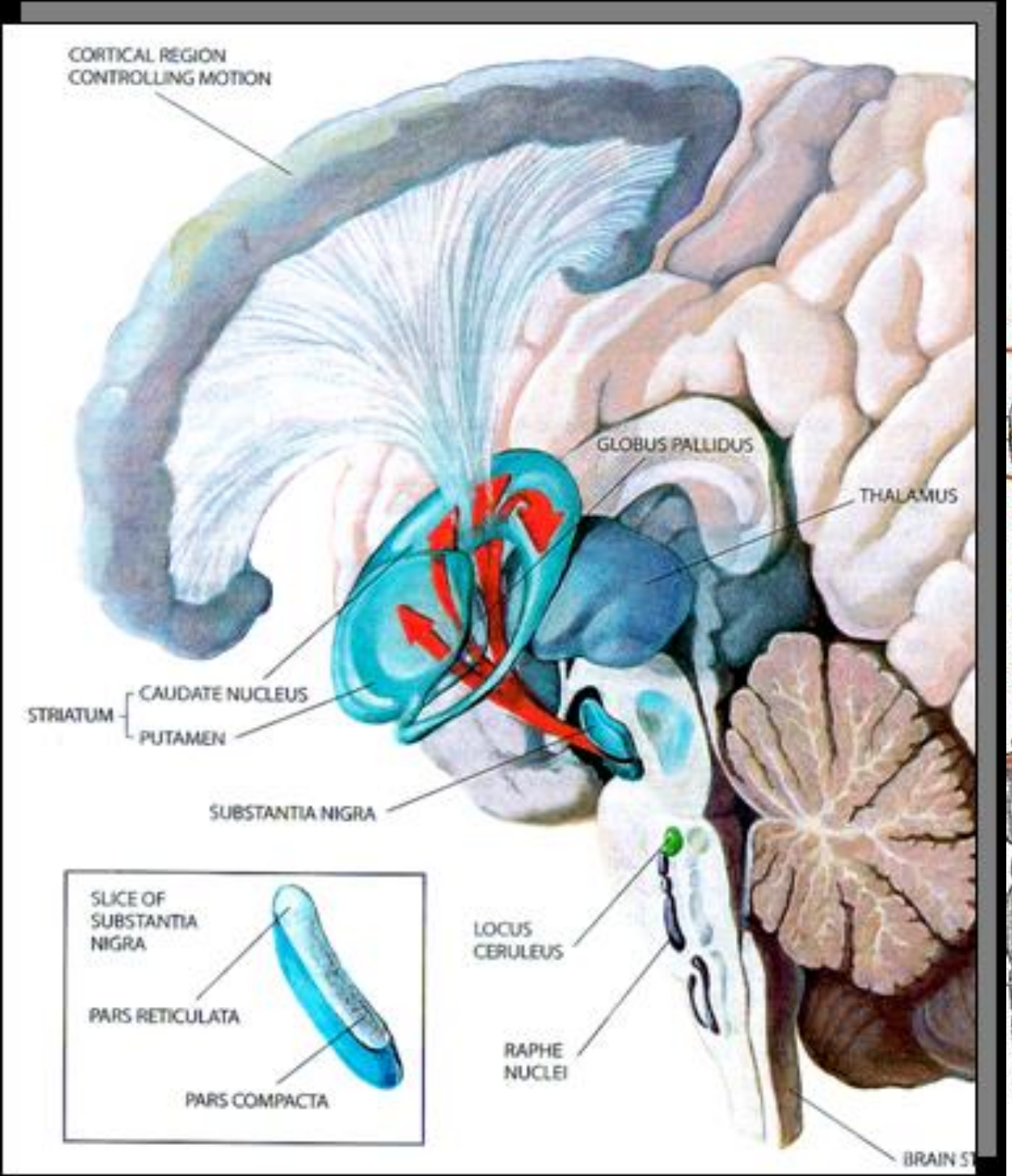
This could affect day-to-day patient care . Neuroimaging can improve diagnostic rates

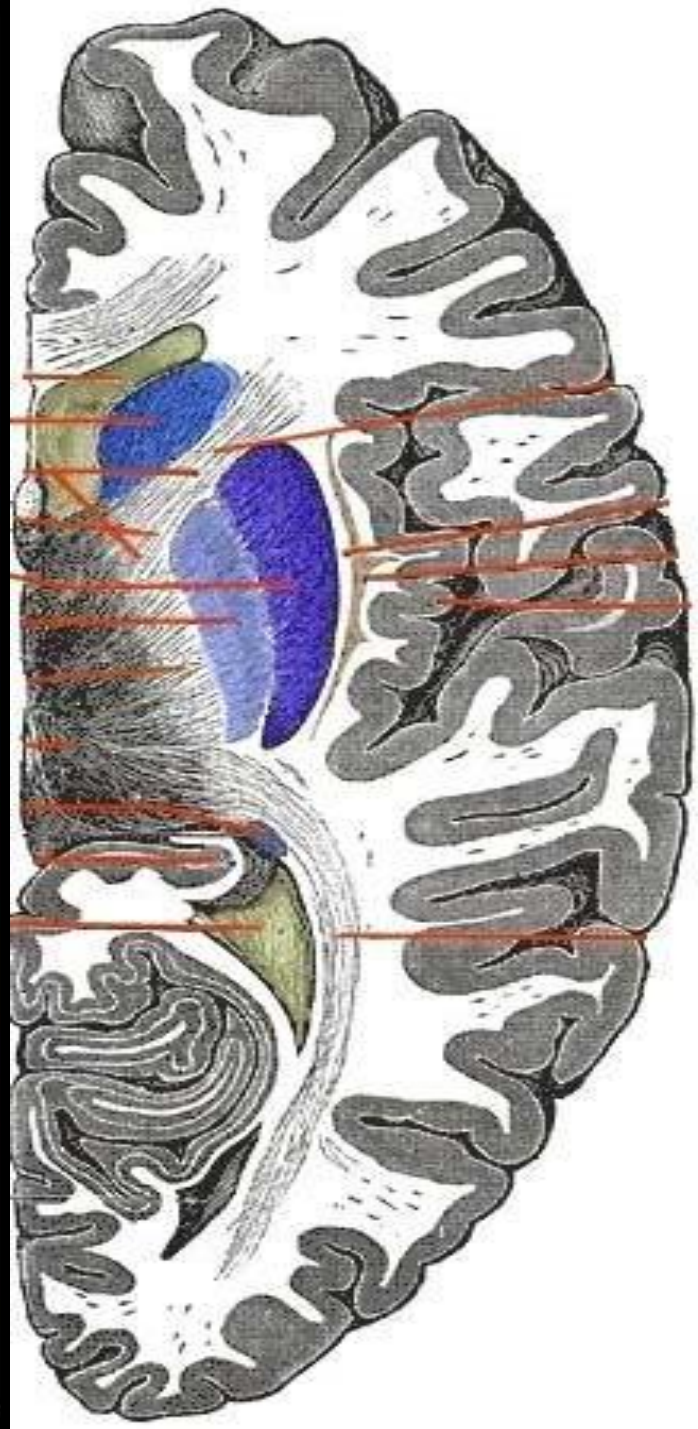
Medico-economic studies are needed

Other Disorders in the Parkinsonian Syndromes

Lewy Body Disease (LBD)

- Progressive supranuclear palsy (PSP)
- Corticobasal Degeneration or Syndrom (CBD or S)
- Multisystem Atrophy (MSA-C and MSA-P)
- All these share with idiopathic PD loss of DA neurons but differ in other symptoms and are much less common

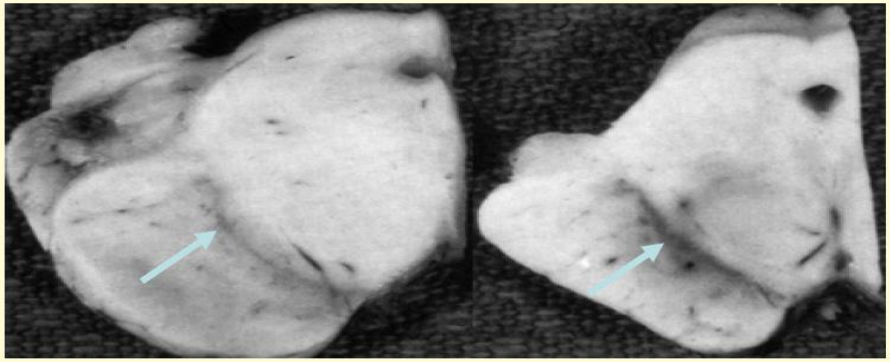

CORTICAL REGION
CONTROLLING MOTION
GLOBUS PALLIDUS
THALAMUS
STRIATUM
CAUDATE NUCLEUS
PUTAMEN
SUBSTANTIA NIGRA
SLICE OF
SUBSTANTIA
NIGRA
PARS RETICULATA
PARS COMPACTA
LOCUS
CERULEUS
RAPHE
NUCLEI



Parkinson Disease

Neuronal degeneration characterized pathologically by development of filamentous cytoplasmic inclusions - Lewy bodies - in substantia nigra and locus coeruleus

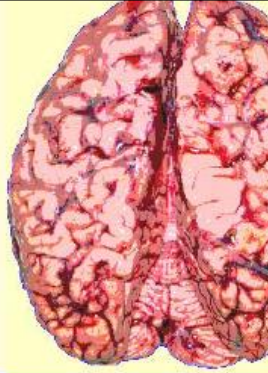
Parkinson's disease Normal

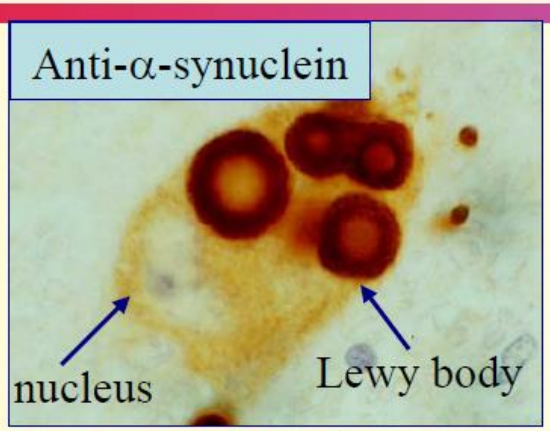


Loss of dopamine producing neurons in substantia nigra - 70% at diagnosis.

α-Synuclein is Key Protein in PD

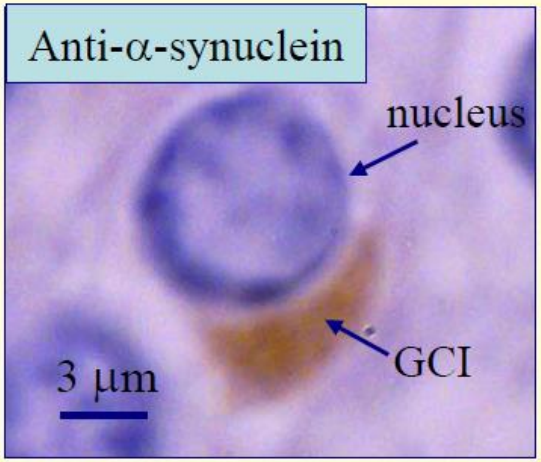
α-Synucleinopathies





Neuronal inclusions

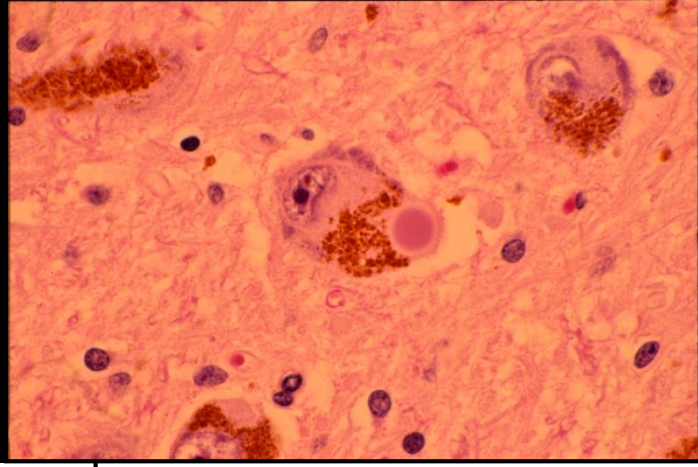
- **Parkinson's Disease**
- Lewy Body Dementia
- Alzheimer's Lewy BodyVariant
- Hallervorden-Spatz

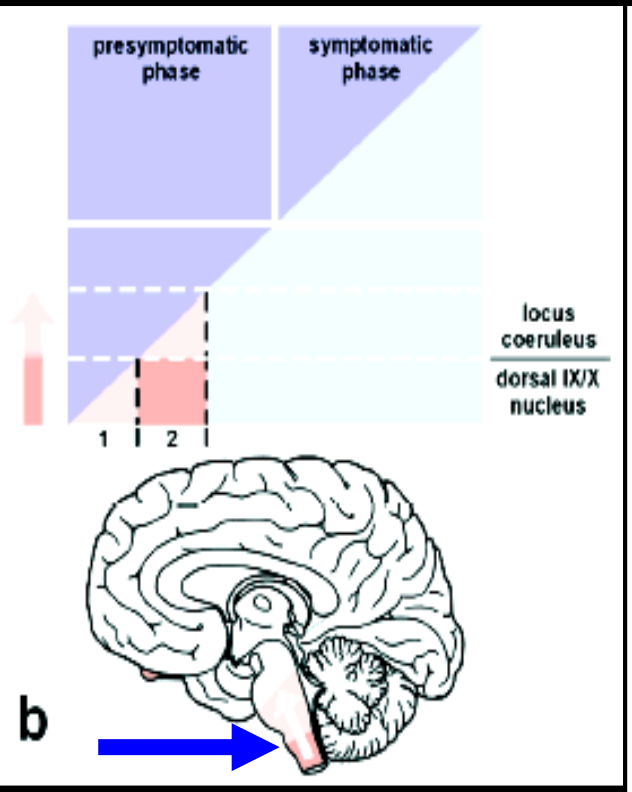


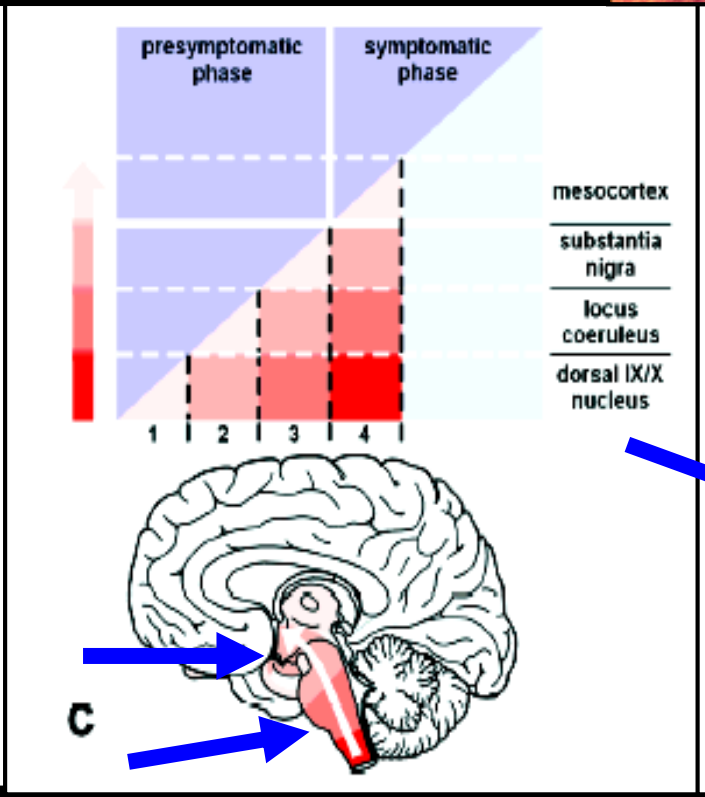
Glial Inclusions

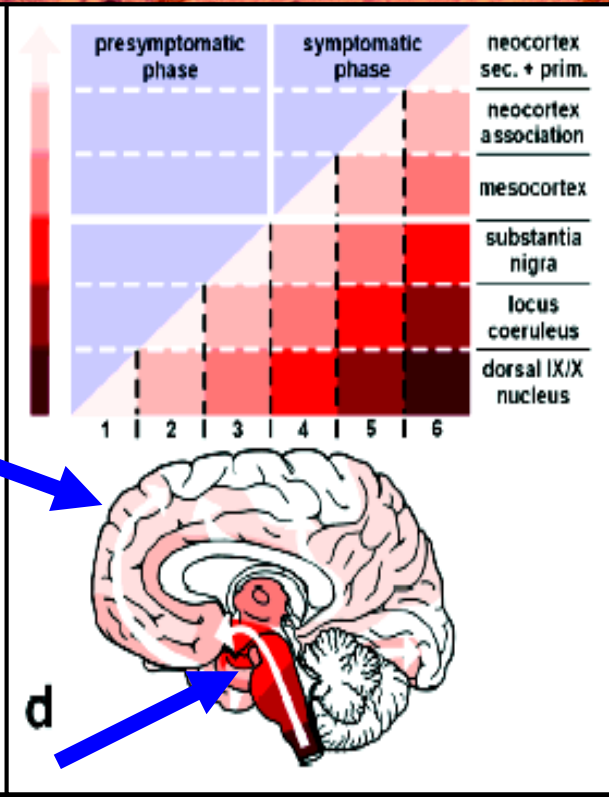
Multiple System Atrophy
(Shy-Drager Syndrome,
Striatonigral Degeneration,
Olivopontocerebellar atrophy)

Braak Staging of Lewy Bodies









Braak H, et al. *J Neurology*. 2002;249(suppl 3):1432-1459.

Braak Model for Pathologic Staging of Parkinson's Disease

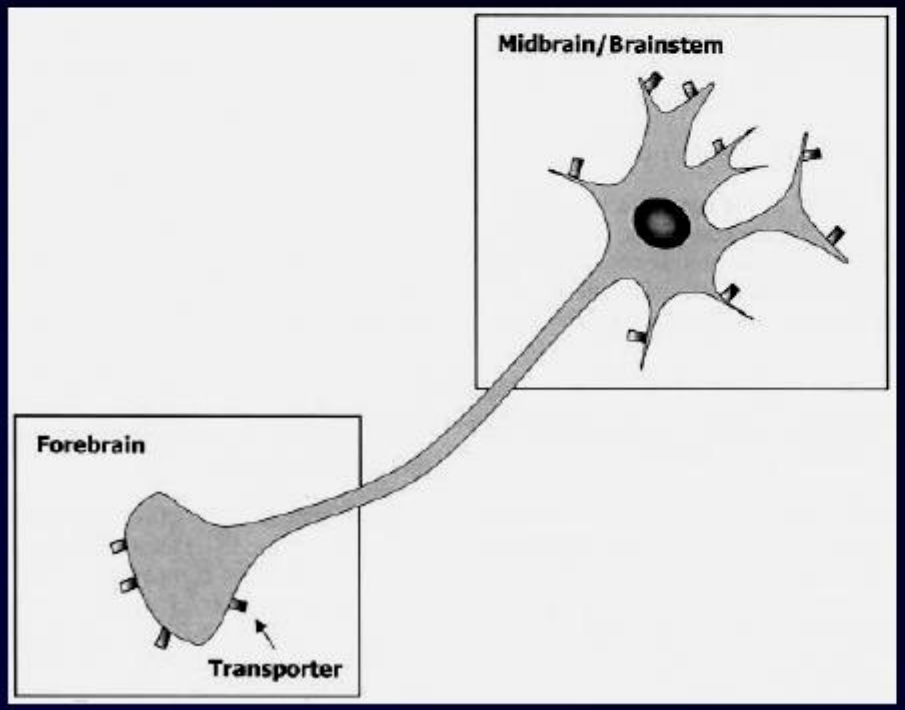
- Based on Lewy body localization[1]
- Suggests that Lewy body pathology does not begin in substantia nigra[1,2]
  - Begins in dorsal motor nucleus of glossopharyngeal and vagus nerves, anterior olfactory nucleus, and enteric nerve cell plexus[1,2]
  - Proceeds in rostral direction toward neocortex[1]
  - Progression of Parkinson's Disease may not always comply with this model[5-9]

Braak stage[3-5]	Clinical symptoms
1-2	• Premotor
3-4	• Motor
5-6	• Cognitive decline

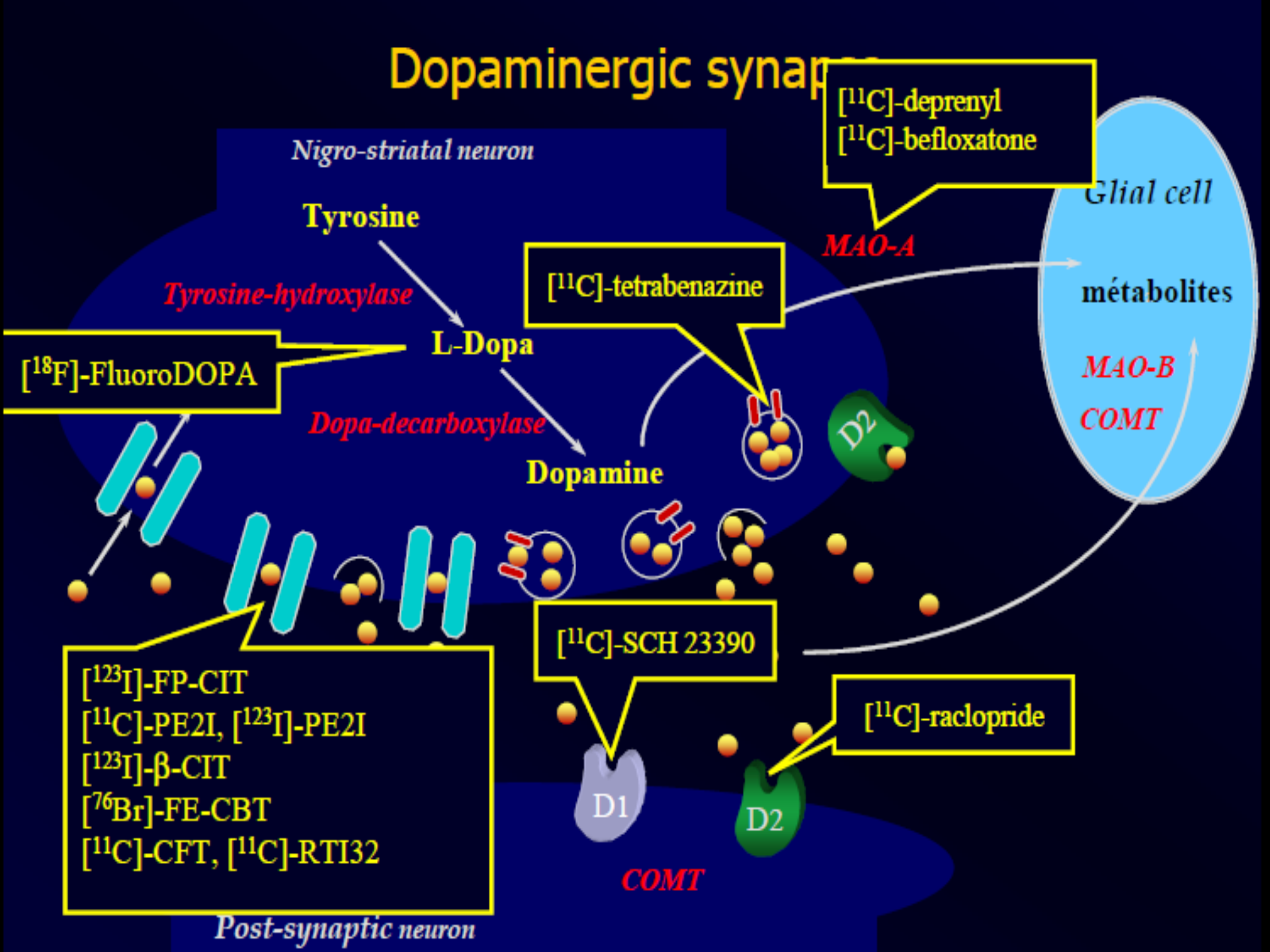
1. Braak et al. *Neurobiol Aging.* 2003;24:197-211. **2.**Braak et al. *Neurosci Lett.* 2006;396:67-72. **3.** Braak et al. *Cell Tissue Res.* 2003;318:121-134. **4.** Braak et al. *Neurology.* 2005;64:1404-1410. **5.** Halliday et al. *Acta Neuropathol.* 2008;115:409-415. **6.** Parkkinen et al. *Acta Neuropathol.* 2008;115:399-407. **7.** Kalaitzakis et al. *Neuropathol Appl Neurobiol.* 2008;34:284-295. **8.** Parkkinen et al. *Ann Neurol.* 2005;57:82-91. **9.** Attems et al. *Neuropathol Appl Neurobiol.* 2008;34:466-467

Location of the DAT on dopamine neurons

The dopamine transporter is localized to dendritic and axonal plasma membranes of nigrostriatal dopaminergic neurons



Nirenberg et al., J Neurosci, 199


Dopaminergic synap
[11C]-deprenyl
[11C]-befloxatone
Nigro-striatal neuron
Tyrosine
MAO-A
Glial cell
Tyrosine-hydroxylase
[11C]-tetrabenazine
métabolites
L-Dopa
[18F]-FluoroDOPA
MAO-B
COMT
Dopa-decarboxylase
D2
Dopamine
[11C]-SCH 23390
[123I]-FP-CIT
[11C]-PE2I, [123I]-PE2I
[123I]-β-CIT
[76Br]-FE-CBT
[11C]-CFT, [11C]-RTI32
[11C]-raclopride
D1
D2
COMT
Post-synaptic neuron

^{123}I FP-CIT FDA and EU Indications among Parkinson Σ

- **Non-degenerative disorders**
- Essential tremor FP-CIT
- Dystonic tremor
- Vascular parkinsonism (MRI)
- Drug induced parkinsonism FP-CIT +-
- Tremor related to metabolic or functional causes

- **Degenerative disorders**
- Lewy Body Dementia (MA vs LBD or PDD) FP-CIT
- Progressive Supranuclear Palsy (now spectrum)
- Cortico Basal Degenerescence (or CB syndrome)
- Multiple System Atrophy

FDA 2011
to assist in the evaluation of adult patients with suspected Parkinsonian syndromes (PS). In these patients, DaTscan may be used to help differentiate essential tremor from tremor due to PS (idiopathic Parkinson's disease, multiple system atrophy and progressive supranuclear palsy). DaTscan is an adjunct to other diagnostic evaluations.

EU 2000, 2006 « »adultes présentant un syndrome parkinsonien cliniquement douteux, par exemple ceux qui présentent des symptômes précoces, afin d'aider au diagnostic différentiel entre tremblement essentiel et syndromes parkinsoniens liés à la maladie idiopathique de Parkinson, à l'atrophie MS ou à la PSP. DaTSCAN ne permet pas la différentiation entre maladie de Parkinson, atrophie multisystématisée et paralysie supranucléaire progressive.

pour aider au diagnostic différentiel entre une démence à corps de Lewy probable et la maladie d'Alzheimer. DaTSCAN ne permet pas la différentiation entre démence à corps de Lewy et démence parkinsonienne

^{123}I - IOFLUPANE «day-to-day practice» indications

- The main indication is striatal DaT visualization in the evaluation of adult patients with suspected Parkinsonian syndromes
- Differentiate essential tremor from tremor due to presynaptic Parkinsonian syndromes (SP, MSA, CBS, LBD)

- Early diagnosis of presynaptic Parkinsonian syndrome young people

- Differentiation of presynaptic Parkinsonian syndromes from parkinsonism without presynaptic dopaminergic loss, such ET and DIP.

- Differentiation of dementia with Lewy bodies from Alzheimer's disease
- The patient wants to know !!!

Imaging with I ^{123} ioflupane

- Referring physician prescribes thyroid blockade solution or tablets
- Referring physician decides which medications should be held prior to scanning
- On day of scan, patient takes thyroid blocking medication 1 hour prior to injection

- Patient injected slowly with 111-185 MBq I ^{123} ioflupane
- Hydrate well and continue to do so for next 48 hrs

Request/history

- The requisition should include a brief description of symptoms and the clinical question.

- Information should be obtained regarding the following:

  - 1. Past or current drug use, head trauma, stroke, psychiatric illness, epilepsy, or tumor.
  - 2. Neurologic symptoms: kind, duration, and left or right sidedness.
  - 3. Current medications and when last taken.
  - 4. Patient's ability to lie still for approximately 30– 45 min.
  - 5. Prior brain imaging studies (e.g., CT, MRI, PET, and SPECT)

- NM physician interaction with the patient ++++

Medications Affecting Imaging

Amoxapine, amphetamine, benztropine, bupropion, buspirone, cocaine, mazindol, methamphetamine, methylphenidate, norephedrine, phentermine, phenylpropanolamine, selegiline, sertraline, citalopram and paroxetine

interfere with imaging (should be discontinued for scan)

Medications Not affecting (significant) Imaging

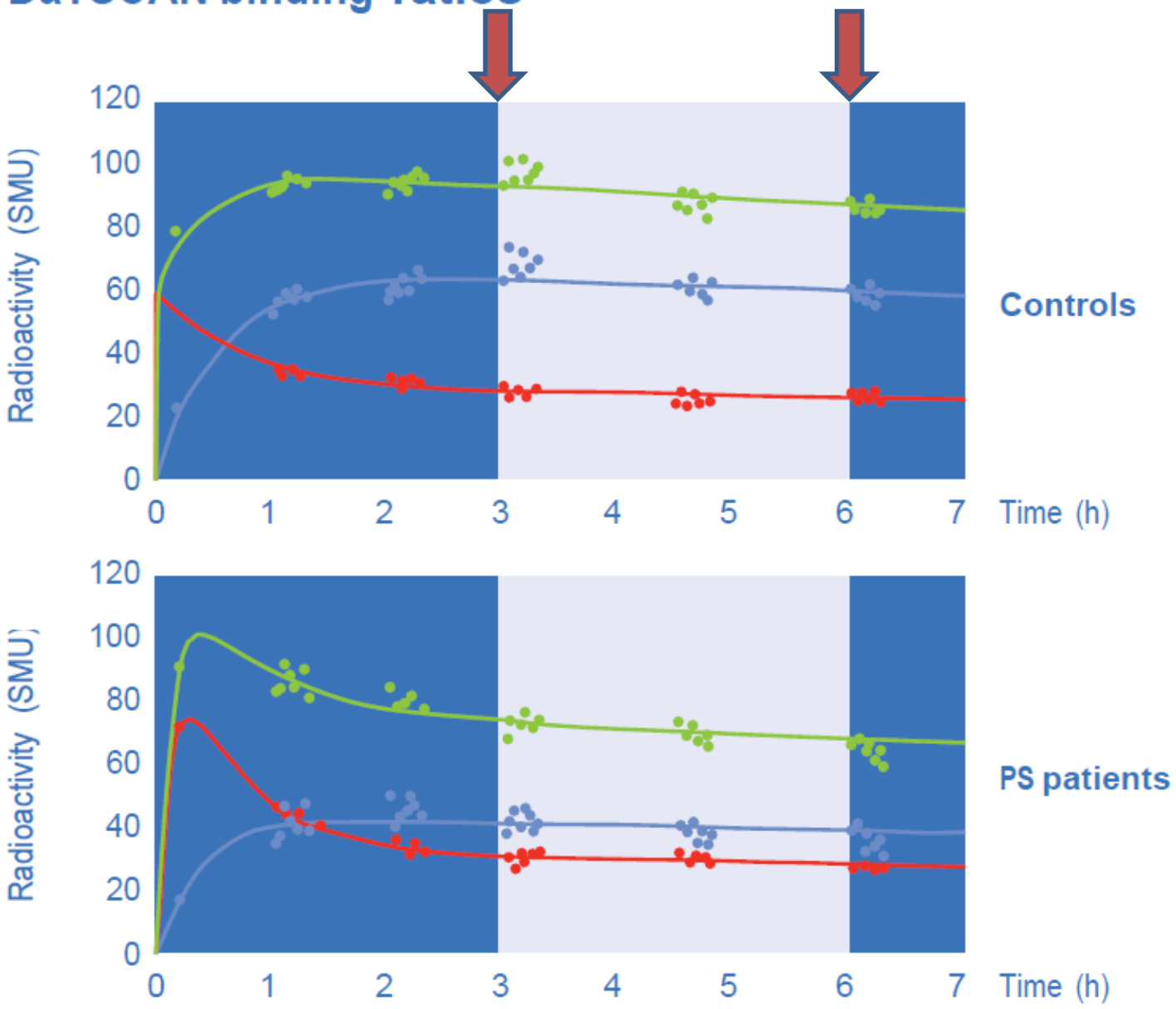
Antipsychotic drugs (neuroleptics)

Antiparkinsonian therapeutics

Patient preparation

- Either 100mg potassium iodide or 400 mg potassium chlorate-blocks I^{123} uptake in thyroid

DaTSCAN binding ratios



Adapted from reference 6

ossible to
tic multislice-CT
ction of TruePoint
m several
ed system.
With diagnostic
ons available at
proves workflow
n. Integration
form, enables
ions to easily
a common,

A huge leap forward in a small footprint. Symbia, the first product family to incorporate TruePoint SPECT-CT technology, enables you to perform three separate studies on one modality. All in a room approximately 11' x 21'.*

- 1 h

120 mg KI

+3 h

SPECT

+3 h40

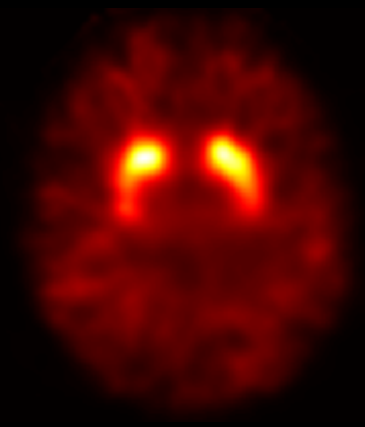
+12 h

120 mg KI

111 – 185 MBq

FP-CIT

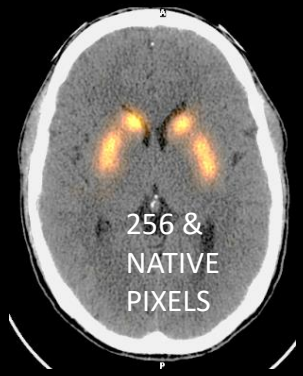
40 mn



2 mn

GE D670 NM/CT CZT

Brain : Ioflupane Acq. Params
DaTQUANT & Normal DB



Objectives :

1. SBRs stability for Low SBRs – reasonable AQ time or Dose
2. use DaTQUANT as soon as possible : AQ params such that « normal » SBRs = PPMI DaTQUANT
3. Taking into account 670 CZT characteristics

CZT + : effective FoV – frame +++
Mean rotational radius
13,6 cm (14-12 cm)

CZT + : energy resolution
single asymetric window
-6% 159 keV +5%

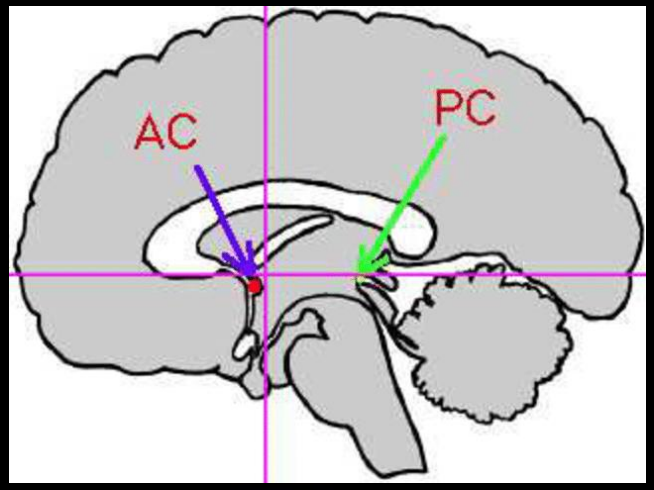
CZT+ : AQT 15’ to 30’ (185 -110 MBq)
Stats more than 1.5 M counts

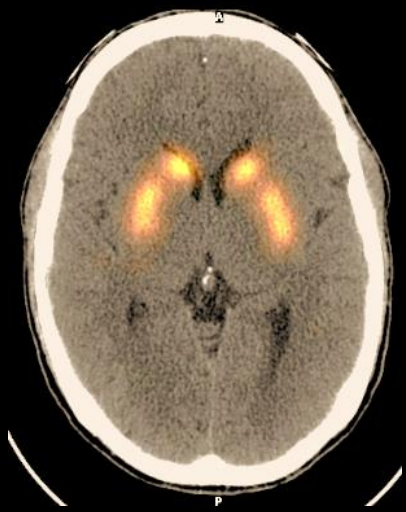
Reconstruction Par. DaTQUANT
OSEM 2/10 BT 0,60/10 CT AC or
Chang (5%) No RR (normal DB pars)

Reconstruction Par. Visual analysis
OSEM 4/10 BT 0,4/10 CT AC RR

Ioflupane – normal imaging

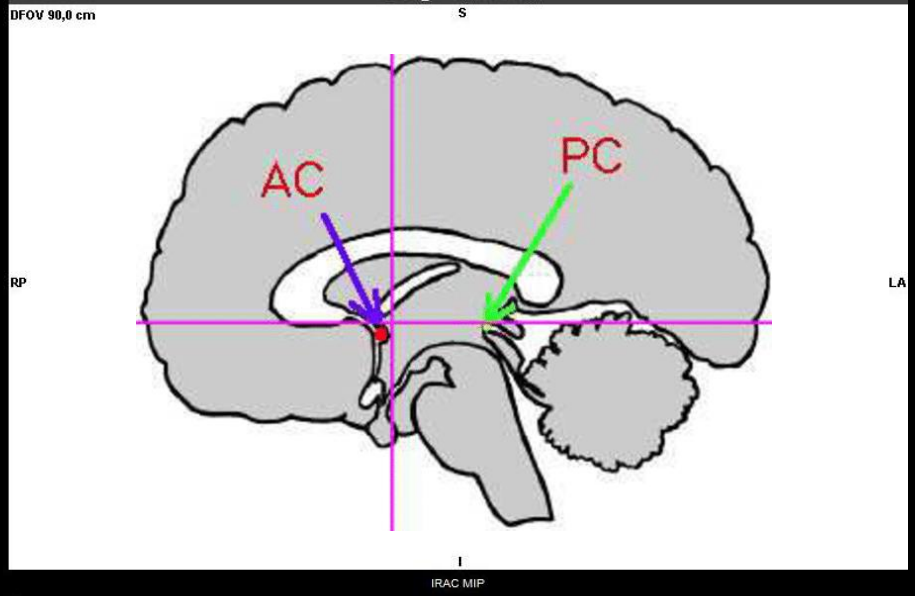
On AC-PC axial slices
Comma shape
SNR decline slowly f° age
Should stay symetric





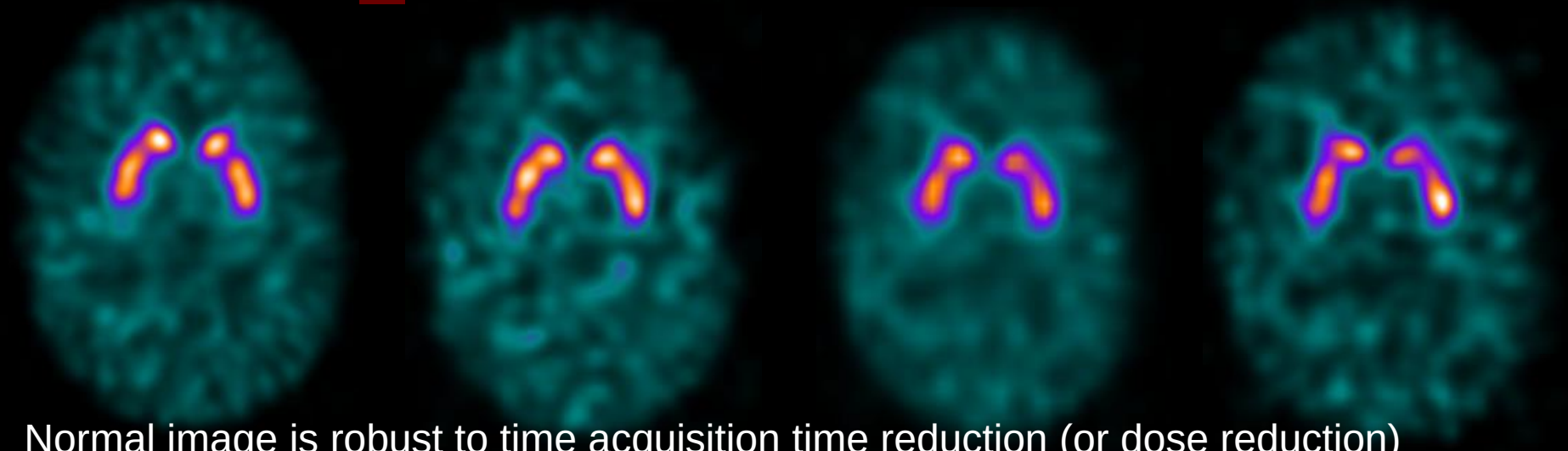
Clinical signs : # 70% local denervation

Axial AC-PC line mandatory for visual analysis

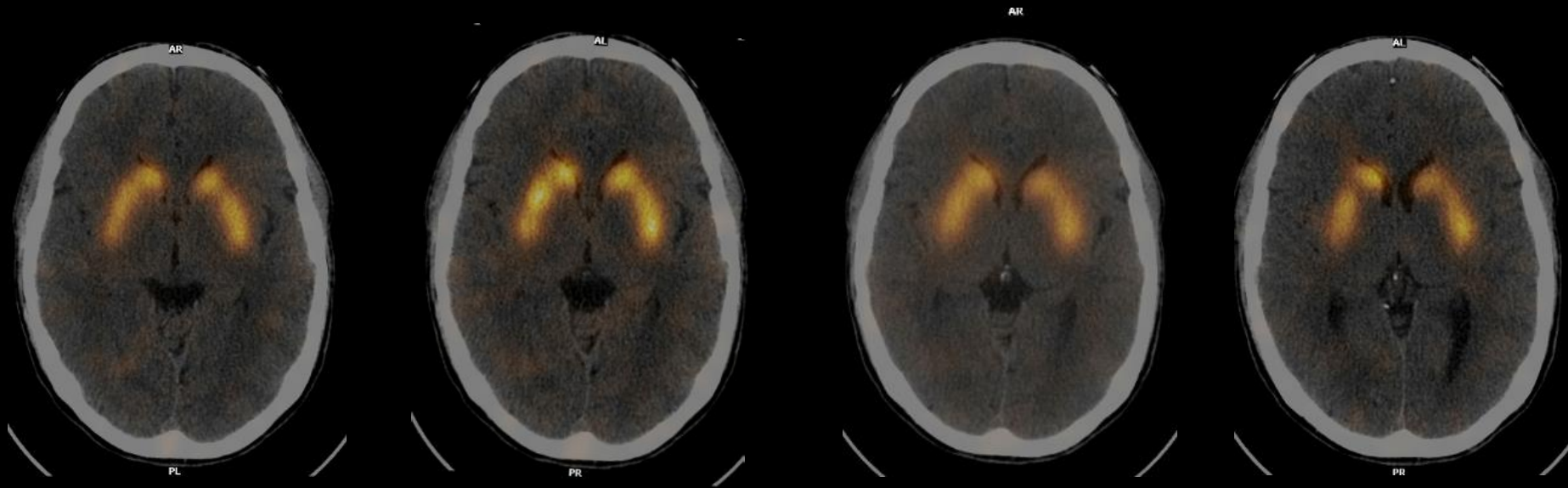


[Hybrid QC passed]

185 111 90 70



Normal image is robust to time acquisition time reduction (or dose reduction)



False-Positive DaTscan Features With Methylphenidate and Phentermine Therapy

Kenneth N. Huynh, BS, Ba D. Nguyen, MD

Mayo Clinic Proceedings
Volume 93, Issue 11, Pages 1690-1691 (November 2018)
DOI: 10.1016/j.mayocp.2018.09.012

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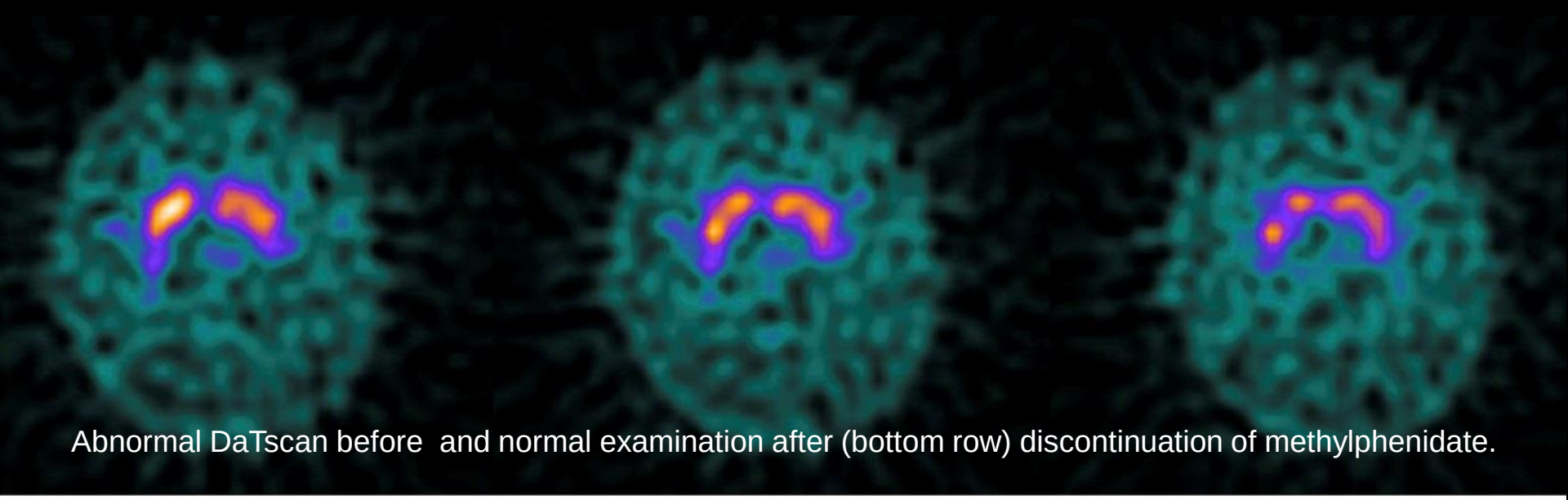
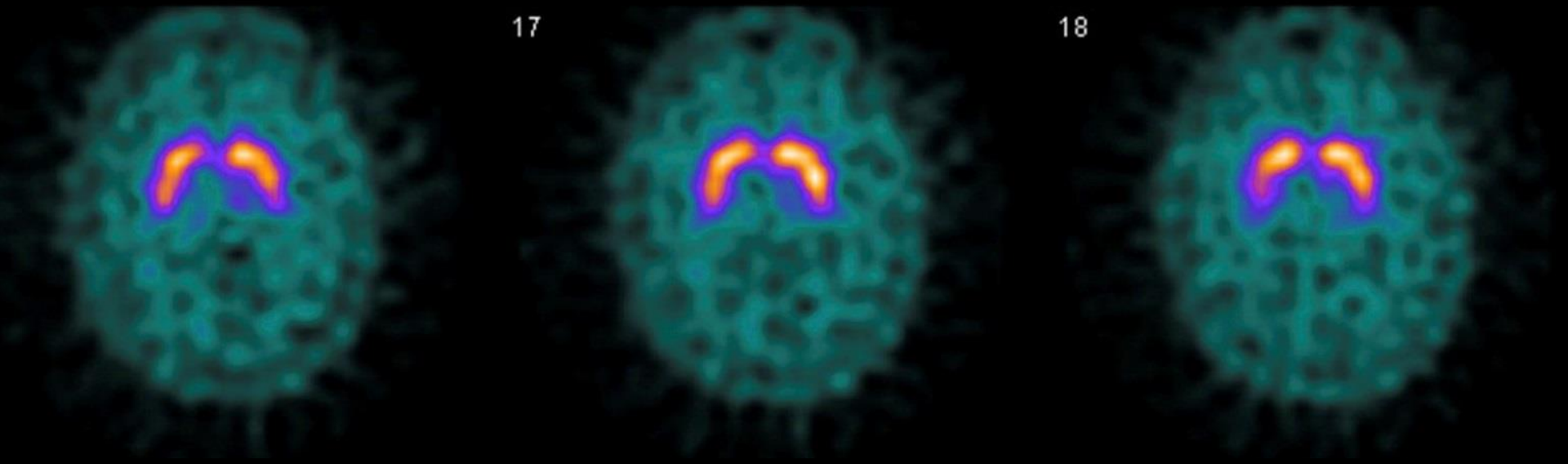


Abnormal DaTscan before and normal examination after (bottom row) discontinuation of methylphenidate.



Mayo Clinic Proceedings 2018 93, 1690-1691DOI: (10.1016/j.mayocp.2018.09.012)
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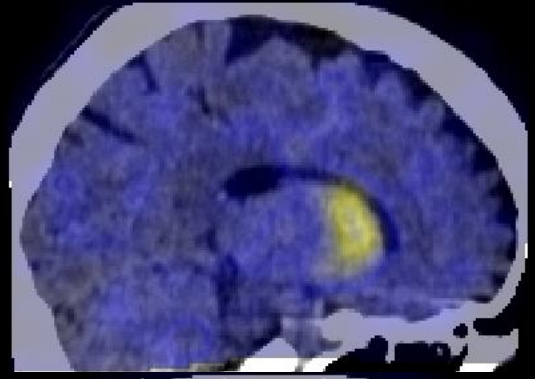
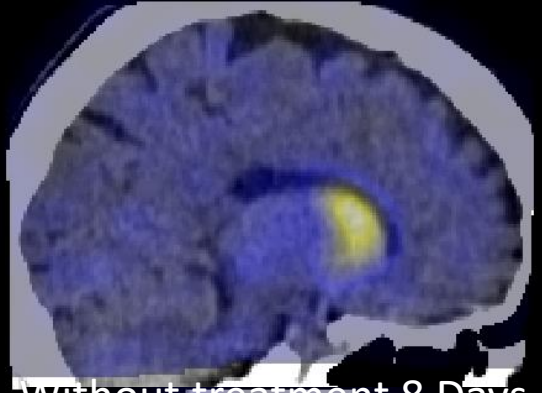
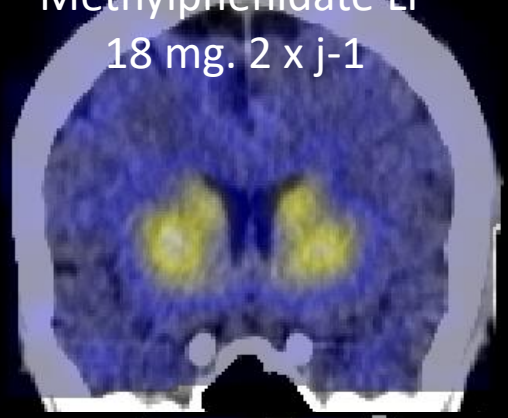
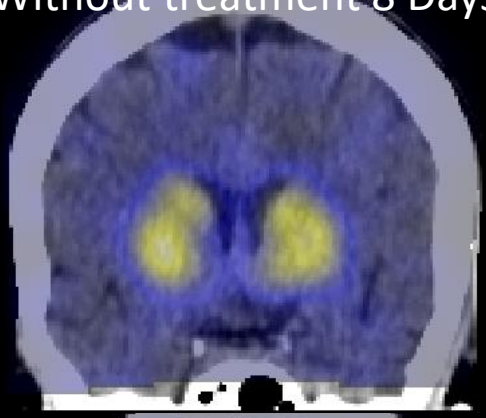


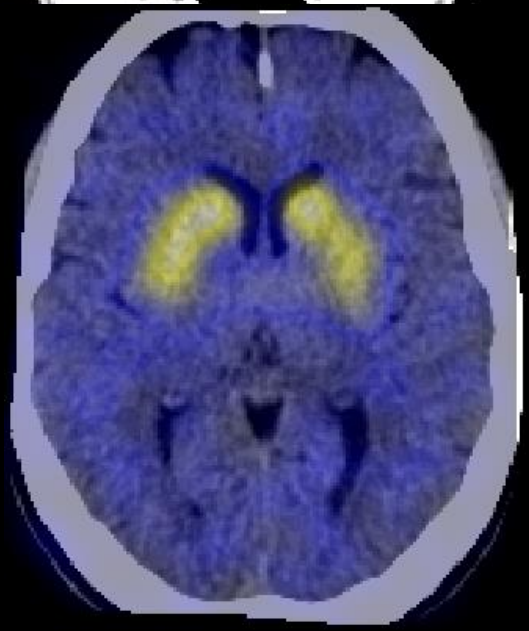


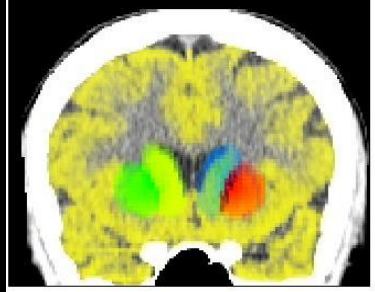
Methylphenidate LP
18 mg. 2 x j-1

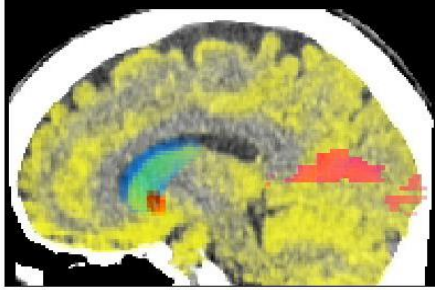
Without treatment 8 Days

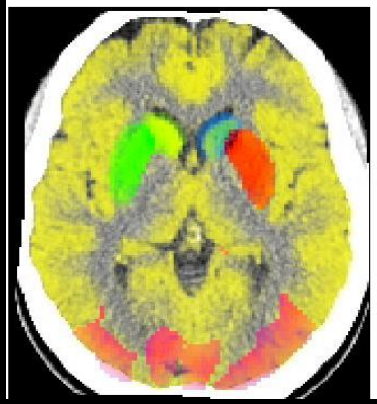






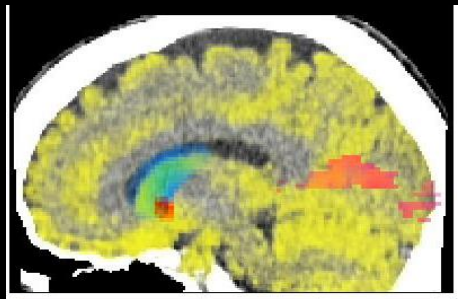






	Droit	Gauche
Striatum	2.0	2.0
Caudé	1.7	1.7
Putamen	2.1	2.0
Put/Cau	1.4	1.2
Striatum D/G	1.0	
Caudé D/G	0.9	

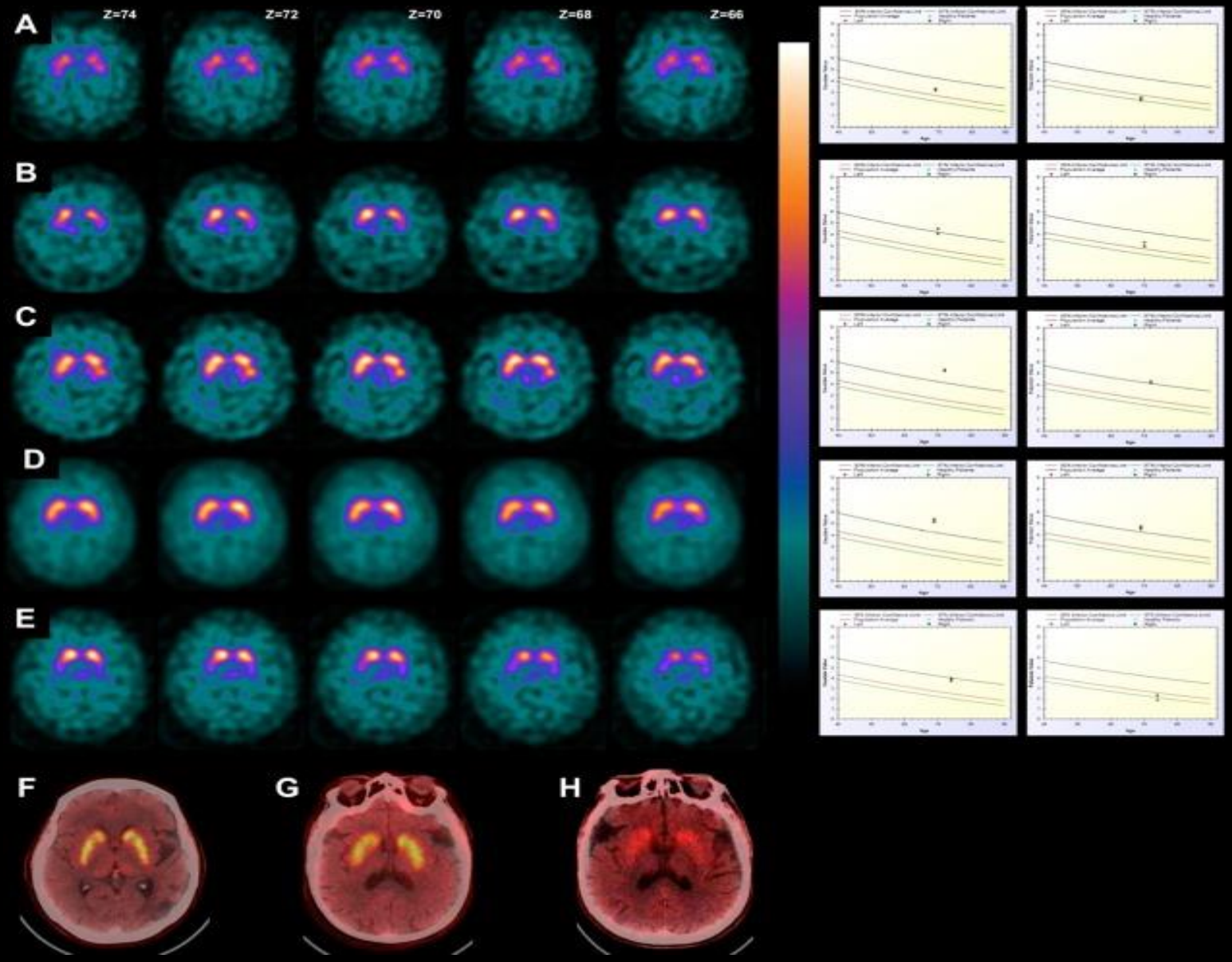
Methylphenidate LP
18 mg. 2 x j-1



	Droit	Gauche
Striatum	2.8	2.8
Caudé	2.6	2.4
Putamen	2.8	2.8
Put/Cau	1.2	1.2
Striatum D/G	0.9	
Caudé D/G	1.0	
Putamen D/G	0.9	

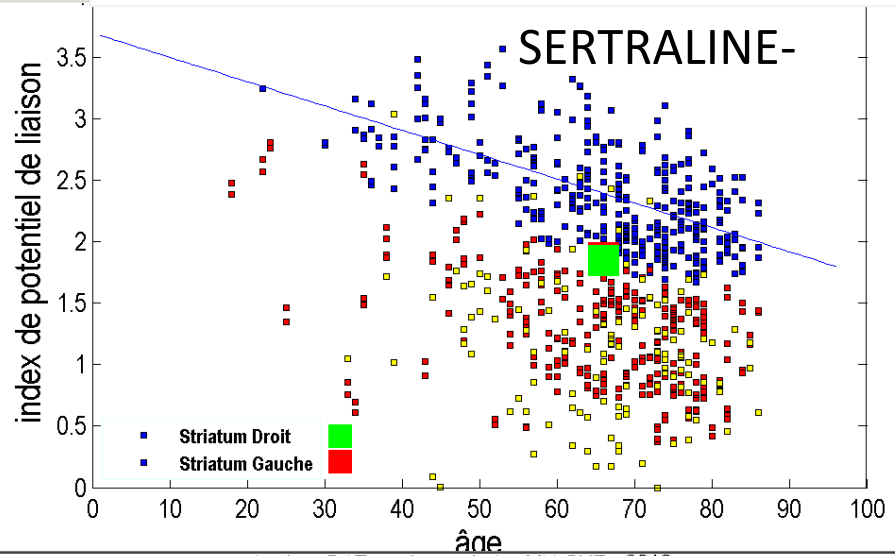
8 days after
withdrawal Trt

Lithium reversible DIP



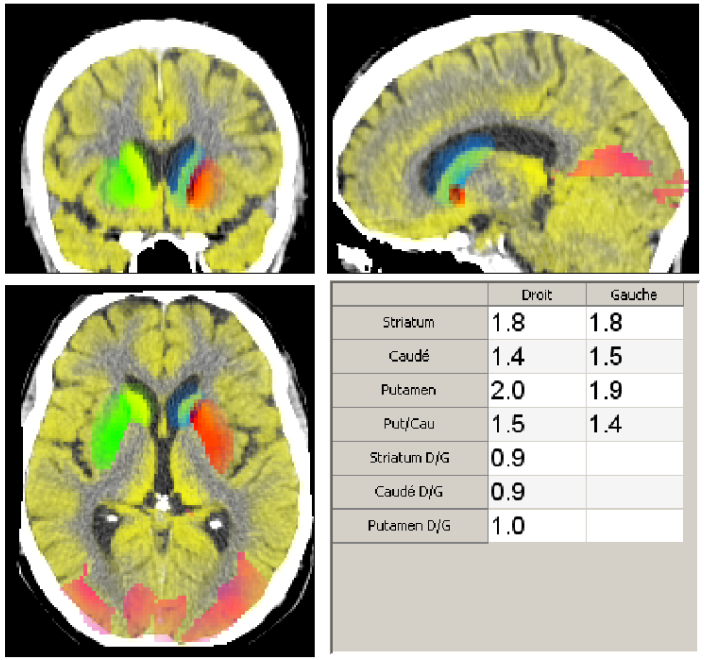
Cilia R, Marotta G, Belletti A, Siri C, Pezzoli G. Reversible dopamine transporter reduction in drug-induced parkinsonism. Mov Disord 2014;29:575e7

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber



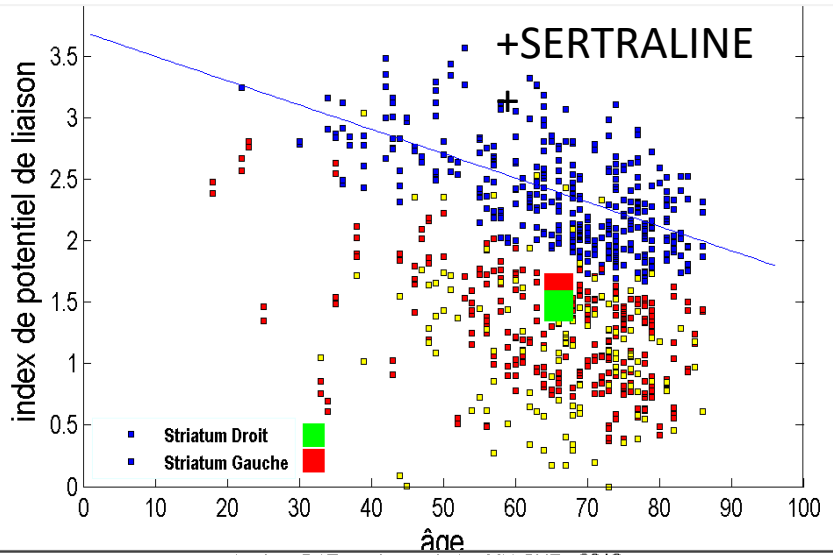
Analyse DAT semi-quantitative MN-GHE v 2010

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques



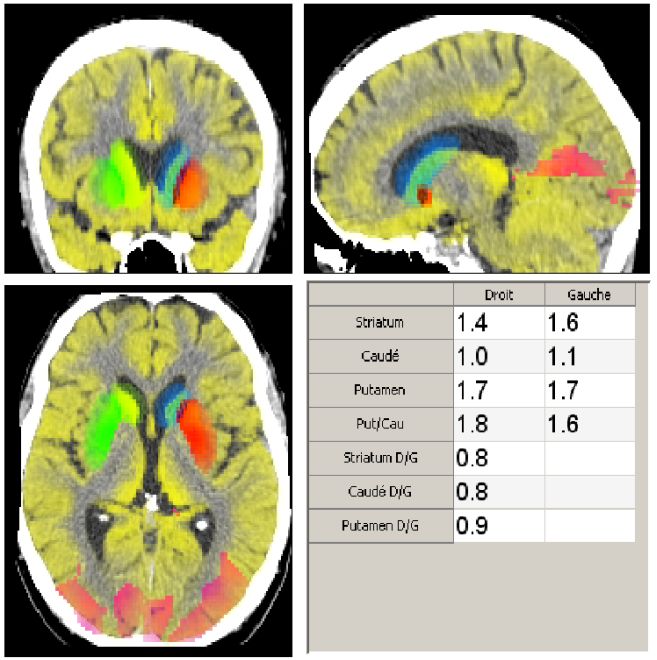
	Droit	Gauche
Striatum	1.8	1.8
Caudé	1.4	1.5
Putamen	2.0	1.9
Put/Cau	1.5	1.4
Striatum D/G	0.9	
Caudé D/G	0.9	
Putamen D/G	1.0	

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber



Analyse DAT semi-quantitative MN-GHE v 2010

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques



	Droit	Gauche
Striatum	1.4	1.6
Caudé	1.0	1.1
Putamen	1.7	1.7
Put/Cau	1.8	1.6
Striatum D/G	0.8	
Caudé D/G	0.8	
Putamen D/G	0.9	

SWEDD

Scan Without Evidence of Dopaminergic Deficit

- A long story 2000-2018
- (methodology, imaging technique, reporting, diagnosis errors)

- N. Nicastro et al. J of the Neurological Science 385 (2018) 17-21
  - 372 ioflupane exams 155 PD, 53 DLB,
  - 3/125 (2,1%) 1 CBS – 1 MSA-C and 1 PD (½ quant was abnormal)
  - 1/53 (1,9%) with DLB

  Only 2 patients 1 CBS and 1 MSA had a strictly normal assessment

About ioflupane reporting in clinical routine work …

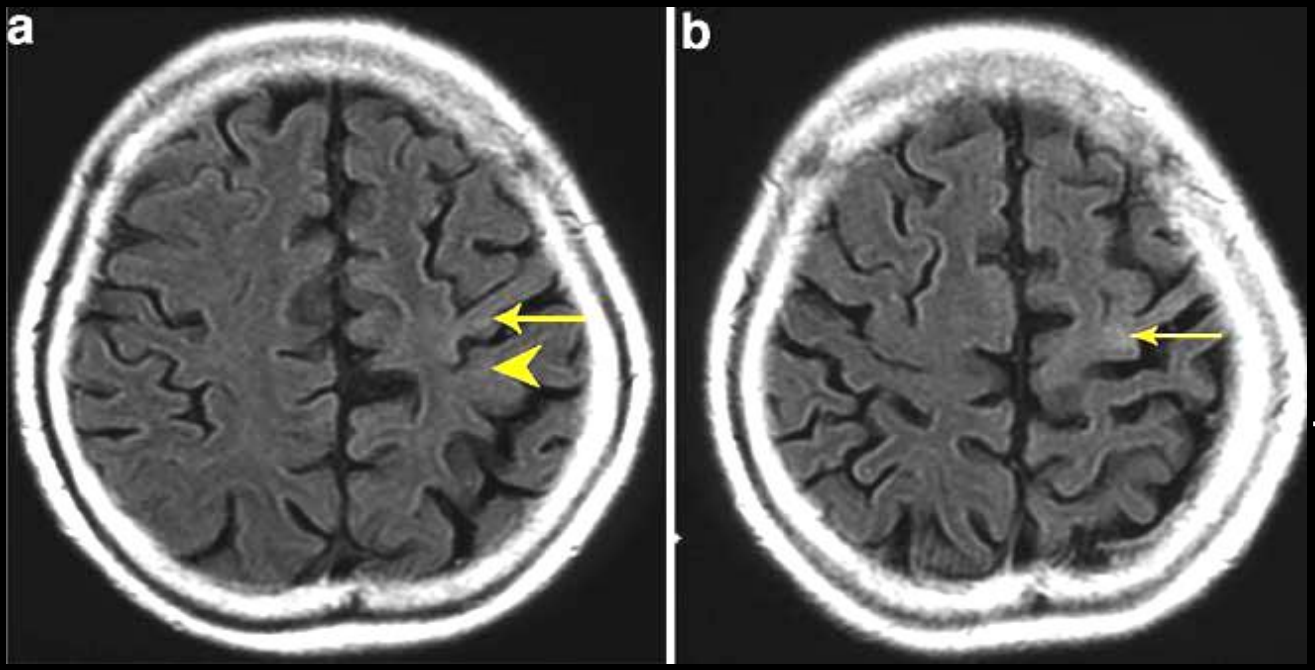
« A 3 mn reporting time …. »

Yes, possibly, but need always a significant medical time to take into account the patient's status ……

Tip: always see the patient before ioflupane scan

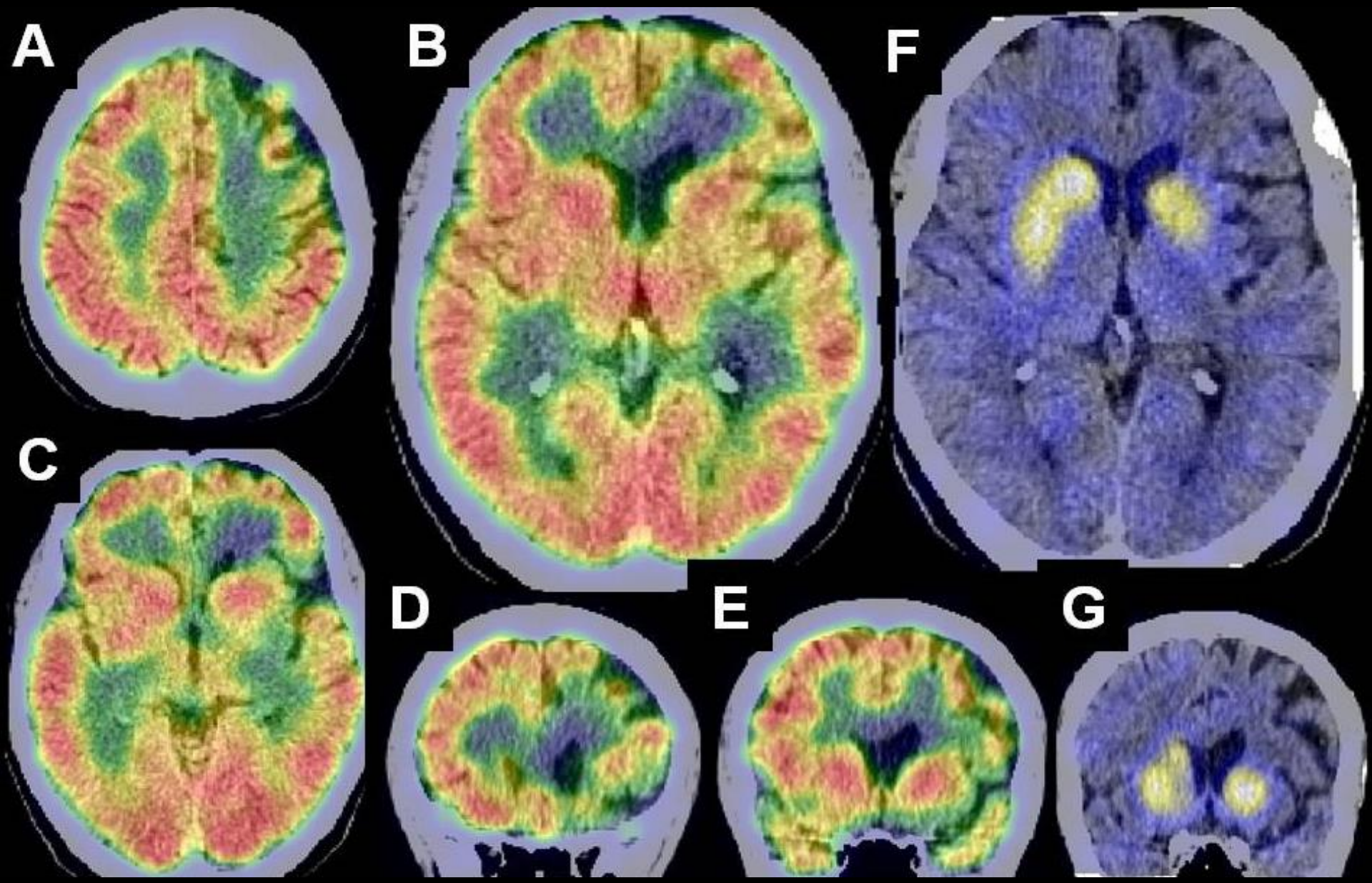
BEFORE reading Datscan
Patient file mandatory – See the patient
Morphological Analysis

Koyama M.et all., Neuroradiology (2007) 49:905–912



Refered to DAT for right parkinsonism

- Review Raw CTX or MRI first (not only report
- If possible SPECT- diagnostic CT +++



Diagnosis left cortico-basal degeneration
(or left cortico-basal syndrome)

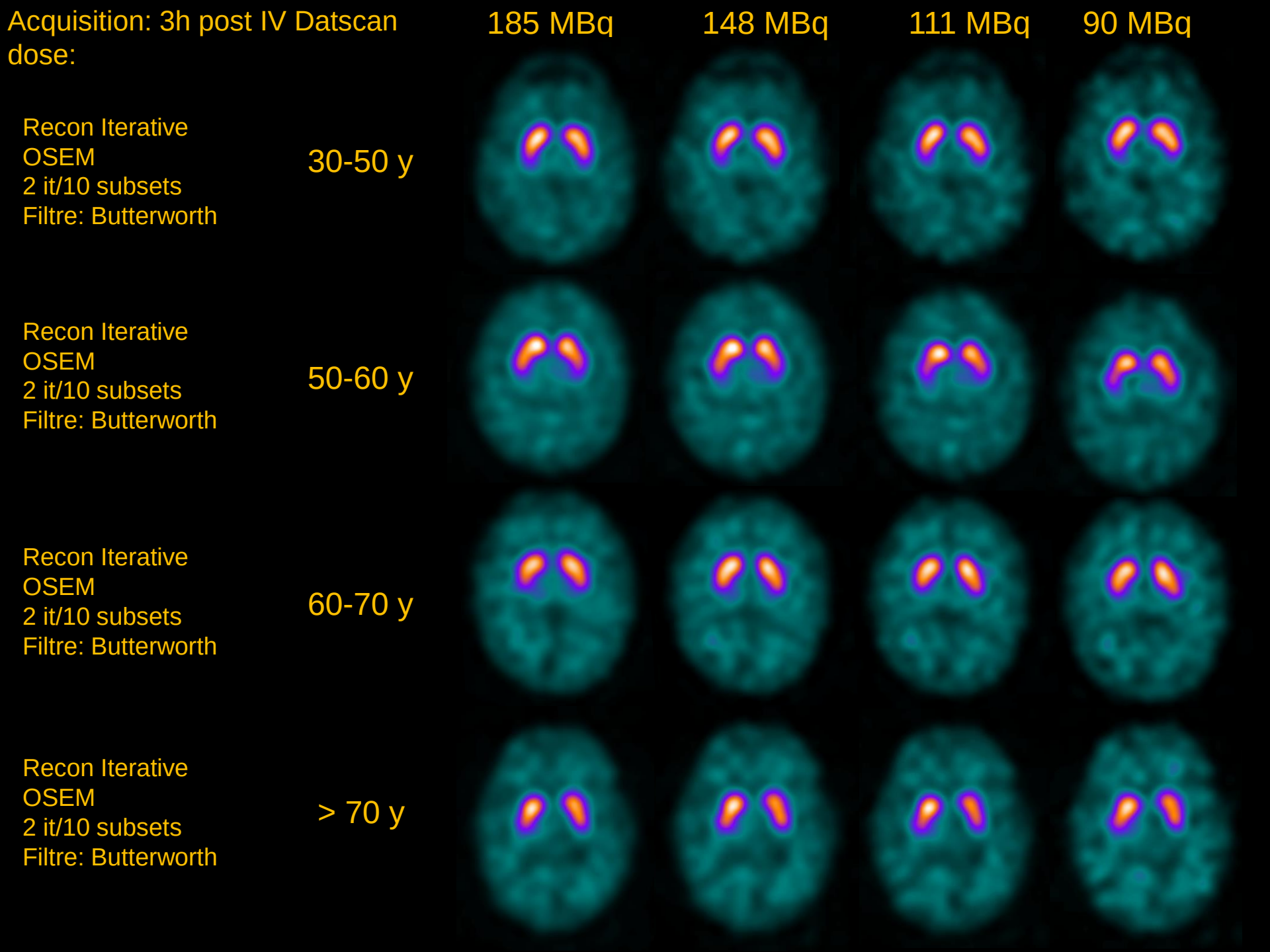
2nd STEP DaTSCAN analysis

Requires knowledge of normal Image and variants

Normal values decline f° age

should stay symetric

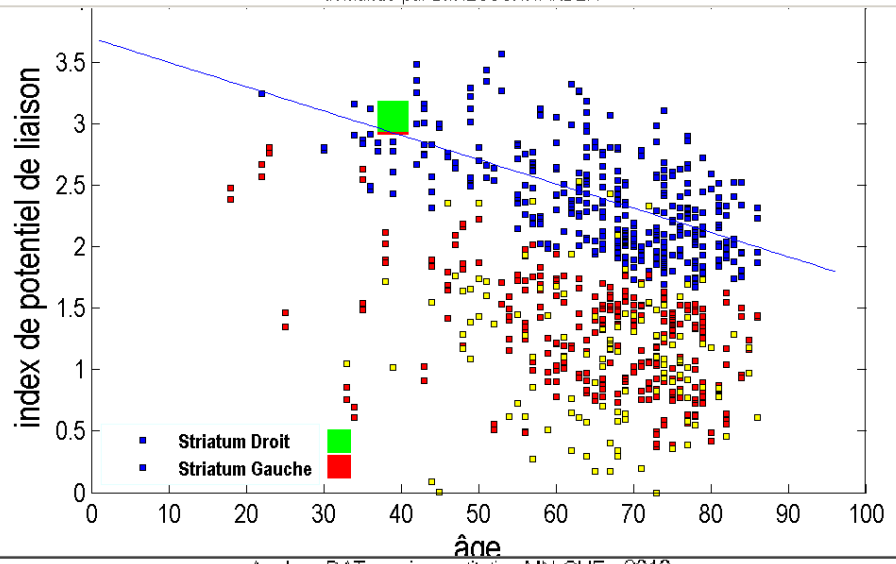
clinical signs : 70% denervation


Acquisition: 3h post IV Datscan
dose:
185 MBq
148 MBq
111 MBq
90 MBq
Recon Iterative
OSEM
2 it/10 subsets
Filtre: Butterworth
30-50 y
Recon Iterative
OSEM
2 it/10 subsets
Filtre: Butterworth
50-60 y
Recon Iterative
OSEM
2 it/10 subsets
Filtre: Butterworth
60-70 y
Recon Iterative
OSEM
2 it/10 subsets
Filtre: Butterworth
> 70 y

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

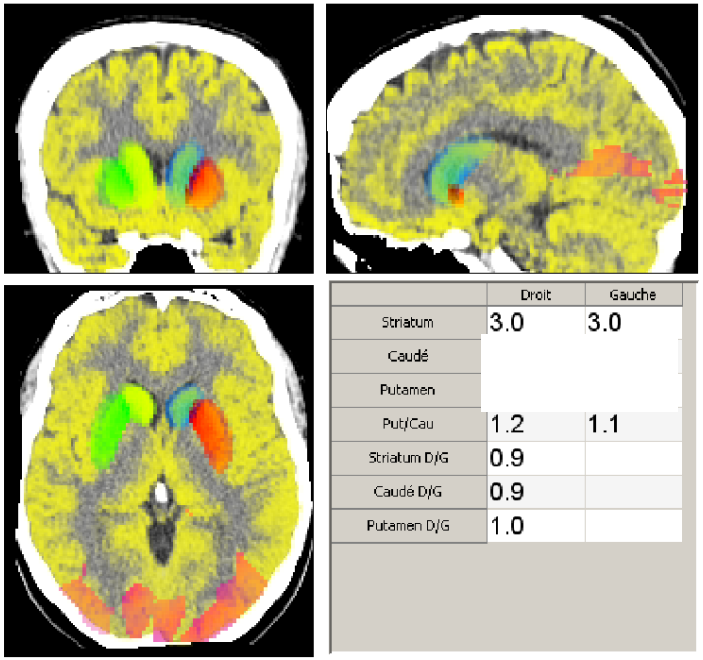
Mme.Genevieve.MUSSET.né le20/11/1971.Datscan du.28/04/2011

demandé par Dr.NEUSCHWANDER



Analyse DAT semi-quantitative MN-GHE v 2010

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques

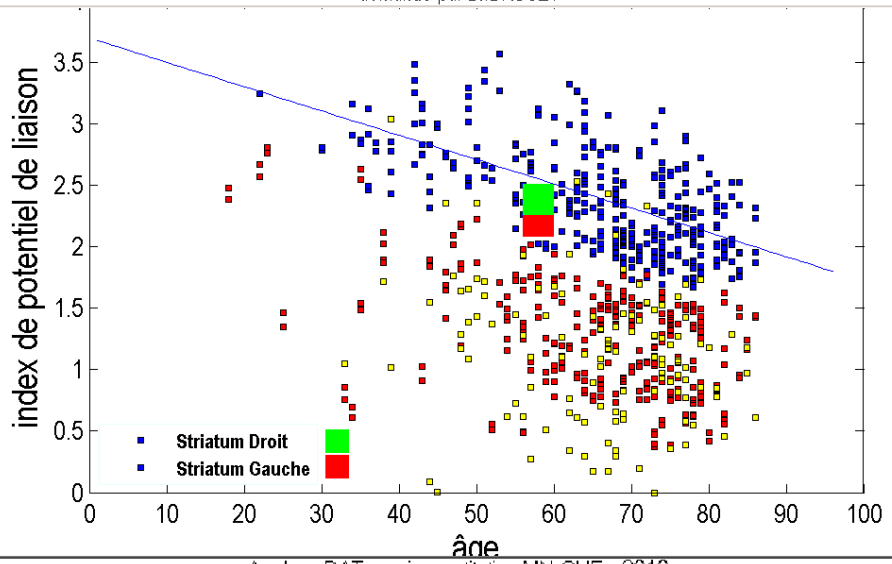


	Droit	Gauche
Striatum	3.0	3.0
Caudé		
Putamen		
Put/Cau	1.2	1.1
Striatum D/G	0.9	
Caudé D/G	0.9	
Putamen D/G	1.0	

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

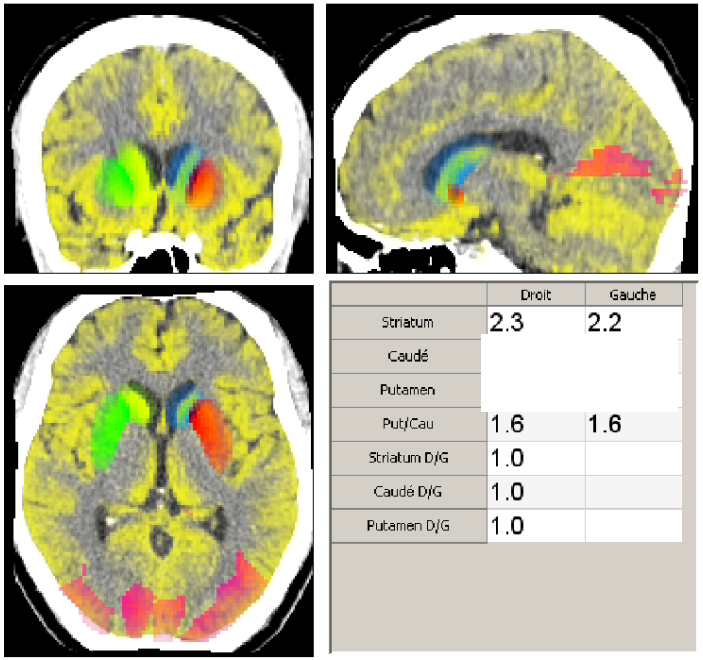
Mr.Mariano.M TIMA.né le29/05/1953.Datscan du.28/04/2011

demandé par Dr.DROUET



Analyse DAT semi-quantitative MN-GHE v 2010

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques

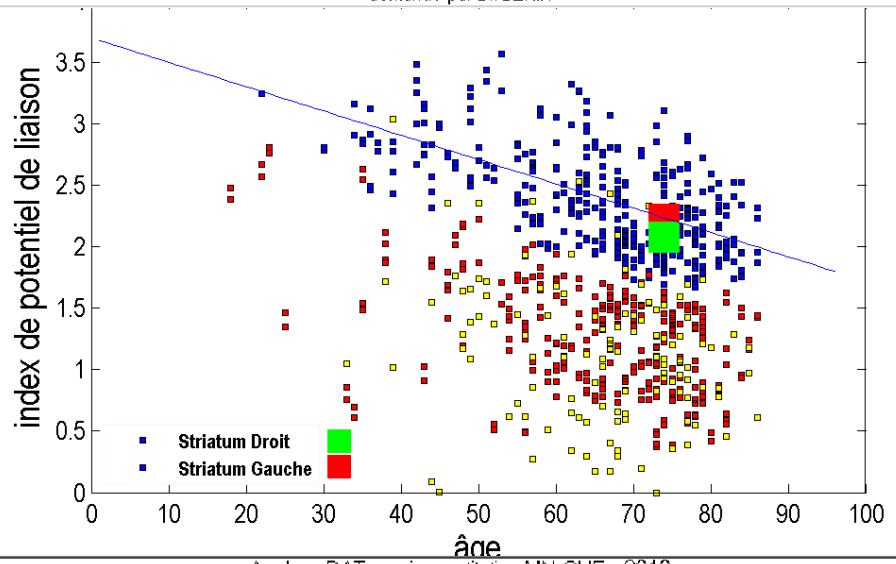


	Droit	Gauche
Striatum	2.3	2.2
Caudé		
Putamen		
Put/Cau	1.6	1.6
Striatum D/G	1.0	
Caudé D/G	1.0	
Putamen D/G	1.0	

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

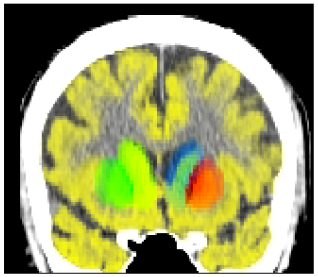
Mr.Daniel.SILVESTRE.né le15/04/1937.Datscan du.19/04/2011

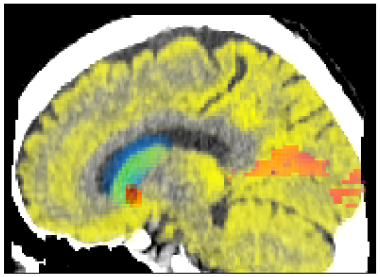
demandé par Dr.GEHIN

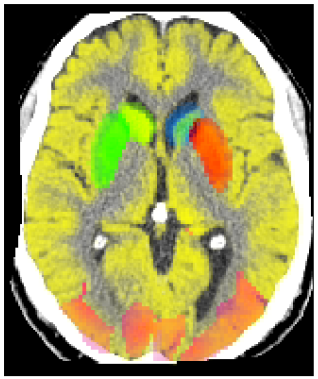


Analyse DAT semi-quantitative MN-GHE v 2010

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques





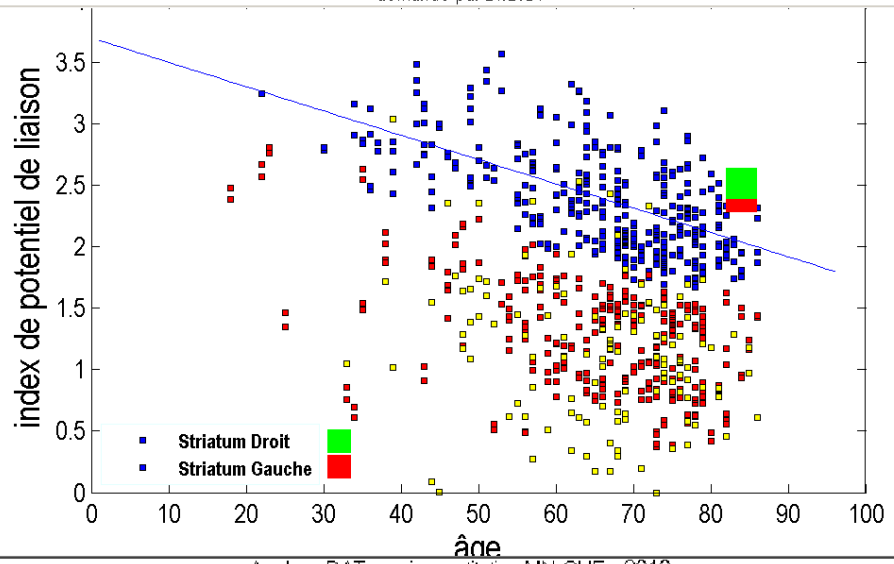


	Droit	Gauche
Striatum	2.0	2.2
Caudé	1.8	1.9
Putamen	2.0	2.1
Put/Cau	1.2	1.2
Striatum D/G	0.9	
Caudé D/G	0.9	
Putamen D/G	0.9	

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

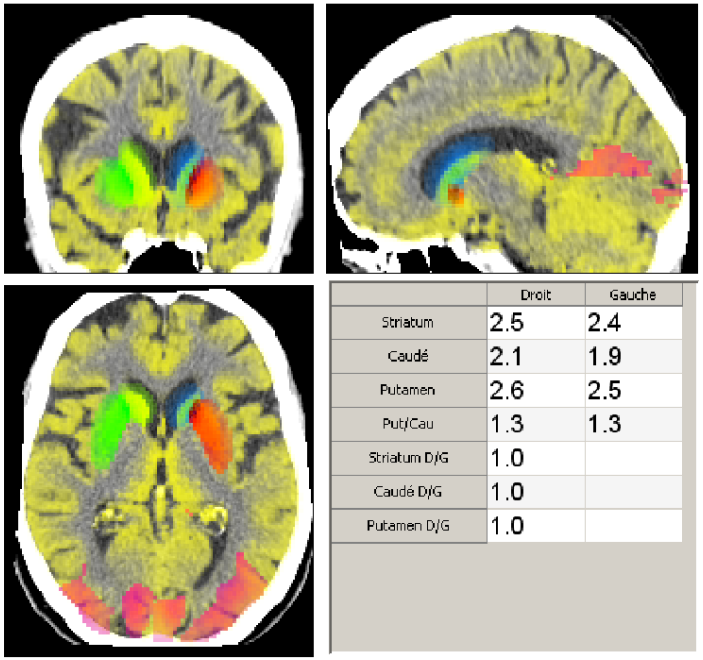
Mme.Diane.DURANTON.né le10/10/1927.Datscan du.07/04/2011

demandé par Dr.DIOT

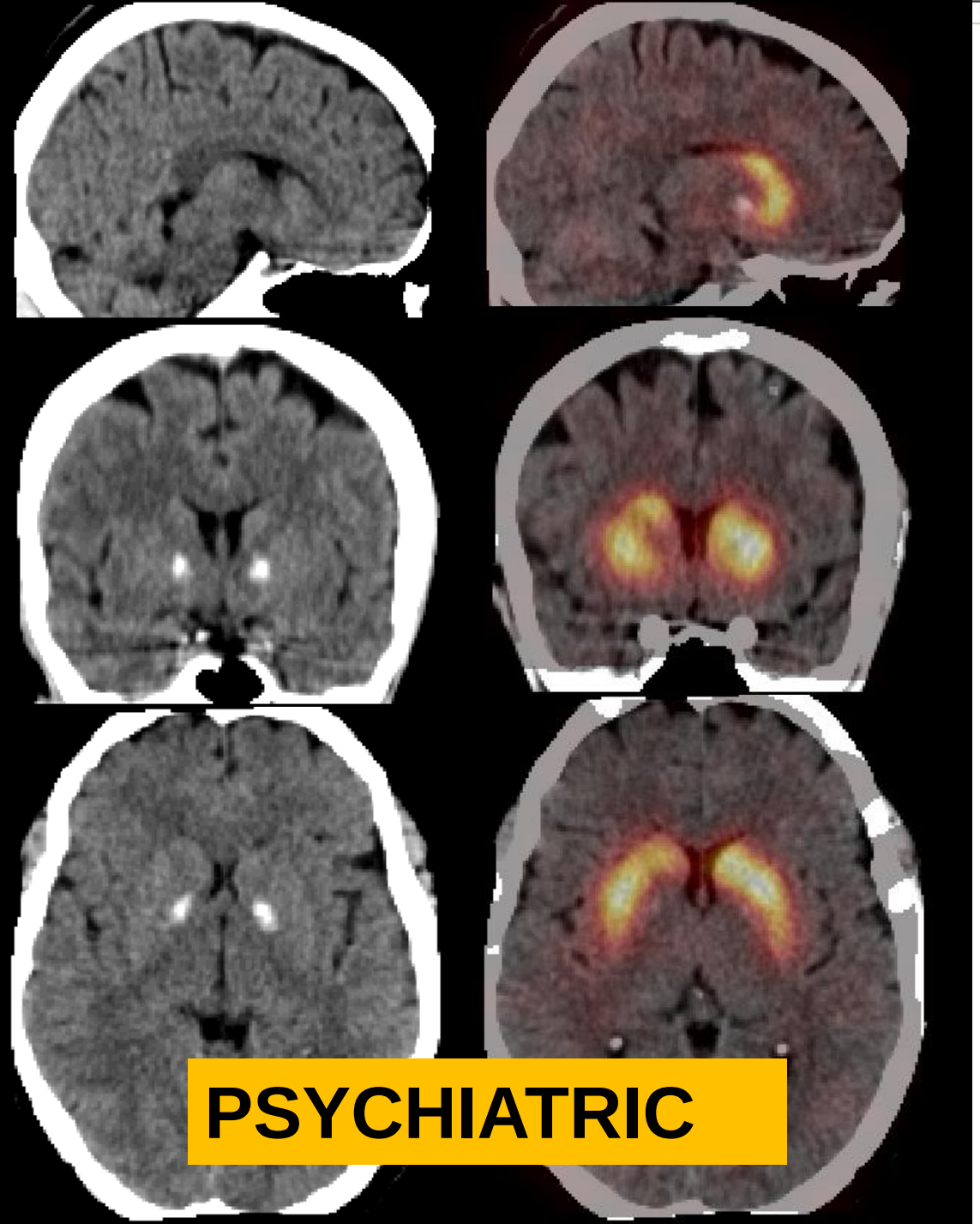


Analyse DAT semi-quantitative MN-GHE v 2010

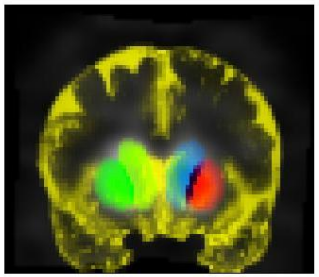
Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques

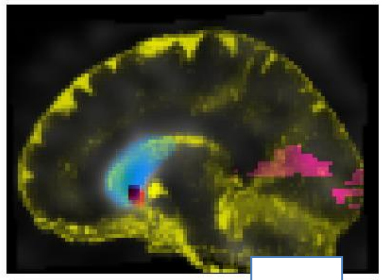


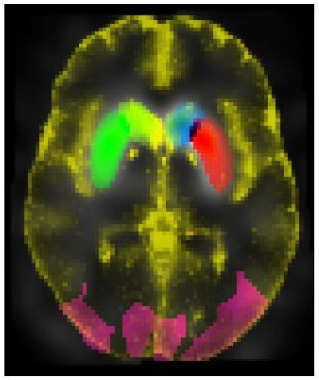
	Droit	Gauche
Striatum	2.5	2.4
Caudé	2.1	1.9
Putamen	2.6	2.5
Put/Cau	1.3	1.3
Striatum D/G	1.0	
Caudé D/G	1.0	
Putamen D/G	1.0	



PSYCHIATRIC



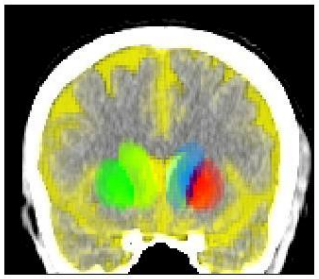


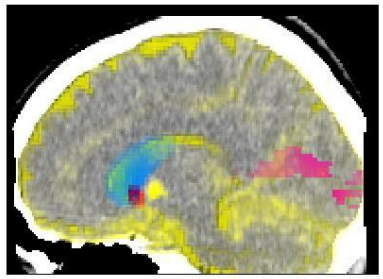


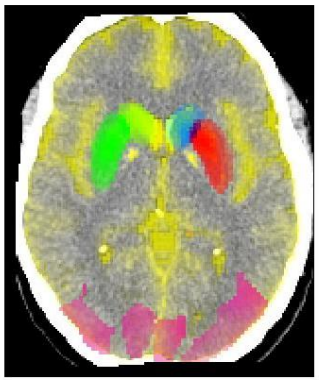
Mme.Samia.KHC
15/02/1967
examen du.05/08/2010

demandé par Dr.XIE
référent Pr.Christian Scheiber

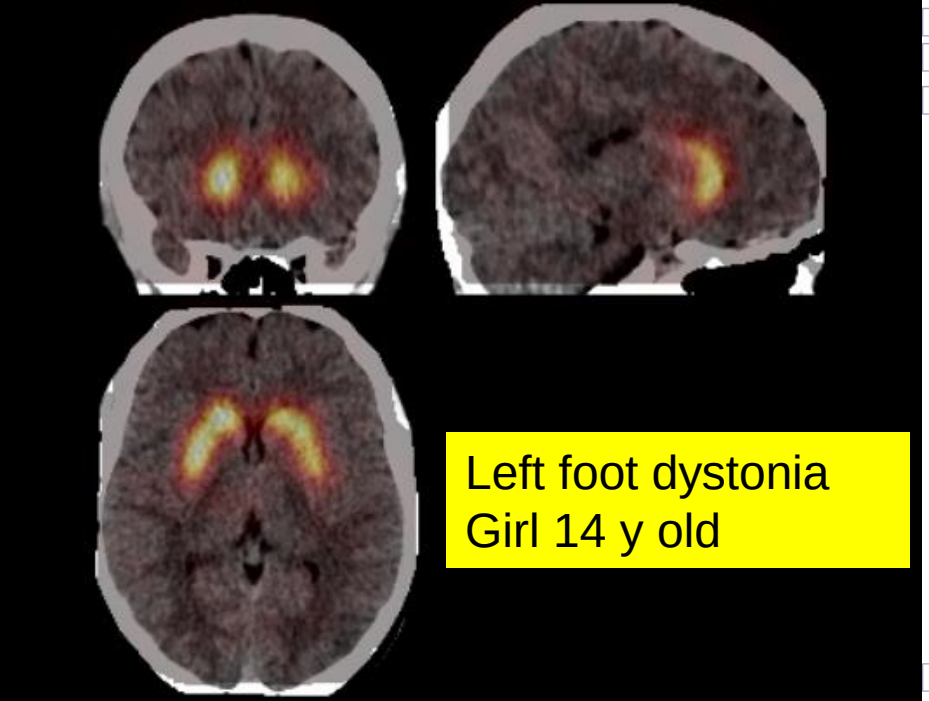
Légende
substance grise normalisée sur Colin
ROIs: parcellation par Ciceron sur Colin
images normalisées - MNI



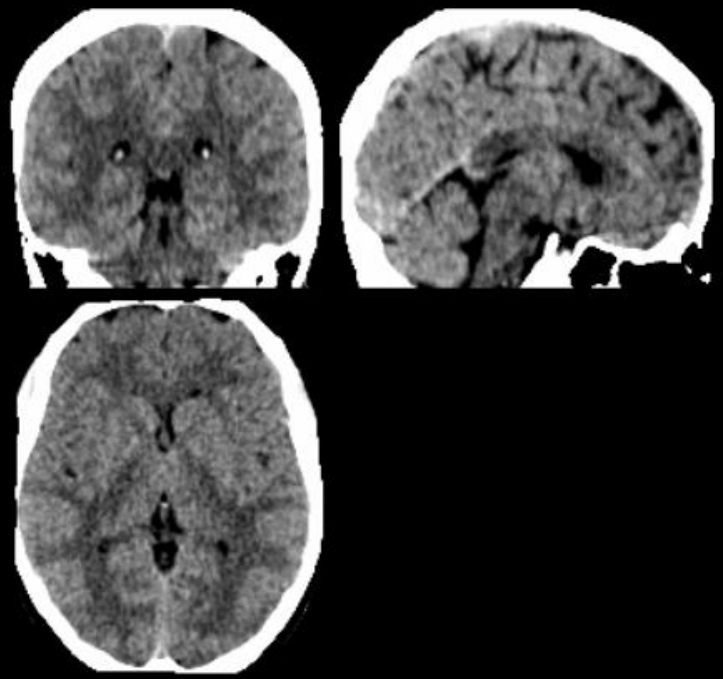




	Droit	Gauche
Striatum	3.5	3.4
Caudé	3.2	3.1
Putamen	3.5	3.4
Put/Cau	1.2	1.1
Striatum D/G	1.0	
Caudé D/G	0.9	
Putamen D/G	1.0	



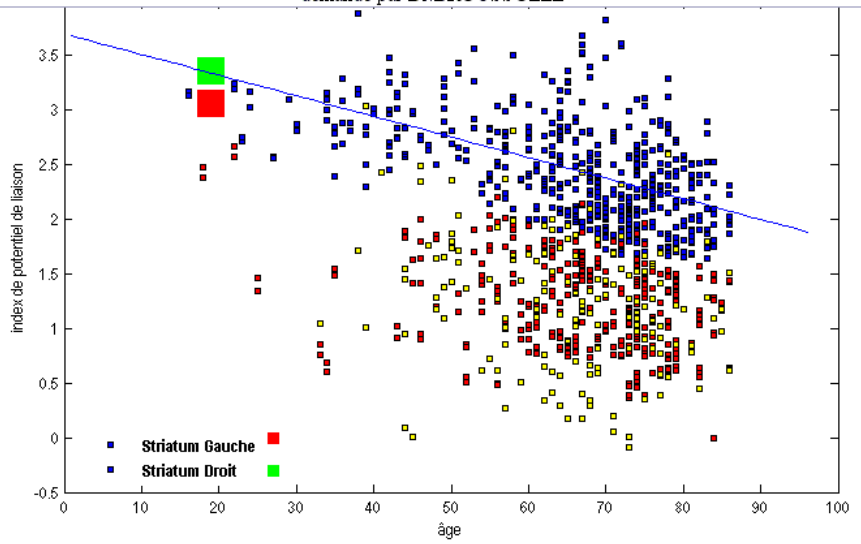
Left foot dystonia
Girl 14 y old



Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

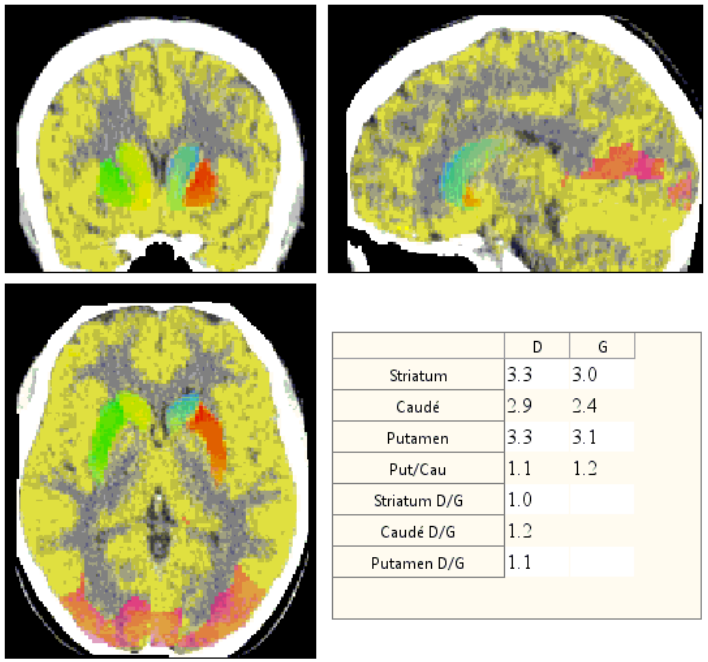
Mme.Anna. [redacted] 16/11/1994.Datscan du.29/08/2013

demandé par Dr.BROUSSOLLE

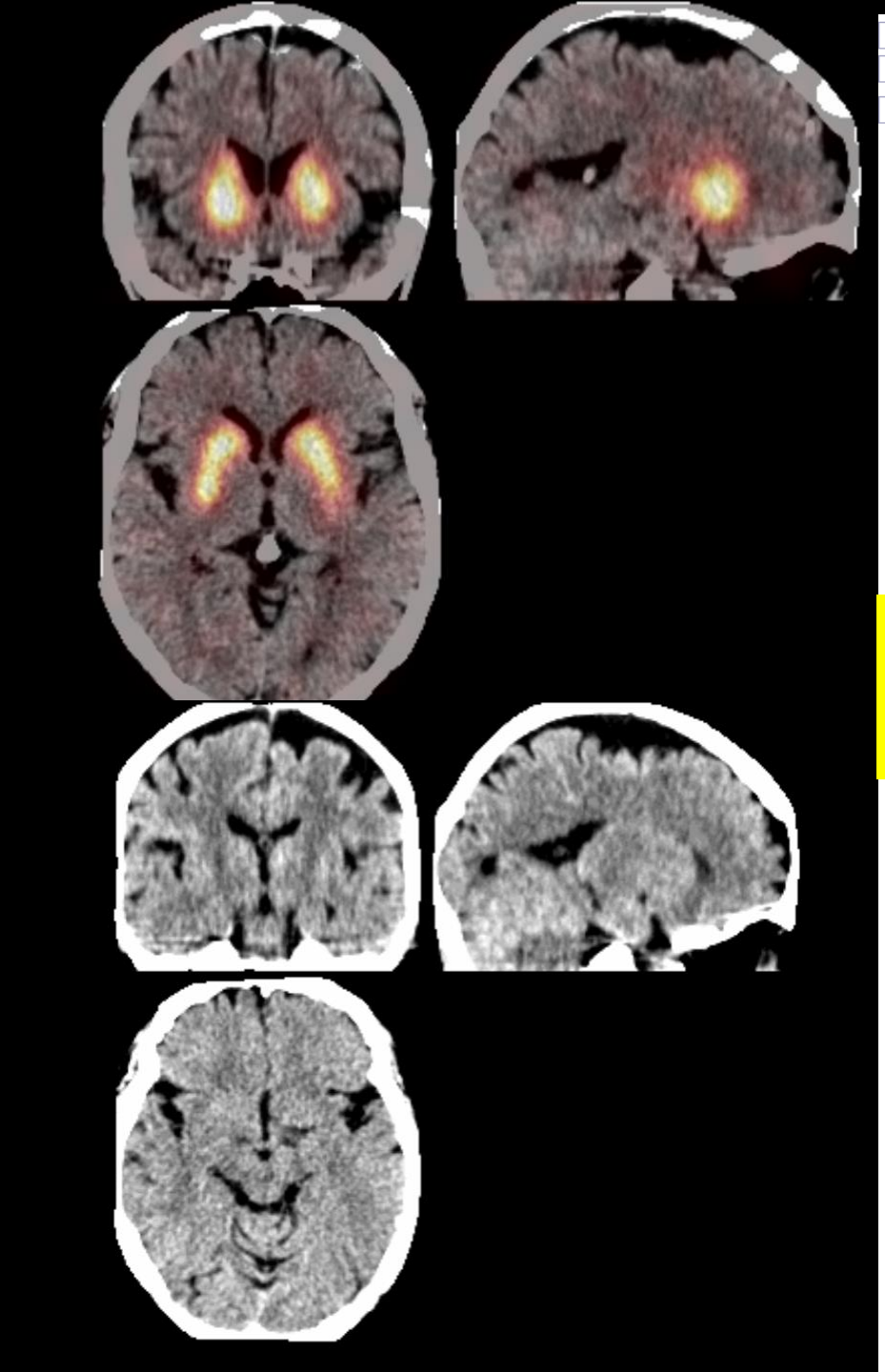


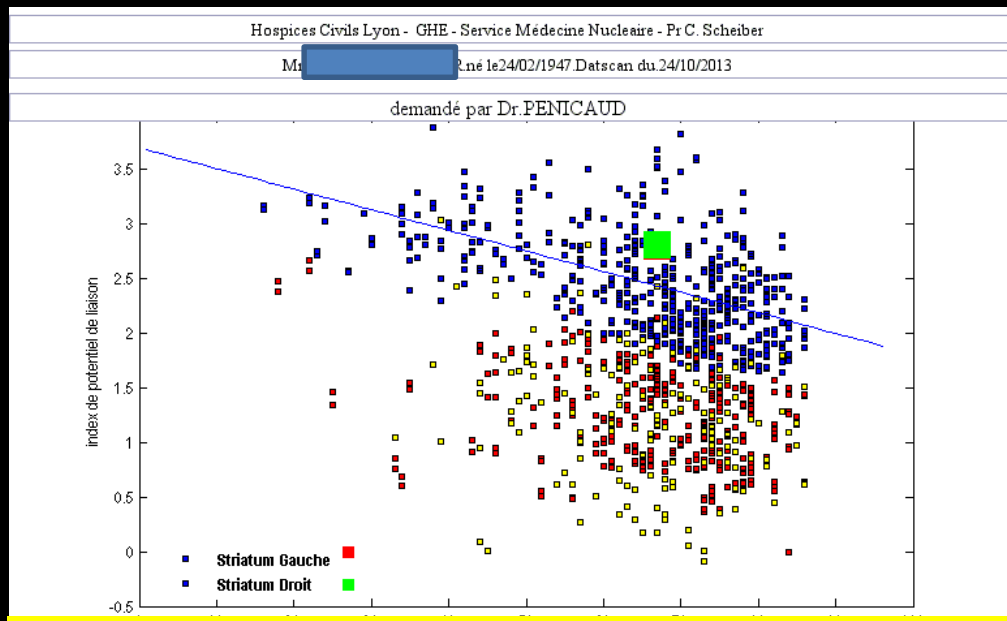
Analyse DAT semi-quantitative MN-GHE v 2012

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques

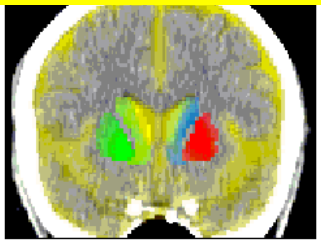


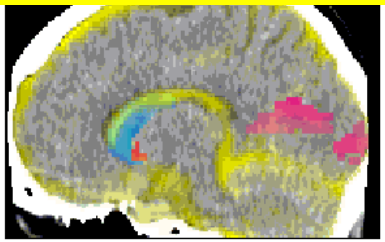
	D	G
Striatum	3.3	3.0
Caudé	2.9	2.4
Putamen	3.3	3.1
Put/Cau	1.1	1.2
Striatum D/G	1.0	
Caudé D/G	1.2	
Putamen D/G	1.1	

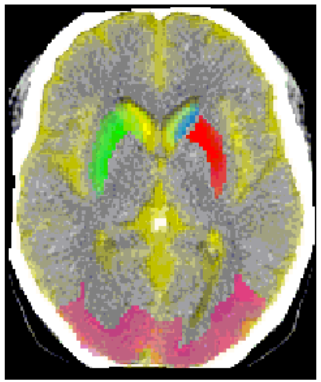




Woman 66 years
Atypical Rest Less Legs Syndrome
after chinkungunya virus disease







	D	G
Striatum	2.8	2.7
Caudé	1.9	1.5
Putamen	3.4	3.7
Put/Cau	1.9	2.5
Striatum D/G	0.9	
Caudé D/G	1.2	
Putamen D/G	0.9	

NORMAL IMAGE in ESSENTIAL TREMOR

- Begin gradually
- Worsen with movement
-Usually occur in the hands first, affecting one hand or both hands
- Can include a "yes-yes" or "no-no" motion of the head
-Are aggravated by emotional stress, fatigue, caffeine or extremes of temperature

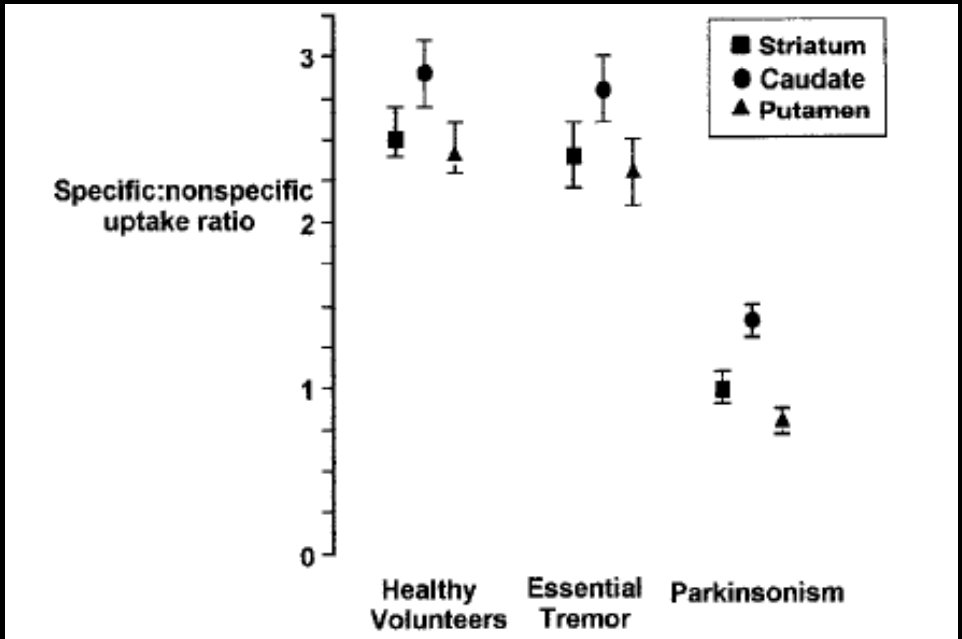


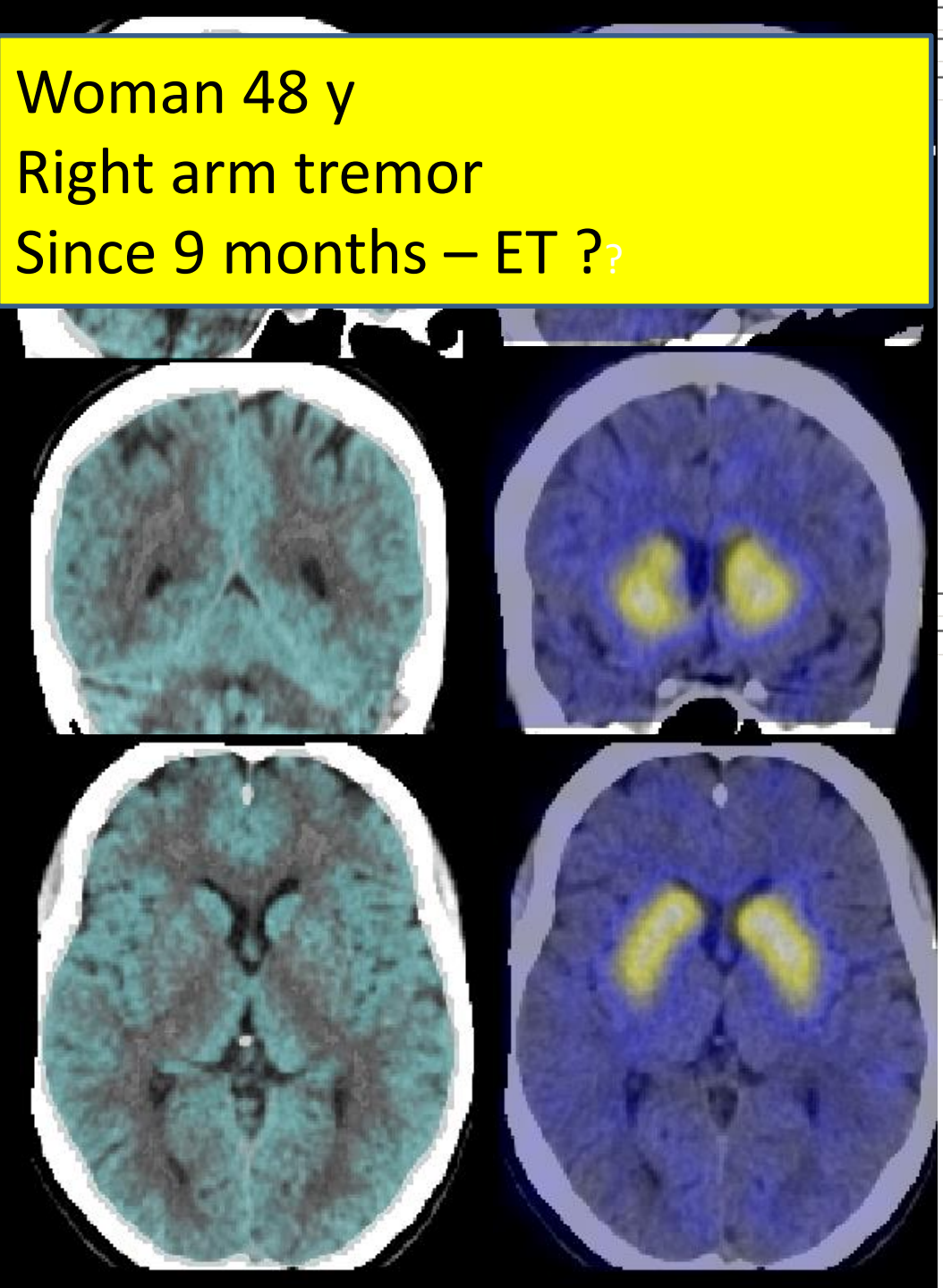
FIG. 2. Mean specific:nonspecific uptake ratio in per-protocol patients with parkinsonism (n = 115), essential tremor (n = 16), and healthy volunteers (n = 27). Specific:nonspecific ratio is significantly reduced in parkinsonism compared with essential tremor and healthy volunteers ($p < 0.001$). Data are mean and 95% confidence interval.

". up to 25% of patients initially diagnosed as idiopathic Parkinson's disease (iPD), later having their diagnosis changed to ET. " Mov. Dis. 15 (2000): 503-10

Woman 48 y

Right arm tremor

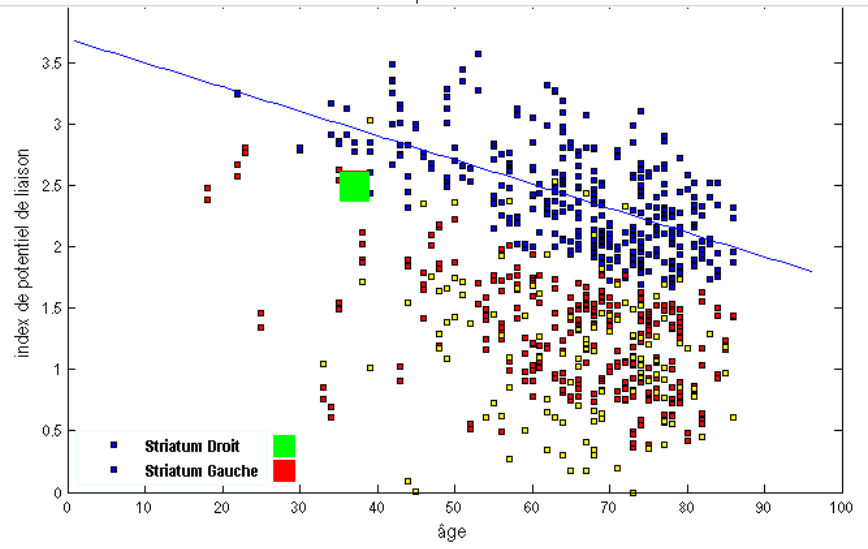
Since 9 months – ET ??



Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

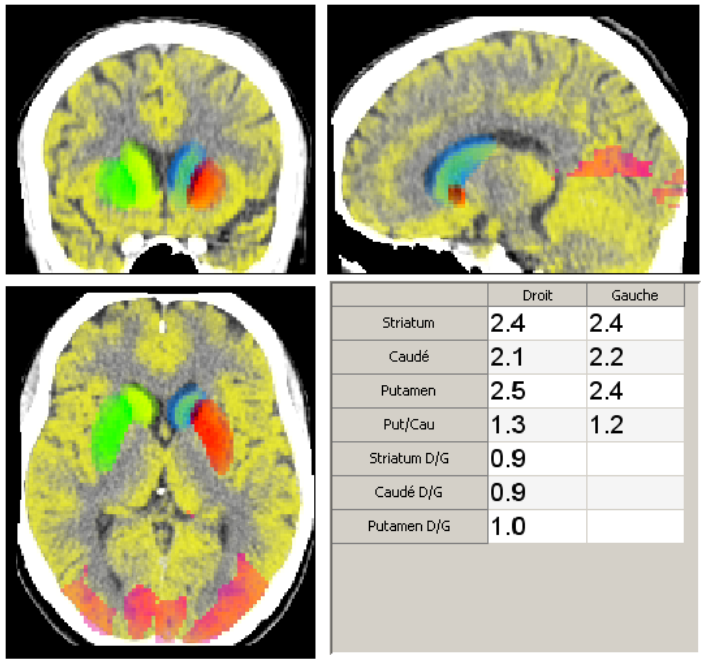
Mme.Yannick.PUITS.né le31/12/1973.Datscan du.01/03/2011

demandé par Dr.DROUET



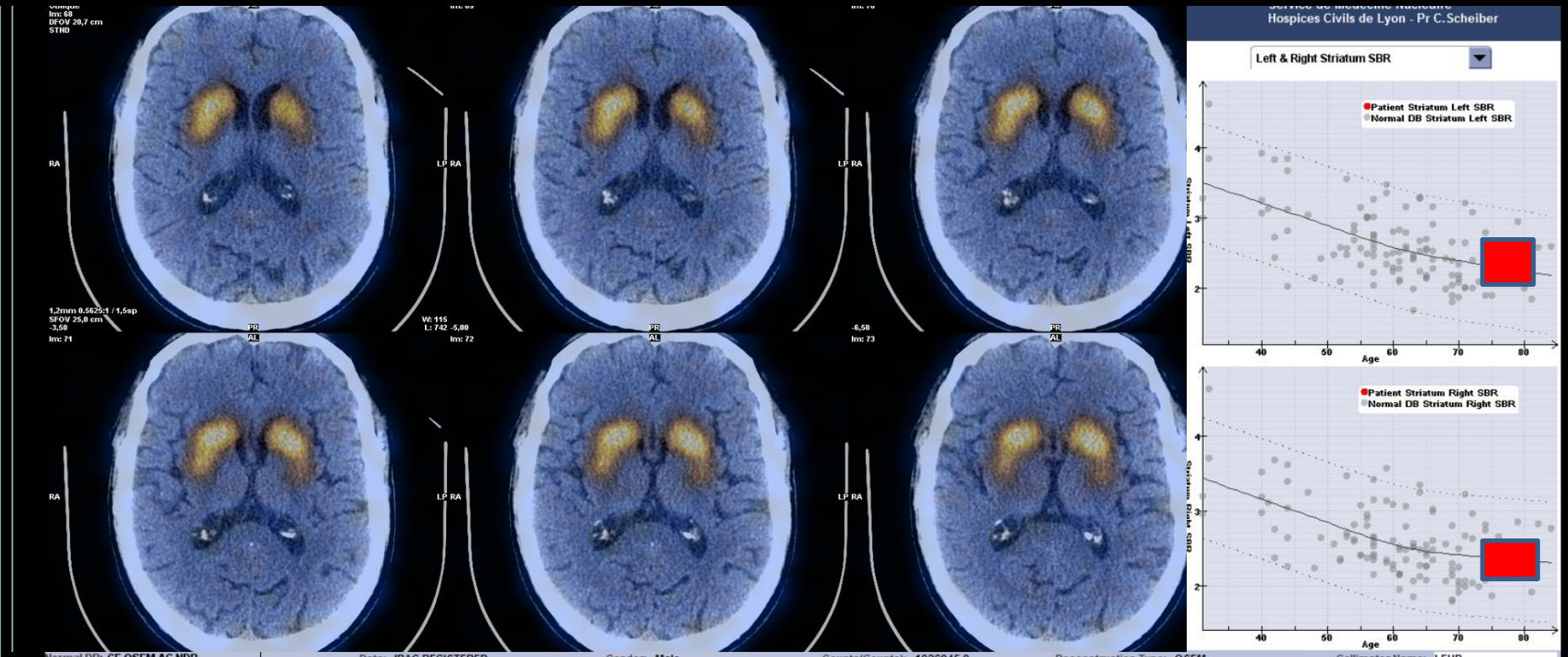
Analyse DAT semi-quantitative MN-GHE v 2010

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques



	Droit	Gauche
Striatum	2.4	2.4
Caudé	2.1	2.2
Putamen	2.5	2.4
Put/Cau	1.3	1.2
Striatum D/G	0.9	
Caudé D/G	0.9	
Putamen D/G	1.0	

Essential Tremor DaTSCAN normal f° age



Normal DB: GE OSEM AC NDB	Data: IRAC REGISTERED	Gender: Male	Counts(Counts): 1926945,0	Reconstruction Type: OSEM	Collimator Name: LEHR
GE normals database for OSEM with att...	Camera: Tandem_Apollo	Age(Years): 77	Dose(MBq): 122,0	Corrections: Attenuation correction	Collimator Type: Parallel

Normal DB mismatch – Corrections : Attenuation correction (Chang attenuation correction)

	Striatum Right SBR	Striatum Left SBR	Putamen Right SBR	Putamen Left SBR	Caudatus Right SBR	Caudatus Left SBR
Measured	+2,38	+2,14	+2,08	+1,80	+3,07	+2,81
Mean (±1 SD)	+2,36 (±0,40)	+2,29 (±0,42)	+2,27 (±0,39)	+2,19 (±0,41)	+2,57 (±0,48)	+2,48 (±0,50)
Deviation	+1%	-7%	-8%	-18%	+19%	+13%
Z-Score	+0,05	-0,35	-0,48	-0,96	+1,04	+0,66

Simple Advanced Ratios Asymmetry

datquant
14:44:00.0

[Hybrid QC passed , Non-Rigid Registration : Automatic Processing]

Nigrostriatal pathway imaging in PD

DATscan

PD is a clinical diagnosis but … 10-20 % errors in specialized centers

Idiopathic PD : 60 - 80% parkinsonism

-Sensitivity ?

- Specificity ?

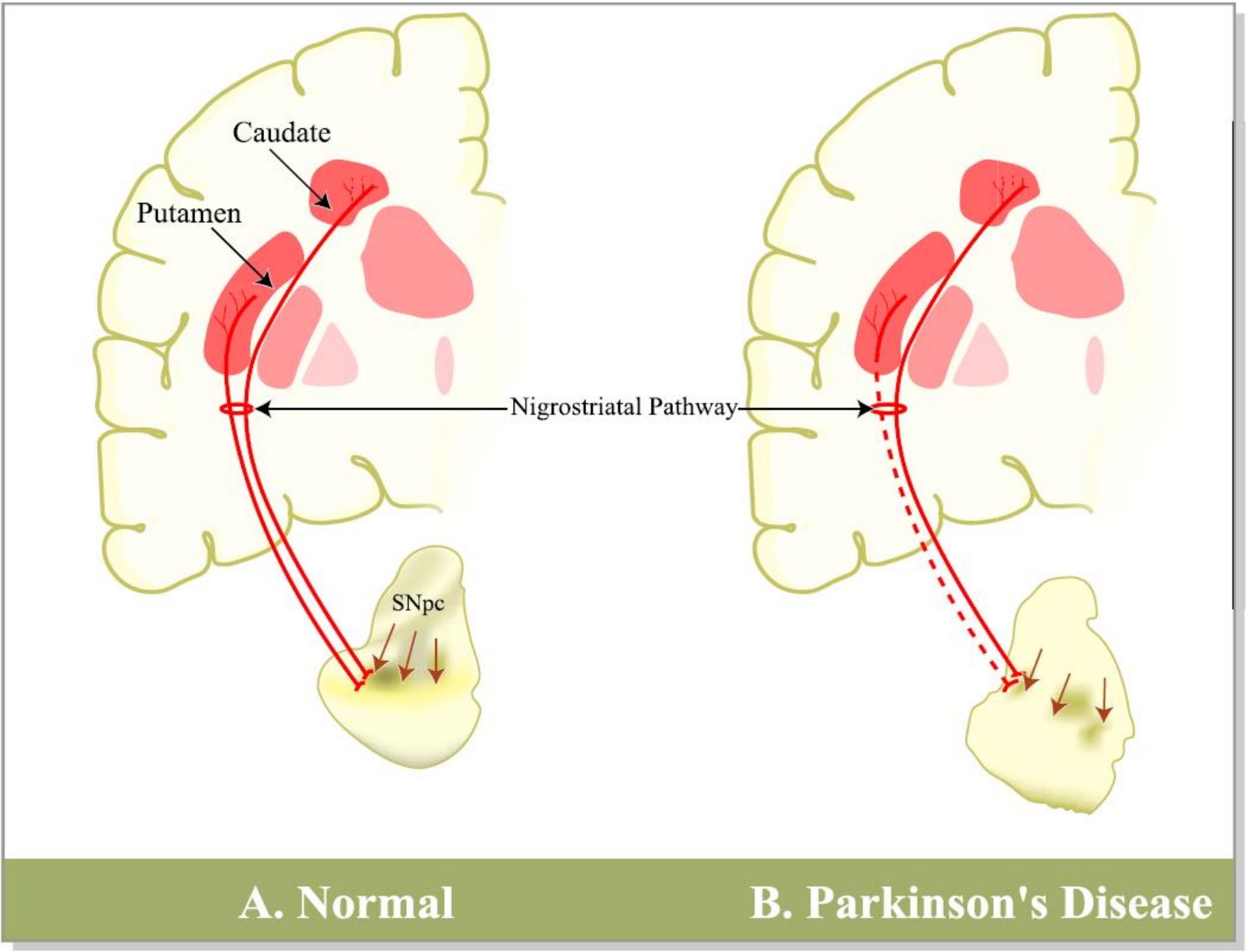
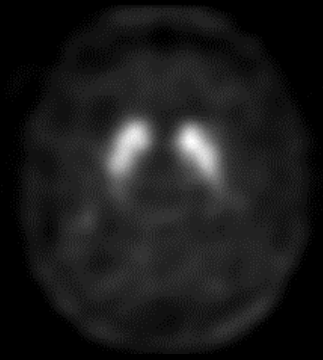


Figure by MIT OCW.

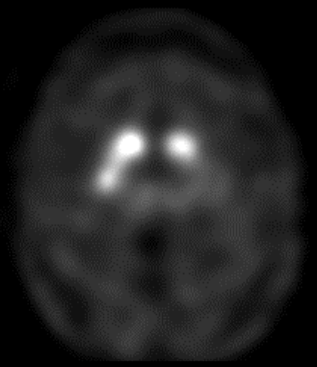
Dauer & Przedborski (2003)

DaTSCAN visual analysis - PCNS advisory document 2009

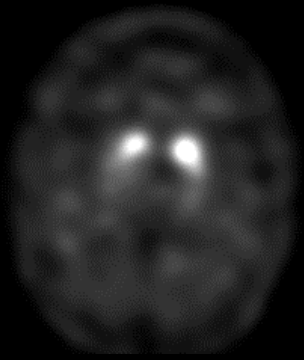
-



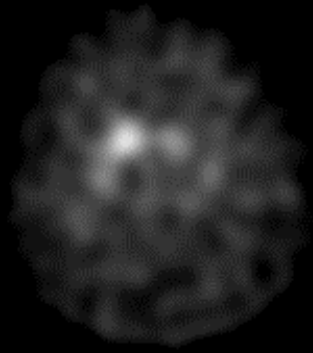
Normal Uptake



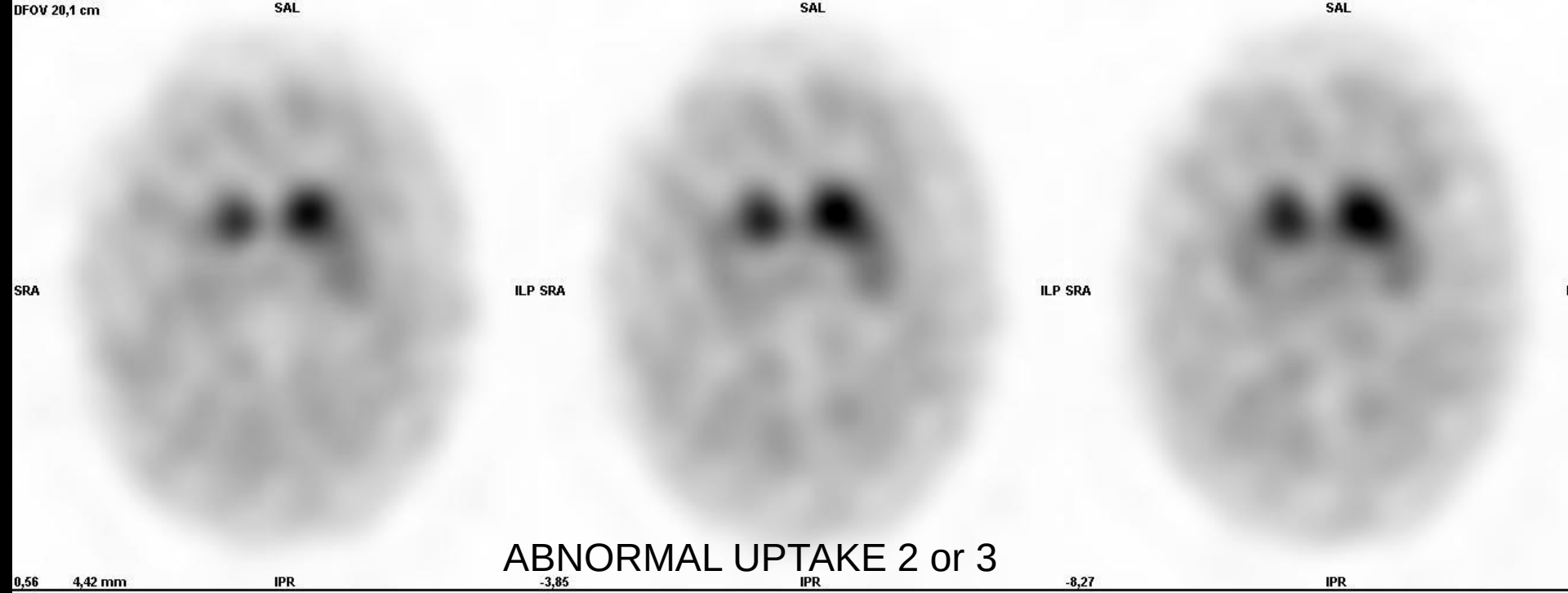
Abnormal Uptake Type 1

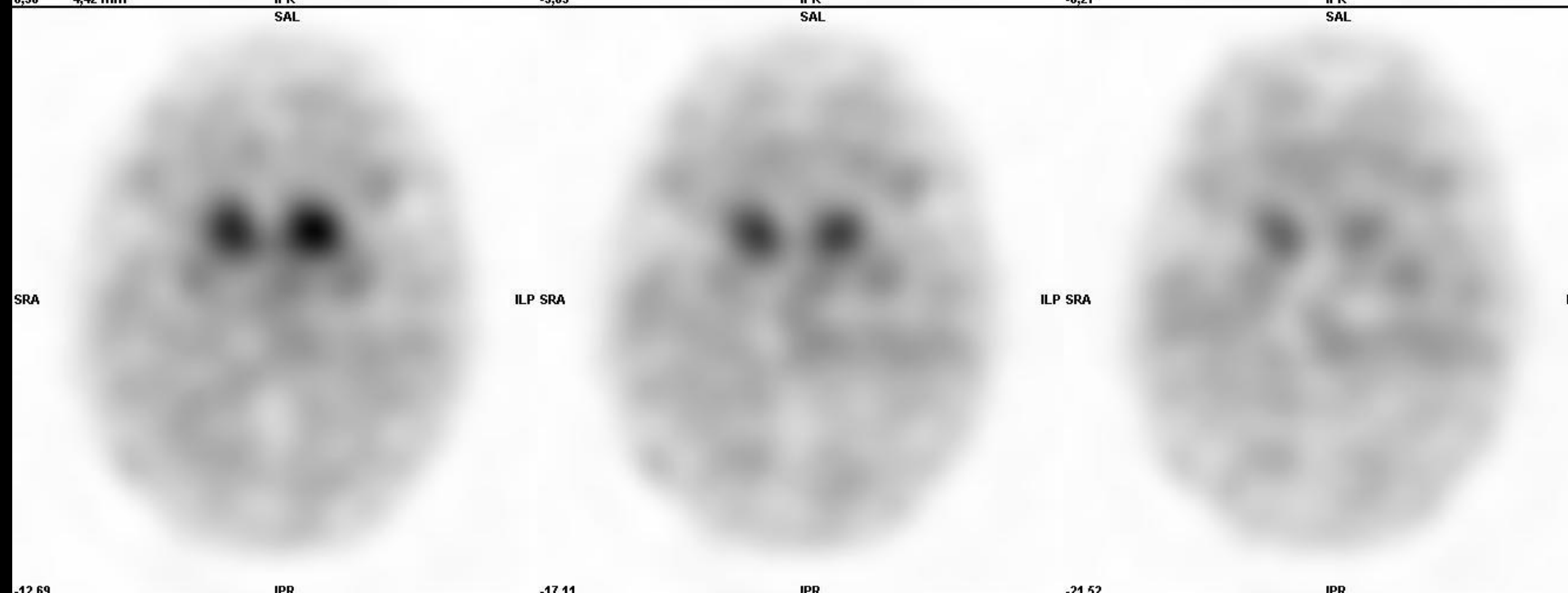


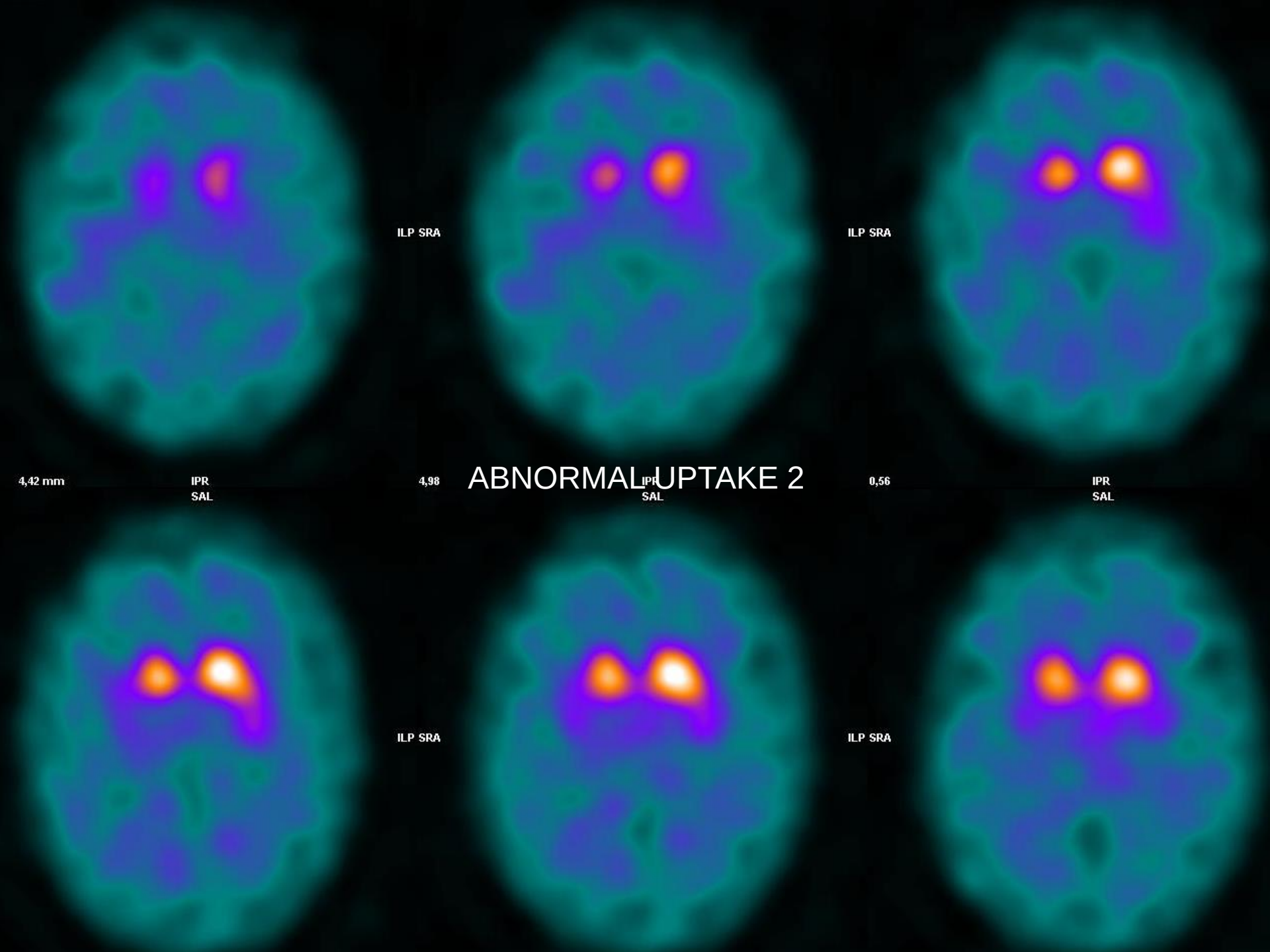
Abnormal Uptake Type 2



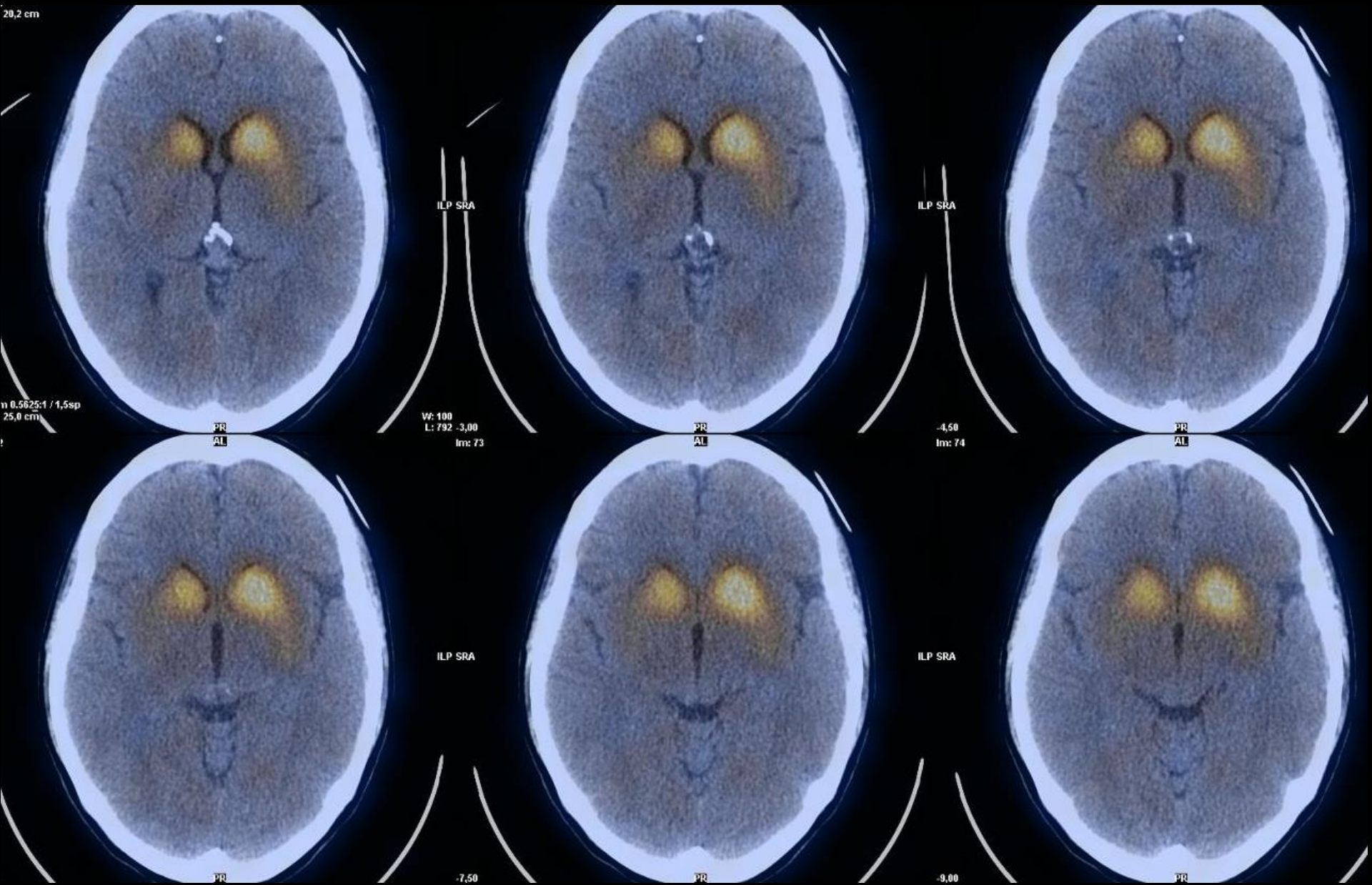
Abnormal Uptake Type 3


DFOV 20,1 cm
SAL
SAL
SAL
SRA
ILP SRA
ILP SRA
ABNORMAL UPTAKE 2 or 3
0,56
4,42 mm
IPR
-3,85
IPR
-8,27
IPR


SAL
SAL
SAL
SRA
ILP SRA
ILP SRA
-12,69
IPR
-17,11
IPR
-21,52
IPR



ABNORMAL UPTAKE 2


20,2 cm
ILP SRA
W: 100
L: 792 -3,00
Im: 73
PR
AL
ILP SRA
-4,50
Im: 74
PR
AL
ILP SRA
-7,50
PR
ILP SRA
-9,00
PR

Ioflupane Semiquantitative Analysis

- Mandatory – especially for non-specialists
- Use « normal DB f°age
- Several softwares
- Choose one
- Know +/-

Automatic semi-quantification of [^{123}I]FP-CIT SPECT scans in healthy volunteers using BasGan version 2: results from the ENC-DAT database

Flavio Nobili · Mehrdad Naseri · Fabrizio De Carli · Susan Asenbaum · Jan Booij · Jacques Darcourt · Peter Ell · Özlem Kapucu · Paul Kemp · Claus Varer · Silvia Morbelli · Marco Pagani · Osama Sabri · Klaus Tatsch · Livia Tossici-Bolt · Terez Sera · Tierry Vander Borght · Koen Van Laere · Andrea Varrone

A total of 151 healthy controls (80 men, 71 women, age 20–83 years, mean 53) were included in the study by 13 centres in 10 European countries. The health status of subjects was carefully checked by means of medical history, blood chemistry, general medical and neurological evaluation, including the Unified Parkinson's Disease Rating Scale (UPDRS), and psychiatric evaluation, including the symptom checklist (SCL)-90-R [13] and the Beck Depression Inventory

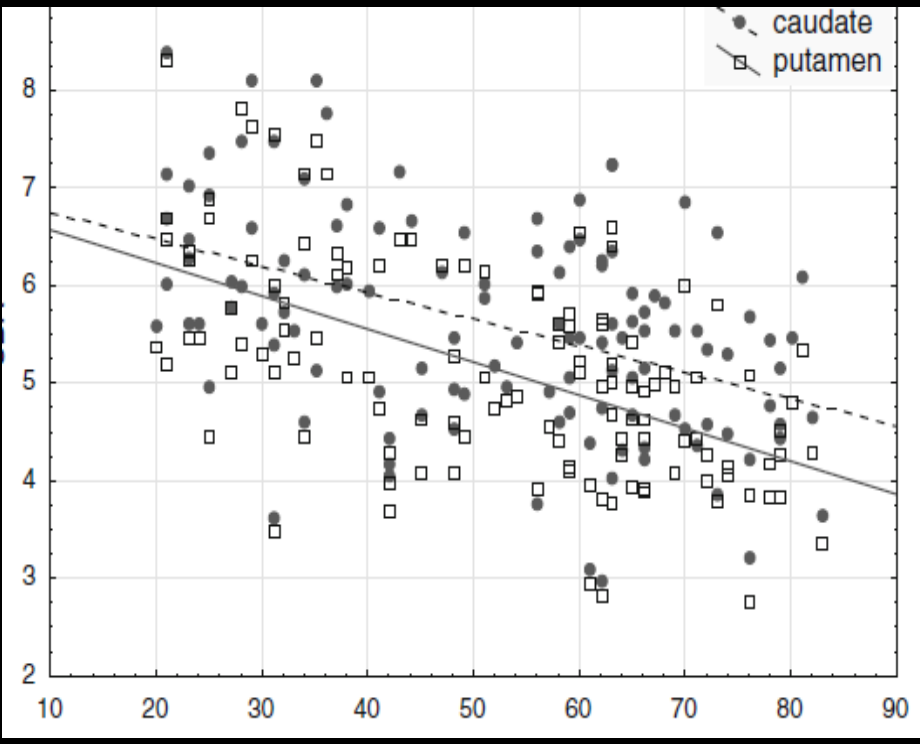
Eur J Nucl Med Mol Imaging
DOI 10.1007/s00259-012-2304-8

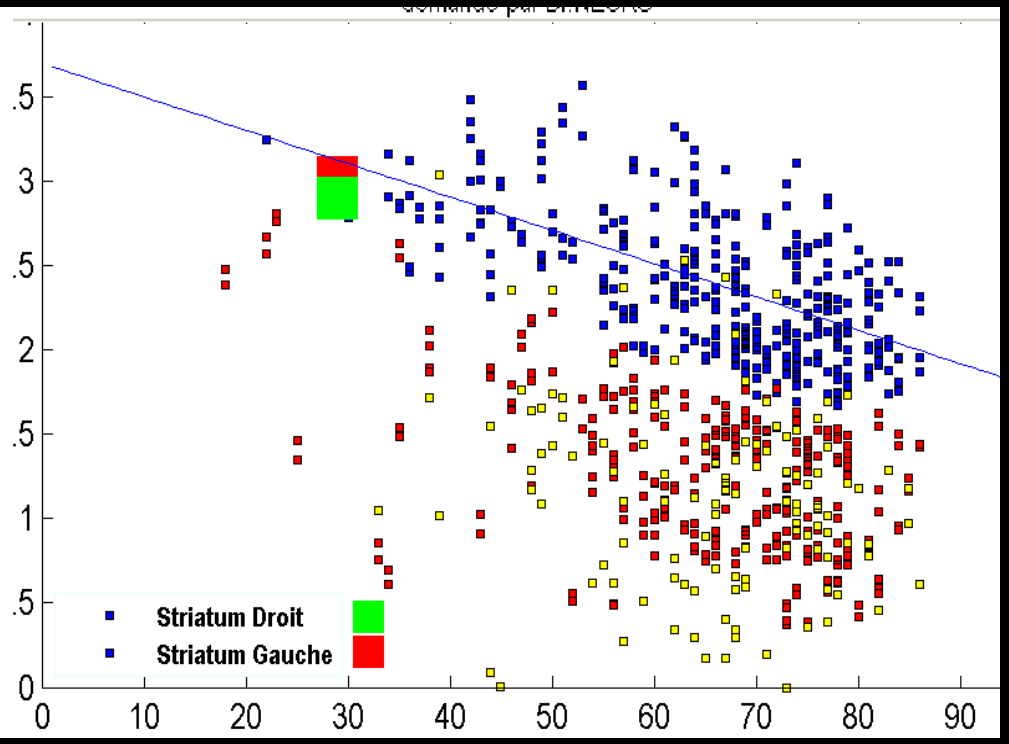
SBR=6.8 -0.027* age +-1.88 caude (PVC)

SBR=7.23-0.033* age +-1.77 putamen (PVC)

5.7% /10a - Publis 4-8% /10a

Lyon local database
SBR=3.7 - 0.019 *age striatum (NoPVC)





BRASS

Hermes Medical Solution, Stockholm, Sweden

ENC-DAT

Scan Inj + 3H

European multicentre database of healthy controls for [^{123}I] FP-CIT SPECT (ENC-DAT): age-related effects, gender differences and evaluation of different methods of analysis

Andrea Varrone · John C. Dickson · Livia Tossici-Bolt · Terez Sera · Susanne Asenbaum · Jan Booij · Ozlem L. Kapucu · Andreas Kluge · Gitte M. Knudsen · Pierre Malick Koulibaly · Flavio Nobili · Marco Pagani · Osama Sabri · Thierry Vander Borght · Koen Van Laere · Klaus Tatsch

Eur J Nucl Med Mol Imaging (2013) 40:213–227

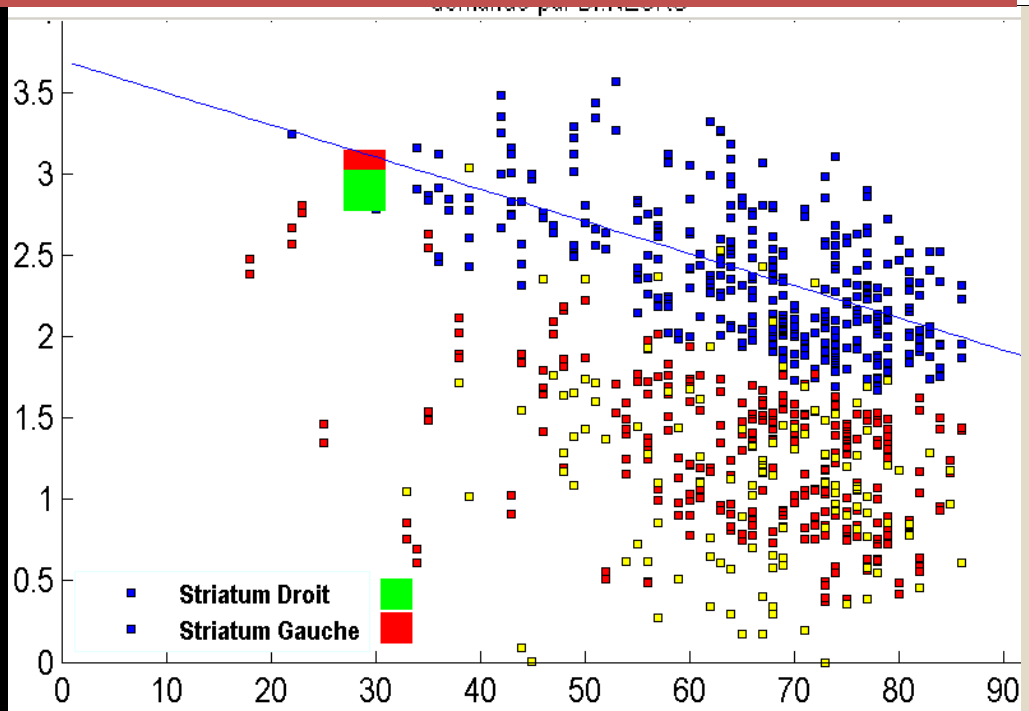
SBR= - 0.042 to - 0.058 * age

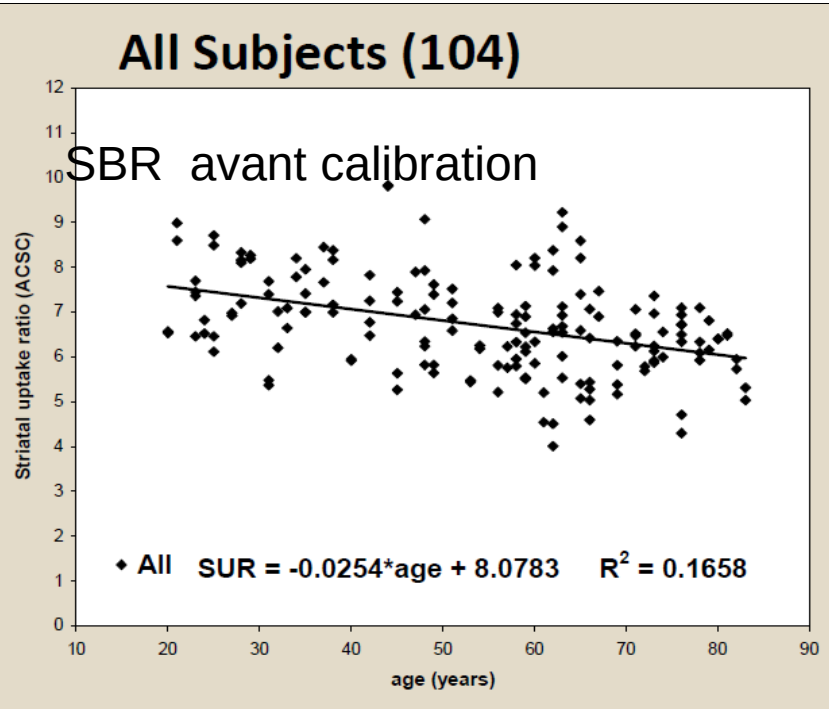
résultats / noyau publiés

Lyon local database

SBR=-0.019*age + 3.7 striatum (NoPVC No calibration)

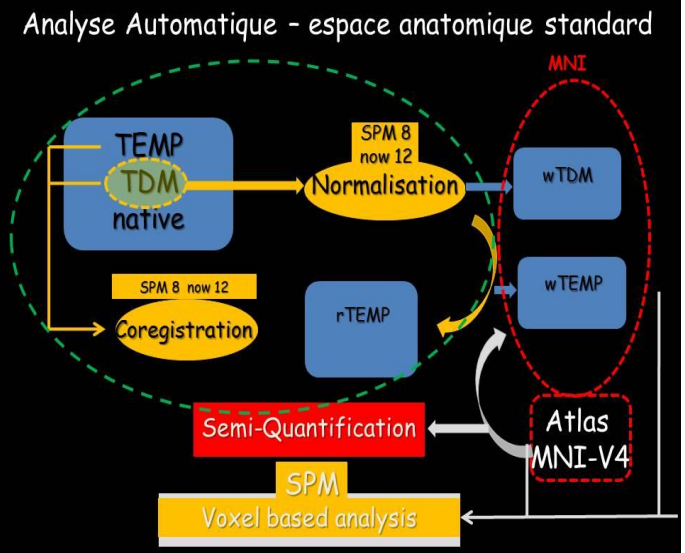
SUR = -0.0254*age + 8.0783 R^2 = 0.1658

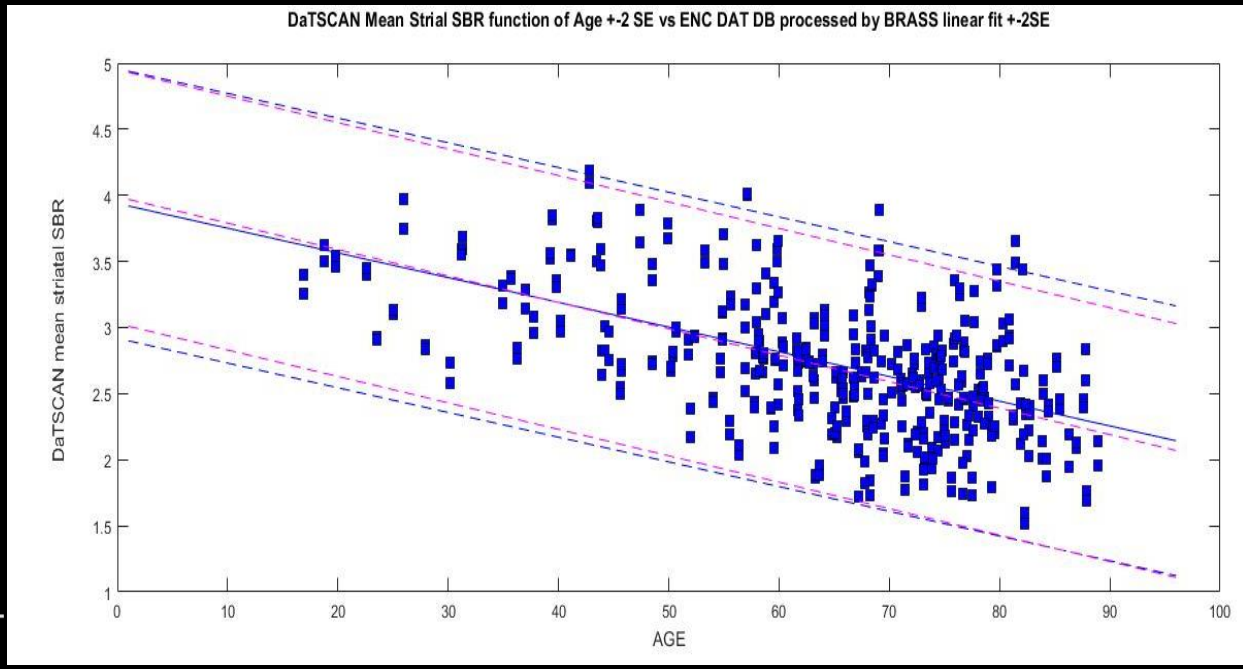




More than 2500 DaTSCAN studies 2008-2016

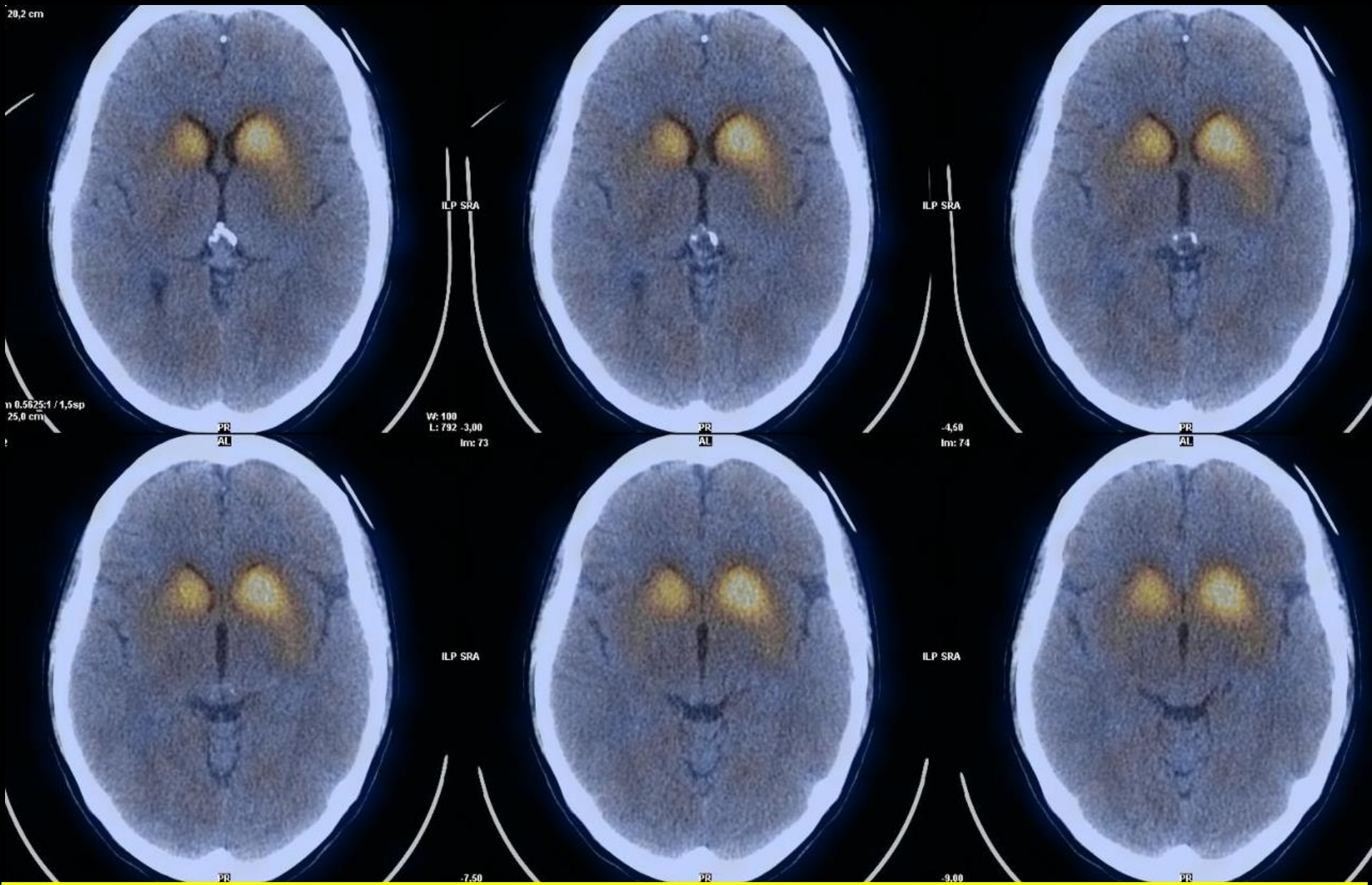
Symbia T2 acquisition Ioflupane 185 MBq





Local normal DB from patients normal DaTSCAN (n=252)

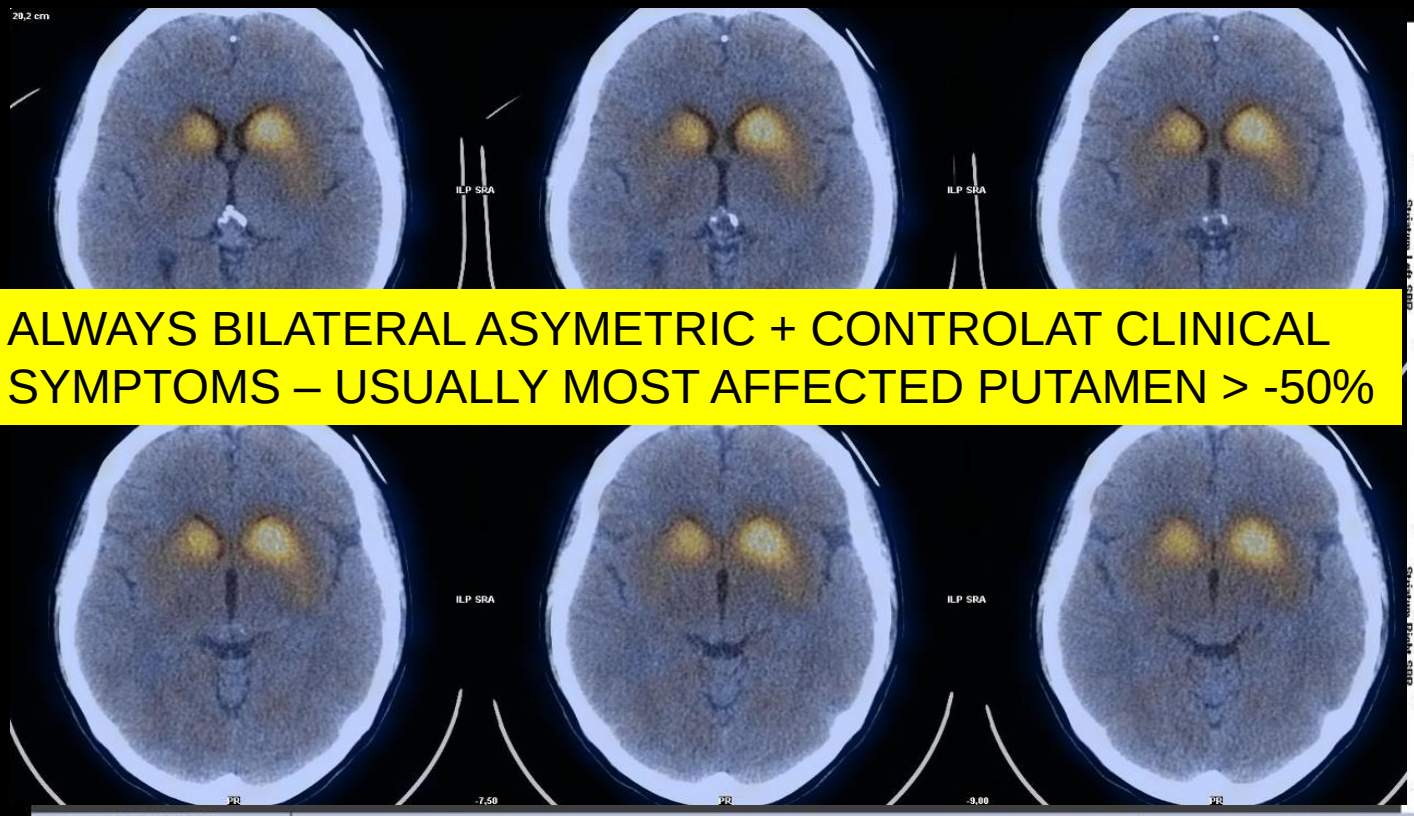
4- 5 years follow up (clinical diagnostic)



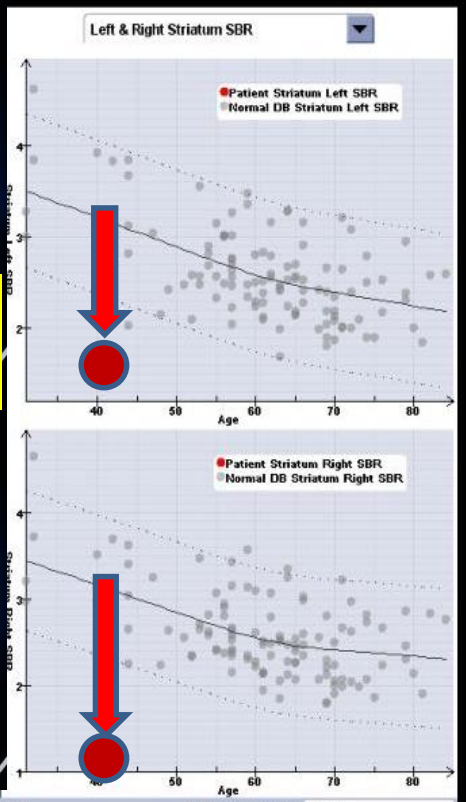
PARKINSON DISEASE : ALWAYS BILATERAL ASYMETRIC + CONTROLAT
CLINICAL SYMPTOMS USUALLY MOST AFFECTED PUTAMEN > -50%

Service de Médecine NucléaireHospices Civils de Lyon - Pr C.Scheiber

Manufacturer Model: Tandem_Apollo



ALWAYS BILATERAL ASYMETRIC + CONTROLAT CLINICAL SYMPTOMS – USUALLY MOST AFFECTED PUTAMEN > -50%



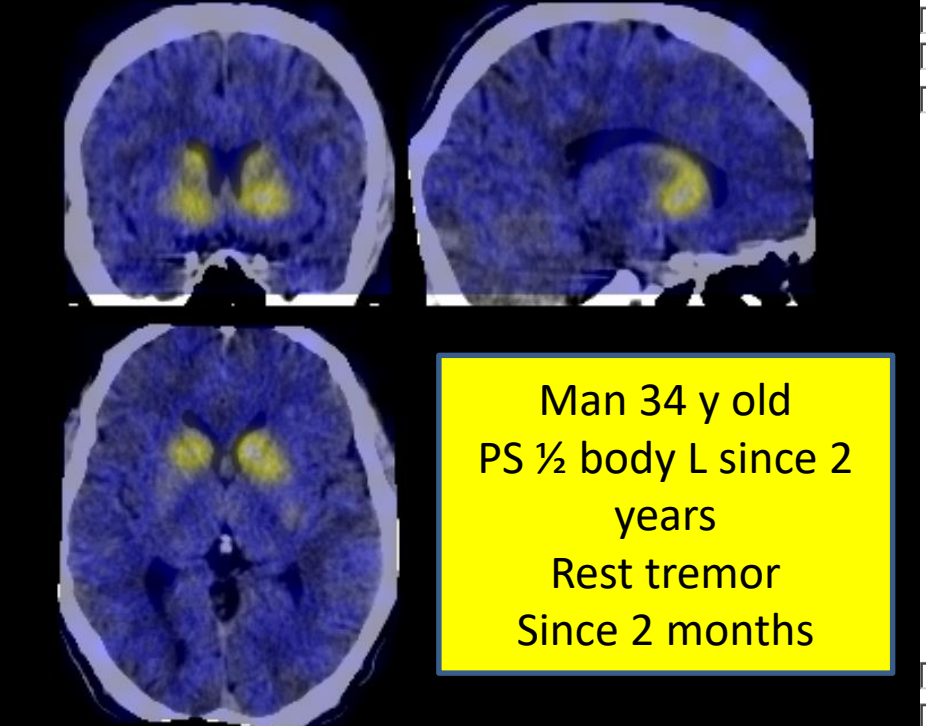
Normal DB: GE OSEM AC NDB	Data: IRAC REGISTERED	Gender: Female	Counts(Counts): 2102135,0	Reconstruction Type: OSEM	Collimator Name: LEHR	
GE normals database for OSEM with att...	Camera: Tandem_Apollo	Age(Years): 41	Dose(MBq): 125,0	Corrections: Attenuation correction	Collimator Type: Parallel	
Normal DB mismatch - Corrections : Attenuation correction (Chang attenuation correction)						

	Striatum Right SBR	Striatum Left SBR	Putamen Right SBR	Putamen Left SBR	Caudatus Right SBR	Caudatus Left SBR
Measured	+1,04	+1,43		+1,12	+1,54	+2,04
Mean (±1 SD)	+3,13 (±0,40)	+3,18 (±0,42)	+3,01 (±0,39)	+3,02 (±0,41)	+3,41 (±0,48)	+3,50 (±0,50)
Deviation	-67%	-65%		-63%	-55%	-42%
Z-Score	-5,17	-4,15	-5,59	-4,65	-3,87	-2,92

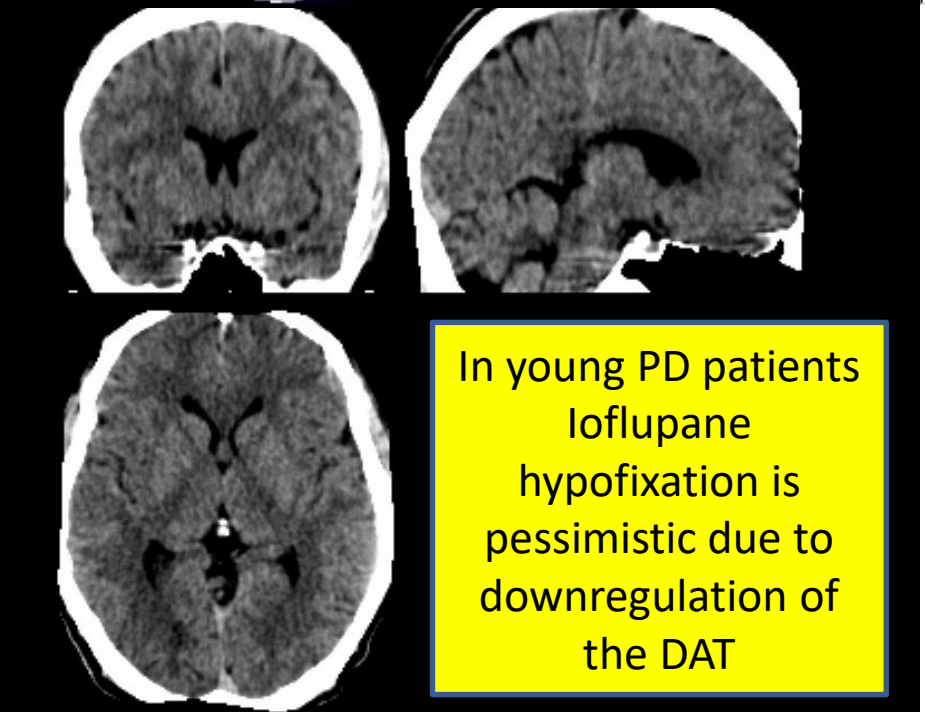
RIGHT PUTAMEN

- 73 %

Simple Advanced Ratios Asymmetry



Man 34 y old
PS ½ body L since 2 years
Rest tremor
Since 2 months

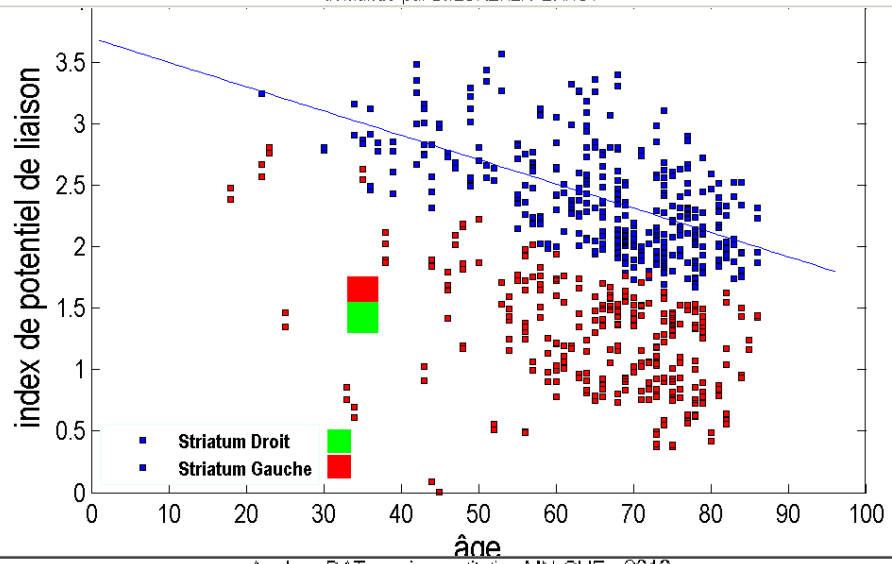


In young PD patients Ioflupane hypofixation is pessimistic due to downregulation of the DAT

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

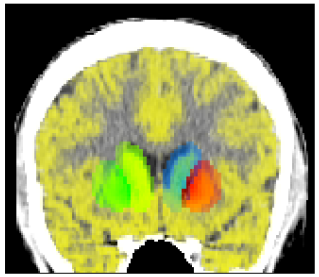
Mr.Emi [redacted] né le23/01/1977.Datscan du.28/06/2012

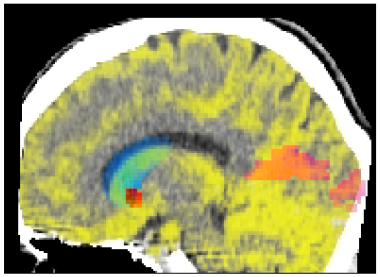
demandé par Dr.LORENZI-PERNOT

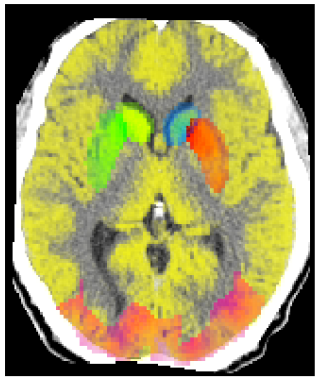


Analyse DAT semi-quantitative MN-GHE v 2010

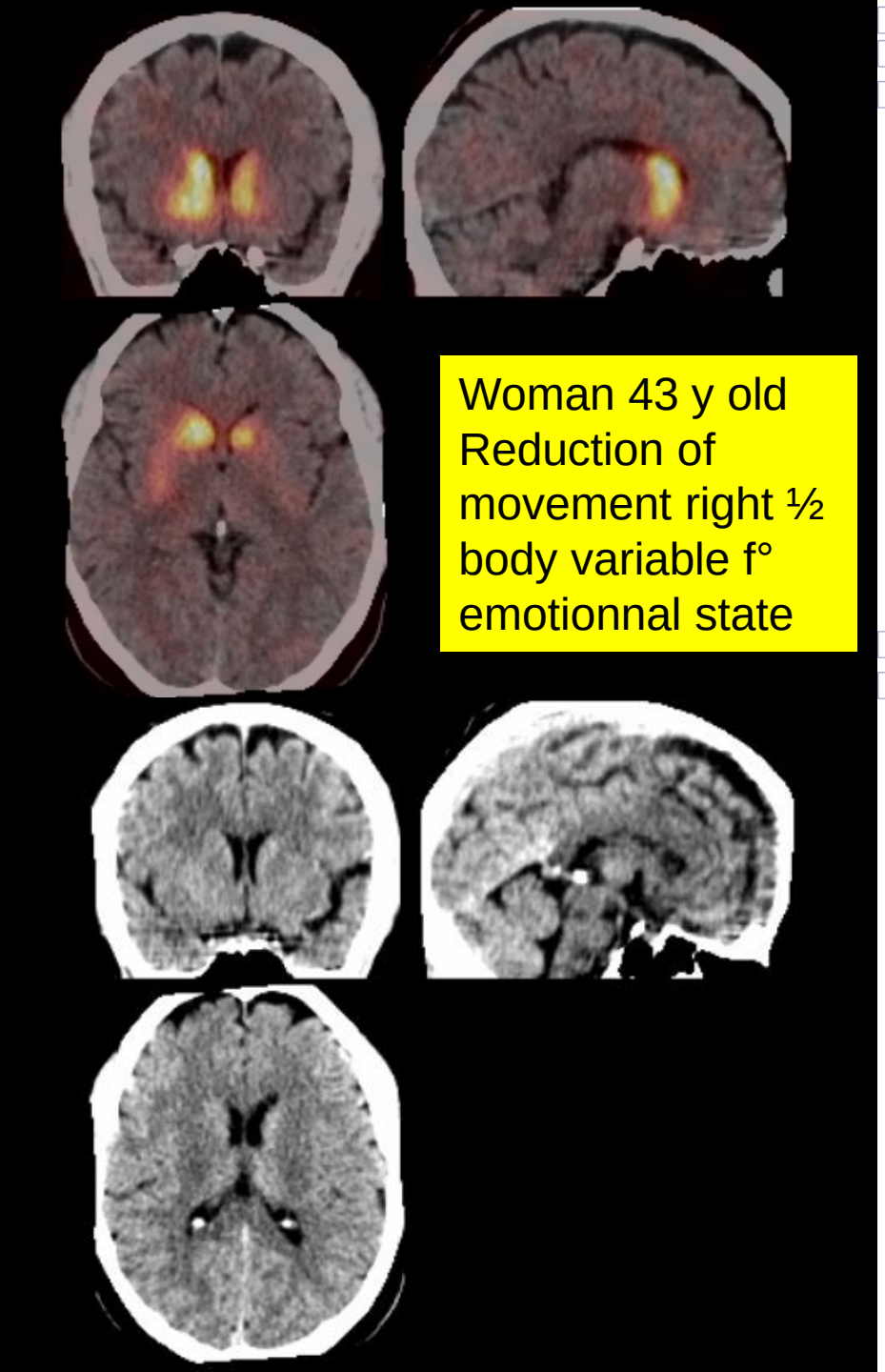
Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques







	Droit	Gauche
Striatum	1.4	1.6
Caudé	1.7	1.7
Putamen	1.0	1.3
Put/Cau	0.6	0.8
Striatum D/G	0.8	
Caudé D/G	0.9	
Putamen D/G	0.7	

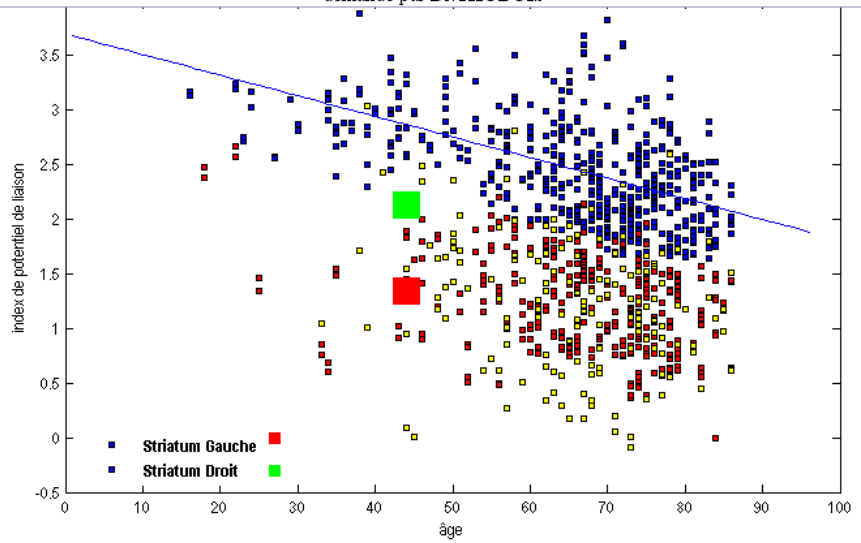


Woman 43 y old
Reduction of movement right ½ body variable f° emotionnal state

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

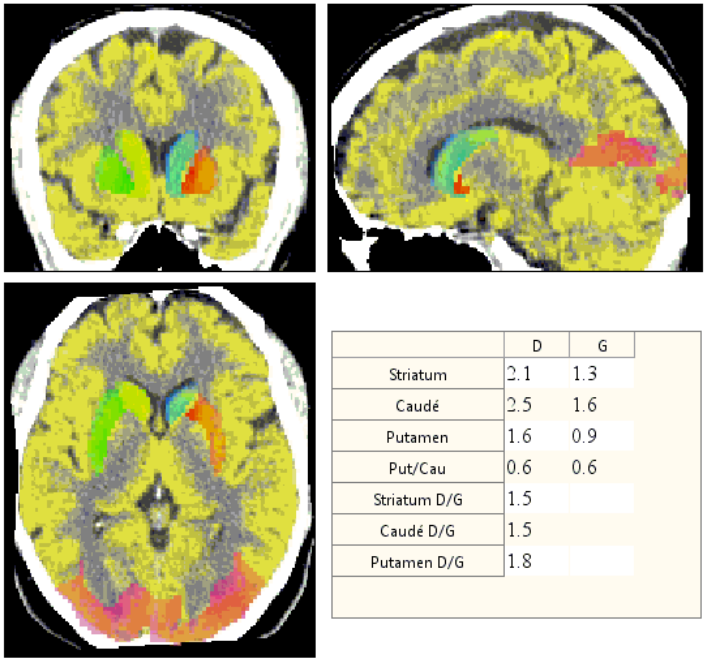
Mme.S [redacted] 03/1970.Datscan du.30/01/2014

demandé par Dr.THOBOIS



Analyse DAT semi-quantitative MN-GHE v 2012

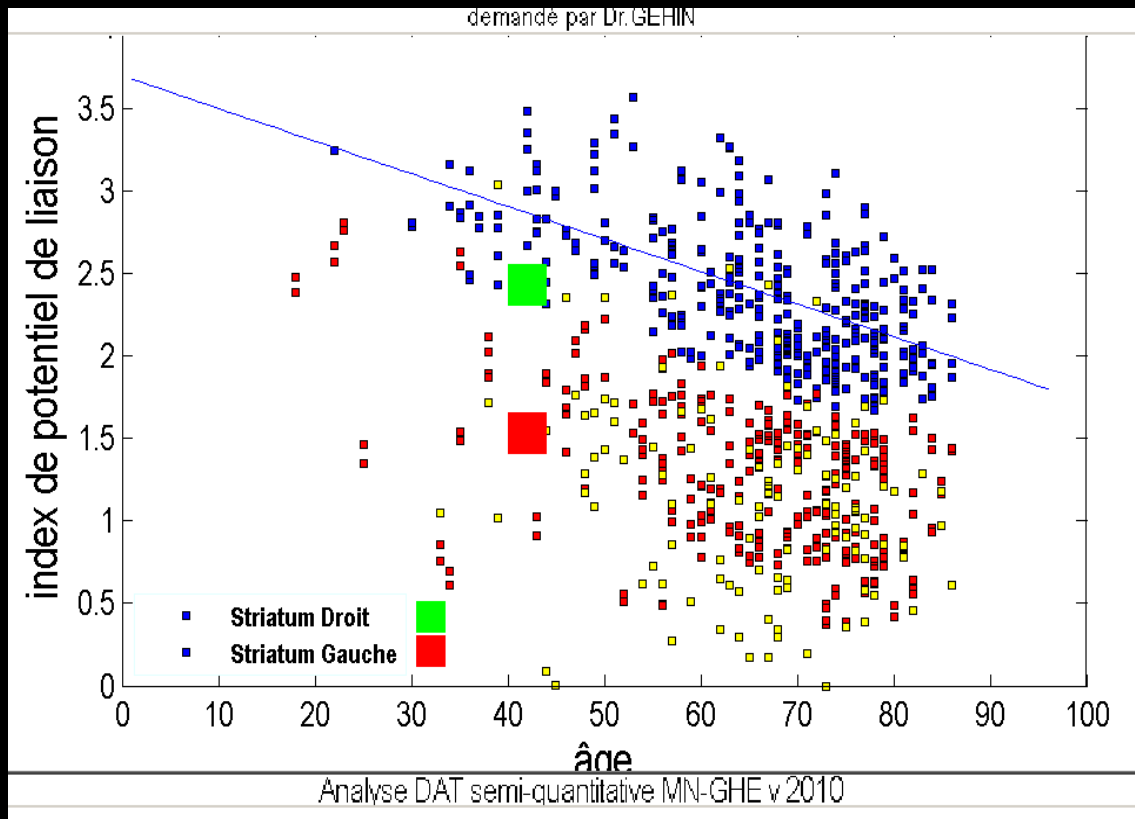
Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques



	D	G
Striatum	2.1	1.3
Caudé	2.5	1.6
Putamen	1.6	0.9
Put/Cau	0.6	0.6
Striatum D/G	1.5	
Caudé D/G	1.5	
Putamen D/G	1.8	

43 y old, right Parkinsonian right > left syndrome 6 months Brain MRI normal

MPI



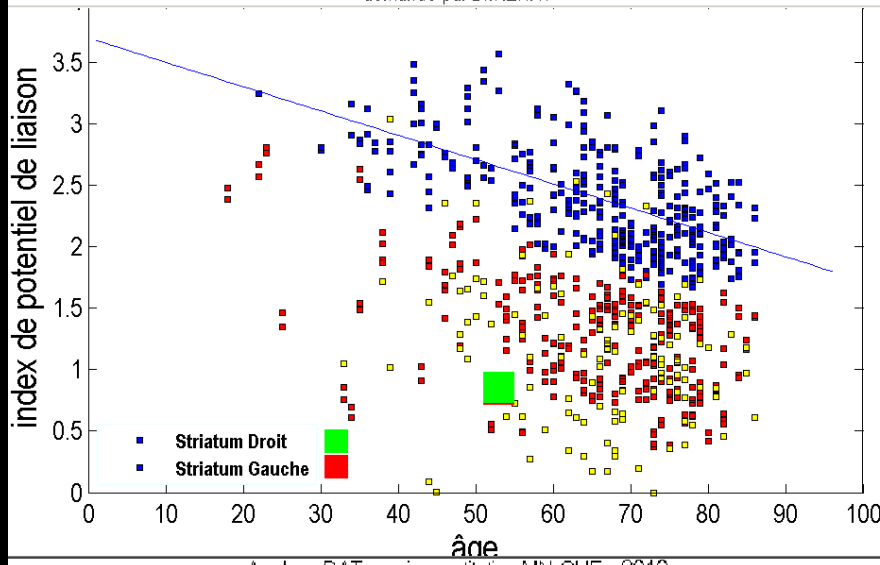
Male 54 y since 2 years hand tremor
increasing since several months
hypokinésia – hypomimia – fatigue

MPI 54 y old

- Service Médecine Nucleaire - Pr C. Scheiber

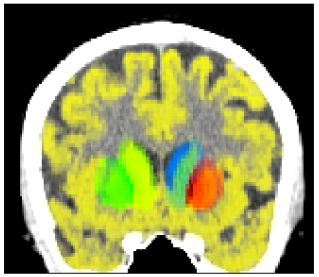
\O.né le04/11/1957.Datscan du.03/03/2011

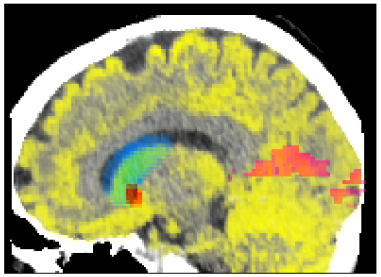
demandé par Dr.HENRY

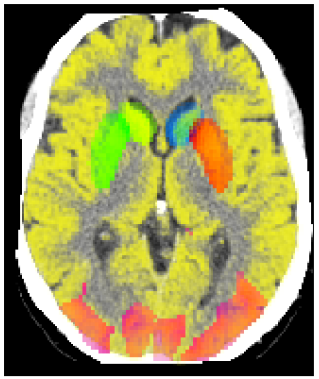


Analyse DAT semi-quantitative MN-GHE v 2010

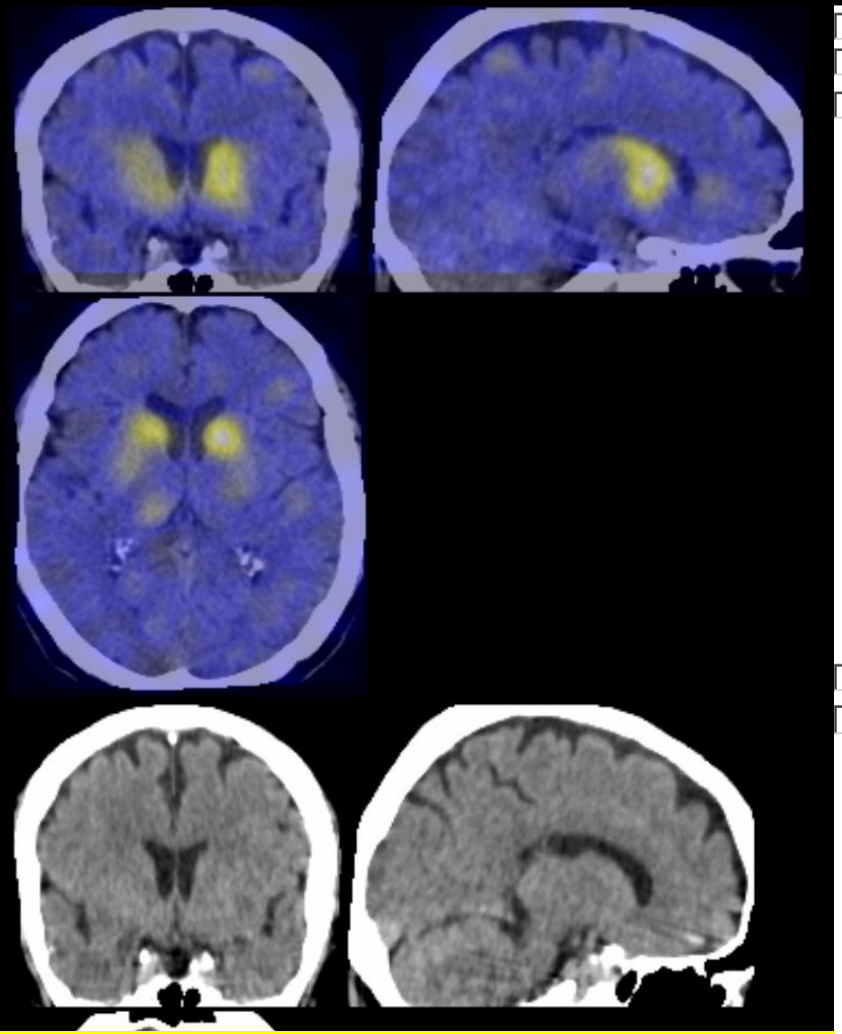
Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques







	Droit	Gauche
Striatum	0.8	0.8
Caudé	0.9	0.8
Putamen	0.7	0.6
Put/Cau	0.8	0.7
Striatum D/G	1.0	
Caudé D/G	0.9	
Putamen D/G	1.0	



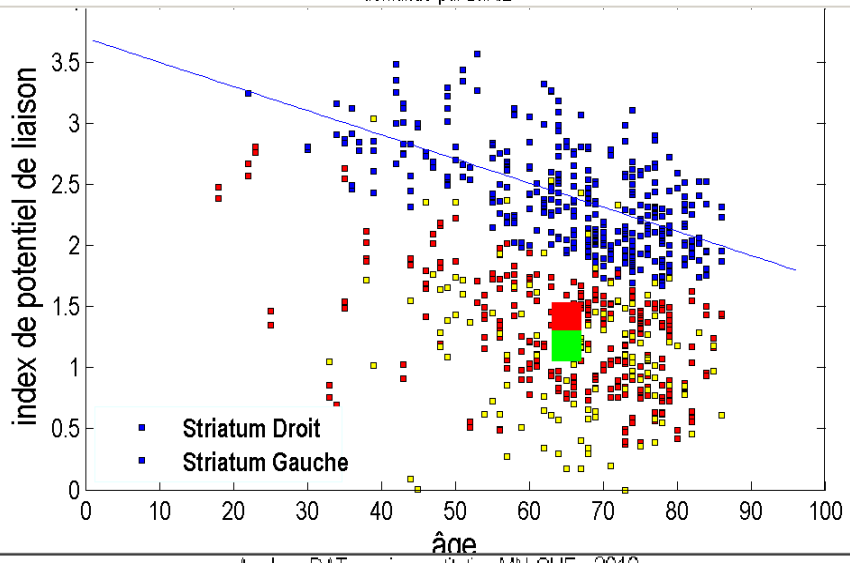
Male 55 y
MH : polyomyelitis

Since 6 months
Rest Tremor Left Hand

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

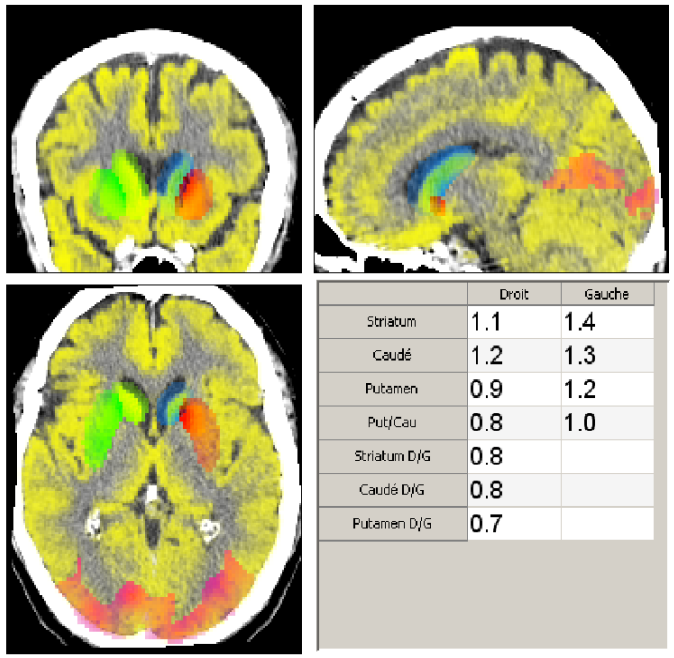
[redacted]07/10/1946.Datscan du.29/09/2011

demandé par Dr.XIE

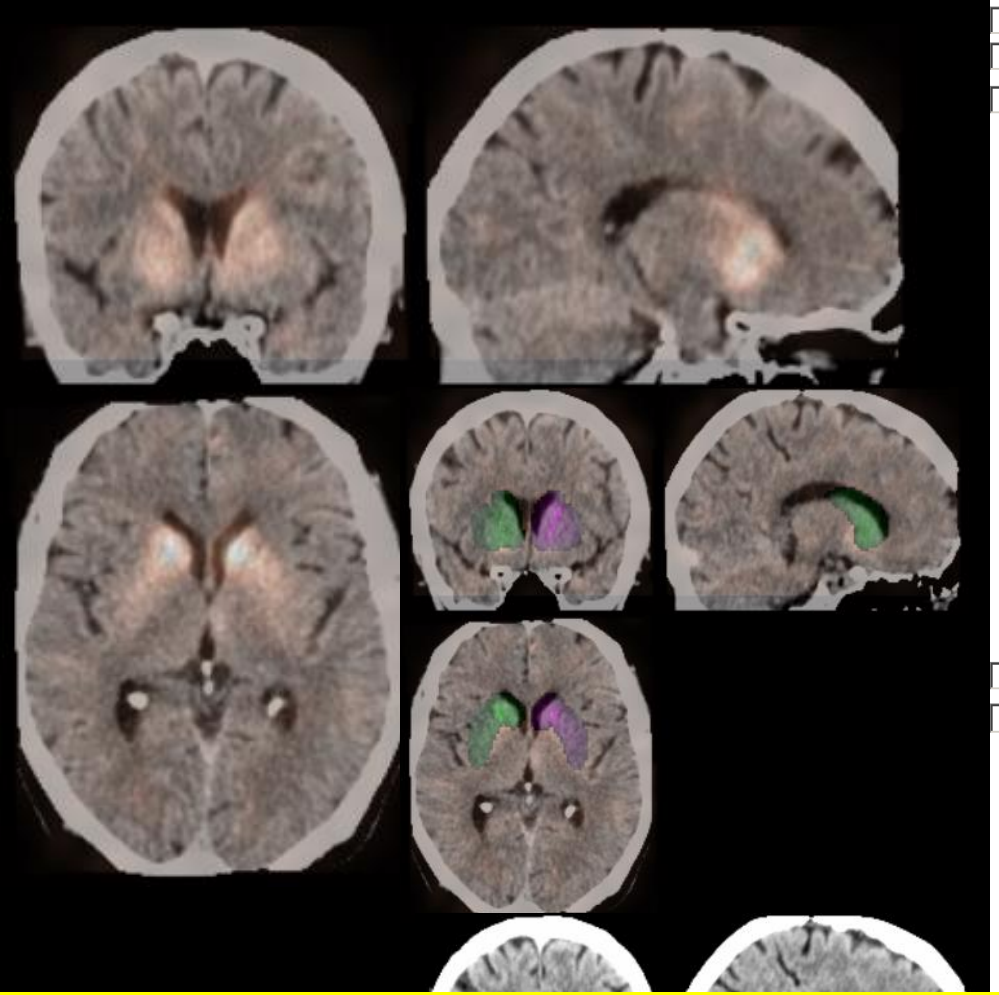


Analyse DAT semi-quantitative MN-GHE v 2010

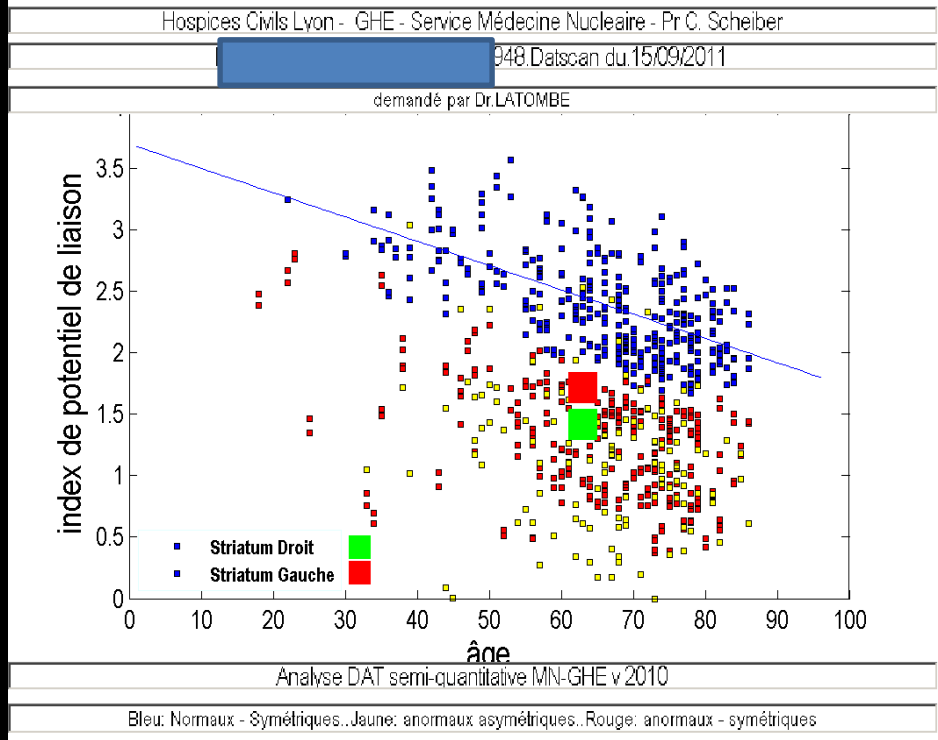
Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques

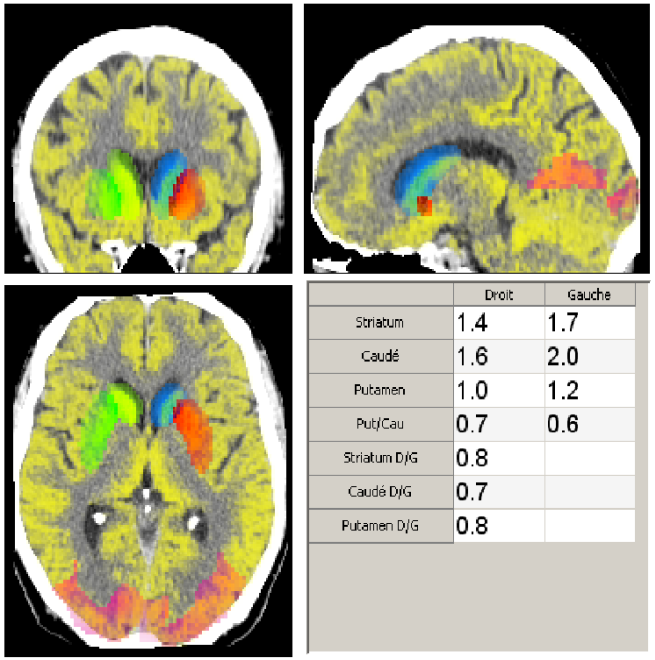


	Droit	Gauche
Striatum	1.1	1.4
Caudé	1.2	1.3
Putamen	0.9	1.2
Put/Cau	0.8	1.0
Striatum D/G	0.8	
Caudé D/G	0.8	
Putamen D/G	0.7	

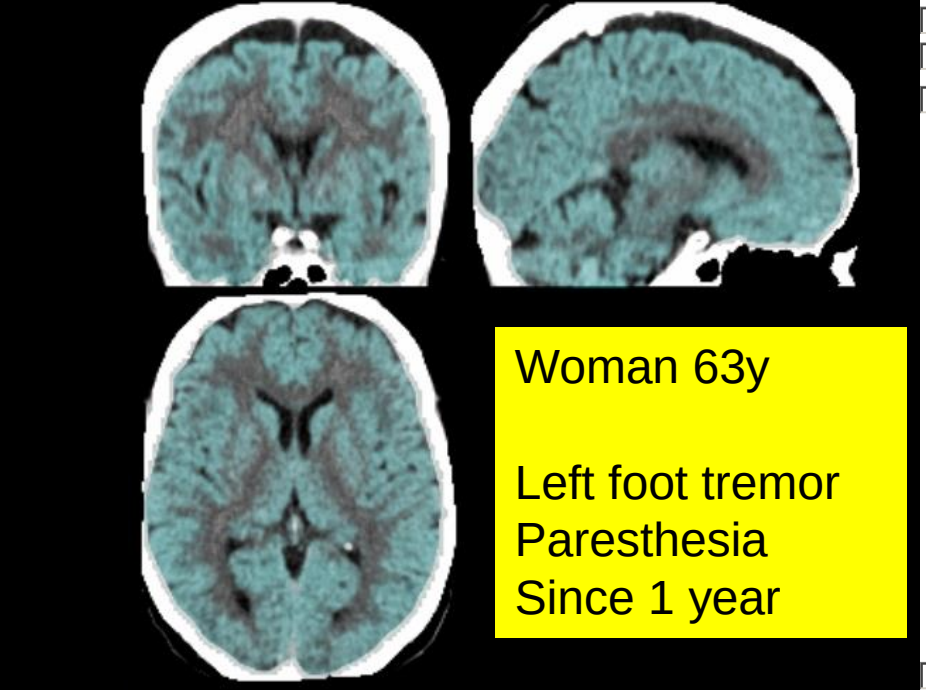


Tennis Player 63 years old
Since 6 months
Hypokinesia right –
Tremor ½ body right not all the time – atypical (attitude & rest)



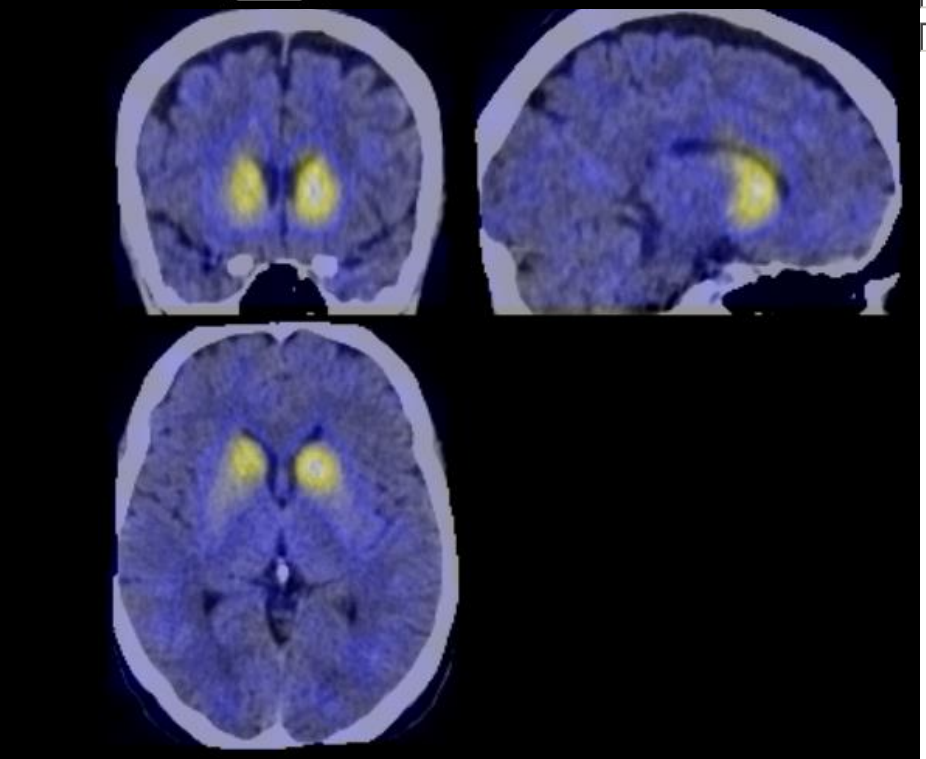


	Droit	Gauche
Striatum	1.4	1.7
Caudé	1.6	2.0
Putamen	1.0	1.2
Put/Cau	0.7	0.6
Striatum D/G	0.8	
Caudé D/G	0.7	
Putamen D/G	0.8	



Woman 63y

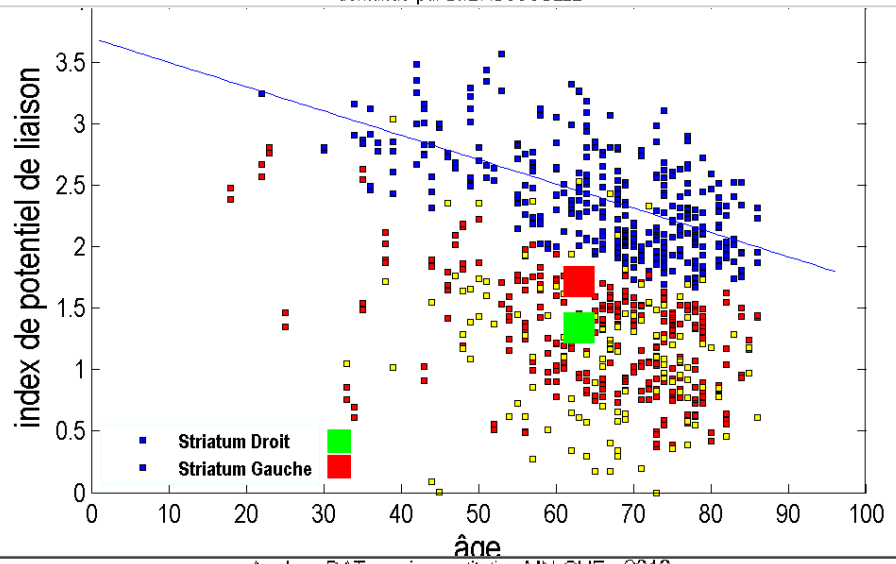
Left foot tremor
Paresthesia
Since 1 year



Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

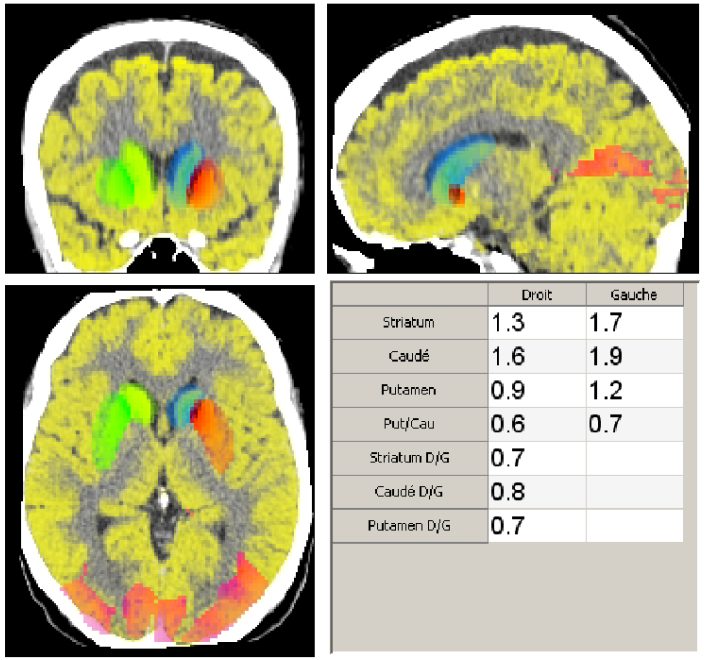
Mme.Marie Josephe.M[redacted]né le12/02/1948.Datscan du.05/05/2011

demandé par Dr.BROUSSOLLE



Analyse DAT semi-quantitative MN-GHE v 2010

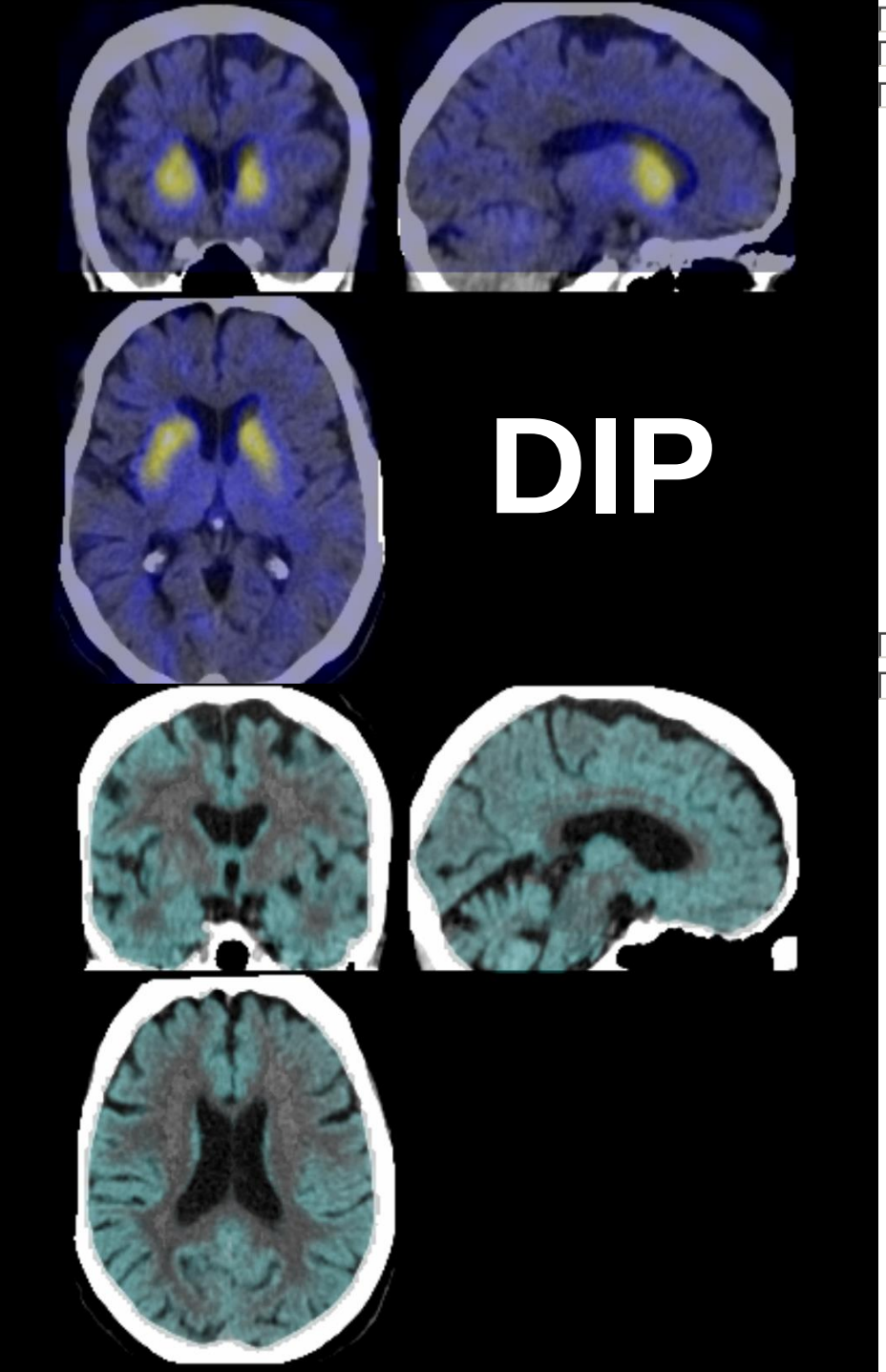
Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques



	Droit	Gauche
Striatum	1.3	1.7
Caudé	1.6	1.9
Putamen	0.9	1.2
Put/Cau	0.6	0.7
Striatum D/G	0.7	
Caudé D/G	0.8	
Putamen D/G	0.7	

Drug Induced Parksonian (DIP)

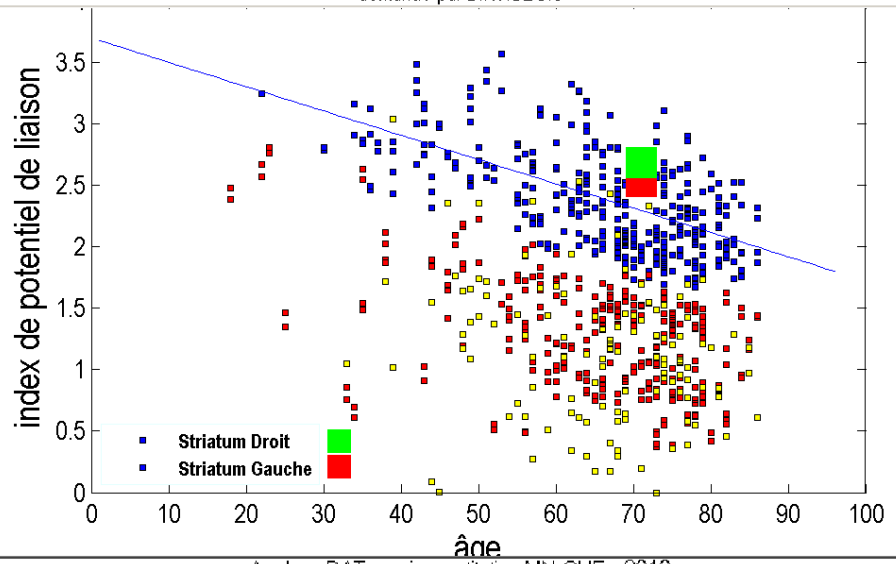
- Very common cause of misdiagnosis
- ▪Results from pharmacologic agents that block DA receptors but don't affect DAT
- ▪Common drugs include neuroleptics (eg prochlorperazine, and metoclopromide), and calcium channel blockers
- ▪DIP more common in women and elderly and does not clearly relate to dosage or length of usage
- IOFLUPANE scan look normal !



Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

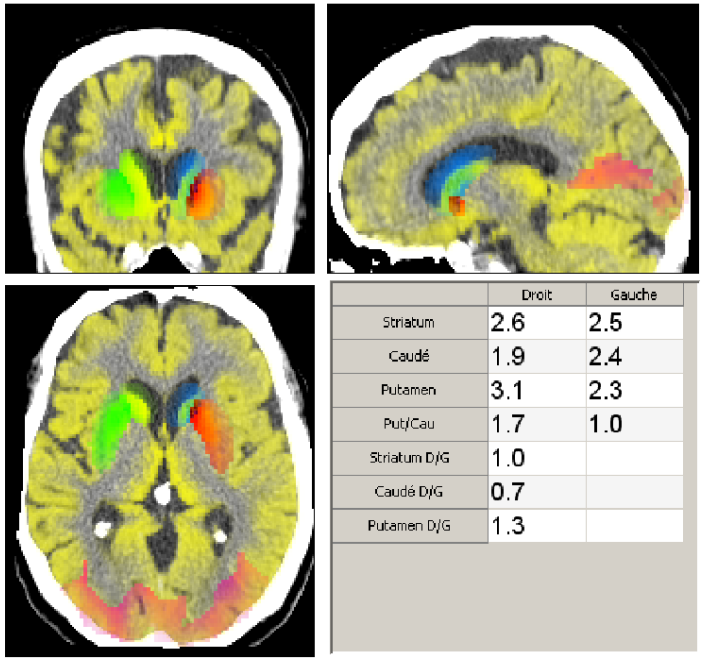
Mme [redacted] le04/11/1940.Datscan du.19/05/2011

demandé par Dr.THOBOIS



Analyse DAT semi-quantitative MN-GHE v 2010

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques

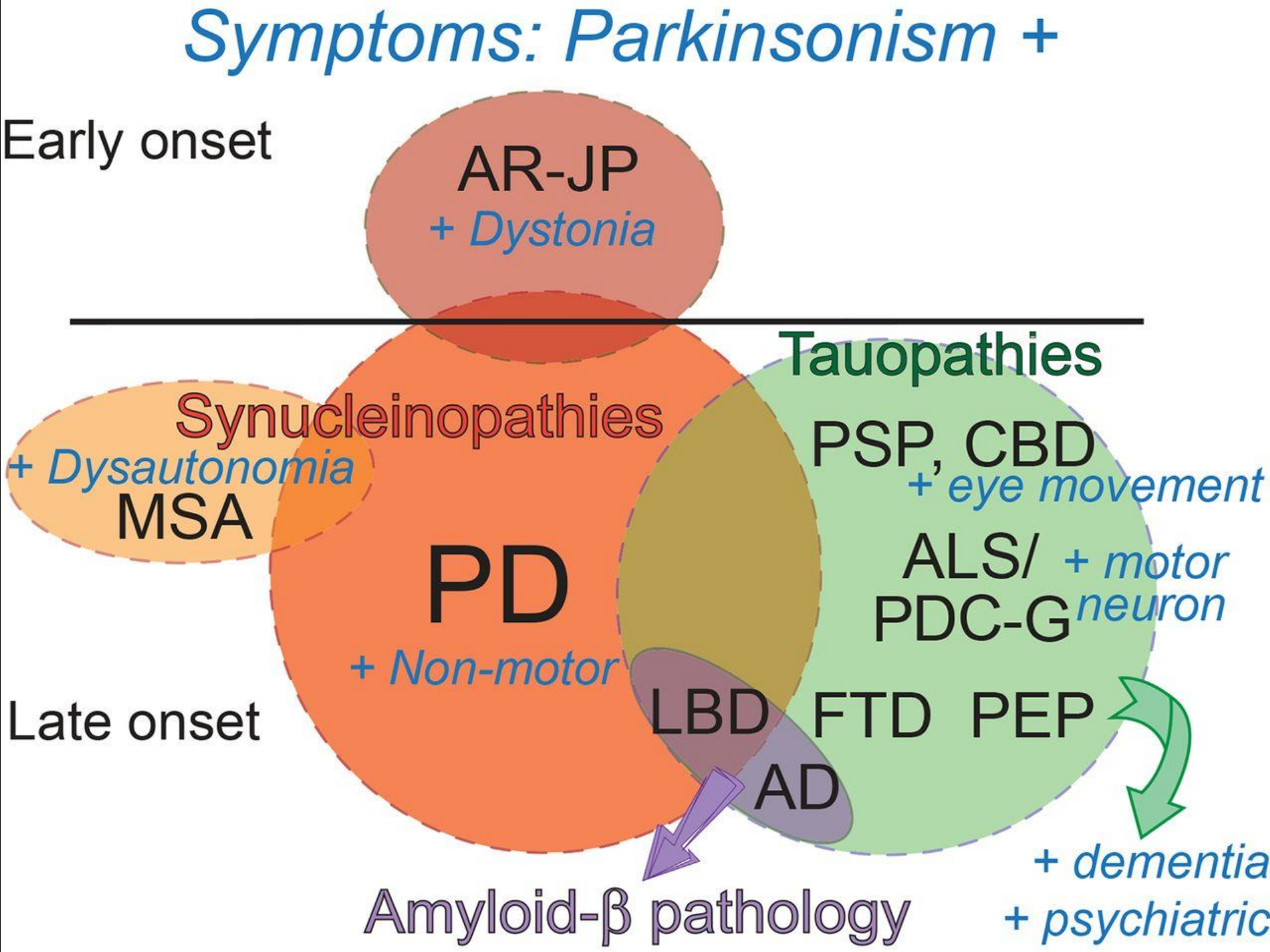


	Droit	Gauche
Striatum	2.6	2.5
Caudé	1.9	2.4
Putamen	3.1	2.3
Put/Cau	1.7	1.0
Striatum D/G	1.0	
Caudé D/G	0.7	
Putamen D/G	1.3	

Real life – extended indications

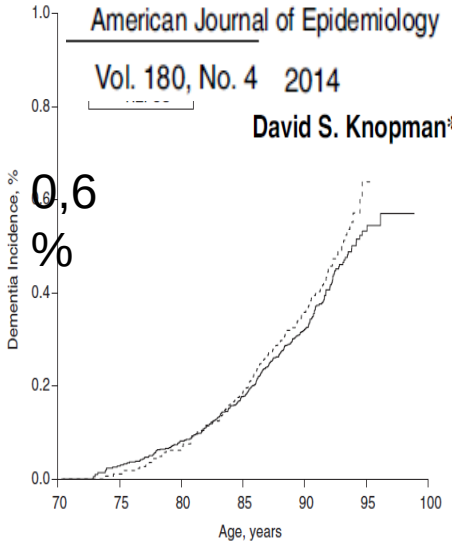
- > 75 y often disabled patients including some demented subjects (or psychiatric) - MA vs DLB
- Differential diagnosis of atypical tremor
- Clinical Parkinsonism treatment resistant
- < 65 y early diagnosis of NDD with Parkinsonism
- < 50 y early motor signs PD (adher to treatment)

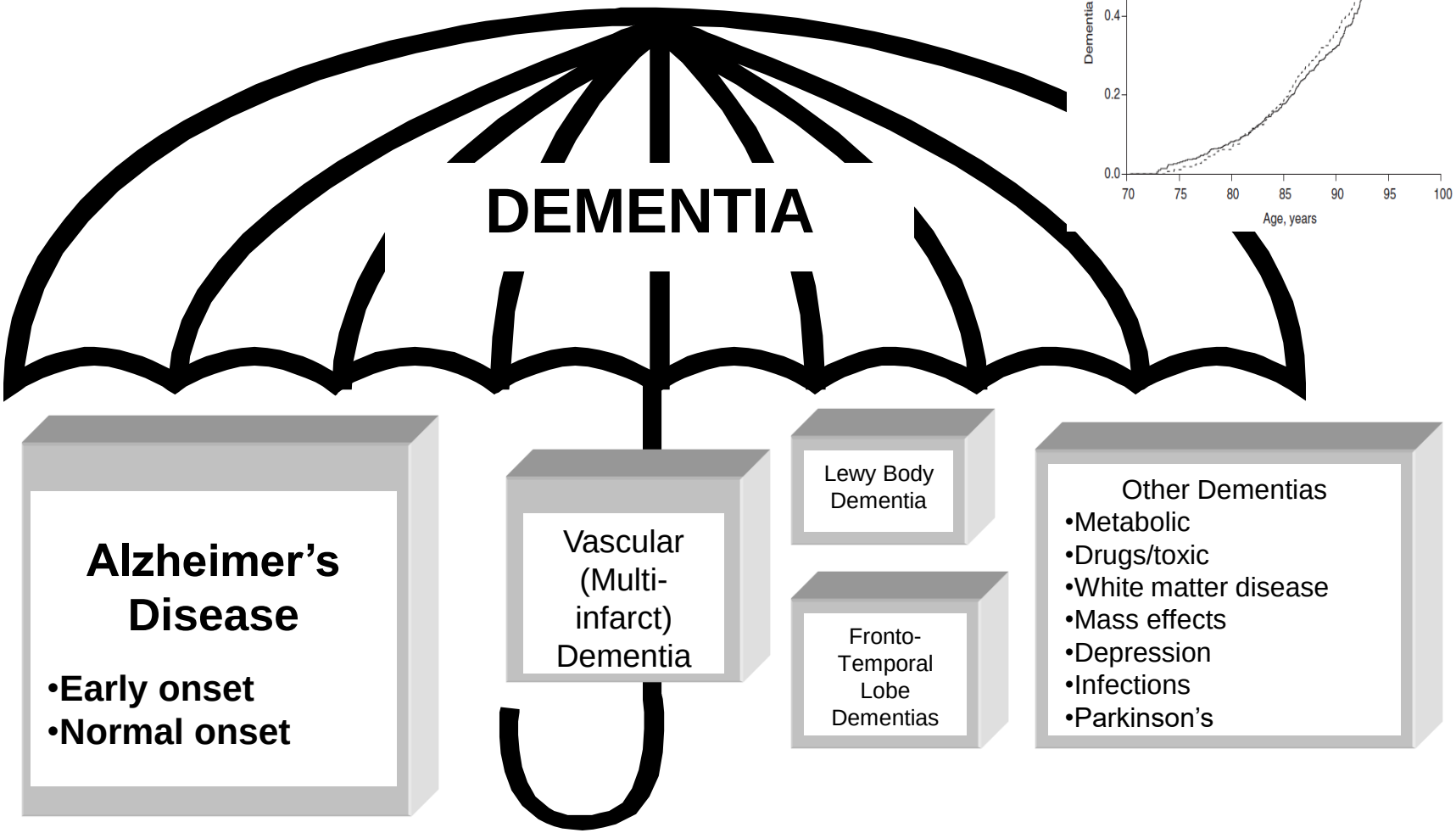
- Fast – Robust - Easy to manage one stop shop
- Taking into account health care costs


Symptoms: Parkinsonism +
Early onset
AR-JP
+ Dystonia
Synucleinopathies
+ Dysautonomia
MSA
PD
+ Non-motor
Tauopathies
PSP, CBD
+ eye movement
ALS/
PDC-G
+ motor neuron
Late onset
LBD
FTD
PEP
AD
Amyloid-β pathology
+ dementia
+ psychiatric

Dementia is a usually late evolution of the majorit diseases.

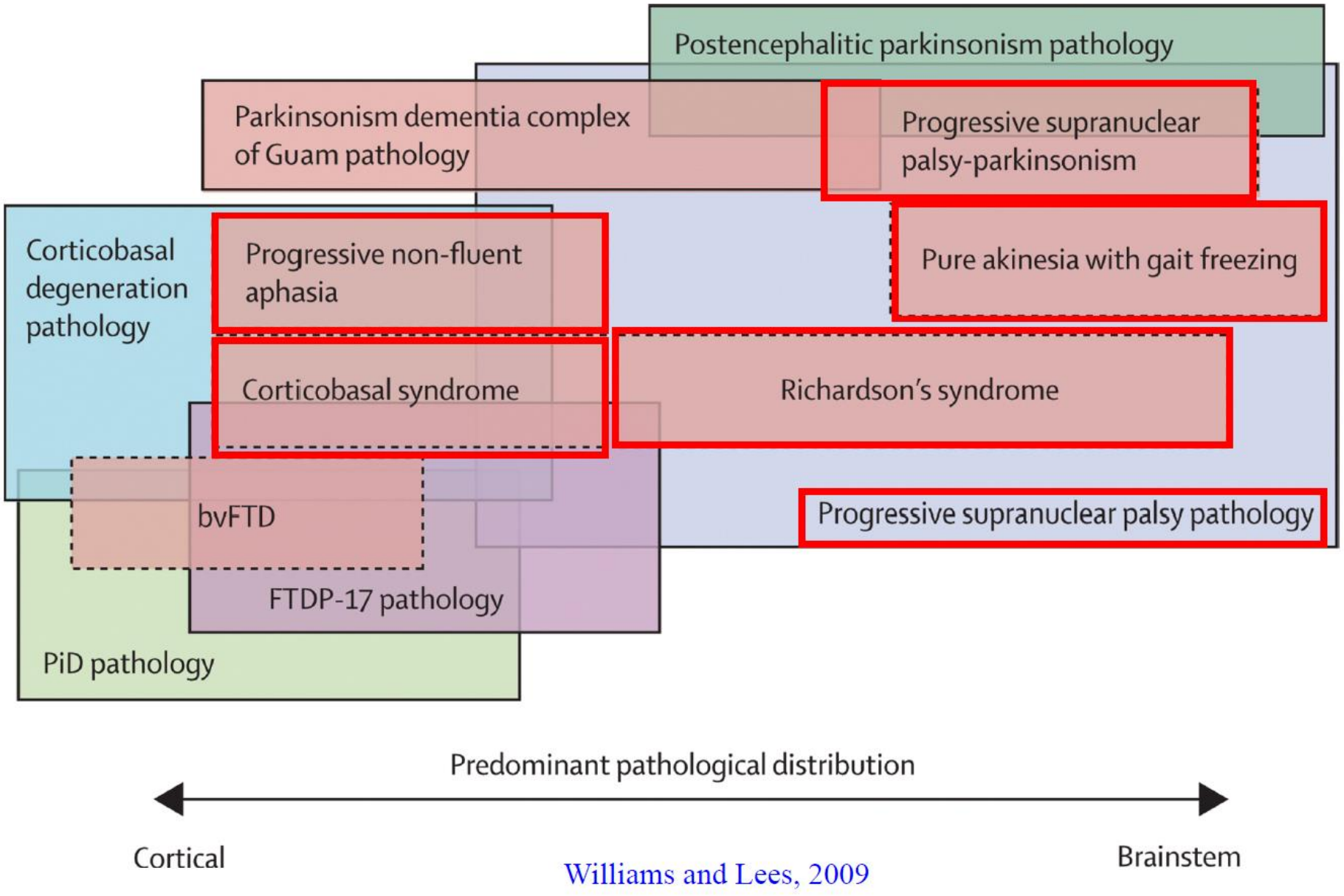
Increase of copathologies with age (up to 50%)





Biomarkers to predict future evolution or risk towards dementia would be useful for patient management

Cortical and brainstem predominant pathological distribution



Williams and Lees, 2009

PRACTICAL NEUROIMAGING TECHNIQUES TO INVESTIGATE ATYPICAL PD

MRI rule out curable causes

good specificity – typical - advanced stages

brain or brainstem atrophy analysis

knowledge of ageing brain spec versus pathologic

High performance of vascular/perfusion analysis - vascular parkinsonism +

Diagnostic still uncertain

HYBRID NUCLEAR IMAGING PARADIGMS

Diagnostic CT - 3 planes analysis of brain morphology (or MRI)

High sens of ^{18}F FDG or ^{99}mTc HMPAO to impaired Glu mb / perfusion

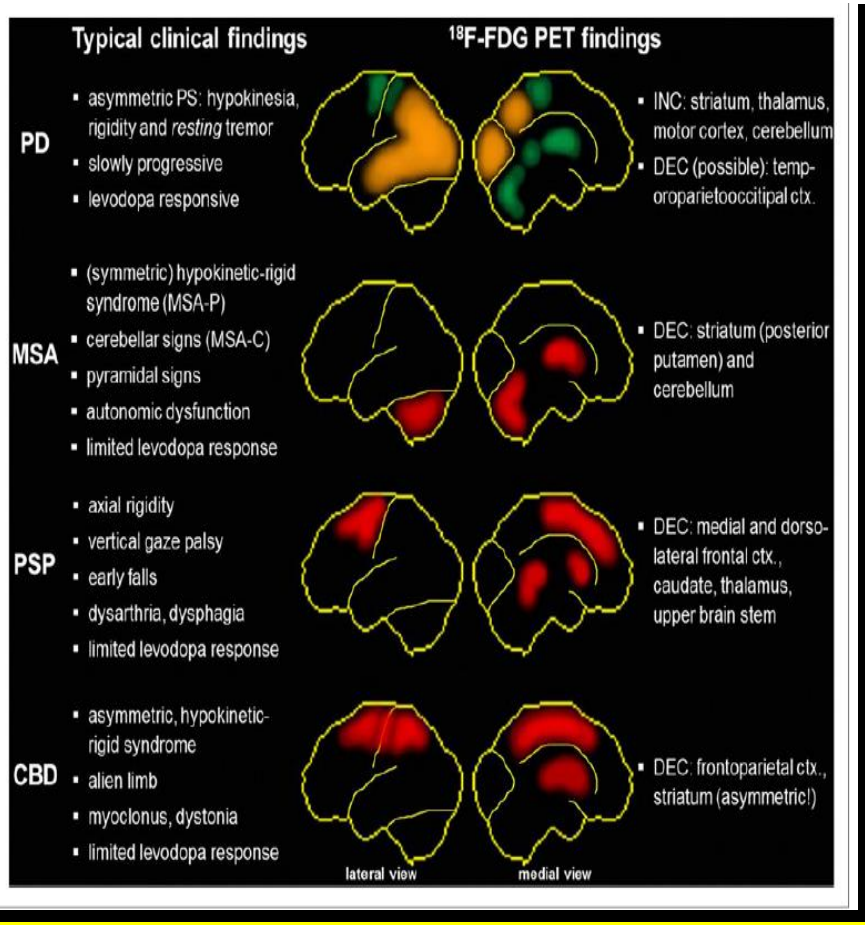
High sens & specif of ^{123}I mIBG to adrenergic denervation

High sens & specif of dopamine transporter tracers (^{123}I-FP-CIT, DaTSCAN)

^{18}F-FDG PET in Parkinsonism: Differential Diagnosis and Evaluation of Cognitive Impairment

J Nucl Med 2017; 58:1888–1898
DOI: 10.2967/jnumed.116.186403

Philipp T. Meyer[1], Lars Frings[1,2], Gerta Rücker[3], and Sabine Hellwig[4]



« Workup usually includes MRI »

« ^{18}F FDG may be used after comprehensive evaluation by a movement disorder specialist and when result is expect to alter patient management « Level 1 AA Neurology

current literature underscores the utility of ^{18}F-FDG PET for diagnostic evaluation of parkinsonism and the promising role of ^{18}F-FDG PET for assessment and risk stratification of cognitive impairment in PD.

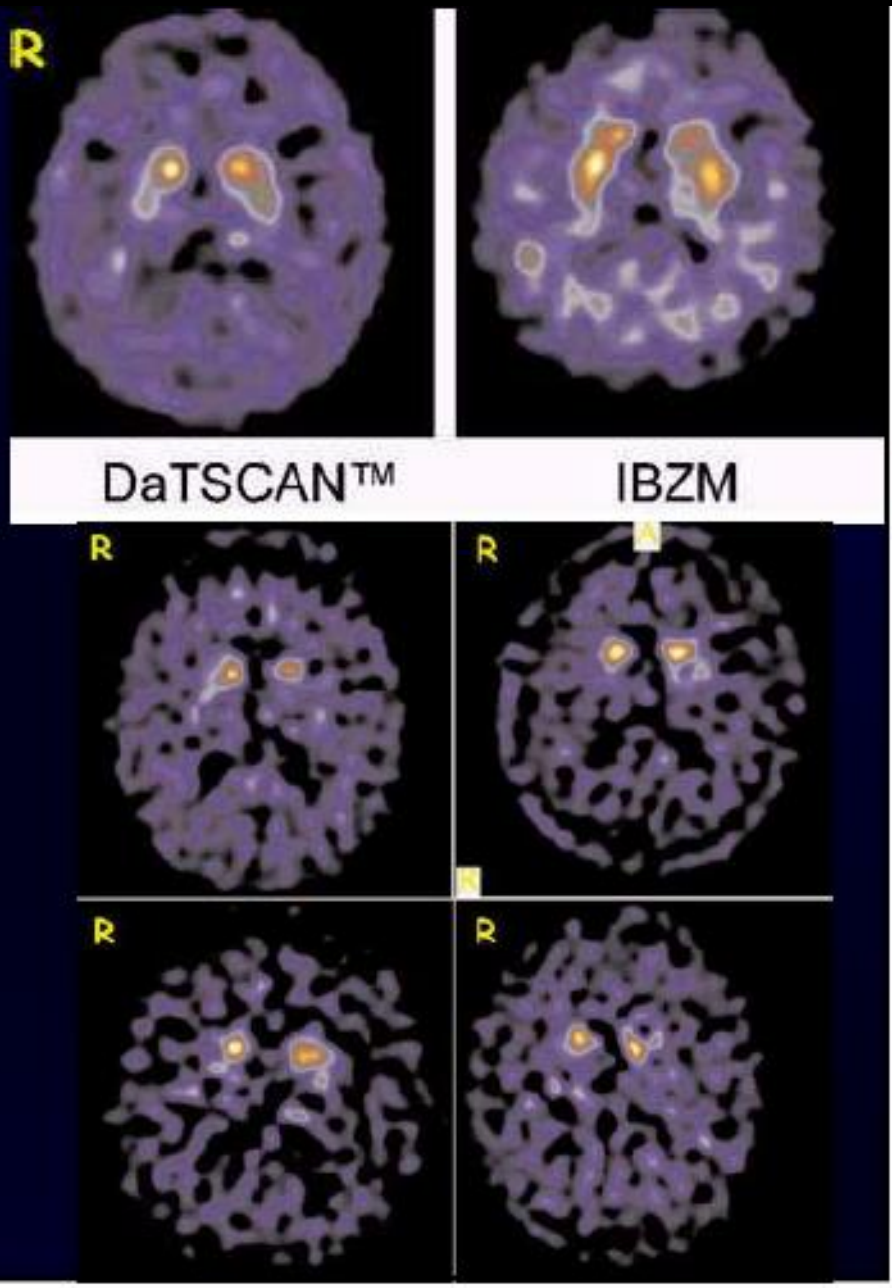
« On the basis of a preliminary meta-analysis of currently available studies with inclusion of multiple disease groups we estimated that the diagnostic sensitivity and specificity for visual PET readings supported by voxel-based statistical analysisf or diagnosis of atypical parkinsonian syndromes are 91.4% and 90.6 % respectively »

DaTSCAN in Lewy Body Dementia

Costa et al., 2003

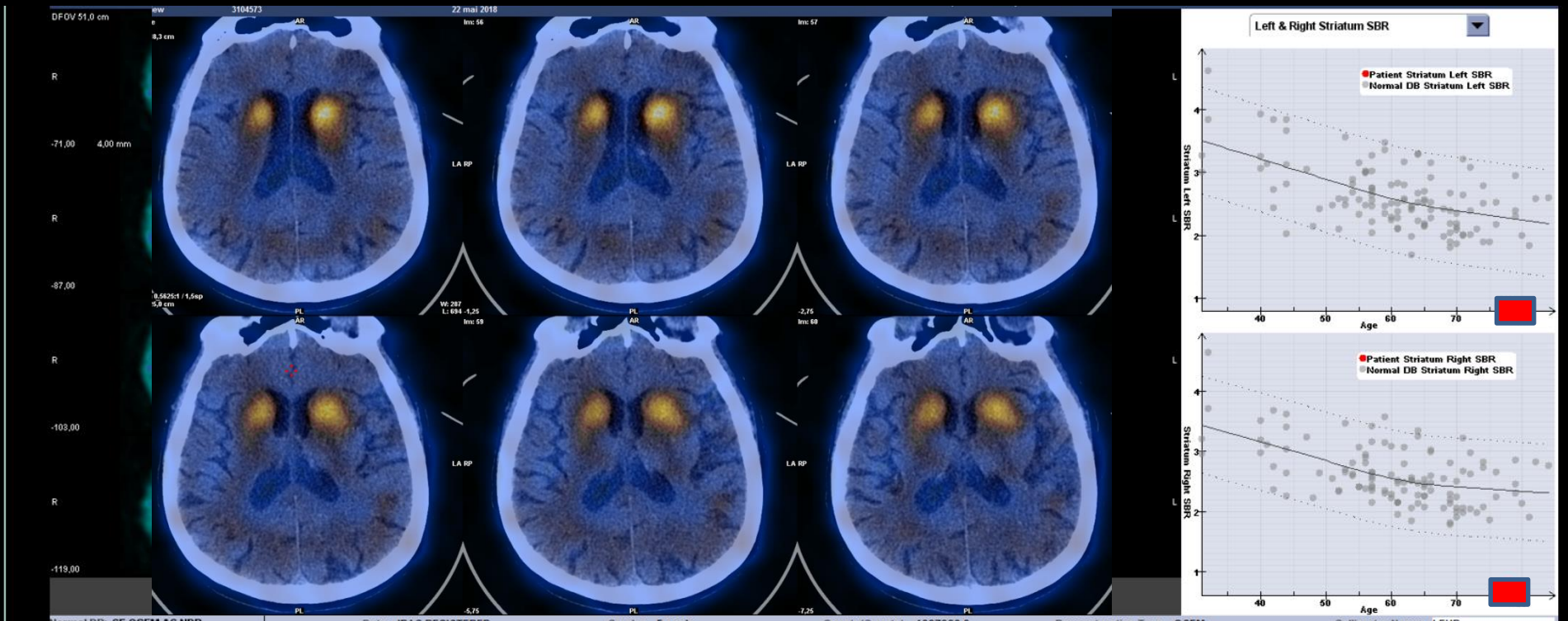
Postmortem analysis:

- 6/6 DLB had abnormal DaTScan
- 5/6 misclassified as DLB had normal DaTScan
- 1 abnormal DaTScan had Alzheimer + vascular dementia



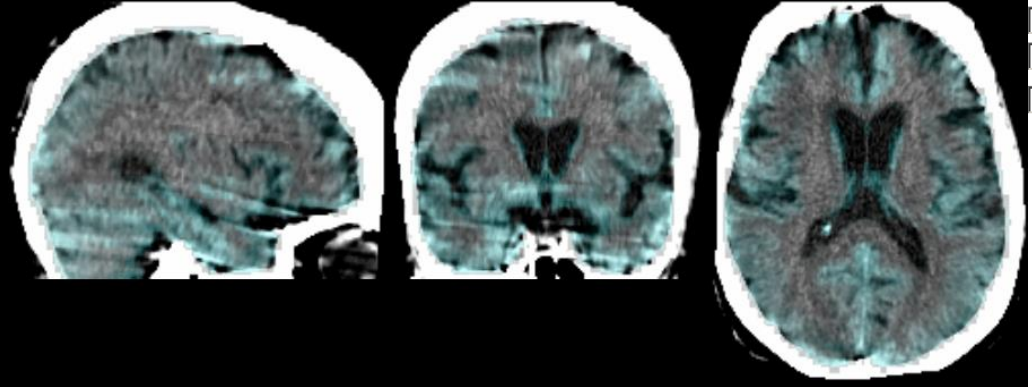
Lewy Body Disease (and LB or PD dementia)

DaTscan can’t differentiate advanced PD (+/- dementia PDD) and Lewy Body Disase
Symptoms : hallucinations , fluctuations might be present in PDD and PC Atophy also
Very low SBRs – symetric - or burned striatum image Spe: DLB High Sens Low



Normal DB: GE OSEM AC NDB	Data: IRAC REGISTERED	Gender: Female	Counts(Counts): 1887920,0	Reconstruction Type: OSEM	Collimator Name: LEHR	
GE normals database for OSEM with att...	Camera: Tandem_Apollo	Age(Years): 78	Dose(MBq): 121,0	Corrections: Attenuation correction	Collimator Type: Parallel	
Normal DB mismatch – Corrections : Attenuation correction (Chang attenuation correction)						

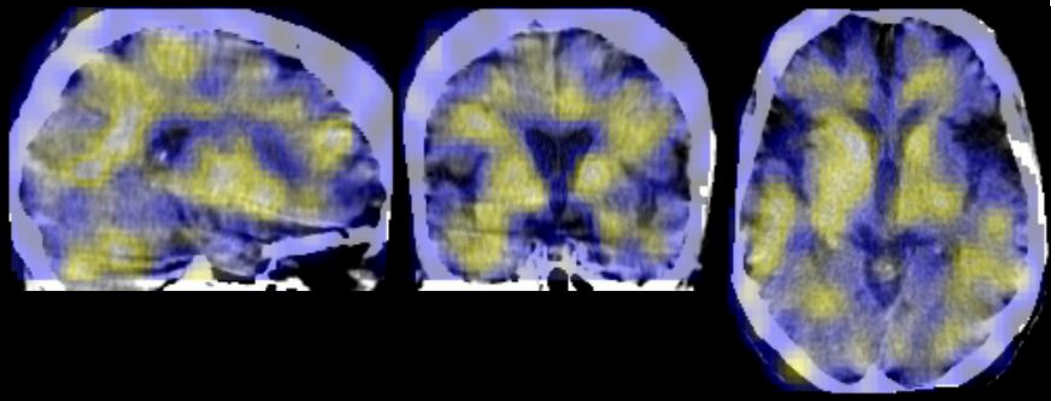
	Striatum Right SBR	Striatum Left SBR	Putamen Right SBR	Putamen Left SBR	Caudatus Right SBR	Caudatus Left SBR
Measured	+0,76	+0,88	+0,59	+0,63	+1,14	+1,39
Mean (±1 SD)	+2,35 (±0,40)	+2,27 (±0,42)	+2,26 (±0,39)	+2,18 (±0,41)	+2,57 (±0,48)	+2,46 (±0,50)
Deviation	-68%	-61%	-74%	-71%	-56%	-43%
Z-Score	-3,94	-3,30	-4,26	-3,80	-2,97	-2,15



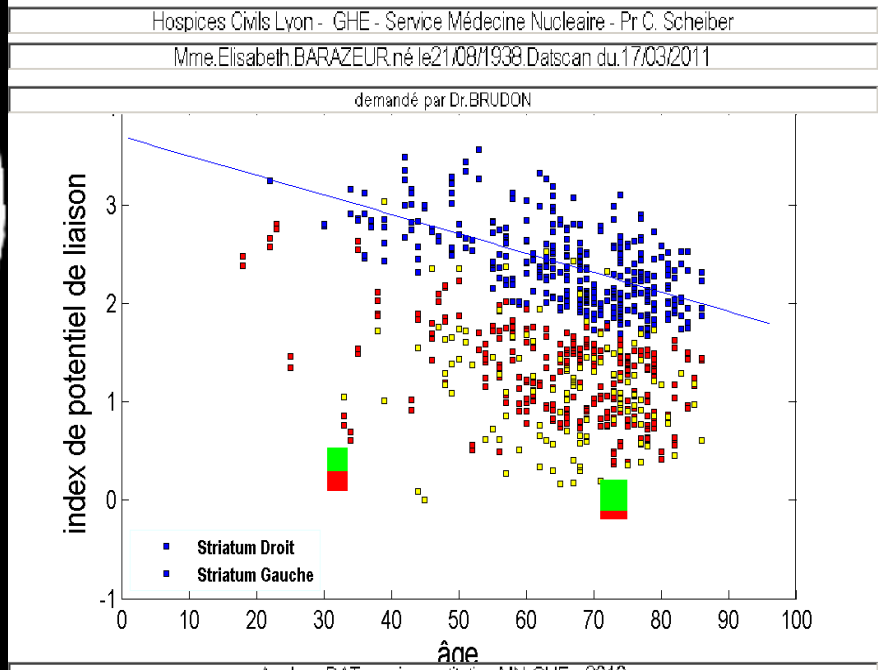
Atypical PS - Fluctuations

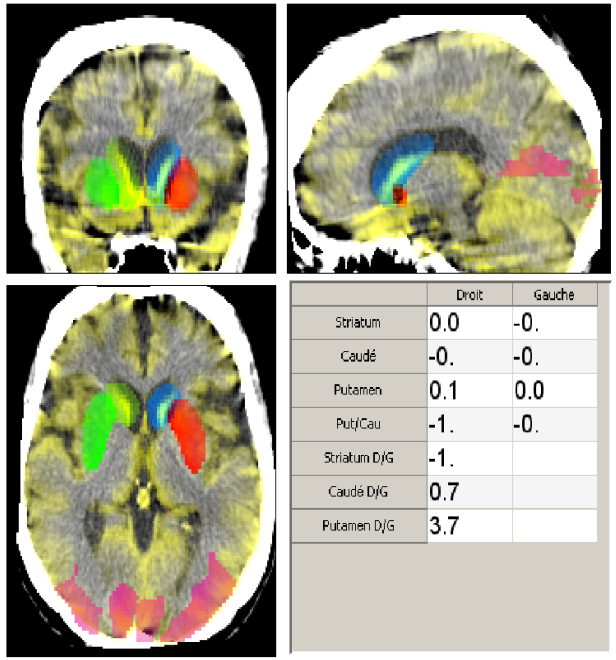
Visual hallucinations

BURNED STRIATUM



LEWY BODY DEMENTIA

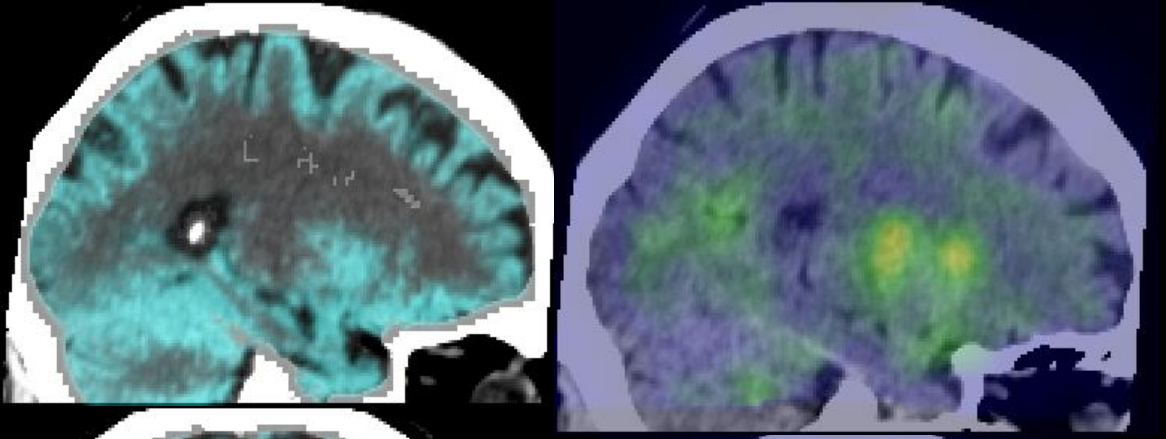


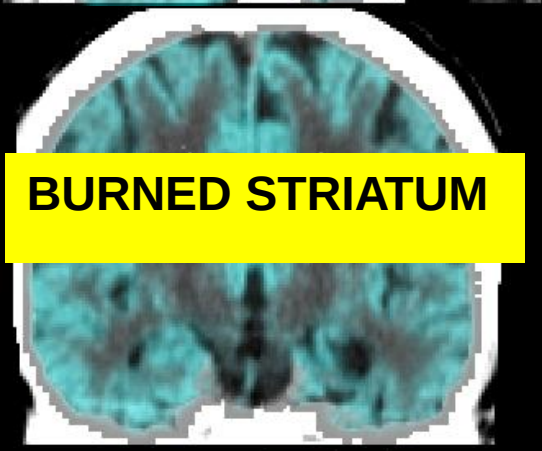


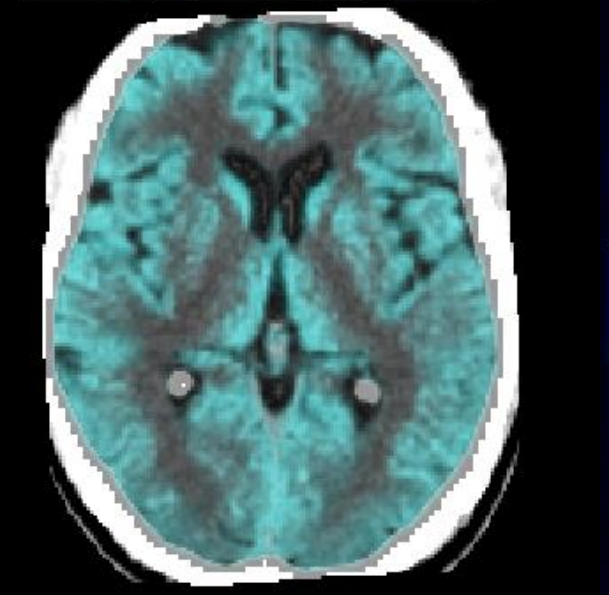
	Droit	Gauche
Striatum	0.0	-0.
Caudé	-0.	-0.
Putamen	0.1	0.0
Put/Cau	-1.	-0.
Striatum D/G	-1.	
Caudé D/G	0.7	
Putamen D/G	3.7	

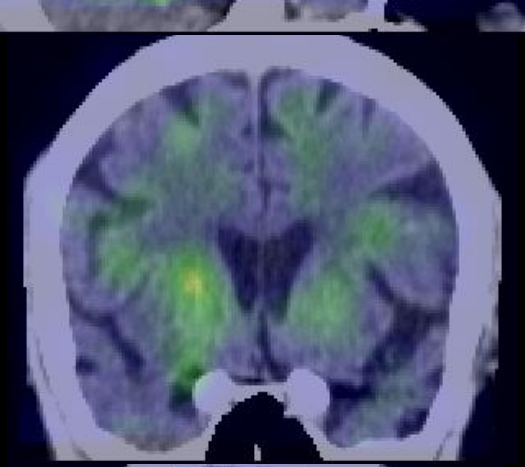
M 68 y recent fast cognitive decline
comportmental troubles
right 1/2body bradykinesia
sleep disturbance (agitation)
hallucinations:none
MRI brain normal

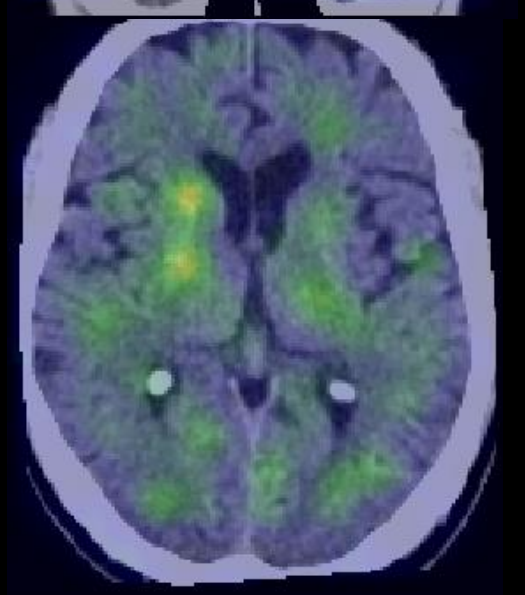
BURNED STRIATUM





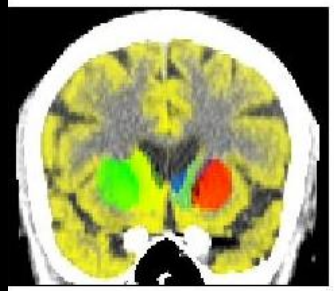


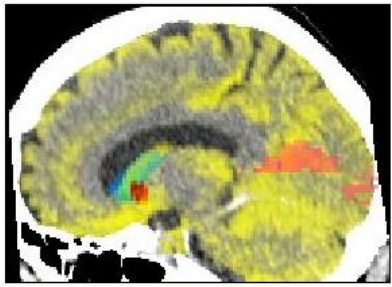


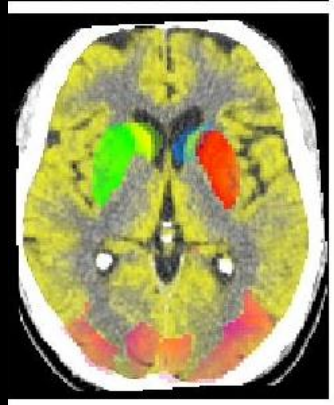


ROIs: parcellation MNI_V4

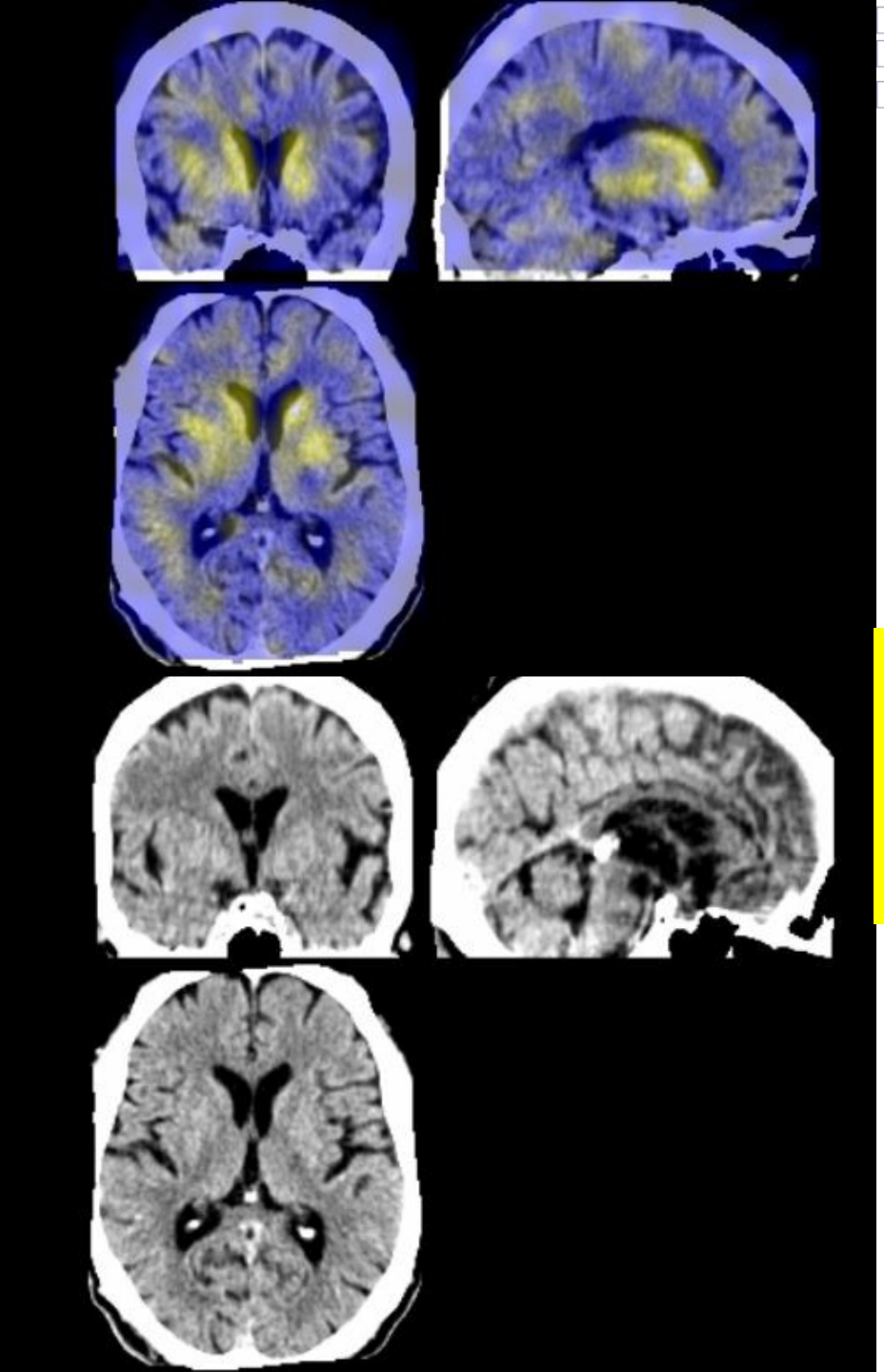
Sans et Avec Correction Vol Partiel







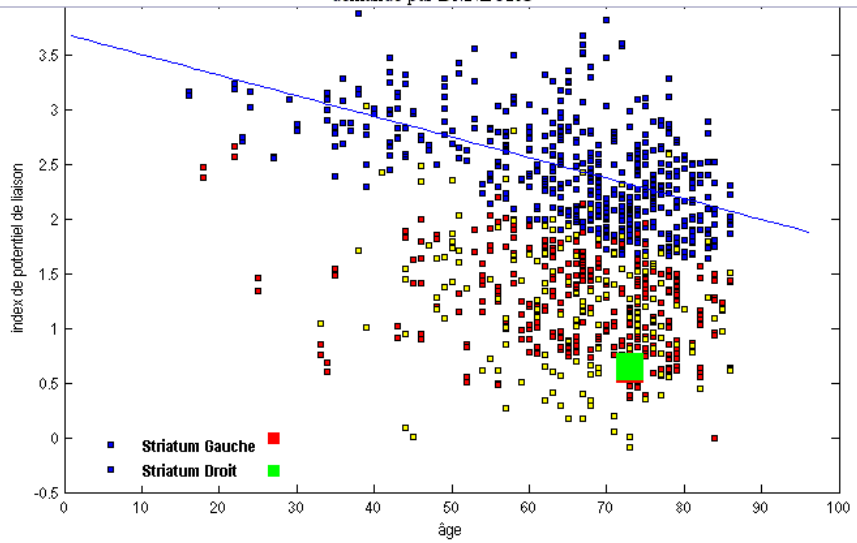
	Droit	Gauche
Striatum	0.2	0.0
Caudé	0.0	-0.
Putamen	0.4	0.1
Puta/Caud	4.8	-0.
Striatum D/G	6.6	
Caude D/G	-0.	
Putamen D/G	2.2	
	CorrVolPar	CorrVolPar
Striatum	0.4	0.1
Caudé	0.4	0.2
Putamen	0.3	0.1
Puta/Caud	1.8	1.8
Striatum D/G	2.1	
Caude D/G	1.9	
Putamen D/G	1.9	



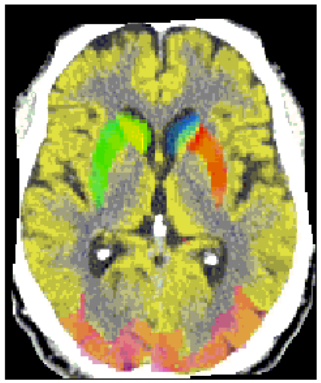
Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

Mr.Jean.GAILLARD.né le17/08/1940.Datscan du.03/09/2013

demandé par Dr.NEURO

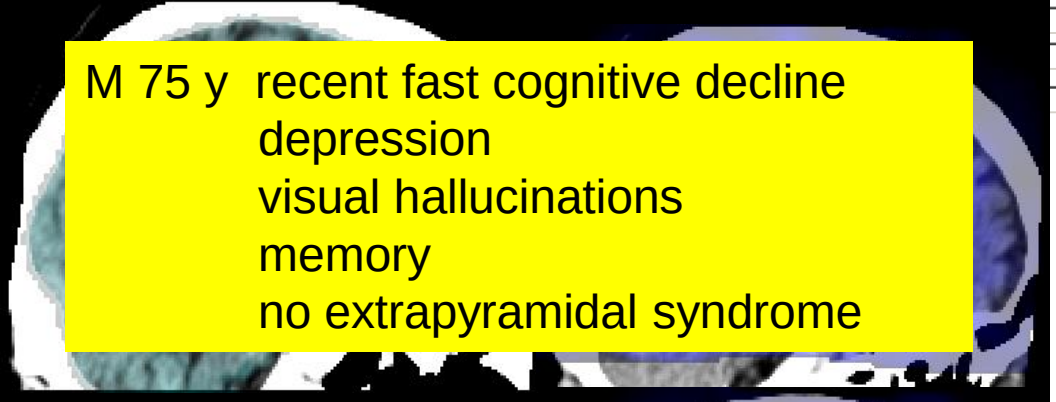


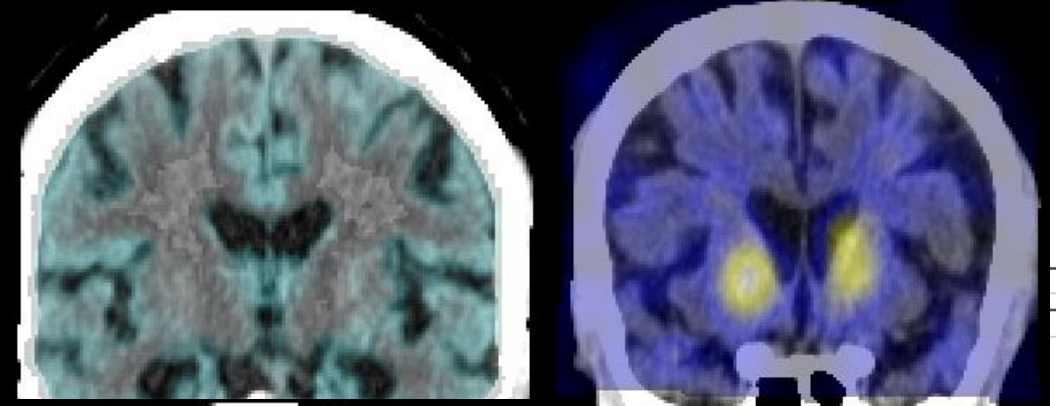
M 75 y recent fast cognitive decline
comportmental troubles
bradykinésia
non hypertonic
hallucinations:none

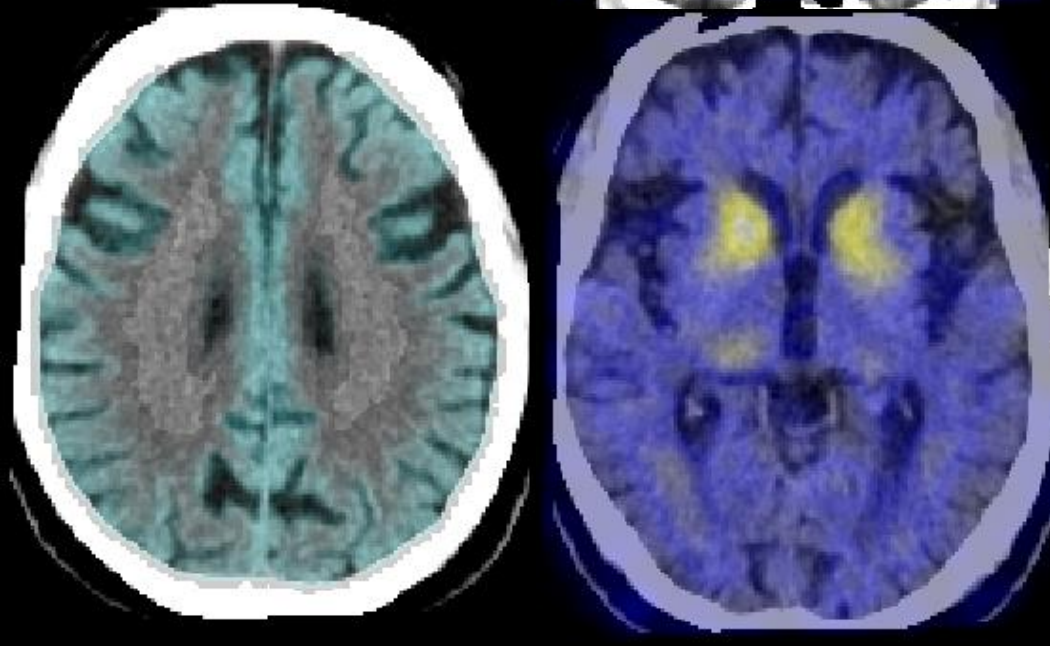


	D	G
Striatum	0.6	0.6
Caudé	0.6	0.4
Putamen	0.4	0.6
Put/Cau	0.7	1.3
Striatum D/G	1.0	
Caudé D/G	1.4	
Putamen D/G	0.7	

M 75 y recent fast cognitive decline
depression
visual hallucinations
memory
no extrapyramidal syndrome



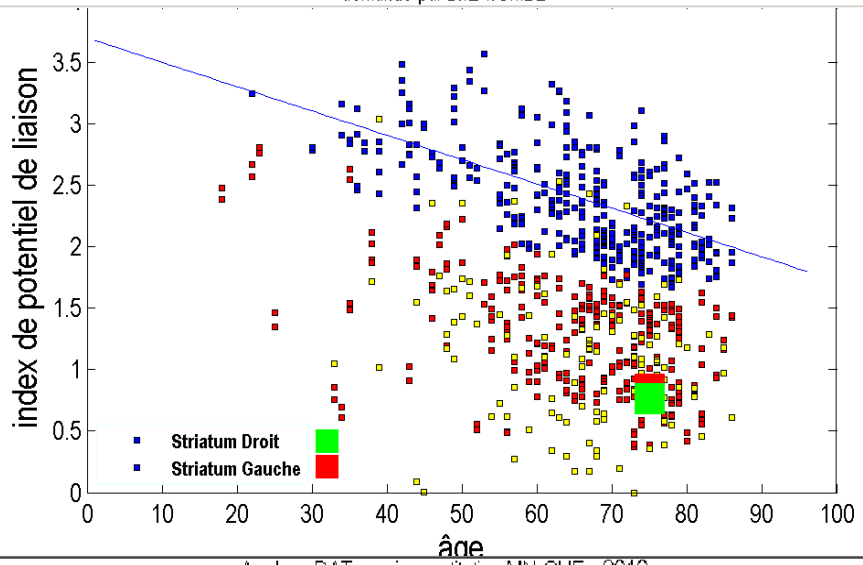




Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

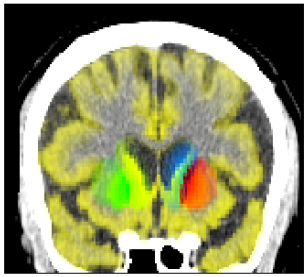
[redacted] 16/06/1936.Datscan du.03/03/2011

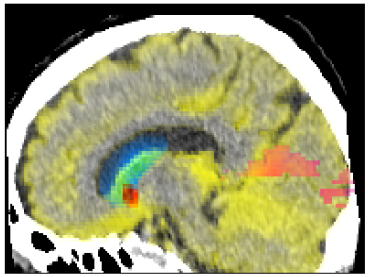
demandé par Dr.LATOMBE

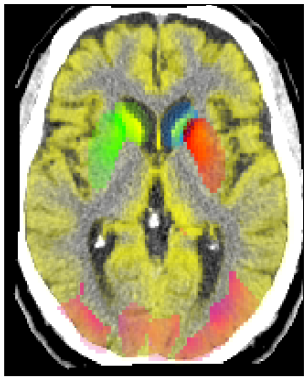


Analyse DAT semi-quantitative MN-GHE v 2010

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques







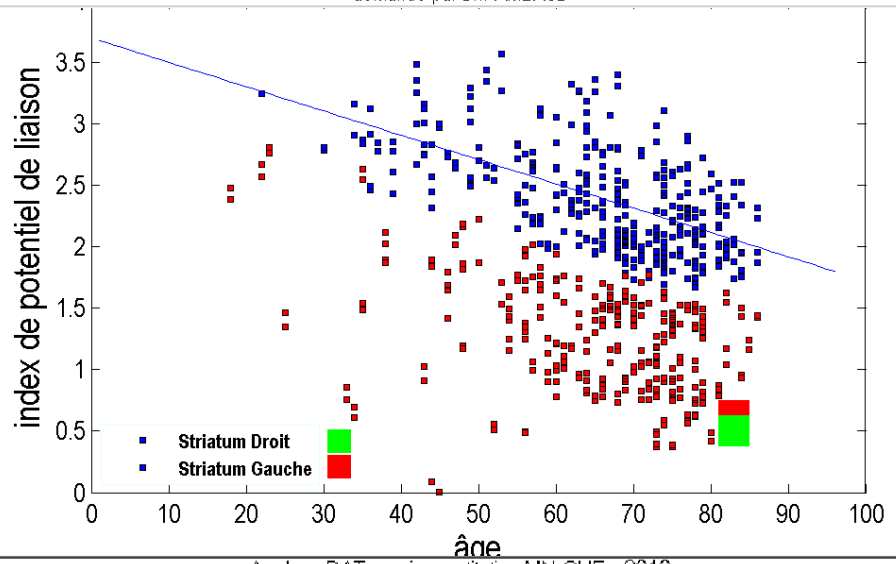
	Droit	Gauche
Striatum	0.7	0.8
Caudé	0.6	0.7
Putamen	0.7	0.7
Put/Cau	1.3	1.1
Striatum D/G	0.8	
Caudé D/G	0.8	
Putamen D/G	0.9	

Parkinsons disease since 20 years

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

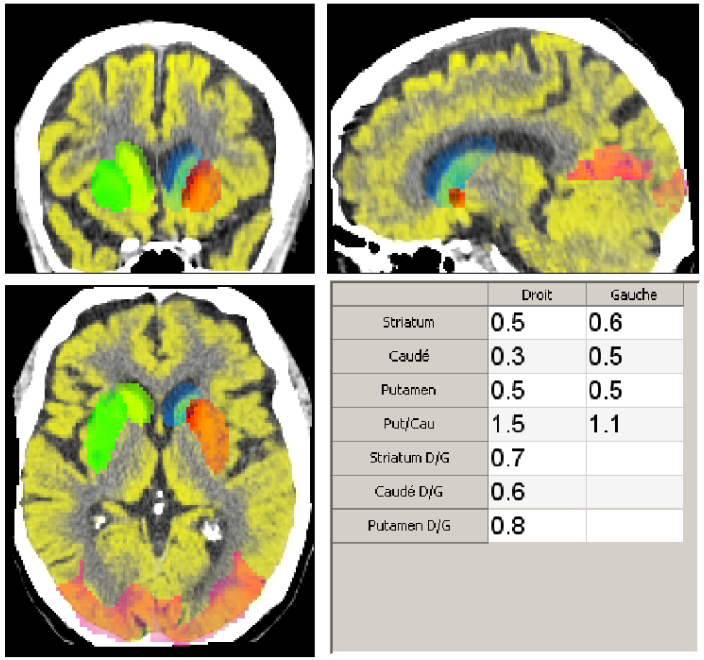
Mme.Anna.REYNARD.né le24/05/1929.Datscan du.30/08/2012

demandé par Dr.RAMBAUD



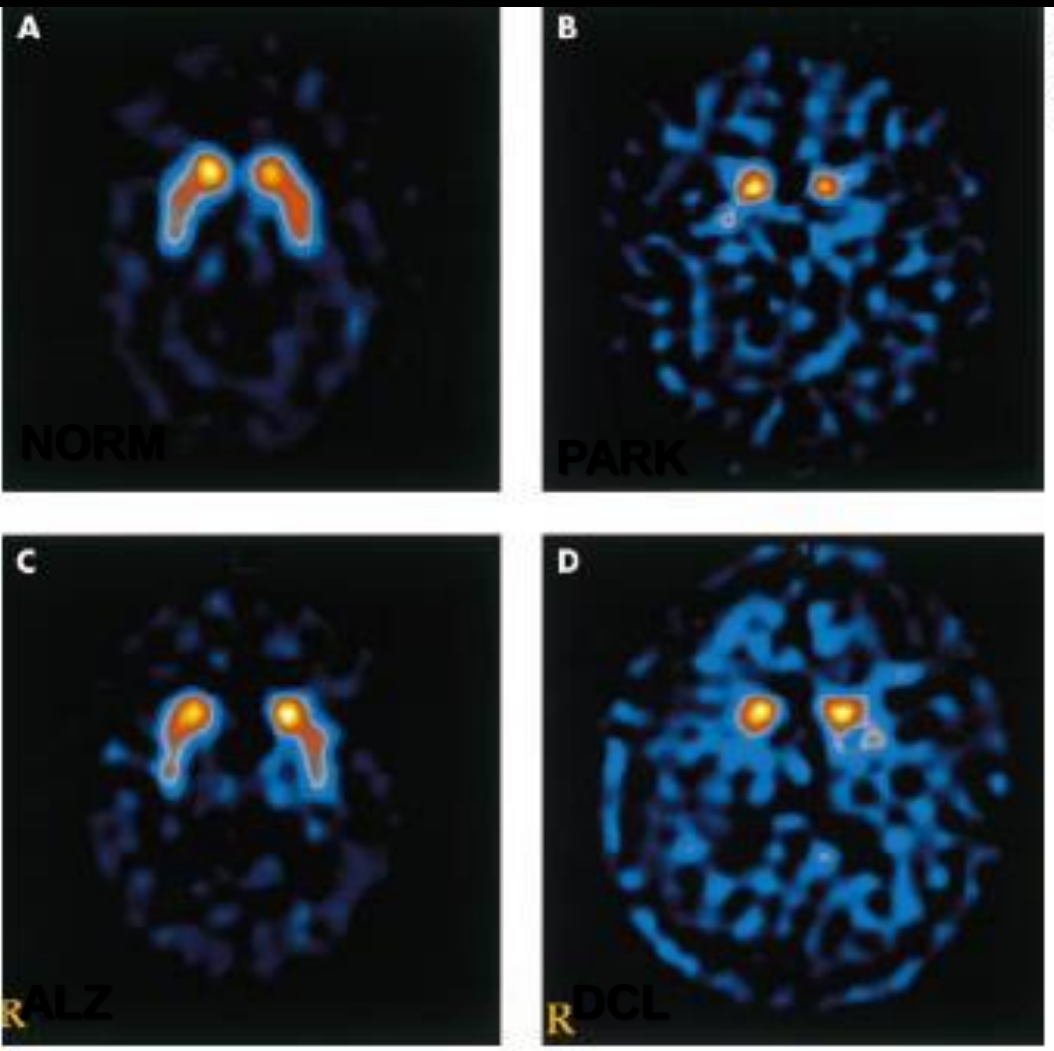
Analyse DAT semi-quantitative MN-GHE v 2010

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques



	Droit	Gauche
Striatum	0.5	0.6
Caudé	0.3	0.5
Putamen	0.5	0.5
Put/Cau	1.5	1.1
Striatum D/G	0.7	
Caudé D/G	0.6	
Putamen D/G	0.8	

LBD vs Alzheimer



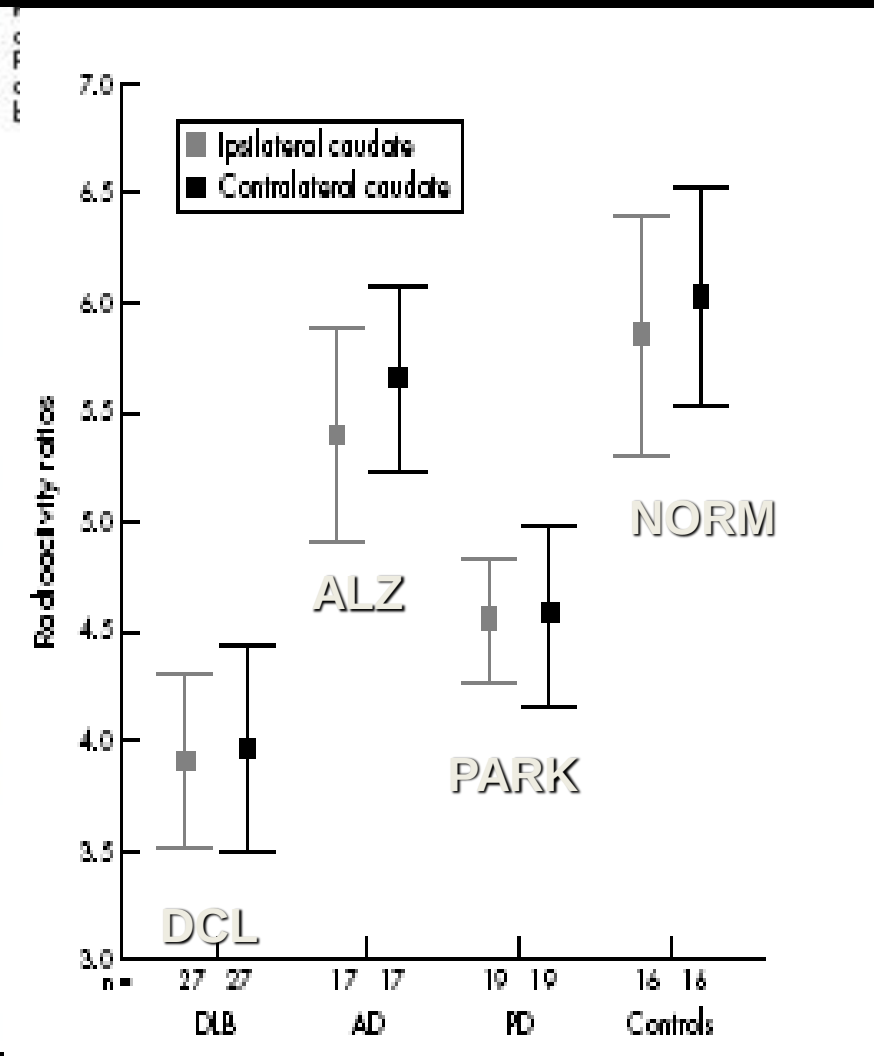
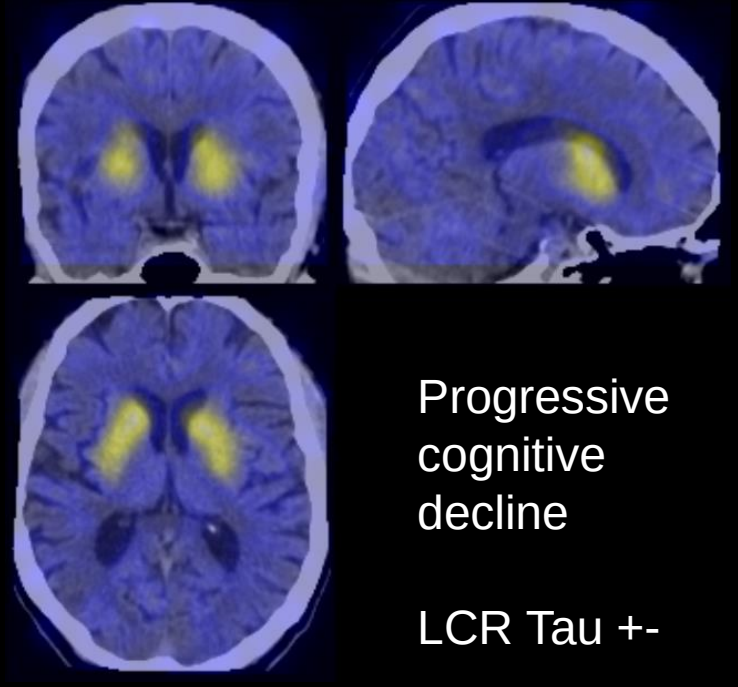
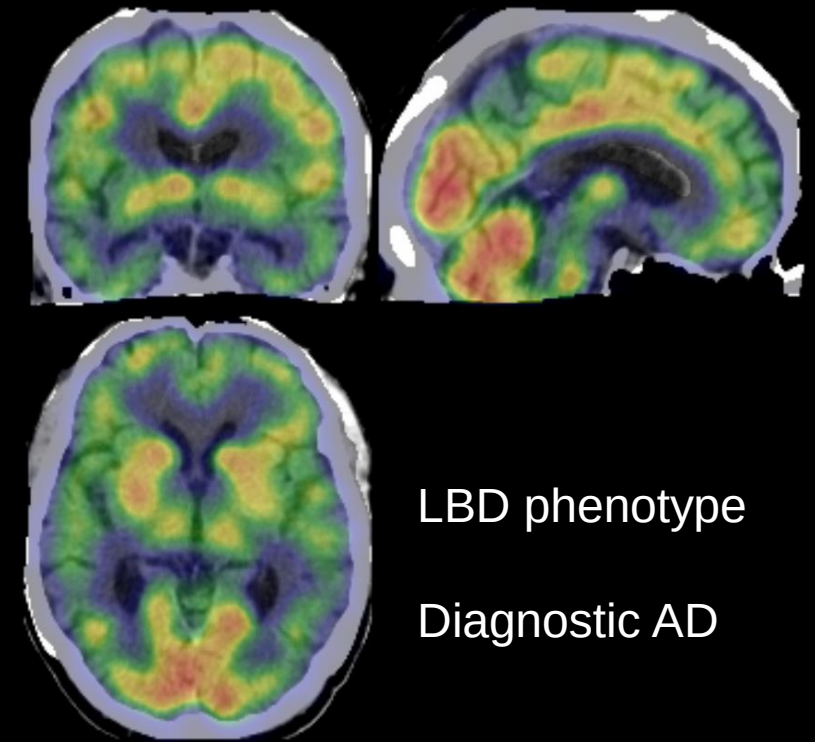


Figure 1 FP-CIT scans of a healthy control (A) and patients with (B) Parkinson's disease, (C) Alzheimer's disease, or (D) dementia with Lewy bodies.



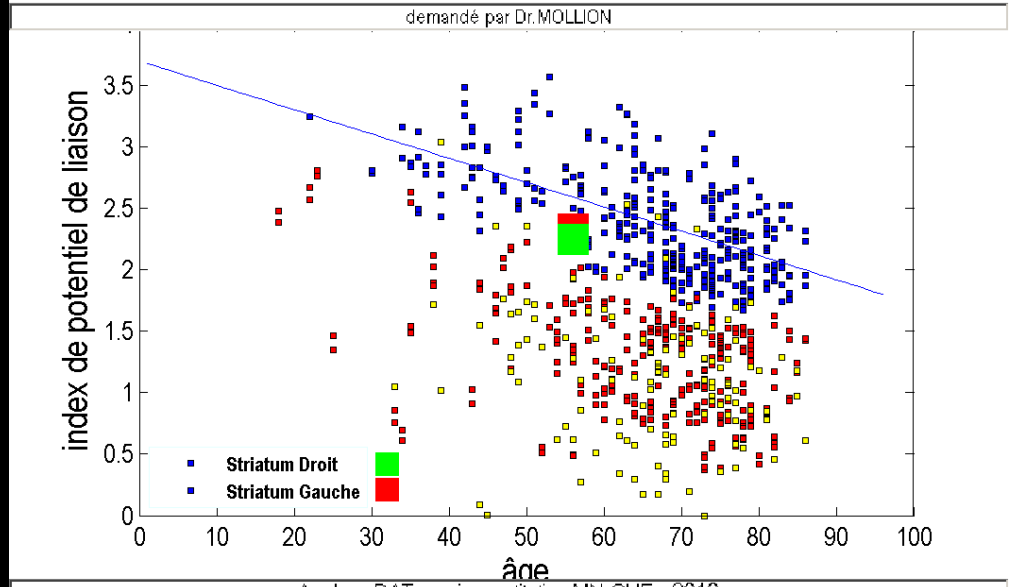
Progressive cognitive decline

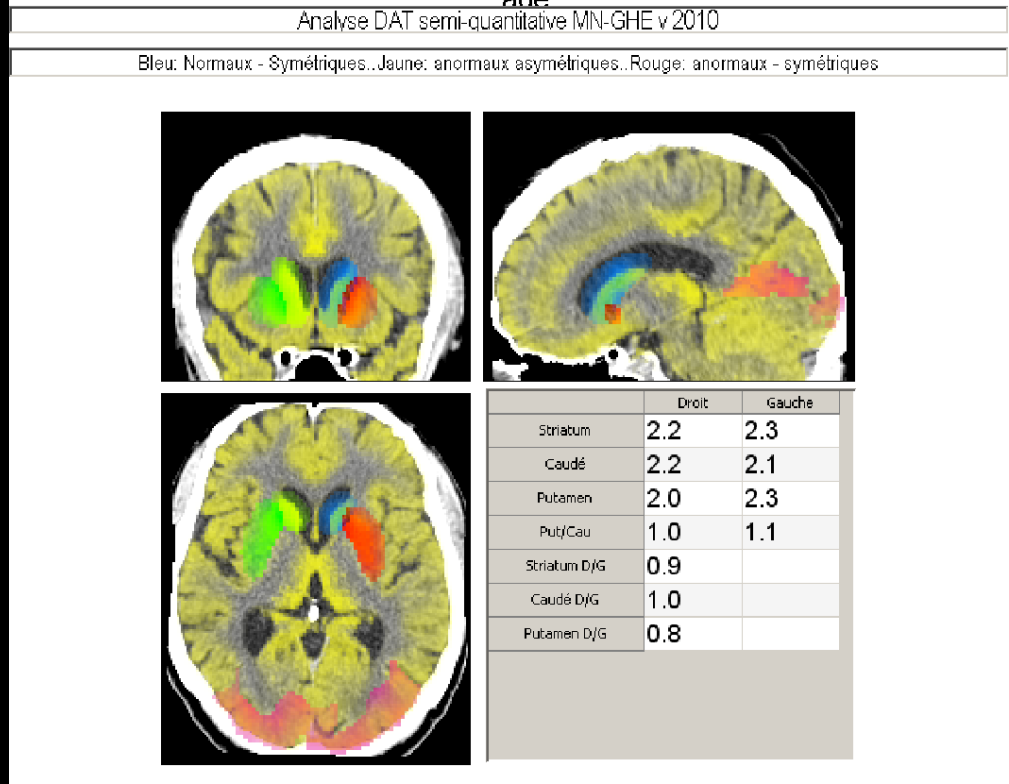
LCR Tau +-



LBD phenotype

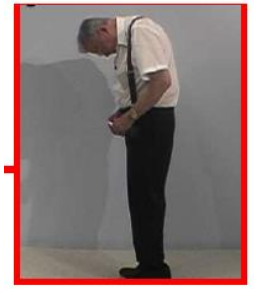
Diagnostic AD





	Droit	Gauche
Striatum	2.2	2.3
Caudé	2.2	2.1
Putamen	2.0	2.3
Put/Cau	1.0	1.1
Striatum D/G	0.9	
Caudé D/G	1.0	
Putamen D/G	0.8	

The term « multiple system atrophy » denotes a sporadic progressive neurodegenerative disorder of adult onset and of unknown etiology, which is clinically characterized by autonomic failure, parkinsonism, cerebellar ataxia, and pyramidal signs in any combination. »



Dysautonomie

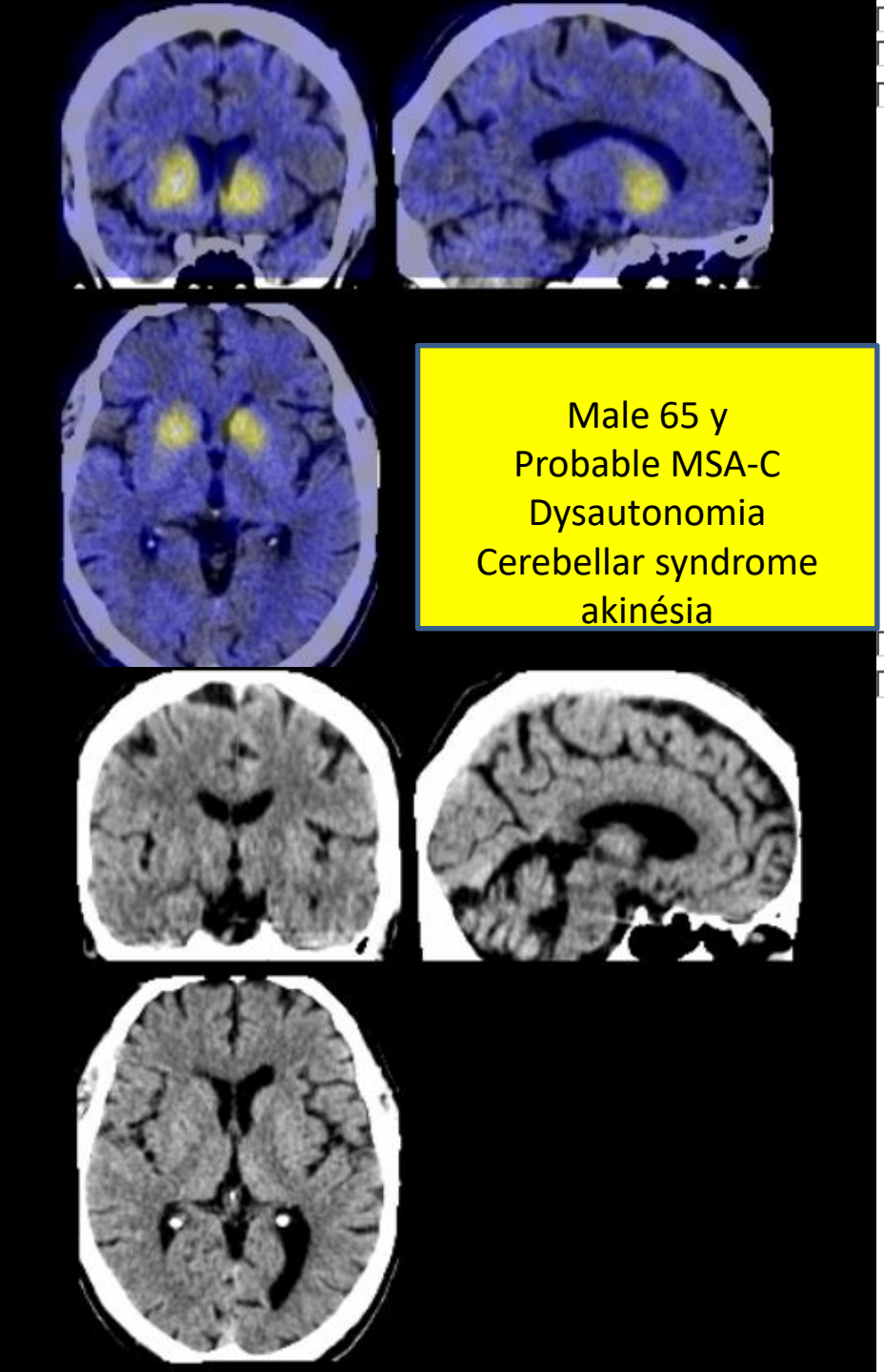
Wenning et al., Mov Dis 2013

Fanciulli A, Wenning GK. Multiple System Atrophy. Review article. NEJM, 2015, 372:249-263

- **Forme la plus fréquente de syndrome parkinsonien atypique**

SPORADIQUE

- **Diagnostic différentiel**
  - **15 % missdiagnosis « parkinson de novo » ++++++**
  - **AMSc : SCA 2 +++, ataxies sporadiques acquises**
  - **Syndrome FXTAS**
  - **Dysautonomie primitive isolée rare**

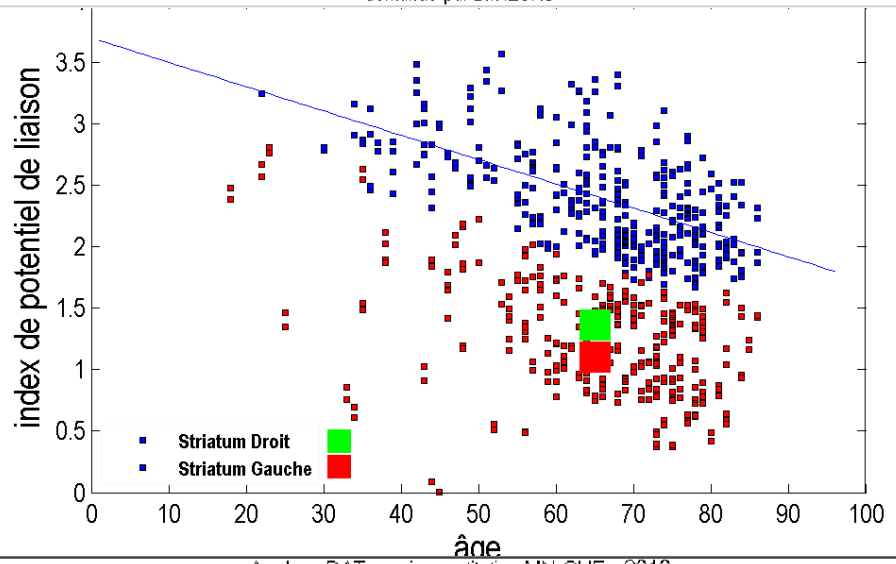


Male 65 y
Probable MSA-C
Dysautonomia
Cerebellar syndrome
akinésia

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

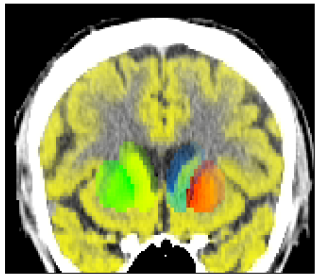
Mr.Luc.[redacted] 16/02/1948.Datscan du.04/09/2012

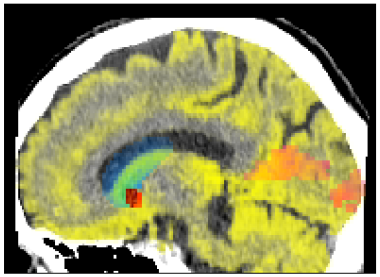
demandé par Dr.NEURO

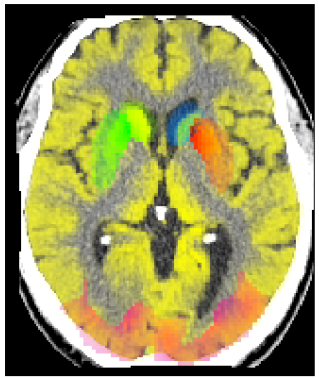


Analyse DAT semi-quantitative MN-GHE v 2010

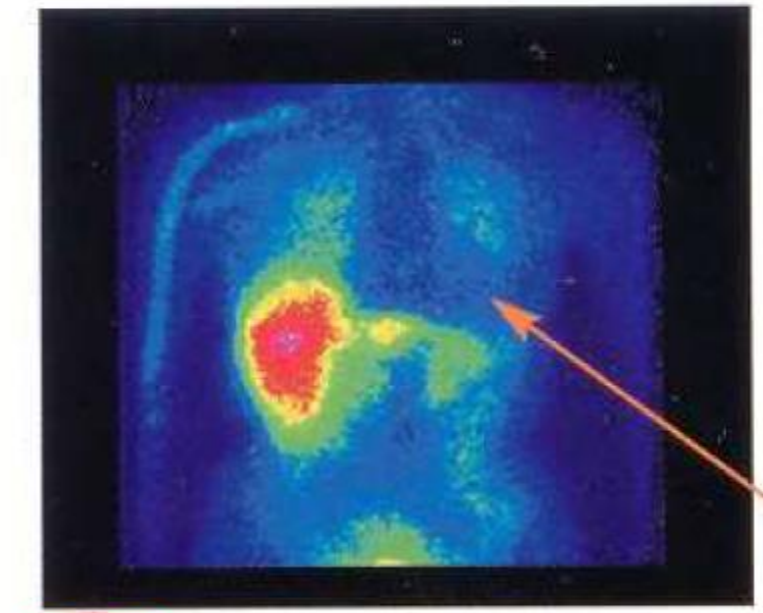
Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques



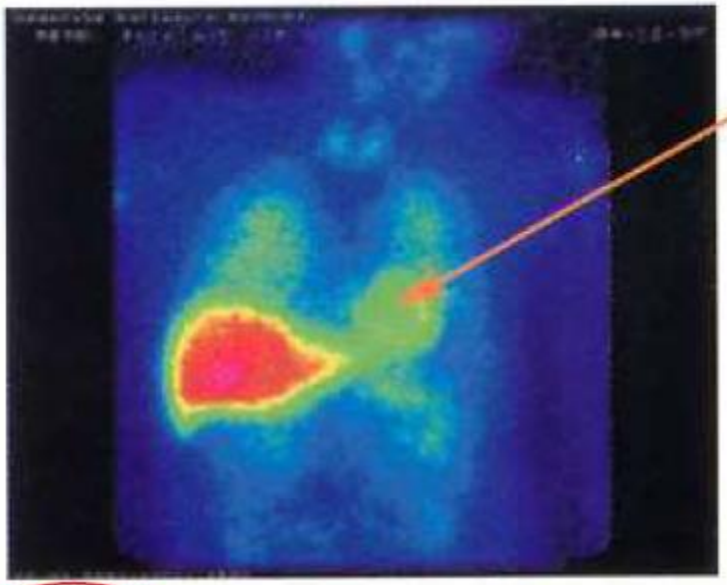




	Droit	Gauche
Striatum	1.3	1.1
Caudé	1.2	1.1
Putamen	1.3	0.8
Put/Cau	1.2	0.8
Striatum D/G	1.2	
Caudé D/G	1.0	
Putamen D/G	1.5	



MPI



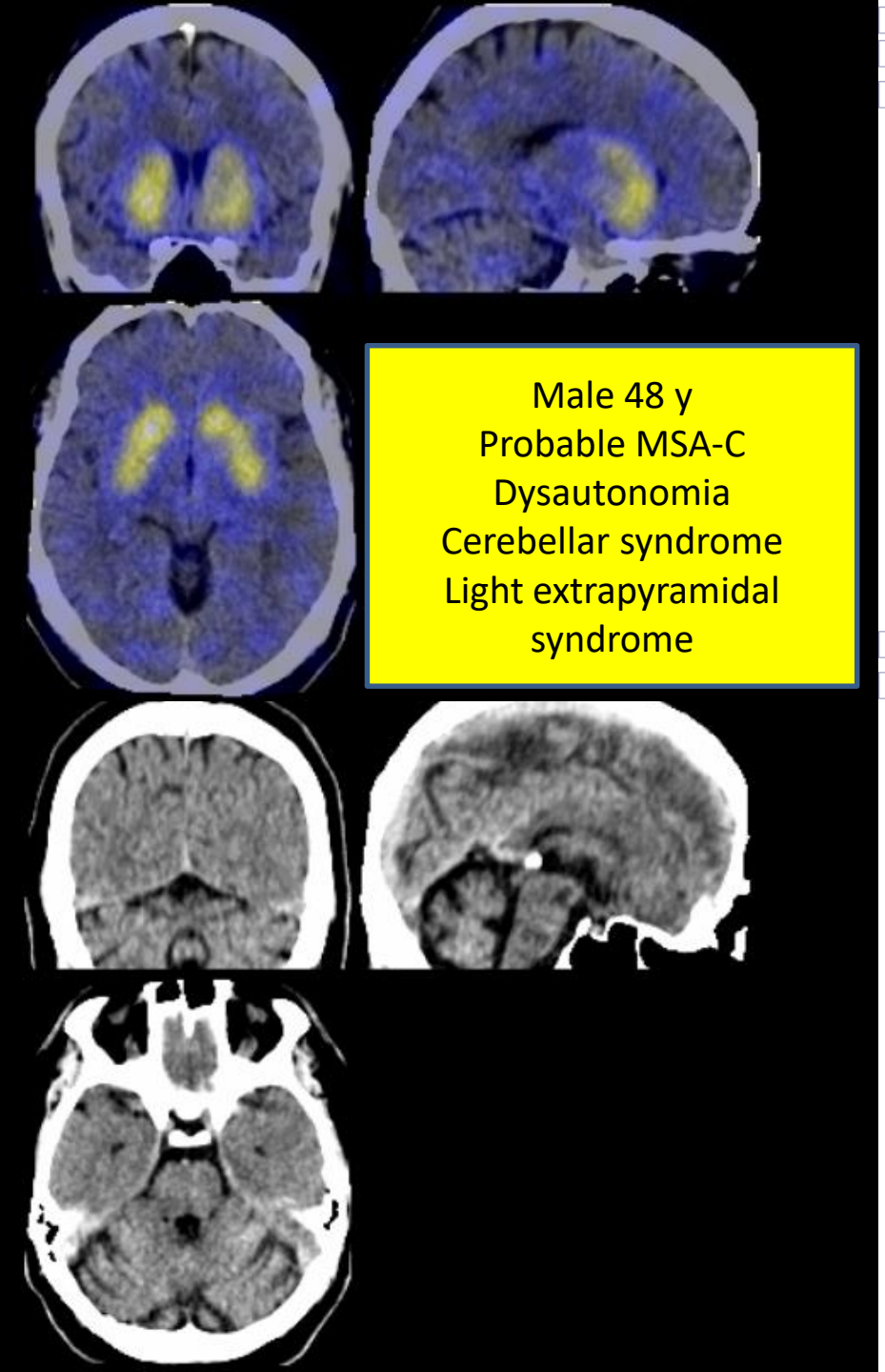
AMS

^{123}I mIBG

Differential diagnosis

MPI and MSA

Cœur

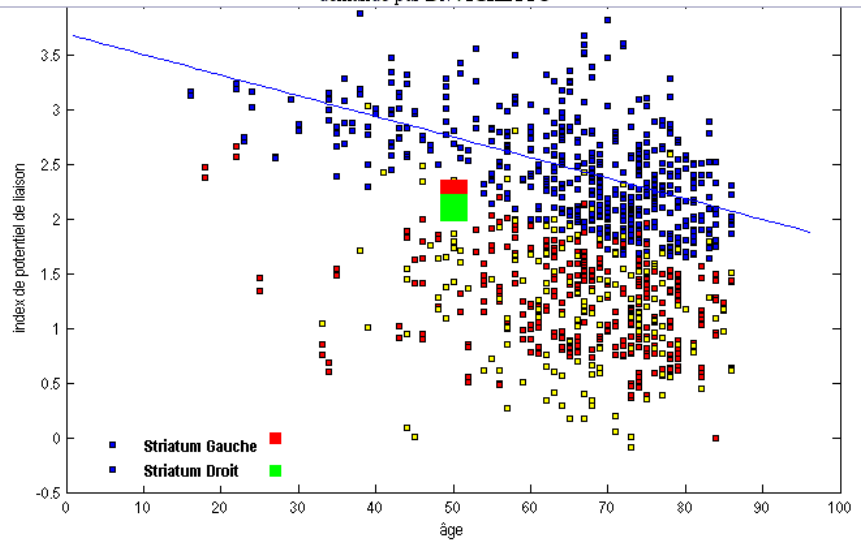


Male 48 y
Probable MSA-C
Dysautonomia
Cerebellar syndrome
Light extrapyramidal syndrome

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

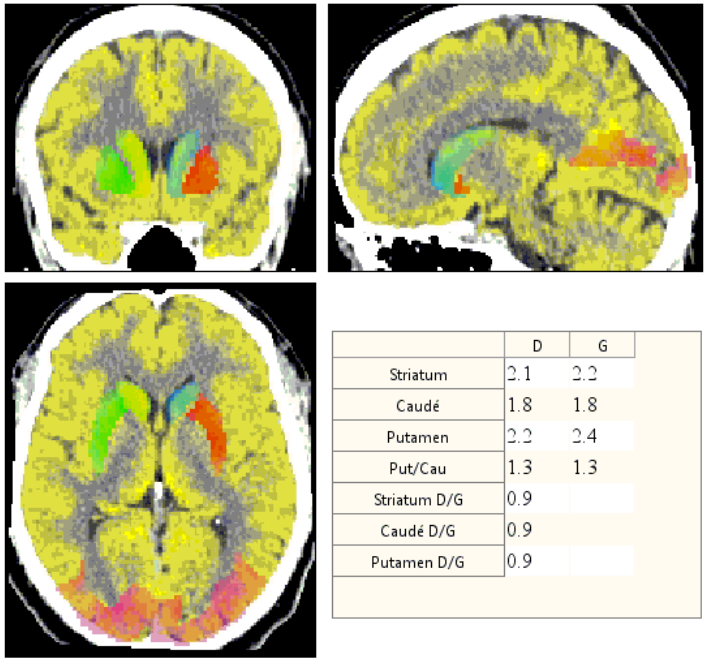
Mr.Marcel.MONNIN.né le17/09/1963.Datscan du.28/01/2014

demandé par Dr.VIGHETTO



Analyse DAT semi-quantitative MN-GHE v 2012

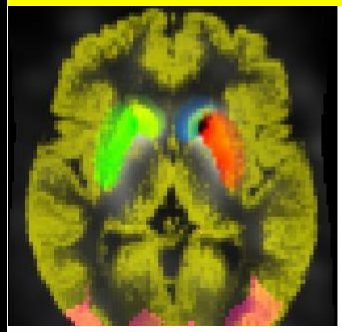
Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques



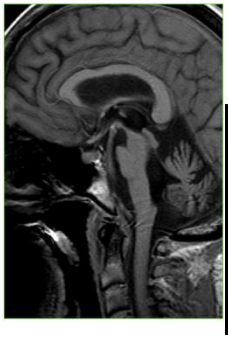
	D	G
Striatum	2.1	2.2
Caudé	1.8	1.8
Putamen	2.2	2.4
Put/Cau	1.3	1.3
Striatum D/G	0.9	
Caudé D/G	0.9	
Putamen D/G	0.9	

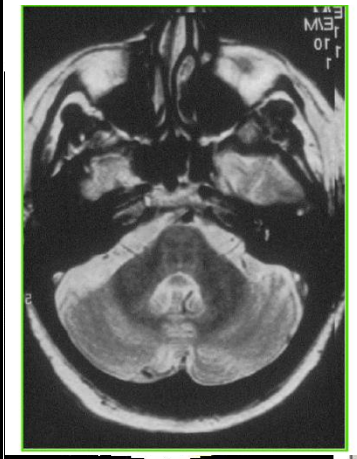
Since 1 year
Gait disturbance
Cerebellar dysarthria
Cerebellum syndrome static
Tetrapyramidal syndrome

AMS-C

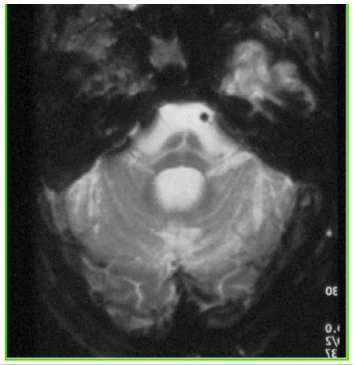


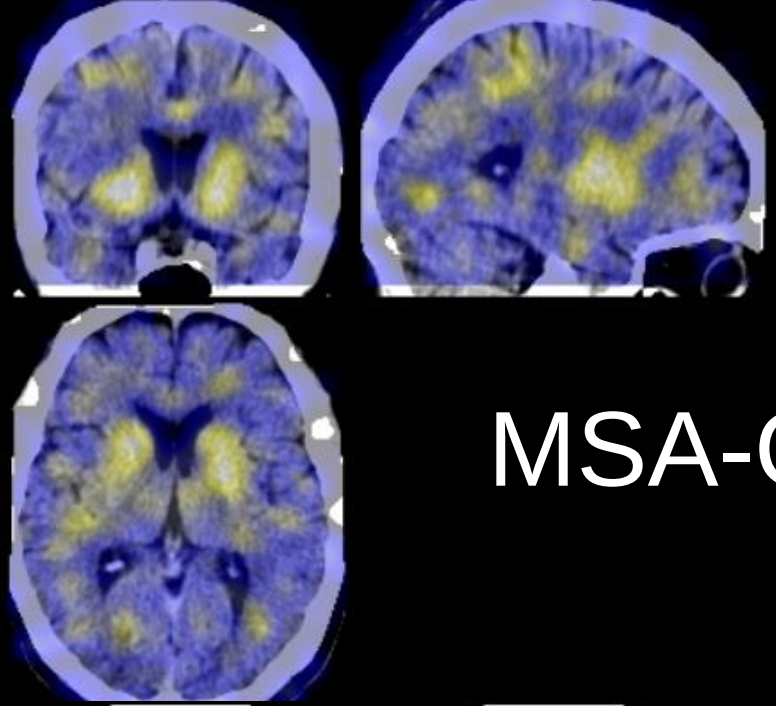
Mme.Marie.DEGE
17/08/1950
examen du.06/08/2009
demandé par Dr.NEURO
référent Pr.Christian Scheiber
Légende
substance grise normalisée sur Colin
ROIs: parcellation par Ciceron sur Colin
images normalisées - MNI



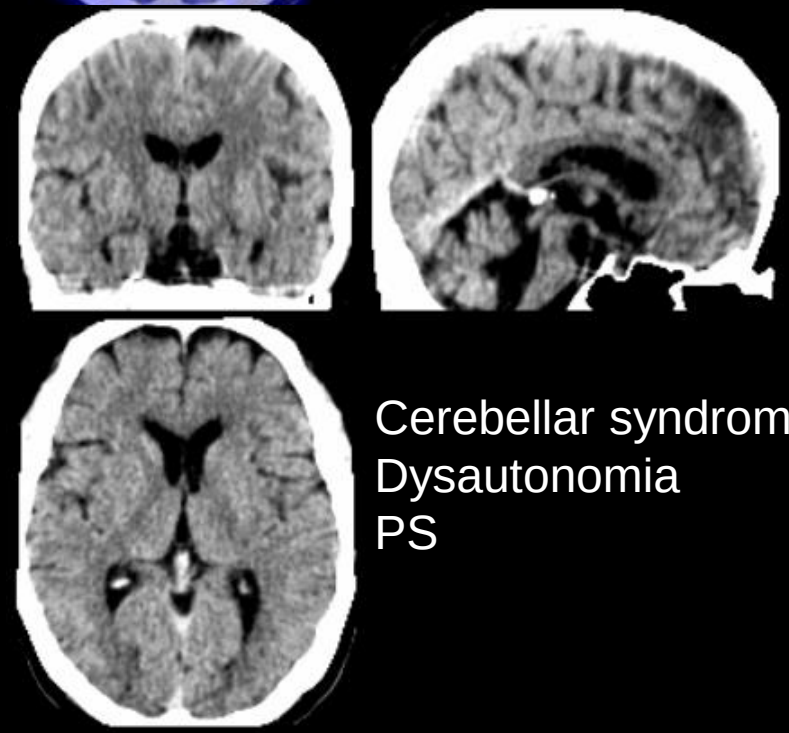


hot cross bun





MSA-C

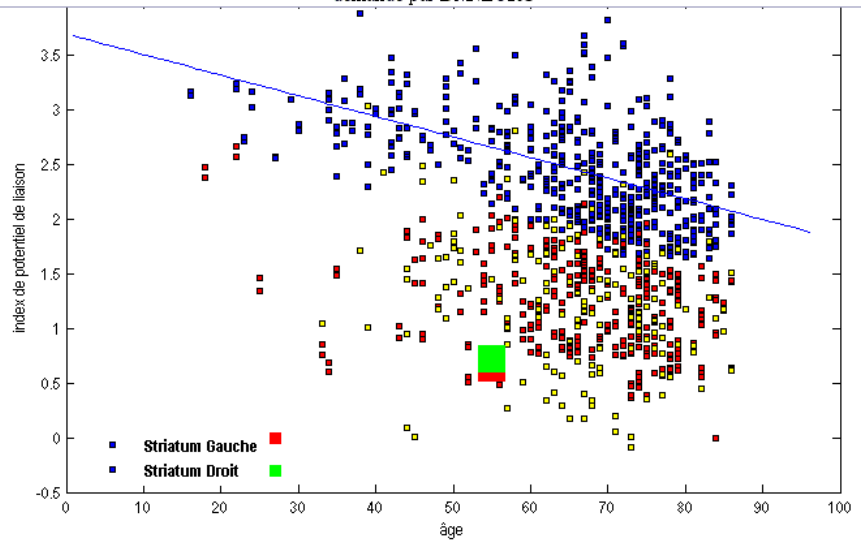


Cerebellar syndrome
Dysautonomia
PS

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

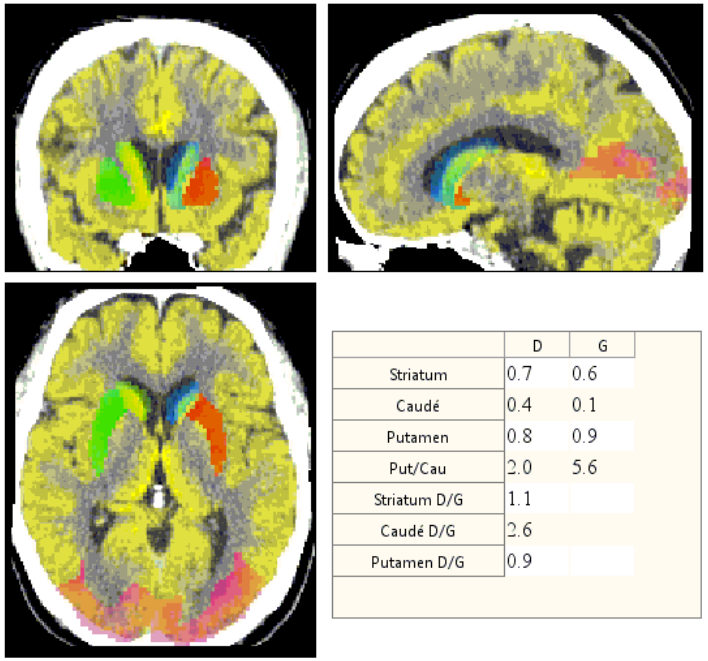
Mr.Roberto.PARODI.né le29/05/1959.Datscan du.25/03/2014

demandé par Dr.NEURO

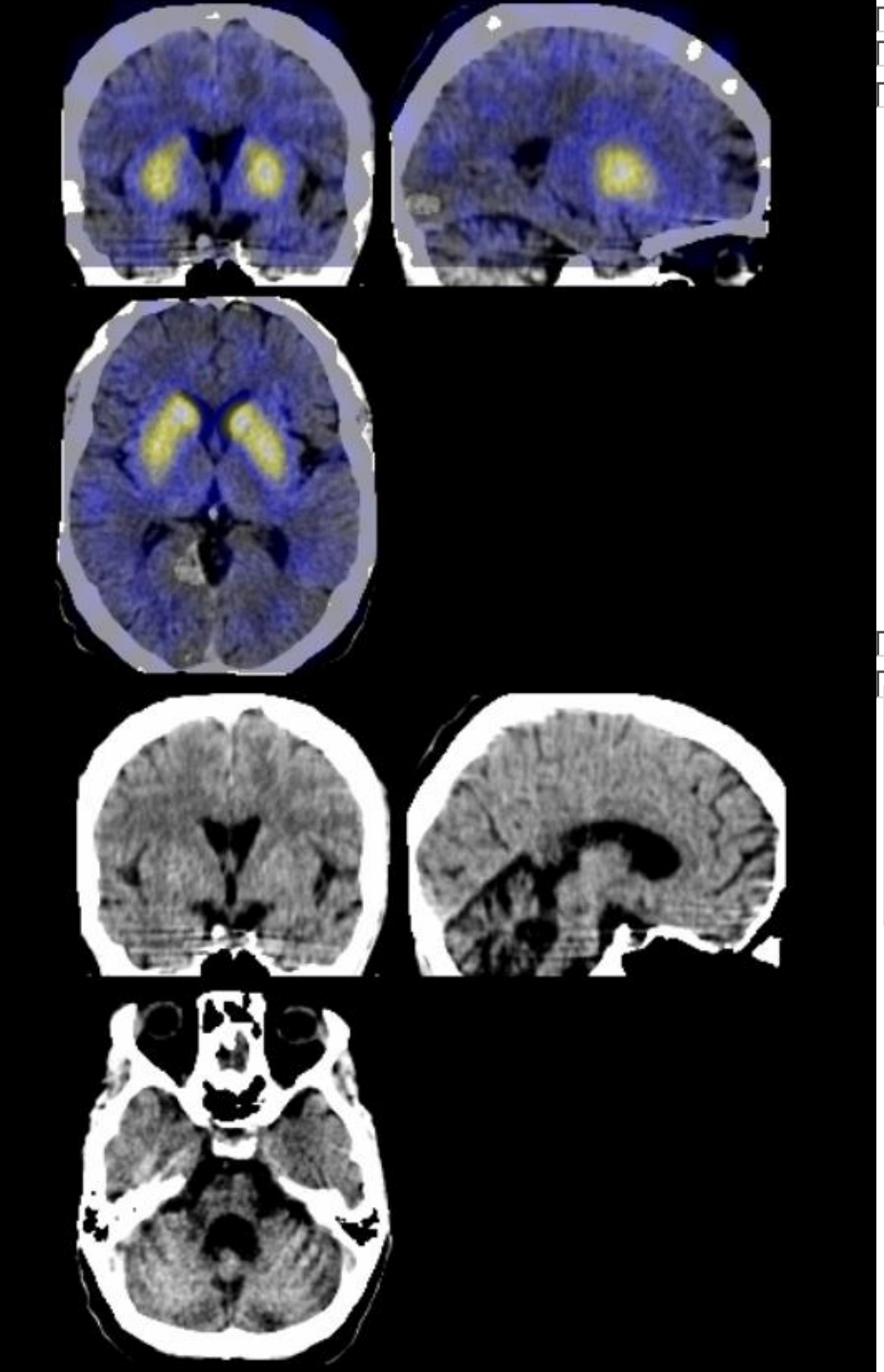


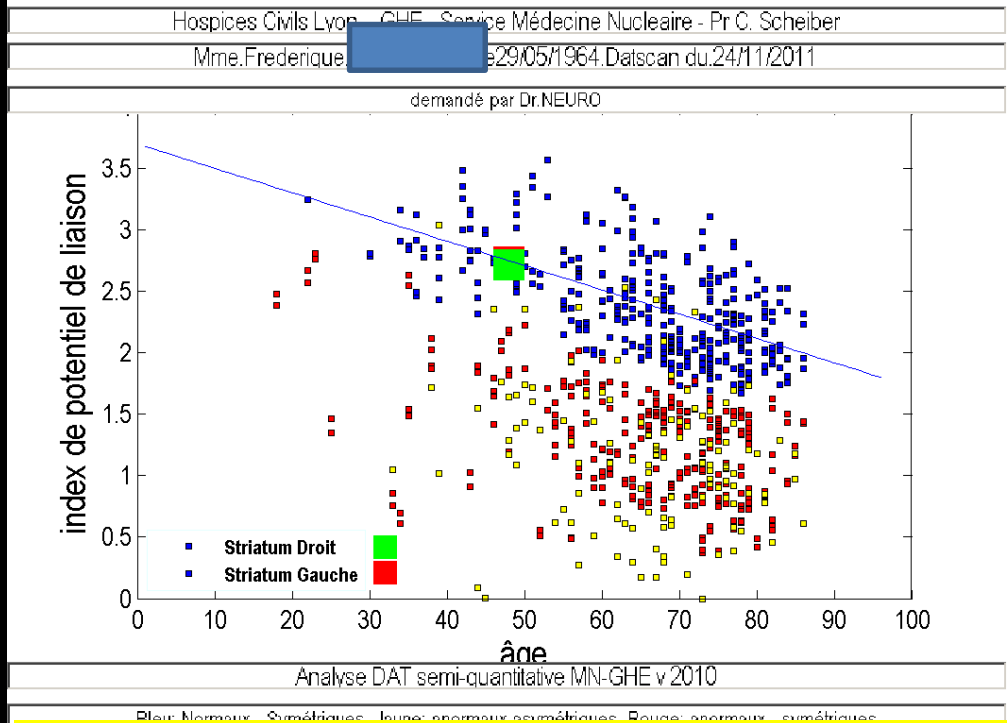
Analyse DAT semi-quantitative MN-GHE v 2012

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques

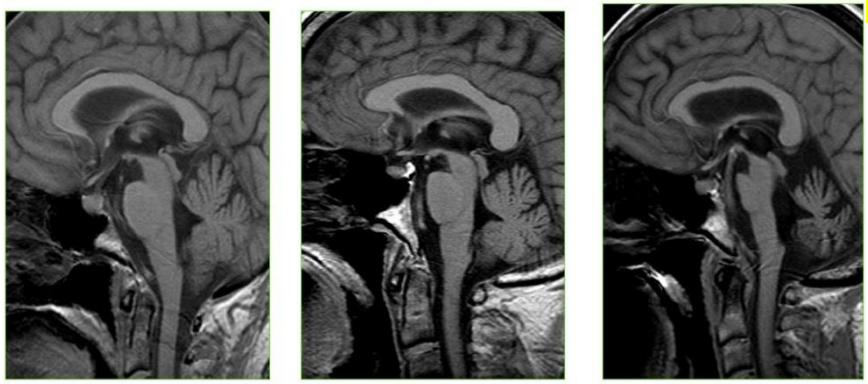


	D	G
Striatum	0.7	0.6
Caudé	0.4	0.1
Putamen	0.8	0.9
Put/Cau	2.0	5.6
Striatum D/G	1.1	
Caudé D/G	2.6	
Putamen D/G	0.9	





Progressive cerebellar syndrome
Dysautonomia
No PS
MSA-C ? Datscan normal



Absente Minime Sévère

SPINO CEREBELLAR ATAXIA Type 2 and Ioflupane

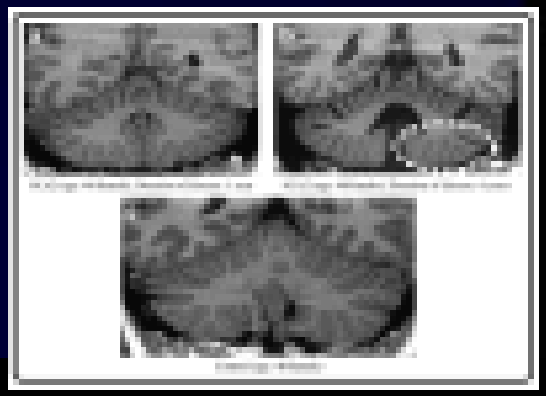
Reduced Striatal [^{123}I]FP-CIT Binding in SCA2 Patients without Parkinsonism

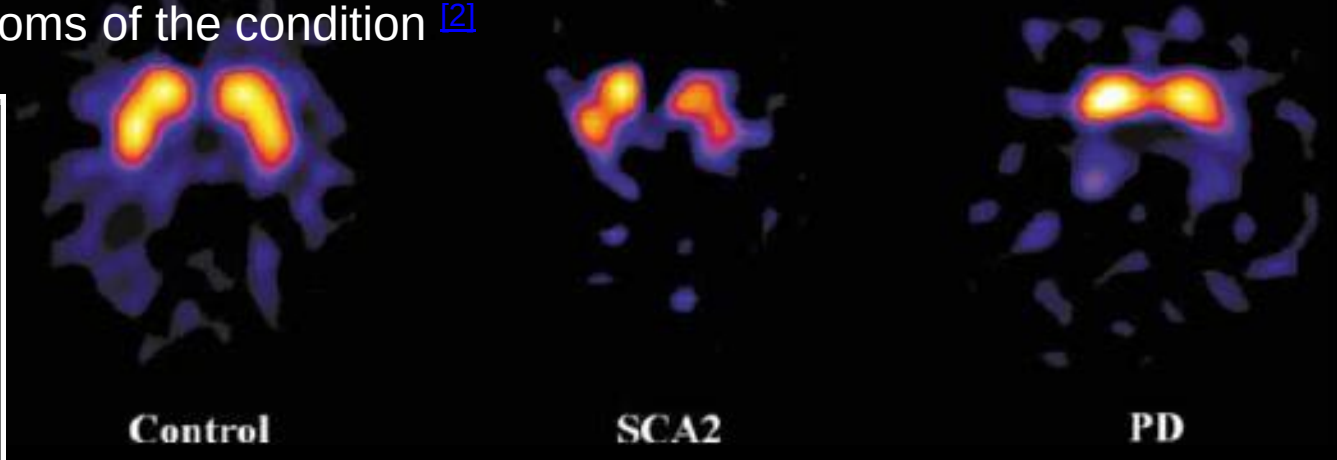
Andrea Varrone, MD, PhD,[1] Elena Salvatore, MD,[2] Giuseppe De Michele, MD,[2] Paolo Barone, MD,[2] Valeria Sansone, MD[3], Maria Teresa Pellecchia, MD,[2] Imma Castaldo, PhD,[4] Giovanni Coppola, MD,[2] Arturo Brunetti, MD,[1] Marco Salvatore, MD,[3] Sabina Pappatà, MD,[1] and Alessandro Filla, MD[2]

High negative correlation between ATAXIA and Ioflupane binding ratios

(r =-0,84)

Spinocerebellar ataxia 2 (SCA2) is inherited in an autosomal dominant manner. This means that having one changed (mutated) copy of ATXN2 (gene) in each cell is enough to cause signs and symptoms of the condition [2]





Atypical Parkinsonim & Tauopathies: Clinical Diseases

Alzheimer's disease

Dementia pugilistica

Guam ALS/PD

PSP Atypical PS

CBD Atypical PS

Pick disease

disease

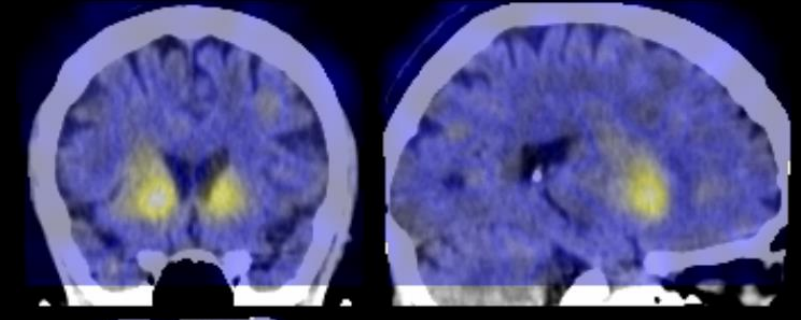
Nieman-Pick, type C

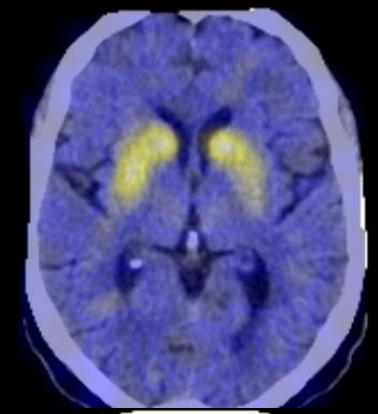
SSPE

FTDP-17

Postencephalatic PD

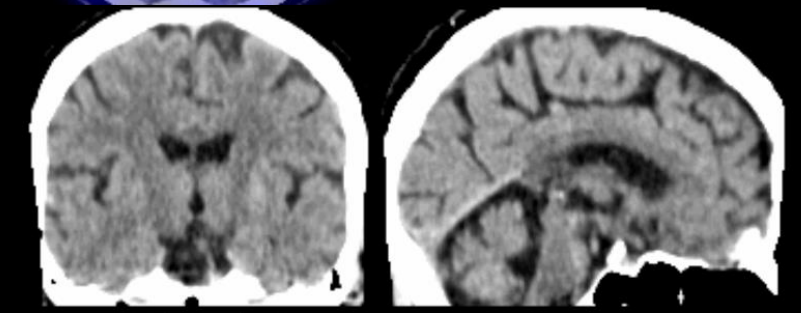
Autosomal recessive PD





Progressive
Oculomotor Palsy
Verticality

Since 4 years

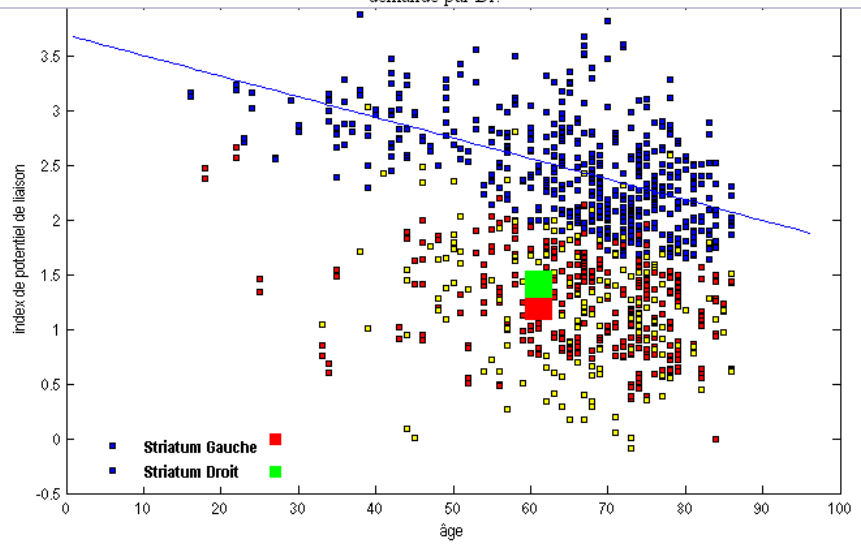


Probable PSP
Discrete
asymetry
Global decrease

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

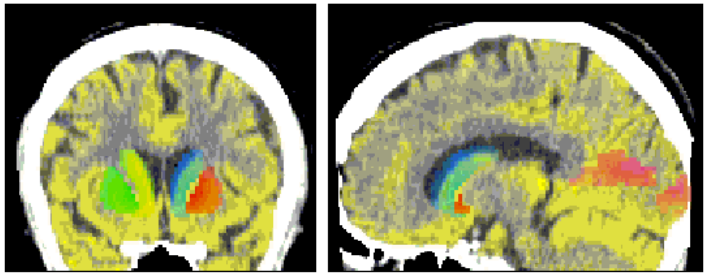
Mme.Elisabeth.C [redacted] 1/1951.Datscan du.07/02/2013

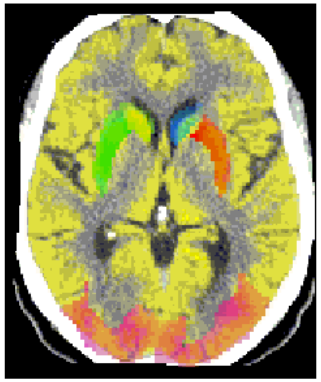
demandé par Dr.



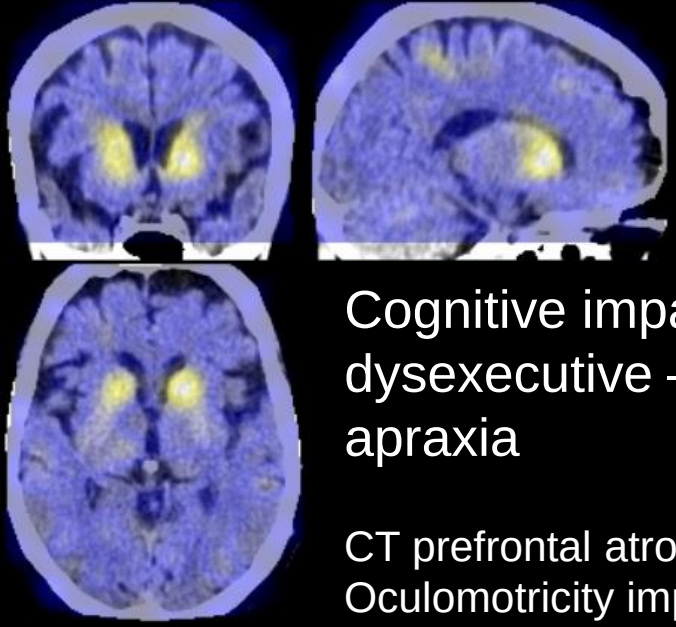
Analyse DAT semi-quantitative MN-GHE v 2012

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques



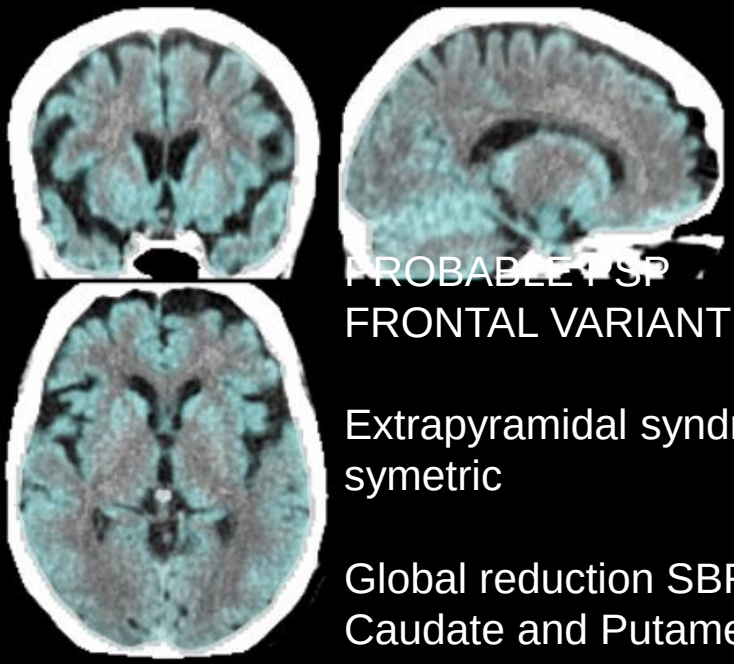


	D	G
Striatum	1.4	1.2
Caudé	1.0	1.0
Putamen	1.6	1.2
Put/Cau	1.5	1.3
Striatum D/G	1.1	
Caudé D/G	1.0	
Putamen D/G	1.3	



Cognitive impairment dysexecutive – apraxia

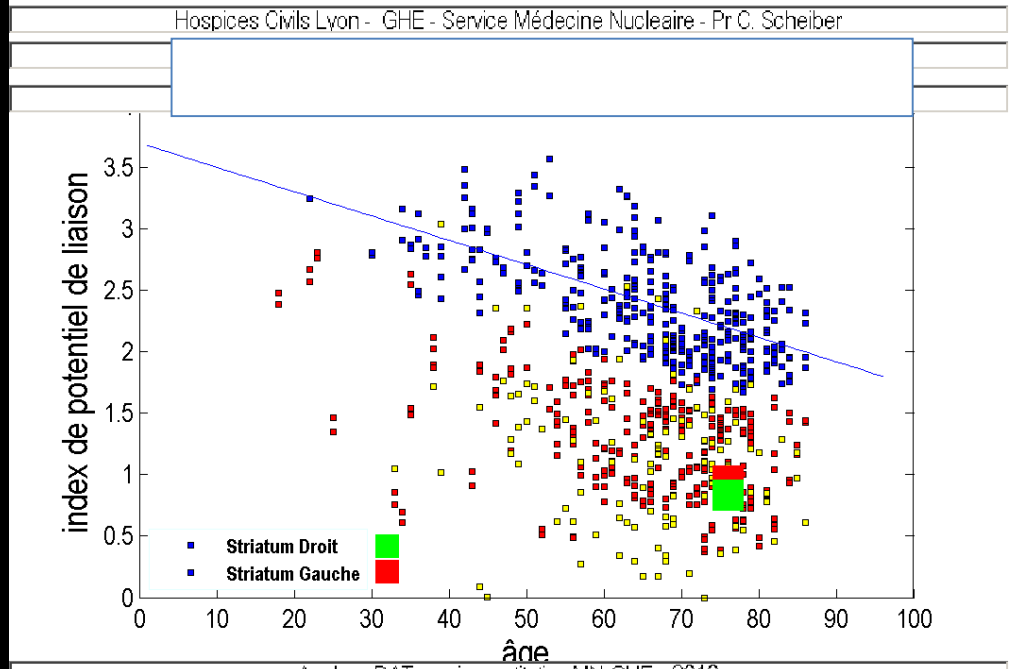
CT prefrontal atrophy
Oculomotricity impaired

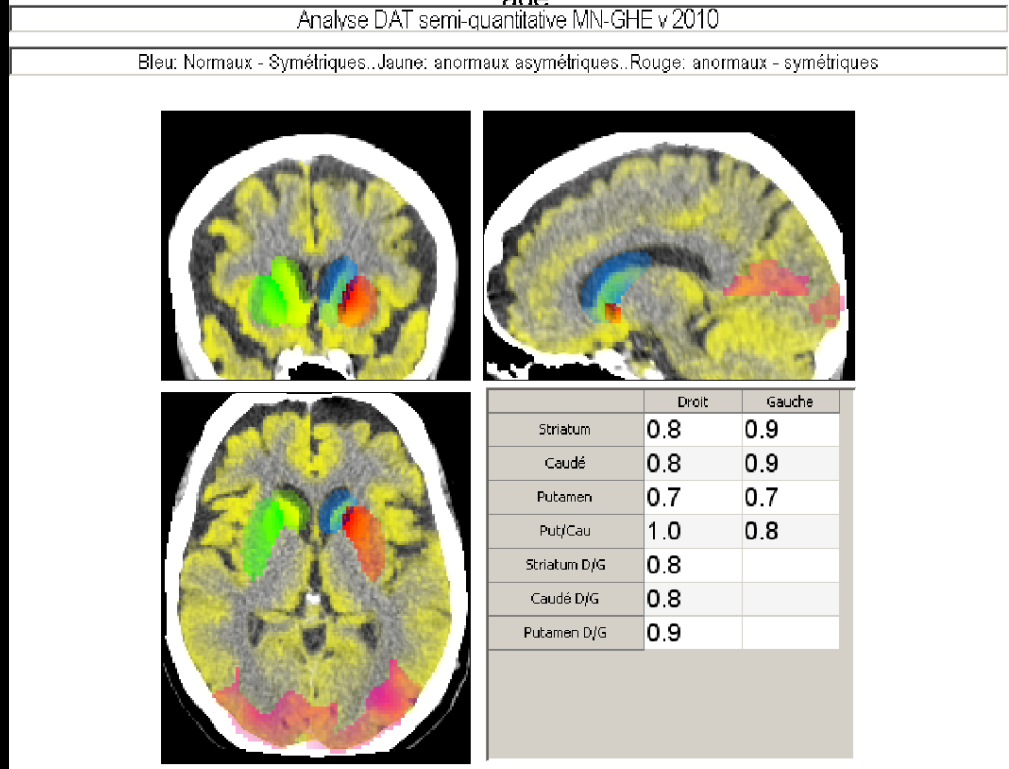


PROBABLE FTSP FRONTAL VARIANT

Extrapyramidal syndrome symetric

Global reduction SBRs Caudate and Putamen



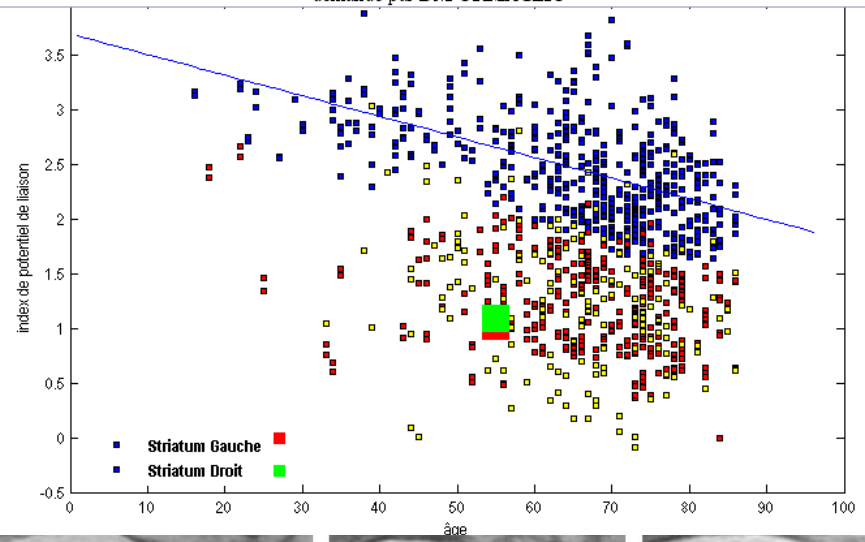


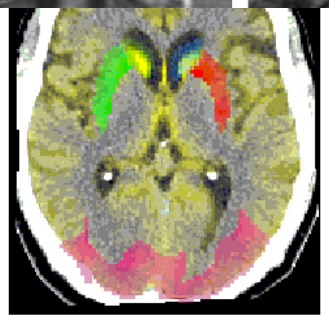
	Droit	Gauche
Striatum	0.8	0.9
Caudé	0.8	0.9
Putamen	0.7	0.7
Put/Cau	1.0	0.8
Striatum D/G	0.8	
Caudé D/G	0.8	
Putamen D/G	0.9	

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

Mr.Philippe [redacted] le22/06/1959.Datscan du.27/02/2014

demandé par Dr.FORMAGLIO





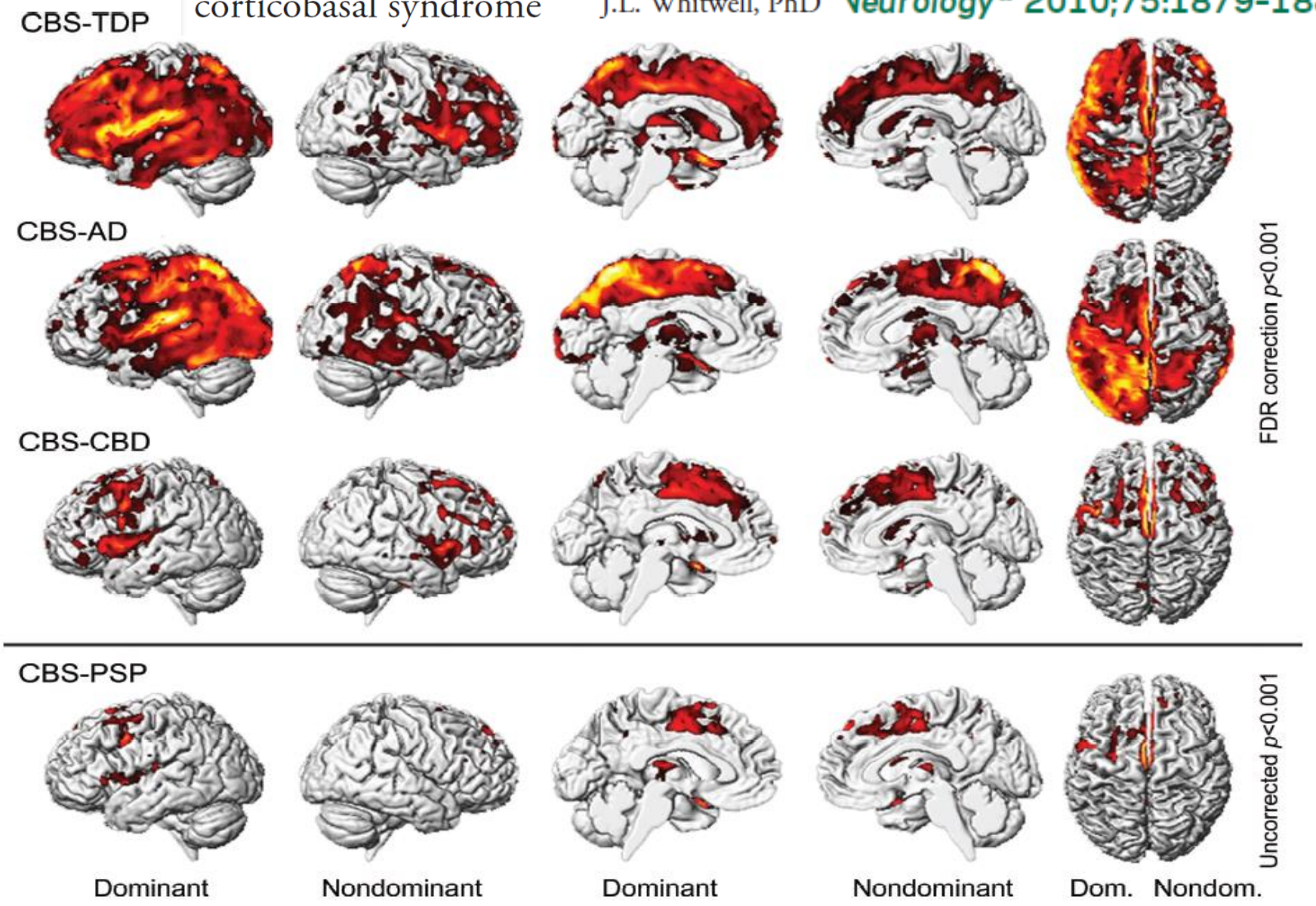
Striatum	1.0	1.0
Caudé	0.7	0.1
Putamen	1.2	1.6
Put/Cau	1.8	12.
Striatum D/G	1.0	
Caudé D/G	5.2	
Putamen D/G	0.8	

Imaging correlates of pathology in corticobasal syndrome

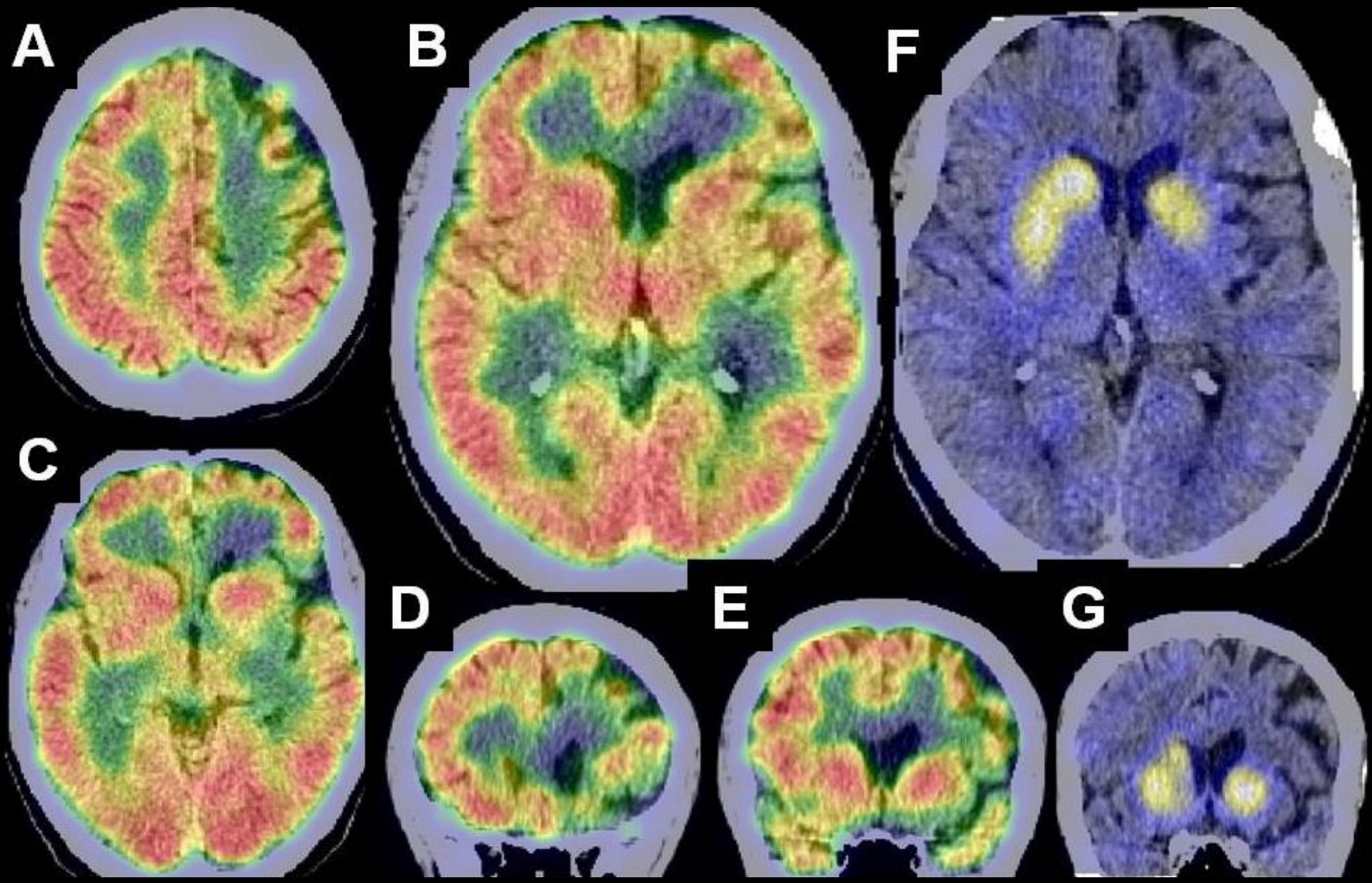
J.L. Whitwell, PhD

Neurology® 2010;75:1879-1887

Figure 1 Patter … athologic group compared to controls

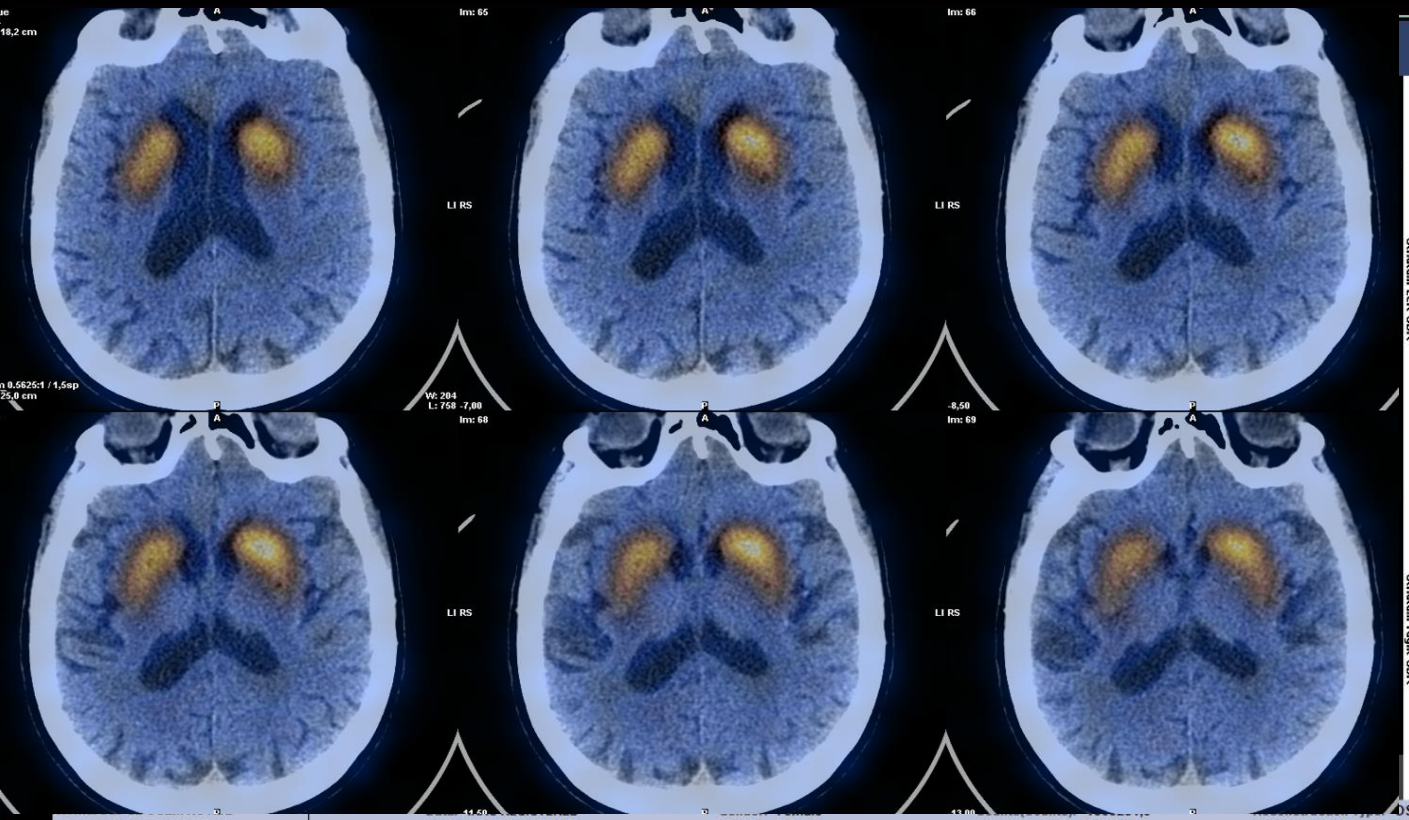


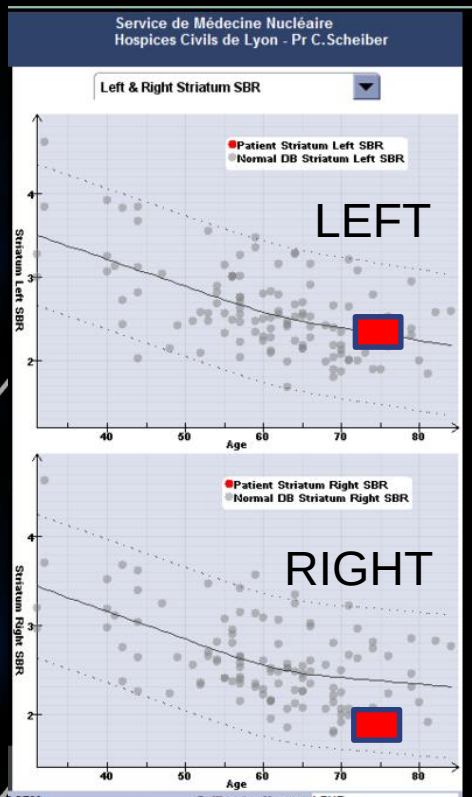
Surface renderings showing regions of gray matter loss in the dominant and nondominant hemisphere of CBS-TDP, CBS-AD, CBS-CBD, and CBS-PSP compared to controls. All results are shown after correction for multiple comparisons using the false discovery rate (FDR) at $p < 0.001$, except for the results from the CBS-PSP group, which are shown uncorrected at $p < 0.001$. AD = Alzheimer disease; CBD = corticobasal degeneration; PSP = progressive supranuclear palsy; TDP = TDP-43 immunoreactivity.



Diagnosis left cortico-basal degeneration TDP-43
(or left cortico-basal syndrome)

Mrs BON.. 65 y – Cognitive decline 2017 – MRIb normal 2x - NDG check-up in NDG center > diag: depression – 2018 worsening + left apraxia – No Extrapyramidal syndrome > refered for Ioflupane ? POSSIBLE CORTICO-BASAL SYNDROME 110 MBq 30 min – Dual Isotope study – 670 CZT





GE normals database for OSEM with att...

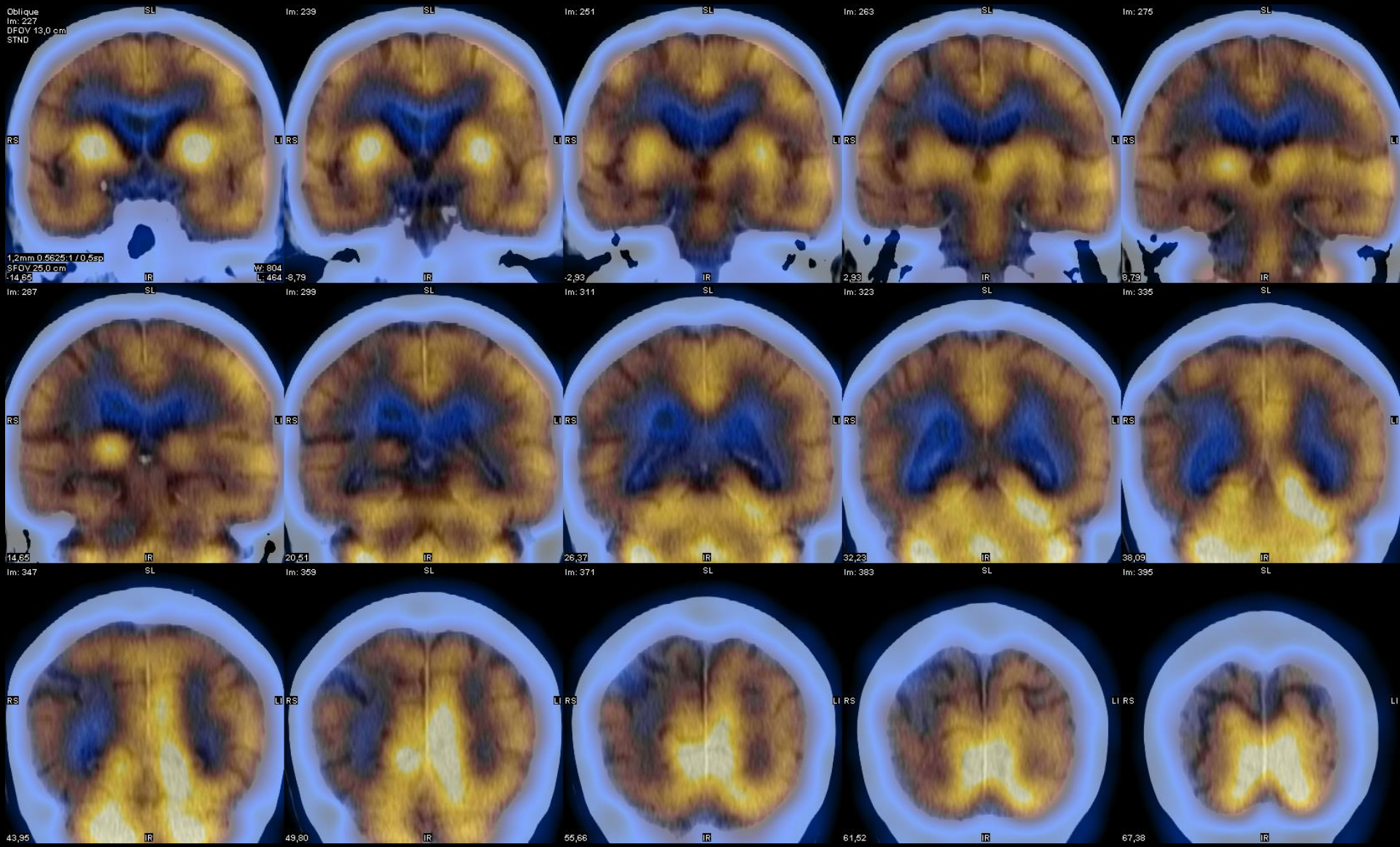
Camera: Tandem_Apollo | Age(Years): 74 | Dose(MBq): 123,0 | Corrections: Attenuation correction | OSEM | Collimator Name: LEHR | Collimator Type: Parallel

Normal DB mismatch – Corrections : Attenuation correction (Chang attenuation correction)

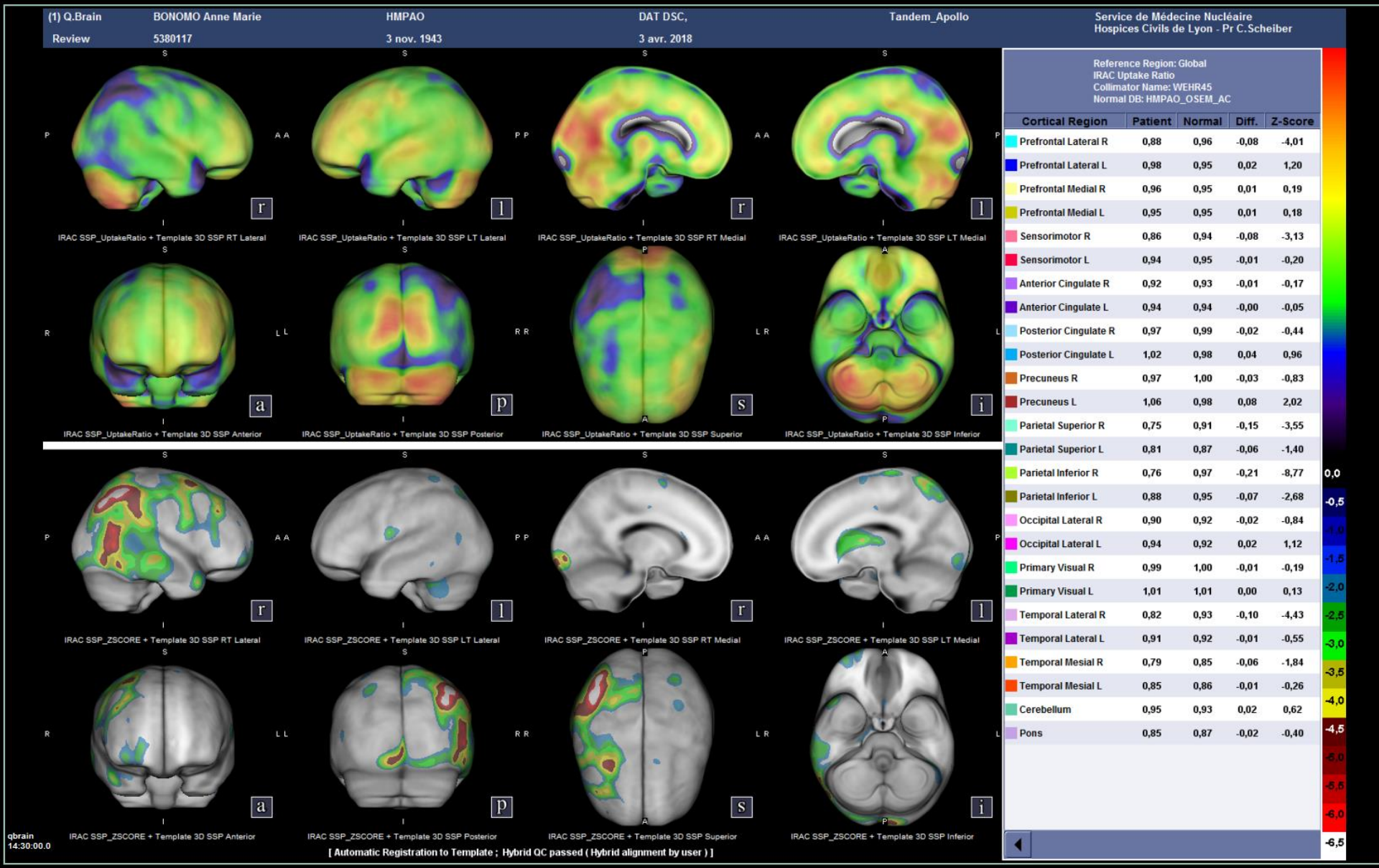
	Striatum Right SBR	Striatum Left SBR	Putamen Right SBR	Putamen Left SBR	Caudatus Right SBR	Caudatus Left SBR
Measured	+1,92	+2,29	+1,69	+1,98	+2,46	+2,91
Mean (±1 SD)	+2,38 (±0,40)	+2,33 (±0,42)	+2,29 (±0,39)	+2,23 (±0,41)	+2,59 (±0,48)	+2,54 (±0,50)
Deviation	-19%	-2%	-26%	-11%	-5%	+15%

DaTQUANT : asymetrical uptake (lower on the right side)
right putamen -26% from the mean – not enough to be conclusive (still normal range)

Mme BO … ^{99m}Tc HMPAO Dual isotope study 670 CZT



Mrs BO …. QBRAIN
Possible CBS-AD or Post Cortical atrophy (AD)



Atypical Parkinsonism and Psychiatry

Neuroleptics (including new generation)

Behavioral (even psychotic) phenotypes of NDG

Depression under neuroleptics, valproate sodium

Dual tracer SPECT-CT contribution :

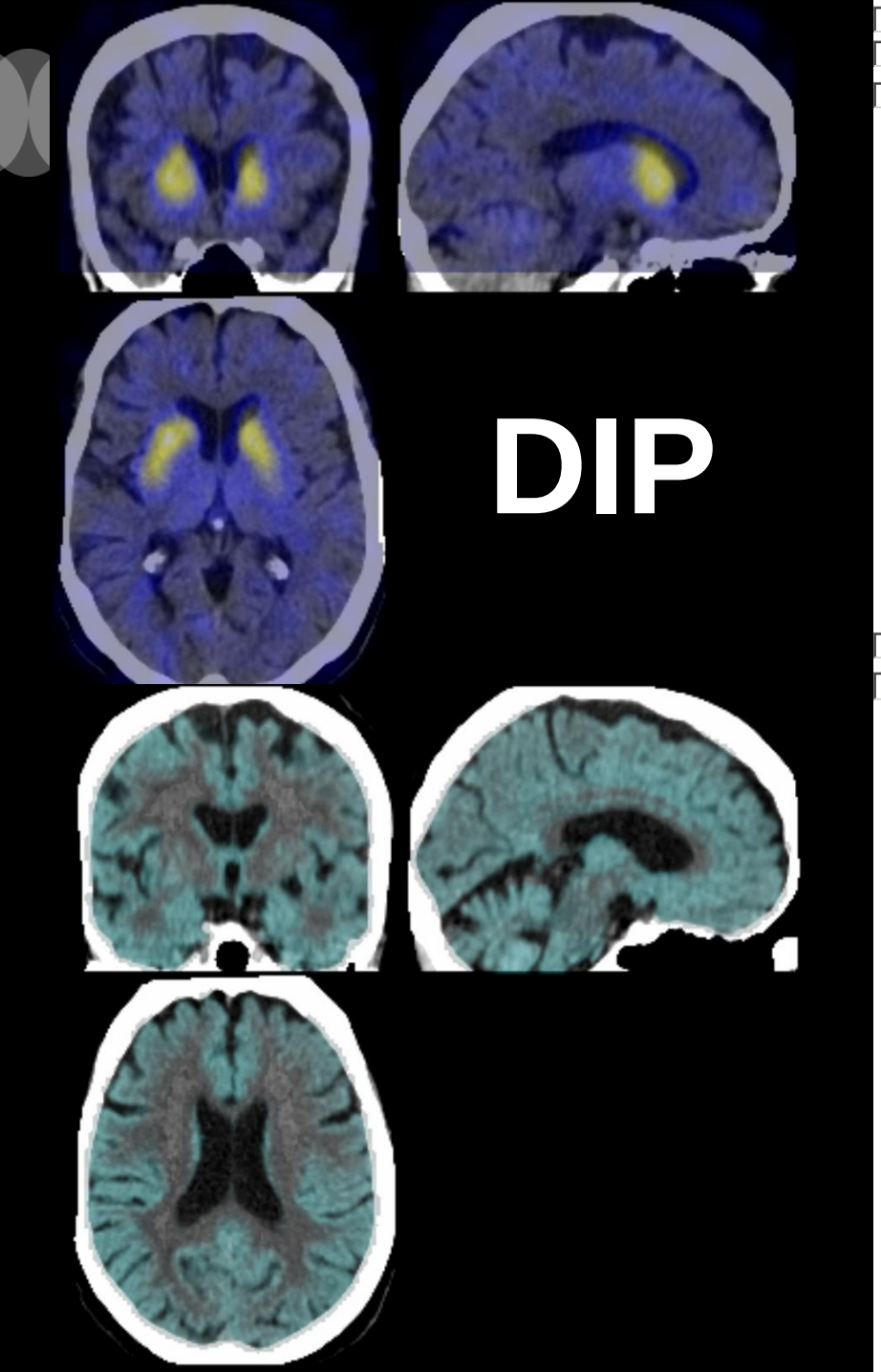
Presynaptic dopaminergic denervation ? Y/N severity laterality

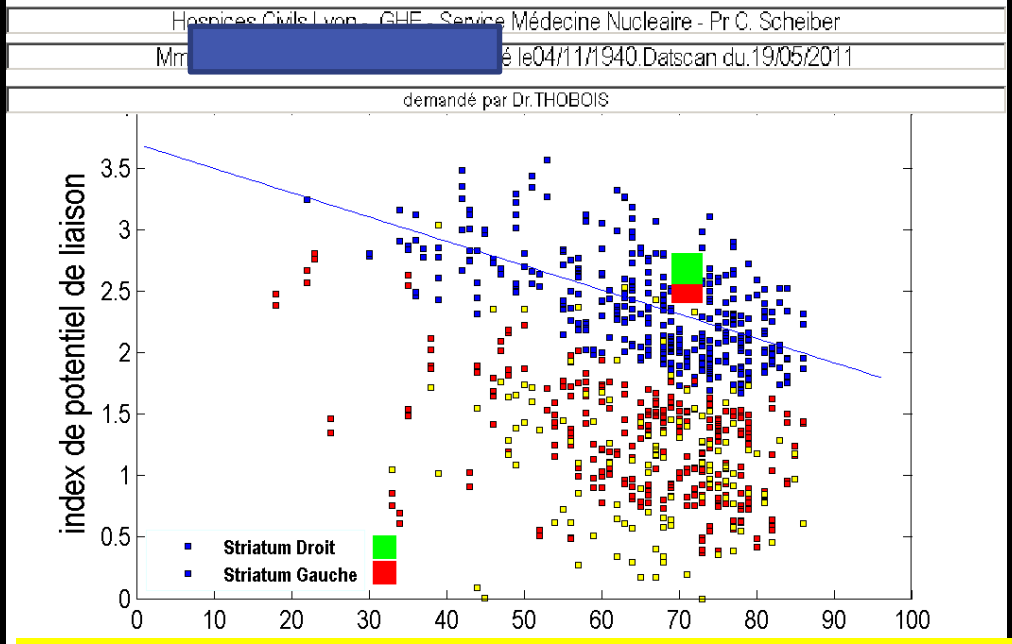
Perfusion abnormalities & atrophy ?

Drug Induced Parksonian (DIP)

Very common cause of misdiagnosis

- Results from pharmacologic agents that block DA receptors but don't affect DAT
- Common drugs include neuroleptics (eg prochlorperazine, and metoclopromide), and calcium channel blockers
- DIP more common in women and elderly and does not clearly relate to dosage or length of usage
- DATScan will look normal !

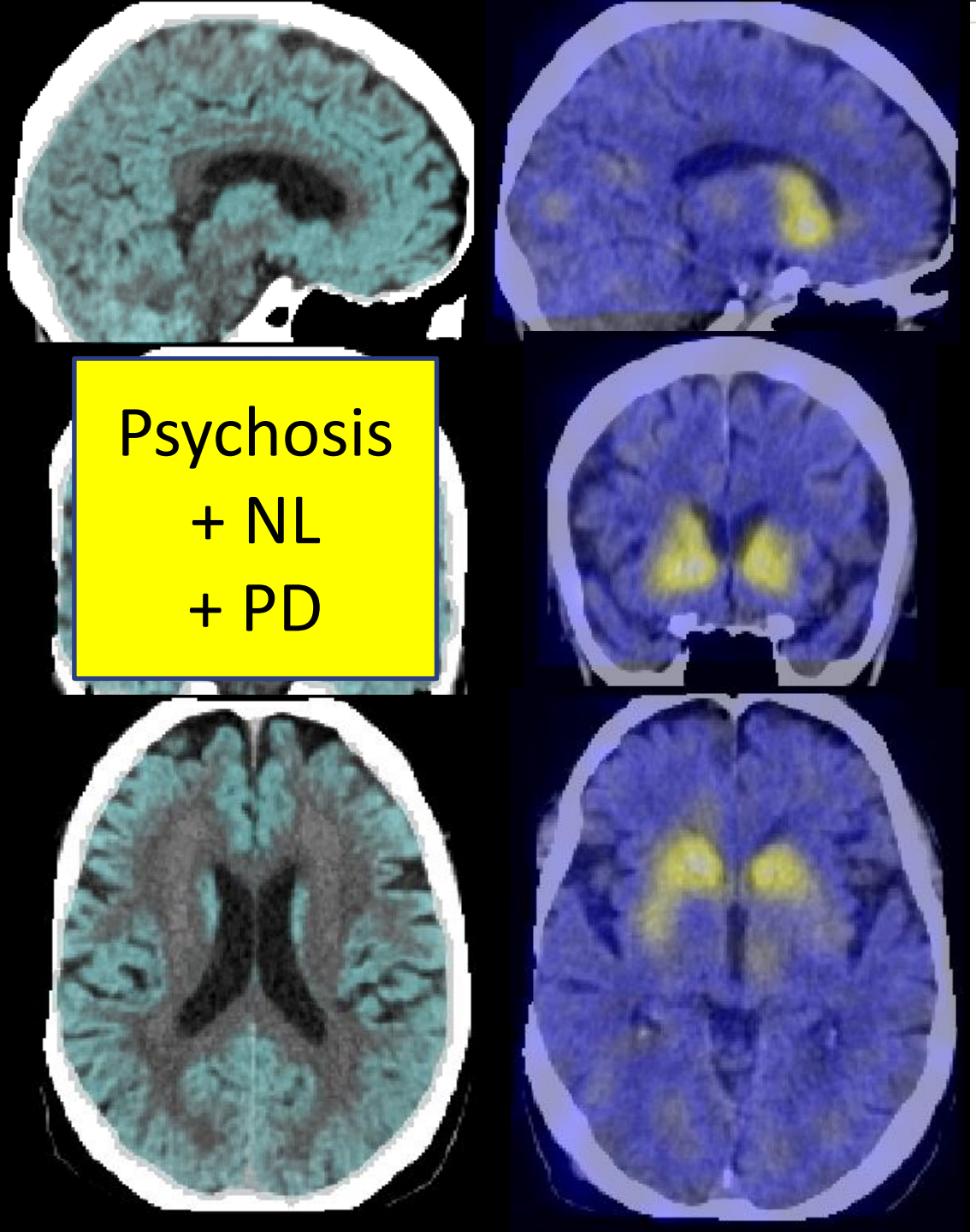




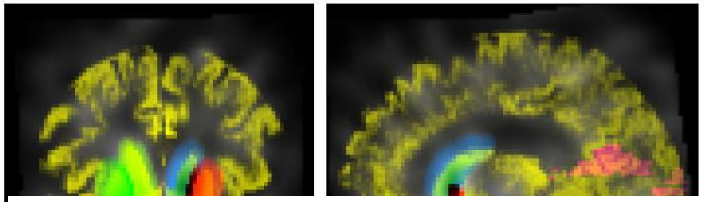
Woman 65 y
10 y melancolia

Akineto hypertonic light

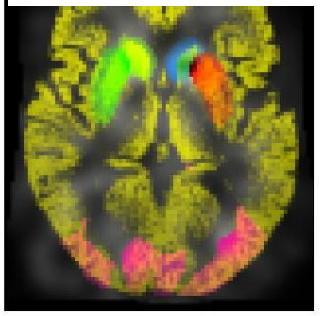
Hypomimia micrography
Solian, Zyprexa, Risperdal…
Discont 1 year without changes



Psychosis
+ NL
+ PD



78 y, psychosis – neuroleptics for 50 years. Parkinsonism since 6 months
> MPI ?



examen du.03/02/2011

demandé par Dr.VINATIER

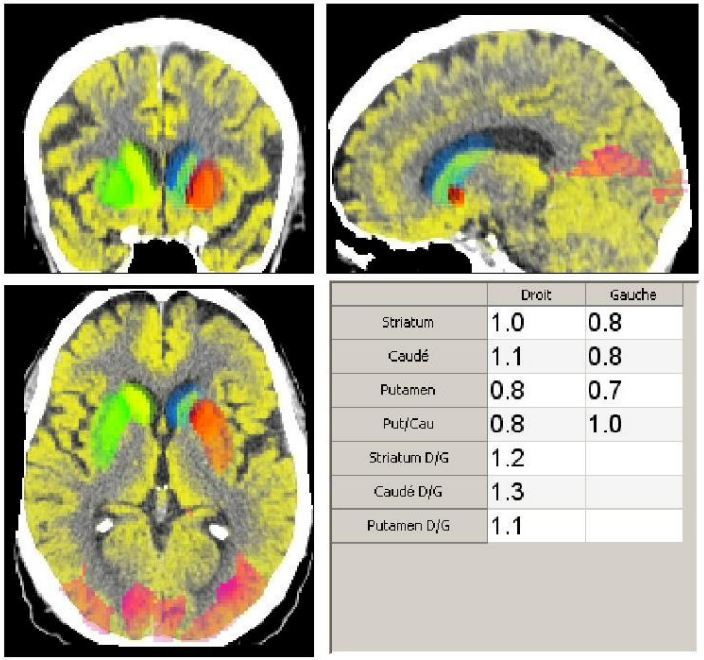
réferent Pr.Christian Scheiber

Légende

substance grise normalisée sur Colin

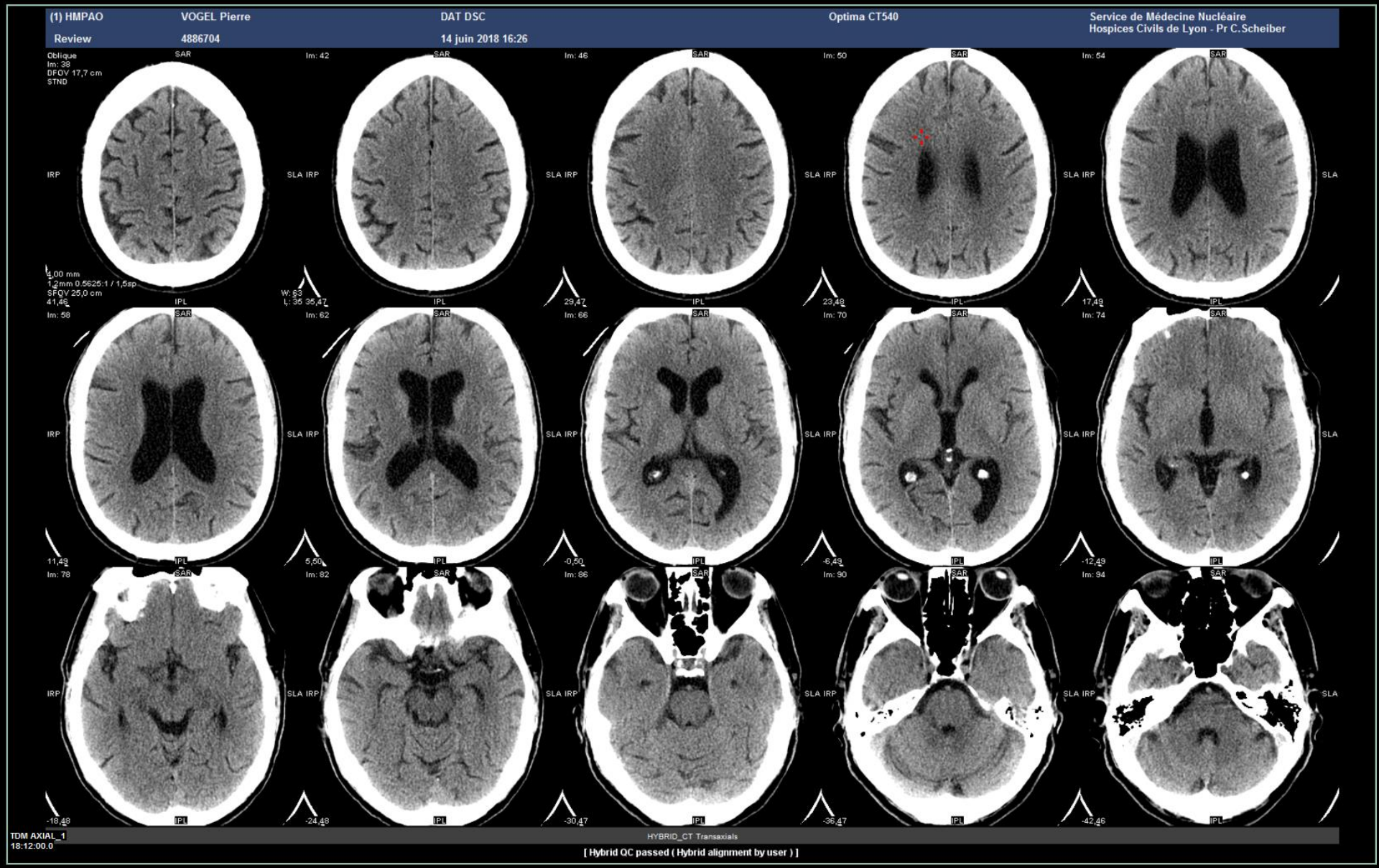
ROIs: parcellation par Ciceron sur Colin

images normalisées - MNI

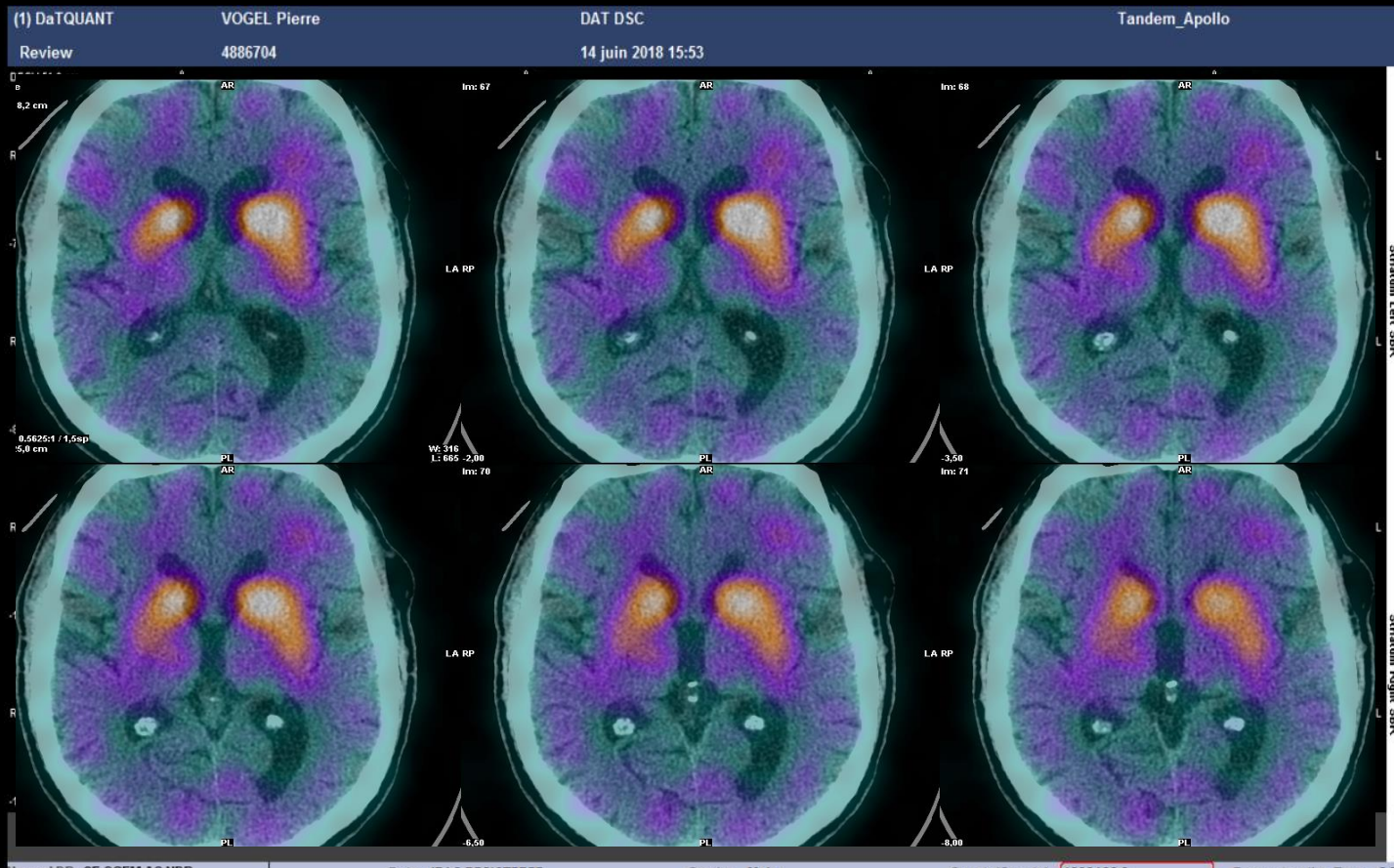


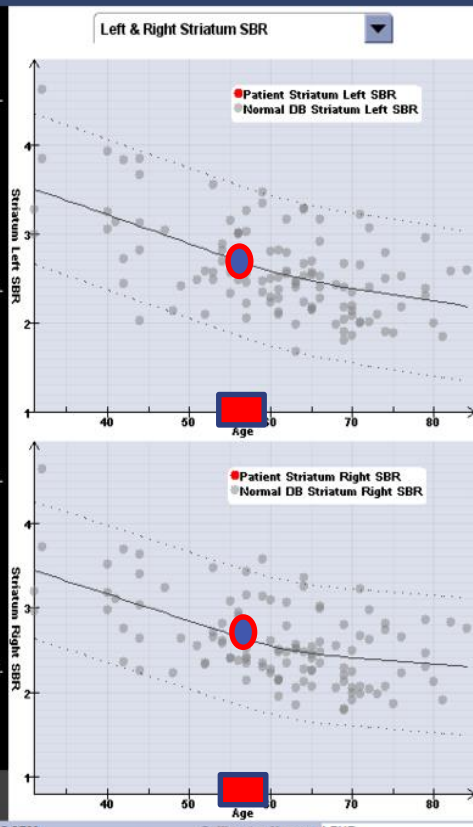
	Droit	Gauche
Striatum	1.0	0.8
Caudé	1.1	0.8
Putamen	0.8	0.7
Put/Cau	0.8	1.0
Striatum D/G	1.2	
Caudé D/G	1.3	
Putamen D/G	1.1	

VO.. 58 y. was commercial director pharmaceutical firm - anxio-depressive syndrome 2016 –(Behavior troubles, hallucinations) – Nleptics – MMSE 20/30 - MRIb normal 2018 - Atypical presentation depression vs NDG ? referred for DaTSCAN + Perfusion



Semi-quantitative analys shows that dopaminergic denervation is much severe as it could be seen on axial standard images





Normal DB: GE OSEM AC NDB	Data: IRAC REGISTERED	Gender: Male	Counts(Counts): 1283166,0	Reconstruction Type: OSEM	Collimator Name: LEHR
GE normals database for OSEM with att...	Camera: Tandem_Apollo	Age(Years): 58	Dose(MBq): 120,0	Corrections: Attenuation correction	Collimator Type: Parallel

Normal DB mismatch – Corrections : Attenuation correction (Chang attenuation correction)

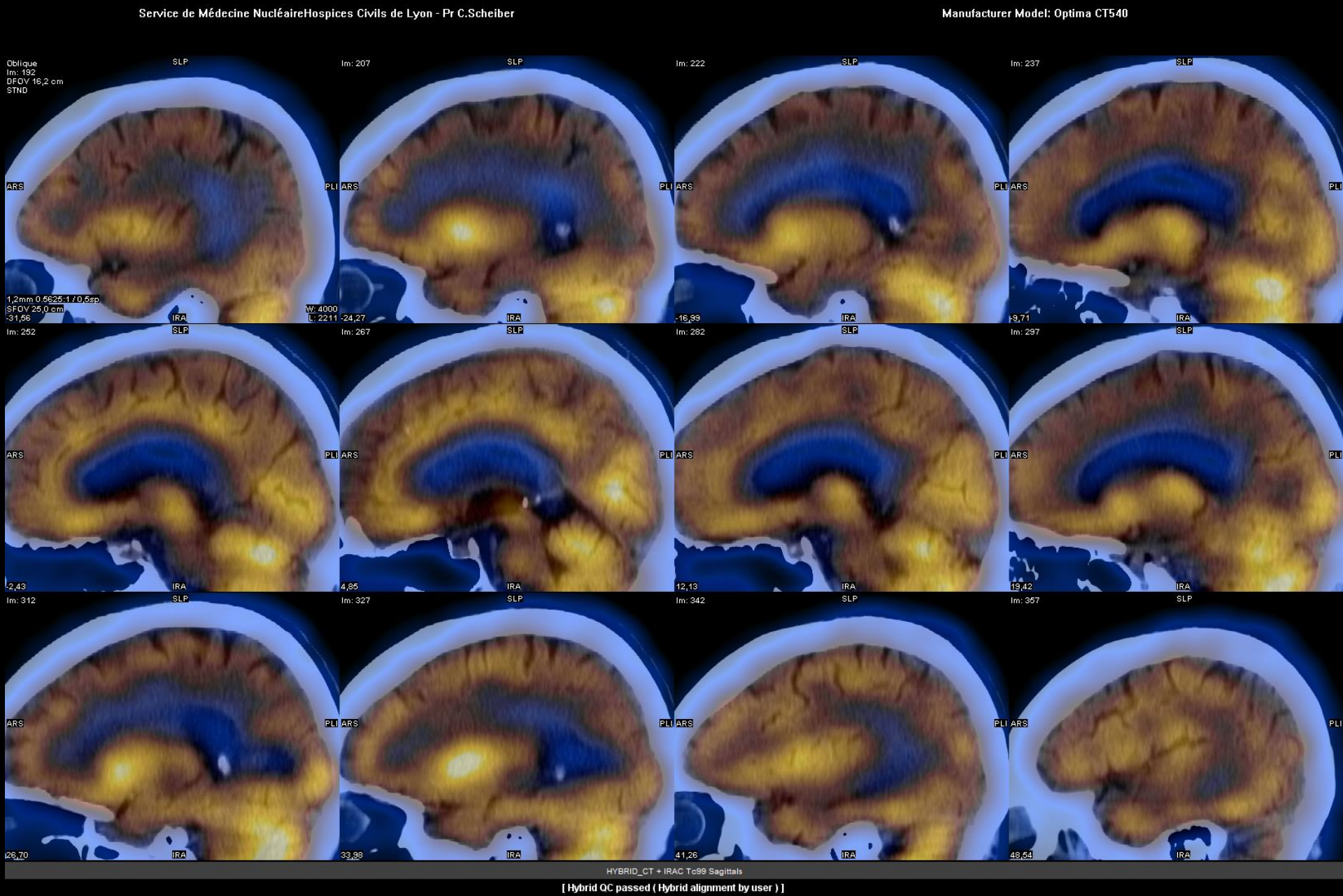
	Striatum Right SBR	Striatum Left SBR	Putamen Right SBR	Putamen Left SBR	Caudatus Right SBR	Caudatus Left SBR
Measured	+0,83	+1,05	+0,66	+0,85	+1,23	+1,45
Mean (±1 SD)	+2,60 (±0,40)	+2,64 (±0,42)	+2,51 (±0,39)	+2,52 (±0,41)	+2,80 (±0,48)	+2,88 (±0,50)
Deviation	68%	60%	-74%	-66%	-56%	-50%
Z-Score	-4,38	-3,77	-4,74	-4,10	-3,26	-2,86

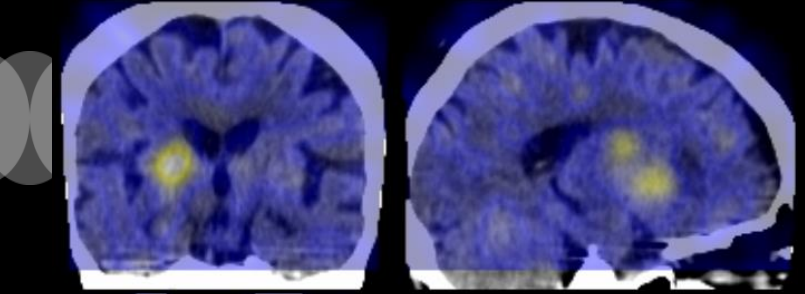
-68%

-60%

Simple Advanced Ratios Asymmetry

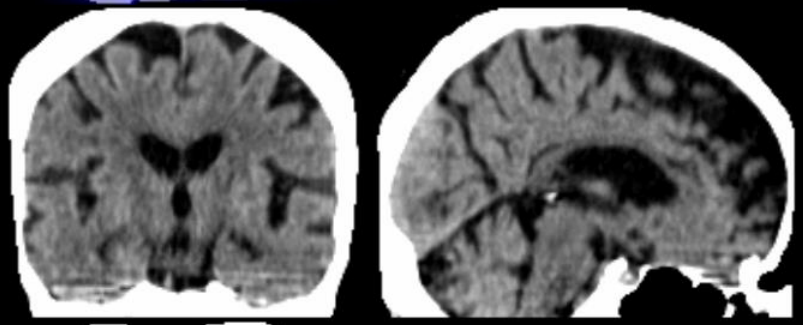
HMPAO 99mmTc – 900 MBq – DUAL Isotope acquisition window -4,+3 peak 140 keV
Smoothed reconstruction to fit the Normal DB (QBRAIN TM)

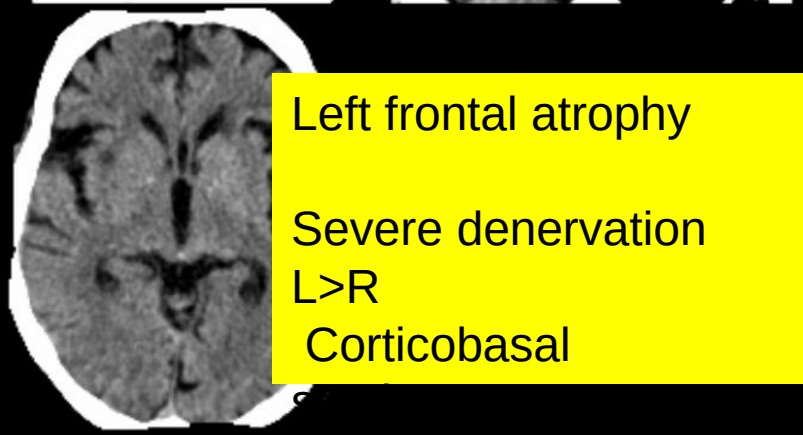




Pychosis (FTD)
NL treatment
Atypical PS

DIP ?





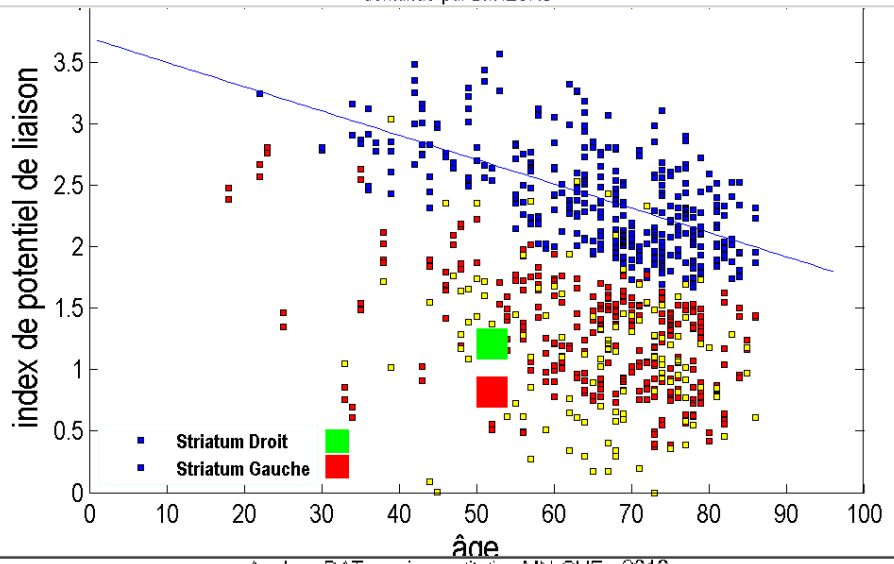
Left frontal atrophy

Severe denervation
L>R
Corticobasal

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

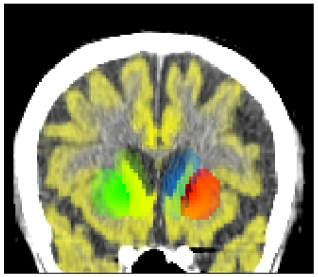
Mme.Annick.JESKO.né le15/04/1960.Datscan du.01/12/2011

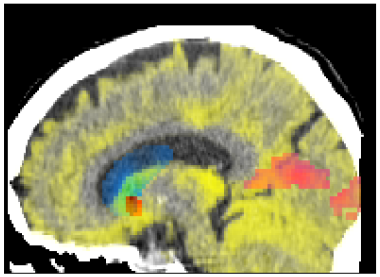
demandé par Dr.NEURO



Analyse DAT semi-quantitative MN-GHE v 2010

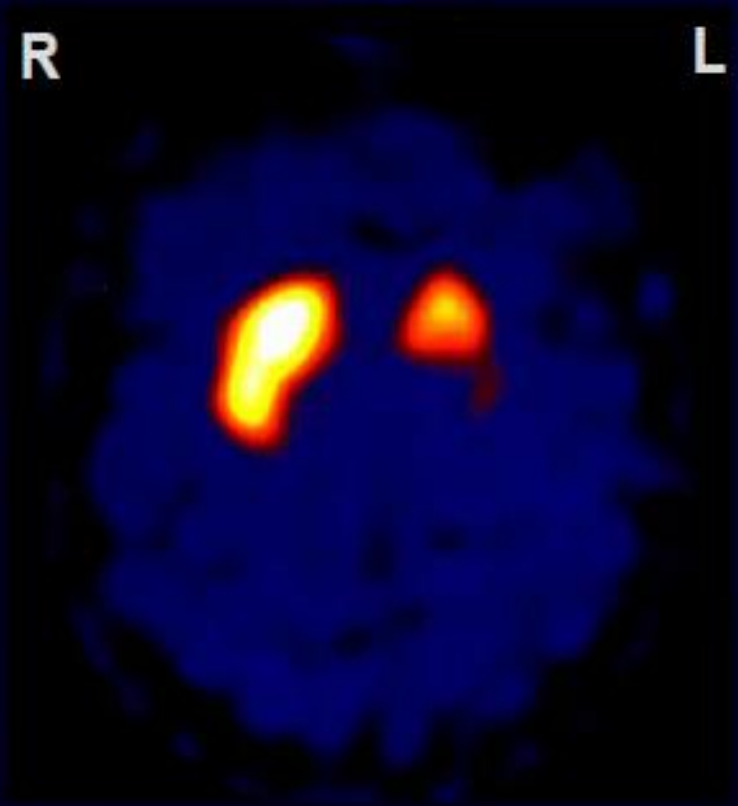
Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques





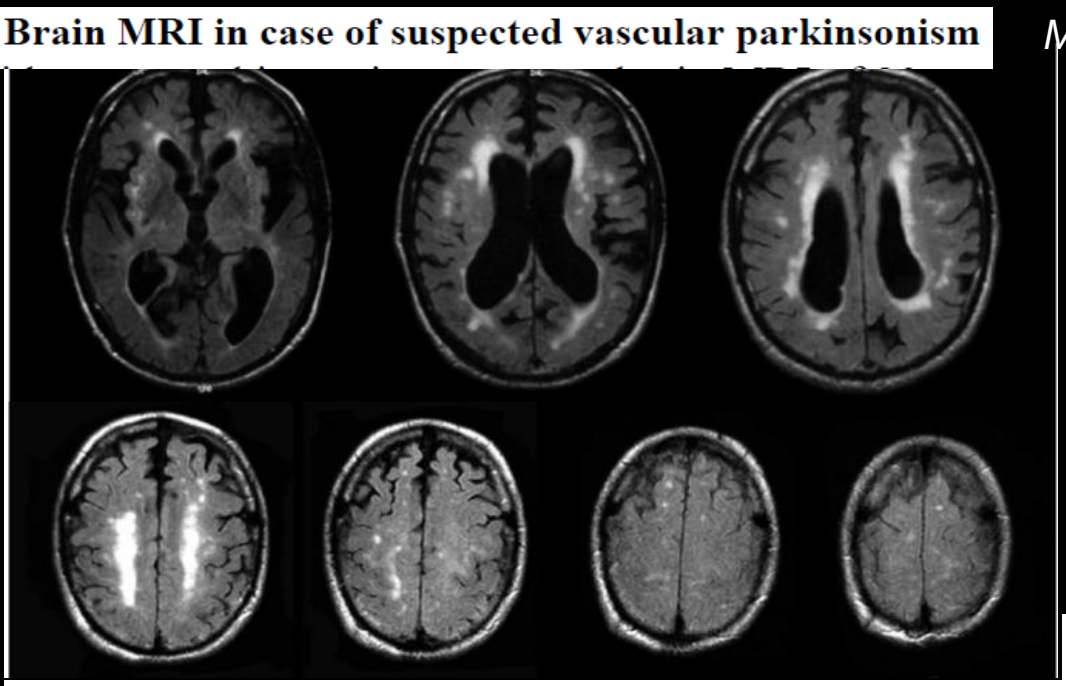
	Droit	Gauche
Striatum	1.2	0.8
Caudé	1.0	0.4
Putamen	1.2	0.9
Put/Cau	1.3	2.1
Striatum D/G	1.4	
Caudé D/G	2.0	
Putamen D/G	1.2	

IOFLUPANE in midbrain (Holmes) tremor



Remy et al., 2003

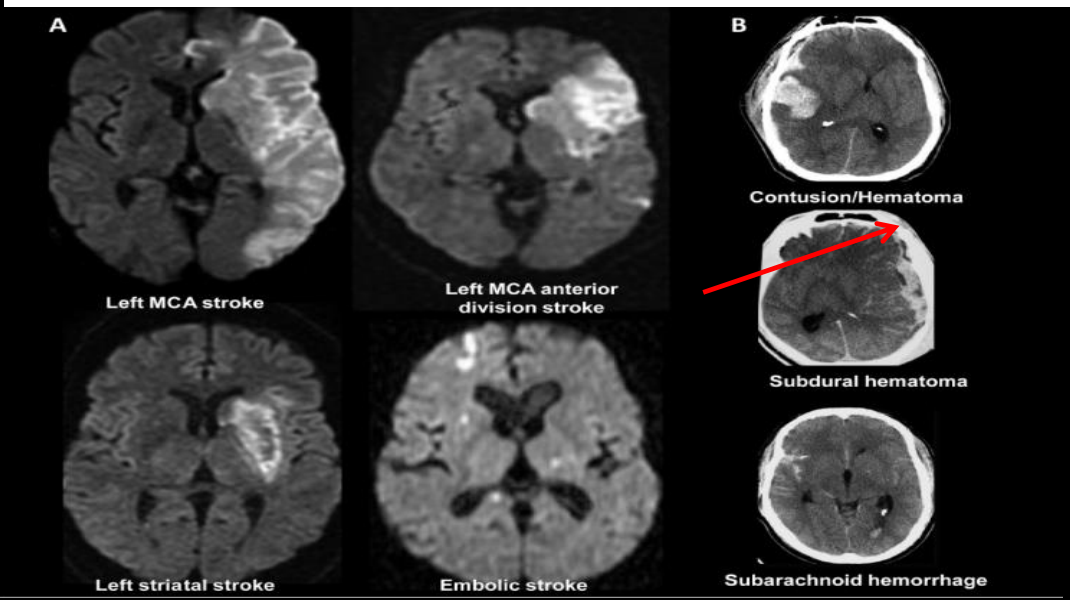
deconstructing a syndrome Joaquin A. Vizcarra

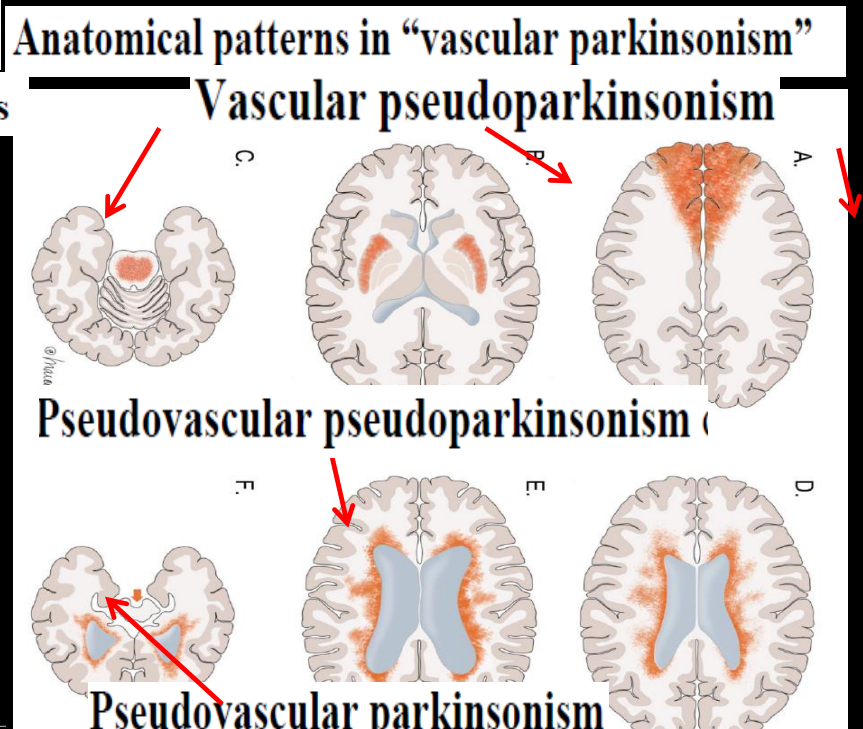


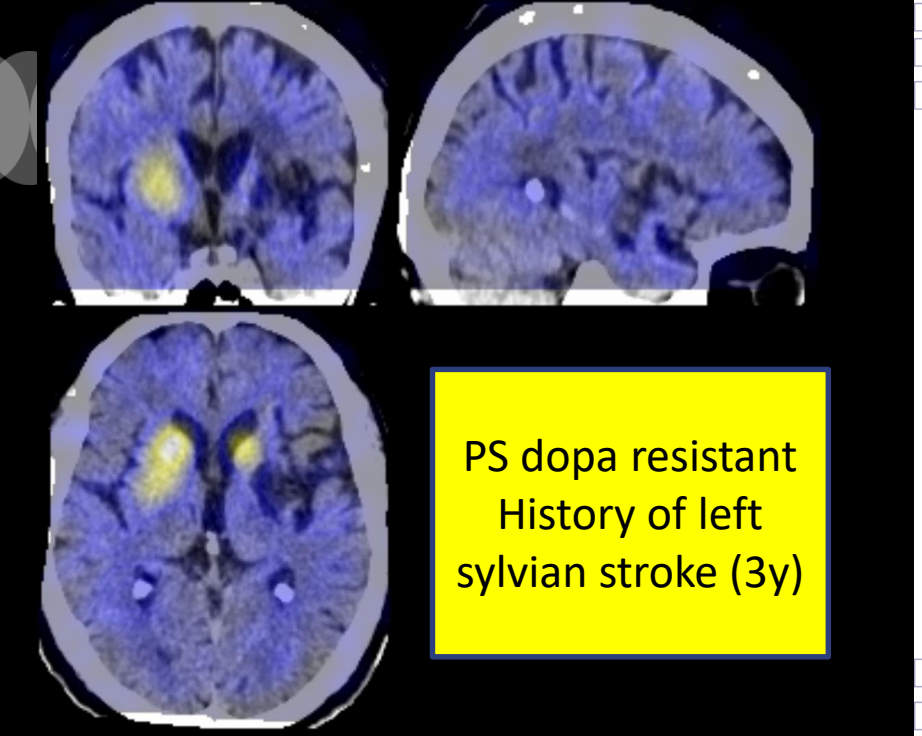
Mov Disord. 2015 June ; 30(7): 886–894

Vascular Parkinsonism and ^{123}I FP-CIT

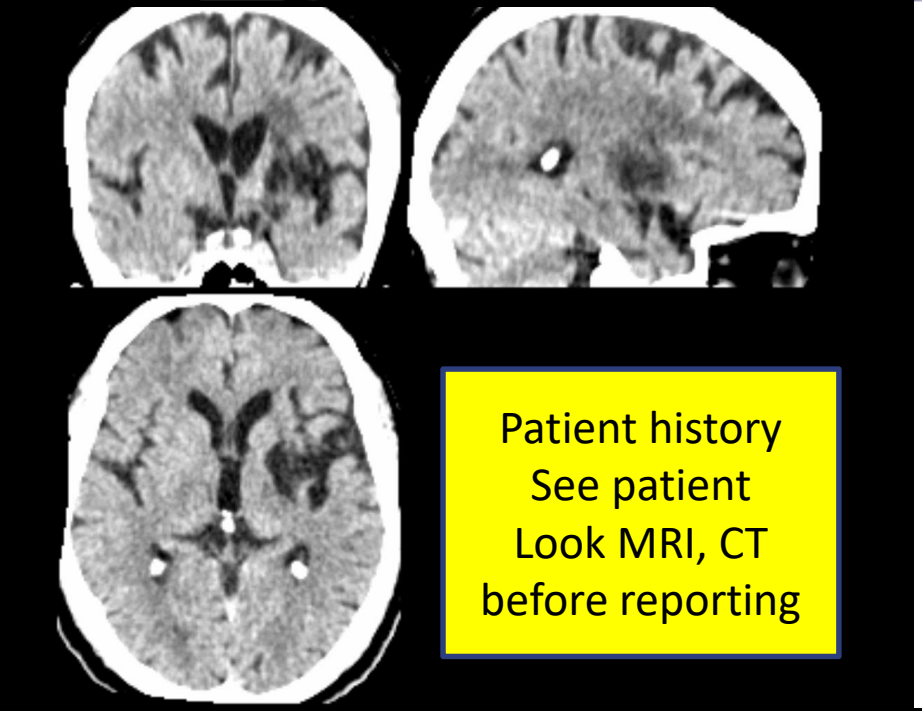
Usually Normal
but severe lesions exist







PS dopa resistant
History of left
sylvian stroke (3y)

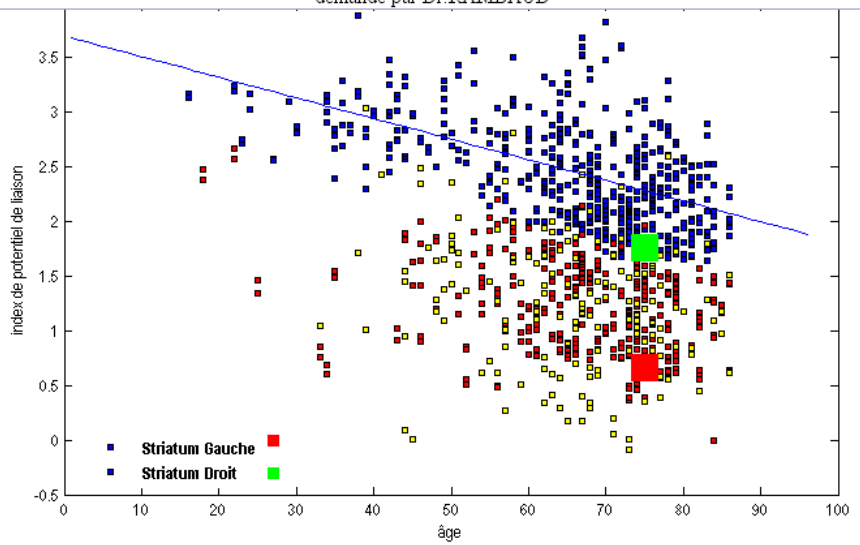


Patient history
See patient
Look MRI, CT
before reporting

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

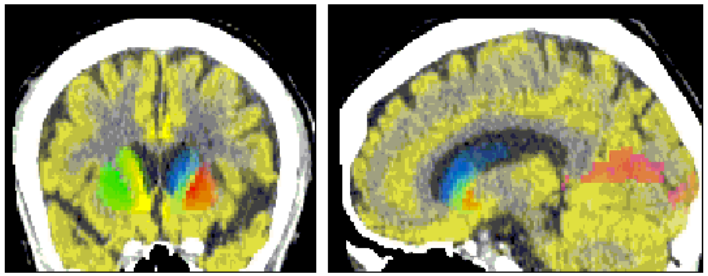
Mr.Claude.MONDON.né le27/11/1937.Datscan du.25/04/2013

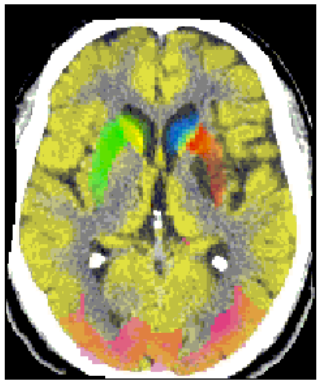
demandé par Dr.RAMBAUD



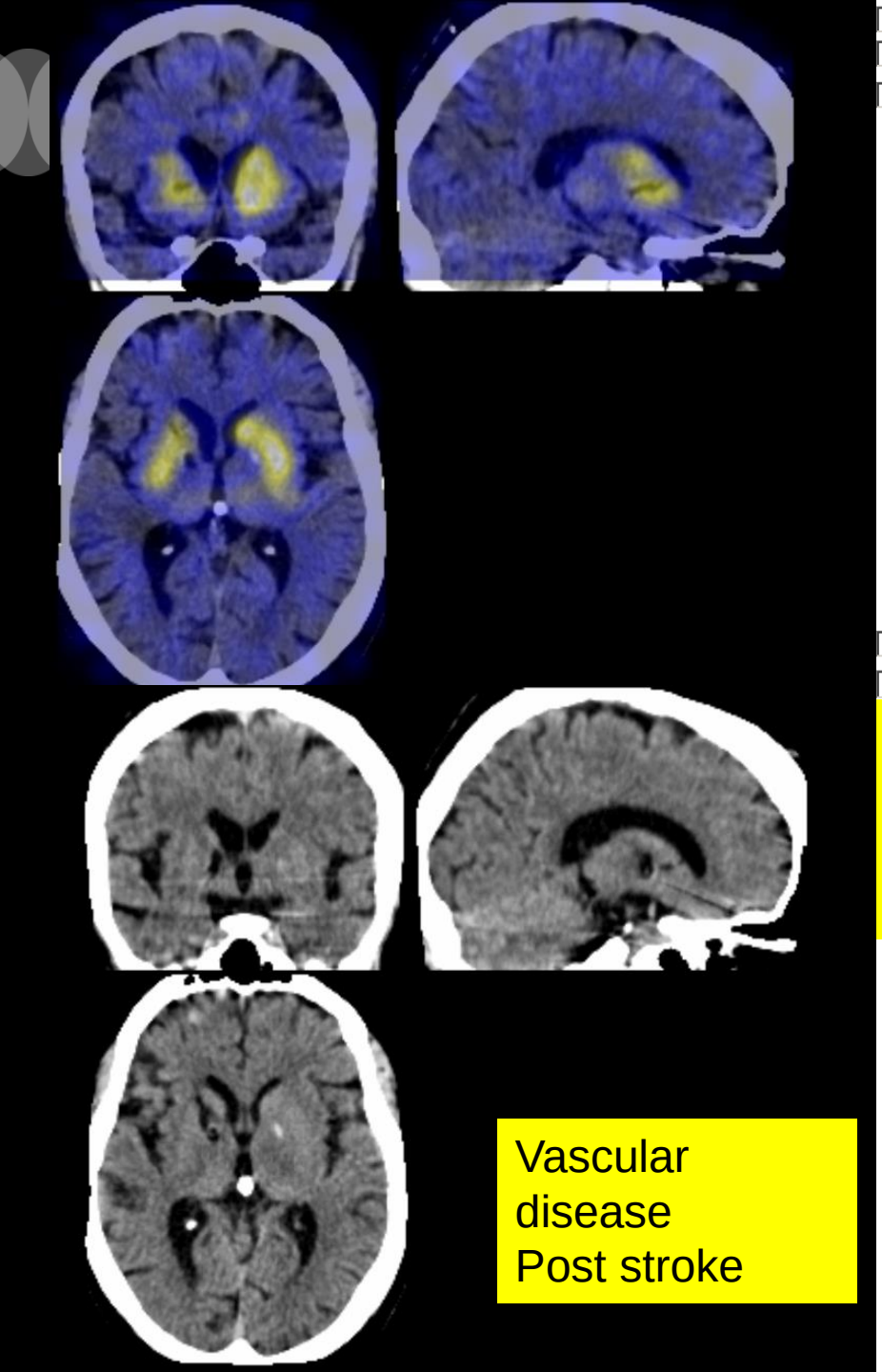
Analyse DAT semi-quantitative MN-GHE v 2012

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques





	D	G
Striatum	1.7	0.6
Caudé	1.4	0.7
Putamen	1.7	0.3
Put/Cau	1.3	0.4
Striatum D/G	2.5	
Caudé D/G	1.8	
Putamen D/G	5.3	

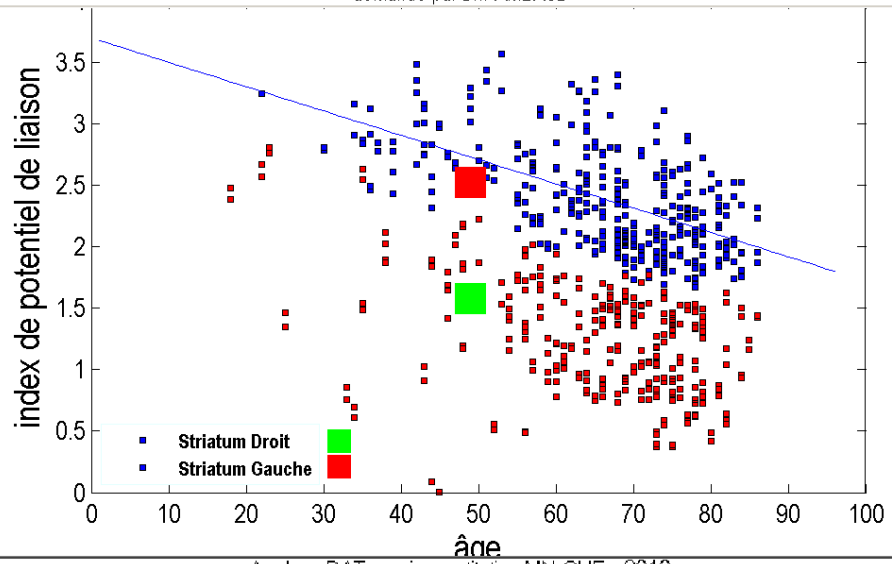


Vascular disease
Post stroke

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

Mr.Jean Luc.CARCEL.né le03/06/1963.Datscan du.26/06/2012

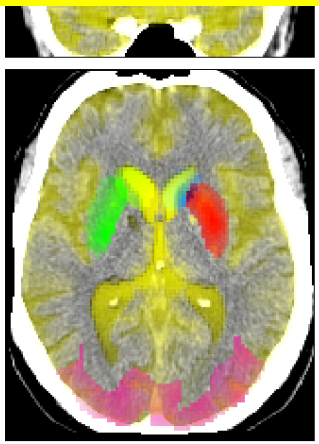
demandé par Dr.RAMBAUD



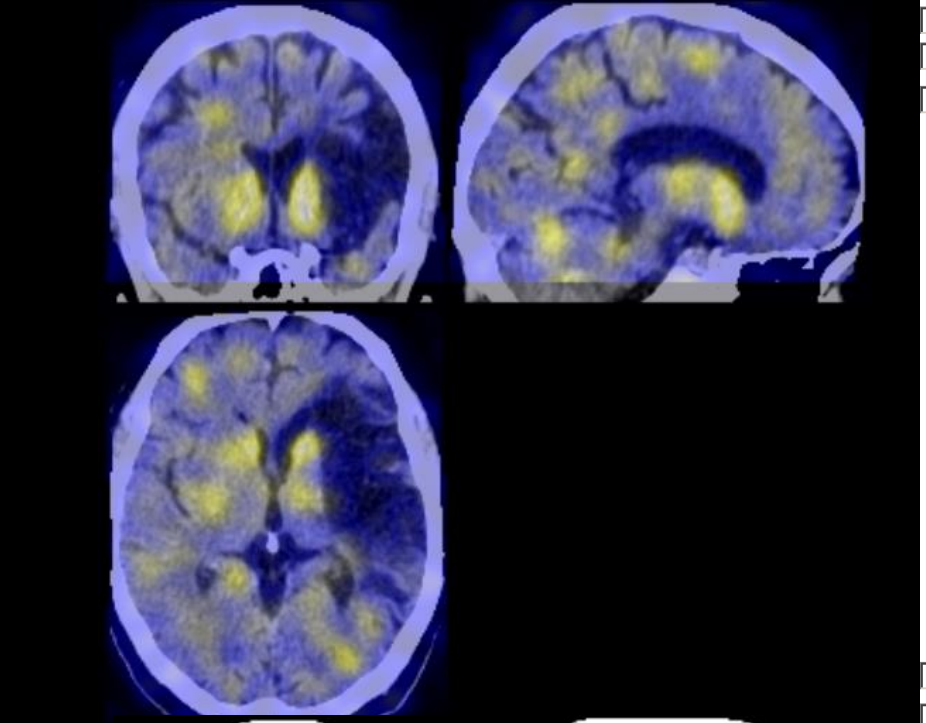
Analyse DAT semi-quantitative MN-GHE v 2010

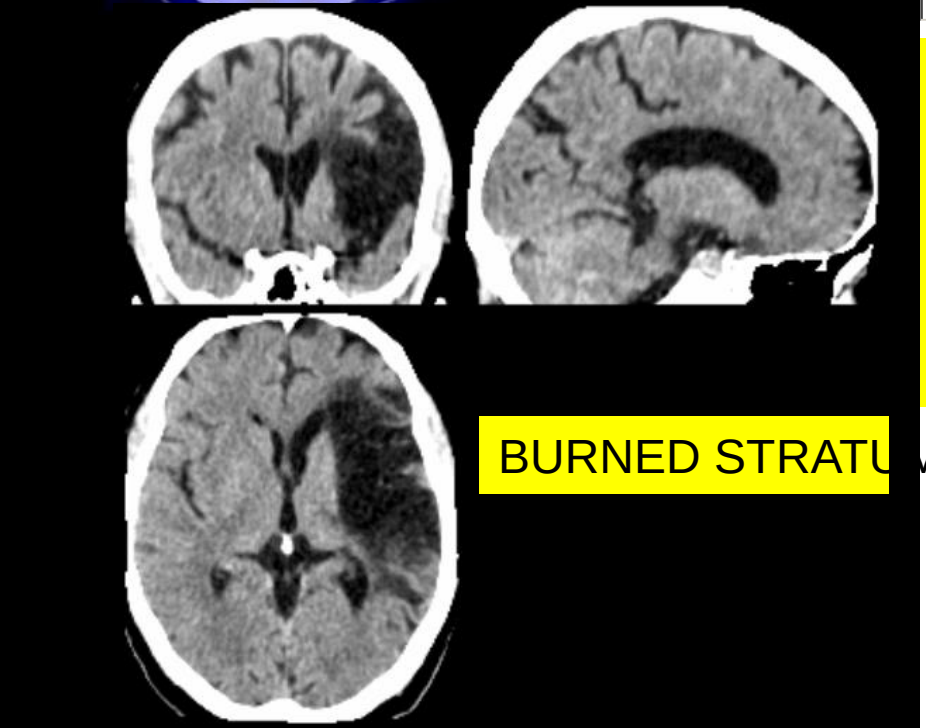
Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques

Psychosis – NL – 10 years - Epilepsy
Head injury 3 years ago – right lenticular hematoma
Left hand tremor – atypical PS – DIP ?



	Droit	Gauche
Striatum	1.5	2.5
Caudé	0.8	1.6
Putamen	2.0	3.0
Put/Cau	2.7	2.0
Striatum D/G	0.6	
Caudé D/G	0.5	
Putamen D/G	0.6	



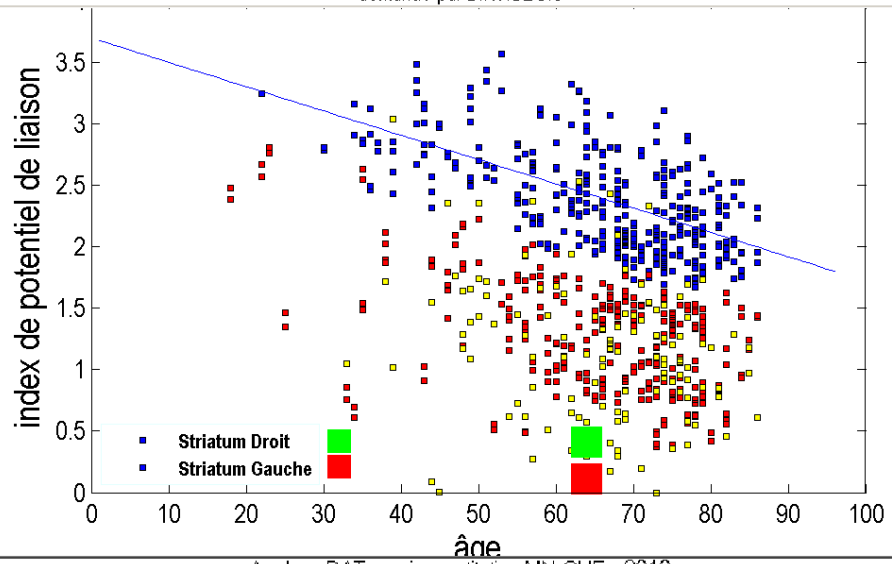


BURNED STRATUM

Hospices Civils Lyon - GHE - Service Médecine Nucleaire - Pr C. Scheiber

Mr.Alain.GUILLOT.né le19/06/1947.Datscan du.20/09/2011

demandé par Dr.THOBOIS

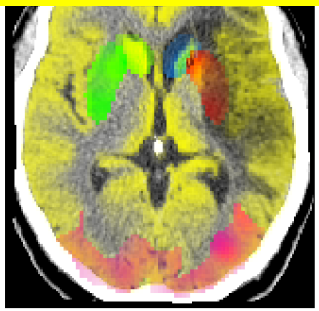


Analyse DAT semi-quantitative MN-GHE v 2010

Bleu: Normaux - Symétriques..Jaune: anormaux asymétriques..Rouge: anormaux - symétriques

Atypical PS
Ischemic old left Sylvian stroke
Aphasia – right hemiparesia

Diag: Lewy Body Disease



Caudé	0.3	0.0
Putamen	0.3	0.0
Put/Cau	1.0	1.0
Striatum D/G	3.6	
Caudé D/G	4.8	
Putamen D/G	5.2	

What the neurologist expects from NM !

Spectrum of atypical parkinsonism disease complex

Diagnosis of early PD is difficult

Always :

Patient and Family expectations are very high - Although diagnosis is feared

- presynaptic dopaminergic denervation / âge
- brain atrophy
- global and regional perfusion of the brain
- correlation between morphology and perfusion
- correlation between affected side and symptoms

Sometimes :

- typical images for an MSA-C, PSP, CBS (if Biomarker AD neg)
- iatrogenic Parkinsonism (neuroleptics)
- essential tremor (normal exam)
- mixed pathology (HPN, VD, ALZ) and/or PDD

TAKE HOME MESSAGE

- PD and « Atypical Parkinsonisms » are diagnosed clinically
- But failed frequently < 5 years of the symptoms (15-47%)
- Complex tauopathies and a-synucleopathies nosology
- Copathologies frequency increase with age (up to 50%)
- First imaging modality : MRI (curable causes, vascular)
- Imaging paradigm has to be adapted to the prevalence of the disease
- Depression + neuroleptics is now a common indication (NDG)
- Alzheimer differential diag versus Lewy Body Disease
- Possible underestimation of CBS-PSP frequency

referred to NM in atypical situations

- DaTSCAN - mIBG scintigraphy efficient for PD, PDD versus others causes
- PET ^{18}F FDG efficient for diagnostic orientation (localisation, volumes) and good performance on preselected population
- New SPECT systems allow HMPAO – DaTSCAN – diagnostic CT in 30 min
- Visual (3 planes) and semi-quantitative analysis for DaTSCAN and HMPAO
- Analysis on fused scans – morphology 3 planes CT important

Diagnostic and pronostic are important for cargivers, patient &

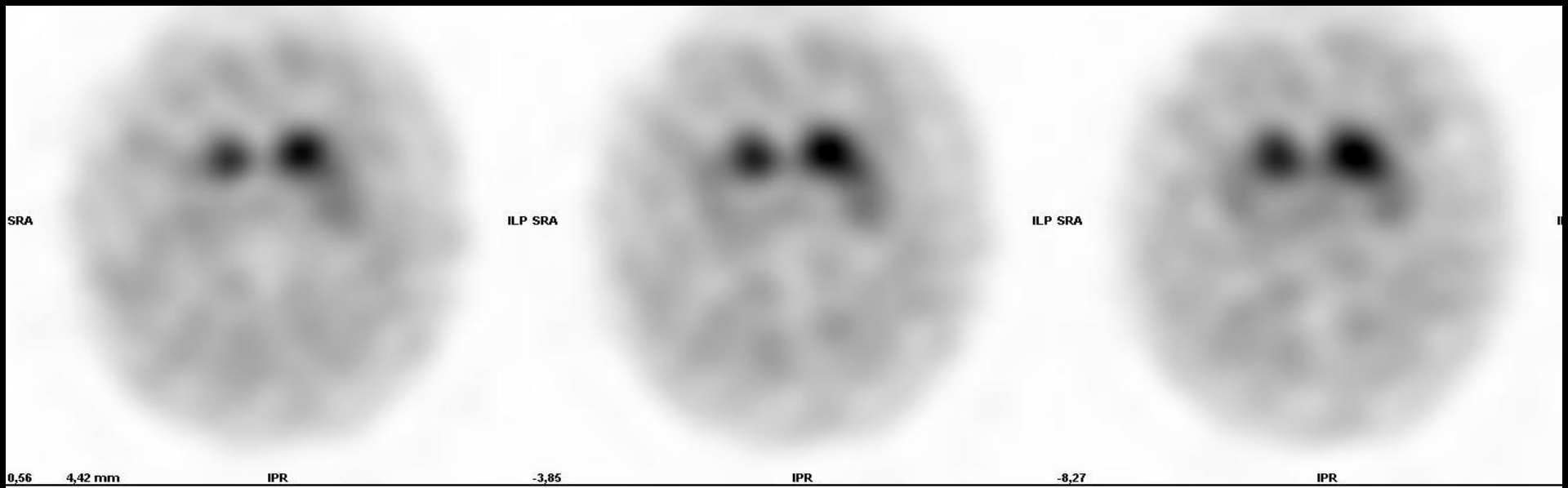
20 Neuroimaging SPECT-CT procedures .week^{-1}

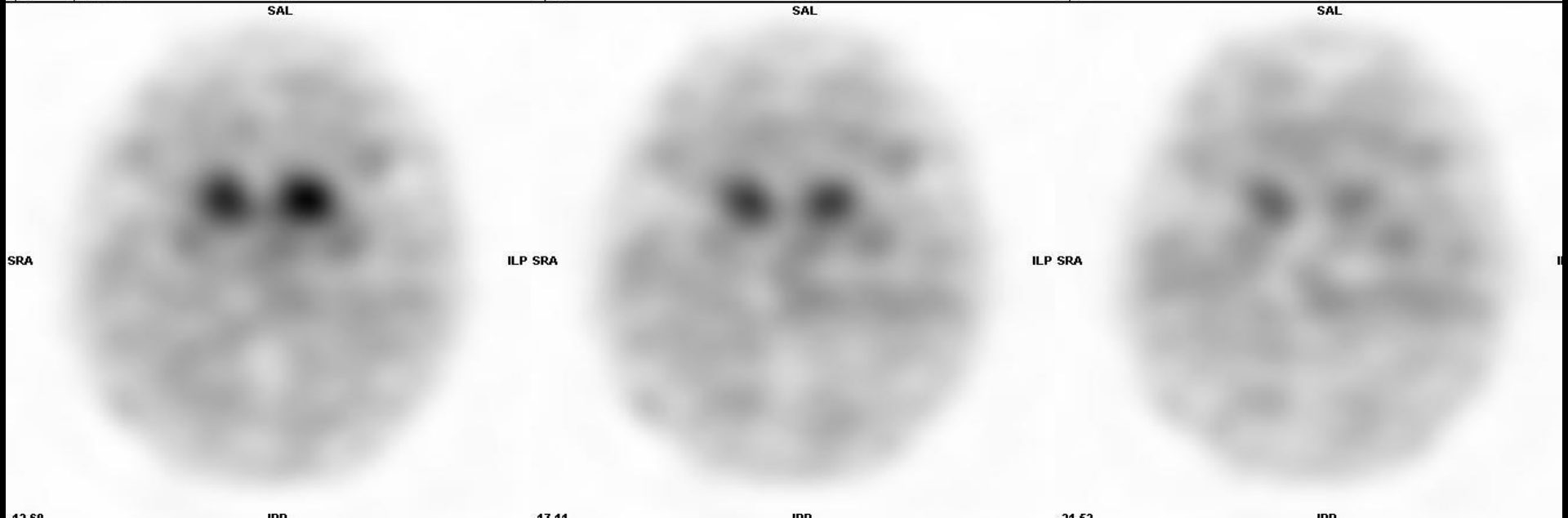
Method: all NM procedures , including CZT, fulfill EANM guidelines

IOFLUPANE CLINICAL CASES

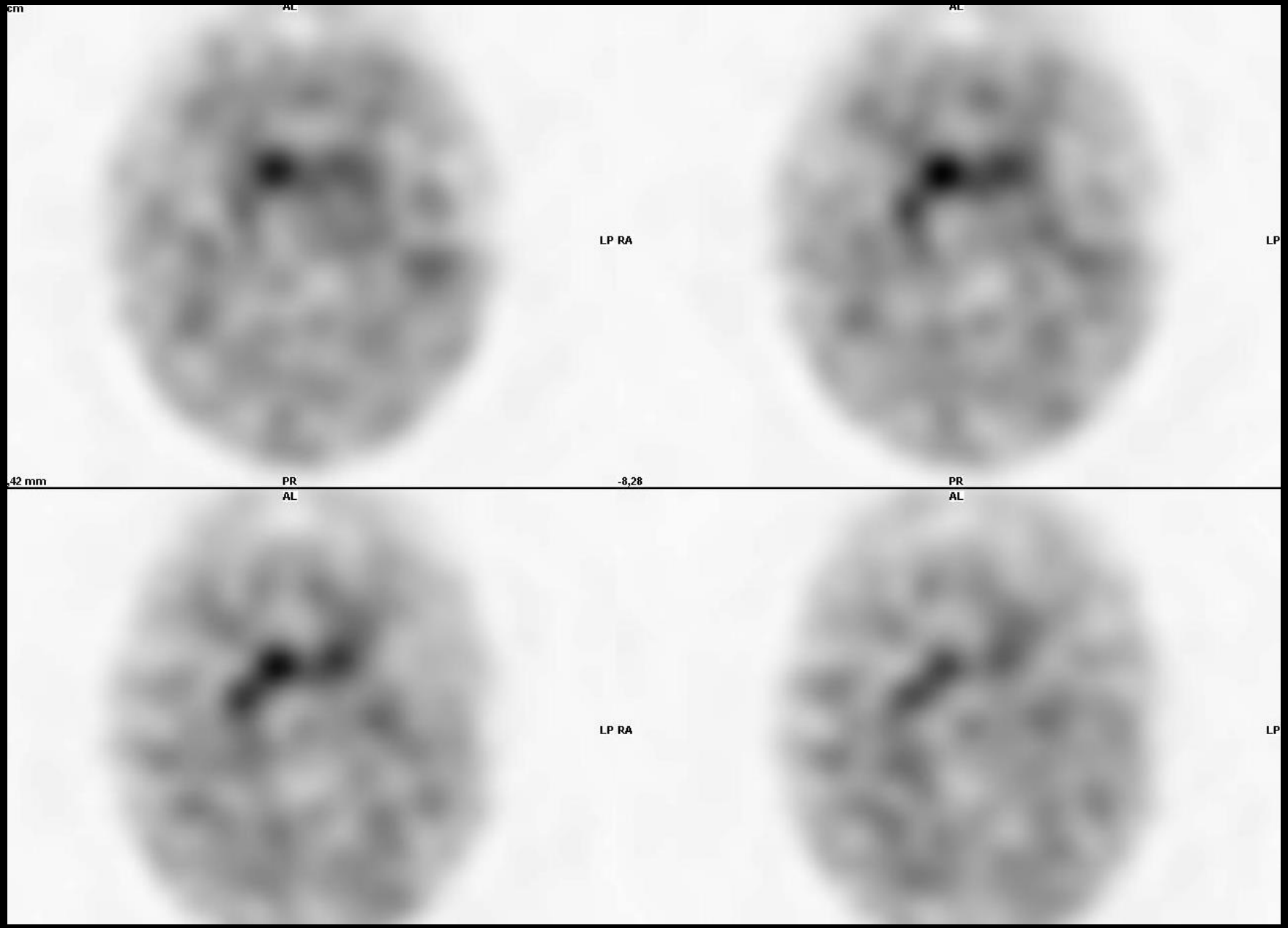
40 years old men – Progressive left hand tremor and rigidity – micrographia

Suspected Parkinson disease : datascan ? wants to know !!!

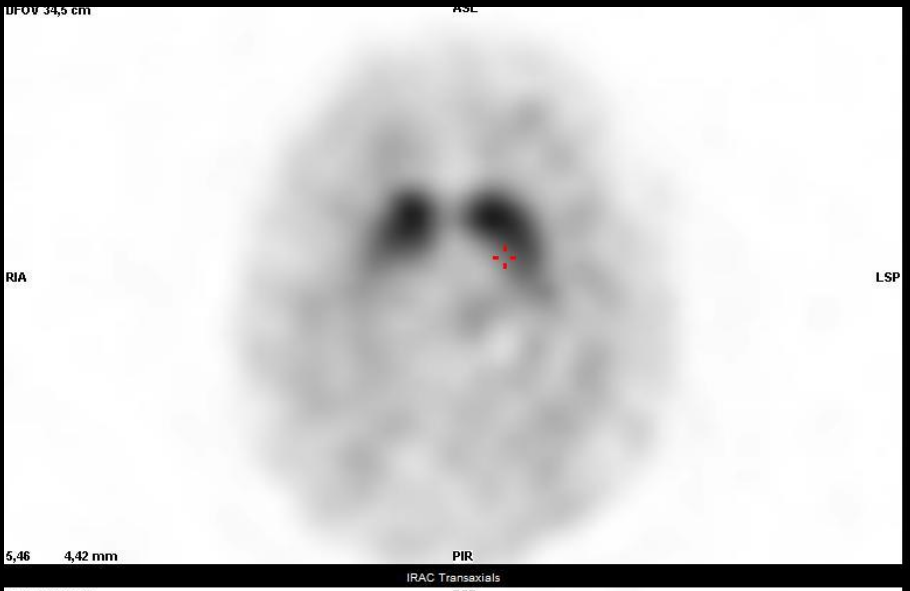


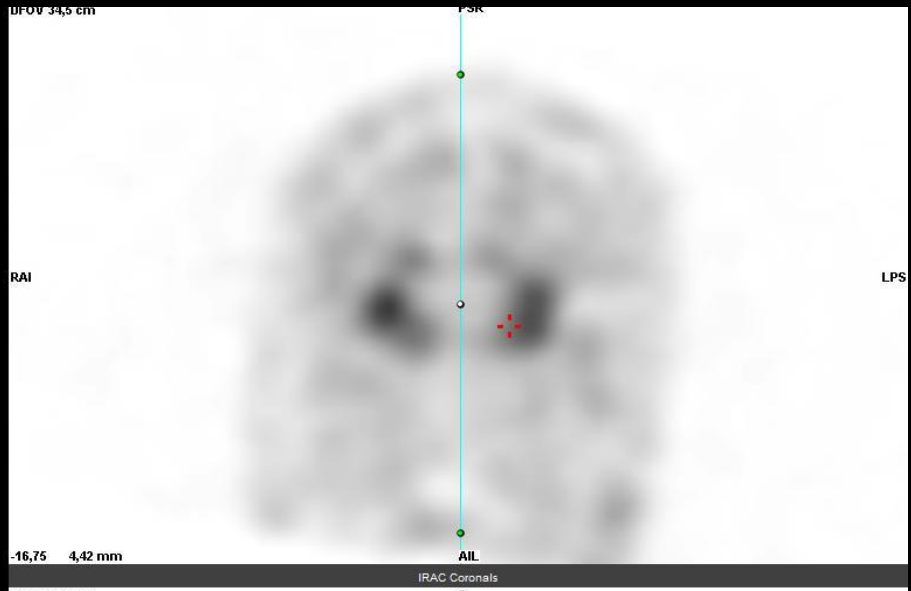


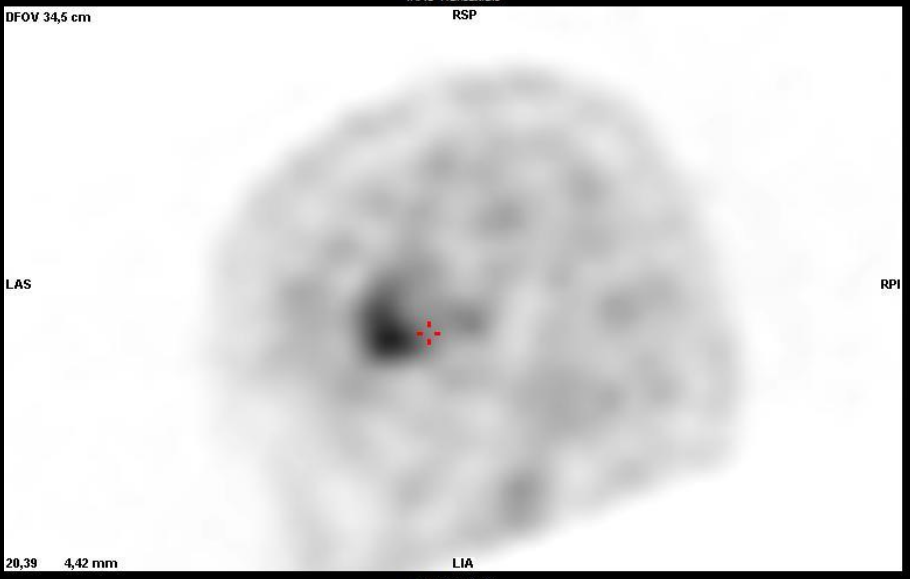
5 years history of depression (neuroleptics now stopped) – progressive but fluctuant right akinesia and rigidity – Psychiatric vs iatrogenicity ?

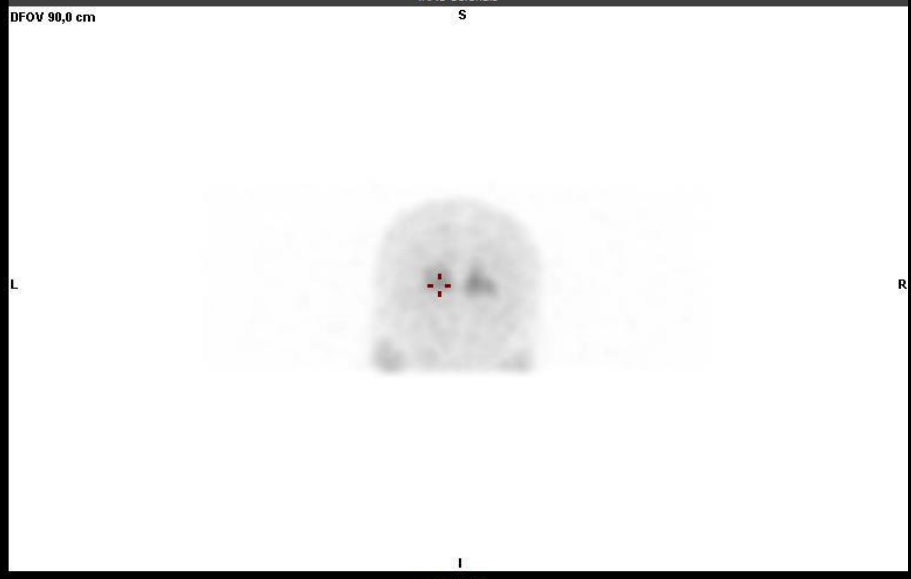


60 years old psychotic – neuroleptics – extrapyramidal syndrome : iatrogenicity ?



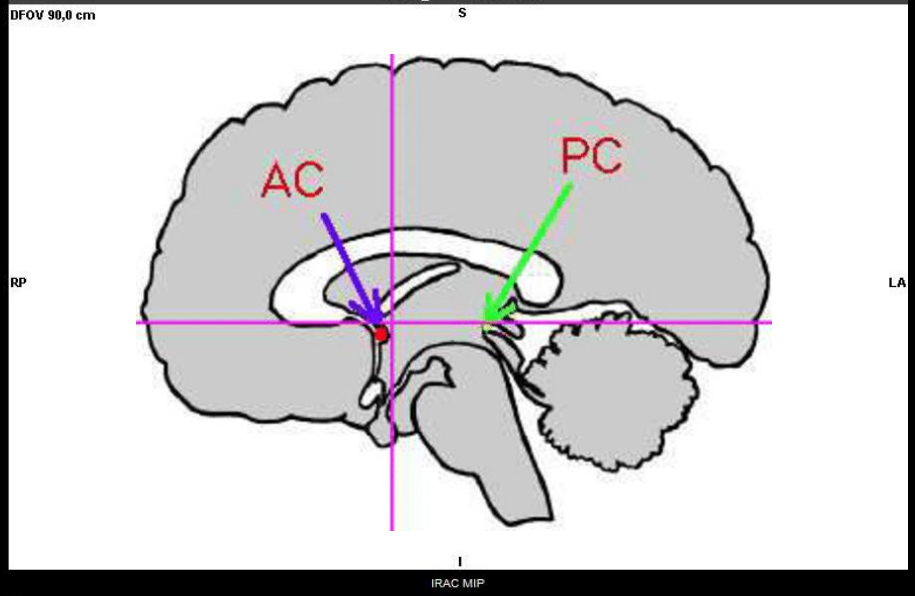




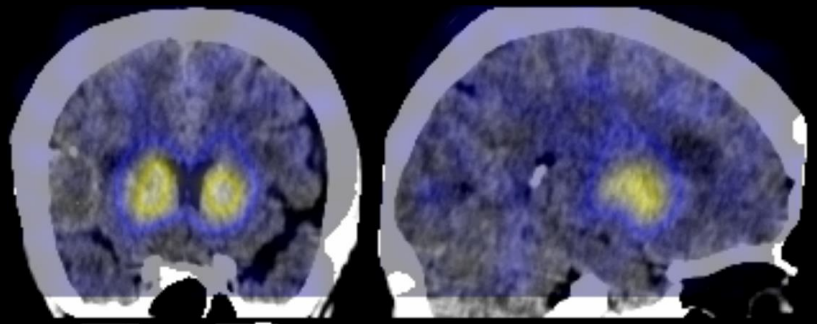


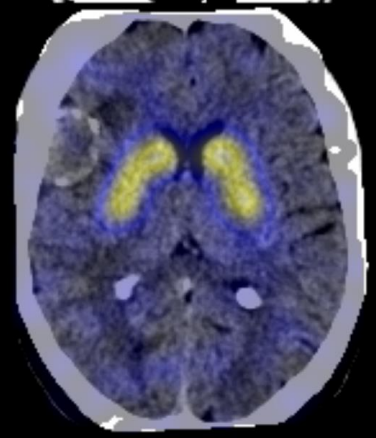
[Hybrid QC passed]

Axial AC-PC line mandatory for visual analysis

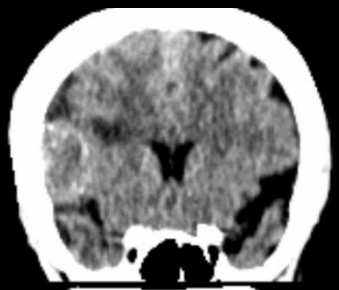


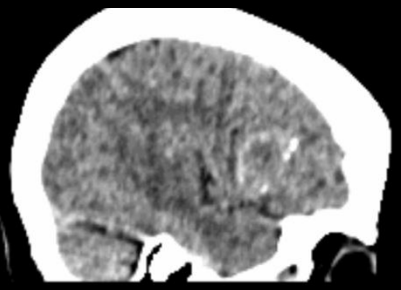
[Hybrid QC passed]





Refer for ioflupane for intermittent tremor left thumb



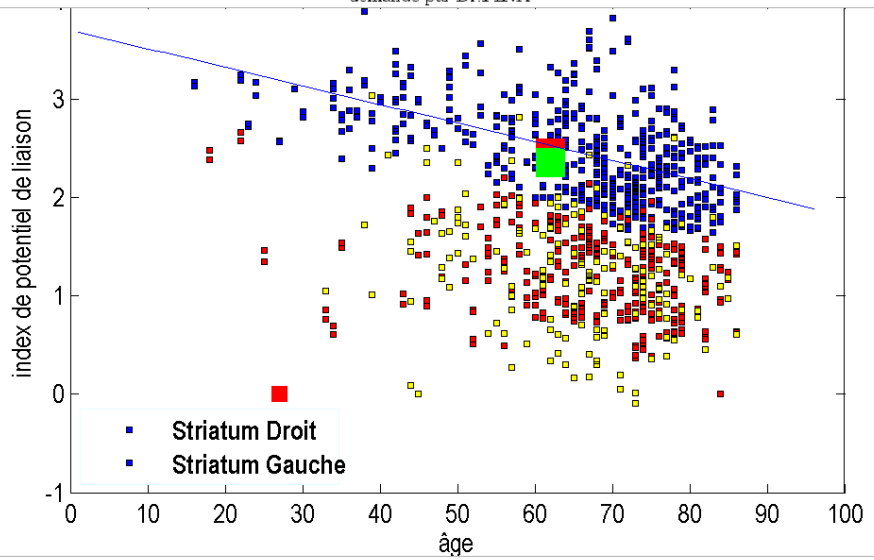


Diagnosis : epilepsy due to meningioma

Hospices Civils Lyon - GHE - Service Médecine Nucléaire - Pr C. Scheiber

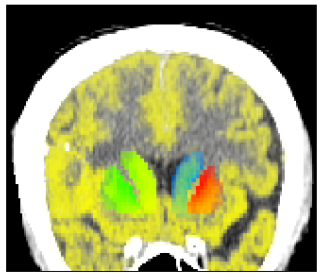
Mme Jocelyne MOLLICA né le 22/05/1951 Datscan du 10/01/2013

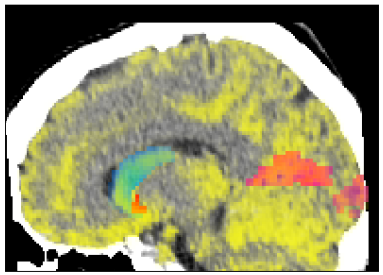
demandé par Dr. PINA



Analyse DAT semi-quantitative MN-GHE v 2012

Bleu: Normaux - Symétriques. Jaune: anormaux asymétriques. Rouge: anormaux - symétriques





	D	G
Striatum	2.3	2.4
Caudé	2.2	2.1
Putamen	2.1	2.5
Put/Cau	1.0	1.2
Striatum D/G	0.9	
Caudé D/G	1.1	
Putamen D/G	0.9	

About Ioflupane ^{123}I SPECT

select the false proposition

More about Ioflupane ^{123}I - IFP

select the false proposition

About medication affecting IFP imaging

select the false proposition

About Ioflupane imaging analysis

select the false proposition

About Pathological IFP images

select the false proposition

IFP imaging is rather to be anormal with :

select the false proposition

Syndroms evolving loss of CNS dopamine may include

select the false proposition

About Drug induced Parkinonism (DIP)

select the false proposition