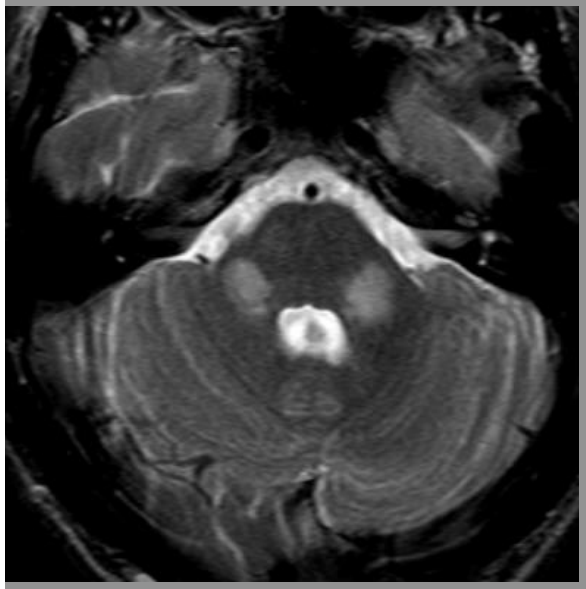
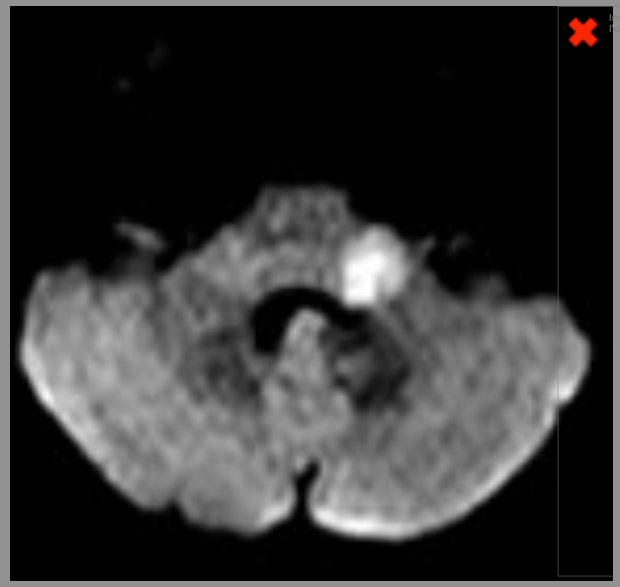
IRM dans la sclérose en plaques





Service de Radiologie
Centre Hospitalier Lyon-Sud

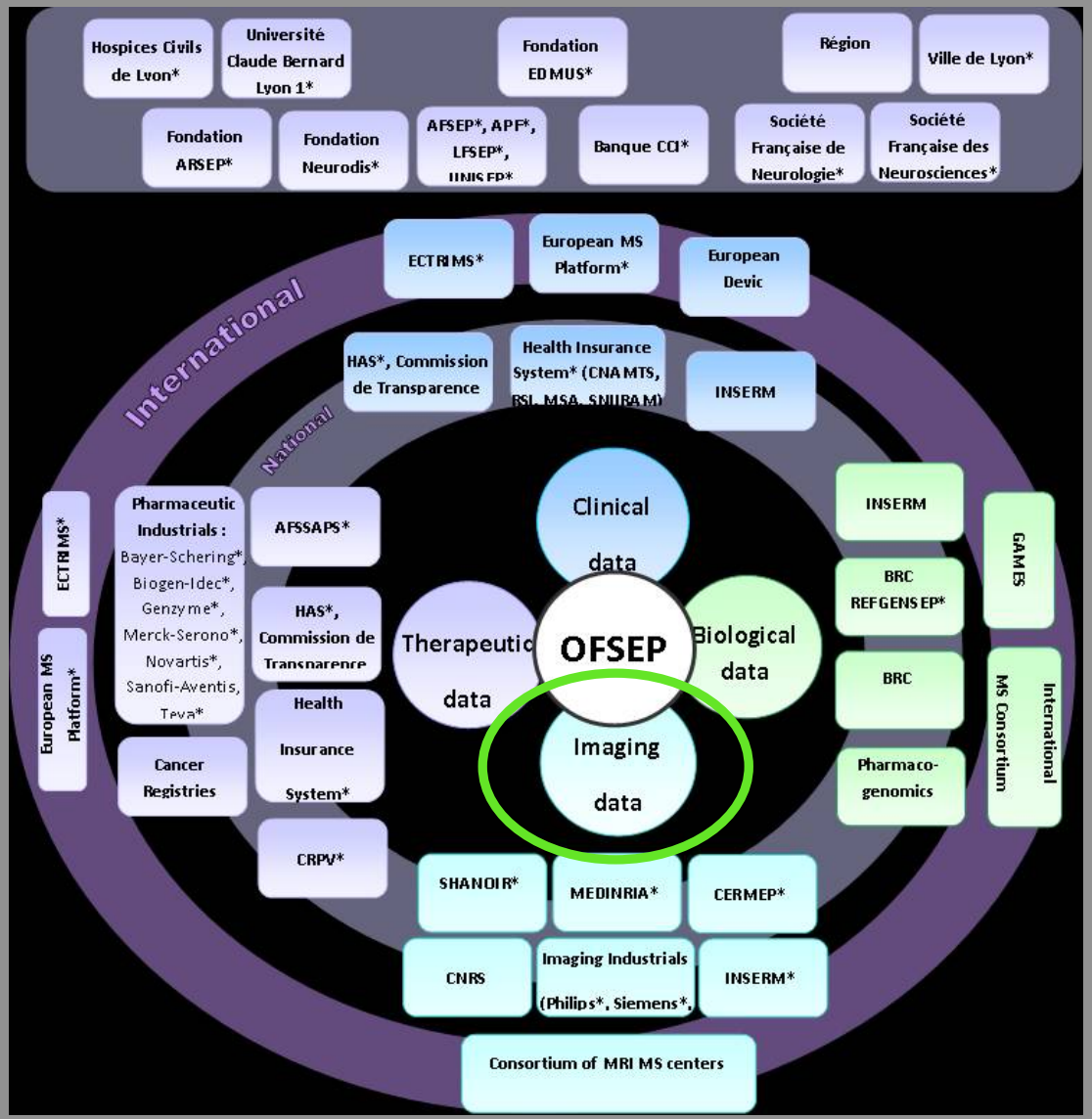
Laboratoire d' Anatomie
UFR Laennec

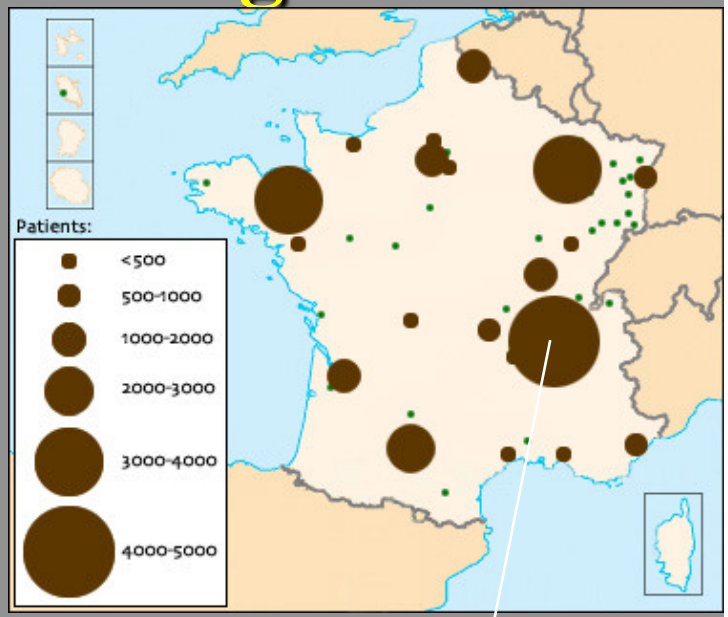
CREATIS

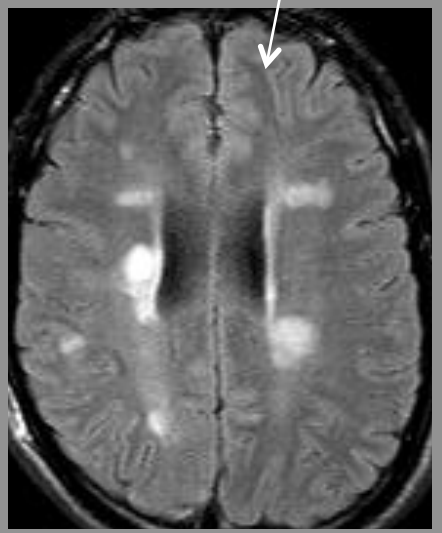
Mars 2012, SFR-RA, Vienne

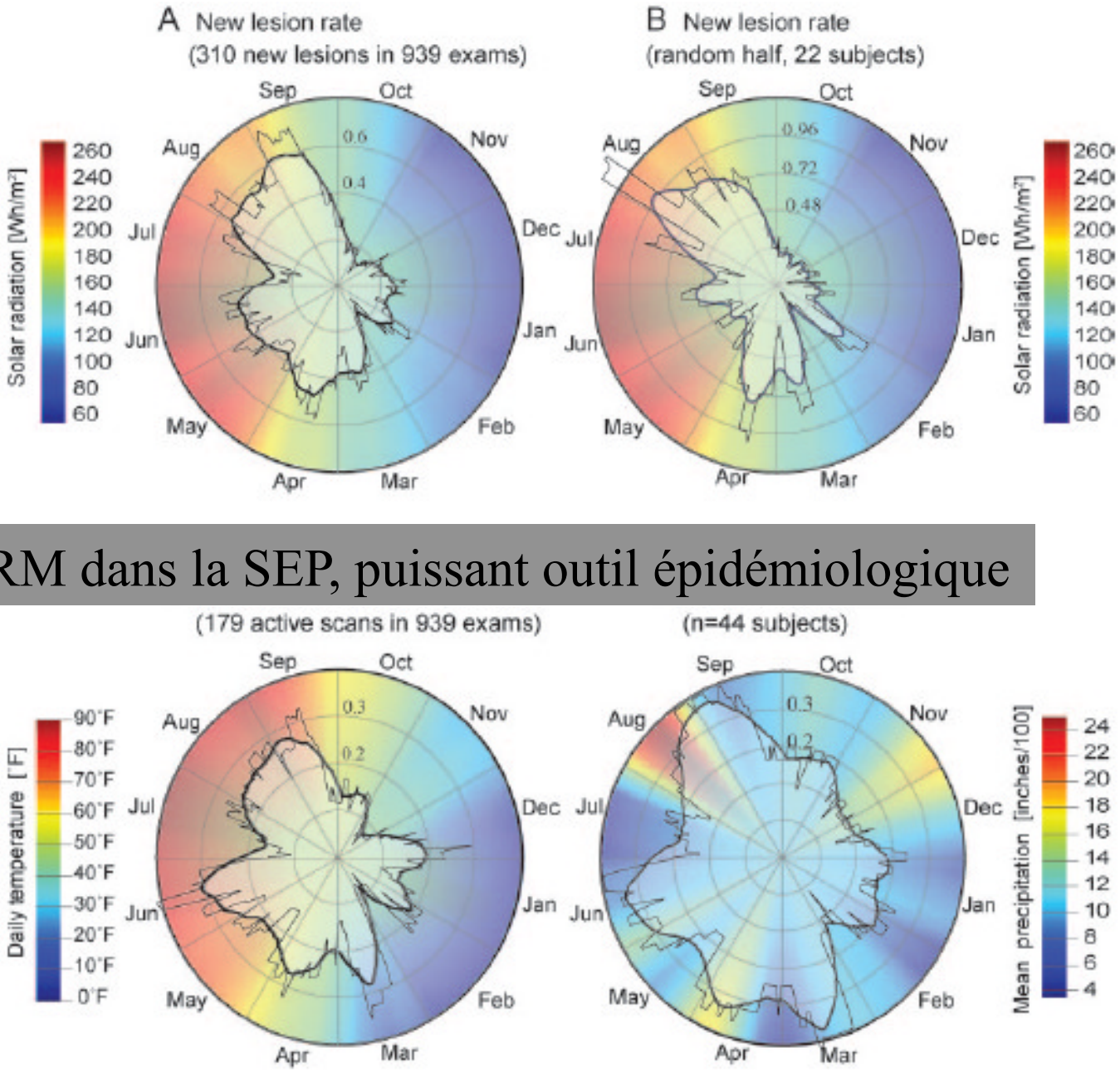
Pr. François Cotton

Observatoire Français de la SEP, une opportunité unique pour l'imagerie









IRM dans la SEP, puissant outil épidémiologique

Seasonal prevalence of MS disease activity
D.S. Meier, K.E. Balashov, B. Healy, H.L. Weiner and C.R.G. Guttmann
Neurology 2010;75;799-806

OFSEP: Organisation of the Imaging Group

Work package "NeuroImaging"
- Coordinator: F. Cotton, A. TourbahC. Barillot,
- Steering Committee: (chair: I. Berry, members: Tasks leaders)

"Acquisition" Task
- Coordination: *JP. Ranjeva, F. Durand Dubief , Bruno Stankoff, neuroradiologue ?*

- Standardization of sequence
- Scanning
- Data gathering (clinical, biology, genetics?)
- Quality Control
- Derived data interpretation

"Data Management" Task
- Coordination: *CBarillot, CRG Guttmann*

- Distributed data sharing environment
- Quality Control
- Security control
- Anonymization
- HPC access
- Image analysis client access
- Source and derived data archiving
- Reusability

"ImageAnalysis" Task
- Coordination: *G. Malandain, D sappey-marinier ?*

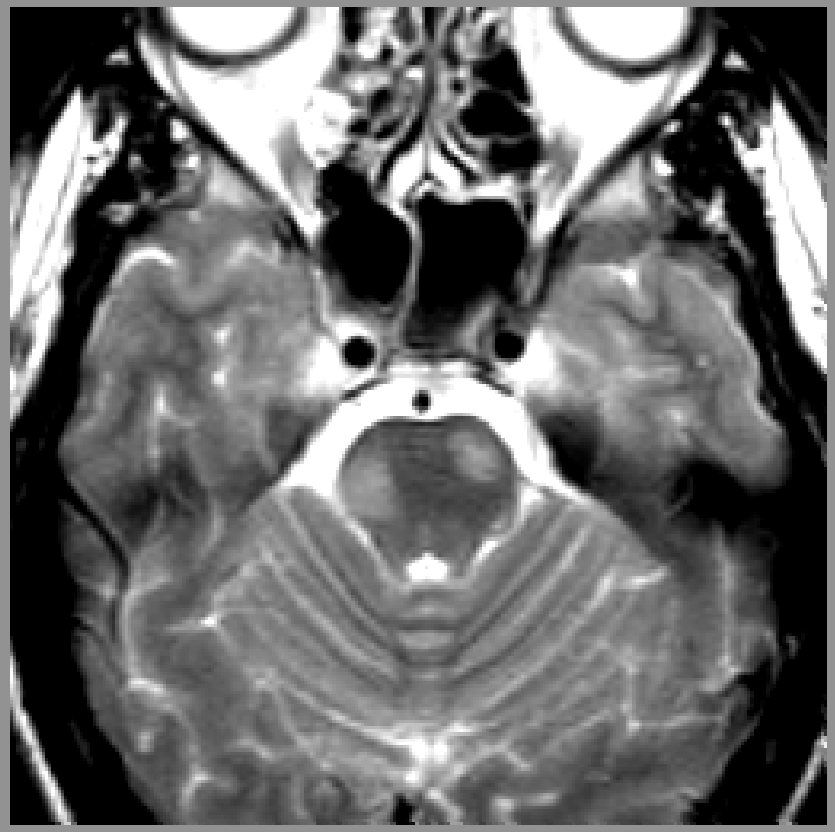
Pre-processing
- Image reconstruction
- Registration
- Intensity normalization
- Spatial Normalization
- Denoising
- Artifacts corrections

Analysis & Processing
- Feature extraction
- Focal lesion segmentation
- Diffuse lesion segmentation
- Longitudinal analysis
- Modeling (lesions, tissues)
- Statistical analysis

Quality Control and Certification group
(to be drafted by the steering committee)

Protocole d'acquisition SEP, particularités

- T2* non nécessaire
- T2/DP nécessaire
- 3D T1 ou Axi T1 post gadolinium,
Attendre 5 minute avant l'injection de gadolinium
- Diffusion, recommandations avec minimum 6 directions

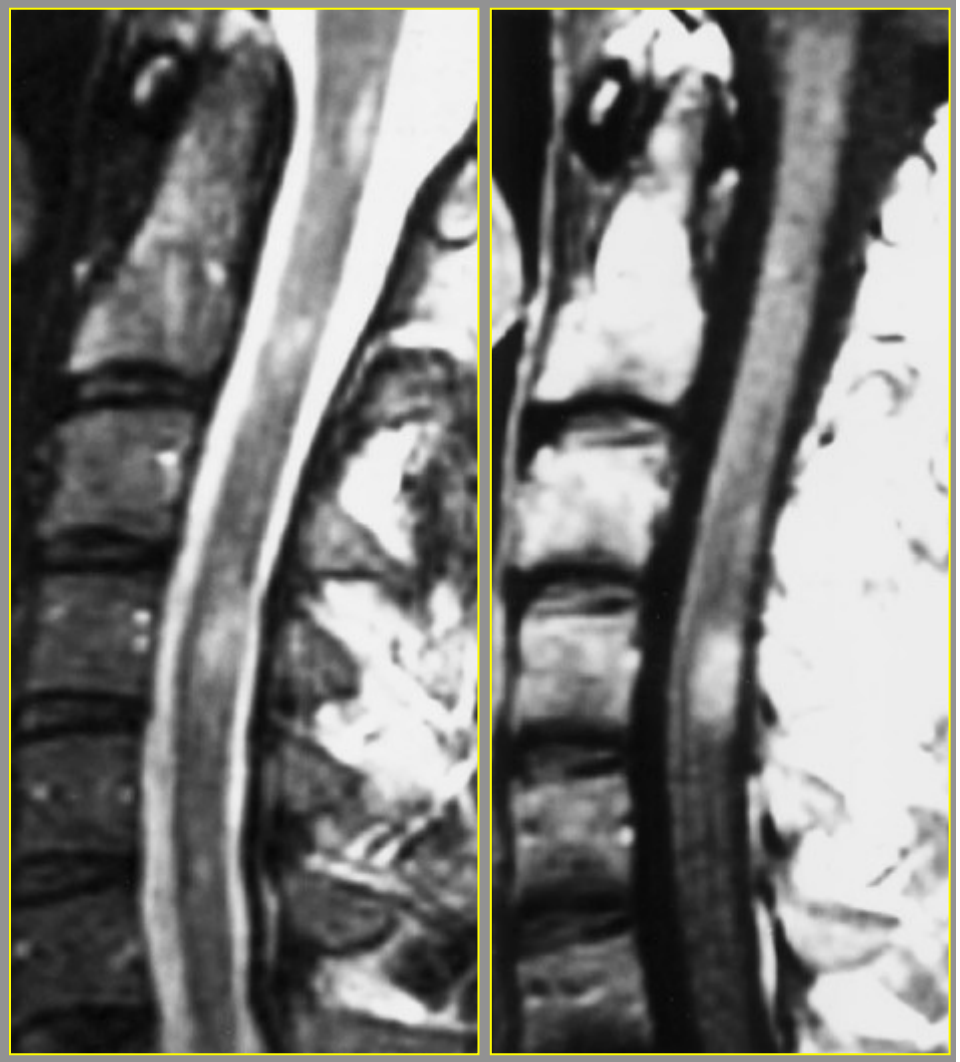


Protocole d'acquisition SEP, particularités

-T2 SAG

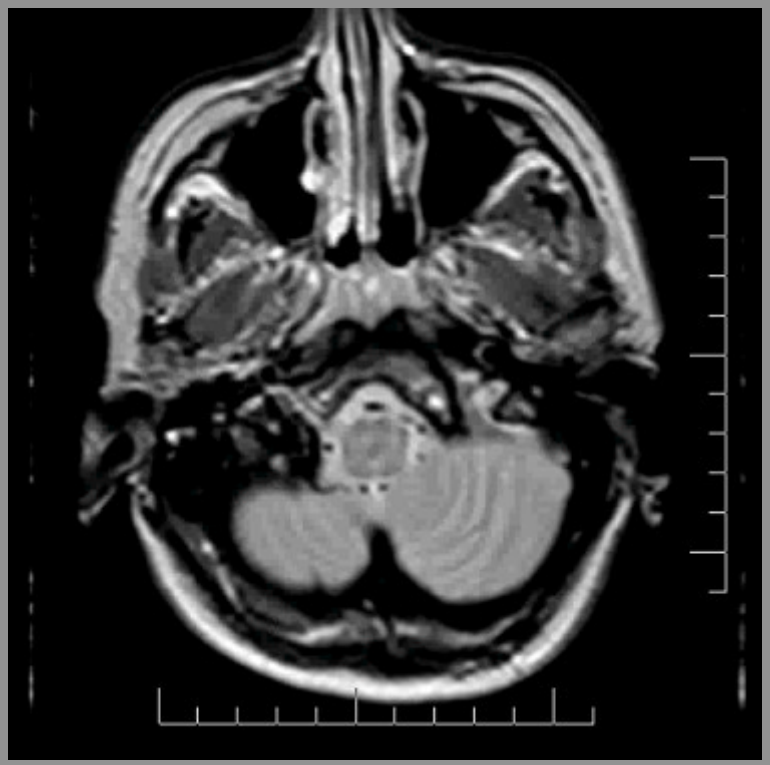
Si positif,
- Axial ou Sag T1 post-gadolinium (activité)
- Axial EG T2 (identification gris-blanc)

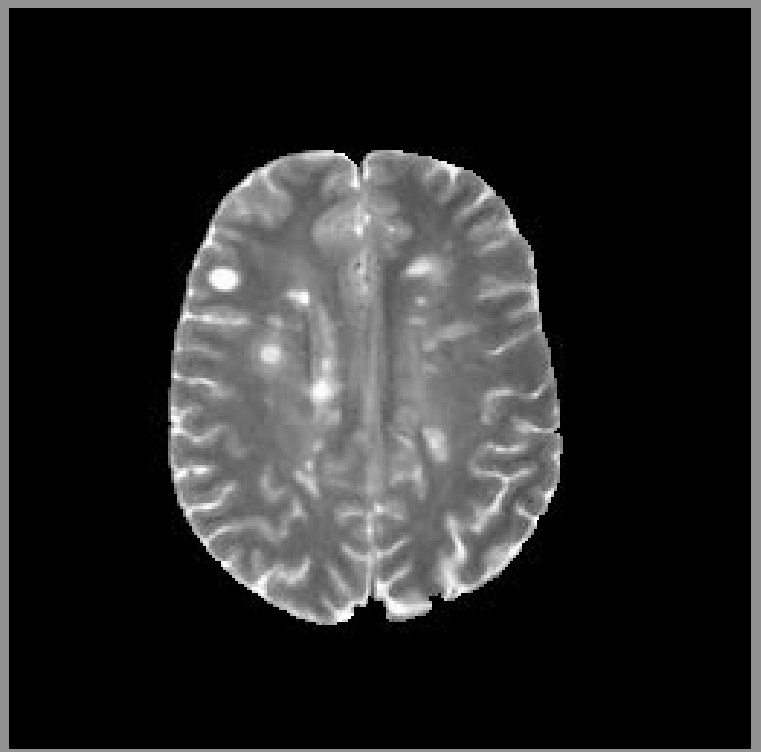
- STIR et diffusion optionnel



5 notions fondamentales pour le diagnostic de SEP

- Dissémination dans le temps - Dissémination dans l'espace
- Inflammation limitée au SNC (pas d'atteinte des nerfs périphériques, pas d'atteinte méningée)
- Atteinte médullaire ne s'étendant pas à plus de segments
- Absence de meilleure explication





Aspects évocateurs en IRM

- 1 Dissémination spatiale

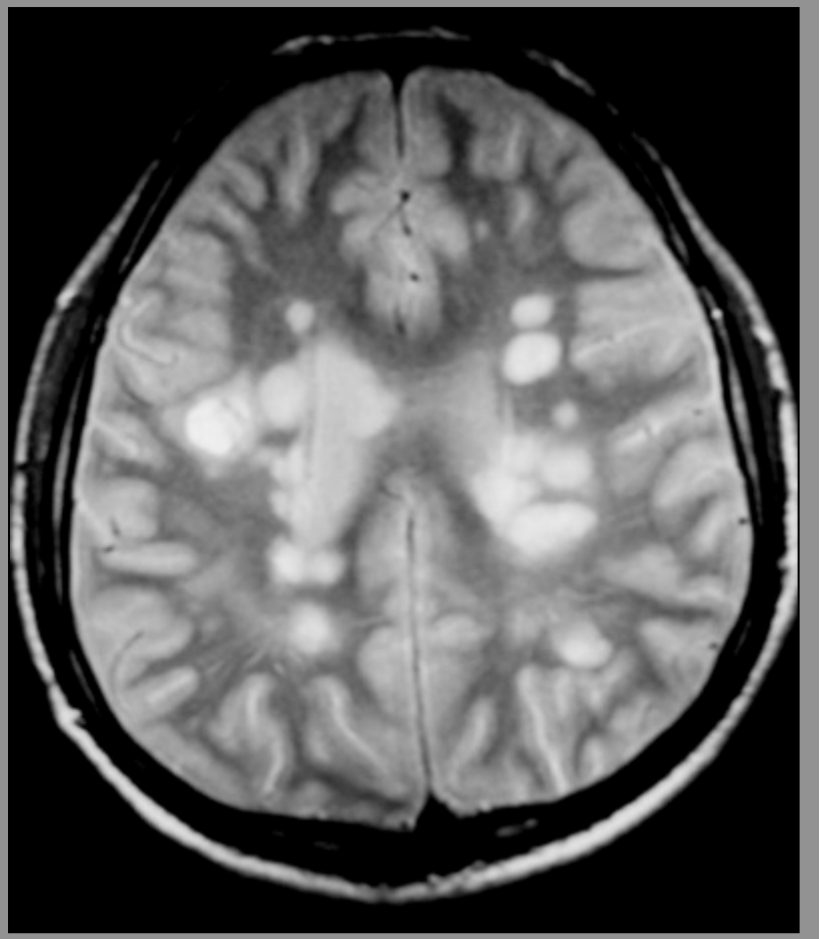
- 2 Formes, contours

- 3 Localisation anatomique

- 4 Lésions d'âges différents, activité (diffusion, gadolinium)

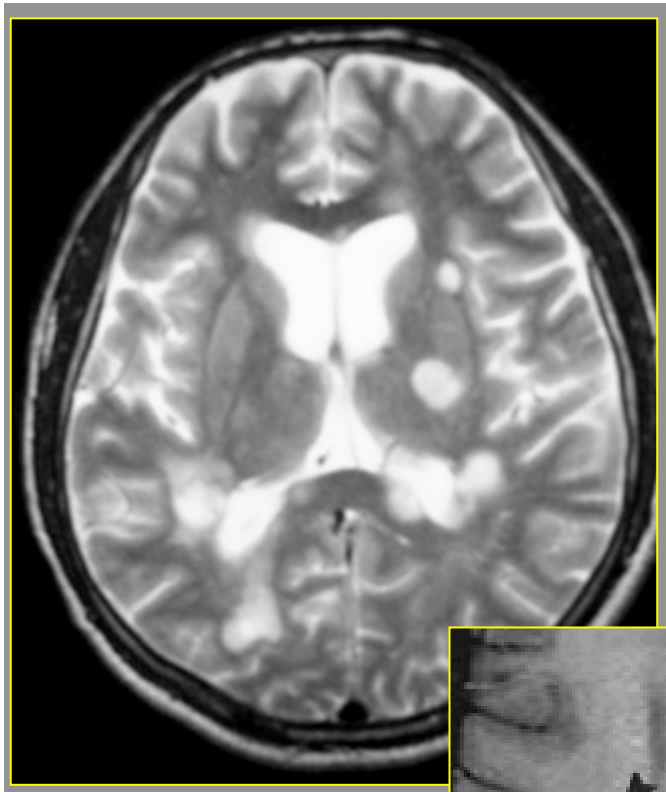
- 5 Lésions infra-IRM c

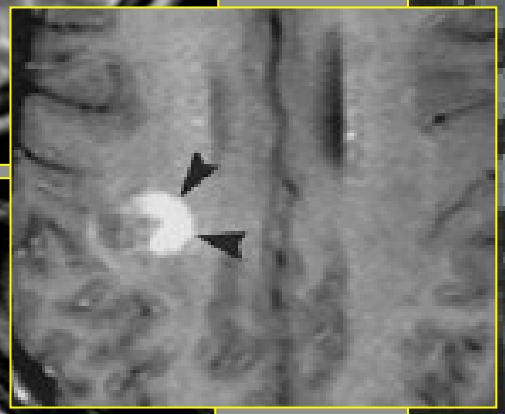
- 6 Atrophie

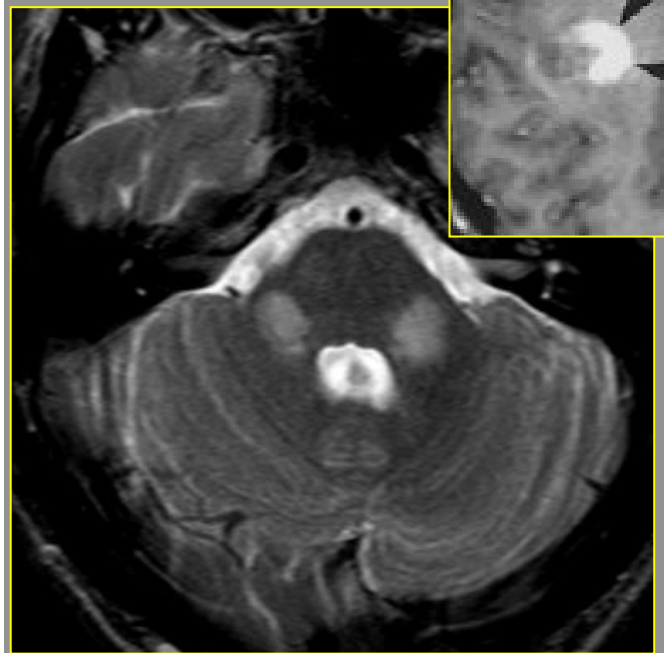


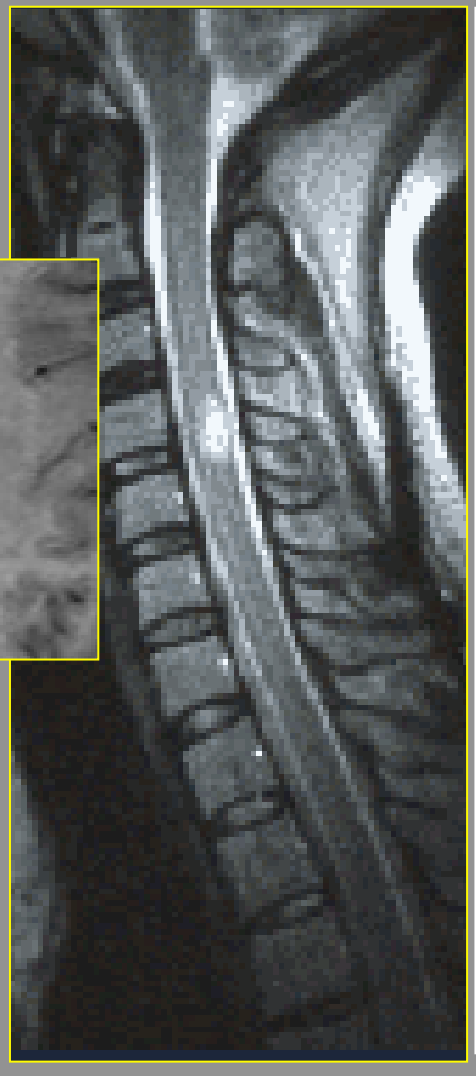
Barkhof (1997)

Meilleur compromis sensibilité-spécificité pour le diagnostic de dissémination spatiale









Au moins 3 des 4 critères ⇒ diagnostic de SEP (80%)

→1 lésion T1 rehaussée par le gadolinium ou **9 lésions hyperT2**

→au moins 1 lésion sous-tentorielle

→au moins 1 **lésion juxta-corticale**

→au moins **3 lésions périventriculaires**

Classifications modernes (McDonald, MAGNIMS

Table 2 MRI criteria for dissemination in space and time for multiple sclerosis

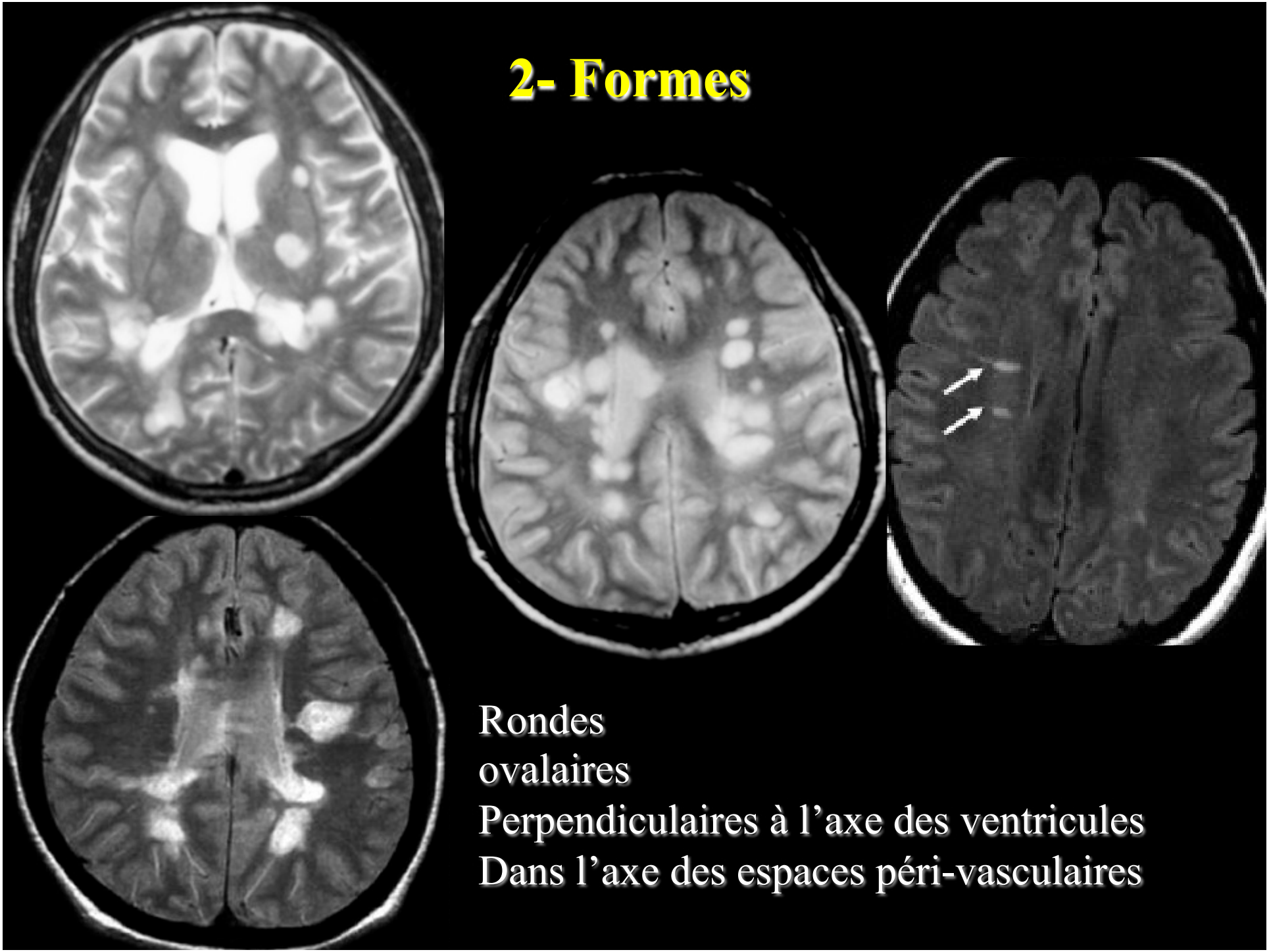
	McDonald 2001[1]	McDonald 2005[2]	MAGNIMS proposal
DIS (on either baseline or follow-up MRI)[a]	3 or more of:	3 or more of:	≥1 lesion in each of ≥2 characteristic locations:
	≥9 T2 lesions or ≥1 Gd-enhancing lesion	≥ 9 T2 lesions[a] or ≥1 Gd-enhancing lesion	PV
	≥3 PV lesions	≥3 PV lesions	JC
	≥1 JC lesions	≥1 JC lesions	PF
	≥1 PF lesions	≥1 PF lesions or spinal cord lesion	Spinal cord
	1 cord lesion can replace 1 brain lesion	Any number of cord lesions can be included in total lesion count[a]	All lesions in symptomatic regions excluded in BS and SC syndromes
DIT	1) ≥1 Gd-enhancing lesion at least 3 months after CIS onset (if not related to CIS)	1) ≥1 Gd-enhancing lesion at least 3 months after CIS onset (if not related to CIS)	1) Simultaneous presence of asymptomatic Gd-enhancing and nonenhancing lesions at any time
	2) A new T2 lesion with reference to a prior scan obtained at least 3 months after CIS onset	2) A new T2 lesion with reference to a baseline scan obtained at least 30 days after CIS onset	2) A new T2 and/or Gd-enhancing lesion on follow-up MRI irrespective of timing of baseline scan

Montalban X, neurology 2010

Abbreviations: BS = brainstem; DIS = disseminated in space; DIT = disseminated in time; Gd = gadolinium-enhancing lesion; JC = juxtacortical; PF = posterior fossa; PV = periventricular; SC = spinal cord.

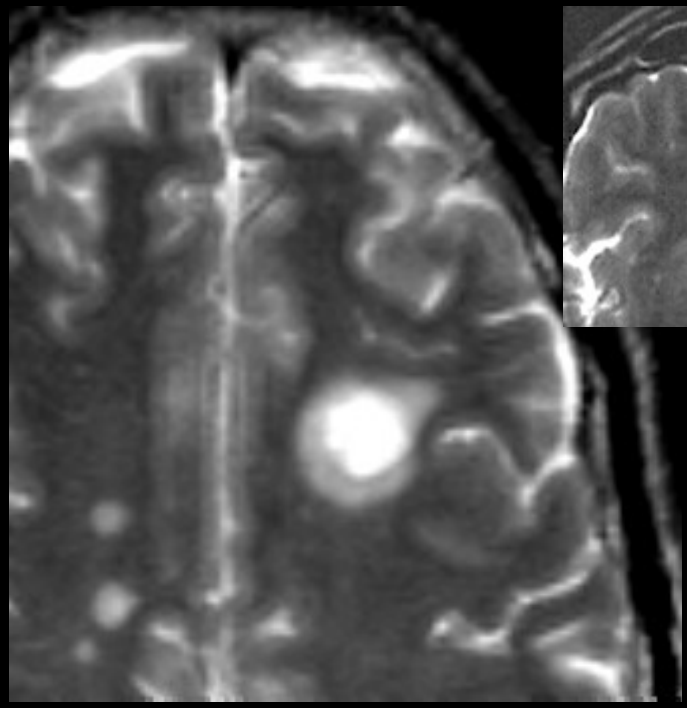
[a]The McDonald 2001 and 2005 DIS criteria also include the presence of 2 or more T2 lesions plus CSF oligoclonal bands. Because CSF was not examined systematically in the MAGNIMS cohort, only the MRI criteria for DIS are considered in this study.

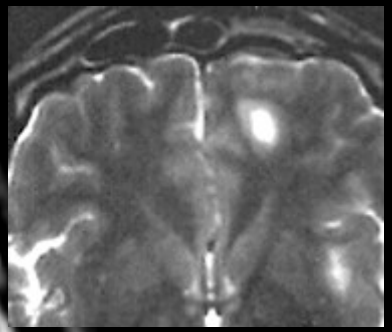
2- Formes

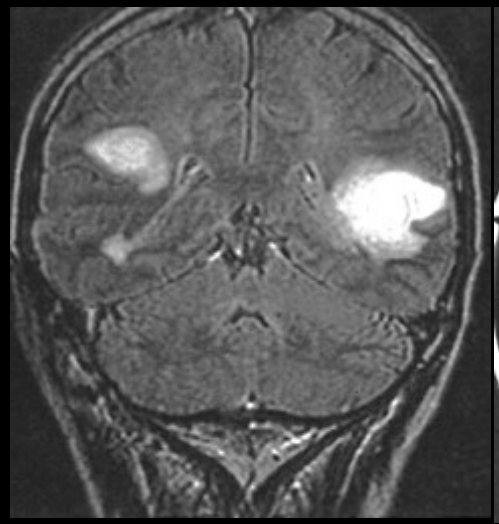


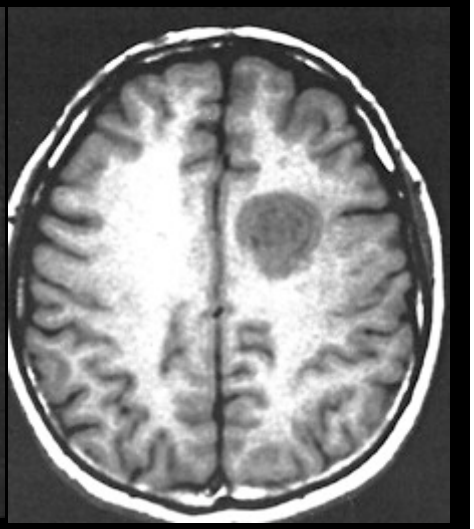
Rondes
ovalaires
Perpendiculaires à l'axe des ventricules
Dans l'axe des espaces péri-vasculaires

2- Formes

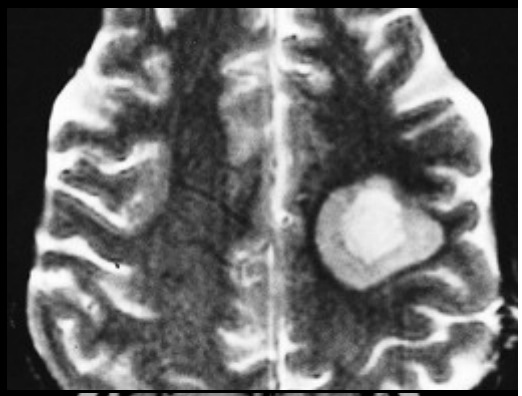


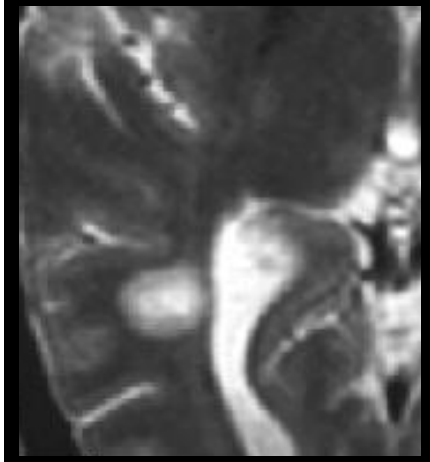


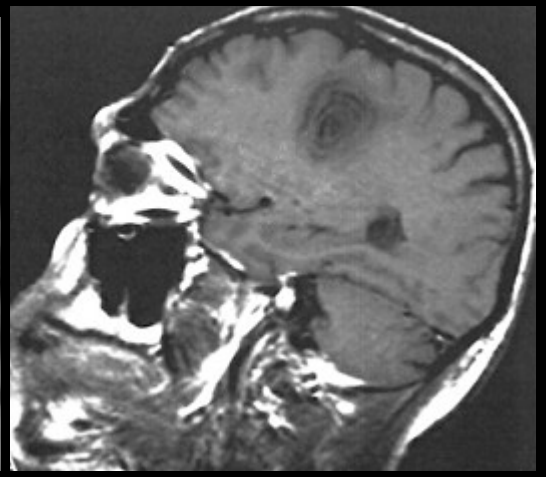


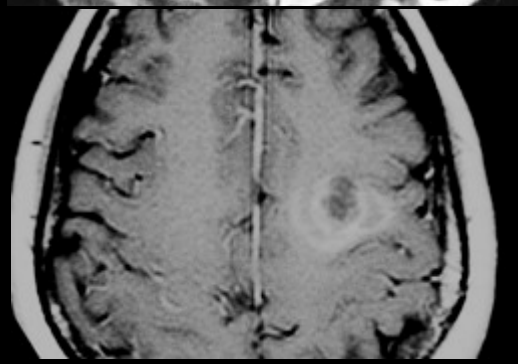


Front de démyélinisation,
Aspect en bulbe d'oignon
Sclérose de Balo
Macrophages

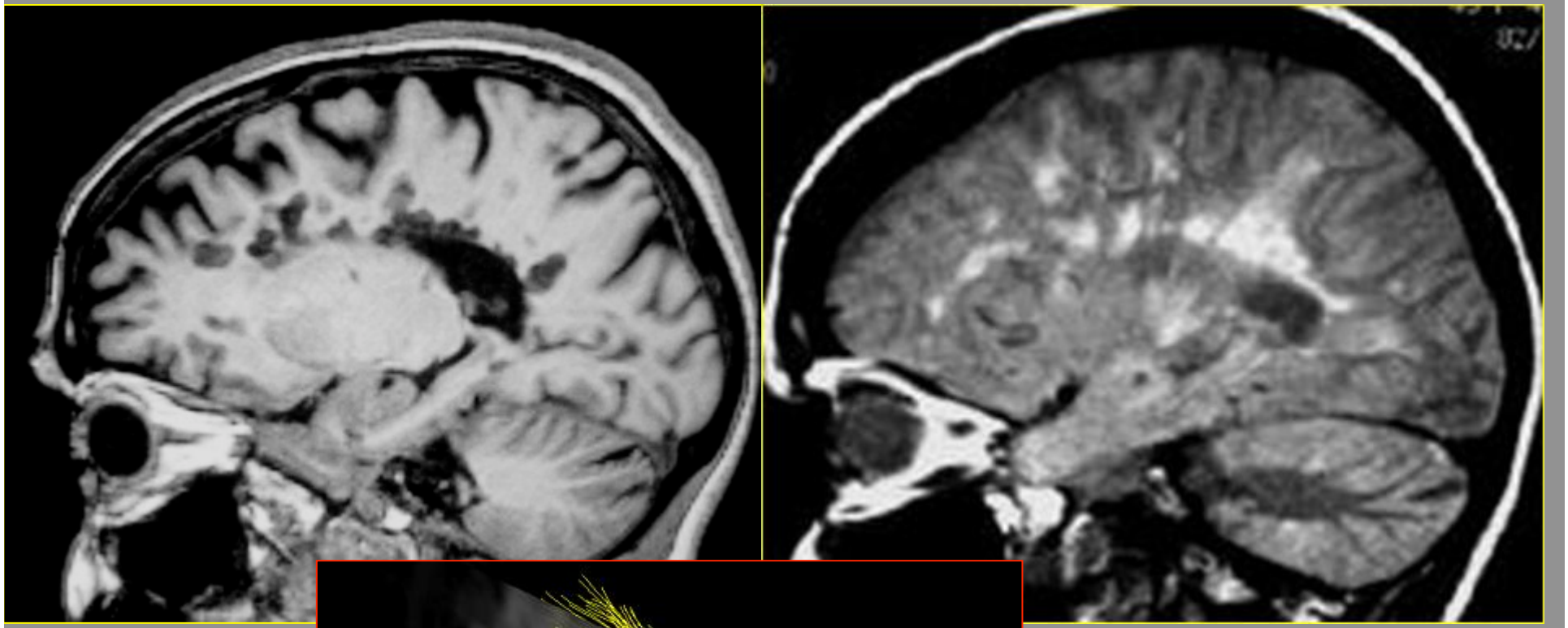


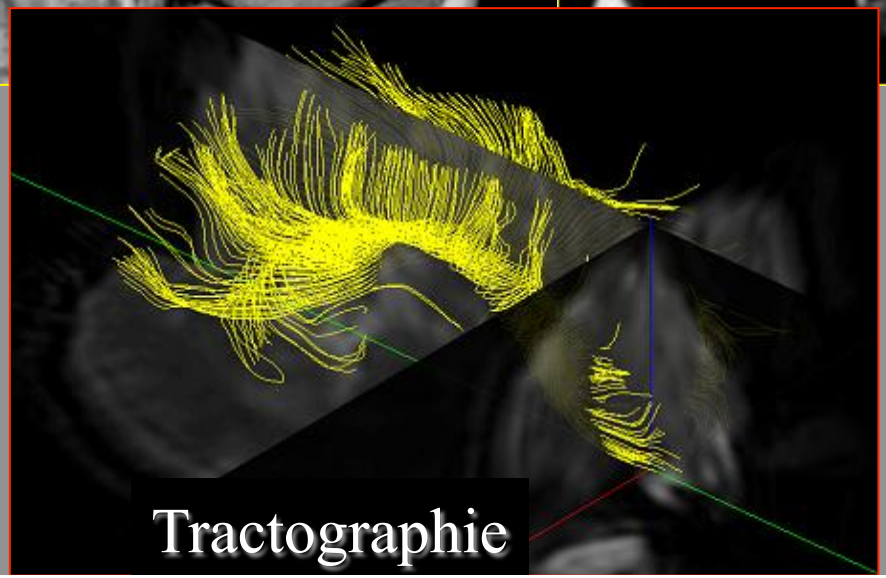






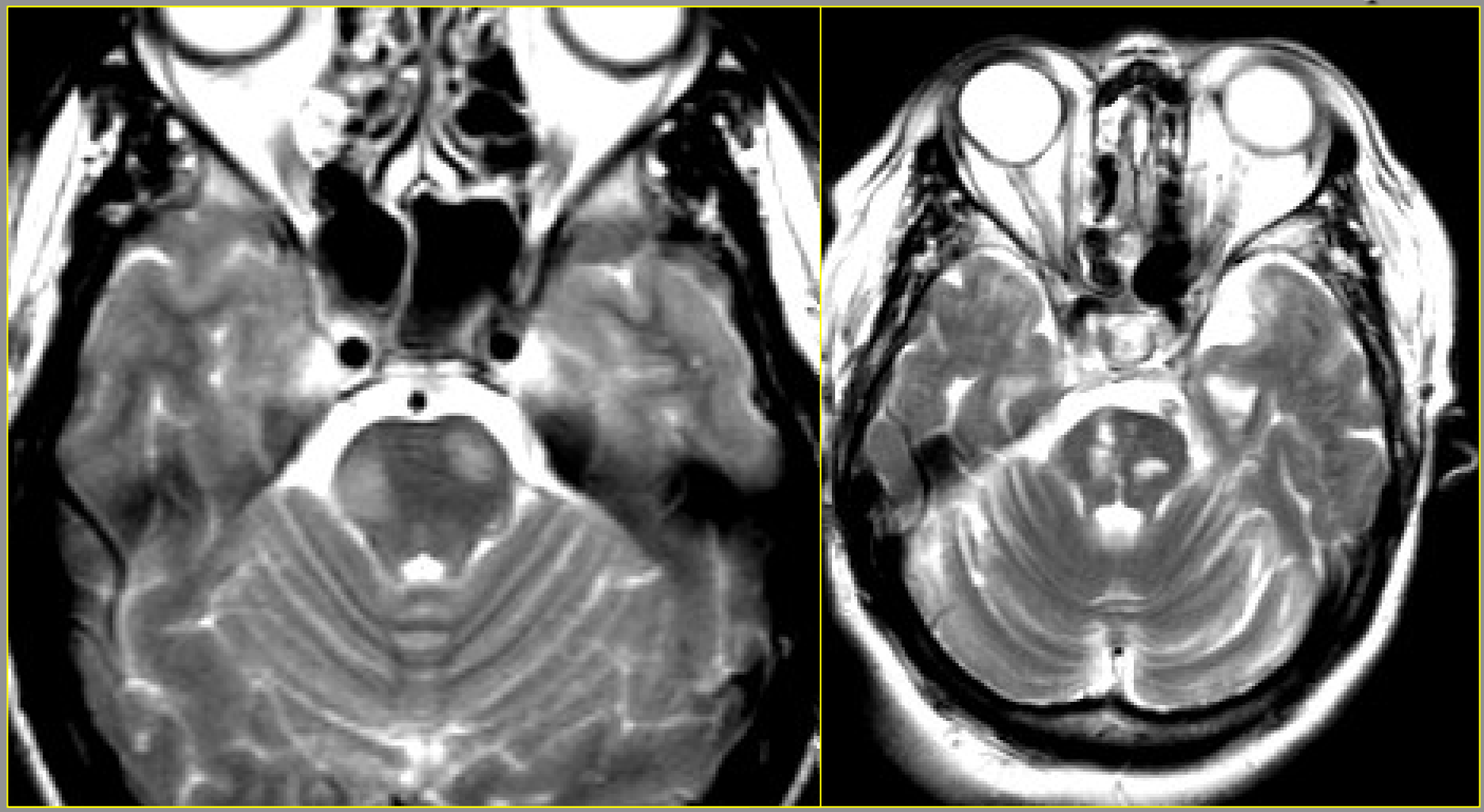
2- Formes: aspect en crête de coq





2- Contours: réguliers

Lacunes ischémiques



Aspects évocateurs en IRM

- 1 Dissémination spatiale

- 2 Formes, contours

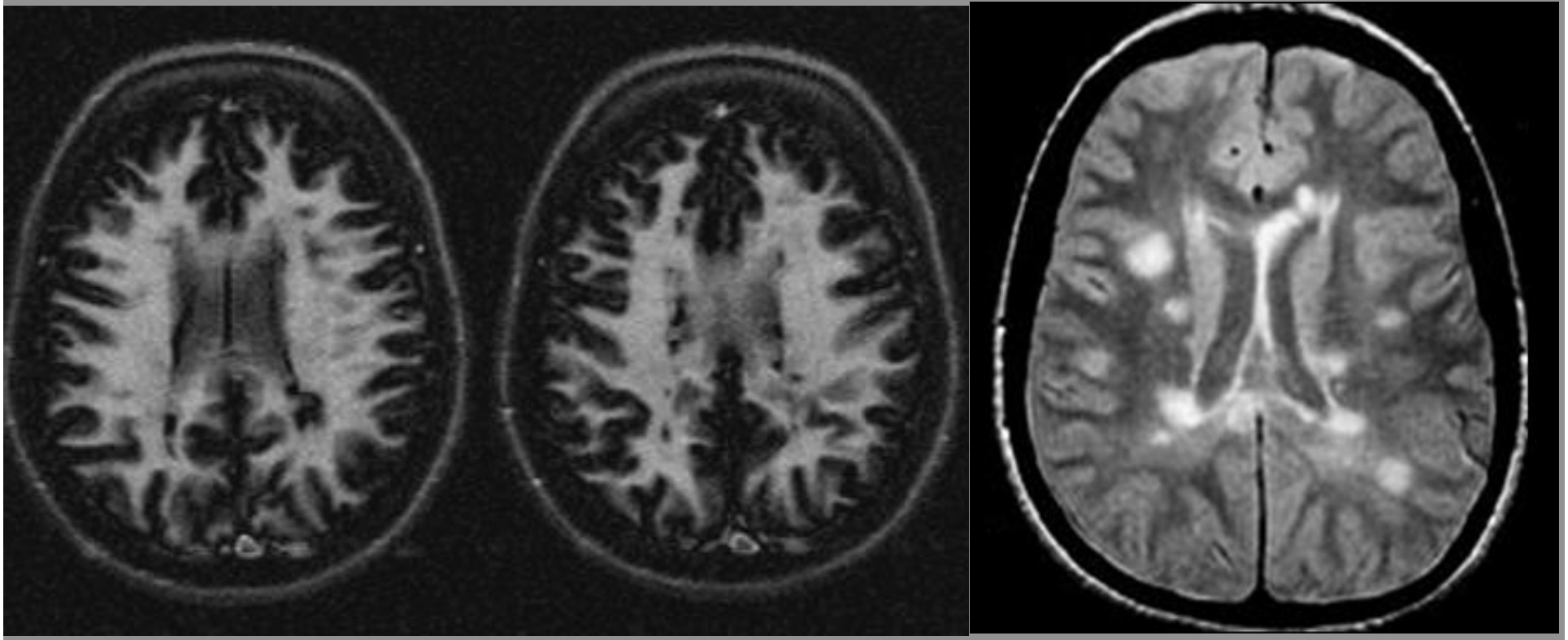
- 3 Localisation anatomique

- 4 Lésions d'âges différents, activité (diffusion, gadolinium)

- 5 Lésions infra-IRM c

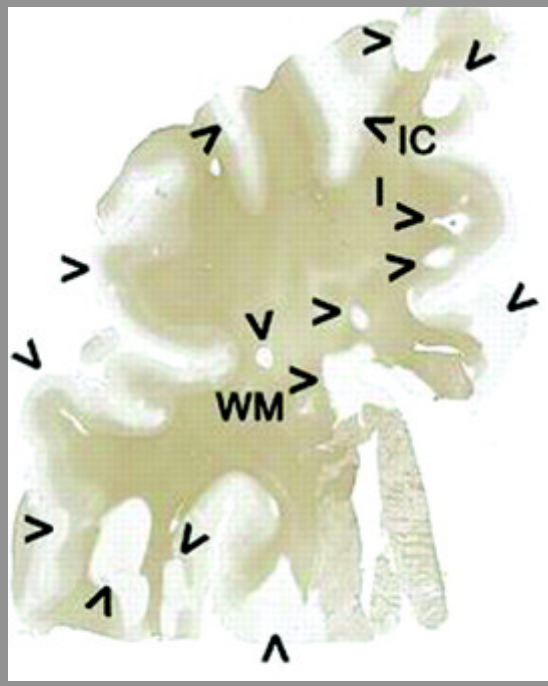
- 6 Atrophie

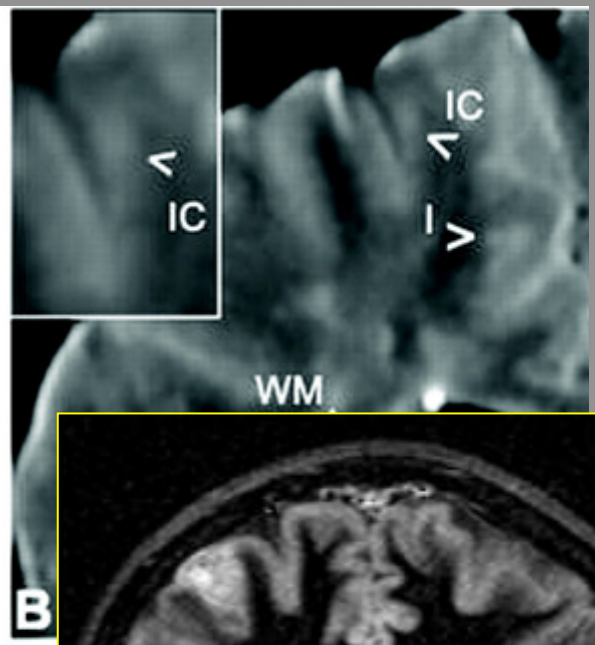
3- Localisation anatomique: substance blanche
Près des espaces sub-arachnoïdiens

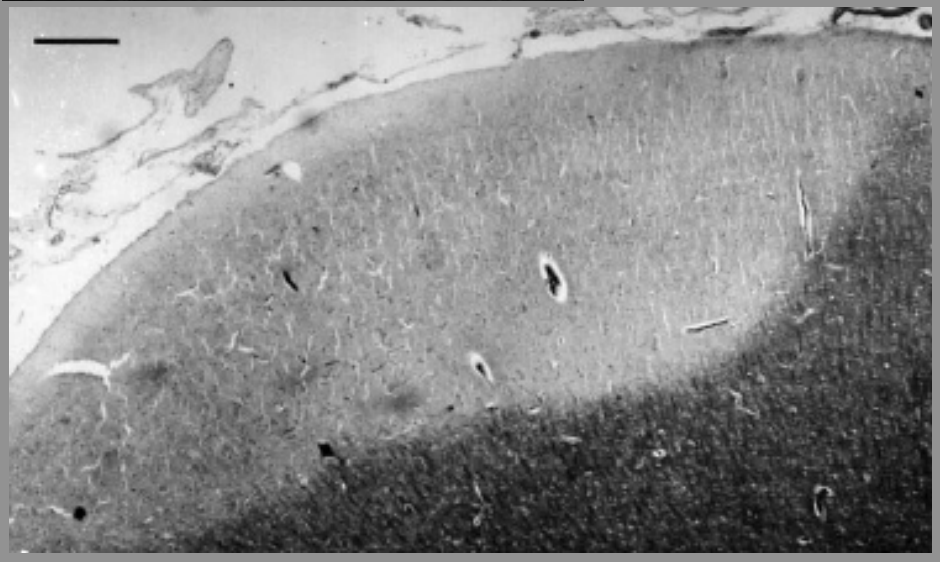


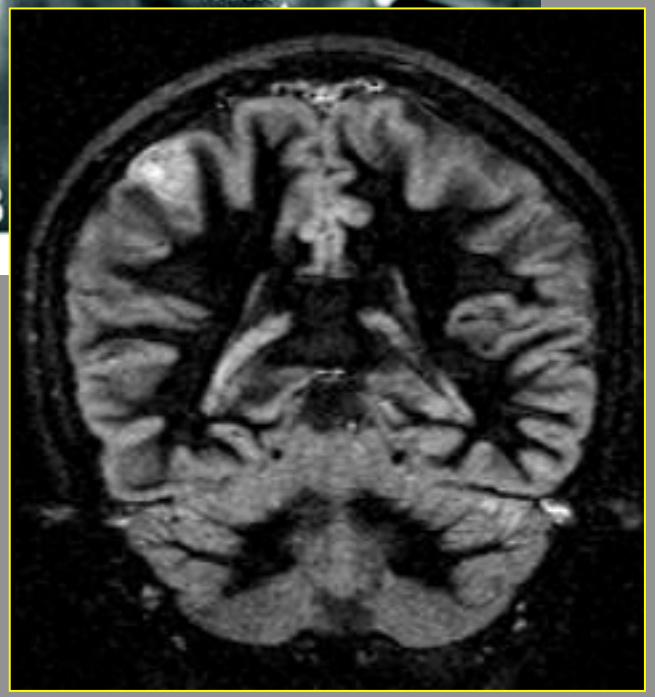
Séquence en double inversion-récupération
de type white matter

3- Localisation anatomique: substance grise



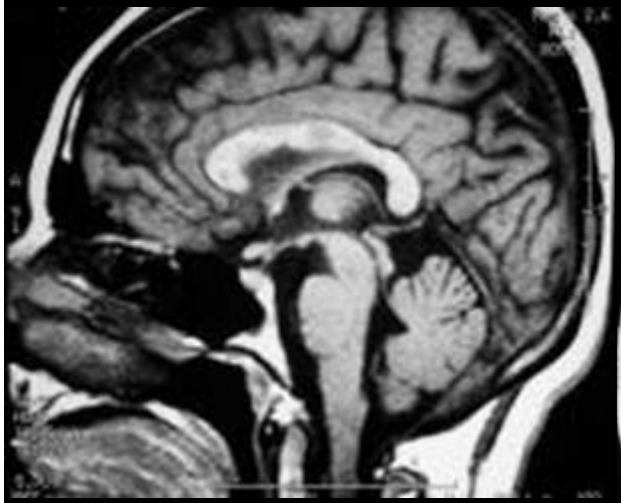


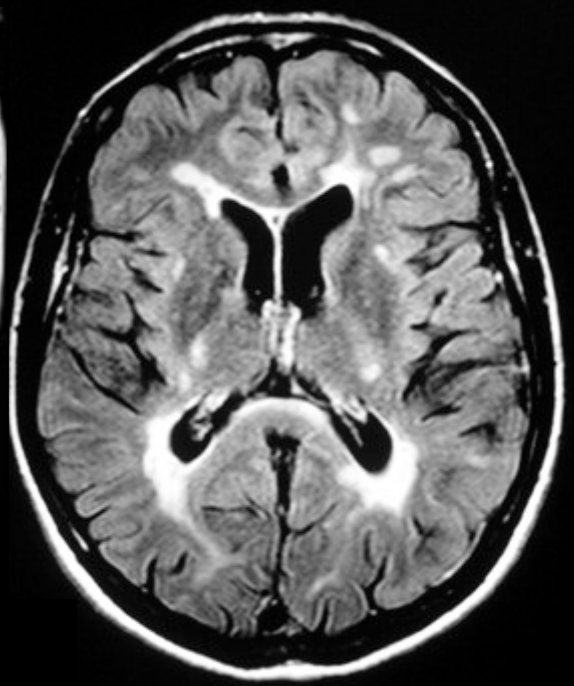




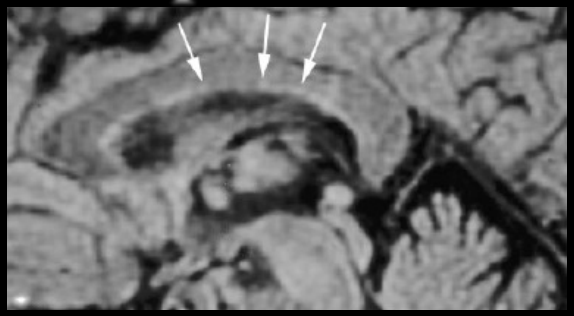
Séquence en double IR
de type Grey matter

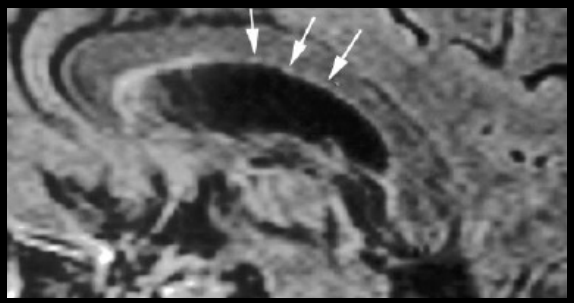
3- Localisation anatomique: corps calleux



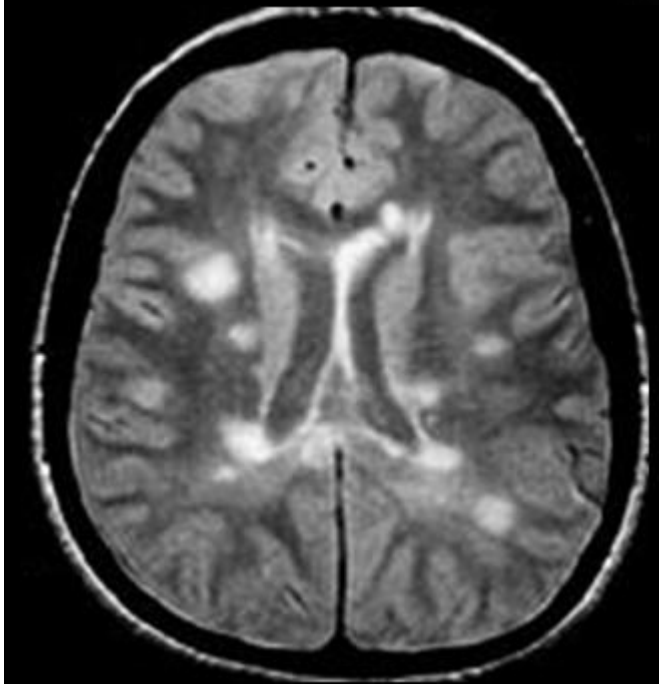


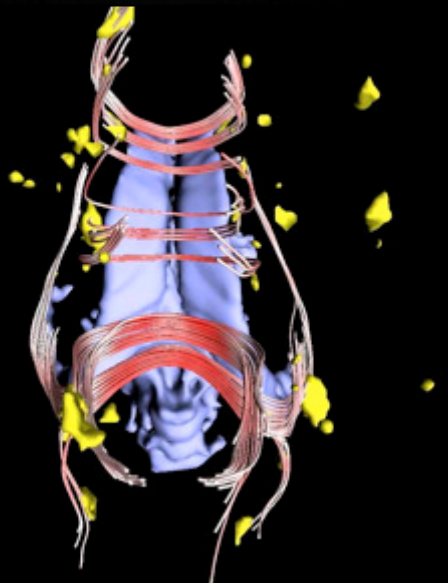
55-93% des séries

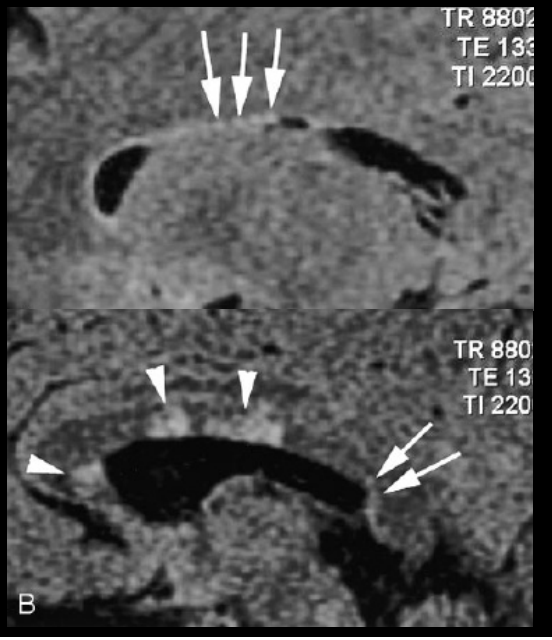




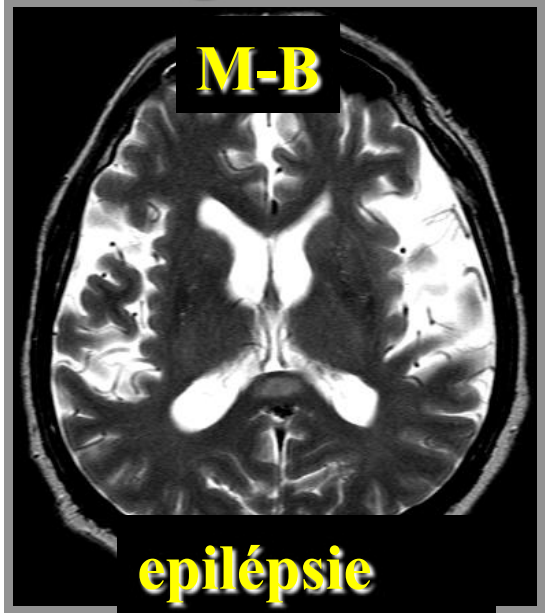
The Ependymal "Dot-Dash" Sign; Lisanti J, AJNR 2005

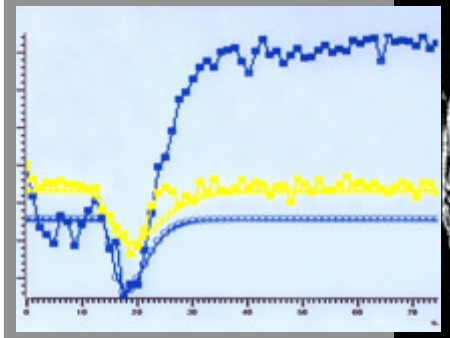


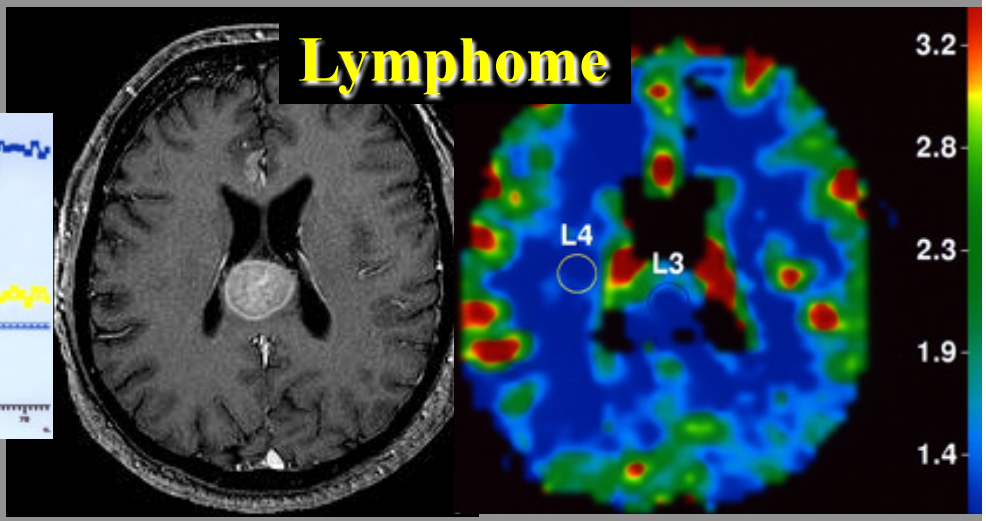


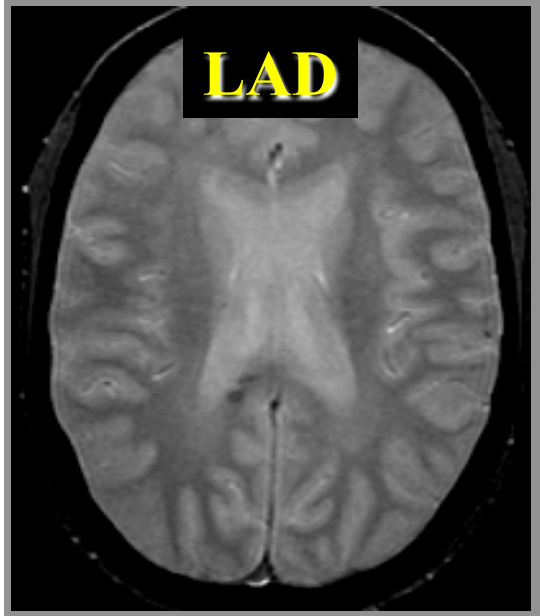


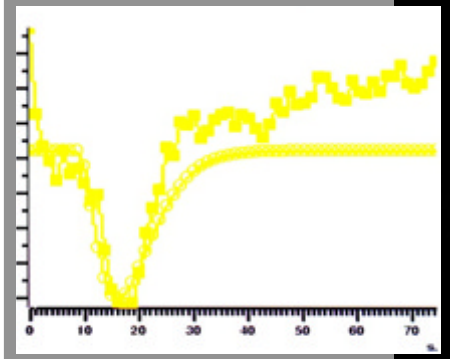
Diagnostic différentiel des lésions du corps calleux

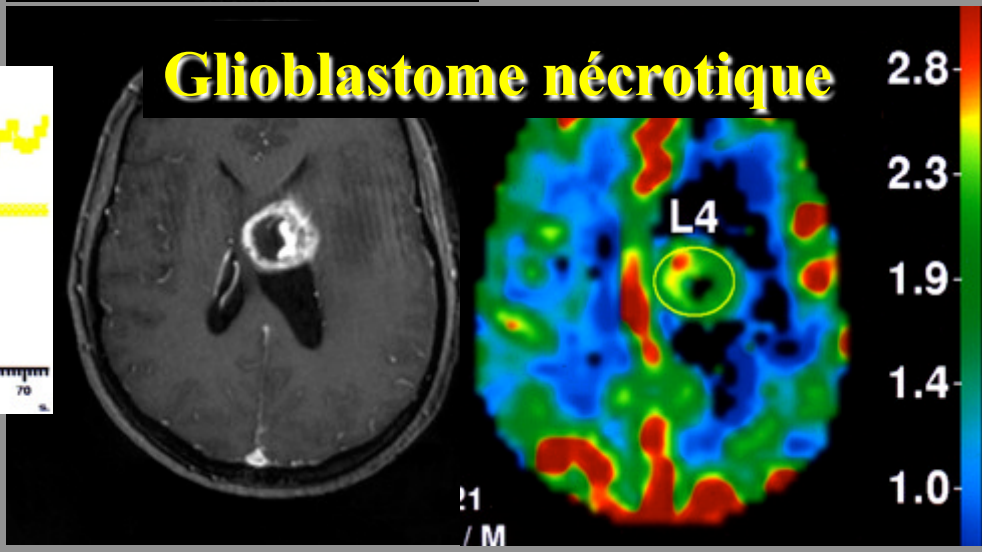




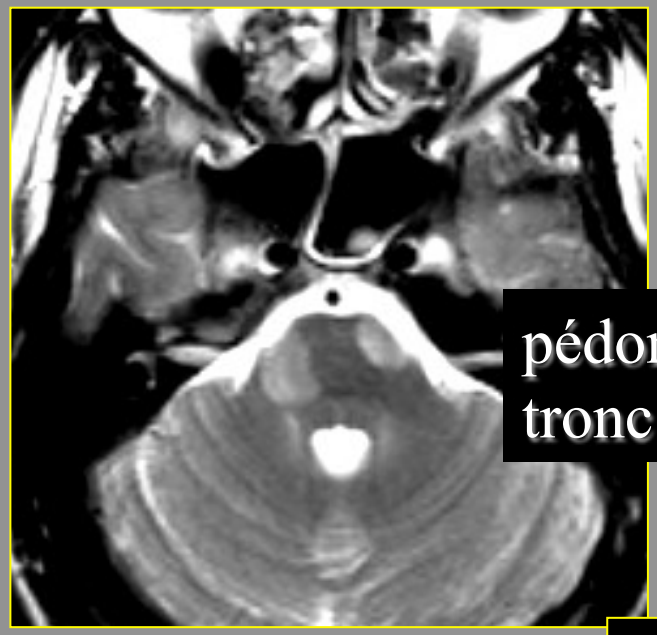


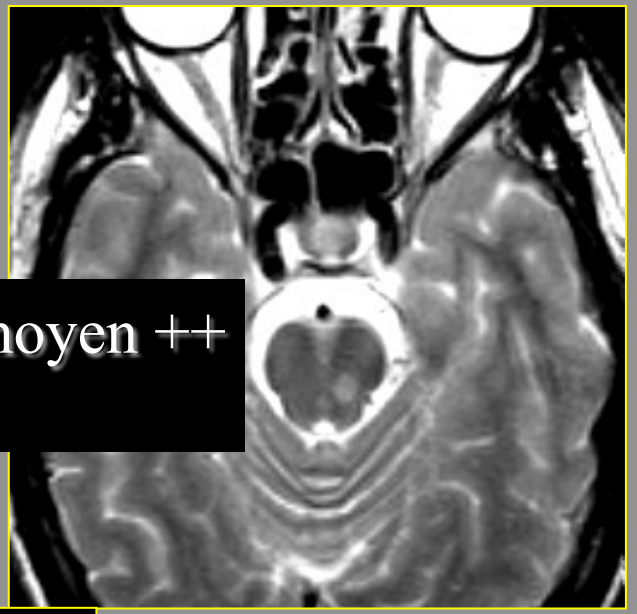




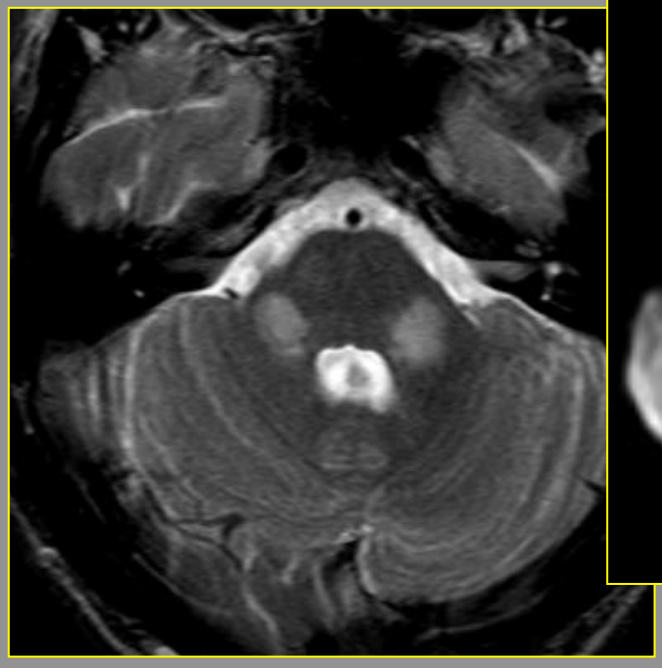


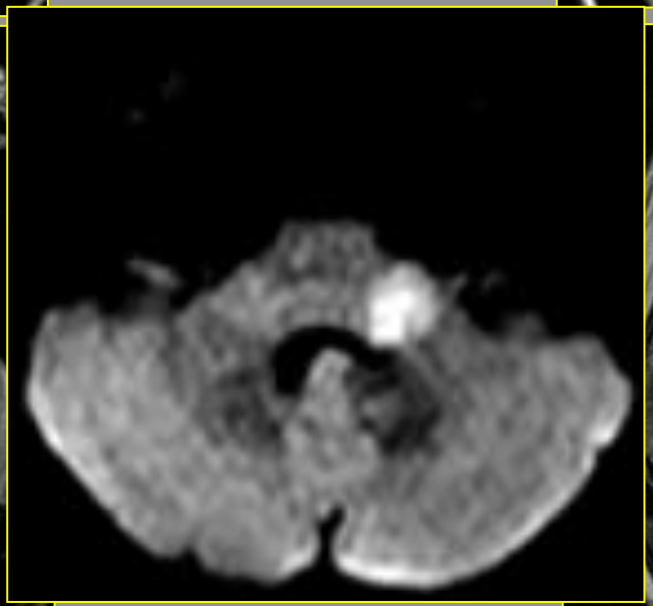
3- Localisation anatomique: sous-tentorielle

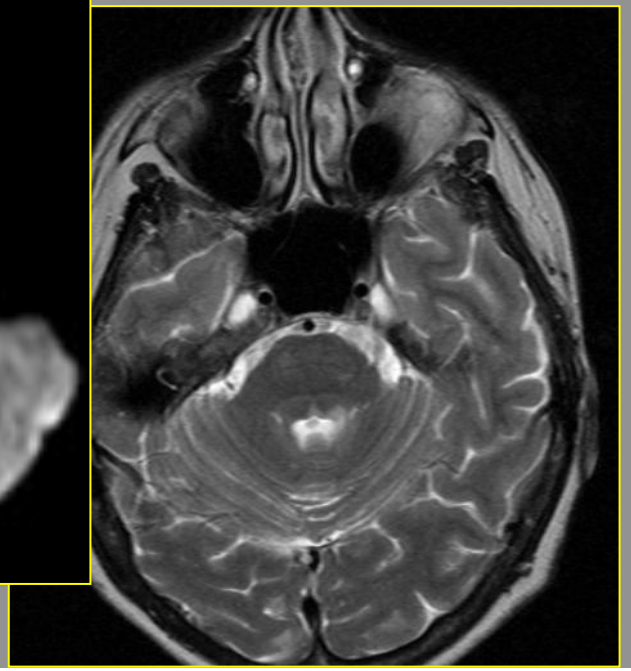




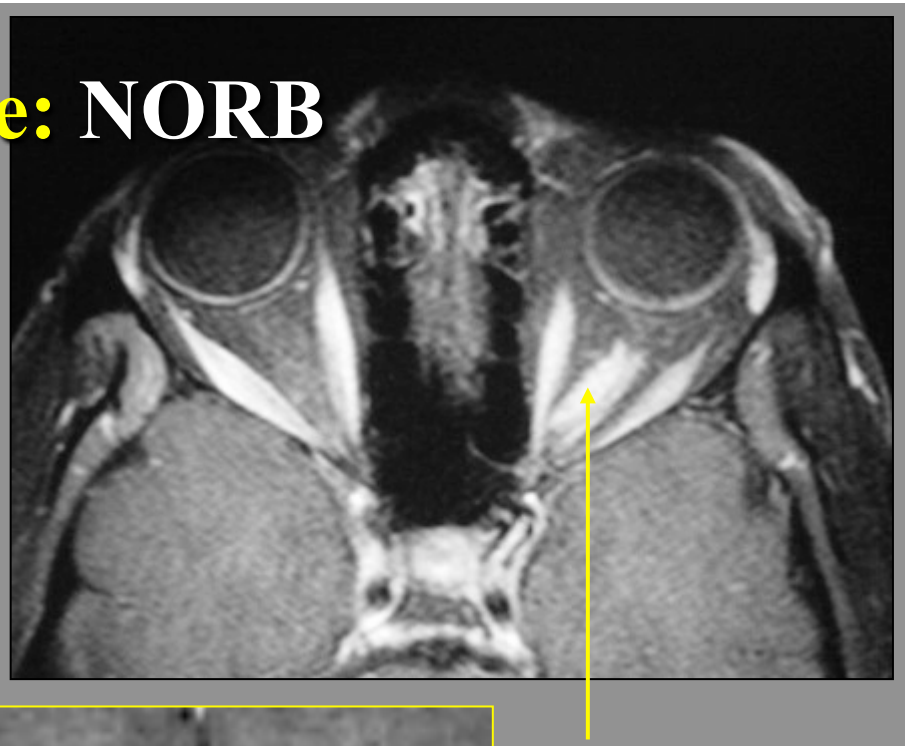
pédoncule cérébelleux moyen ++
tronc cérébral



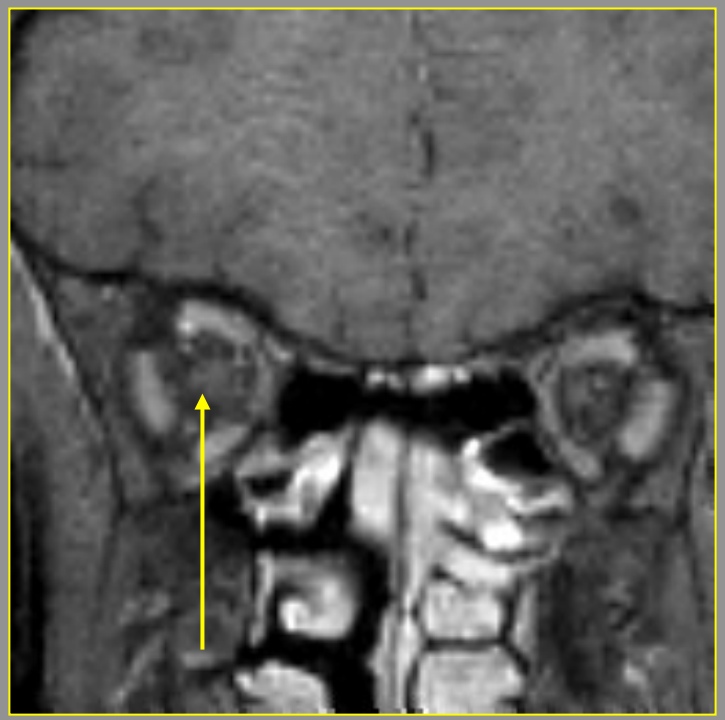


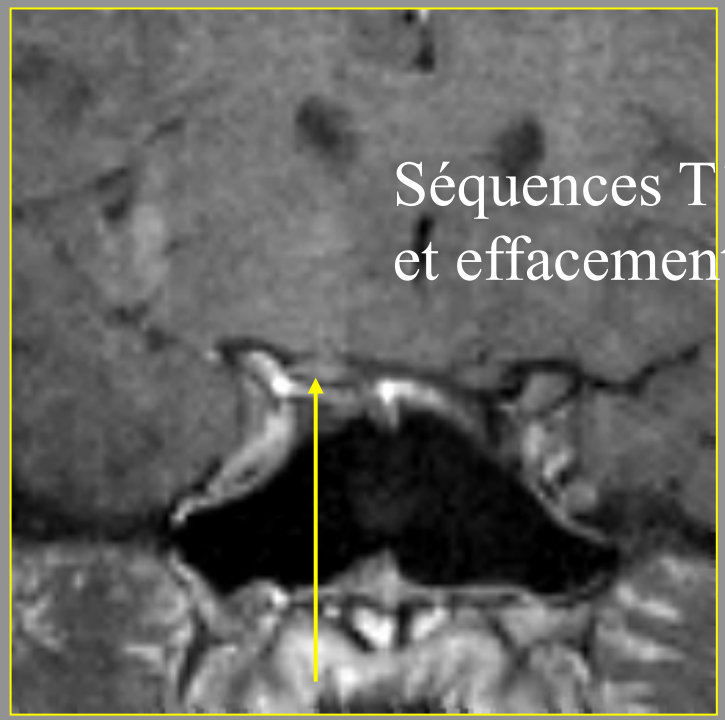


3- Localisation anatomique: NORB



Attention, si extension à l'ensemble du nerf optique ou au chiasma penser à la maladie de DEVIC ?

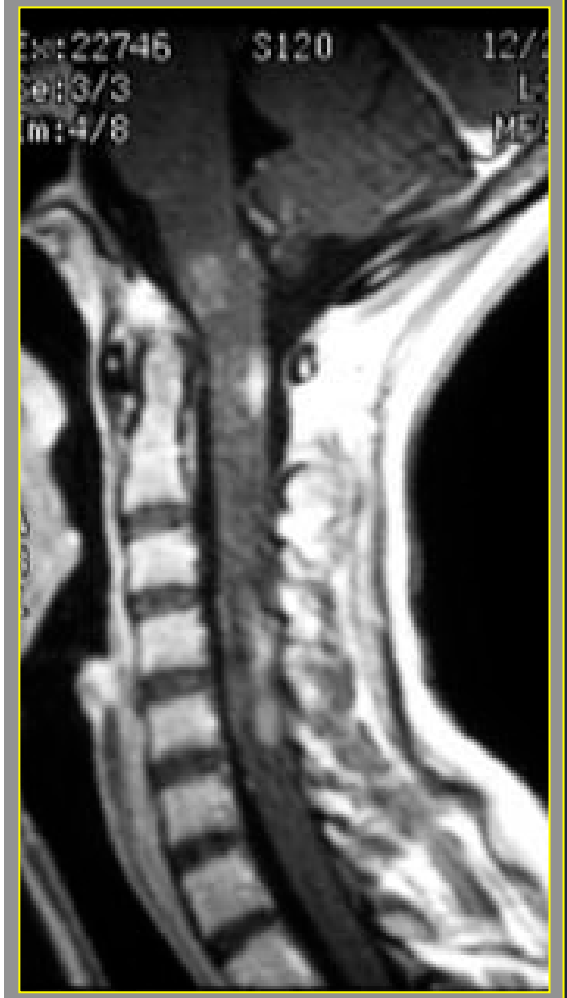


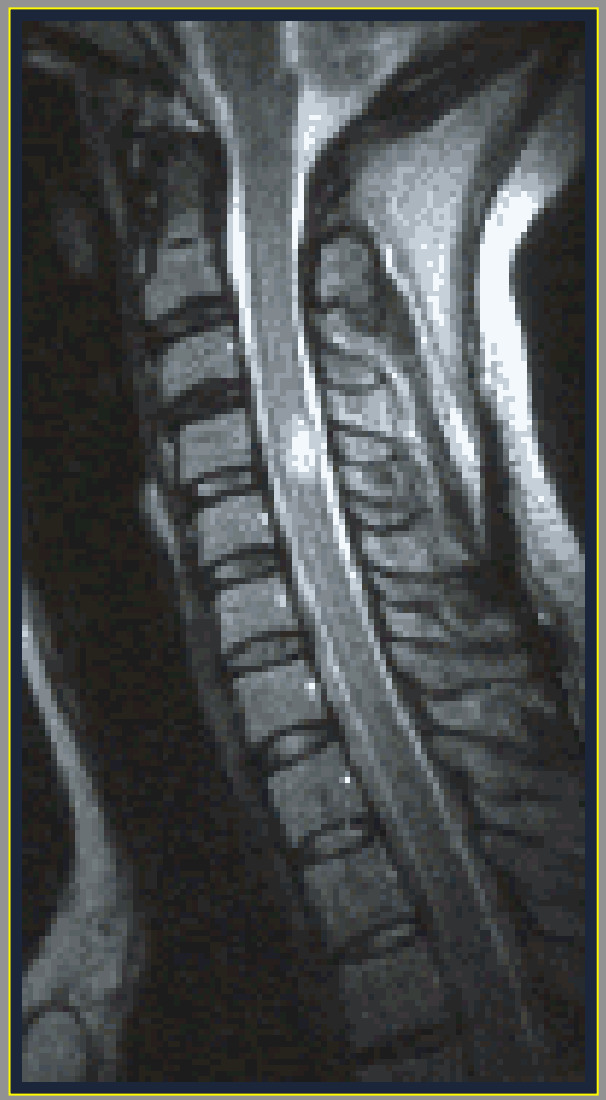


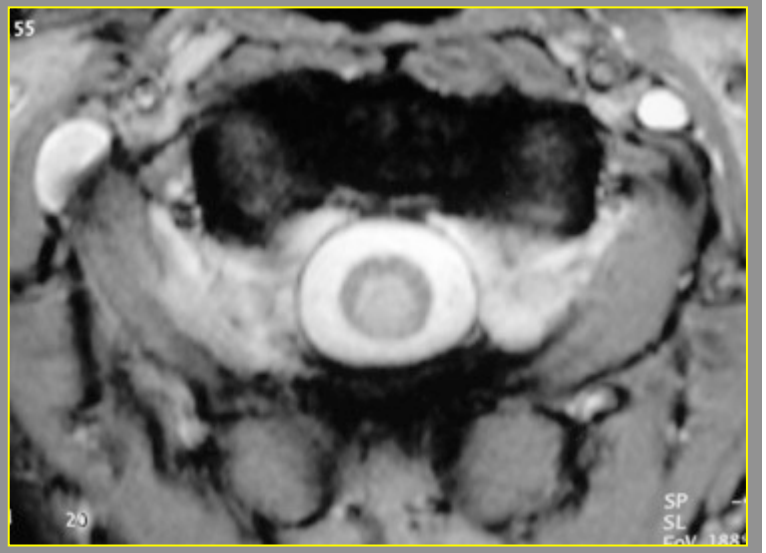
Séquences T1 avec injection et effacement de la graisse

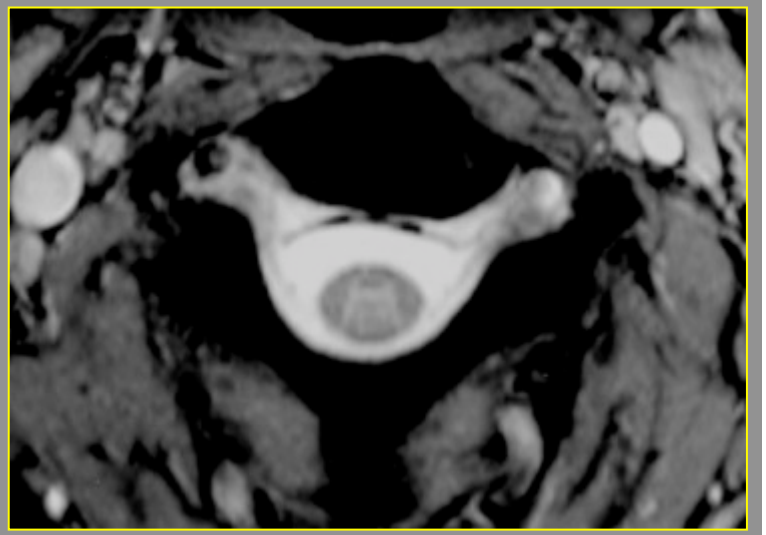
3- Localisation anatomique: Moelle épinière

C>T>L; Substance grise et blanche; Cordons postéro-latéraux

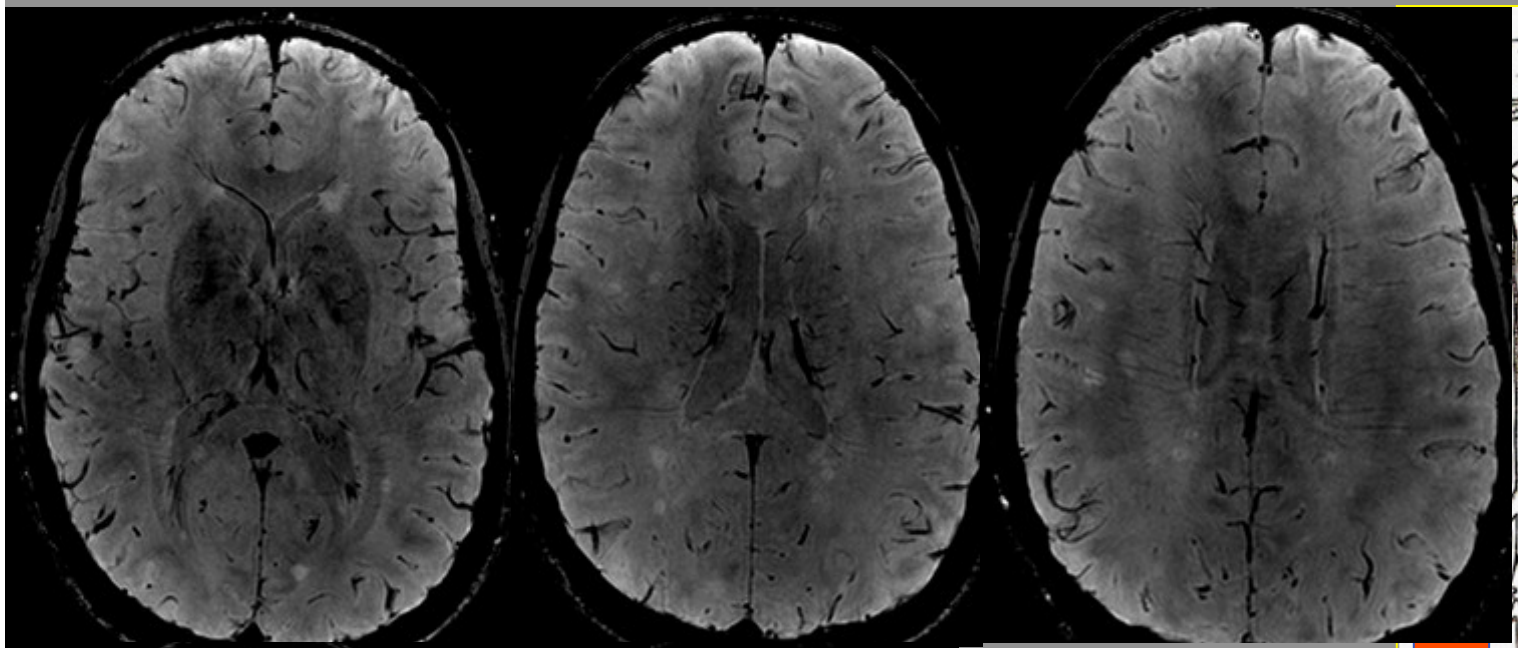


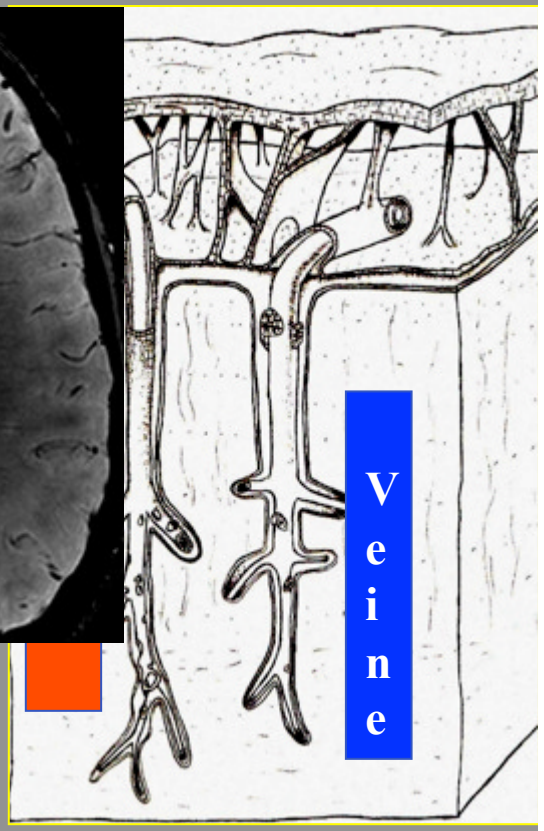


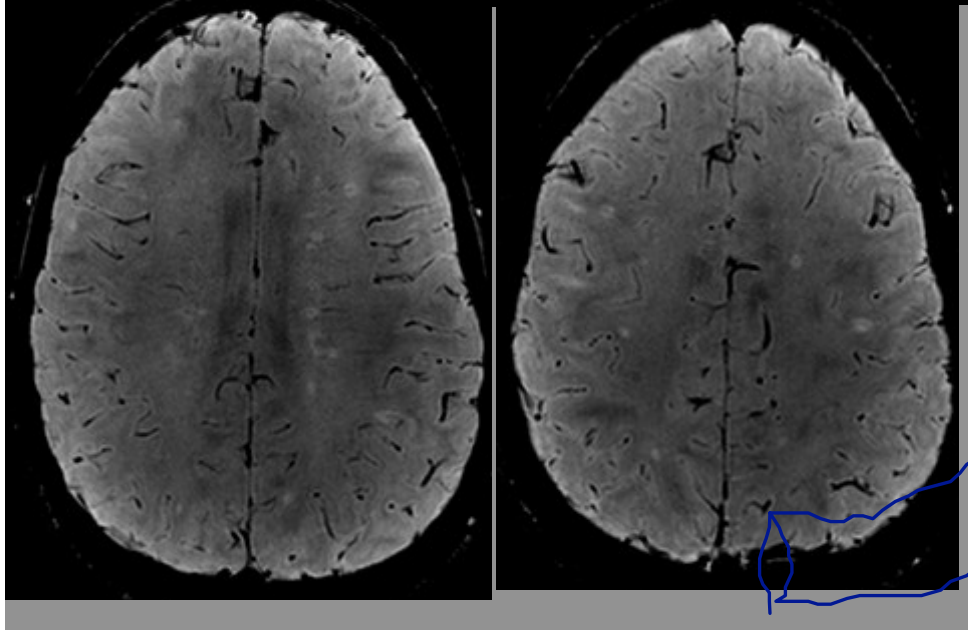




3- Localisation anatomique: péri-veinulaire

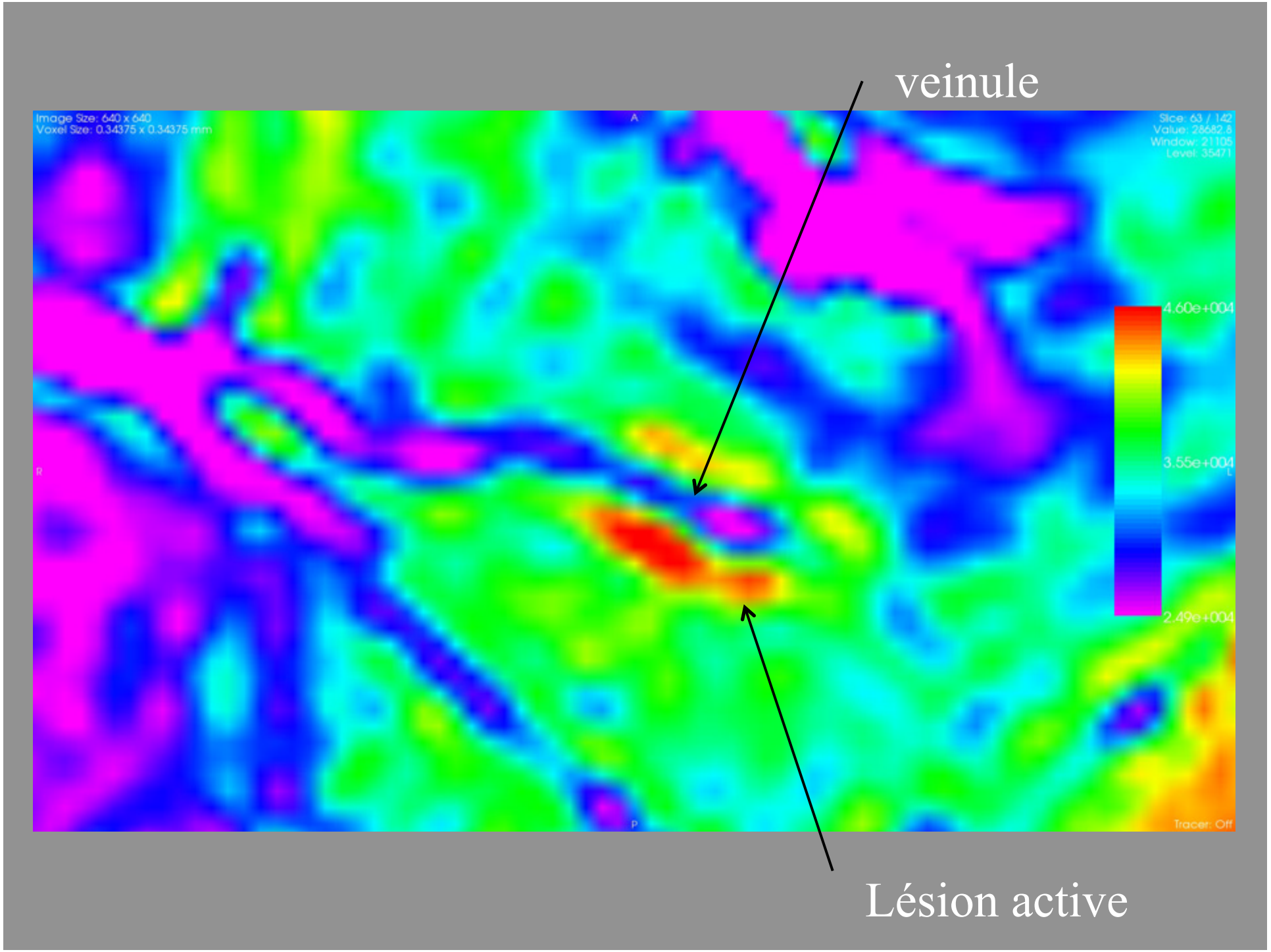






Demyelinating plaque (Dawson finger)

veinule


veinule
Image Size: 640 x 640
Voxel Size: 0.34375 x 0.34375 mm
Slice: 63 / 142
Value: 28682.8
Window: 21105
Level: 35471
4.60e+004
3.55e+004
2.49e+004
Tracer: Off
Lésion active

Aspects évocateurs en IRM

- 1 Dissémination spatiale

- 2 Formes, contours

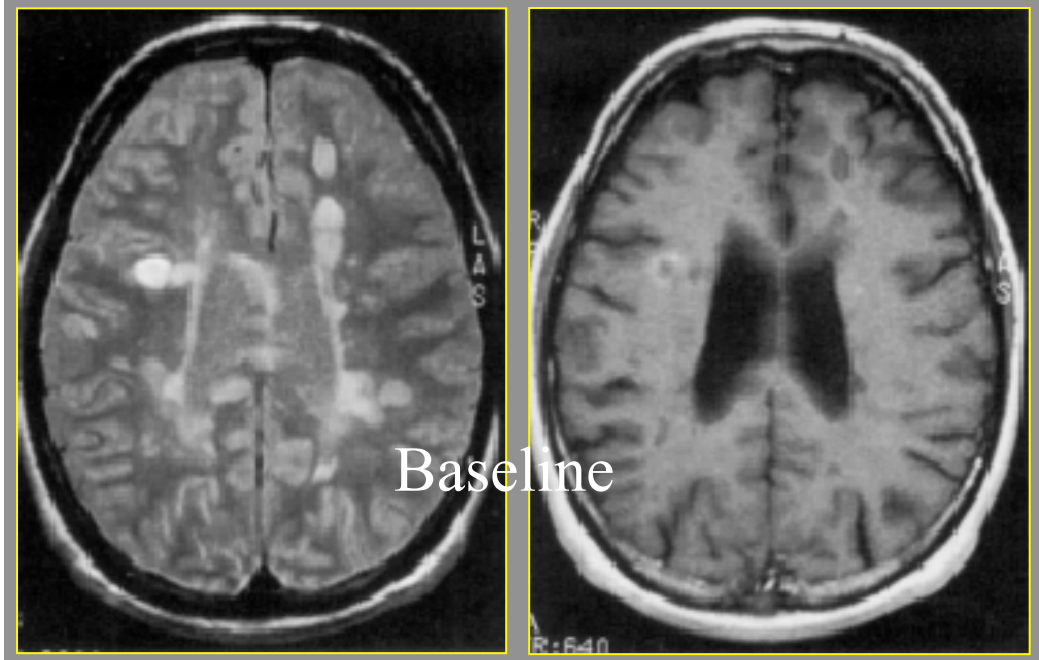
- 3 Localisation anatomique

- 4 Lésions d'âges différents, activité (diffusion, gadolinium)

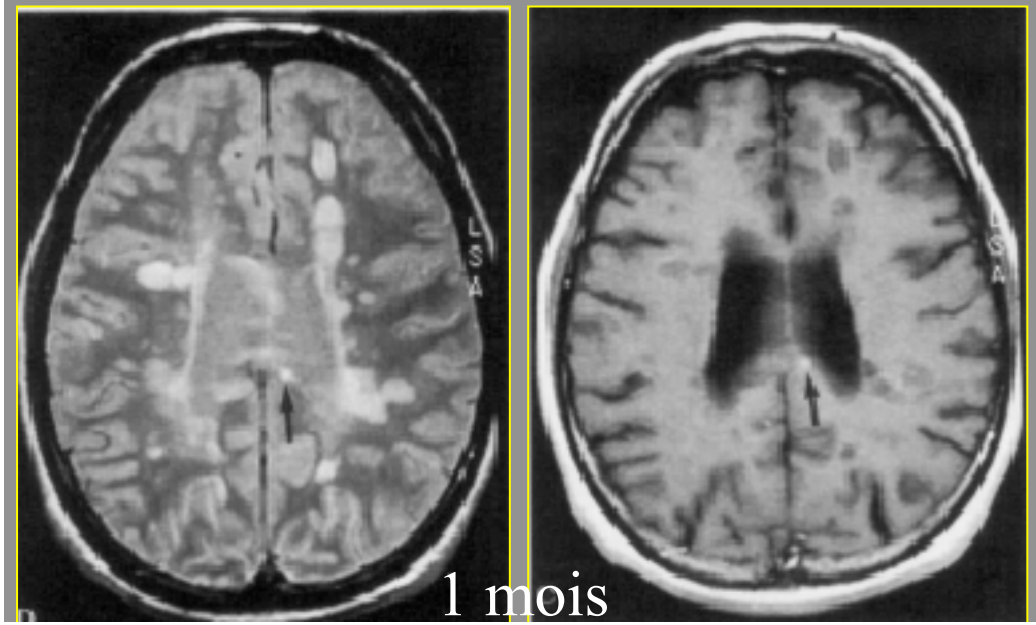
- 5 Lésions infra-IRM c

- 6 Atrophie

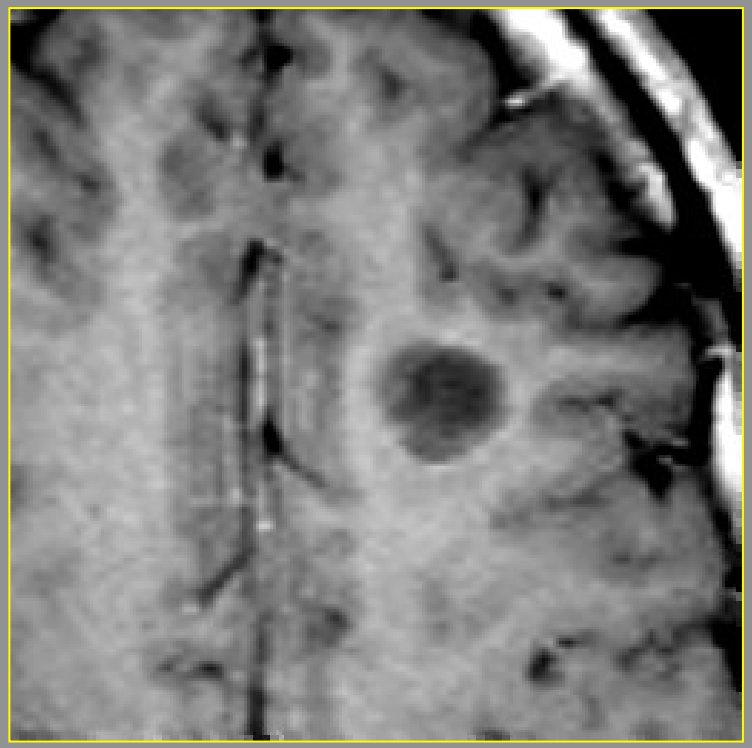
4- Ages différents: trous noir



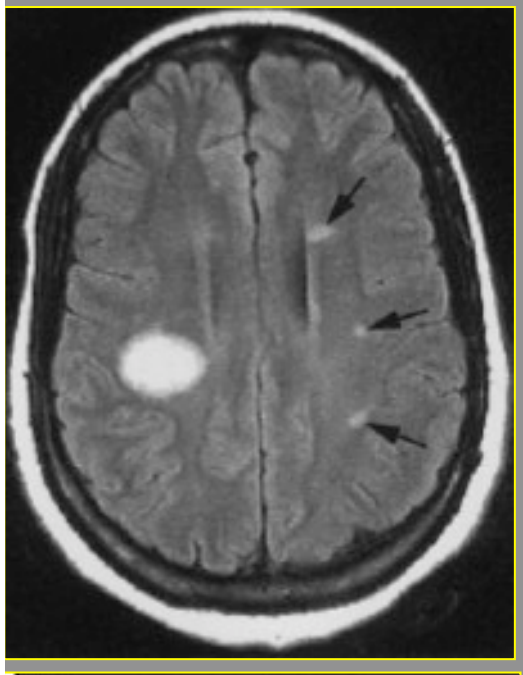
Baseline

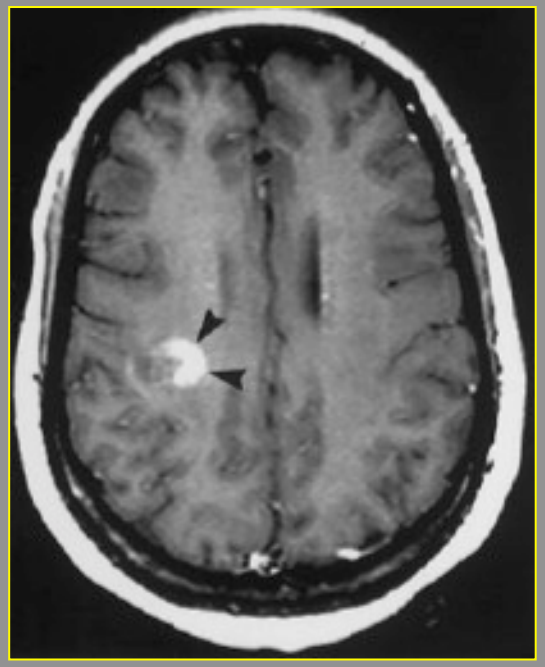


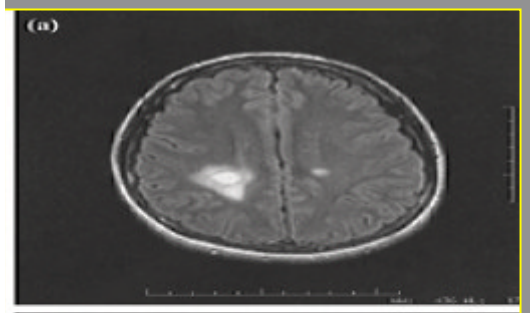
1 mois

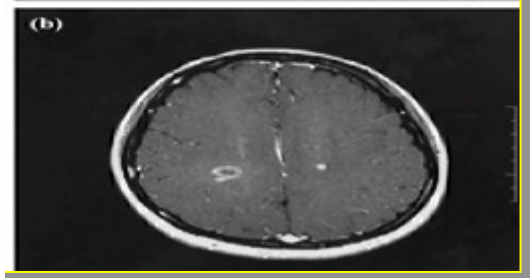


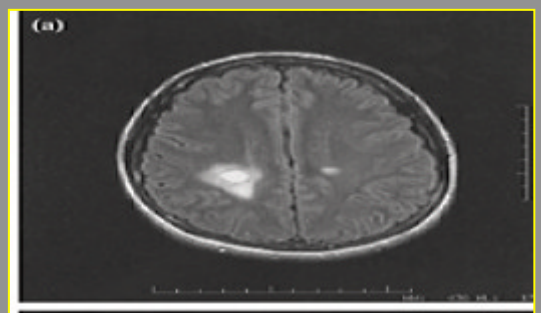
4- Ages différents: rupture de la BHE

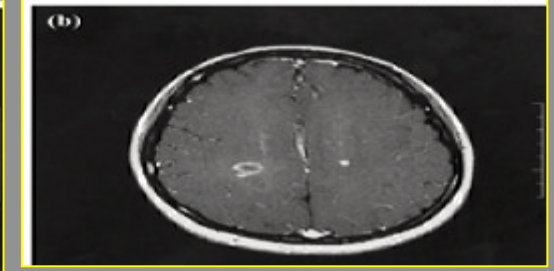


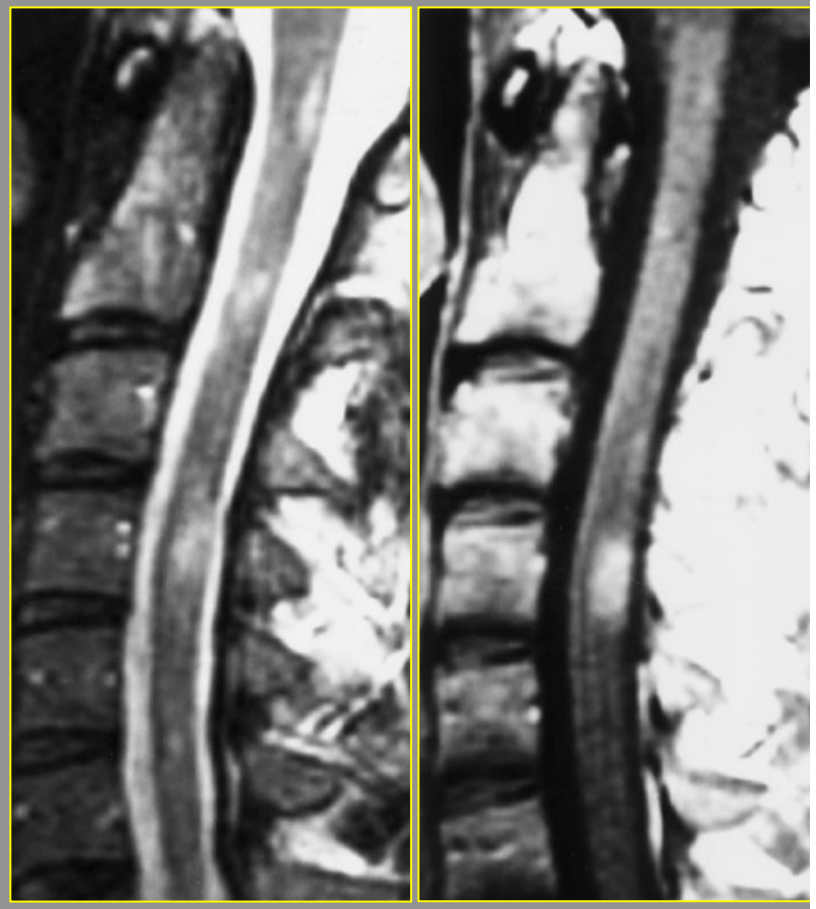


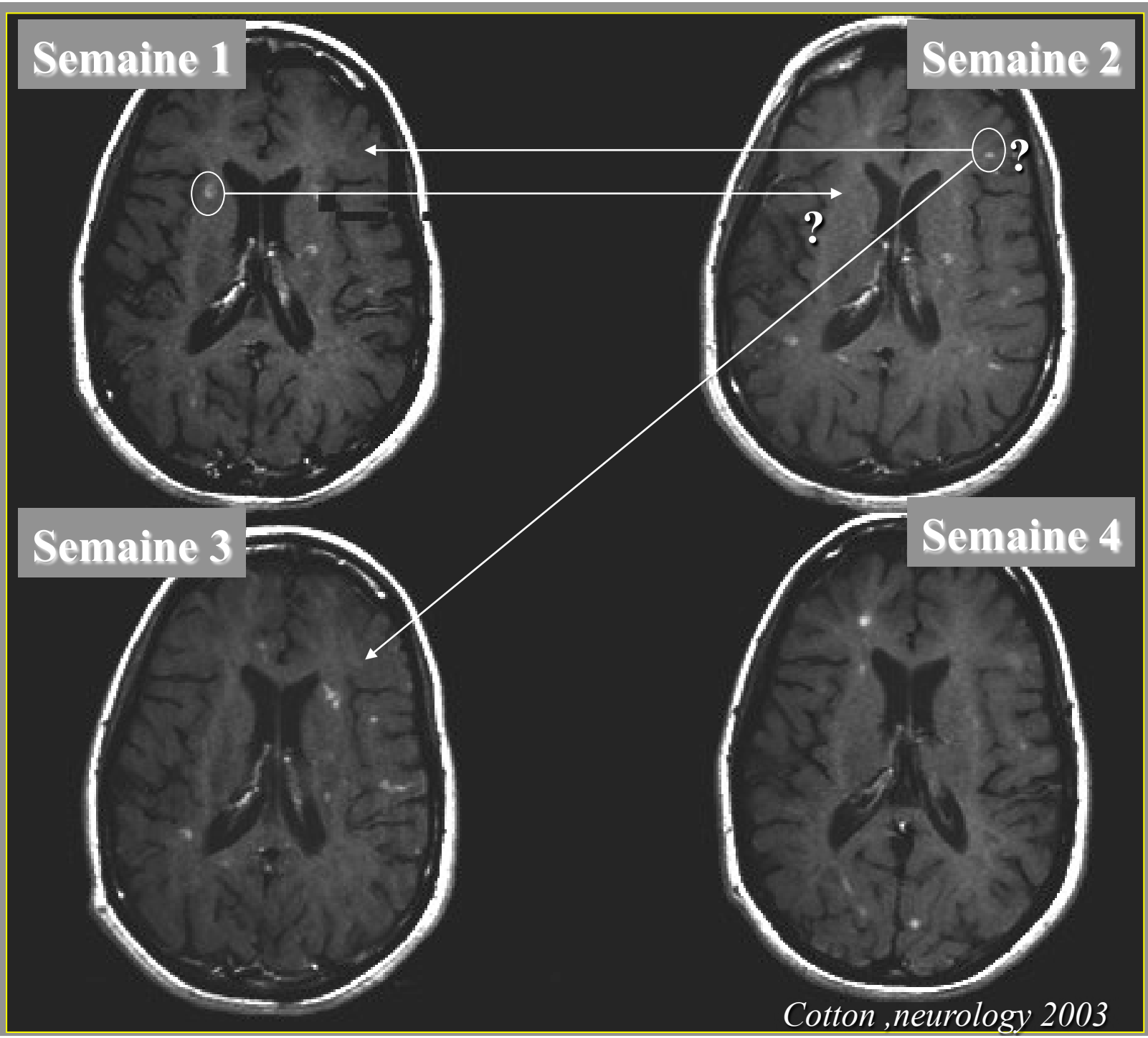




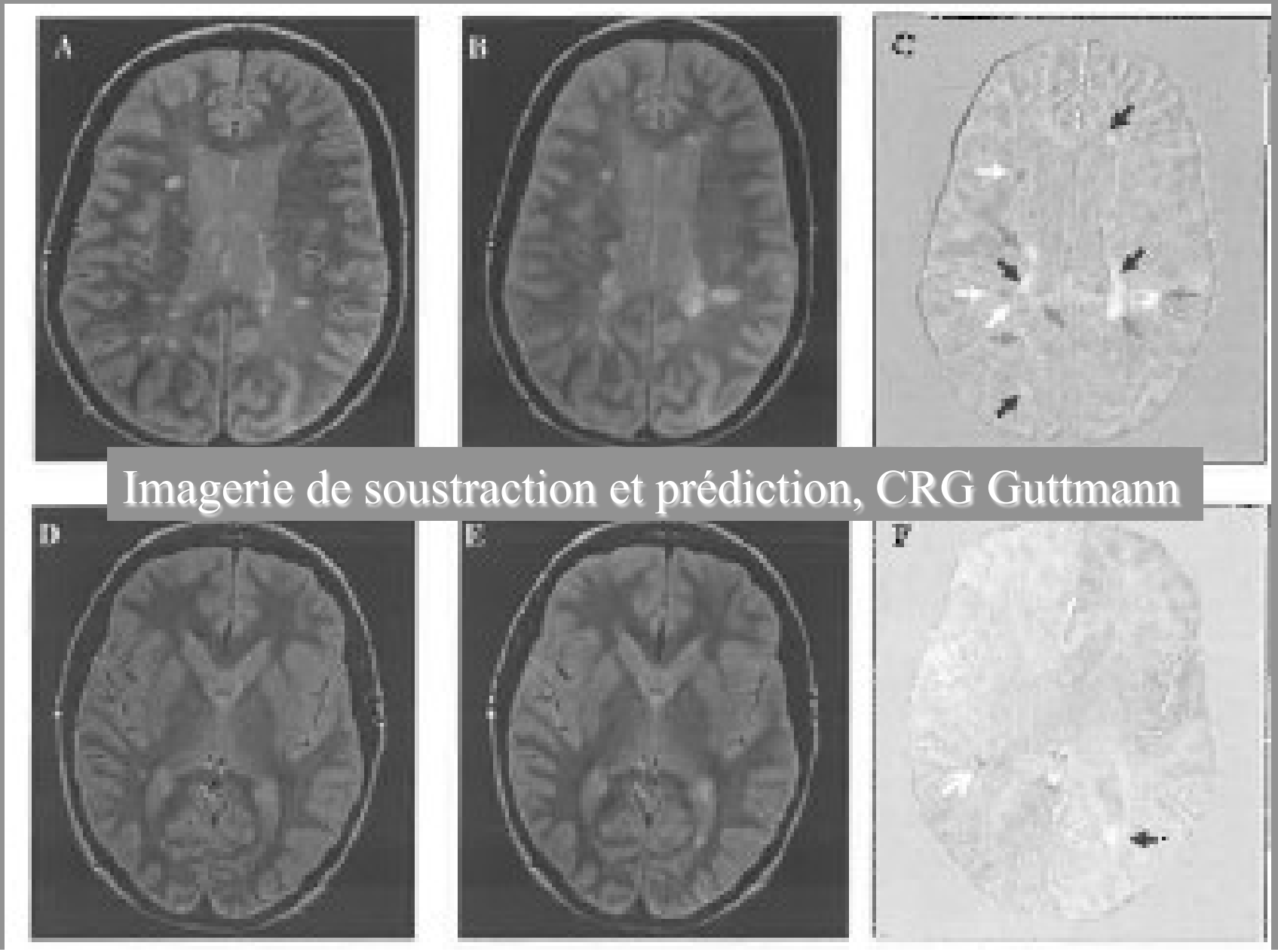






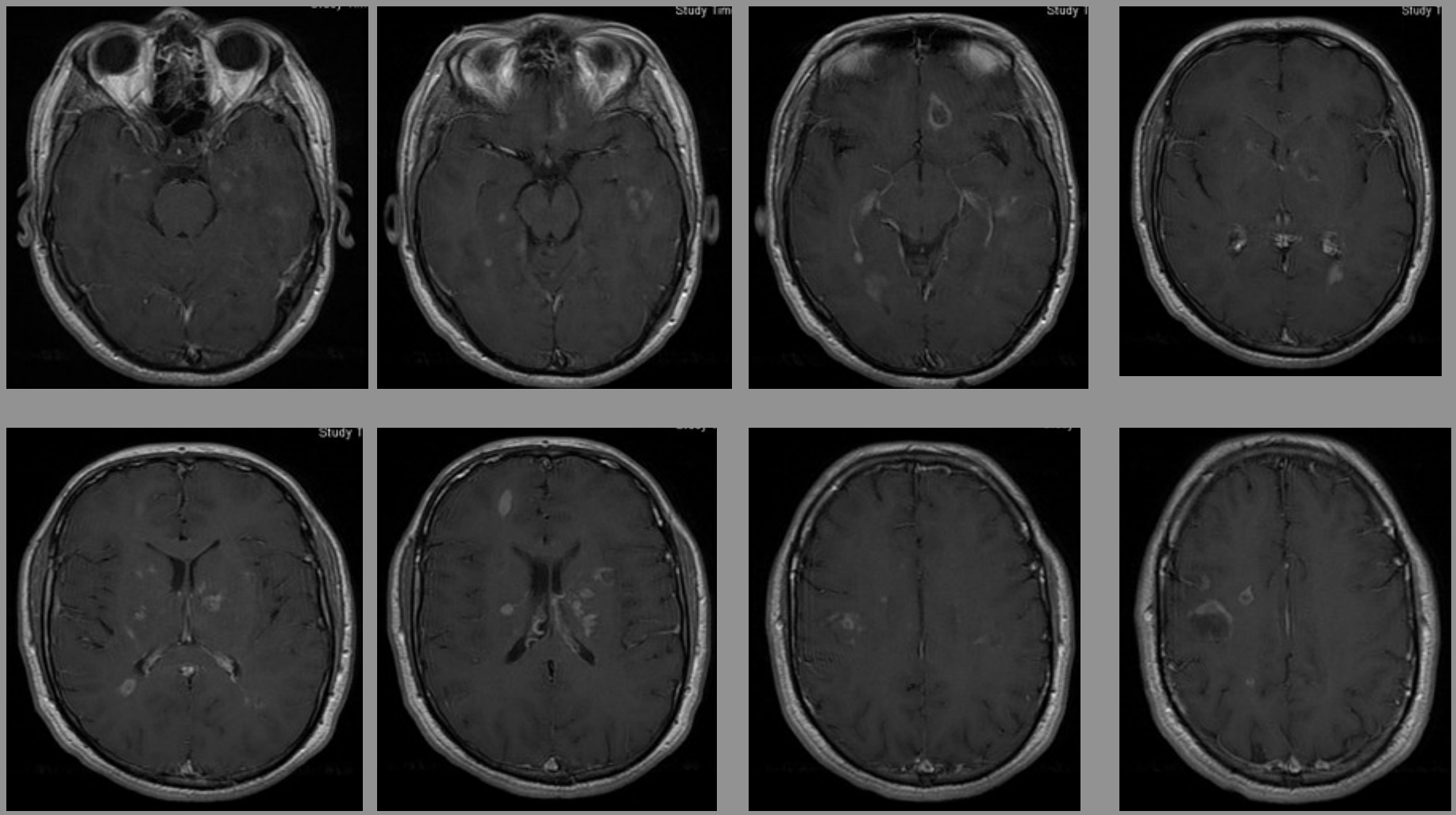

Semaine 1
Semaine 2
?
?
Semaine 3
Semaine 4
Cotton ,neurology 2003

Peut-on se passer du gadolinium ?



Imagerie de soustraction et prédiction, CRG Guttmann

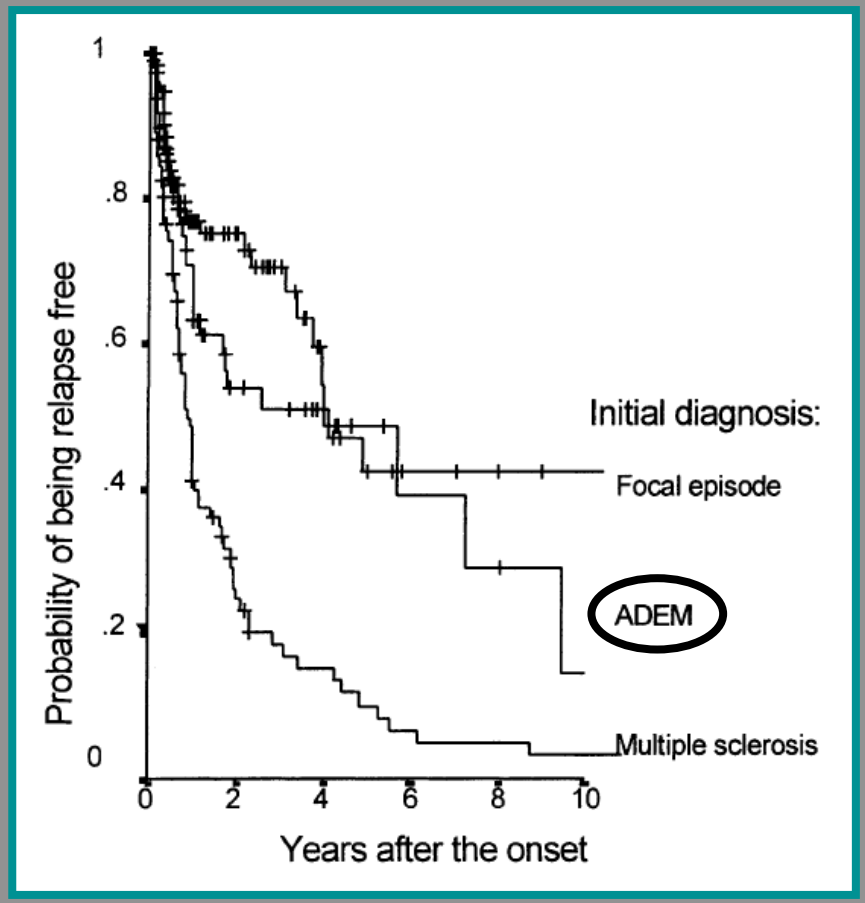
Lésions synchrones rehaussées: encéphalomyélite aigüe disséminée



ADEM ou SEP ?

Un Continuum plus qu'une hétérogénéité ?

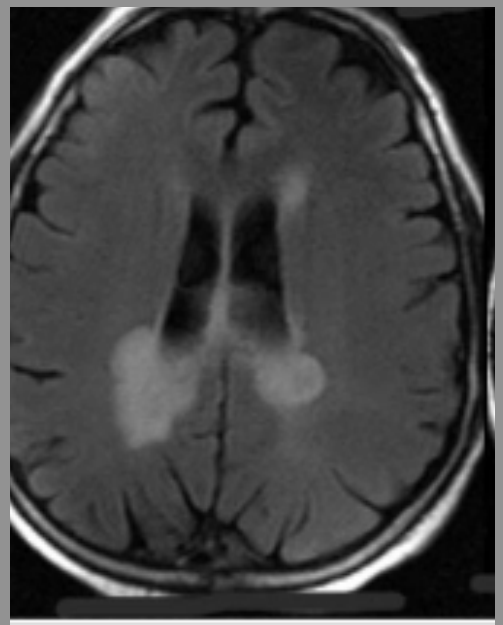
Mikaeloff et al. J Pediatr 2004; 144: 246-52.

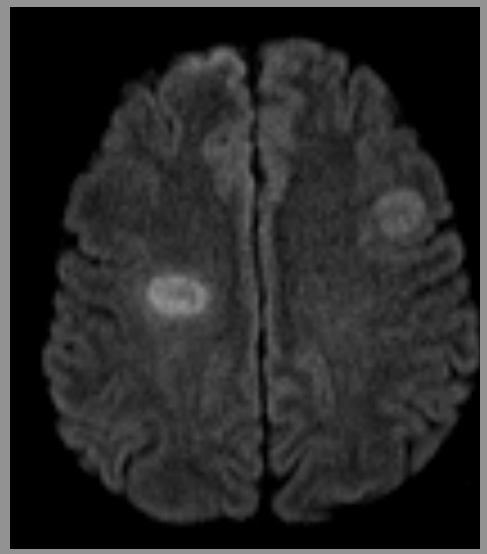


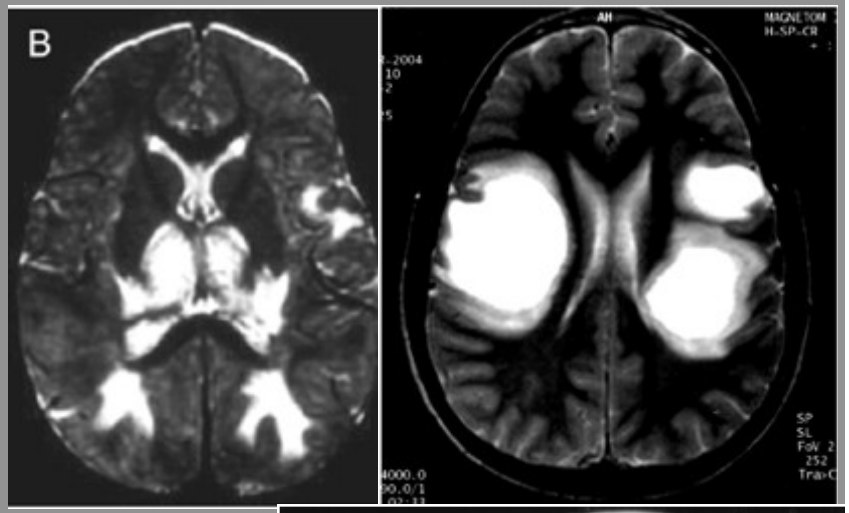
29 % convertis en SEP
après 1.9 ans de suivi (médiane)

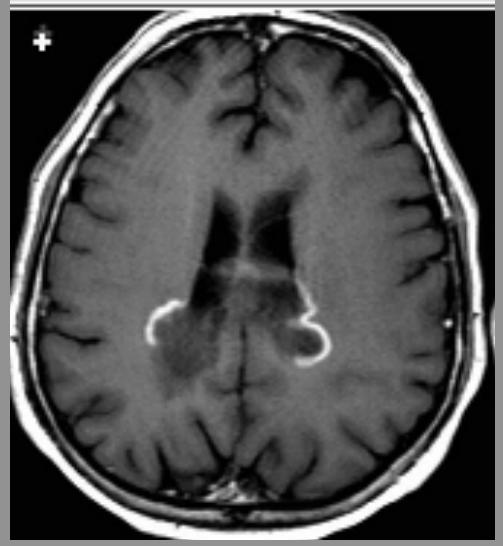
Homme, 63 ans, HLH G
depuis 10 jours

Atteinte des noyaux gris centraux ++
Formes pseudo-tumorales juxta-corticales

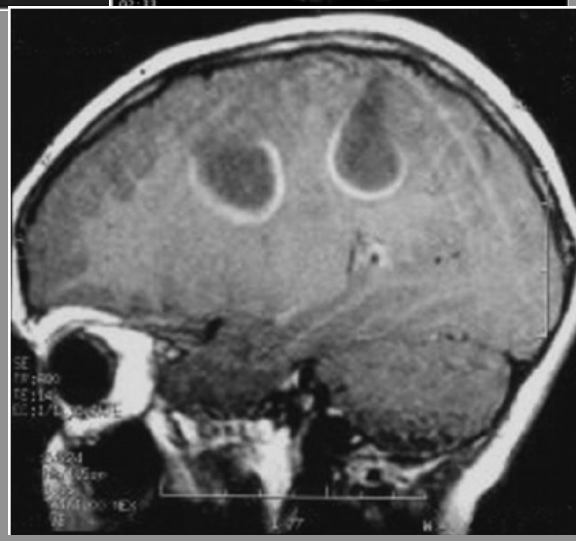






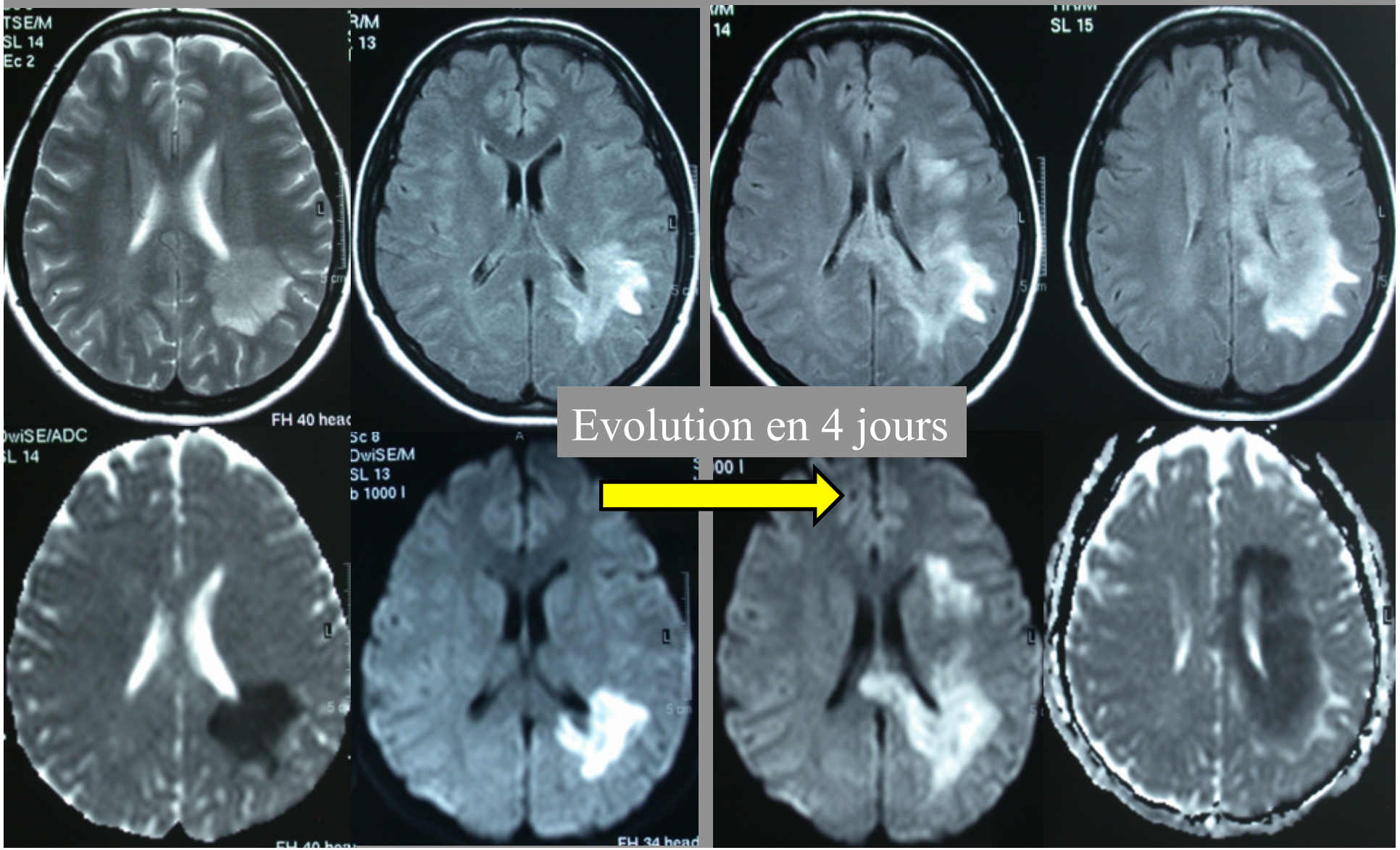


Lésions de type
inflammatoire, synchrones,
présentant un rehaussement
particulier arciforme ou
annulaire

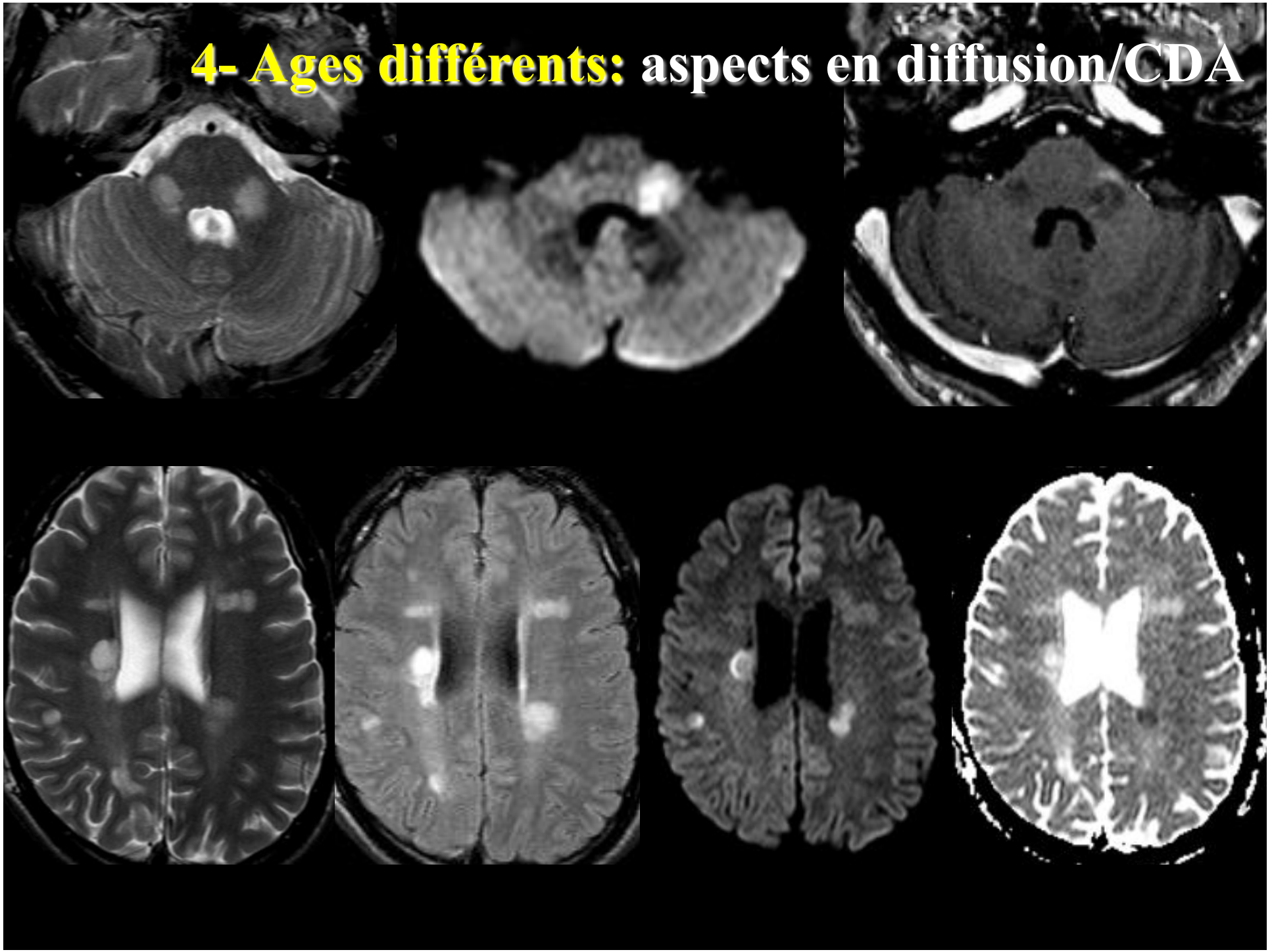


Tenembaum et al. Neurology 2007

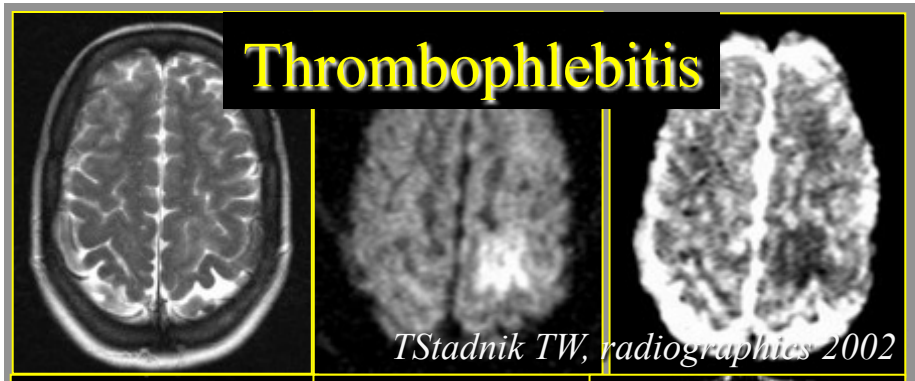
Lésions démyélinisantes pseudo-tumorales avec baisse du CDA…mais ce n'est pas une ischémie



4- Ages différents: aspects en diffusion/CDA

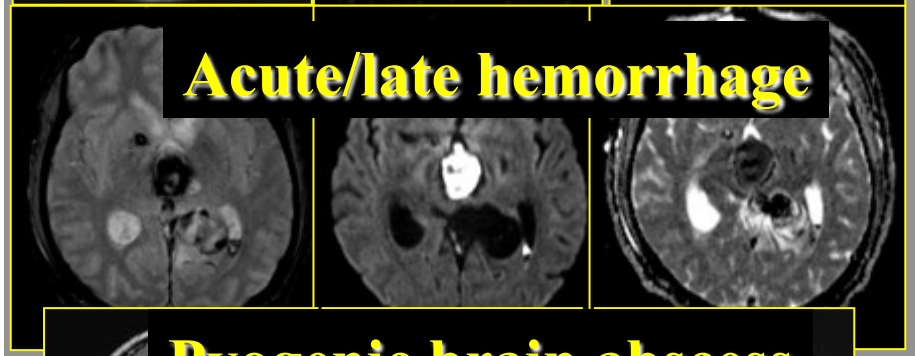


Thrombophlebitis

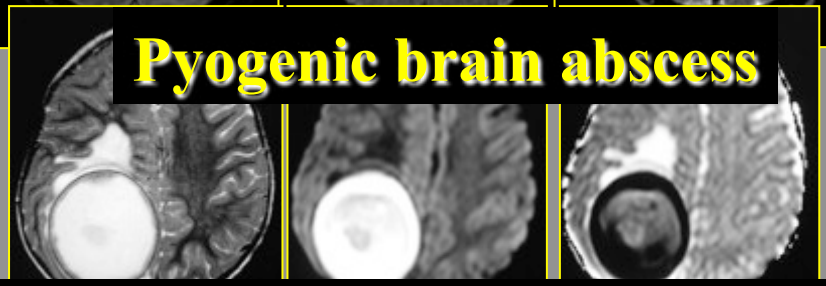


TStadnik TW, radiographics 2002

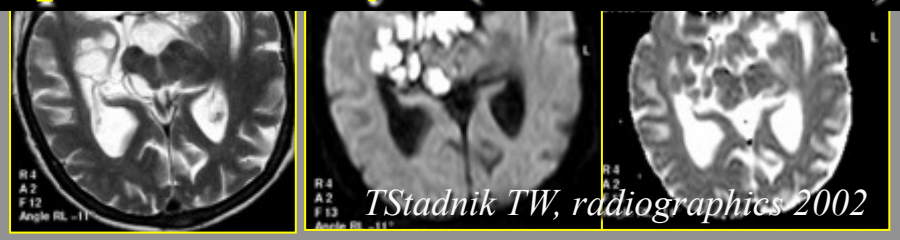
Acute/late hemorrhage



Pyogenic brain abscess

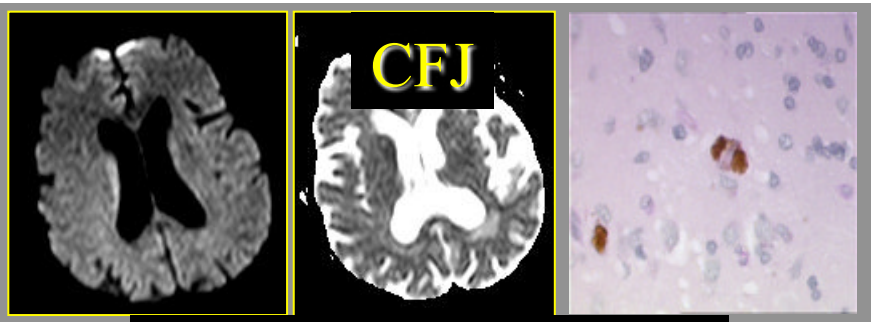


Epidermoid cyst (cellular tumor)

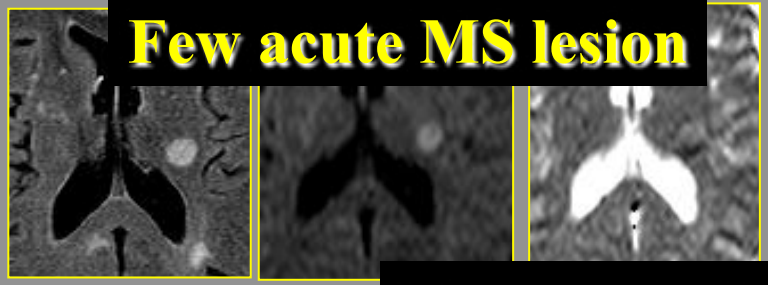


TStadnik TW, rradiographics 2002

CFJ

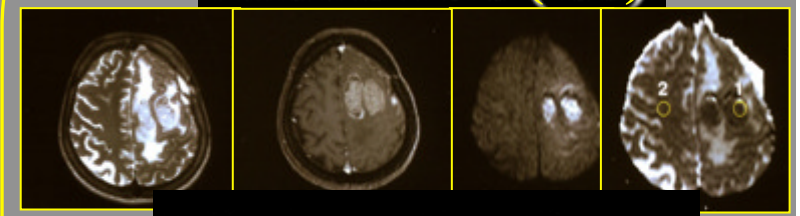


Few acute MS lesion

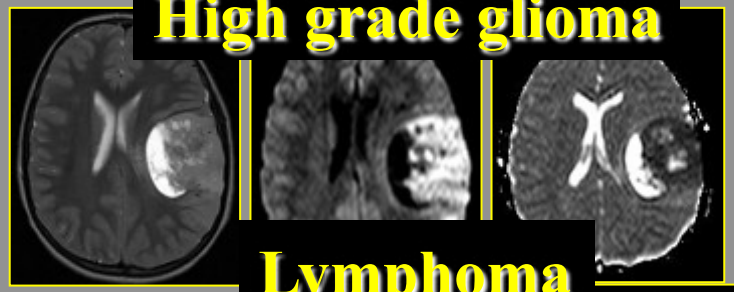


TUMORS

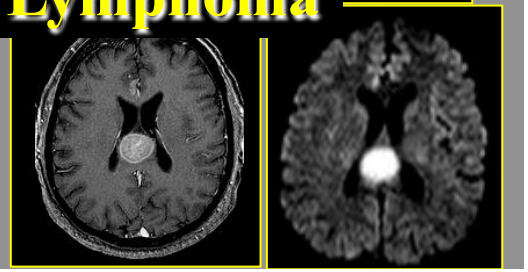
Metastasis (1/8)



High grade glioma

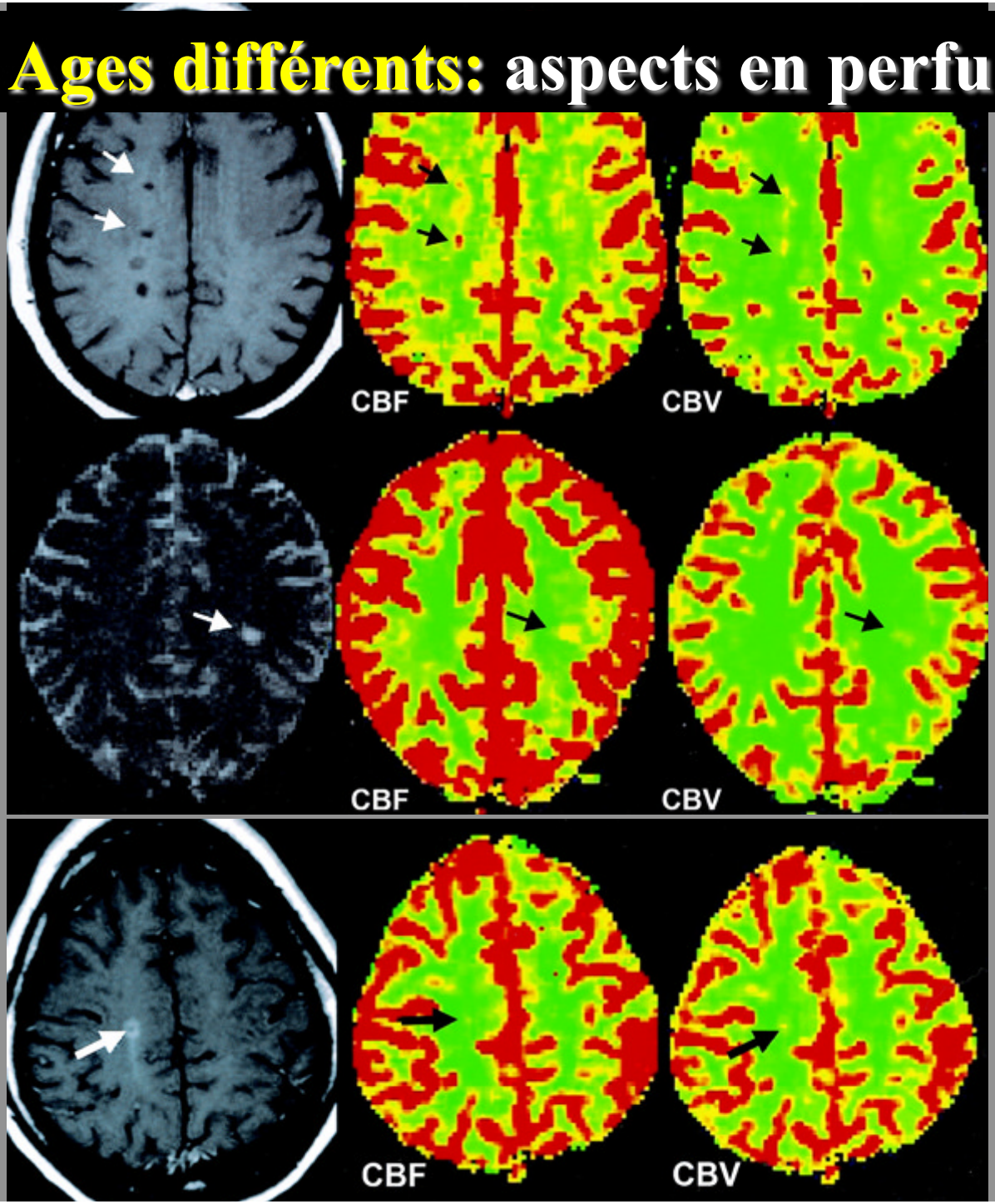


Lymphoma



every high signal on diffusion with decrease of ADC ≠ acute ischemic lesion

4- Ages différents: aspects en perfusion



Gey Y
AJNR 2005

Aspects évocateurs en IRM

- 1 Dissémination spatiale

- 2 Formes, contours

- 3 Localisation anatomique

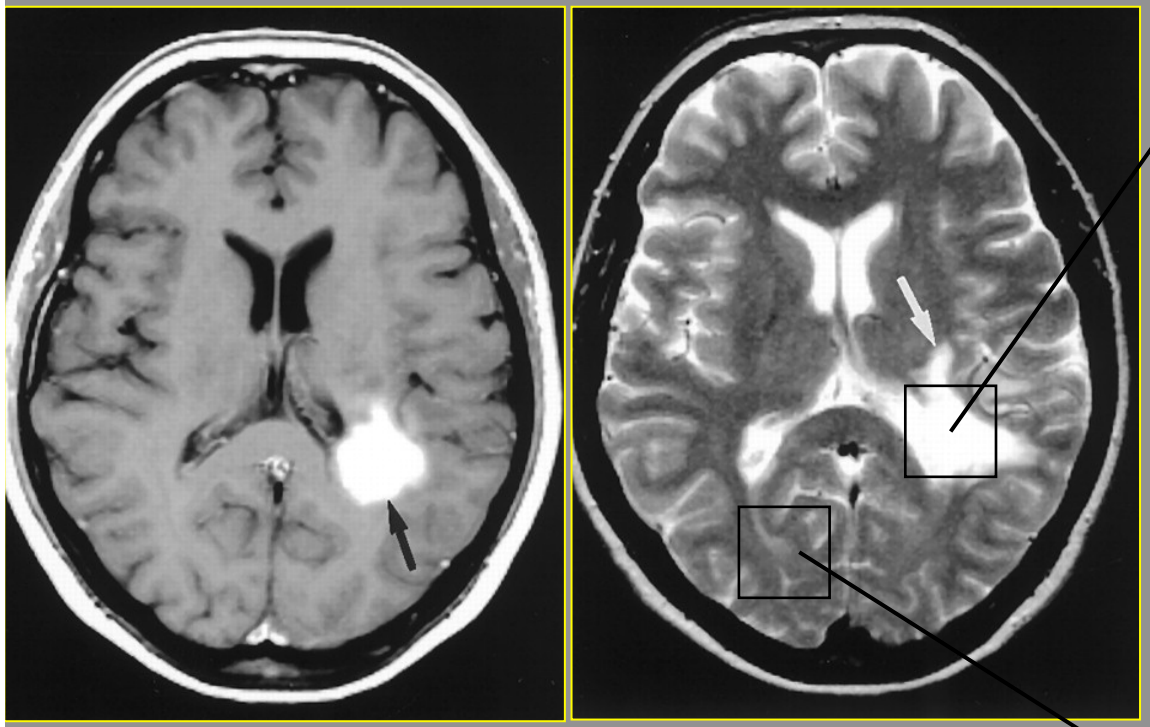
- 4 Lésions d'âges différents, activité (diffusion, gadolinium)

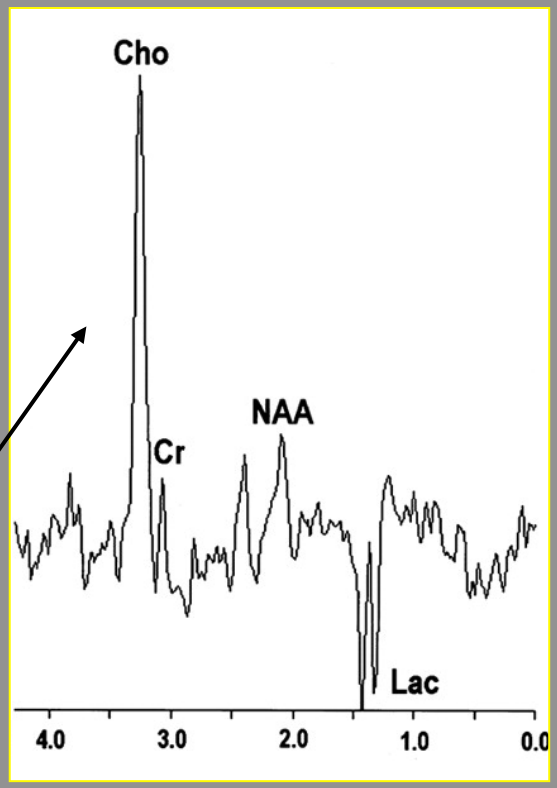
- 5 Lésions infra-IRM c

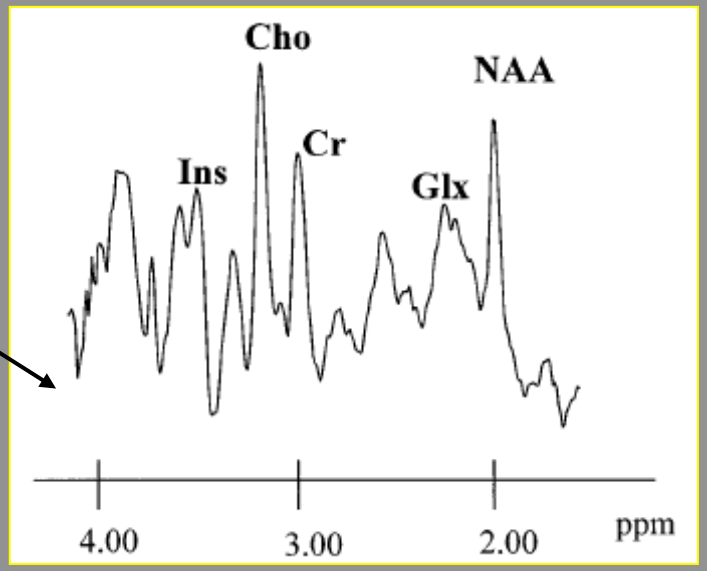
- 6 Atrophie

5- Lésions infra-IRMc:

Spectroscopie Proton

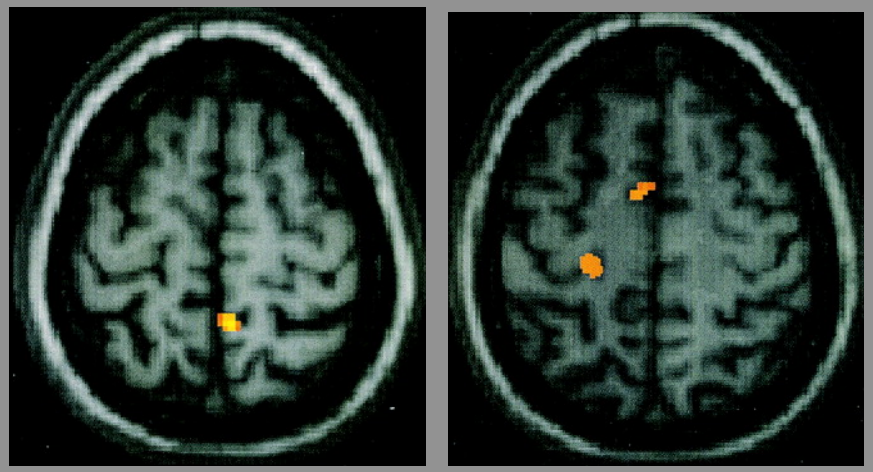






5- Lésions infra-IRMc: recrutement cortical

IRM f



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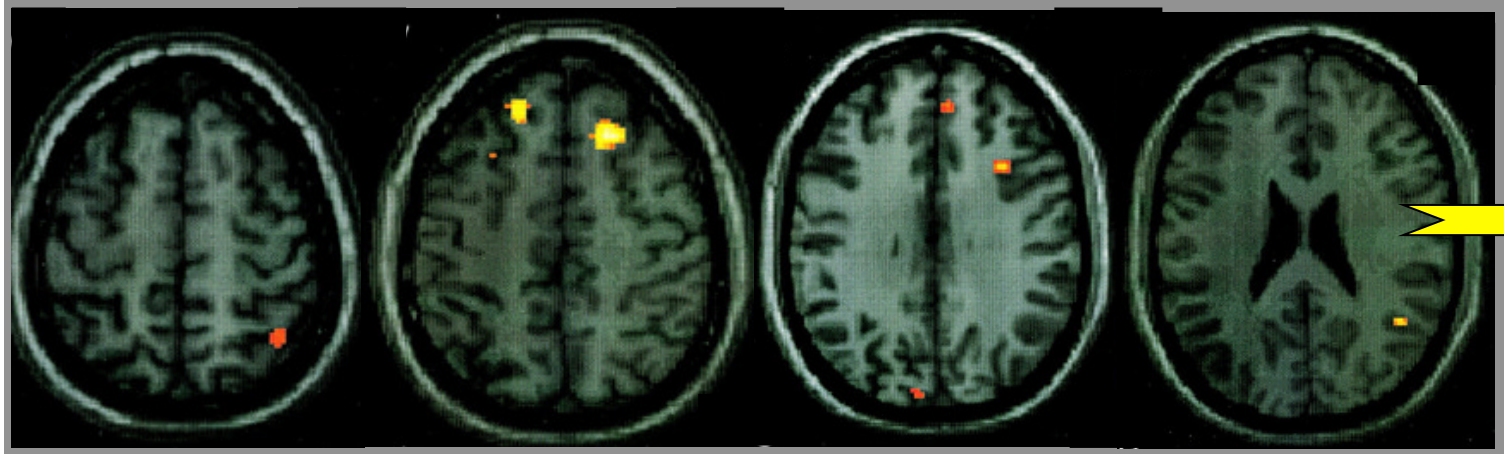


SEP

Aspects évocateurs en IRM

- 1 Dissémination spatiale

- 2 Formes, contours

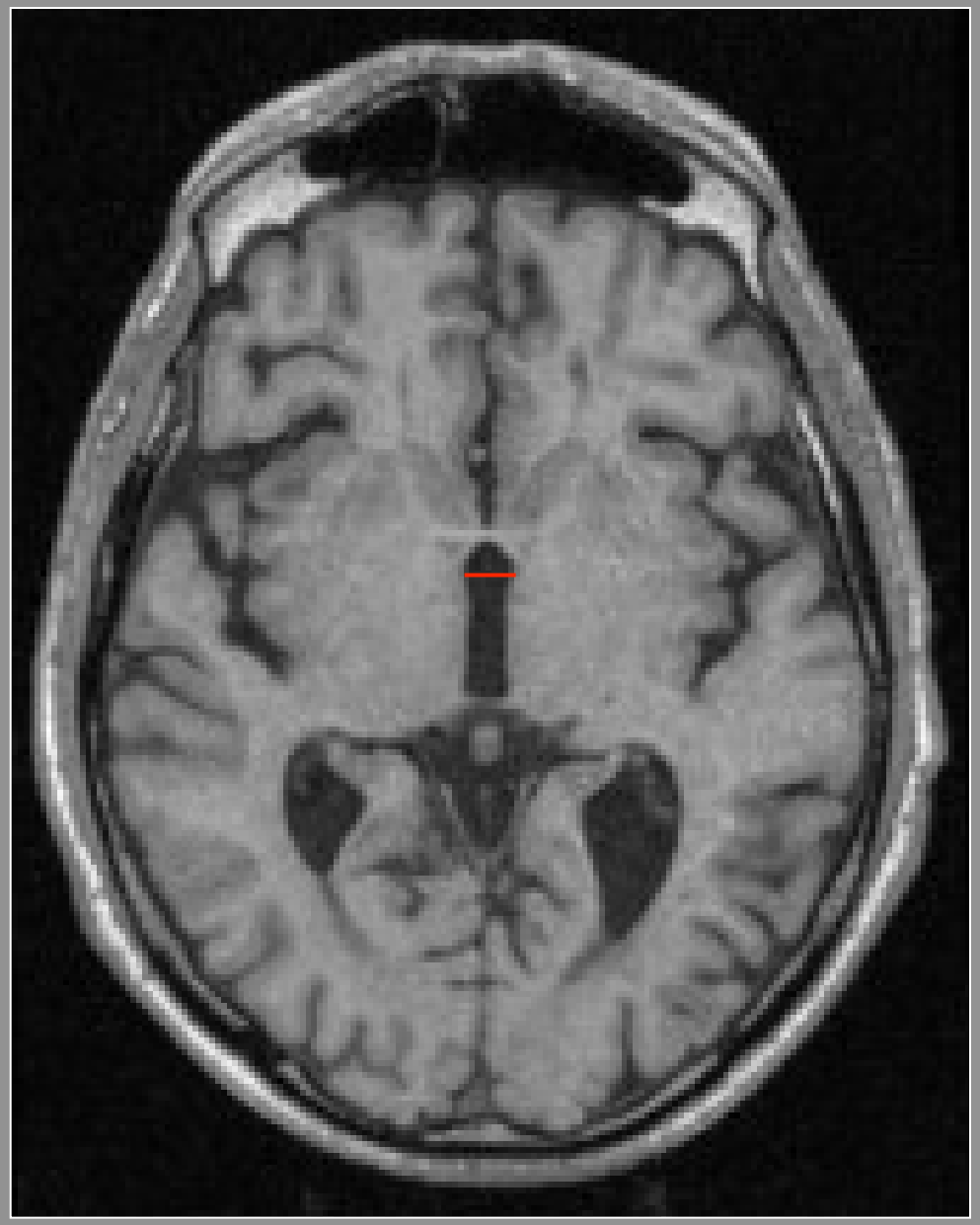
- 3 Localisation anatomique

- 4 Lésions d'âges différents, activité (diffusion, gadolinium)

- 5 Lésions infra-IRM c

- 6 Atrophie

Composante neuro-dégénérative de la SEP

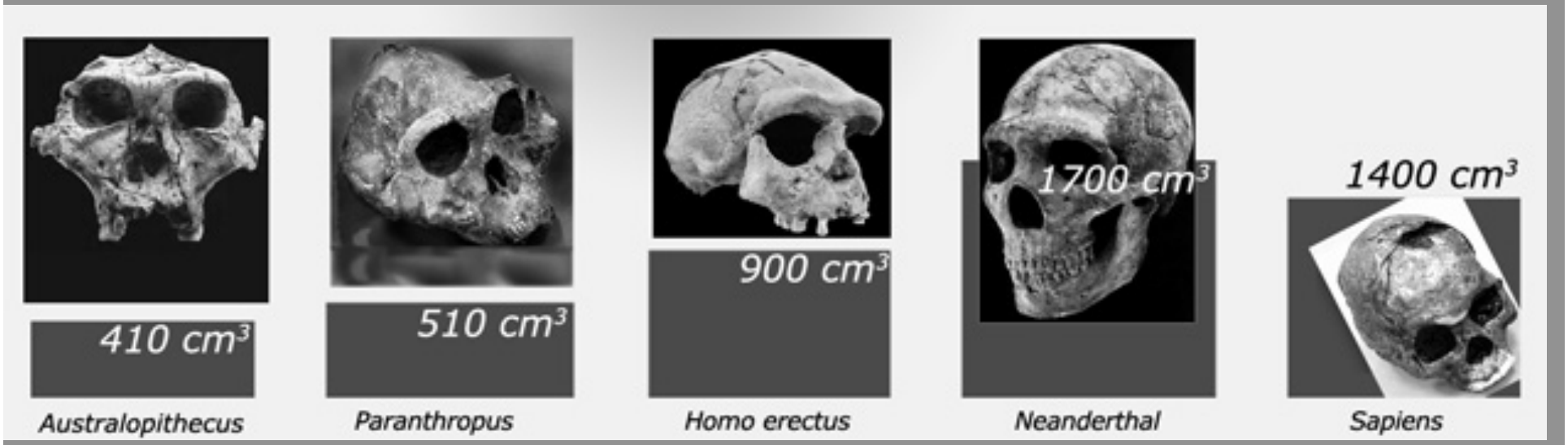


Normal ou pathologique

?

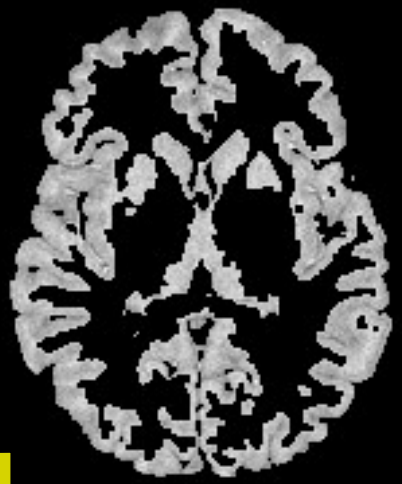
Femme de 29 ans

Évolution de la voûte crânienne chez les hominidès



Substance Grise

Substance Blanche

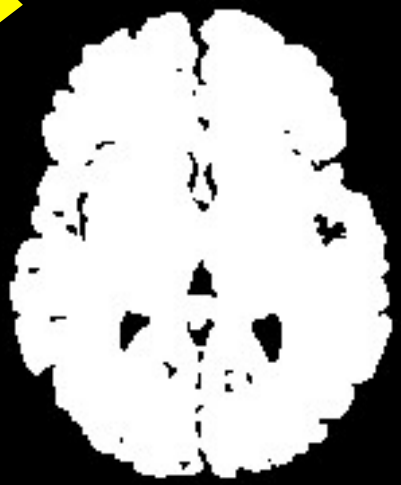


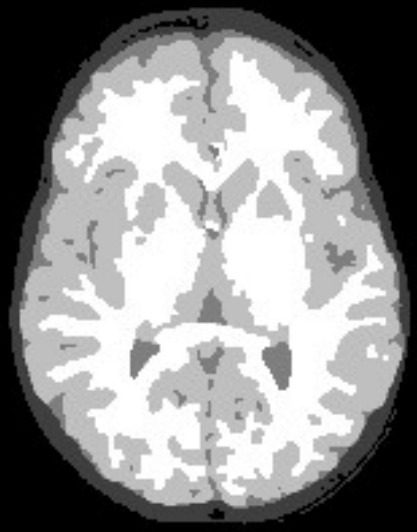
Post-traitement

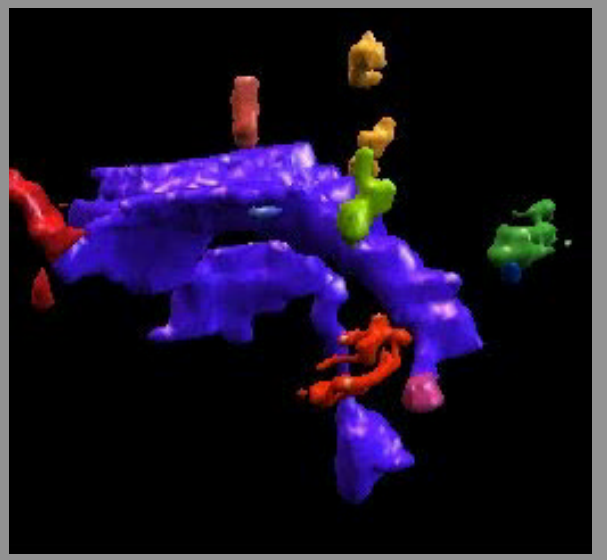
Mesure du BPF (Brain Parenchymal Fraction) pour quantifier et normaliser l'atrophie

Parenchyme

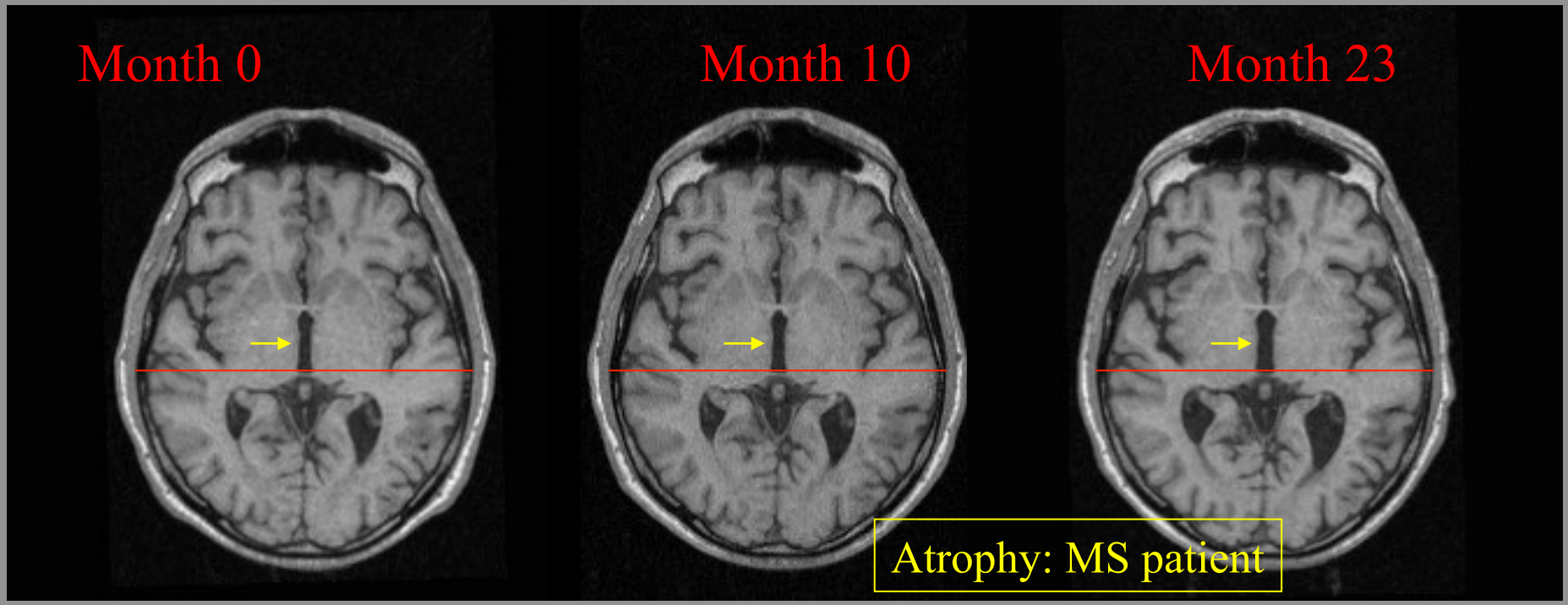
Parenchyme + voûte







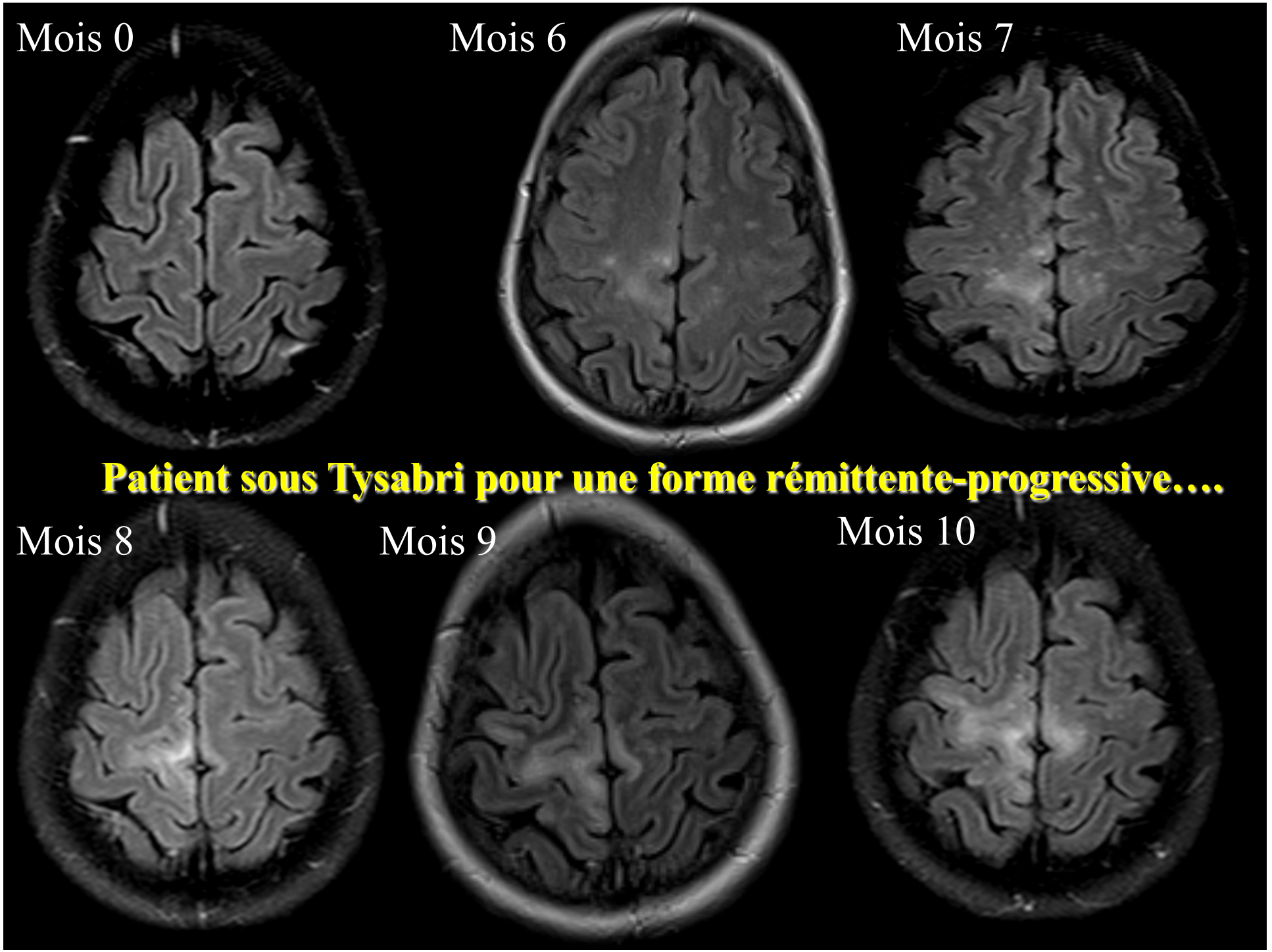
Temporal evolution: parenchyma/ bone structures



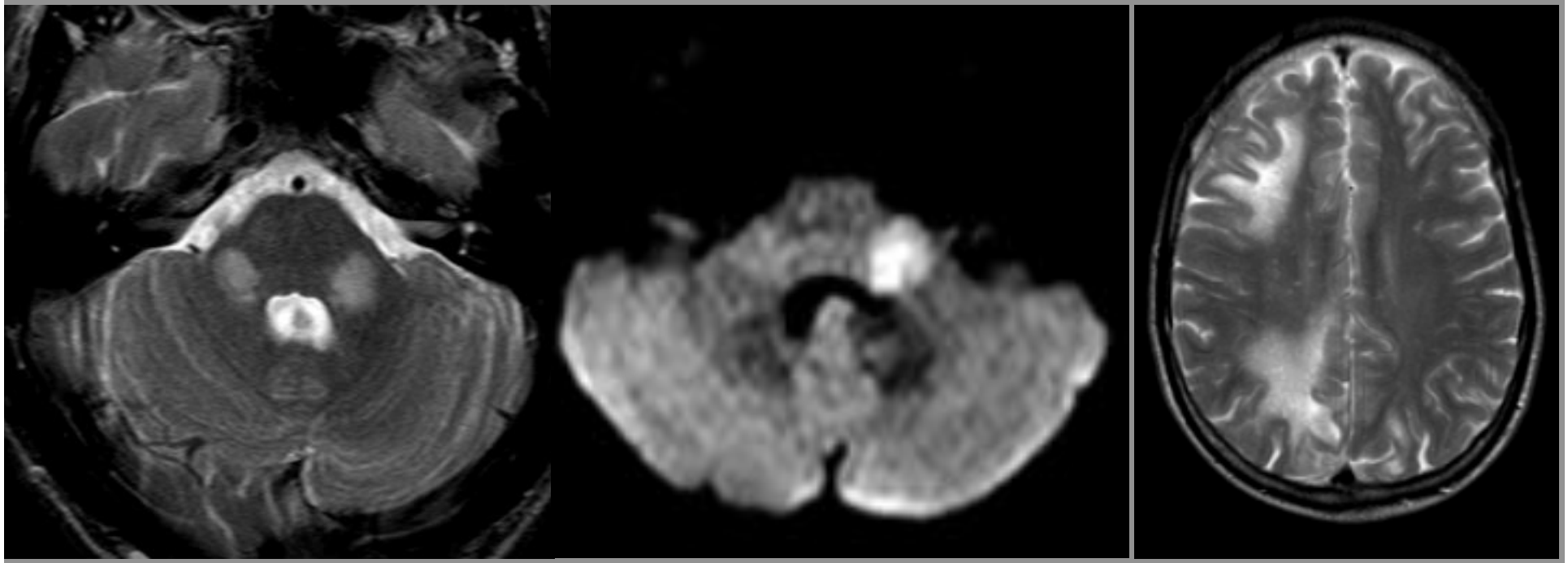
Surface of CA-CP(mm^2) plane	14836	14365	14123

Variability 0-10 months - 3.22 %

Variability 0-23 months - 4.92%


Mois 0
Mois 6
Mois 7
Patient sous Tysabri pour une forme rémittente-progressive….
Mois 8
Mois 9
Mois 10

Je vous remercie



Mars 2012, SFR-RA, Vienne

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CREATIS