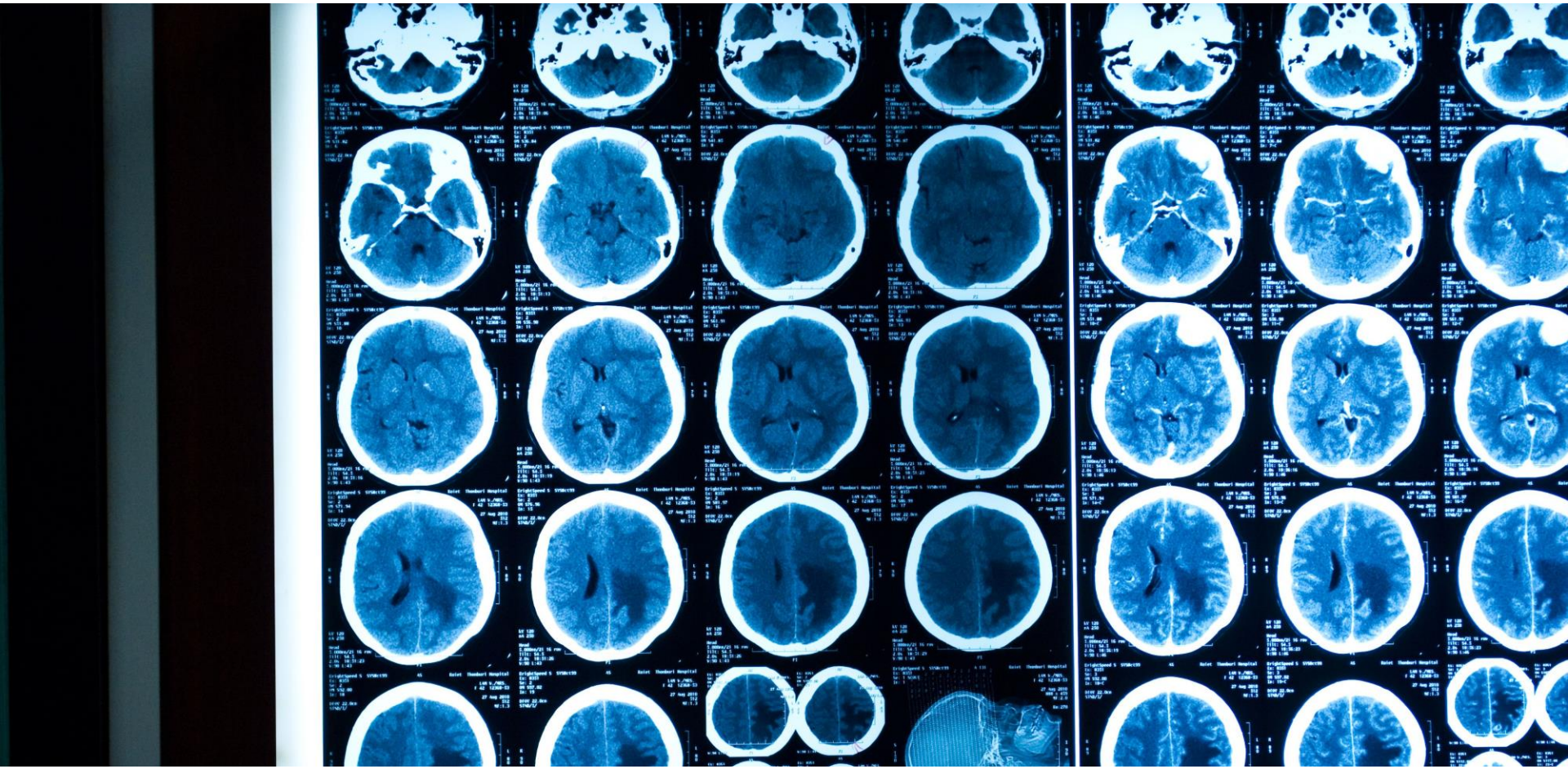
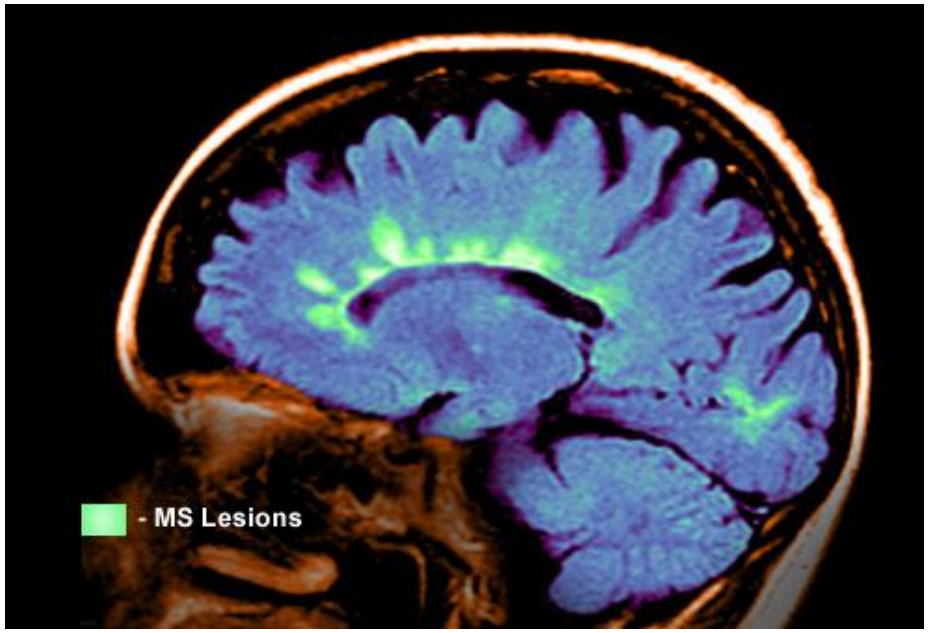
Imaging in Multiple Sclerosis



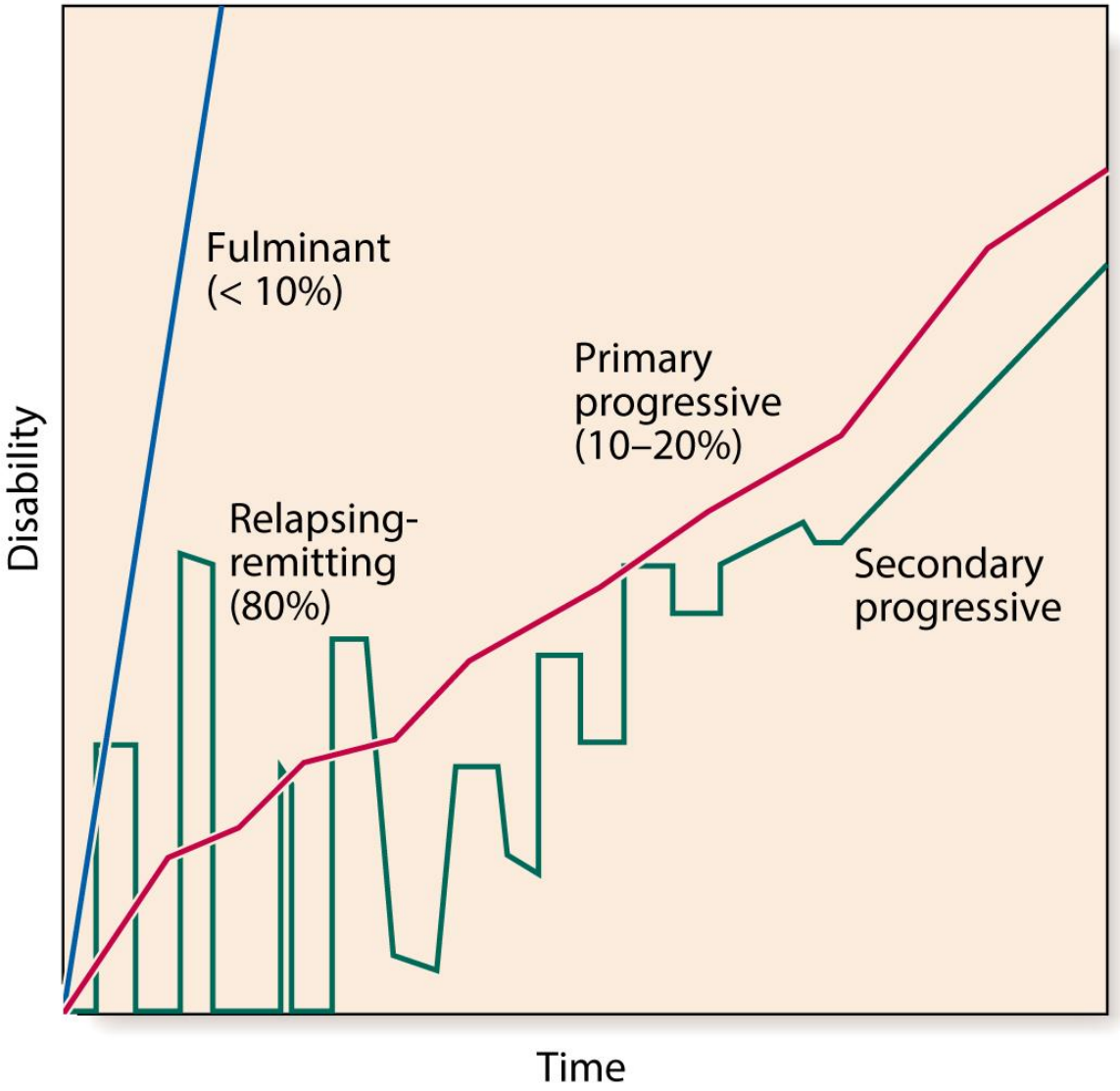
Amiel Dror | Neurology clerkship| Tel Aviv University

Imaging of Multiple Sclerosis

- Scars from areas of demyelinated nerves
  - Sclerotic lesions throughout nervous system
  - Called MS plaques
- MRI is modality of choice
  - MRI demonstrates areas of recent and old demyelination.
  - The MRI lesions may not, however correlate with clinical symptoms.



The progression of disability in multiple sclerosis.



The Macdonald criteria for the diagnosis of MS

26.67 The Macdonald criteria for the diagnosis of multiple sclerosis[1]

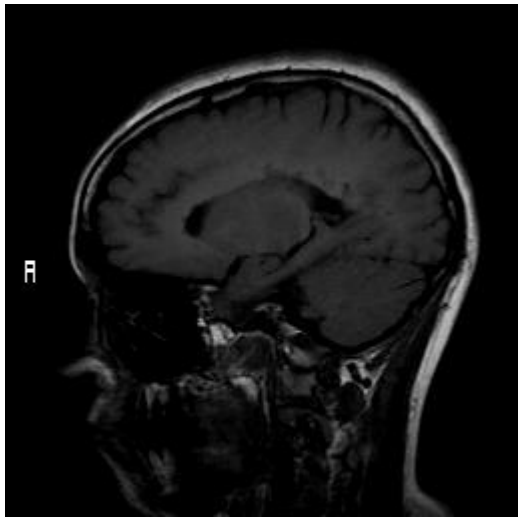
Clinical presentation[2]	Additional evidence required for diagnosis of MS
Two or more attacks separated in 'time' (at least 3 months apart) and 'space' (involving different parts of the CNS) with objective clinical evidence of two or more lesions	None
Two or more attacks separated in 'time' and 'space', but with objective clinical evidence for only one lesion	Dissemination in 'space' demonstrated by MRI (multiple lesions in several different sites) *or* Two or more MRI-detected lesions consistent with MS *and* oligoclonal bands in CSF *or* Await further clinical attack at different anatomical site
One attack with objective clinical evidence of two or more lesions in different parts of the CNS (dissemination in 'space')	Dissemination in 'time' demonstrated by serial MRI scans (looking for a new lesion developing at least 3 months after the initial presentation) *or* Await further (second) clinical attack at different anatomical site
One attack with clinical evidence of only one lesion (clinically isolated syndrome)	MRI demonstration of dissemination in 'space' and 'time' (as above) *or* Two or more MRI-detected lesions with CSF showing oligoclonal bands *and* dissemination in 'time', demonstrated by MRI *or* Await further (second) clinical attack at different anatomical site
Insidious neurological progression suggestive of MS	CSF positive for oligoclonal bands *and* Dissemination in 'space' and 'time' on MRI and/or abnormal VER[3] *or* Continued progression for a year

The Macdonald criteria imaging principle

- An inflammatory demyelinating disease of the CNS where there is:
  - **Dissemination in space (DIS)**
  - **Dissemination in time (DIT)**
  - No alternative neurologic disease
- MS is a clinical diagnosis

Typical location of MS Plaques

- Periventricular
- Juxtacortical
- Infratentorial
- Spinal Cord



Distribution of white matter lesions

	Vascular	MS
Corpus callosum	- uncommon	- common
U-fibers	- uncommon	- common
Cortical lesions	- infarction	- sometimes
Basal nuclei	- typical	- uncommon
Infra tentorial	- uncommon	- typical
Temporal lobe	- uncommon	- early involvement
Periventricular	- uncommon	- typical
Spinal cord	- uncommon	- typical
Gd-enhancement	- no	- yes
Dawson fingers	- no	- typical
Distribution	- asymmetric	- symmetric/diffuse

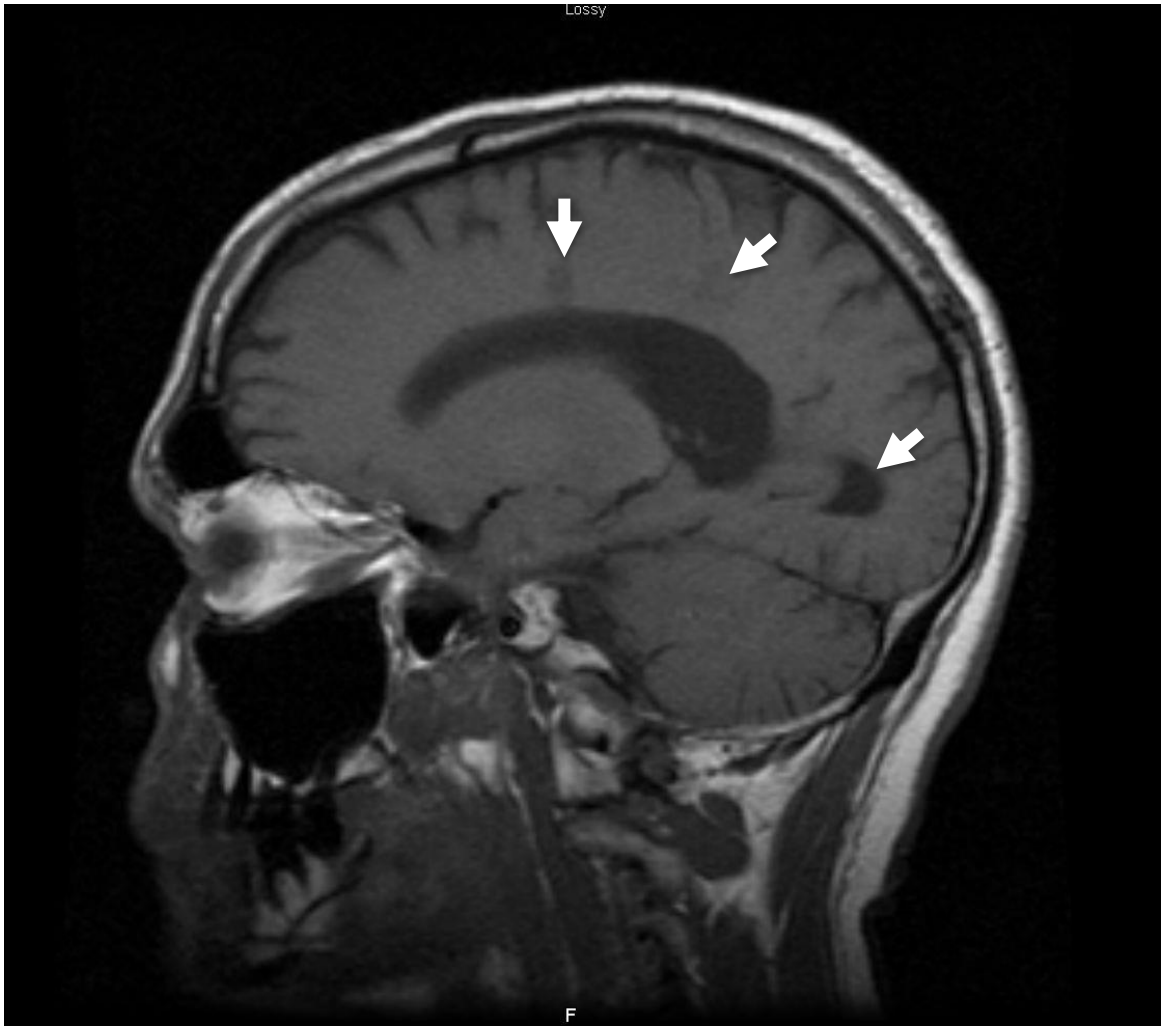
Typical appearance of MS on MRI

T1-weighted image

CSF is…

Dark

On T1, demyelinated areas are isointense or hypointense.



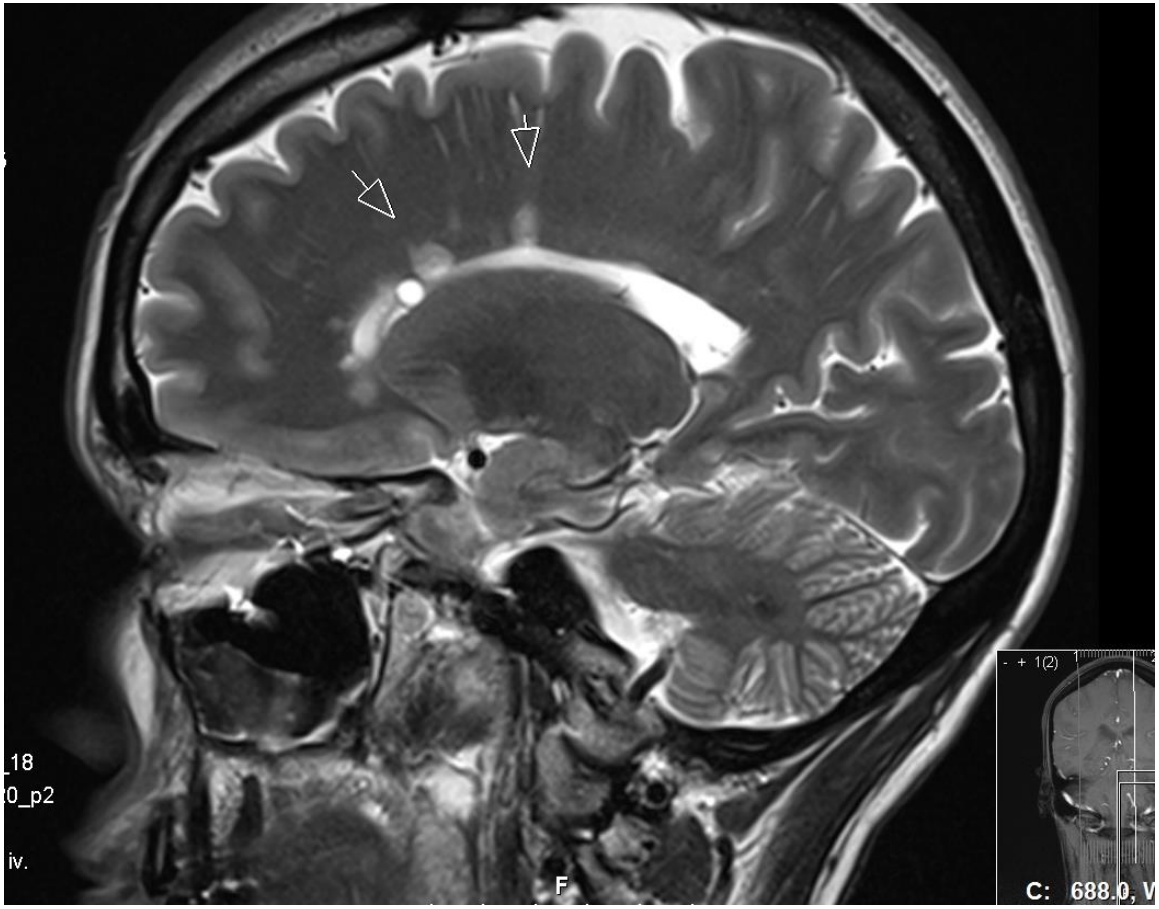
Typical appearance of MS on MRI

T2 weighted images

CSF is…

Bright

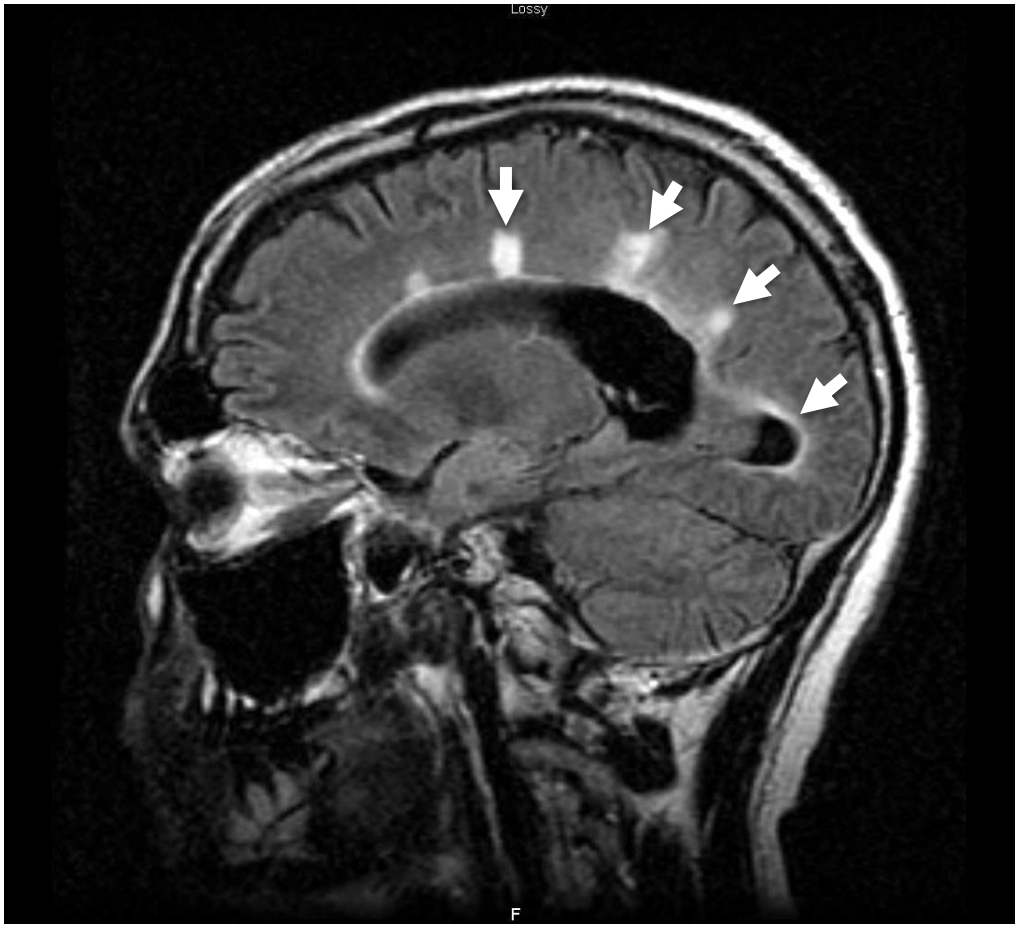
On T2, demyelinated demyelinated areas are bright



Fluid-attenuation inversion recovery (FLAIR) MRI

Shows lesions the same way T2 does, but CSF is dark.

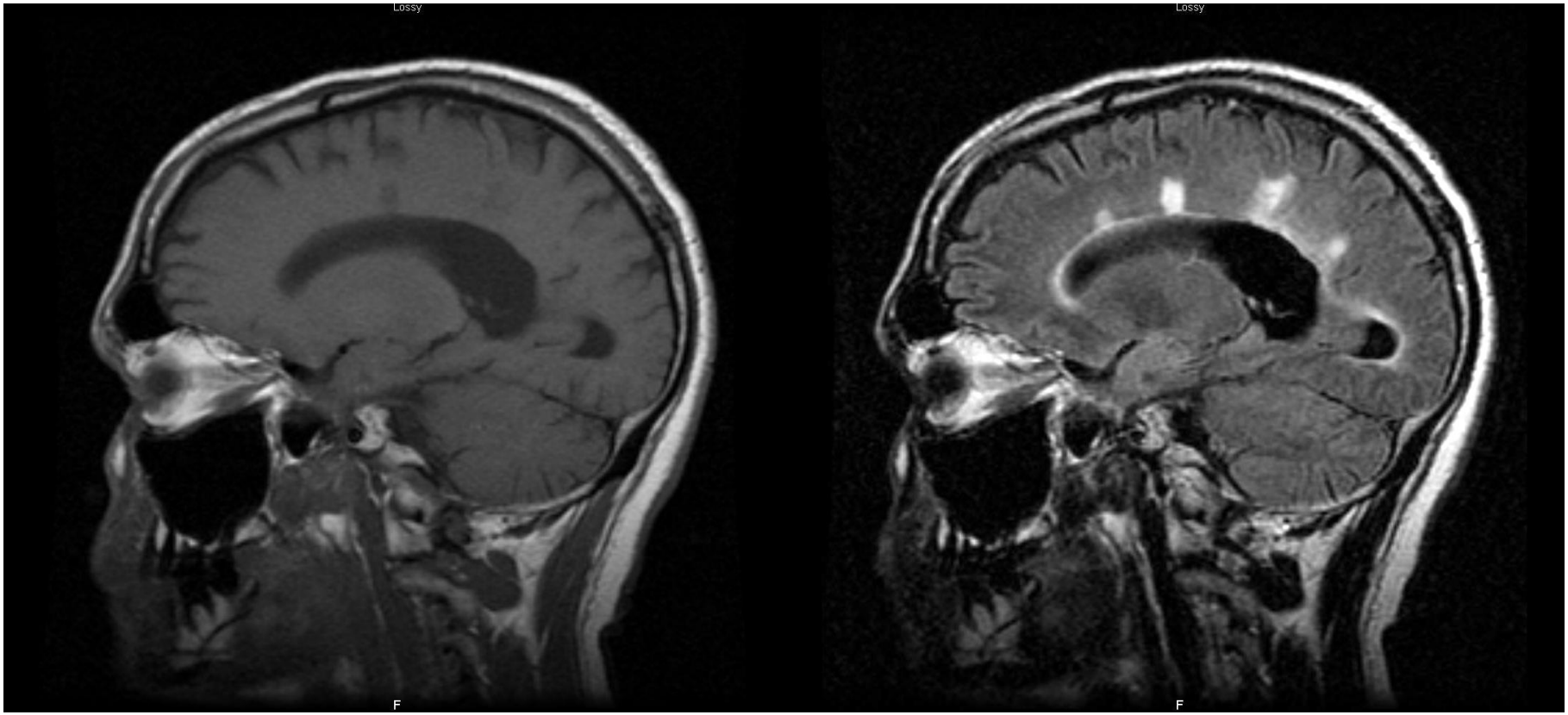
So… easier to see abnormal areas.



Dissemination in Space (DIS)

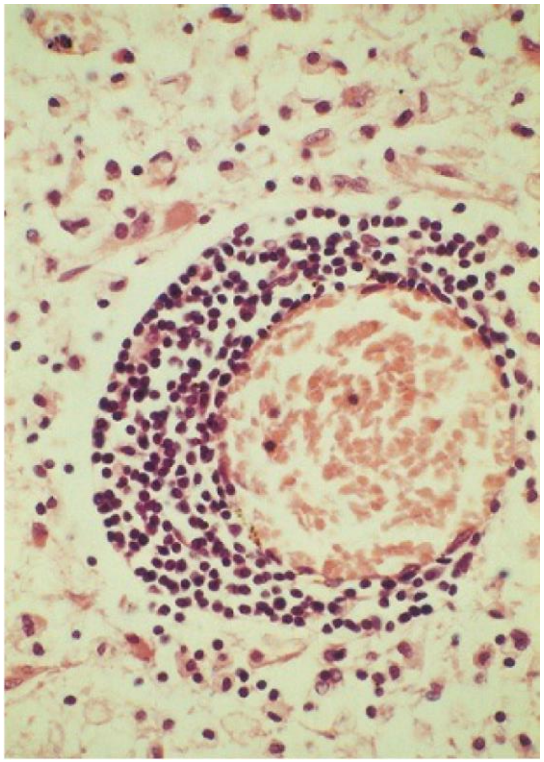
MRI: T1 “Black Holes”

MRI: T2 FLAIR

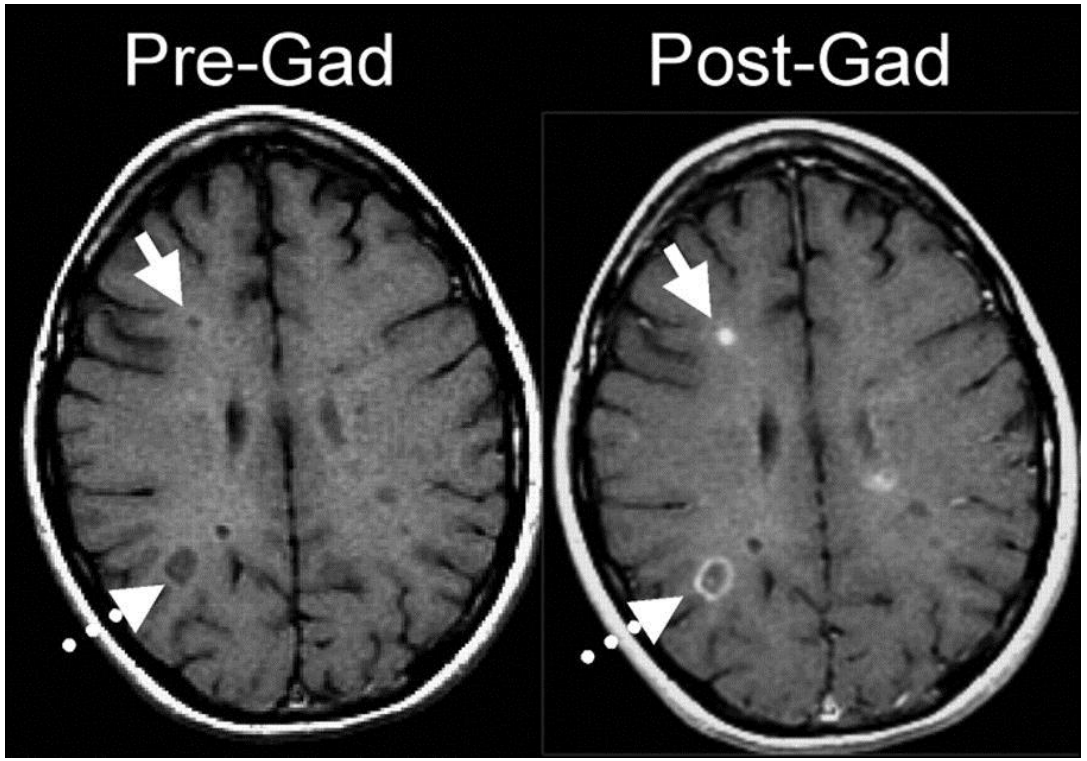


Gadolinium Enhanced MRI

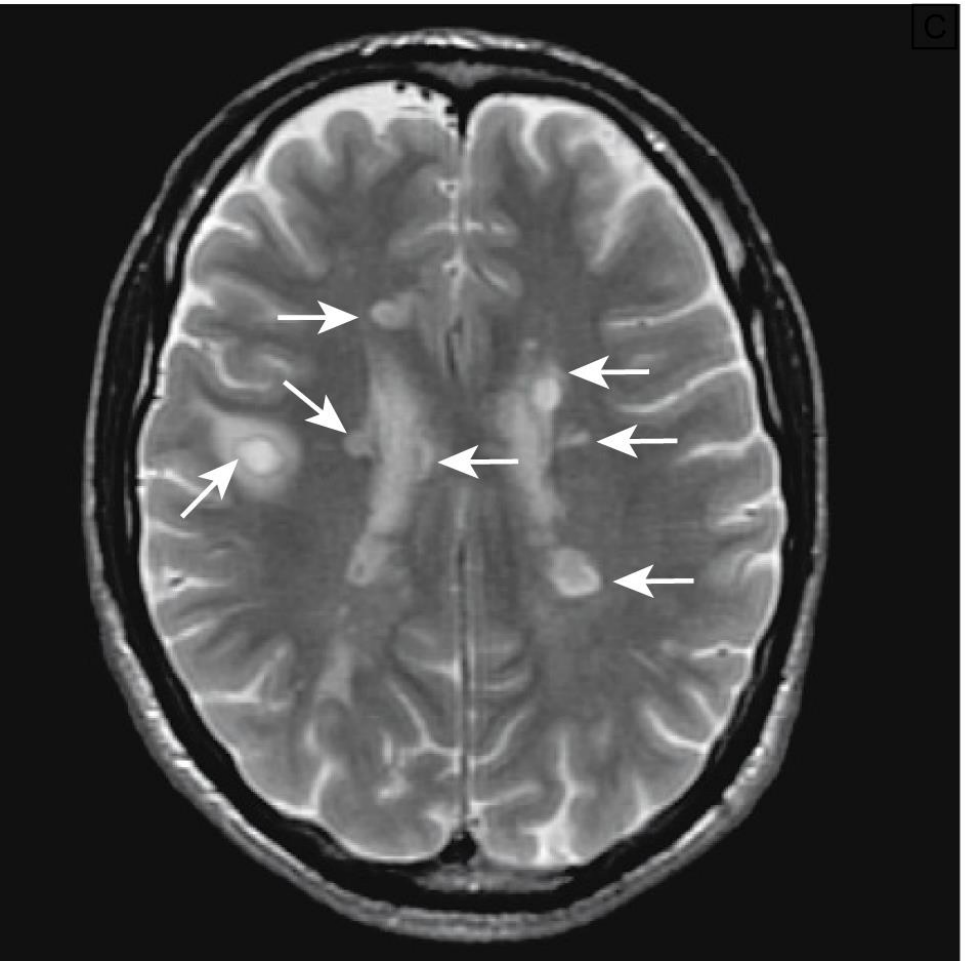
White lesions indicate areas of fresh inflammation and open BBB.



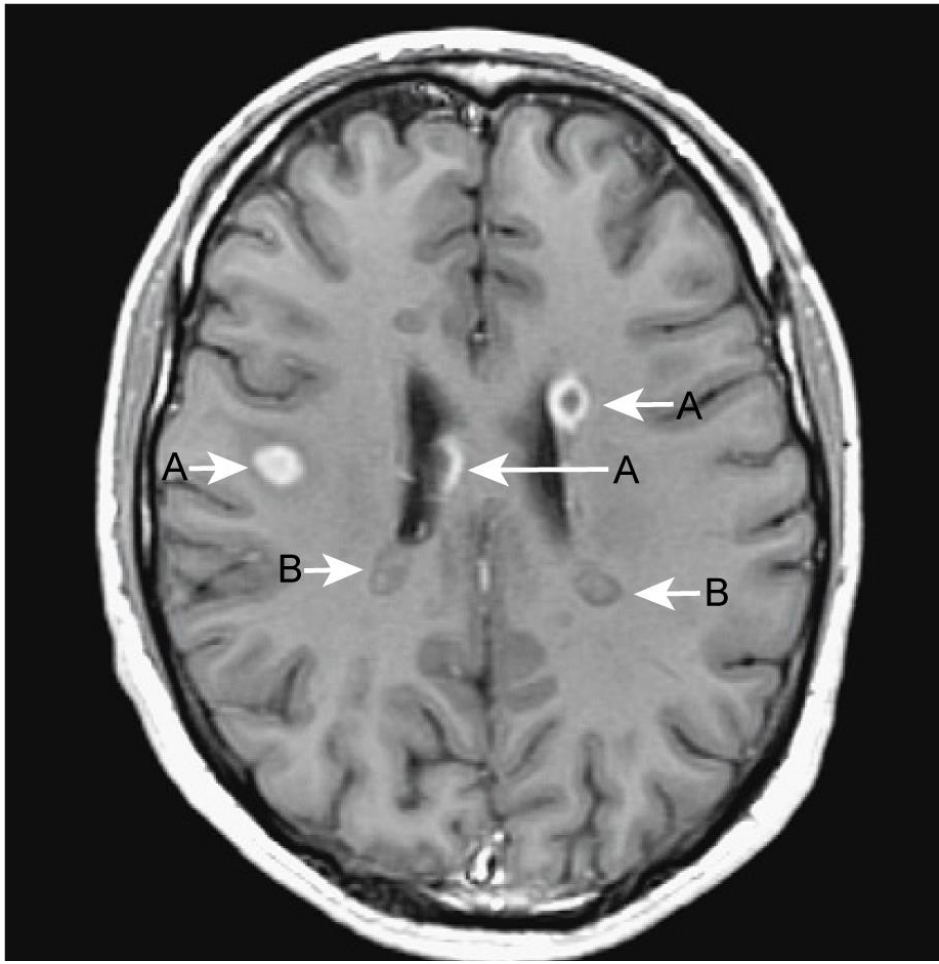
Demyelinating plaque showing perivascular cuffing of blood vessel by lymphocytes.



Gadolinium Enhanced MRI



T2 image



T1 image with gadolinium

Dissemination in Time (DIT)

New and old lesions can be distinguished on MRI