

Foundation Rothschild, a hospital specialized in head and neck care, exploits the power of Ingenia 3.0T to excel in advanced neuro imaging.

# High quality imaging in **MS, stroke** and **brain tumor**

In any type of neurological MRI, it's crucial to gather as much information as possible to increase diagnostic confidence. So, scanning must be fast and efficient, and images must provide high detail.

Ingenia 3.0T is ideal for demanding brain imaging due to its high SNR, good spatial resolution, and flexibility to accommodate many different protocols.

Fondation Rothschild (Paris, France) is a tertiary care hospital that specializes in head and neck care. Neuroradiologist Julien Savatovsky, MD, has been using Ingenia 3.0T since 2012 to optimize image quality and examination times for a broad range of neuro applications.

## **32-channel dS head coil a high-resolution solution**

The hospital uses the 32-channel dS Head coil for every examination type that

doesn't include the lower neck. "This coil's biggest advantage is the exceptional SNR. This allows us to use higher acceleration factors than with the standard coil."

"In some cases, the high resolution that this coil provides is really necessary. For example, in a head and neck case when we look for a small lesion or small vascular conflict, or in IAC imaging or fifth cranial nerve imaging, we want to achieve very good spatial resolution. In brain disease it's always better to get more details than less. We gain more diagnostic confidence when we have more information."

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***"Every center is different, but for me the ideal stroke protocol includes diffusion, FLAIR, fast susceptibility imaging and MR angiography."***

***"The challenges of brain imaging are many, but we are very satisfied with the capabilities of Ingenia 3.0T."***



**Julien Savatovsky, MD**, is neuroradiologist at Fondation Rothschild (Paris, France). His clinical interests include brain tumor imaging, inflammatory diseases, HIV-associated brain disease, head and neck vascular CT, and neuro-ophthalmology. He was educated and performed his residency and subspecialty qualification at Université Pierre et Marie Curie, Paris and a fellowship at Pitié-Salpêtrière hospital.

## Multiple sclerosis imaging requires precision, speed

When multiple sclerosis (MS) is suspected, clinicians need a diagnosis early on, so treatment can begin as soon as possible. “A challenge for imaging is that MS lesions in the brain and spine may be very small,” says Dr. Savatovsky. “We need precise imaging to tell exactly where the lesion is, so we need high quality, very high resolution images, preferably in 3D[1]. We need to know if a high T2 signal intensity is suggestive of MS or just aspecific. And we want to visualize active lesions very well.”

“Ingenia 3.0T provides us very good image quality with high SNR, even if we push the resolution. For example, in FLAIR images we may have an isotropic resolution of 0.9 mm. Ingenia allows us to use 3D T1 TSE with BrainView, which has a better sensitivity than 2D spin echo imaging[2] and 3D gradient echo imaging. Ingenia also provides highly reproducible exams, which is important in MS imaging so that follow-up exams at different time points are done the same way.”

### Imaging MS in brain

For MS imaging in the brain, Dr. Savatovsky uses 3D FLAIR as the basic sequence to visualize the lesions and assess the situation and lesion load. “We count the lesions in each location to determine if the criteria of the disease are fulfilled. We use a T2-weighted sequence because our neurologists are used to it. We compare the lesion load on FLAIR with a 3D T1 post-contrast sequence to help us determine whether lesions are old or new. We typically administer the contrast before the patient enters the machine because it shortens the examination time and allows us to visualize active lesions that tend to be more visible after several minutes. When a differential diagnosis is difficult, we add sequences such as susceptibility imaging, because some focal MS lesions have a small vein in the center[3].”

### MS imaging in spine is more complicated

“For MS imaging in the spine, the basic examination includes a sagittal T2 and a post-contrast sagittal T1-weighted sequence in the whole spine. These are done in two stacks and using thin slices,

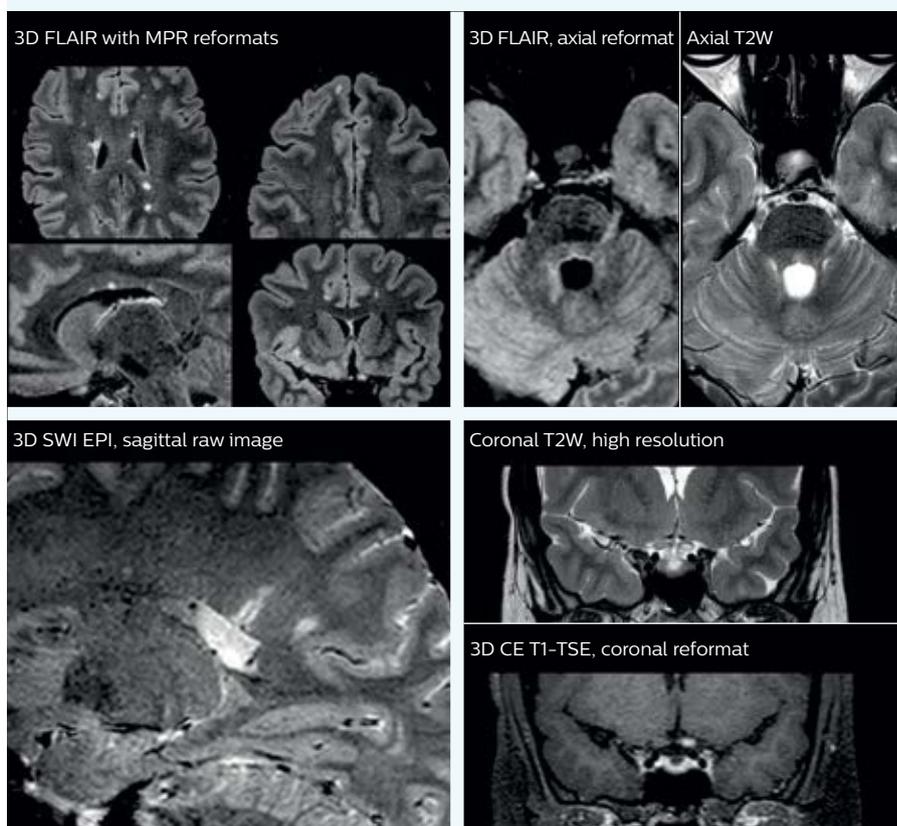
### Multiple sclerosis with acute optic neuritis

This 23-year-old female has left visual loss for 3 days and a past history of transient left facial paresthesias. The 3D FLAIR and MPR reformats show multiple T2 FLAIR high signal intensity lesions, including in paraventricular regions and juxtacortical white matter. The axial 3D FLAIR reformat and axial T2-weighted image show two lesions in the brainstem and one in the right superior cerebellar peduncle.

On the 3D SWI EPI image the medullary vein (linear low signal intensity) is seen in the center of a periventricular inflammatory lesion. The coronal high resolution T2-weighted and reformatted 3D CE T1-TSE demonstrate the left optic nerve acute inflammatory lesion in high T2 signal intensity. The diagnosis is multiple sclerosis fulfilling spatial dissemination criteria and acute left optic neuritis.

The powerful combination of dStream and dS SENSE provides high spatial resolution, SNR and good contrast of lesions on FLAIR images, which allows a good identification of lesions and therefore helps to diagnose MS early in the course of the disease. Such high image quality can be achieved in a short acquisition time, thanks to the possibility to use high dS SENSE factors. Being able to use short sequences allows to invest more time during the same exam session for higher resolution and more specific acquisitions, such as the high-resolution optic nerve imaging in this patient.

Brain MS exam on Ingenia 3.0T with 32-channel dS Head coil in 18:04 min.



for example 2 mm, without gap. As in the brain, the T2-weighted sequence visualizes the overall lesion load and helps determine if lesions are old or new. The post-contrast T1-weighted sequence helps in assessing if a lesion is new. We will sometimes add a T1 inversion recovery sequence, which has very good sensitivity, if we don't find any lesions on T2 additionally, if there is contrast enhancement outside the spine, it's usually not MS but another kind of inflammation.”

**“Ingenia provides us highly reproducible exams, which is important in MS imaging so that follow-up exams at different time points are done the same way.”**

# Every minute counts in **stroke** imaging

“In France, stroke is usually imaged with MRI, not CT, even for emergency treatment. This is because MRI helps us directly visualize ischemia in the acute phase, but can also help rule out differentials such as MS and hematoma. In addition, we can assess the intracranial and extracranial vessels during the same examination,” says Dr. Savatovsky.

The first challenge in MRI of stroke is speed. The patient typically arrives from an ambulance in the MRI preparation room and the installation is done on a separate dock outside the scanner room. “The venous access is placed during the neurological examination. If the delay from the first symptoms allows the patient to receive thrombolysis we do a very fast examination that typically lasts about 11 minutes including the pre-scans. In the case of transient ischemic stroke we usually add ASL perfusion because in some symptoms with negative diffusion, ASL sometimes indicates a vascular origin.”

“Ingenia provides great flexibility in the parameters setting. We can tune a sequence the way we want,” says Dr. Savatovsky. “For example, in a stroke exam we use a FLAIR sequence of about two minutes instead of the four-minute FLAIR we use for MS. The diffusion is 30 seconds, the T2\*-weighted scan is 30 seconds, the angiography scan time is less than one minute. Ingenia is a great scanner in that situation; even with these fast sequences we can achieve good images with good SNR. When the first sequence tells us that it’s not an ischemic stroke but a hemorrhagic stroke, we may switch to a time-resolved angiography to look for vascular malformations and venous thrombosis.

## The ideal stroke protocol?

“Every center is different, but for me the ideal protocol for stroke includes diffusion weighted imaging, FLAIR, and fast susceptibility imaging,” says Dr. Savatovsky. “Our fast susceptibility weighted imaging takes 50 seconds, so it’s as fast as T2\*-weighted imaging. It visualizes hemorrhage but also the clots. We also do 3D MR angiography that provides information on cervical and brain vessels. If the patient does not need immediate treatment, or if

additional information is needed to decide on treatment, we might also add perfusion imaging and post-contrast T1-weighted imaging.”

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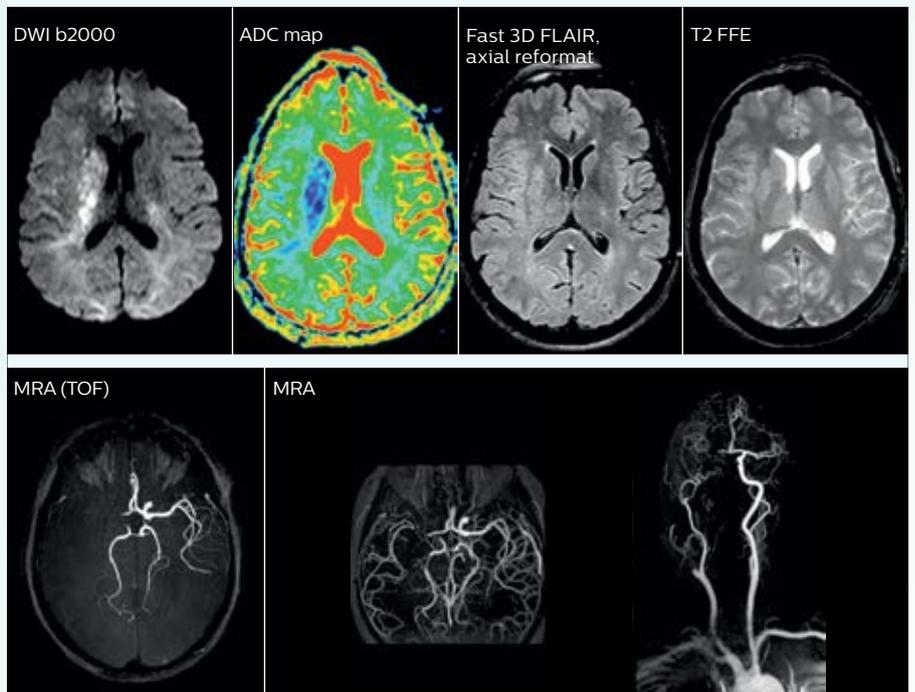
## Acute ischemic stroke with ICA and MCA occlusion

A 67-year-old female with contraindication of IV thrombolytic therapy underwent an MRI exam 1:35 hours after acute onset of left hemiplegia. NIH stroke scale = 10.

In the right deep MCA territory high signal is seen on the DWI images (b2000) with low ADC. No obvious abnormality (except subtle asymmetry of the right putamen) is seen on the FLAIR images, which rules out differential diagnoses and subacute stroke. No hematoma or blood products are seen on T2-weighted FFE. TOF MRA suggests right carotid and proximal MCA occlusion. On MRA of the supra-aortic vessels and cerebral arteries a right internal carotid bulbular occlusion is seen. Note that right MCA distal branches are visible from cortical collaterals and therefore that thrombus length can be estimated, unlike with the TOF sequence. The diagnosis is acute right deep MCA territory ischemic stroke associated with right carotid and MCA occlusion.

A stroke exam benefits from the fast imaging capacities of the system. The mobile docking table helps to speed up patient installation in an emergency setting. Our comprehensive but short stroke protocol allows the evaluation of both ischemic core extent and arterial clot. Simultaneous assessment of the supra-aortic vessels provides a “roadmap” for neuro-interventionalists and can help reduce the procedure time.

Acute stroke exam on Ingenia 3.0T with dS HeadNeck coil in 7:21 min.



  
View extended explanation in article on [www.philips.com/fieldstrength](http://www.philips.com/fieldstrength)

## Left frontal glioblastoma multiforme

A 27-year-old female with recent onset of seizures and headaches underwent MRI. 3D FLAIR and post-contrast T1-weighted reformats (axial and sagittal) depict an intraaxial mass with a contrast-enhancing component and a non-enhancing, high T2 signal intensity infiltrative component. pCASL perfusion, overlaid on the post-contrast T1W images, displays a highly perfused zone (star) outside the enhanced lesion. Susceptibility weighted imaging demonstrates abnormal vessels (arrow) and small foci of intratumoral susceptibility signal intensities (arrowheads) inside the contrast-enhancing and necrotic component.

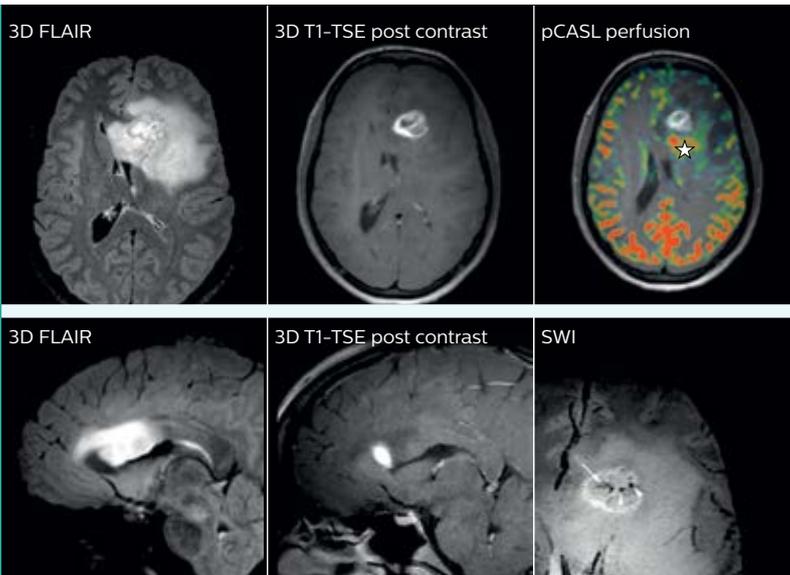
The contrast-enhancing component is high in DWI signal intensity with heterogeneous apparent diffusion coefficient (ADC), and low fractional anisotropy (FA). Left arcuate fasciculus tracking demonstrates displaced fibers within the non-enhancing component of the lesion.

Multi-voxel MR spectroscopy (MRS) is performed with TE 135 ms. High choline (membrane proliferation) and low N-acetyl-aspartate (neuronal loss) are seen in both contrast-enhancing and non-enhancing parts of the lesion. Elevated lipids and lactate in areas are seen close to the contrast-enhancing lesion (necrosis).

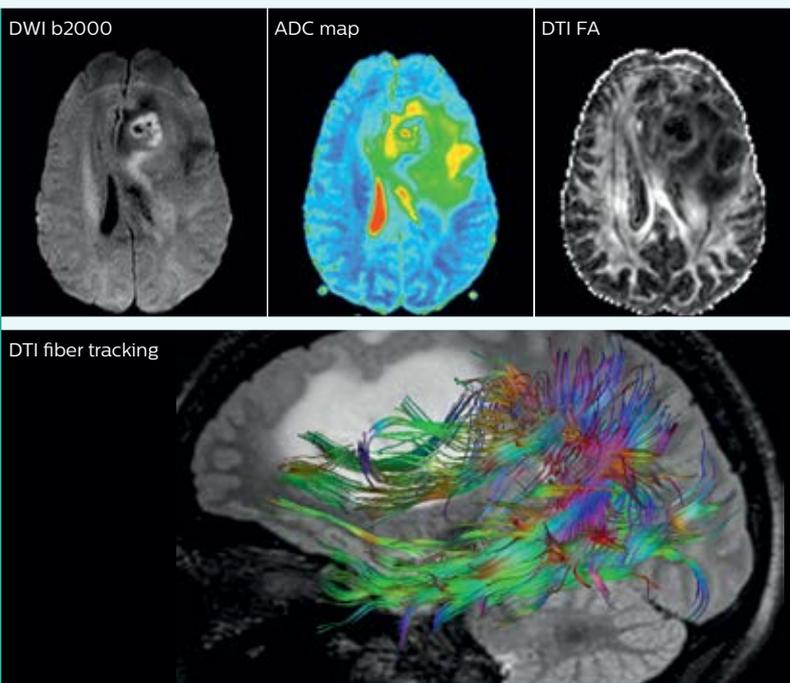
The diagnosis is left frontal glioblastoma multiforme (WHO grade 4).

Using Ingenia 3.0T with the 32-channel dS Head coil allows both high SNR and high acceleration factors to keep duration of each sequence short and thus allows to perform a comprehensive examination in an acceptable time.

### Morphologic imaging and perfusion



### Diffusion imaging



### Spectroscopy

