

GE Healthcare
Tomorrow Today

NeuroWorks

SIGNA™Works
Fueling the future of MR



SIGNA™Works

The new standard is extraordinary

Our new SIGNA™Works productivity platform redefines productivity across the breadth of our core imaging techniques. It takes full advantage of Total Digital Imaging (TDI), further advancing diagnostics and quickening throughput, while improving patient outcomes and your ROI. It is upgradeable and customizable with additional applications to suit your growing practice.

Standard Applications

Energize your clinical capabilities with all the tools you need to complete an exam. Imaging solutions cover a variety of contrasts, 2D and 3D volumetric data and motion correction capabilities.



Innovative Applications

Expand your expertise to the next level, to deliver improved image quality, higher efficiency and a more streamlined workflow, so you perform better than ever before.



SIGNA™Works

The new standard is extraordinary



► Standard Applications Innovative Applications

BodyWorks

One of the fastest growing areas in MR, BodyWorks allows you to image abdominal and pelvic anatomy with user flexibility to adapt to different patient types.

CVWorks

Gain crucial insights into vascular structure and flow dynamics and access morphology, flow, function and tissue viability with CVWorks.

NeuroWorks

This one-stop solution enables you to image brain, spine, vascular and peripheral nerve anatomy with exceptional tissue contrast.

OncoWorks

Delivers robust tissue contrast, motion-insensitive, high temporal and spatial resolution imaging techniques that capture anatomical and morphological data for oncological assessment.

OrthoWorks

This extensive library of musculoskeletal imaging techniques enables you to image bone, joint and soft tissue with remarkable tissue contrast.

PaedWorks

Delivers distinctive child-centered imaging techniques that provide ease of use for the user and clinical excellence for your smallest, most fragile patients.

SIGNA™Works

The new standard is extraordinary



Standard Applications

► **Innovative Applications**

HyperWorks

HyperWorks means hyper scanning with astonishing imaging and impressive speed. It includes HyperSense, which can deliver higher spatial resolution images or reduced scan times.

ImageWorks

ImageWorks boosts your overall MR performance. READYView visualization and MAGiC one-and-done scanning help ensure consistent and clear results.

SilentWorks

SilentWorks is GE's most advanced noise reducing technology. Traditional exams can be extremely loud. SilentWorks brings the sound level down to ambient noise.

ViosWorks

ViosWorks reduces the complexity and cost of cardiac imaging. For the first time, all 7 dimensions of information can be captured in a cardiovascular scan in 10 minutes or less.

NeuroWorks

NeuroWorks is GE's solution for fast neuro imaging. This one-stop solution enables you to image brain, spine, vascular and peripheral nerve anatomy with exceptional tissue contrast.

These motion insensitive techniques feature single-click auto-alignment, providing the complete neuro solution from scanning to post processing.

NeuroWorks includes a range of applications designed to advance your neuro imaging capabilities.

- Standard Applications
- Elective Applications
- Innovative Applications



46%

Neuro scans, which include brain and spine,¹ account for 46% of all MR procedures.²

24% Spine procedures

22% Brain procedures

¹ Spine as a category could also apply to orthopedics

² Source: IMV 2016 Market Outlook

NeuroWorks

Standard Applications

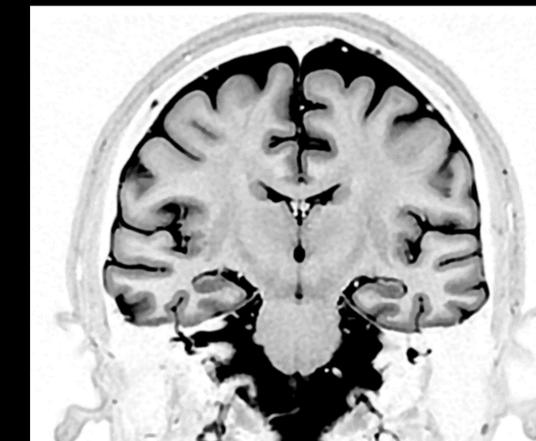
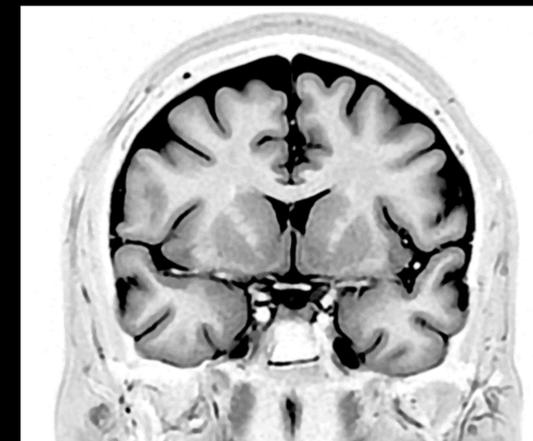
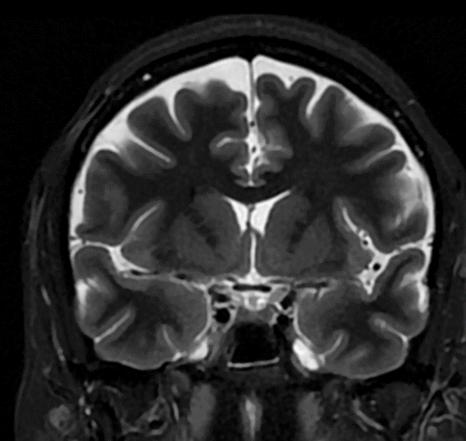
PROPELLER

PROPELLER Multi-Blade (MB) is a multi-shot approach that preserves tissue contrast regardless of weighting while also reducing motion artifacts and providing a more signal-rich image. Additionally, this technique introduces new contrasts such as T1 FSE.

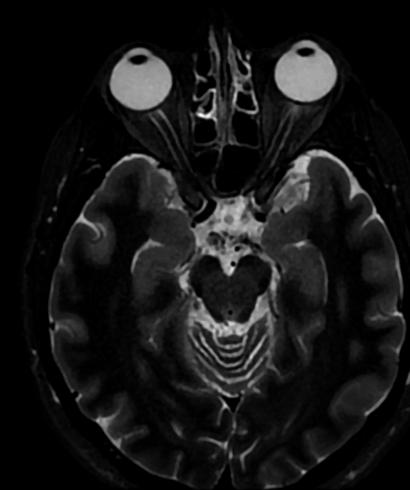
Clinical benefits:

- Sedation-free scanning and increased patient tolerance
- Reduces overall scan time
- Delivers motion artifact free diagnostic images
- Increases productivity and decreases the number of repeated scans

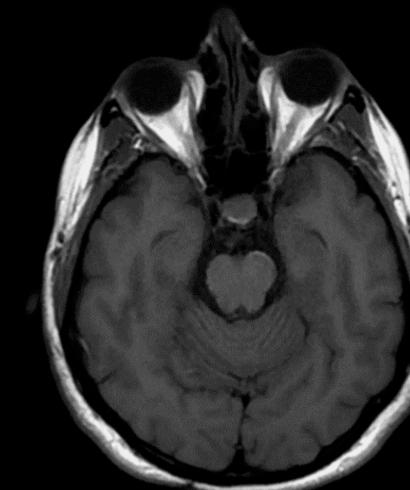
Coronal T2 STIR PROPELLER MB and inverted grayscale 0.8 x 0.8 x 3mm



Axial T2 STIR PROPELLER MB
0.8 x 0.8 x 2mm



Axial T1 PROPELLER MB
0.8 x 0.8 x 4mm



NeuroWorks

Standard Applications

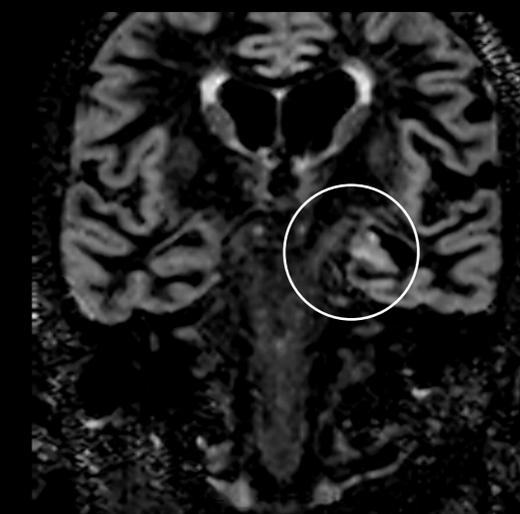
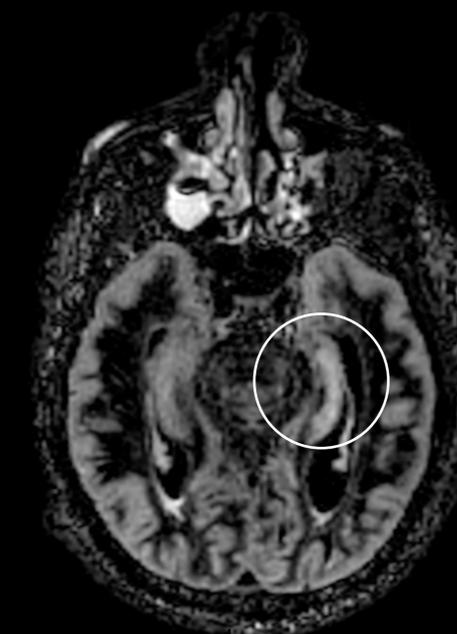
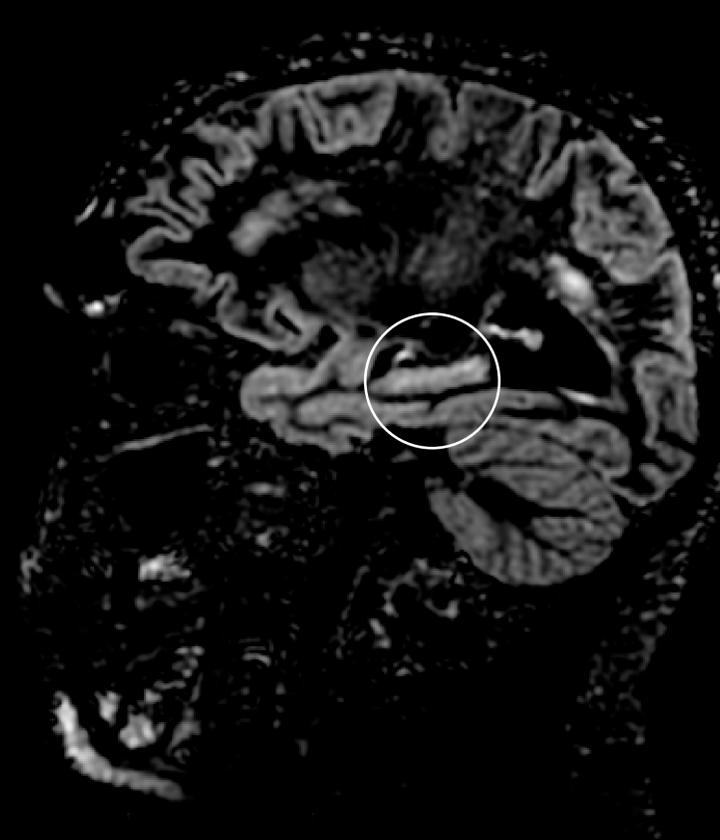
Cube

Cube is our 3D volumetric imaging suite. This application allows you to suppress cerebrospinal fluid (CSF) and either white or gray matter to increase lesion conspicuity. Scan once, format many.

Clinical benefits:

- Spatial anatomical localization for tumor evaluation
- Free breathing and respiratory triggered to reduce motion artifacts
- High slice resolution to evaluate disease
- Decreases flow artifacts

Cube DIR demonstrates mild signal changes with dilation of the ipsilateral temporal horn



NeuroWorks

Standard Applications

Case Study: Brain Imaging on MS Patient with Cube

“GE’s Cube Double Inversion Recovery (DIR) imaging now enables us to confidently diagnose cortical and juxtacortical plaques in multiple sclerosis.”

Dr. Roland Lee, UCSD Medical Center

Clinical solutions

System: Discovery™ MR750w GEM 3.0T

Coil: HNU

Protocols used

Axial T2 FLAIR, Sagittal Cube T2 FLAIR PROMO, Sagittal Cube DIR

Patient history

33 year-old patient with multiple sclerosis since 2007. Presented with new onset pain, leg weakness and right optic neuritis.

Procedure

Total exam time took 36 minutes (10 sequences). Seven minutes for Cube T2 FLAIR PROMO, 5.5 minutes for Cube DIR and 4 minutes for Axial T2 FLAIR. Post processing reformats and Integrated Registration done on AW 3.2.

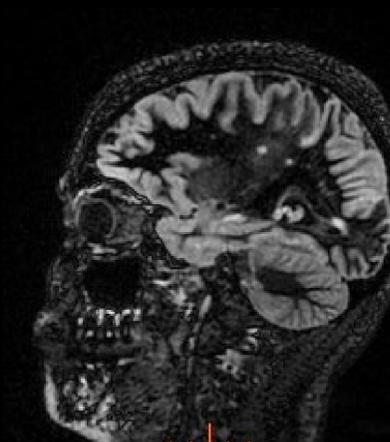
Diagnosis

White, gray and juxtacortical lesions consistent with multiple sclerosis. Cube DIR aided a great deal in the diagnosis due to its increased conspicuity when compared to standard T2 FLAIR images.

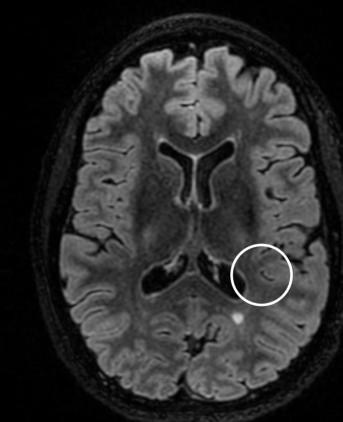
Sagittal Cube T2 FLAIR



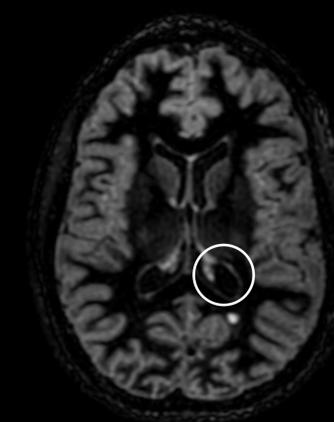
Sagittal Cube DIR



Axial Cube T2 FLAIR Reformat



Axial Cube DIR Reformat



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Standard Applications

FastBrain

A high-resolution, rapid brain imaging protocol in 5 minutes or less.

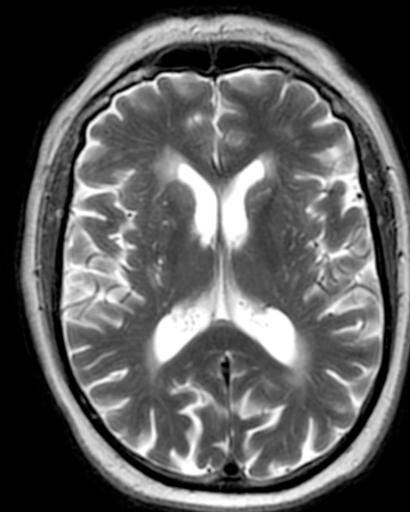
Protocols include:

- T1
- T2
- FLAIR
- GRE
- DWI

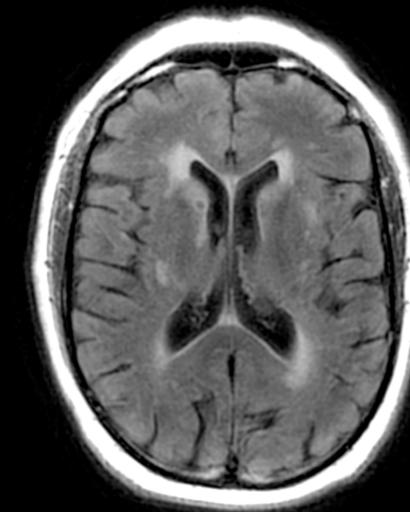
Clinical benefits:

- Provides reliable image quality at extraordinary acquisition speed
- Reduces patient motion artifacts and the need for rescans
- Offers efficient operating power enabled by fast and optimized push-button exams
- Compensates for uncooperative patients with conditions that make it hard to comply
- Helps to increase patient throughput

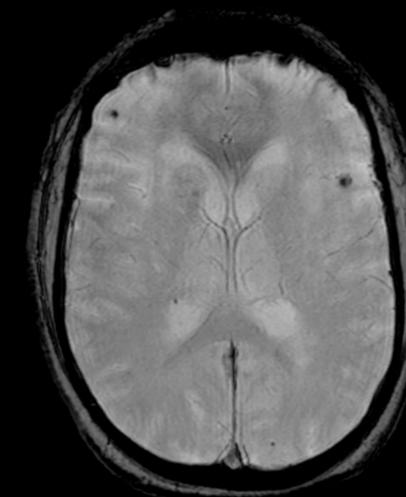
T2 PROPELLER MB 1 min



T2 FLAIR PROPELLER MB 1:22 min

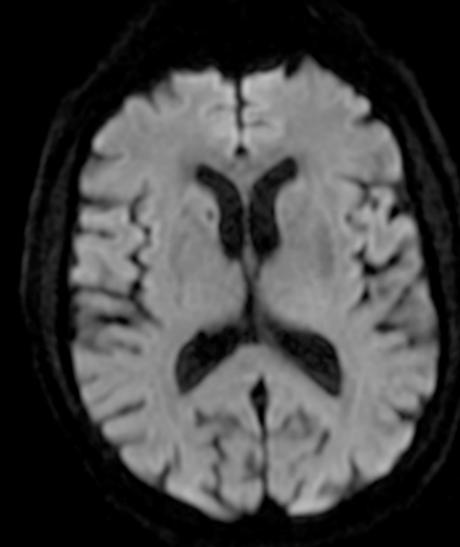


T2 GRE 56s

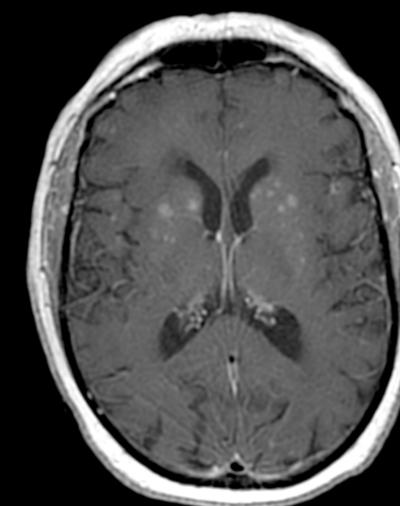


Total
scan time
4:45 min

Diffusion b1000 14s



T1 PROPELLER MB 1:13 min



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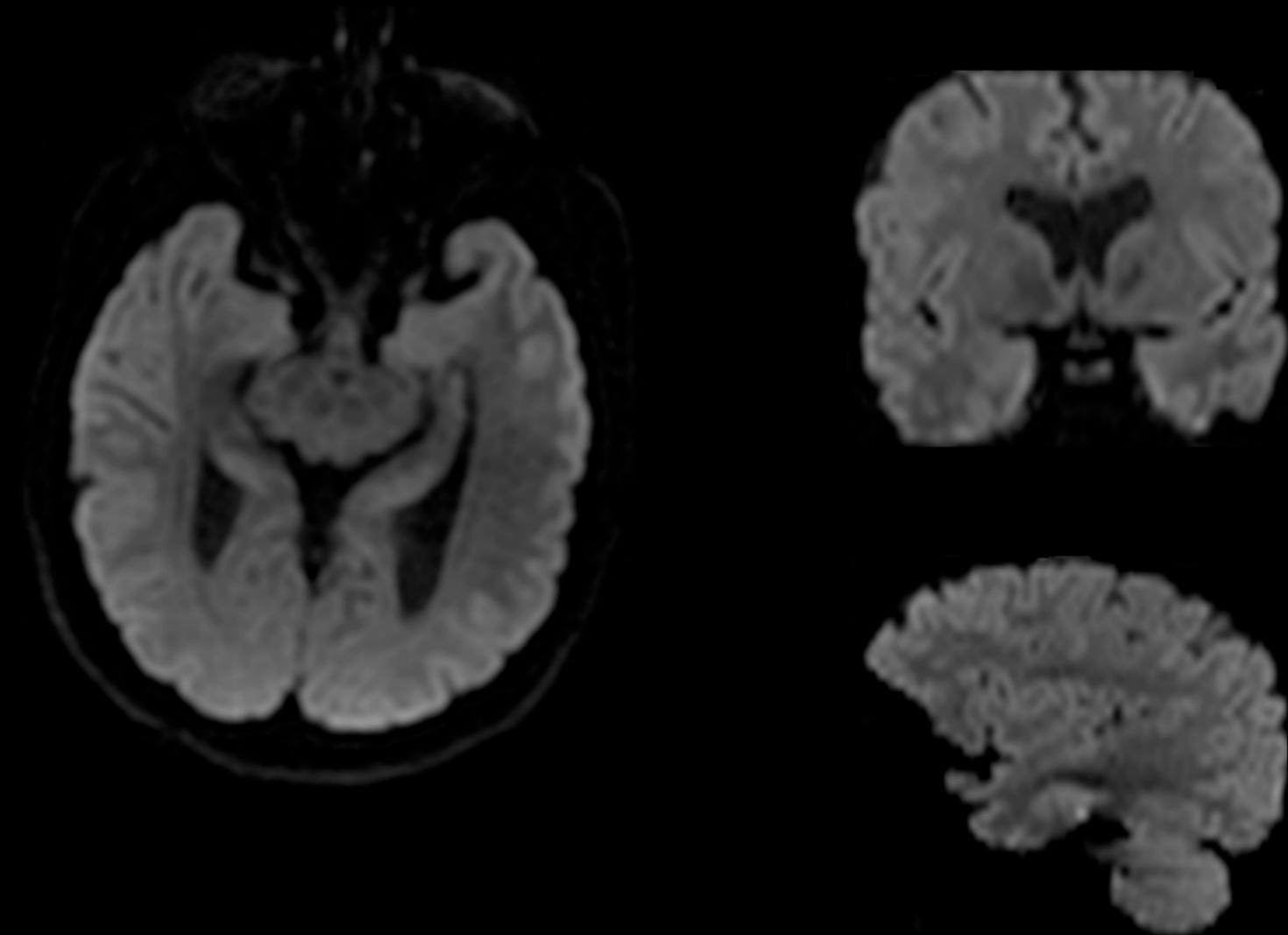
Standard Applications

eDWI

Diffusion Weighted Imaging (DWI) is used to image diffusivity of water molecules (Brownian motion). This enhanced Diffusion Weighted Imaging (eDWI) technique is designed to provide high signal-to-noise-ratio (SNR) diffusion images, with short-acquisition time and shortest possible echo time (TE). Its multi-b feature is designed to provide measurement of apparent diffusion coefficient (ADC) map with reduced effect of perfusion.

Clinical benefits:

- By achieving shorter TE's, lessens susceptibility and distortions in problematic areas (such as temporal lobes in the brain)
- Increases sensitivity and specificity of lesions
- Decreases overall exam sequences and time



NeuroWorks

Standard Applications

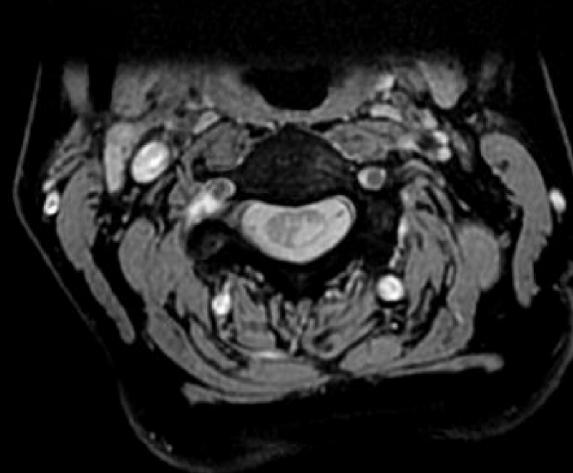
MERGE

Multi-Echo Recalled Gradient Echo (MERGE) uses multiple TE's to generate superior contrast and visualization of the different layers of cartilage in MSK imaging and better definition of gray/white matter in the spine. It can be acquired in 2D or in 3D with excellent spatial resolution, includes water excitation for elimination of fat, and maintains ligament visualization while adding soft tissue contrast.

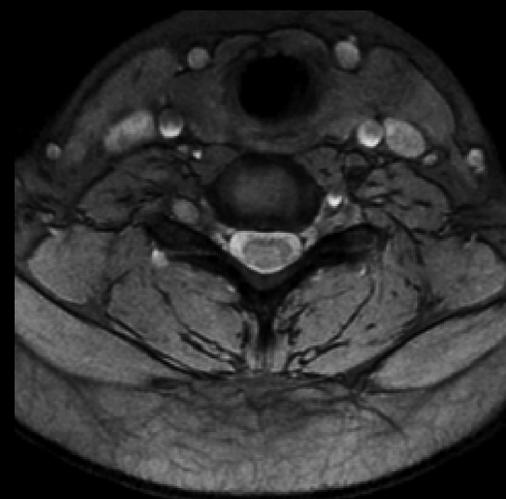
Clinical benefits:

- Distinguishes femoral and acetabular cartilage in the hip
- Helps visualize scaphoid fractures and delineation of ligaments in the wrist
- Offers better visualization of lesions in the spinal cord (e.g., Multiple Sclerosis)

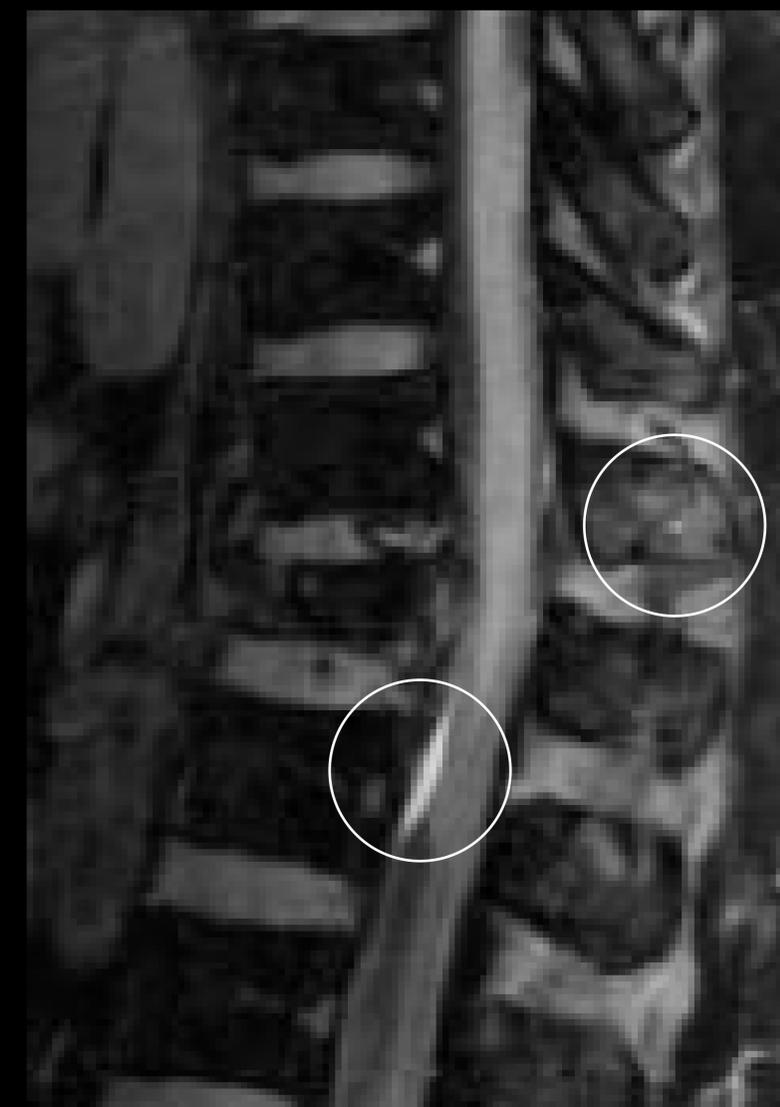
3D MERGE



2D MERGE



2D MERGE



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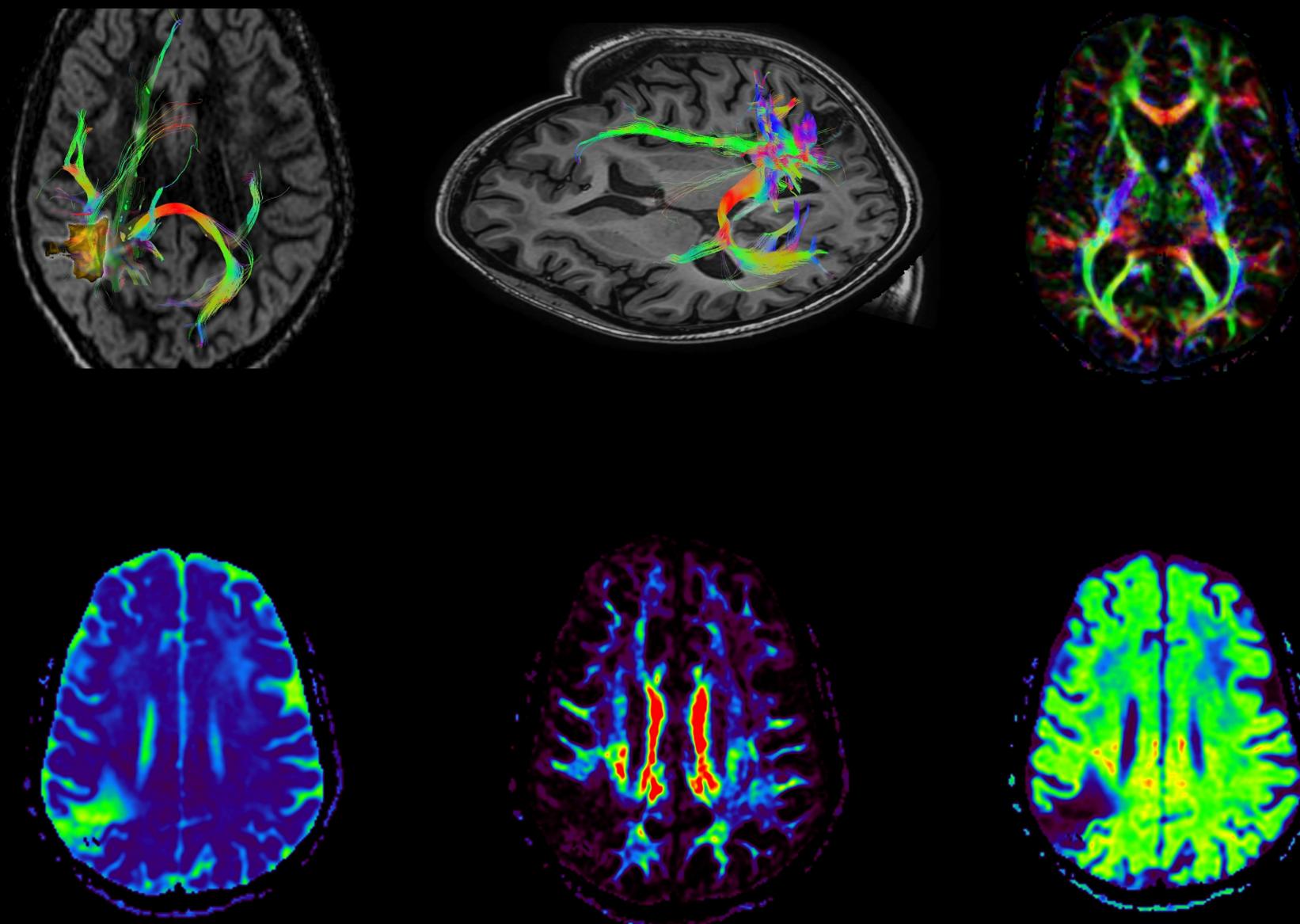
Elective Applications

DTI

Diffusion Tensor Imaging (DTI) needs at least 6 diffusion encoding directions to assess the pathway of the water molecules. DTI data are used for fiber tracking.

Clinical benefits:

- Discerns disruptions to the path of white matter fiber tracts (e.g. Multiple Sclerosis, neoplasm or trauma)
- Helps with pre-surgical planning to ensure the least amount of trauma to healthy tissue



NeuroWorks

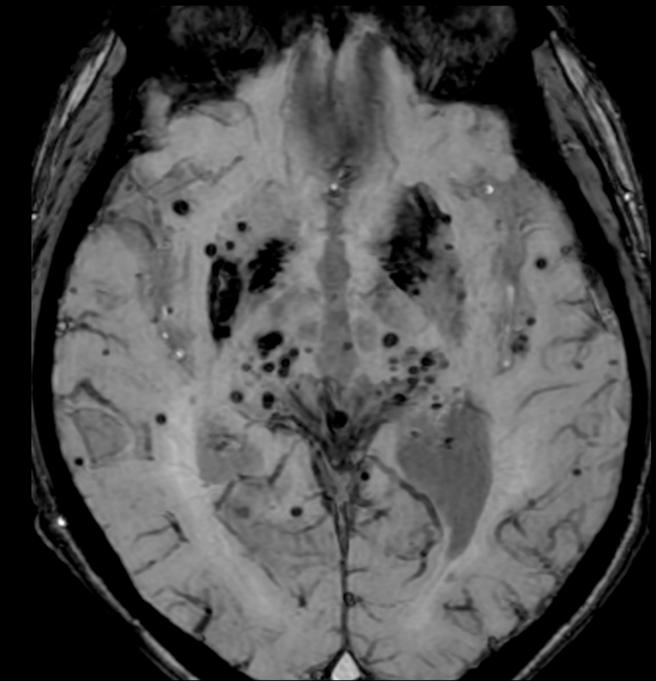
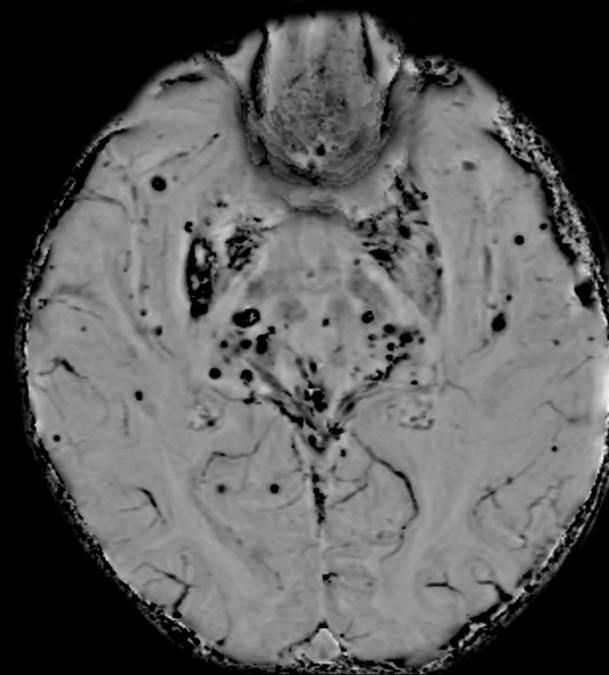
Elective Applications

SWAN

T2 Star Weighted ANgiography (SWAN) is a high-resolution 3D multi-echo gradient echo sequence that produces weighted averaging across images with different TE's to achieve higher susceptibility weighting. It provides minimum intensity projections over neighboring slices, enhancing tissue contrast for tissues containing iron, venous blood and other substances with susceptibilities that are different than the background tissue.

Clinical benefits:

- Helps determine blood products (paramagnetic) from calcium products (diamagnetic) in the brain
- Helps monitor calcified lesions, such as those found in MS patients or in infections
- Delivers CT-like imaging, without the ionizing radiation or contrast injection



NeuroWorks

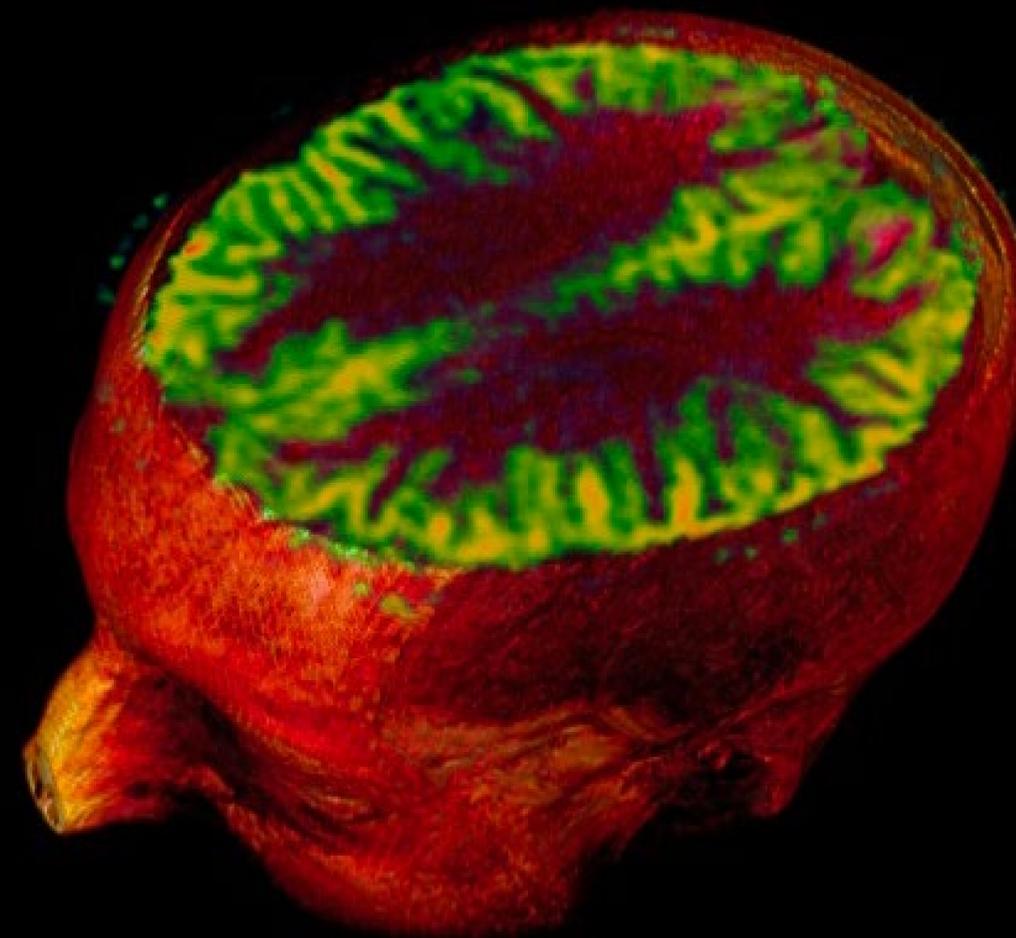
Elective Applications

3D ASL

3D Arterial Spin Labeling (ASL) is a quantitative application that allows the assessment of blood flow of the whole brain using a non-contrast method of quantifying Cerebral Blood Flow (CBF), eliminating needles or radiation.

Clinical benefits:

- Helps diagnose and monitor treatment with quantitative results
- CBF values aid to grade tumors
- Helps monitor therapy progression in treatment of infection or tumors
- Helps with assessment of stroke damage



NeuroWorks

Elective Applications

Case Study: Brain Imaging on Meningioma Patient with 3D ASL

Clinical solutions

Applications: 3D FSE ASL

System: Optima™ MR450w GEM 1.5T

Protocols used:

Sagittal T1w FSPGR, Axial T2 FLAIR, Axial T2*, Axial DWI b1000, Axial T2* DSC Perfusion, Axial 3D T1w FSPGR post contrast

Patient history

63 year-old with a left parietal meningioma surgery one year before. A standard brain MR was performed to follow up the surgery.

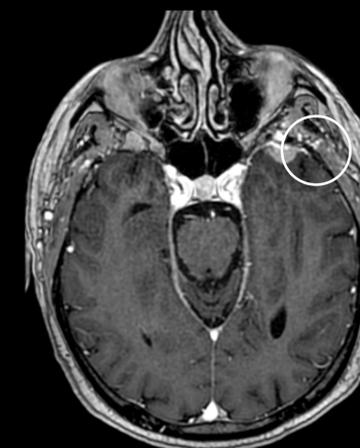
Procedure

As surgery often involves susceptibility artifacts that may hide perfusion information, a 3D ASL was performed before the injection. T2* DSC however did not show any lesion due to the susceptibility artifacts, but 3D ASL showed an increased area in the CBF map leading to the discovery of a lesion.

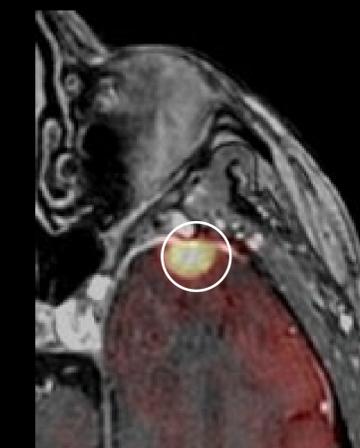
Diagnosis

The 3D ASL demonstrates the clinical benefit of using FSE acquisition to detect lesions even in a challenging area like the temporal lobe. In this case, it was the only imaging sequence that shows the second meningioma in the temporal lobe before the post-contrast 3D T1 performed as the last sequence.

3D T1w +C



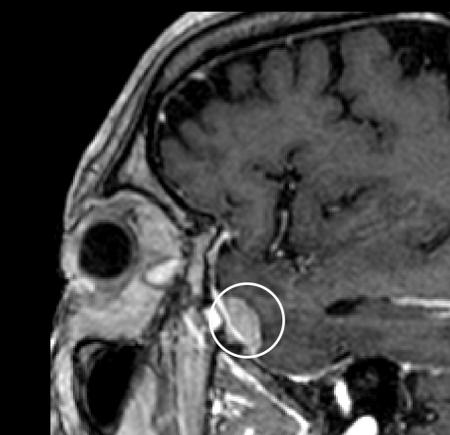
ASL CBF/3D T1w



T1 Reformat Coronal & Sagittal



T1 Reformat Coronal & Sagittal



back to app

NeuroWorks

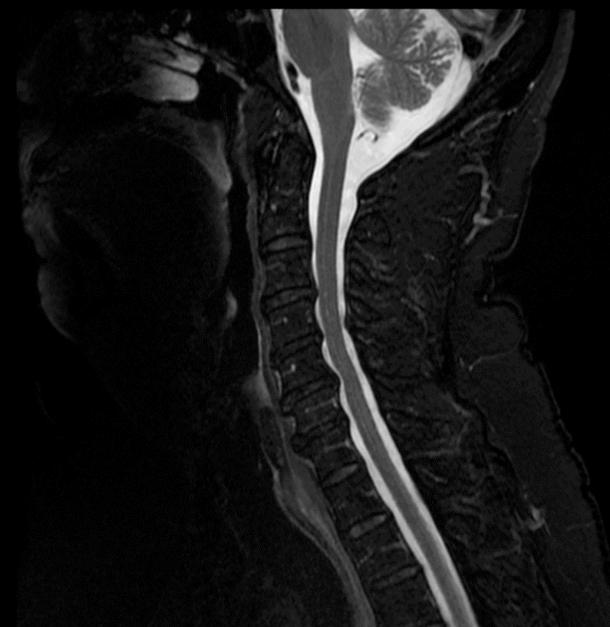
Elective Applications

FSE Flex

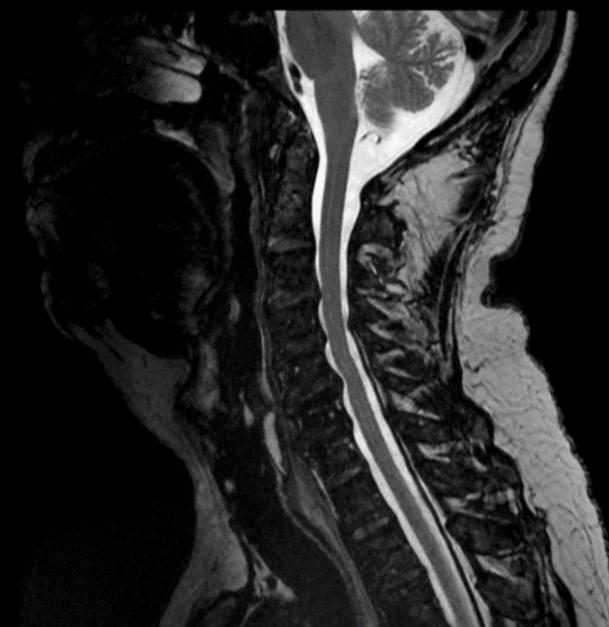
Fast Spin Echo (FSE) Flex uses a 2-point Dixon technique to produce water, fat, in-phase and out-of-phase images. It provides robust, homogenous, fat/water separation– even in difficult-to-scan anatomies such as the Brachial Plexus, neck, C-spine, fingers, toes and wrists.

Clinical benefits:

- Generates two series of images in a single scan, one with fat suppression and one without
- Acquires multiple contrasts in a single scan, reducing need for multiple acquisitions
- Compatible with 2D and 3D imaging, which is helpful in challenging off-isocenter anatomies or larger fields of view
- Can be combined with ARC acceleration to reduce scan times



T2 FSE Flex Sagittal
Water, Fat, In-phase and
Out-of-phase images
0.6 x 0.9 x 3mm
3:54 min



NeuroWorks

Elective Applications

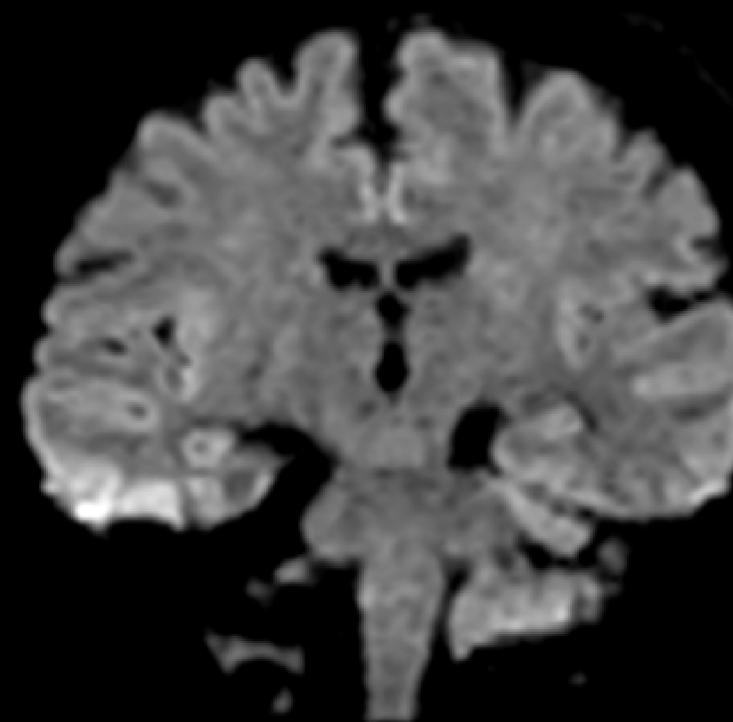
FOCUS DWI

FOV Optimized & Constrained Undistorted Single-shot (FOCUS) is a 2D Spatially Selective RF Excitation method for DW-EPI and DTI that reduces the FOV in the phase encode direction, to reduce geometric distortion, eliminate phase wrap artifacts and increase image sharpness. It provides high resolution DWI scans, especially useful when the region of interest is small in the phase encode direction.

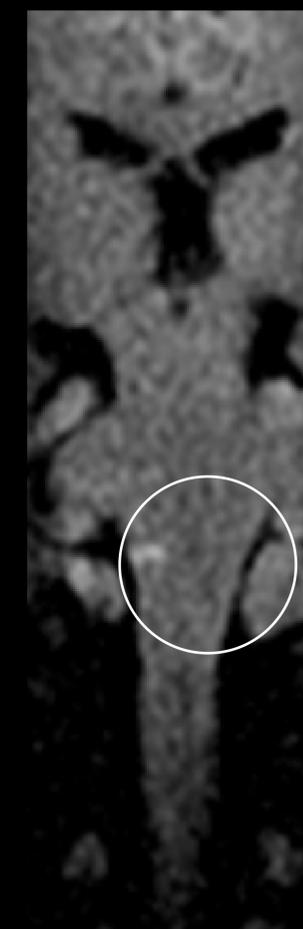
Clinical benefits:

- Helps evaluate the spine with reduced distortion
- Provides a higher spatial resolution diffusion compared with conventional EPI diffusion techniques
- Helps detect and evaluate small lesions that may be obscured by distortion
- Reduces motion contamination outside the region of interest

Conventional DWI



FOCUS DWI b1000 2.5mm slice 3:33 min



HyperWorks

Innovative Applications

HyperSense

HyperSense is an acceleration technique based on sparse data sampling and iterative reconstruction, that delivers higher image resolution with reduced scan time, without the typical penalties of conventional parallel imaging. It can be combined with other acceleration methods (ARC) to achieve high SNR with shorter acquisition times.

Clinical benefits:

- Lowers scan time, without reducing SNR
- Provides faster 3D imaging acquisitions
- Combines with ARC for higher acceleration



3D TOF

Matrix 320 x 280 = 0.75 x 0.85 = 0.6mm³

Slice 1.0mm / 194 slice / two slabs

ARC = 2.0

6:49 min



3D TOF with HyperSense

Matrix 400 x 400 = 0.4mm³

Slice 1.0mm / 194 slice / two slabs

HyperSenser Factor = 3.6

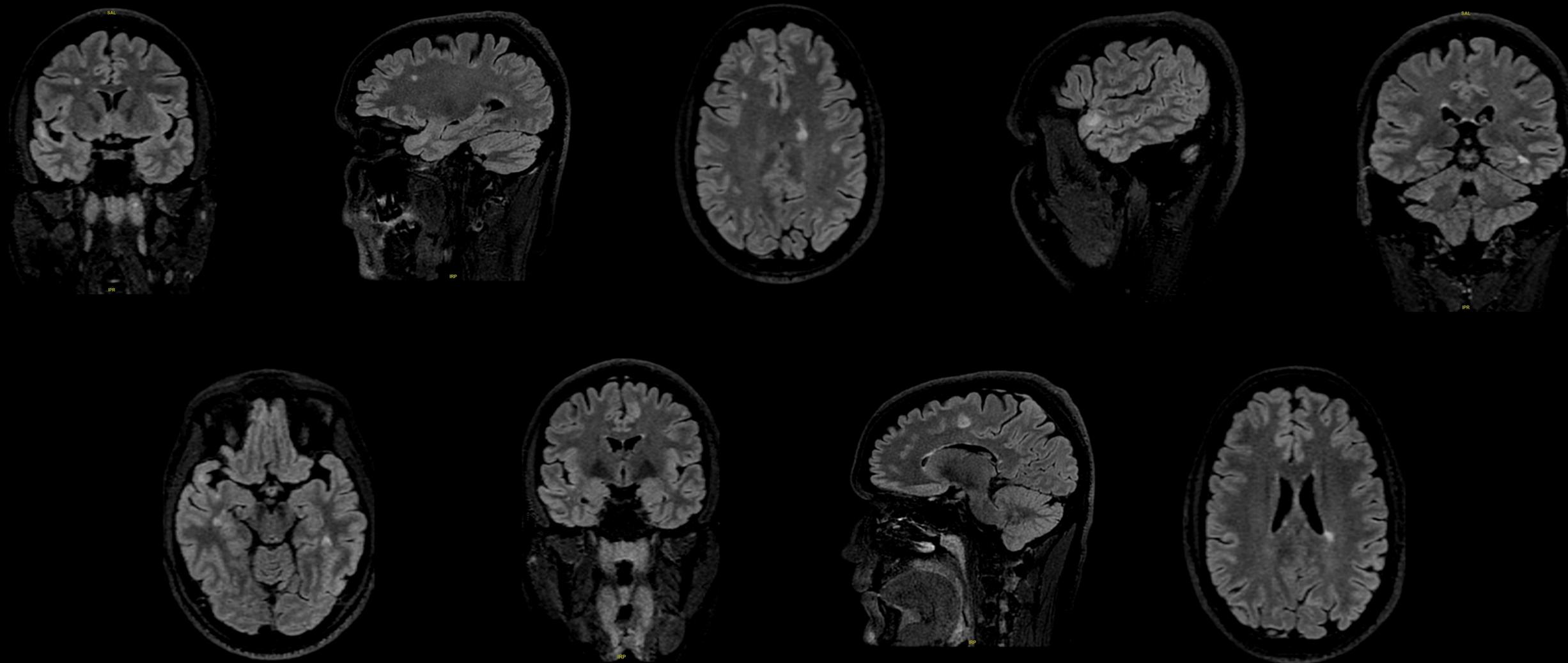
4:07 min



HyperWorks
Innovative Applications

HyperSense

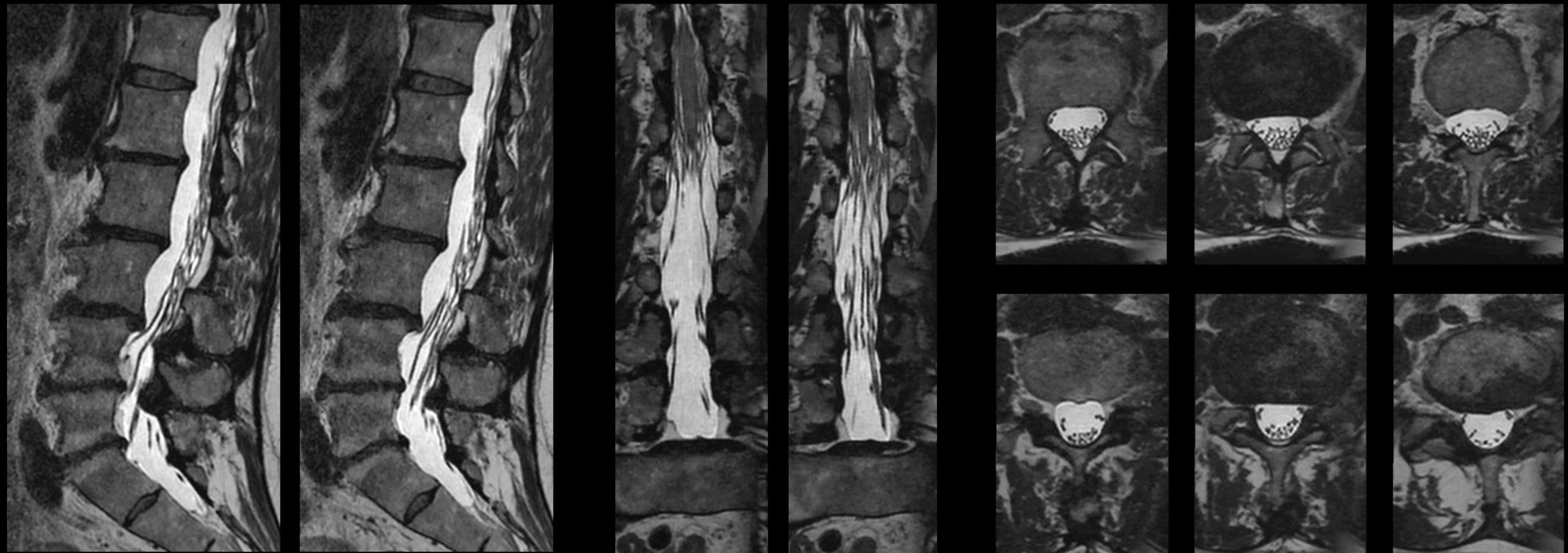
T2 FLAIR Cube
with HyperSense
5.2x Acceleration
1 x 1 x 1mm
3:19 min



HyperWorks
Innovative Applications

HyperSense

T2 Cube Sagittal
Coronal and Axial
Reformats
0.8 x 0.8 x 0.8mm
5:01 min



HyperWorks

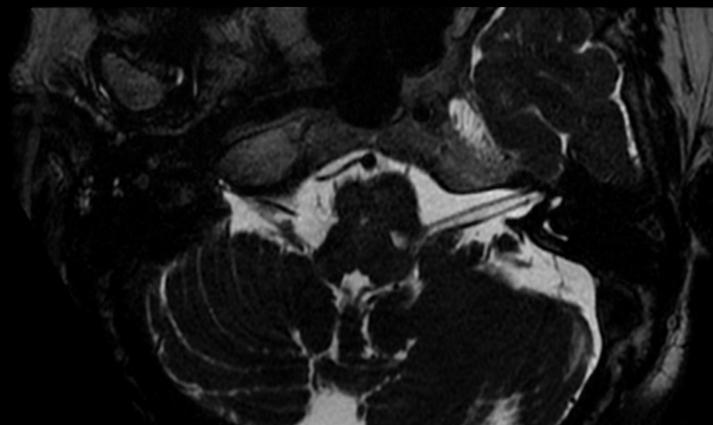
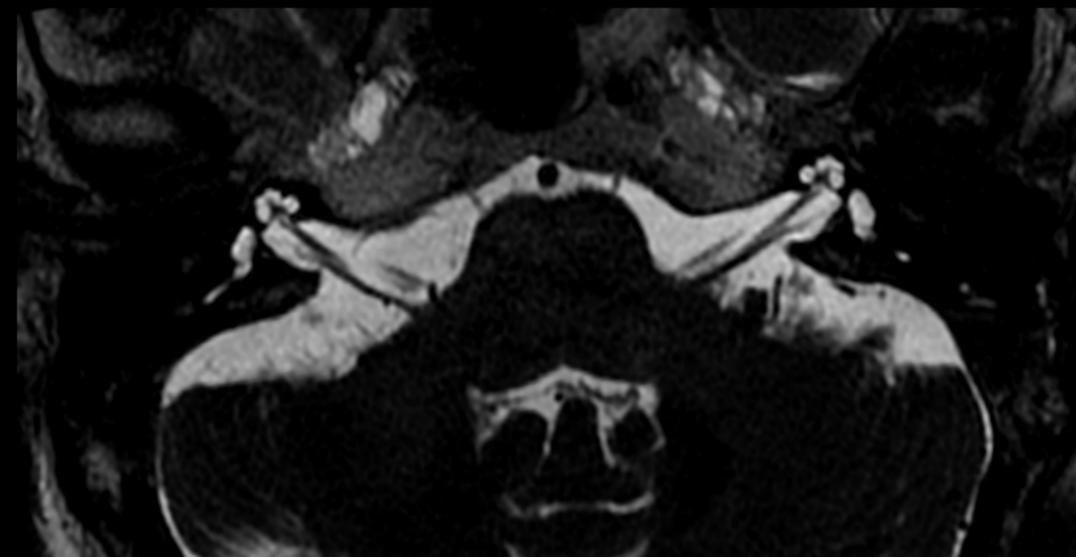
Innovative Applications

HyperCube

HyperCube reduces scan time and limits artifacts such as motion and aliasing by reducing the phase FOV. It can be applied with or without fat suppression and significantly lowers imaging time without sacrificing contrast quality. It allows focus on the area of interest, to avoid phase wrap and other artifacts, and can be used on the entire body.

Clinical benefits:

- Lowers scan time without SNR loss, allowing less potential for patient motion and less repeats
- Eliminates time consuming parameters e.g., NPW
- Provides high resolution small FOV imaging
- When combined with FSE Flex, helps with large FOV robust fat suppression
- Reduces image artifacts, enables better IQ



HyperWorks

Innovative Applications

HyperBand

HyperBand reduces scan time by simultaneously exciting multiple slices at multiple locations. Combined with other parallel imaging methods, it can lead to higher acceleration reduction factors. It enhances productivity and patient experience, with increased anatomy coverage and higher IQ.

Clinical benefits:

- Shortens acquisition time
- Scans more diffusion directions or temporal resolution, without increasing scan time
- Combines with ARC for high acceleration factor

DWI B-value 1000 s/mm² 1:04 min



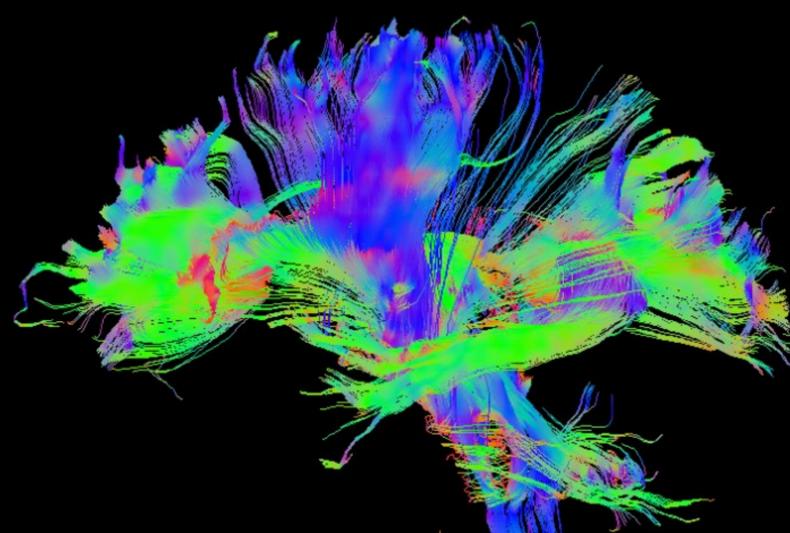
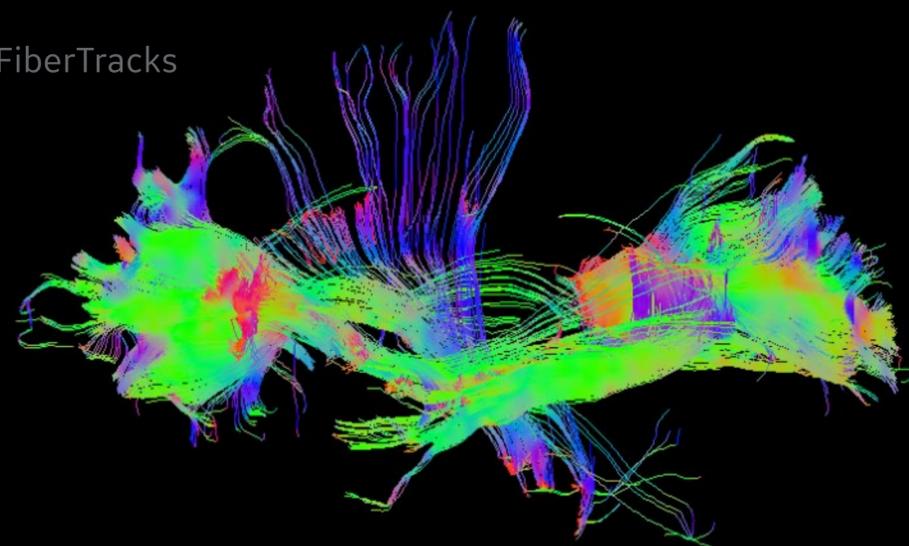
DWI HyperBand B-value 1000s/mm² 35s



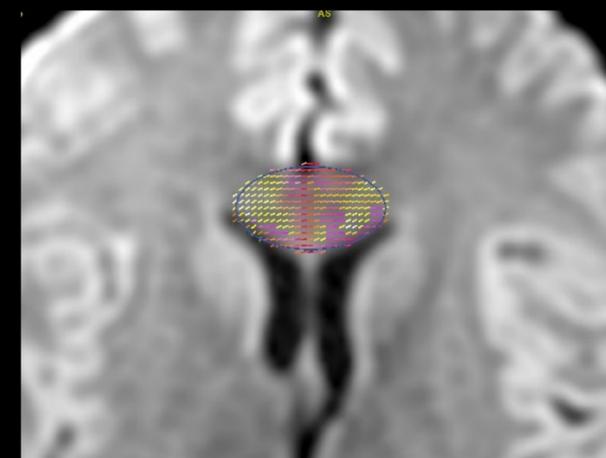
HyperWorks
Innovative Applications

HyperBand

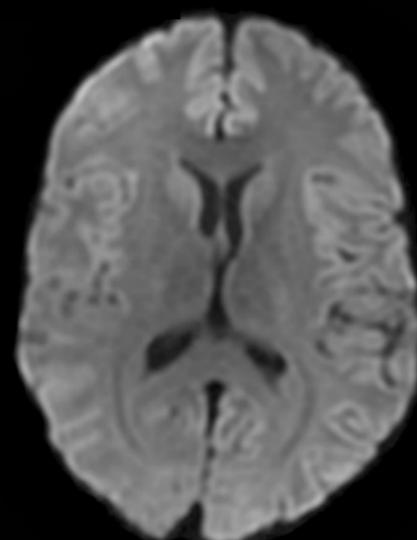
FiberTracks



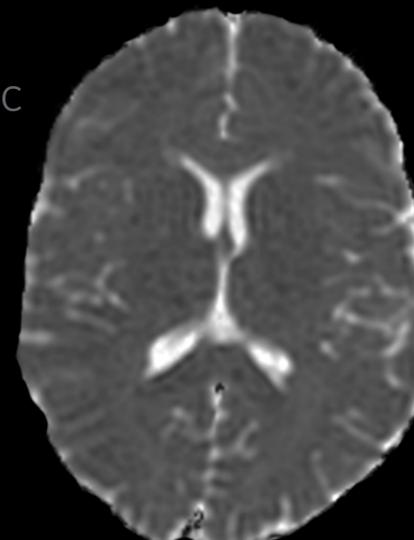
Main Eigenvector



Trace



ADC

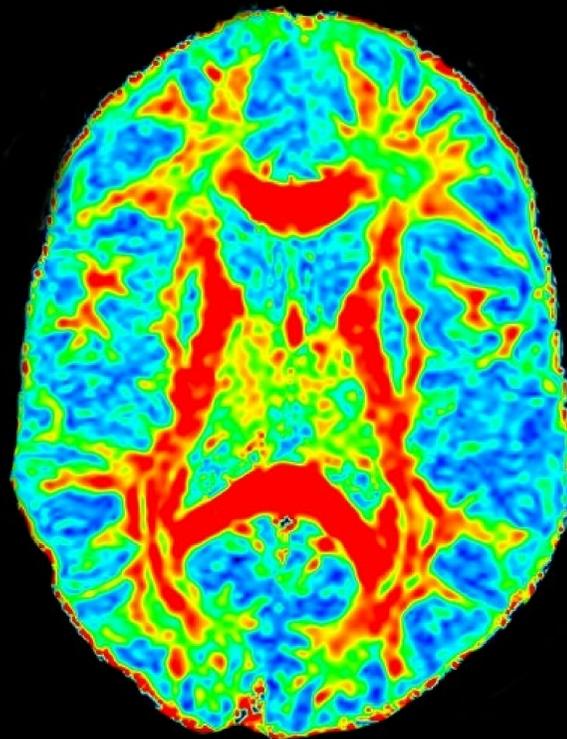


HyperWorks

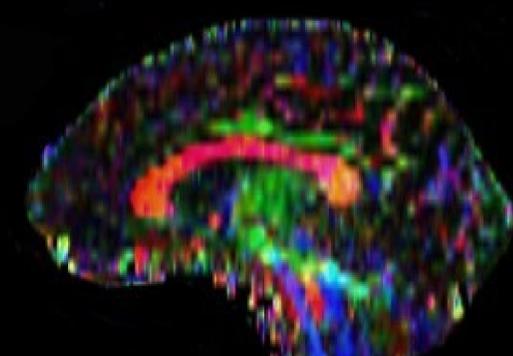
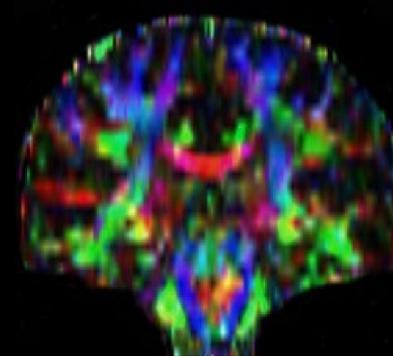
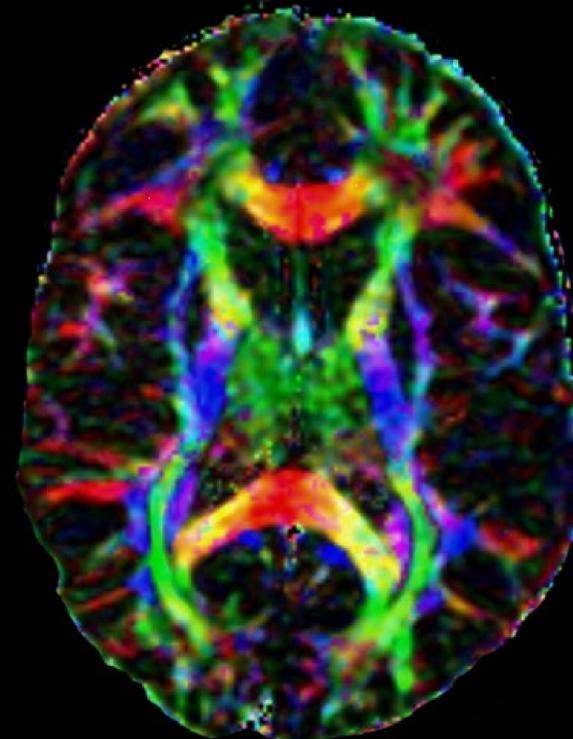
Innovative Applications

HyperBand

FA Map



Colored Orientation



ImageWorks

Innovative Applications

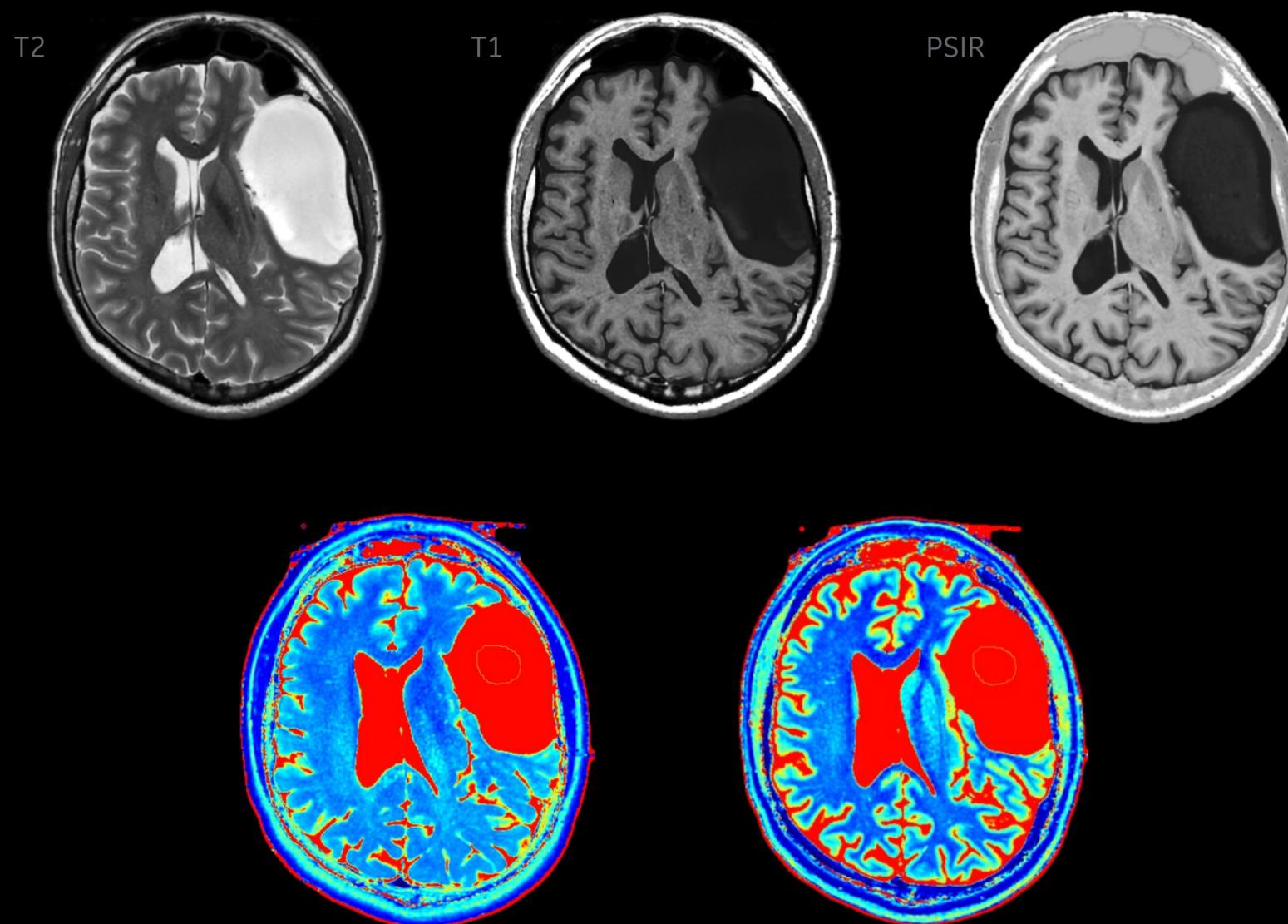
MAGiC

MAGnetic resonance image Compilation (MAGiC) delivers multiple contrasts in a single scan, including T1, T2, PD and Inversion Recovery weighted images (T1 FLAIR, T2 FLAIR, STIR, Dual IR white or gray matter suppression and PSIR with PSIR vessel view), reducing scan time by up to 50% compared to acquiring all contrasts separately.

Clinical benefits:

- Scans up to 8 contrasts in one 5½ minute scan
- Allows for contrast change after acquisition
- Enhances image slice registration
- Provides quantitative parametric maps: T1, T2, R1, R2, PD
- Includes quantitative mapping to determine tissue type
- Provides more diagnostic information without extra time

Quantitative assessment of the lesion T1 and T2 helps to identify the Arachnoid Cyst



ImageWorks

Innovative Applications

Case Study: Brain Imaging with MAGiC & Silent

Clinical solutions

Applications: MAGiC, Silent PROPELLER, Cube FLAIR

System: SIGNA™ Explorer 1.5T

Coil: HNU Brain

Patient history

44 year-old patient presented with double vision and dizziness for 2 months. Previous imaging showed negative CT. Possible multiple sclerosis (MS) indicated.

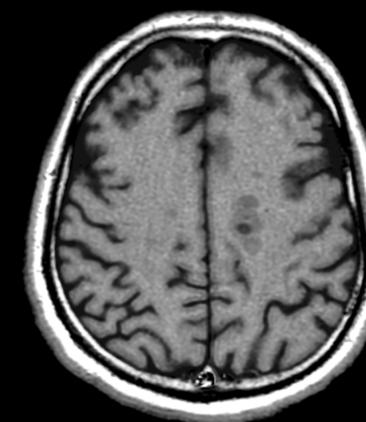
Procedure

Brain MR with and without contrast ordered with demyelinating protocol.

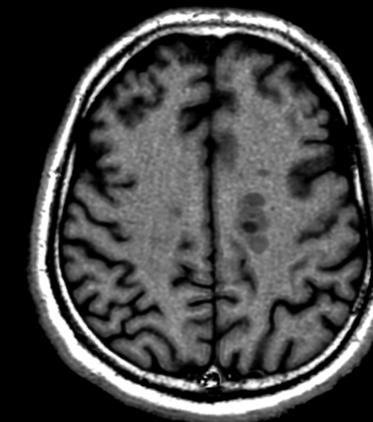
Diagnosis

Multifocal signal abnormality compatible with a mild to moderate burden of MS. Lobular enhancement at the high posterior left frontal lobe, in the splenium the corpus callosum and in the periventricular white matter about the atria of the lateral ventricles consistent with areas of active demyelination. Mild to moderate inflammatory changes in the paranasal sinuses.

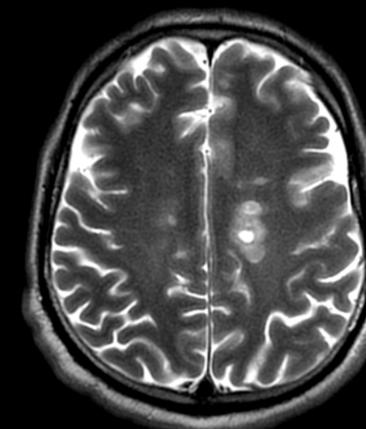
Axial T1 MAGiC, 500 TR



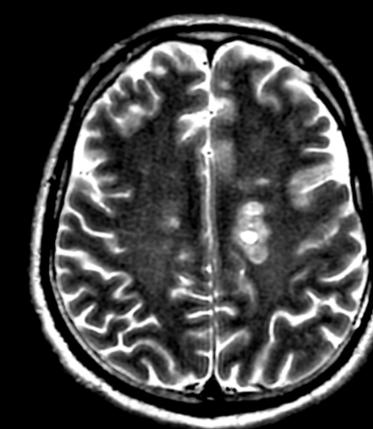
Axial T1 FLAIR MAGiC, 2500 TR



Axial T2 PROPELLER Silent 3:26



Axial T2 MAGiC High ART 0:00



ImageWorks

Innovative Applications

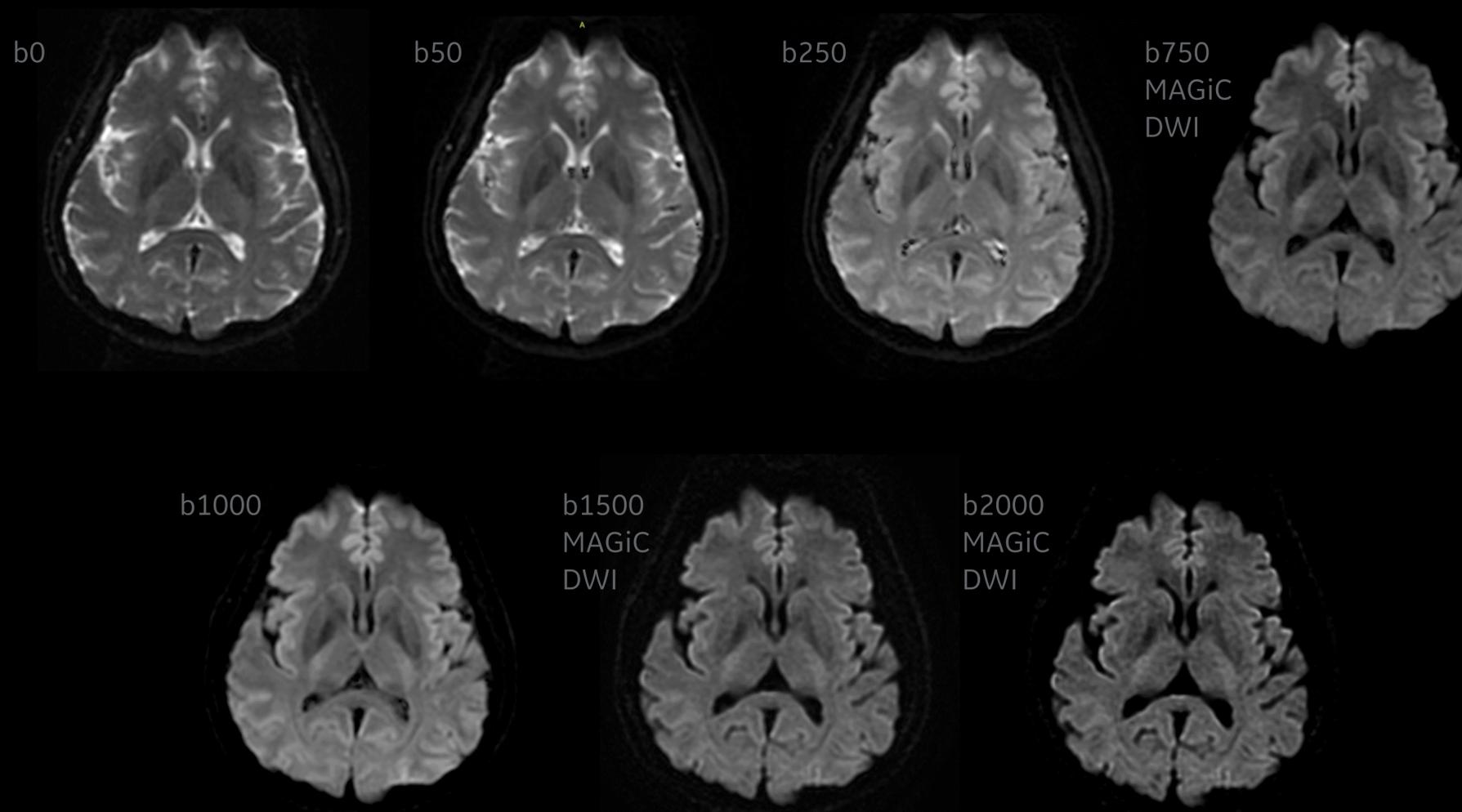
MAGiC DWI

MAGnetic resonance image Compilation Diffusion Weighted Imaging (MAGiC DWI) generates multiple synthetic b-values from one DWI scanned series so you can view diffusion contrast changes in real time after acquisition. It delivers high b-values without stressing protocol parameters, and shorter scan times without sacrificing contrast or anatomy coverage. It also allows shorter TE, improving SNR and sharpness.

Clinical benefits:

- Multiple synthetic b-values from a single DWI scan
- High b-values in shorter scan times
- Compatible with FOCUS diffusion
- Calculates high b-value as required by PIRADS for prostate

Multi b-values acquired: 4 acquired, 3 synthetic 1:17 min

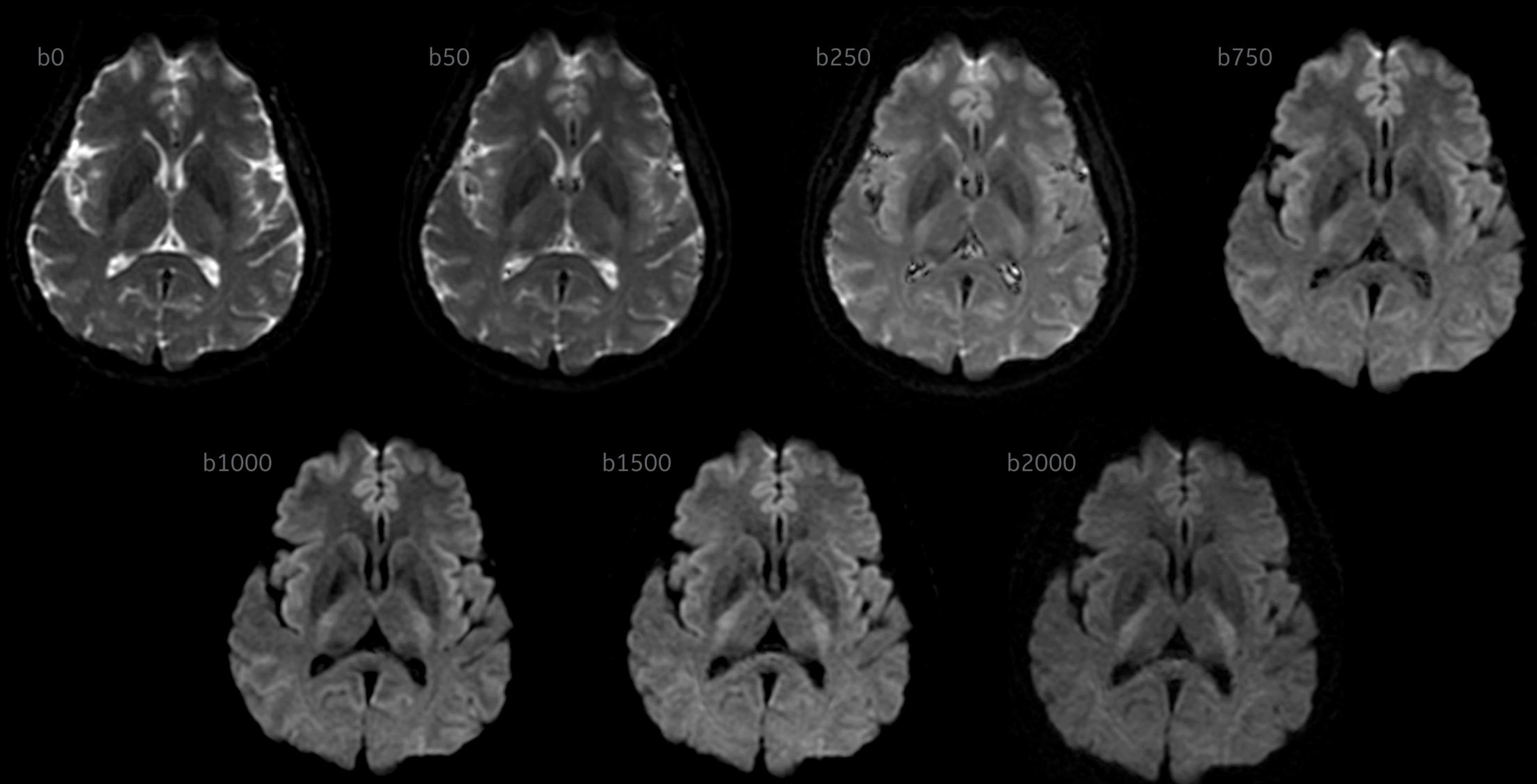


ImageWorks

Innovative Applications

MAGiC DWI

Multi b-values
acquired: All 7
3:21 min



ImageWorks

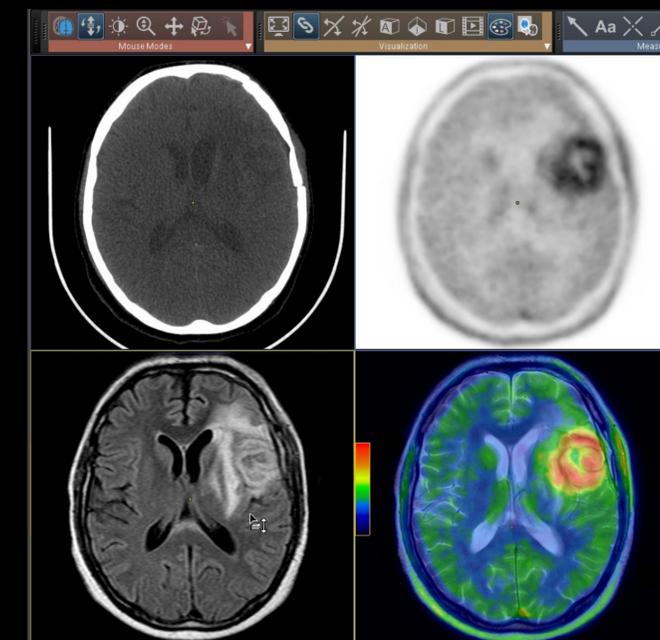
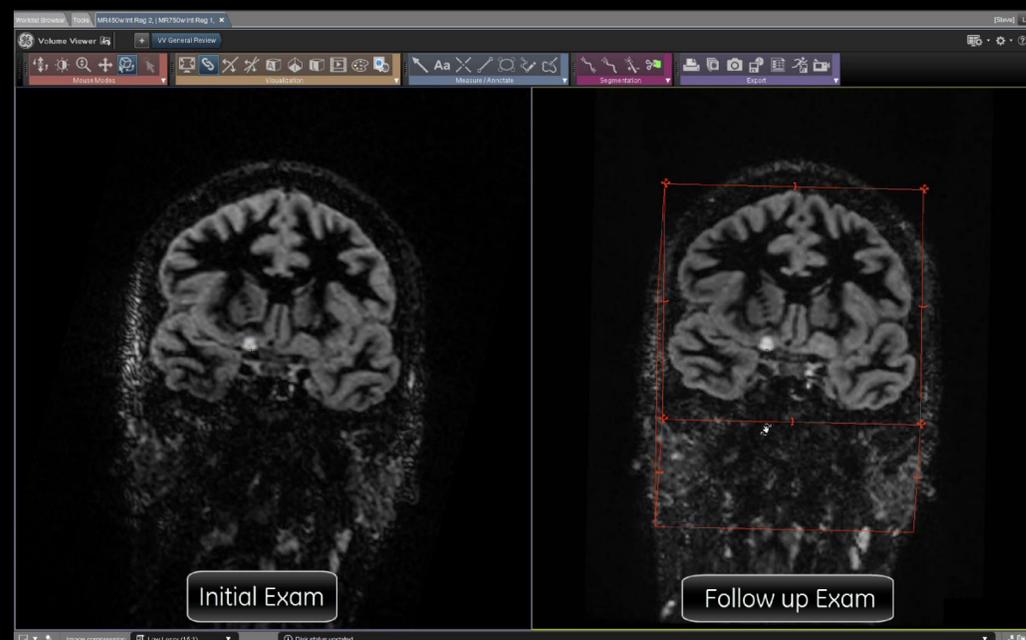
Innovative Applications

READYView

READYView allows processing of dynamic or functional volumetric data and generates maps that display changes in image intensity over time, echo time, b-value (diffusion imaging) and frequency (spectroscopy). It powerfully brings together acquired images, reconstructed images, calculated parametric images, tissue segmentation, annotation and clinician measurements, allowing multiparametric analysis.

Clinical benefits:

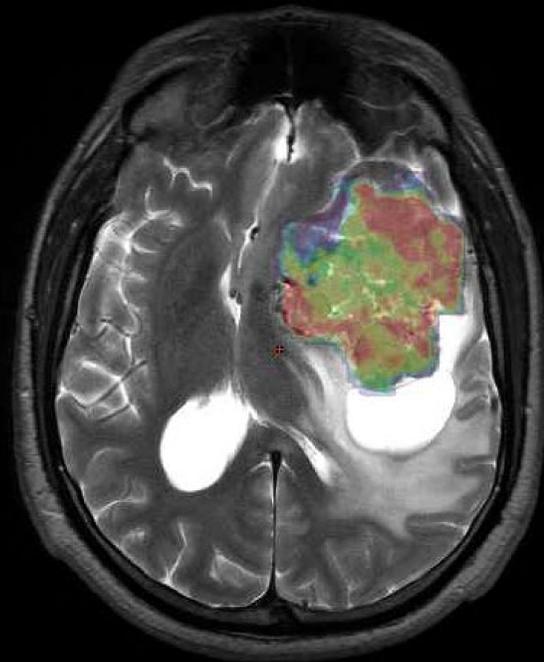
- Enhances productivity
- Features tools and custom layouts for speedy, accurate analysis
- Delivers quantifiable data for focused analysis



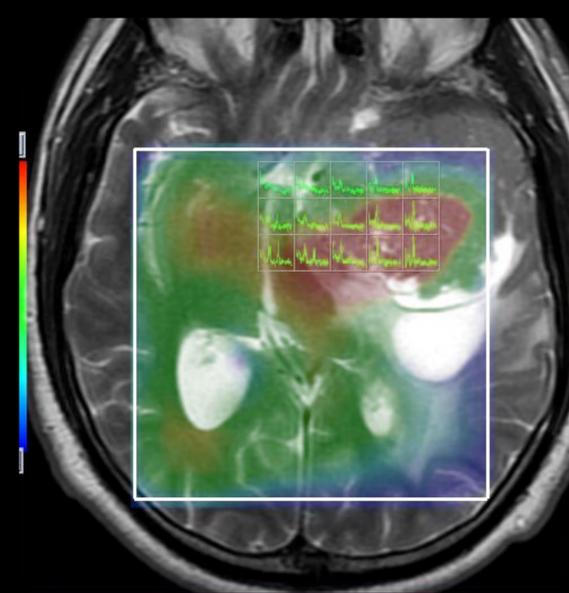
ImageWorks
Innovative Applications

READYView

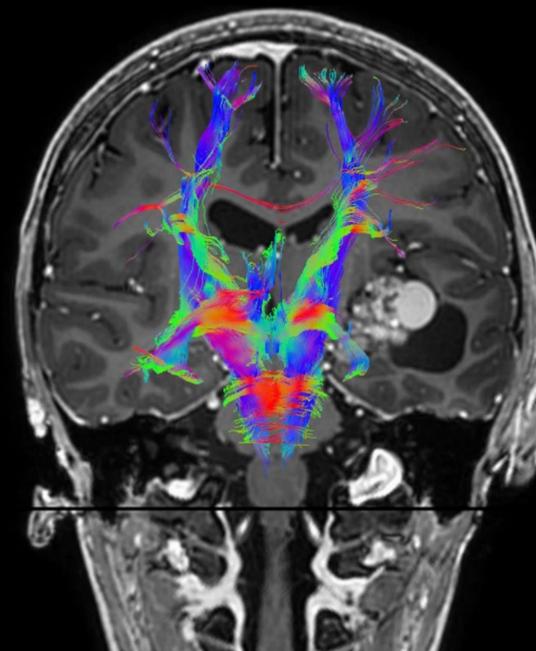
Perfusion map



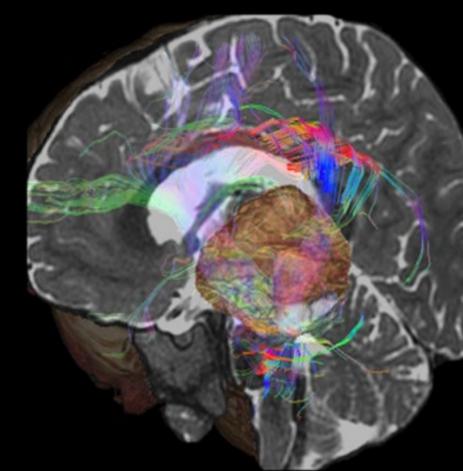
Metabolite map



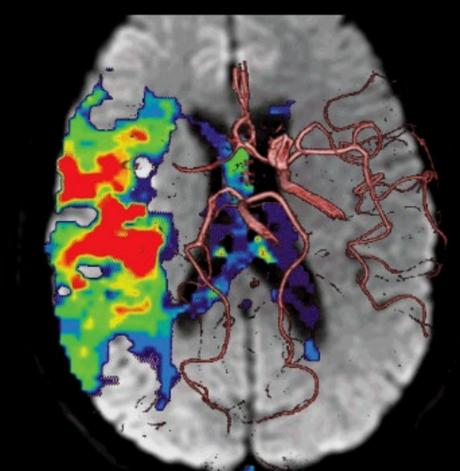
FiberTrak overlay



3D Volume rendering



Perfusion map



ImageWorks

Innovative Applications

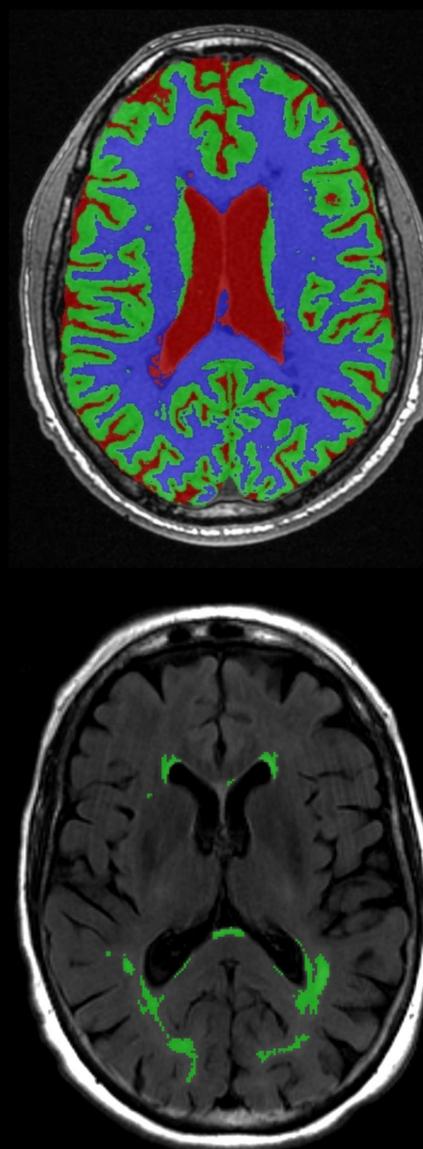
Quantib Brain

Quantib Brain offers automated quantification of brain tissue and white matter hyperintensities (WMH). It delivers valuable information about neurodegenerative disease at a fraction of the time required by manual procedures, without the need for highly trained clinicians.

Clinical benefits:

- Automatically detects WMH typically seen in neurodegenerative diseases such as MS
- Measures and quantifies the cerebrum
- Fully integrated into READYView
- Provides longitudinal measurement over time

Color-coded WMH



Longitudinal report

Anonymized		Jan 01 2010	Jan 01 2014
1 - Finding 1	MR - M10/FSPGR: Sag FSP...	MR - M10/FSPGR: Sag FSPGR 3D	MR - M10/FSPGR: Sag FSPGR 3D
	ROI 56 - Intracranial Volume (ICV)	ROI 1 - Intracranial Volume (ICV)	ROI 1 - Intracranial Volume (ICV)
	Gross vol. : 1092 cm3	Gross vol. : 1095 cm3	Gross vol. : 1095 cm3
	Rel. vol. : 100.0% of ICV	Rel. vol. : 100.0% of ICV	Rel. vol. : 100.0% of ICV
2 - Finding 2	MR - M10/FSPGR: Sag FSP...	MR - M10/FSPGR: Sag FSPGR 3D	MR - M10/FSPGR: Sag FSPGR 3D
	ROI 57 - Cerebrospinal Fluid (CSF)	ROI 2 - Cerebrospinal Fluid (CSF)	ROI 2 - Cerebrospinal Fluid (CSF)
	Gross vol. : 218 cm3	Gross vol. : 241 cm3 (+10%)	Gross vol. : 241 cm3 (+10%)
	Rel. vol. : 20.0% of ICV	Rel. vol. : 22.0% of ICV (+10%)	Rel. vol. : 22.0% of ICV (+10%)
3 - Finding 3	MR - M10/FSPGR: Sag FSP...	MR - M10/FSPGR: Sag FSPGR 3D	MR - M10/FSPGR: Sag FSPGR 3D
	ROI 58 - Grey Matter (GM)	ROI 3 - Grey Matter (GM)	ROI 3 - Grey Matter (GM)
	Gross vol. : 523 cm3	Gross vol. : 515 cm3 (-1%)	Gross vol. : 515 cm3 (-1%)
	Rel. vol. : 47.9% of ICV	Rel. vol. : 47.0% of ICV (-2%)	Rel. vol. : 47.0% of ICV (-2%)
4 - Finding 4	MR - M10/FSPGR: Sag FSP...	MR - M10/FSPGR: Sag FSPGR 3D	MR - M10/FSPGR: Sag FSPGR 3D
	ROI 59 - White Matter (WM)	ROI 4 - White Matter (WM)	ROI 4 - White Matter (WM)
	Gross vol. : 351 cm3	Gross vol. : 338 cm3 (-3%)	Gross vol. : 338 cm3 (-3%)
	Rel. vol. : 32.2% of ICV	Rel. vol. : 31.0% of ICV (-4%)	Rel. vol. : 31.0% of ICV (-4%)
5 - Finding 5	MR - T2flair: Ax T2 FLAIR	MR - T2flair: Ax T2 FLAIR	MR - T2flair: Ax T2 FLAIR
	ROI 106 - Total WMH	ROI 55 - Total WMH	ROI 55 - Total WMH
	Gross vol. : 7.70 cm3	Gross vol. : 19.19 cm3 (+149%)	Gross vol. : 19.19 cm3 (+149%)
	Rel. vol. : 2.19% of WM	Rel. vol. : 5.66% of WM (+158%)	Rel. vol. : 5.66% of WM (+158%)
	Burden : 45	Burden : 48 (+7%)	Burden : 48 (+7%)
	Brain	Brain	Brain
	Gross vol. : 874 cm3	Gross vol. : 854 cm3 (-2%)	Gross vol. : 854 cm3 (-2%)
	Rel. vol. : 88.0% of ICV	Rel. vol. : 78.0% of ICV (-9%)	Rel. vol. : 78.0% of ICV (-9%)

SilentWorks

Innovative Applications

SilentScan

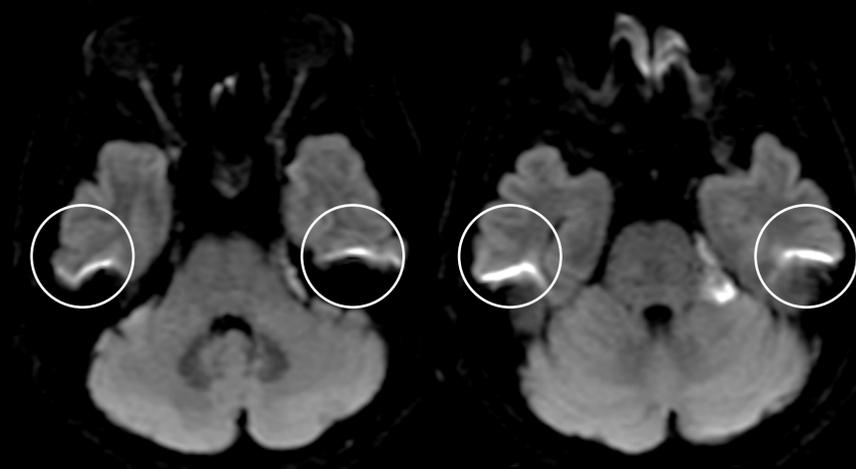
Silent Scan is a revolutionary neuro acquisition technique that makes the sound of an MR scan as silent as a whisper, without compromising image quality. It combines three advanced technologies – Silenz with Zero Echo Time (ZTE)*, High Fidelity Power Electronics and Ultra-fast Switching Capabilities – to eliminate acoustic noise at the source, revolutionizing how MR images are acquired.

Clinical benefits:

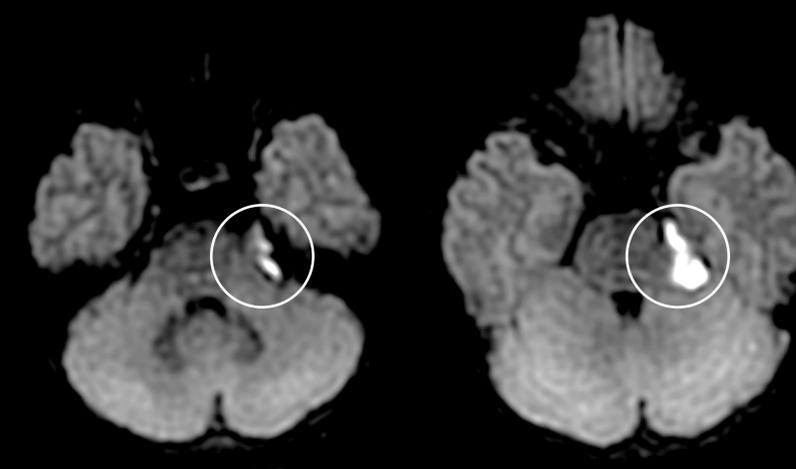
- Reduces flow related artifacts with 3D ZTE acquisitions
- May reduce the need for rescans which enables faster throughput
- May reduce patient anxiety which could result in a better patient experience



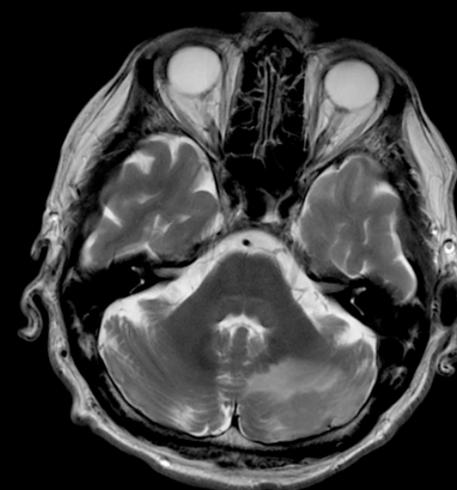
EPI Diffusion, b1000



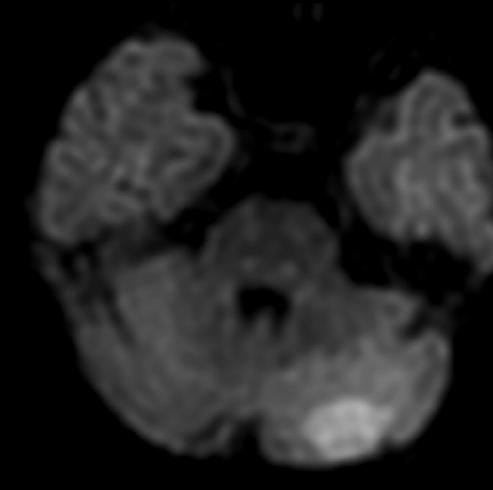
SilentScan DWI, b1000



SilentScan T2w



SilentScan DWI

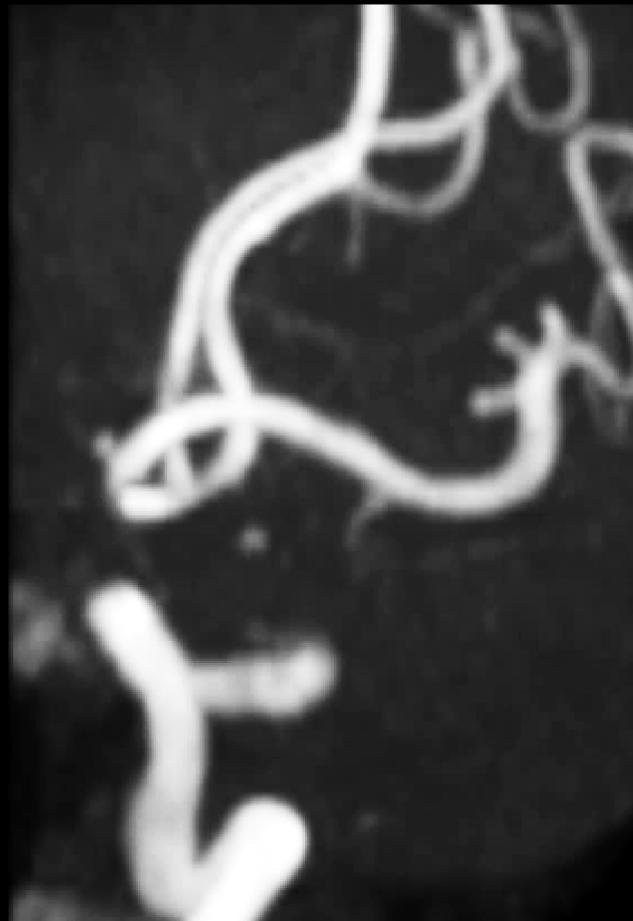


SilentWorks

Innovative Applications

SilentScan

TOF MRA



SilentScan MRA



Angiography





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