

The background of the cover is a photograph of two female MRI technologists in a clinical setting, looking intently at a large computer monitor. The monitor displays several MRI scan images of a human head. The overall lighting is dim, with the primary light source being the glow from the monitor, which creates a professional and focused atmosphere.

PHILIPS

MRI magazine

Publication for the Philips MRI community Issue 59 – 2023

FieldStrength

Fast, high quality imaging with SmartSpeed

High-powered gradients boost
MR research projects

Versatility, quality, reliability experienced
with sealed magnet system

Upgrade instead of new system
provided clear advantages



Dear Friends,

At Philips, we are driving towards high quality ultrafast exams and automated, patient centered workflows. We recently introduced SmartSpeed – powered by AI – that allows for substantial improvements in speed and image quality¹. After introducing Compressed SENSE a few years ago, many experienced MR users were amazed at how much acceleration was possible without significant quality loss. And now we impress users again with SmartSpeed, as you can read in this issue's article about Mermaid Beach Radiology, Australia.

We now have a portfolio of fully sealed 1.5T MR systems which contain only 7 liters of helium with no compromise on clinical confidence and patient- and staff experience. Those systems delight customers around the world and help them in advancing their practice: Dr. Gellée experiences versatility, high quality and diagnostic reliability using the MR 5300. The efficient workflow and lightweight coils improve examinations for patients and staff, and the sustainable helium-free operation of MR 5300 is highly valued. The improvement in clinical confidence with our helium-free MR solutions is also being enjoyed at Live Healthy Imaging, Texas, USA, where the 1.5T Ambition is used for a full range of exams, with a focus on cardiac studies. This team is pushing the boundaries of MRI and has a clear vision on broadening the use of cardiac MR.

And if you want to learn more about our premium line MR 7700 system, I recommend the article where Prof. Heindel explains how their clinical research will be centered around this exceptional 3.0T system and how well the system performs with excellent delineation of small pathology.

Switching back to sustainability and partnering with our customers. We offer advanced options for customers who desire to have our latest MRI capabilities with an older Philips system. By choosing a major upgrade which turns their existing magnet into a modern MR system, customers have experienced advantages such as improved quality, lower costs and limited downtime for the conversion, as you can read in this issue. At the same time, extending the use of a magnet instead of replacing it fits with a mindful use of our planet's resources.

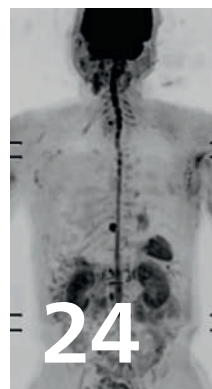
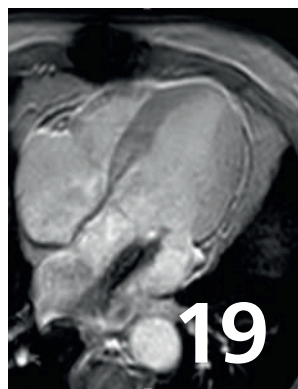
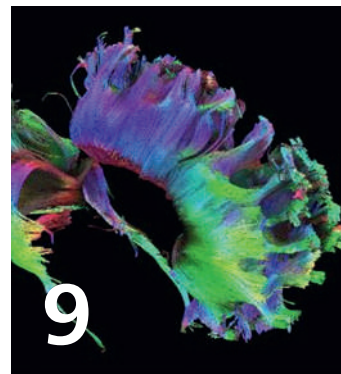
Enjoy reading either as printed or digital version of this issue!

A stylized, handwritten signature in blue ink, likely belonging to Margriet Nijdens.

Margriet Nijdens

Head of Global Product Marketing MR, Philips

Fast MRI with high quality



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1) Compared to SENSE imaging.

Results from case studies are not predictive of results in other cases. Results in other cases may vary.

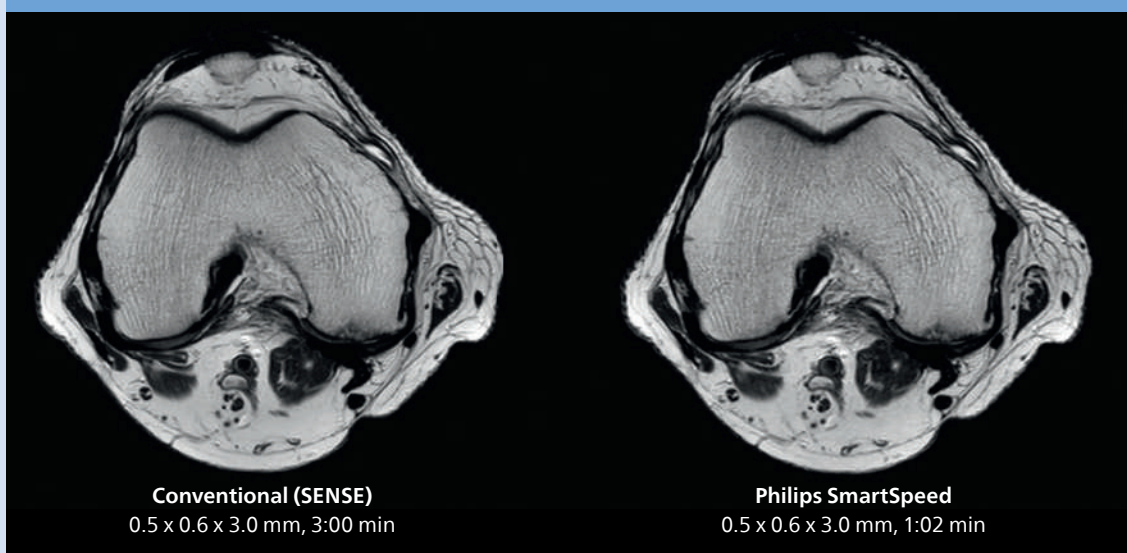
Results obtained by facilities described in this issue may not be typical for all facilities.

Philips MR spearheading fast, high quality imaging and sustainability

At recent events, Philips showcased some key MRI solutions. We launched SmartSpeed to advance both speed and image quality in MRI. In addition, we are expanding the success of our helium-free operations by introducing a third MR system with a sealed magnet. This helium-free technology offers benefits for users and respects the limited resources of our planet. We've also extended Smart Workflow, which now offers enhanced ease of use and automated, AI-based patient sensing.

Shorten scan times and boost image quality with SmartSpeed

About 3 times faster with SmartSpeed¹



SmartSpeed not only allows users to scan up to three times faster, but also to achieve up to 65% higher resolution¹. And this is not just applicable to a few sequences, but covers 97% of all clinical protocols². Our first customers are already confirming the advantages of this award-winning technology³.

SmartSpeed combines the Philips-unique Compressed-SENSE speed engine with a deep learning AI reconstruction at the source, where information is the richest. SmartSpeed preserves image detail by using a very intelligent denoising technique.



Reduce resource consumption with helium-free MR operations

At Philips, we are conscious of our responsibility towards society and of the need to continue to embed sustainability even deeper in the way we do business. Our BlueSeal MR magnet requires only 7 liters of liquid helium for magnet cooling⁴ (<0.5% of today's volume), decreasing the consumption of this scarce resource. With the fully sealed magnet, no helium refill is required during its lifetime, saving the helium cost and avoiding operational disruption. BlueSeal technology decreases helium-related CO₂ emissions by 5.1 ton per customer⁵. The BlueSeal magnet currently provides helium-free operations to customers around the world who are using our Ambition 1.5T or our MR 5300.

Low power consumption

AI-powered SmartSpeed not only provides faster scanning¹, but also reduces power consumption by up to 53% per scan (32% on average)⁶.

MR PowerSave reduces power consumption by up to 46%⁷ by switching automatically to stand-by mode when the system is not being used for scanning.

Our most recently introduced MRI systems



The **1.5T MR 5300** system features a BlueSeal magnet for helium-free operations. Its lightweight coils enable easy and fast positioning of the patient on the MR table. The coils can be used separately or in combination, for a versatile range of anatomies and patients – from adult to pediatric – to provide MR images of exceptional quality.



MR 7700 is built on a leading 3-Tesla platform and is designed to meet the most demanding needs of both clinical and research programs. Its high-fidelity XP gradients deliver high levels of clinical performance, providing up to 35% higher SNR⁸, 50% more DTI directions, and 20% more fMRI volumes⁹. Switching to imaging of different nuclei (1H, 31P, 13C, 23Na, 19F and 129Xe) is seamlessly integrated¹⁰ into the MR 7700 workflow as a scan parameter in the regular user interface, so that imaging of proton and other nuclei can easily be combined into one examination.

- 1 Compared to Philips SENSE imaging.
- 2 On average, measured across a sample of sites from Philips MR installed base.
- 3 Adaptive-C-SENSE-Net technology is the winner of Fast MRI Challenge hosted by Facebook AI research and New York Langone Health.
- 4 Compared to the Ingenia 1.5T zero boil-off magnet.
- 5 Compared to Philips conventional systems, with average annual refilling over a 10-year lifetime.
- 6 Philips SmartSpeed power consumption versus Philips SENSE based scanning. Based on COCIR and in-house simulated environment. Results can vary based on site conditions.
- 7 Applicable to Elition and MR 7700. Philips stand-by versus ready-to-scan mode. Results can vary based on site conditions. Based on COCIR typically day definition (10 hours activity: 3 hours ready-to-scan, 7 hours scan).
- 8 Compared to Ingenia Elition X.
- 9 Compared to Philips fMRI without MB SENSE.
- 10 Caution: Investigational device for imaging with fluorine (19F) and xenon (129Xe). Limited by federal (or United States) law to investigational use. Clinical imaging with these nuclei requires usage of a cleared drug. No FDA-cleared drugs are currently available for these nuclei.



Faster scans and better image quality¹ at Mermaid Beach Radiology

According to Ben Kennedy the biggest change they have seen over time in MR imaging is alleviating the trade-off between speed and image quality. "MRI has always been wonderful at showing high detail contrast, but acquisition time has often been the challenge. Now with SmartSpeed, what we thought normal for speed versus quality is changing to a whole new level."

"Our workflow and productivity are vastly improved. For many complex cases that would often take longer, we're now able to fit them into a normal routine scanning time."

Ben Kennedy, Director of MRI at Mermaid Beach Radiology



Using Philips SmartSpeed we've taken resolution to a new level across all applications with faster protocols, so the patient, referring physician and reporting radiologist all benefit."

Ben Kennedy, Director of Clinical and Research MRI



Amazing productivity and clinical confidence

Mermaid Beach Radiology, Australia, values accuracy in medical care and patient satisfaction. To provide the best service, they partner with Philips to use the latest innovations. "We've enjoyed a good collaboration with Philips that's grown a strong trust over time," says Ben Kennedy. "We've seen research applications translate into the clinical world, where we have had a chance to review and help optimize them before they came to market."

After using Philips SENSE, Mermaid Beach had adopted Compressed SENSE that offers a k-space sampling approach to speed scans while preserving details. "And now SmartSpeed enables denoising the sparse under-sampling in a new way that has allowed us to increase acceleration and bring image quality to a whole new level," notes Kennedy, "It's truly revolutionized our MRI work space, especially for difficult patients."

"After enjoying the fruits of Compressed SENSE for quite some time, we didn't think productivity would get much better, but seeing the difference with SmartSpeed is just amazing. It's almost too good to believe," says Kennedy.

Philips SmartSpeed has multiple approaches to denoising. Raw k-space data, coil sensitivity and coarse background information are all used and reconstructed with artificial intelligence (AI) to provide true resolution in shorter scan

times¹ with more sequences. Kennedy states, "I noticed that since the introduction of SmartSpeed, our day is a lot less stressed. When complicated exams need extra time, we just get on with them. And if we need to do something new or extra, we have the time for it and our workflow is still a lot more efficient."

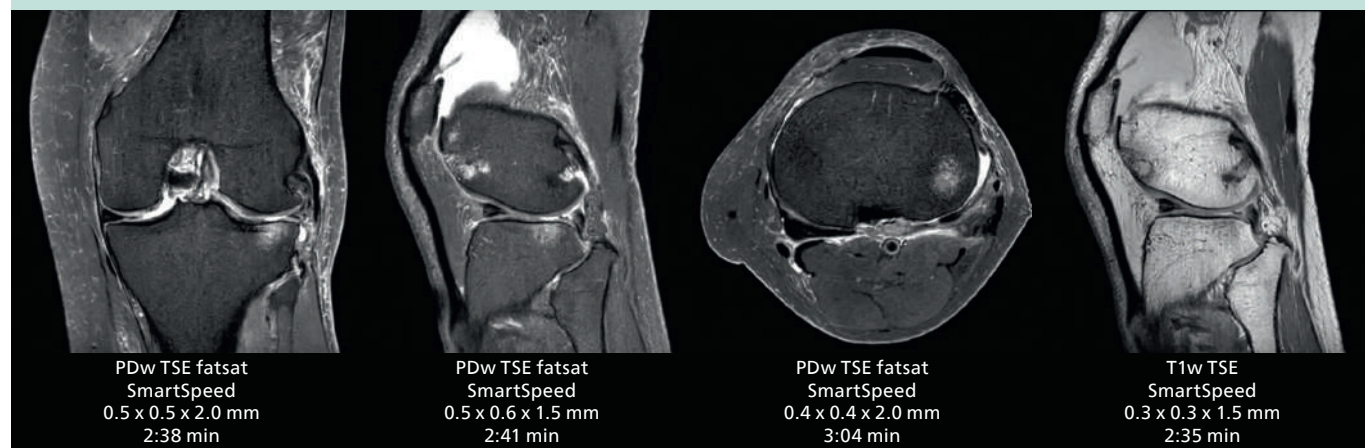
In addition to workflow benefits, Kennedy highlights the improvement in their diagnostic confidence. "The quality of output is so much higher than what we believed was possible, and it is very consistent across multiple patients. SmartSpeed made it feasible for us to include extra sequences in our exams and still maintain routine scanning times. This allows us to make a surprising number of diagnoses that we couldn't have appreciated before with our previous protocol. We've gotten an extremely positive response from our referrers." ►

"Being able to use it everywhere and anywhere has been a whole new transformation to our productivity and confidence."

Ben Kennedy, Director of Clinical and Research MRI

Knee with SmartSpeed

More details, within the same scan time, up to 65% higher spatial resolution.



Opening up new opportunities

"With SmartSpeed, we've been able to use some extended applications more routinely. A good example is Philips 3D NerveVIEW. Being able to bring its scan time down to 3 or 4 minutes rather than 6 or 7, has allowed us to use it routinely and find answers that we haven't achieved before. We've introduced it in many peripheral MSK and extracranial neural applications. Now we are seeing diagnoses of neuritis in regions that we've never seen previously. It's a whole new way of looking at peripheral neurography." As a result, Mermaid Beach receives great feedback from their referring hospitals.

The broad applicability of SmartSpeed allowed the imaging center to use this technology across many scan types, including non-cartesian imaging as used for motion correction in uncooperative patients or challenging anatomies.

"We use SmartSpeed frequently on difficult areas such as the abdomen and chest where it is common to see respiratory motion and other bowel motion," says Kennedy. In MSK scans they use SmartSpeed not only for speeding up their exams, but also to reduce slice thickness and improve resolution "We may be increasing the number of slices, but we're still doing this in less time than we were previously."

SmartSpeed also helps taking on implant imaging. "From time to time we get people with implants, like hip replacements or knee replacements. O-MAR has always been our go-to sequence for metal artifact reduction in those patients. However, it takes substantial time for acquisition. Using Philips SmartSpeed has allowed us to cut this scan time in half. It's a huge innovation."

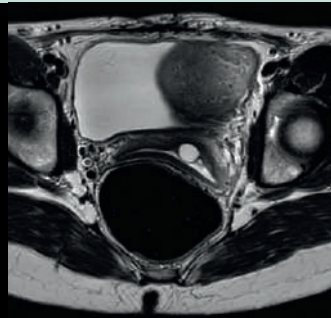
Easy to adopt into a daily routine

Philips SmartSpeed is designed with ease-of-use in mind and therefore easy to adopt. "It has been really easy to implement across all of our Exam Cards, which is one of the pleasures of SmartSpeed. Often with a new innovation comes some nervousness as to how we can use it best. SmartSpeed however has just been a breeze since the get go."

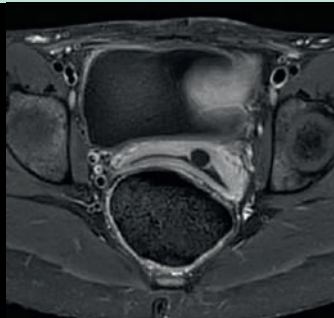
Initially, Mermaid Beach worked out the exact level of denoising preferred by each of their radiologists to support their applications for the best possible diagnoses. After completing that step, each radiologist will consistently have their preferred level. According to Kennedy, "It's very simple for the staff and we can enjoy the fruits of beautiful images and very fast imaging." ■

Motion robustness and high-resolution

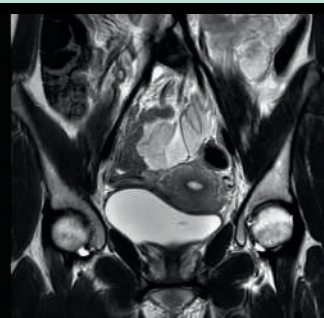
Uterus protocol with SmartSpeed MotionFree



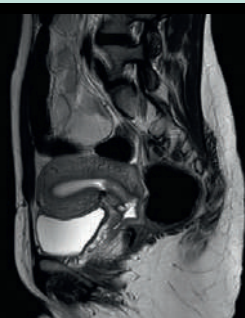
Axial T2w TSE
0.4 x 0.4 x 3.0 mm
3:11 min



Axial T1w TSE FS
0.5 x 0.5 x 3.0 mm
2:18 min



Coronal T2w TSE
1.1 x 1.1 x 3.0 mm
2:09 min



Sagittal T2w TSE
0.4 x 0.4 x 3.0 mm
3:25 min



To sum it up, SmartSpeed is easy to use, we can use it everywhere with confidence, it virtually works first time every time, and it helps us reduce the number of repeats. If we need to go fast, we can go really fast. If we want to accentuate our quality for time, we can really go for it."

Ben Kennedy, Director of Clinical and Research MRI

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of this article



High-powered gradients boost MR research projects at UKM

University Hospital Münster one of the world's first to benefit from exceptional diffusion capabilities

University Hospital Münster (UKM) radiologists and researchers are among the world's first to experience what the high gradient power of MR 7700 means for clinical research studies. The team is eagerly exploring the 3.0 Tesla MR system's potential for supporting their ongoing neuroscience research and innovations in prostate, liver and lymph node imaging. For diffusion imaging in particular, they see markedly higher SNR, shorter scan times and reduced distortions.



Walter Heindel, MD

Professor of Radiology and Chair, Director of the Clinic for Radiology at the University Hospital Münster. His major fields of research are early detection of disease by imaging (screening, molecular imaging, advanced imaging approaches, population-based research) and minimal-invasive image-guided therapy (interventional oncology and cardiovascular radiology).



The higher gradients of the MR 7700 allow improved diffusion measurements, meaning more directions and/or more shots for higher b-values, without lengthening examination times."

Beginning a new era of outstanding scanning

At UKM, the team led by Dr. Walter Heindel operates six MRI scanners. Their latest addition, the Philips MR 7700 is dedicated to research and was chosen for the strength and quality of its XP gradients and numerous other innovations.

"We expect that the system will help us to speed up high-end MR imaging even more, without losing image quality," Dr. Heindel says. "We will concentrate our clinical research projects on this system, especially studies related to patients with neurological and neurosurgical issues and patients with oncologic diseases."

In its first few weeks of operation, more than 100 patients and volunteers have been scanned on the MR 7700. Initial projects for which the team will harness the system include high-resolution multiparametric prostate MRI, developing innovative protocols for stroke imaging, and diffusion studies of the lymph nodes. ►

"In one of our first patients we were able to acquire a quite high-resolution diffusion image with a b-value of 3000, which clearly delineated the prostate lesion."

"We expect that the more powerful gradient system will allow improved diffusion results, meaning more directions and/or more shells [i.e. b-values] and higher SNR without lengthening examination times," he says. "We also are confident that the Compressed SENSE and MultiBand SENSE acceleration methods will help here. For example, we plan to investigate, whether diffusion techniques in body imaging may serve as an alternative to contrast agent application."

Improved prostate diffusion images to guide ultrasound biopsies

Dr. Heindel believes the MR 7700 will benefit the hospital's existing program in which multiparametric MRI of the prostate is not only used for diagnosis, but also for MRI/ultrasound fusion guiding targeted prostate biopsies.

"Working with our colleagues in urology, we have been focusing on early detection of prostate cancer," he says. "Multiparametric MRI helps us identify suspicious lesions. Then fusing the MRI data with ultrasound imaging enables real time MRI-guidance during biopsy, so that urologists can

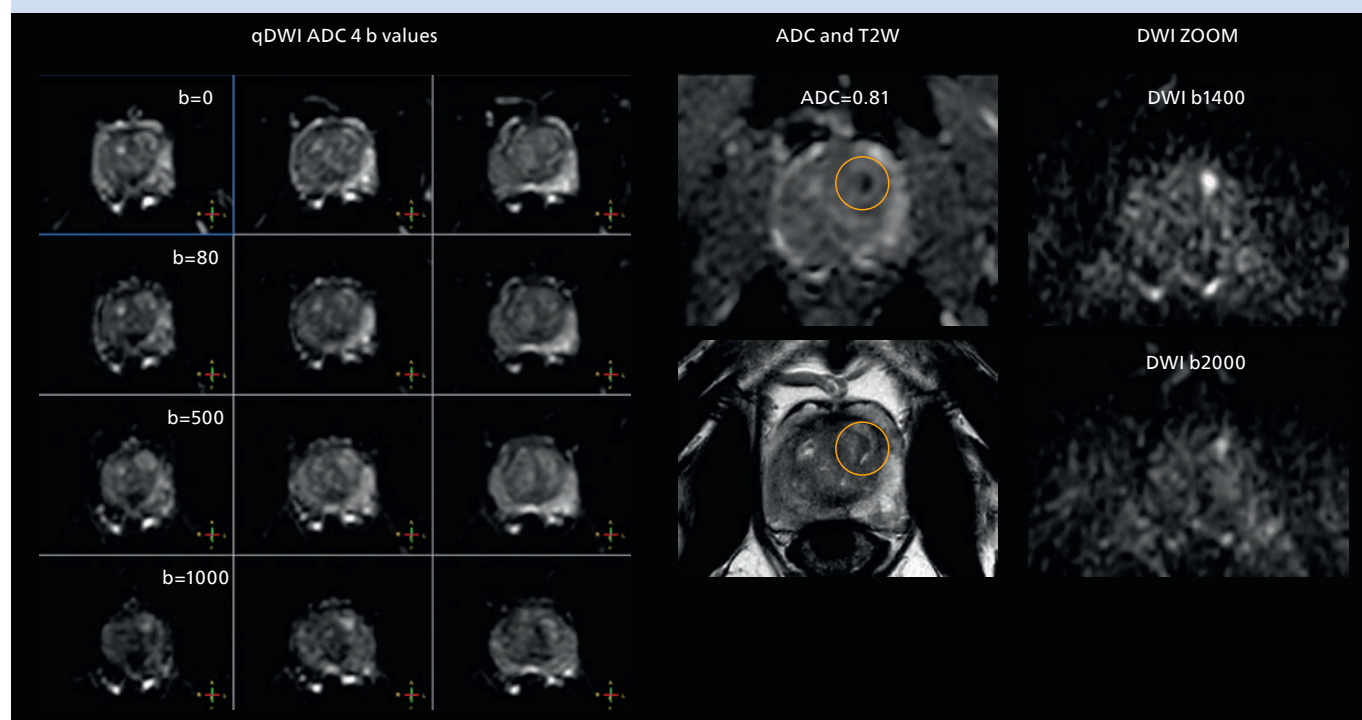
see the lesion and perform a targeted biopsy. We established this interdisciplinary process during the past years to replace conventional blind prostate biopsies. This was also done with Philips and it was a great success."

"From our experience, the diffusion imaging (DWI) seems to provide the most useful information in this process. And it is exactly the diffusion imaging that benefits much from the powerful MR 7700 gradients. So, we will investigate how even higher resolution DWI may enable an innovative approach in this area. The team also aims to investigate multiparametric imaging in combination with machine learning."

The prostate DWI done so far with the MR 7700 looks promising; the quality of visualizing the gland and the areas of disease seems significantly improved. "In one of our first prostate patients we were already able to acquire a quite high-resolution diffusion image – using a b-value of 3000 – that clearly delineated the prostate lesion. That was a very nice example of what the MR 7700 gradients can achieve," he says.

Diffusion weighted imaging of prostate

The examples on the left show the regular clinical diffusion protocol with four b-values up to $b1000 \text{ s/mm}^2$. On the right, the T2W image shows a hypointense lesion that has low ADC and is clearly visible in $b1400$ and $b2000$ diffusion images, suggesting malignancy.



Innovating stroke imaging

The UKM is a leading neurovascular center and stroke research is an important activity. DWI's sensitivity for small and early infarcts of stroke helps in managing these patients. "Using the MR 7700 we want to develop and test innovative diffusion protocols for stroke imaging to allow fast, confident diagnosis," Dr. Heindel says. "Apart from critically ill patients, individuals often present here with stroke symptoms for whom we have to quickly assess if they are really having a stroke and need rapid hospitalization in the stroke unit, while in the case of a stroke mimic the patient may be sent home with medication if needed."

High resolution providing diagnostic confidence

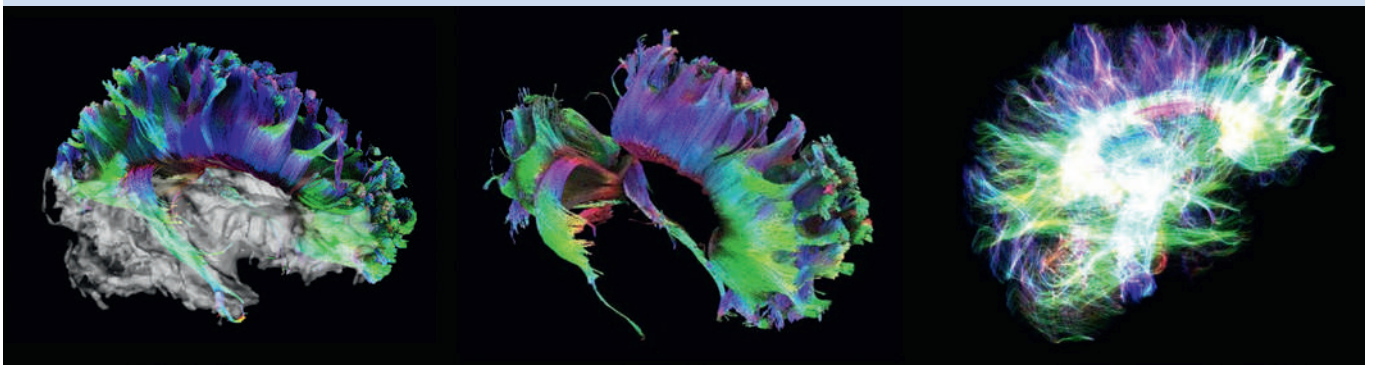
In select cases, the MR 7700 has helped the hospital's physicians more clearly visualize pathology. "We're definitely getting the impression that tumors are better delineated with the MR 7700," Dr. Heindel says. "For example, I examined a patient who had been diagnosed in another hospital with possible neuritis of the optic nerve. However, the MR 7700 images allowed me to diagnose it as an optic nerve sheath meningioma, a rare and often misdiagnosed, slowly growing tumor that was causing the visual disturbances in the patient. The lesion was so well delineated on the high resolution MR 7700 images that our neurosurgeon decided he did not need a biopsy before proceeding directly with decompression of the optic canal and peeling away those tumor cells." ►



"We're definitely getting the impression that tumors are better delineated with the MR 7700."

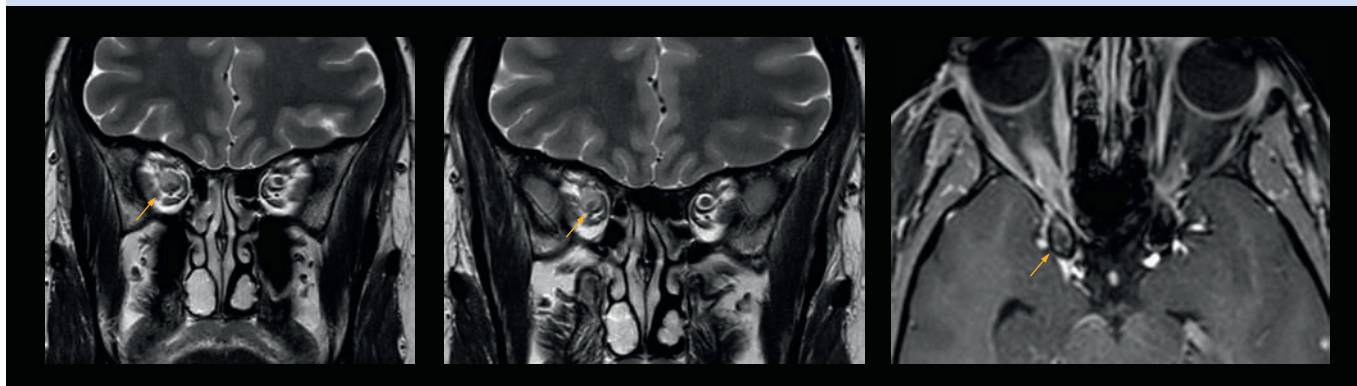
High angular diffusion imaging

The neuroscience team used 257 different directions, 23 b-values and a maximum b-value of 4000 s/mm² to collect the data below in a total scan time of 11 minutes. The higher number of gradient directions combined with multiple b-values not only allows for improved fiber tracking in these examples, but also enhances the analysis of intra-voxel incoherent motion (IVIM) and diffusion kurtosis (DK) effects in one single measurement.



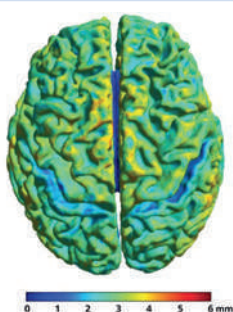
Imaging of the optic nerve sheath

High resolution-MRI impressively demonstrates the compression and narrowing of the right optic nerve in this case of optic nerve sheath meningioma (ONSM). The coronal T2-weighted images show the hyper-intense, half-moon shaped lesion, that is clearly visible in the axial T1W image after contrast injection (right). These imaging findings were so convincing that the responsible neurosurgeon did not consider a pretherapeutic histological clarification.

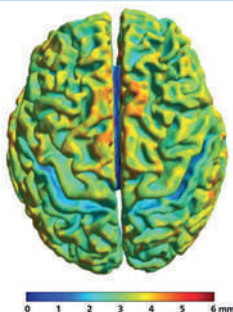


Voxel based morphometry

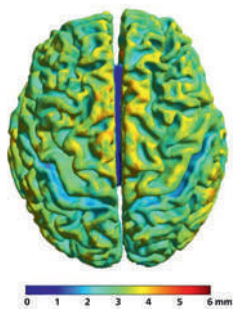
The neuroscience team compared their standard T1 brain morphometry sequence with alternate protocols facilitating Compressed SENSE. Selected examples shown here include adaption 1 with moderate CS=1.9, higher voxel resolution (0.85 mm), adaption 3 with CS=1.8 and 0.8 mm isotropic voxel size and the Philips protocol database default with CS=3.0 and 0.75 mm isotropic voxel size. All protocols resulted in comparable cortical thickness results with a slight decrease for higher CS-factors.



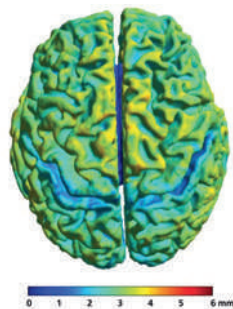
Original
1 mm isotropic
Thickness 2.70 ± 0.69
mm 11:00 min.



Adaption 1
0.85 mm isotropic,
CS=1.9 Thickness 3.02 ± 0.87
mm 6:35 min.



Adaption 3
0.8 mm isotropic,
CS=1.8 Thickness 2.77 ± 0.71
mm 8:49 min.



Philips CS
0.75 mm isotropic,
CS=3 Thickness 2.55 ± 0.69
mm 3:50 min.

Easy design of imaging protocols and amazing patient comfort

Dr. Heindel has received impressions that MR 7700 operation has been straightforward. "My highly specialized team of MR physicists raves about the ease of use of the system, especially the simple implementation of new imaging protocols. The low effort required to modify scan parameters and protocols enables fast and easy experimentation with imaging techniques," he says. "This clearly distinguishes Philips and was one of the reasons to choose this system."

There has also been positive feedback from patients. "One patient told me that she had never had an MRI examination that was so comfortable," Dr. Heindel says. "By virtue of the softness of the ComfortPlus mattress, combined with the short exam time, she was surprised at how pleasant the experience was, while in earlier examinations at other sites she just wanted to get out of the system. She said she would definitely drive the long distance again to have her follow-up examination also in this system."

Expanding research horizons with the MR 7700

University Hospital Münster will also harness the MR 7700 to support interventions, such as laser interstitial thermal therapy (LITT). LITT is a minimally invasive surgical technique to treat brain tumors and epileptic foci by implanting a laser catheter into the tumor or epileptic focus and heating it to temperatures high enough to ablate the disease.



We are interested in doing thermometry with the MR 7700 system to find out if the MR 7700 enables faster, more precise monitoring of LITT thermal changes."

"While depositing heat energy with LITT to destroy pathology, the surgeon has to take care to prevent or limit damage to surrounding normal tissues," Dr. Heindel says. "We are interested in doing thermometry with the MR 7700 system – measuring body tissue temperatures with MR to find out if the MR 7700 enables faster, more precise monitoring of LITT thermal changes."

In a neurosurgery project, Dr. Heindel's team is eager to discover how the MR 7700 gradients might help provide a more comprehensive picture of the brain prior to neurosurgery. "In the preoperative diagnostic work-up, DTI and fMRI are used to find out how close a tumor is to motor cortex areas, and to discover whether fiber tracts go around a tumor or through a tumor," he says. "We can then transmit these data into the neurosurgeon's brain imaging suite." There are also ongoing projects with real-time resting state fMRI.

Finally, in keeping with a worldwide focus on hygienic practices as a result of Covid-19, University Hospital Münster has placed its MR 7700 in a special scan room to allow investigation of fumigation for room cleaning. "This special exam room is equipped with an innovative sterilization technique involving the application of nebulized hydrogen peroxide," Dr. Heindel says. "This will allow us to investigate whether our approach is feasible to prevent the transmission of pathogens such as bacteria or viruses during radiological examinations. Sterile conditions in hospital environments have never been more important." ■



Some highlights of MR 7700

- 3.0T MR with XP gradient system for accuracy, power and endurance (65 mT/m, slew rate of 220 T/m/s, 2.4 MW amplifier)
- Higher diffusion IQ, for all anatomies:
 - Up to 35% higher SNR in similar scan time ¹,
 - Up to 35% shorter scan time using same spatial resolution [2]
 - Exceptional image quality, even at very high b-values; limits distortions, even in large FOV
- 20% more fMRI volumes ²
- 50% more DTI directions ³
- Ease of use, easy installation of new imaging protocols, uncomplicated access to modify parameters, easy data transfer
- Seamless integration of Multi Nuclei

1 Compared to Ingenia Elition X with Vega HP gradients, measured in brain white matter.

2 Compared to Ingenia Elition X with Vega HP gradients.

3 According to the definition of AI from the EU High-Level Expert Group.

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Saint-Augustin Clinic increases imaging capacity, reproducibility and patient satisfaction

MR 5300 system delivers versatility and efficiency

When Saint-Augustin Clinic, an illustrious private hospital in Bordeaux, France, decided to add a second MRI system to accommodate its high patient load, they were looking for an all-around, easy-to-use 1.5T system that provides high image quality throughout the body. They found what they wanted in the Philips MR 5300 system, and began operation with the system in January 2022. Saint-Augustin's radiologists and technologists prize the MRI system for its ability to deliver high quality imaging in a short time, as well as for the remarkably lightweight coils that are easy to position. Radiologist Stéphane Gellée, MD, shares her experiences.



We are able to have excellent image quality while also respecting natural resources, and that contributes to the health of people in two ways."



Dr. Stéphane Gellée,
radiologist at Saint Augustin Hospital
in Bordeaux. She specializes in liver and
other digestive imaging as well as female
pelvis imaging.

Serving more patients and helium-free operation

Saint-Augustin Clinic chose the [MR 5300](#) system to help it serve more patients. According to Dr Gellée this system meets its clinical needs for versatility, high quality and diagnostic reliability, while also addressing the need for better workflow and ergonomics that enhance both patient and operator experience.

The decision-makers were also impressed by the system's magnet that enables helium-free operation. The fully-sealed BlueSeal magnet uses just 0.5%¹ of the helium of a conventional system – and no refills are required.

Because no helium can escape, there is no need for a vent pipe, which makes siting easier and less costly. Dr. Gellée says the sealed magnet is also perceived as 'insurance' against quench.

Consistent image quality and speed impress

According to Dr. Gellée, the hospital conducts an average of four studies each hour, totaling about 40-45 patients per day on their MR 5300. Studies are read by approximately 50 radiologists in the Bordeaux area. Dr. Gellée is especially satisfied with the image quality of the MR system. "I obtain

higher image contrast and more anatomical precision than I was used to," she says. "When I am able to choose, I request that studies be done on this system, because I get better anatomical image quality. For example, in the knees, I can get great images of the meniscus. To me, it looks as pretty as 3T."

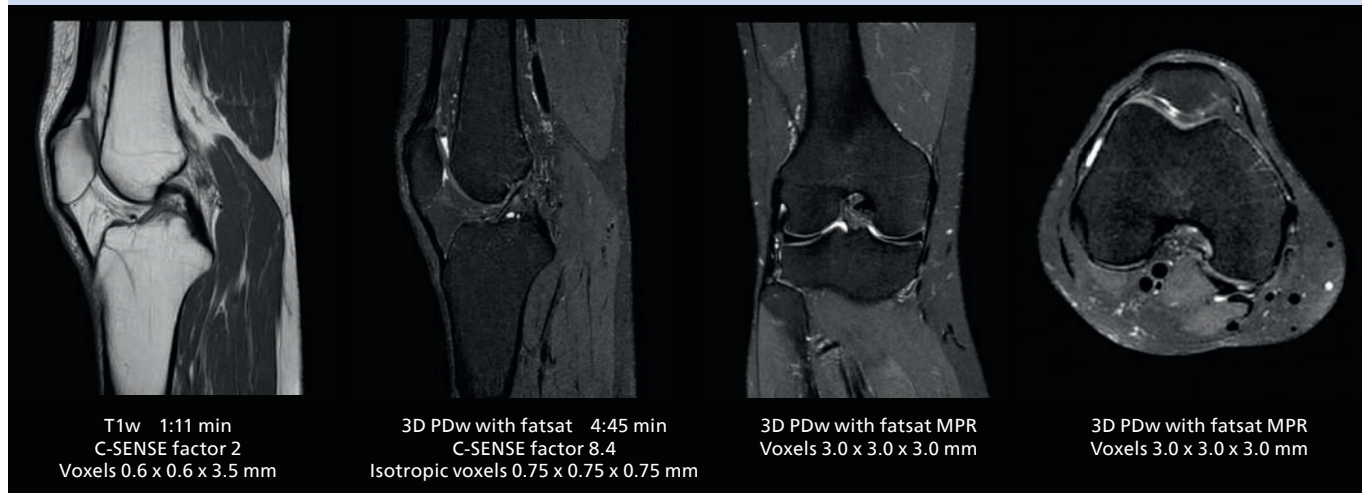
She values the consistent, reproducible results for all anatomies. "I have seen no bad exam on this system. I always can answer the question asked," she says.

Dr. Gellée also appreciates the large FOV imaging that the system makes possible. "I can image the intestines in a single acquisition by using a large field of view, which is enabled by combining coils to get more coverage. The images are of good quality and look very crisp." ►

"I can image the intestines in a single acquisition by using a large field of view, which is enabled by combining coils to get more coverage. The images are of good quality and look very crisp."

3D knee imaging

The isotropic high resolution 3D sequence in this MRI case allows for reformatting to obtain other orientations with high quality. Acquired on the MR 5300 system.





Saint-Augustin Clinique, (Bordeaux, France)

Supports management of emergency patients without disrupting schedule

Also remarkable is the high-quality black blood imaging for vascular and brain imaging as well as the fast stroke imaging. "In stroke imaging we achieve high quality diffusion, T2* with excellent homogeneity and high resolution TOF (time-of-flight) images. Even with this high resolution, the protocol is very fast, which allows us to include emergency imaging in our daily schedule," she says. "We often can accommodate an emergency patient without disrupting the schedule of other patient's appointments. Having the MR 5300 helps us in good emergency management in daily practice."

Free-breathing scans provide reproducibility and patient comfort

Dr. Gellée highlights the robust free-breathing scans as "the feature that makes the biggest difference in my daily work. The 3D free breathing sequences are very reproducible, and the axial acquisition is very good. For example, in endometriosis, which is one of my focus areas, it provides high contrast and good resolution so that I can see small details. We also use free breathing for liver and pancreas imaging. In multi-phase liver studies, 4D Free Breathing delivers 3-second temporal resolution, making a dynamic scan with more than one arterial phase possible."

For elderly patients in particular, free-breathing protocols make exams more comfortable while providing the image quality needed for confident diagnosis. "We have a large elderly population in the city, and because long breath holds are difficult for many older patients, free-breathing is a significant advantage," Dr. Gellée says. "In cardiac MR for example, with 4D flow and late enhancement, we get excellent diagnostic quality without asking our patients to hold their breath."

"In cardiac MR we get excellent diagnostic quality with 4D flow and late enhancement, without asking our patients to hold their breath."



She also uses free breathing with 3D mDIXON to obtain in-phase, water and fat images in a single scan. "It is very reproducible before and after gadolinium, which makes it useful for liver imaging," she adds.

The free breathing sequences use VitalEye touchless patient sensing, which provides a respiratory signal without requiring a respiratory belt.

Imaging speed benefits diagnostic confidence

The MR 5300 with Compressed SENSE is up to 50%² faster for many exams. It can provide routine exams in less than 5 minutes and whole-body exams in less than 20 minutes. Saint-Augustin has taken advantage of that speed to create highly efficient protocols. The hospital's standard stroke protocol is just about 8 minutes, and standard ENT, prostate PIRADS staging, and endometriosis studies all clock in at just about 10 minutes³.

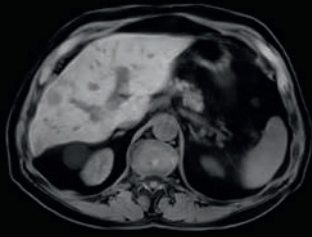
"We have more speed in 3D sequences," Dr. Gellée states. "With Compressed SENSE, we can replace two or three 2D scans with one high-quality 3D scan. High quality additional orientations are then obtained by post-processing of the 3D data set, thus saving scanning time."

Dr. Gellée often takes advantage of the system's speed to add more sequences to an exam. "When Compressed SENSE reduces typical exam duration, I can add sequences to increase my confidence in diagnosing. For example, post-gadolinium liver scans used to be axial, but now we can use a faster coronal scan. And because I know that the quality will be good the first time, I know I won't have to repeat the sequence. That frees up time to comfortably add one more sequence," she says.

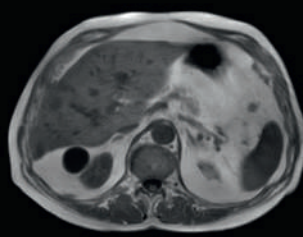
"Having this speed is better for patients as well. For example, if a patient has a fibroma, I like to include a post-gadolinium scan, because the enhancement pattern helps in diagnosis. Without that sequence, we sometimes need another appointment to perform additional scanning, but I really prefer to do it all in just one scan session. So, adding that post-gadolinium sequence is more valuable to me than reducing exam length."

Liver imaging using MR 5300

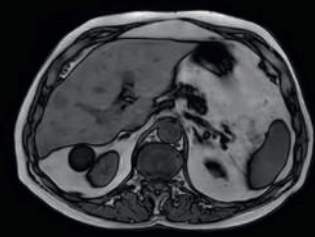
This case includes 3D free breathing and 4D dynamic free breathing MRI of a metastasized liver. A high quality fatsat sequence with good resolution is obtained in 1:36 minutes with T2-weighted MultiVane XD.



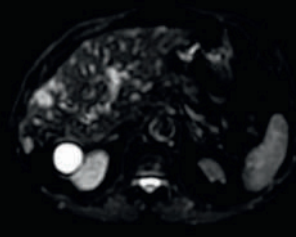
3D VANE XD free breathing 2:52 min
Voxels 1.7 x 1.7 x 5.0 mm



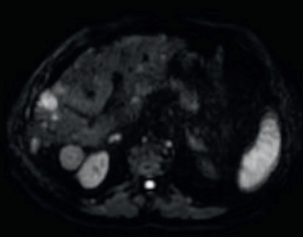
3D VANE XD free breathing with
mDIXON XD in phase 2:52 min
Voxels 1.7 x 1.7 x 5.0 mm



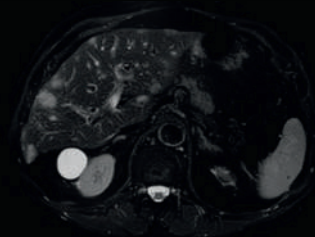
3D VANE XD free breathing with
mDIXON XD out phase 2:52 min
Voxels 1.7 x 1.7 x 5.0 mm



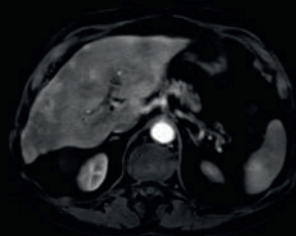
DWI b0 2:42 min
Voxels 3.5 x 3.5 x 6.0 mm



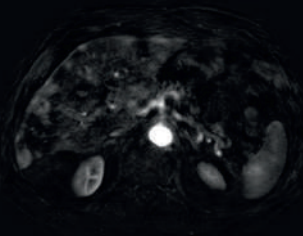
DWI b800 2:42 min
Voxels 3.5 x 3.5 x 6.0 mm



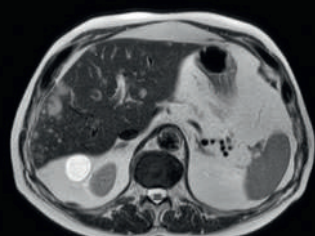
T2w MultiVane XD fatsat 1:36 min
Voxels 1.5 x 1.5 x 5.0 mm



4D FreeBreathing 4:50 min
Dynamic, 7 sec phase
Voxels 1.7 x 1.7 x 5.0 mm



4D FreeBreathing subtraction



T2w Single shot 0:19 min
Voxels 1.5 x 1.6 x 6.0 mm

Efficient workflow and light coils improve exams for staff and patients

The Saint-Augustin technologists appreciate the fresh approach to exam efficiency that includes guided patient set-up in under a minute. The extensive set of workflow features contributes to a more pleasant working environment, and changes the experience for both staff and patient, says Dr. Gellée. "Patient set-up is faster. The technologists can begin the exam when they are near the patient, and they don't have to stop the acquisition if the patient has a question. If we can image one or two more patients in a day, that adds up to many more patients that we can help."

"Our technologists are also very happy with the Breeze coils," says Dr. Gellée. "They like that these are lightweight and easy to connect. A light signal confirms that the coil is properly

connected, and we can check that any time on the console as well. Coils can also be combined to increase coverage."

Touchless patient sensing is always ready – no respiratory belt positioning needed – and the system offers automatic centering and in-room exam starting. Automated exam planning, scanning, post-processing and automated patient coaching support the technologist in the operator room. These Smart Workflow features reduce the number of steps involved in an MR exam, so that patients – not technology – retain the focus of operators. ►

"I have seen no bad exam on this system. I always can answer the question asked."

Hospital values creating a positive patient experience

Saint-Augustin puts high value on creating a good patient experience for patients. The team receives positive feedback from patients, who appreciate the comfortable memory foam mattress of the MRI system as well as the Ambient features. "We talk to the patient after each exam," Dr. Gellée says. "They appreciate the 'Zen atmosphere' and they like that they can choose a film to watch. It makes the experience less 'cold' for them. The lighting is beautiful, and it calms their fears. Sometimes, with our other MRI, it is more intimidating."

Another way technologists put patients at ease is by maintaining an open line of communication during exams. "Our patients like that they have the possibility to speak to the technologist during the exam. They can ask questions about what they are feeling, and these can be answered by the technologist without having to interrupt the exam."

System is a game-changer

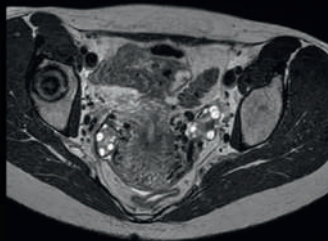
Dr. Gellée notes that the combination of productivity features, high diagnostic quality and potential to conduct research and partner with Philips make the MR 5300 a perfect fit for Saint-Augustin Clinic. "The MR 5300 is a game-changer in medical imaging for a large range of applications," she says. "We are pleased with the high level of diagnostic confidence it brings us, regardless of the anatomy or the sequences used." ■



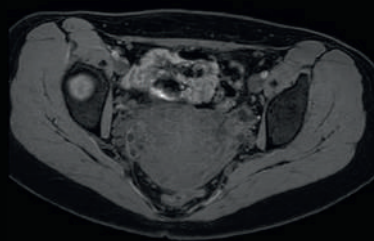
The MR 5300 with Compressed SENSE is up to 50% faster for many exams."

Female pelvis imaging

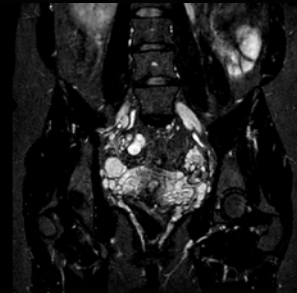
This MRI case illustrates good resolution and imaging quality obtained within reasonable scan times using the MR 5300 1.5T system with the anterior torso cardiac coil that allows use of a large field of view (FOV).



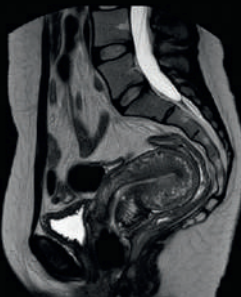
3D T2w PelvisVIEW 4:32 min
C-SENSE factor 6.5
Voxels 1.0 x 1.0 x 1.2 mm



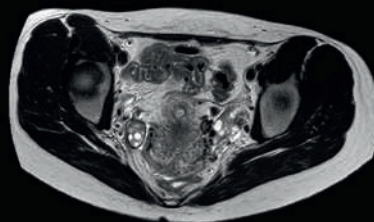
3D T1w mDIXON XD 2:33 min
C-SENSE factor 2
Voxels 1.0 x 1.2 x 2.0 mm



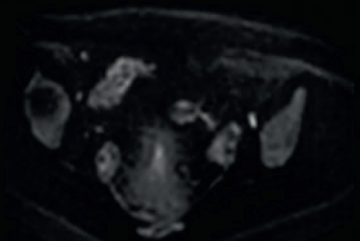
3D STIR 4:17 min
C-SENSE factor 10
Voxels 1.3 x 1.3 x 1.5 mm



T2w MultiVane XD 2:56 min
Voxels 0.9 x 0.9 x 3.5 mm



T2w MultiVane XD 2:44 min
Voxels 0.9 x 0.9 x 3.5 mm



DWI b1200 2:56 min
Voxels 3.0 x 3.0 x 4.0 mm

1. Compared to the Ingenia 1.5T ZBO magnet
2. Compared to Philips scans without Compressed SENSE
3. Webinar: Transform MR productivity quickly, easily and confidently with MR 5300

Results from case studies are not predictive of results in other cases. Results in other cases may vary.

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Outpatient imaging center aims to broaden use of cardiac MR

Live Healthy Imaging focuses on pushing the boundaries of MRI

Close to the world-renowned Texas Medical Center in Houston, TX, USA, Benjamin Cheong, MD, Raja Muthupillai, PhD and Claudio Arena, MR technologist are using their Philips Ingenia Ambition 1.5T MR system at Live Healthy Imaging for a full range of exams, with a focus on cardiac studies, an area in which all three have extensive experience. The team envisions a growing use of cardiac MR as a primary diagnostic tool. ►

"We want to narrow the gap between what is possible and what is being routinely done as much as we possibly can."

Raja Muthupillai, PhD

"The 1.5T Ambition and accelerated scanning give us the flexibility to tailor our scanning by either making the exams shorter or improving the SNR or spatial resolution."

Benjamin Cheong, MD



Raja Muthupillai

PhD is CTO at Live Healthy Imaging, and is an imaging scientist by training. He has 20 years of experience in the field of Cardiac MR research and clinical practice across industry, academia, and hospital settings. When he is not scanning inanimate objects, he enjoys teaching the art and science of CMR to fellows, and students.



Benjamin Cheong

MD, specialized in cardiology and radiology. He previously worked at Baylor St. Luke's Medical Center as the Clinical Director of cardiovascular imaging from 2006 – 2020. He specializes in non-invasive imaging of the heart using MR and CT. Ben is the resident guru of Pokemon lore and a good friend of Pikachu, and Pichu.



Claudio Arena

MR/CT technologist. He has 30 years of experience in general MRI and Cardiac MRI. He was previously employed as at Baylor St. Luke's Hospital as a research imaging technologist for more than a decade. When he is not creating art in front of the MRI scanner, Claudio likes sharing his knowledge on how to make good espresso.



Towards using the full potential of MRI

Dr. Muthupillai explains that the center's goal is to bring to fruition the full potential of MRI, both for cardiac MR and for all other applications. "We want to narrow the gap between what is possible and what is being routinely done as much as we possibly can," he says.

Opened in January 2021, [Live Healthy Imaging](#) (Bellaire, Texas, USA) schedules clinical studies three days per week and reserves two days for research. Cardiac studies make up approximately 60% of cases. A full cardiac workup – including cine imaging, viability, T1 and T2 mapping – takes about 35 minutes. If perfusion is added, this adds 6 minutes to the protocol duration.

"This is faster than in the past, when these studies typically took us 55 minutes," Dr. Cheong points out. "The Ambition and accelerated scanning using Compressed SENSE reduces scan time and significantly improves our imaging. This gives us the flexibility to tailor our scanning to the needs of the patient by either making the exams shorter, or improving the SNR or the spatial resolution."

Dr. Cheong adds that workflow efficiency also contributes to a shorter time slots. "We can setup the room easily, and patients follow the instructions from the AutoVoice – this makes a tremendous difference with these multiple breath holds needed in cardiac MR."

"We do a targeted acquisition of the heart with a small field-of-view of about 300 mm. By keeping our field-of-view fairly constant across patients, we improve workflow. The other important advantage is that this immediately gives the physician a good impression of the relative volume of space occupied by the heart within the field-of-view."

Proactively catching disease early in outpatient setting

While an outpatient cardiac MR center may be seen as an anomaly, Dr. Muthupillai and Dr. Cheong think it is a natural fit, because an outpatient center is more likely to encounter

"We would like to see a change in our reactive mindset and instead diagnose patients before they are significantly ill."

Raja Muthupillai, PhD

patients earlier in the disease process. In 2017, 5.7 million people in the US had heart failure, and it is estimated that by 2030, more than 8 million people will have this condition – a 46% increase in prevalence in just over a decade¹, and will impose a staggering economic cost to the US health system and the team envisions that not only will cardiac MR increasingly become a primary tool for cardiac diagnosis, but that its use will expand from diagnosis to prevention and treatment assessment.

Dr. Cheong notes that in a hospital setting, echocardiography is likely to always be the first modality used to image heart patients. It is portable, patient-friendly and very familiar to cardiologists. "However, in a nonemergent setting, MR can be the primary modality," he says. "If a patient has heart failure, I'd want to know the cause, so rather than doing an echocardiogram, I would use MR to assess heart function. I can also look at morphology to assess proximal coronary arteries, and look at viability to see if there is prior damage. MR also can help us determine if the patient has non-ischemic cardiomyopathy versus ischemic cardiomyopathy."

"Heart disease develops over decades before it manifests itself as a significant disease," Dr. Muthupillai adds. "When I worked at a tertiary care setting, 90% of the patients we imaged were already very sick. They had already had echocardiography and nuclear studies, and only when they were out of options were they sent to the MR department."

"We would like to see a change in our reactive mindset that we have to wait for disease to develop before doing anything, and

instead want to diagnose patients before they are significantly ill. To spur that change, a concerted effort is needed to make powerful clinical tools like cardiac MRI accessible to the general population."

Shortened protocol for fast preventive assessments

When thinking of MRI's potential to help detect dysfunction before symptoms appear, Dr. Muthupillai envisions the use of an abbreviated, non-contrast study that measures left ventricle function, flow, and tissue characterization. "That can give quite a bit of information about chamber sizes and chamber volumes. In a subset of patients with very vague symptoms we might look at the proximal coronary artery origins," he says. "From the shape of the left ventricle, we can determine if patients have a hypertrophic cardiomyopathy or a dilated cardiomyopathy, independent of the body habitus. We can also quantify valvular regurgitation really well with MR."

Investigating Fast-SENC for early detection

The Live Healthy team is also investigating the Fast-SENC technique that is available on their Ambition system. "It's quite intriguing to look at SENC for measuring myocardial strain, because it is rapid," says Dr. Muthupillai. Fast-SENC enables

pixelwise strain measurements inside the heart muscle. The data is then processed and analyzed with MyoStrain software which generates a clinical report. The clinical report provides a health score of heart function. Healthy LV myocardium is quantified in a single percentage number². With the combination of Philips Fast-SENC and MyoStrain early dysfunction of heart failure may be detected across 48 segments of the heart³ in 10 minutes.

Cardiac MR adding information for treatment assessment

Cardiac MR's reproducibility can benefit assessment of treatments as well, according to Dr. Cheong. He cites heart function assessment after bypass surgery and hypertension as two areas where cardiac MR may have a role. "If a patient with hypertension has concentric hypertrophy, MRI can help detect if there's a regression in heart thickness, which would indicate good blood pressure management," he explains.

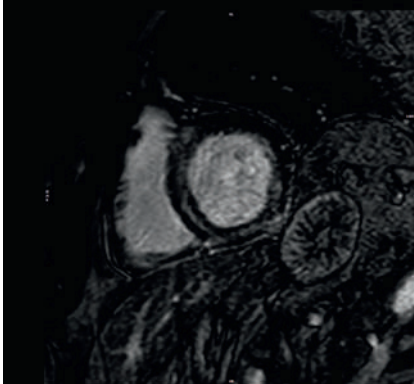
He also notes that while echocardiography is very good at assessing mitral regurgitation, MRI also can be used to measure regurgitant volume and regurgitant fraction. ►

Cardiomyopathy

Cardiac MR images of a patient with non-ischemic cardiomyopathy showing delayed enhancement and severe mitral regurgitation.



PSIR - 4 chamber view



PSIR - short axis view



bTFE - 4 chamber view



EPI cine - 4 chamber view

It's quite intriguing to look at SENC for measuring myocardial strain, because it is rapid."

Raja Muthupillai, PhD

"By doing tissue characterization, I can see whether there is improvement as a result of treatment."

Benjamin Cheong, MD

User experiences

Amyloidosis is a fourth area that would benefit from follow-up via MRI. "In the past, if a patient was diagnosed with amyloidosis, we only could do symptom management," he explains. "But new medication substantially improves the mortality of the patient. And by doing tissue characterization, I can see whether there is improvement as a result of treatment."

Research aims to increase cardiac MR utility for COVID patients

Live Healthy Imaging also plans to conduct research centering on COVID and myocardial inflammation. "A study conducted in Germany showed that 60 days after COVID infection, a significant number of patients had myocardial inflammation. One of the interesting things about their study was that they found that this inflammation was present even in patients who were not hospitalized⁴," according to Dr. Muthupillai. "So, we are preparing for a study along the same lines. I think the MR can play a very big role to first help determine if there is active inflammation and then to assess how the various types of treatments mitigate that inflammation."

The team at Live Healthy Imaging is closely working with Dr. Melvyn Ooi, clinical scientist from Philips, to investigate the role of advanced CMR methods in improving patient care.

Ambition 1.5T is well-designed for cardiac imaging

The combination of motions of the beating heart, respiration, and blood flow make cardiac studies a demanding area of MRI. Live Healthy Imaging chose a Philips Ingenia Ambition 1.5T system because it offers excellent image quality as well as

flexibility, speed and advanced technology to conquer motion artifacts. "I don't think there is a better MR system. In so many ways the flexibility of a Philips system is such that our decision was a no-brainer," Dr. Muthupillai notes. "Philips provides a comprehensive set of tools to address motion, both with VCG for cardiac pulsation as well as sophisticated navigators and VitalEye to address respiratory motion." VitalEye touchless patient sensing provides breathing detection without a respiratory belt and without any operator interaction.

"Compressed SENSE to shorten the scan time and length of breath holds is also very useful," Mr. Arena states. "Free-breathing protocols and sequences that require breath holds of only a few seconds allow us to obtain images with both high temporal and spatial resolution," Dr. Cheong adds. "The patient comfort, the reduced scan times and the high image quality really help me in delivering a good cardiovascular MR service. Having all tools and features I need for myocardial characterization is a big bonus as well."

Helium-free operation and easy siting are other advantages of the Ambition system. Particularly for those building an MRI room from scratch, not having to install a vent pipe saves on construction cost.

Ambient Experience and AutoVoice aid patient compliance and comfort

According to Mr. Arena, Ambient Experience sound and vision combined with AutoVoice and in-bore breath hold guidance help patients comply with breath hold requirements.

"Before, I really thought of the Ambient package as just eye candy; I didn't realize the impact it would have on patients."

Raja Muthupillai, PhD



Ambient Experience is a big advantage, because when patients are scared, their heart rate goes up, which affects imaging."

Benjamin Cheong, MD

In combination with VitalEye breathing detection, AutoVoice works within the natural breathing cycle of the patient and relieves technologists from manually instructing patients to hold their breath.

"The AutoVoice is fantastic! It works very well for patients and with the many breath holds in cardiac MR it makes a tremendous difference for me as technologist. And it's combined with Ambient Experience so patients not only hear the AutoVoice breathing instruction, but also visually see an indication of how long to hold their breath and how many scans are left," Mr. Arena says. Particularly in cardiac MR, breath hold coaching is a great benefit. It helps patients relax and stay calm because their minds are distracted with video and music.

"With the many breath holds in cardiac MR, AutoVoice makes a tremendous difference for me as technologist."

Claudio Arena, technologist

"The Ambient package makes a big difference in the patient experience," he points out. "Patients ask us for business cards because they want to give them to everybody that they know."

"Before we began using the system, I really thought of the Ambient package as just eye candy more than anything else," Dr. Muthupillai says. "I didn't realize the impact that it would have on patients, so that has been a pleasant surprise."

"So far we have not cancelled any clinical patients because of claustrophobia symptoms," Dr. Cheong adds. "They are a bit concerned walking in, but when they see the system, hear the music and see the screen, they just chill out. This is a big advantage because when patients are scared, their heart rate goes up, which affects imaging. When a patient needs sedation, they may fall asleep, which affects quality. Also, if patients receive sedation they can't drive home, which is a complication when exams are in an outpatient center."

"The patient comfort, reduced scan times and high image quality really help me in delivering a good cardiovascular MR service."

Benjamin Cheong, MD



We want to give them the confidence that they can get cardiac diseases diagnosed early and accurately by referring to cardiac MR."

Raja Muthupillai, PhD

Education is key to expanding use of MRI as a primary cardiac imaging modality

The Live Healthy Imaging team notes that one way to broaden use of cardiac MR as primary modality is driving acceptance among primary care physicians. "We hope to start educating primary care physicians about how advanced MR imaging can help them manage their patients better," Dr. Muthupillai says. "We want to give them the confidence that they can get cardiac diseases diagnosed early and accurately by referring to cardiac MR."

Dr. Muthupillai points out that faster post-processing is another factor that will increase utilization of cardiac MR. Artificial Intelligence can potentially decrease post-processing time, as well as simplify image acquisition.

The future is bright

The Live Healthy Imaging team anticipates that in five years, cardiac MR will become an increasingly integral part of patient care, from early diagnosis through treatment assessment.

"Long-term, the goal for diagnosis is a single-button, 15-minute cardiac MR exam," Dr. Muthupillai says. "That could make cardiac MR like a 'mammography of the heart', although it would contain functional information, rather than just anatomic information as in mammography." ■

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Sannodai Hospital



Dr. Mikio Makuuchi
Chairman of Medical corporation Makuuchi-kai and Director of Sannodai Hospital.



Yoshihiro Otsu, RT
Chief of Radiological department.

Hospital saves cost by choosing MRI upgrade instead of new installation

Transition from Ingenia 3.0T to Elition X supports superb image quality and speed at Sannodai Hospital

When their Ingenia 3.0T was eight years old, Sannodai Hospital was interested in the newer Ingenia Elition X. The hospital opted for SmartPath to Ingenia Elition X: instead of buying a completely new system, it could retain their Ingenia magnet, while all other hardware and software was replaced. This alternative to buying a complete new system saves money and limits the downtime. Moreover, it gave clinicians the powerful Elition 3.0T platform, offering cutting-edge MR imaging techniques.



This upgrade allowed us to already get a new high-end MRI system and it presented a major advantage in shorter downtime as well as lower cost."

The right offer at the right time

The ambition of Sannodai Hospital (Ishioka City, Japan) is to provide the most advanced medical service to its many patients with the goal of early diagnosis and treatment, especially in emergency care. When the hospital's radiologists had enjoyed eight years of exceptional MRI scanning with their Ingenia 3.0T system, they began thinking about replacing that system in a few years. Then in 2021, they learned about [SmartPath to Ingenia Elition X](#), the option to upgrade their MRI system to a high-end Elition X, keeping their existing magnet and getting new software and hardware, providing high levels of diagnostic confidence.

Hospital administrators and radiology department officials knew that – compared to a full system replacement – the SmartPath upgrade would save on the cost of the system itself and avoid cost related to exchanging the magnet. It would also reduce the downtime during which no patients can be scanned and no revenue is gained.

"The opportunity to choose SmartPath to Elition X came at just the right time," says Mikio Makuuchi, MD, Chairman of the Medical Corporation Makuuchi-kai and Director of Sannodai Hospital. "This upgrade was attractive as it allowed us to already get a new high-end MRI system. Moreover, it presented a major advantage in shorter downtime as well as lower cost. Because the hospital has only one MRI system, the importance of short downtime was also stressed by doctors

"Some high resolution examinations that were not possible before due to long scan time, are now routinely performed with the upgraded system."

in other departments, particularly for 24/7 emergency care." The MRI system also serves internal medicine, cardiology, neurology and other departments.

"We also anticipated that the system's high-performance gradients would allow us to achieve better image quality and higher scanning speeds. Beyond that, the many features for improved workflow were attractive to support our technologists and save time," Dr. Makuuchi says.

The hospital began using its new Elition system in December of 2021. Since then, the system has exceeded the expectations of clinicians and technologists.

Boosting scanning speed and image quality

Sannodai Hospital radiologists had been very satisfied with their Ingenia 3.0T with Compressed SENSE, however after acquiring SmartPath to Elition X they have demonstrated improved image quality and even higher speeds in imaging studies throughout the body, according to Dr. Makuuchi.

"Generally, we were impressed by seeing that images are very sharp and have higher SNR than we used to get with our Ingenia 3.0T system," he notes. "We were delighted to see that high image quality can be obtained in a short time thanks to the Elition with its powerful gradients. Some high resolution examinations that were not possible before due to their longer scan time, are now routinely performed with the upgraded system." ►

Before



Ingenia 3.0T



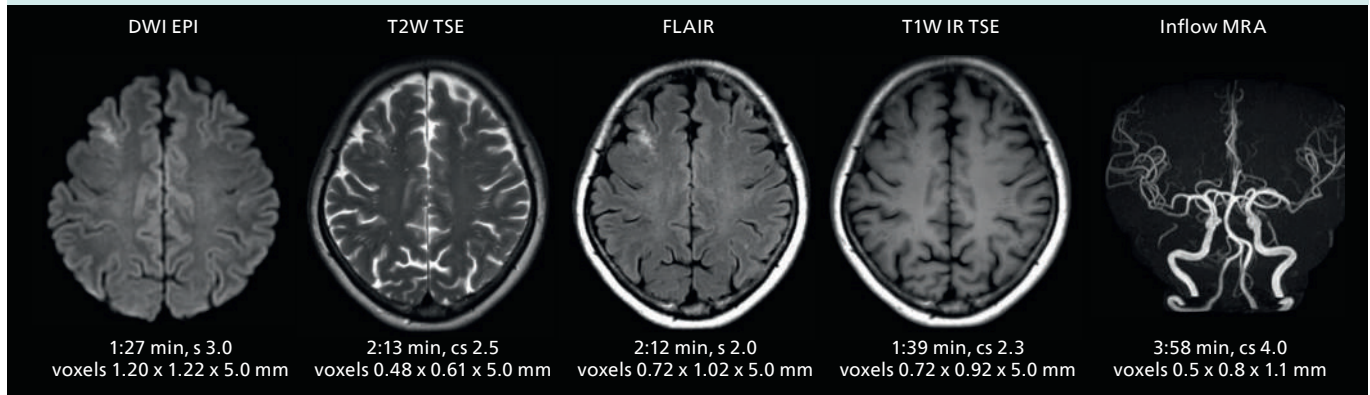
After



SmartPath to Ingenia Elition X

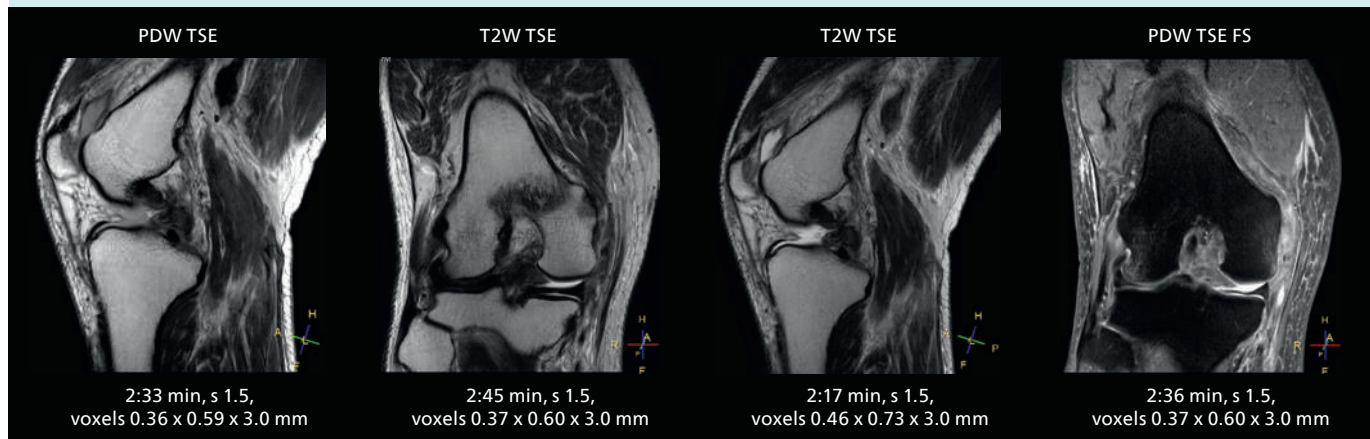
Brain MRI

These images of an old cerebral infarction demonstrate the speed and image quality after upgrading to Elition X.



MRI of the knee

Images showing a posterior cruciate ligament (PCL) tear, a detached medial collateral ligament (MCL) on the tibial side and an intact anterior cruciate ligament (ACL). SmartPath to Elition X helped reduce scan time compared to previous imaging while maintaining resolution.



"As our hospital has many elderly patients, we consider it important to obtain high-quality data in a short time."

Dr. Mikio Makuuchi

An example of increased imaging speed is in knee studies. "There is a definite scan time reduction for T2* mFFE and proton density TSE – both of these sequences benefit from much shorter repetition times," he reports. Overall, imaging time per sequence has been reduced since the Elition X upgrade. This can help reduce the risk of patient movement and the need for rescans.

"As our hospital has many elderly patients, we consider it important to obtain high-quality data in a short time," Dr. Makuuchi says. "Shorter imaging times are also useful for accepting emergency patients, because faster emergency

"The Vega HP gradients enable us to scan faster and use b-values as high as 2000."

Dr. Mikio Makuuchi

studies have a reduced impact on the daily examinations schedule. In emergency cases it is also important that high quality images are obtained in a short time."

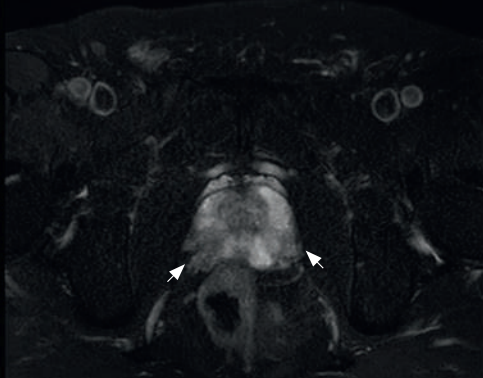
Diffusion studies benefit from powerful gradients

The high performance of the Vega HP gradients is particularly impressive in DWI. "The Vega HP gradients enable us to scan faster and use b-values as high as 2000, for example in prostate DWI and in DWIBS, which provides image quality that is remarkably improved over the previous system and we are able to more easily see lesions."

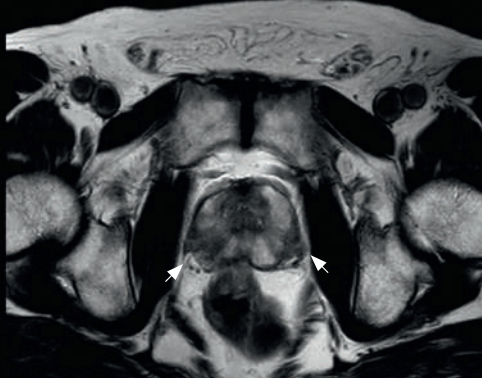
MRI of prostate

Examples of prostate imaging showing faster scan times and improved resolution illustrate the power of SmartPath to Elition X in this case of prostate cancer with PI-RADS score 4.

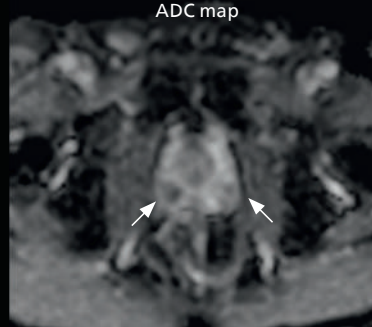
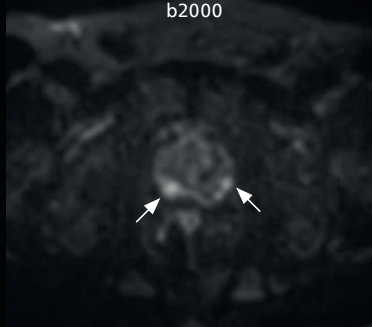
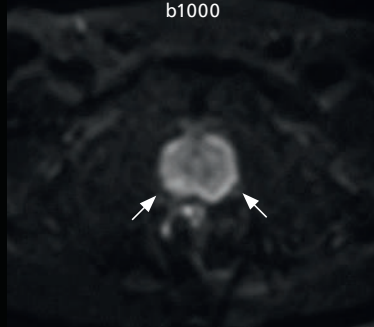
T2W FS, 1:53 min, cs 2.5, voxels 0.60 x 0.88 x 4.0 mm



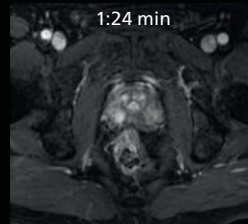
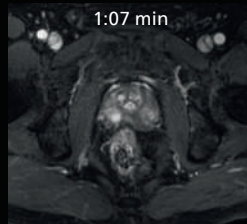
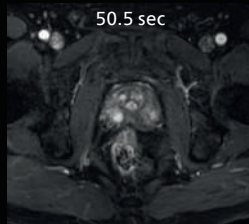
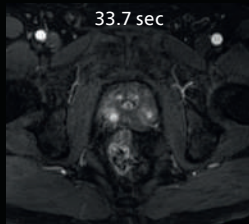
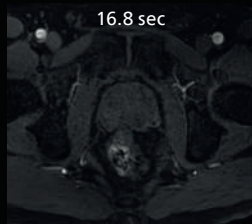
T2W, 2:18 min, cs 2.0, voxels 0.60 x 0.79 x 4.0 mm



DWI, 3:15 min, s 2.0, voxels 3.13 x 3.19 x 4.0 mm



Dynamic eTHRIVE, 16.8 sec/dyn, voxels 1.06 x 1.29 x 4.0 mm



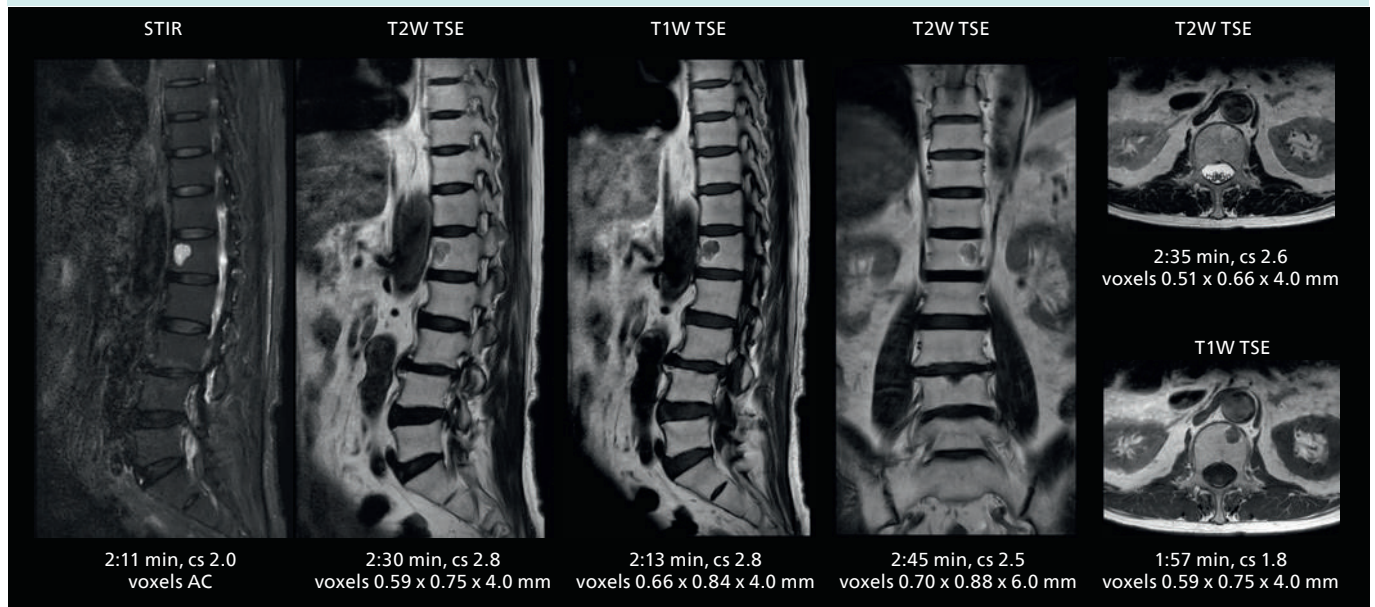
The value of the Elition X gradients is also evident in DWIBS studies. "The fact that we can consistently obtain distortion-free DWIBS while reducing imaging time at three coronal stations is excellent," Dr. Makuuchi says. "In these patients, it's also important that the application of Compressed SENSE to T2-weighted, STIR and mDIXON sequences has no impact on the examination time of whole-body imaging. As a result of the increased speed and higher image quality we realize, DWIBS studies have now become routine examinations." ►

"As a result of the increased speed and higher image quality, 3.0T DWIBS studies are now routine examinations."

Dr. Mikio Makuuchi

Lumbar spine MRI

Crisp images are obtained with high resolution and short scan times using Elition X. A cyst can be seen.



VitalEye has increased the possibility of obtaining sharp images with less blurring. Clinicians here really appreciate this improvement in MRCP image quality."

Yoshihiro Otsu



Workflow innovations streamline studies

SmartPath to Elition X comes with Smart Workflow technologies that support technologists and can save them time. VitalEye for touchless patient sensing is one example.

"The implementation of VitalEye respiratory synchronization has had a significant impact," says MR technologist Yoshihiro Otsu, Chief of the Radiological Department. "It not only improves workflow, but it also has increased the quality of examinations. Particularly for the large number of MRCP examinations performed in this hospital, VitalEye has increased the possibility to obtain sharp images with less blurring. Clinicians here really appreciate this improvement in MRCP image quality."

The VitalScreen on the scanner has helped reduce the risk of patient misidentification. "It allows patient information to be viewed in the magnet room when standing next to the patient," he says. "And the automated patient centering in the magnet is very useful as well."

Apart from reducing stress for technologists, Smart Workflow helps improve respiratory synchronization and reduce examination stress for the patient.

Patient comfort evokes positive feedback

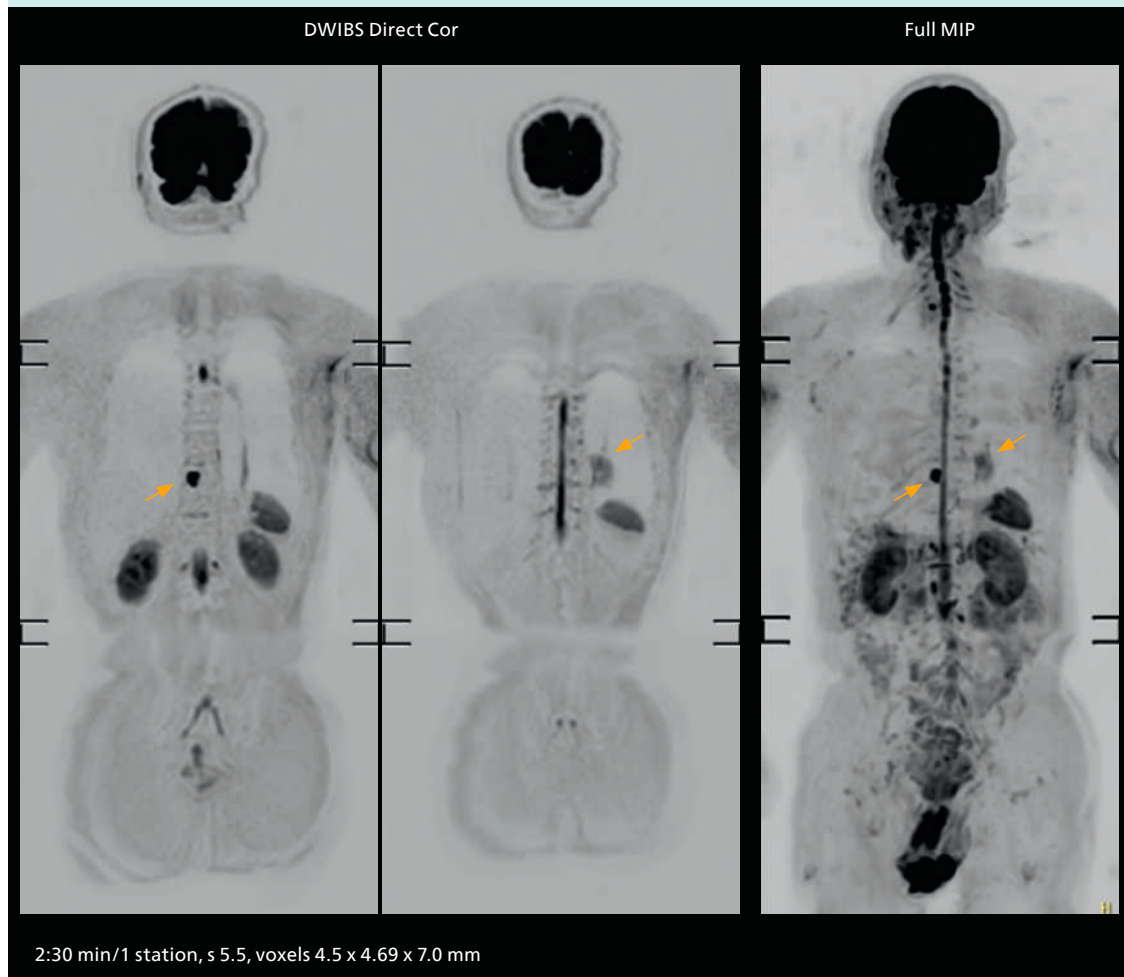
Regarding patient support and comfort, the ComfortPlus mattress on the Elition system has made a significant impact, Dr. Makuuchi says. "We scan a lot of elderly patients here and this thick, soft mattress has made examinations more comfortable for them – and of course also for other patients. And relaxed patients are less likely to move, so that translates into enhanced examination quality. Many patients have provided good feedback on this mattress."

SmartPath to Elition X the smart choice for Sannodai Hospital

Since upgrading its Ingenia 3.0T to Elition X in 2021, Dr. Makuuchi is more convinced than ever that Sannodai Hospital made the right move by choosing SmartPath to Elition X.

Fast whole body DWIBS examination

With SmartPath to Elition X the team can obtain excellent quality DWIBS imaging and reduce imaging time. Other sequences also fit in the examination slot. This case shows left paravertebral neurogenic tumor and Th10 vertebral hemangiomas.



"We are very satisfied with the SmartPath to Ingenia Elition X upgrade," he says. "There are many difficulties in installing a new system, and we think this upgrade of our 8-year-old system provided us numerous benefits. The Elition gradients have been a real game-changer for us, significantly shortening scan times and increasing image quality and clinical utility."

"The SmartPath option that made the Elition acquisition possible limited both our downtime and our costs."

"The SmartPath to Ingenia Elition X has reduced both our downtime and our costs," he concludes. "Hospitals currently using Ingenia 3.0T should definitely consider SmartPath to Elition X. It offers numerous advantages when accounting for the economic aspects of hospitals and the services they provide to patients." ■



The SmartPath option that made the Elition acquisition possible limited both our downtime and our costs."

Dr. Mikio Makuuchi

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Upgrade instead of reinstallation – the sensible choice for a proven system

MR SmartPath to Ingenia 1.5T Evolution

It took just 10 days for a radiology practice in Germany to upgrade their MRI scanner with a completely different look and the latest functionality – all achieved in cooperation with Philips. The MR SmartPath to Ingenia 1.5T Evolution program enabled radiologists to upgrade their proven Philips MR system without the hassle of magnet replacement. New functionalities now enable diagnostic reliability, increased speed and even more patient-friendly care. Above all, the practice is enthusiastic about the trusting, friendly cooperation with Philips.





In ten days to a system for the next ten years – that's what I call securing the future in a turbo process."

Martin Kollerer, Radiologist

Martin Kollerer,
MD is radiologist at Radiology
Marktreidwitz & Center for
Prostate MRI since 2002.

Considering the need for new technology

It is a challenge many clinics and radiology practices face: in order to benefit from the latest innovations – especially in the field of MRI – a new system purchase must be considered. Future-proof software and newest imaging methods are needed to expand diagnostic capabilities and increase speed. Workflow and comfort for patients and staff need to be improved. But the question is how to install a new system without having to shut

down your practice for weeks? How do you get by not being able to scan any patients, having to postpone exams to a later date, and having to accept the associated economic losses?

These questions weighed heavily on radiologist Martin Kollerer. Together with Dr. Margit Purucker, he runs a radiological practice in Marktreidwitz in Germany. Since 2002, he has been working with Philips solutions, including the Ingenia 1.5T MRI scanner. "A reliable, stable system," he says. But it was time to expand functionality.

Dr. Kollerer wanted to take advantage of recent advancements and make them accessible to his patients and staff. "Technology is constantly evolving towards enabling both faster examinations and higher quality images, as well as an increasing focus on the patient," he says. However, an MRI scanner cannot typically be replaced just like that. A magnet weighing more than three tons can only be changed with great effort. Walls or ceilings may have to be lifted and a heavy-duty crane brought in to take the magnet in or out of the building. In addition, the magnet that has been in use in the Marktreidwitz practice for several years, is still far from outdated. "Replacing it would have been neither economical nor sustainable," says Dr. Kollerer.

Efficient upgrade instead of time-consuming full system exchange

Dr. Kollerer reached out to Philips to discuss options for strategically shaping his business model for the next ten years. "Working with Philips is like working with friends," he says. For years, the relationship with Philips has been based on trust and characterized by open communication. "I knew that if I wanted to discuss my concerns and my ideas, it would be with this company."

The solution they eventually agreed upon is called MR SmartPath, a Philips program to extend the useful life of MR systems. SmartPath gives a radiology practice the opportunity to easily and cost-effectively upgrade their Philips systems to the latest technology and thus expand the practice's MRI capabilities. "For us, this was the optimal way," says Martin Kollerer. ►

MR SmartPath to Ingenia 1.5T Evolution

With the Philips upgrade program 'MR SmartPath to Ingenia 1.5T Evolution', an existing MRI system can be equipped with modern functionalities without magnet replacement. It allows you to boost your performance with innovative SmartWorkflow solutions that include touchless patient sensing technology, in-room guidance on patient set-up and initiation of the exam at the patient's side. Compressed SENSE allows you to scan up to 50% faster with virtually equal image quality, in both 2D and 3D scanning and for all anatomies.¹ Your SmartPath conversion also gives you access to the latest scanning techniques for confident diagnosis.

A radiology practice that takes such a step benefits from higher image quality for improved diagnostic confidence, as well as faster exam speed, while their patients enjoy greater comfort.

"Replacing the proven Philips magnet would have been neither economical nor sustainable."

Martin Kollerer, Radiologist



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**Working with Philips
is like working with
friends."**

Martin Kollerer, Radiologist

Based on the SmartPath business case, it was decided to preserve the existing high-end system, but to equip it with new, comprehensive functionalities. This approach provides substantial benefits for ongoing operation. While a completely new scanner and thus magnet replacement would have paralyzed practical operation for quite a long time, the changeover time in the MR SmartPath program was just ten days. "In ten days to a system for the next ten years – that's what I call securing the future in a turbo process," says Dr. Kollerer.

Advantages for both staff and patients

With the renewed Ingenia 1.5T Evolution system, the practice can now continue to provide a high level of diagnostic confidence and patient-friendly examinations. "For example, it allows us to use faster scan methods," explains Martin Kollerer. "The integrated Compressed SENSE acceleration technology, allow us to make scan times shorter² while maintaining consistently high image quality."

This not only affects the work of staff in the practice, but also benefits the patients, as MRI technologist Ina Rank observes, "Thanks to Compressed SENSE, the examination time is remarkably shorter compared to the previous version of the scanner." For patients, this means greater comfort. The technologists see great advantages for patients after

"Thanks to Compressed SENSE, the examination time is remarkably lower compared to the previous version of the device."

Ina Rank, MR technologist

upgrading the existing Ingenia 1.5T scanner to Ingenia Evolution. "For example, the upgraded scanner is now equipped with a special thick ComfortPlus mattress that is so comfortable that patients can lie completely relaxed." This also has an effect on the image quality – the calmer the patients can remain, the better images can be achieved.

Exceptional patient and user friendliness

The upgraded system features VitalEye and VitalScreen, both of which contribute to a fast and smooth examination process. The sensor technology of VitalEye allows contactless monitoring of the patient's breathing pattern, so that it relieves technologists from having to place a respiratory belt on the patient.

The VitalScreen provides technologists with the most important patient and examination information during patient positioning, its touchscreen allowing to adjust if necessary. "Along with improved usability, another important VitalScreen advantage is that the technologists can stay with the patient during the exam preparation. This has a very calming effect on most patients," says Rank.

During the scan, AutoVoice gives spoken instructions to the patient and visible breathing instructions are automatically displayed along with information to let the patient know how long the examination will still take. Based on Ina Rank's experience, these are pleasant distractions that ease the exam: when patients are more relaxed it is easier for them to remain still and this can benefit image quality.

Excellent image quality and acceleration

According to Dr. Kollerer, the image quality gain is an essential advantage of the upgrade. "This is one of the most important requirements for our work. With high-resolution

"We have set the course for the future security of this practice and our prostate center."

Ina Rank, MR technologist



and excellent image quality we can make diagnoses as reliable as possible." This applies in particular to prostate cancer diagnoses. The Marktredwitz practice is certified as a center for prostate MRI, and as such specializes in diagnosing prostate cancer as early as possible with multiparametric MRI (mpMRI) to help them characterize the tumor and its spread.

Dr. Kollerer has found he really appreciates being able to use Compressed SENSE for dedicated, detailed prostate imaging. In addition, an acceleration of up to 35 percent was achieved with Compressed SENSE, according to a SpeedTrack analysis performed by Philips in the radiology practice.² For Dr. Kollerer, one thing is certain, "With the MR SmartPath upgrade, Philips and I have set the course for the future security of this practice and our prostate center."

Mutual trust and knowledge

"Philips and I", that's what Dr. Kollerer repeatedly says. When asked about this, he laughs, "Indeed, it feels like we managed this upgrade project together, as equal partners." This did not surprise him. His many years of experience with the Philips service team have been good. However, setting up a business case together requires an increased degree of trust, mutual respect and know-how on both sides.

It is foreseeable that at some point in future, perhaps again in ten years, a new functional expansion for the scanner will be necessary. Neither medicine nor medical technology stands still. Technical developments continue to progress. And Dr. Kollerer will keep an eye out for new emerging solutions and features he can use to keep his practice fit for the future and to provide his patients with the best possible care. One thing is already certain – it will be good to have a proven friend at his side. ■

Summary

- The MR SmartPath to Ingenia 1.5T Evolution program enabled a radiology practice in Germany to upgrade its MR system in just a few days – without magnet replacement.
- The practice now benefits from a high level of diagnostic confidence, excellent image quality, as well as increased speed. Patients benefit from greater comfort.
- Philips is seen as a trustworthy partner.

1. Compared to Philips scans without Compressed SENSE.
2. Individual SpeedTrack analysis for benchmarking on request.

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Intraoperative MRI enhances precision in glioma resection

Tokai University Hospital excels with streamlined MRI-guided neurosurgical workflow

MRI is not simply an indispensable diagnostic tool, neurosurgeons can harness the modality intraoperatively to improve neurosurgical confidence and the completeness of CNS tumor resections. In clinical use for 30 years, centers can implement intraoperative MRI cost-effectively – particularly in a shared imaging equipment arrangement - as professionals at Tokai University Hospital in Japan have demonstrated.



Mitsunori Matsumae, MD, DMSc
is Professor and Chair of Neurosurgery at Tokai University School of Medicine and Neurosurgeon in Chief at Tokai University Hospital. Prof. Matsumae has practiced general neurosurgery since 1988 and his primary activities in this field grew to encompass head injury management, brain tumor surgery and new imaging techniques.



At our hospital we prioritize speed and we have seen that Compressed SENSE helps us to reduce intraoperative MRI scan time for our 3D T1W scans with about 40%."

Prof. Matsumae, MD

A cost-effective solution

Intraoperative MRI (ioMRI) has been performed for three decades, providing neurosurgeons with up-to-date image information during neurosurgery procedures¹. Tokai University Hospital's (Kanagawa, Japan) neurosurgeon Prof. Mitsunori Matsumae, MD, has been performing intraoperative MRI to resect a variety of brain tumors – particularly gliomas – using his center's sophisticated and cost-effective multi-modality imaging suite. The suite, which opened in 2006 at Tokai University Hospital and has received continuous updates since then, includes a [Ingenia 1.5T MR-OR intraoperative MRI system](#) equipped with Compressed SENSE. The multi-modality imaging suite – employed for both intraoperative MRI procedures and diagnostic imaging in a shared arrangement – has been a cost-effective solution for Tokai University Hospital, which has become a leading facility in interventional radiology and image-guided surgery.

Increasing the potential of gross total tumor resection with intraoperative MRI

"Generally, the outcome of glioma surgery is strongly related to how much of the tumor is resected^{2,3}," Prof. Matsumae says. "Because glioma is an infiltrative disease, it is important to remove as much tumor as possible, while also preserving neurological function. Thus, surgical planning by carefully observing the relationship between the glioma infiltration area and eloquent region is needed."

With its undisputed soft tissue visualization, MRI is the modality of choice for diagnostic (pre-operative), intraoperative and post-operative imaging.

"Intraoperative MRI is needed because MRI is the clinical gold standard for identifying the lesion and evaluating the extent of resection with both preoperative and post-operative images," he observes. "Neurosurgeons acquire intraoperative MR images to characterize the surgical procedure performed and to consider whether the surgical strategy needs to be revised for the next step."



Ingenia MR-OR 1.5T installation with short, in-line transfer between OR and MR suite using Mizuho IntraOP transfer trolley and NORAS OR Head Coil.

Key advantages of intraoperative MRI

Prof. Matsumae summarizes four key advantages of intraoperative MRI during a glioma resection procedure:

- 1 After the initial craniotomy, intracranial pressure increases, causing the brain to bulge. In addition, the brain shifts in various directions during resection due to aspiration of cerebrospinal fluid, expansion of the compressed brain, and increasing brain edema. This brain shift increases as surgery progresses, and, consequently, the accuracy of neuronavigation based on preoperative MR images decreases. Neurosurgeons, therefore, want to use intraoperative MRI to update and re-register images for neuronavigation as surgery continues.
- 2 Intraoperative MR images can reveal unexpected tumor remnants.
- 3 Evaluation of surgical success: When the neurosurgeon has determined that the glioma has been removed to some extent, it is not only the percentage of the lesion resected that is important to ascertain, but also the relationship between the remnant tumor and eloquent regions, connecting fibers, ventricular wall and major vessels. The latter can inform the degree of risk involved in continuing the resection.
- 4 Intraoperative MR images can be used for early detection of unexpected vascular complications.

"Generally, the outcome of glioma surgery is strongly related to how much of the tumor is resected."

Prof. Matsumae, MD

Equipment sharing makes intraoperative MRI economically feasible at Tokai University Hospital

In Prof. Matsumae's view, neurosurgeons value intraoperative MRI as a tool to improve surgical results, but this desire does not supersede financial considerations. At Tokai University Hospital the Ingenia MR-OR is part of a sophisticated MR/CT/angiography/operating room (MRXO) suite that permits efficient image-guided neurosurgeries.

"The bottleneck for introducing intraoperative MRI is the initial cost," he says. "Installing an expensive MRI system within an operating room is disadvantageous in terms of cost-effectiveness, so sharing the equipment can be a practical solution. At our hospital, the imaging systems are located close to each other, separated by shielded doors. In this multi-theater setup, each system can be used independently or in different combination. Therefore, the Ingenia MR-OR can be employed for intraoperative MRI, and when not in combined use the MRI can be separated and used for routine diagnostic imaging to maximize cost performance via high throughput."

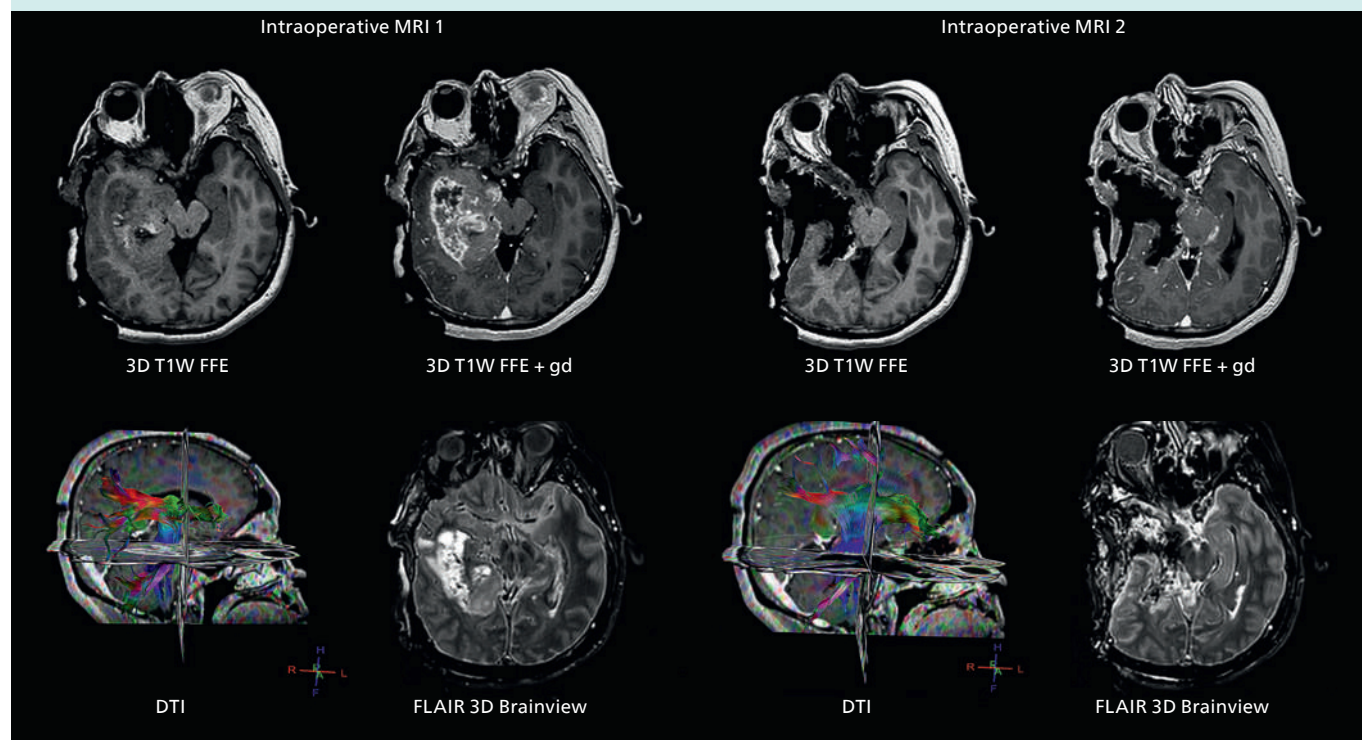
High throughput is virtually a guarantee at Tokai, as the MRXO suite is adjacent to, and part of, the emergency department. Therefore, the imaging systems can be operated 24 hours a day, 365 days a year.

Focus on MR safety minimizes risks and enables fast procedures

"In intraoperative MRI procedures, the standard workflow is altered to when the patient is moved to the MRI," Prof. Matsumae says. "All involved staff participate in multi-disciplinary discussions and simulations to standardize the processes. MR safety is the key word in the intraoperative workflow to minimize risks and enable procedural efficiency." ►

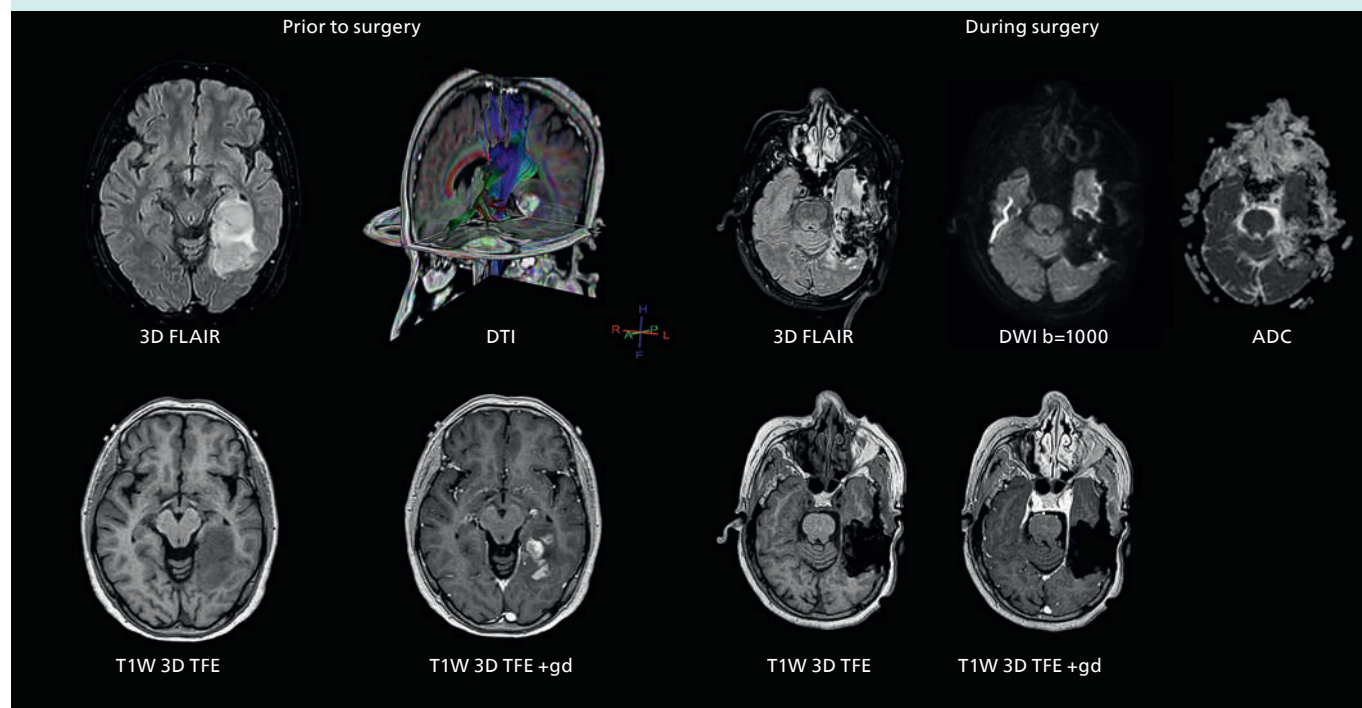
Intraoperative MRI to update neuronavigation

In a patient experiencing headache, the pre-operative MRI showed a high-grade glioma in the right temporal lobe. The first intraoperative MRI scan was used to update neuronavigation to compensate for brain shift, the second intraoperative MRI scan showed satisfactory resection of the lesion.



Intraoperative MRI confirms complete tumor resection

A patient first experienced epilepsy. The diagnostic MRI showed brain tumor in the left temporal lobe. On the day of surgery, pre-operative images were acquired. Surgery was performed in the MR-OR suite, and the intra-operative MRI showed satisfactory removal of the high-grade tumor.



"If I notice that the navigation is out of position due to brain shift or brain bulging, intraoperative MRI will be used to update or correct it."

Prof. Matsumae, MD



Efficient workflow streamlines acquisition of MR images

An observed out-of-position neuronavigation will prompt the surgical team to prepare for intraoperative MRI^{4,5}. Under the direction of the nurse safety manager, all ferromagnetic instruments are removed from the surgical field and the surgical wound is covered with a sterile drape. These preparations take about 10 minutes, followed by an in-line patient transport to the MR-OR using a Mizuho IntraOP transfer trolley. The anesthesia machine and monitors are transported together with the patient to the MRI unit.

"Prior to the patient transfer, the MR technologist can prepare the Ingenia MRI from diagnostic use to intraoperative use in as little as two minutes and we can move the patient from the OR to the MRI room in one fast procedure," Prof. Matsumae notes.

Short scan times, detailed image information

To enable evaluation of resection completeness or to acquire images to correct for brain shift, the MR staff will perform several sequences using a NORAS OR head coil.

Because imaging speed in intraoperative MRI is important at Tokai, the center has been using SENSE parallel imaging since the beginning. In 2020, the team started employing Compressed SENSE instead to achieve greater scan time reductions. "At our hospital we prioritize speed and we have seen that Compressed SENSE helps us to reduce intraoperative MRI scan time for our 3D T1W scans with about 40%," Dr. Matsumae says.

Using up-to-date MRI information for enhanced confidence

The intraoperative MRI scans are evaluated and can be used to update neuronavigation, guide the surgeon on the location of tumor remnants that can be further resected, or inform the decision to forego further tumor resection to preserve neurological function.

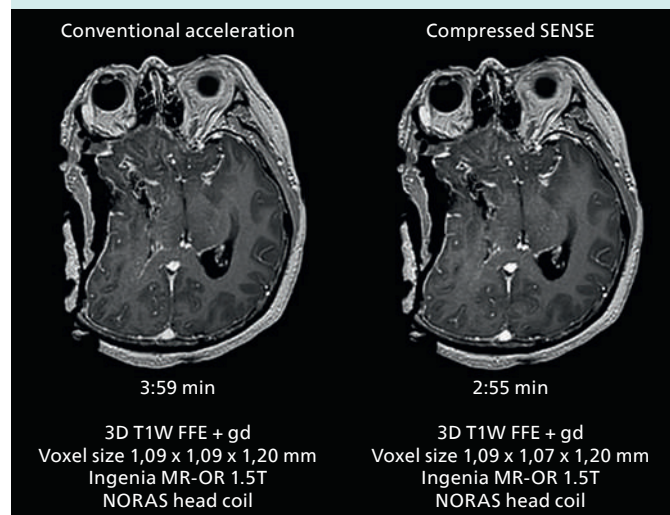
"Regarding the last point, ambitious surgical invasion in an attempt to resect the entire lesion can cause serious neurological dysfunction," he explains. "So, neurosurgeons may decide to not 'chase' the lesion deeper and rather continue treating the remnant with chemotherapy or radiation therapy." ►

Standard protocols for high-grade gliomas include:

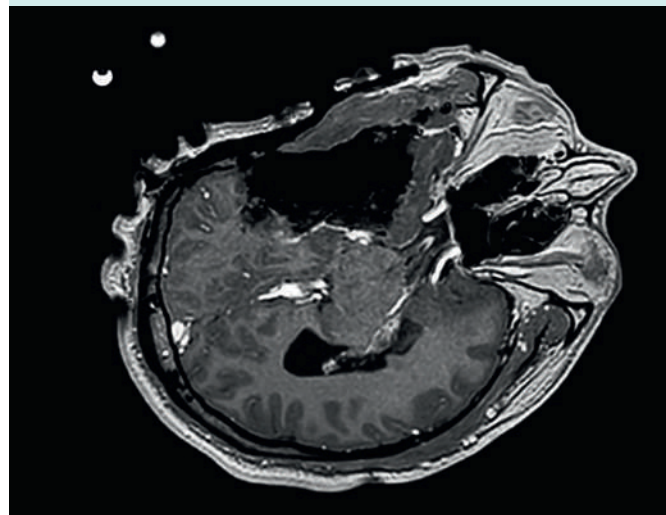
Sequence	Benefit	Resolution	C-SENSE factor	Typical scan time
Marker 3D T1W TFE	Marker visualization	1.56 x 1.64 x 5 mm	3	0:31 min
3D T1W TFE without and with gadolinium (Gd) enhancement	Contrast-enhanced T1 is useful because high grade gliomas are typically Gd-enhanced.	1.03 x 1.08 x 1.20 mm	3.5	1:47 min
3D FLAIR BrainView	For non-enhancing gliomas. Helps in identifying low-grade glioma and for distinguishing brain edema from tumor.	1.1 x 1.1 x 2.4 mm	5	5:01 min
Diffusion tensor imaging (DTI)	Visualization of the anatomical location of white matter tracts. Fiber tracking software converts these images to a parametric color-coded display of white matter fiber tracts. In tumor resection surgery, it is critical to know the topographic relation of white matter fiber tracts (e.g., associated with Broca's or Wernicke's functional areas) that are near a lesion and the connecting fibers originating from these regions.	3 mm isotropic	NA	3:14 min
Diffusion-weighted (DWI)	Evaluation of ischemic complications (e.g., stroke).	1.9 x 1.9 x 5.0 mm	NA	0:45 min

Shorter scan time in intraoperative scans

Compressed SENSE reduces scan time from 3:59 min to 2:55 min with the same spatial resolution.



The Brainlab neuronavigation system employs automatic detection of MR marker spheres, which are attached to the NORAS head coil to update anatomical data during the operation. In this way, physicians can efficiently assess brain shift or evaluate resection progress.



Restarting a resection procedure after an intraoperative MRI scan takes about 10 minutes; the total time used for intraoperative MRI cases averages 30 minutes including preparations, patient transfer, image acquisition and restart.

A post-operative MRI scan is done immediately after resection when the neurosurgeon suspects ischemic complications based on the intraoperative MRI DWI images. However, typically the post-op MRI – in the Ingenia MR-OR or at one of Tokai's other six Philips MRI systems – is performed the following day absent complications.

Intraoperative MRI feedback boosts neurosurgical skills

Since Prof. Matsumae began using intraoperative MRI, he has found that his skill in achieving gross tumor resection in glioma resection has increased, a reflection of the quality of feedback he is receiving from the intraoperative MRI scans.

"In the early years, resection completeness ranged from 50 to 60 percent, even with four to five intraoperative MRI scans per

surgery," he notes. "Today, in about 70 percent of cases, the initial resection is considered a satisfactory tumor resection [≥ 98 percent resected]."

In the cases where intraoperative MRI is used, it's seldom more than one scan. The decision to perform a second intraoperative MRI scan is determined by "the surgeon's proficiency, intraoperative impression and surgical plan," he says.

Prof. Matsumae attributes his center's increasing success rates to periodic upgrades of its Philips MRI hardware and software that have enhanced image quality and shortened acquisition time, as well as the insights on anatomy and pathology provided by the intraoperative MRI procedure itself.

"Intraoperative MRI provides the feedback needed to differentiate tumor versus eloquent structures or simple edema," he says. "This feedback also sharpens the neurosurgeon's skills over time, such that the number of MRI scans needed during a surgical procedure decreases." ■

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1. Adaptive-C-SENSE-Net technology is the winner of Fast MRI Challenge hosted by Facebook AI research and New York Langone Health.

2. Compared to Philips SENSE.

3. On average, measured across a sample of sites from Philips MR installed base.