TOMORROW TODAY

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A new era of deep-learning image reconstruction

Radiologists and technologists are intimately familiar with the traditional compromise in MR between image quality and scan time. Higher image quality — through higher SNR and/or spatial resolution needed to resolve anatomical detail — necessitates long scan times, whereas faster scans — desired for patient comfort and productivity — compromise image quality and diagnostic confidence. AIR™ Recon DL‡, an innovative new reconstruction technology from GE Healthcare based on deep learning, offers a fundamental shift in this balance between image quality and scan time, resulting in TrueFidelity™ MR images that elevate the science of image reconstruction for clinical excellence without conventional compromises.

Conventional MR image reconstruction gives rise to well-known image artifacts as a direct result of the data acquisition and reconstruction process. For example, thermal and electrical noise during data sampling translates into random image noise that reduces SNR, while incomplete sampling of high spatial frequencies creates partial volume and edge ringing (i.e., Gibbs ringing) artifacts in the final reconstructed image.

Traditional methods to address these artifacts include hardware, software and acquisition approaches. Hardware solutions such as higher field strength magnets and more RF coil elements can improve SNR. Software filters are commonly applied in the data reconstruction pipeline to mitigate noise and ringing; however, these are only partially effective and can have the undesired impact of reducing effective spatial resolution. In the acquisition protocol, scan parameters can be adjusted to improve image quality, but this comes at a high cost. For example, SNR can be improved by increasing the number of signal averages (NEX) with a proportional increase in scan time; truncation artifacts can be mitigated by increasing spatial resolution, which in turn typically increases scan time and also reduces SNR. This costly SNR/spatial resolution/scan time interdependency forces clinicians to make difficult trade-offs between image quality and scan time for a given patient and clinical need.

Though there has been some success easing this MR trade-off with existing technologies, the reality is that many images today still suffer from low SNR and artifacts, which can lead to decreased diagnostic confidence and reduced radiologist productivity. Patients may be called back for re-scans, which leads to fewer daily scan slots available for scheduling new patients. It can also lead to lower patient throughput due to repeated scans during the exam, further backlogging the schedule and leading to a poorer patient experience.

Artificial intelligence now offers an exciting new means to mitigate traditional image artifacts and generate clearer, higher-quality images than previously obtainable from the same MR data.

‡Not yet CE marked. Not available for sale in all regions.

Pascal Roux, MD

Centre Cardiologique du Nord
Paris, France

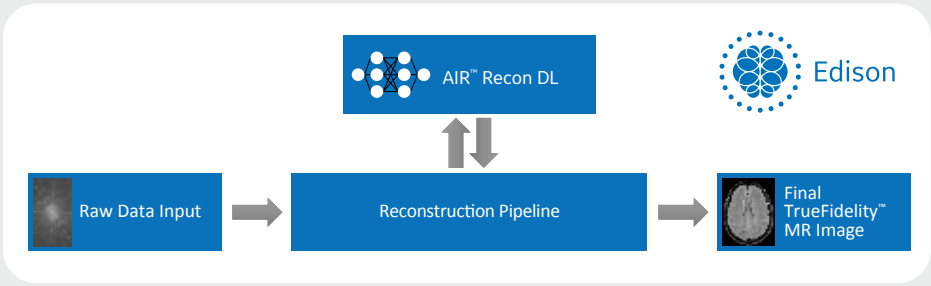


Figure 1. AIR™ Recon DL is integrated directly into the MR image reconstruction pipeline to intelligently reconstruct a final image with high SNR and sharpness.

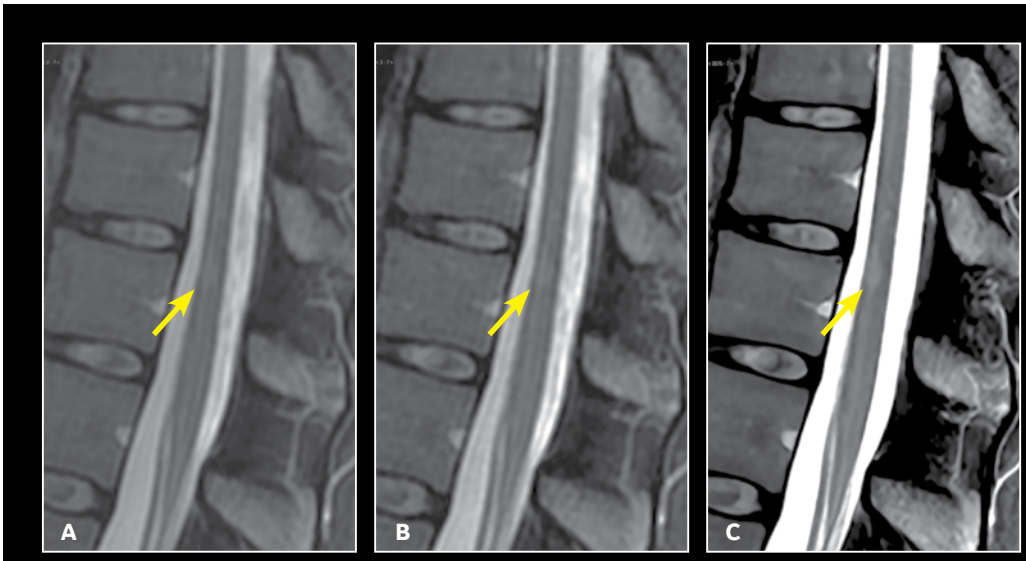
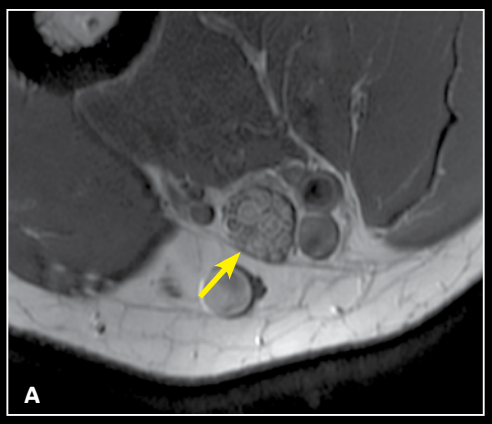


Figure 2. AIR™ Recon DL improves SNR to help depict lesions. (A) Existing protocol: sagittal T2 FSE, 0.9 x 1.0 x 3.5 mm, 4 NEX, 2:50 min. (B) Revised protocol: sagittal T2 FSE, 0.9 x 1.0 x 3.5 mm, 2 NEX, 1:28 min. (C) Image in 2B reconstructed with AIR™ Recon DL at maximum noise reduction to enable shorter scan time without sacrificing SNR.

Images courtesy of CCN

AIR™ Recon DL represents a revolution in MR image reconstruction by introducing a deep learning-based convolutional neural network to intelligently reconstruct a final MR image with high SNR and image sharpness. AIR™ Recon DL is not a post-processing technique but rather is embedded directly in the reconstruction pipeline, where the neural network model is applied to acquired input data to remove noise and ringing artifacts prior to final image formation (Figure 1). By operating on raw data within the online reconstruction pipeline, AIR™ Recon DL benefits from access to the full set of acquired source data to generate an image, compared to post DICOM image conversion where important information has been lost.

AIR™ Recon DL uses a feed-forward deep convolutional neural network trained on over 10,000 images using GE's Edison AI Platform. Supervised learning was performed by using data pairs of high SNR, high-resolution images and low-SNR, low-resolution images. The trained network employs a cascade of over 100,000 unique filters that recognize patterns characteristic of noise and low resolution to reconstruct only the ideal object image. The network includes a tunable SNR improvement level expressed as mild, medium and maximum to accommodate user preference. AIR™ Recon DL includes an innovative ringing suppression technology: rather than simply removing Gibbs ringing, the network recognizes where ringing occurs and recasts this former artifact into improved image detail. The result is an image with



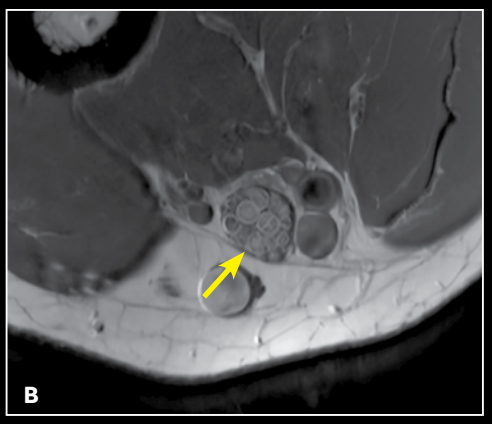


Figure 3. Spontaneous median neuropathy of the elbow. Axial PD 2D FSE. (A) Image acquired with standard protocol, 512 x 352, 12 cm FOV, 2 NEX; (B) image reconstructed with AIR™ Recon DL at maximum SNR improvement. Note the clarity of the median nerve in the AIR™ Recon DL image.

Images courtesy of HSS

high SNR and spatial resolution that is virtually free of truncation artifacts.

With AIR™ Recon DL, the potential is for technologists to acquire higher SNR without a time penalty and for radiologists to have more consistency and quality in the images they interpret. Alternatively, scan time may be reduced without compromising detail or SNR.

For example, if an MR technologist decreases slice thickness or in-plane pixel size, the amount of signal is proportionately reduced, which typically leads to noisier images. With AIR™ Recon DL, the result is higher SNR images and this may enable radiologists to be more confident in their reading and reporting.

The best of both worlds

Pascal Roux, a radiologist at Centre Cardiologique du Nord (CCN), one of the first global clinical sites to evaluate AIR™ Recon DL for GE, believes that AIR™ Recon DL is a solution that offers a dramatic improvement over existing image reconstruction techniques. "In my experience, AIR™ Recon DL demonstrated high-resolution images with no truncation artifact, imperceptible noise and depiction of sharp structure," Dr. Roux says. As of the end of August 2019, CCN had performed nearly 1,000 exams with a prototype version of AIR™ Recon DL.

In one case, he was able to detect a lesion on a spinal cord exam that was difficult to appreciate on the images processed without AIR™ Recon DL. In Dr. Roux's opinion, the lesion was more clearly visible on the images processed with AIR™Recon DL (Figure 2).

> "Anytime a new technology can help improve resolution, it will help us to better analyze lesions."
>
> *Dr. Pascal Roux*

Reading an AIR™ Recon DL image is very natural and comfortable for Dr. Roux. He expects to be more confident in his diagnosis because AIR™ Recon DL is designed to help improve SNR and image sharpness, which can enhance spatial resolution as well as help remove artifacts and reduce acquisition time.

"I have the best of both worlds. I do not have to choose between improving the quality of the exam and shortening the exam time," he says.

AIR™ Recon DL is an excellent tool to improve workflow. If Dr. Roux's department can increase the number of exams even by a fraction each hour, the cumulative result at the end of the day could be significant. With a three-exam-each-hour schedule, Dr. Roux believes it is possible to add five to six more patients in a 12-hour day.

The shorter acquisition time also means that when he needs to capture an additional image for a difficult case, he can do it without worrying about the schedule.

"Sometimes a sequence fails, or you get great information and want to add something," Dr. Roux explains. "It is hard to do that when an MR exam is 20-30 minutes. However, if we can go faster because we can reconstruct it with a deep-learning solution such as AIR™ Recon DL, then we have sufficient time to do this in the scan room."

Finding the "sweet spot"

The Hospital for Special Surgery (HSS) is another of several global sites evaluating AIR™ Recon DL and its impact on image quality, spatial resolution and acquisition scan time. Darryl Sneag, MD, Director of Peripheral Nerve MRI, Erin Argentieri, senior lead research specialist and Hollis Potter, MD, Chairman, Department of Radiology and Imaging, examined the use of AIR™ Recon DL in peripheral nerve and musculoskeletal (MSK) imaging.

"AIR™ Recon DL provides the added resolution that we need when looking at musculoskeletal structures, such as ligaments, tendons, nerves and the trabecular detail of the bones," says Dr. Sneag.

The difference is like 'night and day' for Dr. Potter, particularly when using a 512 x 512 matrix with one excitation (1 NEX). With AIR™ Recon DL, trabecular

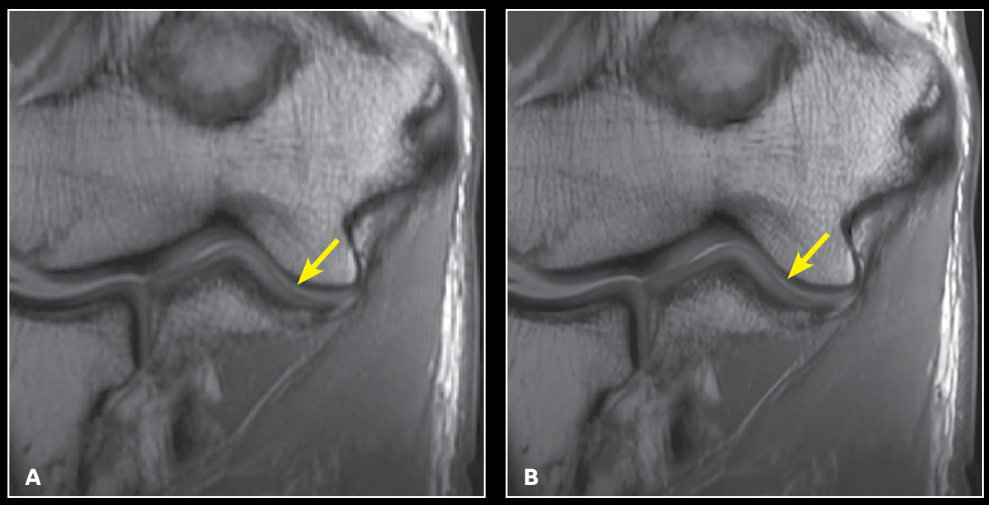


Figure 4. Coronal PD 2D FSE image of the elbow depicts normal ulnotrochlear cartilage. (A) Standard protocol, 512 x 352, 14 cm FOV, 1 NEX; (B) AIR™ Recon DL at maximum SNR improvement more clearly demonstrates the superficial cartilage layer (lamina splendens) and subchondral bone.

Images courtesy of HSS

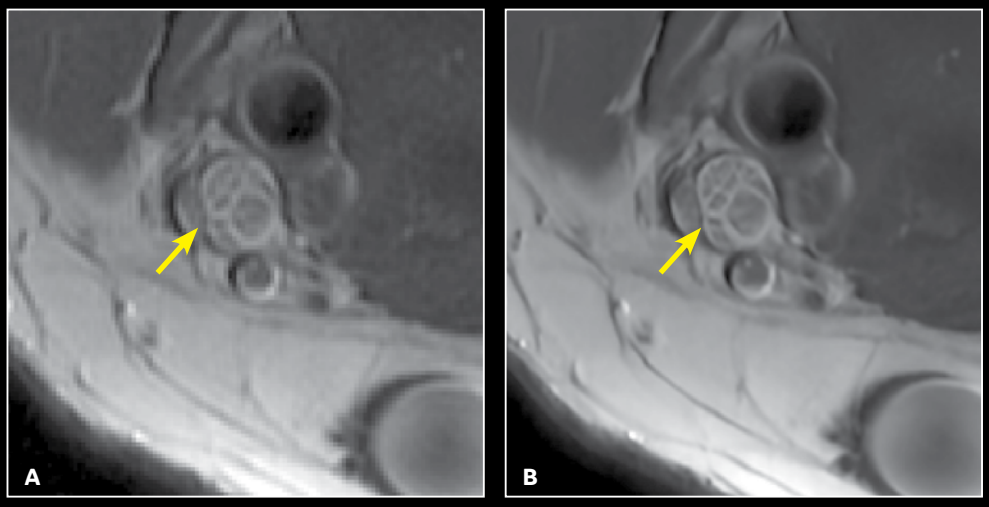


Figure 5.Axial PD 2D FSE image through the arm in a patient with a severe, spontaneous median neuropathy. (A) 512 x 352, 12 cm FOV, 2 NEX; (B) AIR™ Recon DL at maximum SNR improvement more clearly depicts fascicular detail and enlargement.

Images courtesy of HSS

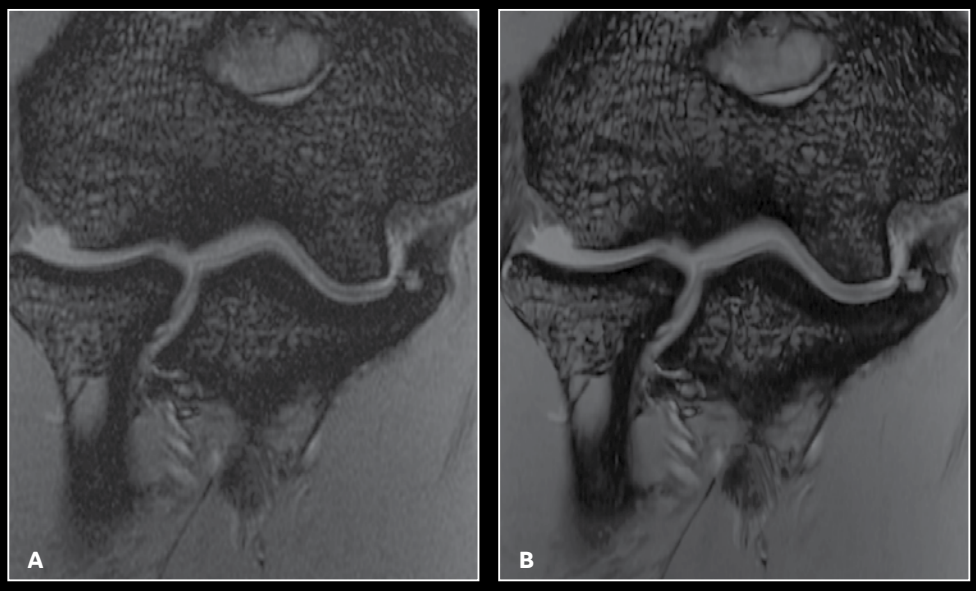


Figure 6. (A) Standard protocol. Coronal T2* GRE, 0.3 x 0.6 x 1.7 mm; (B) AIR™ Recon DL at maximum SNR improvement.

Images courtesy of HSS

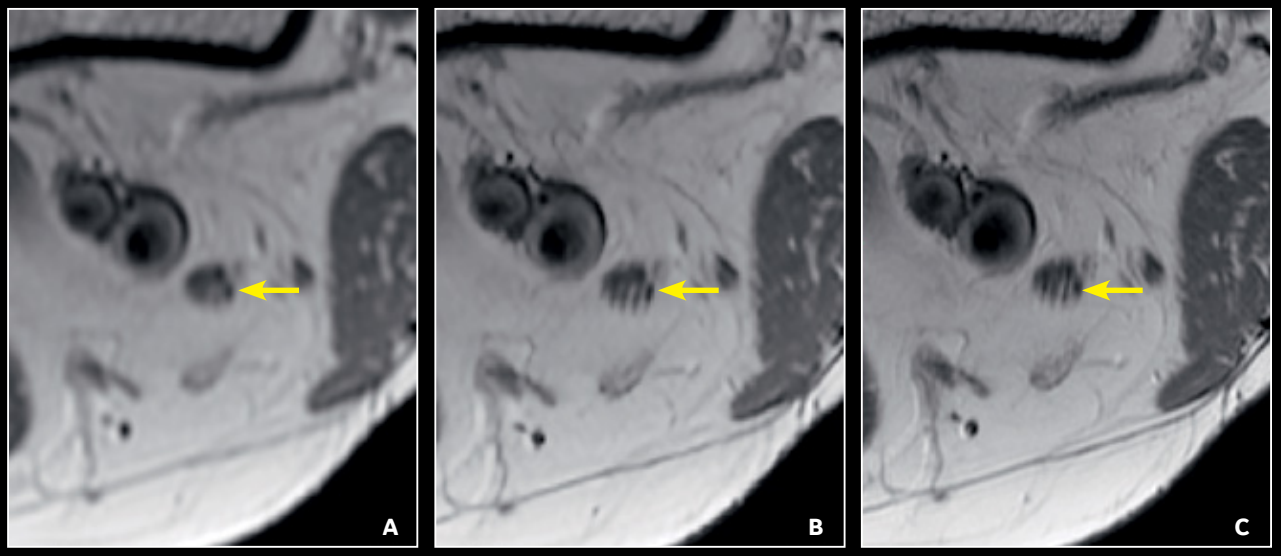


Figure 7. Elbow. (A) Unfiltered, axial 2D FSE, 256 x 180, 1 NEX, 1:10 min. (B) AIR™ Recon DL at maximum-plus SNR improvement, 256 x 180, 1 NEX, 1:10 min. (C) Reference unfiltered, 512 x 352, 2 NEX, 4:09 min.

Images courtesy of HSS

detail is not blurred and the individual nerve fascicles are clearly demonstrated (Figures 3 and 4). Previously, at a 512 x 512 matrix, SNR would be a challenge, but with AIR™ Recon DL, Drs. Potter and Sneag can push the MR system to a higher matrix and achieve impressive imaging results.

"In our experience, this tool enables us to back off on the number of averages or achieve a higher matrix, to either save on scan time or achieve a higher resolution image."

Dr. Hollis Potter

"There is more detail in the image, especially at a lower matrix. In some conventionally-processed MR images, the trabecular pattern is poor, the nerves are blurred and there is a lot of noise in the image. With AIR™ Recon DL, the difference is striking," Dr. Potter says (Figure 7).

Dr. Potter adds that with the high-resolution AIR™ Recon DL images, she can confidently evaluate the internal architecture of the nerve — something she couldn't routinely see before.

"In my opinion, we are seeing better image quality and faster radiology reads. This will help us be more confident in our diagnosis," she adds.

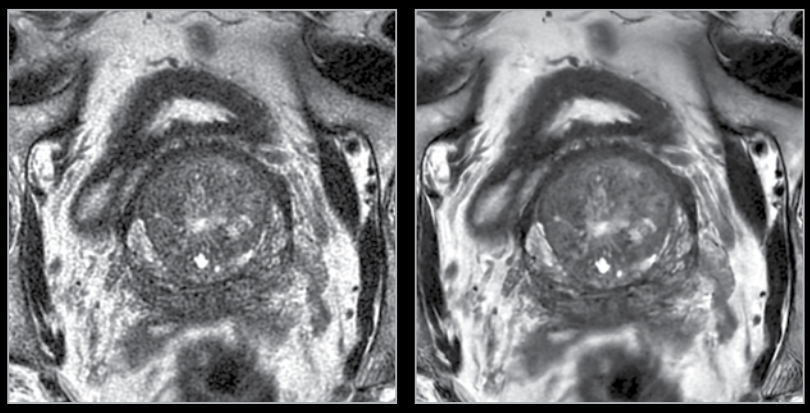
With AIR™ Recon DL, the power of deep learning and neural networks is unleashed in MR image reconstruction. AIR™ Recon DL was designed to improve SNR and image sharpness, thereby improving image quality in MR exams.

Beyond enhancing image quality, AIR™ Recon DL complements GE's AIR x™ automatic prescription and AIR Touch™ workflow tools to help improve scan consistency and usability, and potentially help facilitate shorter scan times.

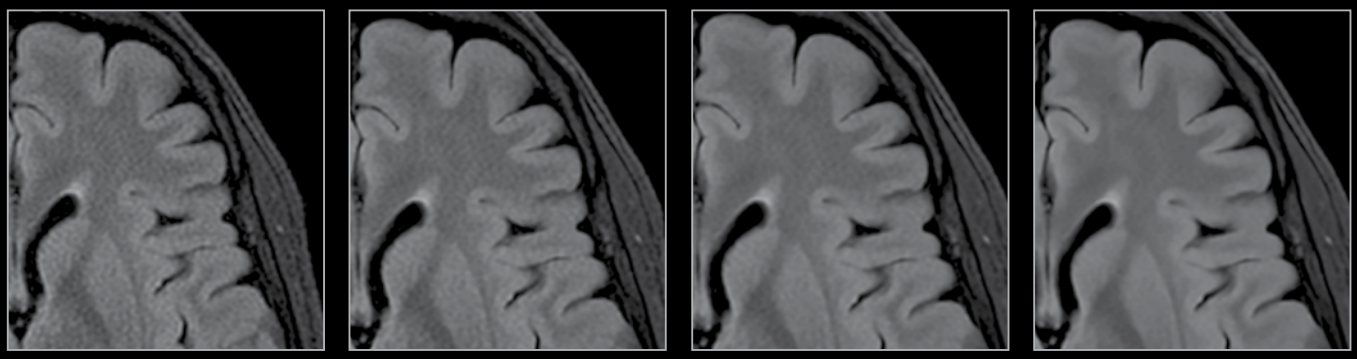
Based on initial evaluations at HSS and CCN, AIR™ Recon DL demonstrates that it can provide high-quality images across a variety of anatomies and scan protocols and has the potential to reduce scan times while preserving high image quality for more efficient exams.

Editor's note: The editors gratefully acknowledge the assistance of R. Marc Lebel, PhD, Lead Scientist, Julie Poujol, PhD, Research Scientist and Anja C.S. Brau, PhD, General Manager, MR Collaboration & Development, in the development of this article.

AIR™ Recon DL gallery

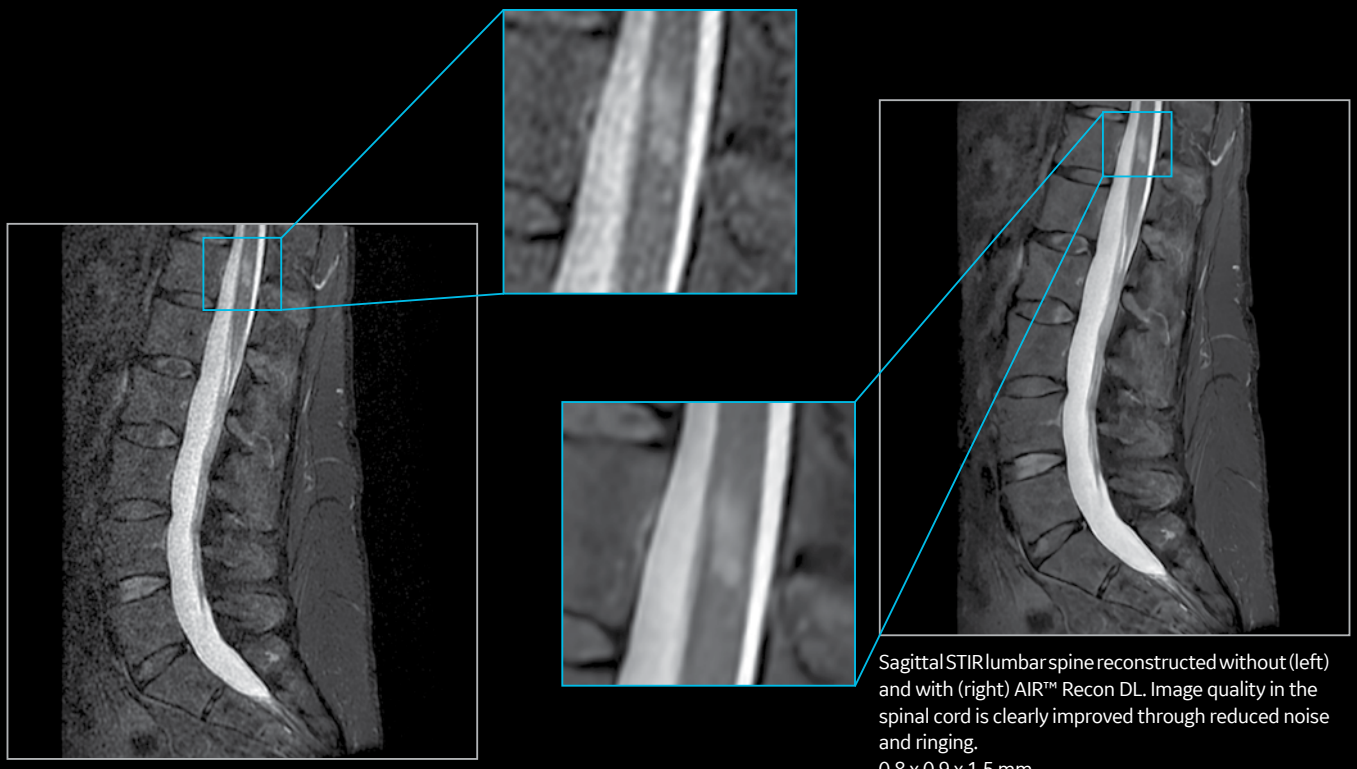


AIR™ Recon DL‡ recovers a high-quality image from an otherwise noisy thin-slice axial T2 prostate image acquired in only 1:07 min.



Original image | Mild SNR improvement | Medium SNR improvement | Maximum SNR improvement

With AIR™ Recon DL, images can be reconstructed with mild, medium or maximum SNR improvement for visibly improved image quality compared to the original image.



Sagittal STIR lumbar spine reconstructed without (left) and with (right) AIR™ Recon DL. Image quality in the spinal cord is clearly improved through reduced noise and ringing.
0.8 x 0.9 x 1.5 mm
2:47 min.

‡Not yet CE marked. Not available for sale in all regions.

Håkan Boström, MD
The Queen Silvia Children's Hospital
Gothenburg, Sweden

Pär-Arne Svensson
The Queen Silvia Children's Hospital
Gothenburg, Sweden

Transforming the MR imaging experience for one of Sweden's largest pediatric hospitals

As part of a modernization project, The Queen Silvia Children's Hospital upgraded to the SIGNA™ Architect with AIR™. An initial evaluation by the Department of Pediatric Radiology found the new AIR™ Anterior Array (AA) Coil delivers good SNR and homogeneity for high-resolution imaging. The coil also enables flexibility and ease of positioning patients, and when used with AIR Touch™ makes coil selection easier and helps with workflow.

As one of the largest pediatric hospitals in Sweden, The Queen Silvia Children's Hospital at Sahlgrenska University Hospital in Gothenburg provides care to children from newborns up to age 18. The Department of Pediatric Radiology performs around 45,000 exams each year. Named for the country's current Queen, the hospital has undergone a modernization project to improve workflow and enhance clinical services as well as create a safe and secure healing environment for its young patients.

The pediatric radiology department recently upgraded its Discovery™ MR750w 3.0T wide-bore system to SIGNA™ Architect. With new gradients and Total Digital Imaging (TDI), the cutting-edge platform is designed to help facilities like The Queen Silvia Children's Hospital adapt to existing and future advancements in MR imaging technologies, such as AIR™ and the SIGNA™Works productivity platform.

"We want to be on the front line of new technology and prepare for the future," says Håkan Boström, MD, pediatric radiologist at The Queen Silvia Children's Hospital.

In addition to the recently upgraded SIGNA™ Architect, the hospital also has an Optima™ MR450w 1.5T. Combined, these two MR systems enable the hospital to perform more than 2,000 MR exams each year.

According to Pär-Arne Svensson, MR research radiographer, a key motivation behind the SIGNA™ Architect upgrade was the ability to acquire the new AIR™ family of products, including the AIR™ 48-channel Head Coil, along with new MR sequences available in SIGNA™Works, specifically MUSE, PROPELLER MB (multi-blade), MPRAGE and distortion correction with diffusion-weighted imaging (DWI) like PROGRES.

The radiology department has been evaluating MUSE as a replacement sequence for single-shot diffusion imaging in neonates. With MUSE, Dr. Boström can obtain higher resolution and the distortion correction is better with less distortion artifacts. In addition to Dr. Boström finding that MUSE delivers high resolution and excellent image quality, PROPELLER MB is also helpful in avoiding metal artifacts. PROPELLER MB is particularly beneficial when imaging the cervical spine and temporal bone with diffusion sequences. Svensson and Dr. Boström are still evaluating MPRAGE, however, they are obtaining better contrast between white and gray matter in the brain compared to other conventional 3D FSPGR sequences. This

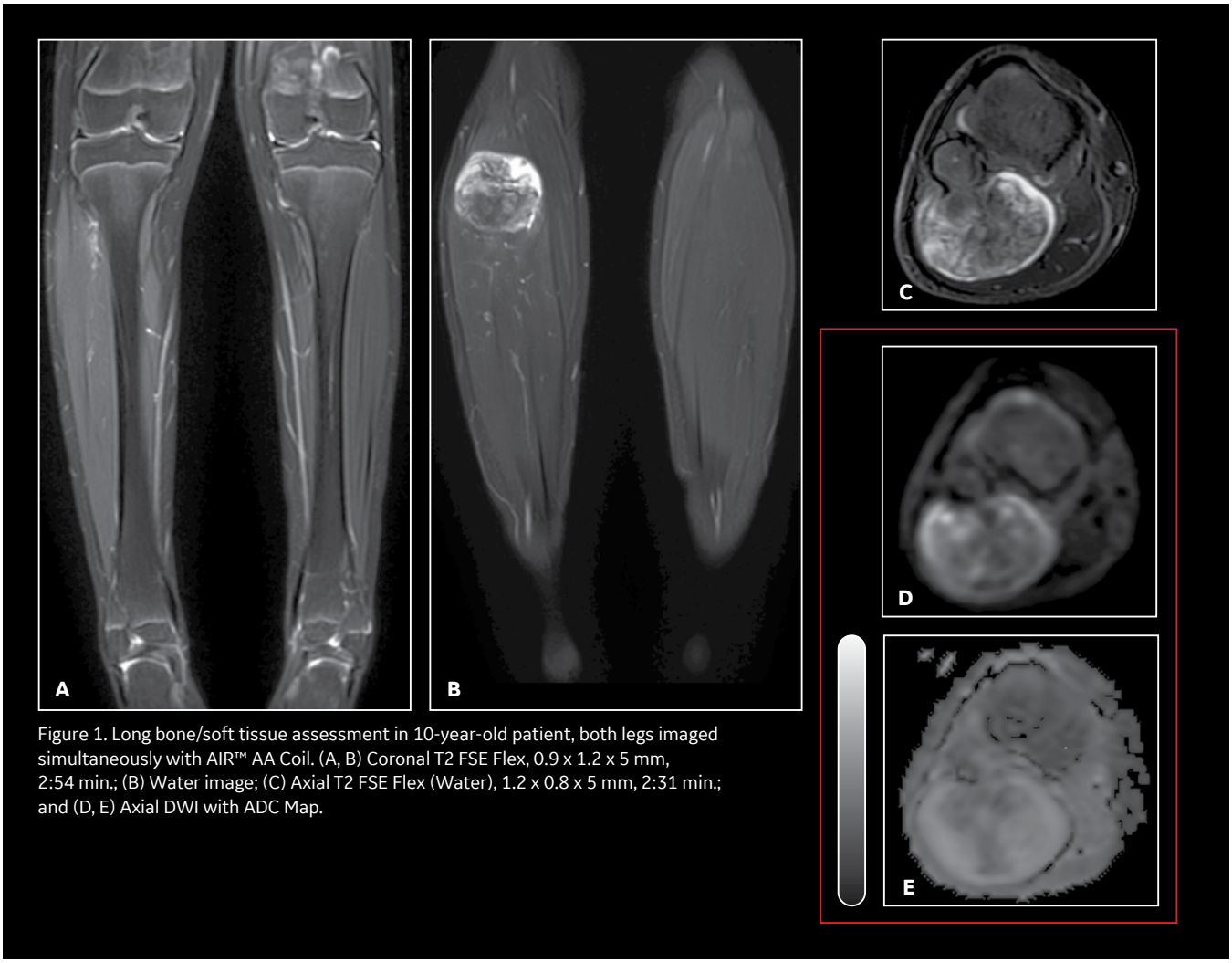


Figure 1. Long bone/soft tissue assessment in 10-year-old patient, both legs imaged simultaneously with AIR™ AA Coil. (A, B) Coronal T2 FSE Flex, 0.9 x 1.2 x 5 mm, 2:54 min.; (B) Water image; (C) Axial T2 FSE Flex (Water), 1.2 x 0.8 x 5 mm, 2:31 min.; and (D, E) Axial DWI with ADC Map.

sequence would be particularly helpful when imaging epilepsy patients before and after surgery.

In addition to the new sequences, the department received the AIR™ AA Coil and 48-channel Head Coil in early 2019. The AIR™ AA Coil has the highest channel count and coverage in the industry.

"Our initial experience is very good," says Dr. Boström. "We've used the AA for several exams, such as the abdomen, pelvic, lower extremities, shoulder and fetal imaging. The main advantages with the AIR™ AA are the flexibility and ease of positioning on the patient."

It is lightweight—60 percent lighter than conventional, hard-shell coils—and children in pain may not tolerate a heavy coil on their body, Dr. Boström explains. This includes children who had open heart surgery at The Queen Silvia Children's Hospital, one of only two pediatric cardiac surgery centers in Sweden.

"Fetal imaging is another area where we see an advantage with the AIR™ AA," adds Svensson. "It can be difficult to put a conventional, hard-shell coil around a pregnant woman's abdomen and get a good, homogeneous signal."

For women in the late stage of pregnancy, lying on their back can be uncomfortable. Svensson wants to try imaging them on their side with the AIR™ AA Coil wrapped around them and see what the impact is on patient comfort and image quality.

In musculoskeletal imaging of the shoulder and arm, lower extremities or imaging both legs, Svensson can wrap the coil around larger field-of-views (FOVs) and obtain a homogenous signal for good image quality. For example, patients with multifocal chronic osteomyelitis or muscular dystrophy/myositis will often require imaging of both legs simultaneously.

"With the AIR™ AA, we can cover large areas but we also get good SNR, so we can provide detailed images of specific joints with high resolution," he says.

Positioning these precious patients is also easier now with AIR™ Coils. There are many factors that can impact the overall time a child is in the MR scanner and any time saved in positioning means the sooner the patient can get back to his or her parents.

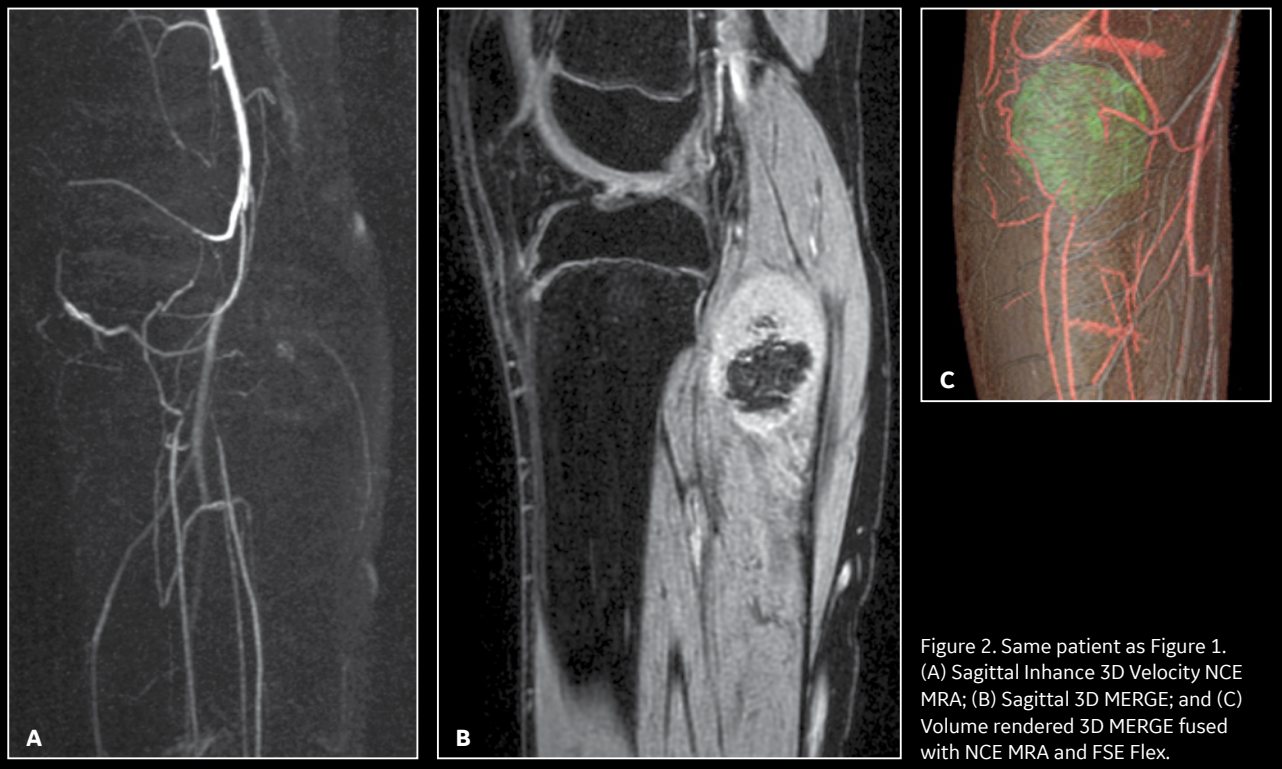


Figure 2. Same patient as Figure 1. (A) Sagittal Inhance 3D Velocity NCE MRA; (B) Sagittal 3D MERGE; and (C) Volume rendered 3D MERGE fused with NCE MRA and FSE Flex.

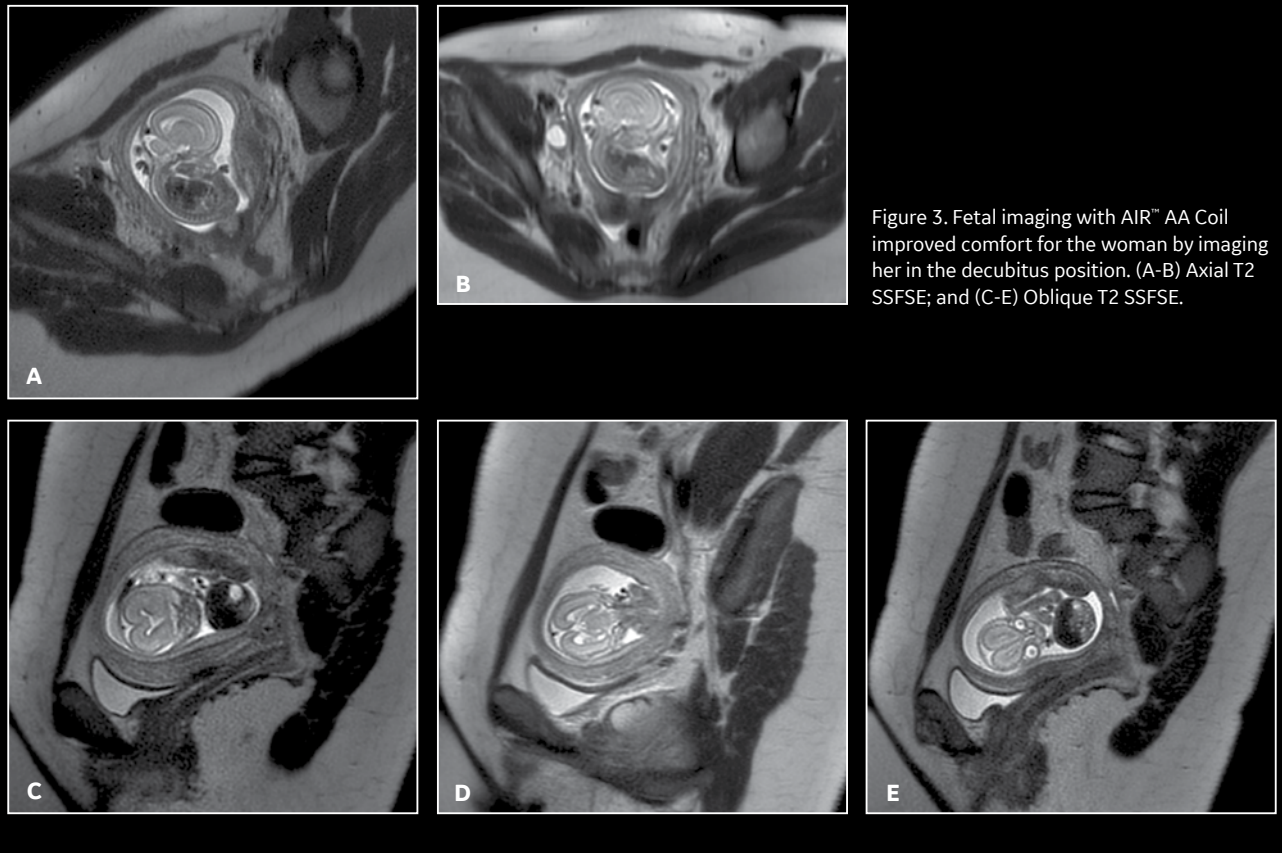


Figure 3. Fetal imaging with AIR™ AA Coil improved comfort for the woman by imaging her in the decubitus position. (A-B) Axial T2 SSFSE; and (C-E) Oblique T2 SSFSE.

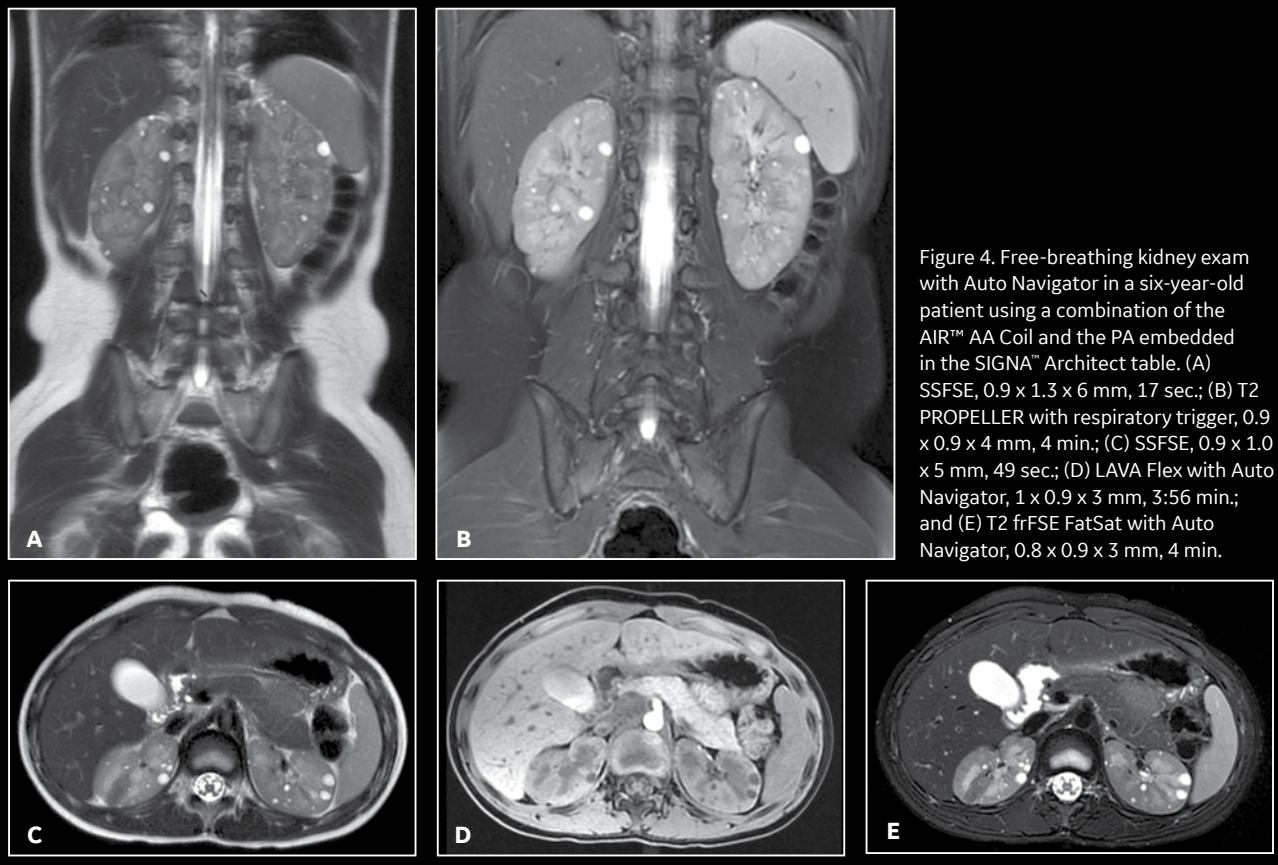


Figure 4. Free-breathing kidney exam with Auto Navigator in a six-year-old patient using a combination of the AIR™ AA Coil and the PA embedded in the SIGNA™ Architect table. (A) SSFSE, 0.9 x 1.3 x 6 mm, 17 sec.; (B) T2 PROPELLER with respiratory trigger, 0.9 x 0.9 x 4 mm, 4 min.; (C) SSFSE, 0.9 x 1.0 x 5 mm, 49 sec.; (D) LAVA Flex with Auto Navigator, 1 x 0.9 x 3 mm, 3:56 min.; and (E) T2 frFSE FatSat with Auto Navigator, 0.8 x 0.9 x 3 mm, 4 min.

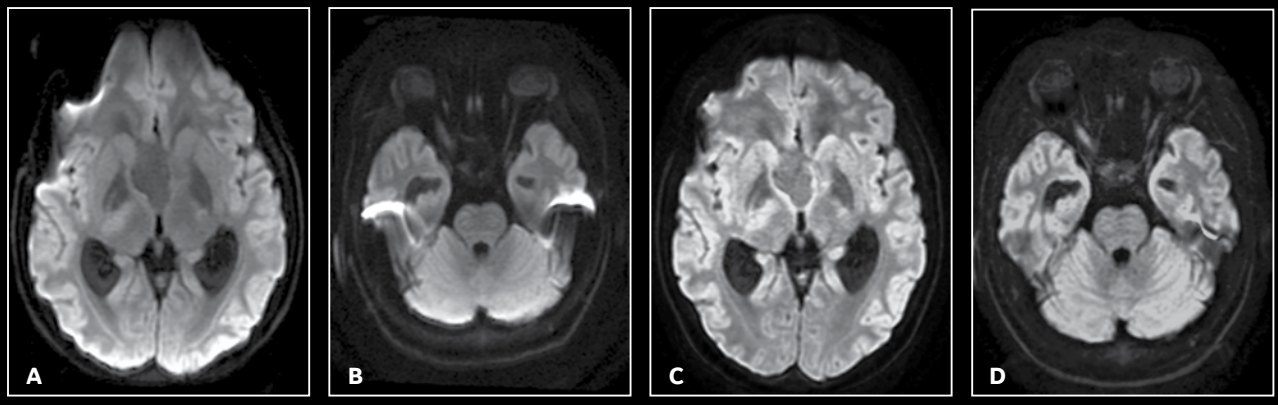


Figure 5. Neuro imaging with the AIR™ 48-channel Head Coil in a three-year-old patient. Note the same resolution with less blurring in the MUSE DWI sequence. (A-B) Traditional single-shot DWI, 1.8 x 1.4 x 3.6 mm, 2 shots, acceleration factor of 2, 1:58 min.; and (C, D) MUSE DWI, 1.8 x 1.4 x 3.6 mm, 2 shots, acceleration factor of 2, 2:16 min.

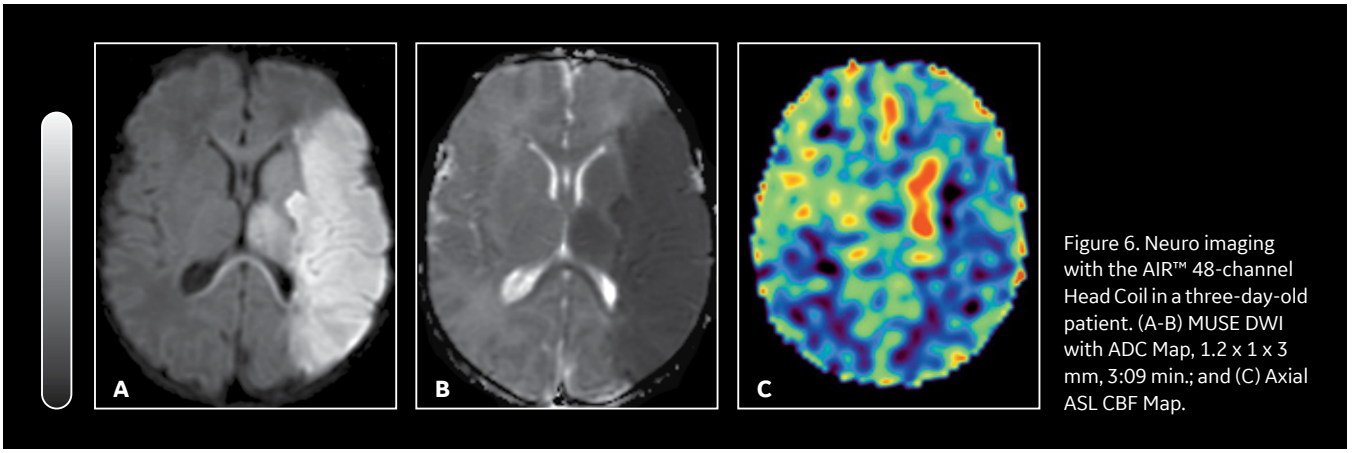


Figure 6. Neuro imaging with the AIR™ 48-channel Head Coil in a three-day-old patient. (A-B) MUSE DWI with ADC Map, 1.2 x 1 x 3 mm, 3:09 min.; and (C) Axial ASL CBF Map.

Another patient-centric feature of AIR Touch™ is that it assists with patient positioning. It automatically selects the best elements to use and uniquely optimizes uniformity, SNR, artifacts and parallel imaging.

"AIR Touch™ makes coil selection much easier and I don't have to check what elements are activated because the system does it. It helps with workflow, but the most important factor is that it helps me focus more on the child."

Pär-Arne Svensson

AIR Touch™ even helps when using more than one coil. Embedded in the SIGNA™ Architect table is the Posterior Array (PA). With small children, Dr. Boström and Svensson are using GE's Flex Coil in combination with the PA. They have seen excellent results using the combination of both coils in cardiac and abdominal exams.

After using the impressive AIR™ AA Coil for just two months Svensson and Dr. Boström no longer use the conventional AA. They look forward to receiving the new AIR™ Multi-Purpose (MP) Coil‡, a smaller version of the AIR™ AA Coil.

There have been a few patients who had MR exams with both the conventional coil and the AIR™ AA Coil. Svensson says when asked, these patients preferred the new coil, especially because it was not so heavy and confining on their bodies.

"The most important benefit of AIR™ is the patient comfort," says Dr. Boström. "It is lightweight and can lay on the patient like a blanket. We believe this also impacts patient compliance." Overall, Dr. Boström and Svensson are impressed with SIGNA™ Architect, SIGNA™Works and especially AIR™.

"This is a stable MR system with very good image quality," says Svensson. "We are satisfied with the upgrade and our initial experience with AIR™."

‡Not yet CE marked. Not available for sale in all regions.

Takafumi Naka, RT(R)(MR)
Kawasaki Saiwai Hospital
Kawasaki, Kanagawa, Japan

Ultra-flexible AIR Coils making a difference in the technologist's workflow

The AIR™ Coil simplifies patient positioning and setup with AIR Touch™ automatic coil and element selection, a 60 percent lighter design than prior generations of coil technology and a flexible design that fits patients of various sizes and shapes.

Kawasaki Saiwai Hospital in Kanagawa, Japan, installed the SIGNA™ Architect 3.0T MR system in late 2017. In February 2019, the hospital upgraded to the latest version of the SIGNA™Works productivity platform and acquired AIR™. As one of the main healthcare providers for the region, especially for acutely ill patients, the hospital embraces the concept of patient-centered healthcare. The AIR™ Anterior Array (AA) Coil conforms to the human body, is flexible to fit all shapes and sizes and has a 60 percent lighter design compared to previous generations of conventional coil technology—making it the ideal coil to deliver both patient comfort and high image quality at Kawasaki Saiwai Hospital.

Takafumi Naka, RT(R)(MR), Chief Technologist, evaluated the new system and coils and the impact on the technologist's workflow and patient experience. He was most impressed that the AIR™ AA Coil is ultra-flexible and can be wrapped around the patient to facilitate positioning and fits a variety of patient body sizes.

In musculoskeletal (MSK) extremity imaging, coil selection for MR exams of the humerus and antebrachial bone would require two coils to image from the shoulder to the elbow. The AIR™ AA Coil, however, covers a larger region of interest (ROI) with a comfortable wrap-around fit and a higher SNR. Naka expects the same results in lower extremity imaging, particularly for patients with cellulitis and muscle contusions where large ROIs need to be acquired.

A conventional heavy, hard-shell coil on a patient's chest could impact the respiratory detection device, so Naka would place a spacer between the coil and the patient.

"However, with the AIR™ AA, we no longer have to do that," Naka says. "We now have better patient positioning workflow and also get an improvement in SNR because the coil is closer to the patient's chest."

In addition, he does not have to worry about setting the coil center because AIR Touch™ automatically detects it, providing additional workflow improvements and removing the chance for human error.

Naka is also thrilled that he can use higher parallel imaging acceleration factors with the AIR™ AA Coil. In one case, he applied a factor of 4x for a body Coronal DWI and had less distortion and blurring than with a conventional coil (Figure 1).

"It was a single-shot EPI DWI, however, the anatomy detail and information was really amazing," he adds.

Naka has also used higher parallel imaging acceleration factors in body PROPELLER exams. He leveraged this capability for better image quality, such as refocusing the flip angle for higher T2 contrast. He sees the same impact in neuro imaging with the the AIR™ 48-channel Head Coil.

"We already use MAGiC in clinical routine neuro examinations to acquire excellent T1 contrast, which by principle is difficult to obtain at 3.0T," Naka says. "However,

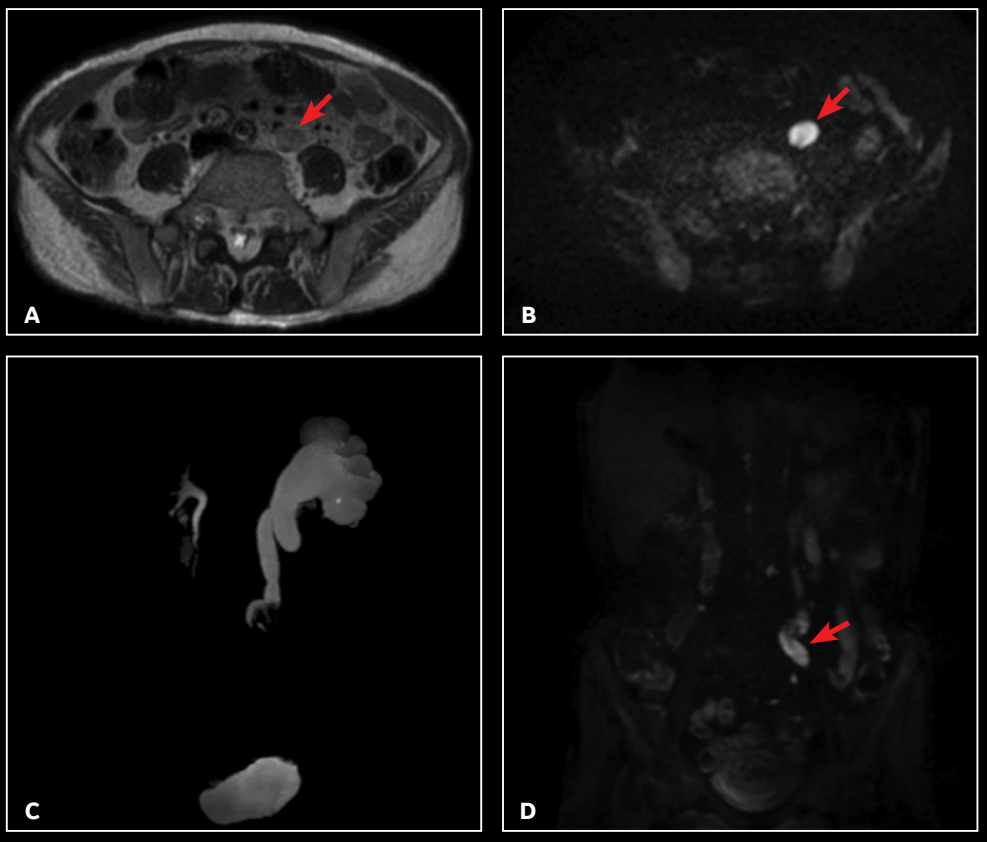


Figure 1. High-resolution MR Urography with reduced scan time is possible using HyperSense and HyperCube. A urethral tumor was visualized on the Coronal DWI using long axis. Even with an ASSET factor of 4.0, there was low distortion in the diffusion-weighted images. All images acquired with the AIR™ AA Coil. (A) Axial T2w SSFSE, 1.3 x 1.4 x 4 mm, 1:28 min.; (B) Axial DWI b1000, 2.7 x 2.7 x 4 mm, 3:57 min.; (C) MR urography, 0.7 x 1.2 x 1.4 mm, 2:40 min. (RTr); and (D) Coronal DWI b800, 3.1 x 1.6 x 4.5 mm, ASSET factor 4, 4:27 min. (RTr).

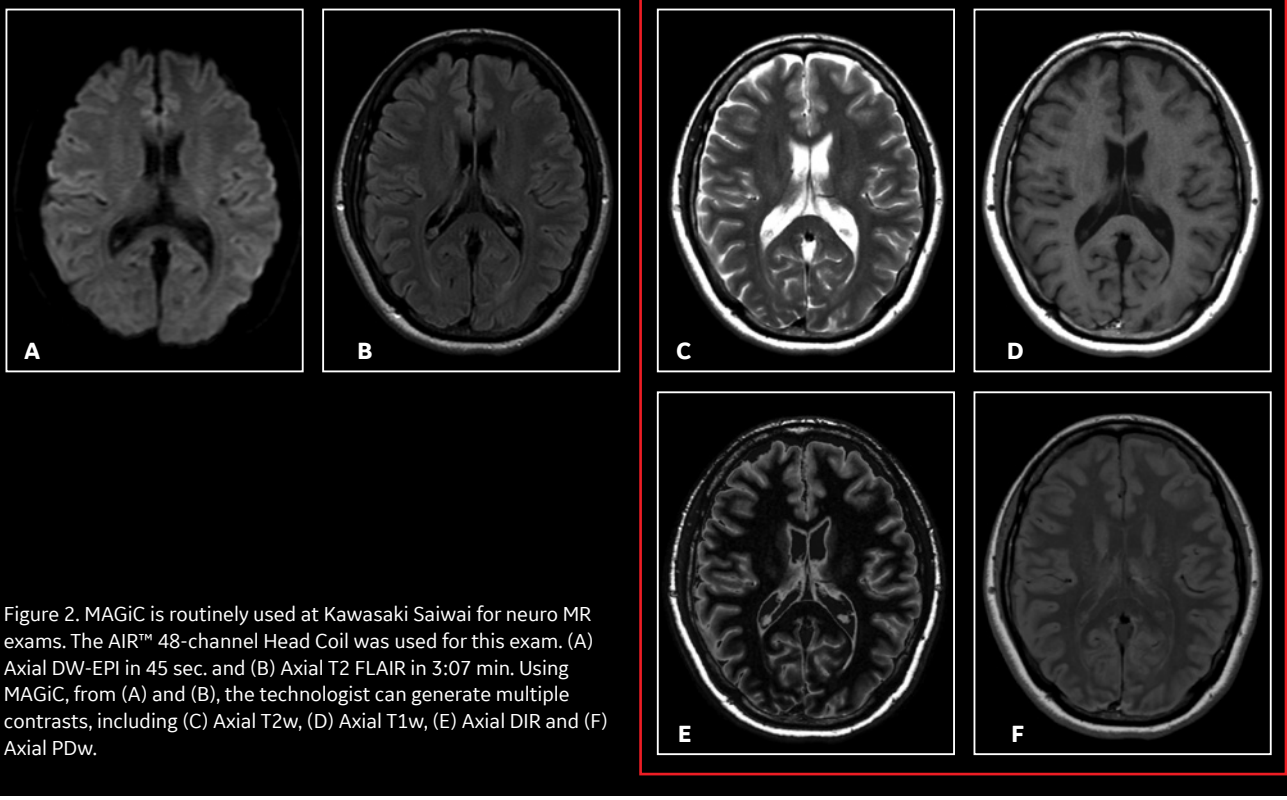


Figure 2. MAGiC is routinely used at Kawasaki Saiwai for neuro MR exams. The AIR™ 48-channel Head Coil was used for this exam. (A) Axial DW-EPI in 45 sec. and (B) Axial T2 FLAIR in 3:07 min. Using MAGiC, from (A) and (B), the technologist can generate multiple contrasts, including (C) Axial T2w, (D) Axial T1w, (E) Axial DIR and (F) Axial PDw.

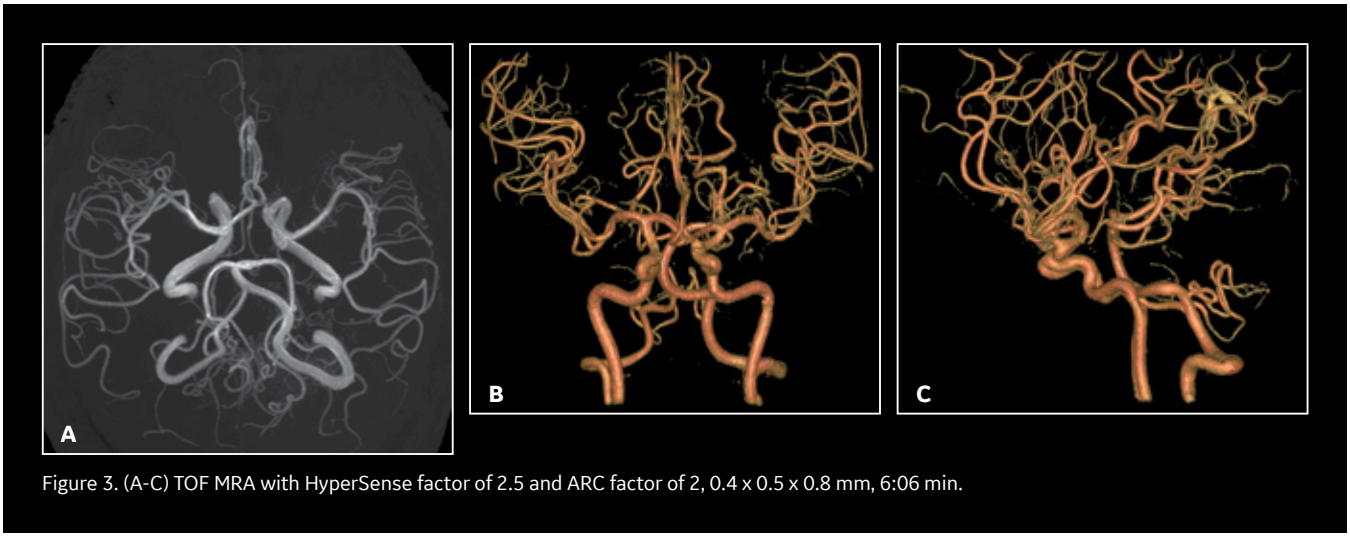


Figure 3. (A-C) TOF MRA with HyperSense factor of 2.5 and ARC factor of 2, 0.4 x 0.5 x 0.8 mm, 6:06 min.

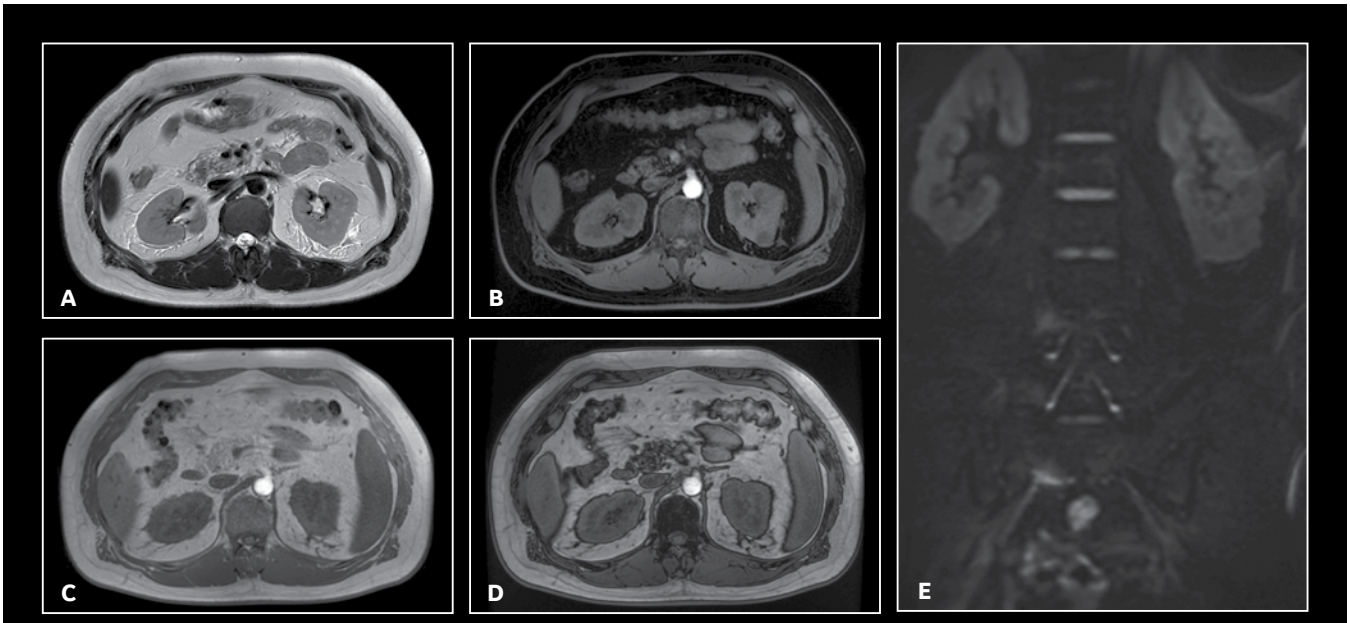


Figure 4. Patient weighed over 200 lbs. (120 kg). Abdominal kidney exam using the AIR™ AA Coil required a wide FOV, however, highly uniform images were acquired. (A) Axial T2w PROPELLER MB, 0.8 x 0.8 x 5 mm, ASSET 4.0, 5:39 min.; (B-D) Axial LAVA Flex; (B) water; (C) in-phase; (D) out-of-phase: 1.6 x 1.6 x 4 mm, 14 sec.; and (E) Coronal DWI b900, 3.1 x 1.6 x 5 mm, ASSET 4.0, 4:20 min.

with the AIR™ 48-channel Head Coil, we can reduce the scan time from six to three minutes because of the higher SNR," (Figure 2).

Plus, the AIR™ 48-channel Head Coil allows Naka to use a higher HyperSense factor because of the high SNR and spatial resolution. As a result, he can now acquire a high-resolution MR angiography exam in six minutes—something that previously took approximately 20 minutes (Figure 3).

He has noticed that patients are more relaxed with the AIR™ AA Coil than with conventional coils. Even large-sized patients weighing over 200 lbs. can fit comfortably inside the MR, with space between the coil and the bore (Figure 4).

Kawasaki Saiwai Hospital also installed the latest version of the SIGNA™Works productivity platform with SIGNA™ Architect. Naka loves the improvements in DWI, especially MUlti-plexed Sensitivity Encoding technique (MUSE) and PROGRES.

"The most impressive application is MUSE, a multi-shot DWI that allows us to achieve quite high spatial resolution compared to conventional DWI," he explains. "I find that MUSE DWI provides us completely different image quality versus the conventional sequence."

Figure 5. MUSE acquires high resolution DWI even at high b-values (b1000) and by using 4 shots with ARC acceleration of 1, distortion can be reduced. Fusing Sagittal T2w PROPELLER MB with the ADC map does not lead to distortion even in the presence of rectal gas. (A) Sagittal MUSE b1000, 1.5 x 0.9 x 6 mm, 4 shots with ARC acceleration of 1, 5 NEX, 4:39 min.; (B) Sagittal T2w PROPELLER MB, 0.8 x a0.8 x 6 mm, 4:12 min.; and (C) Fused ADC map with Sagittal T2w PROPELLER MB.

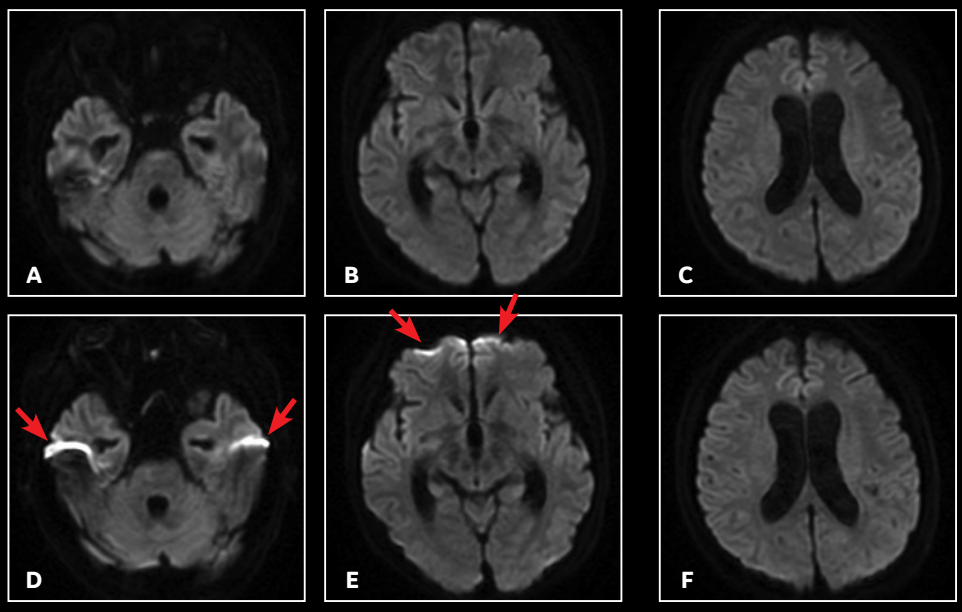


Figure 6. (A-C) DWI with PROGRES; and (D-F) conventional DWI. PROGRES provides less distortion than conventional DWI sequences, including fewer susceptibility artifacts (arrows) around the eye and inner ear.

In particular, the improvement in female pelvis imaging is notable. MUSE DWI clearly depicts details of cervix and endometrial lesions when Naka sets the acquisition plane (slices) along the uterine axis (Figure 5).

"We could see almost no distortion even in the Sagittal plane and there was less artifact from rectal gas," explains Naka. "Surprisingly, when we fuse MUSE DWI with T2-weighted images, we could not find misregistration caused by distortion. So, we think high-resolution MUSE DWI will have an advantage in detecting small lesions in the pancreas."

After investigating several sequences, Naka and his colleagues found PROGRES provided the best DWI image with the least distortion. Susceptibility artifacts around the eye and inner ear were decreased with no major impact on scan time when using PROGRES. As a result, PROGRES is being frequently used for neuro DWI at Kawasaki Saiwai Hospital (Figure 6).

From streamlined patient positioning to greater patient comfort, Naka sees the difference that the AIR™ Coil has on the patient experience. For his department, the ability to use higher acceleration factors and save time in patient set-up will positively impact the technologist's workflow, further improving staff satisfaction. And, with the new sequences available in SIGNA™ Works, he and his team can deliver the excellent image quality clinicians need for a more confident diagnosis.

Masatoshi Hori, MD, PhD
Osaka University Hospital
Suita, Osaka, Japan

An upgrade that meets the expectation for higher resolution, SNR and productivity

After upgrading its SIGNA™ Architect to the latest SIGNA™ Works productivity platform and acquiring the AIR™ Anterior Array (AA) Coil, Osaka University Hospital is delivering exceptional MR imaging that also promotes patient-centered care—two tenets of the hospital's core philosophy. The combination of these three advanced technologies is delivering excellent image uniformity across a wide range of patients and clinical exams.

For nearly 150 years, Osaka University Hospital (originally Osaka Medical School, circa 1869) has served the residents of Osaka and fostered the education of medical professionals throughout the region. The hospital's dedication to providing high-quality medical care is centered on the belief that adopting new and advanced technologies further promotes patient-centered, safe and reliable holistic care that contributes to the society.

"At Osaka University Hospital, we always seek the latest innovative technology to provide the best clinical performance and patient care," says Masatoshi Hori, MD, PhD, Associate Professor, Department of Radiology at Osaka University Hospital. With this philosophy, the department recently upgraded its existing Discovery™ MR750w 3.0T to SIGNA™ Architect and also acquired the AIR™ AA Coil.

"Our key expectation for MR is higher resolution, higher signal-to-noise ratio and higher temporal resolution," Professor Hori says. "This upgrade completely meets our expectations."

He found the AIR™ AA Coil to be lighter than expected and anticipates it will provide a better patient experience during an MR exam. Technologists have also shared with him that patient and coil set-up is much easier and that SNR gains are being realized because, in most cases, the coil fits the many shapes and sizes of patients much better than conventional arrays.

"The AIR™ AA Coil is one of the biggest innovations I have seen in the last decade," adds Professor Hori. He believes it will become a future standard technology and is excited to be an early adopter.

An important benefit of AIR™ is the ability to utilize higher parallel imaging acceleration factors with the coil element configuration and lower g-factor of the new coils. Specifically, in a 640 x 640 matrix T2-weighted PROPELLER Multi-shot Blade (MB) FatSat pancreas exam, high-resolution images were obtained with an ARC factor of 4 in 4:24 minutes (Figure 1).

PROPELLER MB is one key enhancement that Professor Hori is routinely using. It combines multiple blades together to achieve shorter TEs and improved motion correction. PROPELLER MB is also compatible with Auto Navigator, a free-breathing approach to combat respiratory motion in the body, cardiac and chest imaging with automatic tracker placement.

"We are now using PROPELLER MB for all abdominal cases, such as pelvis, liver and pancreas," he says. "There

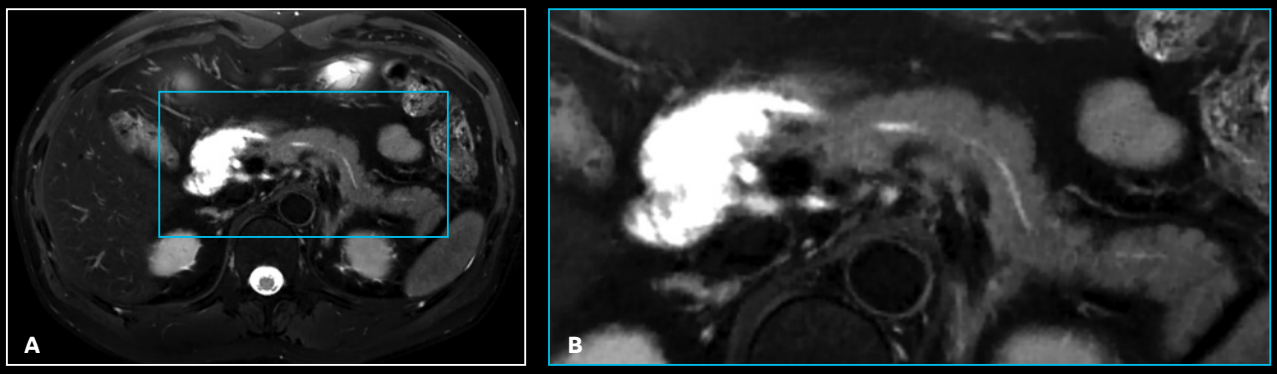


Figure 1. AIR™ enables the use of higher parallel imaging factors with improved SNR for high-resolution imaging and reduced scan times. (A) Axial T2w FatSat acquisition with PROPELLER MB, 0.6 x 0.6 x 4 mm, ARC factor of 4, 4:24 min.; (B) ROI in (A) magnified.

Figure 2. A female weighing 287 lbs. (130 kg) referred for MR imaging of the pelvis. (A) Sagittal T2w frFSE, 0.8 x 0.9 x 4 mm, 6:08 min.; (B) Sagittal T2w PROPELLER MB, 0.9 x 0.9 x 4 mm, 3:02 min.

is also the additional big advantage of motion correction without any critical disadvantage."

For example, he obtained good contrast of the endometrium and junctional zone in a patient without motion artifact. In the upper abdomen, he acquired good images that were also not compromised due to motion (Figure 2).

It's not just the coil that is leading to excellent imaging results at Osaka University. Professor Hori found the combination of the SIGNA™ Architect, advanced sequences and AIR™ together deliver robust imaging with excellent image uniformity.

"Sometimes we needed different WW/WL adjustments so we could clearly see the anatomy between the center and the edge of the FOV to make a diagnosis. Now, we no longer need to make this change in most patients," he says (Figure 3).

Professor Hori evaluated the AIR™ AA Coil and a conventional AA in a patient exam. He discovered that with the latest uniform correction application, reFINE, he could acquire higher image quality and better uniformity in many clinical cases and contrasts.

"Also, I found the AIR™ AA Coil provides better signal penetration, so image quality and SNR are better than a conventional coil, especially in large patients," he adds.

Using HyperCube with the AIR™ AA Coil in prostate imaging, Professor Hori can perform thin-slice imaging. He acquires 1-2 mm slice 3D images with HyperCube and obtains good quality compared to conventional 2D 5 mm Axial imaging. The advantage is that the thin slices provide him with a better understanding of capsular invasion, which can impact patient management and treatment options (Figures 4 and 5).

Multi-plexed Sensitivity Encoding (MUSE) DWI is another impressive application, especially in the prostate. It provides both high SNR and high spatial resolution.

"Currently, we acquire both conventional EPI DWI for the whole pelvis and FOCUS

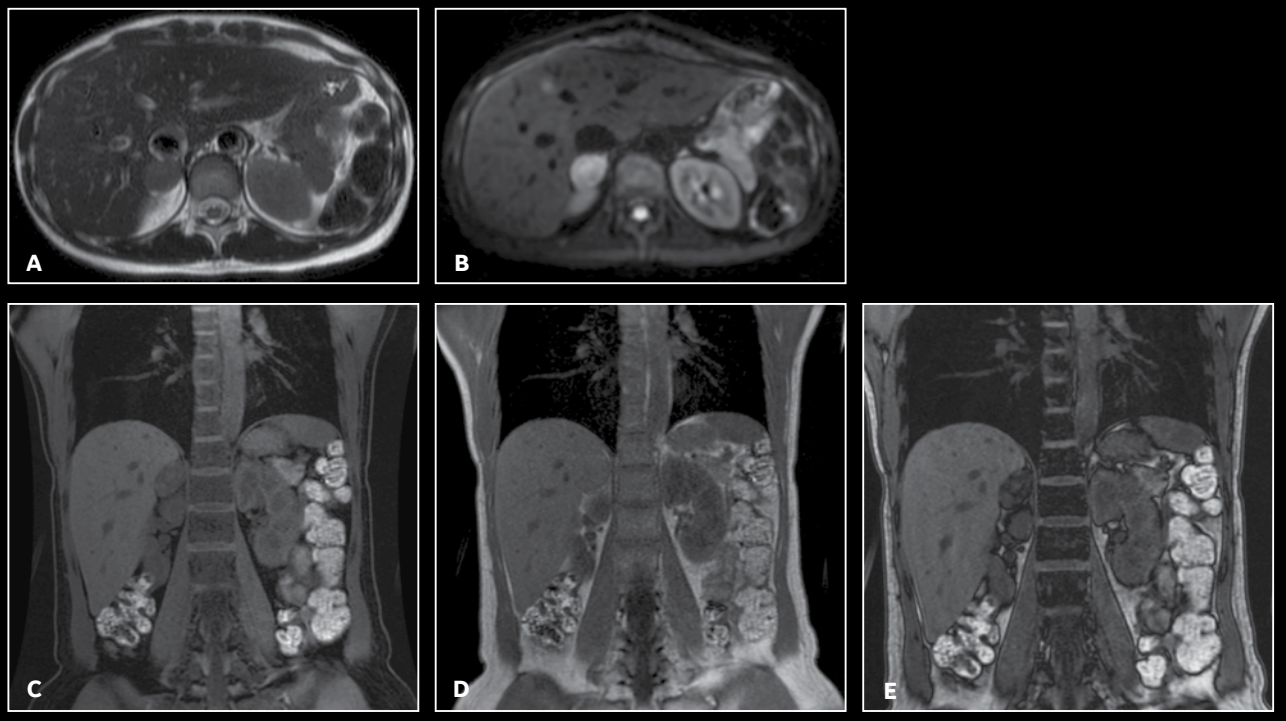


Figure 3. Patient with an adrenal mass. (A) Axial T2w SSFSE, 1.1 x 1.8 x 5 mm, 18 sec.; (B) Axial DW-EPI, 2.8 x 2.8 x 5 mm, 3:49 min. (RTr); (C-E) Coronal LAVA Flex, 1.4 x 1.6 x 3 mm, 16 sec.; (C) water, (D) in-phase and (E) out-of-phase.

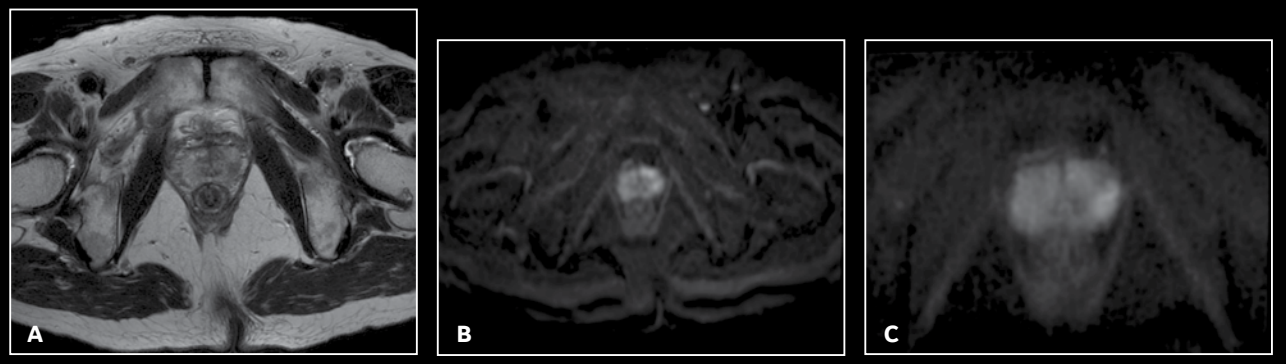


Figure 4. Prostate cancer patient (A) Axial T2w PROPELLER MB, 0.6 x 0.7 x 4 mm, 3:25 min; (B) EPI DWI b1000, 2.3 x 2.3 x 4 mm, 2:08 min.; and (C) FOCUS DWI, b1000, 1.5 x 1.5 x 4 mm, 4:10 min.

DWI for targeted small FOV with high resolution," Professor Hori explains. "However, MUSE can provide high-quality imaging in both larger and smaller FOV for the prostate," (Figure 6). In MRCP imaging, HyperSense is shortening scan times by 30 percent at Osaka University. He has also increased matrix size, from 512 x 320 to 512 x 416. With this protocol, he can more clearly see the small intrahepatic bile duct with less motion due to the shortened scan time (Figure 7).

Looking forward, Professor Hori wants to evaluate the use of AIR™ in exams that require wide scan coverage, from the upper to the lower abdomen. This coil has the highest channel count and coverage in the industry today.

"With the AIR™ AA Coil, 65 cm wide coverage might be very beneficial for these types of studies," he adds.

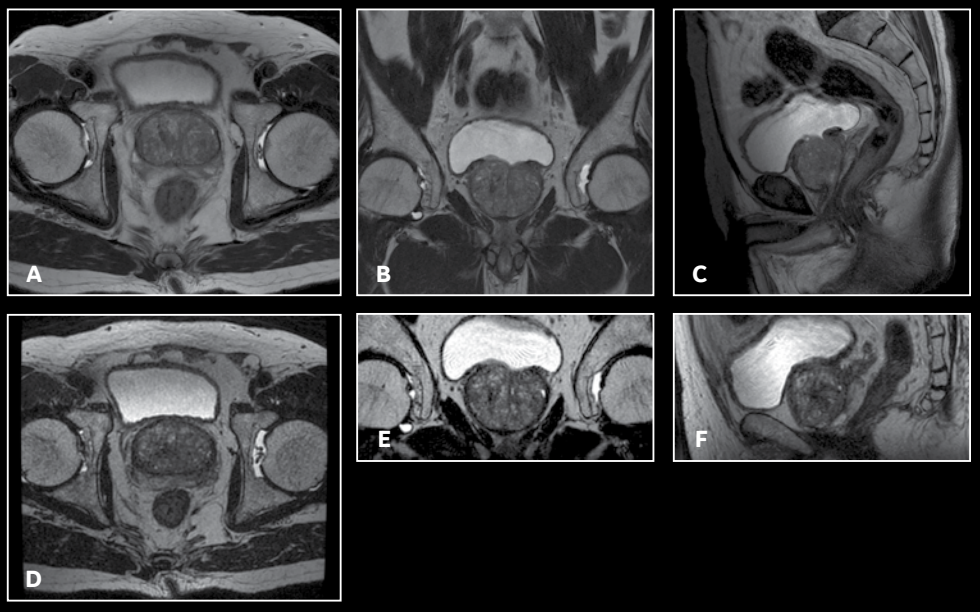


Figure 5. Prostate exam using HyperCube. (A-C) Conventional 2D T2w in 3 planes. (D-F) T2w with HyperCube enables (E-F) thin-slice imaging. (A) Axial T2w, 0.6 x 0.8 x 4 mm, 3:42 min.; (B) Coronal T2w, 0.6 x 0.8 x 4 mm, 3:25 min.; (C) Sagittal T2w, 0.6 x 0.8 x 4 mm, 2:36 min.; and (D-F) T2w with HyperCube acquired in the Axial plane and reformatted to (E) Coronal and (F) Sagittal, 0.9 x 0.9 x 2 mm, 3:54 min.

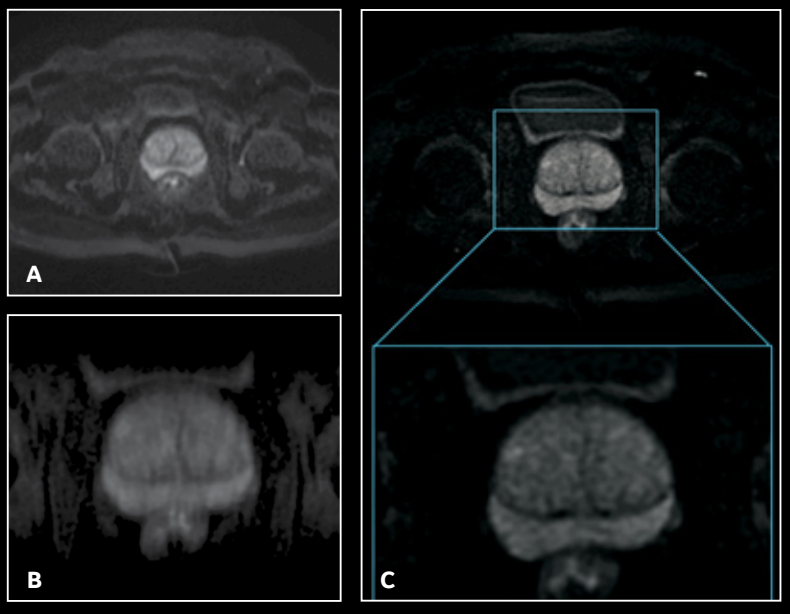


Figure 6. Patient referred for prostate exam. (A) DWI b1000, 2.3 x 2.3 x 4 mm, 2:08 min.; (B) FOCUS b1000, 1.5 x 1.8 x 4 mm, 4:10 min.; and (C) MUSE 3 shot b1000, 1.6 x 1.6 x 4 mm, 4:15 min.

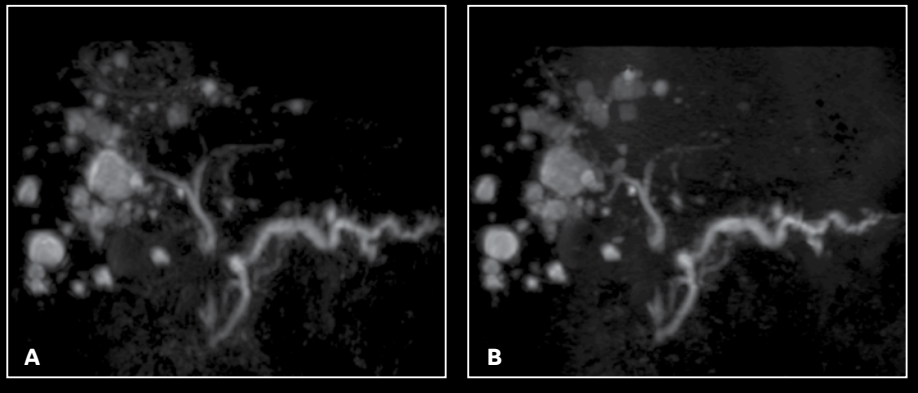


Figure 7. Comparison of MRCP exam with and without HyperSense. Scan time was reduced 30% with HyperSense. (A) Conventional MRCP RTr, 0.7 x 1.1 x 1.6 mm, 3:51 sec. and (B) MRCP RTr with HyperSense, 0.7 x 0.9 x 1.6 mm, 2:45 min.

Tom Schrack, ARMRIT, MRSO
Fairfax Radiological Consultants
Fairfax, Virginia

New deep learning tool streamlines MR slice prescription

A new deep learning software from GE Healthcare is helping streamline MR scan prescription that may help reduce inconsistencies in imaging across patients and technologists. AIR x™ is an AI-based, automated workflow tool for MR brain scanning that automatically "prescribes" slices to help reduce redundant, manual steps. It uses deep learning algorithms built right into the MR technologist's workflow to automatically detect and prescribe slices for neurological exams, delivering consistent and quantifiable results. AIR x™ also helps produce images that have less variability between technologists and between scans, helping to lower the chances a patient will be recalled due to incorrect slice placement. An increase in consistency is particularly important when doing longitudinal assessments on patients with diseases that progress over time.

"Every time I select a landmark for the prescription, the slice placement is dead on," says Tom Schrack, ARMRIT, MRSO, Manager of MR Education and Technical Development at Fairfax Radiological Consultants in Fairfax, Virginia.

Schrack and two other senior technologists at Fairfax Radiological Consultants have used a prototype of AIR x™—which stands for Artificial Intelligence prescription (AI Rx)—since early November 2018, conducting about 15 cases on their facility's 3.0T SIGNA™ Architect MR scanner.

Deep learning for faster imaging

AIR x™ is built on Edison, a new platform that helps accelerate the development and adoption of AI technology and empower providers to deliver faster, more precise care. Edison is a holistic, integrated digital platform for healthcare, combining globally diverse data sets from across modalities, vendors, healthcare networks and life sciences settings.

It enables GE Healthcare to integrate and assimilate data from disparate sources, apply advanced analytics and AI to transform the data, and generate insights to support clinical, financial and operational decision-making. Edison includes deployment-agnostic intelligent applications and smart devices, designed to help achieve greater efficiency, increase access to care, and improve patient outcomes.

By leveraging this platform, AIR x™ features a pre-trained neural network model that leverages deep learning algorithms and anatomy recognition based on a database of over 36,000 images sourced from clinical studies and reference sites.

AIR x™ helps increase productivity by simplifying workflow steps, thus significantly reducing user prescription time. A study showed average prescription time savings can be up to 62%.‡‡

It precisely places slices on the smallest and most challenging neurological anatomy, such as optic nerves. "Everything that it says it can find, it finds it with amazing accuracy," says Schrack. "For example, if I tell AIR x™ that I want an oblique sagittal of the left optic nerve, it puts a slice right down the center of that left optic nerve. AIR x™ does that immediately and perfectly, every time. It can save me some eye strain, save time from tweaking parameters, and get me going a little bit faster."

Schrack says AIR x™ is one step in the right direction of fulfilling the promise of AI, with the potential to use it on complicated anatomy such as the heart and joints, while continuing to simplify the technologist's job.

"You'll never hear a technologist say, 'I wish this was harder to use,' or 'I wish the machine would stop automating tasks for me'," says Schrack. "They want the machine to make decisions for them so that it's easier, and I think the only way that's going to happen is with deep learning and artificial intelligence. For the technologist, anything that reduces the number of decisions in an MR exam will make their job better."

‡‡According to an internal study conducted by GE Healthcare.

Edwin Oei, MD, PhD
Erasmus Medical Center
Rotterdam, Netherlands

Alexander Hirsch, MD
Erasmus Medical Center
Rotterdam, Netherlands

AIR: a brilliant improvement in high-quality imaging and patient comfort

As one of the first sites in the world to install SIGNA™ Premier with AIR™, Erasmus Medical Center is a leader in adopting cutting-edge technologies. These new solutions are providing a better patient experience while delivering high-quality imaging and advanced applications, further enhancing the excellent care provided by clinicians at Erasmus.

Erasmus Medical Center in Rotterdam, Netherlands, is a leading university medical center in Europe and has long been recognized for its adoption of cutting-edge technologies and advanced medical solutions. For the last few years, Erasmus has collaborated with GE Healthcare to evaluate the introduction of new technologies into the clinical environment. One of these is AIR™.

AIR™ Coils are designed to fit all patients, allow flexibility in any direction and closely wrap around the patient's anatomy for greater visibility of hard-to-scan areas with excellent image quality. By conforming to the patient habitus and bringing the coil elements closer to the patient, AIR™ Coils improve signal quality and signal-to-noise ratio (SNR) and reduce imaging artifacts when compared to previous generations of conventional coil technology.

Recently, several clinicians from Erasmus shared their initial impression of AIR™ on the SIGNA™ Premier 3.0T MR system, including the AIR™ Anterior Array (AA) Coil, the AIR™ 48-channel Head Coil and AIR Touch™.

Cardiac imaging

Alexander Hirsch, MD, cardiologist, specializes in non-invasive cardiac imaging. In cardiac patients, Dr. Hirsch scans cardiomyopathy and ischemic heart disease patients on SIGNA™ Premier. Typically, the 2D FIESTA, first-pass perfusion and MDE images are the most common sequences for these patients. Image quality is important, particularly in the late enhancement (MDE) sequence where Dr. Hirsch evaluates myocardial viability. With the 2D FIESTA sequence, he is looking at cardiac function. However, 2D FIESTA sequences have historically been problematic at 3.0T.

"The new SIGNA™ Premier system is especially good for late enhancement images and also for perfusion," Dr. Hirsch says. "I was able to see the anatomy and the function, as well as differentiate the contrast between the blood and the myocardium. Previously in a 3.0T system, that was a problem, however, with the SIGNA™ Premier this has improved a lot."

A key factor in the improved image quality is the AIR™ AA Coil. Dr. Hirsch says he gets a more homogeneous signal and better contrast between the blood and the myocardium.

"Because of the specialized nature of our facility, with referrals from all over the Netherlands, it is important to have the latest technology," he says. "With the new GE SIGNA™ Premier and AIR™, we can provide high- quality care for our patients."

"The new AIR™ AA has a major advantage in that it helps provide high image quality," Dr. Hirsch adds. Plus, with SIGNA™ Premier he has been able to achieve high SNR, which is very

Juan Hernandez Tamames, PhD

Erasmus Medical Center
Rotterdam, Netherlands

Brendan Bakker

Erasmus Medical Center
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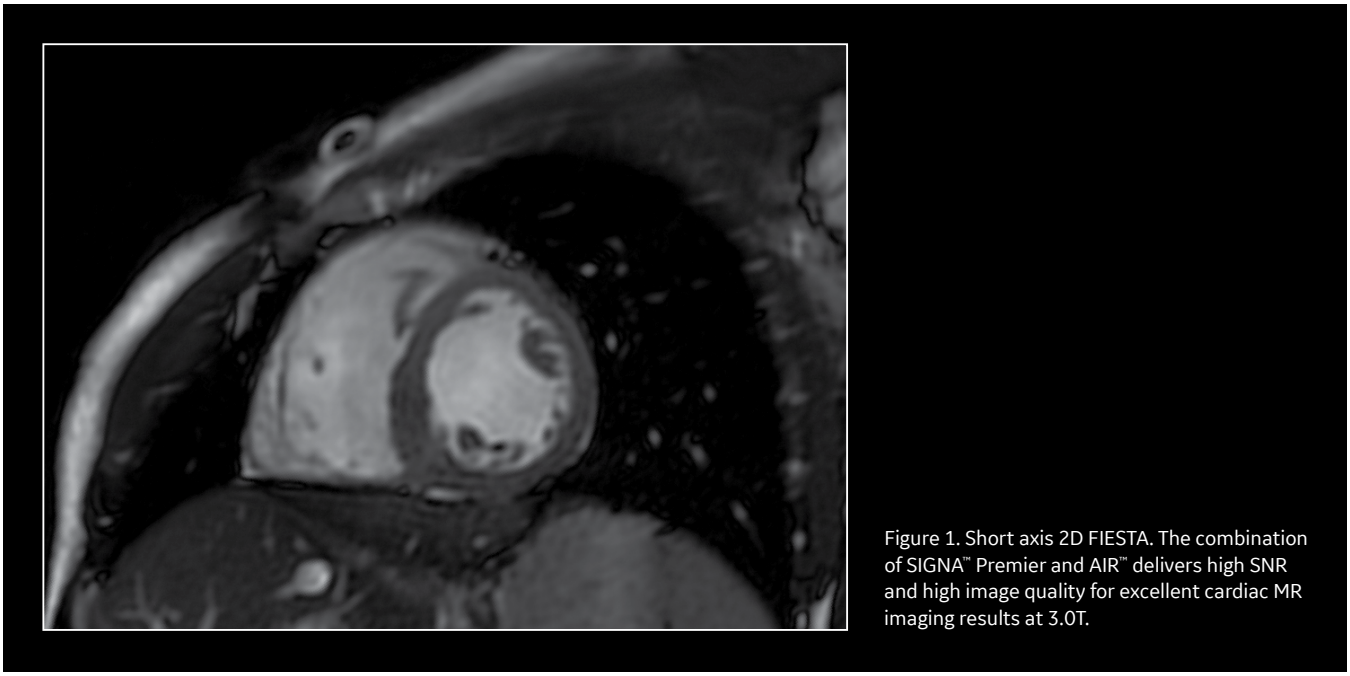

Figure 1. Short axis 2D FIESTA. The combination of SIGNA™ Premier and AIR™ delivers high SNR and high image quality for excellent cardiac MR imaging results at 3.0T.

important for the sequences he is using. Dr. Hirsch also expects to see improvements in 4D Flow (ViosWorks), as well as the new 3D MDE sequence.

"When we started working with SIGNA™ Premier, I was pleasantly surprised to see the image quality, especially for the 2D FIESTA sequence," he says.

Brendan Bakker, MR radiographer, has developed cardiac MR (CMR) protocols at Erasmus with Dr. Hirsch. While 1.5T was typically preferred for CMR, he worked with Dr. Hirsch to evaluate CMR exams on the SIGNA™ Premier 3.0T MR system with AIR™.

"The AIR™ AA Coil is brilliant and it's an improvement for the patient. It is very easy to handle, very lightweight and the quality is very good for cardiac imaging, especially on the SIGNA™ Premier system," Bakker says.

"The AIR™ AA Coil is very flexible, you can put it around the chest or stomach but also use it around the knee or shoulders," Bakker says. "With other coils that are more rigid, this is not possible."

In pediatric imaging, the AIR™ Coils fit almost like a blanket on the child, he adds.

MSK imaging

Edwin Oei, MD, PhD, is an Associate Professor of Musculoskeletal Imaging and Section Chief of Musculoskeletal Radiology at Erasmus Medical Center. He dedicates half his time to research and working with MR physicists and PhD students to improve technologies and apply MR imaging in population health studies.

"SIGNA™ Premier offers advantages in musculoskeletal imaging because of its higher gradient performance, especially when it is used with the AIR™ Coil," Professor Oei says.

According to Professor Oei, musculoskeletal (MSK) MR imaging tends to suffer from artifacts and movement more than in other body parts. Often, there are difficulties with positioning patients due to their

Watch the team at Erasmus discuss their experience with AIR™.
https://youtu.be/MeGebBSjUNQ

Jean Paul Laarhoven

Erasmus Medical Center
Rotterdam, Netherlands

Sita Ramman

Erasmus Medical Center
Rotterdam, Netherlands

injury or ailment, as well as using the right coil. While coil selection is not as problematic in the knee or ankle, it can be more difficult when imaging the shoulder, wrists or ribs.

"With AIR™, we are more flexible in choosing the coil, which allows for imaging specific body parts with greater accuracy. For patients with chronic diseases such as arthritis, it may not be easy for them to lie still in the scanner for a long time with a rigid coil. The AIR™ AA Coil is lighter and more comfortable for the patient so, indirectly, I think it will also reduce movement artifacts. "

Professor Edwin Oei

AIR™ also assists with patient positioning. When using traditional rigid coils, the body part being imaged had to be positioned precisely in the coil. With the AIR™ AA Coil, this is less of an issue.

"We mainly now use the blanket-type AA Coil and have achieved great imaging results in the chest wall and in joints," adds Professor Oei. "I think AIR™ is beneficial for diverse patient groups, including pediatric and elderly patients."

Professor Oei believes there is a movement in MR imaging toward whole-body imaging, particularly for oncology. He anticipates that AIR™ Coils will provide excellent results over existing coil technology due to its wide coverage.

"Since the introduction of SIGNA™ Premier and with AIR™ Coils at Erasmus, I've seen image quality improve over previous scans and I believe that AIR™ can greatly improve patient throughput," Professor Oei says.

The AIR™ family of products also includes a 48-channel Head Coil. Jean Paul Laarhoven, MR radiographer, has scanned patients with both the AIR™ 48-channel Head Coil and the AIR™ AA Coil on SIGNA™ Premier. With the ability to adjust the coil for larger-sized heads and necks, he can accommodate more patients. He has found that patients with anxiety or claustrophobia can better tolerate the AIR™ 48-channel Head Coil because the front part of the coil is slightly smaller and doesn't cover the patient's entire face.

"You can immediately see the high-quality images that the AIR™ 48-channel Head Coil captures," Laarhoven explains. "Of course, we also have the Posterior Array (PA) in the table so we only have to position the AIR™ AA on top of the patient."

Improving the patient experience

Sita Ramman has been an MR radiographer for nearly 28 years at Erasmus. Often, she has had to comfort and reassure patients who are nervous about their MR exams. She will explain that they have to remain very still and may have to hold their breath while the system acquires the images.

Since the introduction of AIR™, she has seen a noticeable difference.

"The patients like the AIR™ Coils because they are very lightweight and flexible, and mold to the patient's anatomy," Ramman says. "For us, it is very easy to position. You just put it on the patient and that's it. That's all you have to do."

She has also used AIR Touch™, an intelligent coil localization and selection tool that enables automatic coil element selection and uniquely optimizes uniformity and SNR. AIR Touch™ informs the system when the coil is connected, allows the technologist to landmark the patient with a single touch and even optimizes the element configuration. Coil coverage, uniformity and parallel imaging acceleration are generated dynamically to optimize image quality. A simplified user interface allows the technologist to focus on the patient and also maximizes examination efficiency.

"We just put the AIR™ Coil on the patient, localize using the AIR Touch™ button on the table and move the patient inside the SIGNA™ Premier," Ramman explains. "With AIR™ Coils and AIR Touch™, we don't need to do any calibration as it is done automatically. This makes a difference in our daily routine because it takes less time to position a patient."

A remarkable advance

Juan Hernandez Tamames, PhD, Associate Professor (MR) and Head of the MR Physics group in the radiology department at Erasmus, facilitates the introduction of new technology in MR imaging for both clinical and research purposes.

"SIGNA™ Premier incorporates several new approaches and breakthroughs in technology," Professor Tamames says.

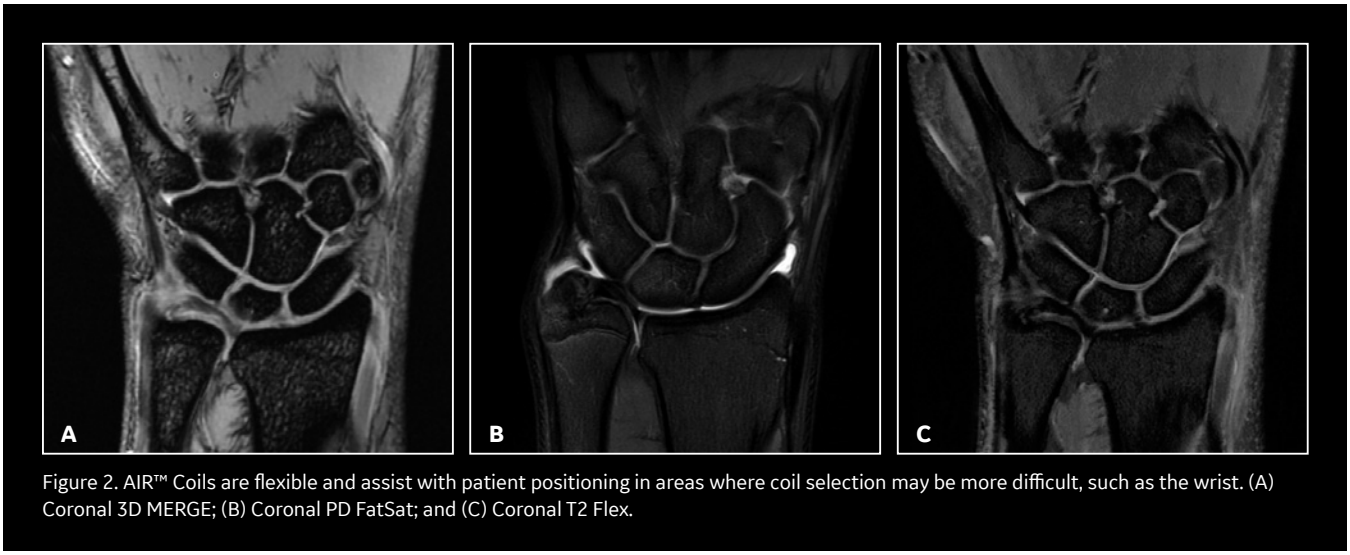

Figure 2. AIR™ Coils are flexible and assist with patient positioning in areas where coil selection may be more difficult, such as the wrist. (A) Coronal 3D MERGE; (B) Coronal PD FatSat; and (C) Coronal T2 Flex.

"For example, the AIR™ Coils are one of the most remarkable innovations I've seen because they increase SNR."

He also discovered that the HyperBand capability on SIGNA™ Premier enables the possibility to simultaneously scan several slices, accelerating acquisition with the potential to shorten scan times when using DWI. With the parallel transmission, he can tailor the RF for specific tissues in a more appropriate way.

"Compressed sensing is another remarkable advance on SIGNA™ Premier," Professor Tamames adds. "When used with AIR™, which improves signal due to the closer proximity to the patient anatomy and tissue, we can increase the acceleration with compressed sensing and parallel imaging to reduce scan times."

For example, since the lungs are filled with air, it is often difficult to obtain good SNR. Because the AIR™ AA Coil lays on the patient's chest, it is as close to the body as possible. This enables a high SNR.

Another advantage is in pediatric imaging. Professor Tamames says a baby can be wrapped in the coil, which makes them more comfortable and enables the coil to get closer to the anatomy.

"In general, AIR™ is more convenient and it can fit almost any sized anatomy," adds Professor Tamames.

Professor Tamames is interested in testing the AIR™ AA Coil with a conventional head coil and also with the AIR™ 48-channel Head Coil.

"With 48-channels we can accelerate more because we have a really good, high-quality signal," Professor Tamames explains. "By accelerating, we reduce the echo time, which means less distortion in an EPI sequence. And that is important for exploring the basal ganglia and frontal or temporal areas. Not only is the signal better, but the anatomy and morphology of the tissue is more realistic."

And, because the headset for the AIR™ 48 channel Head Coil is compatible with EEG systems, clinicians at Erasmus can simultaneously record EEG and capture MR images. Professor Tamames also sees the potential for continued innovation in technology and sequences to shorten MR scan times, in some cases to as quick as five or 10 minutes.

"I think SIGNA™ Premier and AIR™ are paving the way to achieve this goal," Professor Tamames adds.

Watch Dr. Hirsch's 2019 SCMR presentation, "Getting consistent and quantifiable results in cardiac imaging:"
https://youtu.be/dQ3-sU-kPv0

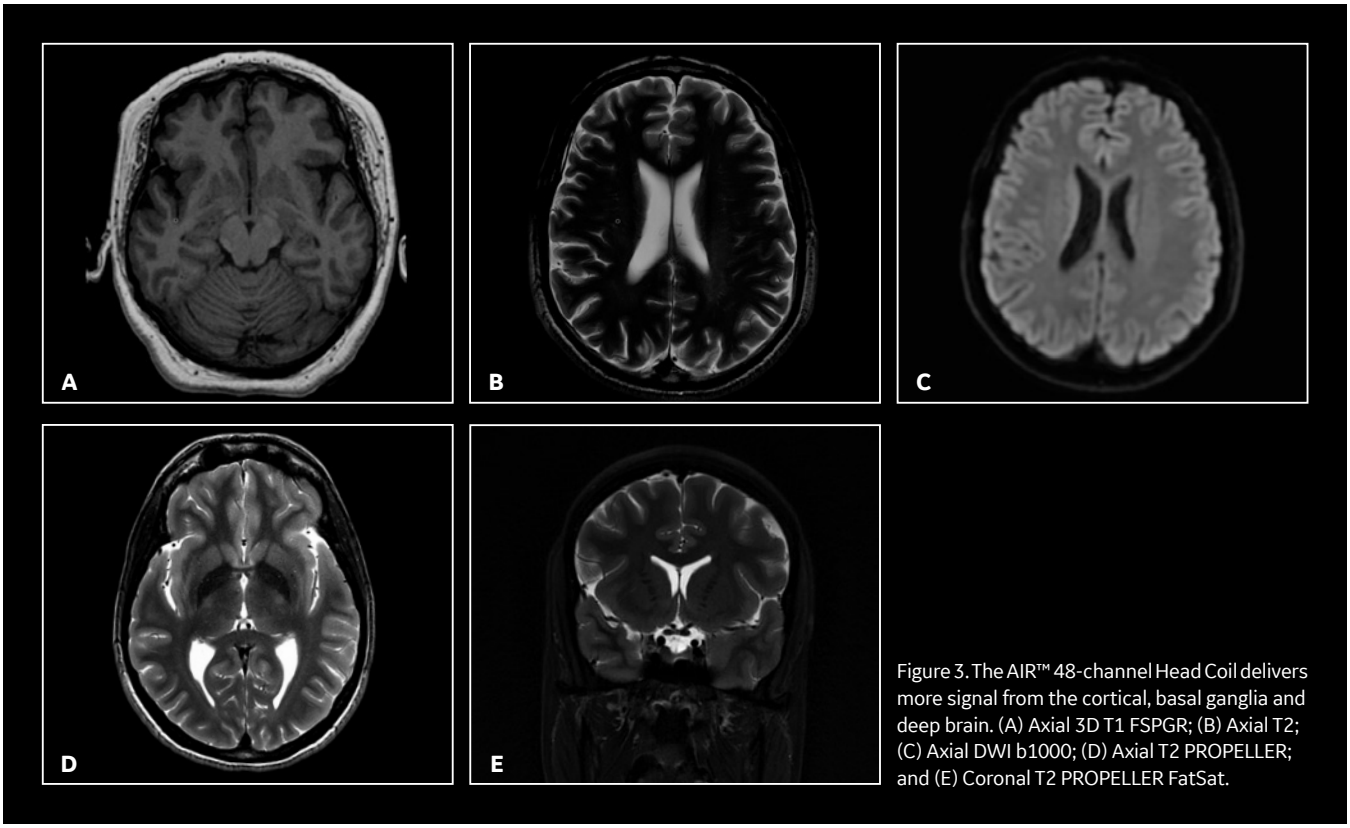

Figure 3. The AIR™ 48-channel Head Coil delivers more signal from the cortical, basal ganglia and deep brain. (A) Axial 3D T1 FSPGR; (B) Axial T2; (C) Axial DWI b1000; (D) Axial T2 PROPELLER; and (E) Coronal T2 PROPELLER FatSat.

Utaroh Motosugi, MD, PhD
University of Yamanashi Hospital,
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A lighter, more flexible and comfortable way to scan

At the University of Yamanashi Hospital in Japan, Utaroh Motosugi, MD, PhD, Associate Professor, Department of Radiology, is focused on research in abdominal MR imaging. Dr. Motosugi has collaborated with GE Healthcare, Richard L. Ehman, MD, Mayo Clinic and Scott Reeder, MD, PhD, University of Wisconsin-Madison using MR elastography and IDEAL IQ.

The importance of this research is underscored by the clinical needs of an aging Japanese society. Cancer, which accounts for nearly one-third of all deaths in Japan, along with Alzheimer's and heart disease, are top concerns for the country's health ministry.[1,2]

Locally, GE researchers often actively work with Dr. Motosugi and his colleagues to explore new technologies and sequences for MR imaging, including SIGNA™ Premier and AIR™.

In March 2018, SIGNA™ Premier and the AIR™ 48-channel Head Coil were installed, followed by AIR™ Anterior Array (AA) Coil and Posterior Array. The hospital already had a good experience with the Discovery™ MR750 in both clinical and research use. According to Dr. Motosugi, the university chose SIGNA™ Premier because of the SuperG gradient capabilities and the new AIR™ family of products.

"We wanted to add a higher performance system that is research capable but also increases patient comfort during scanning," Dr. Motosugi says. "We found SIGNA™ Premier to be the best product for this purpose."

In the first three months of operation, the facility had performed over 400 clinical exams with SIGNA™ Premier, including 284 head/neck, 71 abdomen and 57 musculoskeletal (MSK) exams.

"AIR™ is the biggest technology breakthrough in MR imaging in the last two decades," Dr. Motosugi adds. "It's a key reason to choose a GE MR system."

He cites the advantage of patient comfort with the flexible coil but also the high signal penetration and uniformity when imaging deep areas of the body as well as the lower g-factor for faster imaging.

AIR™ Coils are 60% lighter than conventional hard-shell coils and are flexible to fit all body shapes, sizes and ages. In these instances, they deliver consistent, high-quality images with higher signal-to-noise ratios (SNR) and freedom in coil positioning by fitting 99.9% of the population.

In brain imaging, the AIR™ 48-channel Head Coil and SIGNA™ Premier are now the preferred choice at the University of Yamanashi Hospital. Routine MSK imaging with the AIR™ AA Coil for shoulder, long bone and femoral imaging has delivered very good, uniform images with larger Z coverage than previously attainable.

"While we would like to use SIGNA™ Premier for all of our body work, we have several ongoing liver research studies on the Discovery™ MR750 that include collaboration from other sites throughout the world," he explains. "However, as a body radiologist, I'm eager to run more research on SIGNA™ Premier with AIR™."

Dr. Motosugi appreciates the quality of the facility's existing 3.0T scanner but is excited by the potential from the higher performance and wider bore of SIGNA™ Premier. He also likes the sleek, modern look. With the new coil technology, his first impression is that a conventional MSK coil could be replaced with the AIR™ AA Coil for routine clinical exams.

In abdominal imaging, deep signal penetration with AIR™ AA Coil in pancreatic imaging has delivered better image uniformity and larger coverage. When imaging specific body areas for lesions, such as the liver or kidneys, it is not uncommon to find a lesion in

Figure 1. Using the same AIR™ AA Coil setting, the technologist can acquire the target region of interest (FOV 13 cm) and wide coverage depicting the patient's chest, abdomen and pelvis (FOV 34 cm x 2 stations).

another area. Prior to AIR™ Coils, this required the repositioning of the coil and/or patient, taking up valuable imaging time. This is no longer the case with AIR™, leading to higher efficiency and more productive exams.

One area of exploration is the use of AIR™ Coils with 3D dynamic imaging and a reduction in breath-hold time. "We often want to acquire multiple arterial phases for dynamic liver sequences with high image quality. I believe AIR™ will help accelerate higher reduction factors due to the lower g-factor," Dr. Motosugi says. He also expects to see faster and higher spatial resolution volumetric imaging with the AIR™ family of products. In particular, he anticipates high-resolution volumetric T2-weighted imaging in the abdomen will help him detect small cysts in the pancreas and find the relationship to the pancreatic duct, all in one scan.

In the shoulder, arm and femoral regions, AIR™ Coils have replaced conventional coils for most clinical exams, especially in cases of suspected inflammatory disease. In these types of cases, the clinician needs to visualize a wide area to determine the extent of inflammation.

"Conventional rigid MSK coils cannot provide the coverage we need in cases of inflammation. This is a clear benefit of AIR™ Coils."

Dr. Utaroh Motosugi

Patient positioning in upper extremity exams has also changed with the addition of AIR™ Coils. Now, the technologist can position the patient in the center of the magnet for these exams, which further enhances image quality.

AIR Touch™ has also helped the technologists with reducing coil selection errors. It helps technologists determine the best configuration for each patient with an intelligent patient recognition algorithm and system intelligence to automatically optimize every scan, even the element configuration.

Reducing scan times is a key initiative at the University of Yamanashi, as it will free up SIGNA™ Premier for more research-related scanning.

The AIR™ 48-channel Head Coil has helped immensely in this regard, reducing total exam time for a comprehensive neuro exam that includes T1-weighted, T2-weighted, FLAIR, T2*-weighted, DWI and MRA with HyperBand and HyperSense to five minutes. Dr. Motosugi believes this is 50 percent less than conventional 3.0T neuro exam times.

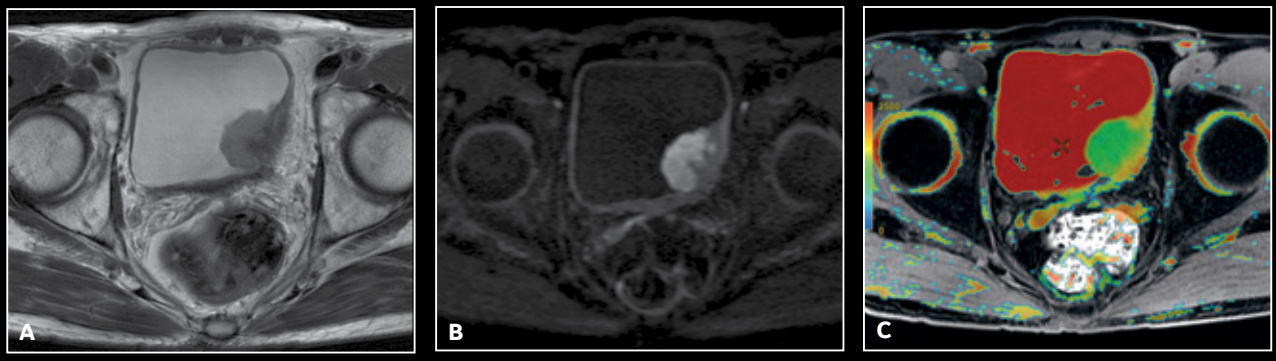

Figure 2. Images acquired on a patient with a bladder tumor using AIR™ AA Coil and Posterior Array. (A) Axial T2w PROPELLER, FOV 20 cm, Th/Sp 5 mm/0.5 mm, 288 x 288 in a scan time of 2:15 min. (B) Axial MUSE with a b1000, FOV 28 cm, Th/Sp 4mm/-2mm, 128 x 256 in a scan time of 2:30 min. (C) ADC Map.

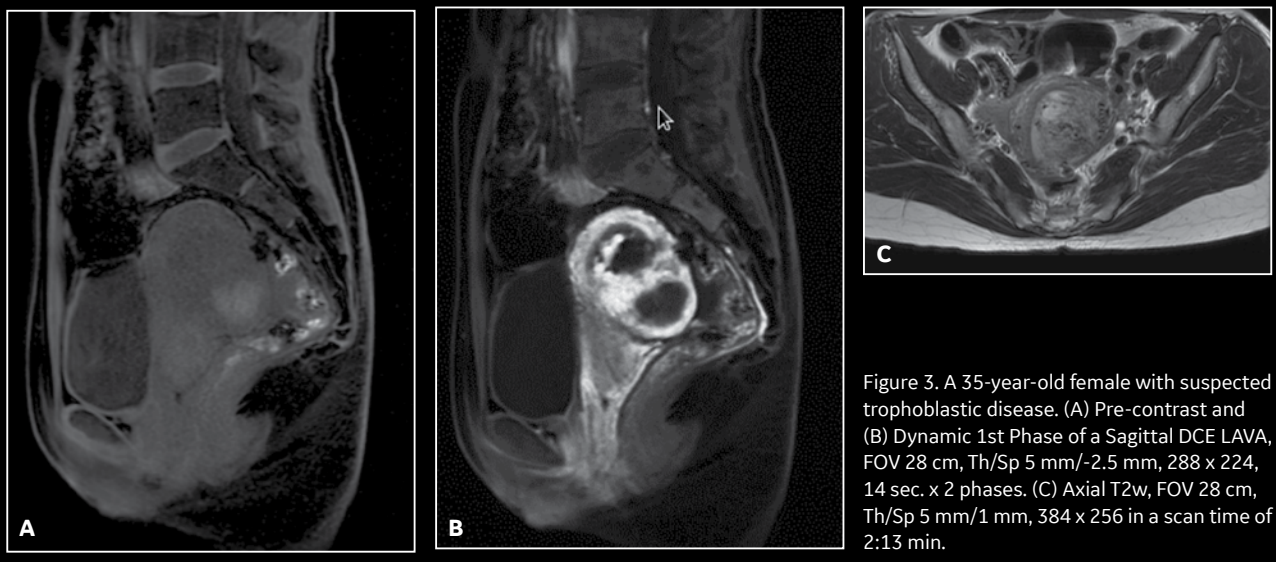

Figure 3. A 35-year-old female with suspected trophoblastic disease. (A) Pre-contrast and (B) Dynamic 1st Phase of a Sagittal DCE LAVA, FOV 28 cm, Th/Sp 5 mm/-2.5 mm, 288 x 224, 14 sec. x 2 phases. (C) Axial T2w, FOV 28 cm, Th/Sp 5 mm/1 mm, 384 x 256 in a scan time of 2:13 min.

A quality MR system is more than just hardware. Several new sequences for body imaging have also impressed Dr. Motosugi.

"A clear benefit of MUSE DWI is less distortion," he says. In abdominal imaging, MUSE DWI was impressive. When the prior DWI sequence was compared to MUSE DWI, Dr. Motosugi and his colleagues found the older images were more distorted than they perceived at the time, even to the point of impacting a confident diagnosis.

With liver MUSE DWI, there is a reduction in the signal drop that occurs near the stomach. For MUSE DWI renal and adrenal gland imaging, the image quality is excellent in the Coronal plane without distortion. The pancreas is another area with great potential for high-resolution DWI.

"MUSE DWI is also promising in extremity imaging for detecting tumors. We were able to obtain excellent image quality in the knee and shoulder," Dr. Motosugi adds.

The University of Yamanashi is implementing free-breathing abdominal scans thanks to the addition of PROPELLER MB. So far, the imaging has been robust with great image quality.

Yet, the real test of implementing the new AIR Coils is the impact it has on the patient experience. The first time they were used, the AIR™ Coils passed the test.

"Surprisingly, the first patient we scanned with an AIR™ Coil said, 'Why is it so comfortable today?' A comfortable exam for the patient is obviously a key benefit of the AIR™."

Dr. Utaroh Motosugi

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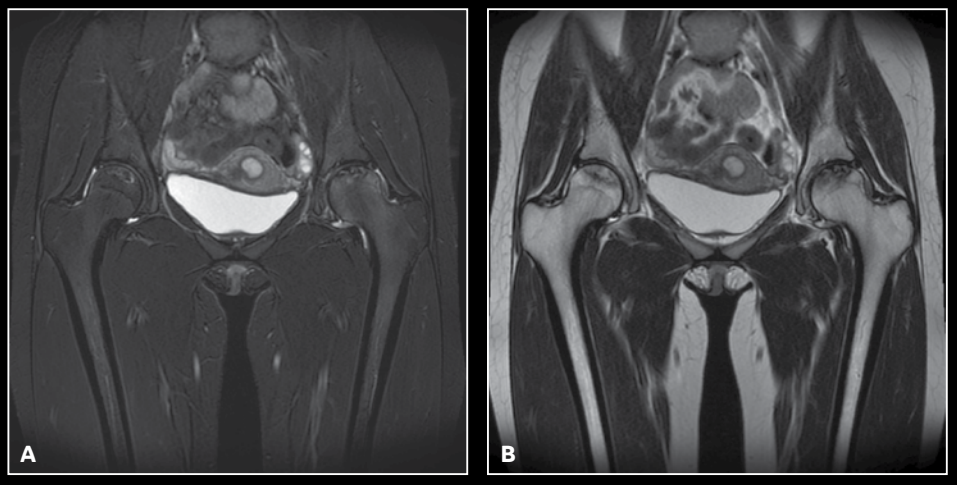

Figure 4. Image of a hip-joint depicting femoral head necrosis. (A) T2w FSE Flex Coronal (Water Image), FOV 36 cm, Th/Sp 4 mm/ 1 mm, 384 x 288 in a scan time of 1:17 min. (B) T2w FSE Flex Coronal (In-phase), FOV 36 cm, Th/Sp 4 mm/1 mm, 384 x 288 in a scan time of 1:17 min.

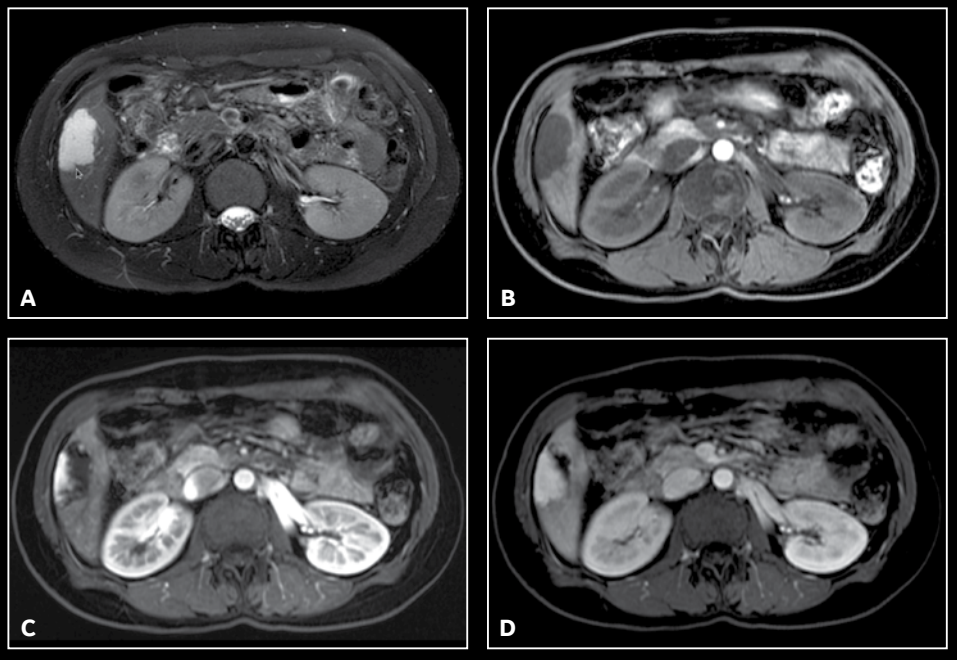

Figure 5. Liver imaging study using AIR™ AA Coil and Posterior Array to assess a hemangioma. (A) Axial T2w PROPELLER, FOV 30 cm, Th/Sp 5 mm/0 mm, 384 x 384 in scan time of 5:04 min. (B) Pre-contrast, (C) Dynamic 1st Phase and (D) Dynamic 2nd Phase.

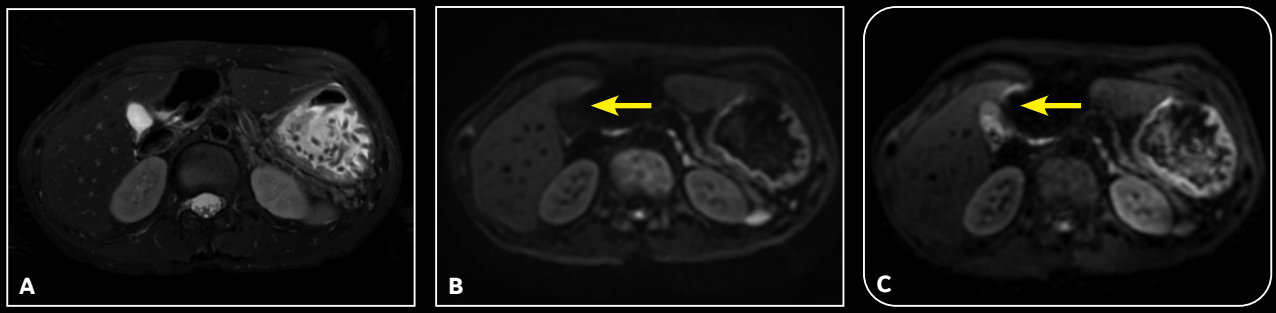

Figure 6. Low distortion DWI is achieved with MUSE. (A) Axial T2w FSE, FOV 30 cm, Th/Sp 5 mm/1 mm, 320 x 320 in a scan time of 2:49 min. (B) Axial MUSE with b1000, FOV 36 cm, Th/Sp 4 mm/1 mm, 128 x 160, shot 2, ASSET 2 in a scan time of 3:30 min. (C) Axial DWI EPI with b1000, FOV 36 cm, Th/Sp 4 mm/1 mm, 128 x 160, ASSET 2 in a scan time of 2:30 min.

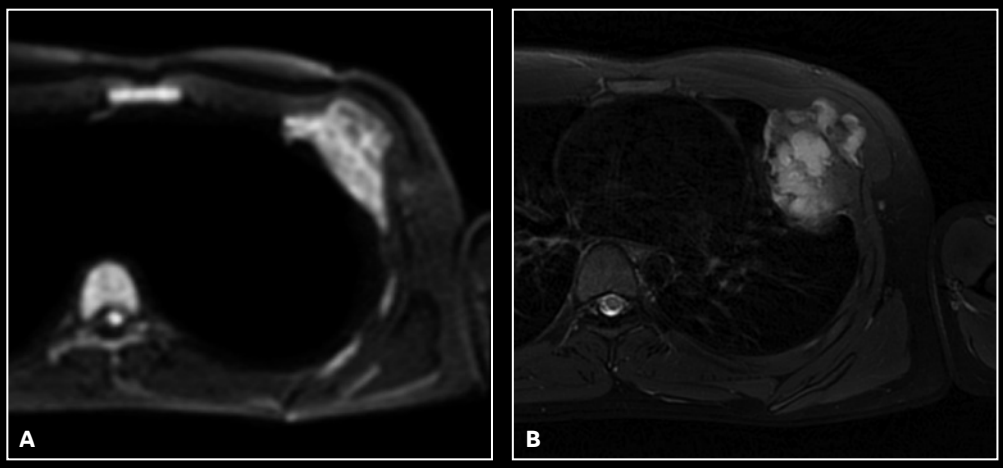

Figure 7. (A) MUSE was utilized for a DWI study of a patient with a suspected bone tumor in the fourth rib. (B) Axial T2w PROPELLER, FOV 24 cm, Th/Sp 5 mm/ 1 mm 256 x 256 in a scan time of 3:22 min.

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A simply better MR experience

In patient neuro MR follow-up studies, consistency of image slices is crucial for determining response to therapy or progression of disease. The quality of the exam is also often dependent upon the technologist's experience. AIR x™ is an AI-based automated workflow tool for MR neuro exams that increases consistency and productivity in slice prescriptions for less variability between technologists and between exams.

As one of Turkey's leading private hospitals, Emsey Hospital provides high-quality healthcare to residents of Istanbul, as well as patients from throughout the region. The radiology department provides a full complement of imaging and interventional services and relies on the advanced technology found across the breadth of GE Healthcare systems. As the hospital embarked on its vision to expand services to international patients, it became apparent that a new 3.0T MR system was needed to complement its existing Brivo™ MR355 1.5T.

To fill this need, the department installed a 3.0T SIGNA™ Pioneer. According to Huseyin Cagil, MD, radiologist, a key factor in selecting the system was the foundation of innovative technologies — from Total Digital Imaging to the AIR™ Coils and AIR x™ to the SIGNA™Works productivity platform of advanced applications. Today, SIGNA™ Pioneer is the first choice for MR imaging at Emsey Hospital, especially for prostate, liver, MSK and neuro.

"AIR x™ has become one of the favorite applications for the technologists and neuroradiologists," Dr. Cagil explains. "This deep-learning automatic slice prescription tool has brought standardized improvement for almost all our head exams today."

In addition to automatically prescribing slices for routine brain exams, AIR x™ is also being used for MR exams of the temporal lobe, internal auditory canal, orbits, optic nerves, pituitary gland and the Circle of Willis.

AIR x™ also enables the department to improve the patient experience. Dr. Cagil and Mahmut Erol, MD, radiologist, explain that if the patient needs to move their head or take a break during the exam, they can. That's because AIR x™ automatically detects anatomy and prescribes the slices to produce images with less variability between scans and technologists. After the technologist performs a scan localizer, AIR x™ handles the rest for reproducible slice planning.

"We see consistently correct slices regardless of the technologist's experience, which contributes to an easier and more reliable evaluation of head exams by the radiologists," Dr. Cagil adds.

Neuroimaging is often dependent upon the technologist's experience in slice prescription. Dr. Erol explains, "This is also important for patients who we follow longitudinally to evaluate the course of their neurological disease. Patients have unique morphologies and we need robust algorithms for these challenging clinical needs. We believe that our decision to implement AIR x™ and SIGNA™ Pioneer now will help with patient follow-up well into the future."

Dr. Erol adds that patients with neurological or neurodegenerative diseases are often assessed for signal changes in brain structures bilaterally with symmetrical evaluations. He believes the consistency in slices provided by AIR x™ will further improve patient management.

Farida Benoudiba-Bataille, MD

Kremlin-Bicêtre Hospital
Kremlin-Bicêtre, France

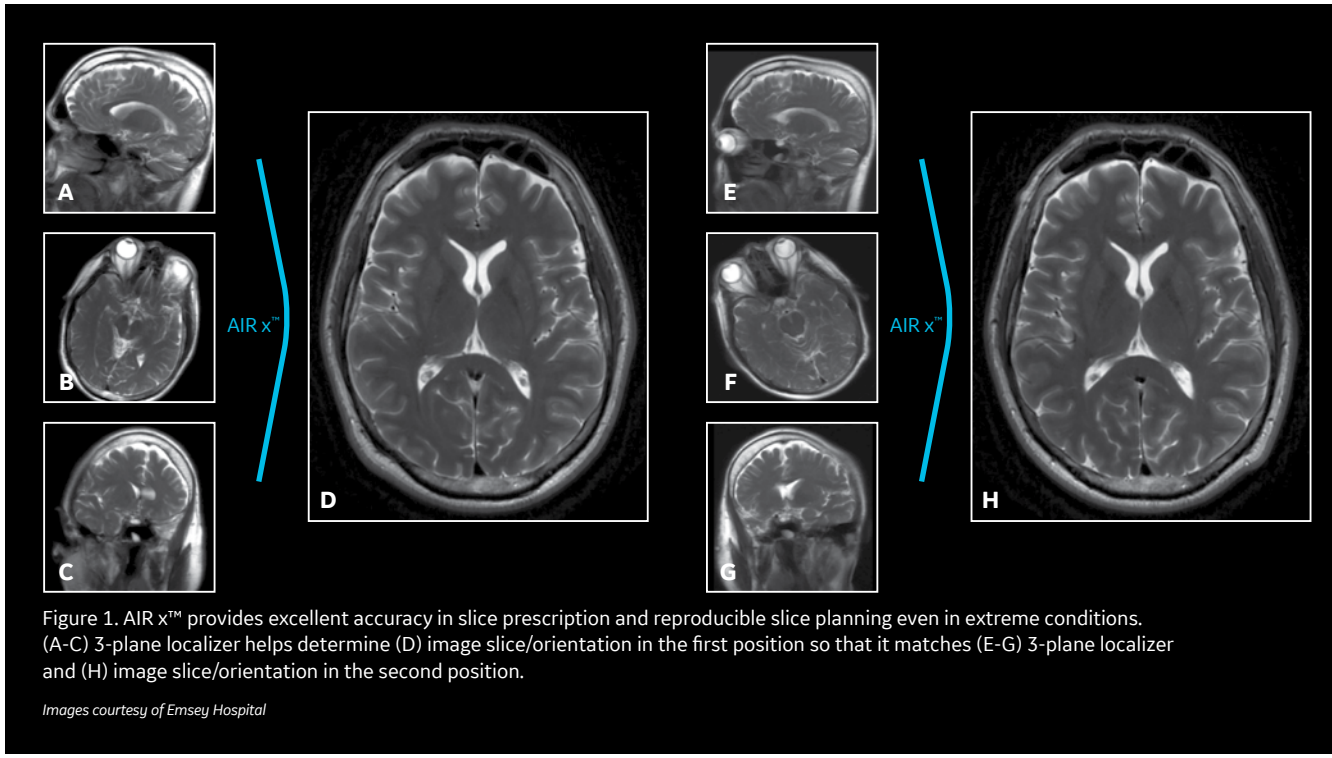

Figure 1. AIR x™ provides excellent accuracy in slice prescription and reproducible slice planning even in extreme conditions. (A-C) 3-plane localizer helps determine (D) image slice/orientation in the first position so that it matches (E-G) 3-plane localizer and (H) image slice/orientation in the second position.

Images courtesy of Emsey Hospital

It's not just AIR x™ that is making a difference in patient care. Emsey Hospital also acquired the AIR™ Anterior Array (AA) Coil with the SIGNA™ Pioneer. Although the AIR™ AA Coil was not yet commercially available when the new system was installed, the radiologists believed the concept of MR coils that conform to the body like a blanket would transform patient comfort and improve image quality.

"The AIR™ AA Coil has significantly improved our SNR and we can use it for many imaging exams, from large to small fields of view and it never disappoints us," Dr. Cagil says. "In patients who are difficult to position or where traditional coils cannot sufficiently cover their anatomy, the AIR™ AA Coil resolves these situations."

For example, patients with severe back pain could only be positioned in the decubitus position in lumbar spine exams. Now, the AIR™ AA Coil is placed on the back of these patients. In long bone scans where no dedicated coil was available, the large coverage and proximity to the anatomy with the AIR™ AA Coil provides better images for patient management. In MSK imaging, combining the Posterior Array (PA) Coil with the AIR™ AA Coil enables the technologist to scan both knees simultaneously with excellent resolution from the approximately 30 active channels (between both coils). This approach also helps save exam time by eliminating patient re-positioning.

"Signal uniformity has significantly improved across all anatomies and coil combinations," Dr. Cagil adds. "We've seen impressive results in dedicated organ studies requiring a small FOV, such as the prostate, female pelvis, pancreas, etc."

AIR™ AA Coils are also impressive in large FOV exams, particularly in abdominal-pelvic oncology cases. According to Dr. Erol, two traditional hard shell AA coils were previously needed for the large coverage on some patients.

"Now, patients are much more comfortable with the AIR™ AA Coil

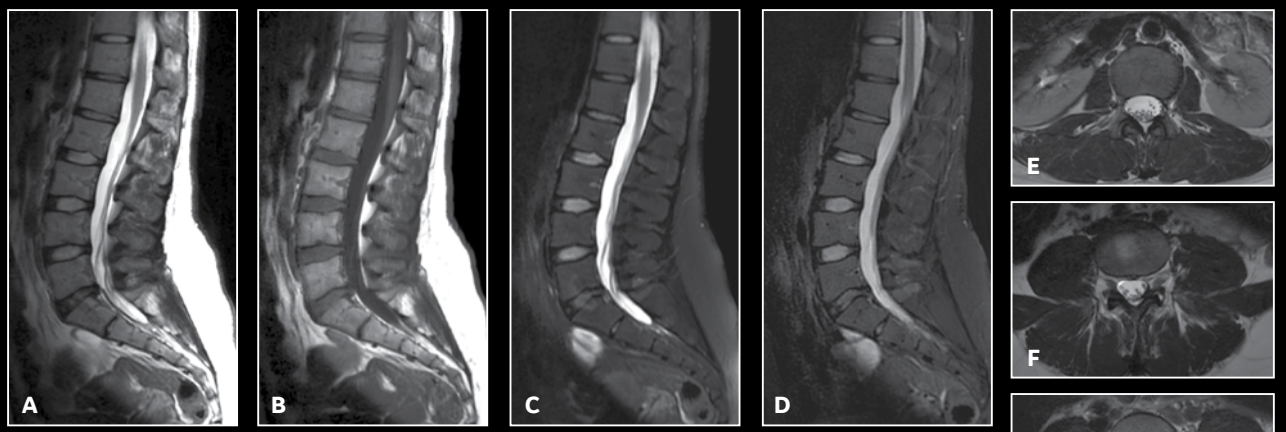

Figure 2. Lumbar spine exam on a patient scanned in the lateral decubitus position performed with only the AIR™ AA Coil for high-quality imaging results. (A) T2 FSE; (B) T1 FSE; (C) T2 ASPIR; (D) T2 STIR PROPELLER; and (E-G) T2 FSE.

Images courtesy of Emsey Hospital

because it helps them tolerate the exam — and that impacts image quality," Dr. Erol says. "Also, having acceleration techniques available with the sequences, especially SSFSE, provides clearer imaging results due to less motion captured during the acquisition."

The feedback from the technologists further supports the radiologists' view on improved patient comfort. Dr. Erol says they are very positive about the easier patient positioning and flexibility of coverage. They can even slide the AIR™ AA Coil up and down on the patient while they are still inside the bore.

Beyond the benefits of AIR™, Emsey Hospital is also exploring the use of MR Touch, IDEAL IQ and StarMap for a comprehensive liver health program. According to Ahmet Kemal Firat, MD, Associate Professor of Radiology and an interventional radiologist, these sequences enable the department to tackle the growing incidence of fatty liver diseases.

"We are currently treating approximately 200 patients each year with interventional radio/chemo-embolization," Professor Firat explains. "We are planning to use these imaging techniques to address liver disease in a larger cohort of patients."

Professor Firat also anticipates participating in research exploring the use of 3D MR elastography techniques in collaboration with other institutions worldwide.

Reproducibility in slice prescription

Kremlin-Bicêtre Hospital is one of three hospitals in the Paris-Sud University Hospitals that provides comprehensive healthcare within the framework of a teaching and research environment. The hospital is renowned for specializing in neurosurgery, interventional neuroradiology, neuro-oncology and polytrauma cases.

In 2017, the hospital implemented SIGNA™ Architect and the AIR™ 48-channel Head Coil to further support neuroimaging for surgery, interventions, radiation therapy and head trauma cases. Recently, AIR x™ was added as part of a SIGNA™Works AIR™ Edition productivity platform upgrade at the hospital.

Many patients receiving a neuro MR exam at Kremlin-Bicêtre Hospital are undergoing some type of therapy or intervention for a neuro disease or injury. According to Farida Benoudiba-Bataille, MD, neuroradiologist, AIR x™ saves time for the patient, technologist and the radiologist.

"We have found that AIR x™ can help save time in the patient set-up and that means less time that they are immobilized and in the scanner," Dr. Benoudiba-Bataille explains.

Adds Laure Cacheux, RT(R), technologist, "AIR x™ is very fast in the slice positioning regardless of the required plan. That saves us time because we just need to check the slice prescription from AIR x™." As a result, the technologists can spend more time addressing any patient concerns, anxiety or stress.

More importantly, since the slice prescription is no longer technologist-dependent, there is greater reproducibility and similarity of the MR slices (images) across studies. This is very important for patient follow-up in oncology, including primary and secondary tumors, neurodegenerative diseases, such as multiple sclerosis, and arteriovenous malformation or other neurosurgery cases.

"In the case of a patient follow-up for tumor assessment, the slice positioning

Figure 3. Knee imaging with the AIR™ AA Coil. (A) PD FatSat PROPELLER; (B) T1 PROPELLER; and (C) PD FatSat PROPELLER. All sequences acquired with a pixel size of 0.7 x 0.7 x 3.5 mm.

Images courtesy of Emsey Hospital

must be as identical as possible to the prior exams in both the axis and the coverage," says Antony Morel, RT(R), technologist. "While AIR x™ is clearly useful for a newer technologist, even the most experienced technologists may not be able to achieve this precision with every follow-up exam."

Dr. Benoudiba-Bataille explains, "With the same slice prescription and patient position, we are more confident that we can detect a residual tumor in our follow-up MR study, for example. It also assists with precise contouring and reliable measurements needed for therapy planning independent of the radiology reviewer."

The reliable and reproducible measurement of tumors is a requirement of the Response Evaluation Criteria in Solid Tumors (RECIST), a set of published rules that define when patients respond, stay the same or worsen during treatment. RECIST is used in many cancer trials to evaluate the efficacy of treatments.

"The reproducibility in imaging that we can obtain with AIR x™ enhances my confidence in patient follow-up cases, and that allows me to better support my colleagues in oncology and surgery."

Dr. Farida Benoudiba-Bataille

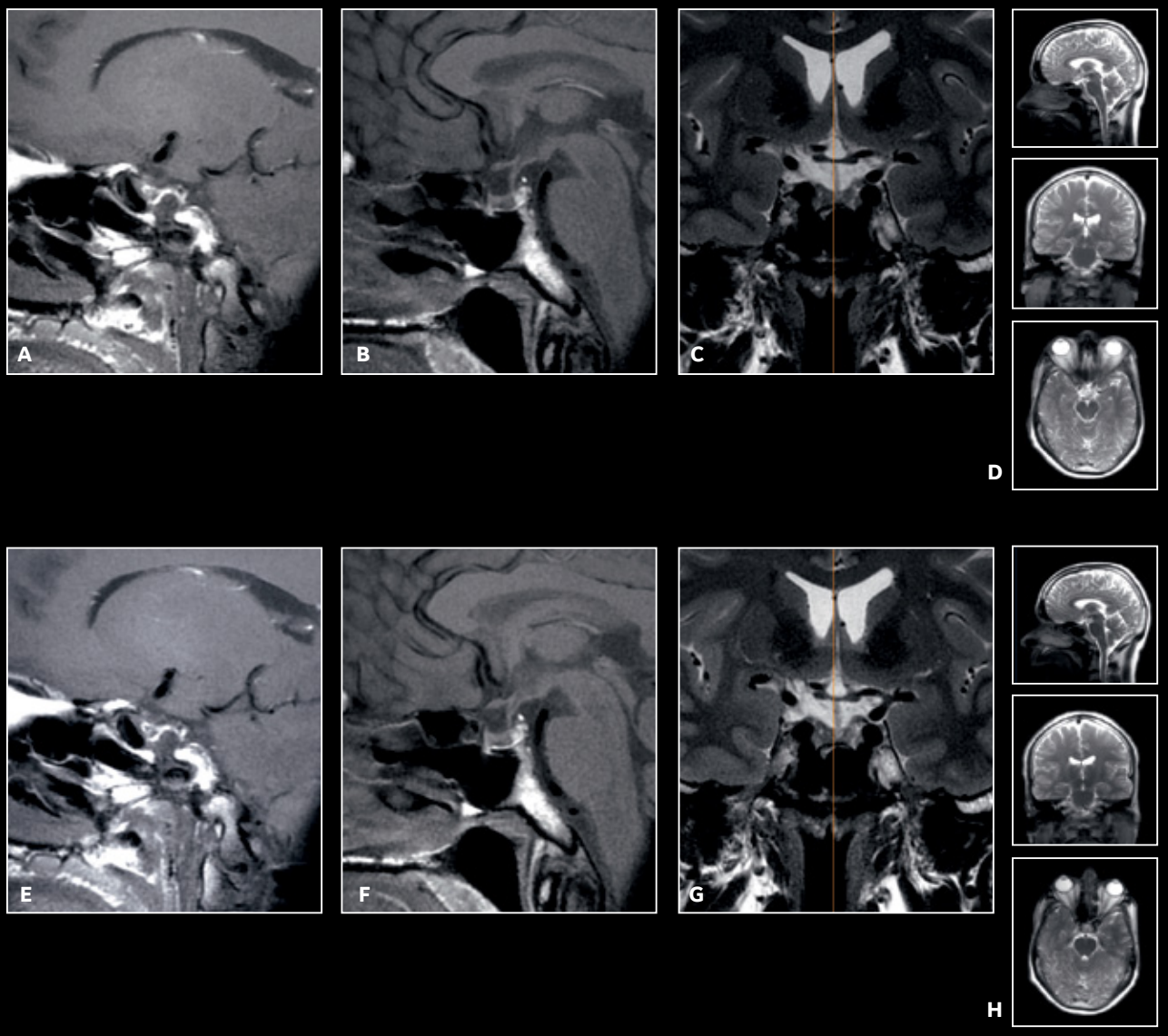

Figure 4. Patient underwent MR imaging of the pituitary on two different days. With AIR x™, the technologist was able to start and finish the acquisition at the same anatomic position to obtain identical coverage and slice positioning data for comparison of the two studies. (A-C) First day exam with (D) 3-plane localizer and (E-G) the second day exam with (H) 3-plane localizer. Notice the slightly different translation and rotation in the 3-plane localizer images between the first and second day.

Images courtesy of Kremlin-Bicetre Hospital

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A coil for all joints in MSK imaging

Patients come in all shapes and sizes. However, traditional hard shell MR coils do not fit all patients, all the time, and this can lead to poor signal and poor image quality. The lack of dedicated coils for orthopedic imaging presents challenges in patient positioning and often leads to longer scan times and lower signal-to-noise ratio. Coupled with the high-performance gradient of the wide bore SIGNA™ Premier system, AIR™ Multi-Purpose (MP) Coils‡ provide flexibility and comfort in positioning, larger Z-coverage of the body and consistent and excellent image quality. Together, they aid in patient diagnosis and surgical planning at the Hospital for Special Surgery in New York.

AIR™ MP Coils were designed to address the need for total positioning freedom with 360-degree coverage in patients of all shapes and sizes. With an adaptive design and both 20- and 21-channel coils that are 38 percent lighter per channel compared to conventional technology, AIR™ MP Coils deliver the coverage needed for a variety of orthopedic, body and cardiac exams.

"The challenge in orthopedic imaging is the lack of dedicated coils," says Hollis Potter, MD, Chairman, Department of Radiology and Imaging at the Hospital for Special Surgery (HSS). As a result, coils designed for other body parts are often used in orthopedic MR imaging.

Take for example the elbow. There is a tremendous degree of rotation in the forearm; however, above the elbow joint, the arm has less rotation. Positioning is very important to obtain high-quality images without the need for a "superman" position where the patient's arms are extended straight up above their head, creating traction on the shoulder and brachial plexus.

With traditional coils, Dr. Potter would regularly see evidence of B_1 inhomogeneities, degradation in the images and a lack of homogeneous fat suppression on elbow images. These were often the result of air gaps between the skin and coils and the inability to completely "wrap" the elbow or overlapping of coil elements due to poor fit.

Positioning the orthopedic patient with a traditional coil is not only more difficult due to its rigid structure, but often requires additional time for localization during scanning. According to Dr. Potter, it would not be unusual to see four different localizer MR scans as the technologist tried to obtain the ideal position for optimal image quality, and often positioning a patient in a hard-shell-cased coil is a difficult task. This is not the case with the AIR™ MP Coils.

"The AIR™ Coils have been great for us," Dr. Potter says. "They are like fabric, so it doesn't matter how big our patient's elbow or arm is. We can wrap the coil around the elbow and overlap elements without perceivable interference or any negative impact on image quality."

In addition to added patient comfort, the technologist can place the AIR™ MP Coil in areas that were previously difficult to access, such as around the neck for a brachial plexus study. "Traditional flex coils are not completely flexible, can be uncomfortable and may impact image quality," says Darryl Sneag, MD, radiologist at HSS.

‡Not yet CE marked. Not available for sale in all regions.

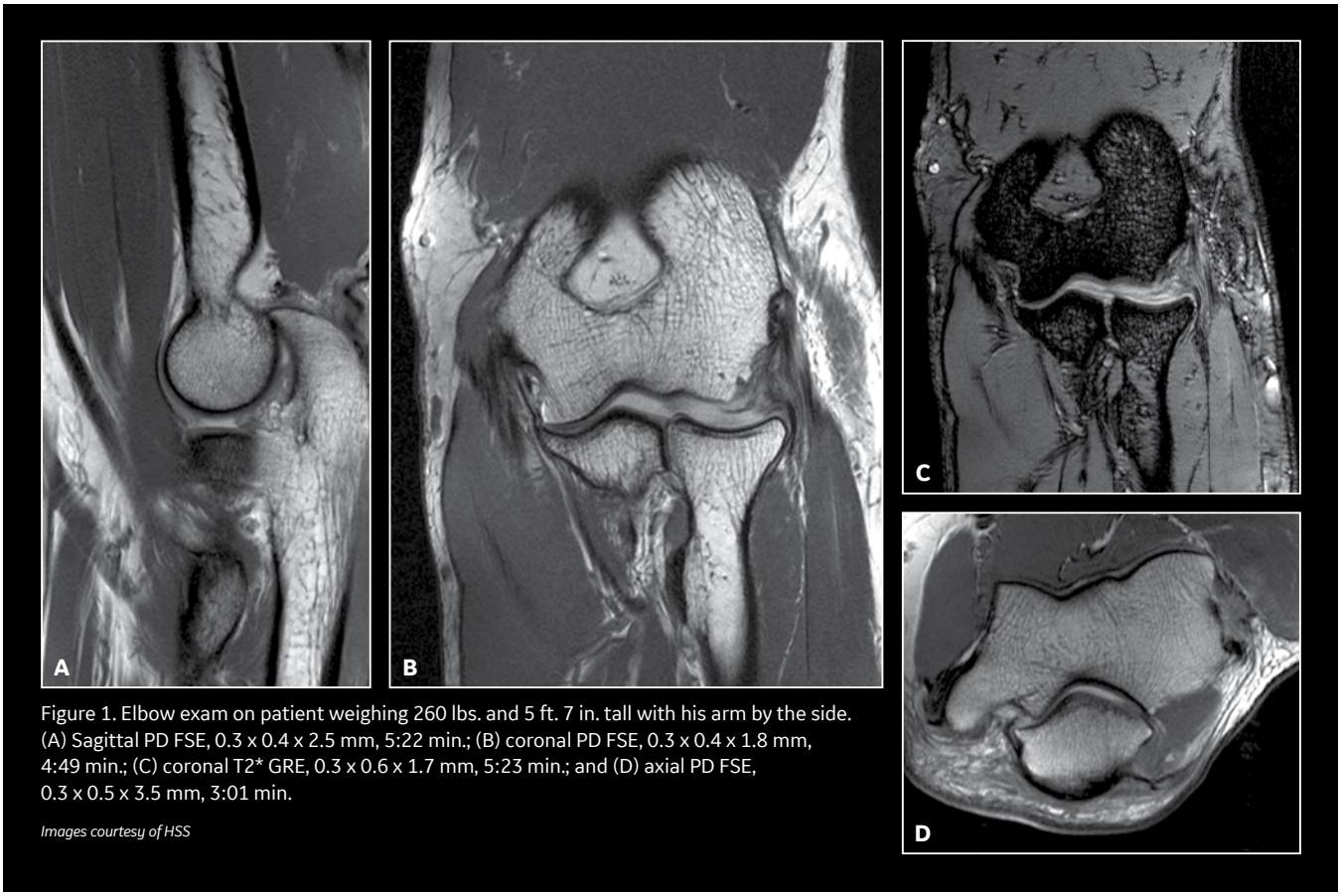

Figure 1. Elbow exam on patient weighing 260 lbs. and 5 ft. 7 in. tall with his arm by the side. (A) Sagittal PD FSE, 0.3 x 0.4 x 2.5 mm, 5:22 min.; (B) coronal PD FSE, 0.3 x 0.4 x 1.8 mm, 4:49 min.; (C) coronal T2* GRE, 0.3 x 0.6 x 1.7 mm, 5:23 min.; and (D) axial PD FSE, 0.3 x 0.5 x 3.5 mm, 3:01 min.

Images courtesy of HSS

The AIR™ MP Coils provide larger Z-coverage of the body area and are particularly useful when imaging an extremity.

"To image a large tumor or to evaluate nerves from the shoulder to the wrist, our technologist had to reposition the coil three to four times to cover the entire anatomy," explains Dr. Sneag. "Now, we only have two position changes.

From my perspective, the biggest advantage is the increase in Z-coverage while still achieving the equivalent in-plane spatial resolution."

Although GE Healthcare's Discovery™ MR750w with GEM had an integrated posterior array providing added flexibility in coil positioning, the SIGNA™ Premier with the integrated AIR™ Posterior Array (PA), AIR™ Anterior Array (AA) and the newly launched AIR™ MP Coils, which come in two different channel counts, deliver added flexibility and coil combinations. With the AIR™ Coils, patients are more comfortable and this leads to a better patient experience.

Patient comfort also impacts image quality and study reproducibility by helping to reduce patient movement. According to Dr. Potter, having high-quality images that are reproducible across MR exams can reduce radiologist fatigue when reading.

"When we have consistent, superior image quality, it is hard not to get excited," says Dr. Potter.

"The superior gradient performance of the SIGNA™ Premier system with solid gradient linearity off of isocenter, combined with the flexibility of the AIR™ Coils, provides us with some of the best and most consistent images that I have encountered across platforms."

Dr. Hollis Potter

For Dr. Sneag, the ability to precisely visualize lesions and nerves, and identify structural changes in peripheral nerves to give patients a reason why they are in pain or weak, is the most significant impact of the combined improvements from AIR™ MP Coils, new pulse sequences and higher performance gradients on SIGNA™ Premier.

"These improvements are not to be taken lightly — these technologies are making a strong impact," adds Dr. Potter. "It is not just the ability to provide the information we need to confidently diagnose conditions that were previously considered a diagnosis of exclusion, but we now find focal lesions that are amenable to surgery. These images provide an essential roadmap to refine the surgical exposure."

The impact is not just in diagnosis, but also in surgical planning. Drs. Sneag and Potter can deliver a more targeted approach to answer the clinical question, such as pinpointing precisely where the

FOV (cm)	RBW (± kHz)	ESP % change from Discovery™ MR750 to SIGNA™ Premier
10	31.25	-9.3
	62.5	-13.7
	83.3	-13.7
	100	-18.4
	111.11	N/A on MR750
	125	N/A on MR750
8	31.25	-8.0
	62.5	-12.5
	83.3	-13.3
	100	N/A on MR750
	111.11	N/A on MR750
7	31.25	-7.4
	62.5	-8.7
	83.3	N/A on MR750
	100	N/A on MR750
6	31.25	-6.8
	62.5	-7.4
	83.3	N/A on MR750

Table 1. Echo spacing (ESP) reductions with a standard 2D FSE acquisition on Discovery™ MR750 and SIGNA™ Premier, as a function of FOV and receive bandwidth (RBW). In several circumstances, the prescription could not be scanned on Discovery™ MR750, as noted. The protocol used for this comparison was a 2D FSE, 512 x 488 matrix, 2 mm slice thickness.

abnormality is located. This approach can help reduce serial imaging, as well as the length of time for the surgical procedure.

In several instances, Dr. Sneag has marked areas on patient scans that have taken a lot of the guesswork out of the procedure for surgeons. In many cases, the surgeon has been able to reduce the incision size significantly because they knew exactly where to operate.

From a research perspective, the results have been equally impressive with AIR™ Coils and SIGNA™ Premier.

"With SIGNA™ Premier, we now have the ability to actively use 120 elements," says Dr. Sneag. "That allows us to think outside the box — previously we only had 32 channels. As we are looking at higher channel coils or combining coils, there are so many more options."

SIGNA™ Premier has gradient performance advantages over the Discovery™ MR750, as evidenced by shorter echo spacing, which leads to sharper images (Table 1). In addition, SIGNA™ Premier has the capacity for more elements, as well as more receivers. By adding the high-density AIR™ Coils, HSS can now scan with the densest coil packing per volume, enabling the use of the highest independent channels for each imaging volume. And that is a benefit for clinicians and patients alike.

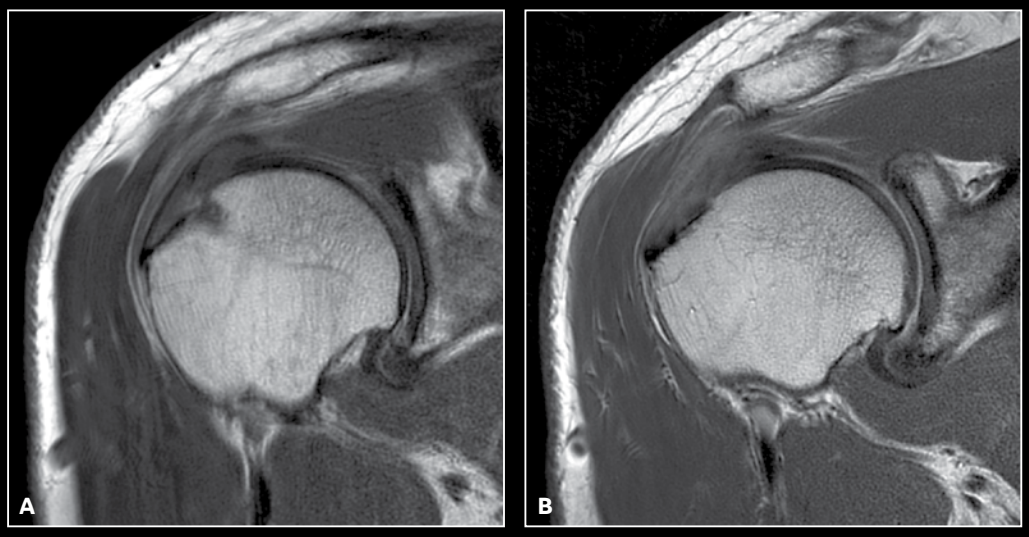

Figure 2. Coronal PD FSE shoulder exam (A) without PROPELLER, 0.3 x 0.4 x 3 mm, 4:04 min., and (B) with PROPELLER, 0.3 x 0.3 x 3 mm, 3:43 min.

Images courtesy of HSS

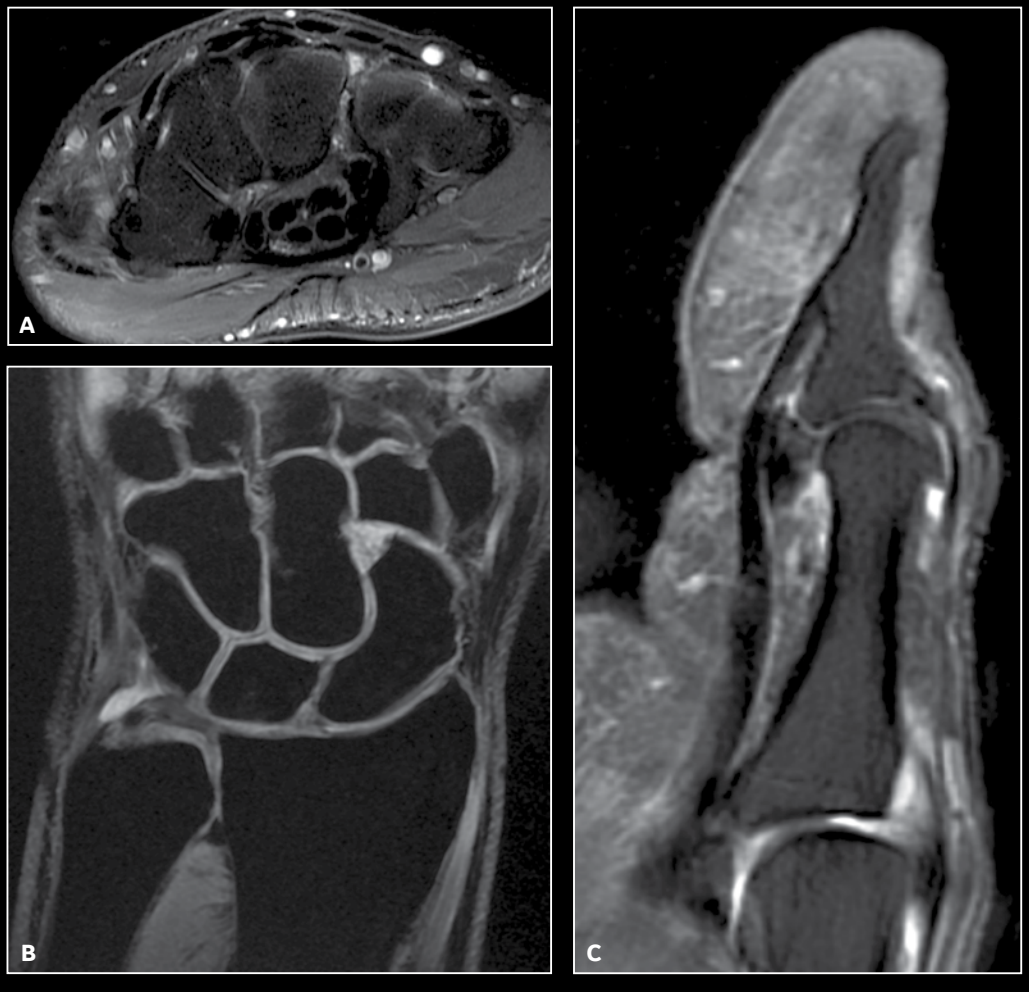

Figure 3. (A) Hand image, axial PD FatSat, 0.3 x 0.3 x 3 mm, 8 cm FOV, 3:36 min.; (B) wrist image, coronal PD, 0.3 x 0.4 x 2 mm; and (C) finger image, sagittal PD FSE Flex, 0.3 x 0.4 x 2.5 mm, 2:17 min.

David Rogers, MBChB, FRANZCR
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Lexie Nelson, MRT
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AIR a true asset in the land of Kiwis

Be the best that you can be is the motto for AUT Millennium, a charitable trust created to help New Zealanders live longer, healthier lives that is home to several sports clubs and national sporting organizations. The same can be said for Ascot Radiology, the radiology group that provides imaging services at AUT Millennium and seven other sites, including Ascot Hospital and the multi-modality clinic Ascot Central.

In 2018, Ascot Radiology upgraded its Discovery™ MR750w wide bore system with SIGNA™Works. One year later, the practice completed a SIGNA™ Lift to bring the system up to a SIGNA™ Architect and the latest SIGNA™Works productivity platform featuring some of GE Healthcare's most advanced MR applications.

"The imaging was good, previously, but naturally we are very happy for any improvement in image quality," says David Rogers, MBChB, FRANZCR, Managing Director for Ascot Radiology. He noticed the improvement in signal-to-noise ratio (SNR) with the system upgrade and, of course, the new AIR™ Coils.

"The AIR™ Coils are the lightest and most flexible coils available today," he explains. As a body radiologist specializing in female pelvic imaging, he sees the difference.

Traditional body arrays are heavy, rigid and fixed. "Almost crushing for the patient, and that makes it more difficult for them to regulate their breathing," Dr. Rogers adds. "The patient would breathe very shallow and then gasp for a deep breath. That, in particular, can ruin the quality of abdominal and pelvic imaging."

Now, with AIR™ Coils, the patient breathing and related body movement is more regular, and that has led to better image quality with fewer artifacts. Patients are not complaining about the heavy weight on them, which makes for a much better patient experience too.

"We are also seeing superb results in joint imaging with the larger coverage afforded by the AIR™ Coils," he says. Since the SIGNA™ Architect is in the Ascot Radiology clinic within the AUT Millennium facility, there are many patients who are professional or semi-professional athletes with large forearms and broad shoulders.

The larger coverage also impacts abdominal imaging, such as in the commonly used coronal SSFSE sequence. With the AIR™ Anterior Array (AA) Coil, the coverage is from the diaphragm through the pelvis, whereas with traditional abdominal coils the coverage stopped before the pelvis. That makes a difference in the reading of the exam, as Dr. Rogers can now report from one sequence versus two.

Dr. Rogers has also found that the dynamic range in the images, or the difference between the darkest and lightest tones, is much better in the abdomen and pelvis with the new system and AIR™ Coils. Specifically, the PROPELLER MB motion insensitive sequence now allows more flexible parameter tailoring, and when used in T2 imaging, the endometrium tissue is brighter and the uterus is a darker shade of gray.

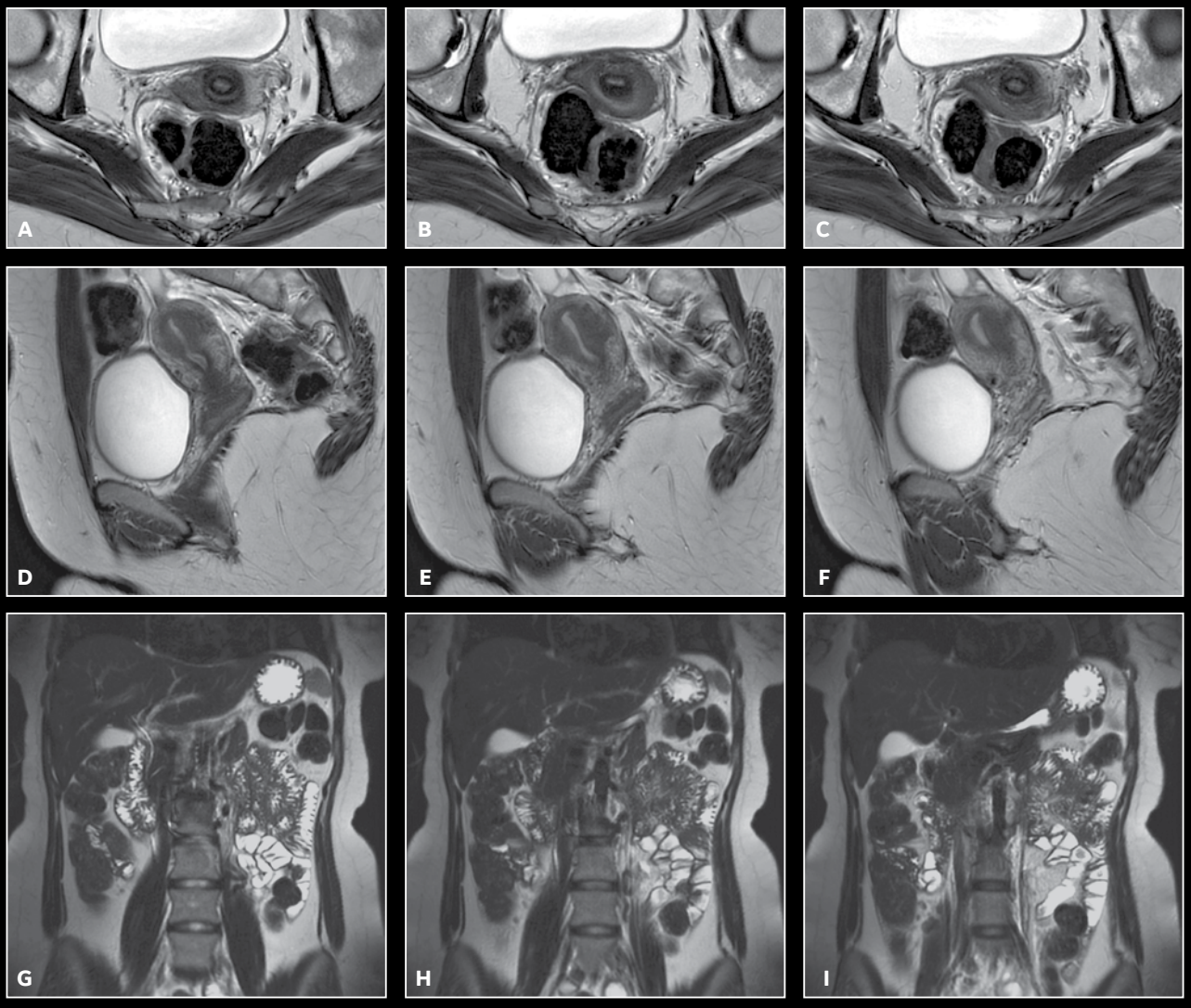


Figure 1. Female pelvis imaging with AIR™ AA Coil and PROPELLER MB. (A-C) T2 axial PROPELLER MB; (D-F) T2 sagittal PROPELLER MB; (G-I) T2 coronal SSFSE.

Images courtesy of Ascot Radiology

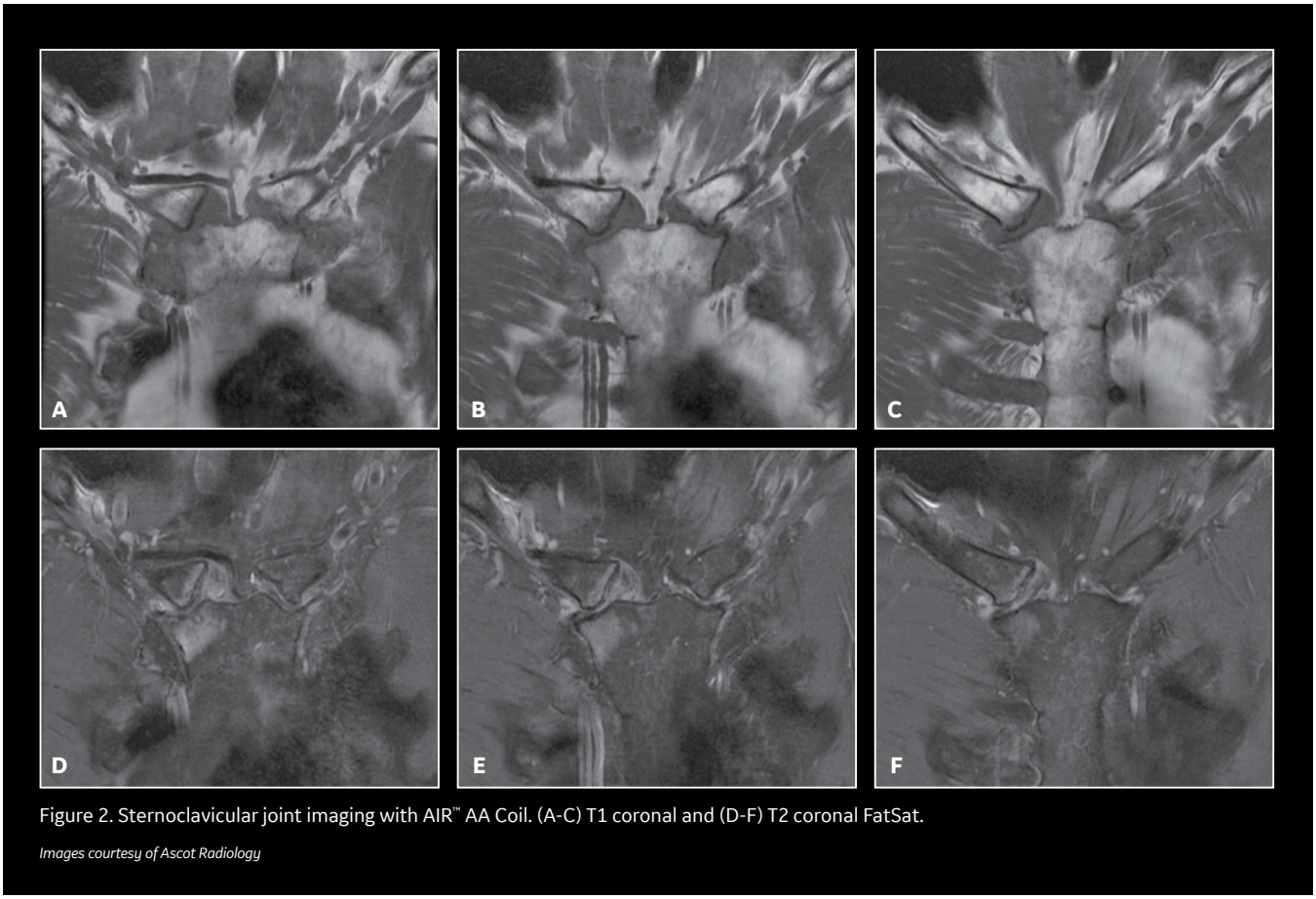


Figure 2. Sternoclavicular joint imaging with AIR™ AA Coil. (A-C) T1 coronal and (D-F) T2 coronal FatSat.

Images courtesy of Ascot Radiology

"There is much better conspicuity of lesions in these images. I've also reviewed several spine exams and found that both the signal and the resolution were improved. Certainly the imaging performance in these areas has increased dramatically. We are more confident diagnostically when we can consistently perform MR exams at a high standard."

Dr. David Rogers

He recalls a patient who had a spine MR exam on three different occasions: the first on the Discovery™ MR750w, the second on the SIGNA™Works upgrade and a third recently on the SIGNA™ Architect Lift with AIR™ Coils. There is an obvious difference in signal and resolution, he adds, and the different exams of the same patient are a clear demonstration of the increased image quality of the new system and coils.

Patient workflow

Although it is difficult to know whether the improvements are from the upgraded system, new sequences, AIR™ Coils, or a combination of these new technologies, Dr. Rogers notices the shorter scan times with the ARC, HyperSense and HyperCube acceleration techniques and a reduction in motion artifacts with the enhanced PROPELLER MB.

"Having these acceleration techniques available gives us the freedom to choose between the same resolution and a faster scan or better resolution at the same exam time," Dr. Rogers says. "We are getting better imaging per minute from the scanner." That ability to save time in a routine exam is important, he adds, because then in difficult cases he can spend the extra time acquiring another view or sequence.

"The AIR™ Coils are really game-changing and make a huge difference in the flexibility of the system."

Dr. David Rogers

That difference in flexibility is also positively impacting the technologists' daily workflow and productivity at Ascot Radiology. Lexie Nelson, MRT, (MR radiographer), has found she needs to change fewer coils to get the MR study completed, even when imaging large-sized professional athletes. It also means she is not taking precious scanner time trying to find a coil that fits, which can also delay the next exam(s).

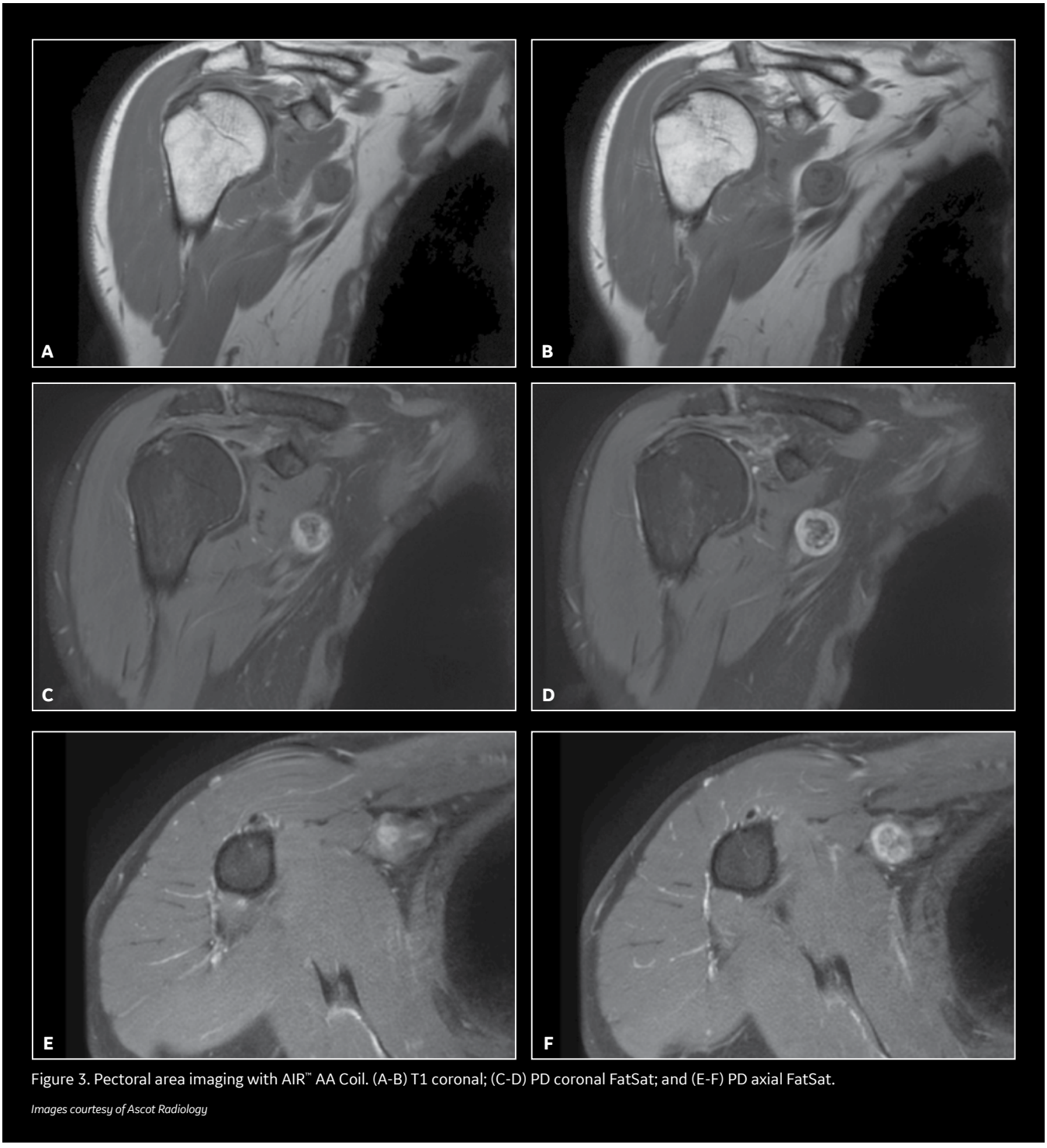


Figure 3. Pectoral area imaging with AIR™ AA Coil. (A-B) T1 coronal; (C-D) PD coronal FatSat; and (E-F) PD axial FatSat.

Images courtesy of Ascot Radiology

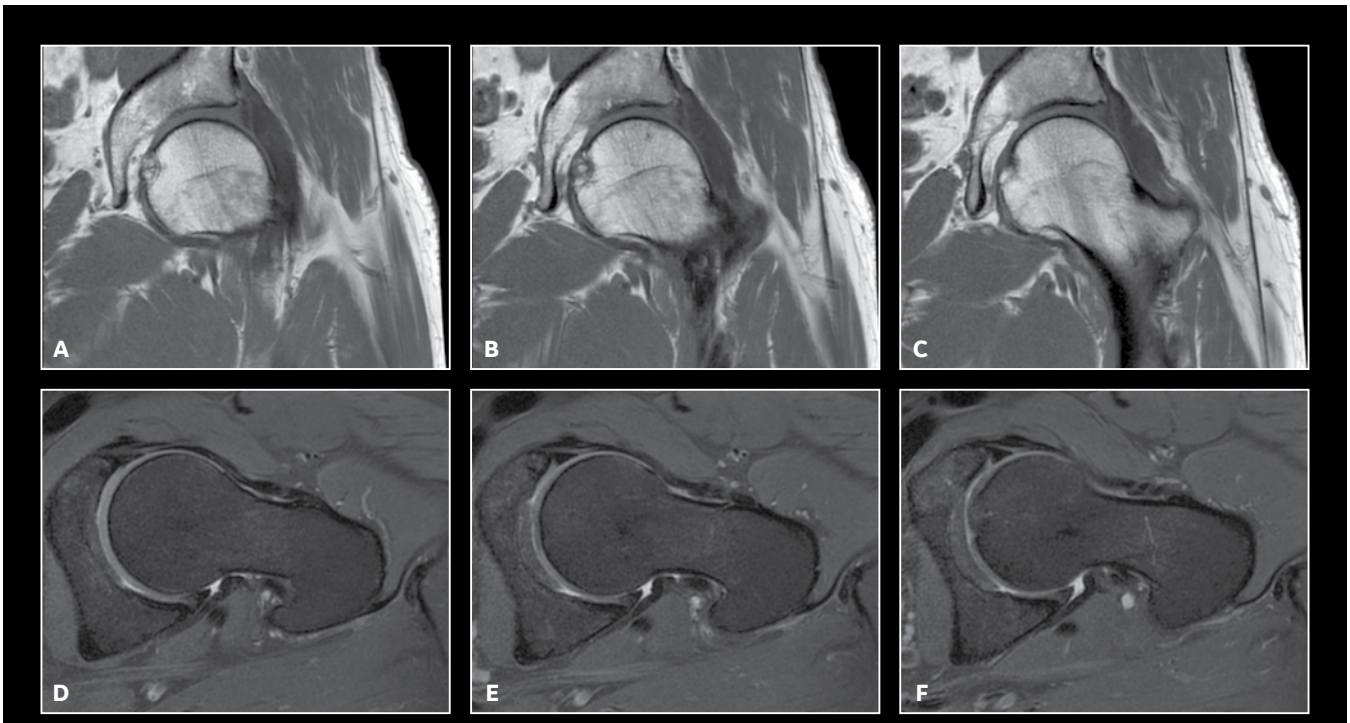


Figure 4. Unilateral hip imaging with AIR™ AA Coil. (A-C) T1 coronal and (D-F) PD axial FatSat.

Images courtesy of Ascot Radiology

"We have a lot of different-sized patients, from very thin runners to the broad and muscular weight lifters," Nelson says. "These people would sometimes not fit in a traditional hard shell coil. We would waste time trying two to three different coils and the patient might get embarrassed. Now, we can just wrap the AIR™ Coil around their body part or area, and that gives us a more efficient workflow. Plus, the coil is not so confining or scary-looking, so in some cases it helps us coax the patient into the scanner for their exam."

With the excellent coil coverage and SNR, Nelson doesn't have to manipulate the patient's position as much as before. The flexible, blanket-like design enables her to more easily wrap the coils around the patient and get them in the correct position for imaging. Plus, the larger field of view (FOV) means she can capture the anatomy in one scan versus having to move the coil and scan again.

For example, the technologists will often perform an exam covering the shoulder, clavicle and pectoral area in athletes who are suspected of tearing a muscle in one of these areas.

"I can wrap the AIR™ Coil from the sternum to the arm and get all the information our radiologists need without losing signal or hurting the patient," Nelson explains. "I don't have to use two coils. Or, if I'm scanning the shoulder, I can image from the tip of the scapula right down to the midline of the clavicle." The AIR™ Coil is also used for smaller FOV sternoclavicular joint imaging.

She has the same experience imaging the hips and female pelvis. Nelson will use both the embedded AIR™ Posterior Array (PA) Coil in the table and then wrap the AIR™ AA Coil on top of the patient without moving them.

"It's good for workflow and the patient, and the images are beautiful. There is no image fallout on the sides, given the large surface area we are scanning," Nelson adds.

The largest coverage and FOV that Nelson has imaged so far is a full femur of a patient who tore their hamstring muscles. She scanned from the crest of the pelvis all the way to the knee — something she could not do with traditional coils and get the necessary coverage.

Several of the newer sequences in SIGNA™Works are also making an impact on the technologist's workflow and imaging from the SIGNA™ Architect. Nelson can easily change a sequence to PROPELLER MB if a patient is moving, which she says is amazing and improves workflow. When using the FSE Flex sequence in more challenging areas, she doesn't lose resolution when compared with FSE FatSat acquisitions.

Yet, it's the AIR™ Coils that are life changing.

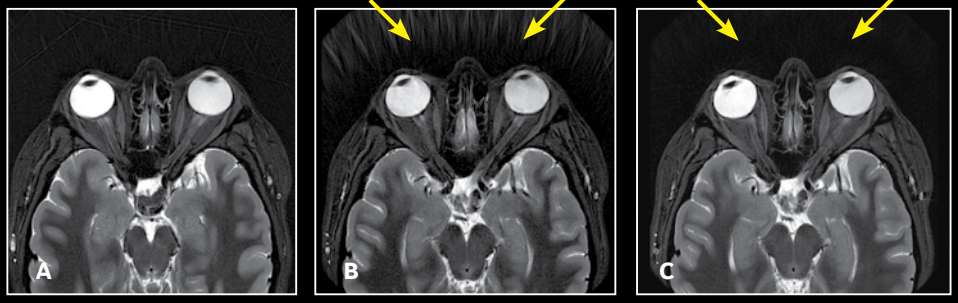
"The AIR™ Coils are a true asset. I would tell others to get one if they can, and better yet, get two, because they are fabulous."

Lexie Nelson

A software package that helps you do more with less

Learn more about what you can do with AIR™:
gehealthcare.com/air

The new SIGNA™Works AIR™ Edition from GE Healthcare packs innovations that deliver versatility, productivity and consistent quality, empowering any technologist to deliver images with remarkable clarity. From new applications to enhancements to existing technologies, the new software release is just simply better.



(A) Typical scanning reconstruction requires significant oversampling (NPW) to prevent out-of-FOV artifacts. This causes the user to scan more than is needed, which has a direct impact on scan time. (B) If we reduce the over oversampling factor (NPW), we're able to lower the scan time but introduce out-of-FOV artifacts (arrows). (C) With AIR™ Recon, we can achieve shorter scan times and remove the out-of-FOV artifacts and improve the quality.

AIR™ workflow and image quality

Intelligent workflow applications powered by AIR™ automate the scan process to drive consistency. When paired with advanced imaging applications, AIR x™, AIR Touch™ and AIR™ Recon deliver simply better versatility and productivity gains along with industry-leading image quality.

AIR x™, a revolutionary workflow tool for brain exams, automatically prescribes slices to help eliminate error-prone, manual slice placements. Studies have shown 5x faster set-up time and 4x fewer clicks with AIR x™. So no matter who is scanning you get consistent and precise prescription set up for patients regardless of their age, pathology or position in the magnet.

AIR Touch™ accelerates the scanning process through automated coil selection and landmarking. Just use IntelliTouch™, GE's 1-touch landmarking tool, to activate an optimized set of coils that is selected based on the patient's anatomy. With the anatomical-based protocol optimization, AIR Touch™ optimizes the protocol parameters with a single touch, delivering a 59%** productivity gain from plan to scan. Realize further scan savings with Flexible No Phase Wrap (NPW) to scan only what you need so you can focus on the patient not the scanner.

AIR™ Recon, GE's new reconstruction algorithm available on several key applications like PROPELLER, Cube, FSE and Flex, helps reduce background noise and out-of-FOV artifacts while improving SNR. The result is cleaner, crisper images without having to overcompensate in your scanning protocol.

Existing app enhancements

MAVRIC SL‡, GE's industry-leading application for imaging in the presence of MR-Conditional implants, now includes T2-weighting (in addition to T1, PD and STIR), NPW and an automated-parameter setting for streamlined workflow. Want to get there faster? **HyperMAVRIC SL** a 3D isotropic acquisition that enables 40 percent shorter scan times by automatically tailoring the acquisition to the patient's implant.

There's even more in the SIGNA™Works AIR™ Edition to make everyday scans exceptional. New standard and expanded advanced applications simply improve your MR imaging capabilities from scan setup to patient comfort to image reconstruction.

** Results may vary.

‡ MAVRIC SL should only be used with MR-Conditional implants and within the MR conditions specified for those implants.

SIGNA™Works AIR™ Edition is not available on all systems. Please contact your local GE representative for more information.

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Body imaging with AIR Anterior Array Coil and Posterior Array

Submitted by Quirónsalud Madrid University Hospital

Fetal imaging

By Manuel Recio Rodríguez, MD, Associate Chief of Diagnostic Imaging Department

With the AIR™ Anterior Array (AA) Coil, we can achieve good signal penetration for fetal imaging. This enables us to obtain high-quality images of the fetal brain with short acquisition times using T2 and DWI sequences.

38-year-old pregnant woman; fetus with hydrocephalus.

Coil:	AIR™ AA Coil
Parameters:	
T2 SSFSE in three planes:	- Sagittal: 0.7 x 0.7 x 3 mm, 1:00 min. - Coronal/Axial: 0.7 x 0.7 x 2.5 mm, 1:22 min.
DWI, b800:	- Axial: 2.8 x 2.8 x 2.5 mm, 0:50 sec.

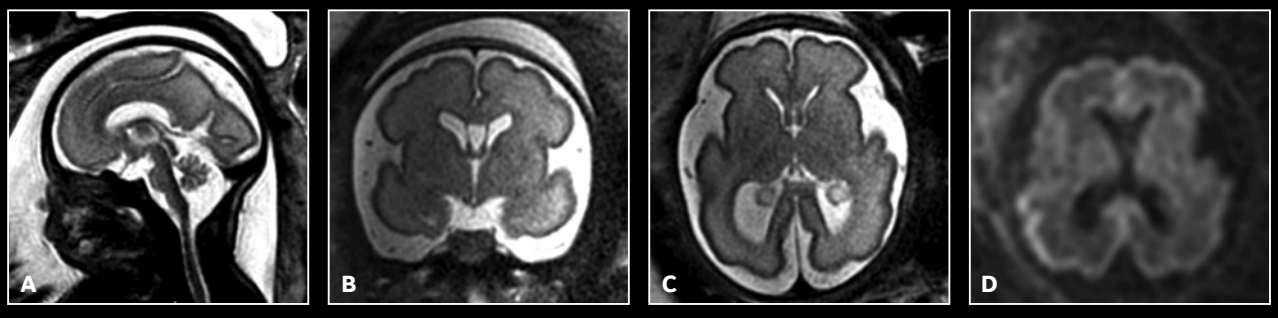


Figure 1. AIR™ AA Coil provides excellent signal penetration for high-quality images. (A) Sagittal T2 SSFSE; (B) Coronal T2 SSFSE; (C) Axial T2 SSFSE; and (D) Axial DWI b800.

Abdominal imaging

By Vicente Martinez de Vega, MD, Chief of Diagnostic Imaging Department

Abdominal imaging with the AIR™ Coils is better than we expected, particularly the coverage, signal homogeneity, high spatial resolution and scanning speed. We were also able to achieve short acquisition times and homogenous fat suppression. In this particular case, a thickening of the terminal ileum can be noticed in a very short segment, which is consistent with Crohn's disease.

48-year-old male with Crohn's disease.

Coils:	AIR™ AA Coil and Posterior Array (PA)
Parameters:	
T2 SSFSE in two planes with and without FatSat:	- Axial: 0.8 x 1 x 4 mm, 0:52 sec. - Axial w/FatSat: 0.9 x 0.9 x 4 mm, 0:54 sec. - Coronal: 1 x 1.25 x 4 mm, 0:38 sec.
Axial DWI:	b1000, 2.9 x 1.2 x 5 mm
T1 LAVA ASPIR in two planes:	- Axial 1 x 1.25 x 2.4 mm, 0:24 sec. - Coronal: 1 x 1.25 x 3 mm, 0:19 sec.
Coronal T1 DISCO:	1 x 1.6 x 2 mm, 7 sec./phase
Coronal T2 FIESTA dynamic:	1 x 1 x 3 mm, 0:54 sec.

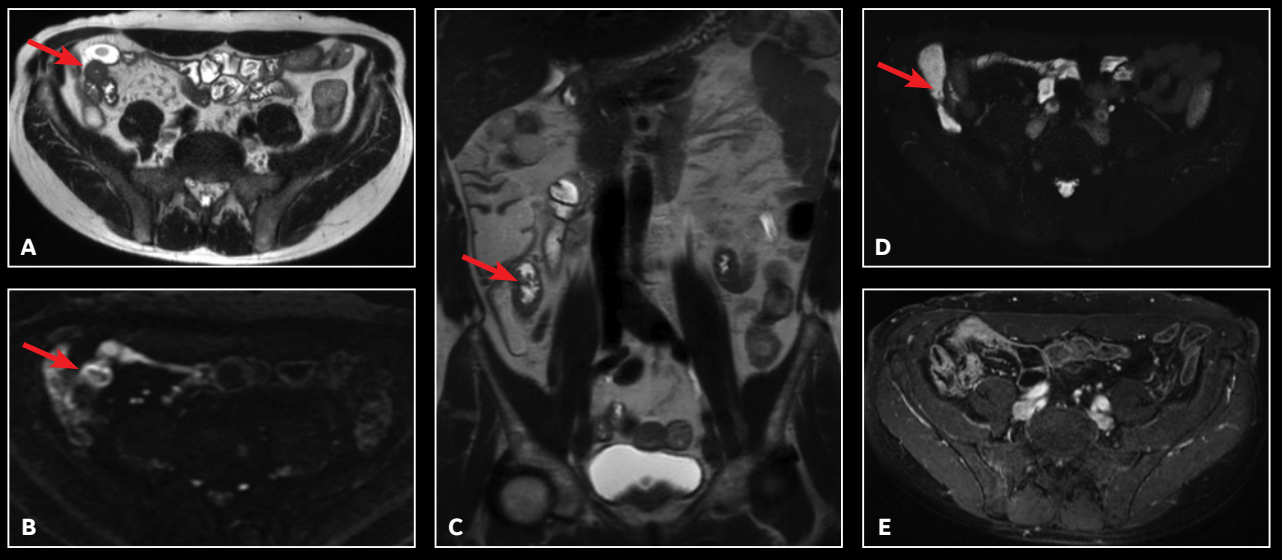


Figure 2. AIR™ AA Coil and PA for abdominal imaging deliver better than expected coverage, signal homogeneity, high spatial resolution and homogeneous fat suppression. A thickening of the terminal ileum (red arrows) is consistent with Crohn's disease. (A) Axial T2 SSFSE; (B) Axial DWI b1000; (C) Coronal T2 SSFSE; (D) Axial T2 SSFSE FatSat; and (E) Axial T1 LAVA ASPIR.

Figure 3. A thickening of the terminal ileum (red arrows) is consistent with Crohn's disease. (A) Coronal T2 SSFSE; (B) Coronal T1 LAVA ASPIR; and (C) MIP from DISCO, arterial phase.

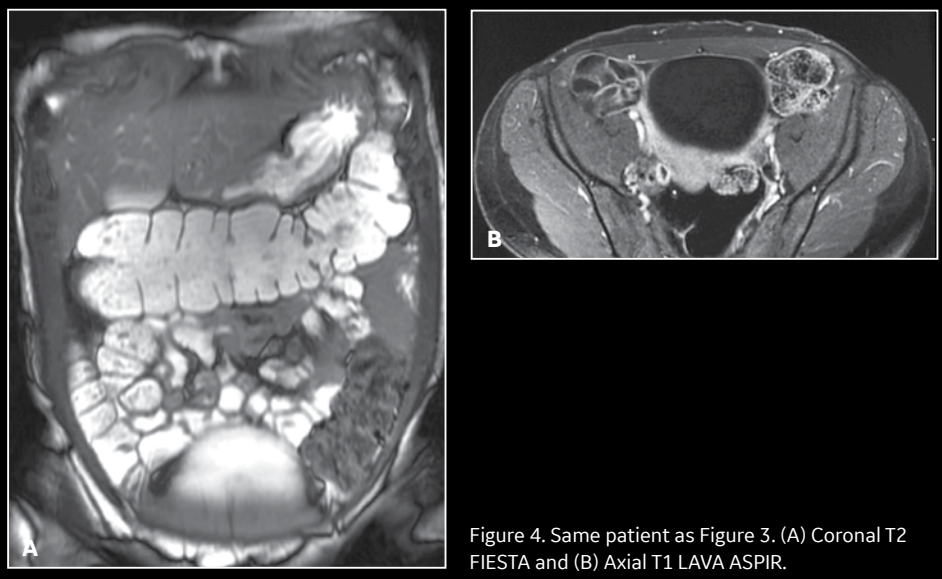


Figure 4. Same patient as Figure 3. (A) Coronal T2 FIESTA and (B) Axial T1 LAVA ASPIR.

Prostate imaging

By Manuel Recio Rodríguez, MD, Associate Chief of Diagnostic Imaging Department

Prostate MR is growing in use and referrals in our institution. However, in order to clearly depict the cancer to determine the extent of disease, it is necessary to obtain T2 sequences with high spatial resolution. Also, T2 Cube images can be used to merge with ultrasound to assist in performing targeted biopsies. In this particular case, a lesion with high signal in the T2-weighted sequence in the central prostate can be seen. There is no enhancement in the dynamic sequence and restricted diffusion is consistent with a prostate abscess. Dynamic acquisition with DISCO LAVA provides high spatial and temporal resolution (4.5 seconds per phase) and the diffusion imaging is very high quality.

71-year-old male with prostate cystic adenoma.

Coils:	AIR™ AA Coil and PA
Parameters:	
Axial T2 FSE:	3 x 0.4 x 0.7 mm, 4:47 min.
Axial T2 Cube:	0.5 x 0.8 x 0.8 mm, 5:31 min.
FOCUS DWI:	b800, 3 x 2 x 2 mm
	MAGiC DWI: b1500
Axial DISCO LAVA:	1.5 x 1 x 1 mm, 4.5 sec./phase

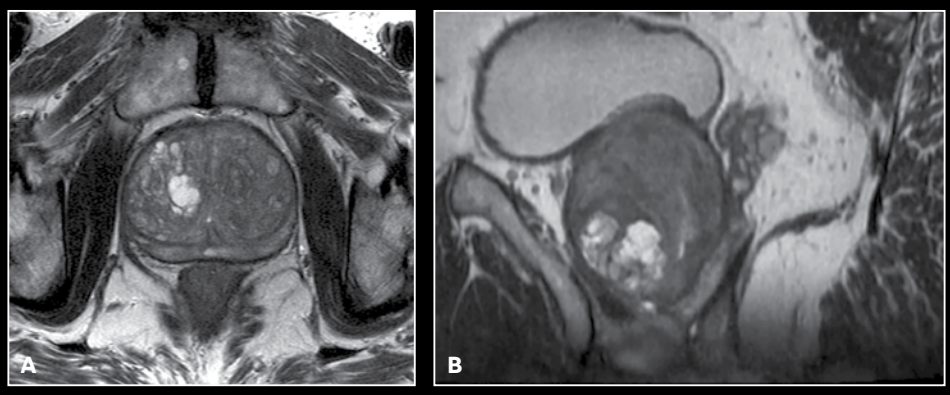
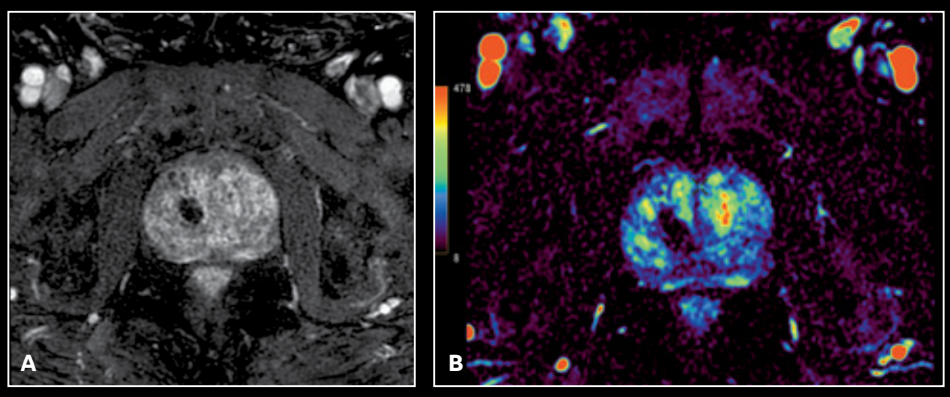


Figure 5. AIR™ AA Coil and PA provide high spatial resolution in T2 sequences, which improves visualization of the cancerous lesion for staging. Note the lesion with a high signal in the central prostate. (A) Axial T2 and (B) Axial T2 Cube.



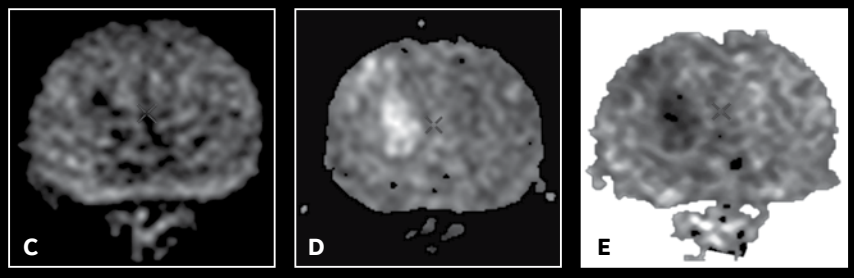


Figure 6. There is no enhancement in the dynamic sequence and restricted diffusion is consistent with a prostate abscess. (A) Axial DISCO LAVA; (B) enhancement integral map; (C) Axial DWI FOCUS b800; (D) ADC map; and (E) MAGiC DWI b1500.

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Neuro imaging with the AIR 48-channel Head Coil

By Krisztina Baráth, MD, neuroradiologist, and Brigitte Trudel, RT(R)(MR), MRI Chief Technologist, RNR Institute of Radiology and Neuroradiology at Glattzentrum

When scanning with the new AIR™ 48-channel Head Coil on the SIGNA™ Pioneer 3.0T MR system, routine neuro acquisitions show significantly higher signal-to-noise ratio (SNR) compared to prior acquisitions with the conventional Head Neck Unit (HNU) coil.

With the embedded AIR™ element design, we can observe a very homogenous signal distribution over the whole field-of-view without any signal drop in the center of the brain. In our experience, we know this is not the case for every dedicated neuro coil available on the market.

Additionally, the coverage of the coil in the z-direction gives us the versatility to easily scan the brain and cervical spine for multiple sclerosis as well as carotid MRA studies.

The AIR™ 48-channel Head Coil has an adaptable design with an additional 3 cm expansion to gain more room for very large-sized heads and necks. It also helps reduce the patient feeling confined or having their nose in contact with the front of the coil. The coil is compatible with the comfort tilt device, which is very important when scanning elderly patients suffering from kyphosis because it helps them lie comfortably on the table. It is essential for our dementia protocols that the patient not move during scanning due to discomfort.

By combining the advantage of extra SNR with high ARC factors and new acceleration techniques, such as HyperSense and HyperBand, we are able to decrease significantly our total examination time for neuro protocols by 25% while maintaining or even increasing image quality and spatial resolution.

The AIR™ 48-channel Head Coil is a real asset for us as a neuroradiological institute and it further extends the clinical benefits of a powerful 3.0T MR system such as the SIGNA™ Pioneer.

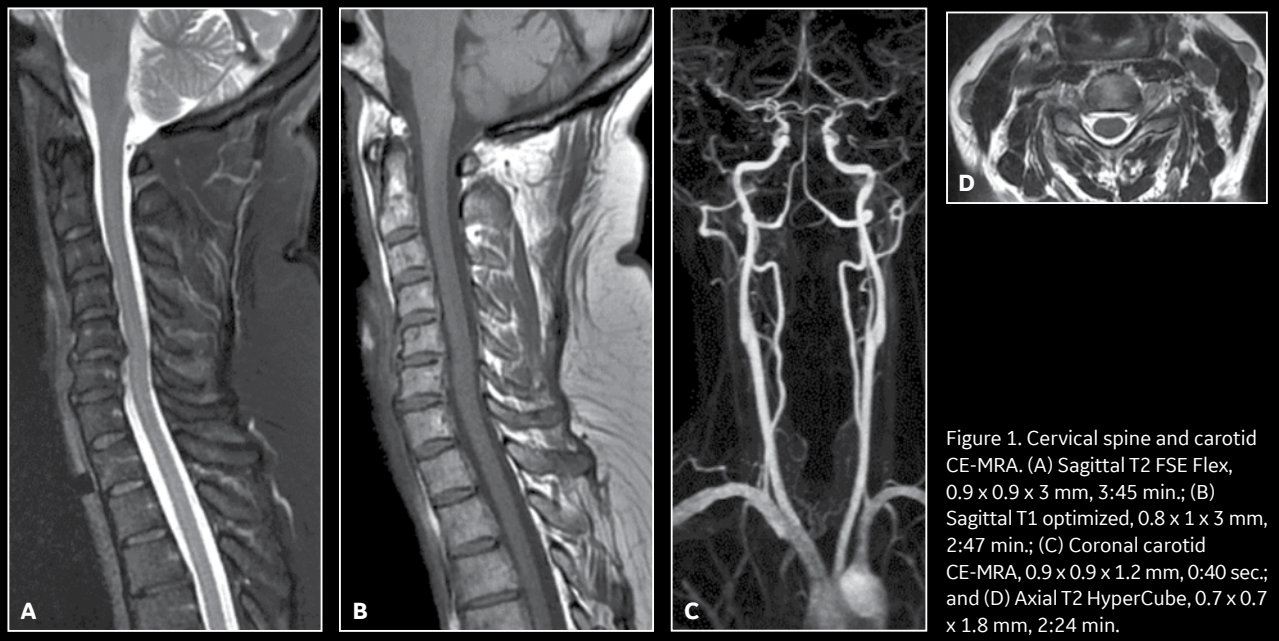


Figure 1. Cervical spine and carotid CE-MRA. (A) Sagittal T2 FSE Flex, 0.9 x 0.9 x 3 mm, 3:45 min.; (B) Sagittal T1 optimized, 0.8 x 1 x 3 mm, 2:47 min.; (C) Coronal carotid CE-MRA, 0.9 x 0.9 x 1.2 mm, 0:40 sec.; and (D) Axial T2 HyperCube, 0.7 x 0.7 x 1.8 mm, 2:24 min.

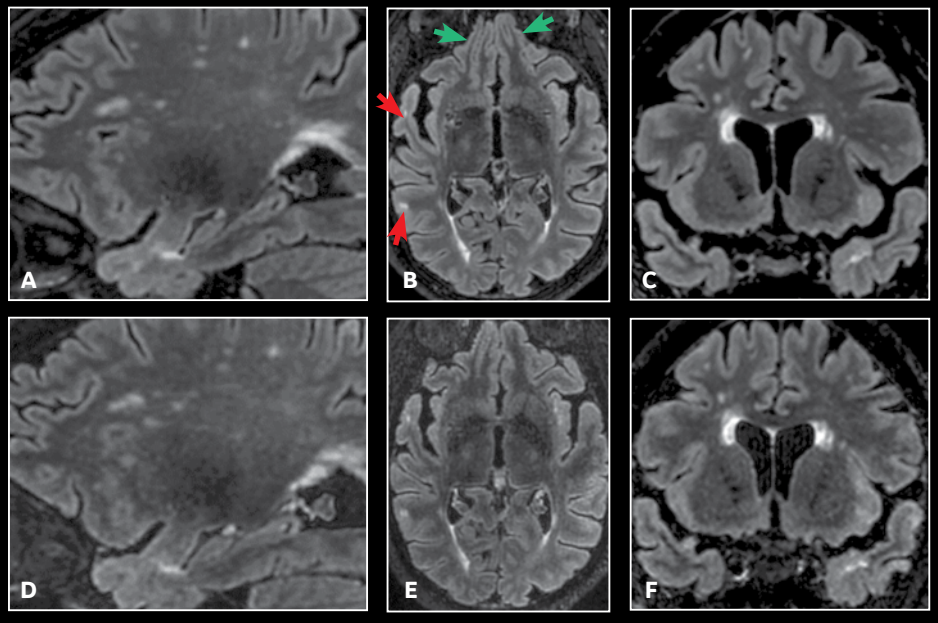


Figure 2. Patient with multiple sclerosis. Higher SNR with the AIR™ 48-channel Head Coil enables better gray matter delineation (green arrows) and enhanced lesion depiction (red arrows).
(A-C) AIR™ 48-channel Head Coil, Sagittal Cube FLAIR HyperSense, 1 x 1.1 x 1.2 mm, 3:30 min.; and (D-F) conventional HNU, Sagittal Cube FLAIR HyperSense, 1 x 1.1 x 1.2 mm, 3:45 min.

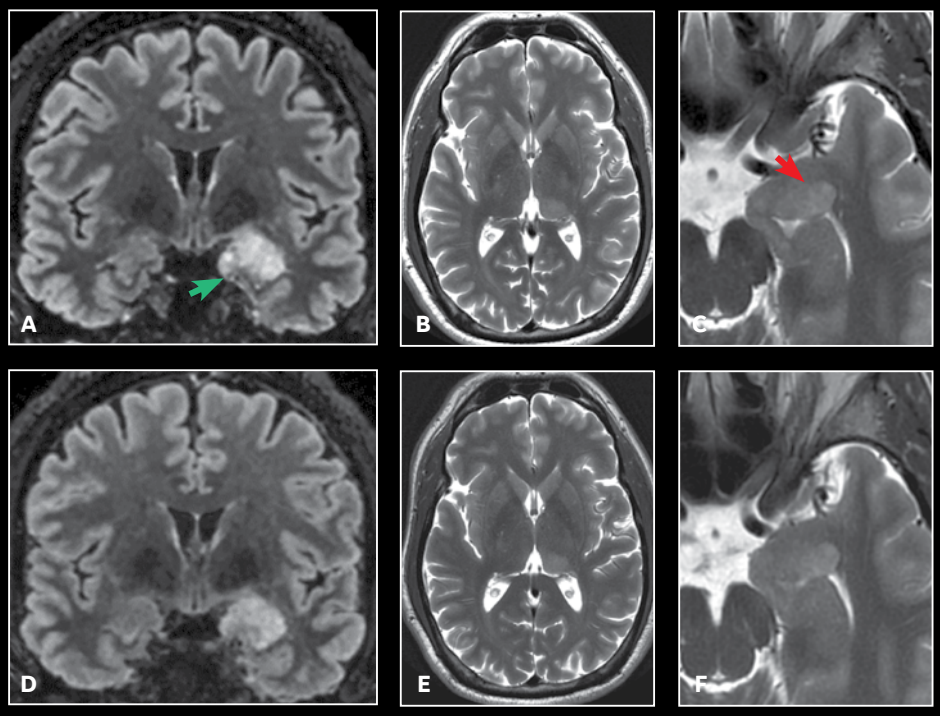


Figure 3. Patient with low-grade glioma. Higher SNR with the (A-C) AIR™ 48-channel Head Coil enables better in-plane resolution (green arrow) and enhanced lesion depiction (red arrow) than (D-F) images acquired with conventional HNU. (A, D) Cube FLAIR with HyperSense, 1 x 1.1 x 1.2 mm, 3:38 min. with 48-channel Head Coil and 3:45 min. with conventional HNU; (B, C, E, F) Axial T2 PROPELLER, 0.5 x 0.5 x 3 mm, 2:10 min. with 48-channel Head Coil and 0.6 x 0.6 x 3 mm, 2:23 min. with conventional HNU.

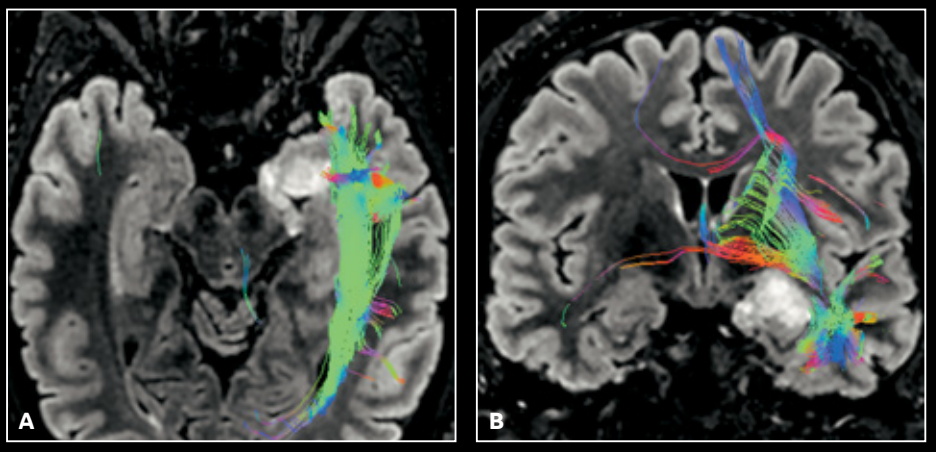


Figure 4. Patient with low-grade glioma. (A, B) DTI HyperBand with 32 directions, 2.2 x 1.8 x 4 mm, 3:43 min.

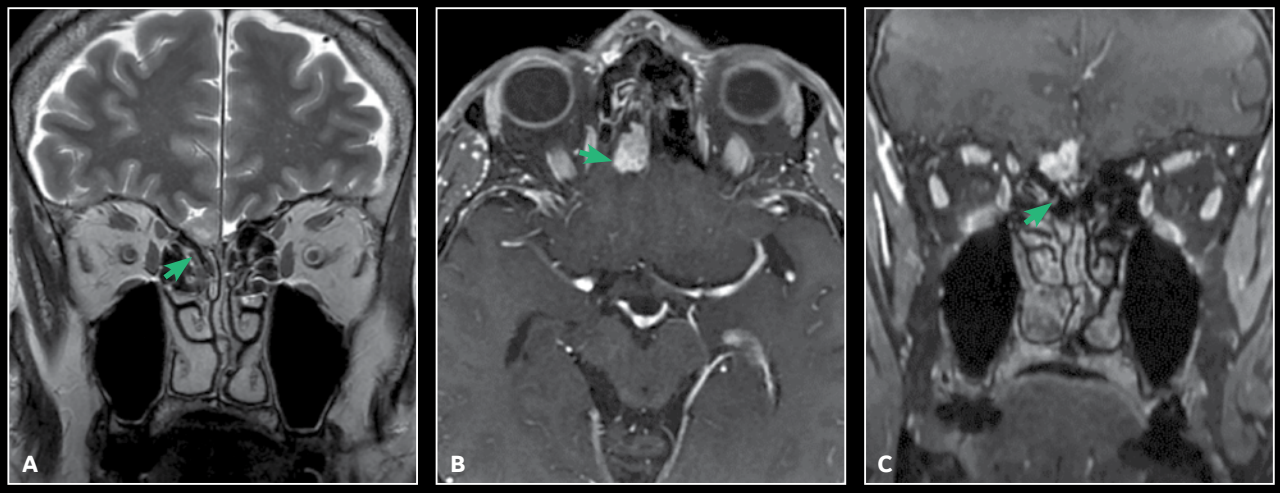


Figure 5. Patient with meningioma scanned with the AIR™ 48-channel Head Coil. (A) Coronal T2, 0.5 x 0.6 x 3 mm, 2:15 min.; (B) Axial LAVA ASPIR post contrast, 0.8 x 0.8 x 1 mm, 3:50 min. with (C) Coronal reformat.

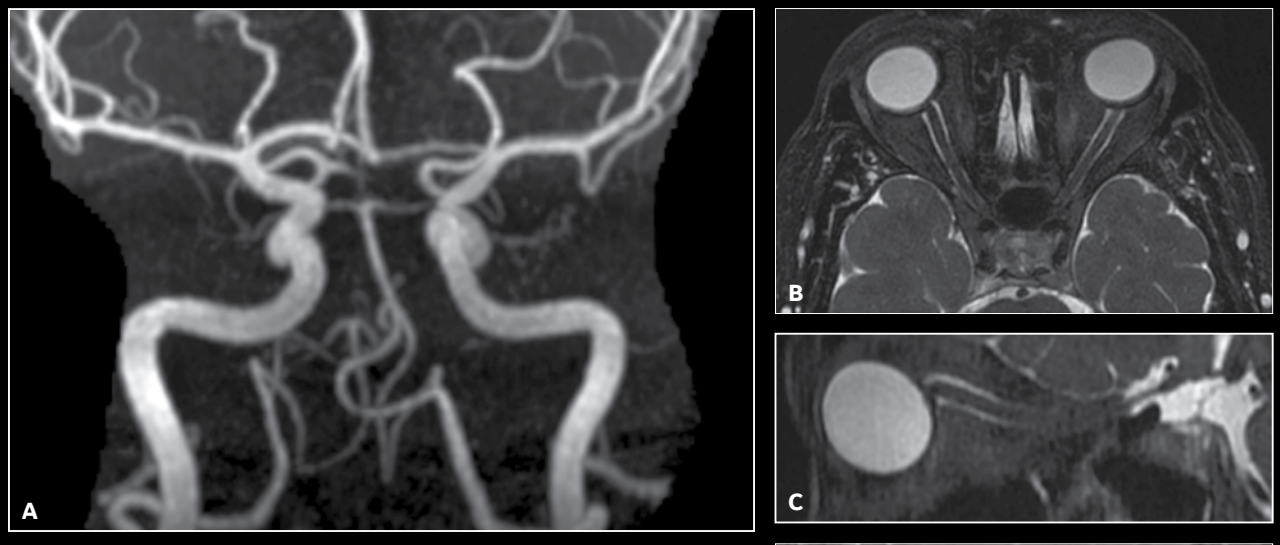


Figure 6. Standard brain and orbits protocols acquired with the AIR™ 48-channel Head Coil. (A) TOF with HyperSense, 0.7 x 0.7 x 1 mm, 3:21 min.; with (C) Sagittal and (D) Coronal reformats; and (B) Axial T2 HyperCube with Flex and HyperSense, 3:53 min.

Diffusion imaging with AIR family of products

Submitted by Kawasaki Saiwai Hospital

Case 1

A 59-year-old female with loss of consciousness. Prior history includes gall bladder stone and cholecystitis.

MR findings

Patient has multiple infarction. Micro infarction was not clearly visualized in conventional DWI sequence. However, MUSE enabled high-resolution DWI that enabled depiction of micro infarction in the gray matter.

59-year-old female.

Coil:	AIR™ 48-channel Head Coil
Parameters:	
DWI, b1000:	0.9 x 1.9 x 5 mm
MUSE, b1000:	0.8 x 0.9 x 5 mm

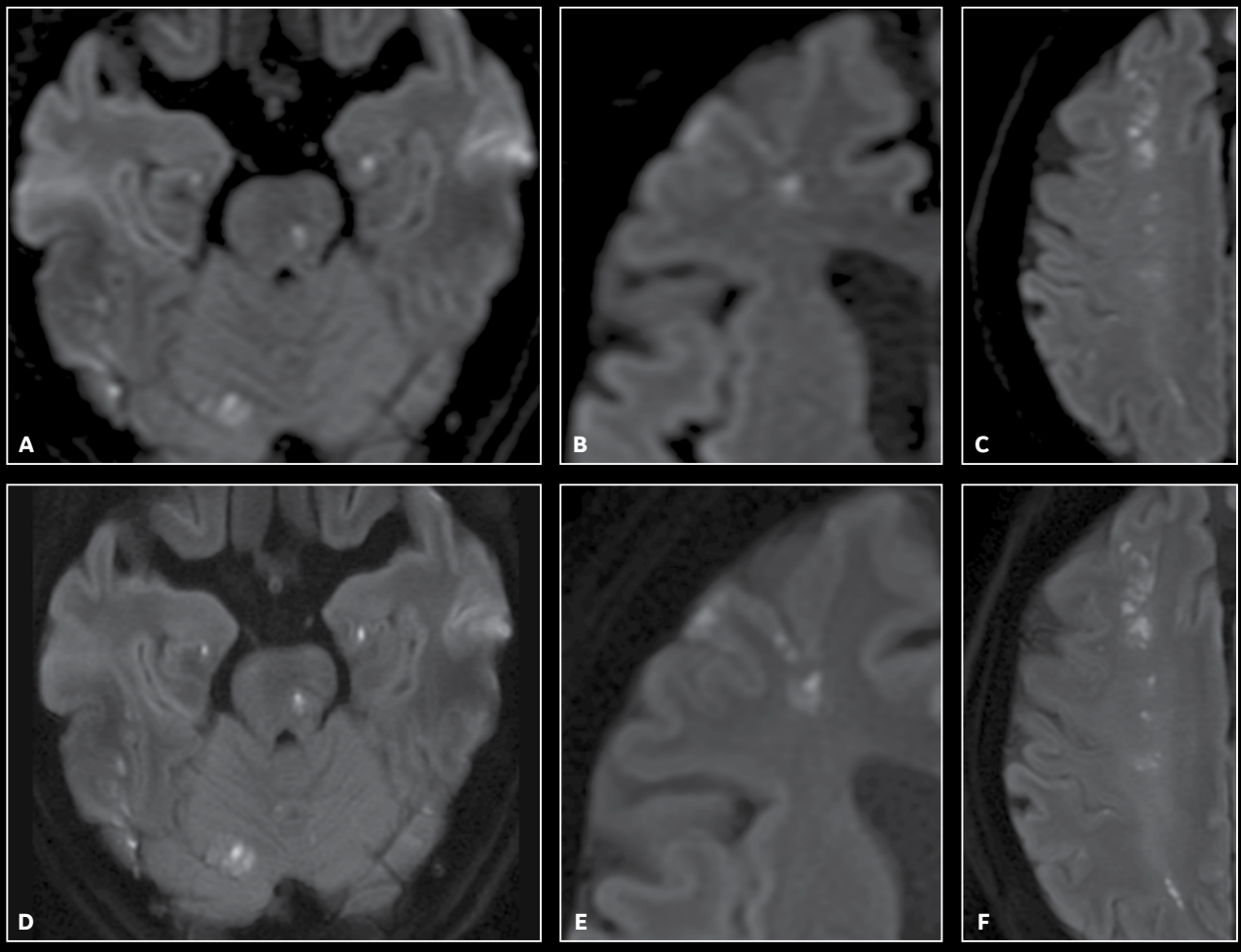


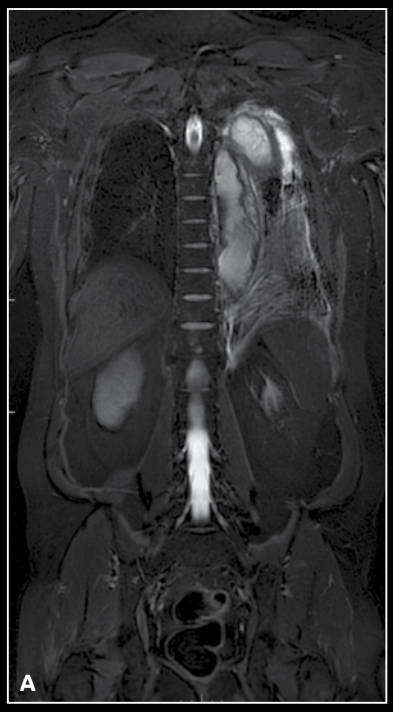
Figure 1. With the improvement in resolution using MUSE, there is clear depiction of the infarct in the gray matter compared to the conventional sequence. (A-C) Conventional DWI, b1000; (D-F) MUSE, b1000.

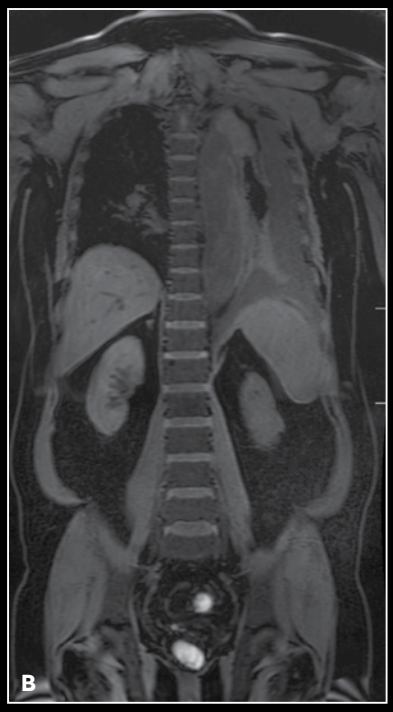
Case 2

A 46-year-old male presenting with fever of unknown origin and suspected infection after aortic stent replacement surgery.

MR findings

T2 SSFSE and T2 STIR PROPELLER MB confirmed abscess formation in the left upper lung lobe without having to reposition the coil. High signal DWI confirmed location. Whole-body Coronal DWI was acquired in two stations. The AIR™ Anterior Array (AA) Coil allows higher parallel imaging factors, enabling low-distortion DWI even in cases with a large field-of-view. S

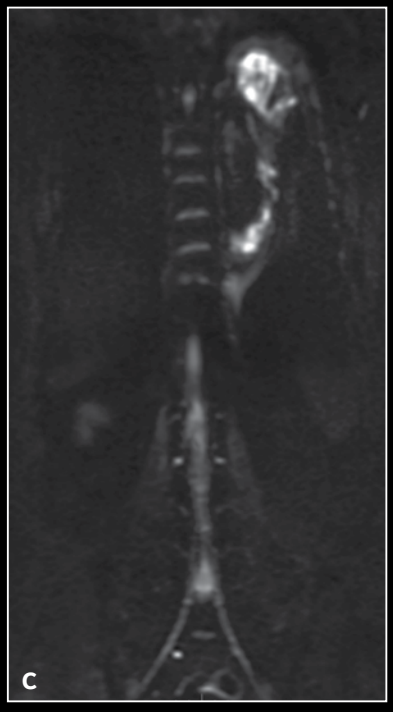


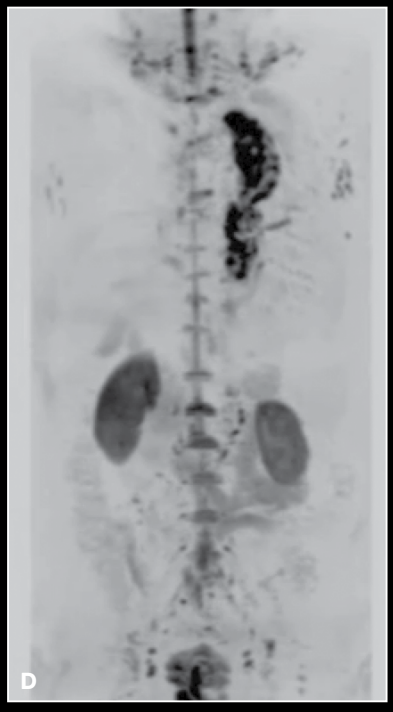


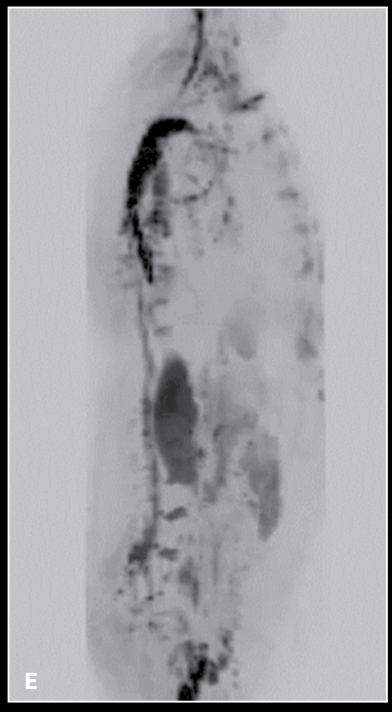
46-year-old male.

Coil:	AIR™ AA Coil
Parameters:	
T2 STIR PROPELLER MB:	1.6 x 1.6 x 5 mm ARC factor of 3 3:49 min.
T2-weighted SSFSE:	1.3 x 2.1 x 5 mm 1:10 min.
Whole-body DWI, b800:	2 station Coronal DWI, 1.8 x 4.2 x 5 mm Acc 2.0/4.0 4:00 min.

Figure 2. (A) Coronal T2w STIR PROPELLER MB; (B) Coronal LAVA; (C) Coronal DW-EPI, 2 stations; (D) whole-body DWI, radial MIP; (E) whole-body Coronal DWI radial MIP, 2 stations.

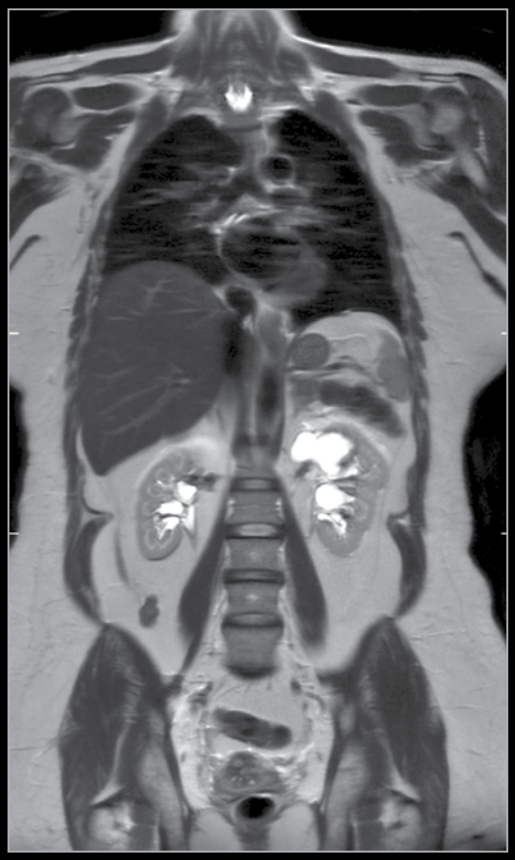




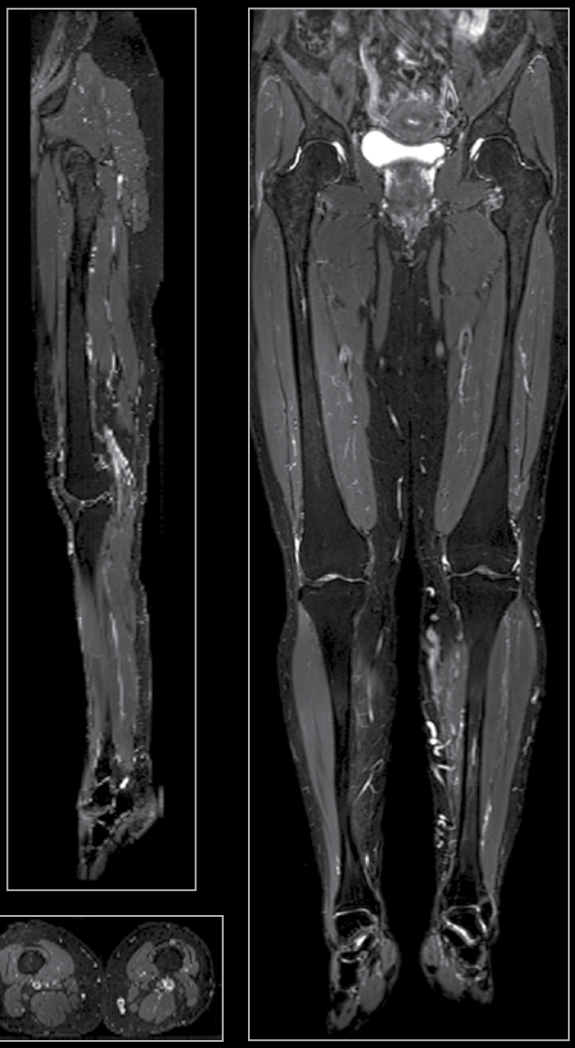


SIGNA™ Works AIR™ Edition gallery:
Coil combinations with AIR Touch™

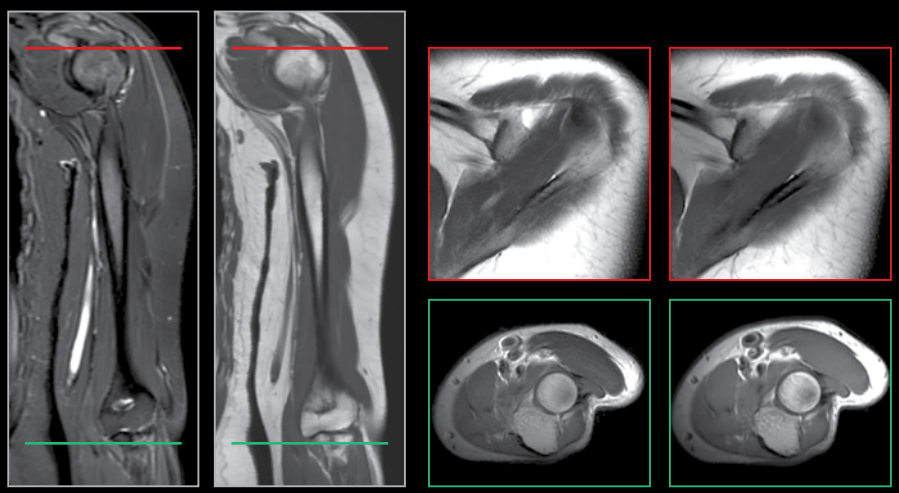
All images in this gallery were acquired using AIR™



Two-station chest/abdomen/pelvis (above) and the upper extremity (below) demonstrate the coverage of the AIR™ Anterior Array Coil. The coil was not repositioned, allowing flexibility in imaging while maintaining versatility, comfort and quality.

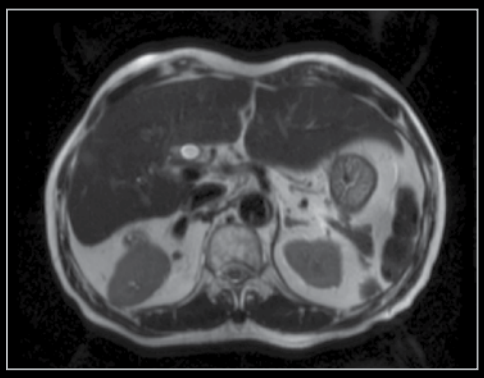


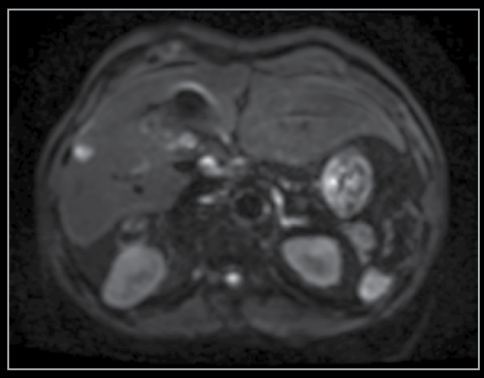
With two AIR™ AA Coils wrapped around the lower extremities, a multi-station exam (above) can be performed with ease. AIR Touch™ automated coil selection allows for improved workflow while optimizing parallel imaging performance with minimal interaction from the user.



All images courtesy of Emsey Hospital, Istanbul, Turkey

SIGNA™Works AIR™ Edition gallery:
Abdominal imaging



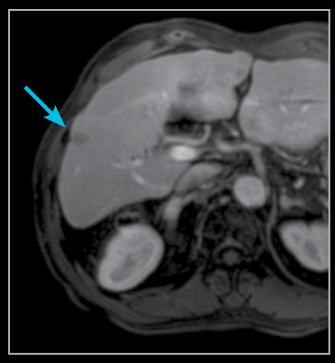


T2 SSFSE, DWI and dynamic LAVA depict a rapidly enhancing liver lesion.

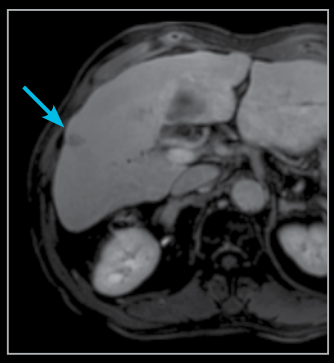
Images courtesy of Hospital Universitario Quirón Salud, Madrid, Spain

Pre-contrast enhancement

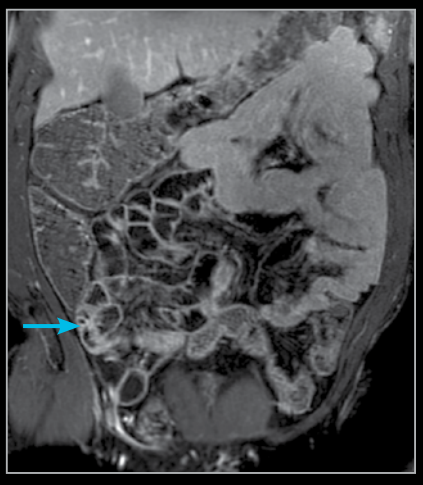
Arterial phase



Portal phase

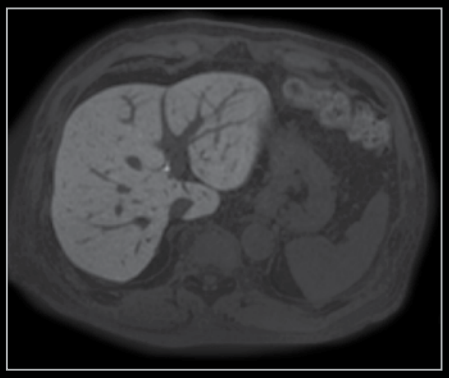


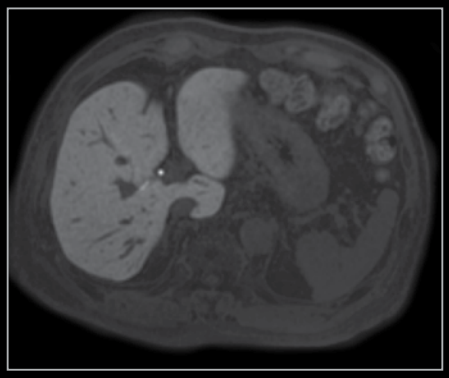
Late phase



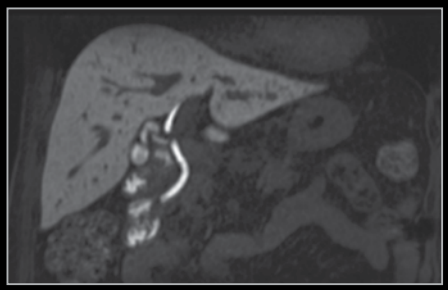
Patient with Crohn's disease demonstrating post-contrast enhancement of the terminal ileum. MRA was obtained in the same exam during the early arterial phase of a DISCO LAVA sequence.

Images courtesy of Hospital Universitario Quirón Salud, Madrid, Spain





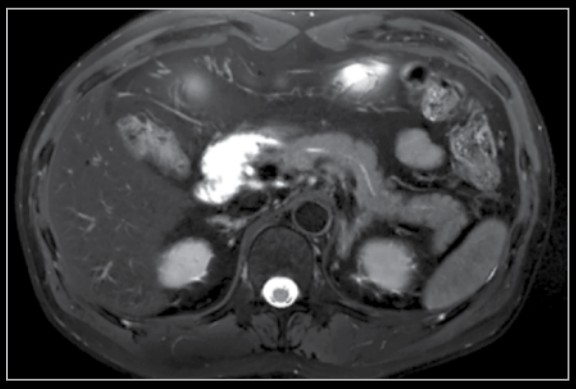
Delayed phase axial LAVA acquisition 15 min. post Gd-EOB-DTPA. Scan time was 0:20 min.



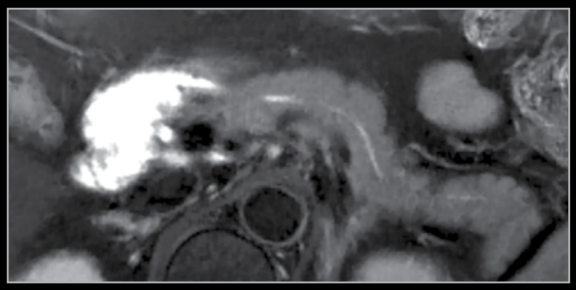
Coronal MPR of an axial LAVA acquisition.

Images courtesy of Osaka University Hospital, Osaka, Japan

SIGNA™Works AIR™ Edition gallery:
Abdominal imaging (pancreas & MRCP)

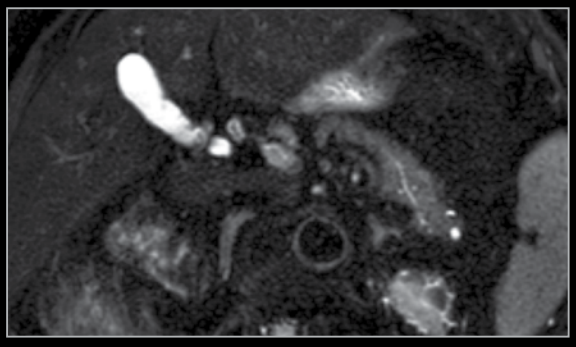


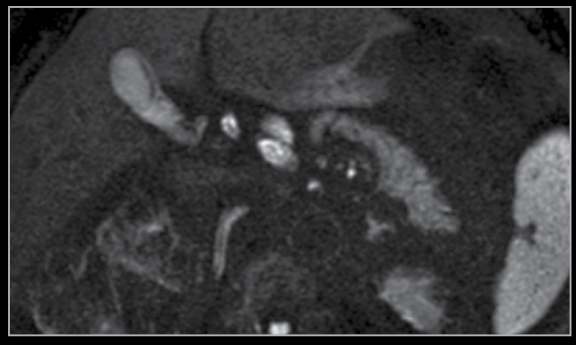
Axial T2 FatSat
PROPELLER MB
0.6 x 0.6 x 4 mm
ARC 4.0
4:24 min



AIR™ Coils are comfortable for the patient and enable higher parallel imaging factors, which reduces patient exam times and drives productivity.

Images courtesy of Osaka University Hospital, Osaka, Japan

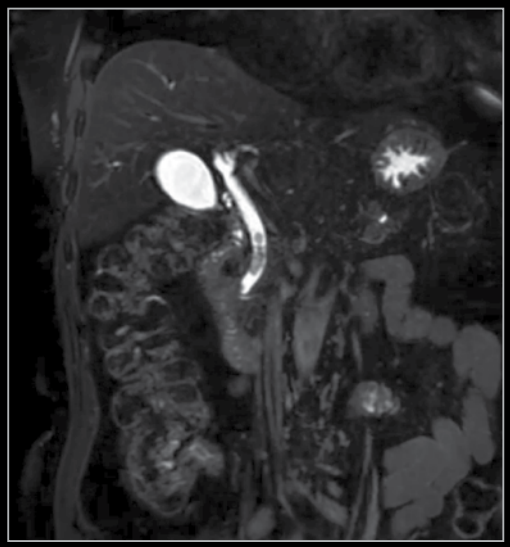




Improved DWI EPI imaging with multi-shot DWI and AIR™ AA Coils.

MUSE allows for reduced susceptibility artifacts, incorporates large matrices for submillimeter resolution and can be combined with distortion correction for additional artifact reduction. Combining MUSE with AIR™ Coils ensures a simply better patient experience and exceptional image quality.

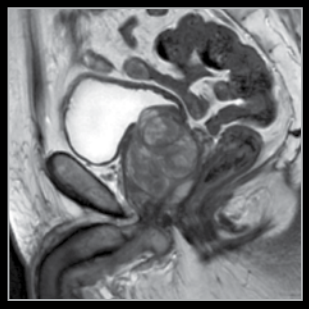
Images courtesy of Emsey Hospital, Istanbul, Turkey



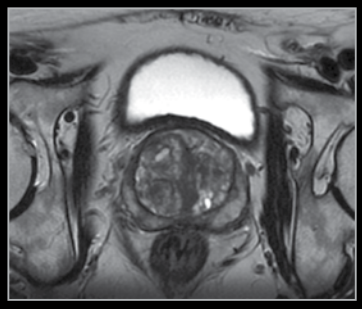
3D MRCP with HyperSense
1.2 x 1.2 x 1.6 mm
3:08 min.

Images courtesy of Haeundae Paik Hospital, Busan, Korea

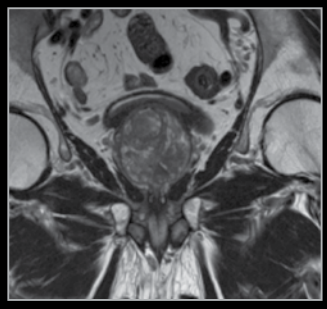
SIGNA™Works AIR™ Edition gallery:
Pelvis imaging (male & female)



Sagittal T2 PROPELLER
0.7 x 0.7 x 3 mm
3:16 min.



Axial T2 frFSE
0.6 x 0.8 x 3 mm
3:24 min.



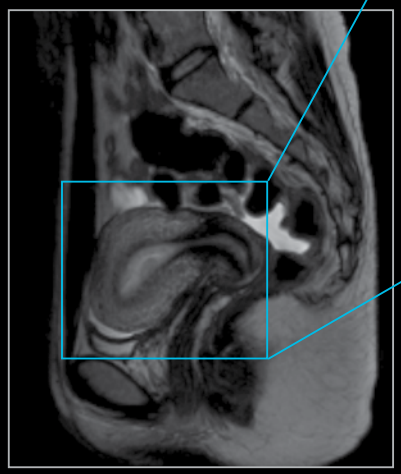
Coronal T2 frFSE
0.7 x 0.7 x 3 mm
3:50 min.

Images courtesy of radiomed, Mainz, Germany

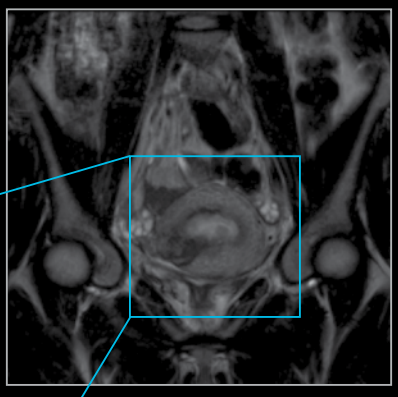
Without AIR™ Recon
4:35 min.

With AIR™ Recon
3:37 min.

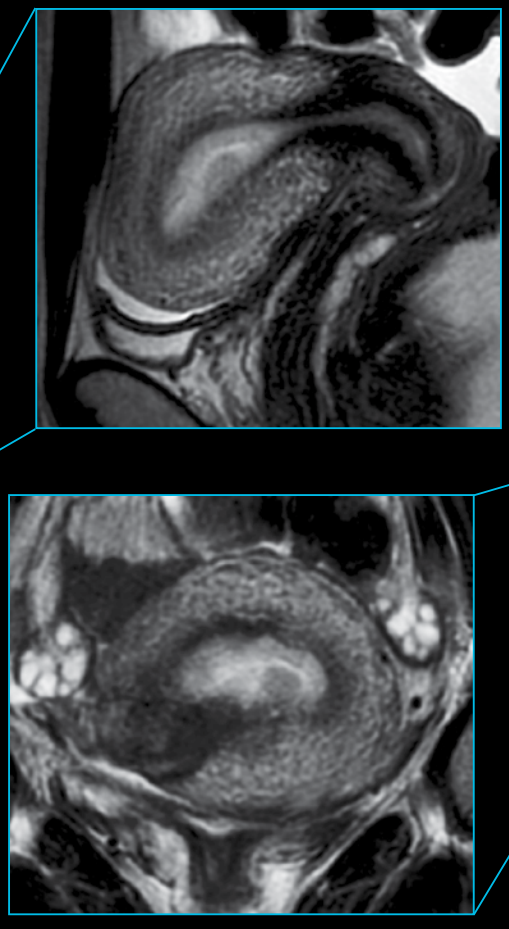
AIR™ Recon allows reduction in scan times and can lessen out of field-of-view artifacts to improve image quality and workflow. Both coronal T2 PROPELLER scans were acquired with the same resolution, however, the left image was acquired in 4:35 min. while the image on the right was acquired in only 3:37 min. using AIR™ Recon.



Sagittal T2-weighted
0.6 x 0.8 x 5 mm
3:25 min.

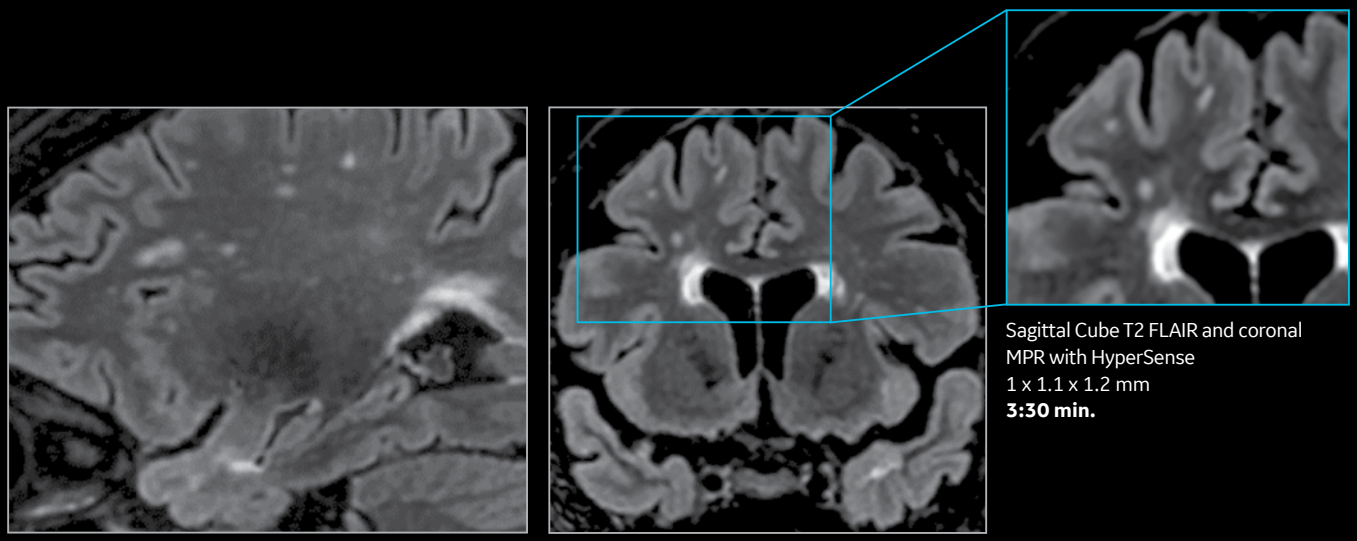


Coronal T2 FSE
0.6 x 0.8 x 5 mm
3:58 min.



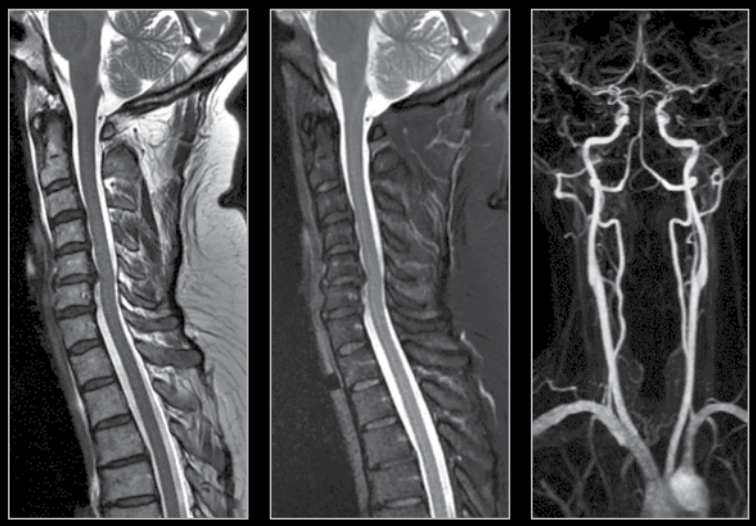
Images courtesy of Osaka University Hospital, Osaka, Japan

SIGNA™ Works AIR™ Edition gallery:
Neuroimaging



Sagittal Cube T2 FLAIR and coronal MPR with HyperSense
1 x 1.1 x 1.2 mm
3:30 min.

The AIR™ 48ch Head Coil, available on all 3.0T GE MR scanners, provides excellent SNR and uniformity as demonstrated in a patient with Multiple Sclerosis (above). Cervical spine imaging with FSE Flex and carotid (images on the right).

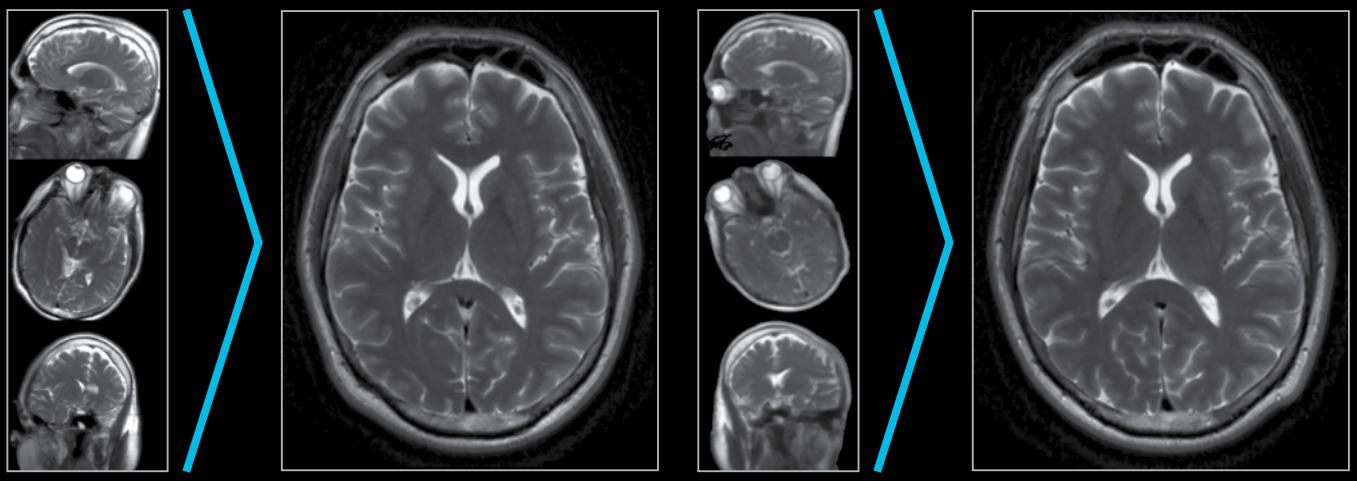


Sagittal T2 FSE (left)
0.7 x 0.8 x 3 mm

Sagittal T2 FSE Flex (center)
0.9 x 0.9 x 3 mm

ceMRA (right)
0.9 x 0.9 x 1.2 mm

Images courtesy of RNR, Zurich, Switzerland

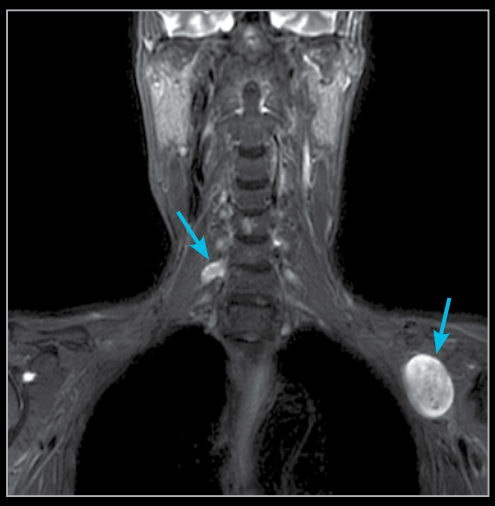


3 plane localizer

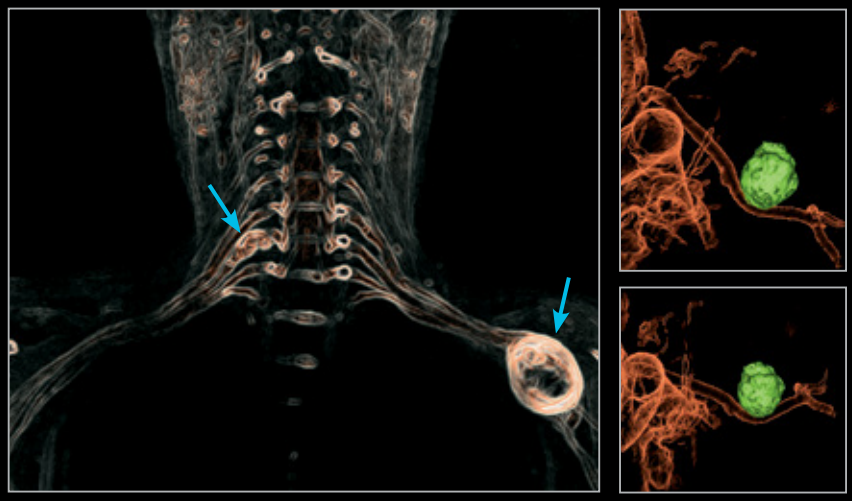
3 plane localizer

Using a deep-learning algorithm trained on tens of thousands of images, AIR x™ revolutionizes the workflow for brain exams. It automatically prescribes slices to help drive consistency and reproducibility regardless of user, patient age, pathology or patient position in the magnet.

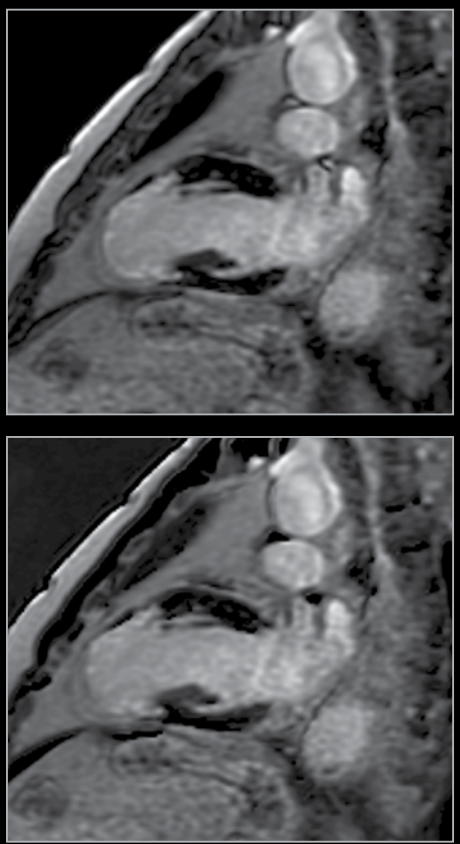
SIGNA™ Works AIR™ Edition gallery:
Chest or thoracic imaging



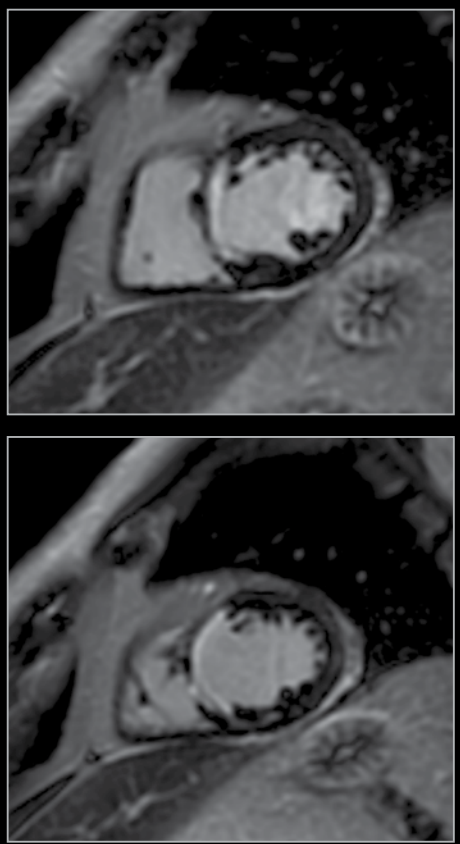
Coronal T2 STIR PROPELLER
1.1 x 1.1 x 3 mm
4:28 min.



Coronal T2 STIR Cube
1 x 1 x 1.2 mm
4:32 min.



Phase Sensitive MDE
Phase (top) and magnitude (bottom)
1.9 x 2.8 x 8 mm
0:48 min.

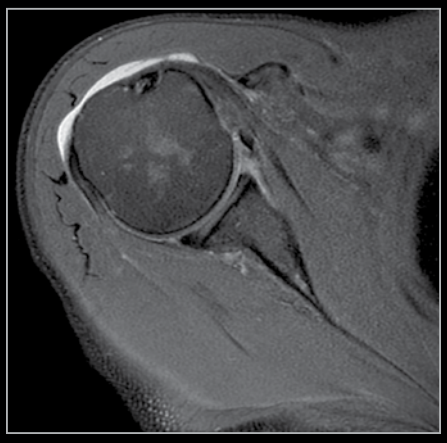


Short Axis MDE
1.9 x 2.3 x 8 mm
3:57 min.

Images courtesy of Hospital Universitario Quirón Salud, Madrid, Spain

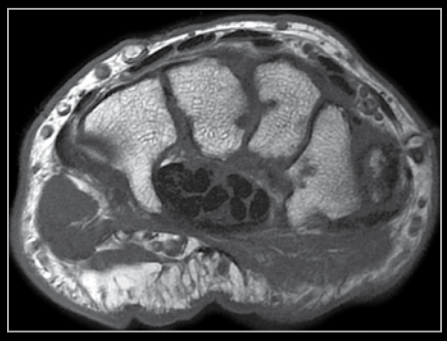
SIGNA™ Works AIR™ Edition gallery:
Musculoskeletal imaging

All images on this page were acquired with AIR™ Multi-Purpose Coils‡.



Axial PD FatSat
0.4 x 0.6 x 3 mm

Coronal 3D MERGE
0.3 x 0.3 x 2 mm

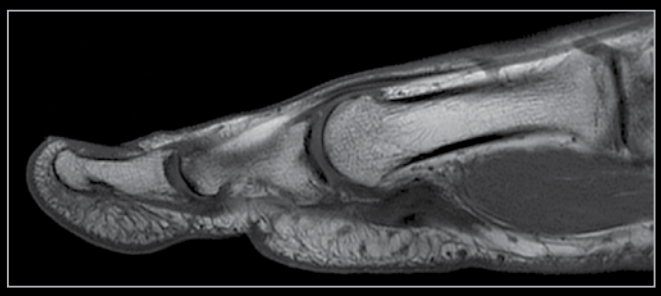


Axial T1 FSE
0.26 x 0.3 x 2.5 mm

Sagittal PD
0.4 x 0.6 x 3 mm

Coronal PD FatSat
0.3 x 0.3 x 3 mm

Coronal PD FatSat
0.4 x 0.4 x 3 mm



Sagittal PD
0.3 x 0.4 x 3 mm

‡ Not yet CE marked. Not available for sale in all regions.

Simply better

AIR™ transforms the MR experience. Its flexible and versatile coil design conforms to almost any part of the human body, so you can get closer to the anatomy you need to see. When paired with intelligent applications that automate and personalize your workflow, you'll be able to achieve industry-leading productivity and image quality. Imagine the possibilities with an MR experience that's simply better.

To learn more, visit us online at gehealthcare.com/AIR.

gehealthcare.com/mr

Simply better compared to conventional technology.

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