

CASE STUDY

High-Definition Images Obtained Using Advanced intelligent Clear-IQ Engine (AiCE) Improve Diagnostic Capabilities

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Background

Fujita Health University Bantane Hospital was founded in 1930 as Bantane Hospital by the Banbuntane Houtokukai Foundation with the aim of providing comprehensive healthcare and welfare services. By 1971, the facility had joined the Fujita Academy Group, located in central Nagoya, to provide community-focused services to the area.

In addition to being a core hospital, the facility also serves as a university hospital and has an excellent reputation as an advanced medical care center. Its radiologists use a Vantage Orian MRI system incorporating Advanced intelligent Clear-IQ Engine (AiCE) to acquire high-quality images in their daily clinical practice.

The broad clinical utility of AiCE supports many types of examinations.

AiCE, which is incorporated into the newly installed Vantage Orian system, employs advanced deep learning technology to significantly improve the signal-to-noise ratio (SNR) of acquired images. Because the system is trained using only noise components (which are high-frequency components), it is considerably easier to reduce noise for all types of examinations. Figure 1 shows images of a patient with a chocolate cyst in the left ovary, a hysteromyoma, and adenomyosis uteri. AiCE can be used in various scan sequences, including T2WI, T1WI, and fat-suppressed T1WI. AiCE can also be used in combination with many high-speed scanning techniques, regardless of the type of coil used. We employ AiCE in a wide range of examinations at our hospital due to its broad clinical utility.

High-resolution images obtained using AiCE are of great clinical value.

At our hospital, thin-slice images of lesions are obtained using AiCE to determine whether the lesions include solid components and also to evaluate the morphological characteristics of the solid tissues. Figure 2 shows images of a patient with myxoma of the appendix. The images in the lower row are T2WI, obtained using conventional scan parameter. The images in the upper row are thin-slice T2WI with a slice thickness of 1.8 mm obtained using AiCE. The conventional scan images suggest that solid components may be present in the tumor, but the morphological characteristics are not clearly depicted. The thin-slice images obtained using AiCE, on the other hand, clearly show the presence of solid components with pronounced papillary morphology.

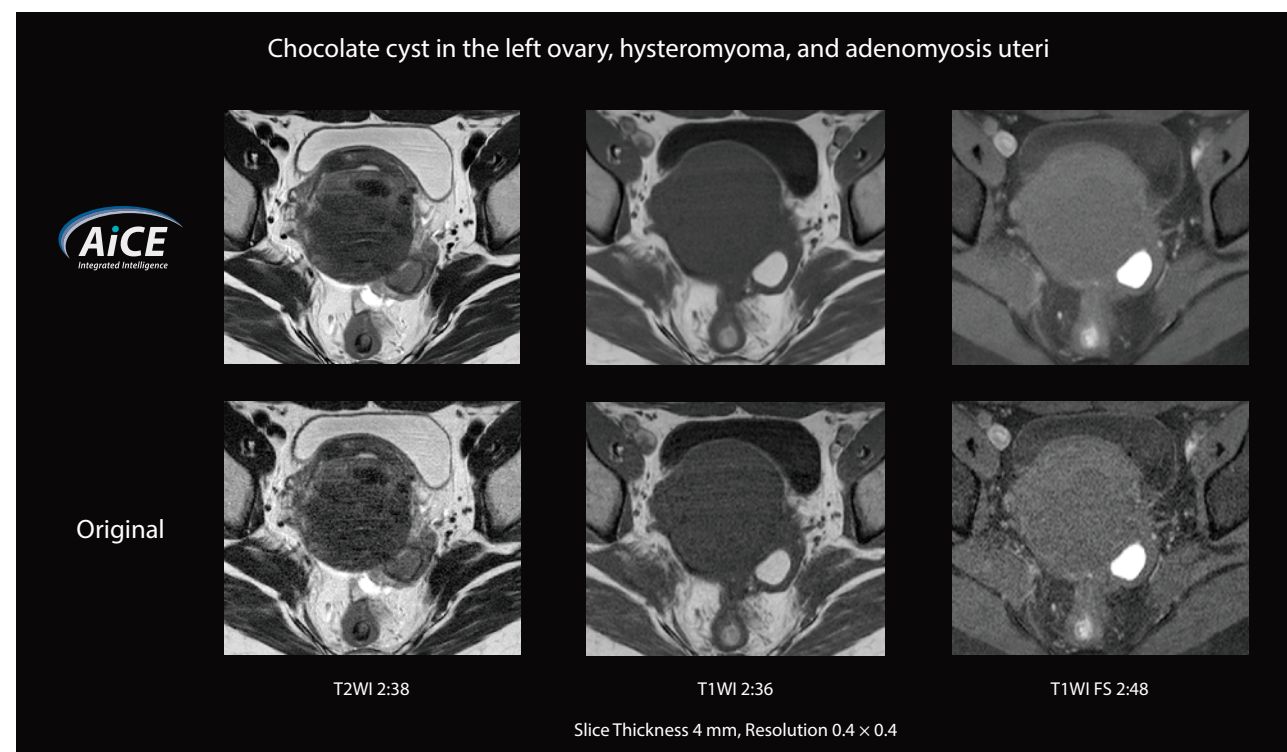


Figure 1

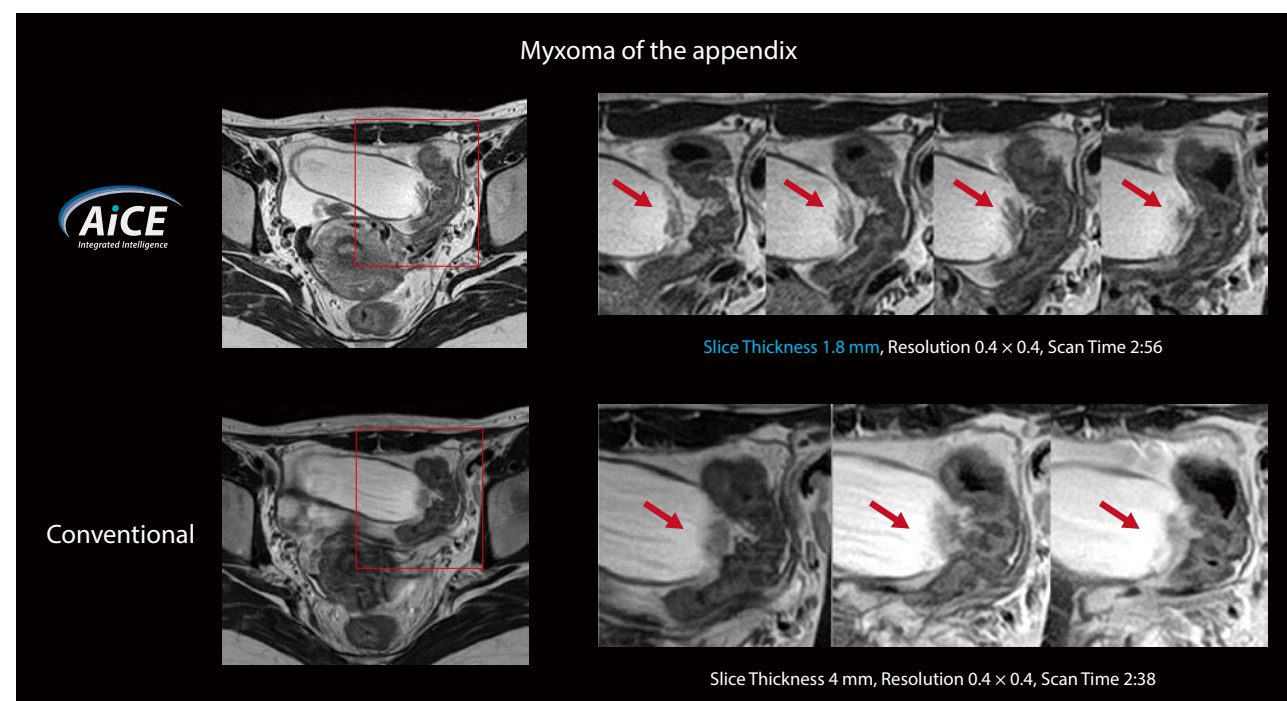


Figure 2

Figure 3 shows images of a patient with a ruptured ovarian cyst. The image on the left is a T2WI, obtained using conventional scan conditions. The image on the right is a thin-slice T2WI with a slice thickness of 1.8 mm obtained using AiCE. The conventional scan image suggests that solid components may be present on the inner surface of the cyst, but the detailed structure cannot be clearly visualized. However, the thin-slice image

obtained using AiCE clearly depicts a linear structure that appears to be continuous. This patient underwent surgery and was found to have a ruptured ovarian cyst associated with hemoperitoneum. In addition, the margins of the cyst were seen to be covered with hematoma, and part of the cyst wall was damaged. The linear structure seen in the thin-slice image may correspond to the rupture in the cyst wall found during surgery.

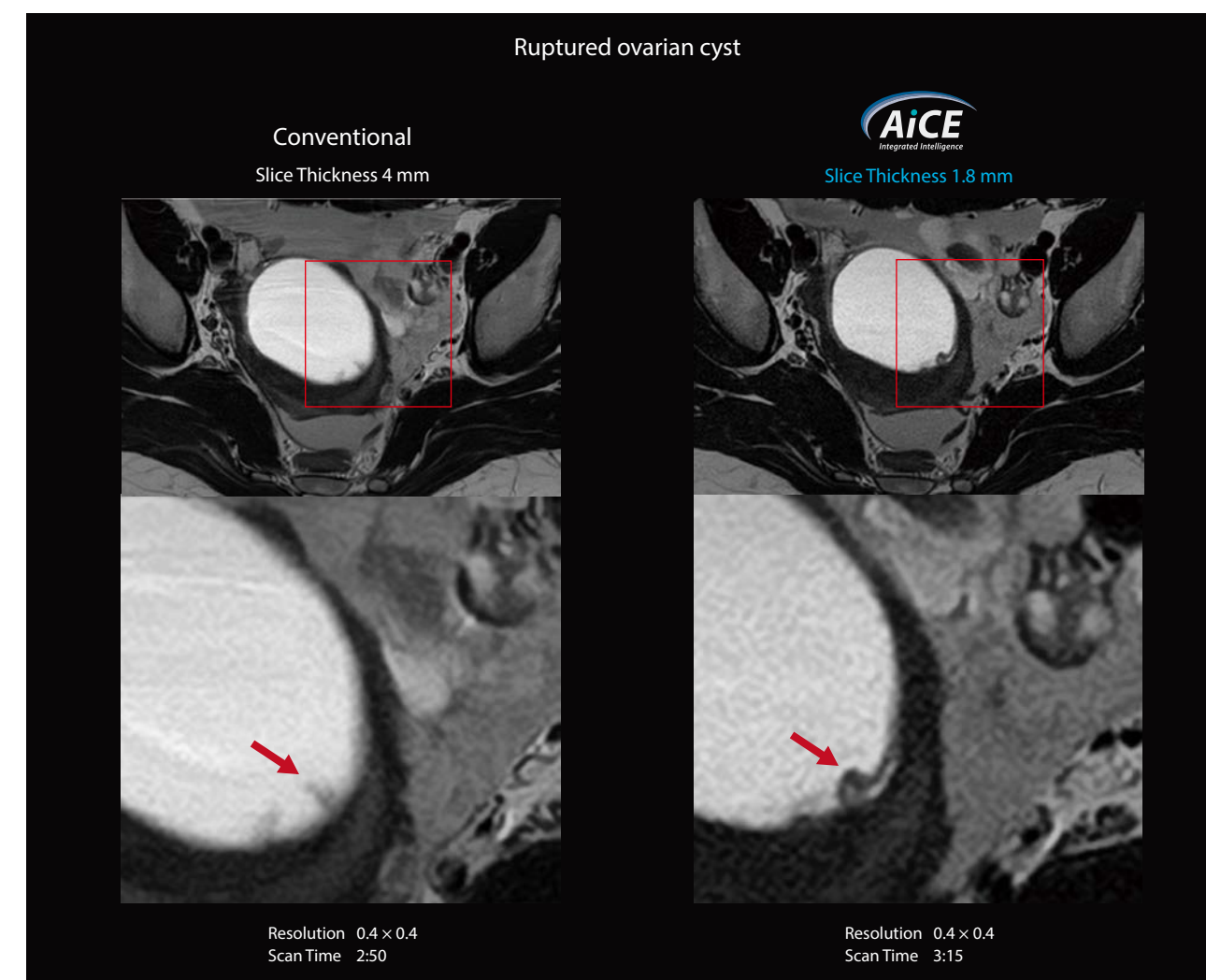


Figure 3

Figure 4 shows images of a patient with intervertebral disc herniation. The image on the left is a sagittal T2WI and the images in the center are axial T2WI, all obtained using conventional scan conditions. The images on the right are thin-slice T2WI with a slice thickness of 2.0 mm. Herniation of the L5/S1 disc in the right posterolateral to caudal direction can be seen in both the conventional and thin-slice images. The conventional scan images suggest that the nerve root is compressed by the dorsal part of the L5/S1 disc, but the images are not sufficiently clear to permit detailed evaluation. The thin-slice images, on the other hand, clearly show compression of the nerve root by the herniated disc. In addition, some bulging is observed above the L5/S1 disc. The thin-slice images also reveal disc herniation into the right intervertebral foramen medially and laterally, as well as narrowing of the right intervertebral foramen at L5/S1. These abnormal findings could not be clearly visualized using conventional scan parameter.

Figure 5 shows an axial T2WI of the intervertebral disc of a patient who underwent a detailed examination for back pain. The images on the left were obtained using conventional scan parameter. The images on the right are thin-slice images with a slice thickness of 2 mm. In the thin-slice images, in addition to compression of the nerve root, flow voids indicating compression of the anterior radicular artery or radiculomedullary artery are also observed. These abnormal findings could not be clearly depicted using conventional scan conditions. In patients with abnormalities of the radiculomedullary artery or with arteriovenous fistulas, thin-slice images acquired using AiCE may be very useful for evaluating the fine blood vessels. As discussed above, thin-slice images showing extremely subtle abnormal findings in patients with various diseases can be obtained using AiCE, clearly demonstrating its outstanding clinical usefulness.

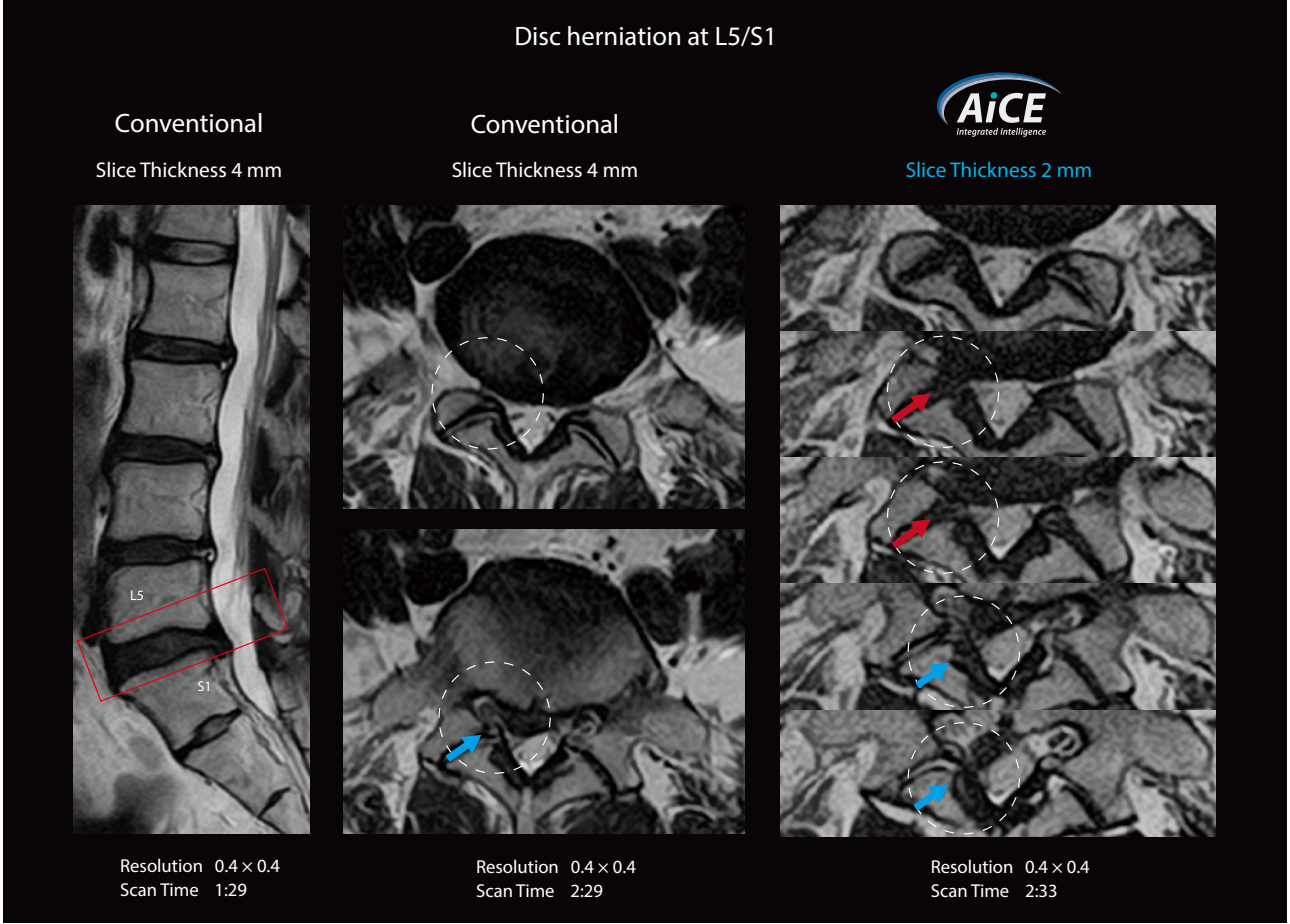


Figure 4

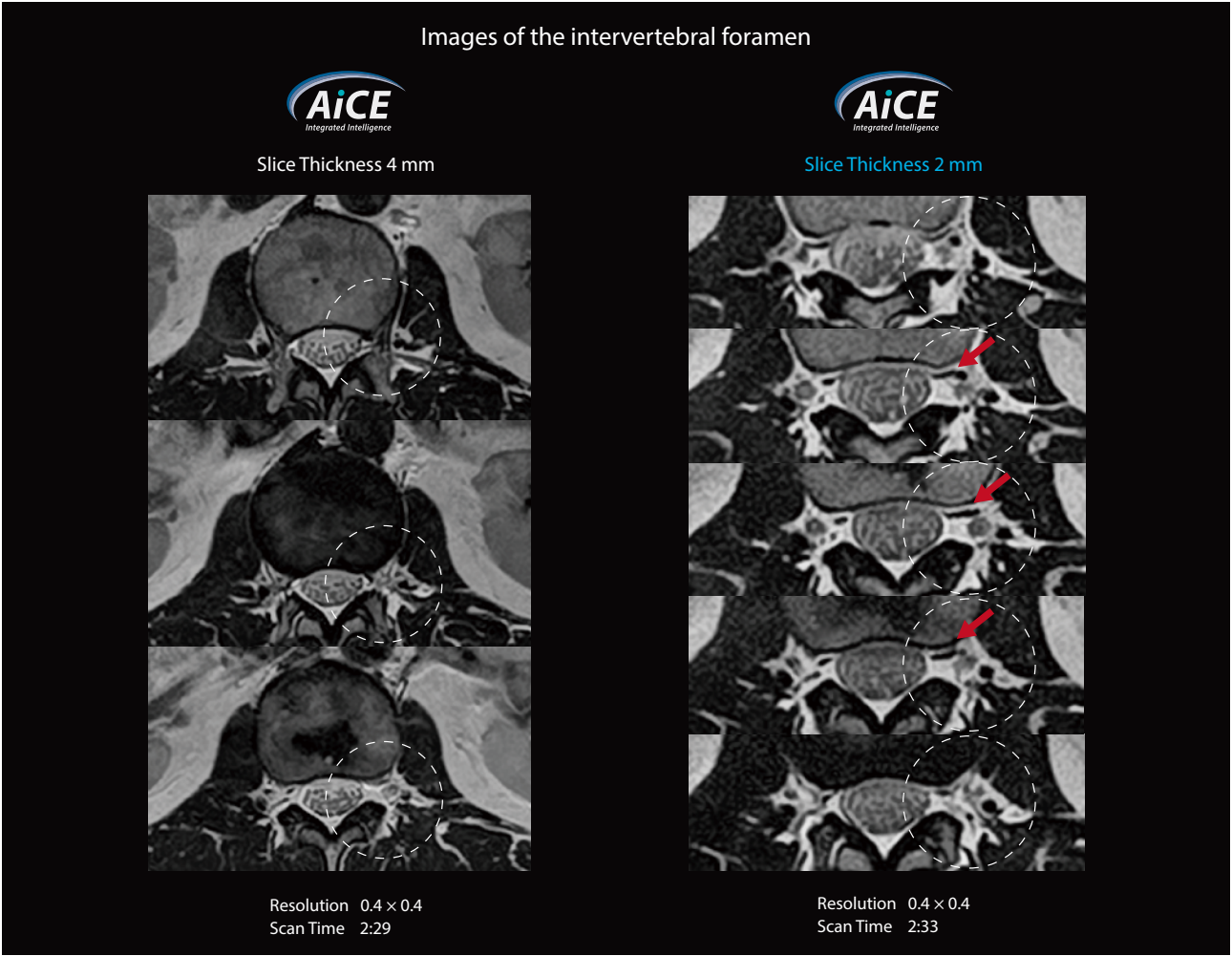


Figure 5

AiCE allows examinations to be performed with less burden on the patient.

AiCE has broad clinical utility and can be used in combination with Compressed SPEEDER or Fast 3D mode (Fast 3D), which are technologies for reducing scan times. Figure 6 shows respiratory-gated magnetic resonance cholangiopancreatography (MRCP) images obtained for the evaluation of the biliary system. The MRCP image at the top left was acquired using conventional scan conditions. The MRCP image in the center is a thin-slice image with a slice thickness of 0.5 mm acquired using Fast 3D. The MRCP image on the right is a thin-slice image obtained using AiCE. The images on the bottom row are enlarged views of the area where the pancreatic duct and the bile duct join in the MRCP image acquired using conventional scan conditions and in the thin-slice MRCP image acquired using AiCE combined with Fast 3D. The use of Fast 3D allows images with approximately one-half the slice thickness of conventional scan images to be obtained in about the same scan time. In addition, the use of AiCE improves the SNR. The thin-slice MRCP image obtained using AiCE clearly depicts the area where the pancreatic duct and the bile duct join.

Figure 7 shows MRCP images of a patient with chronic pancreatitis. This patient had a high respiratory rate, so examination was performed using diaphragm-gated scanning rather than the usual respiratory-gated scanning, which was judged to be ineffective in this case (bottom row). Even though diaphragm-gated scanning was used, the images contained severe artifacts, possibly caused by respiratory motion. To address this problem, MRCP was also performed using AiCE combined with Fast 3D mode, with the longest breath-hold time the patient could achieve (upper row). Occlusion of the pancreatic duct in the head of the pancreas caused by a pancreatolith and the presence of RAS (which is indicative of gallbladder adenomyomatosis) could be clearly seen in the breath-hold Fast 3D MRCP images. In addition, the breath-hold Fast 3D MRCP images clearly depicted the anatomy of the biliary system and the pancreatic duct. As described above, the use of AiCE in combination with high-speed scanning techniques provides us with a wider range of examination options, allowing higher resolution images or shorter scan times to be selected depending on the patient's respiratory rate.

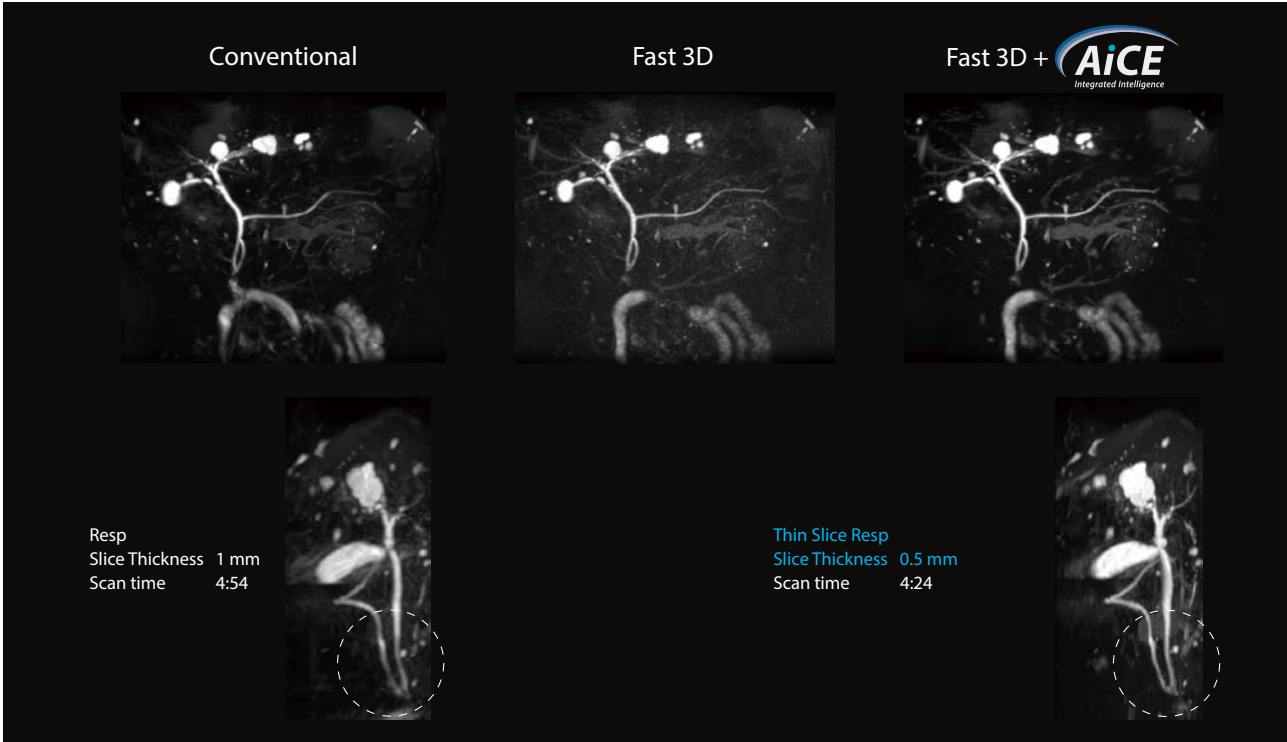


Figure 6

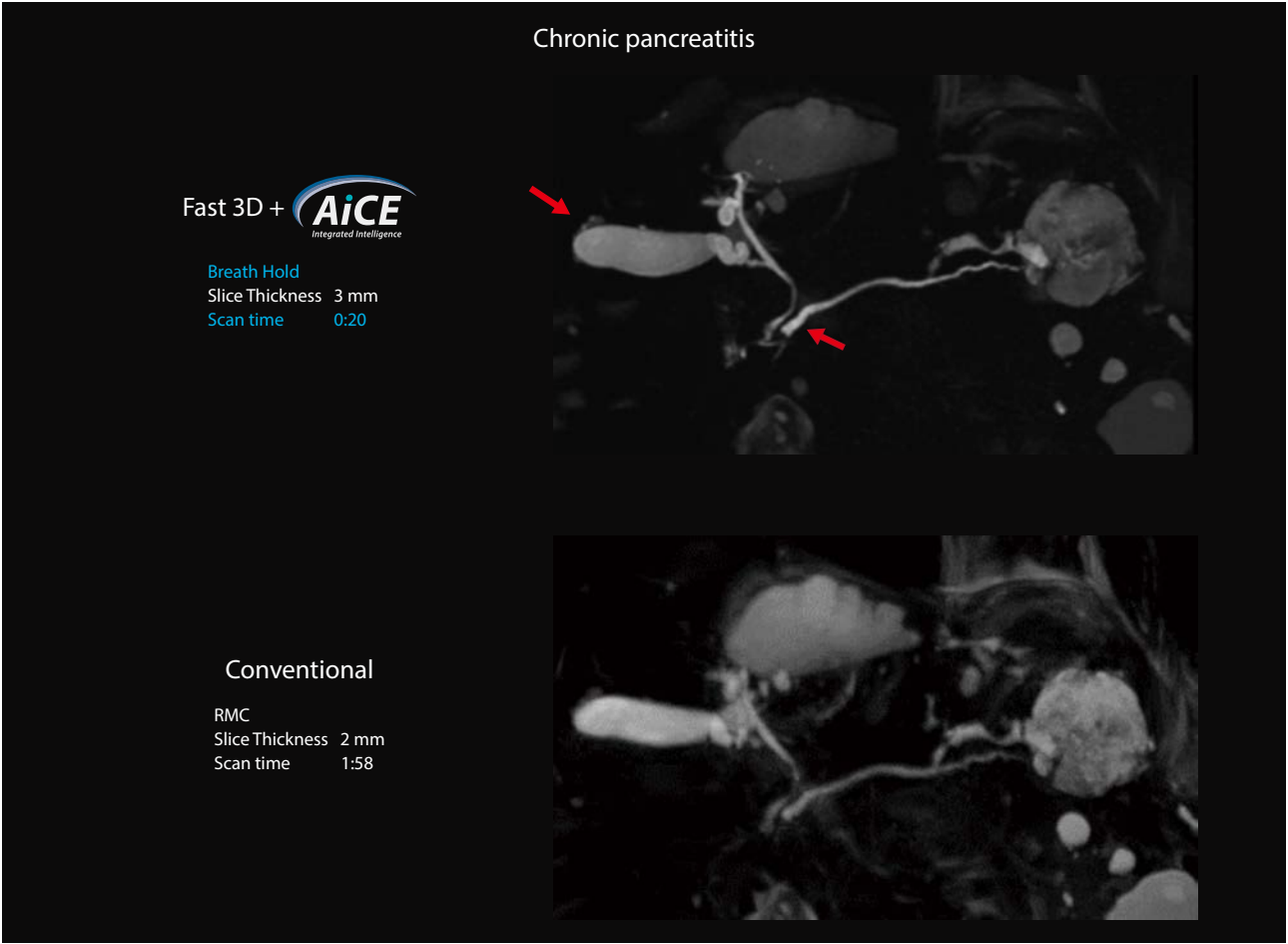


Figure 7

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We have very high expectations for the future of AiCE.

Our expectations for the future of AiCE can be divided into two broad areas. Our first expectation is that the use of AiCE will promote the routine use of thin-slice imaging and that the higher resolution images obtained will not only improve diagnostic performance but also lead to safer and more reliable treatment planning. As discussed above, thin-slice images of the intervertebral discs provide more detailed information concerning anatomical structures as compared to images obtained using conventional scan conditions. Furthermore, thin-slice images obtained using AiCE are very useful, not only for evaluating the lesions, but also for obtaining detailed anatomical information that is of great value when performing therapeutic procedures.

Our second expectation is that the use of AiCE in combination with high-speed scanning techniques will lead to greater patient satisfaction as well as higher hospital profitability. When AiCE and high-speed scanning are employed for routine MRI examinations, excellent image quality can be maintained even with short scan

times. This not only reduces the burden on the patient but also allows more flexible examination scheduling, making it easier to handle urgent unscheduled examinations. As a result, improvements in both patient satisfaction and hospital profitability can be expected.

We highly appreciate the clinical usefulness of AiCE, and we feel that AiCE is a very impressive new technology that adds real value to the many scan sequences for which it can be used.



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