

Clinical Benefit of AiCE Deep Learning Reconstruction Compared to the Conventional Reconstruction in Knee Imaging

Brian Tymkiw B.S. RT(R)(MR)

Introduction

Magnetic Resonance Imaging (MRI) has been relied upon for the diagnosis of musculoskeletal (MSK) conditions due to its ability to produce images in multiple planes, with high resolution, and excellent soft-tissue contrast. For MSK imaging, high resolution, and high signal-to-noise ratio (SNR) are often needed for imaging of small anatomical and pathological structures. The fundamental tradeoff between scan time, resolution, and SNR in MRI, can many times result in longer acquisitions.

Canon's Advanced Intelligent Clear-IQ Engine (AiCE) Deep Learning Reconstruction (DLR) removes inherent noise which helps you to alleviate the fundamental tradeoff between SNR, resolution, and scan time. Through the denoising process, SNR gain could assist you in providing flexibility in scan parameters enabling you to increase resolution and/or shorten scan time. This case study evaluates the benefit of AiCE DLR compared to the conventional reconstruction in knee imaging at GO Imaging—Humble, Texas.

Case Study

History: A 56-year-old male patient presented to the imaging department with pain in his left knee. This patient has a history of chronic knee pain, with progressively worsening symptoms predominantly on the lateral side. The patient stated that there is no history of trauma or fracture.

Image Findings: MRI findings reveal a prominent joint effusion. Areas of grade 1 and grade 2 chondromalacia are seen along the medial aspect of the patella and the medial femoral trochlea.

A moderate popliteal cyst is identified (Figure 1).

There is a grade 1 sprain of the ACL (Figure 2) and a grade 1 sprain of the medial collateral ligament with associated tibial collateral ligament bursitis (Figure 3). AiCE has removed noise from the image resulting in improved image quality with sharp clear and distinct images.

The medial meniscus is displaced medially in association with medial compartment narrowing with evidence of a predominantly oblique tear

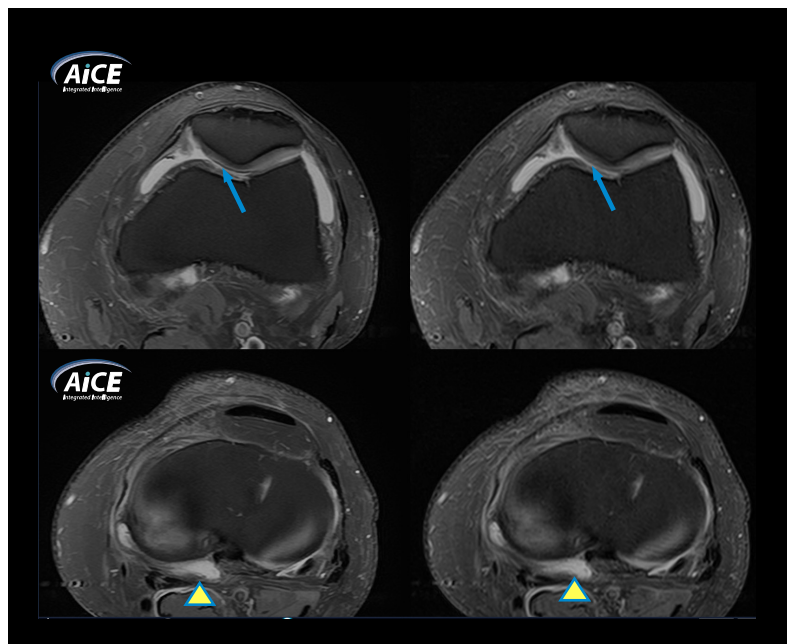


Figure 1: On the left, an Axial PD with fat saturation reconstructed with AiCE. The scan time is 2 minutes and 23 seconds with a resolution of 0.3x0.3. The right side shows the site's routine protocol without AiCE which has a scan time of 2 minutes and 56 seconds and a lower resolution of 0.4x0.4mm. The yellow triangle points to the popliteal cyst and the blue arrow points to the grade 2 chondromalacia.

extending to the inferior articular surface and with a para-meniscal cyst measuring 6 by 5 mm (Figure 3) in diameter at the medial aspect of the meniscus. As mentioned before, AiCE has learned what noise is and can remove noise from the image. This removal of noise accounts for a higher SNR. This higher SNR gives you the flexibility to make other protocol changes to optimize the sequence further to meet your needs: increase resolution, decrease scan time, or both.

Discussion

The site performed two routine sequences without AiCE and repeated them after optimizing the protocol for AiCE, allowing them to directly compare the image quality of the two scans. The two sequences with Canon's AiCE DLR showed an increased SNR by removing noise. The additional gain in SNR was utilized to increase the resolution. Since the customer increased the resolution, the images are sharper and have more detail.

Conclusion

This case study is a great example of how Canon's AiCE Technology can produce a higher signal-to-noise ratio in the images, allowing the user to strategically alter their protocol and provide the radiologists with higher-quality images than their routine imaging sequences without AiCE.

Acknowledgments

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The clinical results, performance and views described in this paper are the experience of the author. Actual results and performance of Canon Medical's product may be materially different due to clinical setting, patient presentation and other factors.

AiCE provides higher SNR compared to typical low-pass filters

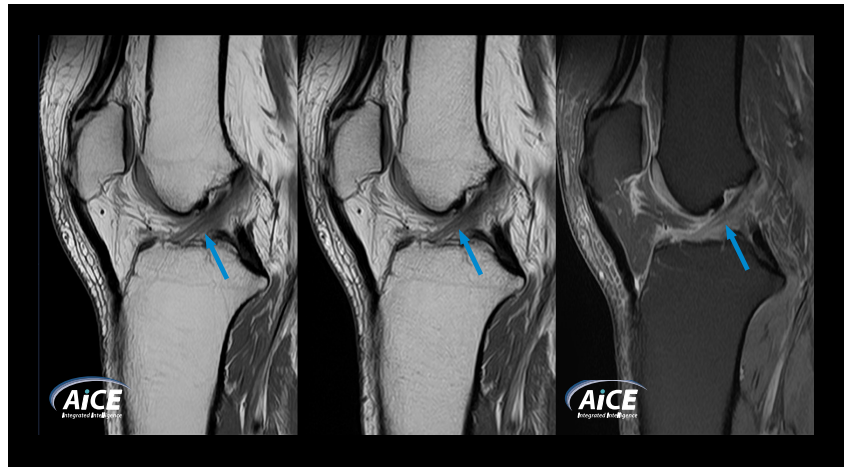


Figure 2: Sagittal PD with an AiCE image on the left and a scan time of two minutes with a resolution of 0.2x0.2 mm. The image in the middle is the sagittal PD without AiCE with a scan time of 2 minutes and 21 seconds and a lower resolution of 0.3x0.3 mm. The image on the right is a PD FS with AiCE and the scan is two minutes long with a resolution of 0.3x0.3mm. The blue arrows are demonstrating the grade 1 sprain of the ACL.

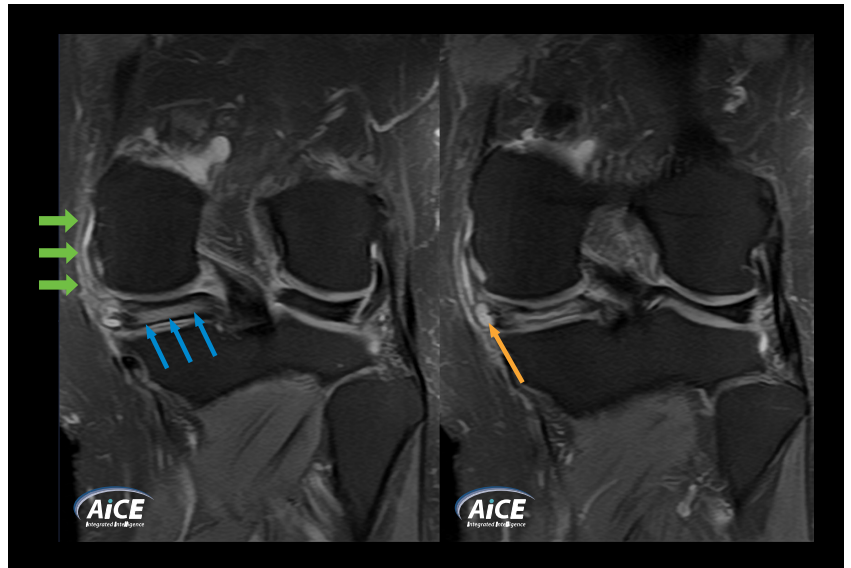


Figure 3: COR PD FS with AiCE. The blue arrows indicate the medial meniscal tear. The orange arrow indicates the para meniscal cyst and the green arrows indicate the grade 1 medial collateral ligament sprain.

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2441 Michelle Drive, Tustin, CA 92780 | 800.421.1968

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