

High-Resolution MRI with Reduced Scan Time: Clinical Evaluation of PIQE Reconstruction



Brian Tymkiw, B.Sc., R.T.(R)(MR)
Manager Medical Affairs
Clinical Development, MR
Canon Medical Systems USA, Inc.

Introduction

Magnetic Resonance Imaging (MRI) is a widely utilized modality for the imaging and diagnosis of soft tissue conditions due to its ability to produce images in multiple planes, with high resolution, and excellent soft-tissue contrast. High resolution, and high signal-to-noise ratio (SNR) are often needed for imaging of small anatomical and pathological structures. However, there is an inherent tradeoff between scan time, resolution, and SNR in MRI. For example, increased resolution and image sharpness often results in longer acquisition times.

Precise IQ Engine (PIQE) is a Deep Learning based technique designed to enhance SNR and spatial resolution without compromising the scan time. PIQE generates higher in-plane resolution images from lower resolution images by

effectively tripling the matrix dimensions in both in-plane directions. It also mitigates ringing artifact, denoises, and increases image sharpness. PIQE can decrease scan times by allowing an acquisition with lower matrix size while maintaining image quality. In this clinical case study, we evaluate the benefit of PIQE reconstruction compared to the conventional reconstruction at Keck Medicine of University of Southern California on their 3T Vantage Galan system.

Case 1

History: A male patient of unknown age presenting for a follow-up MRI of the pituitary gland with a prior history of a macroadenoma.

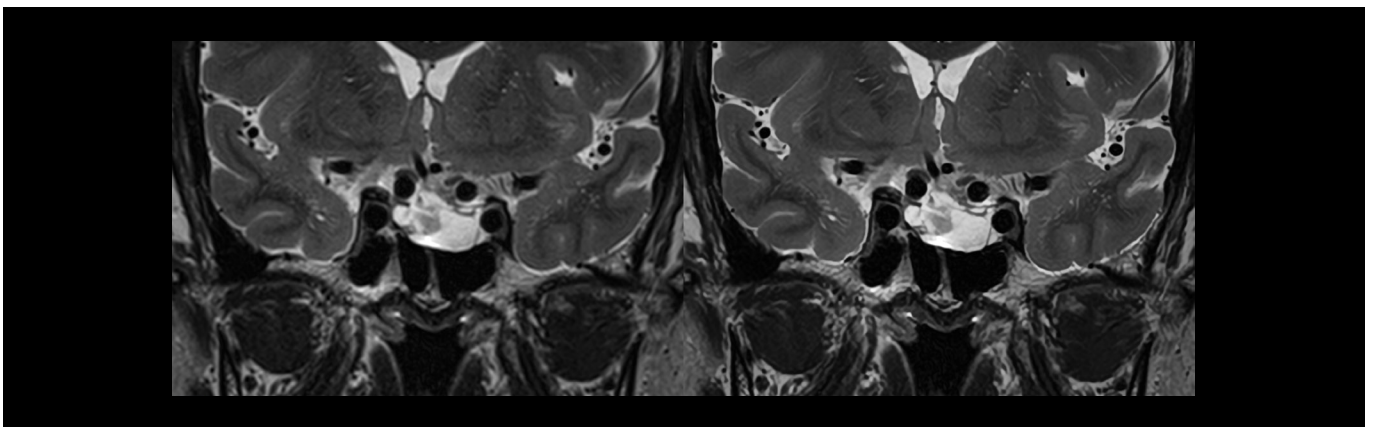


Figure 1: Coronal T2-weighted images show findings of a heterogeneous mixed signal lesion. The image on the left is shown with a standard reconstruction matrix of 448 x 448 and the image on the right is shown with PIQE reconstruction upscaled 3-fold to a matrix of 672 x 672. The PIQE-enhanced image exhibits improved sharpness, higher spatial resolution, and enhanced signal quality due to effective noise reduction.

Imaging Findings: There is a slight decrease in the size of the sella/suprasellar macroadenoma compared to prior imaging. Evaluation is limited by differences in imaging technique and contrast bolus timing. Persistent mass effect is noted on the optic chiasm and right optic tract. Notably, there is a slight increase in the cystic component at the anterior aspect of the lesion, which is consistent with either an intratumoral or peritumoral cyst.

Case 2

History: A male patient of unknown age presented to the imaging department for a follow up exam with a history of a meningioma. (Figure 2)

Imaging Findings: An enhancing meningioma, measuring approximately $3.0 \times 2.1 \times 4.1$ cm, is centered at the anterior

aspect of the right middle cranial fossa. No evidence of acute infarction, intracranial hemorrhage, mass effect, or midline shift is identified. No significant interval change in the size or appearance of the meningioma is observed since prior imaging.

Discussion

The imaging site performed routine MRI sequences without PIQE, along with one to two additional sequences using Canon's Precise IQ Engine (PIQE), enabling direct comparison of image quality between standard and PIQE-enhanced acquisitions. The sequences reconstructed with PIQE demonstrated increased signal-to-noise ratio (SNR) through effective noise reduction, as well as improved image sharpness via 3x in-plane upscaling. In cases where the matrix size was adjusted accordingly, the use of PIQE also resulted in a reduction in scan time without compromising image quality.

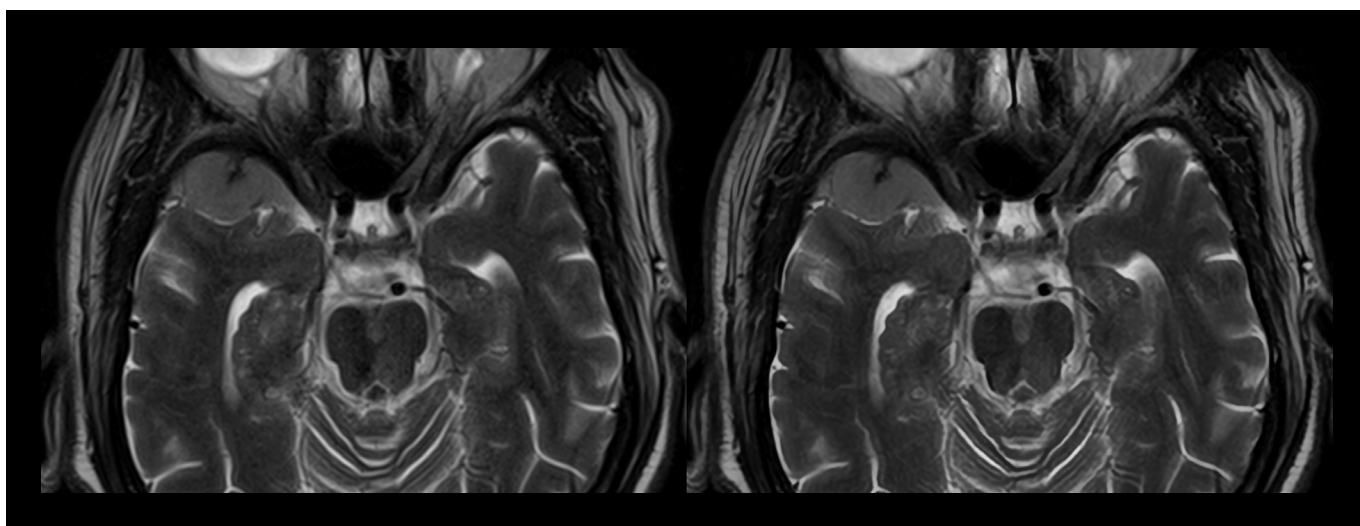


Figure 2: Axial T2-weighted images demonstrate an enhancing meningioma. The image on the left was acquired using a standard reconstruction filter with a matrix size of 768×768 and a scan time of 1 minute and 24 seconds. The image on the right was processed using the Precise IQ Engine (PIQE), resulting in an upscaled matrix of 1008×1008 . The PIQE-enhanced image demonstrates improved spatial resolution and image sharpness, with a reduced scan time.

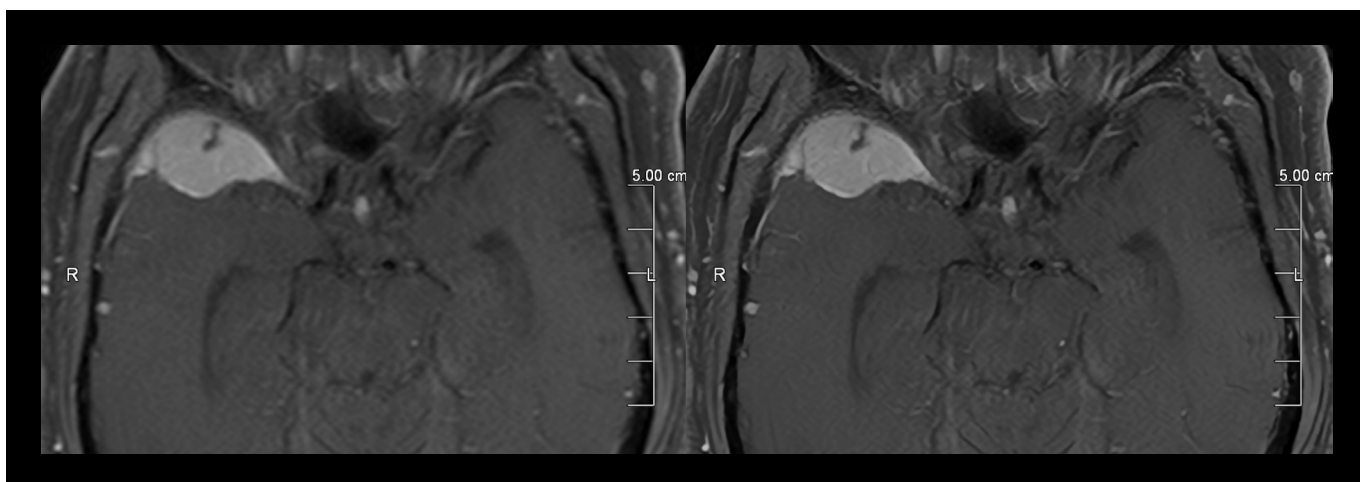


Figure 3: Axial T1-weighted post-contrast fat-saturated images demonstrate the enhancing meningioma. The standard reconstruction is shown on the left, while the PIQE-enhanced image is shown on the right. The PIQE image exhibits noticeably improved sharpness and enhanced anatomical detail compared to the standard image, allowing for better visualization of lesion margins and adjacent structures.

Conclusion

These case studies illustrate the clinical value of Canon's Precise IQ Engine (PIQE) technology in generating images with a higher signal-to-noise ratio, enhanced sharpness, and improved spatial resolution, all within comparable or reduced scan times. PIQE offers the flexibility to maintain the original imaging protocol or modify it to optimize efficiency. This enables radiologists to receive higher-quality images while

potentially reducing overall exam duration compared to routine imaging sequences performed without PIQE.

Acknowledgments

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The clinical results described in this paper are the experience of the author.
Results may vary due to clinical setting, patient presentation, and other factors



CANON MEDICAL SYSTEMS USA, INC

<https://us.medical.canon>

2441 Michelle Drive, Tustin, CA 92780 | 800.421.1968

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