MR/Clinical Case Study

High-Resolution MRI with Reduced Scan Time for Male and Female Pelvis Exams



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Introduction

Magnetic Resonance Imaging (MRI) is a widely utilized modality for the imaging and diagnosis of male and female pelvic 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 critical for visualization of the small anatomical and pathological structures in the pelvic region. However, there is an inherent trade-off between scan time, resolution, and SNR in MRI. For example, increased resolution and image sharpness often result 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 increasing the matrix dimensions in both the readout and phase-encoding directions by a factor of 3X. It also mitigates ringing artifacts and increases image sharpness and SNR. PIQE can decrease scan times by allowing acquisition with a lower matrix size while maintaining image quality. In this clinical case study, we evaluate the benefit of PIQE reconstruction compared to conventional reconstruction on a Galan Supreme 3T scanner at Steinberg Diagnostic Medical Imaging in Las Vegas, NV.

Case #1

History: A 66-year-old male patient with elevated prostate-specific antigen (PSA) was referred for a prostate MR exam.

Clinical Findings: Prostate size 4.4 x 5.5 x 5.6 cm (volume = 70 cc). Heterogeneous appearance of the central gland is consistent with benign prostatic hyperplasia. A 17-mm encapsulated T2-hyperintense lesion in the left anterior apex, which may represent an extruded BPH nodule. On T2-weighted and DWI MR imaging in the transition zone, there are partially encapsulated or non-encapsulated (atypical) nodules or areas between nodules with homogeneous, mildly low Signal Intensity (T2 score = 2/5). Overall, PI-RADS v2.1 score = 2.

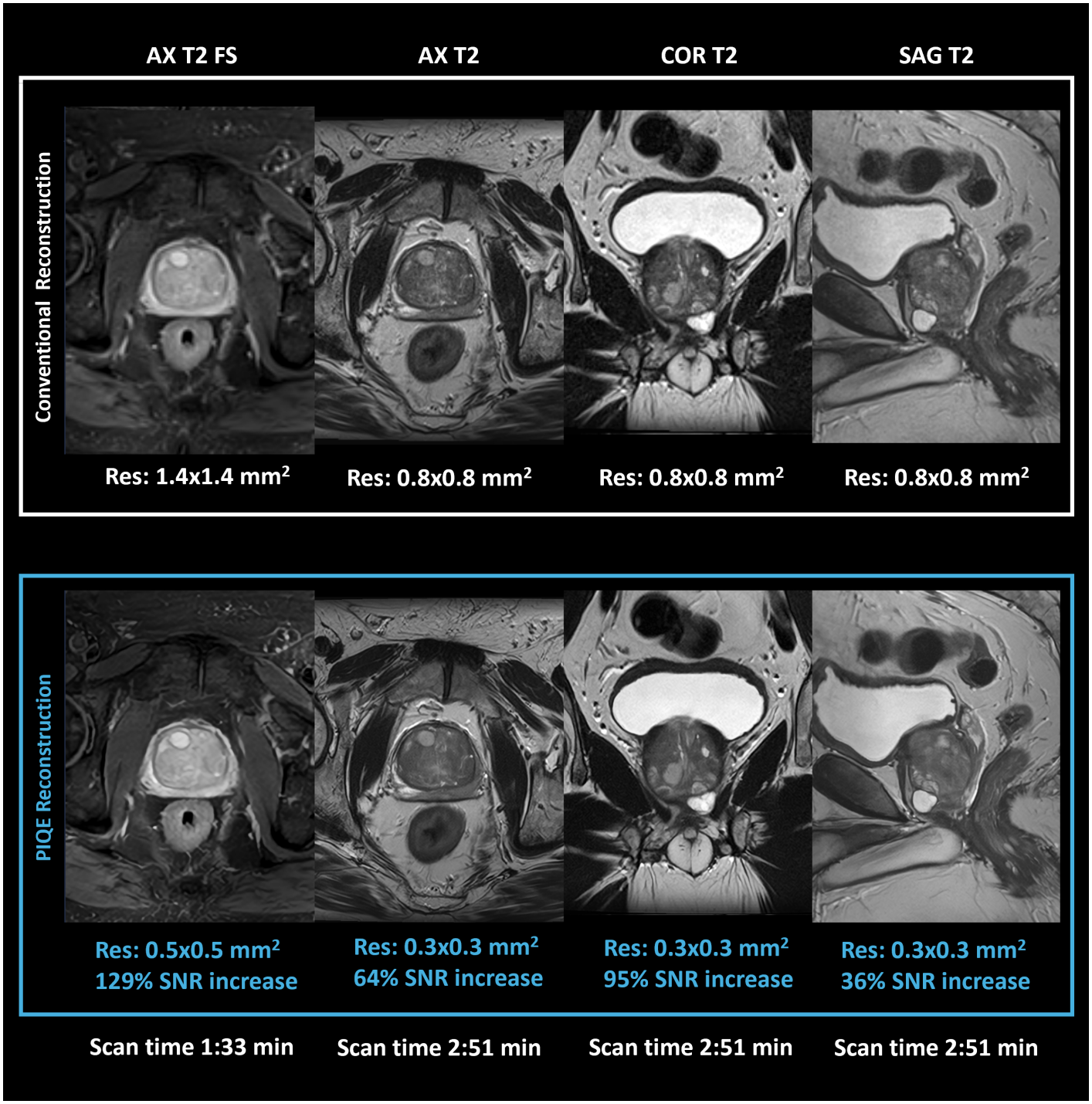


Figure 1: Upper row: axial T2 fat-saturated, axial, coronal, and sagittal T2 prostate acquired using conventional reconstruction. Lower row: same acquisitions reconstructed using PIQE. SNR is calculated as the mean ROI signal drawn in the prostate divided by the standard deviation of the background noise. The percent SNR increase demonstrates the SNR enhancement of PIQE vs conventional reconstructions. PIQE reconstruction demonstrates improved delineation of the prostate capsule, transition zone anatomy, and lesion margins with reduced image noise and increased sharpness compared with the conventional reconstruction.

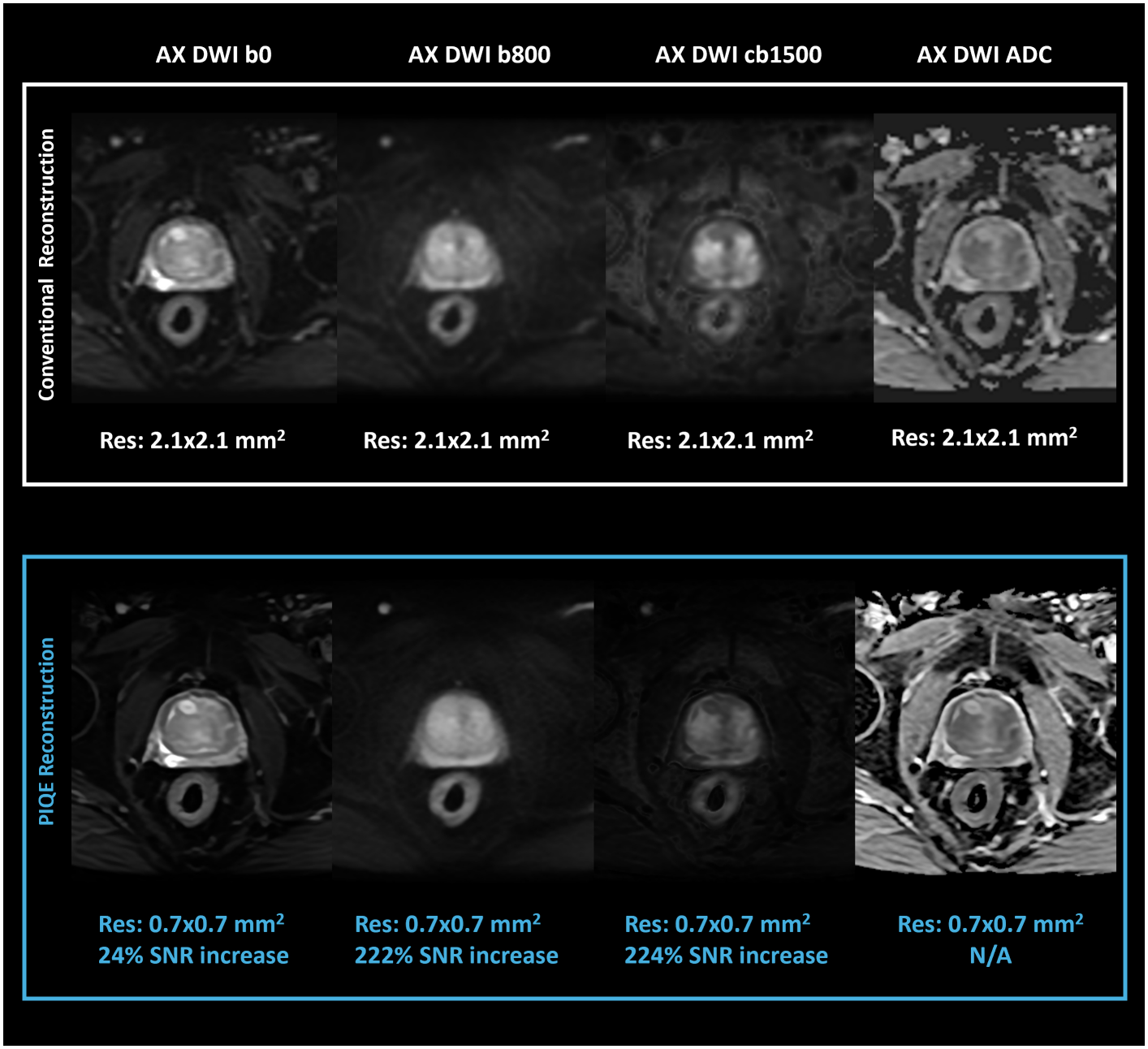


Figure 2: Upper row: axial multi-b-value DWI (b-values b0, b800, c1500, and ADC) acquired using conventional reconstruction. Lower row: same acquisitions reconstructed using PIQE. SNR is calculated as the mean ROI signal drawn in the prostate divided by the standard deviation of the background noise. The percent SNR increase demonstrates the SNR enhancement of PIQE vs conventional reconstructions. PIQE images demonstrate improved lesion margins, which potentially improves reader confidence during PI-RADS assessment.

Case #2

History: A 69-year-old female patient with a history of cystadenoma of the left ovary referred for a pelvic MR exam.

Clinical Findings: The uterus is enlarged, measuring 6.7 x 8.2 x 12.7 cm. Abnormal thickening of the junctional zone of the uterus and the anterior right aspect of the body, measuring up to 28 mm in thickness, consistent with adenomyosis. There are multiple (at least 10) uterine fibroids scattered throughout the uterus. There is a pedunculated exophytic fibroid along the fundus measuring 3.6 x 4.2 cm. The majority of the fibroids are intramural. One of the largest intramural fibroids is in the left lower uterus, measuring 2.2 x 3.1 cm. The endometrium is unremarkable. The left ovary/adnexa has a conglomeration of multiple simple and complex cysts in the left ovary measuring 9.4 x 14.1 cm. No solid or enhancing components. There are thin septations throughout.

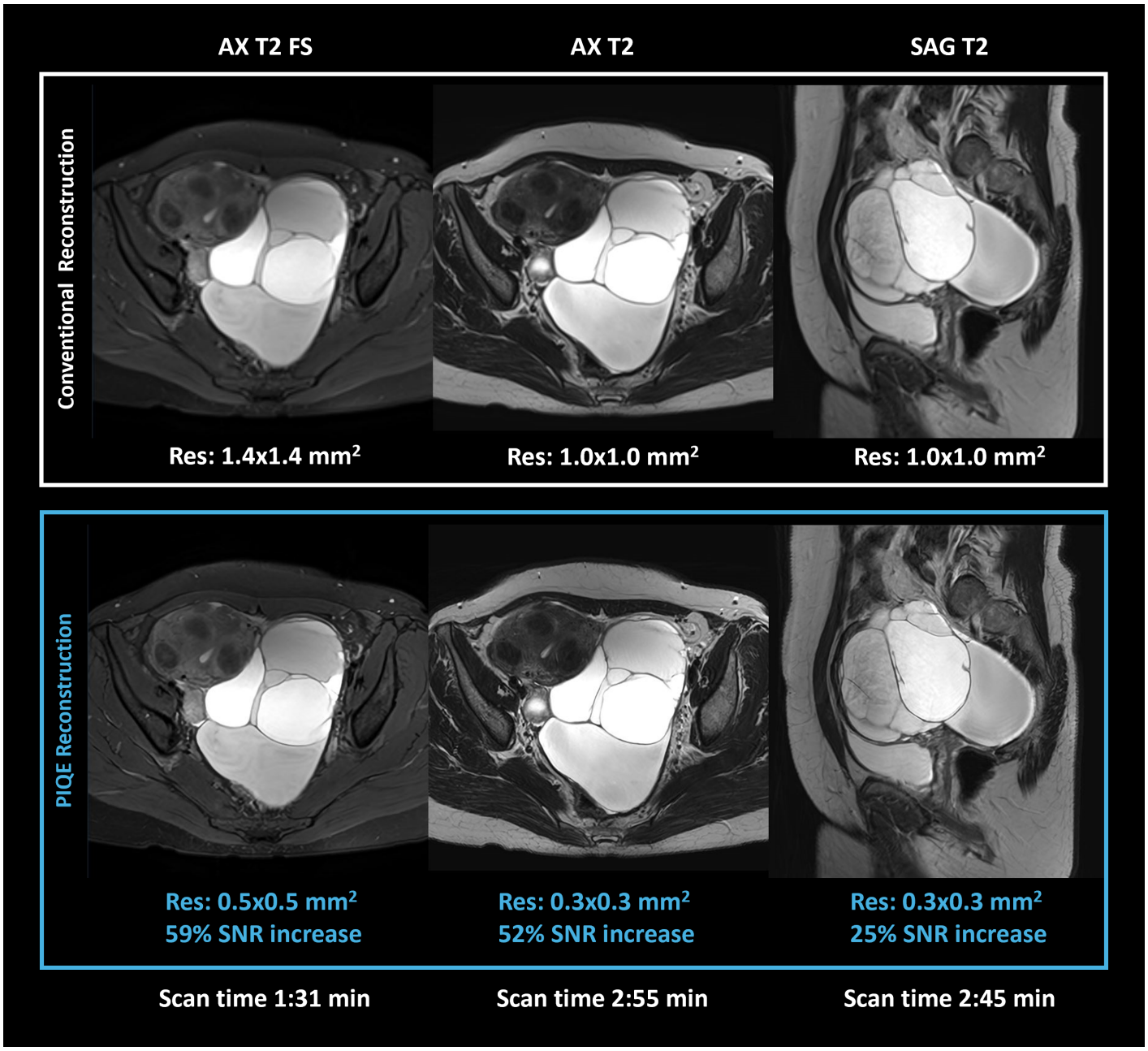


Figure 3: Upper row: axial T2 fat-saturated, sagittal T2, and axial T2 female pelvis MR exam acquired using conventional reconstruction. Lower row: same acquisitions reconstructed using PIQE. SNR is calculated as the mean ROI signal drawn in the uterus divided by the standard deviation of the background noise. The percent SNR increase demonstrates the SNR enhancement of PIQE vs conventional reconstructions. The PIQE images exhibit noticeably improved resolution, sharpness, and SNR, compared to conventional reconstructions, allowing for better visualization of lesion margins, anatomical detail, and adjacent structures.

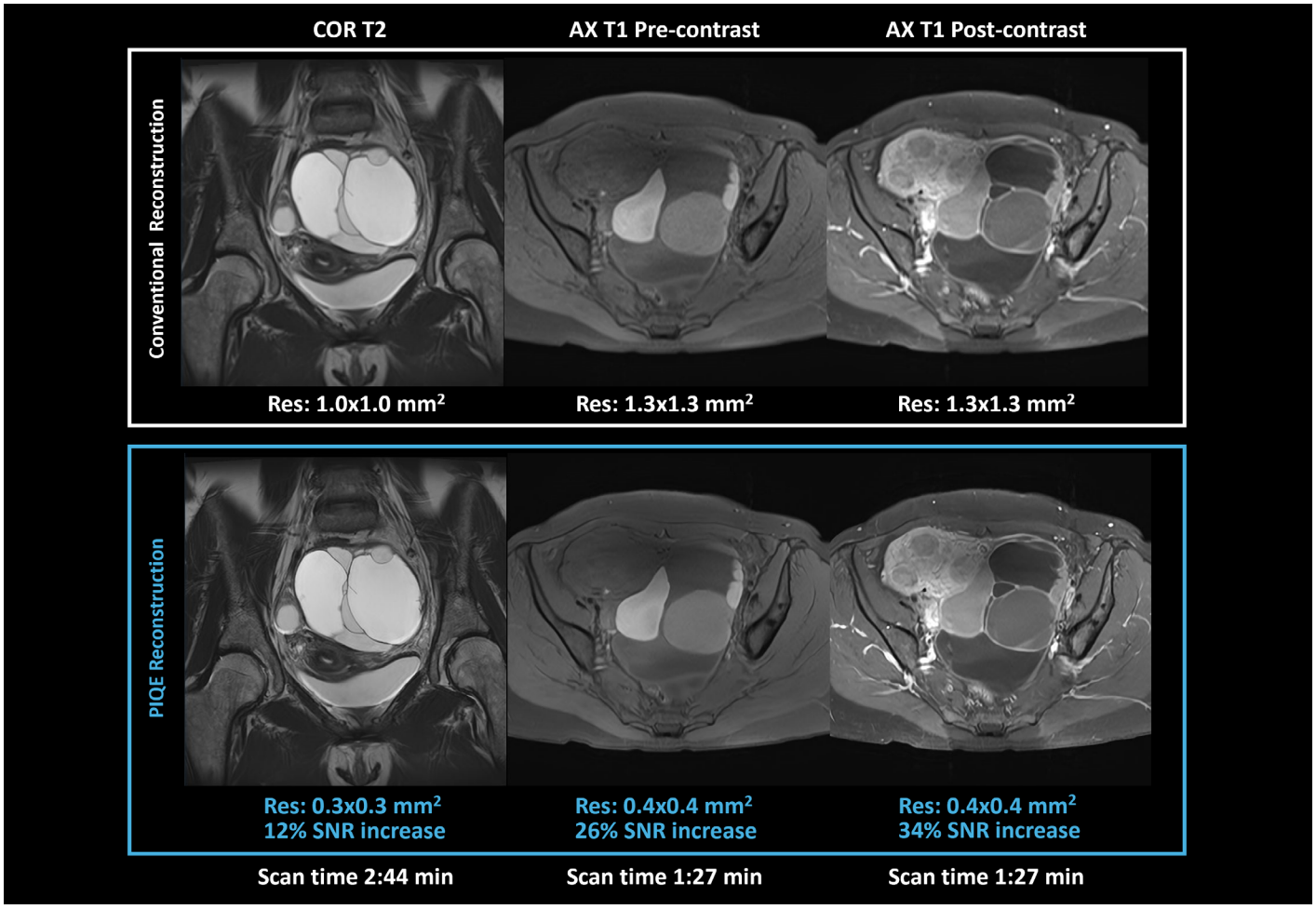


Figure 4: Upper row: coronal T2, axial pre-contrast T1, and axial post-contrast female pelvis MR exam acquired using conventional reconstruction. Lower row: same acquisitions reconstructed using PIQE. SNR is calculated as the mean ROI signal drawn in the uterus divided by the standard deviation of the background noise. The percent SNR increase demonstrates the SNR enhancement of PIQE vs conventional reconstructions. Similar to acquisitions in Figure 3, the PIQE images exhibit noticeably improved visualization of lesion margins, anatomical detail, and adjacent structures.

Discussion

The imaging site performed routine MRI sequences with and without 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. The increased sharpness and improved signal-to-noise ratio provided by PIQE may enhance visualization of anatomical structures and lesion borders, potentially increasing radiologist confidence during detailed image interpretation of small pelvic structures.

Conclusion

This case study demonstrates the clinical value of Canon's Precise IQ Engine (PIQE) technology in generating images with a higher SNR, enhanced sharpness, and improved spatial resolution, all within comparable or reduced scan times. By enabling either improved image quality at equivalent scan times or maintenance of image quality with shorter acquisitions, PIQE offers operational flexibility for imaging centers while providing radiologists with images that may increase confidence during clinical interpretation.

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

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