Case Study

PIQE: Reach a new peak in image quality for heavily calcified coronary arteries

powered by Altivity

"The first time I saw PIQE images, I was surprised by the unexpected combination of high resolution and low noise.

Cardiac CTA is traditionally limited in patients with heavily calcified coronary arteries due to blooming artifacts. PIQE overcomes this by providing sharper boundaries and better delineation of the calcifications, thus allowing a more confident evaluation of these difficult cases.

PIQE is undeniably a valuable AI technical innovation for challenging coronary CTA."

Prof. Mickaël Ohana MD, PhD
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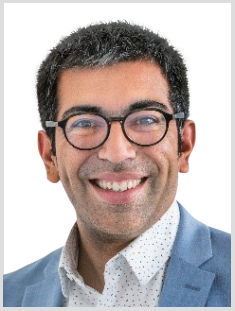
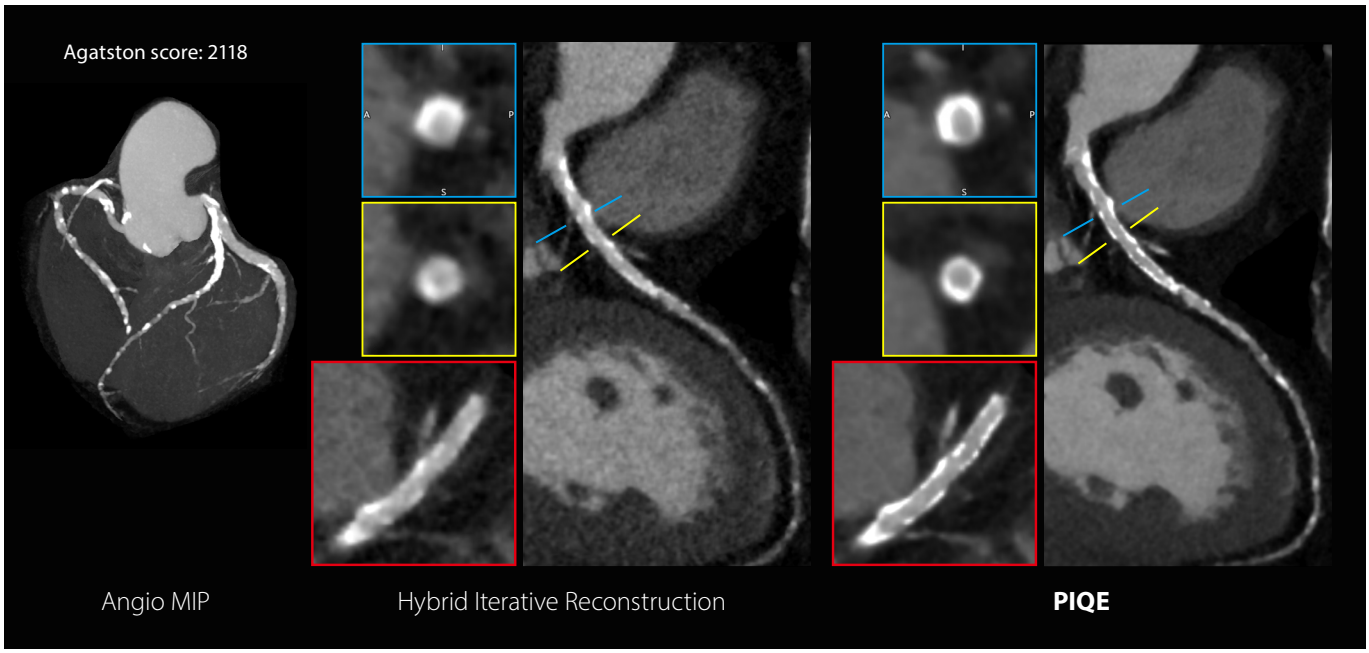
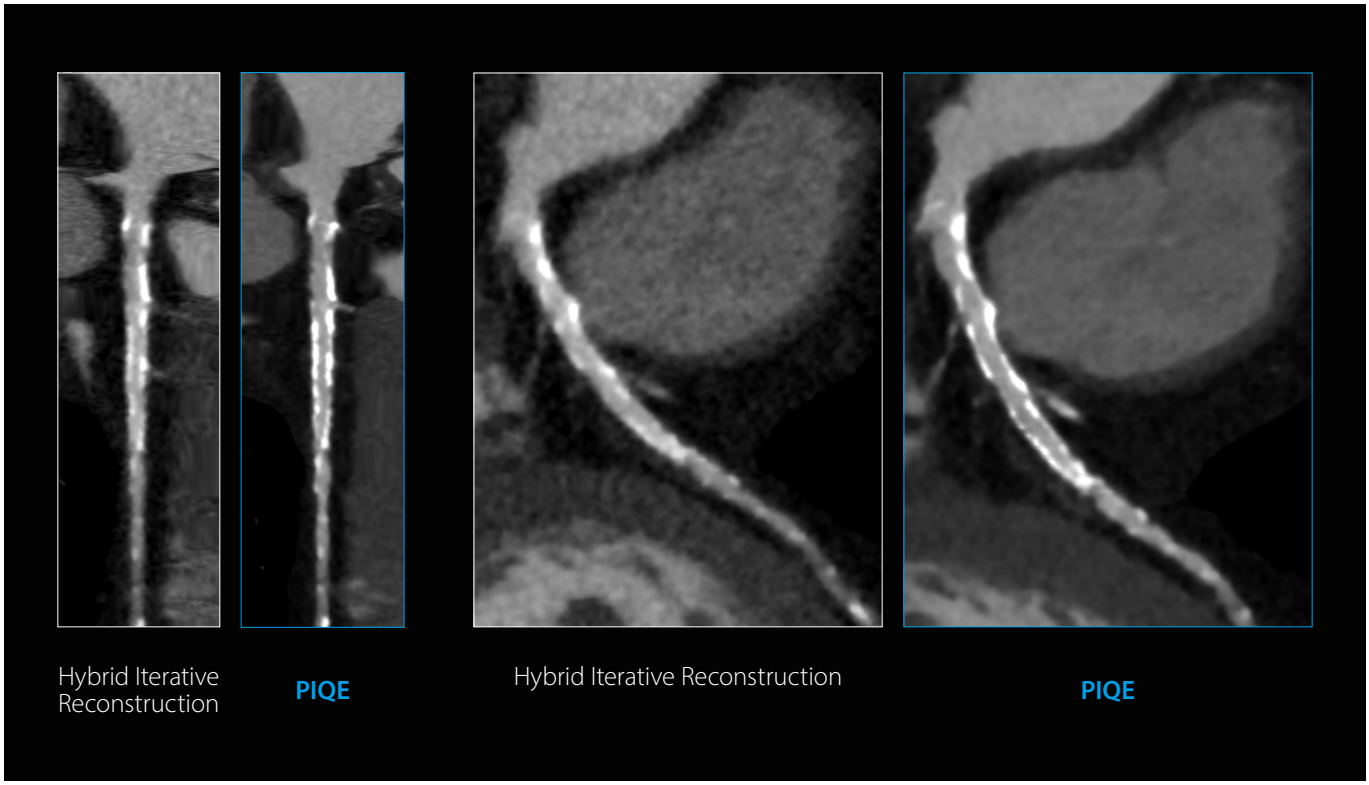


Patient History

This 82-year-old patient with a prior diagnosis of COVID-19 underwent a chest CT scan which demonstrated severe coronary calcifications. The patient was referred to the cardiologist who requested a calcium score and a coronary CTA scan due to non-specific ECG changes. The coronary CTA images were reconstructed with Precise IQ Engine (PIQE) Super Resolution Deep Learning Reconstruction*[1].

Results





The calcium scoring scan showed extensive Coronary Artery Disease (CAD) with an Agatston score of 2118. In the CTA scan, the Left Main coronary artery (LM) and the proximal and mid-segments of the Left Anterior Descending artery (LAD) show significant wall calcifications with 25-49% stenosis in all these segments.

PIQE provides better depiction of the vessel lumen which is sharper and less noisy compared to Hybrid Iterative Reconstruction. In this patient, the increased spatial resolution resulted in less blooming artifacts, allowing a more confident assessment of the lumen patency even in the presence of circumferential calcified plaques.

Conclusion

PIQE enables excellent visualization of calcified plaque and improves evaluation of potential luminal stenosis. In addition, PIQE is combined with the already proven advantages of wide-area detector CT with one-beat cardiac acquisition and high temporal resolution to achieve robust coronary CTA images at a low radiation dose. Heavily calcified coronary arteries were demonstrated in this clinical example where PIQE improved the assessment of the calcified plaques and made it possible to confidently exclude a significant stenosis, avoiding the need for an invasive coronary angiogram.

Technology

PIQE maximizes the inherent spatial resolution of Cardiac CTA examinations performed with a one-beat scanning technique provided by the 16 cm coverage of the Aquilion ONE CT scanner.

1 Training data preparation

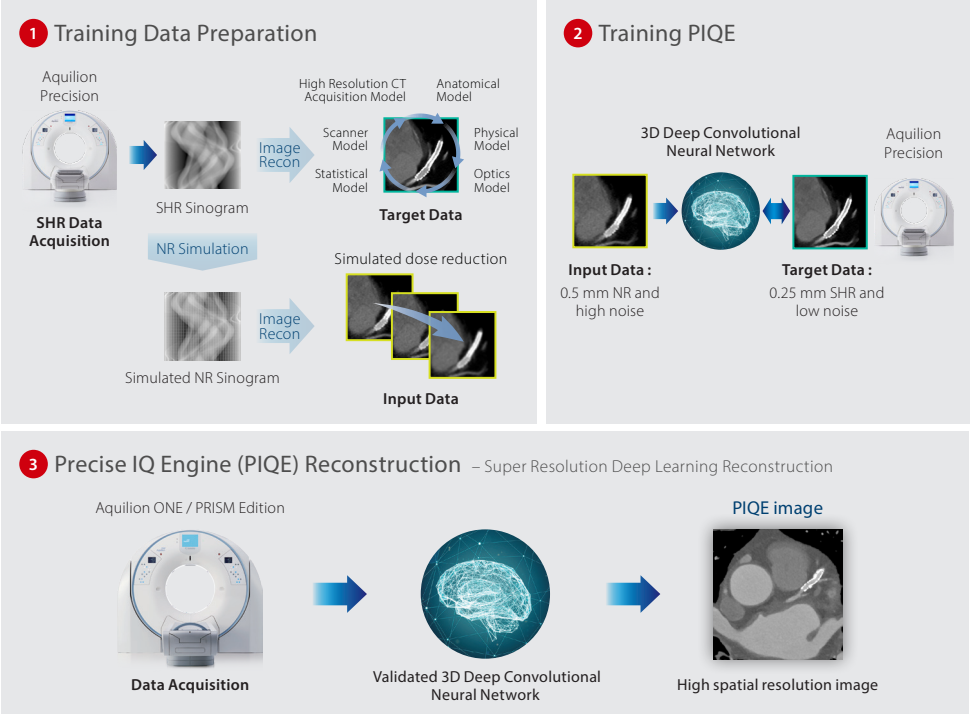
PIQE's 3-Dimensional Deep Convolutional Neural Network (DCNN) is trained using high quality cardiac cases acquired on the Aquilion Precision, which is equipped with a 160 row × 0.25 mm detector, able to resolve anatomical detail as small as 150 microns. From this Ultra-High Resolution (UHR) CT scanner, pairs of 0.25 mm UHR and 0.5 mm simulated Normal Resolution (NR) images can be produced from a single acquisition and have perfect spatial alignment, ideal for training the neural network.

2 Training PIQE

Simulated NR images (0.5 mm) correspond to the input data to the DCNN and the corresponding UHR images (0.25 mm) are used as the gold standard target data.
The 3D DCNN learns to maximize the inherent resolution possible with NR images and enhance resolution further while decreasing noise.

3 Clinical implementation

Once trained the network is validated and installed in the Aquilion ONE / PRISM Edition, where it does not continue to learn.



Acquisition

Scanner Model:
Aquilion ONE / PRISM Edition

Scan Mode:	ECG gated Volume
Collimation:	0.5 mm
Exposure:	100 kV, SURE Exposure
Rotation Time:	0.275 s
Reconstruction:	PIQE
CTDI vol:	11.1 mGy
DLP:	177.2 mGy·cm
Effective Dose:	2.48 mSv
k-factor:	0.014 *2

Benefits of PIQE

- Sharper anatomical detail
- Reduced calcium blooming
- No additional dose

*1 PIQE is designed to fully utilize the maximum resolution of the detector.
*2 American Association of Physicists in Medicine (AAPM) Report 96, 2008.

Altivity

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