Diagnostic Accuracy of a Novel Hybrid Local Tomography Image Reconstruction Algorithm for Evaluating Coronary Arteries with Calcified Plaque and Stents*

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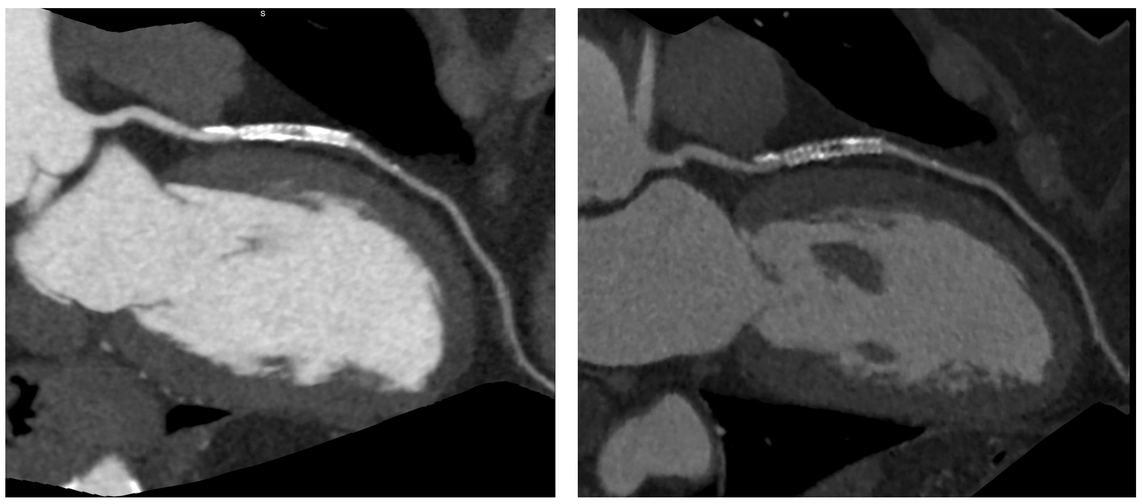
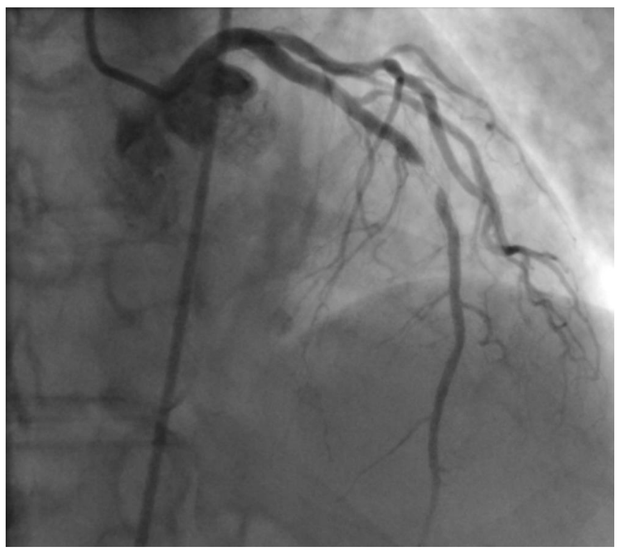
Introduction

Blooming artifacts from calcified plaques and stents can compromise reader confidence and diagnostic accuracy of coronary computed tomography angiography (CCTA). Hybrid Local Tomography (HLT) Image Reconstruction Algorithm is a novel reconstruction technique that combines iterative reconstruction with high spatial resolution edge-enhanced reconstruction, potentially reducing artifacts from calcified or stented regions. The purpose of this study was to evaluate whether HLT reconstruction improves diagnostic accuracy and reader confidence.



STD reconstruction (left) vs. HLT reconstruction (right) showing in-stent stenosis within a stent in the Left Anterior Descending Artery (LAD).



Coronary angiogram with severe in-stent stenosis.

References

A. Katsevich and M. Frenkel (2015). System and method for hybrid local tomography image reconstruction. US Patent 9,042,626.

Methods

33 patients underwent invasive coronary angiography and CCTA using a 320-detector row scanner. Two datasets were reconstructed: a conventional CCTA (STD) from the scanner console and Hybrid Local Tomography CCTA (HLT) from an off-line workstation. Two blinded readers independently assessed coronary segments from each reconstruction in separate sessions. Epicardial coronary arteries greater than 2 mm were included in the analysis. Reader confidence was assessed with a 4-point Likert score. Quantitative coronary angiography (QCA) was performed by a reader blinded to CCTA data. QCA stenosis >50% was considered significant coronary artery disease.

Results

A total of 442 target segments were identified; 209 segments contained calcified plaque and 11 segments had stents. Mean confidence scores improved between the STD and HLT reconstructions (3.3 vs 3.5, $p<0.0001$, particularly in stented segments (2.1 vs. 3.4, $p<0.0001$) and calcified segments (2.9 vs 3.2, $p<0.0001$). There was improved diagnostic accuracy of HLT over STD (Table).

DIAGNOSTIC ACCURACY OF STD vs. HLT RECONSTRUCTION TECHNIQUES		
OVERALL	**STD (95% C.I.)**	**HLT (95% C.I.)**
ROC AUC (p=0.03)	0.87 (0.833-0.904)	0.93 (0.902-0.956)
Sensitivity	0.78 (0.660- 0.875)	0.89 (0.688-0.955)
Specificity	0.96 (0.934-0.98)	0.97 (0.950-0.989)
PPV	0.81 (0.686-0.896)	0.88 (0.772-0.945)
NPV	0.96 (0.926-0.975)	0.98 (0.954-0.991)
CALCIFIED SEGMENTS	**STD (95% C.I.)**	**HLT (95% C.I.)**
ROC AUC (p=0.03)	0.85 (0.793-0.899)	0.93 (0.881-0.960)
Sensitivity	0.78 (0.644-0.879)	0.91 (0.797-0.969)
Specificity	0.93 (0.867-0.964)	0.95(0.895-0.979)
PPV	0.81 (0.675-0.904)	0.88 (0.759-0.948)
NPV	0.91 (0.851-0.954)	0.96 (0.914-0.987)

Conclusions

There was significant overall improvement in diagnostic accuracy with the HLT reconstruction technique, including in regions with calcified plaque. There was also increased reader confidence, particularly in calcified vessels and stented segments. This technology may enhance detection of significant coronary artery disease particularly in challenging coronary segments.

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