

# Use of $FFR_{CT}$ to Diagnose Lesion-Specific Ischemia

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# Disclosures

- **Extramural Research Support:**
  - Dalio Institute of Cardiovascular Imaging @ NYPH / WCMC (Dalio Foundation)
  - NIH R01 HL115150
  - NIH R01 HL111141
  - NIH R01 HL118019-01
  - NIH U01 HL105907
  - NPRP 09-370-3-089
- **Equity Interest:** MDDX, Autoplaq
- **Consultant / Medical Advisory Board:** Abbott Vascular, Arineta, Astra Zeneca, Cardiovascular Research Foundation, GE Healthcare, HeartFlow, Myokardia

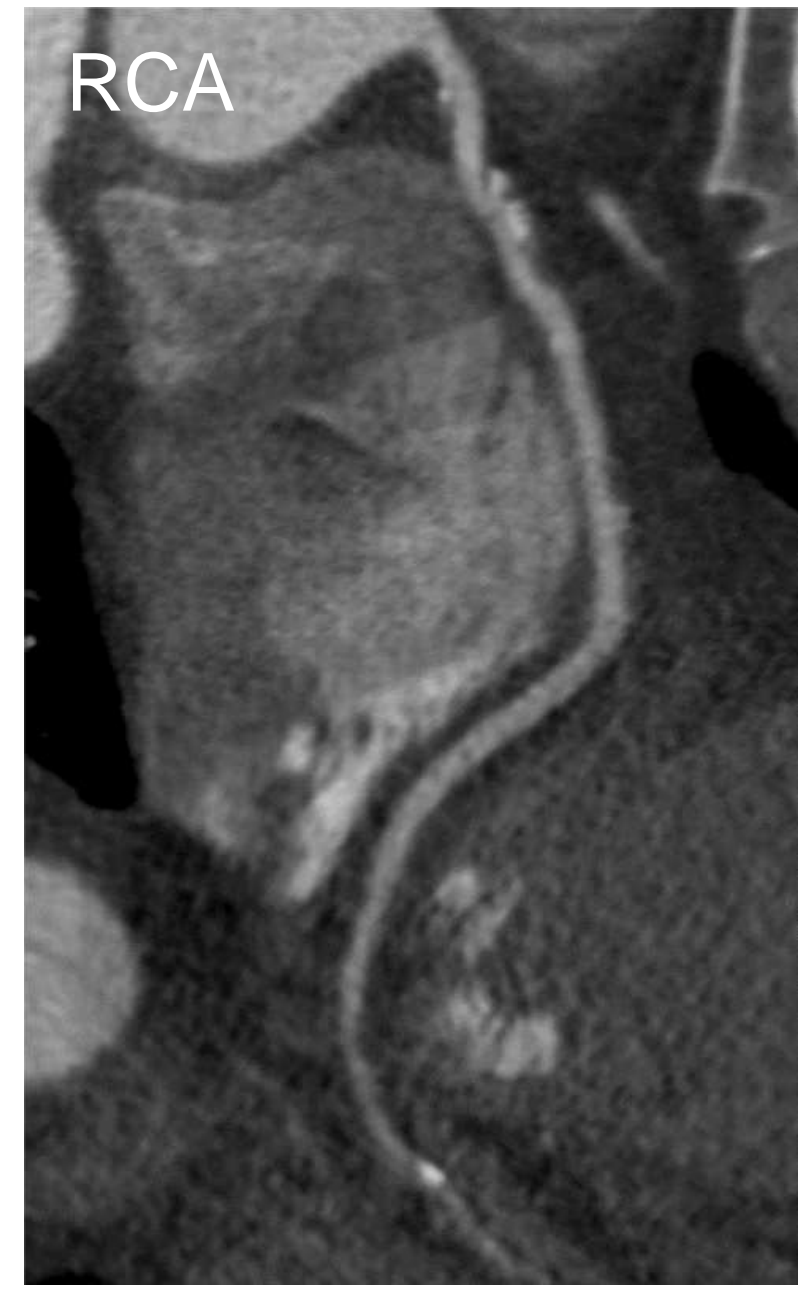
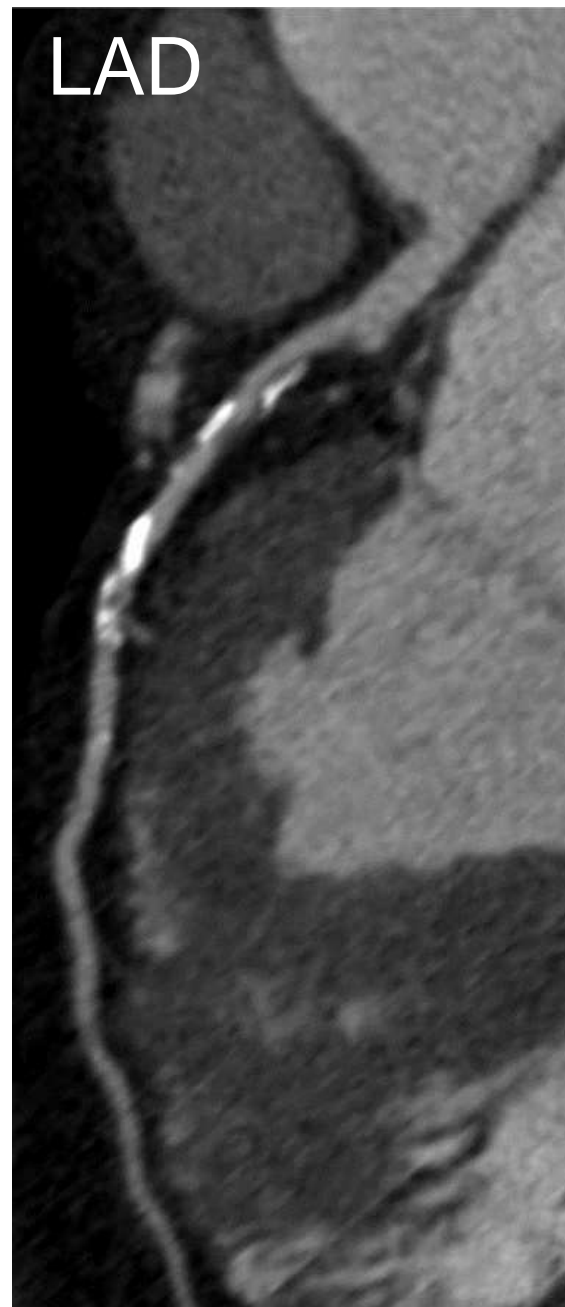
# Case: 60 y/o Caucasian man

(Performed @ Cornell / NewYork-Presbyterian 4/15/15)

- Atypical chest pain with slow walking
- Vegetarian
- No exercise
- Former smoker
- High triglycerides (normal LDL / HDL) – no statins
- Sedentary

# Case: 60 y/o Caucasian man

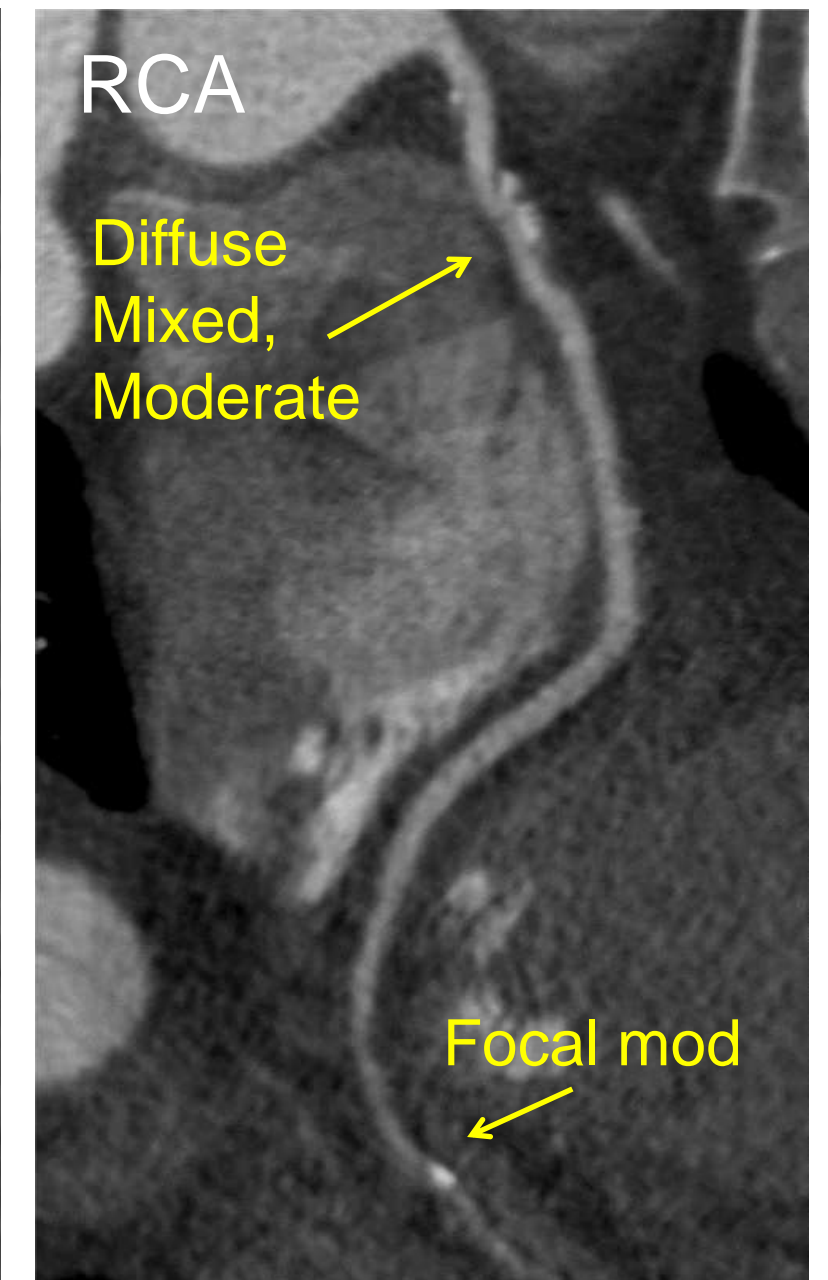
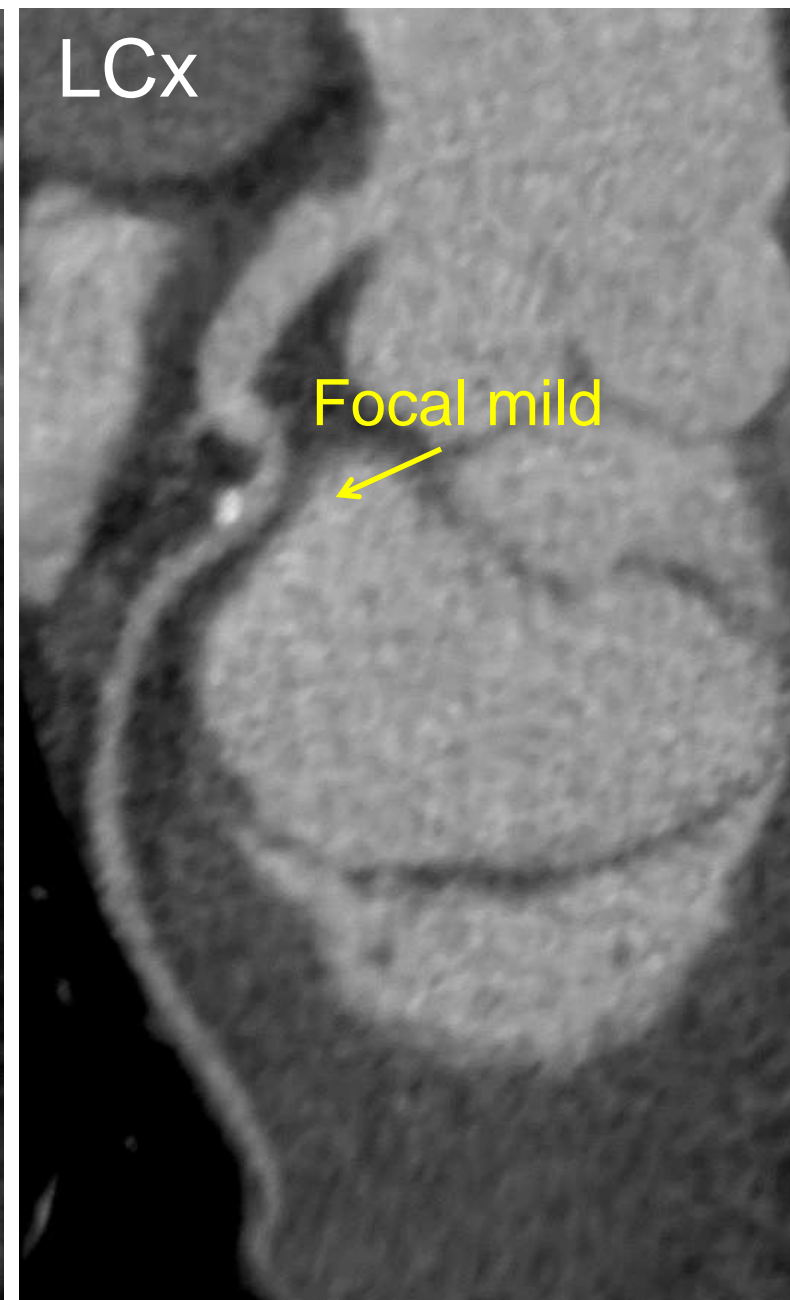
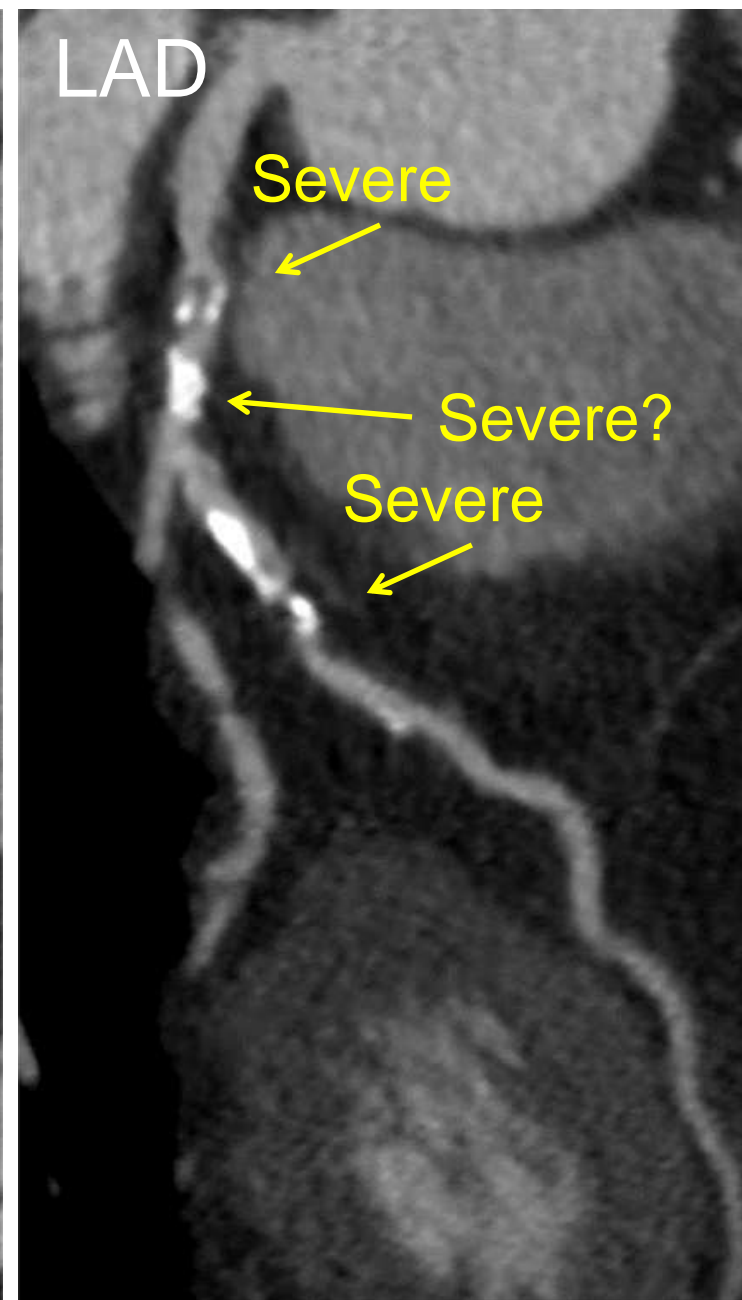
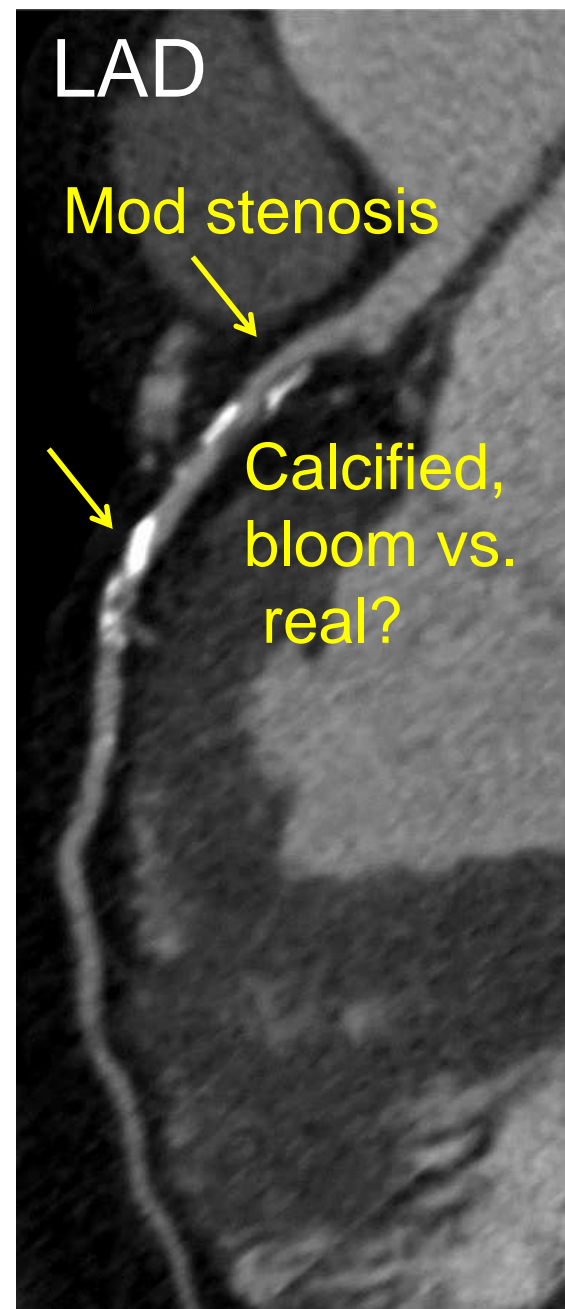
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# Case: 60 y/o Caucasian man

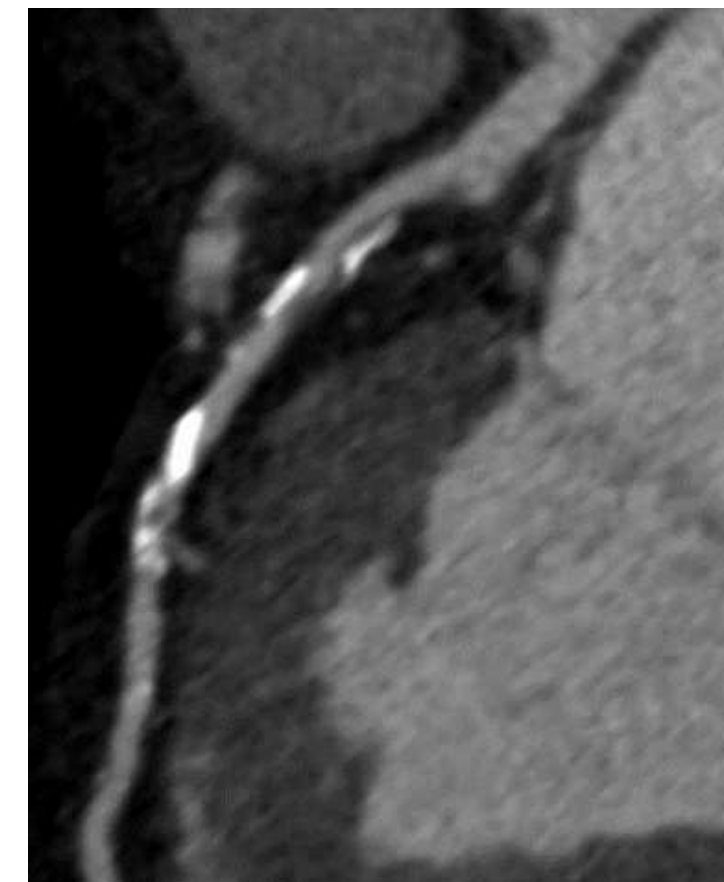
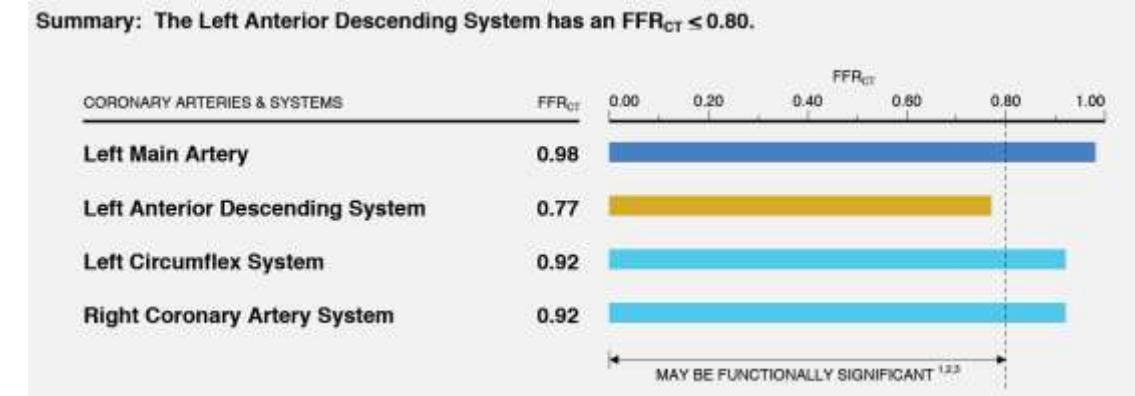
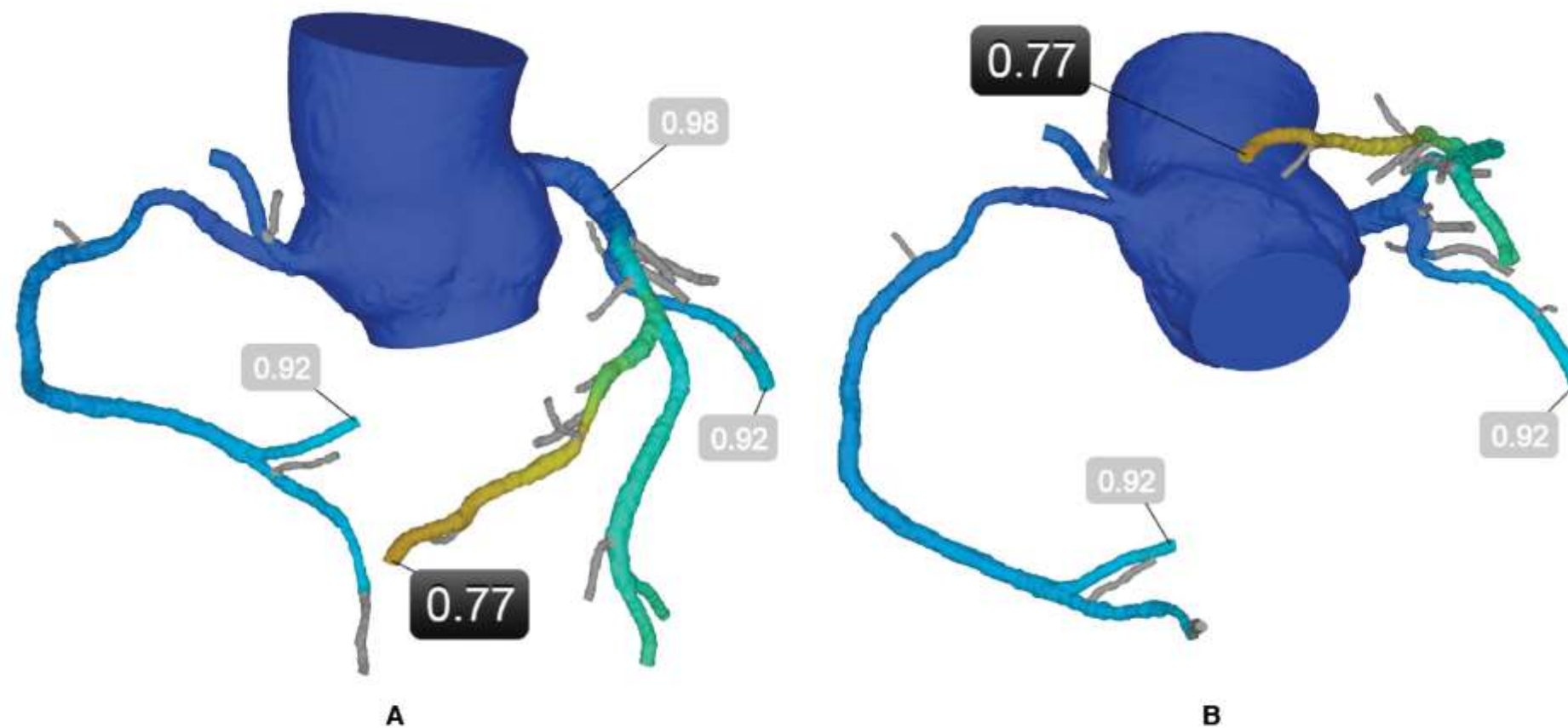
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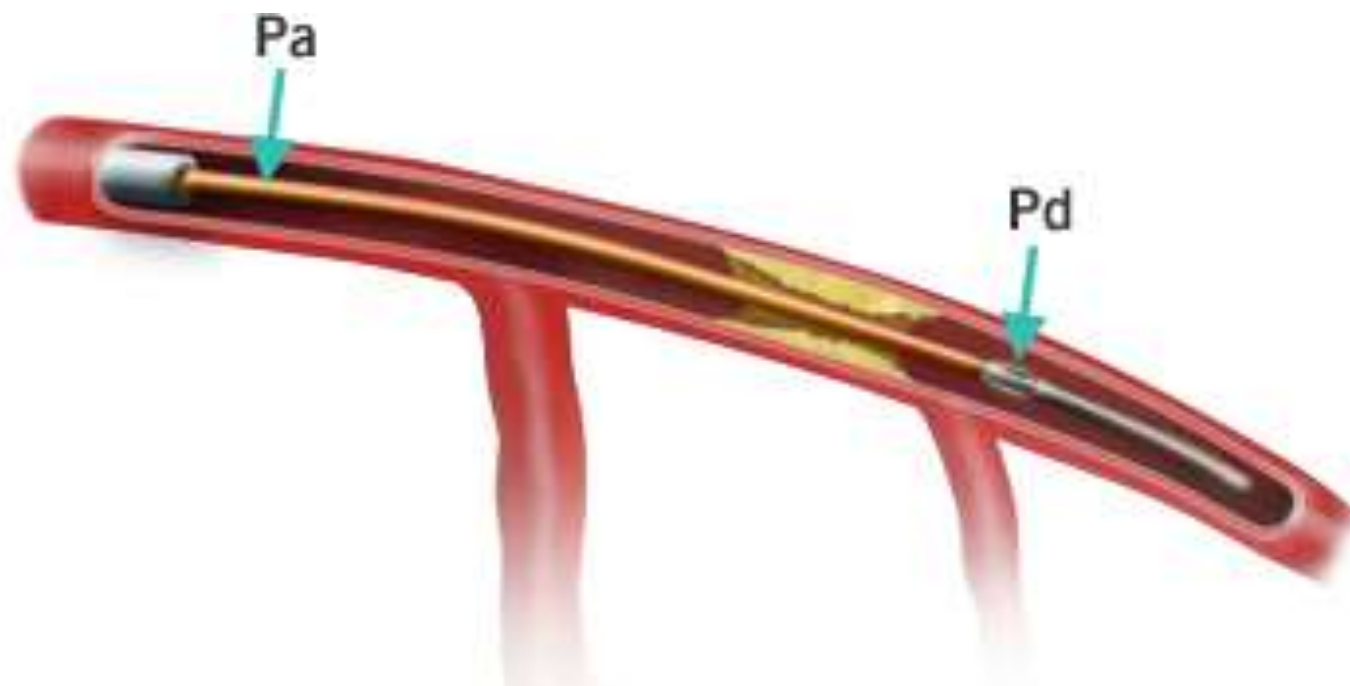
**FDA Approval 11/14**



# “Gold” standard for lesion-specific ischemia Invasive Fractional Flow Reserve (FFR)

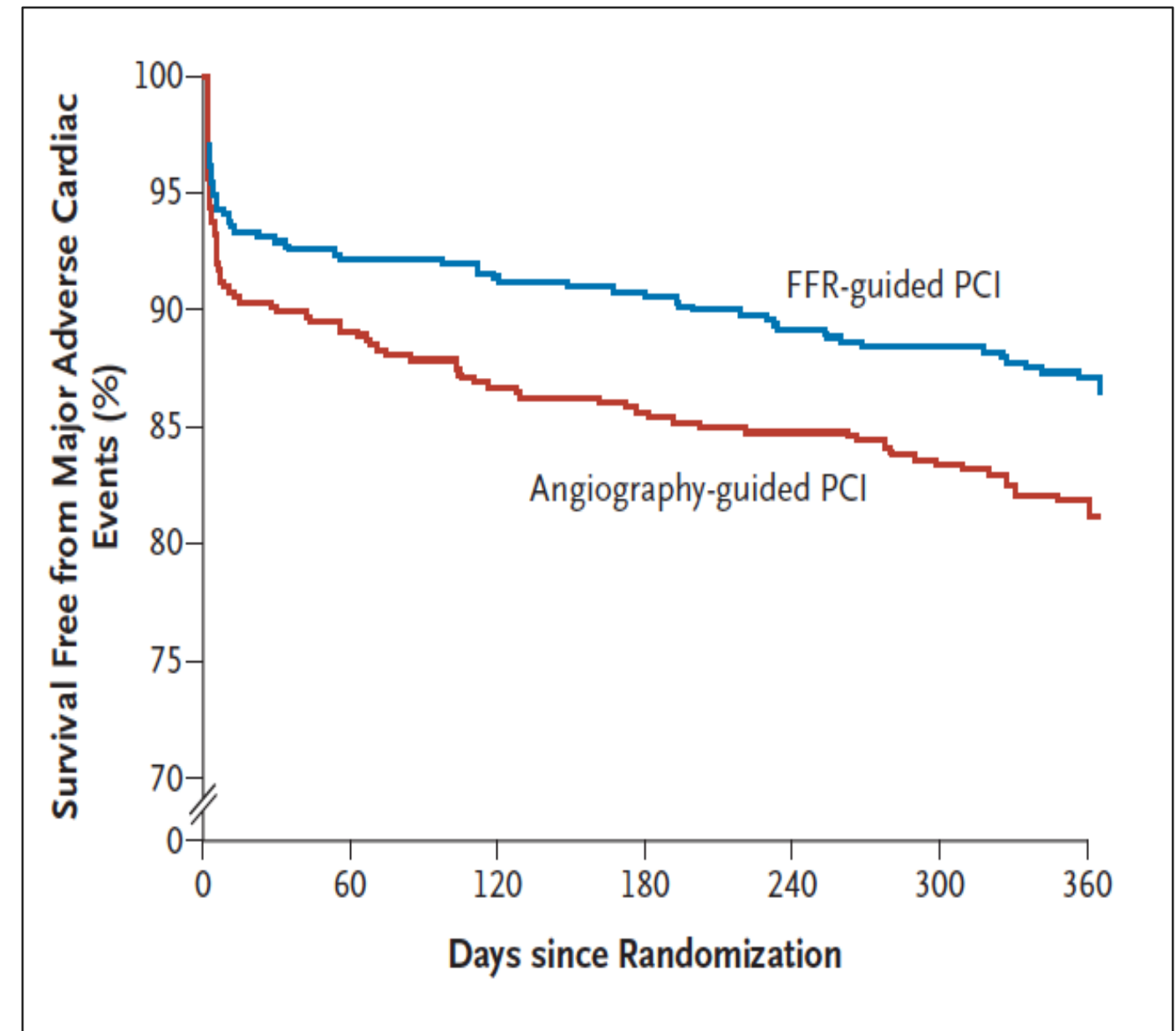
FAME RCT, N=1,005  
Multivessel CAD  
“Anatomy vs. Physiology”

Maximal MBF through a diseased artery  
MBF in the hypothetical case the artery is normal



Lesion-specific ischemia:  $FFR \leq 0.80$

- Only method to **pinpoint ischemia-causing lesions**
- Only method to guide revascularization to **improve event-free survival**

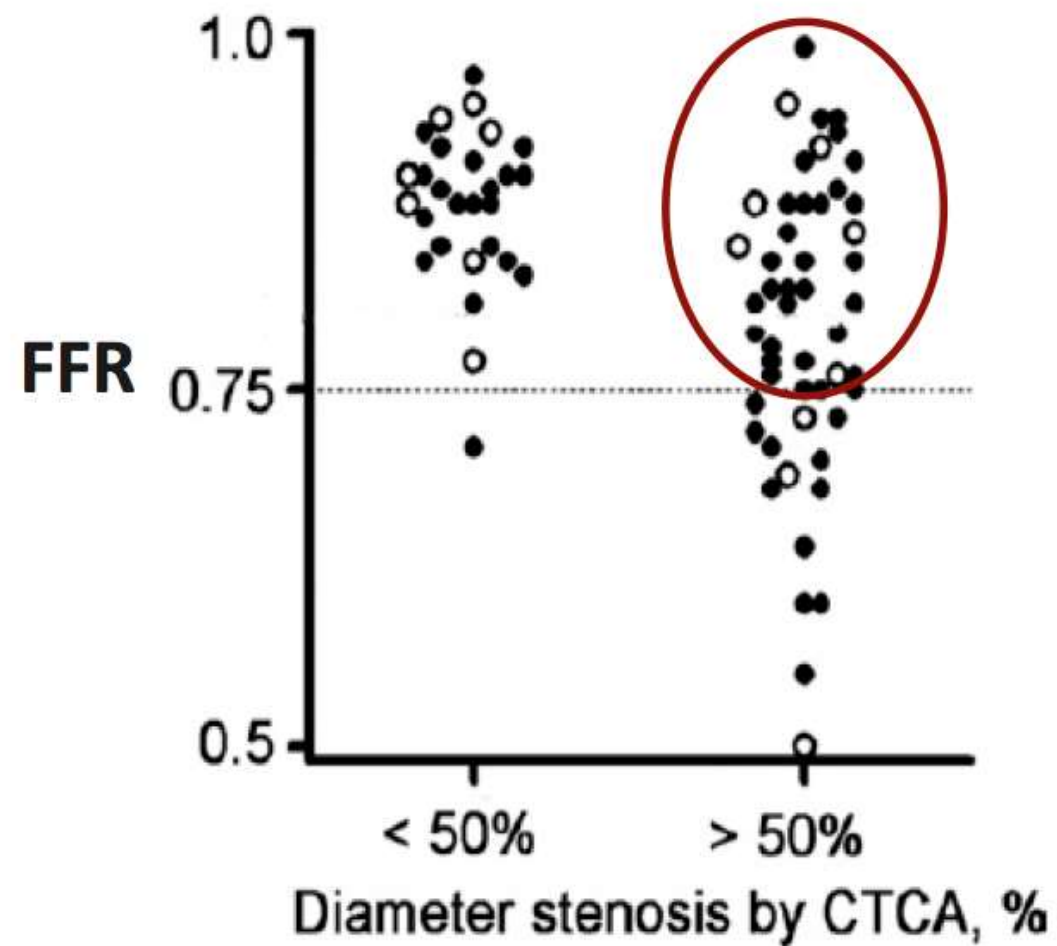




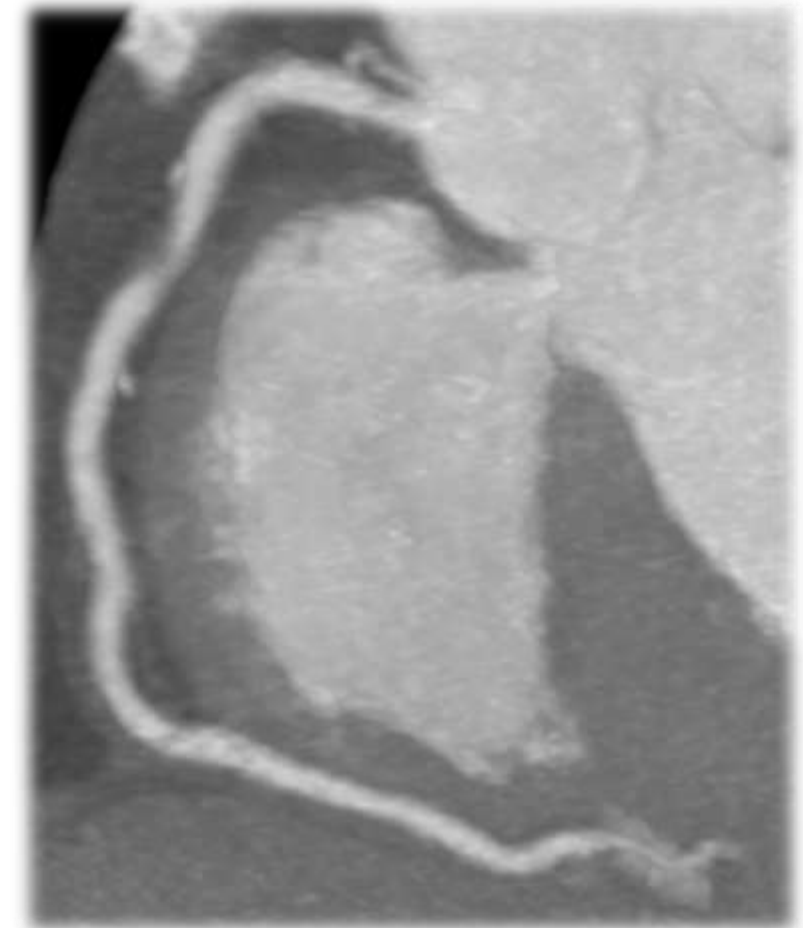
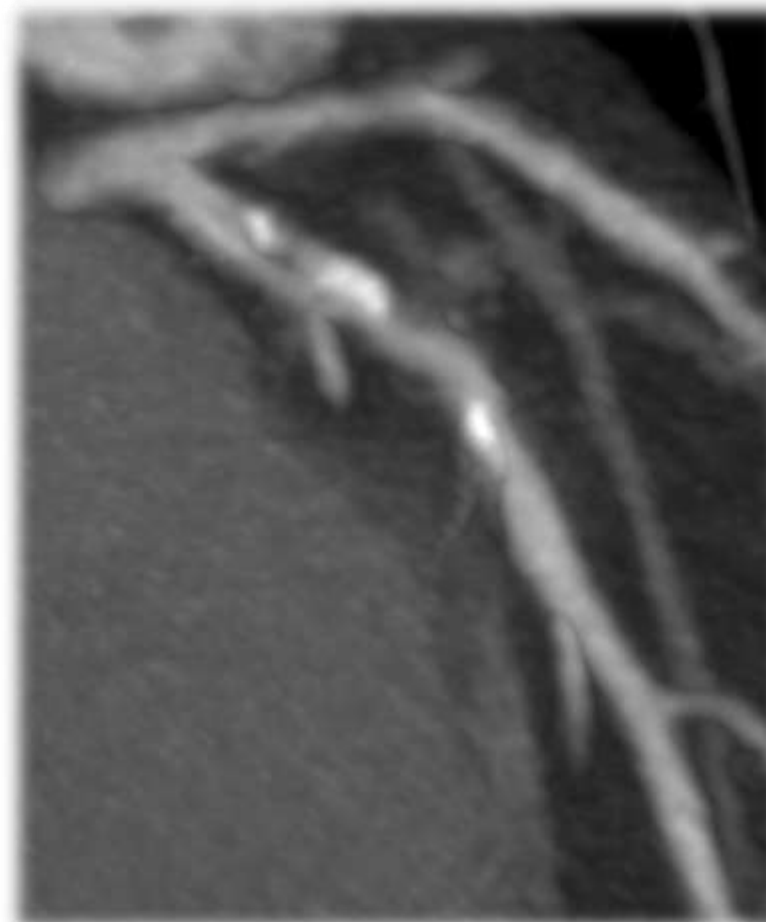
# CT to Diagnosis and Exclude Lesion Ischemia

Only one of these patients has hemodynamically significant CAD.

**Who has ischemia?**



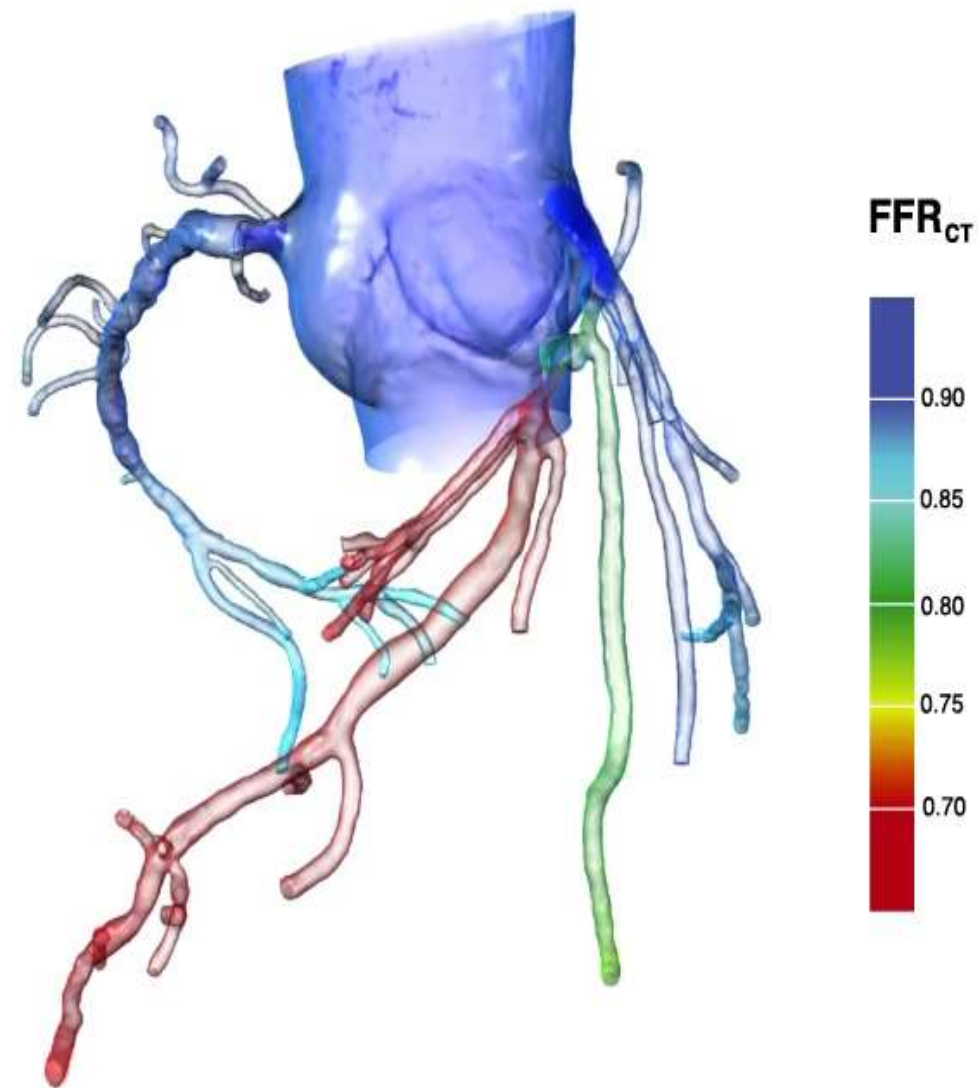
**75% false positives**





# Non-invasive $FFR_{CT}$

**FDA Approval 11/14**



- From typically acquired CCTA
- No additional radiation
- No modification to imaging protocols
- No administration of medications

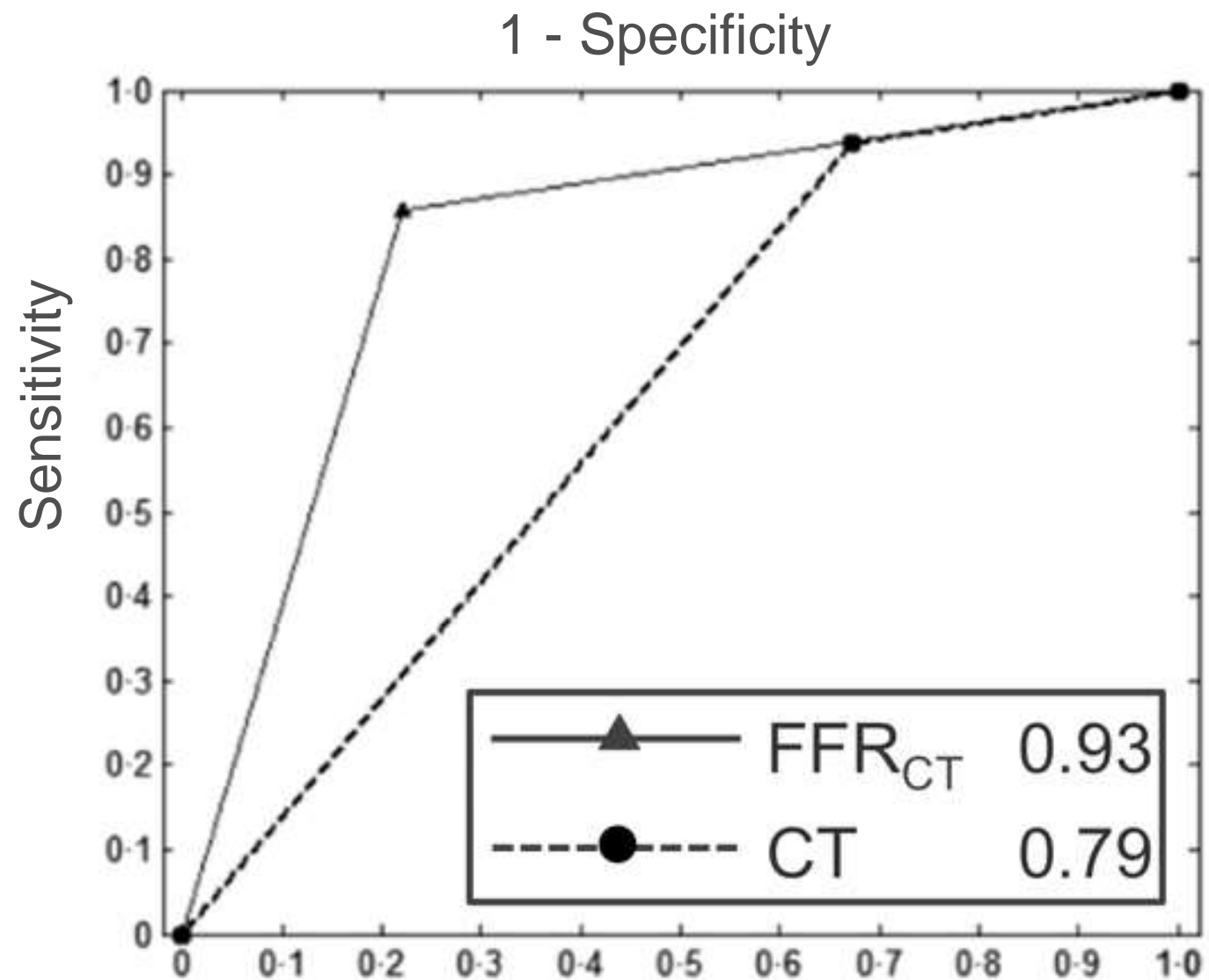
# FFR<sub>CT</sub>: Three (3) Prospective Multicenter Trials

	<b>DISCOVER-FLOW</b>	<b>DeFACTO</b>	<b>NXT</b>
Principal Investigator	Min (JACC)	Min (JAMA)	Norgaard (JACC)
Primary end point	Per pt. diag accuracy	Per pt. diag accuracy; lower limit 95% CI 0.7	Per pt. AUC
Study sites/ countries	4 / 3	17 / 5	10 / 8
Site expertise qualification	FFR	CT or FFR	CT plus FFR
CT training of site	Yes	No	Yes
FFR training of site	No	No	Yes
CT quality check	No	No	Yes
CT results reading	Core lab	Core lab	Site
FFR results report	Site	Site	Site with core lab overview
Vessel size for inclusion	≥ 2.0 mm	≥ 1.5 mm	≥ 2.0 mm
Software version*	V 1.0 manual	V 1.2 partial automation ~6 hrs	V 1.4 automation; <4 hours

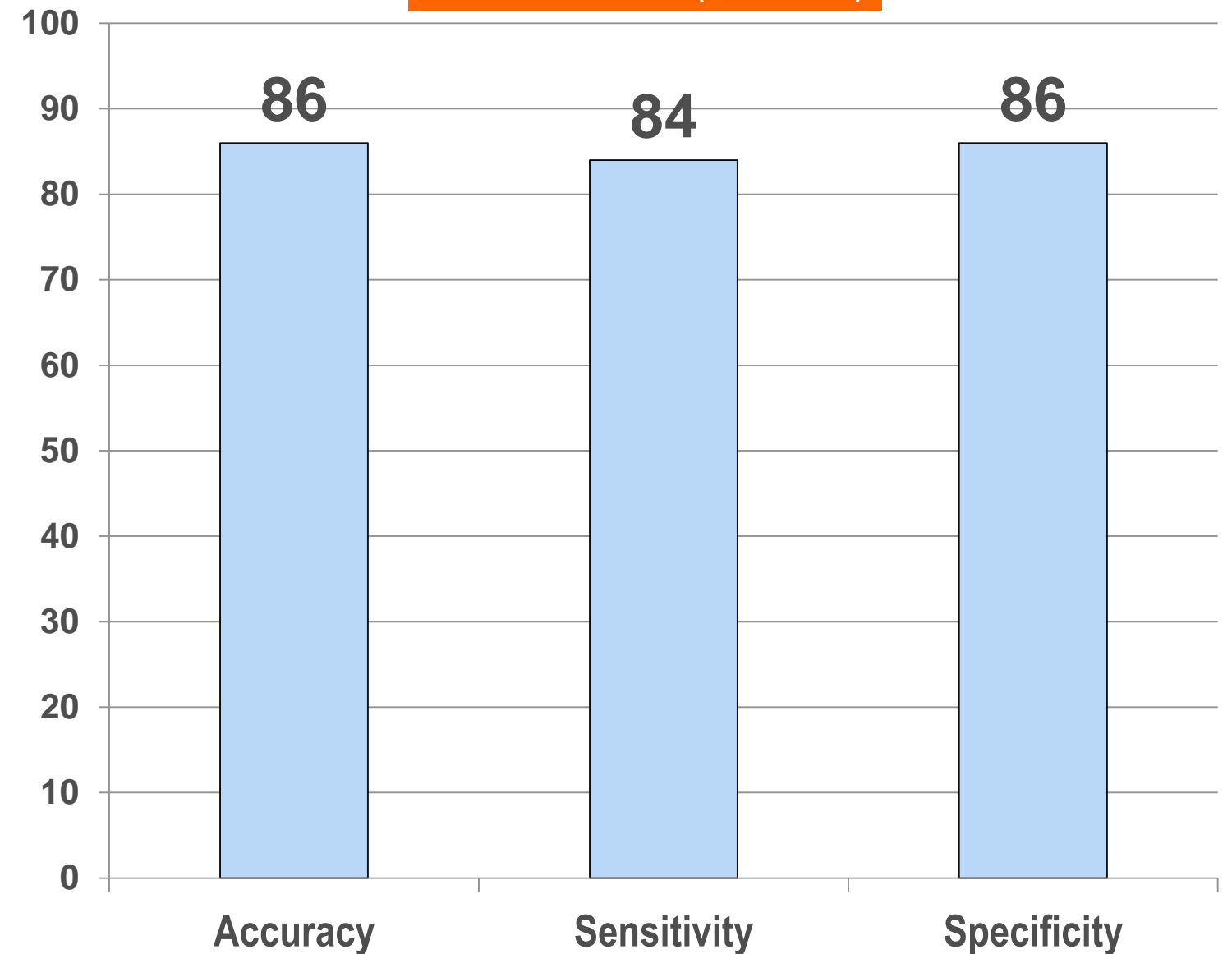
# NXT: Discrimination of ischemia

Prospective multicenter  
N=251 (n=484 vessels)  
Comparator: Invasive FFR

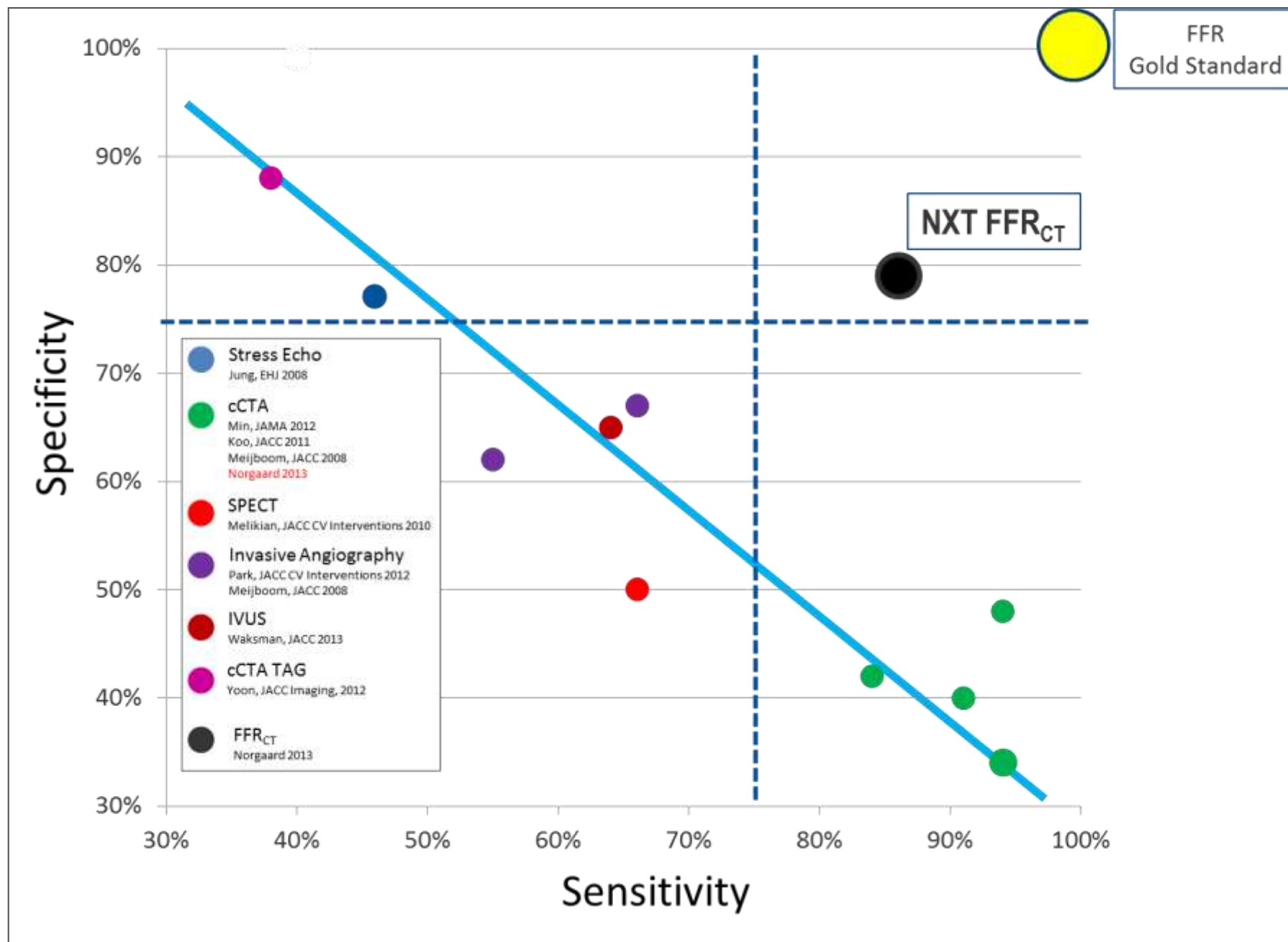
Per-Patient (n=251)



Per-Vessel (n=484)

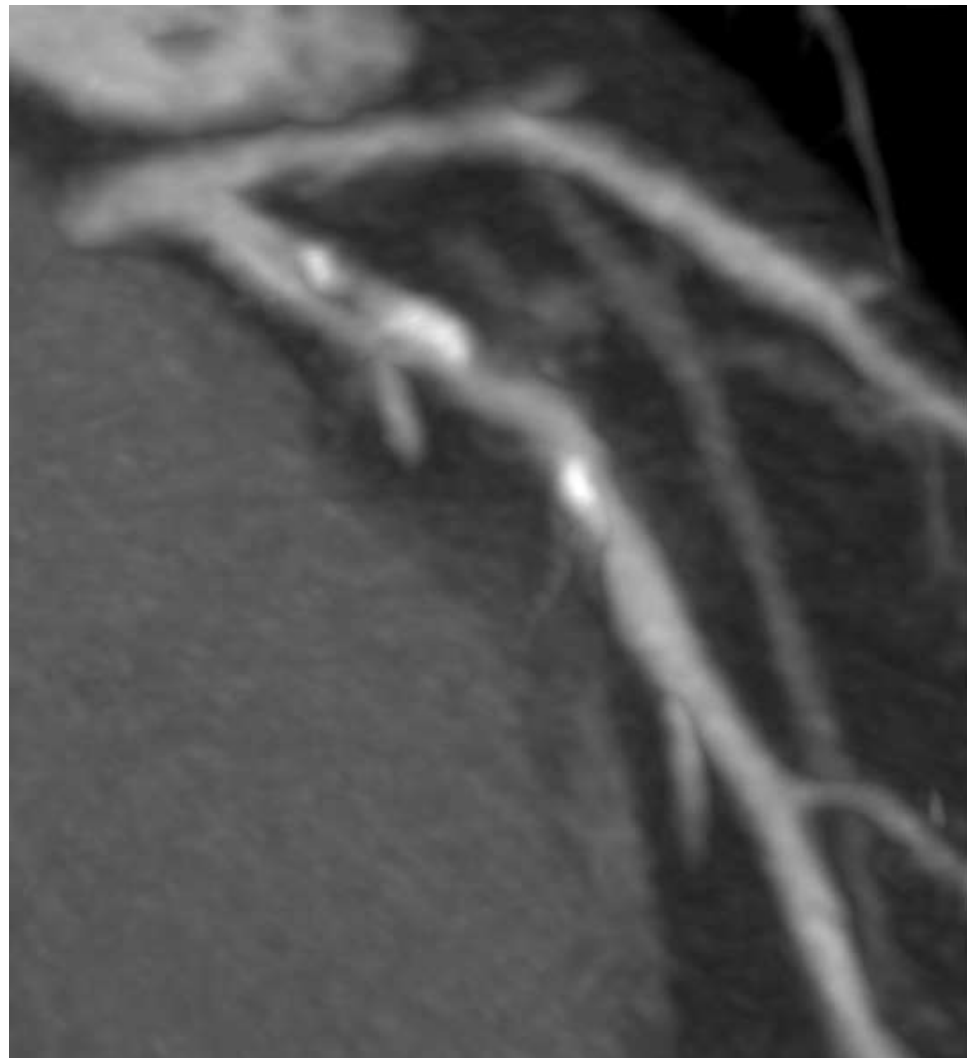


# FFR<sub>CT</sub> Superior to All Methods to Date

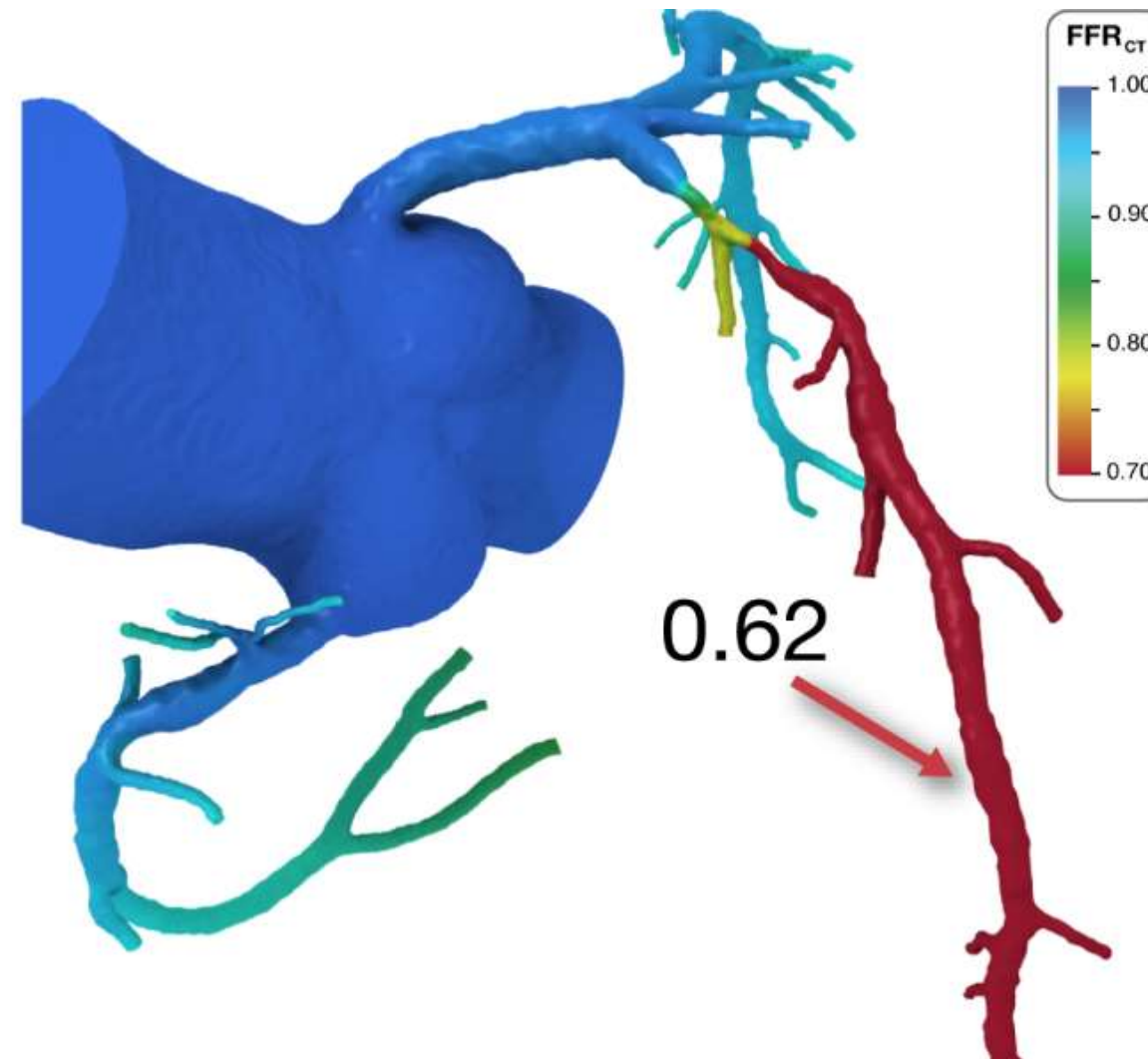




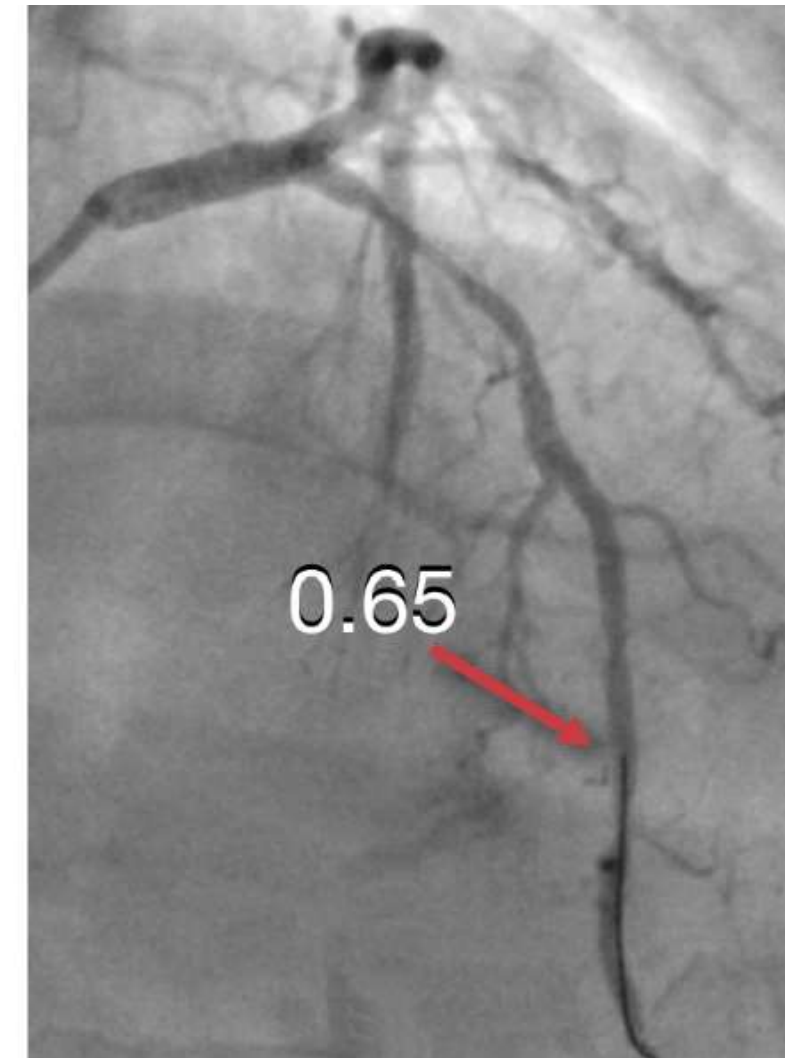
# FFR<sub>CT</sub>: Severe LAD Stenosis



**CT: Severe Stenosis**

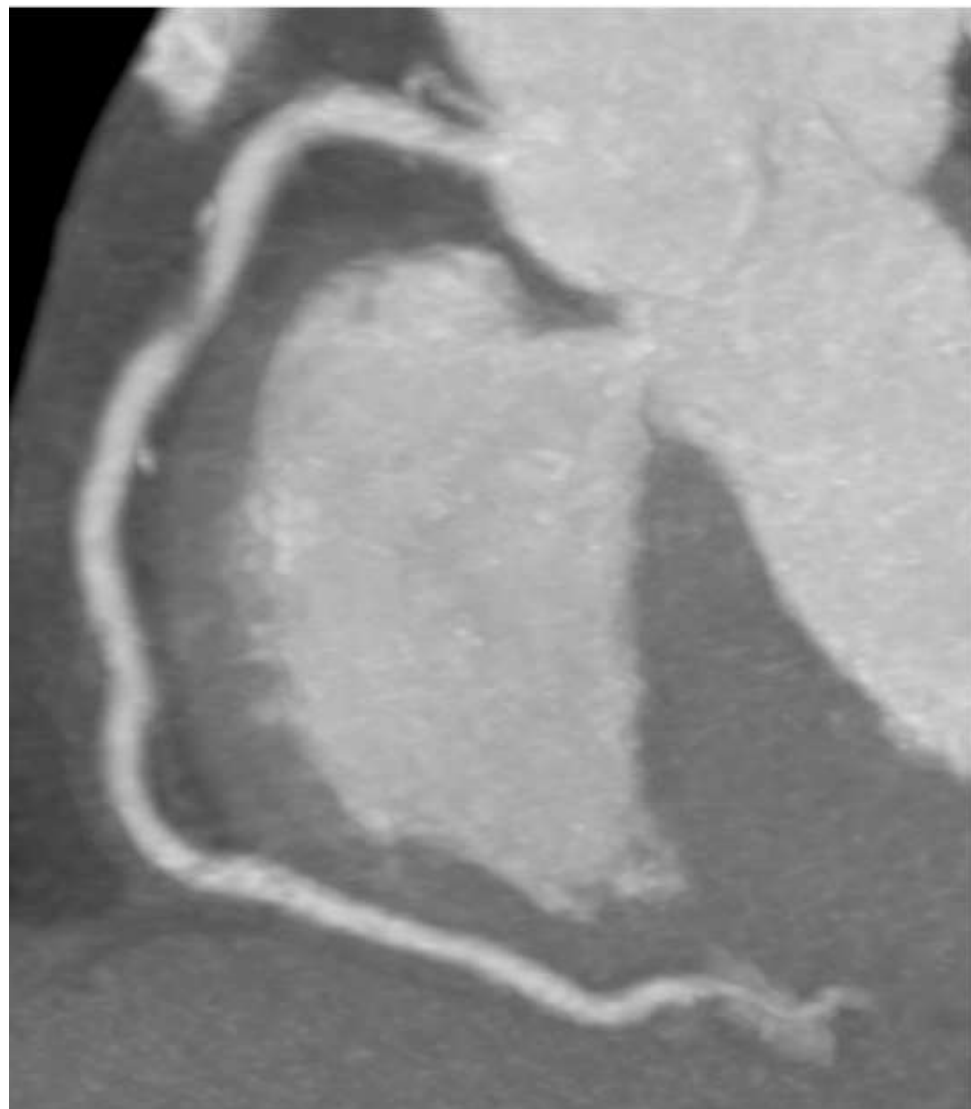


**FFR<sub>CT</sub>: Lesion-specific Ischemia**

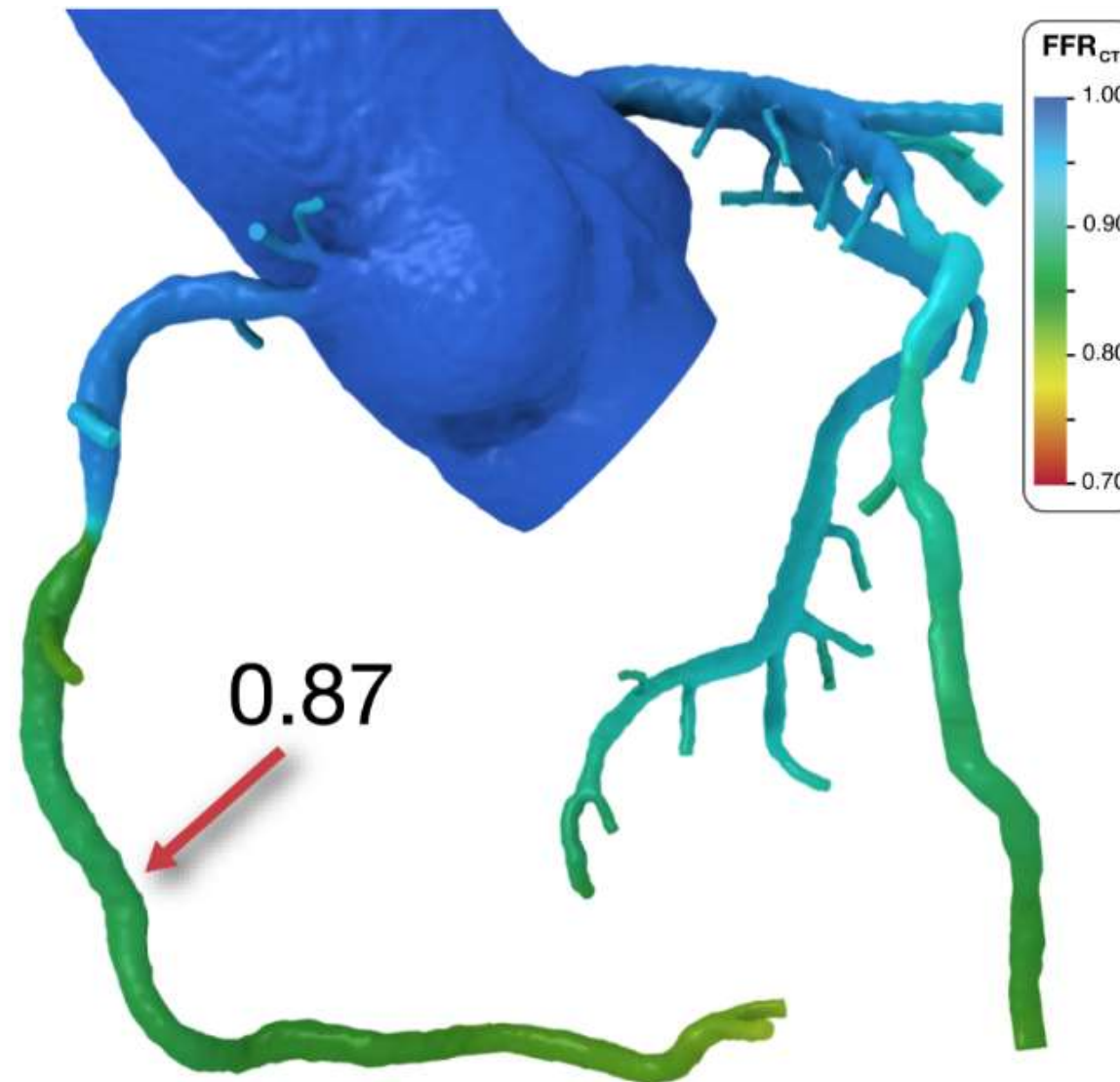


**FFR: Ischemia**

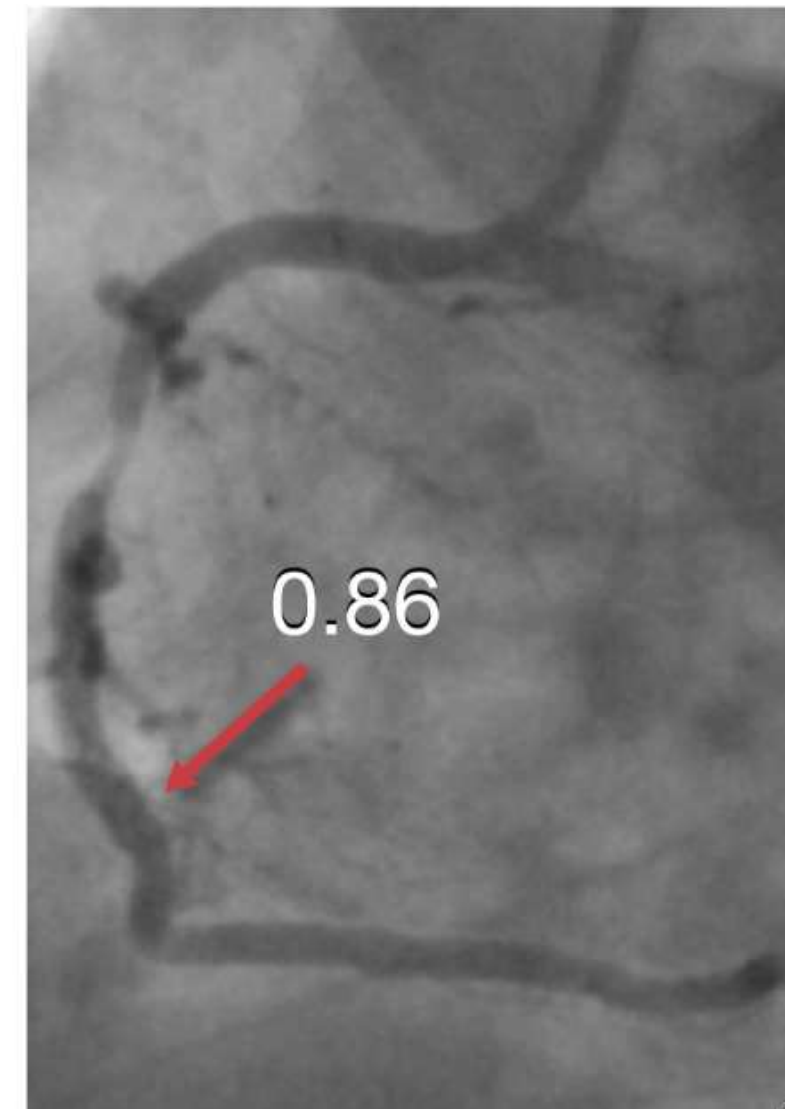
# FFR<sub>CT</sub>: Severe RCA Stenosis



**CT: Severe Stenosis**



**FFR<sub>CT</sub>: No Ischemia**



**FFR: No Ischemia**

# Case: 73 y/o Caucasian man

- Chest pain with exertion
- Dyslipidemia (HDL 34 mg/dl, LDL 90 mg/dl)
- Borderline hypertension
- Medications: ASA 81 mg, HCTZ 25 mg

# Case: 73 y/o Caucasian man

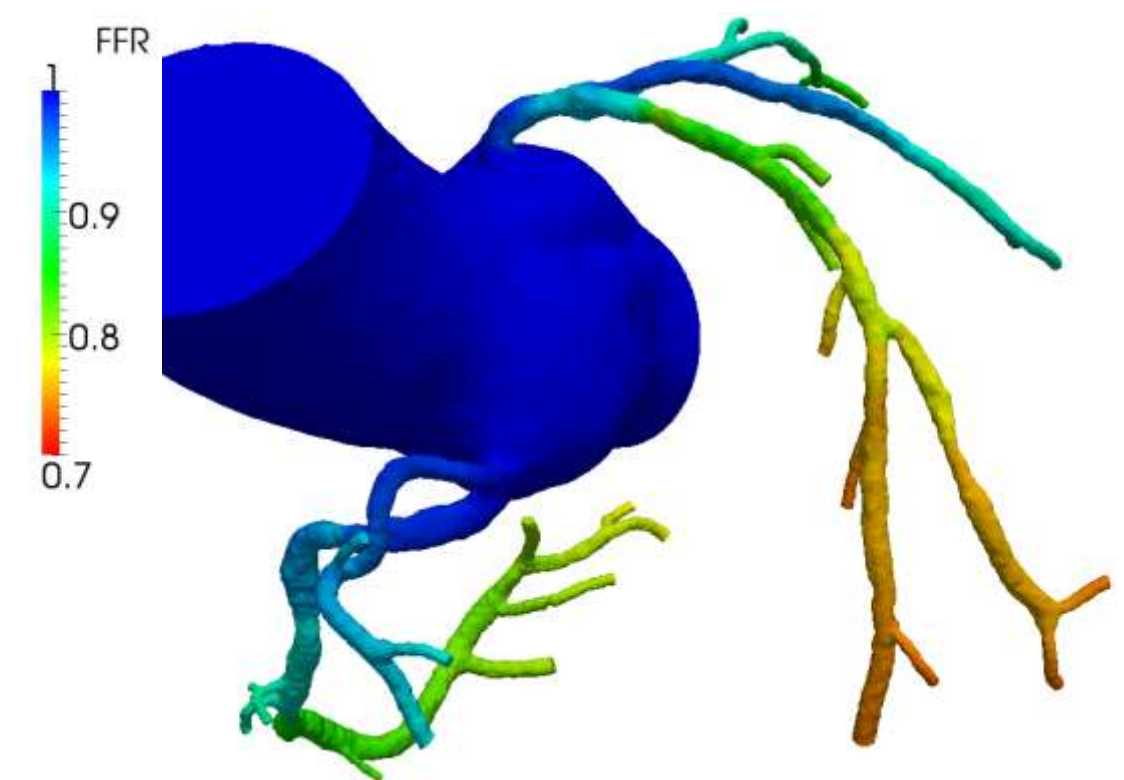
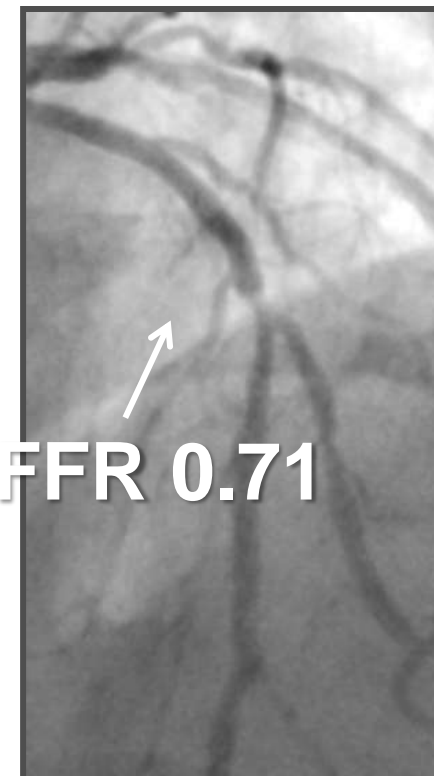
High accuracy  
across common CT  
artifacts

Agatston score 2314

CTA  
Non-evaluatable

QCA 43%

FFR<sub>CT</sub> 0.74



- Calcium: No  $\Delta$  accuracy up to CAC >2000
- Motion / Misregistration: 90.5% accuracy



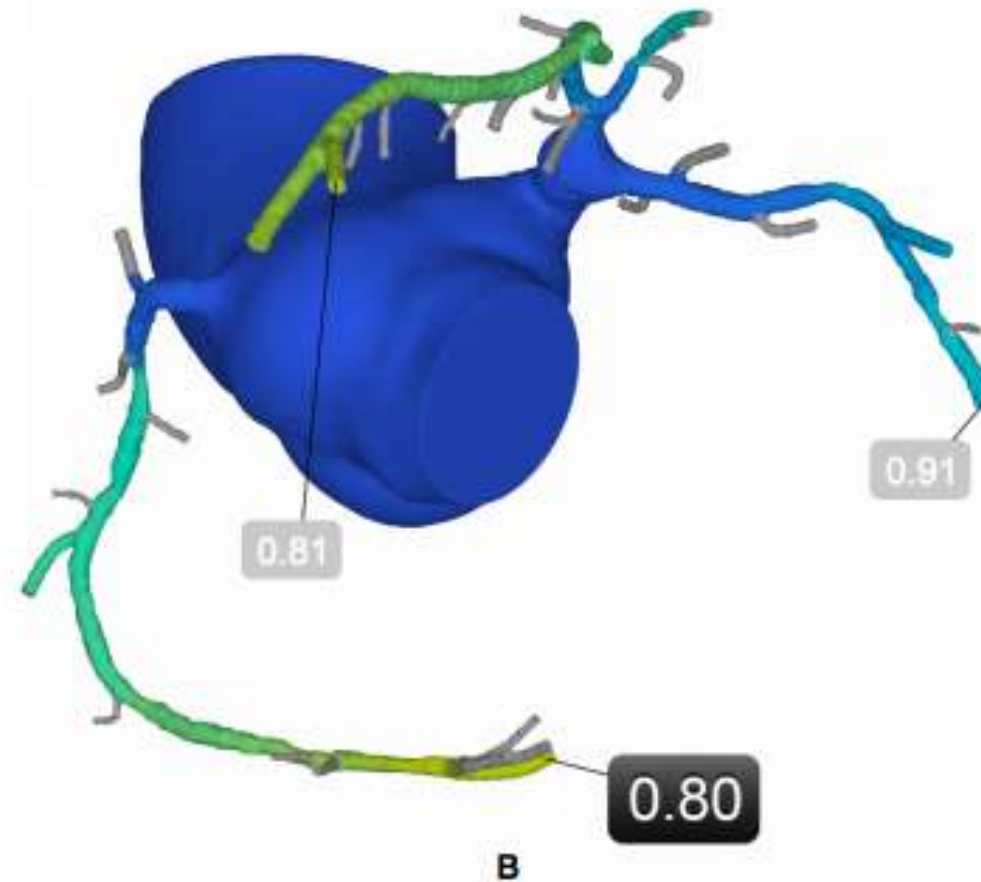
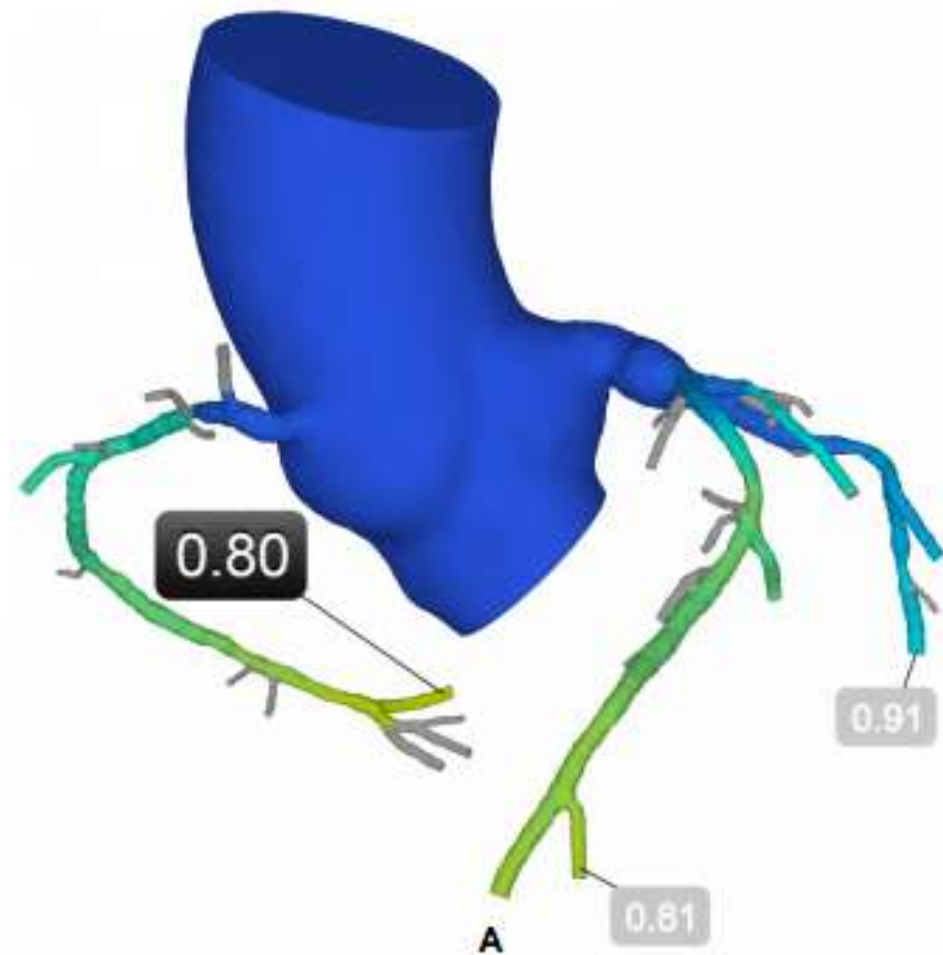
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Summary: The Right Coronary Artery System has an  $FFR_{CT} \leq 0.80$ .

CORONARY ARTERIES & SYSTEMS	FFR <sub>CT</sub>	FFR <sub>CT</sub>
Left Main Artery	—	
Left Anterior Descending System	0.81	
Left Circumflex System	0.91	
Right Coronary Artery System	0.80	

MAY BE FUNCTIONALLY SIGNIFICANT <sup>1,2</sup>



# Conclusions: FFR<sub>CT</sub>

**FDA approval 11/15**

- Superior to all modalities for lesion-specific ischemia: 86% accuracy
- FFR<sub>CT</sub> useful across all ranges of stenosis severity:
  1. Severe: 75% false positives
  2. Intermediate: ~50% prevalence, FFR<sub>CT</sub> 95% NPV
  3. Non-obstructive (<50% stenosis): 17% ischemic
  4. Tandem lesions
- FFR<sub>CT</sub> enables assessment of lesion-specific ischemia across a continuum, rather than simply as a binary measure
- FFR<sub>CT</sub> diagnostic accuracy robust across common CT artifacts