

Is it possible to detect VP
with 64/256 slice CT?

S. Achenbach

Modern CT Systems:

<420ms Rotation

=> Temporal resolution

<0.6mm Collimation

=> Spatial resolution

64 Slices or More

=> Rapid coverage

"Coronary Angiography"



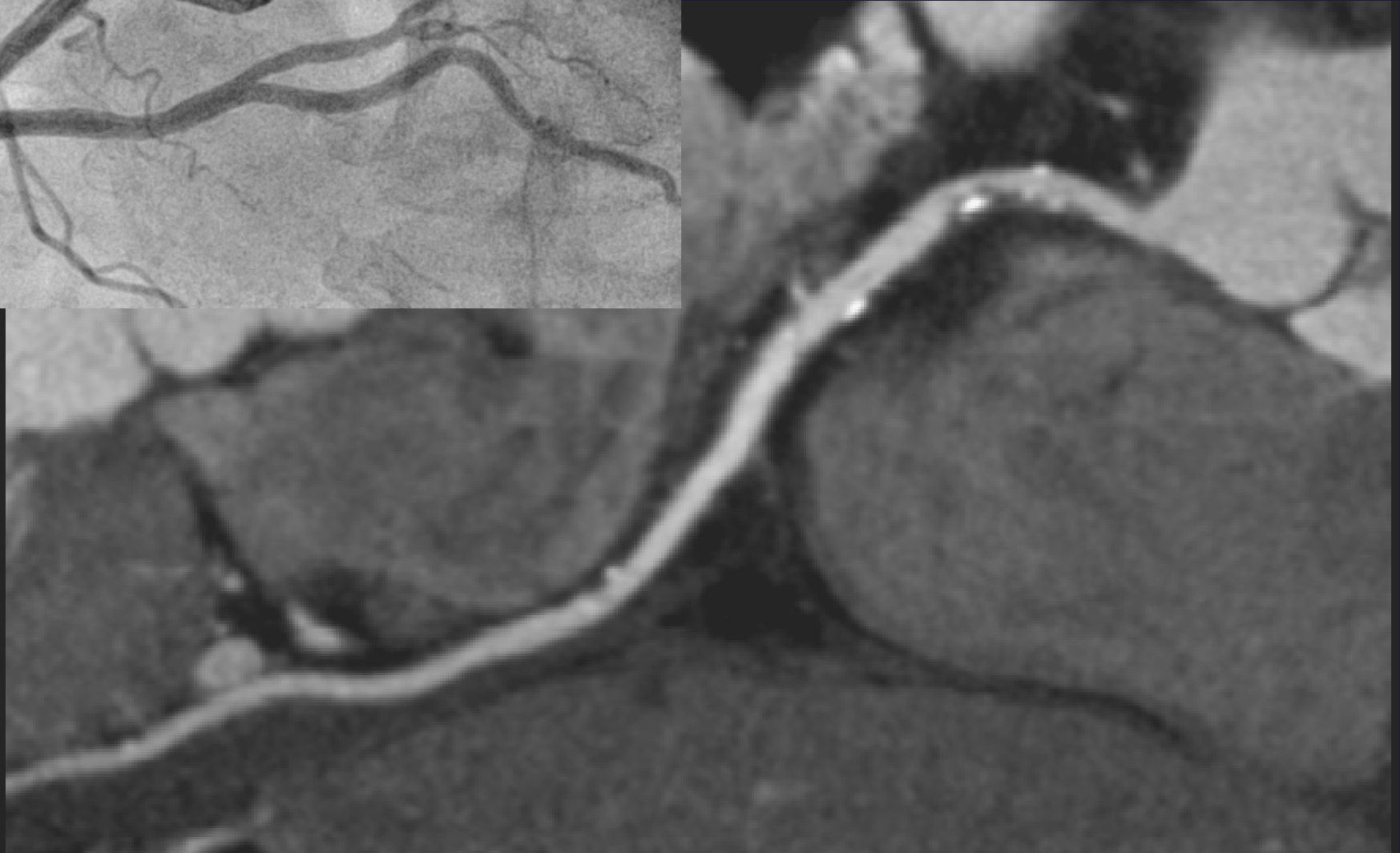
RULE OUT STENOSES

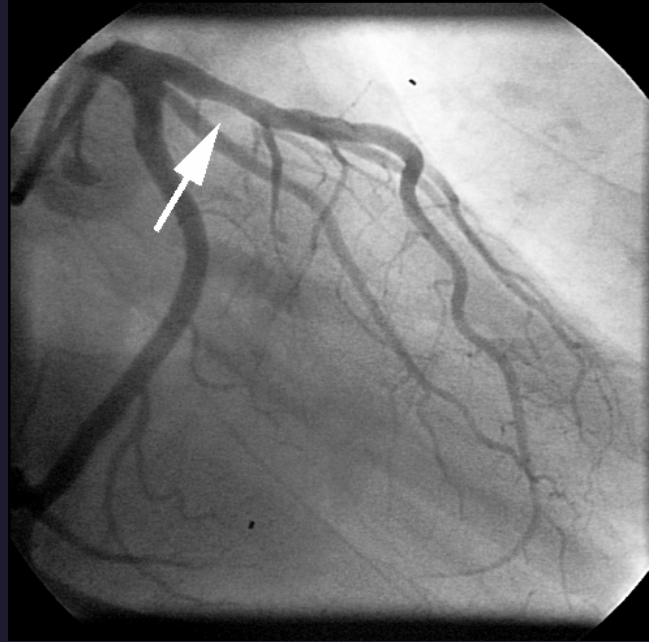
AHA Scientific Statement, 2006

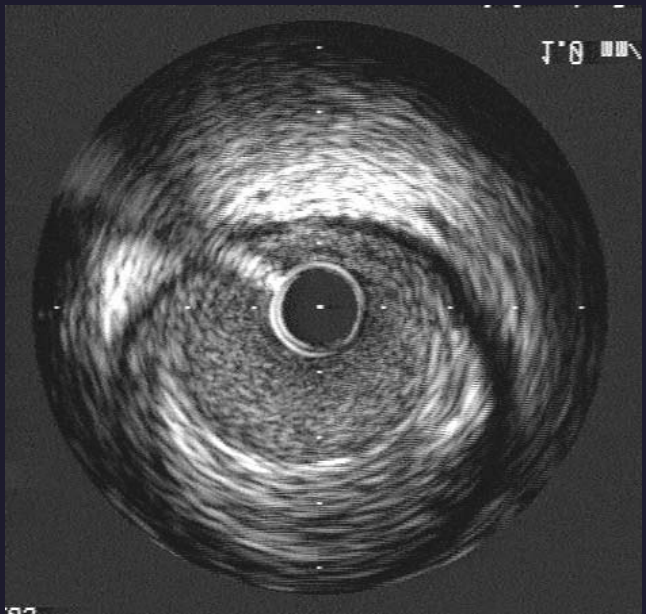
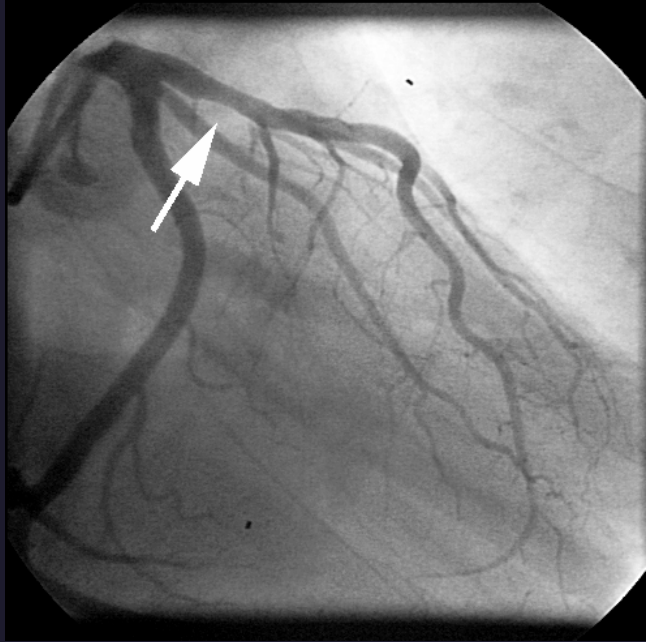
*ACCF/ACR/SCCT/SCMR/ASNC/NASCI/SCAI/
SIR. Appropriateness Criteria, 2006:*

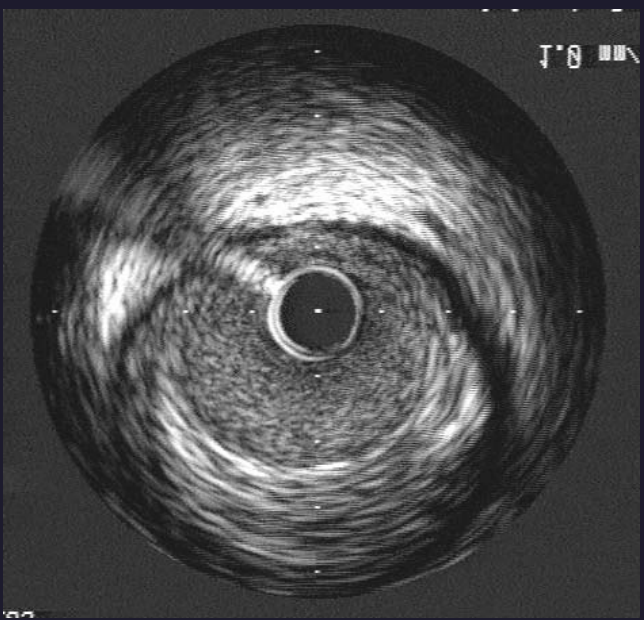
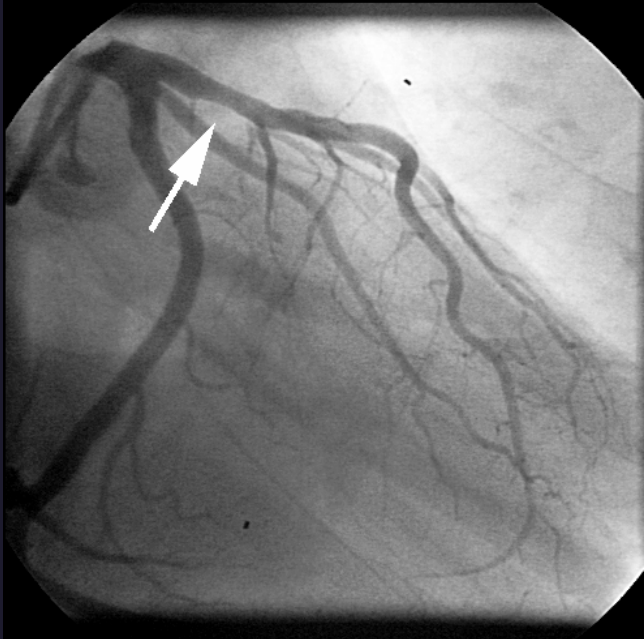
Chest pain of intermediate likelihood,
ECG/stress test impossible or unclear

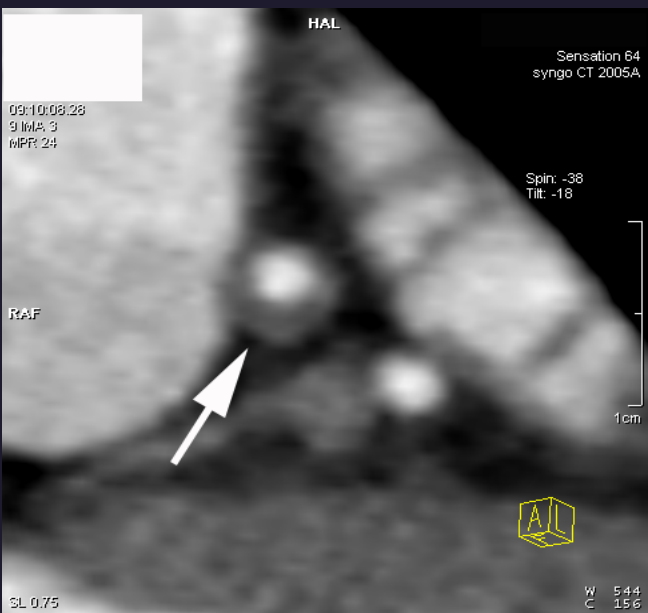
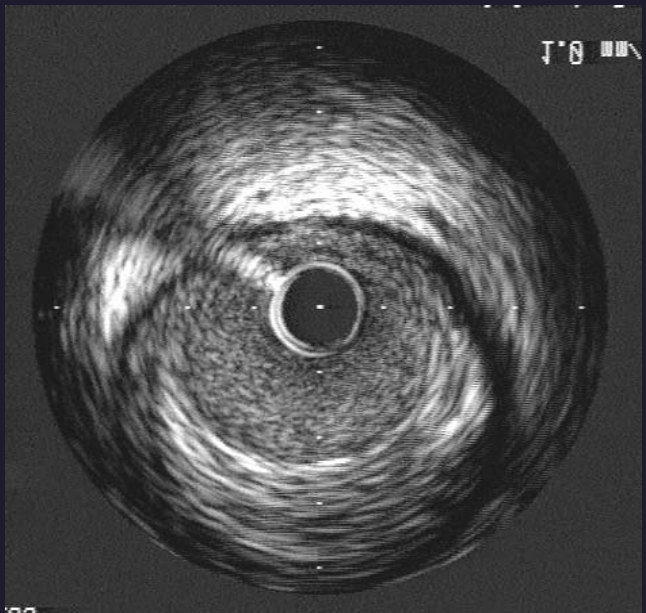
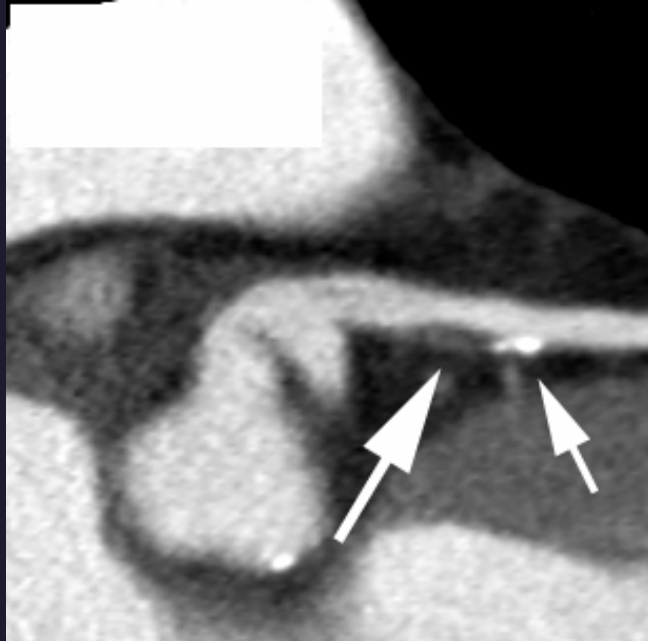


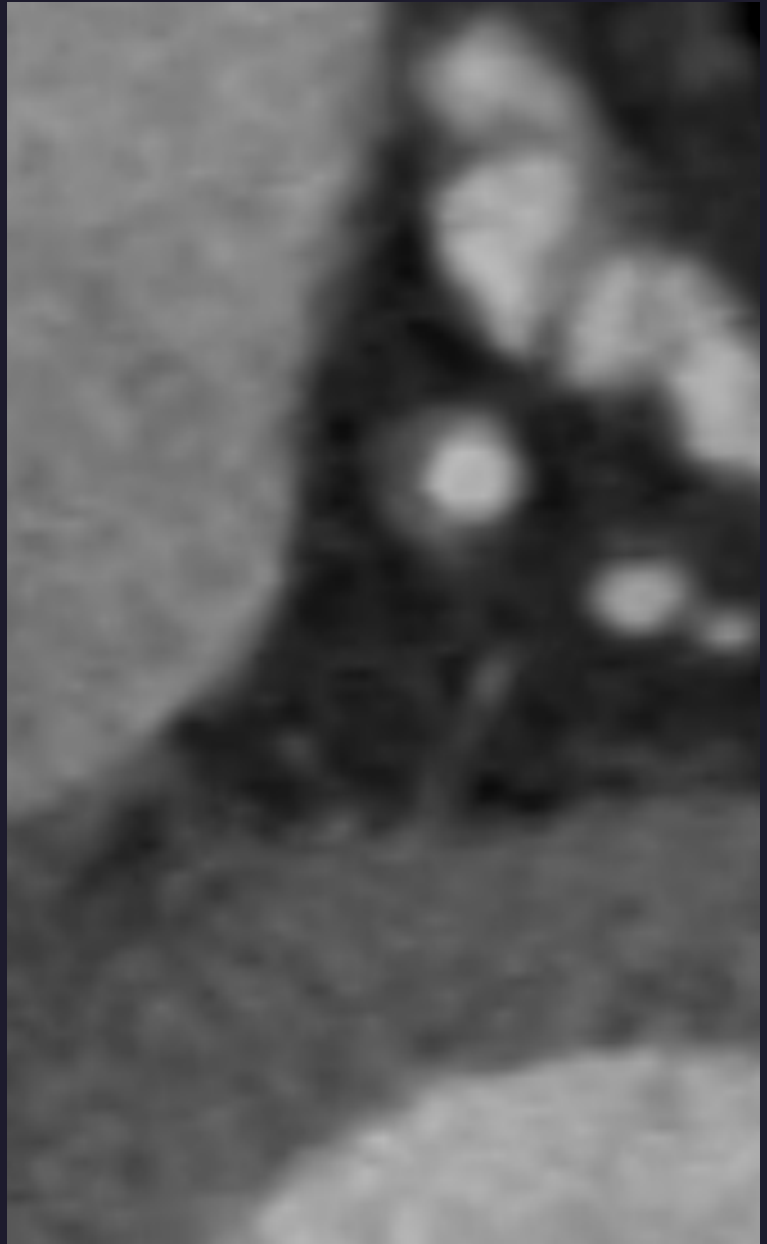












Plaque Detection: MDCT vs. IVUS

46 segments in 14 patients

Accuracy plaque per segment: 87%-90%

16-slice CT

Schoenhagen et al, Coron Arter Dis 2003

83 segments in 22 patients

Sensitivity plaque per segment: 94% (all)

16-slice CT

53% (non-calcified)

Achenbach et al, Circulation 2003

58 vessels in 37 patients

Sensitivity plaque detection: 85% (all)

16-slice CT

per 3 mm segment

82% (non-calcified)

Leber et al, JACC 2004

36 vessels in 19 patients

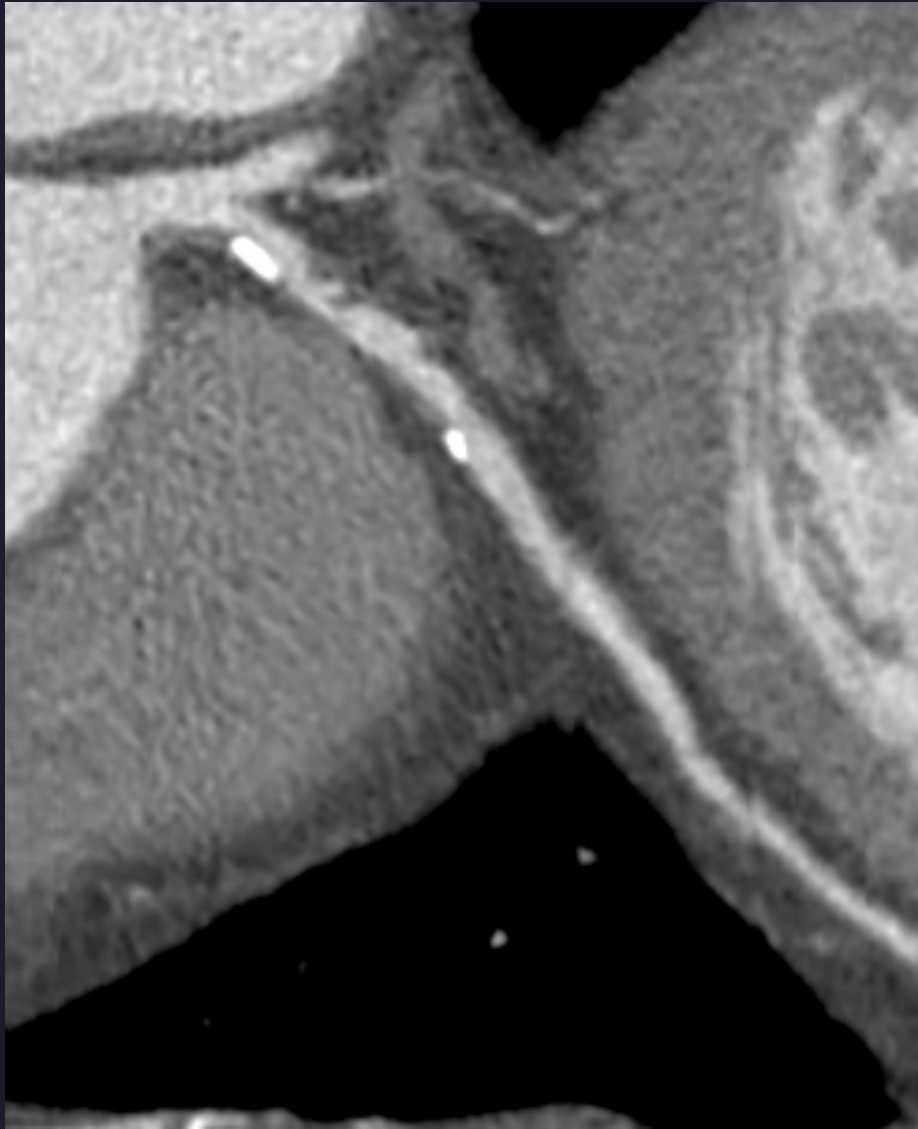
Sensitivity plaque detection: 83% (all)

64-slice CT

per 3 mm segment

95% (calcified)

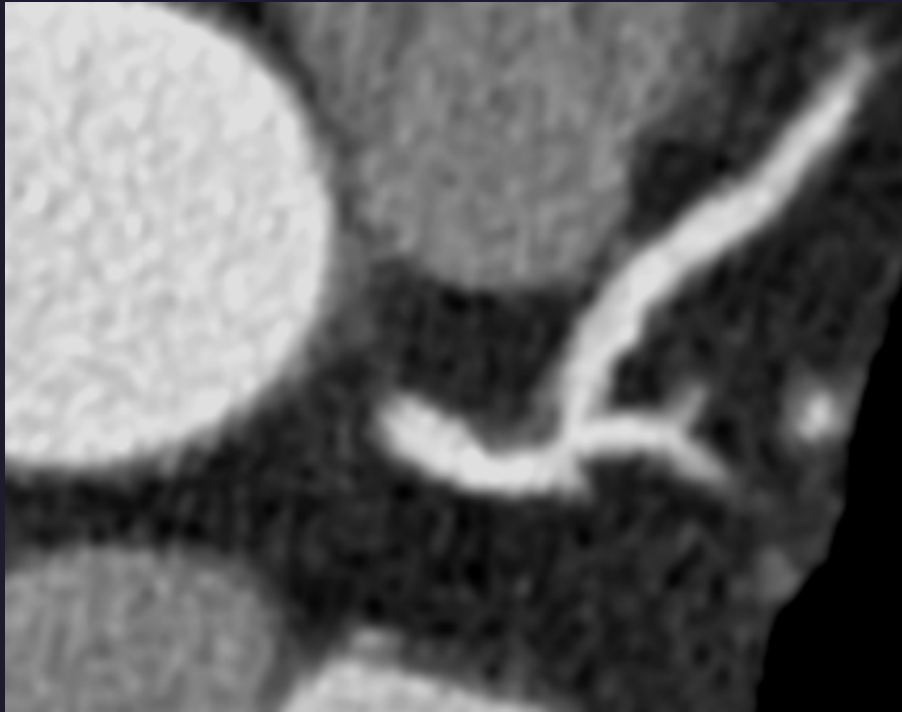
Leber et al, JACC 2006

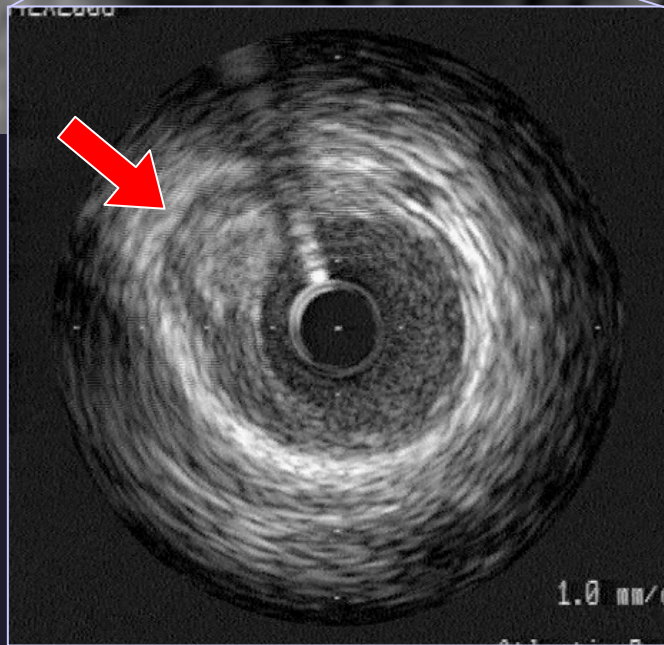
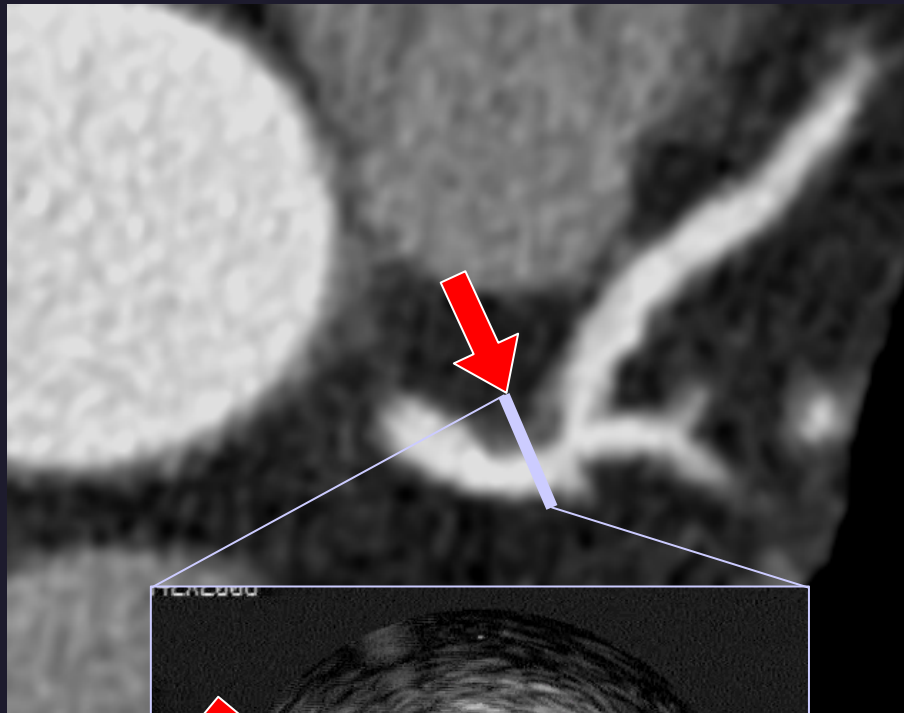


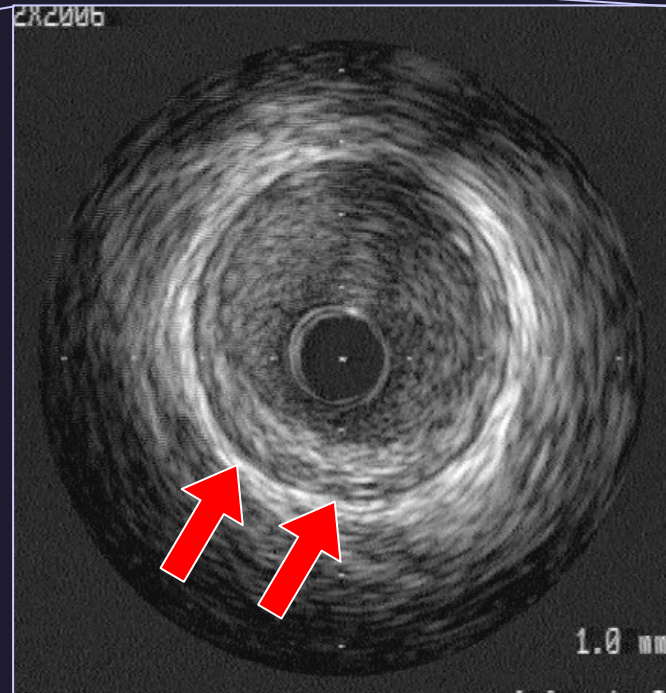
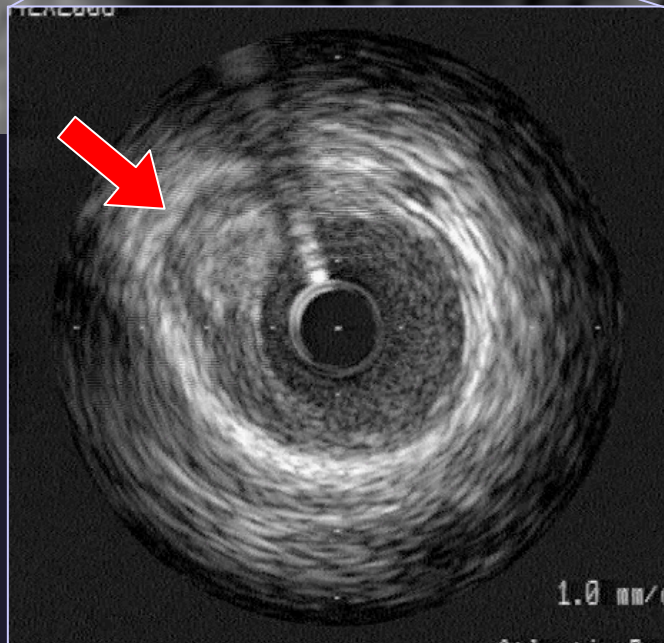
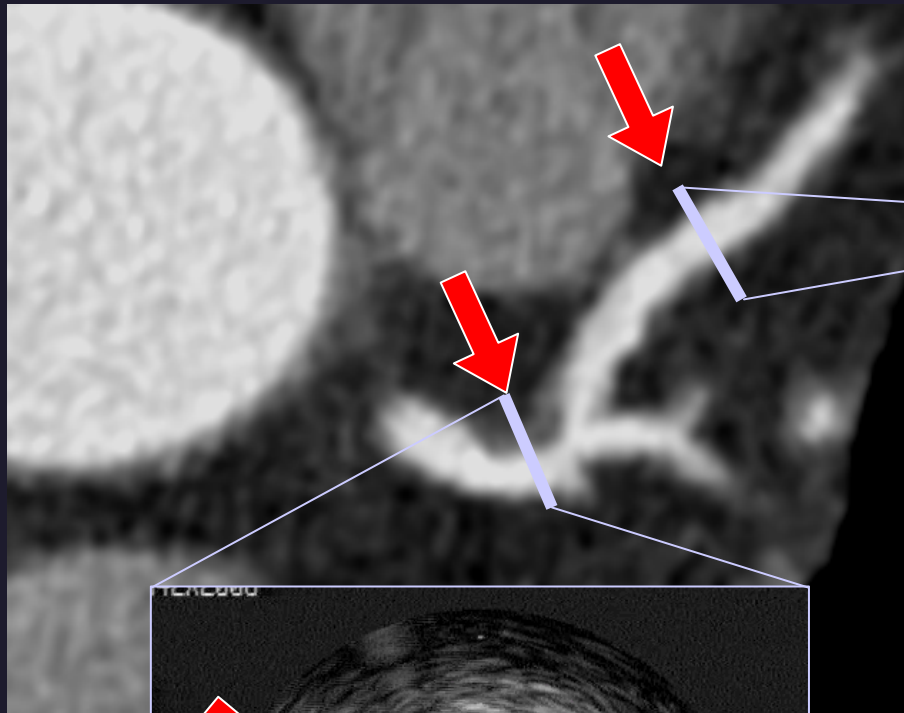
Imaging coronary plaque is difficult!



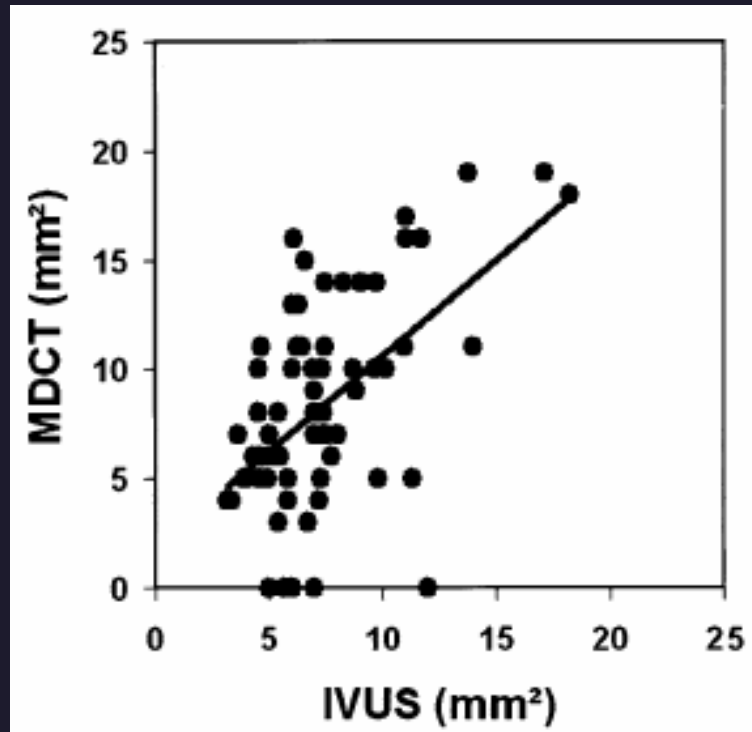
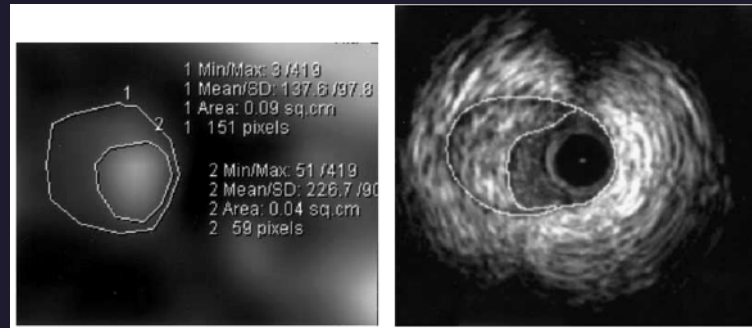
CT Spatial
Resolution:
0.4 mm





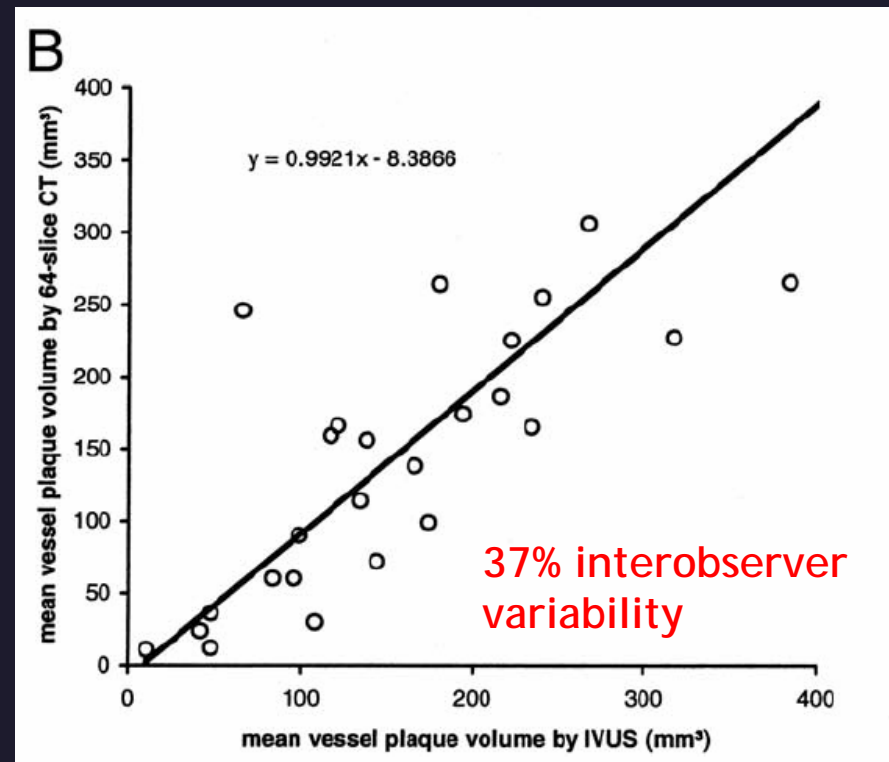


Plaque Quantification: MDCT vs. IVUS



Plaque area, $r = 0.55$

Moselewski et al, AJC 2004



Plaque volume, $r = 0.83$

Leber et al, JACC 2006

Assessment of non-stenotic coronary artery plaque is possible, but it stretches the resolution of MDCT to its very limits

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Histology markers of plaque vulnerability:

Thin fibrous cap ($< 65 \mu\text{m}$)

Necrotic core

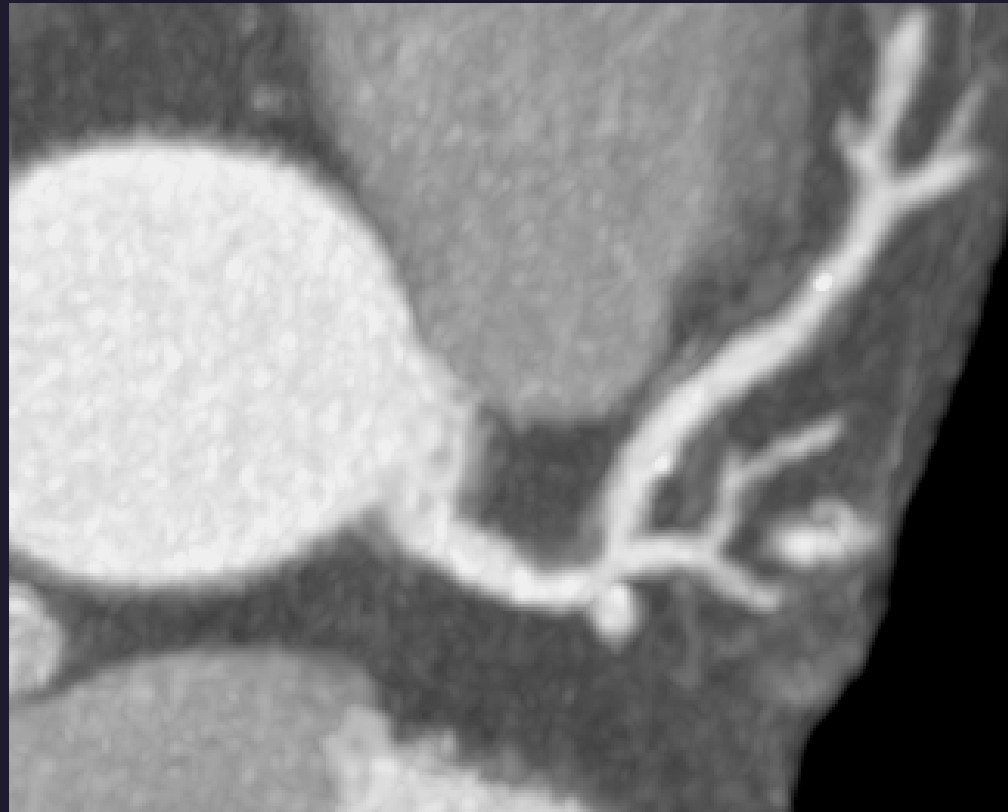
Macrophage infiltration

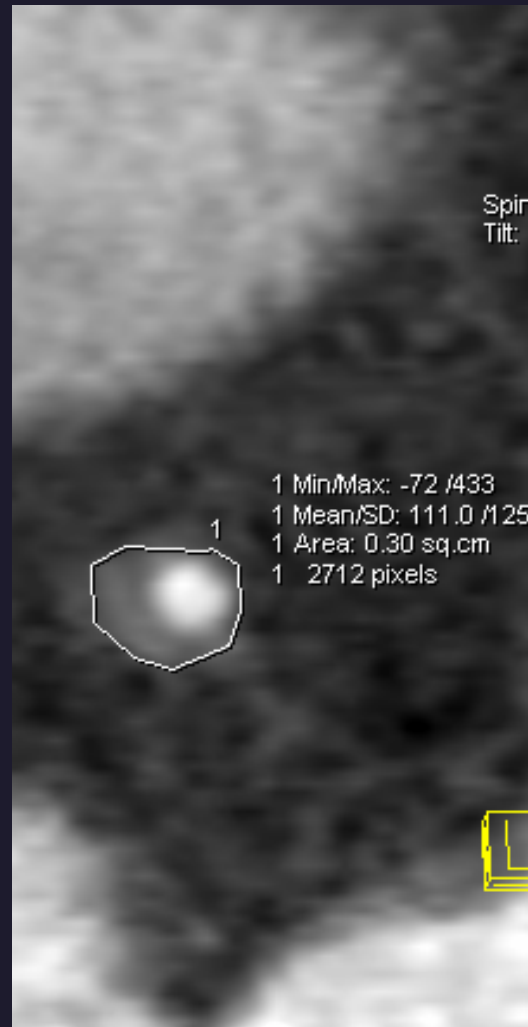
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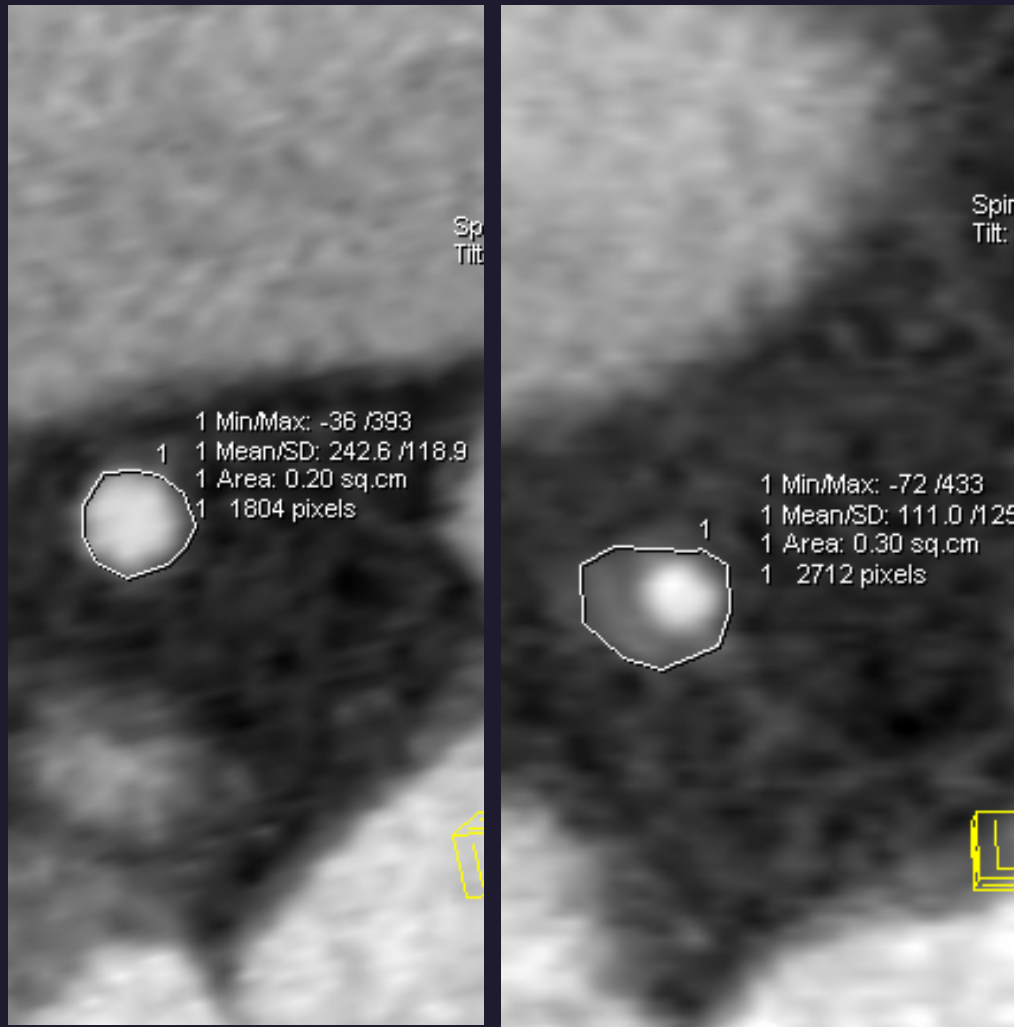
Thin fibrous cap ($< 65 \mu\text{m}$)
Necrotic core
Macrophage infiltration

} IMPOSSIBLE

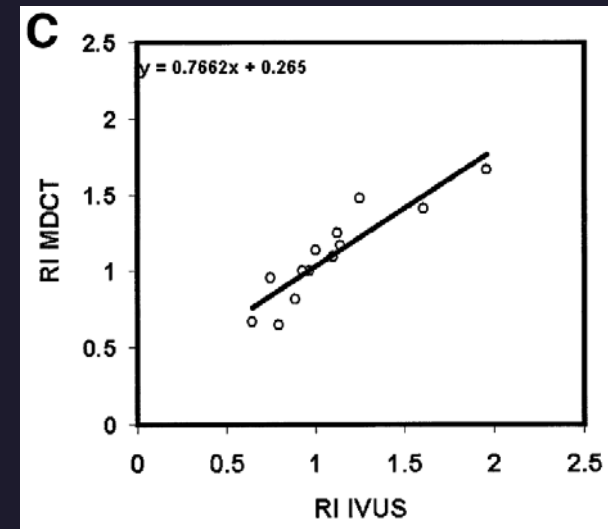
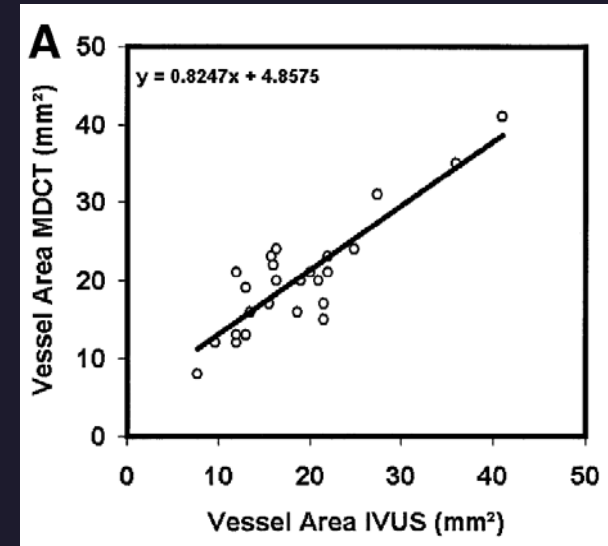




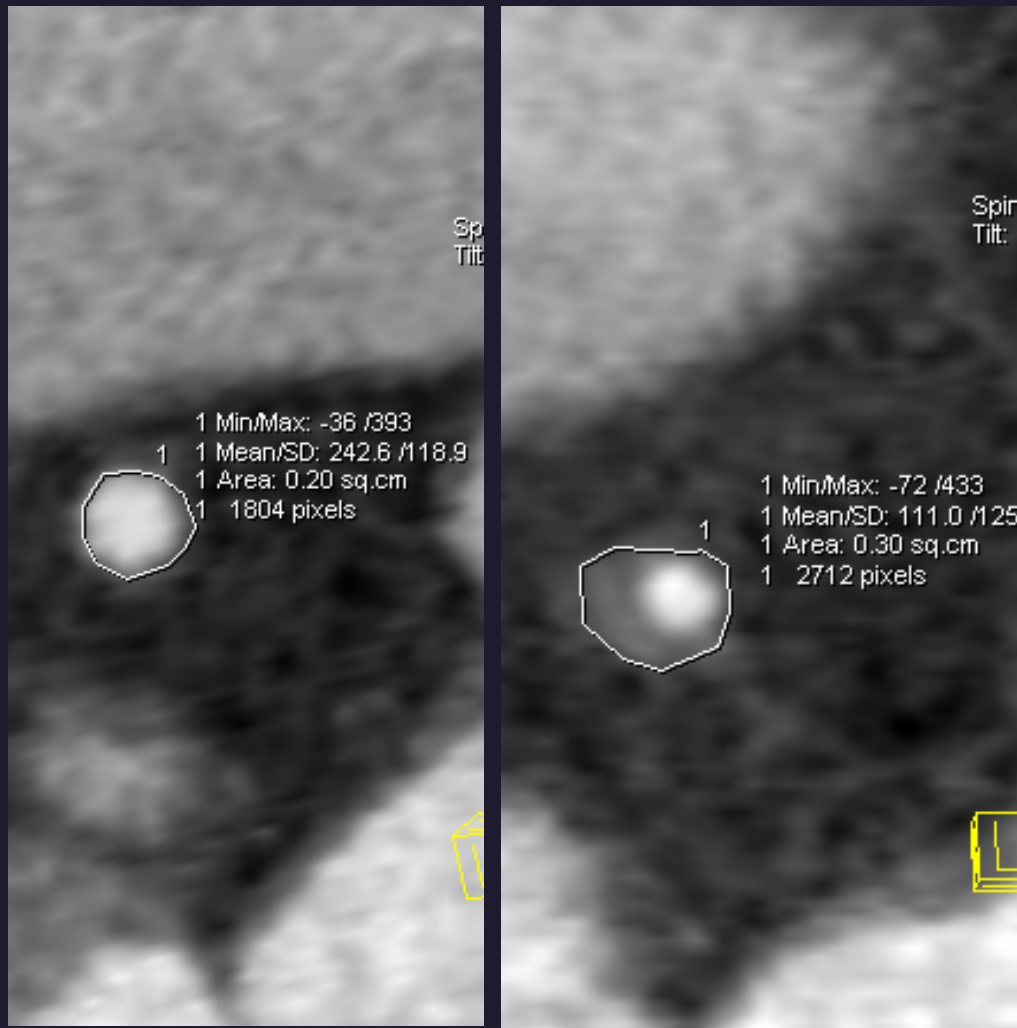
Remodeling Index: 1.5



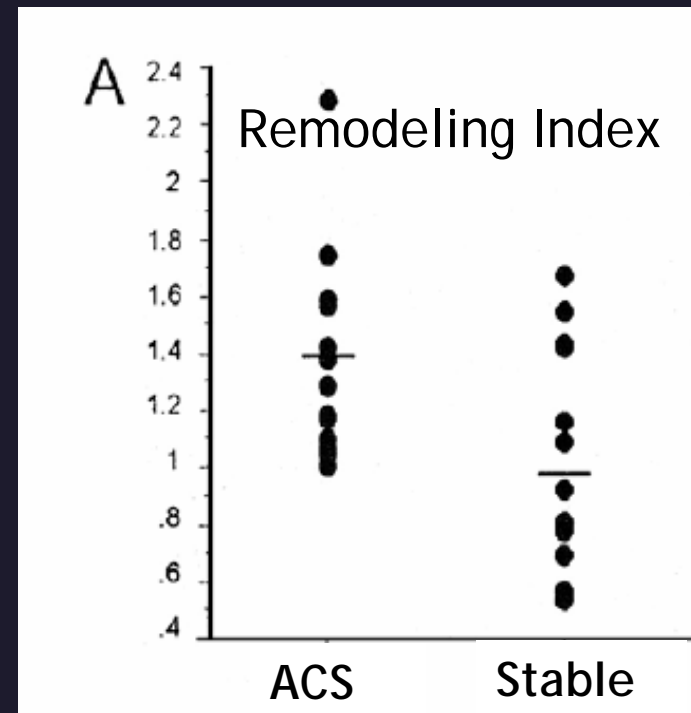
Remodeling Index: 1.5



Achenbach et al, JACC 2006



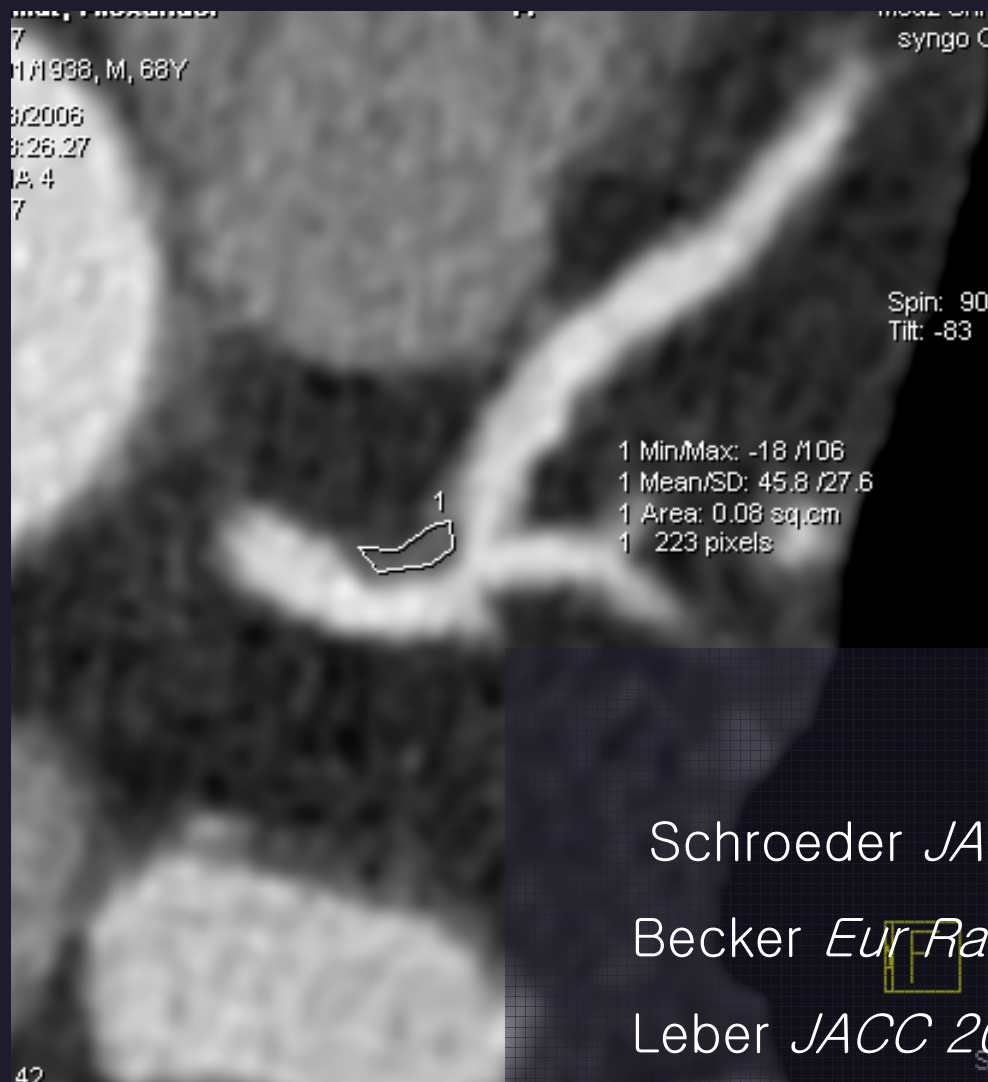
Remodeling Index: 1.5



Hoffmann et al, JACC 2006



Mean density: 46 HU



42

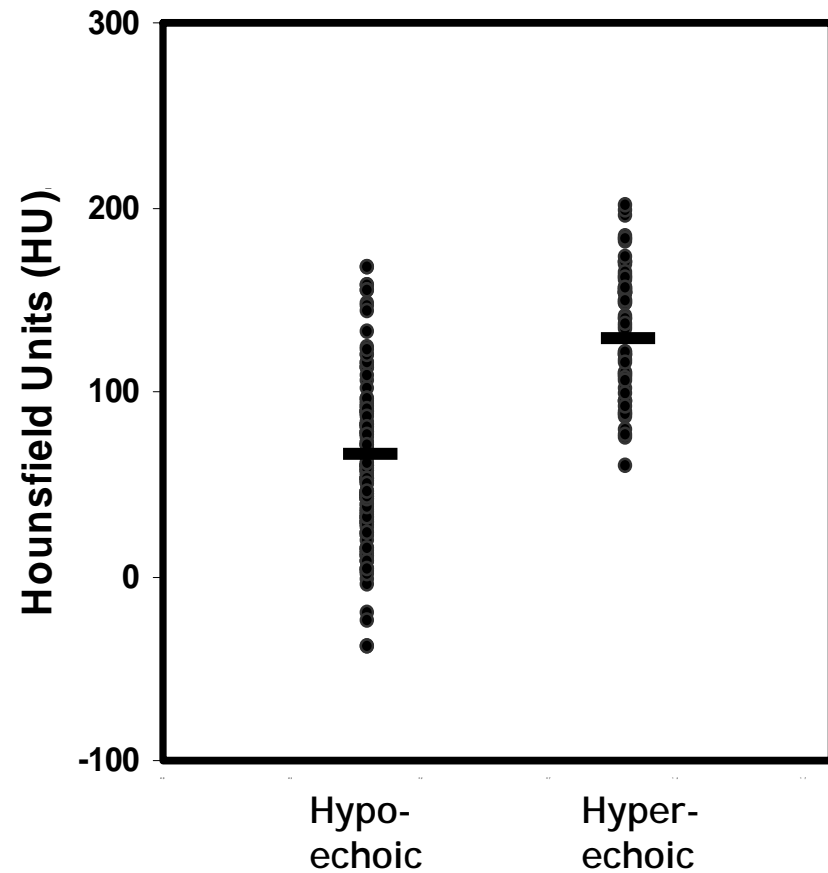
Mean density: 46 HU

Lipid Rich Fibrous

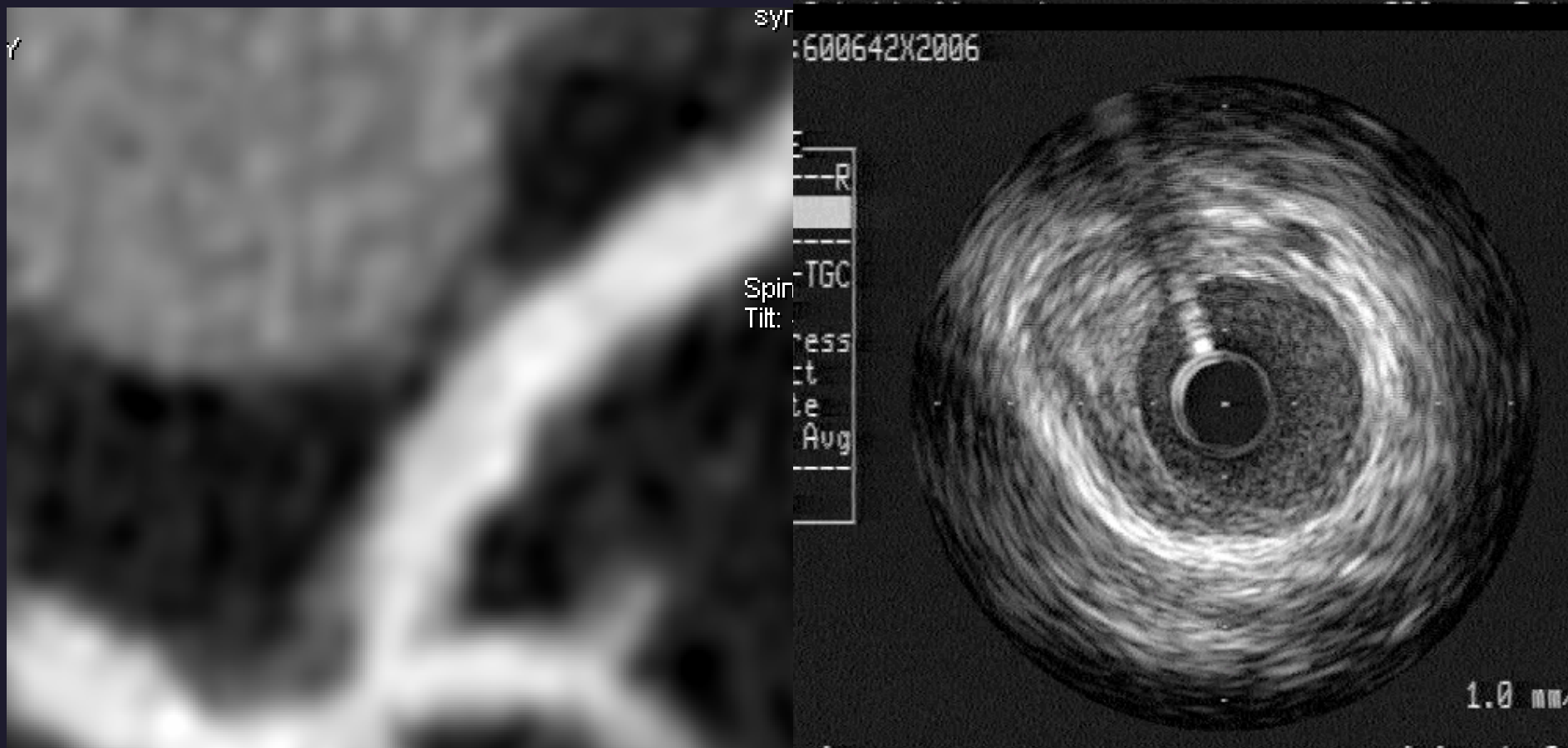
Schroeder <i>JACC</i> 2001	14 HU	91 HU
Becker <i>Eur Radiol</i> 2006	47 HU	104 HU
Leber <i>JACC</i> 2004	49 HU	91 HU
Carrascosa <i>AJC</i> 2006	71 HU	116 HU
Pohle <i>Atheroscler</i> 2007	58 HU	121 HU



Mean density: 46 HU



Pohle et al, Atherosclerosis 2006



Leber et al: 7//10
necrotic cores detectable
by 64 slice CT

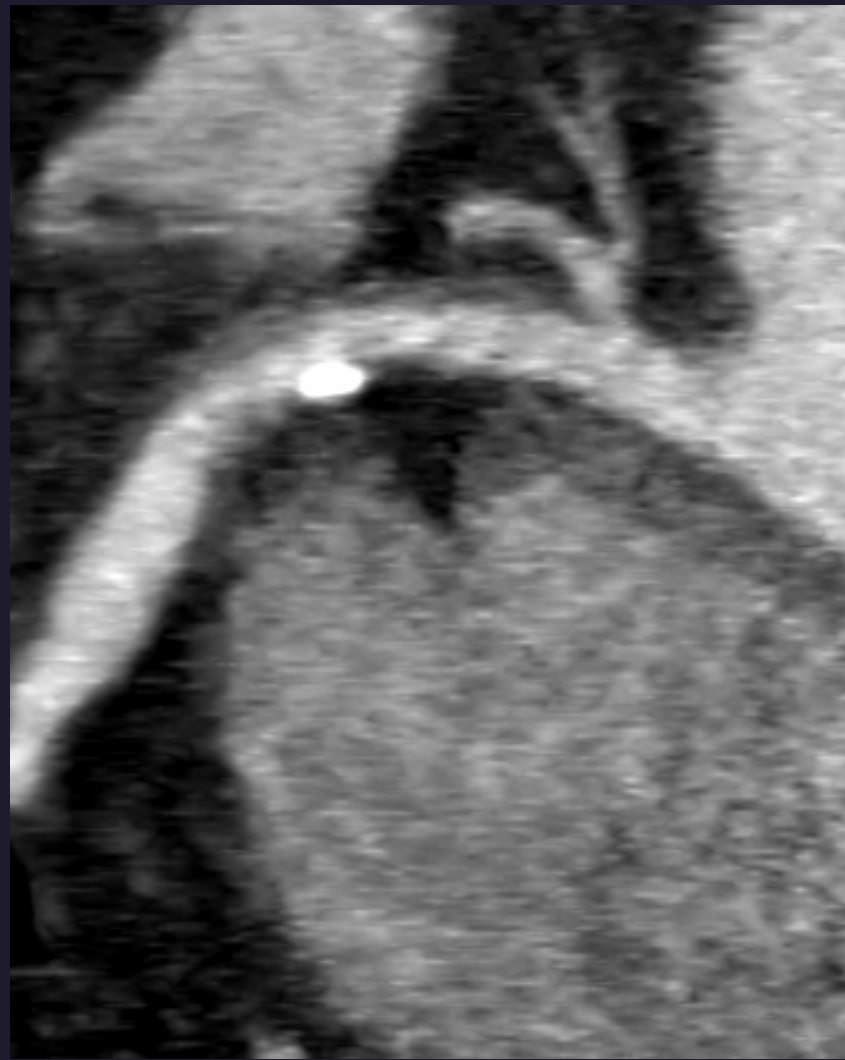
J Am Coll Cardiol 2006

Possible Factors Associated with Plaque „Vulnerability“ in CT:

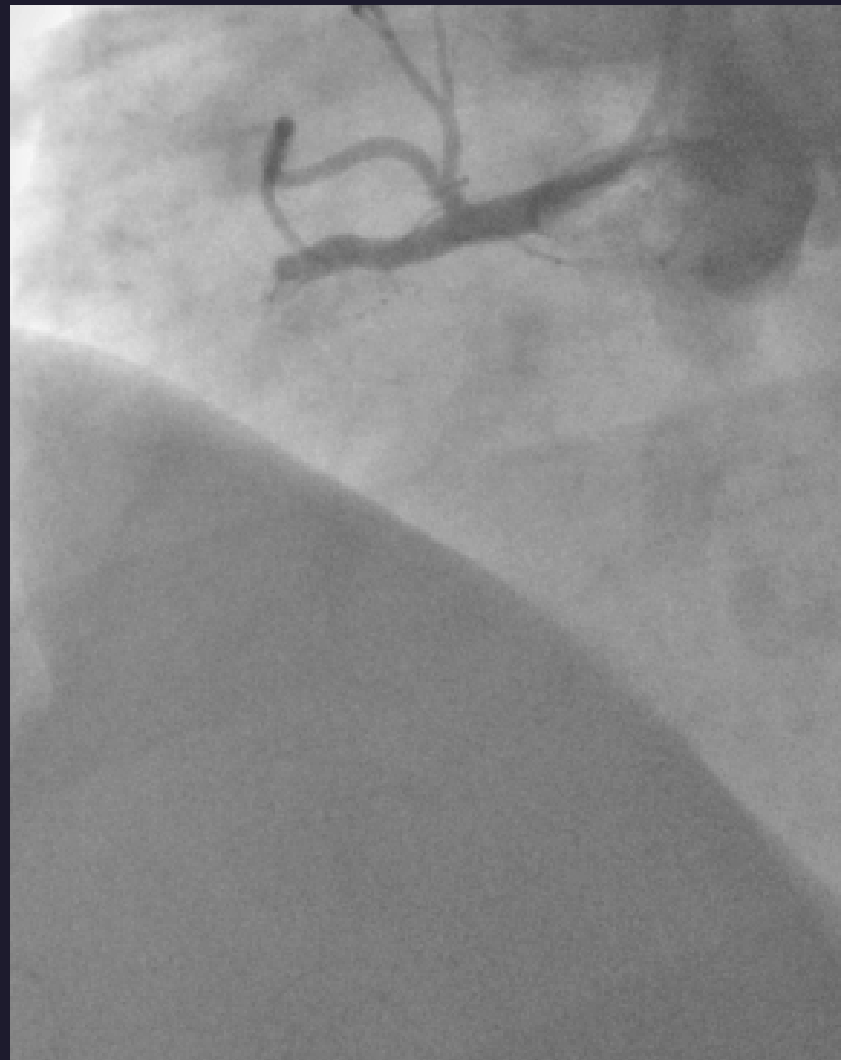
- Large plaque volume
- Positive remodeling
- Low CT attenuation
- Necrotic core??



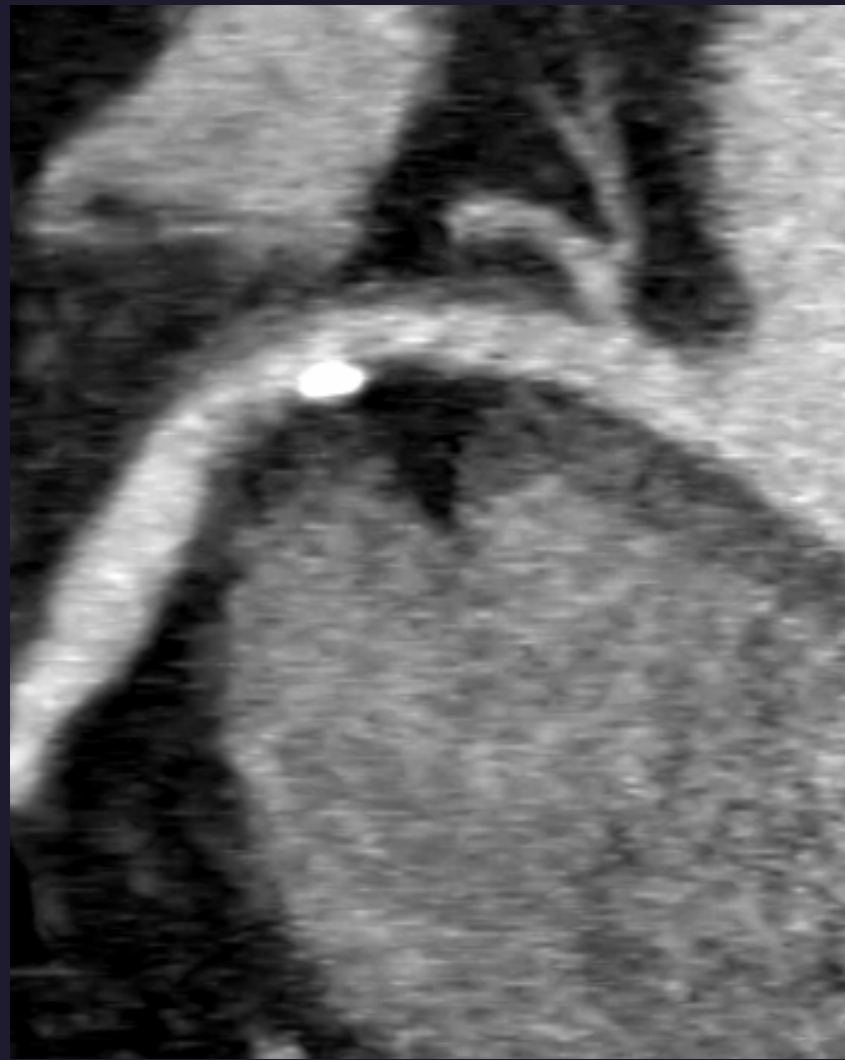
6/2006



6/2006



2/2007



6/2006

Clinical Significance?



Clinical Significance?

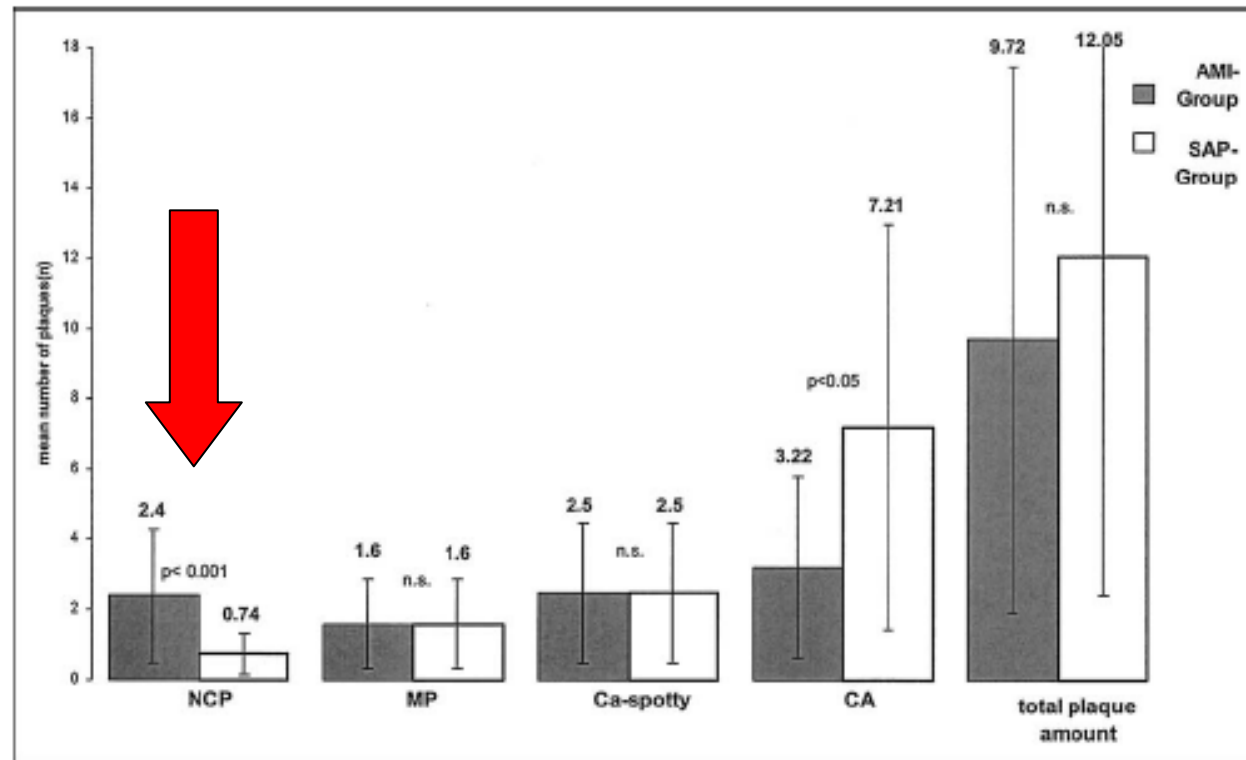


FIGURE 2. Average number of noncalcified plaques (NCP), mixed plaques (MP), spotty calcium (Ca), and heavy calcified plaques (CA) in the AMI and SAP groups.

Less overall plaque, but more non-calcified plaque in patients after acute MI

21 Patients with AMI

19 patients with stable AP

Leber et al, AJC 2003

Clinical Significance?

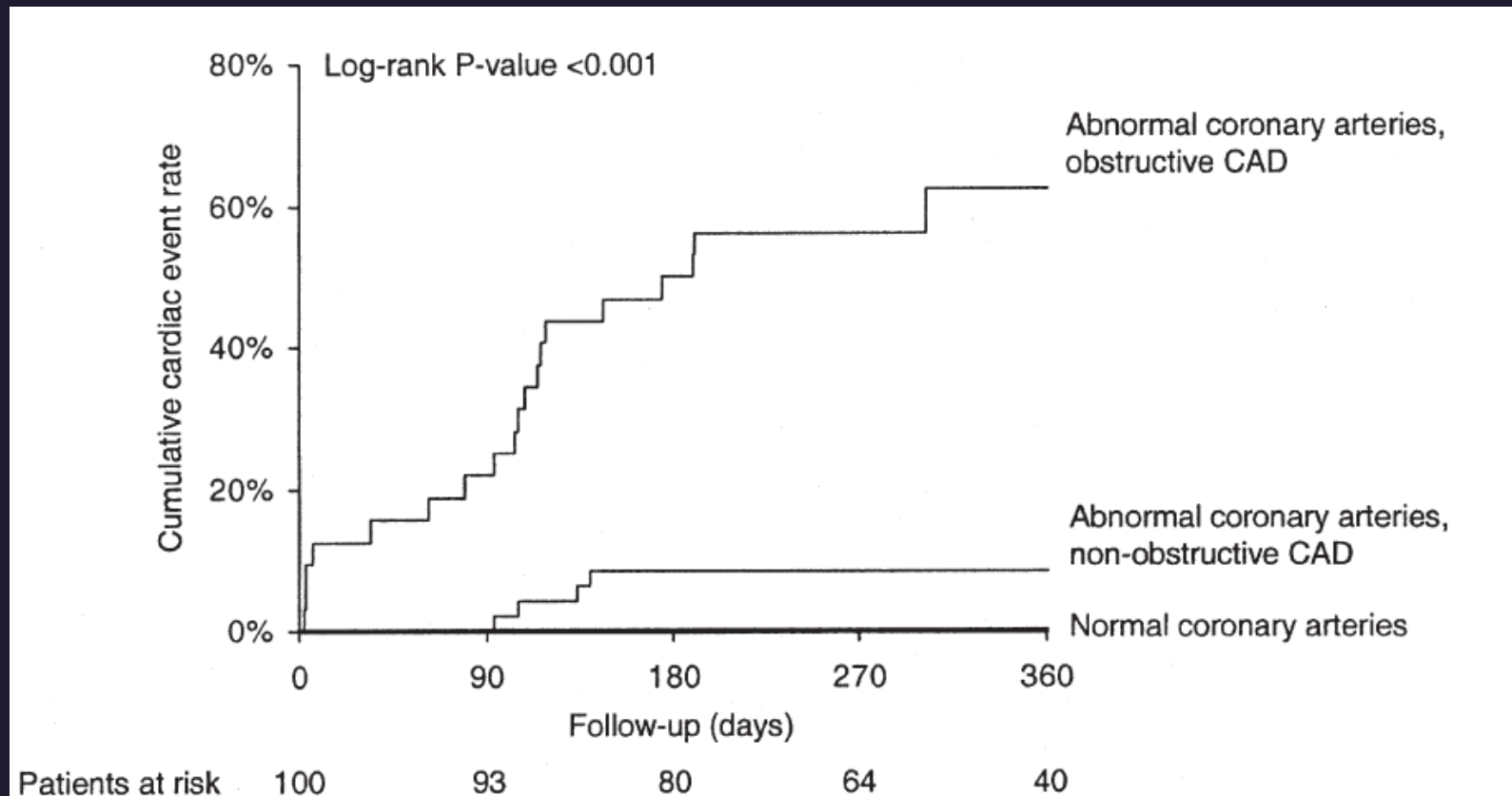


Figure 4

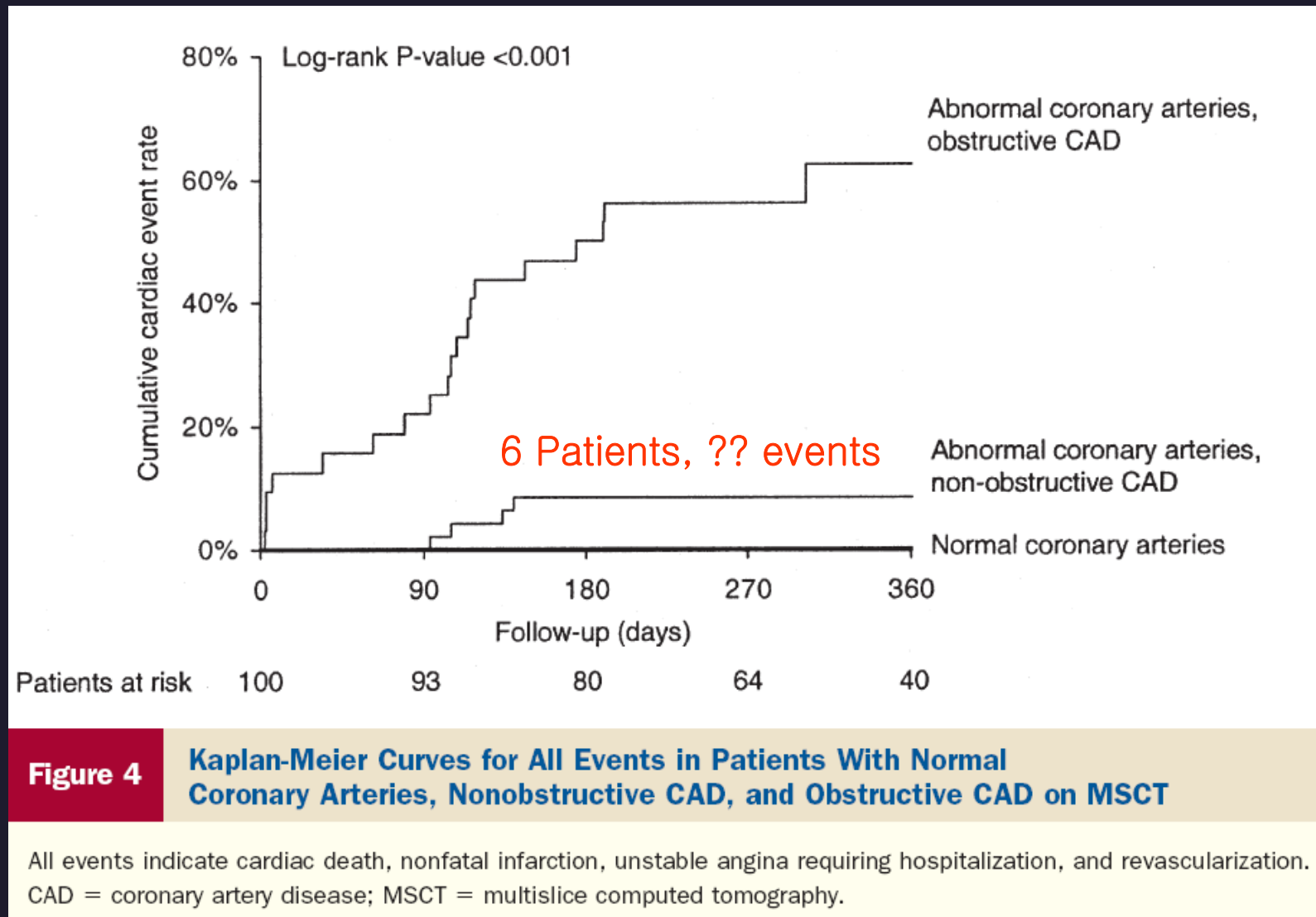
Kaplan-Meier Curves for All Events in Patients With Normal Coronary Arteries, Nonobstructive CAD, and Obstructive CAD on MSCT

All events indicate cardiac death, nonfatal infarction, unstable angina requiring hospitalization, and revascularization. CAD = coronary artery disease; MSCT = multislice computed tomography.

100 patients, 16 months

Pundzuite et al, JACC 2007

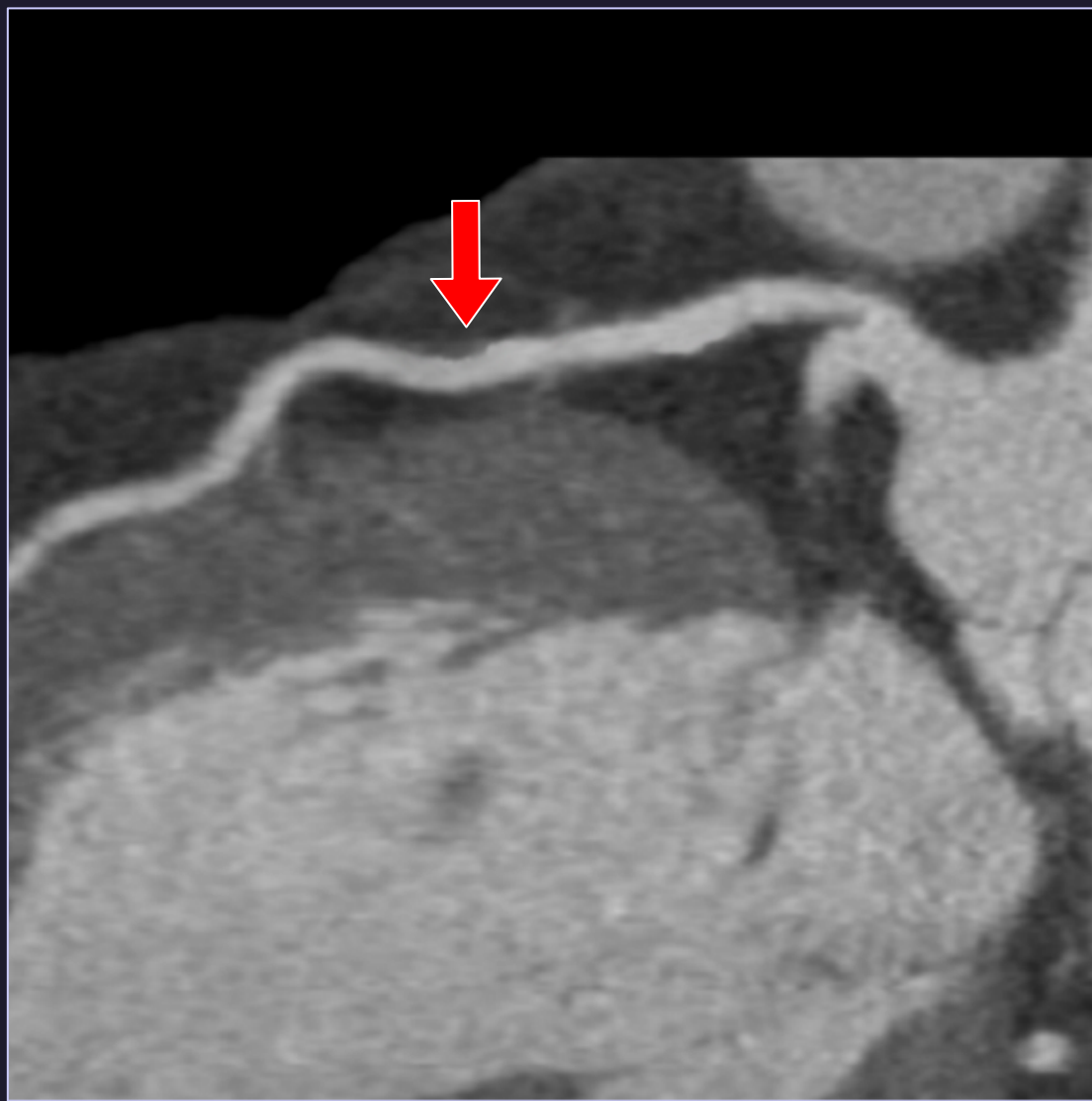
Clinical Significance?



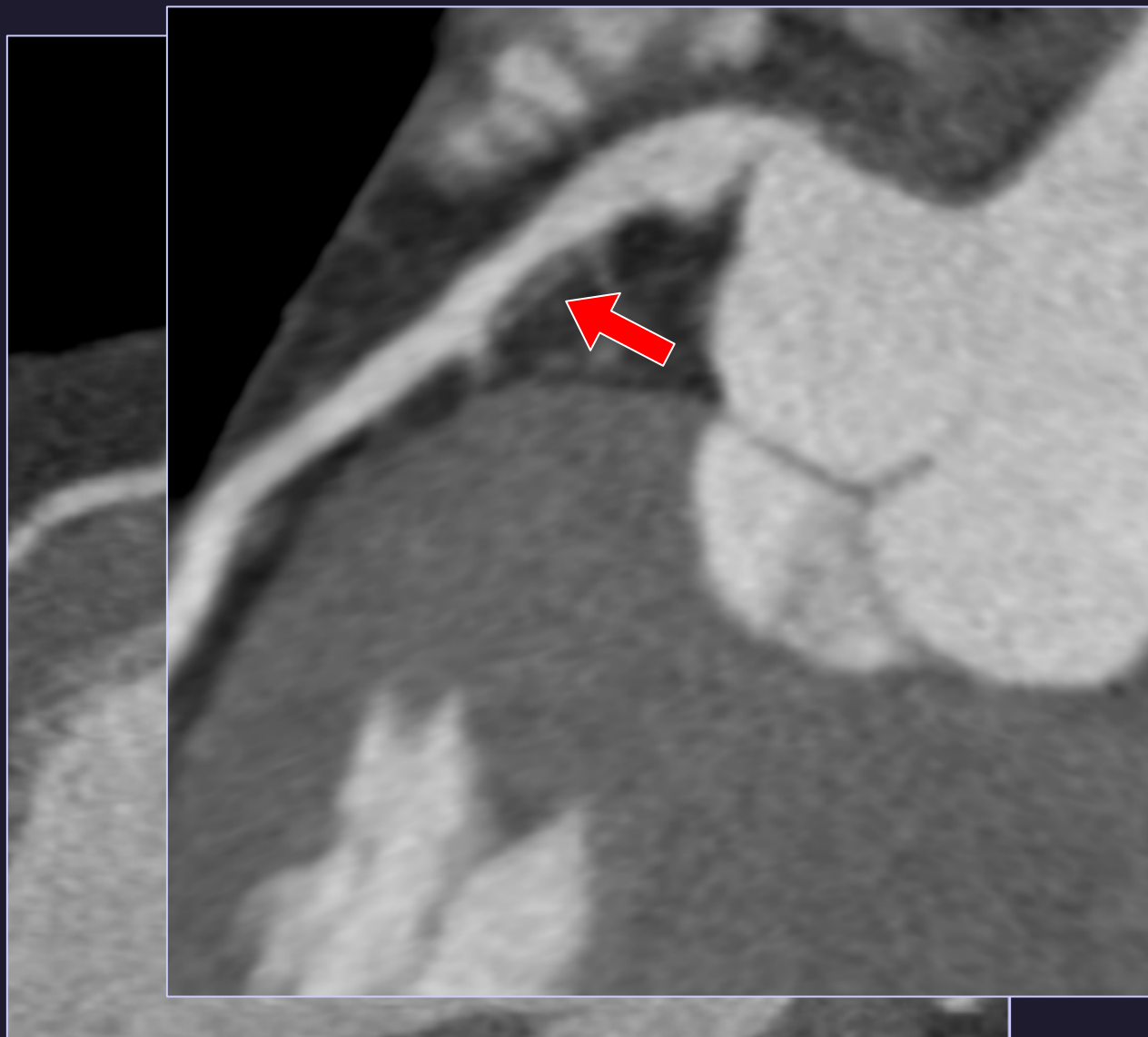
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Pundzuite et al, JACC 2007

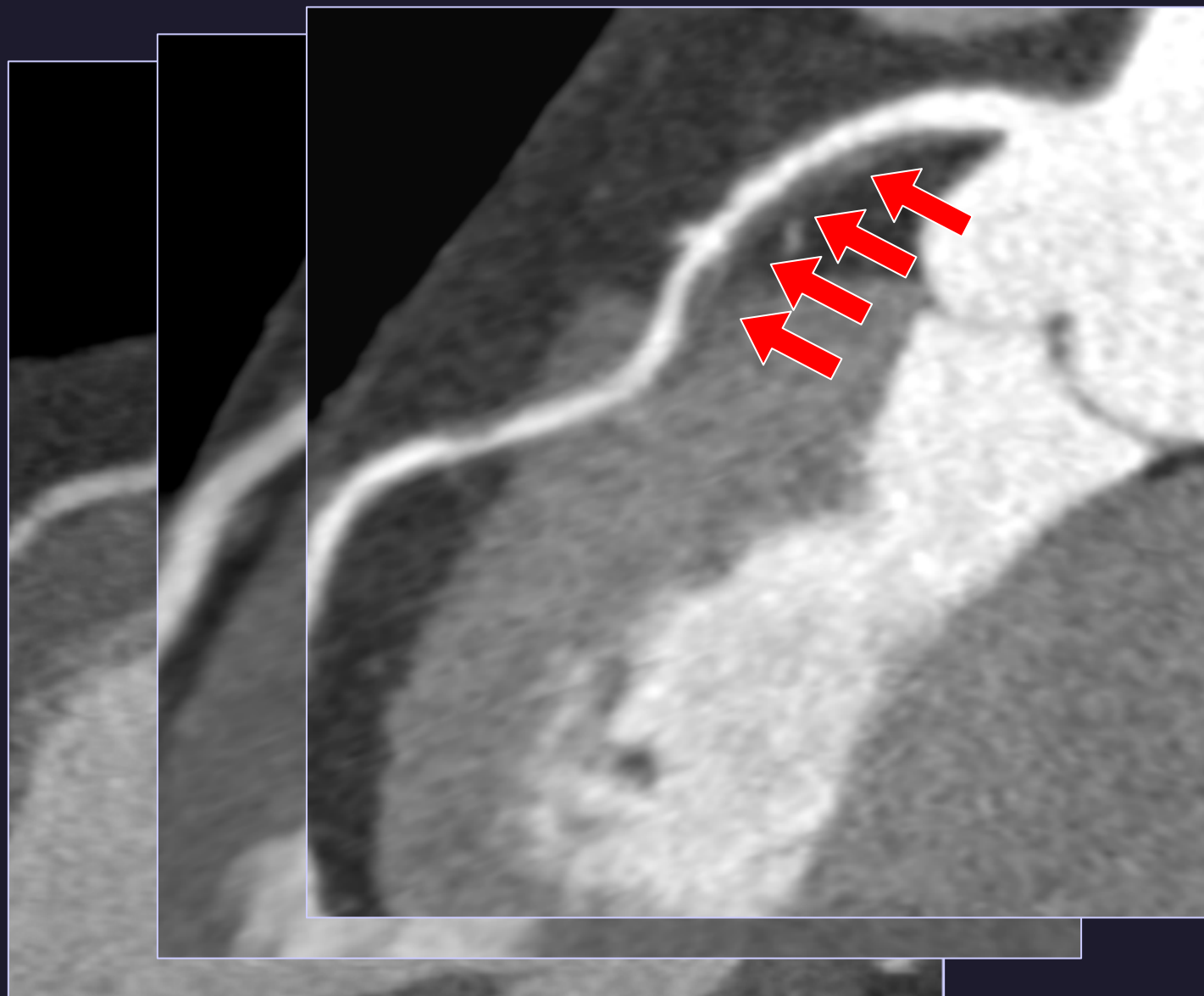
Where do we draw a line?



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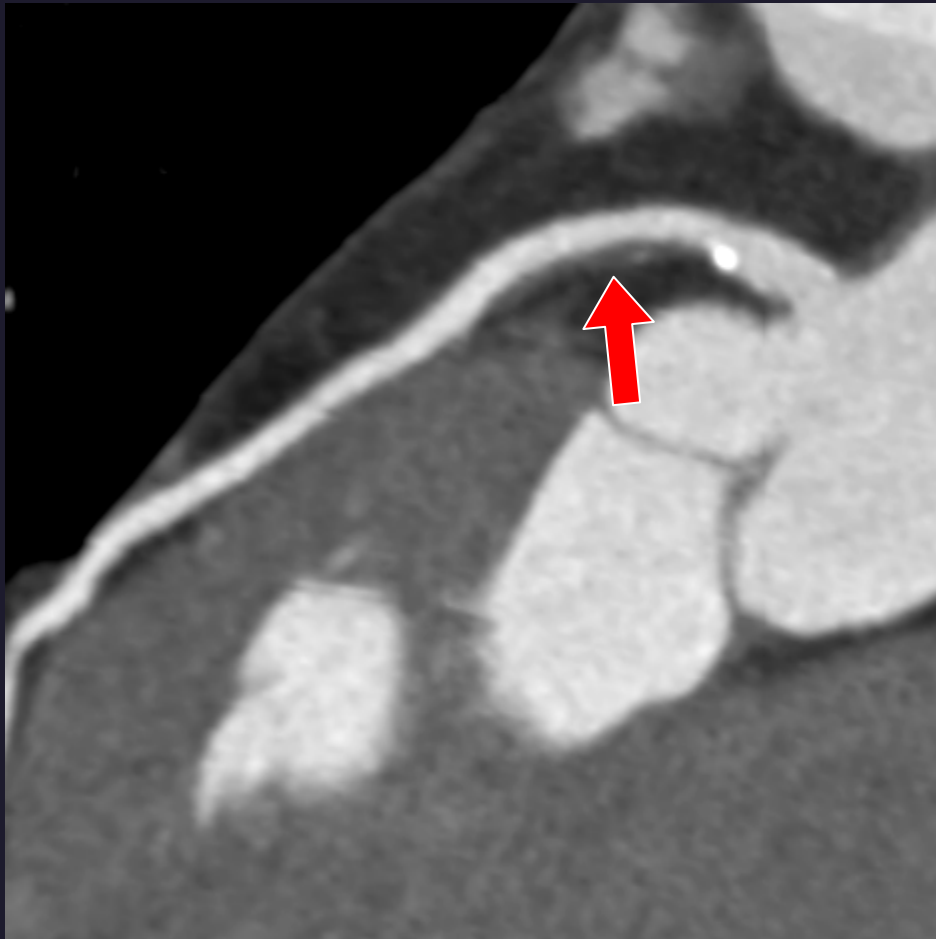
Where do we draw a line?



The ability of CT to often „see“ non-calcified coronary atherosclerotic plaque is promising.



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*Lack of clinical data
to justify CT
angiography specifically
for risk stratification or
to define plaque
„vulnerability“*

... I would admit:



Increased risk can be assumed

CT allows detection of calcified and non-calcified coronary plaque

Potential markers of vulnerability:

- Plaque volume
- Remodeling
- CT density

Lack of clinical data

