Role of MDCT in Detection, Evaluation, and Quantification of Restenosis

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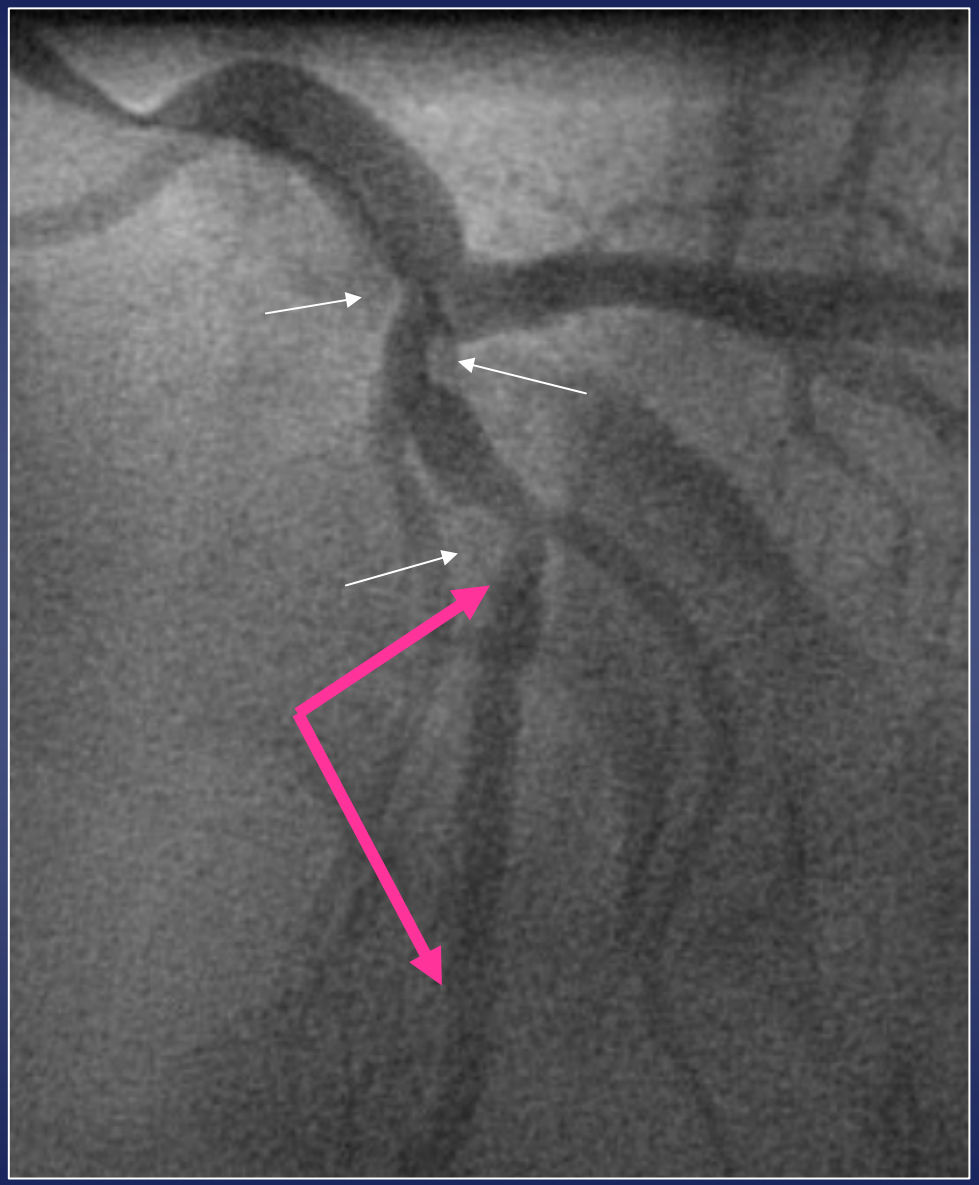
Overview

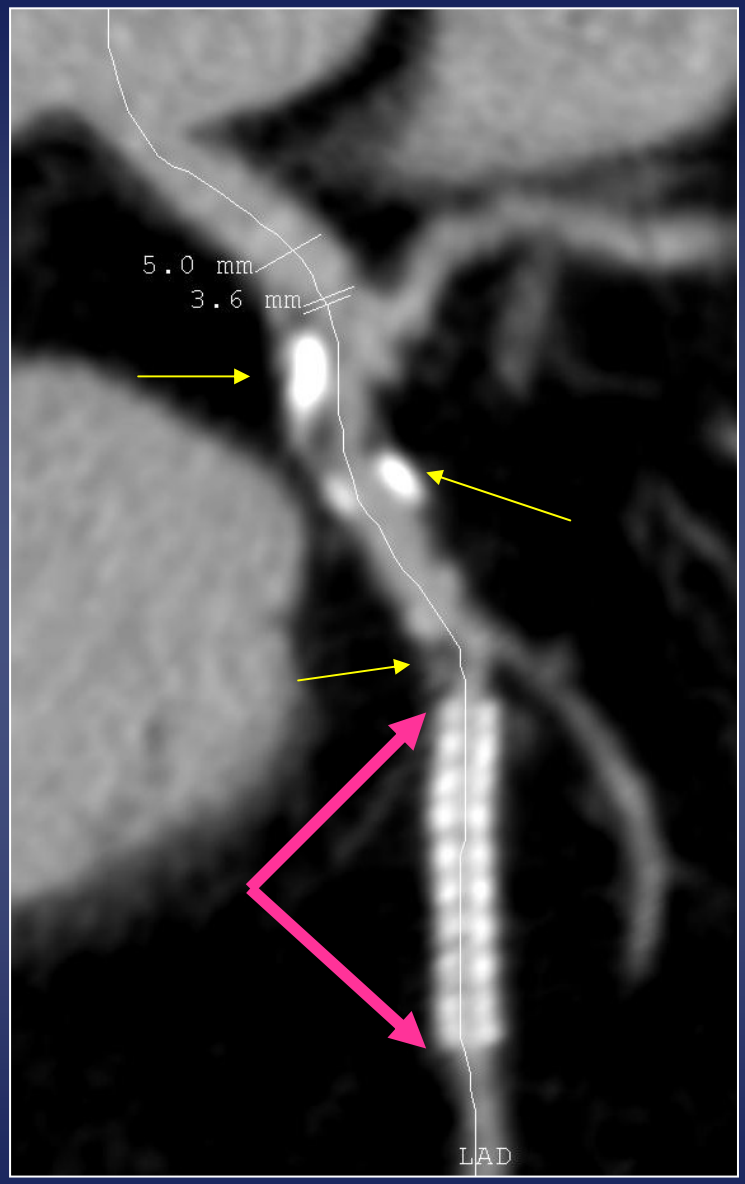
- Technical Aspects of Stent Imaging
- Clinical Examples
- Current / Recent Data
- Understand Applications & Limitations
- Clinical Aspects

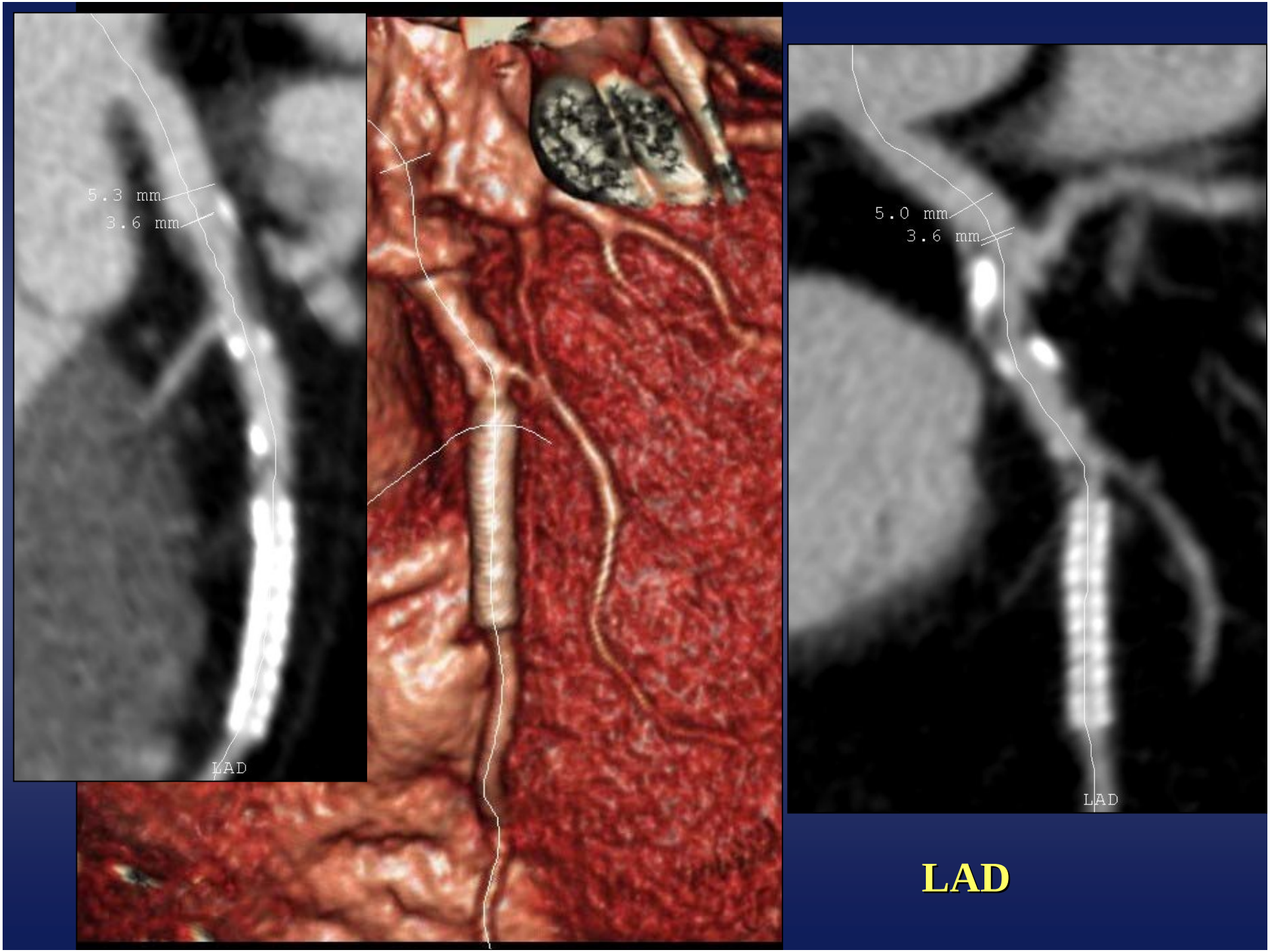
Cath Lab vs CT Lab Stent Imaging

- Dense material – Small volume
- Low radio-opacity by fluoroscopic x-ray
- Highly radio-opaque by tomographic x-ray

Proximal LAD

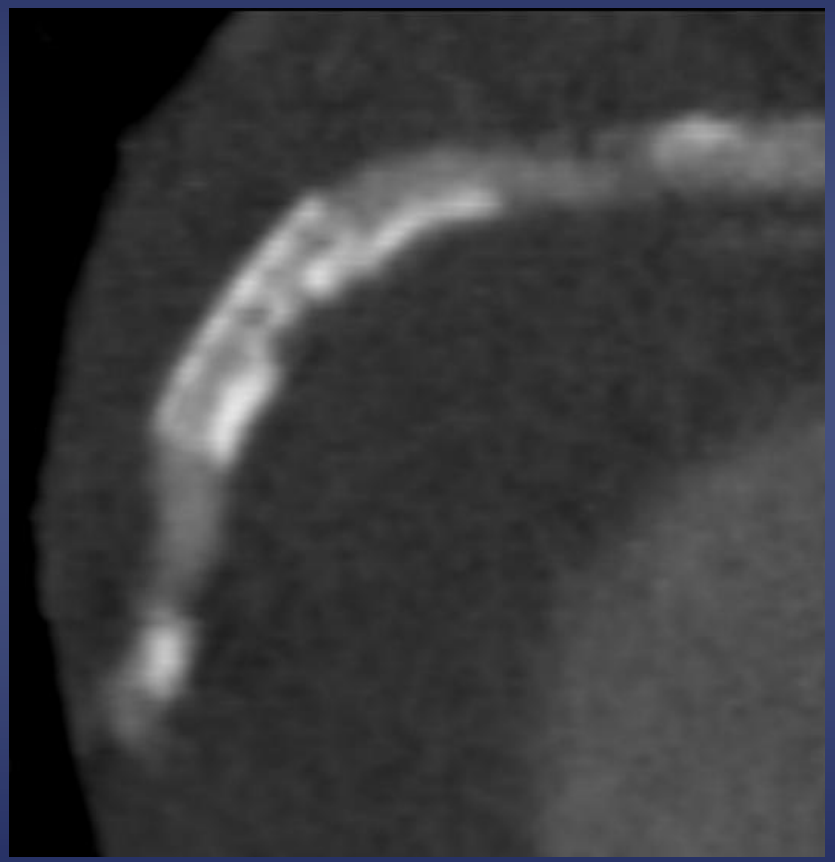


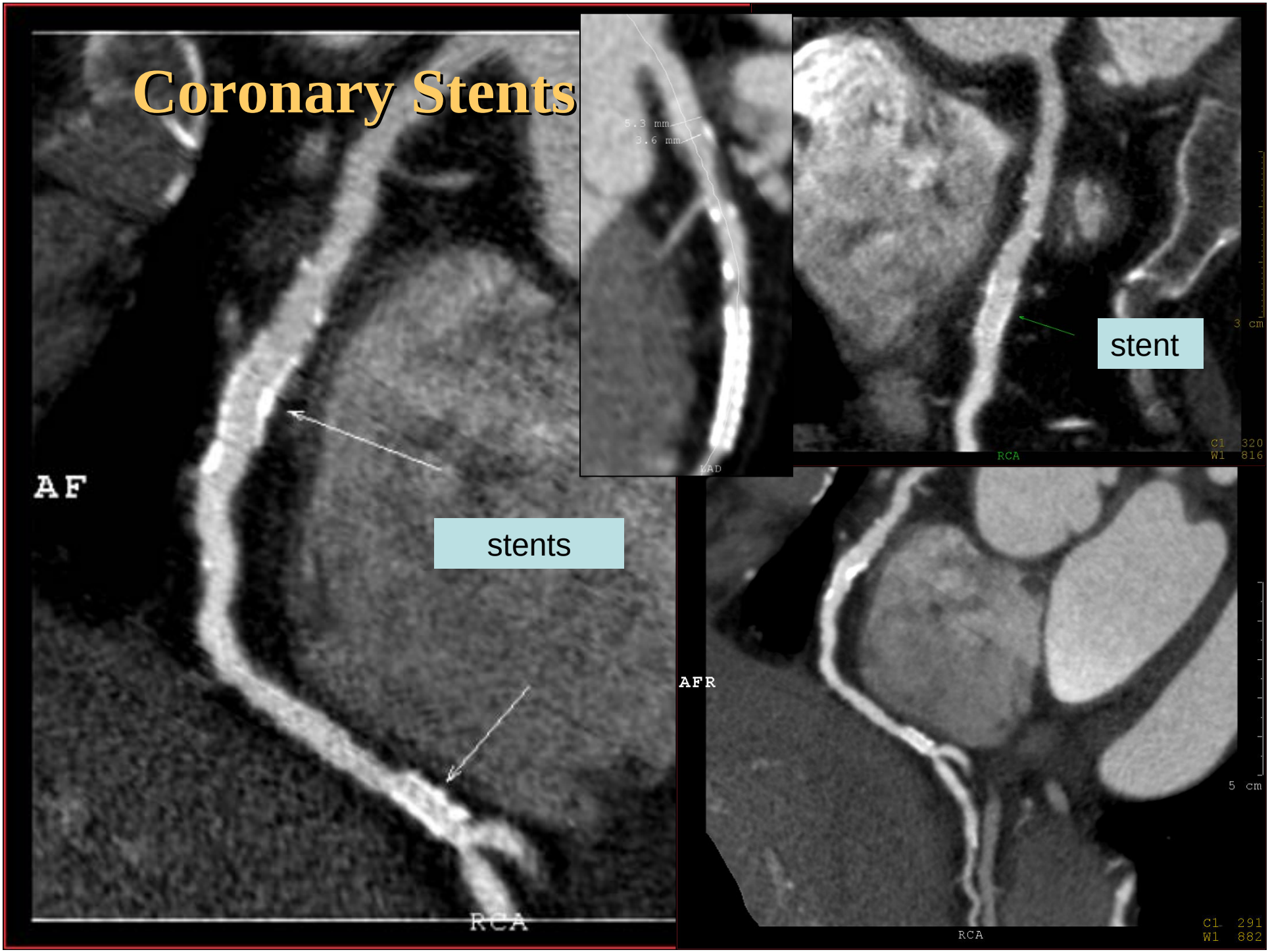




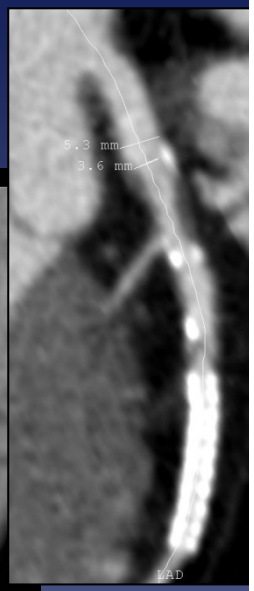
LAD

Metal “Blooming” Artifact = Poor Lumen Visualization



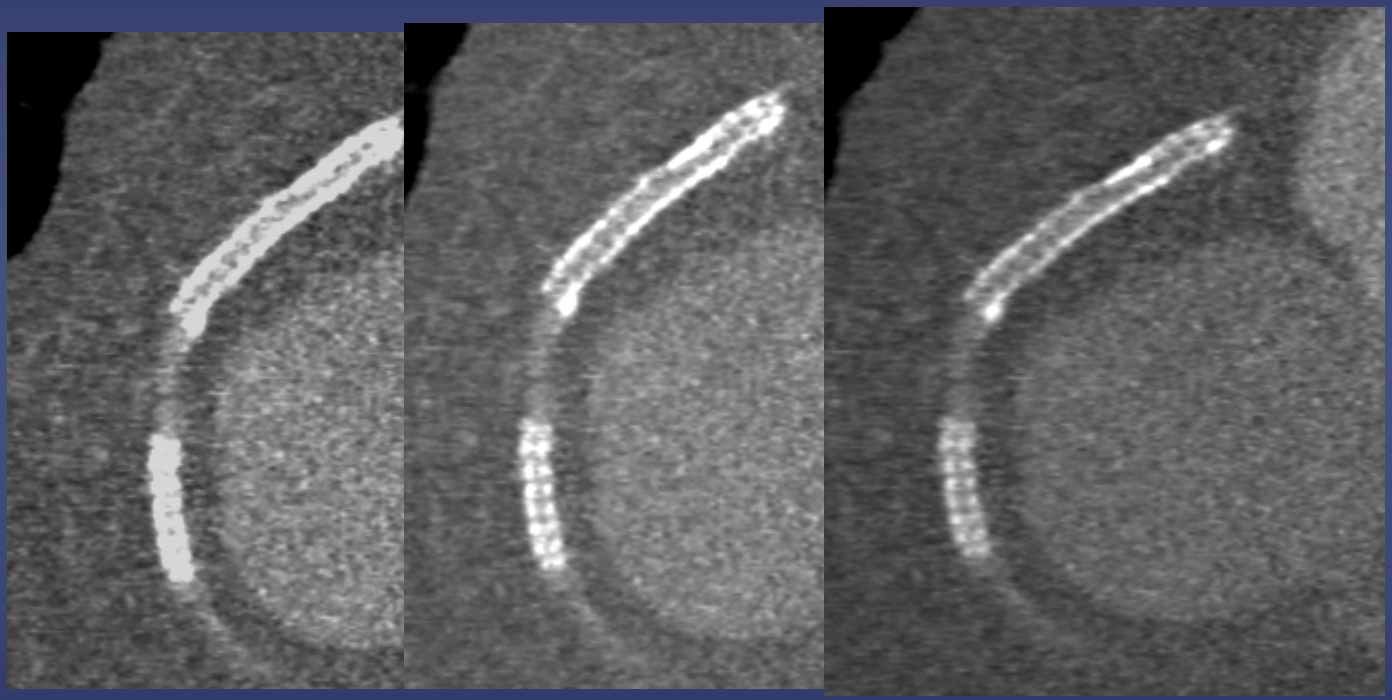

Coronary Stents
5.3 mm
3.6 mm
LAD
stent
3 cm
RCA
C1 320
W1 816
AF
stents
AFR
5 cm
RCA
C1 291
W1 882

Two patent stents proximal LAD



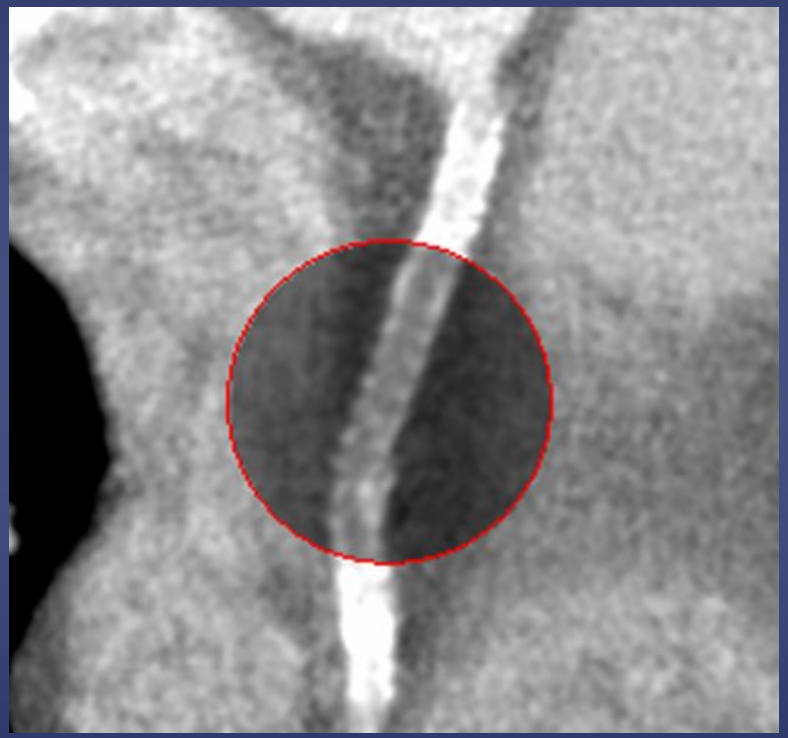
LMCA, RCA, and proximal LAD &
Circ stents are usually well visualized

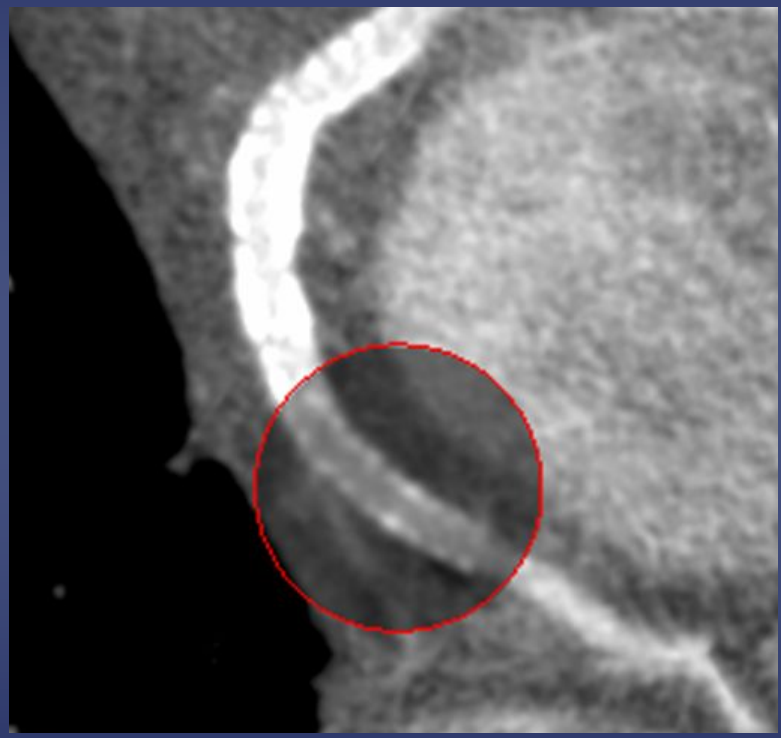
Adjusting window levels can help



64 MSCT of Cypher

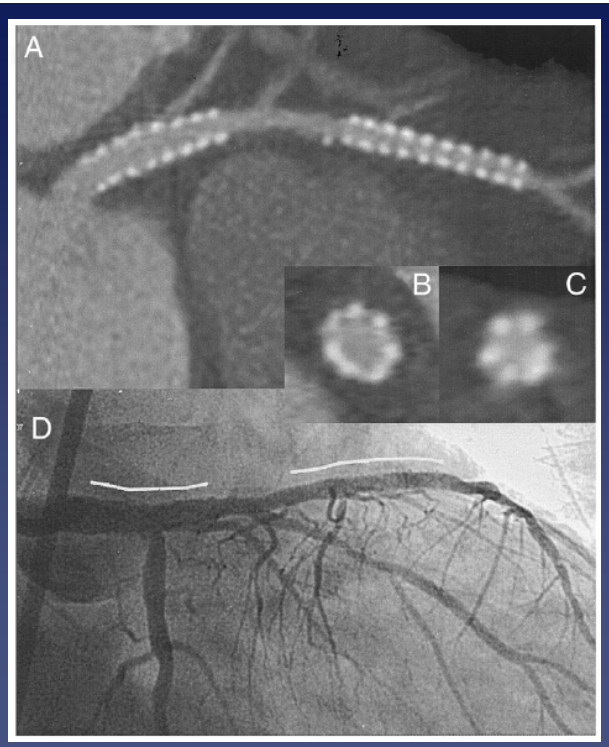
Special visualization tools

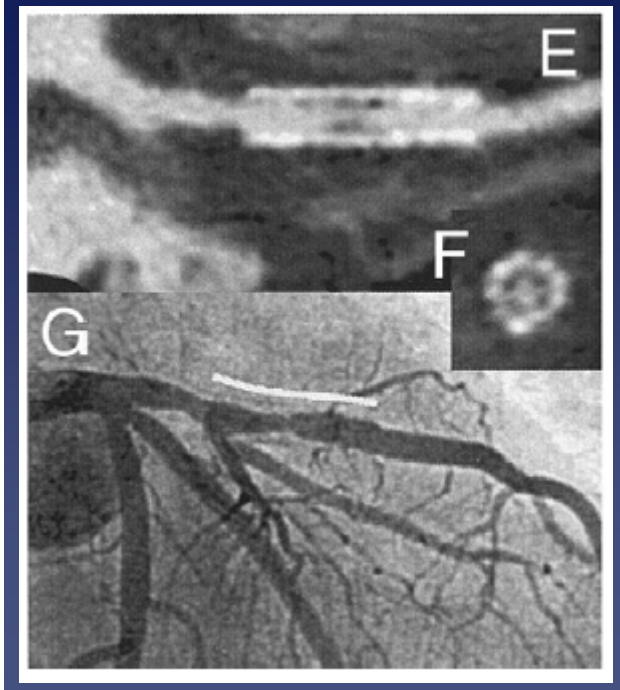


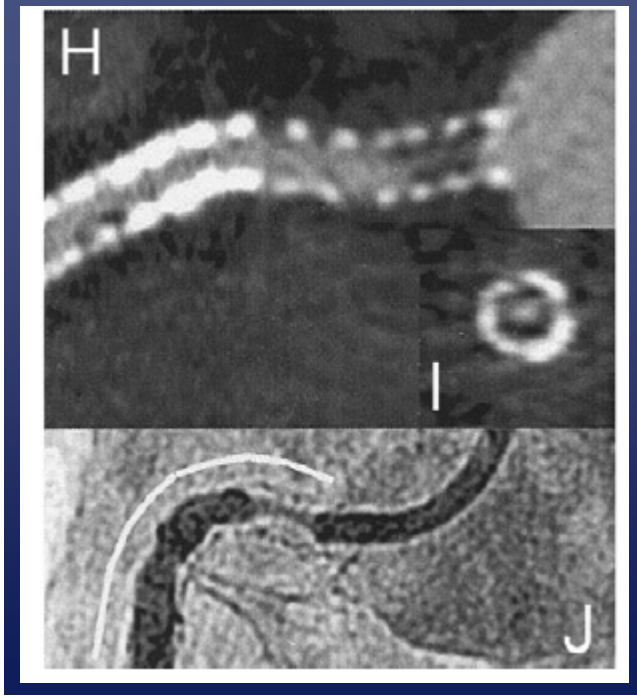


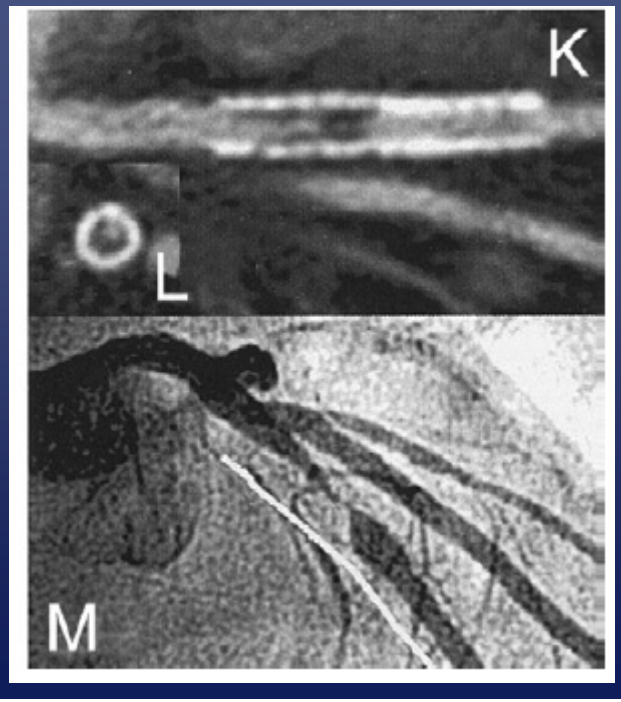
Cor CTA for Detection or Exclusion of ISR

Study	CT	N (stents)	% Evaluable	Sens	Specf	PPV	NPV
Cademartiri Radiol Med 2006	16	47	NR	83	98	83	97
Ohnuki Int J Cardiol 2006	16	20	96	75	88	NR	NR
Chabbert Eur Radiol 2006	16	121	NR	92	67	43	97
VanMieghem Circ 2006	16 & 64	70 (LM only)	100	100	91	67	100
Gaspar JACC 2006	40	111	96	99	81	48	97
Rist Acad Radiol 2006	64	46	98	75	92	67	94
Ehara JACC 2007	64	121	88	92	81	54	98
Oncel Radiol 2007	64	39	95	89	95	94	90
Bax JACC 2007	64	192	93	95	93	63	99





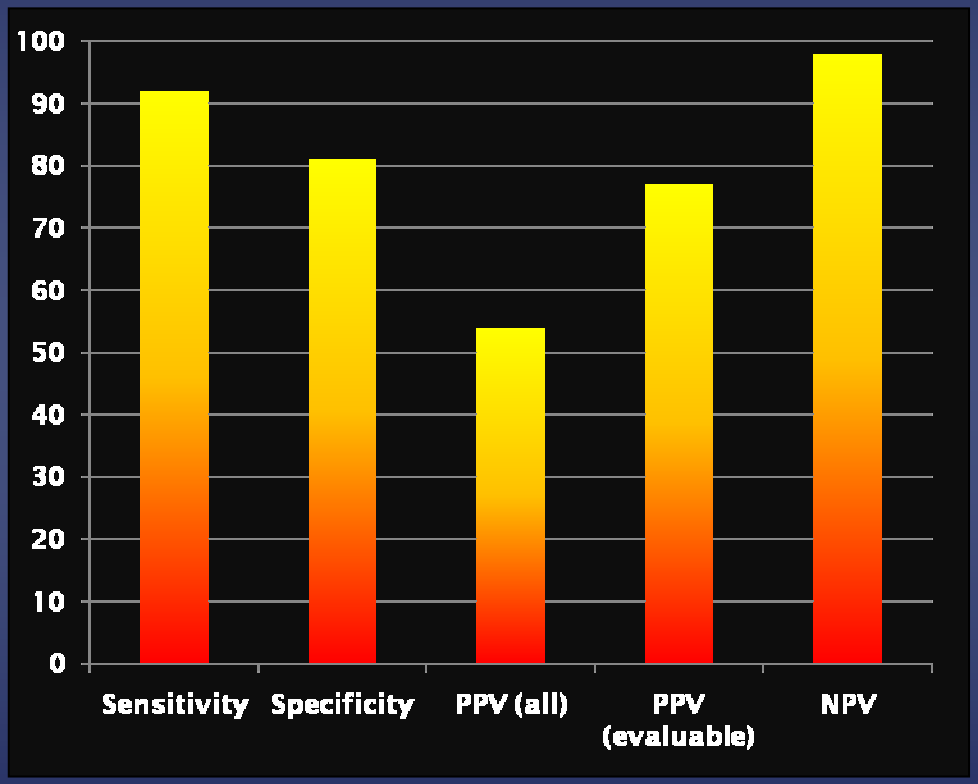




Mild (E-G), Moderate (H-J), and Severe (K-M) neointimal proliferation and in-stent stenosis. Moderate and Severe considered to indicate binary restenosis (>50%)

From: Ehara, 2007

Challenges of Stenosis Quantification in Stents by CTA



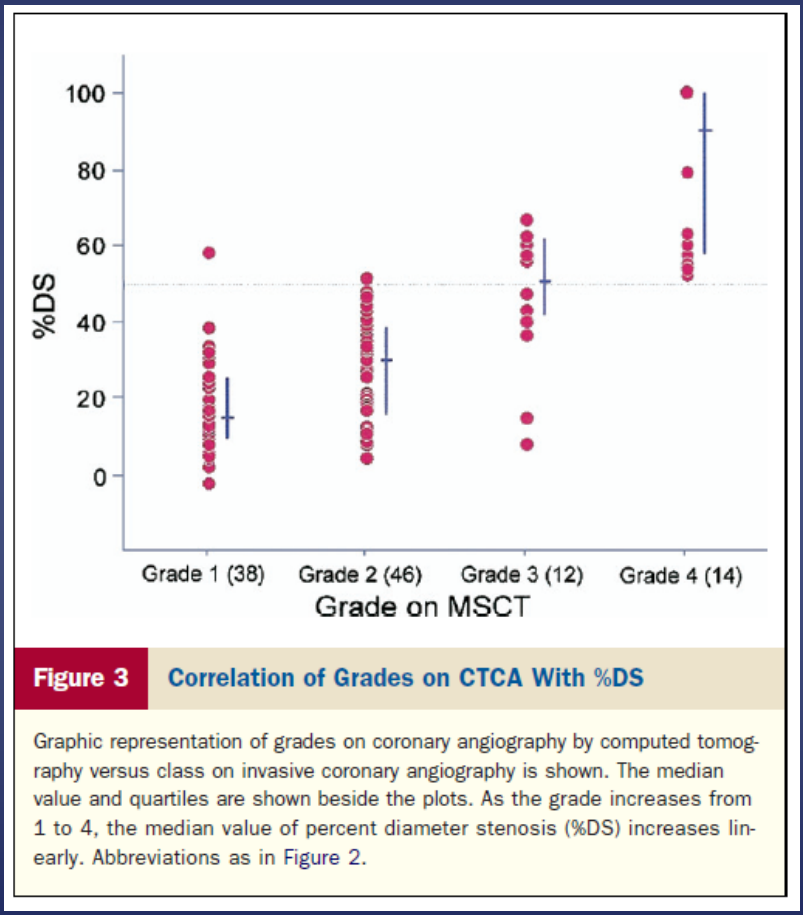


Figure 3 **Correlation of Grades on CTCA With %DS**

Graphic representation of grades on coronary angiography by computed tomography versus class on invasive coronary angiography is shown. The median value and quartiles are shown beside the plots. As the grade increases from 1 to 4, the median value of percent diameter stenosis (%DS) increases linearly. Abbreviations as in Figure 2.

Motion artifact & calcification are the most common reasons for inaccuracy

Determinants of Stent Lumen **Evaluability**

	Schuijf
Thick (>140um)	41
Thin	89
</= 3.0mm	72
>3.0mm	89
LAD	
LCX	
RCA	

Schuijf 2004 AJC
Ligabue 2004 Radiol Med
Kitagawa 2006 Int J Cardiol
Gilard M 2006 Heart

Determinants of Stent Lumen **Evaluability**

	Schuijf	Ligabue
Thick (>140um)	41	
Thin	89	
</= 3.0mm	72	33
>3.0mm	89	85
LAD		82
LCX		76
RCA		52

Schuijf 2004 AJC
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Determinants of Stent Lumen **Evaluability**

	Schuijf	Ligabue	Kitagawa
Thick (>140um)	41		
Thin	89		
</= 3.0mm	72	33	57
>3.0mm	89	85	88
LAD		82	
LCX		76	
RCA		52	

Schuijf 2004 AJC
Ligabue 2004 Radiol Med
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Determinants of Stent Lumen **Evaluability**

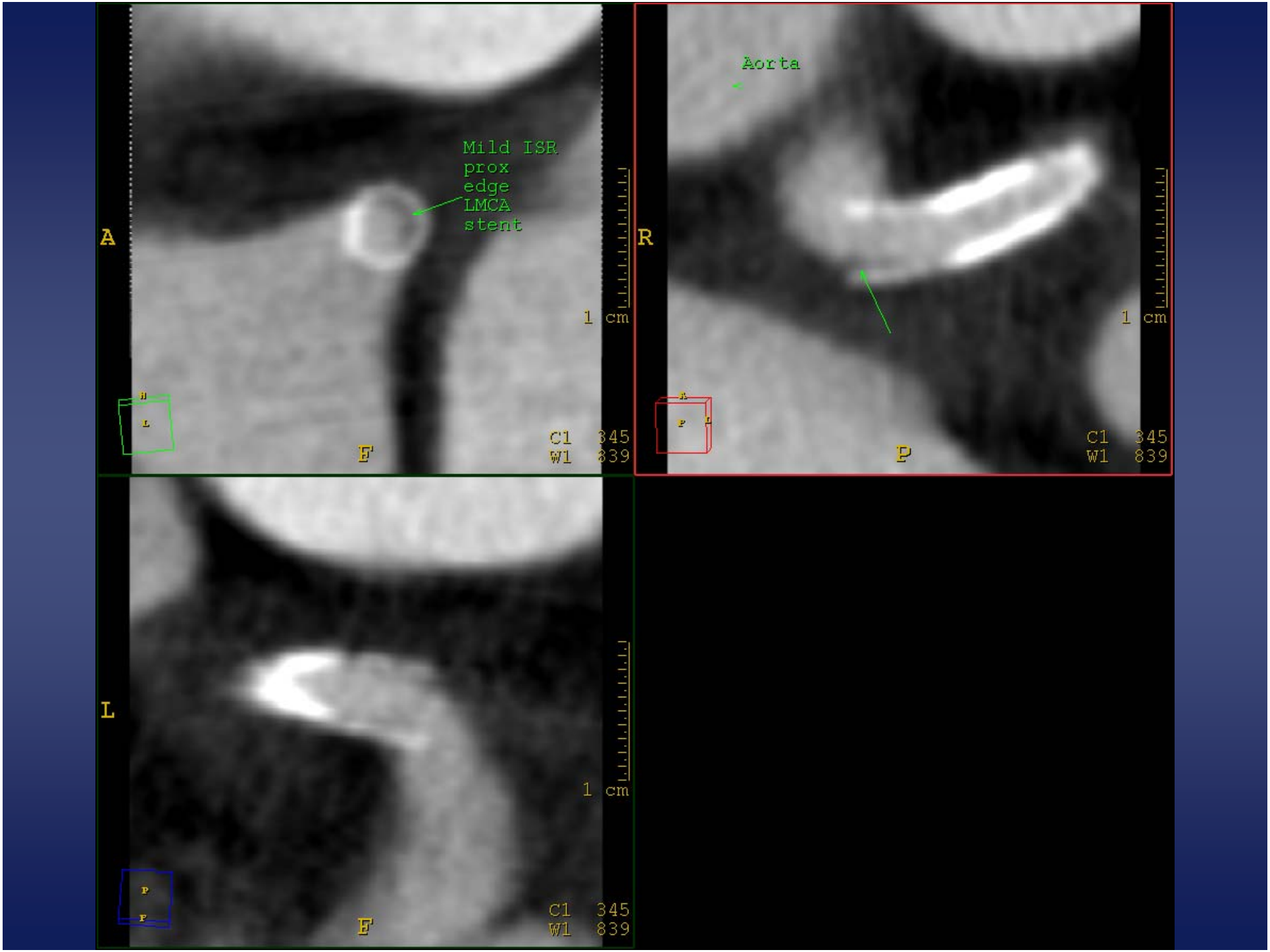
	Schuijf	Ligabue	Kitagawa	Gilard
Thick (>140um)	41			
Thin	89			
</= 3.0mm	72	33	57	51
>3.0mm	89	85	88	81
LAD		82		
LCX		76		
RCA		52		

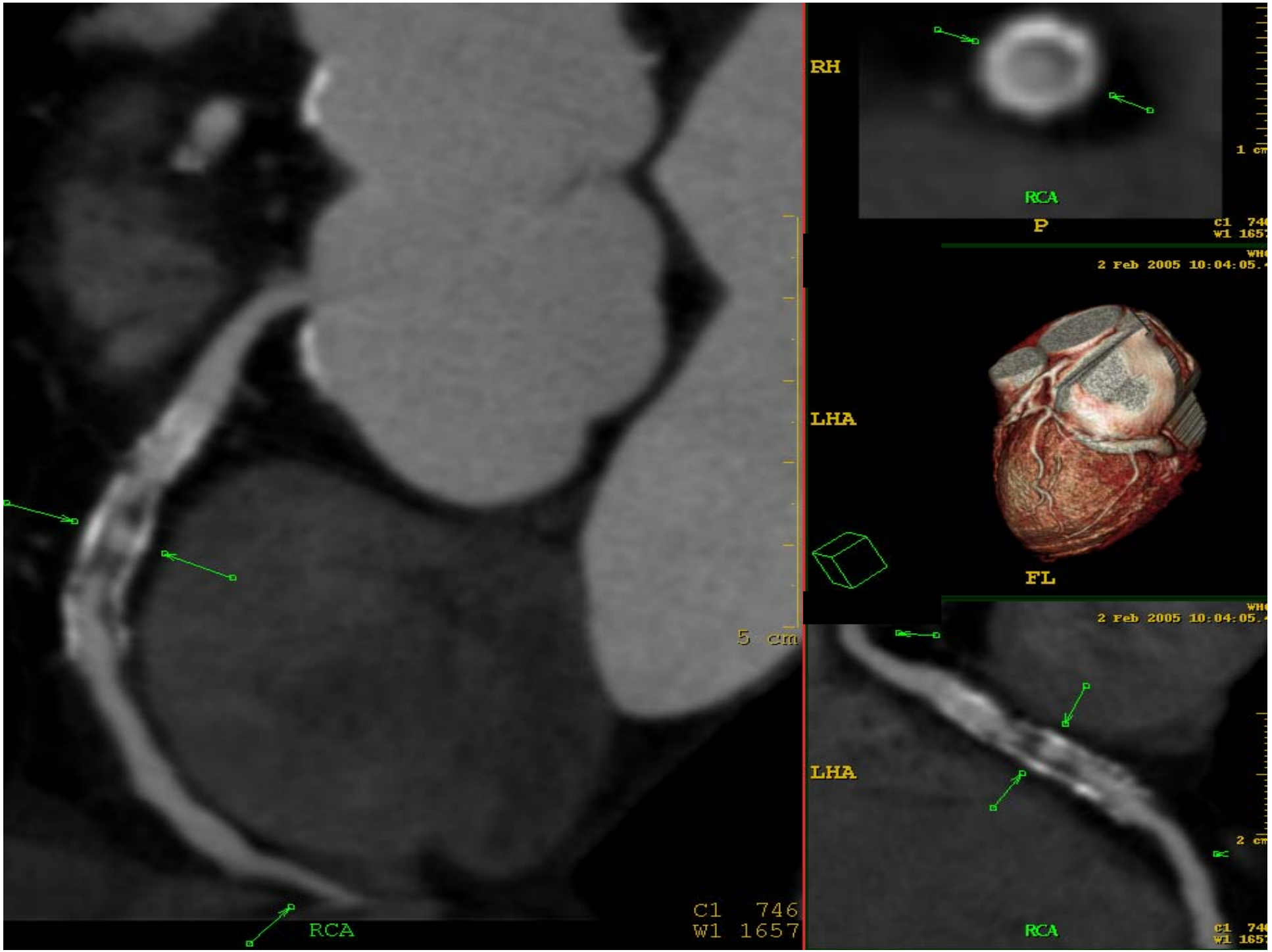
Schuijf 2004 AJC
Ligabue 2004 Radiol Med
Kitagawa 2006 Int J Cardiol
Gilard M 2006 Heart

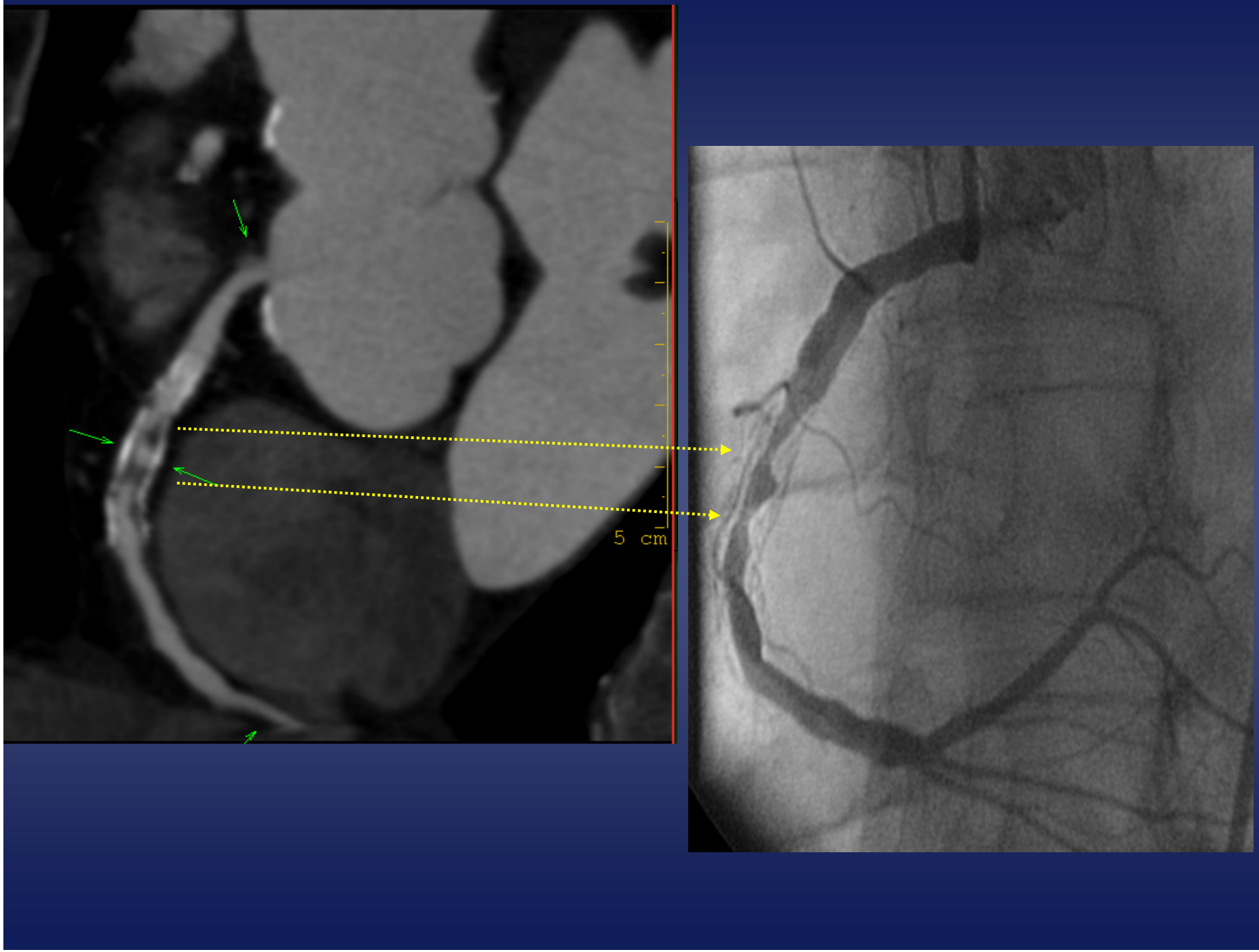
Determinants of Stent Lumen Evaluability

- Size (< 3mm = reduced evaluability)
- Strut Thickness (>100-140 um = decr. eval.)
- Strut material
- Location
- Calcium
- Length

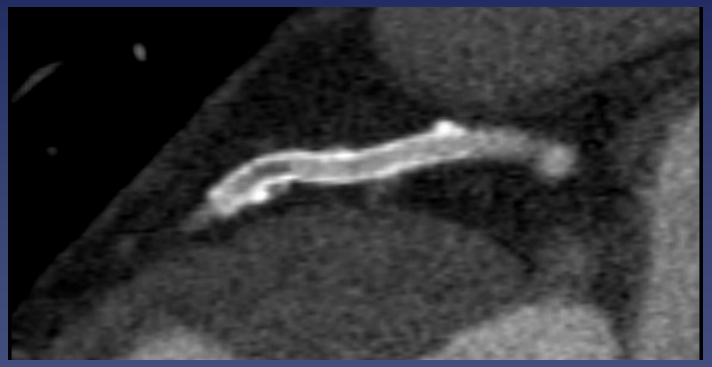
Maintz et al Eur Rad 2005

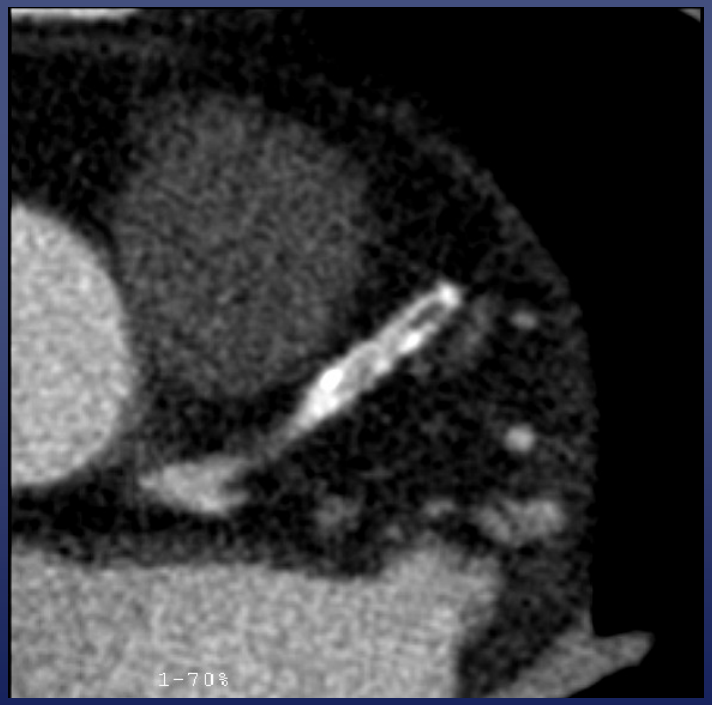

Mild ISR
prox
edge
LMCA
stent
A
F
1 cm
C1 345
W1 839
Aorta
R
P
1 cm
C1 345
W1 839
L
F
1 cm
C1 345
W1 839


RH
RCA
P
1 cm
C1 746
W1 1657
2 Feb 2005 10:04:05.
LHA
FL
5 cm
LHA
2 cm
RCA
RCA
C1 746
W1 1657

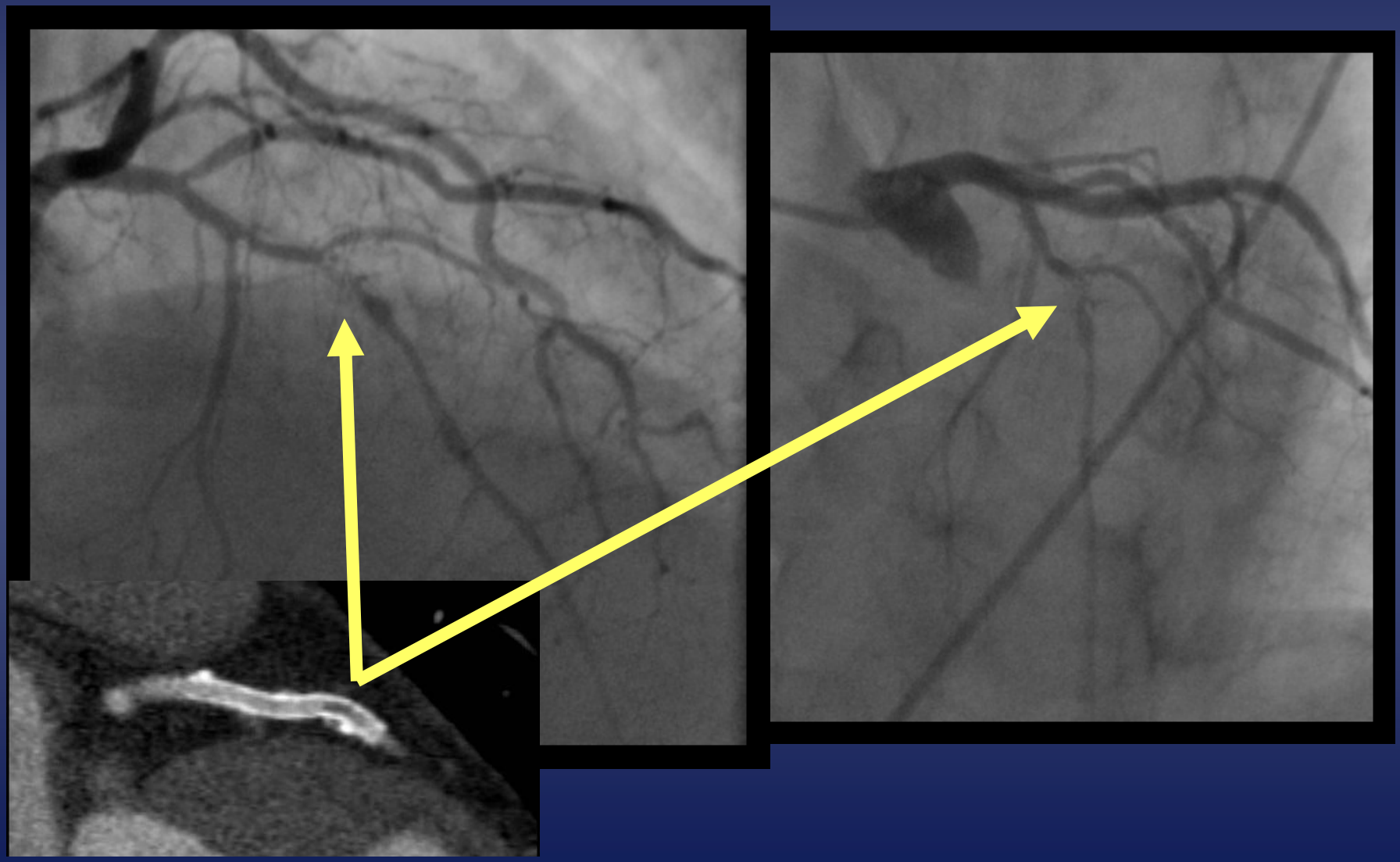

5 cm

Stent





Left coronary artery



Impact of Stent Characteristics on Accuracy (Dx/Excl of ISR)

Stent Size	N pt/stents	Sensitivity %	Specificity %	Uneval %
Gilard	143/232			37
</= 3.0mm		54	100	
>3.0		86	100	

Gilard M et al Heart 2006 92 58-61
Gaspar T JACC 2005 46 1573-9

Impact of Stent Characteristics on Accuracy (Dx/Excl of ISR)

Stent Size	N pt/stents	Sensitivity %	Specificity %	Uneval %
Gilard	143/232			37
</= 3.0mm		54	100	
>3.0		86	100	
Gaspar	65/111			5
In Stent		63	78	
In Segment		78	69	

Gilard M et al Heart 2006 92 58-61
Gaspar T JACC 2005 46 1573-9

Stent Evaluation by CTA: Clinical Practice

- Obtain stent history / information if possible
  - Limited number of stents (1-2) in proximal segments /distal segments
- Strict patie)
- In the righ d way to evaluate restenosis
- In routine use post-PCI for follow-up *(ie asymptomatic)* beware of incomplete or inconclusive exam and high false positive rate