SOLACI '12
MEXICO DF
In partnership with TCT

Use of IVUS for Intermediate Lesion Assessment

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Intermediate Lesions

- Definition and Incidence
- Limitations: coronary angiography
- IVUS : criteria validation
- IVUS: when to intervene?
- Clinical Implications

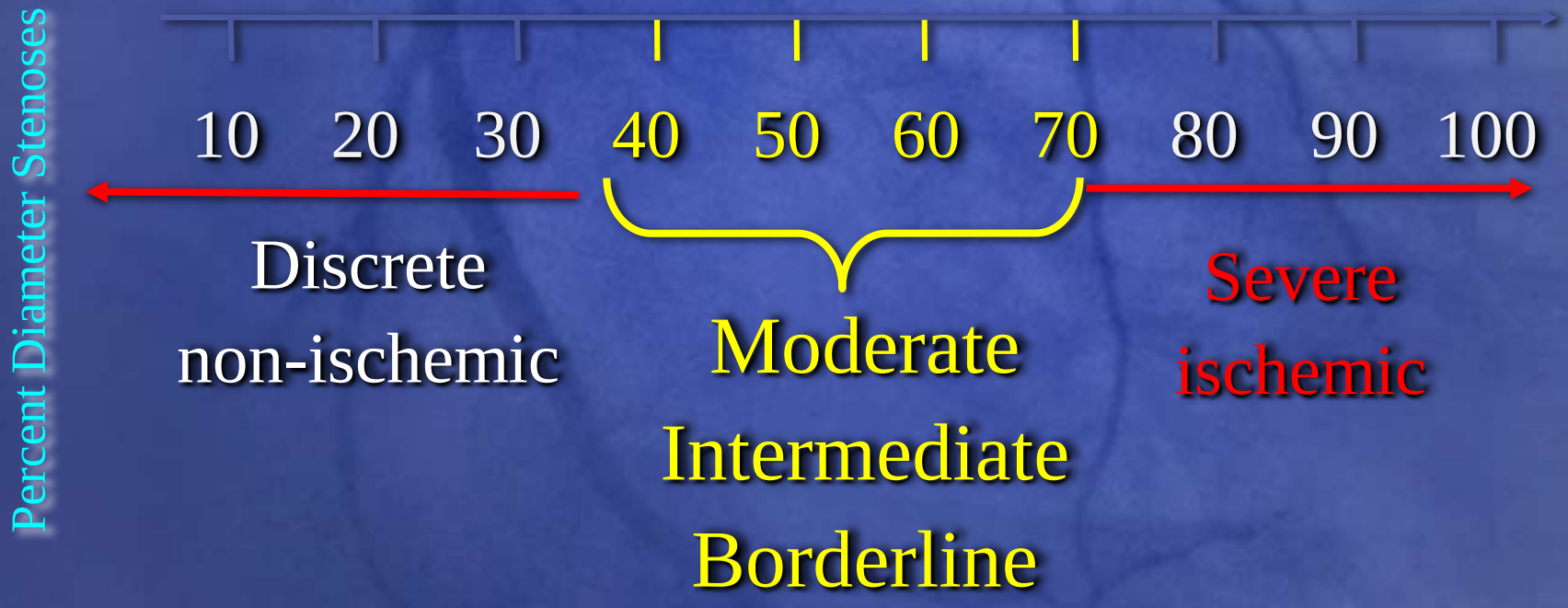
Intermediate lesions: Clinical Significance?

”Stenosis is like **beauty**: it's hard to define, but **you know** it **when you see it**"

UT Health Science Center

Intermediate Coronary Lesion

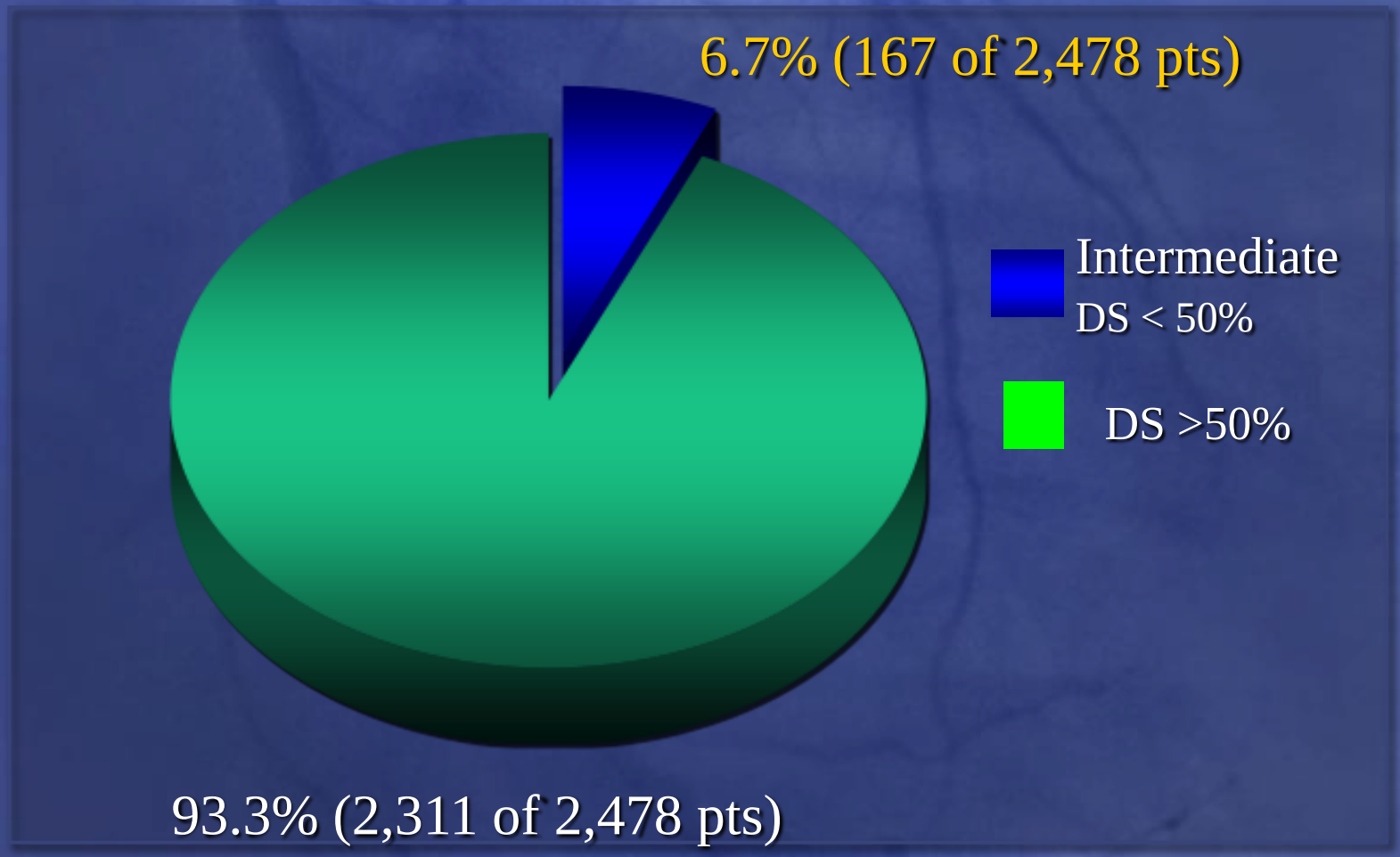
Angiographic Significance of Coronary Lesions



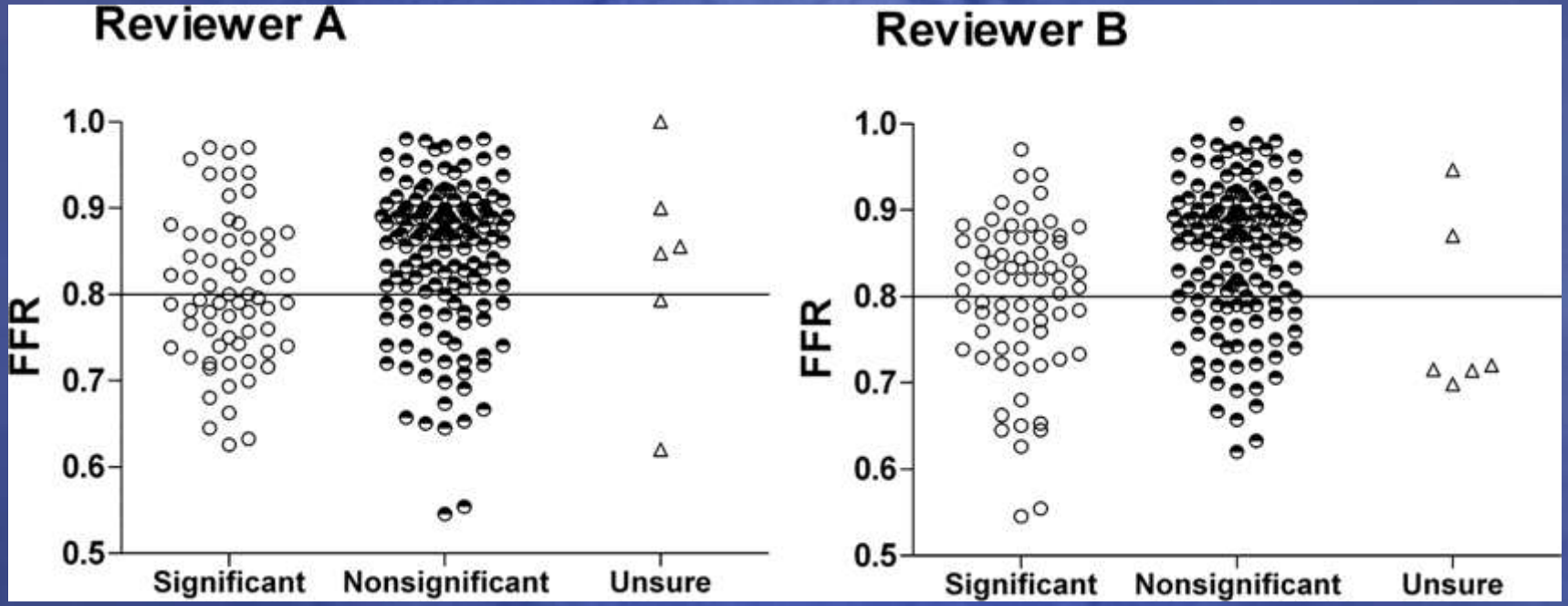
Gould KL. Am J Cardiol, v. 33, p. 87-94, 1974

Frequency of Intermediate Lesions:

SIRIUS, TAXUS IV, FUTURE I AND II (n=2.478 pts)

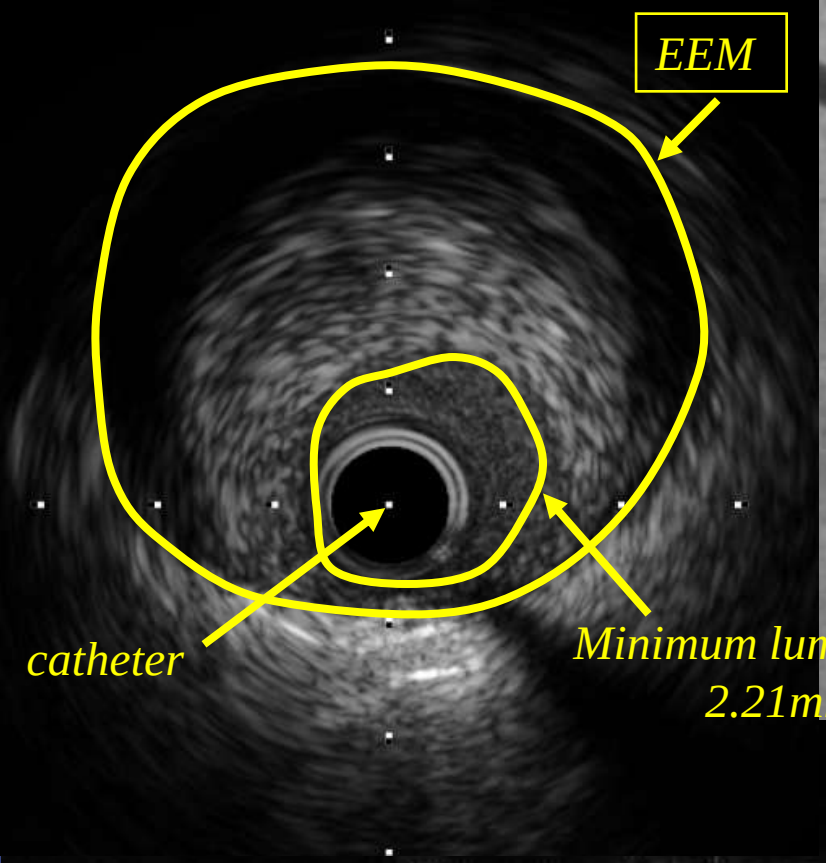


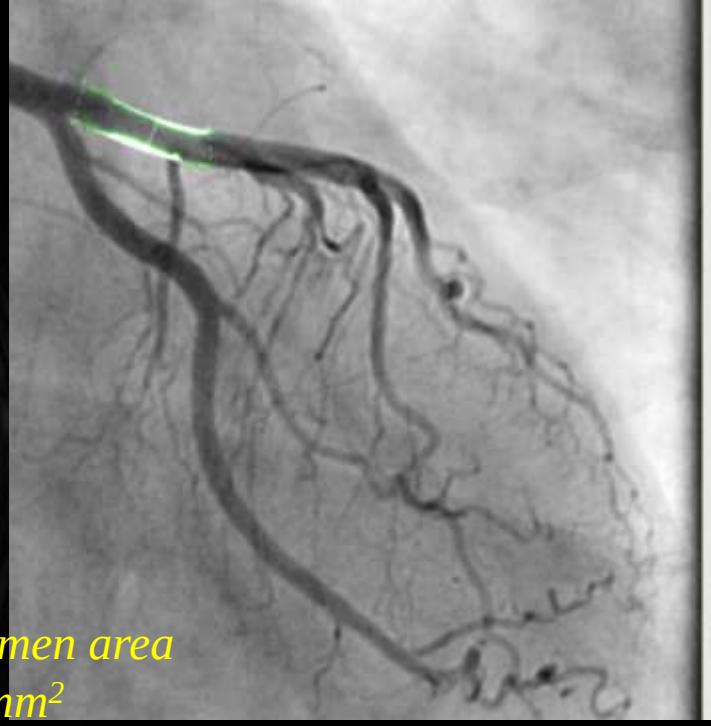
Comparative Assessment of Lesion Severity

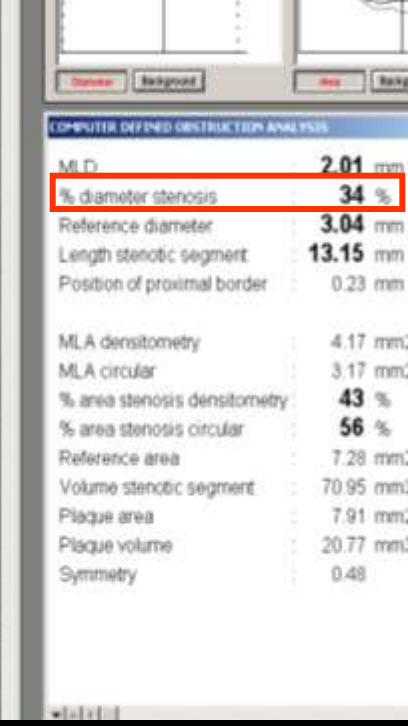


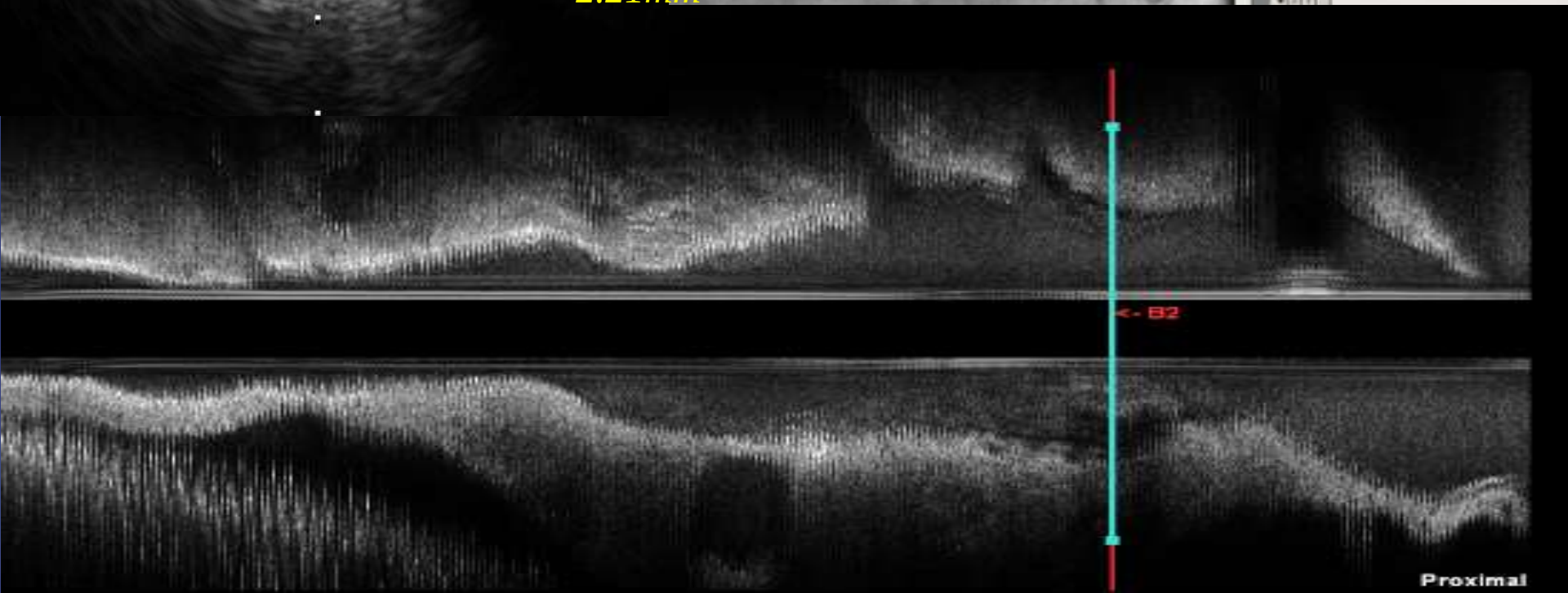
In 158 patients (74%), there was agreement between the 2 reviewers. Among these 158 patients, 48 were misclassified: 23 patients had an estimated DS >50% while the FFR was >0.80, and 25 patients had an estimated DS <50% while the FFR was <0.80

Hamilos et al. Circulation 2009;120:1505-1512


EEM
catheter
Minimum lumen area
2.21mm²




COMPUTER DEFINED OBSTRUCTION ANALYSIS
MLD 2.01 mm
% diameter stenosis 34 %
Reference diameter 3.04 mm
Length stenotic segment 13.15 mm
Position of proximal border 0.23 mm
MLA densitometry 4.17 mm²
MLA circular 3.17 mm²
% area stenosis densitometry 43 %
% area stenosis circular 56 %
Reference area 7.28 mm²
Volume stenotic segment 70.95 mm³
Plaque area 7.91 mm²
Plaque volume 20.77 mm³
Symmetry 0.48


B2
Proximal

Intermediate Lesions

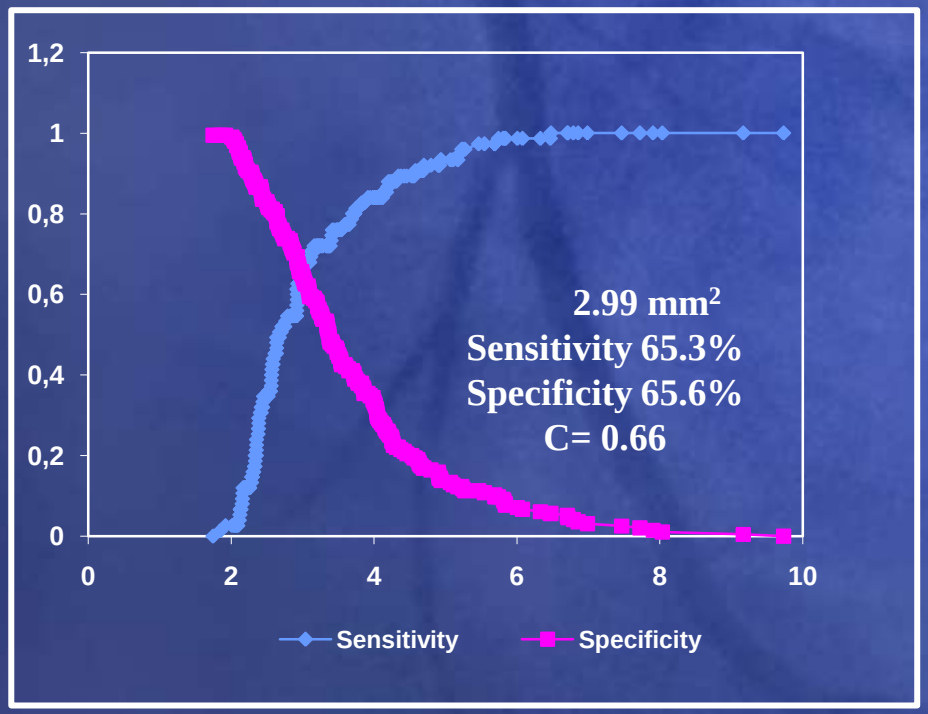
- Definition and Incidence
- Limitations: coronary angiography
- IVUS : criteria validation
  - Non Left Main
  - Left Main
- IVUS: when to intervene?
- Clinical Implications

Cut-Off Values : Validation

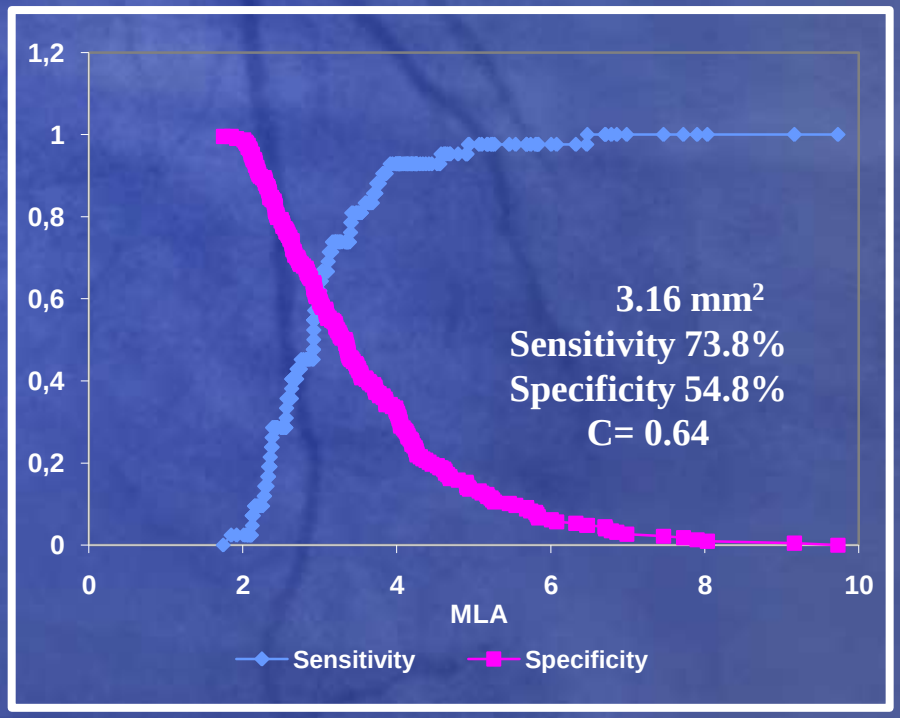
	Comparison	Threshold
Abizaid, et al. (AJC 1998)	CFR	MLA < 4.0 mm^2
Nishioka, et al.(JACC1999)	SPECT	MLA < 4.0 mm^2
Briguori, et al. (AJC 2001)	FFR	MLA < 4.0 mm^2
Caussin, et al. (AJC 2006)	64-CT	MLA < 4.0 mm^2

IVUS MLA cut-off for ischemic FFR

Cut off for FFR = 0.80

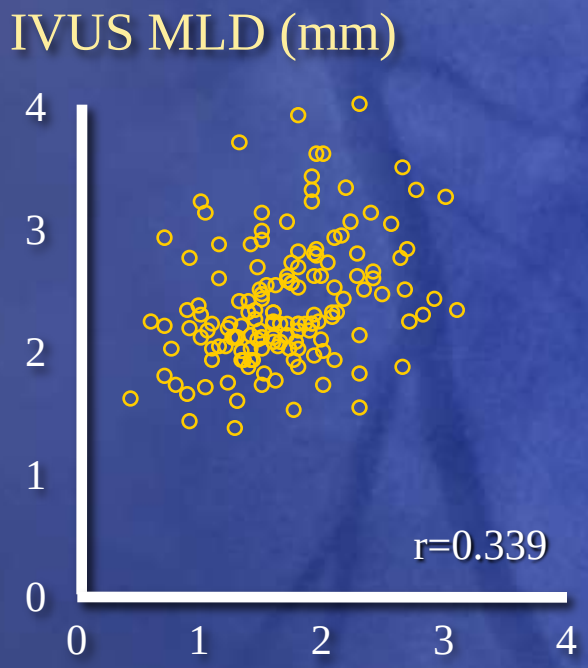


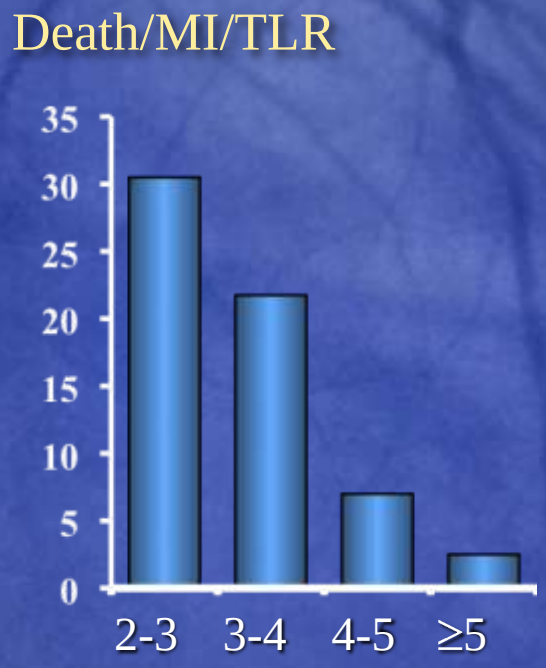
Cut off for FFR = 0.75

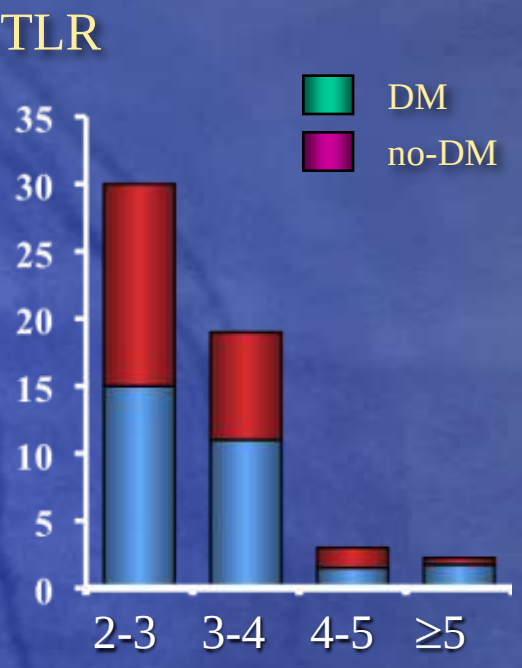


Waksman et First Trial TCT 2011

Clinical Follow up in 357 Intermediate Lesions in 300 Pts Deferred Intervention After IVUS Imaging







- Death/MI/TLR @ (mean) 13 mos = 8% overall (2% death/MI and 6% TLR)
- Death/MI/TLR @ (mean) 13 mos = 4.4% in lesions with MLA >4.0mm^2
- Only independent predictor of death/MI/TLR was IVUS MLA (p=0.0041)
- Independent predictors of TLR were DM (p=0.0493) and IVUS MLA (p=0.0042)

Abizaid AS, et al. Circulation 1999;100:256-61

	Abizaid AJC 1998; 82: 423-8	Nishioka JACC 1999; 33: 1870-8	Takagi. Circ. 1999; 100: 250-5	Briguori AJC 2001; 87: 136-41	Takayama CCI 2001;53:48 -55	Lee AJC 2010; 105: 1378-84	Kang Circ CV Interv 2011; 4:65-71 (AJC, in press)	Ahn JACC CV Interv 2011;4:6 65-71	Ben-Dor Eurointervent 2011;7:225-33	Tahk ACC 2011	Koo JACC CV Interv 2011;4:8 03-11	Waksma n TCT2011 (F1RST)	Gonzalo JACC 2012;59: 1080-9
	CFR	SPECT	FFR	FFR	FFR	FFR	FFR	SPECT	FFR	FFR	FFR	FFR	FFR
N	112	70	51	53	14	94	336	170	92	110	267	304	47
% abn													%
IVUS													
Ref lu (mm²)													)
MLA off (r													4
C-st (AUC													63)
Other determ ischem													
QCA													
Length (mm)			14	8.5	17.9	15.1		21.2			16.5	15.0	7.1
QCA Ref (mm)			3.0	3.1	2.9	2.7		3.3			3.1	2.9	2.6
DS (%)			46	52	53			55			50	45	51

All of these studies had two things in common. Lesions with an MLA above the cut-off were associated with a very low frequency of ischemia such that the negative predictive value was high, but the positive predictive value was low and c-statistic was relatively weak. Therefore, when confronted by an intermediate non-LMCA lesion in the cath lab, current evidence indicates that FFR is a better technique than IVUS.

IVUS Criteria for a 'Significant' Stenosis

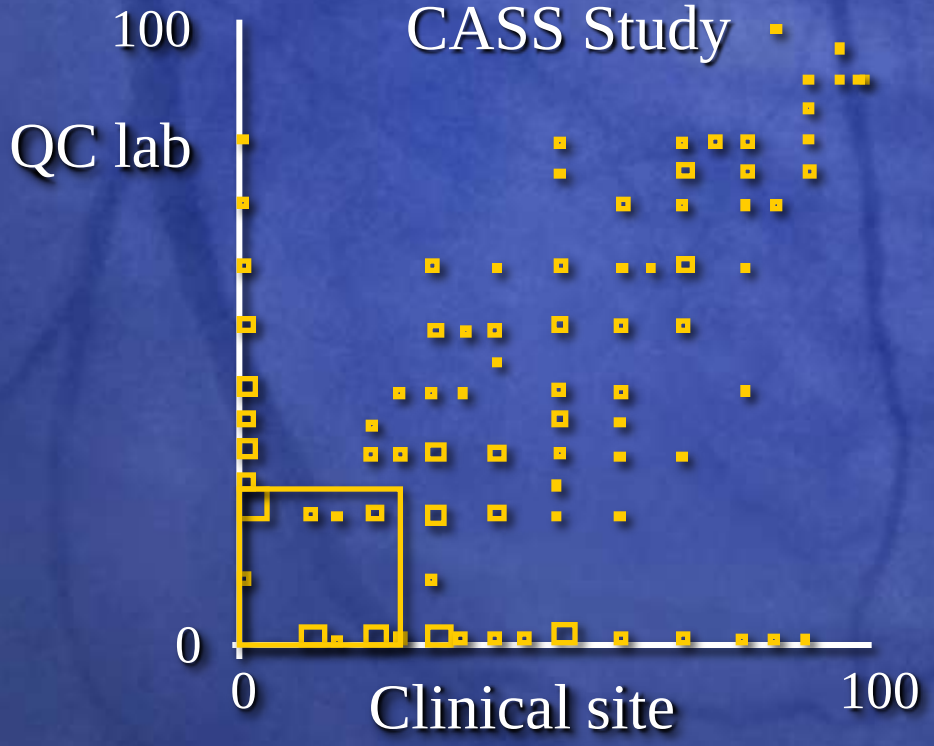
- Based on the studies comparing IVUS to
  - FloWire,
  - Pressure wire,
  - SPECT thallium
- And based on studies with clinical outcome
- most feel that a lumen area >4.0mm^2 in a proximal, >3.5mm epicardial artery *excluding the Left Main* (and SVGs) **is NOT** a flow limiting stenosis. This may be too large a lumen cutoff value for smaller vessels

What about LM disease?

Which of these LMCA lesions is significant and, therefore, should be treated and which should not be treated?

Of all the coronary segments, the LMCA has the greatest angiographic assessment variability

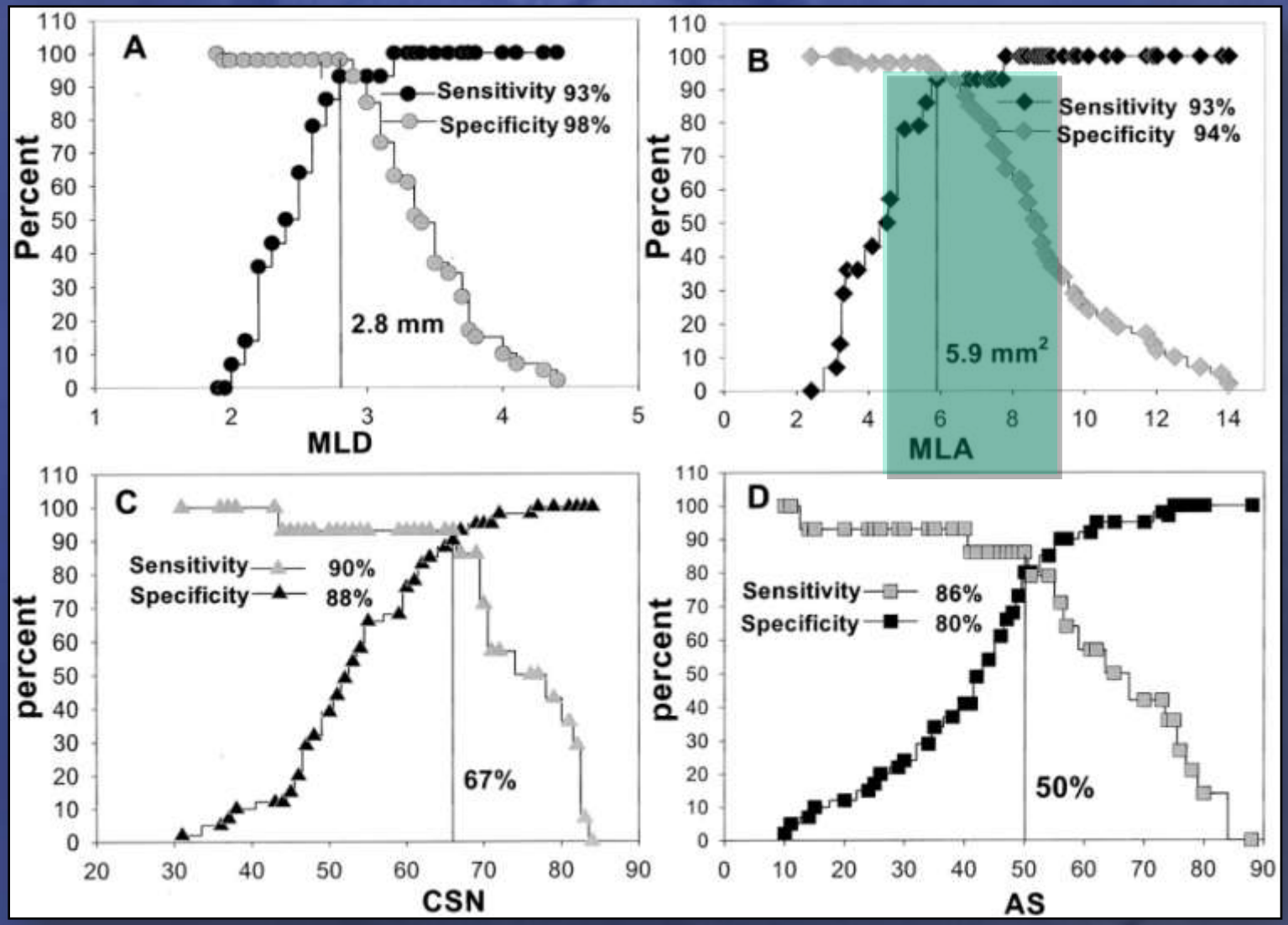
Comparison between percent stenosis assessment from the quality control (QC) lab vs the clinical site in the CASS Study



*area of the square is proportional to the number of cases

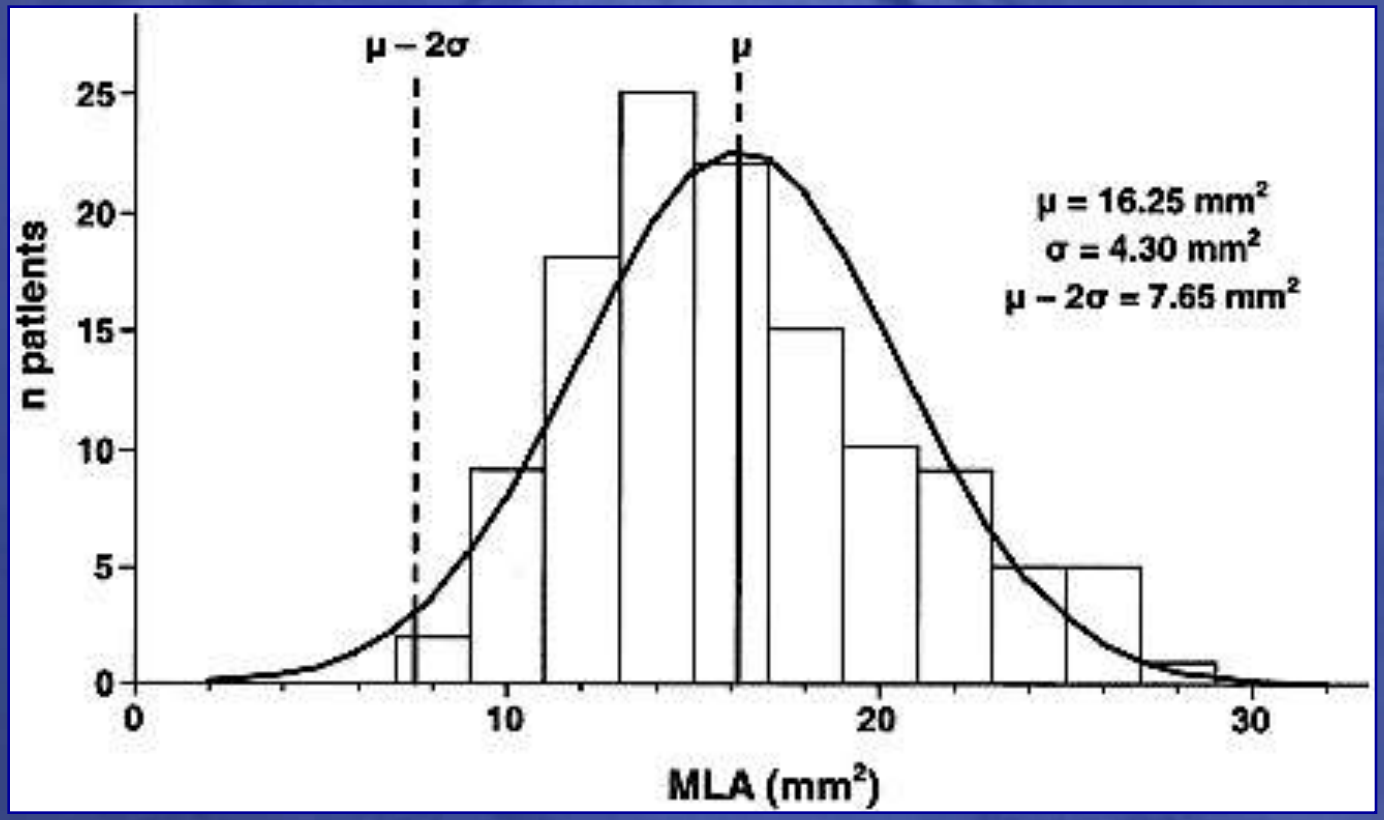
Fisher et al. Cathet Cardiovasc Diagn 1982;8:565-75

IVUS determinants of LMCA FFR <0.75



Jasti et al. Circulation 2004;110:2831-6

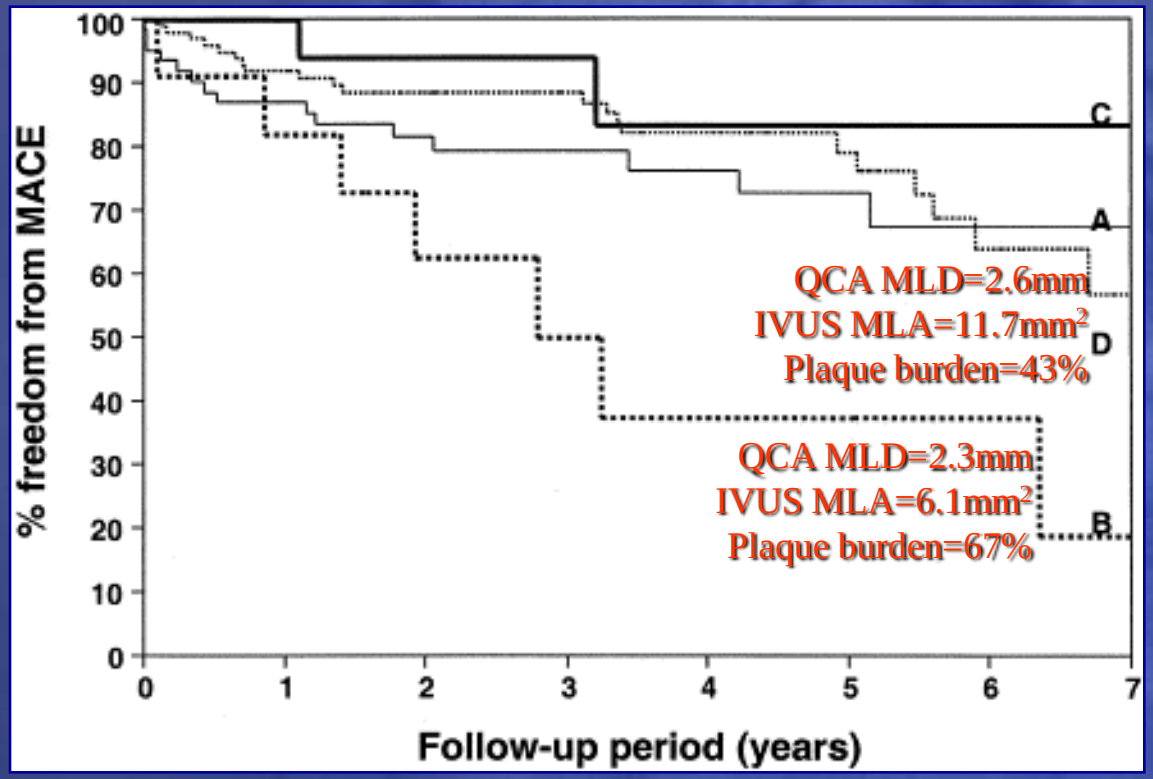
IVUS assessment of 121 pts with angiographically normal LMCA



If one accepts "normal" being mean-2SD, the lower limit of normal for a LMCA lumen CSA was 7.5mm²

Fassa et al. J Am Coll Cardiol 2005;45:204-11

Long-term follow-up



MLA≥7.5mm²+CABG/PCI (n=17)

MLA<7.5mm²+CABG/PCI (N=71)

MLA≥7.5mm²+Deferral (n=114)

MLA<7.5mm²+Deferral (n=12)

- Clinical significance driven by Group B (12 pts with MLA <7.5mm² and deferred revascularization due to medical comorbidities)

Fassa et al. J Am Coll Cardiol 2005;45:204-11

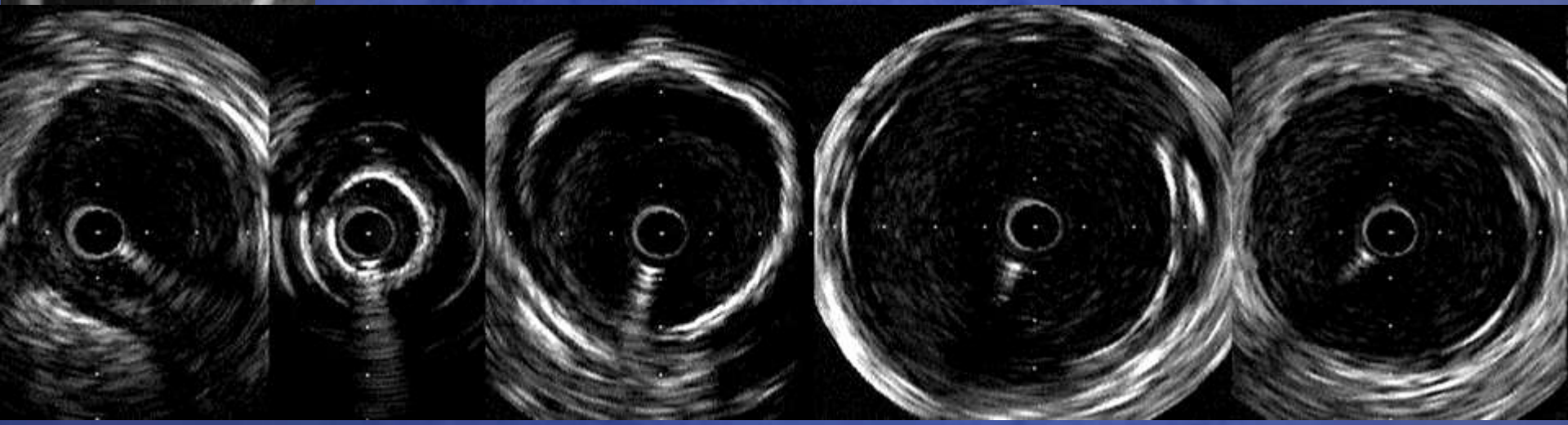
IVUS Criteria for a 'Significant' LMCA Stenosis

- Most IVUS LMCA studies show either insignificant disease or critical disease. Studies of "Normal" left mains suggest a CSA of 7.5 mm^2
- Absolute lumen CSA <6.0mm^2 (or MLD <3.0mm) is the suggested criterion for a significant LMCA stenosis
  - Correlates with a LMCA FFR<0.75
  - Murray's Law ($_{LMCA}r^3 = {}_{LAD}r^3 + {}_{LCX}r^3$)
  - Does not depend on finding a disease-free reference segment
  - May depend upon diabetic status
- It is not clear whether the same criteria should be used for ostial LM lesions as for mid-shaft/distal bifurcation lesions and for positively vs negatively remodeled lesions

Ivus Assessment of Unusual "Intermediate" Lesion Morphologies

- Filling Defects
- Aneurysms
- Acute Coronary Syndromes
- Hazy Lesions

Aneurysm Assessment



0 → ***2.5*** → ***10.0mm***

IVUS Classification of Angiographic Aneurysms

- Of 77 angiographic aneurysms
  - 21 (27%) true aneurysm
  - 3 (4%) pseudoaneurysm
  - 12 (16%) complex plaques or unhealed dissections
  - 41 (53%) normal segment adjacent to one or more stenoses

	True Aneurysm	PSA	Complex Plaque	Normal Site with Adjacent Stenoses
No prior PCI	10	0	6	26
Prior PCI	11	3	6	15

Maehara et al Am J Cardiol 2001;88:365-70

IVUS for Intermediate Lesion Assessment
Take home I

- Angiography is a POOR tool to determine lesion significance (e.g. physiologic flow)
- IVUS for left main and non left main lesions has been correlated with other measures of ischemia
- If you are interested in just the physiologic significant use FFR for intermediate lesion assessment

IVUS for Intermediate Lesion Assessment
Take home II

- The value of 4 mm^2 may be correct number in proximal (>3.5mm) vessels with normal myocardial function
  - deferral of PCI has been shown to be safe.
  - Smaller lumen areas are appropriate for smaller arteries
- Use IVUS for left main
  - Minimal area may either 6mm^2 or 7.5mm^2 for estimation of significance
  - Plaque burden not useful for determination of severity
- Use IVUS for intermediate lesions with uncertain pathology or for assessment for planned PCI