IVUS Prediction of Functional Significance In Coronary Lesion

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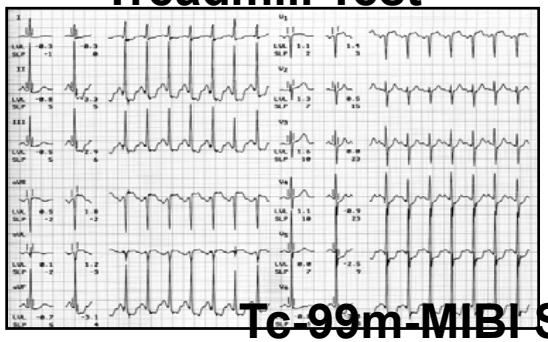
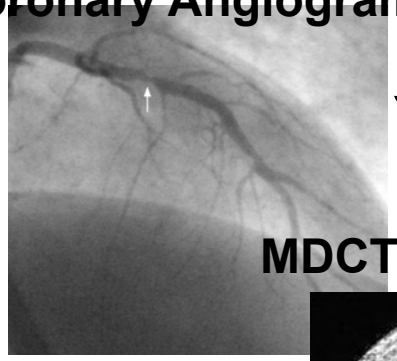
Anatomical vs Functional Significance?

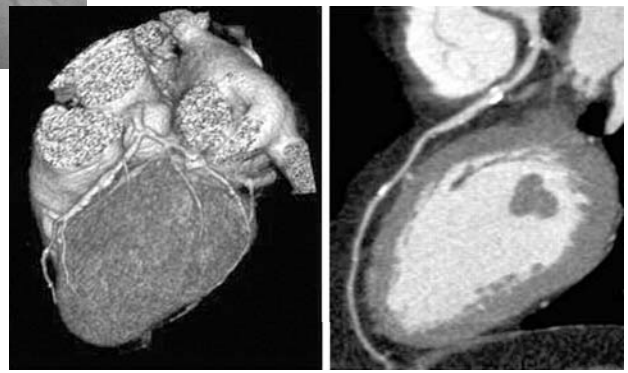
Treadmill Test



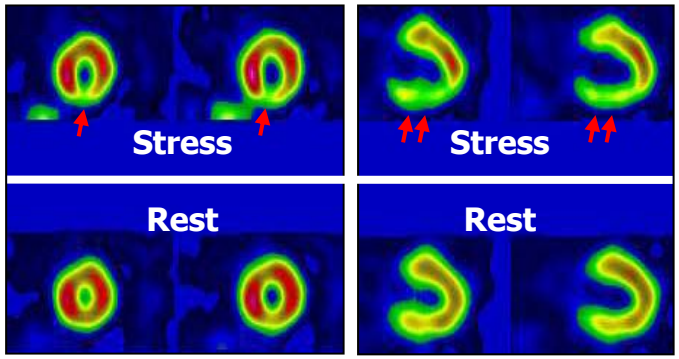
Coronary Angiogram



MDCT Coronary Angiogram

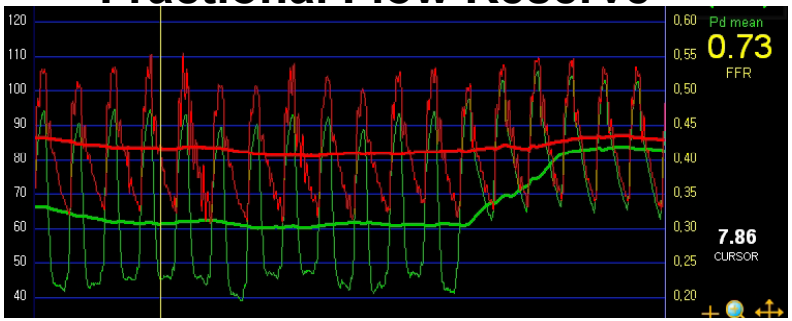


Tc-99m-MIBI SPECT



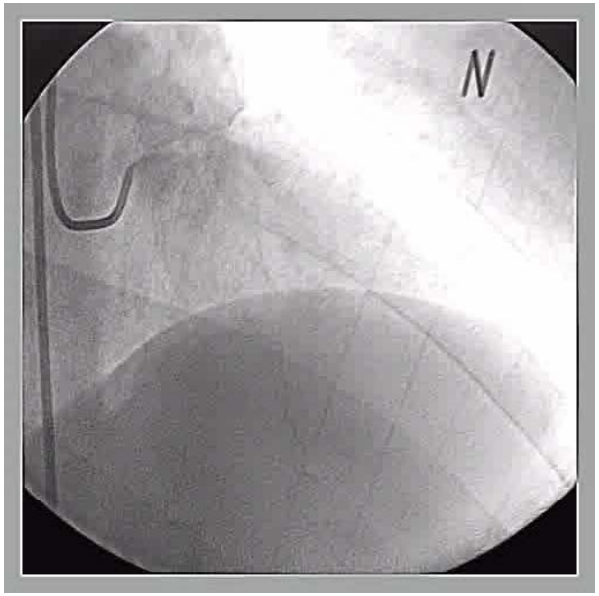
Intravascular Ultrasound

Fractional Flow Reserve

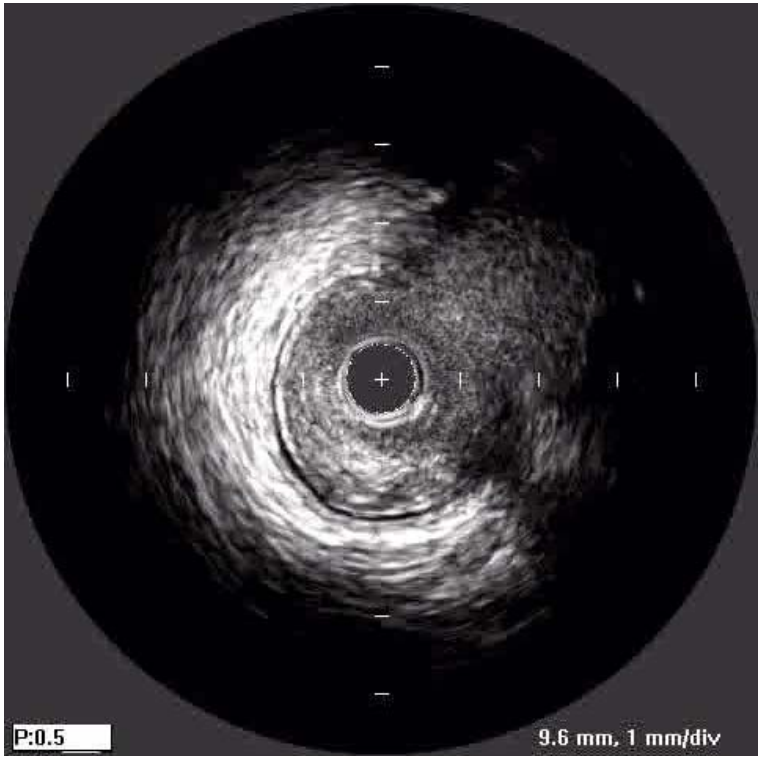


Case #1

KJM, M/43 with effort angina
HTN, DL, smoking

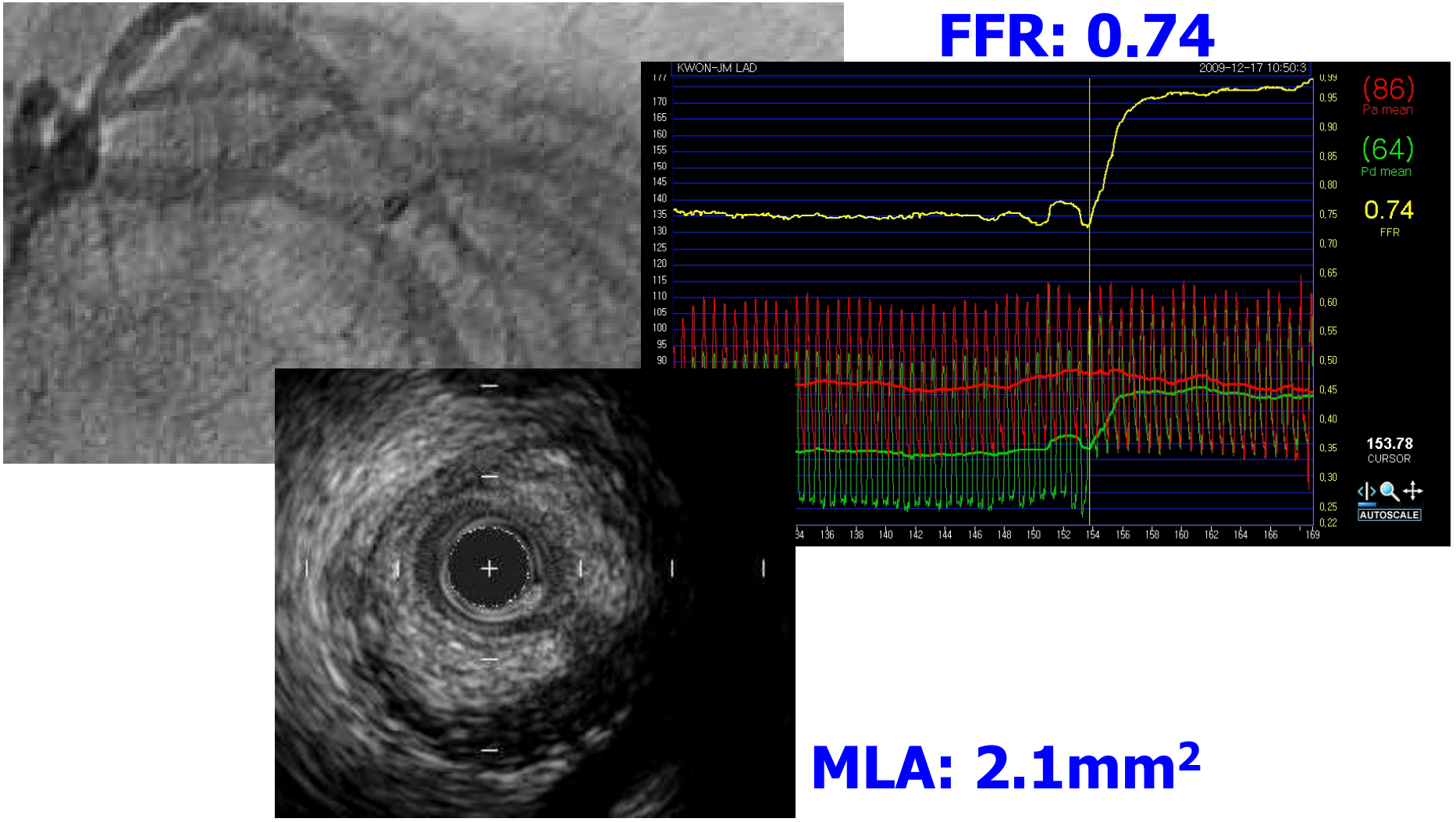


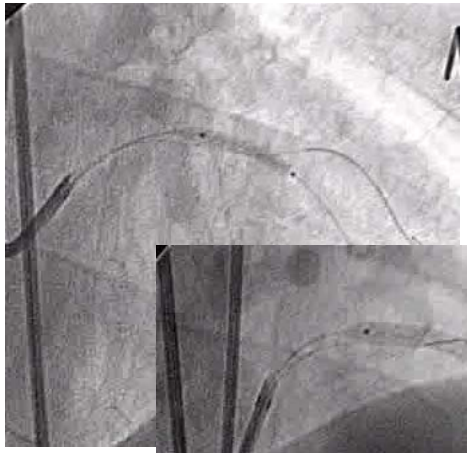
60% stenosis at pLAD



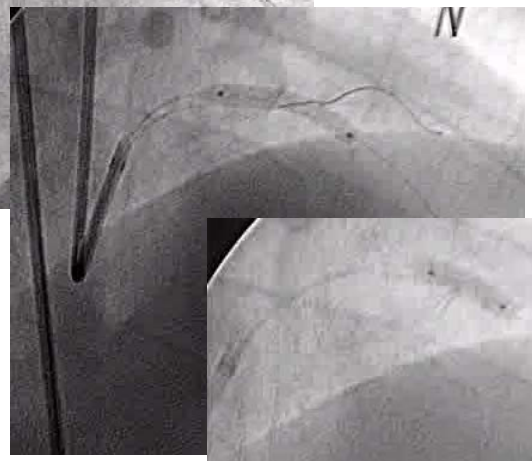
MLA 2.1mm^2
VA 11.1mm^2
PA 9.4 mm^2
PB 85%

Average reference LA
9.23 mm^2
AS 77%
Length 22.7mm

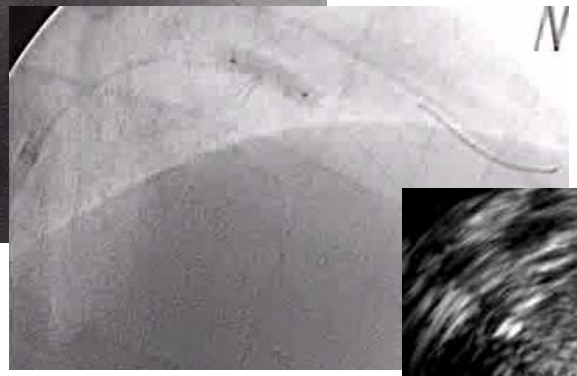

FFR: 0.74
KWON-JM LAD
2009-12-17 10:50:3
(86)
Pa mean
(64)
Pd mean
0.74
FFR
153.78
CURSOR
AUTOSCALE
MLA: 2.1mm²



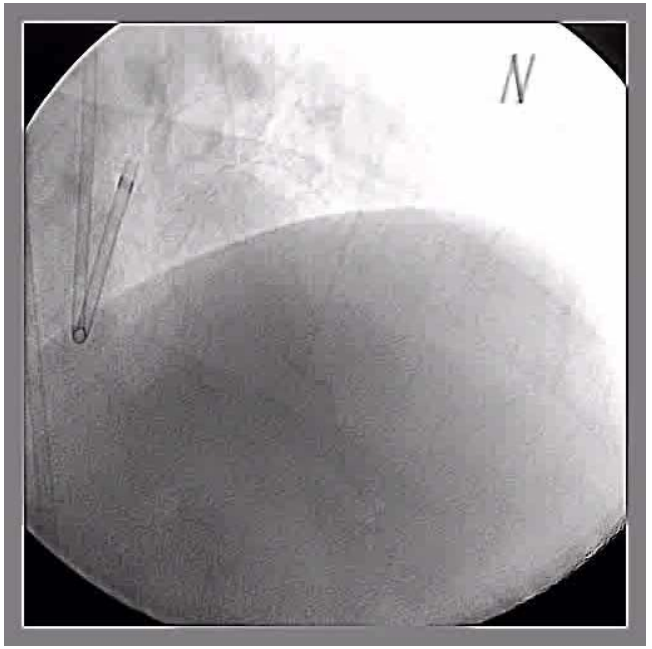
Ballooning with Sprinter
2.5/20mm at 14atm

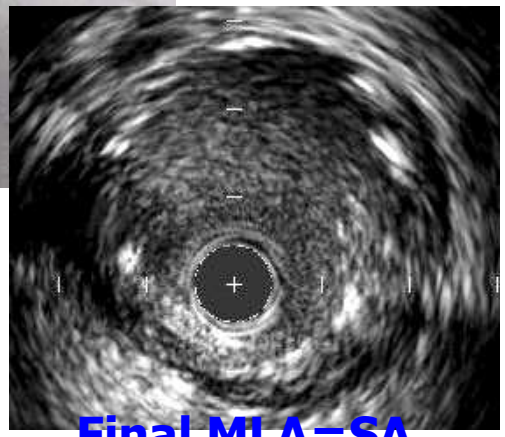


Stenting with Cypher
3.5/23 at 11atm

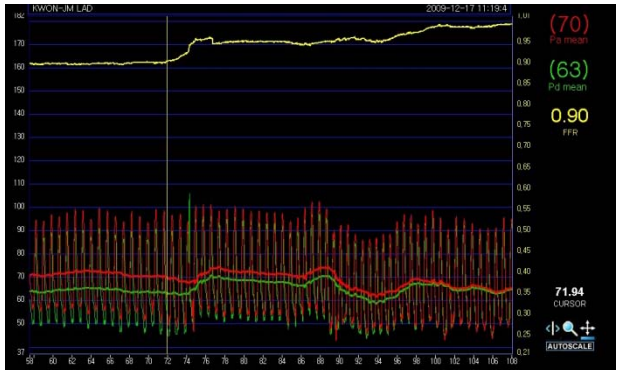


High Pr-ballooning with
Fortis 3.5/13mm at 20atm





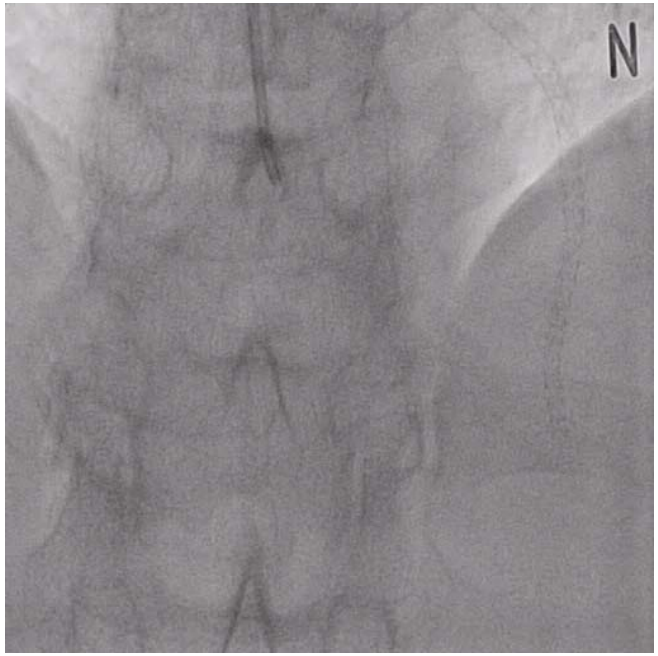
Final MLA=SA
8.6mm²

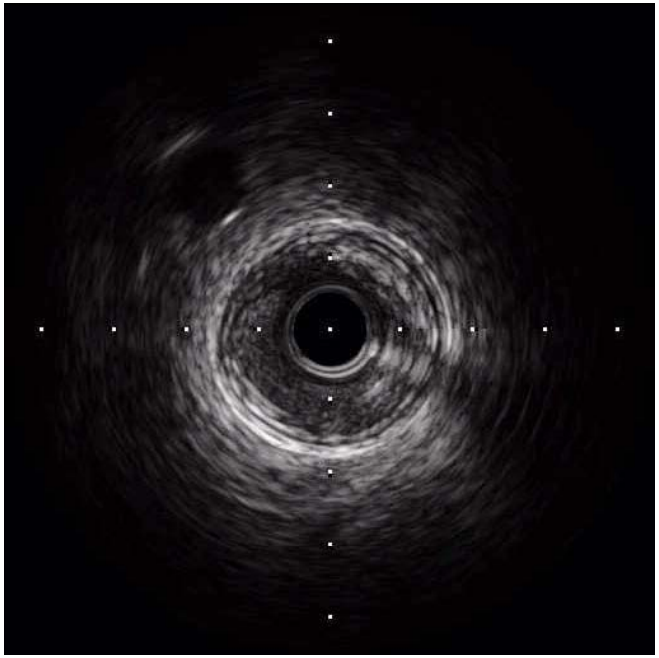


Final FFR: 0.96

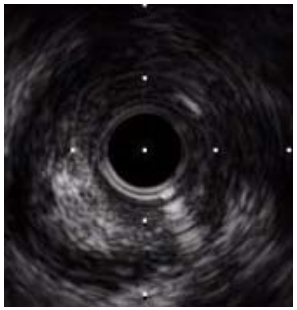
Case #2

SYK, F/67 with chest pain





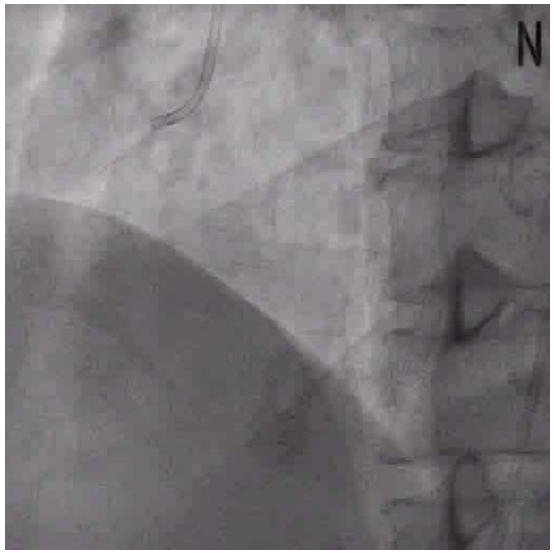
80% stenosis
at PDA ostium



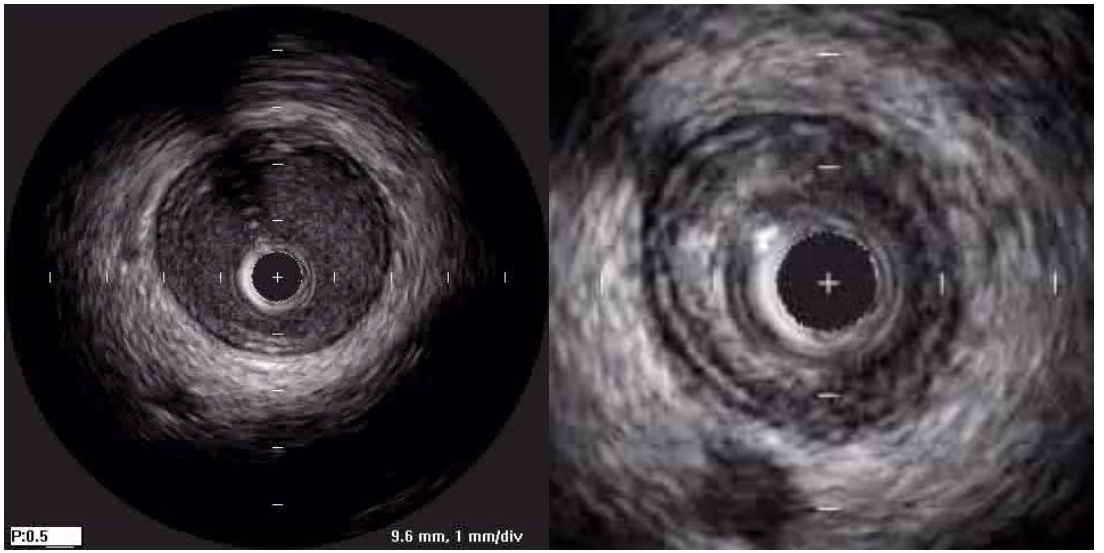
MLA 2,4mm^2
VA 7.5mm^2
PB 68%
AS 43%

Case #3

LBY, M/50 with chest pain



80% stenosis
at distal RCA

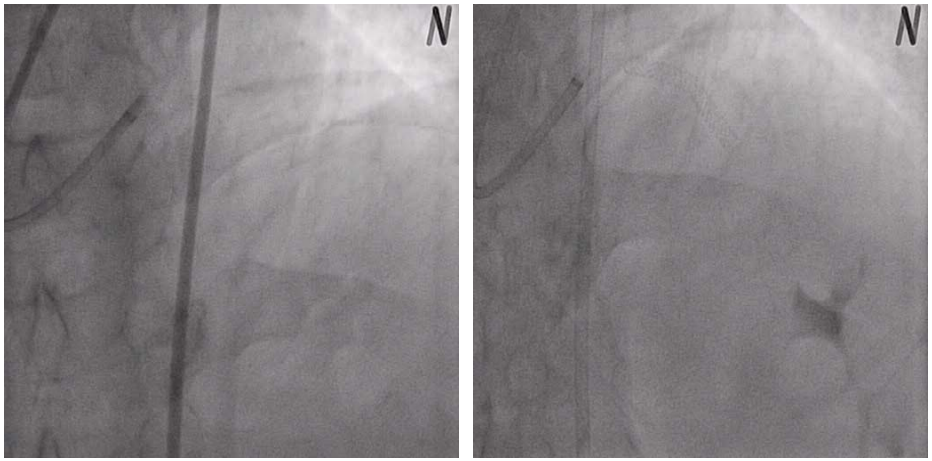


MLA 1.9 mm^2
VA 6.1 mm^2
PB 82%

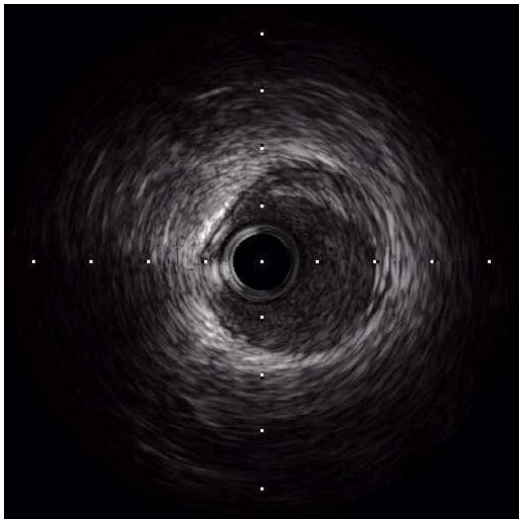
Average ref LA 10.1mm^2
Average ref VA 12.9mm^2
AS 81%
Lesion length 8.2mm
Remodeling index 0.47

Case #4

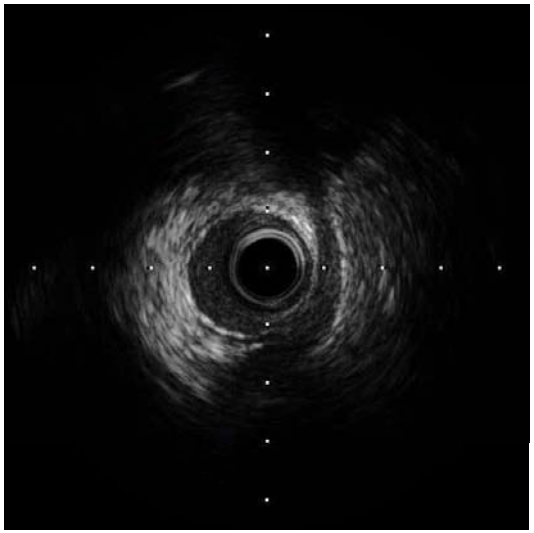
KSJ, M/63, SA with HTN, FHx



Post-Stent

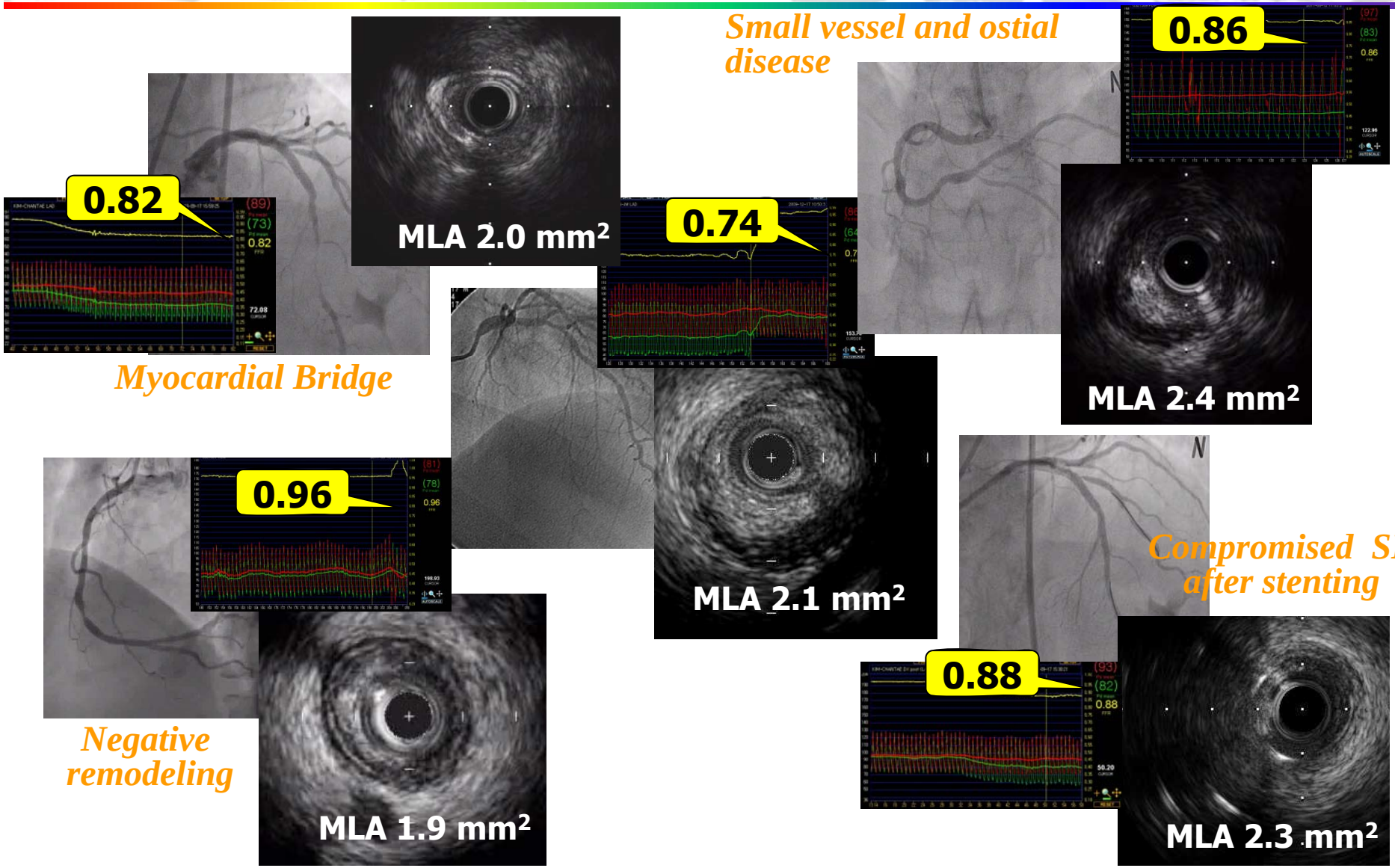


MLA 2,3mm^2
VA 3.5mm^2
PB 34%
AS 69%
LA of RV 6.5mm^2



MLA 2,0mm^2
VA 2.8mm^2
PB 28%
AS 55%
LA of RV 4.5mm^2

Which case do you want to treat?



Indication for PCI by IVUS?

Left main

Lumen CSA <6 mm^2

Major epicardial vessel

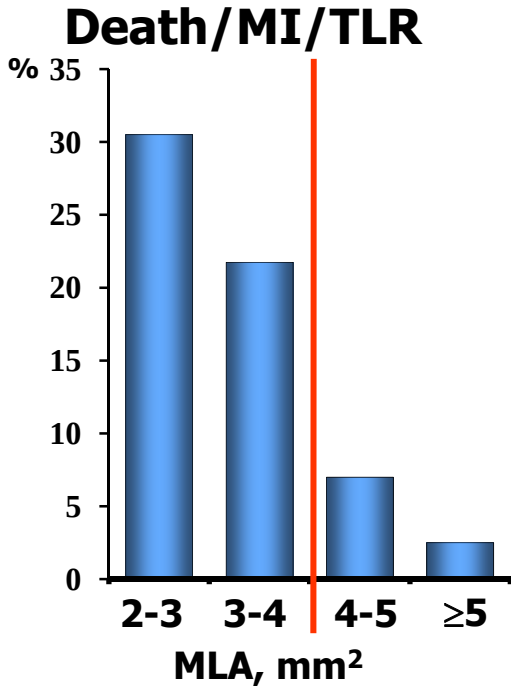
Lumen CSA <4 mm^2

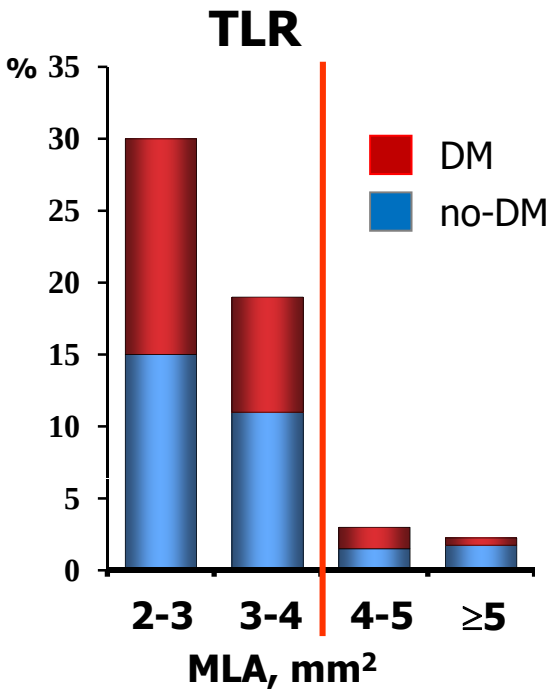
*Plaque burden >50% and Area stenosis >50~70%

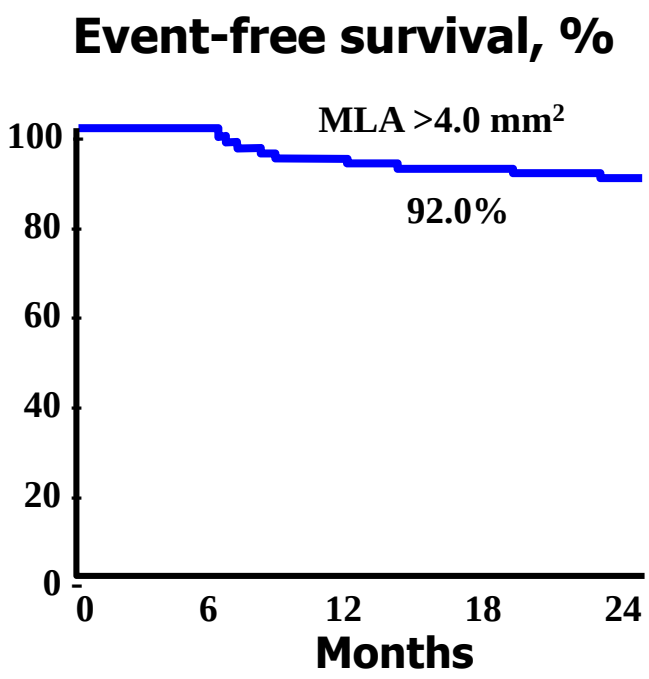
?

≥4mm of MLA is the value not to treat

357 lesions in 300 pts with deferred intervention after IVUS imaging
Mean FU duration=13months







- **The only independent predictor of death/MI/TLR was IVUS MLA (p=0.0041) and independent predictors of TLR were DM (p=0.0493) and IVUS MLA (p=0.0042)**

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

IVUS Predictors for Functional Significance

Study	Patient no	**Methods**
Kang et al	236/201	• Included 28% of ACS (8% of NSETMI) • 67% of LAD
Koo et al	267/252	• Specified lesion characterization (lesion with additional stenosis (>30% by visual assessment) in same vessel was excluded, only non-culprit lesion in ACS), 74% of LAD • No information about IVUS lesion length
Yang et al	137/137	• Only proximal to mid LAD lesions • Volumetric analysis
Ben-Dor et al.	92/84	• AMI, <2.5mm in RVD and >1 lesion were excluded • No baseline clinical and angiographic information

Kang et al, Circ Cardiovasc Interv. 2011;4:65-71
Ku et al, J Am Coll Cardiol Intv 2011;4:803-11
Yang et al, 2011ACC poster presented
Ben-Dor et al, EuroIntervention 2011;7(2):225-33

IVUS Predictors for FFR <0.8

Study	n	IVUS Predictors	B/OR	95% CI	p
Kang et al	236/201	**MLA** **PB** **Length with LA<3mm²** **LAD location**	0.020 -0.002 -0.003 -0.035	0.008~0.031 -0.005~0.001 -0.005~0.001 -0.055~-0.016	0.032 0.001 0.005 0.001
Koo et al	267/276	**MLA** **Proximal** **LAD location**	0.35 2.97 3.40	0.19~0.66 1.20~7.32 1.24~9.30	0.001 0.02 0.02
Yang et al	137/137	**Lesion length** **MLA** **Proximal** **Age**	1.21 0.28 4.04 0.93	1.111.31 0.110.71 1.2712.88 0.880.98	<0.001 0.007 0.018 0.007
Ben-Dor et al.	92/84	**MLA**			

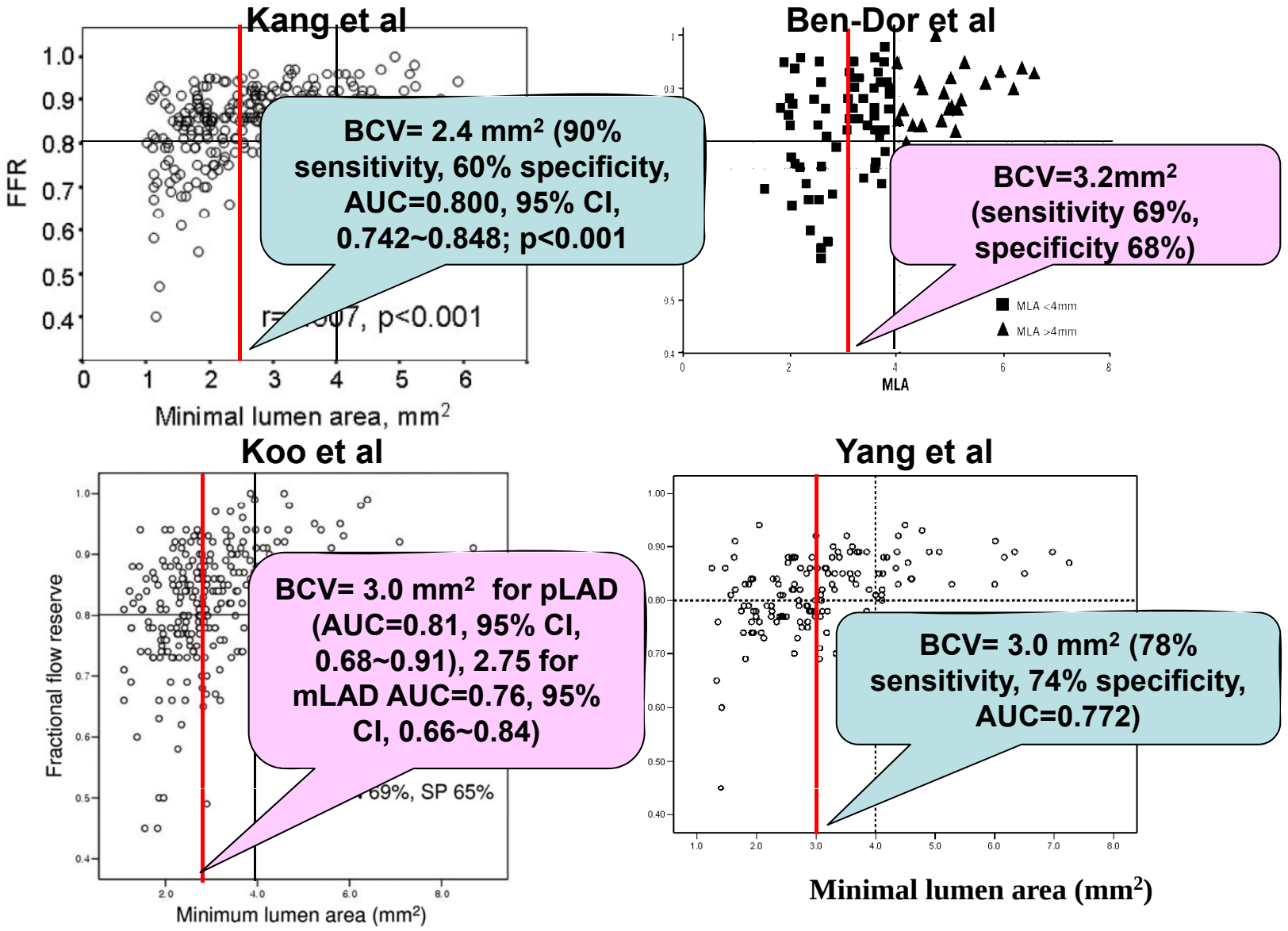
Kang et al, Circ Cardiovasc Interv. 2011;4:65-71

Ku et al, J Am Coll Cardiol Intv 2011;4:803-11

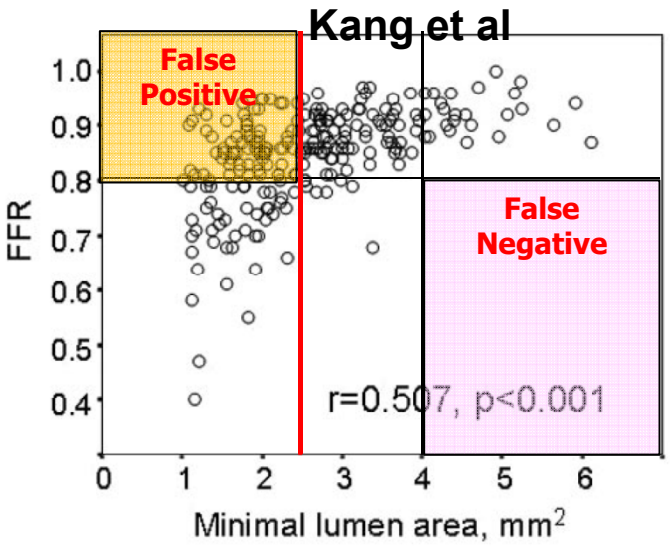
Yang et al, 2011ACC poster presented

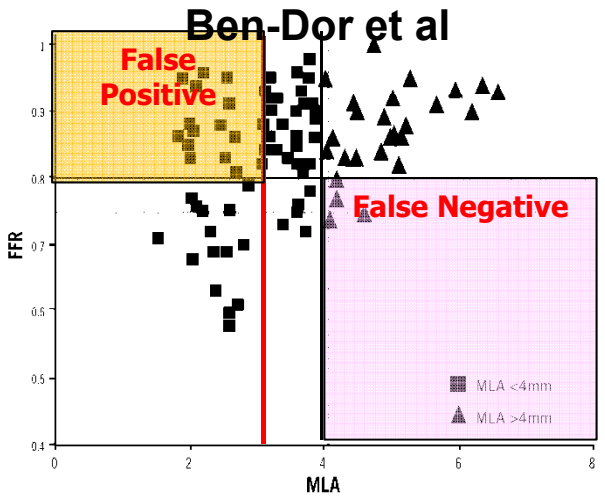
Ben-Dor et al, EuroIntervention 2011;7(2):225-33

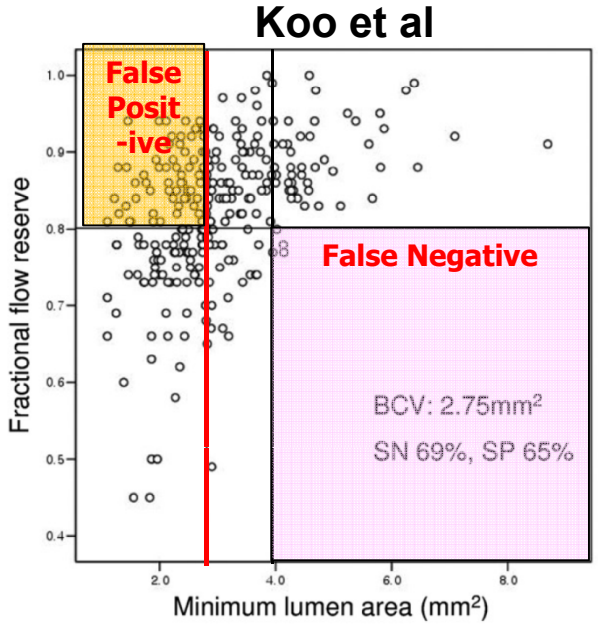
MLA is an IVUS predictor for FFR<0.8

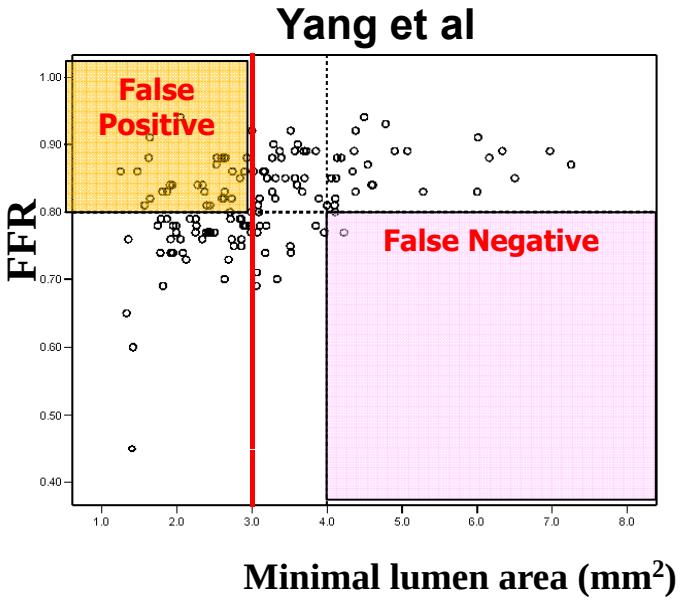


≥4mm of MLA is the value not to treat









Comparison of IVUS parameters

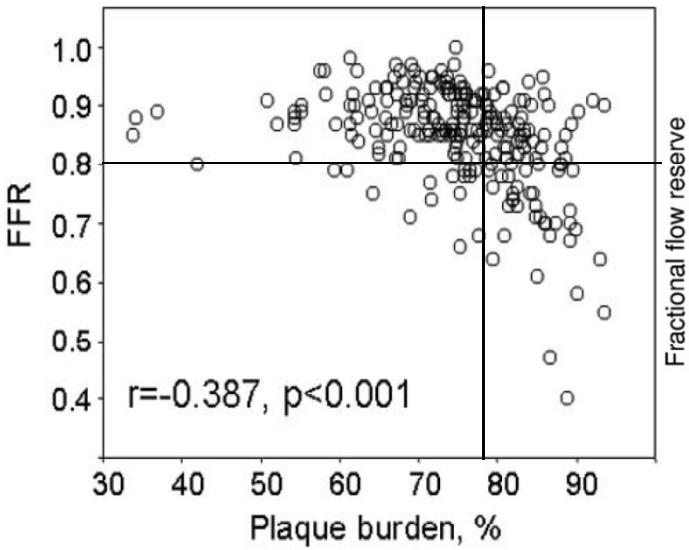
In lesions with <4mm² MLA

From Ajou data

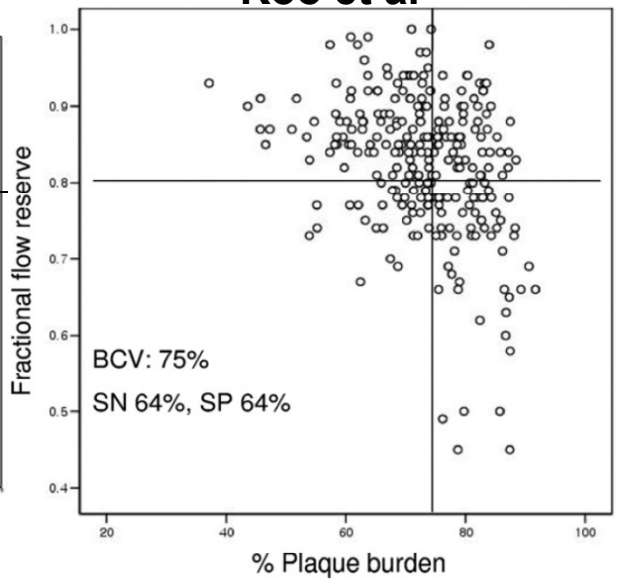
		<0.8 n=51	≥0.8 n=58	p Value
Reference	Average LA, mm²	8.6±2.3	8.5±2.3	0.853
	Average EEM area, mm²	12.2±2.8	11.8±3.3	0.493
MLA site	**MLA, mm²**	**2.49±0.64**	**2.81±0.68**	**0.013**
	EEM area, mm²	11.1±3.3	10.1±2.8	0.096
	%PB, %	**76±8**	**71±9**	**0.002**
Area stenosis, %		**70±9**	**65±11**	**0.021**
Remodeling index		0.99±0.11	0.95±0.16	0.110
Volume analysis				
	IVUS lesion length, mm	**26.9±8.3**	**18.3±7.5**	**<0.001**
	Lumen volume, mm³	**130.1±51.5**	**90.3±35.0**	**<0.001**
	Plaque volume, mm³	**197.4±82.5**	**125.9±81.4**	**0.001**
	EEM volume, mm³	**327.5±127.8**	**216.2±109.6**	**<0.001**
	Lumen volume index, mm³/mm	4.91.1	5.11.9	0.359
	Plaque volume index, mm³/mm	7.42.0	6.52.4	0.053
	EEM volume index, mm³/mm	12.22.8	11.73.5	0.372
	%Plaque volume, %	**59.9±5.4**	**55.5±8.3**	**0.001**

Plaque burden

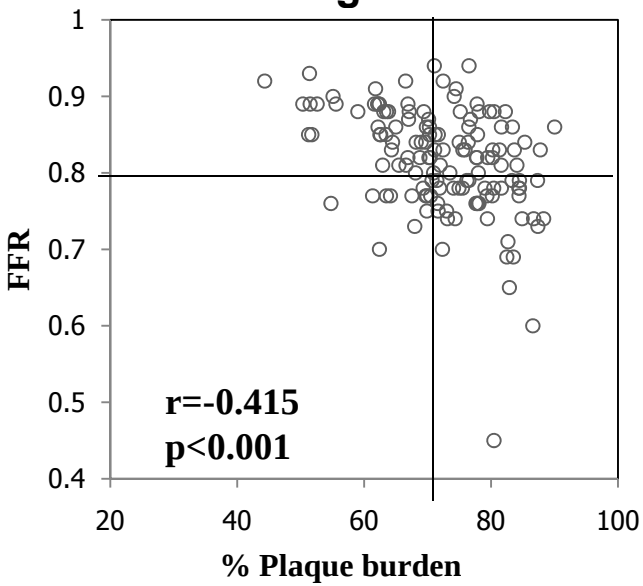
Kang et al



Koo et al



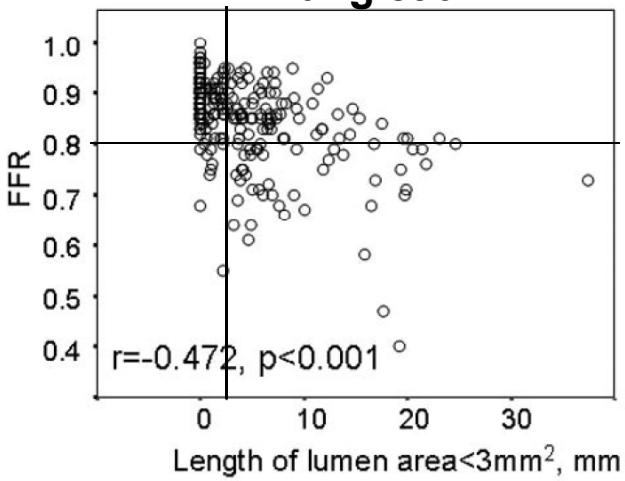
Yang et al



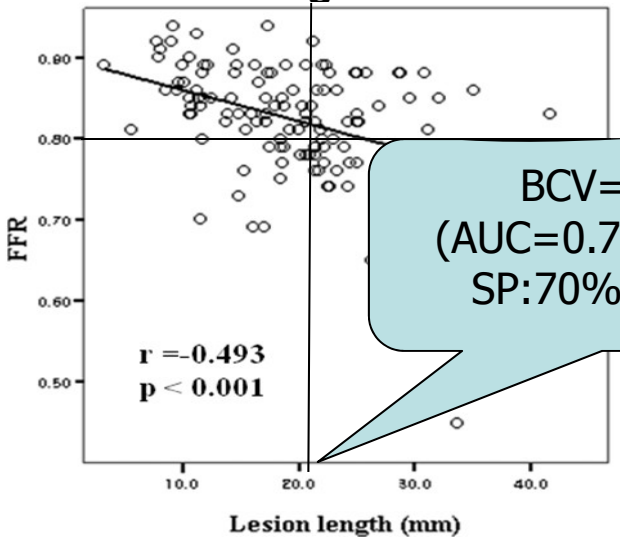
	Kang et al.	Koo et al.	Yang et al.
BCV	79%	75%	73%
Sensitivity	69	64	65
Specificity	75	64	62
AUC	0.756		0.698
p value	<0.001		<0.001

Lesion length and Lesion location

Kang et al

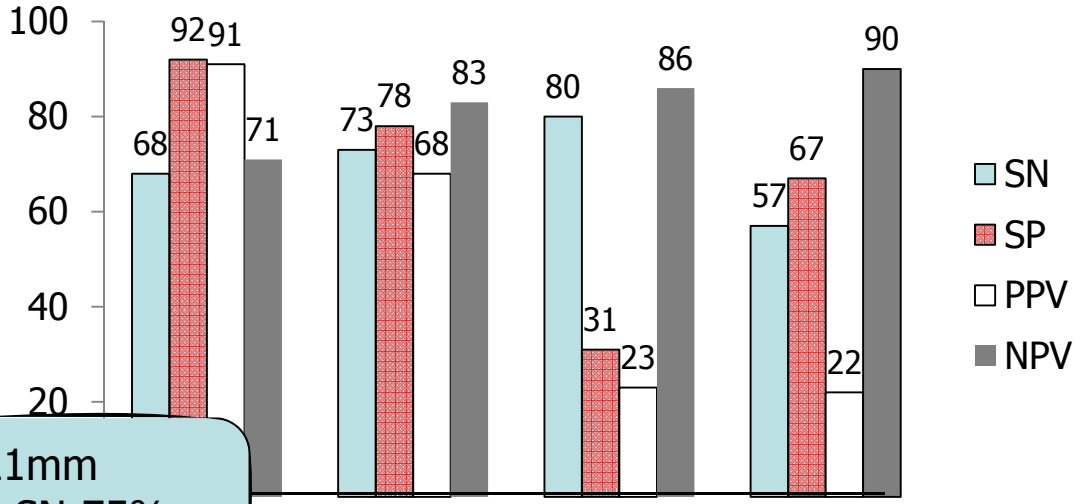


Yang et al



BCV=≥21mm
(AUC=0.799, SN:75%,
SP:70%, p<0.001)

Diagnostic Accuracy of MLA 2.75 at different lesion locations



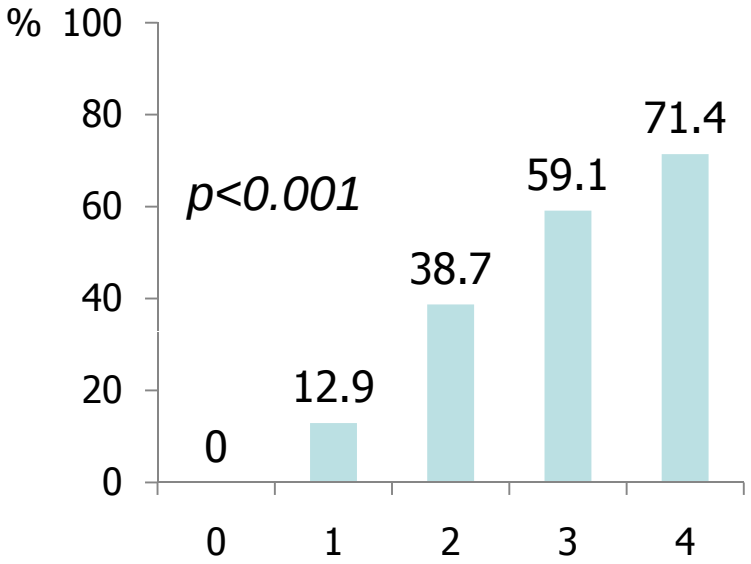
Koo et al, J Am Coll Cardiol Intv 2011;4:803-11

IVUS Predictors for FFR<0.8

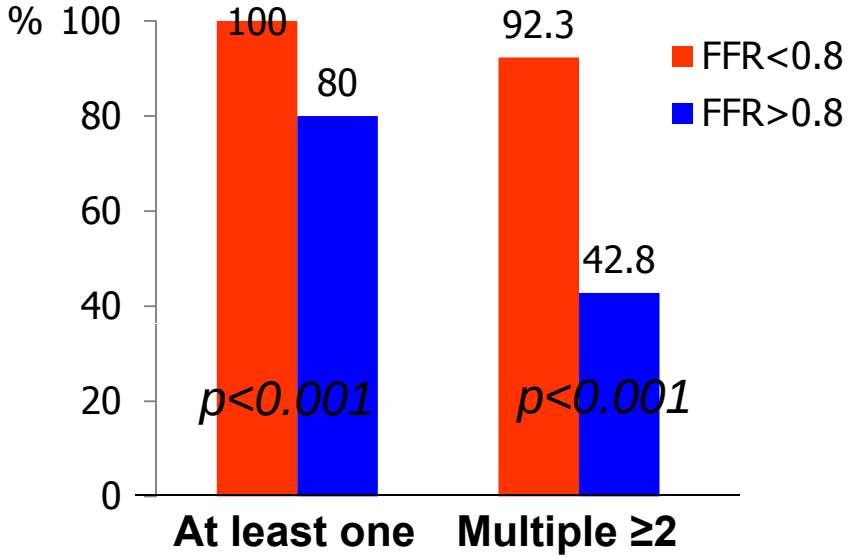
Significant features:

- MLA <3 mm2 (AUC=0.745, SN:78%, SP:74%, p<0.001)
- Lesion length ≥21mm (AUC=0.799, SN:75%, SP:70%, p<0.001)
- PB ≥73%(AUC=0.698, SN:65%, SP:62%, p<0.001)
- Proximal location

% FFR<0.8



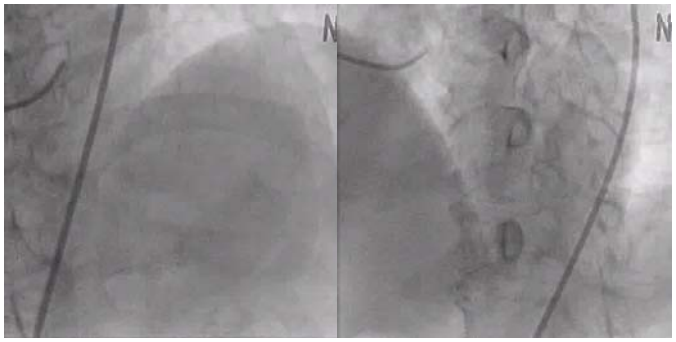
% Significant Feature



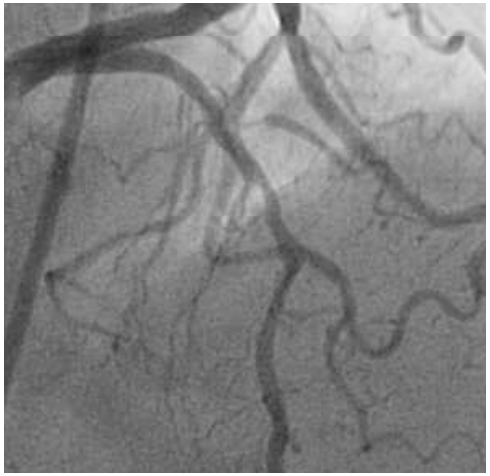
From Ajou data

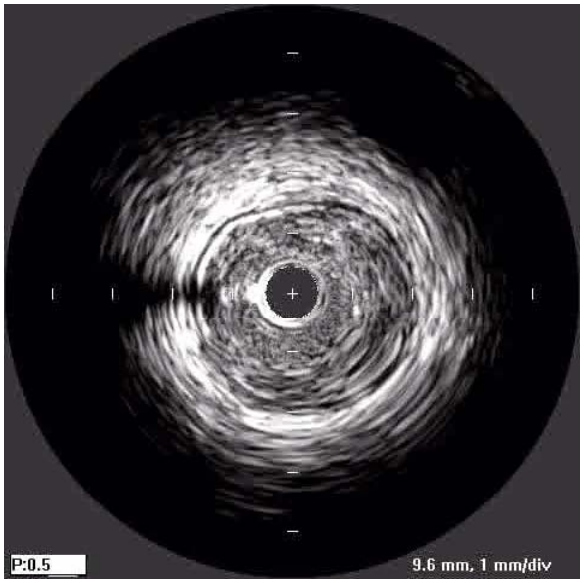
Case #5

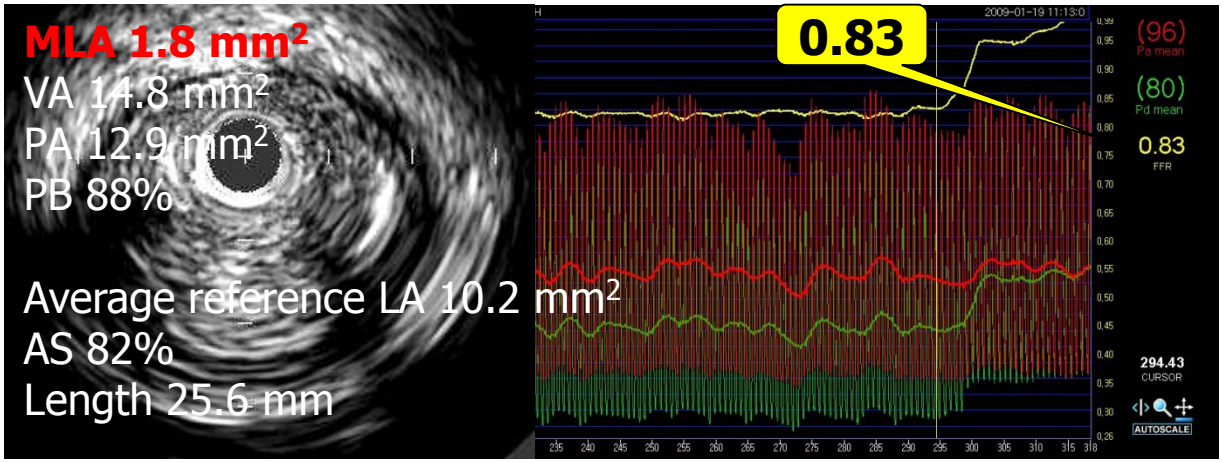
CYH, F/79 with chest pain, HTN, DM



60% stenosis at pLAD







Mismatched !!!

IVUS vs FFR for Evaluating Disease Severity

IVUS
Anatomical
Stenosis

FFR
Functional
Significance