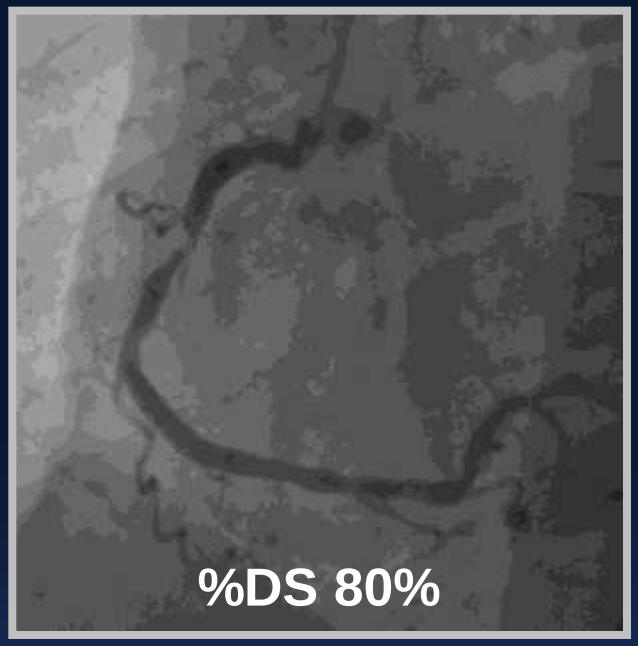
Visual-Functional Mismatch

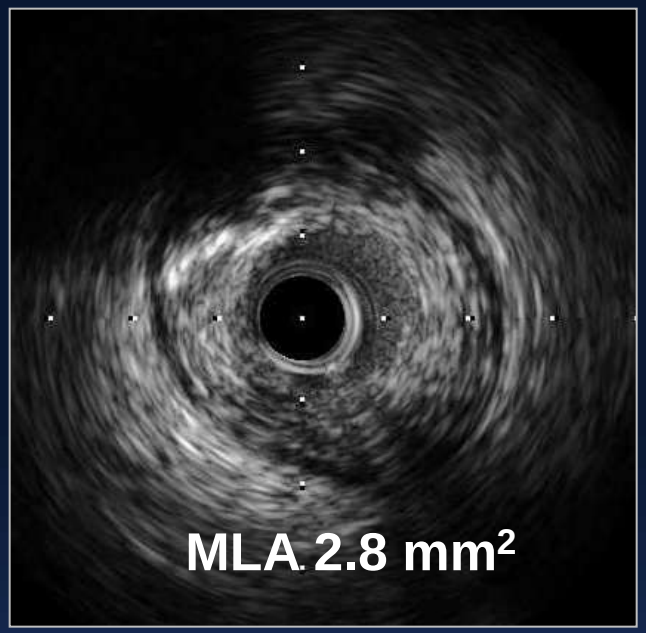
Soo-Jin Kang, MD., PhD.

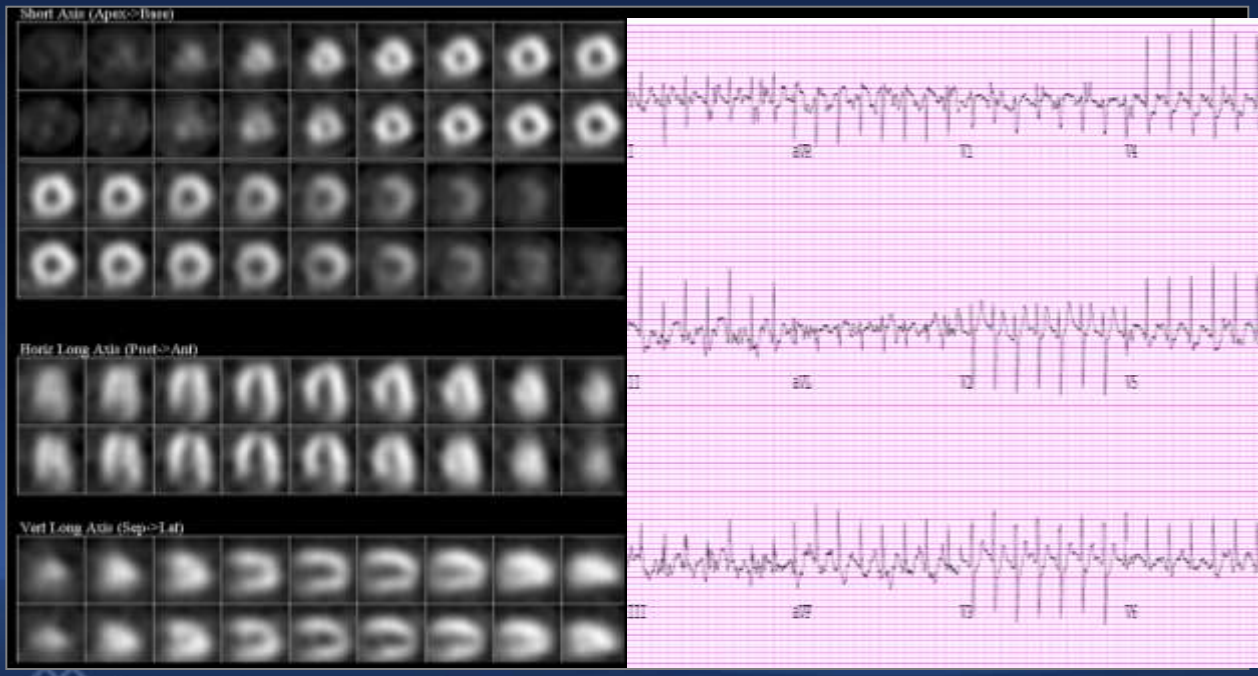
Department of Cardiology, University of Ulsan College of Medicine
Asan Medical Center, Seoul, Korea

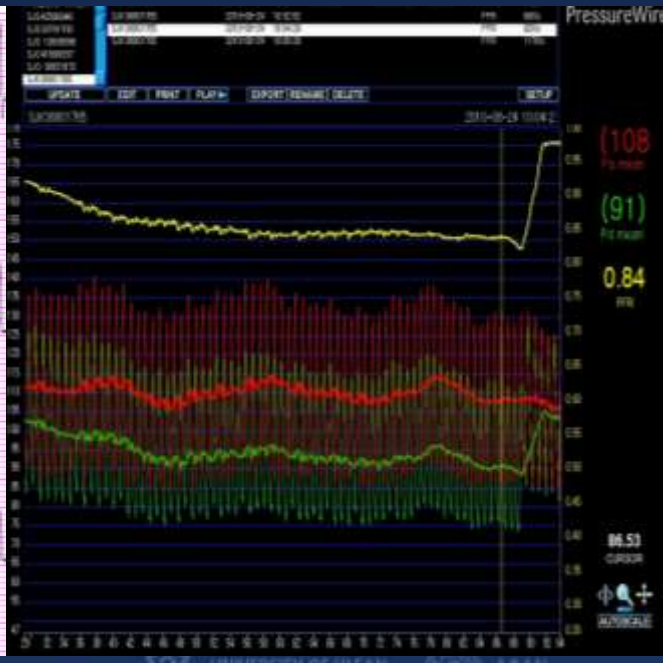
Disclosure Statement of Financial Interest

I, Soo-Jin Kang DO NOT have a financial interest /arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation


%DS 80%


MLA 2.8 mm²


Short Axis (Apex->Base)
Horiz Long Axis (Post->Ant)
Vert Long Axis (Sep->Lat)

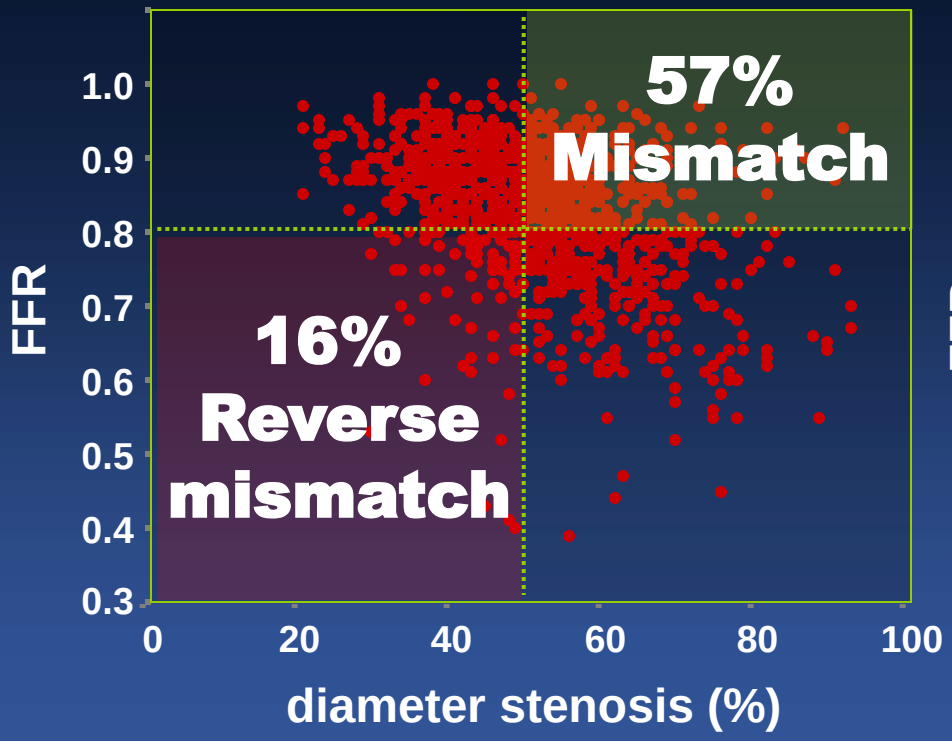

PressureWire
(108
(91)
0.84
86.53

QCA-DS vs. FFR

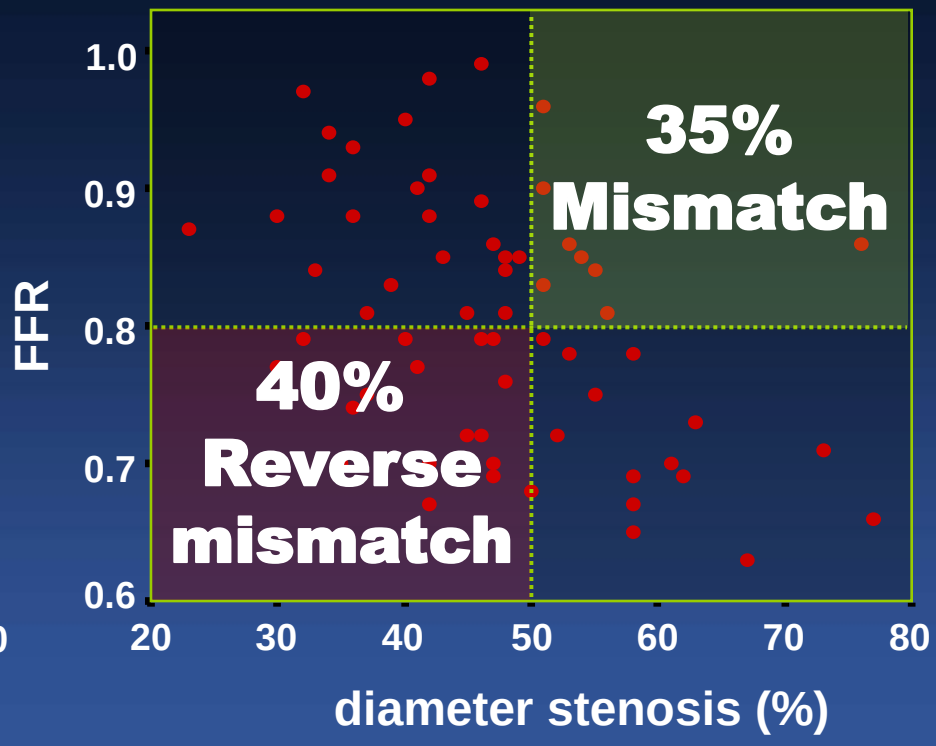
(1129 lesions with DS >30%) who underwent IVUS and FFR

ClinicalTrials.gov NCT01366404

1066 Non-LM lesions



63 LM lesions



Park et al. JACC interv 2012;5:1029-36

Meta-analysis of 11 Clinical Trials

1759 patients with 1953 lesions

Predict FFR<0.80

Weighted **MLA 2.61**mm^2

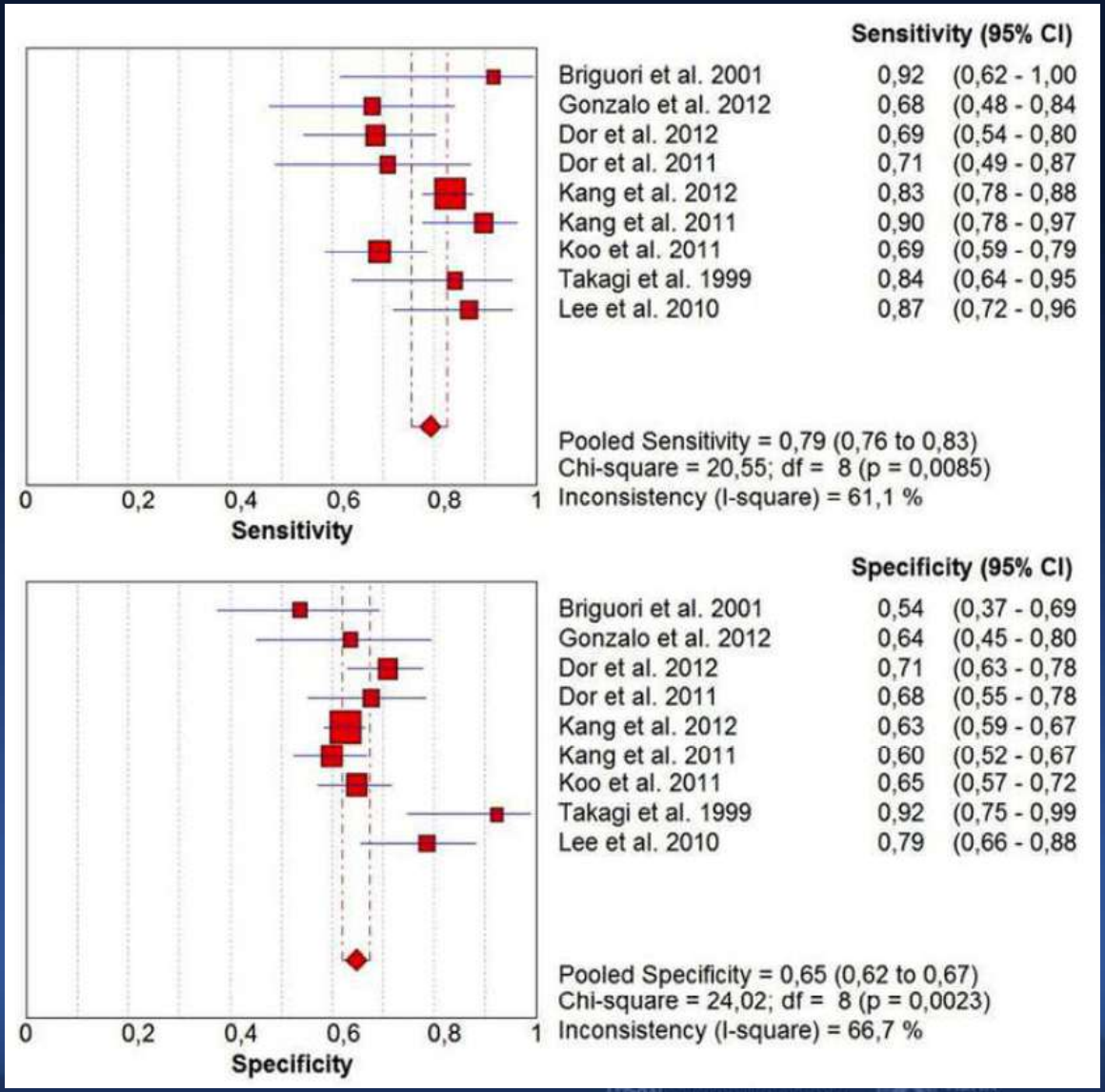
Pooled sensitivity **79%**

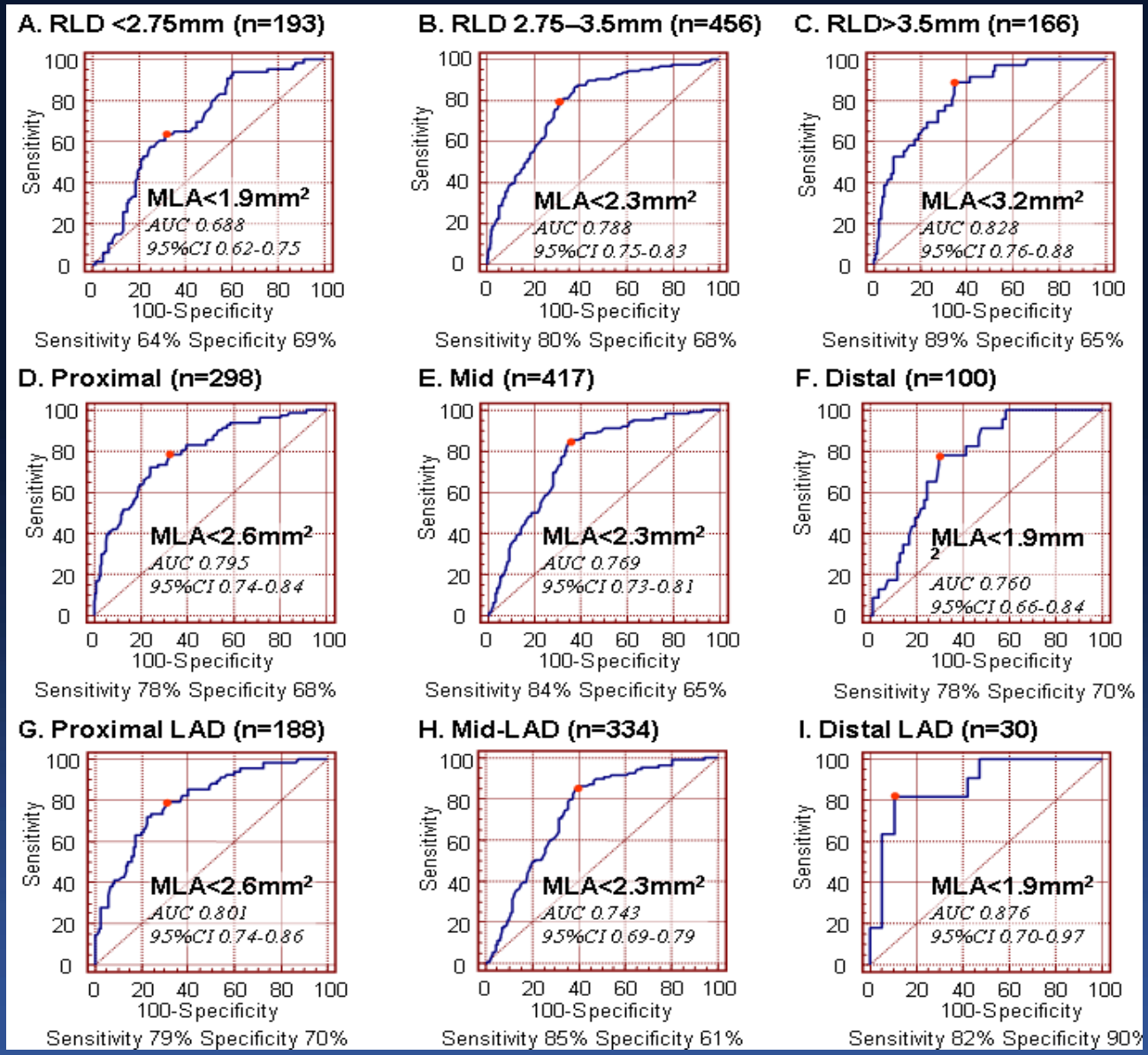
Pooled specificity **65%**

Smaller Cut-off than Used

Poor Accuracy

Nascimento et al. Catheter Cardiovasc Interv 2013 (in press)





All Subgroup-specific MLA, accuracies <70-75%

Kang et al. Am J Cardiol 2012;109:947-5

Why Mismatch

Nov 2009-Jun 2011, 1000 consecutive patients (1129 lesions with DS >30%) who underwent pre-PCI IVUS and FFR

(ClinicalTrials.gov NCT01366404)

Factors Affecting FFR

	Beta	p-value	95% CI
Age	0.008	<0.001	0.004 - 0.011
LAD location	-0.386	<0.001	-0.462 - 0.311
Lesion length	-0.006	<0.001	-0.009 - 0.003
Minimal lumen area	0.185	<0.001	0.149 - 0.222
Plaque burden	-0.006	<0.004	-0.009 - 0.003
Plaque rupture	-0.165	0.020	-0.302 - 0.027

Park et al. JACC interv 2012;5:1029-36

Multivariable Analysis Predicting FFR

in 700 LAD lesions of 700 patients

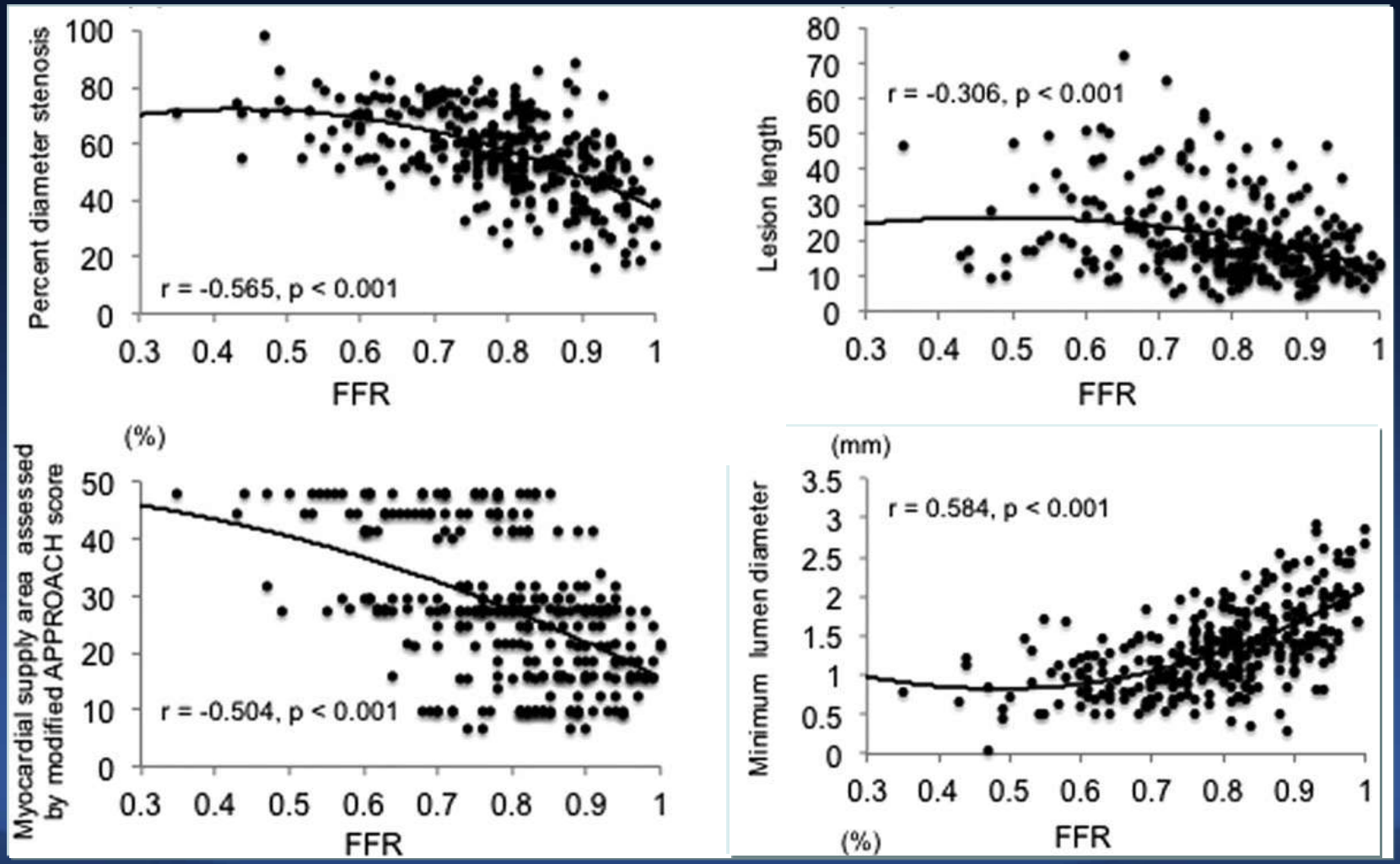
**Including age, female, body surface area, smoking, angiographic DS, minimal lumen diameter, lesion length, IVUS-MLA, plaque burden, averaged reference EEM area and %area stenosis, †addition of left ventricular mass*

	Total (700 patients)*			608 patients with echo data†		
	ß	p value	95% CI	ß	p value	95% CI
Age	0.119	0.001	0.000–0.002	0.192	<0.001	0.001–0.002
BSA	**-0.111**	**0.002**	-0.101– -0.024			
LV mass				**-0.121**	**<0.001**	-0.001 – 0.000
Angiographic DS	-0.185	<0.001	-0.002 – -0.001	-0.190	<0.001	-0.002 – -0.002
Lesion length	-0.110	0.001	-0.001 – 0.001	-0.077	0.027	-0.001 – 0.000
IVUS-MLA	0.312	<0.001	0.022 – 0.035	0.294	<0.001	0.019 – 0.032
Plaque burden	-0.115	0.002	0.001 – 0.000	-0.157	<0.001	-0.002 – -0.001

Kang S-J et al. J Am Coll Cardiol Intv 2013;6:562-8

Impact of Myocardial Territory on FFR

Myocardial area subtended to the artery distal to the stenosis evaluated by angiography using a modified APPROACH score

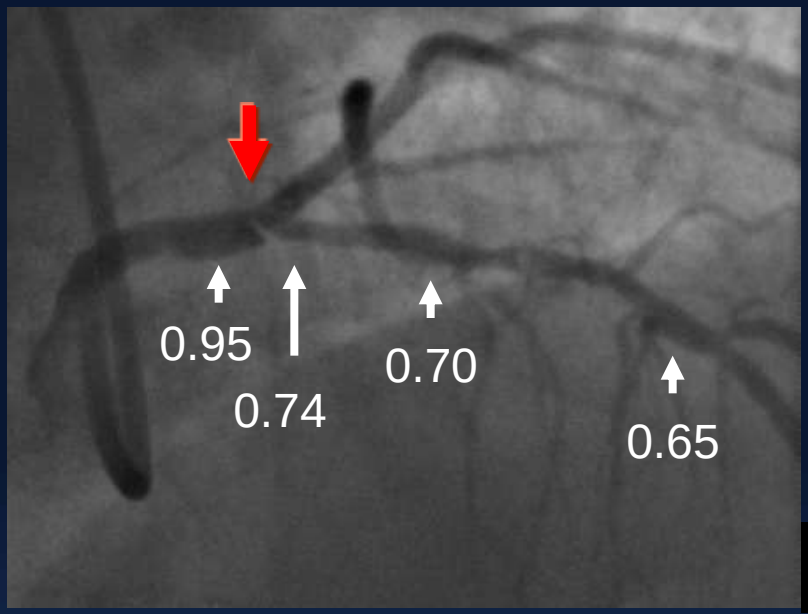


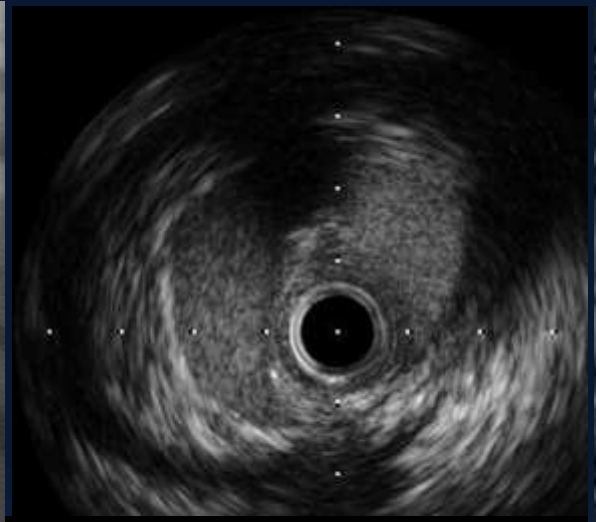
Shiono et al. Catheter Cardiovasc Interv 2014;84:406-13

Multivariable Logistic Regression to Predict FFR<0.80

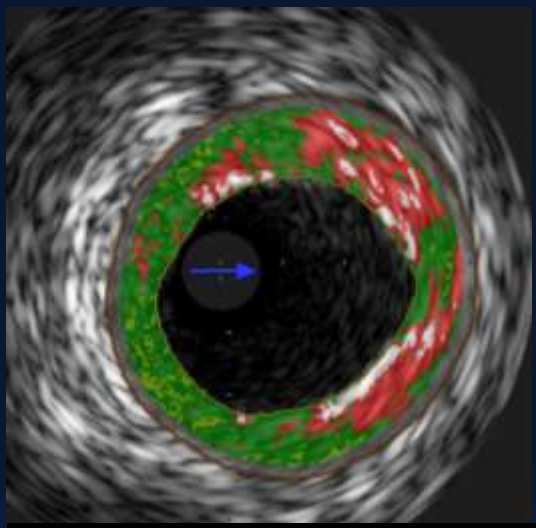
	OR	95% CI	P value
Minimum lumen diameter	0.031	0.013–0.076	< 0.001
Lesion length	1.038	1.009–1.069	0.001
Myocardial supply area (modified APPROACH)	1.113	1.079–1.147	< 0.001

Shiono et al. Catheter Cardiovasc Interv 2014;84:406-13



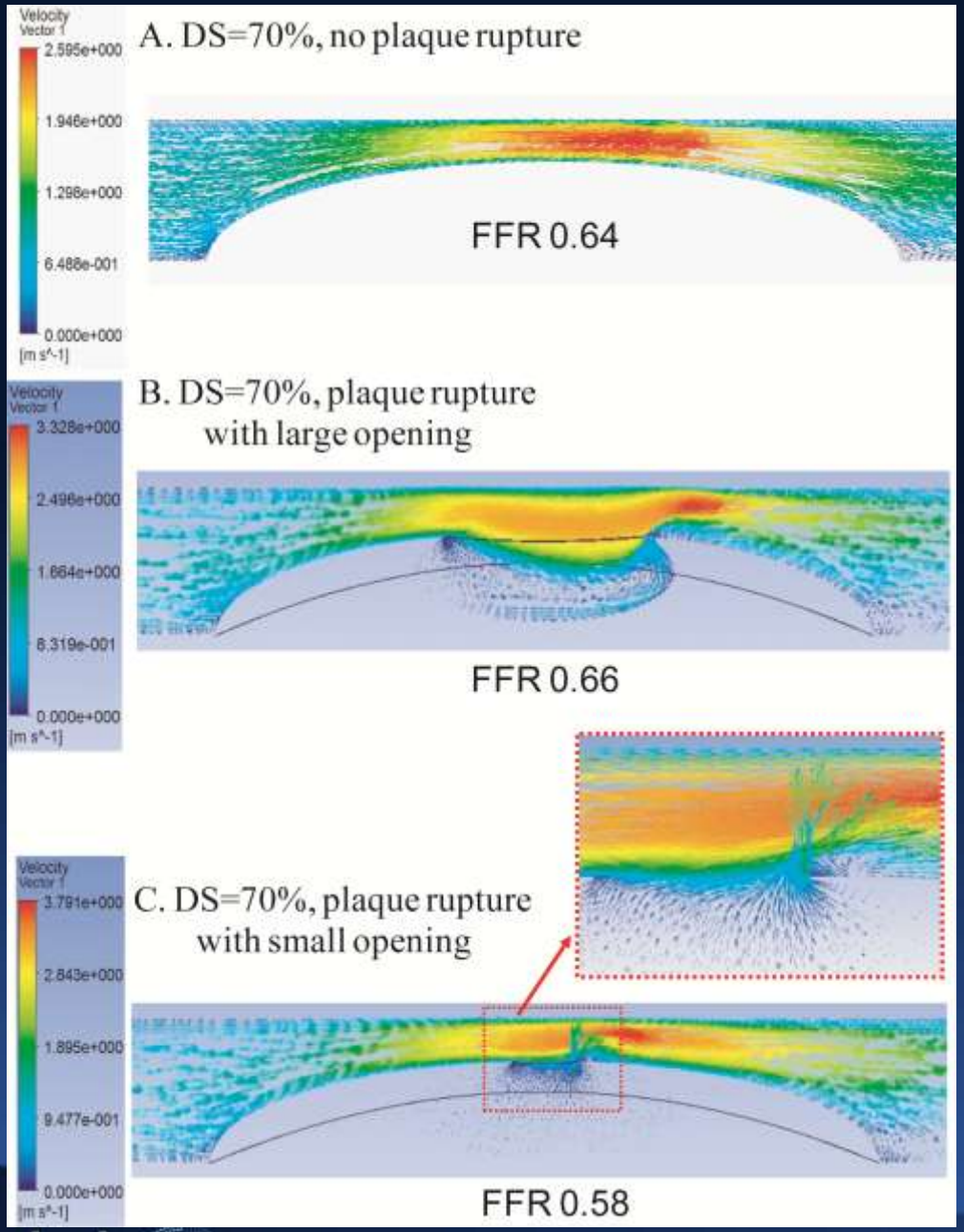


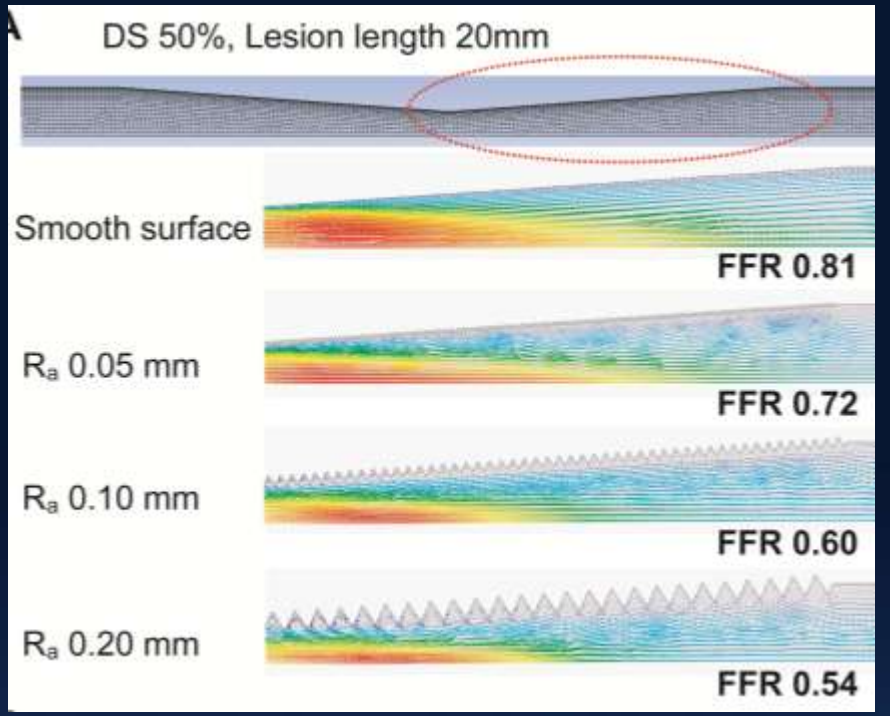
LM MLA 6.2mm^2



LM TCFA

0.65 0.70 0.74 0.95

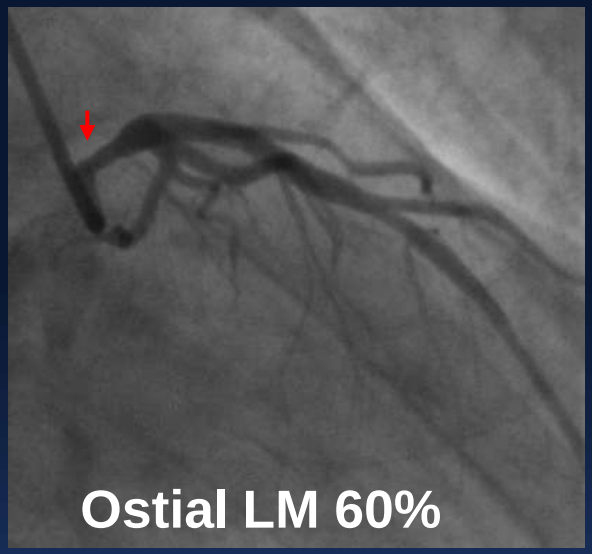




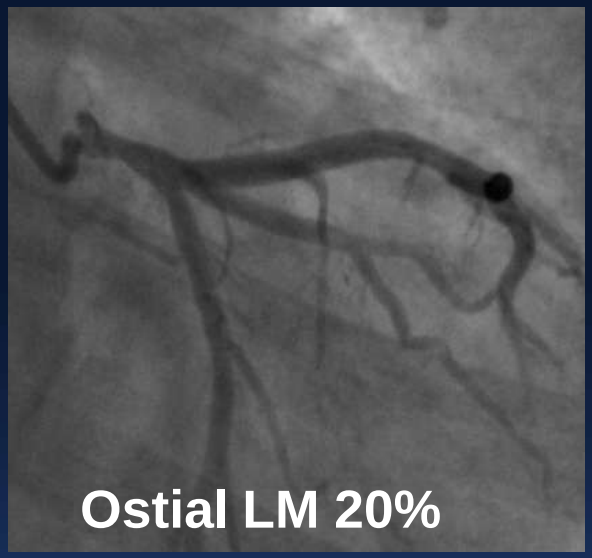
Complex or irregular lumen produces greater flow resistance and energy loss of fluid, thus resulting in pressure drop and FFR↓

Park et al. JACC interv 2012;5:1029-36

Ostial/Shaft LMCA Disease



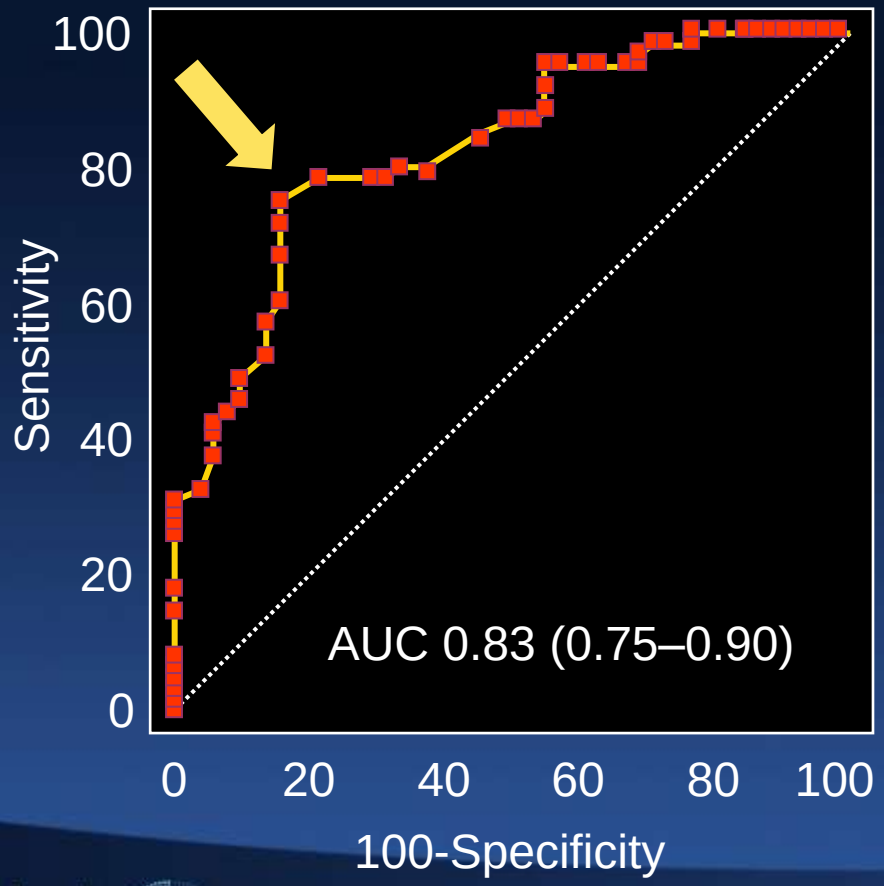
Ostial LM 60%



Ostial LM 20%

LM MLA 4.5mm^2

Matched with FFR <0.80
Ostial and Shaft LM Disease (N=112)



Sensitivity	79%
Specificity	80%
PPV	83%
NPV	76%

Park SJ et al. JACC Interv 2014;7:868–74

Independent Factors of LM FFR<0.80

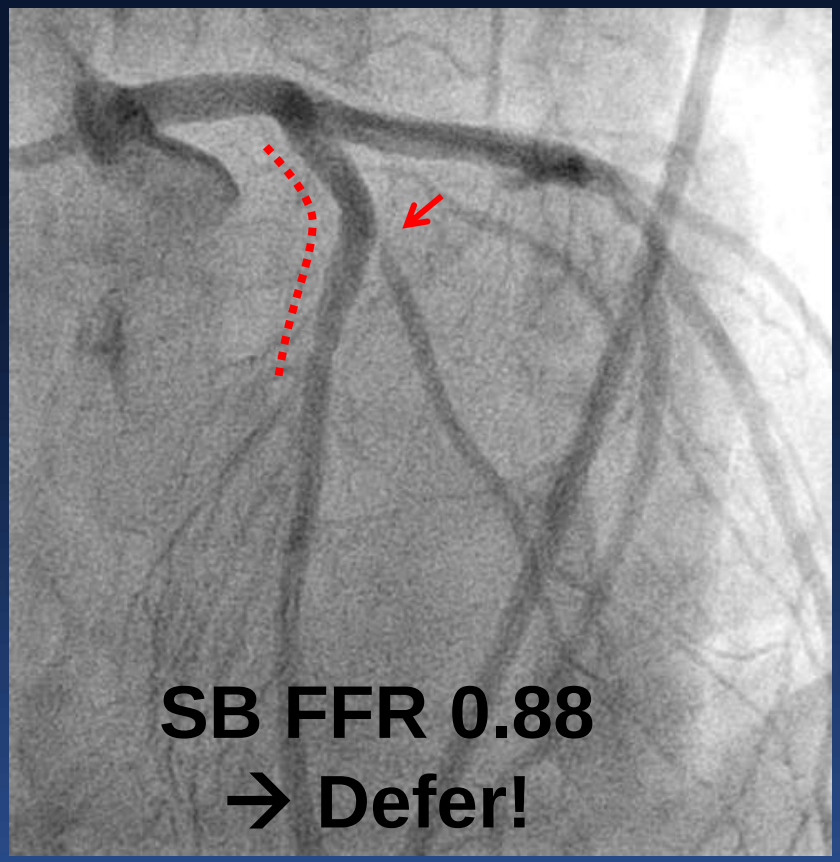
	Odds ratio	95% CI	p
Model 1			
Plaque rupture	4.47	1.35 – 14.8	0.014
BMI, kg/m^2	1.19	1.00 – 1.41	0.05
Age, yrs	0.95	0.90 – 1.00	0.031
MLA, mm^2	0.37	0.25 – 0.56	<0.001
Model 2 including Echo-LV mass			
LV mass, g	1.01	1.00 – 1.03	0.03
Age, yrs	0.94	0.90 – 0.99	0.021
MLA, mm^2	0.34	0.21 – 0.54	<0.001

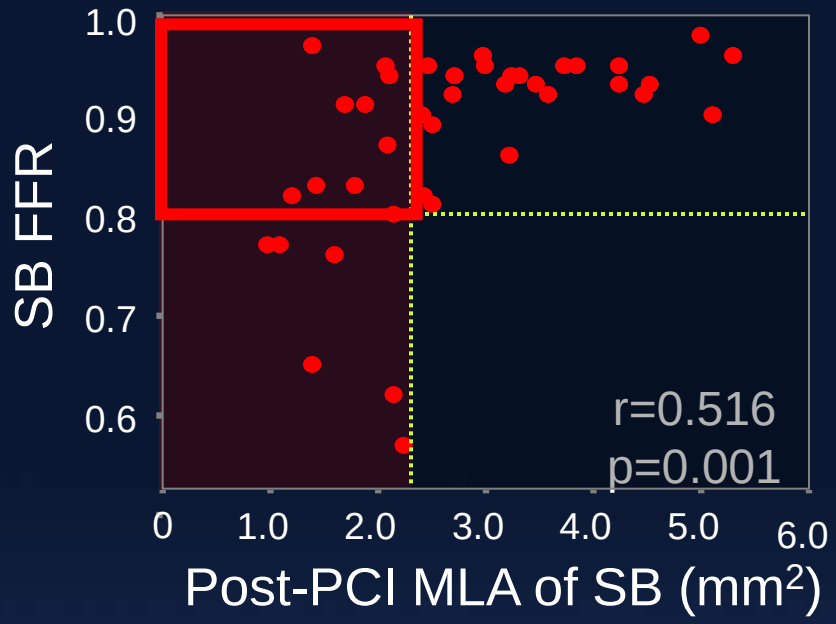
The suboptimal accuracy of LM-MLA is not surprising

Park SJ et al. JACC Interv 2014;7:868–74

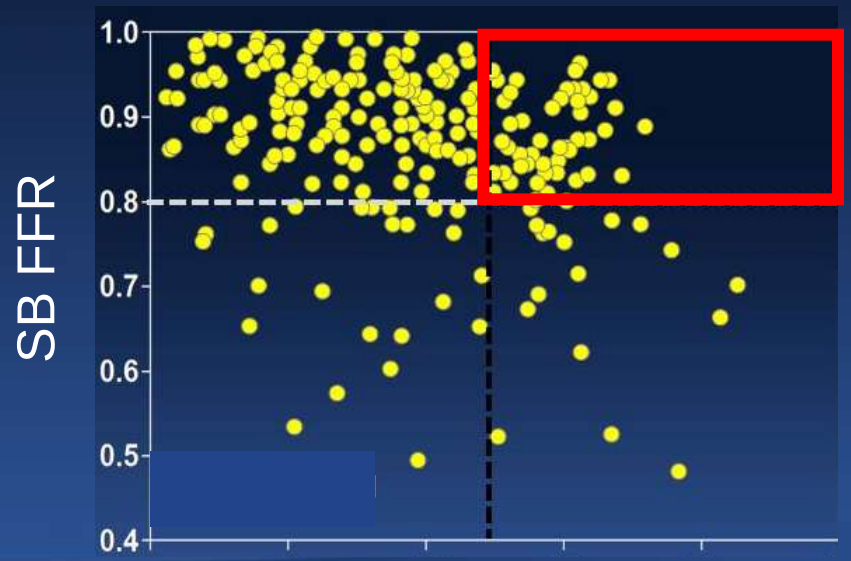
SB Jailing

V-F Mismatch





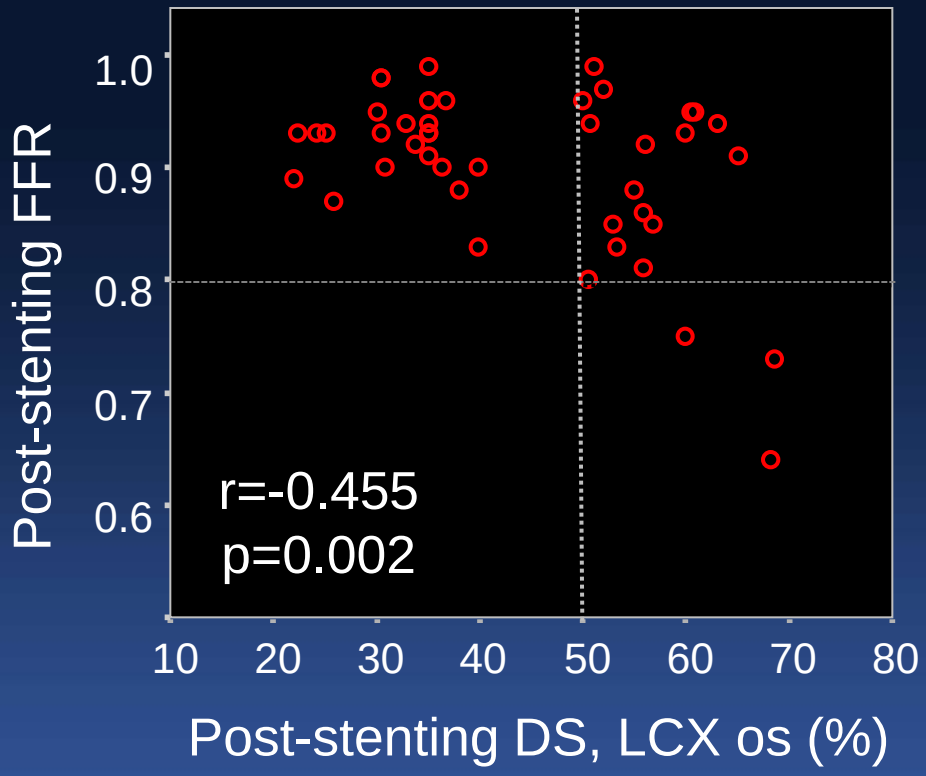
Kang et al. CCI 2013;82:1072-82

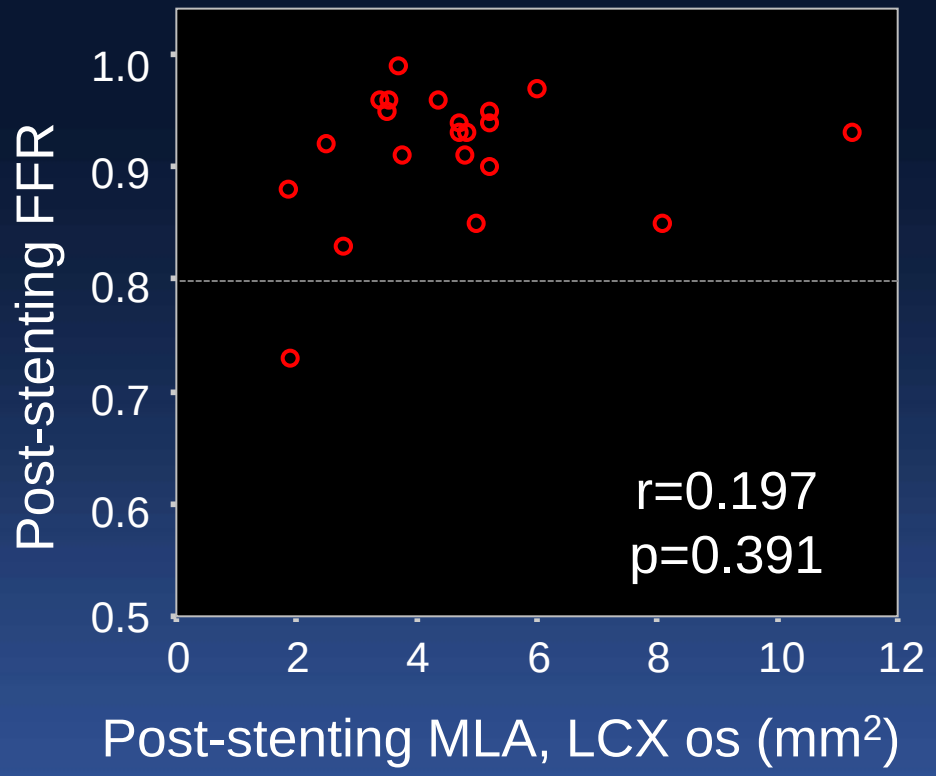


Ahn et al. JACC Interv in Press

SB Jailing After LM Stenting

Post-stening LCX Stenosis vs. FFR

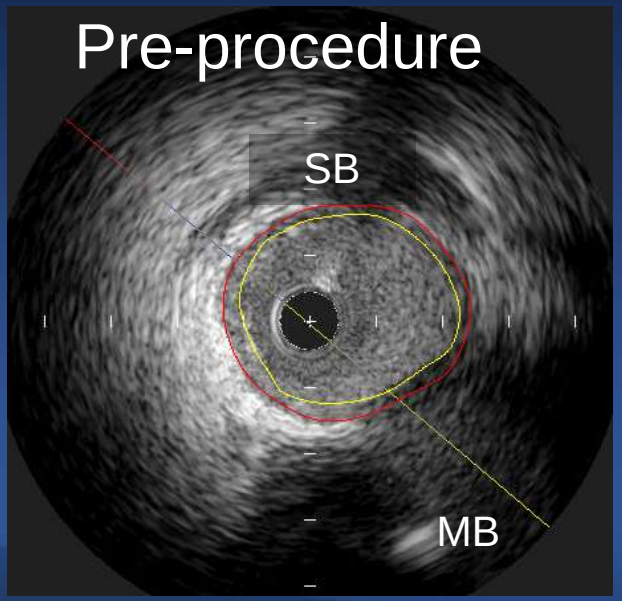


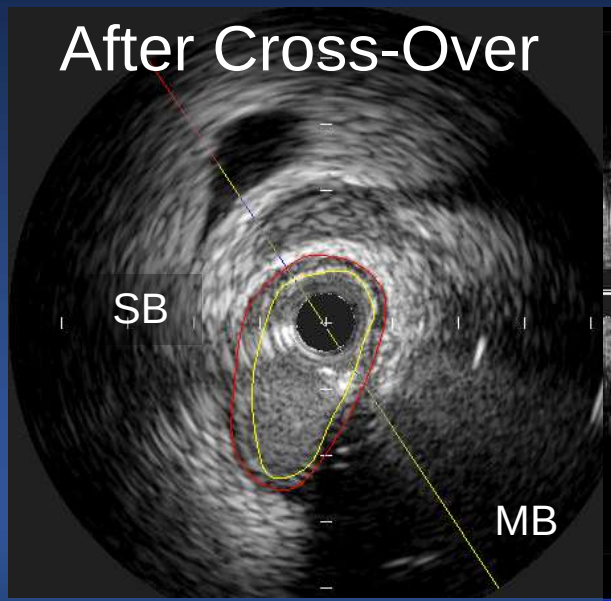


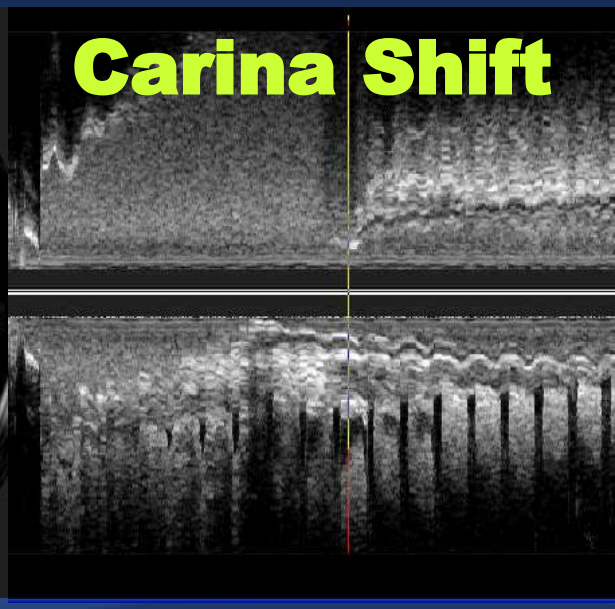
Kang et al. Catheter Cardiovasc Interv 2014;83:542-52

Why Mismatch

- Lesion eccentricity of SB
- Negative remodeling of ostium
- Various size of myocardium
- Strut artifacts
- Focal carina shift



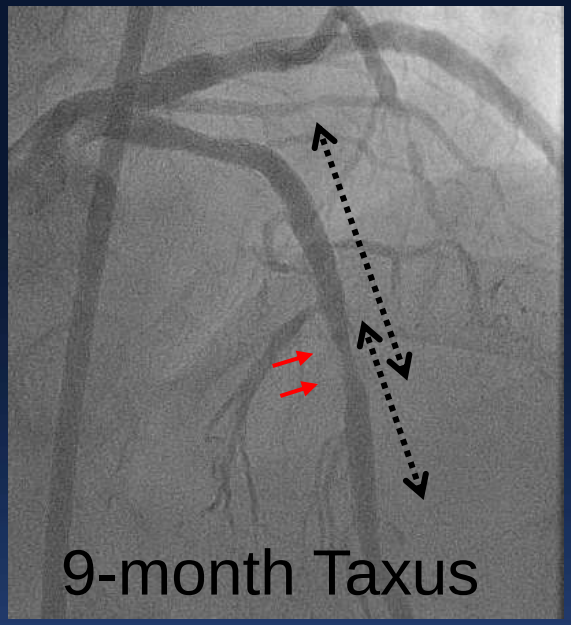




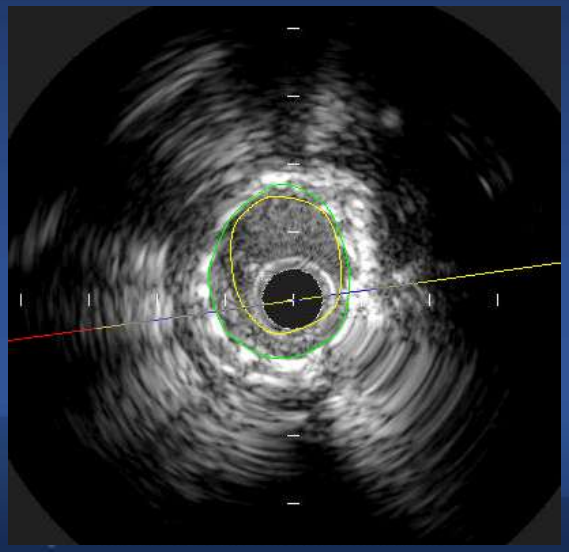
Kang et al. Circ Cardiovasc Interv 2011;4:355-61

Mechanism of In-stent Restenosis

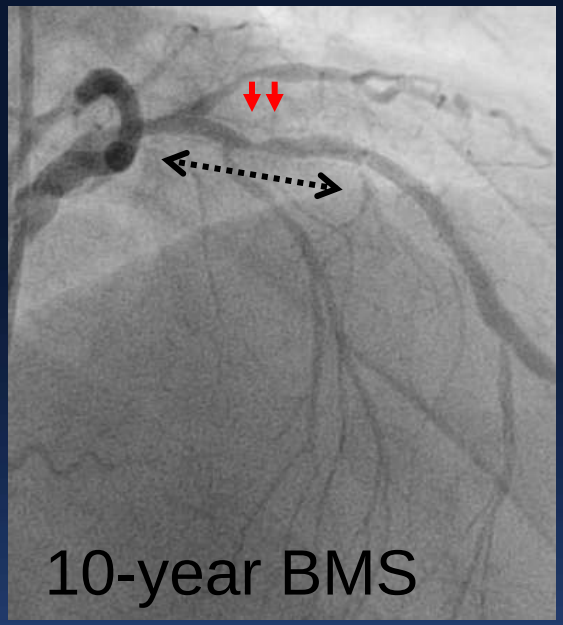
Underexpansion



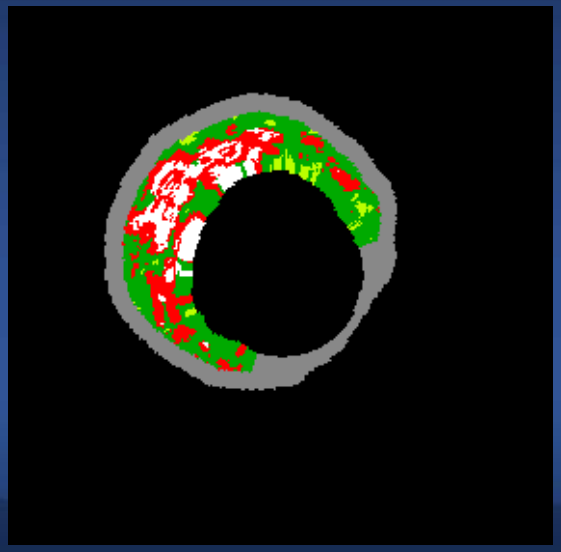
9-month Taxus



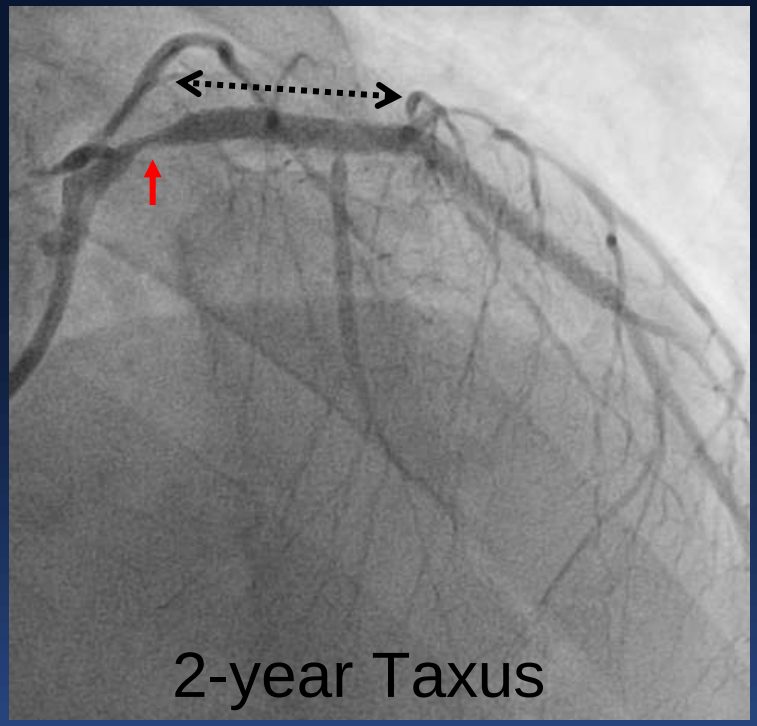
Intimal HP



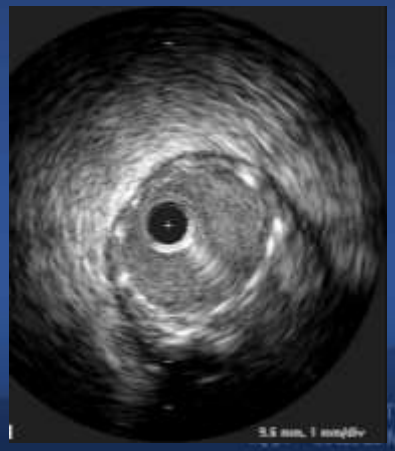
10-year BMS

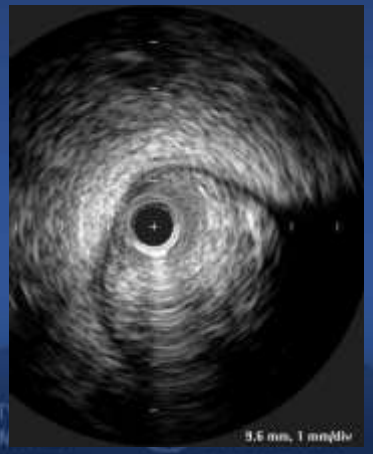


Edge Restenosis



2-year Taxus

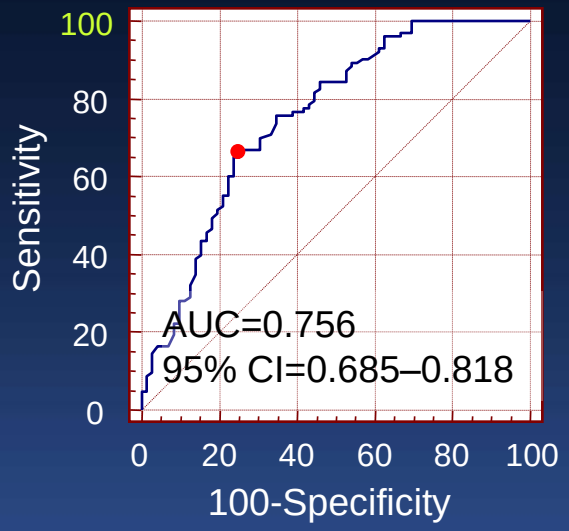




Predictors for Functionally Significant In-stent Restenosis (Positive SPECT)

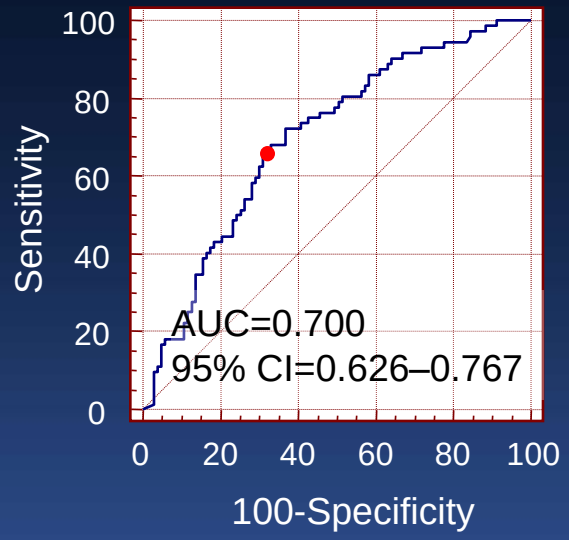
175 patients with ISR of a single coronary artery

In-seg MLA≤1.9mm^2



sensitivity 67%
specificity 75%
accuracy 70%

%IH>68%



sensitivity 67%
specificity 69%
accuracy 68%

Kang et al. JACC Cardiovasc Imaging 2013 6:1183-90

Multivariable Analysis for Predicting **Positive SPECT in ISR Lesions**

	OR	95% CI	p
Diabetes	2.41	1.02–5.68	0.046
In-segment angiographic DS	1.06	1.03–1.09	<0.001
In-segment IVUS-MLA	0.30	0.14–0.63	0.001
Underexpansion (MSA<5mm^2)	2.91	1.19–7.07	0.019
Proximal 1/3 location of MLA	4.62	1.75–12.18	0.002
Multi-focal or diffuse ISR	2.50	0.99–6.28	0.050

Kang et al. JACC Cardiovasc Imaging 2013 6:1183-90

Summary

- IVUS-MLA poorly predicts ischemia. In pure LMCA, MLA can be alternatively used
- Although angiographic SB jailing is common after MB stenting, either angiographic DS or SB-MLA rarely predicts ischemia
- IVUS provides the mechanism of ISR, while MLA cannot predict functional significance