Pre- and Post-PCI IVUS Assessment in LM Lesions

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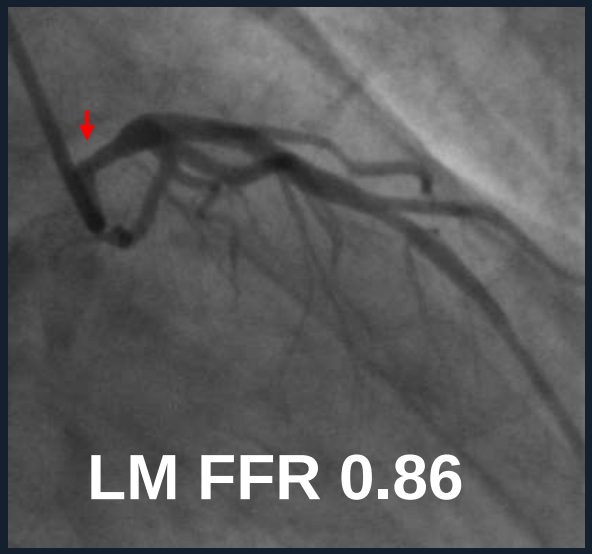
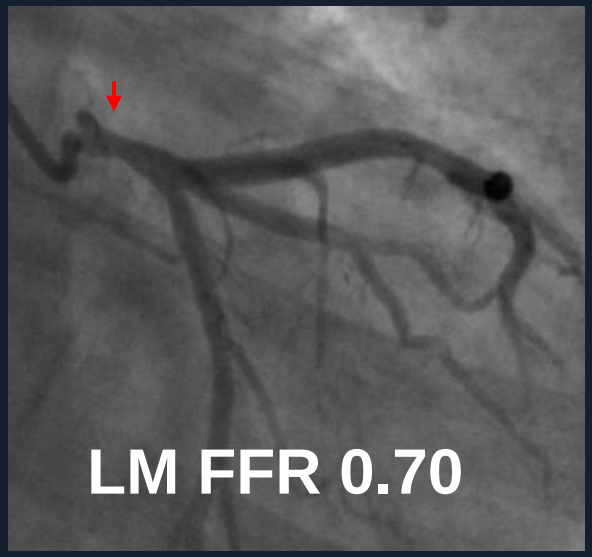
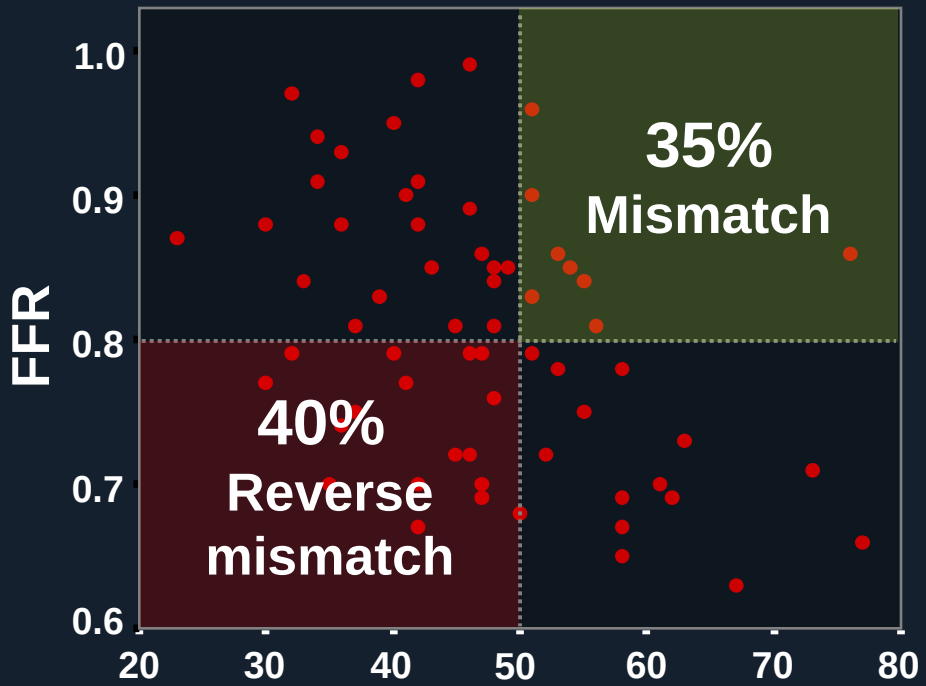
Assessment of Disease Severity

Angiography cannot predict functional severity







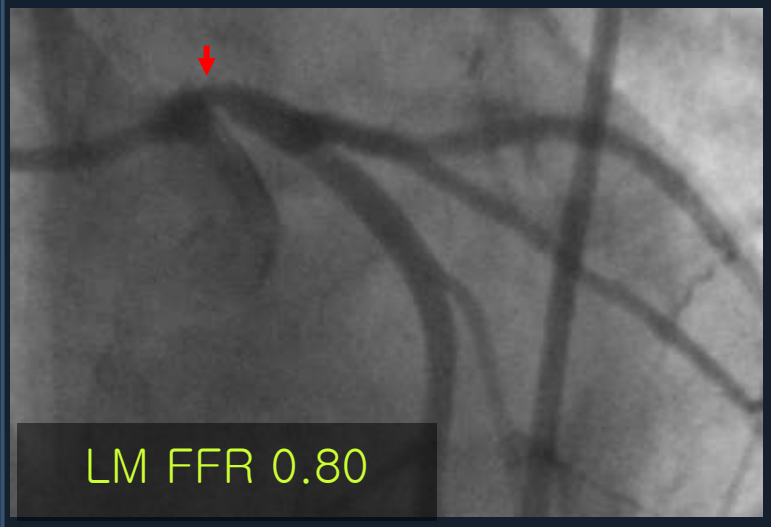
DS 48%

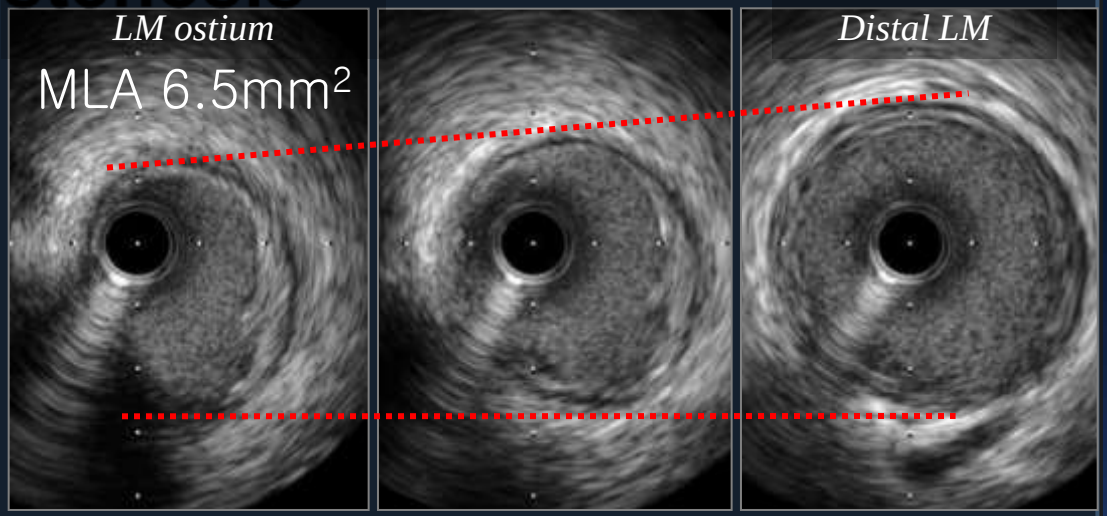
Sensitivity 51%
Specificity 75%
Accuracy 65%

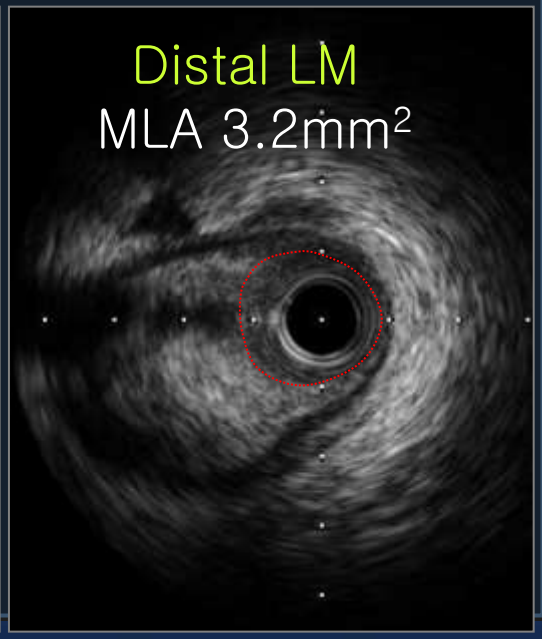
Park et al. JACC interv 2012;5:1029-36

Assessment of Disease Severity

IVUS accurately detects ischemia-inducing LM stenosis

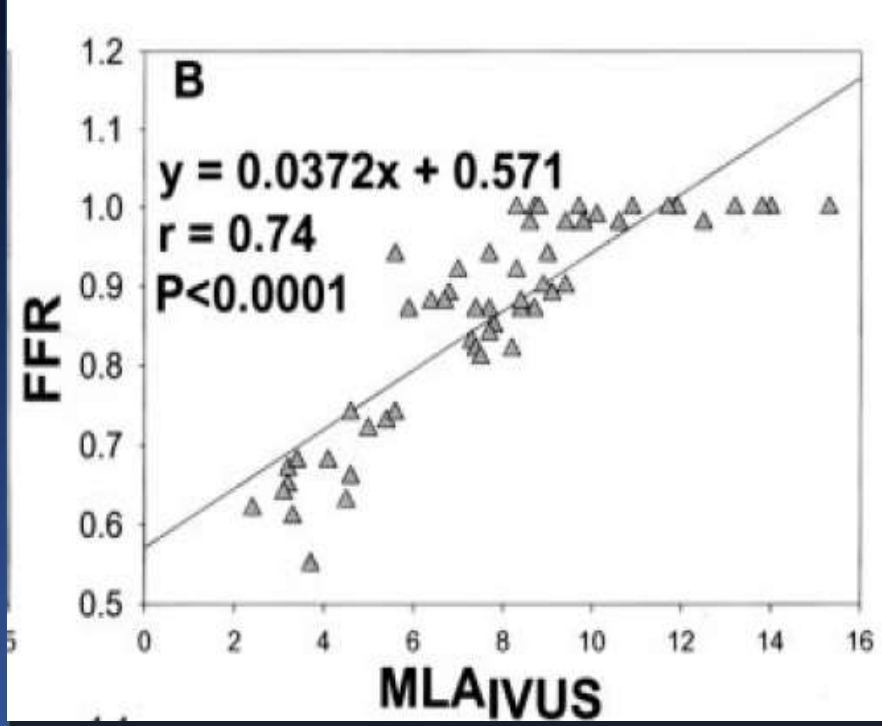


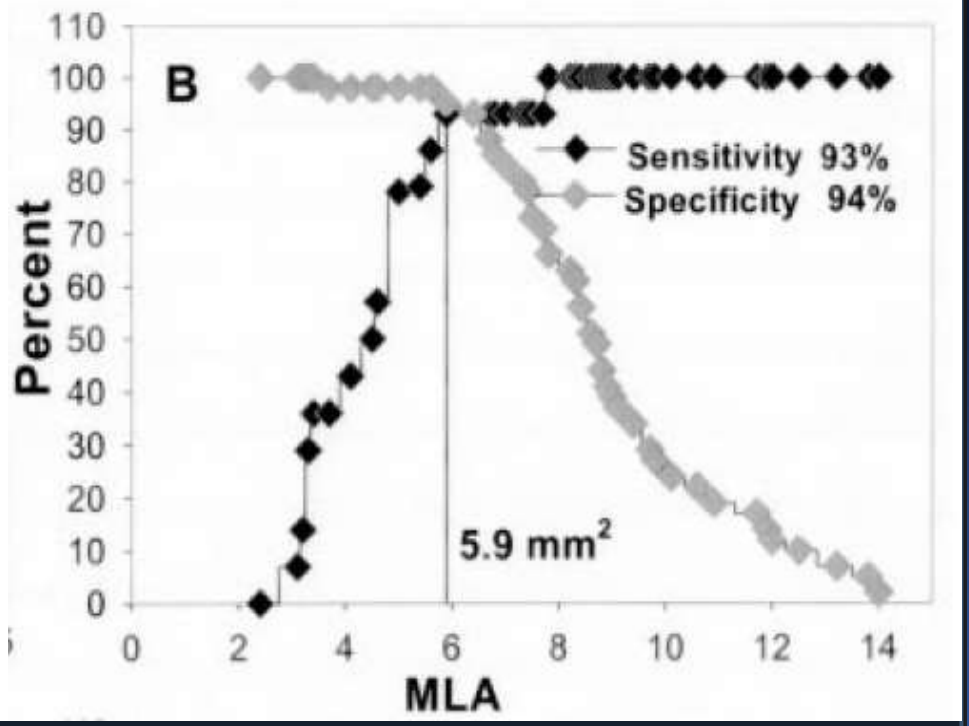




Assessment of Disease Severity

Traditional Cut-off for FFR<0.75
LM MLA 6.0mm²





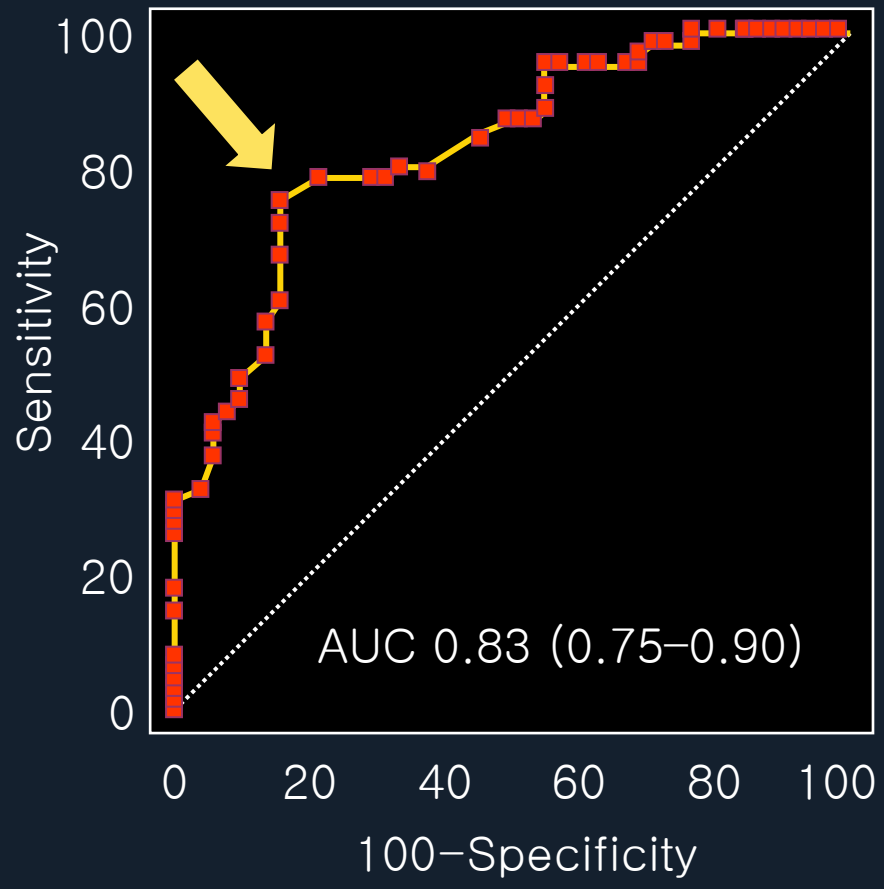
Jasti et al. Circulation 2004; 110: 2831-6

Assessment of Disease Severity

New LM MLA 4.5mm²

Matched with FFR <0.80

Ostial and Shaft LM Disease (N=112)



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

Park SJ, Ahn JM et al. J Am Coll Cardiol Intv 2014; 7:868-74

Assessment of Disease Severity

According to *Murray's law*, LM MLA 6.0mm^2 indicates MLA 4.0mm^2 for both branches as ischemic threshold

LAD	LCX	LM (Murray's)	LM (Finet's)
4.0	4.0	6.35	7.35
4.0	3.9	6.27	7.26
4.0	3.8	6.19	7.17
4.0	3.7	6.11	7.08
4.0	**3.6**	**6.04**	**6.98**
4.0	3.5	5.96	6.89

De La Torre Hernandez et al. JACC 2011;58:351-8
Jasti et al. Circulation 2004;110:2831-6

Assessment of Disease Severity

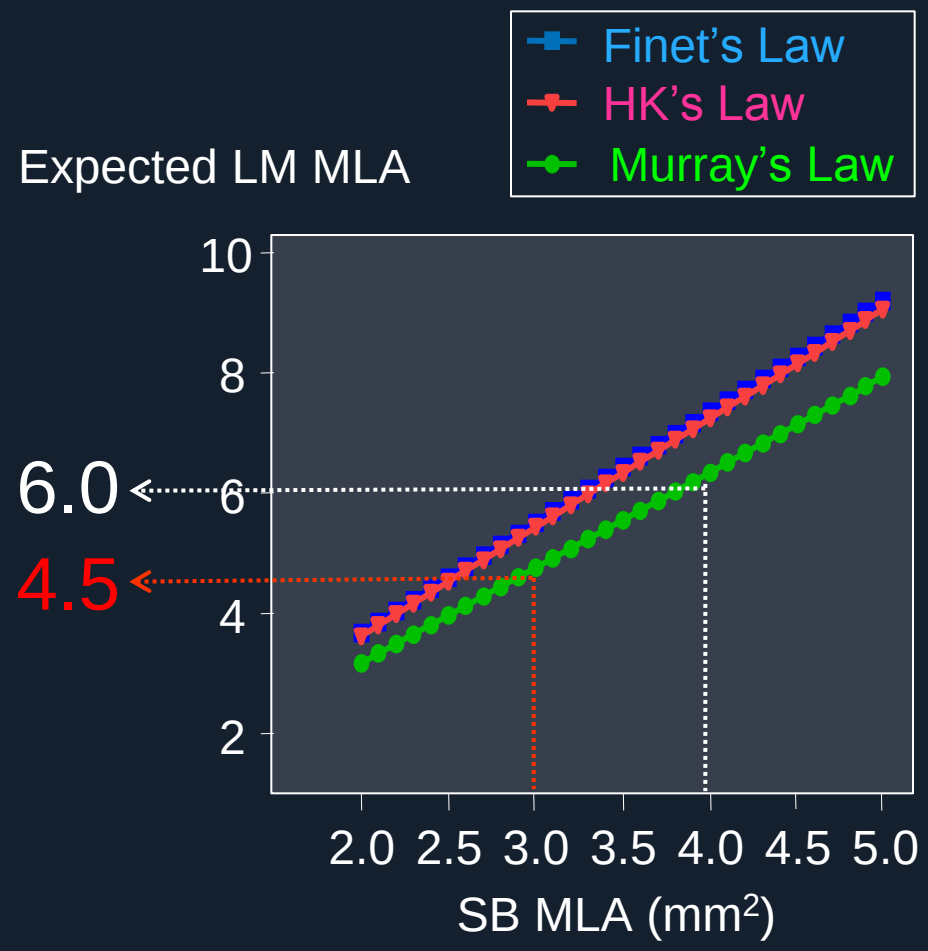
MLA cut-offs for FFR < 0.8 in non-LM stenosis

	N	% of abnormal	Mean MLA	MLA cut-off
Takagi et al	51	49	3.9	3
Briguori et al	53	23	3.9	4
Lee et al	94	40	2.3	2
Kang et al	236	21	2.6	2.4
Ben-Dor et al	205	26	3.5	3.1
Koo et al	267	33	3	2.8
Gonzalo et al	47	46	2.6	2.4
Waksman et al	304	28	3.5	3
Stone et al	544	31	3.3	2.9
Kwan et al	169	59	3	3
Chen et al	323	54	2.9	3
Yang et al	206	44	3.1	3.2
Kang et al	700	38	2.5	2.5

Assessment of Disease Severity

The used cut-off 4.0mm² is too Big!

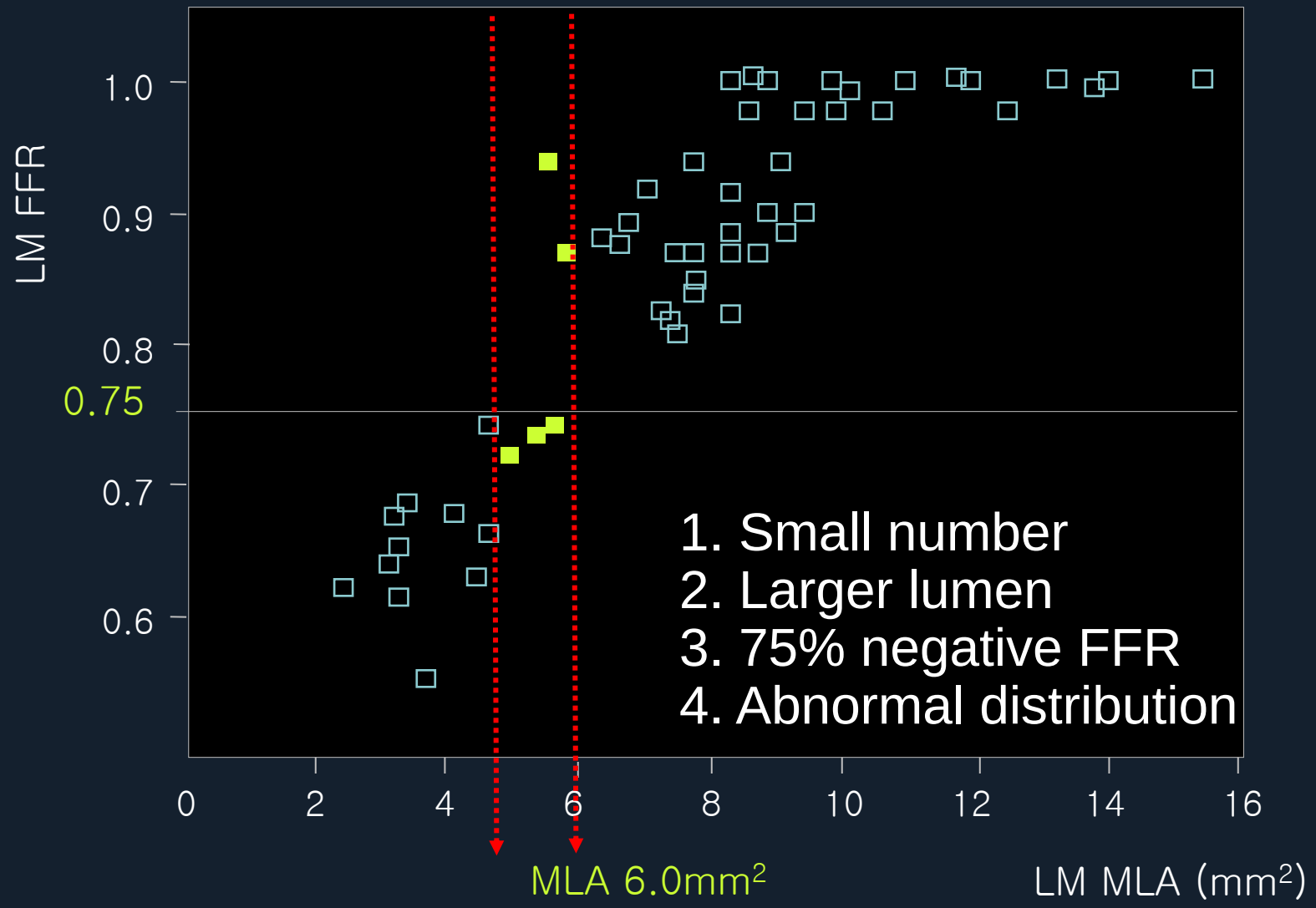
LAD	LCX	LM (Murray's)	LM (Finet's)
3.0	3.0	4.76	5.52
3.0	2.9	4.68	5.42
3.0	2.8	4.60	5.33
3.0	**2.7**	**4.53**	**5.24**
3.0	2.6	4.45	5.14
3.0	2.5	4.37	5.05



Huo et al. Eurointervention 2012;7:1310-6

Assessment of Disease Severity

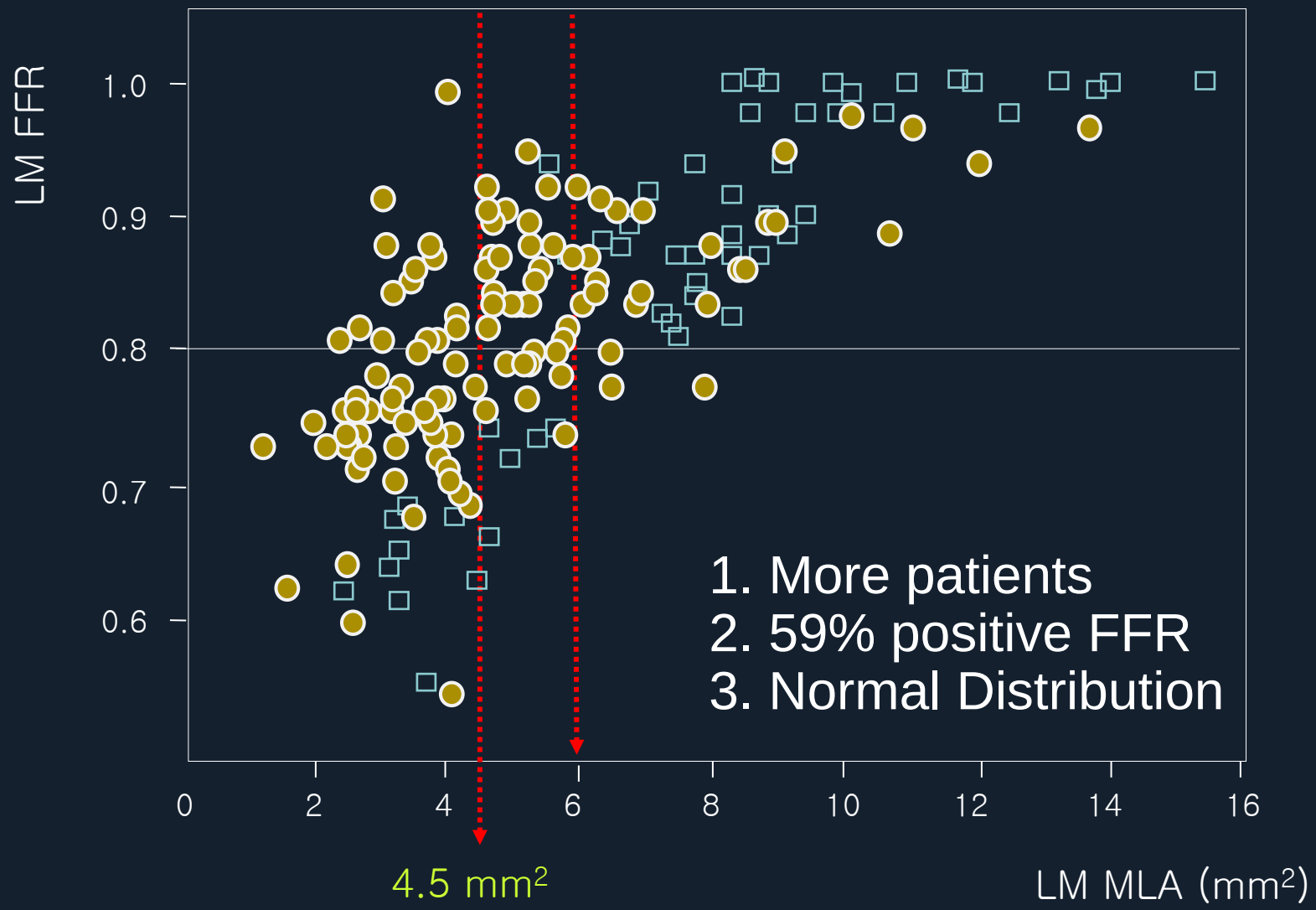
Jasti's data (n=55)



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

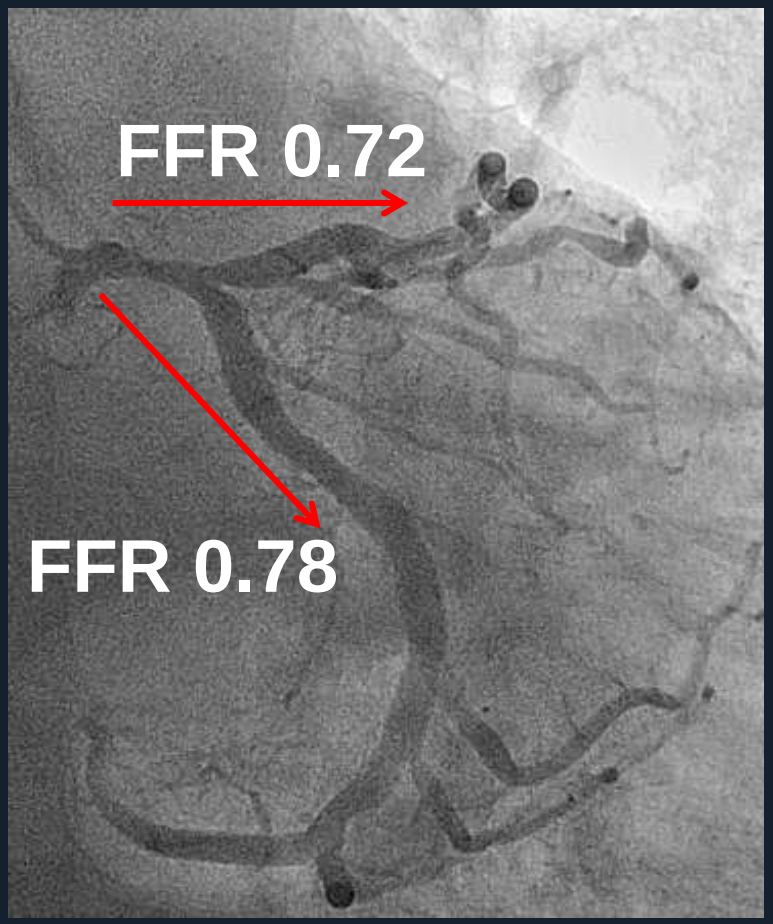
Assessment of Disease Severity

AMC New Data (n=112) Jasti's data (n=55)

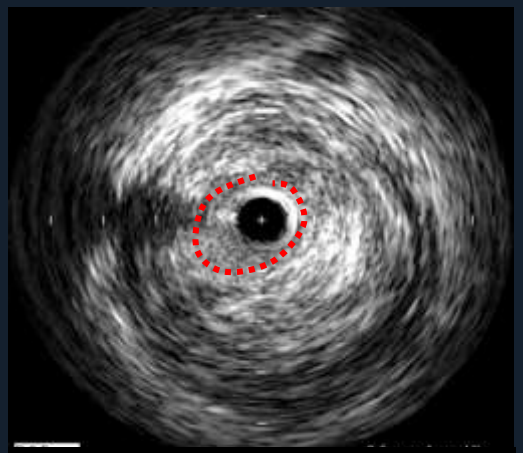


Park SJ, Ahn JM et al. J Am Coll Cardiol Intv 2014; 7:868-74

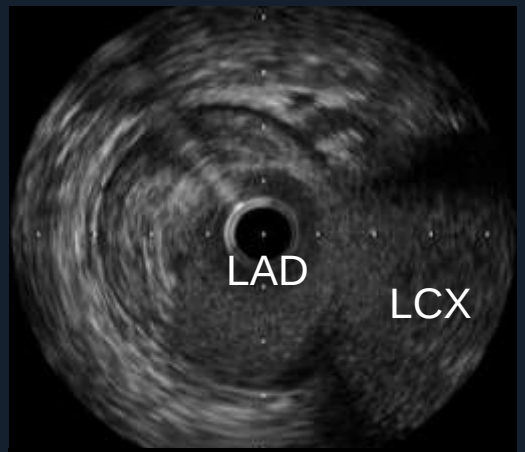
Selection of Stenting Technique



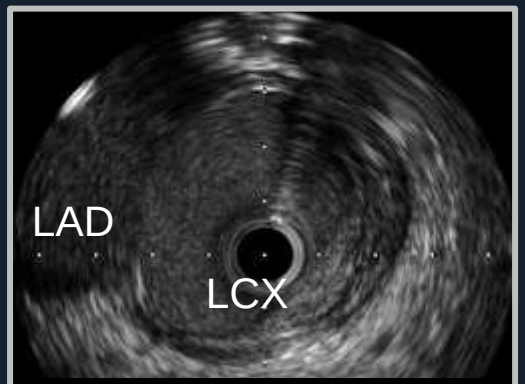
How big?
How severe?



Distal LM
EEMφ 6.2mm
MLA 3.0mm^2



LAD os
EEMφ 5.2mm
MLA 8.0mm^2



LCX os
EEMφ 5.0mm
MLA 12.8mm^2

Selection of Stenting Technique

Angiographic classification of LM bifurcations is not accurate

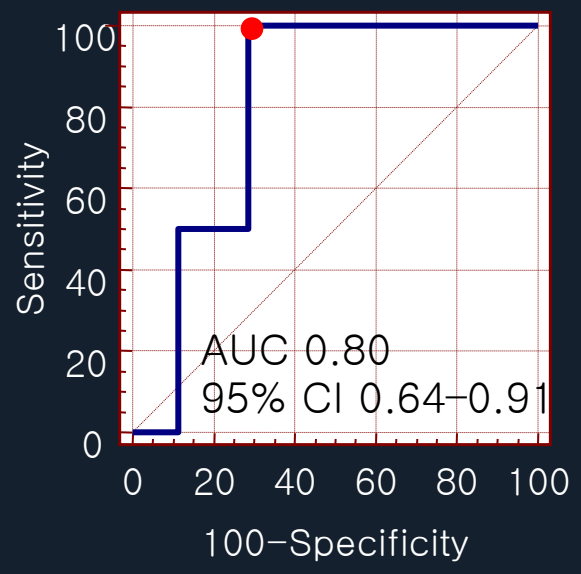
	IVUS Lesion, n (%)	Angiographic Diameter Stenosis ≥50%, n (%)	Positive Predictive Value, %	Negative Predictive Value, %
All segments				
IVUS plaque burden ≥70%	73/420 (17.3)	148/420 (35.2)	35.1	92.3
IVUS MLA <6.0 mm^2 (distal LMCA) or <4.0 mm^2 (ostial LAD or LCX)	128/420 (30.4)		56.7	83.8
Distal LMCA				
IVUS plaque burden ≥70%	27/140 (19.2)	43/140 (30.7)	51.1	95.8
IVUS MLA <6.0 mm^2	40/140 (28.5)		74.4	91.7
Ostial LAD				
IVUS plaque burden ≥70%	34/140 (24.3)	55/140 (39.3)	41.1	87.1
IVUS MLA <4.0 mm^2	40/140 (28.5)		47.2	83.5
Ostial LCX				
IVUS plaque burden ≥70%	12/140 (8.5)	50/140 (35.7)	14	94.4
IVUS MLA <4.0 mm^2	48/140 (34.3)		52	75.5

Oviedo et al. Circ Cardiovasc Interv. 2010;3:105-112

Selection of Stenting Technique

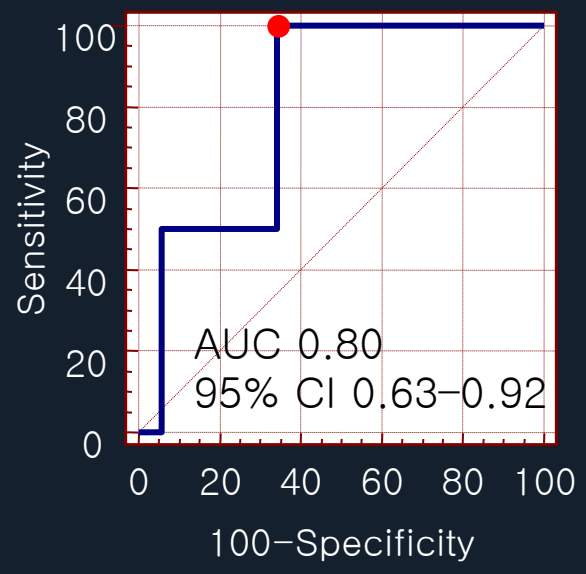
Pre-procedural Predictors for Functional LCX Stenosis (FFR<0.80)

SB MLA <3.7mm^2



Sensitivity 100%
Specificity 71%
PPV 16%
NPV 100%

Plaque burden >56%

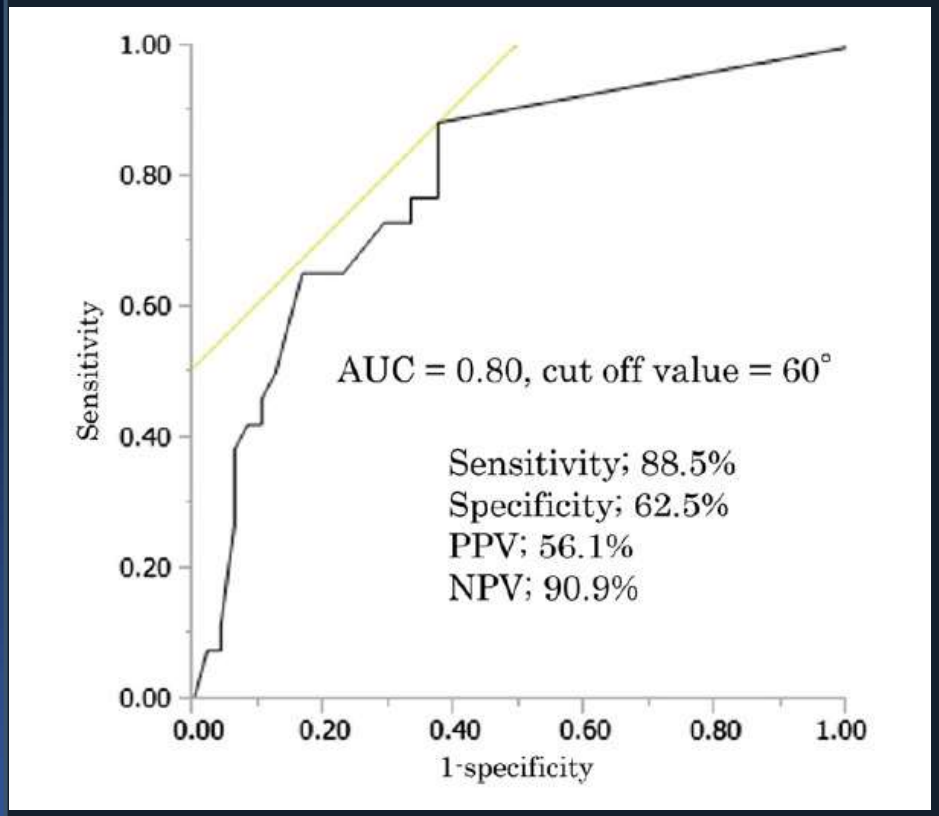


Sensitivity 100%
Specificity 65%
PPV 14%
NPV 100%

Kang et al. Catheter Cardiovasc Interv 2014;83:542-520

Selection of Stenting Technique

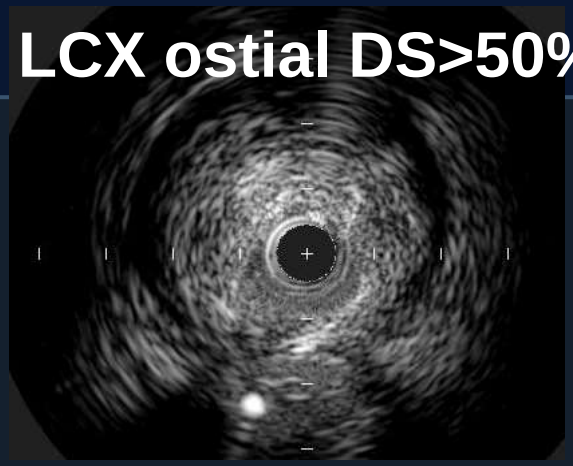
MB calcium arc >60° is independent predictor of LCX compromise

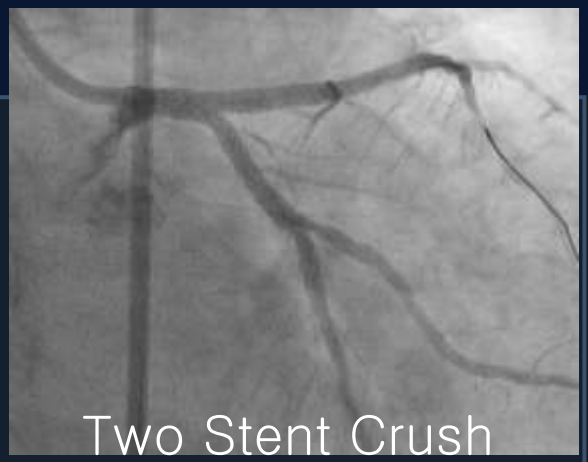


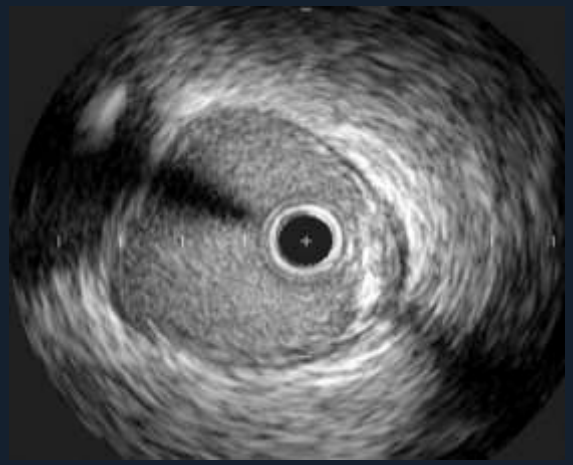
	OR	95% CI	p
The Ca arc (>60°)	5.12	1.21-25.01	0.03
Length of calcified lesion	1.01	0.92-1.11	0.77
Eyebrow sign	2.15	0.64-7.57	0.21
LAD CSA at carina	0.73	0.46-1.04	0.09
LCX MLD	1.14	0.29-4.58	0.85
Bifurcation angle	0.99	0.96-1.00	0.23

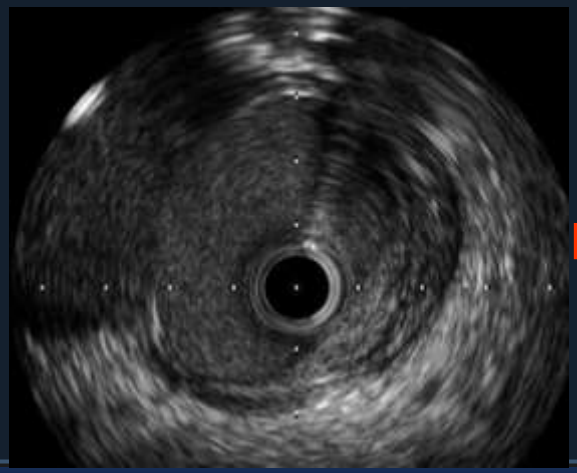
Yoshitaka et al. EuroIntervention. 2012;8:708-16

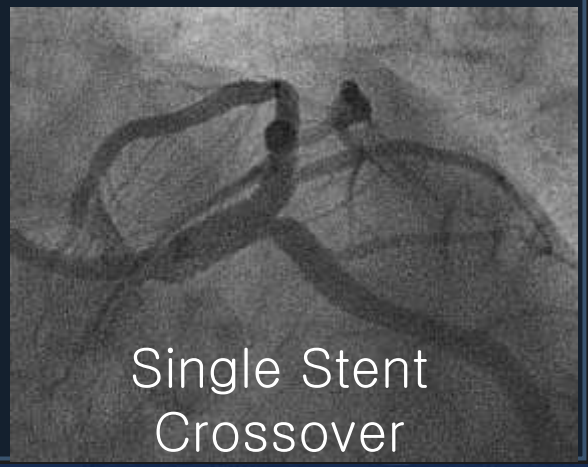
LCX ostial DS>50%





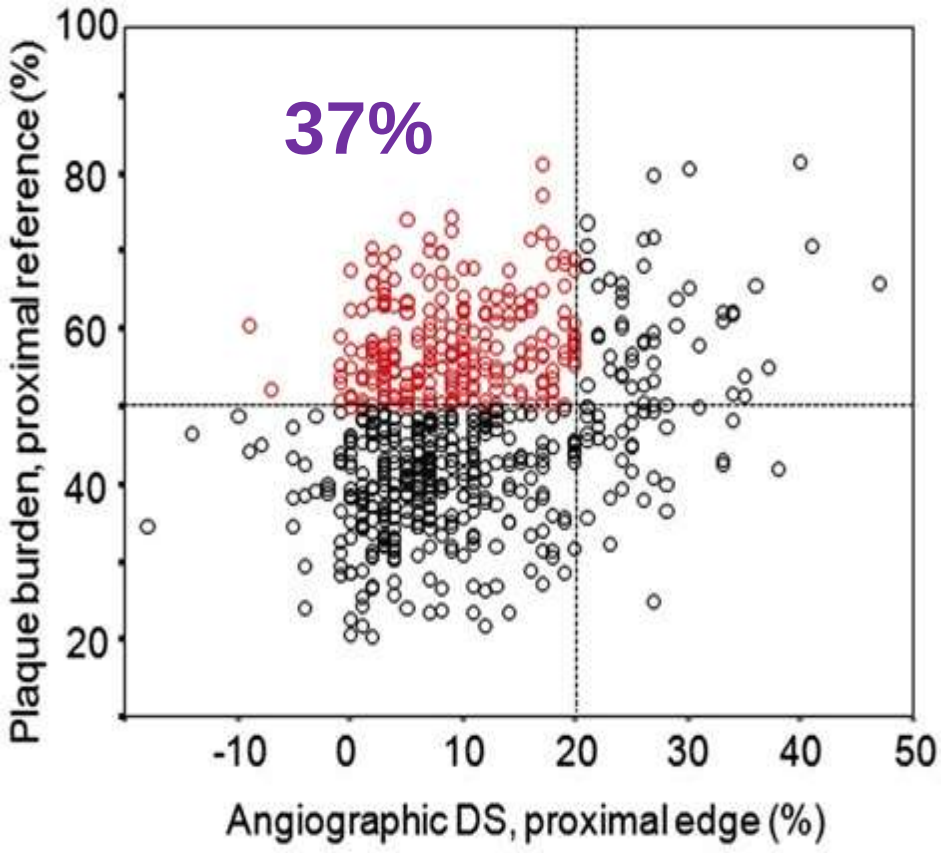


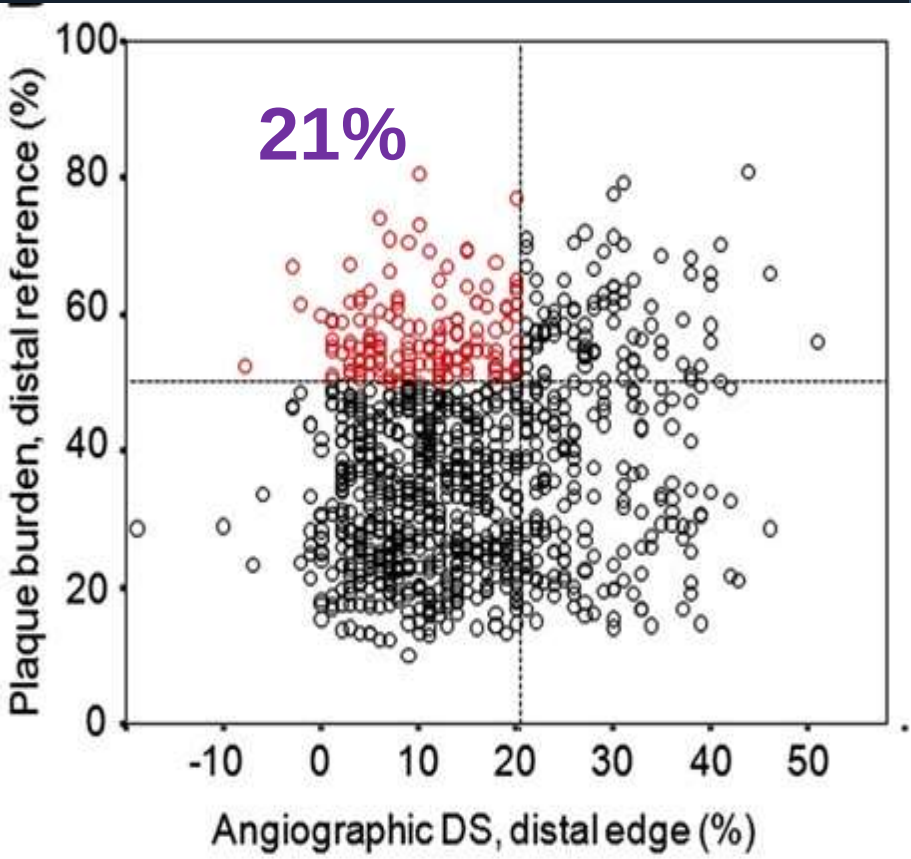




Determination of Landing Site

Angiography poorly predicts the reference segment plaque burden



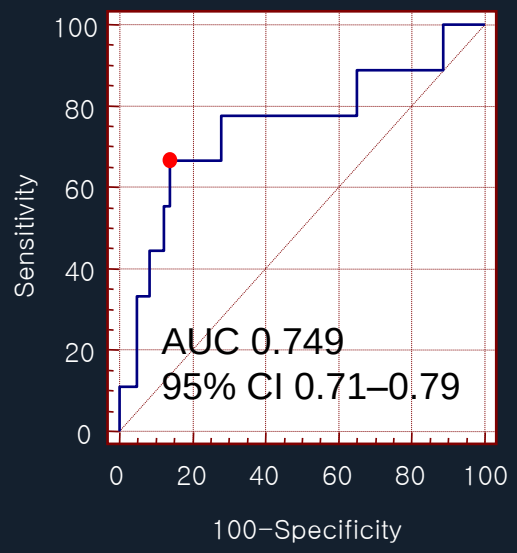


Kang et al. Am J Cardiol 2013;111:1408-14

Determination of Landing Site

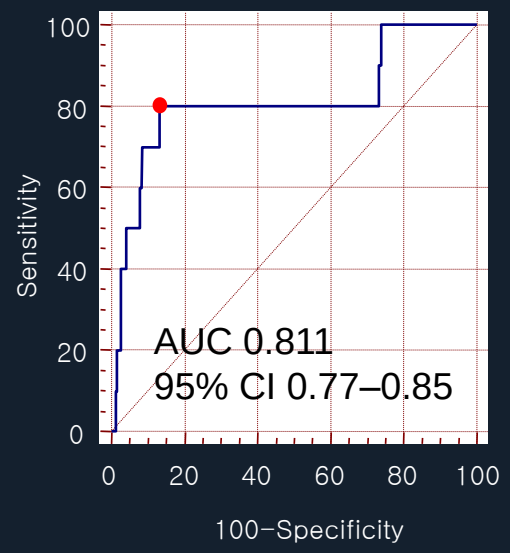
Reference segment residual PB<55% was useful to determine the optimal landing site

433 E-ZES



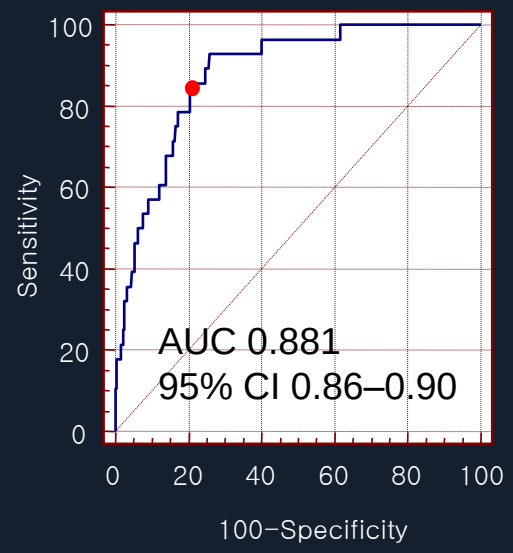
PB 56.3%
Sensitivity 67%
Specificity 86%

422 R-ZES



PB 57.3%
Sensitivity 80%
Specificity 87%

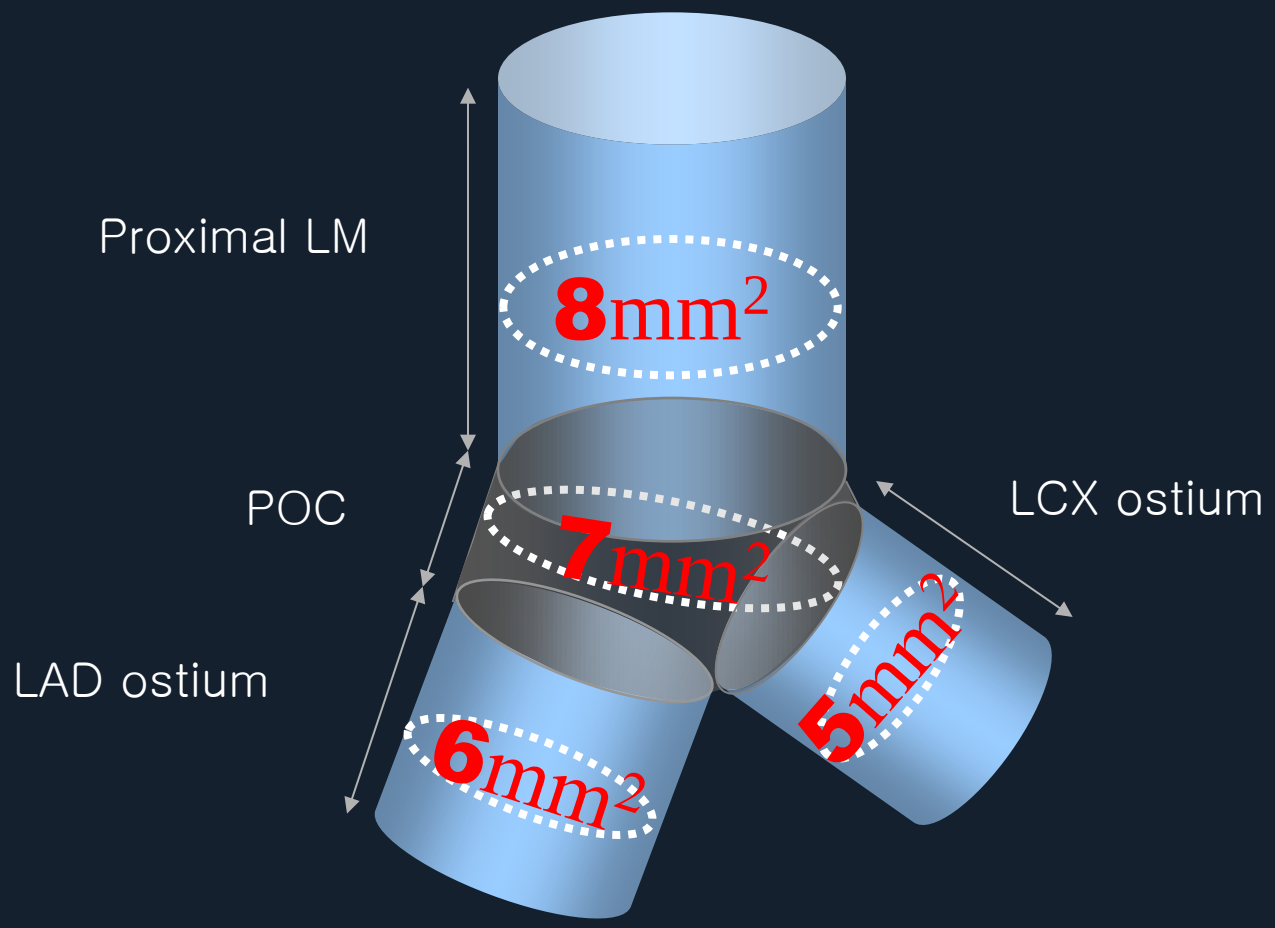
813 EES



PB 54.2%
Sensitivity 86%
Specificity 80%

Kang et al. Am J Cardiol 2013;111:1408-14

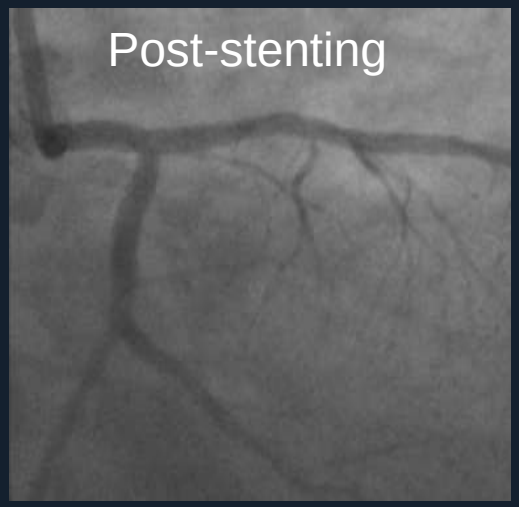
Stent Optimization

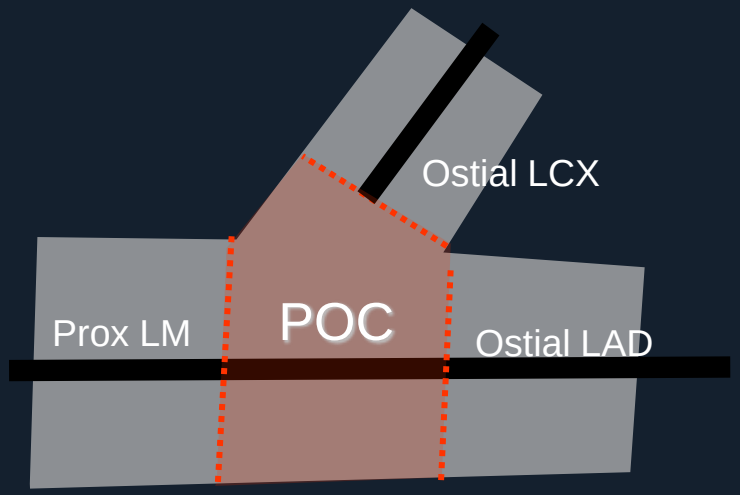


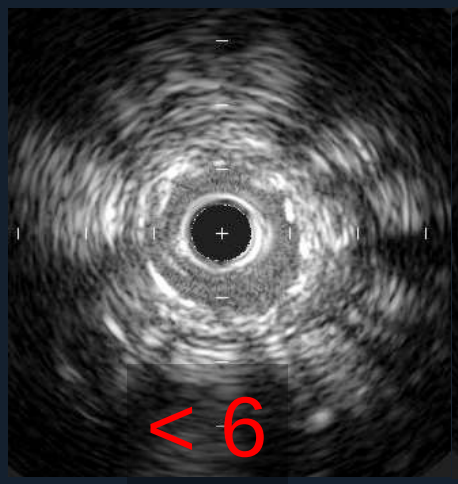
Kang et al. Circ Cardiovasc Interv 2011 2011;4:1168-74

Stent Optimization

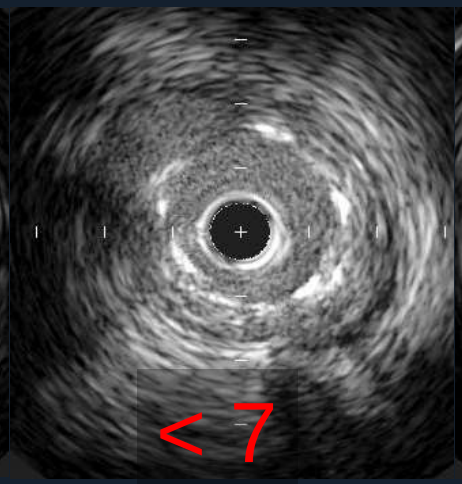
Angiography poorly predicts stent underexpansion



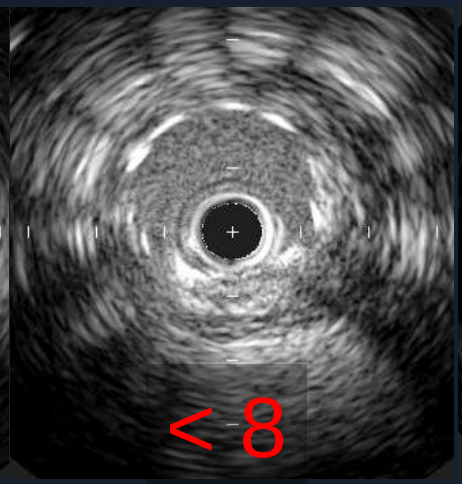




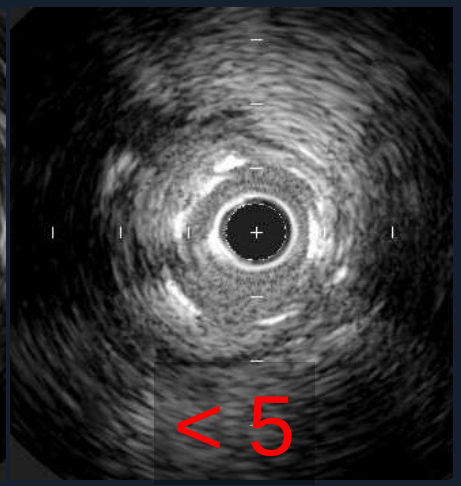
LAD 5.0mm^2



POC 6.3mm^2



Prox LM 6.8mm^2

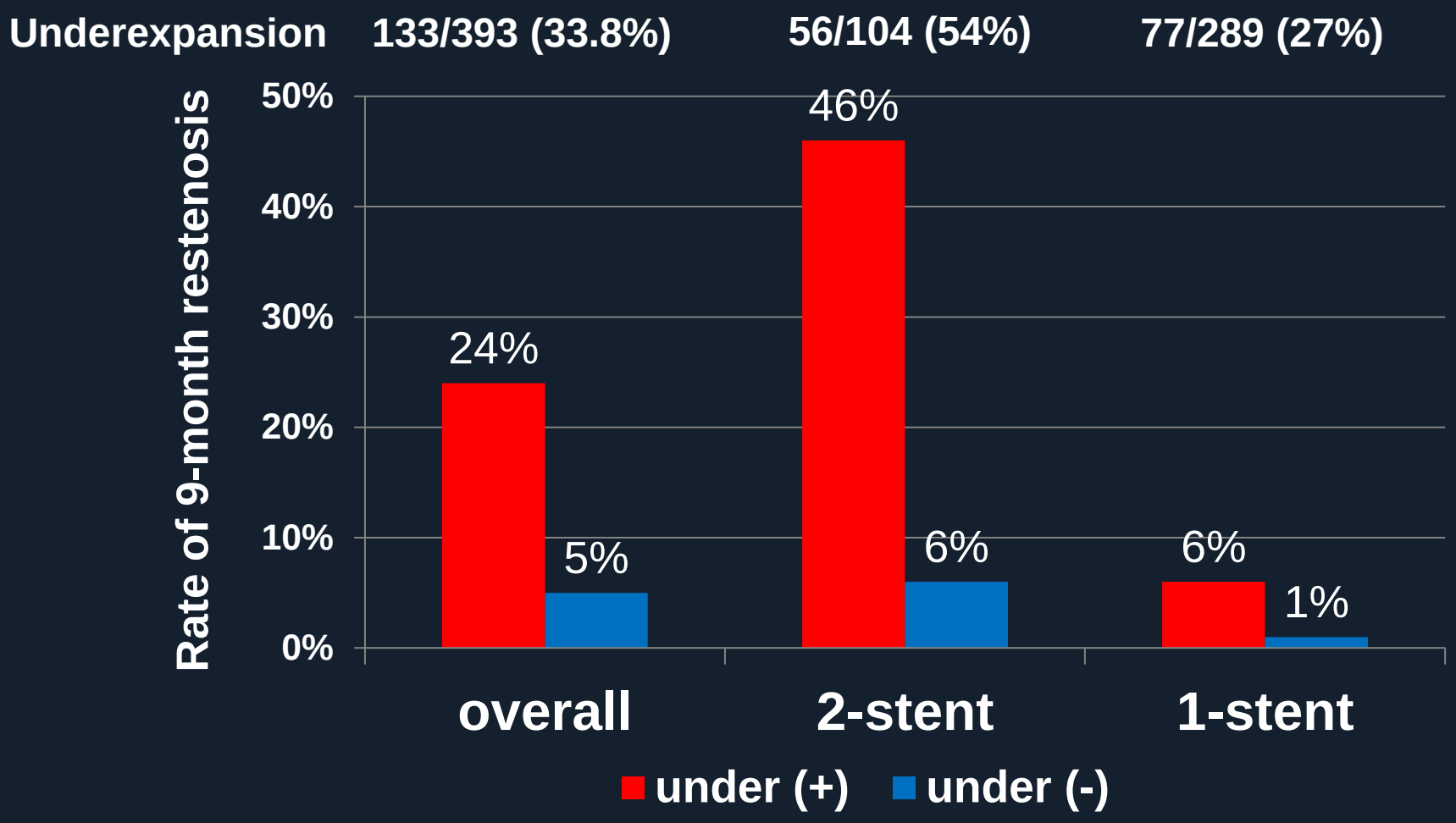


LCX 4.0mm^2

Kang et al. Am J Cardiol 2011;107:367-73

Stent Optimization

Stent underexpansion is frequent and associated with angiographic restenosis

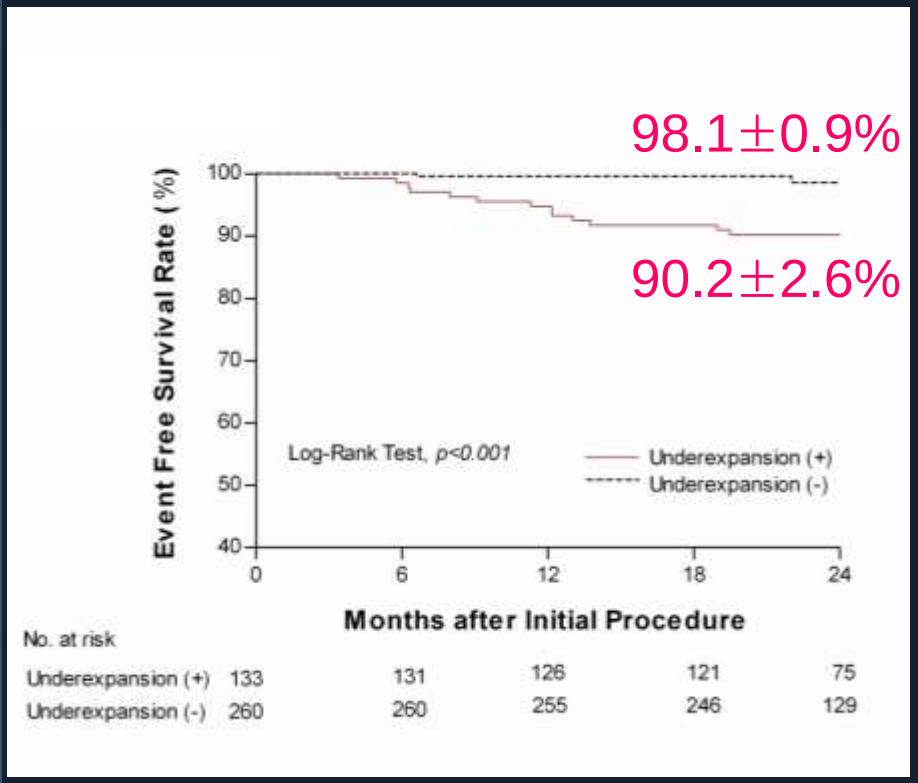


Kang et al. Circ Cardiovasc Interv 2011 2011;4:1168-74

Stent Optimization

Stent underexpansion is a independent predictor of poor clinical outcomes

2-yr MACE-free Survival

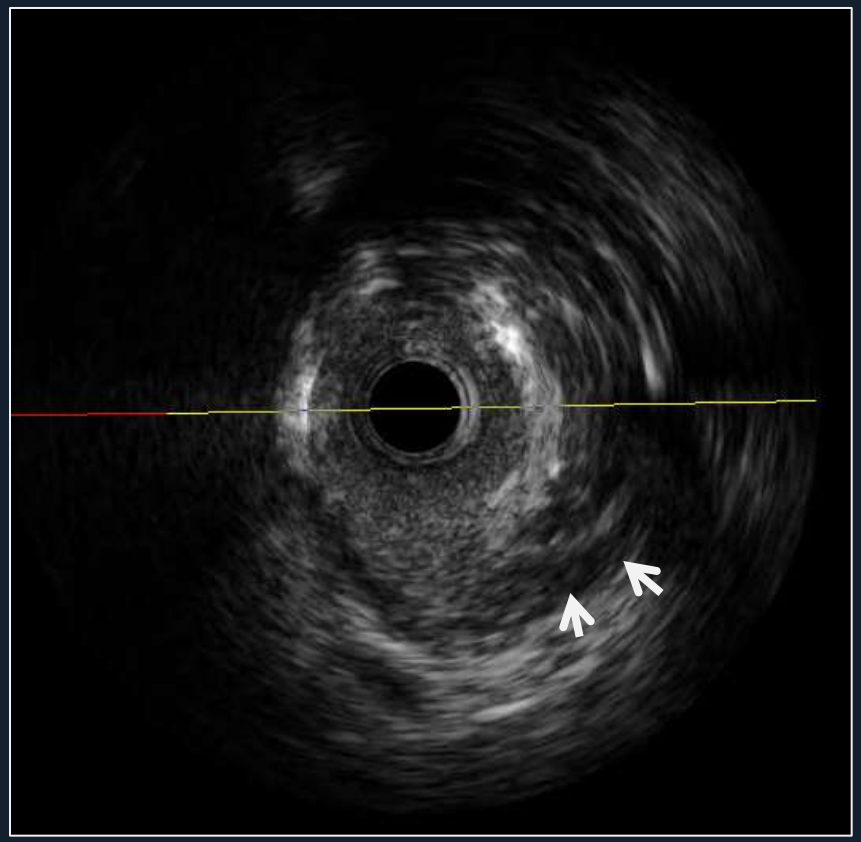


	Adjusted HR	95% CI	p
MACE	5.56	1.99-15.49	0.001
TLR	6.08	1.94-19.01	0.002
MI	NS		
Cardiac death	3.11	0.30-32.4	0.34

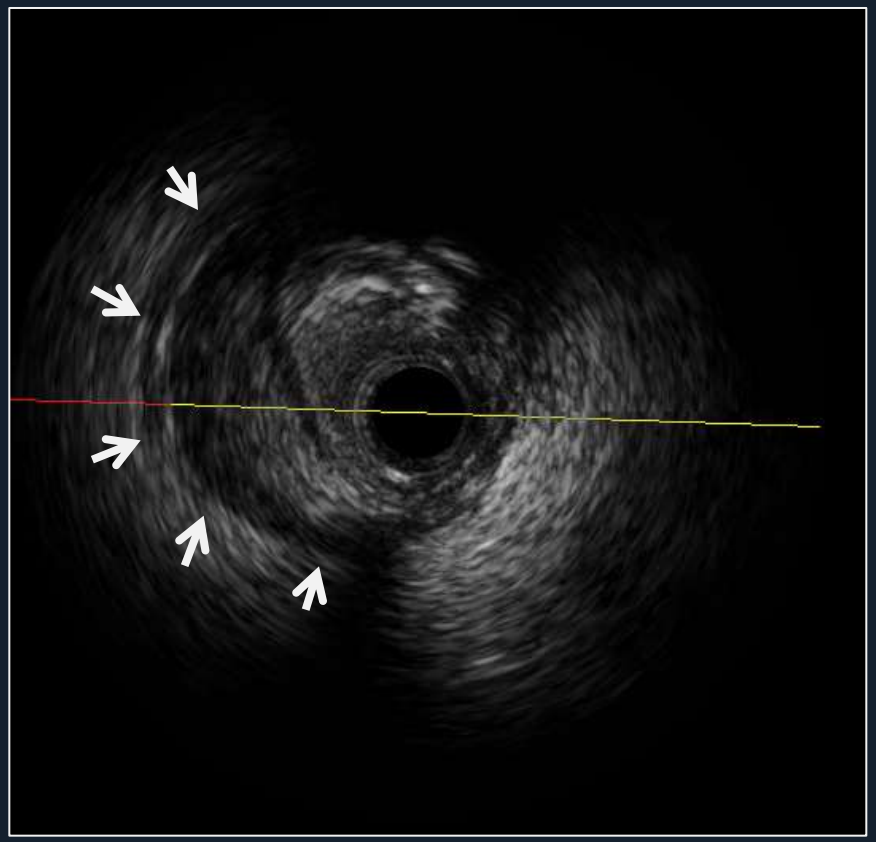
Kang et al. Circ Cardiovasc Interv 2011 2011;4:1168-74

Detection of Complications

Dissection
at proximal stent edge

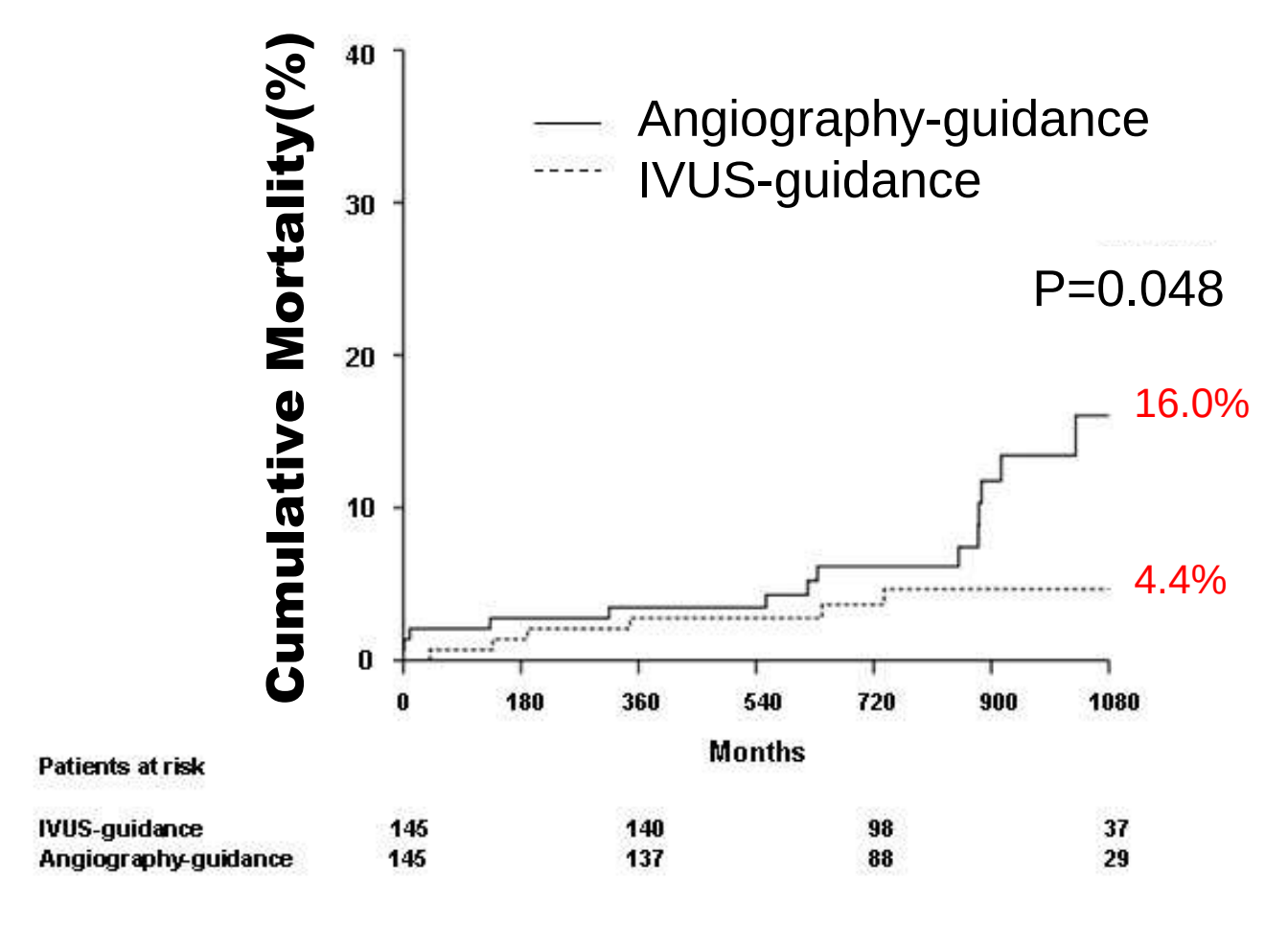


Hematoma
at distal stent edge



IVUS-guided LM PCI Saves Lives

The propensity-matched cohort of the MAIN-COMPARE registry (145 IVUS- vs. 145 angio-guidance)



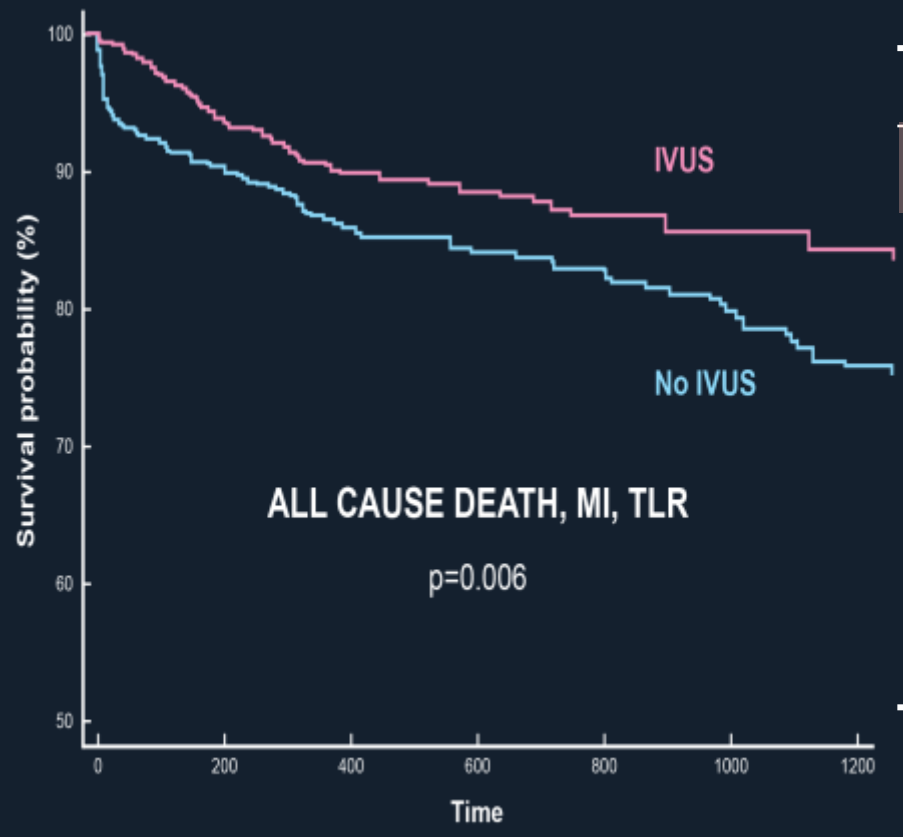
Park SJ et al Circ Cardiovasc Interv 2009;2:167-77

IVUS-guided LM PCI Saves Lives

Pooled Analysis at the Patient-Level of 4 Registries

: ESTROFA-LM, RENACIMIENTO, Bellvitge, and Valdecilla

(485 IVUS- vs. 470 angio-guidance)



	Adjusted HR	95% CI	p
IVUS	0.70	0.52-0.99	0.04
Age	1.03	1.01-1.05	0.0001
LVEF	0.98	0.97-0.99	0.01
DM	1.81	1.32-2.47	0.002
Distal LM with 2-stent	2.23	1.44-3.48	0.004
ACS	1.84	1.30-2.60	0.0006

de la Torre Hernandez et al. *JACC Cardiovasc Interv*, 2014

Conclusions

- Although FFR is a gold standard, IVUS-MLA can be alternatively used to assess the functional significance of LM stenosis
- In LM bifurcation, IVUS is helpful to confirm the real SB ostial disease and to decide stent strategy
- IVUS plays a unique role in device sizing and optimization
- IVUS guidance improves outcomes of LM PCI