

IVUS and FFR to Guide Non-Left Main Bifurcation PCI

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Disclosure

I have nothing to disclose

Issues of Non-LM Bifurcation PCI

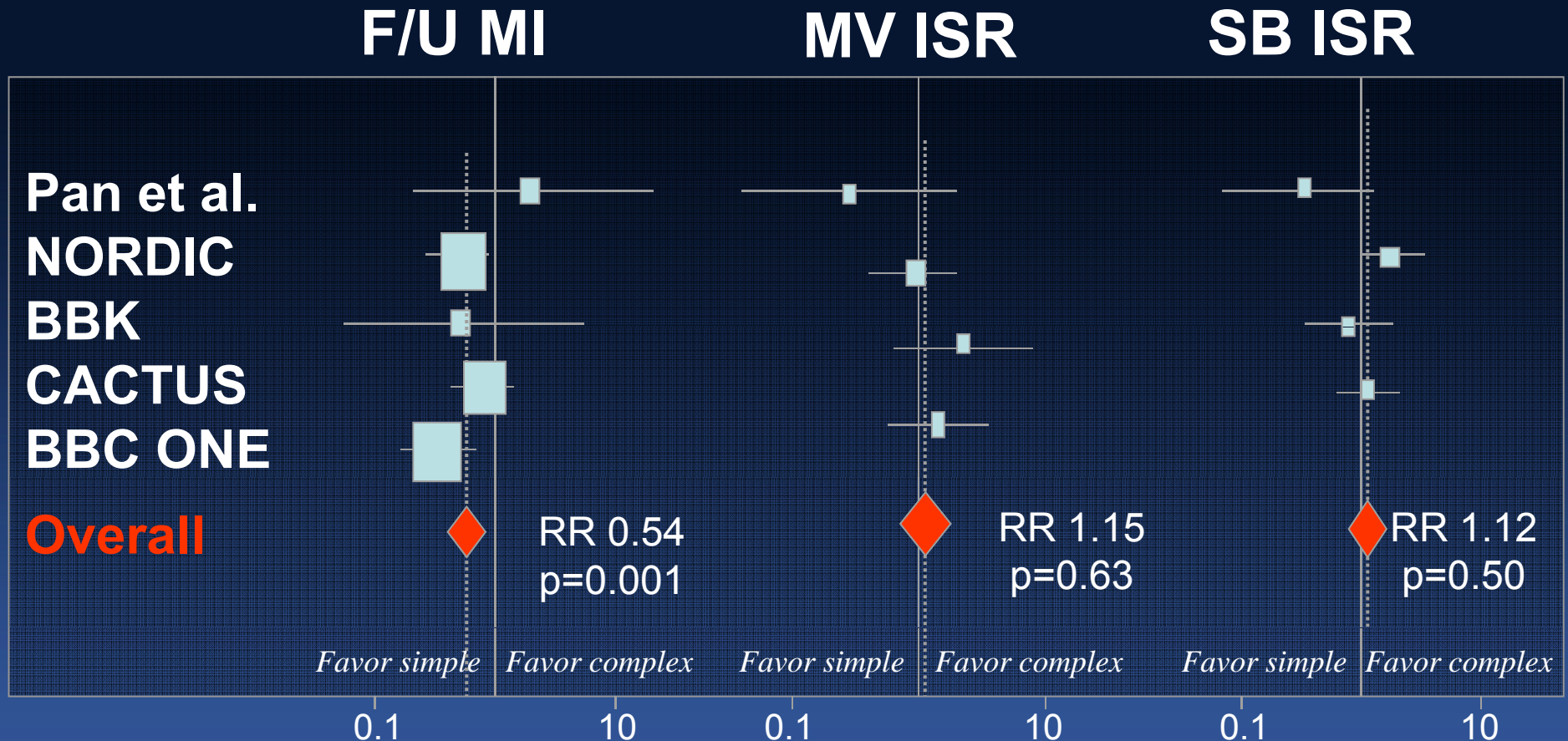
Stent Strategy?

Single

Two

Simple vs. Complex

Relative Ratios of Adverse Events

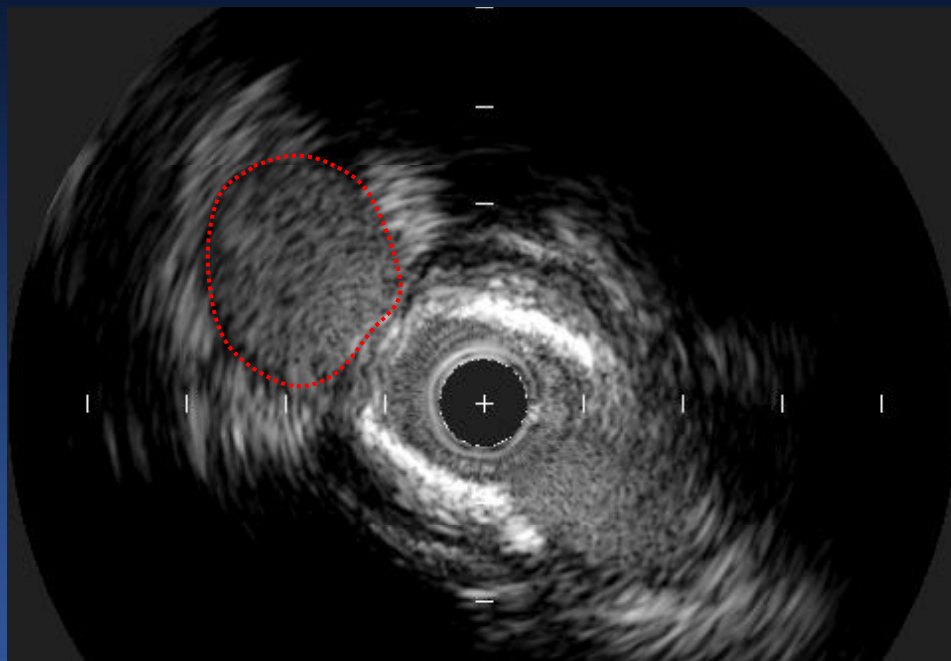


46% ↓ RR

Zhang et al. Heart 2009;95:1676-81

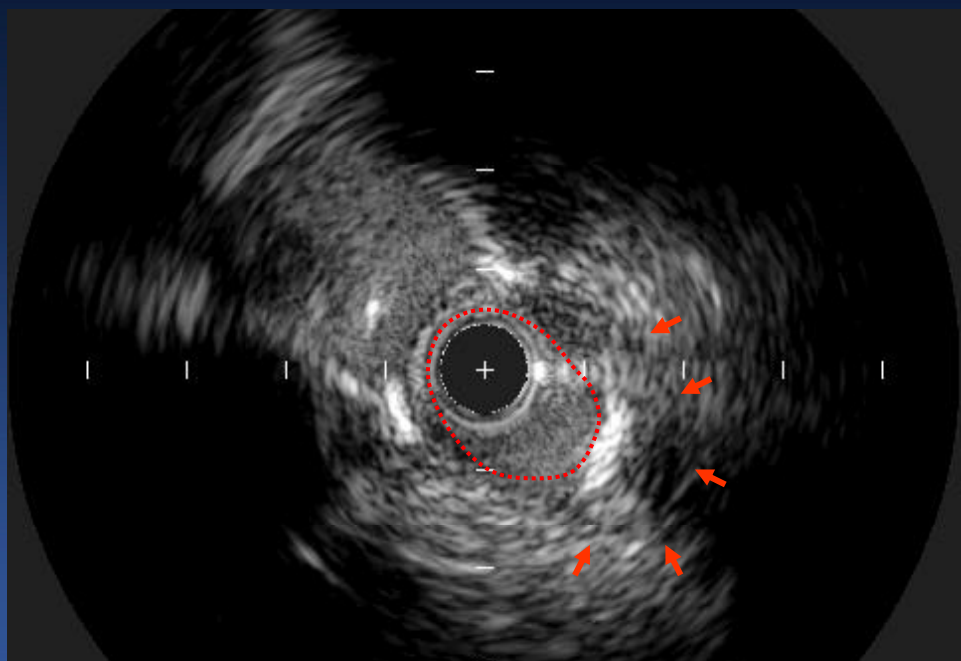
CASE 1

- True Bifurcation
- SB Involvement?



MB-IVUS

Diagonal MLA=3.1mm²



Direct SB-IVUS

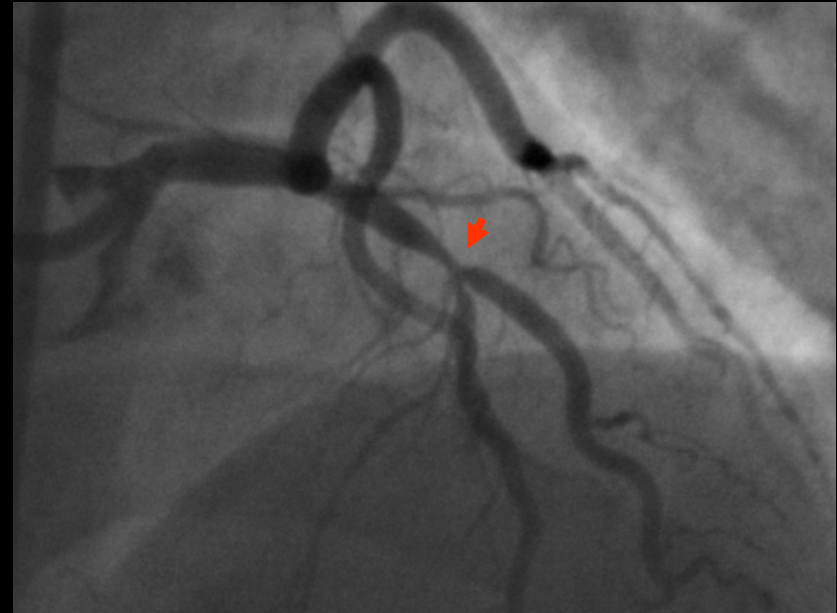
Diagonal MLA=2.0mm²

P:0.5

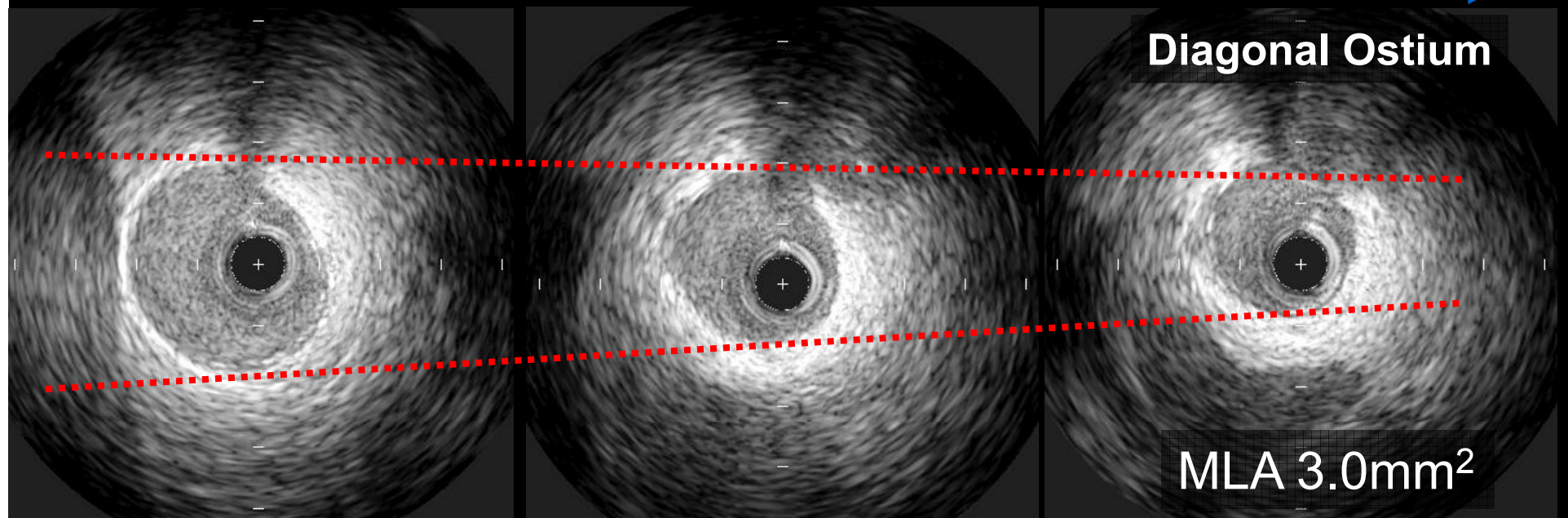
9.6 mm, 1 mm/div

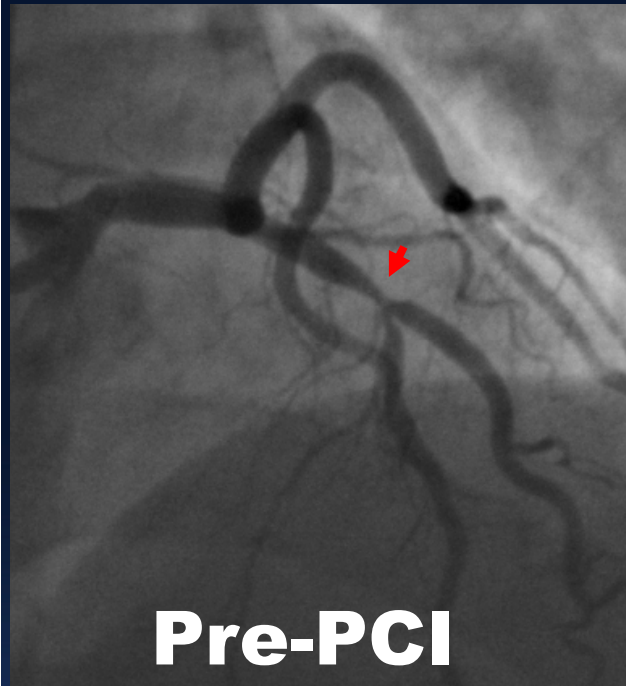
CASE 2

- True Bifurcation
- SB Involvement?



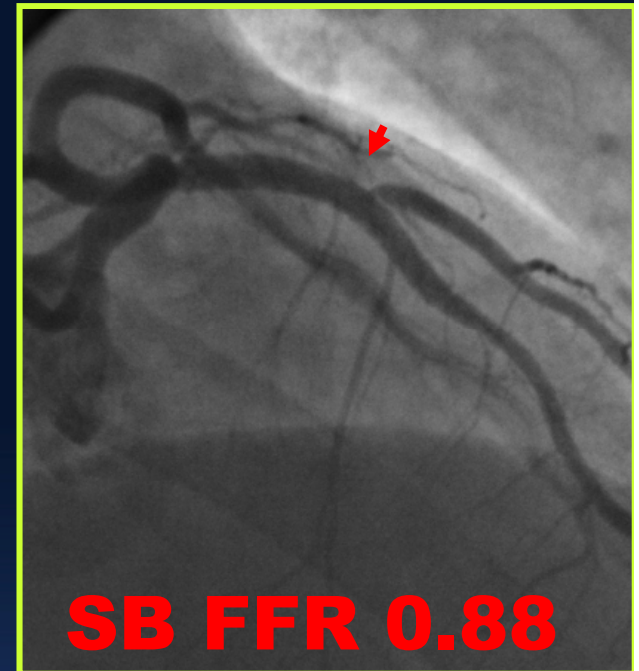
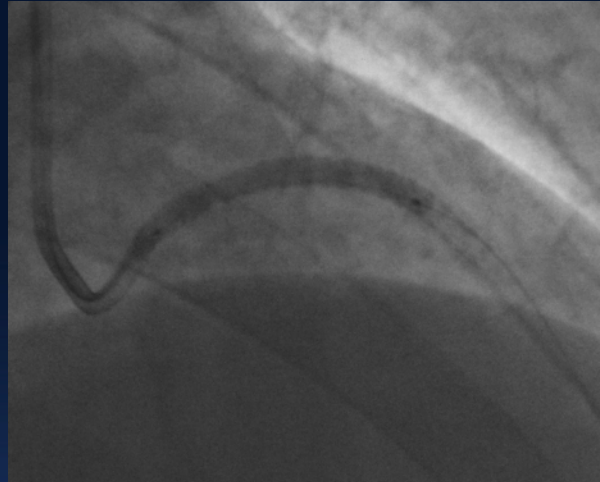
Negative Remodeling without Plaque



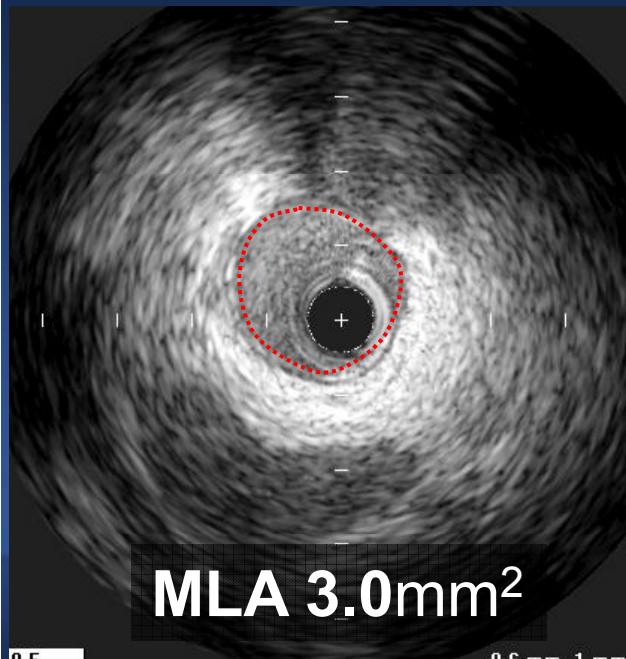


Pre-PCI

MB Cross-over

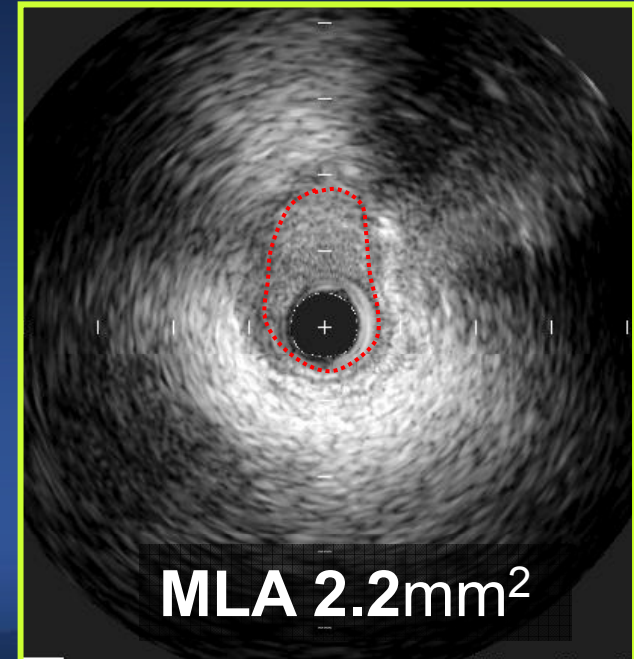


SB FFR 0.88



MLA 3.0mm²

**What should
SB treatment
be based on?**



MLA 2.2mm²

Issues of Non-LM Bifurcation PCI

Stent Strategy?

Single

Two

**Angiographic
Jailing of SB**

How to Treat the SB?

Treatment for **Jailed SB with Normal FFR**

SB FFR >0.75 is safe for deferral in non-LM disease



6 Mo f/u

No change in SB FFR ($0.87 \pm 0.06 \rightarrow 0.89 \pm 0.07$)
Functional restenosis in only 8% (FFR<0.75)

SB FFR at 6-month

	Post-intervention	Follow-up	P-value
Main branch	0.96 ± 0.04	0.96 ± 0.04	0.9
Jailed side branch	0.87 ± 0.06	0.87 ± 0.09	0.7
KB group	0.86 ± 0.05	0.84 ± 0.11	0.4
Non-KB group	0.87 ± 0.06	0.89 ± 0.07	0.1

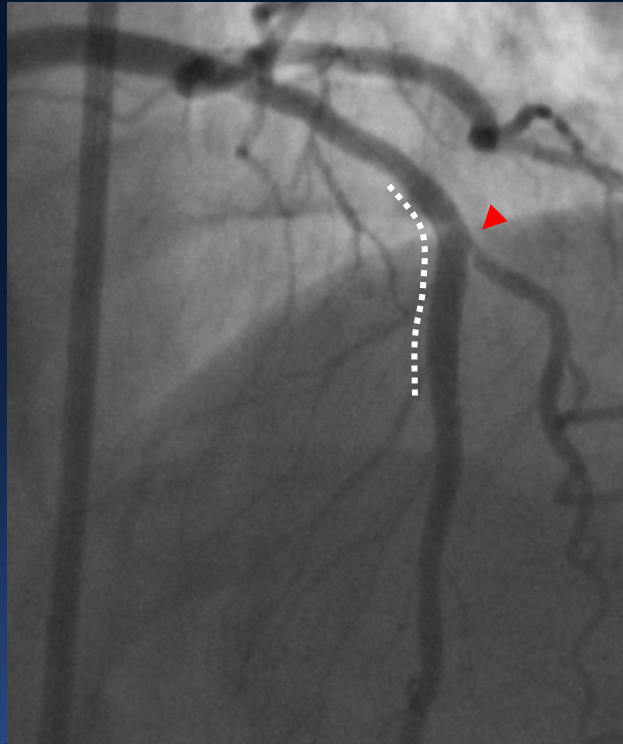
9-month MACE

	FFR group, n = 108 ^a	Conventional group, n = 108 ^b	P-value ^c
Cardiac death	0	0	1
Myocardial infarction	0	0	1
Target vessel revascularization, n (%)	5 (4.6)	4 (3.7)	0.7

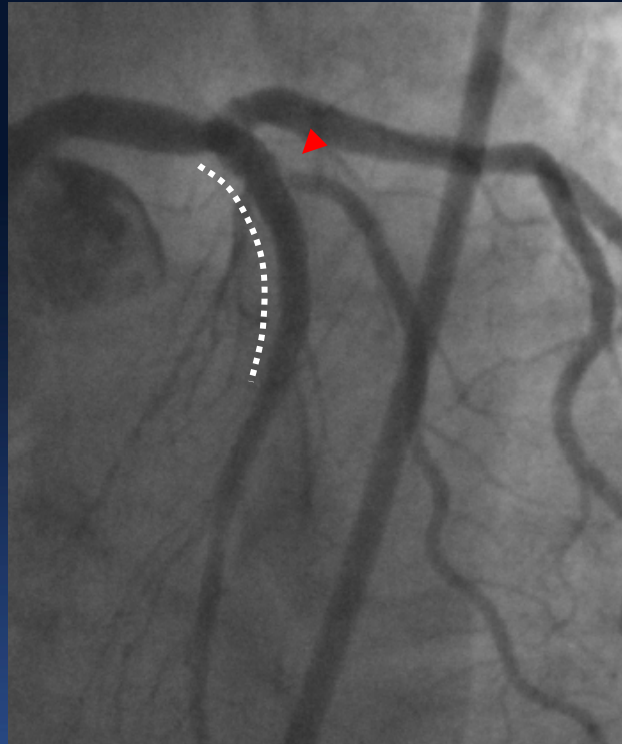
FFR-guided provisional SB intervention
 resulted in a low rate of functional restenosis
 and 9-month adverse cardiac events

Koo et al. Eur Heart J 2008;29:726–32

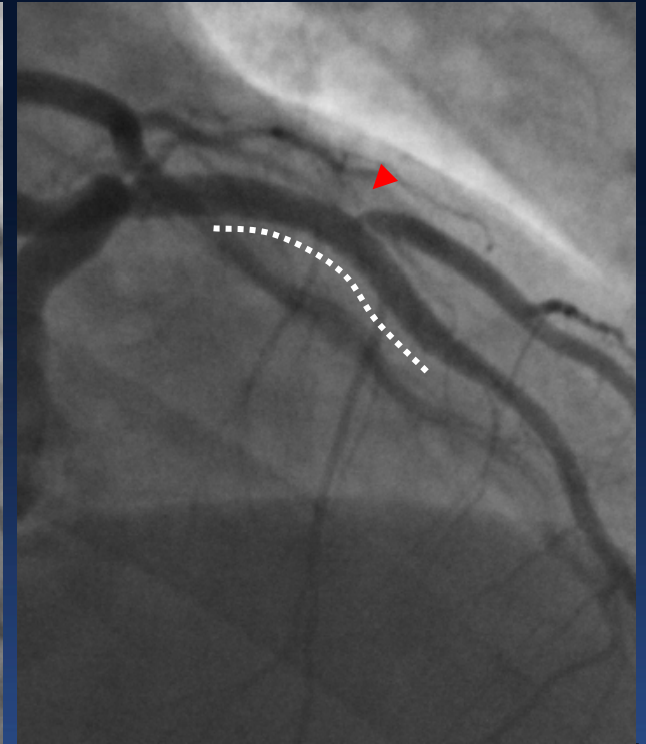
Discordance Between Post-stenting QCA-DS vs. SB FFR



DS 70%
SB FFR 0.83
Mismatch

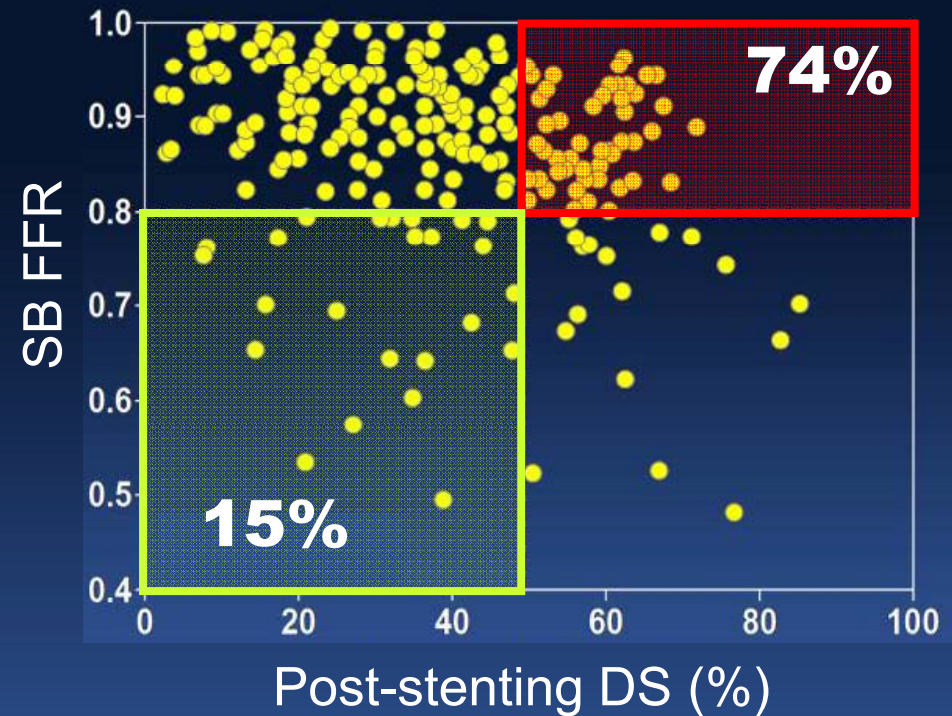
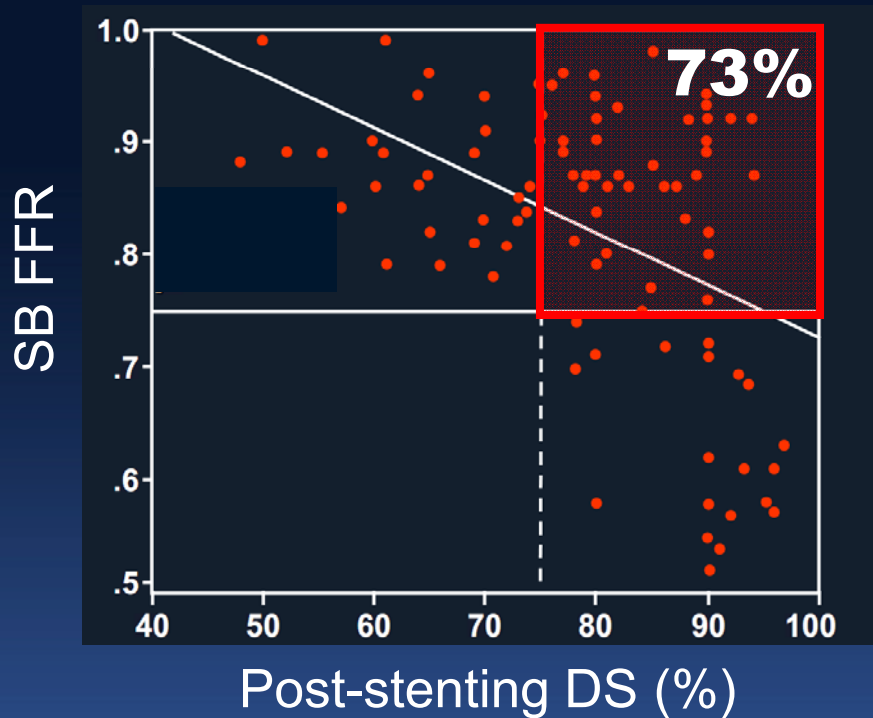


DS 20%
SB FFR 0.71
Reverse-Mis



DS 80%
SB FFR 0.88
Mismatch

Discordance Between Post-stenting QCA-DS vs. SB FFR



- 73% Mismatch
- Cut-off for $FFR < 0.75$: $> 85\%$

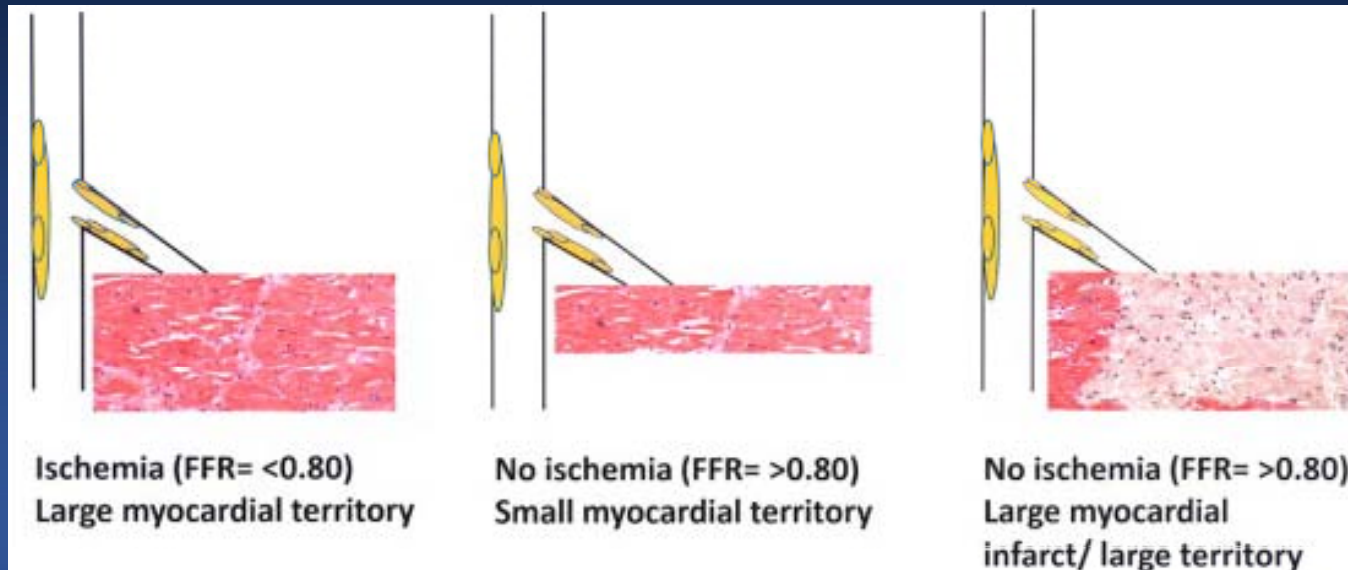
- 74% Mismatch
- 15% Reverse-Mismatch
- Cut-off for $FFR < 0.80$: 54%

Koo et al. JACC 2005;46:633

Ahn et al. JACC Interv in Press

Angiographic SB Assessment is Not Accurate *Neither Anatomically Nor Functionally*

- Lesion eccentricity of SB
- Negative remodeling of ostium
- Various size of myocardium
- Strut artifacts after MB stenting



Sachdeva et al. Am J Cardiol 2011;107:1794-5

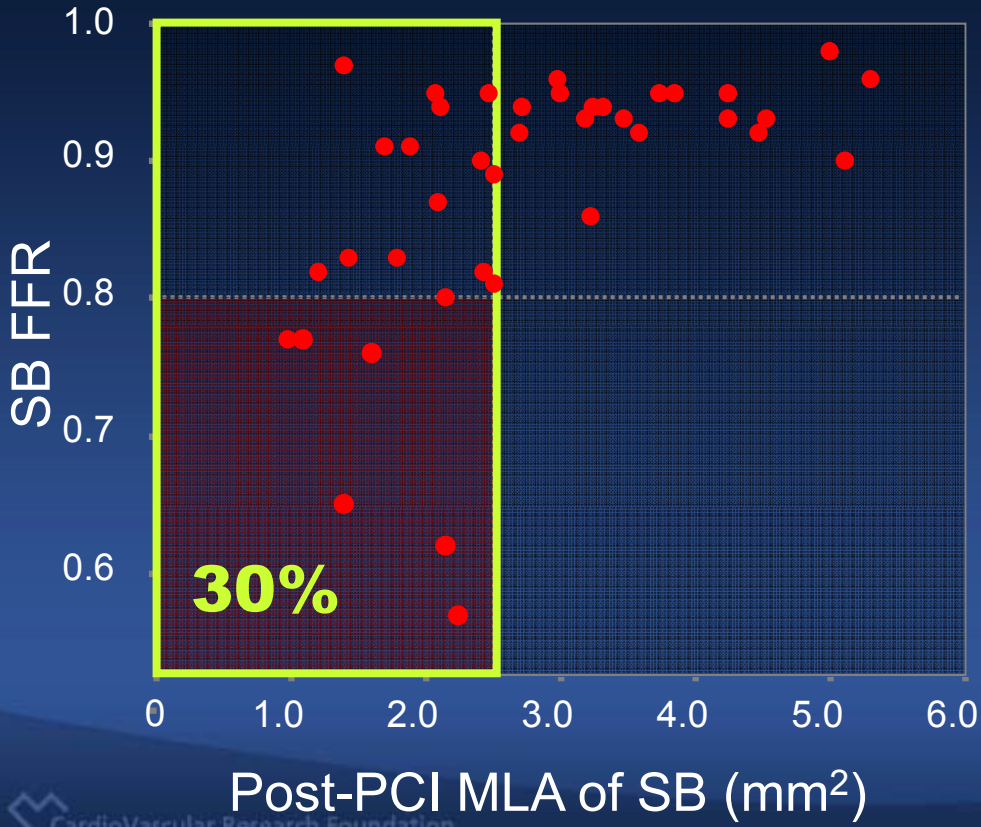


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FFR 0.83



**Post-stenting SB MLA
poorly predicts functional
significance of SB lesion
SB FFR measurement**

AMC Preliminary

Issues of Non-LM Bifurcation PCI

Stent Strategy?

Single

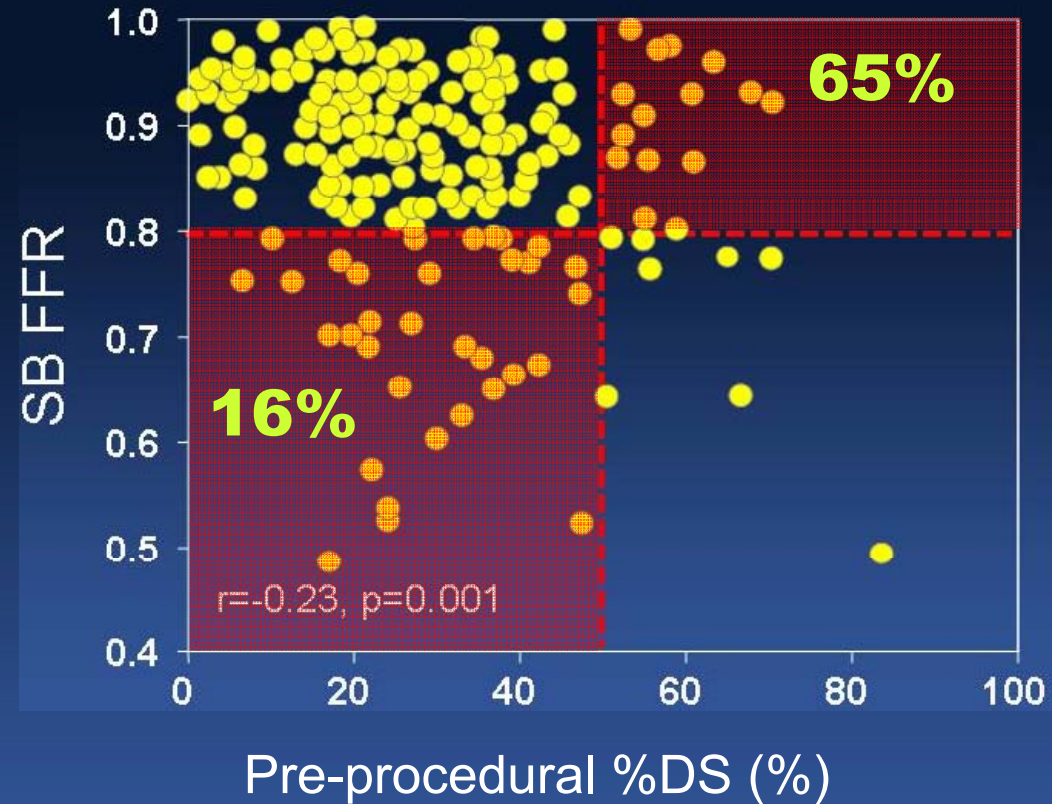
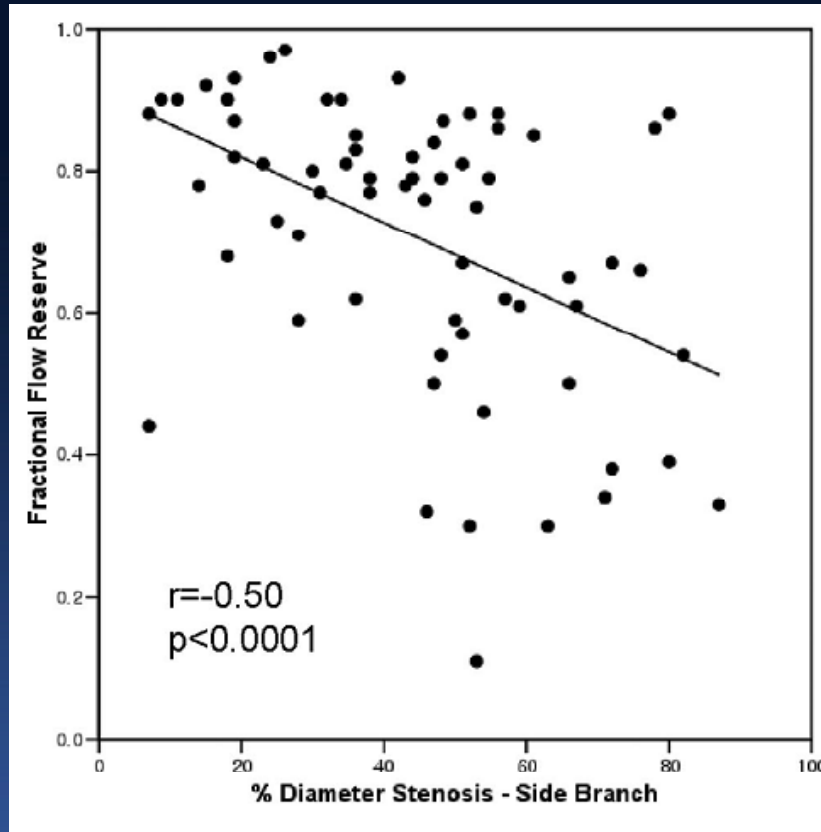
Two

**Angiographic
Jailing of SB**

How to Treat the SB?

Pre-PCI Predictor?

Angiographic DS is a Poor Predictor for Functional SB Compromise



Koo et al. Circ Cardiovasc Interv 2010;3:113-9

Ahn et al. JACC Interv 2011 in Press

Preintervention Angiographic and Intravascular Ultrasound Predictors for Side Branch Compromise After a Single-Stent Crossover Technique

Soo-Jin Kang, MD, PhD^a, Gary S. Mintz, MD^b, Won-Jang Kim, MD^a, Jong-Young Lee, MD^a, Duk-Woo Park, MD, PhD^a, Seung-Whan Lee, MD, PhD^a, Young-Hak Kim, MD, PhD^a, Cheol Whan Lee, MD, PhD^a, Seong-Wook Park, MD, PhD^a, and Seung-Jung Park, MD, PhD^{a,*}

Post-stenting SB FFR <0.80: 18%
SB FFR <0.75: 9%

Independent Predictors for SB FFR	β	95% CI	p
Maximal balloon pressure	-0.265	-0.010 – -0.002	0.003
Pre-PCI MLA of SB ostium	0.216	0.001 – 0.035	0.040
Pre-PCI PB at SB ostium	-0.296	-0.003 – -0.001	0.005
Pre-PCI MLA of distal MB	0.250	0.005 – 0.027	0.025

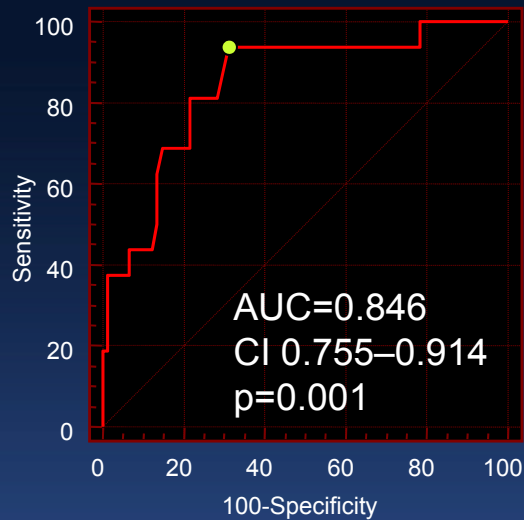
Kang et al. Am J Cardiol 2011;107:1787-93

Pre-intervention SB-IVUS

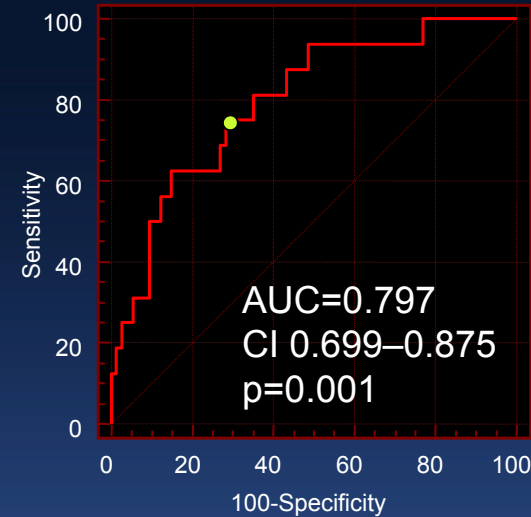
Predicts SB FFR <0.80 after MB stenting

MLA 2.4mm²

Plaque burden 50%

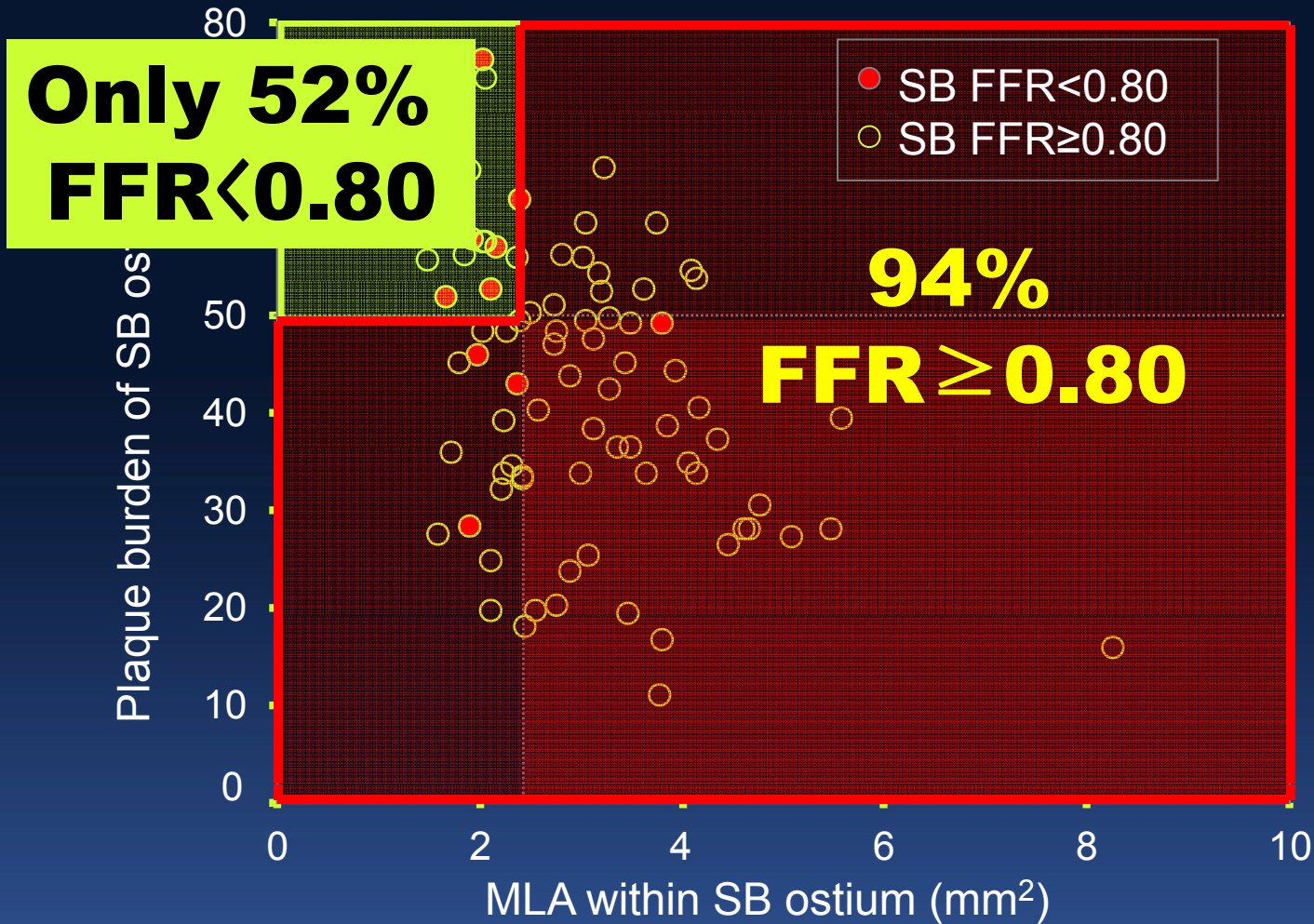


Sensitivity=94%
Specificity=68%
PPV=40%
NPV=98%



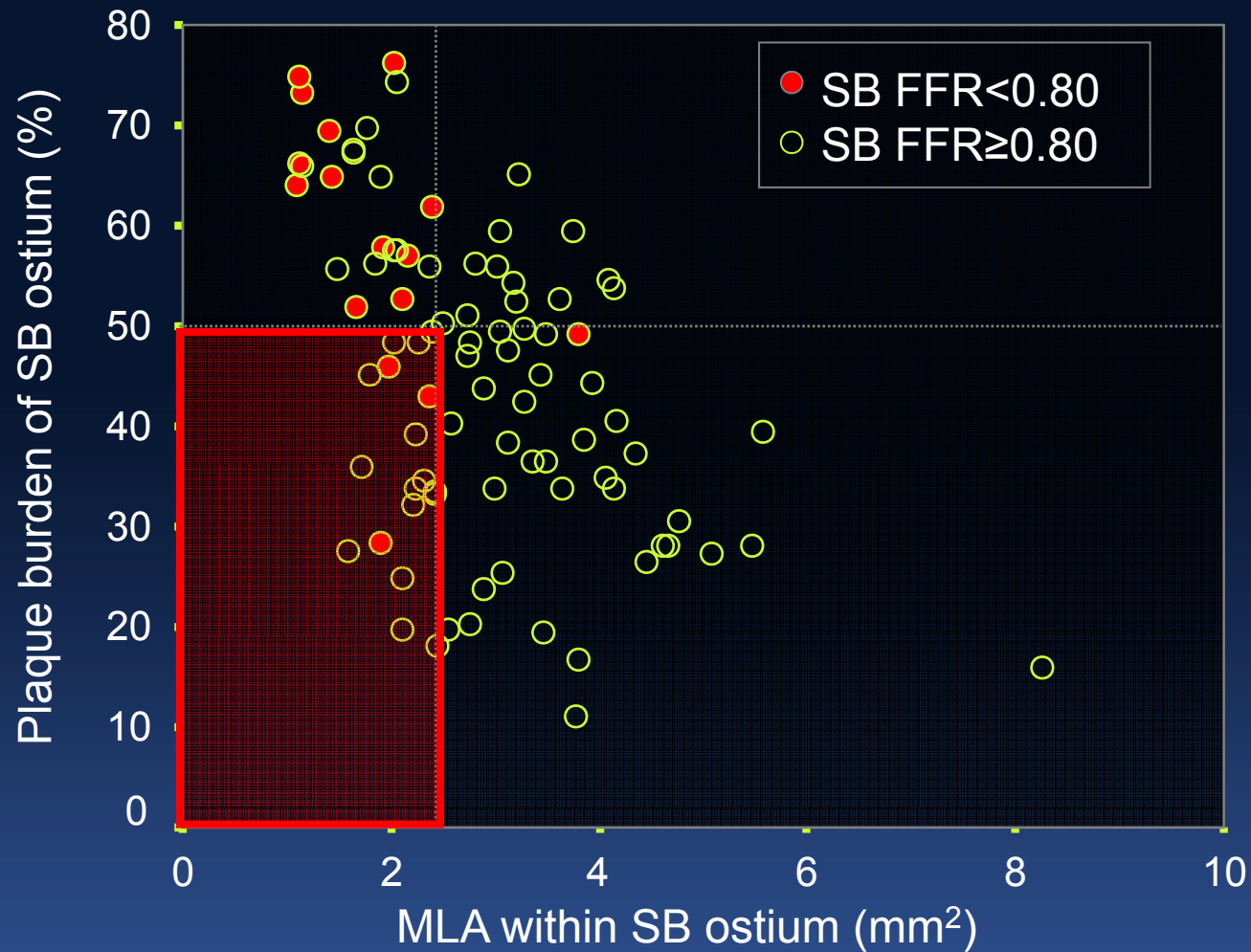
Sensitivity=75%
Specificity=71%
PPV=36%
NPV=93%

Kang et al. Am J Cardiol 2011;107:1787-93



IVUS-MLA is a better predictor with an accuracy 83%
17% are still unpredictable

Kang et al. Am J Cardiol 2011;107:1787-93



If the small MLA is not caused by significant plaque, but caused by negative remodeling or small vessel, FFR is normal in 80%

Kang et al. Am J Cardiol 2011;107:1787-93

2-year MACE

85 (94%) patients followed-up at median 27 months (IQR 20–31 mo)

90 Non-LM bifurcation with **SB DS<75%**

SB FFR after MB Stenting

SB-related cardiac events are rare in the population

No Tx
43 (58%)

Kissing
31 (42%)

No Tx
5 (31%)

Kissing 9 (56%)
T-stent 2 (13%)

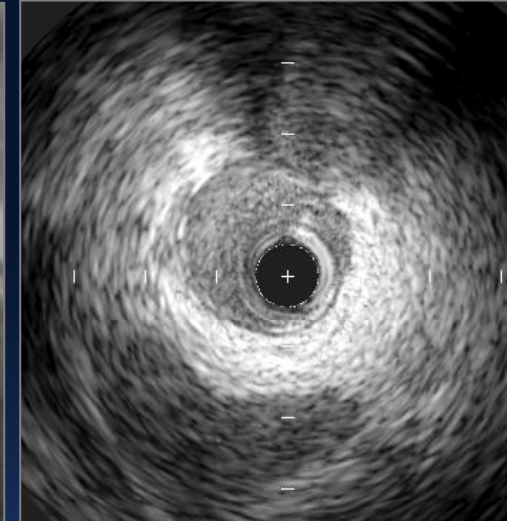
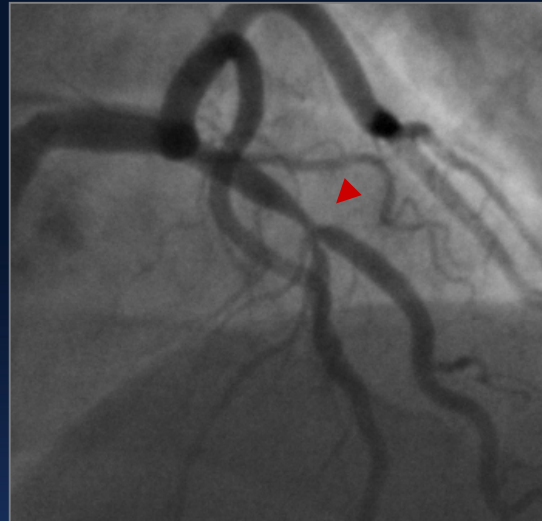
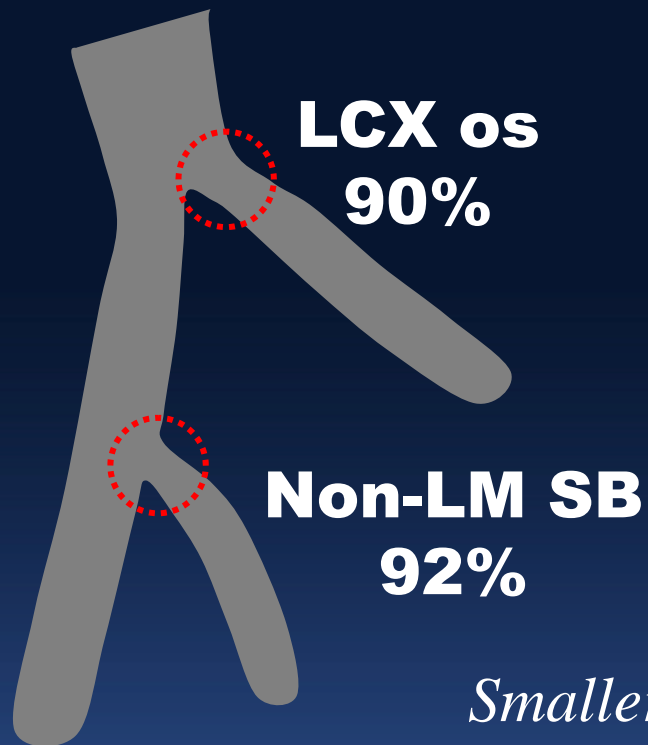
No MACE

1 TLR (3%)

1 TLR (20%)

1 Death (9%)
d/t stroke

Impact of **Negative Remodeling**

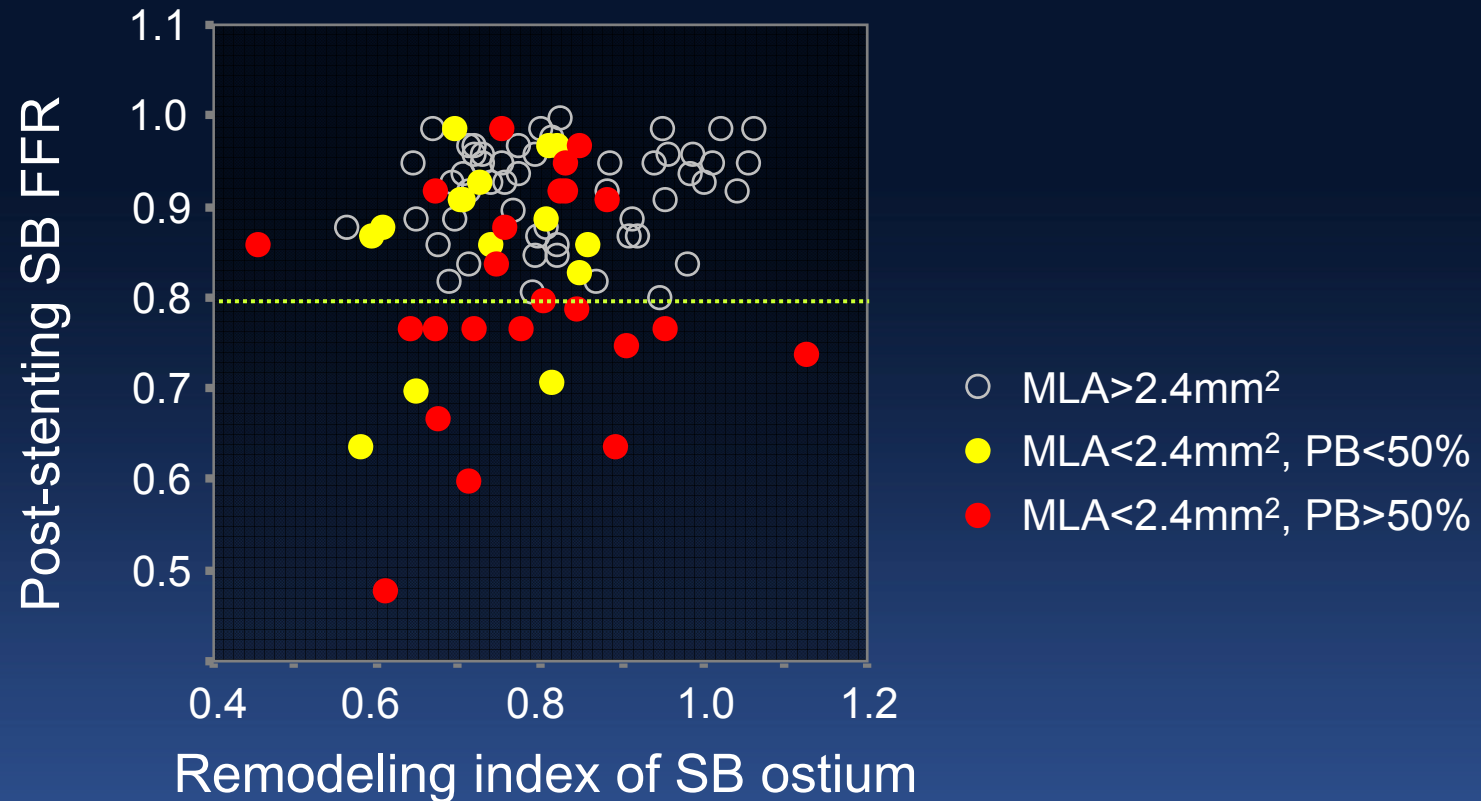


Smaller distal carina angle was found in constrictive remodeling group ($51 \pm 25^\circ$ vs. $64 \pm 14^\circ$, $p=0.044$)

Remodeling index at SB ostium ($\beta=0.435$, $p<0.001$)
independently affects the small MLA of SB ostium

Kang et al. Catheter Cardiovasc Interv 2012 in press

Impact of **Negative Remodeling** on Functional Significance of SB



However, it **rarely affects post-stenting SB FFR**
without a large plaque and a small MLA

Issues of Non-LM Bifurcation PCI

Stent Strategy?

Single

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**Angiographic
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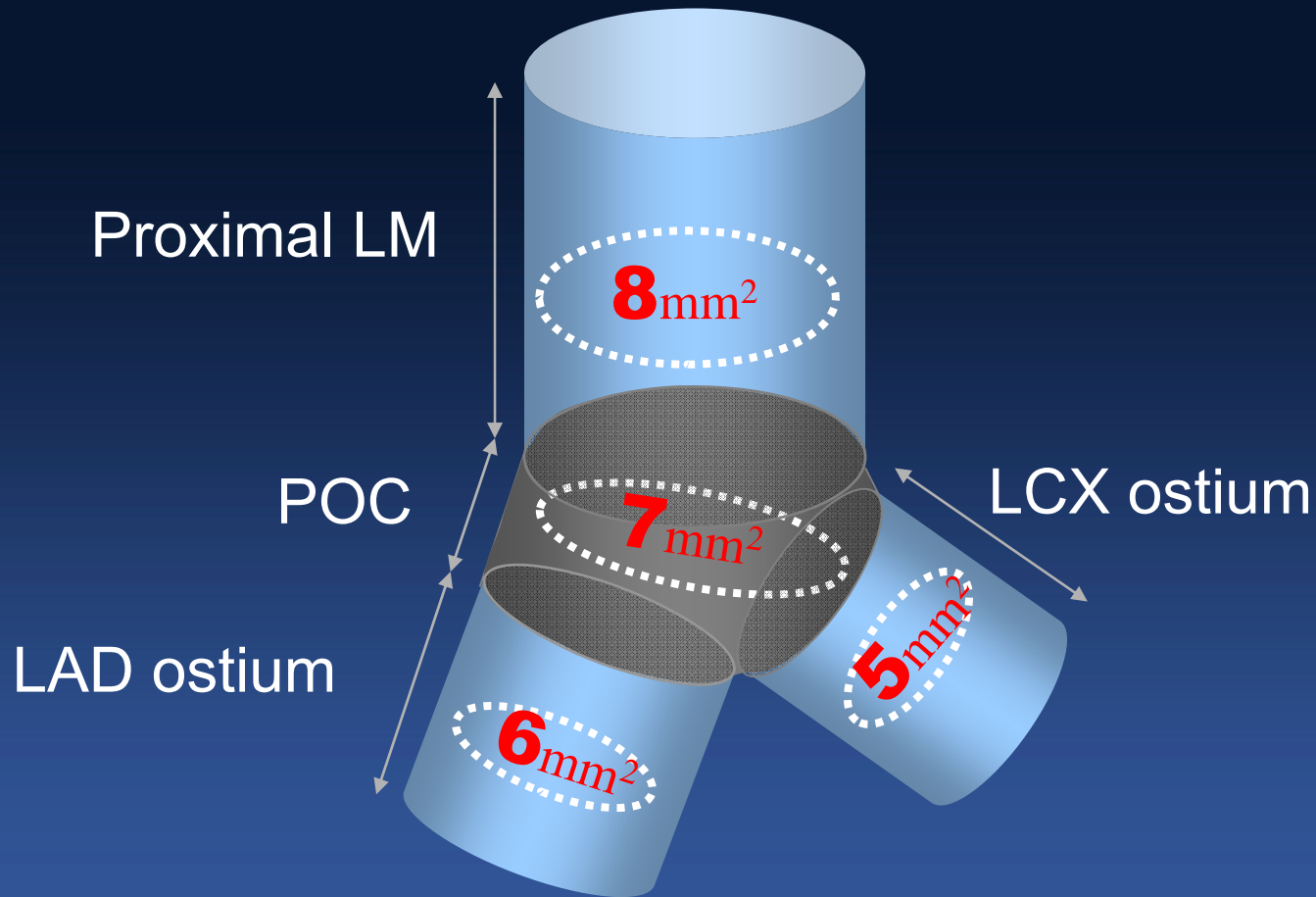
How to Optimize?

How to Treat the SB?

Pre-PCI Predictor?

Optimal MSA

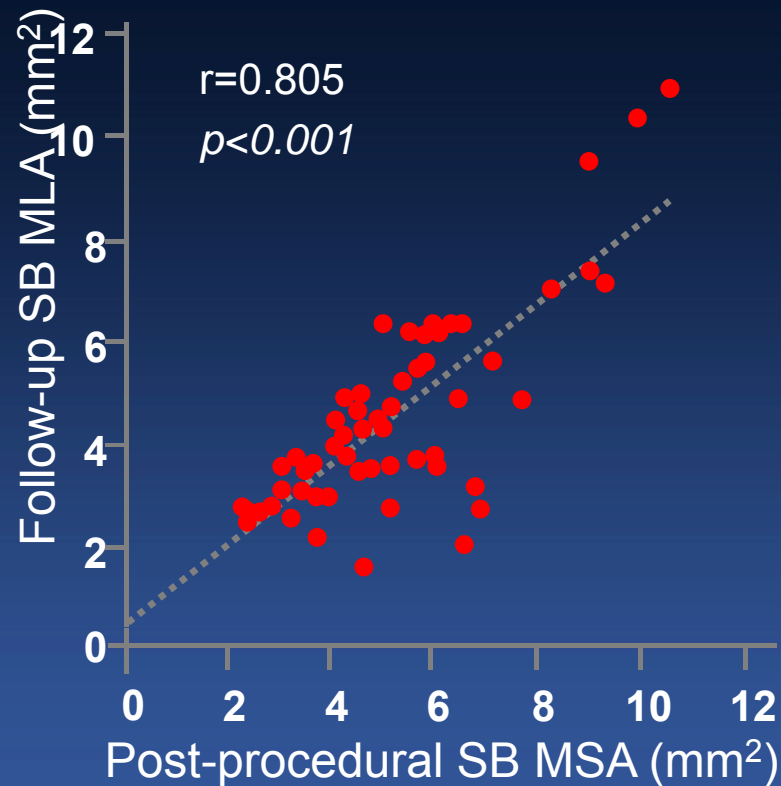
on a segmental basis



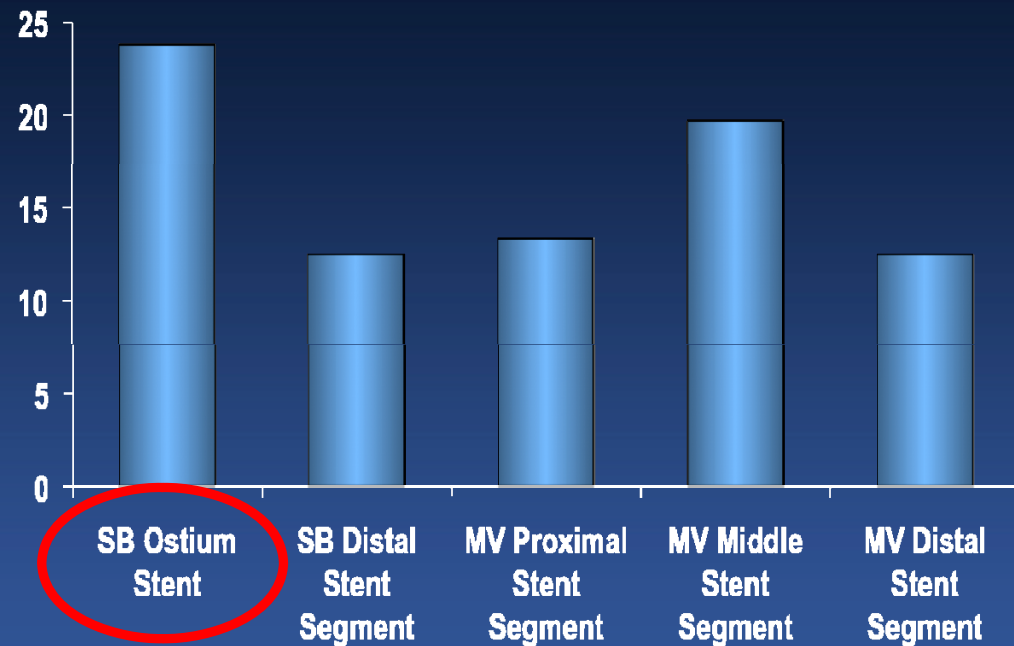
Kang et al. Circ Cardiovasc Interv 2011 2011;4:1168-74

Serial IVUS Analysis in 73 Bifurcations Treated with T-stent (DES)

SB MSA vs. F/U MLA

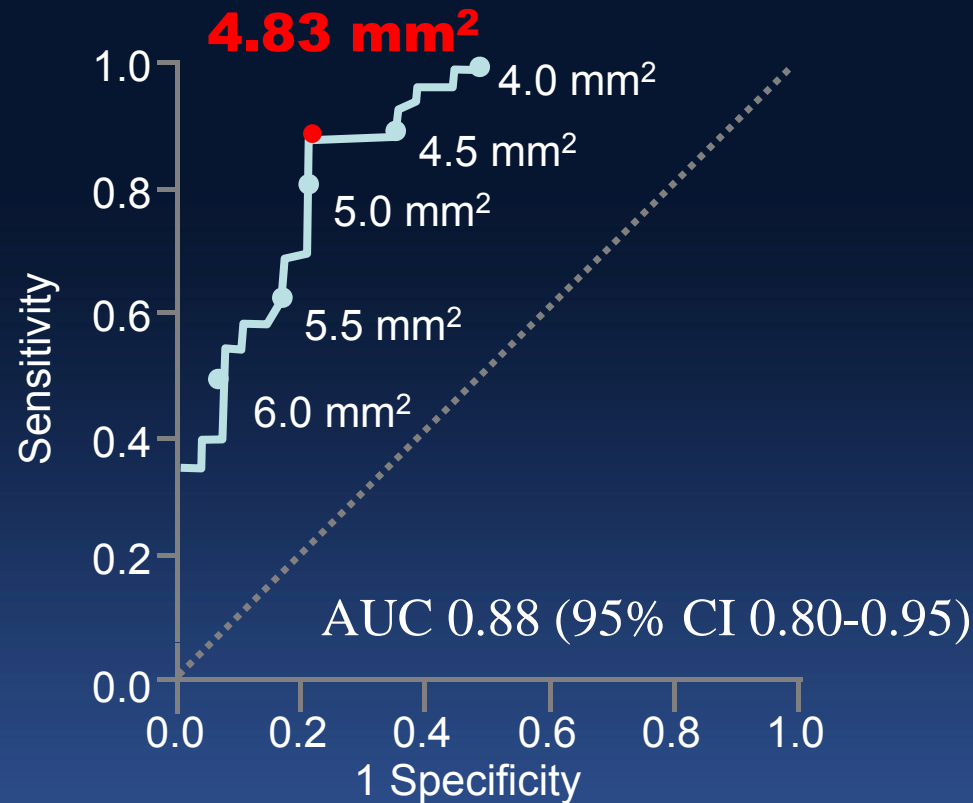


%Intimal Hyperplasia



Hahn et al. *J Am Coll Cardiol* 2009;54:110-7

Optimal SB-MSA to Predict IVUS-defined ISR (F/U MLA 4mm^2)



No difference in the rate of angiographic ISR or TLR between SB with MLA $>4.83\text{mm}^2$ vs. $<4.83\text{mm}^2$

Hahn et al. J Am Coll Cardiol 2009;54:110-7

Bifurcations with Crush-stenting

- SB ostium was most frequent site of MSA in 68%
- Within MB, MSA was found in crush area in 56%

	MV	SB	P
MSA, mm ²	6.5±1.7	3.9±1.0	<0.001
MSA <4 mm ²	10%	55%	0.007
MSA <5 mm ²	20%	90%	<0.001

Costa et al. J Am Coll Cardiol 2005;46:599-605

Issues of Non-LM Bifurcation PCI

Stent Strategy?

Single

Two

**Angiographic
Jailing of SB**

How to Optimize?

How to Treat the SB?

Pre-PCI Predictor?

Although pre-PCI MLA > 2.4mm² predicts normal SB FFR post-stenting, there is *no reliable* predictor for functional compromise