

# **Left Main PCI Supported by FFR and IVUS**

**Seung-Jung Park, MD, PhD**

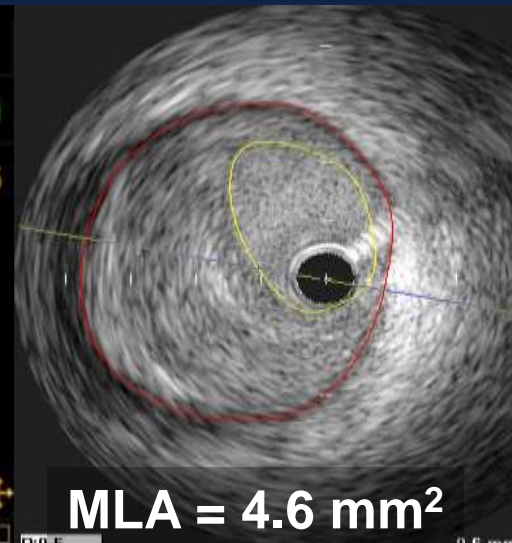
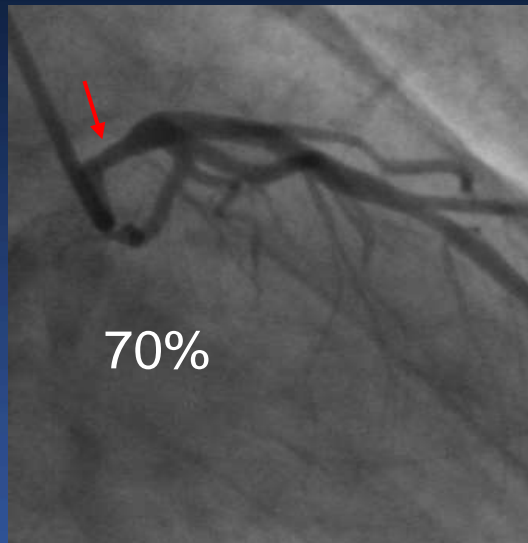
Heart Institute, University of Ulsan College of Medicine  
Asan Medical Center, Seoul, Korea

# **Q1,** **Why FFR ?**

# Significant Stenosis

## *Negative FFR*

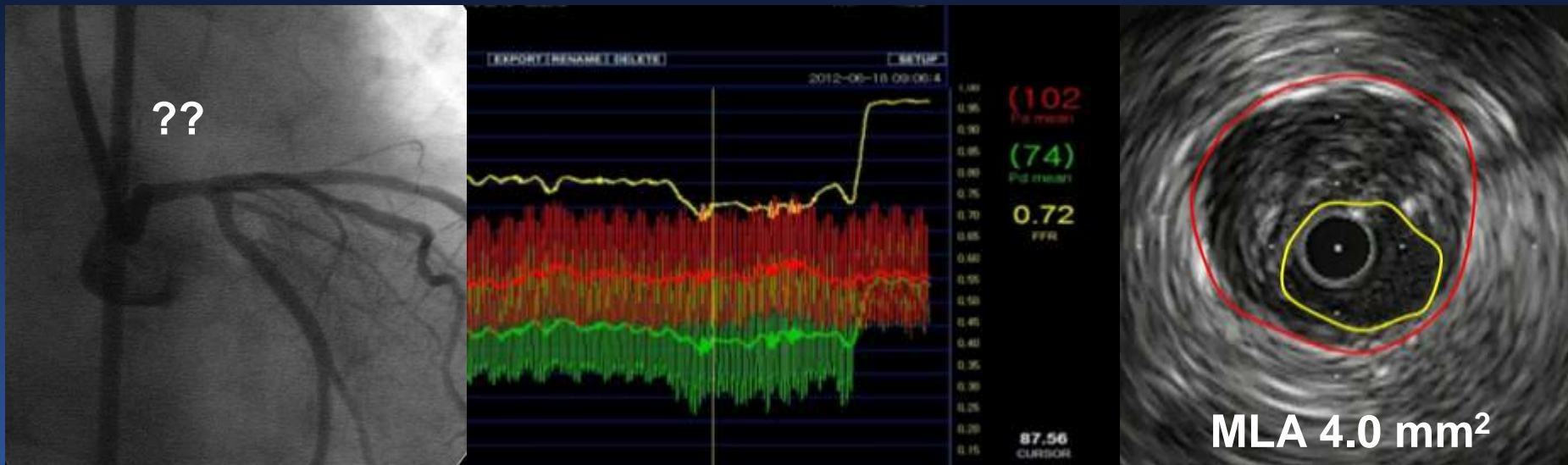
47/M  
Stable Angina



# Insignificant Stenosis

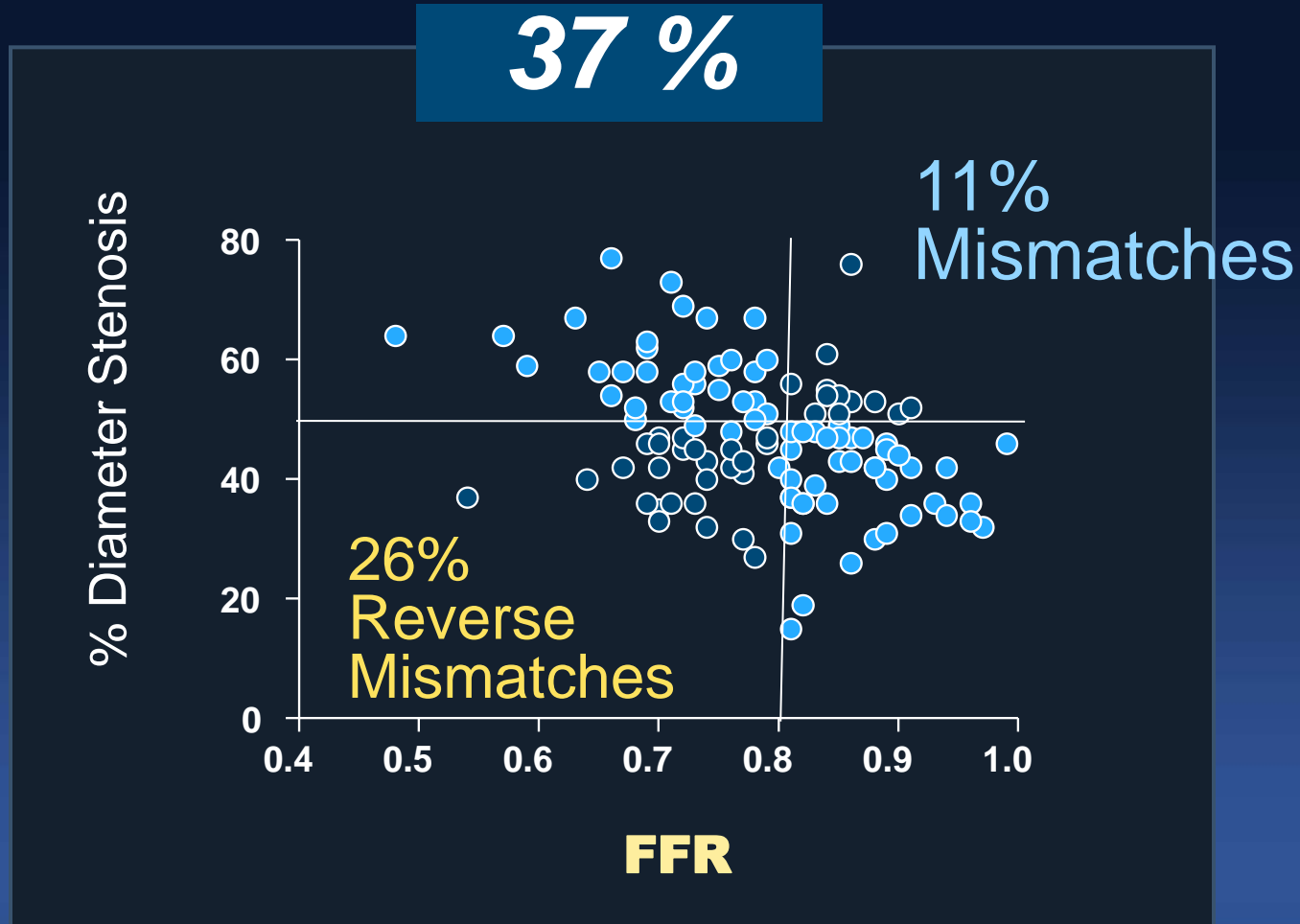
*Positive FFR*

62/F  
Stable Angina



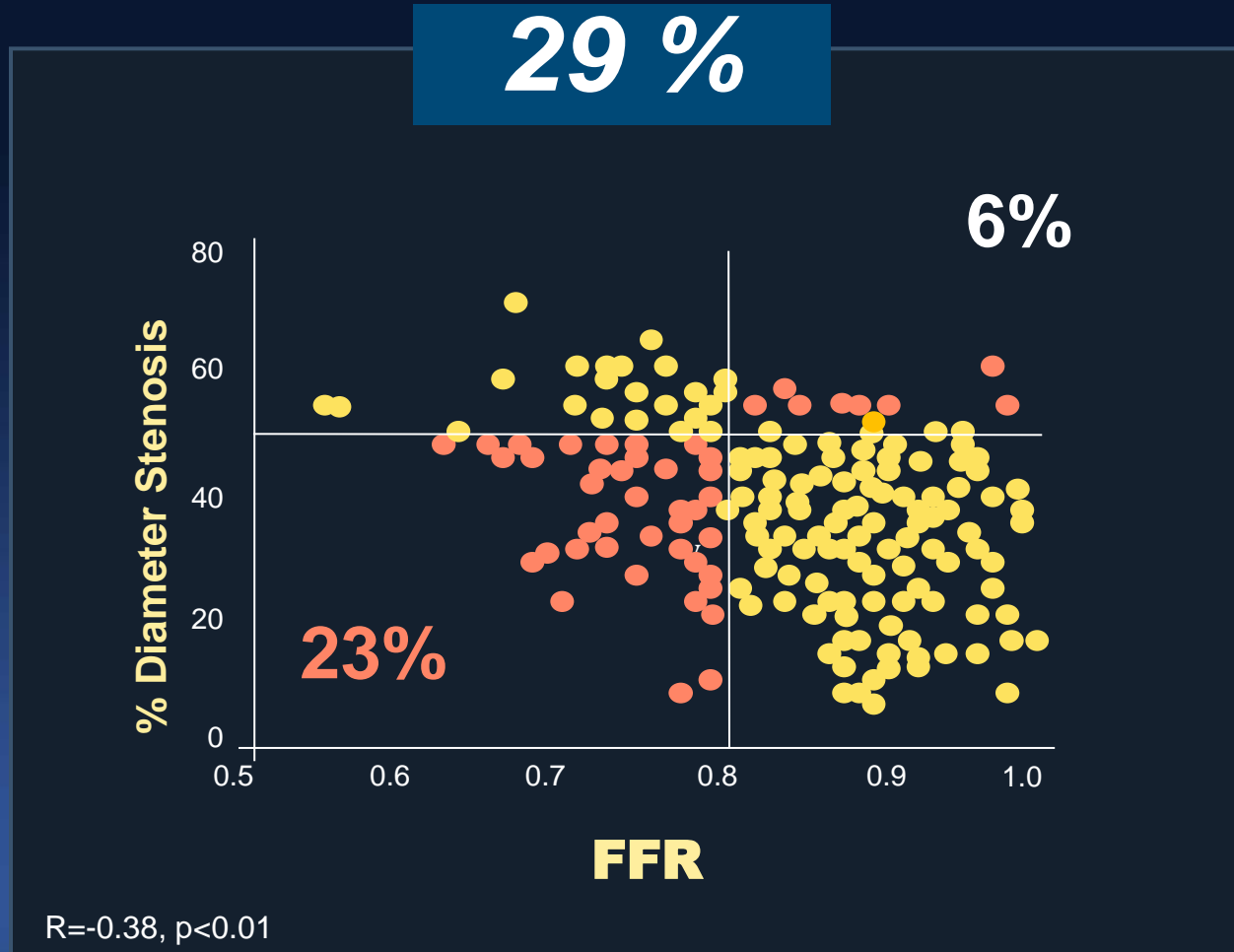
# Many Mismatches

## Os/Shaft, Intermediate LM Disease



# Many Mismatches

## Overall, Intermediate LM Disease



# Why Mismatches ?

# FFR Is Determined By,

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- Size of supplied myocardium  
(reference vessel diameter)
- Degree of diameter stenosis
- Lesion morphology
- Eccentricity
- Lesion length
- Plaque rupture, Plaque burden
- Surface roughness
- Viscous friction, flow separation, turbulence,  
and eddies



# **Independent Predictors for FFR <0.80,**

## **Multivariable Analysis (n=112)**

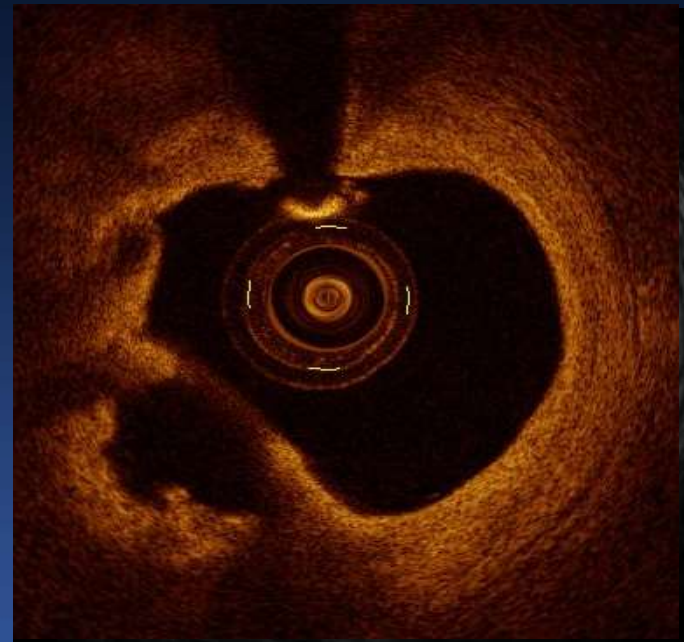
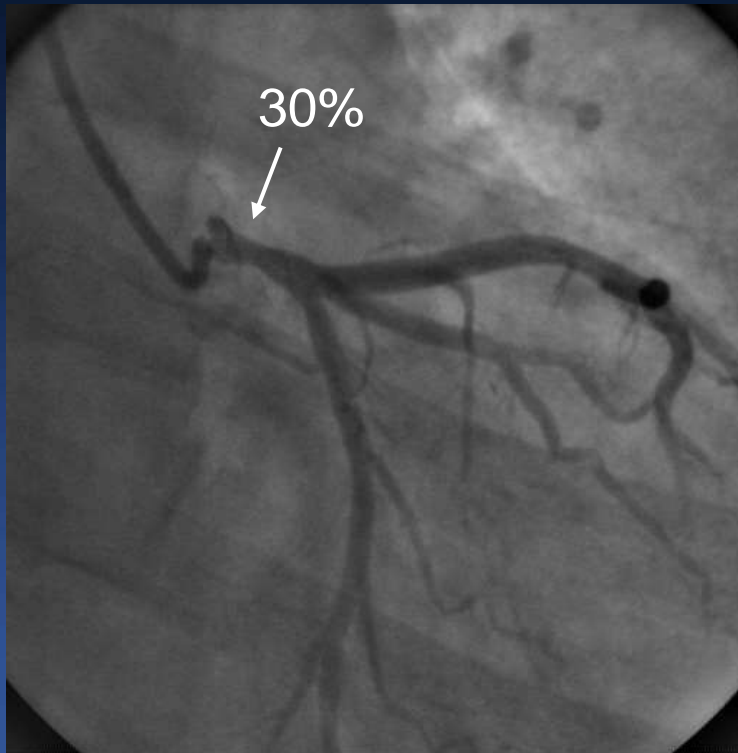
Variables	OR	95%CI	p-value
<b>Model 1</b>			
MLA, mm <sup>2</sup>	0.37	0.25-0.56	<0.001
Plaque rupture	4.51	1.36-14.9	0.014
Age, year	0.95	0.90-1.00	0.033
BMI, kg/m <sup>2</sup>	1.19	1.00-1.40	0.05
<b>Model 2</b>			
MLA, mm <sup>2</sup>	0.34	0.21-0.54	<0.001
Age, year	0.94	0.90-0.99	0.022
LV mass, g	1.01	1.00-1.03	0.03

Model 1 included clinical, QCA, and IVUS variables

Model 2 included Model 1 plus LV mass assessed by Echocardiography

# Presence of Plaque Rupture Can Make A Positive FFR

**Positive FFR : 0.70**

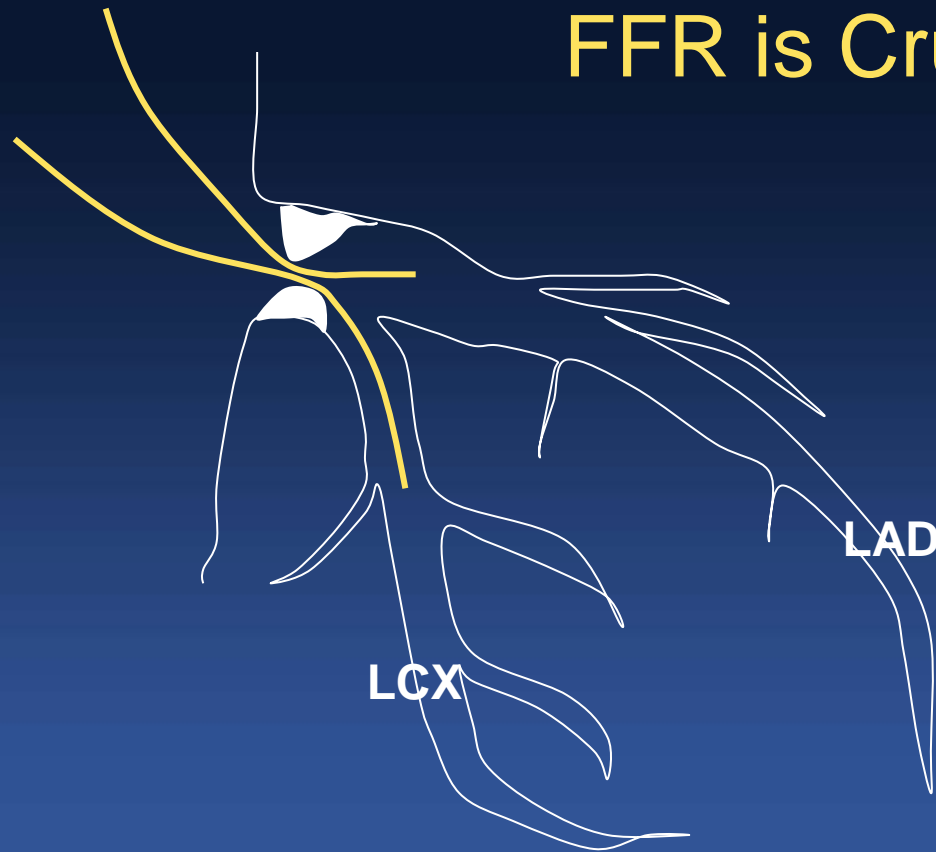


Plaque rupture,  
MLA 6.2mm<sup>2</sup>

# How do I **Implement FFR** in Real Practice ?

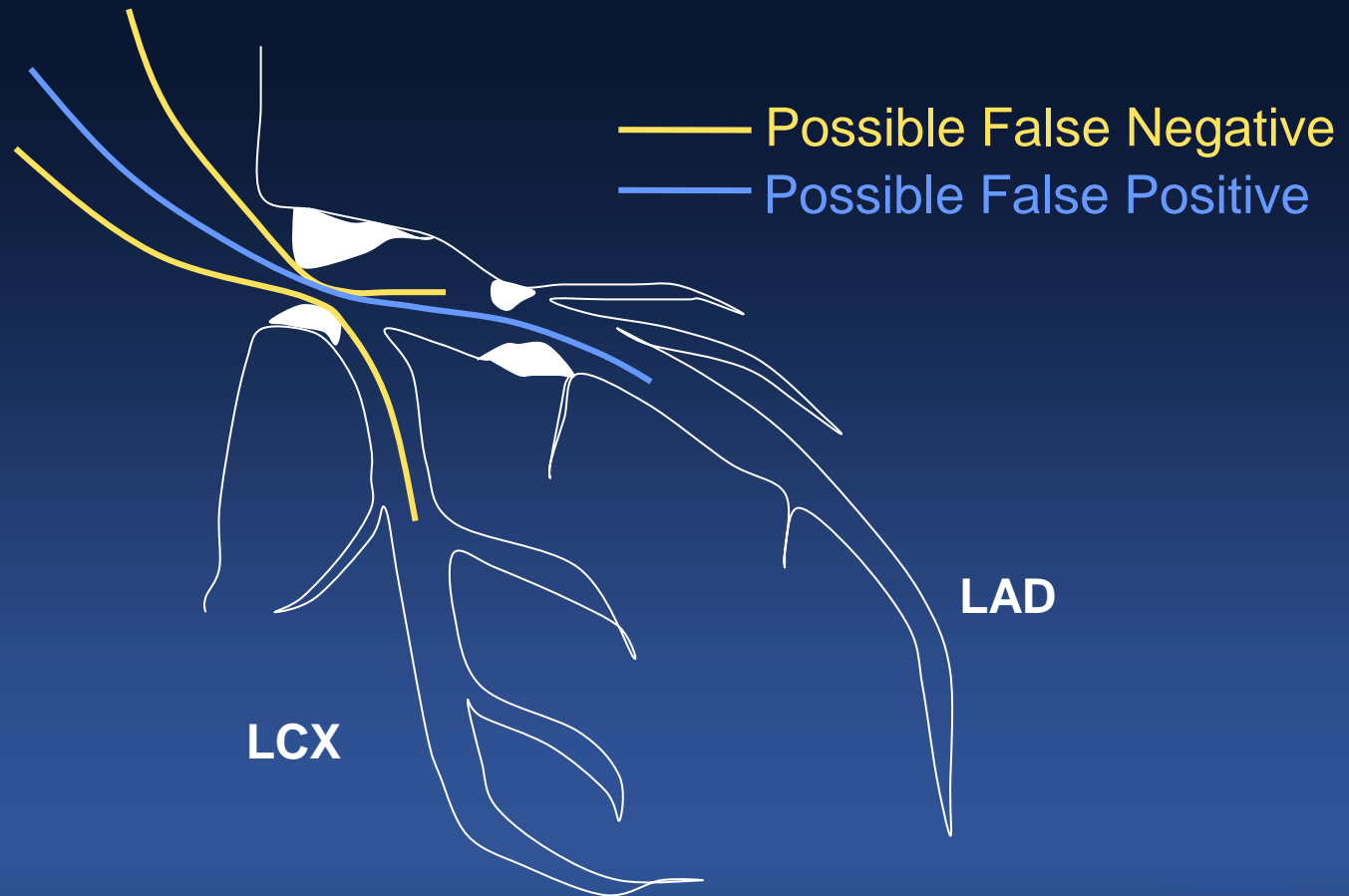
# Intermediate LM **Ostial and Shaft Disease**,

**FFR is Crucial**

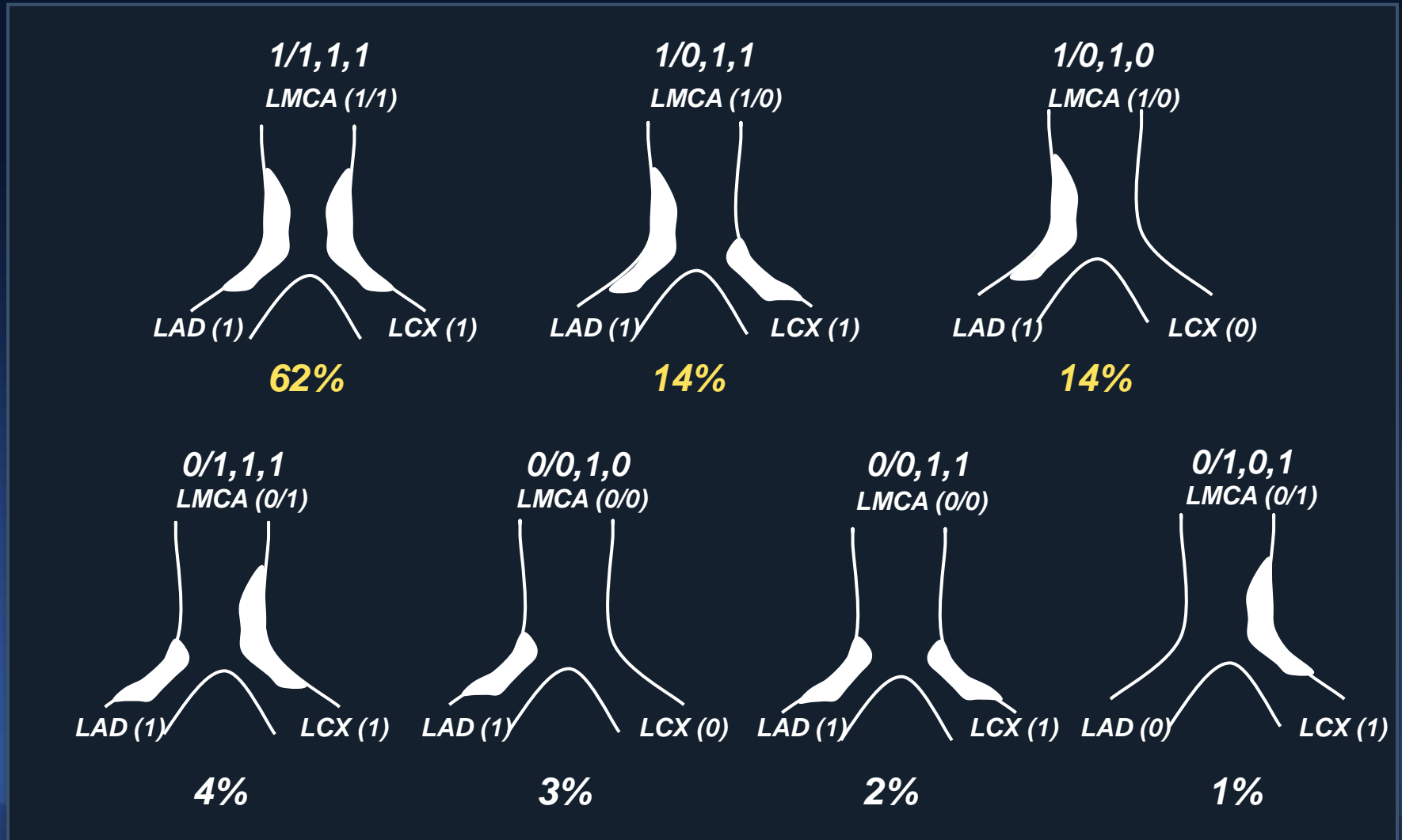


# Intermediate LM Bifurcation Disease,

*Problem to Measure FFR ?*

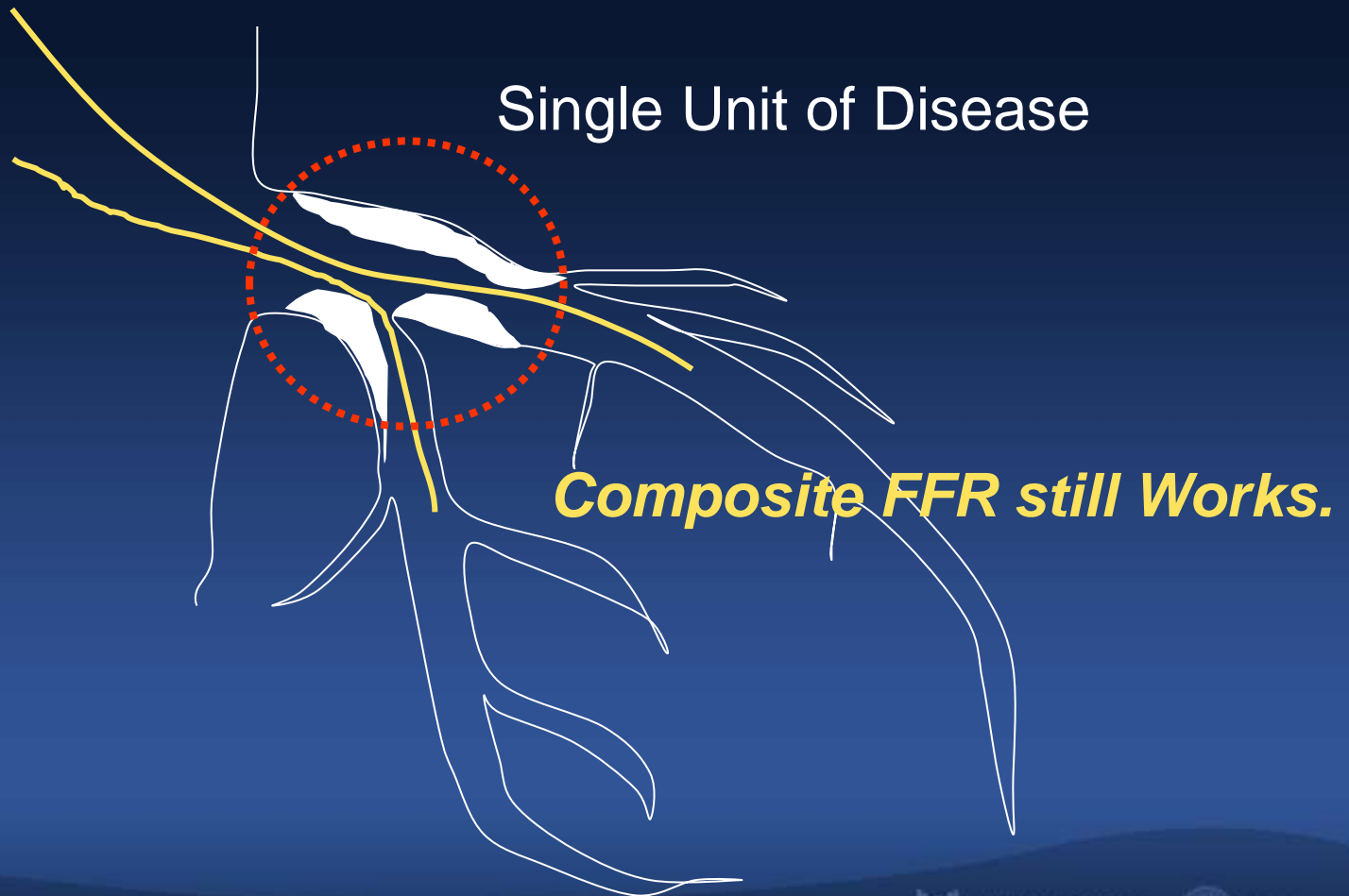


# 90% of Plaque, Extends from LM to LAD In LM Bifurcation Disease



# Intermediate LM **Bifurcation** Disease,

*If Transducer Placed Beyond Bifurcation  
in both LAD and LCX,*

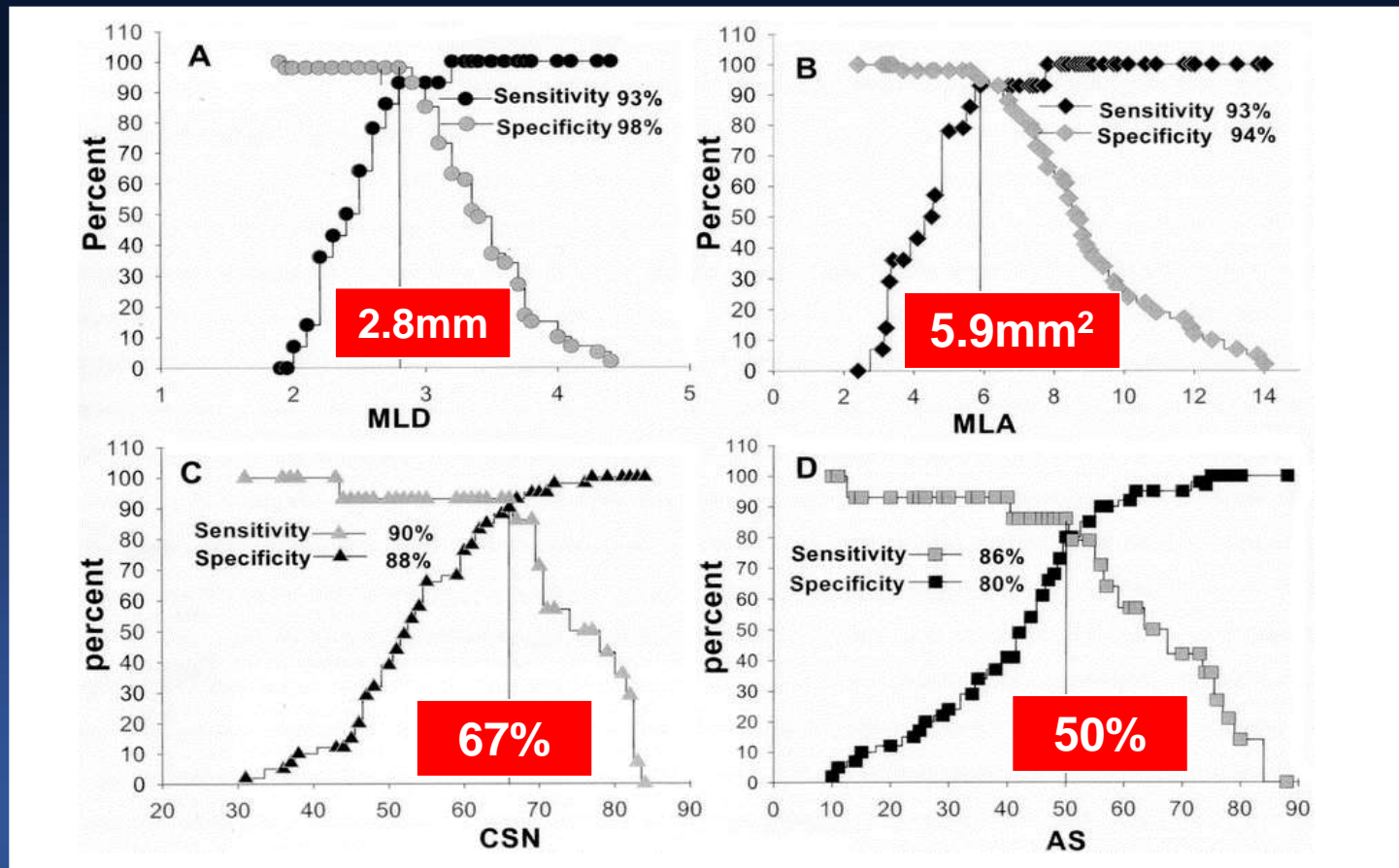


# *What About the IVUS MLA ?*

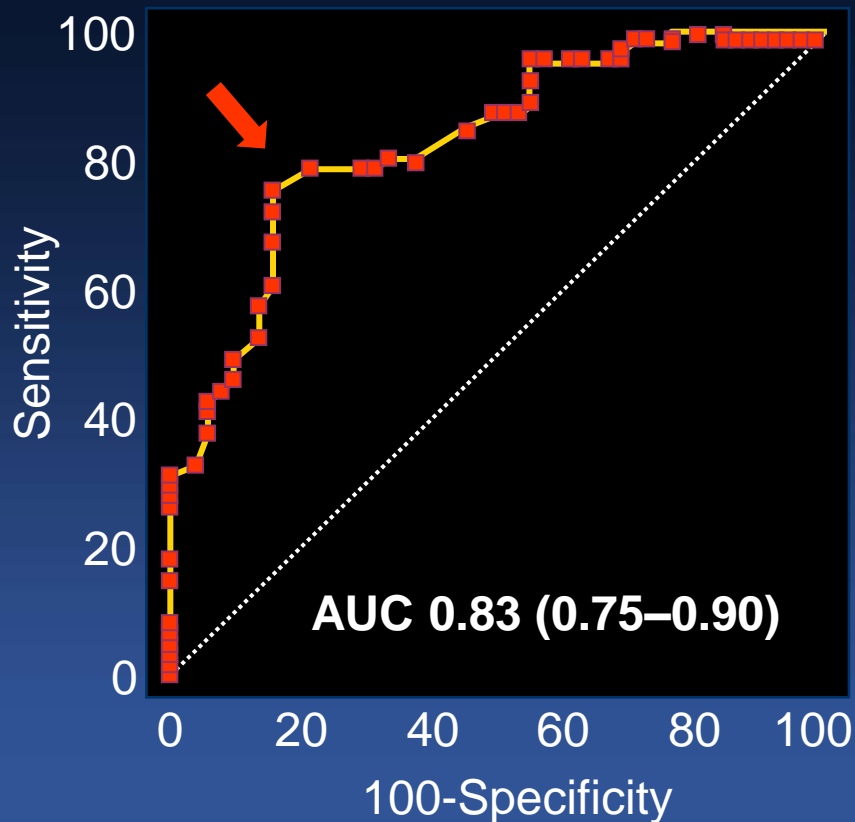
*Can **IVUS MLA** Predict Functional  
Significance of LM Stenosis **too** ?*



# MLA < 6.0 mm<sup>2</sup> matched FFR < 0.75 (n=55, LM disease)



# MLA < 4.5 mm<sup>2</sup> matched FFR < 0.80 (n=112, Os and Shaft LM disease)



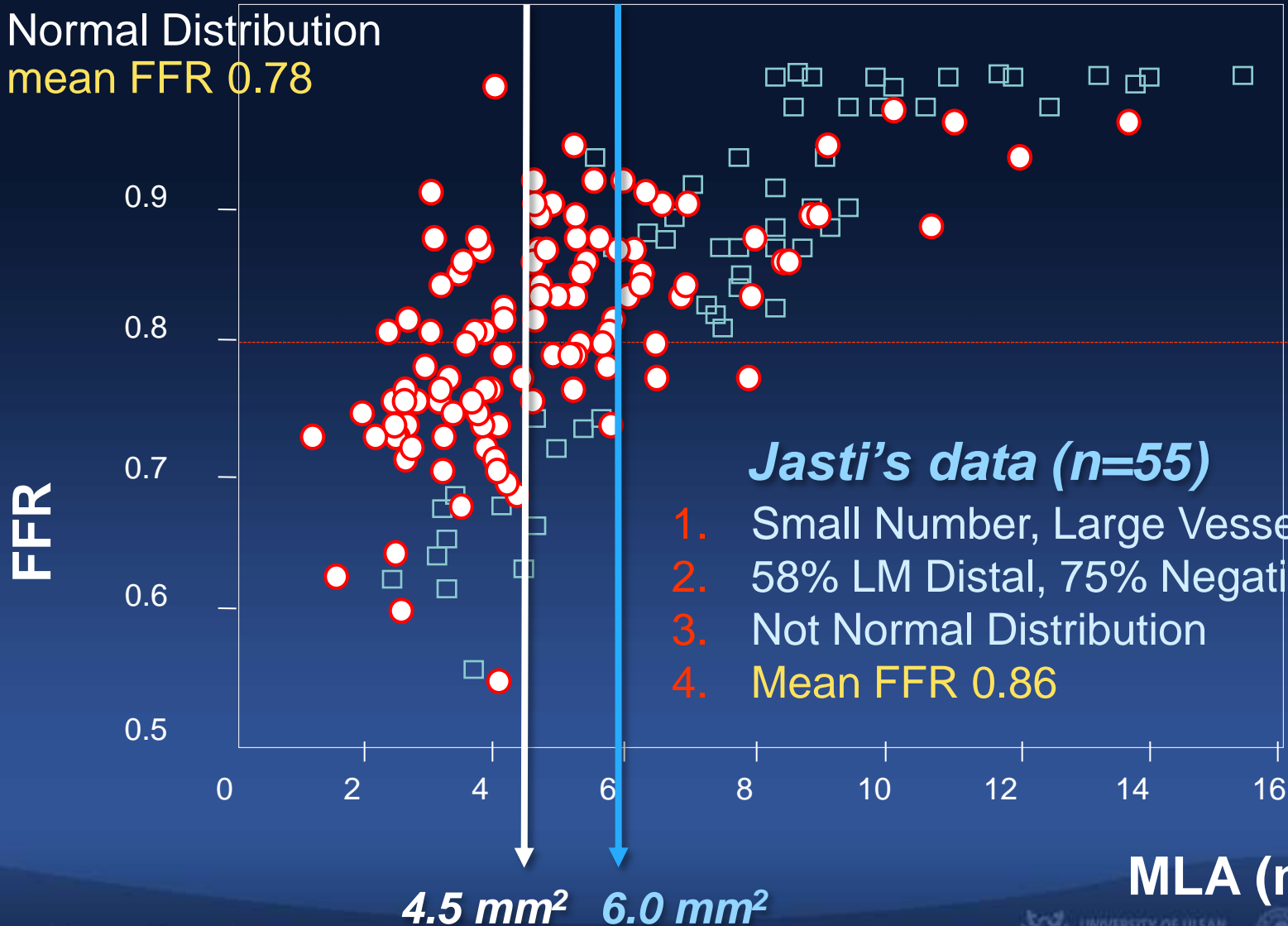
**Cut-off = 4.5 mm<sup>2</sup>**

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

# *What's the Difference ?*

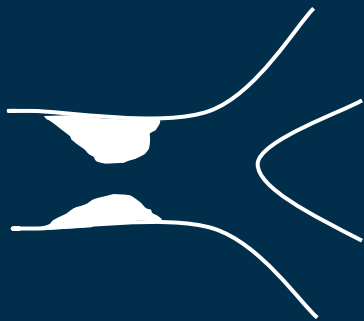
## Park's Data (n=112)

1. 100%, Ostial/Shaft Lesions
2. More Positive FFR
3. Normal Distribution
4. mean FFR 0.78



# How do I Implement ?

## Ostial and Shaft LM Disease



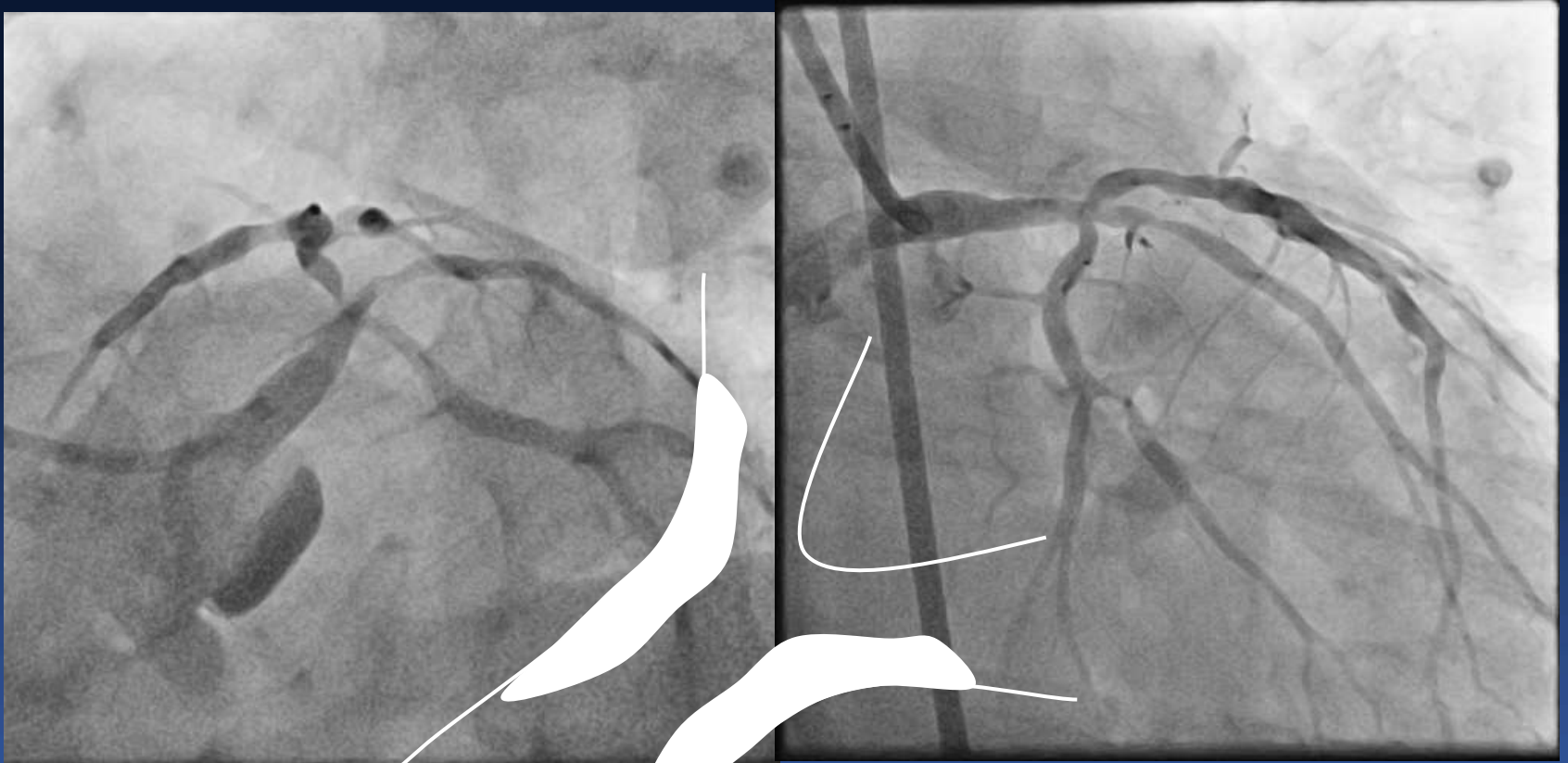
Smaller than  $4.5 \text{ mm}^2$   
**Positive FFR**

## Bifurcation with Down Stream Disease

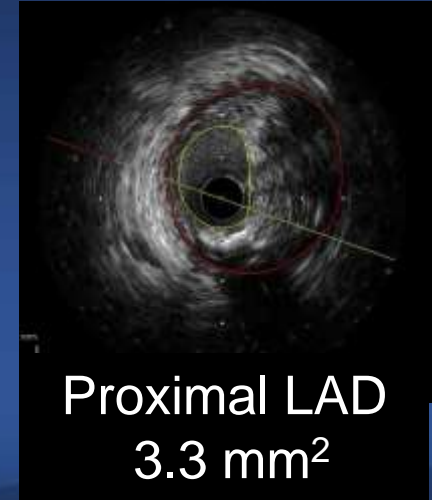
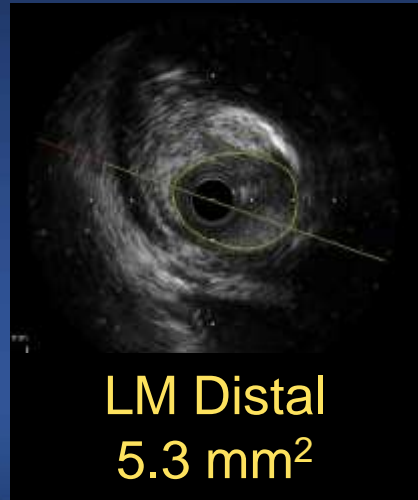
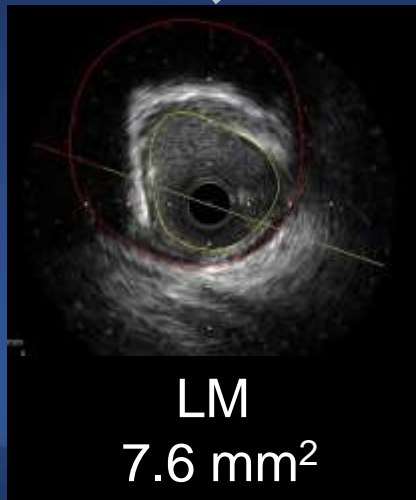
?  $4.5 \sim 6.0 \text{ mm}^2$   
**Consider FFR !**

Larger than  $6.0 \text{ mm}^2$   
**Negative FFR**

# Case 1, 55/M, Effort Chest Pain

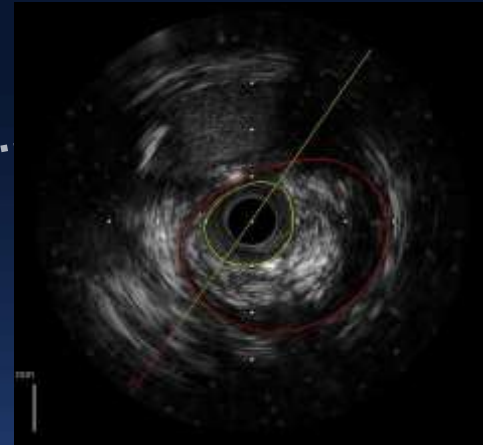


# LAD and LM IVUS





# LCX IVUS

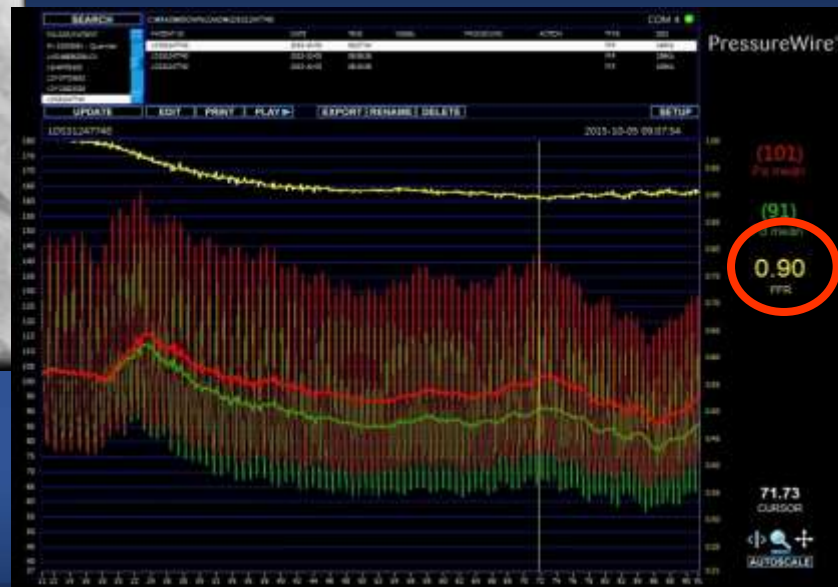
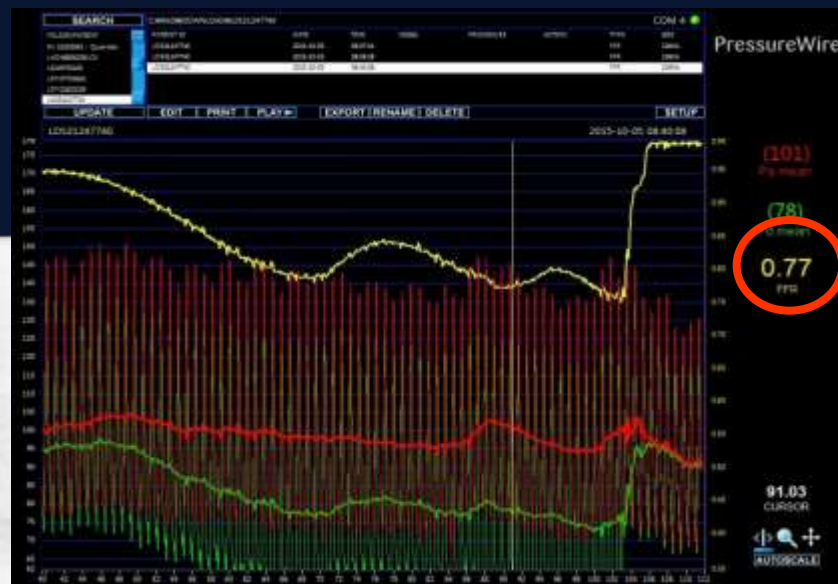
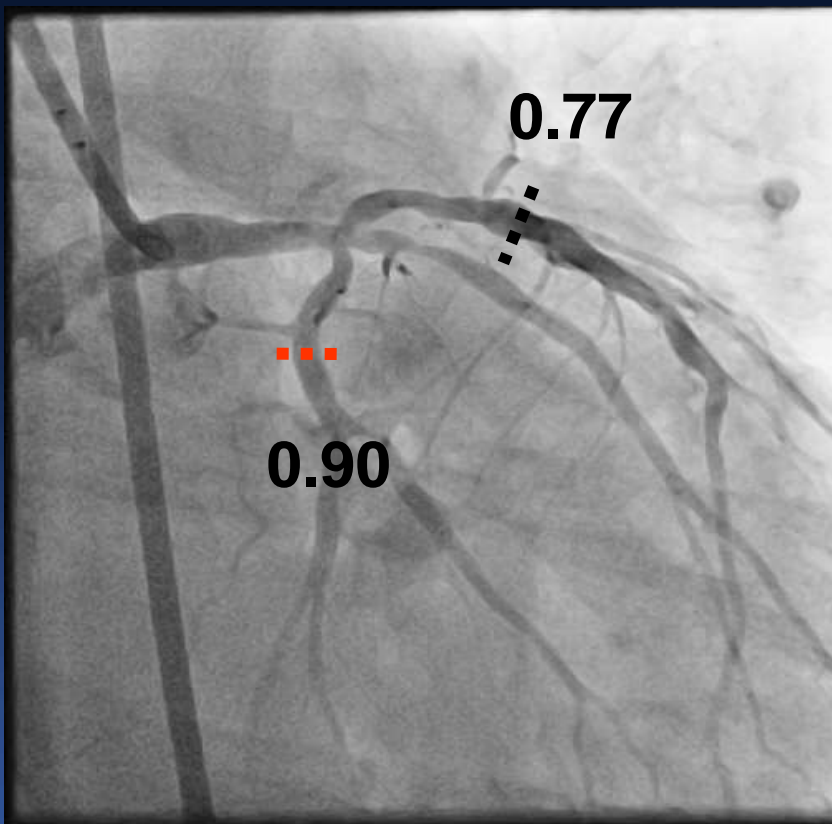


40% Narrowing  
LCX ostium  
MLA : 2.49 mm<sup>2</sup>  
Plaque burden 79.3%



# FFR

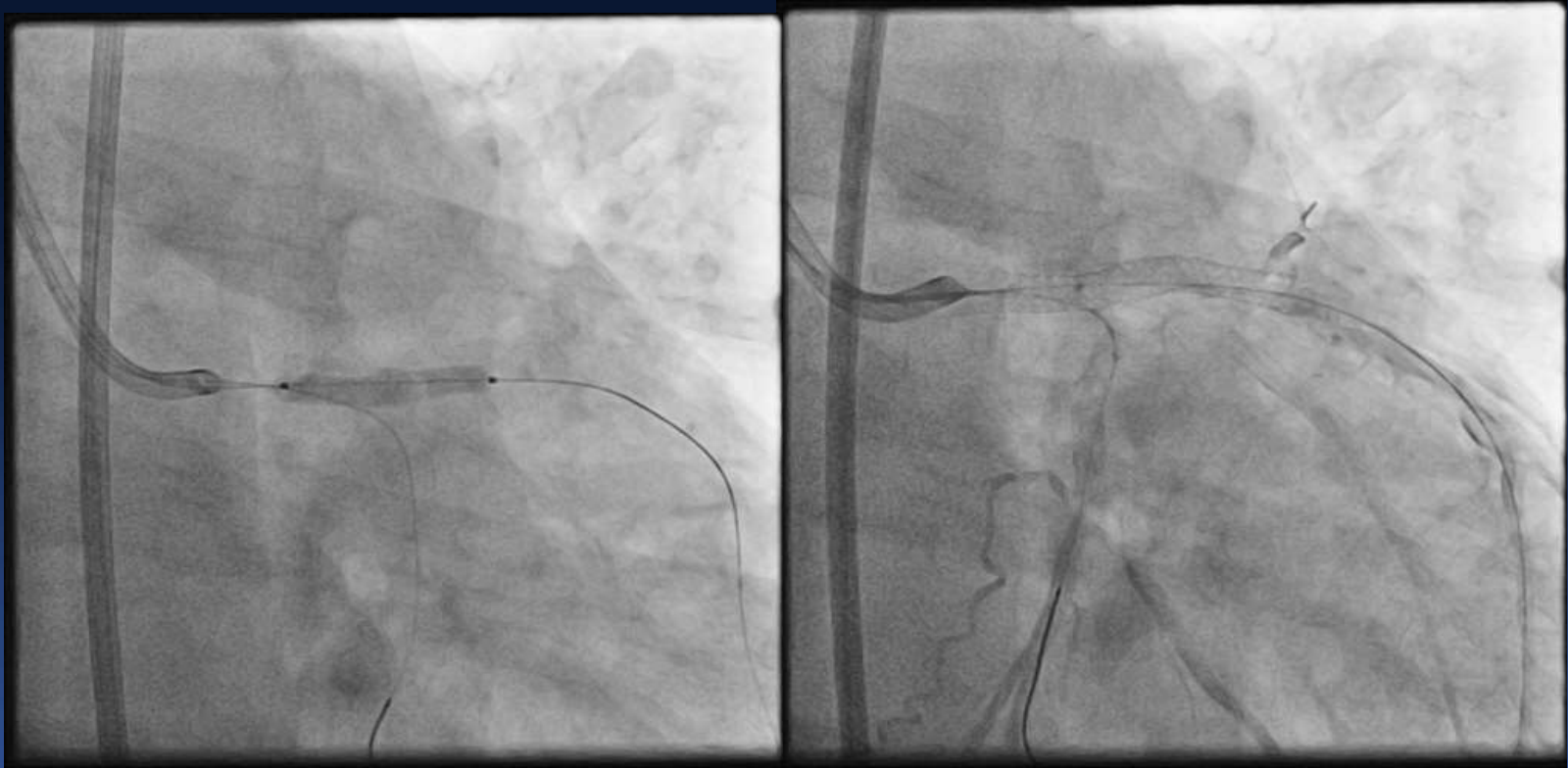
in Both LAD and LCX,



# Why FFR ?

*Decision Making,  
To Treat or Not To Treat !*

# Single Stent Crossover

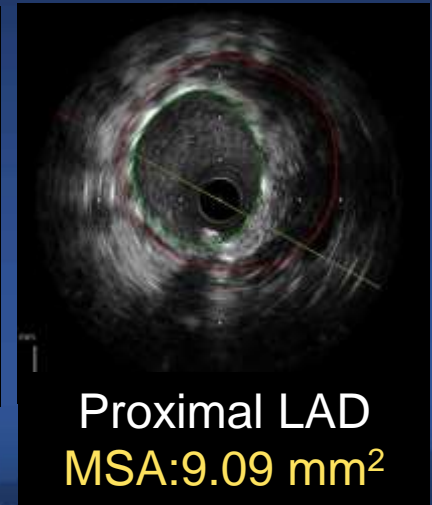
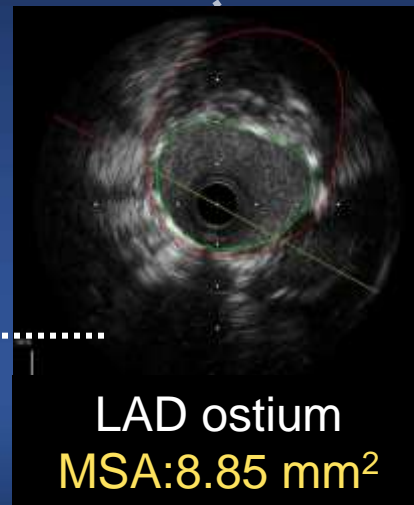
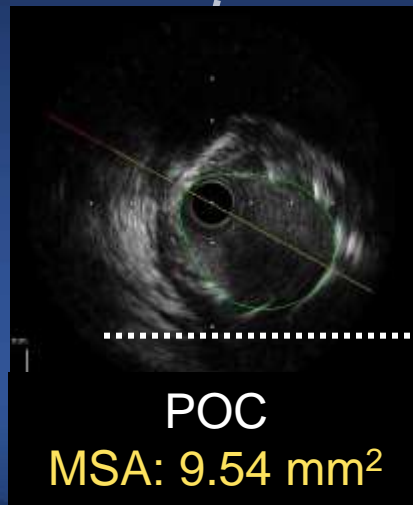
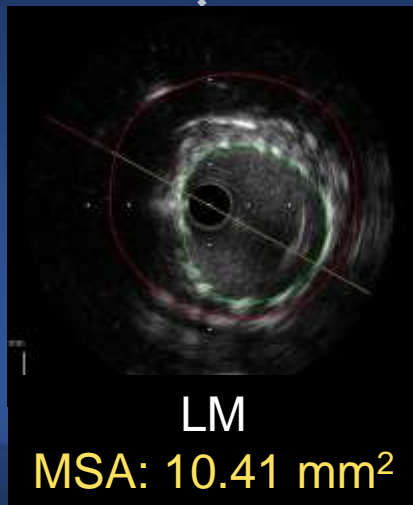


XIENCE Alpine  
4.0mm x 30mm

# Final Angiogram



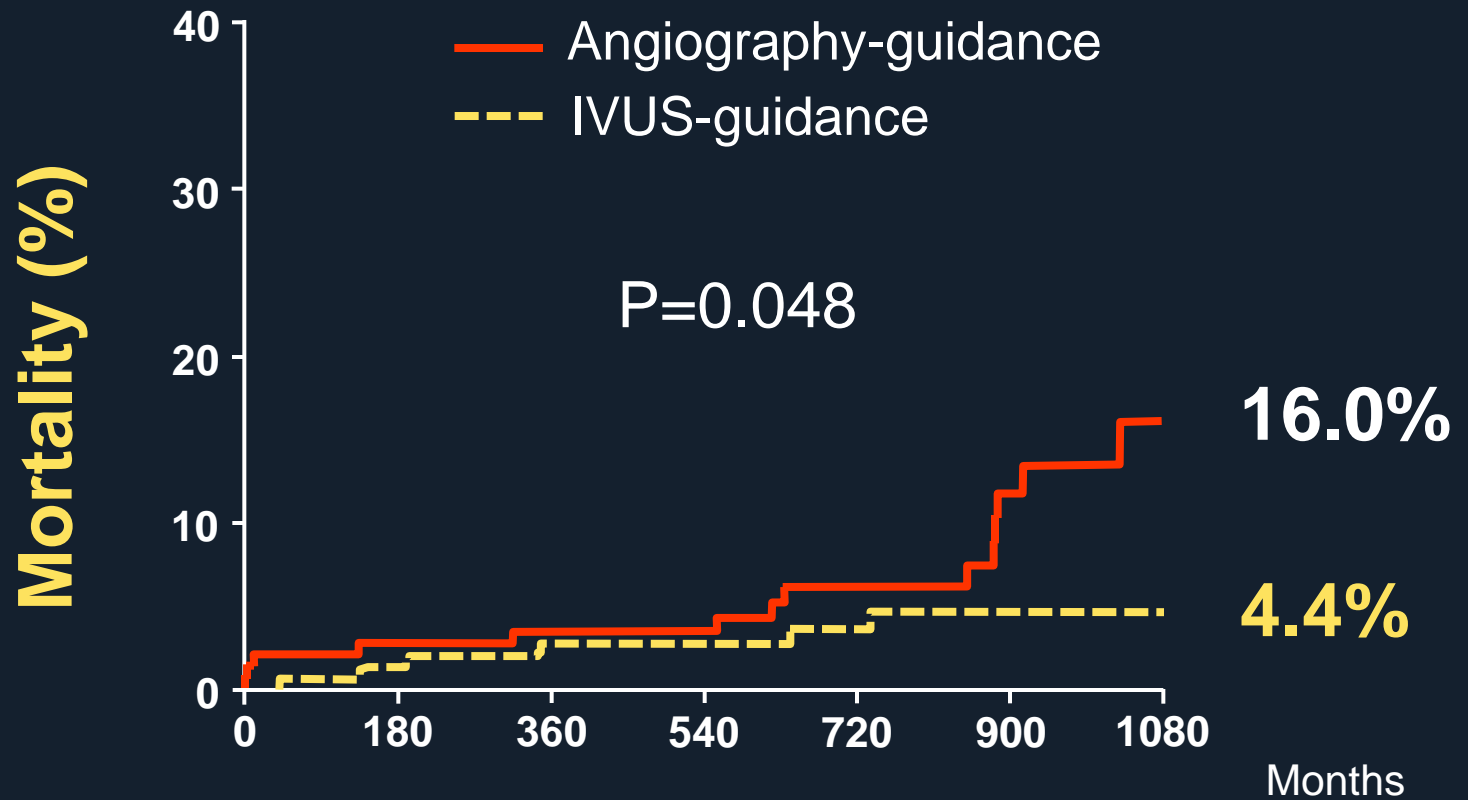
# Post-PCI IVUS



**Q2,**  
**Why IVUS too ?**

***Saves Lives !***

# Angio-Guided vs. IVUS Guided for LM PCI



Patients after risk

IVUS-guidance	145	140	98	37
Angiography-guidance	145	137	88	29



# Impact Of IVUS

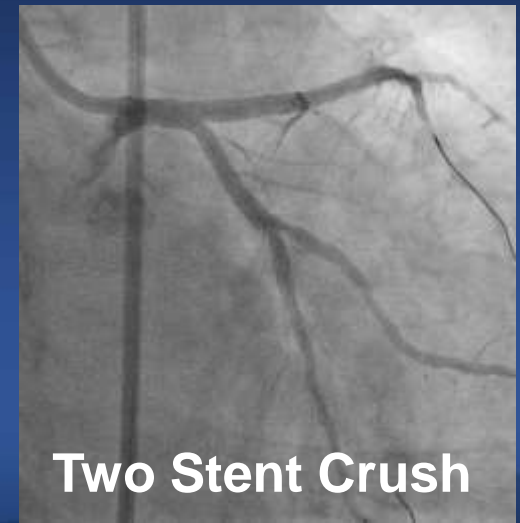
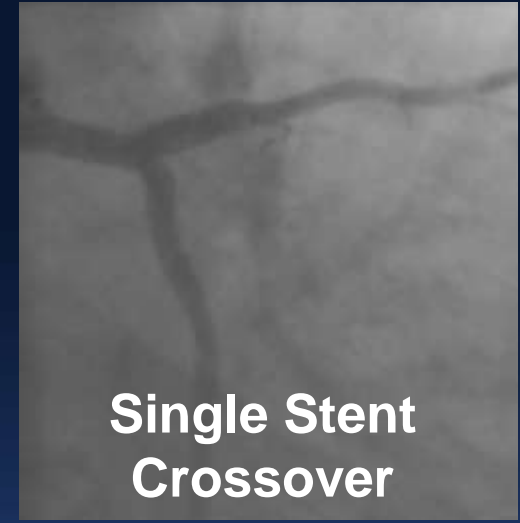
① *Decision Making ;*  
*1 Stent or 2 Stents ?*



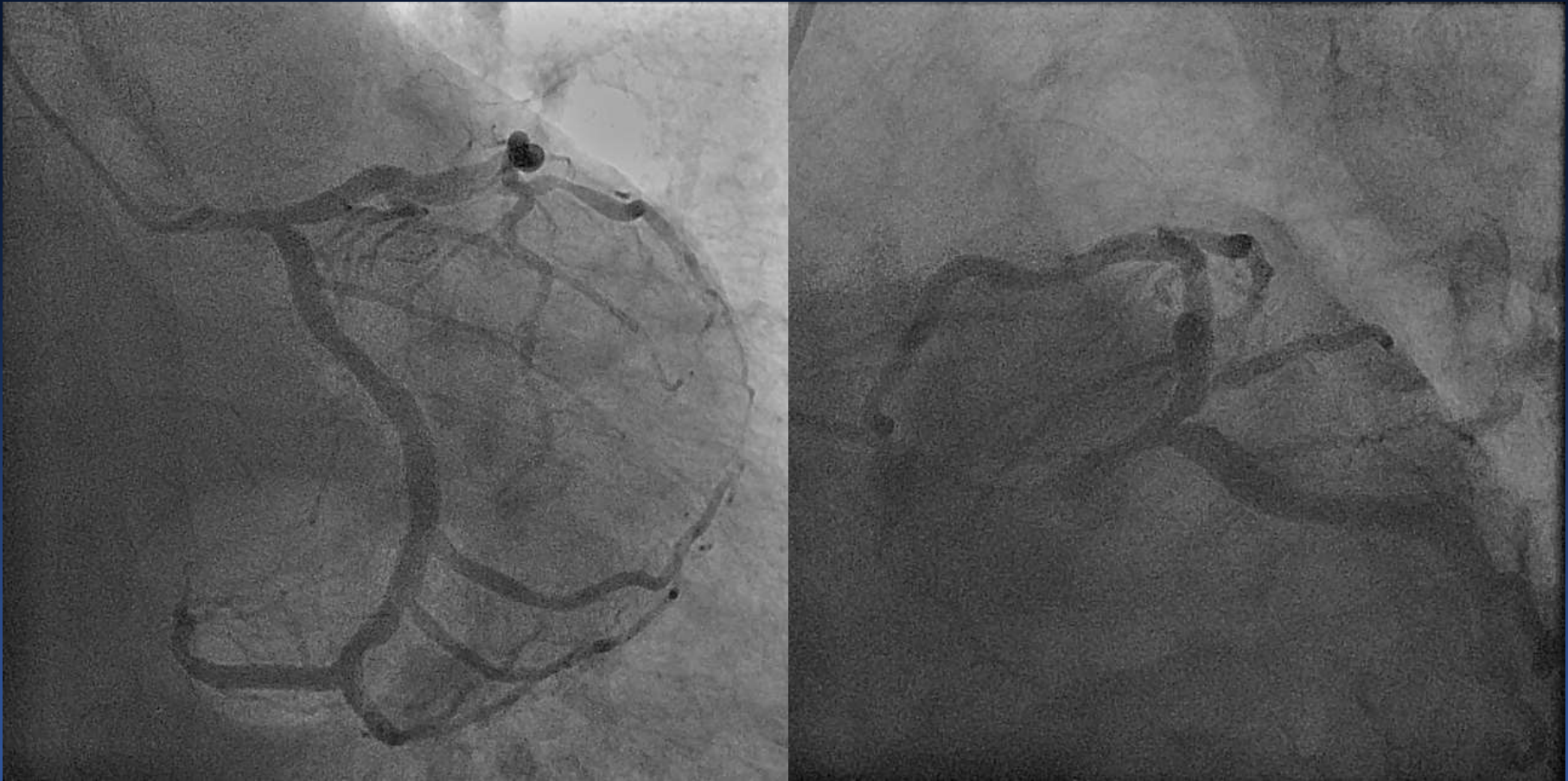
# Distal LM Bifurcation PCI

<b>Stent Cross Over</b>	<b><i>Normal Ostial LCX (Medina 1.1.0., 1.0.0)</i></b> Normal or Diminutive LCX Small LCX with < 2.5 mm in diameter Focal disease in distal LCX
<b>Two Stent</b>	<b><i>Diseased LCX (Medina 1.1.1., 1.0.1)</i></b> Large LCX with $\geq 2.5$ mm in diameter Diseased left dominant coronary system Concomitant diffuse disease in distal LCX

# Depending On Whether or LCX Disease by IVUS

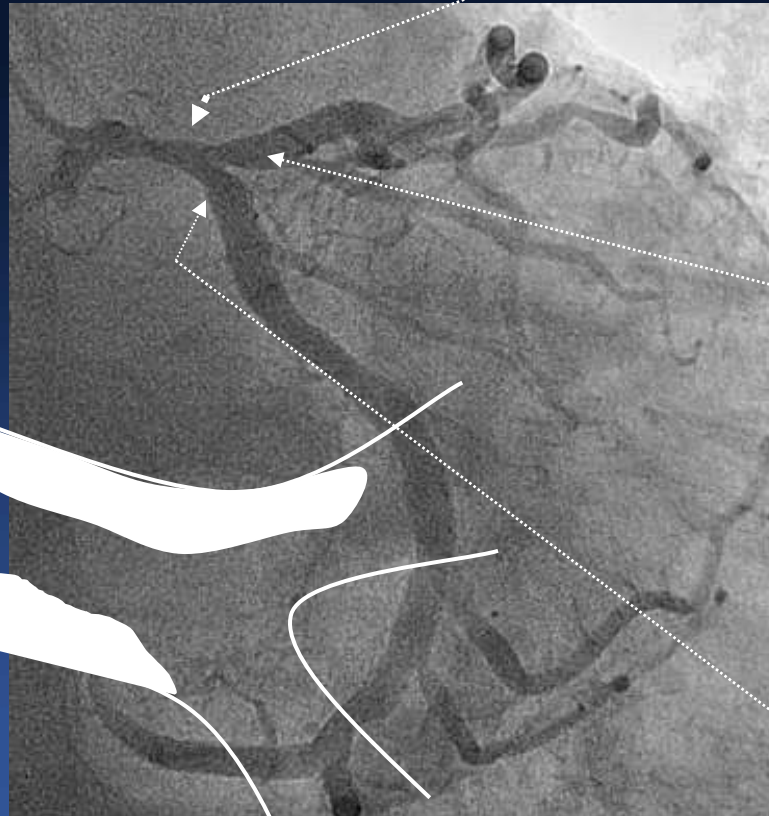


# Case 2, 64/M, Effort Chest Pain

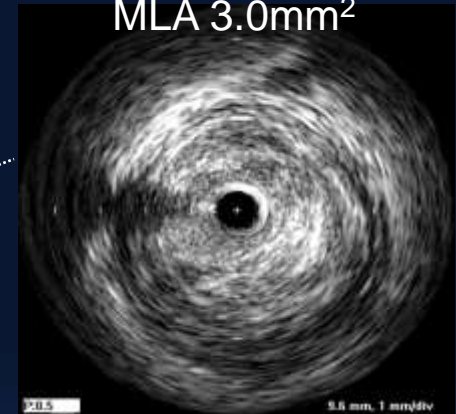




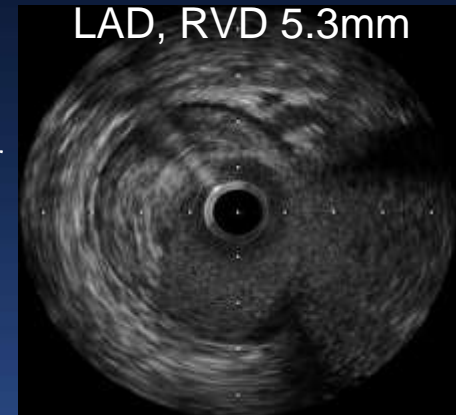
# IVUS in Both LAD and LCX,



Distal LM, RVD 6.2mm  
MLA 3.0mm<sup>2</sup>



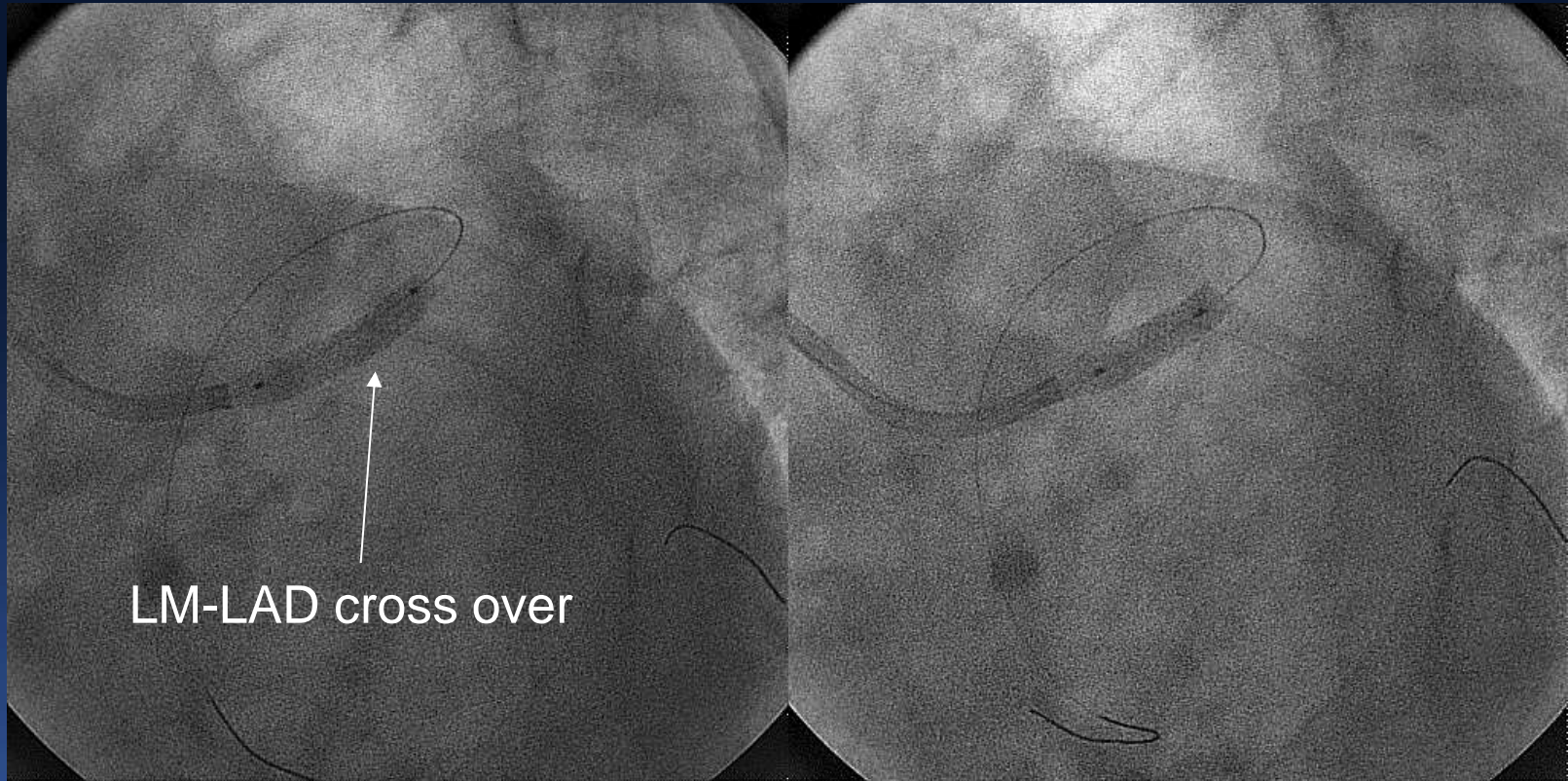
LAD, RVD 5.3mm



LCX, Disease Free



# Stent Cross-Over



DES 4.0x20 mm

Additional high pressure  
Inflation with 4.0 mm  
non-compliant balloon



# Final Result



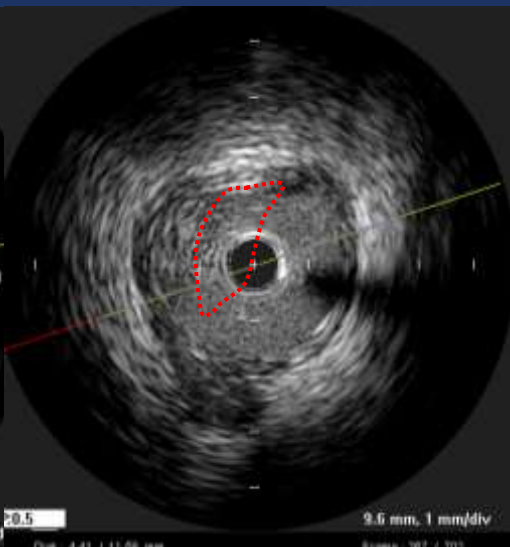
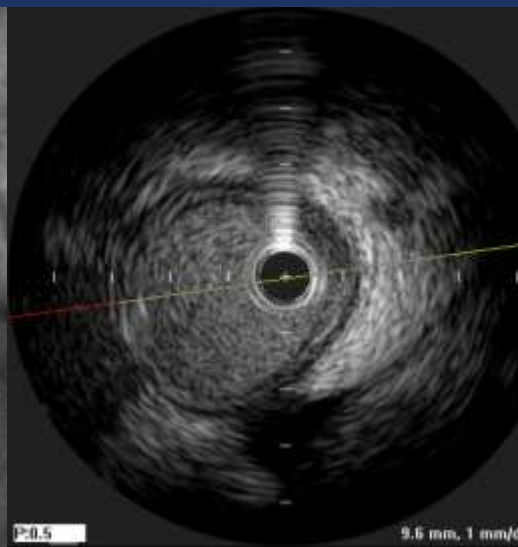
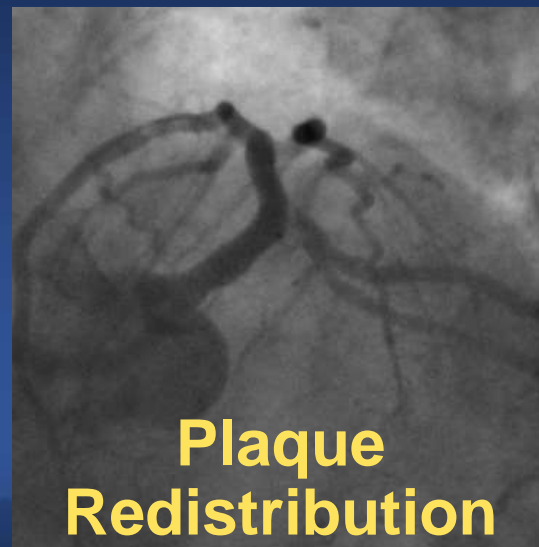
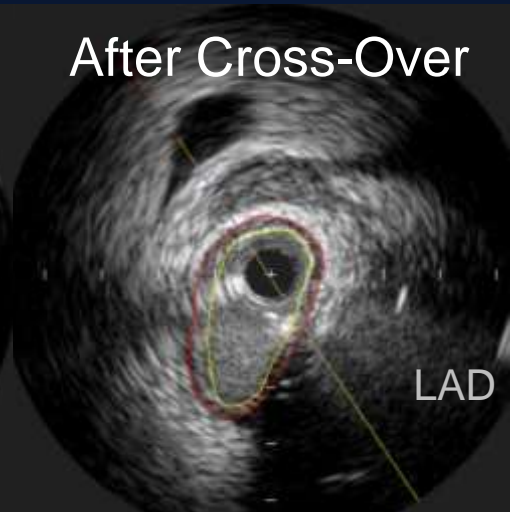
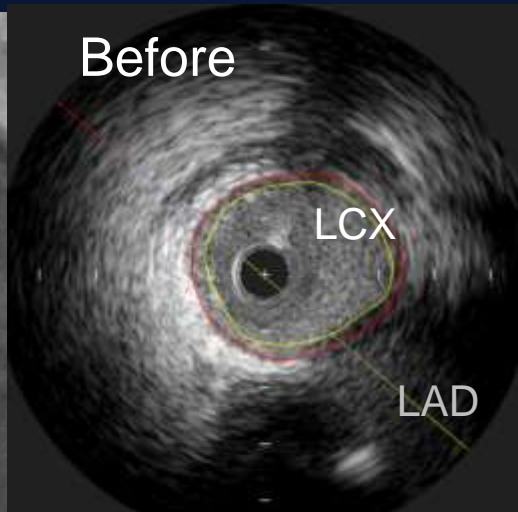
Side branch was  
compromised ?

# FFR of LCX is 0.92



*Defer !*

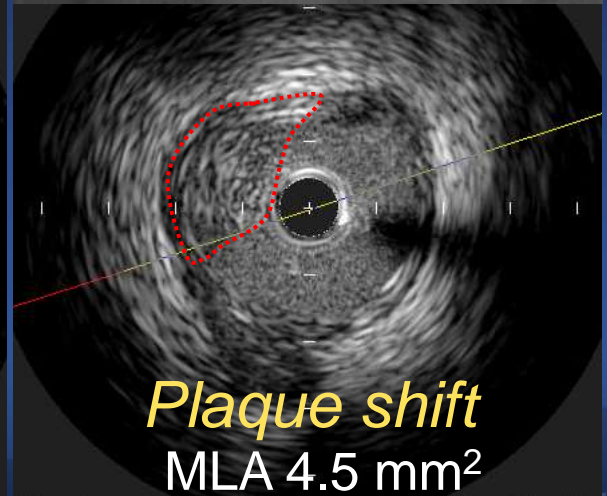
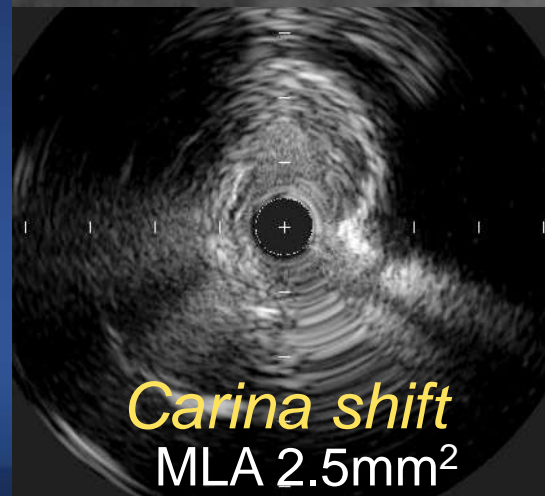
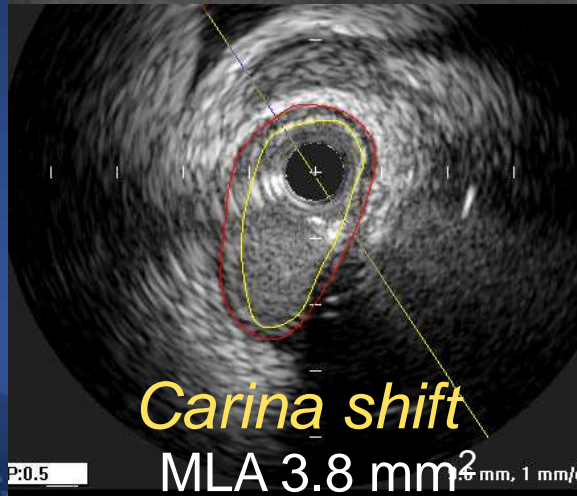
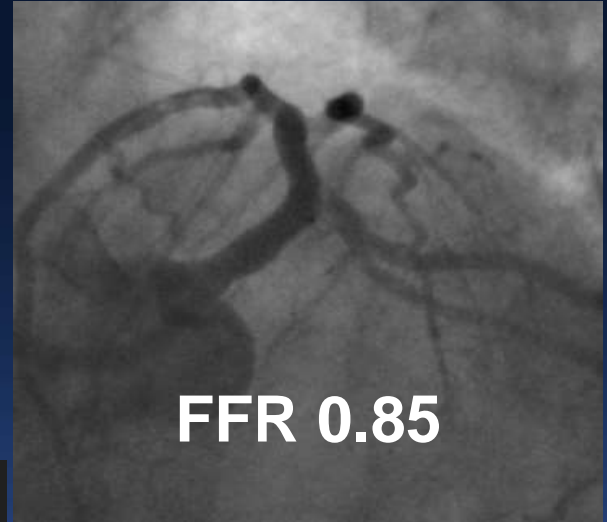
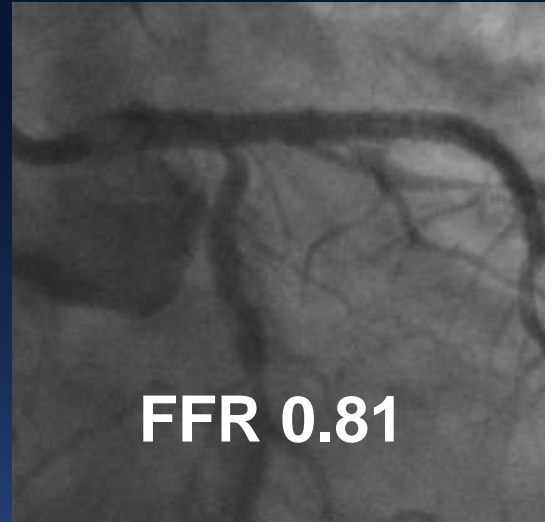
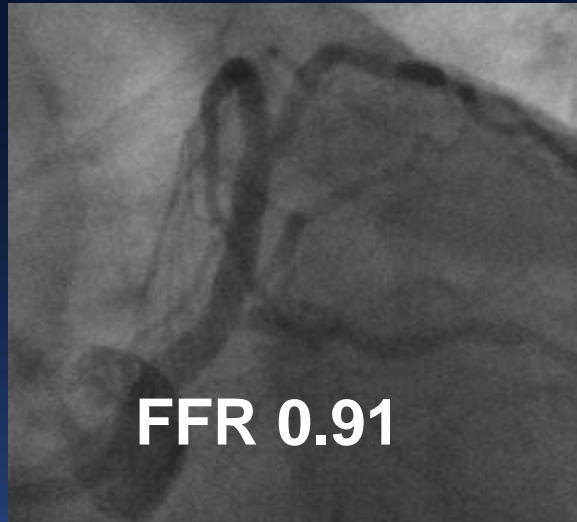
# Mechanism of LCX Jailing After Stent Cross-Over



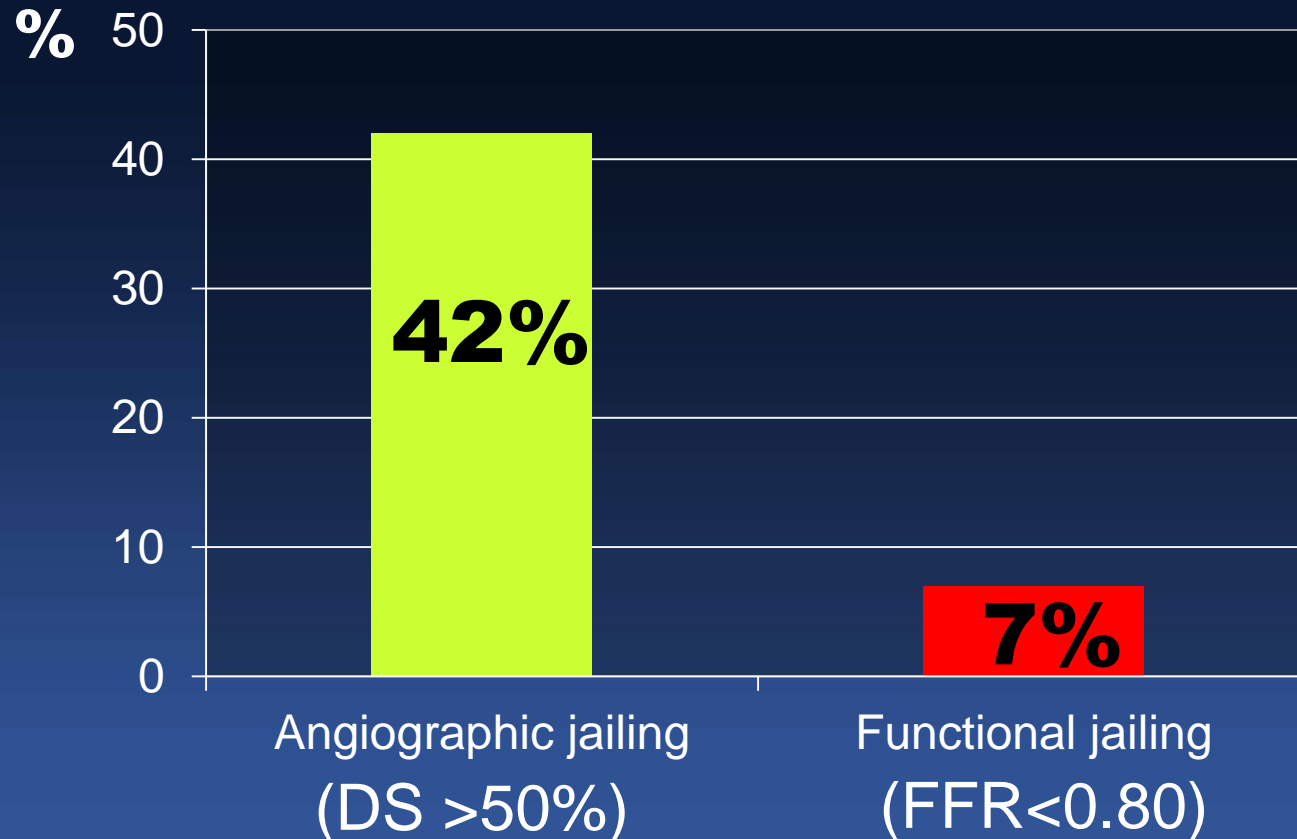


# ***Any Jailing Morphology Cannot Predict Functional Significance of Jailed LCX***

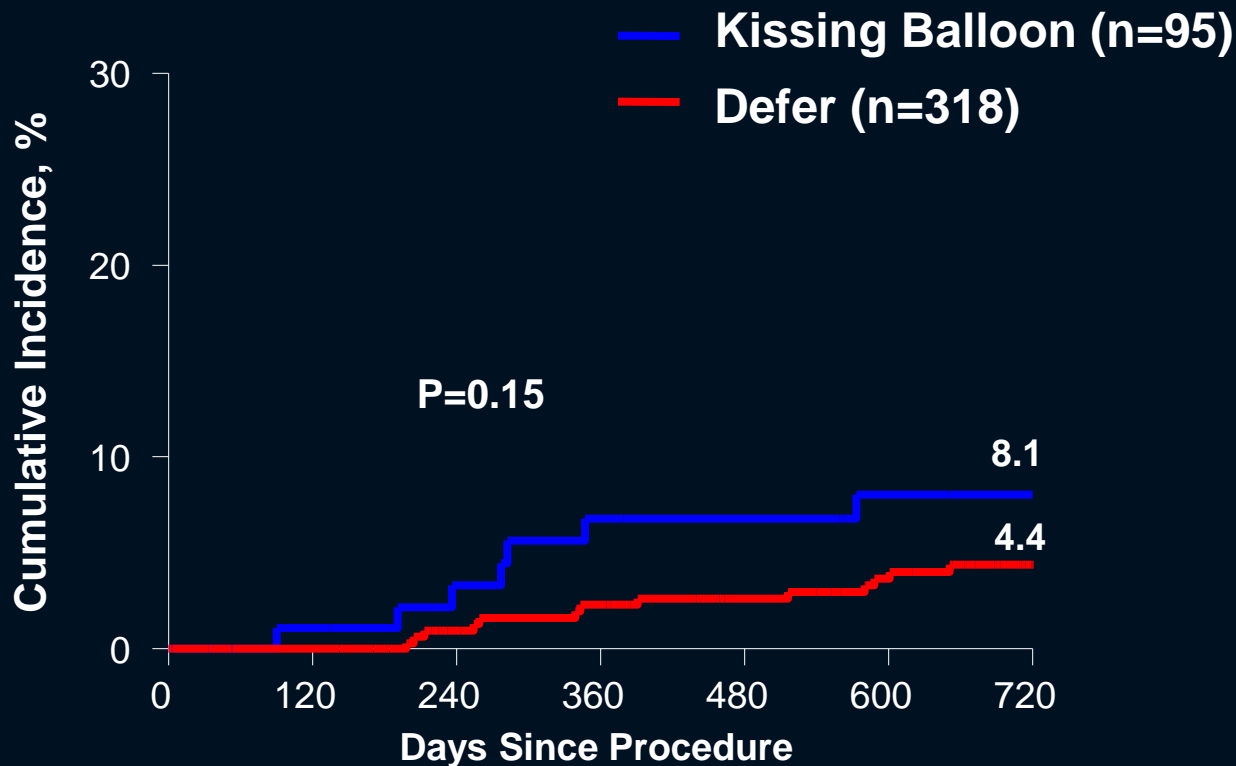
Jailing LCX After Stent Cross-Over



# Functionally Significant LCX Jailing After Stent Crossover



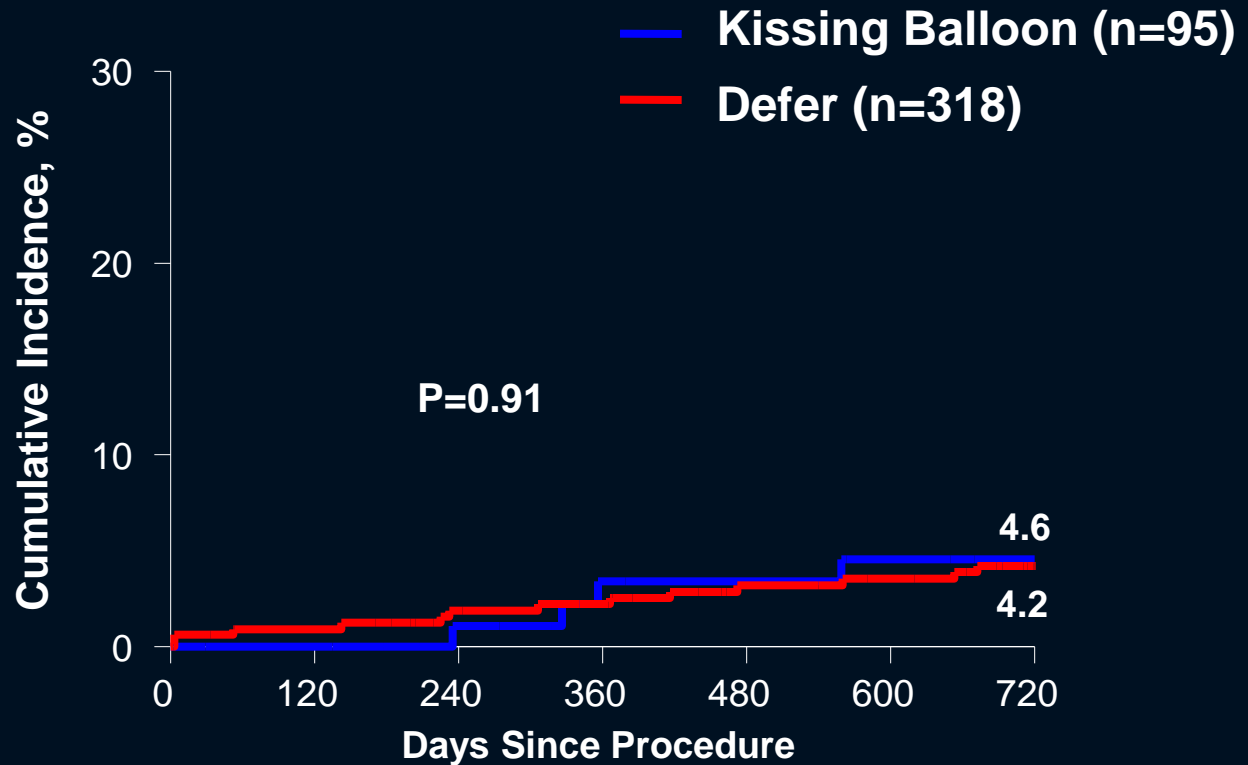
# Left Main-TLR at 2 Years



## No. at Risk

FKB	95	79	74
No-FKB	318	293	265

# Death or MI at 2 Years



**No. at Risk**

FKB	95	85	80
No-FKB	318	300	278

# Impact Of IVUS

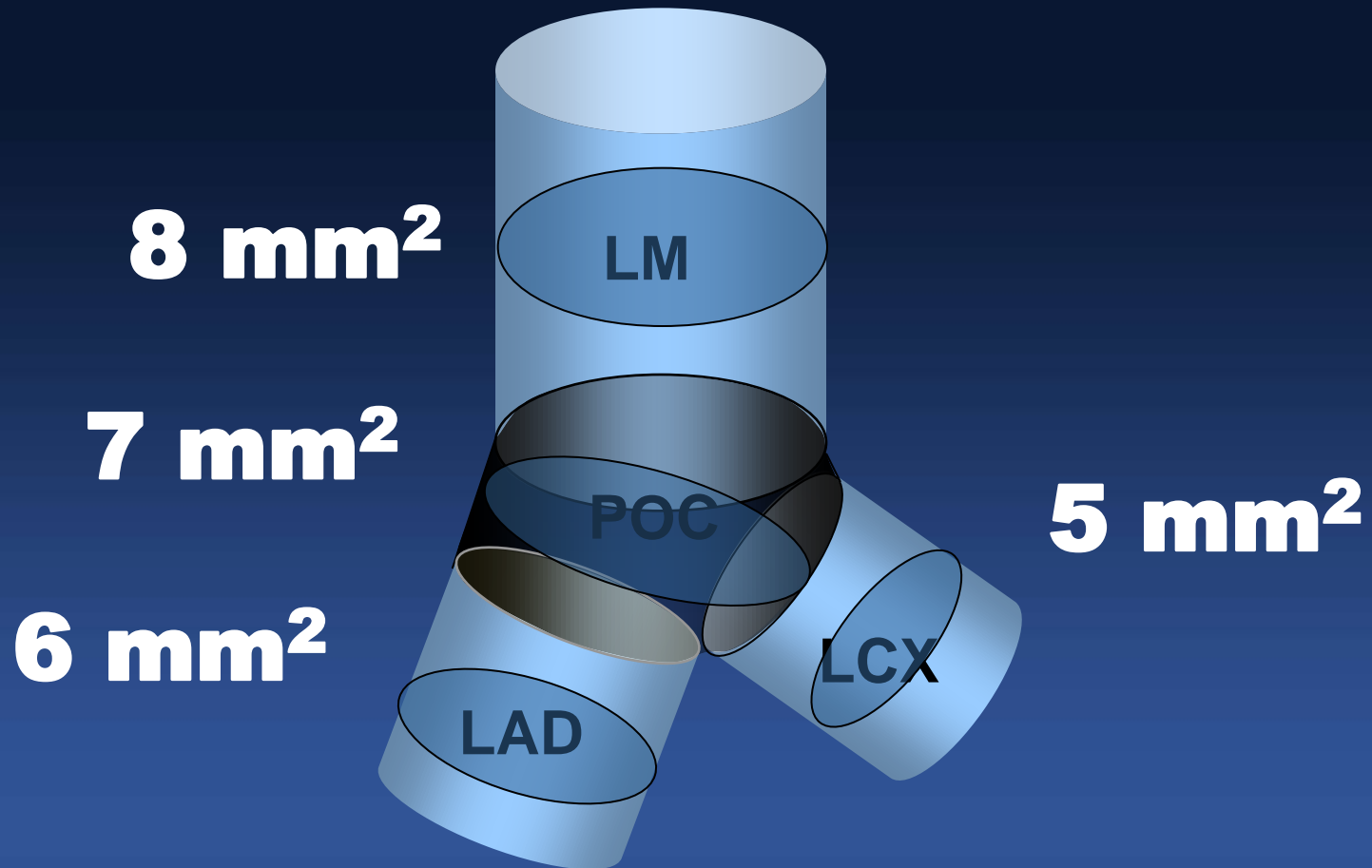
## ② *Stent Optimization ; After 2 DES Stents*

# 2 Stent Techniques

- T-stent, modified T-stent or TAP
- Mini-crush (or step crush)
- Culotte
- V-stent
- Y-stent (SKS-simultaneous kissing stents)

# Effective Stent Area (Rule of 5,6,7,8 mm<sup>2</sup>)

*Restenosis Rate < 5% and TLR < 2%*



# LM Bifurcation PCI

**Single Stent**

**Any 2 Stent**

**After  
Stent Cross-Over**

**How to Optimize ?**

- Do You Want to Treat the Jailed Side Branch ?
- How to Treat ?

IVUS Minimal Stent CSA Criteria 5-6-7-8 mm<sup>2</sup>  
May Improve Long-term Clinical Outcomes.



# Integrated Use of FFR and IVUS

## *The Simpler, The Better*

*Less DES,  
Less Surgery,  
Simplified Procedure, and  
Improved Clinical Outcomes !*



**Thank You !!**

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