

***Left Main PCI :***  
**Expert's Concept and Technique**

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

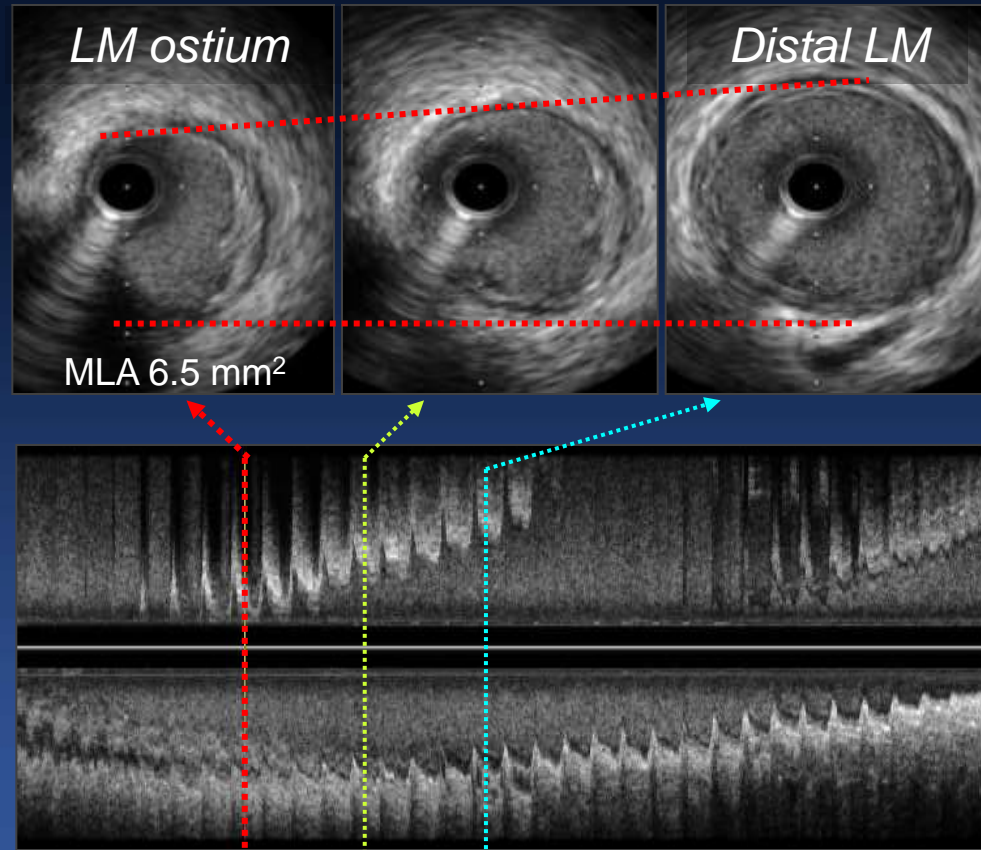
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Asan Medical Center, Seoul, Korea

# Only 2 Fundamental Questions,

1. To Treat or Not To Treat ?
2. How to Optimize ?

# 62/M, Atypical Chest Pain Significant Ostial Stenosis

*To Treat or Not To Treat ?*



*Mainly Negative Remodeling*

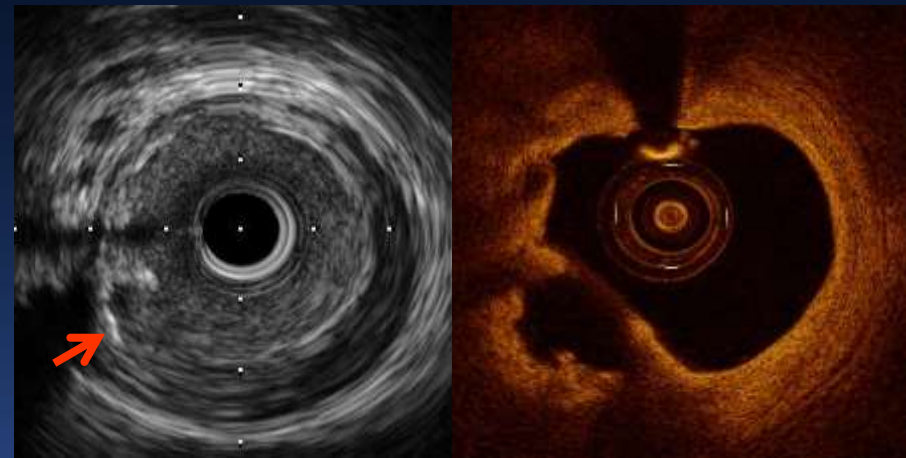
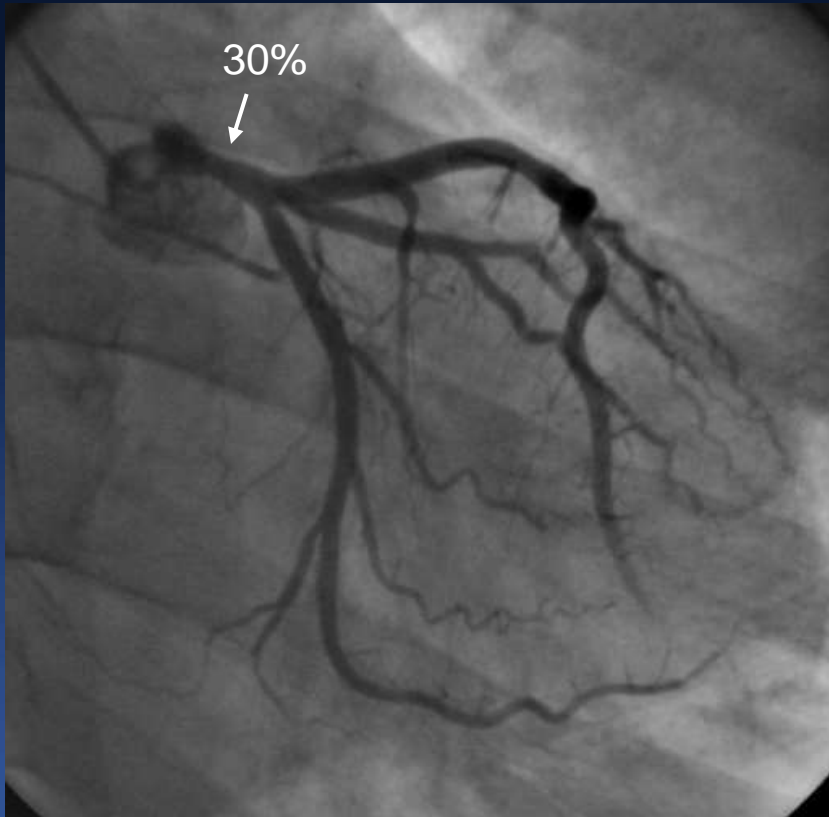
# 62/M, Atypical Chest Pain Significant Ostial Stenosis

*Negative FFR, 0.80*



49/M, Resting Chest Pain  
Insignificant Stenosis,

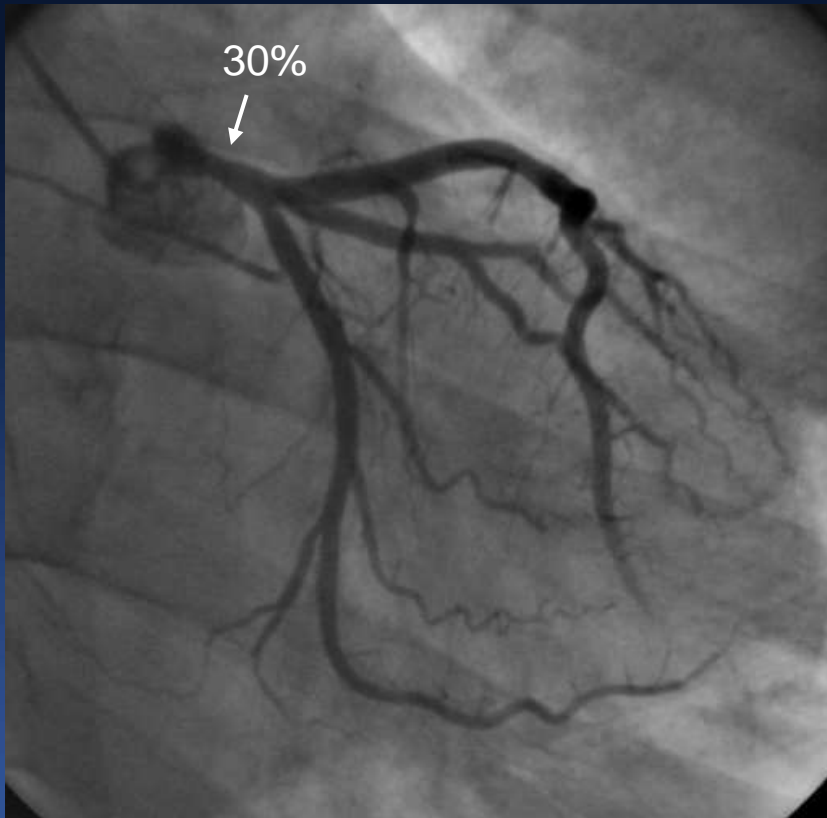
*To Treat or Not To Treat ?*



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

49/M, Resting Chest Pain  
Insignificant Stenosis,

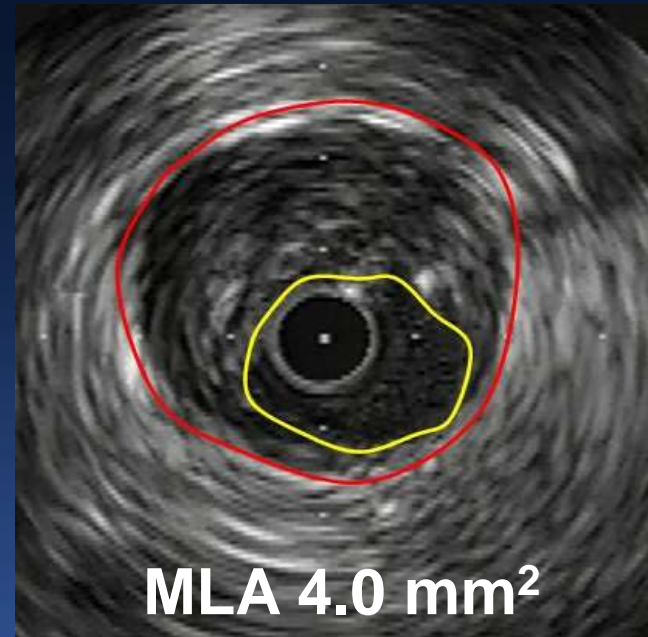
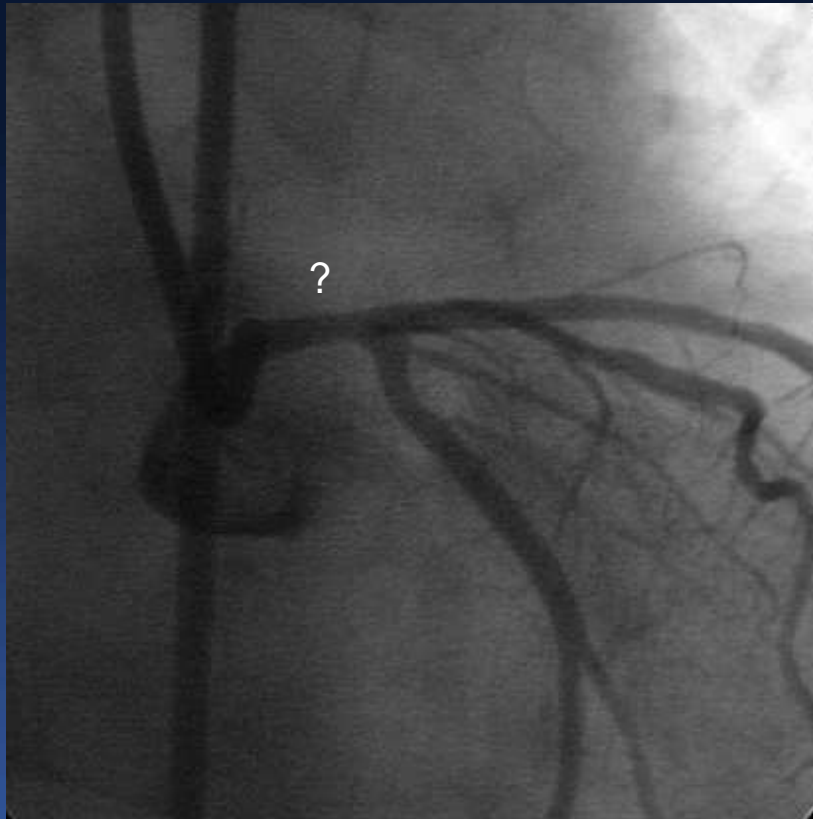
*Positive FFR, 0.70*





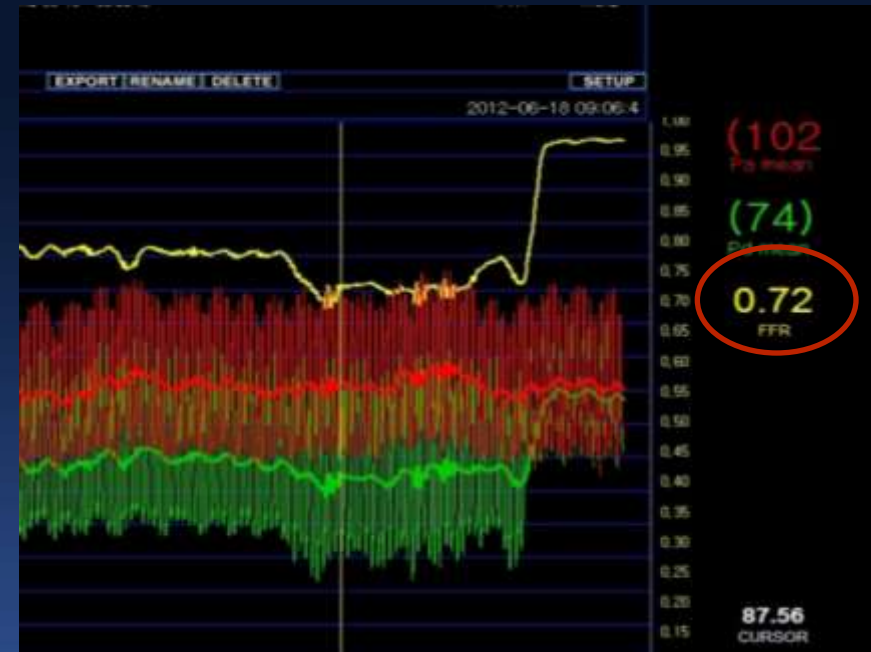
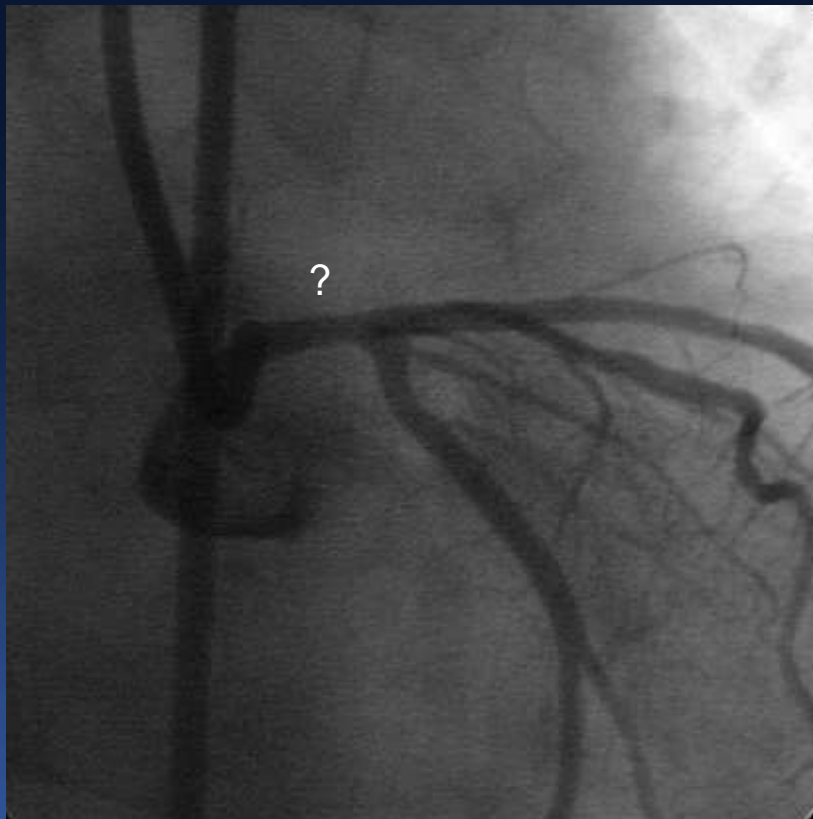
56/M, Effort Chest Pain  
Insignificant Stenosis,

*To Treat or Not To Treat ?*



56/M, Effort Chest Pain  
Insignificant Stenosis,

*Positive FFR, 0.72*

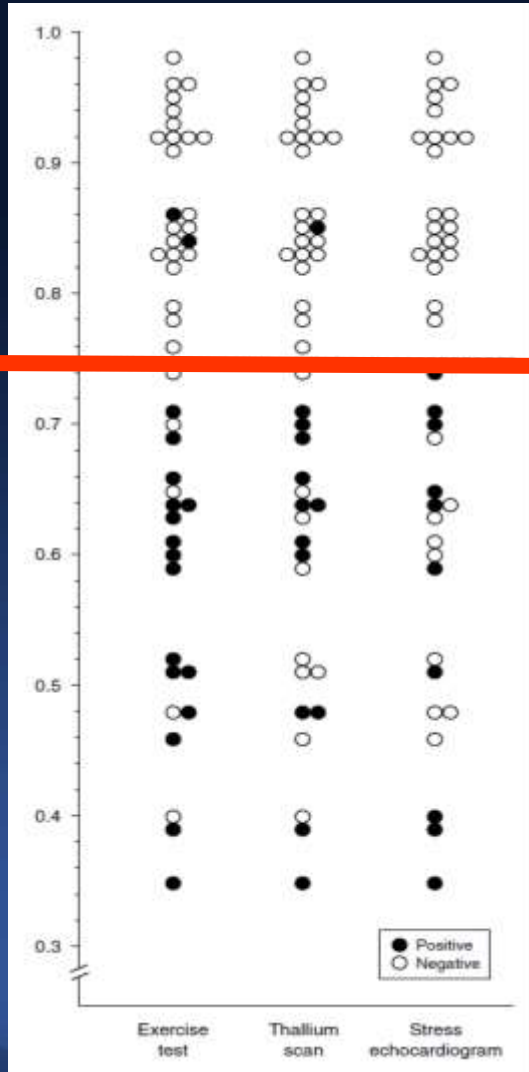




# *Angiographic DS vs. FFR*

# What Does it Mean FFR Guided ?

FFR

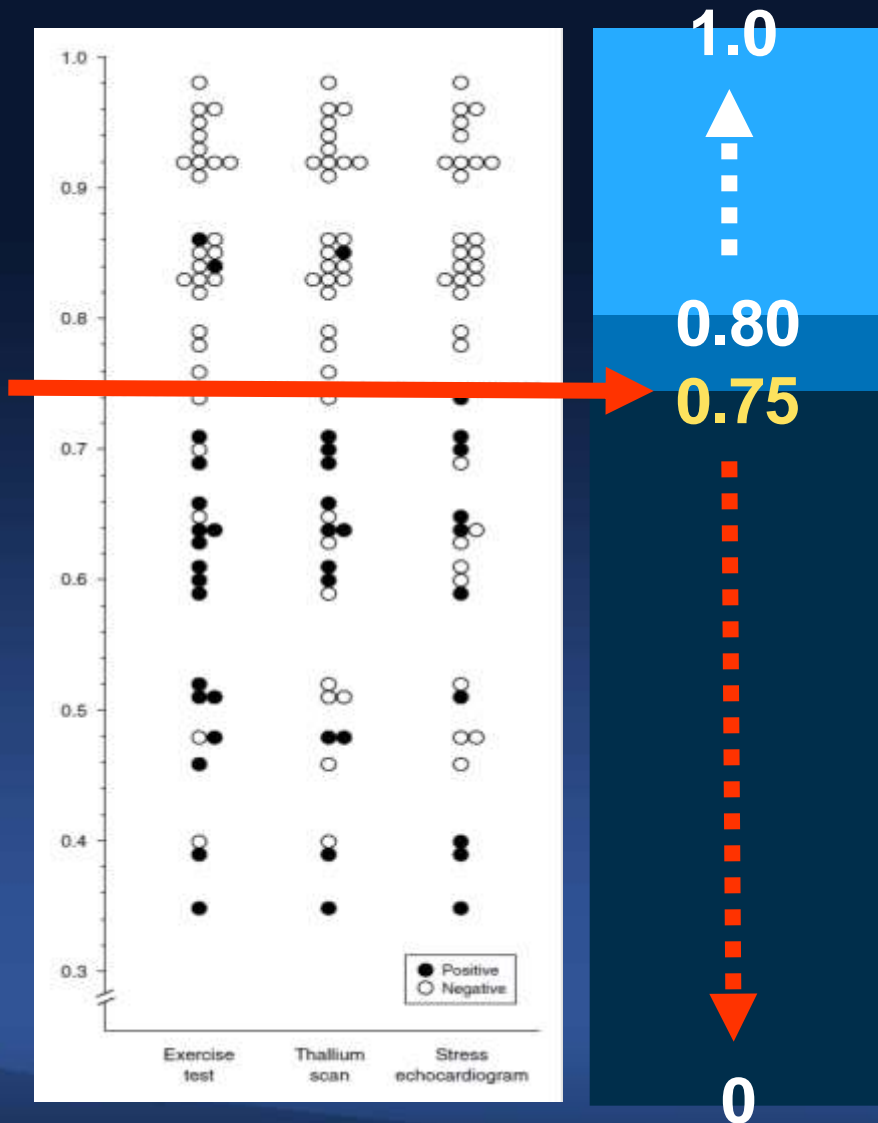


*FFR Cut-Off Value Matched With Positive Non-invasive Stress Test (n=45)*

**FFR < 0.75**

Sensitivity	88%
Specificity	100%
Positive PV	100%
Negative PV	88%
Accuracy	93%

# FFR Guided Means *Ischemia Guided* !



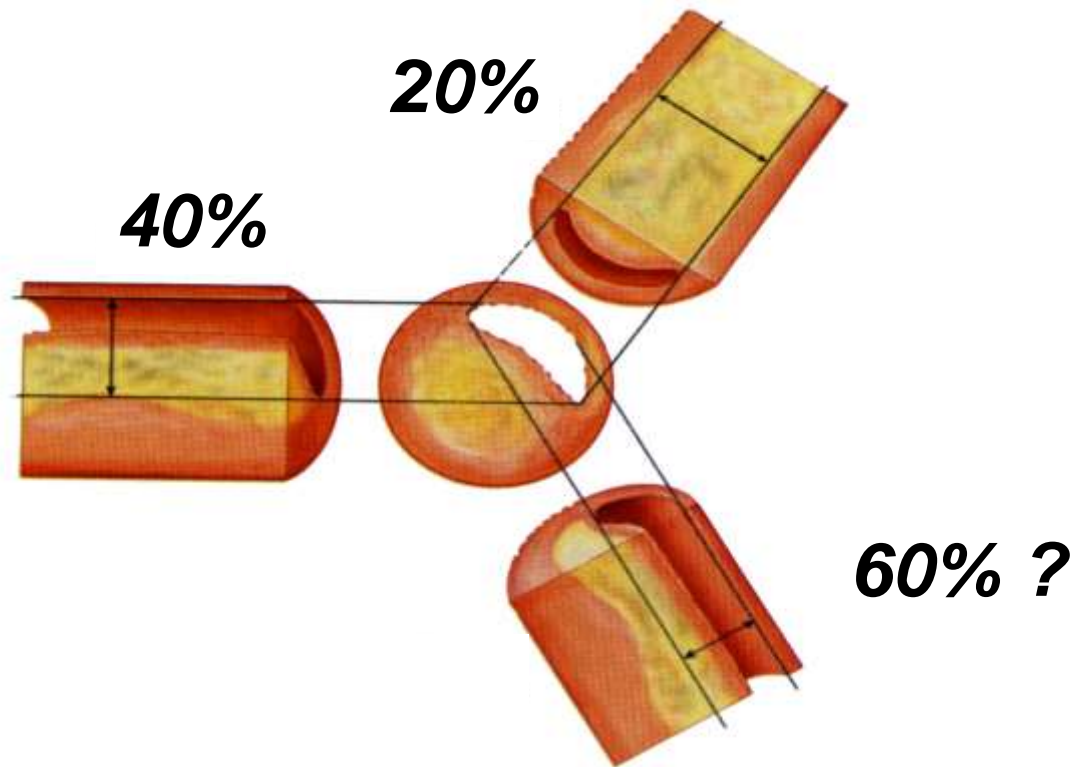
*Non-Ischemic*

*Ischemic*

***FFR-Guided Means,  
Ischemia Guided !***

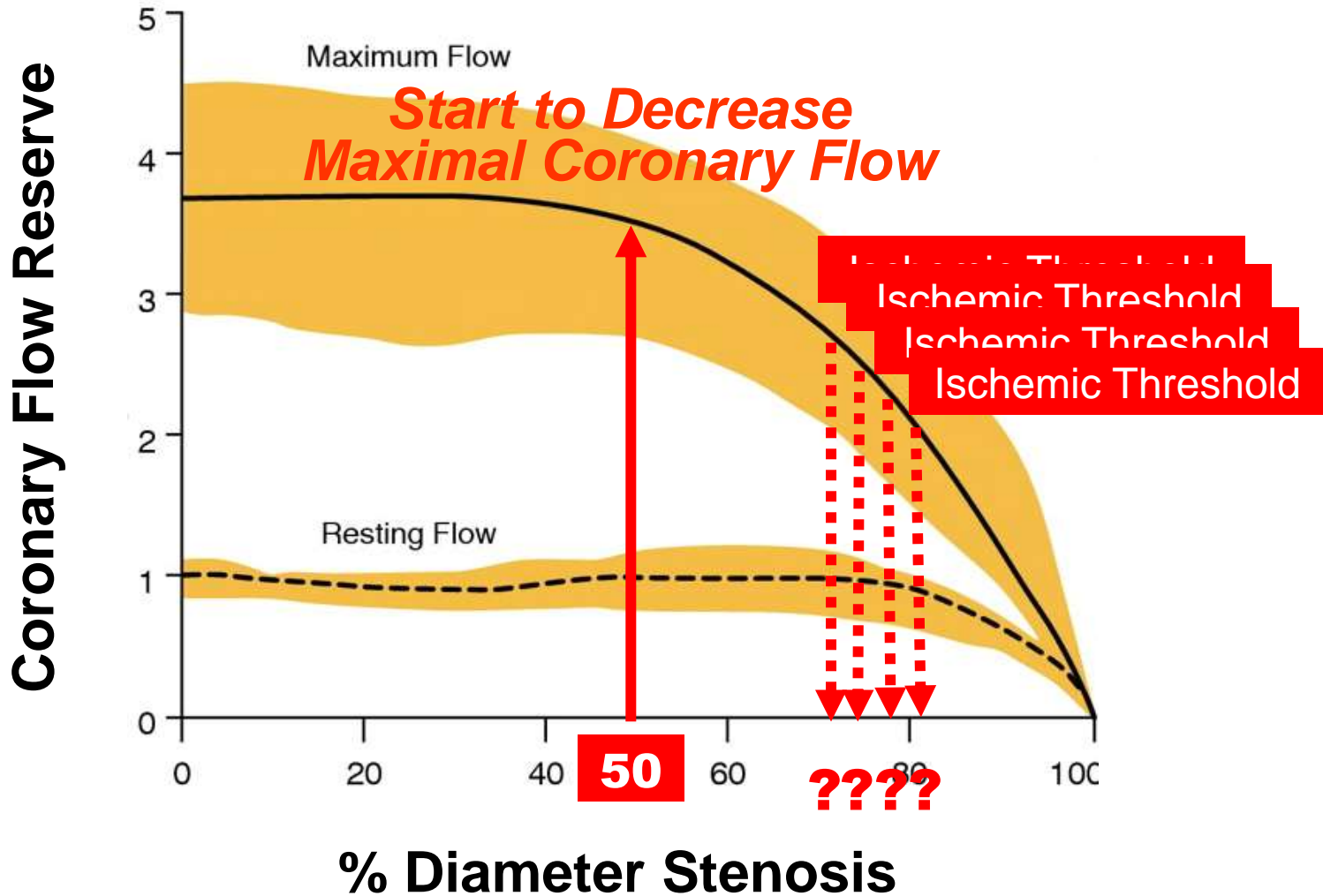
***Angio-Guided Means,  
No Ischemic threshold !  
No Clinical Relevance !***

# ***Angiographic Stenosis Is, 2-Dimensional, Single Cut Image. Different % DS at Different Angle***





# What Does It Mean 50% Diameter Stenosis ?



Gould, K. L. 1974, Animal Study

# Current Guideline of FFR

**Ia**

**ESC/EACTS**

**IIa**

**ACCF/AHA/SCAI**

Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for CardioThoracic Surgery (EACTS); European Association for Percutaneous Cardiovascular Interventions (EAPCI), Wijns W et al. Guidelines on myocardial revascularization. Eur Heart J. 2010 Oct;31(20):2501-55. Levine GN, et al. 2011 ACCF/AHA/SCAI Guideline for PCI: Executive Summary. Circulation 2011;124:2574-2609

# Current Guideline of FFR

Recommendations	Class	Level
FFR is recommended to identify hemodynamically relevant coronary lesion(s) when evidence of ischemia is not available.	<b>I</b>	<b>A</b>
Revascularization of stenosis with FFR <0.80 is recommended in patients with angina symptoms or a positive stress test.	<b>I</b>	<b>B</b>
FFR-guided PCI in patients with multi-vessel disease.	<b>Ila</b>	<b>B</b>
Revascularization of an angiographically intermediate stenosis without related ischemia or without FFR <0.80 is not recommended.	<b>III</b>	<b>B</b>

Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for CardioThoracic Surgery (EACTS); European Association for Percutaneous Cardiovascular Interventions (EAPCI), Wijns W et al. Guidelines on myocardial revascularization. Eur Heart J. 2010 Oct;31(20):2501-55. Eur Heart J 2014;35:2541-2619, Levine GN, et al. 2011 ACCF/AHA/SCAI Guideline for PCI: Executive Summary. Circulation 2011;124:2574-2609

# To Treat or Not To Treat ?

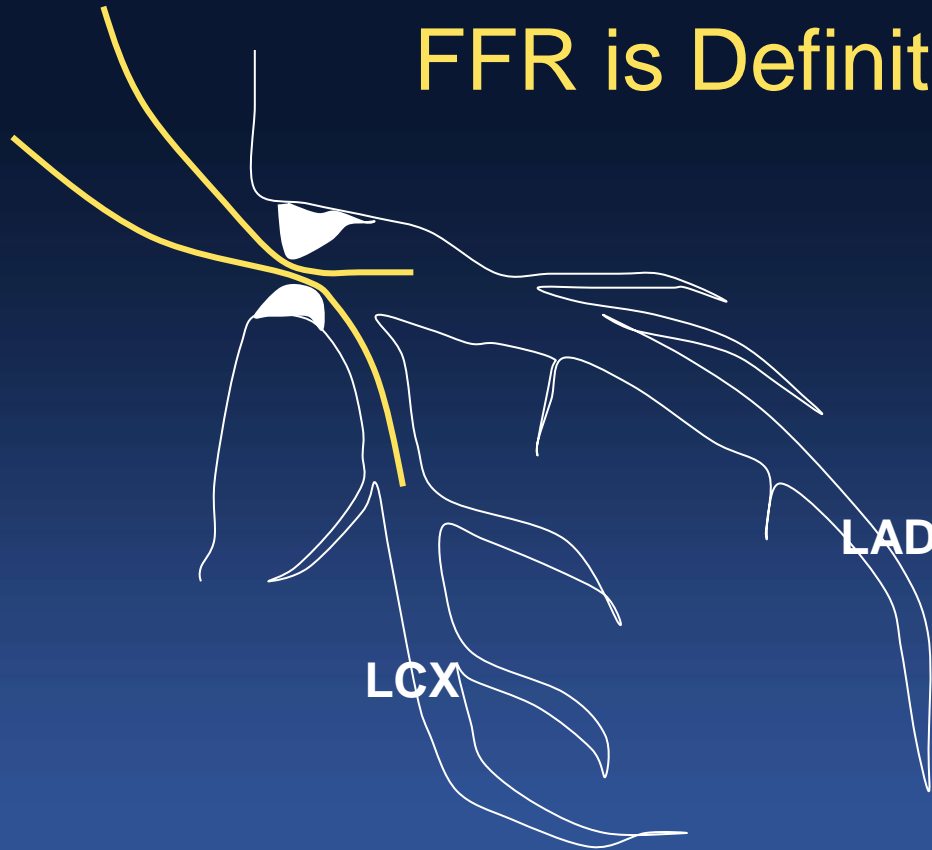
1. Don't Believe Your Eyes ! Angiography Is Not Always Enough.
2. FFR Guided Decision Making Is Standard.

# ***How do I Implement FFR for LM PCI ?***



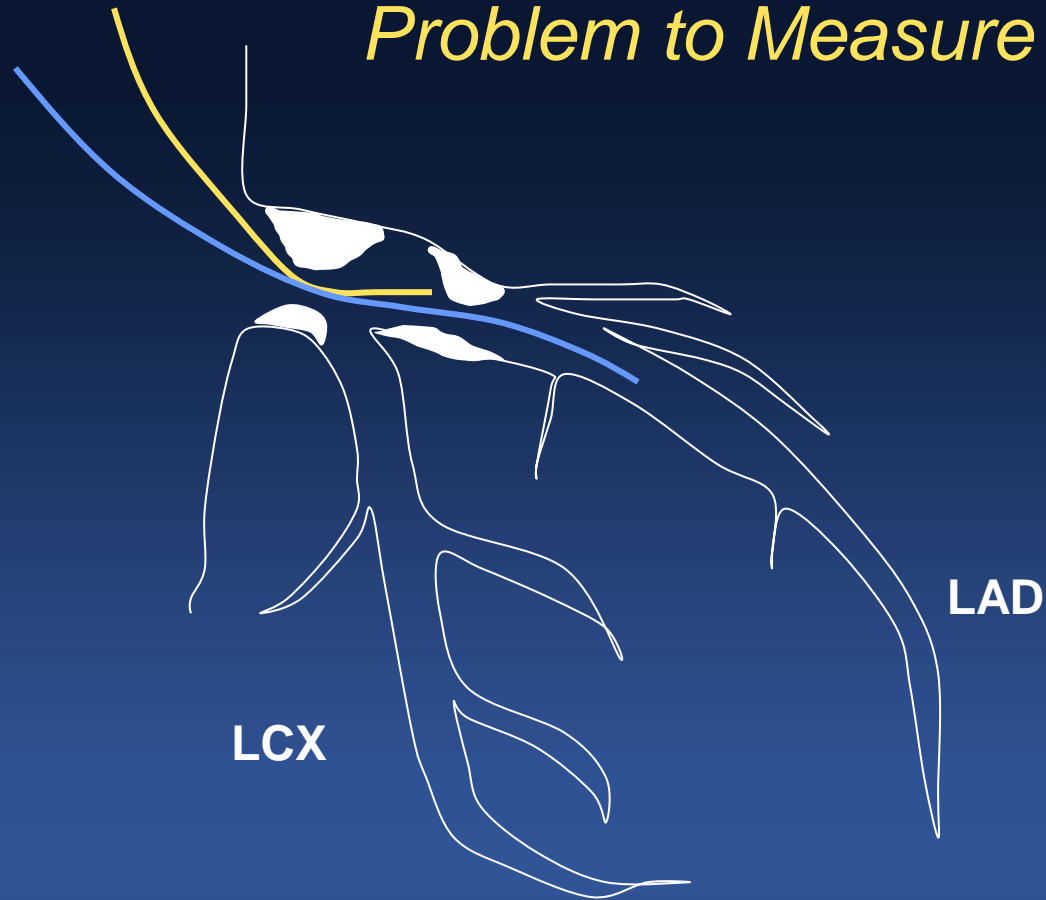
# LM Ostial and Shaft Disease

FFR is Definitely Helpful.

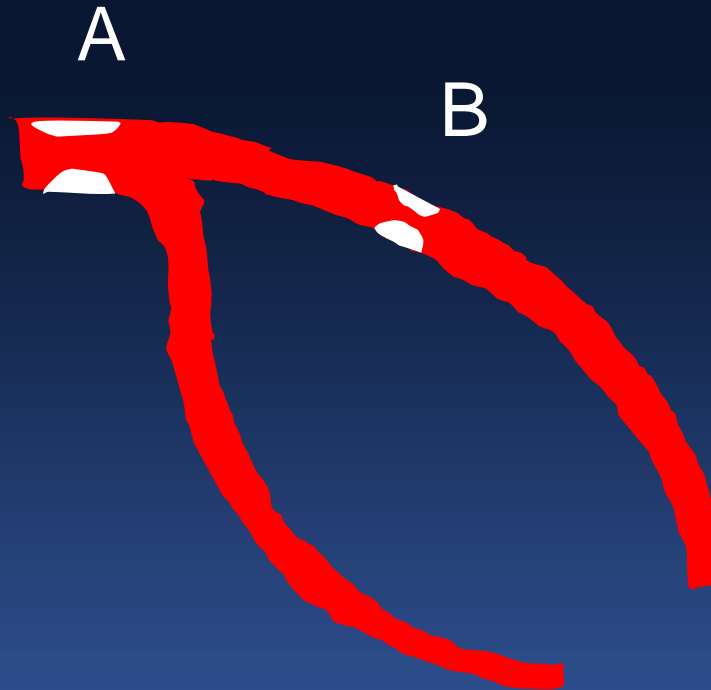


# LM Bifurcation Disease

*Problem to Measure FFR ?*

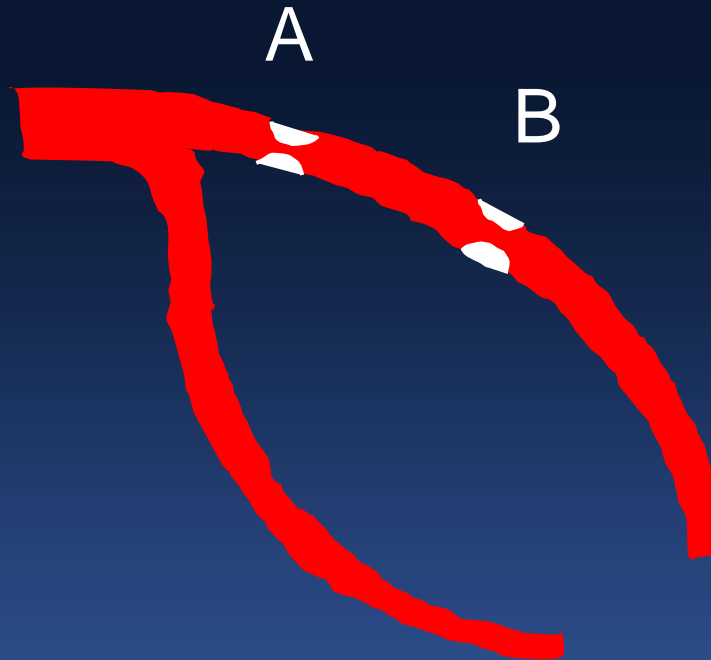


# ***Theoretical* Tandem Lesion with Large Side Branch**



***How Do I Implement the FFR ?***

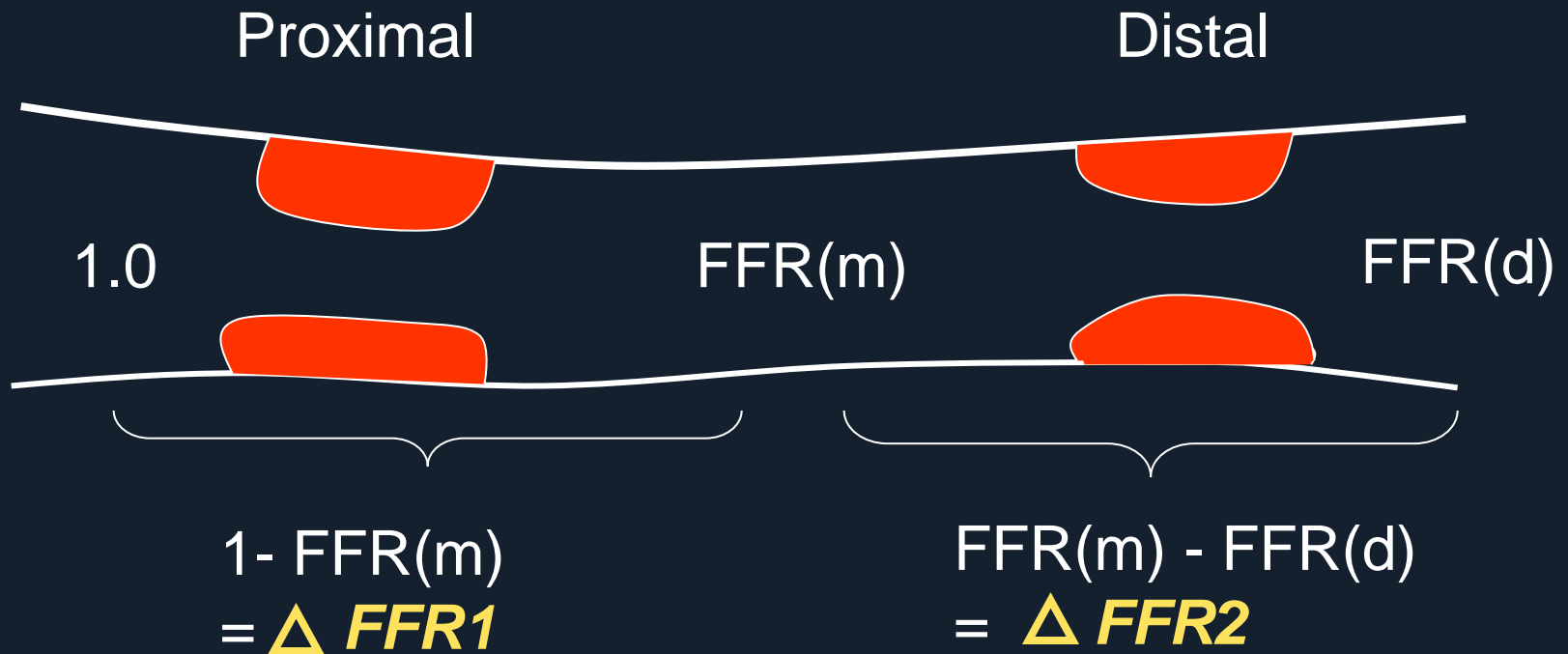
# Tandem lesion in Epicardial Artery



*How Can We Select  
the First Target Lesion ?*

# **“Rule of Big Delta”**

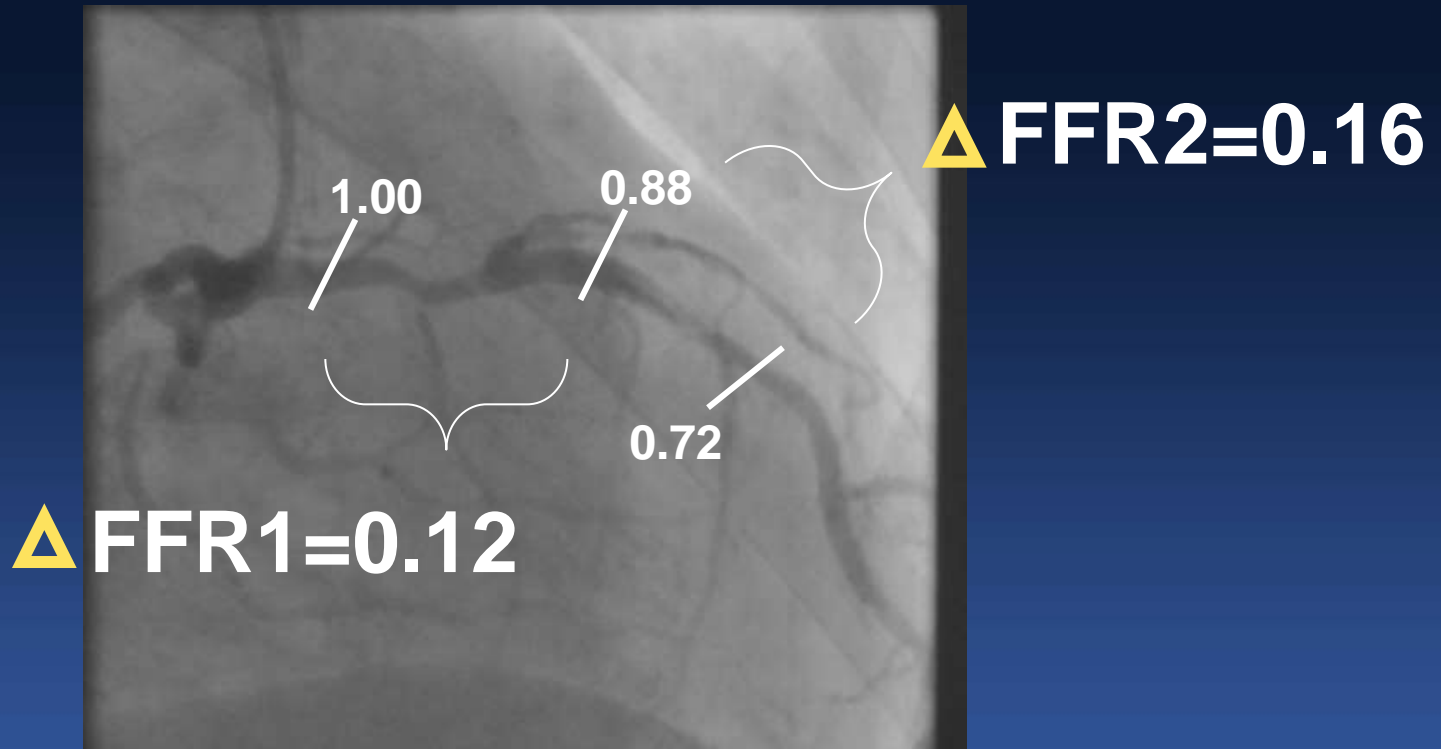
## **The Bigger FFR Difference Is The Tighter Stenosis !**





# *“Rule of Big Delta”*

*The Bigger FFR Difference Is  
The Tighter Stenosis !*



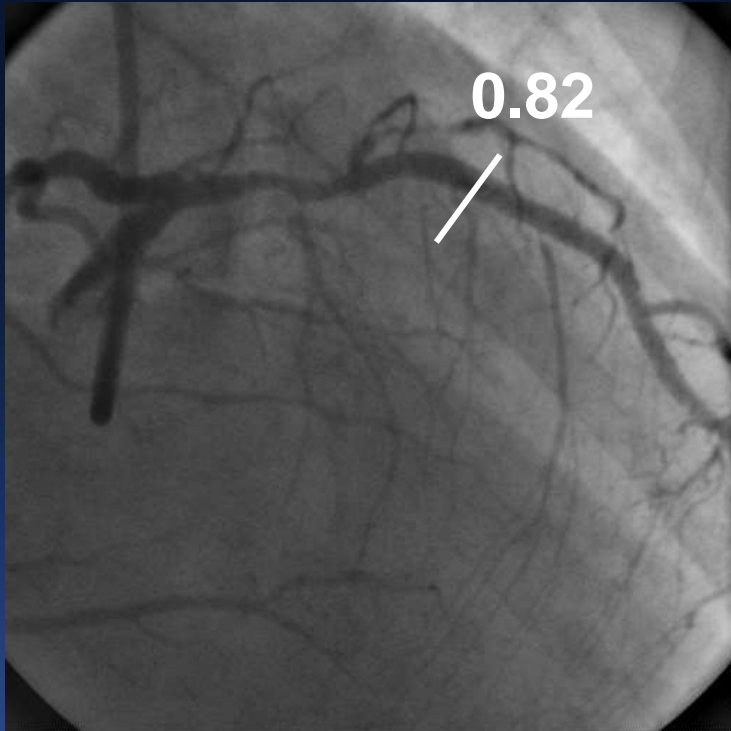
$\Delta FFR1 < \Delta FFR2$

# Treat *Distal Tighter Stenosis First !*



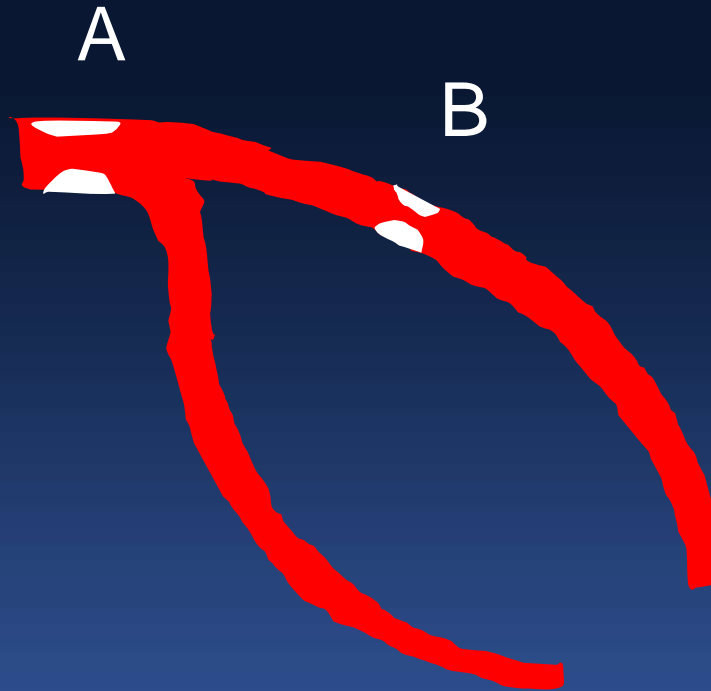
**Xience V 3.0x28**

# FFR again : 0.82



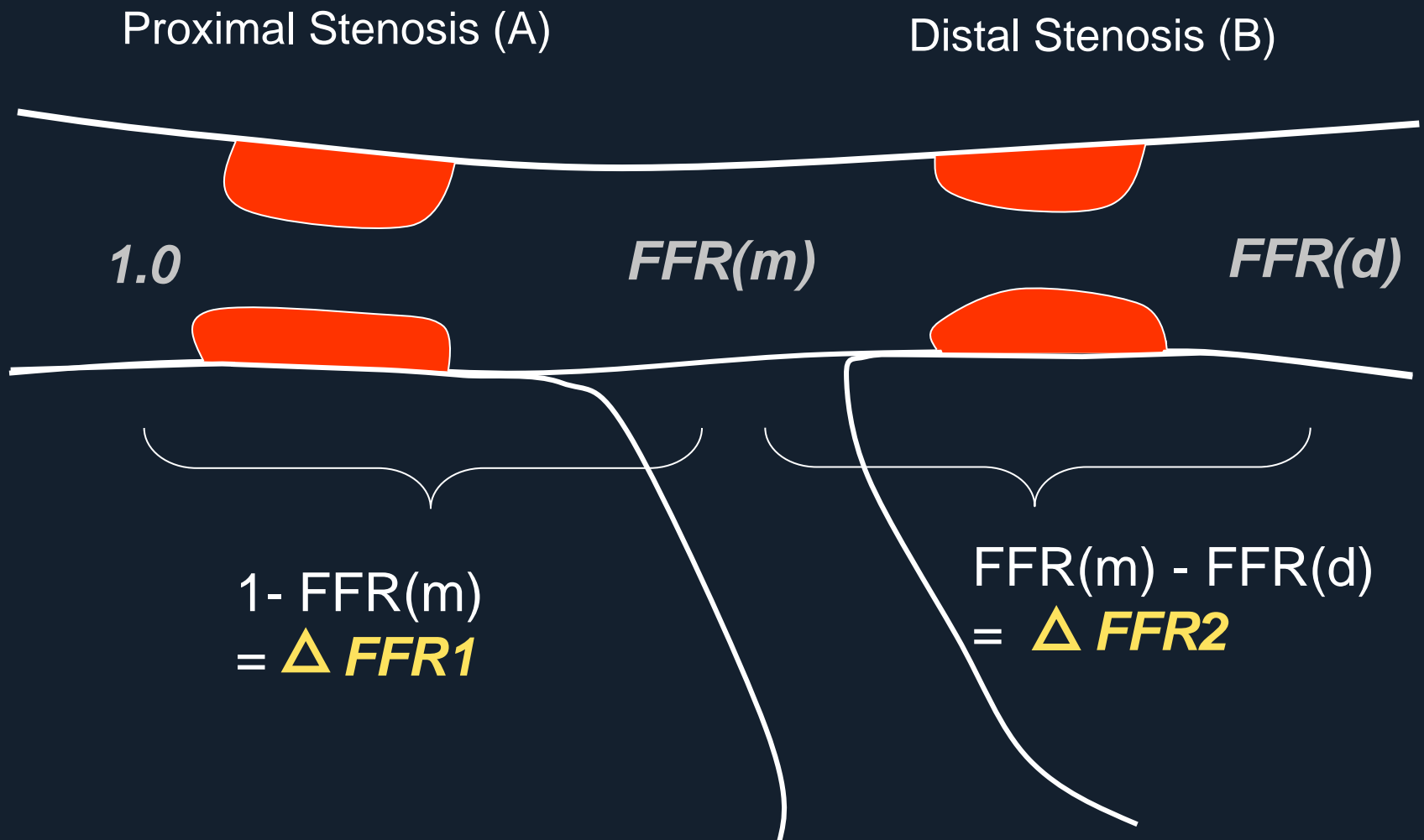
***Avoid Unnecessary Stent !***

# ***Theoretical* Tandem Lesion with Large Side Branch**



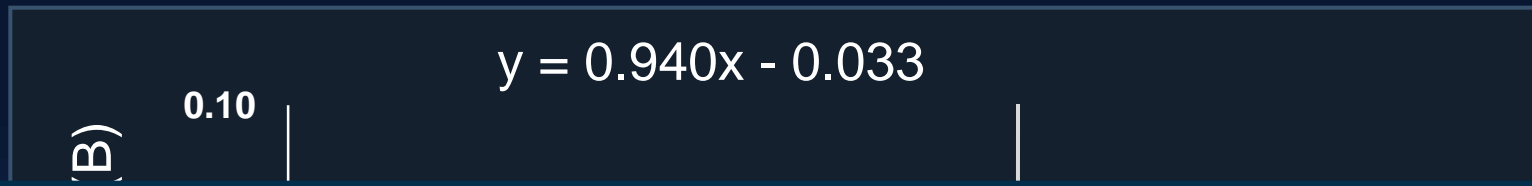
***Does “Rule of Big Delta” Still Work ?***

# Does “Rule of Big Delta” Still Work ? In Tandem Lesion with Large Side Branch





# If Two Lesions Are Functionally Same, *Measured $\Delta FFR$ difference (A-B) Is Usually Underestimated.*



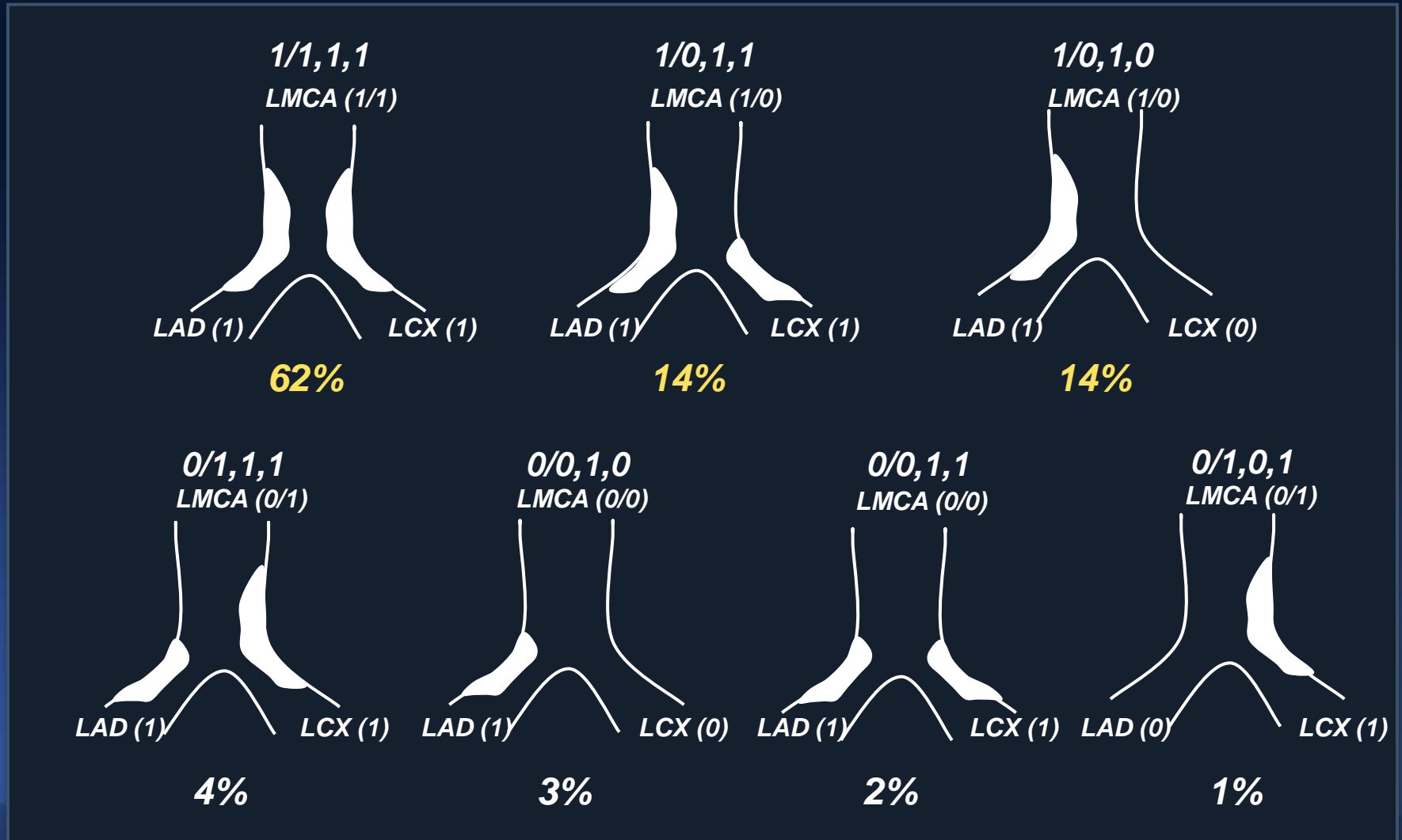
*The Difference Is Too Small (0.01-0.02),  
“Rule of Big Delta” Still Works in Real Practice !*



# LM Bifurcation Disease

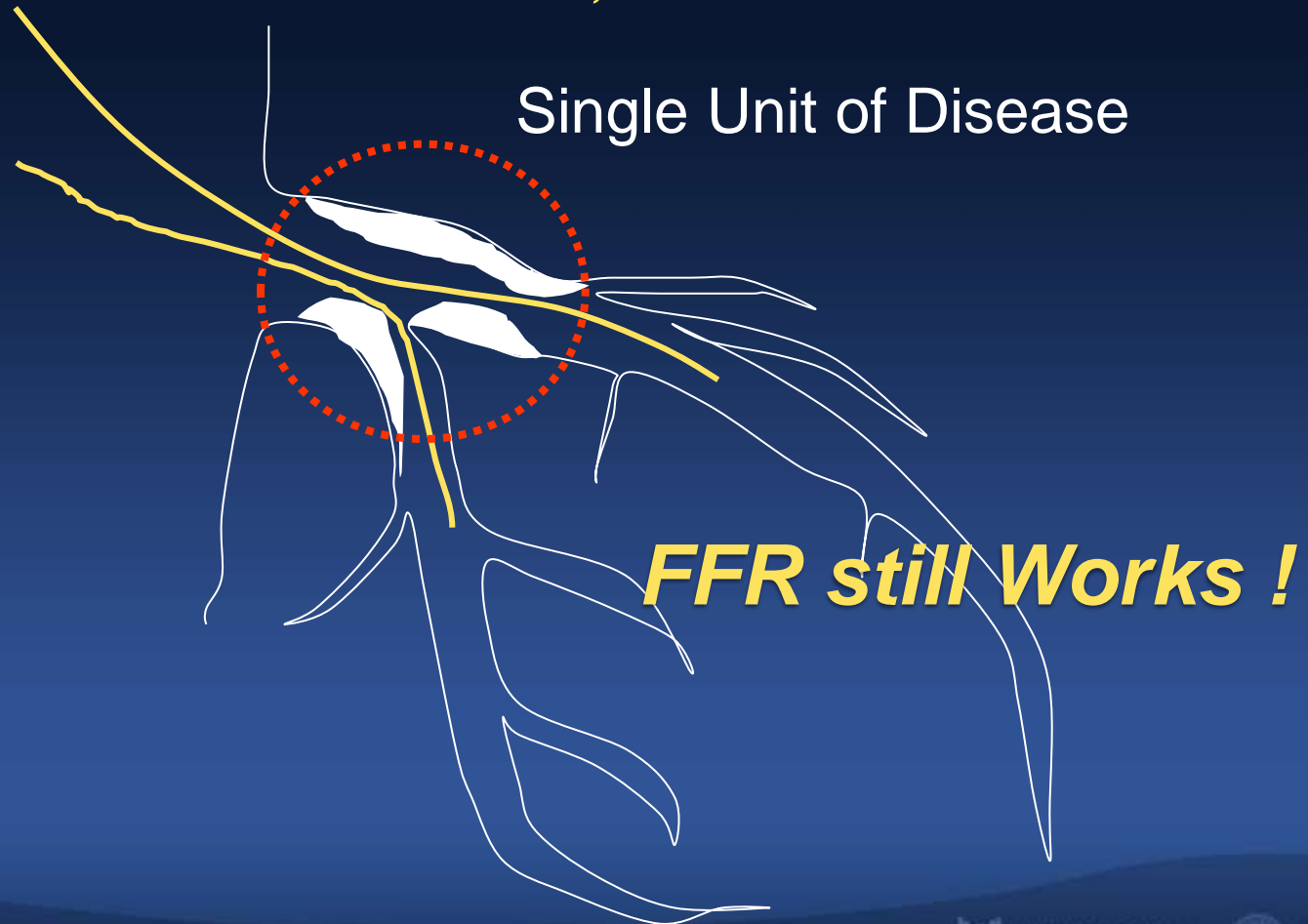
***In Fact,  
Left Main Stem Stenoses are  
Rarely Isolated !***

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



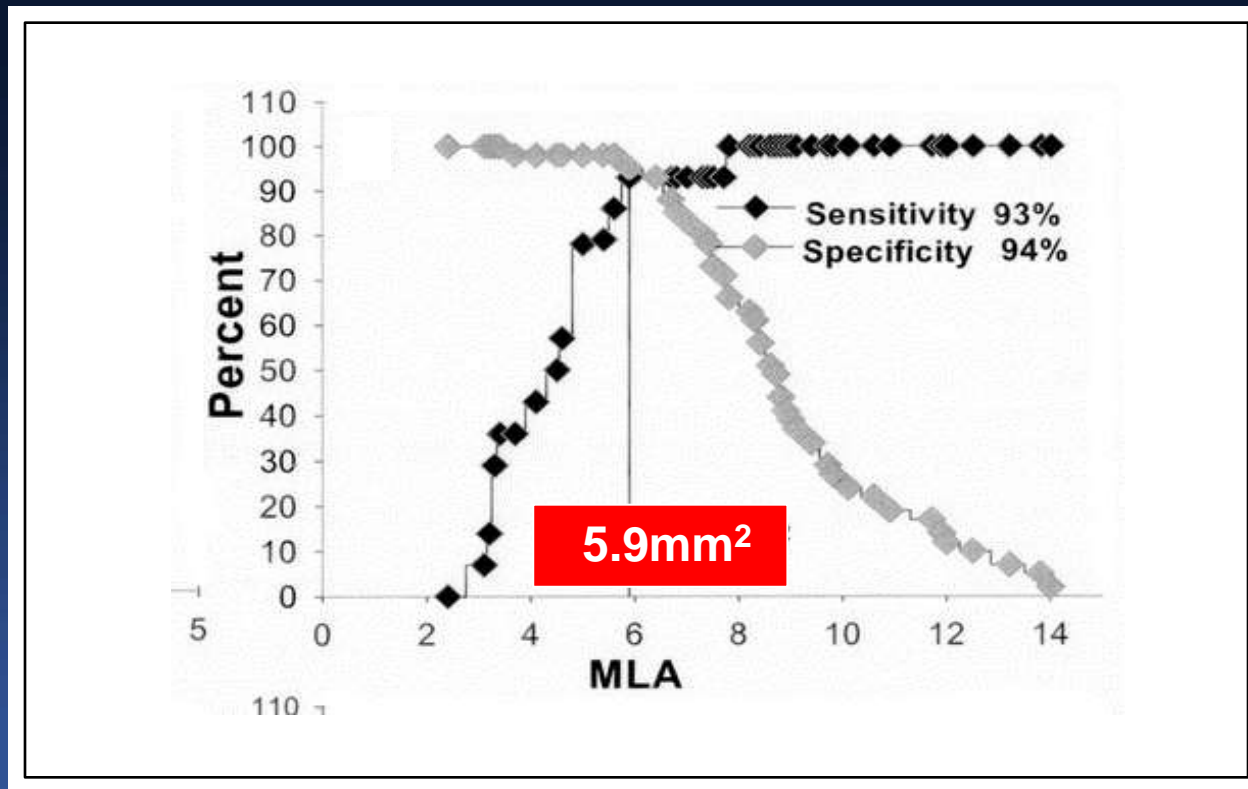
# LM Bifurcation Disease

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

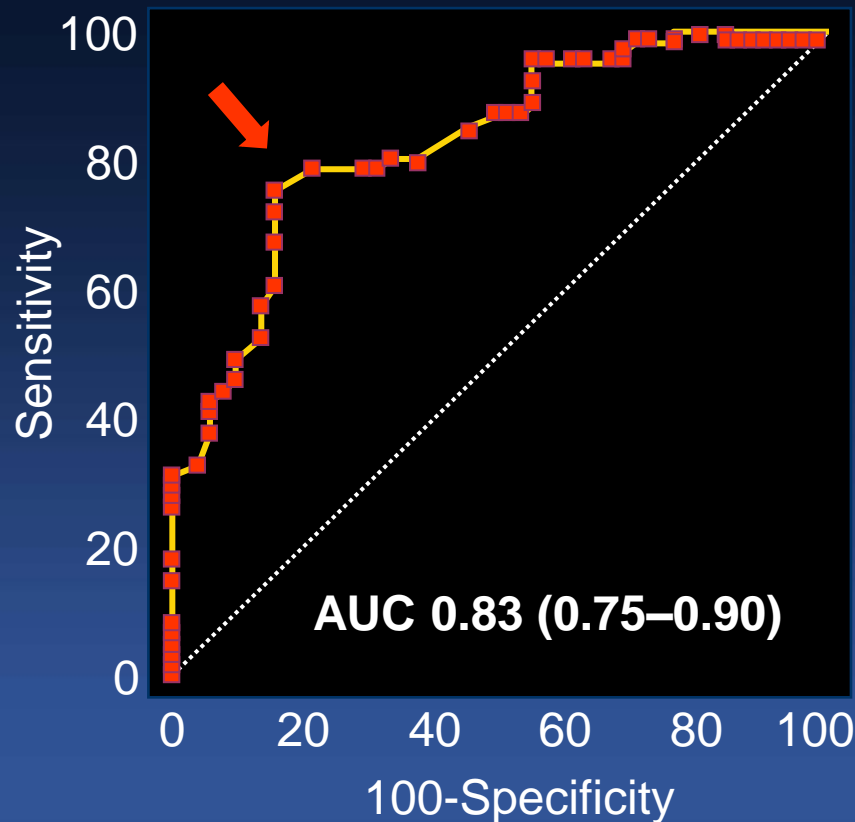


# ***Can IVUS MLA Predict Functional Significance of LM Stenosis ?***

# ***LM, Ischemic Threshold of IVUS MLA Matched with FFR <0.75 (n=55 LM Disease)***



# **New LM, Ischemic Threshold of IVUS MLA Matched with FFR <0.80** (n=112, Os and Shaft LM Disease)

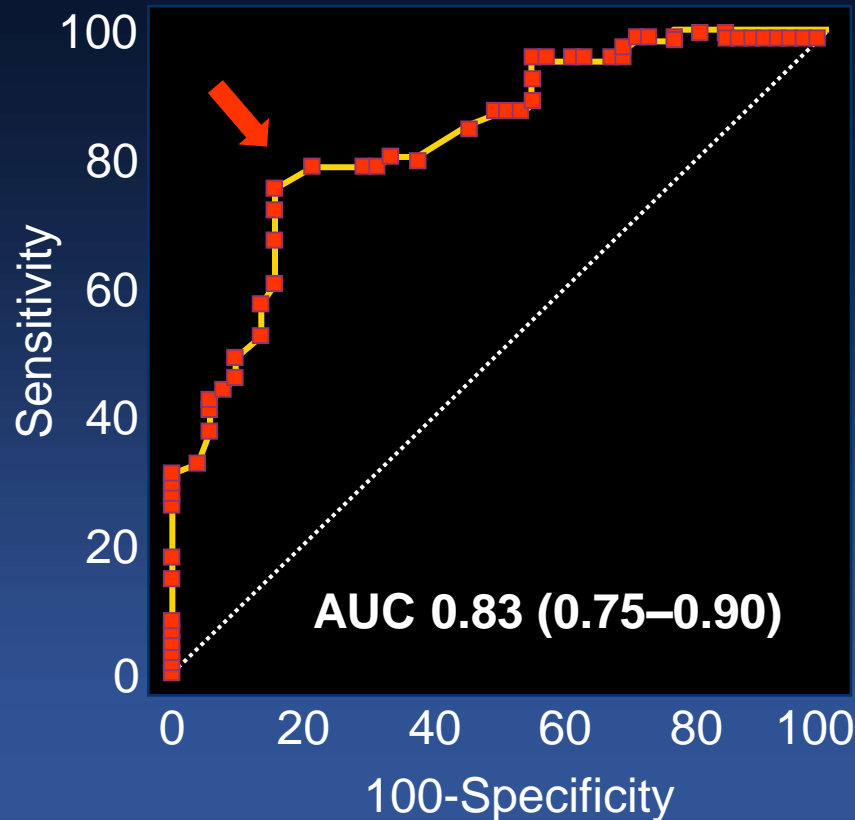


**Cut-off = 4.5 mm<sup>2</sup>**

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

# Can IVUS MLA (4.5 mm<sup>2</sup>) Predict Functional Significance of LM Stenosis ?

## Yes !



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

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



# Park's Data (n=112)

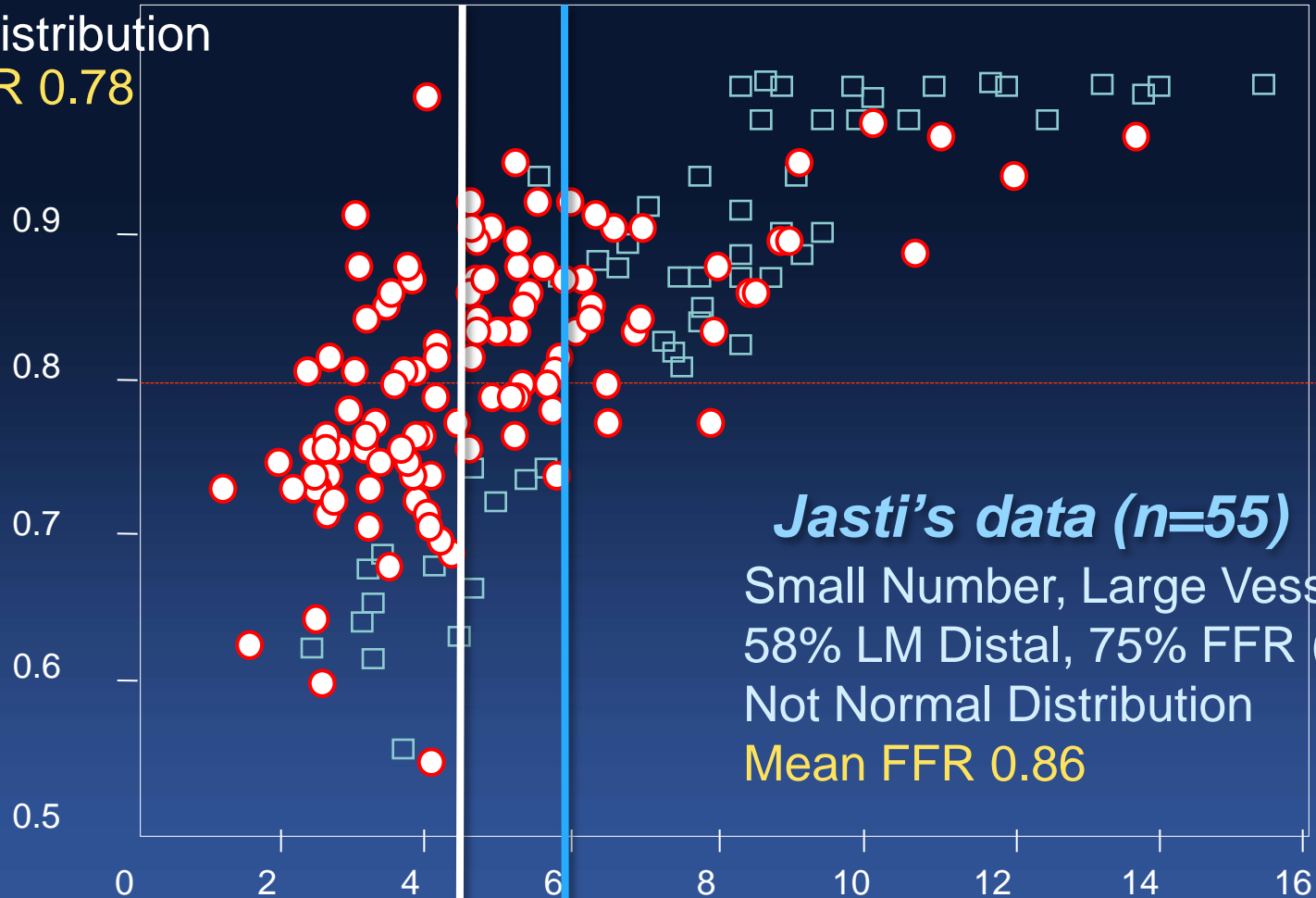
100%, Ostial/Shaft Lesions

More Positive FFR

Normal Distribution

mean FFR 0.78

FFR



# Jasti's data (n=55)

Small Number, Large Vessels

58% LM Distal, 75% FFR (-),

Not Normal Distribution

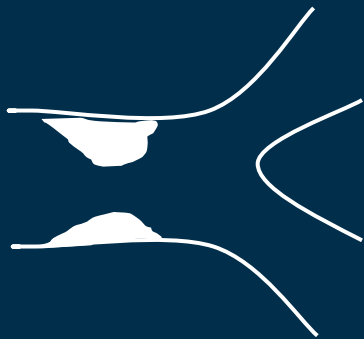
Mean FFR 0.86

4.5 mm<sup>2</sup> 6.0 mm<sup>2</sup>

MLA (mm<sup>2</sup>)

# How do I Implement ?

## Ostial and Shaft LM Disease



**< 4.5 mm<sup>2</sup>**  
**Positive FFR**

## Bifurcation with Down Stream Disease

**4.5~6.0 mm<sup>2</sup>**  
**Consider FFR !**

**> 6.0 mm<sup>2</sup>**  
**Negative FFR**

# To Treat or Not To Treat ?

1. Don't Believe Your Eyes ! Angiography Is Not Always Enough.
2. FFR Guided Decision Making Is Standard.
3. LM IVUS MLA Can Predict Functional Significance of LM Stenosis.

# Only 2 Fundamental Questions,

1. To Treat or Not To Treat ?
2. How to Optimize ?

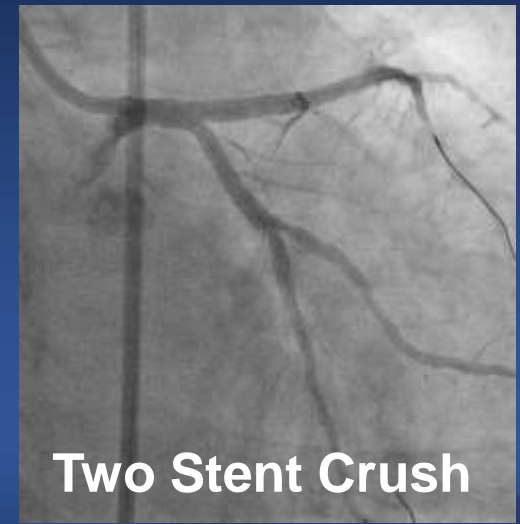
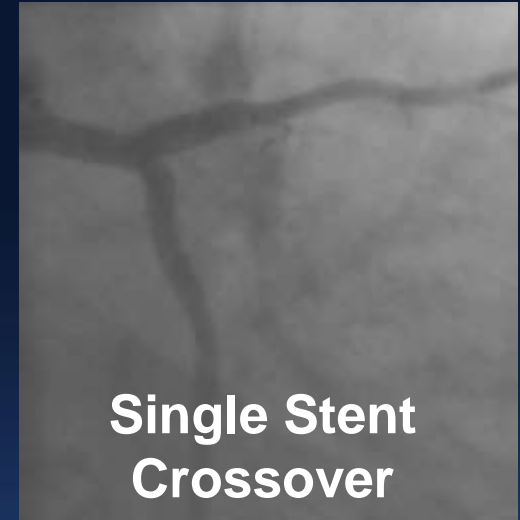
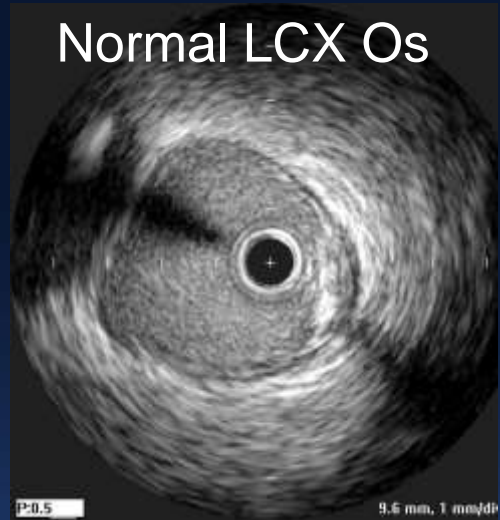
# *Treatment Strategy*

## *1 Stent or 2 Stents ?*

# LM Bifurcation PCI

<b>1 Stent</b>	<b><i>Normal or Diminutive LCX, (Medina 1.1.0., 1.0.0)</i></b> Small LCX with < 2.5 mm in diameter, Focal disease in distal LCX
<b>2 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 Diffuse disease in distal LCX

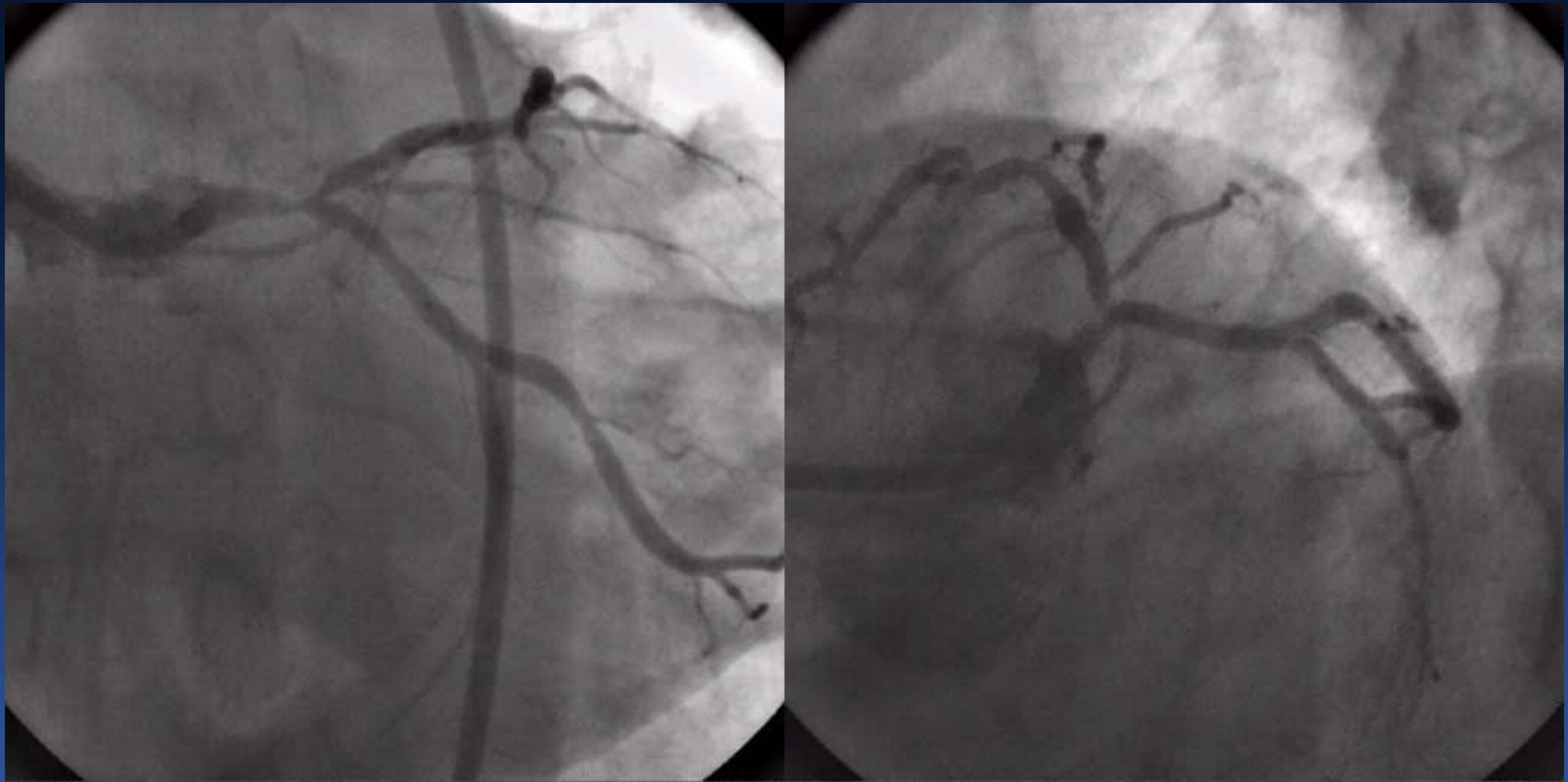
# According to LCX Disease by IVUS



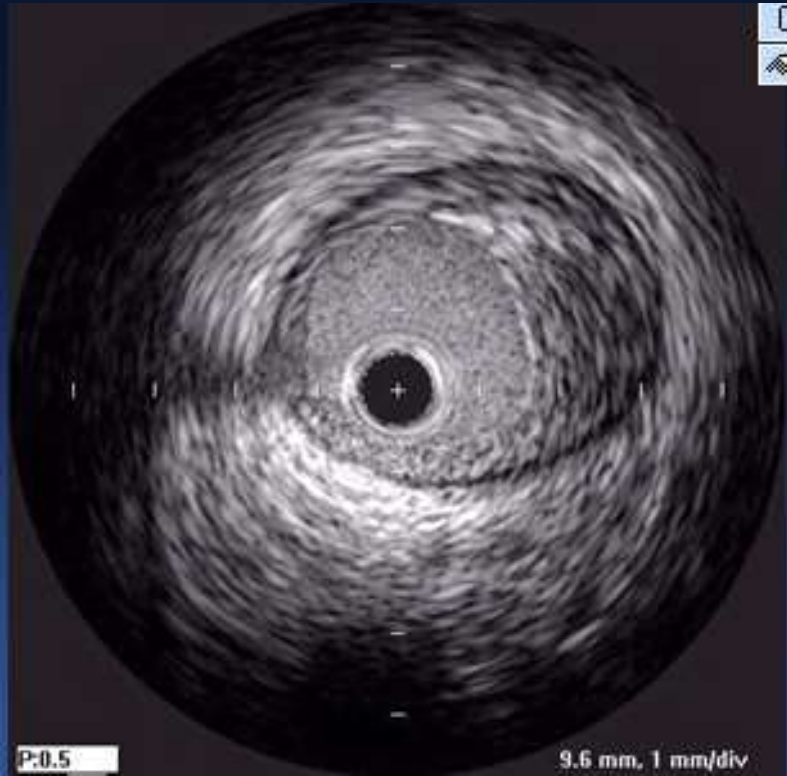
# ***1 Stent for Normal LCX***



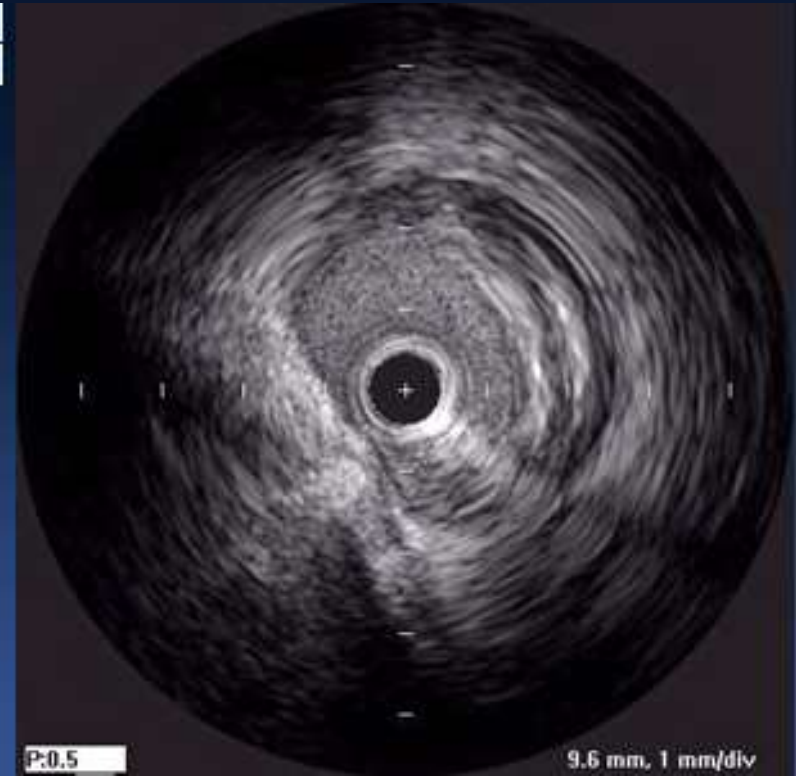
72/M, Unstable angina,



# IVUS

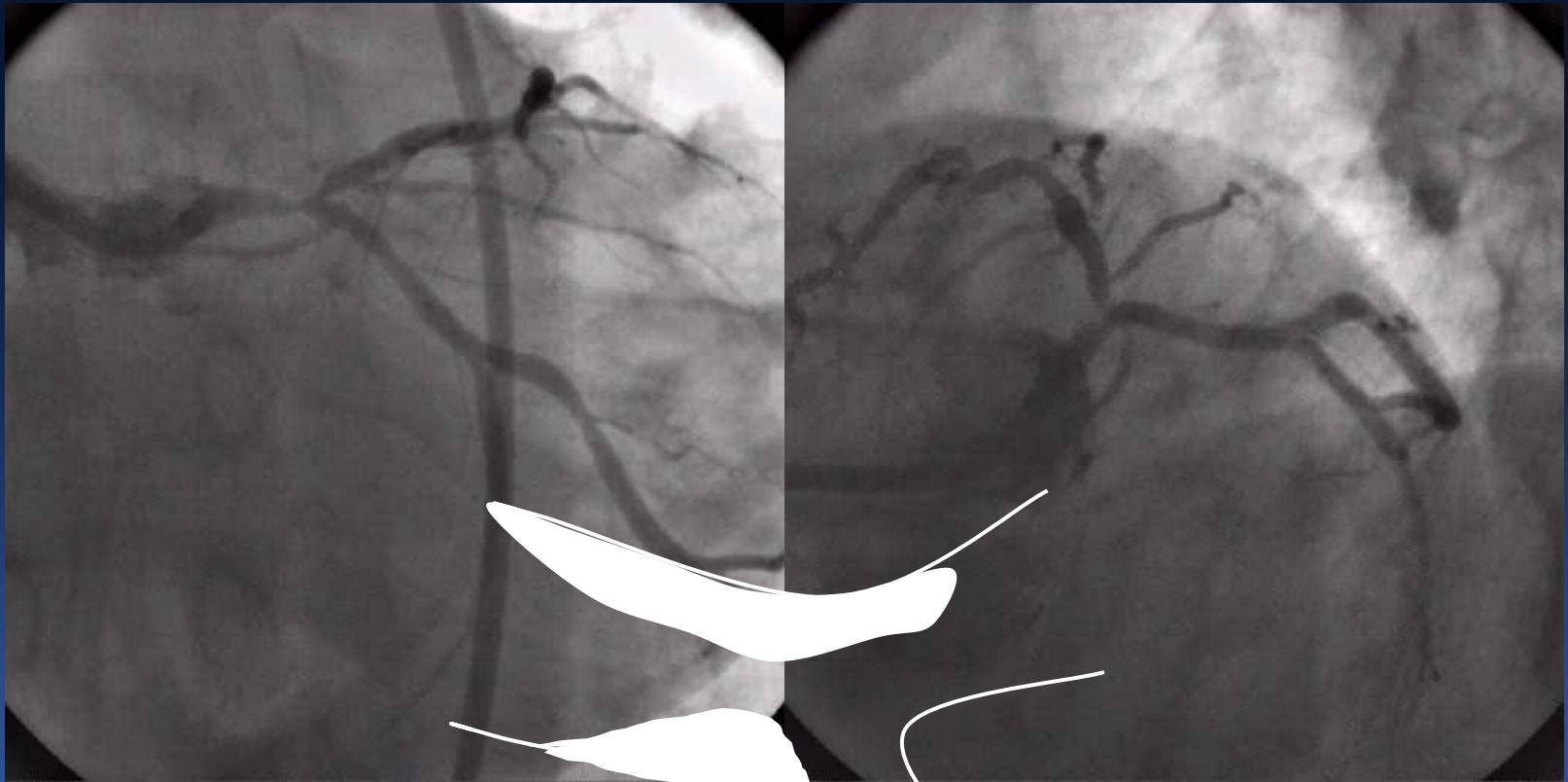


LAD Ostium

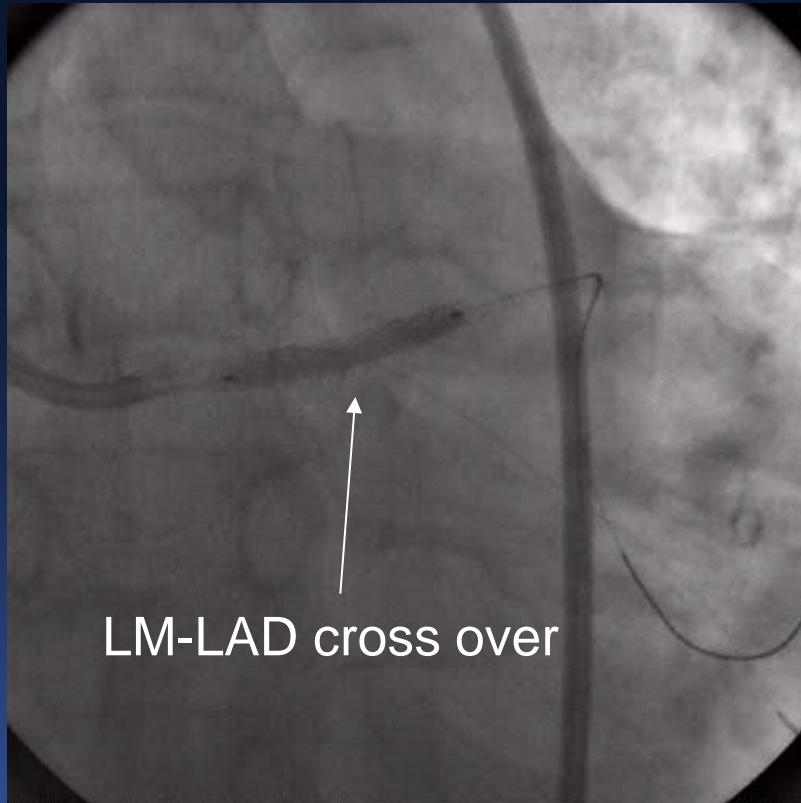


LCX Ostium  
Minimal-disease  
MLA  $5.4 \text{ mm}^2$

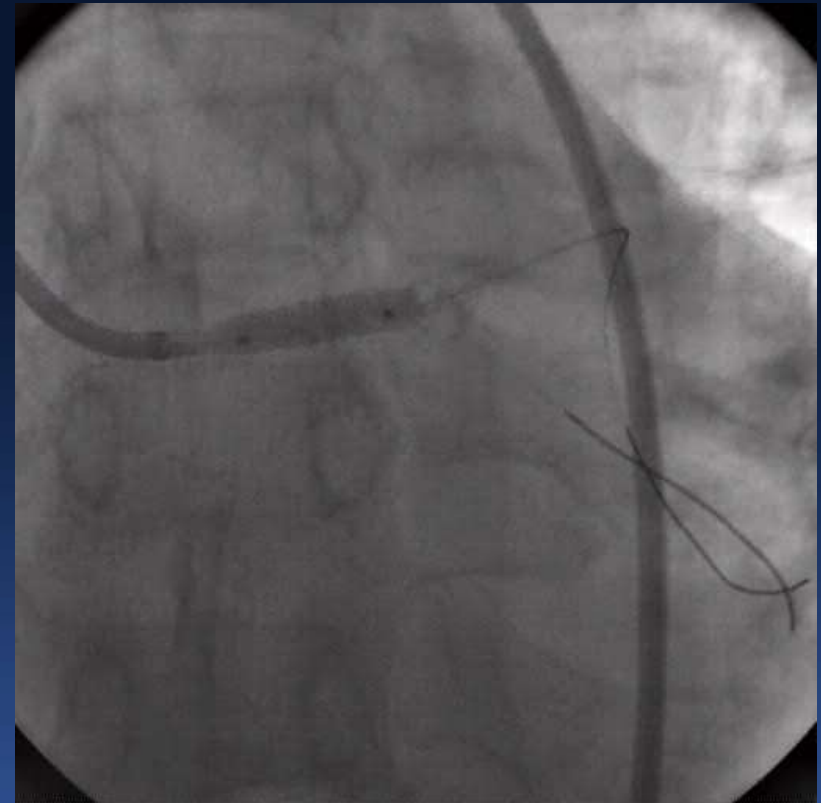
72/M, Unstable angina,



# 1 Stent

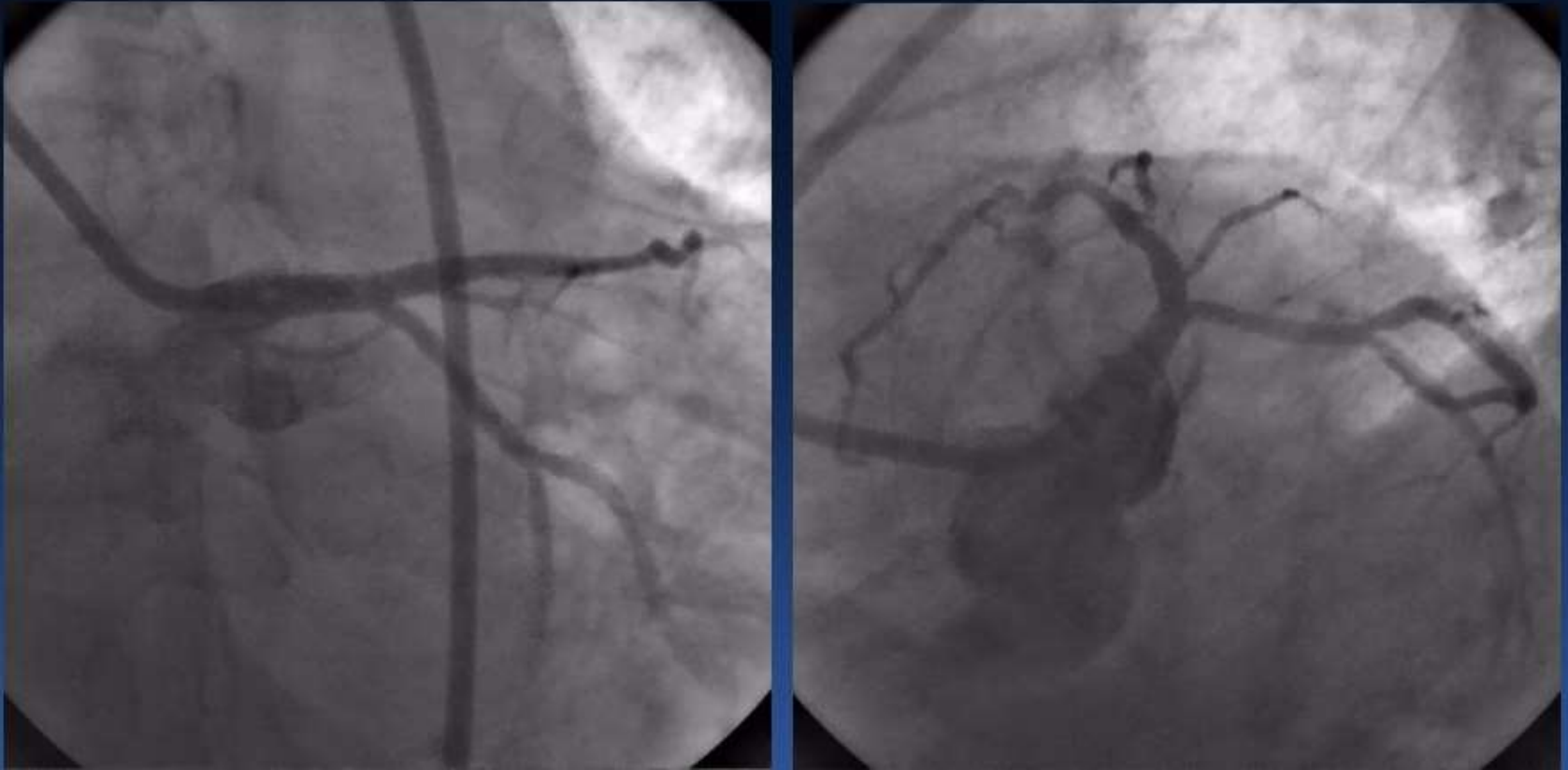


DES 3.5 × 23 mm



Additional high pressure  
Inflation with 4.0 mm  
non-compliant balloon

# Angiographic Result Is Perfect !

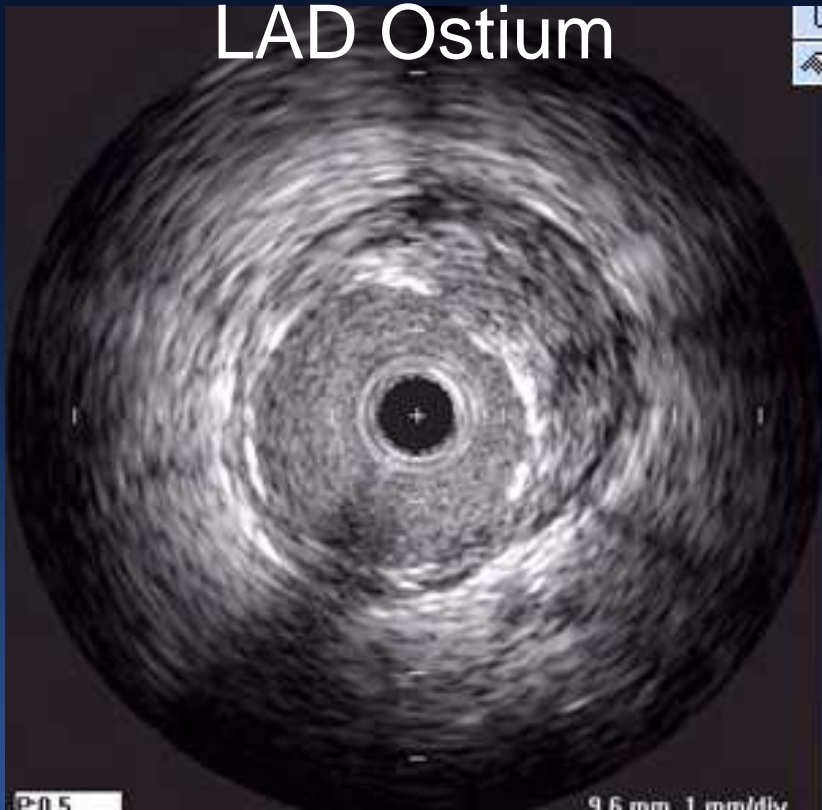


No significant compromise of LCX ostium.



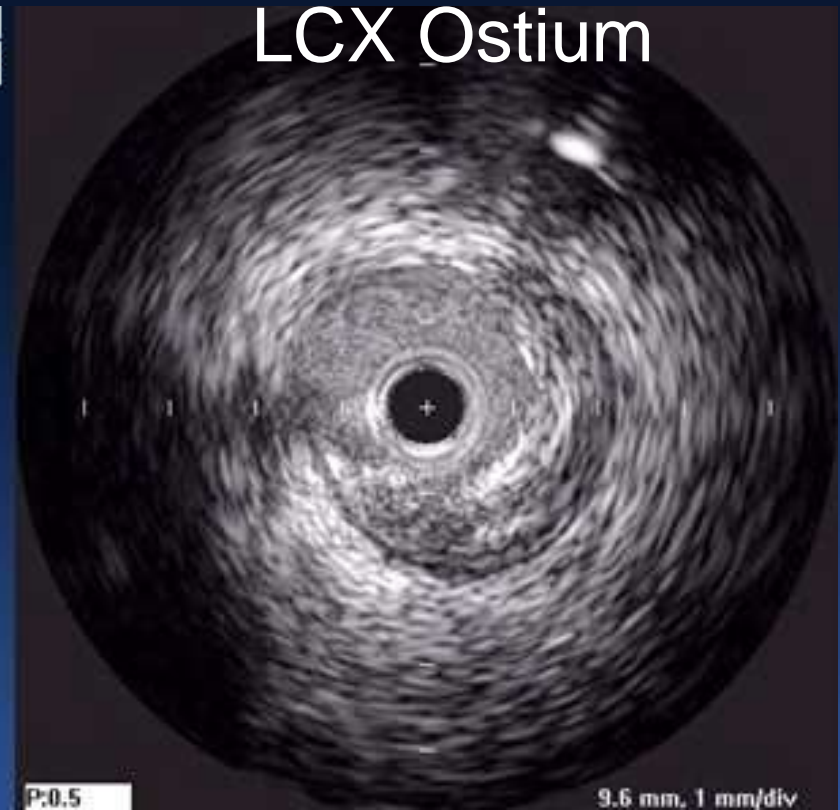
# Post stent-IVUS

LAD Ostium



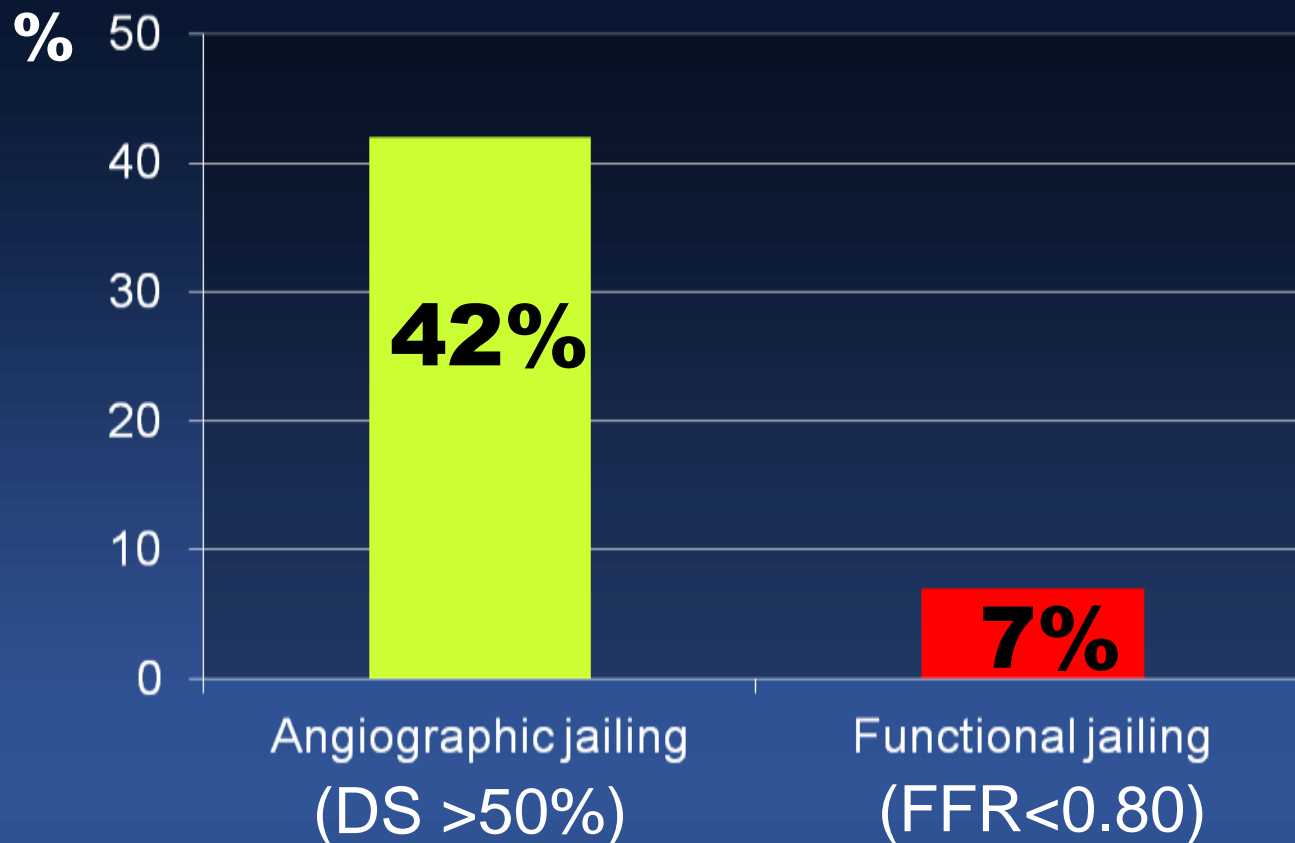
Good Stent Expansion  
Stent Area  $6.2 \text{ mm}^2$

LCX Ostium



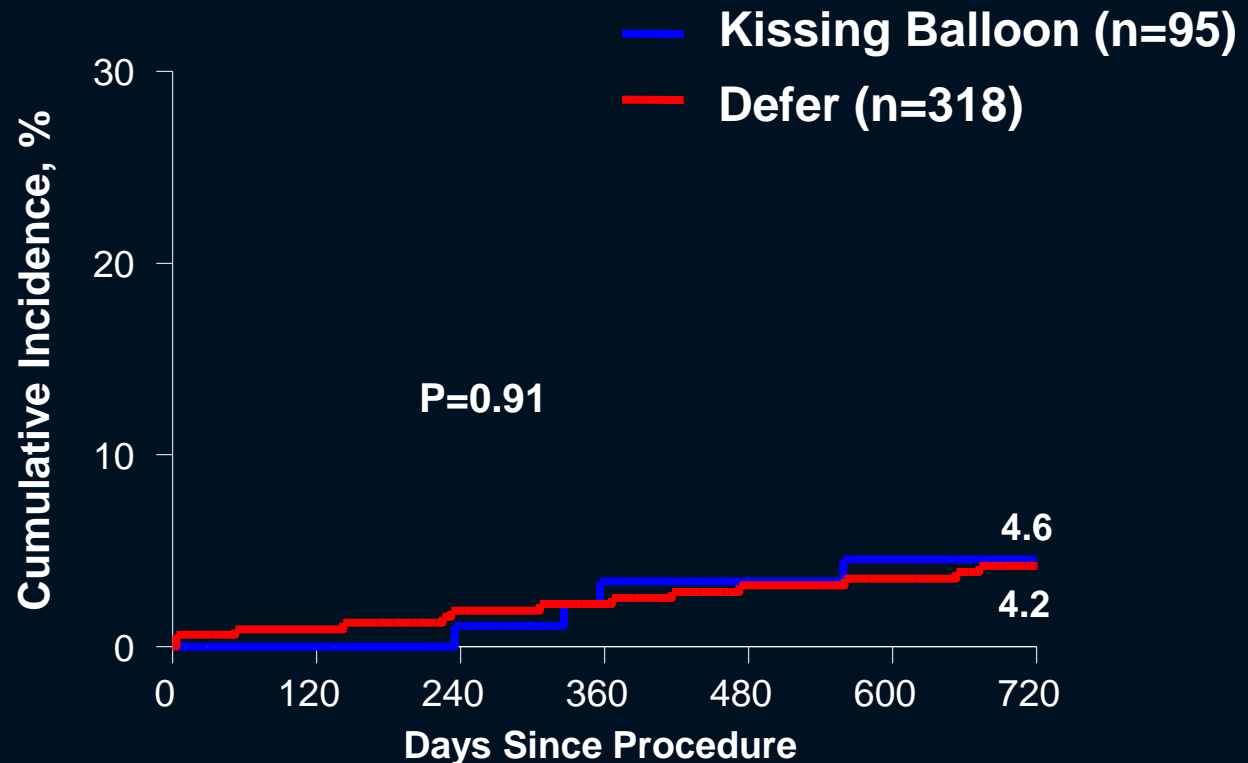
No Carina Shift  
MLA  $4.7 \text{ mm}^2$

# *After Stent Crossover Normal Looking LCX, Functionally Significant LCX Jailing Is Only 7%*



# ***Jailing LCX Defer Is Safe and Good !***

## **Death or MI at 2 Years**



**No. at Risk**

FKB	95	85	80
No-FKB	318	300	278



# ***2 Stents for True Bifurcation***

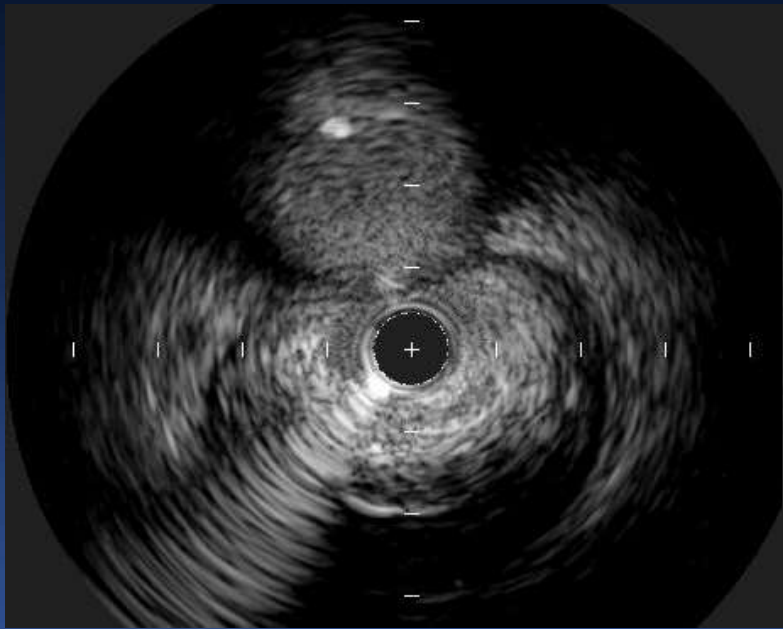
70/M, Unstable angina

*True Bifurcation Lesion (Medina 1,1,1)*

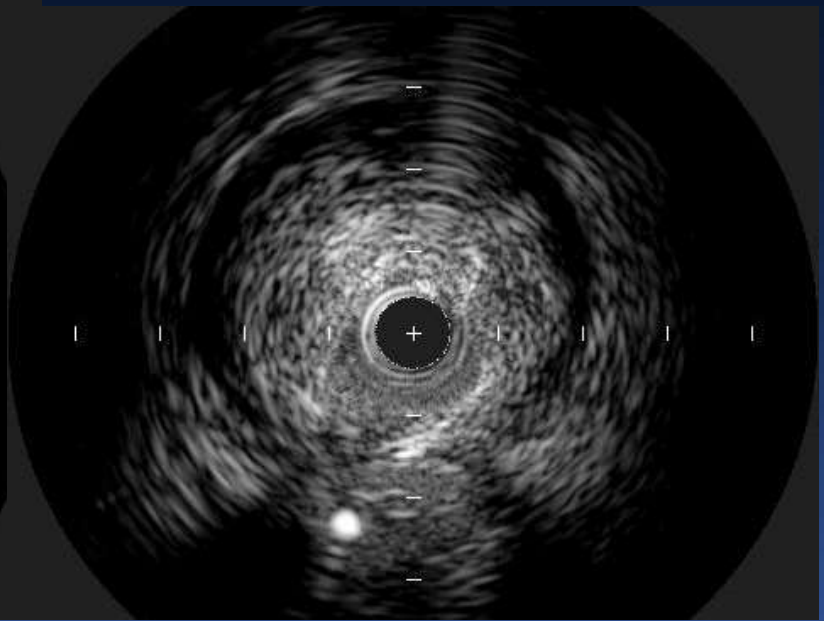


# Separate Pull Back IVUS

True Bifurcation Disease (Medina 1,1,1)

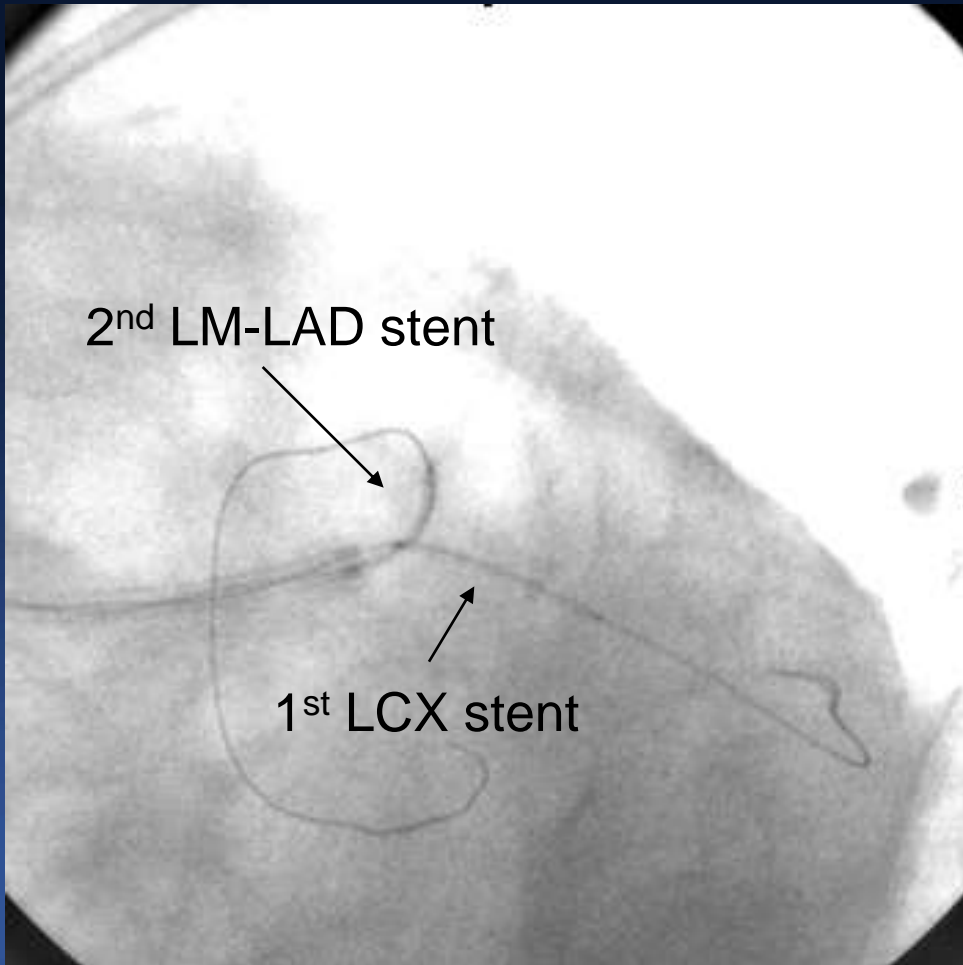


LAD Ostium



LCX Ostium

# Mini-Crushing !

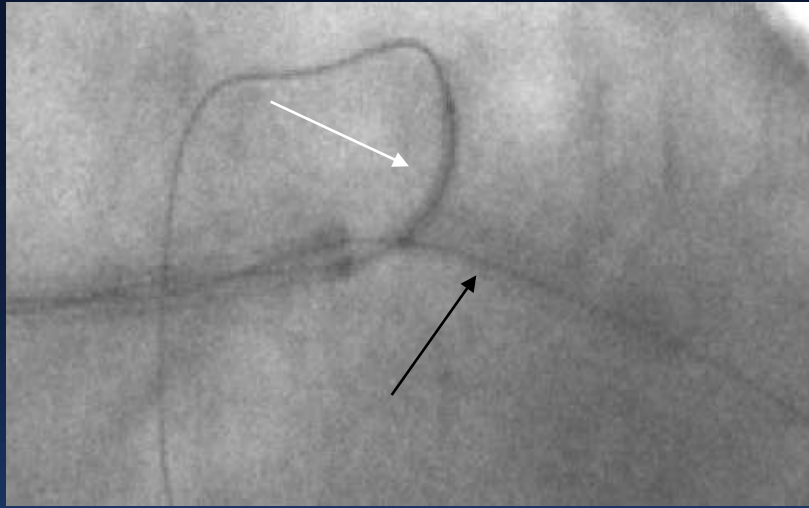


LCX Stenting first  
with DES 3.5x18mm

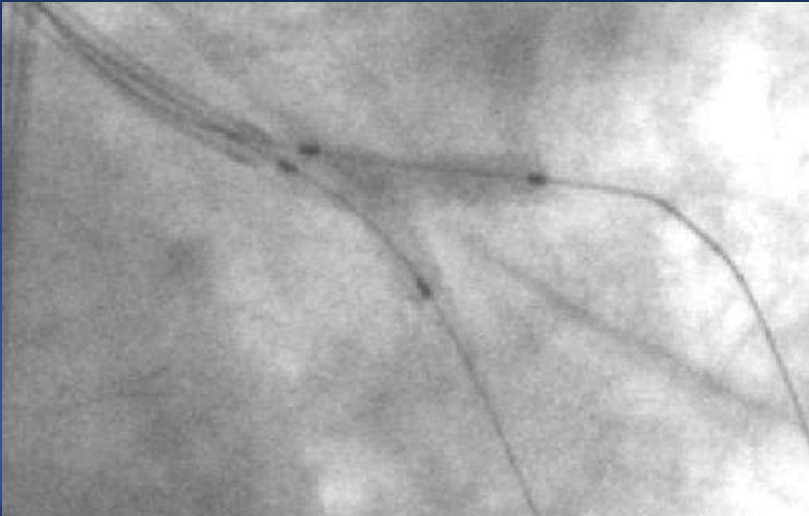


2<sup>nd</sup> LM-LAD stenting  
with DES 3.5x18mm

# Mini-Crushing !



Sequential  
High pressure inflation  
in Both LCX and LAD



Final kissing balloon  
inflation with moderate  
pressure.

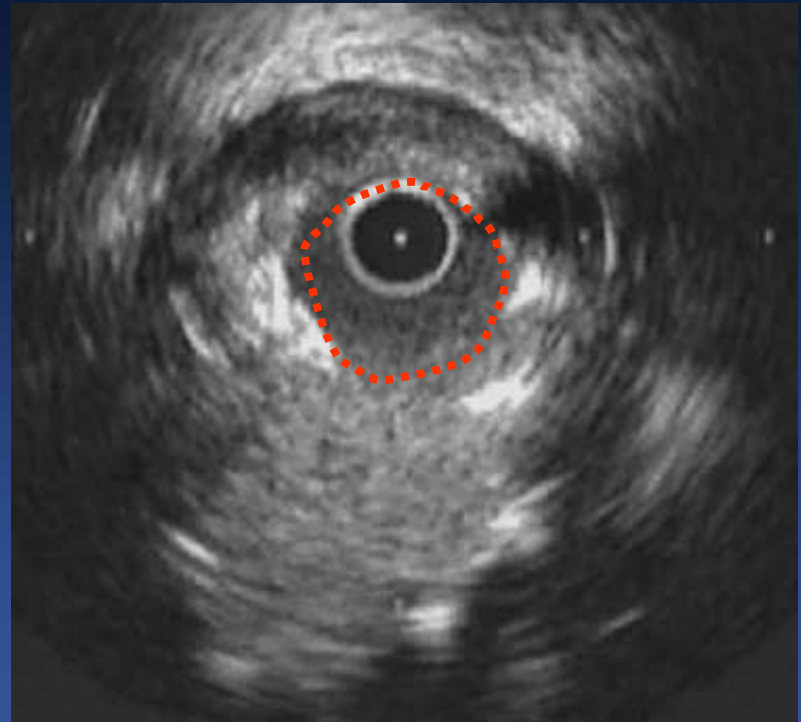
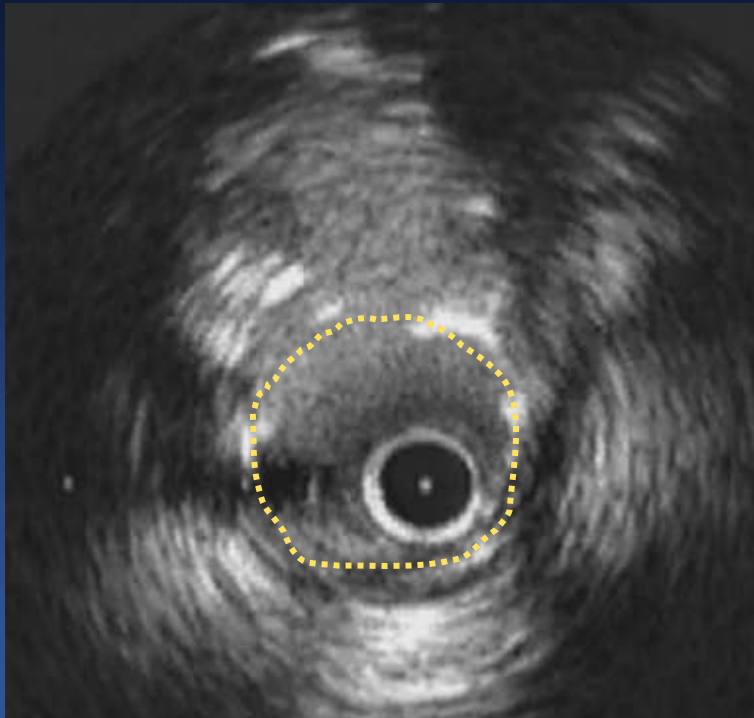
# Final Angiography



# Final IVUS

LAD pullback  
Stent CSA : 8.8 mm<sup>2</sup>

LCX pullback  
Stent CSA : 5.1 mm<sup>2</sup>



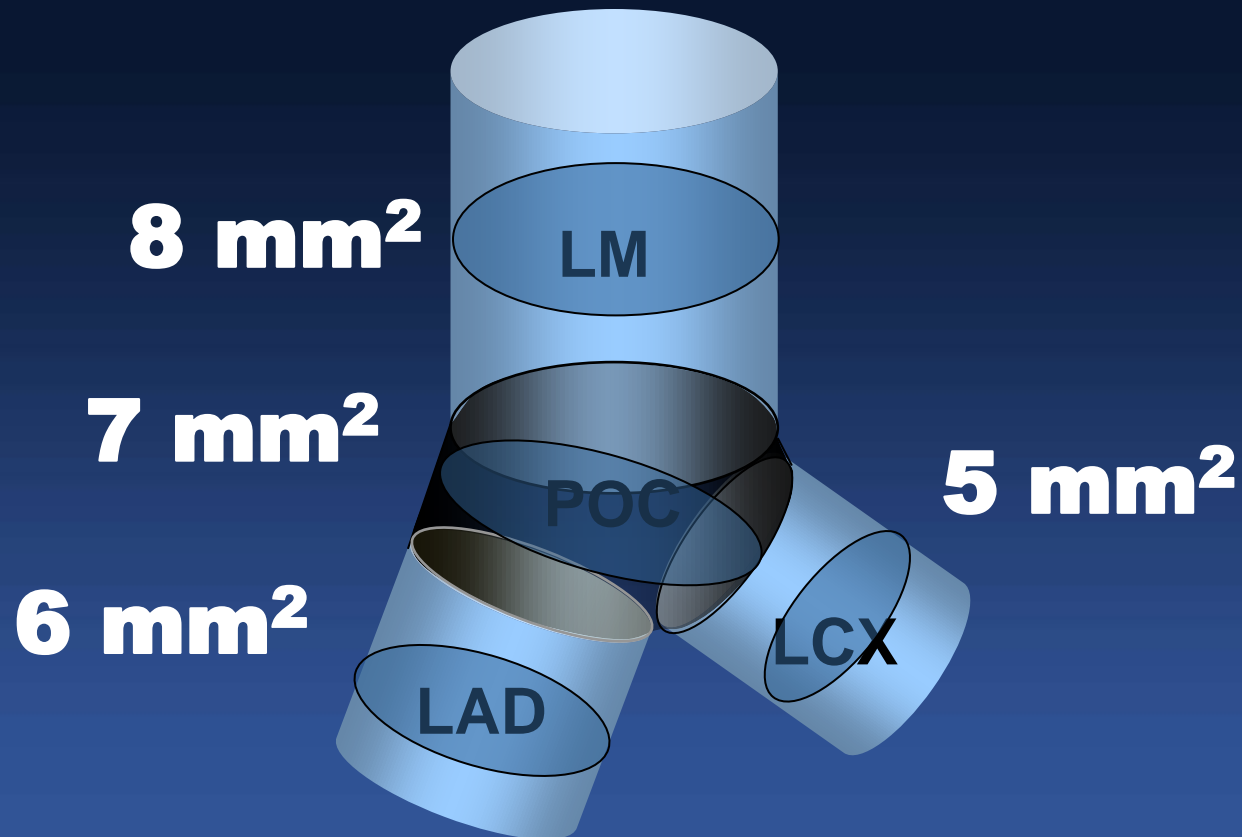
# 2 Stent Techniques

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



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

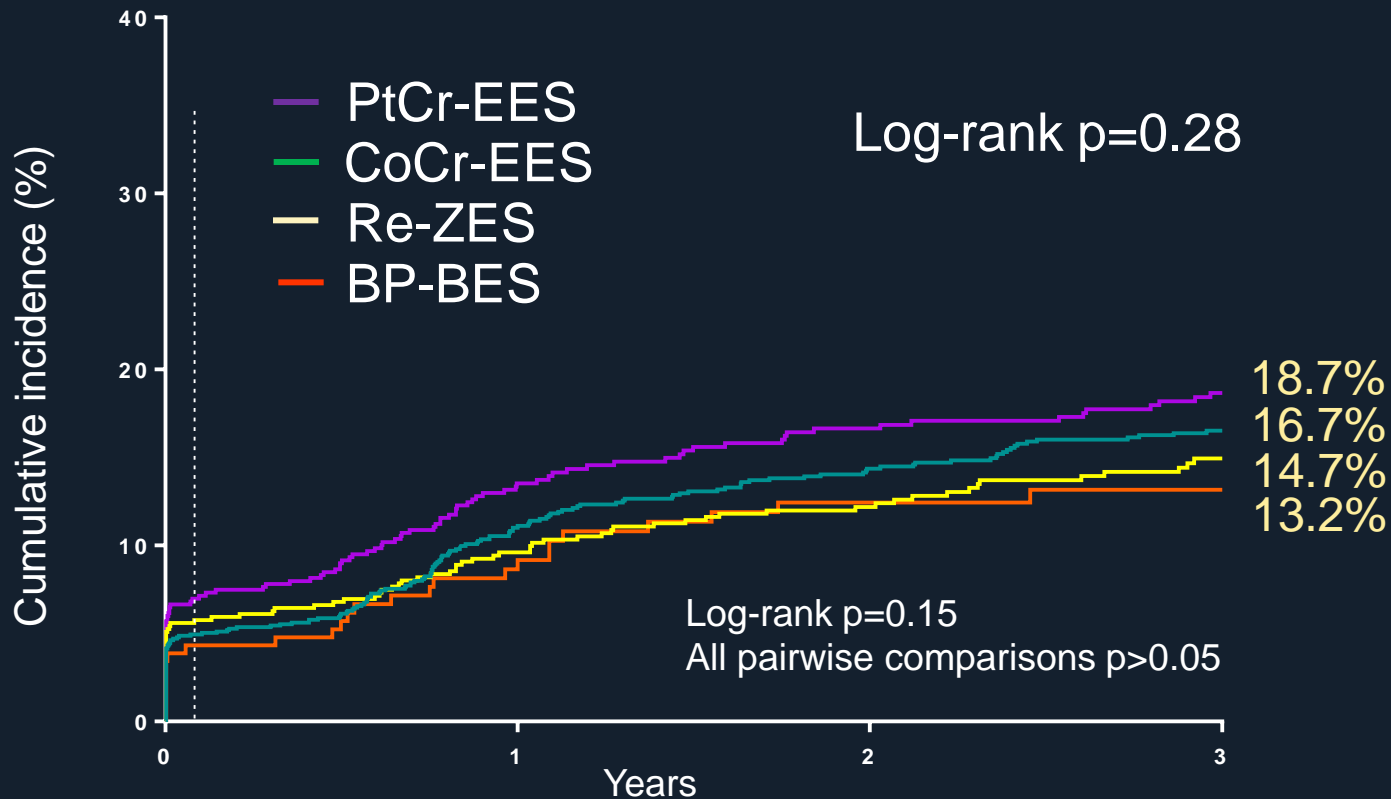
*Restenosis Rate < 5% and TLR < 2%*



# ***Can Different DES Make Any Different Clinical Outcomes ?***

Preliminary Analysis 2017  
IRIS-MAIN, IRIS-DES, and PRECOMBAT (n=2,692 LM PCI)

# Primary End Point Target-Vessel Failure



No. at risk

CoCr-EES	1254	919	766	611
BP-BES	232	175	147	91
PtCr-EES	616	456	393	332
Re-ZES	590	508	442	285

# *Treatment (1 Stent or 2 Stents) and IVUS Guided Optimization*

1. 1 Stent Crossover Is Usually Enough in Case of Normal LCX. Kissing Balloon Inflation Is Not Always Good.
2. Any 2 stents Technique Is Feasible in True LM Bifurcation Disease. In Fact, >75% LM Bifurcation Disease Were Treated With 1 Stent Cross Over (Not Treated LCX) With Integrated Use of FFR and IVUS. Most Important Procedural Issue Is IVUS Guided Optimization (Rule of 5,6,7,8 mm<sup>2</sup>). Different DES Can Not Make Any Different Clinical Outcomes. (Any DESs are Equivalent in LM PCI).

# *Practical Guideline for* LM Bifurcation PCI

**Single Stent**

**Any 2 Stents**

**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.



**Thank You !!**

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