

# **What Really Matter in LM Bifurcation PCI :** **Concept or Technique**

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

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

***Current Status of PCI  
for LM Disease***

# ESC Guidelines 2018

## Elective PCI for LM Stenosis

	CABG		PCI	
Recommendation according to extent of CAD	Class	Level	Class	Level
LM disease a SYNTAX score $\leq 22$	I	A	I	A
LM disease a SYNTAX score 23 -32	I	A	Ila	A
LM disease a SYNTAX score $> 32$	I	A	III	B

Reference; SYNTAX Study, PRECOMBAT study, MAINCOMPARE registry study and Meta-Analysis. *Patrick, SW et al, NEJM. 2009 March 5;360(10), Park SJ et al, NEJM. 2011 May 5;364(18):1718-27, Levin GN et al. ACC/AHA guidelines. JACC 2011;58:44-122, Capodanno et al, JACC 2011;58:1426-32*

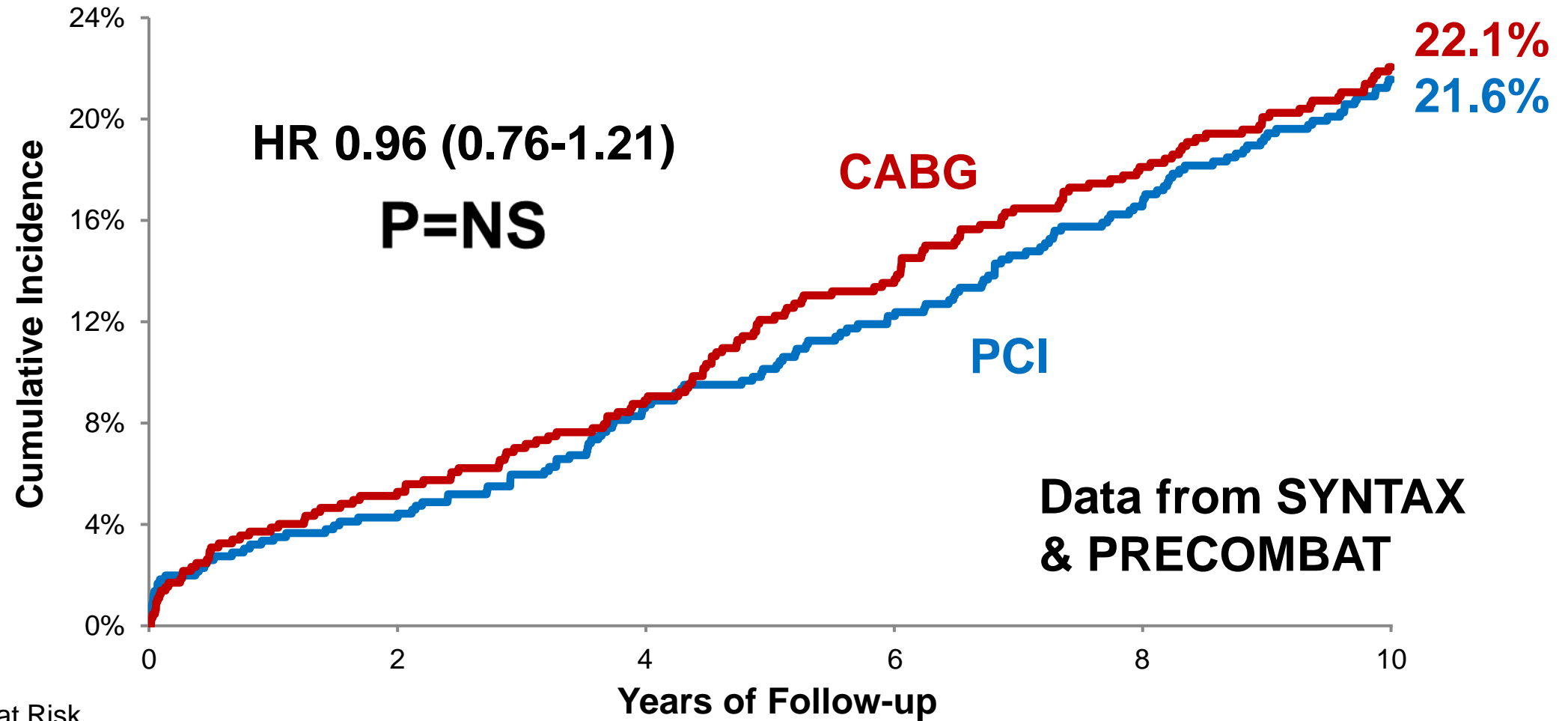
# **Meta-Analysis of 4 Randomized Trials**

## **SYNTAX, PRECOMBAT, NOBLE, and EXCEL**

4394 patients, PCI (n=2197) or CABG (n=2197)

Median SYNTAX score of 25.0 (IQR 18.0-31.0)

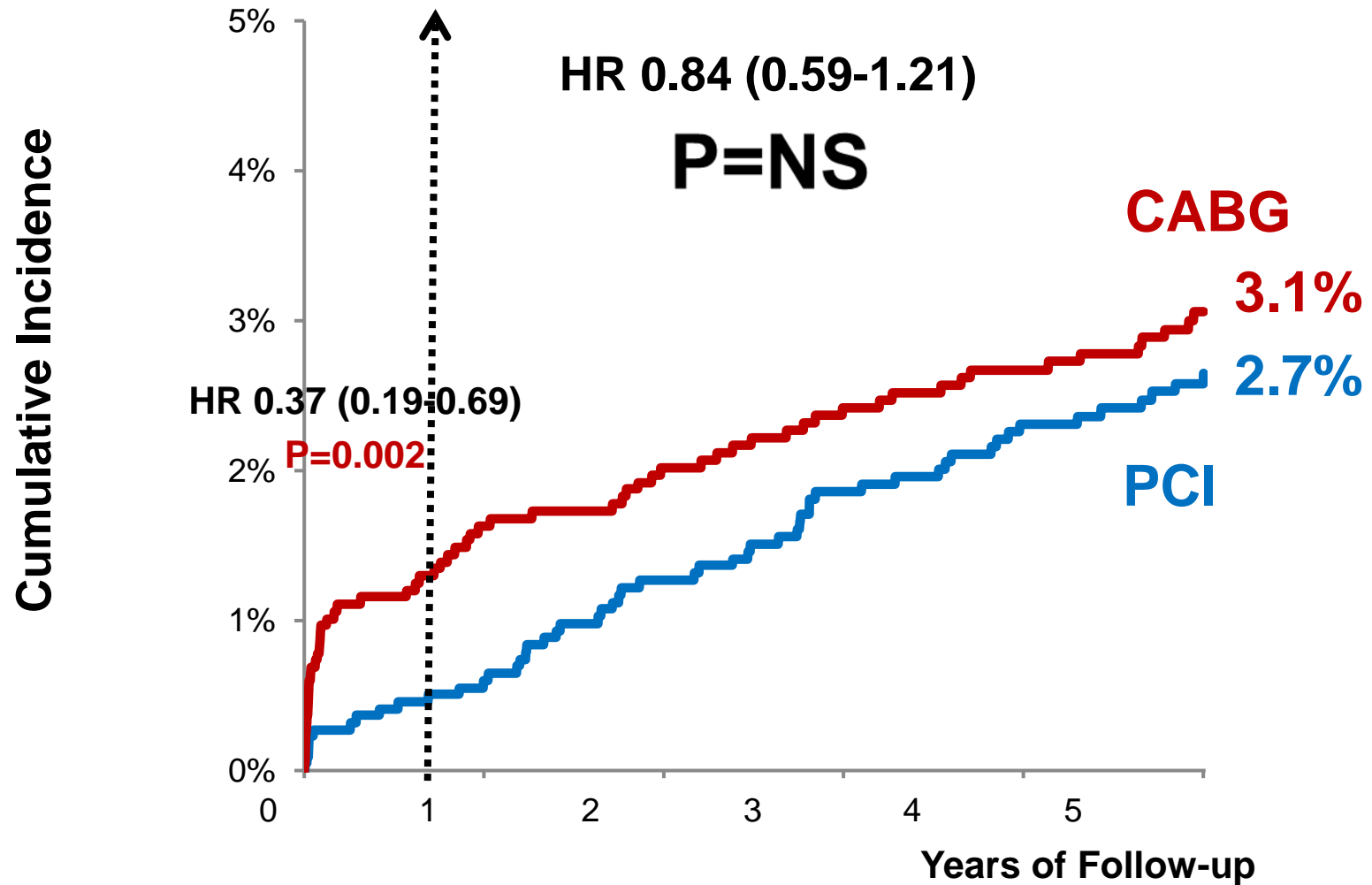
# All Death at 10-Year (2 trials)



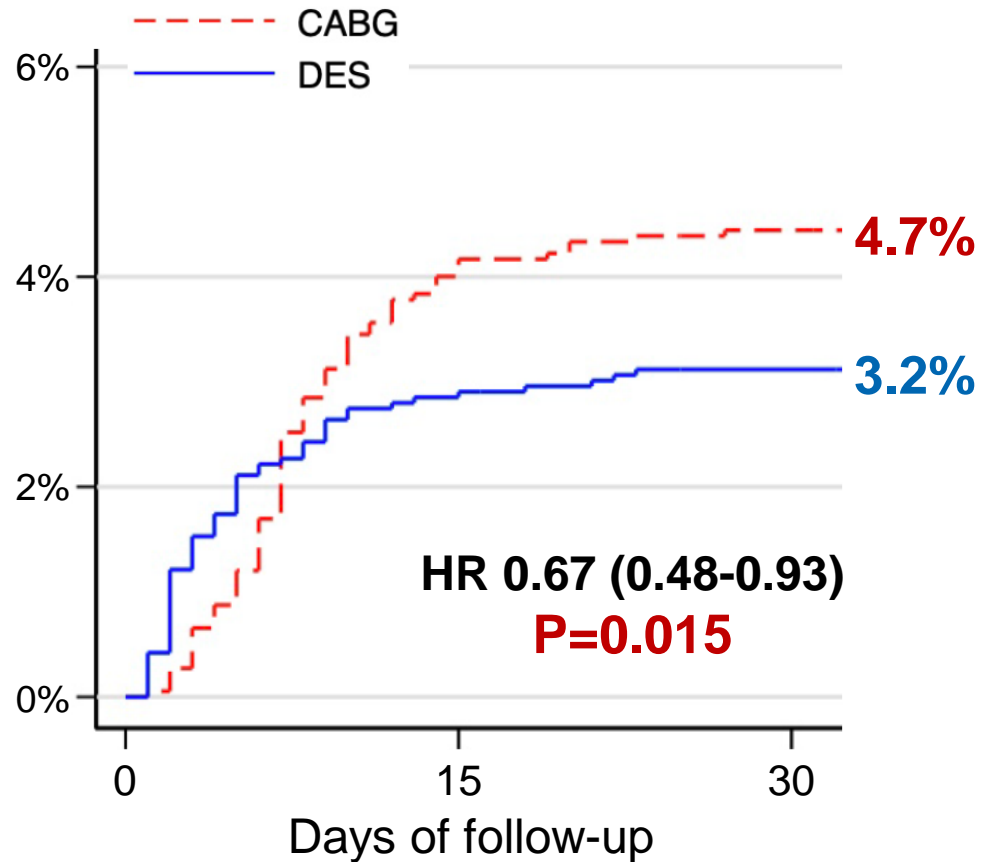
Number at Risk

CABG	648	604	577	531	500	463
PCI	657	623	591	547	519	475

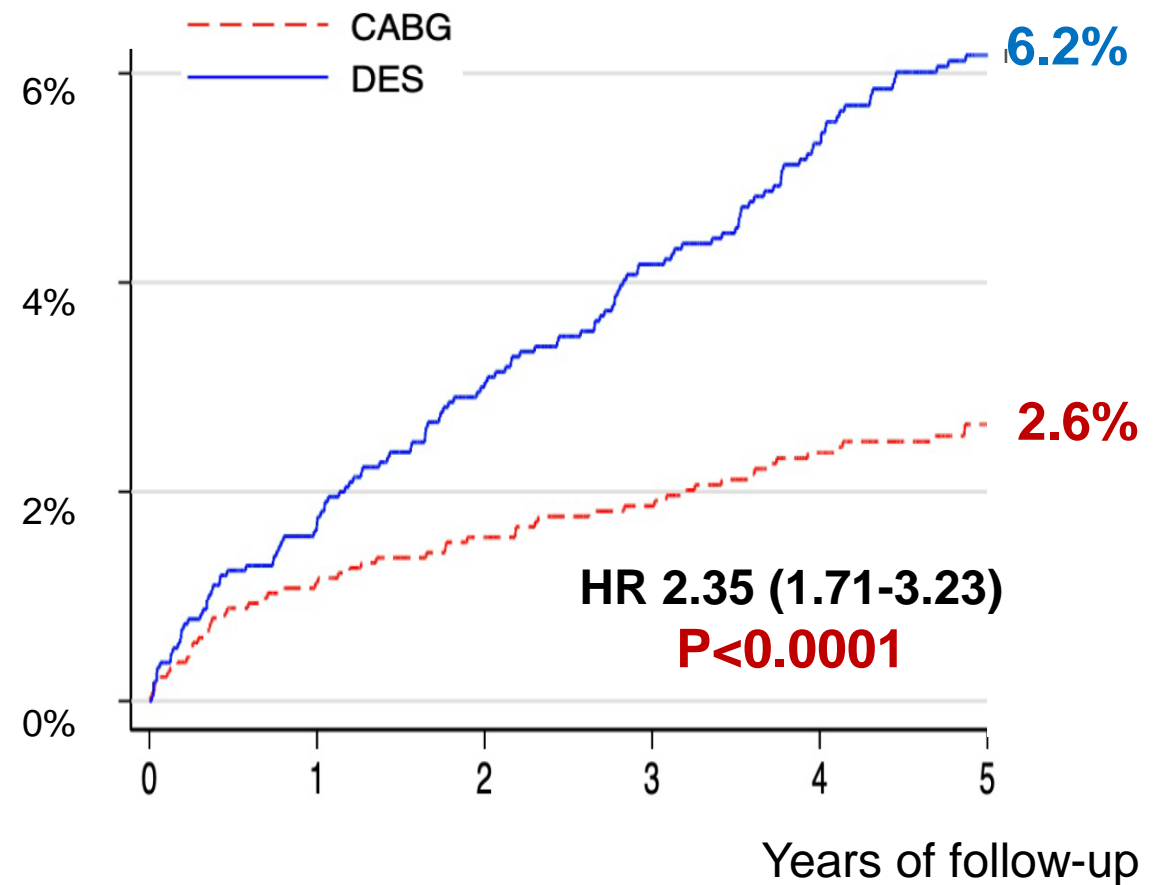
# Stroke at 5-year



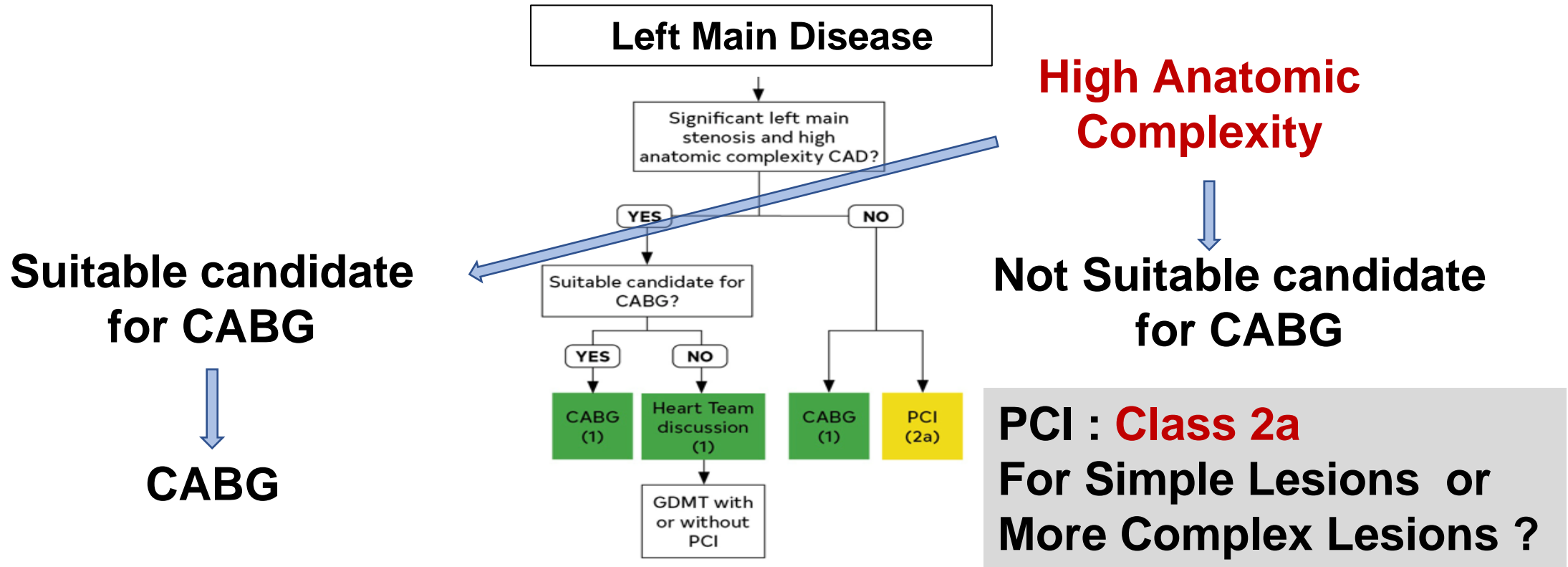
## Procedural MI Higher in CABG at 5 year



## Spontaneous MI Higher in PCI at 5 year



# 2021 ACC/AHA/SCAI, Guideline for Coronary Artery Revascularization





# ***PCI vs. CABG***

***LM Disease is  
Not Surgical Disease  
Anymore !***

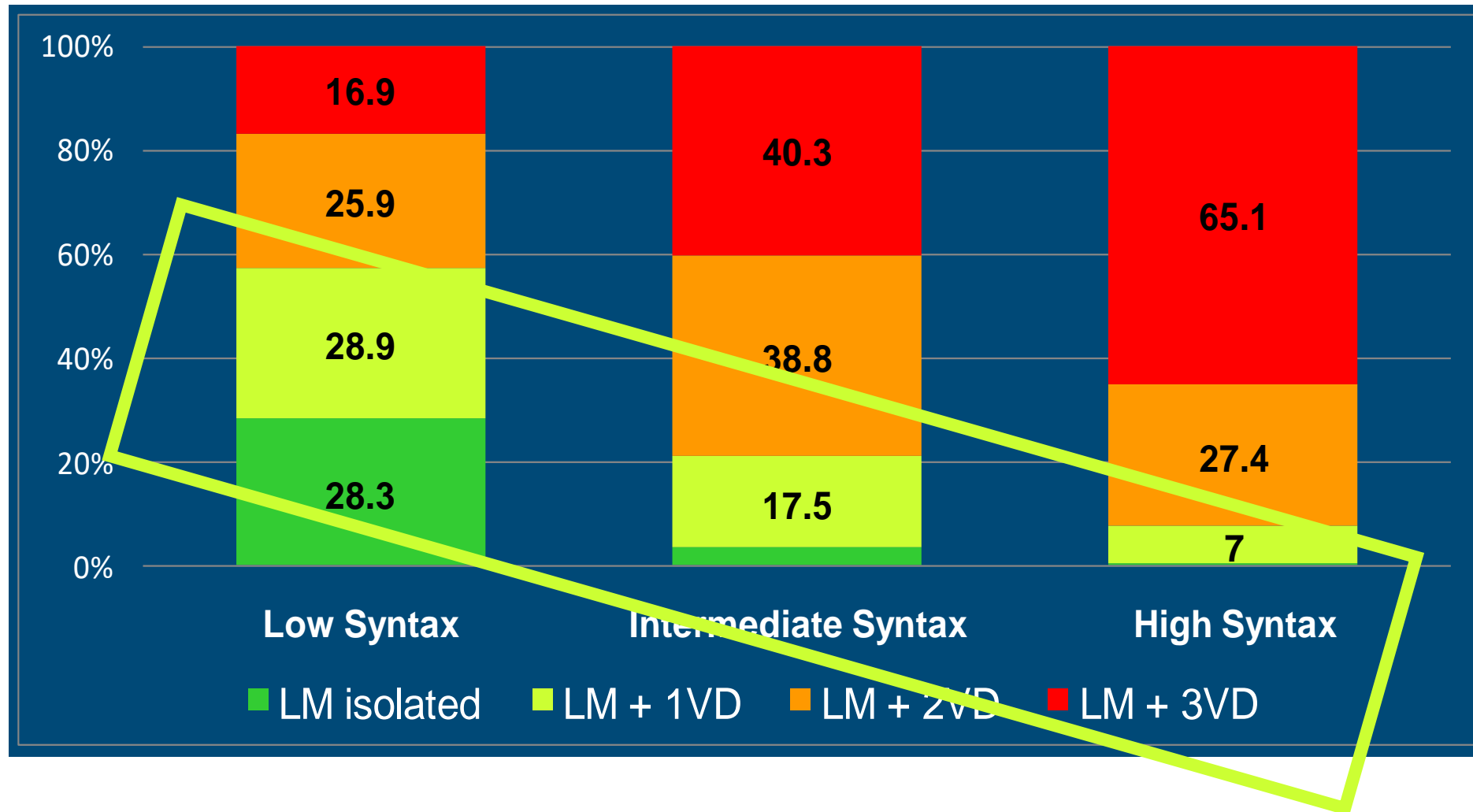
# ***PCI vs. CABG for Left Main Disease***

**If Extensive Non-LM CAD (high SYNTAX score >45)**  
*is present* **CABG** may be strongly preferred

**If Multiple Comorbidities** (prior stroke, lung disease,  
frailty) *are present* **PCI** may be strongly preferred.

# What Does It Mean, High Syntax Score ?

**Due to Concomitant 3VD Distribution**



***If You Look at  
Only Left Main Disease***

# **Left Main Disease**

- 1. Proximal,**
- 2. Big Vessel,**
- 3. Short Lesion Length,**

***If You Look at  
Only Left Main Disease***

***It Is Really Good Target for PCI !***

**Contemporary PCI**  
**Physiology and Image Supported**

***Ischemia Guided !***

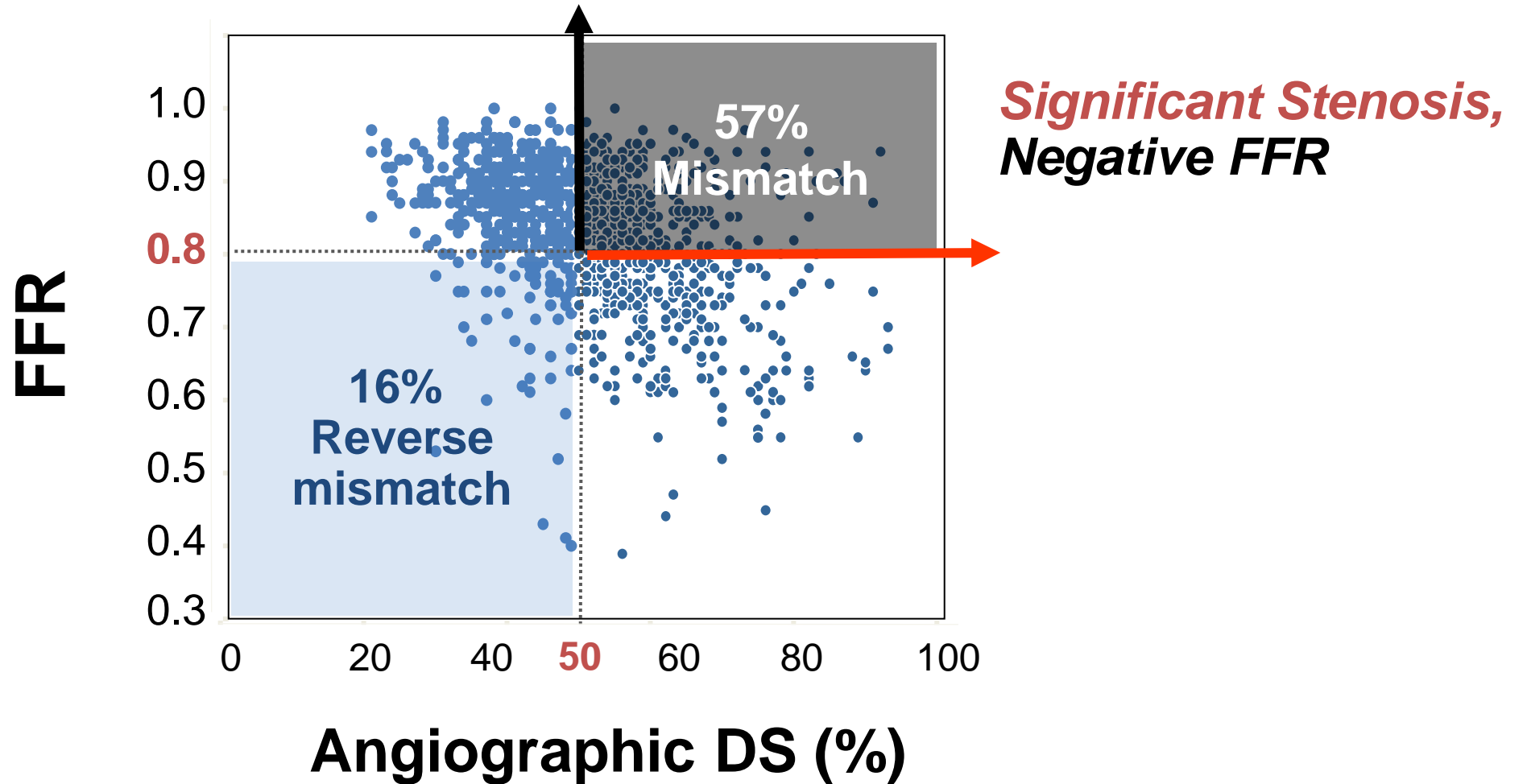
Ahn JM, et al, AJC 2015 Oct;116(8):1163-71.  
Escaned J, Banning A, Serruys PW. Eur Heart J. 2017 Nov 7;38(42):3124-3134.  
Kang DY, et al. Circ Cardiovasc Interv 2021;14(10):e011011

# **Contemporary PCI**

- ***FFR Guided Decision Making,***
- ***IVUS Guided Optimization !***



***Real World,  
Mismatches of Non-LM Stenosis (n=1066)***



# Current Guideline of FFR

2018 ESC Guidelines,  
2021 ACC/AHA/SCAI Guideline

Class	Level
<b>I</b>	<b>A</b>

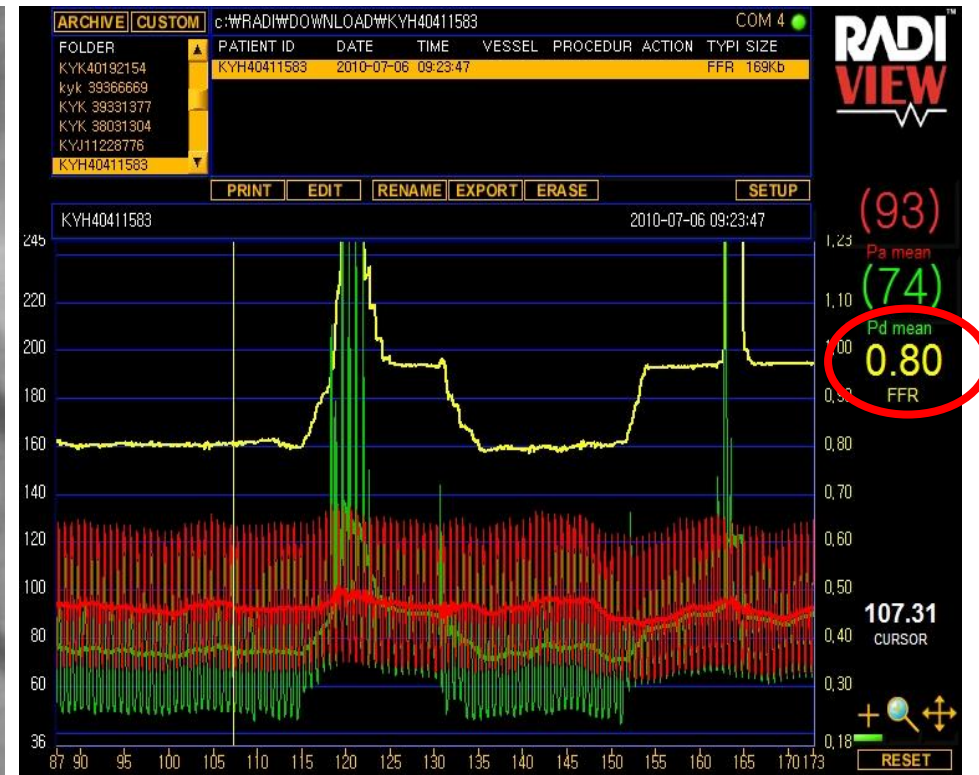
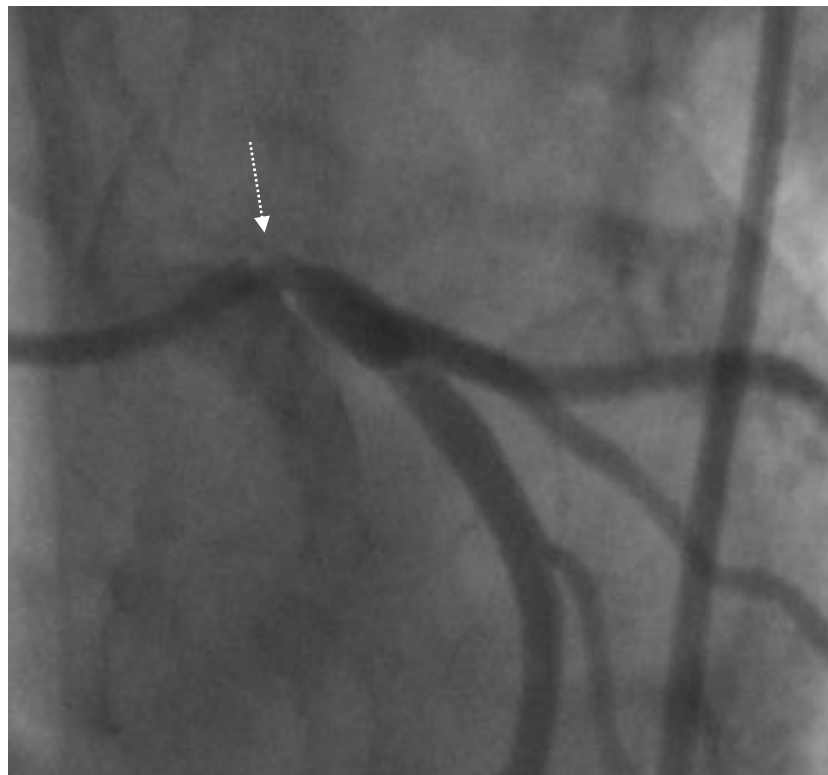
# Unprotected Left Main Percutaneous Coronary Intervention: Integrated Use of Fractional Flow Reserve and Intravascular Ultrasound

[Seung-Jung Park](#), MD, PhD, [Jung-Min Ahn](#), MD, and [Soo-Jin Kang](#), MD, PhD

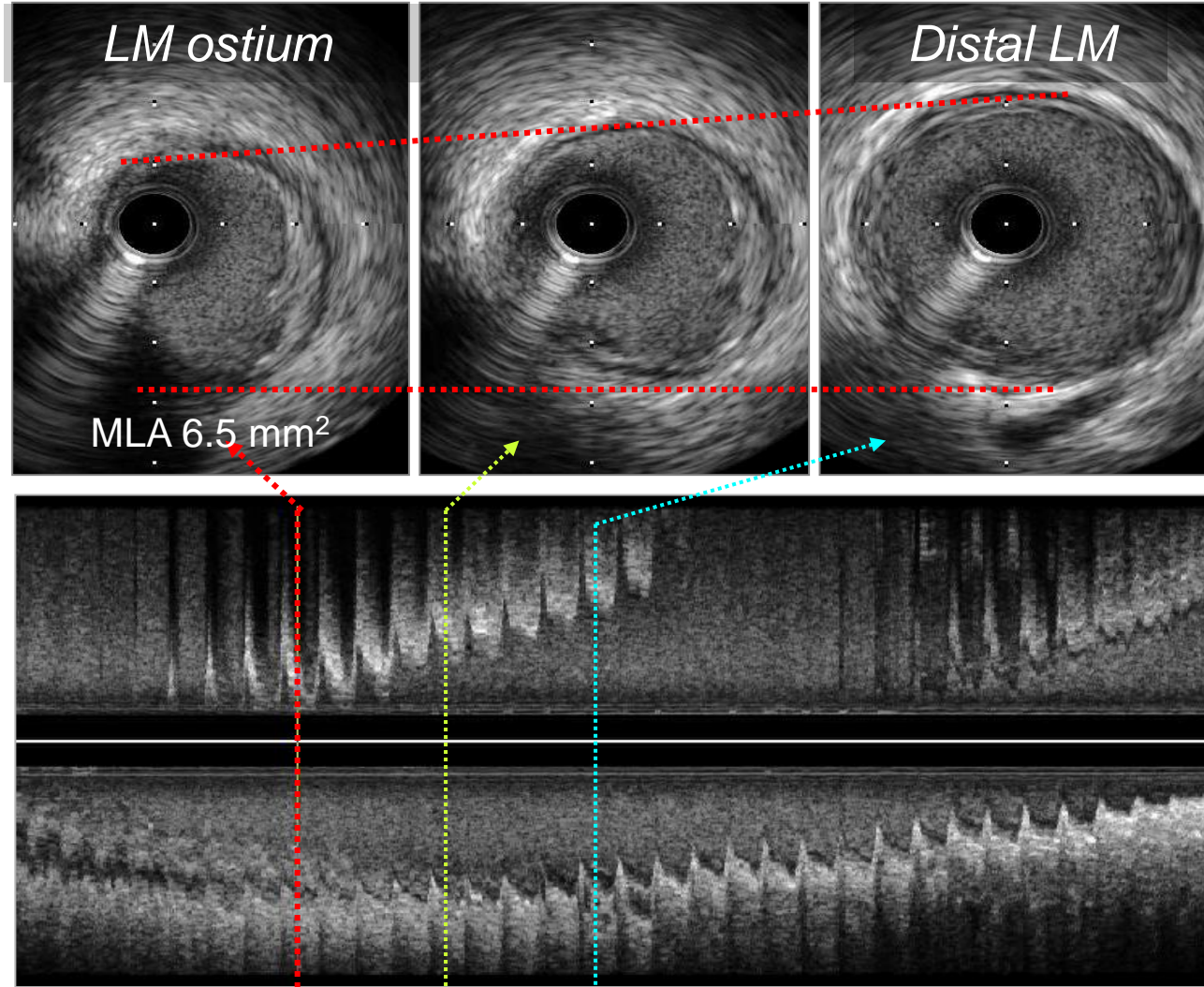
# **Ostial or Shaft LM Disease**

# Mismatch

Significant Stenosis,  
FFR 0.80



# *Negative Remodeling, No Disease at All*



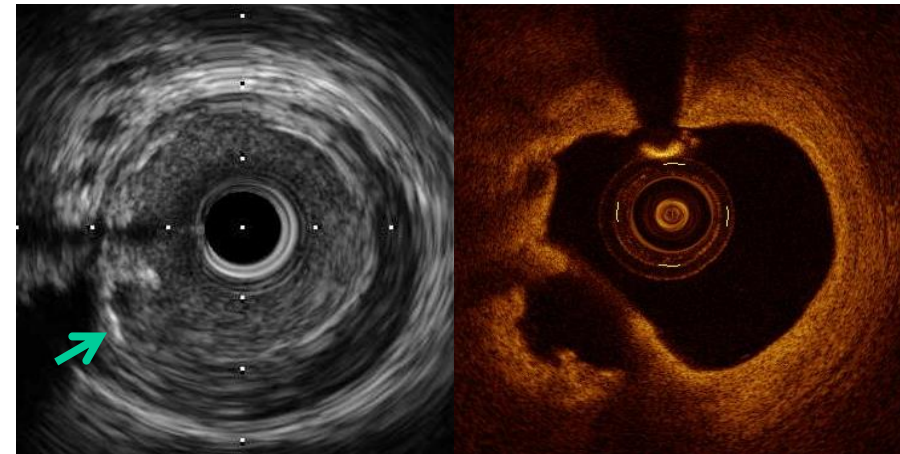
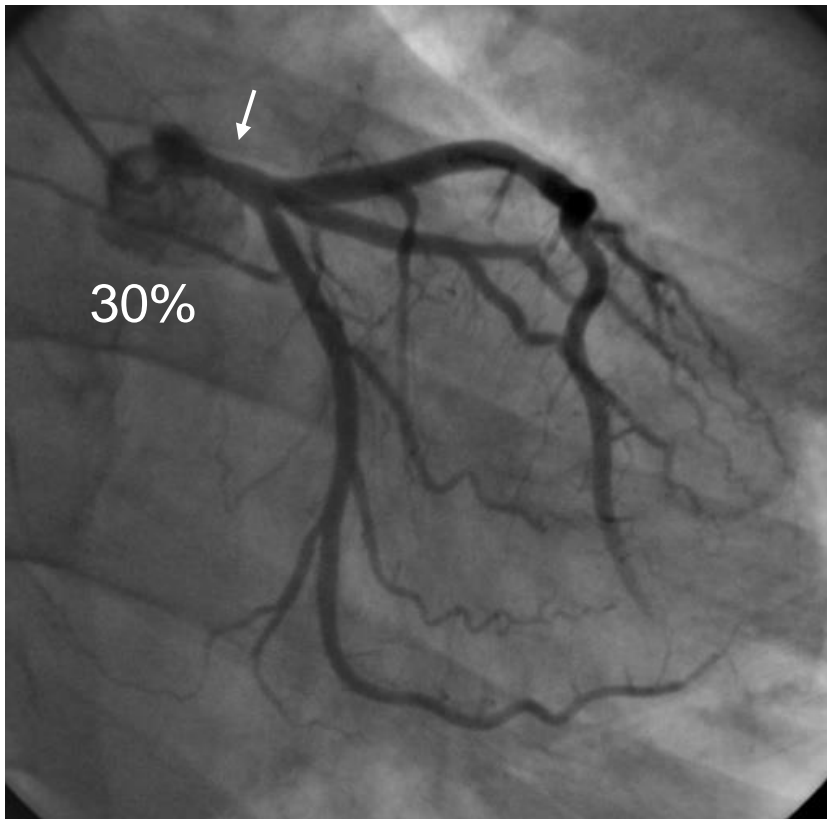
**FFR 0.80,  
MLA 6.5 mm<sup>2</sup>**

**Do You  
Want to Treat ?**



# Reverse Mismatch

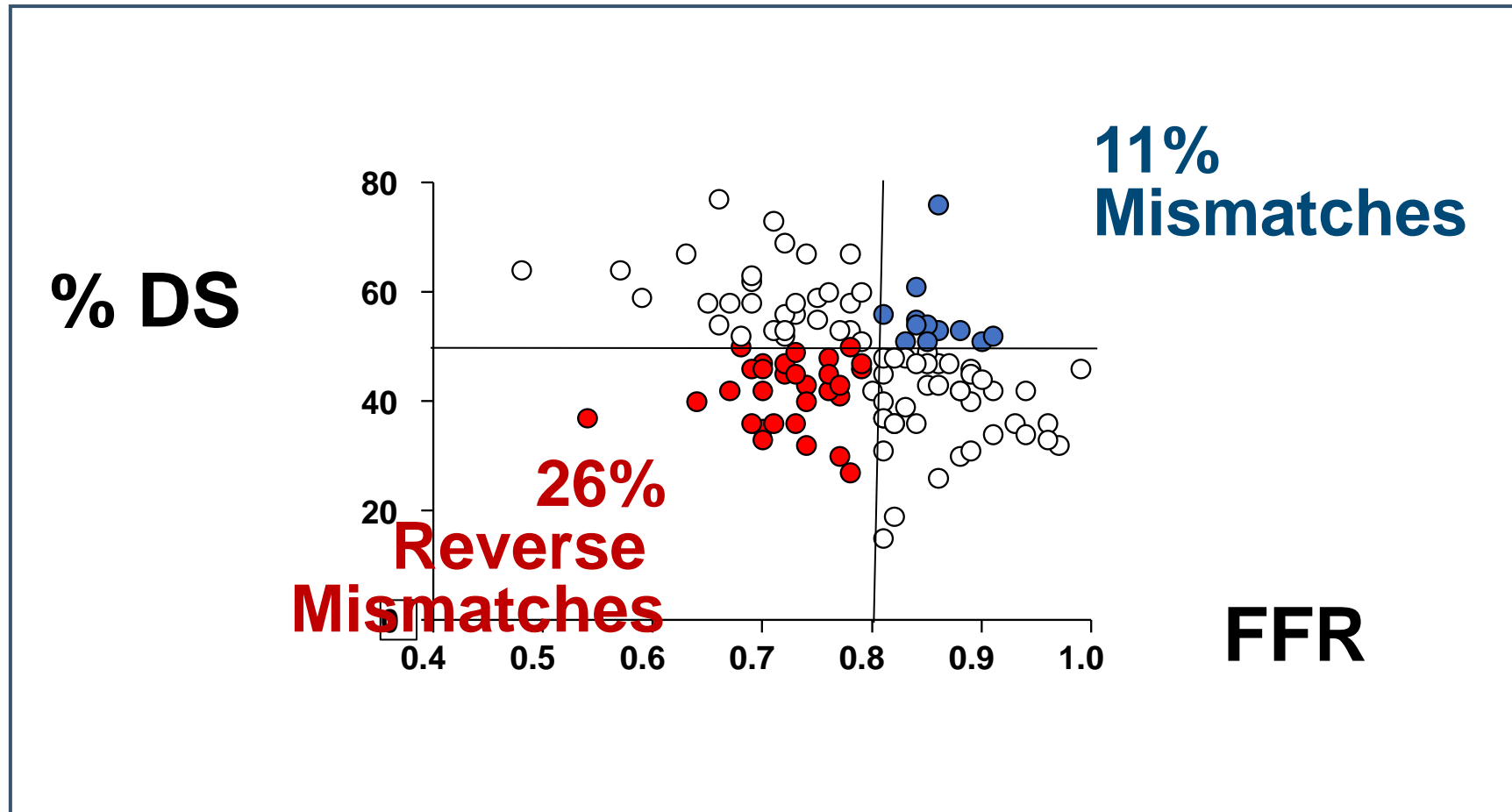
Insignificant Stenosis,  
*Positive FFR, 0.70*



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

# Mismatches of Intermediate LM Disease, Os/Shaft

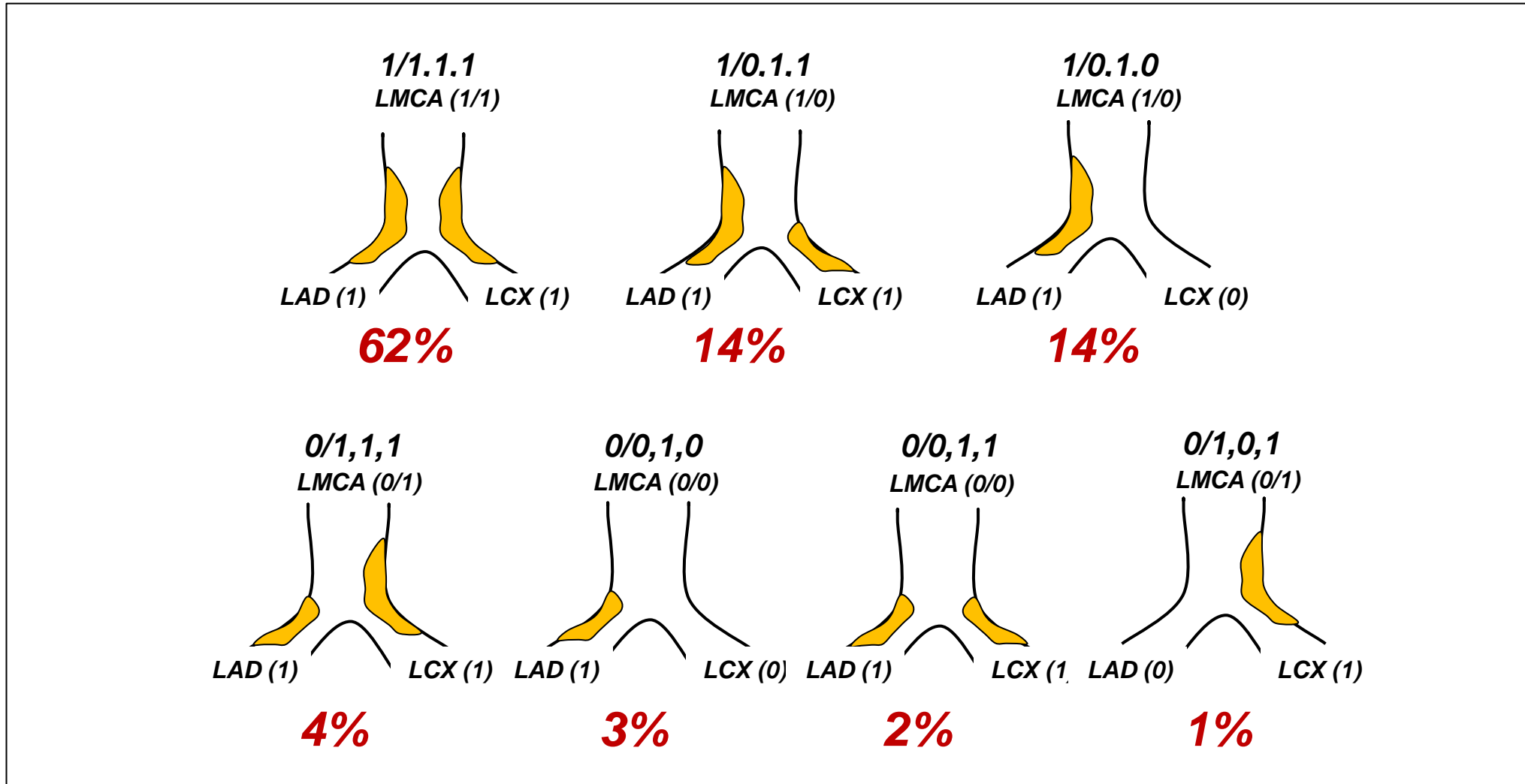
**37 %**





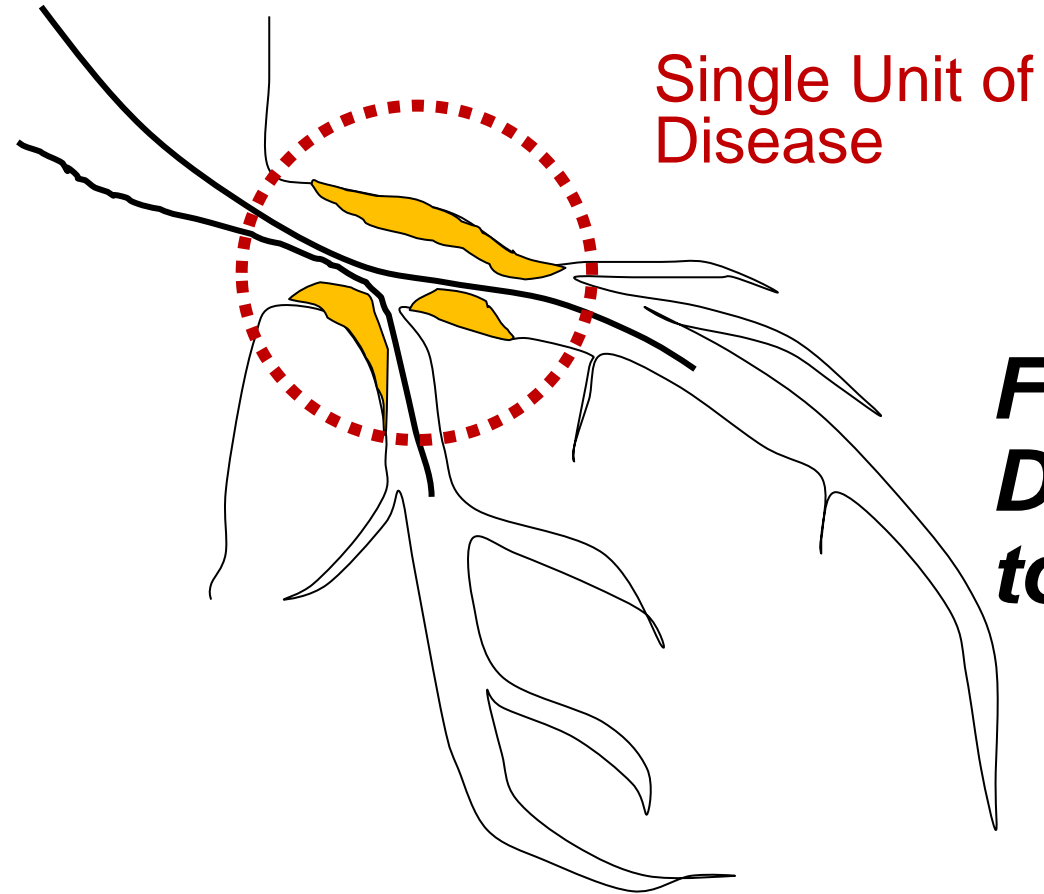
# **Bifurcation LM Disease**

# 90% of Plaques LM Bifurcation Are Not Isolated, Extends from LM to LAD or LCX



# *FFR for LM Bifurcation*

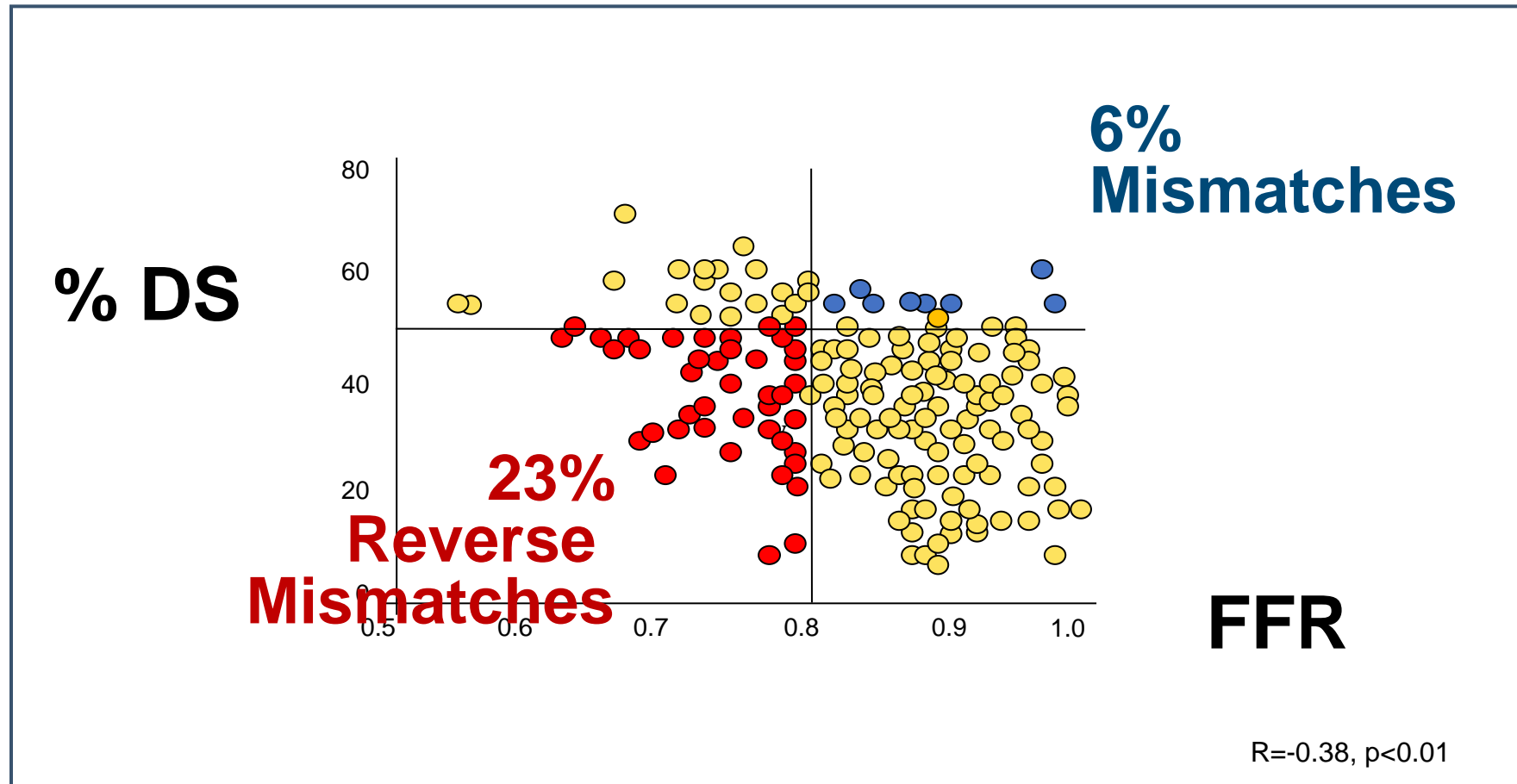
*If Transducer Placed Beyond Bifurcation  
in both LAD and LCX,*



***FFR Works for  
Decision Making  
to Treat or Not !***

# **Mismatches of Intermediate LM Disease, with Downstream Disease**

**29 %**



***We Have to Realize,***

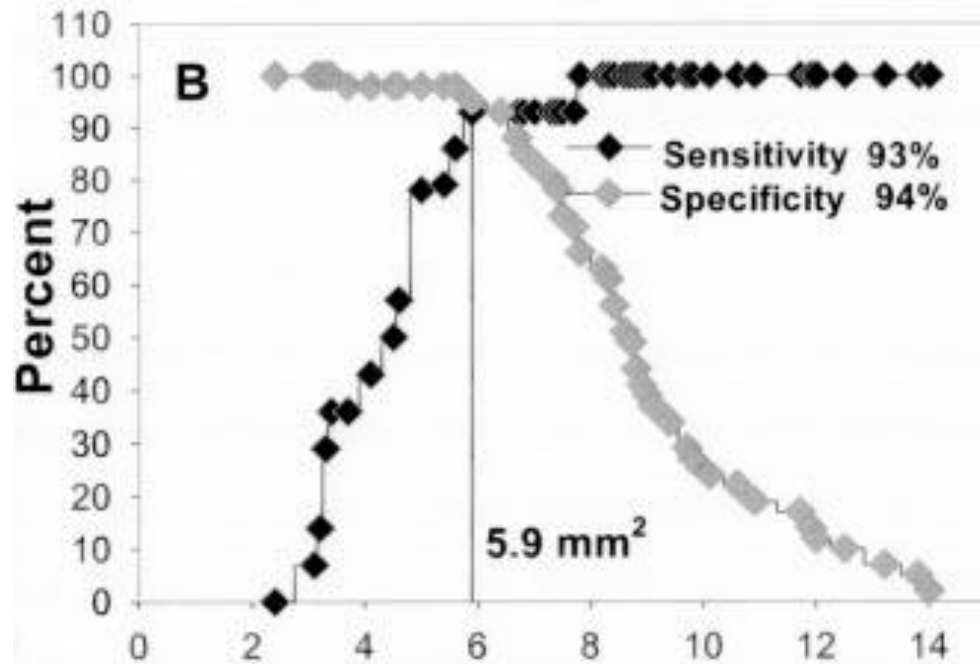
***Relatively, Higher Frequency of Reverse***

***Mismatches In Intermediate Left Main Disease.***

**FFR vs. IVUS MLA**  
**In Left Main Disease**

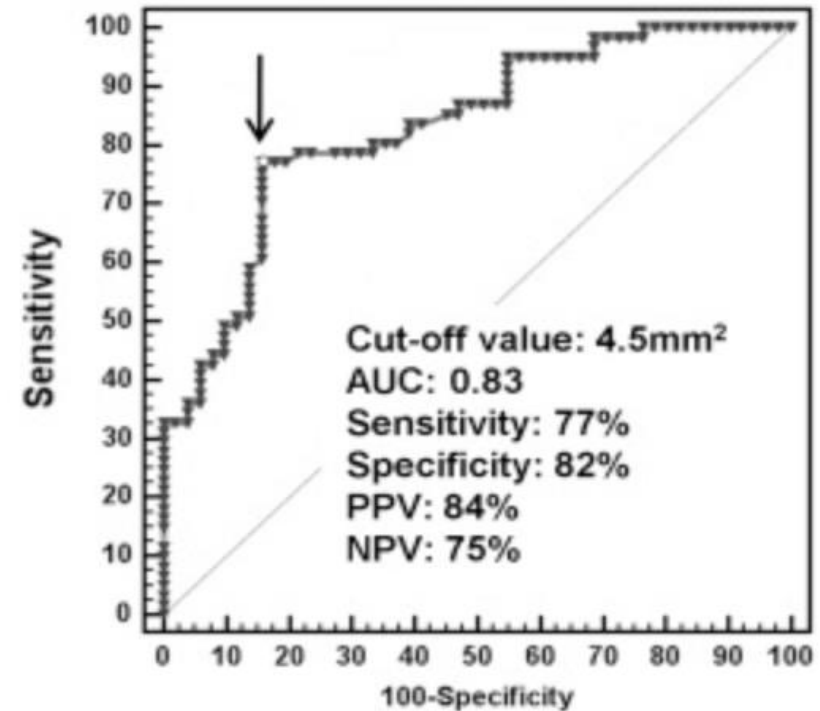
# IVUS MLA of LMCA Stenosis

FFR 0.75 Matched with  
Down stream disease



**MLA 5.9 mm<sup>2</sup>**

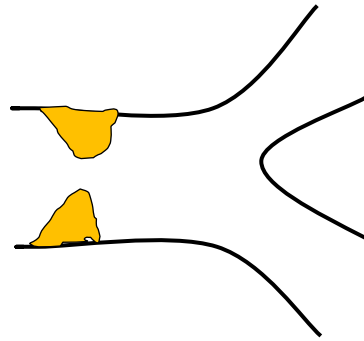
FFR 0.80 Matched with  
Ostial shaft disease



**MLA 4.5 mm<sup>2</sup>**

# How do I Implement ?

## Ostial and Shaft



**< 4.5 mm<sup>2</sup>**  
**Positive FFR**  
**(83%)**

## Down Stream Disease

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

**> 6.0 mm<sup>2</sup>**  
**Negative FFR**  
**(94%)**



# ***LM Bifurcation PCI*** ***Technique***

- 1. Provisional One stent**
- 2. Upfront Two stents**

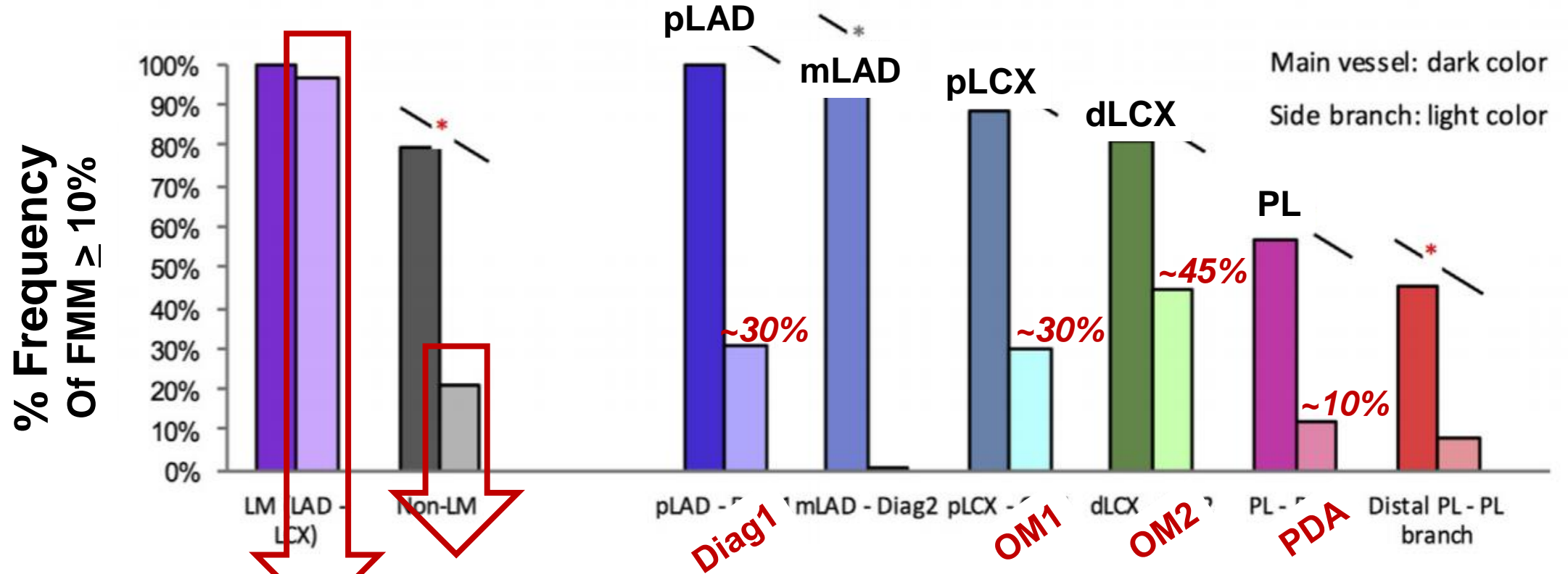
# LM Bifurcation PCI

**1 Stent, *Normal or Diminutive LCX,***  
Small LCX with < 2.5 mm in diameter,

**2 Stent, *True Bifurcation Disease (Medina 1.1.1)***  
***in Large LCX (>2.5 mm),***

# Main Vessel or Side Branch

## Frequency of Fractional Myocardial Mass >10%



**Only 20% of Side branch has >10% FMM**

**>90% of LCX has >10% FMM**

***True LM Bifurcation Disease***  
***If There Are LCX Disease,***

***Left Circumflex Artery Is Usually***  
***Big Enough To Treat !***

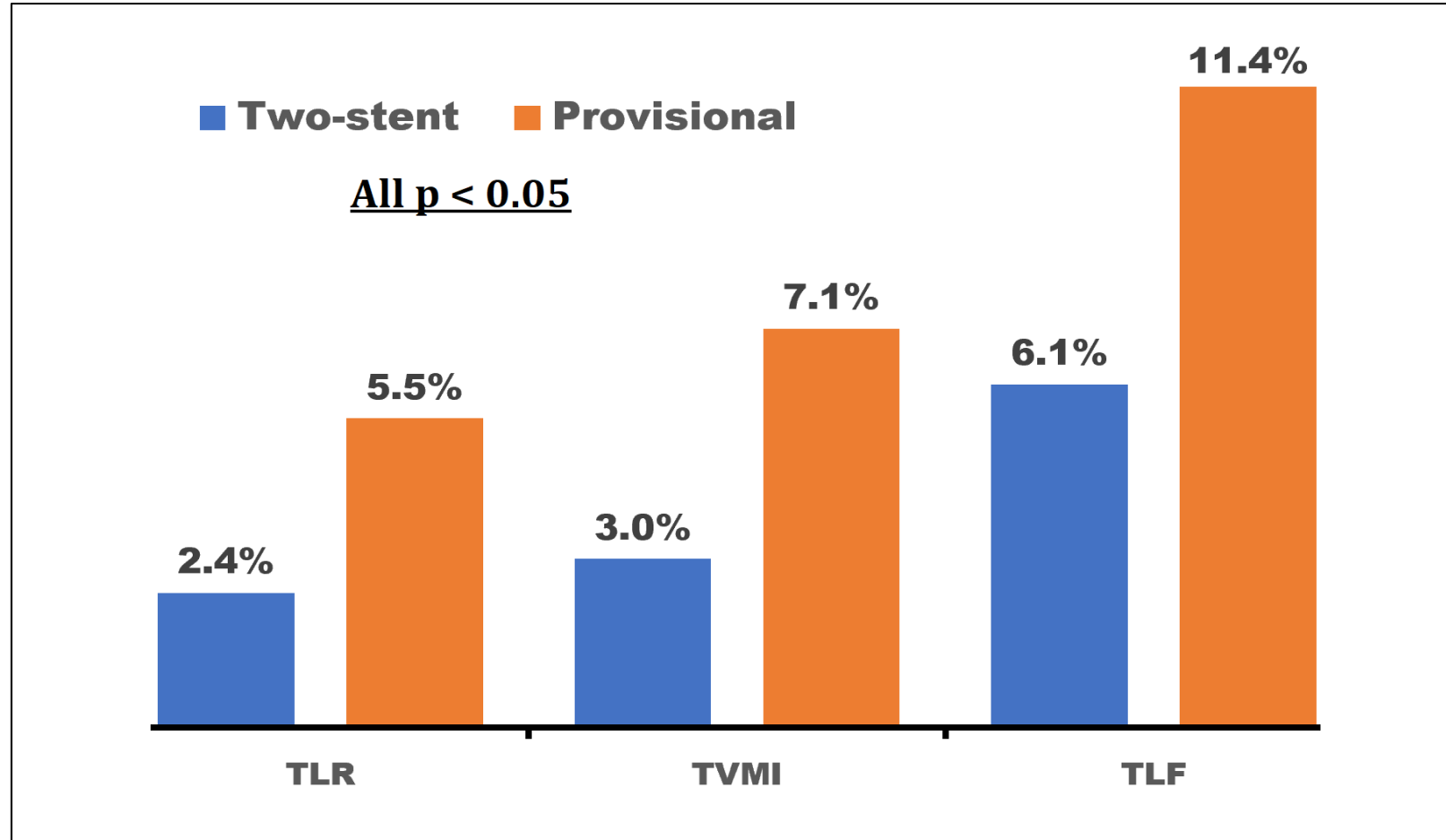
Zhang JJ, Ye F, Xu K, et al. Eur Heart J 2020;Jun 26 (DEFINITION 2)

Cheol Hyun Lee, et al. Catheter Cardiovasc Interv. 2021;97:776–785.

# **True LM Bifurcation Disease**

- 1. *Upfront 2 Stent Strategies Would Be Safe and Good !***
- 2. We Can Avoid Risk of Side Branch Closure.**
- 3. Clinical Outcomes of 2 Stents Are Good.**

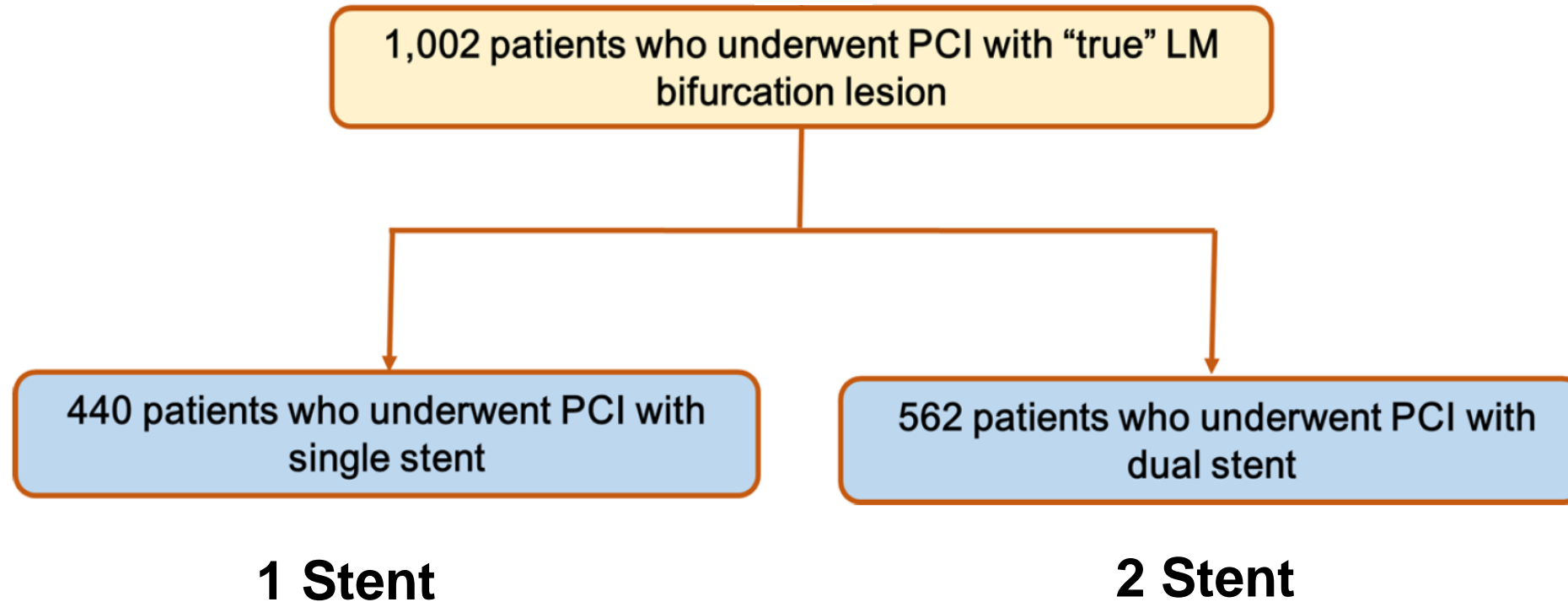
# 2 Stent Is Better !



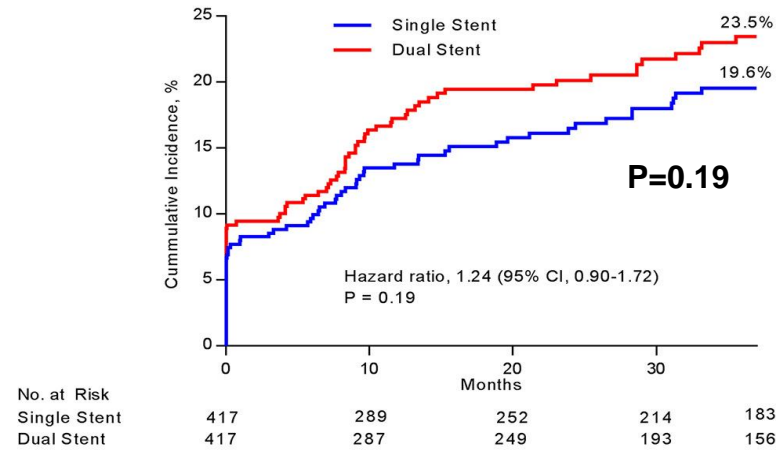
*DKCRUSH For All Complex Bifurcations (RVD>2.5mm)*

# **True LM Bifurcation (n=1,002)**

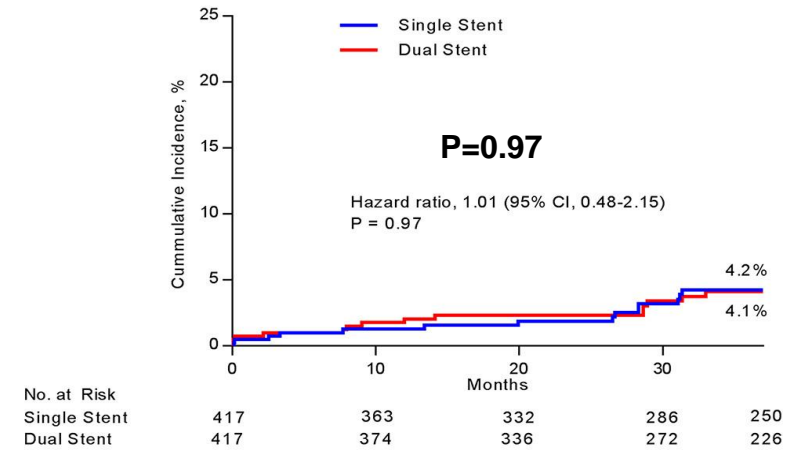
From IRIS LM Registry (n=23,129)



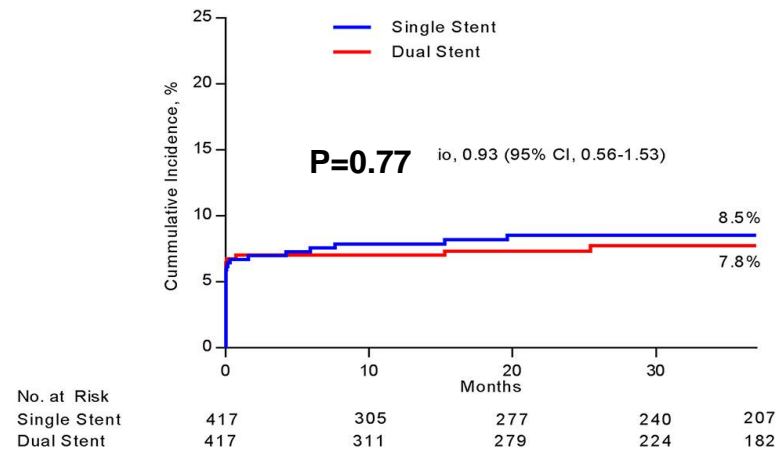
## Target Lesion Failure



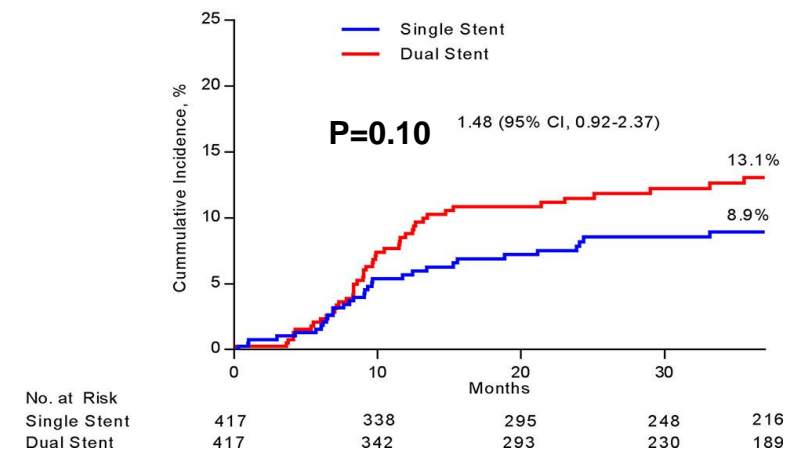
## Cardiac Death



## Target Vessel-MI

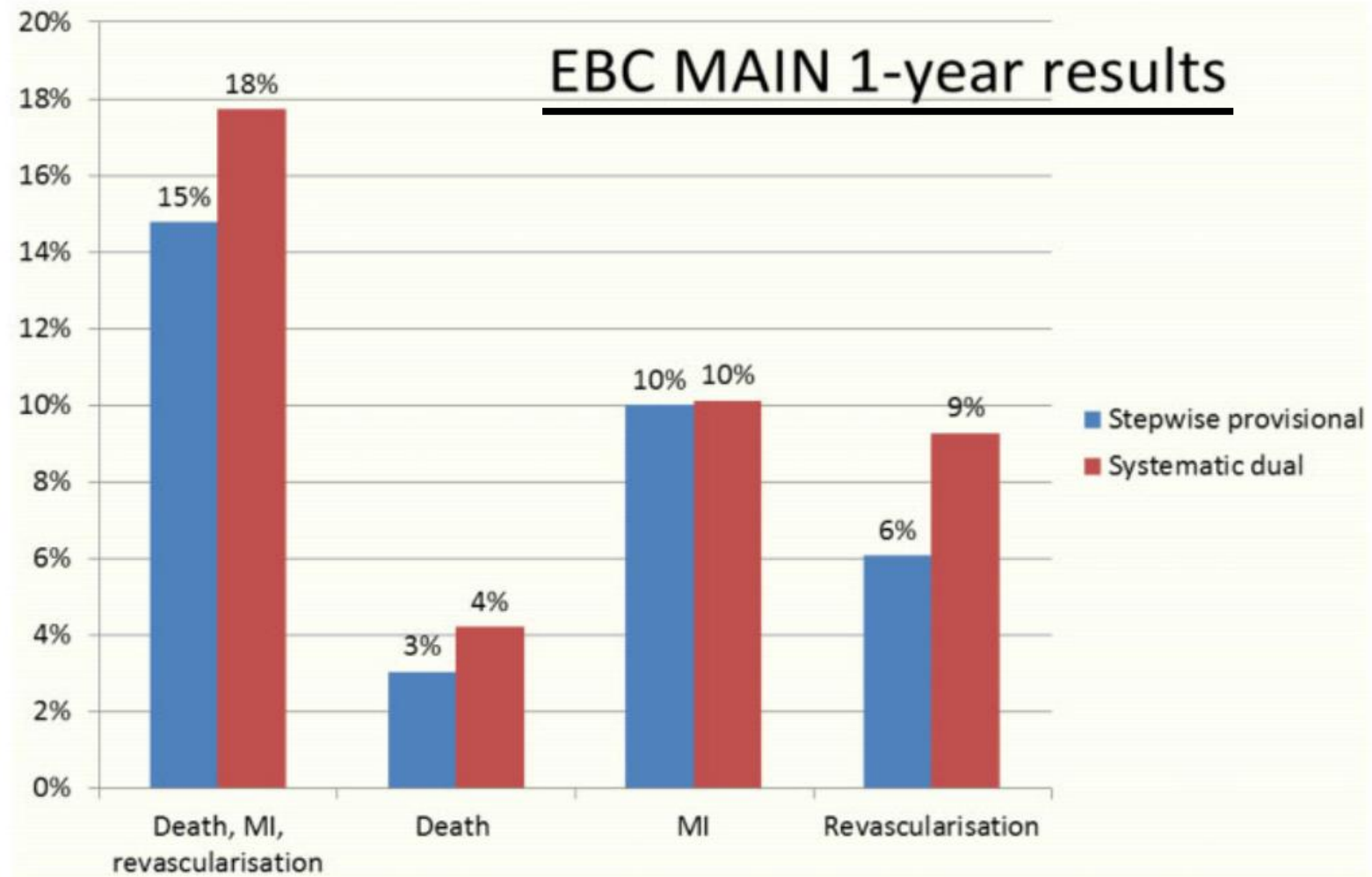


## Target Lesion Revascularization





# *Provisional One Stent Is Better !*



David Hildick-Smith at EuroPCR 2023

**At 3 years,** the combined rate of death, MI, and revascularization **was similar for provisional versus systematic dual stenting** (23% vs 29%;  $P = 0.13$ ). Also similar were death (10% vs 13%;  $P = 0.27$ ) and MI (12% vs 11%;  $P = 0.75$ ).

**Yet the TLR rate was significantly lower with the provisional strategy (8% vs 14%;  $P = 0.02$ ); most of these repeat interventions occurred in the ostium of the circumflex.**

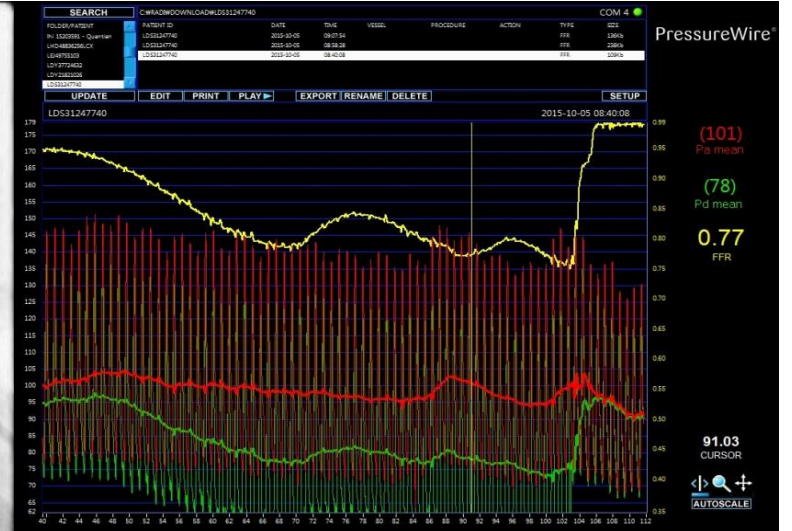
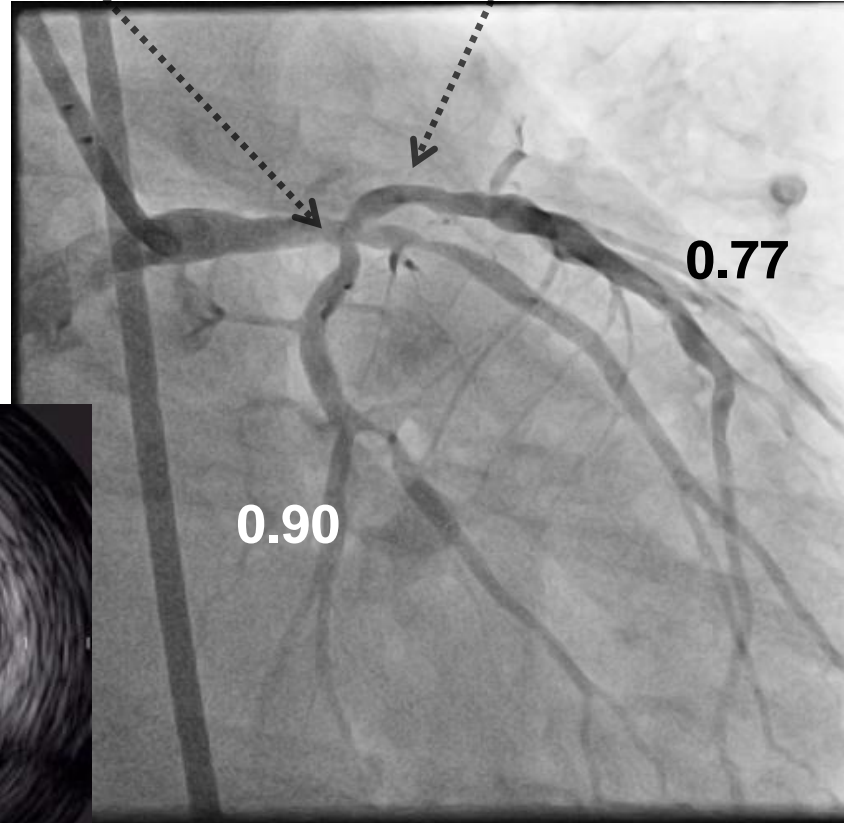
**Interestingly,**  
**EBC, They Have No idea of Image and Physiology !**

# 1. Main Remaining Issue

Seems To be *TLR of LCX Ostium ?*

LM Distal  
MLA 5.3 mm<sup>2</sup>

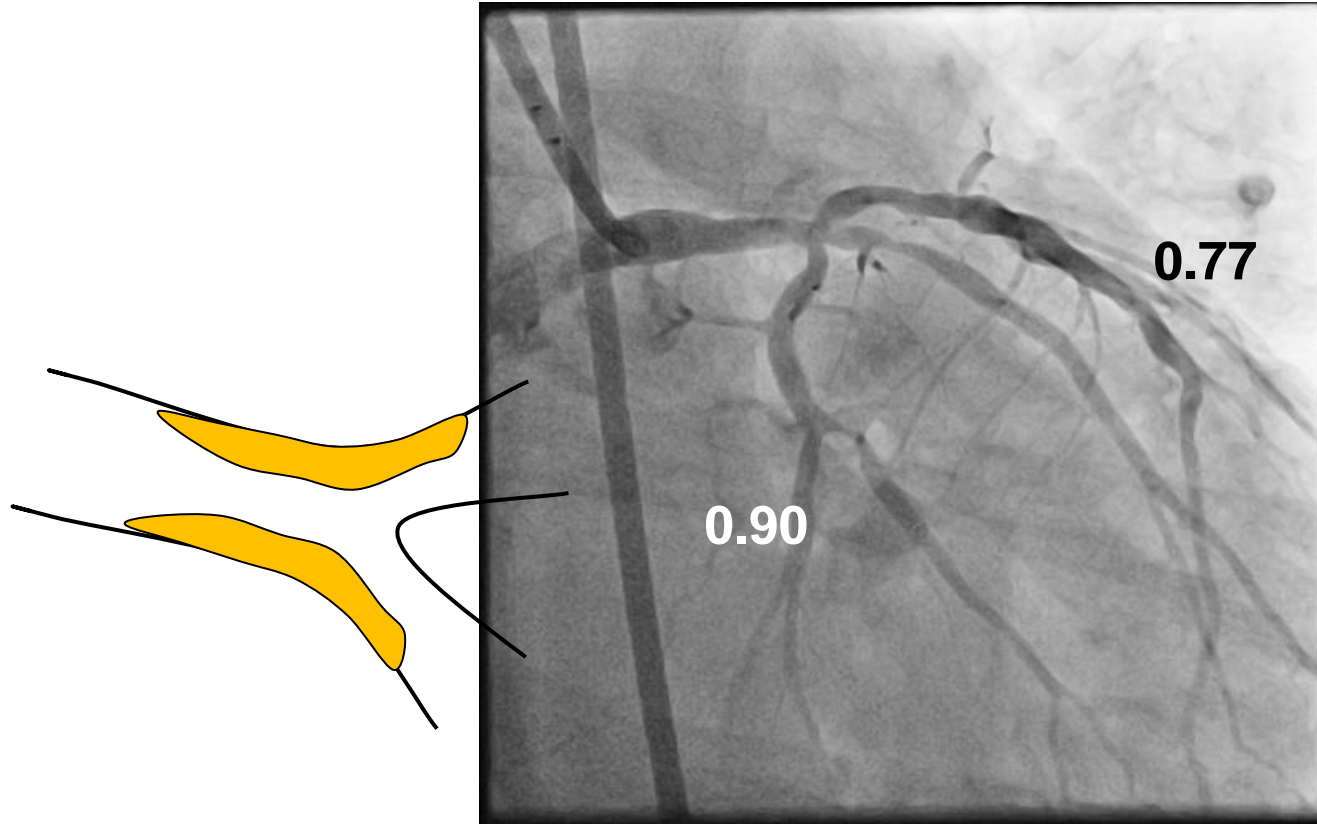
pLAD, MLA 3.2 mm<sup>2</sup>  
FFR 0.77



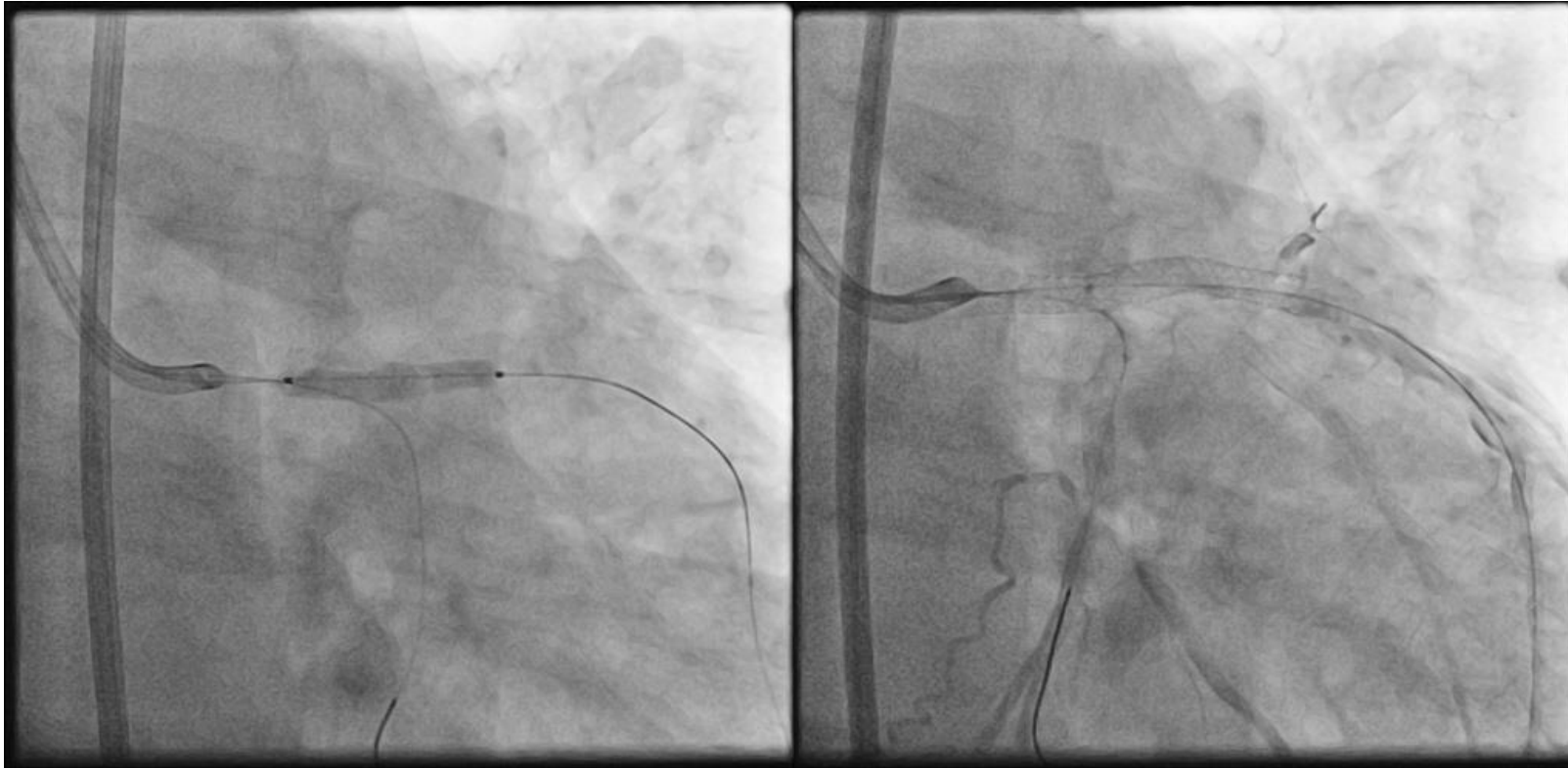
pLCX, MLA 3.3 mm<sup>2</sup>  
FFR 0.90



# How to Treat?

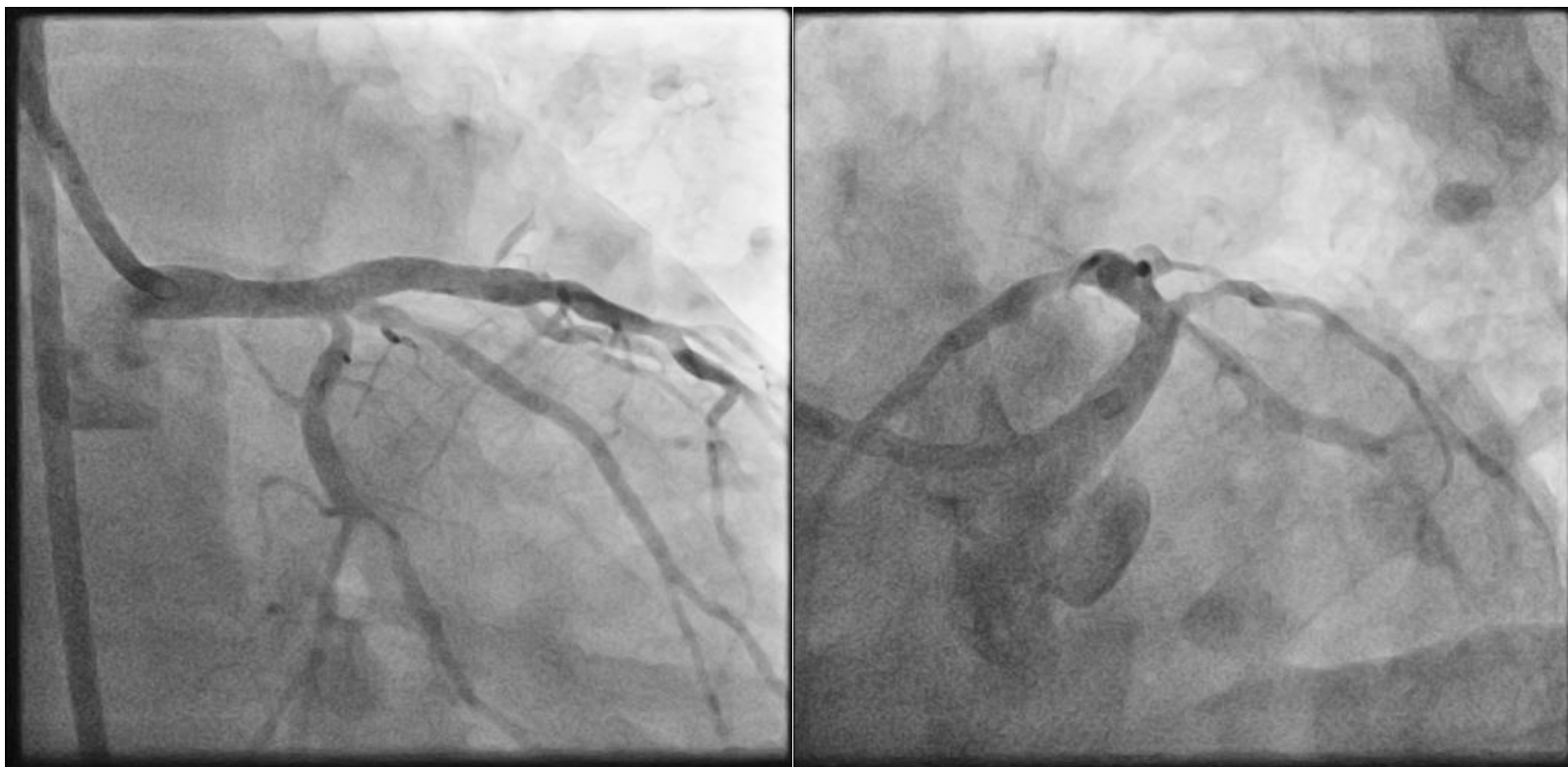


# 1 Stent Crossover

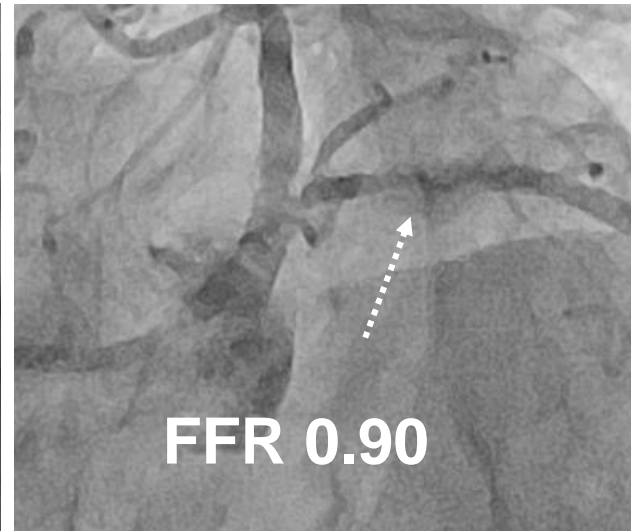
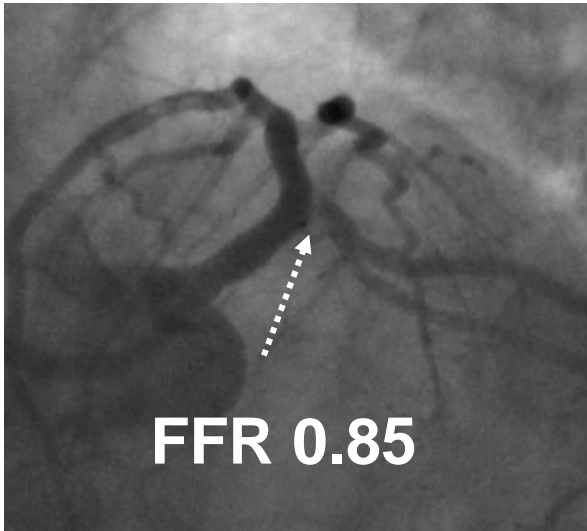
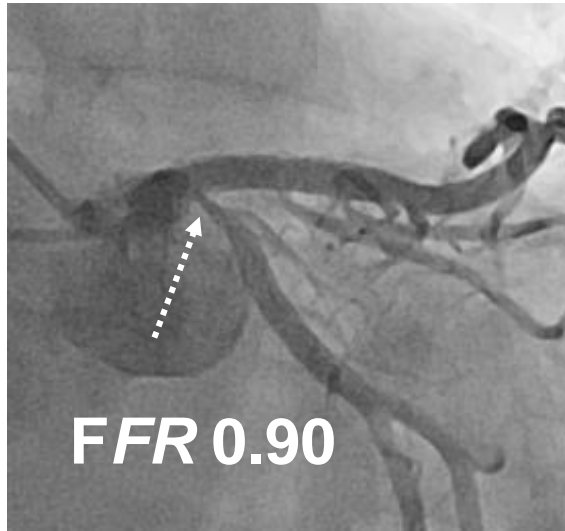


XIENCE Alpine  
4.0mm x 30mm

# Final Angiogram

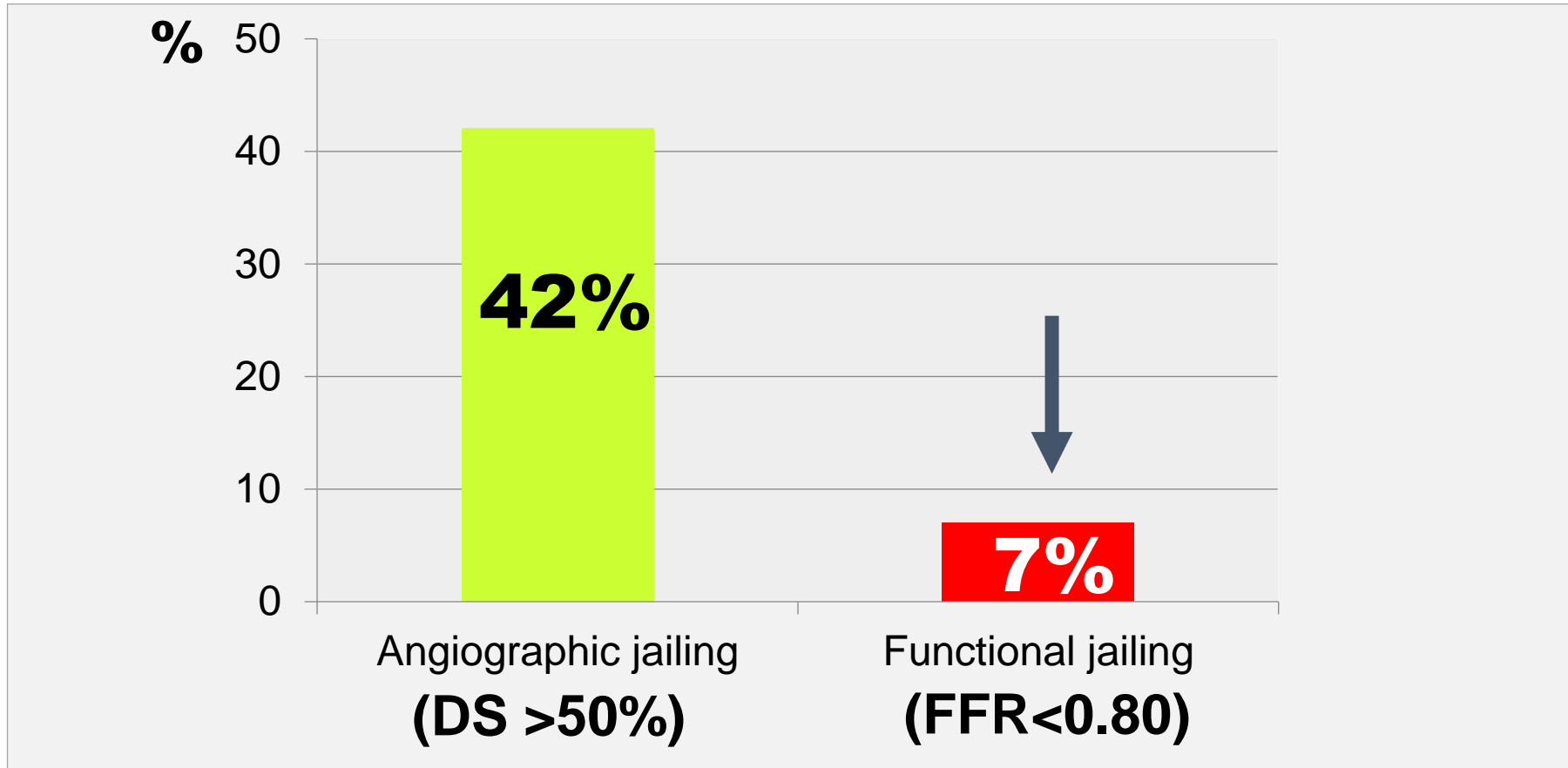


***We Have To Realize,  
There are **Many Mismatches** Between  
Morphologic LCX Jailing and FFR***



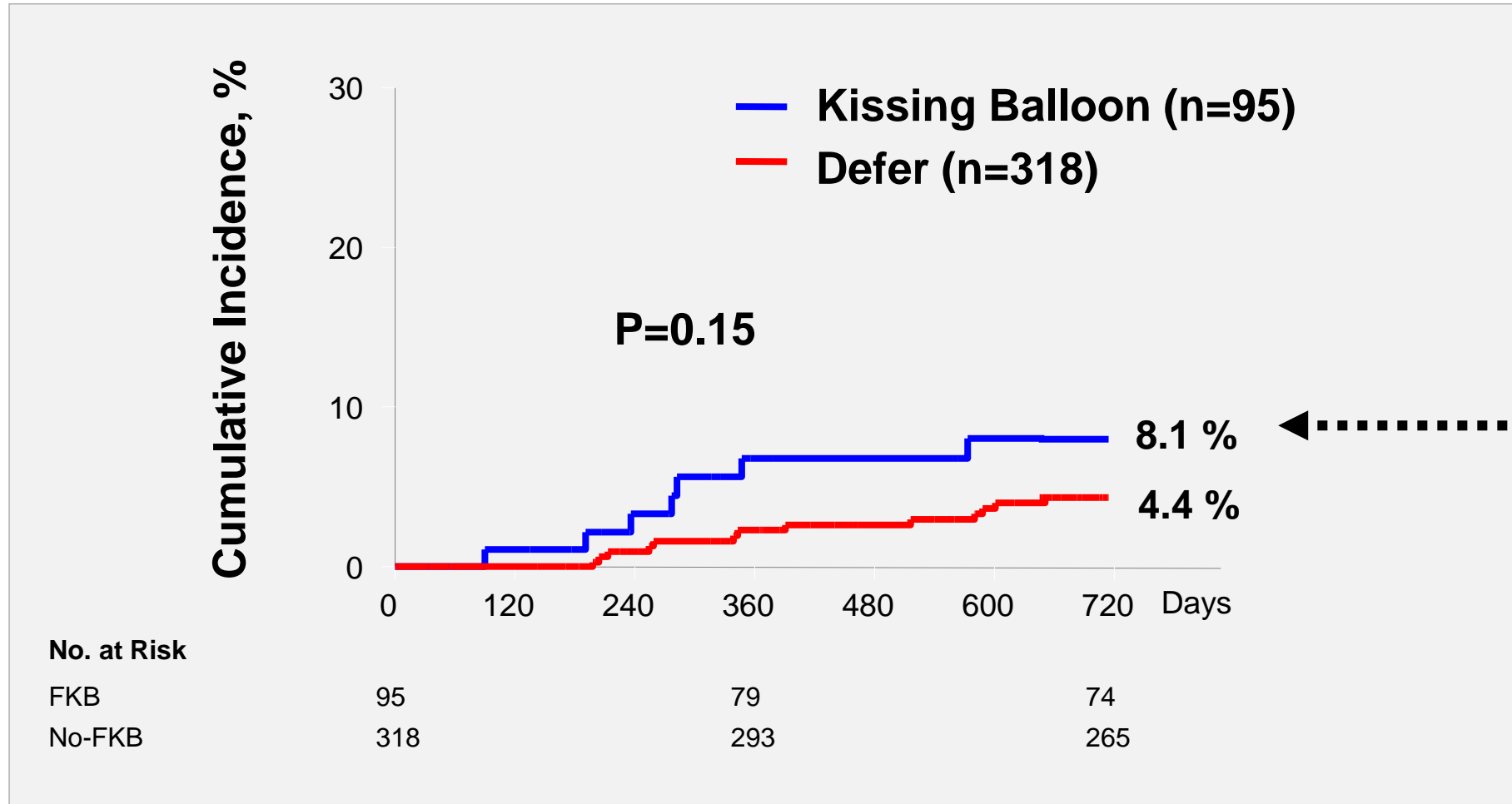


# Functionally Significant LCX Jailing Is Only 7%



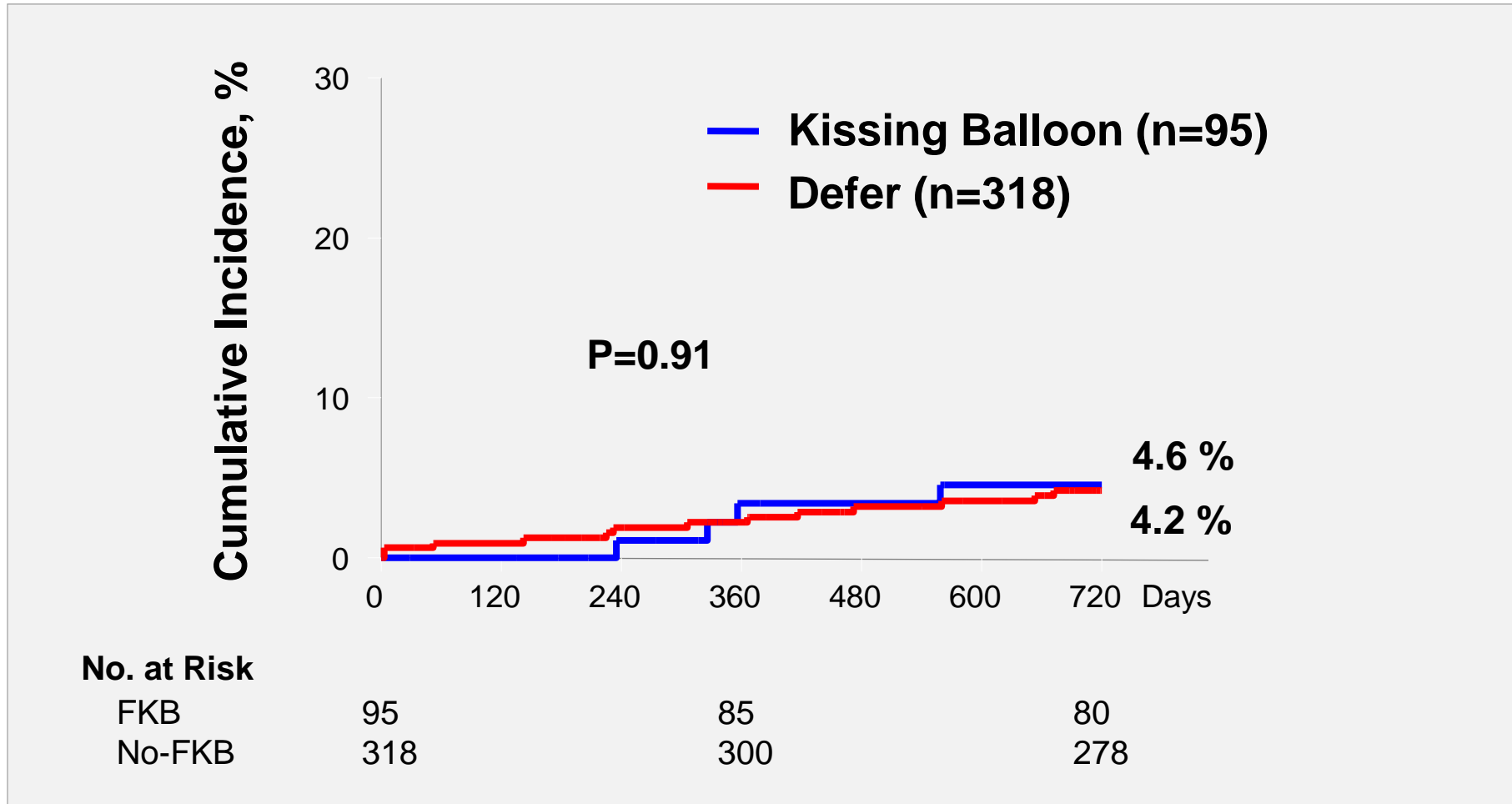
# TLR at 2 Years

*If You Do Touch, May Increase TLR ?*

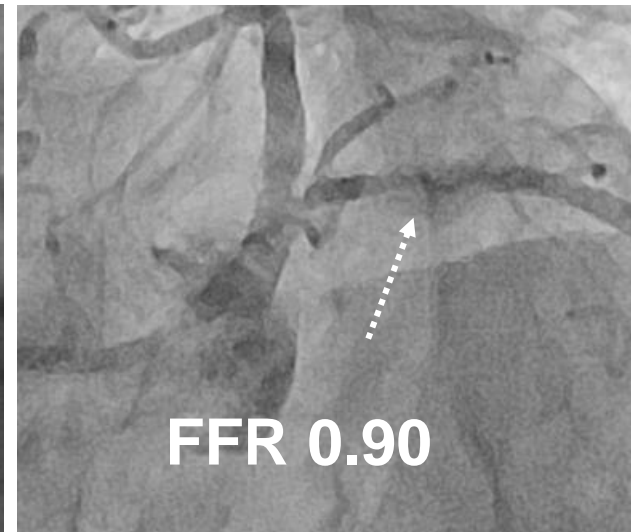
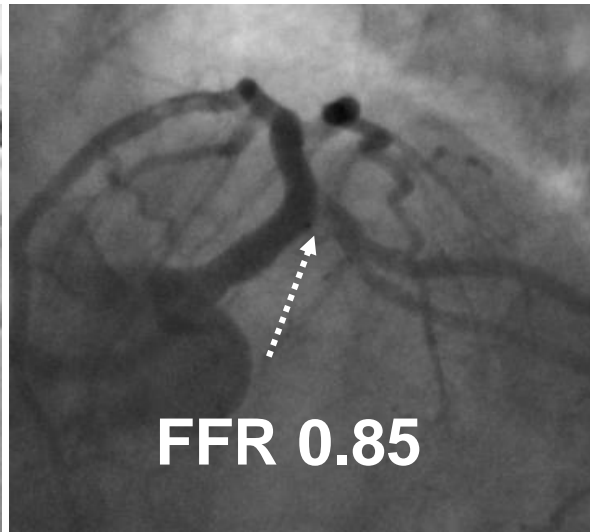
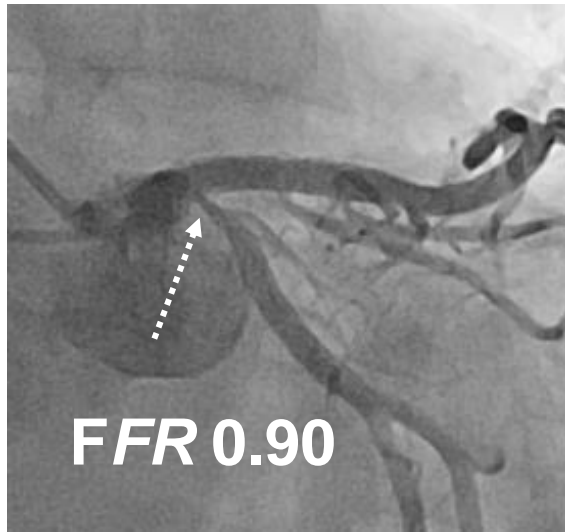


# Death or MI at 2 Years

***No Difference !***

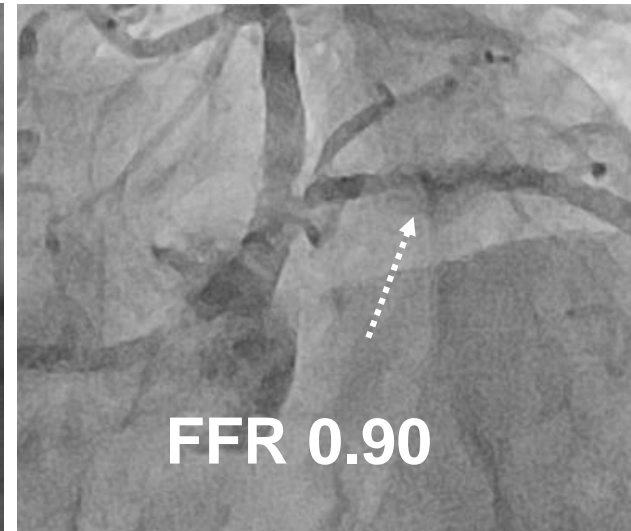
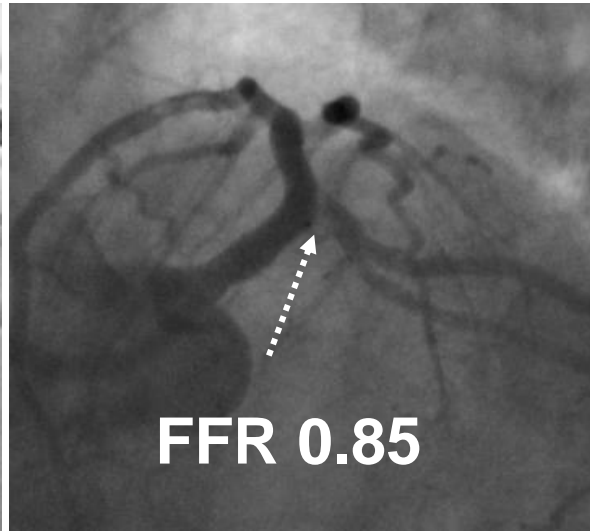
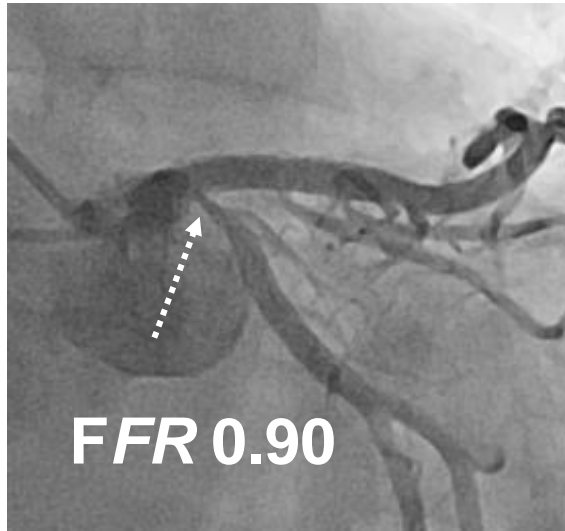


**Don't Touch!**  
**Leave It Alone !**



***If They Have No Understanding About Mismatches of Imaging and Physiology, There May be No Choice But to Treat Based on the Angiographic Ambiguity.***

**Don't Touch!**  
**Leave It Alone !**



***If They Have Idea About Mismatches of Imaging and Physiology, They Can Avoid Unnecessary Procedures.***

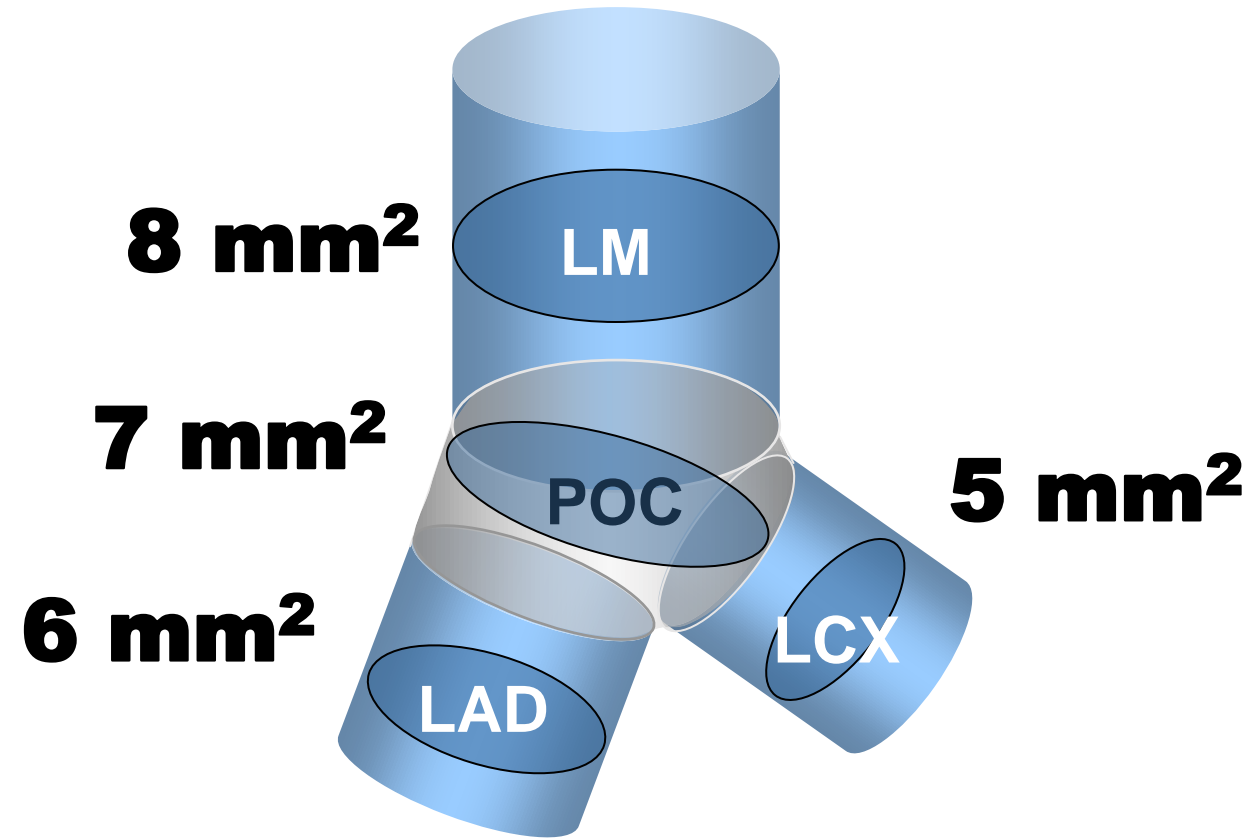
## 2. EBC, They Have No Idea about *IVUS Optimization !*

# **Upfront 2 Stent Strategies** **for True LM Bifurcation Disease**

***Whatever You Used Any 2 Stents Technique,  
The Only Important Predictor for Good Clinical Outcomes  
Is Post-Stenting Minimal Stent Area (MSA)!***

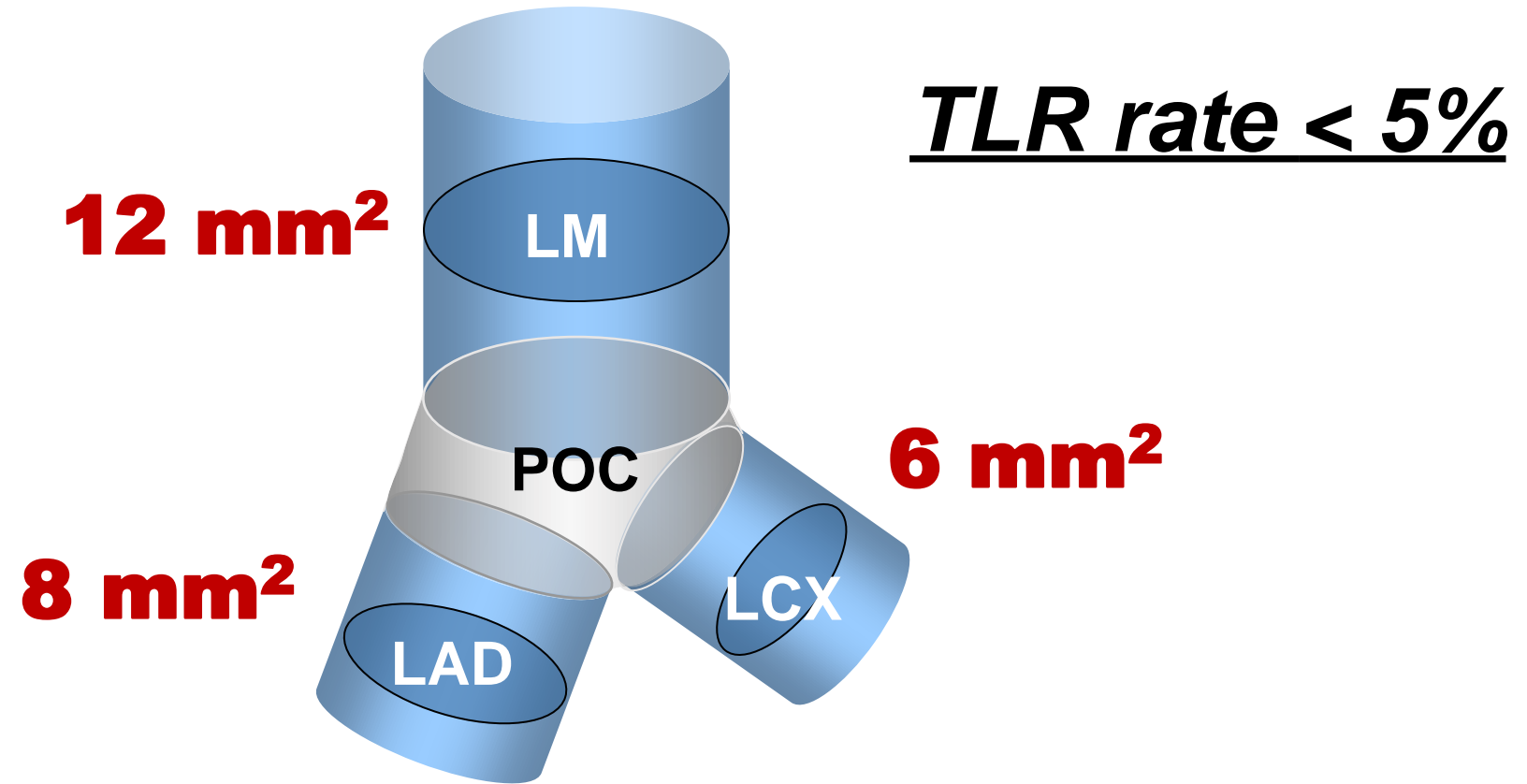
Ahn JM, et al, Preliminary Data from IRIS LM Registry, 2022  
Zhang JJ, Ye F, Xu K, et al. Eur Heart J 2020;Jun 26 (DEFINITION 2)  
Cheol Hyun Lee, et al. Catheter Cardiovasc Interv. 2021;97:776–785.

# Post-Stenting Minimal Stent Area, According to 9 Month Restenosis Rate





# Post-Stenting Minimal Stent Area, According to 5 Year MACE Rate

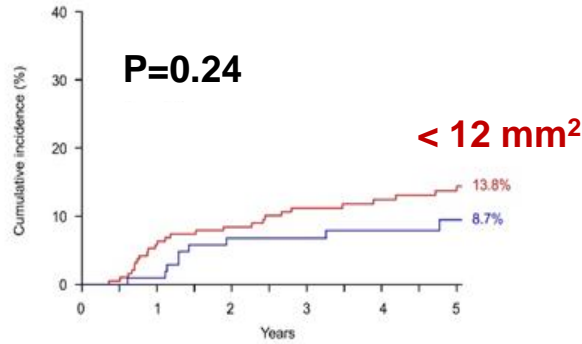


**LM**  
Cutoff **12 mm<sup>2</sup>**

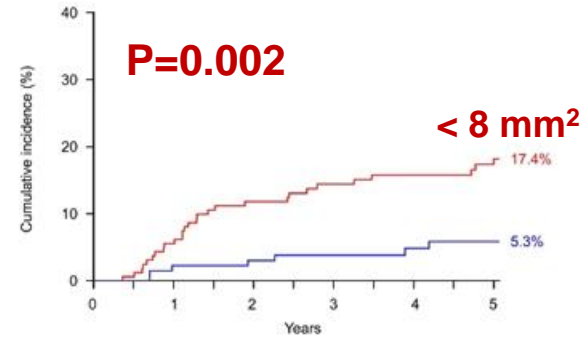
**LAD**  
Cutoff **8 mm<sup>2</sup>**

**LCX**  
Cutoff **6 mm<sup>2</sup>**

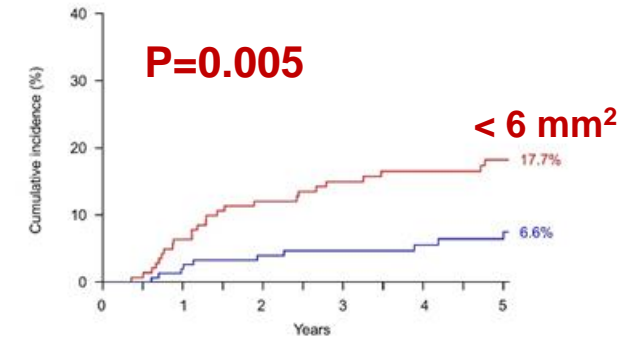
## Major Adverse Cardiac Event (Death, MI, TLR)



< 11.8 mm <sup>2</sup>	189	178	173	155	141	125
≥ 11.8 mm <sup>2</sup>	103	102	94	87	67	56

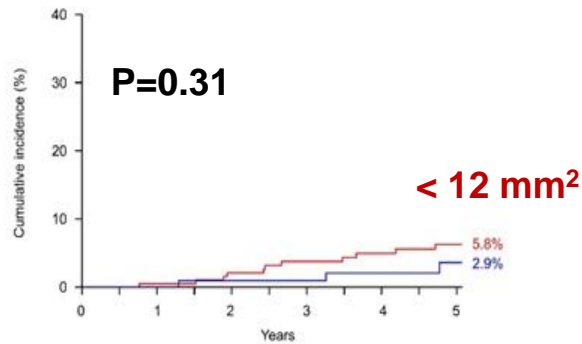


< 8.3 mm <sup>2</sup>	161	152	142	128	114	98
≥ 8.3 mm <sup>2</sup>	131	128	125	114	94	83

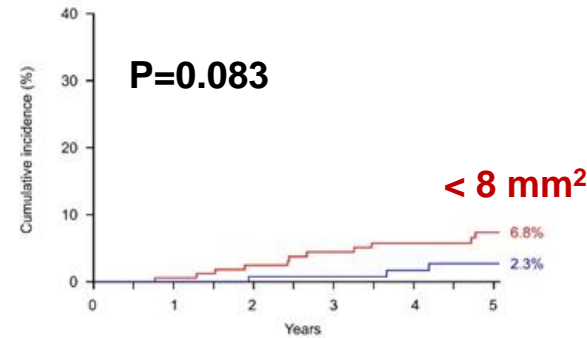


< 5.7 mm <sup>2</sup>	141	132	124	114	103	93
≥ 5.7 mm <sup>2</sup>	151	148	143	128	105	88

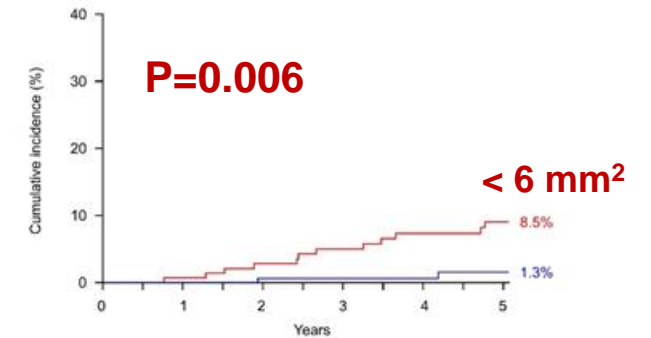
## All Cause Mortality



< 11.8 mm <sup>2</sup>	189	188	185	168	152	135
≥ 11.8 mm <sup>2</sup>	103	103	100	93	72	60



< 8.3 mm <sup>2</sup>	161	160	157	143	128	111
≥ 8.3 mm <sup>2</sup>	131	131	128	118	96	84



< 5.7 mm <sup>2</sup>	141	140	137	127	114	103
≥ 5.7 mm <sup>2</sup>	151	151	148	134	110	92

*Post-Stenting Minimal Stent Area,  
According to 5 Year MACE Rate*

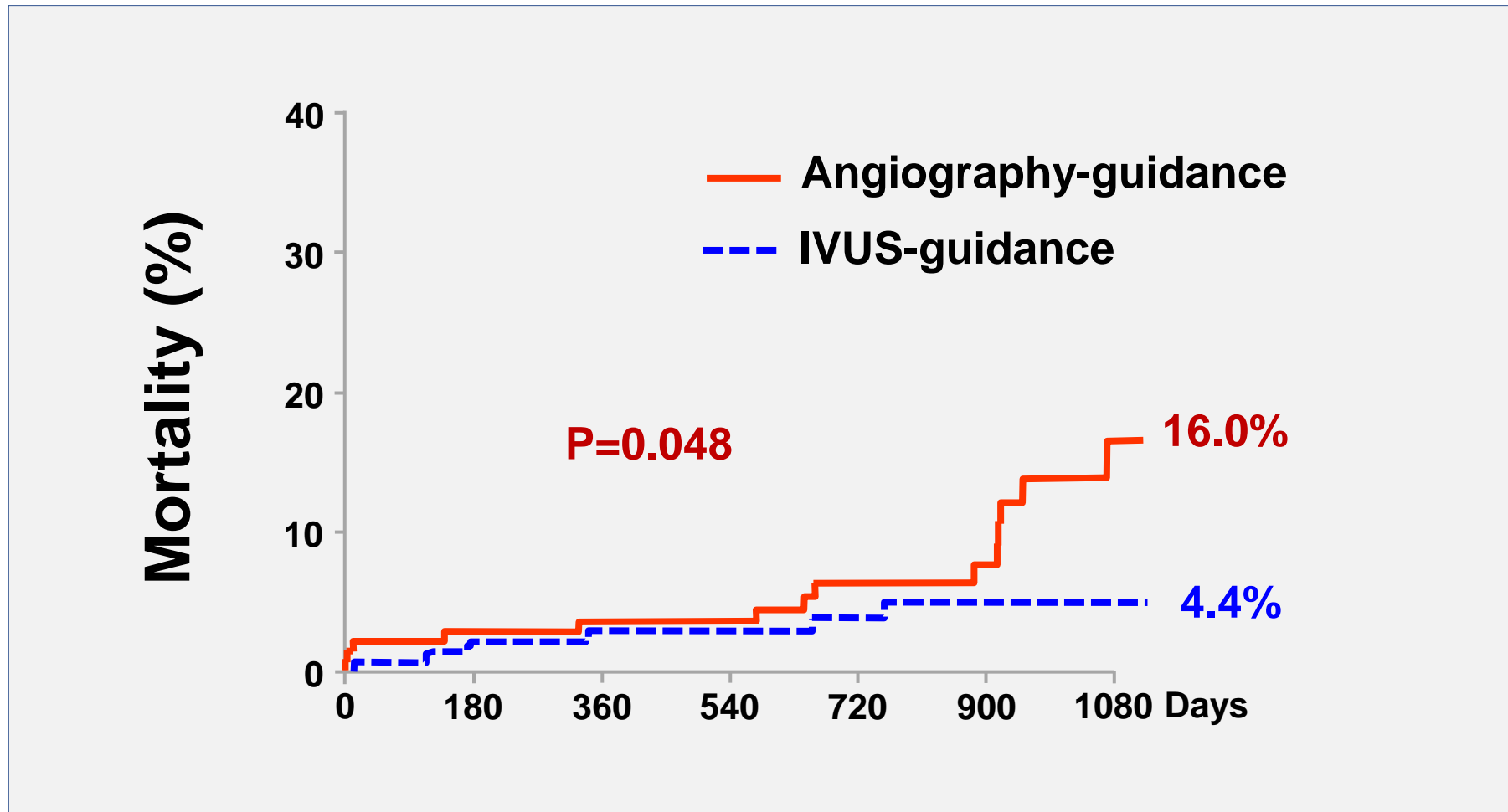
***The Bigger, The Better,***

**8 mm<sup>2</sup>**



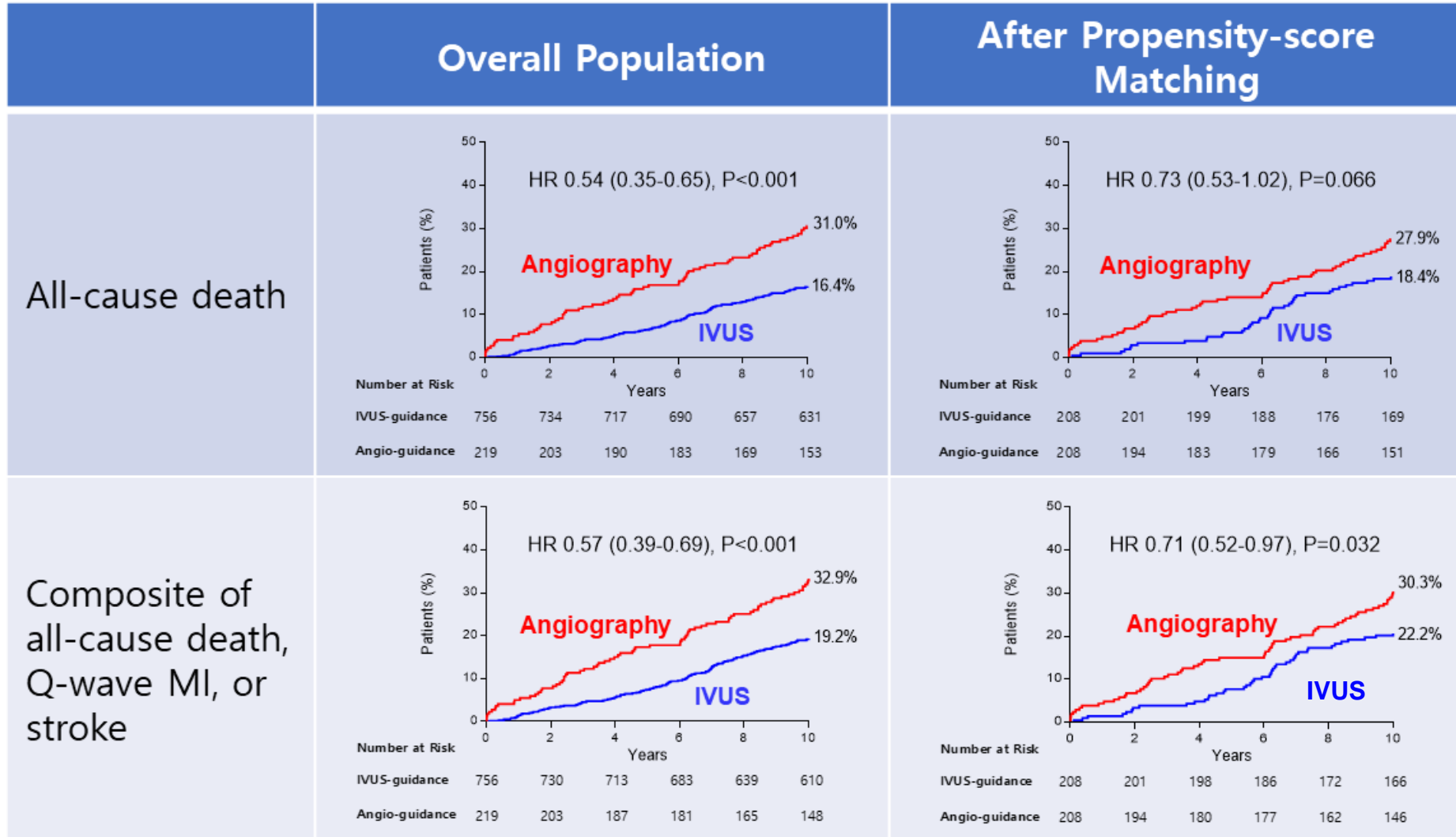
# IVUS-Guidance

## MAIN-COMPARE 3-Year FU



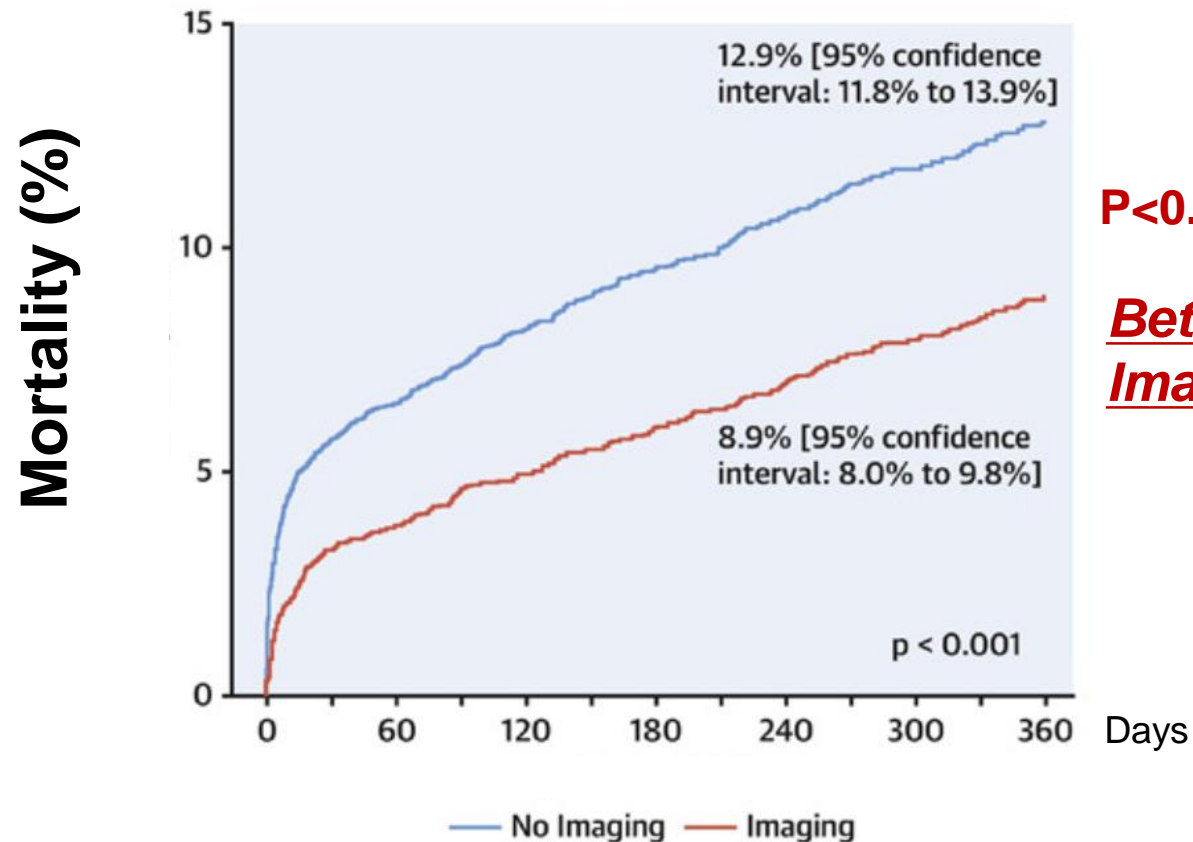
# IVUS-Guidance

## MAIN-COMPARE 10-Year FU



# Imaging-Guidance

## Propensity Matching 5,056 Pairs of LM PCI British Cardiovascular Intervention Society (BCIS) Registry Data at 1 Year



**$P < 0.001$**

**Better Survival !**  
**Imaging Guided**

***Clearly,***  
***IVUS Guided LM PCI***  
***Can Improved Survival !***

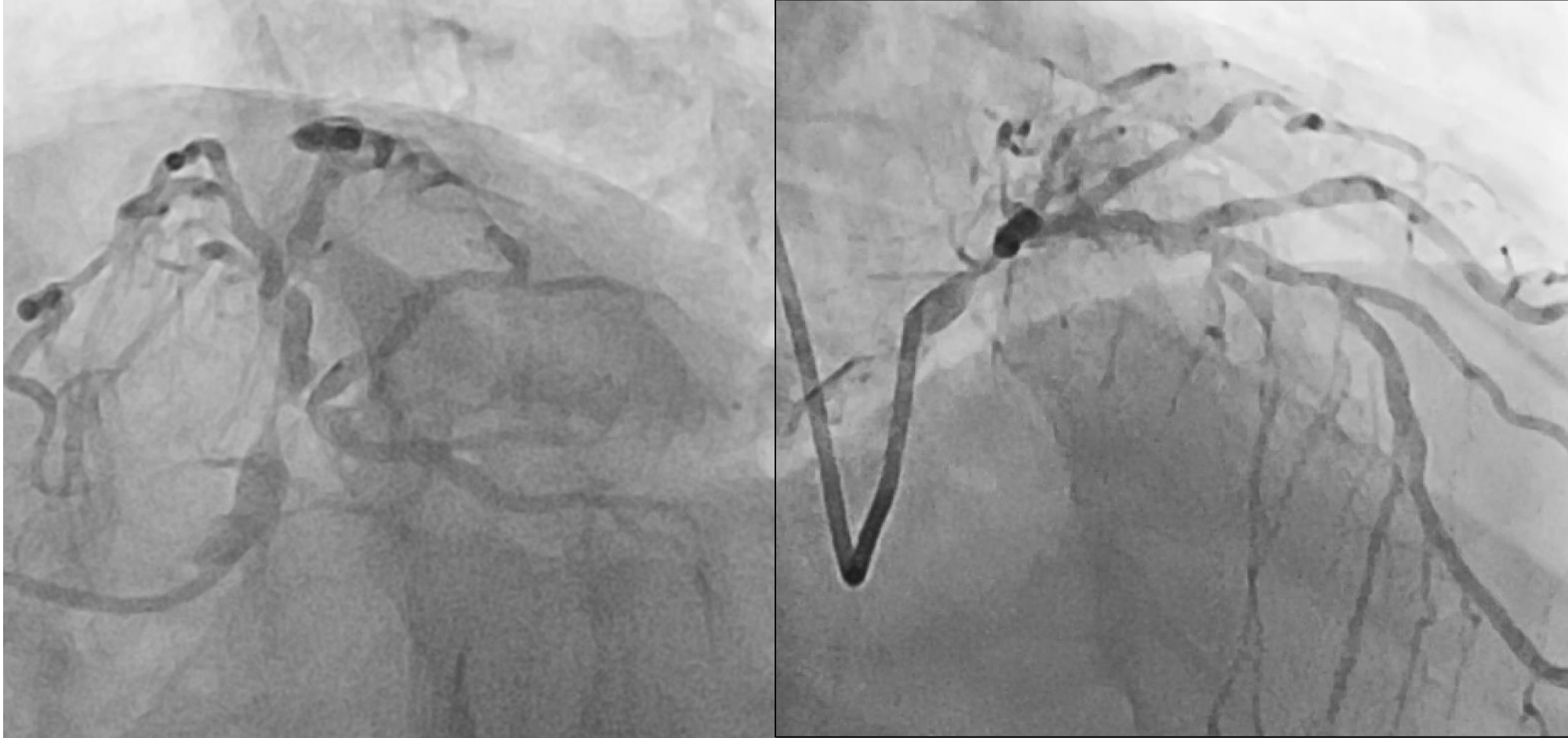
# **Upfront 2 Stents for True Bifurcation**



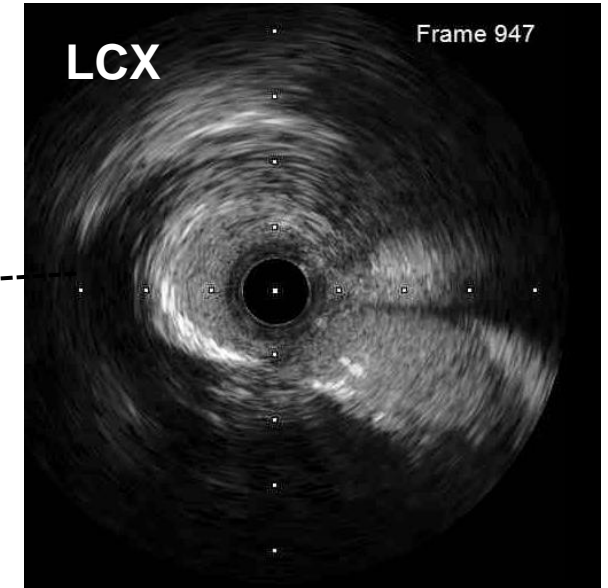
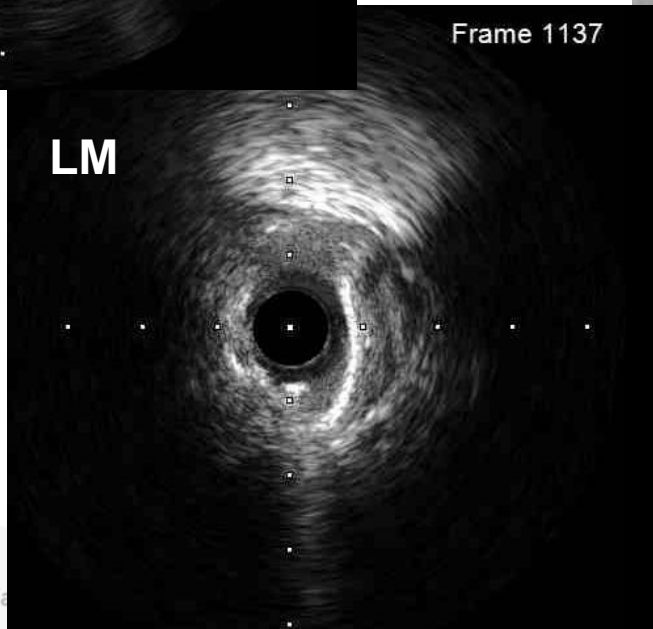
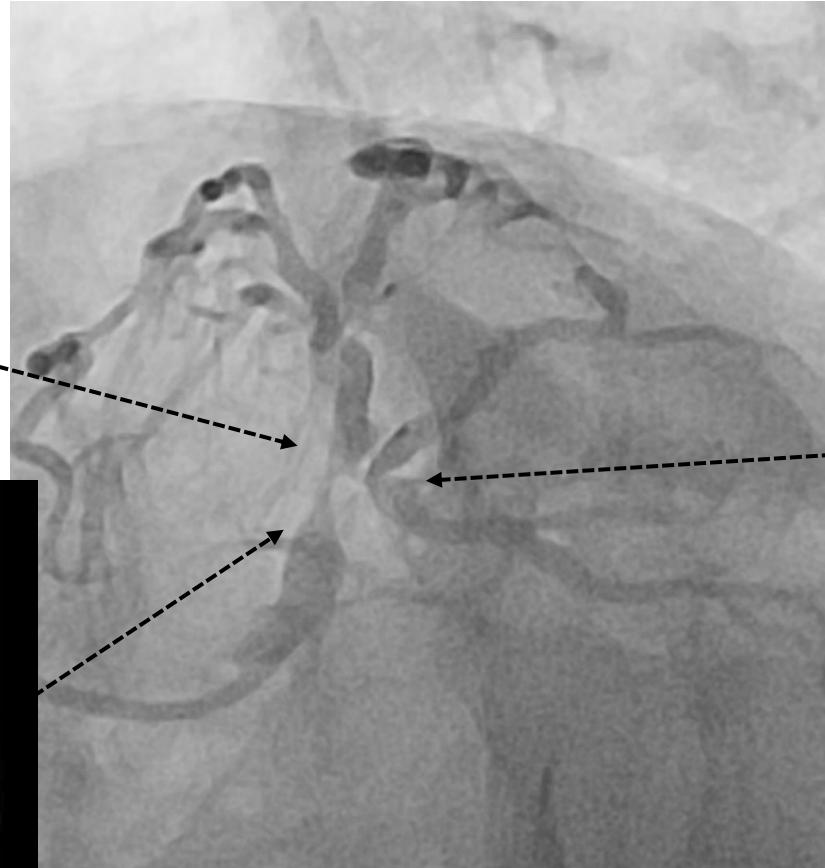
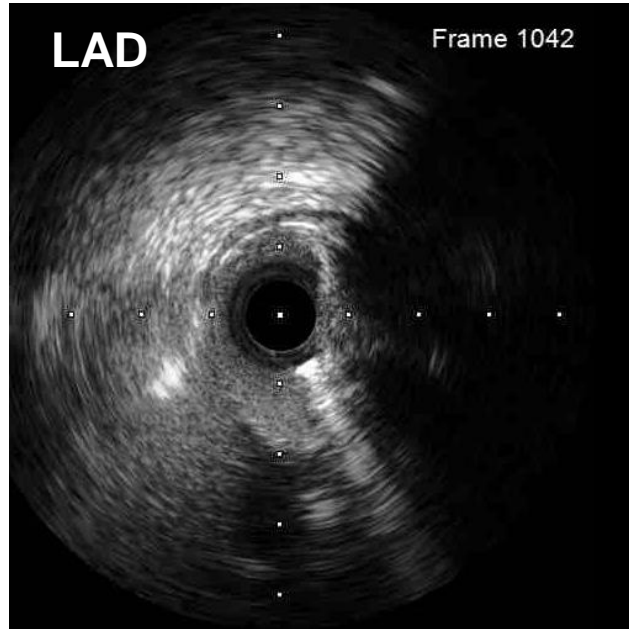
# Calcific LM Bifurcation Disease



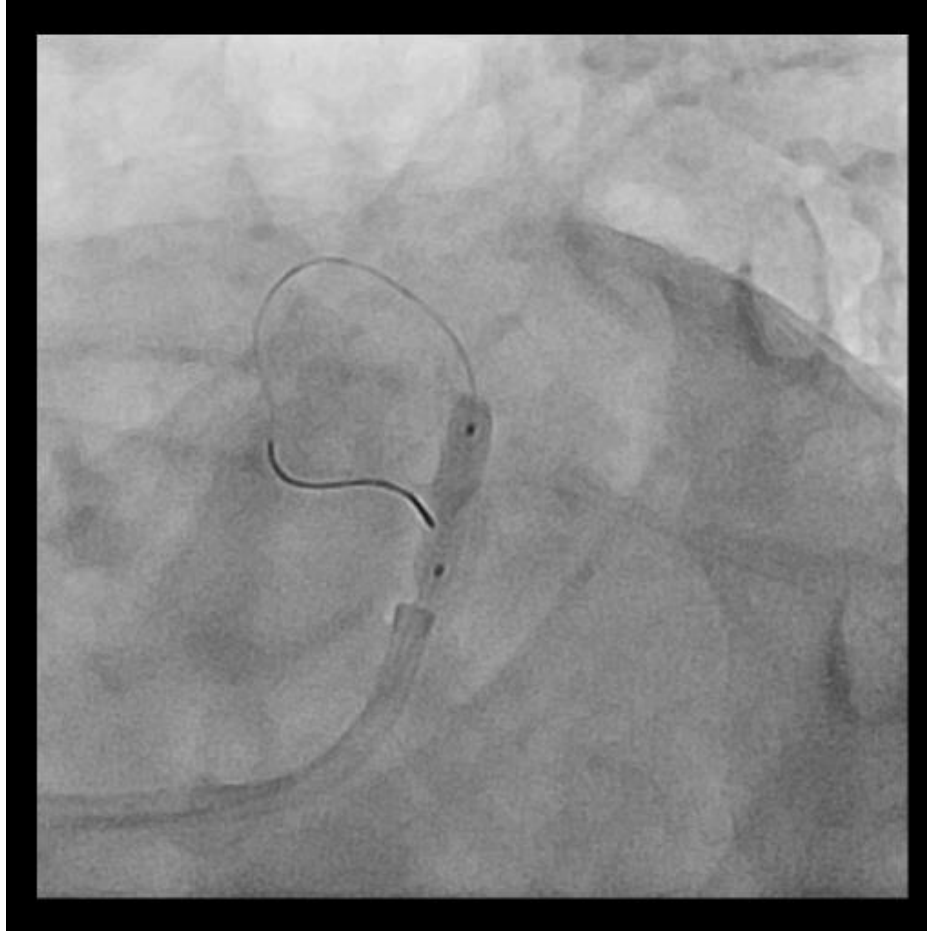
# Calcific LM Bifurcation Disease



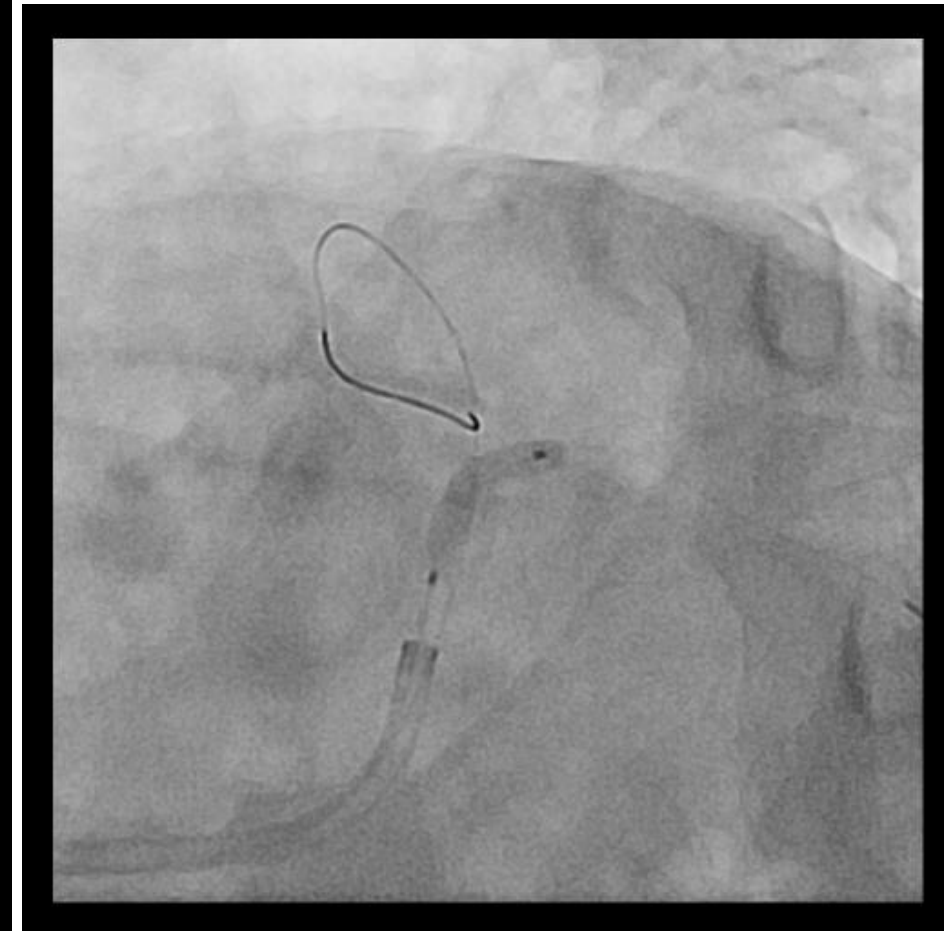
# IVUS – Heavy Calcification of LM



# Pre-Lesion Modification



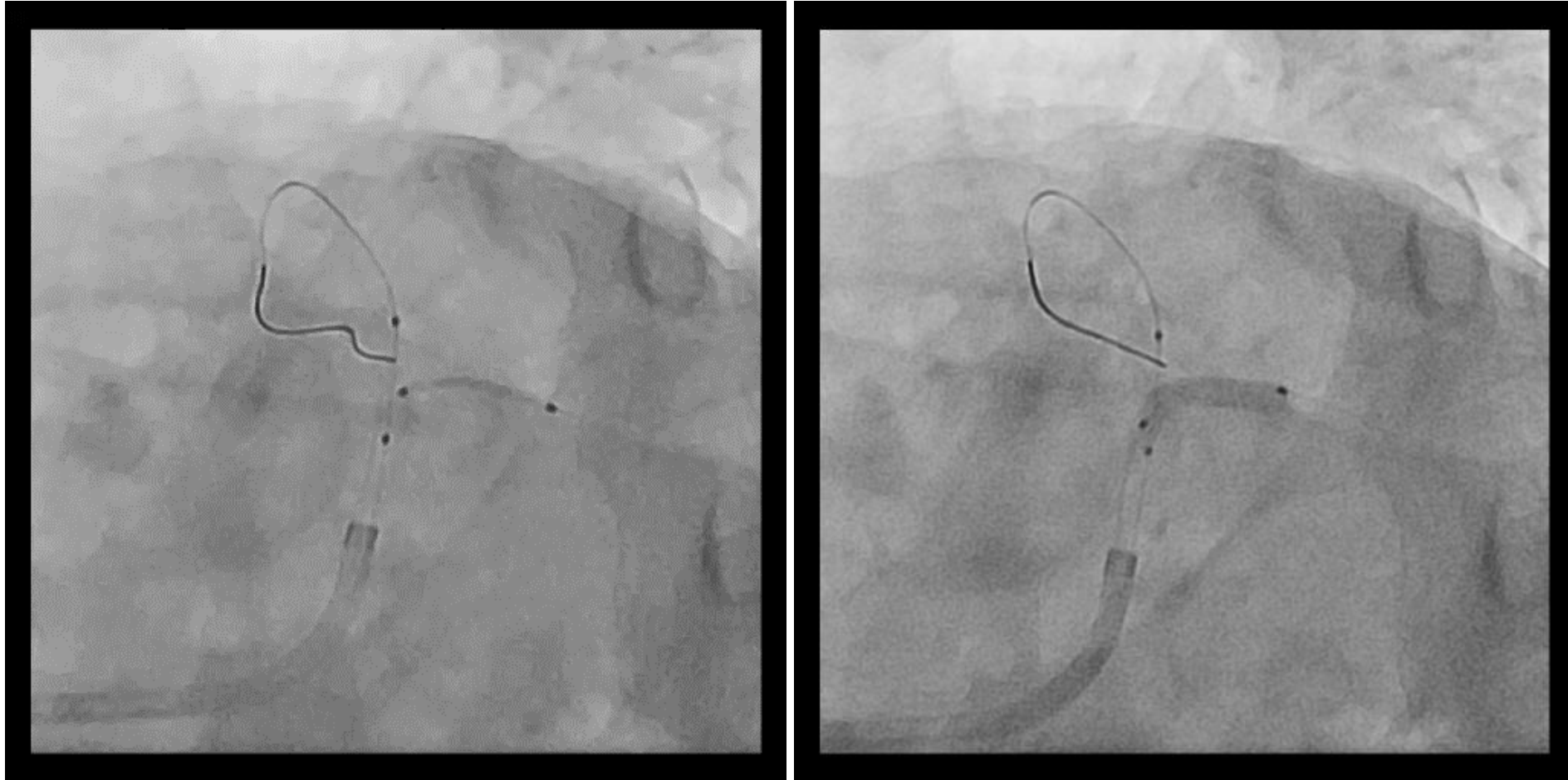
**LAD : NC 3.5 (15) upto 24 atm**



**LCX : NC 3.0 (15) upto 22 atm**

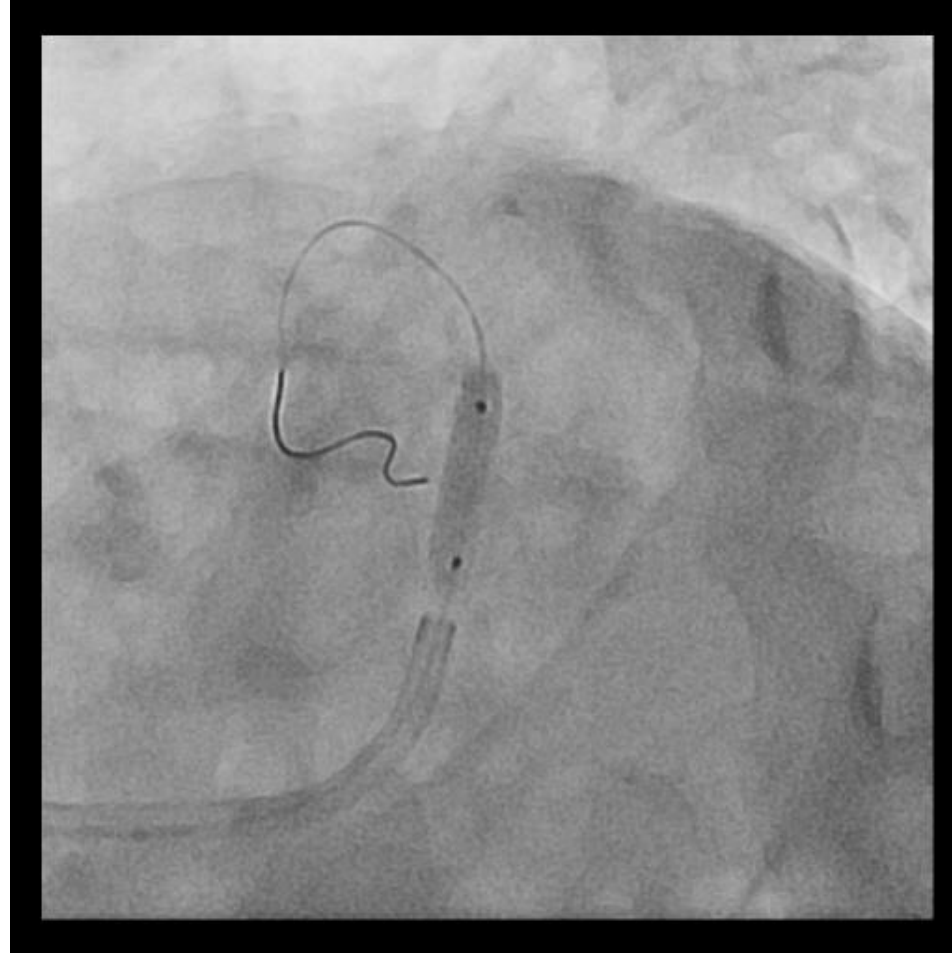


# Side Branch Stenting



LCX : Xience 2.75 \* 15 at 14 atm (2.9)

# Balloon Crush Technique



**LM-pLAD : NC 3.5 upto 16-22 atm (3.6-3.8)**

# LM-LAD Stent Implantation

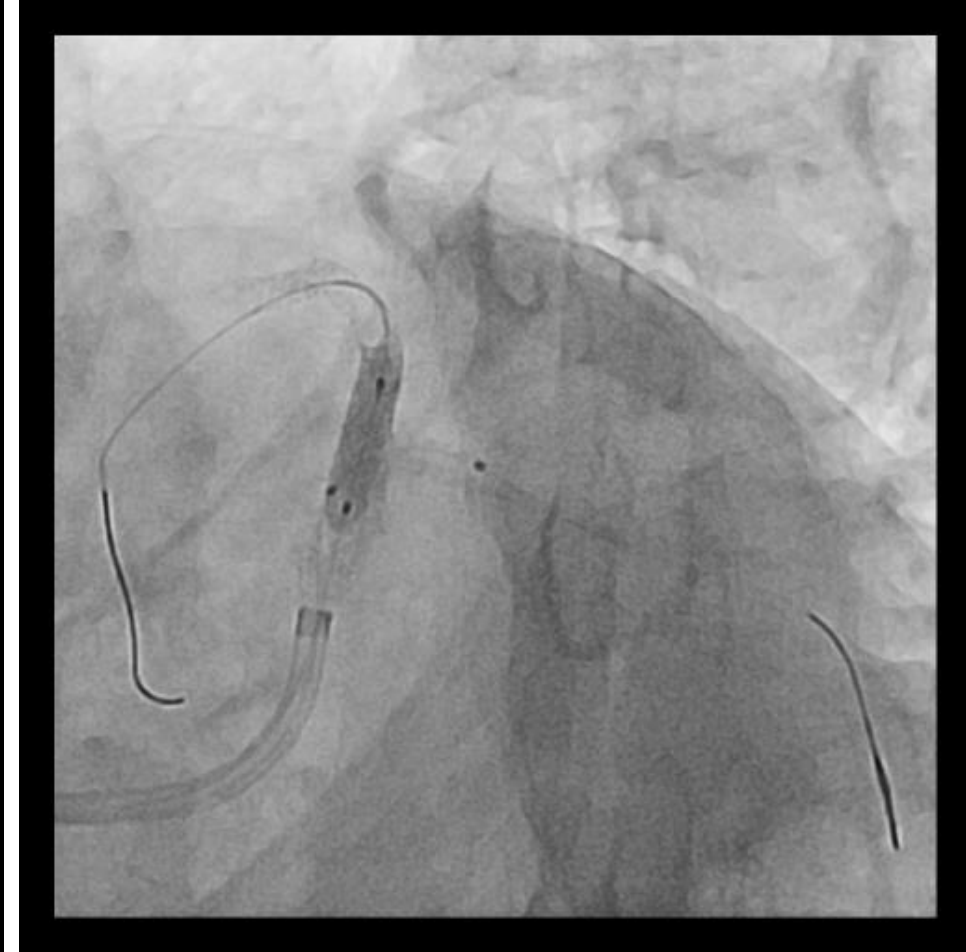


LM-pLAD : Xience 3.5 \* 28 at 12 atm (3.5)

# Sequential High Pressure



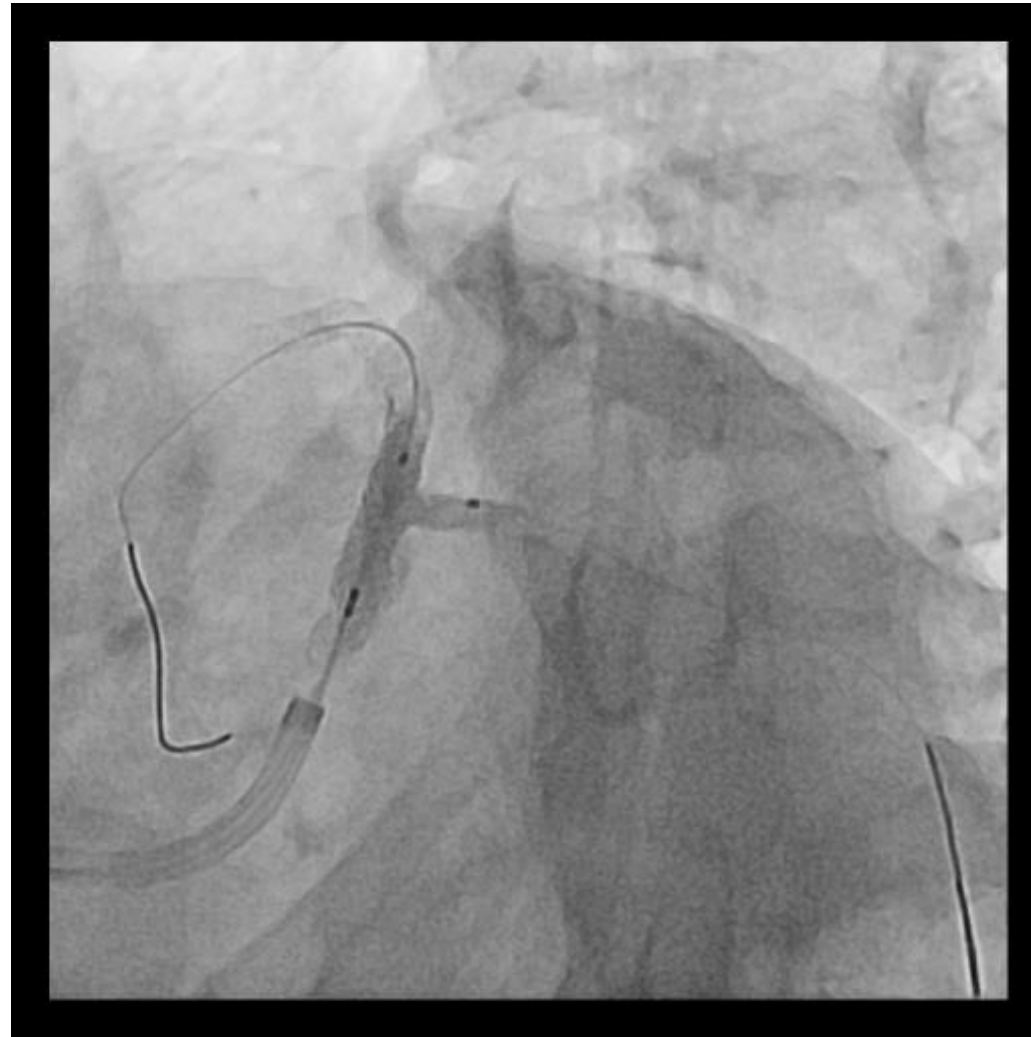
NC 3.0 (15) upto 22 atm



NC 3.5 (15) upto 24 atm



# Final Kissing Balloon



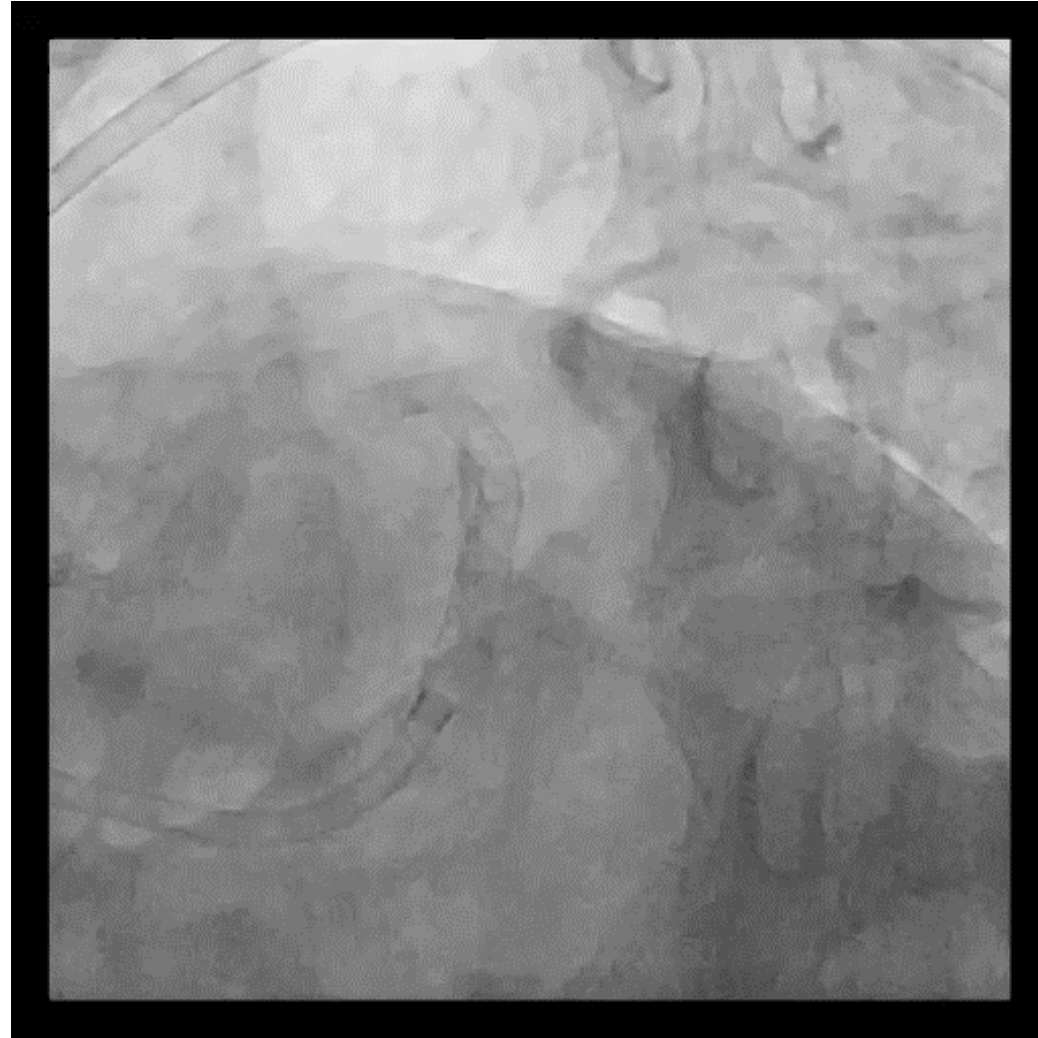
**LM-LAD : NC 3.5 up to 3.5 (10 atm)**  
**LM-LCX : NC 3.0 up to 3.0 (10 atm)**

# High Pressure Balloon Again for LM



NC 4.5 up to 4.8 (20 atm)

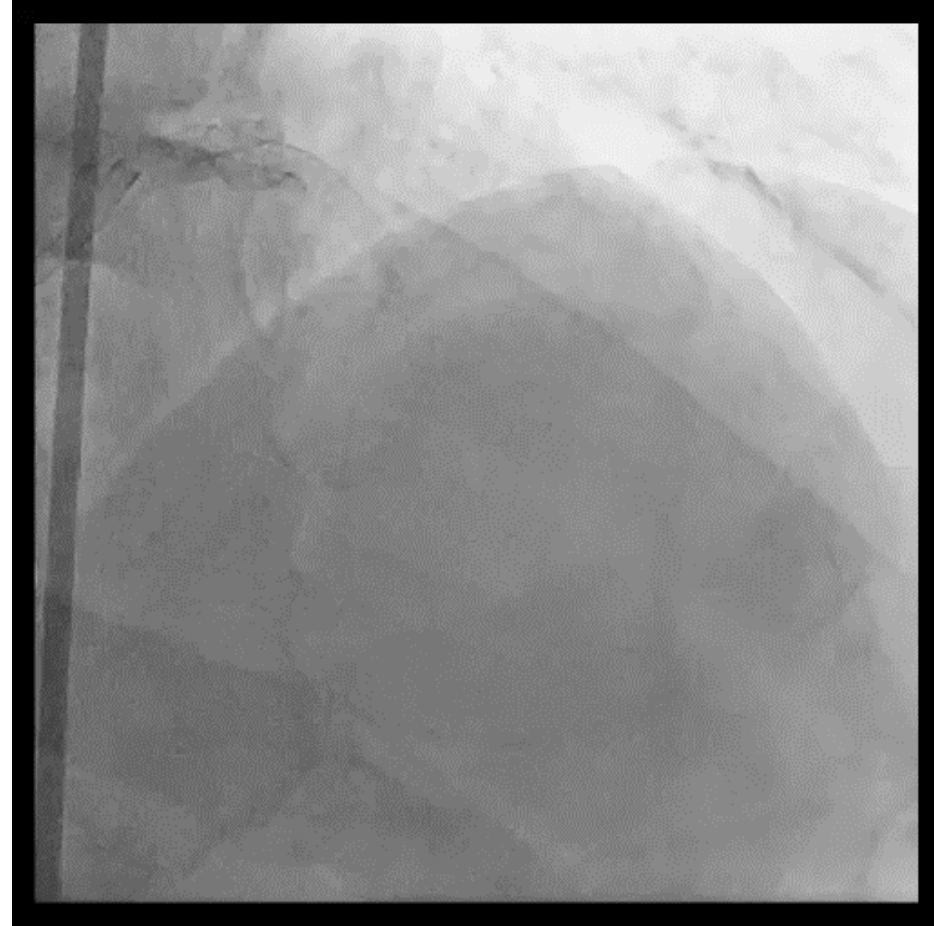
# Final angiography



# Final angiography



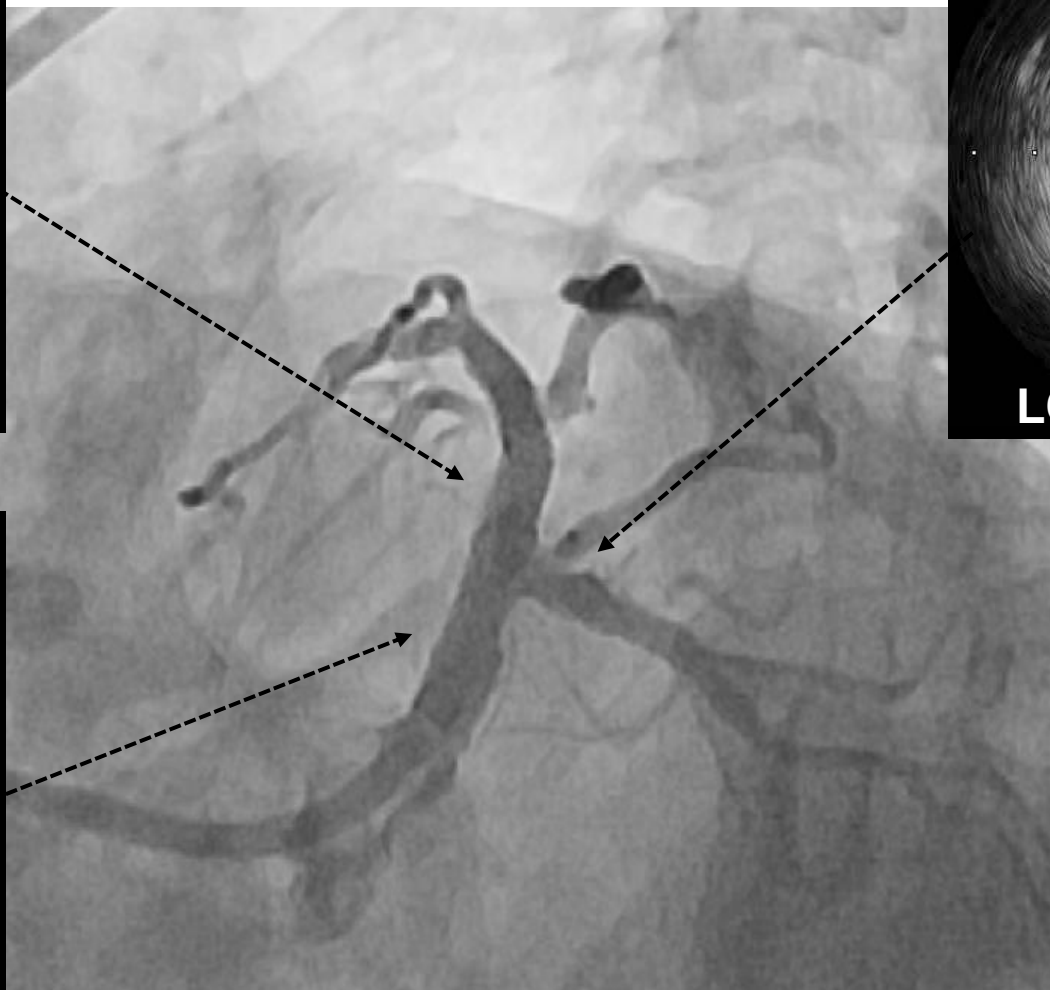
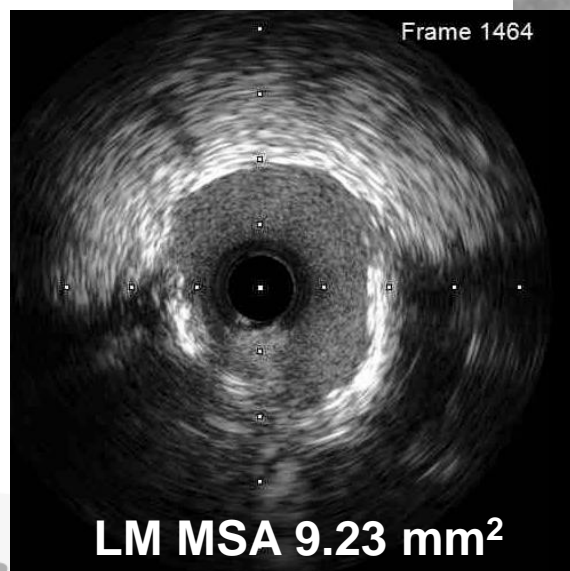
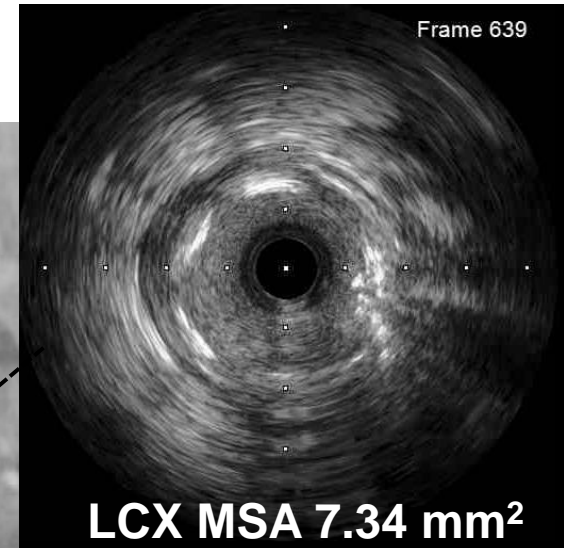
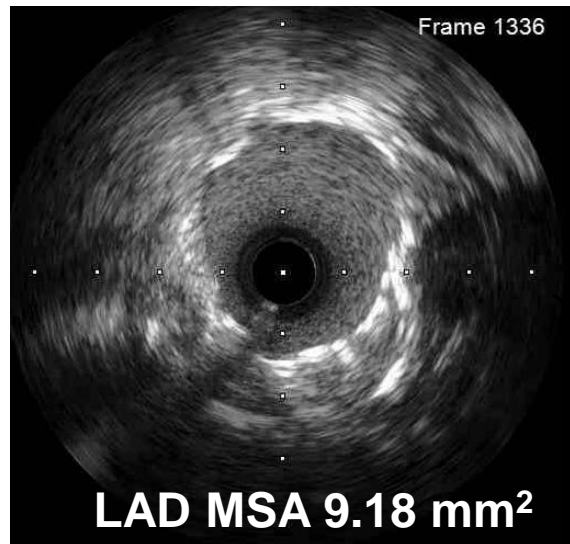
**AP CAUDAL**



**AP CRANIAL**



# Final IVUS



# **Concept and Technique** **for Left Main PCI 2023**

- 1. Evolving Concept ; Imaging and Physiology  
Guided PCI Can Improve Clinical Outcomes.**
- 2. Evolving Technique ; Upfront 2 stents for True  
Bifurcation LM Disease Is Safe and Good !**

**F**ractional Flow Reserve versus **A**ngiography for **T**reatment-Decision and **E**valuation of Significant Left **MAIN** Coronary Artery Disease

## **FATE-MAIN Trial**

**930 Patients with Significant (Angiographic Diameter Stenosis  $\geq 50\%$ ) Left Main Coronary Artery Disease Who Were Eligible for PCI**

1:1 randomization stratified by (1) participating sites and (2) the presence of concomitant non-left main PCI

**FFR-Guided LM PCI  
(N = 465)**

**Angiography-Guided LM PCI  
(N = 465)**

**The primary end point was the composite of death from any cause, myocardial infarction, hospitalization for unstable angina, heart failure, or resuscitated cardiac arrest, or repeat revascularization at 1 year.**



**Thank You !!**

**summitMD.com**