

## Complex Lesions: Left Main, Bifurcations, Tandem, and More

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# Why We Need FFR in LM Disease?

- Inaccuracy of Coronary Angiogram
- Insufficiency of Non-Invasive Functional Study
- FFR guided PCI in LMCA showed favorable outcomes

# Major Randomized Studies in LM

## ORIGINAL ARTICLE

### Outcomes in Patients With De Novo Left Main Disease Treated With Either Percutaneous Coronary Intervention

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doi:10.1016/j.jacc.2007.09.054

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## CLINICAL RESEARCH

## Interventional Cardiology

### Randomized Comparison of Percutaneous Coronary Intervention With Sirolimus-Eluting Stents Versus Coronary Artery Bypass Grafting in Unprotected Left Main Stem Stenosis

Enno Boudriot, MD,\* Holger Thiele, MD,\* Thomas Walther, MD,† Christoph Liebetrau, MD,\*  
Dietmar Boudriot, MD,† Thomas B. H. MD,† Rainer B. H. MD,† Hans-J. M. MD,†

Patients age 18 to 80 years with stenosis ( $\geq 50\%$ ) of the ULM with or without additional multivessel coronary artery disease were included in this multicenter study. Patients had

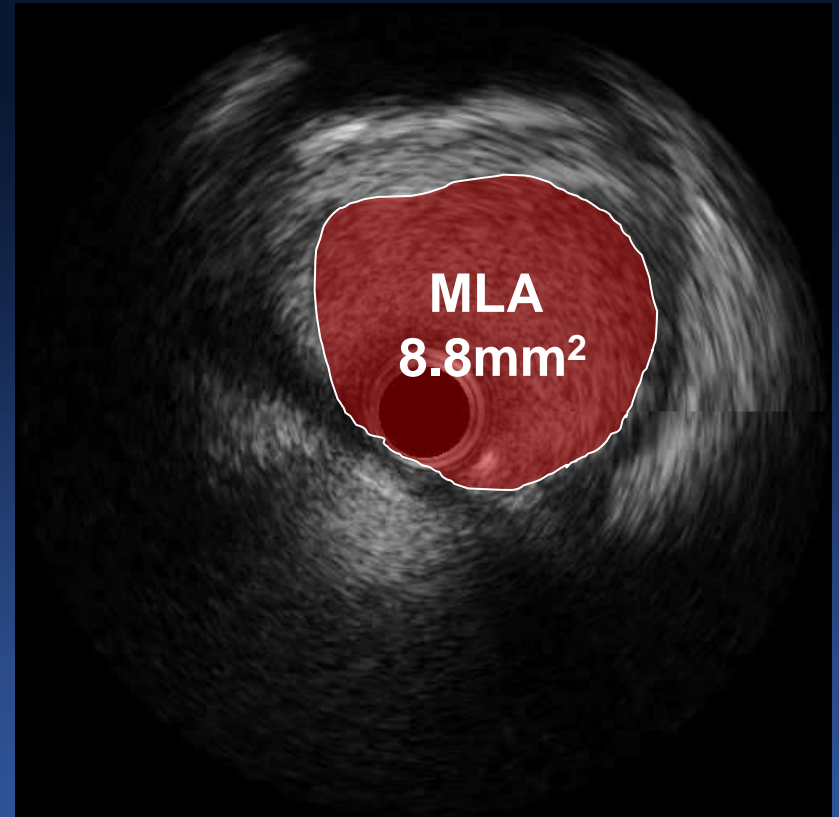
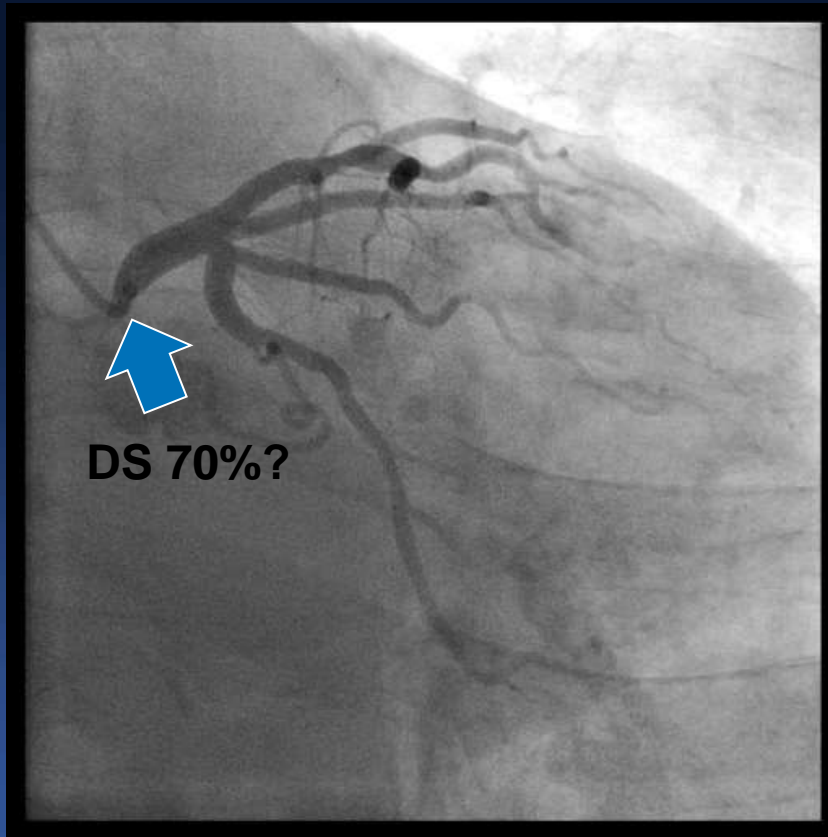
#### Background

CABG is considered the standard of care for treatment of ULM. Improvements in percutaneous coronary intervention (PCI) with use of drug-eluting stents might lead to similar results. The effectiveness of drug-eluting stenting versus surgery has not been established in a randomized trial.

#### Methods

In this prospective, multicenter, randomized trial, 201 patients with ULM disease were randomly assigned to

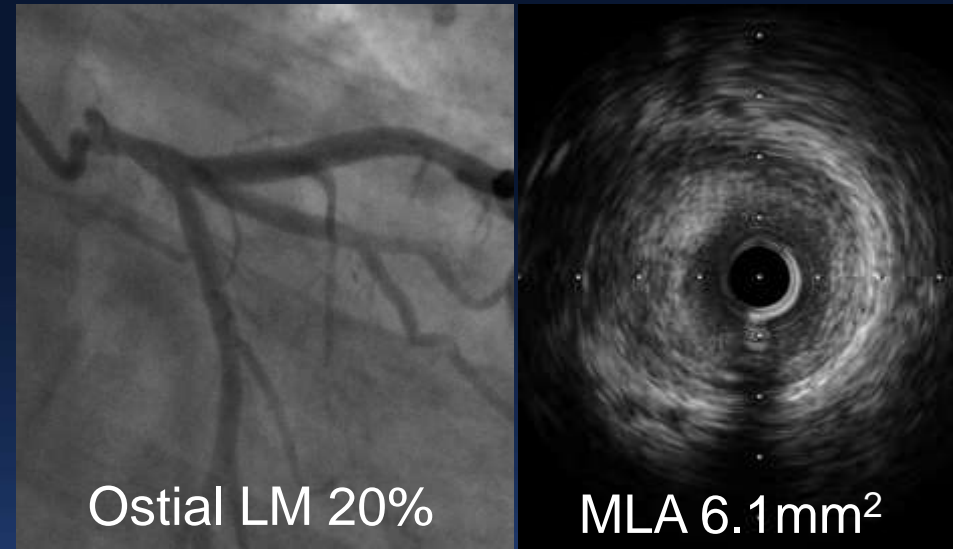
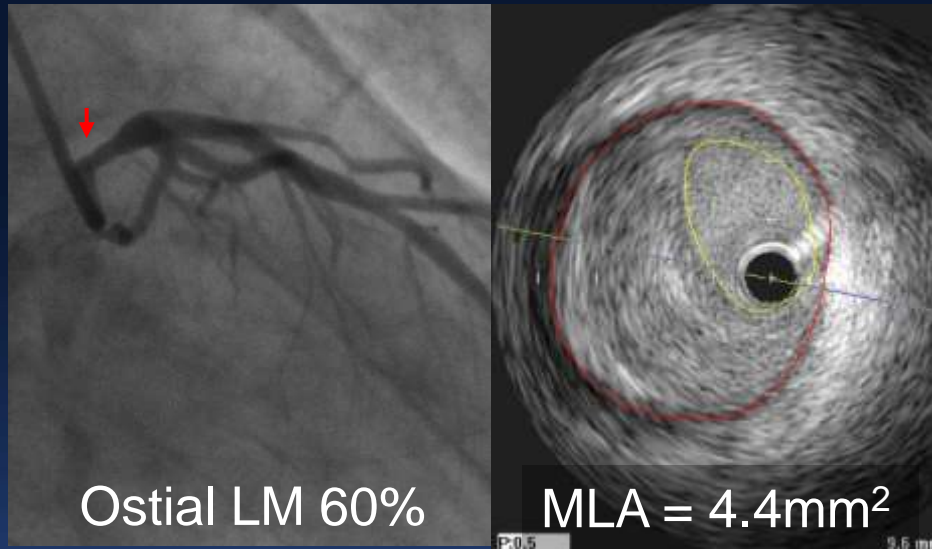
# Why We Need FFR?



# Why We Need FFR in LM?

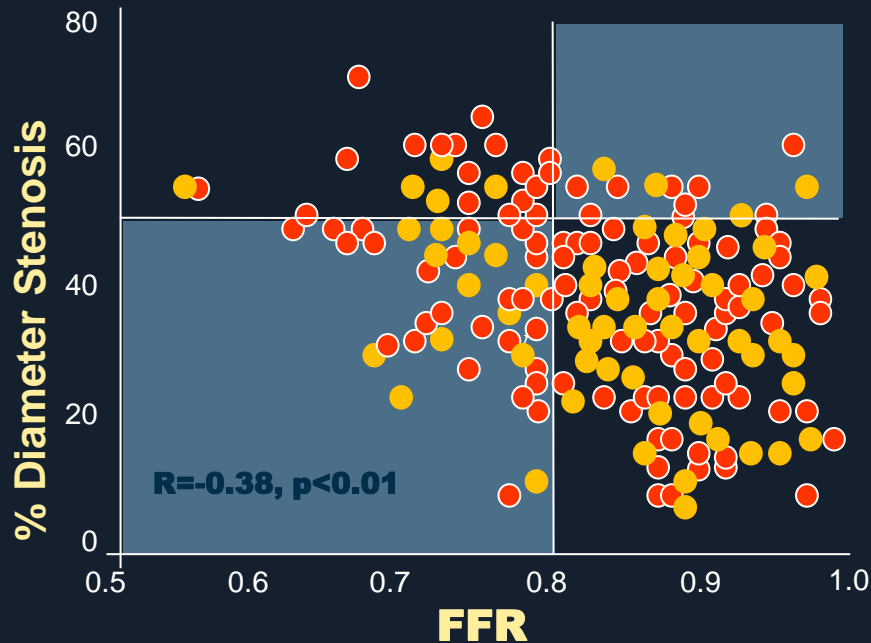
47/M Stable angina

50/M Stable angina



# FFR and %DS in Equivocal LMCA

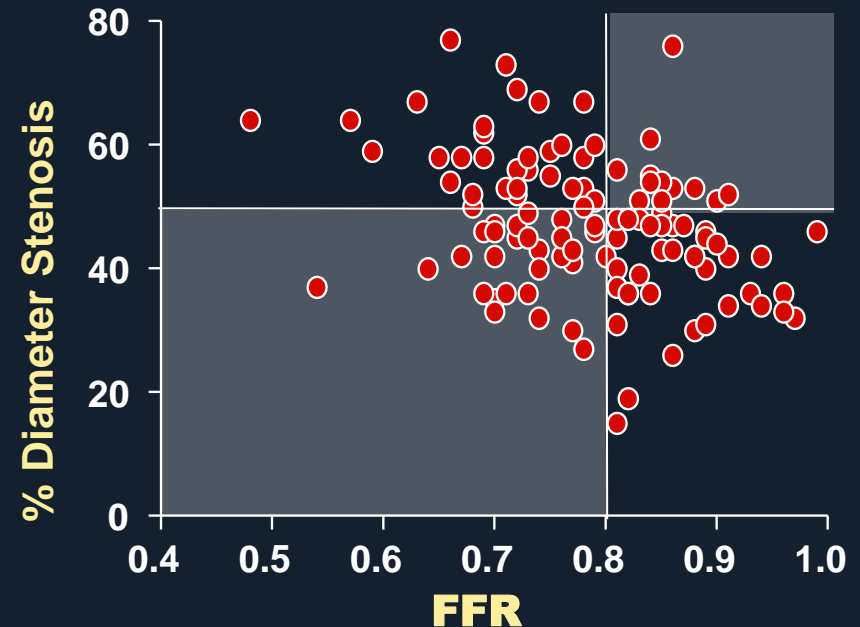
**“Mismatch” is 29% in equivocal LMCA**



Hamilos M et al. *Circulation* 2009;120:1505-1512

● Isolated LMCA disease

**“Mismatch” is 37% in equivocal LMCA**



Park SJ et al. *JACC-CI* (In Press)



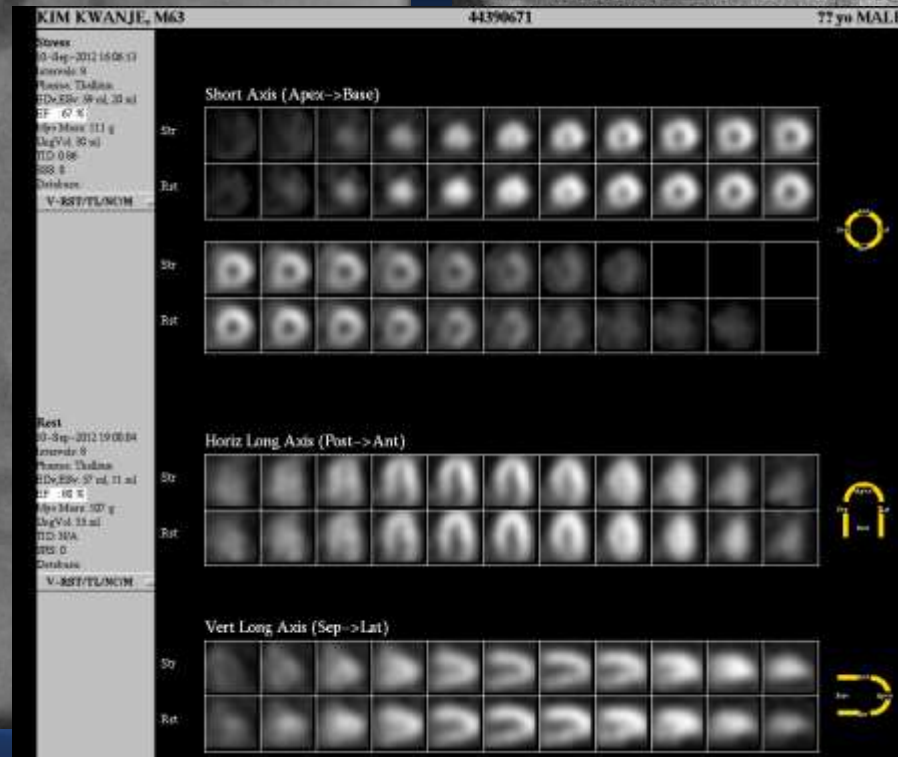
# LM with 3VD

# 65yrs/M, eCP

# RCA

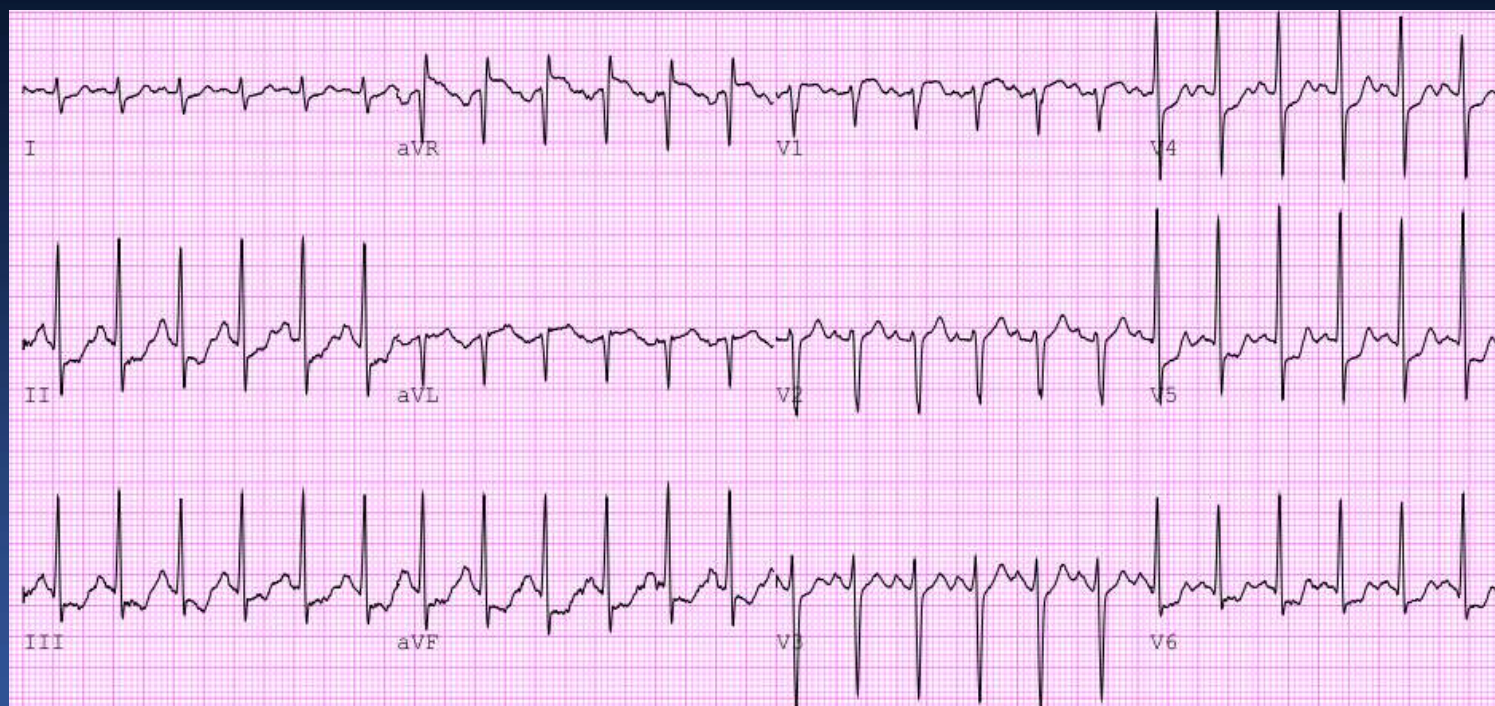
# LCA

## Normal Perfusion in Thallium SPECT



# M/76, eCP

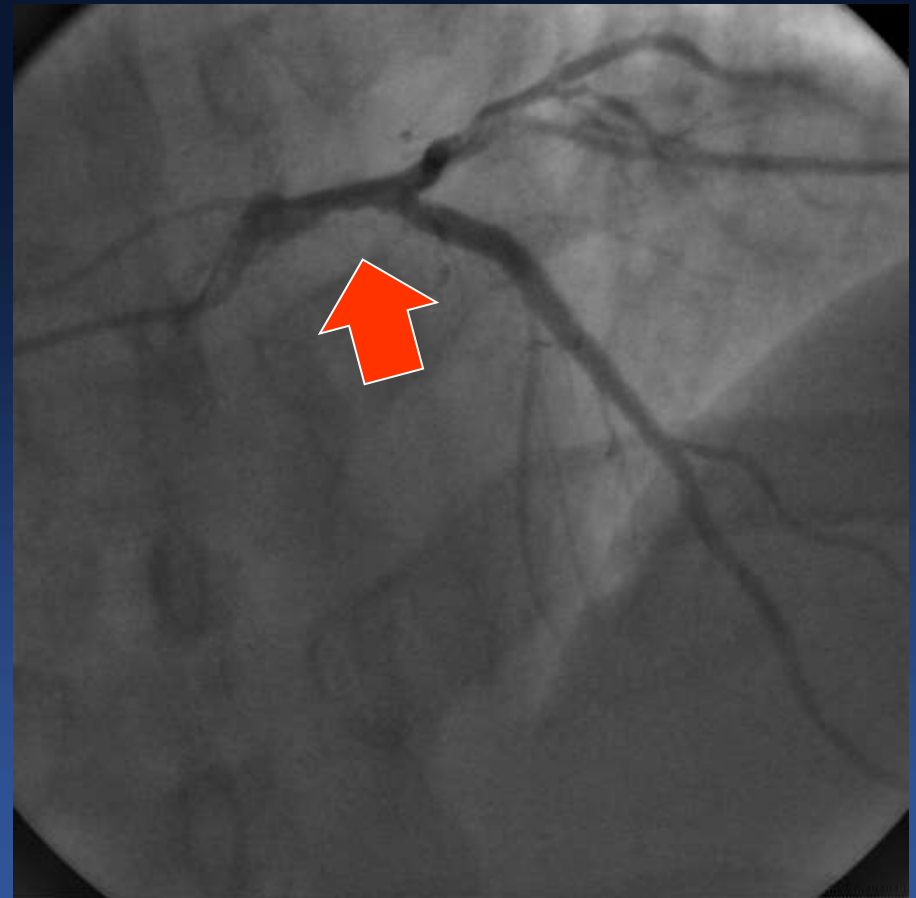
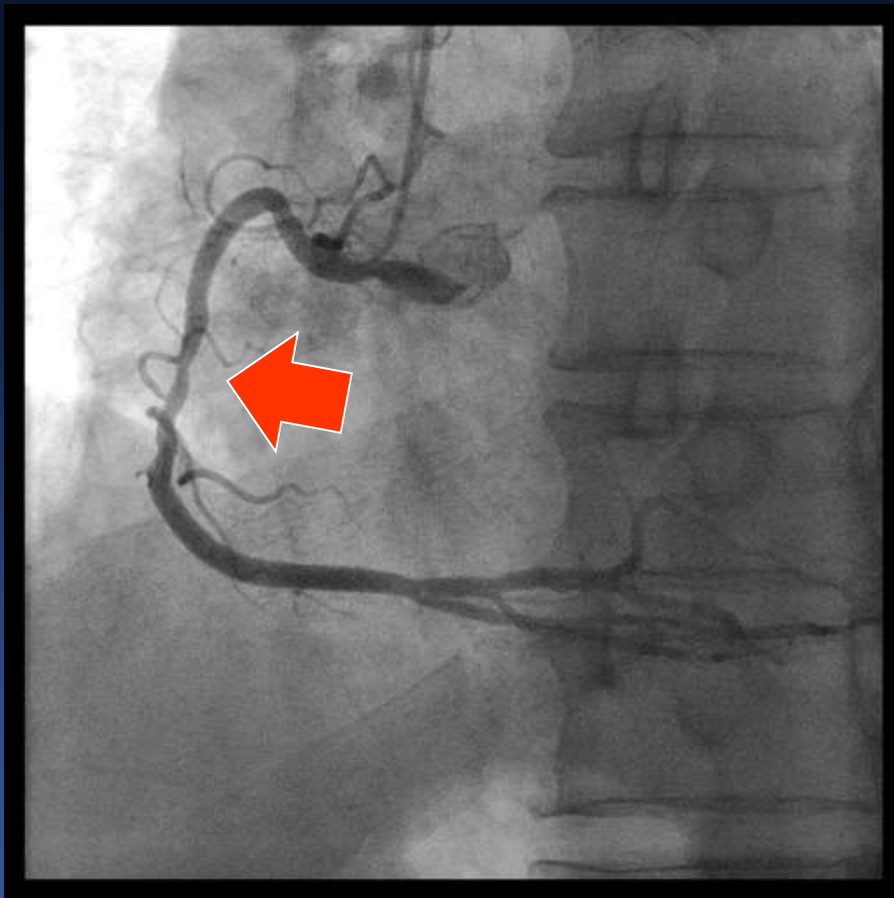
## Treadmill Test



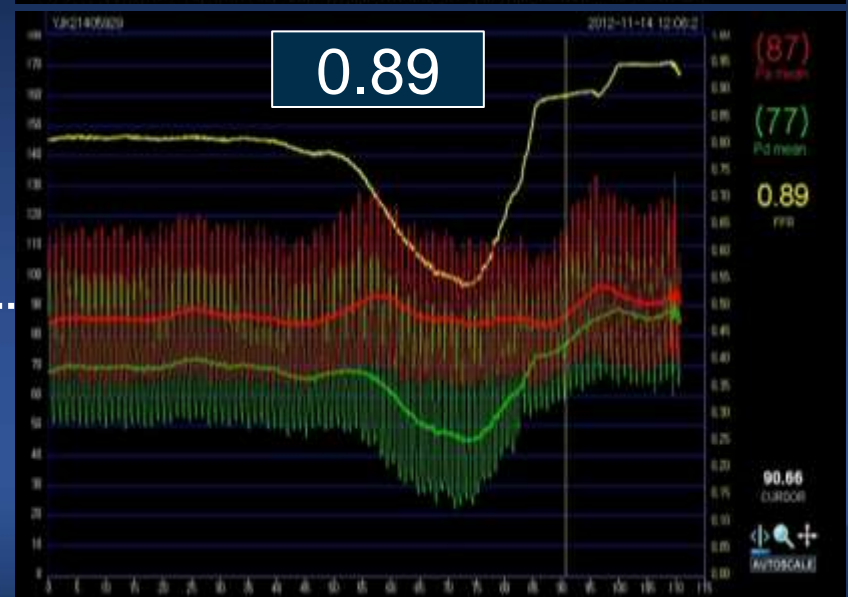
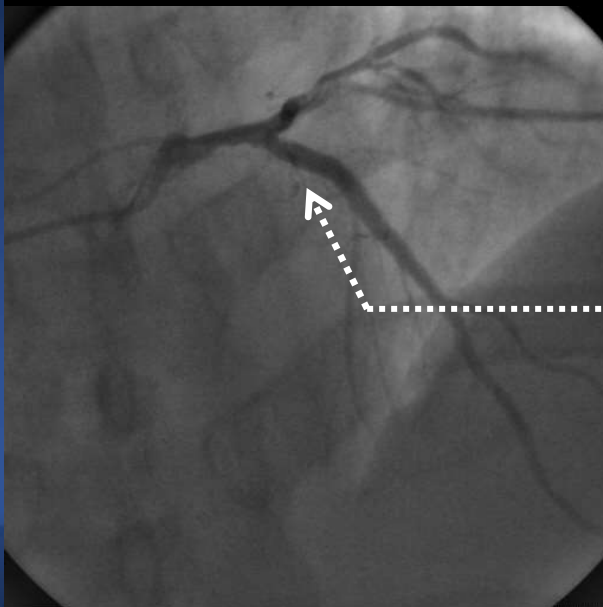
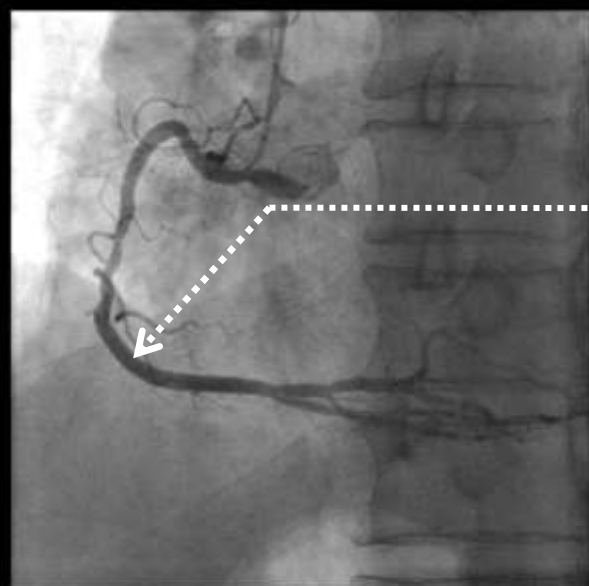
Positive at Stage 4



# Coronary Angiography

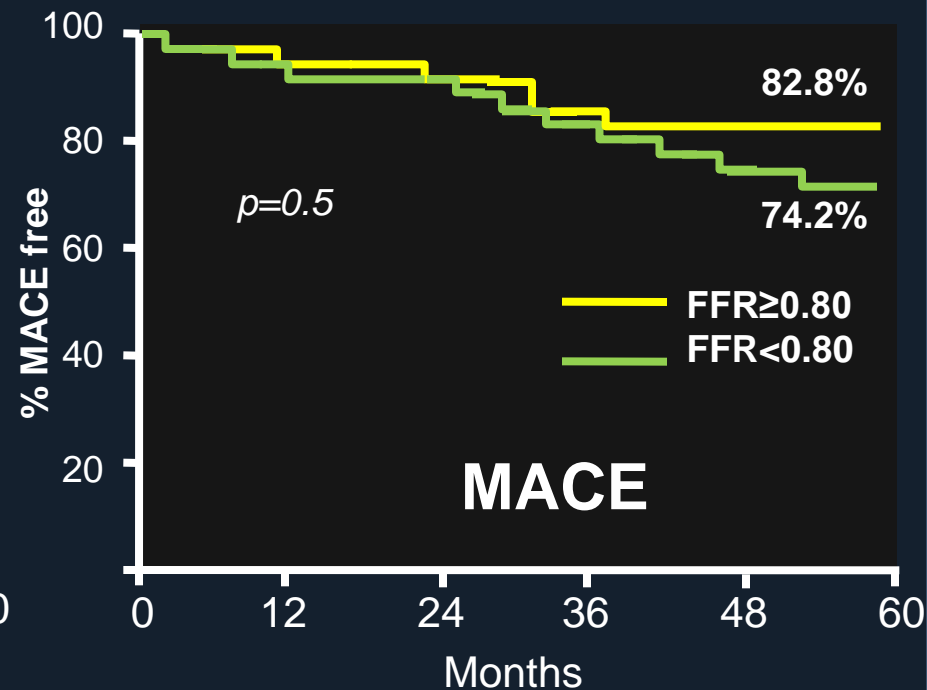
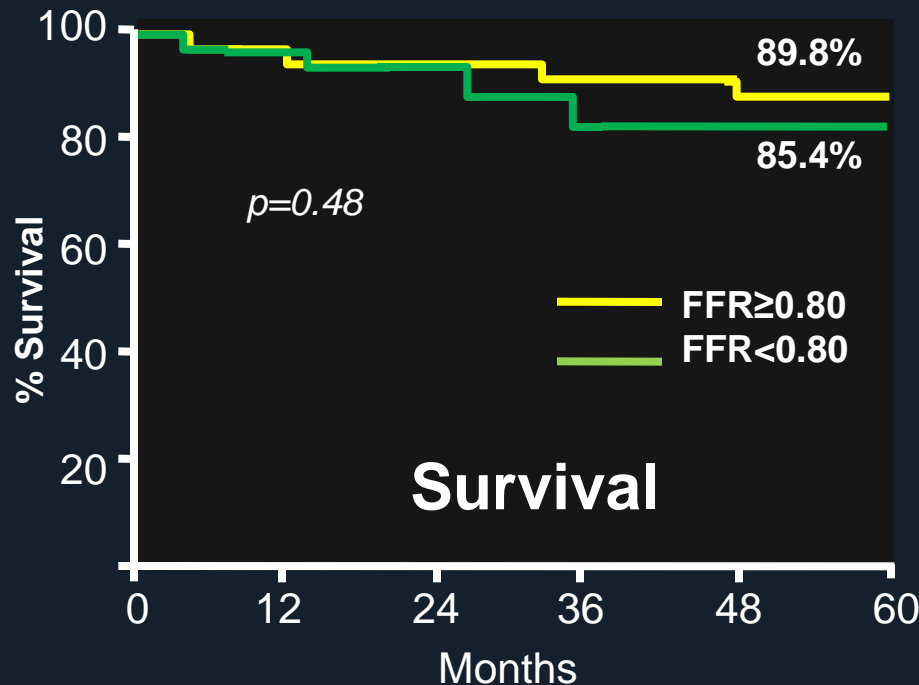


# FFR



# FFR Guided PCI in Equivocal LMCA

- In 213 patients with an equivocal LMCA stenosis
- FFR  $\geq 0.80$ : Medication (n=138) vs. FFR  $< 0.80$ : CABG (n=75)



**An FFR-guided strategy showed the favorable outcome.**

# Why We Need FFR in LM?

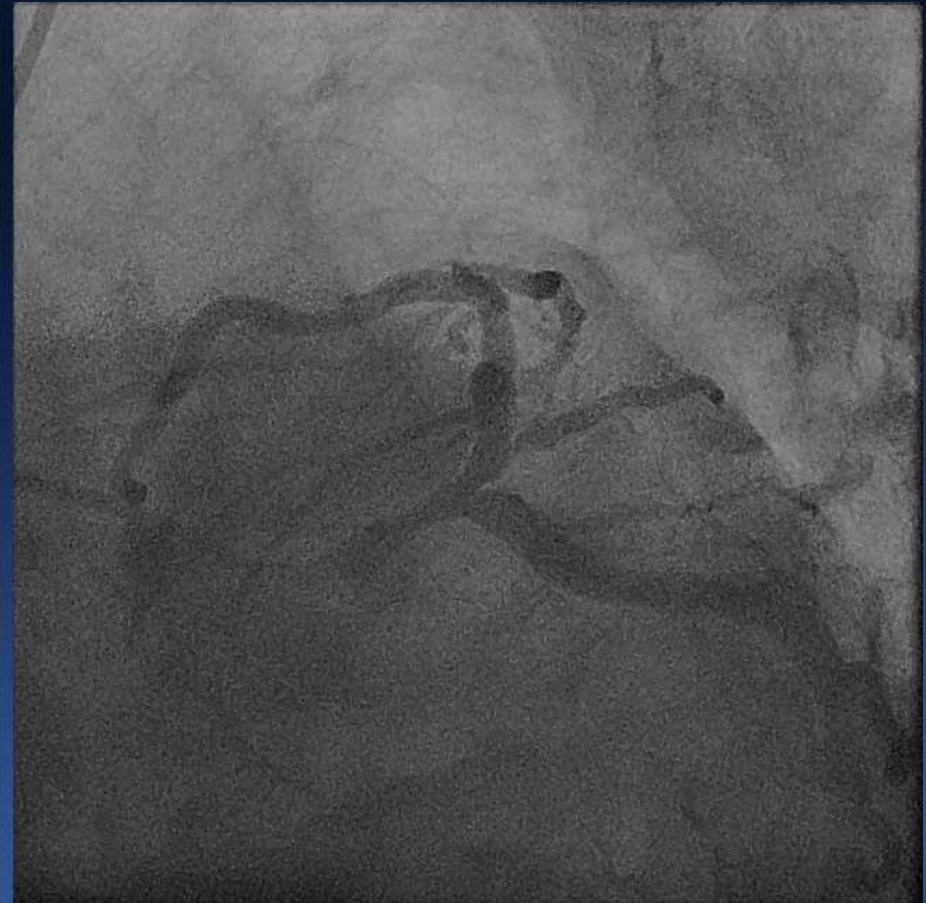
- Inaccuracy of Coronary Angiogram
- Insufficiency of Non-Invasive Functional Study
- FFR guided PCI in LMCA showed favorable outcomes

**So, We have to measure LM FFR directly**

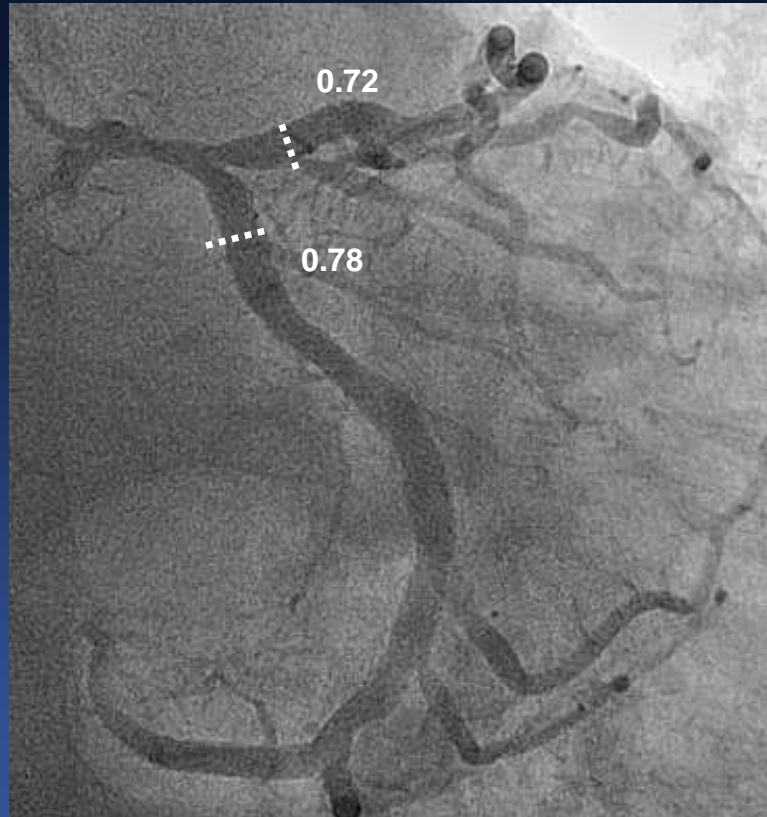


# LM Bifurcation Lesion (Medina 1,0,0) with Minimal LCX Disease

55/M, Stable angina,

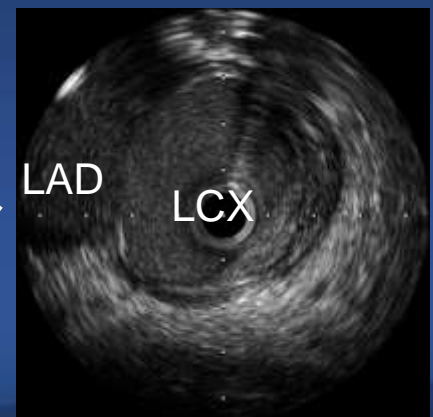
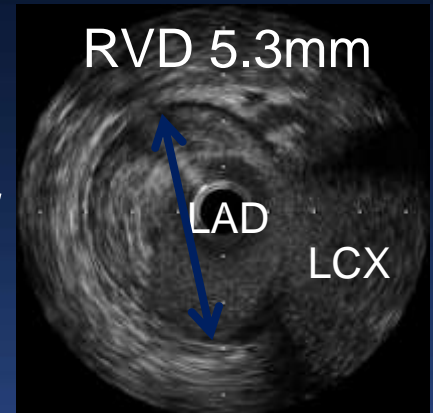
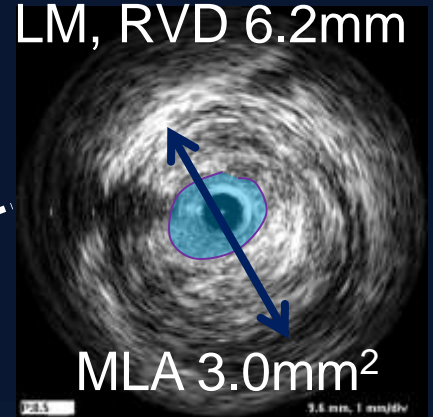
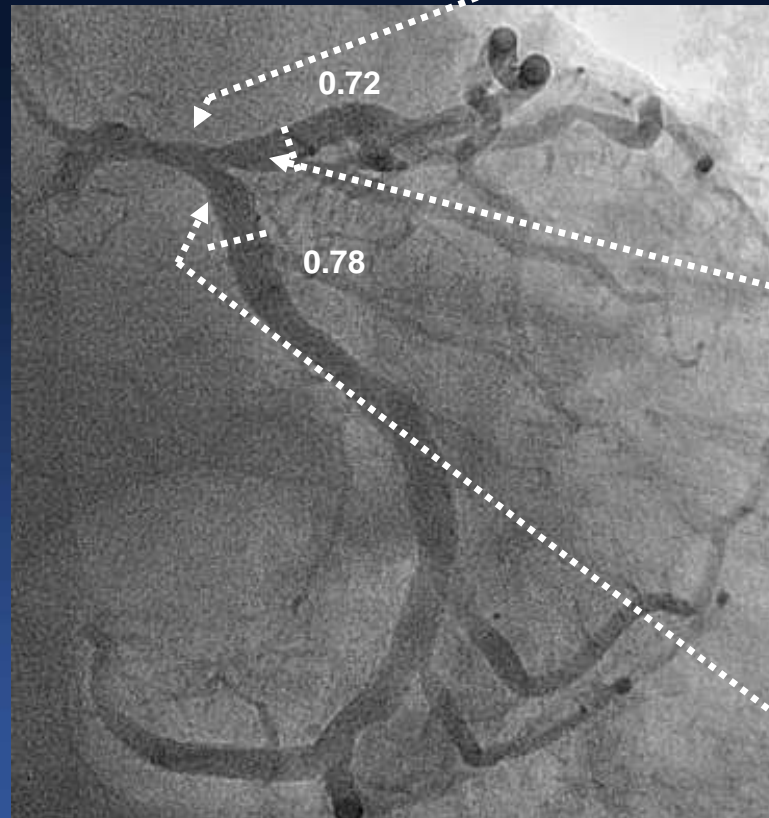


# FFR in Both LAD and LCX,



# IVUS in Both LAD and LCX,

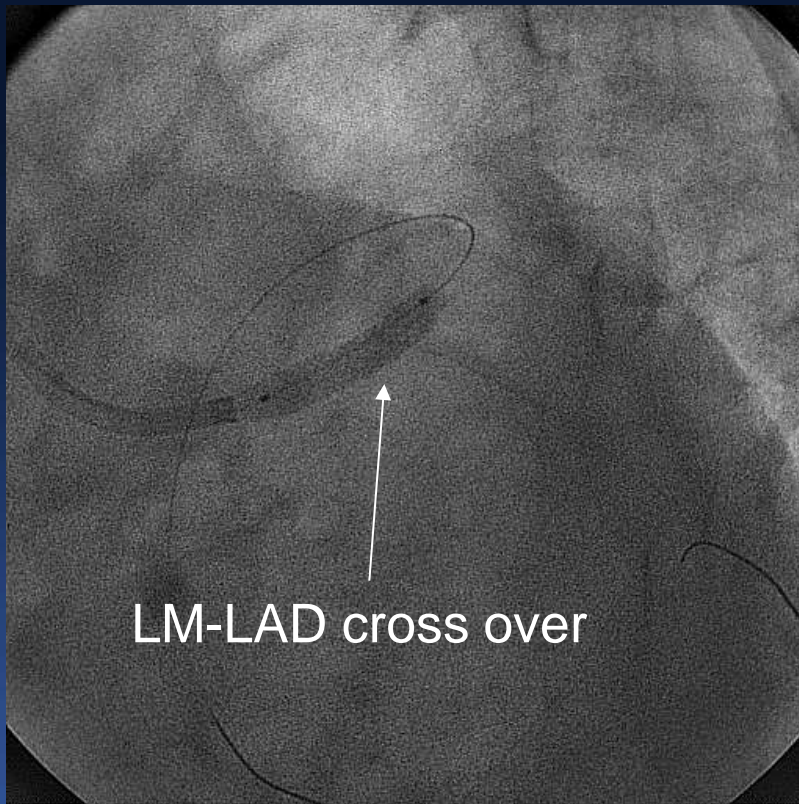
Distal LM, RVD 6.2mm



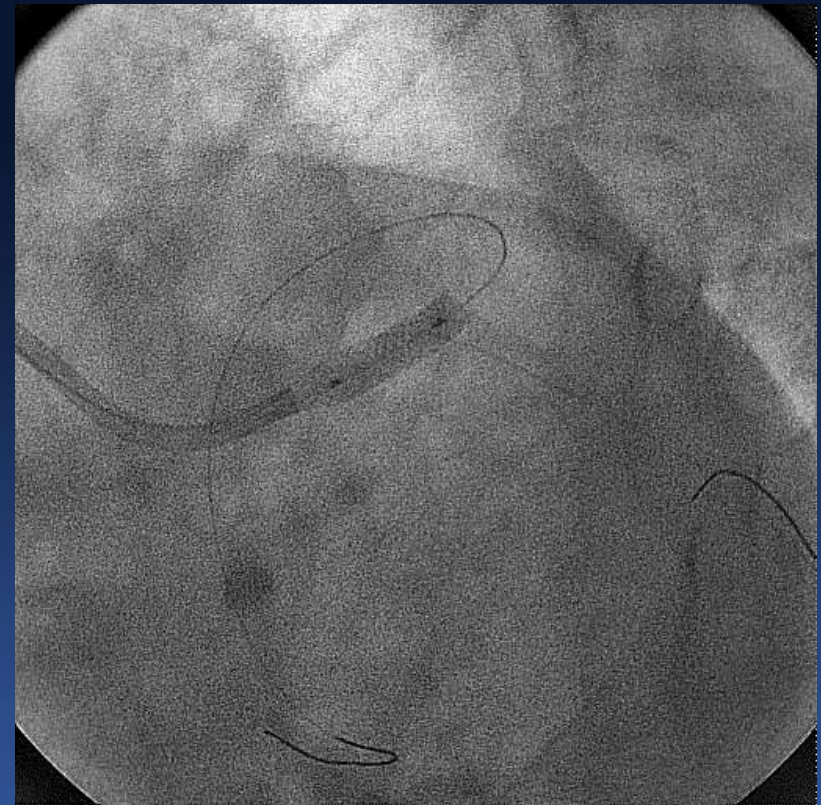
Minimal disease at LCX ostium



# Single Stent Cross-Over with minimal-disease at LCX OS



Promus Element  
4.0x20



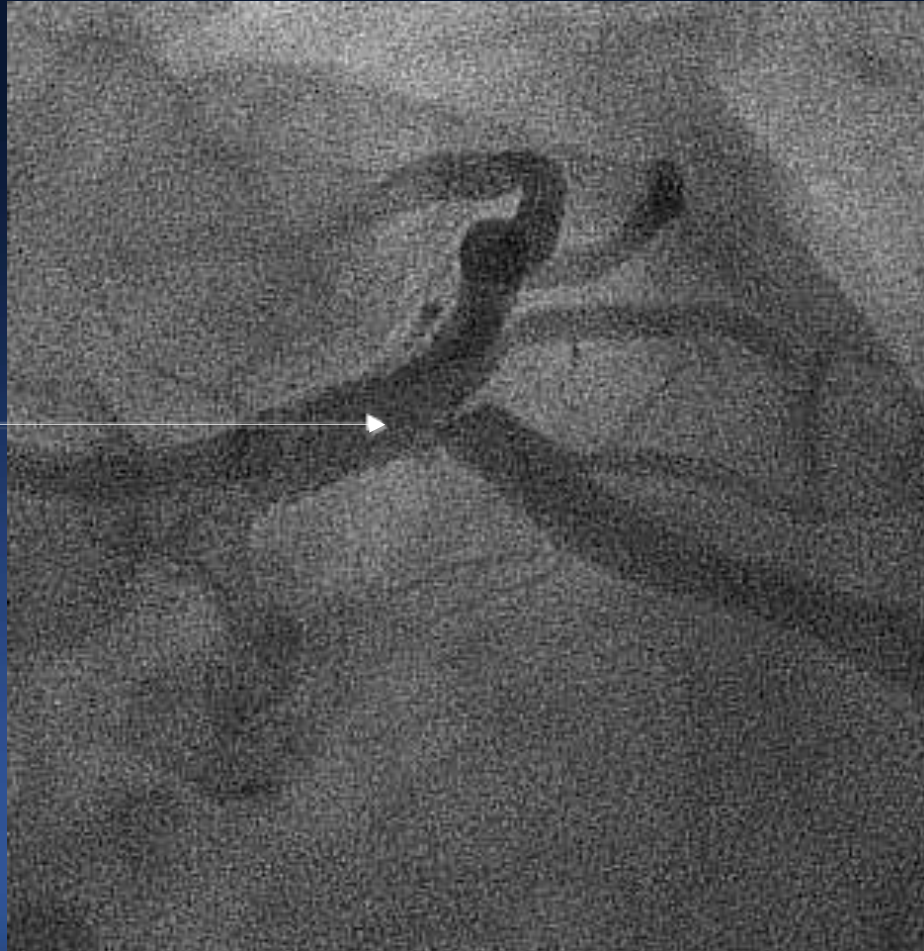
Additional high pressure  
Inflation with 4.0 mm  
non-compliant balloon



# After Single Stent Cross-Over, Angiographic Compromise of LCX Ostium.



# What Would You Do ? To Treat or Not To Treat



# Consider FFR, First !

## FFR is 0.92



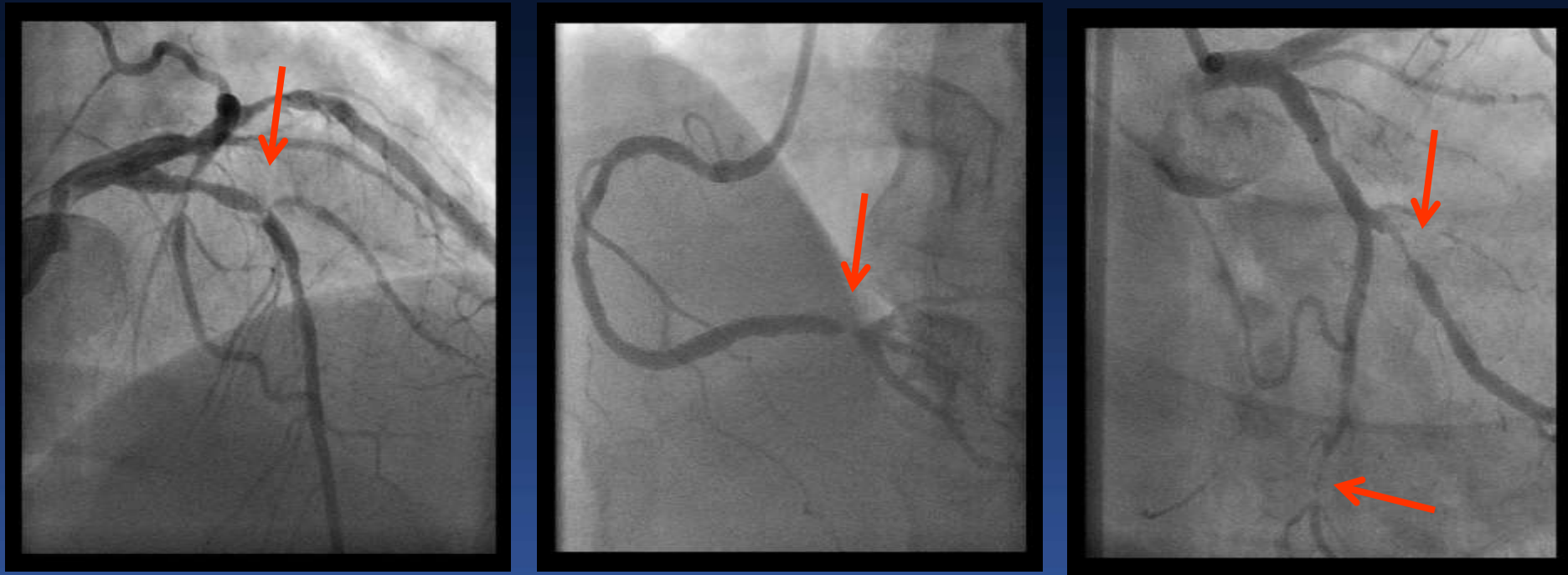
# Defer !

Kang et al. Catheter Cardiovasc Interv. 2014;83(4):545-52 (7%)

Nam et al, Korean Circ J 2011;41(6):304-7 (29%)

# Multivessel and Bifurcation

Angiographically 3 VD



Thallium: large perfusion defect at LAD territory

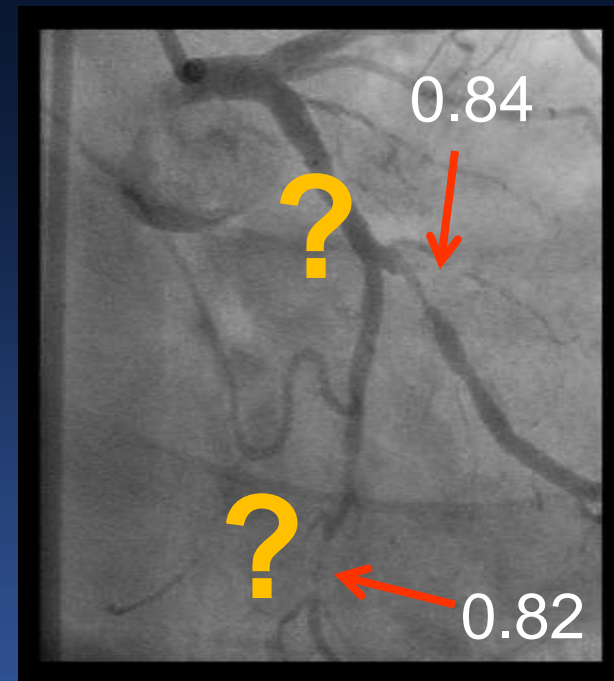
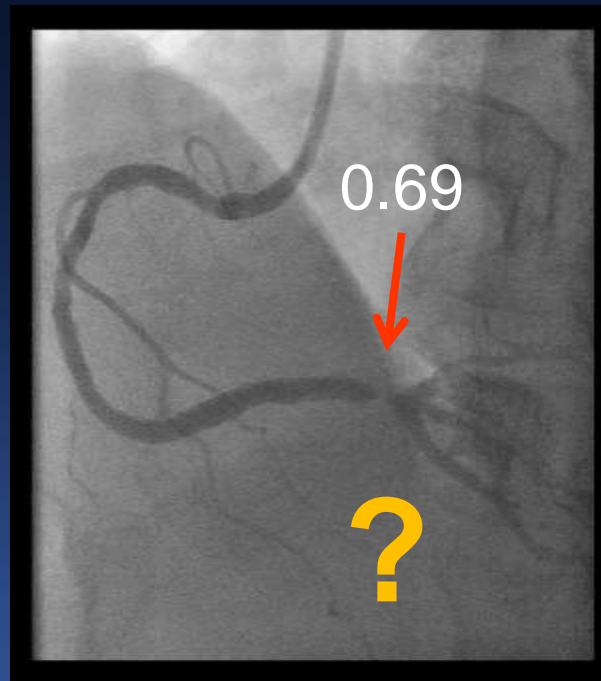


# Fractional Flow Reserve

Functionally 2 VD



Not Done

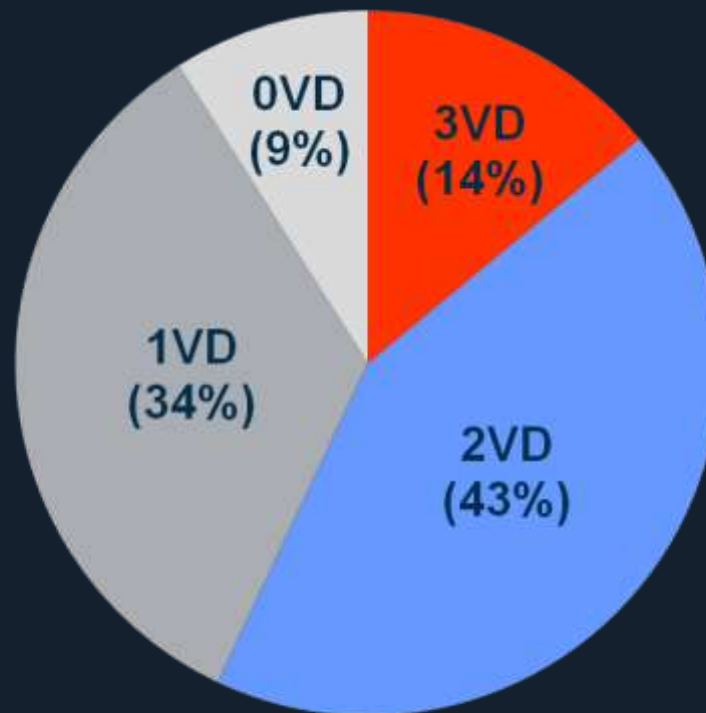


Thallium: large perfusion defect at LAD territory

# Visual-Functional Mismatch

From FAME Study

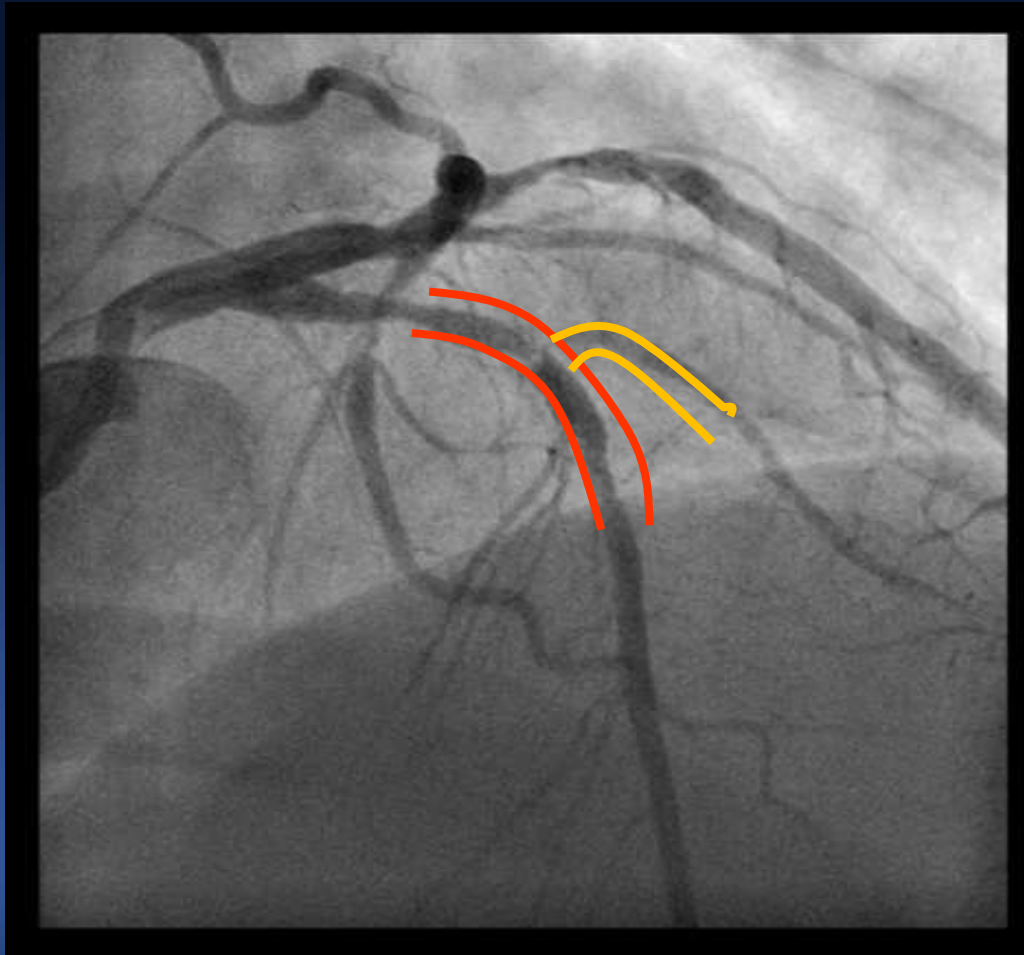
Functionally Diseased Coronary Arteries



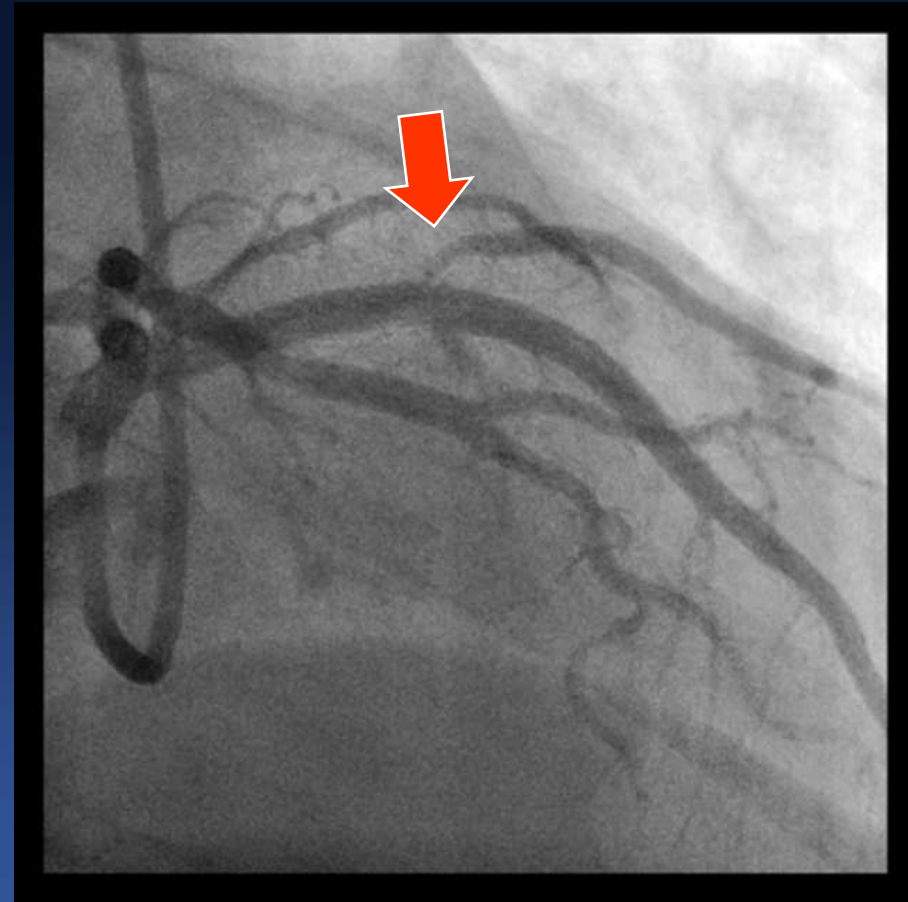
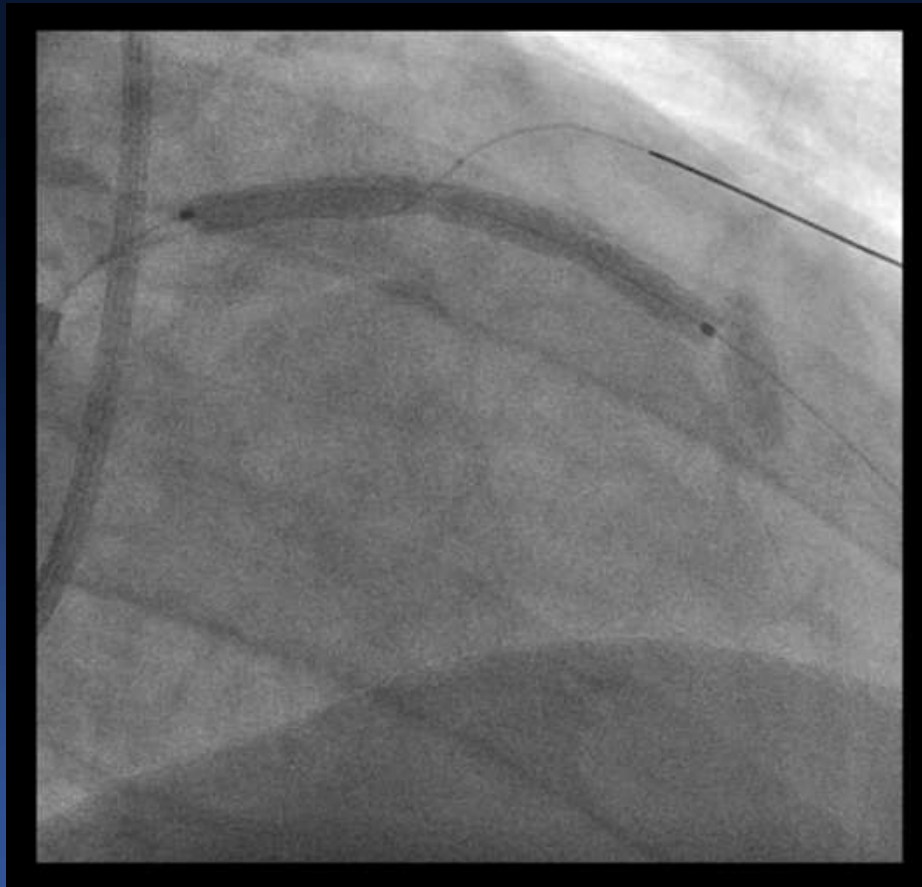
Angiographic 3VD

# LAD

## One or Two Stent Technique



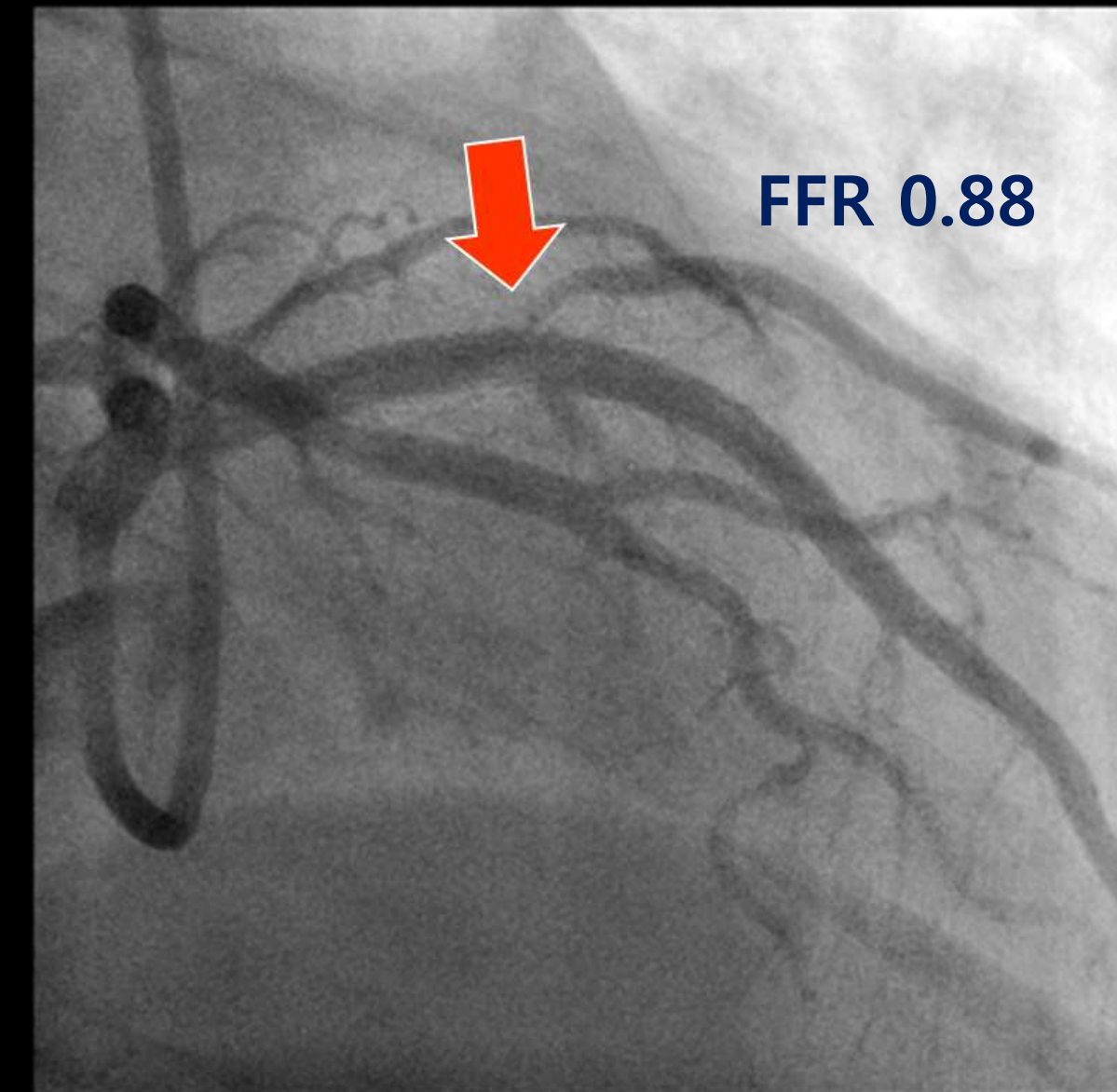
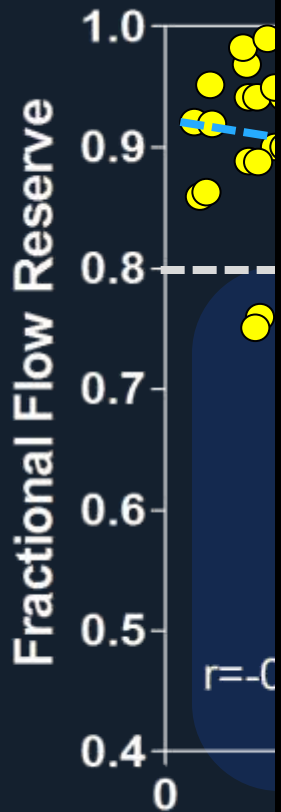
# Stenting



Resolute Integrity 3.0(38)



# FFR of the Isolated Side Branch



SBs  
ation QCA

26.2%  
g SBs  
50%  
sis had  
0.80.

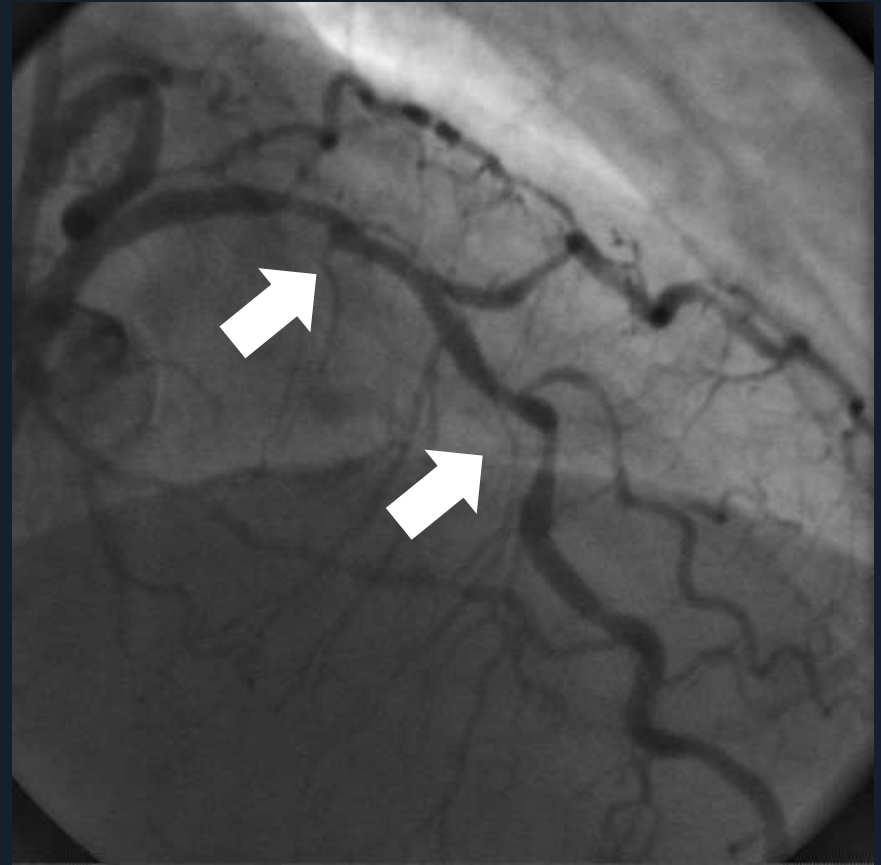
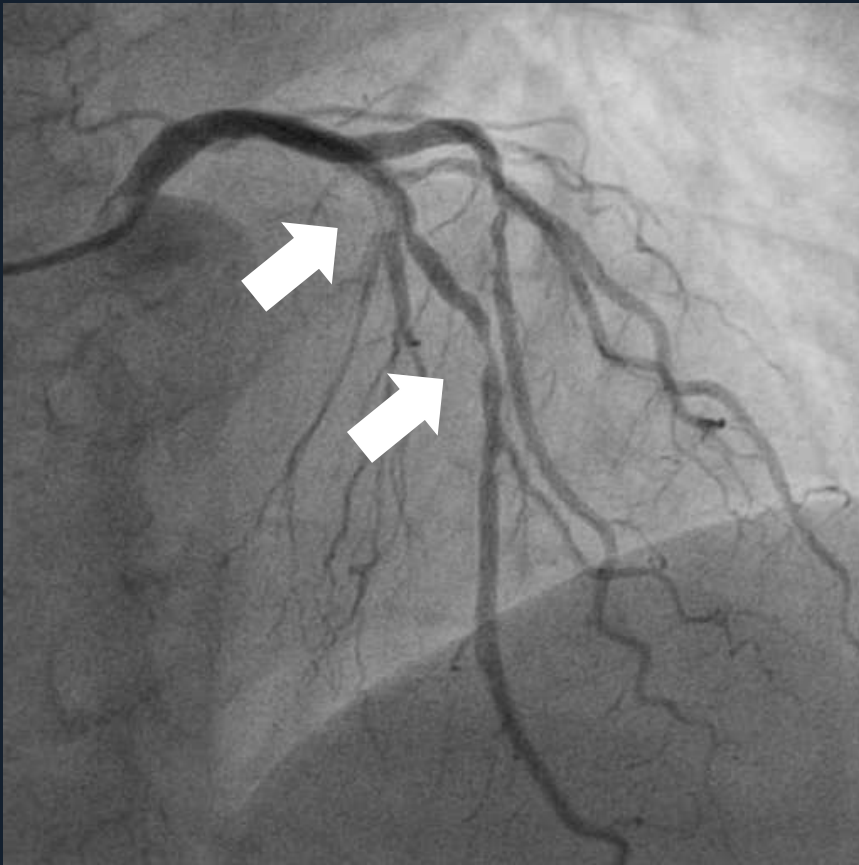
# Final Angiogram



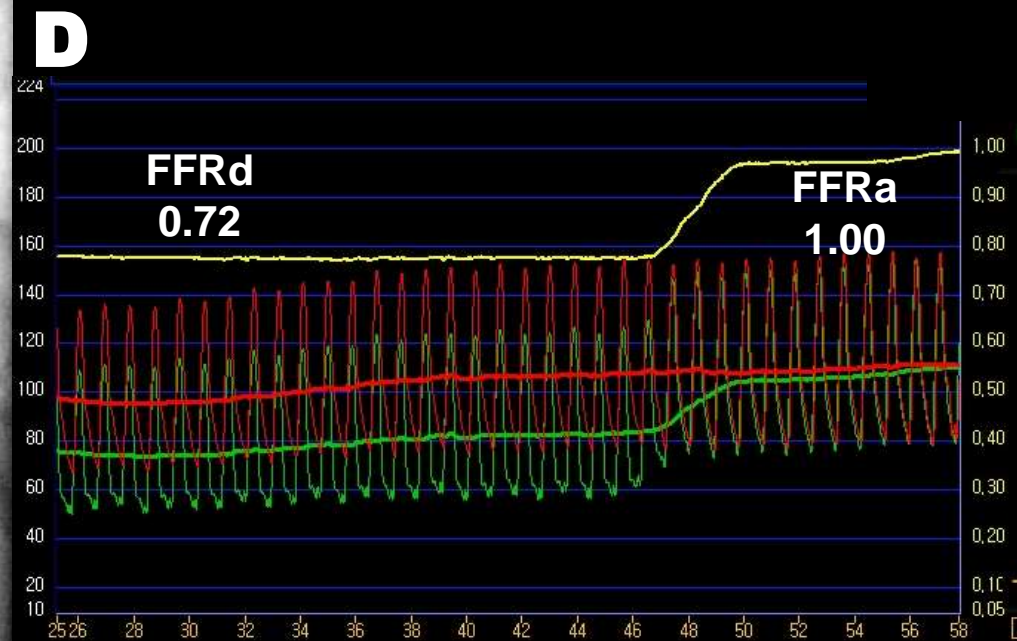
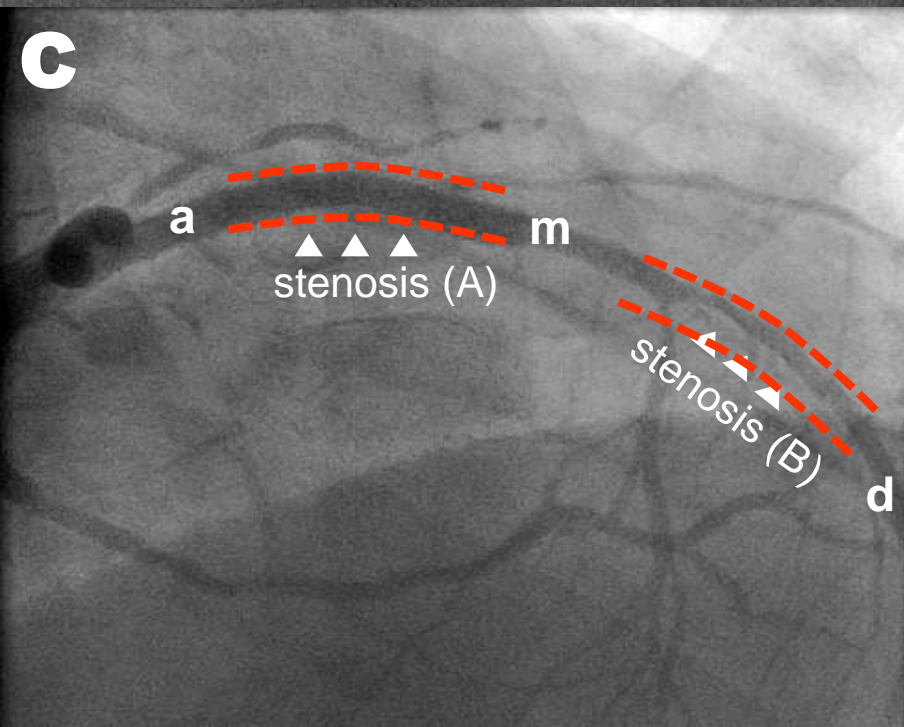
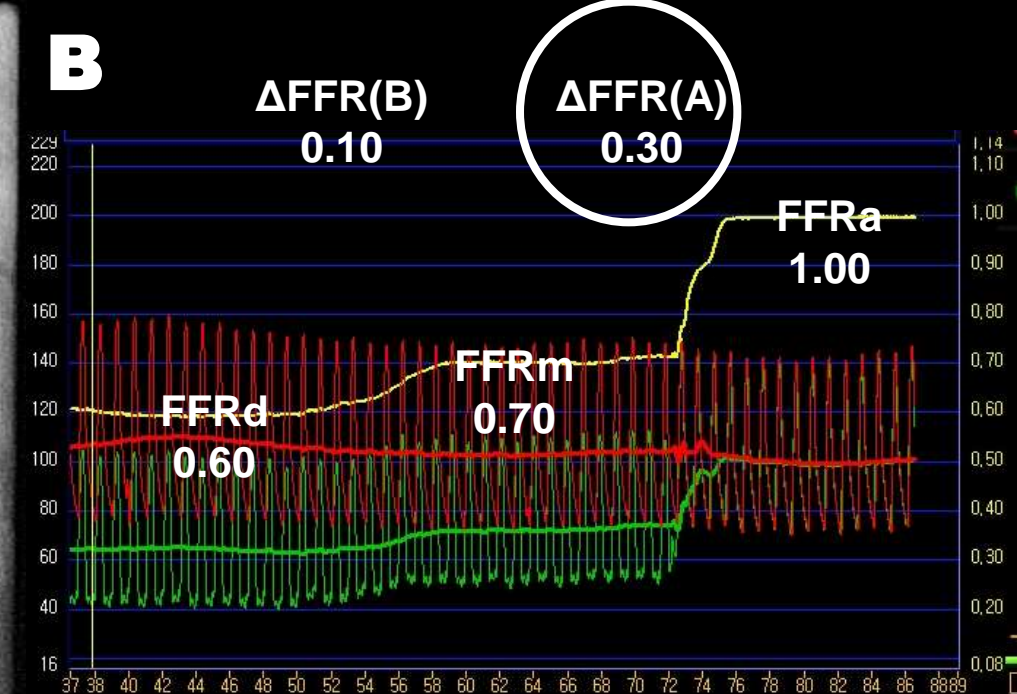
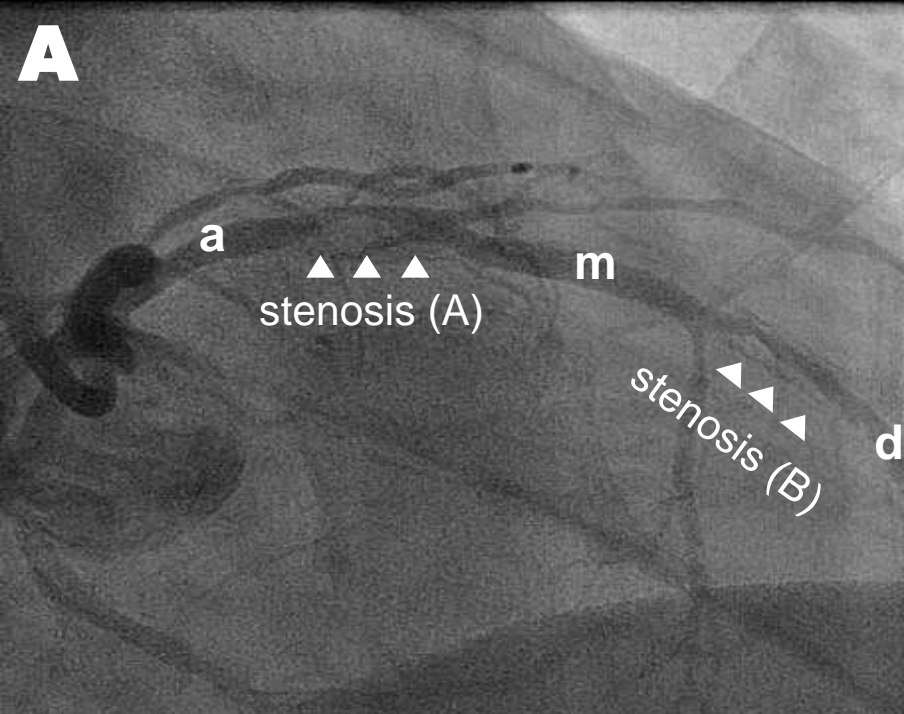
**Fractional flow reserve measurement** in multivessel disease can successfully make *the functionally complete revascularization* of angiographic 3VD including 2 bifurcations by using **only 2 stents**

# Coronary Tandem Lesions

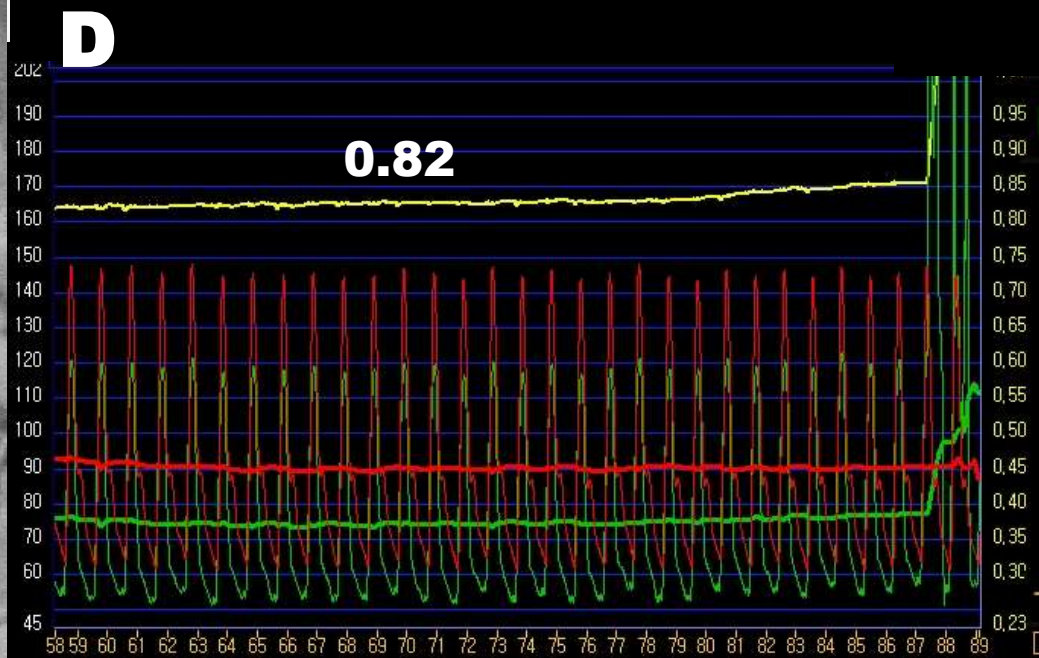
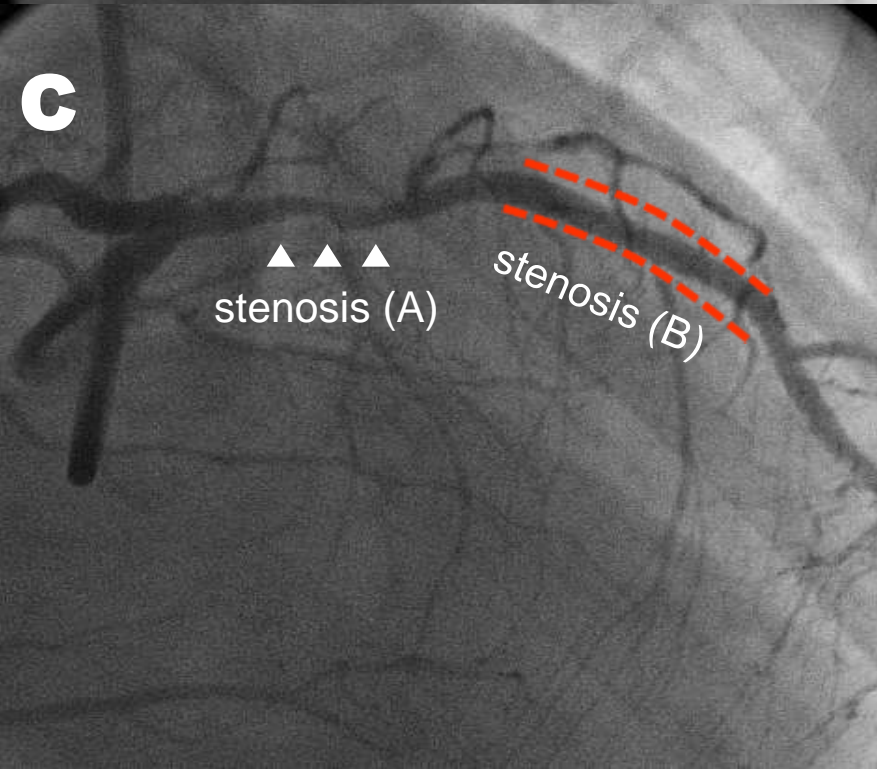
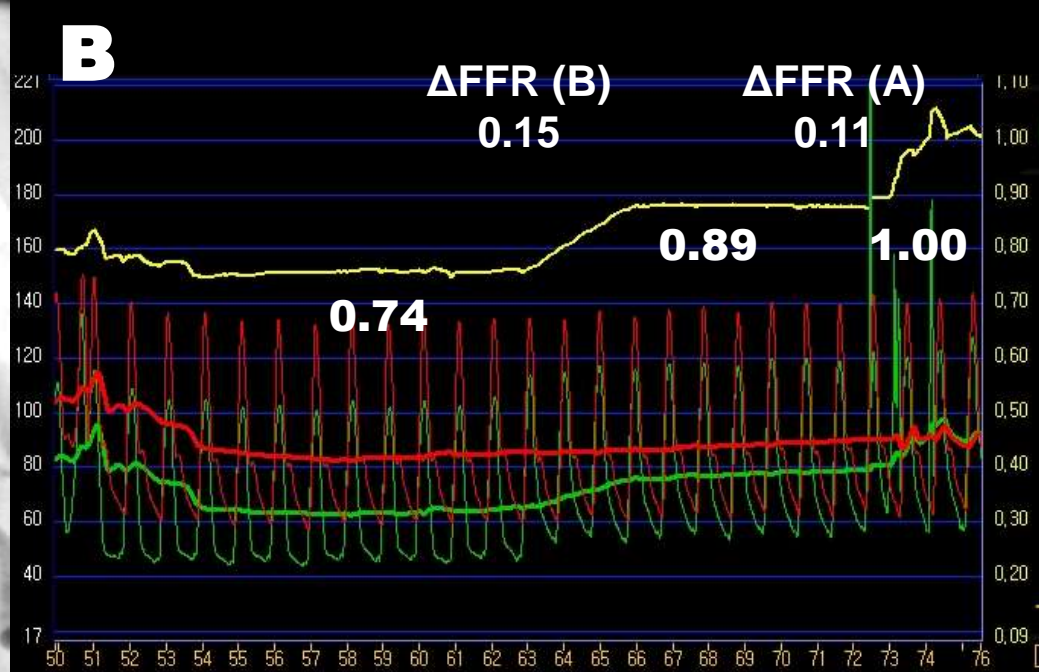
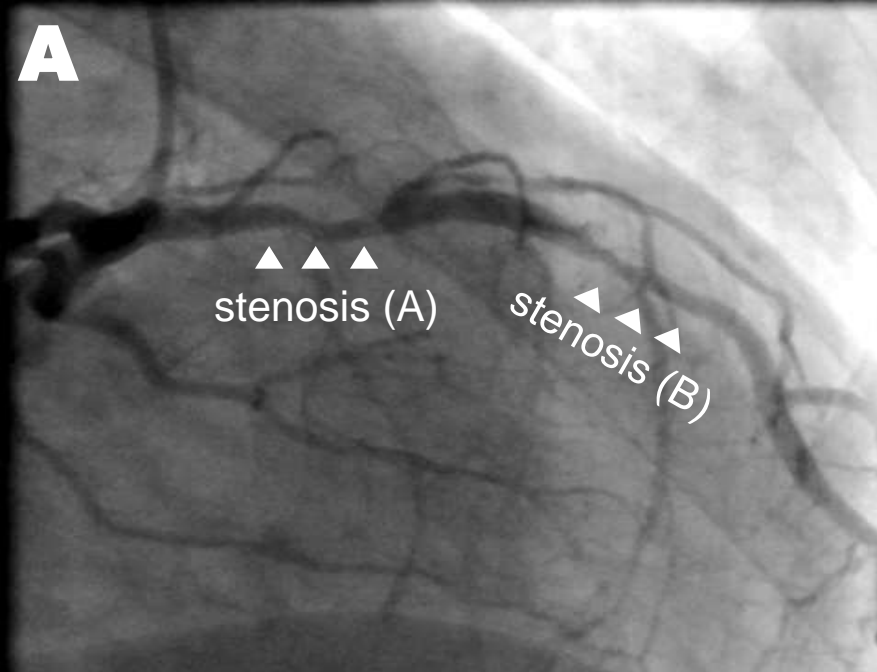
Multiple stenoses in series along one coronary artery











# According to the Rule of “Big Delta”

52 patients with coronary tandem lesion with FFR  $\leq 0.80$



Prioritizing the treatment according to  $\Delta$ FFR (“rule of big delta”)

- 28 (53.8%) patients had only single-lesion Tx
- 28 (26.9%) lesions were deferred

Proximal stenosis  
treated only  
N=16

Both stenoses  
treated  
N=16

Distal stenosis  
treated only  
N=12

Both stenoses  
treated  
N=8

# Summary

- Anatomical significant stenosis is not equivalent to the functional significant stenosis.
- Anatomical complex lesion does not mean the functional complex lesions.
- Therefore, meticulous functional evaluation on complex anatomical stenosis may lead to identify the simple functional stenosis from complex anatomical stenosis and simplify the treatment strategy, which results in the improvement of clinical outcomes.
- For this purpose, FFR may have critical role in daily practice.