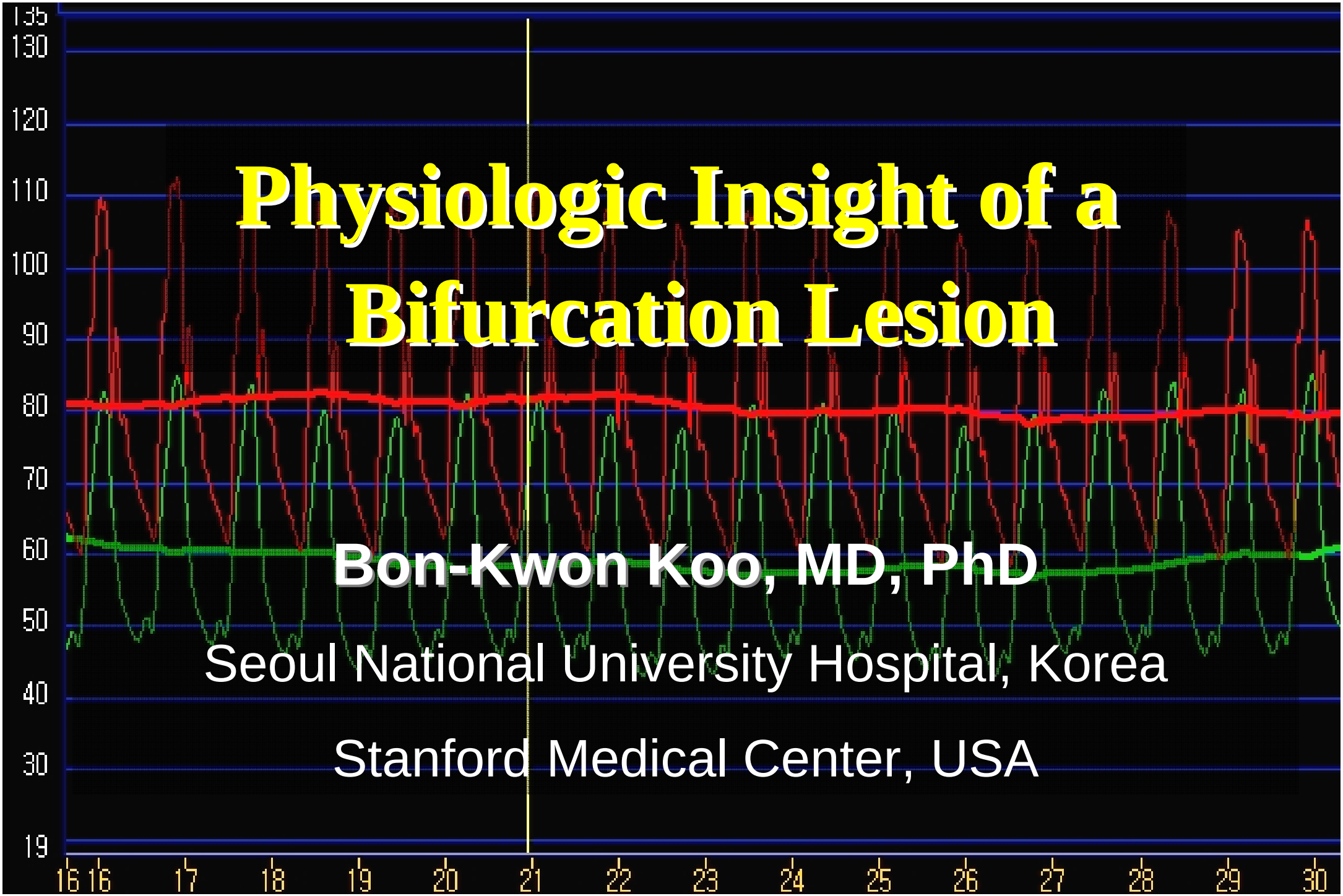


Physiologic Insight of a Bifurcation Lesion

Bon-Kwon Koo, MD, PhD

Seoul National University Hospital, Korea

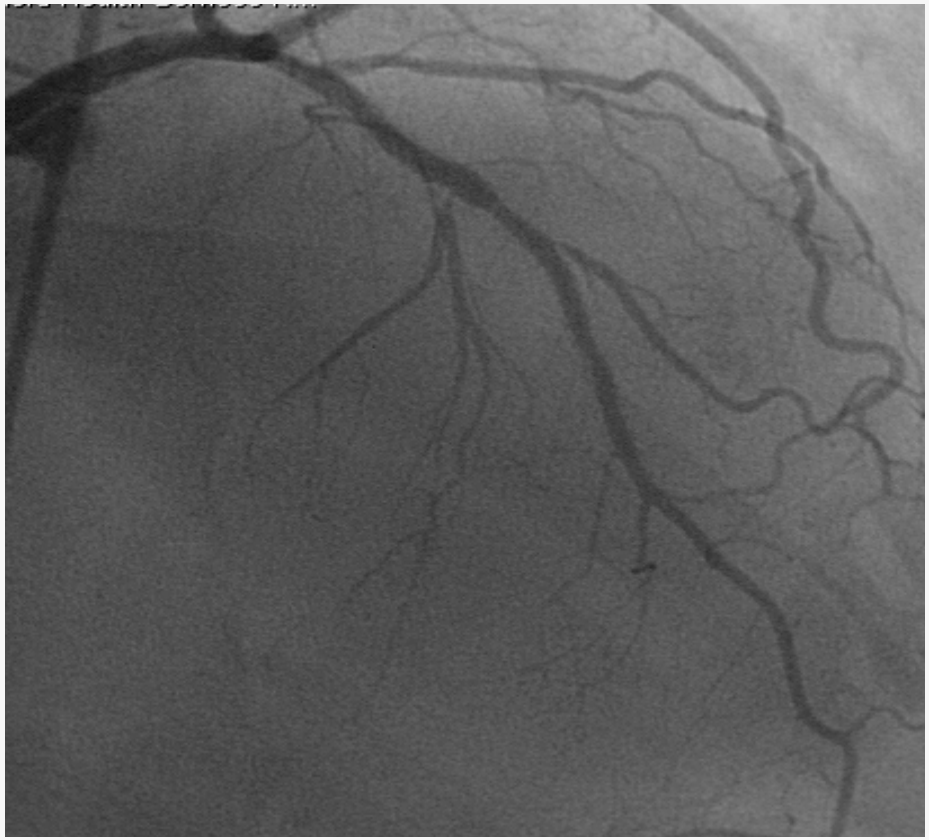
Stanford Medical Center, USA

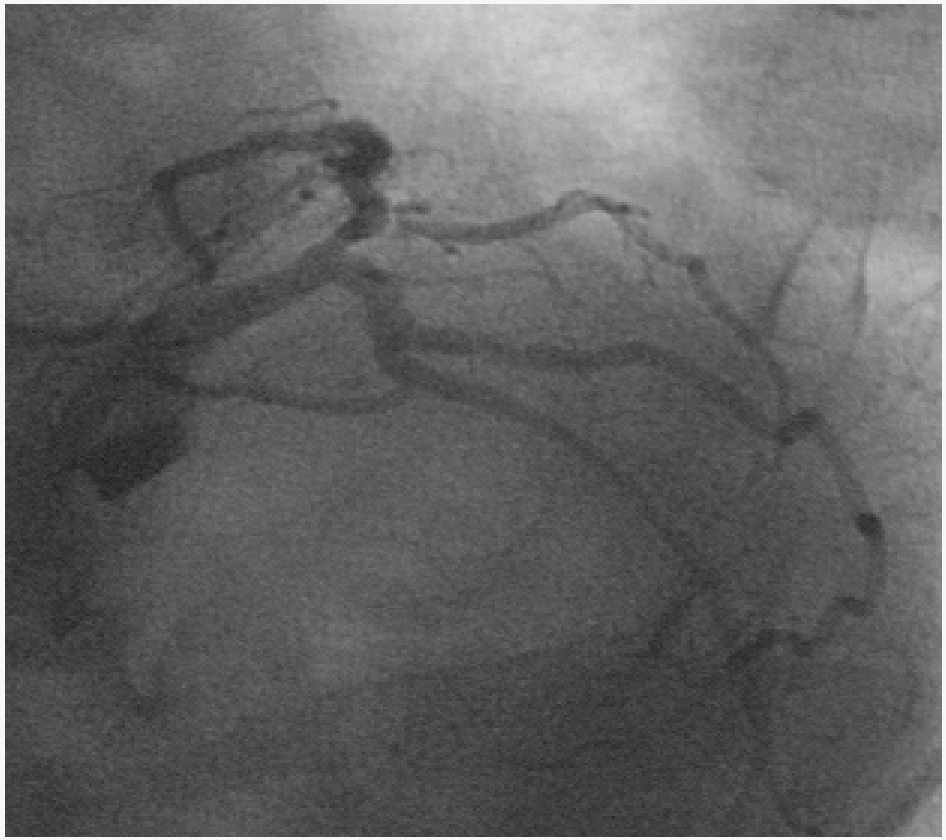
M/65, s/p 2 Stents at LAD, 1yr ago

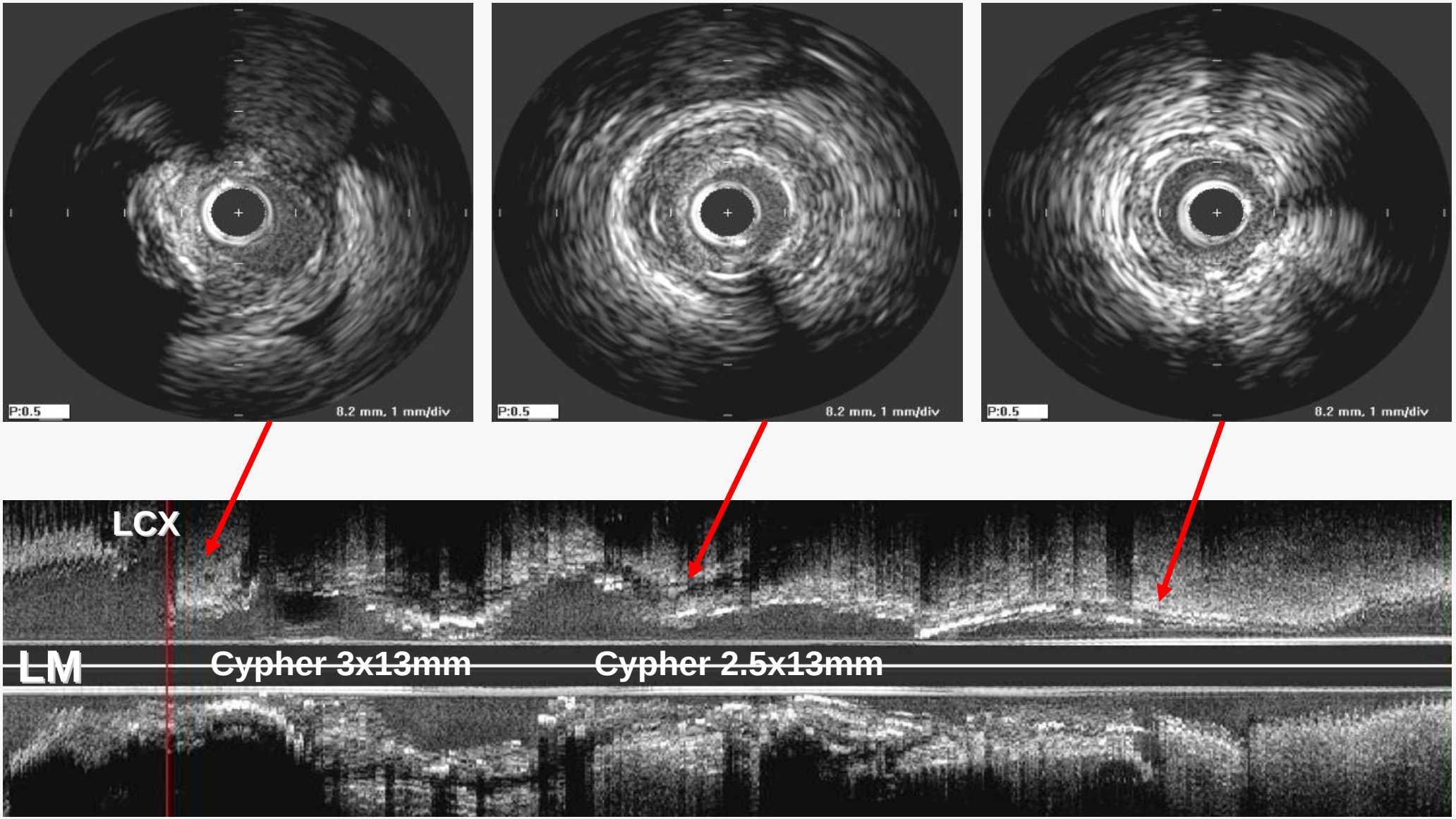
Mild resting discomfort with slight Troponin elevation

No exertional pain

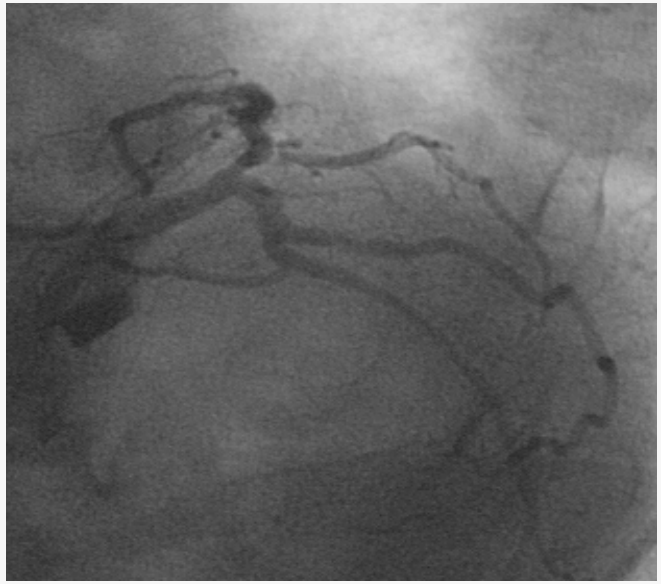
EKG: Normal, LV angiography: normal LV function, no regional wall motion abnormality






P:0.5
8.2 mm, 1 mm/div
P:0.5
8.2 mm, 1 mm/div
P:0.5
8.2 mm, 1 mm/div
LCX
LM
Cypher 3x13mm
Cypher 2.5x13mm

After LAD os stenting



Before PCI

How to treat this lesion??

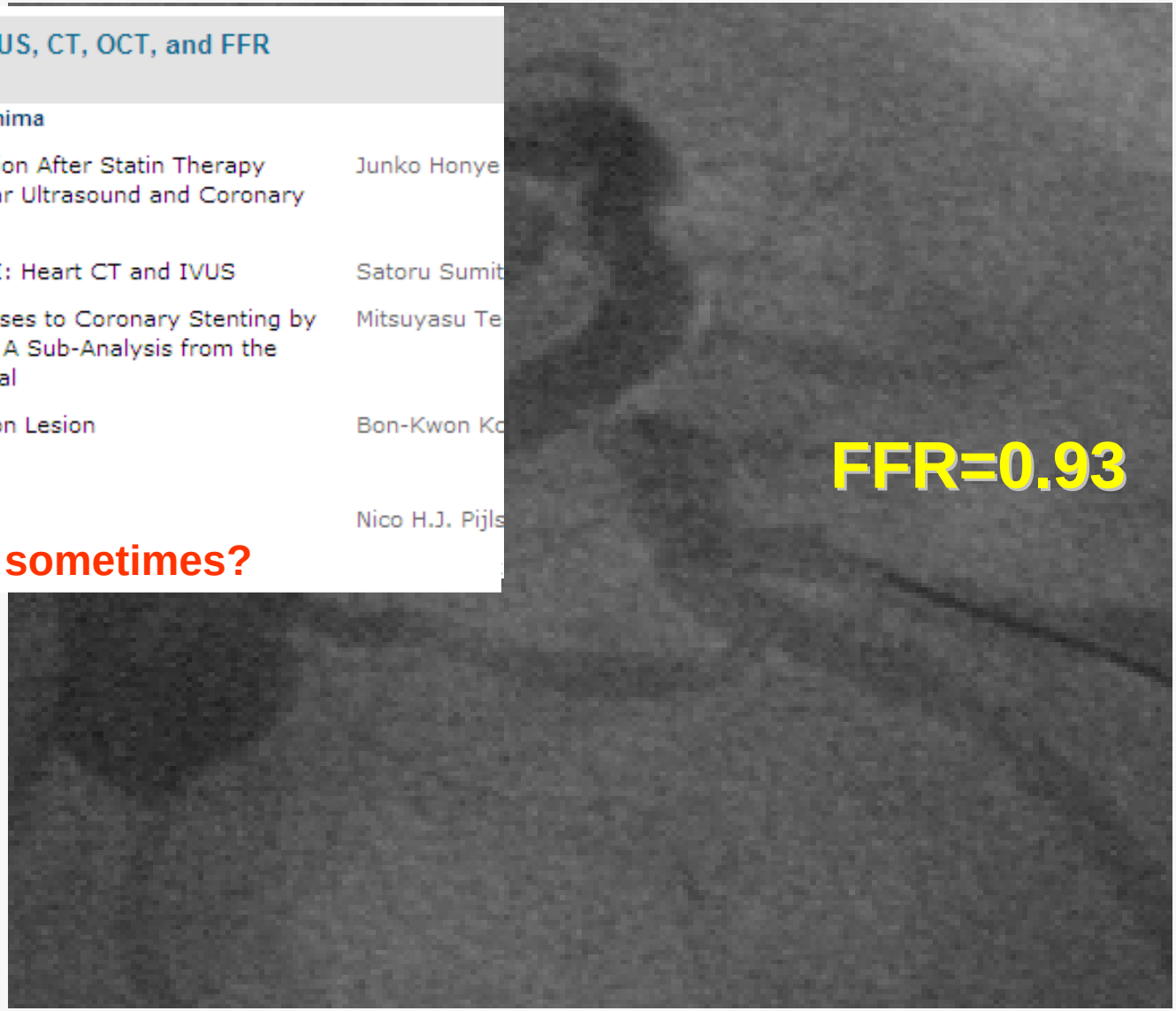
How to evaluate this lesion?

#10. Physiology & Imaging: IVUS, CT, OCT, and FFR
Room 2-3

ors: Nico H.J. Pijls, Mitsuyasu Terashima

Plaque Stabilization and Regression After Statin Therapy Evaluated With Both Intravascular Ultrasound and Coronary Angioscope	Junko Honye
Imaging Supported Complex PCI: Heart CT and IVUS	Satoru Sumit
Identification of Vascular Responses to Coronary Stenting by Optical Coherence Tomography: A Sub-Analysis from the Japanese Multi-Center Safety Trial	Mitsuyasu Te
Physiologic Insight of a Bifurcation Lesion	Bon-Kwon Ko
Case Presentations	
Coronary Pressure Never Lies	Nico H.J. Pijls

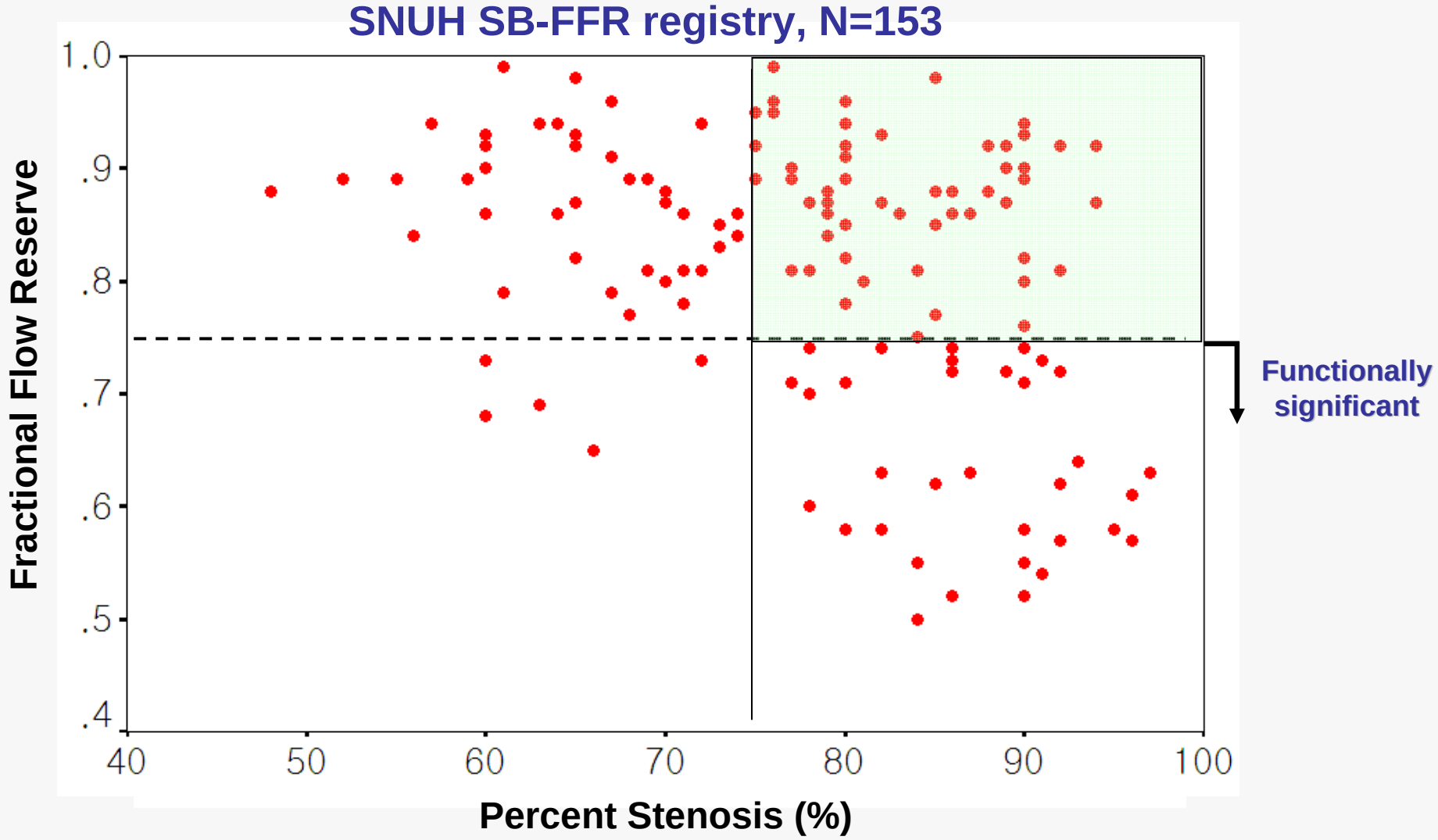
Is FFR telling a lie sometimes?



Physiologic Insight of Bifurcation Lesions

- **“What you see” is NOT “What it is”.**
- **Why?**
- **Functional outcome of jailed SB lesions**

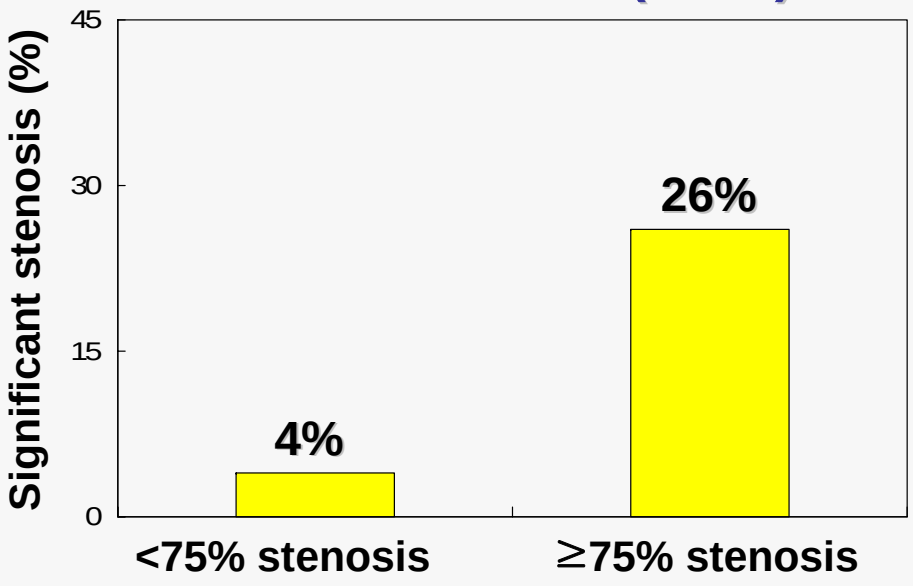
Angiographic severity vs. Functional significance



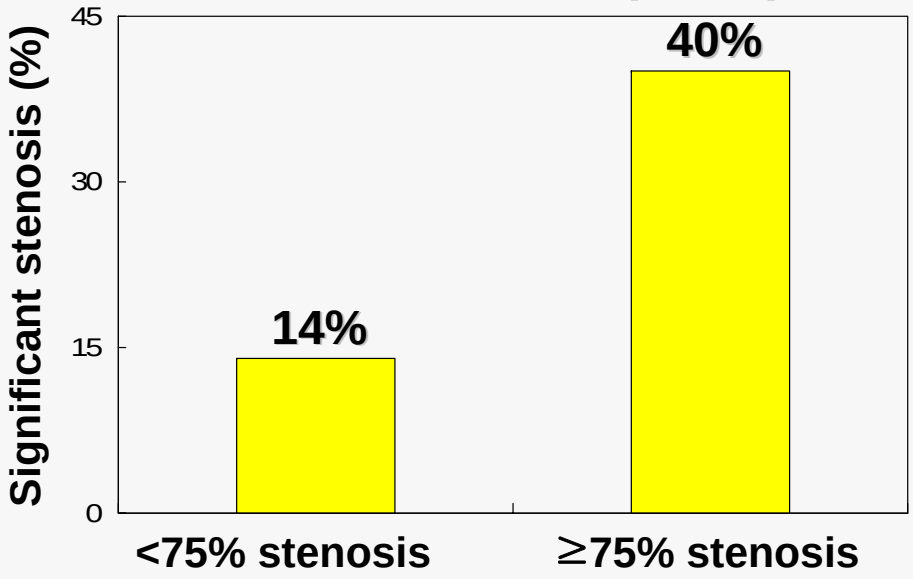
Angiographic severity vs. Functional significance

N=153	Percent stenosis	
	50% ~ 75%	≥75%
FFR <0.75	5 (10%)	35 (34%)
FFR ≥0.75	46	67

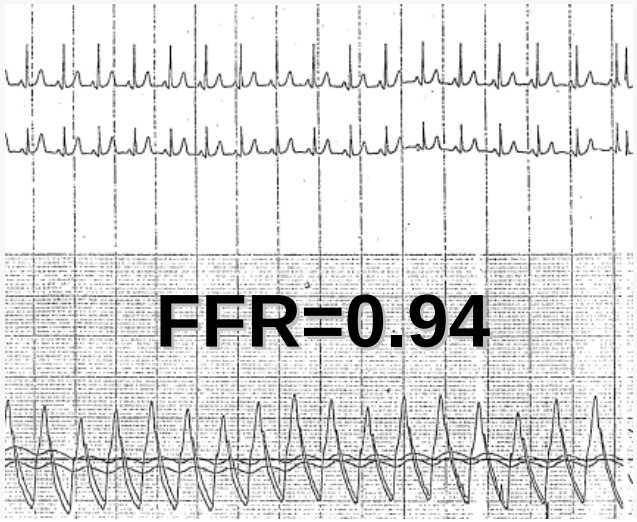
False Bifurcation (N=62)



True Bifurcation (N=91)



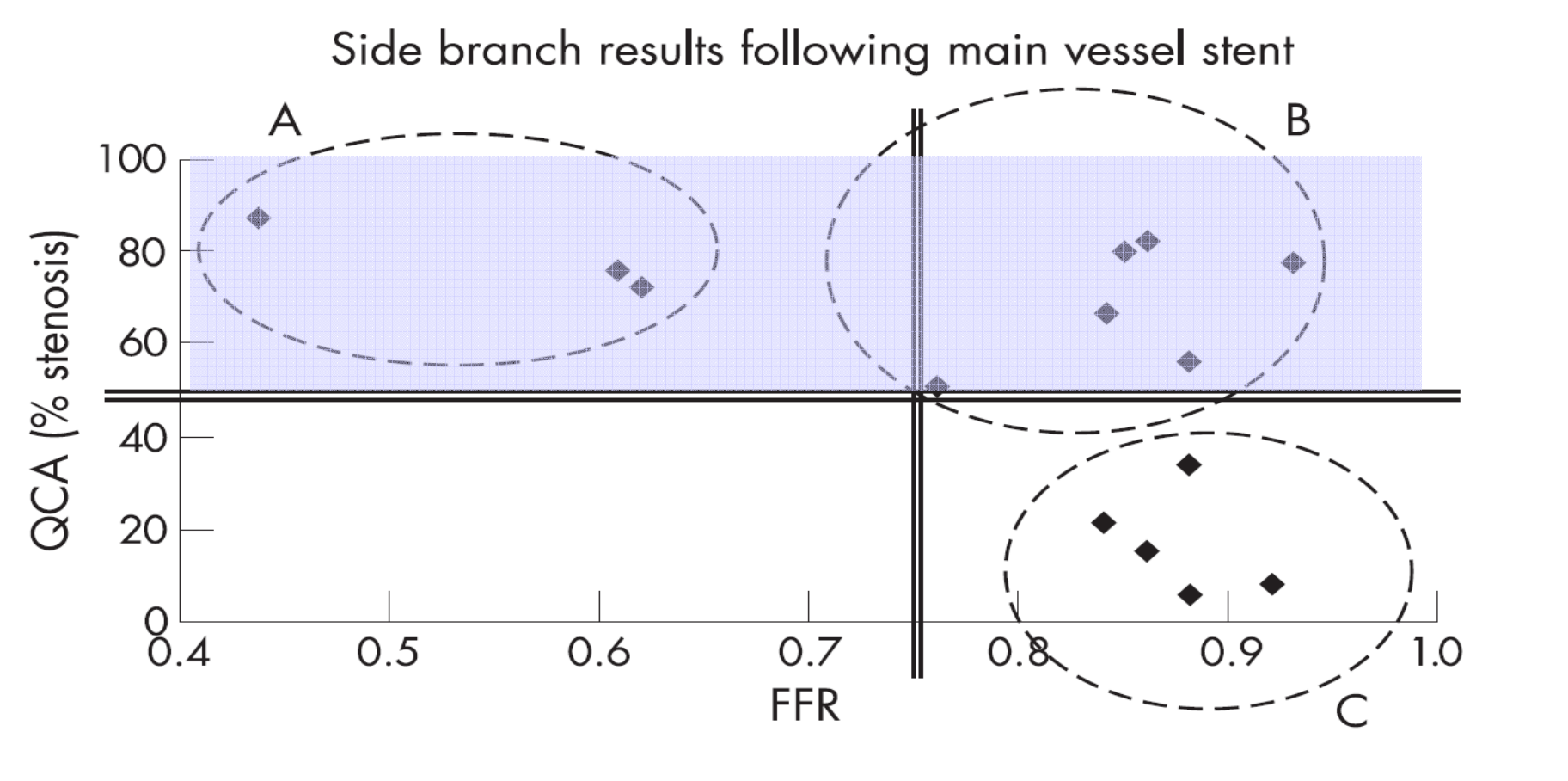
Angiographic severity vs. Functional significance



FFR	≥70% Angiographic Stenosis	50%–70% Angiographic Stenosis
≥0.75	20	30
<0.75	5	0
Sensitivity 100%, specificity 55%, and test accuracy 60%.		

Ziaee A, et al. AJC 2004

Angiographic severity vs. Functional significance



Bellenger, et al. Heart 2007

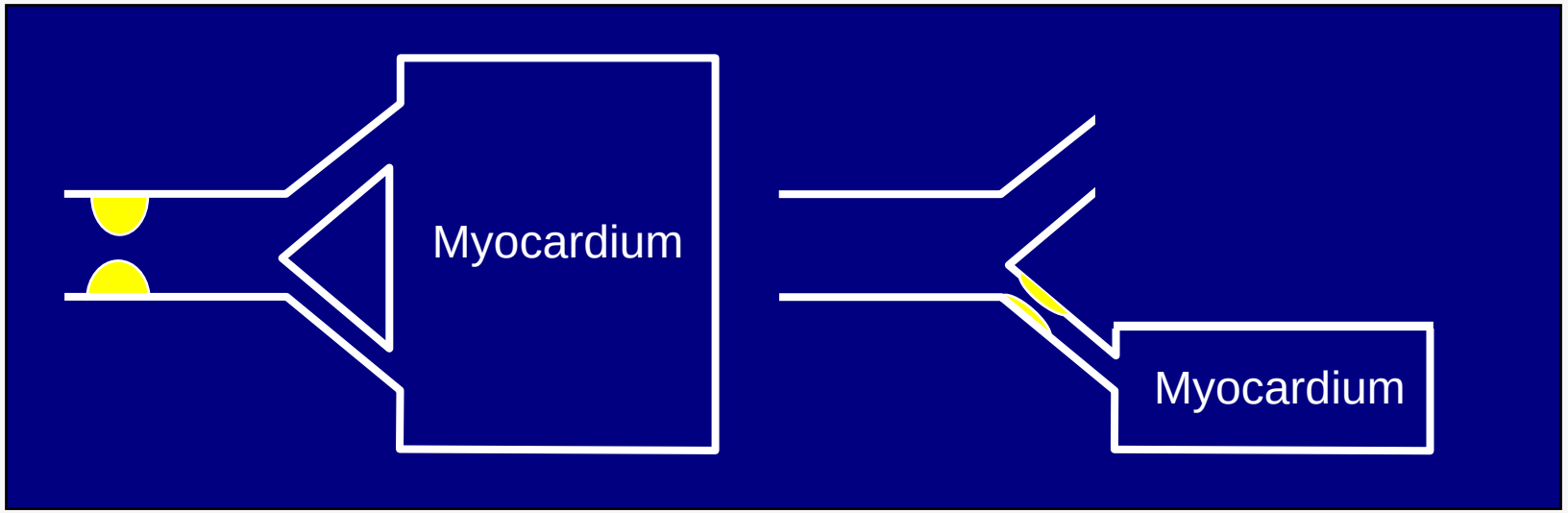
Physiologic Insight of Bifurcation Lesions

- “What you see” is NOT “What it is”.
- **Why?**
- Functional outcome of jailed SB lesions

Why the discrepancy?

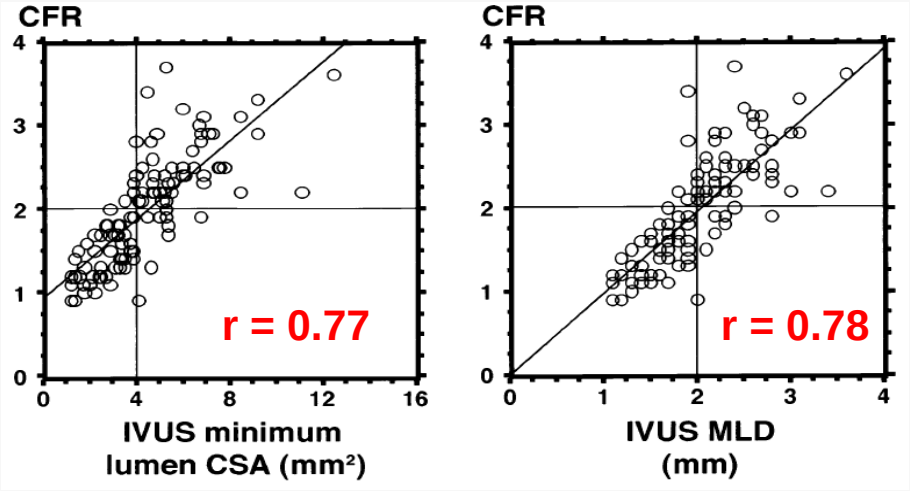
- **Side branch is usually small vessel**

  → **Myocardium supplied by SB is also small.**



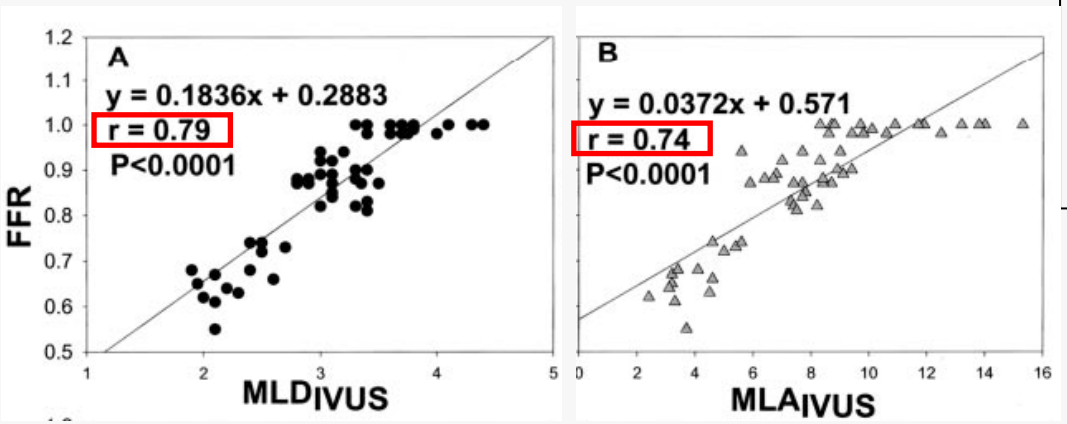
IVUS vs CFR/FFR

Vessel diameter: 2.9mm



Abizaid, et al. AJC 1998

Vessel diameter: 4.2± 2.0mm



Jasti, et al. Circulation 2004

Vessel diameter: 2.1±0.4mm

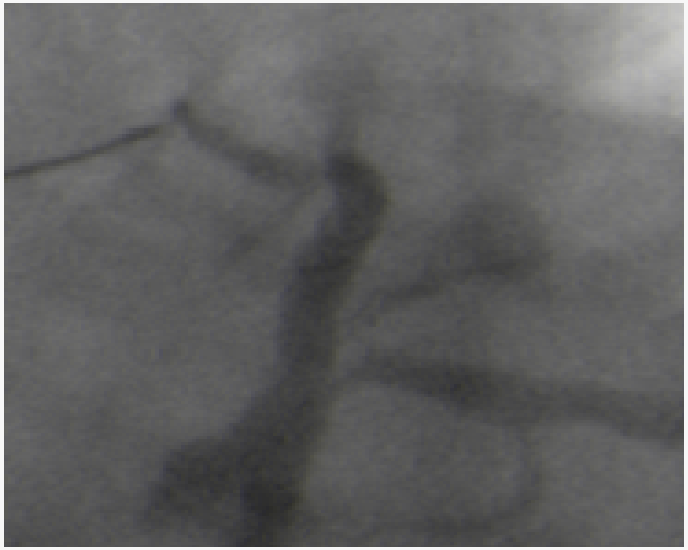
Pearson's correlation coefficients

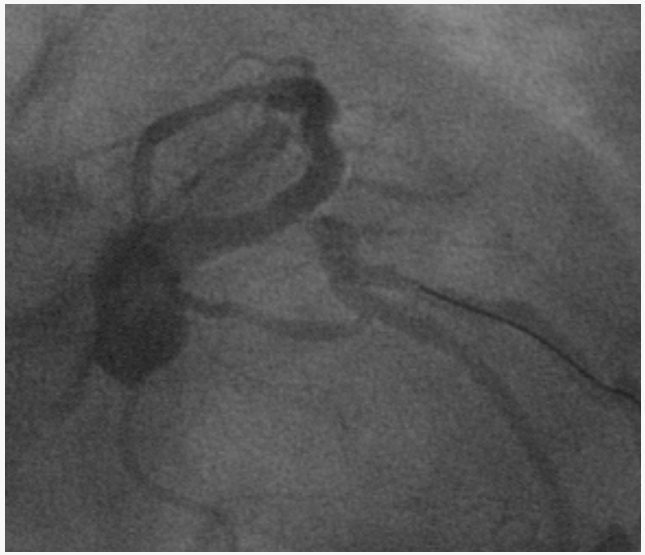
MLA vs. FFR	r=-0.04
Max %Obst vs. FFR	r=-0.06
Lumen Volume vs. FFR	r=0.01
MLD vs. FFR	r=0.27
%DS vs. FFR	r=0.01

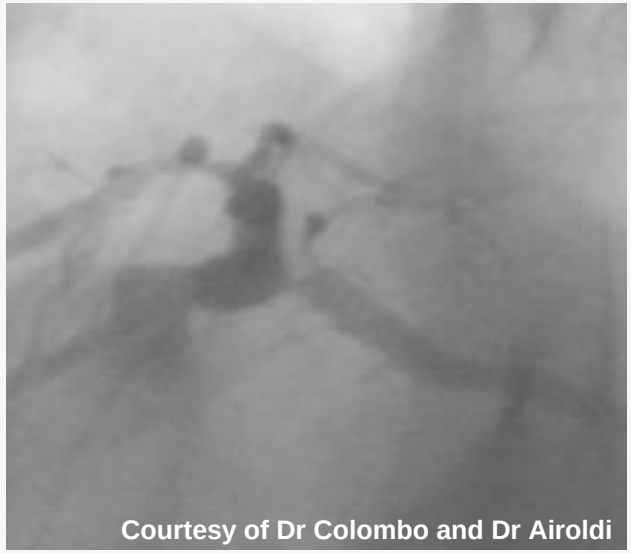
All p values: not significant

Costa, et al. AHJ 2007

Why the discrepancy in large vessels?







FFR=0.67

FFR=0.93

FFR=0.92

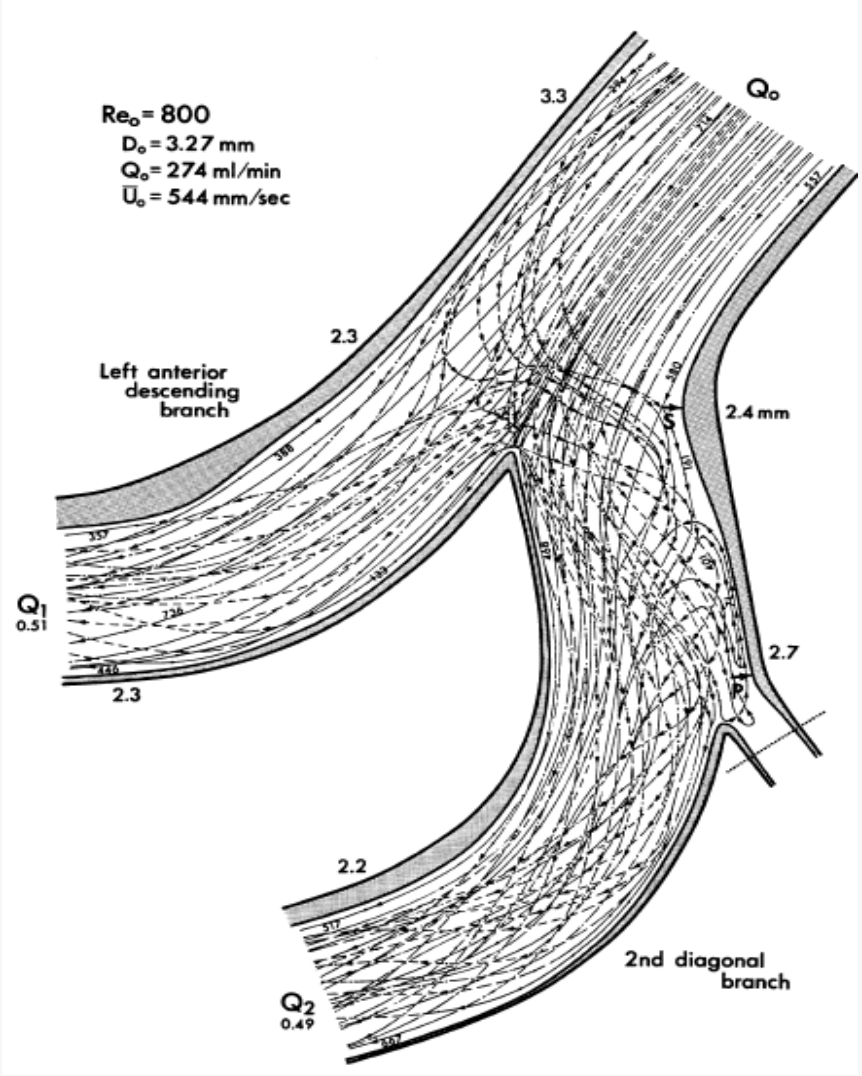
Why the discrepancy?

- Side branch is small vessel

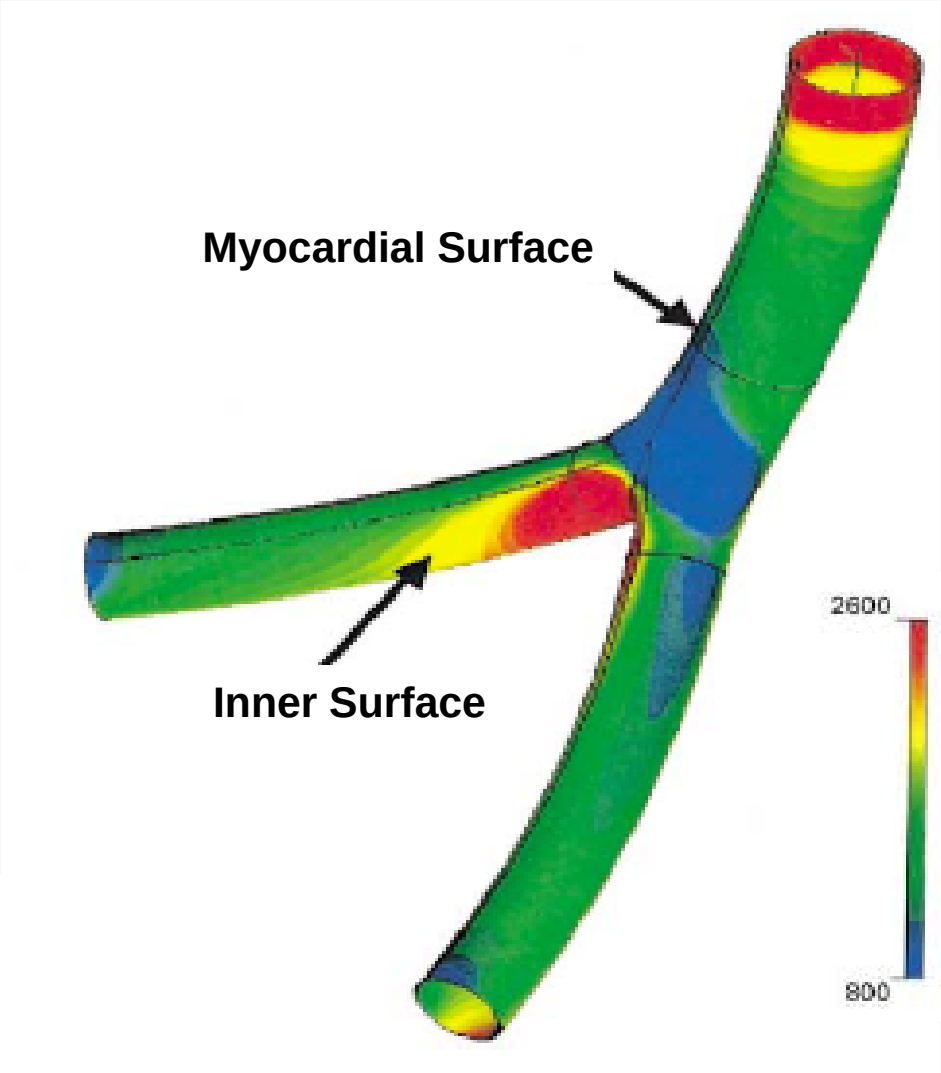
  → Supplies smaller myocardial territory

- **SB ostial lesions are almost always eccentric**

Bifurcation, Flow and Shear

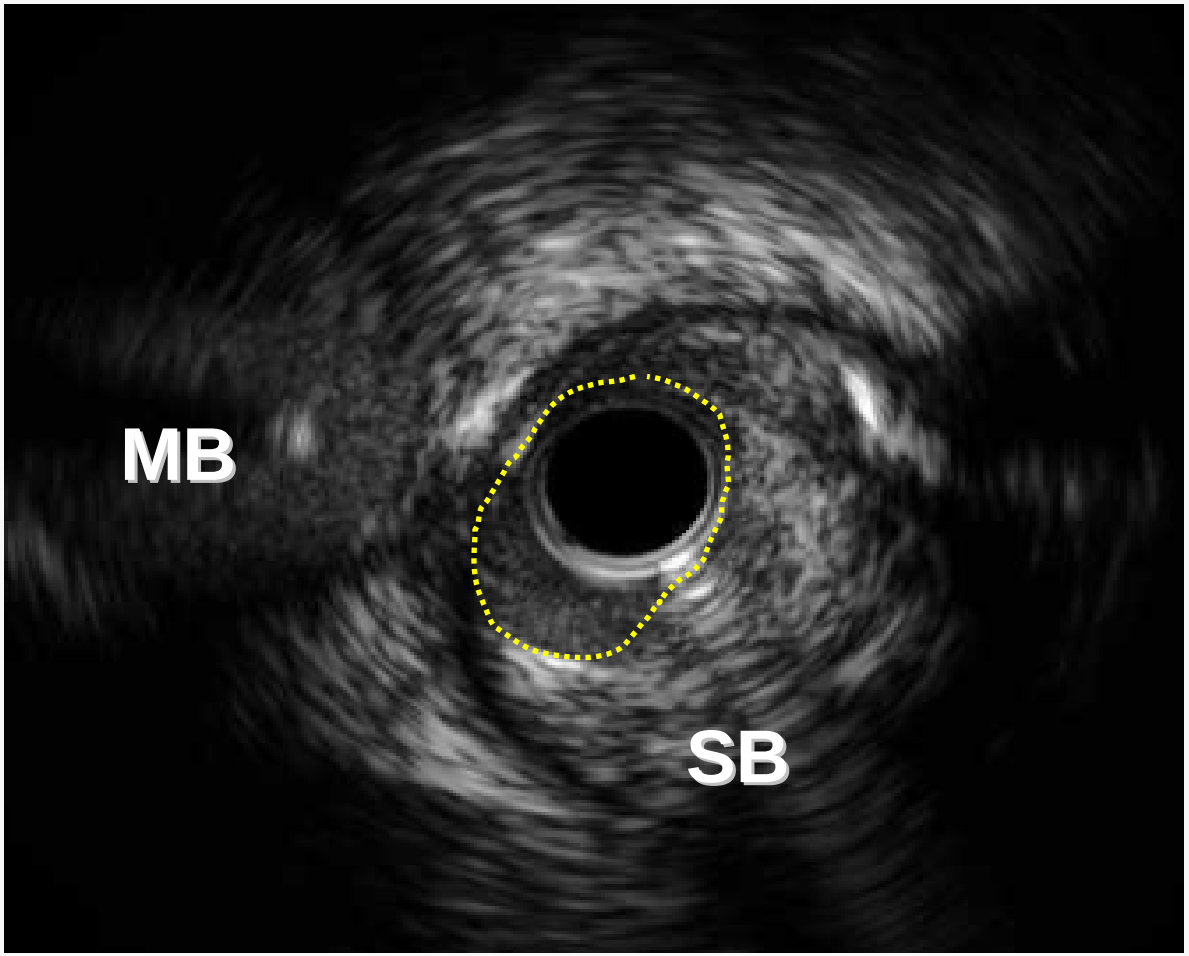


Asakura & Karino Circulation Res 1990



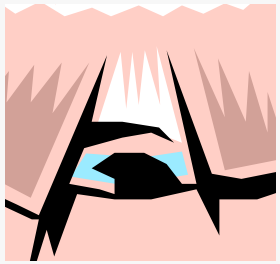
Weydahl & Moore J Biomech 2001

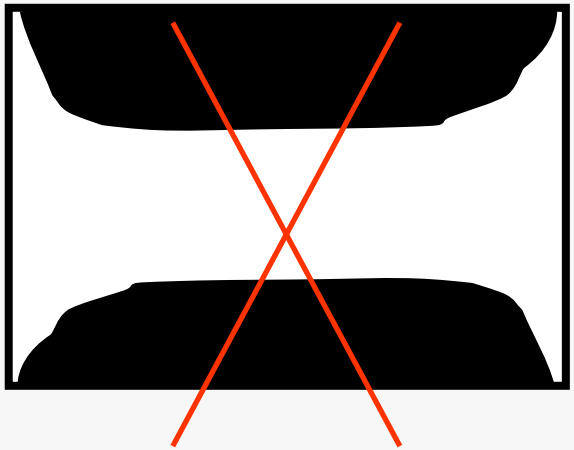
Side branch ostial lesion

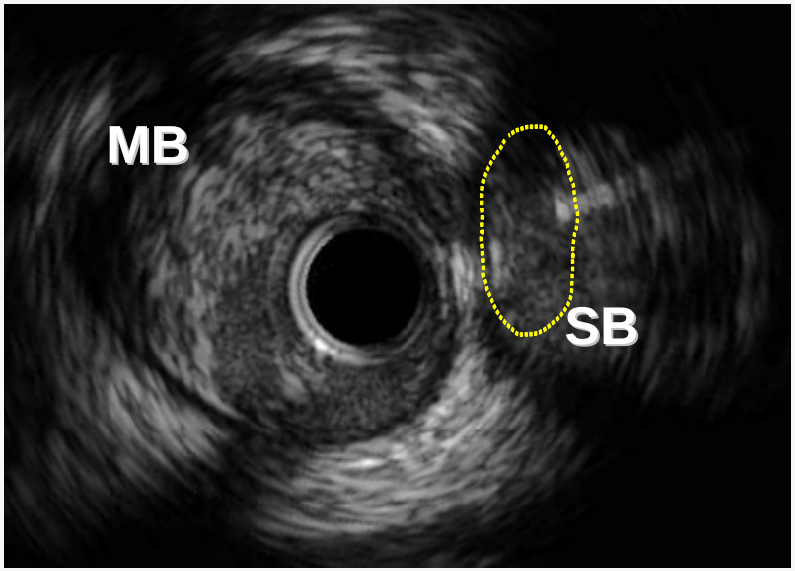


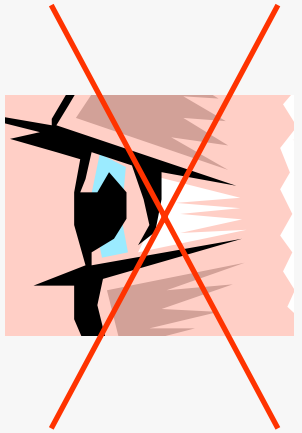
Eccentric plaque with disease free wall at carina

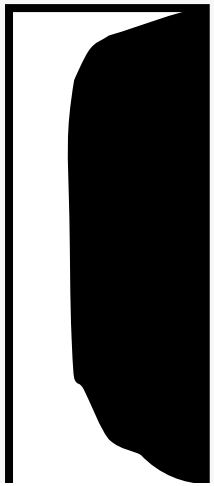
Why discrepancy????











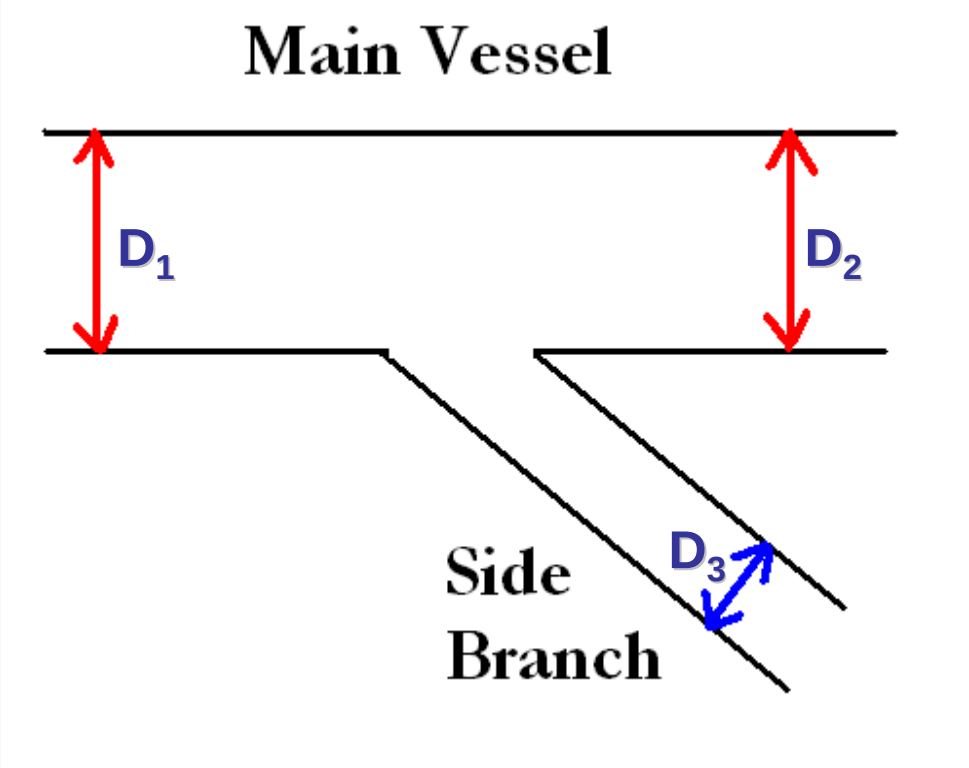
Why the discrepancy?

- Side branch is small vessel

  → Supplies smaller myocardial territory

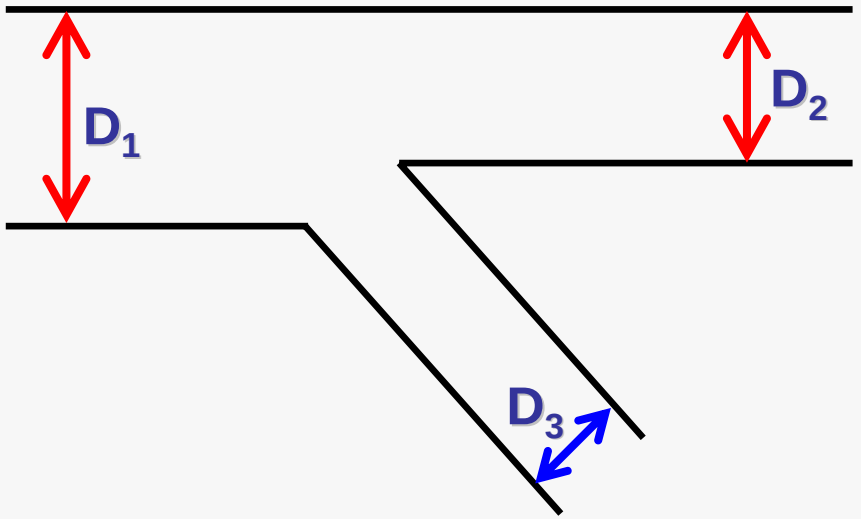
- SB ostial lesions are almost always eccentric
- **Side branch jail occurs due to both plaque and carina shift**

Bifurcation Model



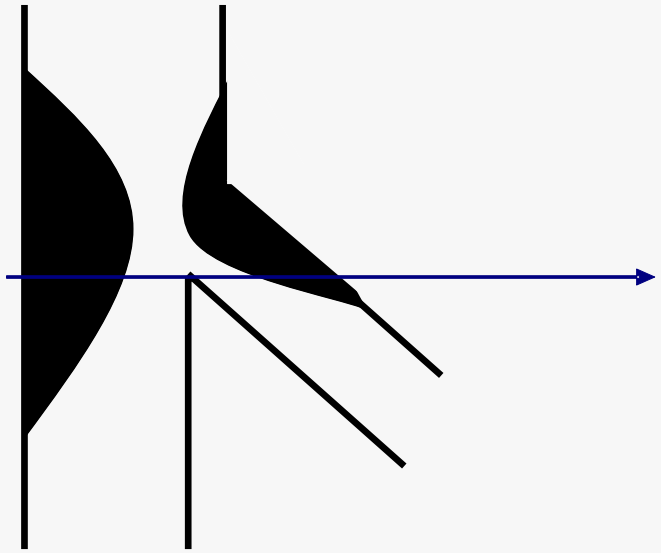
Murray's law

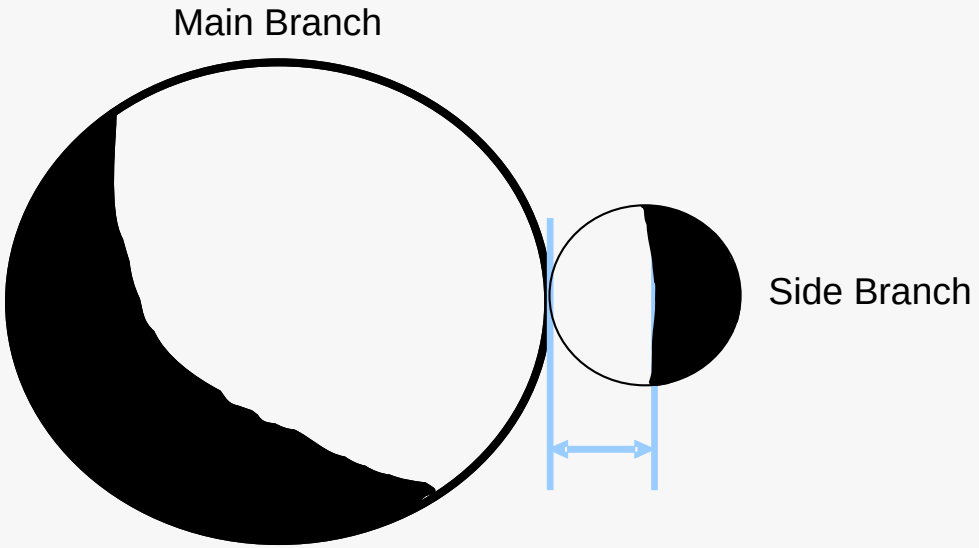
$$D_1^3 = D_2^3 + D_3^3$$



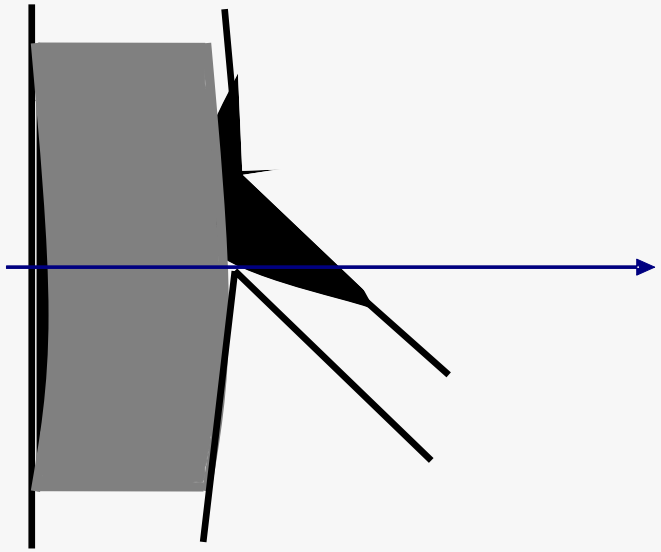
Why discrepancy????

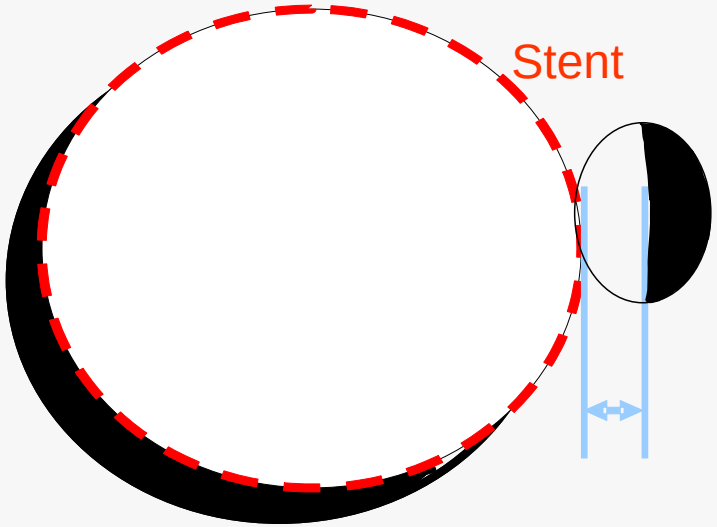
Before PCI



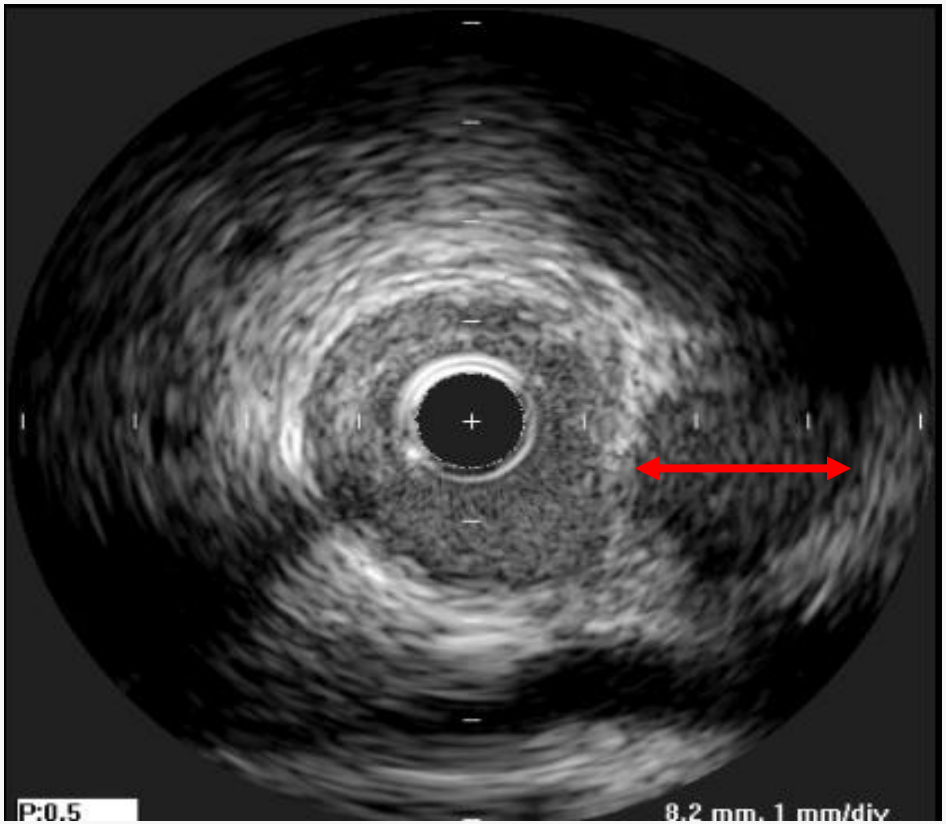


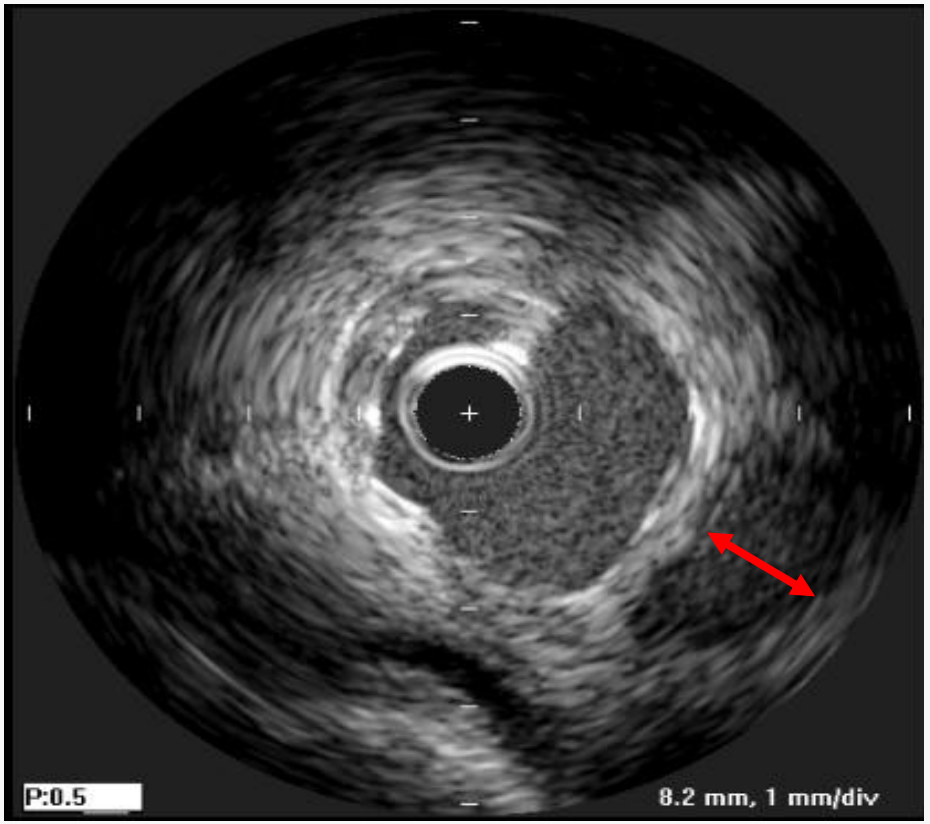
After Main branch stenting

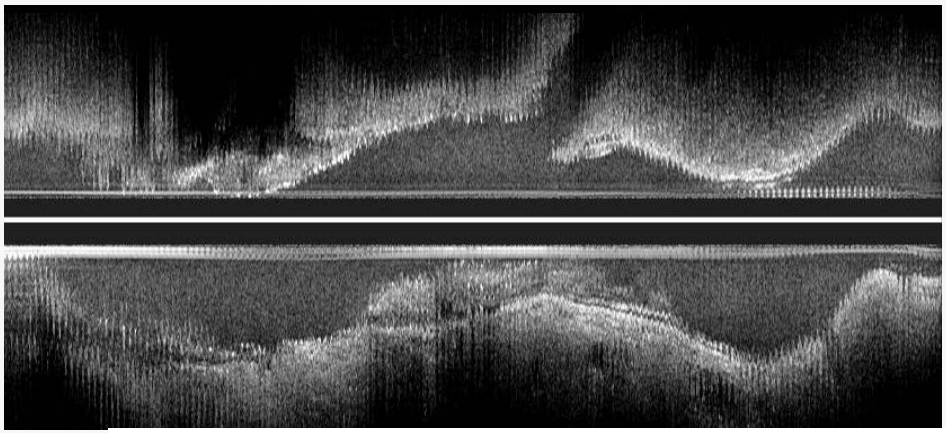


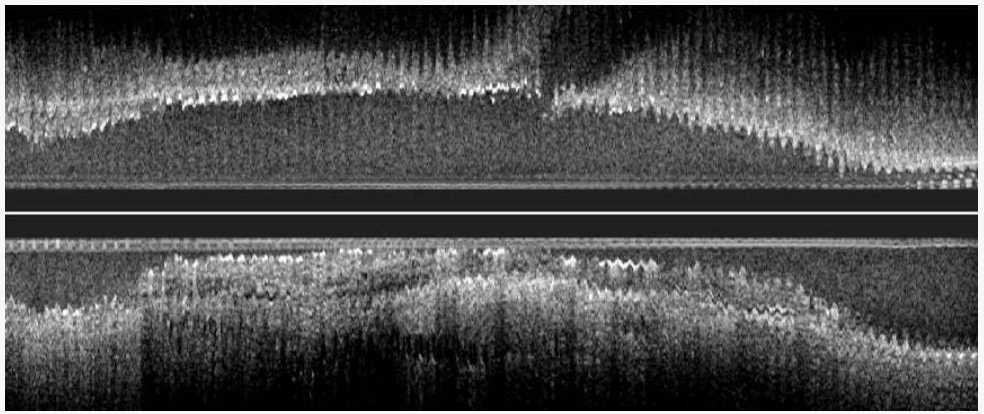


Angiographic View



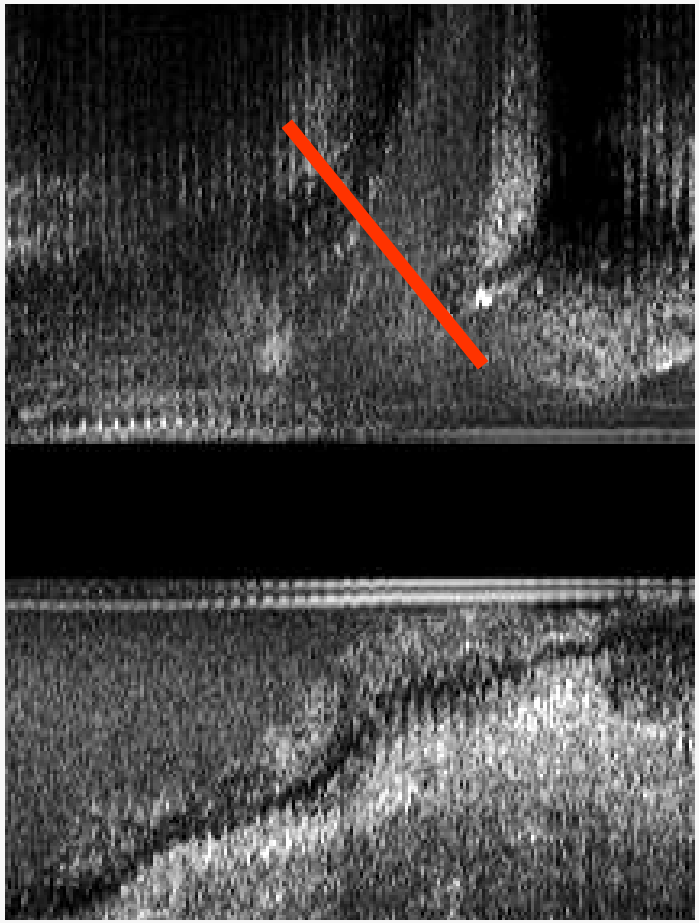




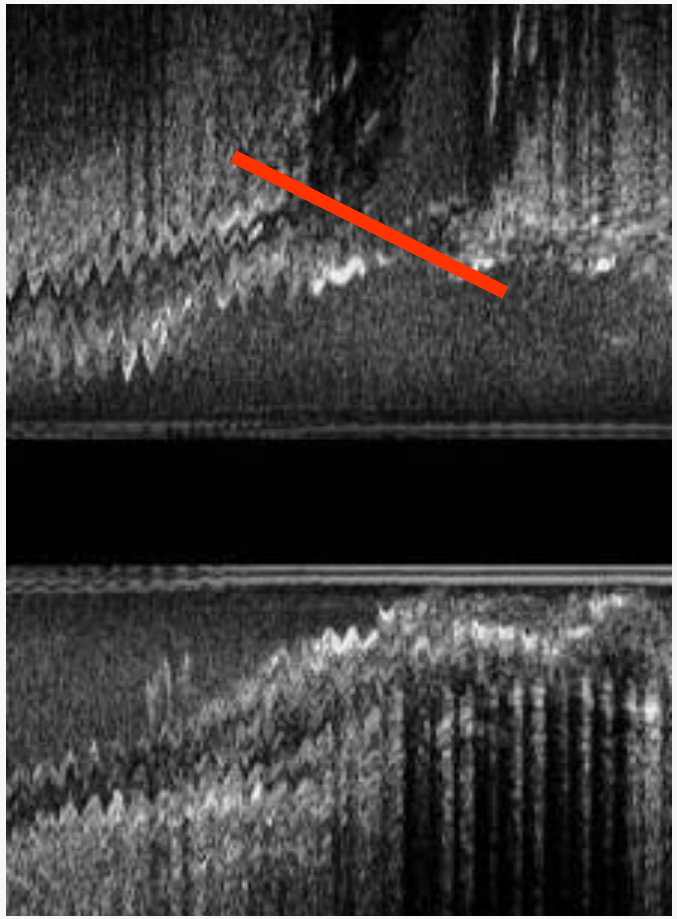


Lumen Area loss << Angiographic diameter loss

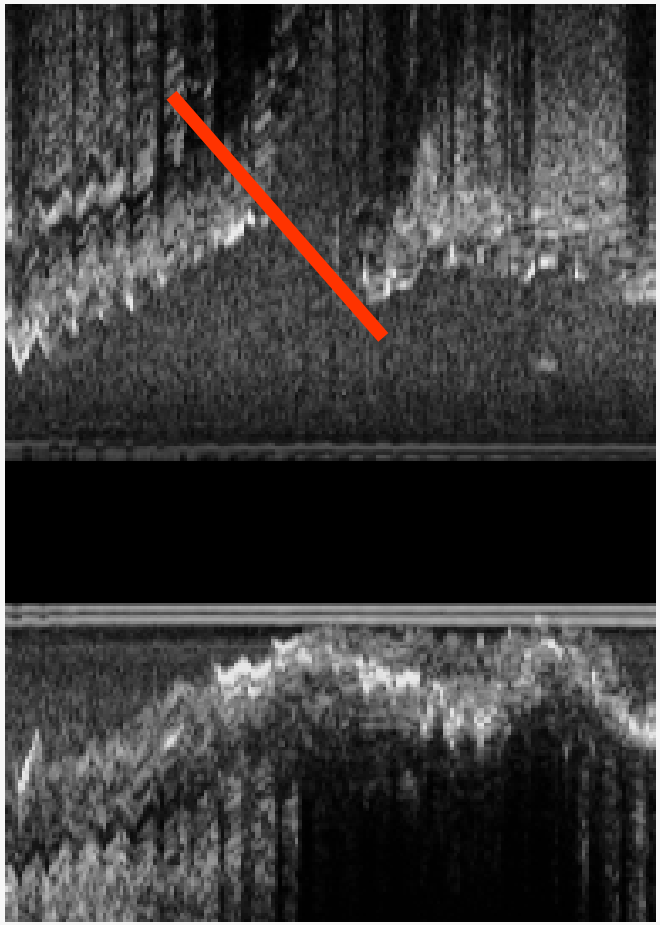
“Gentle kiss” to relocate the carina



Pre-intervention



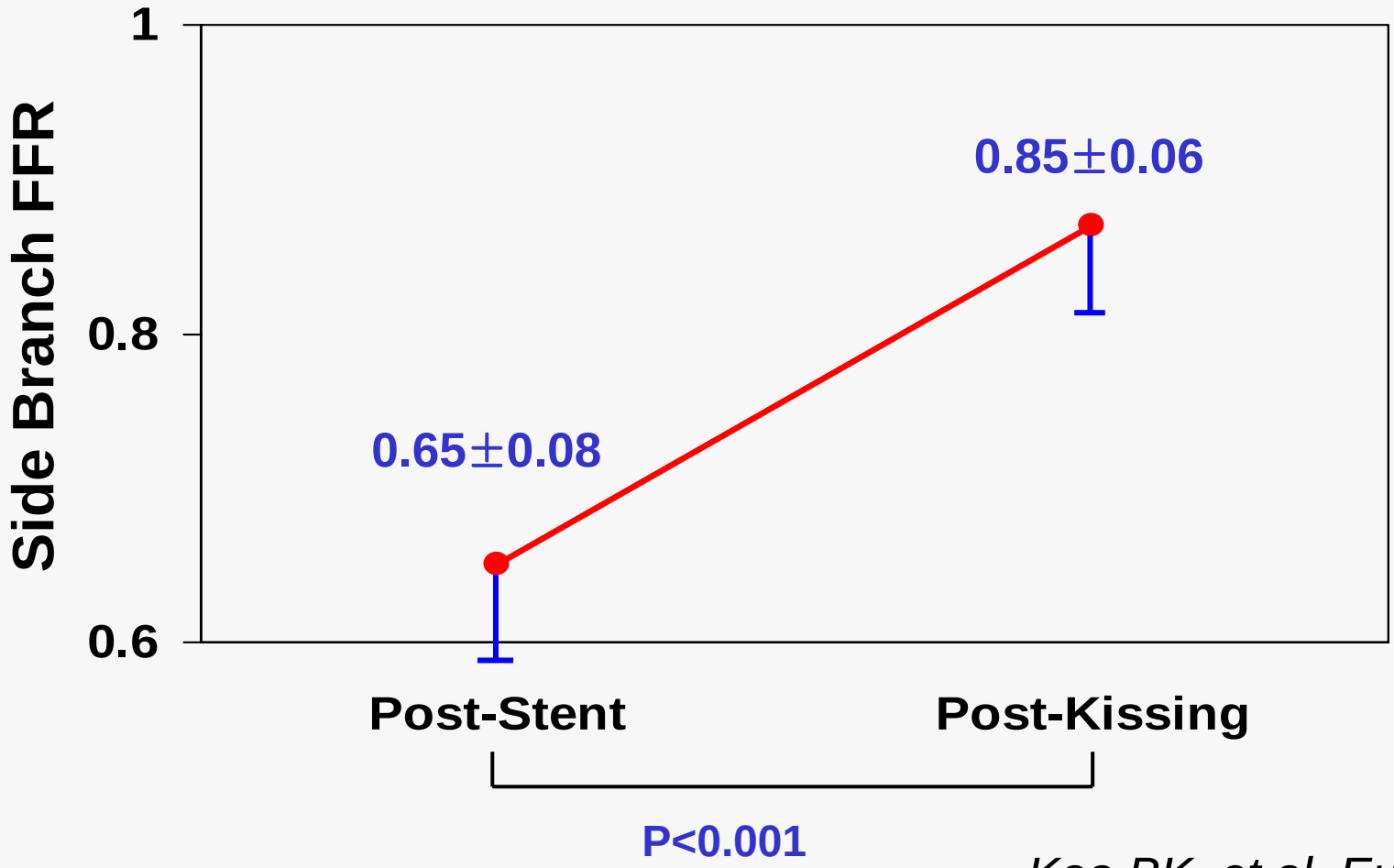
MB stenting



Kissing balloon

* Gentle kiss: Balloon/Artery < 1

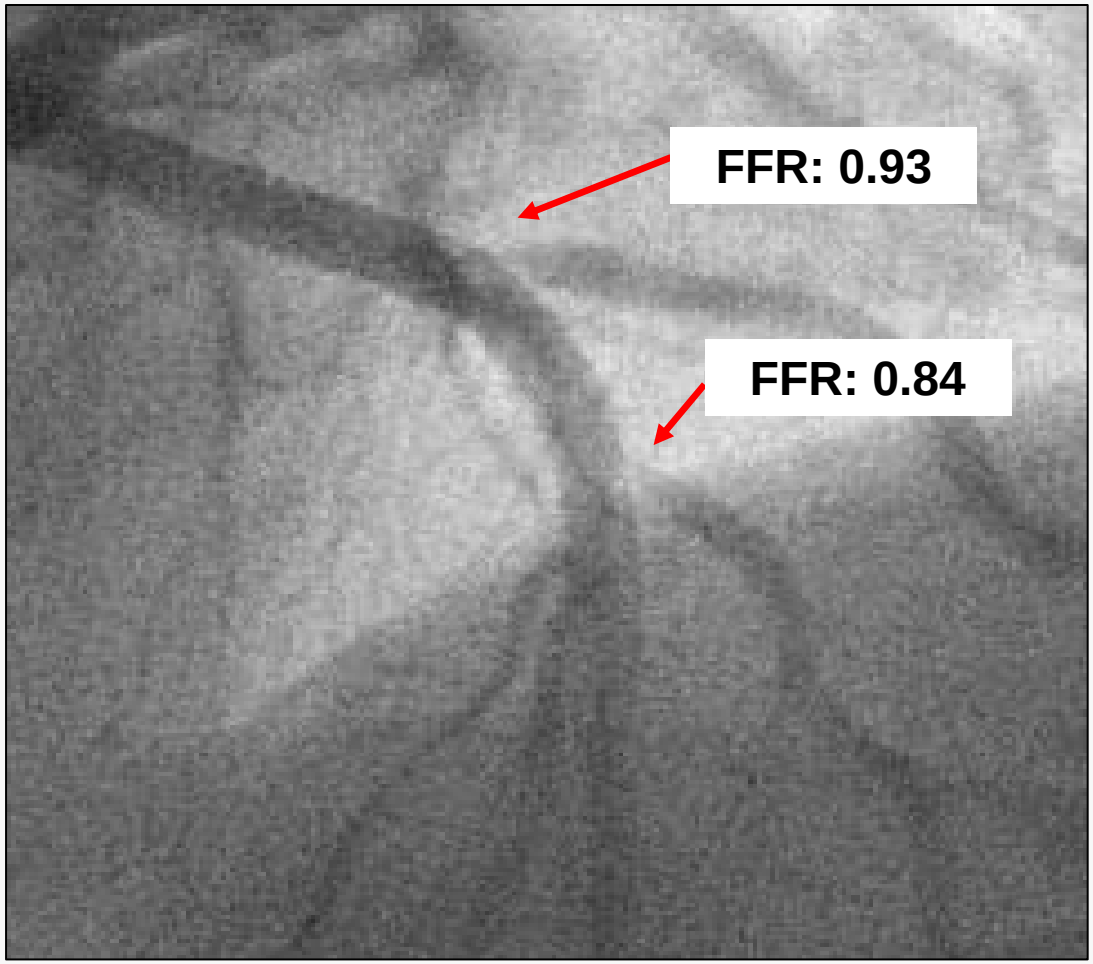
Changes of side branch FFR after “gentle kiss”



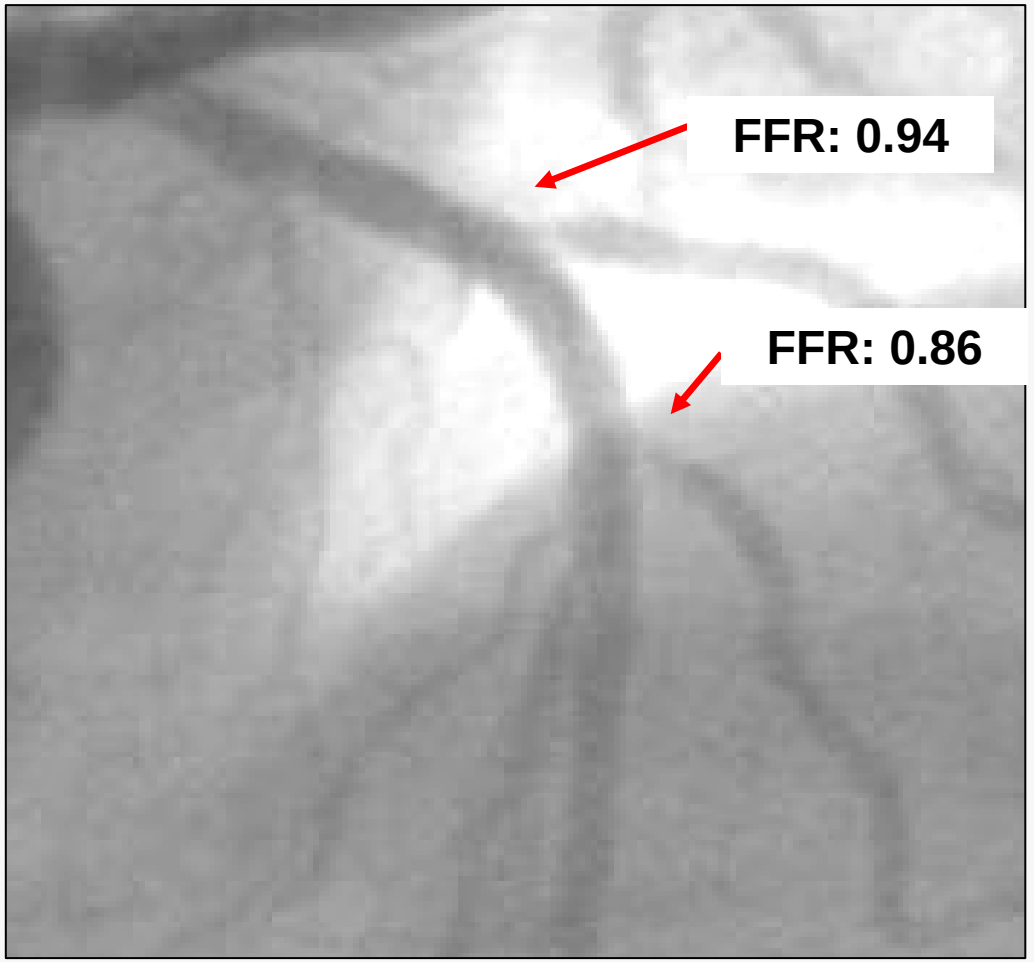
Koo BK, et al. Eur Heart J 2008

Physiologic Insight of Bifurcation Lesions

- “What you see” is NOT “What it is”.
- Why?
- **Functional outcome of jailed SB lesions**



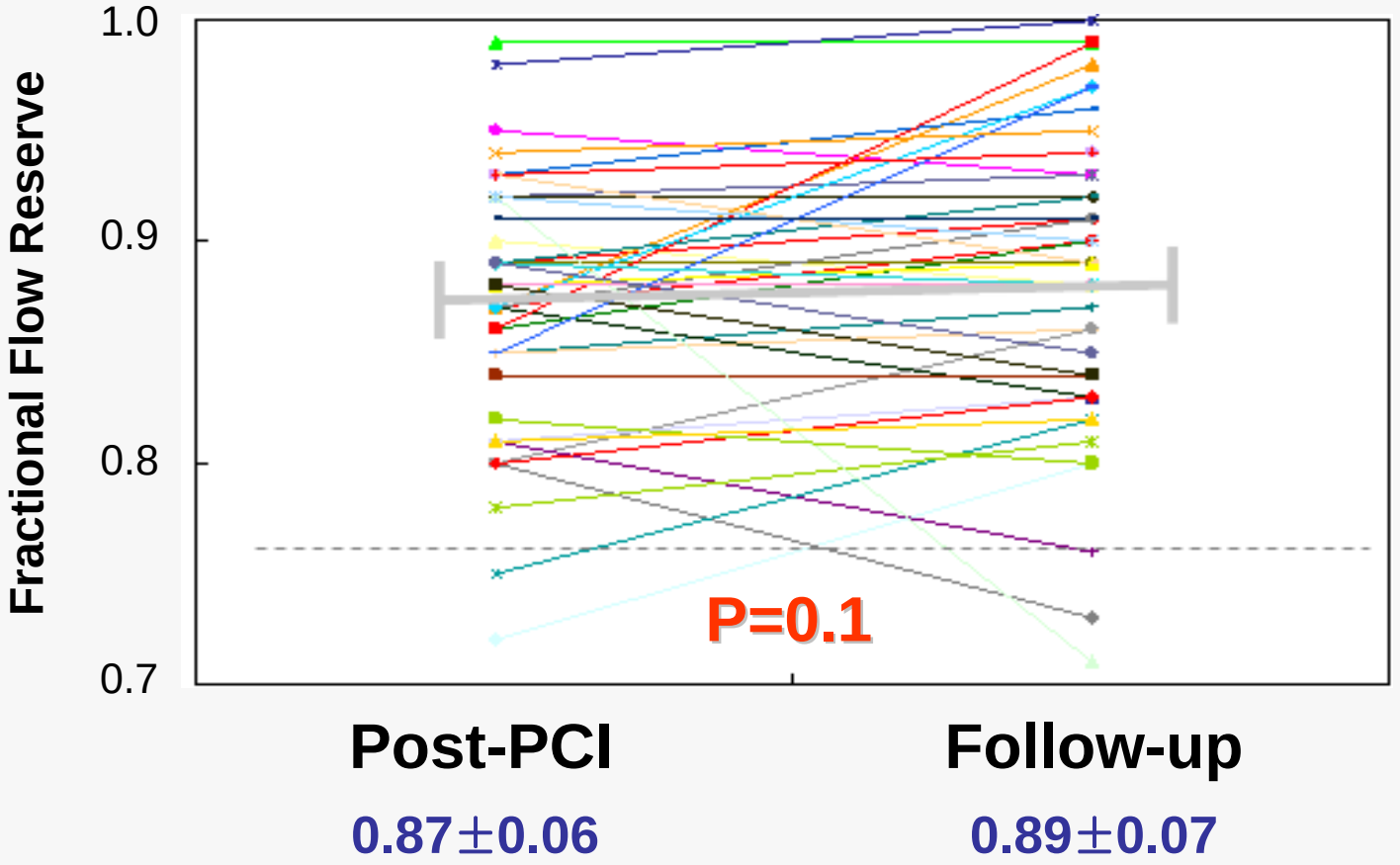
Post-PCI



6 Month Follow-up

Functional outcome of Jailed side branches

Not-treated jailed side branches



Koo BK, et al. Eur Heart J 2008

Summary

- Jailed SB lesion is different from usual MB lesion.
- Angiography overestimates the severity of jailed SB lesion.
- Outcome of functionally non-significant SB lesions is good despite the angiographic severe stenosis.

We still need….

- More comprehensive anatomical, physiological and rheological insight of bifurcation lesions.
- Better way of treatment
- Better devices