

FFR Assessment for Complex Lesions

: LM, Bifurcation and Tandem lesions

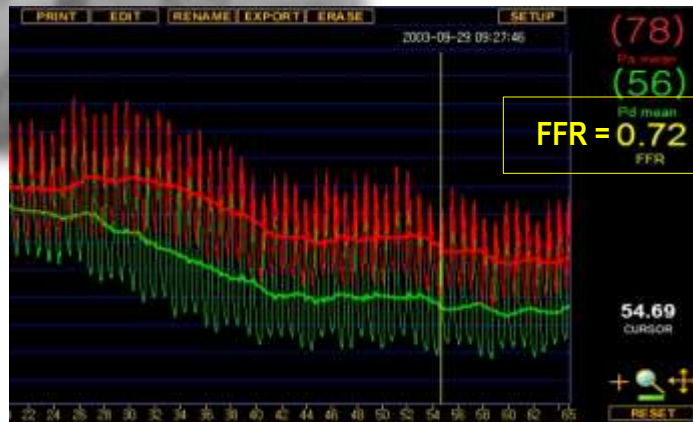
Bon-Kwon Koo, MD, PhD

Seoul National University Hospital, Seoul, Korea



How to use FFR and its concept?

Intermediate stenosis: Which is a significant stenosis?



FFR application: Level of experience

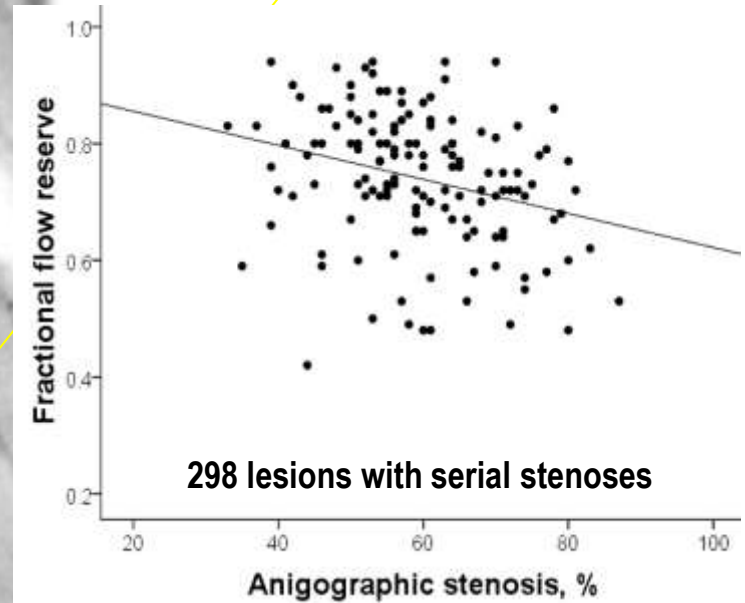
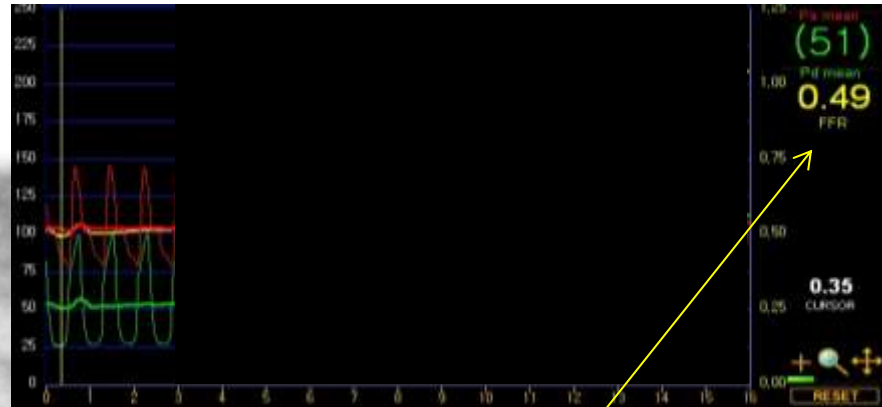
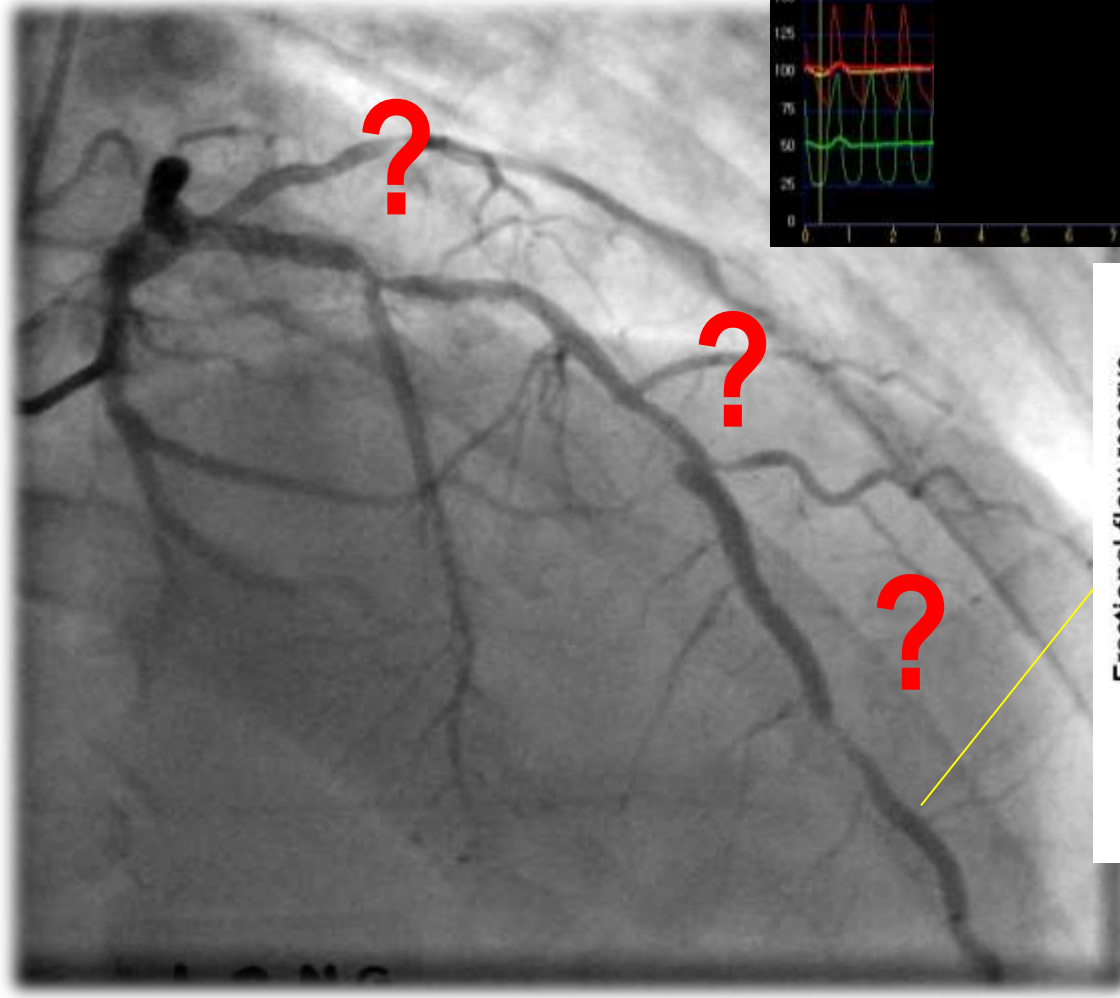
- Level 1: Setting up
- Level 2: Single intermediate stenosis
- ***Level 3: Serial stenoses, multi-vessel disease***
- ***Level 4: Left main, bifurcation, jailed side branches***
- Level 5: Dobutamine-stress FFR, IMR/CFR, wedge pressure.....

FFR in Multi-vessel disease and Multiple lesions

FFR is the only mean of gaining a per segment functional assessment of the coronary tree

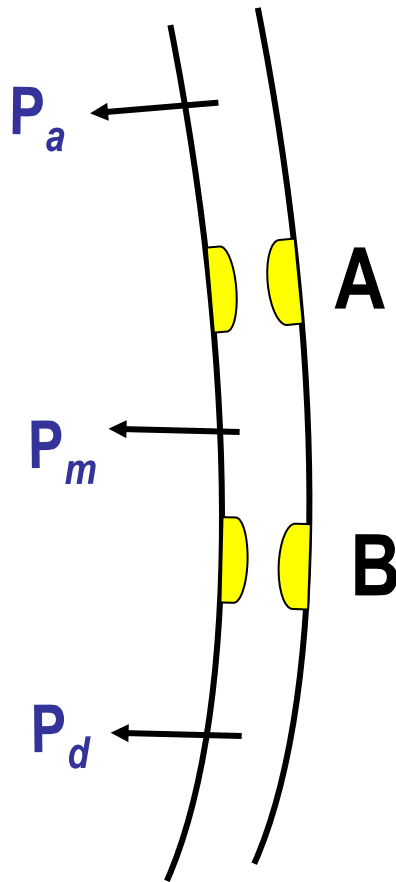
- Stress ECG: *Per patient*
- Radioisotope scan, CFR *Per vessel*
- FFR *Per segment*

FFR in Serial Stenoses



Kim HL, Koo BK, et al. JACC interv 2012

FFR in Serial Stenoses



$$FFR(A)_{pred} = \frac{P_d - (P_m/P_a) P_w}{P_a - P_m + P_d - P_w}$$

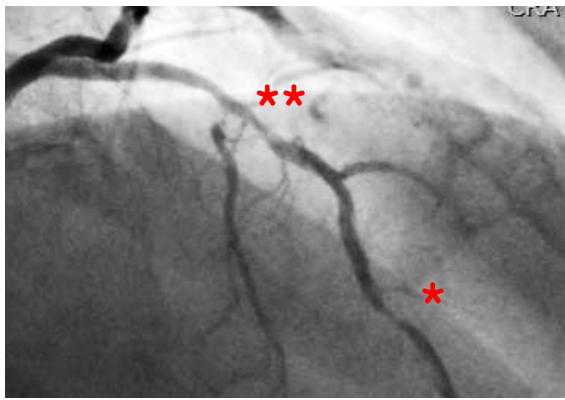
$$FFR(B)_{pred} = \frac{(P_a - P_w) (P_m - P_d)}{P_a (P_m - P_w)}$$

P_w = Coronary occlusive pressure

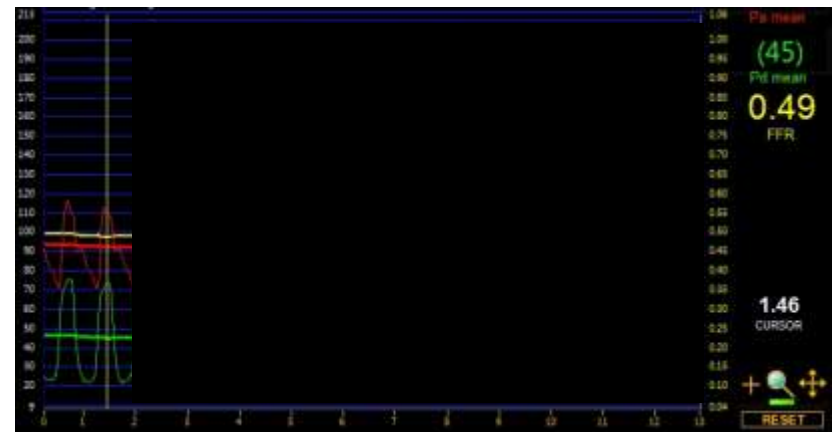
Pijls NHJ et al Circulation 2000
De Bruyne B et al Circulation 2000

FFR in Serial Stenoses: Real world practice

1. Measure FFR of all stenoses together from distal P_d / P_a
2. When FFR is not significant, leave all lesions alone.
3. When it is significant,
Perform a pressure pullback tracing under steady state hyperemia
→ PCI the most severe (pressure step-up >10-15mmHg) first
→ Repeat a pressure pullback tracing



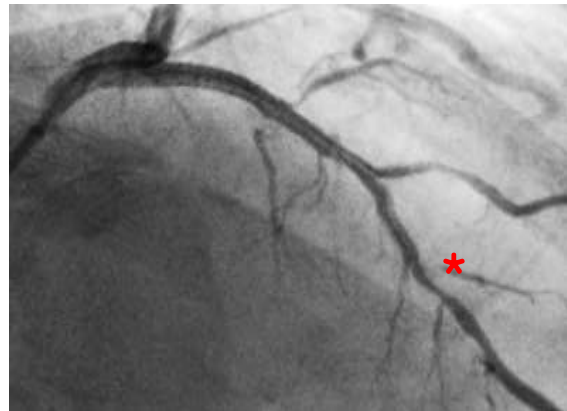
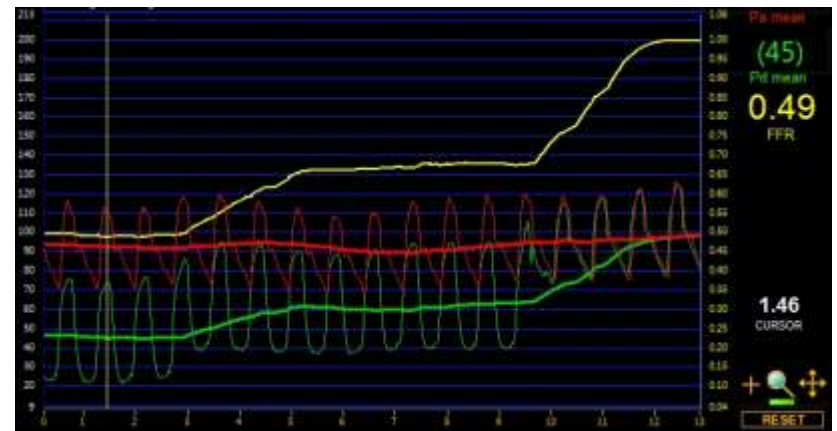
Before PCI



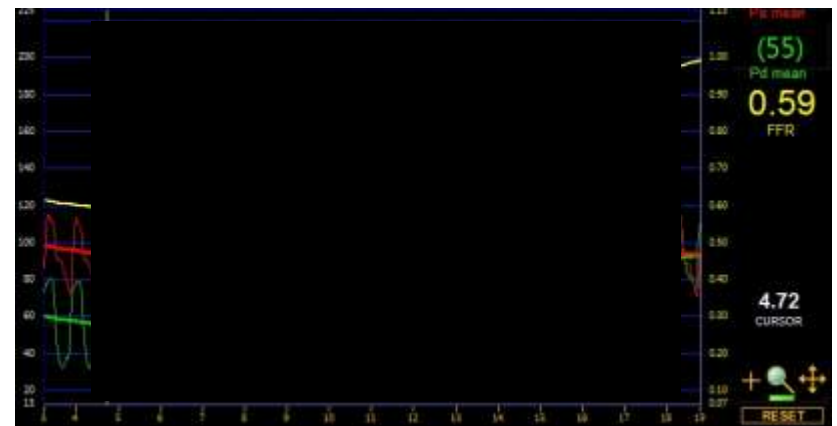
Kim HL, Koo BK, et al. JACC interv 2012



Before PCI

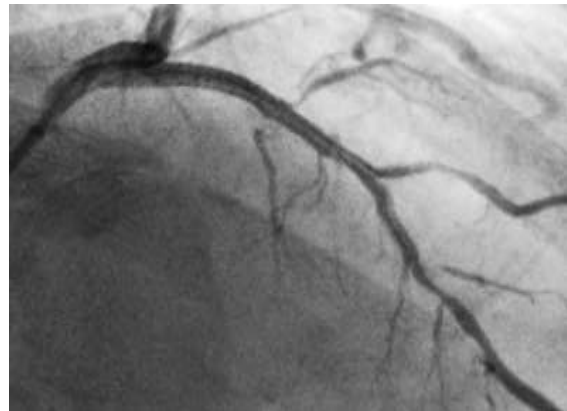
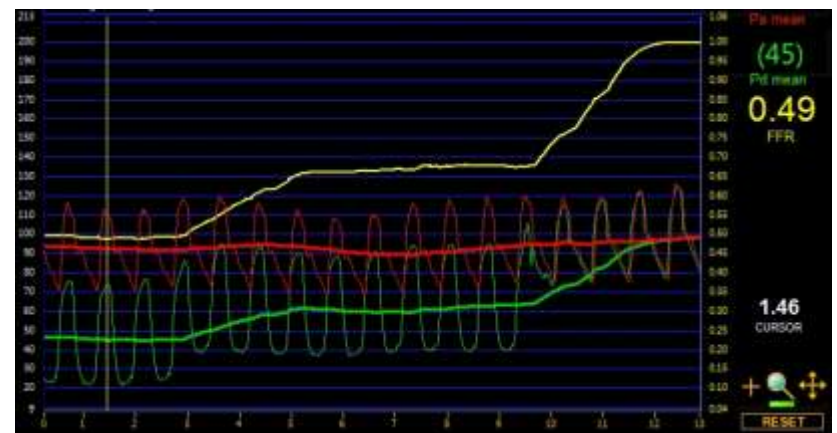


After proximal lesion PCI

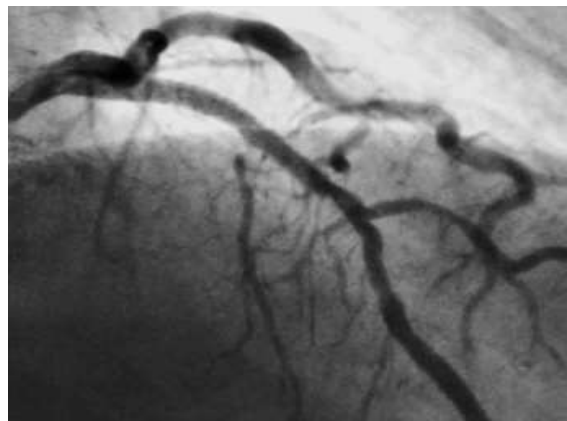
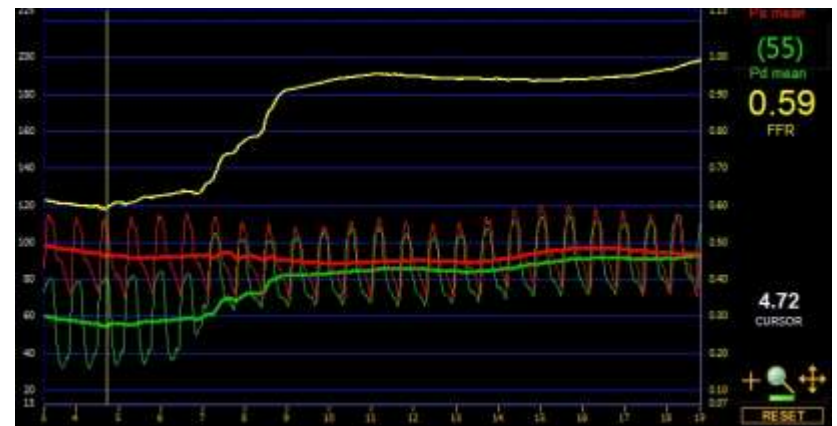




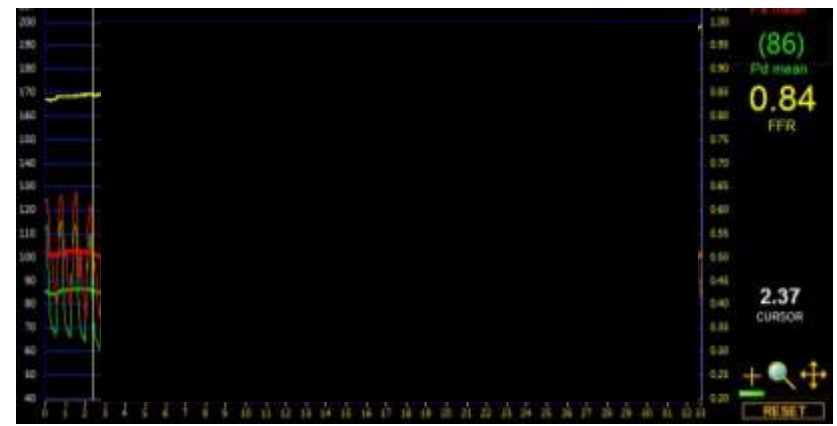
Before PCI



After proximal lesion PCI



After distal lesion PCI



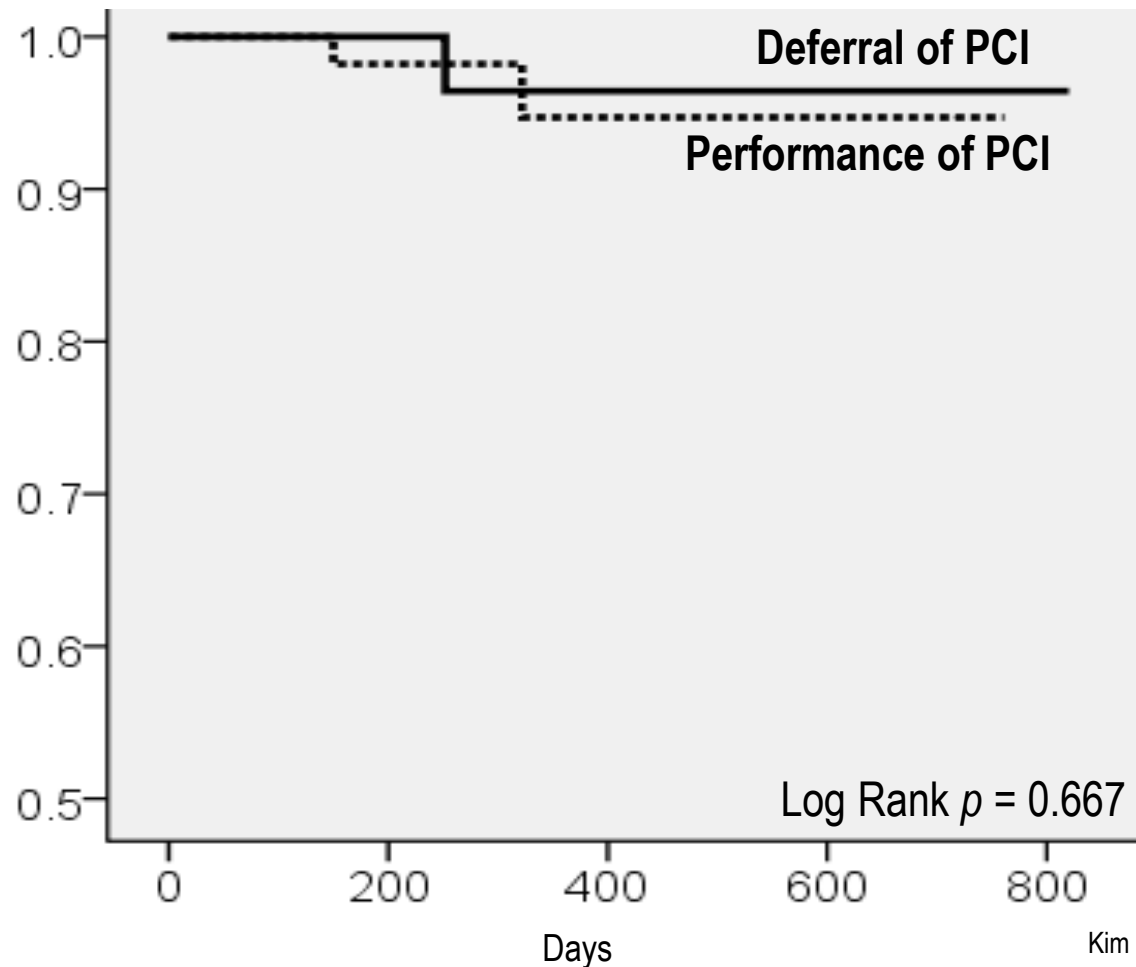
FFR and pressure pullback tracing



- Gentle pulling back of pressure wire under steady state hyperemia
- Guiding catheter should always be out of LM ostium
- Negative tension to the guiding catheter during wire pullback
- Buddy wire is helpful especially in cases with ostial disease

FFR-guided PCI for Serial Stenoses

- 141 vessels with serial stenoses (298 lesions)
- FFR-guided PCI: 116 stents (39%), Deferral: 182 lesions (61%)

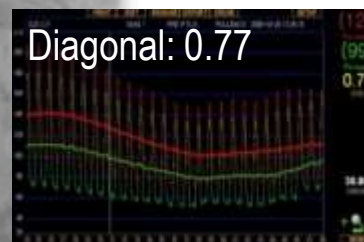
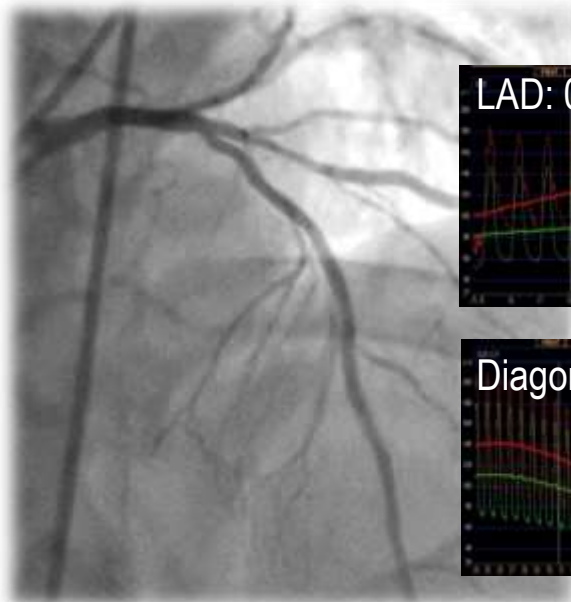
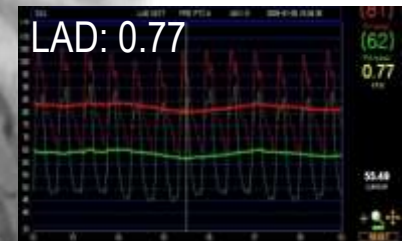
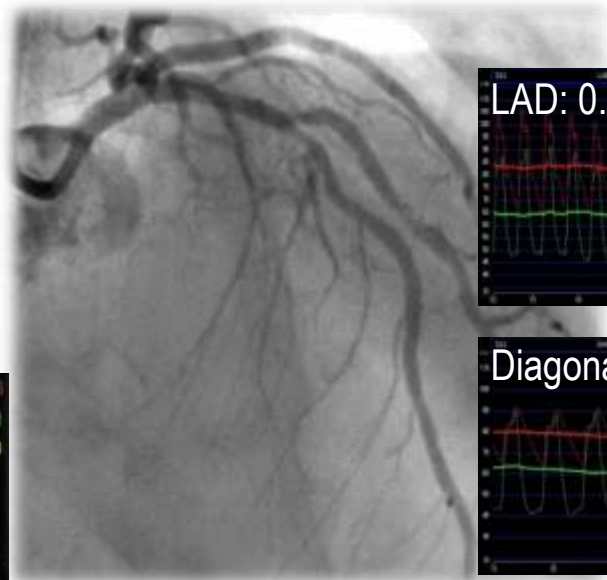
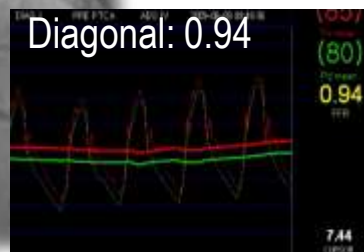
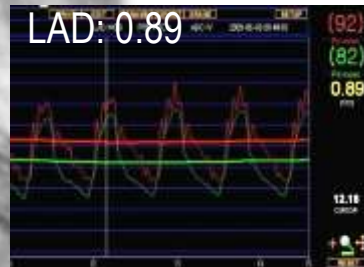
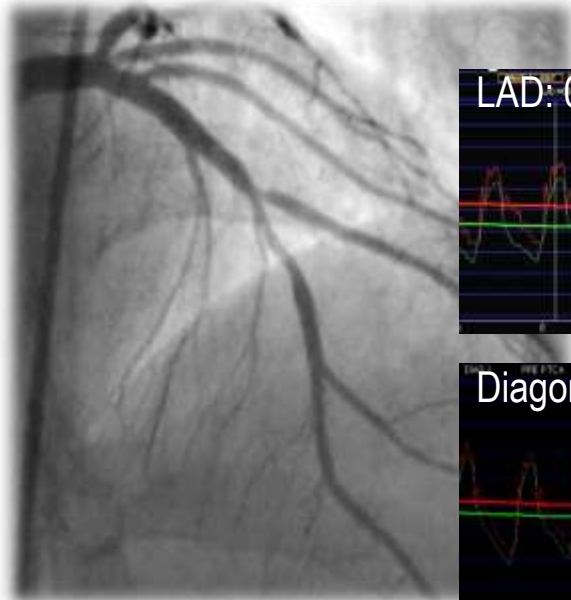


Kim HL, Koo BK, et al. JACC interv 2012

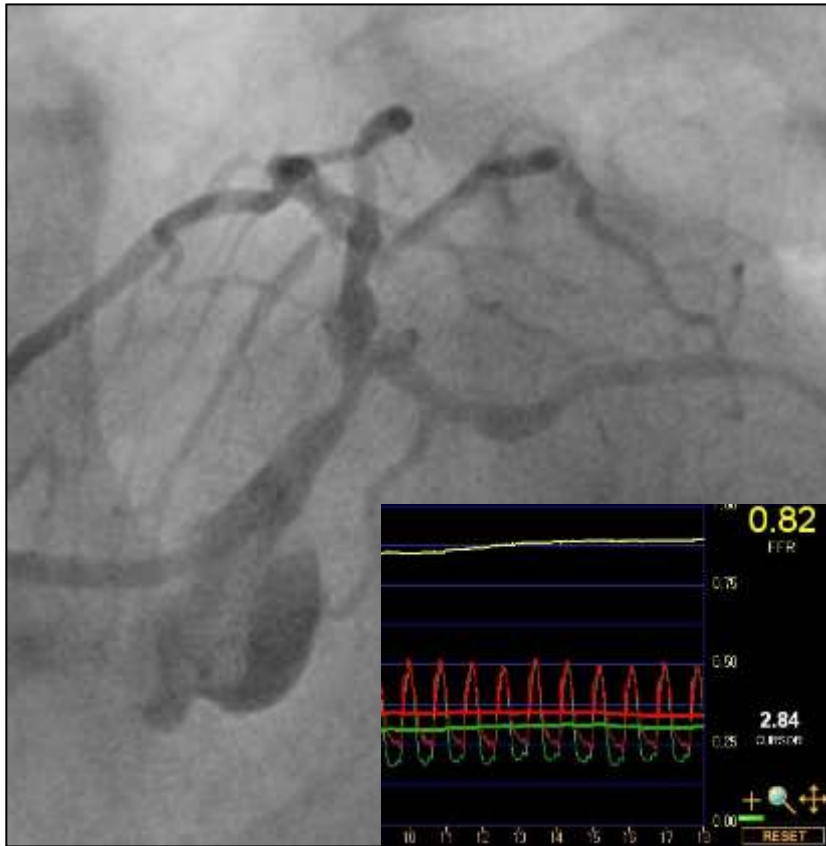
FFR application: Level of experience

- Level 1: Setting up
- Level 2: Single intermediate stenosis
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Bifurcation lesion?

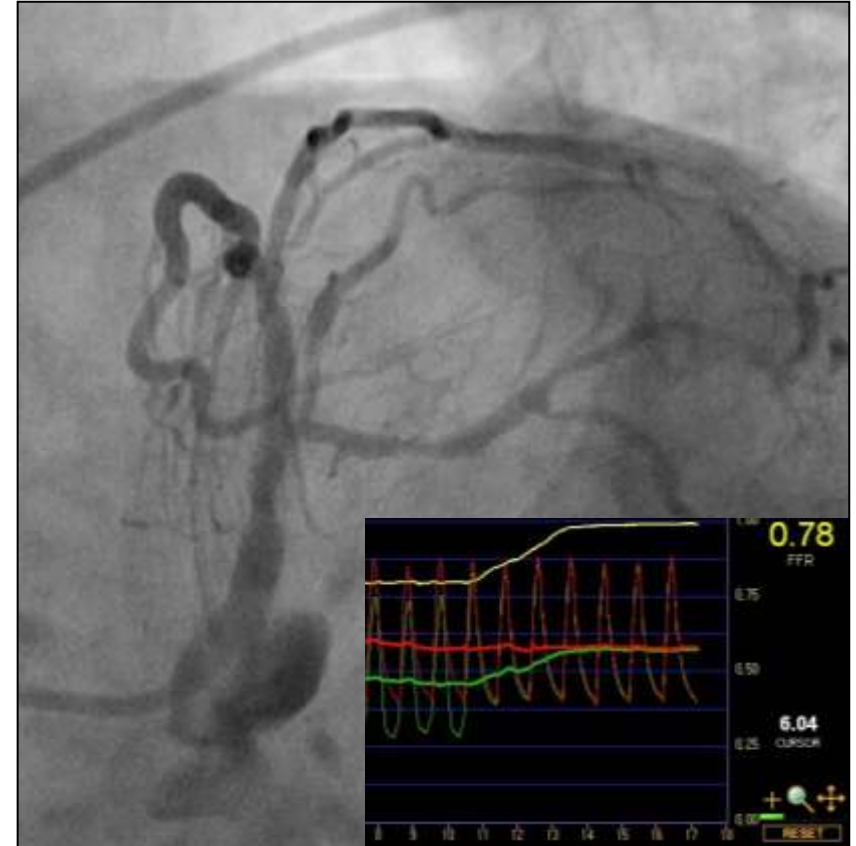


Which LM lesion is significant?



Mismatch

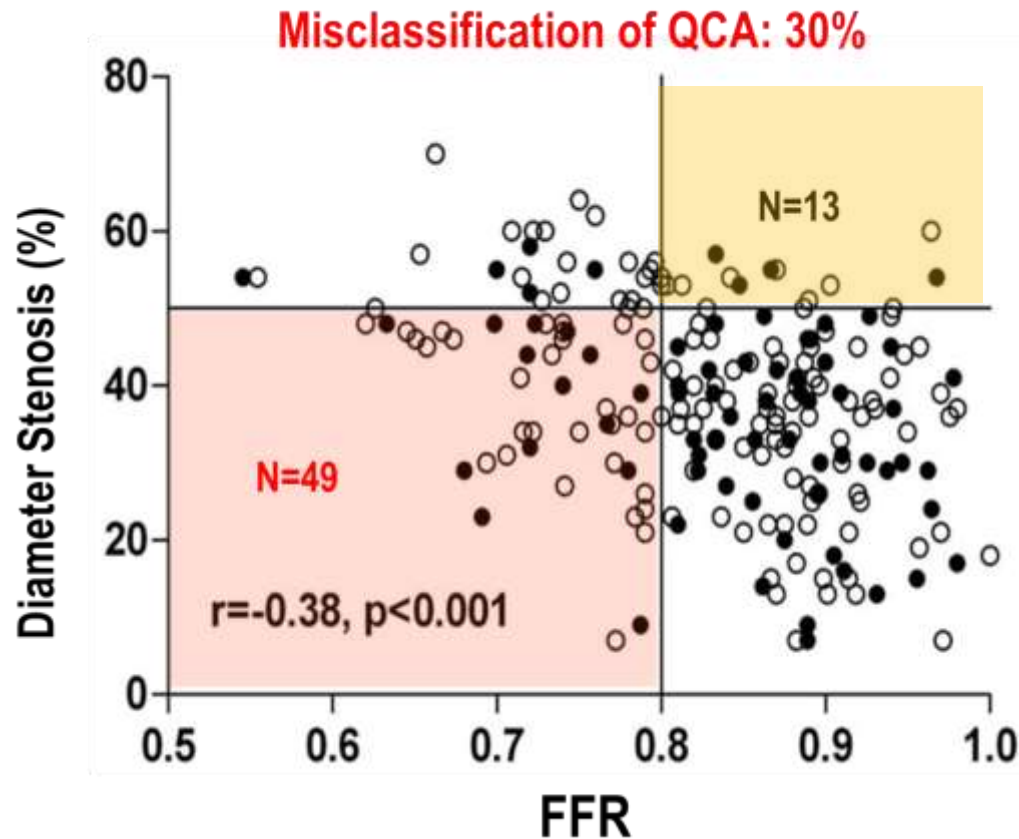
: Angiographically significant, functionally insignificant



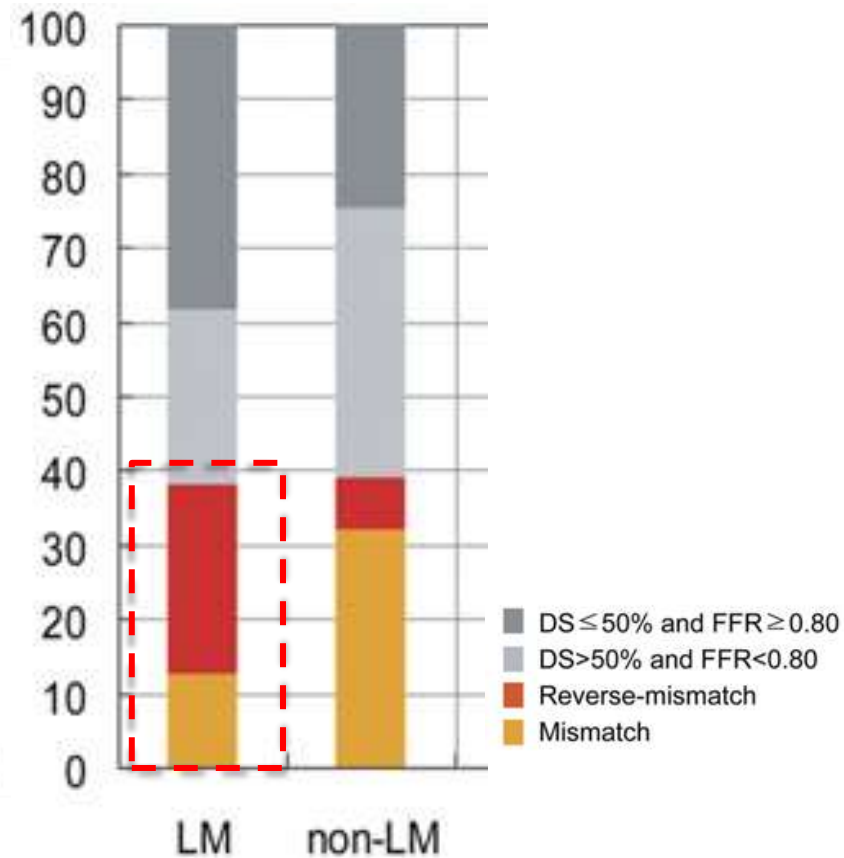
Reverse Mismatch

: Angiographically insignificant, functionally significant

Angiography vs. FFR in Left Main disease



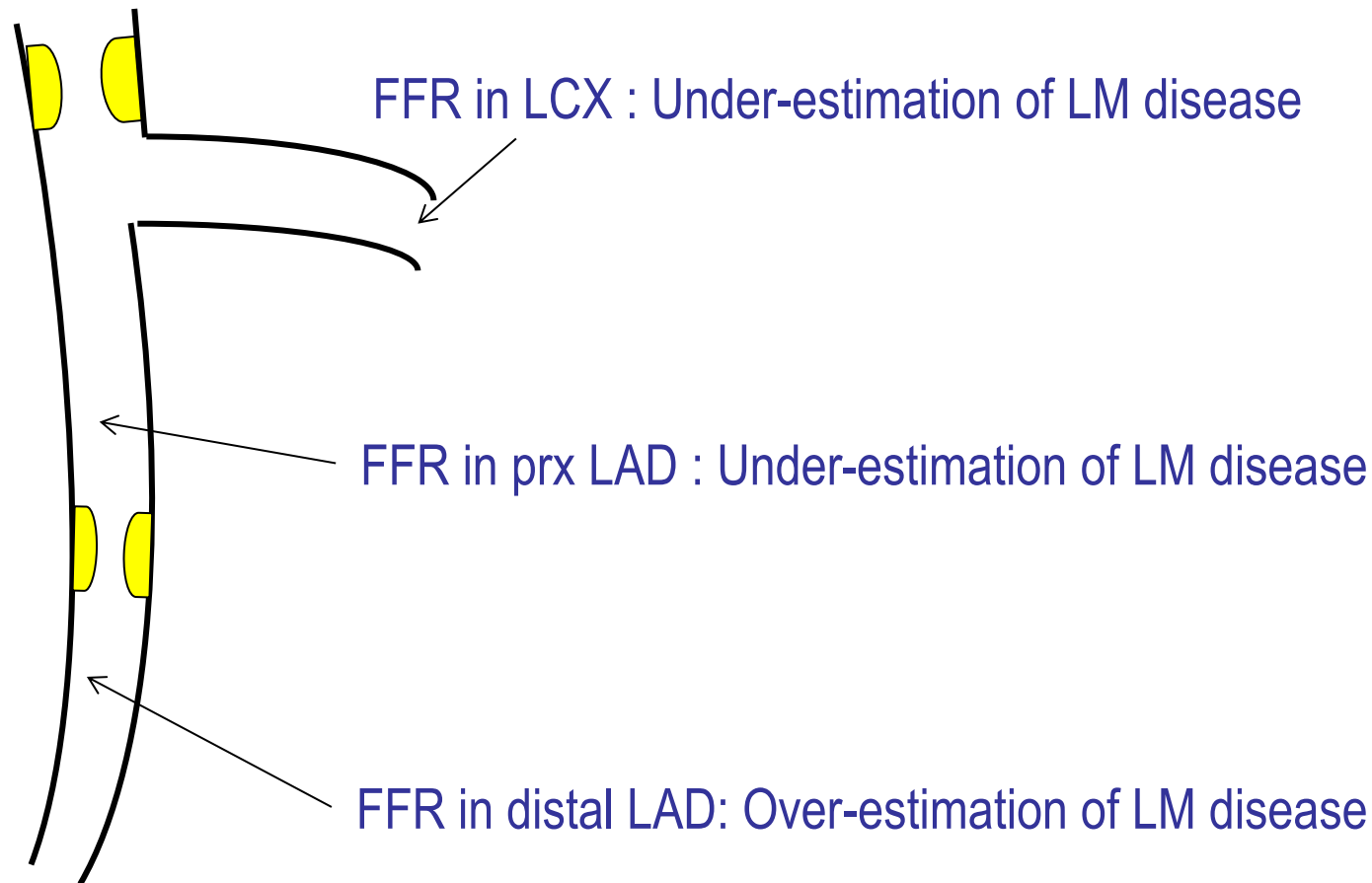
Hamilos et al. Circulation 2009



Park SJ, et al. JACC interv 2012

	30	
	NIS Guidance	Angiography Guidance
Patients	201	201
Age, y	65.28±10.50	64.31±10.00
Male gender	130 (64.2)	128 (63.7)
Diabetes		
Any type	70 (34.8)	63 (31.3)
Insulin-treated	18 (9.0)	17 (8.5)
Extent of diseased vessel		
LM only	28 (13.9)	29 (14.4)
LM plus single-vessel disease	53 (26.4)	45 (22.4)
LM plus 2-vessel disease	50 (24.9)	62 (30.8)
LM plus 3-vessel disease	61 (30.4)	65 (32.3)
RCA disease	76 (37.8)	63 (31.3)
De novo lesions	196 (97.5)	196 (97.5)
No. stents implanted at LM	1.18±0.40	1.20±0.50
Total stent length at LM	29.09±20.61	30.41±21.03
Complete stenting	45 (22.4)	45 (22.4)

FFR in serial stenoses: complex scenarios...



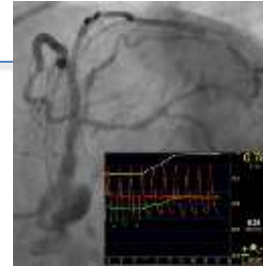
Possible causes of mismatch and reverse mismatch

When there is a mismatch...



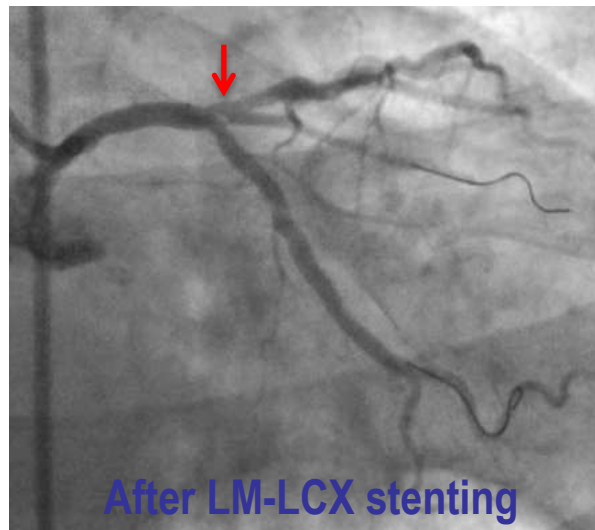
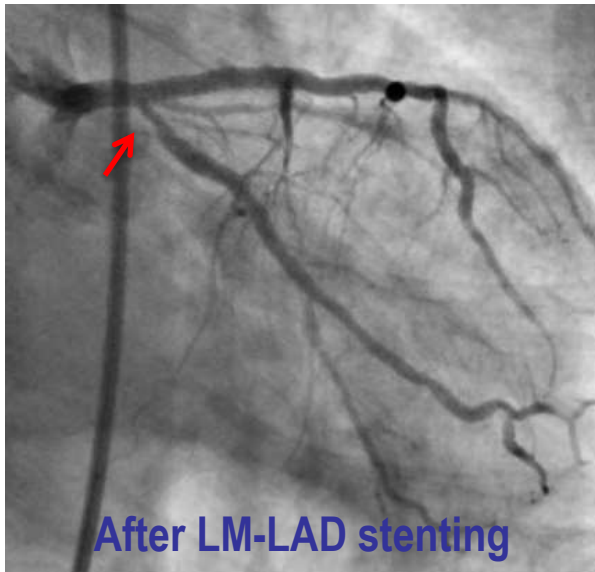
- Pitfalls of FFR measurement
 - Inadequate hyperemia
 - IV adenosine is the ideal hyperemic agent
 - Check the infusion system
 - Use different route, higher dosage, different agent
 - Drift
 - Check with pullback pressure tracing
 - Guiding catheter damping
 - Pull the guide catheter out of the ostium
- Influence of microvascular dysfunction

When there is a reverse mismatch...



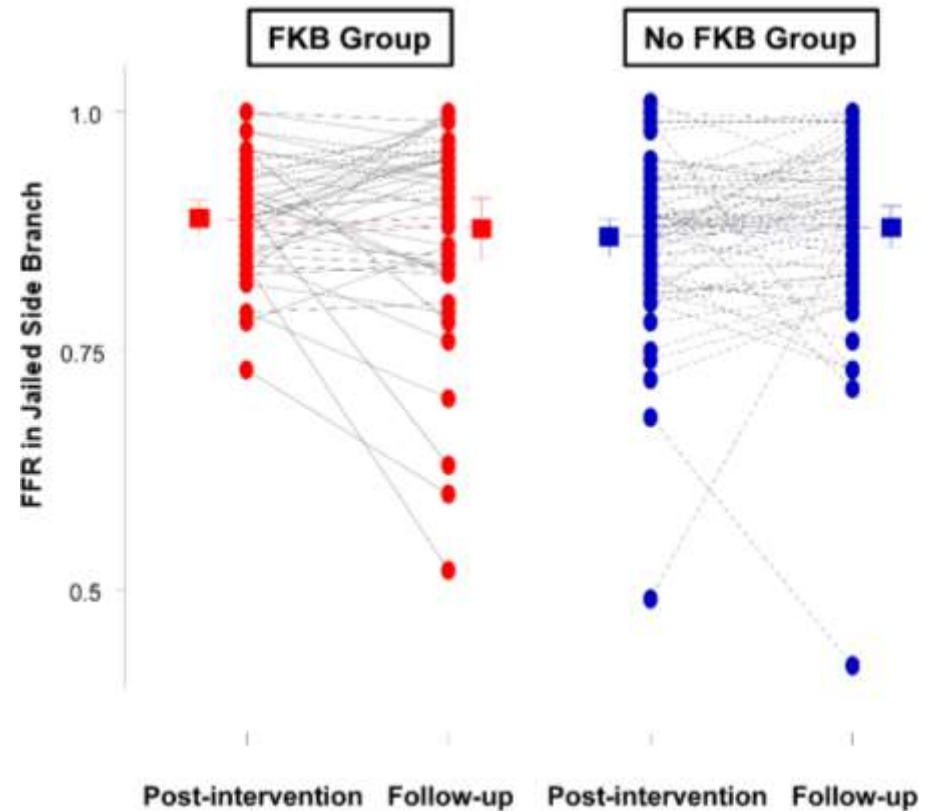
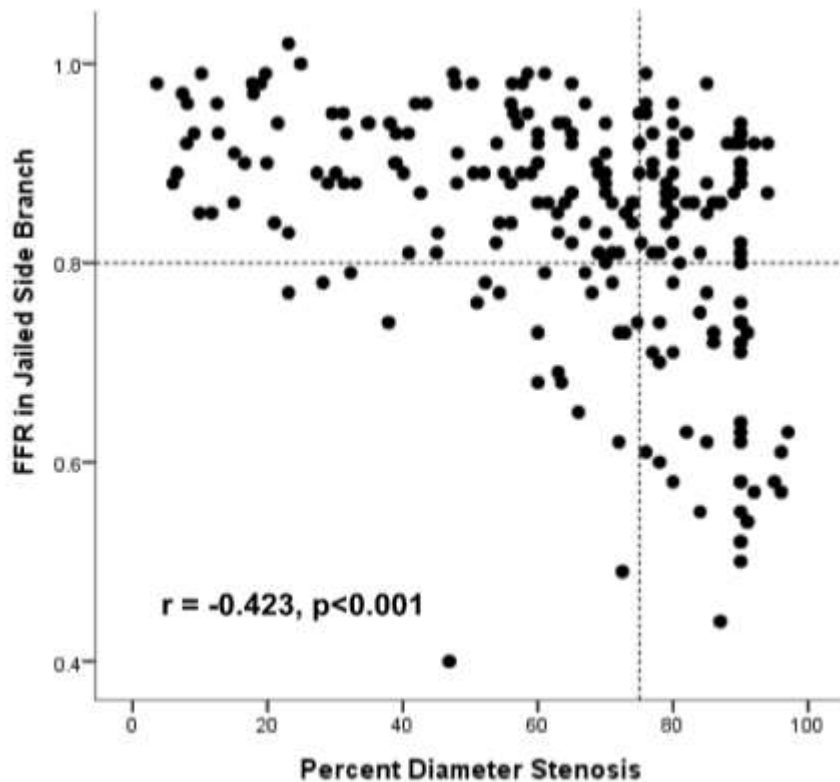
- Pitfalls of FFR measurement
 - Drift
 - Check with pullback pressure tracing
- Influence of other stenosis
 - Pressure pullback tracing
 - Measure FFR at the other vessel
- Diffuse disease
 - Pressure pullback tracing
- Coronary spasm
- Presence of dissection

Assessment for jailed branches after LM stenting

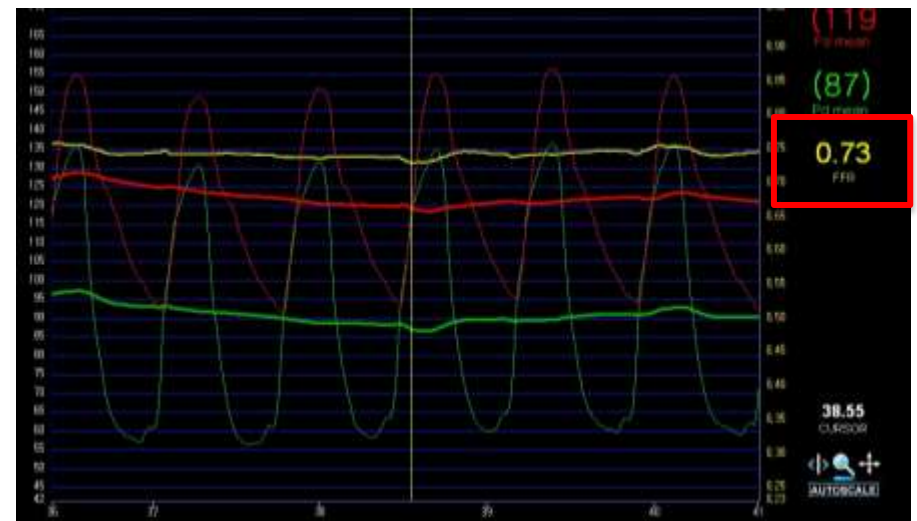
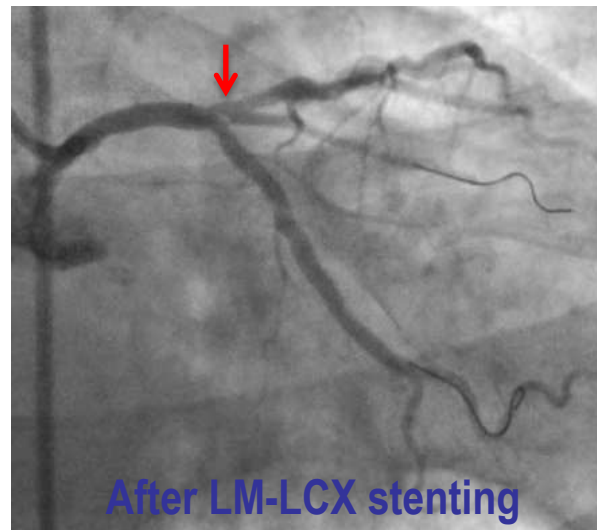
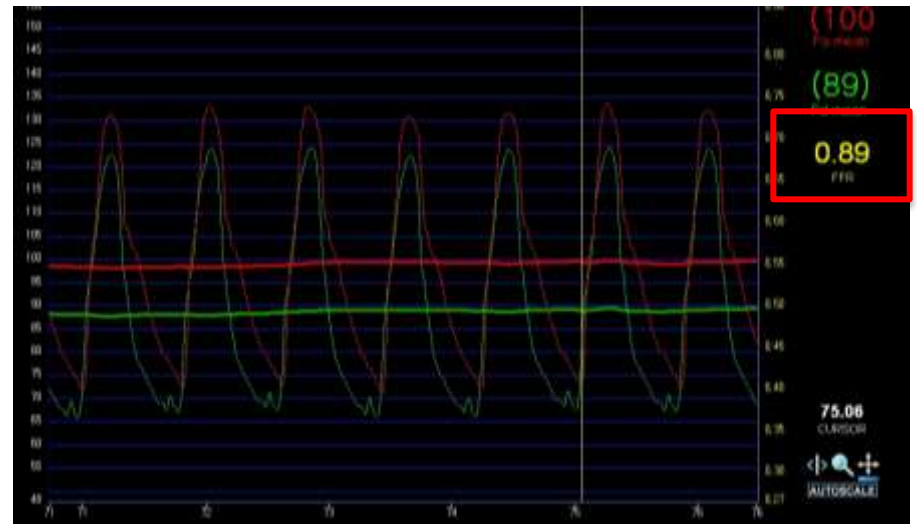
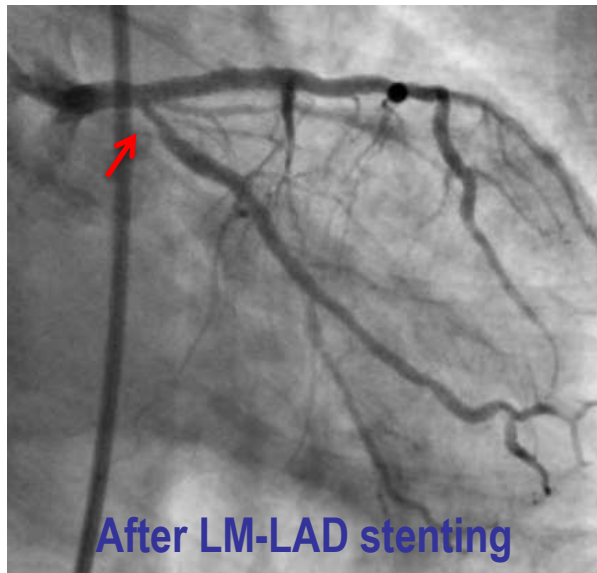


FFR for jailed side branches

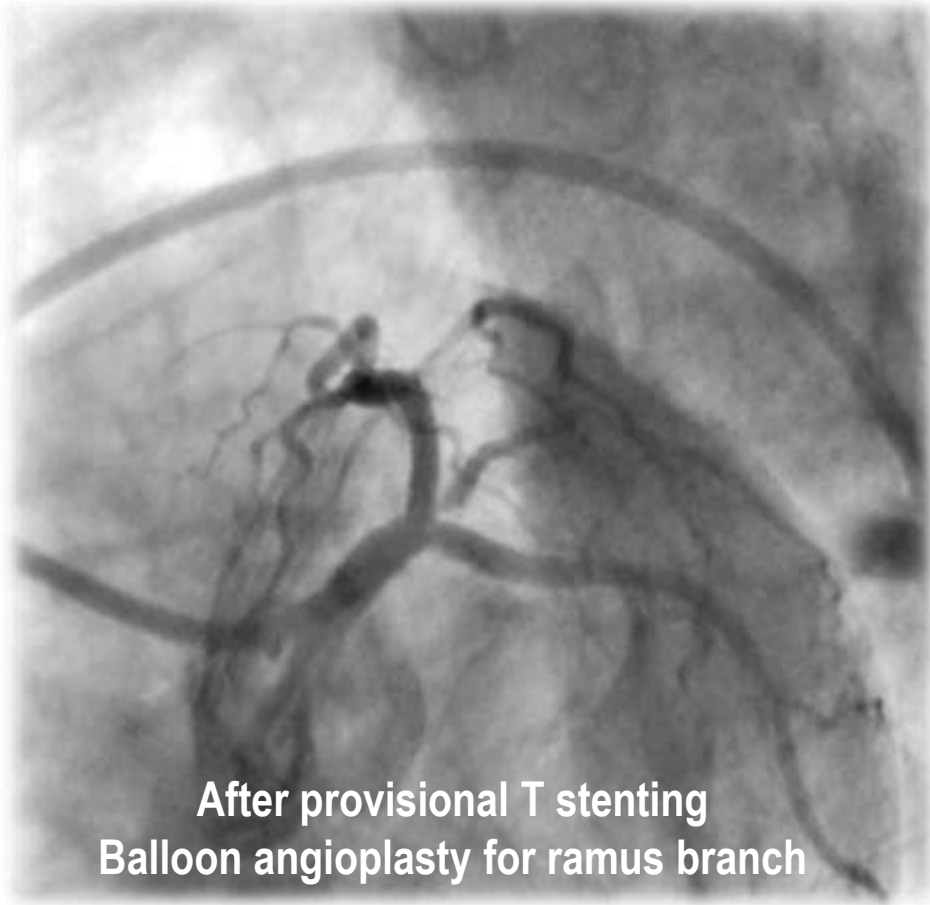
- SNUH registry, Nordic-Baltic bifurcation study and England study -



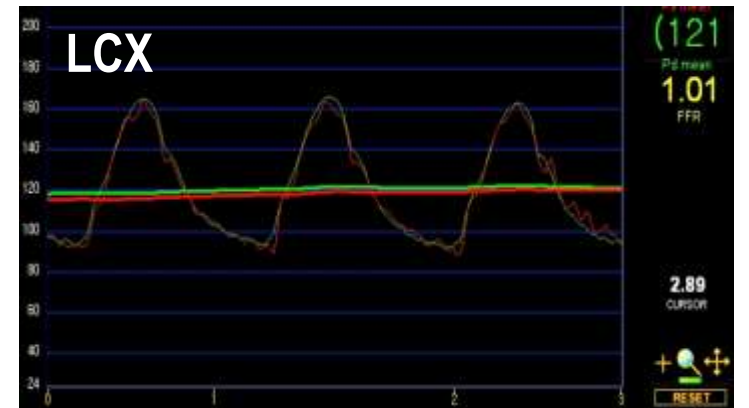
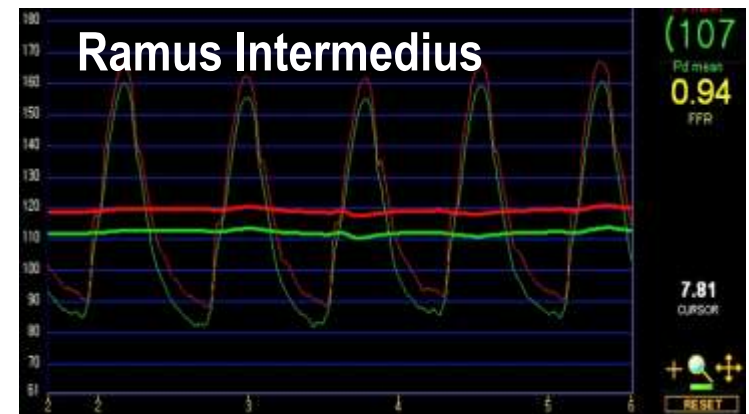
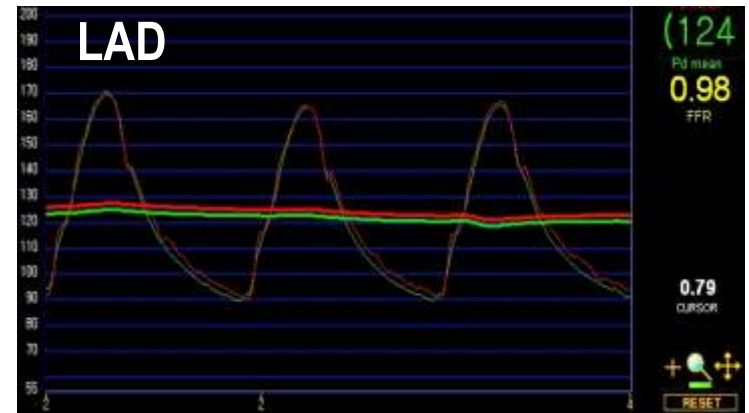
Assessment for jailed branches after LM stenting



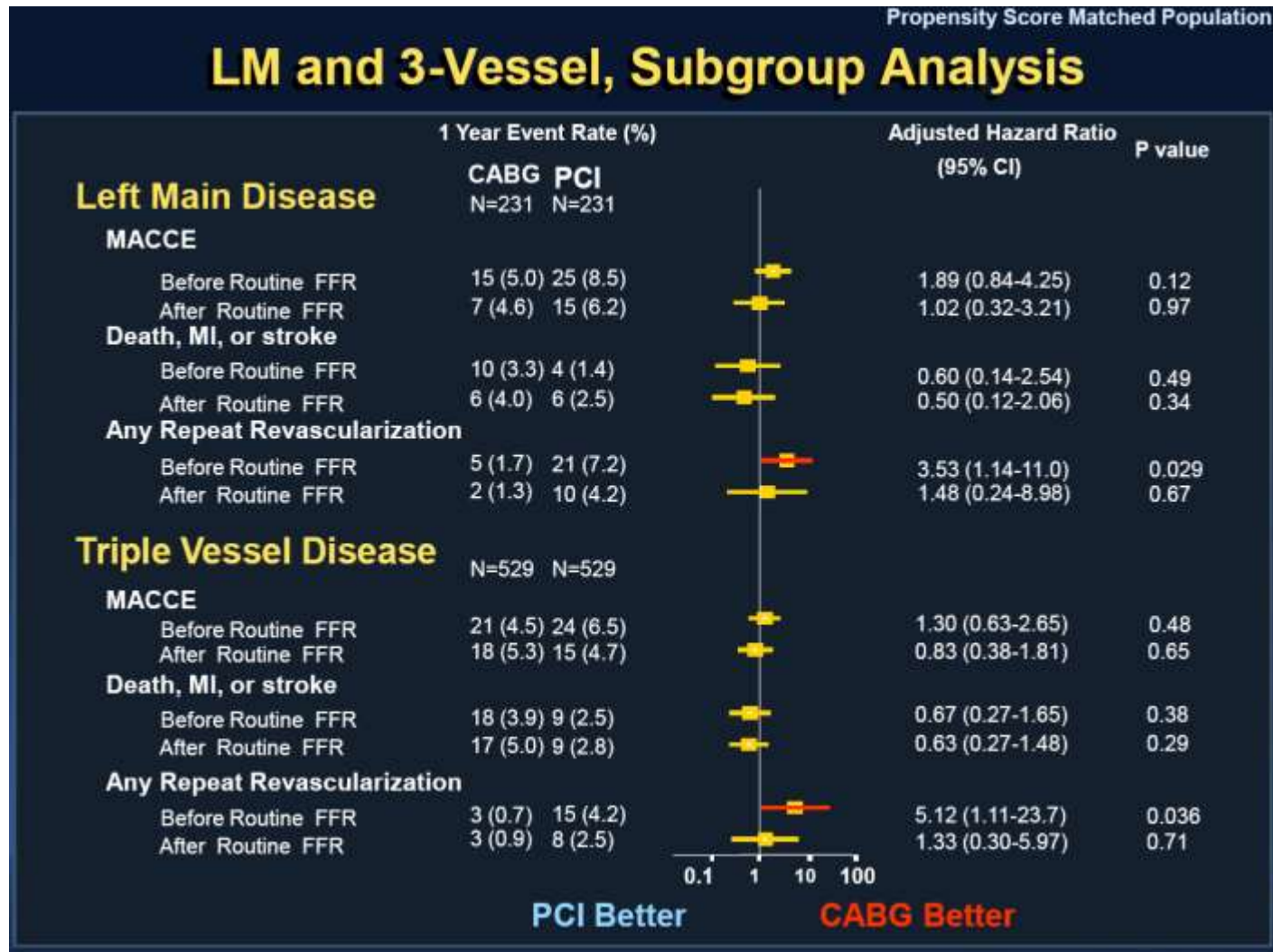
Evaluation of procedure after (complex) stenting



**Functionally complete
revascularization**



Changes of outcome after routine use of FFR



Courtesy of SJ Park, Asan Medical Center

FFR assessment for complex lesions

- In addition to intermediate stenosis, FFR can be helpful in most clinical cases during daily practice.
- Advanced use of FFR enables better stratification and management for patients with complex coronary lesions.