How May FFR Help in LM PCI?

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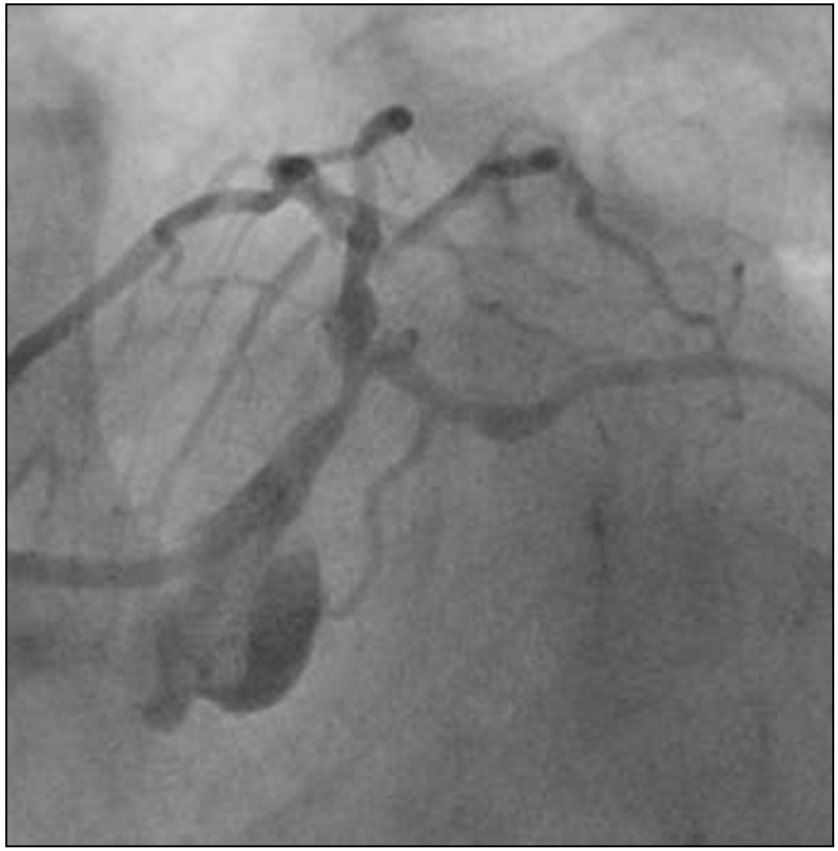
Application of FFR in LM lesions

- Evaluation of intermediate or ambiguous LM lesions
- Decision of treatment strategy
  - Finding a ischemia-causing lesion
  - Measurement of functional SYNTAX score
- Evaluation of jailed LCX or LAD ostial lesion
- Evaluation of non-LM stenoses after LM stenting
- Assessment of residual ischemia after 2 stenting

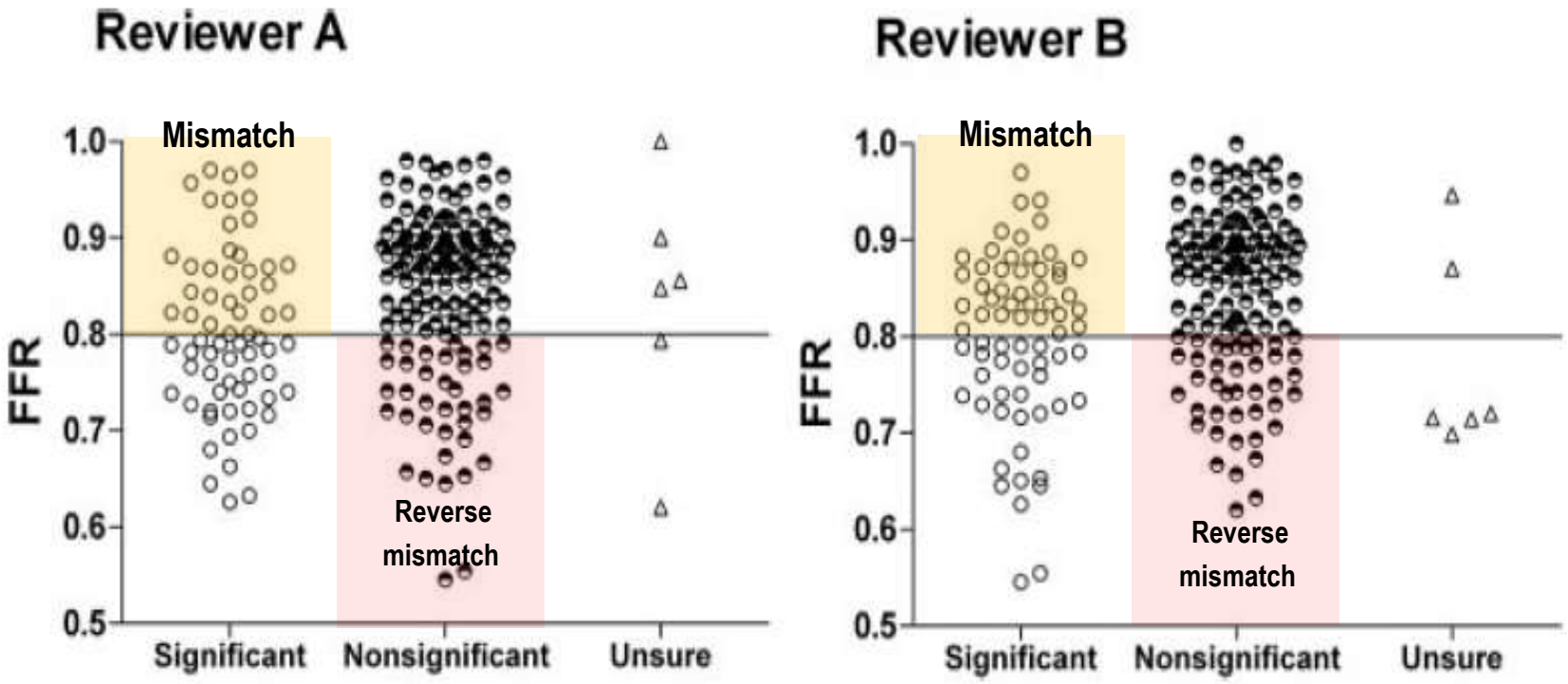
Which LM lesion is significant?



Courtesy of Dr YK Cho, Keimyung University

Why FFR for left main lesions?

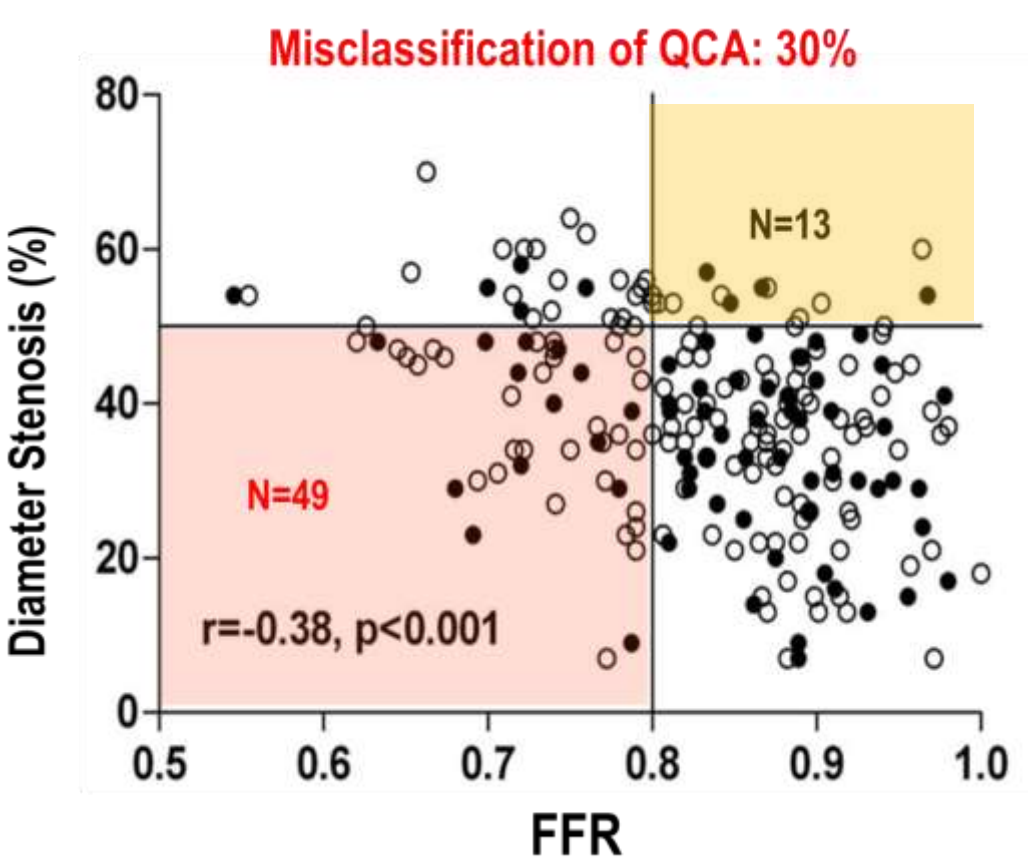
Visual estimation vs. FFR in equivocal left main lesions



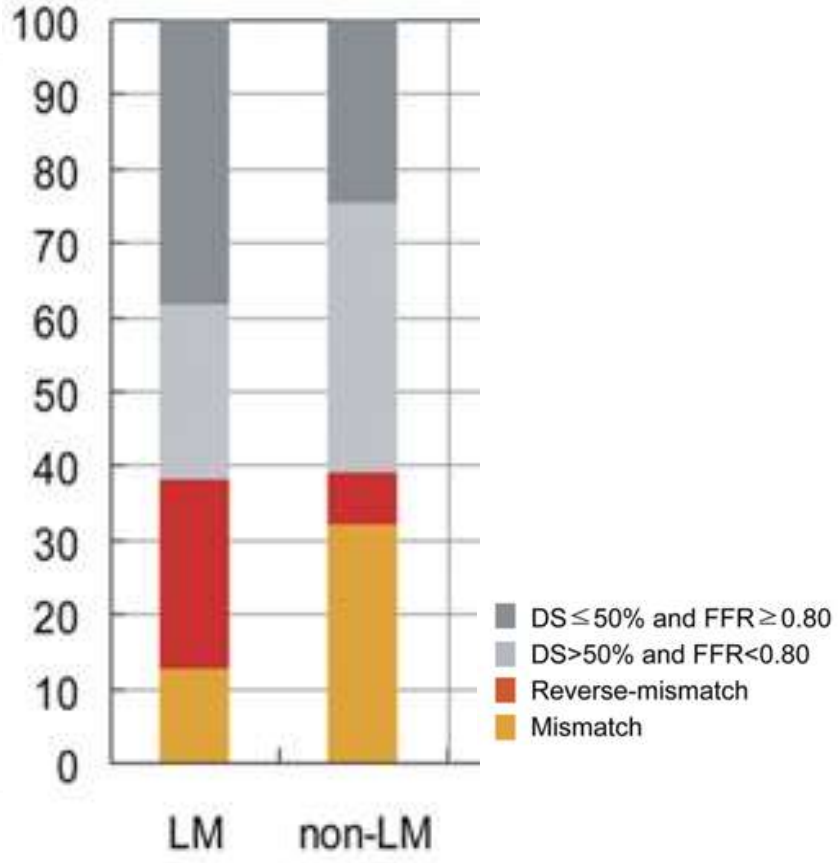
Disagreement: 26%

Hamilos et al. Circulation 2009

Angiography vs. FFR in Left Main disease

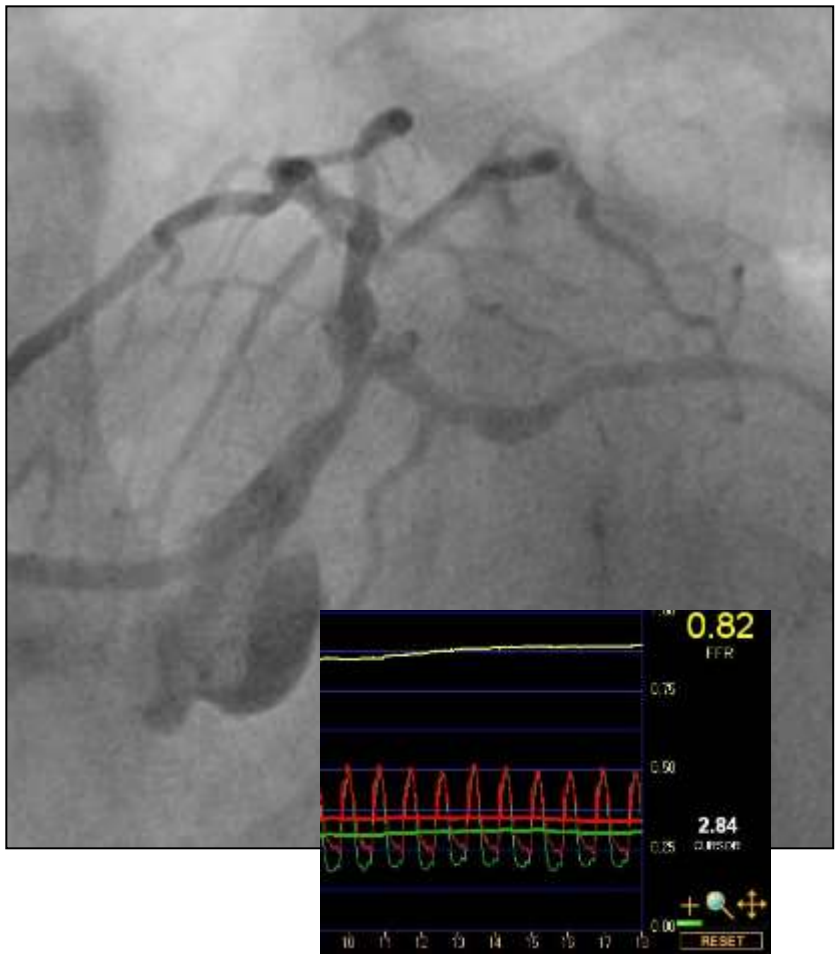


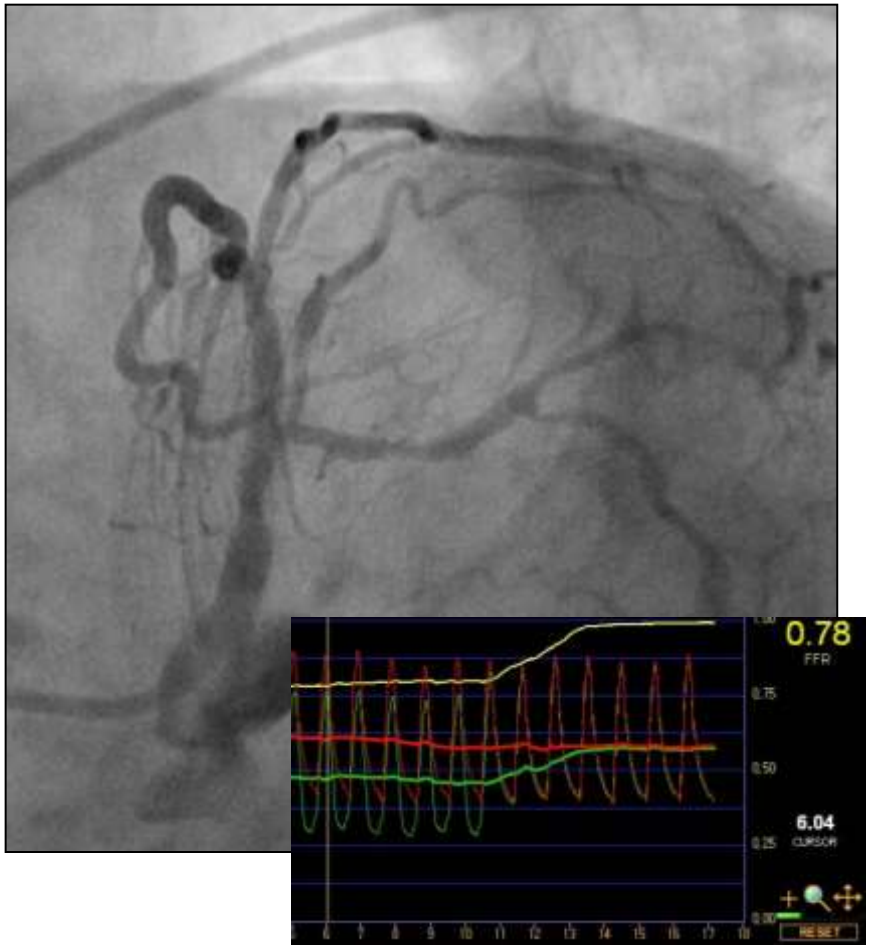
Hamilos et al. Circulation 2009



Park SJ, et al. JACC interv 2012

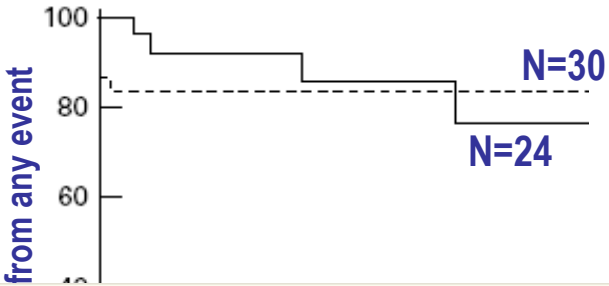
Which LM lesion is significant?

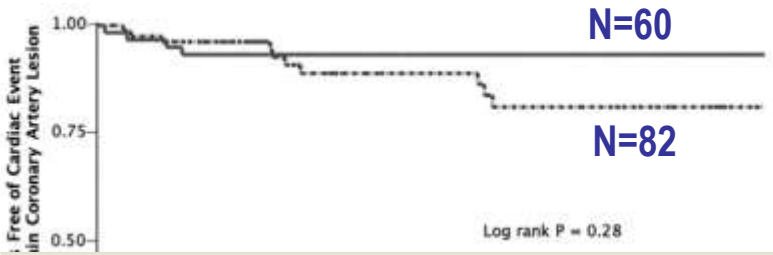




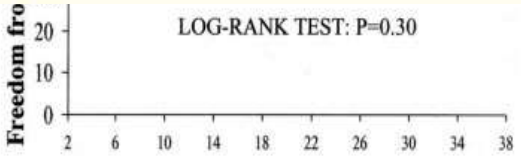
Safety of FFR-guided defer in Left Main stenosis

FFR ≥ 0.75 or 0.8 → Medical treatment vs. FFR < 0.75 or 0.8 → Revascularization



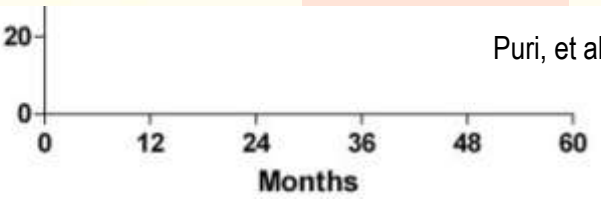


	N				Overall Survival	
First Author (Ref. #)	Total	Defer Group	Surgical Group	FU (Months) Mean Duration	Defer Group (%)	Surgical Group (%)
Bech et al. (23)	54	24	30	29 ± 15	100	97
Jasti et al. (24)	51	37	14	25 ± 11	100	100
Jiménez-Navarro et al. (25)	27	20	7	26 ± 12	100	86
Legutko et al. (26)	38	20	18	24 ± 12	100	89
Suemaru et al. (27)	15	8	7	33 ± 10	100	100
Lindstaedt et al. (28)	51	24	27	29 ± 16	100	81
Hamilos et al. (20)	213	138	75	35 ± 12	90	85
Total or (mean)	449	271	178	(28 ± 13)	(95)*	(89)



Jasti, Circulation 2004

Puri, et al. JACC interv 2012



Hamilos, Circulation 2009

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…….

Possible causes of mismatch and reverse mismatch

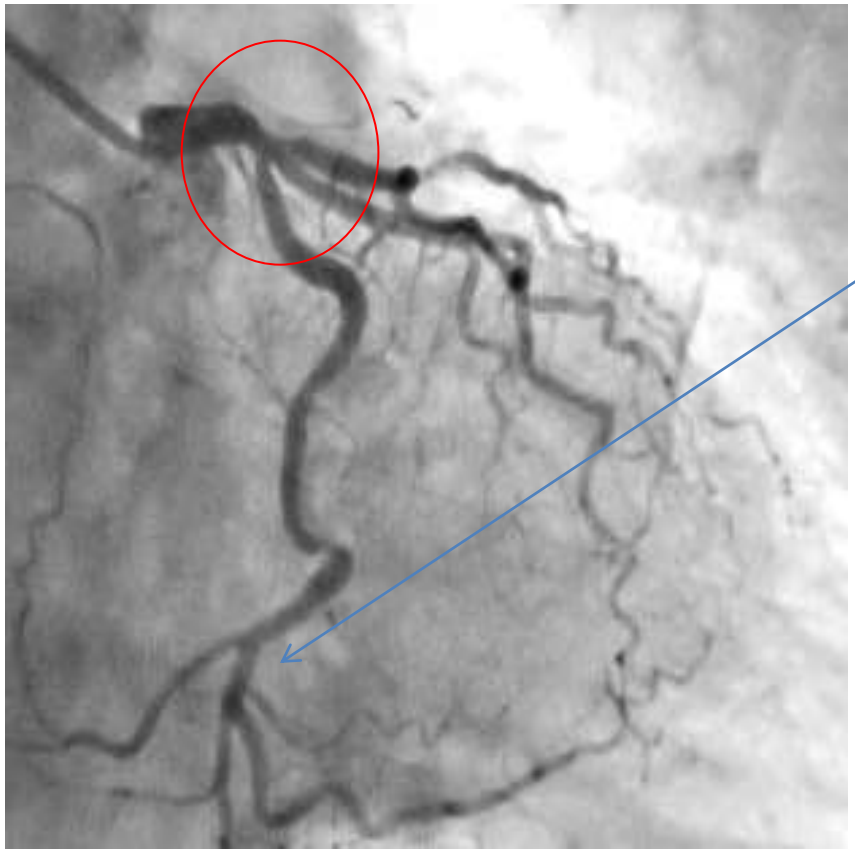
When there is a mismatch..

- 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

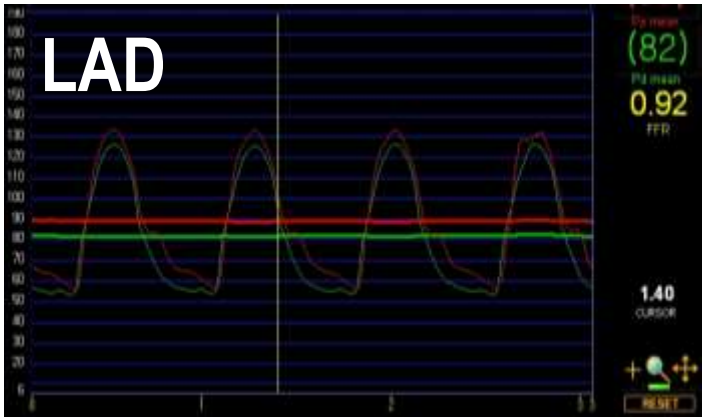
When there is a reverse mismatch…

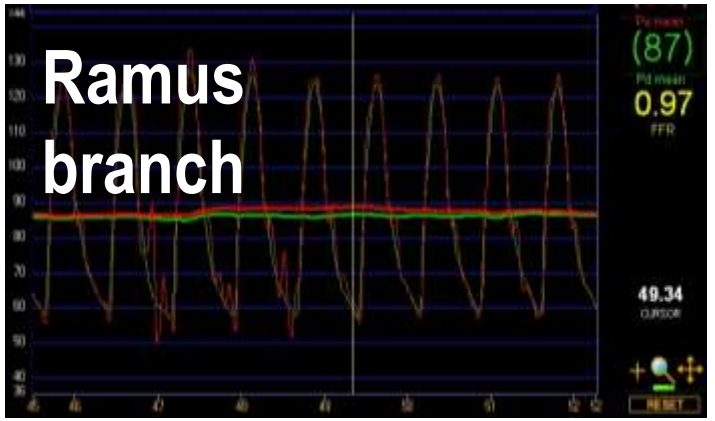
- Pitfalls of FFR measurement
  - Drift
    - Check with pullback pressure tracing
- Influence of other stenosis
  - Pressure pullback tracing
  - Measure FFR at the other vessel
- Diffuse disease
  - Pressure pullback tracing
- Coronary spasm/Accordion
- Presence of dissection

Reverse mismatch ?



FFR = 0.78





Application of FFR in LM lesions

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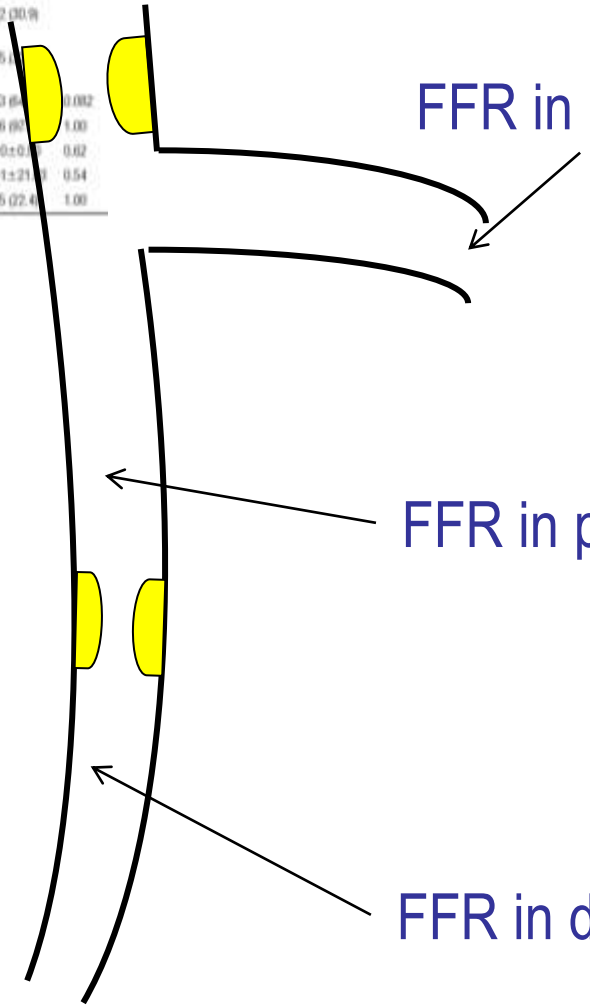
FFR in serial stenoses: complex scenarios...

	All		
	IVUS Guidance	Angiography Guidance	P
Patients	201	201	
Age, y			0.26
Male gender			
Diabetes			
Any type	70 (34.8)	63 (31.3)	0.52
Insulin treated	18 (9.0)	17 (8.5)	1.00
Extent of diseased vessel			
LM only	28 (13.9)	29 (14.4)	0.36
LM plus single-vessel disease	53 (26.4)	45 (22.4)	
LM plus 2-vessel disease	59 (29.4)	62 (30.9)	
LM plus 3-vessel disease	61 (30.4)	65	
RCA disease	76 (37.8)	93	0.002
De novo lesions	196 (97.5)	196	1.00
No. stents implanted at LM	1.18±0.46	1.20±	0.62
Total stent length at LM	29.09±20.81	30.41±21	0.54
Complex stenting	45 (22.4)	45 (22.4)	1.00



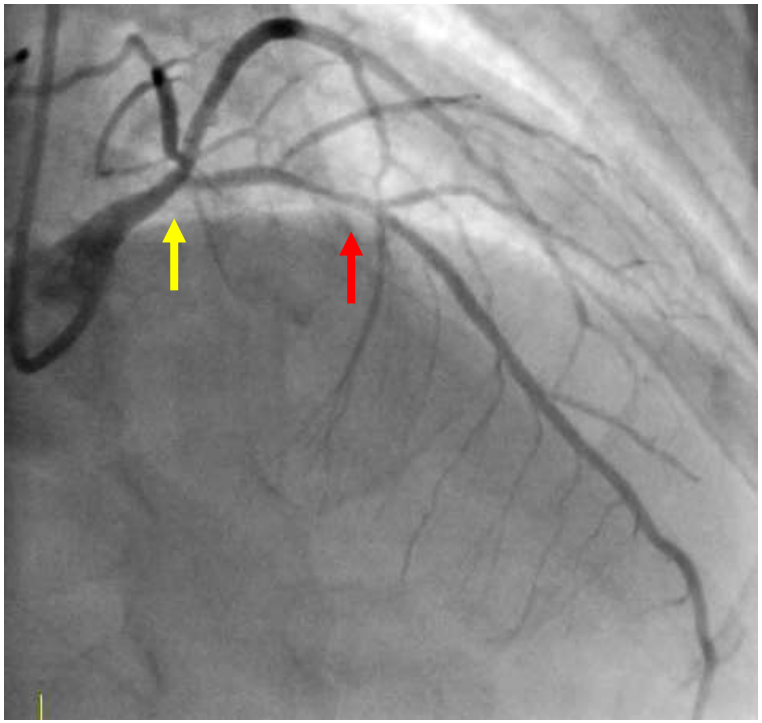
FFR in LCX : Under-estimation of LM disease

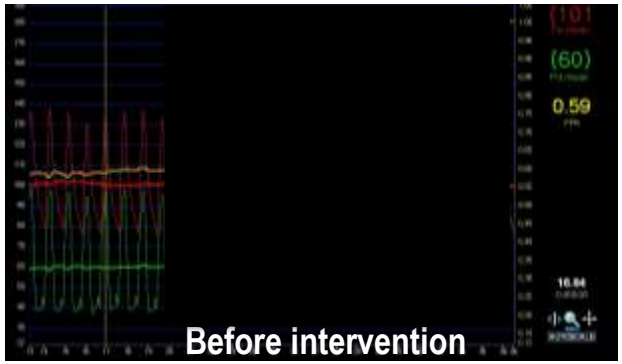
FFR in prx LAD : Under-estimation of LM disease

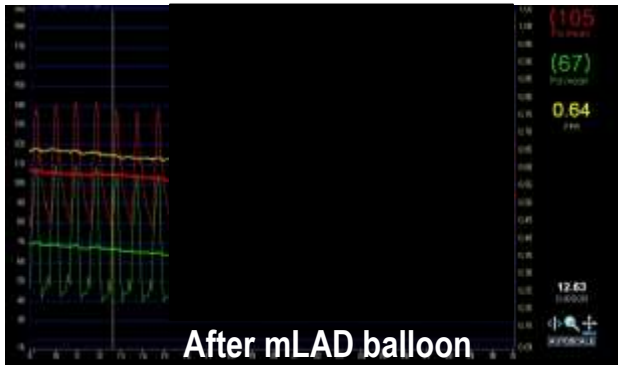
FFR in distal LAD: Over-estimation of LM disease

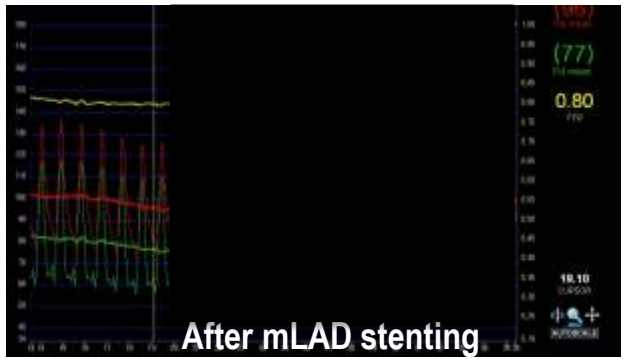
LM FFR in multiple stenoses:

Influence of downstream stenosis to LM FFR



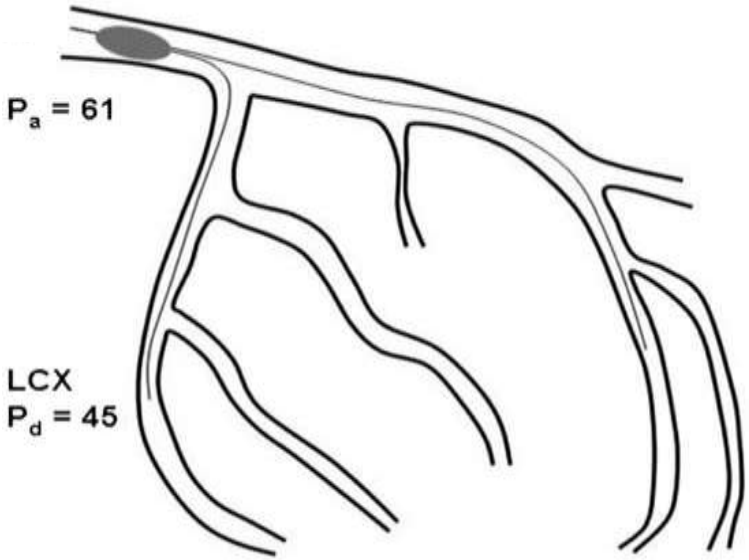




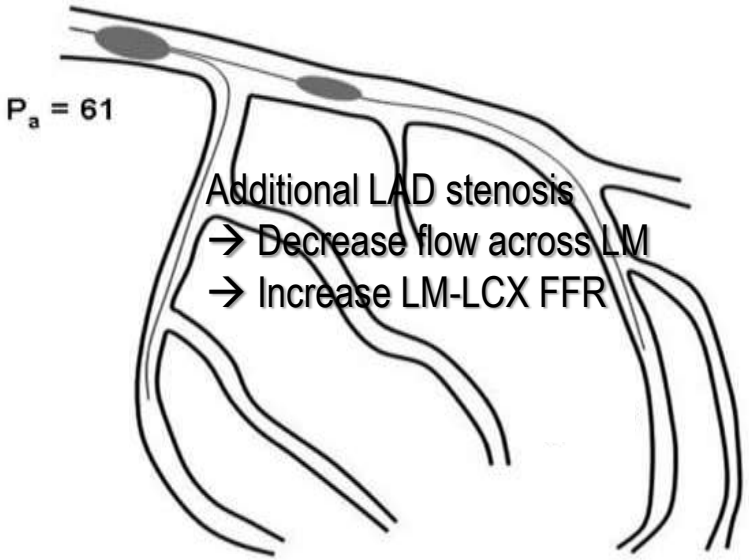


FFR of LM stenosis

: Influence of LAD stenosis on LCX FFR



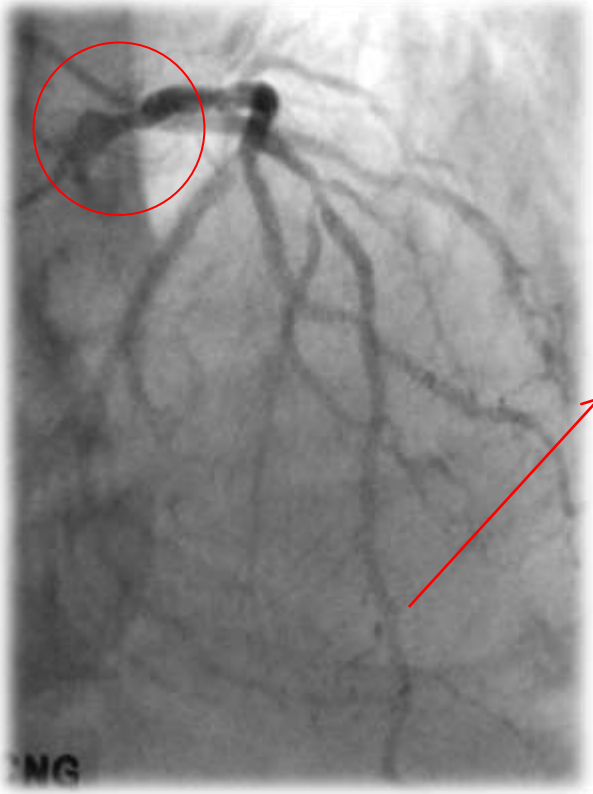
LCX FFR = 45/61 = 0.74

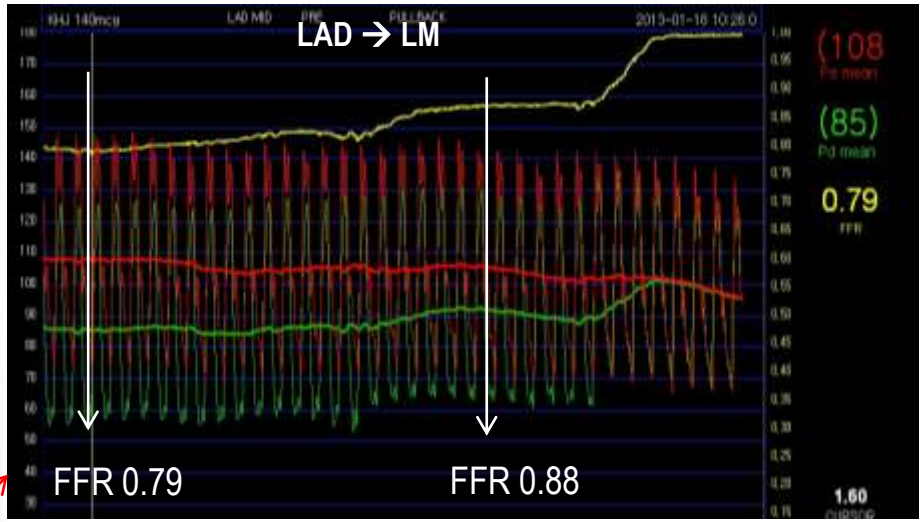


Additional LAD stenosis increases LCX FFR. However, clinically significant change occurs only when LAD stenosis is proximal and severe.

Yong et al. Circ Cardiovasc Interv. 2013;6:161-165.

Lt main FFR?

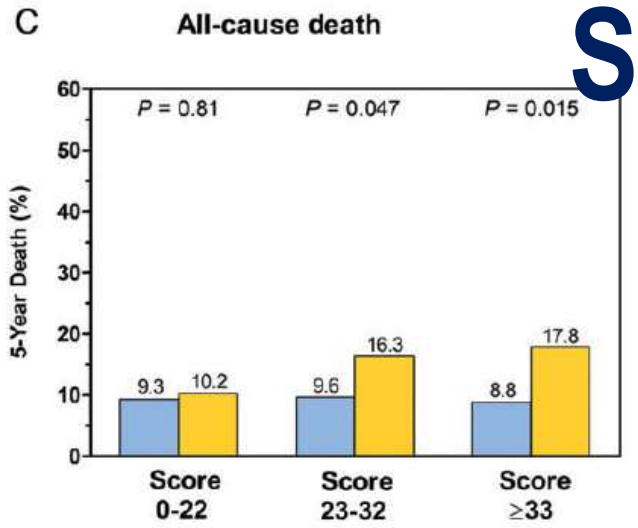




LM FFR = 0.79 + [influence of LAD stenosis] - [influence of LCX stenosis]

= 0.80 ~ 0.84

SYNTAX score



			Left dominance
16c	Posterolateral branch from RCA	0.5	n.a.
5	Left Main	5	6
6	LAD proximal	3.5	3.5
7	LAD mid	2.5	2.5
8	LAD apical	1	1
9	First diagonal	1	1
9a	First diagonal[a]	1	1
10	Second diagonal	0.5	0.5
10a	Second diagonal[a]	0.5	0.5
11	Proximal circumflex artery	1.5	2.5
12	Intermediate/ anterolateral artery	1	1
12a	Obtuse marginal[a]	1	1
12b	Obtuse marginal[b]	1	1
13	Distal circumflex artery	0.5	1.5
14	Left posterolateral	0.5	1
14a	Left posterolateral[a]	0.5	1
14b	Left posterolateral[b]	0.5	1
15	Posterior descending	n.a.	1

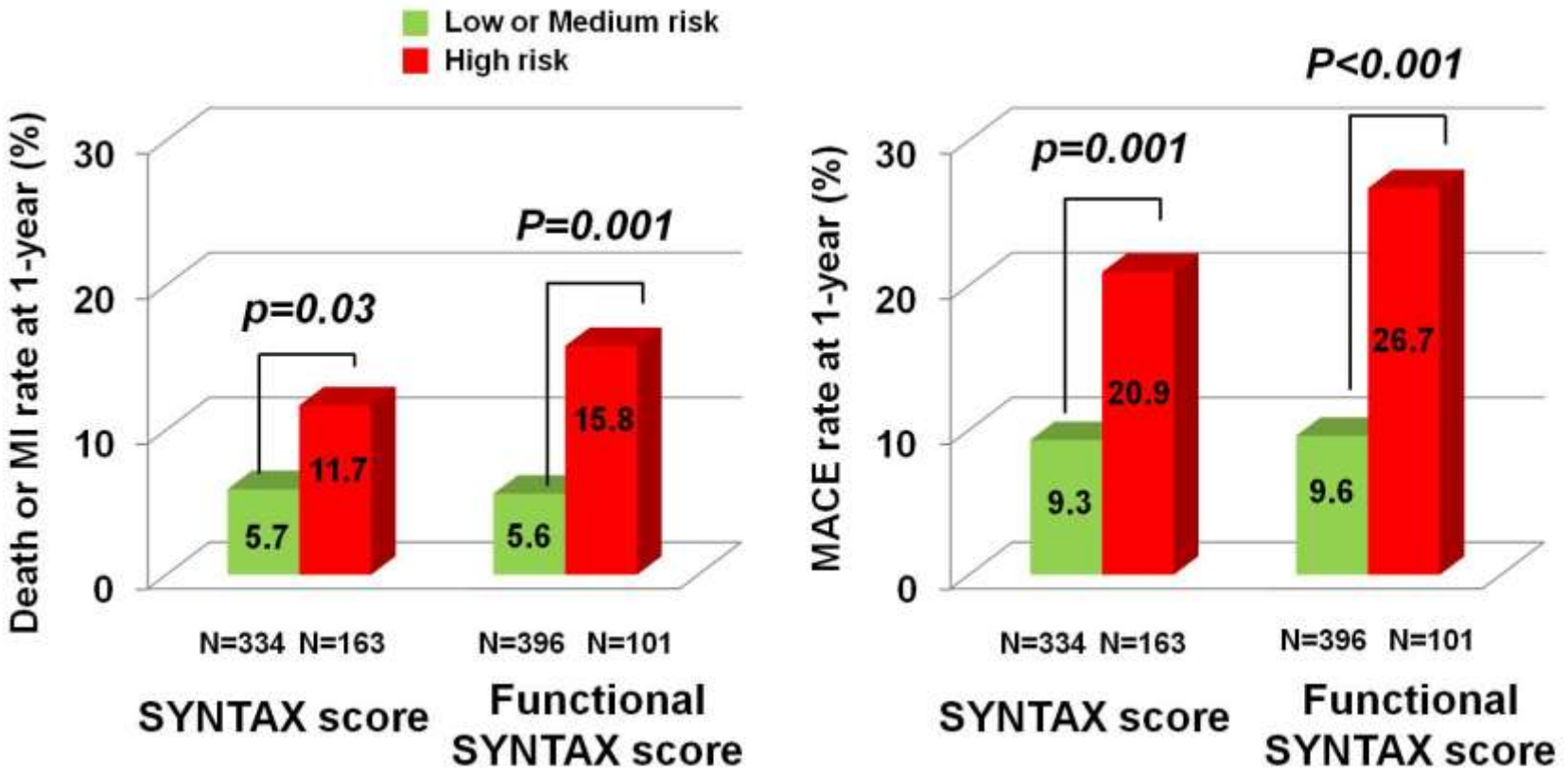
Table 2. Lesions adverse characteristic scoring

Diameter reduction*	
- Total occlusion	x5
- Significant lesion (50-99%)	x2
Total occlusion (TO)	
- Age >3months or unknown	+1
- Blunt stump	+1
- Bridging	+1
- First segment visible beyond TO	+1/ per non-visible segment
- Side branch (SB) - Yes, SB <1.5mm**	+1
- Yes, both SB < & ≥ 1.5mm	+1
Trifurcations	
- 1 diseased segment	+3
- 2 diseased segments	+4
- 3 diseased segments	+5
- 4 diseased segments	+6
Bifurcations	
- Type A, B, C	+1
- Type D, E, F, G	+2
- Angulation <70°	+1
Aorto ostial stenosis	+1
Severe tortuosity	+2
Length > 20mm	+1
Heavy calcification	+2
Thrombus	+1
"Diffuse disease"/small vessels	+1/ per segment number

Serruys, et al. Eurointervention 2009

SYNTAX score vs. Functional SYNTAX score

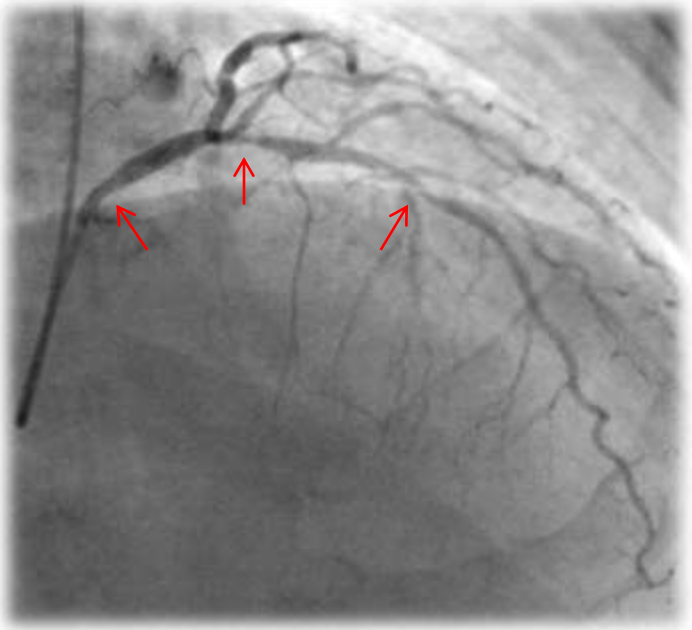
Outcomes after PCI in FAME study



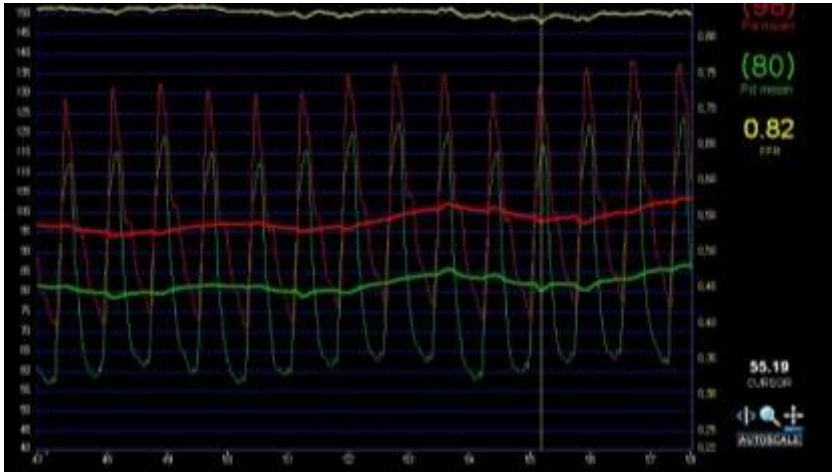
Functional SYNTAX score decreases the number of higher-risk patients and better discriminates risk for adverse events in patients with multivessel PCI.

Nam CW, et al. JACC 2011;58:1211

SYNTAX score vs. Functional SYNTAX score



SYNTAX score: LM ostial + proximal LAD + mid LAD bifurcation lesions = 28



Functional SYNTAX score = 0

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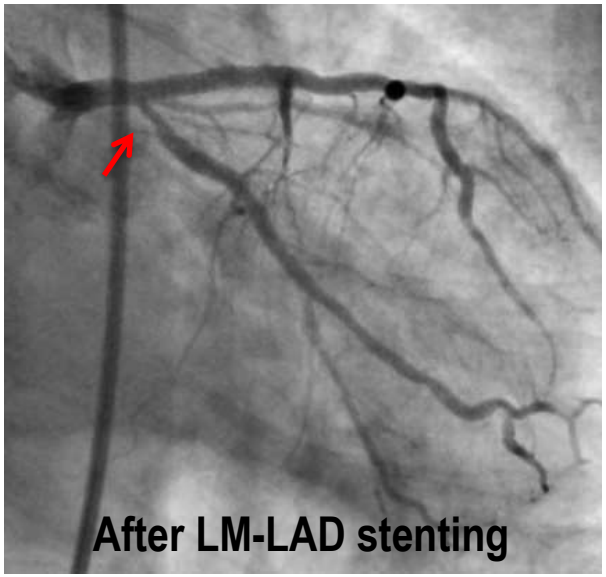
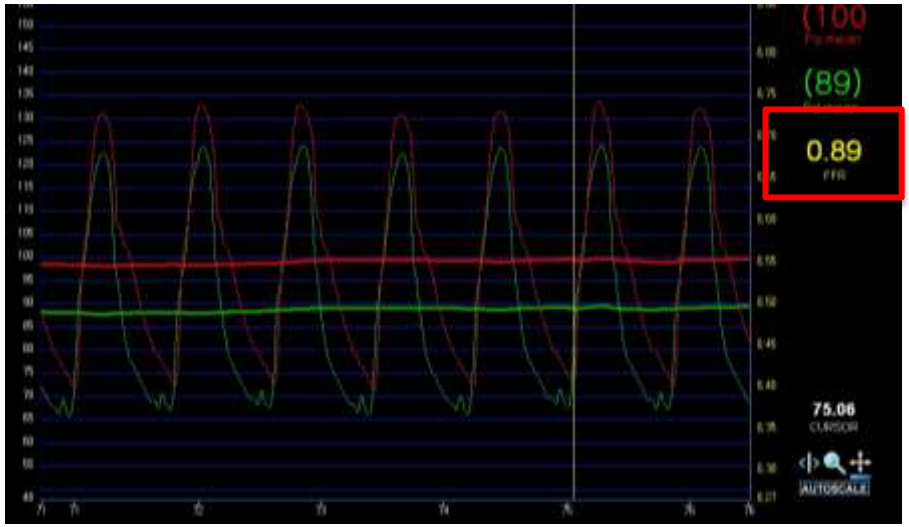
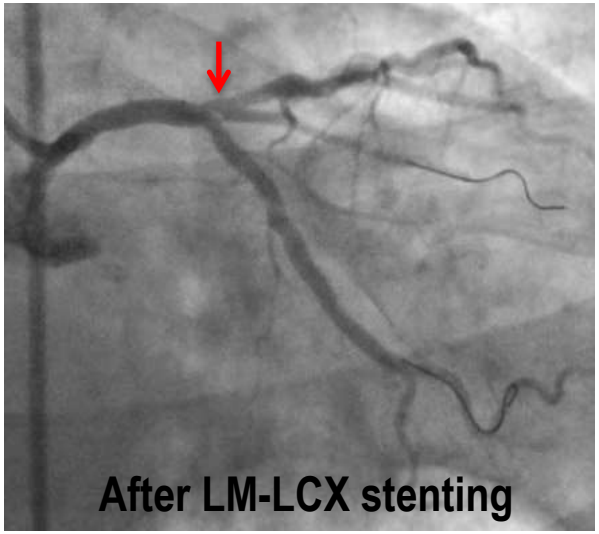
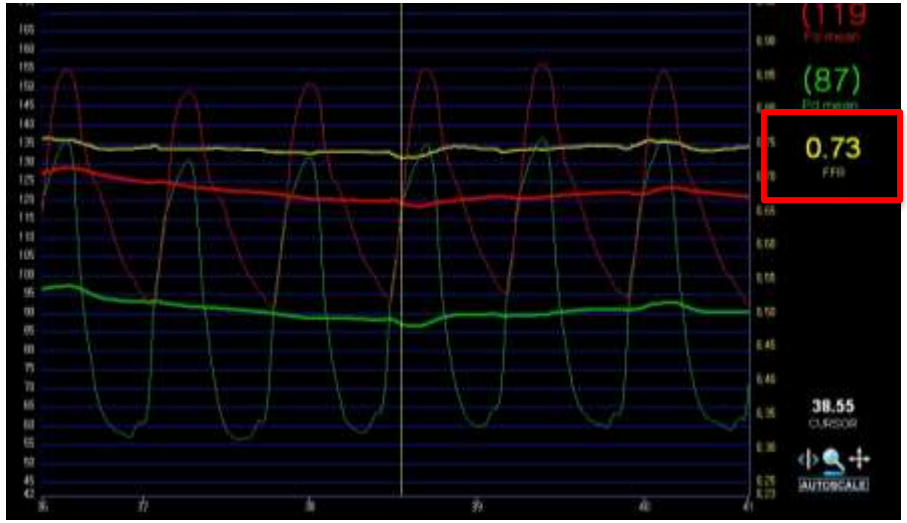
Assessment for jailed branches after LM stenting

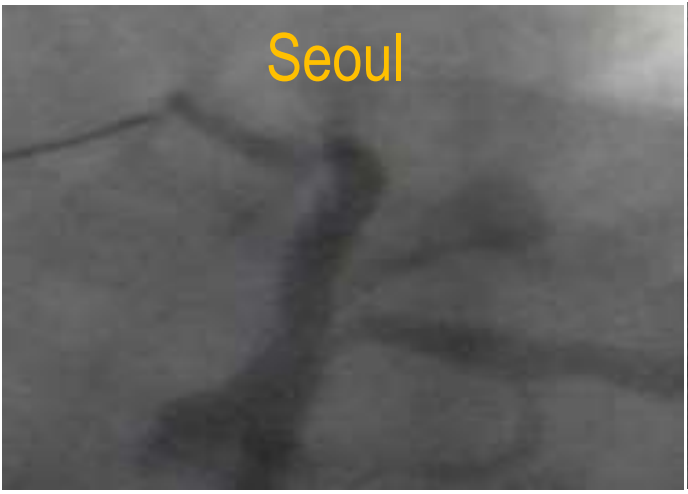


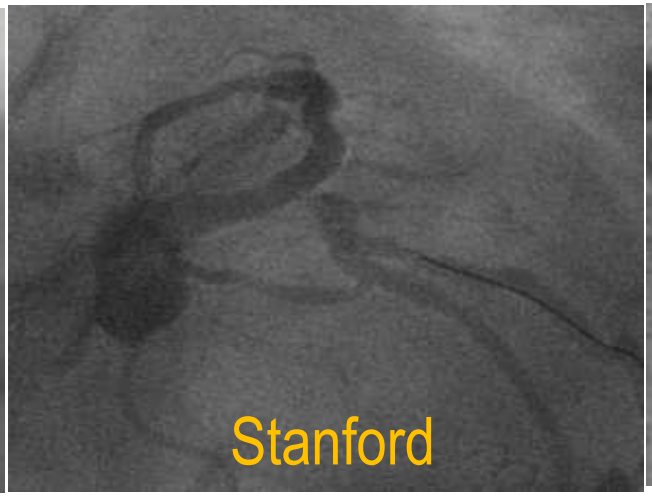


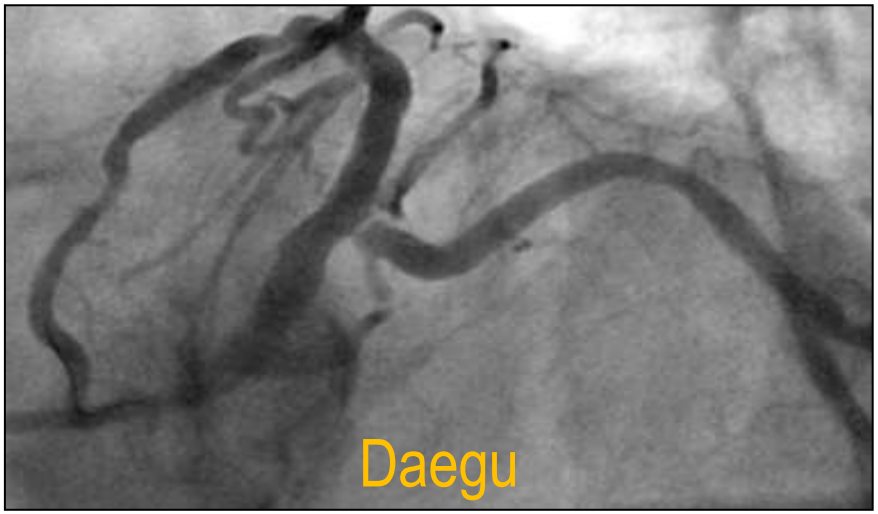




Is FFR needed or useful?







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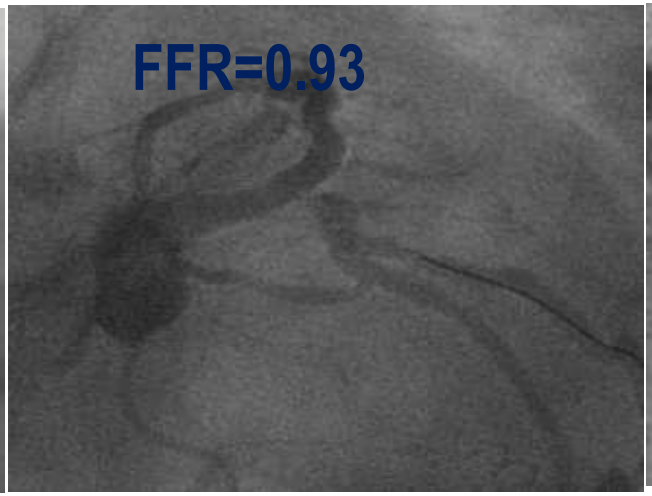
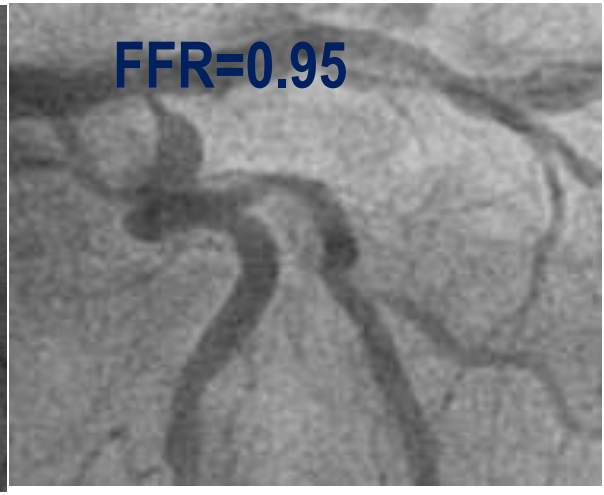
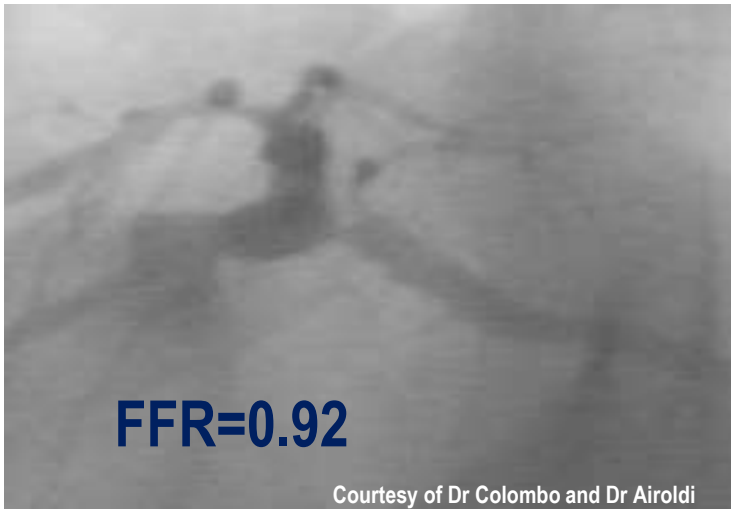
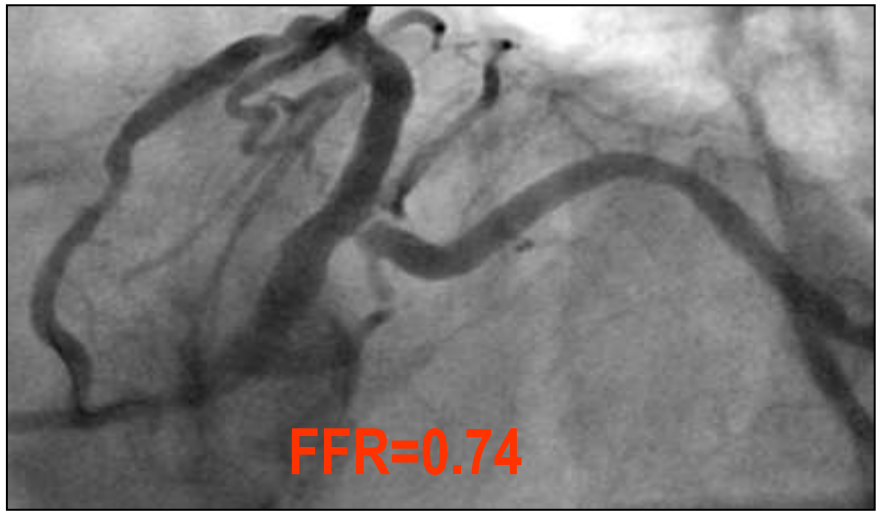
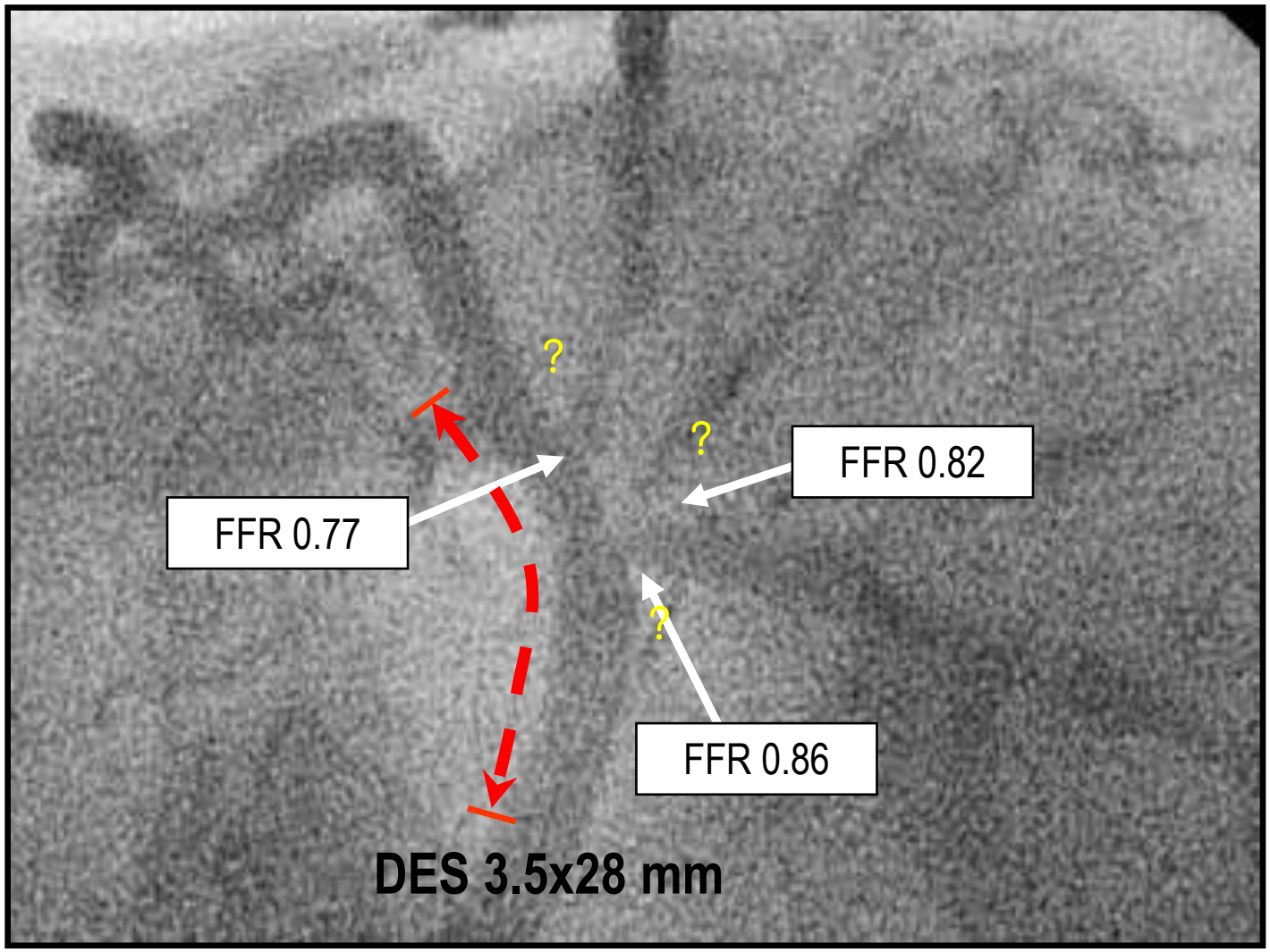




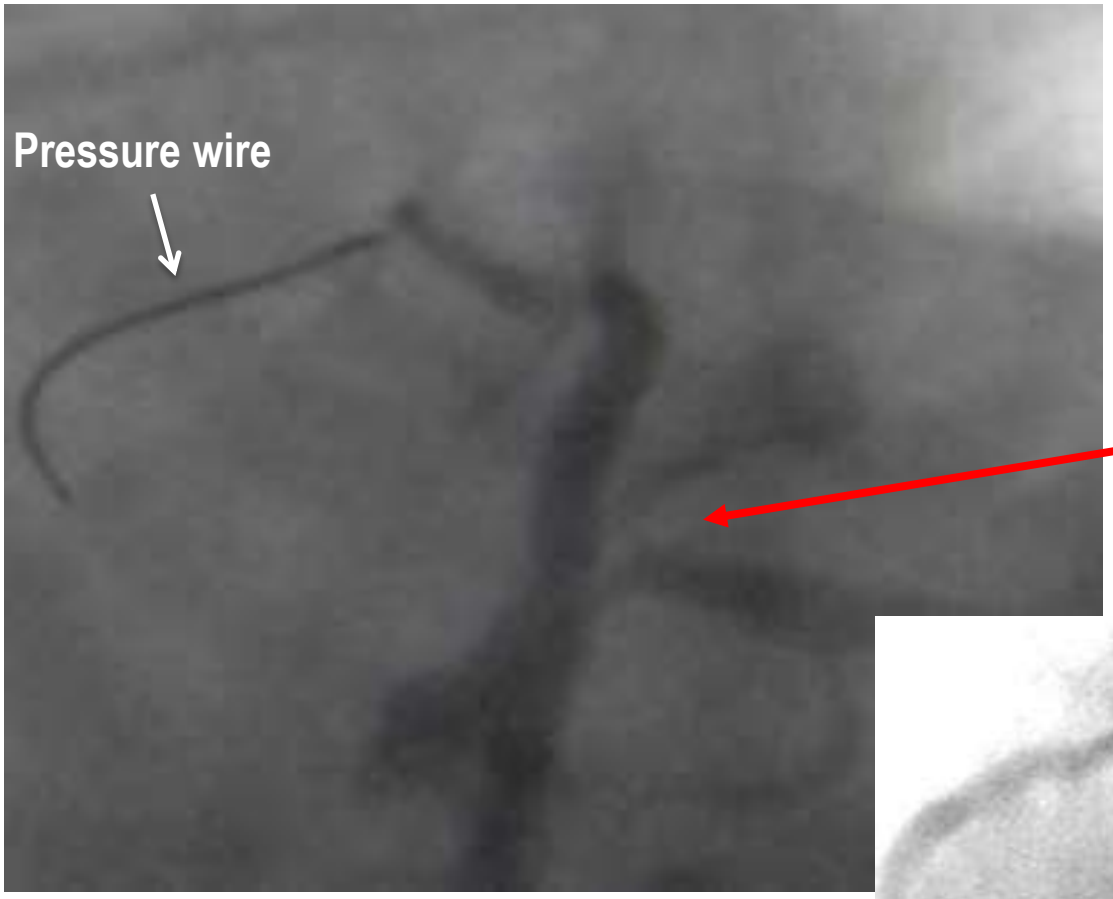


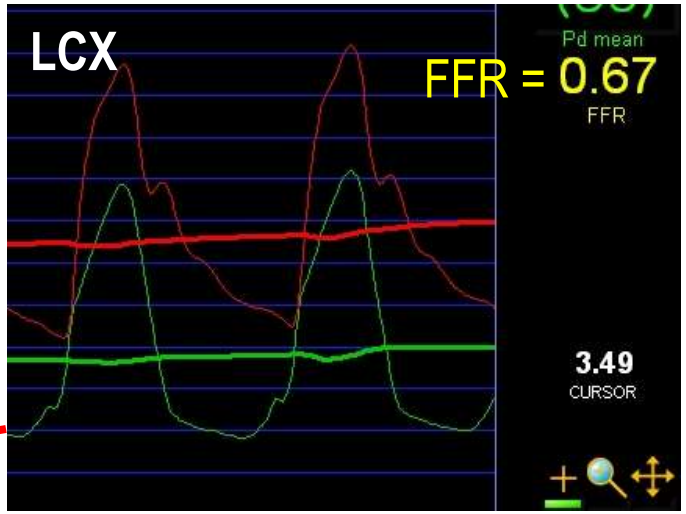


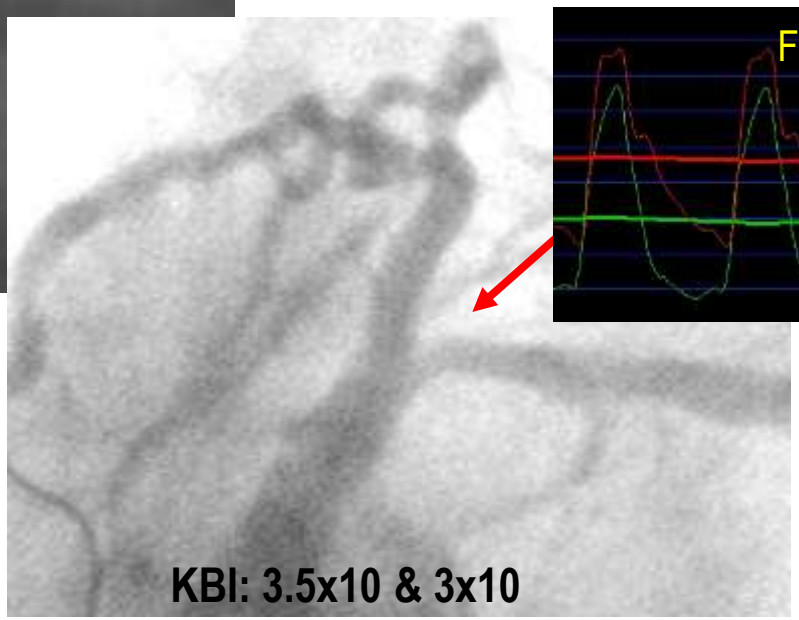
Assessment for ambiguous lesions after LM stenting



FFR-guided provisional T stenting strategy



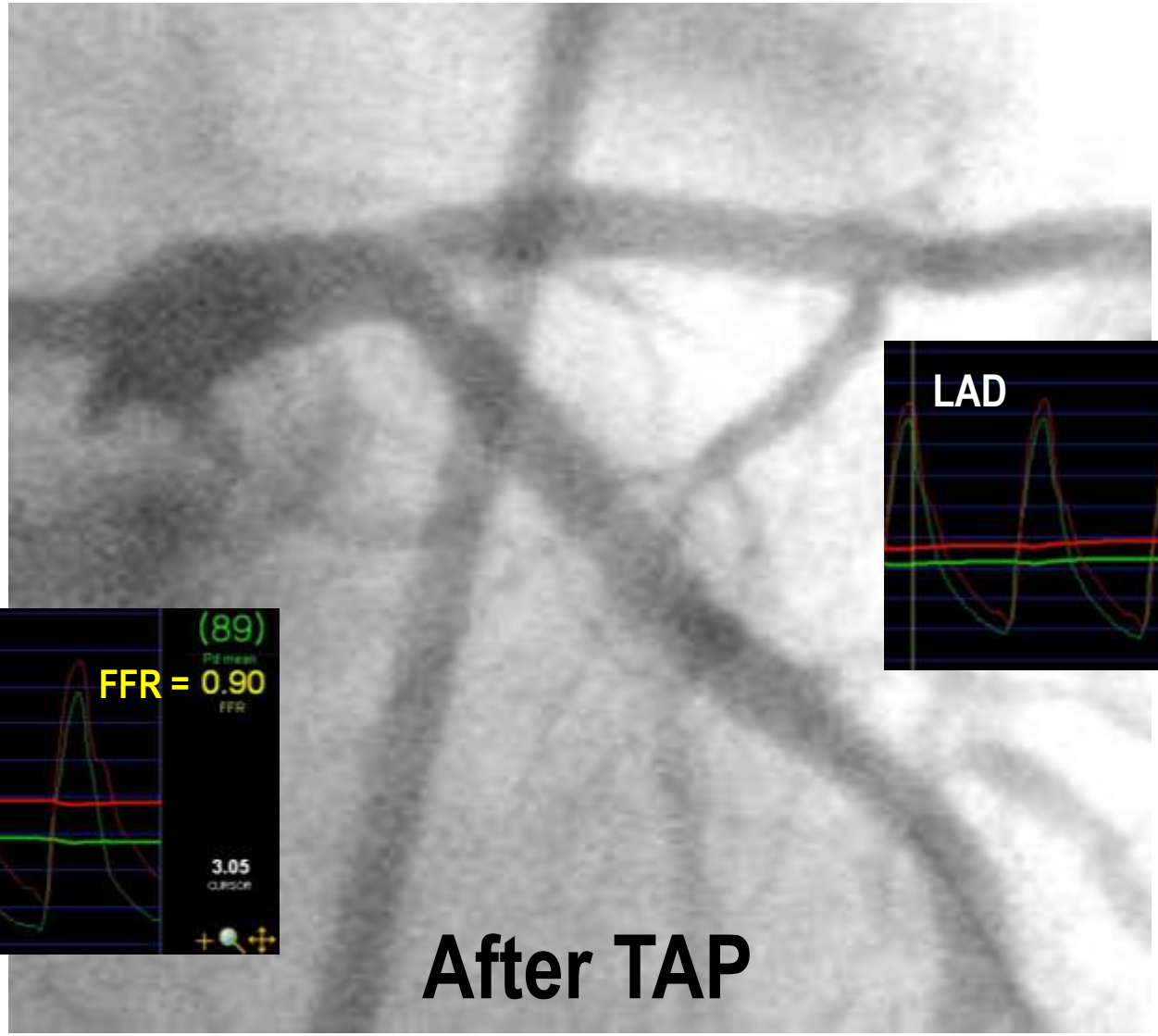




DES 3.5x23mm

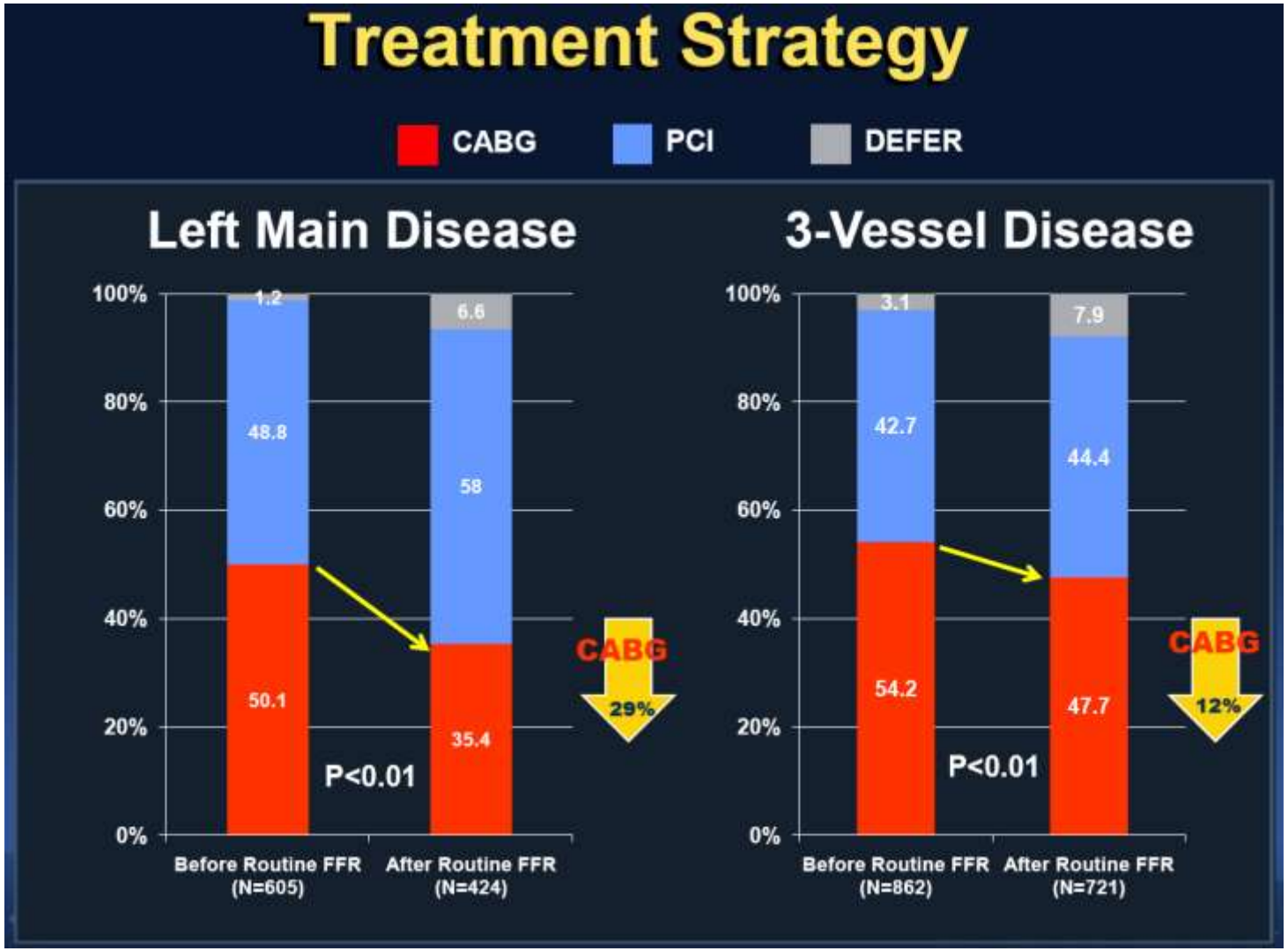
Adjunctive balloon 4x10mm

FFR-guided provisional T stenting strategy



Changes of treatment strategy after routine use of FFR

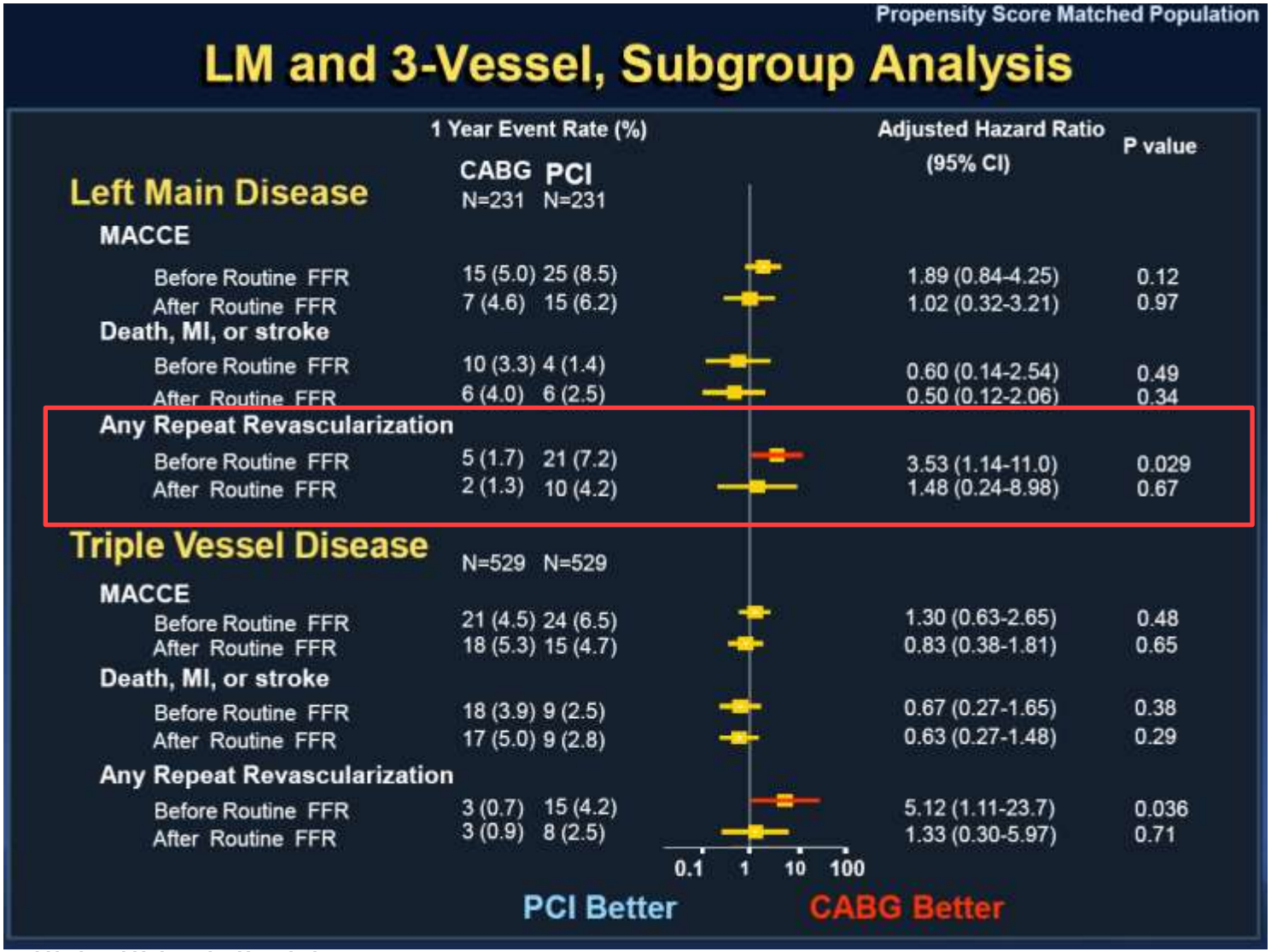
Data from Asan medical center



Park SJ, et al. J Am Coll Cardiol

Changes of outcome after routine use of FFR

Data from Asan medical center



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Application of FFR in LM lesions

- Evaluation of intermediate or ambiguous LM lesions
- Decision of treatment strategy
  - Finding a ischemia-causing lesion to determine the treatment strategy
  - Measurement of functional SYNTAX score
- Evaluation of non-LM stenoses
- Evaluation of jailed LCX or LAD ostial lesion
- Assessment of residual ischemia after 2 stenting

- FFR is useful in LM PCI.
- However, adequate knowledge on coronary physiology and FFR is essential to properly use and interpret FFR in complex LM lesions.