

Why Should Be FFR Believer in Non-LM and LM Bifurcation PCI?

Bon-Kwon Koo, MD, PhD

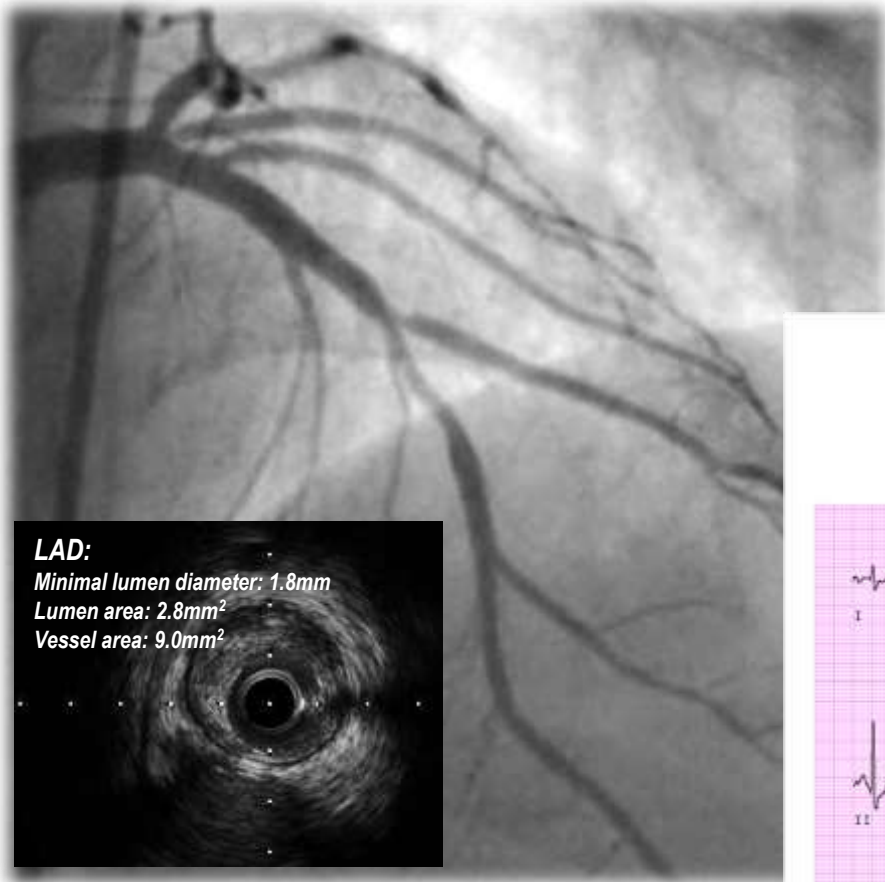
Seoul National University Hospital, Seoul, Korea



Conversion to a new concept and becoming a believer requires...

- Unsolved issues with current concepts ?
- Solid background of a new concept
- Applicability of a new concept to the problem
- Problem solving with the new concept
- Rationale for the difference
- Clinical evidences and outcome data

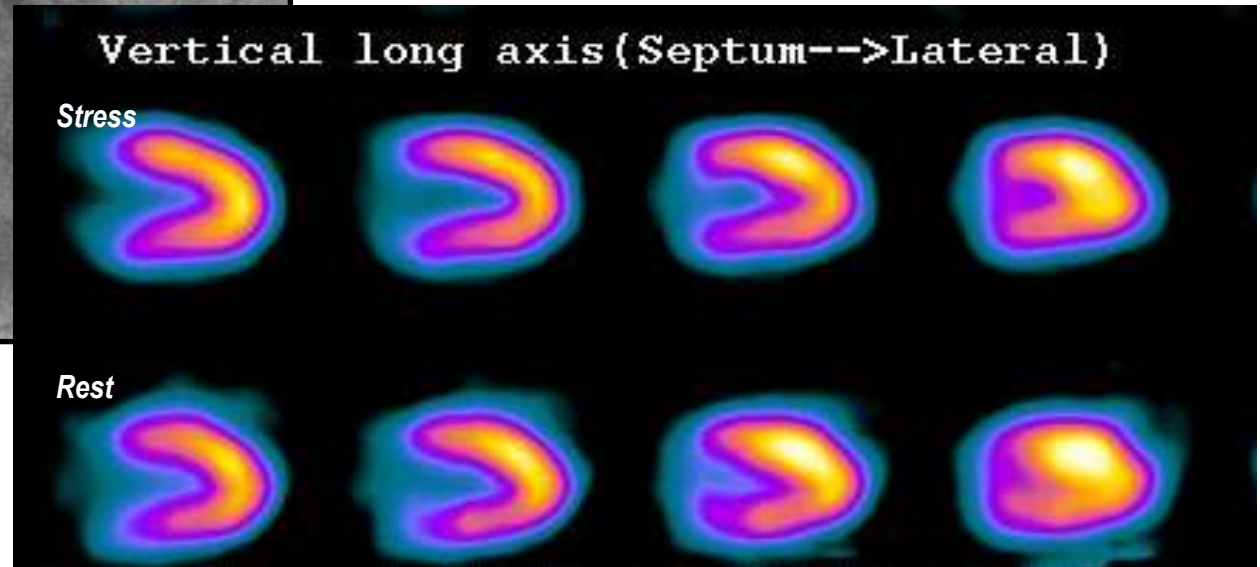
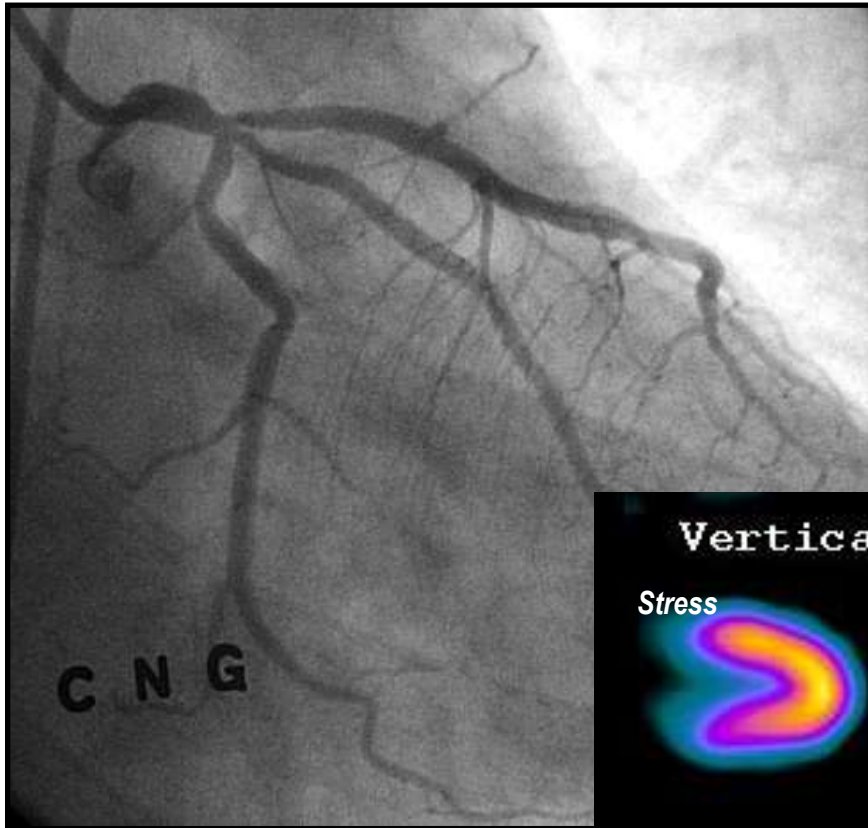
Discrepancy between Angiographic stenosis vs. Exercise stress test



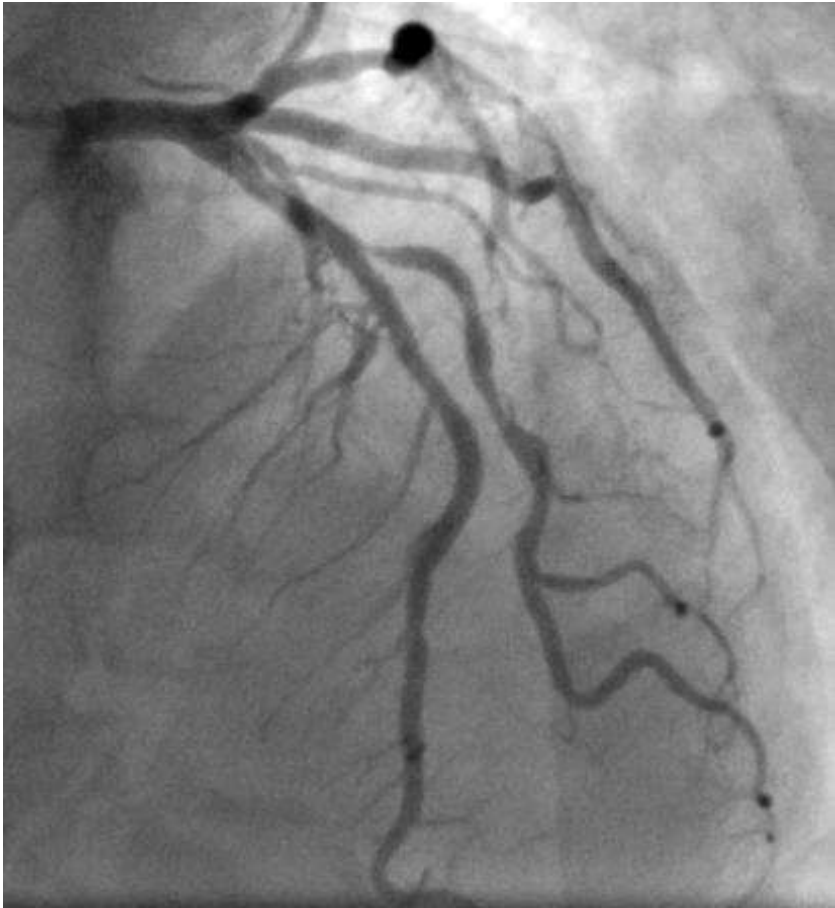
LAD:
Minimal lumen diameter: 1.8mm
Lumen area: 2.8mm²
Vessel area: 9.0mm²



Discrepancy between Angiographic stenosis vs. MPI



Discrepancy between Angiographic stenosis vs. Exercise stress test



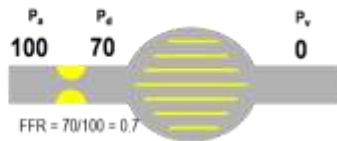
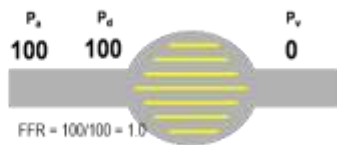
Conversion to a new concept and becoming a believer requires...

- Unsolved issues with current concepts
- Solid background of a new concept ?
- Applicability of a new concept to the problem ?
- Problem solving with the new concept
- Rationale for the difference
- Clinical evidences and outcome data

FFR has more than enough evidences....

Fractional Flow Reserve (FFR)

$$FFR = \frac{\text{Maximum flow in presence of stenosis}}{\text{Normal maximum flow}} = \frac{Q_{max}^S}{Q_{max}^N} = \frac{(P_d - P_v)/R}{(P_a - P_v)/R} = \frac{\text{Distal Pr (P}_d\text{)}}{\text{Proximal Pr (P}_a\text{)}}$$



NCBI Resources How To

PubMed.gov
 US National Library of Medicine
 National Institutes of Health

Search: "fractional flow reserve"
 Create RSS Create alert Advanced

Format: Summary - Sort by: Most Recent - Per page: 20 - Send to -

Search results
 Items: 1 to 20 of 2117

1. [Collateral circulation alters downstream hemodynamic stress caused by intracranial atherosclerotic stenosis.](#)
 Liu X, Dombos D 3rd, Pu Y, Leng X, Song L, Jia B, Pan Y, Wang D, Miao Z, Wang Y, Liu L, Wang Y. *Neural Res.* 2017 Apr 23;1-6. doi: 10.1080/01616412.2017.1315483. [Epub ahead of print]
 PMID: 28436258
[Similar articles](#)

2. [Quantitative assessment of the effect of subclavian steal syndrome on left anterior descending artery flow.](#)
 An H, An S, Camcı S, Karakuş A, Melek M. *Türk Kardiyol Dem Ars.* 2017 Apr;45(3):281-282. doi: 10.5543/kda.2016.84722.
 PMID: 28429699 [Free Article](#)
[Similar articles](#)

3. [Is ischemia the only factor predicting cardiovascular outcomes in all diabetes mellitus patients?](#)
 Kennedy MW, Fabris E, Suryapranata H, Kedhi E. *Cardiovasc Diabetol.* 2017 Apr 20;16(1):51. doi: 10.1186/s12933-017-0533-7. Review.
 PMID: 28427363 [Free PMC Article](#)
[Similar articles](#)

4. [Clinical Decision-Making for the Hemodynamic "Gray Zone" \(FFR 0.75-0.80\) and Long-Term Outcomes.](#)
 Agarwal SK, Kasula S, Edupuganti MM, Raina S, Shailesh F, Almomani A, Payne JJ, Pothineni NV, Uretsky BF, Hakeem A. *J Invasive Cardiol.* 2017 Apr 15. pii: JIC2017415-1. [Epub ahead of print]
 PMID: 28420802 [Free Article](#)
[Similar articles](#)

5. [Fractional flow reserve and pressure-bounded coronary flow reserve to predict outcomes in coronary artery disease.](#)
 Ahn JM, Zimmermann FM, Johnson NP, Shin ES, Koo BK, Lee PH, Park DW, Kang SJ, Lee SW, Kim YH, Lee CW, Park SW, Pijls NHJ, Park SJ. *Eur Heart J.* 2017 Apr 17. doi: 10.1093/eurheartj/ehx139. [Epub ahead of print]
 PMID: 28410283

Clear all
[Show additional filters](#)

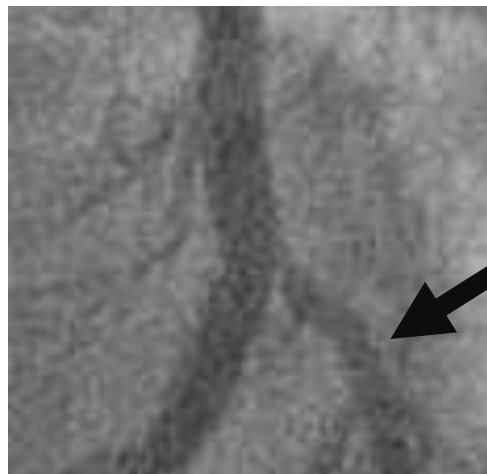
Physiologic Assessment of Jailed Side Branch Lesions Using Fractional Flow Reserve

Bon-Kwon Koo, MD, PhD,* Hyun-Jai Kang, MD, PhD,* Tae-Jin Youn, MD, PhD,†
In-Ho Chae, MD, PhD,† Dong-Joo Choi, MD, PhD,† Hyo-Soo Kim, MD, PhD,*
Dae-Won Sohn, MD, PhD,* Byung-Hee Oh, MD, PhD, FACC,*
Myoung-Mook Lee, MD, PhD, FACC,* Young-Bae Park, MD, PhD,*
Yun-Shik Choi, MD, PhD,* Seung-Jae Tahk, MD, PhD‡
Seoul, Seongnam, Gyeonggi-do, and Suwon, Republic of Korea

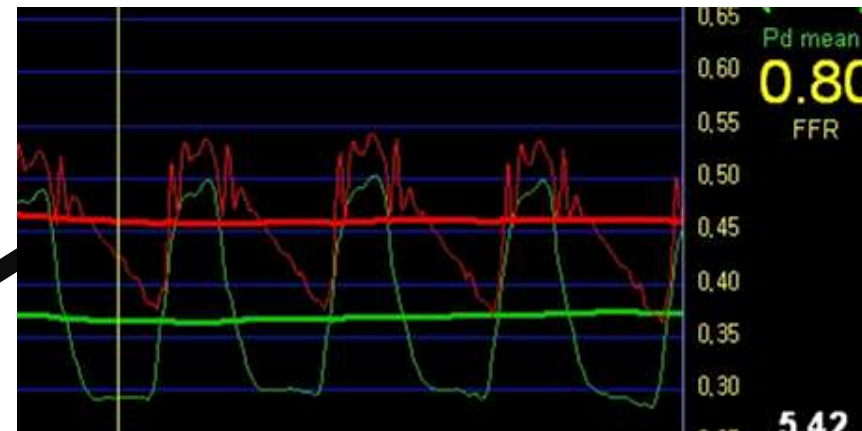
- **RADI4 pressure wire: Successful FFR measurement: 94/97 lesions (97%)**



Initial

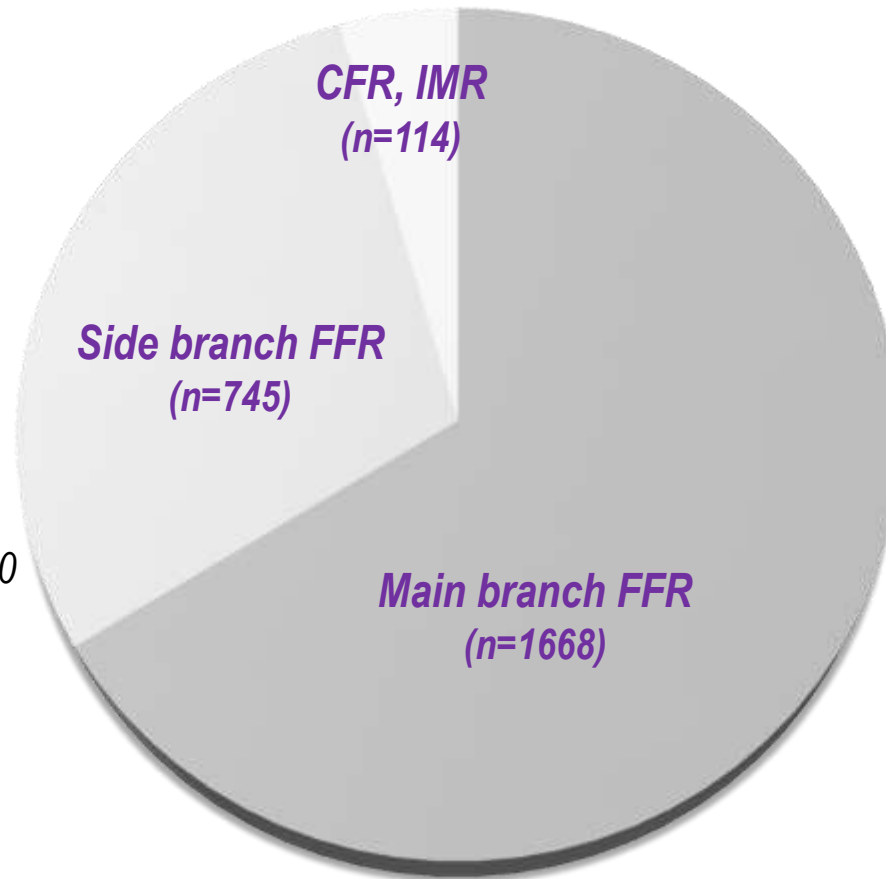


Post-stent



Pressure wire in SNUH (2003-2009)

Total measurement: 2,527




Death: 0

MI: 0

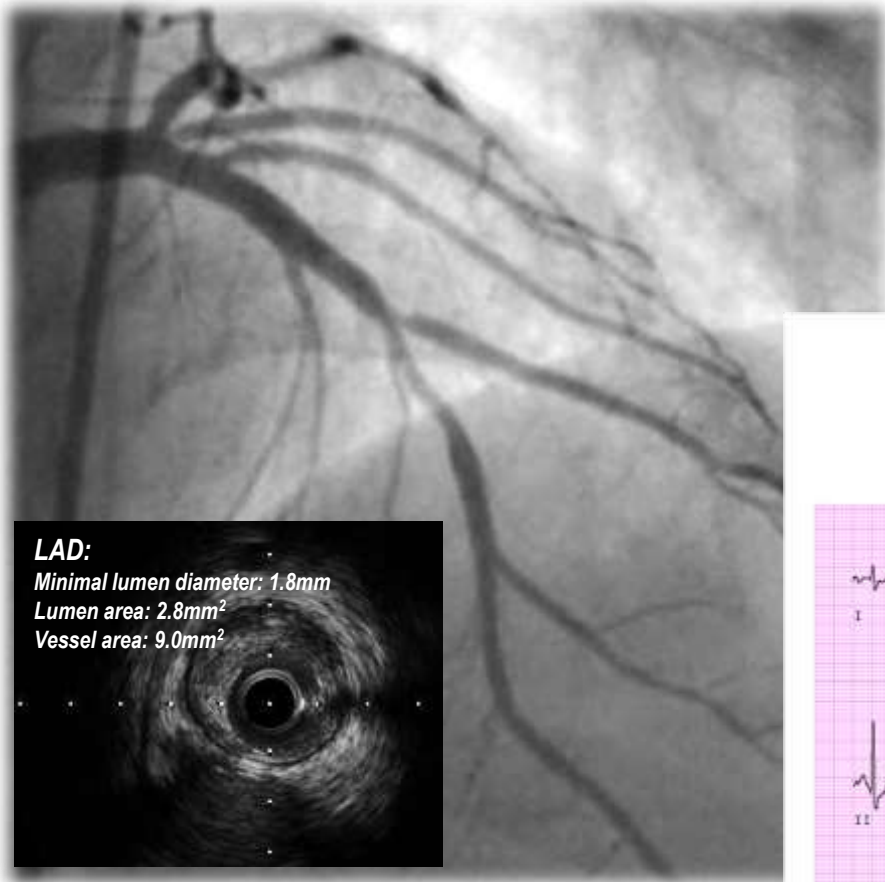
Major dissection: 1 (0.13 %)

Dissection requiring stenting: 0

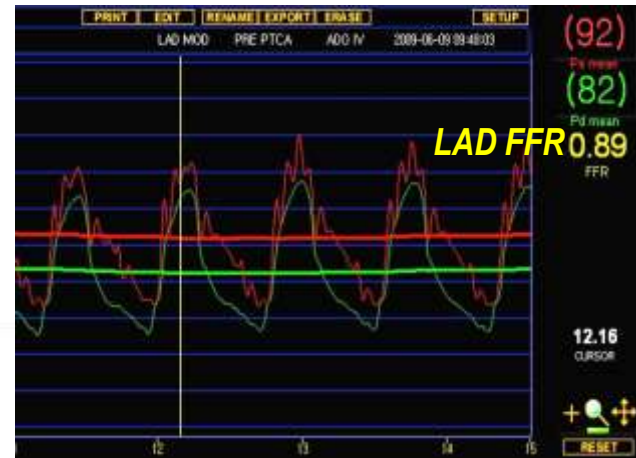
Conversion to a new concept and becoming a believer requires...

- Unsolved issues with current concepts
- Solid background of a new concept
- Applicability of a new concept to the problem
- Problem solving with the new concept 
- Rationale for the difference
- Clinical evidences and outcome data

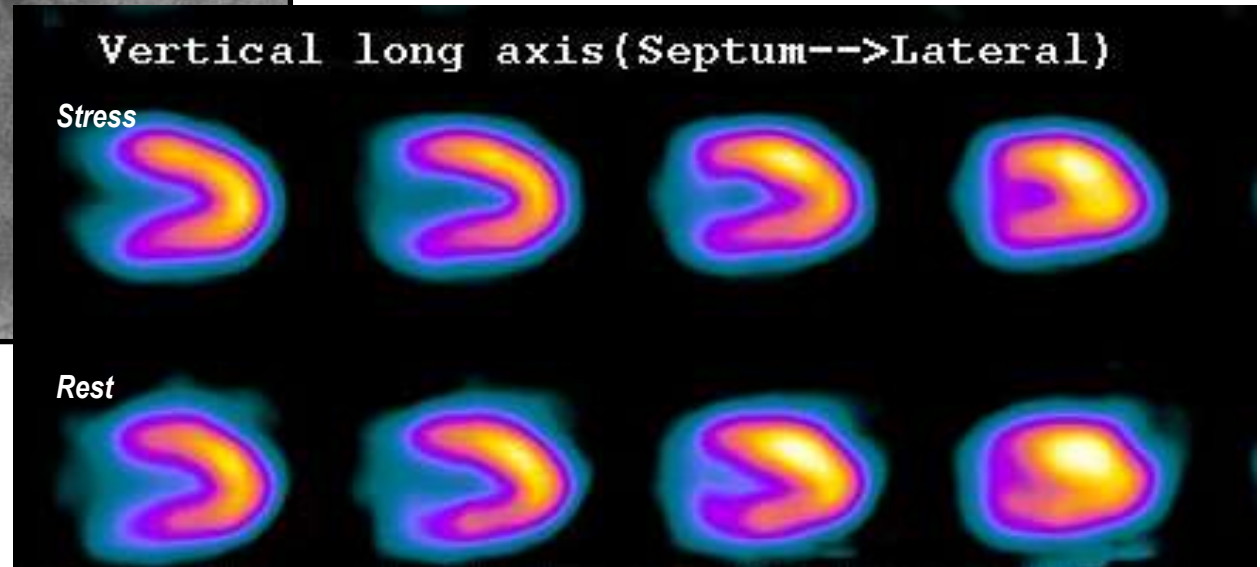
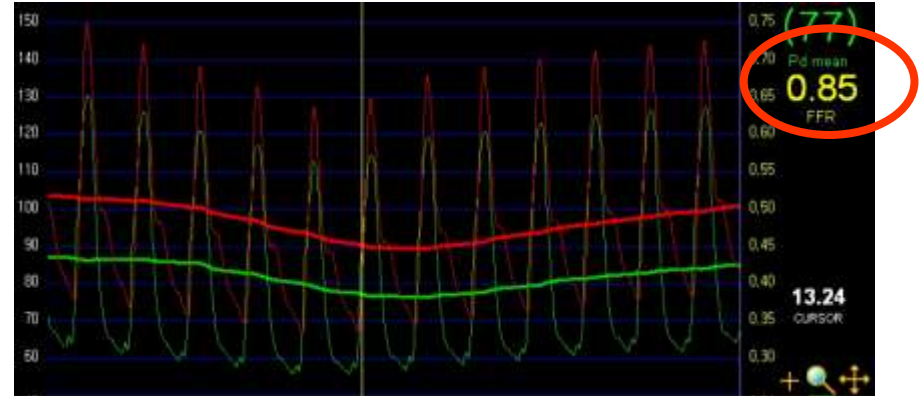
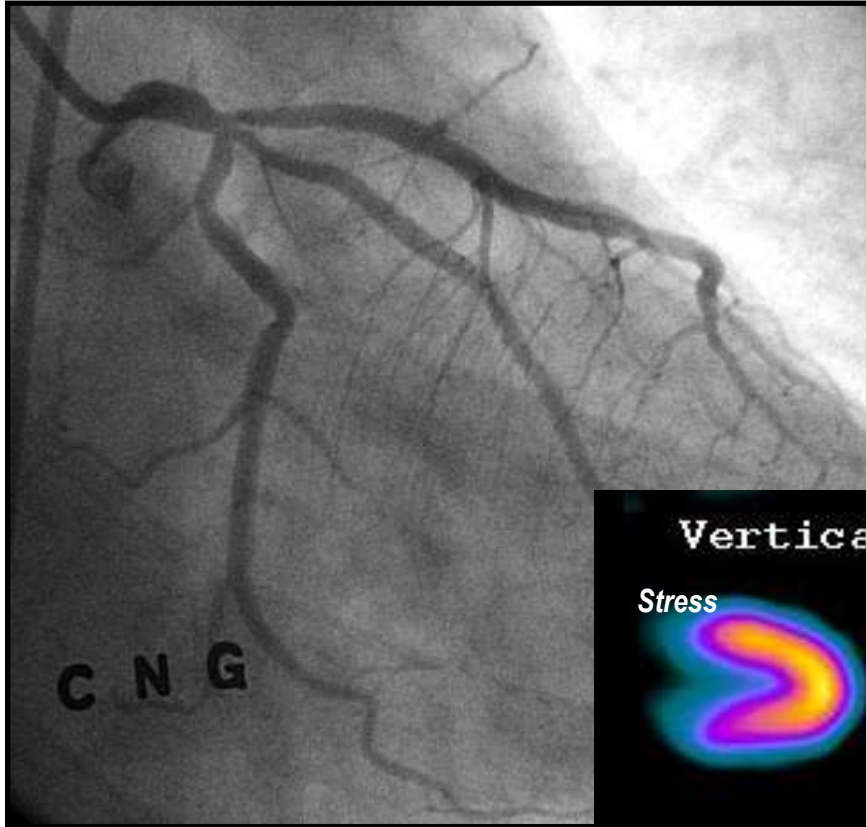
Discrepancy between Angiographic stenosis vs. Exercise stress test



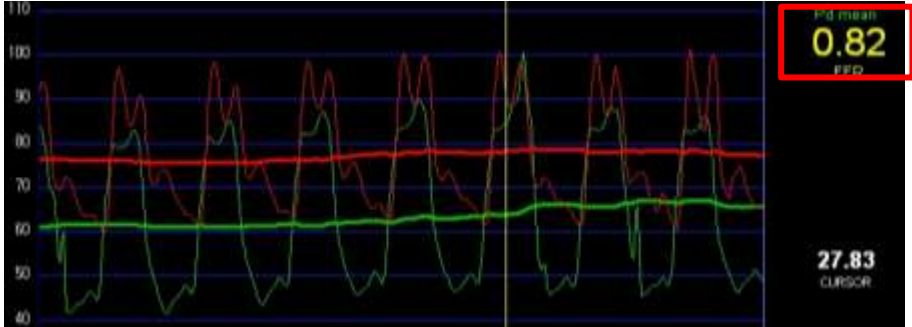
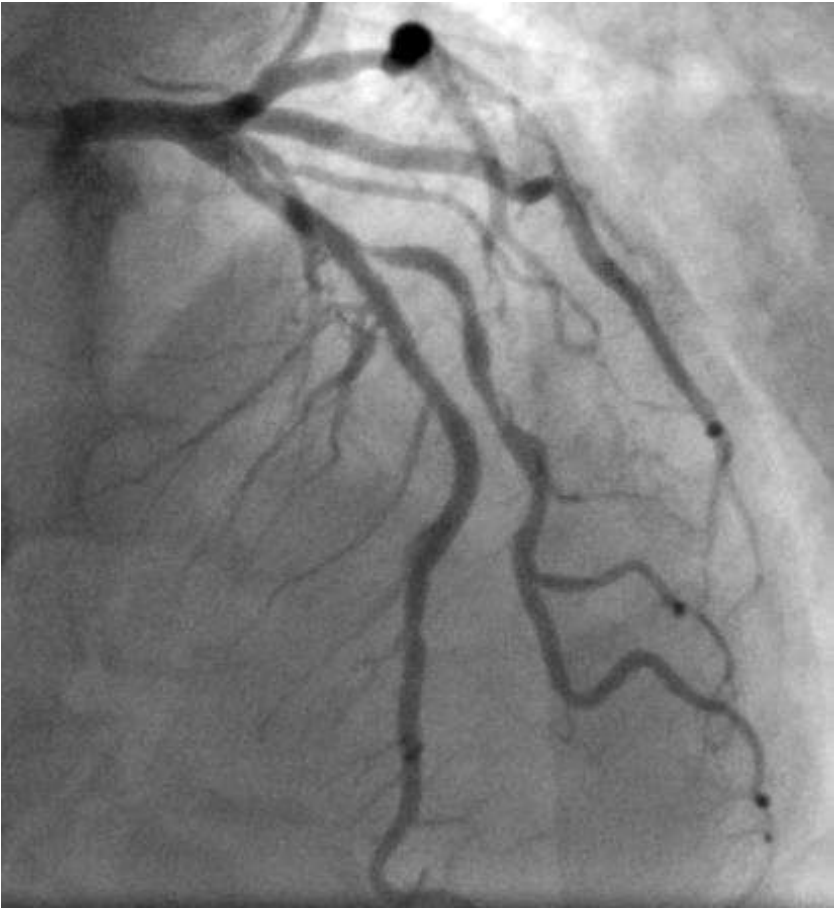
LAD:
Minimal lumen diameter: 1.8mm
Lumen area: 2.8mm²
Vessel area: 9.0mm²



Discrepancy between Angiographic stenosis vs. MPI



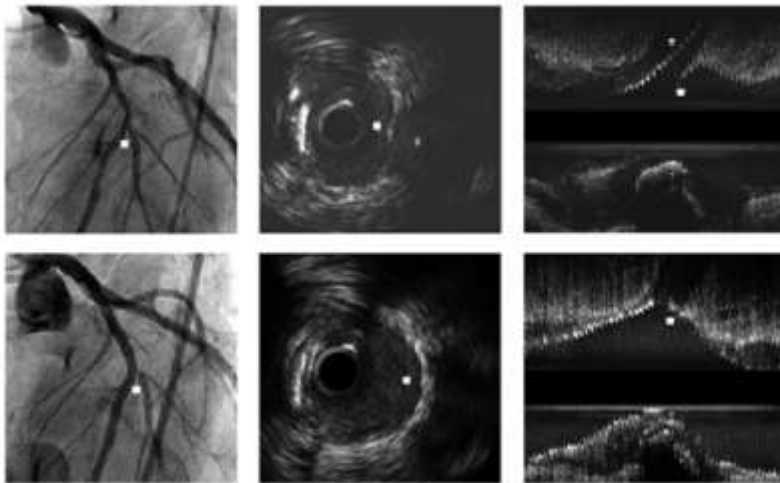
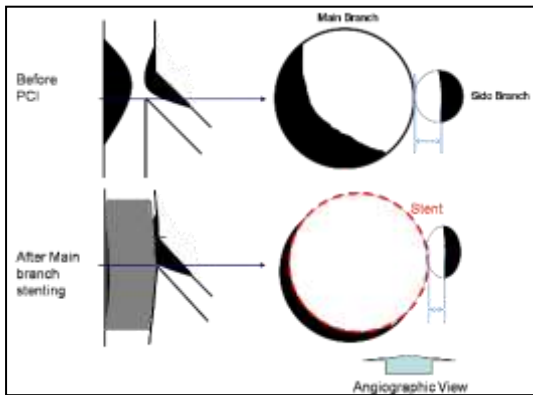
Discrepancy between Angiographic stenosis vs. Exercise stress test



Conversion to a new concept and becoming a believer requires...

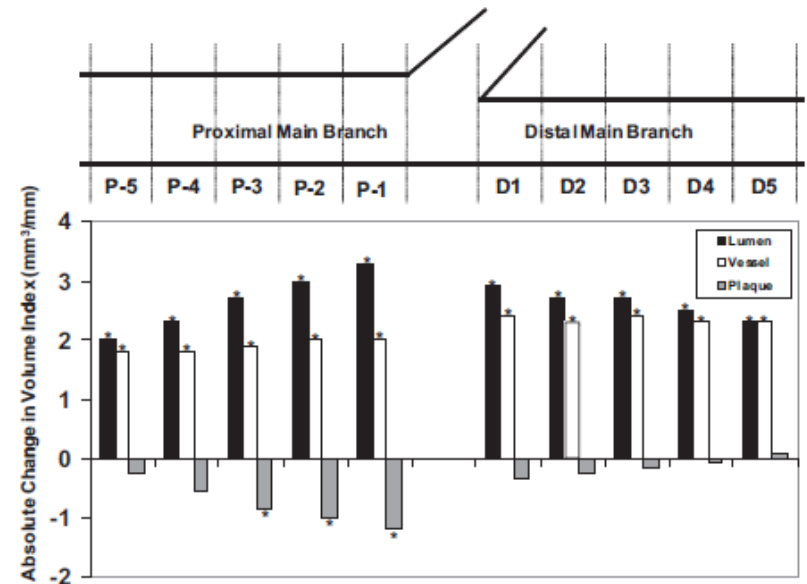
- Unsolved issues with current concepts
- Solid background of a new concept
- Applicability of a new concept to the problem
- Problem solving with the new concept
- Rationale for the difference ?
- Clinical evidences and outcome data ?

'Carina' shift



Carina shift accentuates lumen eccentricity and results in more angiographic diameter loss than lumen area loss.

Koo BK. EBC 2008

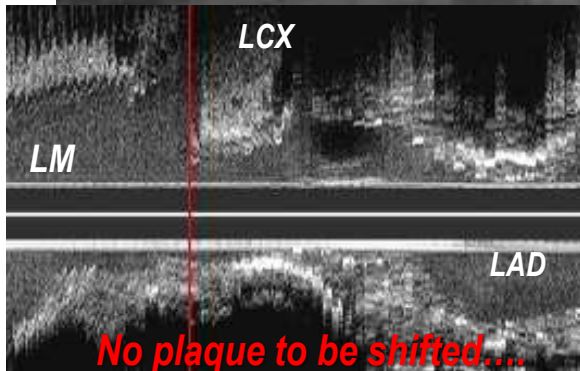


Mechanism of SB jail

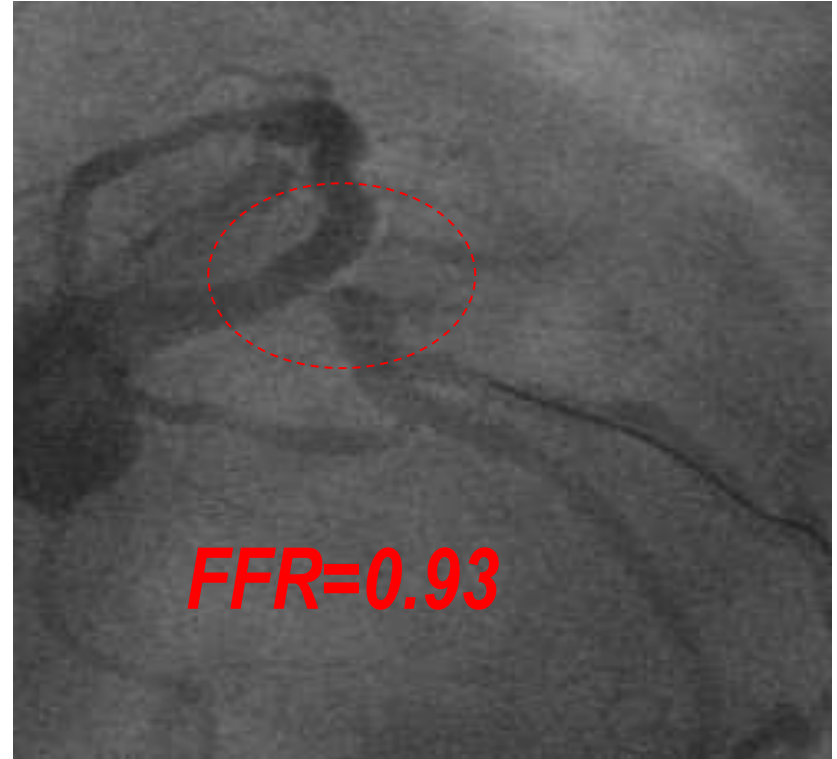
: Plaque shift from proximal MB + **Carina shift**

Koo BK, et al. Circ Cardiovasc Interv 2010;3:113

Carina Shift and Functional significance

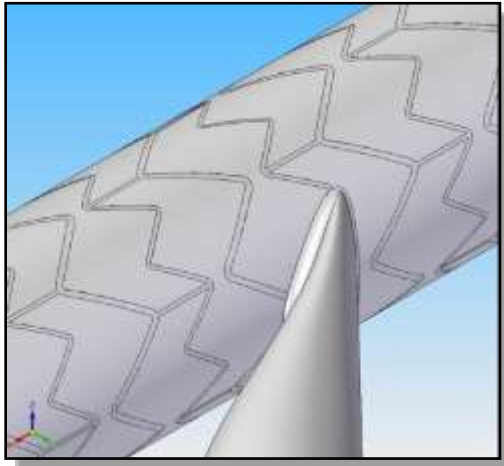


Before LM-LAD stenting



After LM-LAD stenting

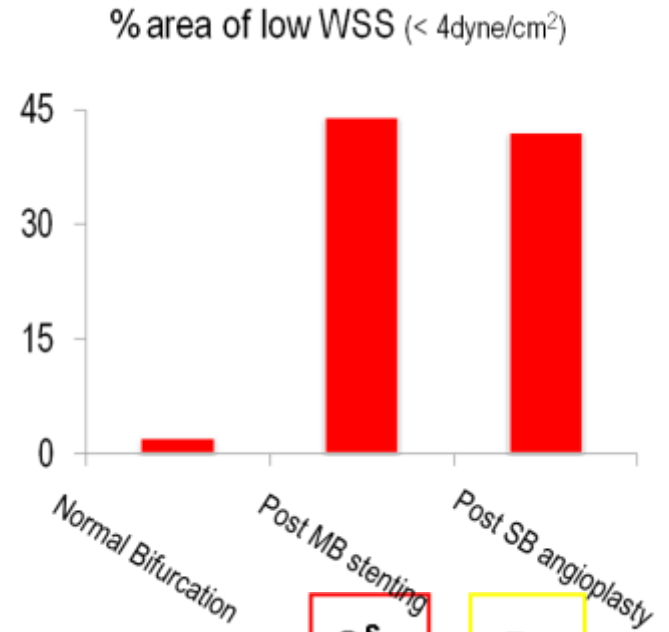
CFD in simple and idealized coronary models



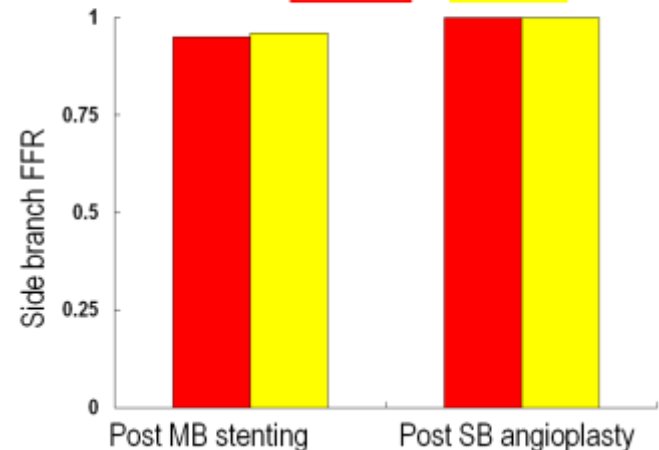
Post MB stenting



Post SB angioplasty

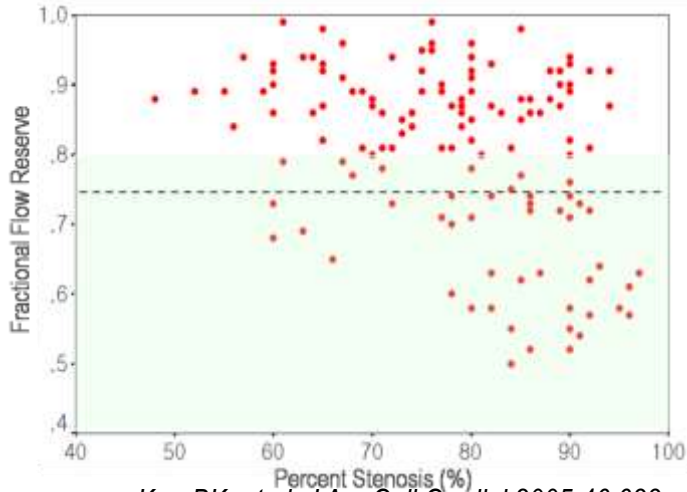


$$FFR = \frac{Q_{max}^S}{Q_{max}^N} = \frac{P_d}{P_a}$$

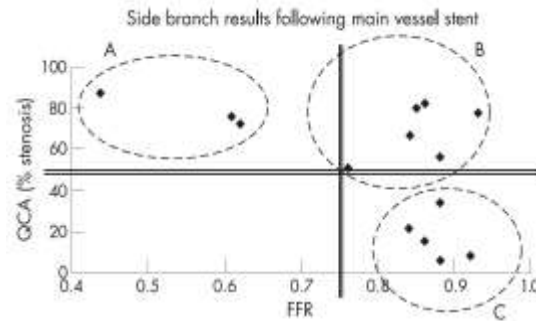


Can anatomical severity predict the functional significance?

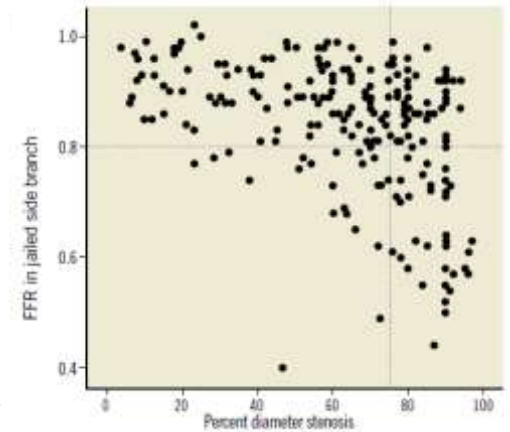
FFR vs. anatomical stenosis in Jailed side branches



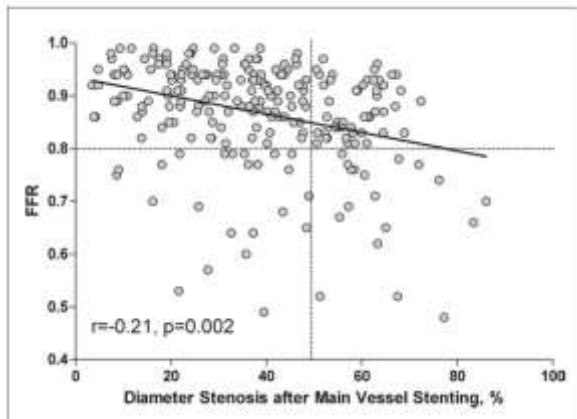
Koo BK, et al. *J Am Coll Cardiol* 2005;46:633
Park SH & Koo BK *J Geriatr Cardiol* 2012;9:278



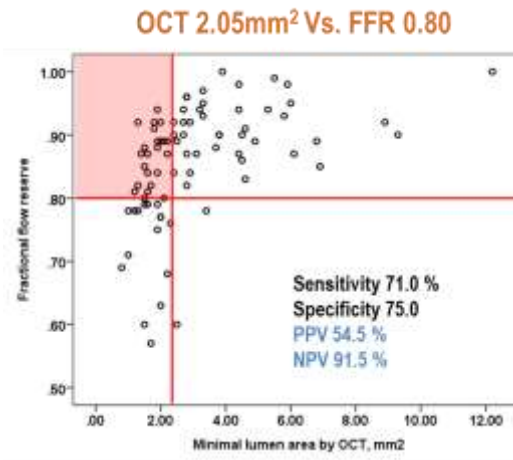
Bellenger, et al. *Heart* 2007



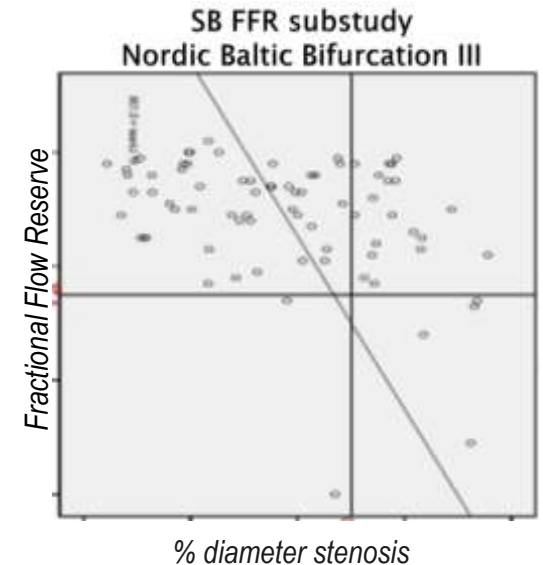
Lee JM, et al. *Eurointervention* 2015;11:V59



Ahn JM, et al. *JACC interv* 2012

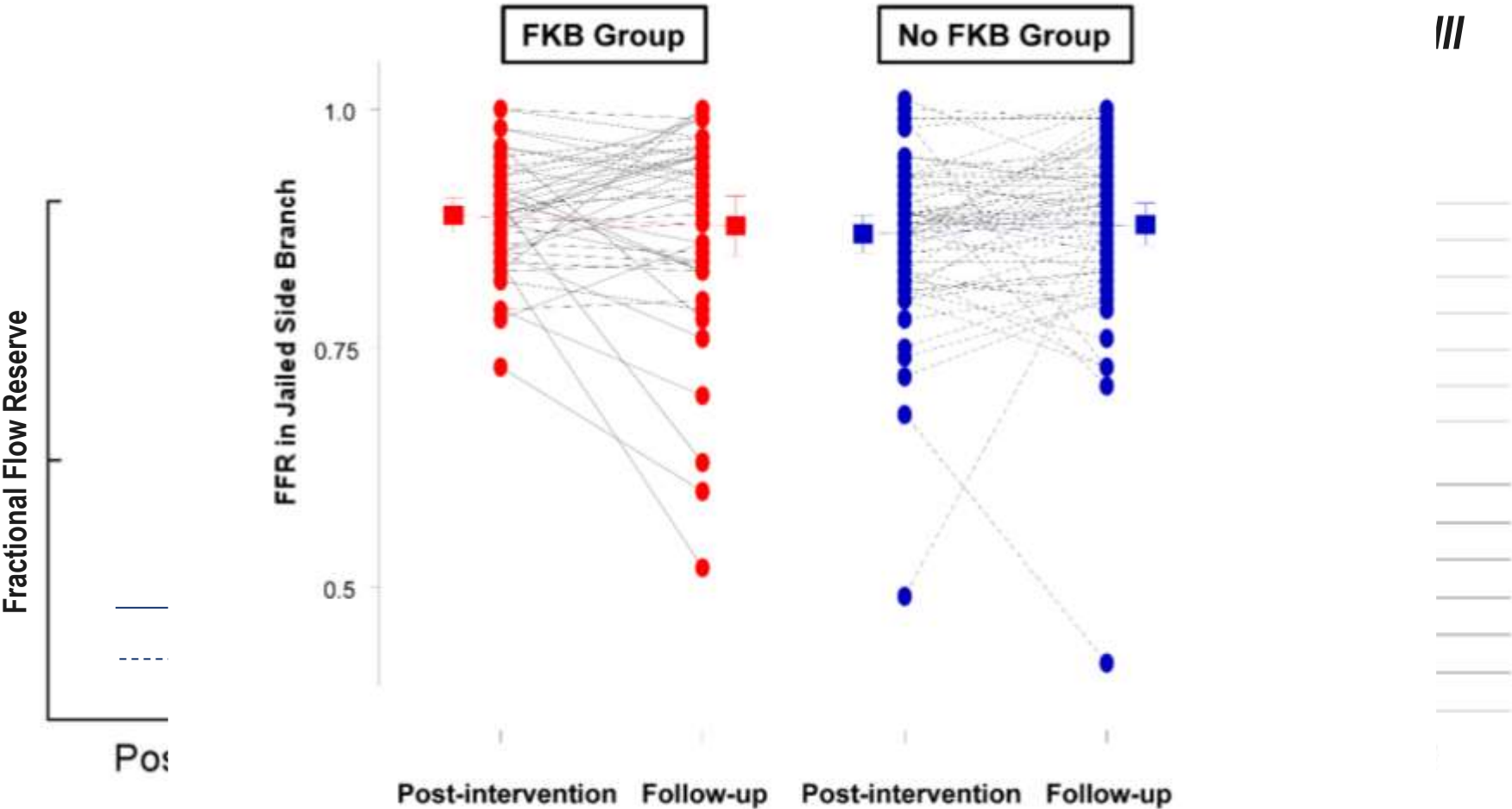


Ha J, et al *JACC Imag* 2013



Kumsars I, et al. *Eurointervention* 2011

Functional outcome of Jailed side branches



Lee JM..... Koo BK, Eurointervention 2015

© 2011

Angio-guided vs. FFR-guided approach: Clinical outcomes

- In non-LM bifurcation lesions, FFR-guided SB intervention can reduce unnecessary PCI.

	FFR-guided group	Angio-guided group	P
	N=108	N=108	
Side branch PCI	30%	45%	0.02
TVR	5 (4.6%)	4 (3.7%)	0.7
MI	0	0	1
Cardiac death	0	0	1

Koo BK, et al. Eur Heart J 2008



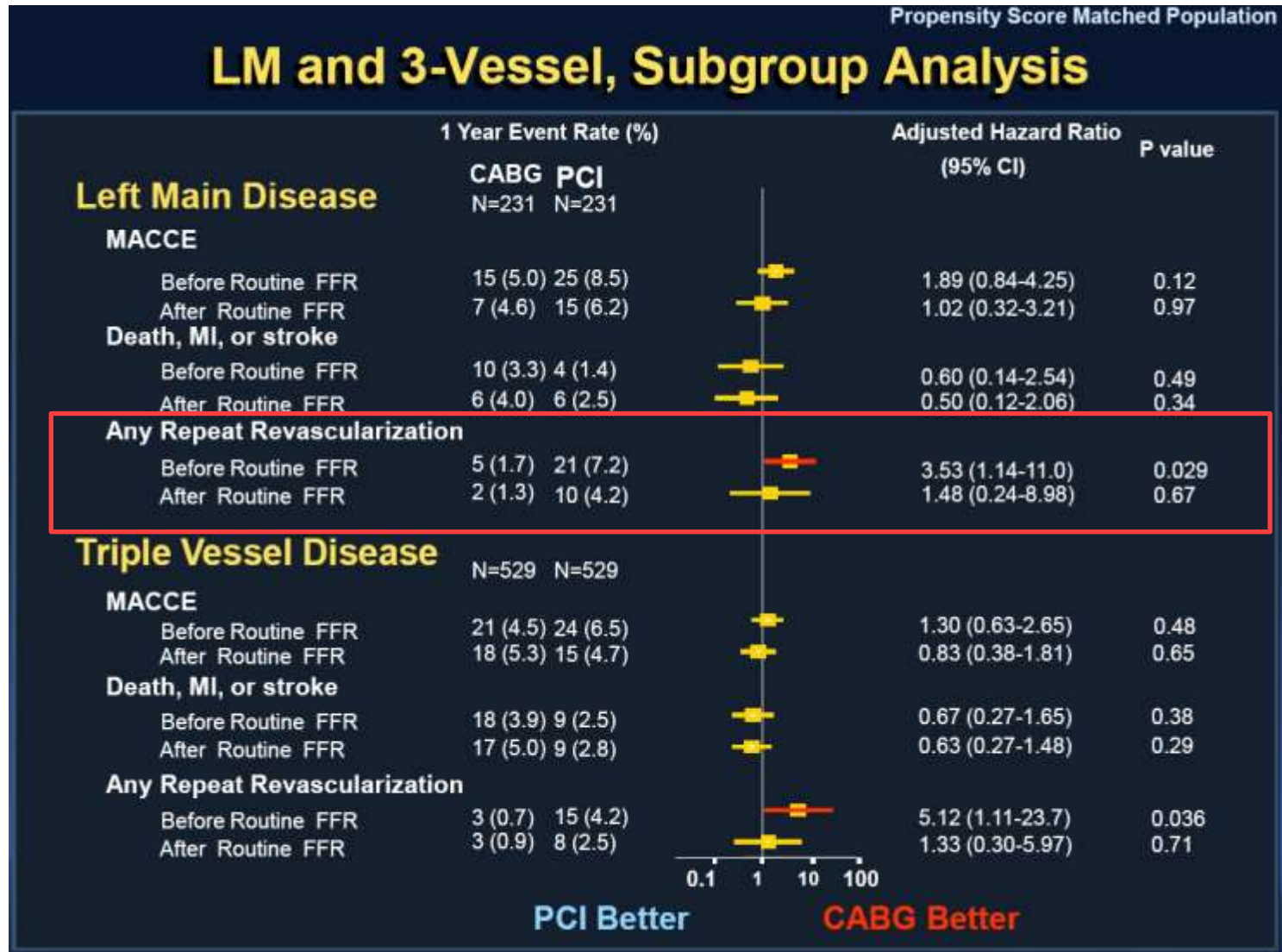
Results (3): One-year clinical outcomes

	Angio group (n=160)	FFR group (n=160)	P
Cardiac death, n(%)	1 (0.6)	2 (1.3)	0.56
MI, n(%)	22 (13.8)	19 (11.9)	0.74
TLR, n(%)	8 (5.0)	5 (3.1)	0.57
CABG, n(%)	0	0	-----
TVR, n(%)	11 (6.9)	9 (5.6)	0.82
MACE, n(%)	29 (18.1)	29 (18.1)	1.00
ST-def/prob, n(%)	2 (1.3)	1 (0.6)	0.56

Chen SL, et al. JACC Cardiovasc Interv 2015

Changes of outcome after routine use of FFR

Data from Asan medical center



Why Should Be FFR Believer in Non-LM and LM Bifurcation PCI?

Conversion to a new concept and becoming a believer requires...

- Unsolved issues with current concepts ? **YES!**
- Solid background of a new concept ? **YES!**
- Applicability of a new concept to the problem ? **YES!**
- Problem solving with the new concept ? **YES!**
- Rationale for the difference ? **YES!**
- Clinical evidences and outcome data ? **YES!**