FFR Digest
: Evolving from PCI to CABG

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Cardiovascular Center

FFR has become the gold standard to detect the ischemia-related lesion in a catheterization lab.

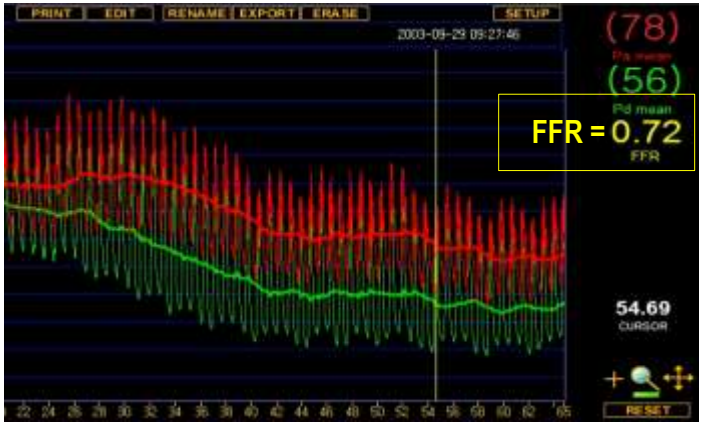
European Heart Journal (2010) 31, 2501–2555
doi:10.1093/eurheartj/ehq277

ESC/EACTS GUIDELINES

Guidelines on myocardial revascularization

The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

	Class[a]	Level[b]
FFR-guided PCI is recommended for detection of ischaemia-related lesion(s) when objective evidence of vessel-related ischaemia is not available.	I	A
DES[d] are recommended for reduction of restenosis/re-occlusion, if no contraindication to extended DAPT.	I	A
Distal embolic protection is recommended during PCI of SVG disease to avoid distal embolization of debris and prevent MI	I	B



Evidences……


The NEW ENGLAND JOURNAL of MEDICINE

JANUARY 15, 2009

Fractional Flow Reserve versus Angiography for Guiding Percutaneous Coronary Intervention


The NEW ENGLAND JOURNAL of MEDICINE

SEPTEMBER 13, 2012

Fractional Flow Reserve–Guided PCI versus Medical Therapy in Stable Coronary Disease

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Interventional Cardiol

Long-Term Clinical Outcome After Fractional Flow Reserve-Guided Percutaneous Coronary Intervention in Patients With Multivessel Disease

Alexandre Berger, MD,* Kees-Joost Botman, MD,* Philip A. MacCarthy, MD, PhD, MRCP,* William Wijns, MD, PhD,* Jozef Bartunek, MD, PhD,* Guy R. Heyndrickx, MD, PhD,* Nico H. J. Pijls, MD, PhD,† Bernard De Bruyne, MD, PhD*
Aalst, Belgium; and Eindhoven, the Netherlands

Coronary Pressure Measurement After Stenting Predicts Adverse Events at Follow-Up

A Multicenter Registry

Nico H.J. Pijls, MD, PhD; Volker Klauss, MD; Uwe Siebert, MPh, MSc; Eric Powers, MD; Kenji Takazawa, MD; William F. Fearon, MD; Javier Escaned, MD; Yukio Tsurumi, MD; Takashi Akasaka, MD; Habib Samady, MD; Bernard De Bruyne, MD, PhD; for the Fractional Flow Reserve (FFR) Post-Stent Registry Investigators

Reliability of Pressure-Derived Myocardial Fractional Flow Reserve in Assessing Coronary Artery Stenosis in Patients With Previous Myocardial Infarction

Yasuhiro Usui, MD, Taishiro Chikamori, MD, Hidefumi Yanagisawa, MD, Takayuki Morishima, MD, Satoshi Hida, MD, Nobuhiro Tanaka, MD, Kenji Takazawa, MD, and Akira Yamashina, MD

Clinical Significance of Fractional Flow Reserve for Evaluation of Functional Lesion Severity in Stent Restenosis and Native Coronary Arteries*

Stefan Krüger, MD; Karl-Christian Koch, MD; Ira Kaumanns, MD; Marc W. Merx, MD; Peter Hanrath, MD; and Rainer Hoffmann, MD

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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-

Interventional Cardiology

Clinical outcome in patients with intermediate equivocal left main coronary artery disease a deferral of surgical revascularization on the basis of fractional flow reserve measurements

Michael Lindstaedt, MD,[a] Aydan Yazar, MD,[a] Alfried Germing, MD,[a] Markus K. Fritz, MD,[b] Tim Holland-Letz, MSC,[c] Andreas Mügge, MD,[a] and Waldemar Bojara, MD[a] *Bochum, Germany*

Physiological evaluation of the provisional side-branch intervention strategy for bifurcation lesions using fractional flow reserve

Bon-Kwon Koo[1], Kyung-Woo Park[1], Hyun-Jae Kang[1], Young-Seok Cho[2], Woo-Young Chung[2], Tae-Jin Youn[2], In-Ho Chae[2], Dong-Ju Choi[2], Seung-Jae Tahk[2], Byung-Hee Oh[1], Young-Bae Park[1] and Hyo-Soo Kim[1]*

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- **Functional evaluation for multi-vessel disease**
- **FFR-guided bypass surgery: Clinical evidences**
- **Functional evaluation for graft stenoses**
- **Non-invasive FFR**

FFR in Multi-vessel disease and Multiple lesions

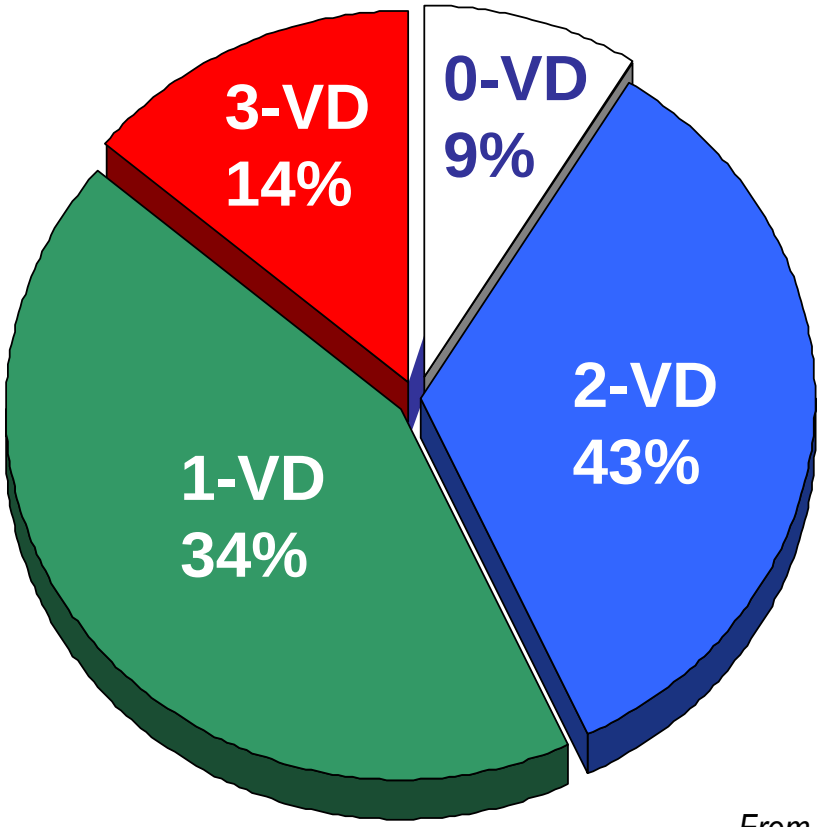
- FFR is the only mean of gaining a per segment functional assessment of the coronary tree

  - Stress ECG: *per patient*

  - Radioisotope scan, CFR *per vessel*

  - FFR *per segment*

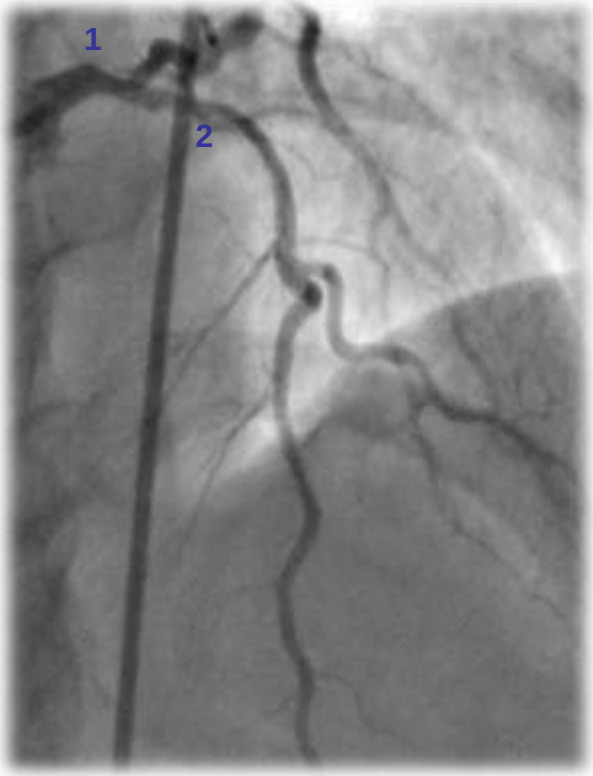
Proportions of functionally diseased coronary arteries in patients with angiographic 3 vessel disease

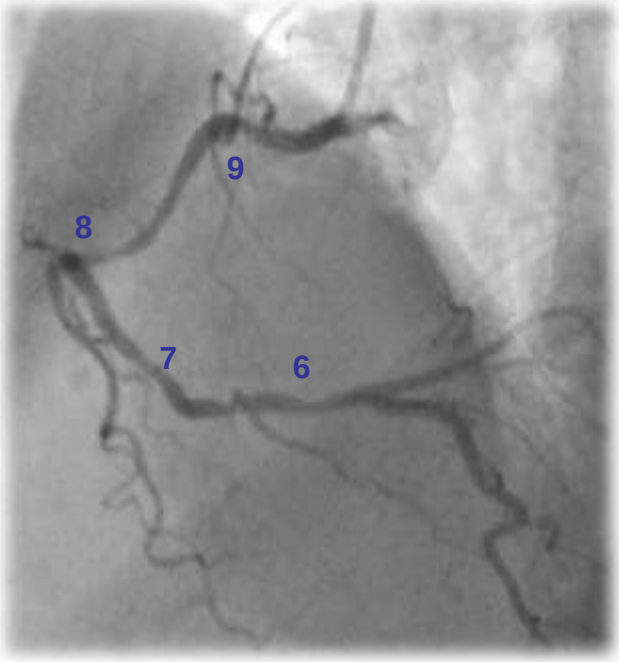


From FAME study, Tonino P, et al.

F/52

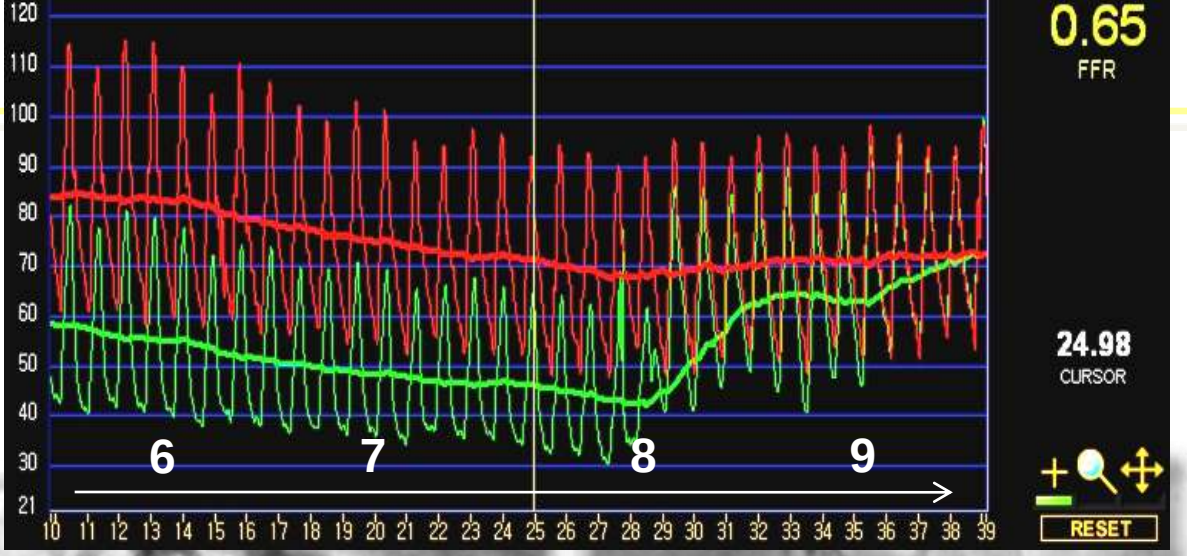
Stable angina

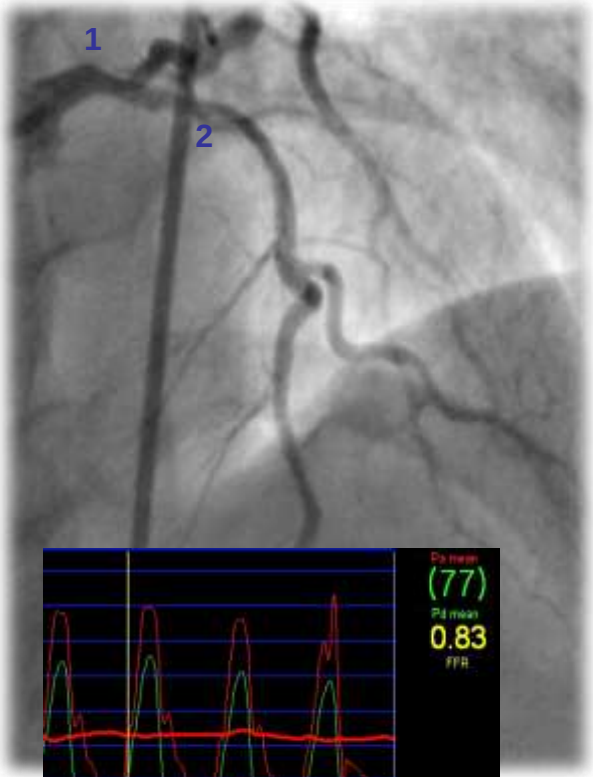


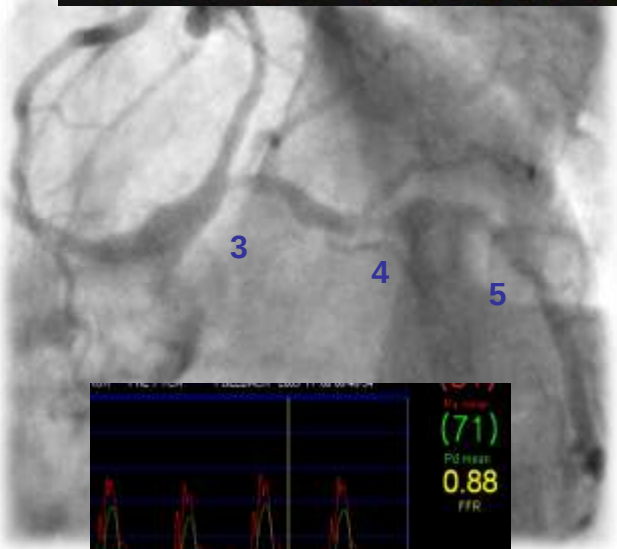


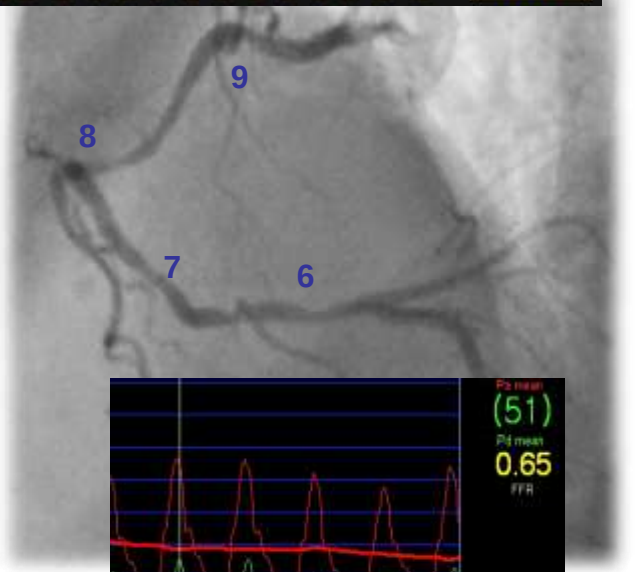
F/52

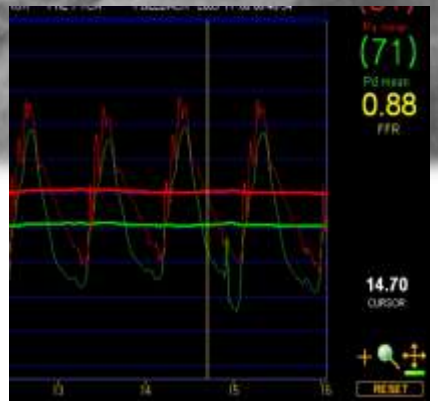
Stable angina

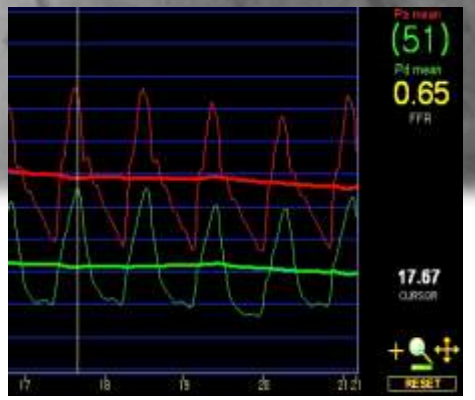








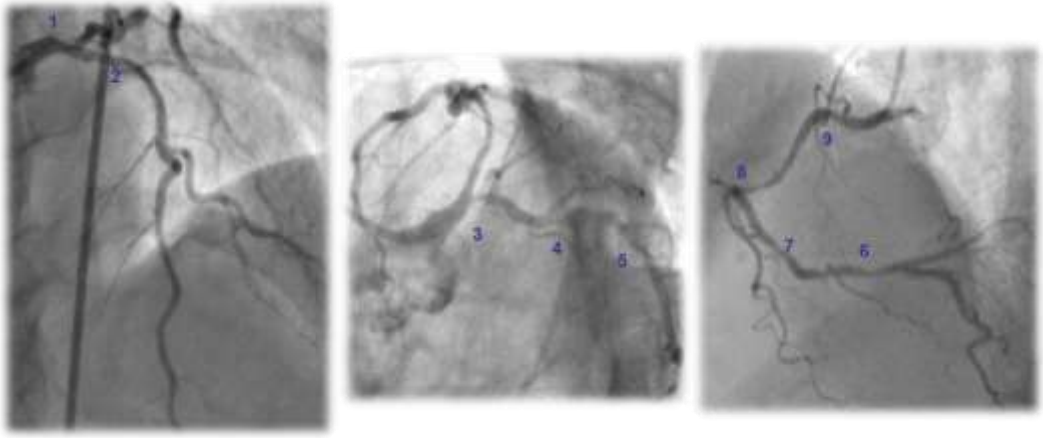


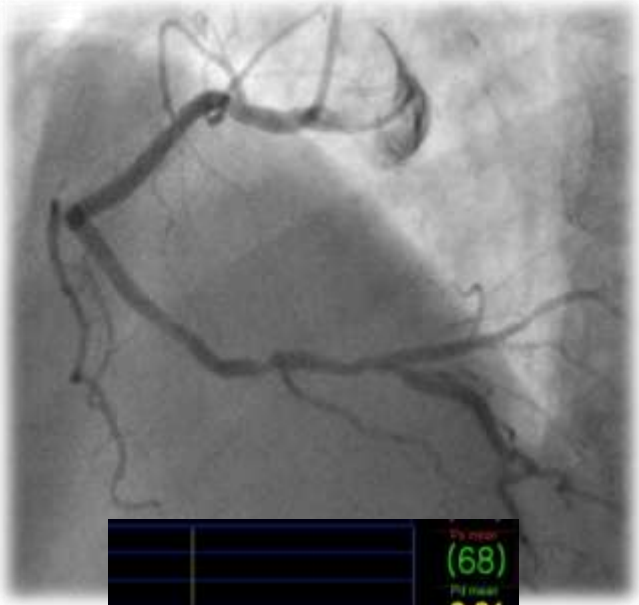


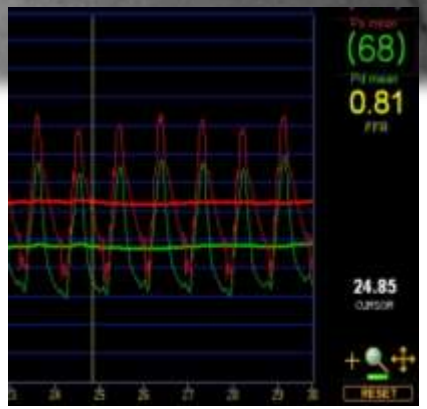
F/52

Stable angina **3VD, 9 lesions by coronary angiography**

After FFR, 1VD, single lesion → Treated with 1 DES







5-6 stents? Bypass surgery?

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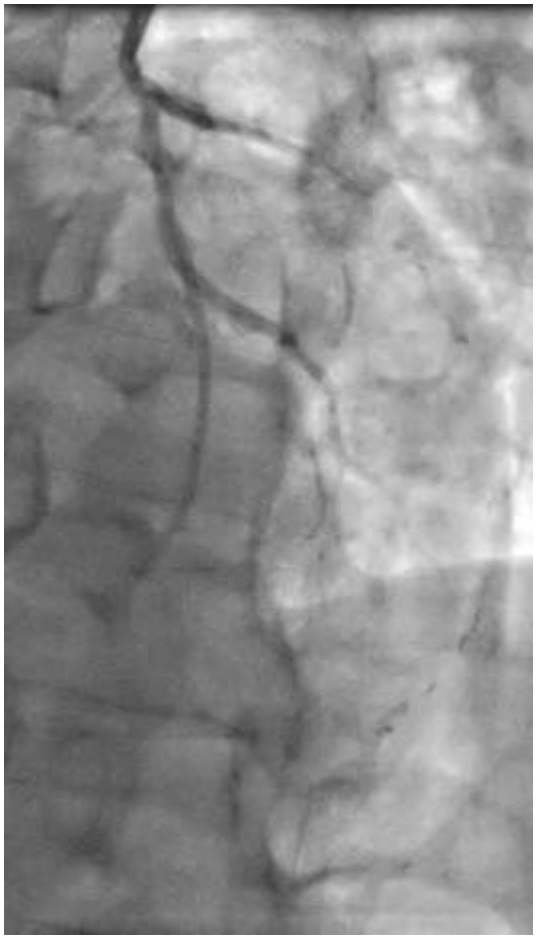
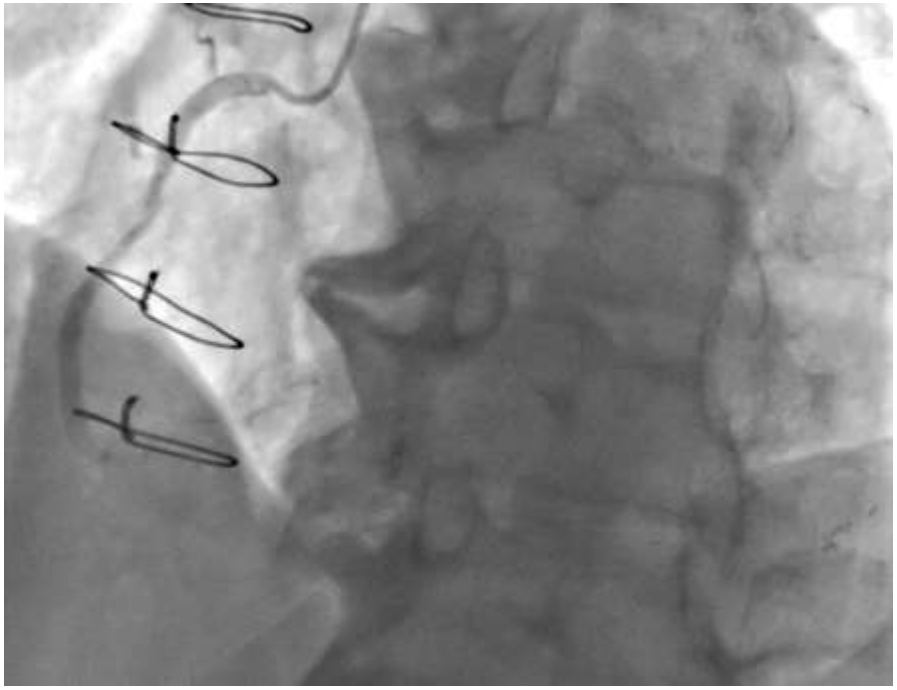
Why is a graft to RCA occluded?



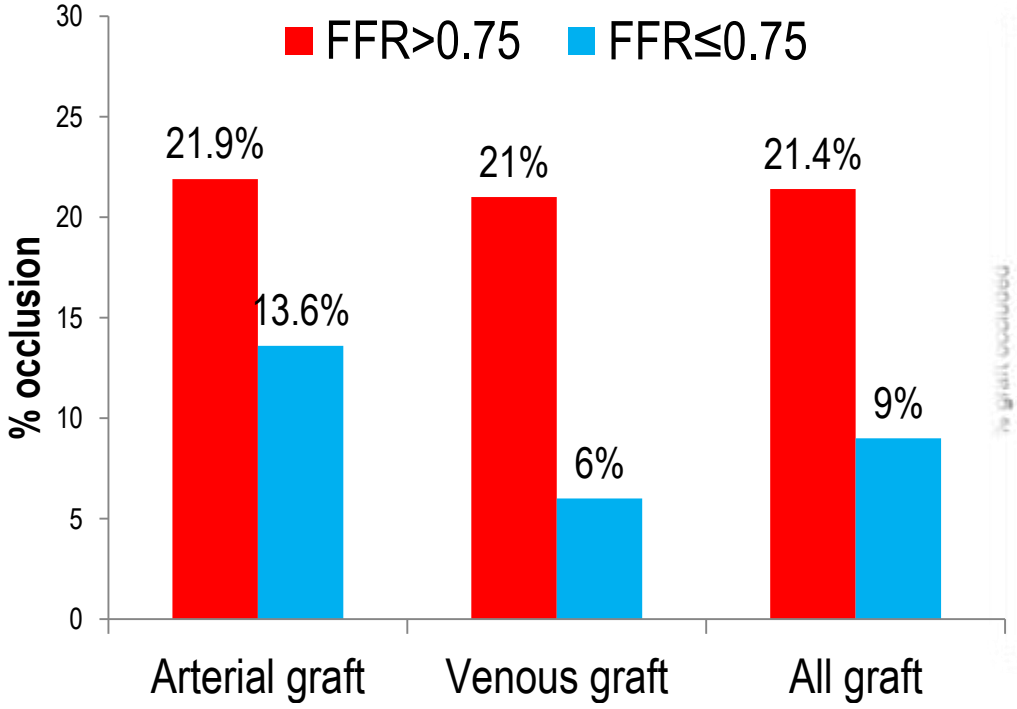


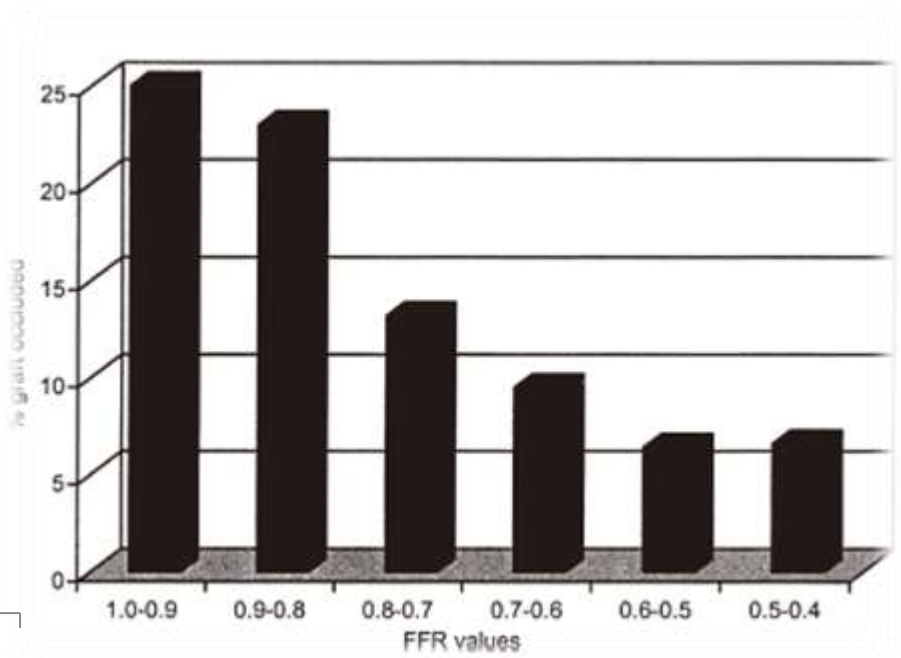
- LITA to LAD, SVG Y-graft to D2
- RITA+SVG Y-graft to D1, **PDA**

FFR 0.83

Does Stenosis Severity of Native Vessels Influence Bypass Graft Patency? A Prospective Fractional Flow Reserve–Guided Study

- Prospective study
- 164 patients with ≥ 1 intermediate stenosis
- FFR was measured, but the surgeon was blinded to the results of FFR
- 1 year angiography to assess the graft patency



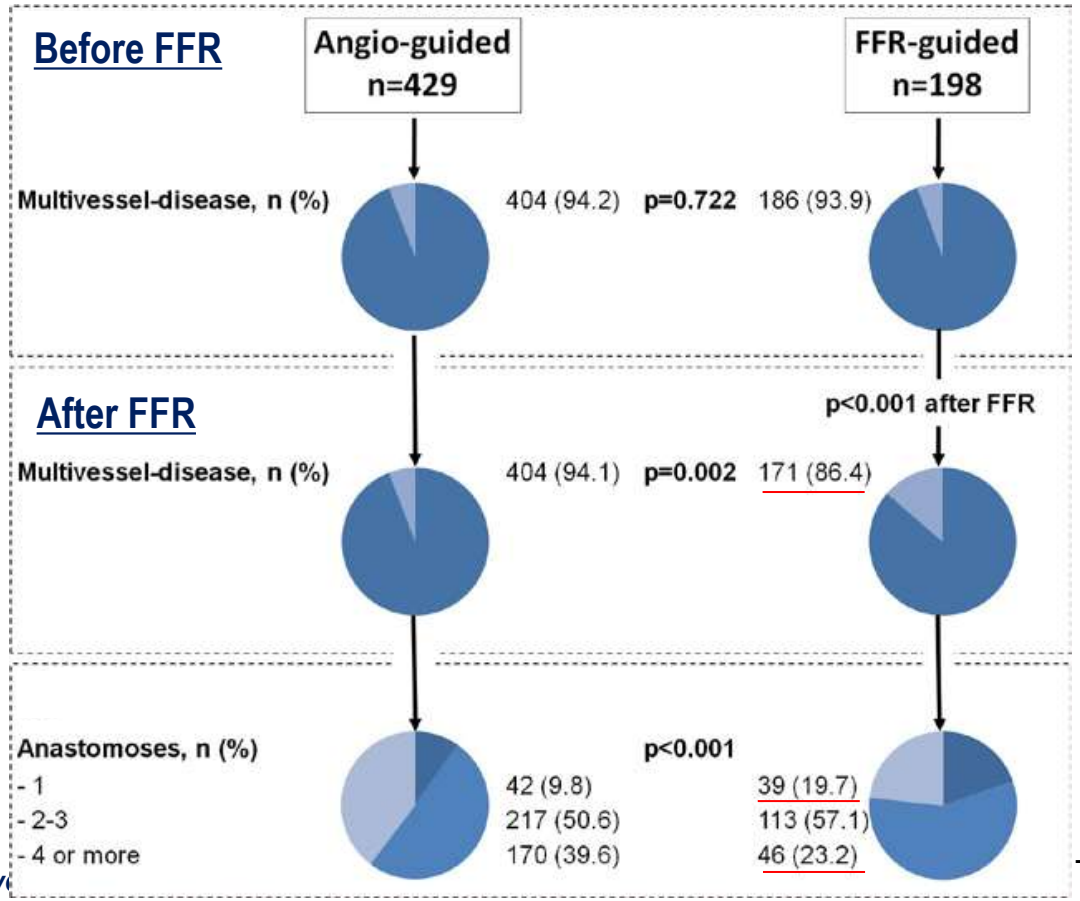


Botman CJ, et al. Ann Thorac Surg 2007

Cardiovascular Surgery

Fractional Flow Reserve–Guided Versus Angiography-Guided Coronary Artery Bypass Graft Surgery

- Retrospective registry, 627 patients with bypass surgery
- ≥ 1 intermediate stenosis
- 429 patients with angio-guided surgery vs. 198 FFR-guided surgery



Toth G, et al. Circulation 2013

Cardiovascular Surgery

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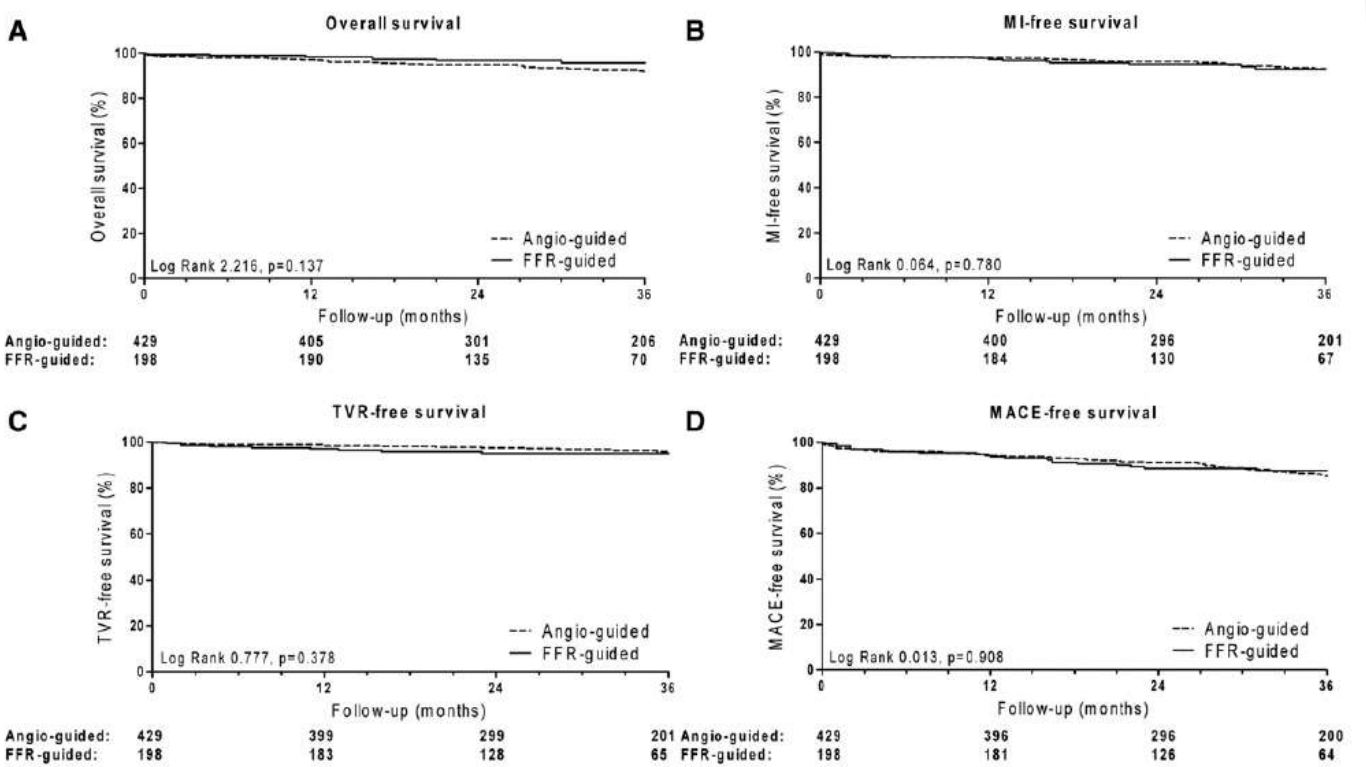

FFR-guided group: Significantly lower rate of angina

(CCS II–IV angina, 31% vs. 47%; *P*<0.001)

Toth G, et al. Circulation 2013

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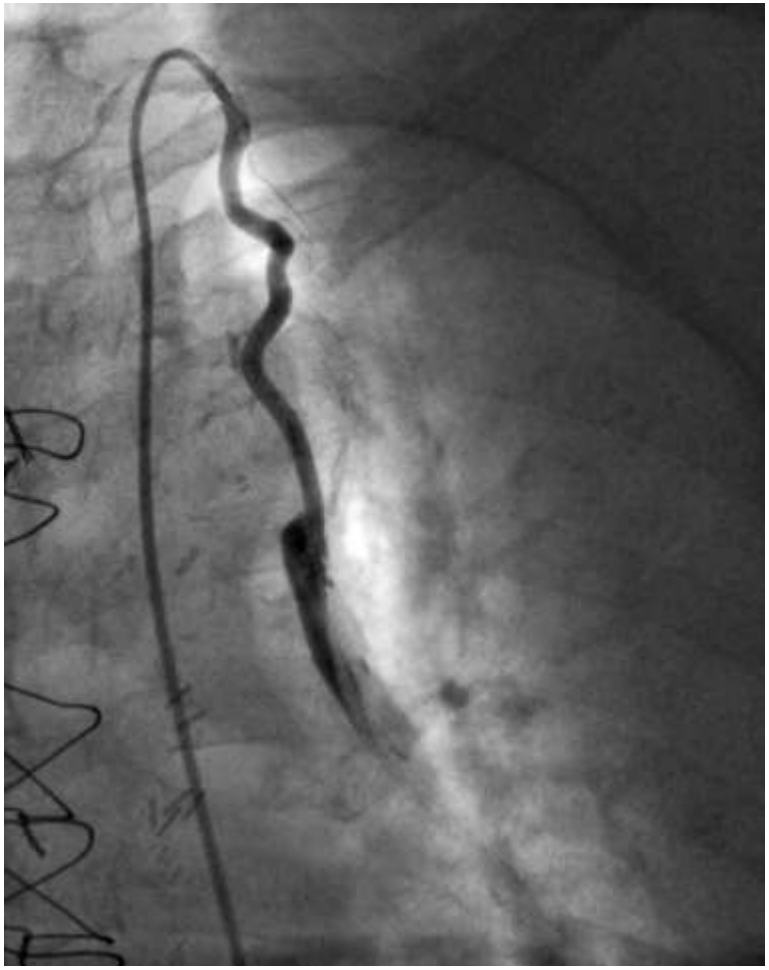
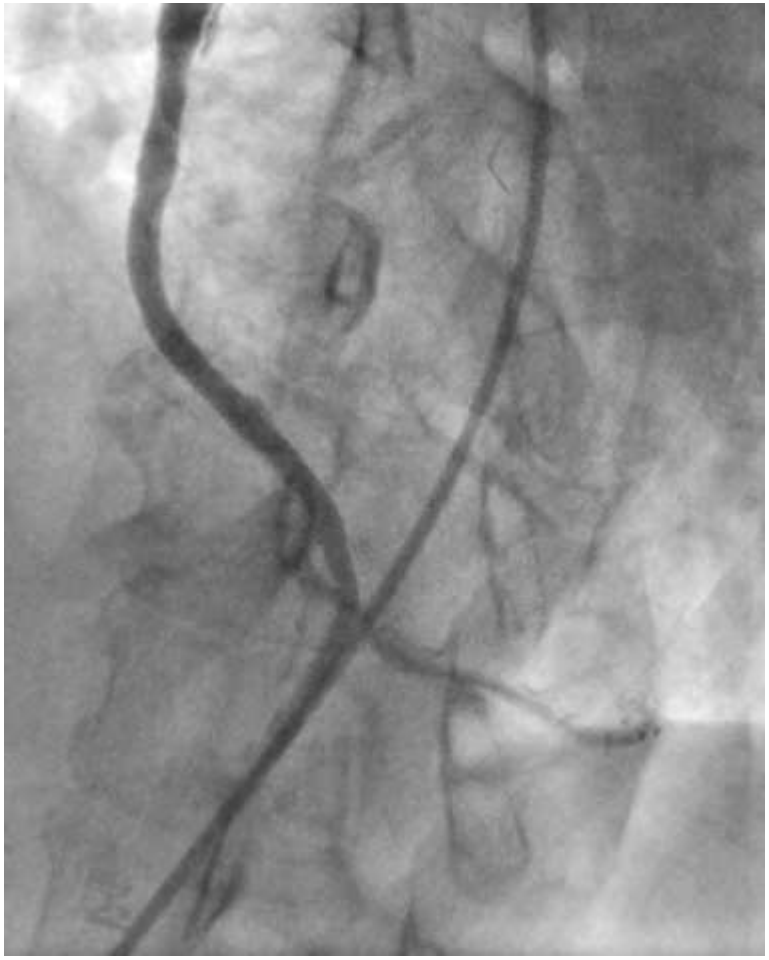
What happened to the graft?

F/73
CABG 10 years ago (LITA-SVG to LAD, RITA Y-graft to OM)
Recurred chest pain





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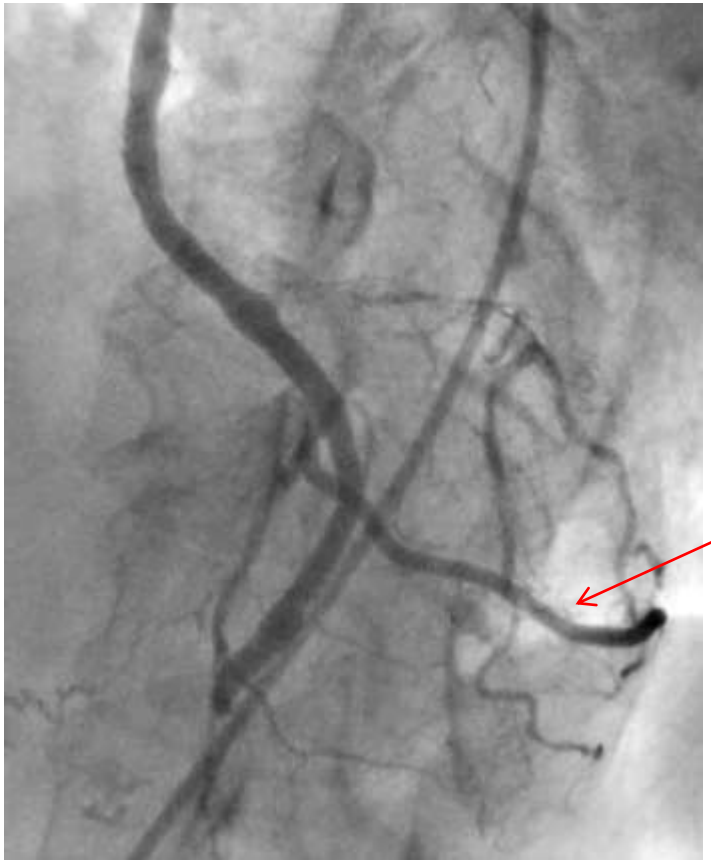
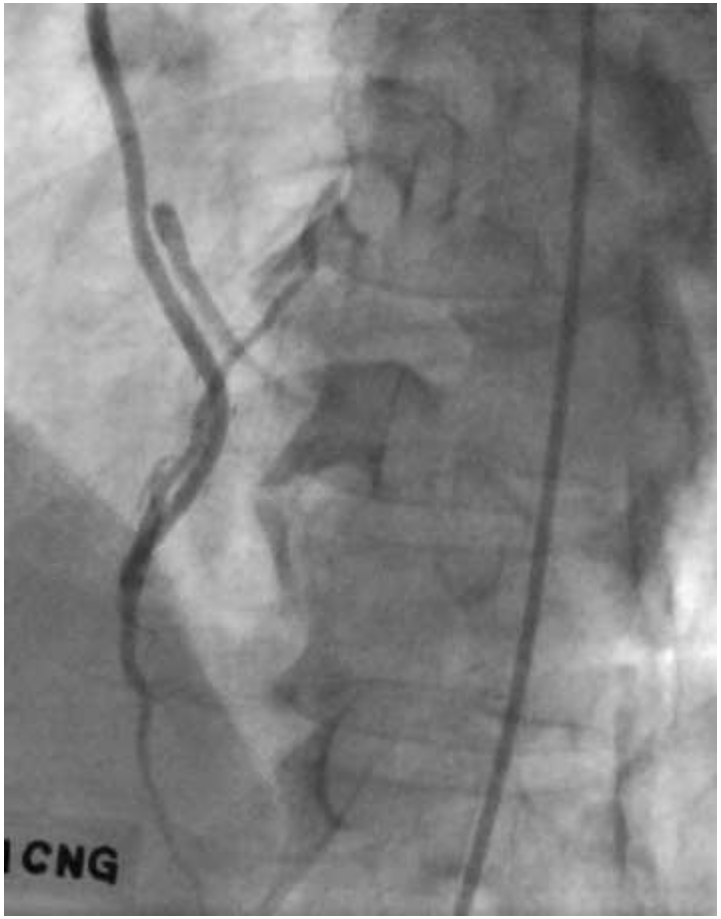
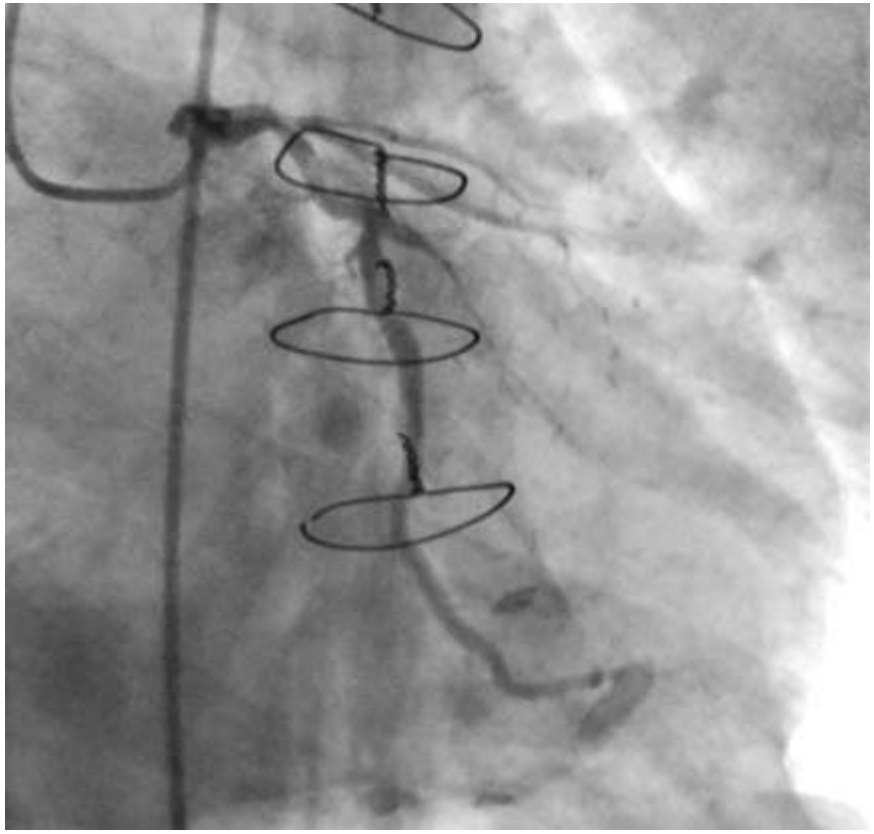


Is perfusion to PL branch enough?

M/61 Asymptomatic, routine 1 year f/u angiography after bypass surgery
: LITA-LAD, Saphenous vein Y-graft to Dg-OM-LCX-PL)





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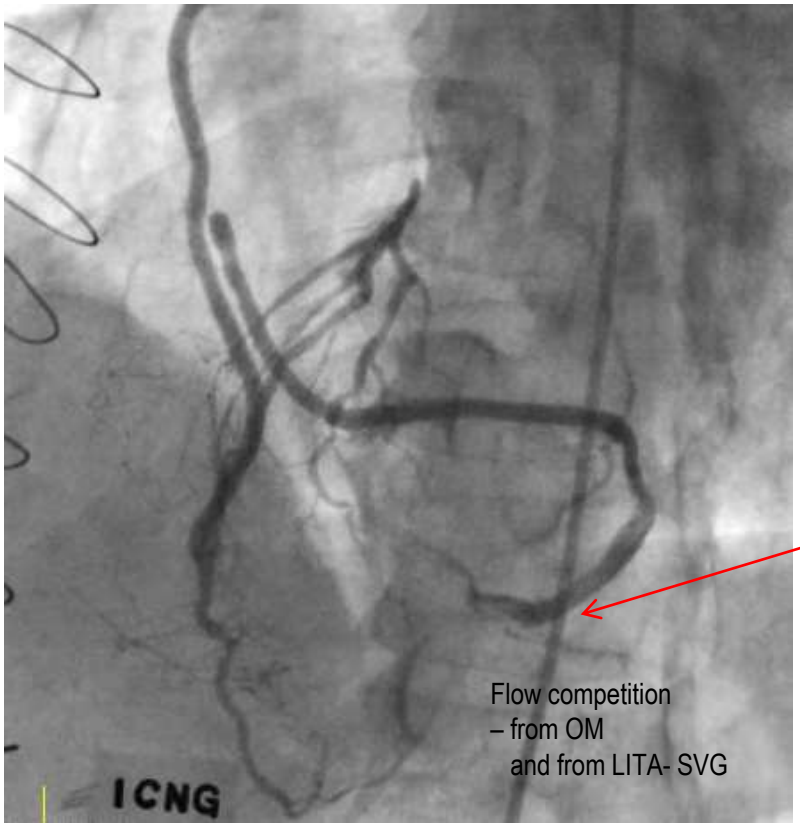

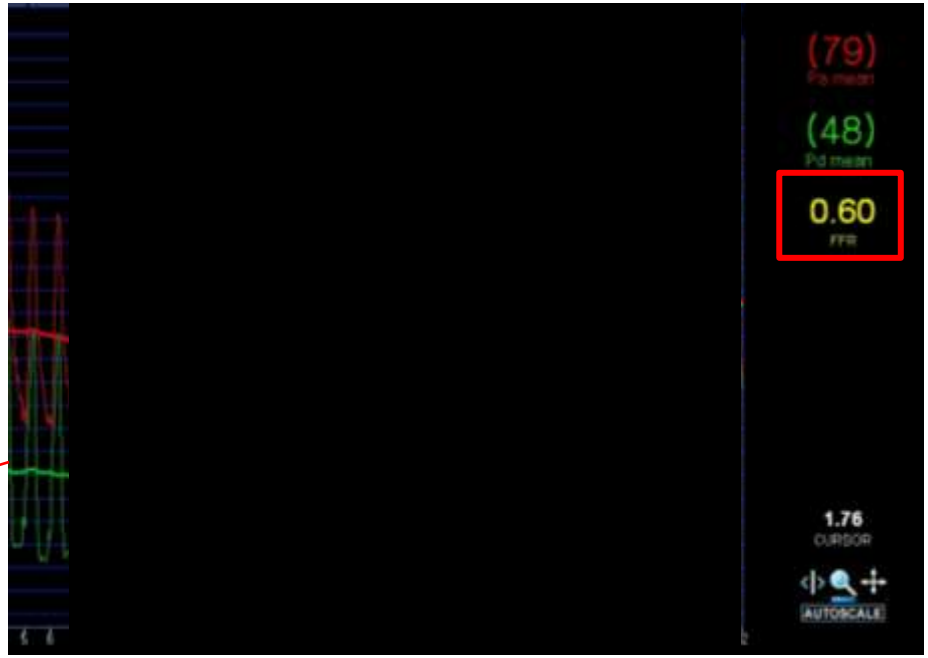

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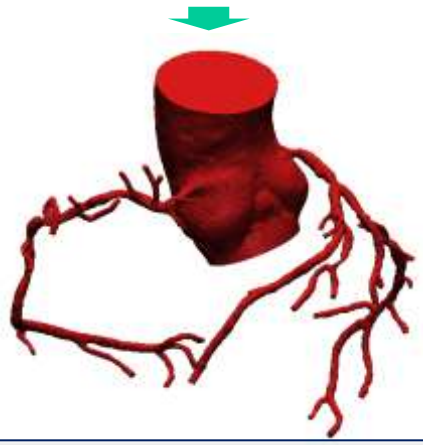
FFR without invasive procedure, without pressure wire…

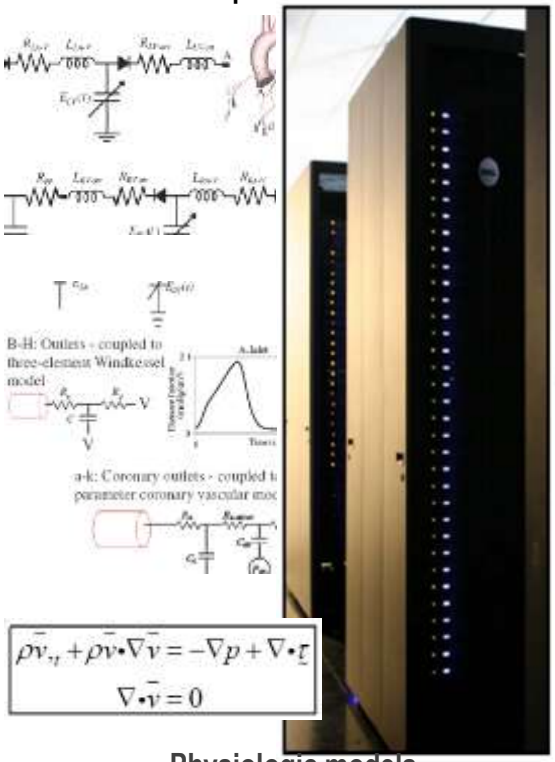
Computational Model based on CCTA

3-D anatomic model from CCTA



Blood Flow Solution

Blood flow equations solved on supercomputer



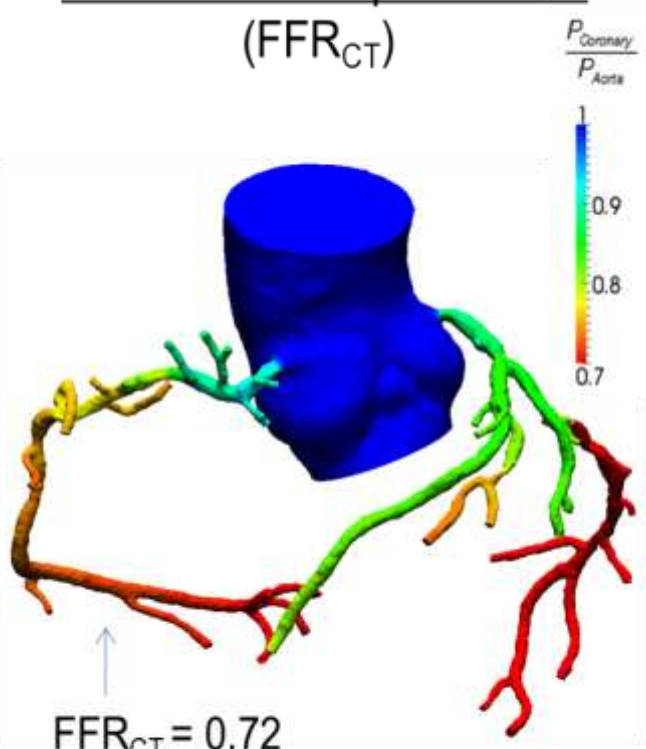
Physiologic models

-Myocardial demand

-Morphometry-based boundary condition

-Effect of adenosine on microcirculation

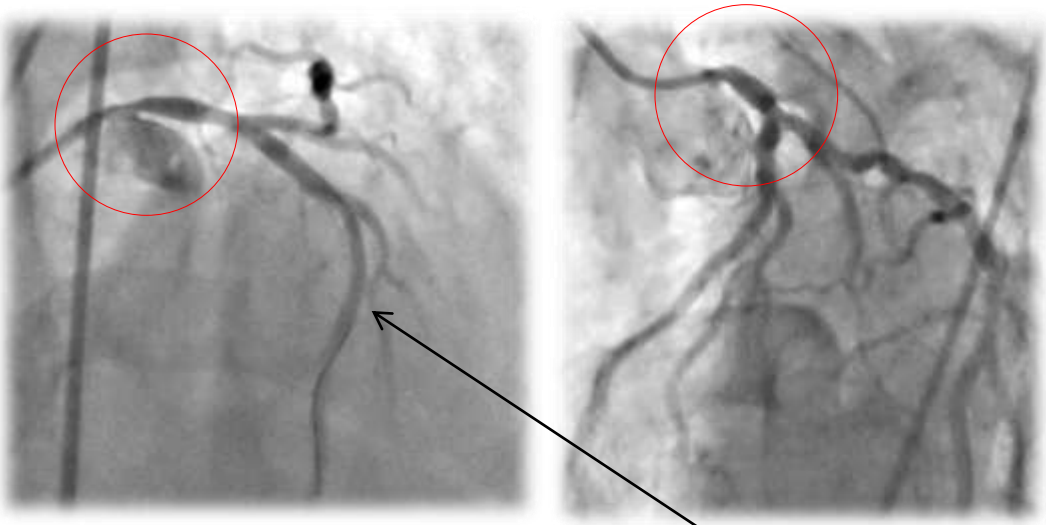
CT-derived computed FFR (FFR_{CT})

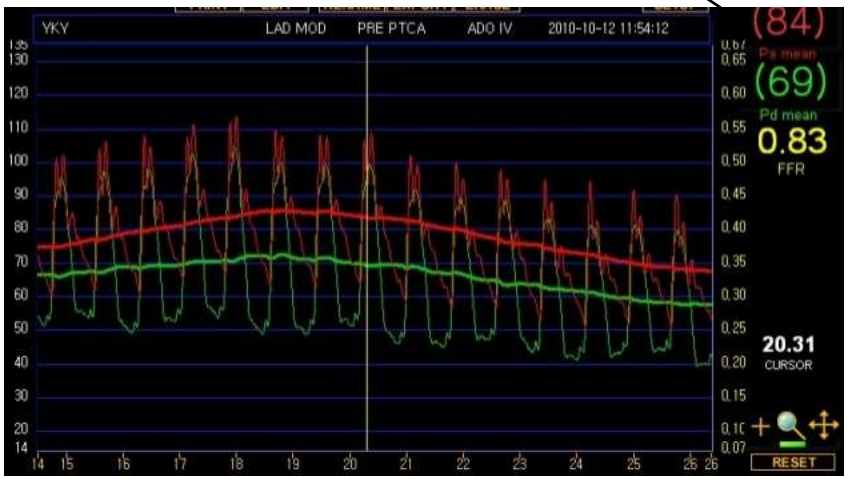


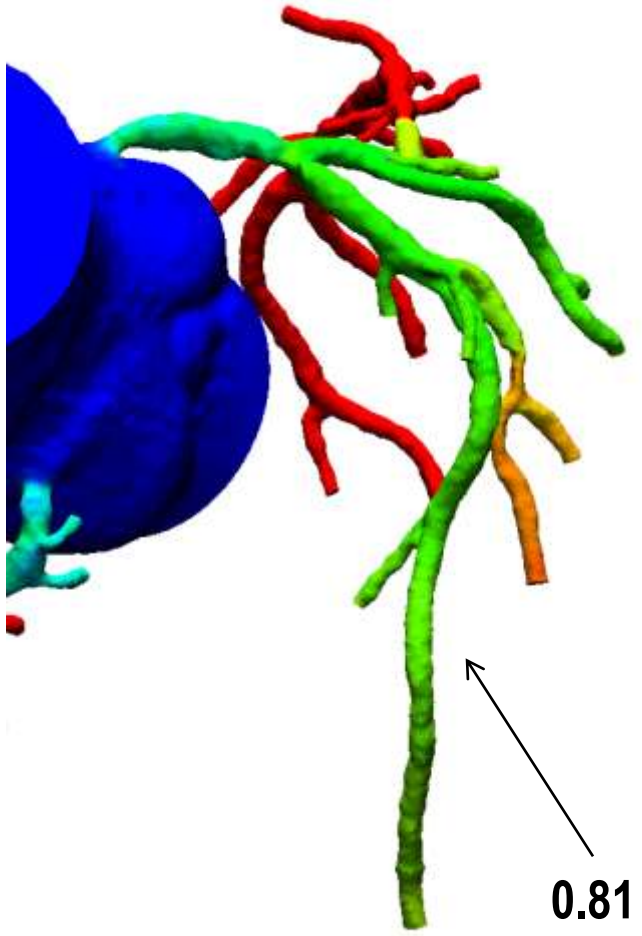
FFR_{CT} = 0.72
(can select any point on model)

Ambiguous left main lesions

(Case #77 from SNUH, Korea)





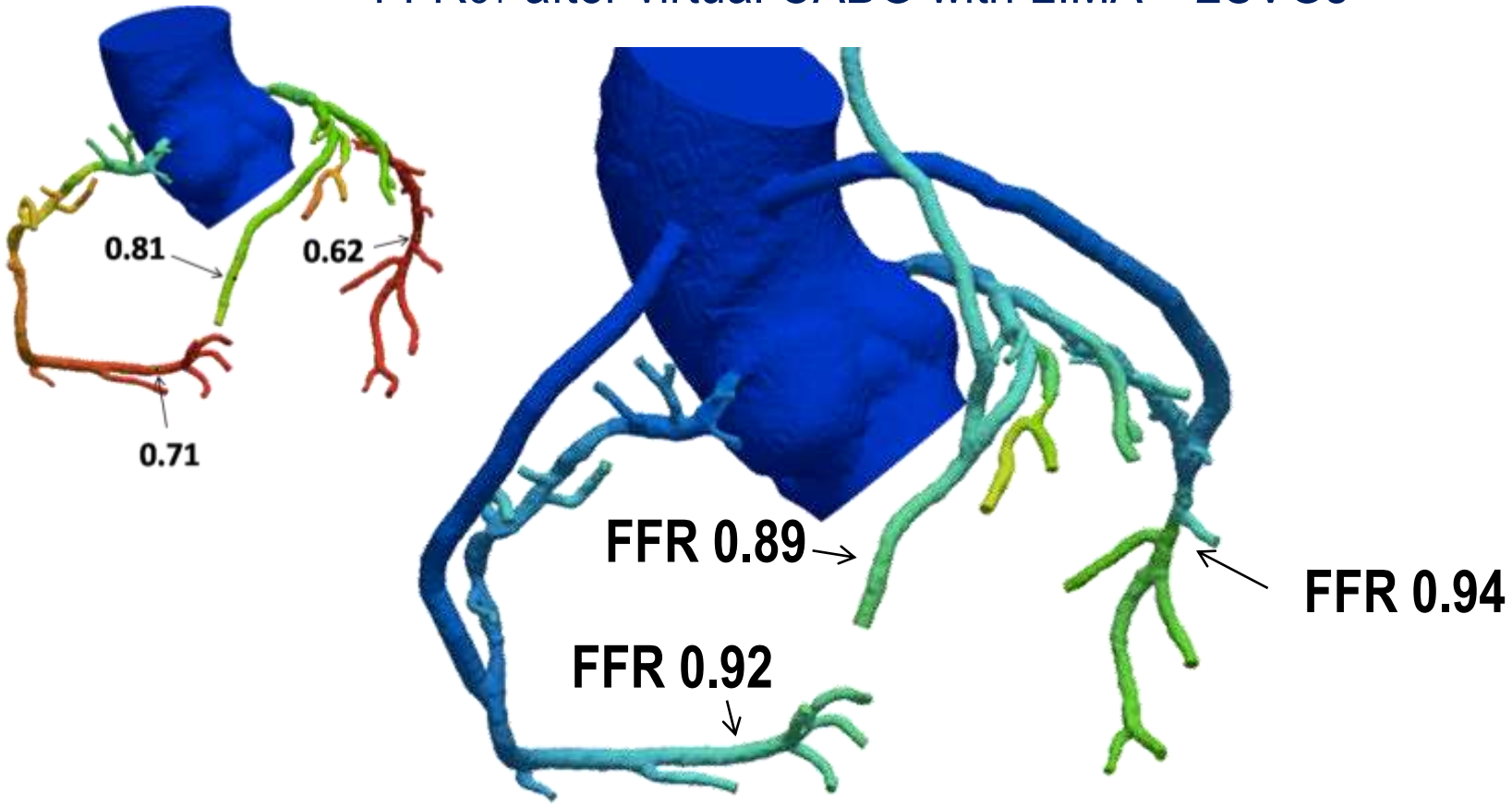


Ambiguous left main lesions

(Case #77 from SNUH, Korea)

Virtual bypass surgery

FFR$_{CT}$ after virtual CABG with LIMA + 2SVGs



Koo BK, EuroPCR 2012

Conclusion

- Functional significance of a stenosis is a key element in the assessment of the patients with coronary artery stenosis.
- FFR is the gold standard invasive method to define ischemia-causing stenosis.
- FFR is still evolving. **More adoption of "ischemia-guided revascularization"** using FFR will improve the patients' outcomes.