

CT-Derived FFR for All Coronary Lesions

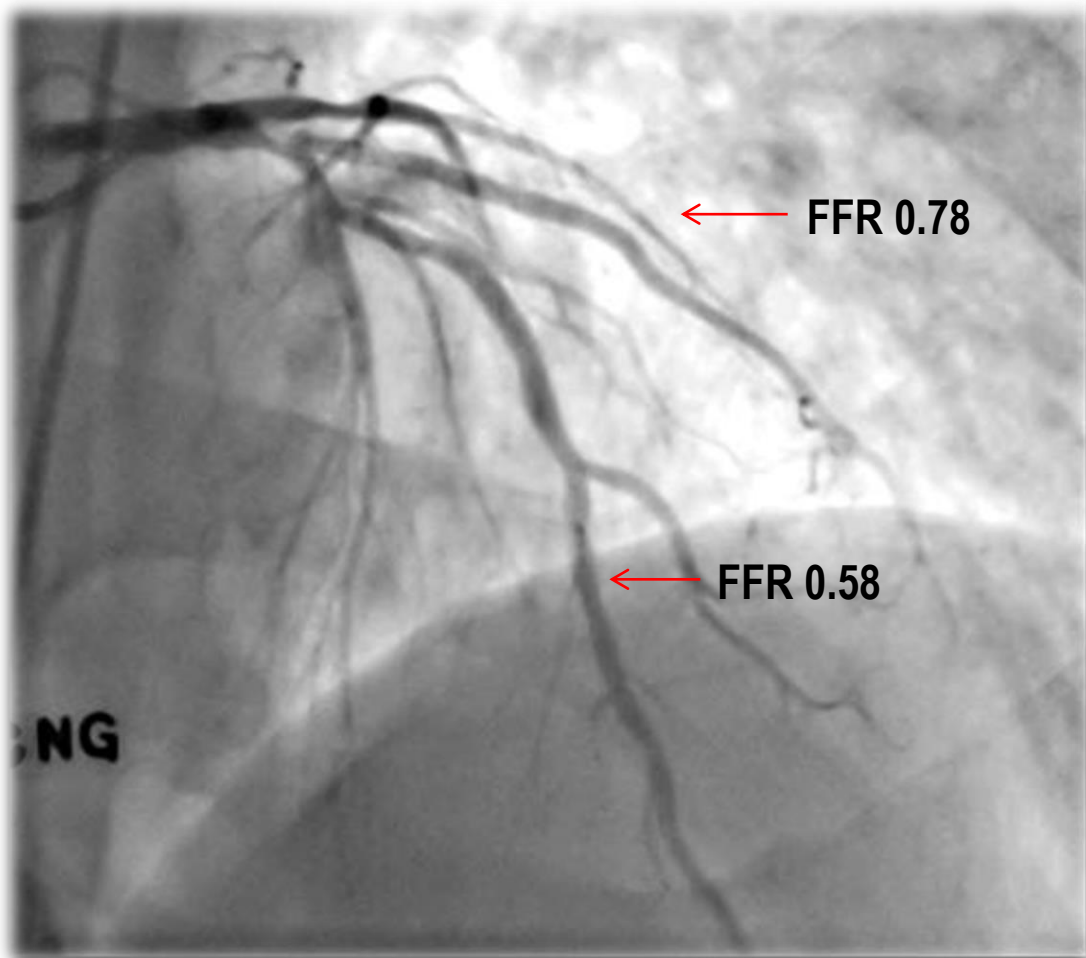
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Is it possible to assess hemodynamics from static images ?

15 years ago, in the cath lab.....



FFR,
Without invasive procedure, pressure wire, adenosine

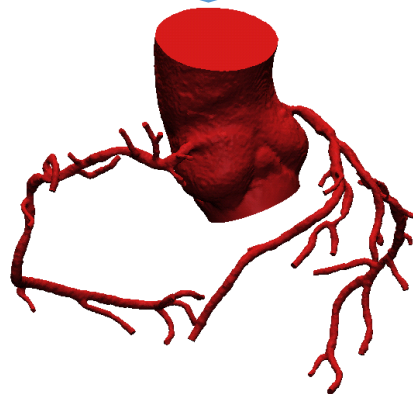
Patient-specific non-invasive FFR using CT & CFD

Computational Model based on CCTA

3-D anatomic model from CCTA

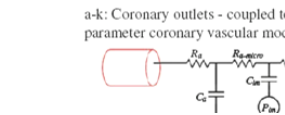
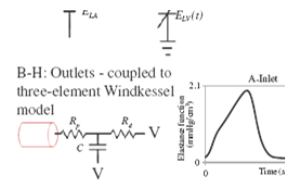
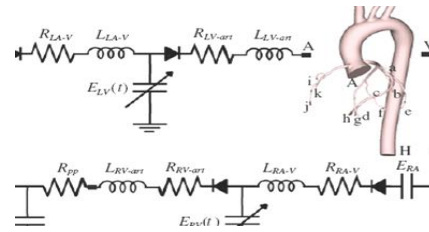


No additional imaging
No additional medications



Blood Flow Solution

Blood flow equations solved on supercomputer



$$\rho \bar{v}_{,t} + \rho \bar{v} \cdot \nabla \bar{v} = -\nabla p + \nabla \cdot \bar{\tau}$$

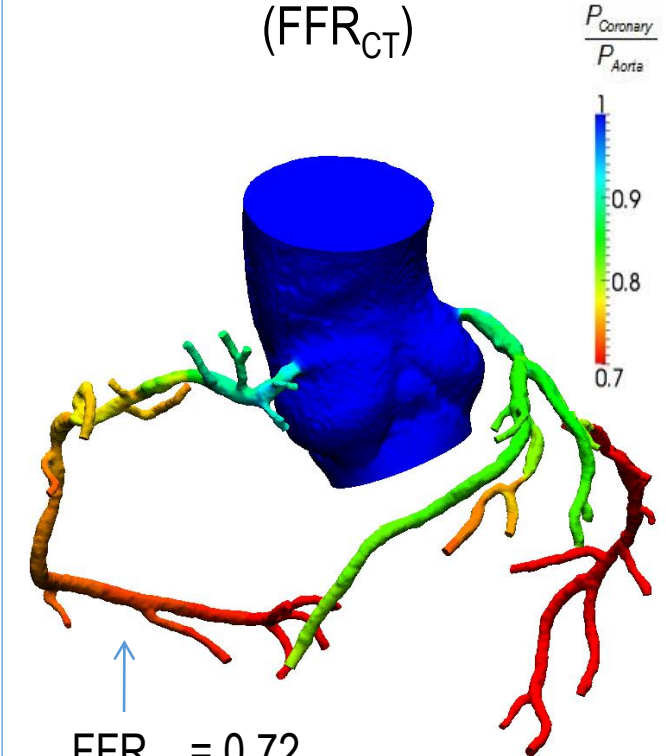
$$\nabla \cdot \bar{v} = 0$$



Physiologic models

- Myocardial demand
- Morphometry-based boundary condition
- Effect of adenosine on microcirculation

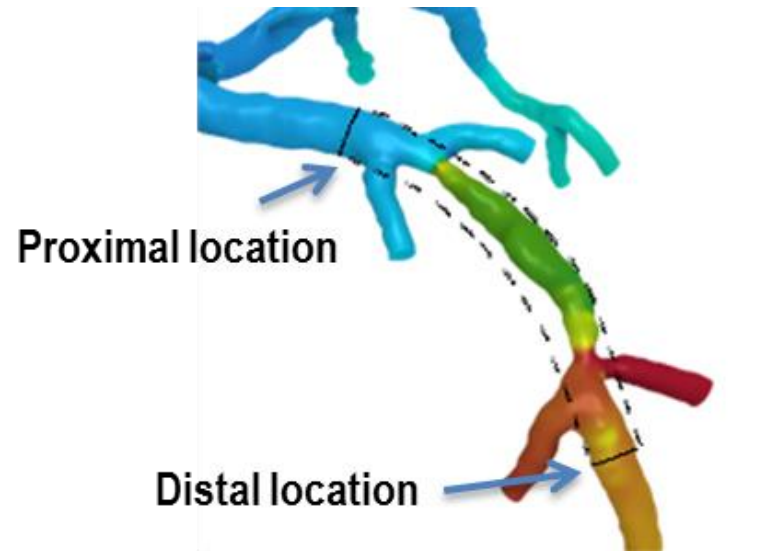
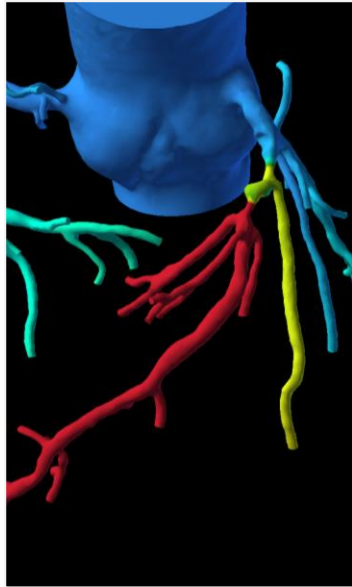
CT-derived computed FFR (FFR_{CT})



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

FFR_{CT} for the treatment of ischemic heart disease

Planning the treatment strategy using Virtual revascularization & FFR_{CT}



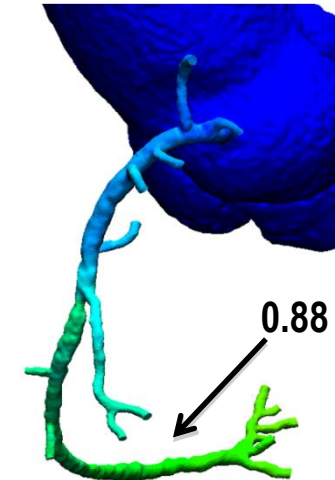
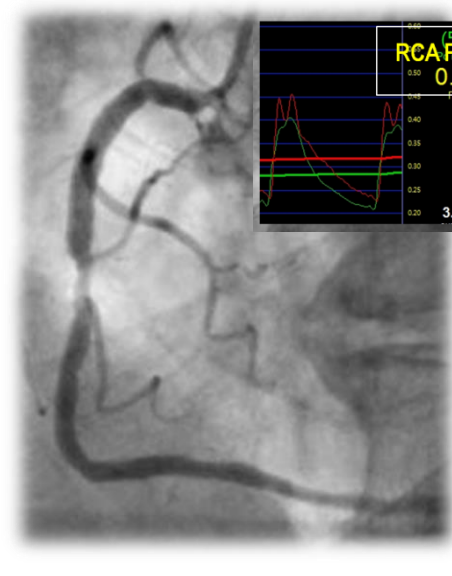
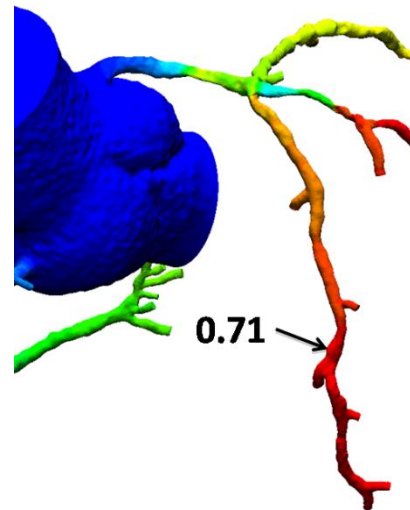
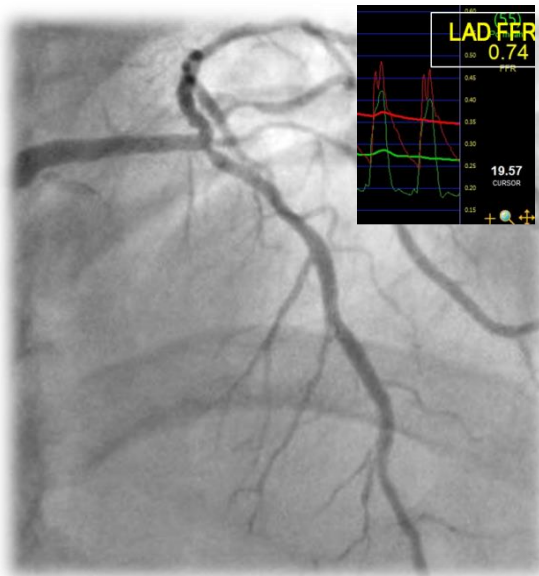
FFR_{CT} in for ALL coronary lesions

- **Multivessel disease**
- Left main disease
- Ostial disease
- Serial stenoses

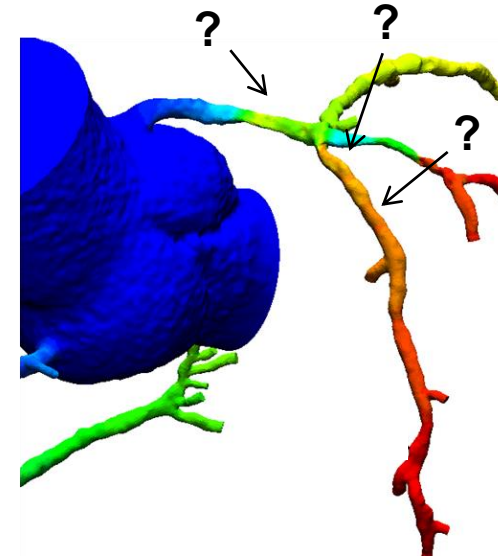
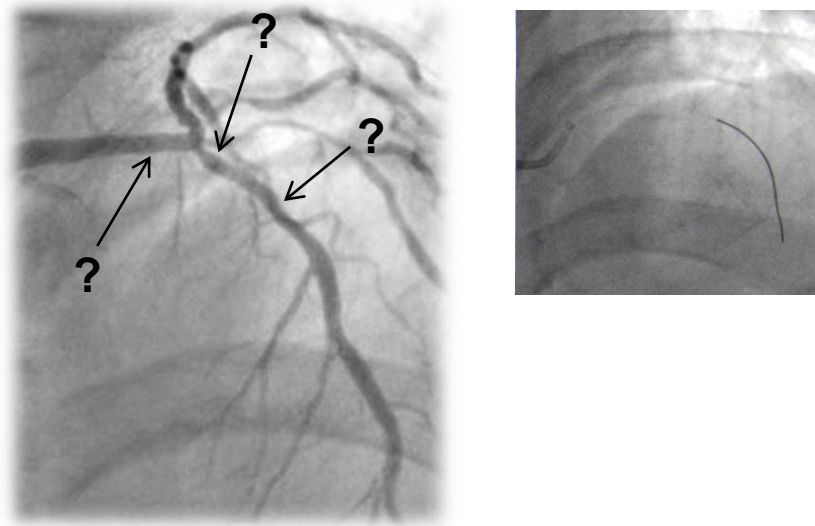
Which lesion needs revascularization? LAD? RCA? Both?

M/63 Stable angina

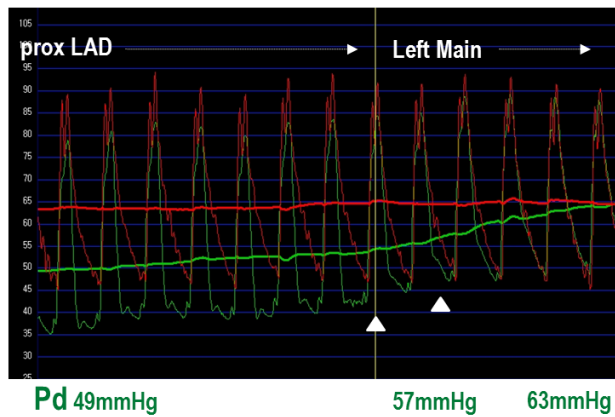
Risk factors: Hypertension, Hypercholesterolemia



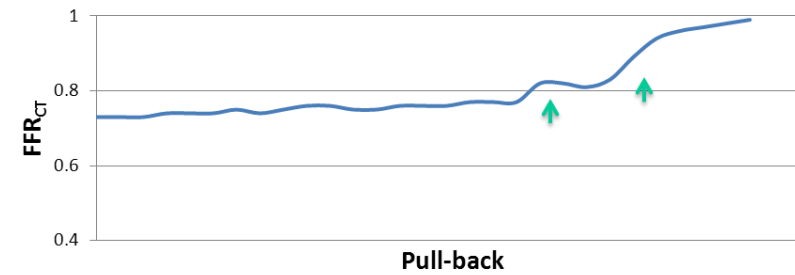
What is the best treatment plan for this patient?



Pressure pull-back tracing



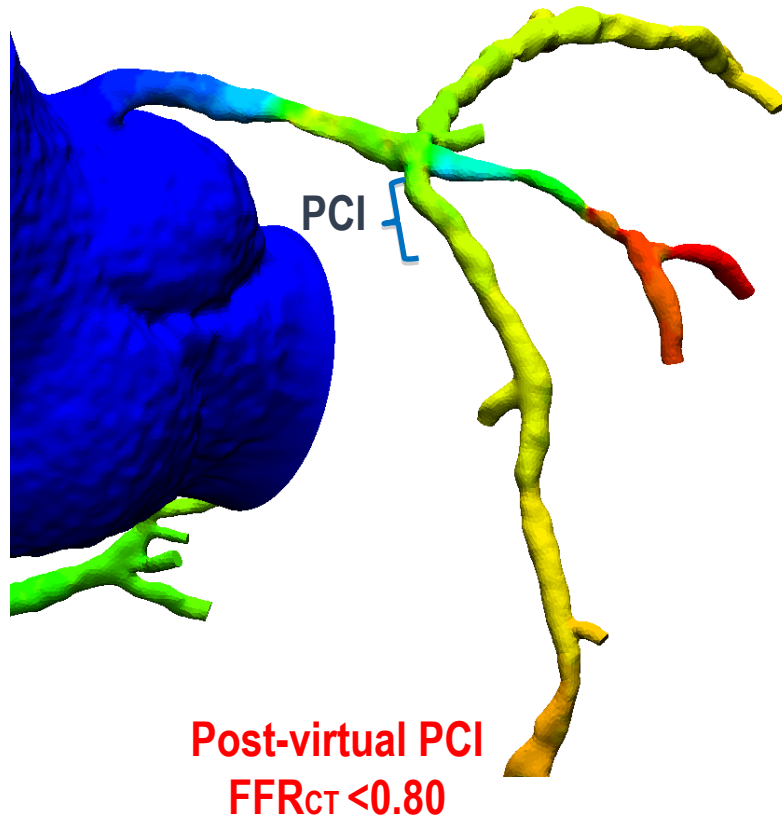
FFR_{CT} Pull-back



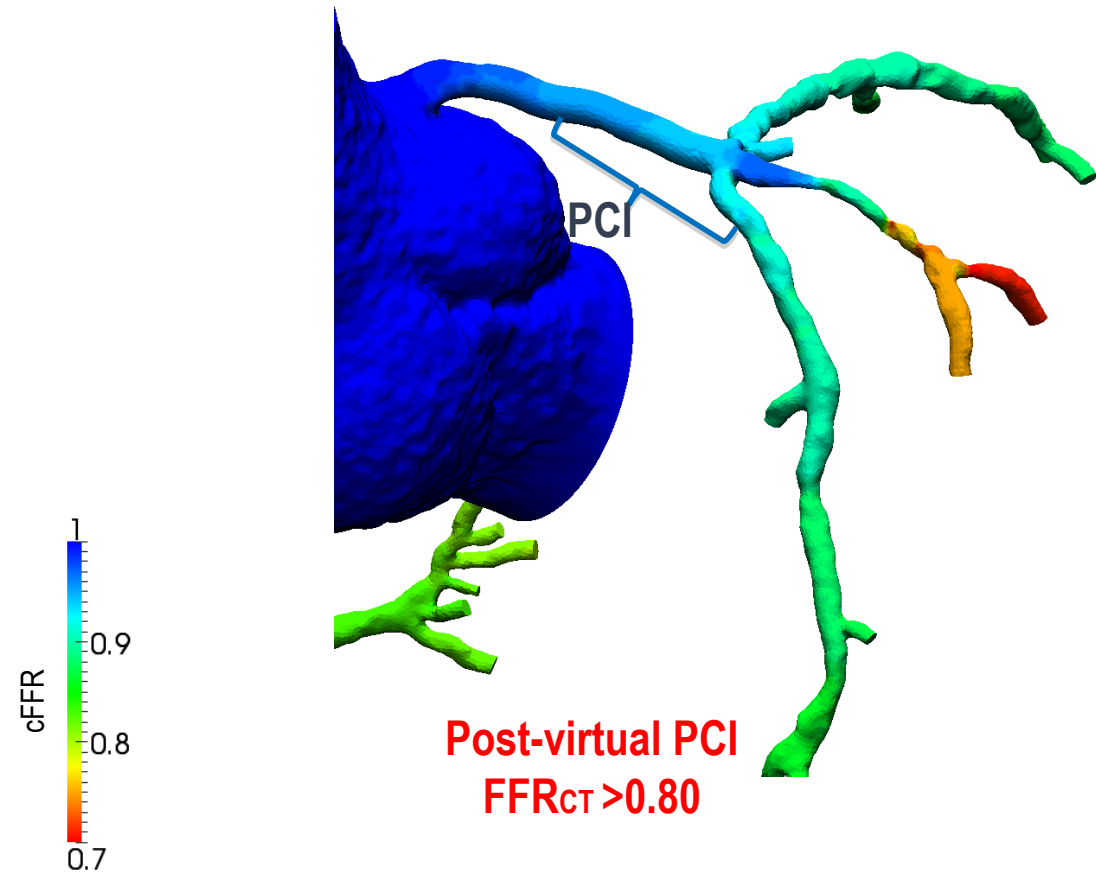
Treatment planning prior to invasive procedures

Virtual PCI and post-PCI FFR_{CT}

After LAD os PCI



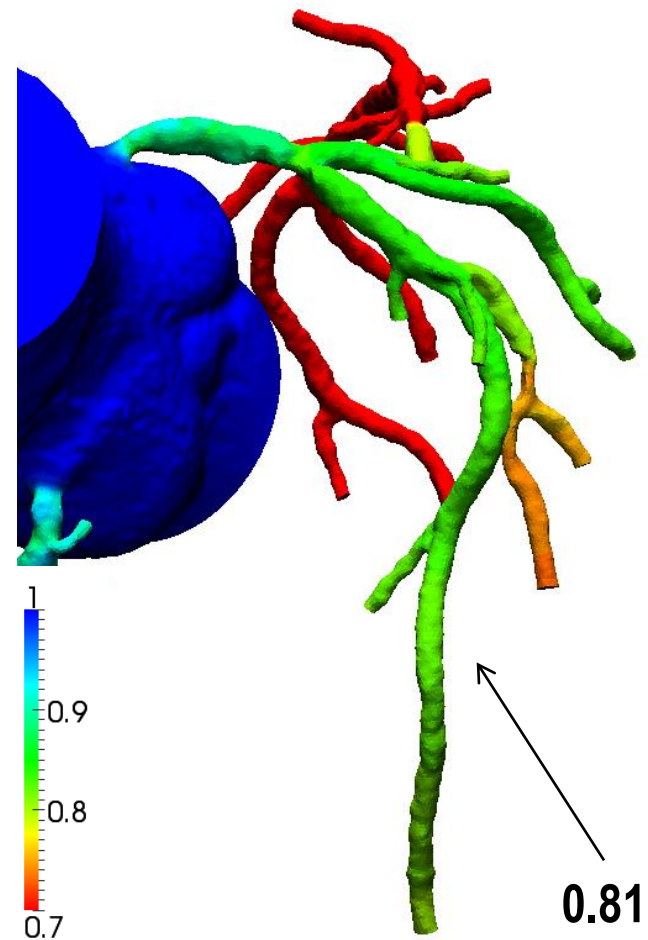
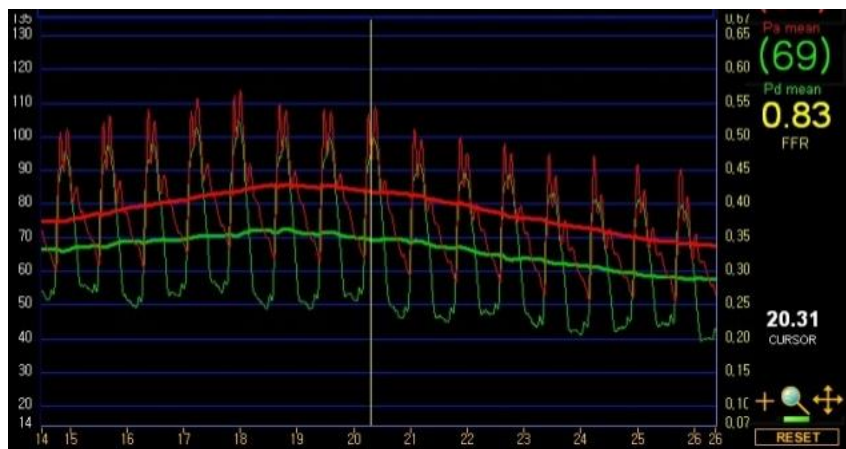
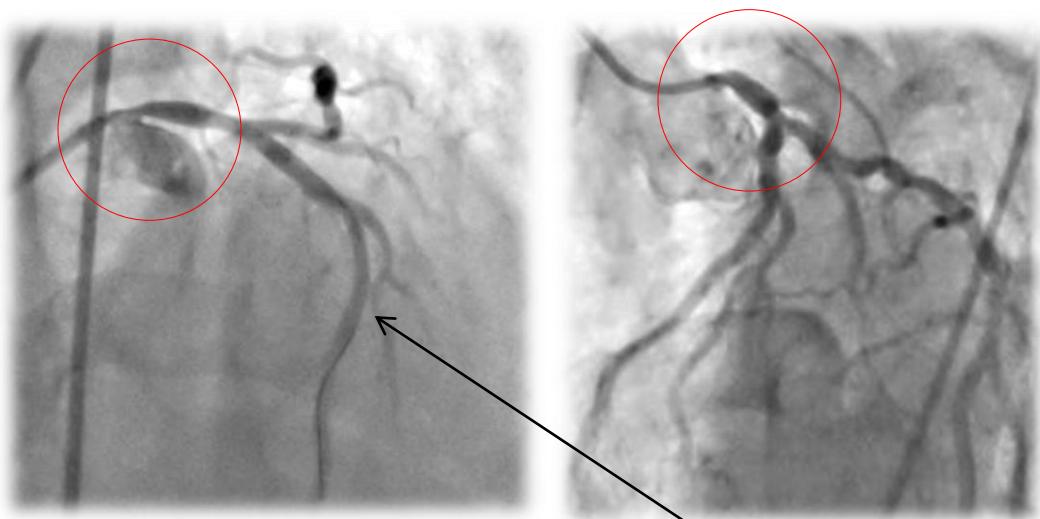
After Left main and LAD os PCI



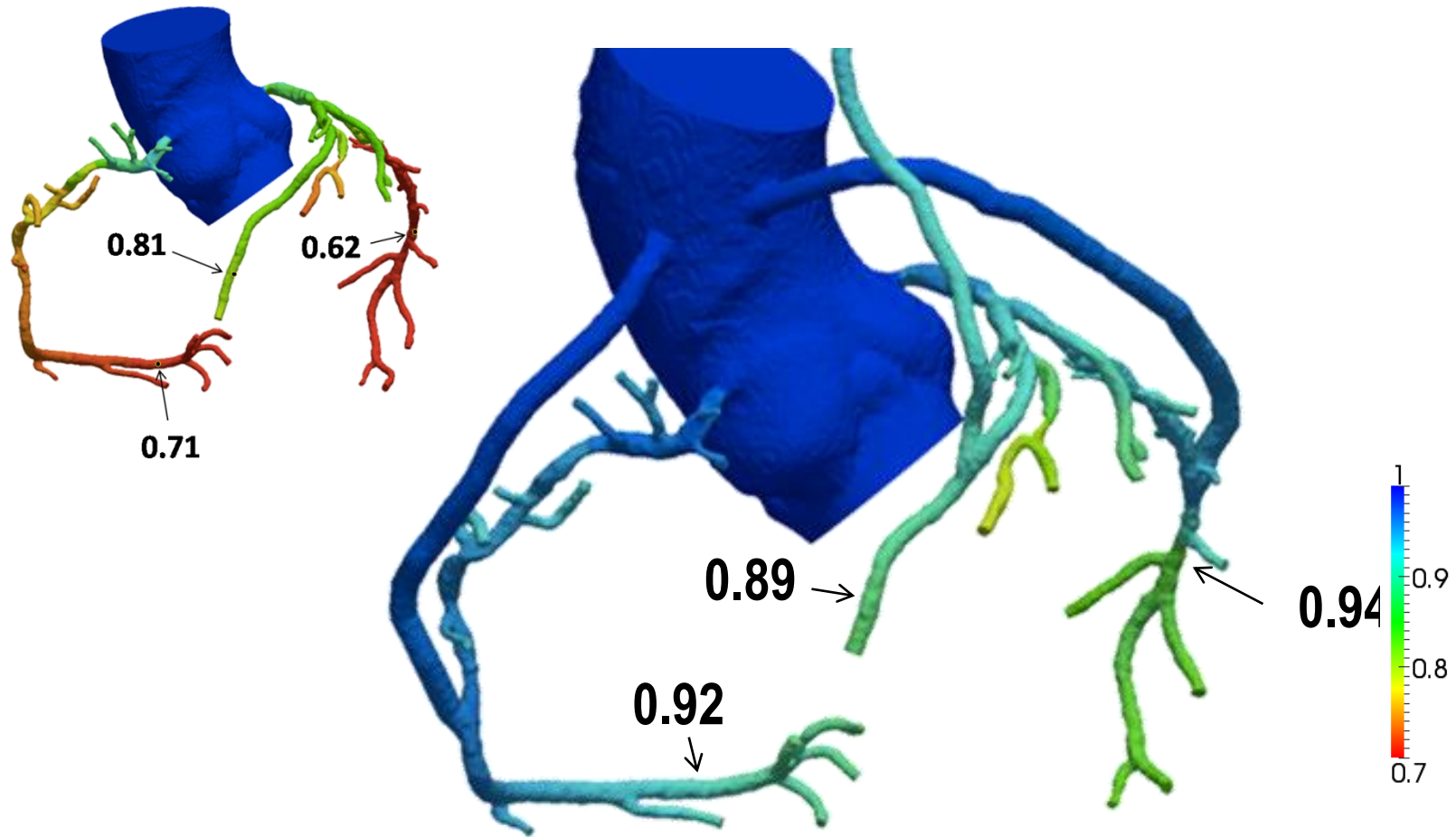
FFR_{CT} in for ALL coronary lesions

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- **Left main disease**
- Ostial disease
- Serial stenoses

Intermediate left main lesion



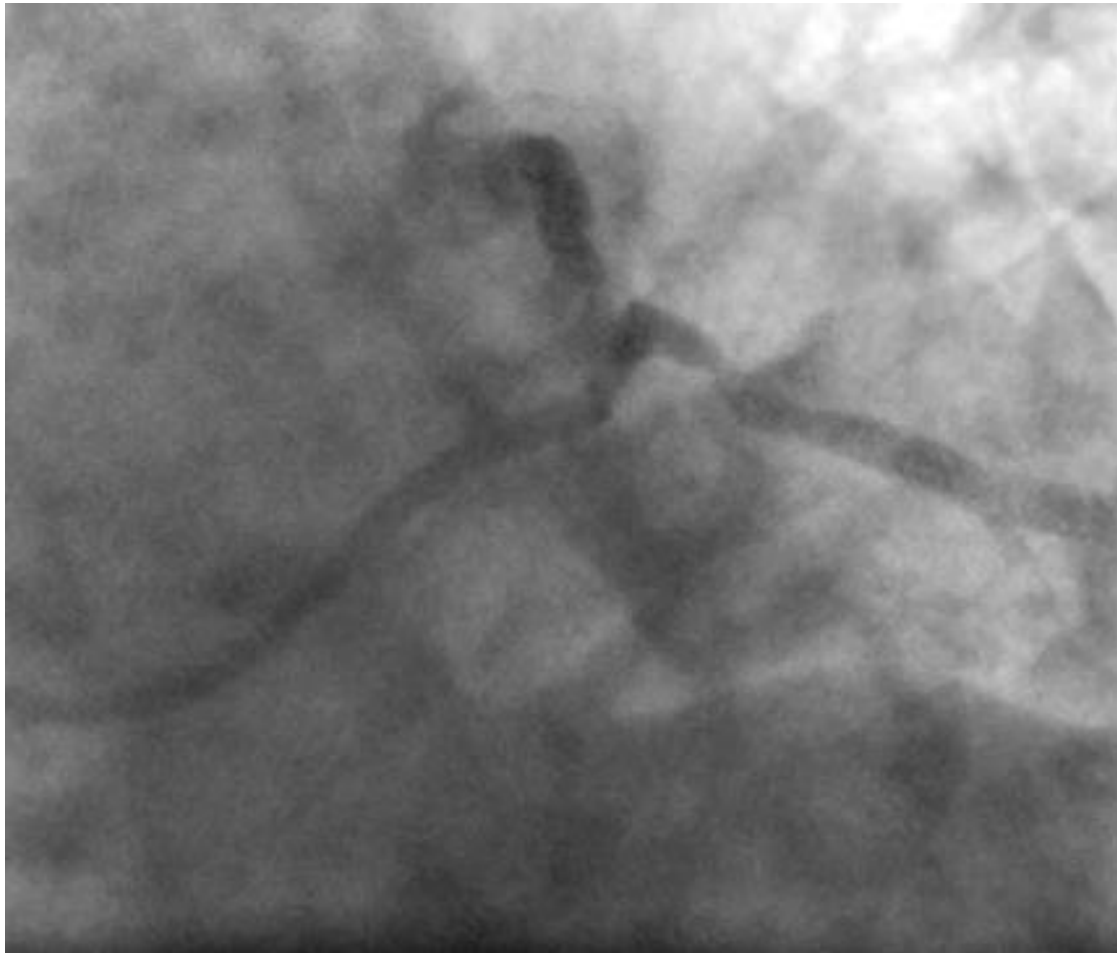
Virtual CABG with LIMA + 2SVGs



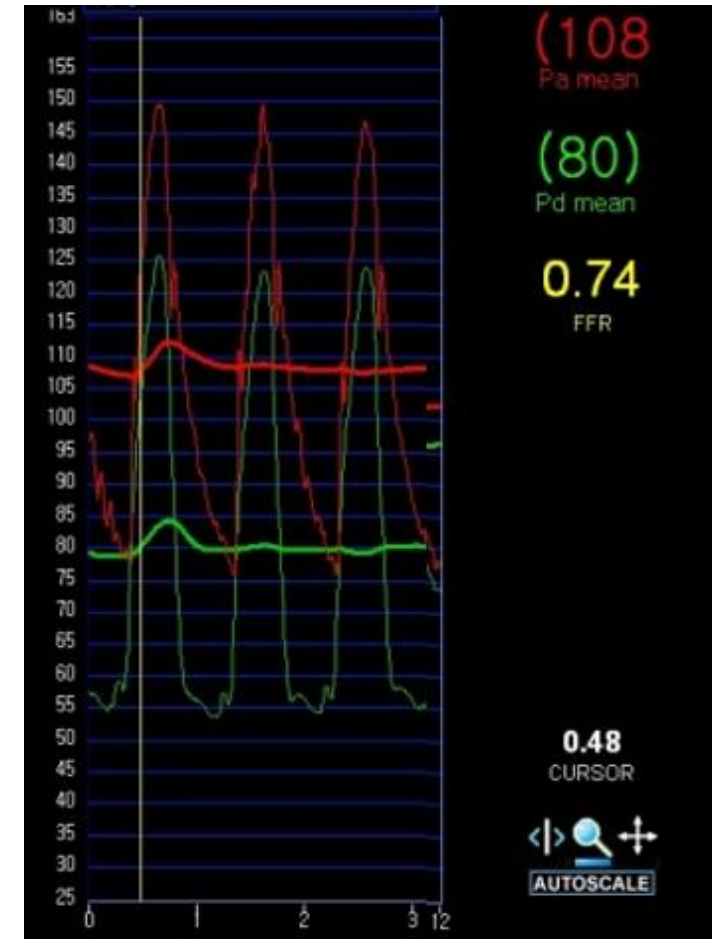
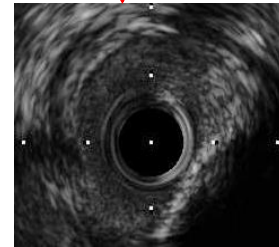
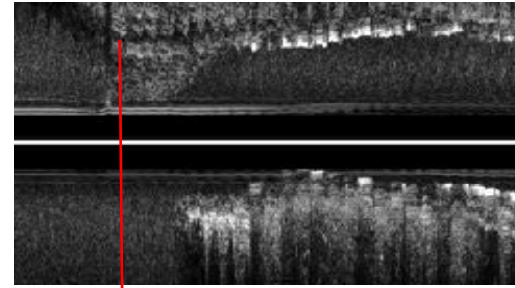
Koo BK, EuroPCR 2012

FFR_{CT} in for ALL coronary lesions

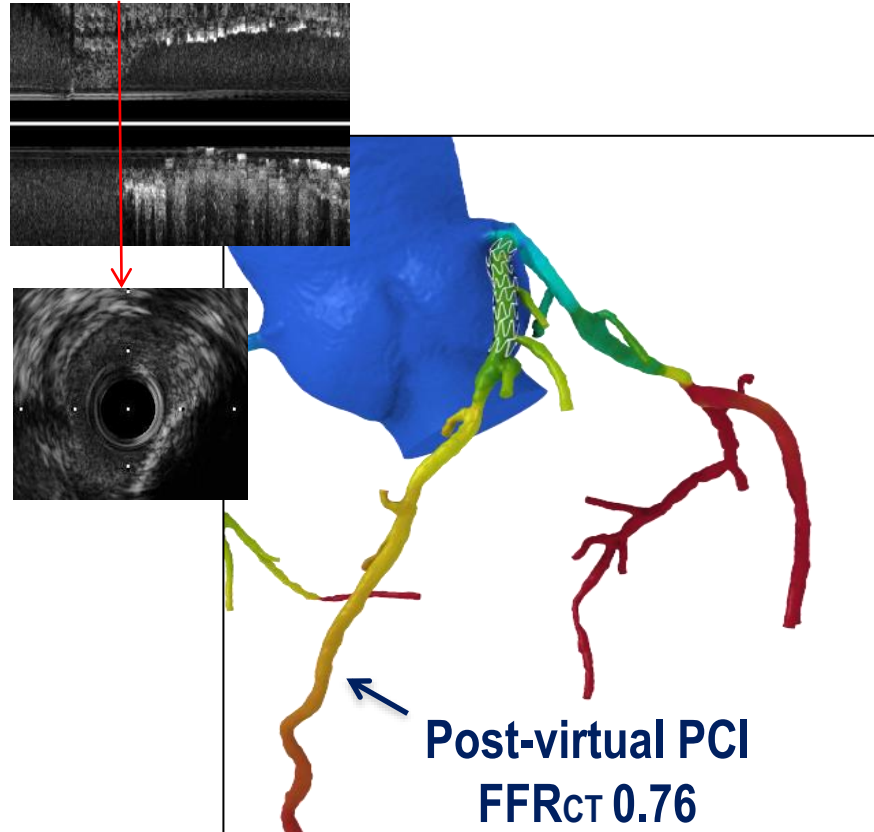
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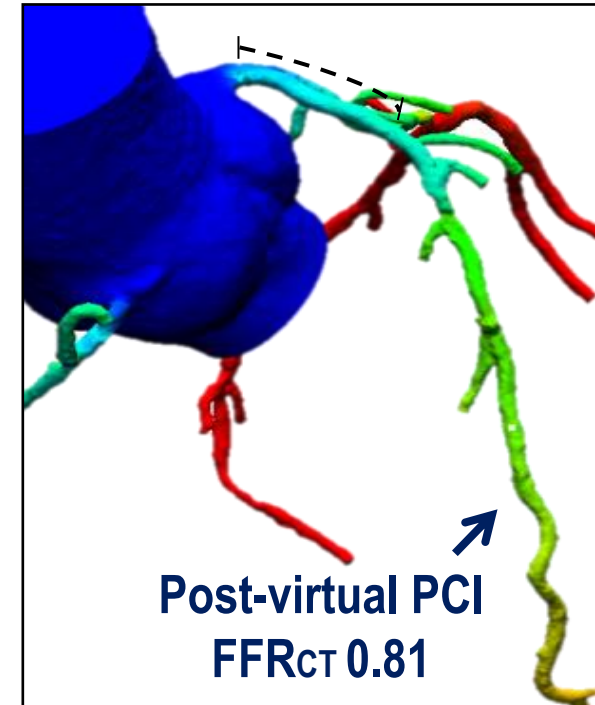
After Stenting of proximal LAD lesion



Cover LAD os or not, that's the question.....



Residual ostial stenosis+



Stenting across the ostial lesion

FFR_{CT} in for ALL coronary lesions

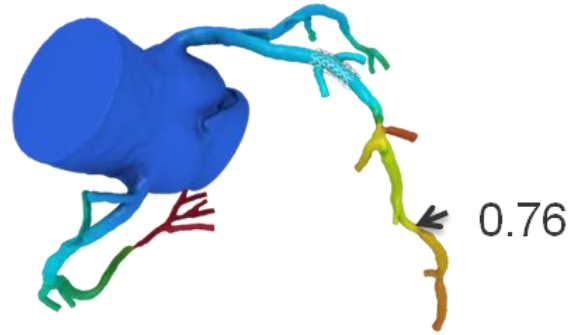
- Multivessel disease
- Left main disease
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Before Stenting

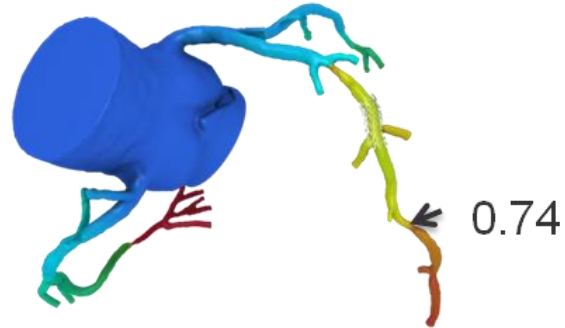
After Stenting

A

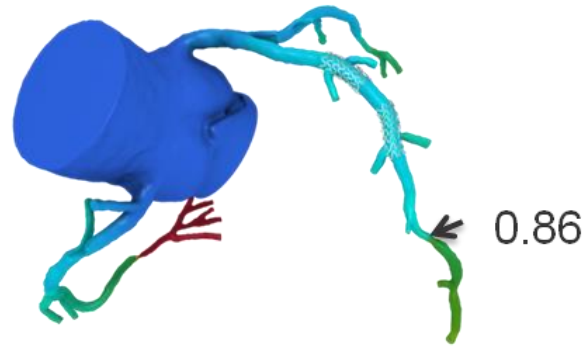
Stent proximal lesion only



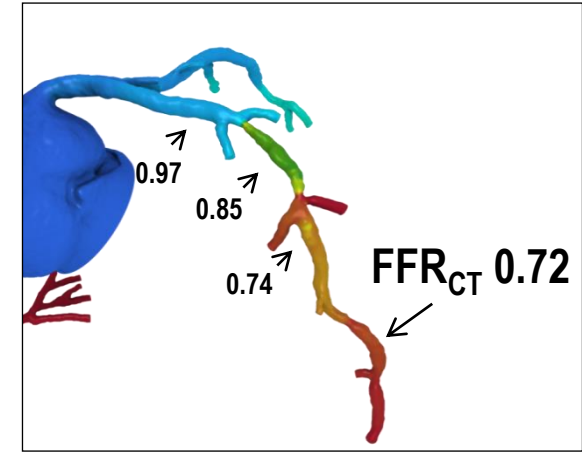
Stent distal lesion only



Stent both



CT-derived computed FFR (FFR_{CT})

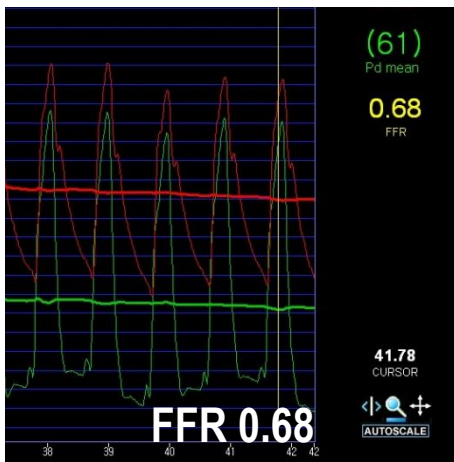


Before Stenting

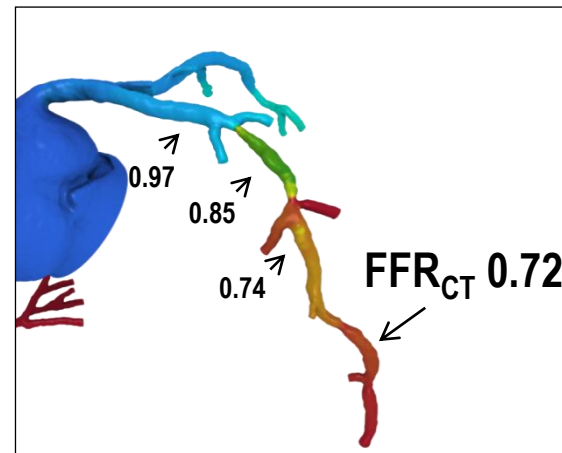
Angiography



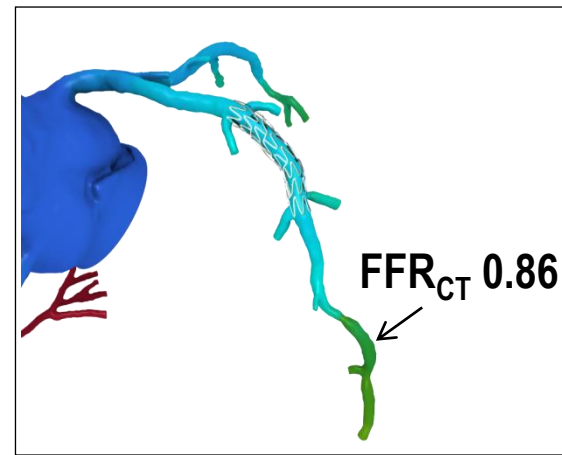
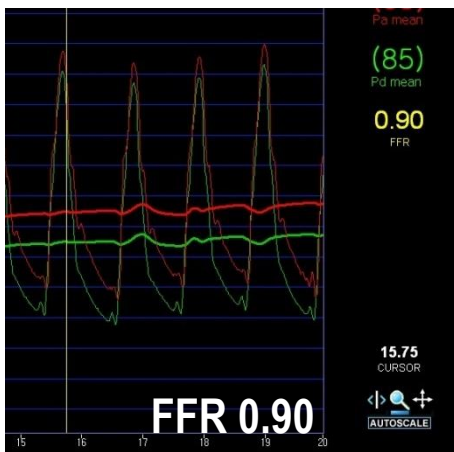
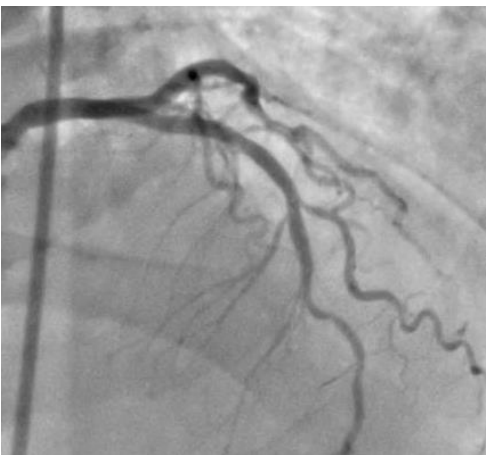
Invasive FFR



CT-derived computed FFR (FFR_{CT})



After Stenting



M/67 Crescendo angina



Lesions in pLAD, LCX os and distal LCX

If LCX ostial lesion is functionally significant,

→ Bypass surgery

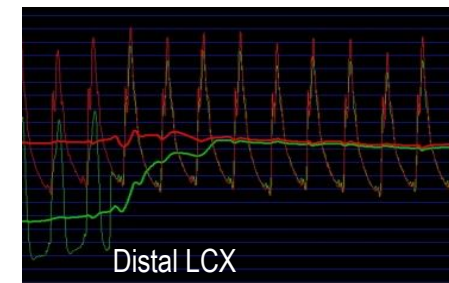
or Complex intervention for LM-LCX and stenting for pLAD and distal LCX.

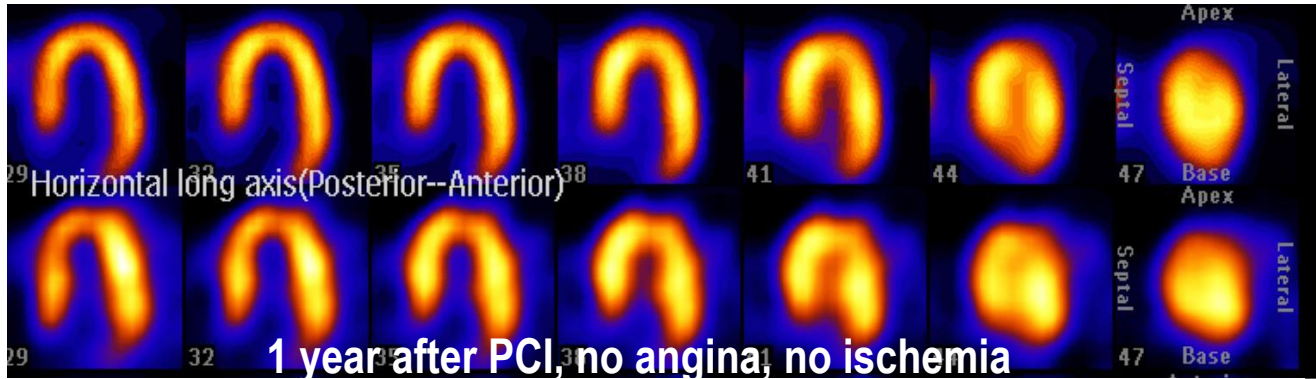
If not,

→ Simple stenting for LAD and distal LCX lesions

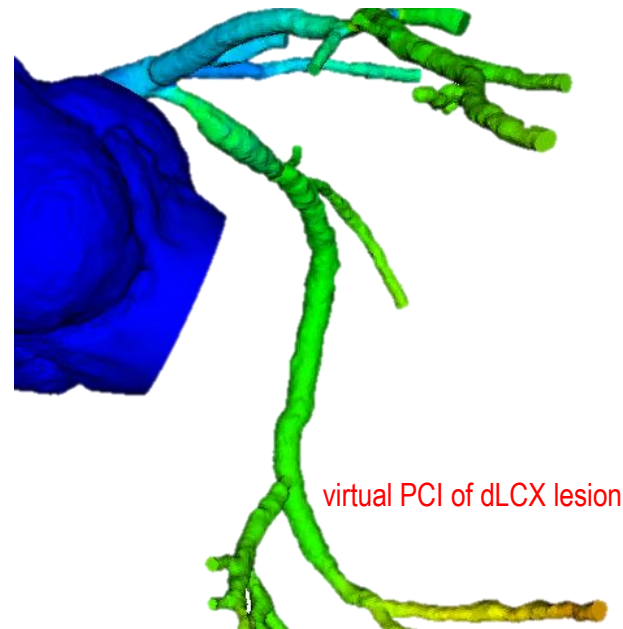
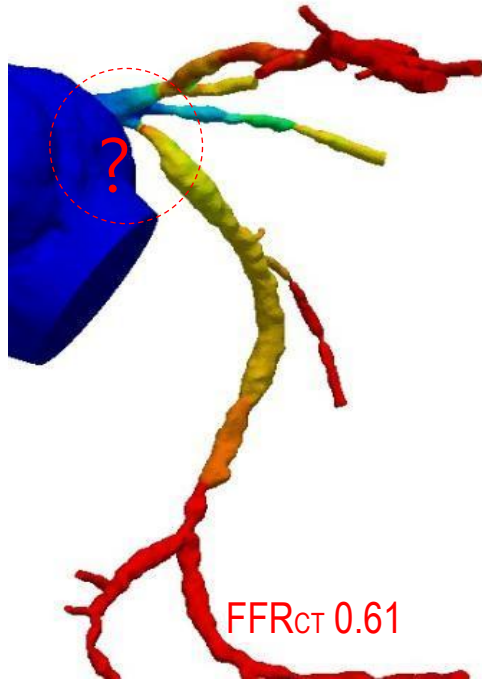
How to assess the functional significance of LCX ostial lesion?

1. Pullback pressure tracing
2. **PCI of largest step up (distal LCX lesion)**
3. Re-measure FFR at LCX

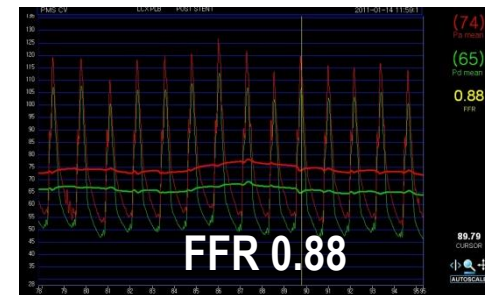
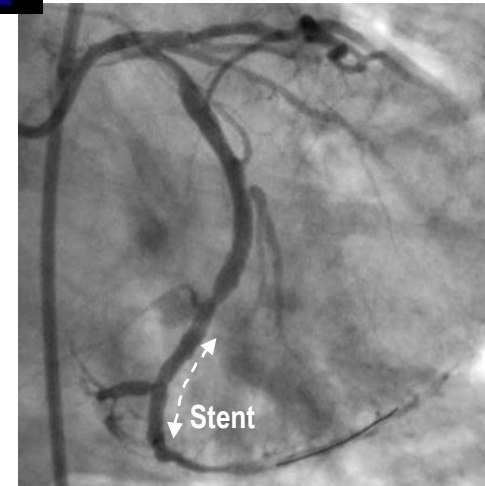




Virtual stenting and



Post virtual-stent FFR_{CT}: 0.83



CT-derived FFR for All coronary Lesions?

: Not for “ALL” lesions, but for “MOST” lesions, FFR_{CT} is useful in defining the ischemia-causing stenosis and planning the treatment strategy.