Focus review: FFR guided PCI

John McB. Hodgson, M.D.

ANGIOPLASTY SUMMIT
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Disclosure Information

John McB. Hodgson MD, FSCAI

The following relationships exist related to this presentation:

Grant support (GS), consultant (C), speakers bureau (SB), stock options (SO), equity interest (EI):

St. Jude/RADI, Boston Scientific, Volcano: GS
Volcano : SB
Technology Solutions Group: EI

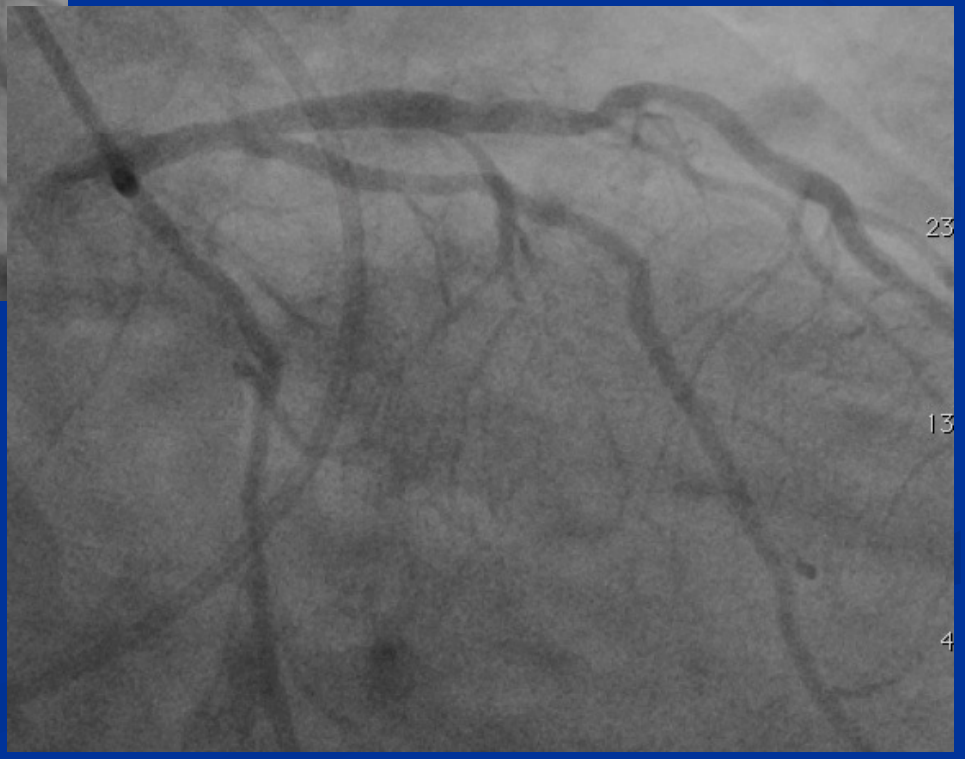
Off label use of products will not be discussed in this presentation.

JB

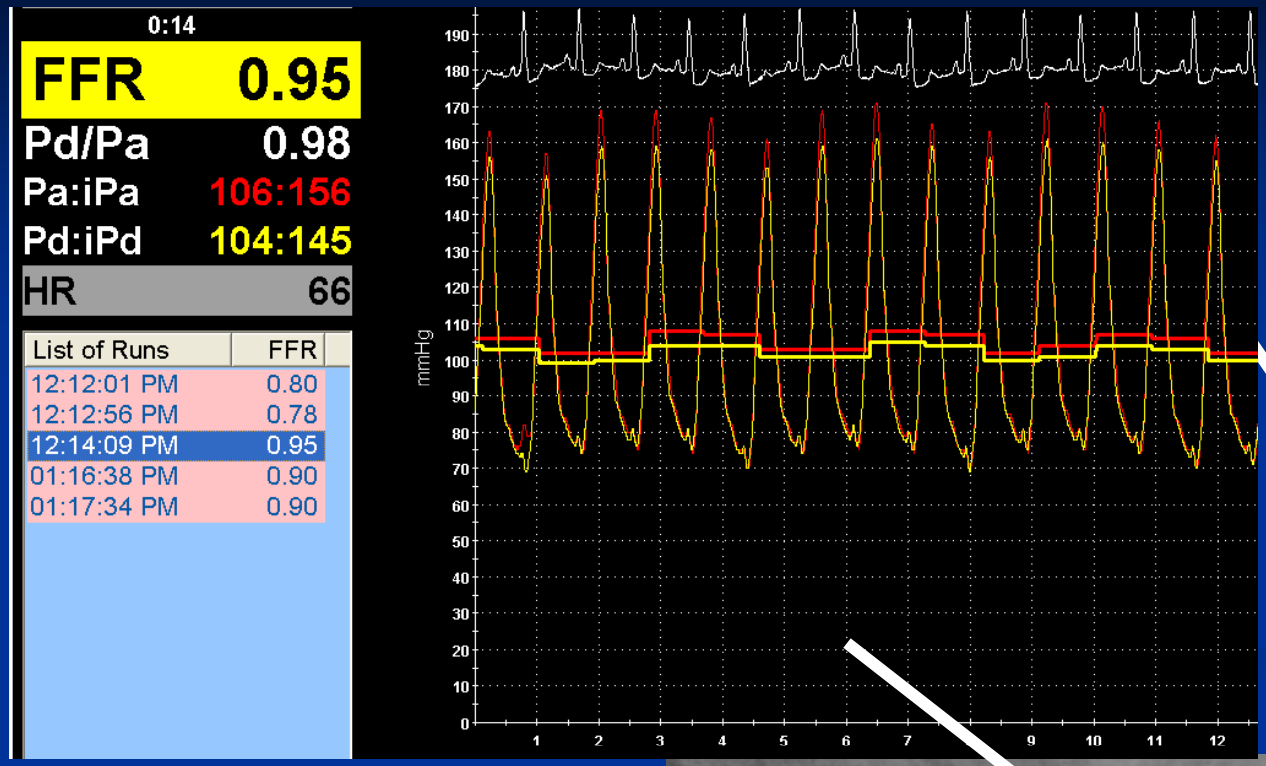
- 65 yo man with atypical chest pains and DOE for many years
- Exercise MIBI: stopped for dypsnea; no ECG changes; possible anterior reversible defect; ischemic dilatation
- History of coronary angiogram 6 years prior: reportedly mild luminal irregularities

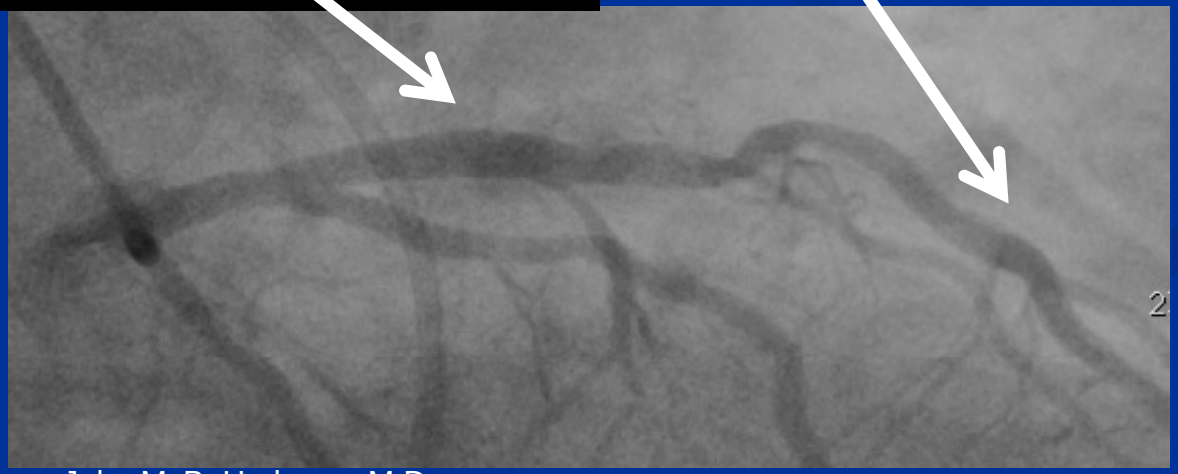
JB: angiography

Smooth intermediate lesion
Clinical uncertainty



JB: FFR of LAD





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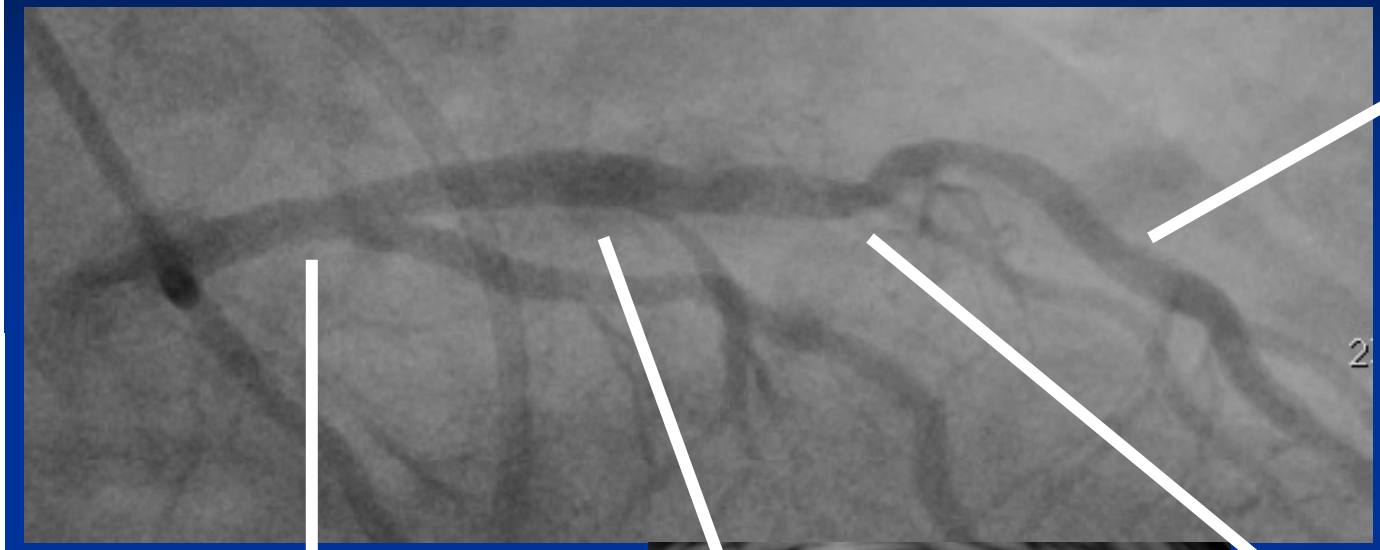
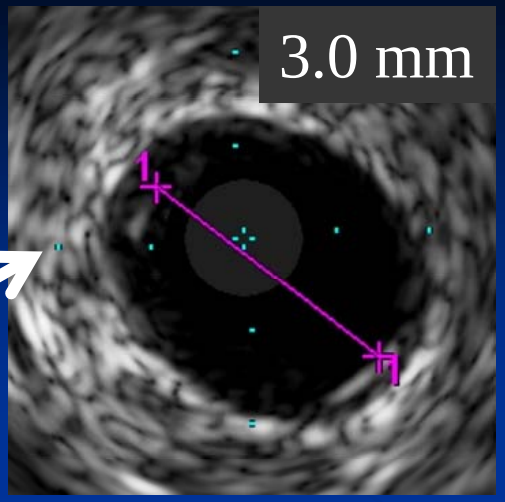
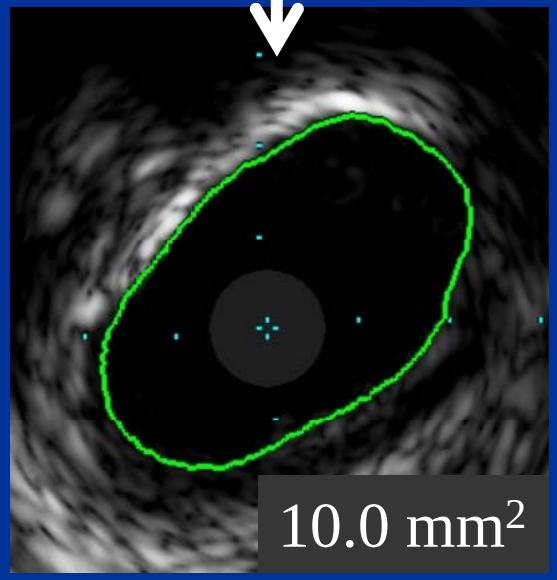
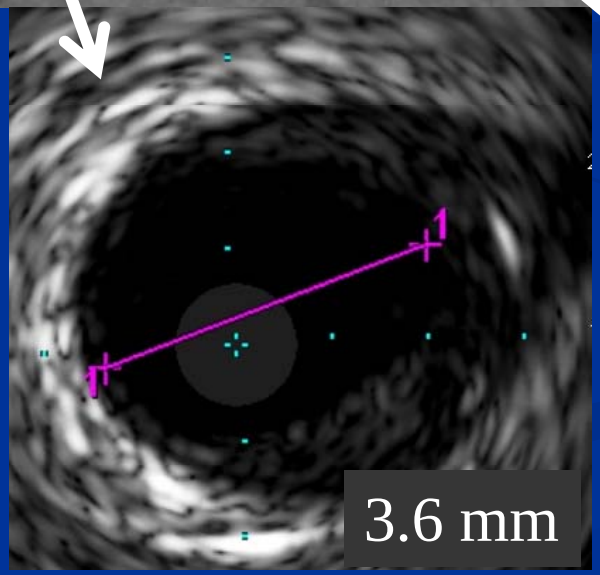
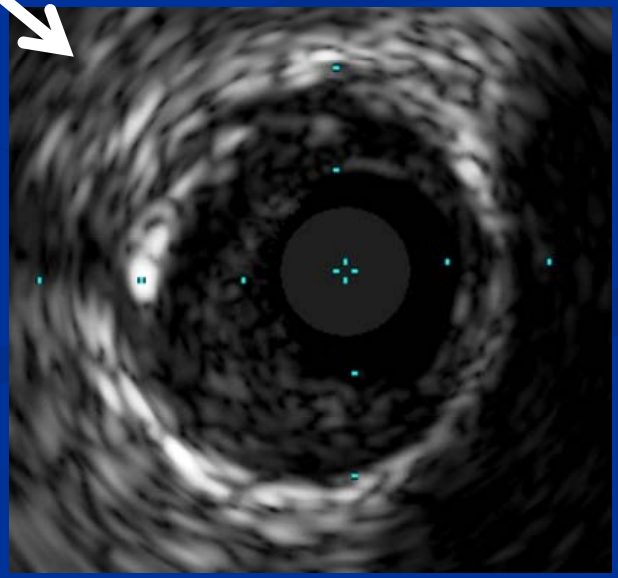
JB: IVUS pre











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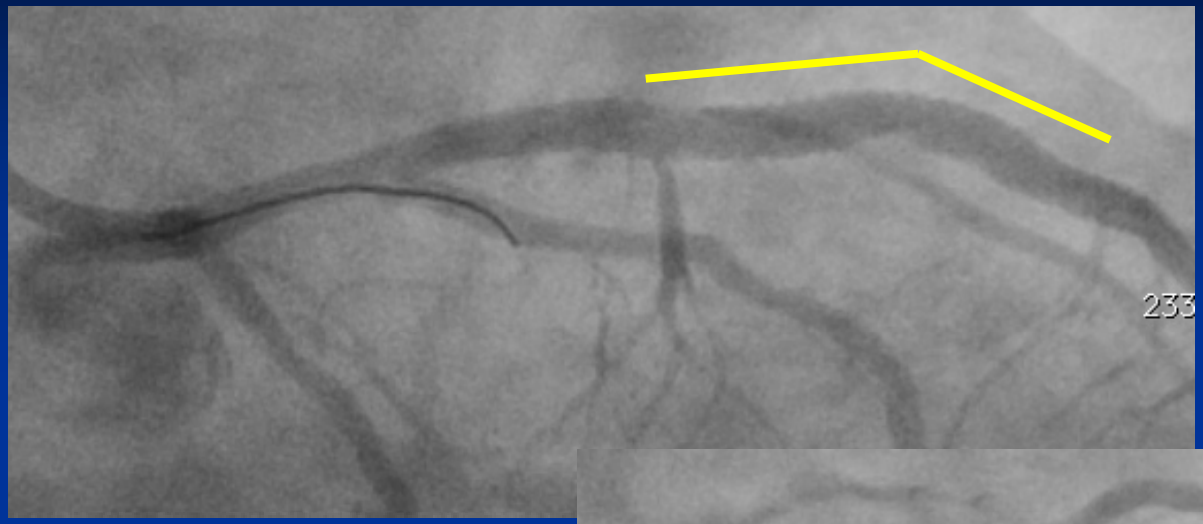
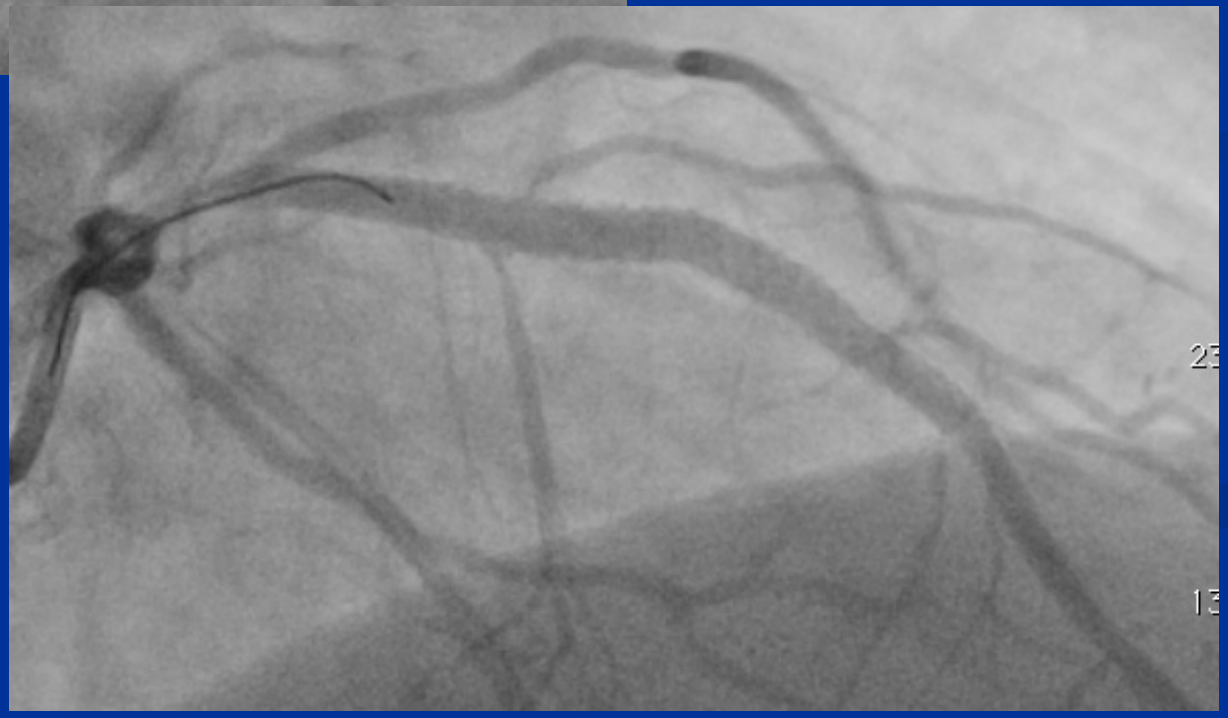
JB: post stent



After 3.5 mm
@ 26 atm



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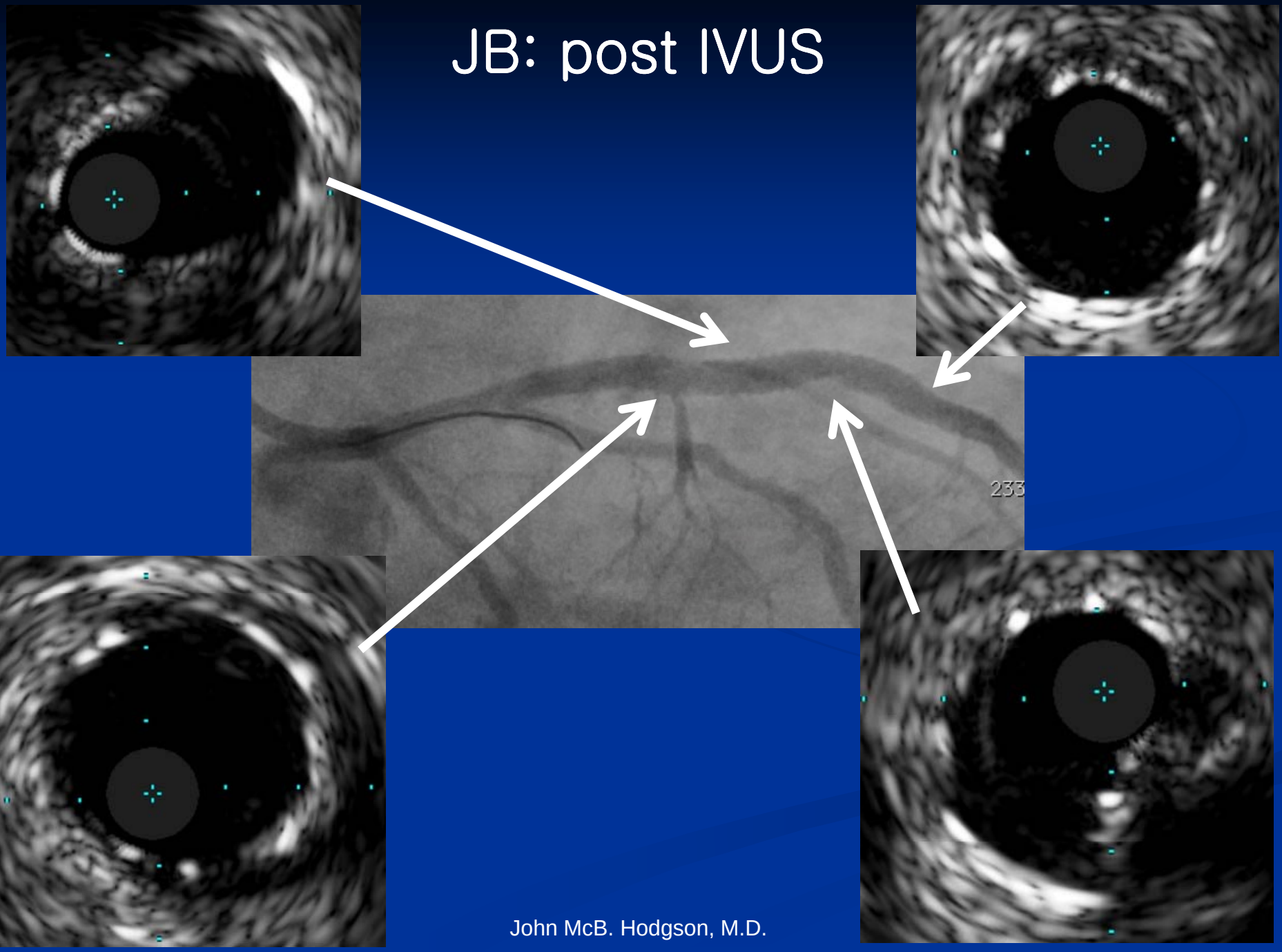
JB: post IVUS



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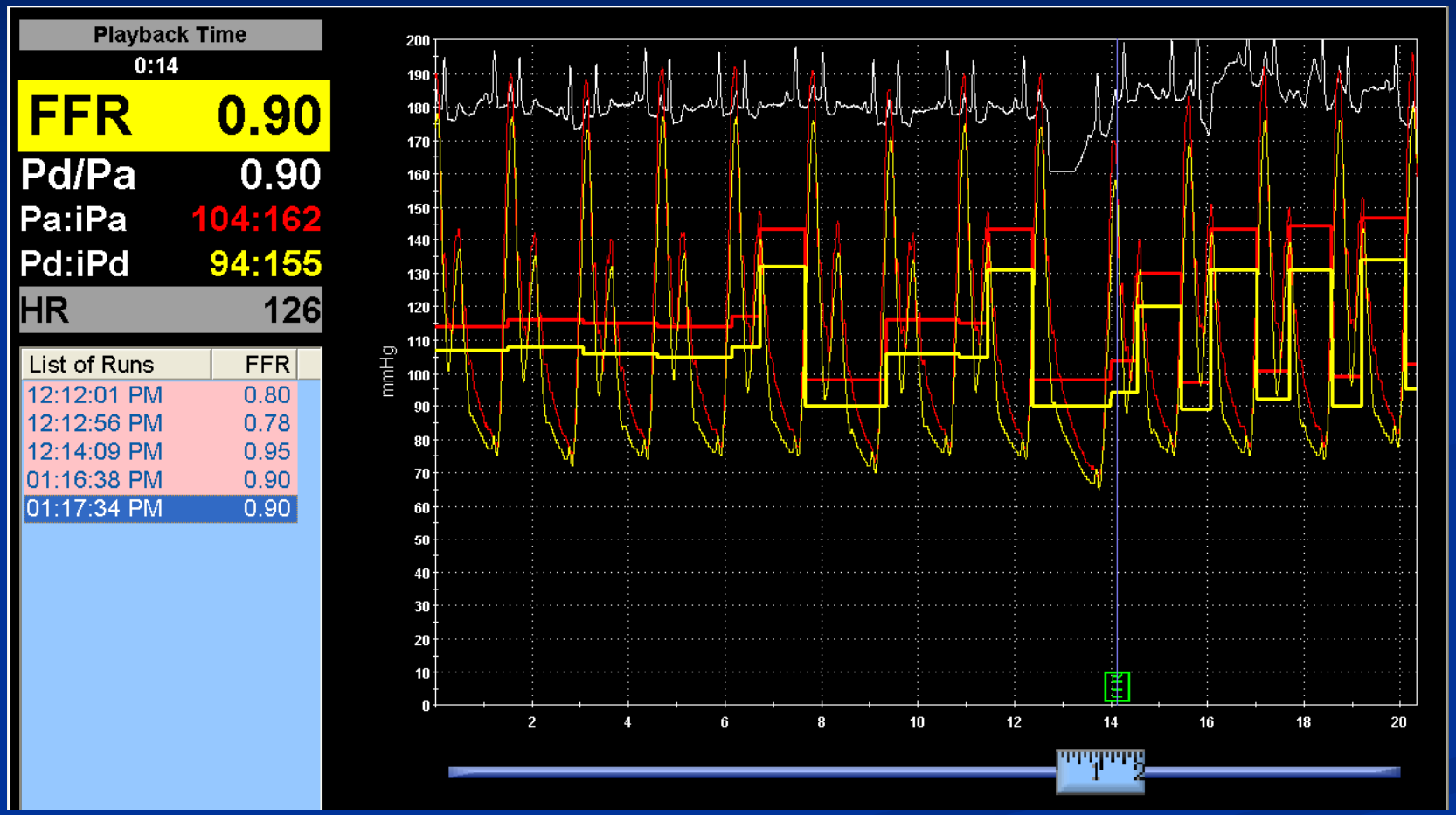
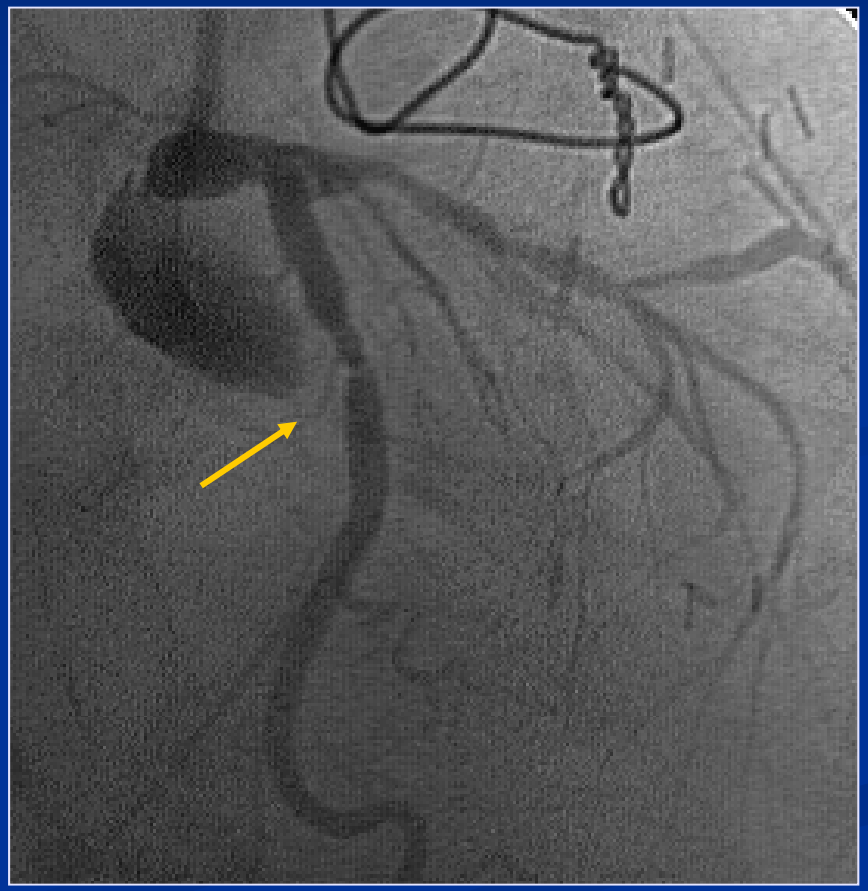
JB: FFR post


Playback Time
0:14
FFR 0.90
Pd/Pa 0.90
Pa:iPa 104:162
Pd:iPd 94:155
HR 126
List of Runs FFR
12:12:01 PM 0.80
12:12:56 PM 0.78
12:14:09 PM 0.95
01:16:38 PM 0.90
01:17:34 PM 0.90
mmHg
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
2
4
6
8
10
12
14
16
18
20

Guidance of Balloon PCI: 1998

82 yo woman with angina after CABG. Cath performed prior to emergent surgery for bowel obstruction.



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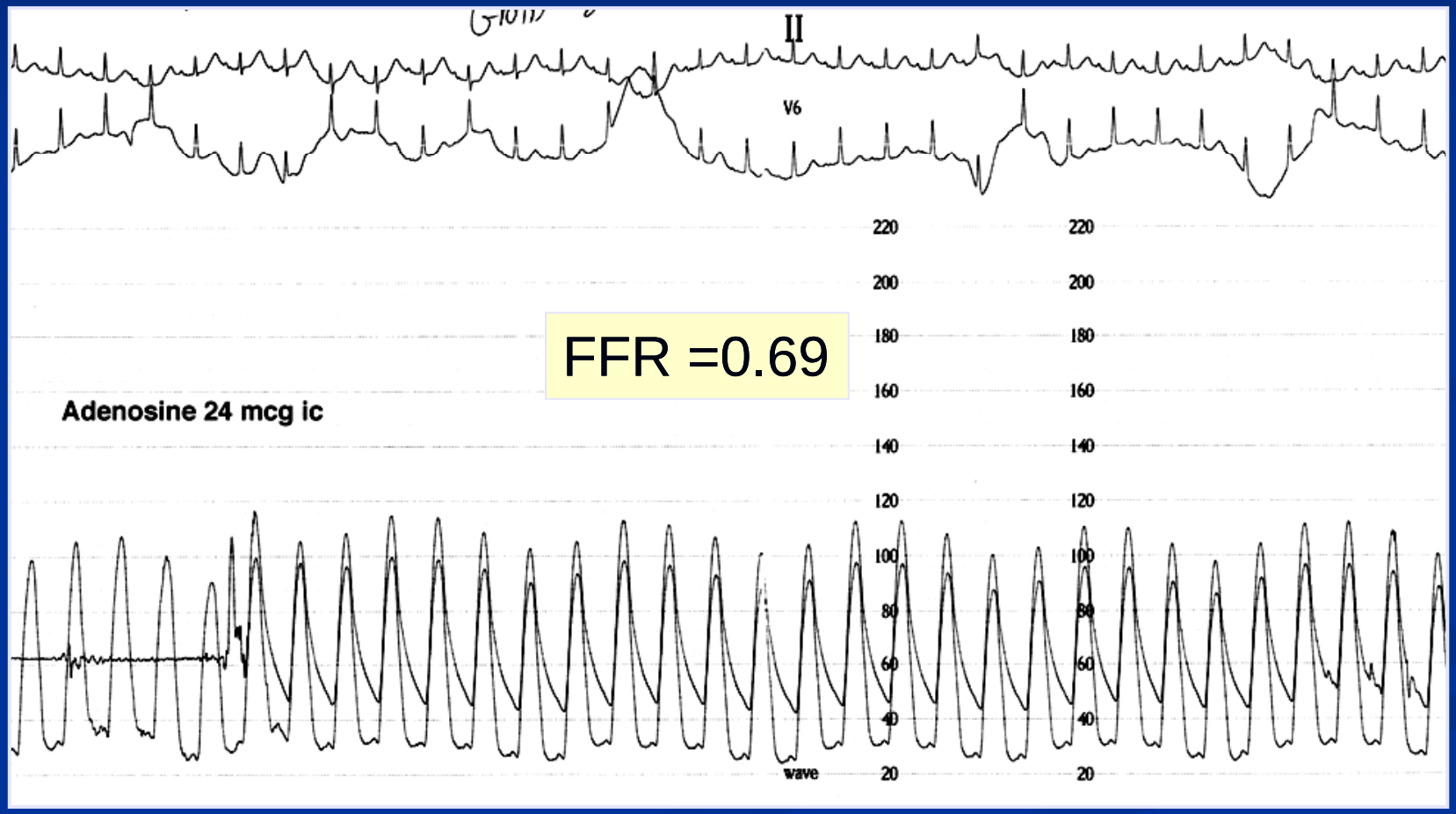
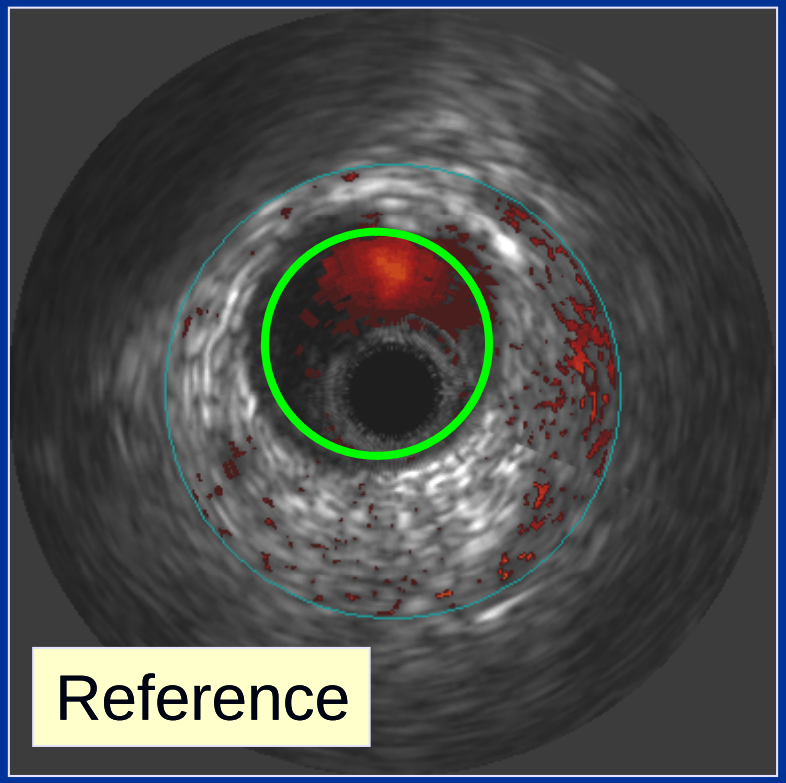
Guidance of Balloon PCI

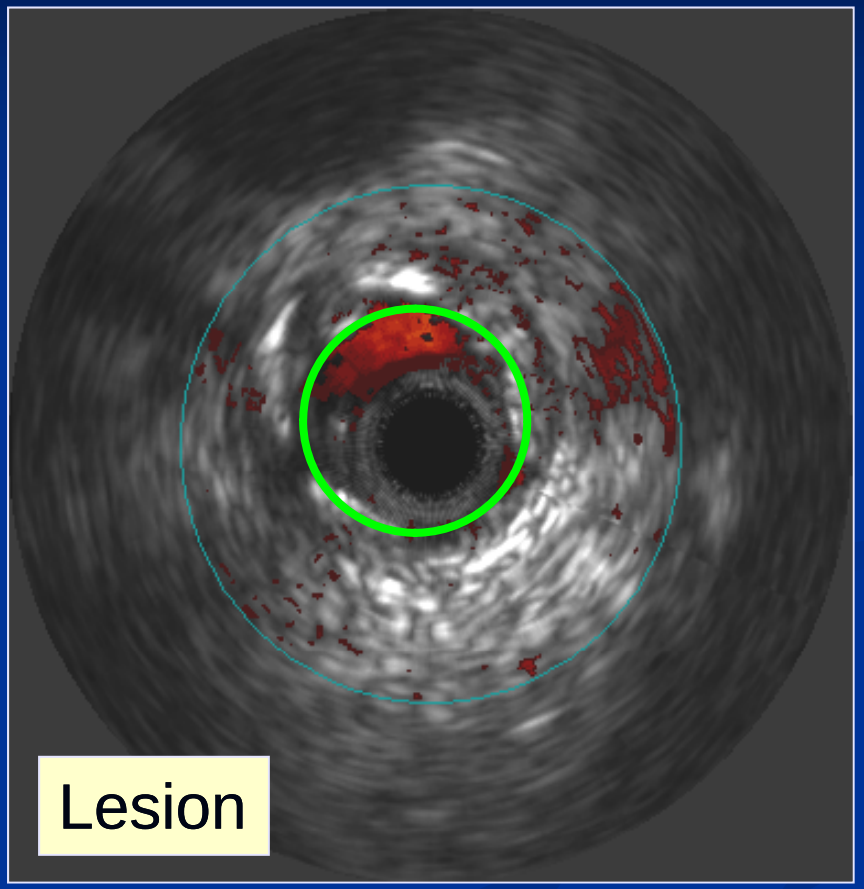
FFR determination pre intervention



Guidance of Balloon PCI

IVUS post dilation

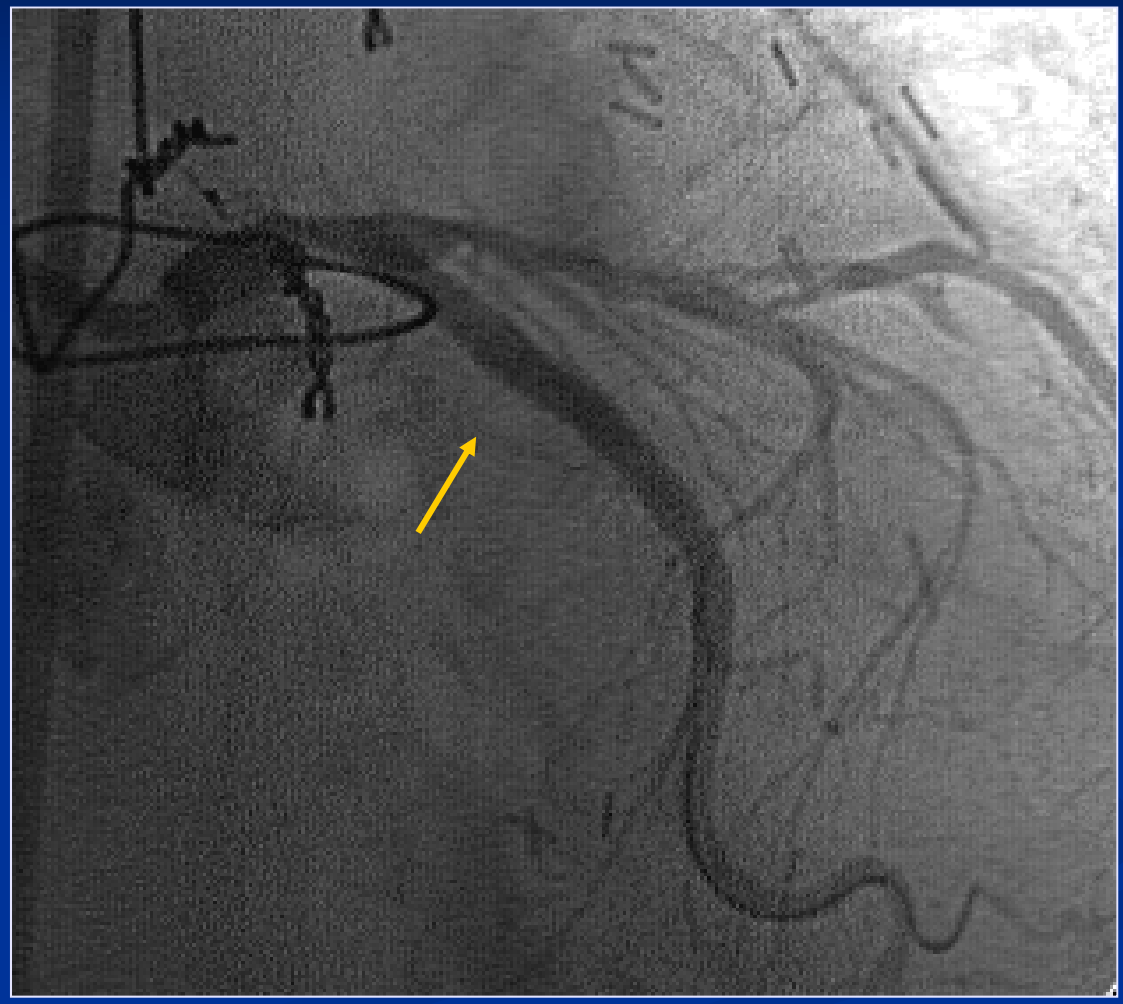




Green circles are identical

Guidance of Balloon PCI

Excellent result with balloon only!
Surgery next day uneventful.



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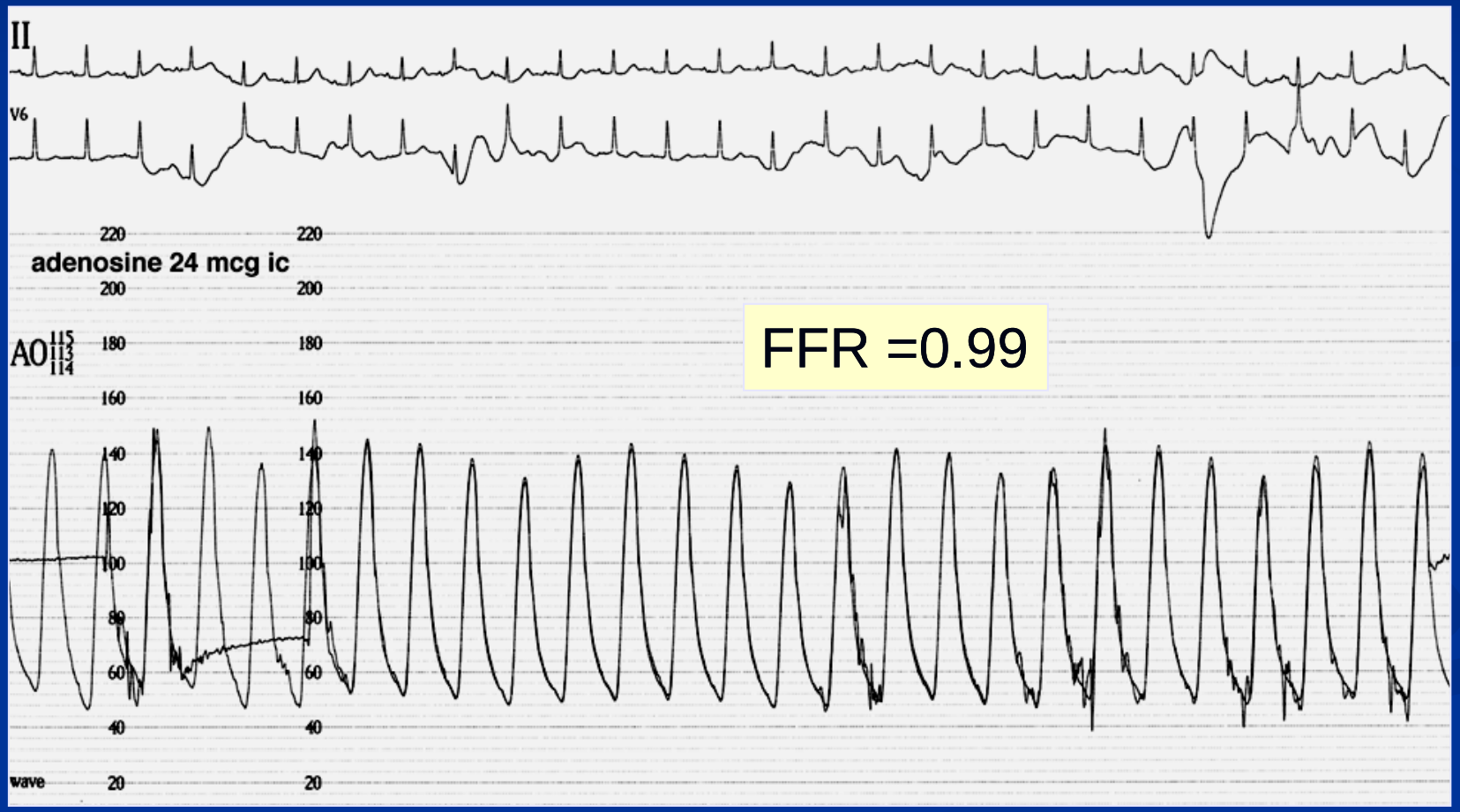
Guidance of Balloon PCI

FFR post dilation



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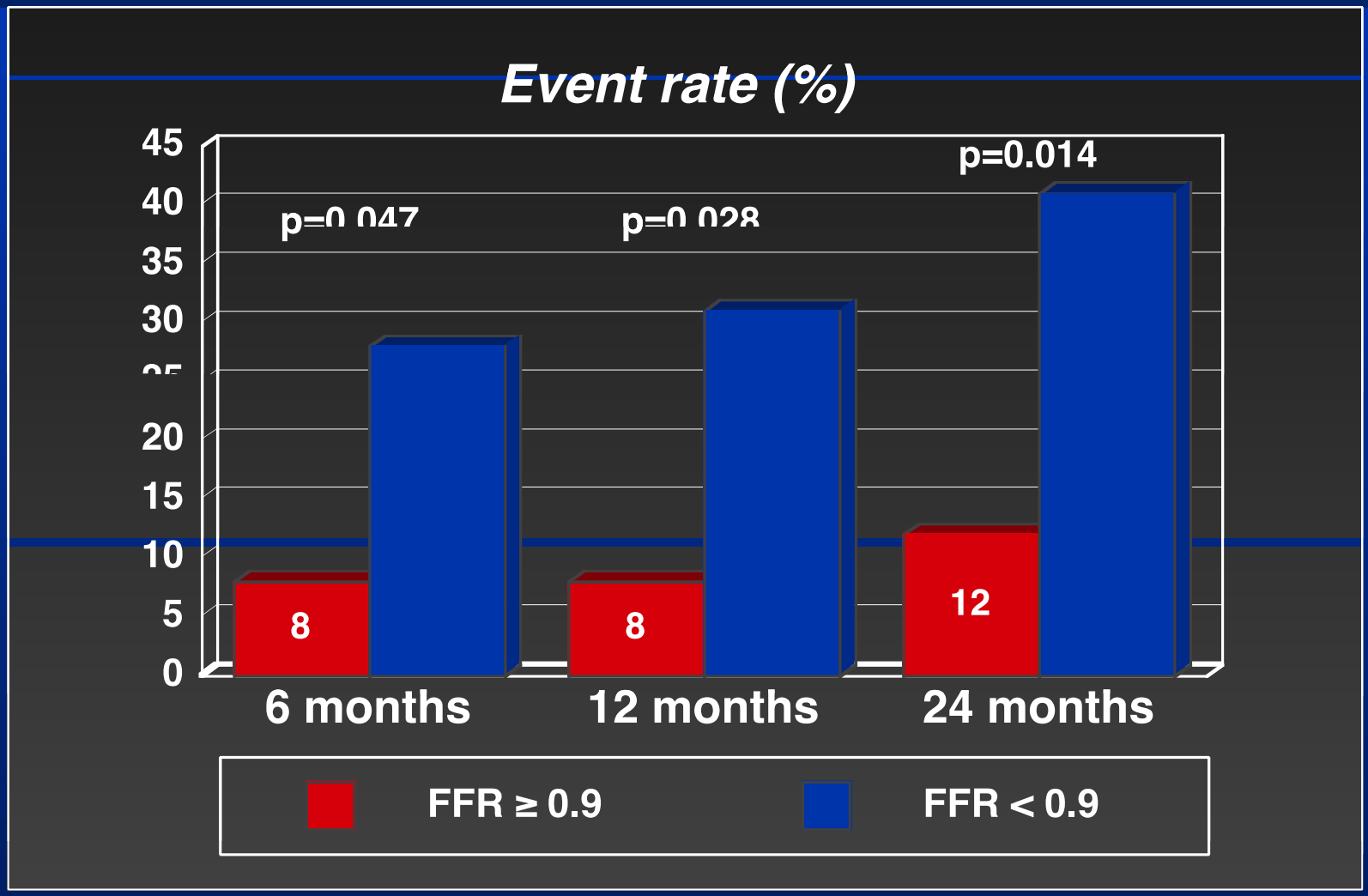
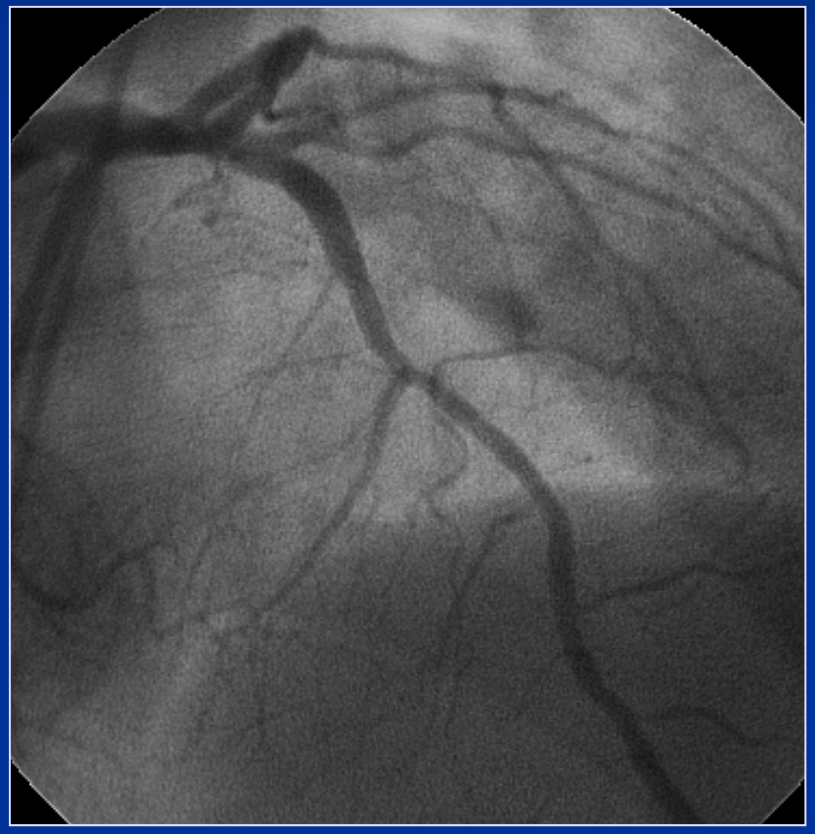
Balloon only: FFR predicts outcome



Bech et al Circulation 1999;99:883

FFR in PCI: lesion specific therapy

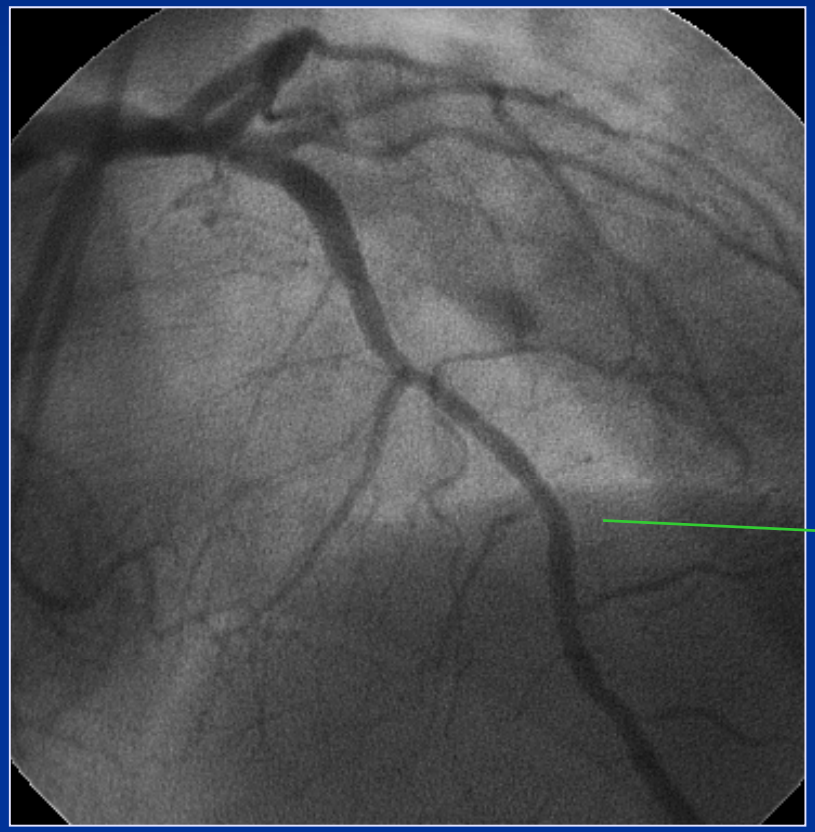
45 yo man with typical angina and positive MIBI anterior



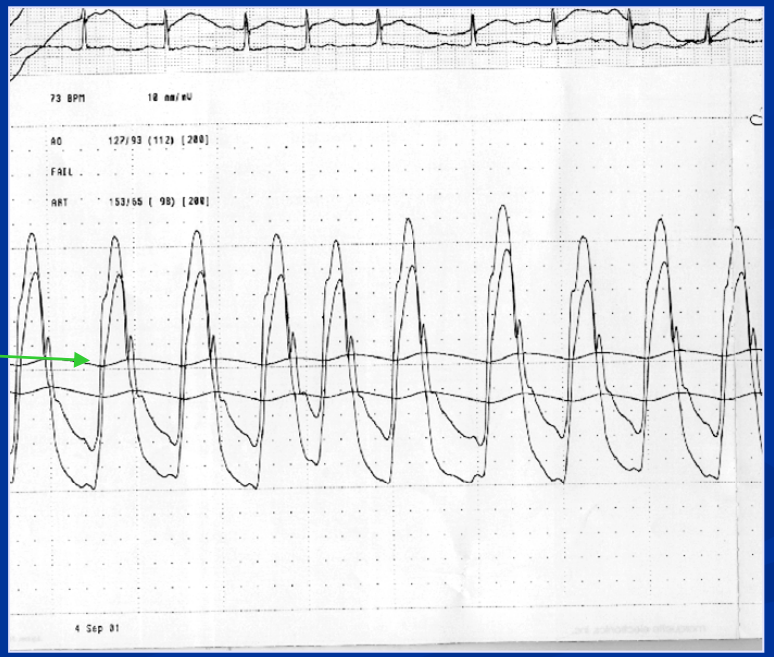
How would you approach this patient?

FFR in PCI: lesion specific therapy

Evaluate the LAD serial lesions

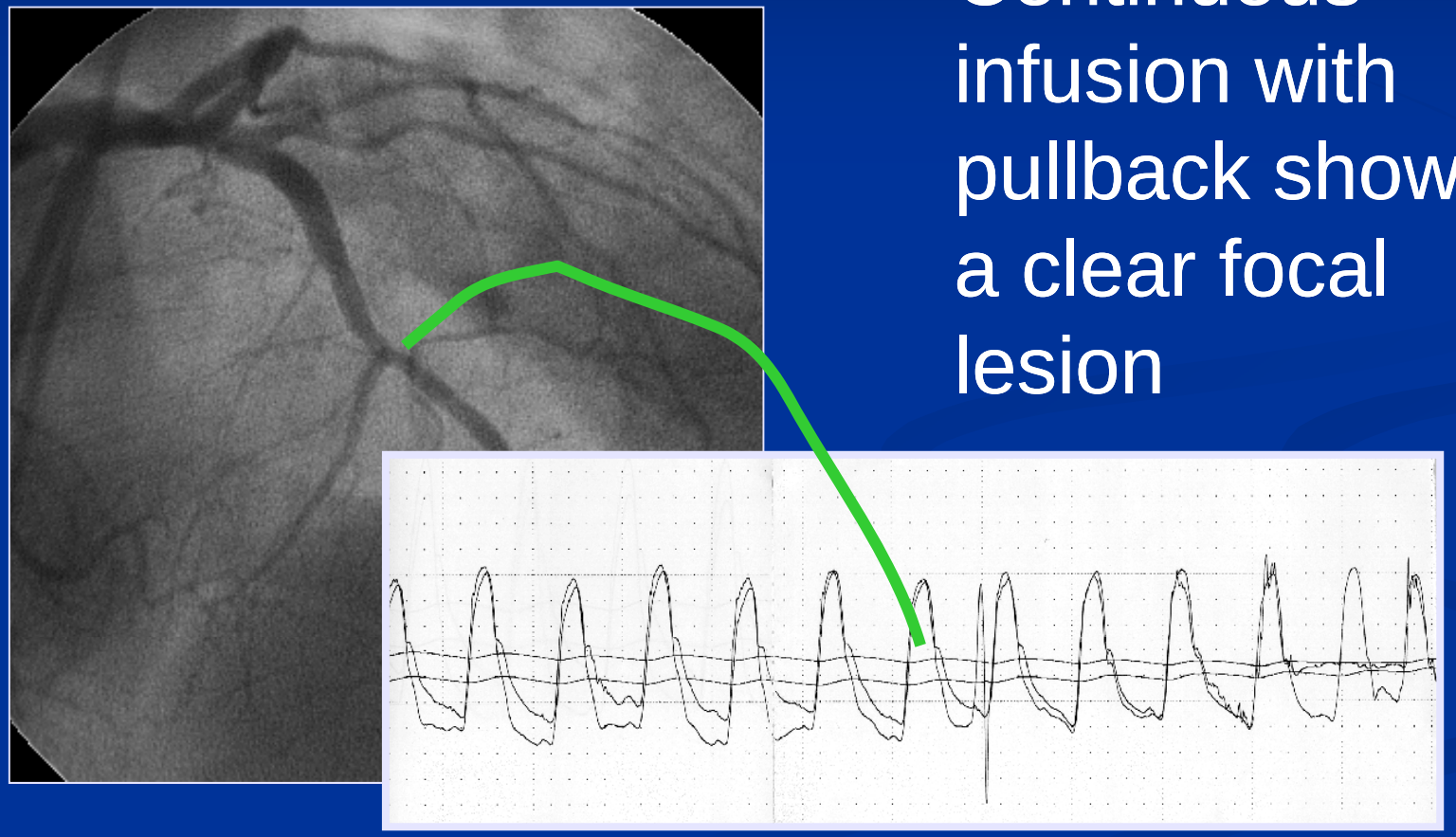


Distal to both:
FFR – 0.75



FFR in PCI: lesion specific therapy

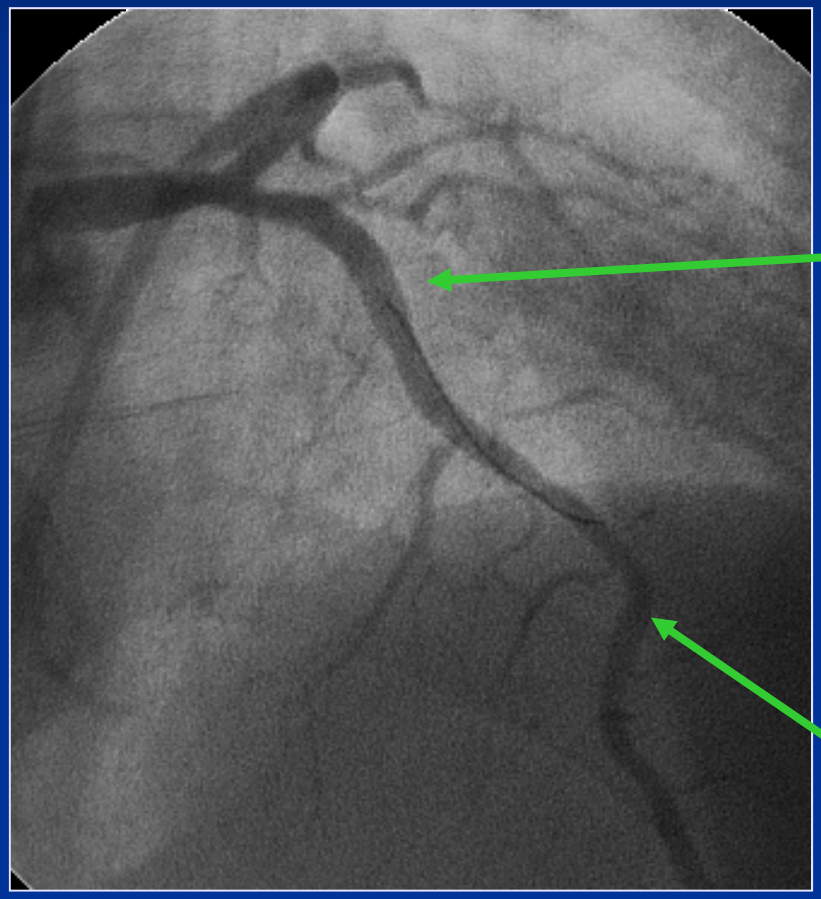
Find the worst lesion

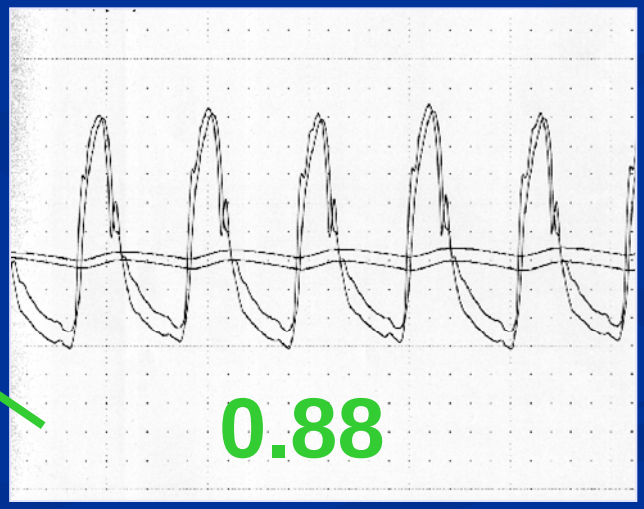


Continuous infusion with pullback shows a clear focal lesion

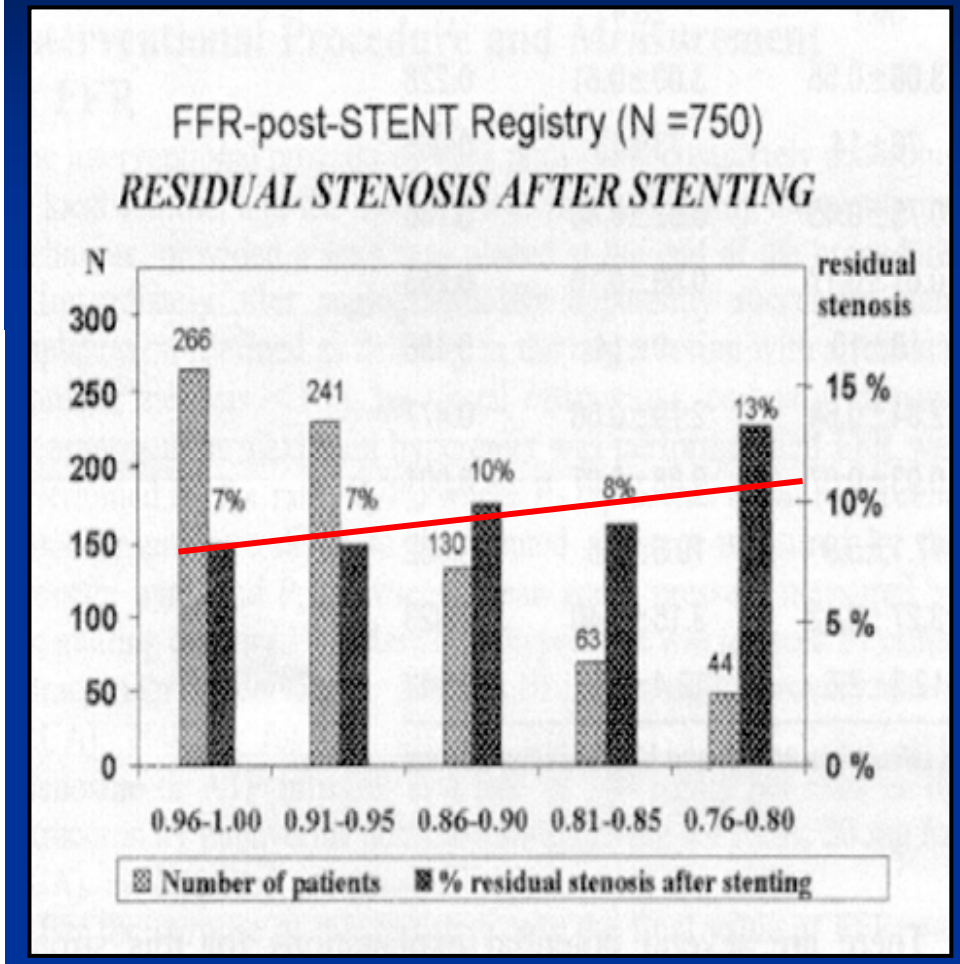
FFR in PCI: lesion specific therapy

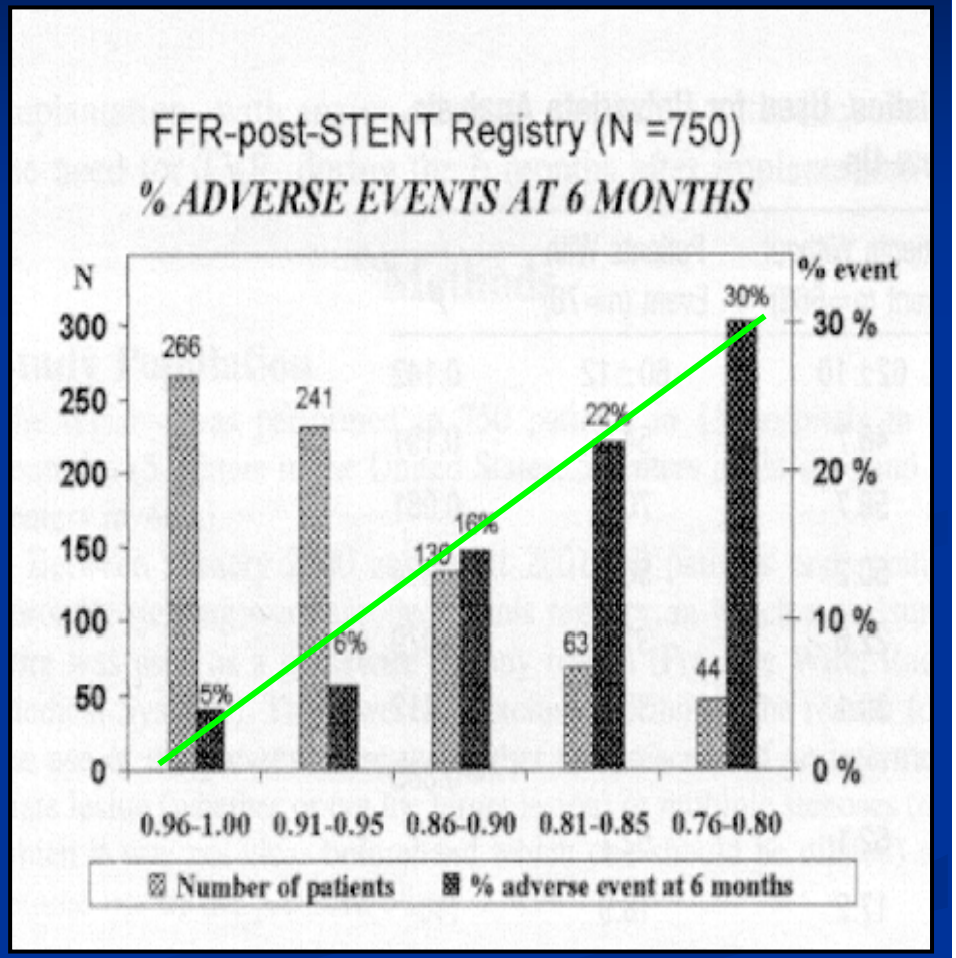
After an 8 mm BMS





FFR post BMS PCI predicts outcome





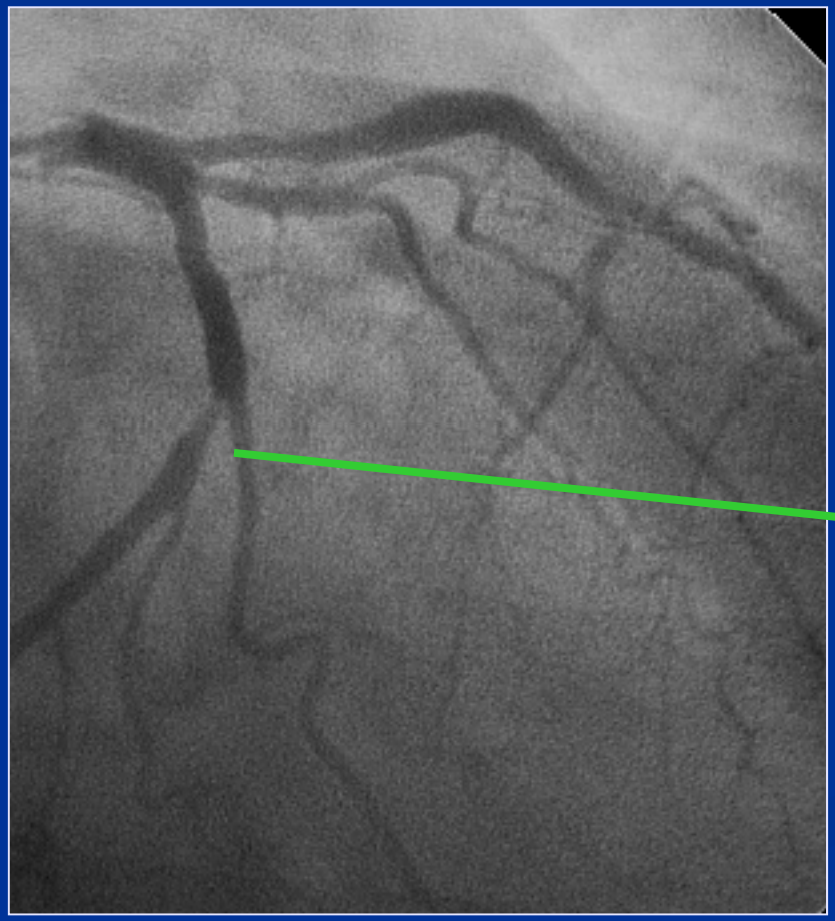
Similar angiographic result

Different outcomes

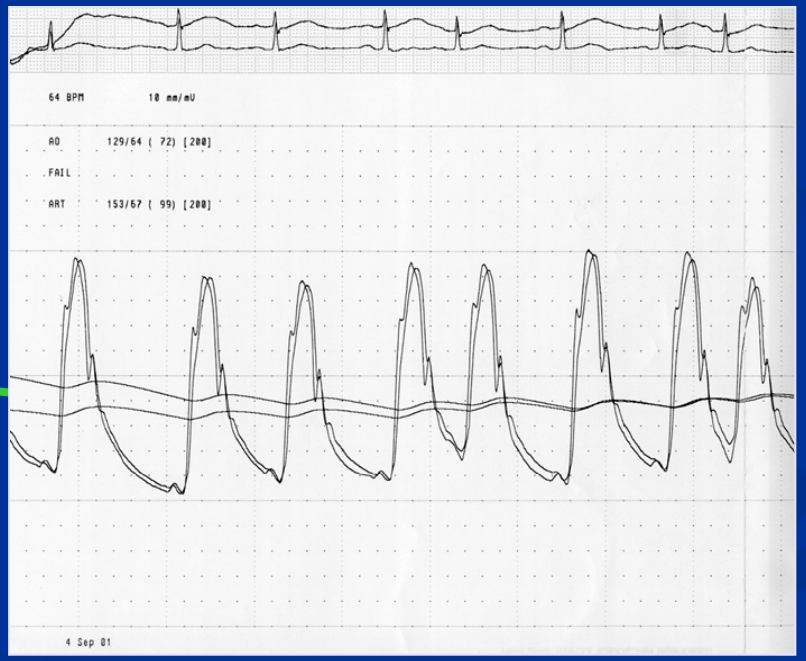
John McB. Hodgson, M.D. Circulation 2002;105:2950

FFR in PCI: optimizing therapy

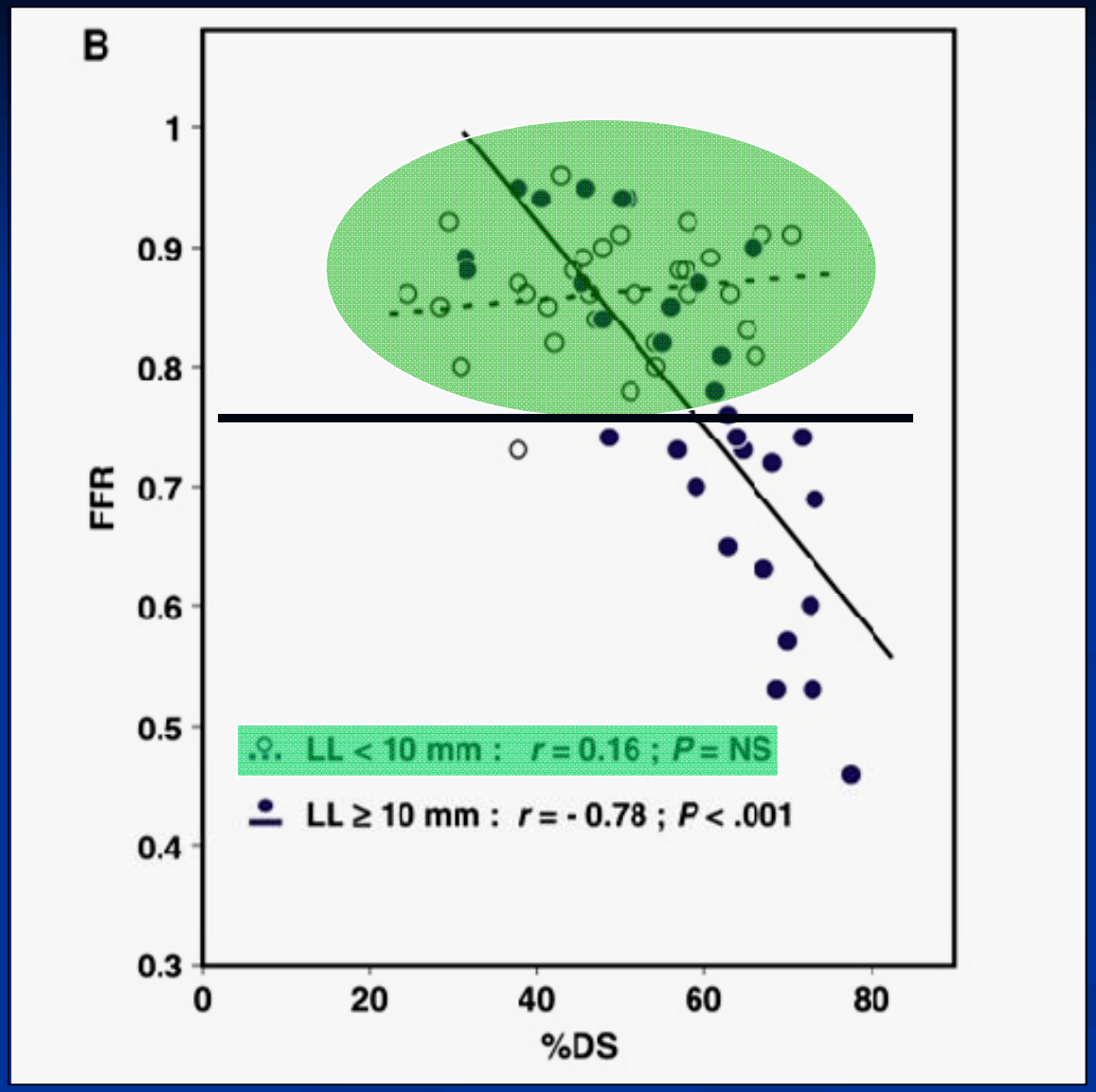
Evaluate the LCx lesion



FFR – 0.92

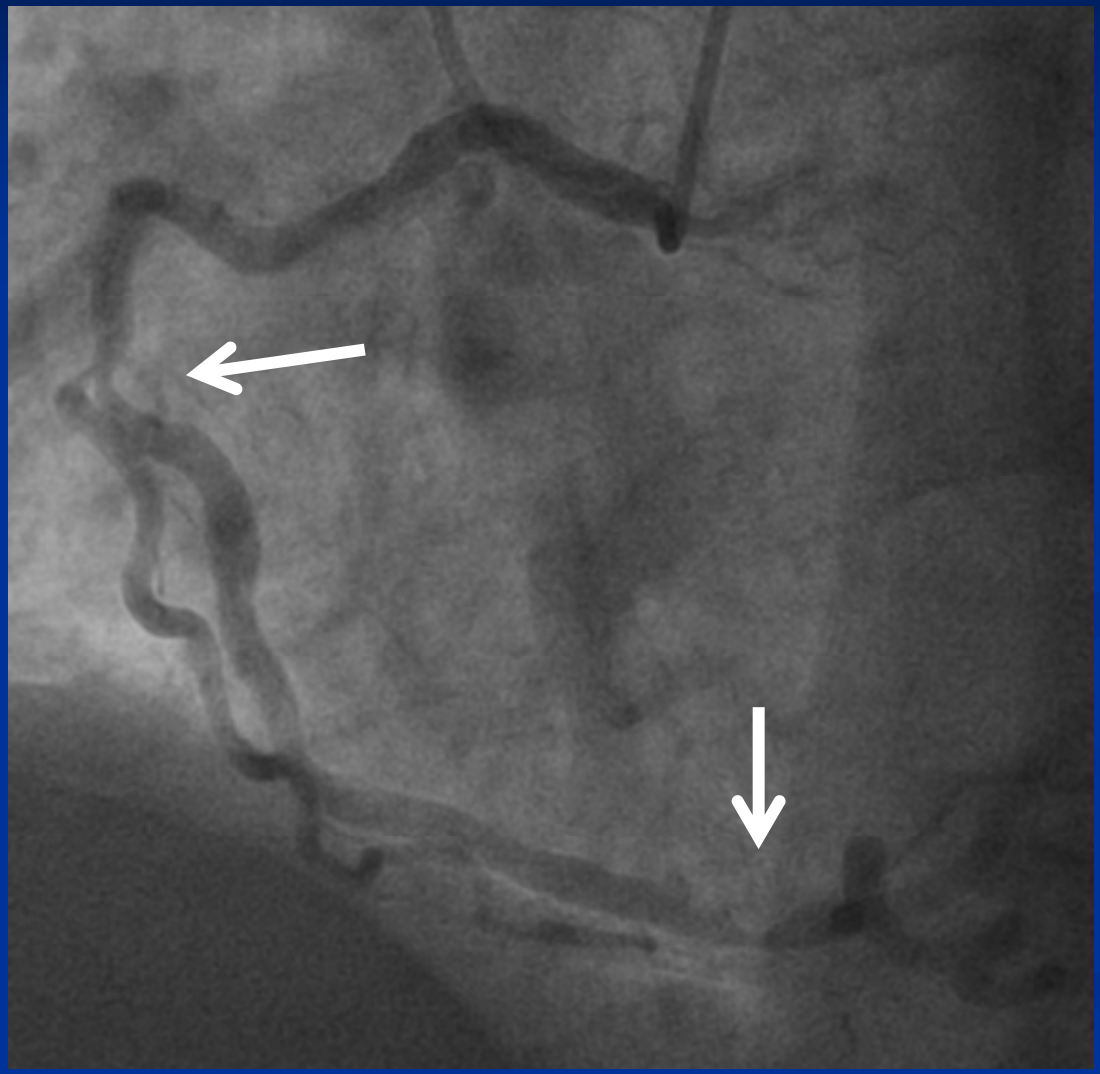


Lesion length:
short lesions in big vessels are usually NOT significant



Brosh et al Am Heart J 2005;150:338

RZ: angiography



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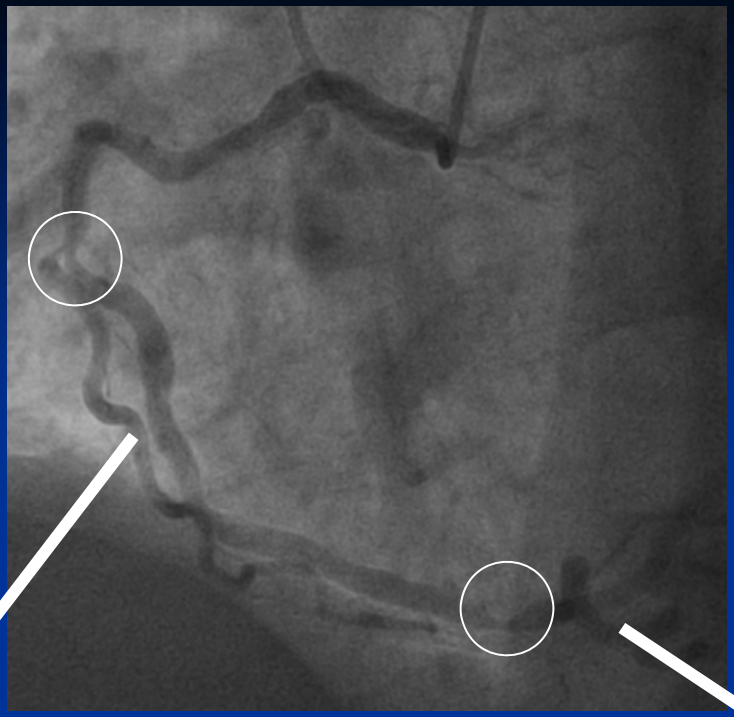
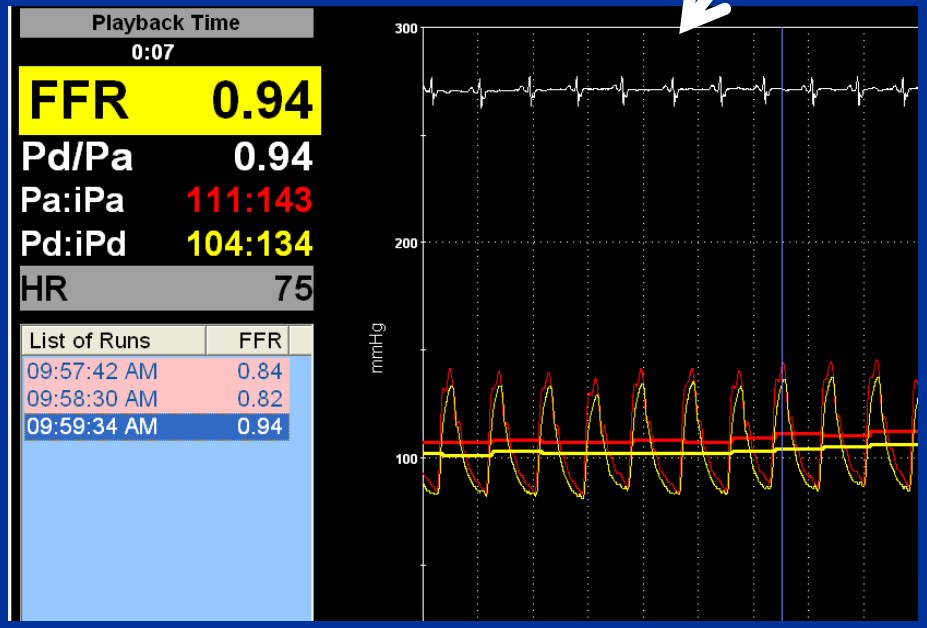
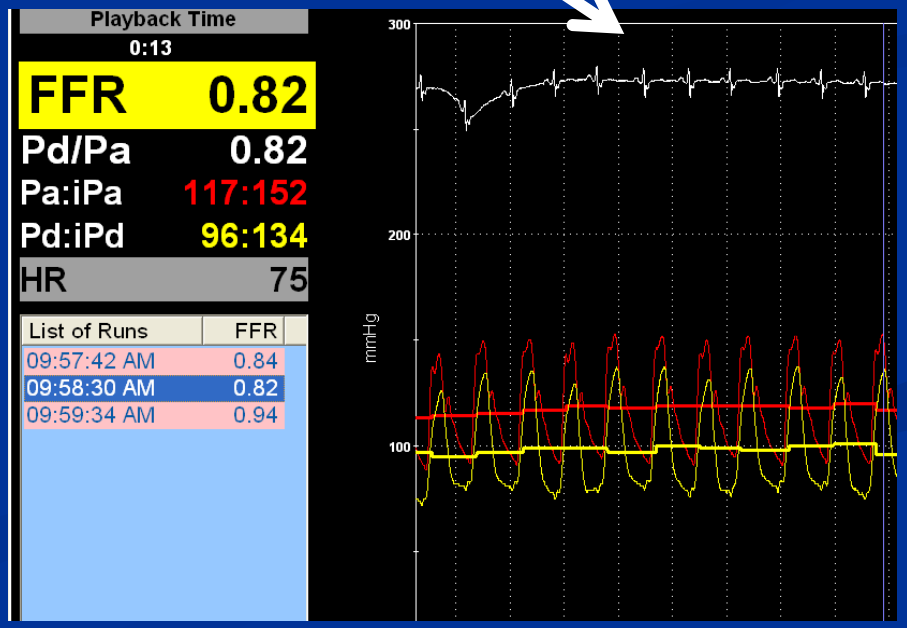
RZ: RCA FFR before LAD PCI

Tight lesion, non-ischemic FFR: Visual miss-match







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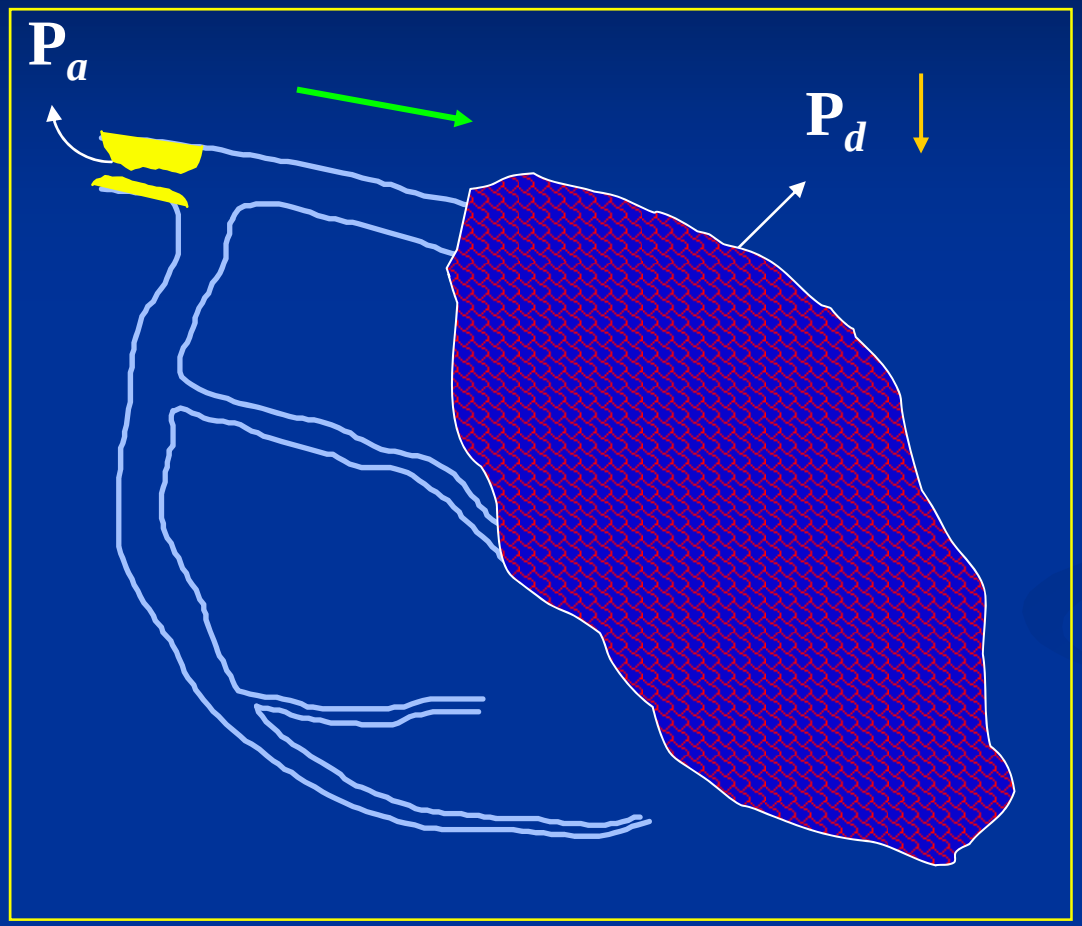
“False” FFR readings

- ALWAYS: error is on high side
  - Inadequate hyperemia (vasodilation)
  - Elevated venous pressure
- High FFR in infarct zones is NOT false
  - Reduced vascular bed: reduced need for flow
  - FFR measures fraction of FLOW reduction due to stenosis, NOT the degree of stenosis
- High FFR in stunned myocardium is NOT false
  - Accurate for the time of measurement
  - May be inaccurate when the myocardium recovers and maximal flow is higher (>5 days later)

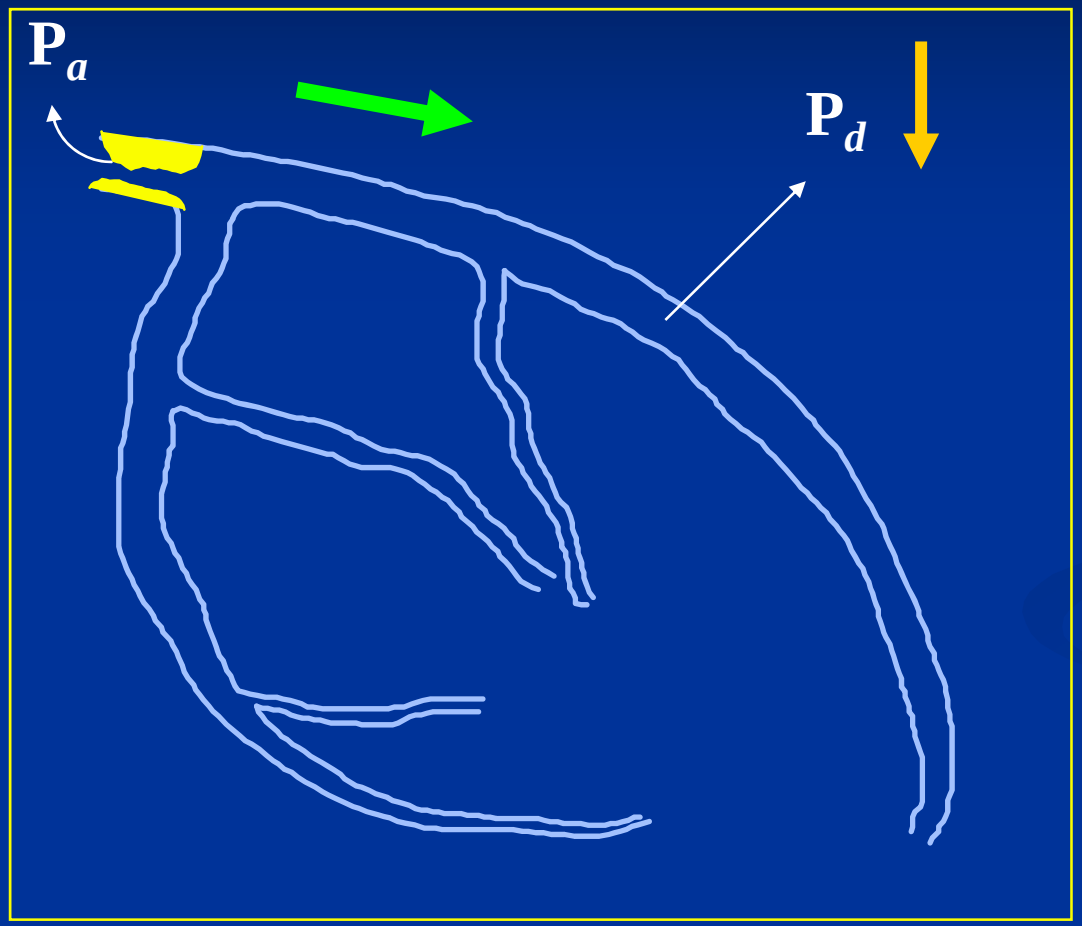
FFR in infarcted myocardium: 90% lesion



50% myocardial tissue loss
50% reduction in myocytes
50% reduction in O_2 needs
Peak flow: 200 ml/min
Loss of pressure less

Aorta: 100 mmHg
Distal: 85 mmHg
FFR: 0.85

FFR in normal myocardium: 90% lesion



No myocardial tissue loss
No reduction in myocytes
No reduction in O_2 needs
Peak flow: 400 ml/min
Loss of pressure more

Aorta: 100 mmHg
Distal: 70 mmHg
FFR: 0.70

Stenosis is the SAME!
But, it has a bigger impact in this patient

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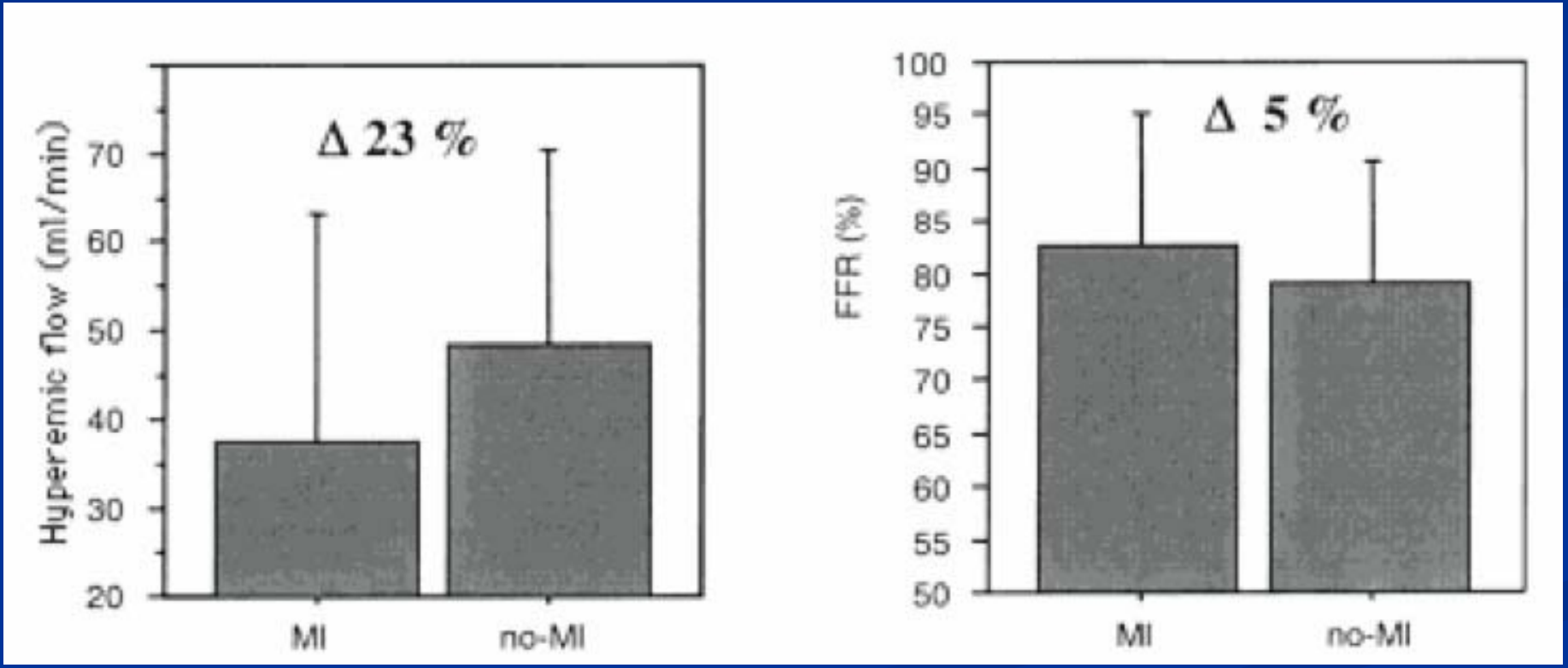
FFR after infarction

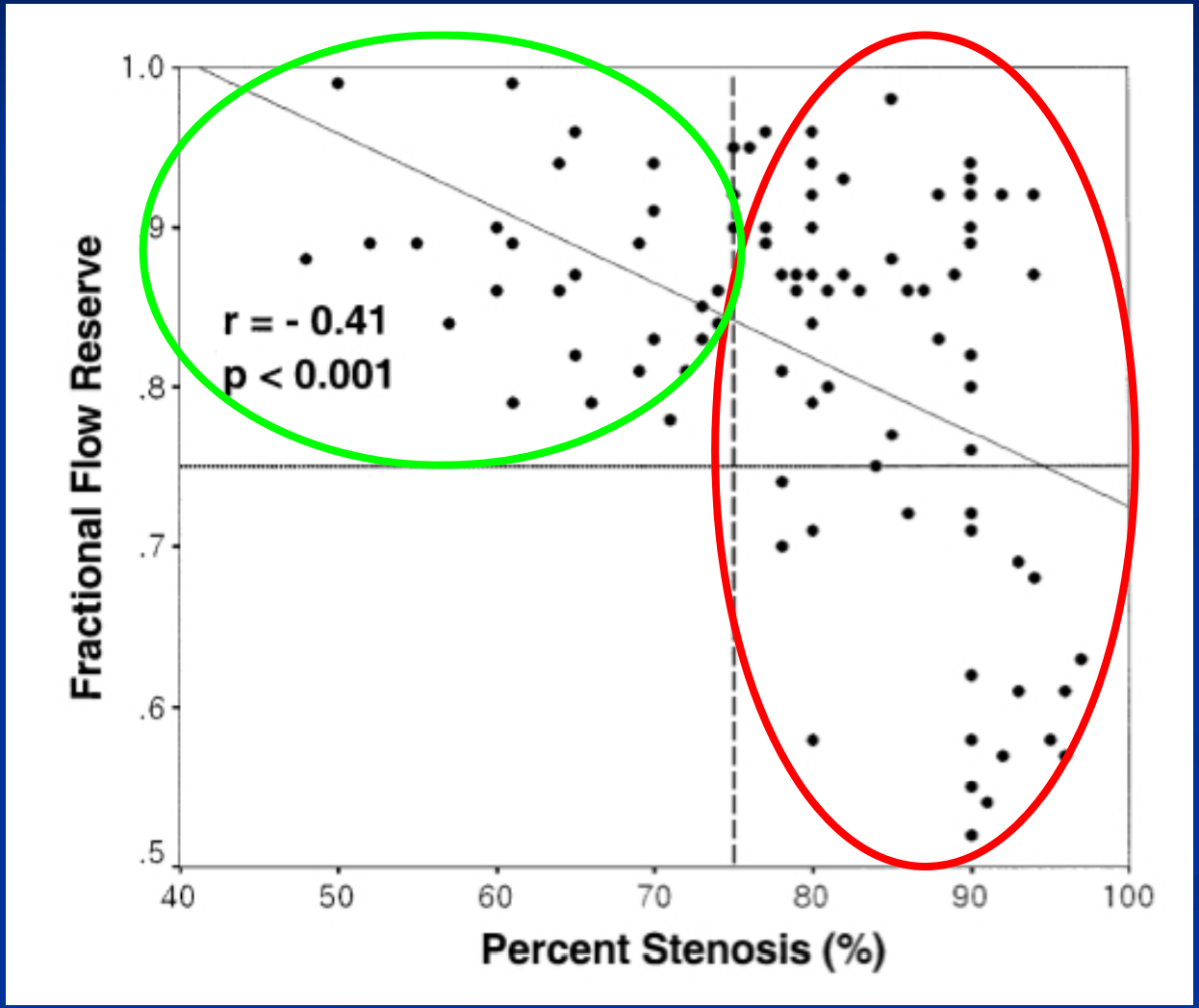
22 patients with infarct related arteries compared to 21 non-infarct related arteries. Mean 43% stenosis in each group.



CCI 2001;54:427-34

FFR vs Angio evaluation of SB

n = 97
% sten > 50%
ref > 2 mm



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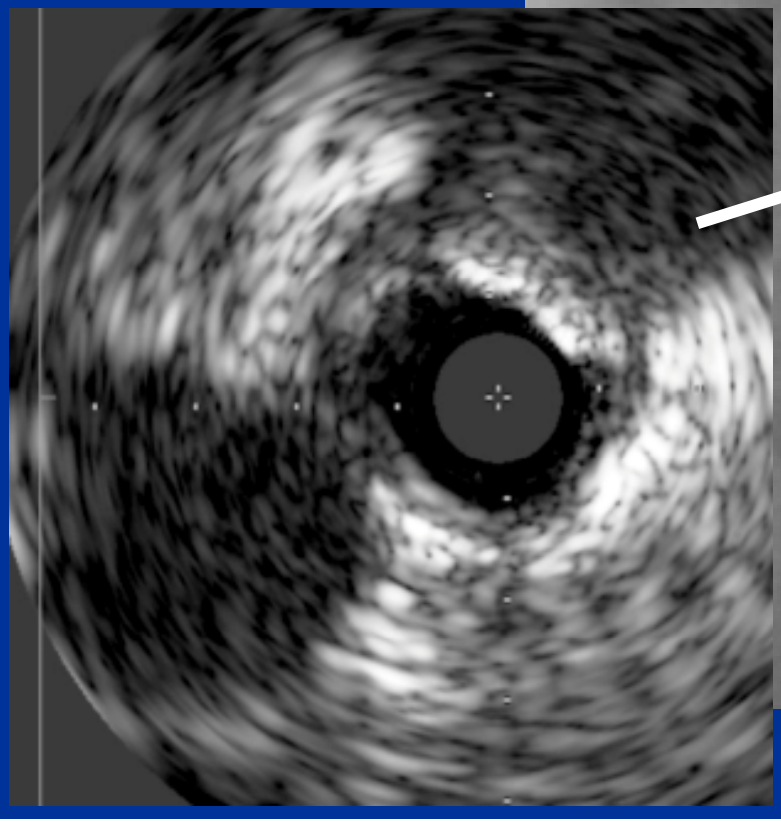
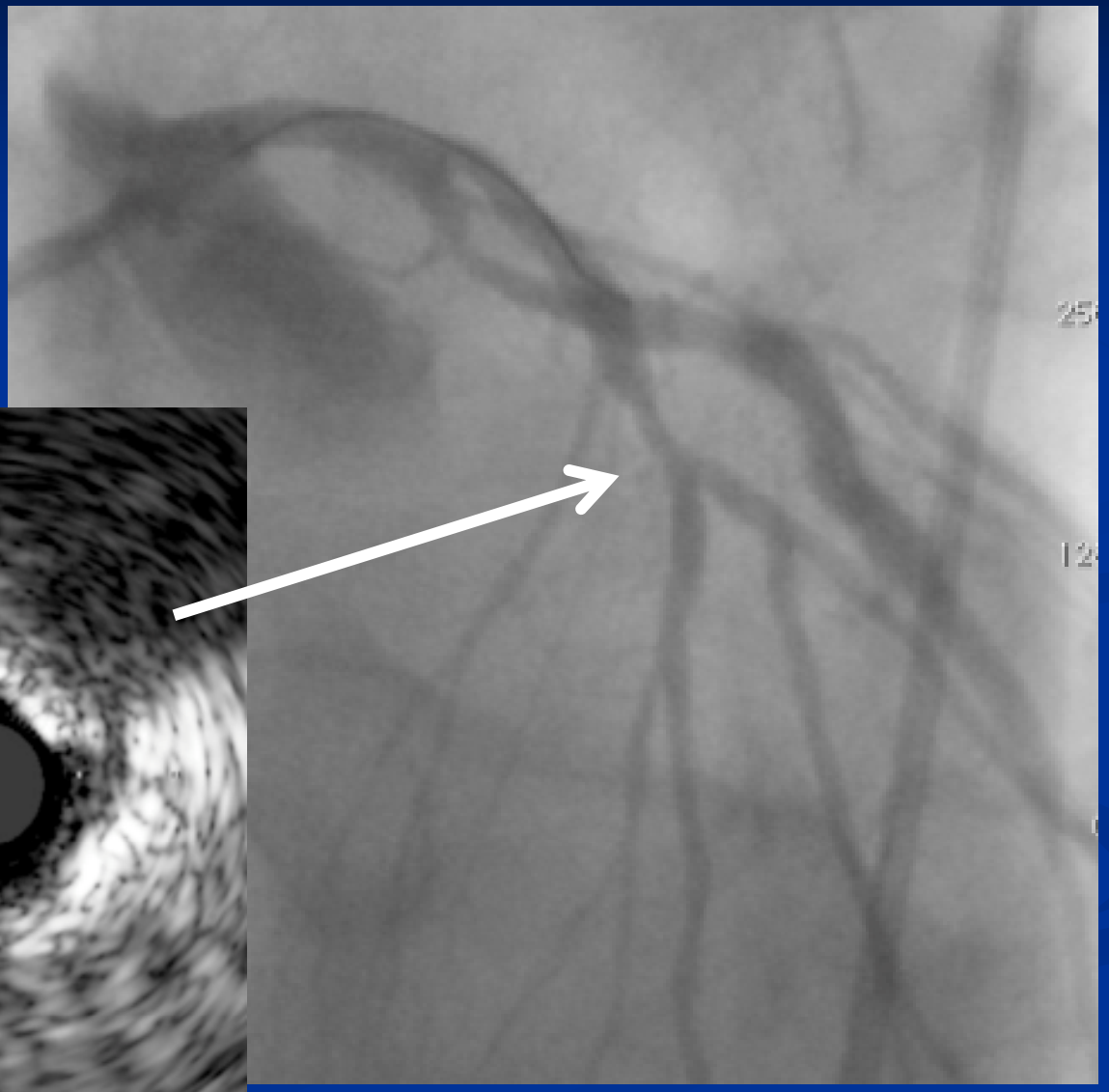
J Am Coll Cardiol 2005;46:633-7

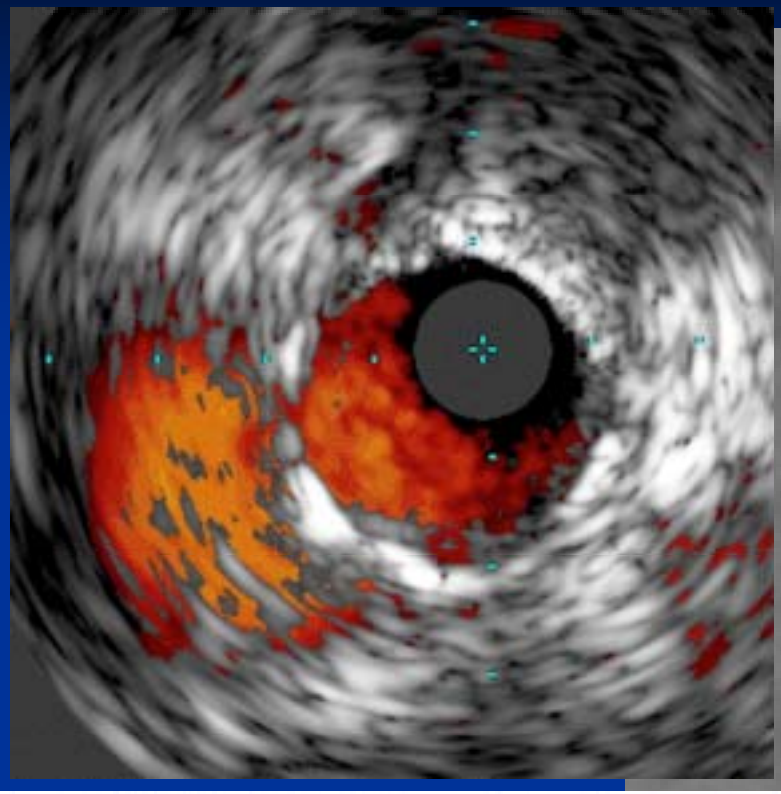
BB: LAD Branch

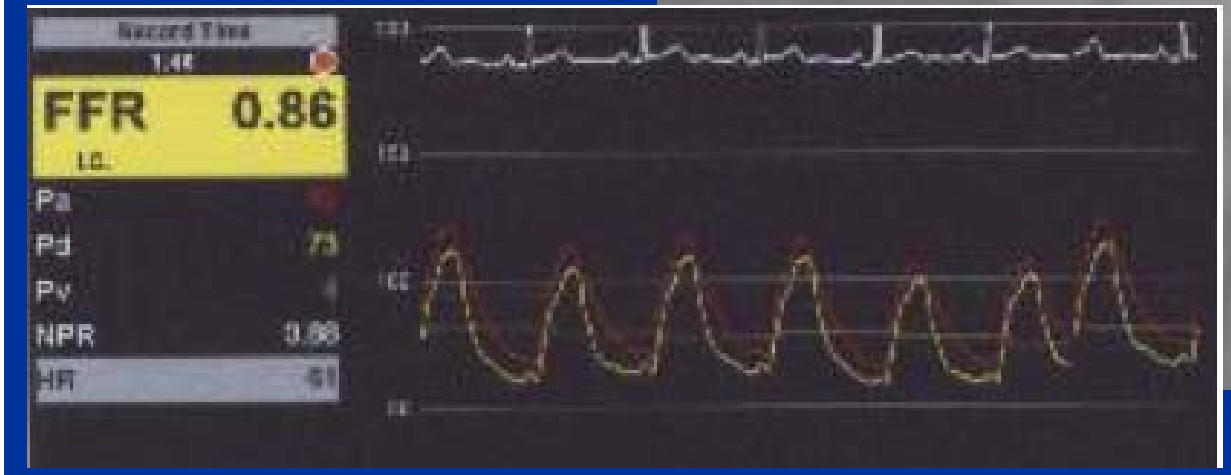
LAD FFR 0.72
at time of RCA STEMI
5 weeks earlier





BB: LAD post Stent





Balloon treated ostial lesions

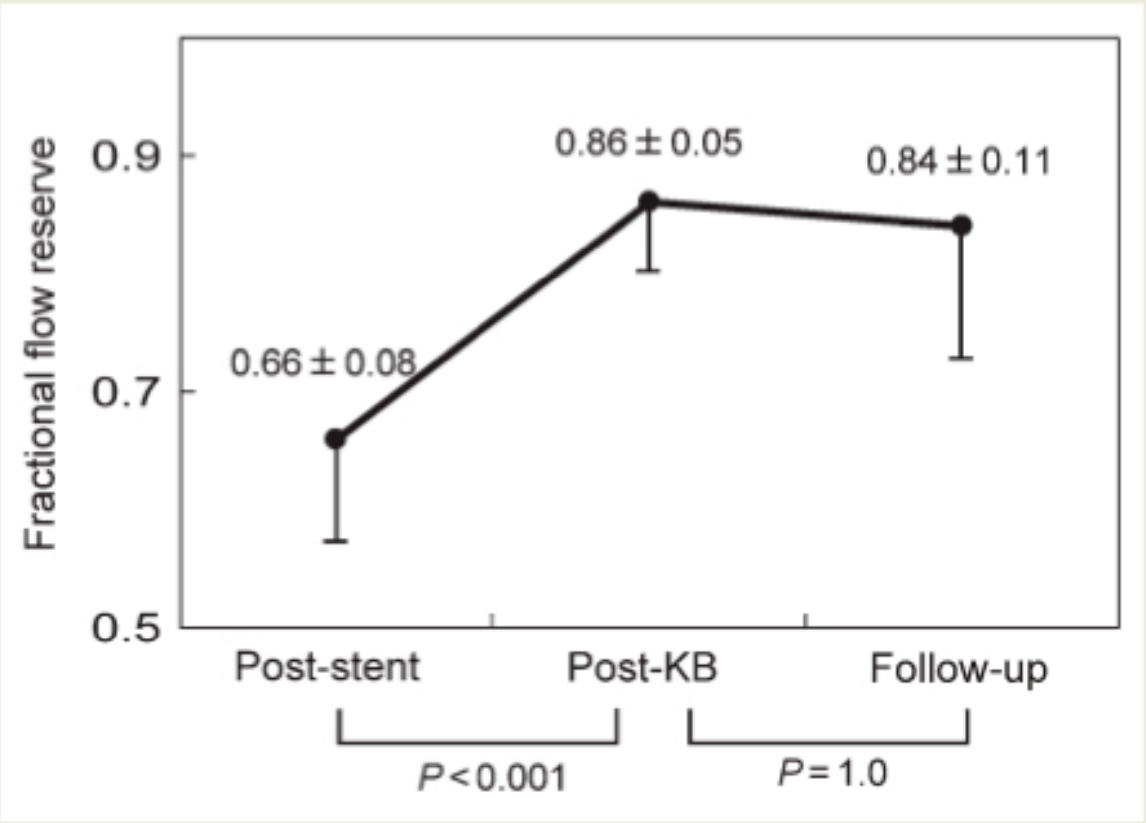
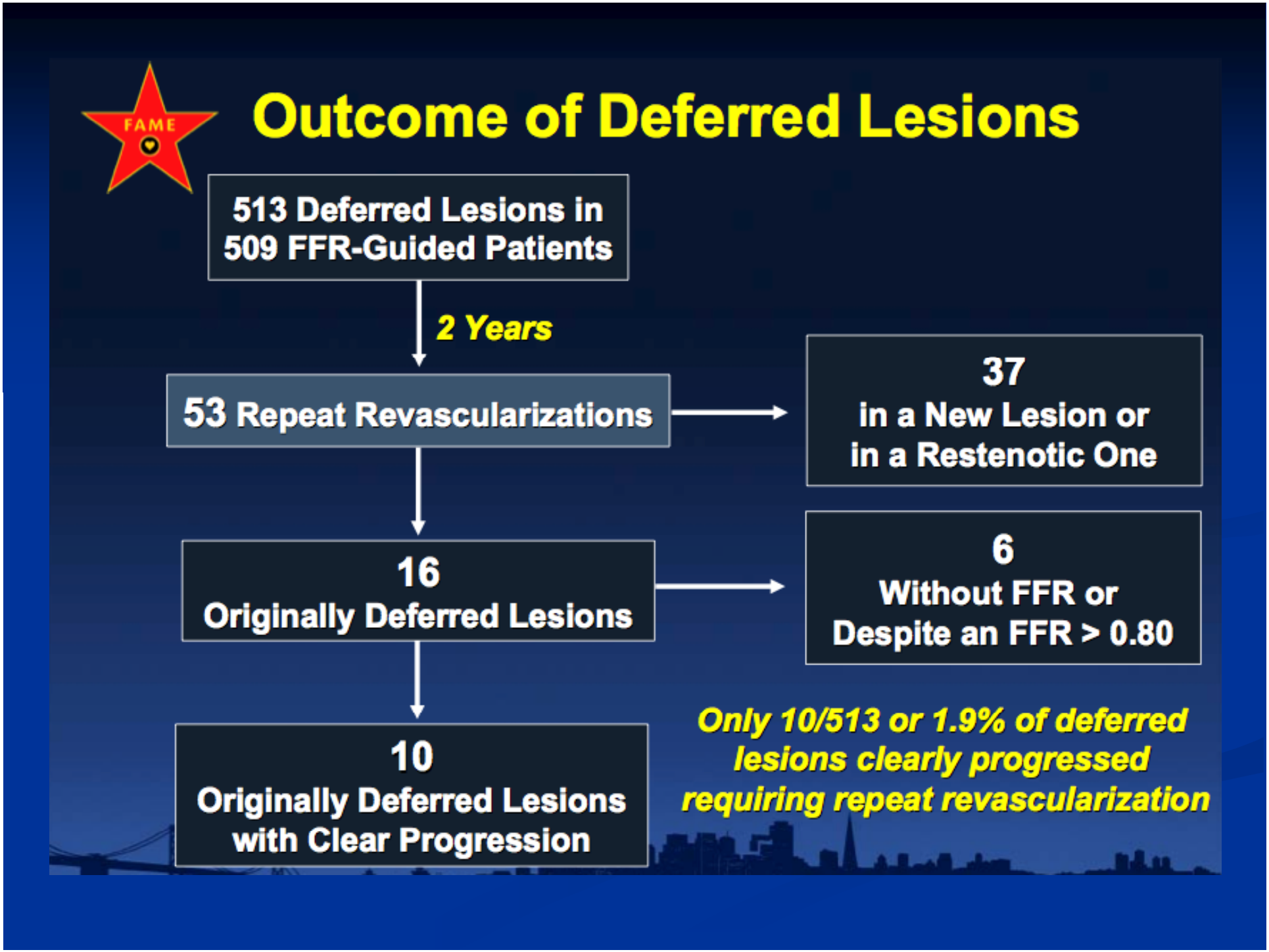
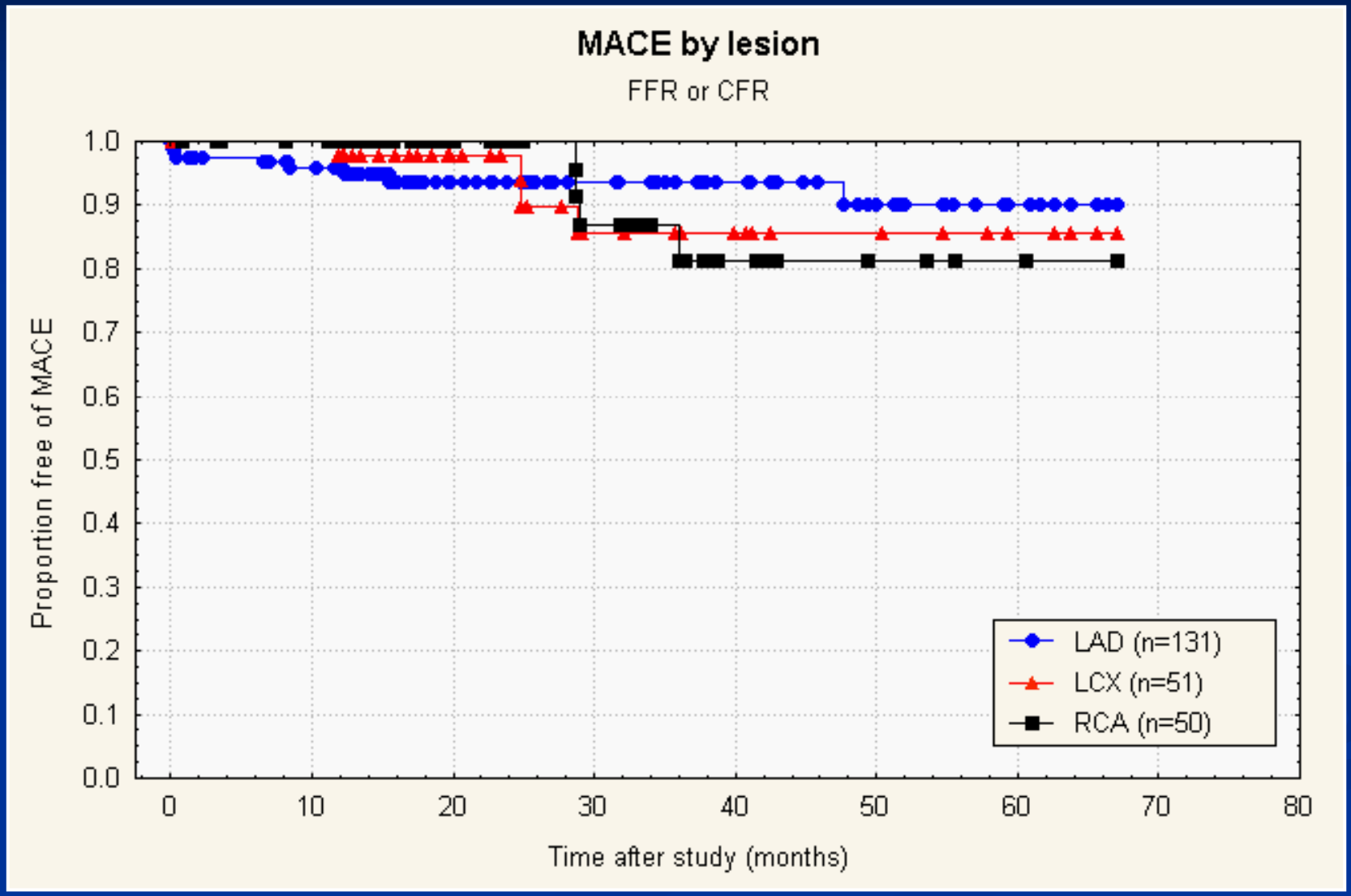


Figure 3 Serial changes of fractional flow reserve in 22 lesions with kissing balloon inflation (KB, kissing balloon inflation).

Eur Heart J 2008;29:726-732

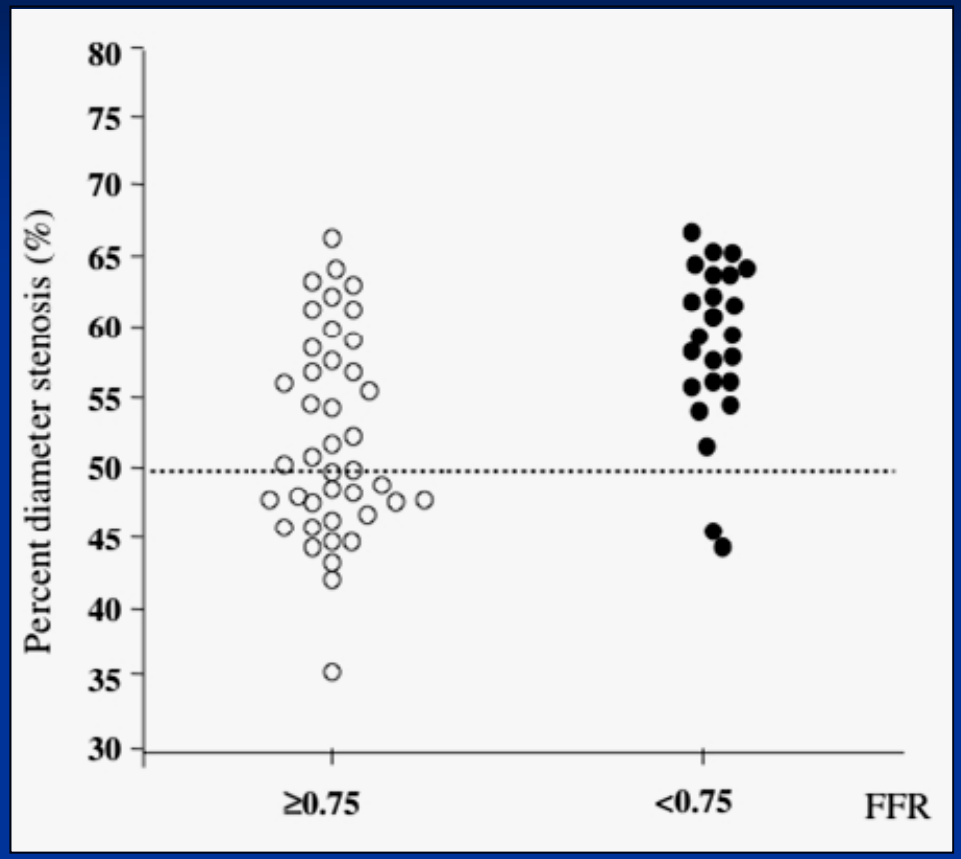

FAME
Outcome of Deferred Lesions
513 Deferred Lesions in 509 FFR-Guided Patients
2 Years
53 Repeat Revascularizations
37 in a New Lesion or in a Restenotic One
16 Originally Deferred Lesions
6 Without FFR or Despite an FFR > 0.80
10 Originally Deferred Lesions with Clear Progression
Only 10/513 or 1.9% of deferred lesions clearly progressed requiring repeat revascularization

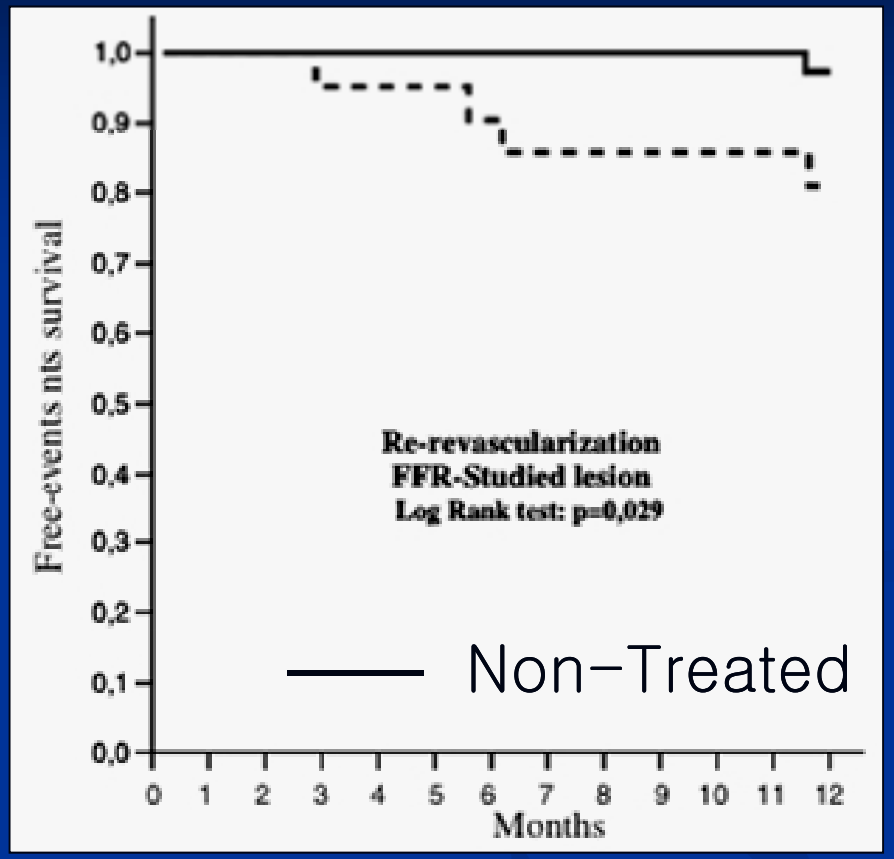
Deferral: effect of lesion location



Cleveland 1996-2001

FFR to guide ISR treatment

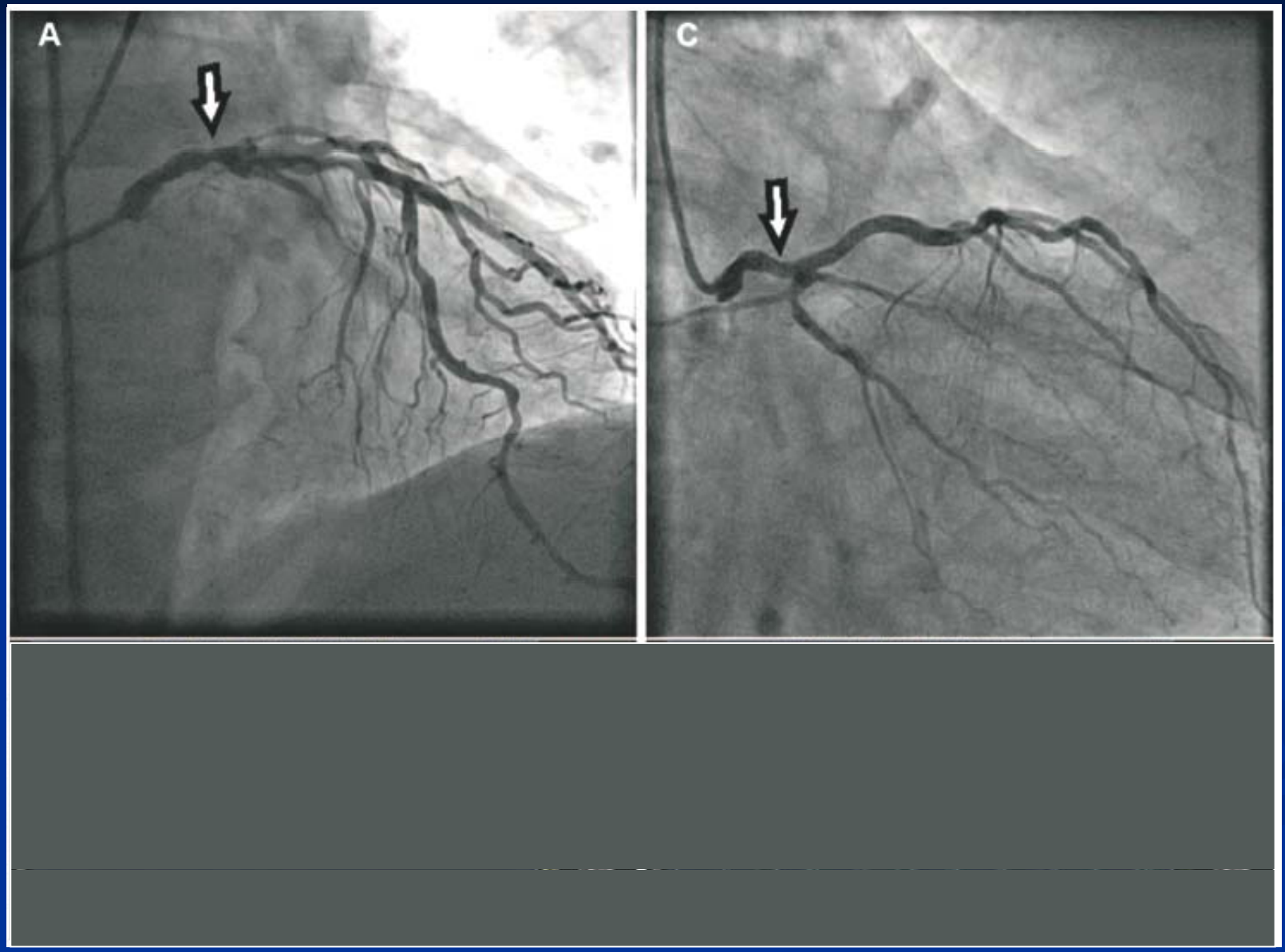




65 lesions with ISR, 63% deferred

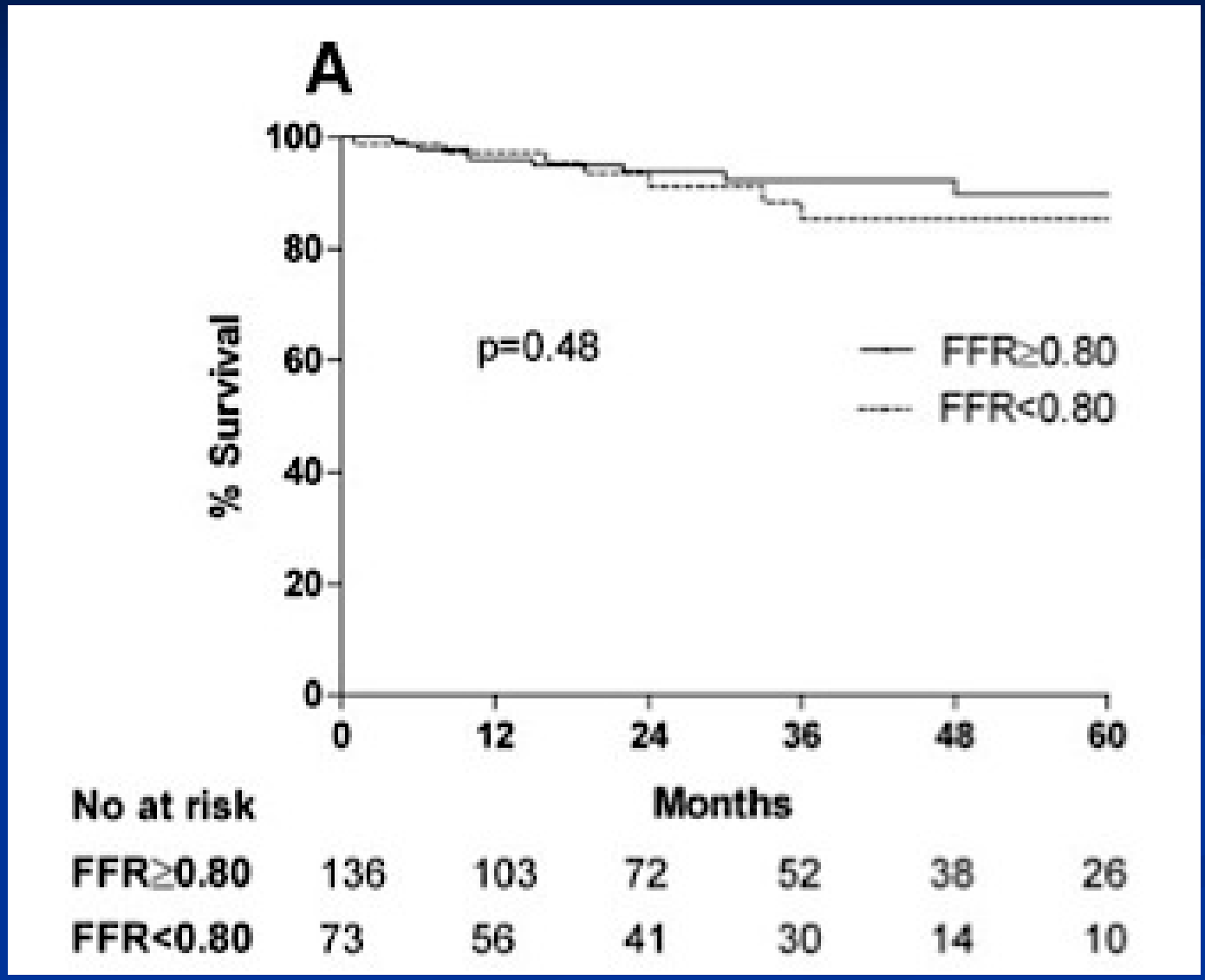
Lopez-Palop et al Eur Heart J 2004;25:2040

Assessment of LM



Hamilos *Circulation*. 2009;120:1505-1512

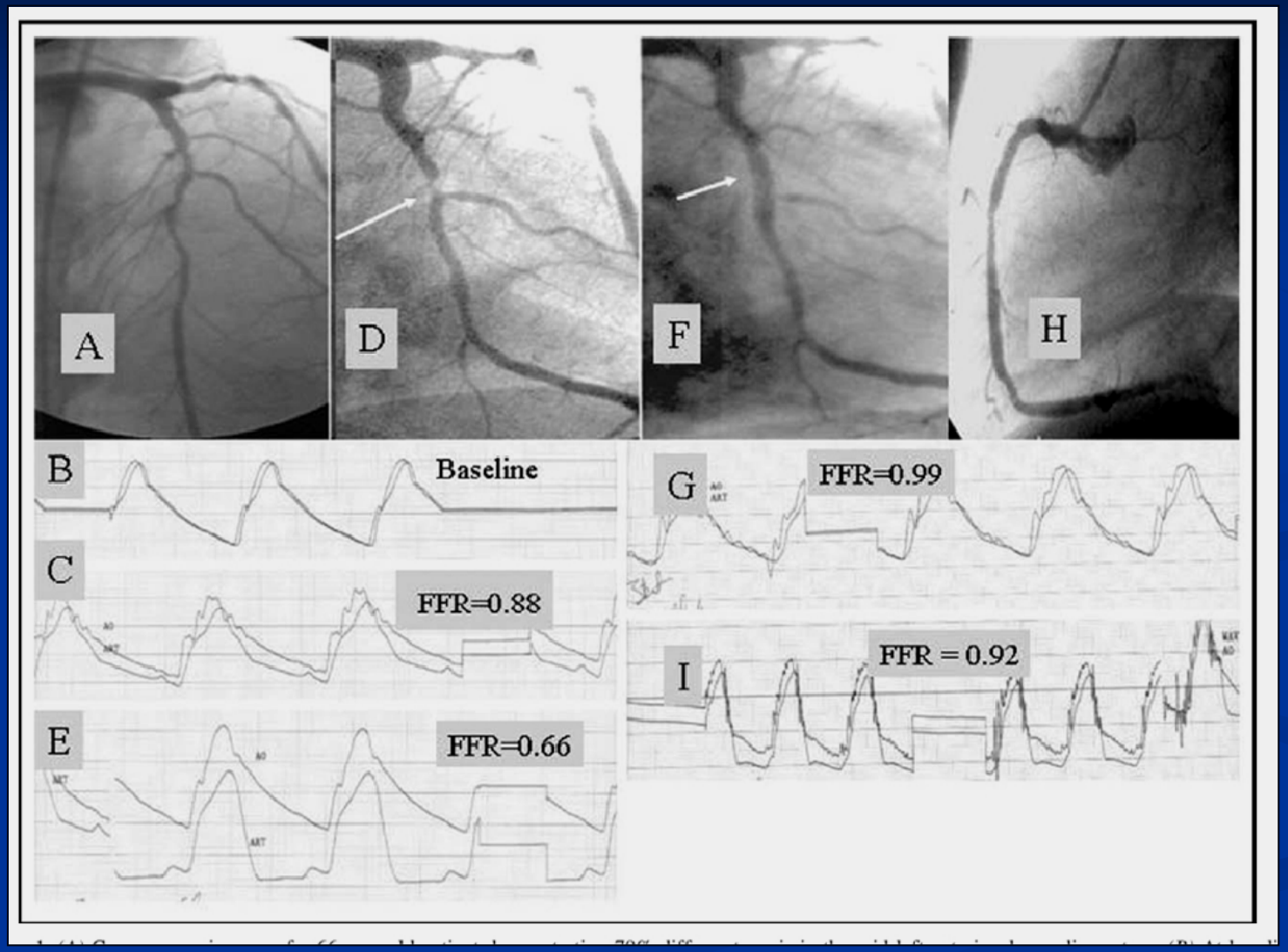
FFR in LM: safety of deferring Tx



Hamilos *Circulation*. 2009;120:1505-1512

FFR–guided PCI

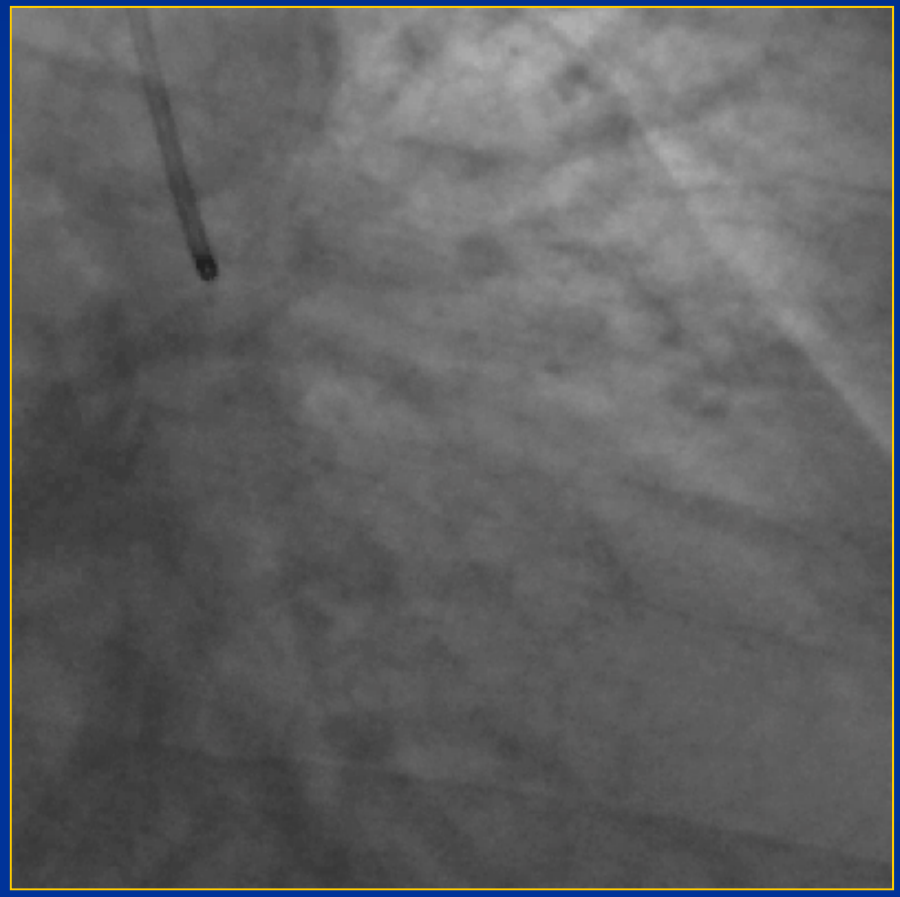
137 pts with MVD (312 ves)



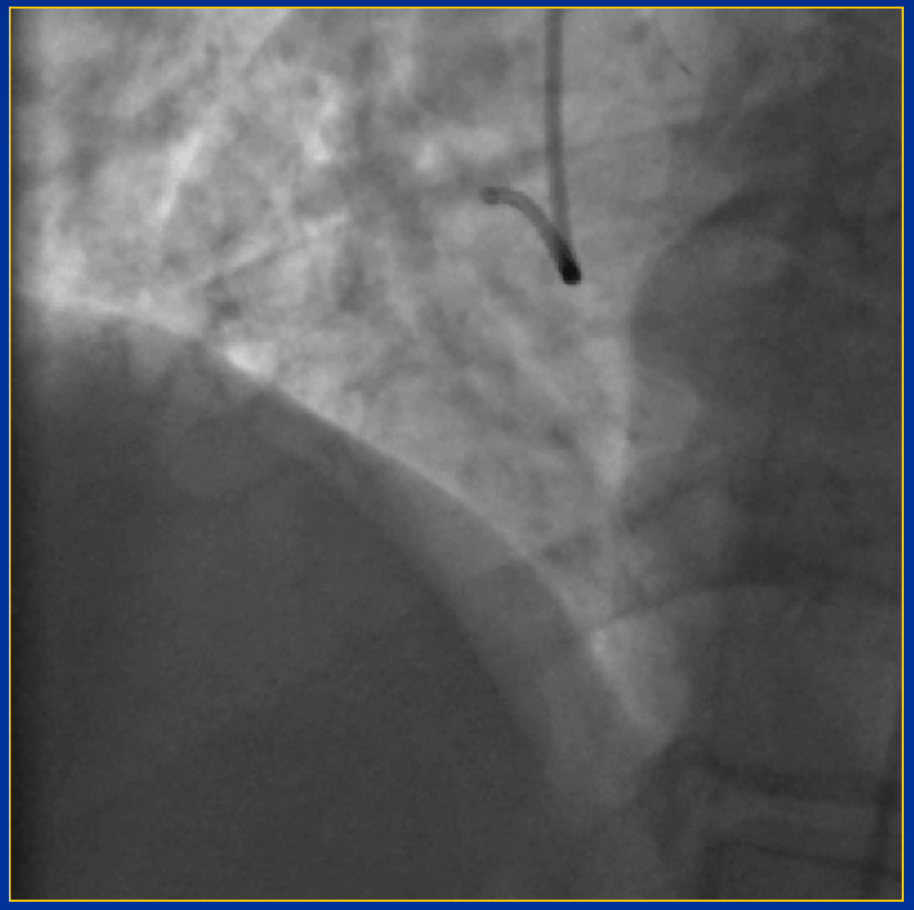
Wongpraparut et al Am J Cardiol 2005;96:877

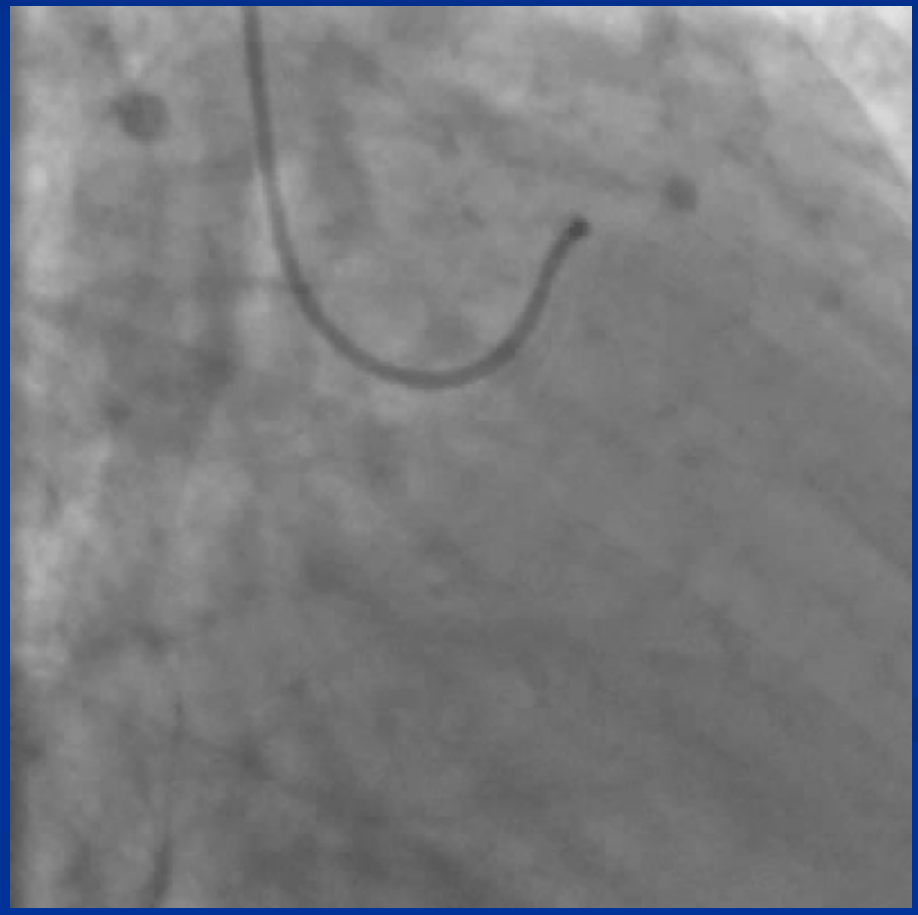
Guidance of DES

60 yo woman with positive stress echo inferior



Guidance of DES





Guidance of DES

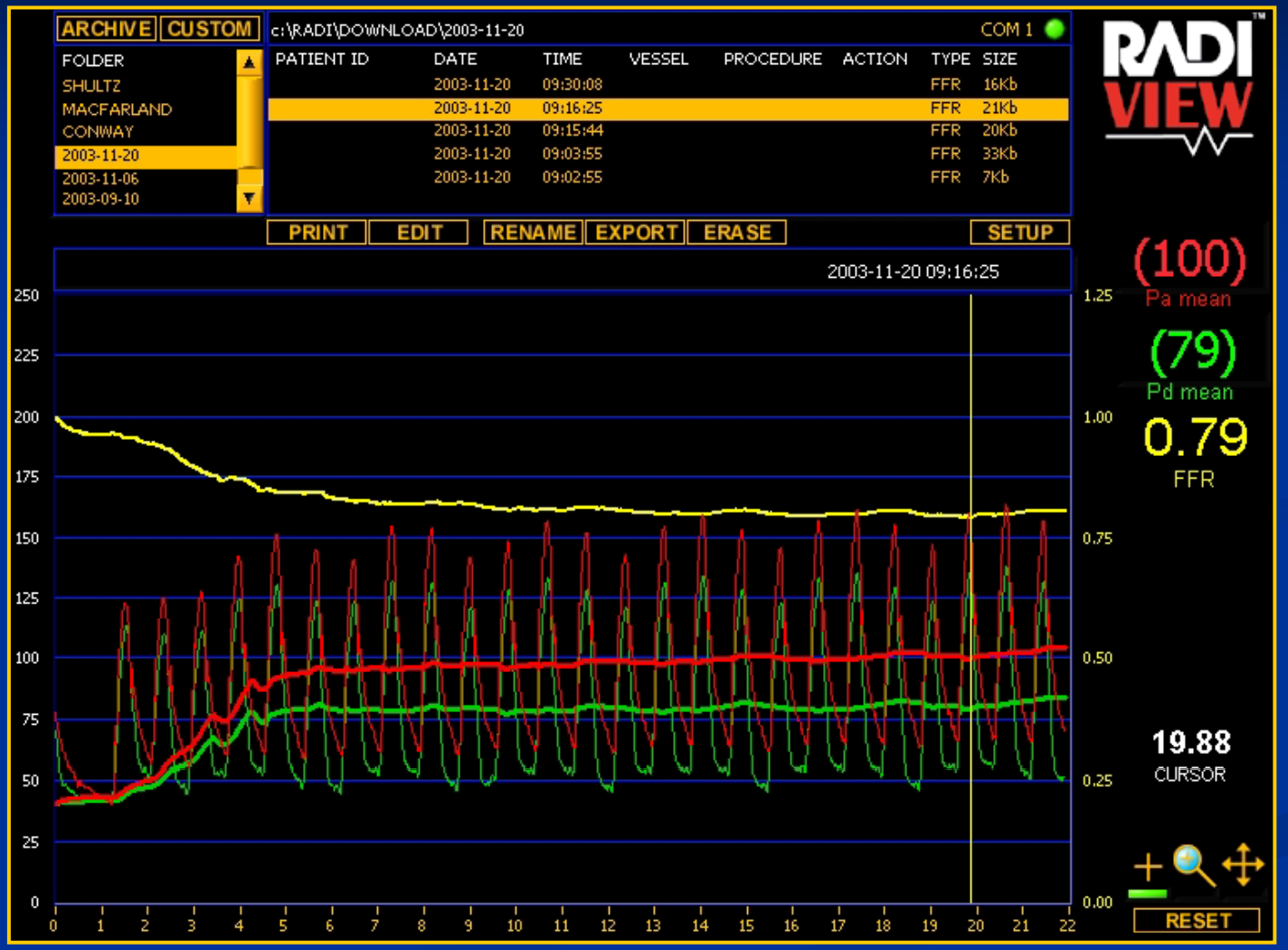
Ramus FFR:
48 and 72 mcg
ic Adenosine

FFR: 0.91
NO PCI needed

Guidance of DES

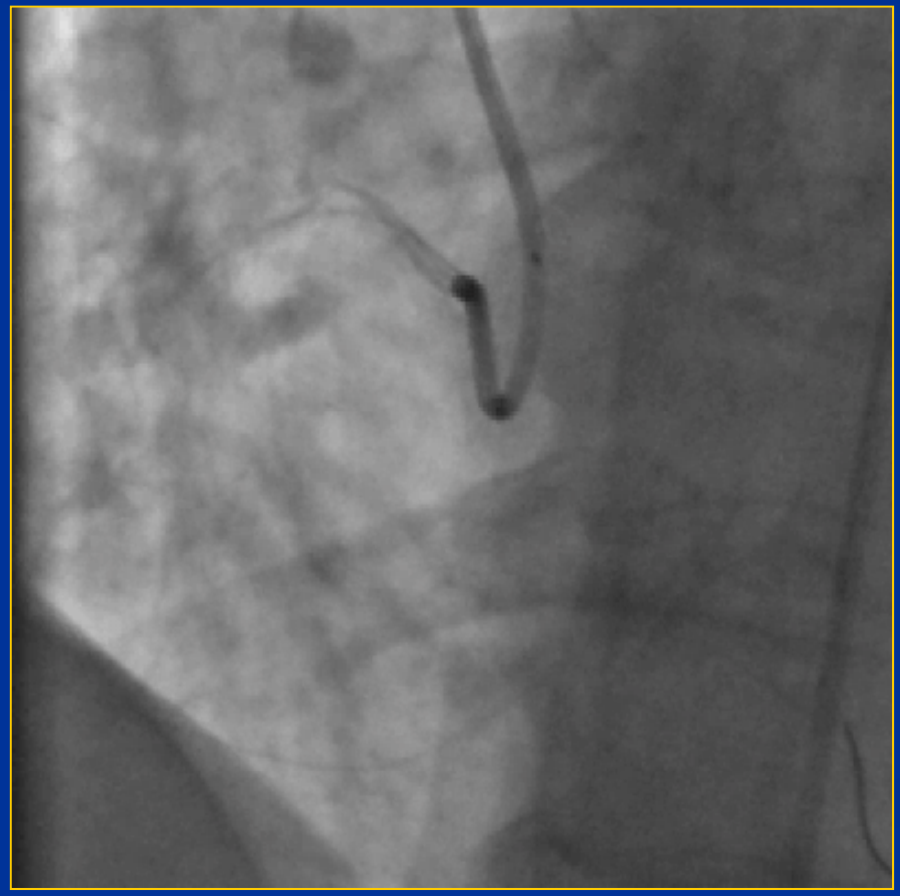
RCA FFR: 48 and 72 mcg ic Adenosine

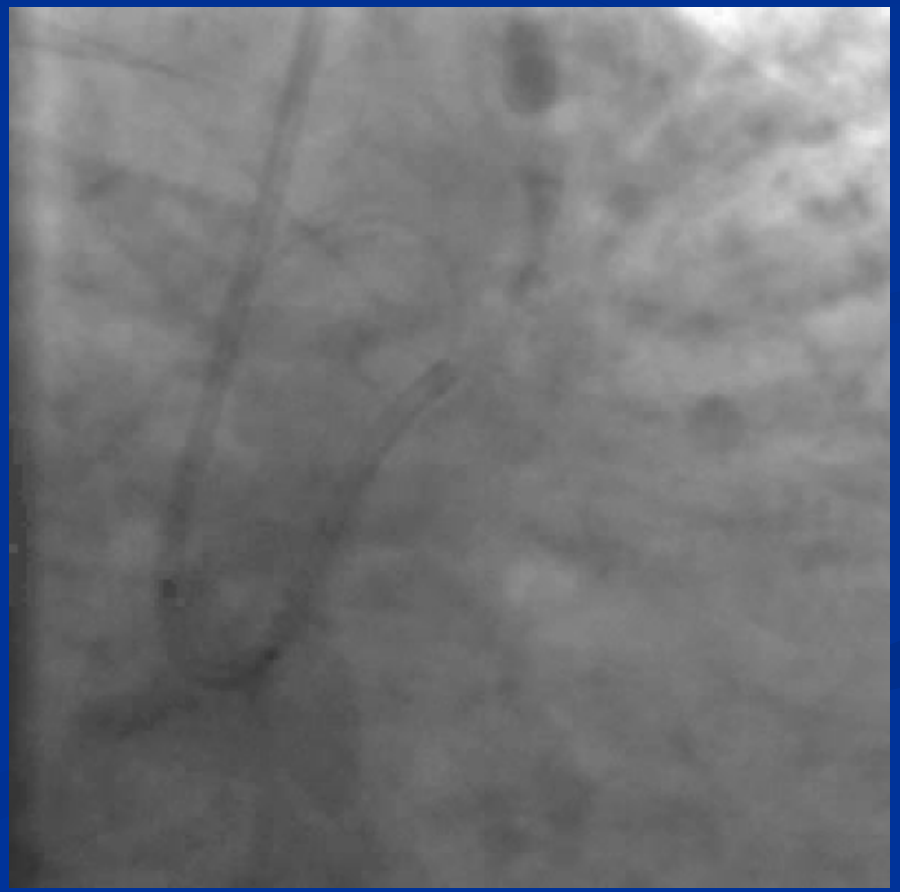
FFR: 0.79 & + stress: PCI needed



Guidance of DES

DES: 2.5 x 18 distal and 3.5 x 18 proximal
Mid lesion remains

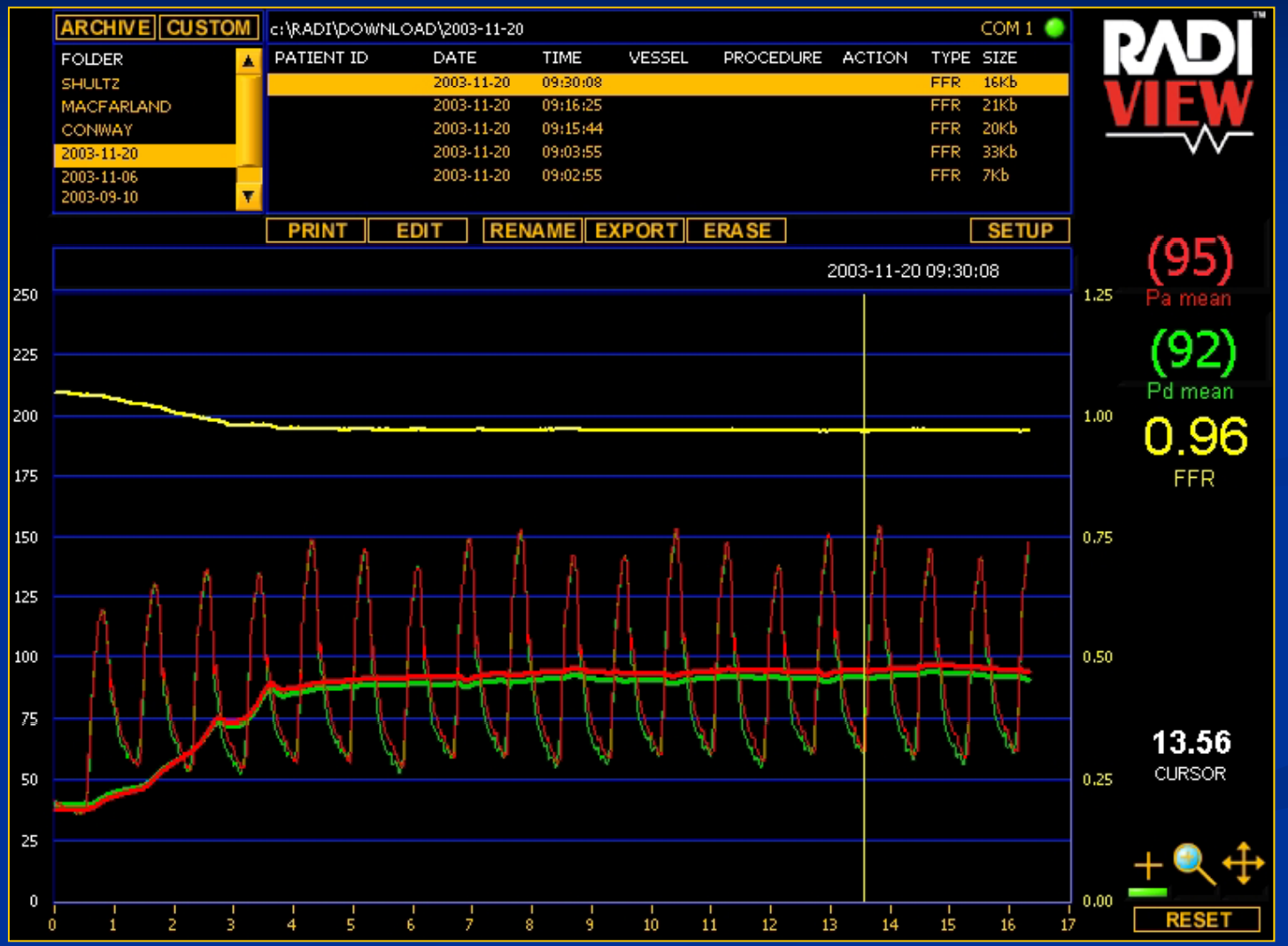




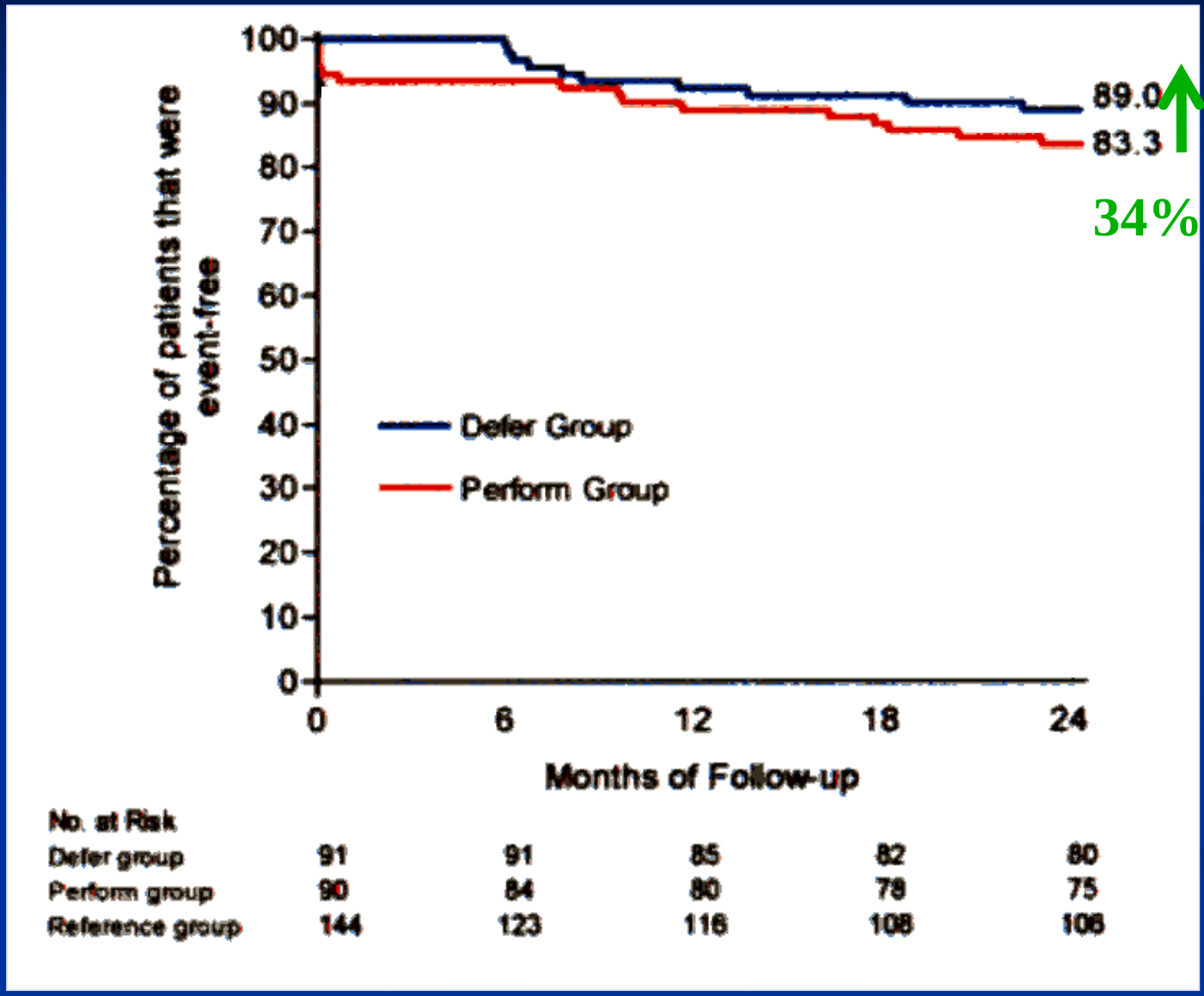
Guidance of DES

RCA FFR:
Post DES
x 2

FFR: 0.96
No further
PCI
needed



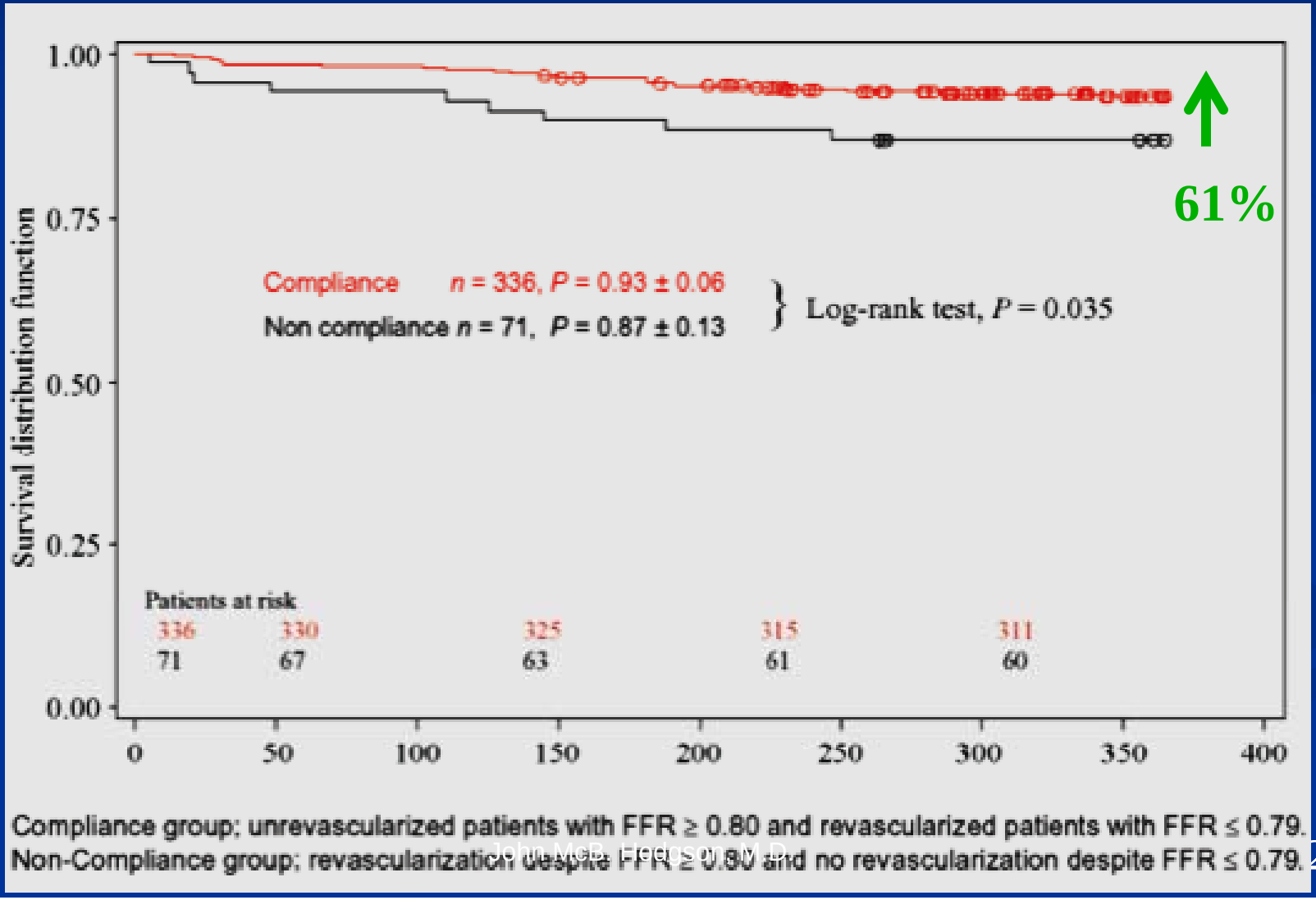
DEFER trial randomized (FFR>0.75)



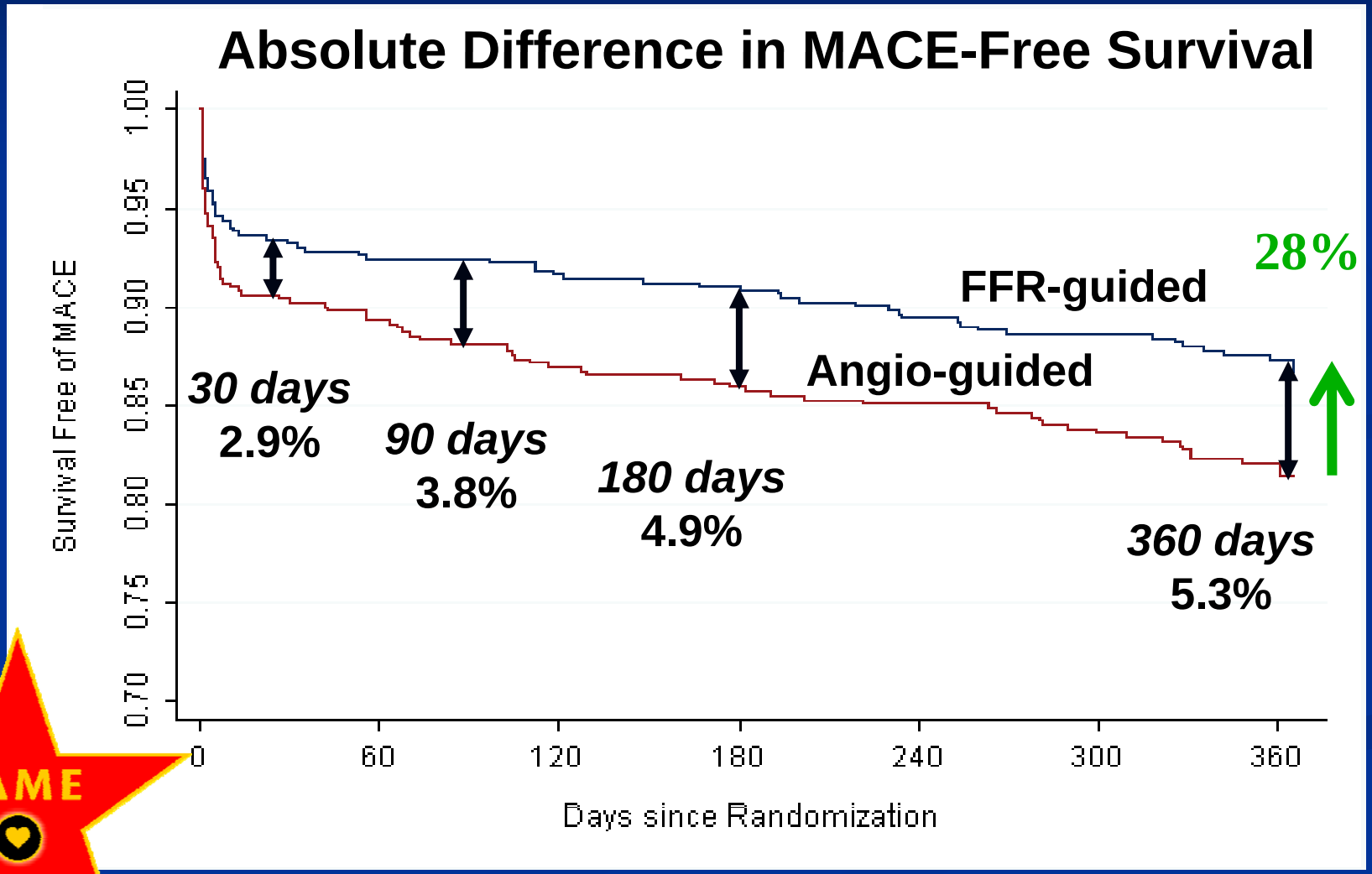
FFR guided multivessel PCI

FFR performed in 6.3% of all patients; deferred in 67% (0.80 cut)

In 17% of FFR tested lesions protocol not followed (n=467 les)



FAME: FFR guided multivessel PCI (n=1005 Pts)



FAME

John McB. Hodgson, M.D.

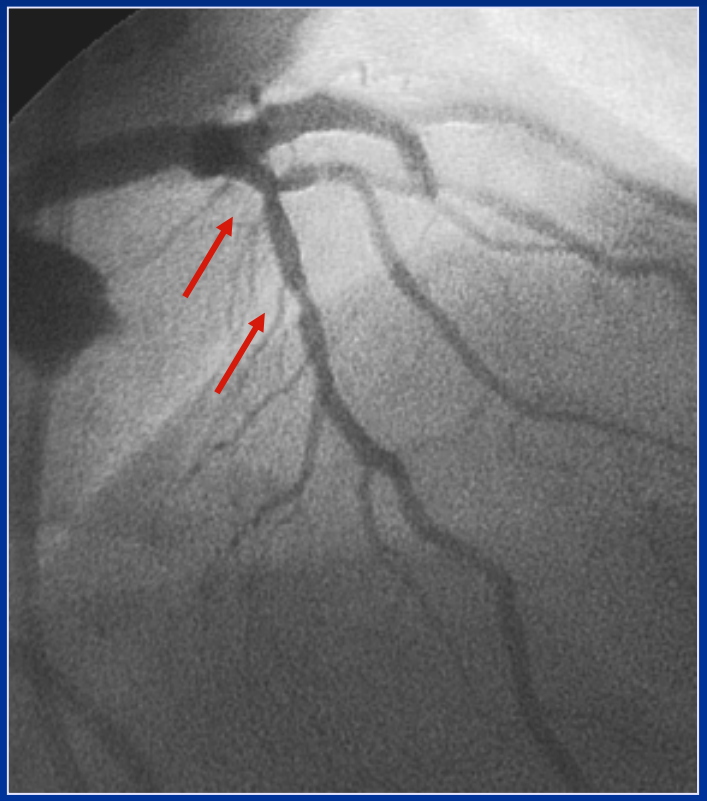
N Engl J Med 2009;360:213-24.

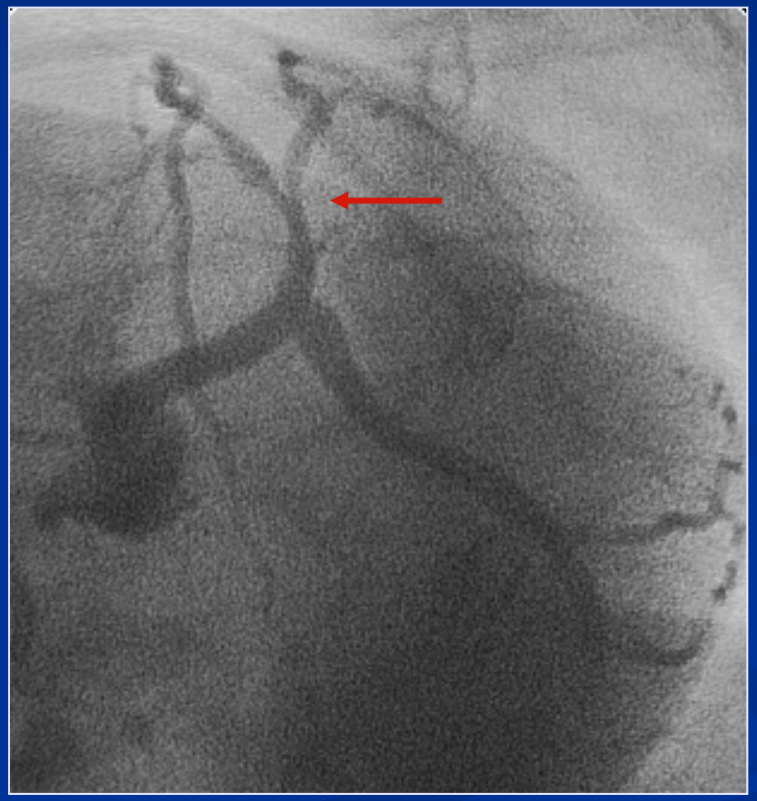
FFR in PCI: CABG vs. Stent

- 72 year old woman with insulin-dependent diabetes and angina
- 125 kg, 152 cm, morbid obesity
- EF: 60%
- Angiography: three vessel disease including proximal LAD
- CABG or PCI?

FFR in PCI: optimizing therapy (1999)

LAD/D1 bifurcation lesion

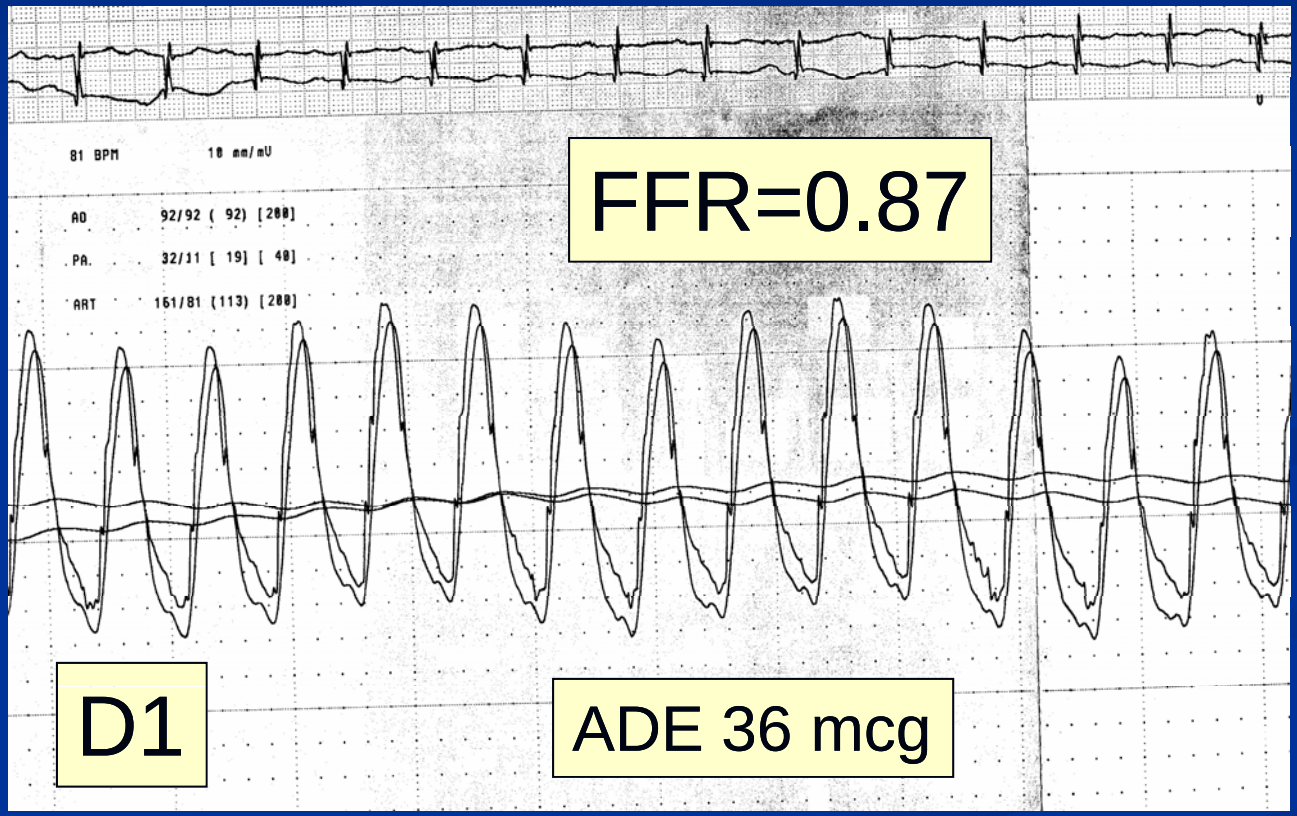




John McB. Hodgson, M.D.

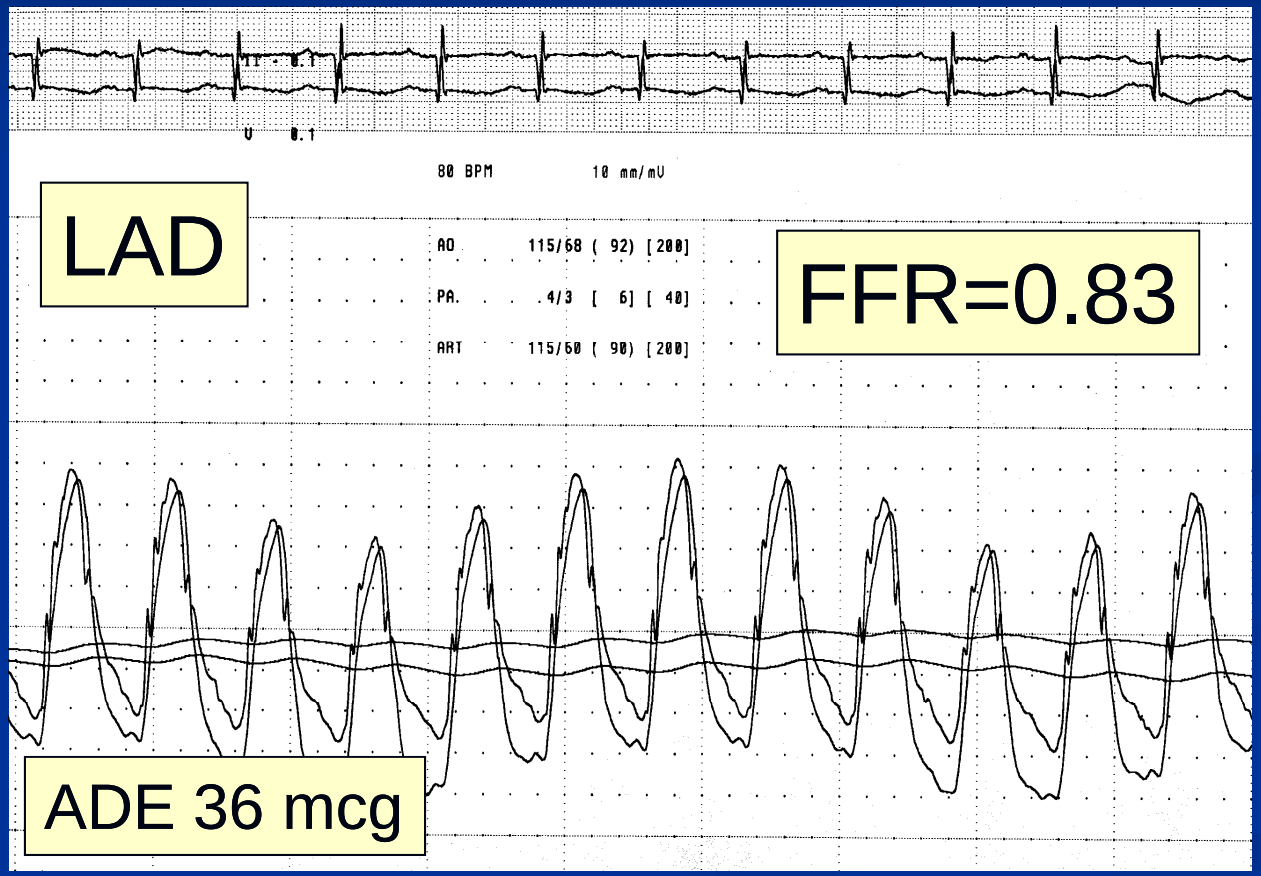
FFR in PCI: optimizing therapy

Evaluate LAD/D1 lesion with FFR



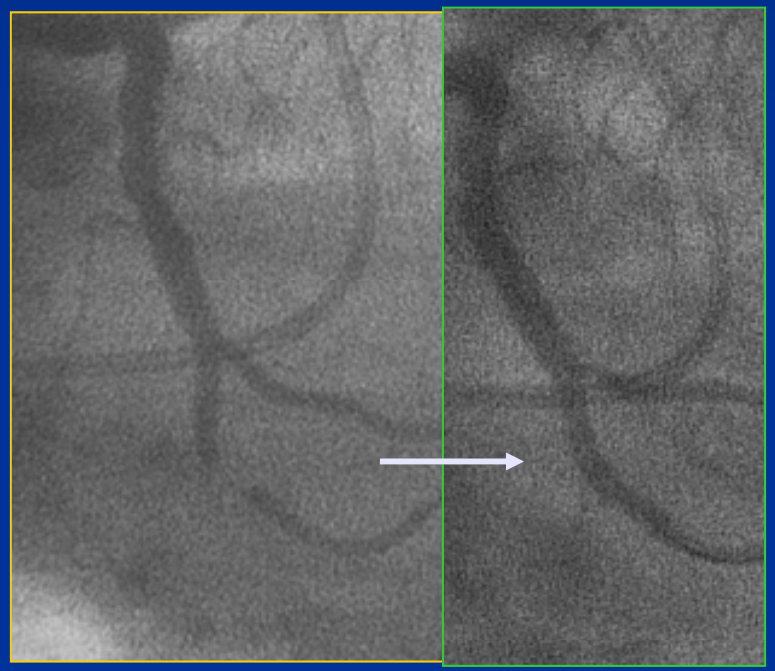
FFR in PCI: optimizing therapy

Evaluate LAD/D1 lesion with FFR

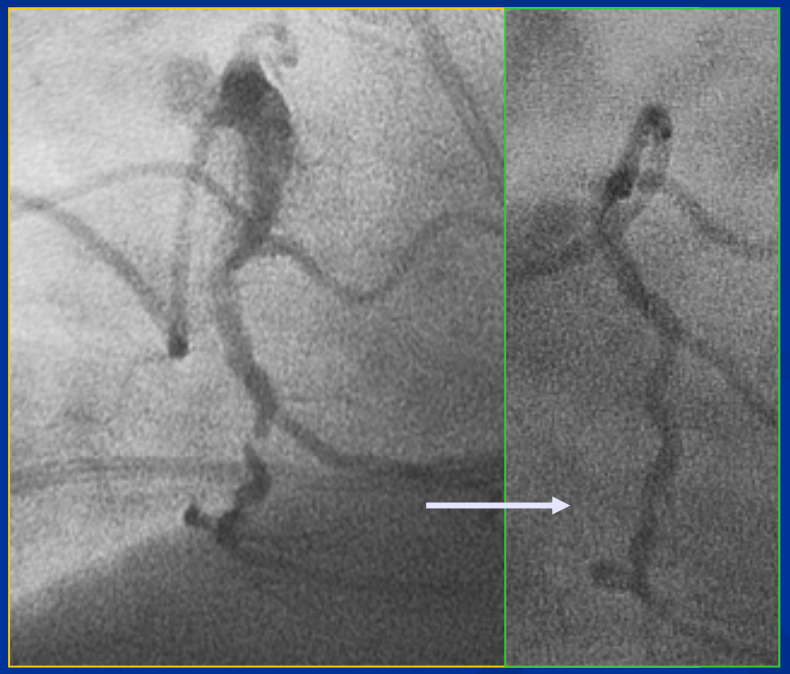


FFR in PCI: optimizing therapy

Treat LCx, RCA with PCI



LCX: stent



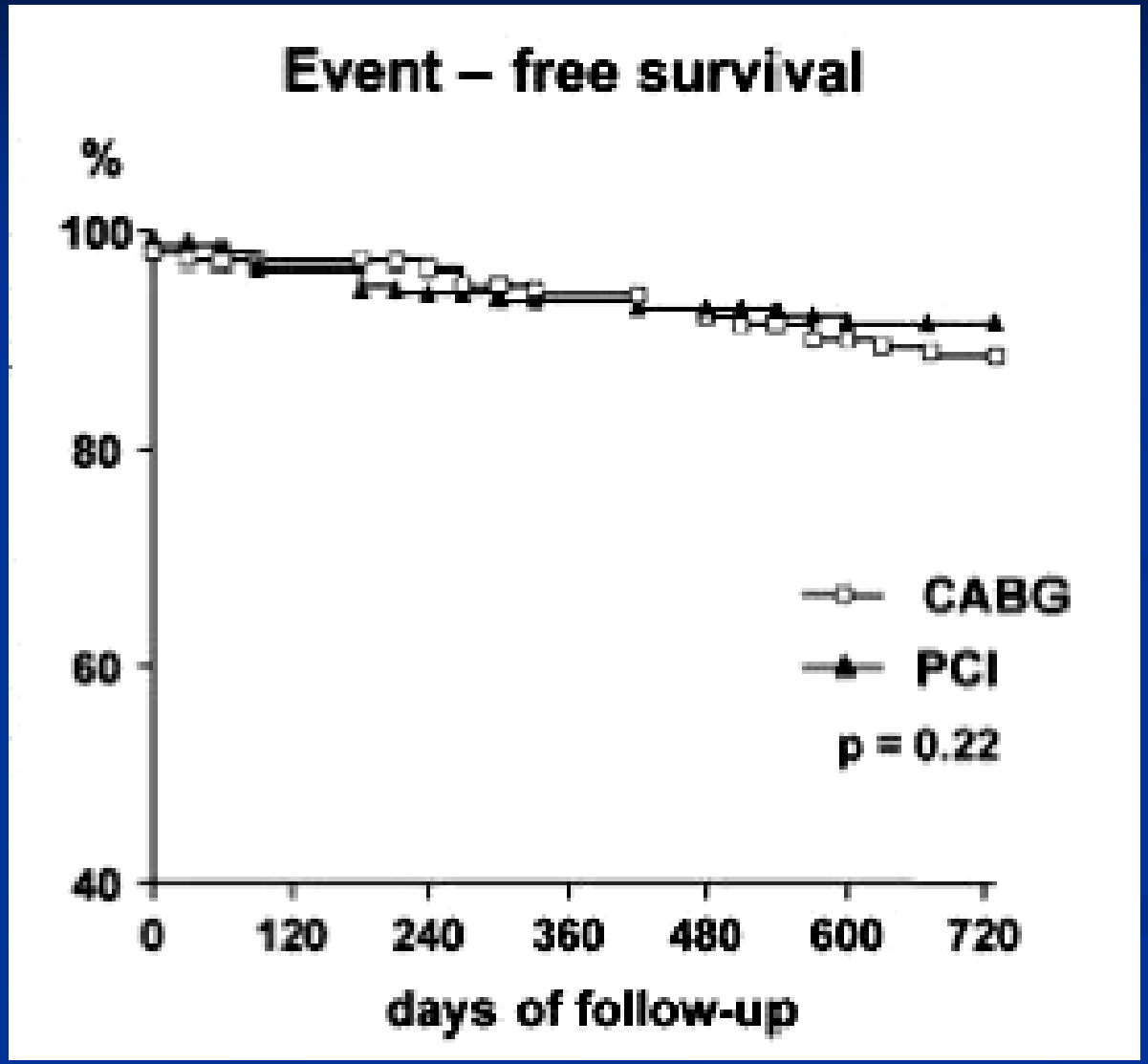
RCA: CB

Tailored Approach Study

Multivessel patients referred for CABG

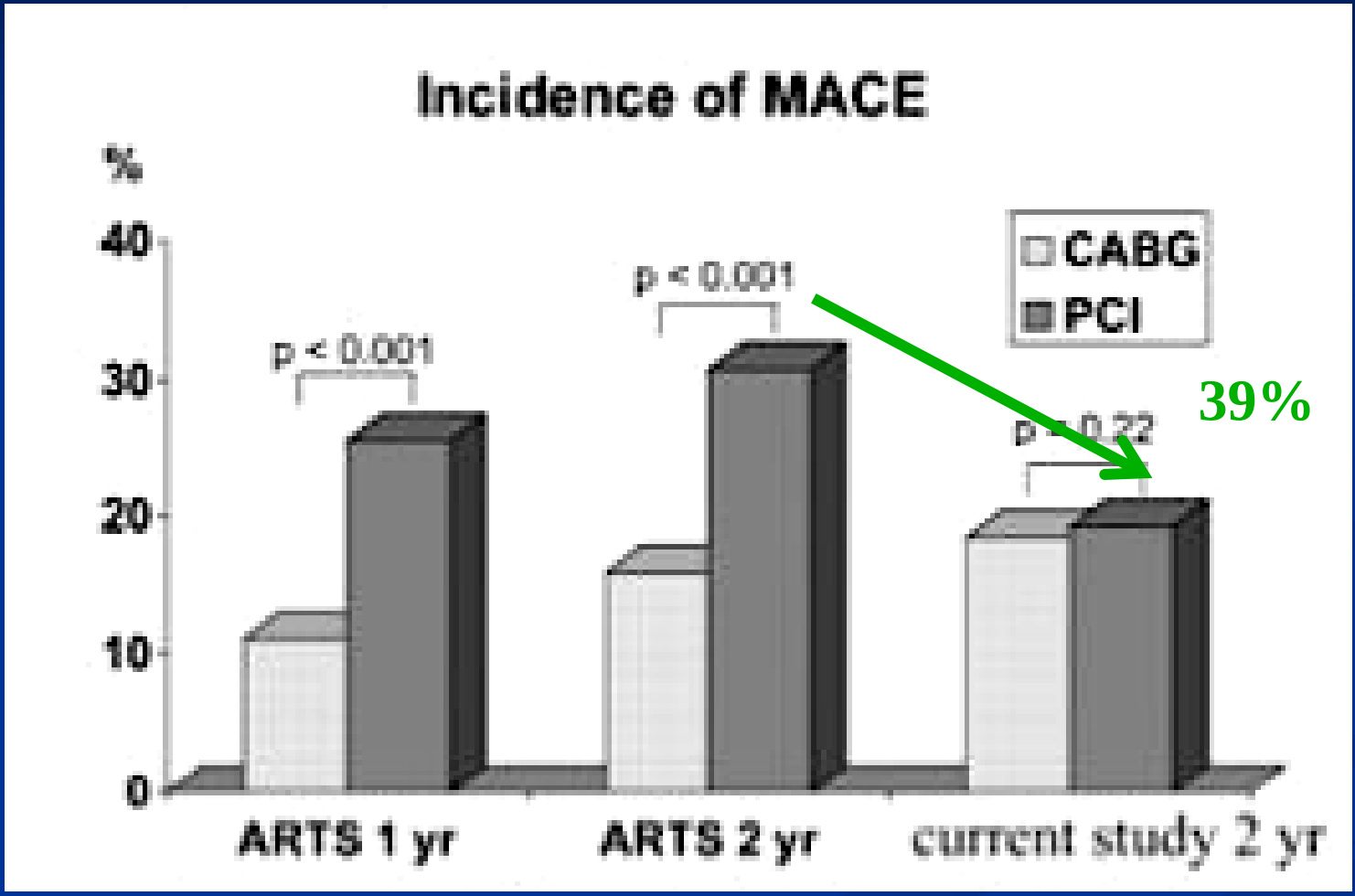
FFR all lesions:

- CABG only if prox LAD or > 2 lesions significant
- PCI for all others



Catheter Cardiovasc Interv 2004;63:184–191

Tailored Approach Study



Angio guided FFR guided

Catheter Cardiovasc Interv 2004;63:184–191

FFR Outcomes Summary

- FFR guided PCI deferral is safe and has low event rate, even with LM lesions or ISR
- Guided Balloon PCI has improved outcomes
- Guided BMS PCI has improved outcomes
- Guided strategy for DES PCI has improved outcomes
- Guided strategy for PCI vs CABG has improved outcomes