Physiology-guided PCI
Present status & future perspectives

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JCR
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Disclosure Statement of Financial Interest

Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below.

Affiliation/Financial Relationship

- **Grant/Research Support** : **Abbott Vascular Japan**
  Goodman Inc.
  St. Jude Medical Japan
  Terumo Inc.

- **Consulting Fees/Honoraria** : **Daiichi-Sankyo Pharmaceutical Inc.**
  Goodman Inc.
  St. Jude Medical Japan
  Terumo Inc.

Concept of FFRmyo

First, it will be p
pressure (P_a) and
subtraction of ver
purpose, suppose i
P_v, that $R_s=\infty$ and
and $P_d=P_w$ by defi

and

Therefore

P
P

Equation A1a can
forms, which will b

and

where C_1, C_2, and
collateral resistanc
dial bed supplied t
The second step
of the stenotic cor

Because $Q_c^N=0$:

Substitution of
tion A1b, gives th

$FFR_{cor}=$

Next, fractional
calculated as follo

$FFR_{myo}=$

Equation A3 ha

The contributi
calculated as foll

Therefore:

and because $Q_s^N=$

In case of inte
maximum vasodil
pressure P_a-P_v. T
through the coron
intervention (situ

By substitution

Note that for evalu
stenotic artery after
better measure than
independent of arter
clear that

$$\frac{FFR_{cor}^{(2)}}{FFR_{cor}^{(1)}}=\frac{P_d^{(2)}-P_w^{(2)}}{P_a^{(2)}-P_w^{(2)}}$$

$$=\left(1-\frac{\Delta}{P_a^{(2)}}\right.$$

The expression FF
of FFR_{cor} of the dila
called pressure-correc
previous study.[11]
Equation A5a can a
the following:

$$\frac{Q_s^{(2)}}{Q_s^{(1)}}=\frac{Q^{(2)}-Q_c^{(2)}}{Q^{(1)}-Q_c^{(1)}}$$

and by substituting Ec
Theoretically, maxi
dium can be compare

$$\frac{Q^{(2)}}{Q^{(1)}}=$$

or, if correction for pr

$$\frac{FFR_{myo}^{(2)}}{FFR_{myo}^{(1)}}=\frac{P_d^{(2)}-P_v^{(2)}}{P_a^{(2)}-P_v^{(2)}}$$

$$=\left(1-\frac{\Delta}{P_a^{(2)}}\right.$$

Finally, the theoretical relation between collateral flow at different degrees of stenosis can be obtained. From Figure 1, it is clear that $Q_c=(P_a-P_d)/R_c$. Therefore:

$$\frac{Q_c^{(2)}}{Q_c^{(1)}}=\frac{(P_a^{(2)}-P_d^{(2)})/R_c}{(P_a^{(1)}-P_d^{(1)})/R_c}=\frac{\Delta^{(2)}P}{\Delta^{(1)}P} \quad \text{(A7a)}$$

or, if correction for pressure changes is made:

$$\frac{Q_c^{(2)}}{Q_c^{(1)}}=\frac{\Delta^{(2)}P}{P_a^{(2)}-P_v^{(2)}}:\frac{\Delta^{(1)}P}{P_a^{(1)}-P_v^{(1)}} \quad \text{(A7b)}$$

In fact, Equation A7 states that decrease of ΔP by improved stenosis geometry after PTCA induces a proportional decrease of the relative contribution of collateral flow to total myocardial flow, which will be further clarified in the following examples.

Application of these equations in clinical practice also will be demonstrated.

Example 1

The first example is based on the simple hemodynamic case in which systemic pressures (P_a and P_v) are unchanged during PTCA. Therefore, according to Equation A1a, wedge pressure (P_w) also is constant.

Before and after PTCA of one of the coronary arteries, pressure measurements are performed by the pressure-monitoring guide wire at maximum coronary hyperemia induced by intracoronary administration of papaverine or adenosine. Mean arterial pressure (P_a) is 90 mm Hg both before and after the procedure; transstenotic pressure gradient ΔP is reduced from 50 mm Hg before to 10 mm Hg after the procedure; and venous pressure (P_v) is 0 both before and after the procedure. P_w measured during balloon inflation, is 20 mm Hg. Therefore, $P_a^{(1)}=P_a^{(2)}=90$ mm Hg, $P_d^{(1)}=40$ mm Hg, $P_d^{(2)}=80$ mm Hg, $P_v^{(1)}=P_v^{(2)}=0$ mm Hg, and $P_w^{(1)}=P_w^{(2)}=20$ mm Hg.

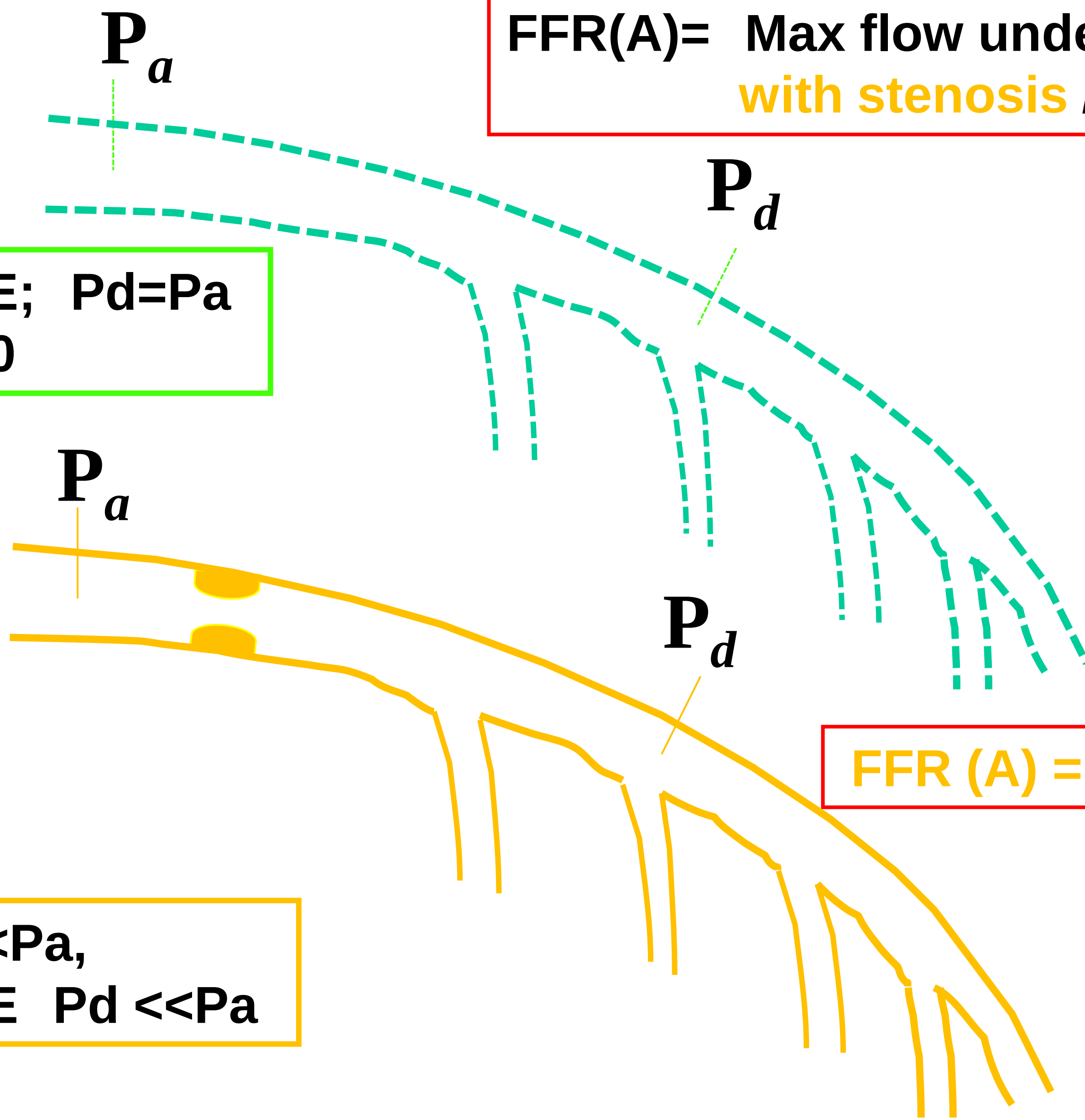
With Equations A6b, A5b, and A7b, the following is obtained:

Pijls N, et al. Circulation 1993;86:1354-1367

Measurement of FFRmyo

FFR(A)= Max flow under the condition with stenosis / without stenosis

No stenosis



During HE; Pd=Pa
P_d / P_a=1.0

Stenosis (A)

FFR (A) = P_d / P_a during HE

Rest Pd<Pa,
During HE Pd <<Pa

Advantage of FFR in daily clinical practice

Easy to measure mean coronary pressure by PGW.

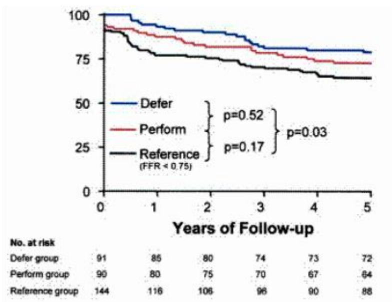
Normal value to FFR is 1.0.

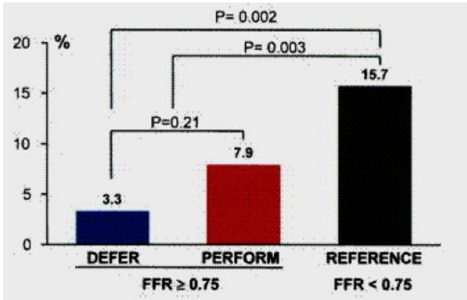
Cut-off value for demonstrating ischemia is 0.75.

Cut-off value for revascularization is 0.8.

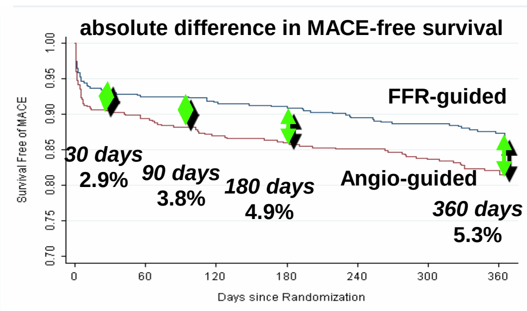
Clinical Evidence in FFR

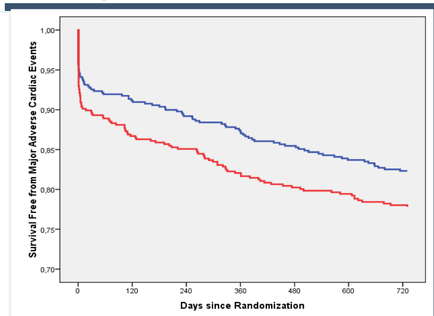
DEFER:J Am Coll Cardiol 2007;49:2105-2111



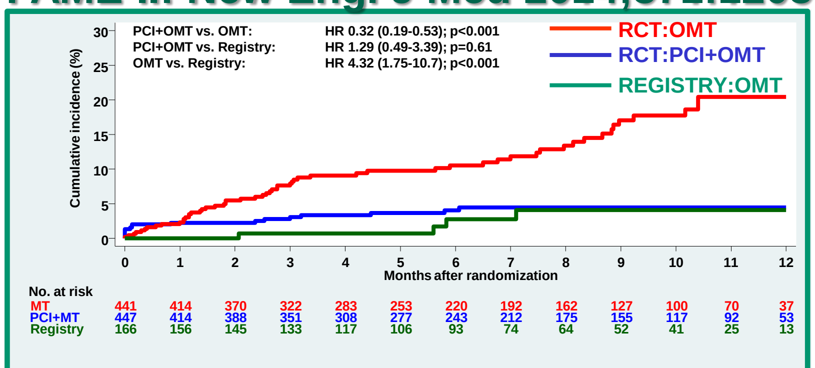


FAME I: New Engl J Med 2009;360:213-224





FAME II: New Engl J Med 2014;371:1208-1218



Intracoronary imaging & physiology in ESC guideline 2014

Recommendations	Class[a]	Level[b]	Ref.[c]
FFR to identify haemodynamically relevant coronary lesion(s) in stable patients when evidence of ischaemia is not available.	I	A	50,51,713
FFR-guided PCI in patients with multivessel disease.	IIa	B	54
IVUS in selected patients to optimize stent implantation.	IIa	B	702,703,706
IVUS to assess severity and optimize treatment of unprotected left main lesions.	IIa	B	705
IVUS or OCT to assess mechanisms of stent failure.	IIa	C	
OCT in selected patients to optimize stent implantation.	IIb	C	

Eur Heart J. 2014;35:2541-2619

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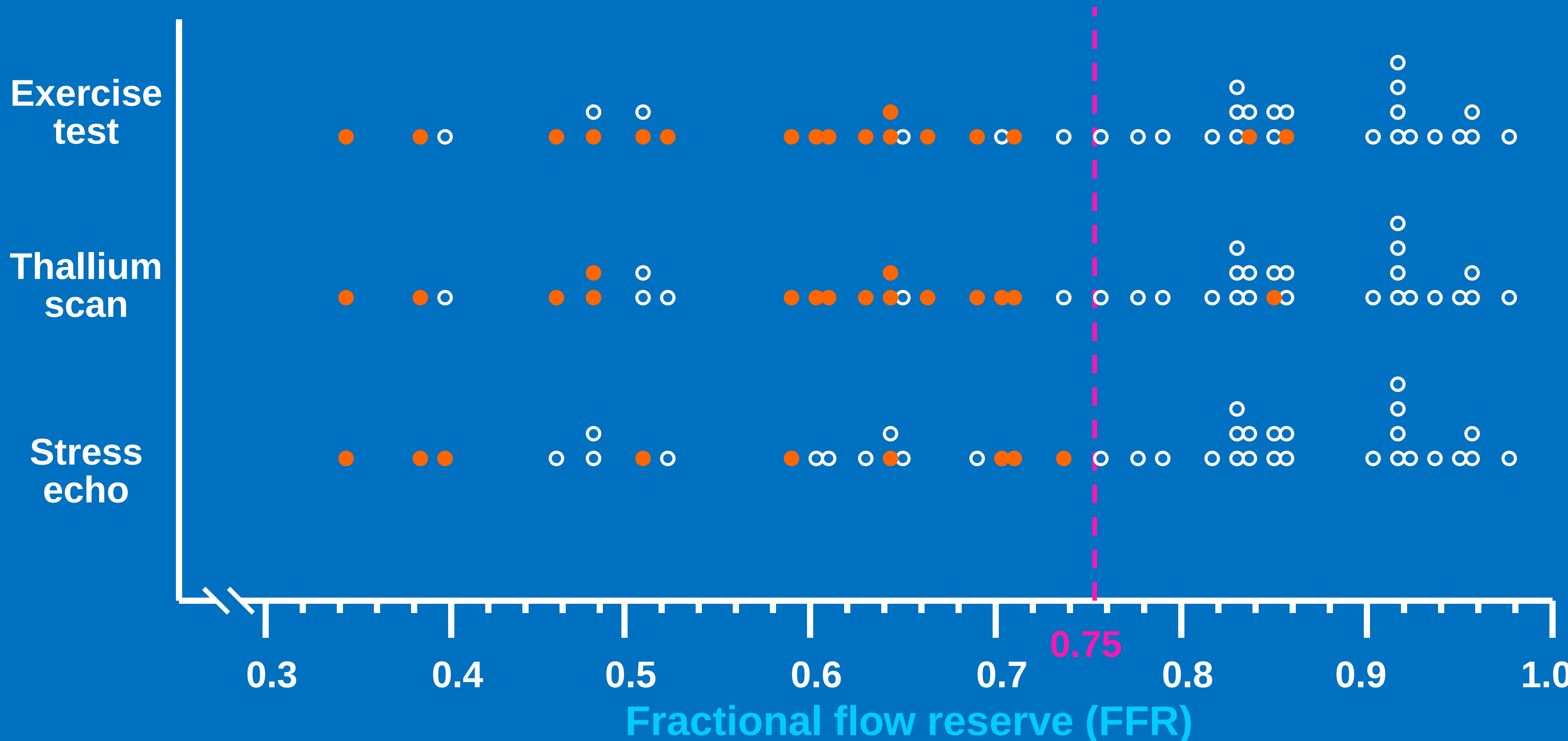
Relationship between FFR & functional tests



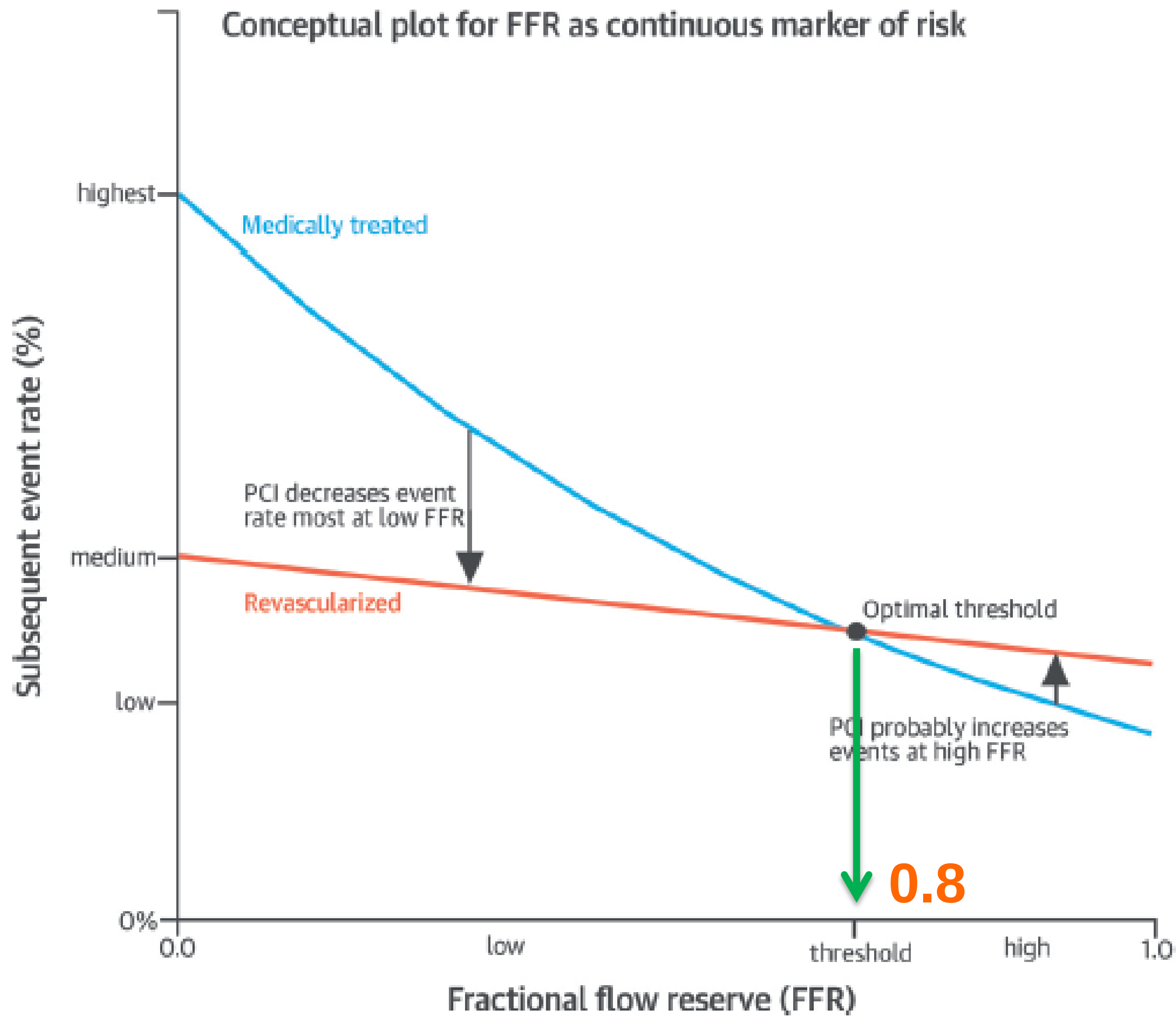
(N.H.J.Pijls, et al. N Engl J Med 1996;334:1703-1708)

Relationship between FFR & other tests

Authors	Number	Ischemic tests	Best cut-off value	Accuracy
Pijls et al.	60	X-ECG	0.74	97
DeBruyne et al.	60	X-ECG/SPECT	0.72	85
Pijls et al.	45	X-ECG/SPECT/pacing/DSE	0.75	93
Bartunek et al.	37	DSE	0.68	90
Abe et al.	46	SPECT	0.75	91
Chamuleau et al.	127	SPECT	0.74	77
Caymaz et al.	40	SPECT	0.76	95
Jimenez-Navarro et al.	21	DSE	0.75	90
Usui et al.	167	SPECT	0.75	79
Yanagisawa et al.	167	SPECT	0.75	76
Meuwissen et al.	151	SPECT	0.74	85
DeBruyne et al.	57	MIBI-SPECT post-MI	0.78	85
Samady et al.	48	MIBI-SPECT post-MI	0.78	85

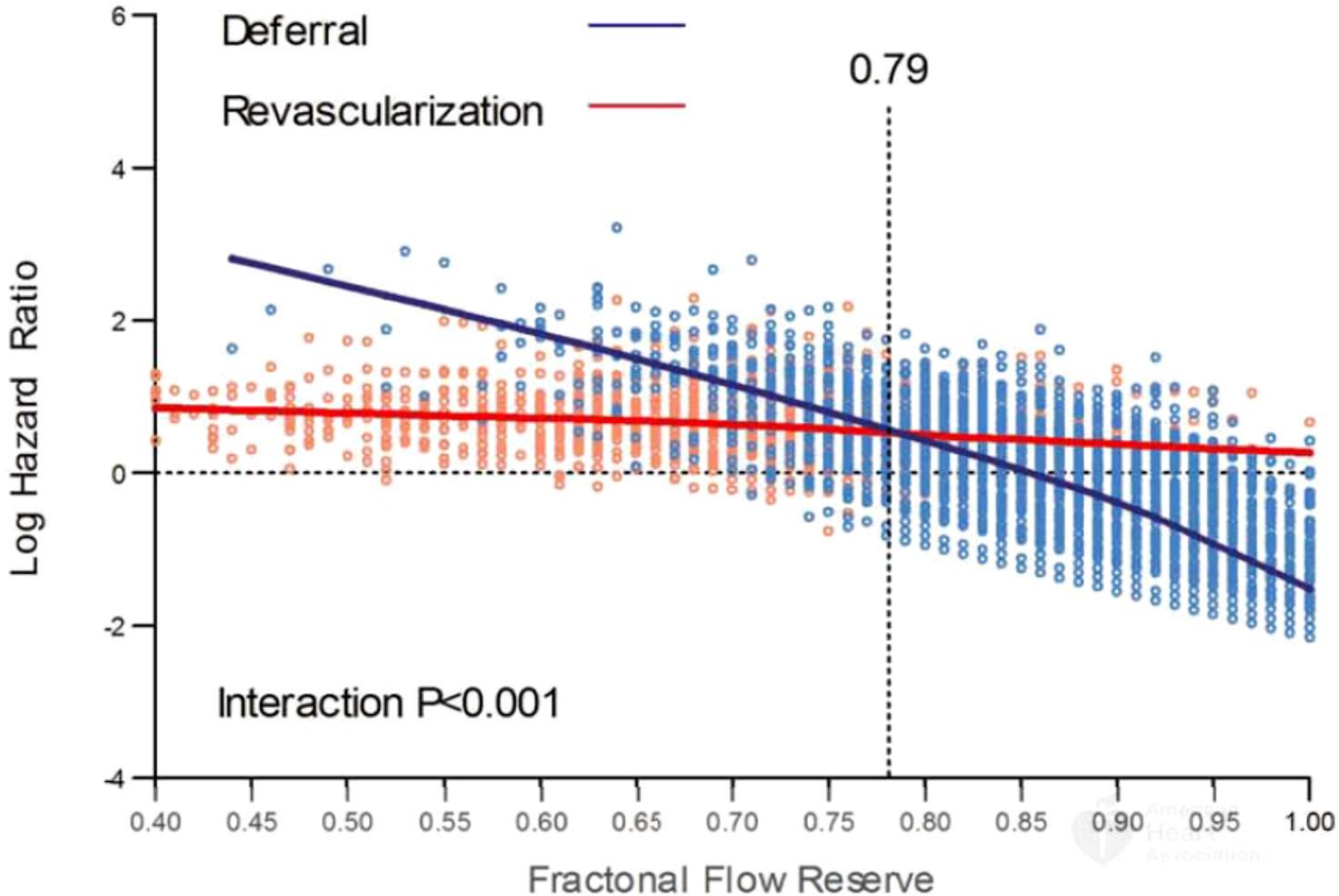
(Kern MJ & Samady H. J Am Coll Cardiol 2010;55:173-185)

Conceptual relationship between FFR & outcomes



Johnson NP, et al. J Am Coll Caridol 2014;64:1641-1654

Hazard Ratio of MACE in each FFR



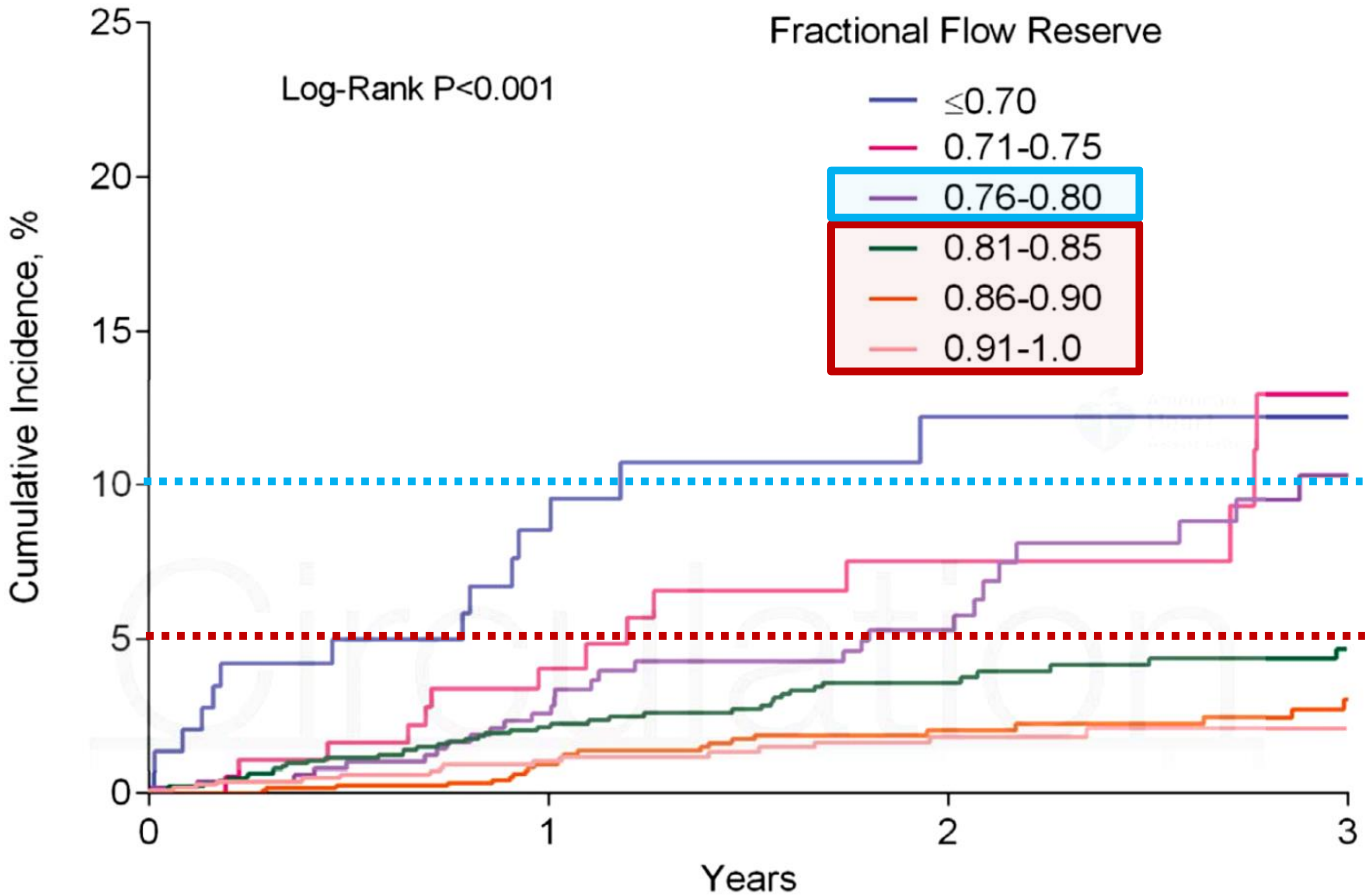
Ahn JM, et al. Circulation in press (CIRCULATIONAHA.116.024433)

Key integrated information from hundreds of studies

Risk to die or experience myocardial infarction in the next 5 years related to a coronary stenosis:

- **Non-ischemic stenosis <1% per year**
  ***NUCLEAR studies, DEFER, FAME, PROSPECT, CCTA*)**
- **Ischemic stenosis, if left untreated 5-10% per year**
  ***Many historical registries, ACIP, etc.*)**
- **Stented stenosis; 2-3% per year after 2 years**
  (*e.g. DEFER, FAME, SYNTAX, many large studies & registries*)

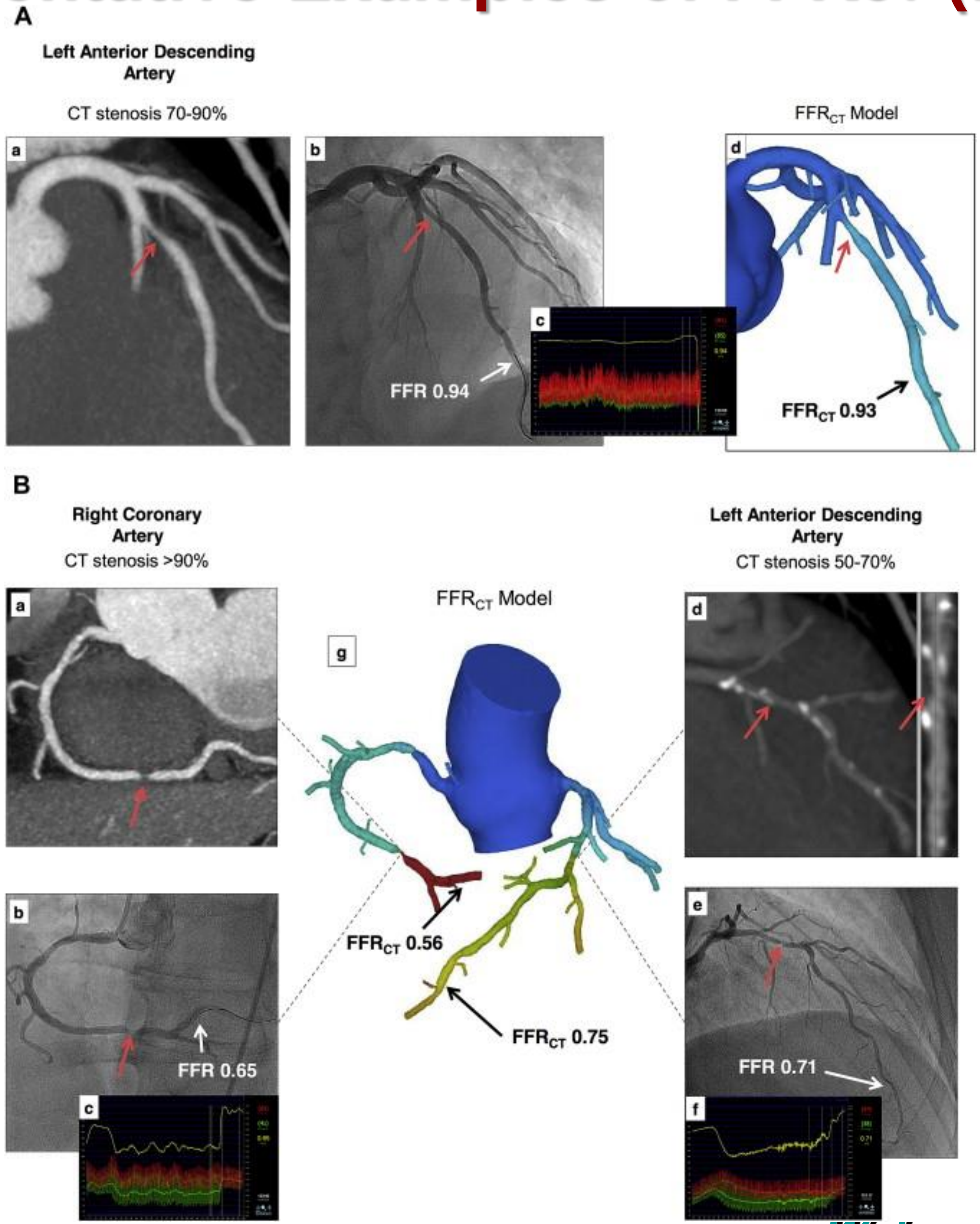
Incidence of MACE in deferred lesions according to each FFR group



≤0.70	148	93	52	27
0.71-0.75	195	140	89	40
0.76-0.80	540	379	216	97
0.81-0.85	1320	953	601	309
0.86-0.90	1329	961	583	292
0.91-1.0	1076	784	482	222

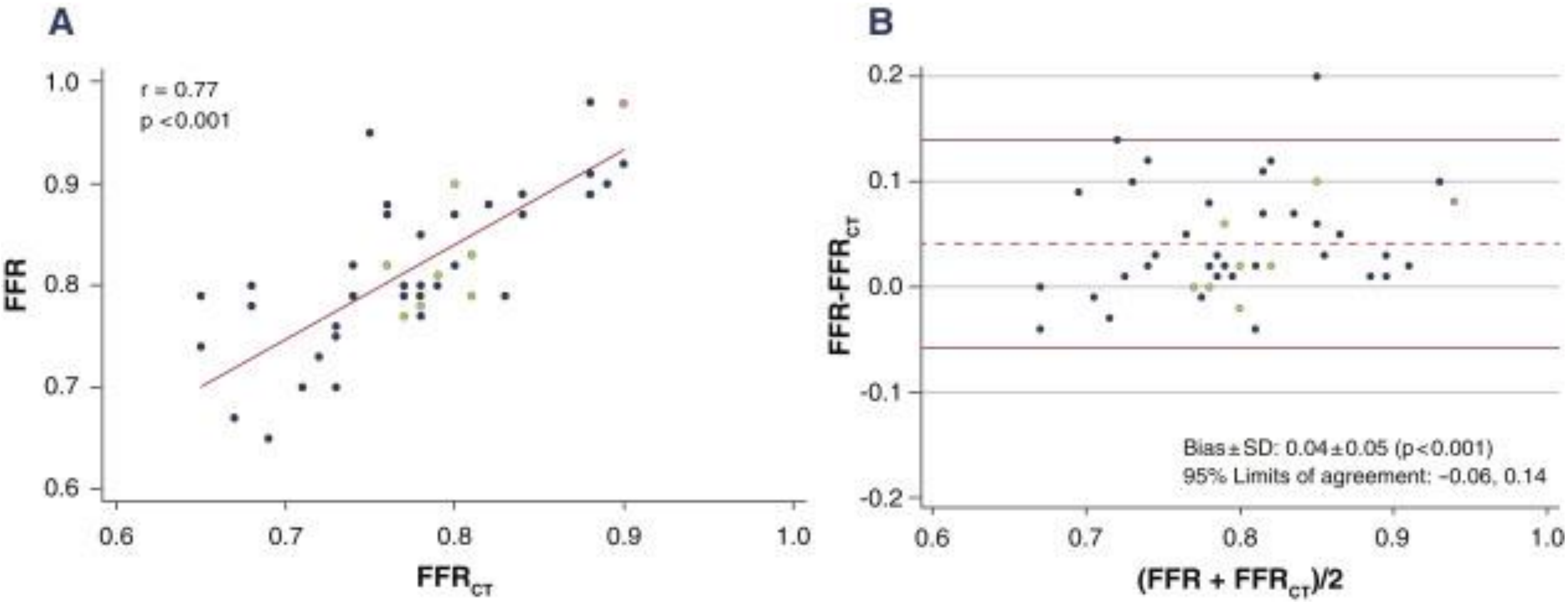
Ahn JM, et al. Circulation in press (CIRCULATIONAHA.116.024433)

Representative Examples of FFRct (NXT trial)



Norgaard BL, et al. J Am Coll Cardiol 2014;63:1145 - 1155

Correlation and Bland-Altman Plots of FFR and FFRCT in Vessels Having FFR Measured (n = 51)



Nørgaard BL, et al. J Am Coll Cardiol Cardiovasc Imag 2016, doi.org/10.1016/j.jcmg.2015.11.025

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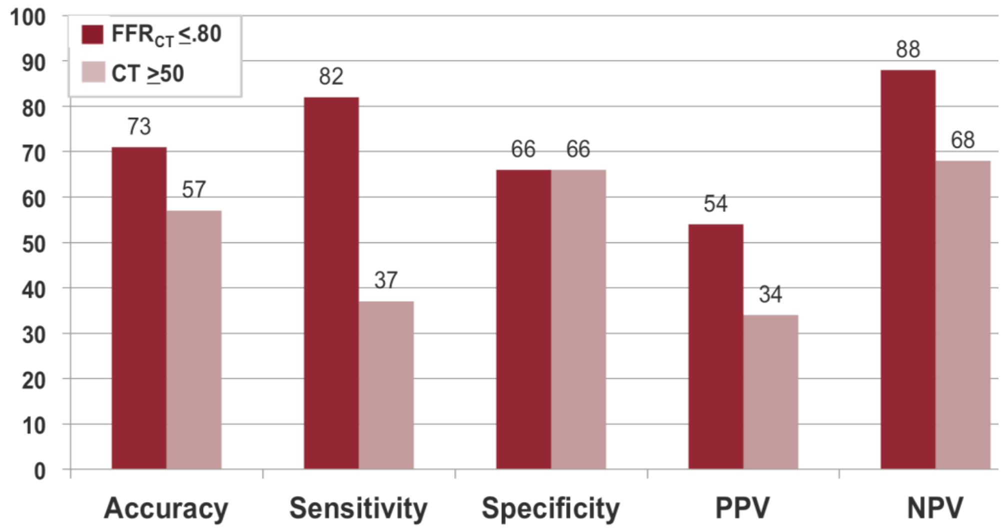
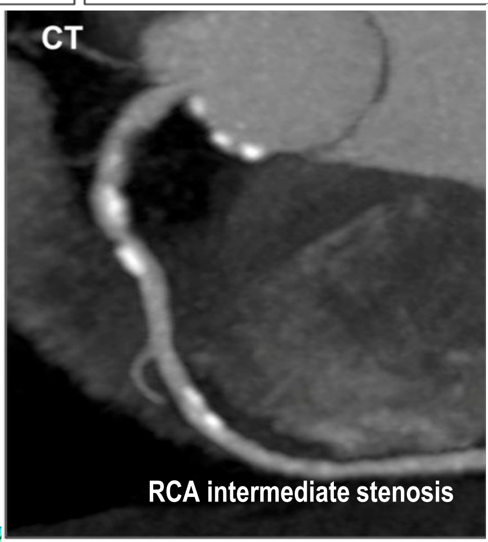
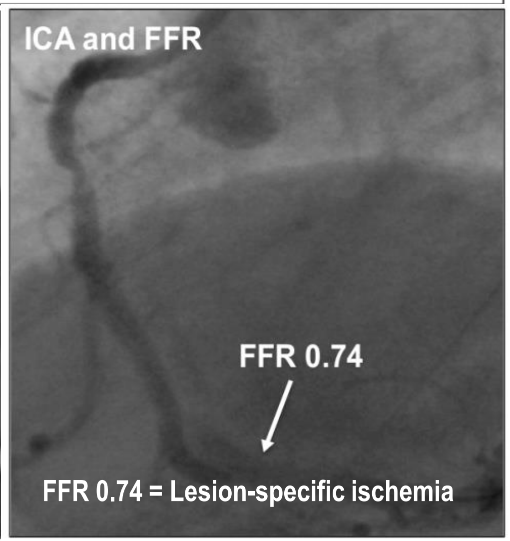
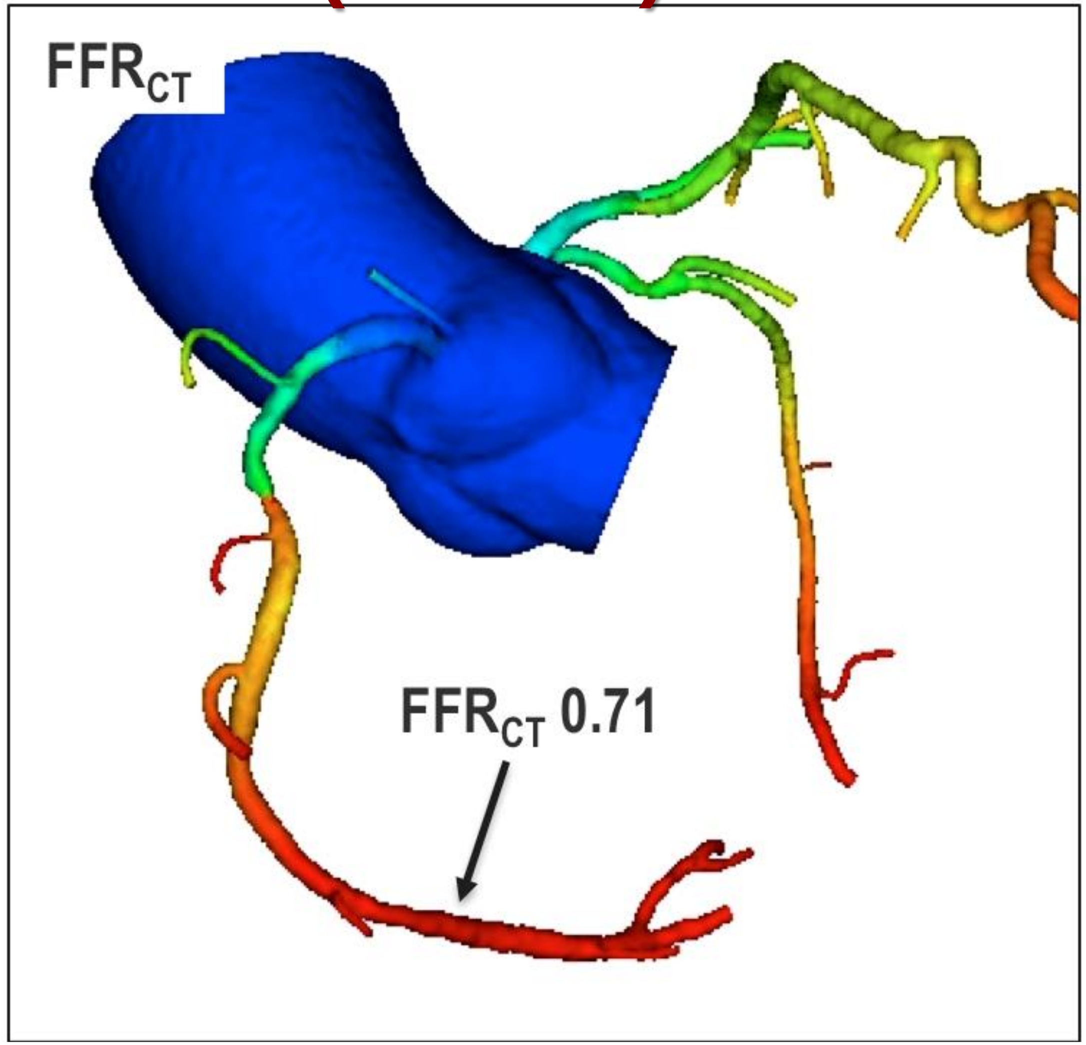
The DeFACTO Study: Intermediate Stenoses (30-70%)



N=83	Accuracy	Sensitivity	Specificity	PPV	NPV
	95% CI	95% CI	95% CI	95% CI	95% CI
FFR$_{CT}$	61-80	63-92	53-77	39-68	75-95
CT	63-92	53-77	53-77	20-53	55-79

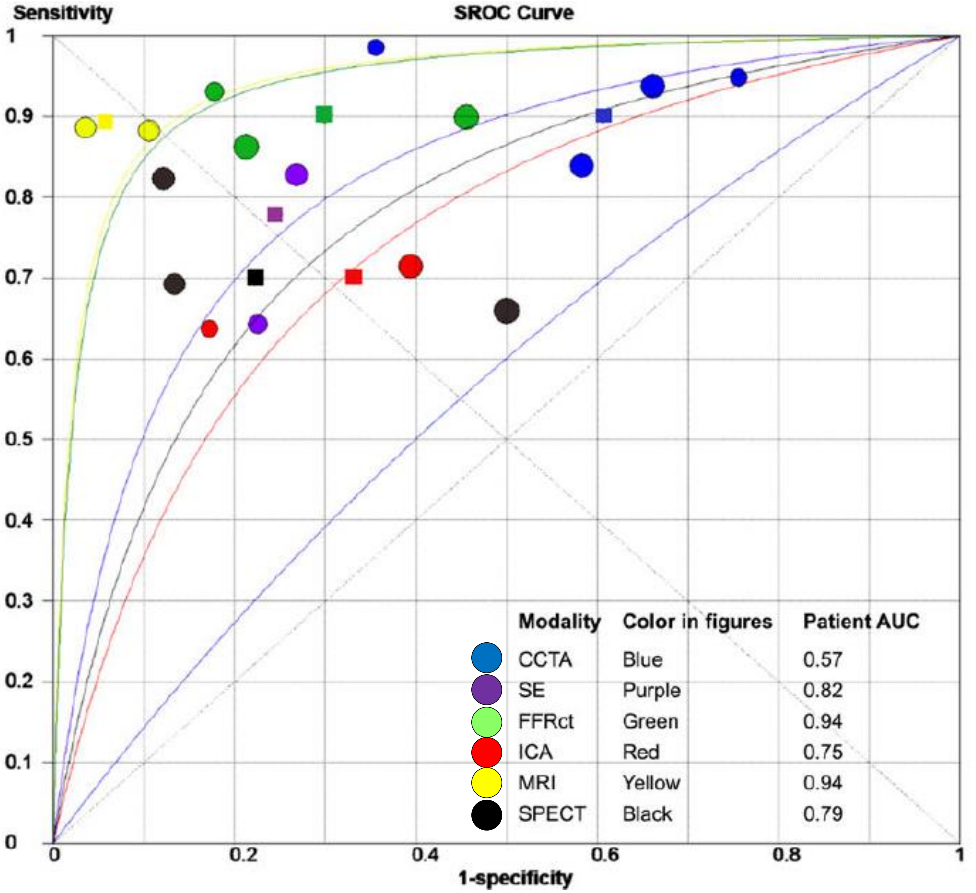


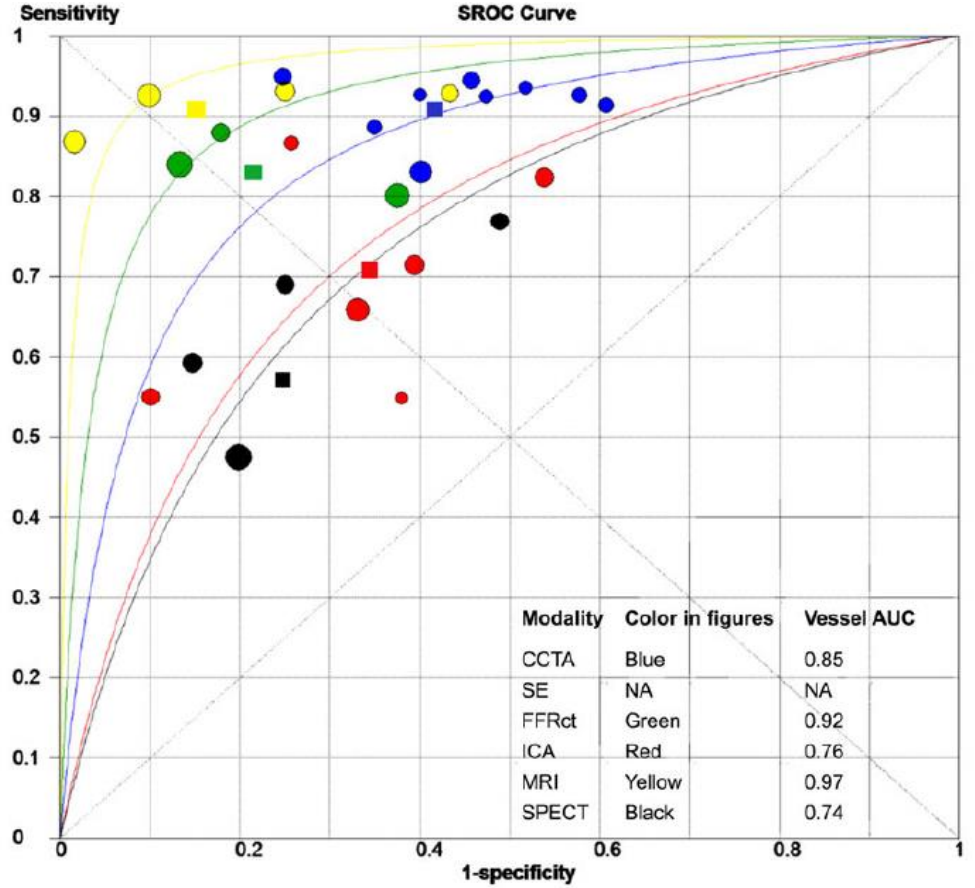




FFR$_{CT}$ 0.71 = Lesion-specific ischemia of an intermediate stenosis (30-70%) - Concordant and in agreement with invasive FFR

SROC curves of the diagnostic accuracy of cardiac imaging compared with FFR





Ibrahim Danad et al. Eur Heart J 2016;eurheartj.ehw095

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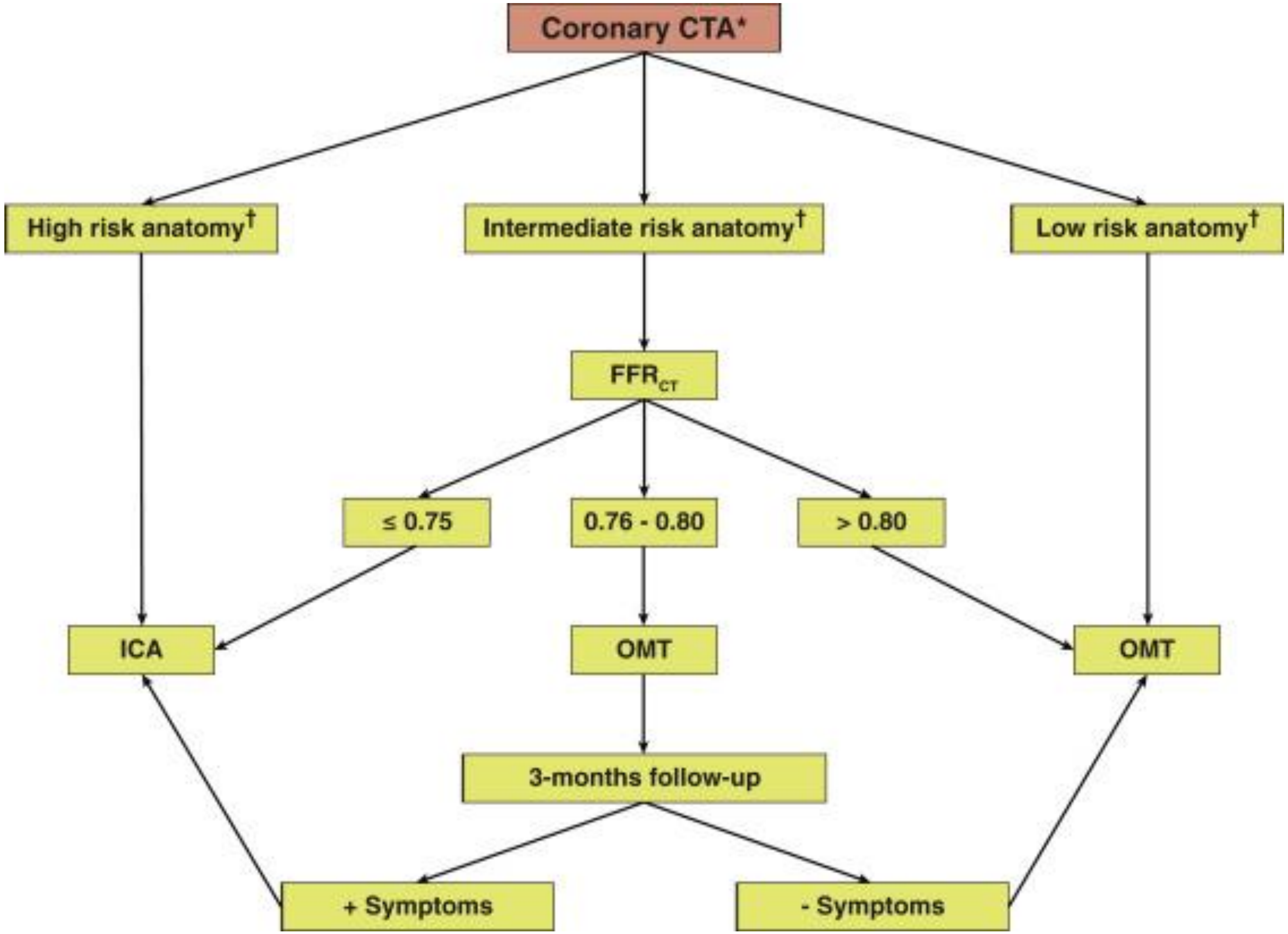
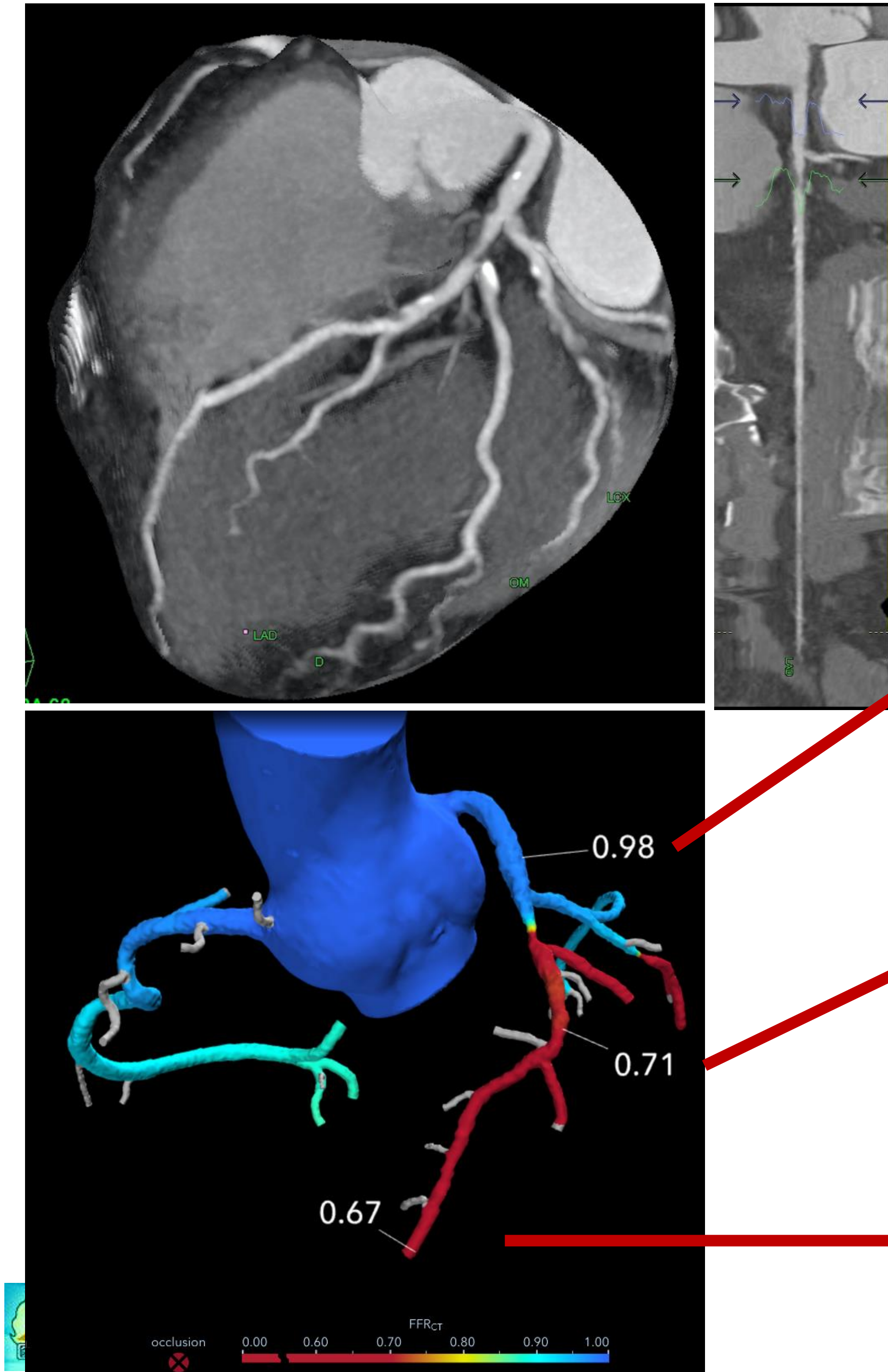
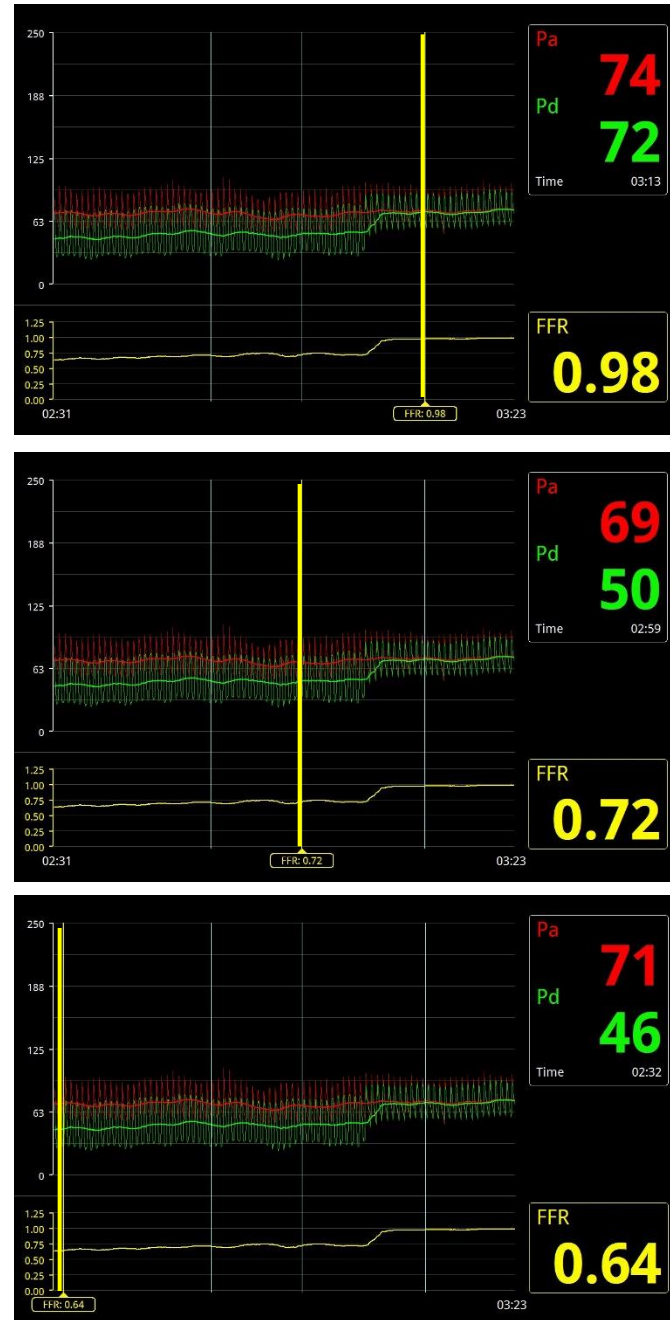
FFRCT Decision-Rule Algorithm in patients with new-onset chest pain without known coronary artery disease

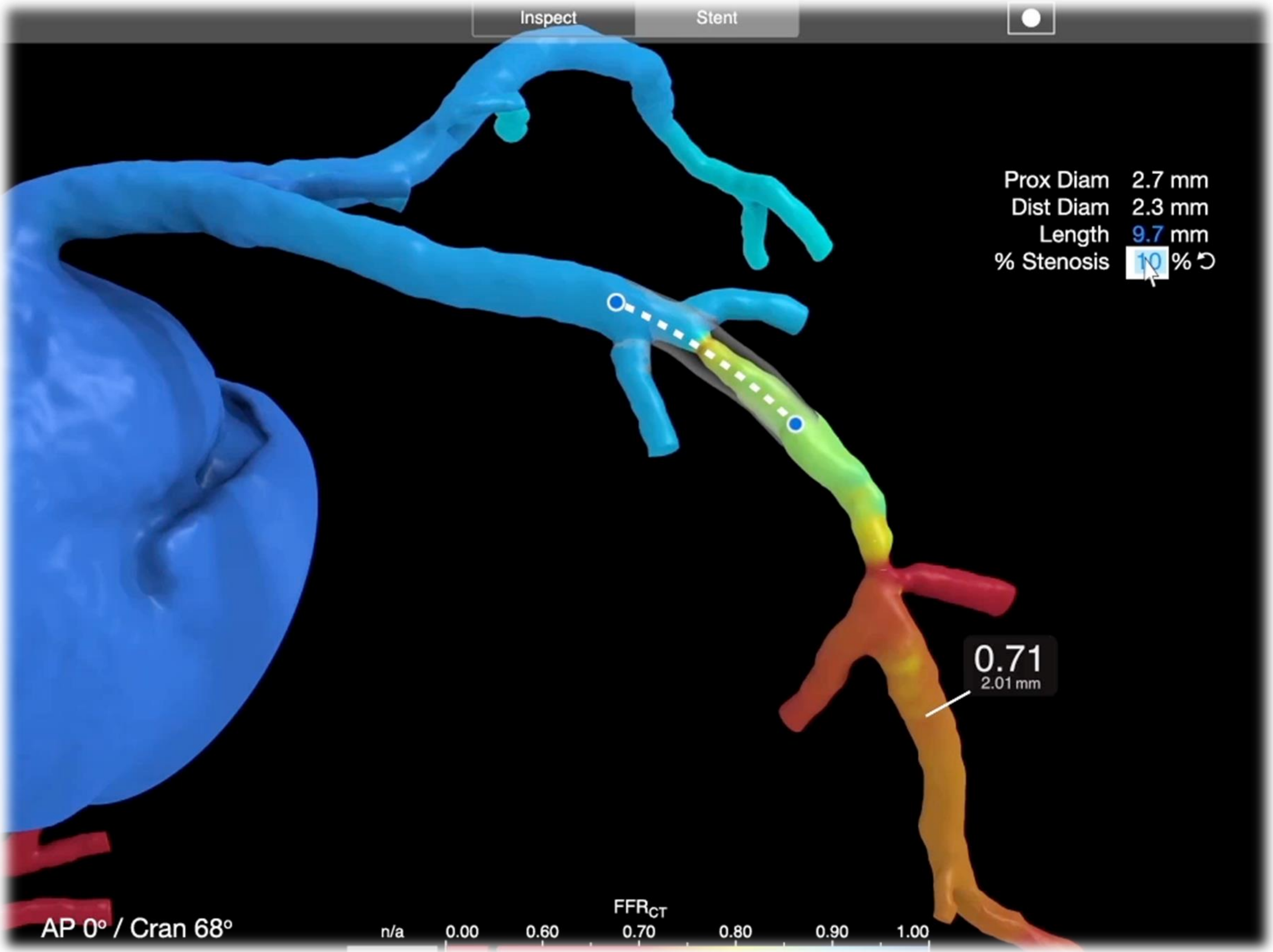


Nørgaard BL, et al. J Am Coll Cardiol Cardiovasc Imag 2016, doi.org/10.1016/j.jcmg.2015.11.025

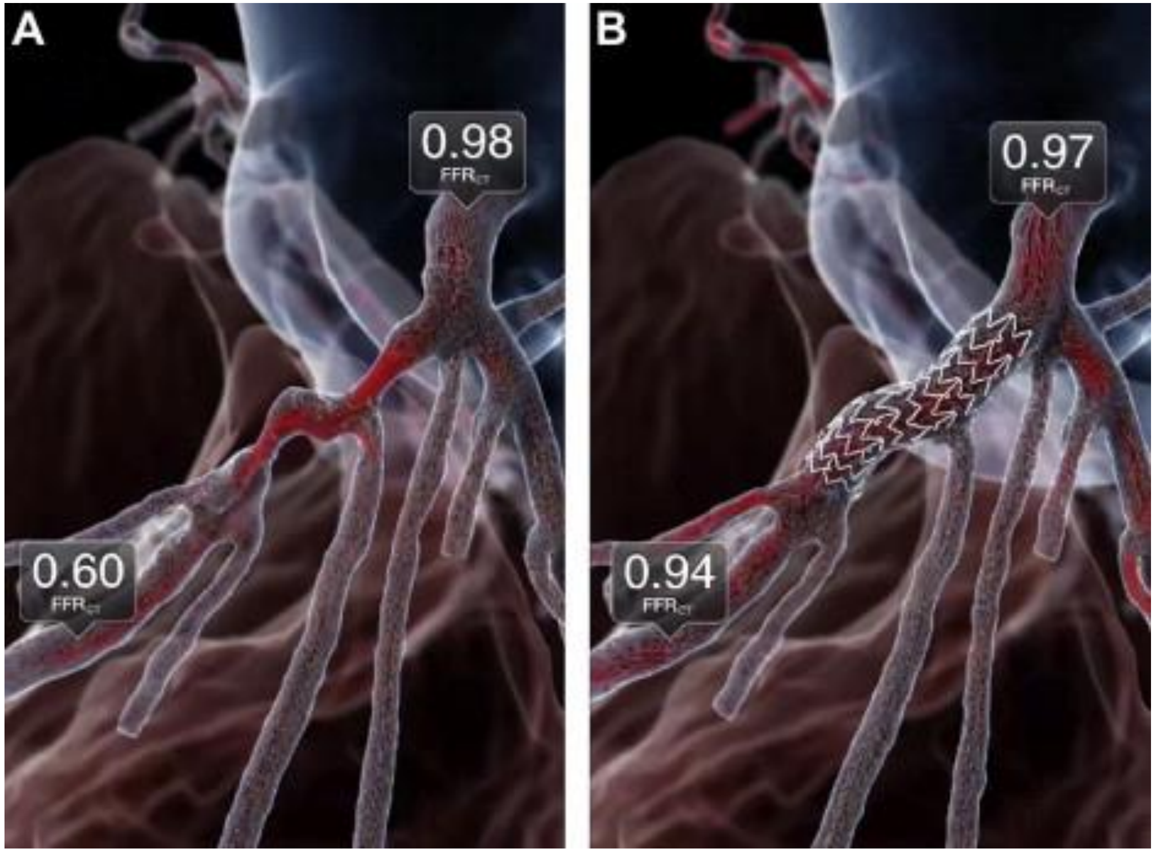
Comparison between FFRCT & FFR





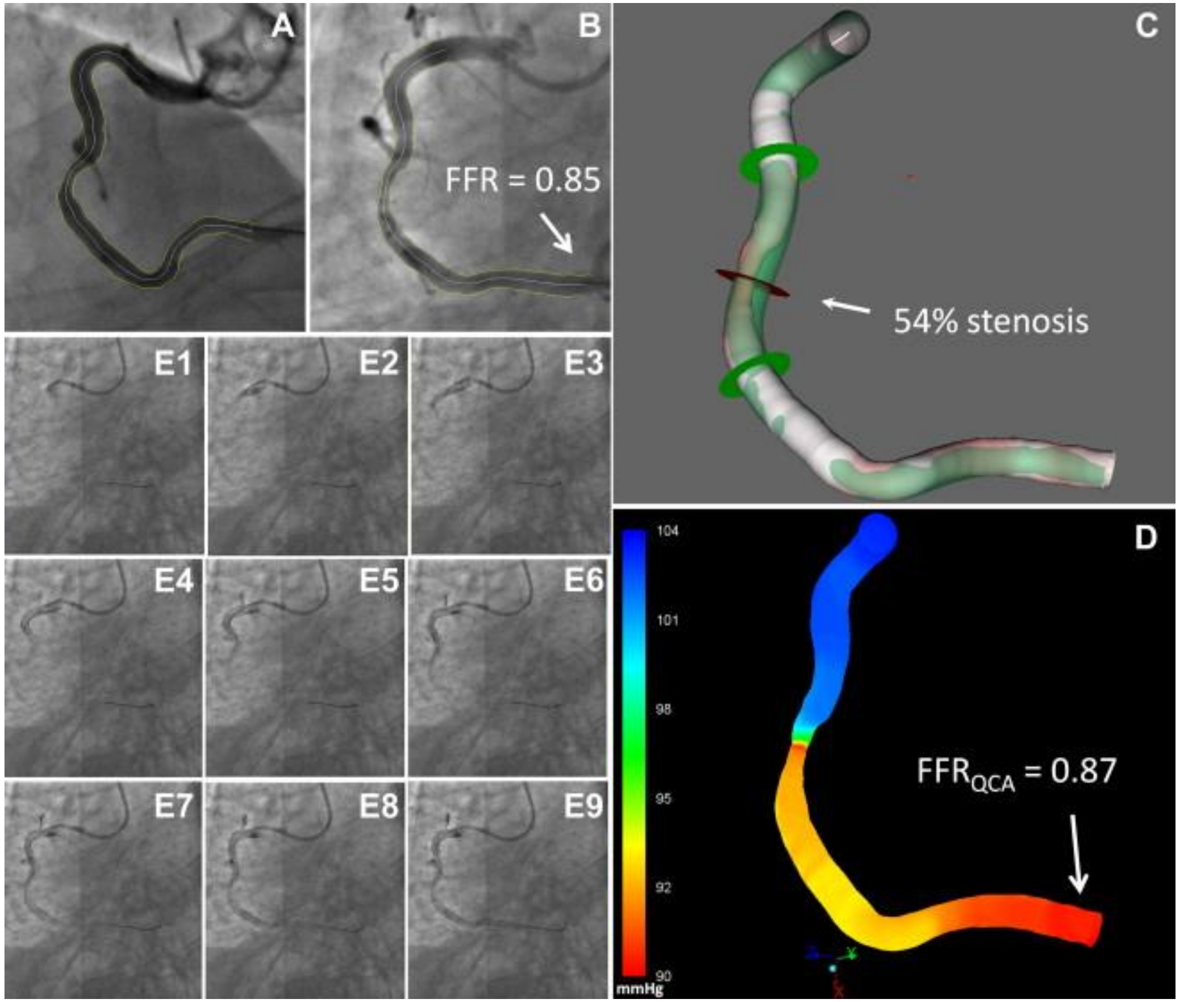

Inspect
Stent
Prox Diam 2.7 mm
Dist Diam 2.3 mm
Length 9.7 mm
% Stenosis 10 %
0.71
2.01 mm
AP 0° / Cran 68°
FFRCT
n/a 0.00 0.60 0.70 0.80 0.90 1.00

Comparison of FFR$_{CTA}$ Results Before and After Simulated PCI With Stent Implantation before (A) and after (B) PCI.



Taylor CA, et al., J Am Coll Cardiol 2013;61:2233–2241

Computation of FFR From 3D QCA and TIMI Frame Count (A,B) X-ray angiography



Tu S, et al. JACC: Cardiovasc Interv, 2014; 7: 768–777

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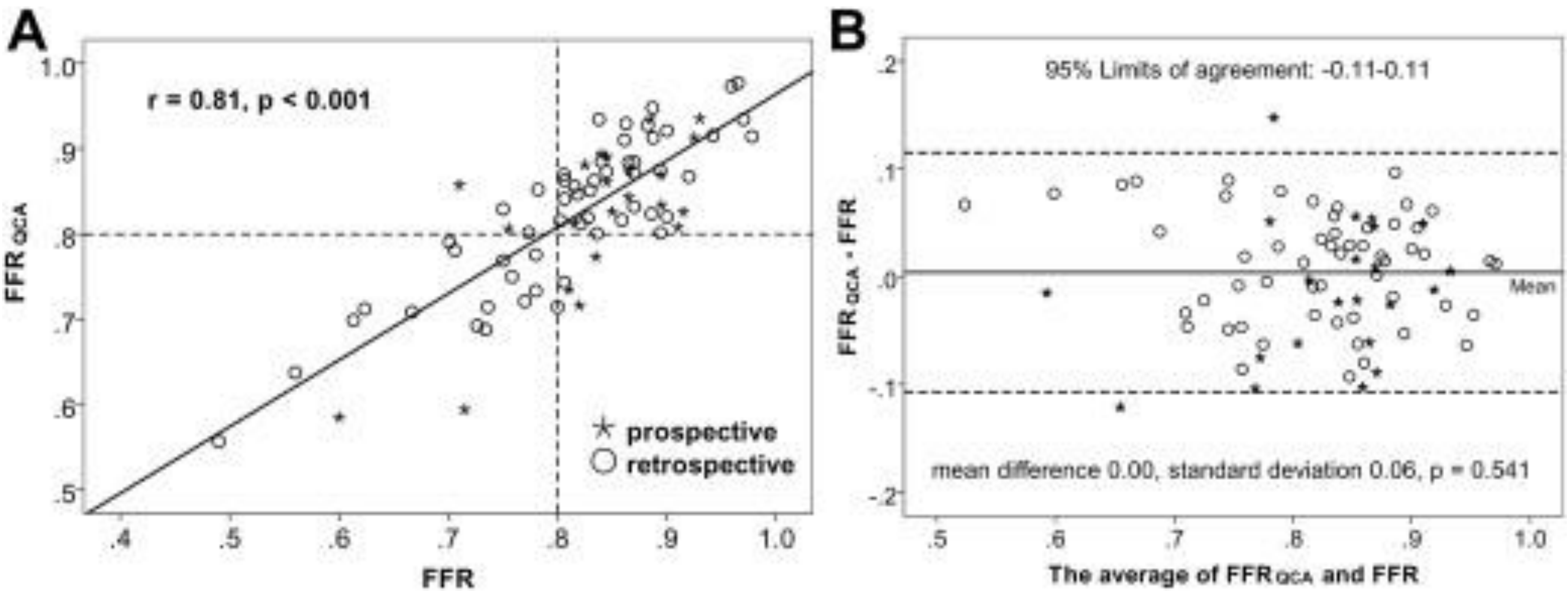
Correlation and Agreement Between FFR and the Computed FFRQCAA



Tu S, et al. JACC: Cardiovasc Interv, 2014; 7: 768–777

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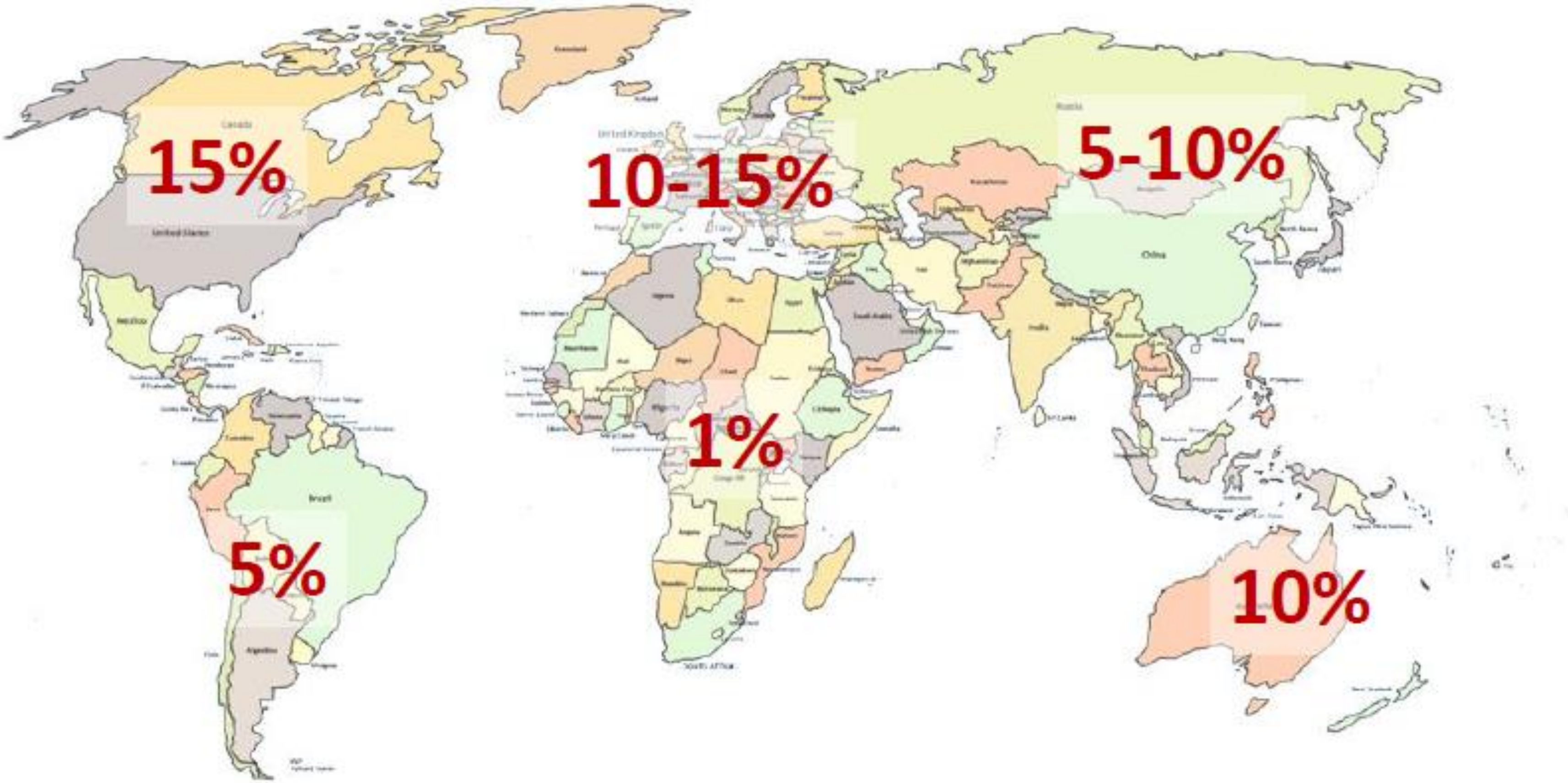
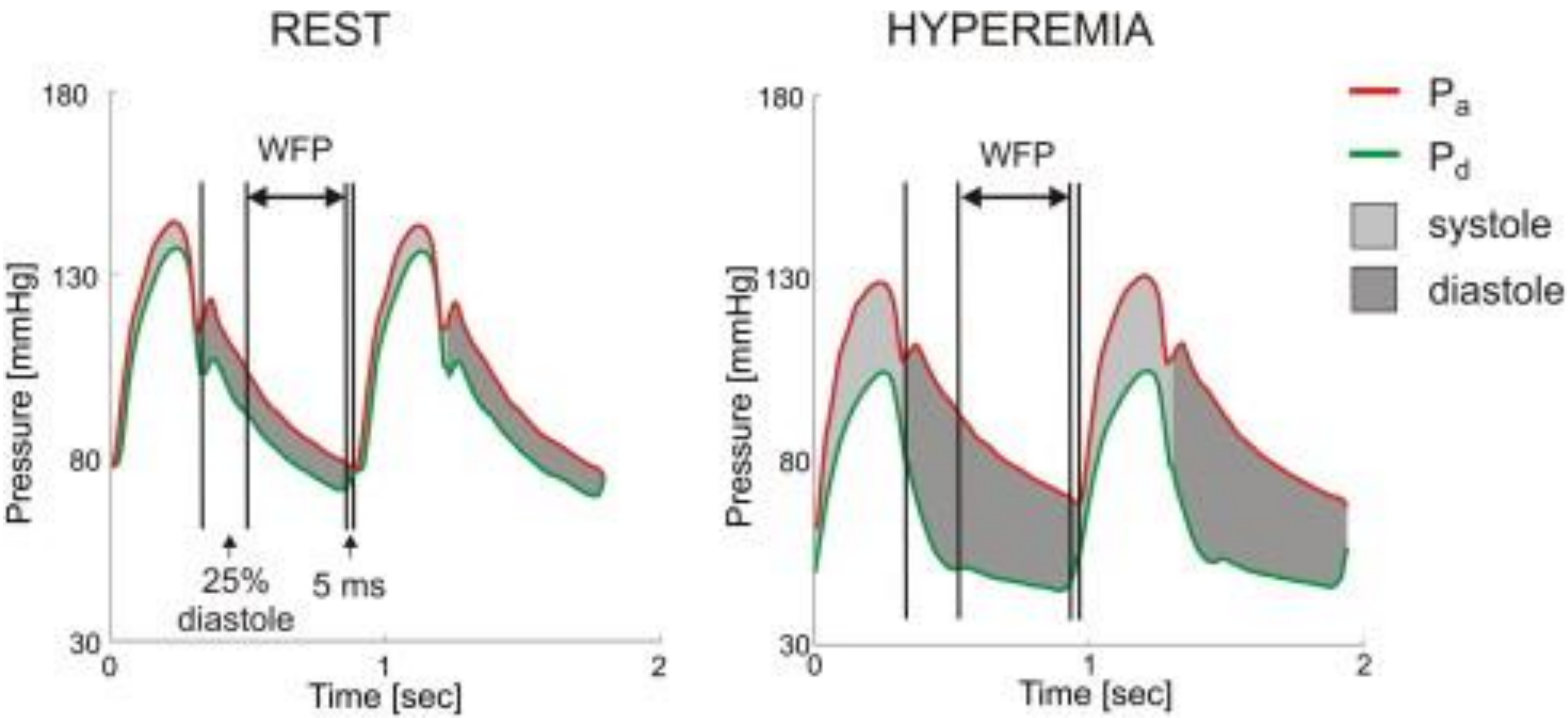
Penetration of FFR



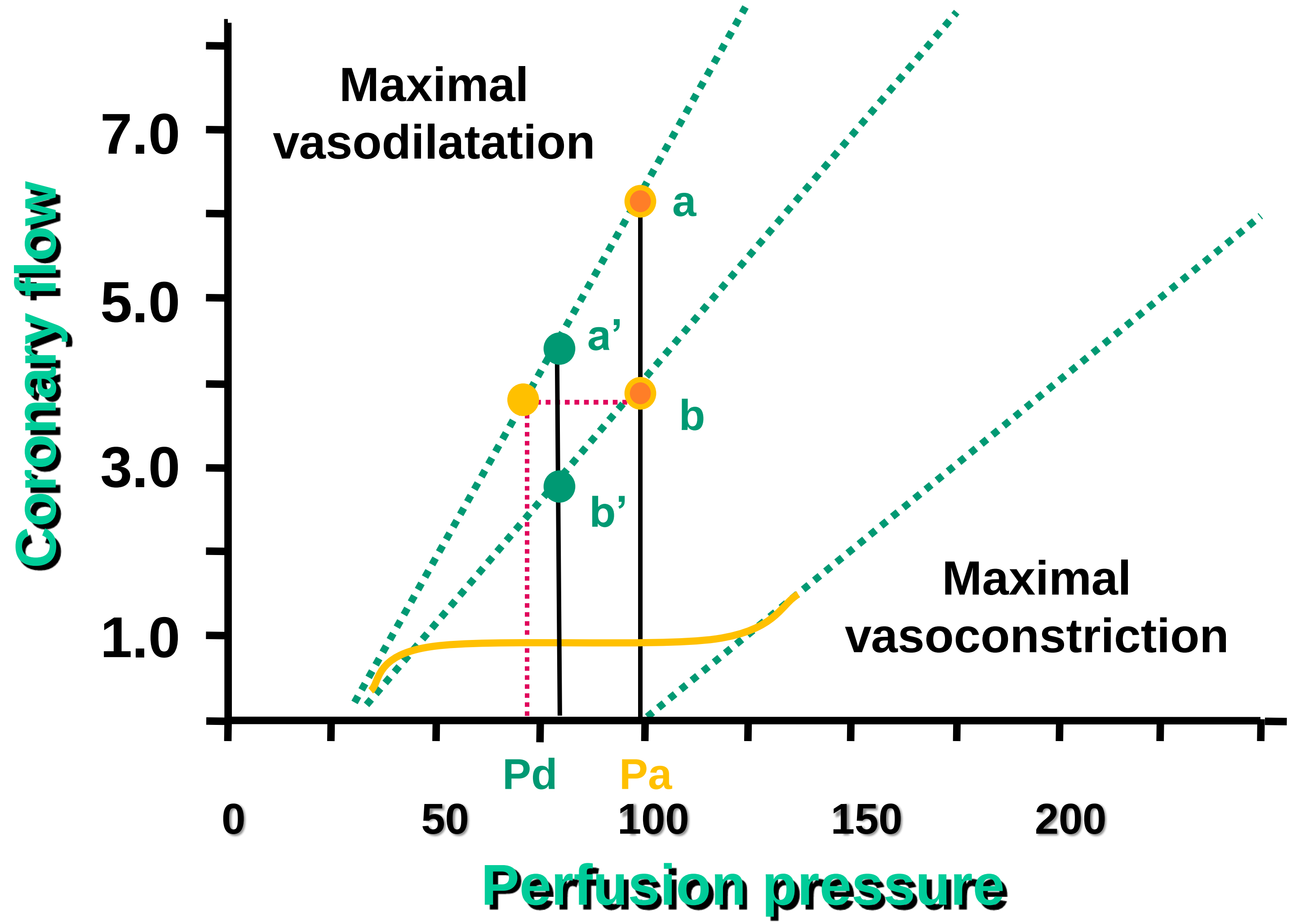
Rough estimates
expressed in percentage of number of PCI

iFR



REST
HYPEREMIA
180
130
80
30
Pressure [mmHg]
WFP
25%
diastole
5 ms
0
1
2
Time [sec]
P_a
P_d
systole
diastole

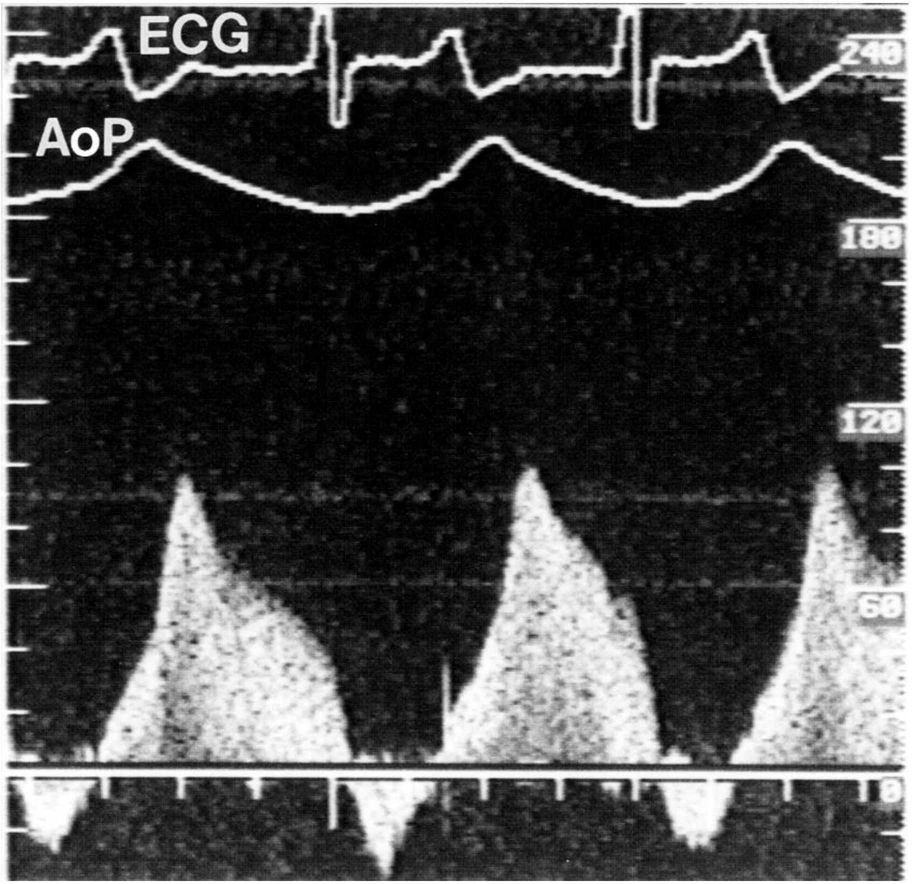
Diastolic pressure－flow relationship & FFR

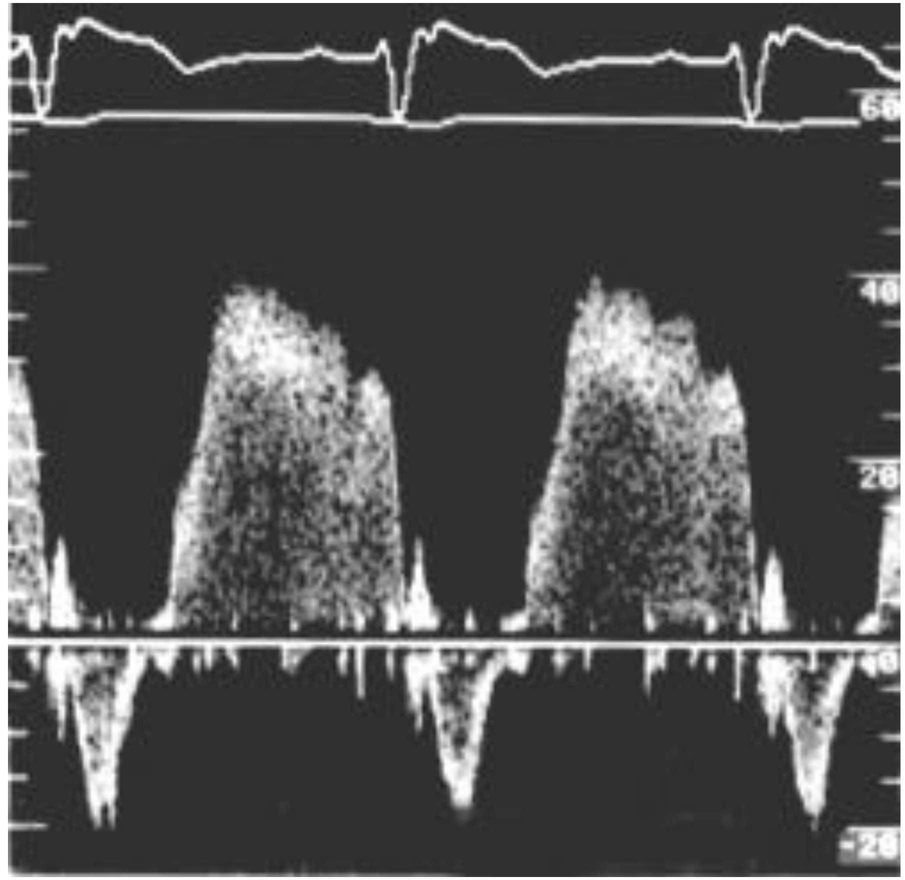


$$FFR = \frac{b}{a} \fallingdotseq \frac{Pd}{Pa} \fallingdotseq \frac{b'}{a'}$$

Coronary flow velocity recordings

Aortic stenosis* **HCM****



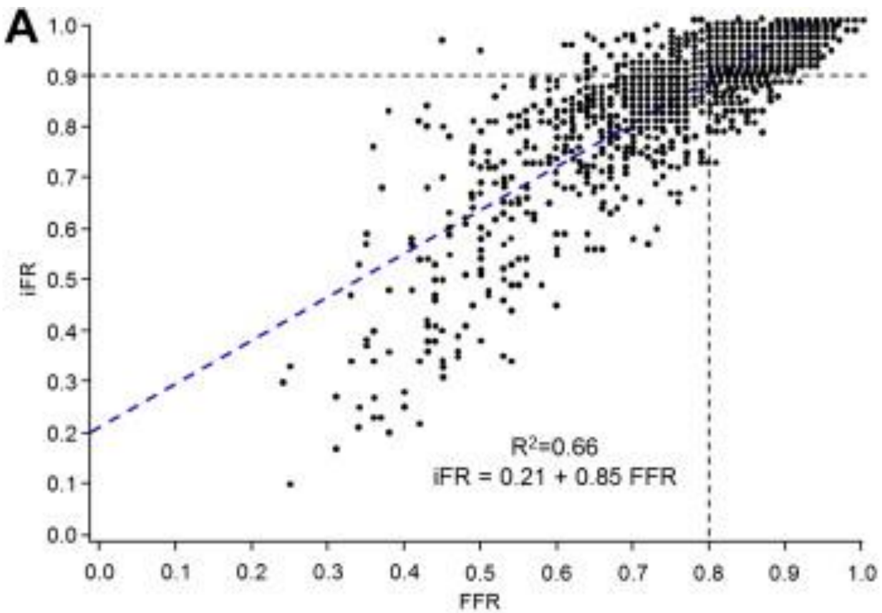


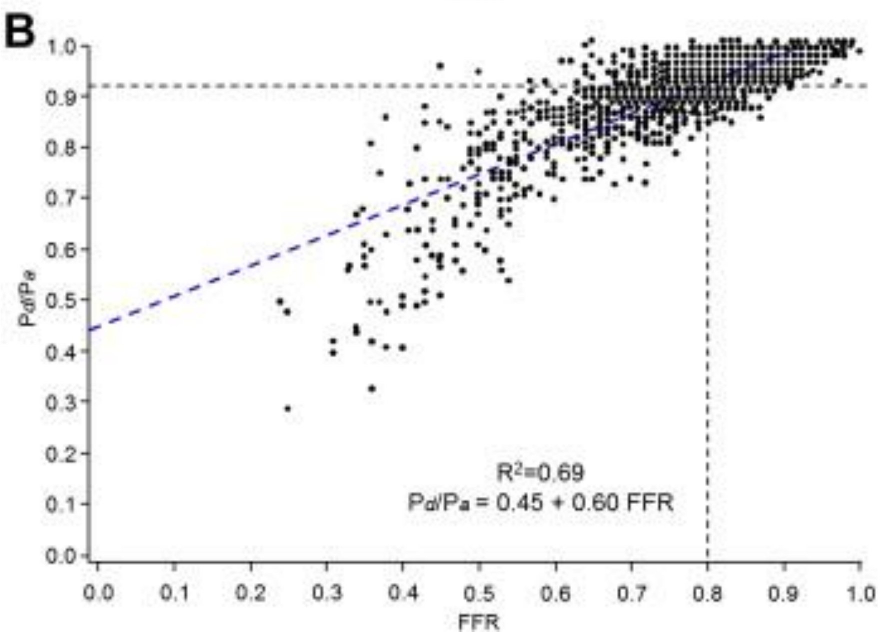
* Yoshikawa J, Akasaka T, et al. J Am Soc Echocardiogr 1993; 6:516-524

** Akasaka T, Yoshikawa J, et al. J Am Soc Echocardiogr 1994; 7:9-19

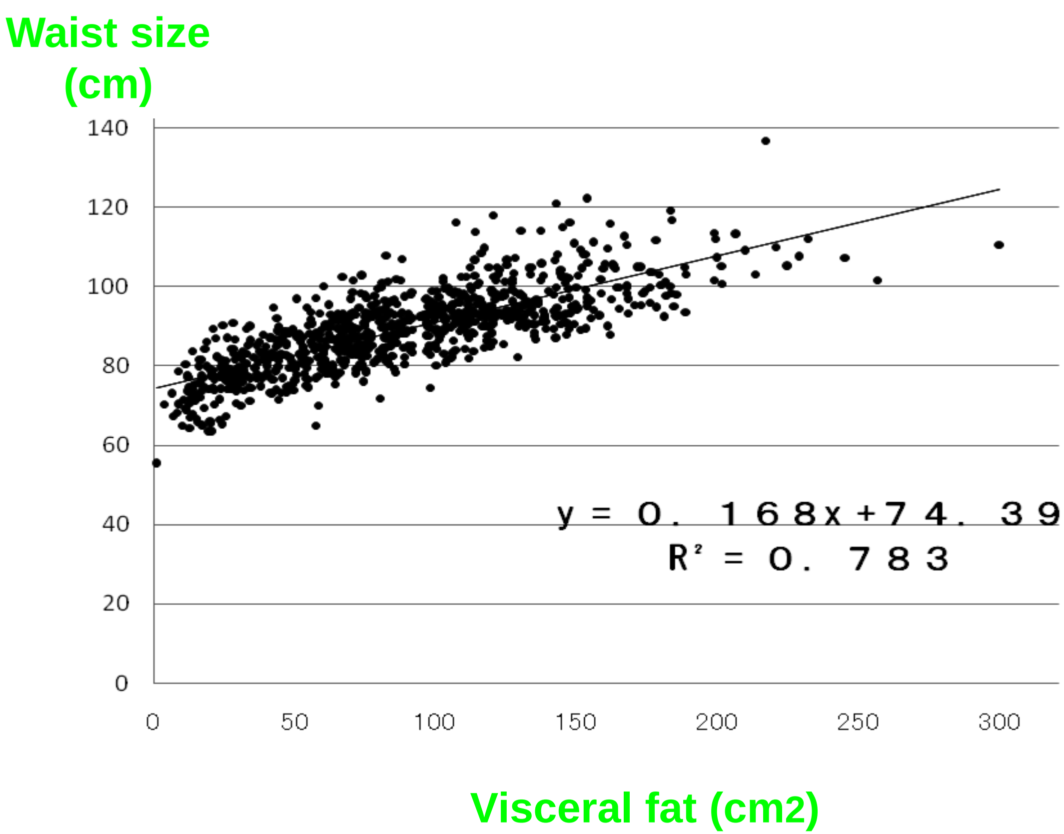
Relationship Between iFR & FFR and Pd /Pa & FFR

Jeremias A, et. Al. J Am Coll Cardiol, 2014;63:1253-1261





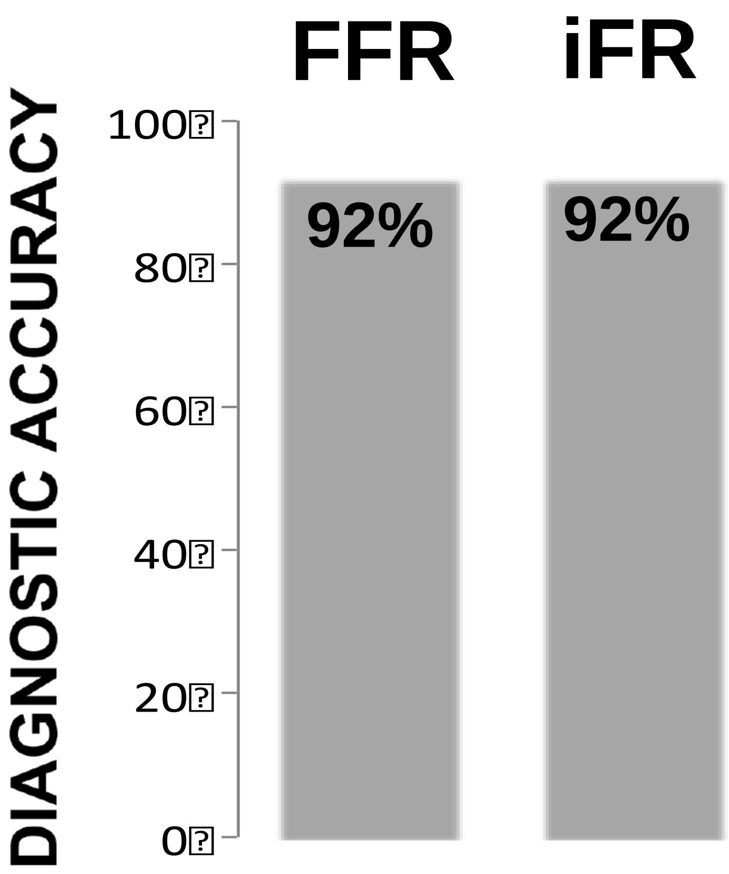
Relation between waist size and visceral fat



CLARIFY

Sen et al. CLARIFY. J Am Coll Cardiol. 2013;61(13):1409-1420

iFR has similar diagnostic accuracy to FFR



iFR and FFR have similar diagnostic accuracies

DEFINE FLAIR

<u>F</u>unctional <u>L</u>esion <u>A</u>ssessment of <u>I</u>ntermediate stenosis to guide <u>R</u>evascularisation

Intermediate lesion requiring physiological assessment
In ACS : intermediate *non-culprit* lesion

N=2500, 1:1 Randomisation

FFR guided PCI

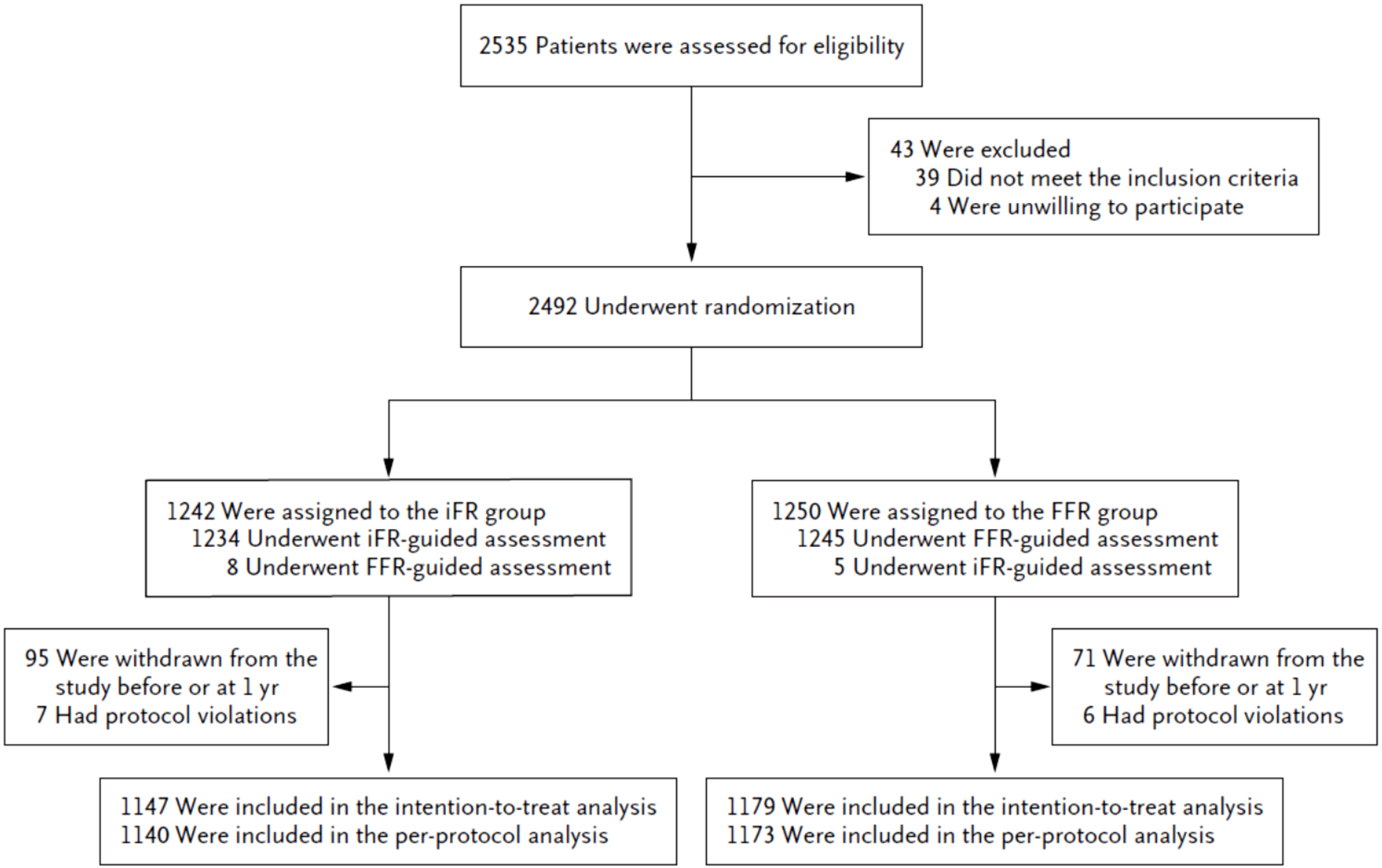
- **FFR>0.8** Defer PCI
- **FFR≤0.8** Perform PCI

iFR guided PCI

- **iFR≥0.9** Defer PCI
- **iFR<0.9** Perform PCI

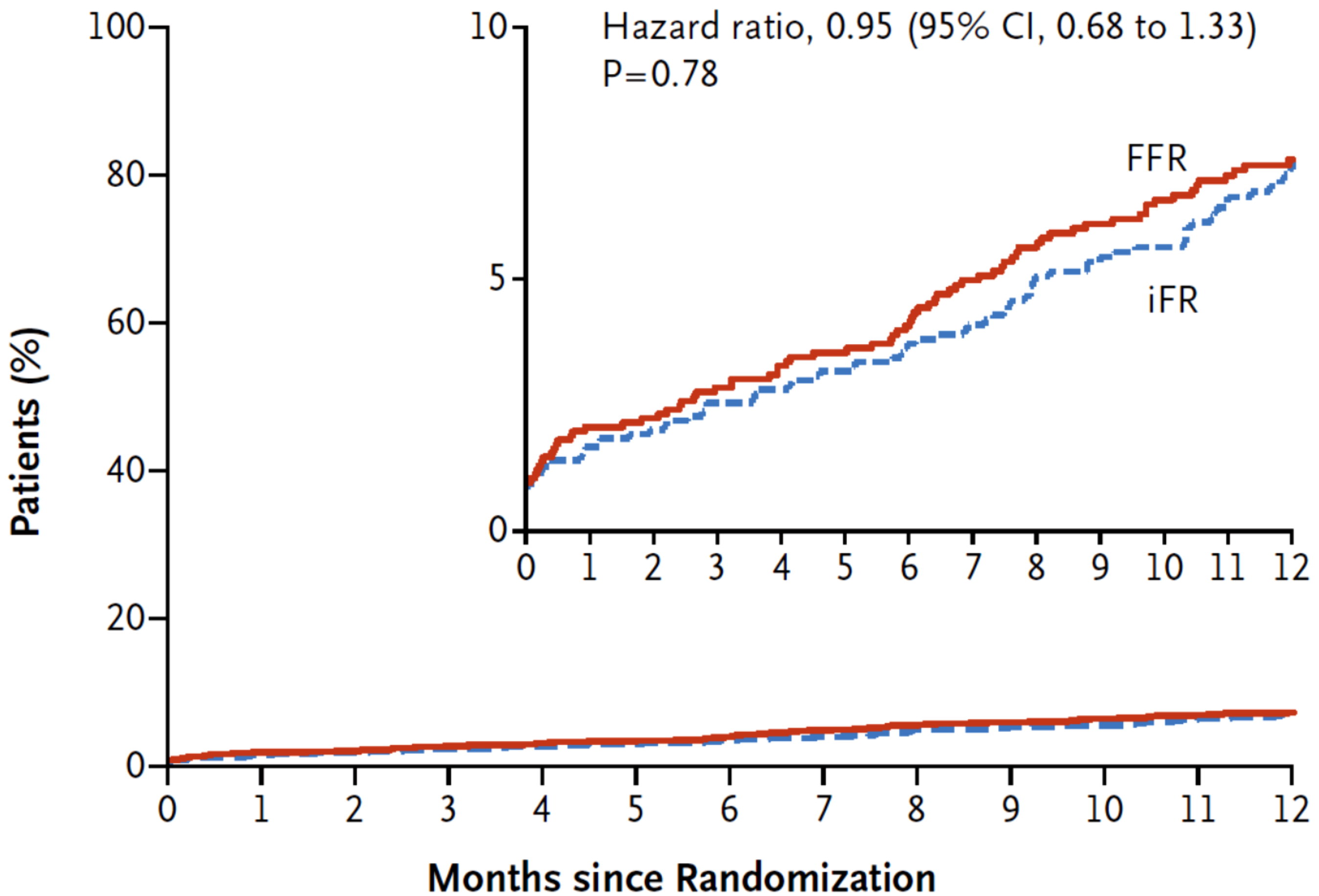
30 day, 1, 2 and 5yr follow-up

Patients enrollment in DEFINE-FLAIR study



Davies JE, et al. N Engl J Med 2017;376:1824-34.

Cumulative Risk of the Primary Endpoint



No. at Risk													
iFR	1242	1149	1131	1122	1118	1111	1088	1052	1037	1027	1019	995	764
FFR	1250	1169	1156	1149	1144	1141	1119	1081	1066	1055	1046	1017	793

Davies JE, et al. N Engl J Med 2017;376:1824-34.

Procedural Characteristics

Superiority of iFR to FFR

Variable	iFR Group (N=1242)	FFR Group (N=1250)	P Value†
Stents placed with postdilation — no. (% of total stents placed)	407 (49.5)	425 (46.9)	0.28
PCI procedures performed with pressure wire — no. (% of total stents placed)	261 (31.8)	278 (30.7)	0.63
Patient-reported adverse procedural symptoms or signs — no. of patients (%)	39 (3.1)	385 (30.8)	<0.001
Patient-reported dyspnea — no. of patients (%)	13 (1.0)	250 (20.0)	
Patient-reported chest pain — no. of patients (%)	19 (1.5)	90 (7.2)	
Physician-reported adverse procedural signs — no. of patients (%)			
Heart-rhythm disturbance	2 (0.2)	60 (4.8)	
Significant hypotension	4 (0.3)	13 (1.0)	
Vomiting or nausea	1 (0.1)	11 (0.9)	
Ventricular arrhythmia or bronchospasm¶	1 (0.1)	8 (0.6)	
Other	4 (0.3)	38 (3.0)	

Davies JE, et al. N Engl J Med 2017;376:1824-34.

Procedural Characteristics

Superiority of iFR to FFR

Variable	iFR Group (N=1242)	FFR Group (N=1250)	P Value†
Radial-artery approach — no. of patients (%)	896 (72.1)	888 (71.0)	0.54
Procedure time — min			
Median	40.5	45.0	0.001
Interquartile range	27.0–60.0	30.0–66.0	
Hyperemic agent administered — no. of patients (% of total no. who received a hyperemic agent)			
Total	NA	1608 (100)	
Intracoronary adenosine	NA	455 (28.3)	
Intravenous adenosine	NA	950 (59.1)	
Other agent	NA	203 (12.6)	
Multivessel disease — no. of patients (%)	505 (40.7)	519 (41.5)	0.66
Type of vessel evaluated — no. (% of total vessels evaluated)‡			
Total	1575 (100)	1608 (100)	0.58
Left anterior descending artery	844 (53.6)	845 (52.5)	0.56
Left circumflex artery	323 (20.5)	333 (20.7)	0.89
Right coronary artery	374 (23.7)	393 (24.4)	0.65
Other	33 (2.1)	31 (1.9)	0.74
Unknown	1 (0.1)	6 (0.4)	0.06

Davies JE, et al. N Engl J Med 2017;376:1824-34.

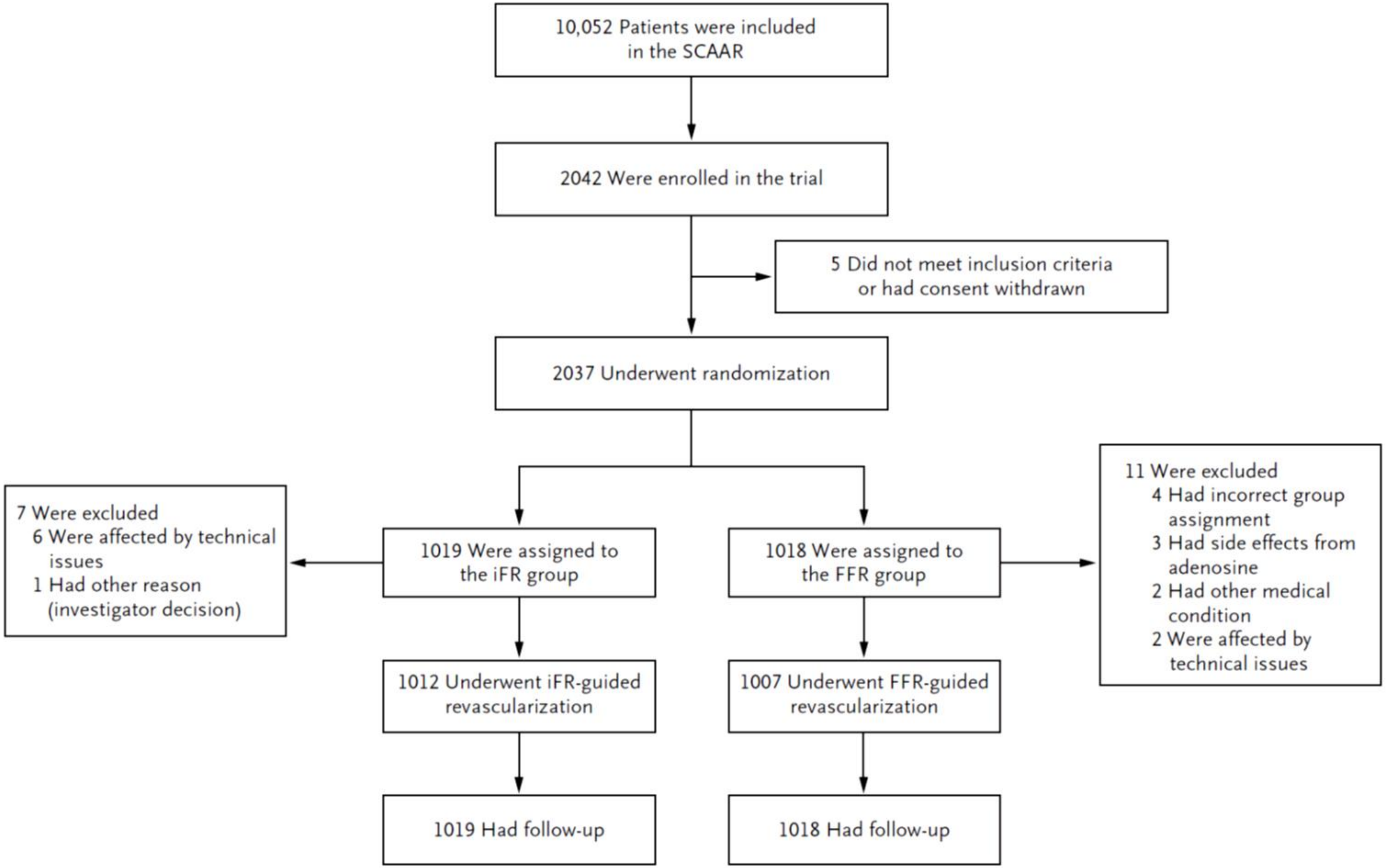
Procedural Characteristics

Total no. of vessels evaluated or treated‡	1879	1940	0.42
No. of vessels evaluated or treated per patient‡	1.51±0.76	1.55±0.80	0.42
Functionally significant lesions — no. (% of total vessels evaluated)§	451 (28.6)	557 (34.6)	0.004
≥1 Functionally significant lesions present — no. of patients (%)§	426 (34.3)	486 (38.9)	0.02
Mean iFR	0.91±0.09	NA	
Mean FFR	NA	0.83±0.09	
Percent of lesions within the FFR range			
<0.60	NA	1.96	
0.60–0.90	NA	75.08	
>0.90	NA	22.96	
Revascularization performed — no. of patients (%)			
Total	590 (47.5)	667 (53.4)	0.003
CABG	25 (2.0)	42 (3.4)	0.04
PCI	565 (45.5)	625 (50.0)	0.02
Stents placed — no. (% of total stents placed)			
Total	822 (100)	906 (100)	0.86
Drug-eluting stent	811 (98.7)	893 (98.6)	
Bioresorbable vascular scaffold	11 (1.3)	13 (1.4)	
No. of stents placed per patient	0.66±0.92	0.72±0.96	0.09

Any issues in iFR compared with FFR ?

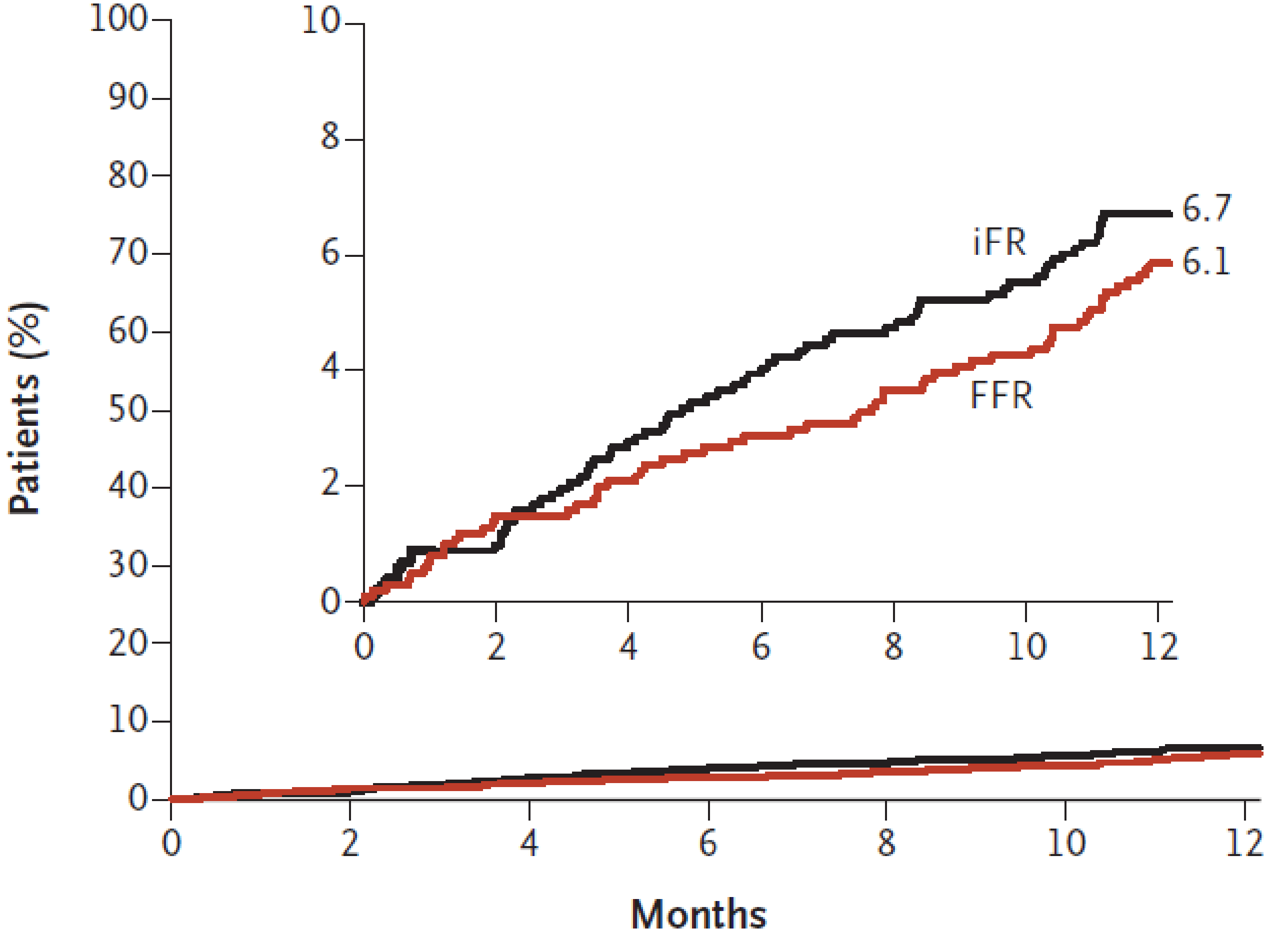
Davies JE, et al. N Engl J Med 2017;376:1824-34.

Patients enrollment in iFR SWEDEHEART Clinical Trials



Gotberg M, et al. N Engl J Med 2017;376:1813-23..

Kaplan-Meier Curve for the Primary Endpoint



No. at Risk

iFR	1012	1002	984	971	963	956	944
FFR	1007	990	984	976	968	961	946

Gotberg M, et al. N Engl J Med 2017;376:1813-23

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Procedural Characteristics

Superiority of iFR to FFR

Characteristic	iFR Group (N=1012)	FFR Group (N=1007)	P Value
Radial-artery approach — no. of patients (%)	841 (83.1)	811 (80.5)	0.13
Contrast material used per patient — ml			0.10
Median	110	115	
Interquartile range	80–155	80–160	
Procedure time — min†			0.09
Median	50.8	53.1	
Interquartile range	13.8–87.8	18.1–88.1	
Fluoroscopy time — min			0.57
Median	10.5	10.2	
Interquartile range	6.3–16.8	6.5–16.0	
Intravenous adenosine administered — no. of patients (%)	NA	695 (69.0)	
Total no. of lesions evaluated	1568	1436	
Chest discomfort during procedure			<0.001†
None	982 (97.0)	319 (31.7)	
Mild	26 (2.6)	316 (31.4)	
Moderate	2 (0.2)	285 (28.3)	
Severe	2 (0.2)	87 (8.6)	

Gotberg M, et al. N Engl J Med 2017;376:1813-23

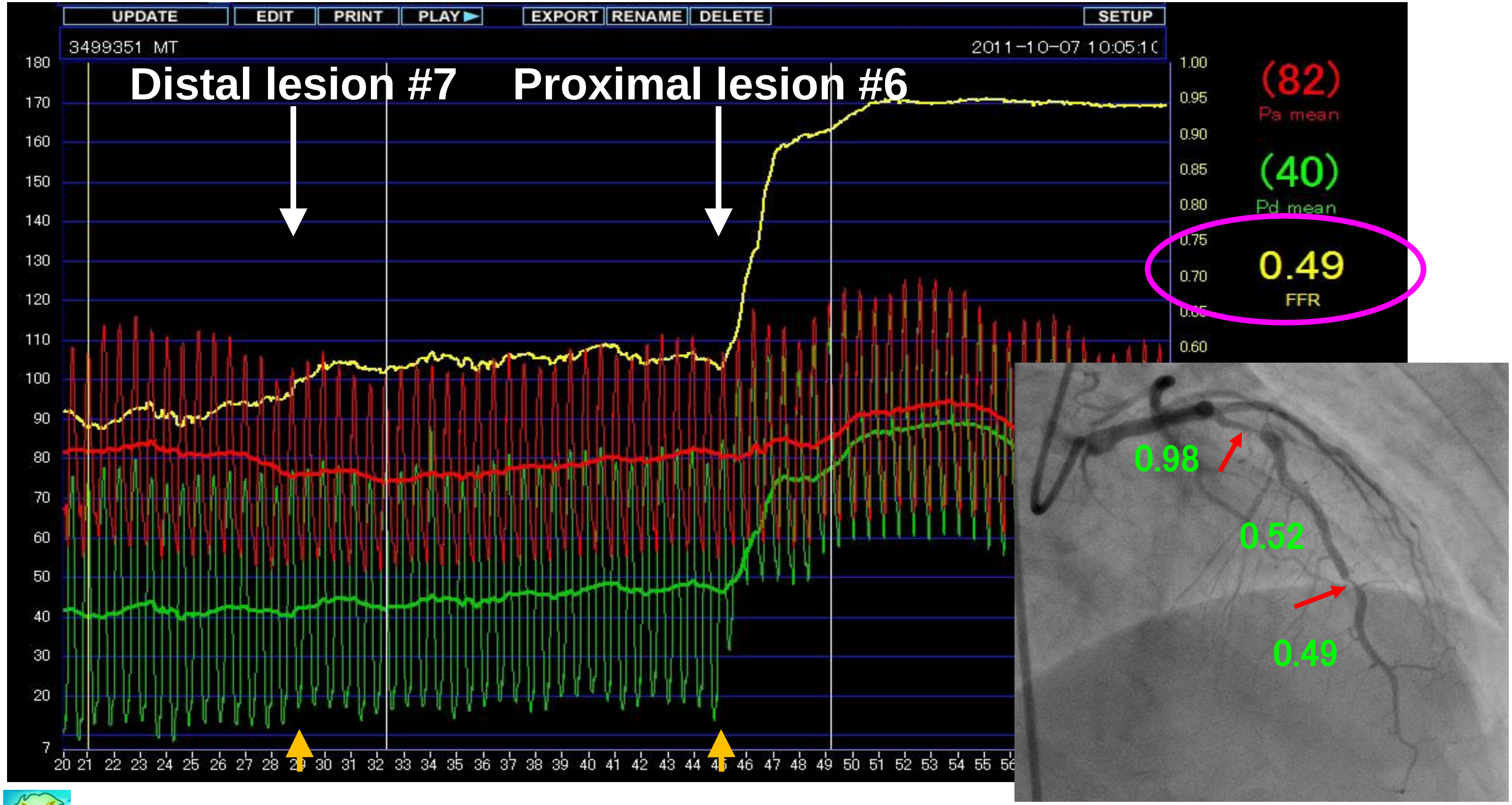
Procedural Characteristics

No. of lesions evaluated per patient	1.55±0.86	1.43±0.70	0.002
Hemodynamically important lesions — no. (% of total lesions evaluated)‡	457 (29.1)	528 (36.8)	<0.001
No. of hemodynamically important lesions per patient‡	0.45±0.71	0.52±0.68	0.05
Mean iFR	0.91±0.10	NA	
Mean iFR in hemodynamically important lesions‡	0.80±0.13	NA	
Mean FFR	NA	0.82±0.10	
Mean FFR in hemodynamically important lesions‡	NA	0.72±0.08	
Lesion complexity according to the ACC–AHA class — no./total no. of treated lesions (%)§¶			[illegible]
A	61/915 (6.7)	73/980 (7.4)	
B1	304/915 (33.2)	320/980 (32.7)	
B2	284/915 (31.0)	300/980 (30.6)	
C	139/915 (15.2)	165/980 (16.8)	
Missing data	127/915 (13.9)	122/980 (12.4)	
Lesions treated in the vessel — no./total no. of treated lesions (%)¶			0.68
Left main coronary artery	14/915 (1.5)	16/980 (1.6)	
Left anterior descending artery	434/915 (47.4)	469/980 (47.9)	
Left circumflex artery	176/915 (19.2)	179/980 (18.3)	
Right coronary artery	164/915 (17.9)	196/980 (20.0)	
Missing data	127/915 (13.9)	120/980 (12.2)	
Total no. of stents placed	698	787	
No. of stents placed per patient undergoing PCI	1.58±1.08	1.73±1.19	0.05

Any issues in iFR compared with FFR ?

Davies JE, et al. N Engl J Med 2017;376:1824-34.

FFR (prePCI)



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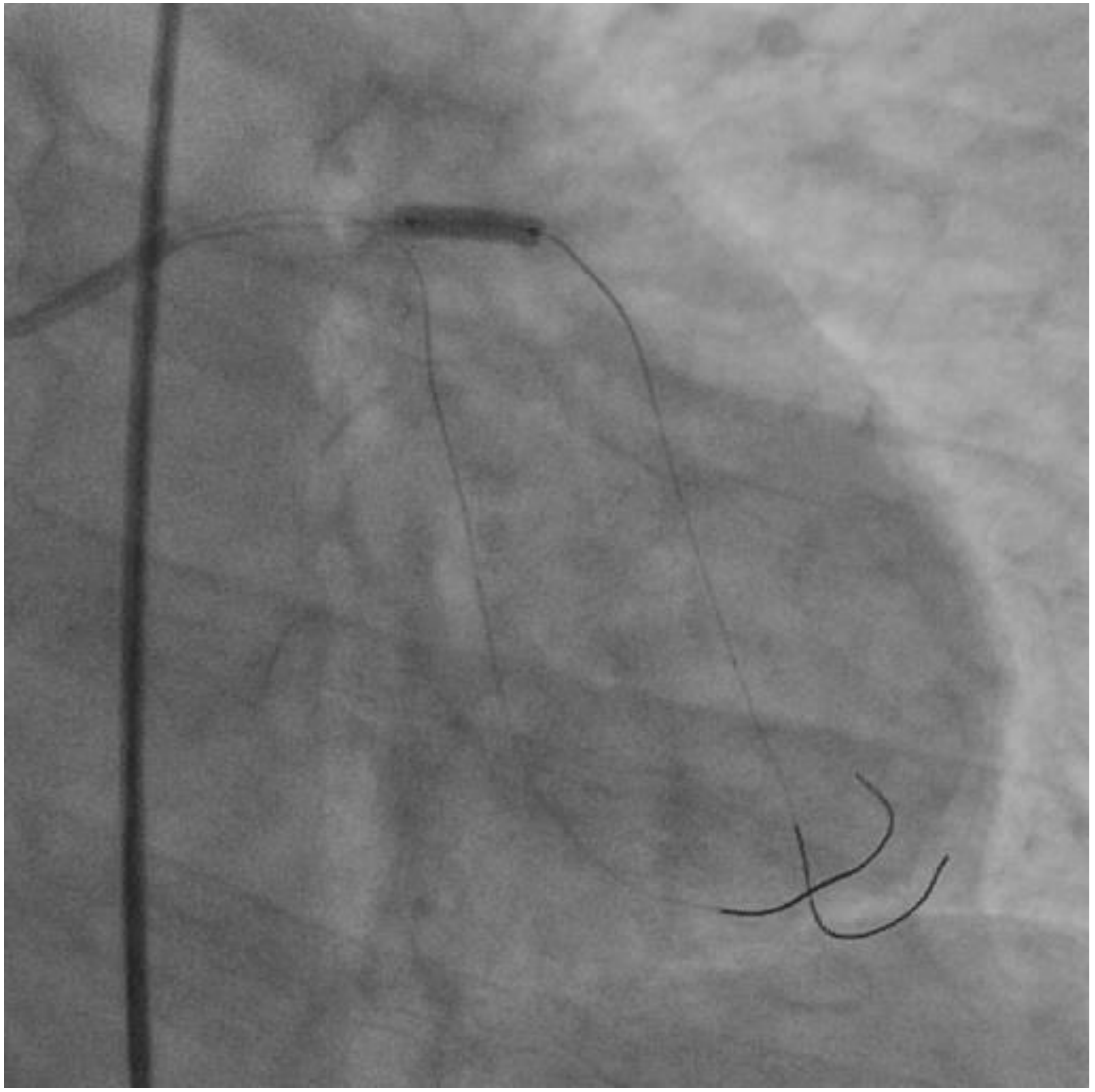
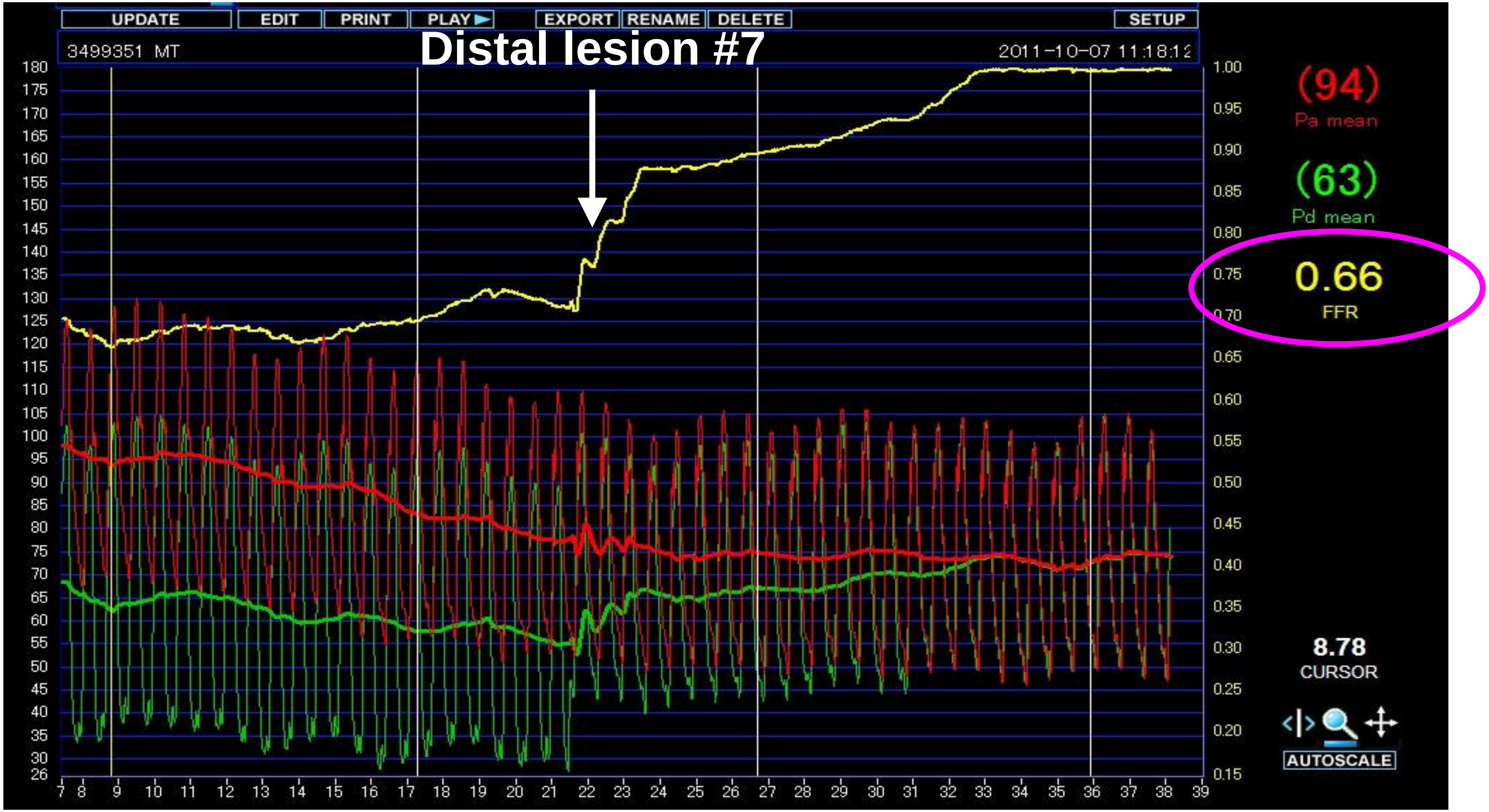
PCI to #6

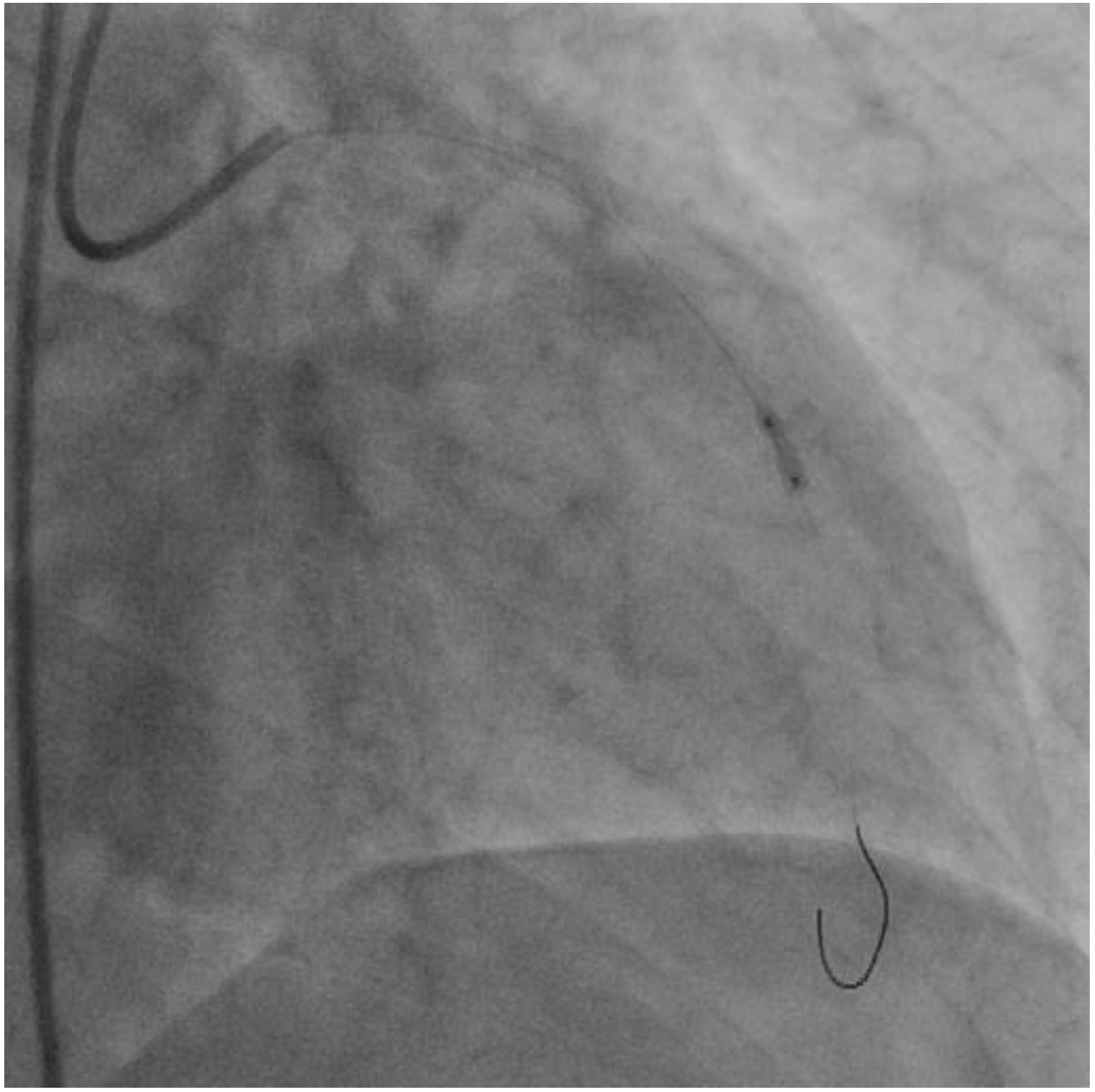


Xience V : 3.5x15mm

FFR (after stenting to #6)

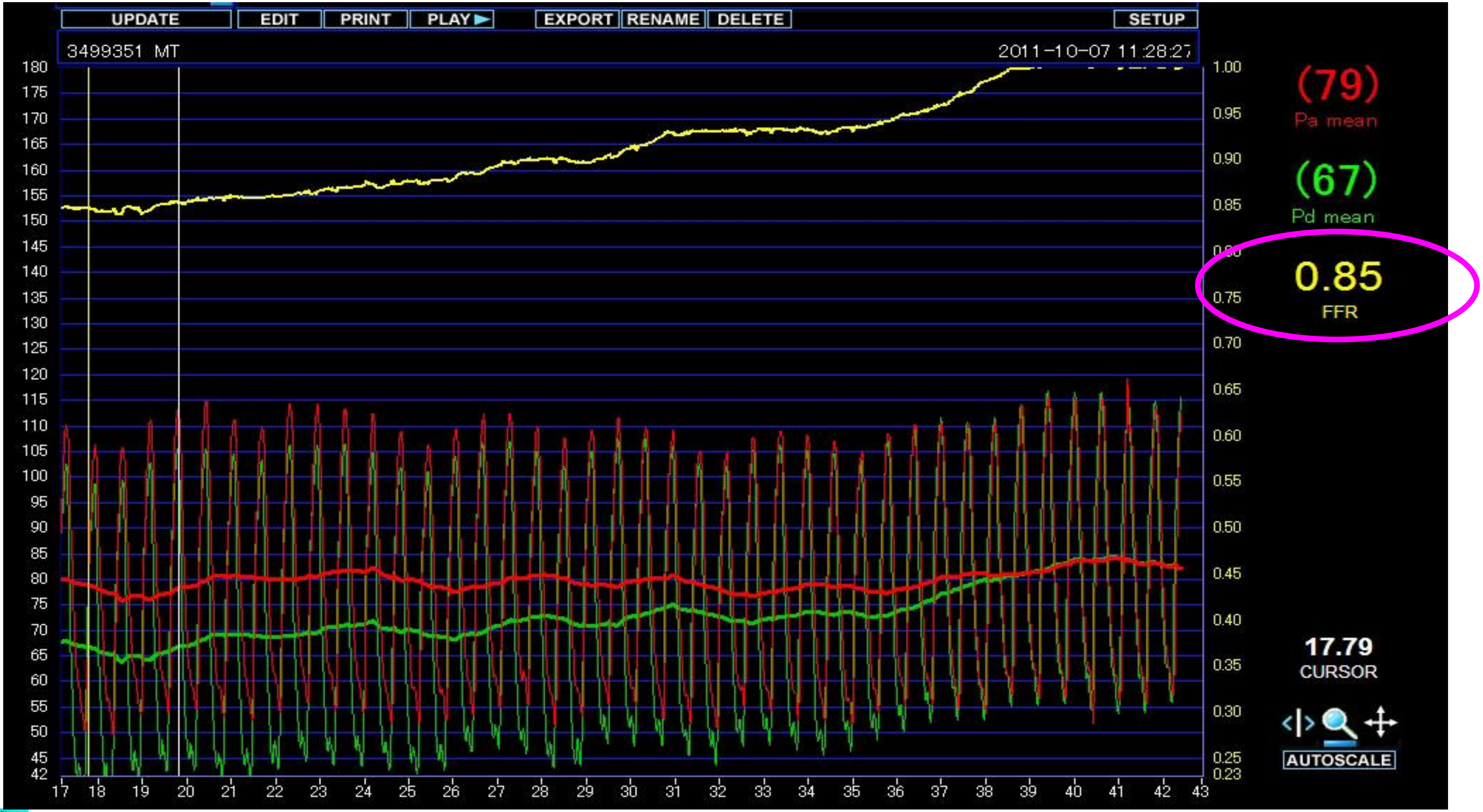


PCI to #7

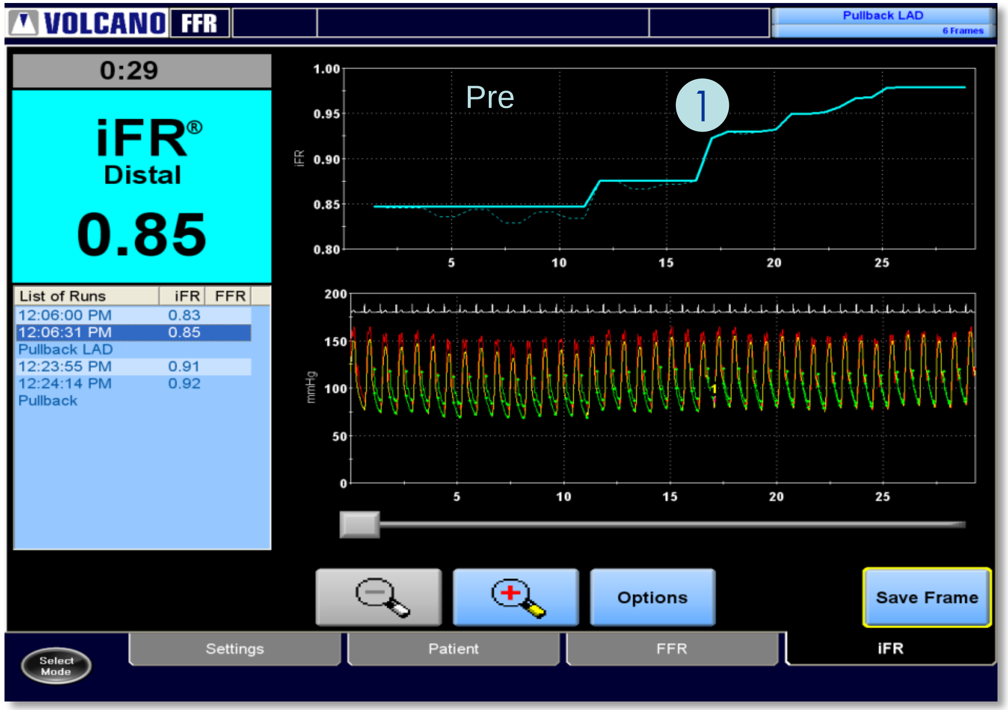


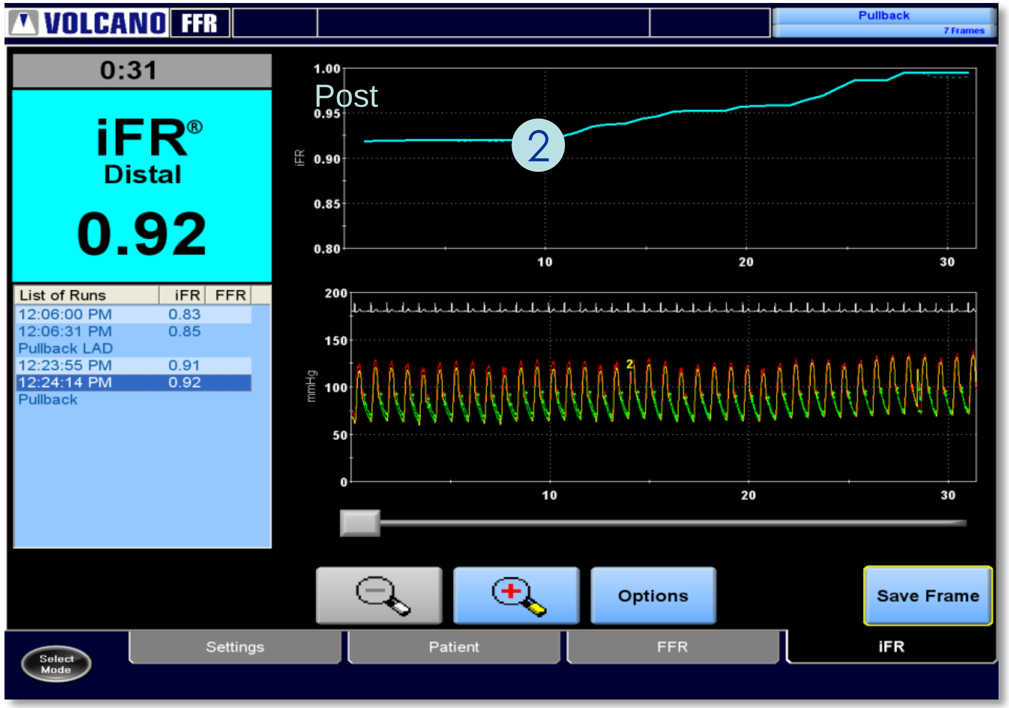
Xience V : 2.5x8mm

FFR (after stenting to #7)



Pullback curve by iFR





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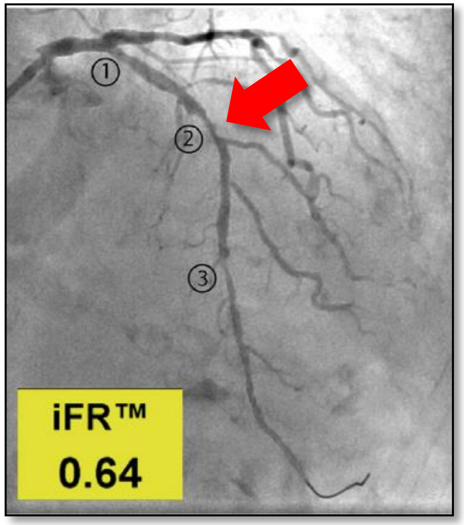
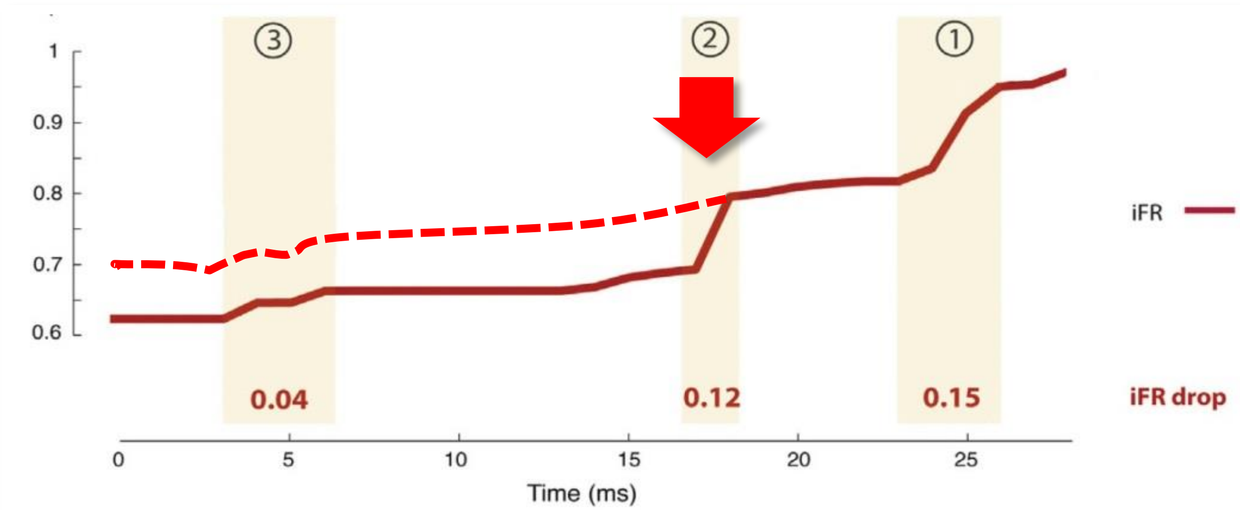
iFR Pullback

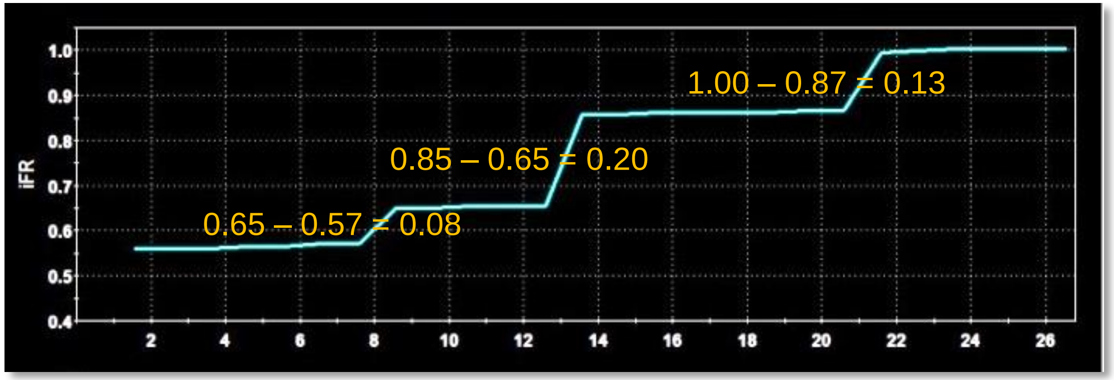


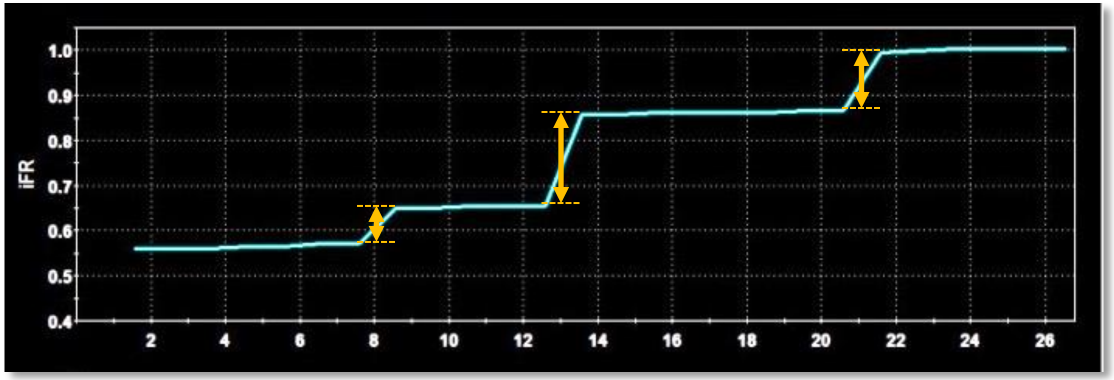


Nijjer S, et al. JACCint 2014; 12: 1386-1396.

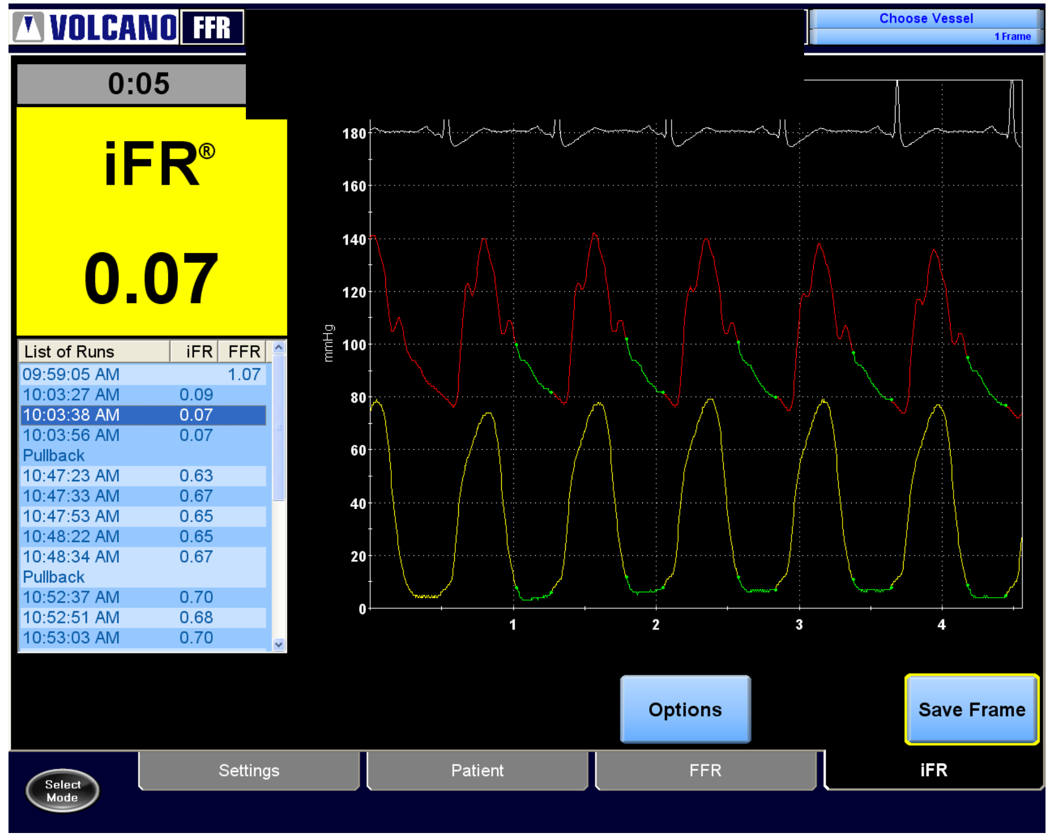
Advantages of iFR pullback

- The most significant lesion could be identified by the finding of maximum pressure (iFR value) difference.

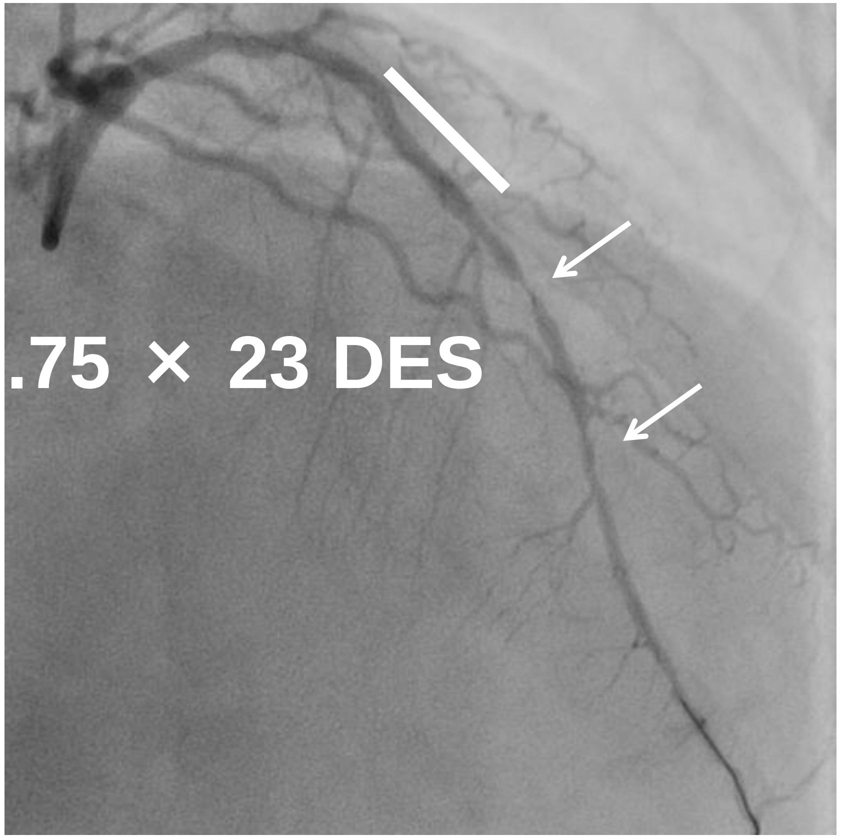


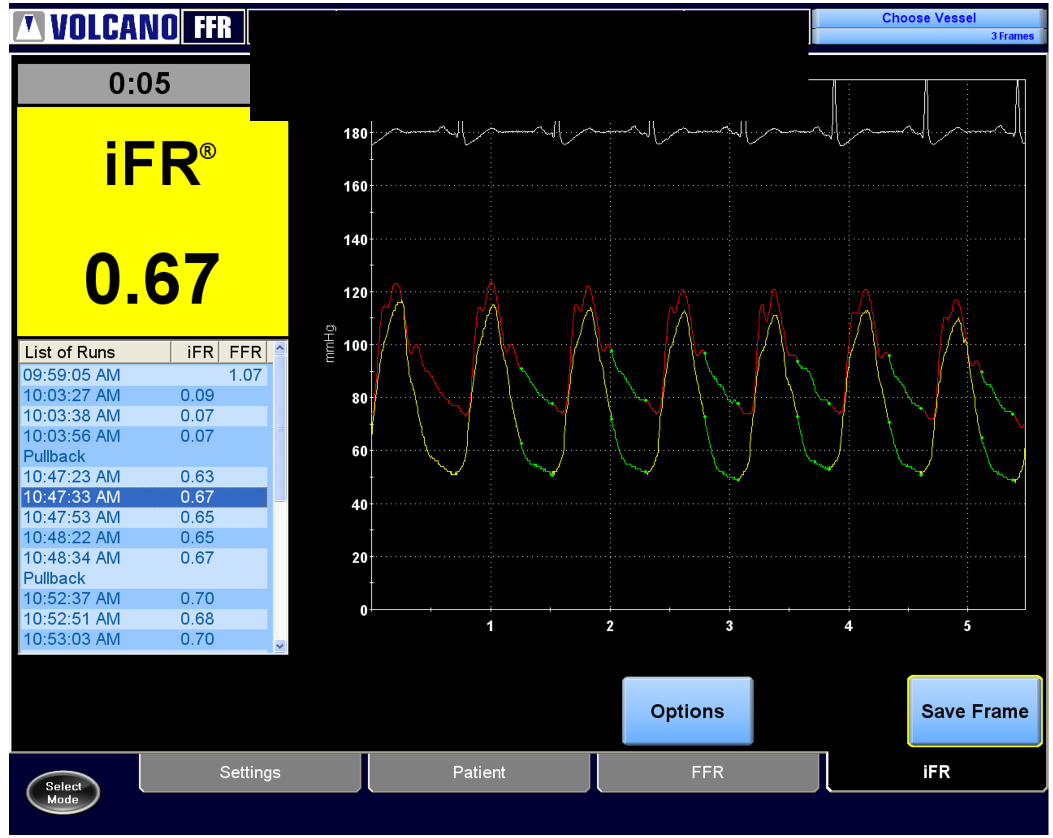


PCI case with iFR co-registration

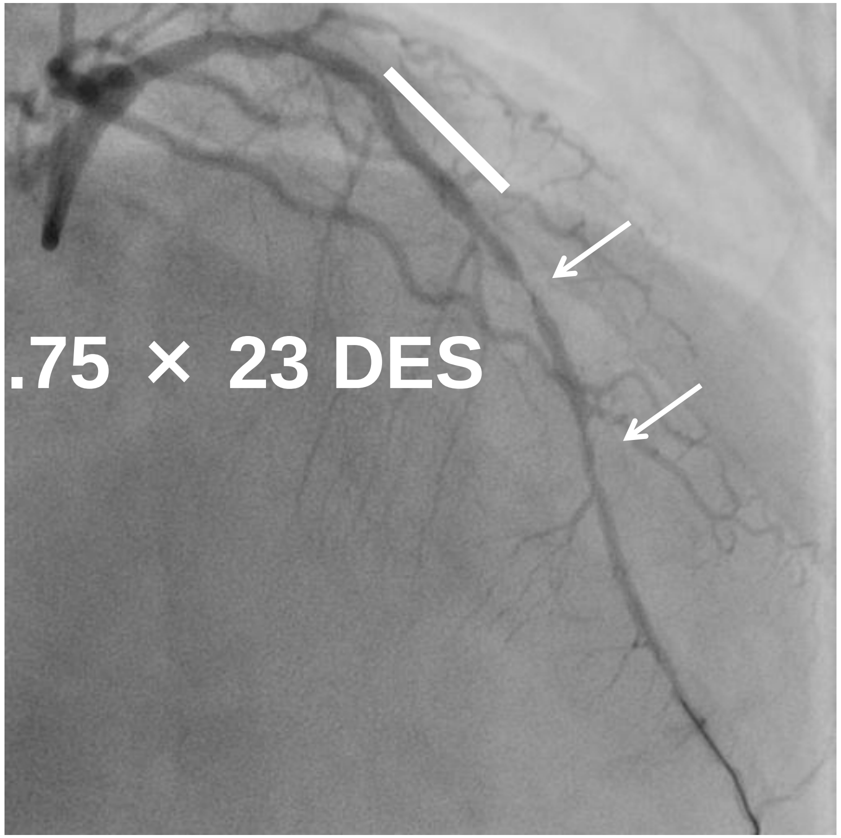


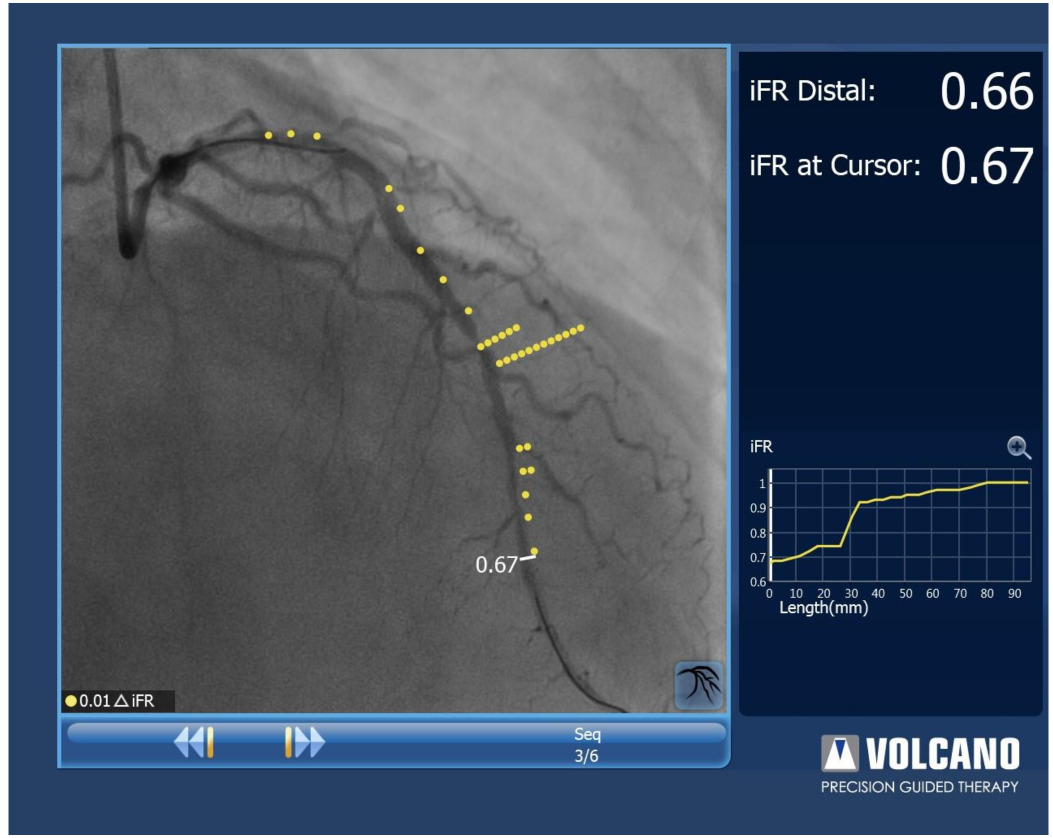
PCI case with iFR co-registration



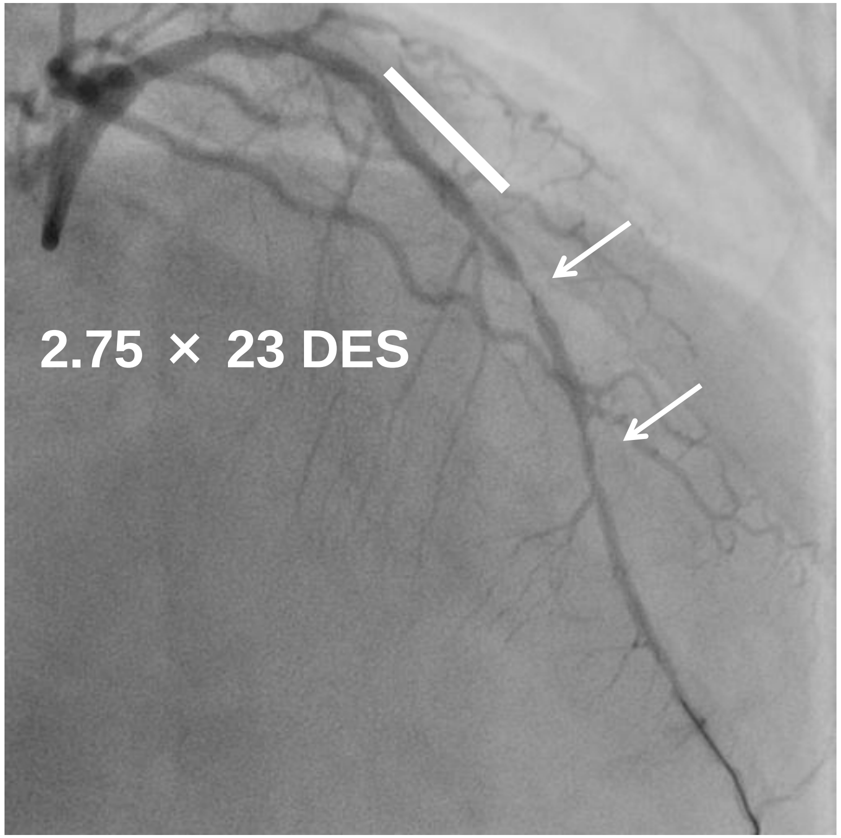


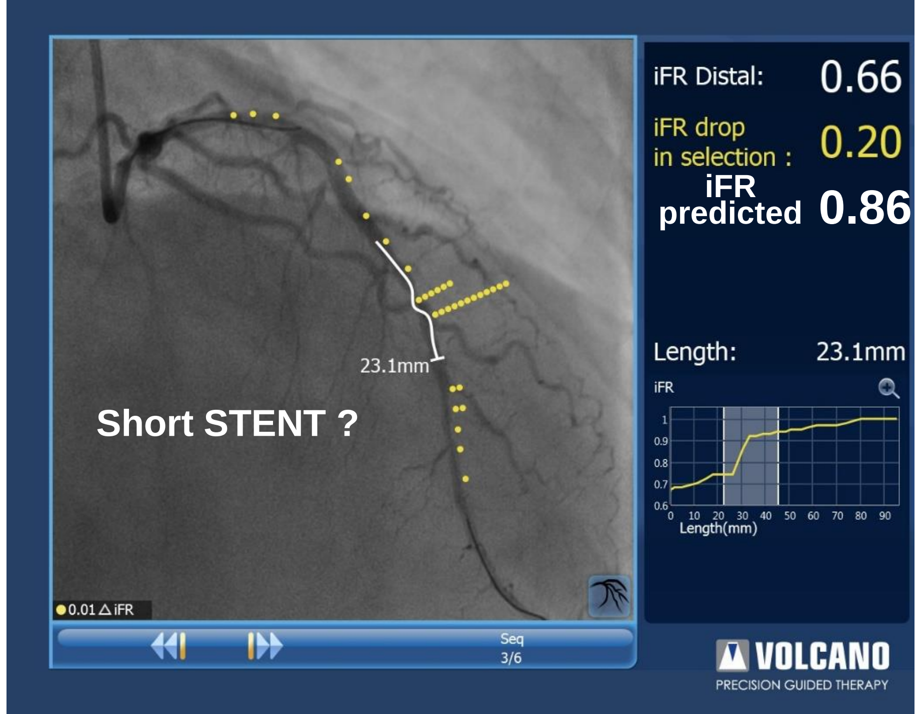
PCI case with iFR co-registration

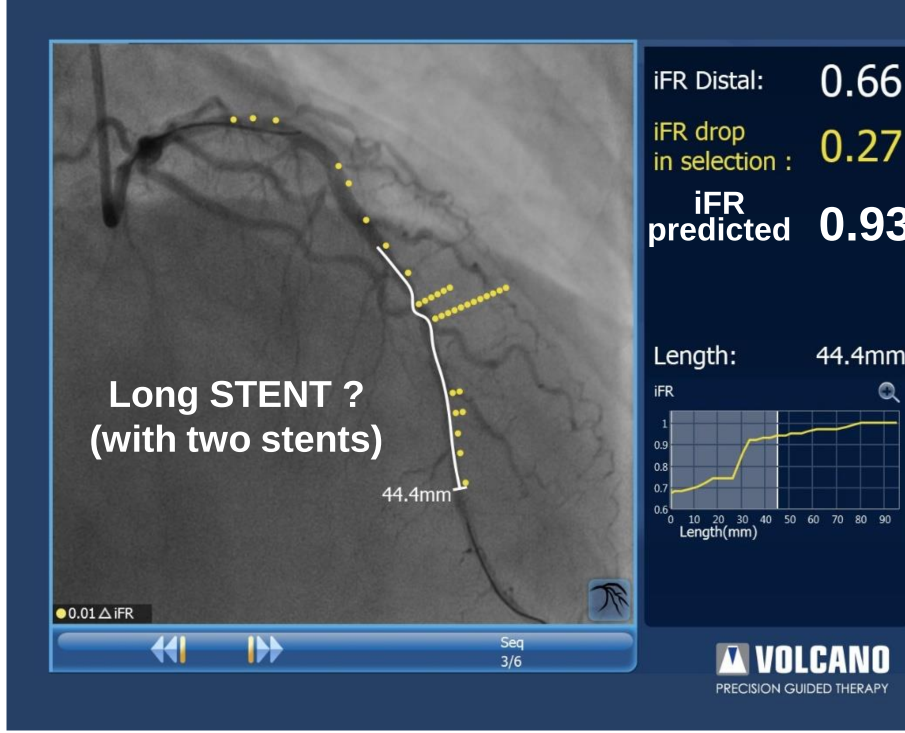




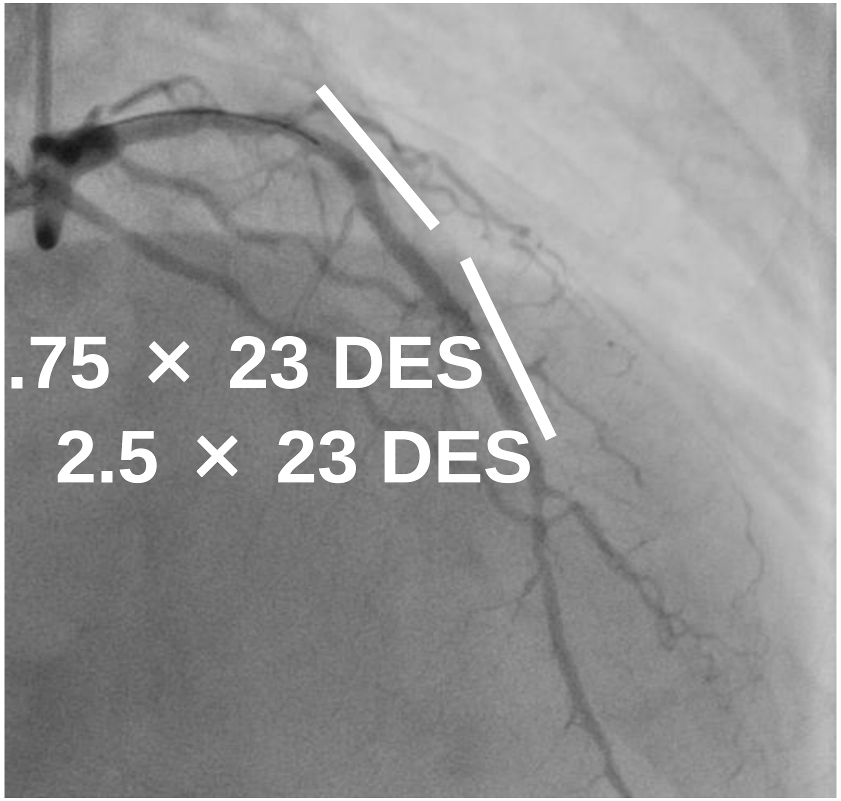
Prediction of post PCI iFR by Syncvision

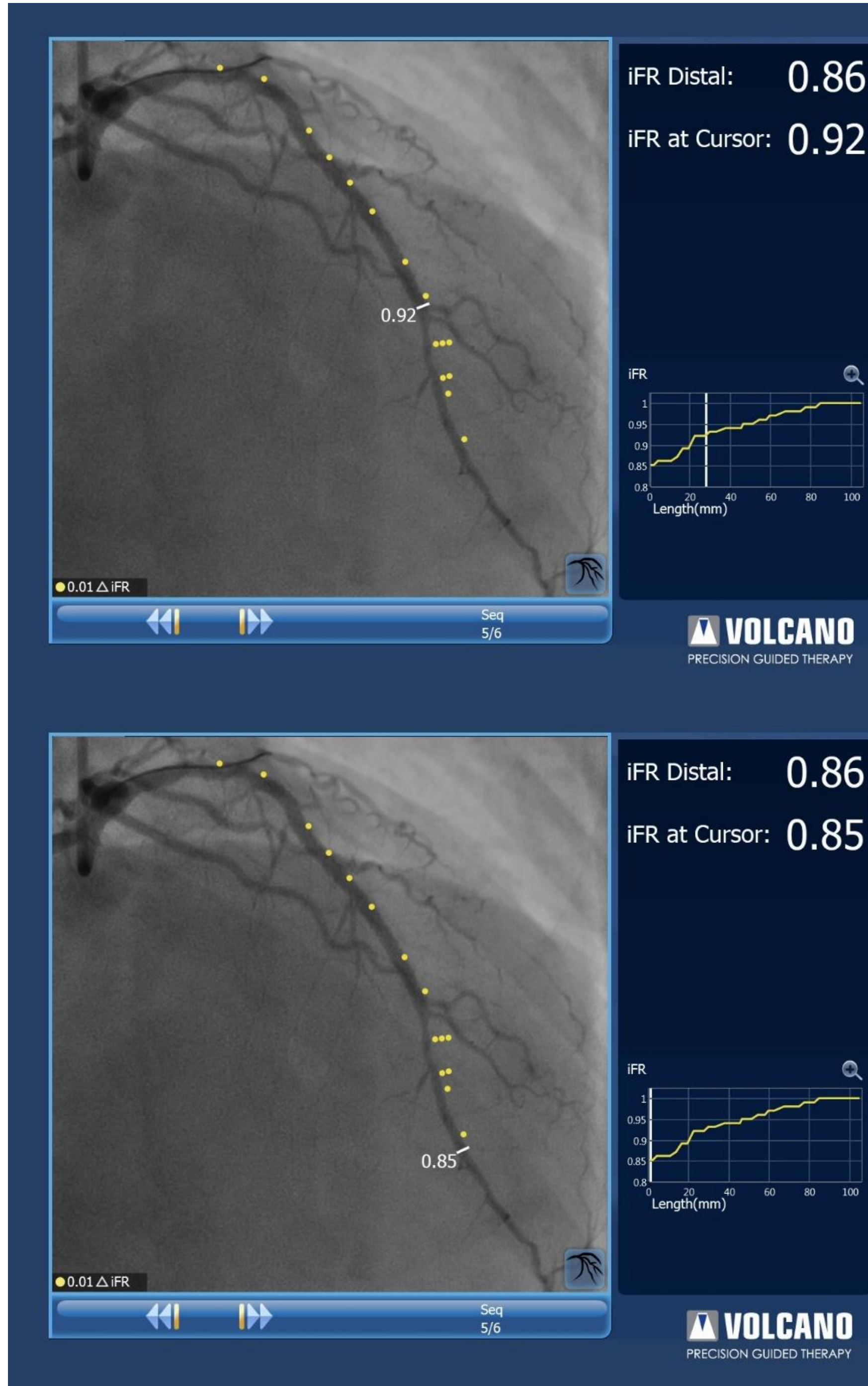






Prediction of post PCI iFR by Syncvision





We chose a short stent.

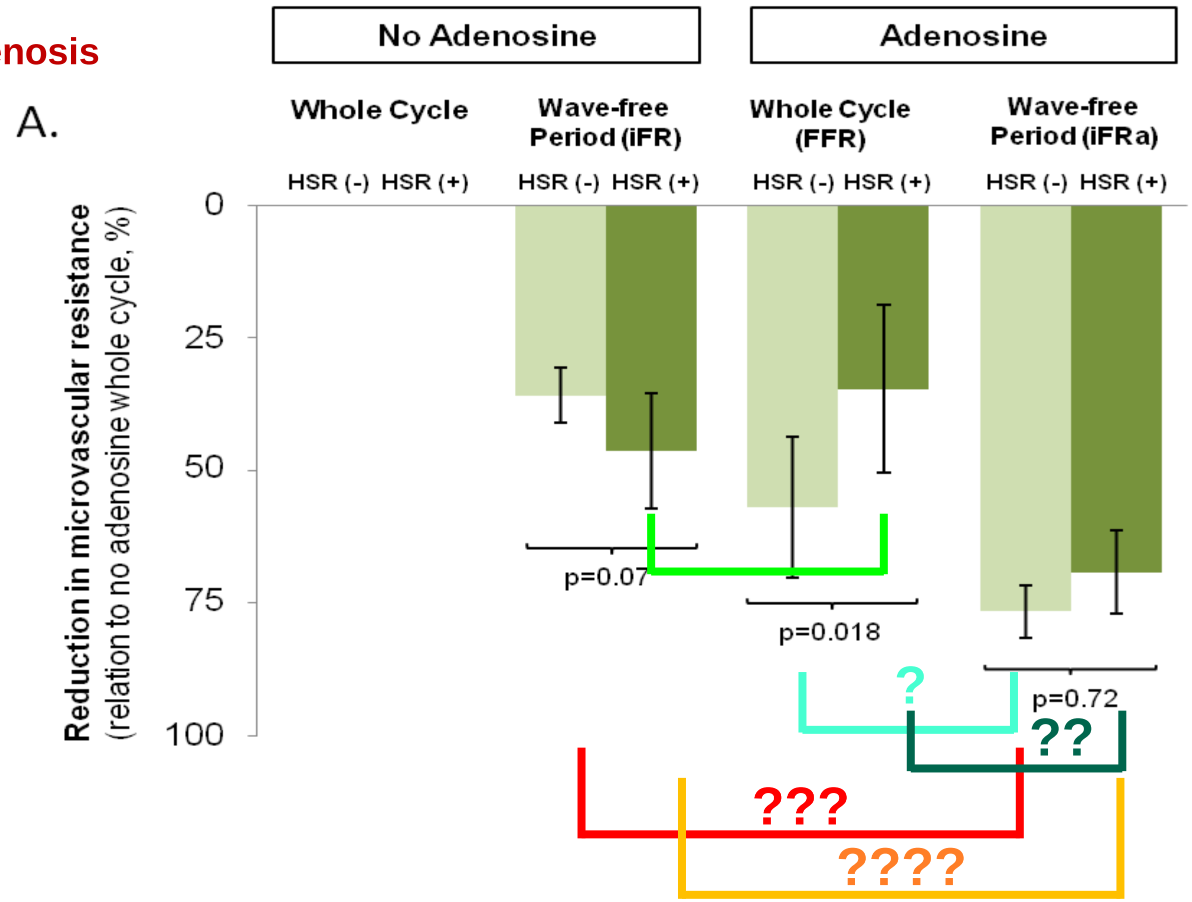
University

CLARIFY an ADVISE sub-study

Summary of microvascular resistance (MVR) reduction with & without hyperemia by adenosine infusion in cases with or without significant stenosis

HSR(−); no stenosis

HSR(+); stenosis



Although reduction of MVR in iFR is grater than FFR in cases with stenosis, much more reduction in MVR is demonstrated during hyperemia in cases with & without stenosis in iFR.

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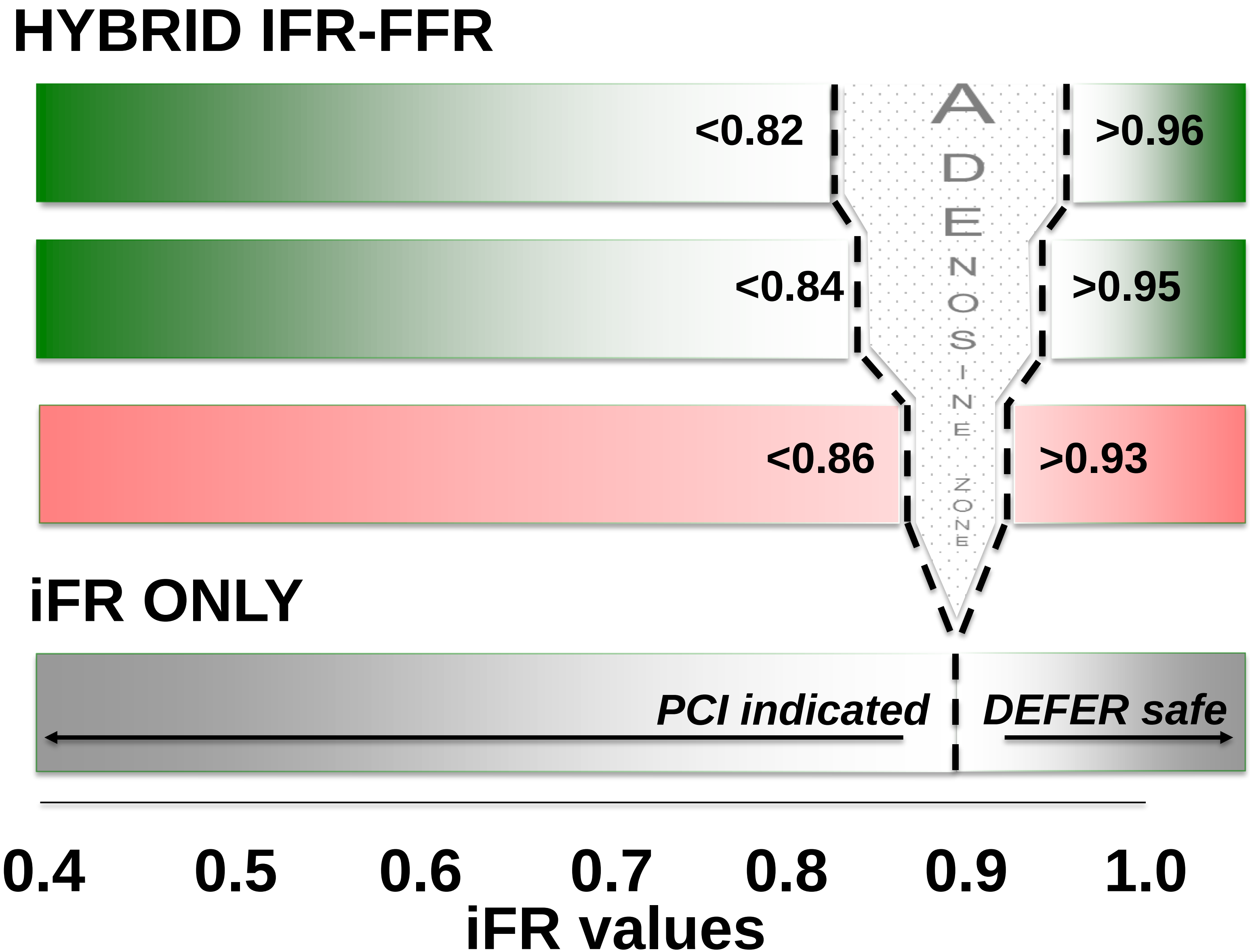
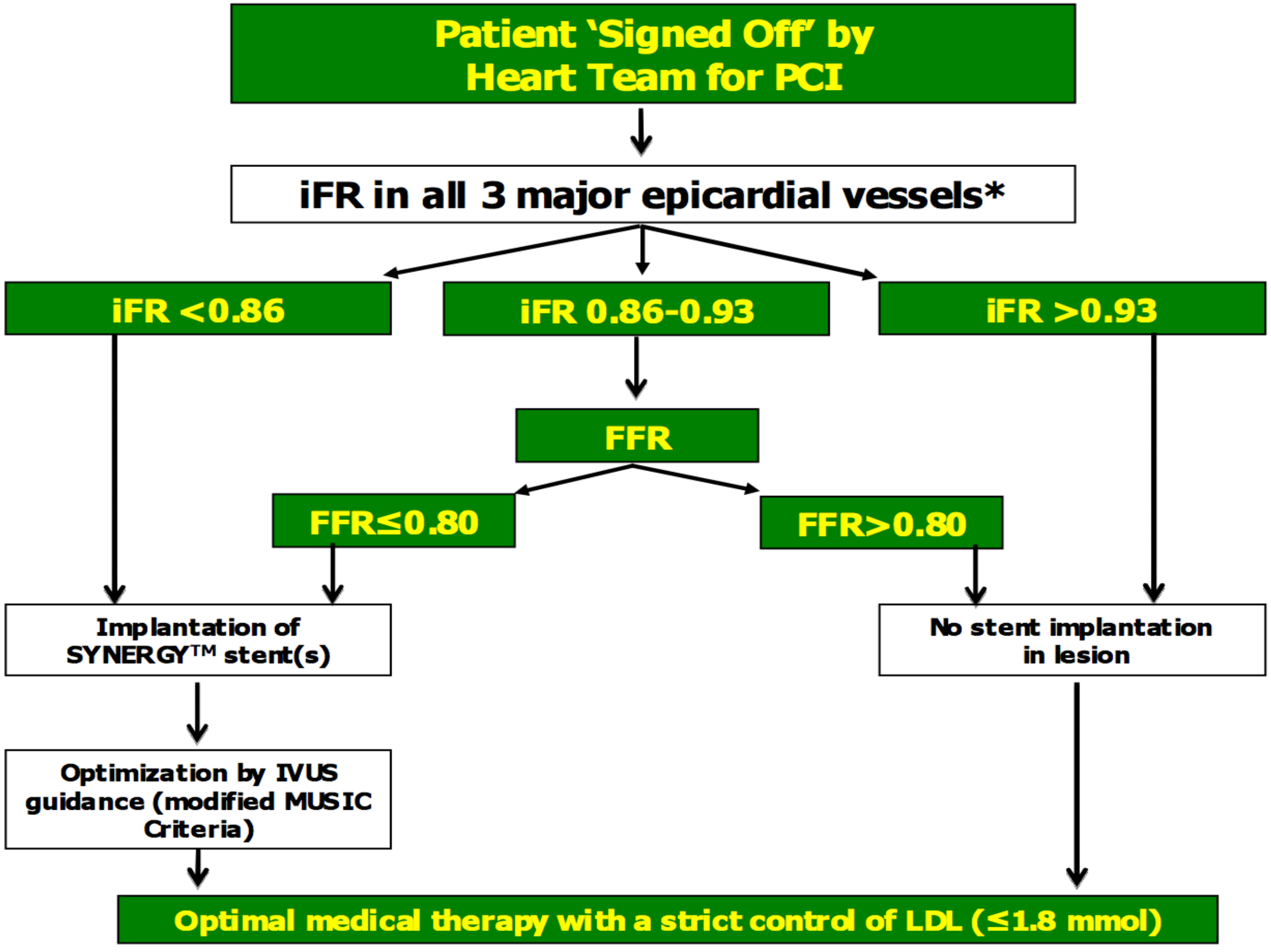


Match with FFR	% more than PdPa
99%	72%
97%	40%
95%	33%
81%	

Petraco R et al. EuroIntervention. 2013 Feb 22;8(10):1157-65

SYNTAX II



**FFR with adenosine, iFR/FFR in side branches, all at discretion of the operator*

Serruys P et al. EUROPCR 2013

European Heart Journal (2017) **00**, 1–11
doi:10.1093/eurheartj/ehx512

FASTTRACK CLINICAL RESEARCH
ESC Late Breaking Science in PCI 1

Interventional cardiology

Clinical outcomes of state-of-the-art percutaneous coronary revascularization in patients with *de novo* three vessel disease: 1-year results of the SYNTAX II study

Javier Escaned[1], Carlos Collet[2], Nicola Ryan[1], Giovanni Luigi De Maria[3], Simon Walsh[4], Manel Sabate[5], Justin Davies[6], Maciej Lesiak[7], Raul Moreno[8], Ignacio Cruz-Gonzalez[9], Stephan P. Hoole[10], Nick Ej West[10], J. J. Piek[2], Azfar Zaman[11], Farzin Fath-Ordoubadi[12], Rodney H. Stables[13], Clare Appleby[13], Nicolas van Mieghem[14], Robert Jm. van Geuns[14], Neal Uren[15], Javier Zueco[16], Pawel Buszman[17], Andres Iniguez[18], Javier Goicolea[19], D...
Andrzej Ochala[21], Dariusz Dudek[22], Colm Hanratty[4], Ra...
Arie Pieter Kappetein[14], David P. Taggart[3], Gerrit-Anne v...
Marie-Angele Morel[23], Ton de Vries[23], Yoshinobu Onuma...
Patrick W. Serruys[6]*, and Adrian P. Banning[3]

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Academic Medical Center of Amsterdam, Cardiology, Amsterdam, the Netherlands; Meibergdreef 9, 1105 AZ Amsterd...
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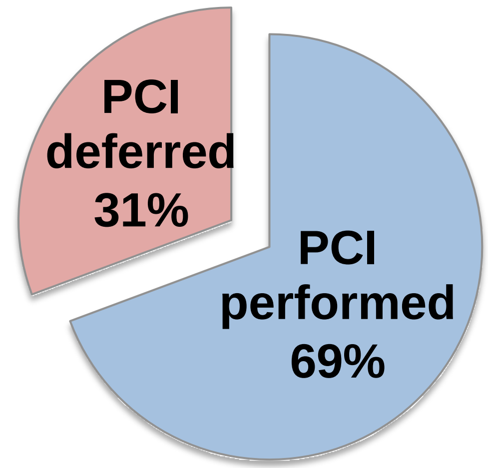
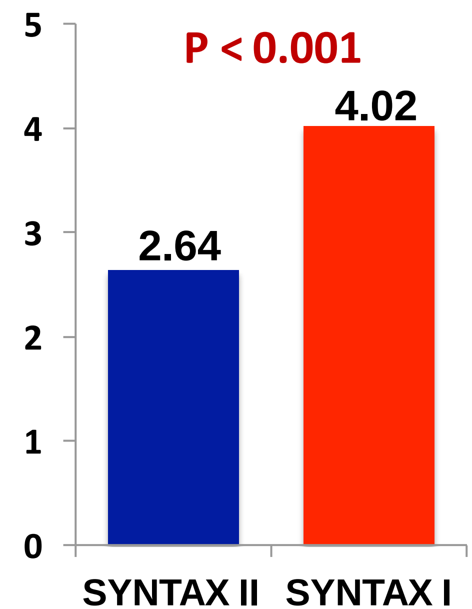
Barcelona, Spain; [6]Department of Cardiology, Imperial College London, London, UK; Kensington, London SW7 2AZ, U...

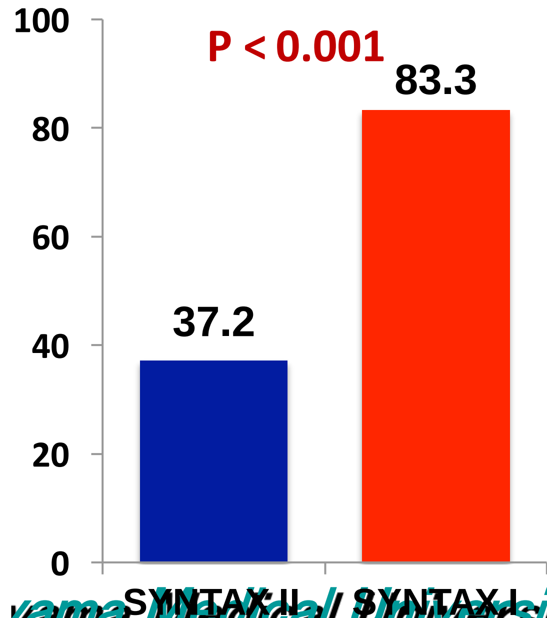
Lesion treatment ater iFR/FFR interrogation (n=1177)



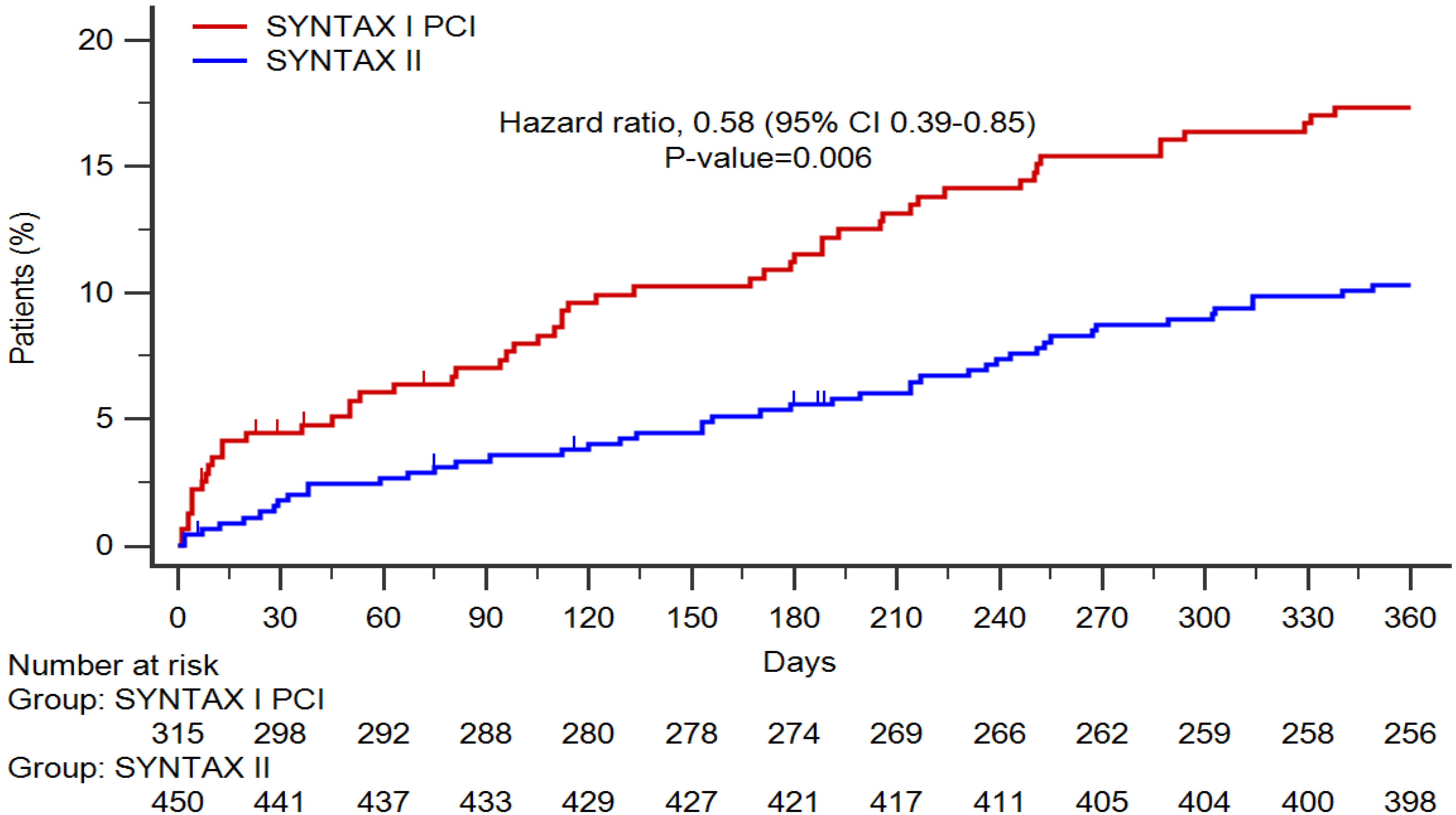
Lesions treated per pa&ent (n) in SYNTAX II and SYNTAX I



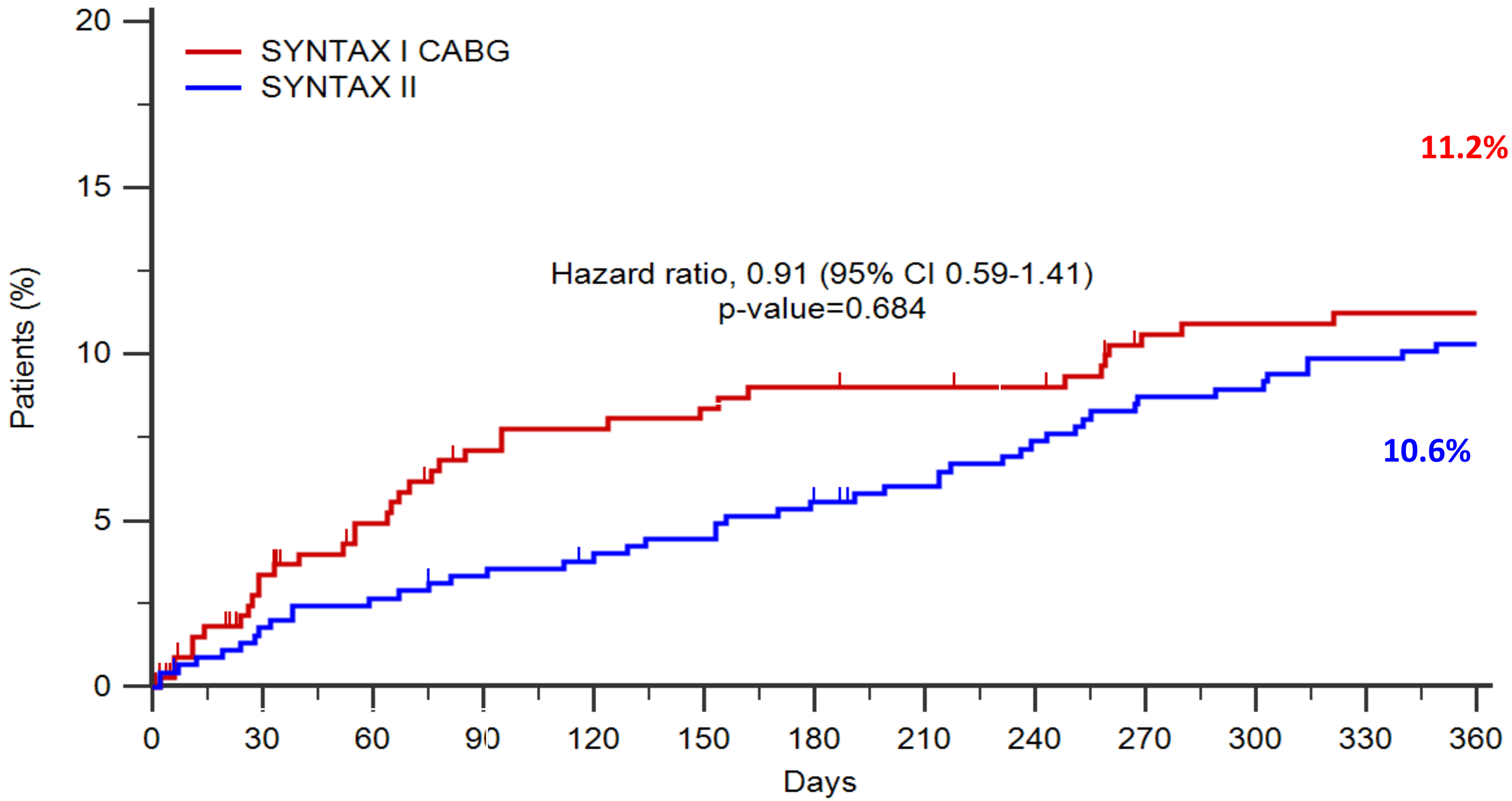
Cases of three-vessel PCI (%) in SYNTAX II and SYNTAX I



Primary endpoint: MACCE



Exploratory End-Point: MACCE PCI vs. CABG

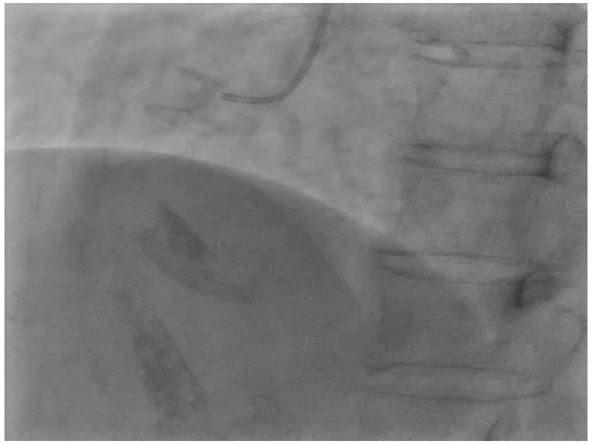


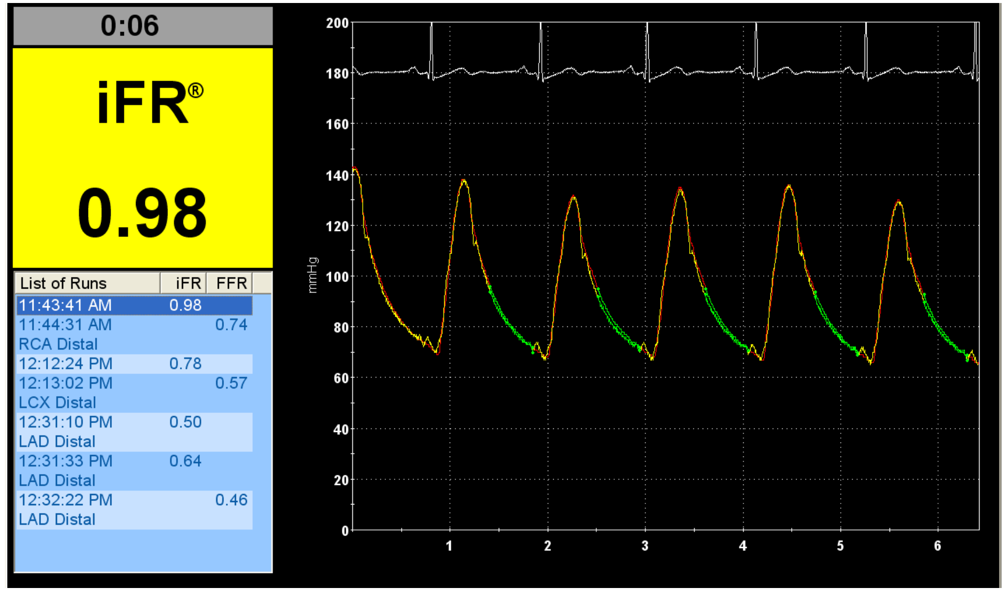
Group: SYNTAX I CABG													
	334	313	304	295	293	291	289	288	287	279	278	277	277
Group: SYNTAX II													
	450	441	437	433	429	427	421	417	411	405	404	400	398

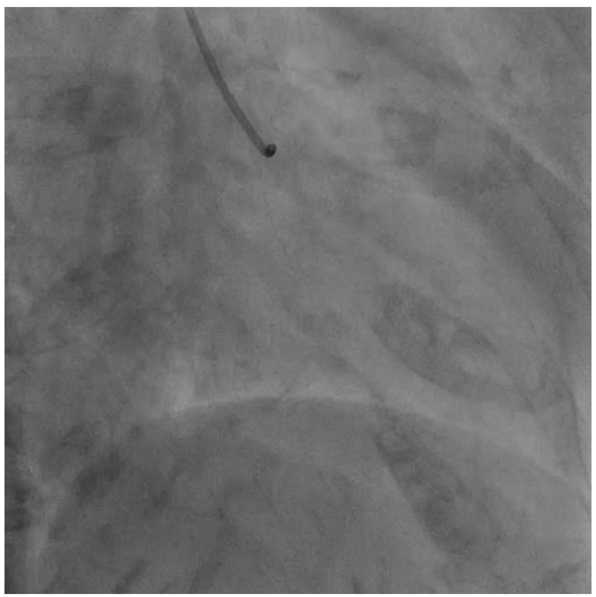
*Non-inferiority margin of 5% with a one-sided alpha of 5%

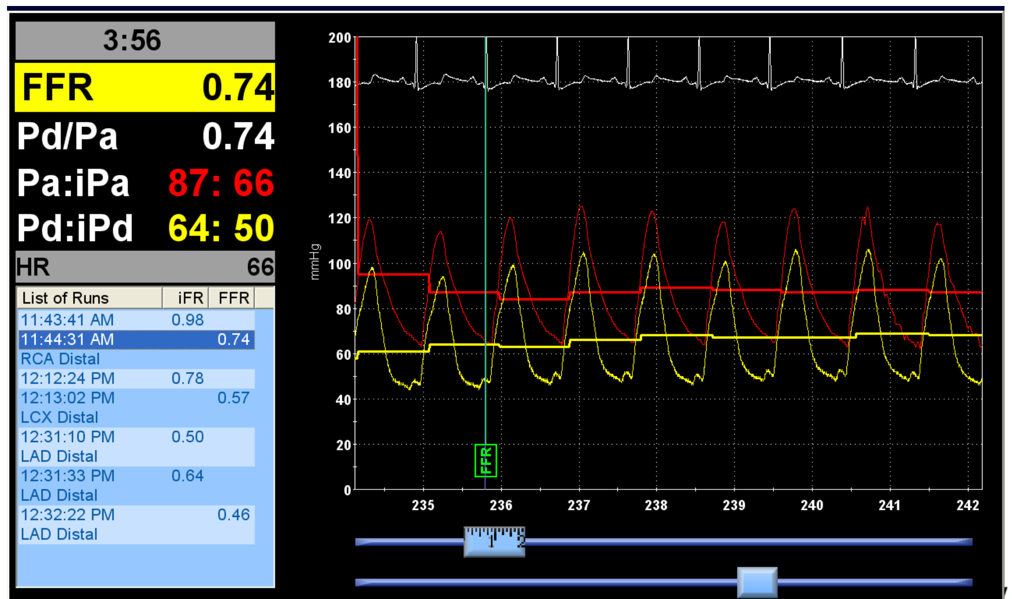
Unresolved issue

Case: 64 y.o., female, NSTEMI (anterior)

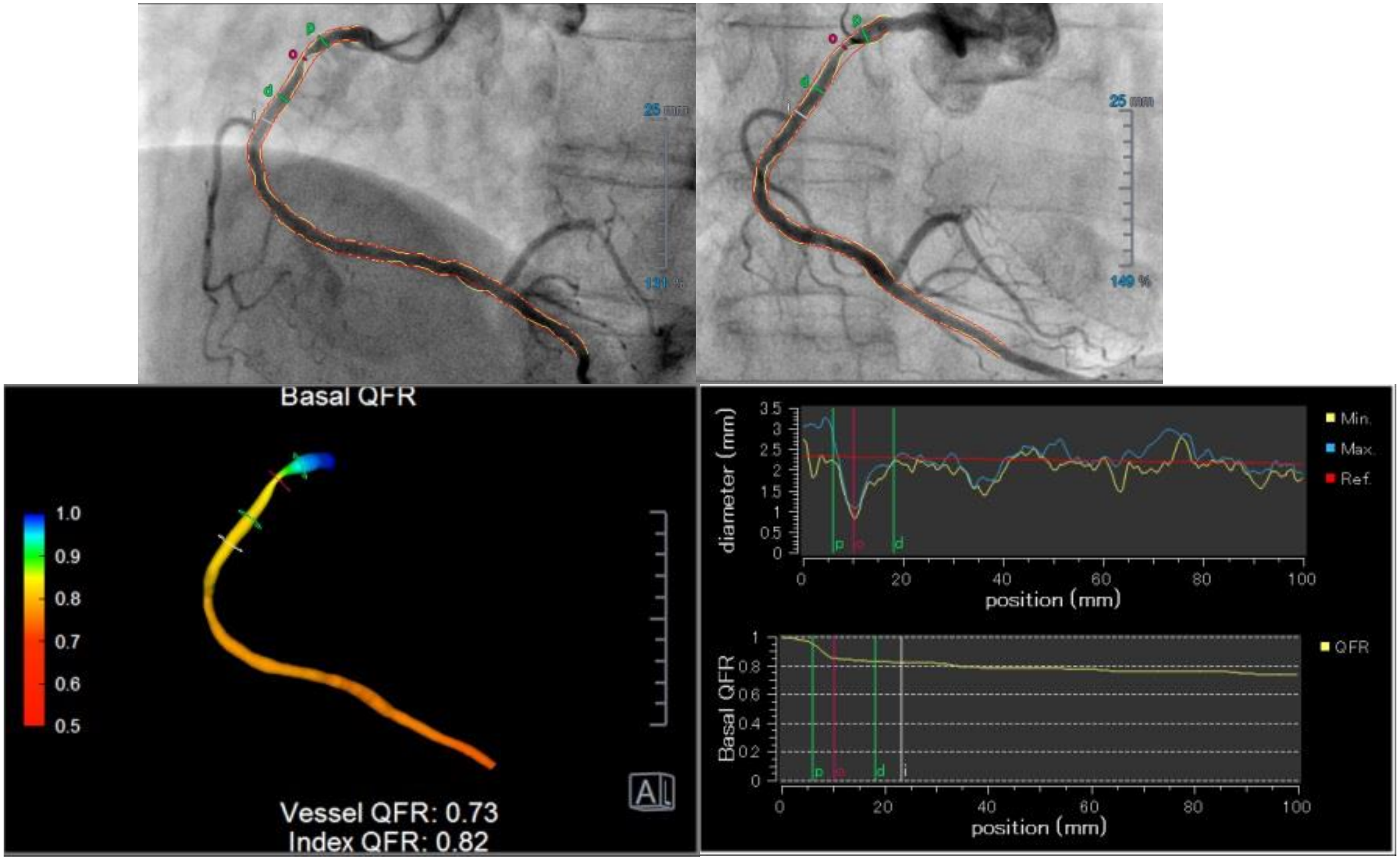






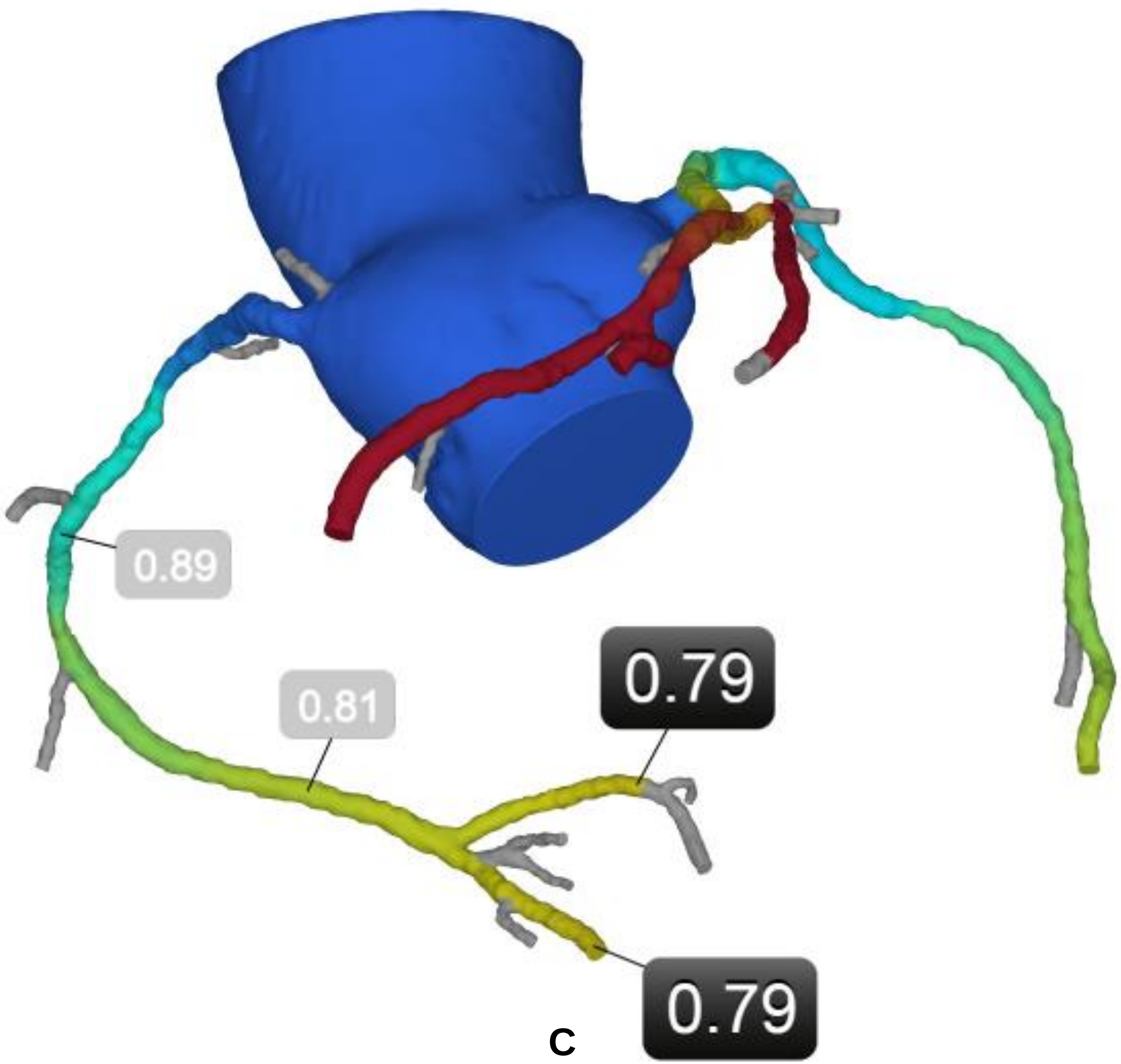


QFR=0.73



25 mm
149 %
Basal QFR
1.0
0.9
0.8
0.7
0.6
0.5
Vessel QFR: 0.73
Index QFR: 0.82
diameter (mm)
position (mm)
Min.
Max.
Ref.
Basal QFR
position (mm)
QFR

FFR CT=0.79



C

Comparison between FFR & iFR at present

	FFR	iFR
Pressure Wire	○	○
Hyperemia free	✗	○
Typical measurement time	5-10 min	1-2 min
Pressure damping unlikely	✗	○
Cost saving(add to FAME)	✗	Adenosine / Time Equipment
Optimized for pullback	✗	○
Peri-PCI assessment	○	✗
Evidence against ischemia	○	△
Clinical outcome data	○	Coming soon !

Comparison among FFRs & iFR

	Imaging modality	On-Line	Pressure-wire use	Analysis time	Hyperemia
FFR p-wire	Angio	Yes	Yes	<5mim	Yes
FFR CTA-HF	CTA	No	No	24 hrs	No
FFR CTA-SM	CTA	No	No	>35min	No
QFR	3D-Angio	Yes	No	<4min	No
iFR	Angio	Yes	Yes	<5min	No/yes

Take home message

- Although FFR might have a limitation based on diastolic coronary pressure-flow relationship, there are many evidence demonstrating clinical usefulness.

- Furthermore, several non-invasive FFR measurement systems are developing according to the evidence of invasive FFR, and clinical evidence have been demonstrated by these methods.

- Although timing of measurement is thought to be ideal in iFR based on diastolic coronary pressure-flow relationship, there are a only few data demonstrating clinical usefulness.

- Although non-inferiority of iFR for PCI guidance compared with FRR has been reported in DEFINE-FLAIR study and iFR SWEDEHEART Trials, there are still unresolved issues which should be resolved adequately and further investigation would be required in the future.