

Advantages/Disadvantages of FFR, iFR and Hybrid Strategy



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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.
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Goodman Inc.
St. Jude Medical Japan
Terumo Inc.



Concept of FFRmyo

No stenosis

P_a

During HE; $P_d = P_a$

FFR (A) = $P_d / P_a = 1.0$

Stenosis (A)

P_a

A

P_d

FFR (A) = P_d / P_a during HE

Rest $P_d < P_a$,

During HE $P_d \ll P_a$

FFR(A) =

Max flow under the condition with stenosis

/max flow without stenosis



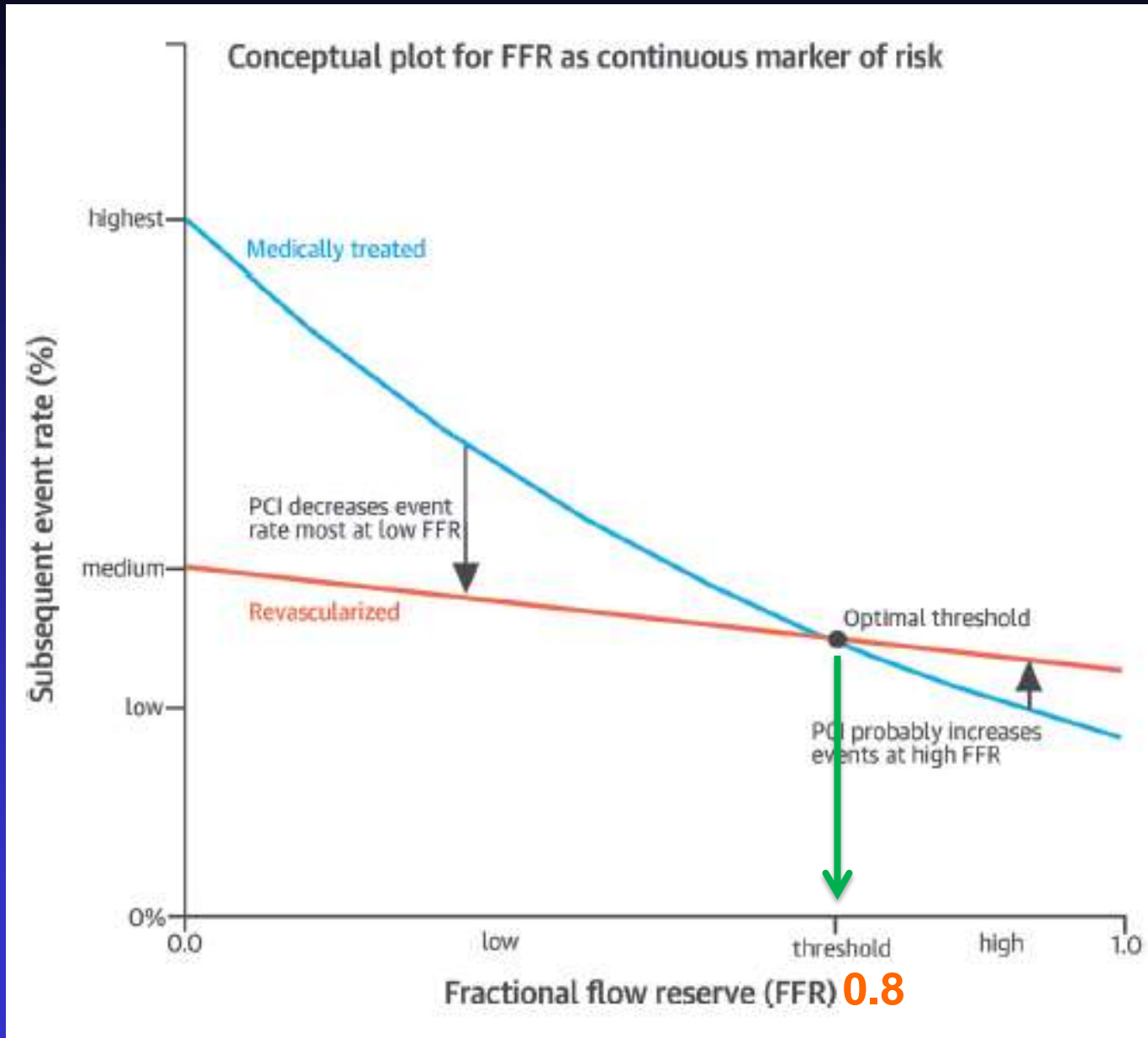
Relationship between FFR & other tests

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



Event Free Survival

Defer: defer PCI

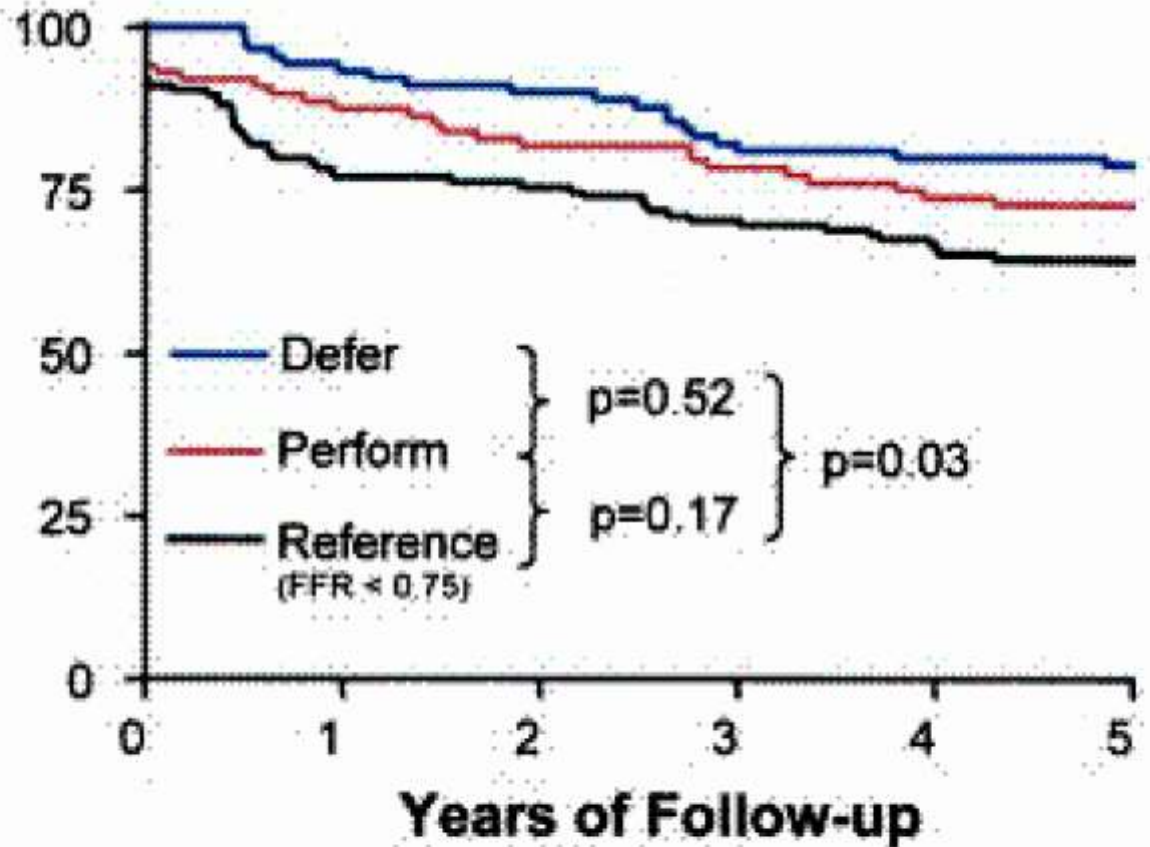
due to $FFR > 0.75$

Perform: perform PCI

even if $FFR > 0.75$

Reference: perform PCI

due to $FFR \leq 0.75$



No. at risk

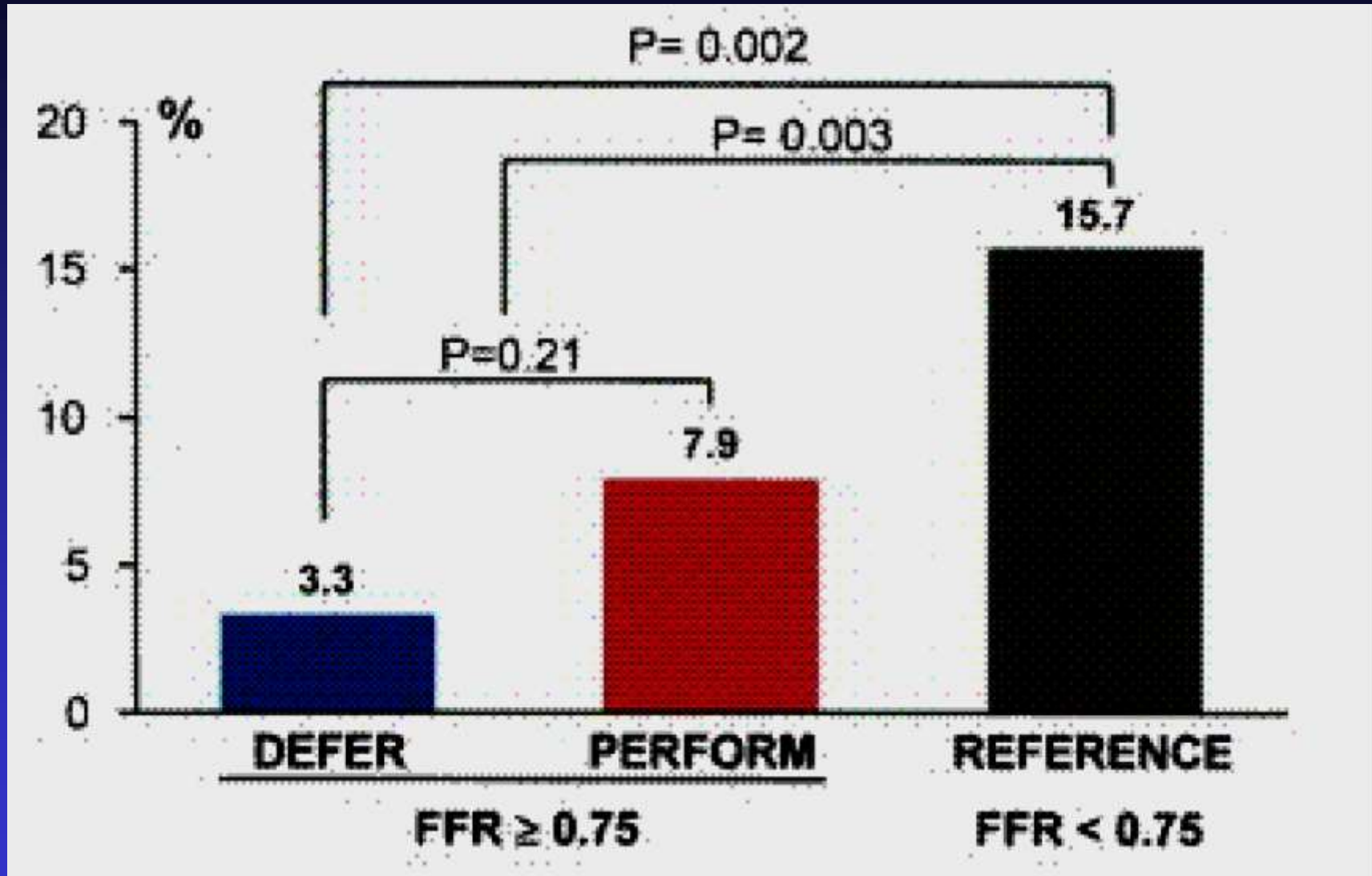
Defer group	91	85	80	74	73	72
Perform group	90	80	75	70	67	64
Reference group	144	116	106	96	90	88

Pijls NHJ, et al. J Am Coll Cardiol 49:2105-2111, 2007

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Cardiac Death & AMI after 5 Years

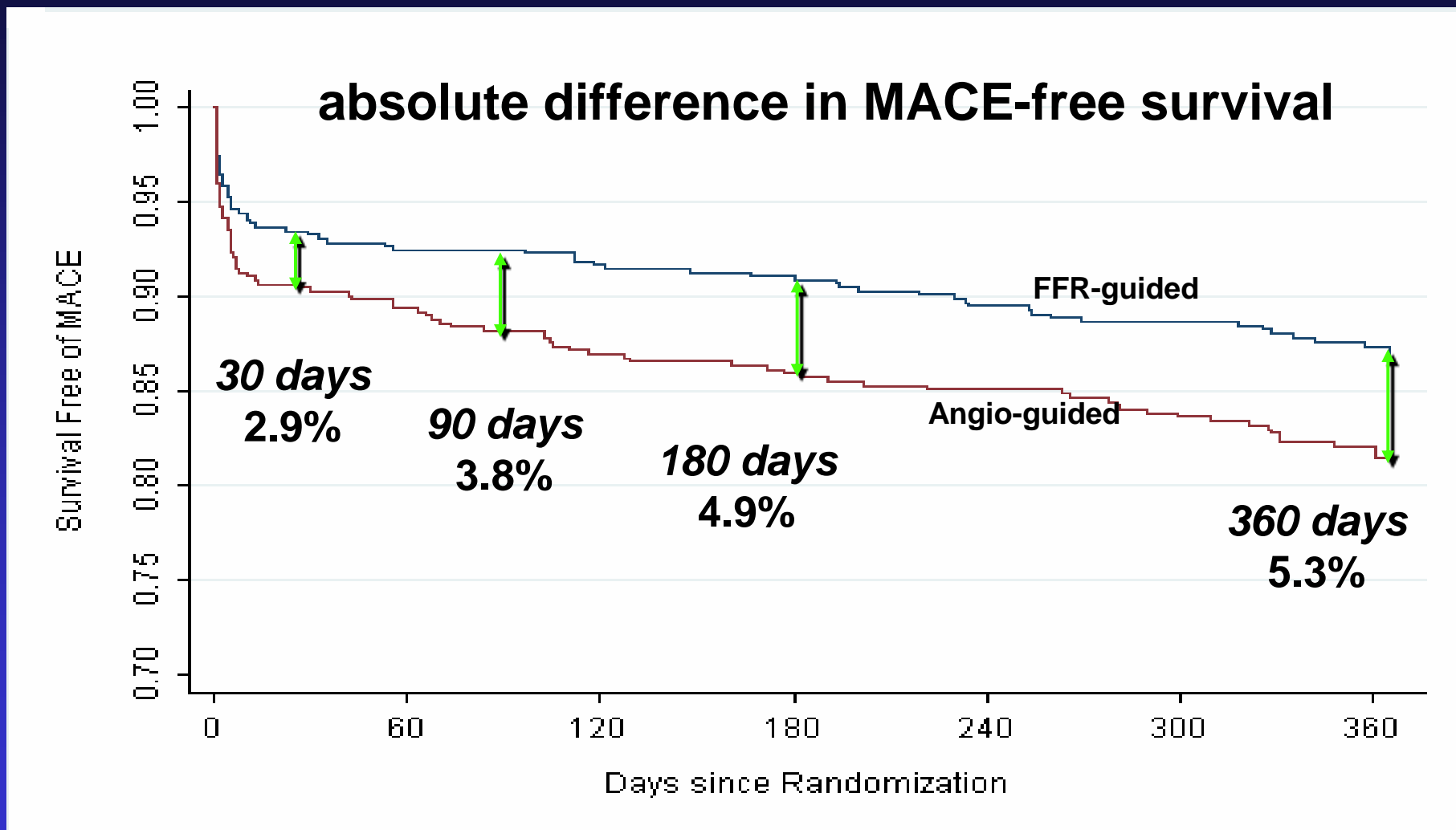


Pijls NHJ, et al. J Am Coll Cardiol 49:2105-2111, 2007

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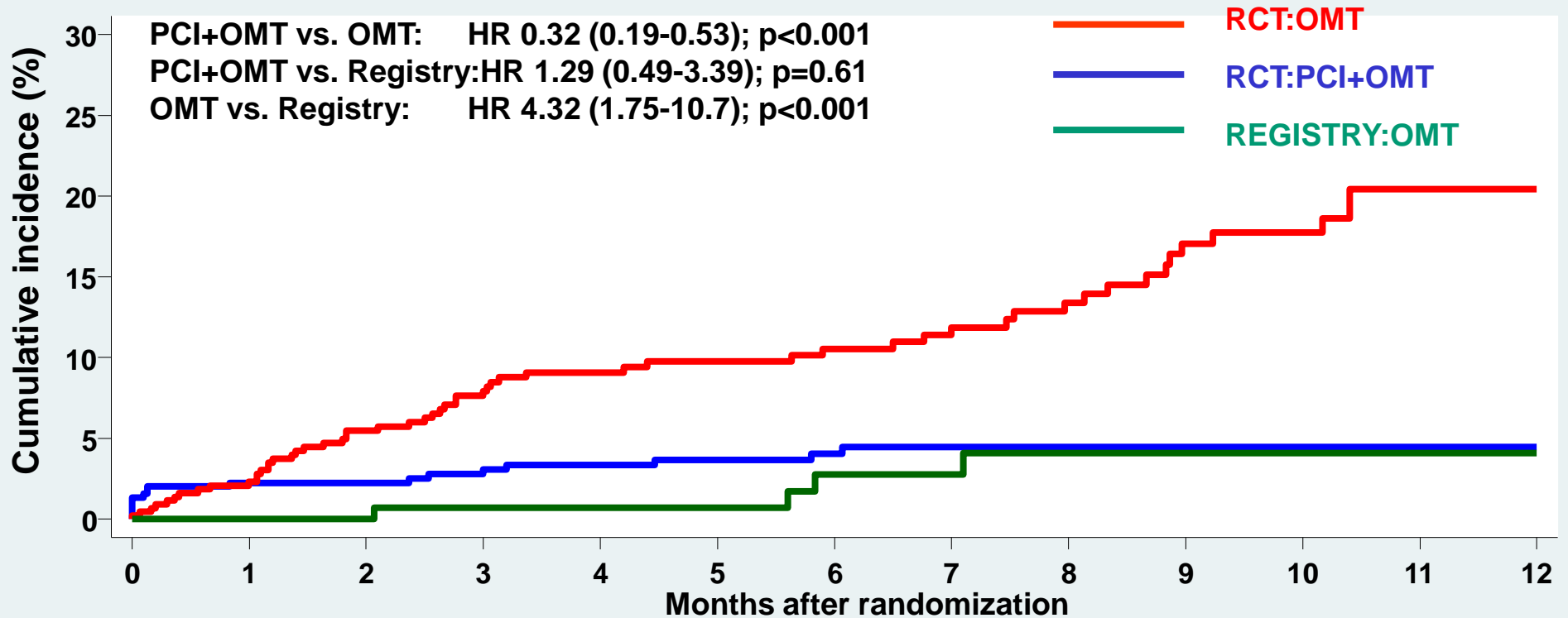


FAME study: Event-free Survival



Primary Outcomes in FAME II

Rate of any revascularization



No. at risk

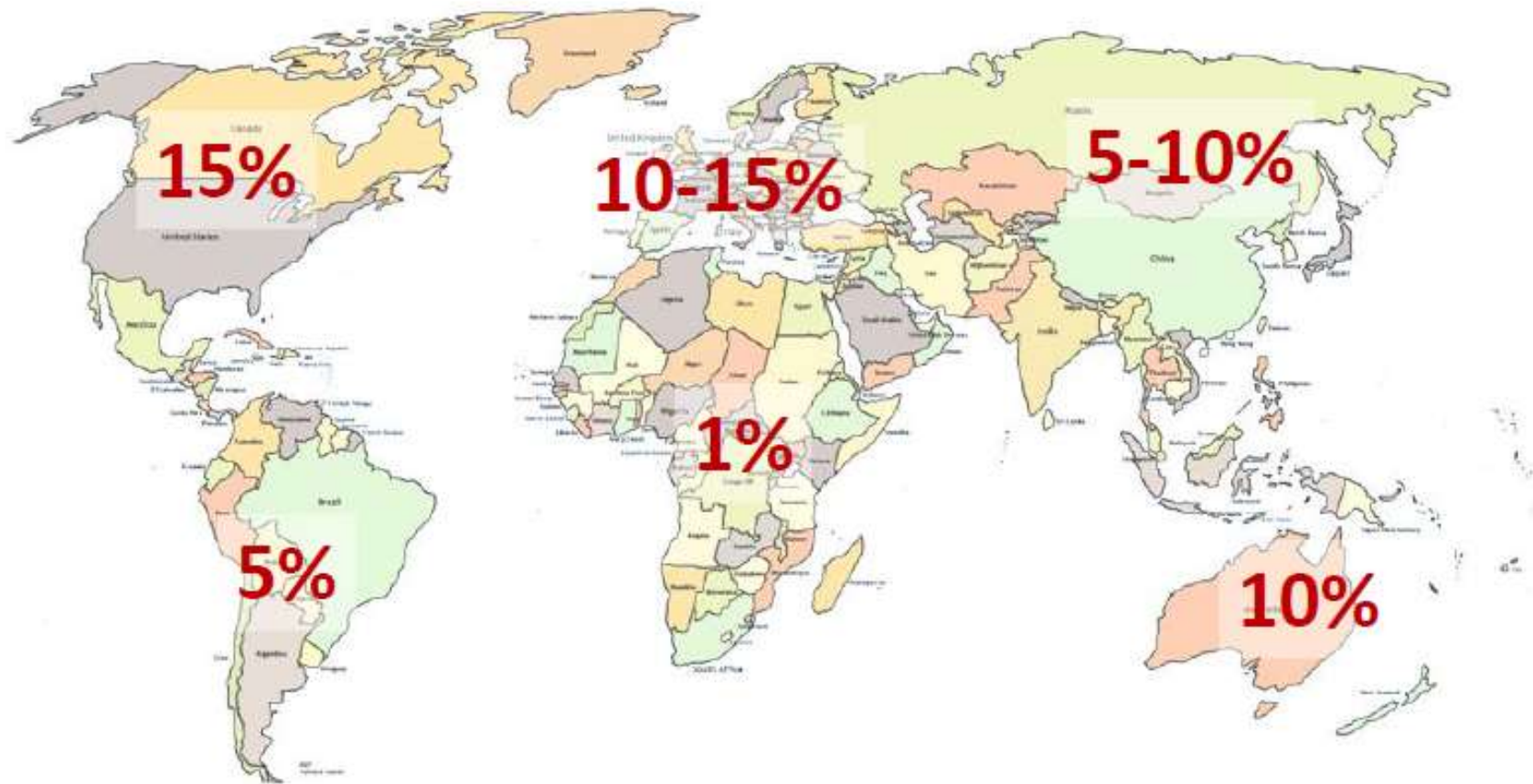
MT	441	414	370	322	283	253	220	192	162	127	100	70	37
PCI+MT	447	414	388	351	308	277	243	212	175	155	117	92	53
Registry	166	156	145	133	117	106	93	74	64	52	41	25	13

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	



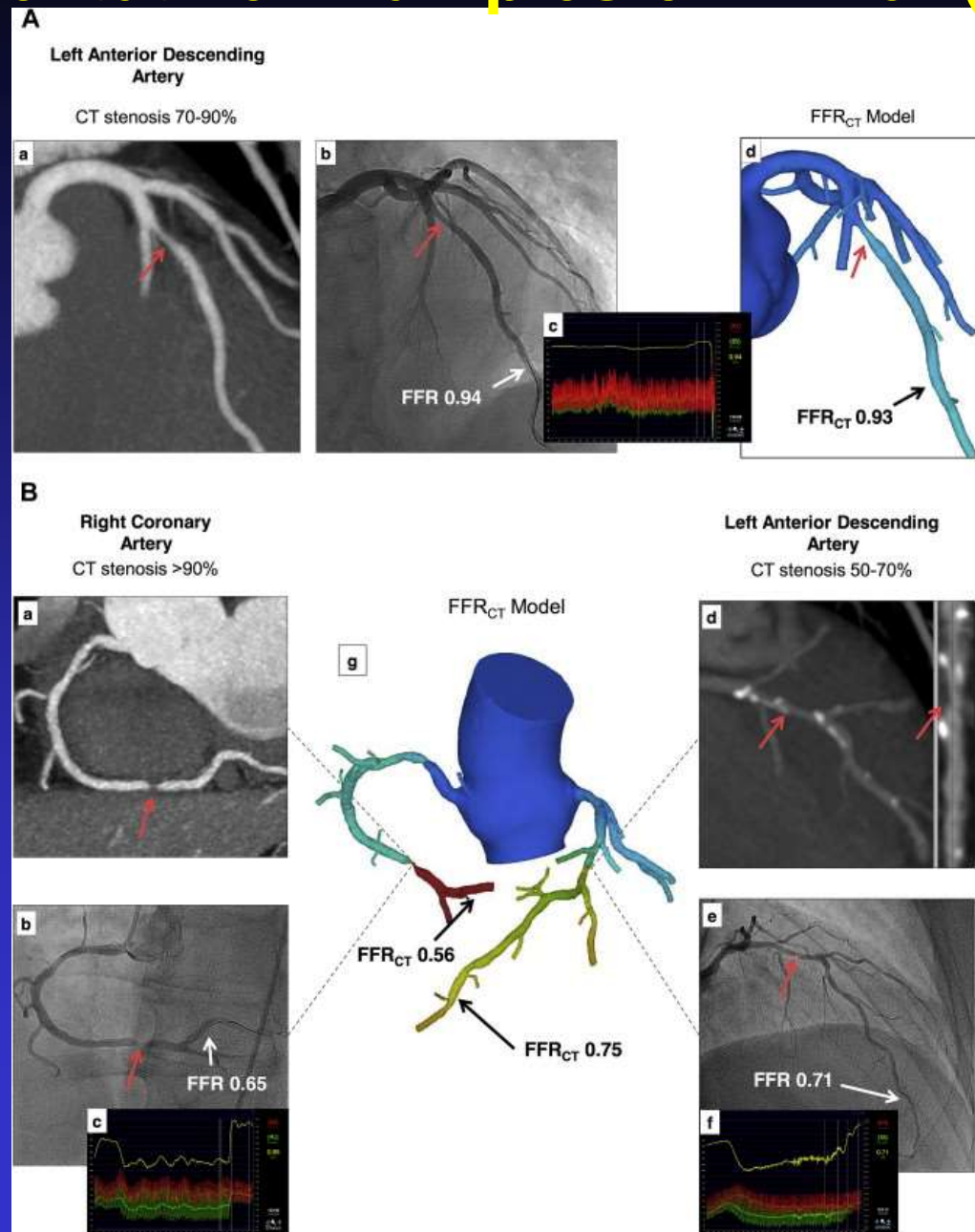
Penetration of FFR



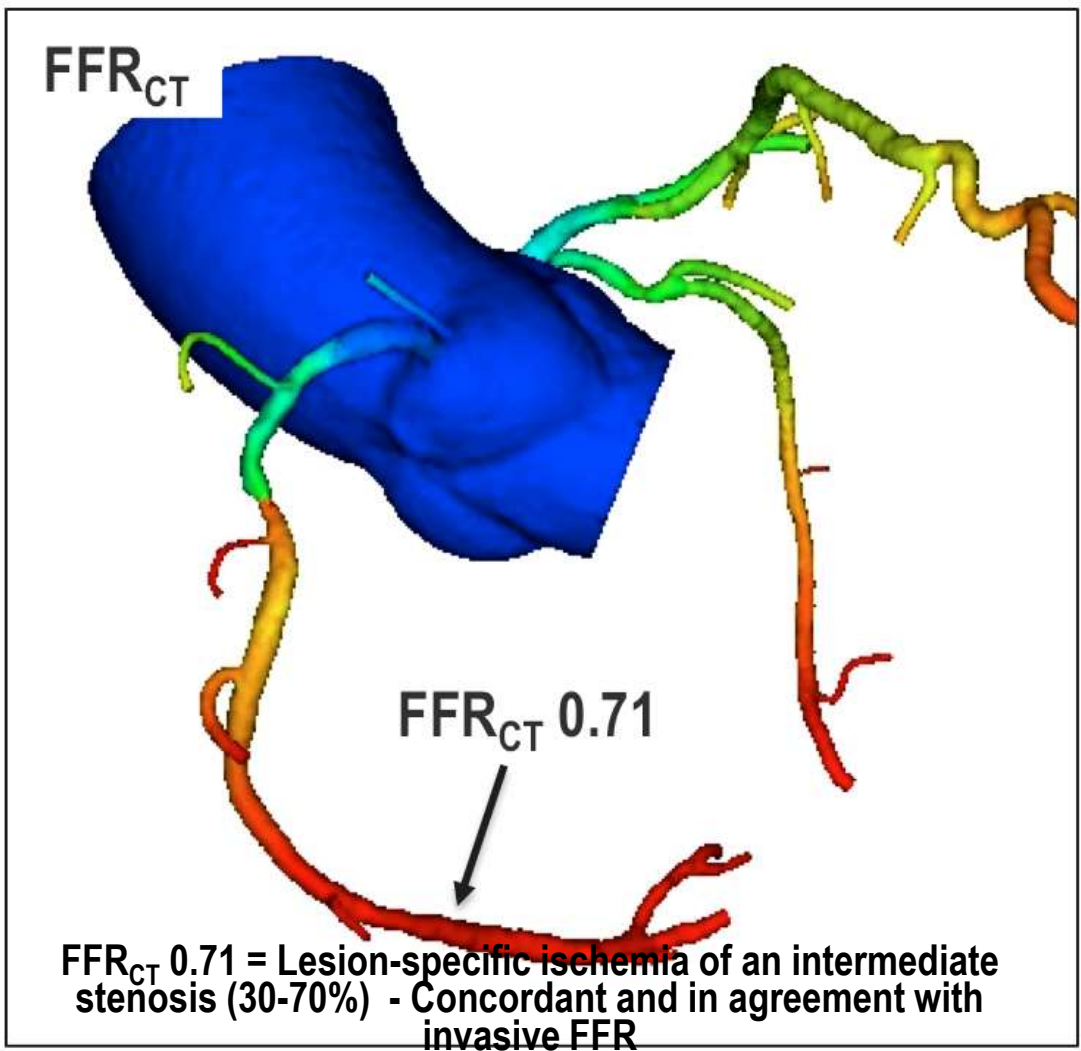
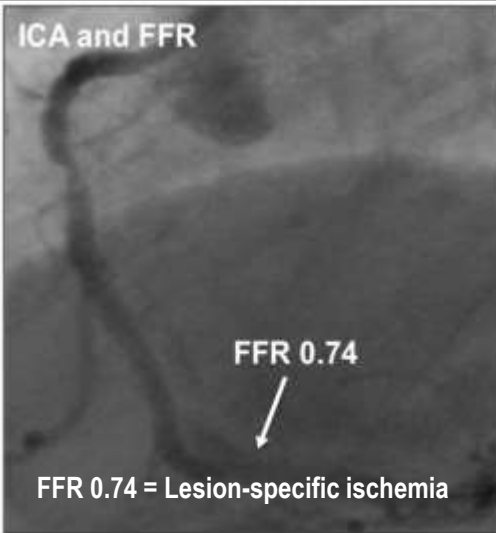
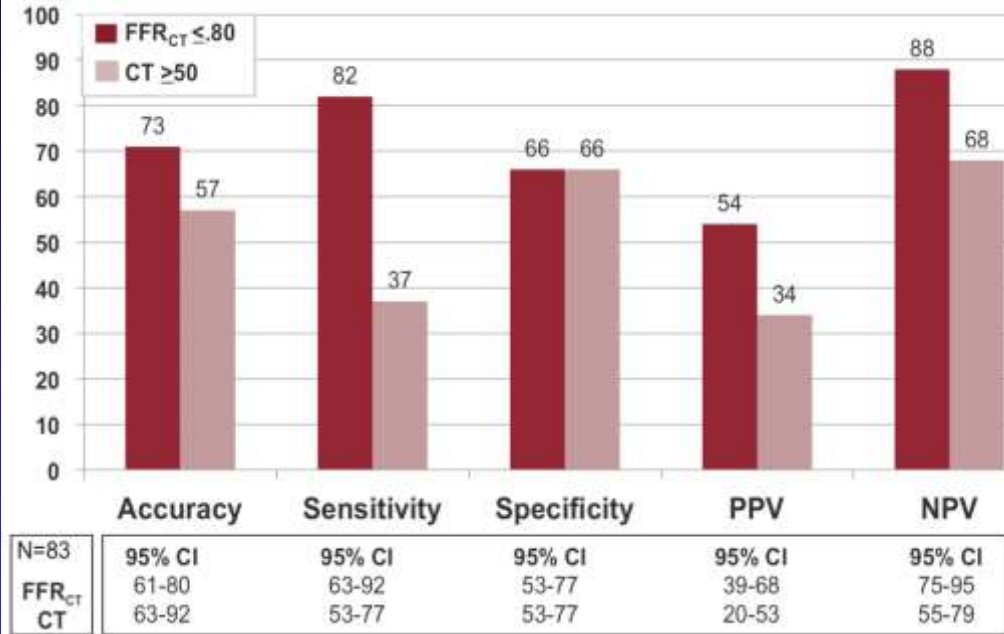
**Rough estimates
expressed in percentage of number of PCI**



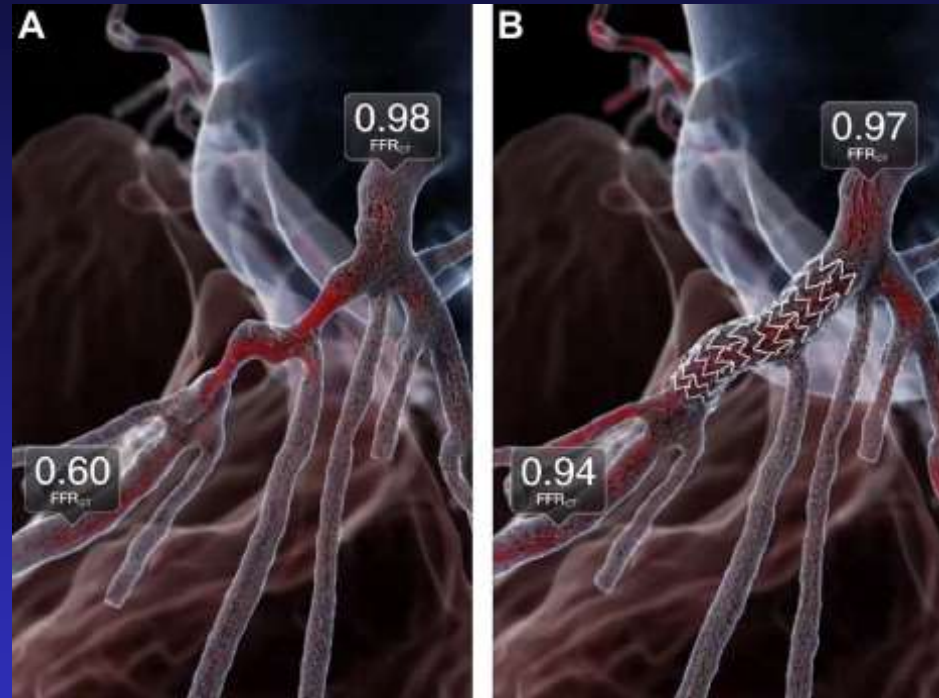
Representative Examples of FFR_{CT} (NXT trial)



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



Comparison of FFRCTA Results Before and After Simulated PCI With Stent Implantation before (A) and after (B) PCI.

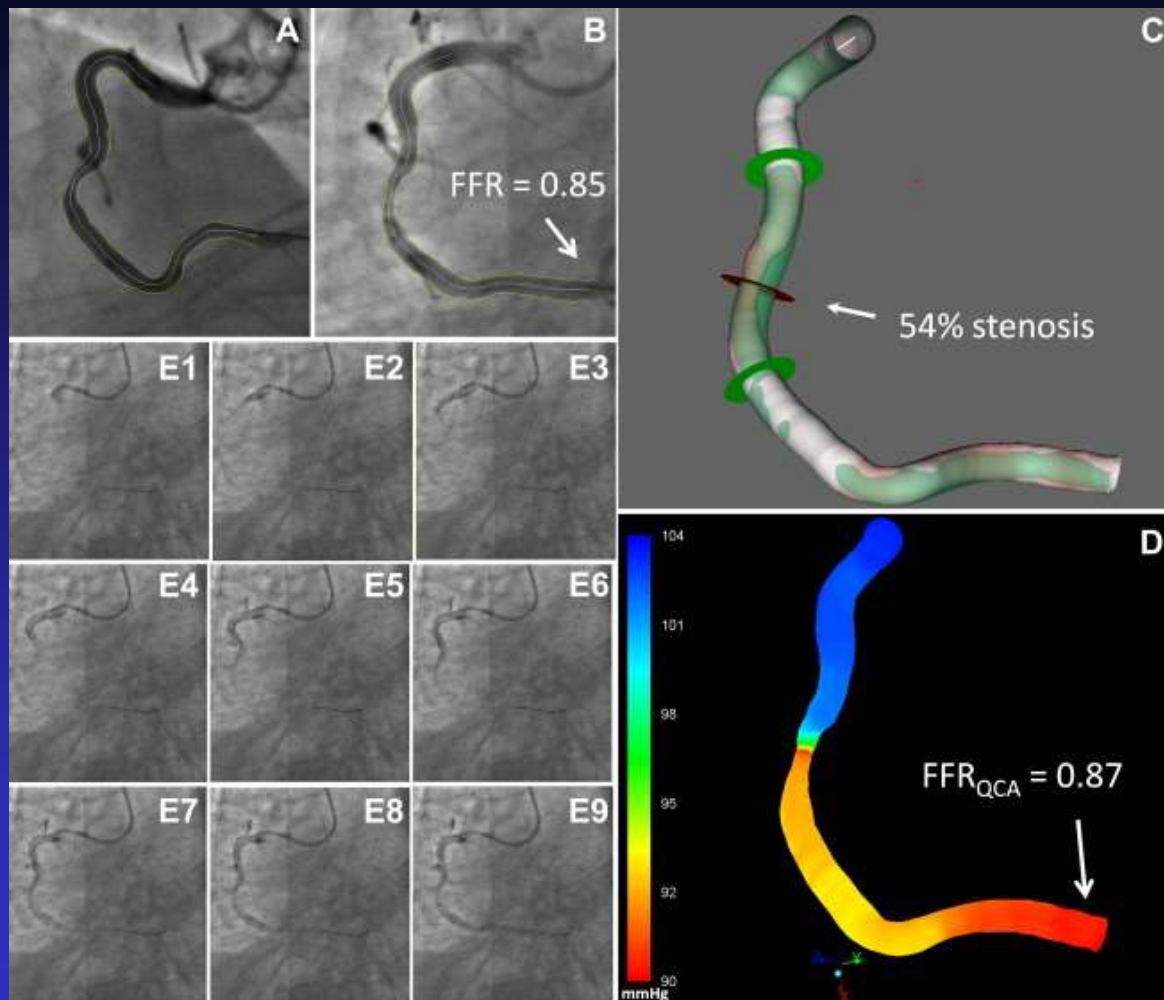


Charles A. Taylor, Timothy A. Fonte, James K. Min

Journal of the American College of Cardiology, 61, 2013, 2233–2241



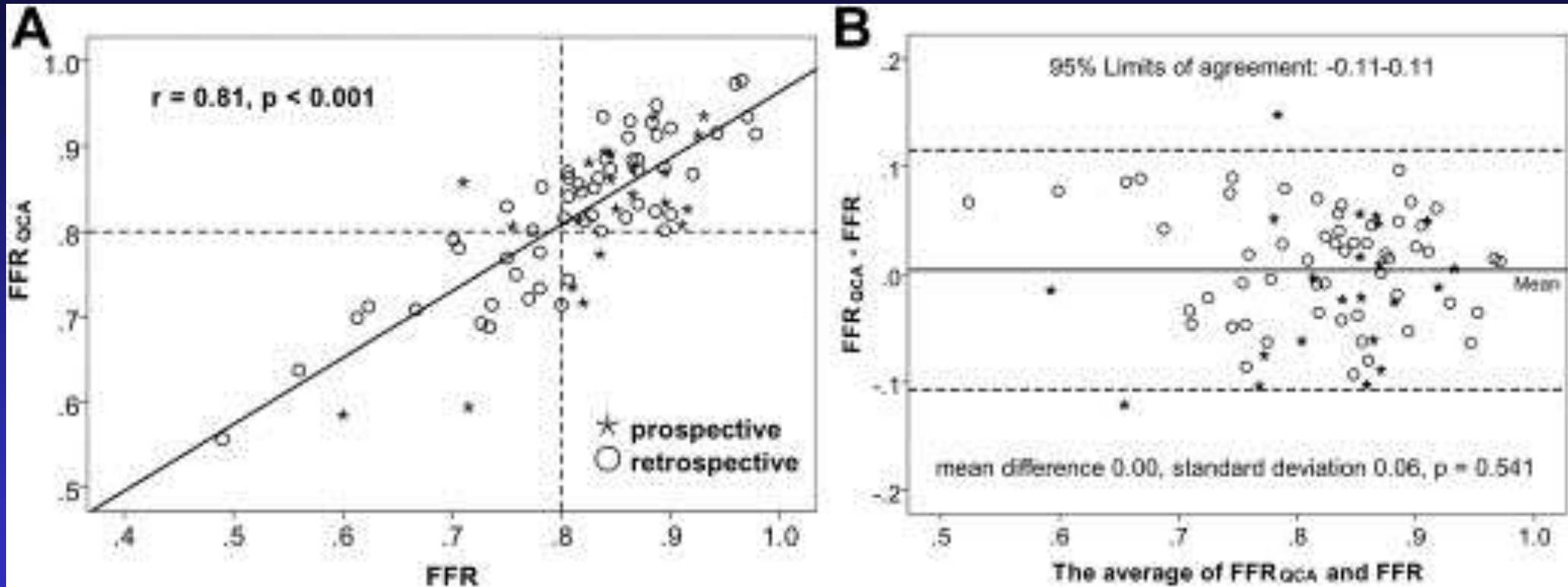
Computation of FFR From 3D QCA and TIMI Frame Count (A,B) X-ray angiography



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



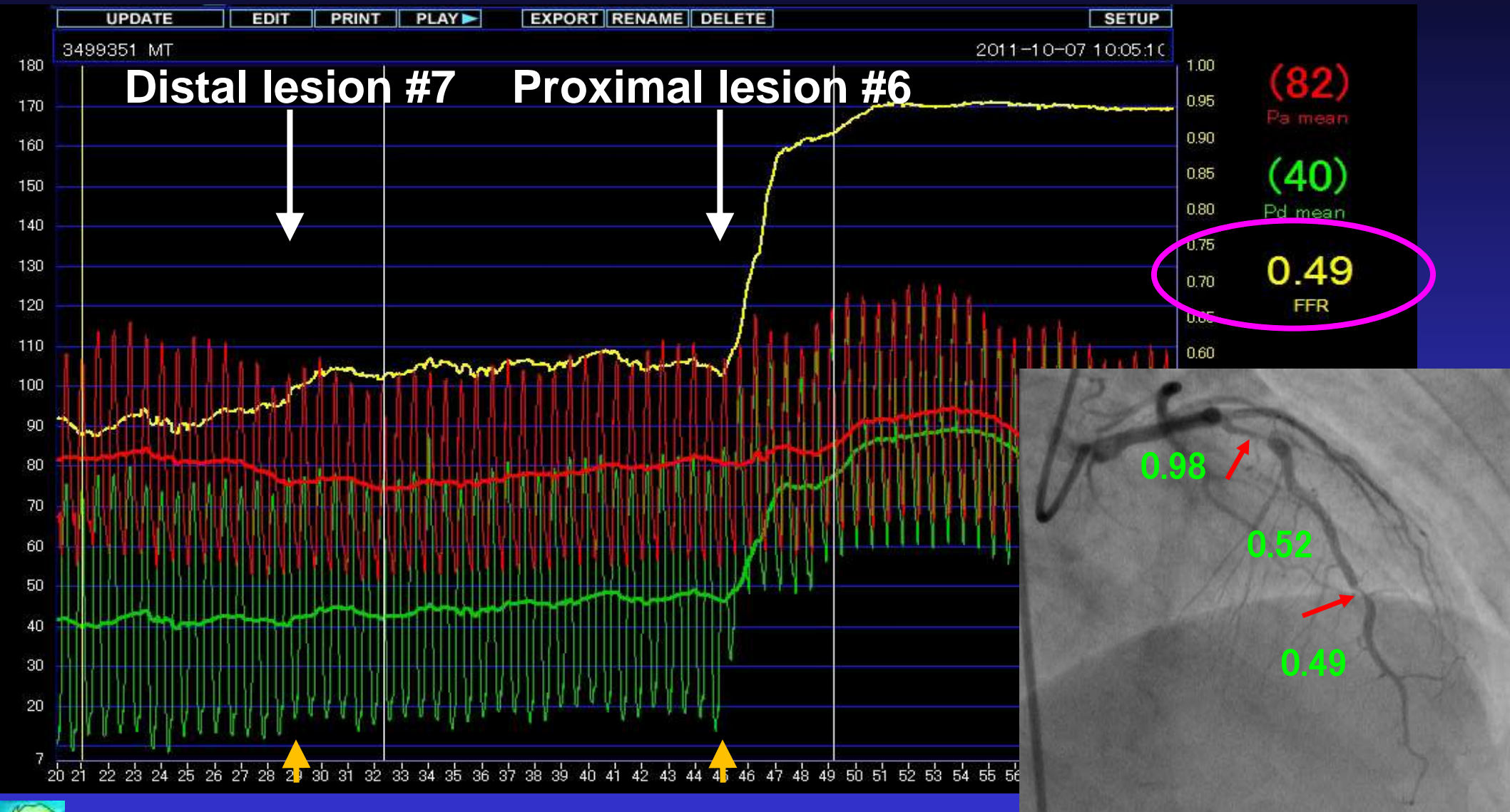
Correlation and Agreement Between FFR and the Computed FFR_{OCA}



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



FFR (prePCI)



Pullback curve by iFR

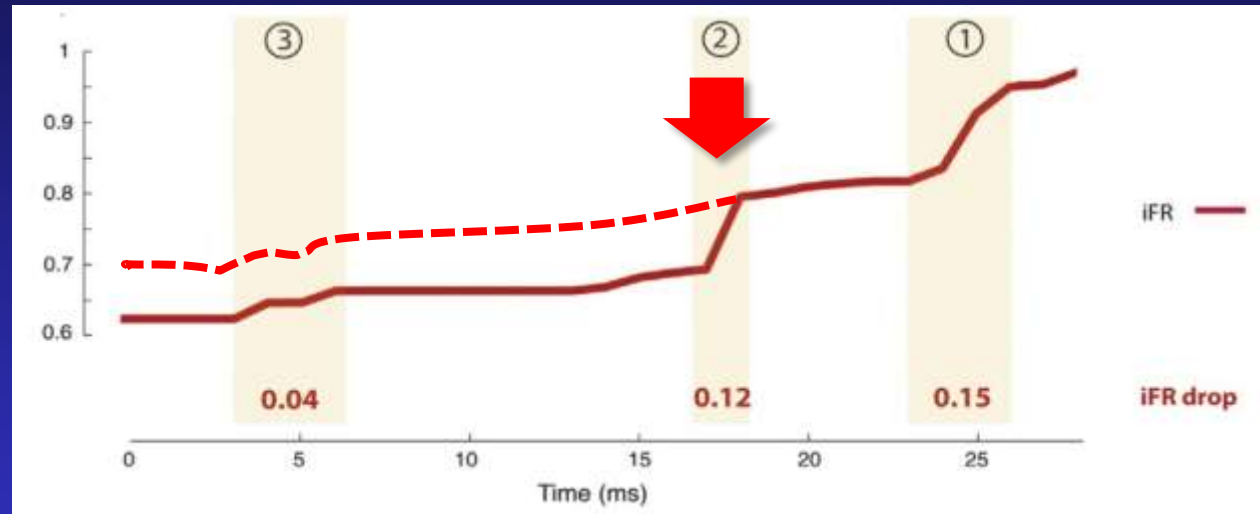
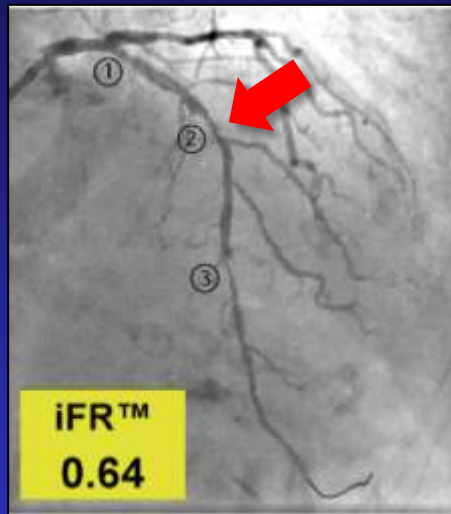
Pre PCI



Post PCI

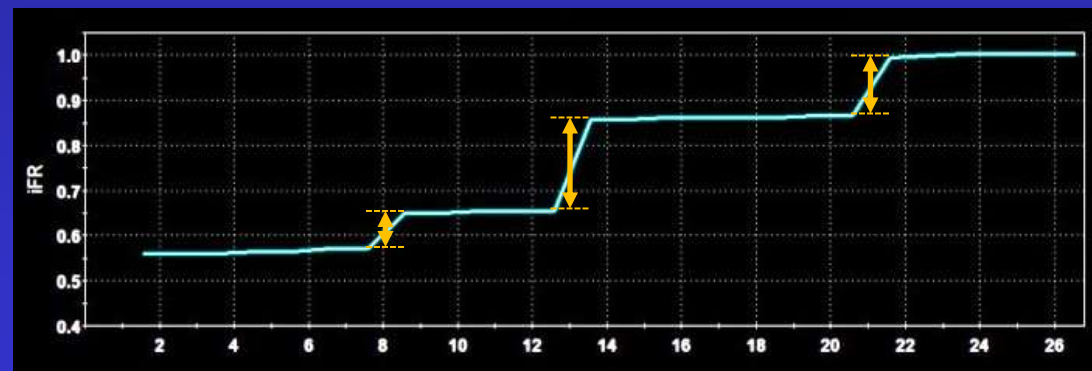
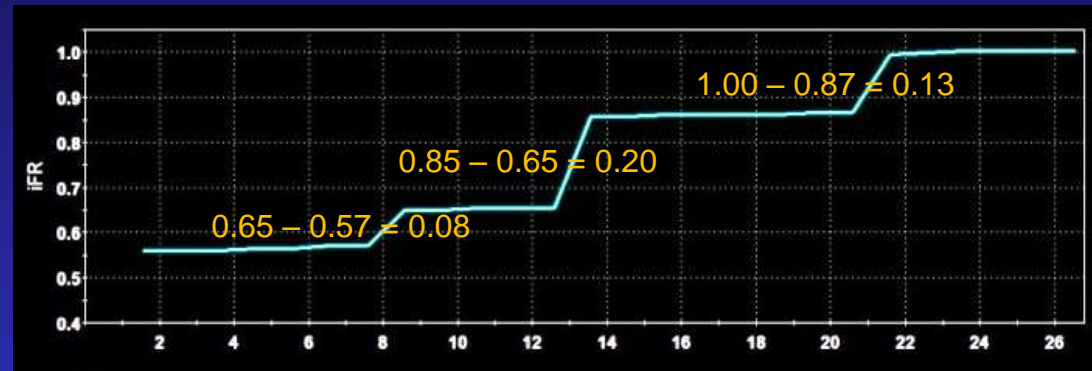


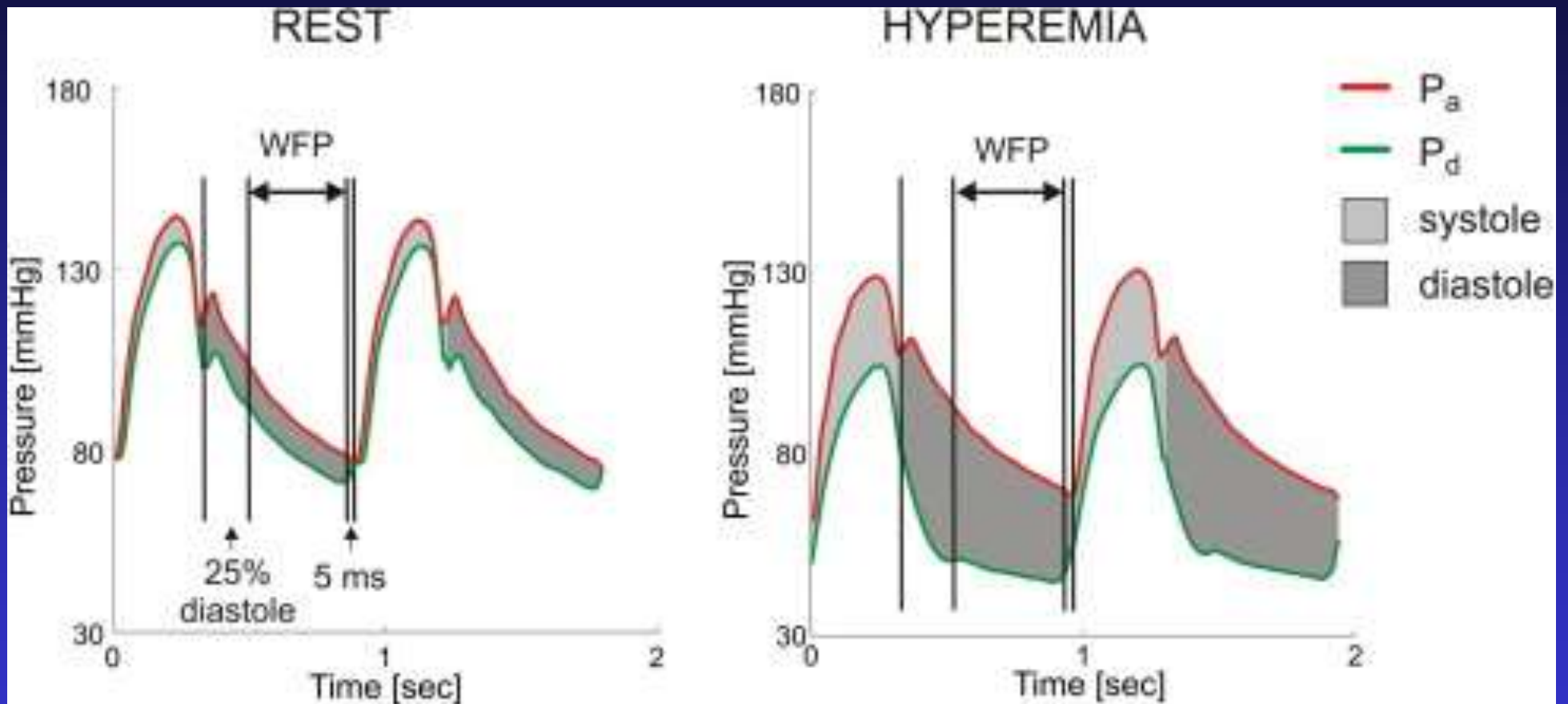
iFR Pullback



Advantages of iFR pullback

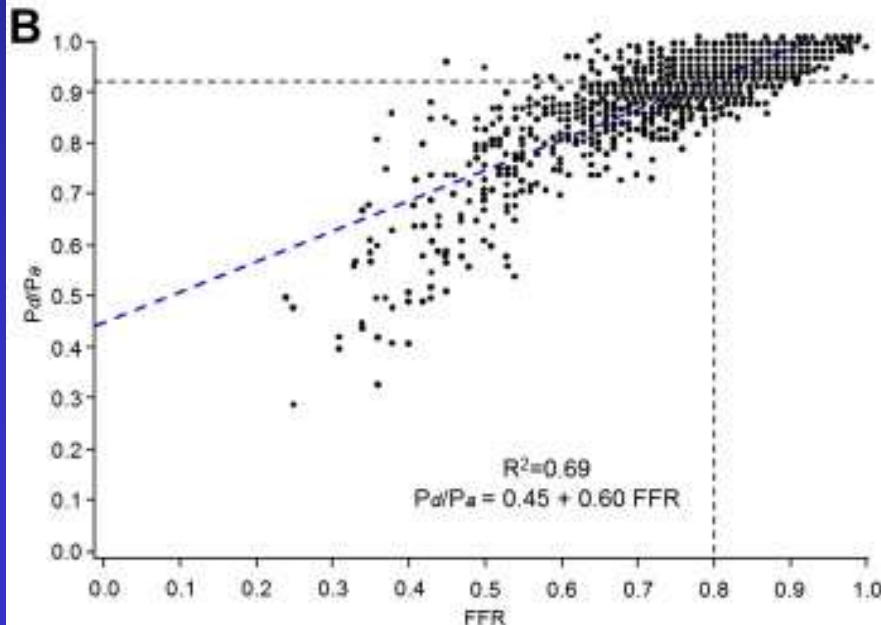
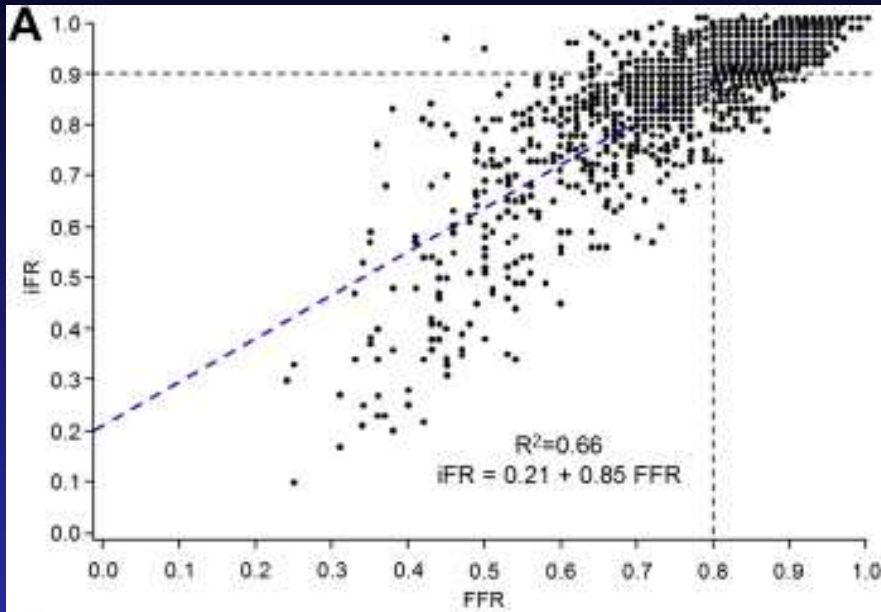
- The most significant lesion could be identified by the finding of maximum pressure (iFR value) difference.





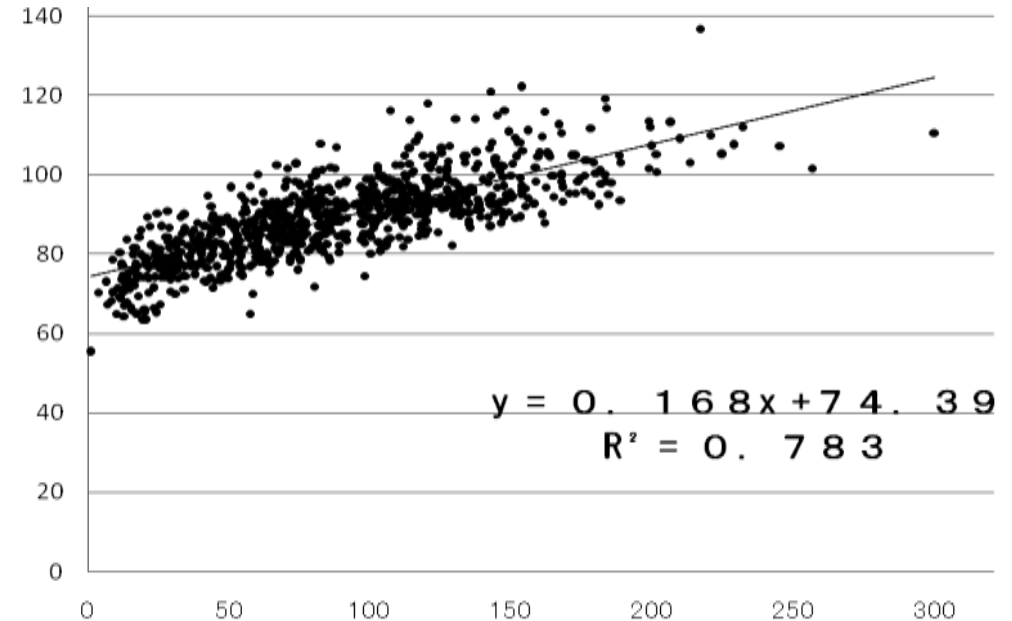
Relationship Between iFR & FFR and Pd/Pa & FFR

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



Relation between waist size and visceral fat

Waist size
(cm)



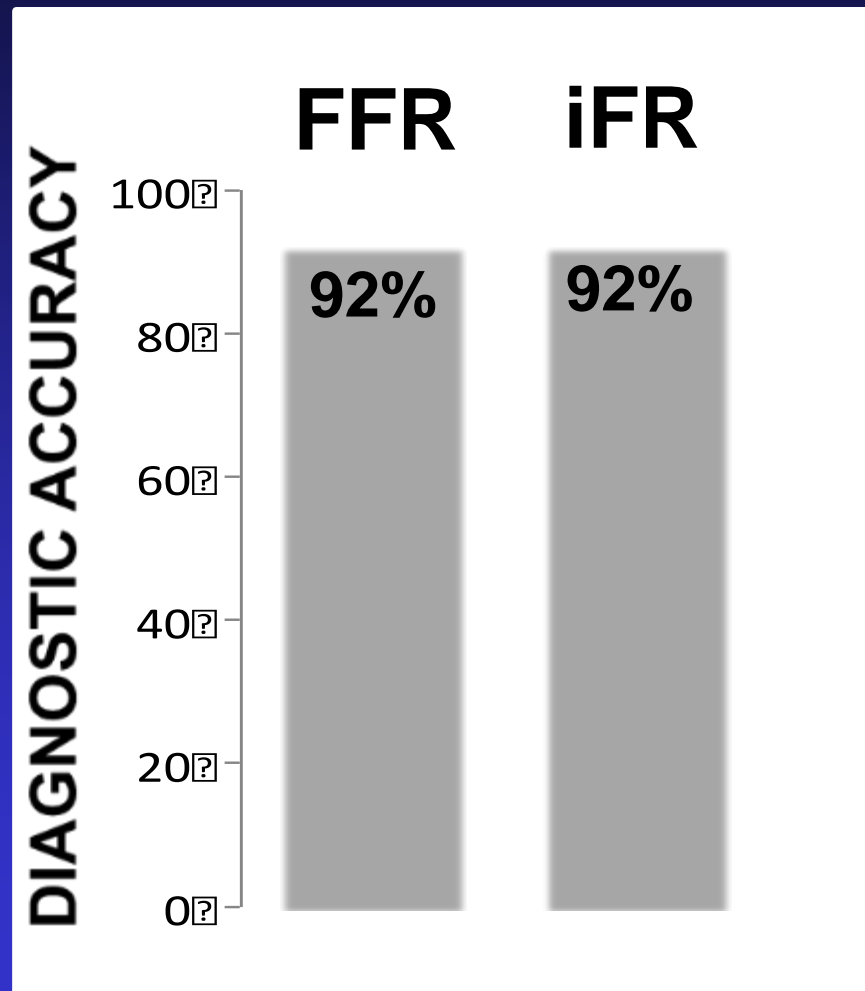
Visceral fat (cm²)



CLARIFY

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

iFR has similar diagnostic accuracy to FFR



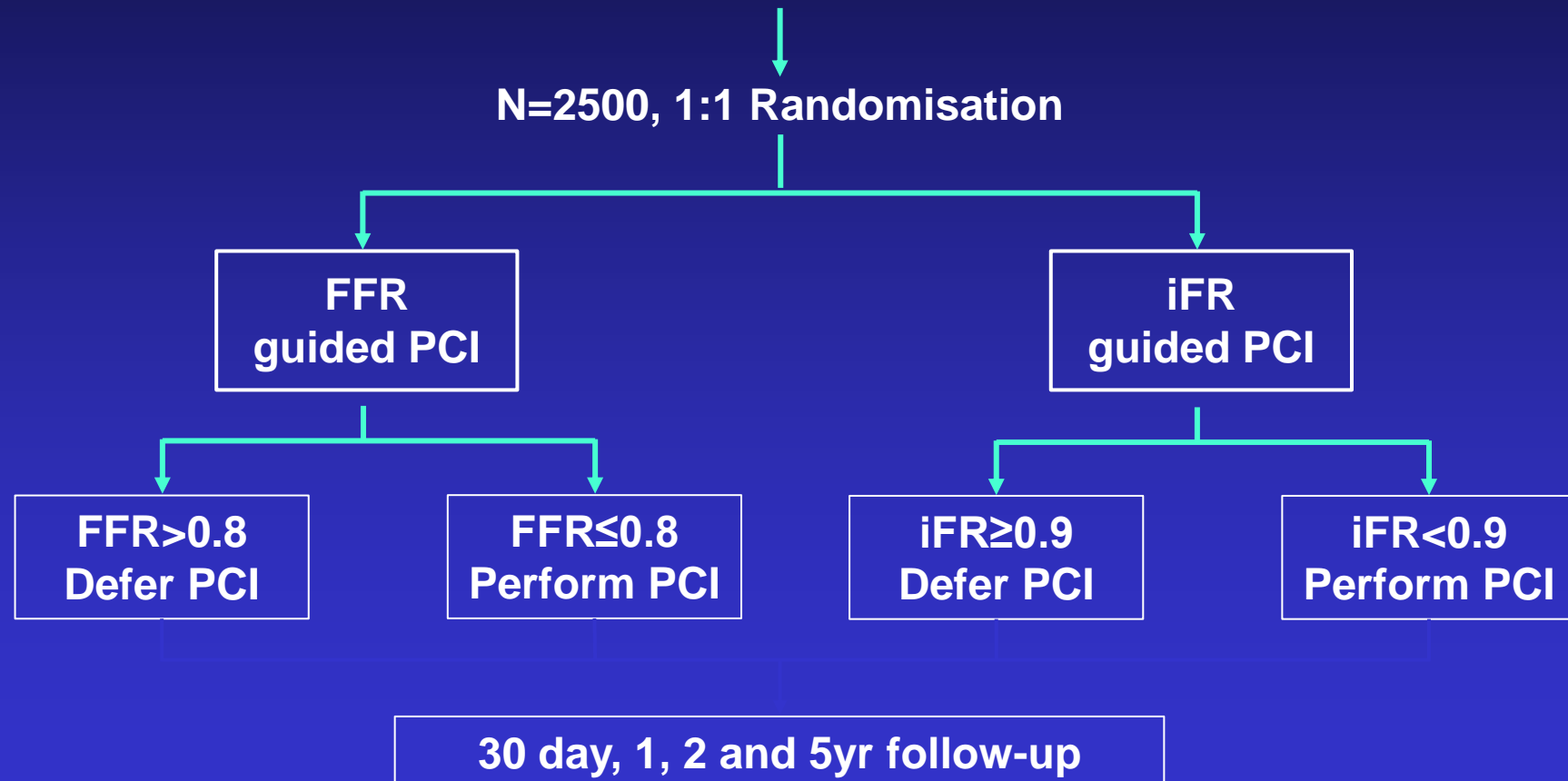
iFR and FFR have similar diagnostic accuracies



DEFINE FLAIR

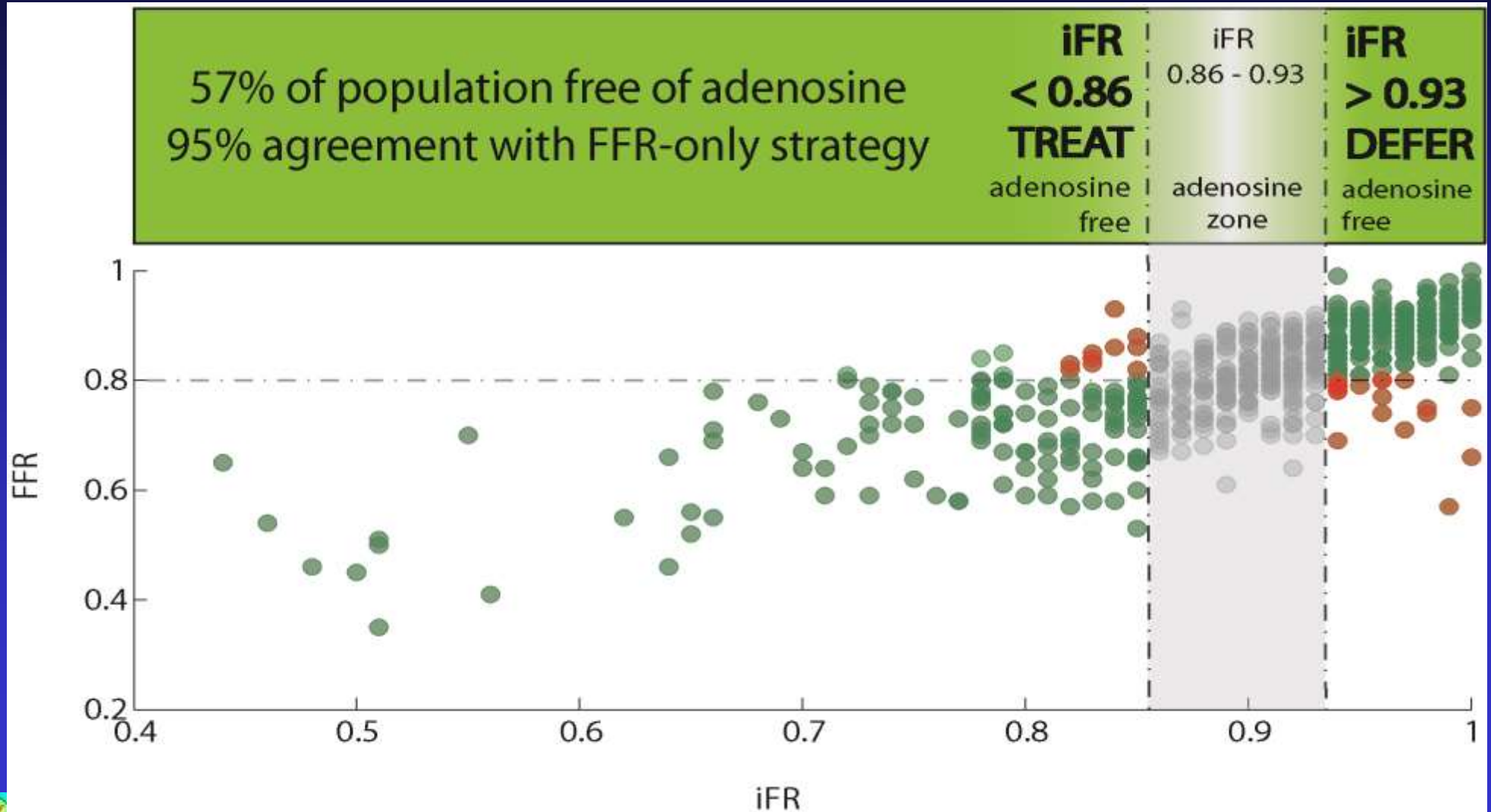
Functional Lesion Assessment of Intermediate stenosis to guide Revascularisation

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

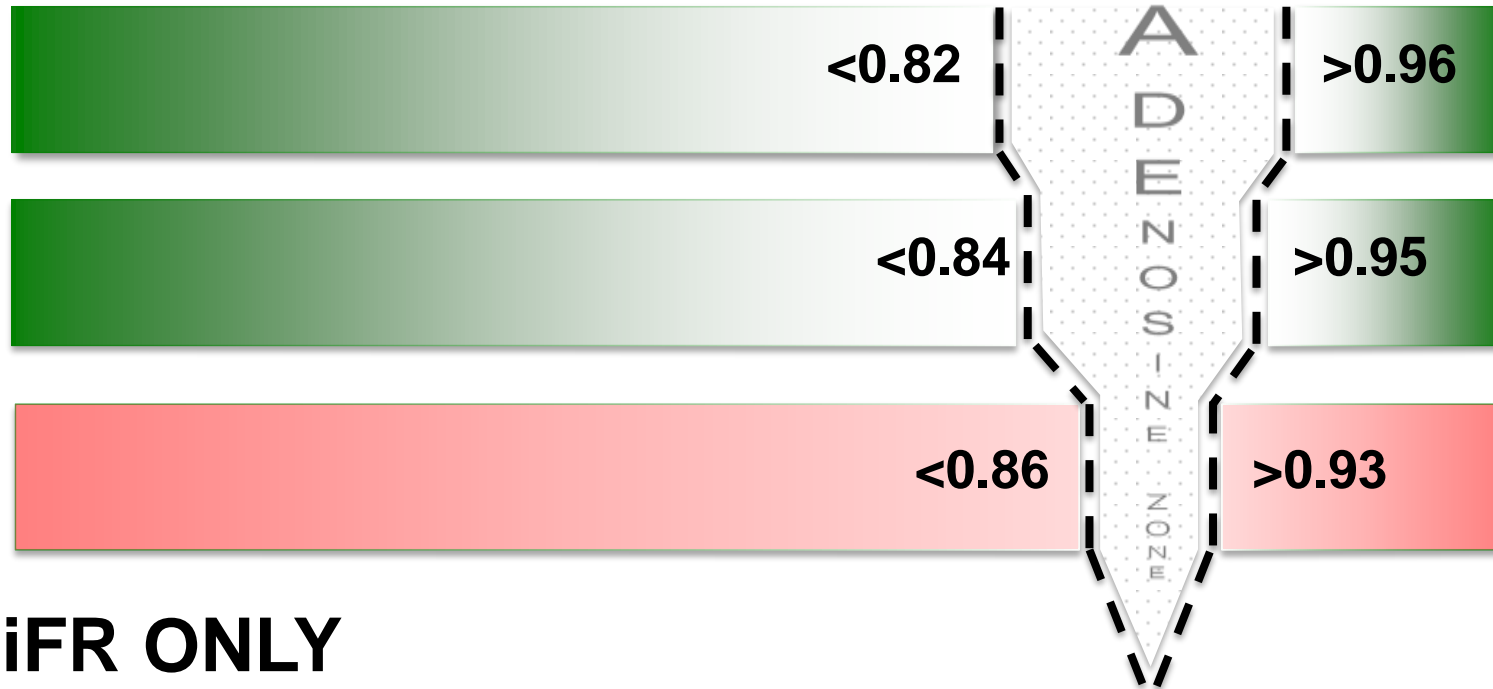


Hybrid iFR-FFR strategy

Increasing adoption of physiology-guided PCI



HYBRID IFR-FFR



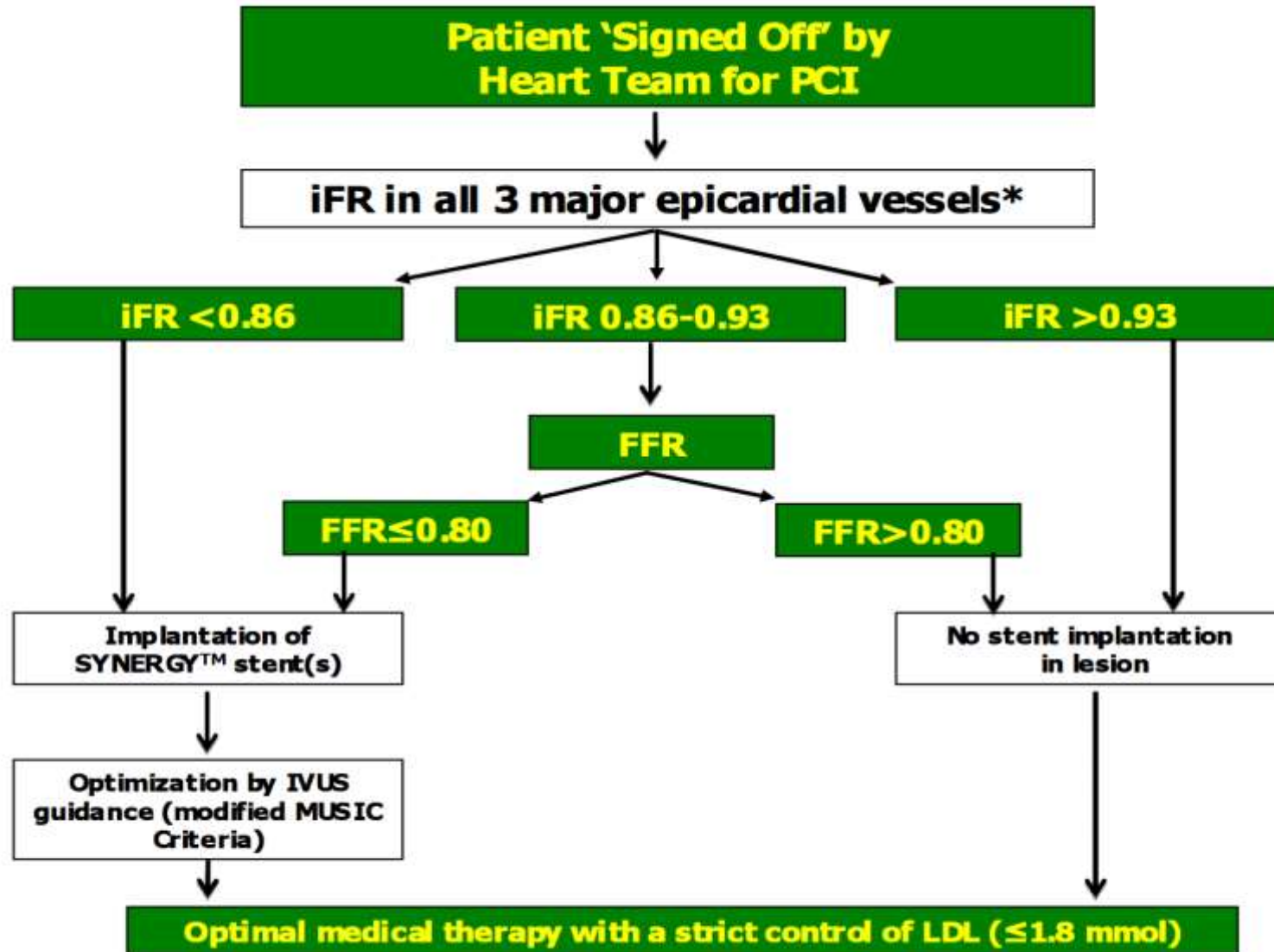
iFR ONLY



0.4 0.5 0.6 0.7 0.8 0.9 1.0
iFR values

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

SYNTAX II



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



	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
Optimised for pullback	×	○
Peri-PCI assessment	○	×
Evidence against ischaemia	○	△
Clinical outcome data	○	Coming!



Comparison among FFRs & iFR

	Imaging modality	On-Line	Pressure-wire use	Analysis time	Hyperemia
FFR p-wire	Angio	Yes	Yes	<5min	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



Summary

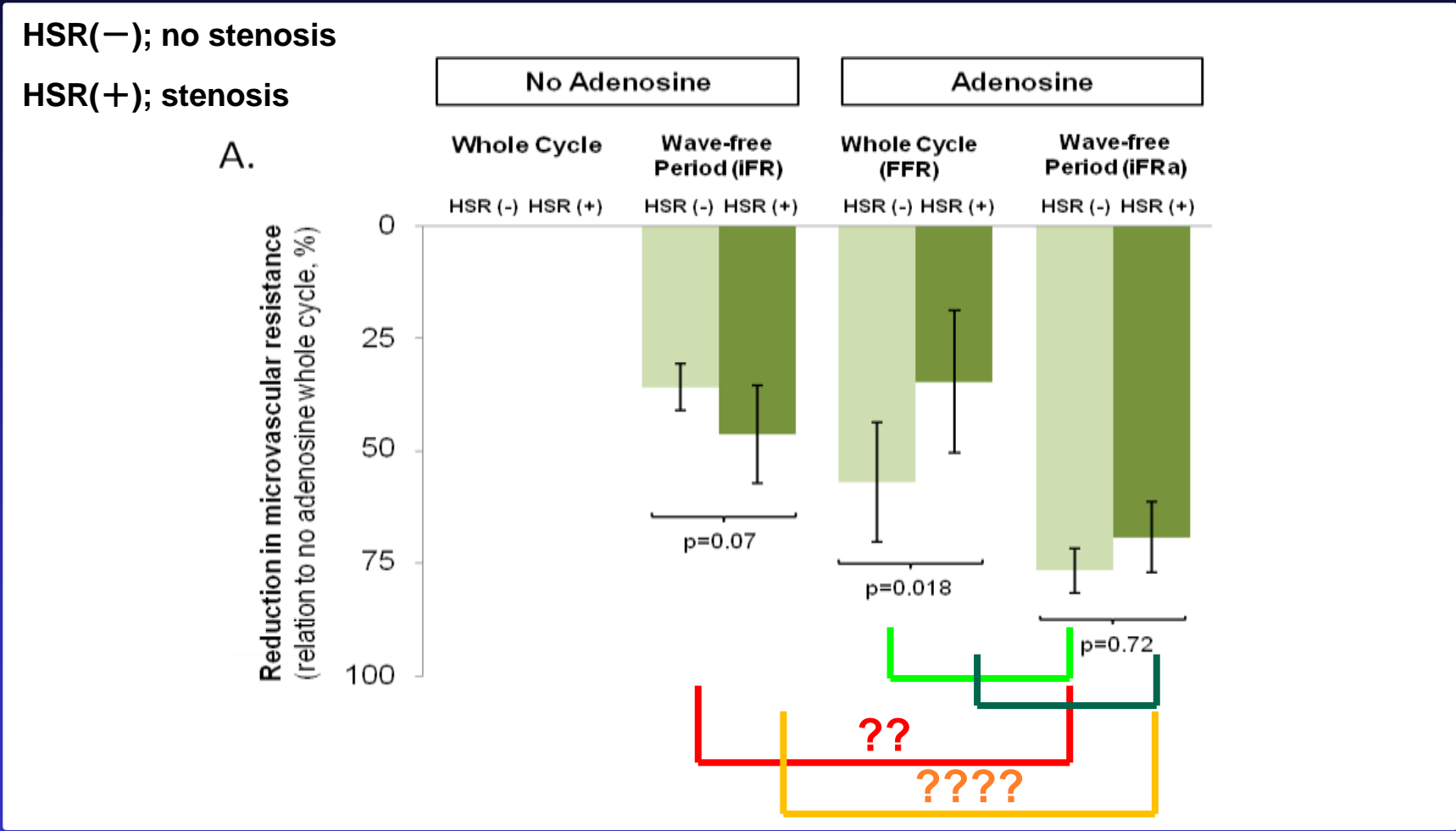
FFR, iFR and hybrid strategy

- iFR might be useful clinically as an index of cut-off point to differentiate significant stenosis, although original concept of iFR might be questionable based on coronary physiology.
- FFR may be correct theoretically according to pressure-flow relationship in diastole, although there might be some limitations if we use mean pressure.
- Although there are many advantages & disadvantages in FFR, iFR and hybrid strategy, it should be important to be able to predict patient prognosis and to be a decision making index for treatment by these indexes.



CLARIFY an ADVISE sub-study

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



Although there are no significant difference in MVR during wave free period in cases with & without stenosis, MVR is higher in cases with stenosis compared with that in cases without stenosis.

