Physiologic Guidance; Synergetic Hybrid Approach for Complex PCI

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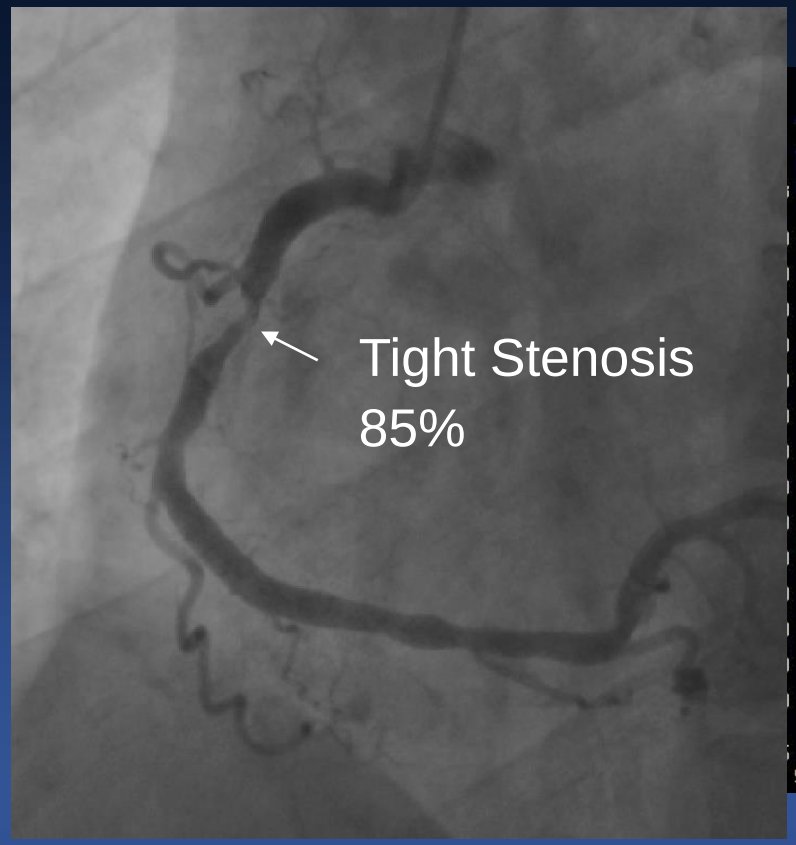
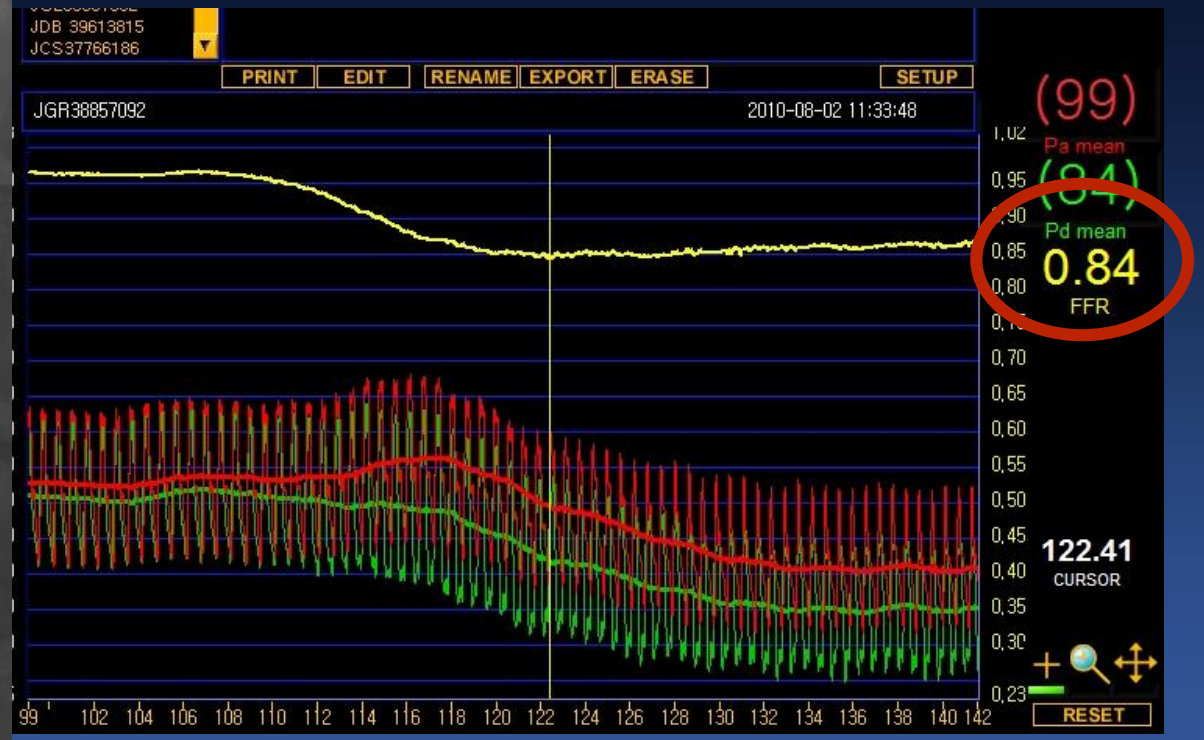
Why FFR ?

Visual Functional Mismatches !

M/72, Recent developed Effort chest pain, Hyperlipidemia, Smoker

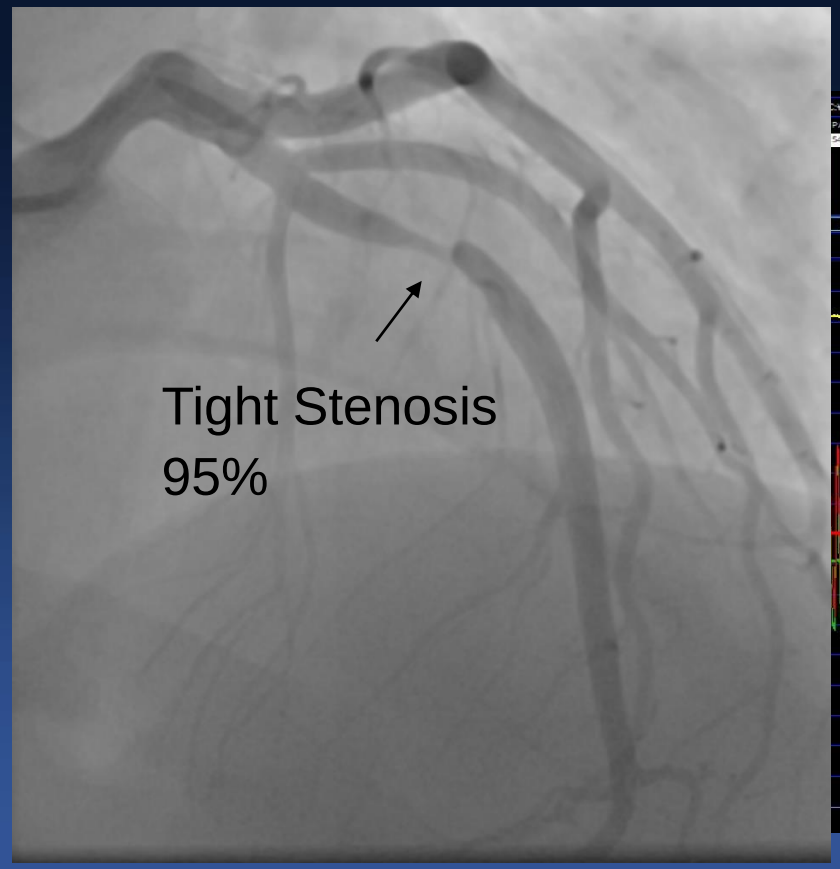


FFR 0.84

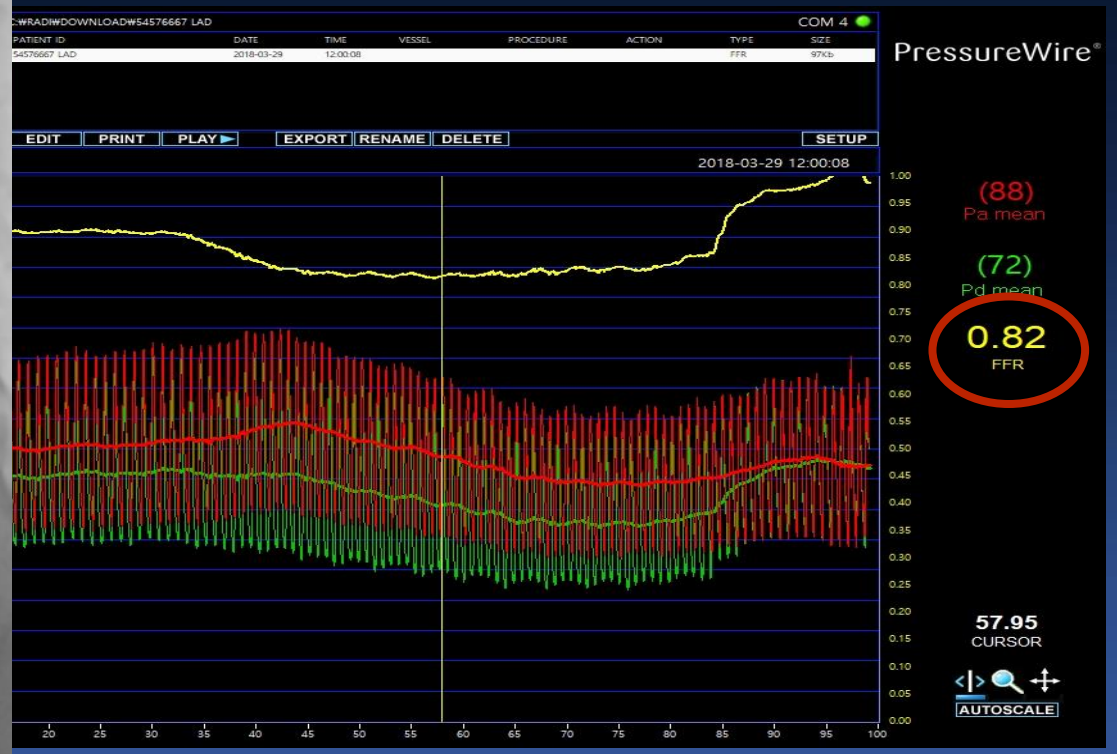


Visual Functional Mismatches !

77/F, Hyperlipidemia

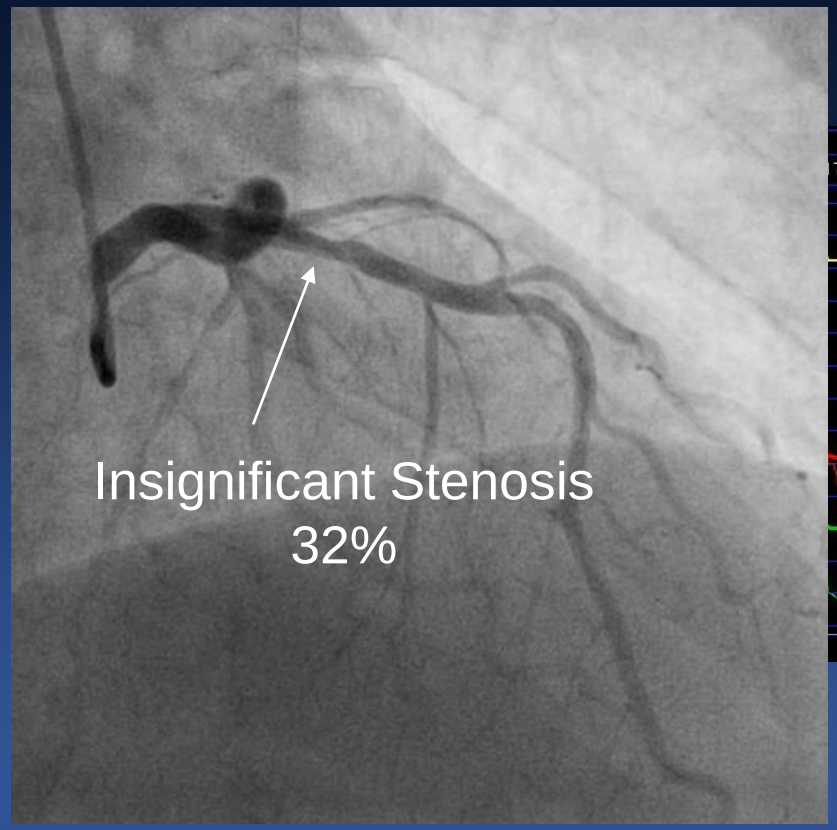


FFR 0.82

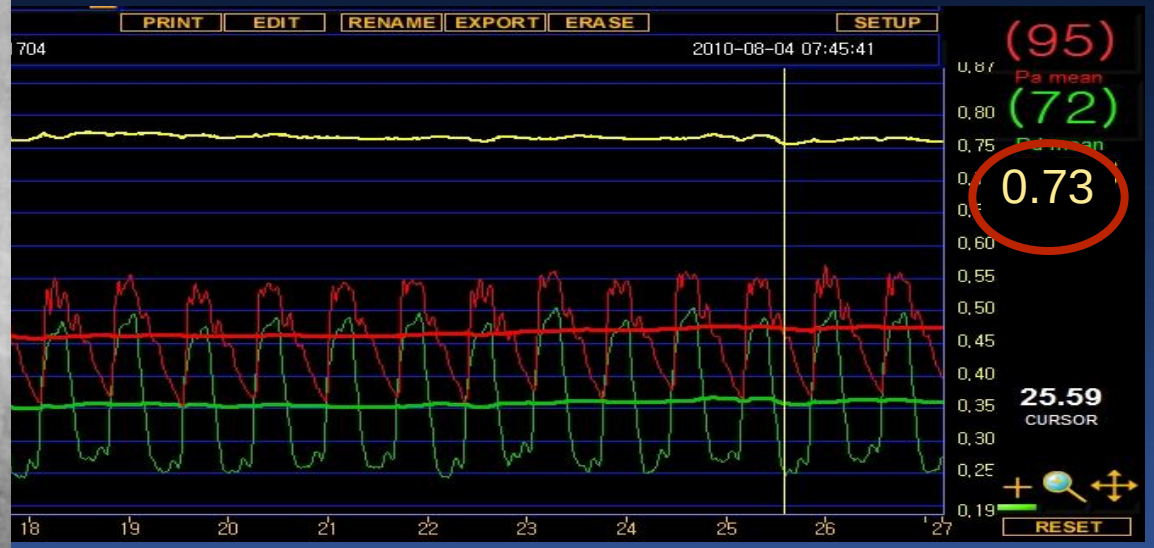


Reverse Mismatches !

M/44, Hyperlipidemia, Smoker,
Hypertension and
Family history of CHD.

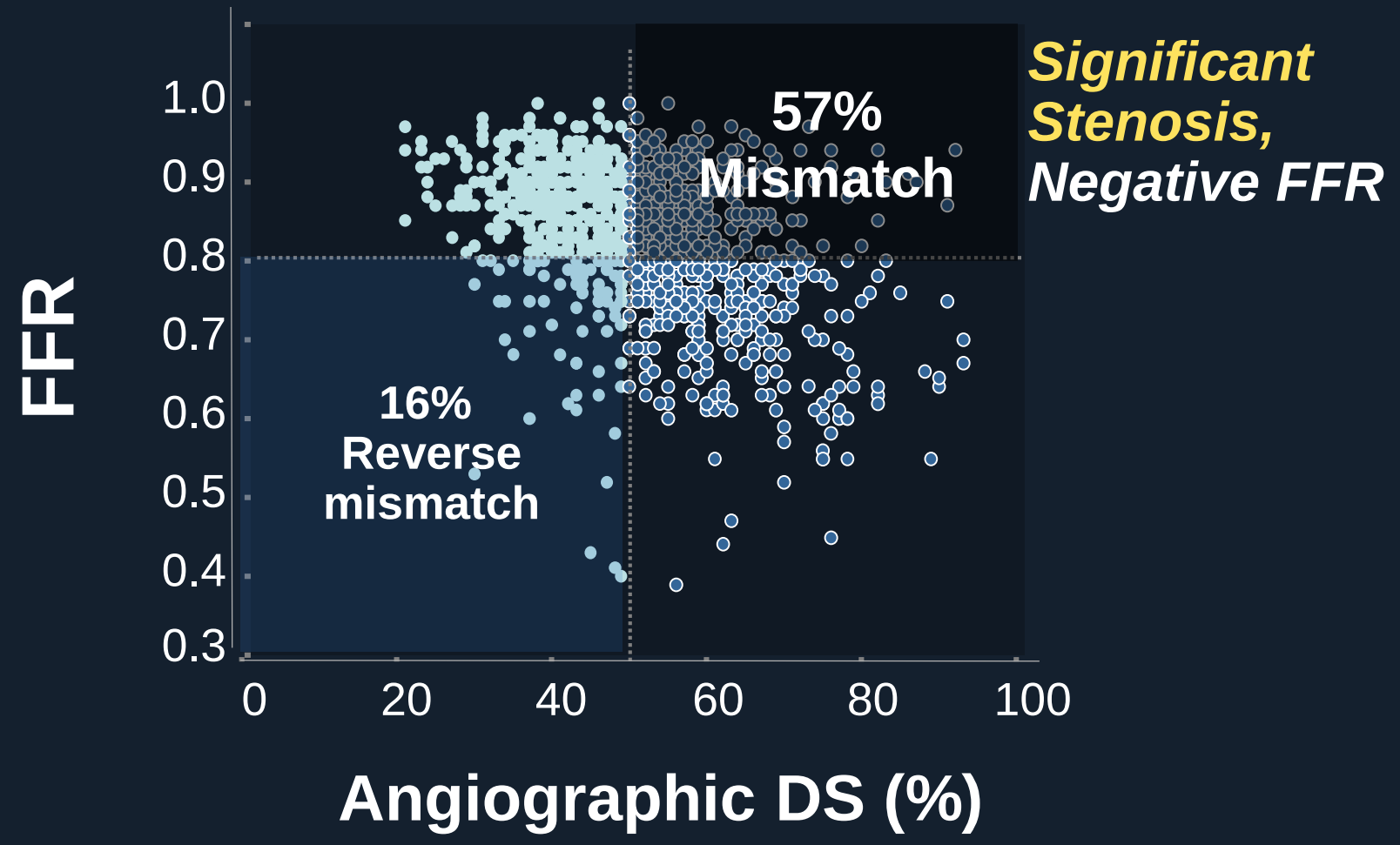


FFR 0.73



Many Mismatches

Non-LM lesions (n=1066)



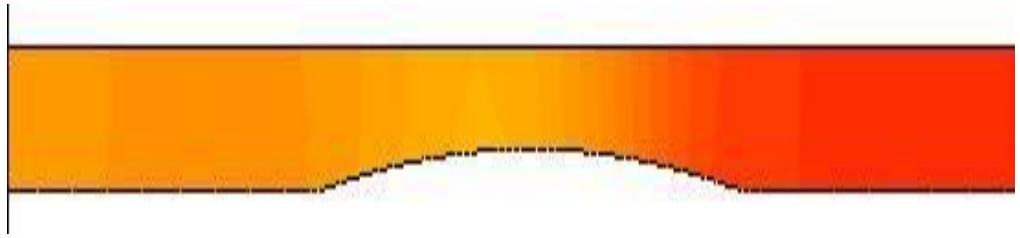
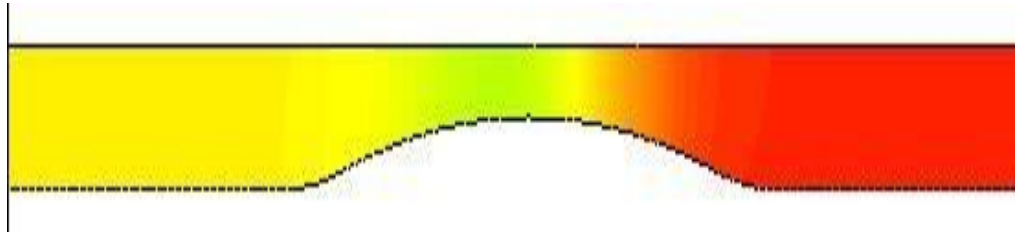
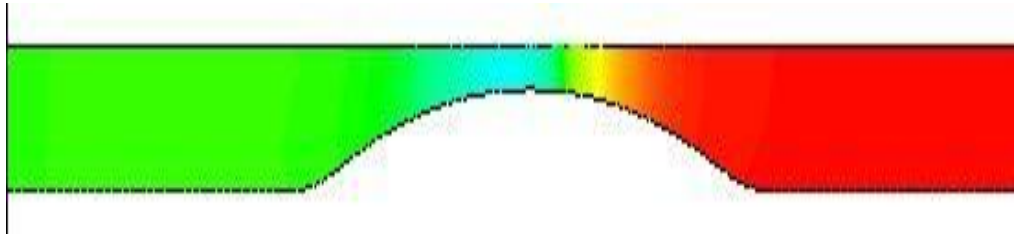
Park SJ et al, JACC Intv 2012;5:1029 –36

Why
Mismatches ?

FFR is Mainly Determined by,

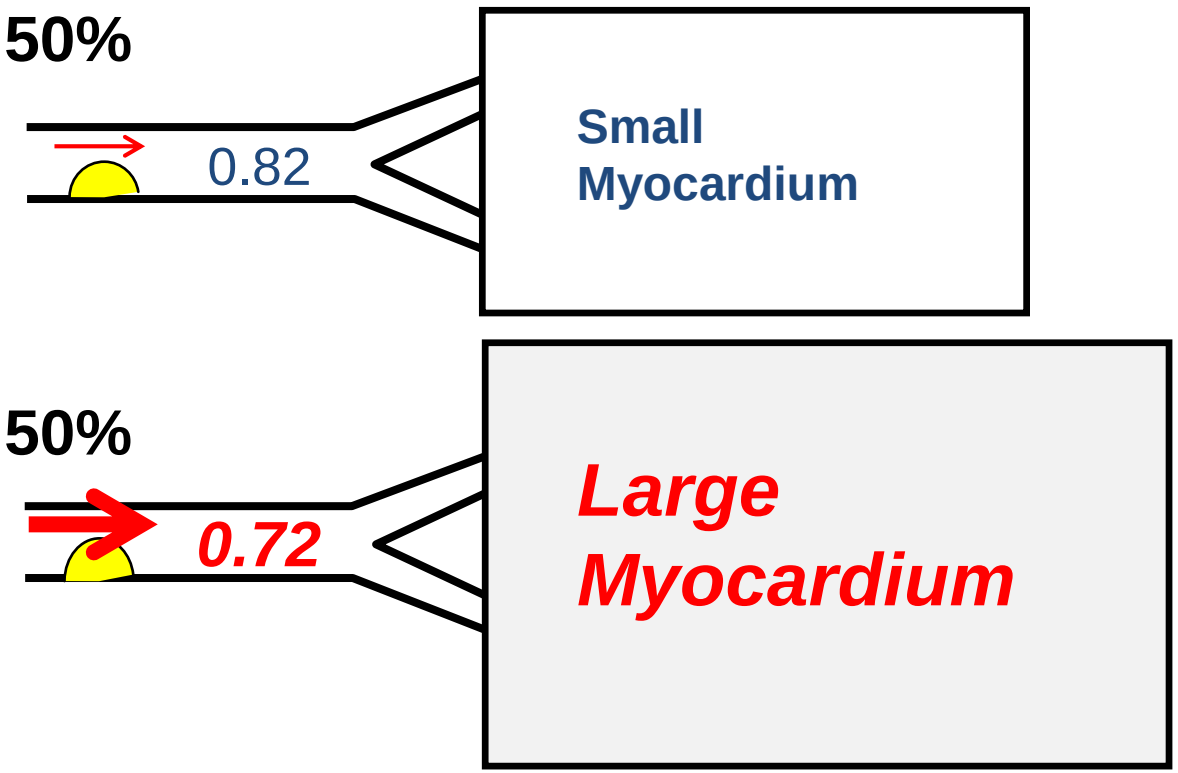
1. Degree of stenosis
2. Size of myocardium
3. Lesion specific morphologies

Degree of Stenosis

		FFR
30%		0.91
50%		0.80
70%		0.58

3D Computational Simulation Study

Large Supplied Myocardium Can Make A Positive FFR

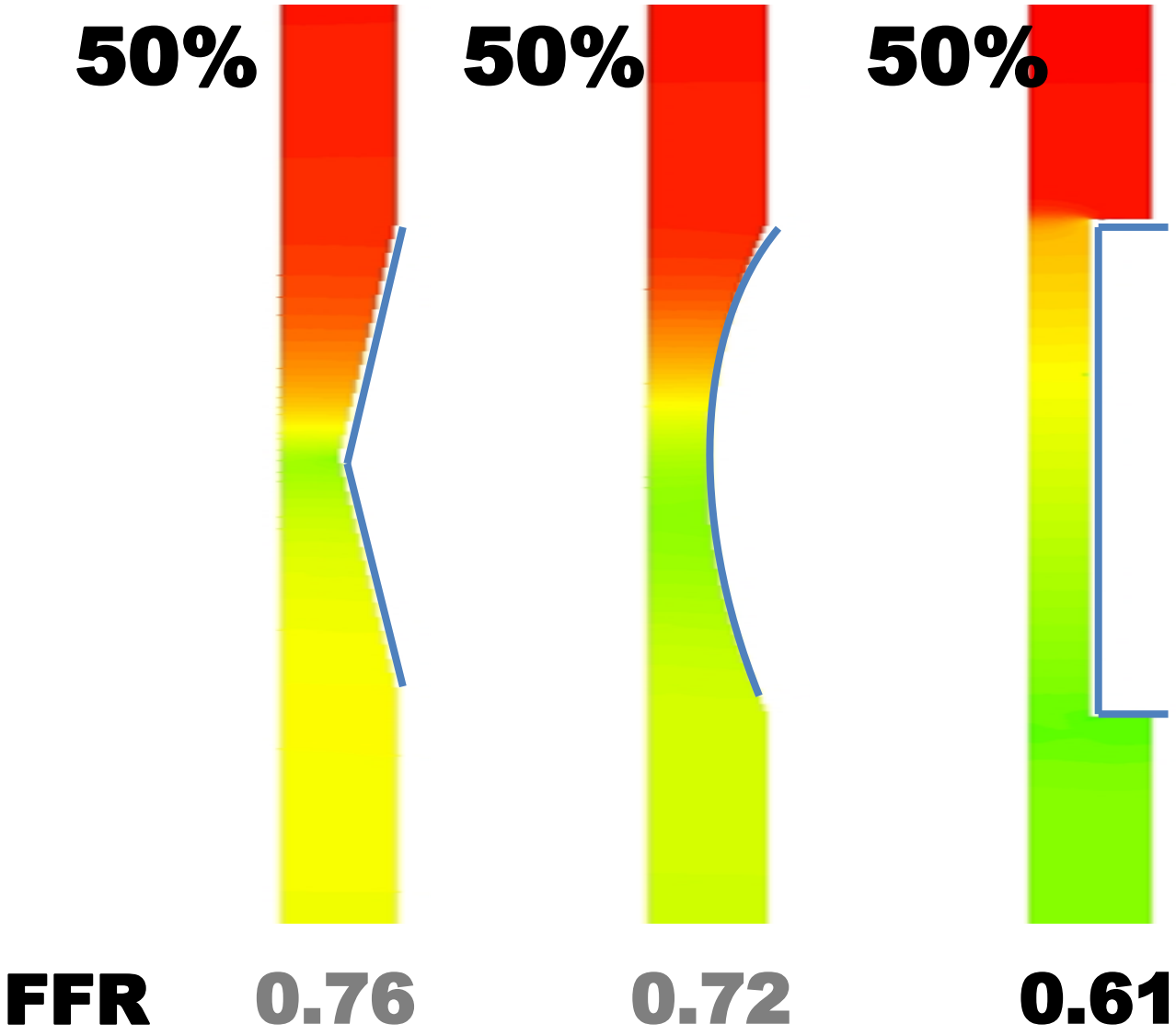


Negative FFR
0.82

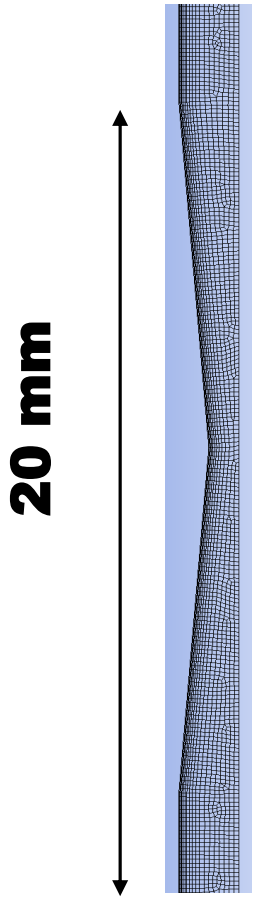
Positive FFR
0.72

Increased Flow Velocity
Increased Vortex flow (Recirculation),
More energy loss, More pressure drop !

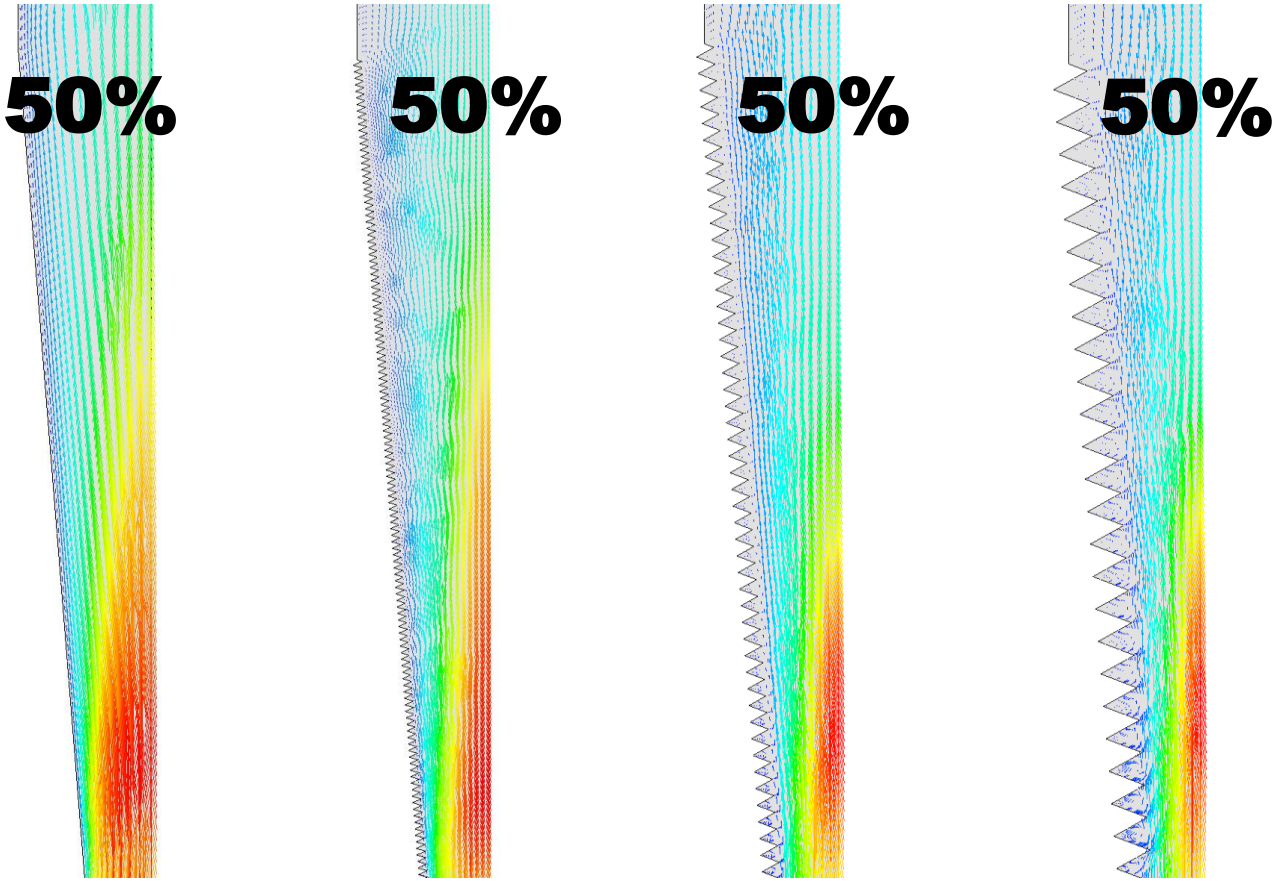
Different Lesion Morphology



Different Surface Roughness



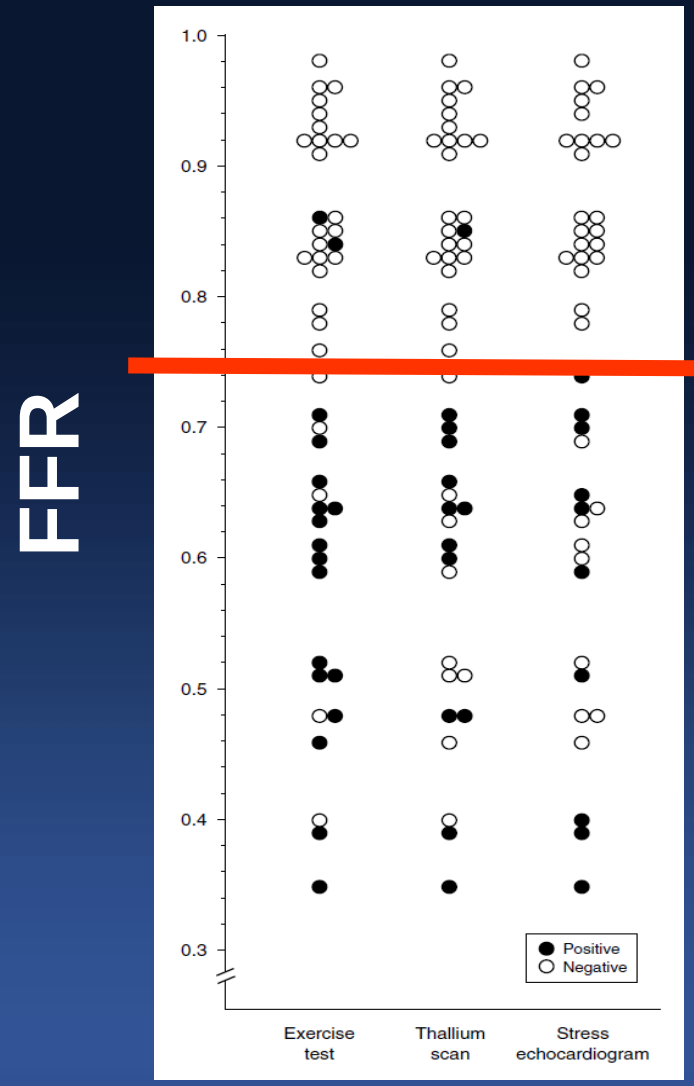
Smooth Surface	Roughness 0.05 mm	Roughness 0.1mm	Roughness 0.2 mm



FFR	0.81	0.72	0.60	0.54

1. FFR-Guided Means Ischemia Guided !
2. Measurement of FFR Is Standard to define clinical ischemia.

FFR Cut-Off Value
Matched with Non-invasive Stress Test Results (n=45)



FFR <0.75

Sensitivity	88%
Specificity	100%
Positive PV	100%
Negative PV	88%
Accuracy	93%

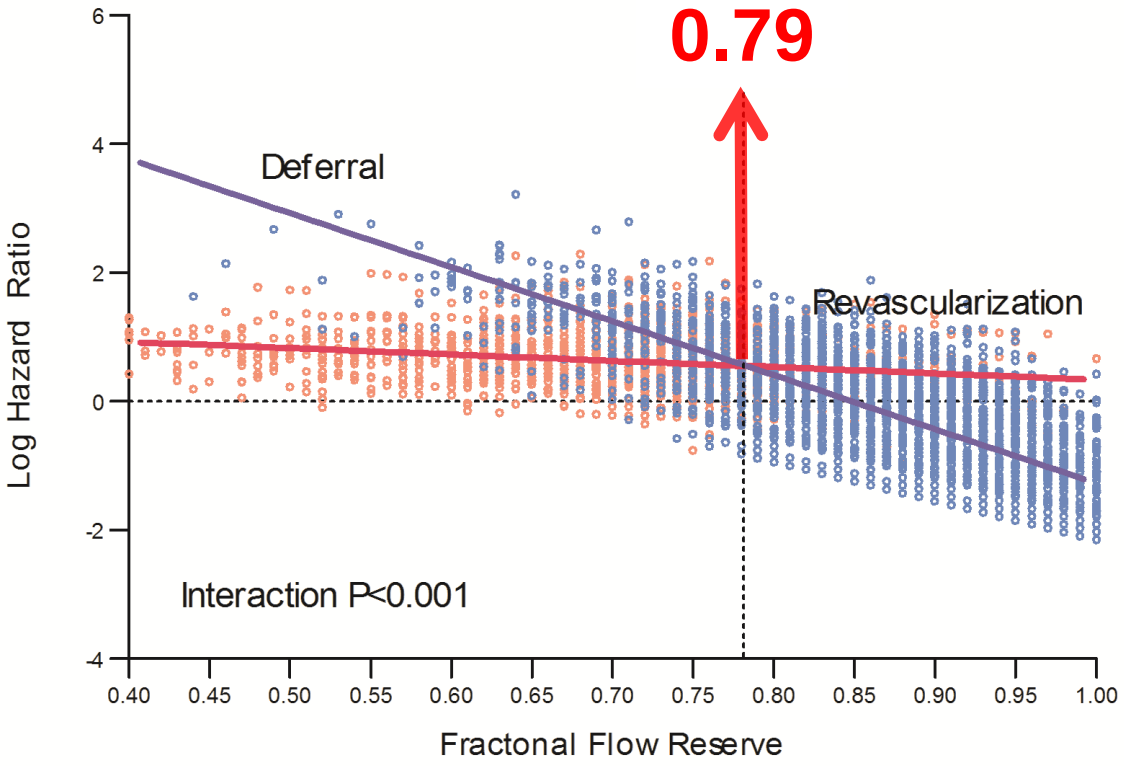
Pijls NHJ, NEJM 1996;334:1703-8

Outcome Derived
Optimal Threshold of FFR

Validated from IRIS-FFR Registry

Outcome Derived Optimal Threshold of FFR (IRIS-FFR Registry, n=8,632)

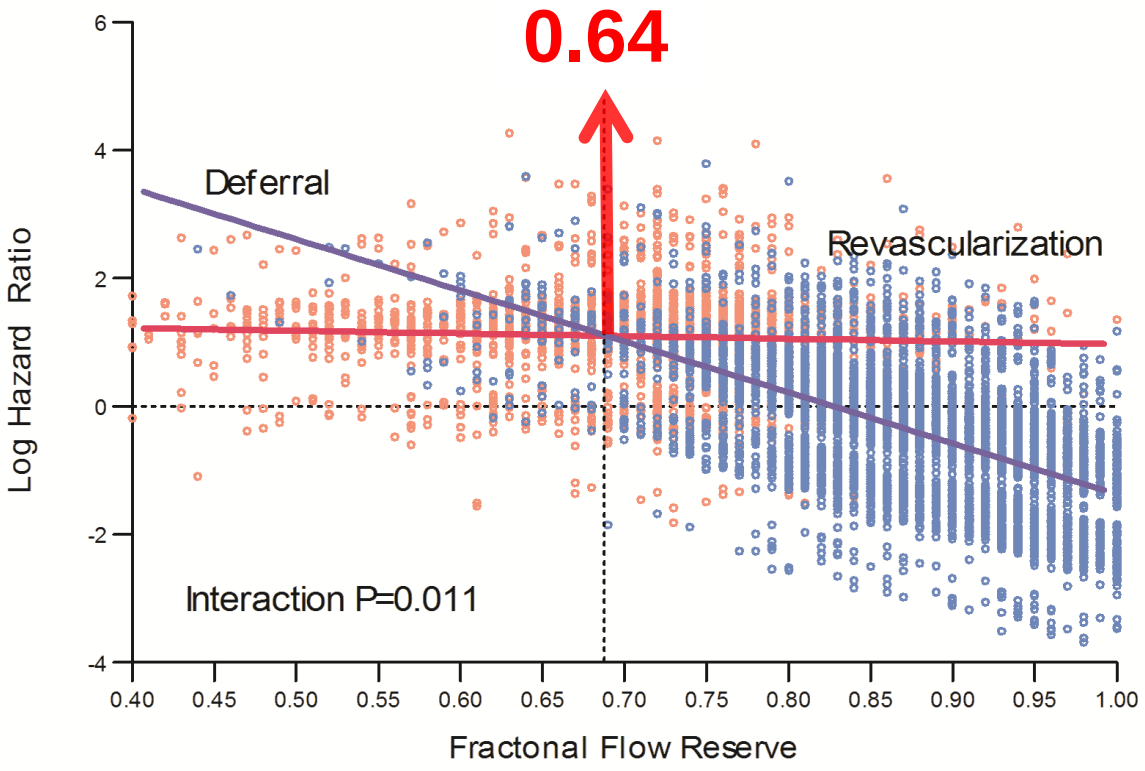
MACE



Ahn JM, Park DW et al, Circulation. 2017 Jun 6;135(23):2241-2251.

Outcome Derived Optimal Threshold of FFR (IRIS-FFR Registry, n=8,632)

Cardiac Death and MI



Ahn JM, Park DW et al, Circulation. 2017 Jun 6;135(23):2241-2251.

FFR 0.80 Is,

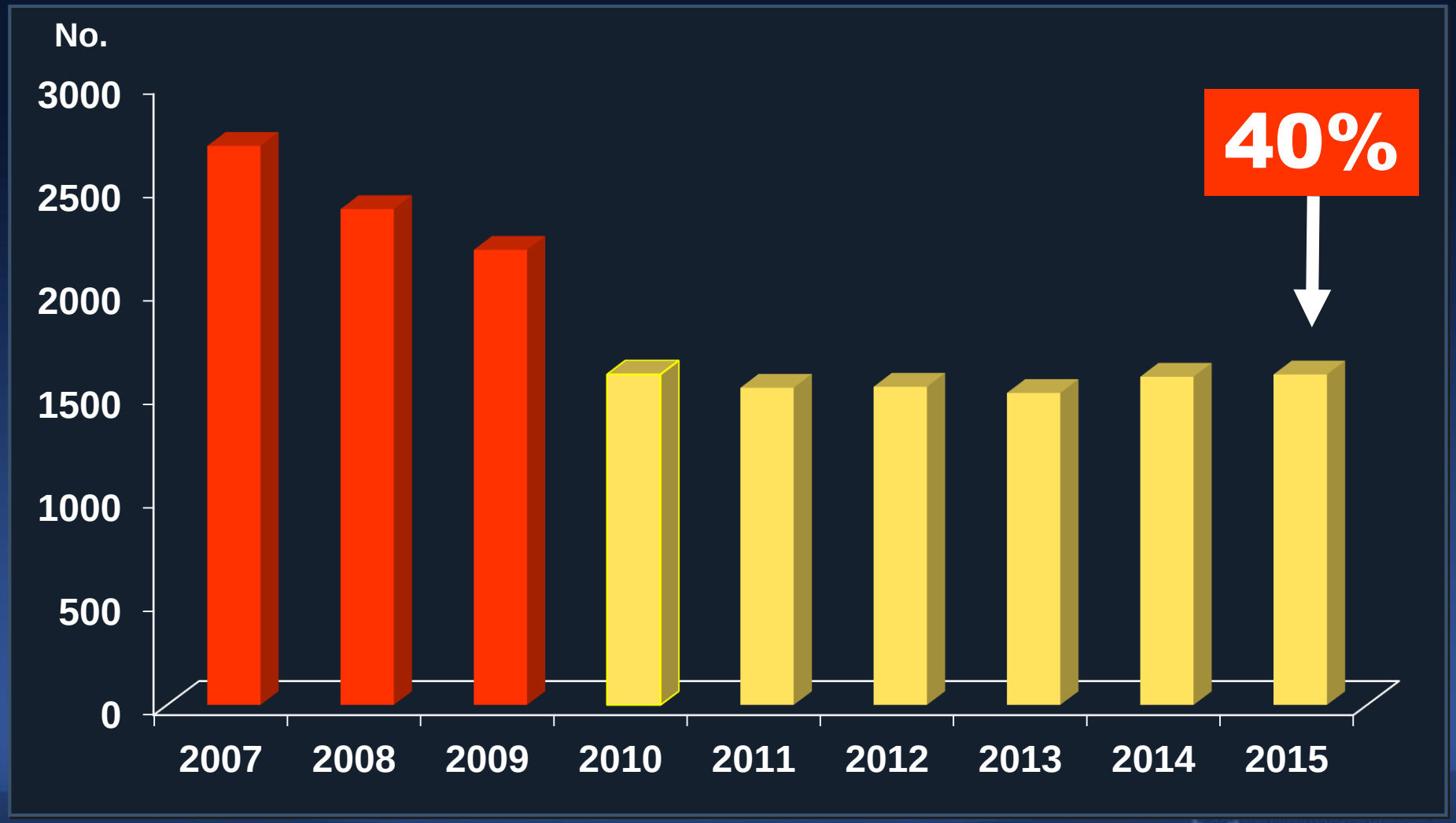
Good Clinical Outcome Threshold !

2018 ESC Guidelines for FFR

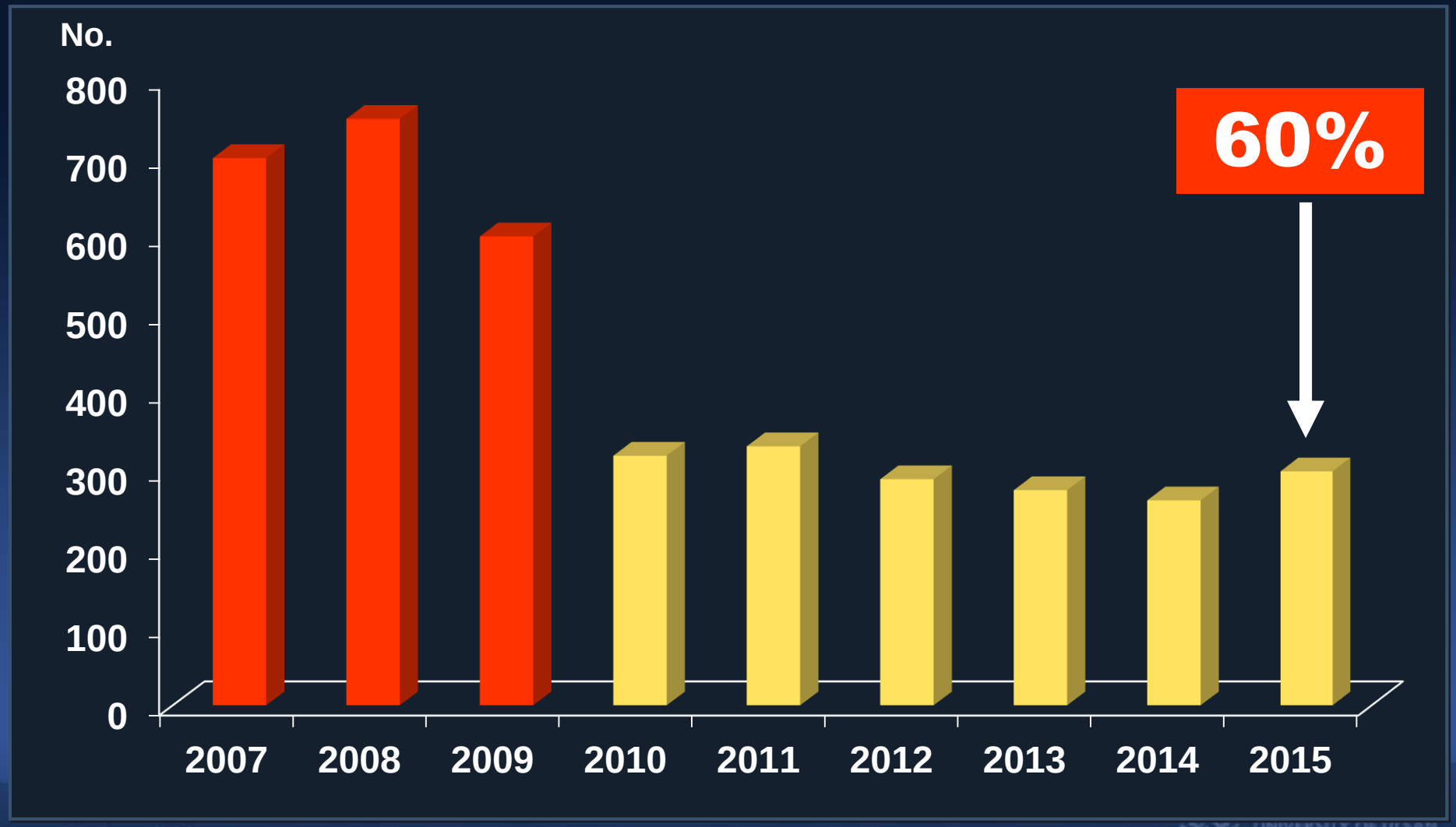
Recommendations	Class	Level
When evidence of ischemia is not available, FFR or iwFR are recommended to assess the hemodynamic relevance of intermediate-grade stenosis.	**I**	**A**
Revascularization of stenosis with FFR <0.80 is recommended in patients with angina symptoms or a positive stress test.	**I**	**B**
FFR-guided PCI shoud be considered in patients with multi-vessel disease undergoing PCI.	**IIa**	**B**
Revascularization of an angiographically intermediate stenosis without related ischemia or without FFR <0.80 is not recommended.	***III***	***B***

How Has It Been Changed My Practice ?

PCI Decreased

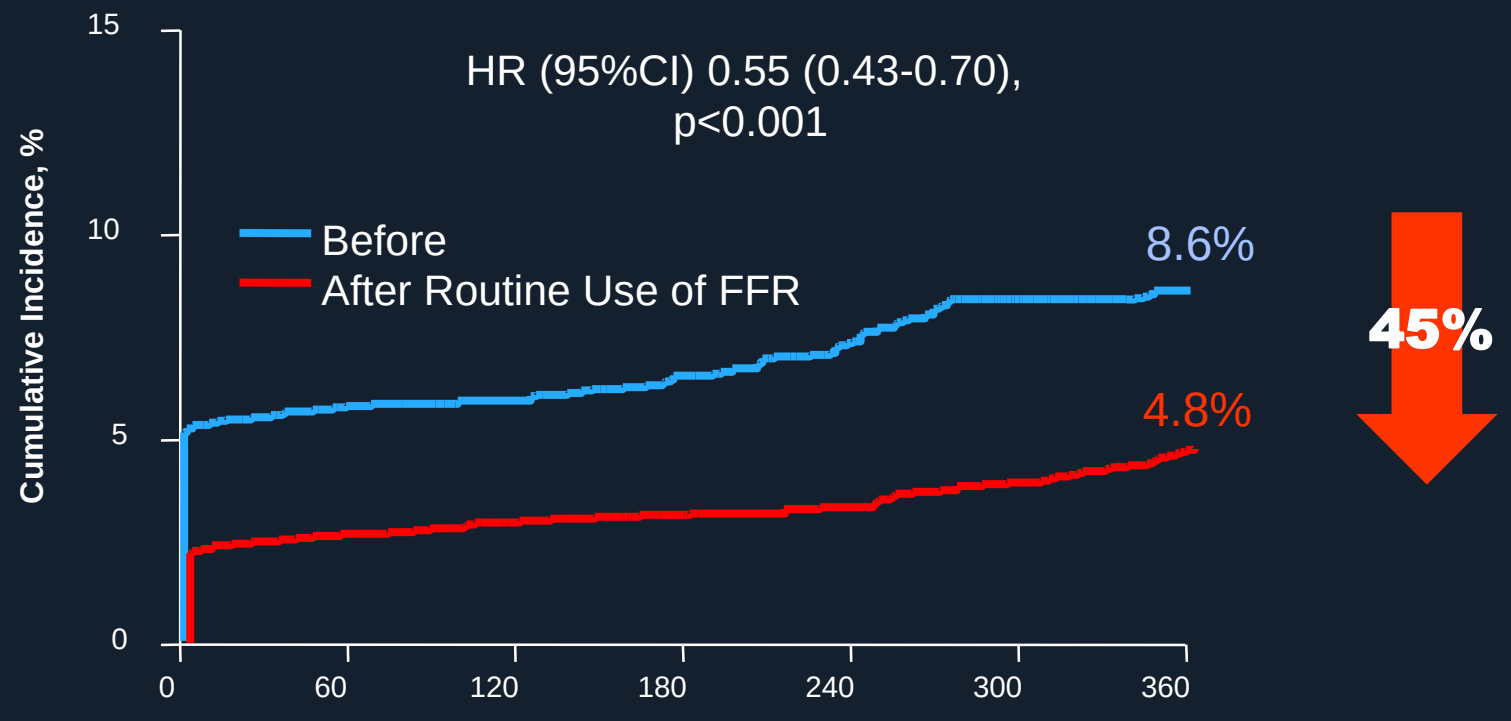


CABG Decreased



Improved PCI Outcomes

Death /MI or Repeat Revascularization



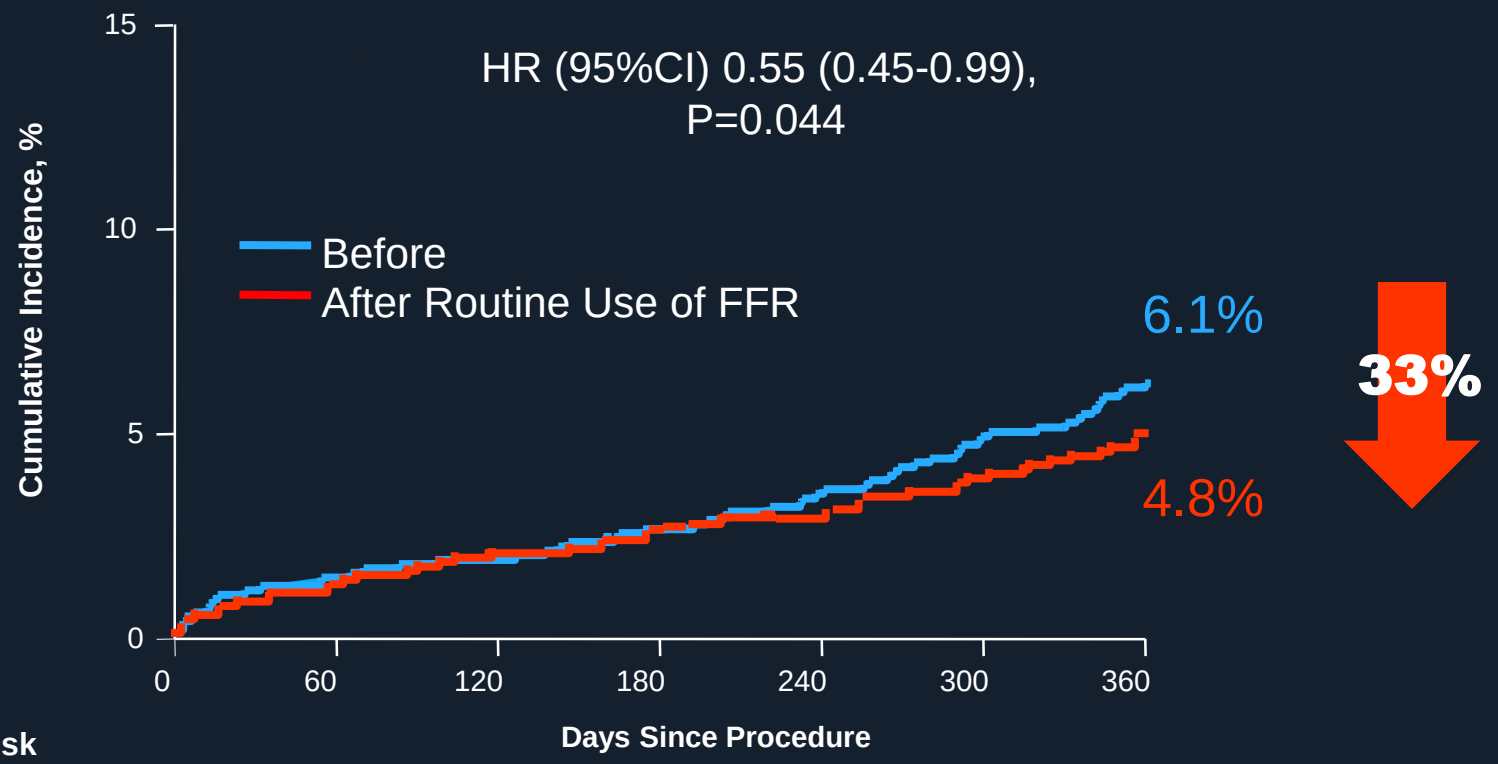
No. at Risk

Before Routine Use	2178	2066	2011	1960
After Routine Use	2178	2092	2067	2037

Park SJ, European Heart Journal. 2013 Nov;34(43):3353-61.

Improved Clinical Outcomes for LM and 3 VD Treatment

Death /MI /Stroke or Repeat Revascularization



No. at Risk				
Before Routine Use	917	901	883	857
After Routine Use	917	898	886	869

Ahn JM, et al, AJC 2015 Oct;116(8):1163-71.

Our Practice Has Been Changed Over the Past Decade !

- Less DES,
- More Less Surgery,
- Improved Clinical Outcomes.

Ahn JM, et al, AJC 2015 Oct;116(8):1163-71.
Park SJ, et al, European Heart Journal. 2013 Nov;34(43):3353-61.

?

iFR

(instantaneous wave-free ratio)

Many Resting Indexes
Non-Hyperemic Pressure Ratio:

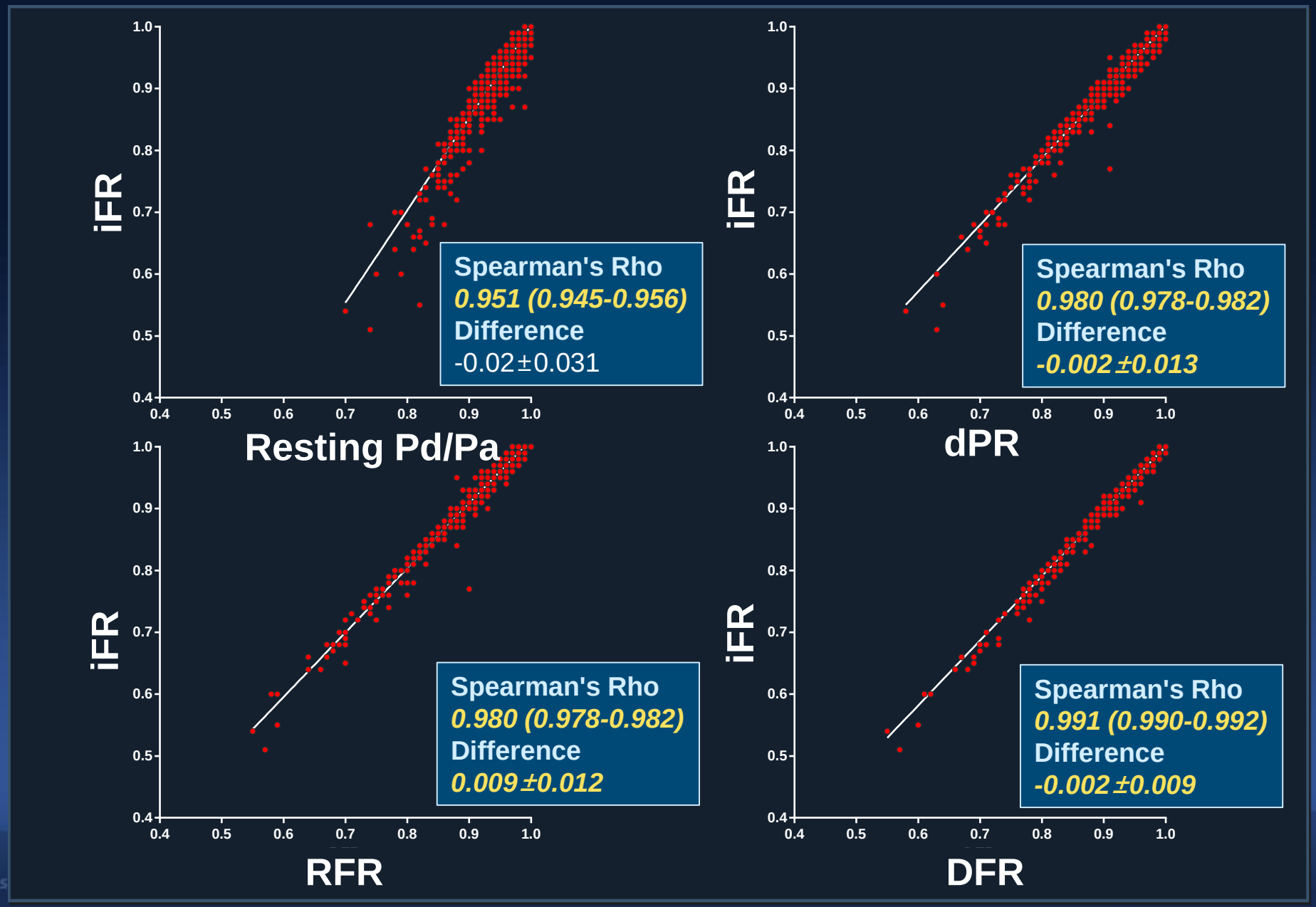
- iFR (instantaneous wave-free ratio)
- Resting Whole Cycle Pd/Pa
- dPR (diastolic pressure ratio)
- RFR (Resting Full-cycle ratio)
- DFR (diastolic flow ratio)

Are They Different ?

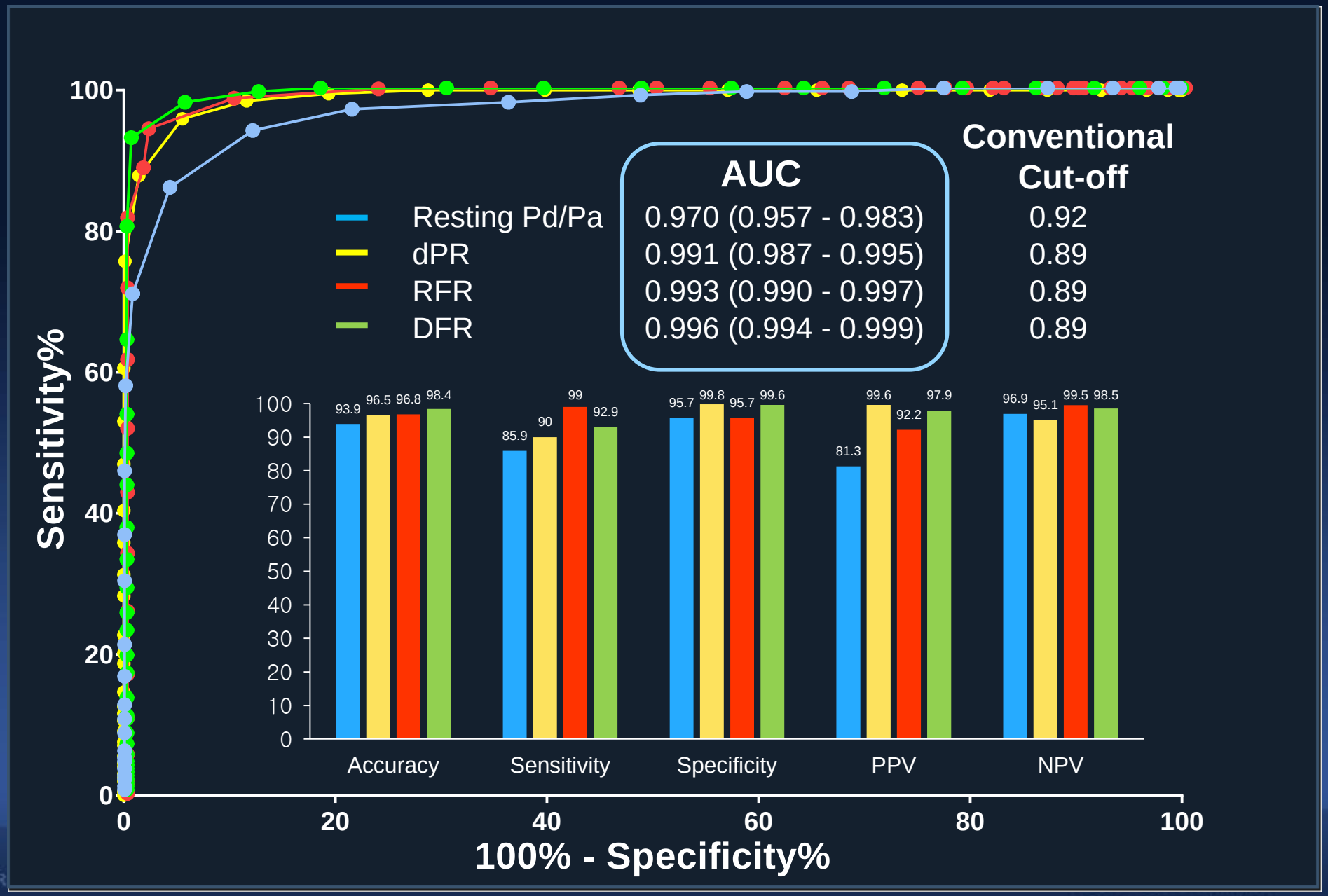
Comparison Data of Different Non-Hyperemic Diastolic Indexes side by side with FFR

1102 lesions in 926 patients were deferred after FFR measurement from IRIS FFR Registry.

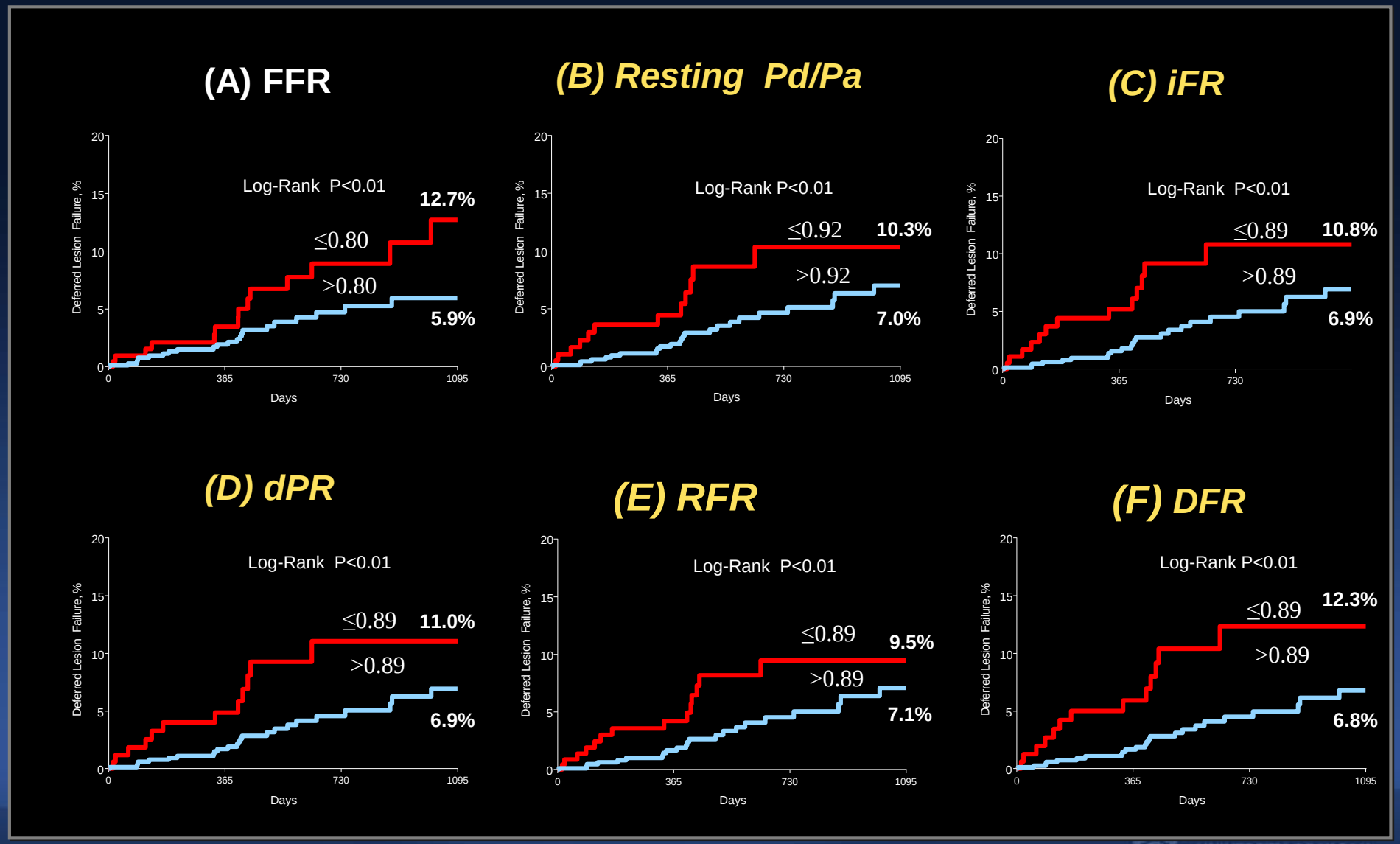
Comparison With iFR: *Correlation*



Comparison With iFR (0.89): *Prediction*



Kaplan-Meier Curves
Deferred Lesion Failure



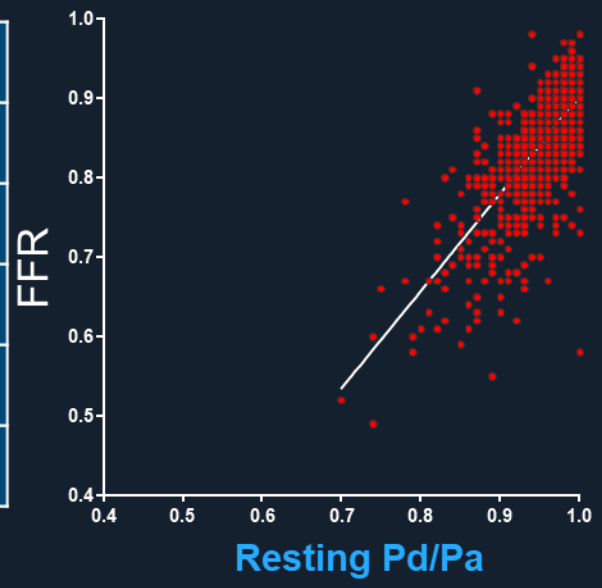
Many Resting Indexes
Non-Hyperemic Pressure Ratio:

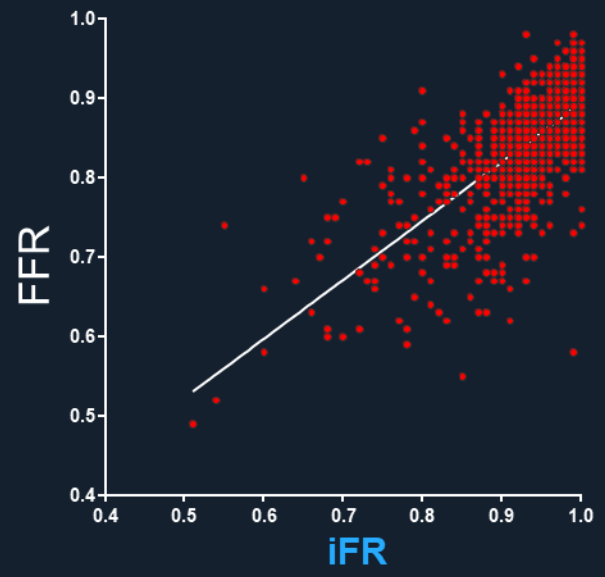
- iFR (instantaneous wave-free ratio)
- Resting Whole Cycle Pd/Pa
- dPR (diastolic pressure ratio)
- RFR (Resting Full-cycle ratio)
- DFR (diastolic flow ratio)

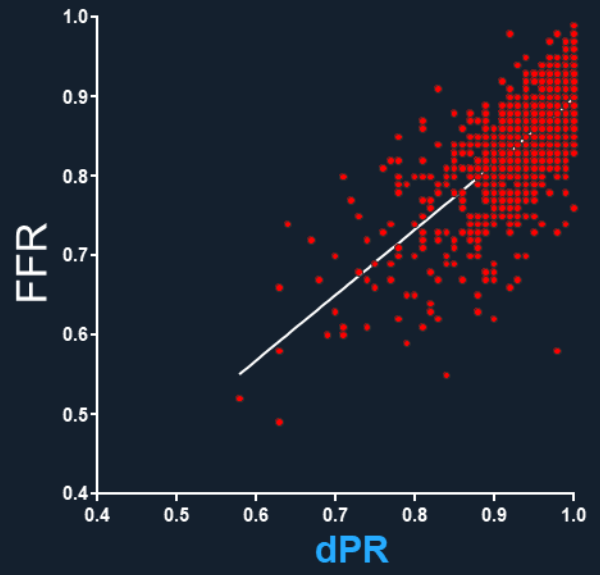
They Are All Equivalent !
"Class Effect"

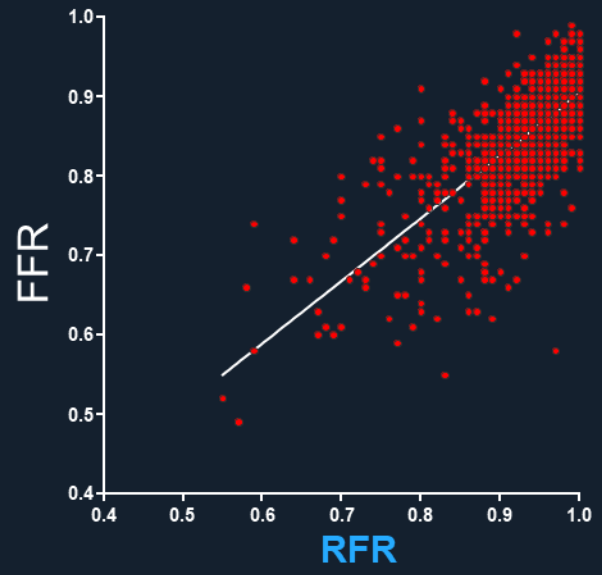
Comparison With FFR: *Correlation*

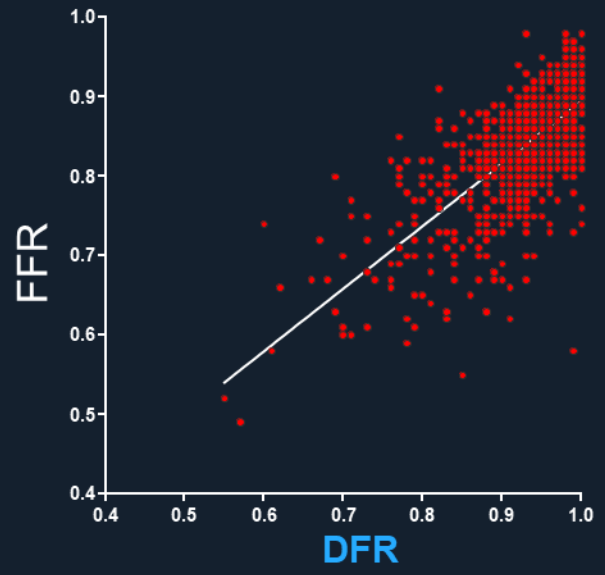
	Spearman's Rho
Resting Pd/Pa	0.746 (0.719 - 0.771)
iFR	0.732 (0.704 - 0.759)
dPR	0.737 (0.709 - 0.763)
RFR	0.733 (0.704 - 0.759)
DFR	0.731 (0.702 - 0.757)





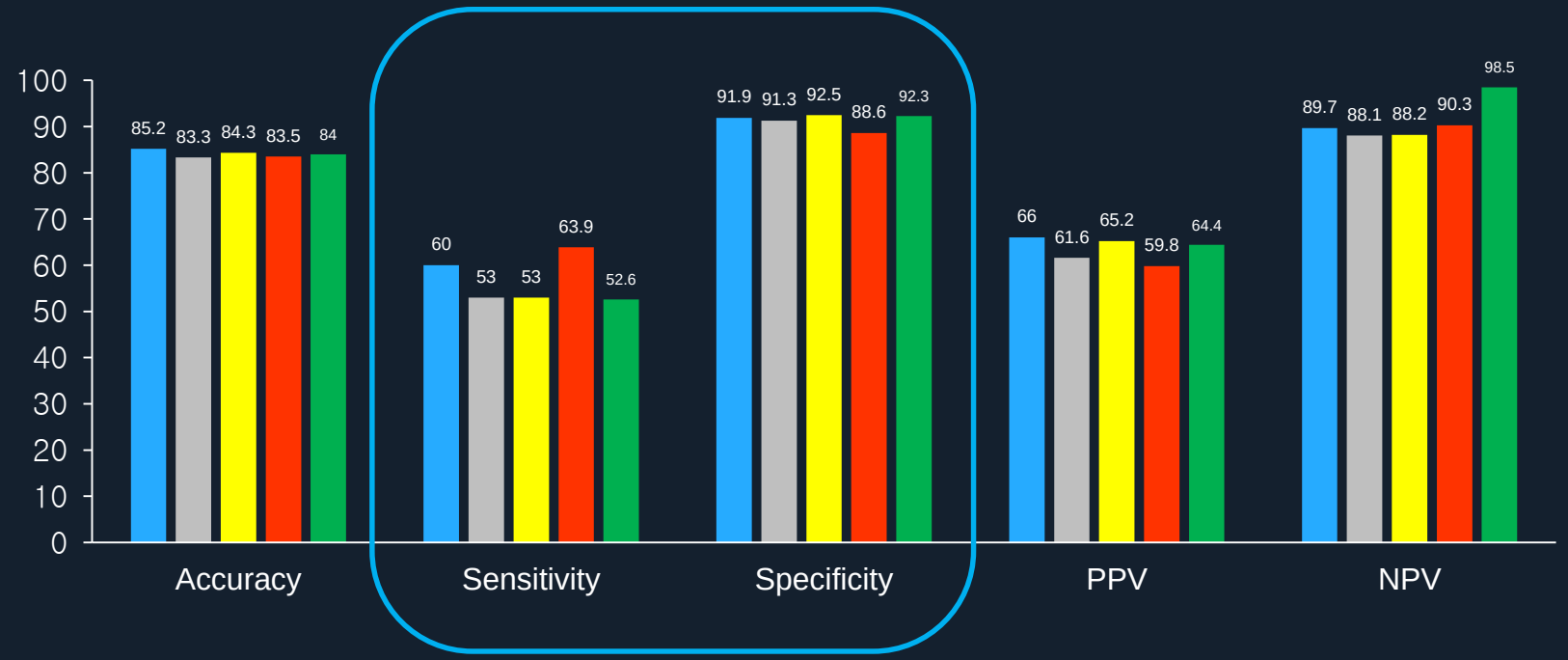






Comparison With FFR (0.80): *Prediction*

	AUC	Conventional Cut-off
Resting Pd/Pa	0.872 (0.846 - 0.898)	≤0.92
iFR	0.863 (0.838 - 0.888)	≤0.89
dPR	0.868 (0.843 - 0.893)	≤0.89
RFR	0.865 (0.840 - 0.890)	≤0.89
DFR	0.863 (0.837 - 0.888)	≤0.89



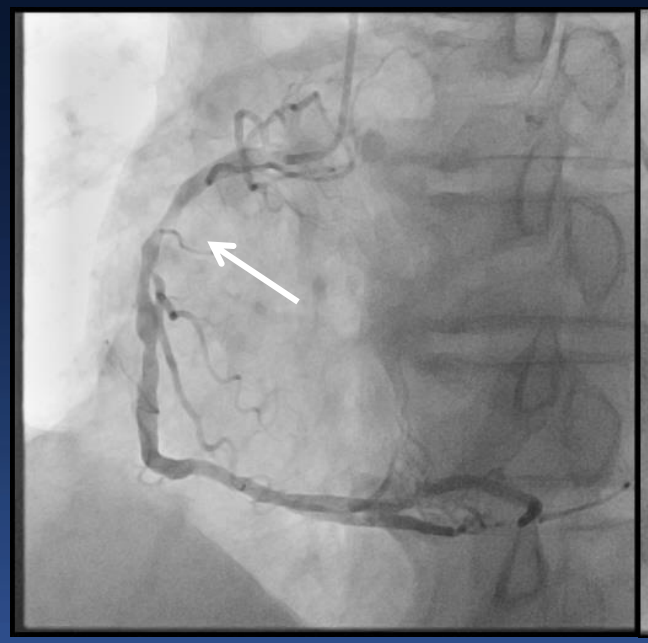
What's the Difference of Non-Hyperemic Pressure Ratio Compared to FFR ?

Low Sensitivity,
High Specificity

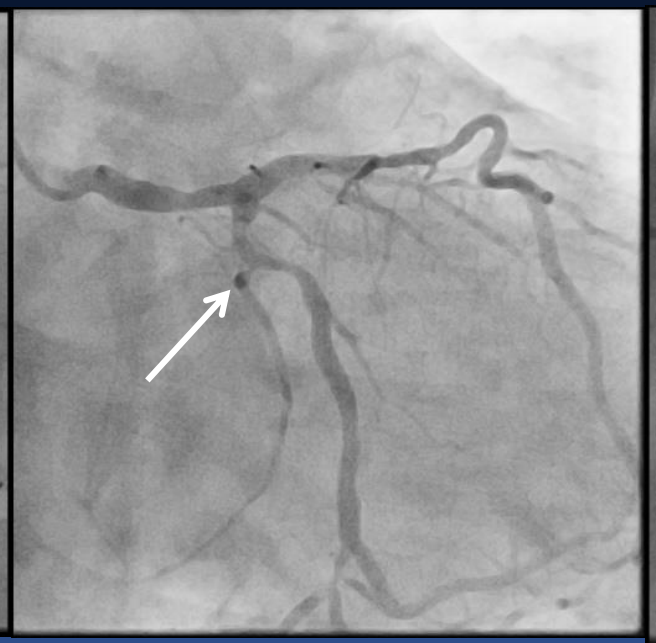
iFR vs. FFR
Concordance and Discordance

Coronary Angiography

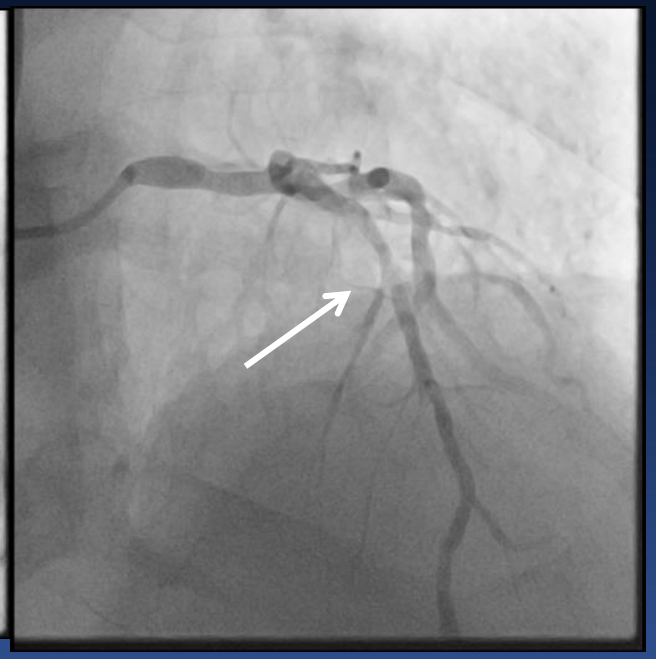
RCA



LCX

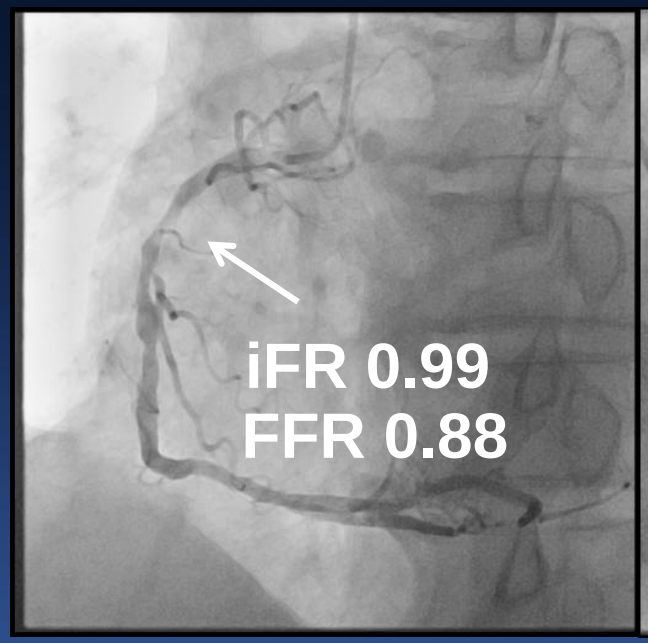
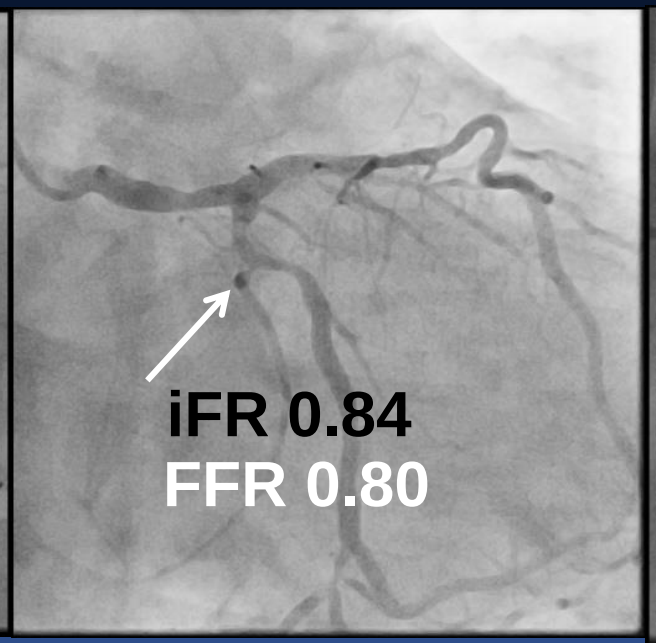
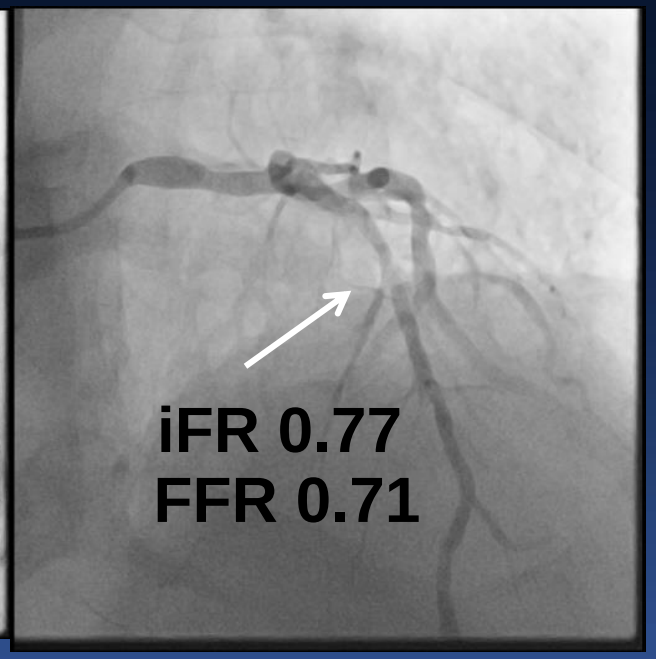


LAD



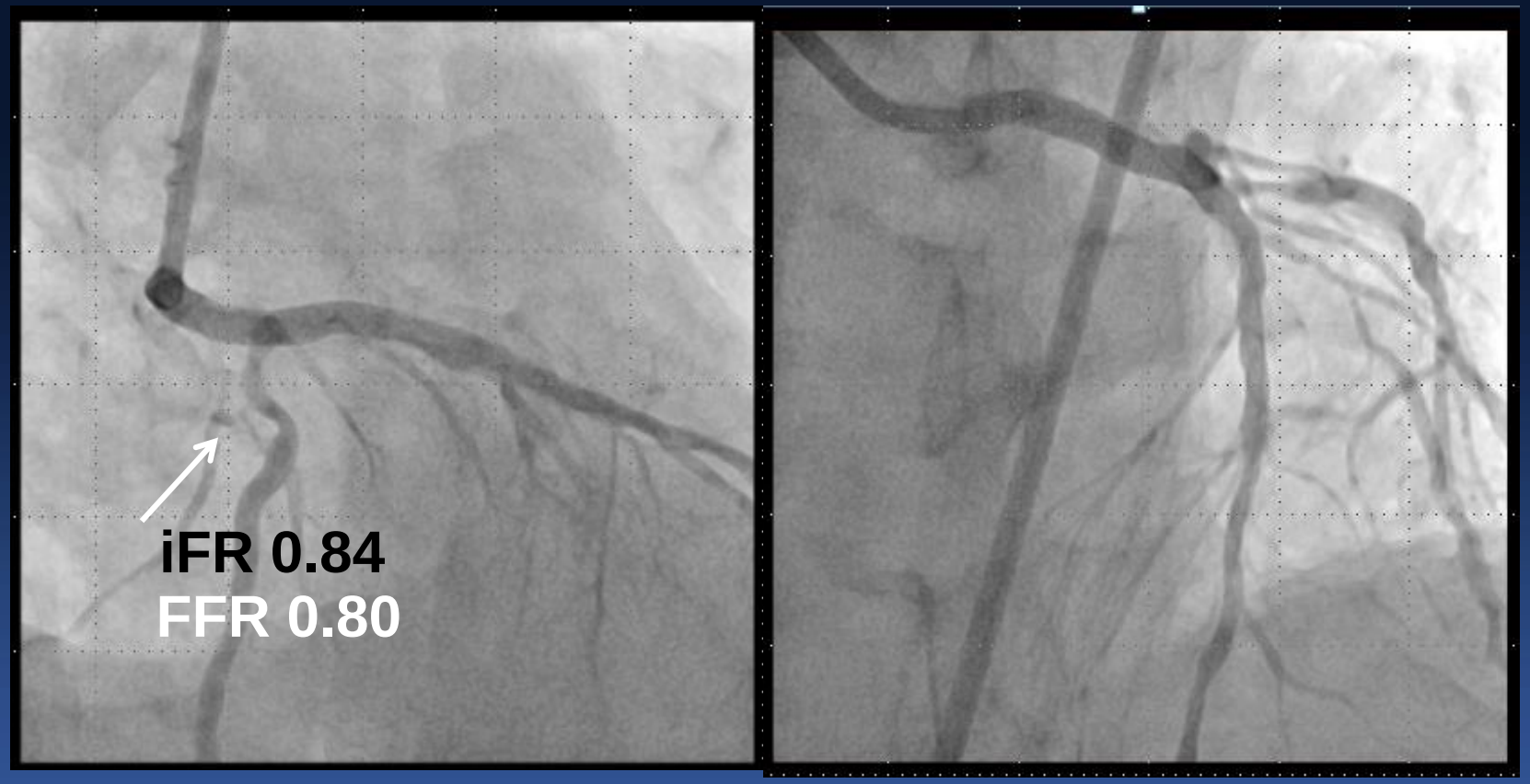
3 VD, Intermediate Stenosis

iFR and FFR

RCA	LCX	LAD
		
Concordant	*Discordant*	*Concordant*

Simply, Stent Cross-Over

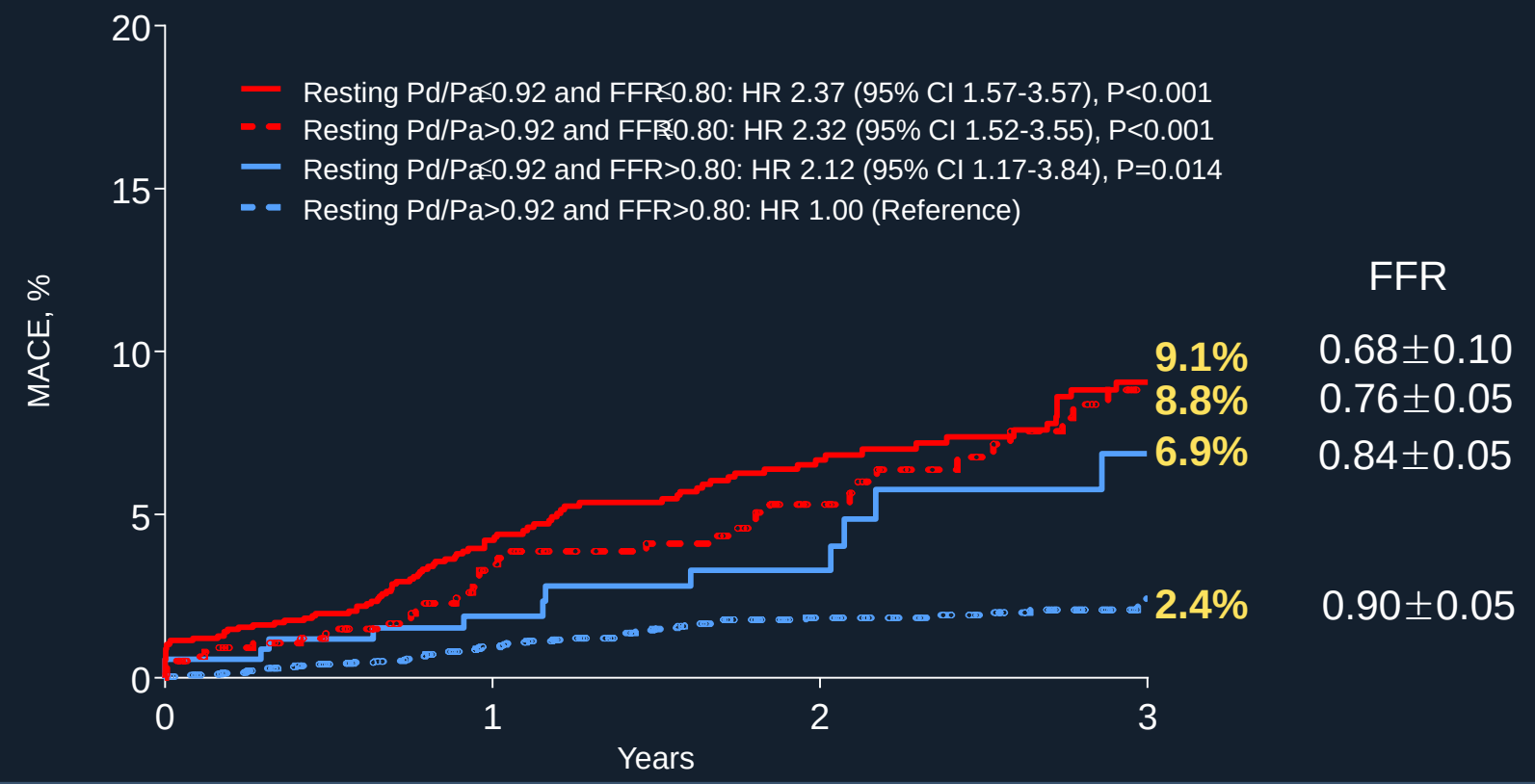
Leave it, LCX lesion !



Excellent Result !

Concordance and Discordance
Make A Different Clinical Outcomes

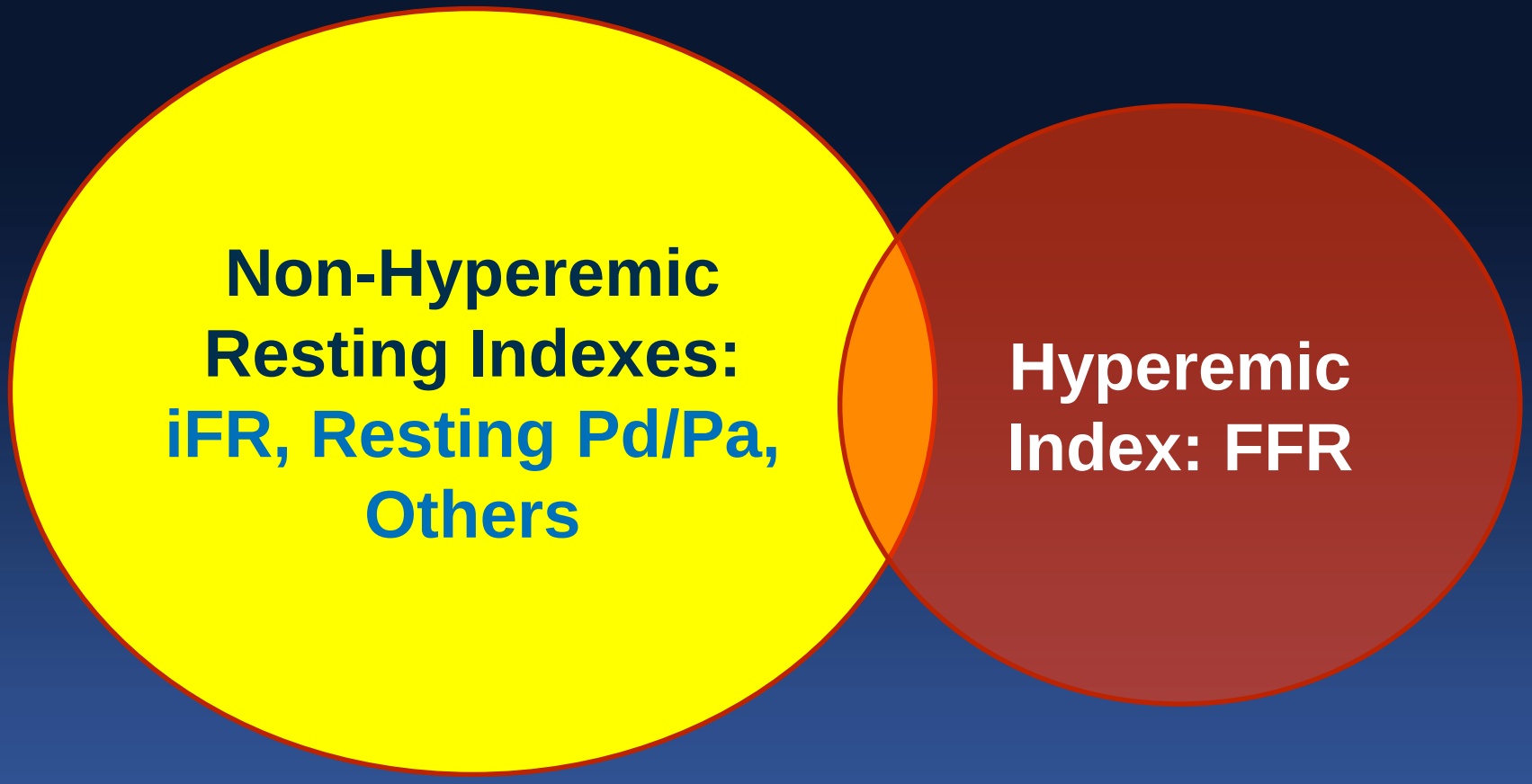
Cardiac Death, MI, RR



Preliminary Analysis from IRIS-FFR registry (7014 lesions in 4707 patients)

How Do I Implement ?

"Synergetic Hybrid"



74% 26%

How Do I Implement ?

"Synergetic Hybrid" showed better predictive performance for cardiac event rather than individual assessment.