



Coronary Physiology / Imaging Co-Registration: Essential or nice to have?

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Disclosures

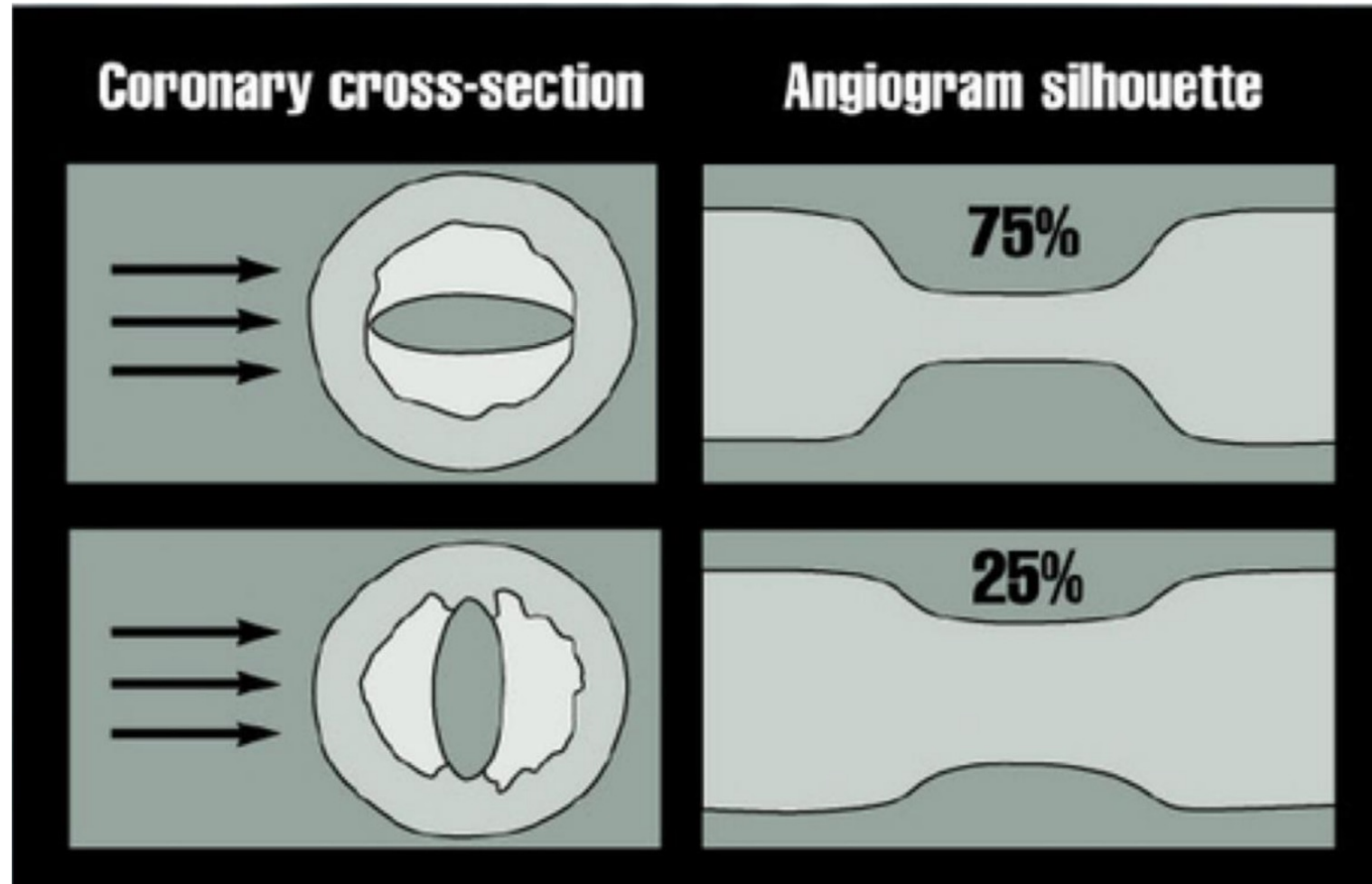
Philips Volcano – Consultant/Speaker Bureau

Edwards LifeSciences – Consultant/Proctor

Medtronic – Consultant/Speaker Bureau

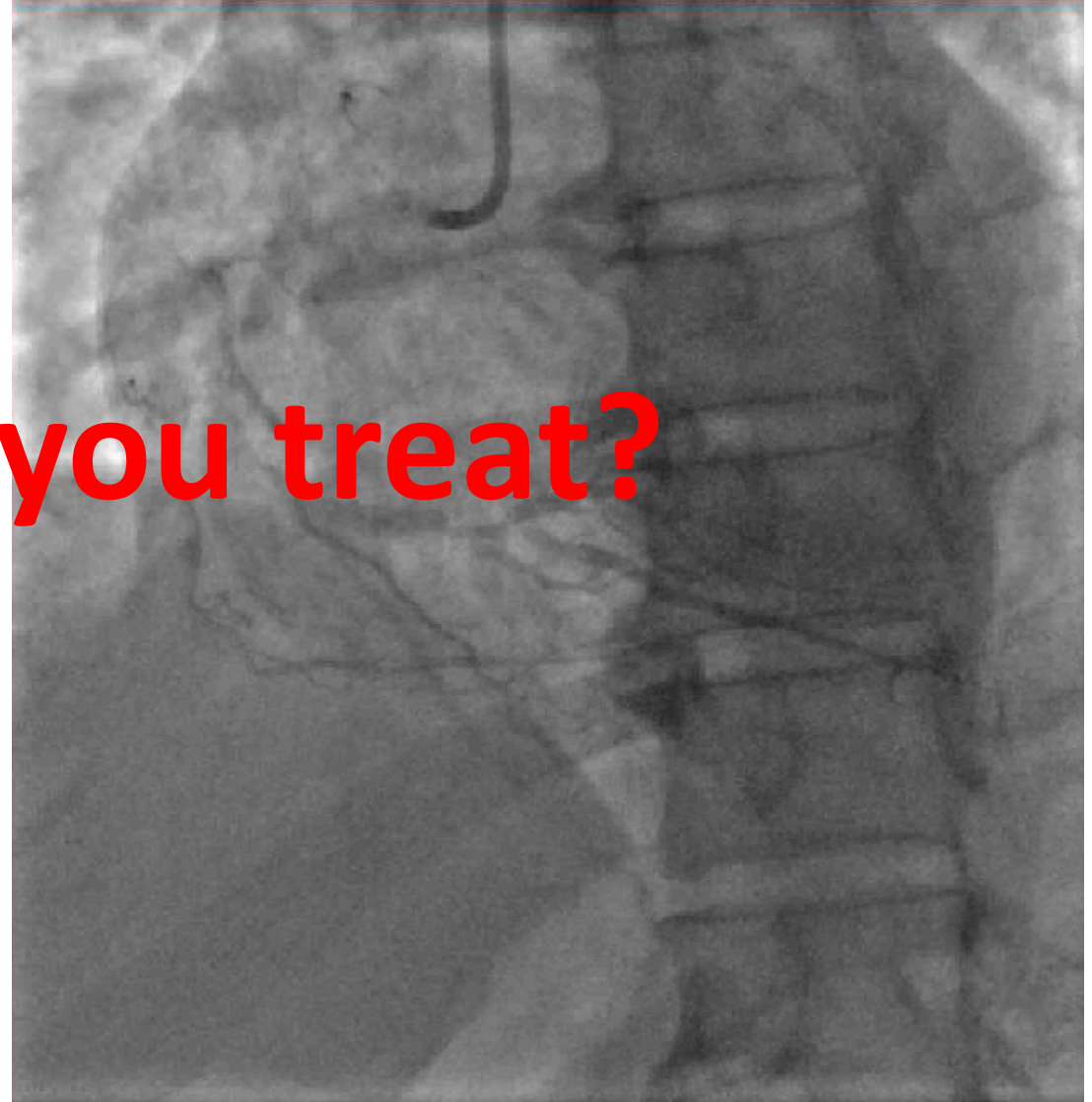
Boston Scientific – Advisory Board/Consultant

Shockwave – Consultant/Speaker Bureau



- 76 yr old female
 - HTN
 - DLD
 - CKD- III
 - DM
 - Rheumatoid Arthritis
 - Inferior ischemia on stress test
 - 2 antianginals

What do you treat?





The NEW ENGLAND JOURNAL *of* MEDICINE

ESTABLISHED IN 1812

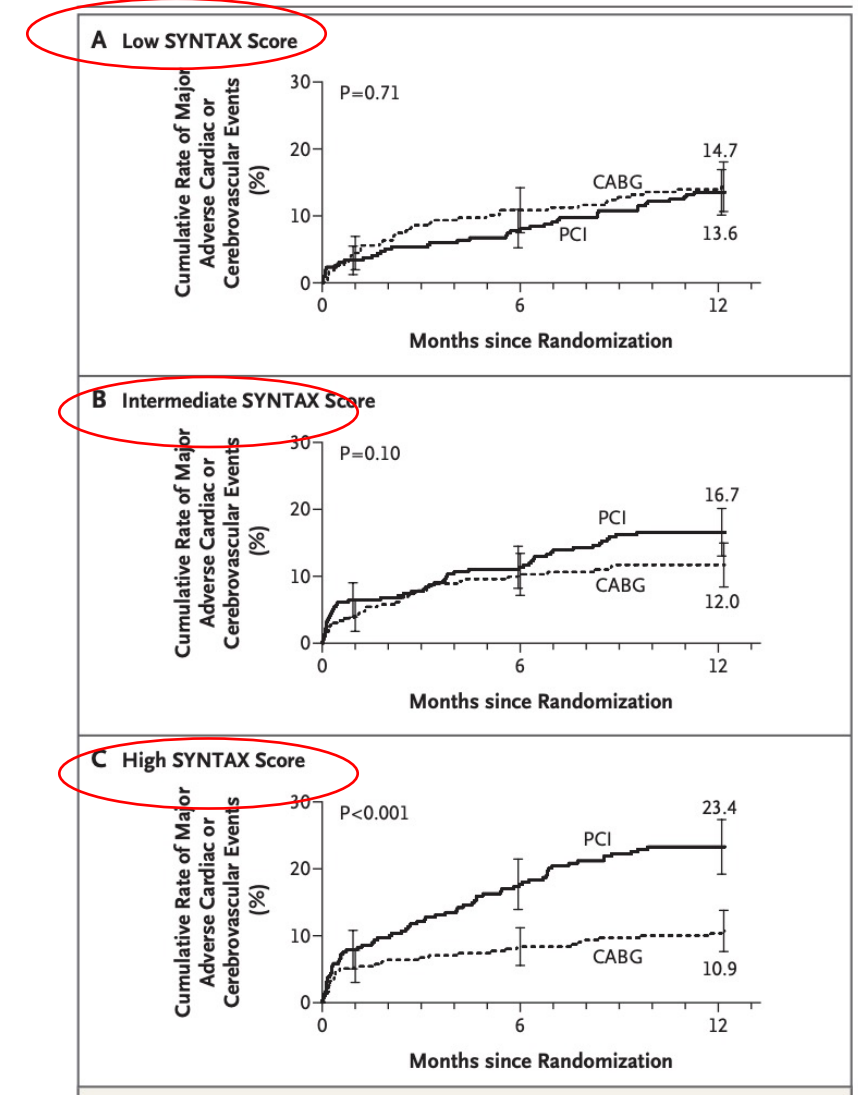
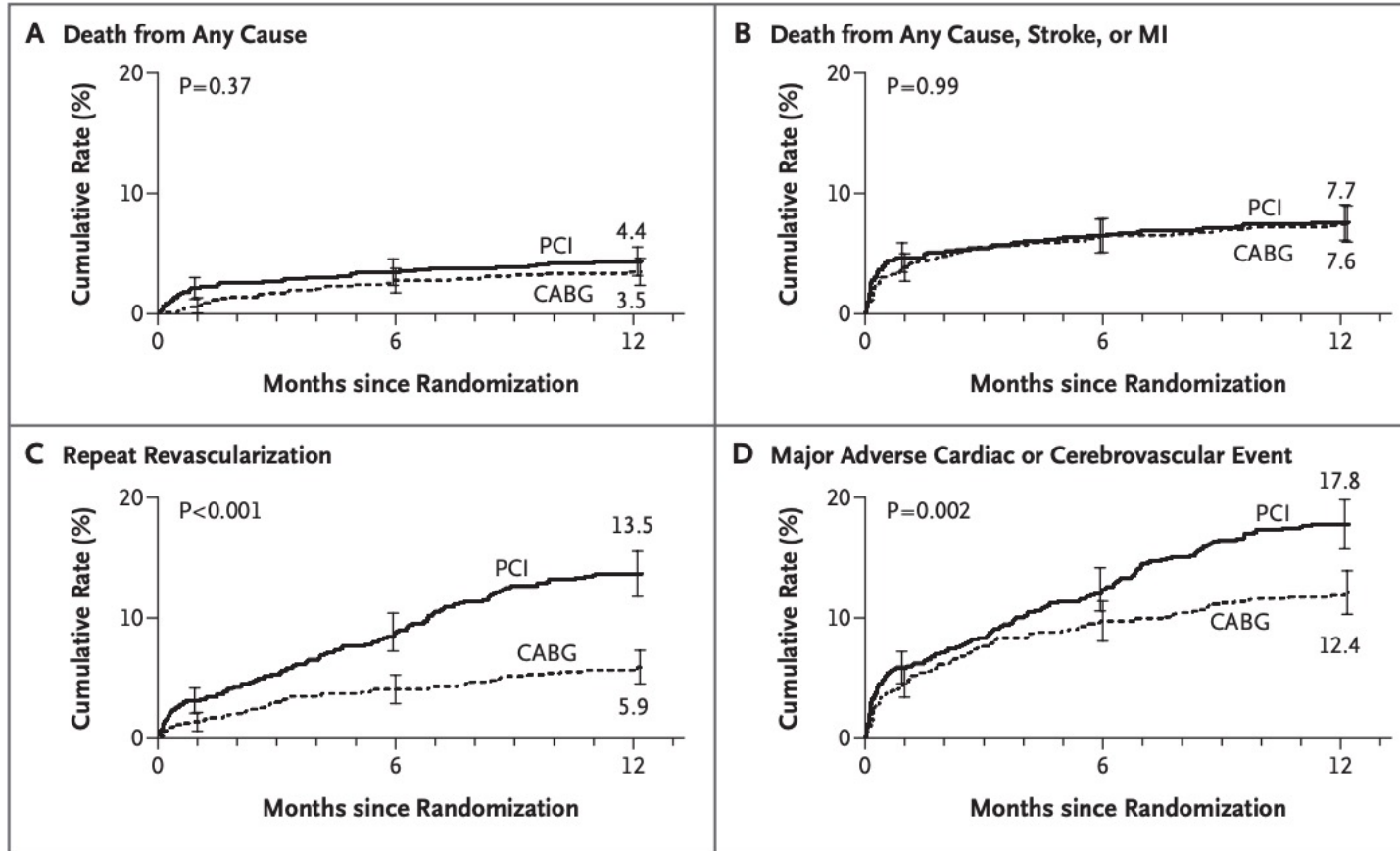
MARCH 5, 2009

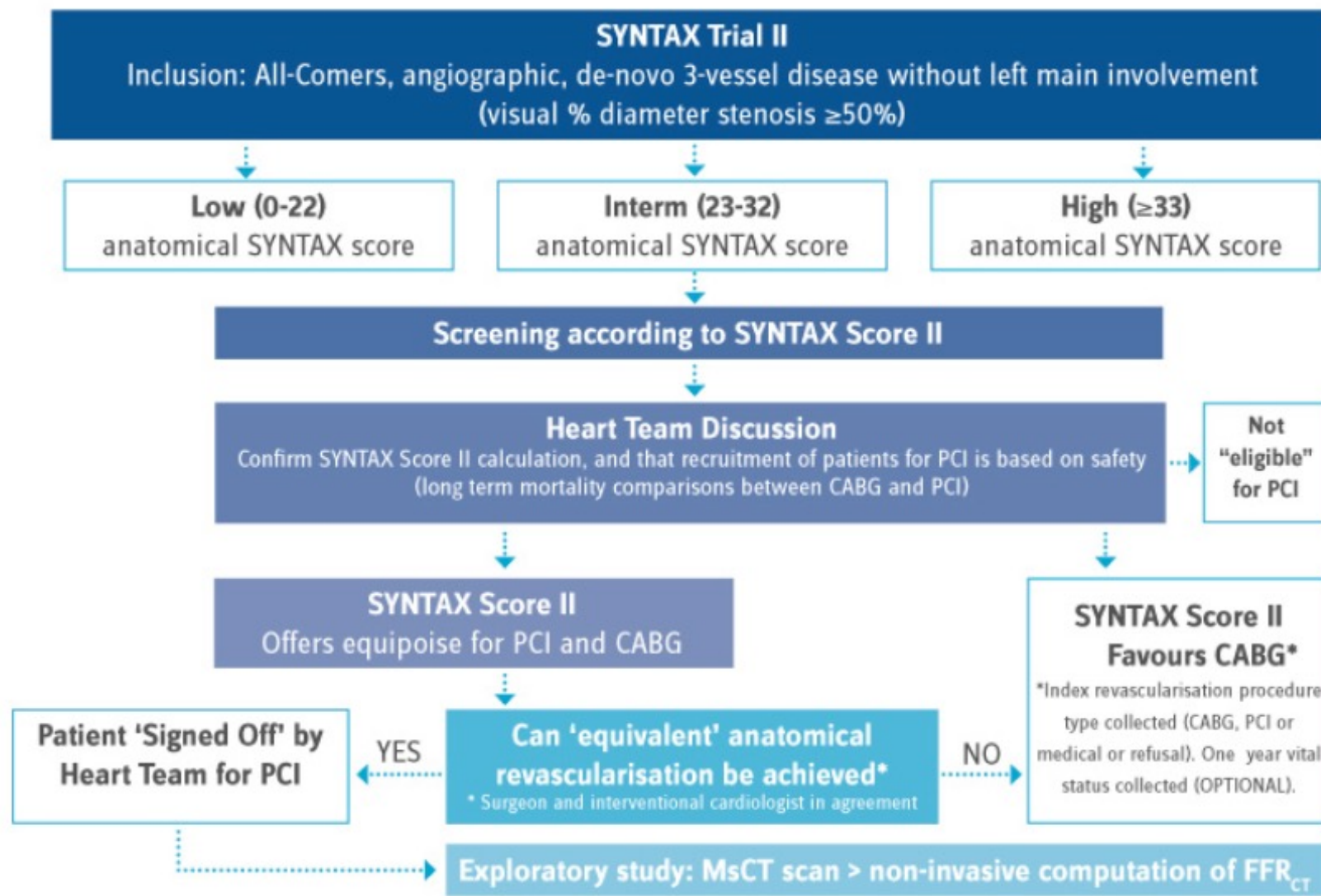
VOL. 360 NO. 10

Percutaneous Coronary Intervention versus Coronary-Artery Bypass Grafting for Severe Coronary Artery Disease

Patrick W. Serruys, M.D., Ph.D., Marie-Claude Morice, M.D., A. Pieter Kappetein, M.D., Ph.D.,
Antonio Colombo, M.D., David R. Holmes, M.D., Michael J. Mack, M.D., Elisabeth Stähle, M.D.,
Ted E. Feldman, M.D., Marcel van den Brand, M.D., Eric J. Bass, B.A., Nic Van Dyck, R.N., Katrin Leadley, M.D.,
Keith D. Dawkins, M.D., and Friedrich W. Mohr, M.D., Ph.D., for the SYNTAX Investigators*

ABSTRACT







PCI approach includes:

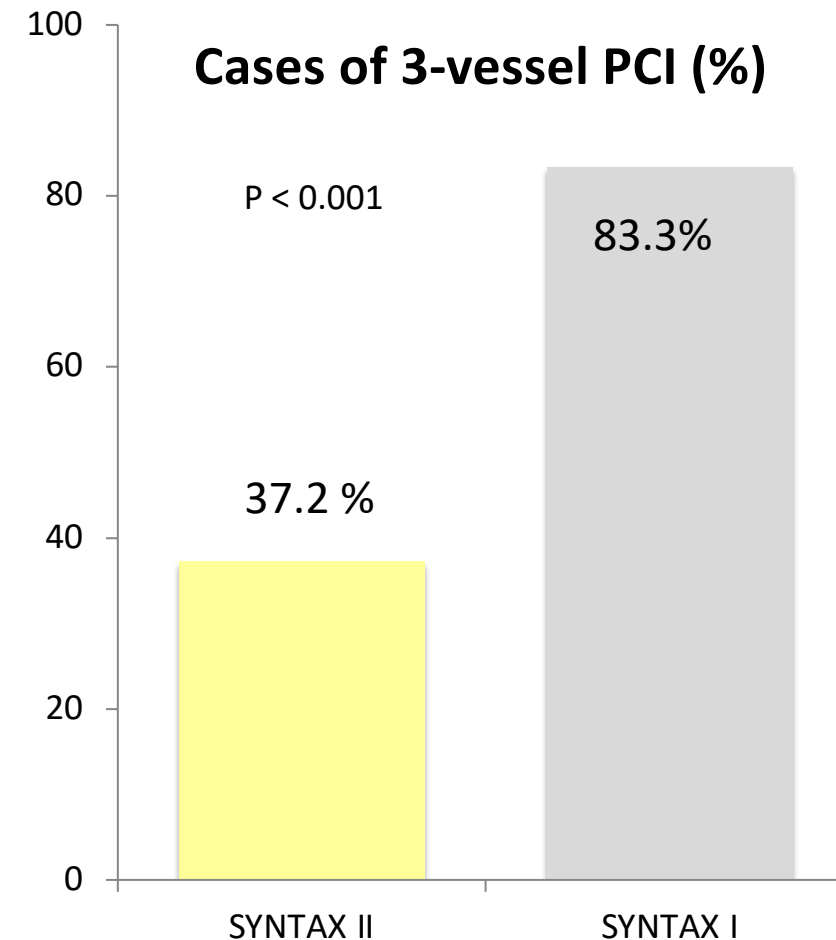
- SYNTAX Score II (incorporating clinical and anatomical variables) to guide Heart Team decisions on myocardial revascularisation.
- Physiology-based revascularisation.
- Second generation DES.
- IVUS-guided optimisation of stent deployment.
- Contemporary CTO revascularization techniques.
- Guideline-directed medical therapy.

SYNTAX II aims to investigate if recent technical and procedural developments in PCI (the SYNTAX II strategy) significantly influence outcomes in appropriately selected patients with three-vessel (3VD) coronary artery disease.

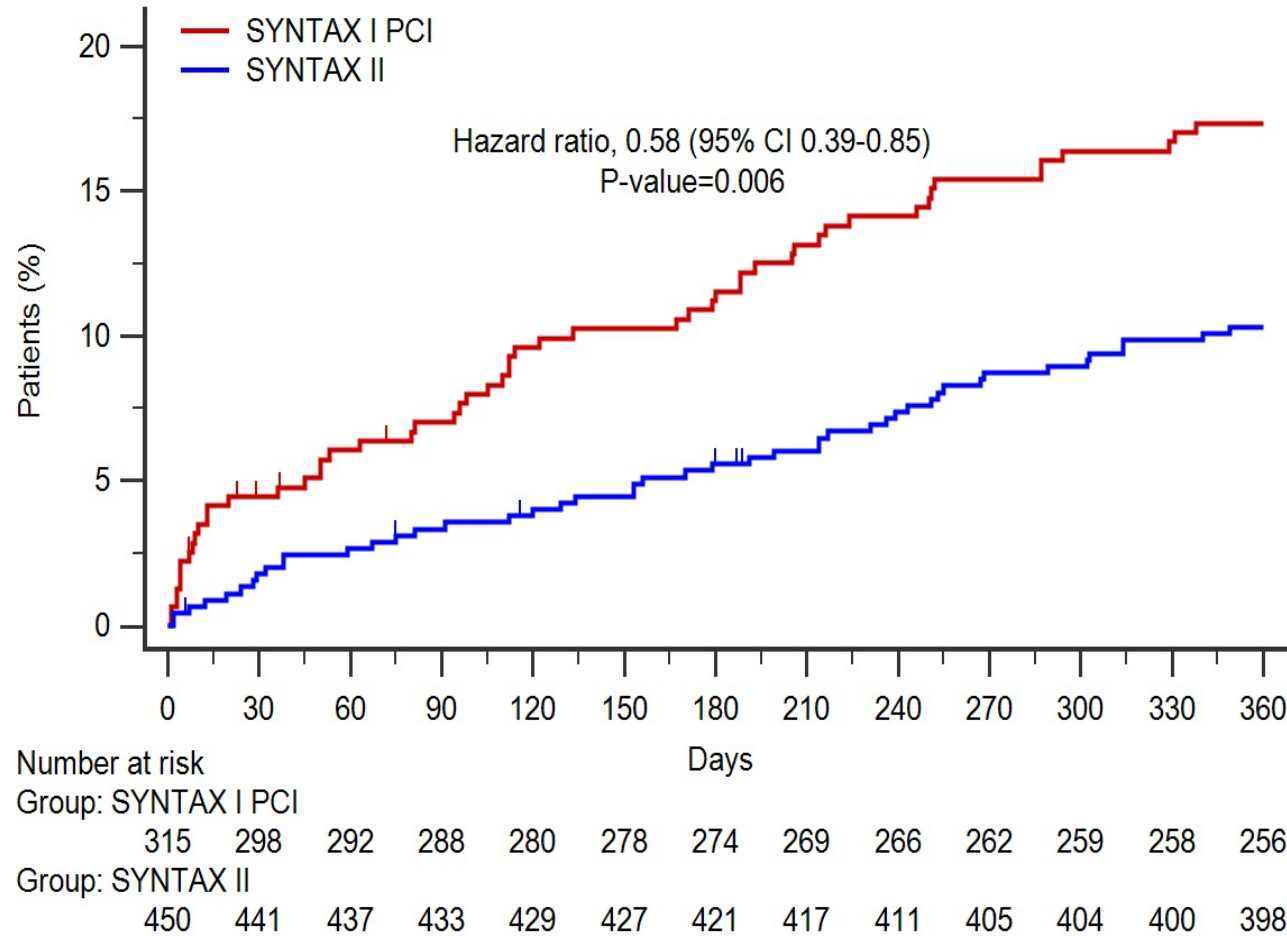


Marked simplification of PCI

- Physiology was performed in **98%** of patients
- Post-PCI IVUS was performed in **84%** of patients.
- **46%** of 3VD patients downgraded to 2VD or 1VD



Escaned et al., European Heart Journal (2017) 00, 1–11 doi:10.1093/eurheartj/ehx512



Significantly lower MACCE rate in SYNTAX II:

17.4%

10.6%

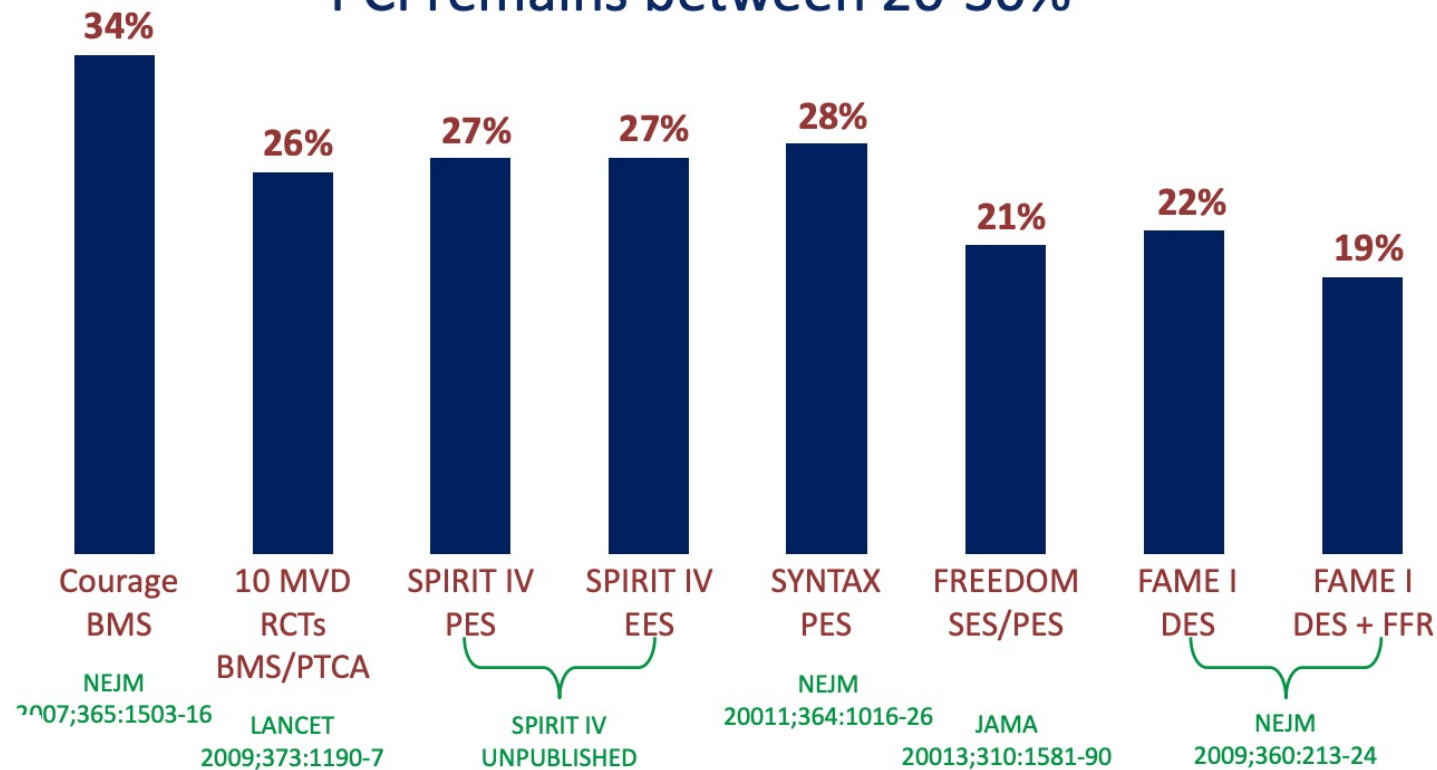
p=0.006

Escaned et al., European Heart Journal (2017) 00, 1–11 doi:10.1093/eurheartj/ehx512



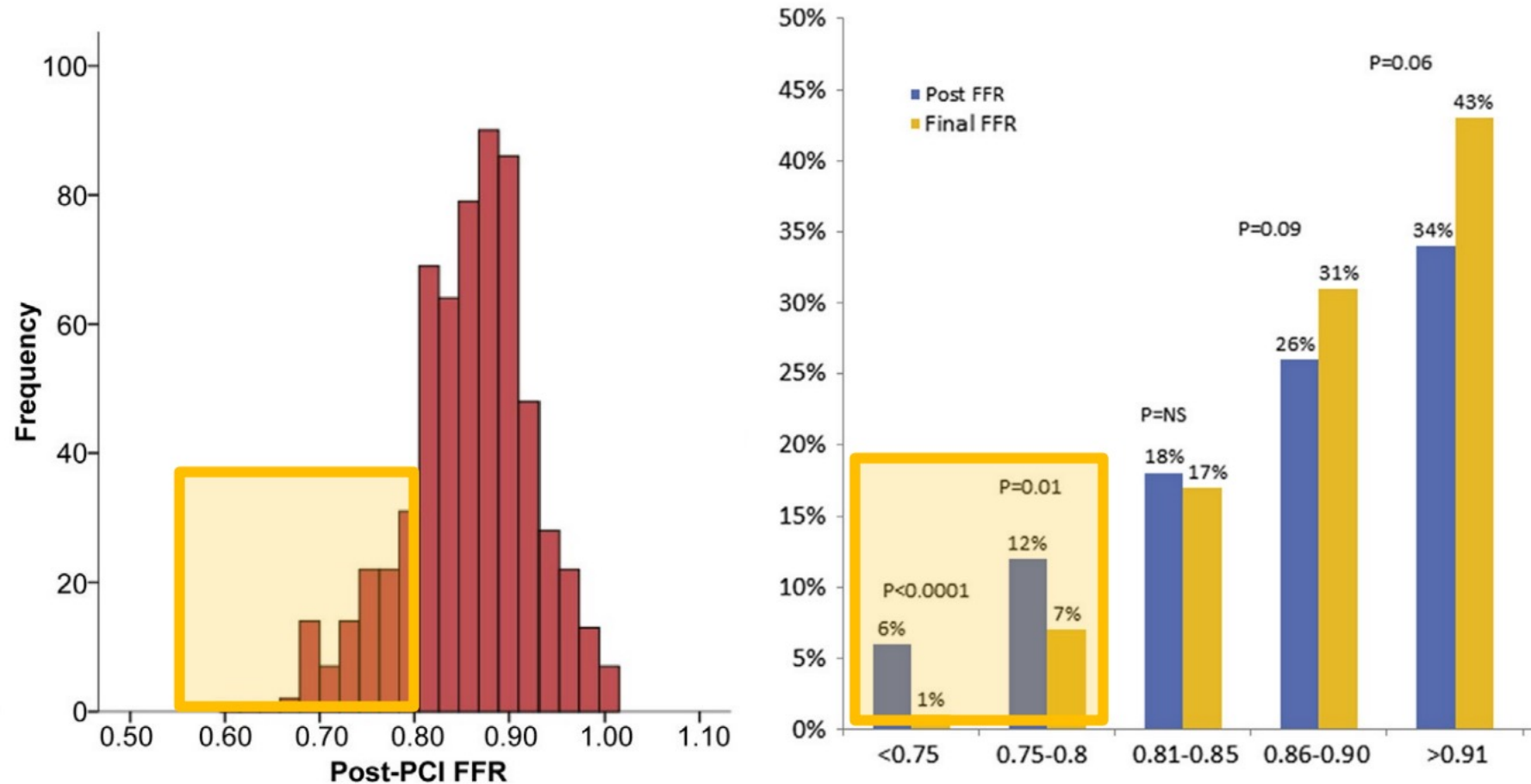
Recurrent Angina post 1-year

Recurrent Angina at 1 Year After
PCI remains between 20-30%

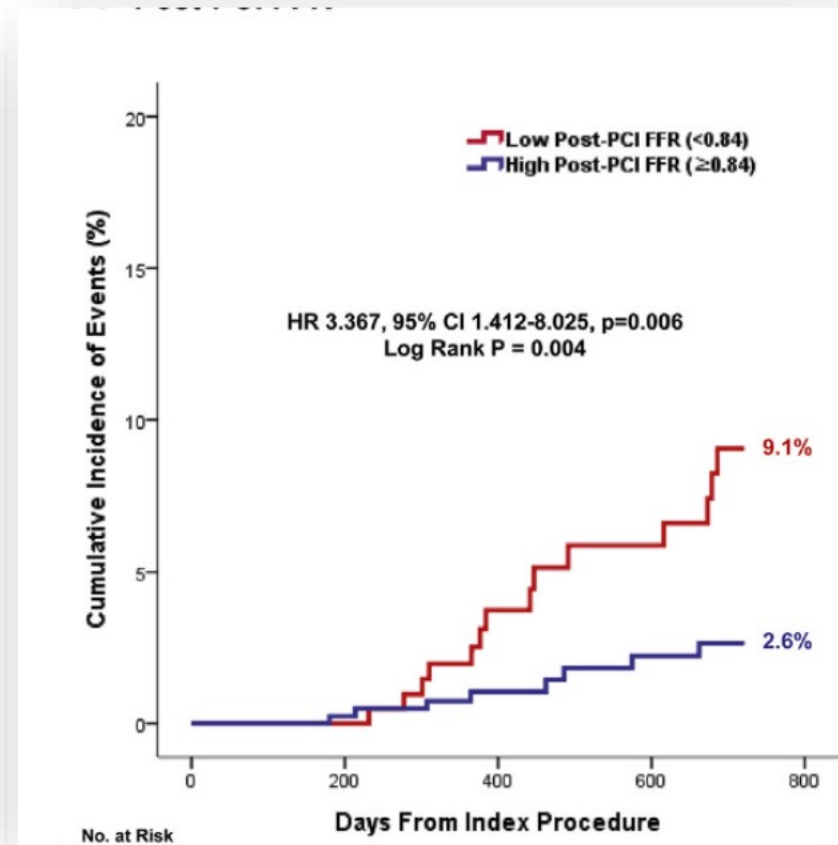
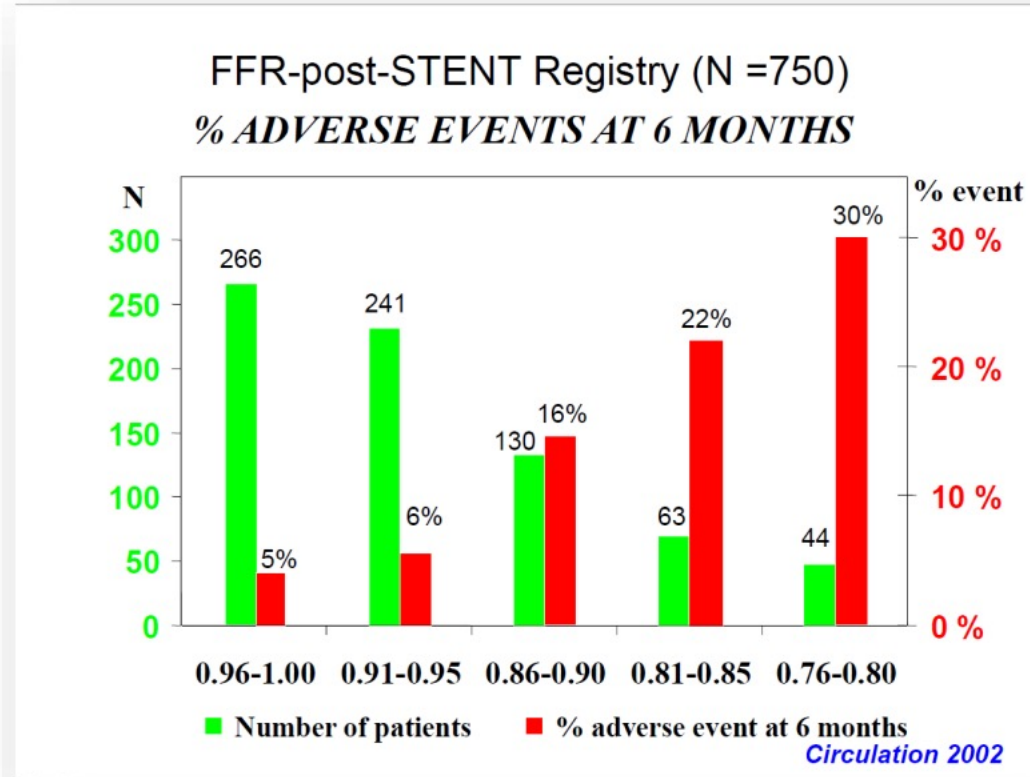


What do we know about post
PCI physiology?

Post PCI ischemia based on FFR ≤ 0.80 occurs in 10-20% of cases



Low post PCI FFR = worse outcomes

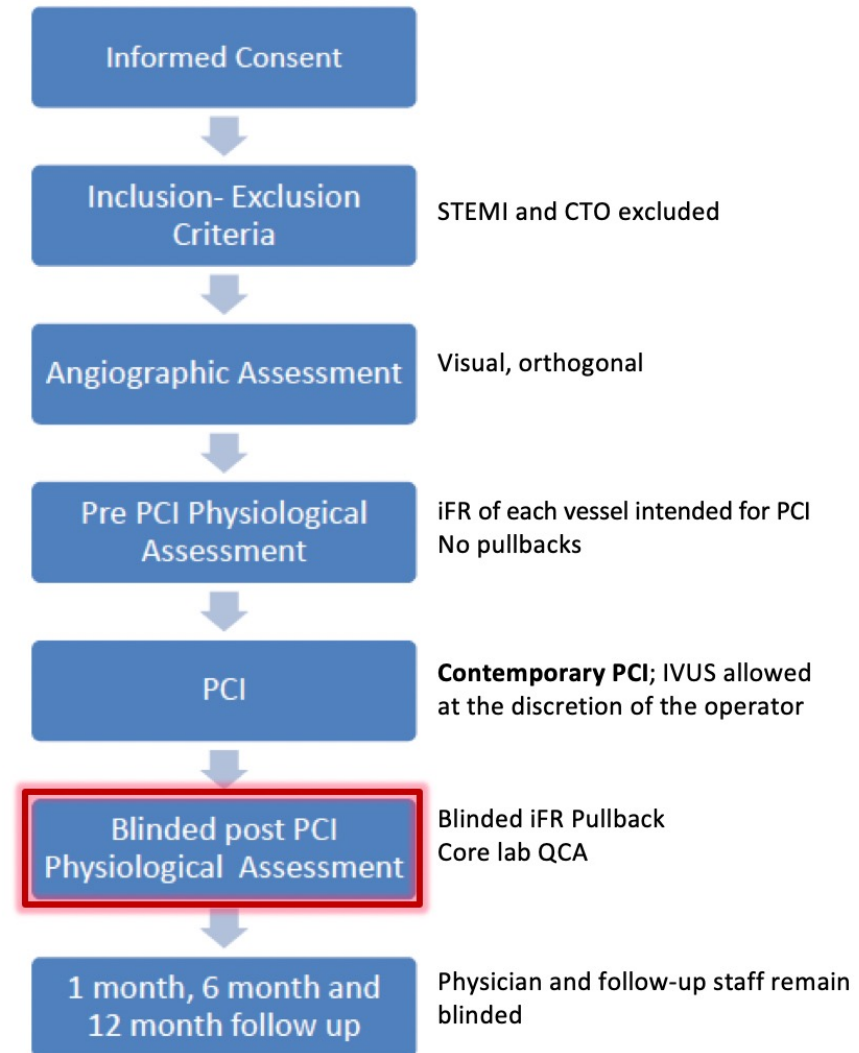


Defining ischemia and intervention



DEFINE PCI Study Design

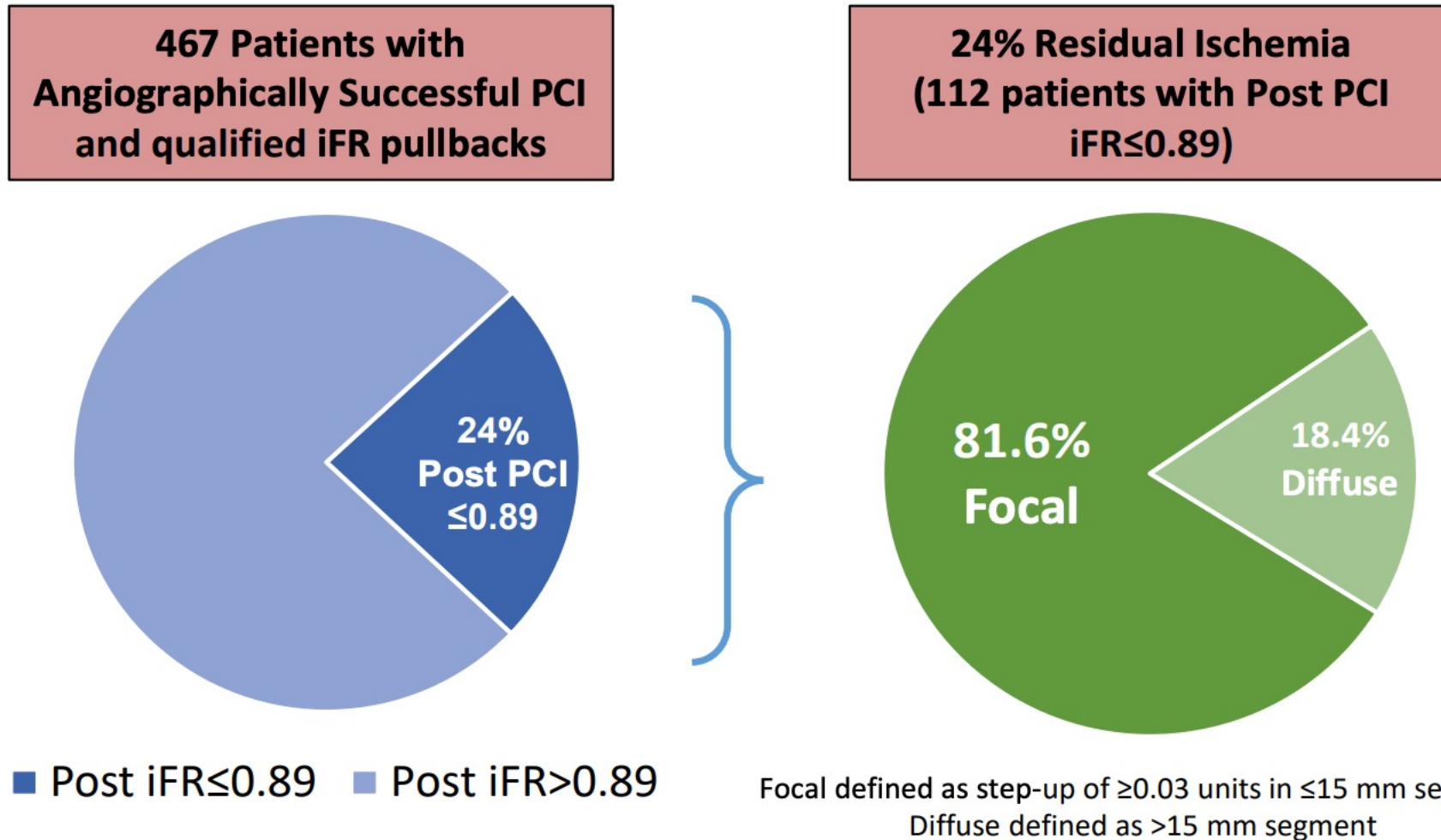
- Multi-center, prospective study in 22 US and 6 international centers
- 500 patients with CAD and iFR <0.90 in at least 1 coronary artery with tandem, diffuse, or multi-vessel intermediate lesions
- Standard of care algorithm for PCI
- Blinded iFR pullback added
- Primary endpoint: rate of residual ischemia (iFR<0.90) after operator-assessed angiographically successful PCI (residual DS<50% in any treated lesion)



Can you guess how many patients left the cath lab with excellent angiographic results yet an ischemic an iFR?



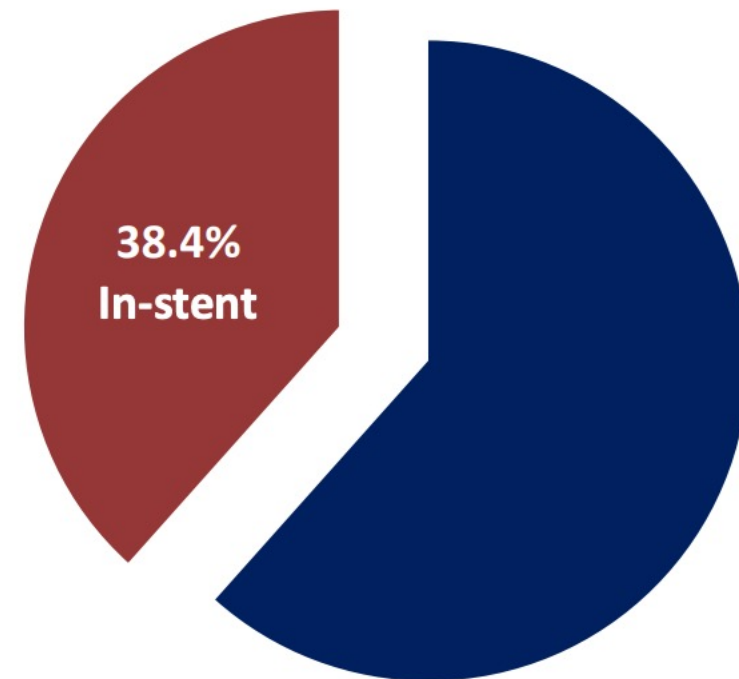
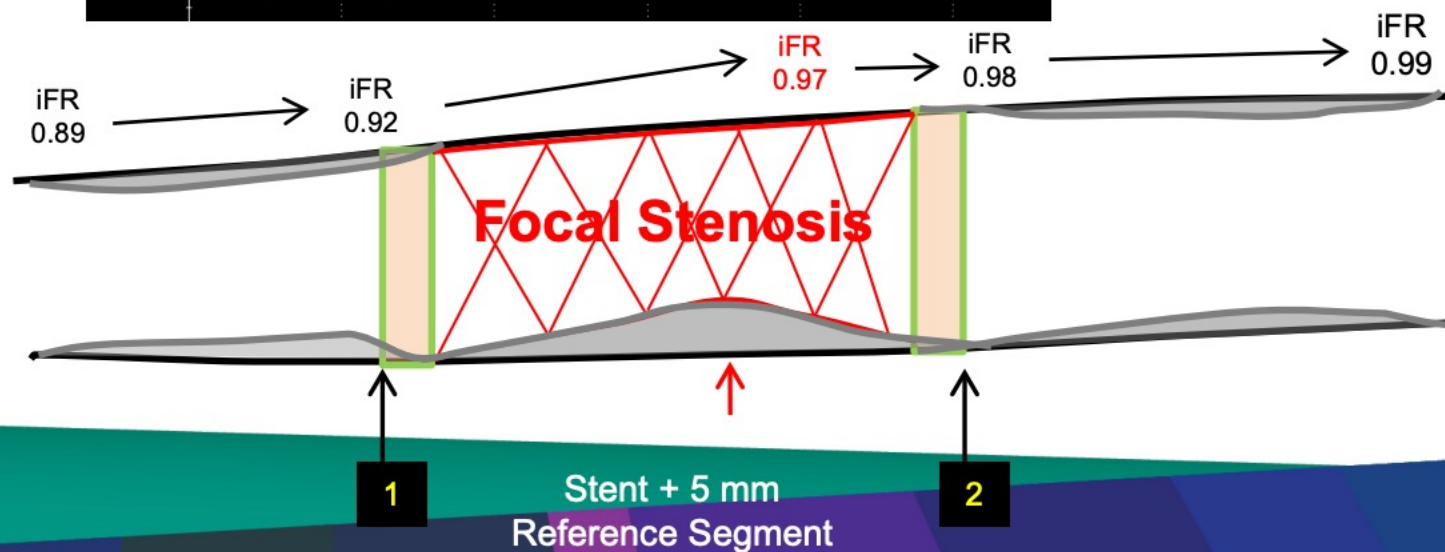
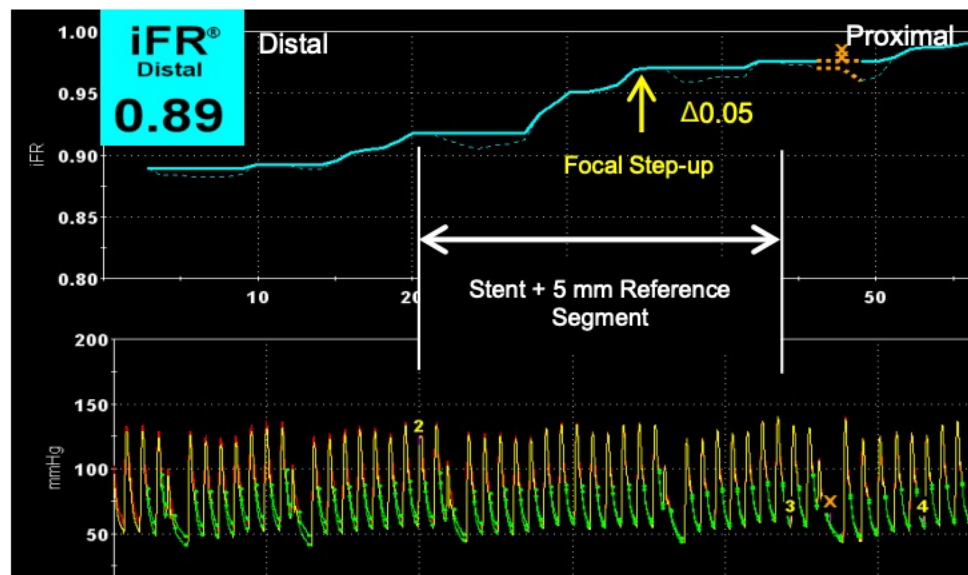
Primary Study Endpoint



Jeremias A. et al. Blinded physiological assessment of residual ischemia after successful angiographic percutaneous coronary intervention: The DEFINE PCI study. Presented at ACC 2019.

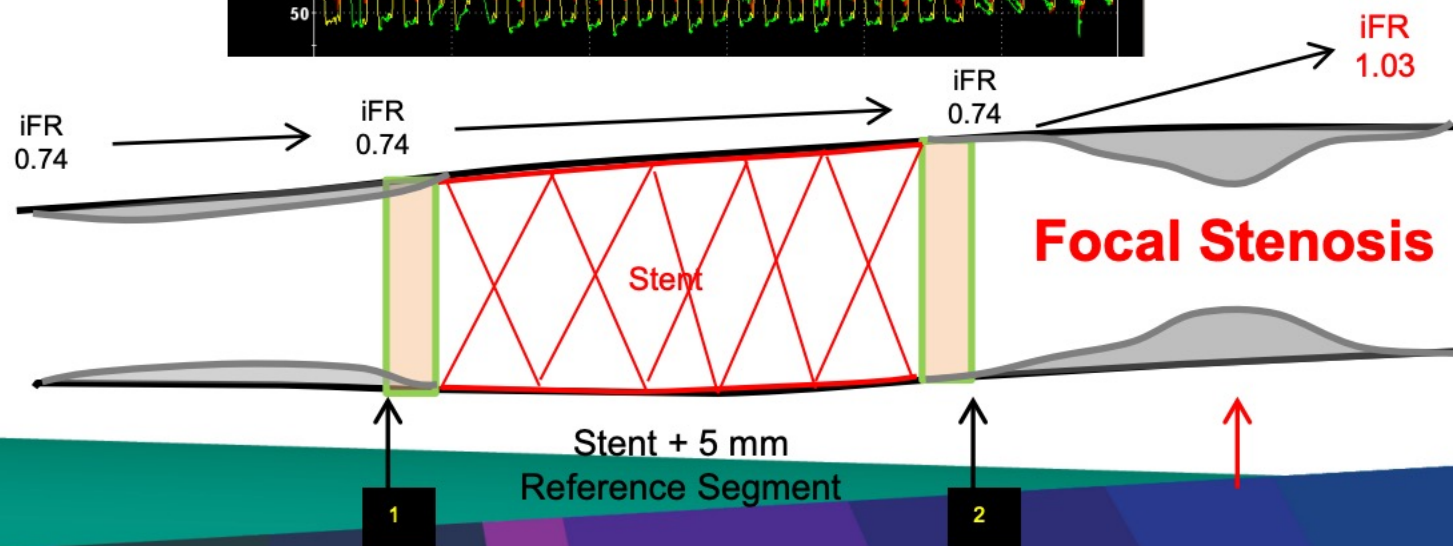
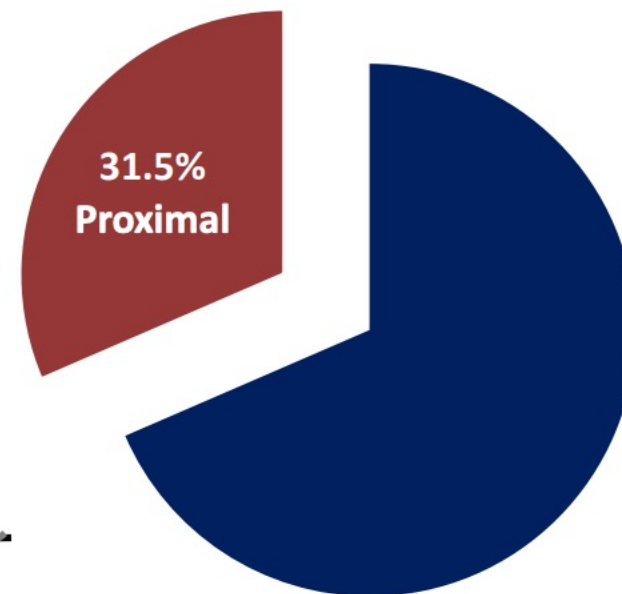
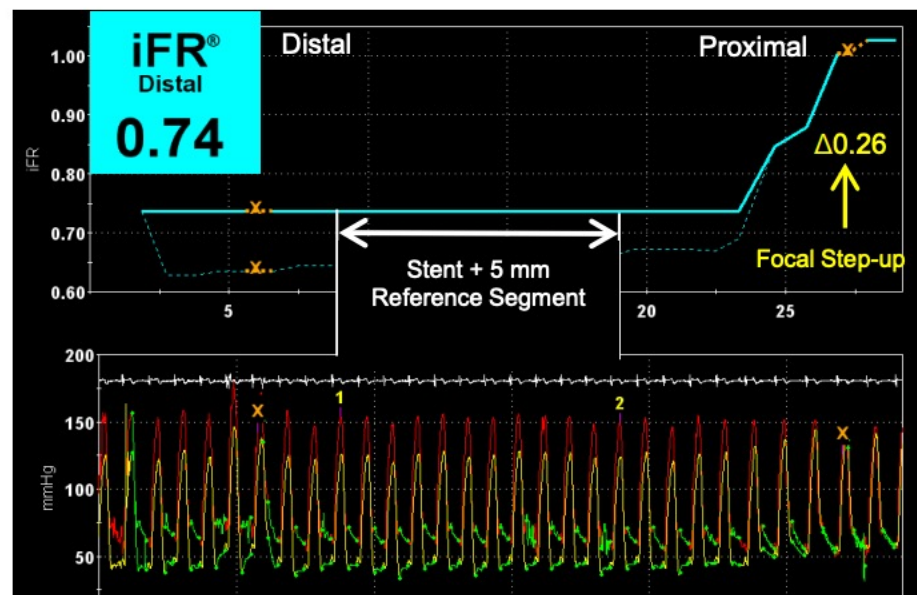
DEFINE PCI Focal Residual Pressure Gradient in-stent

Among the 93 vessels with focal disease, there were 146 segments (stent, proximal or distal) that had significant residual pressure gradients



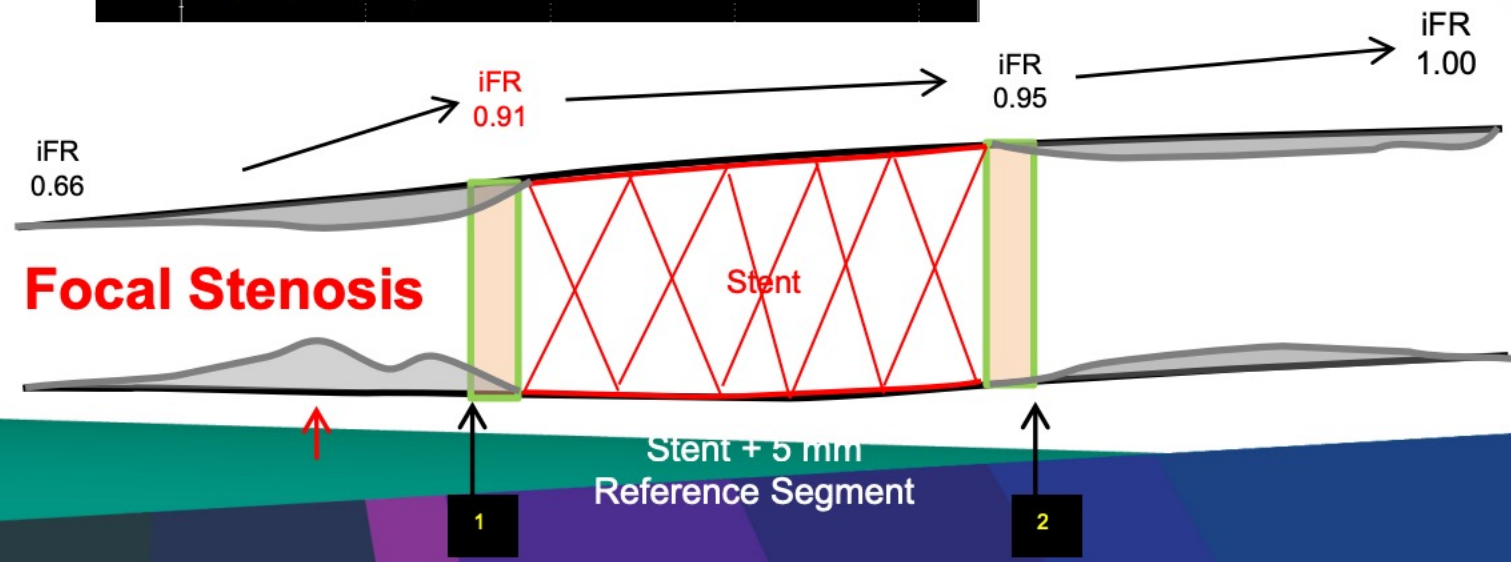
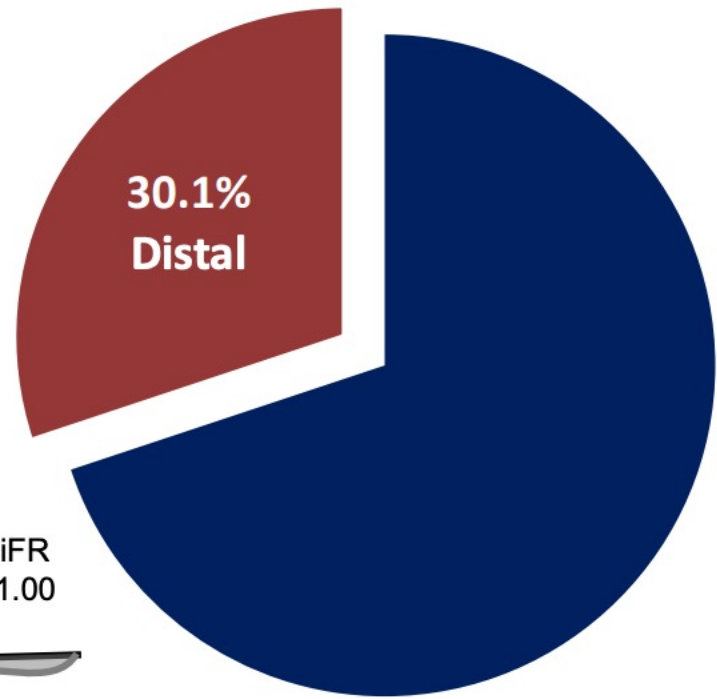
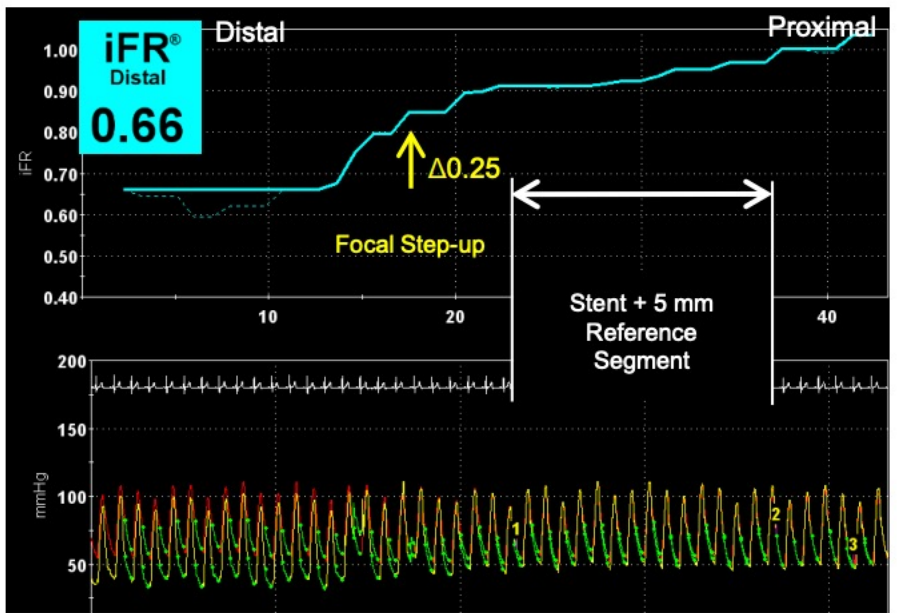
Focal Residual Pressure Gradient Prox to stent

'Physiologic miss' occurred in 31.5% of focal lesions proximally



Focal Residual Pressure Gradient Distal to stent

'Physiologic miss' occurred in 30.1% of focal lesions distally



1-Year Outcomes of Patients with Residual Physiologic Ischemia After Percutaneous Coronary Intervention: The DEFINE PCI Trial

Manesh Patel, Allen Jeremias, Justin Davies, Akiko Maehara, Mitsuaki Matsumura, Arnold Seto, Habib Samady, Andrew Sharp, Joel Schneider, Kare Tang, Ziad Ali, Suneel Talwar, and Gregg W. Stone on behalf of the DEFINE PCI Investigators

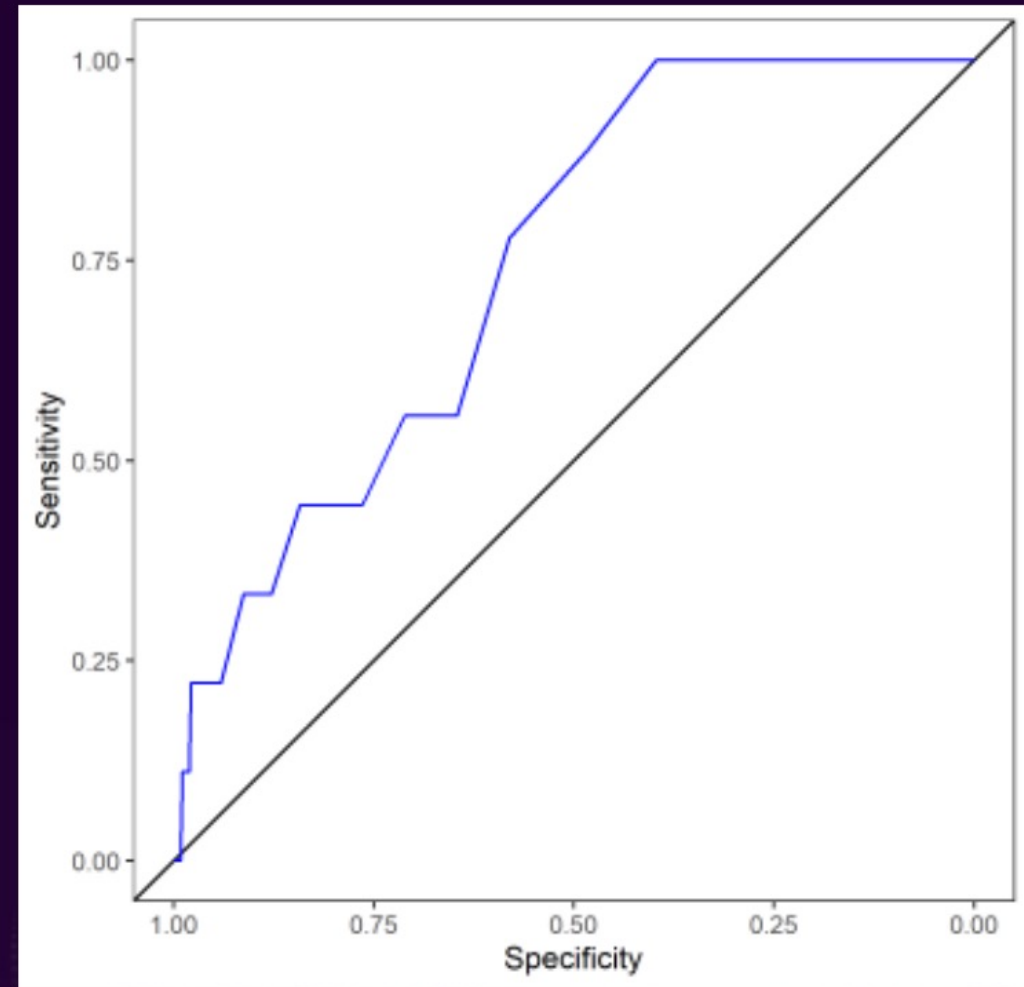


Identification of Post PCI iFR Target

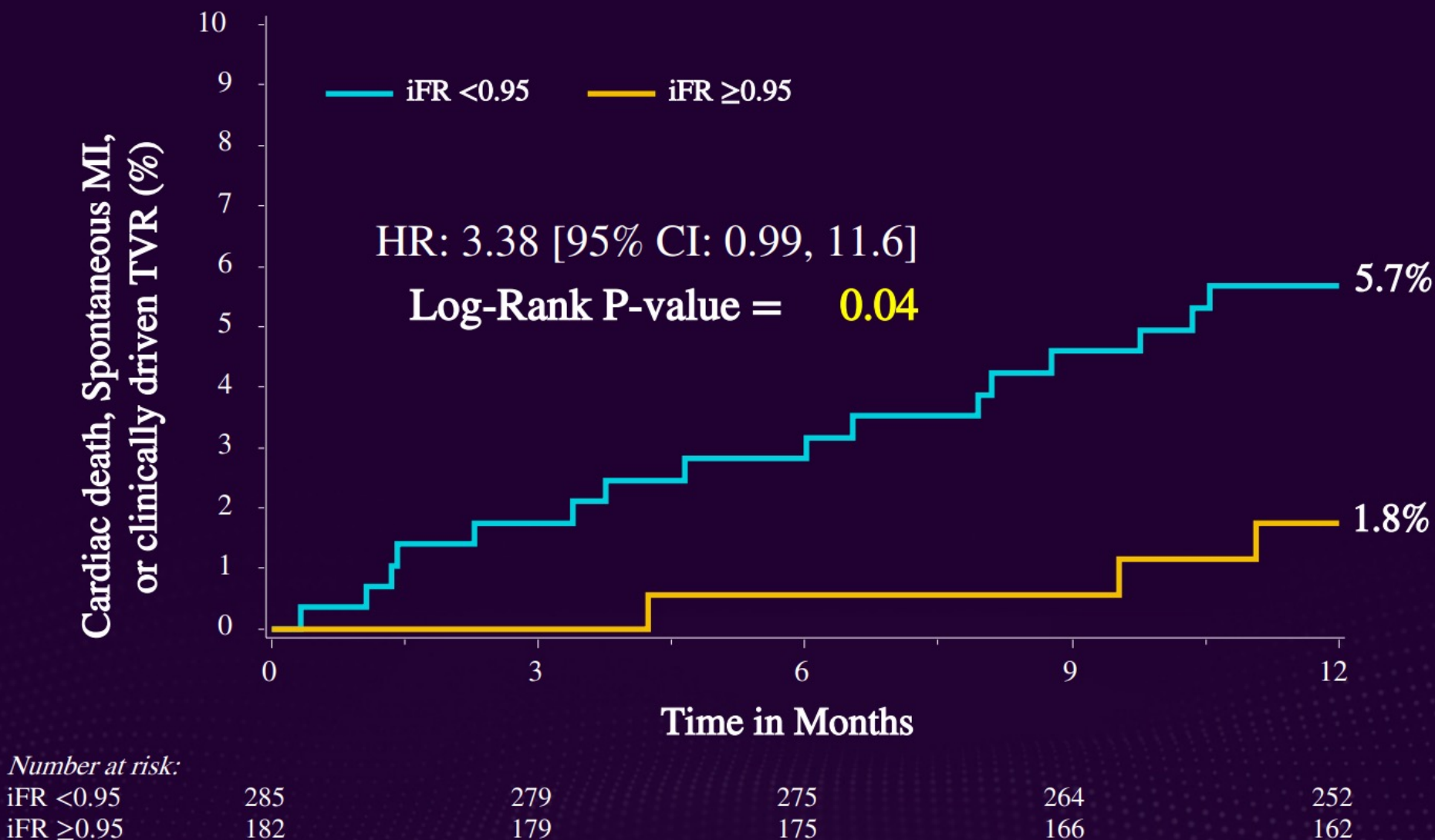
Cardiac Death or Spontaneous MI

Cut-off value **< 0.95**

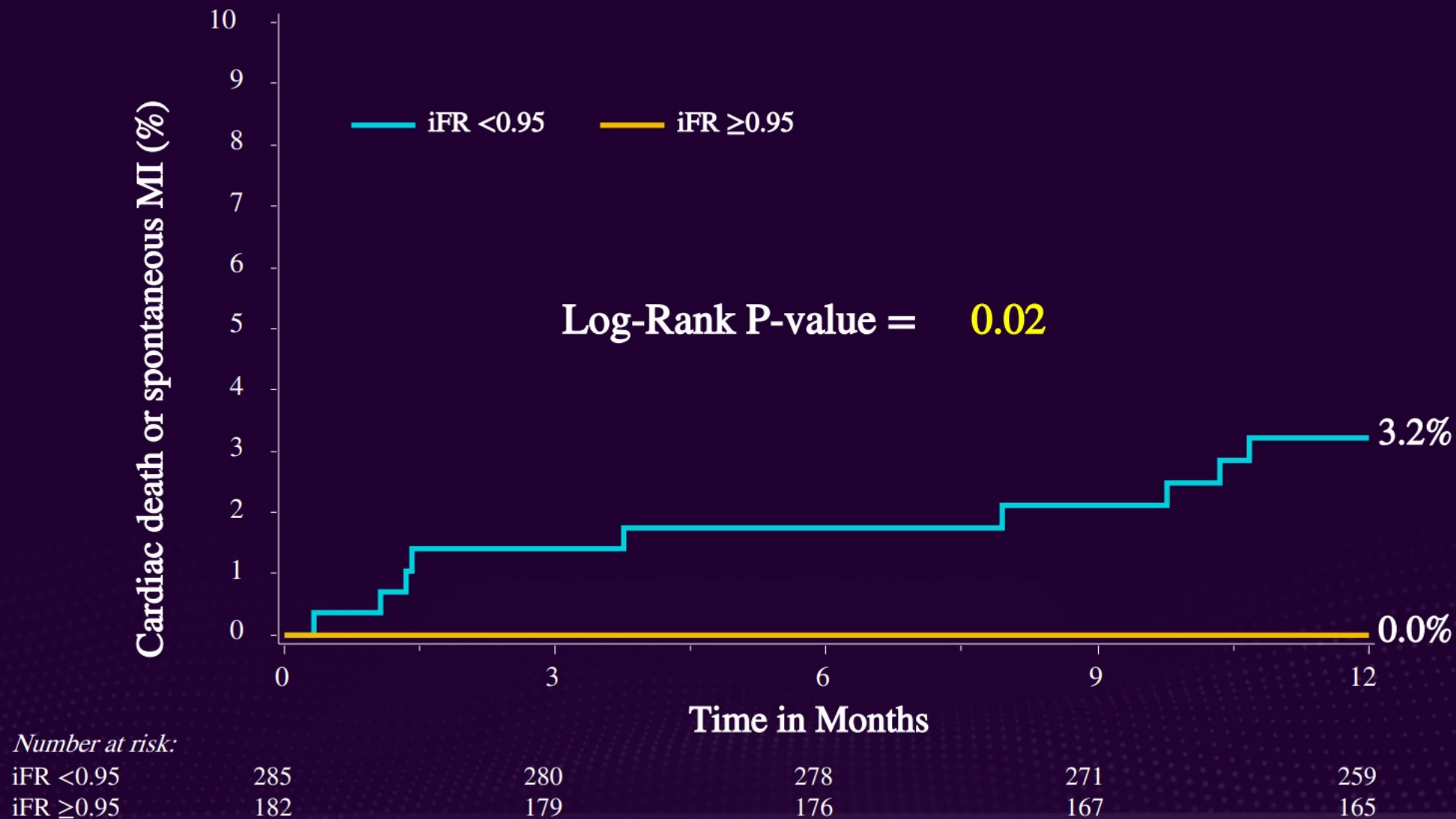
AUC (95%CI)=0.74 (0.61, 0.88)



Cardiac Death, Spontaneous MI, or Clinically Driven TVR



Cardiac Death or Spontaneous MI (%)



What about Imaging?

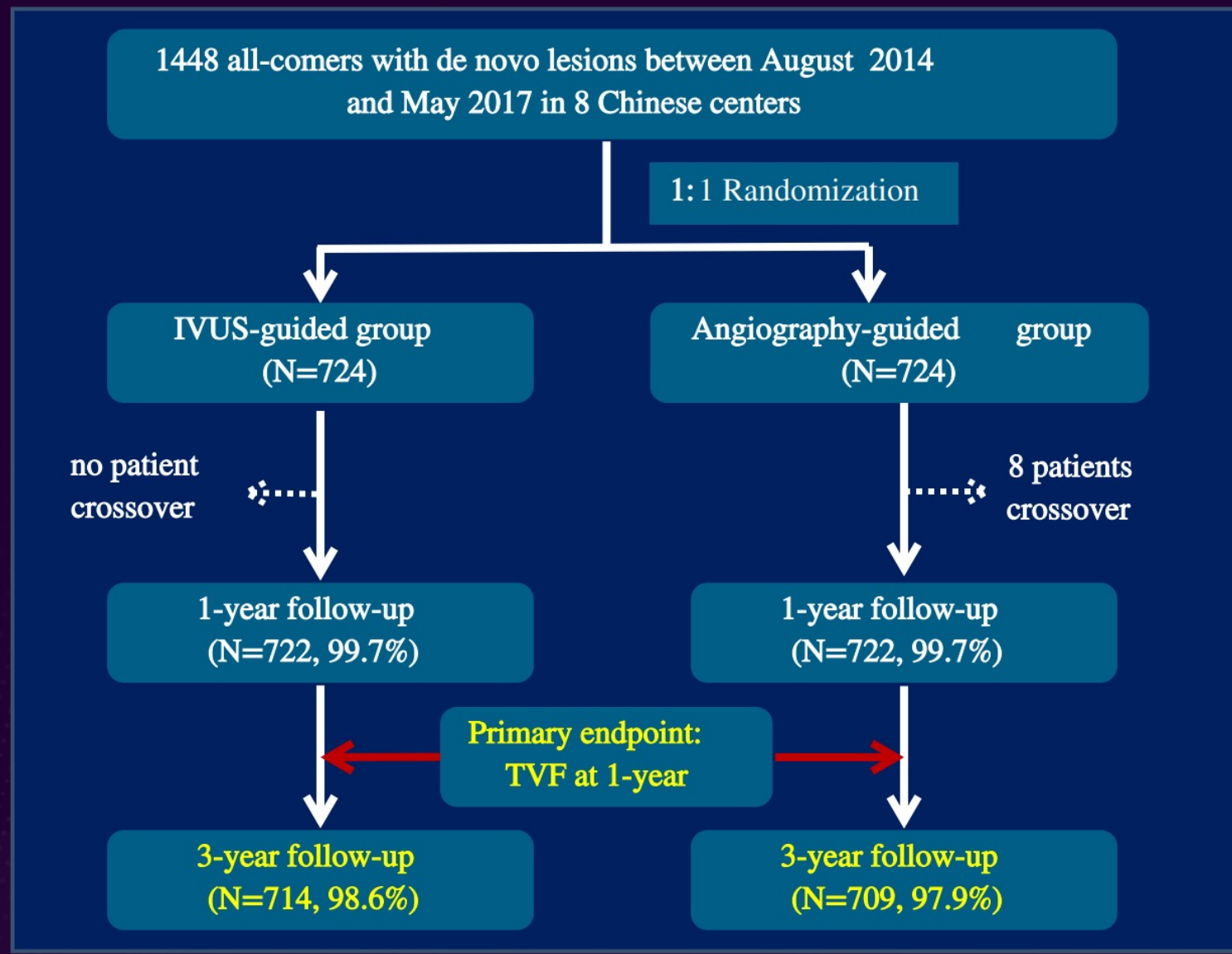
Three-Year Outcomes of the ULTIMATE Trial Comparing Intravascular Ultrasound Versus Angiography-Guided Drug- Eluting Stent Implantation

Jun-Jie Zhang, Shao-Liang Chen

Nanjing First Hospital, Nanjing Medical University

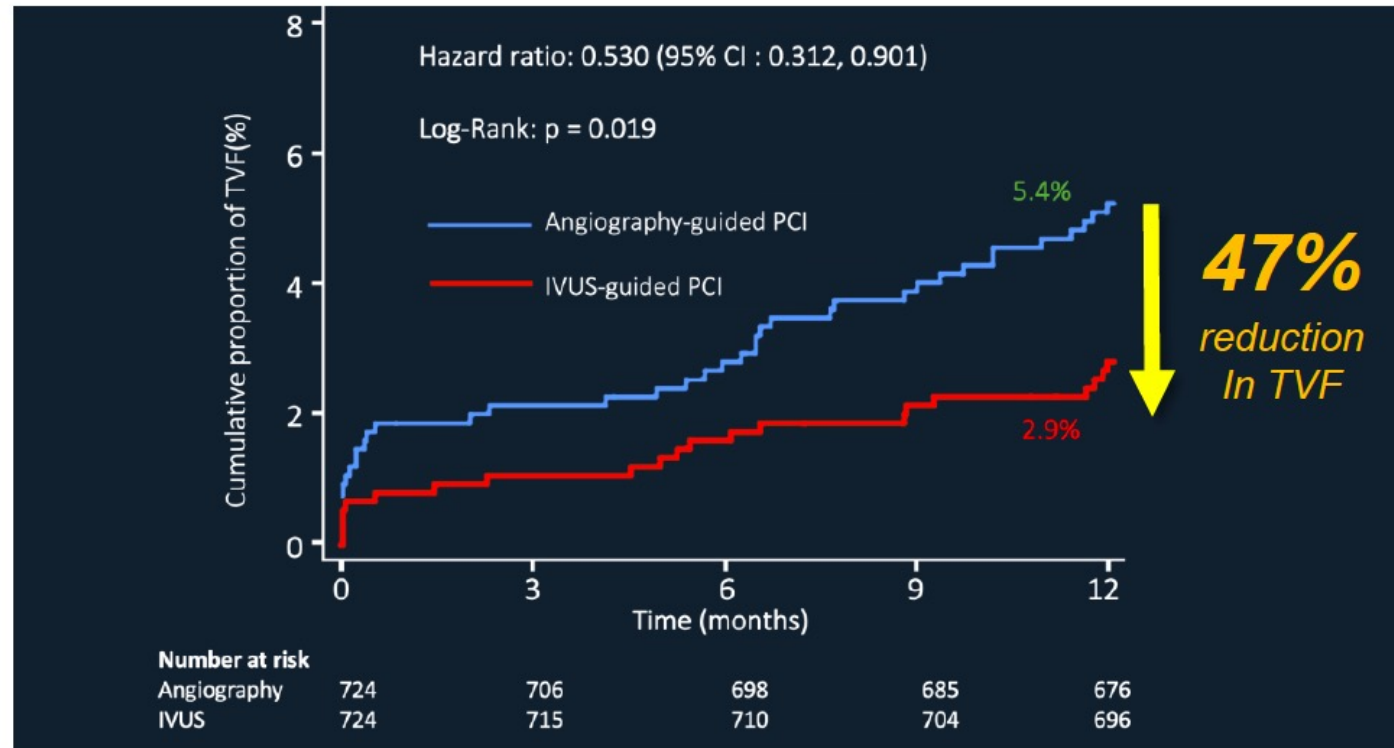
On behalf of ULTIMATE investigators

Study Flowchart

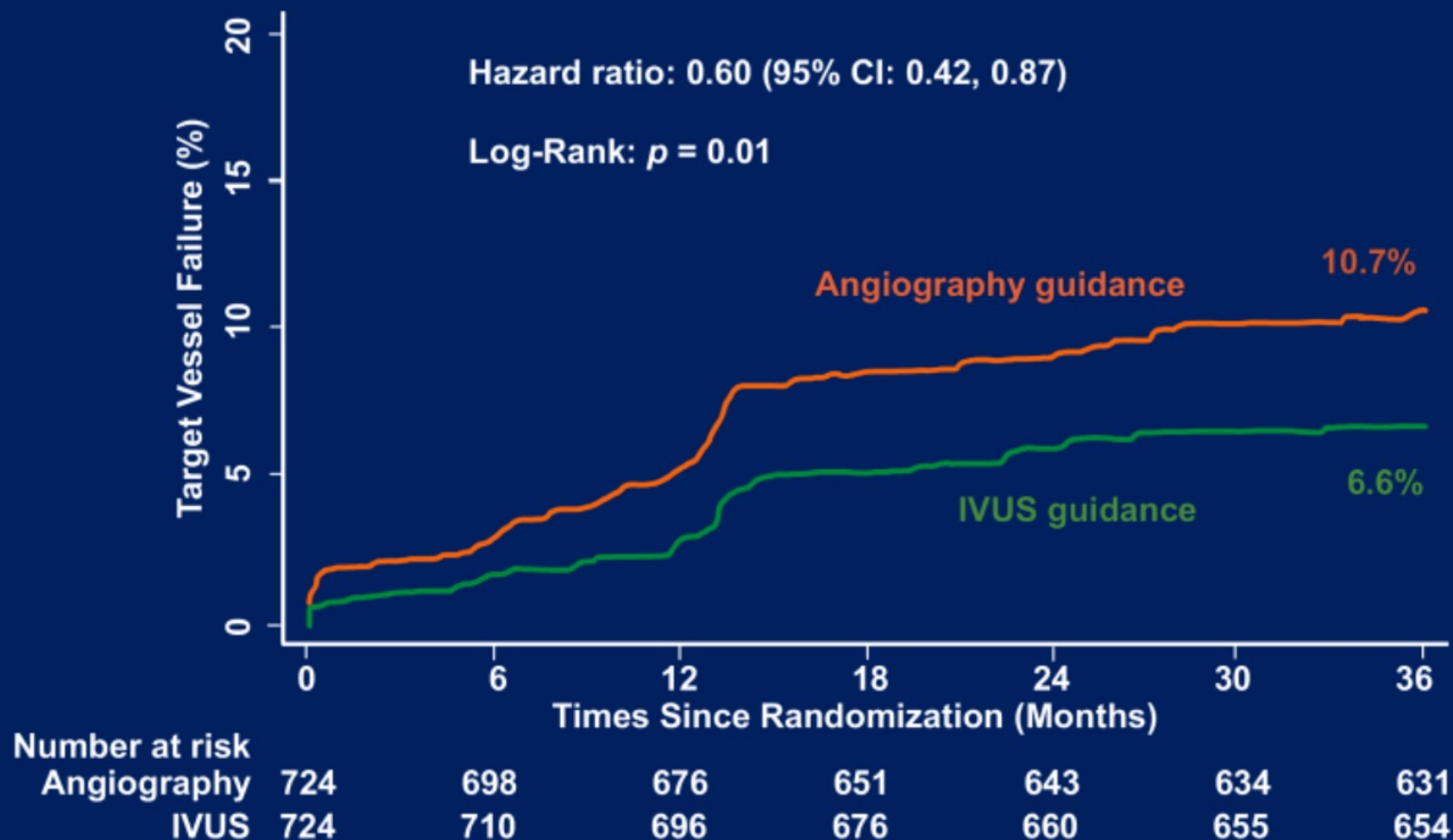


Primary Endpoint

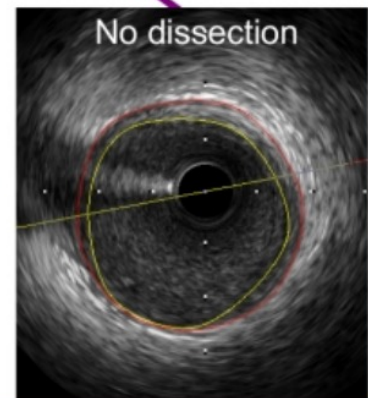
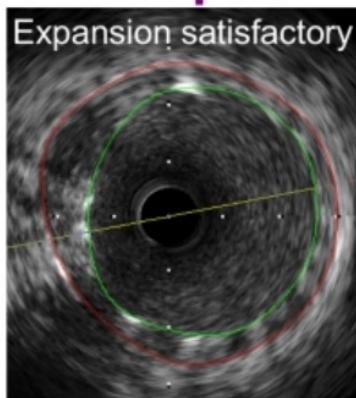
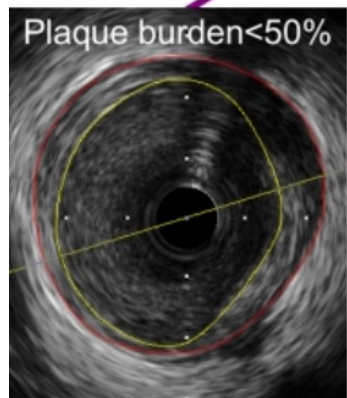
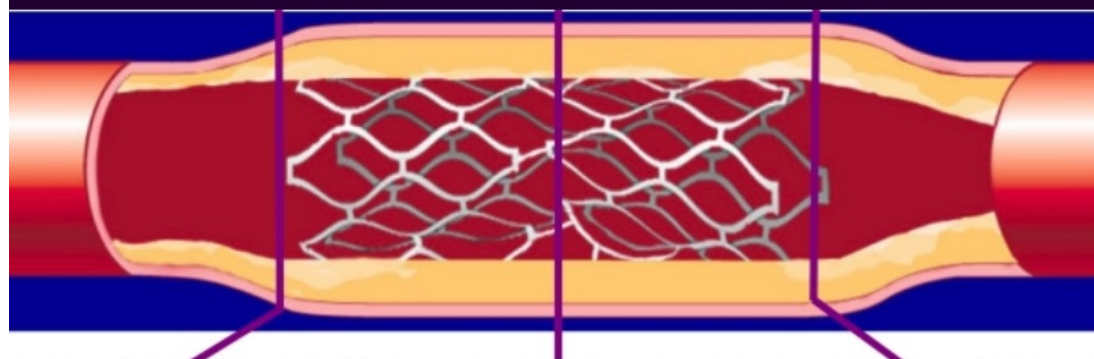
TVF at 12 months



3-year Clinical FU

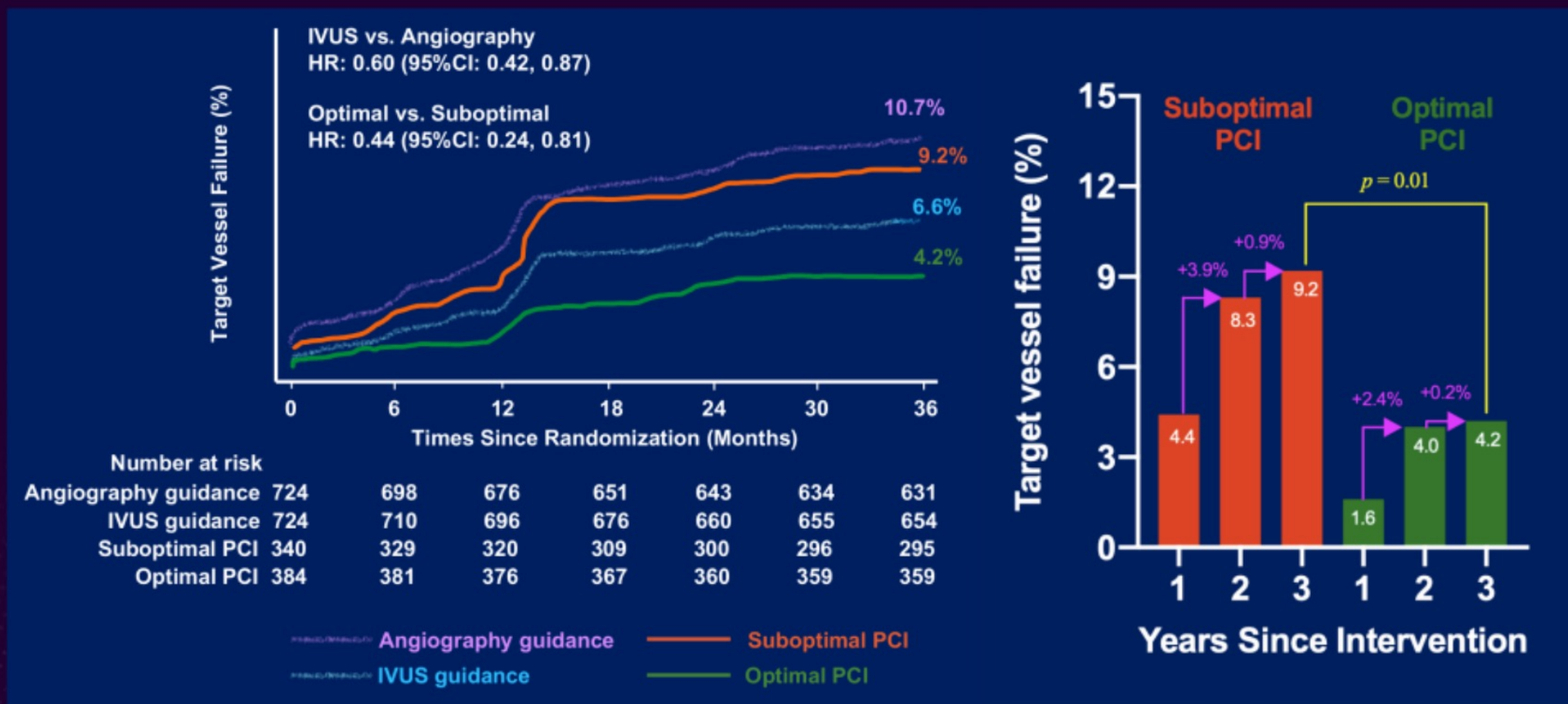


IVUS-defined Criteria for The Optimal Stent Deployment



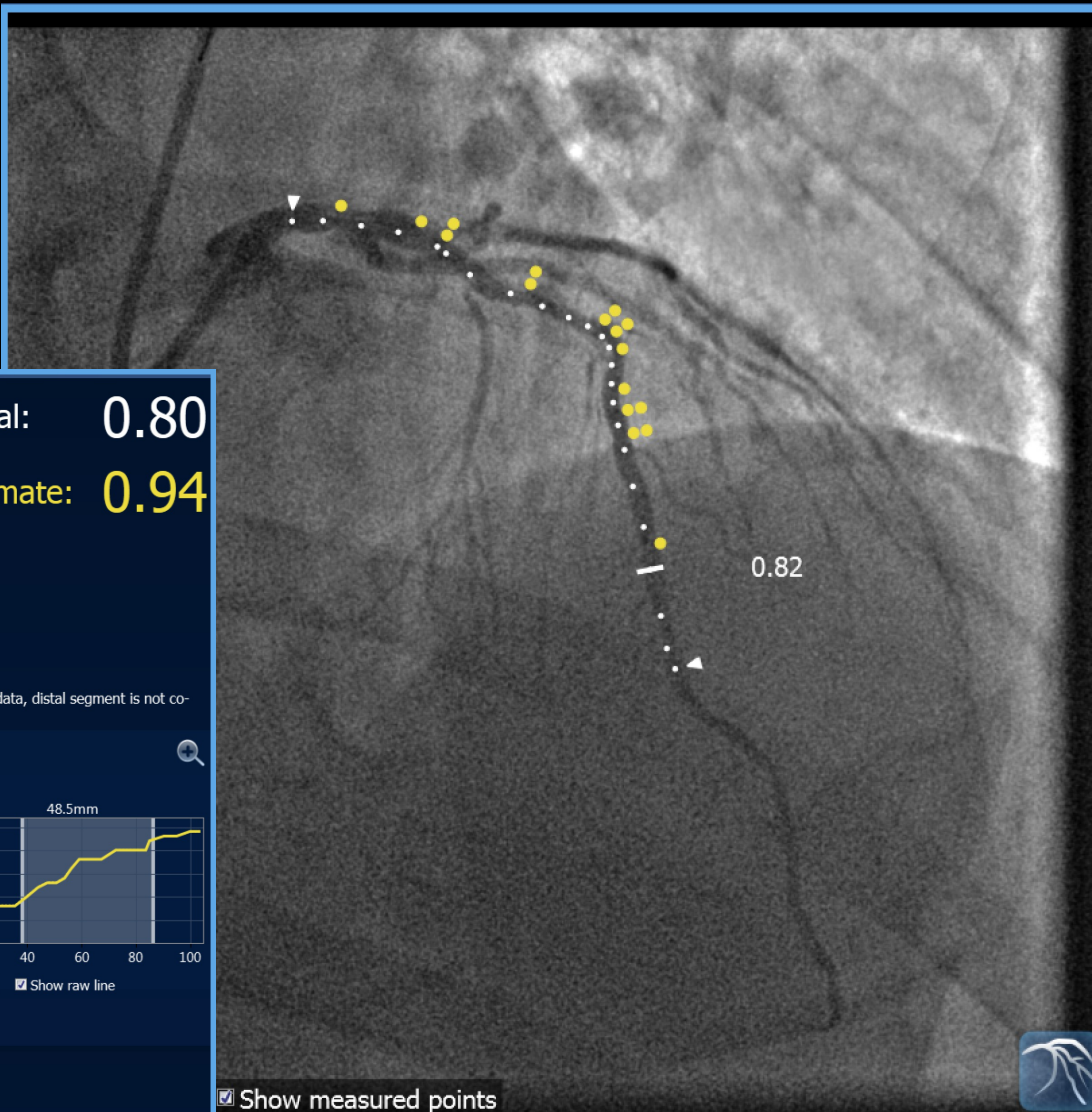
1. *Minimal lumen CSA in stented segment $>5.0 \text{ mm}^2$, or 90% of distal reference lumen CSA;*
2. *Plaque burden at the 5-mm proximal or distal to the stent edge $<50\%$;*
3. *no edge dissection involving media with length $>3\text{mm}$.*

Suboptimal vs. Optimal PCI



How can we utilize all the tools
to achieve the best outcomes?

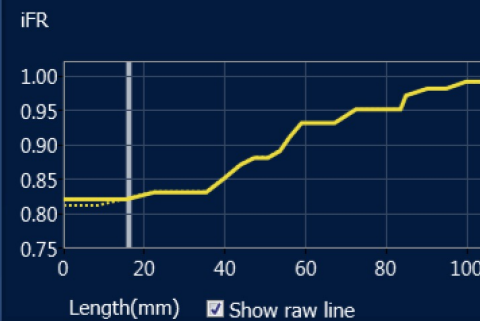
Co-registration



iFR Distal: 0.80

iFR at Cursor: 0.82

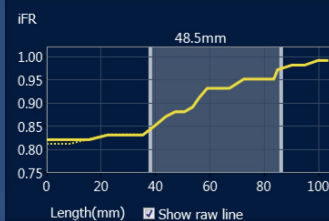
⚠ Insufficient data, distal segment is not co-registered



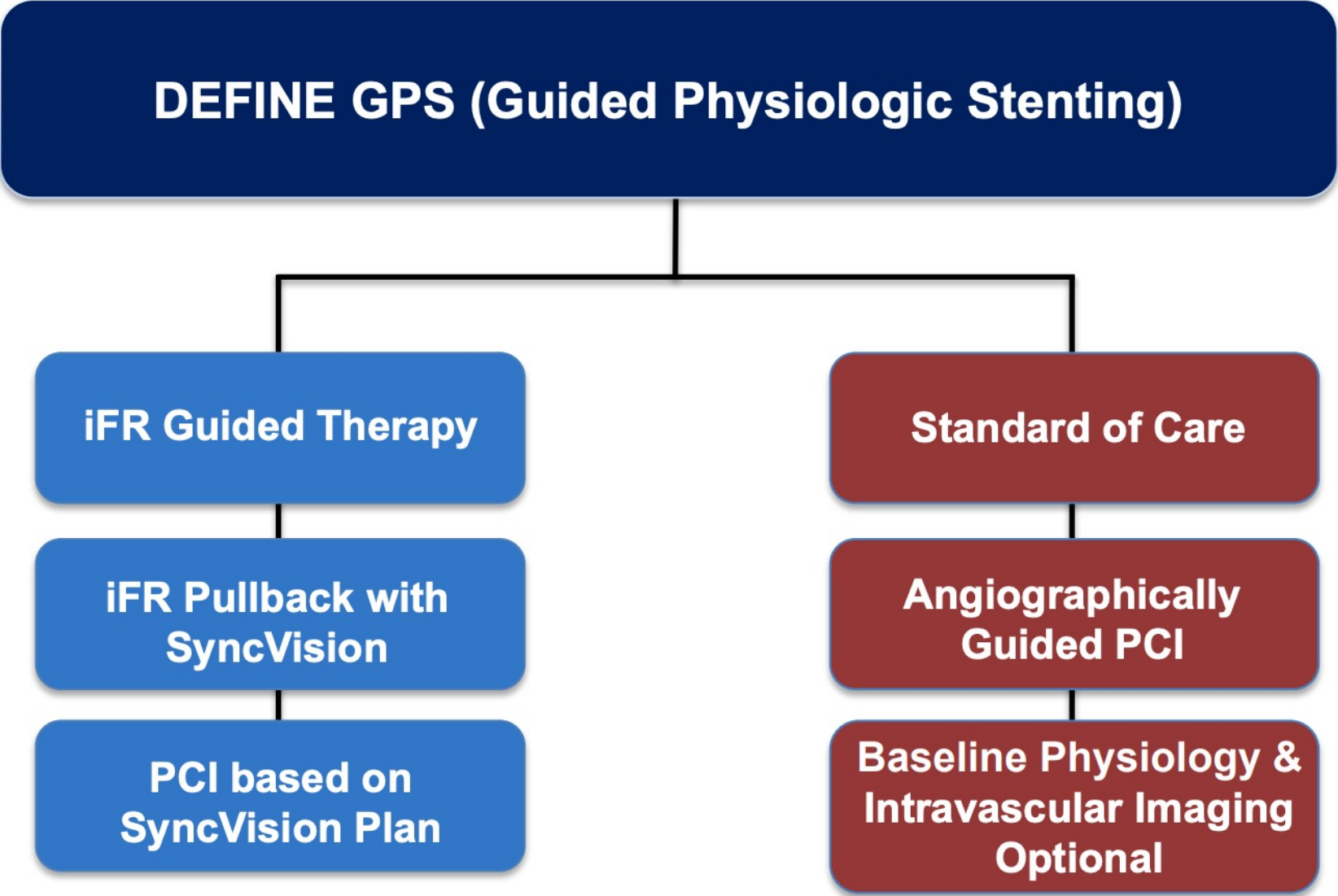
iFR Distal: 0.80

iFR Estimate: 0.94

⚠ Insufficient data, distal segment is not co-registered



DEFINE GPS (Guided Physiologic Stenting)



```
graph TD; GPS[DEFINE GPS Guided Physiologic Stenting] --> iFR[iFR Guided Therapy]; GPS --> SOC[Standard of Care]; iFR --> iFR_PV[iFR Pullback with SyncVision]; iFR_PV --> PCI_PV[PCI based on SyncVision Plan]; SOC --> AG_PCI[Angiographically Guided PCI]; AG_PCI --> BP_OI[Baseline Physiology & Intravascular Imaging Optional];
```

iFR Guided Therapy

**iFR Pullback with
SyncVision**

**PCI based on
SyncVision Plan**

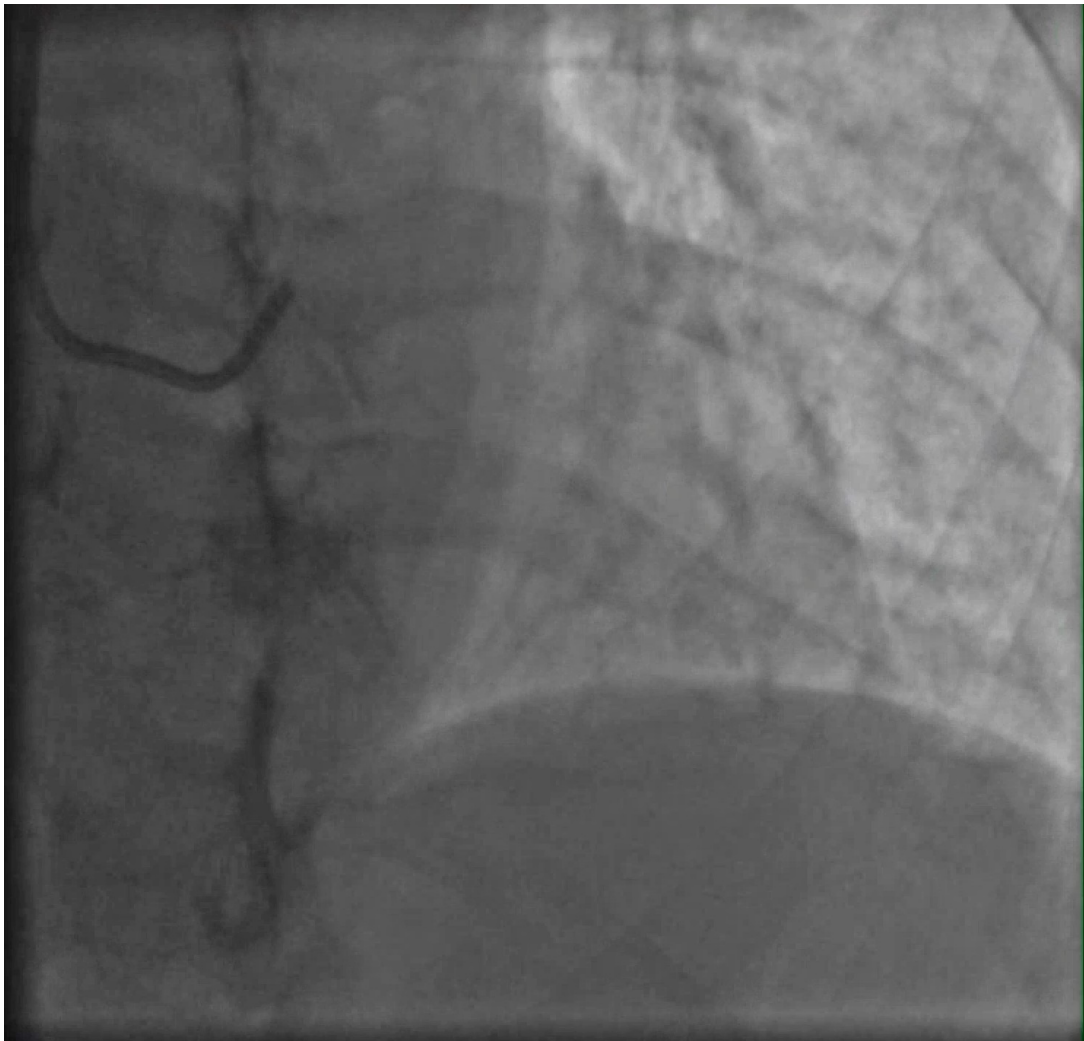
Standard of Care

**Angiographically
Guided PCI**

**Baseline Physiology &
Intravascular Imaging
Optional**



- 82 yr old female with chest pain
 - HTN
 - DM
 - DLD
 - CKD, Cr 2.4, GFR 31
 - Abnormal stress test with anterior ischemia
 - Underwent diagnostic cardiac catheterization which revealed a 70% long proximal to mid LAD lesion
 - Given elevated Cr, and low GFR, PCI of LAD was staged.
 - 10 days later, here for PCI, Cr 2.3
 - Hydration protocol started upon arrival, NS liter bag over 4 hrs.



PRIORITY <=FF		ADDRESSEE(S)	
FILING TIME		ORIGINATOR	<=
SPECIFIC IDENTIFICATION OF ADDRESSEE(S) AND / OR ORIGINATOR			
3 MESSAGE TYPE <=(FPL	7 AIRCRAFT IDENTIFICATION	8 FLIGHT RULES	TYPE OF FLIGHT <=
9 NUMBER	TYPE OF AIRCRAFT	WAKE TURBULENCE CAT.	10 EQUIPMENT <=
13 DEPARTURE AERODROME	TIME		<=
15 CRUISING SPEED	LEVEL	ROUTE	
16 DESTINATION AERODROME		TOTAL EET HR MIN	ALTN AERODROME 2ND ALTN AERODROME <=
18 OTHER INFORMATION			
SUPPLEMENTARY INFORMATION (NOT TO BE TRANSMITTED IN FPL MESSAGES)			
19 ENDURANCE HR MIN	PERSONS ON BOARD	EMERGENCY RADIO UHF VHF ELBA	
E/	P/	R/	
SURVIVAL EQUIPMENT POLAR DESERT MARITIME JUNGLE		JACKETS LIGHT FLUORES UH VHF	
DINGHIES NUMBER CAPACITY COVER		COLOR	
D/	<=		
AIRCRAFT COLOR AND MARKINGS			
A/			
REMARKS			
N/	<=		
PILOT-IN-COMMAND			
C/	)<=		
FILED BY	ACCEPTED BY	ADDITIONAL INFORMATION	

Considerations

- Identify projections that will be helpful to isolate the lesion from the diagnostic cath.
- 50/50 Saline contrast injections
 - 2 baseline images taken (8 cc)
 - Caudal view was taken first and this view second
- LAO cranial was best in this case based on diagnostic cath.
- This was the view chosen for co-registration

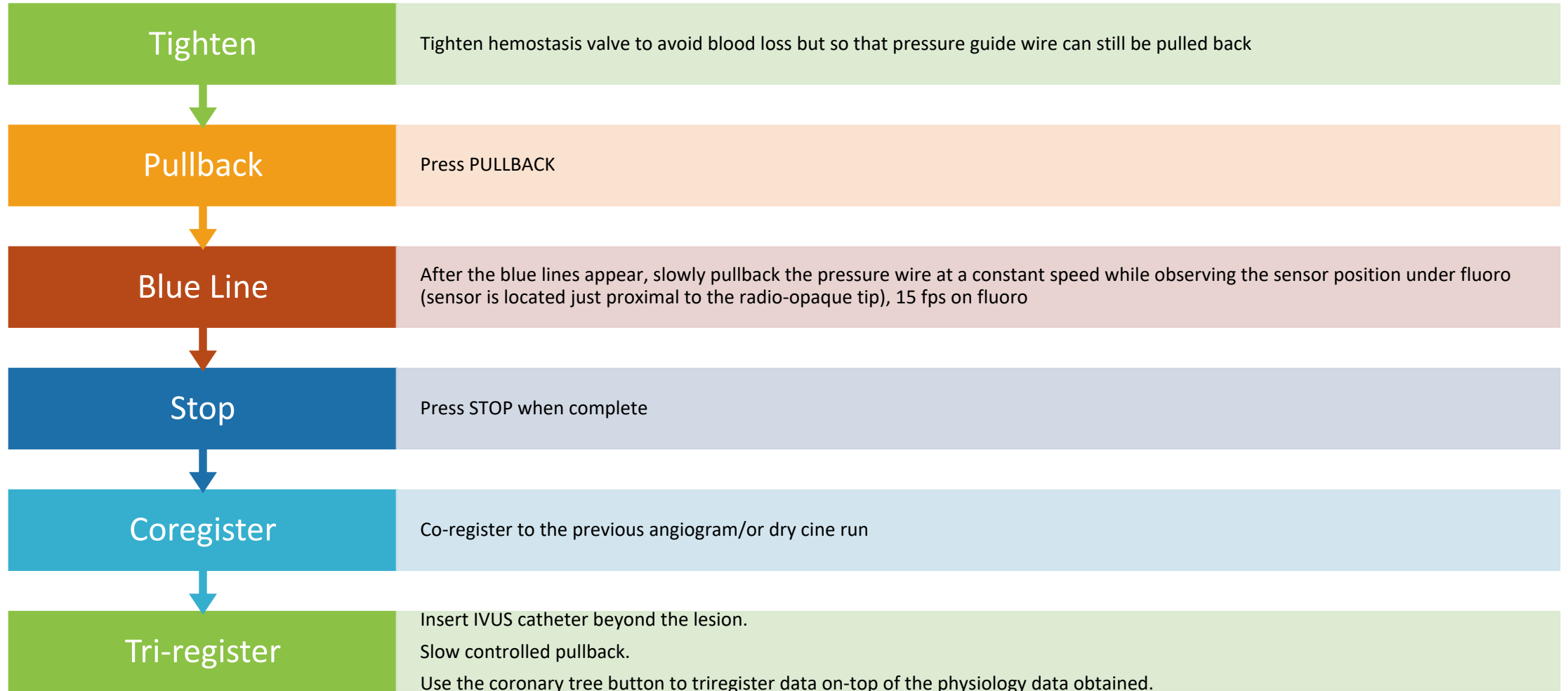




Planning and optimizing the PCI

- Access: Distal radial access
- Heparin with ACT >250 (when collecting ACT, pull back contrast from guide, return to reservoir)
- Equipment:
 - EBU 3.5, 6fr guide
 - Omniwire, iFR of the LAD to plan and perform PCI
- LVEDP – 11 mmHg, normal
- 2 baseline pictures (50/50 contrast saline) 8 ccs of contrast, caudal first and the "co-registration view" second
- iFR pullback to guide PCI, with co-registration to the previous angiogram (did not move the gantry or the patient). **(Panel A)**
- **If not, a dry cine can be used to co-register.**
- IVUS pullback with co-registration to the iFR and angiogram (Tri-reg). **(Panel B)**

Steps recording iFR pullback/iFR co-registration



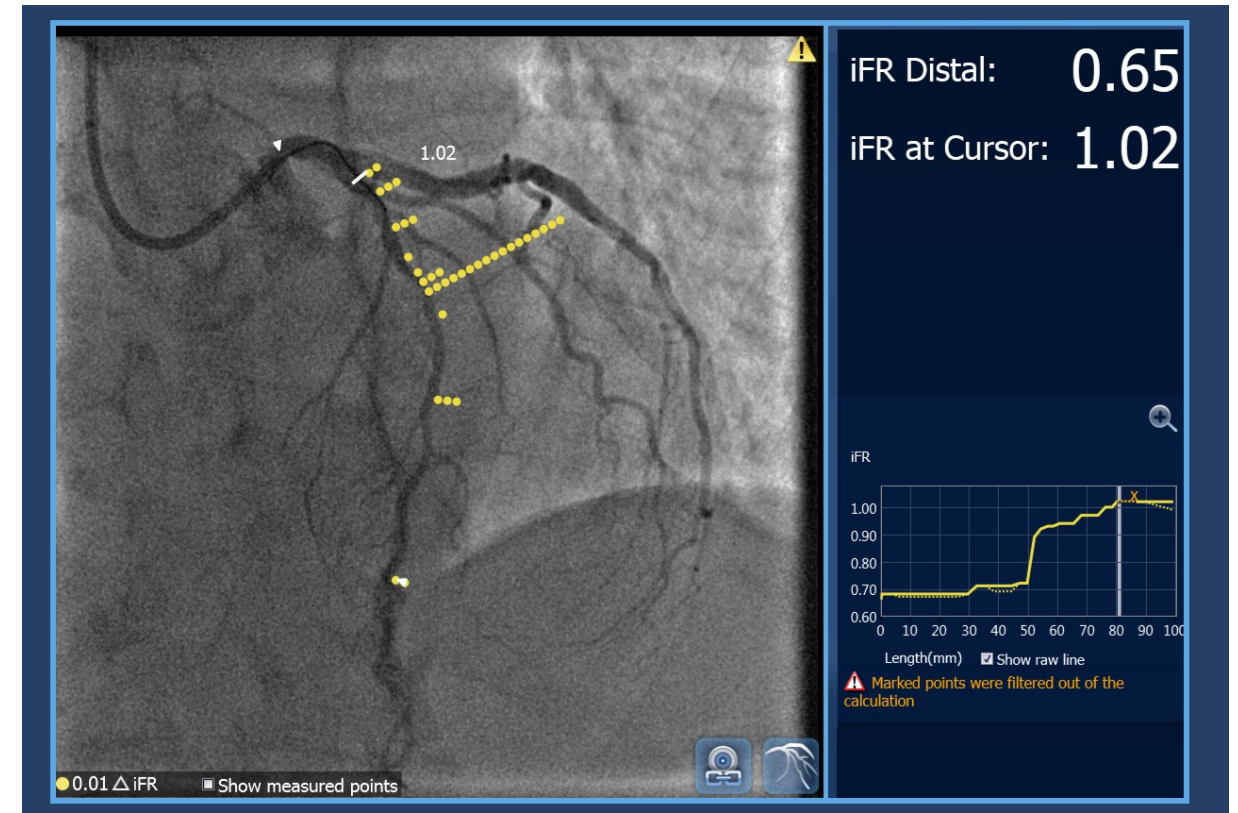




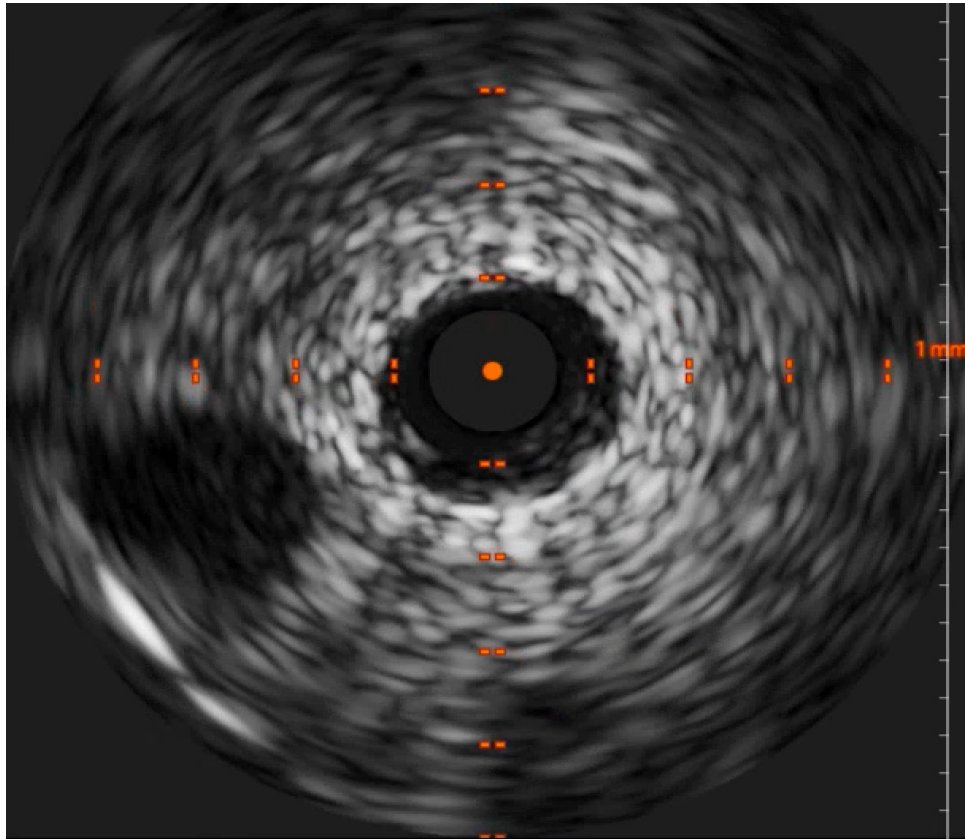
iFR Pre



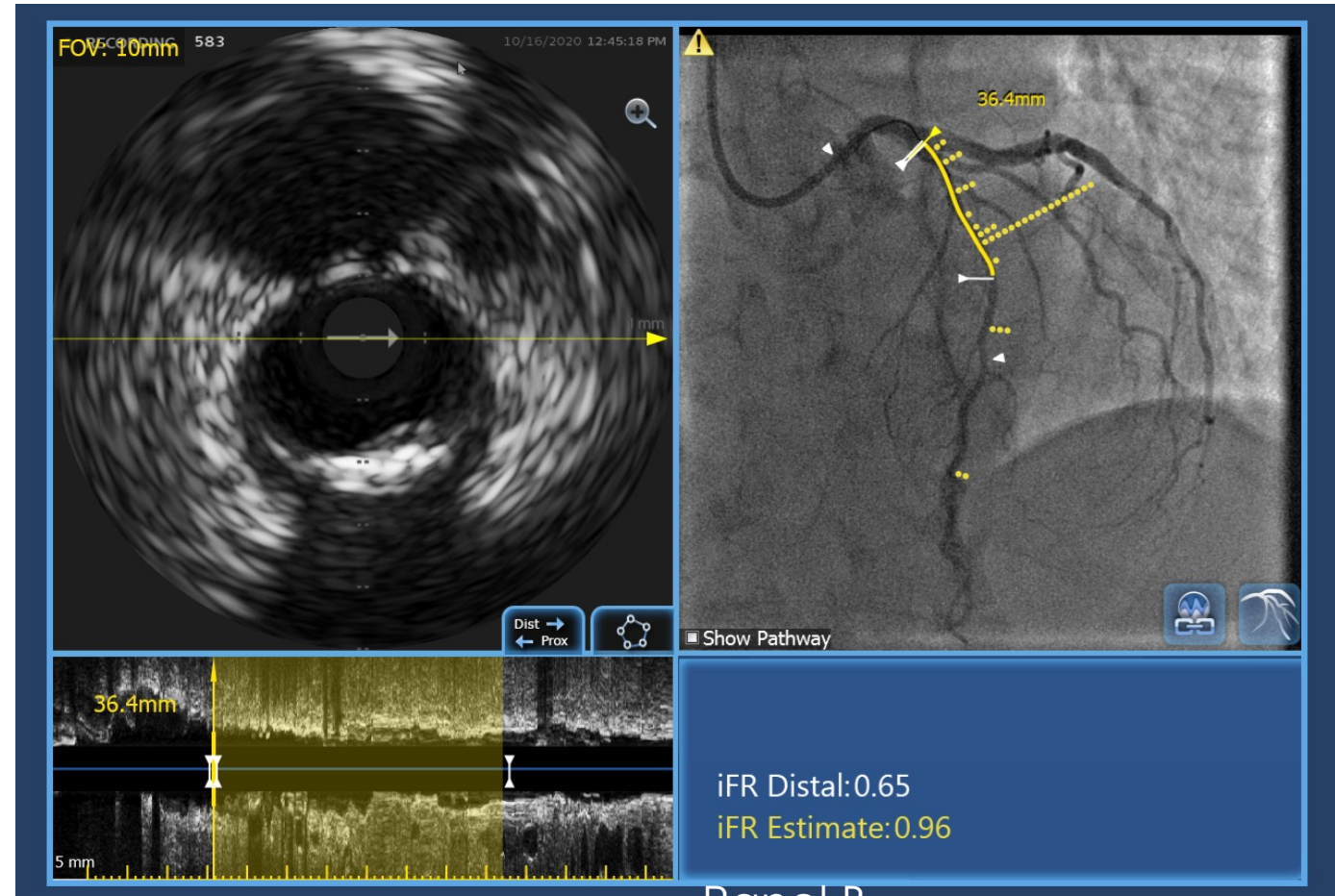
Physiology Co-registration



IVUS

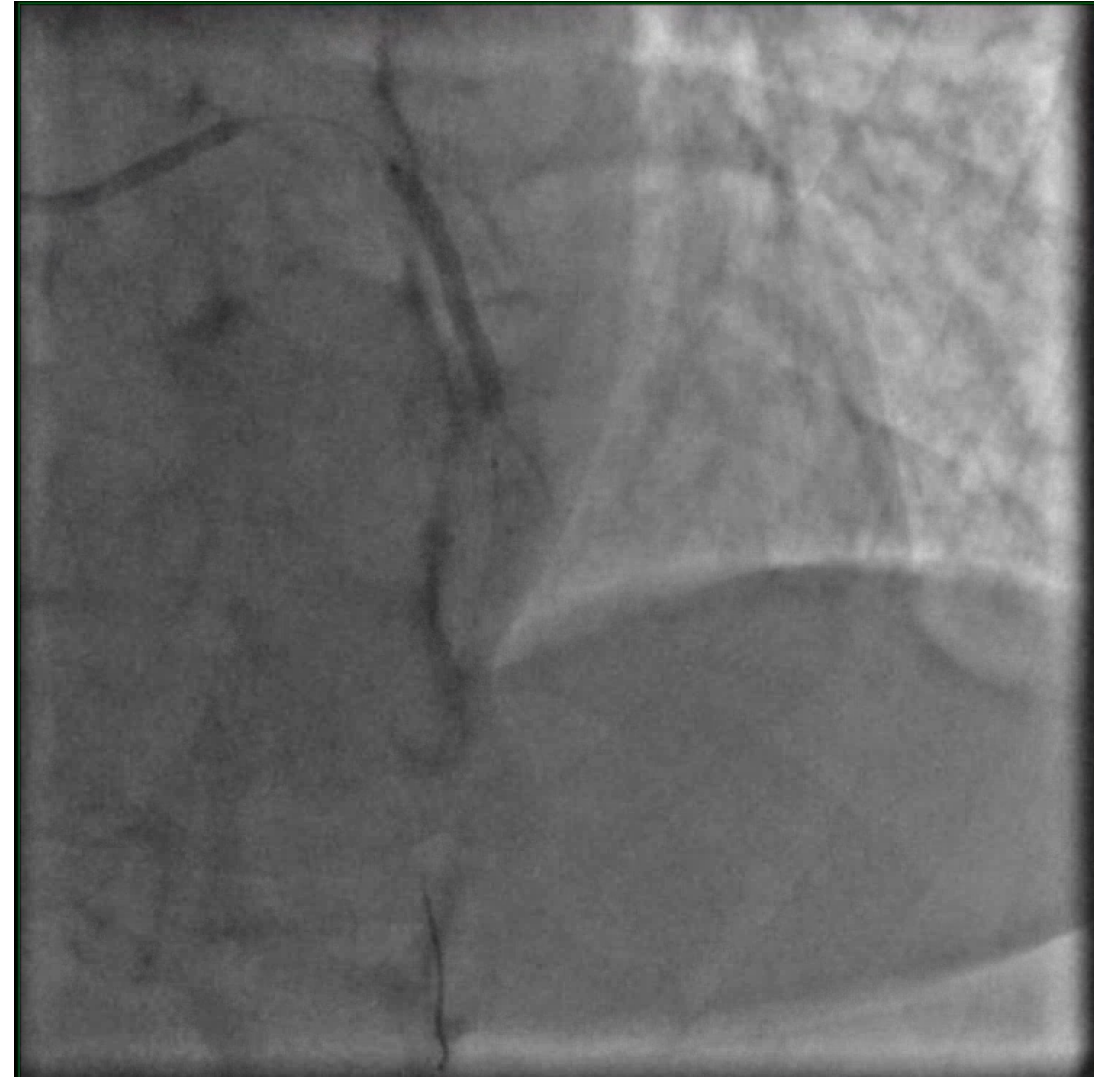


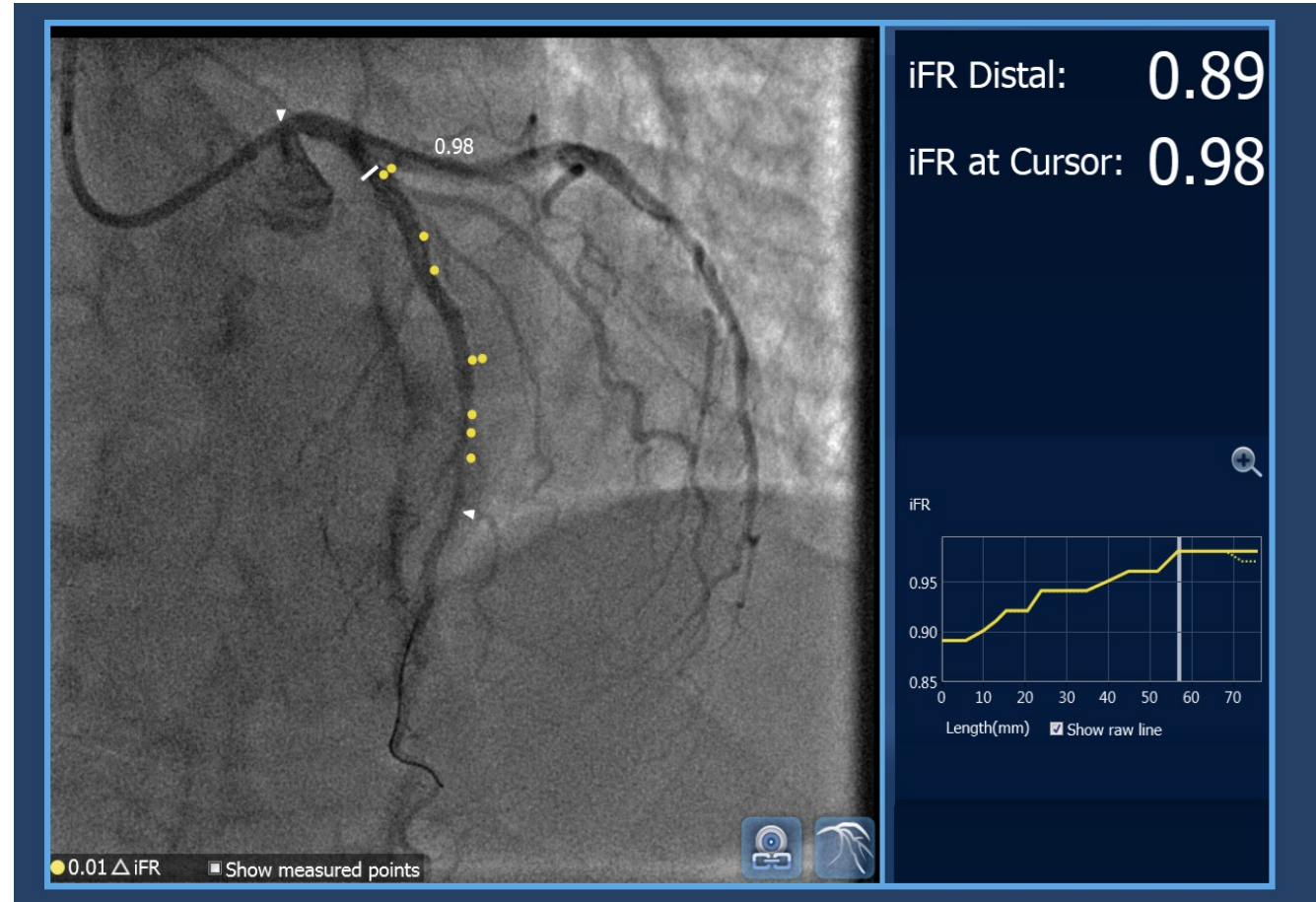
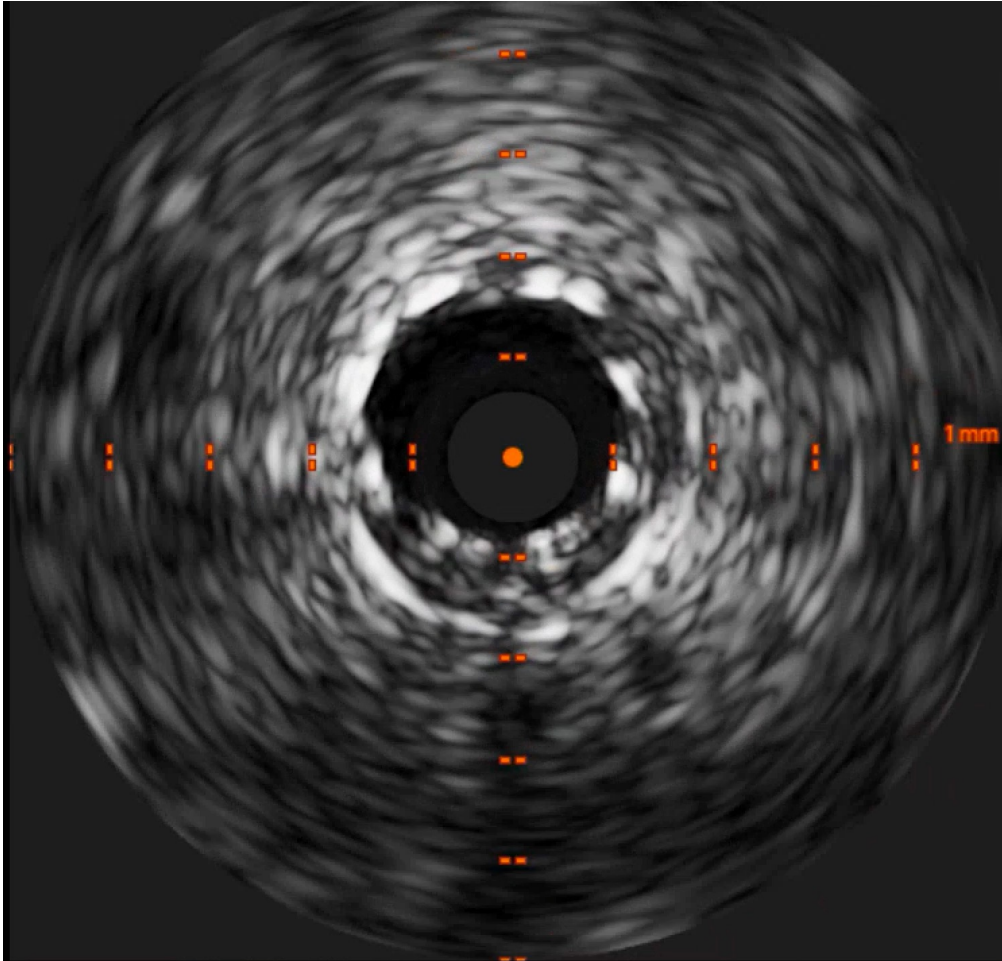
Physiology and Imaging tri-registration

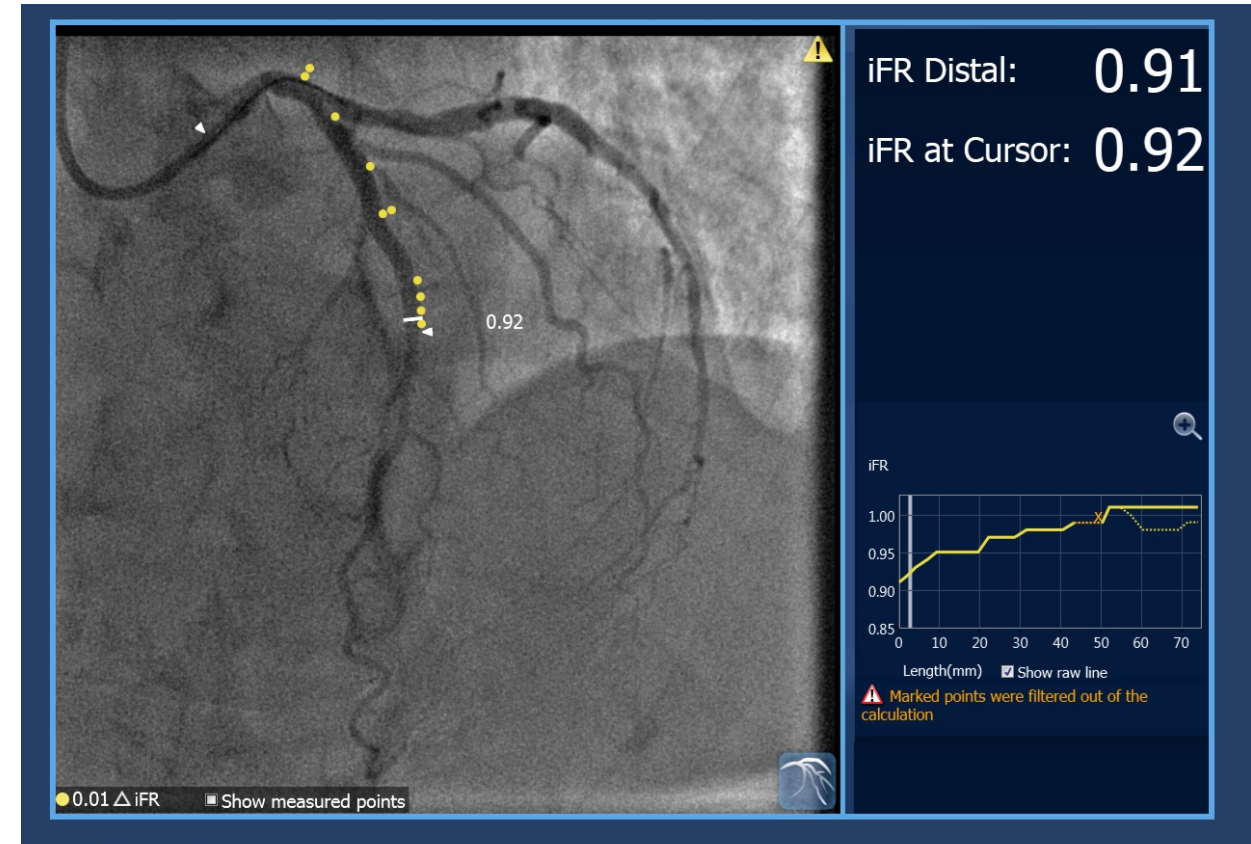
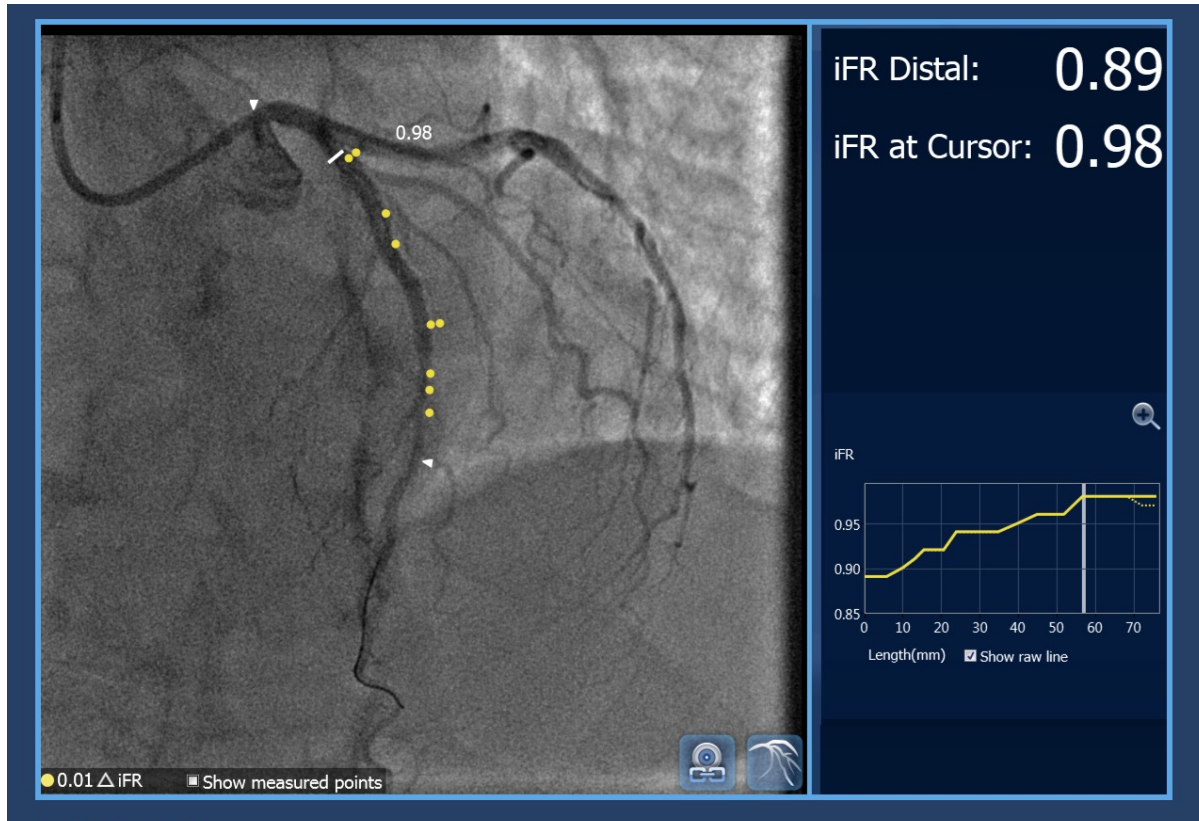


Panel P

- IVUS measurements, distal reference of 3.6 mm
- 3.5 x 38 Resolute ONYX used
- Post dilation to 4.0mm proximally
- Device detection for post dilation

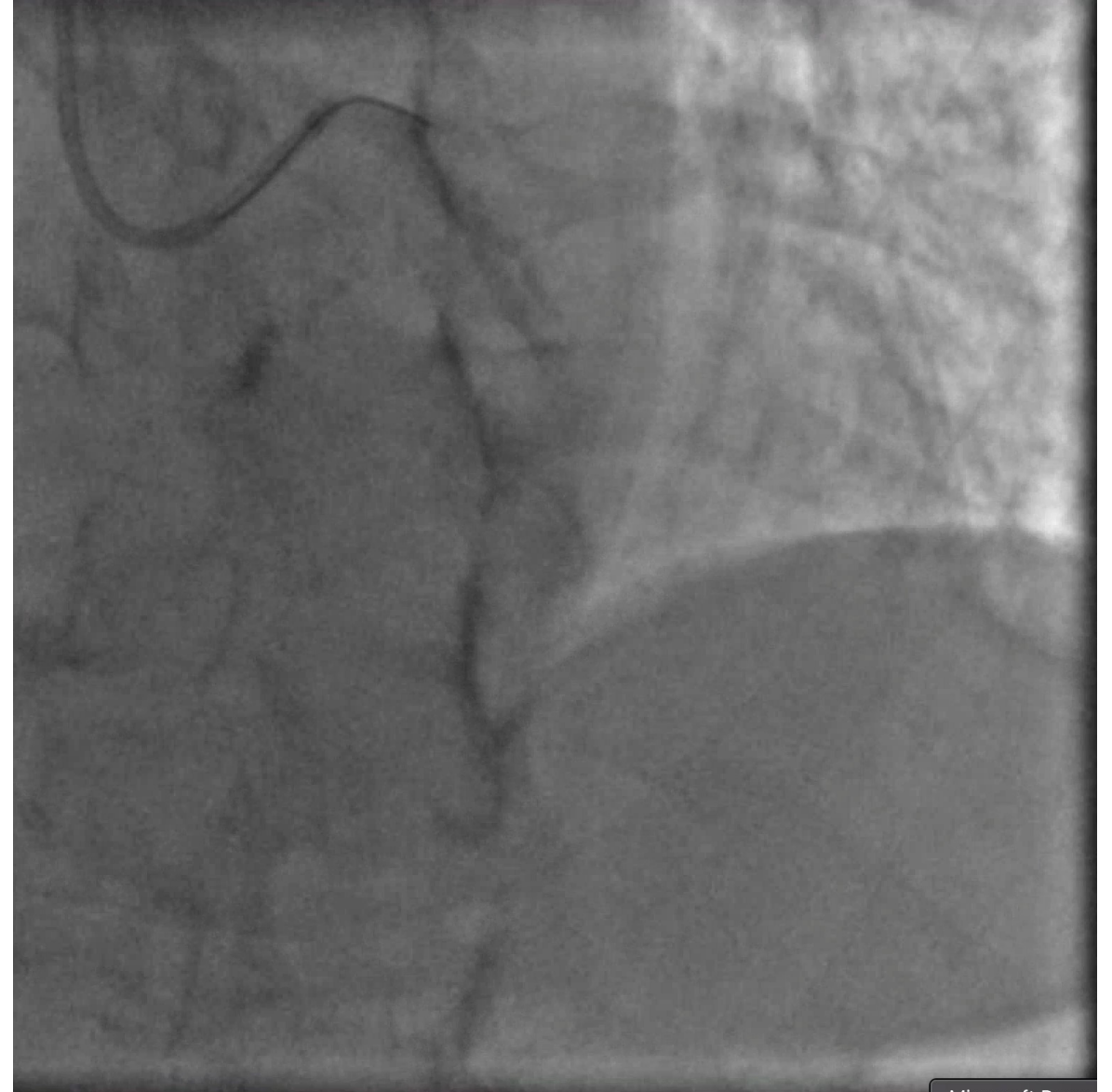






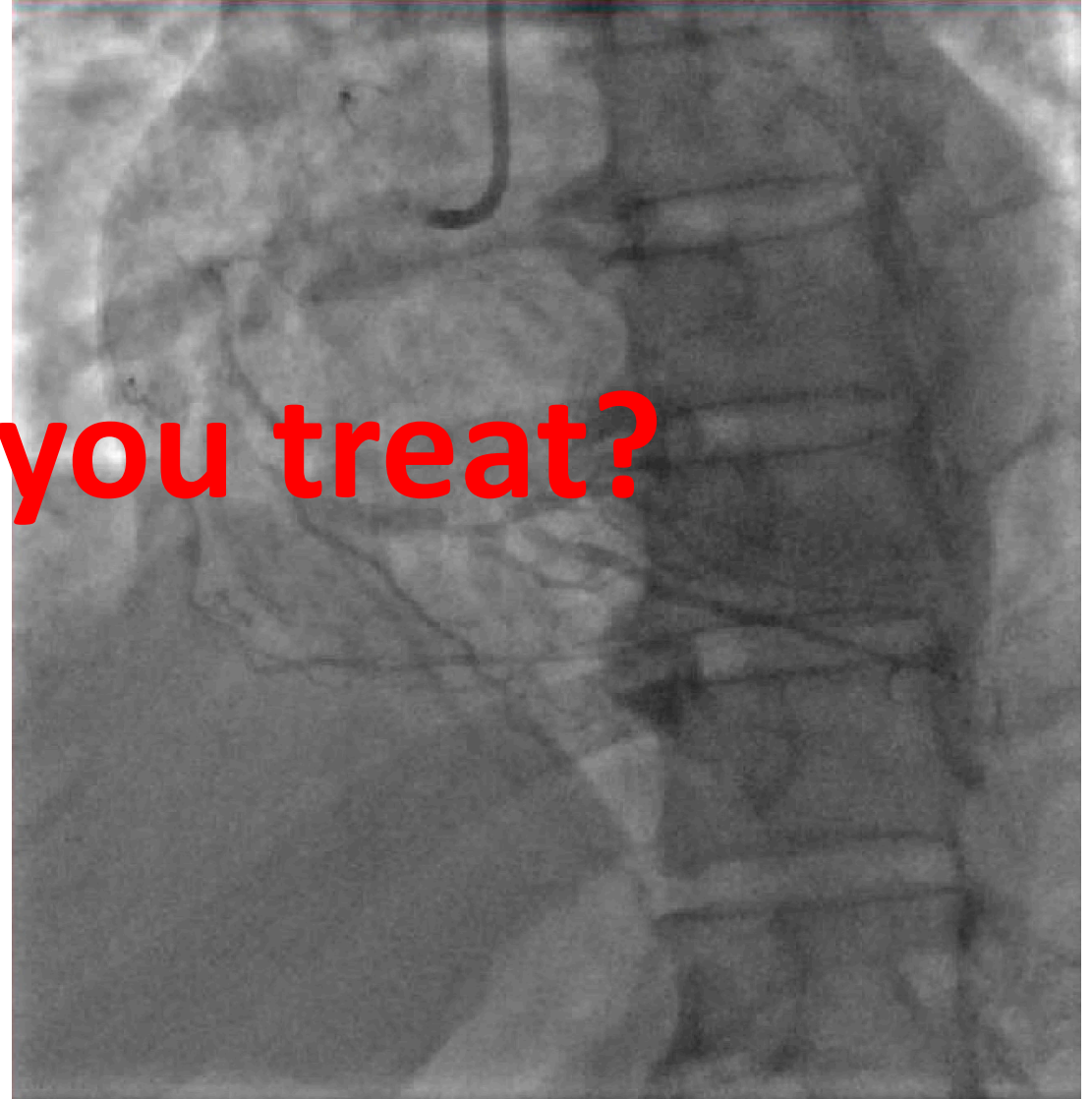
Final angiogram

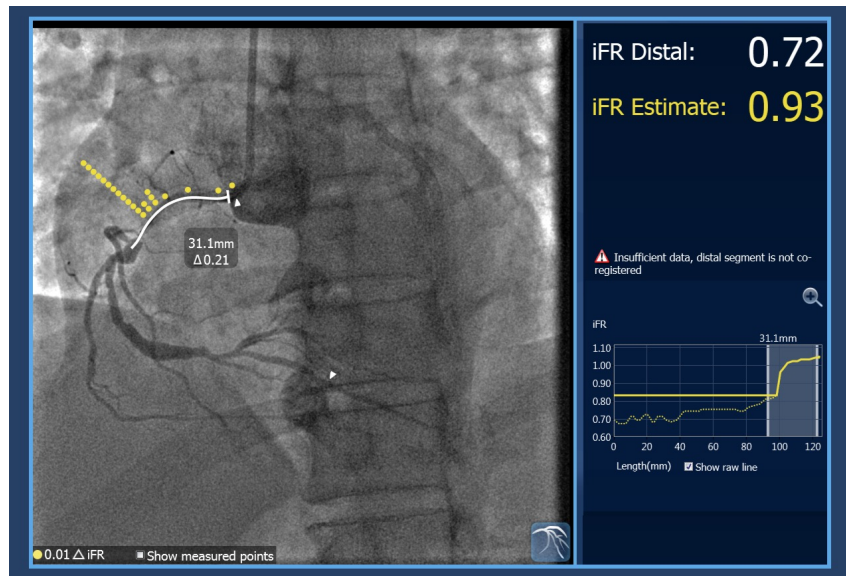
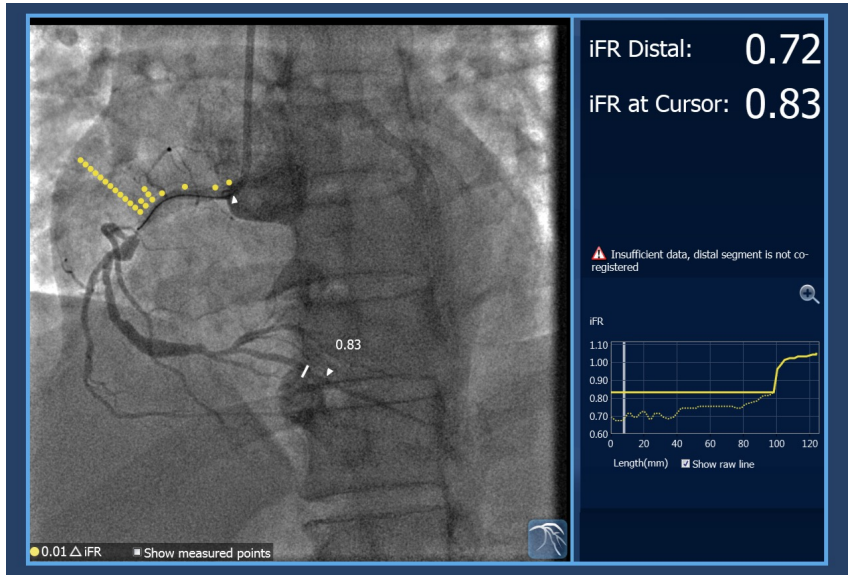
- Total contrast used
 - 16 cc of contrast
- Radial Band
- Hydration for an additional 300 ccs
- Home same day
- 1 week later with stable renal function



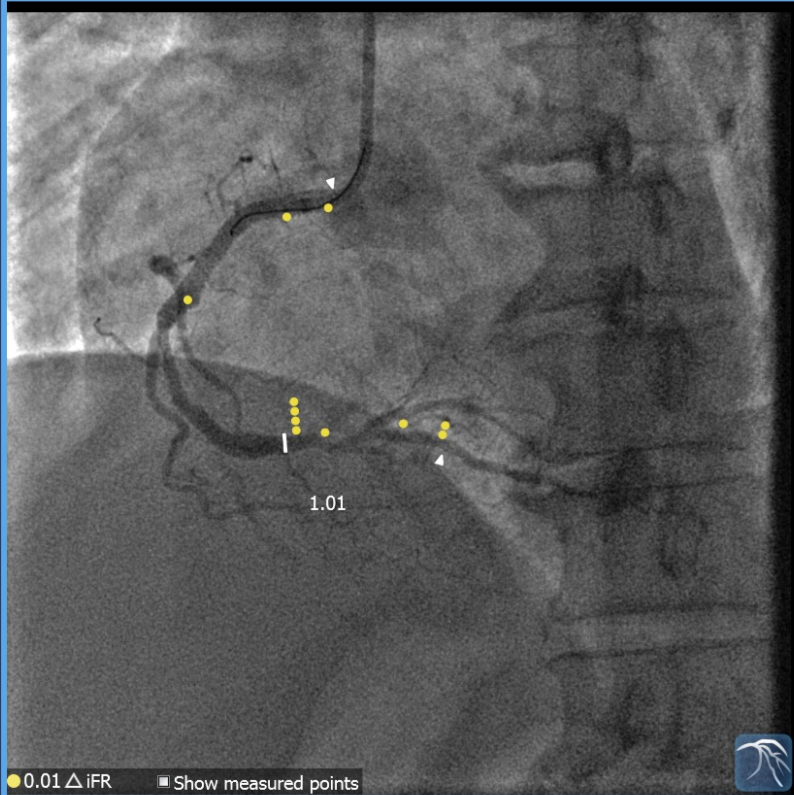
- 76 yr old female
 - HTN
 - DLD
 - CKD- III
 - DM
 - Rheumatoid Arthritis
 - Inferior ischemia on stress test
 - 2 antianginals

What do you treat?

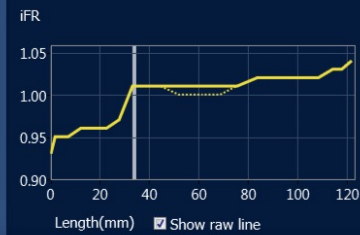




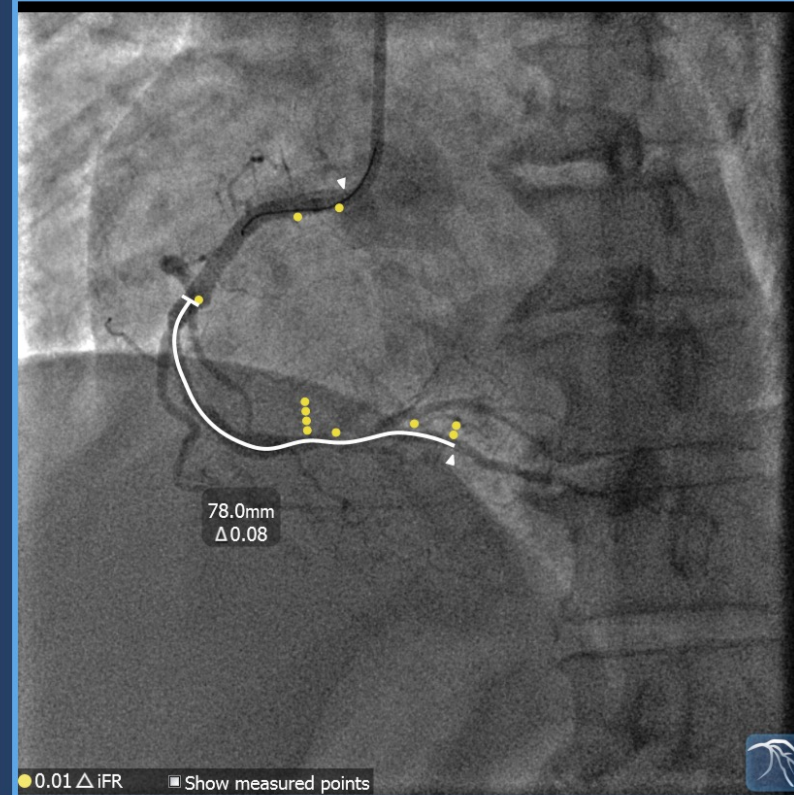
- Omniwire, iFR of the RCA with pull back and coregistration.
- iFR guidance to assess hemodynamic significance.
 - PCI of the proximal RCA, 3.5 x 22 DES
 - Optimized with imaging



iFR Distal: 0.93
iFR at Cursor: 1.01



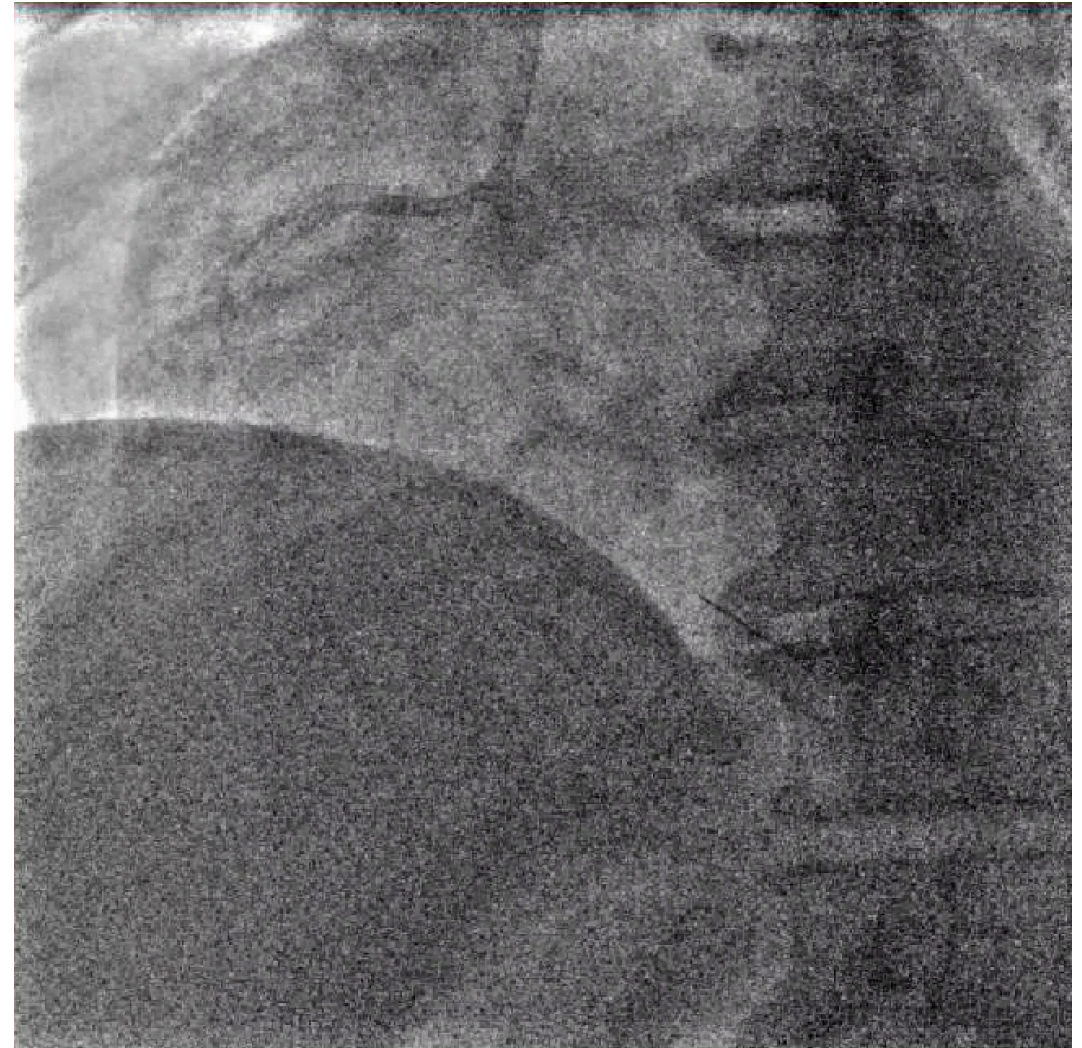
● 0.01 Δ iFR ☒ Show measured points



iFR Distal: 0.93
iFR Estimate: 1.01



● 0.01 Δ iFR ☒ Show measured points



Conclusion

- Residual ischemia, post PCI, is linked to worse outcomes.
- Co-registration is an adjunctive tool to map, plan and optimize PCI.
- Combining both physiology and imaging in “tri-registration” within an algorithm helps improve efficiency of PCI with good outcomes and lower contrast use.
- Optimizing post PCI physiology using co-registration is being evaluated in the DEFINE GPS study.



Thank you!

 @kalazimmd

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