

iFR as the gold standard for coronary revascularization



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Interventional Cardiologist
Hammersmith Hospital,
Imperial College London

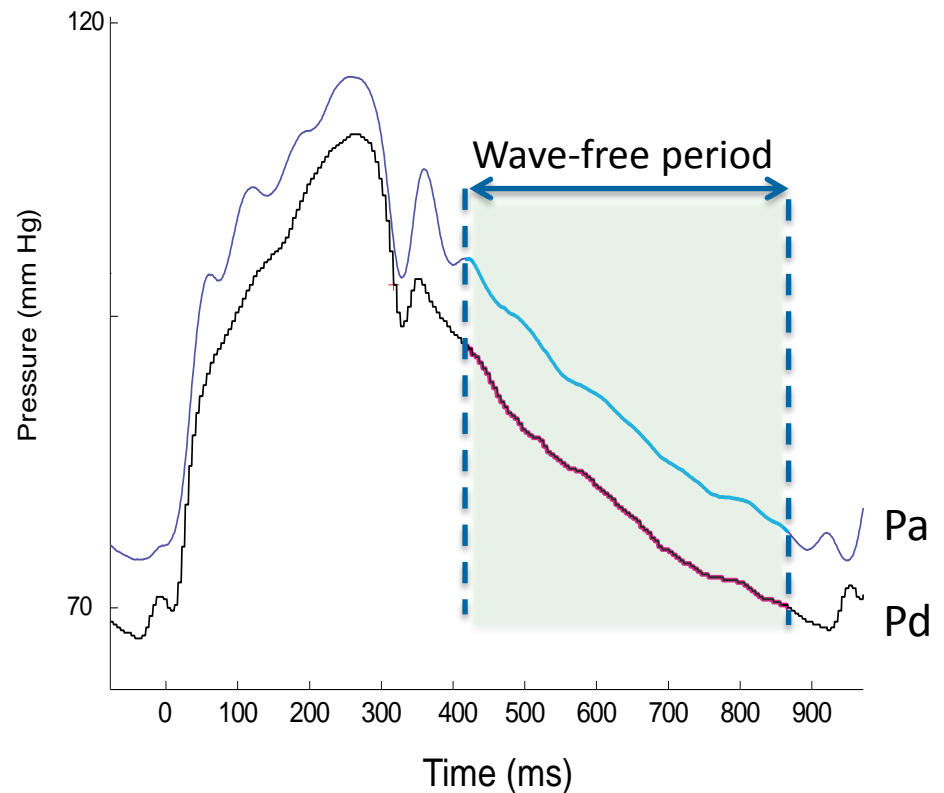
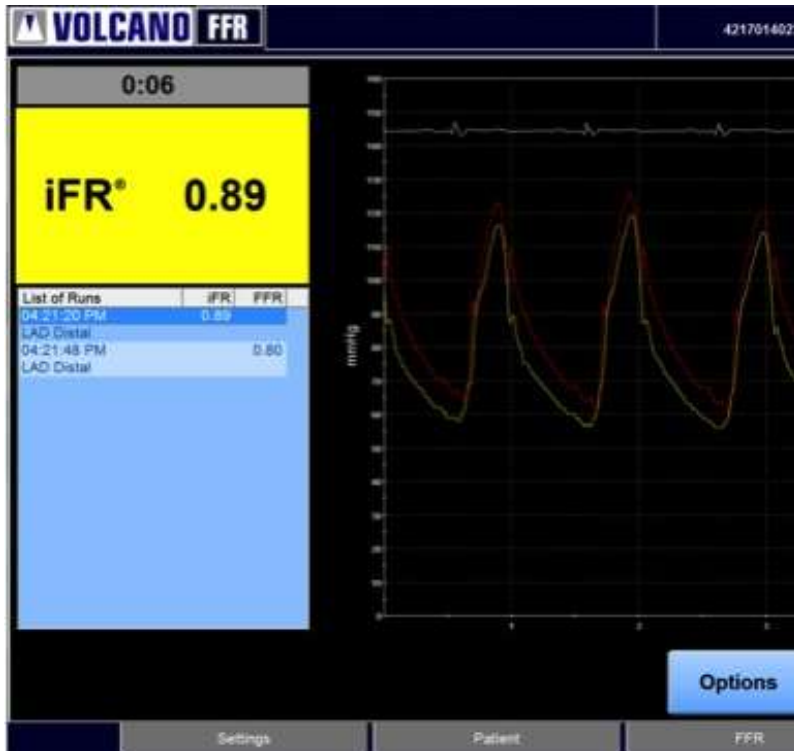


Imperial College
London

TCTAP, 2017

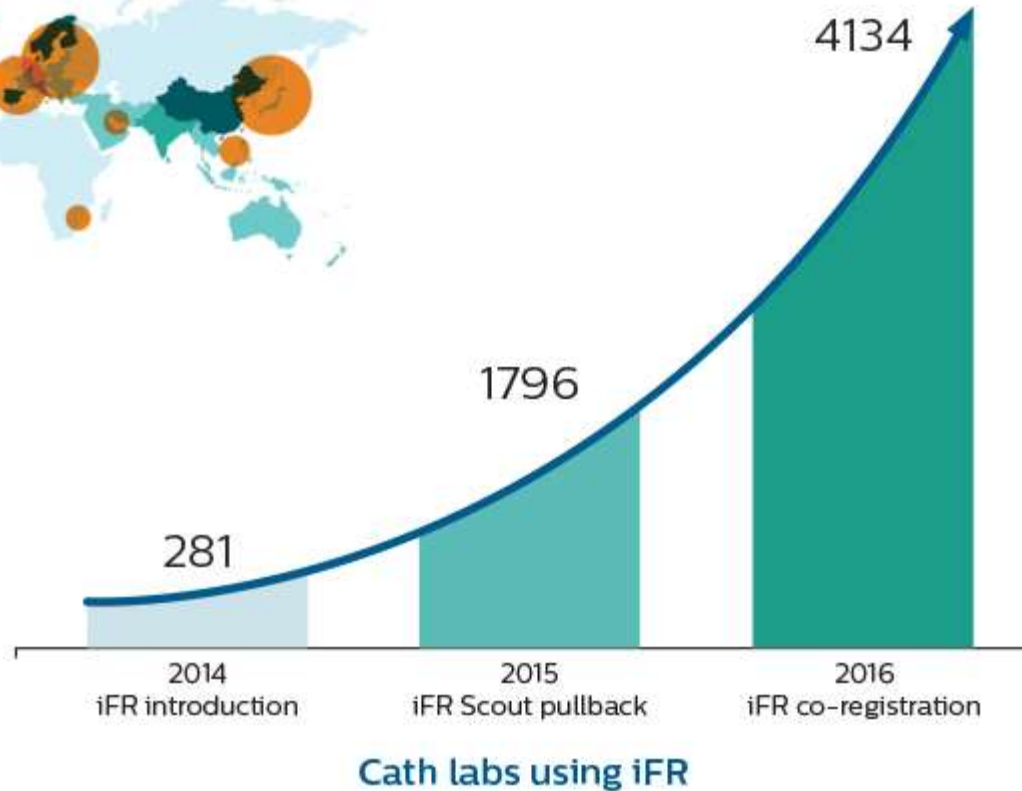
Definition of iFR:

Instant wave-free ratio across a stenosis during the wave-free period, when *resistance is naturally constant* and minimized in the cardiac cycle



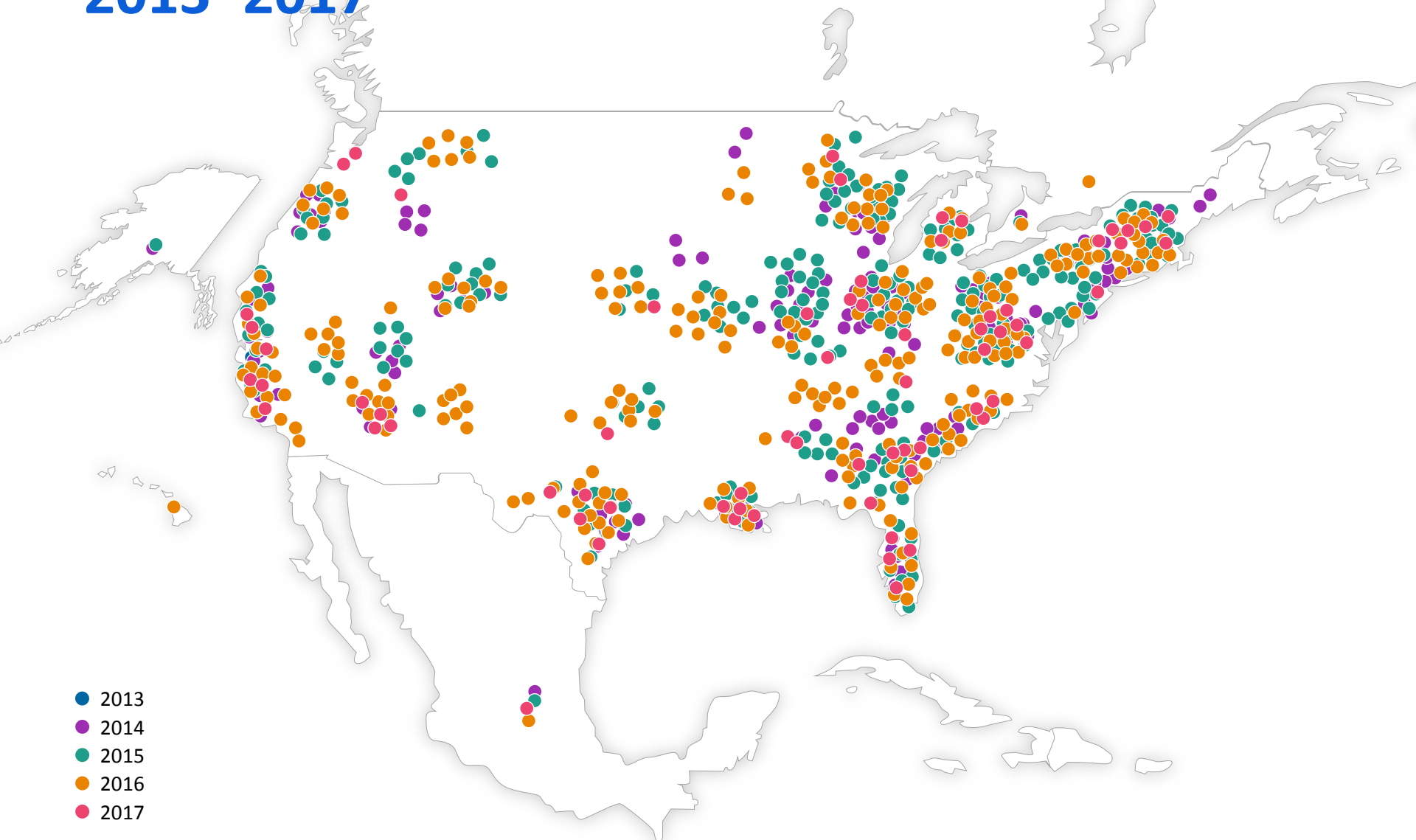
iFR has been adopted in +4000 catheter labs world wide

iFR adoption worldwide



iFR North America

2013–2017



- 2013
- 2014
- 2015
- 2016
- 2017

Published online NEJM



The NEW ENGLAND
JOURNAL of MEDICINE

ORIGINAL ARTICLE

Use of the Instantaneous Wave-free Ratio or Fractional Flow Reserve in PCI

J.E. Davies, S. Sen, H.-M. Dehbi, R. Al-Lamee, R. Petraco, S.S. Nijjer, R. Bhindi, S.J. Lehman, D. Walters, J. Sapontis, L. Janssens, C.J. Vrints, A. Khashaba, M. Laine, E. Van Belle, F. Krackhardt, W. Bojara, O. Going, T. Härle, C. Indolfi, G. Niccoli, F. Ribichini, N. Tanaka, H. Yokoi, H. Takashima, Y. Kikuta, A. Erglis, H. Vinhas, P. Canas Silva, S.B. Baptista, A. Alghamdi, F. Hellig, B.-K. Koo, C.-W. Nam, E.-S. Shin, J.-H. Doh, S. Brugaletta, E. Alegria-Barrero, M. Meuwissen, J.J. Piek, N. van Royen, M. Sezer, C. Di Mario, R.T. Gerber, I.S. Malik, A.S.P. Sharp, S. Talwar, K. Tang, H. Samady, J. Altman, A.H. Seto, J. Singh, A. Jeremias, H. Matsuo, R.K. Kharbanda, M.R. Patel, P. Serruys, and J. Escaned

DEFINE FLAIR

Fractional Flow Reserve Assessment of Intermediate Lesions to Guide Percutaneous Coronary Intervention



The NEW ENGLAND
JOURNAL of MEDICINE

ORIGINAL ARTICLE

Instantaneous Wave-free Ratio versus Fractional Flow Reserve to Guide PCI

M. Götberg, E.H. Christiansen, I.J. Gudmundsdottir, L. Sandhall, M. Danielewicz, L. Jakobsen, S.-E. Olsson, P. Öhagen, H. Olsson, E. Omerovic, F. Calais, P. Lindroos, M. Maeng, T. Tödt, D. Venetsanos, S.K. James, A. Käregren, M. Nilsson, J. Carlsson, D. Hauer, J. Jensen, A.-C. Karlsson, G. Panayi, D. Erlinge, and O. Fröbert, for the iFR-SWEDEHEART Investigators*



iFR[®]

SWEDEHEART[®]

Online now at nejm.org

Call for change in management of CAD

The NEW ENGLAND JOURNAL of MEDICINE

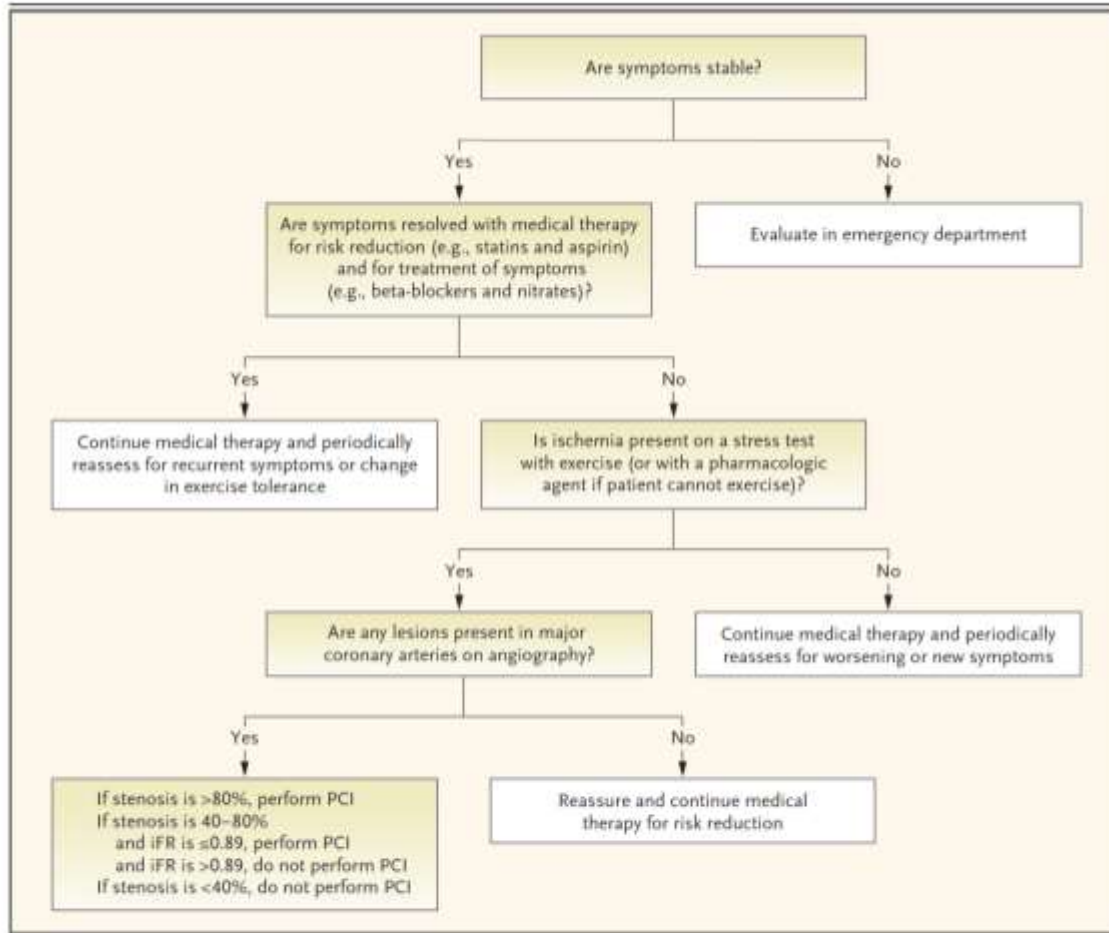


Figure 1. Evaluation of Stable Coronary Artery Disease.

When stable coronary artery disease is suspected, initial medical therapy, noninvasive evaluation, coronary angiography, and assessment with use of the instantaneous wave-free ratio (iFR) can be used to guide decisions regarding percutaneous coronary intervention (PCI).



“ FFR has been the evidence-based standard for invasive evaluation of such lesions, but it now appears that iFR may be the new standard.

Deepak Bhatt, NEJM 2017

iFR now included in AUC guidelines as an alternative for coronary revascularization

ARTICLE IN PRESS

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY
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ISSN 0735-1017/1735-1024, DOI: 10.1016/j.jacc.2017.08.050

APPROPRIATE USE CRITERIA

ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2017 Appropriate Use Criteria for Coronary Revascularization in Patients With Stable Ischemic Heart Disease

A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society of Thoracic Surgeons

A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society of Thoracic Surgeons

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Rene E. Teitel, MD, FACC

*Society for Cardiovascular Angiography and Interventions, Revascularization, Society of Thoracic Surgeons Representative.

Appropriate Use Score (1-9)

Two-Vessel Disease

Indication	Asymptomatic				Ischemic Symptoms			
	Not on AA Therapy or With AA Therapy		Not on AA Therapy		On 1 AA Drug (SB Performed)		On ≥2 AA Drugs	
	PCI	CABG	PCI	CABG	PCI	CABG	PCI	CABG
1. ■ Low-risk findings on noninvasive testing	1 (1)	1 (2)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)
2. ■ Intermediate- or high-risk findings on noninvasive testing	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)
3. ■ No stress test performed or, if performed, results are indeterminate	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)
4. ■ STS <0.50† in both vessels	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)

Appropriate Use Score (1-9)

One-Vessel Disease

Indication	Asymptomatic				Ischemic Symptoms			
	Not on AA Therapy or With AA Therapy		Not on AA Therapy		On 1 AA Drug (SB Performed)		On ≥2 AA Drugs	
	PCI	CABG	PCI	CABG	PCI	CABG	PCI	CABG
1. ■ Low-risk findings on noninvasive testing	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)
2. ■ Intermediate- or high-risk findings on noninvasive testing	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)
3. ■ No stress test performed or, if performed, results are indeterminate	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)
4. ■ STS <0.50†	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)

Proximal LAD or Proximal Left Dominant LAD involvement Present

Indication	Asymptomatic				Ischemic Symptoms			
	Not on AA Therapy or With AA Therapy		Not on AA Therapy		On 1 AA Drug (SB Performed)		On ≥2 AA Drugs	
	PCI	CABG	PCI	CABG	PCI	CABG	PCI	CABG
1. ■ Low-risk findings on noninvasive testing	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)
2. ■ Intermediate- or high-risk findings on noninvasive testing	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)
3. ■ No stress test performed or, if performed, results are indeterminate	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)
4. ■ STS <0.50†	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)

Proximal LAD or Proximal Left Dominant LAD involvement Absent

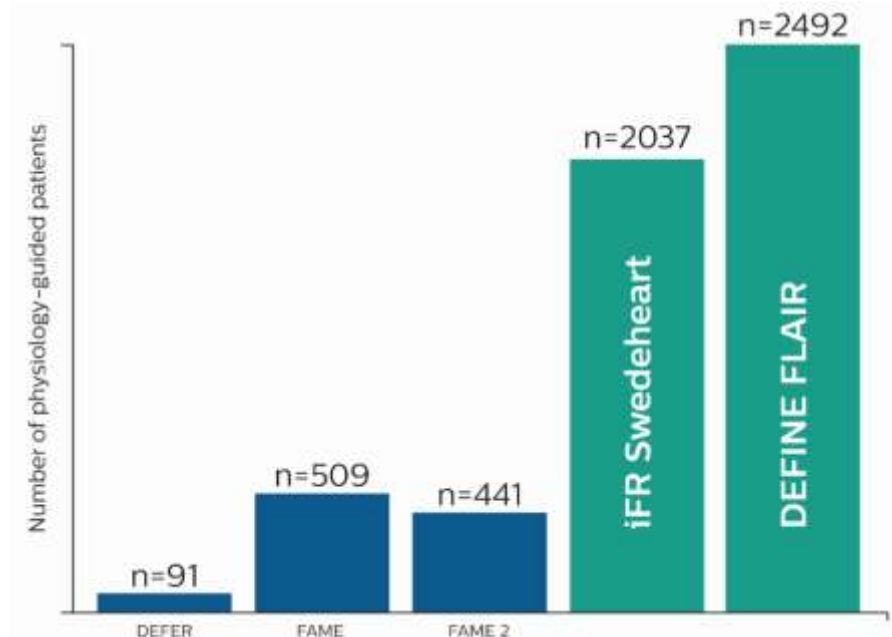
Indication	Asymptomatic				Ischemic Symptoms			
	Not on AA Therapy or With AA Therapy		Not on AA Therapy		On 1 AA Drug (SB Performed)		On ≥2 AA Drugs	
	PCI	CABG	PCI	CABG	PCI	CABG	PCI	CABG
1. ■ Low-risk findings on noninvasive testing	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)
2. ■ Intermediate- or high-risk findings on noninvasive testing	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)
3. ■ No stress test performed or, if performed, results are indeterminate	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)
4. ■ STS <0.50†	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)

The number in parentheses next to the rating reflects the median score for that indication. ¹SB: measurements with appropriate normal ranges may be substituted for STS. ²A indicates appropriate, 0=asymptomatic, 1=low likelihood, 2=intermediate, 3=high likelihood, 4=high likelihood, 5=high likelihood, 6=high likelihood, 7=high likelihood, 8=high likelihood, 9=high likelihood. [†]Indicates score that also LAD, left anterior descending coronary artery, LAD, left circumflex artery, LCx, may be appropriate. [‡]PCI, percutaneous coronary intervention; and [§]SB, stent.

Patel M et al. JACC 2017

DEFINE-FLAIR and iFR SwedeHeart: The largest global physiology outcome trials

- DEFINE FLAIR and iFR Swedeheart are the new landmark physiology studies
- **4500+** patients, more than twice the combined patient population of previous landmark physiology studies
 - DEFINE FLAIR: n = 2492 patients
 - iFR Swedeheart: n = 2037 patients
- **2** prospective, randomized, controlled trials

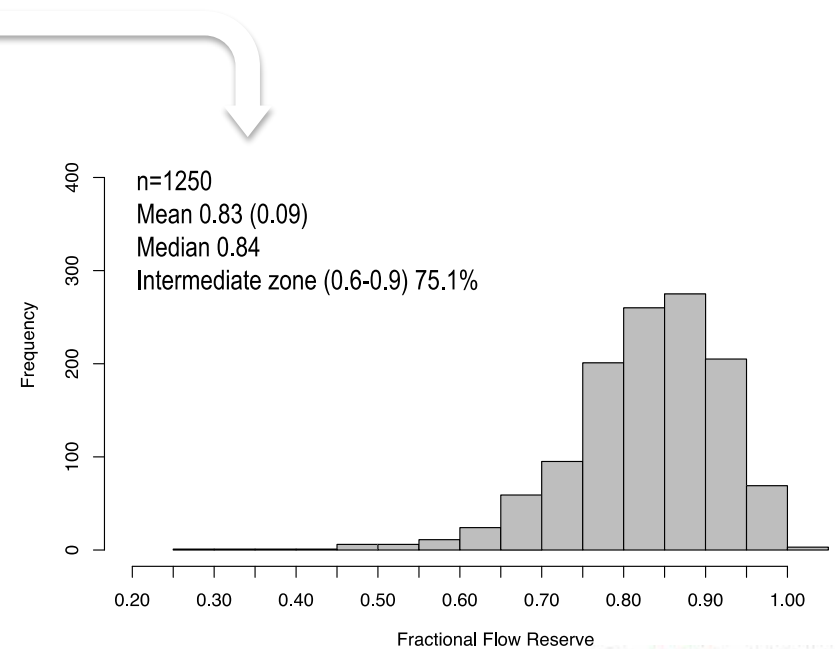


Global recruitment – reflecting real world practice



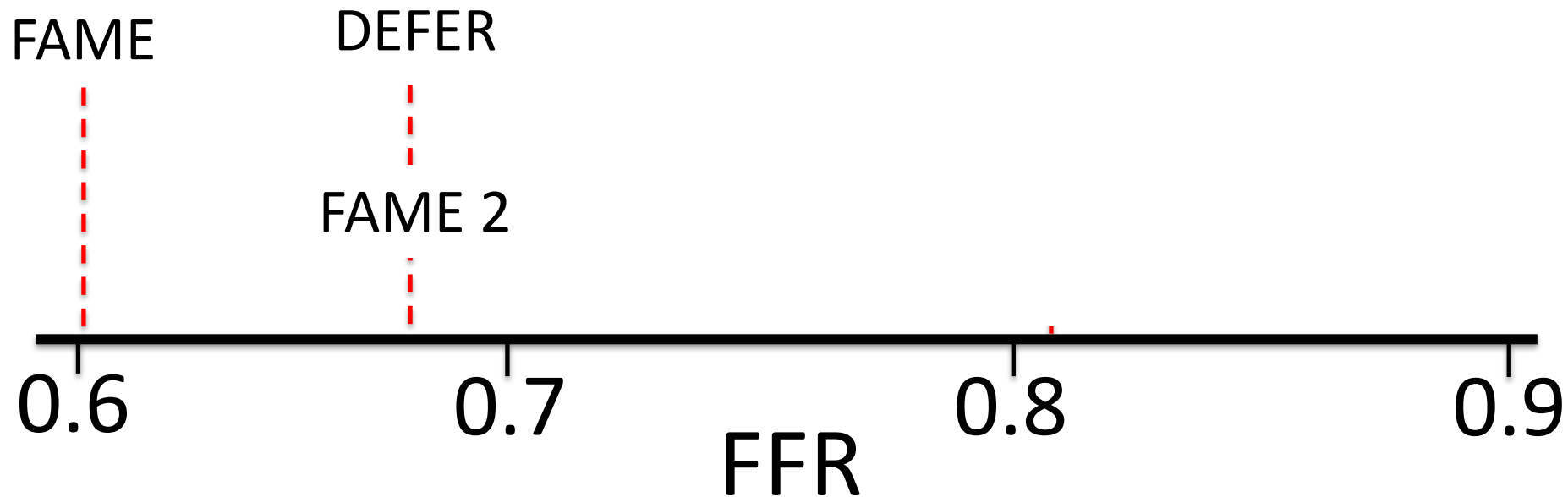
49 Investigators
19 Countries

GENERALIZABLE



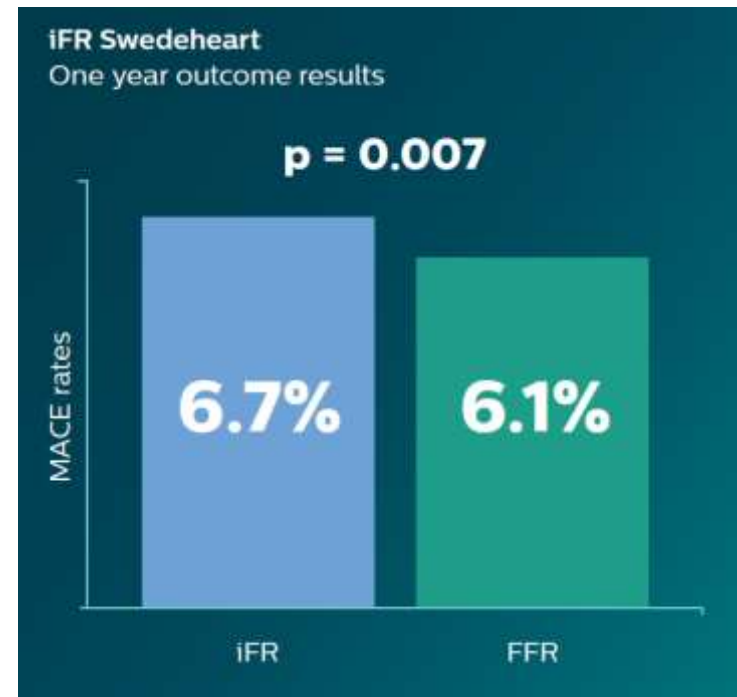
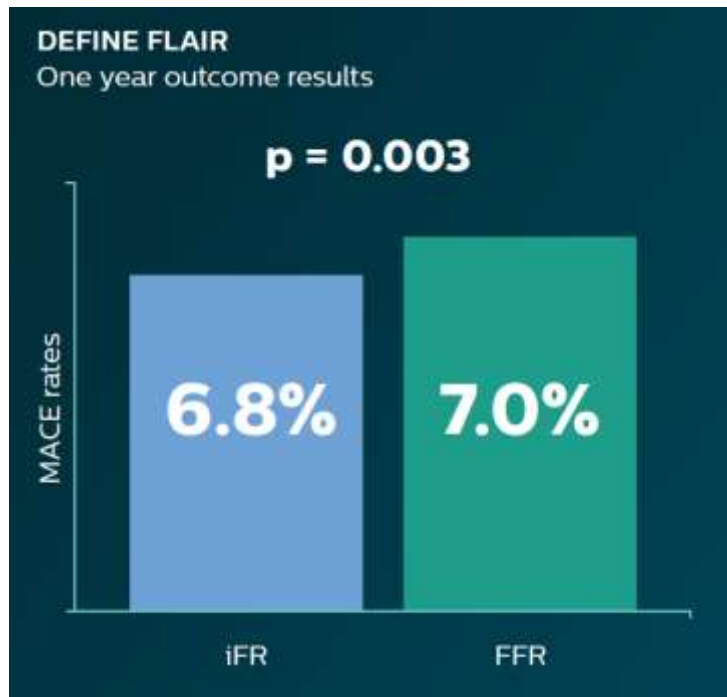
DEFINE FLAIR

DEFINE-FLAIR and iFR SwedeHeart: First clinical outcome trials testing physiological guided revascularization in intermediate zone



Consistent patient outcome

- An iFR guided strategy is statistically comparable to an FFR-Guided Strategy for patient outcome*
 - Primary endpoint: major cardiovascular adverse event rates, assessed at 1-year

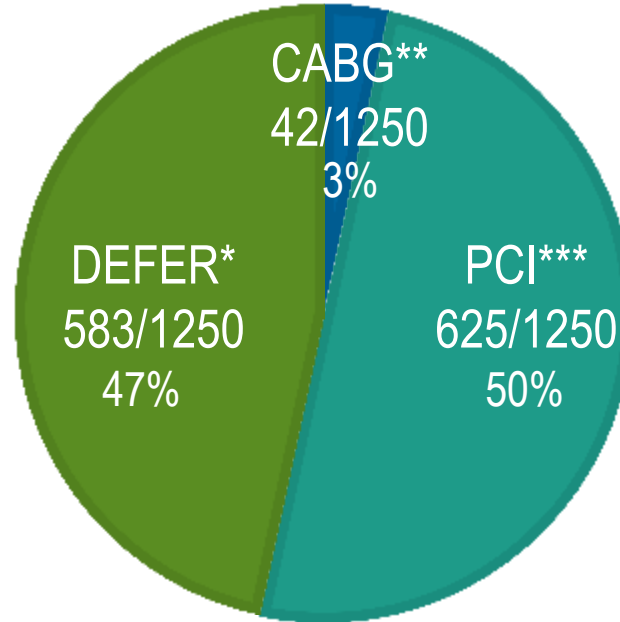
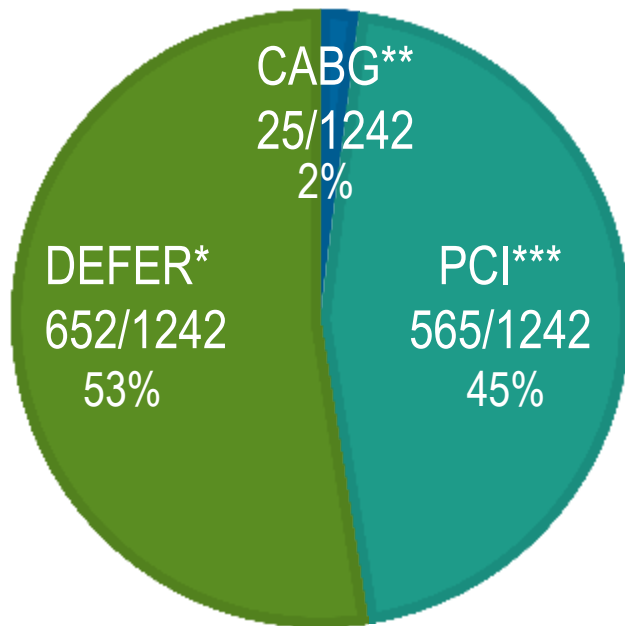


* p-values are for non-inferiority of an iFR-guided strategy versus an FFR-guided strategy with respect to 1-year MACE rates; pre-specified non-inferiority margins were 3.4% and 3.2% in DEFINE FLAIR and iFR Swedeheart, respectively

Treatment allocation with iFR and FFR

iFR

FFR



p for comparison between patients randomized to iFR and FFR

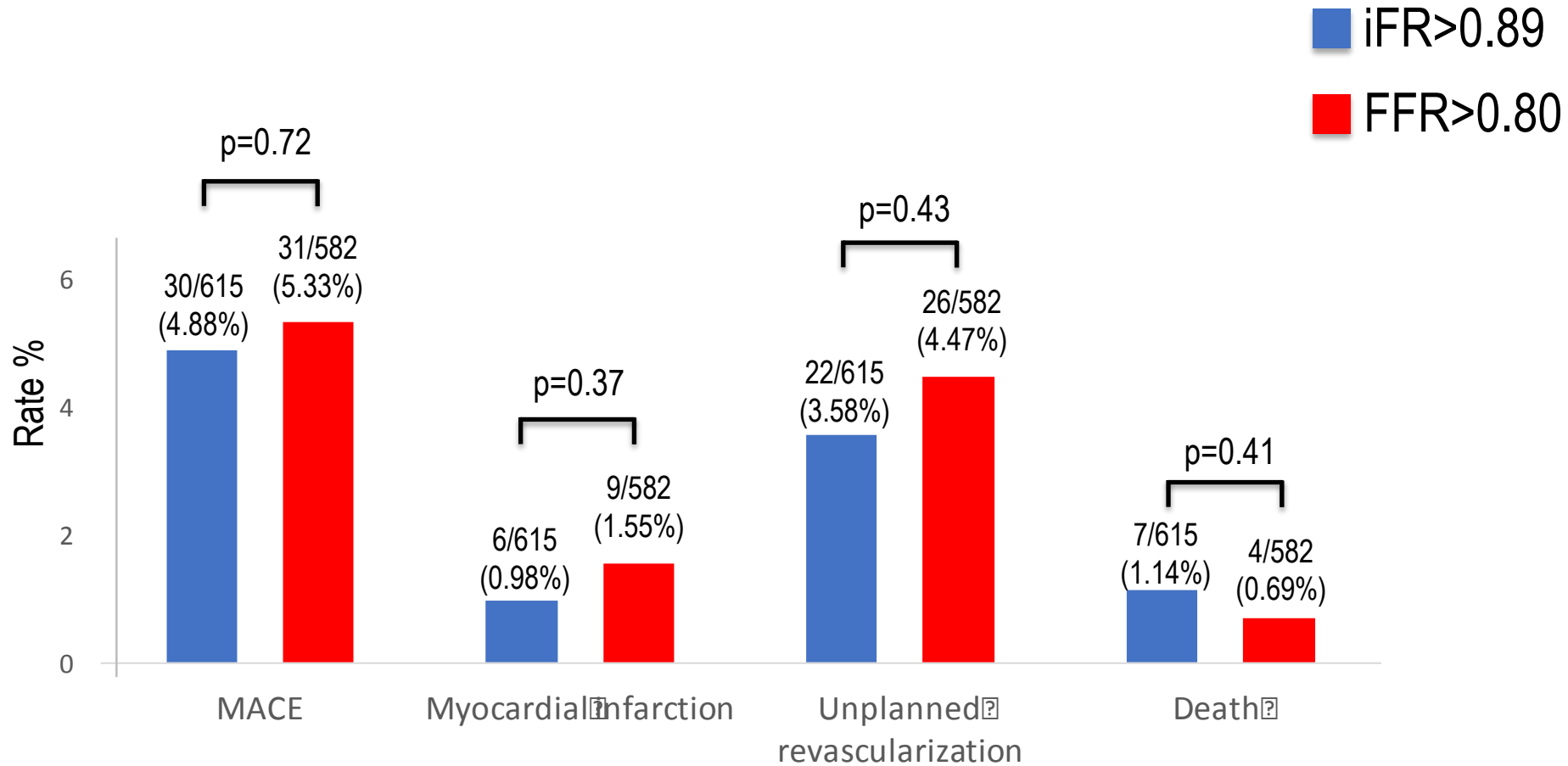
DEFER* p=0.003

CABG** p=0.04

PCI*** p=0.02

Significantly less revascularization based on iFR interrogation

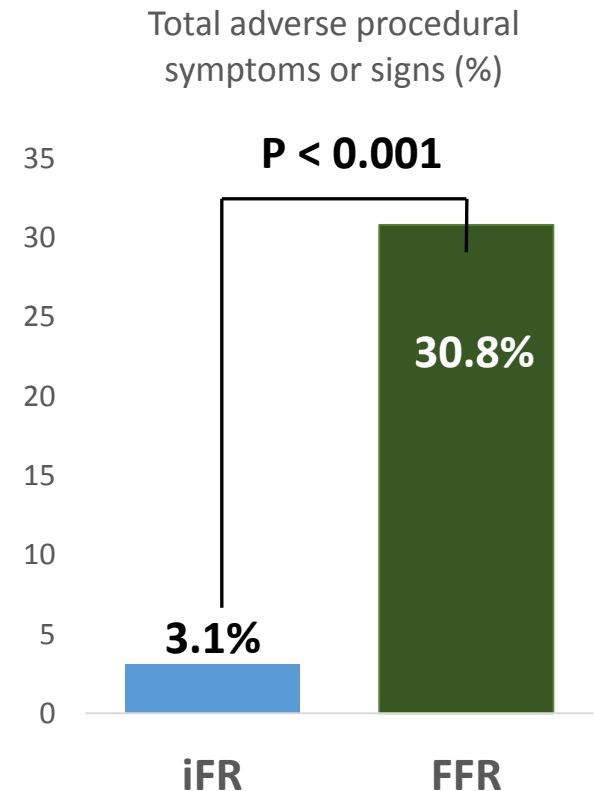
Event rates in deferred patients at 12 months



An iFR-guided strategy significantly reduces patient discomfort

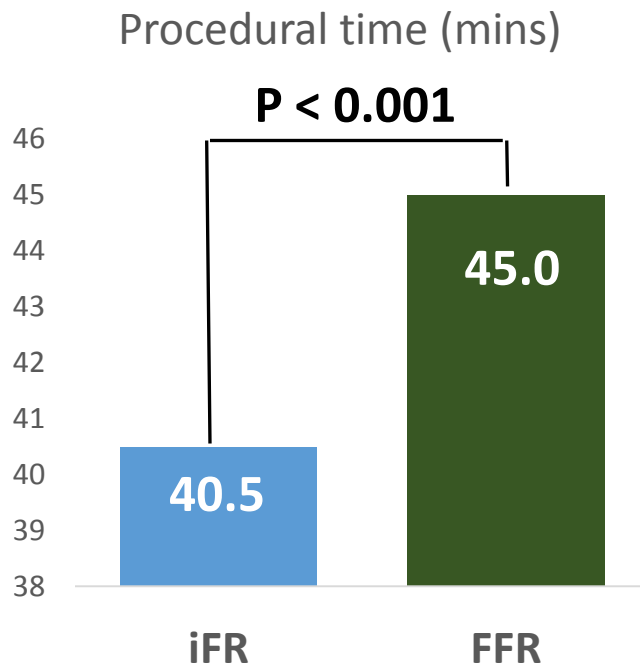
- DEFINE FLAIR reported that without the need of hyperemia, you can achieve a 90% reduction of patient discomfort during procedures

	iFR (n = 1242)	FFR (n=1250)
Patient reported adverse symptoms		
Dyspnoea	13	250
Chest pain	19	90
Patient reported adverse signs		
Rhythm disturbance	2	60
Significant Hypotension	4	13
Vomiting or nausea	1	11
Serious symptoms or bronchospasm	1	8
other	4	38
Total adverse procedural symptoms or signs	39	385



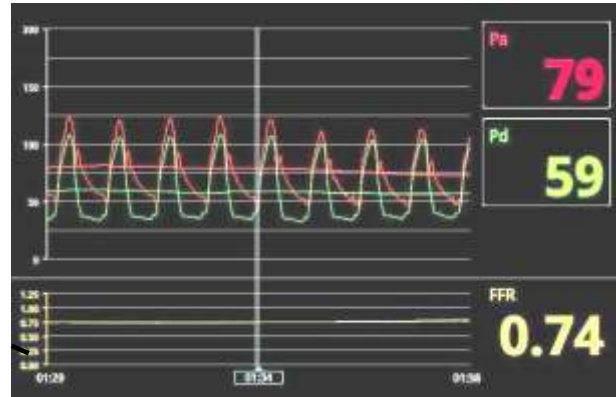
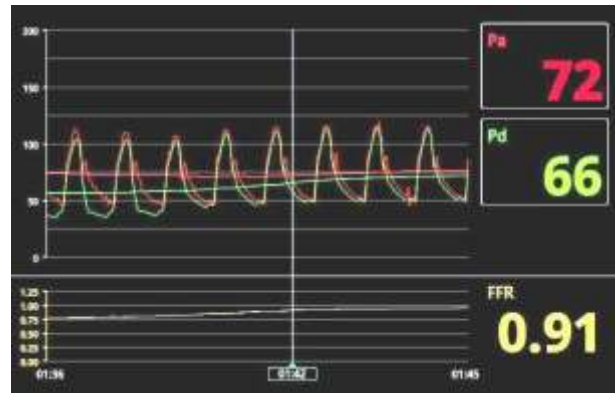
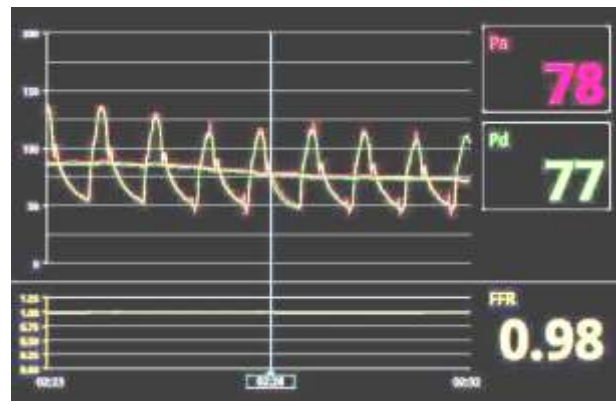
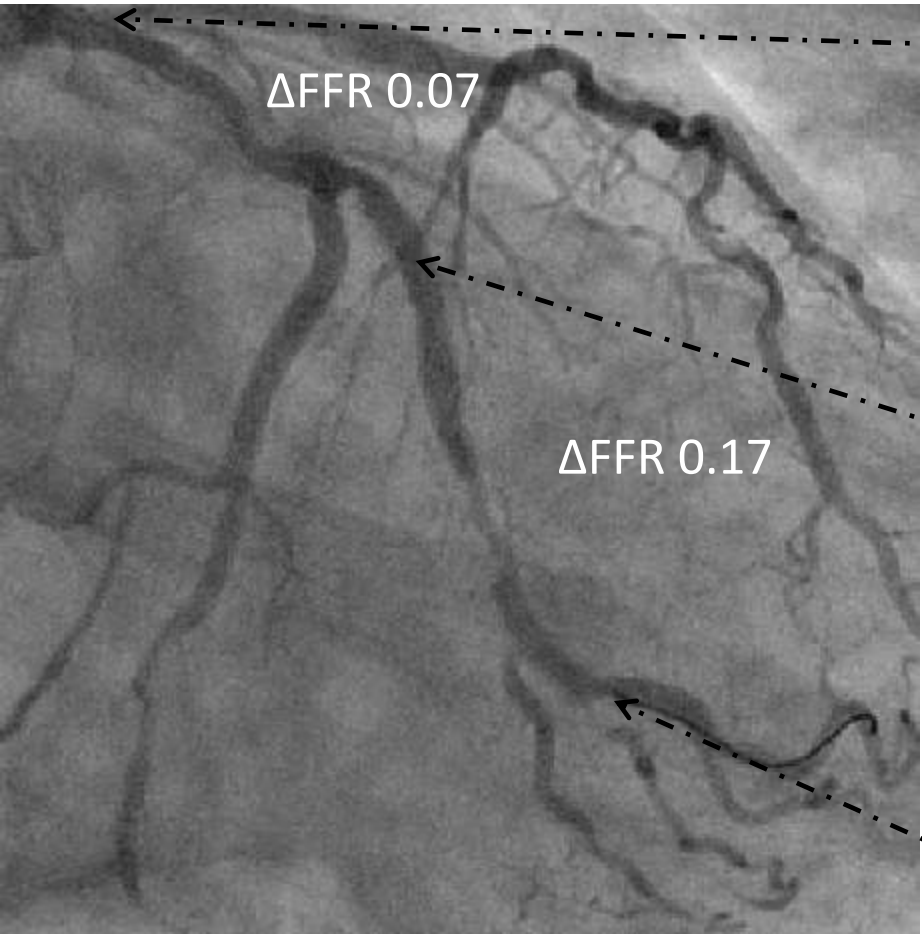
An iFR-guided strategy significantly reduces procedural time and cost

- DEFINE FLAIR reported an average procedural time of 40.5 minutes in the iFR arm, vs. 45.0 minutes in the FFR arm ($p < 0.001$)
- This means a 10% reduction in procedural time



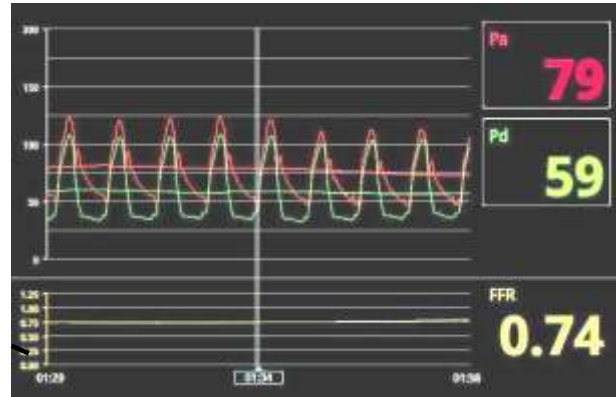
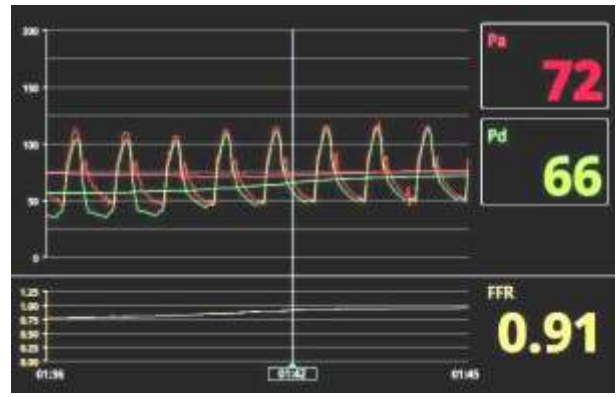
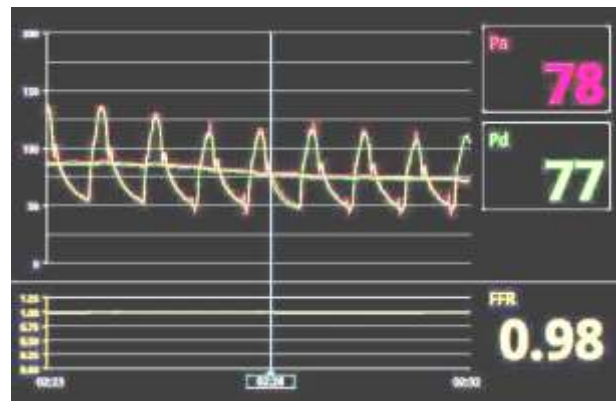
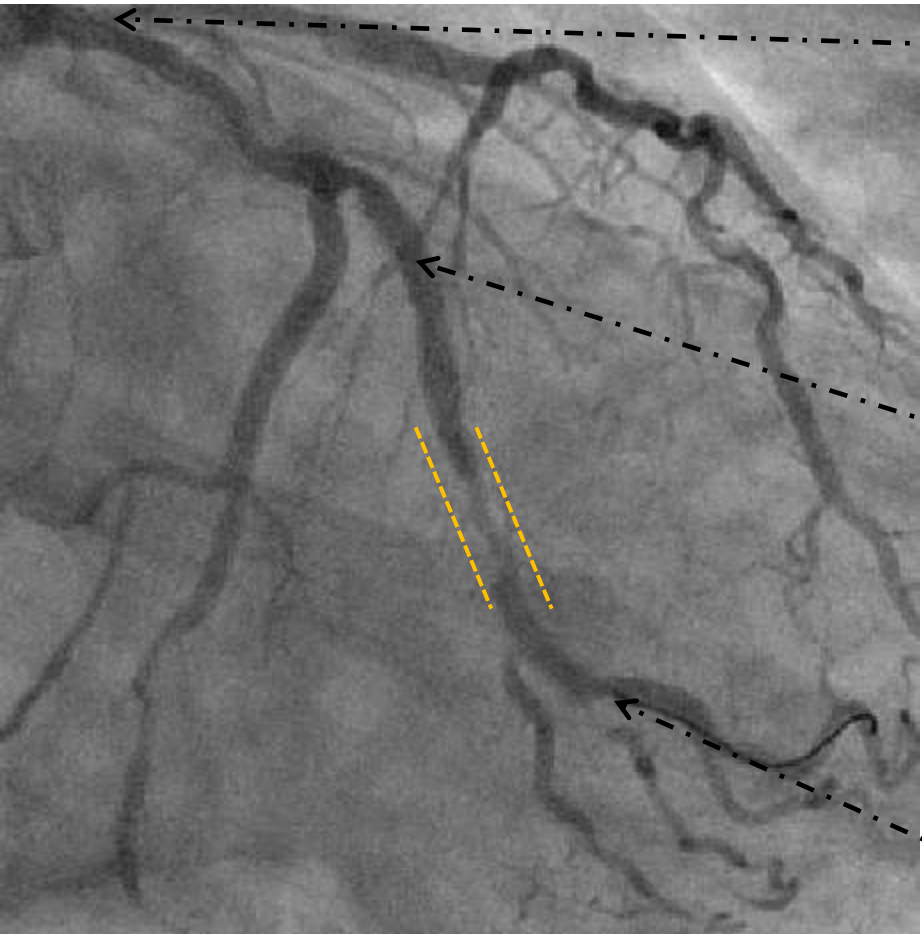
69 years old gentleman with hypertension and hypercholesterolemia; minimal chest pain; enrolled into the ILUMIEN I study

FFR pull-back before treatment



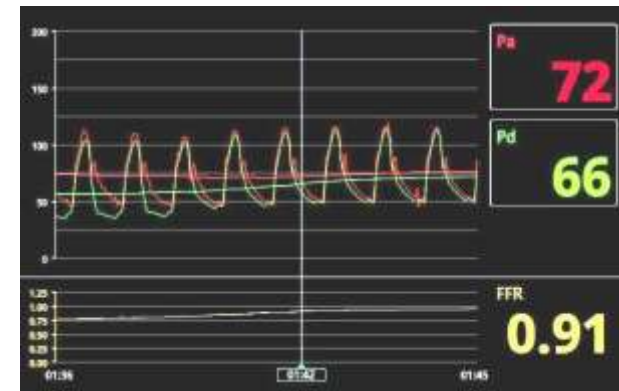
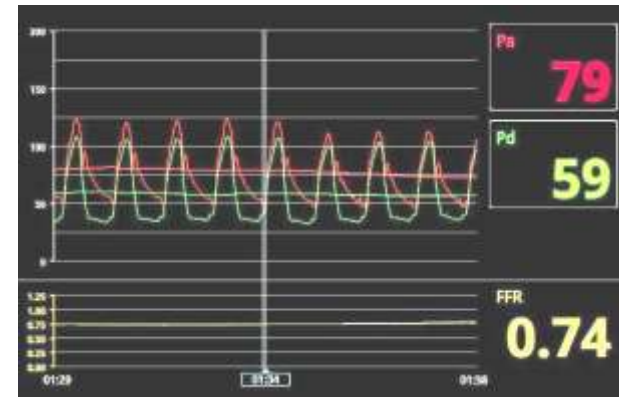
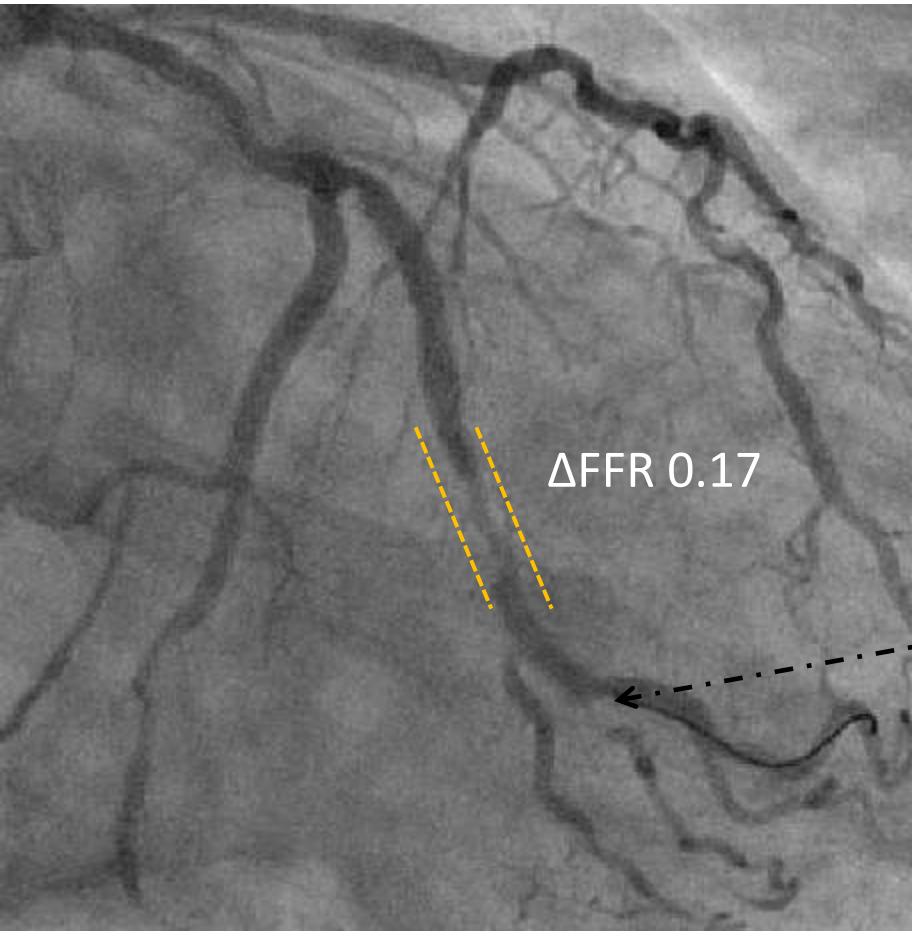
69 years old gentleman with hypertension and hypercholesterolemia; minimal chest pain; enrolled into the ILUMIEN I study

FFR pull-back before treatment

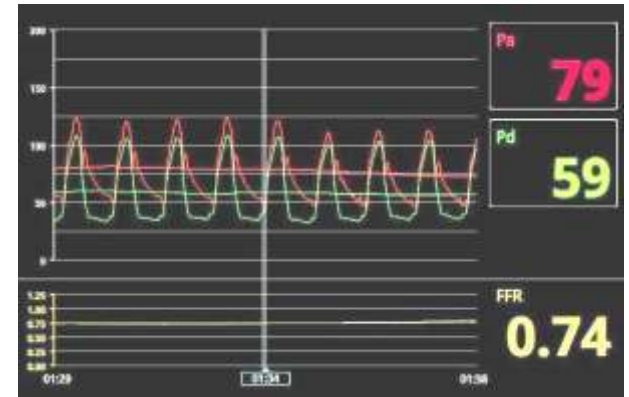


69 years old gentleman with hypertension and hypercholesterolemia; minimal chest pain; enrolled into the ILUMIEN I study

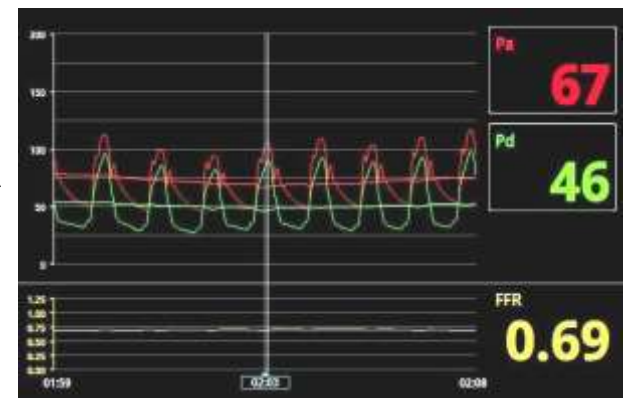
FFR pull-back before treatment



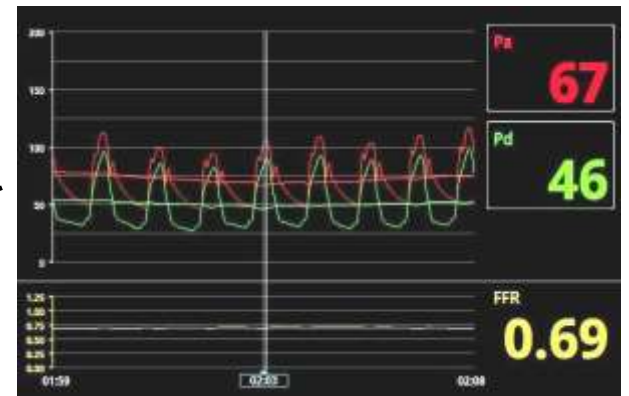
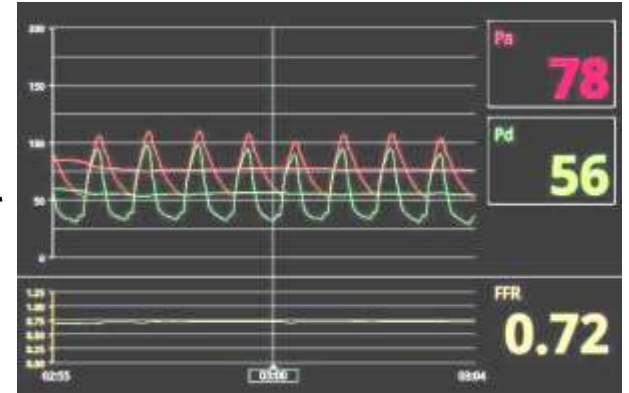
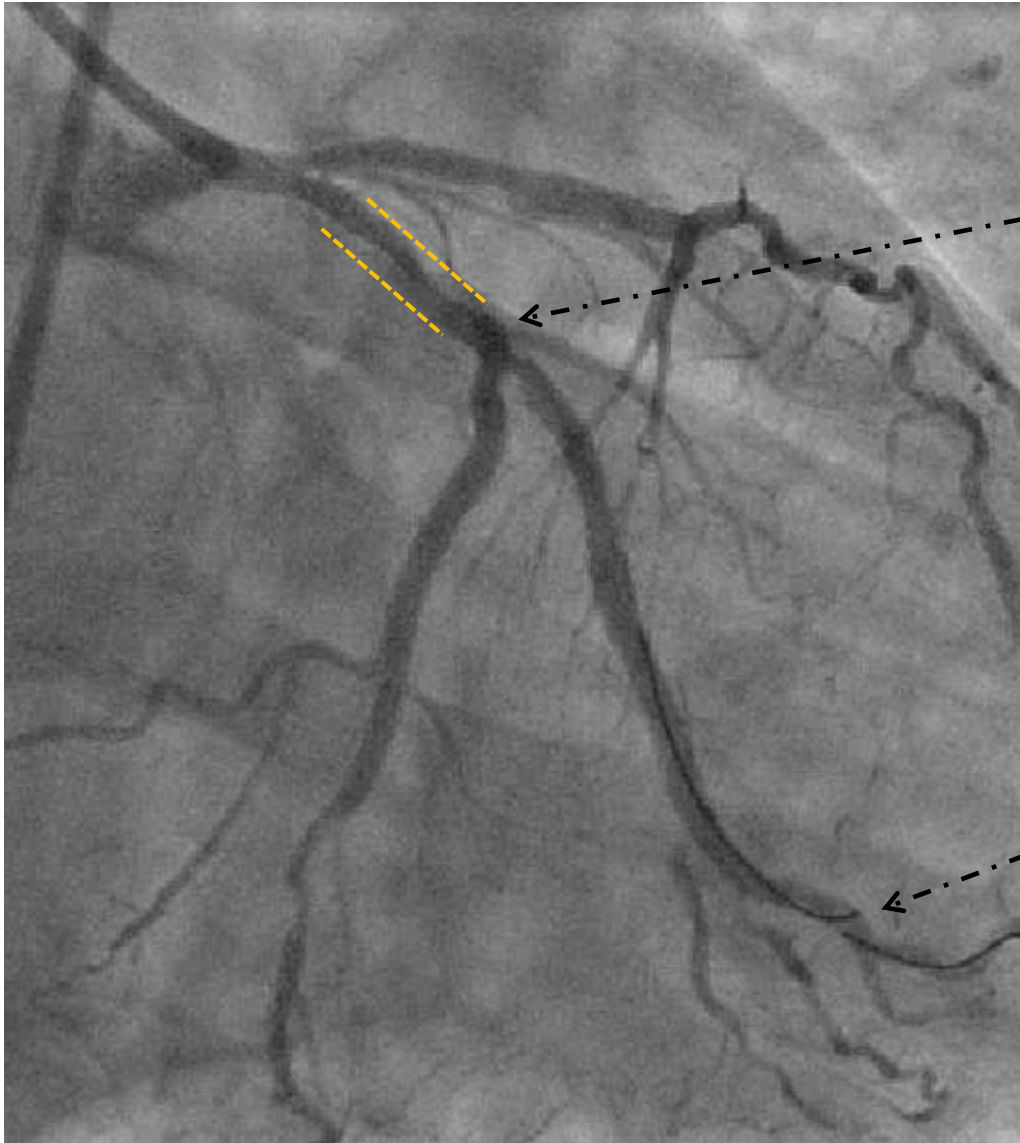
Stent to the Distal Lesion and New FFR assessment



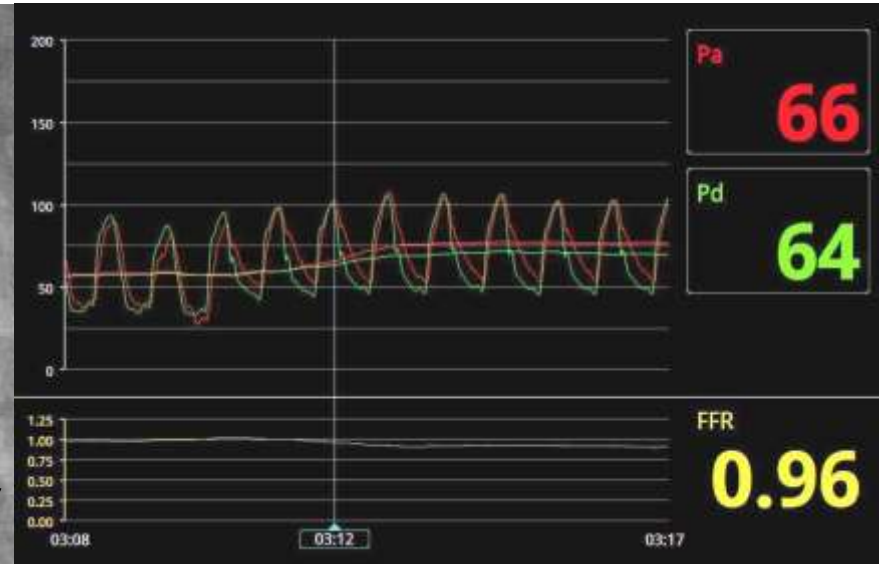
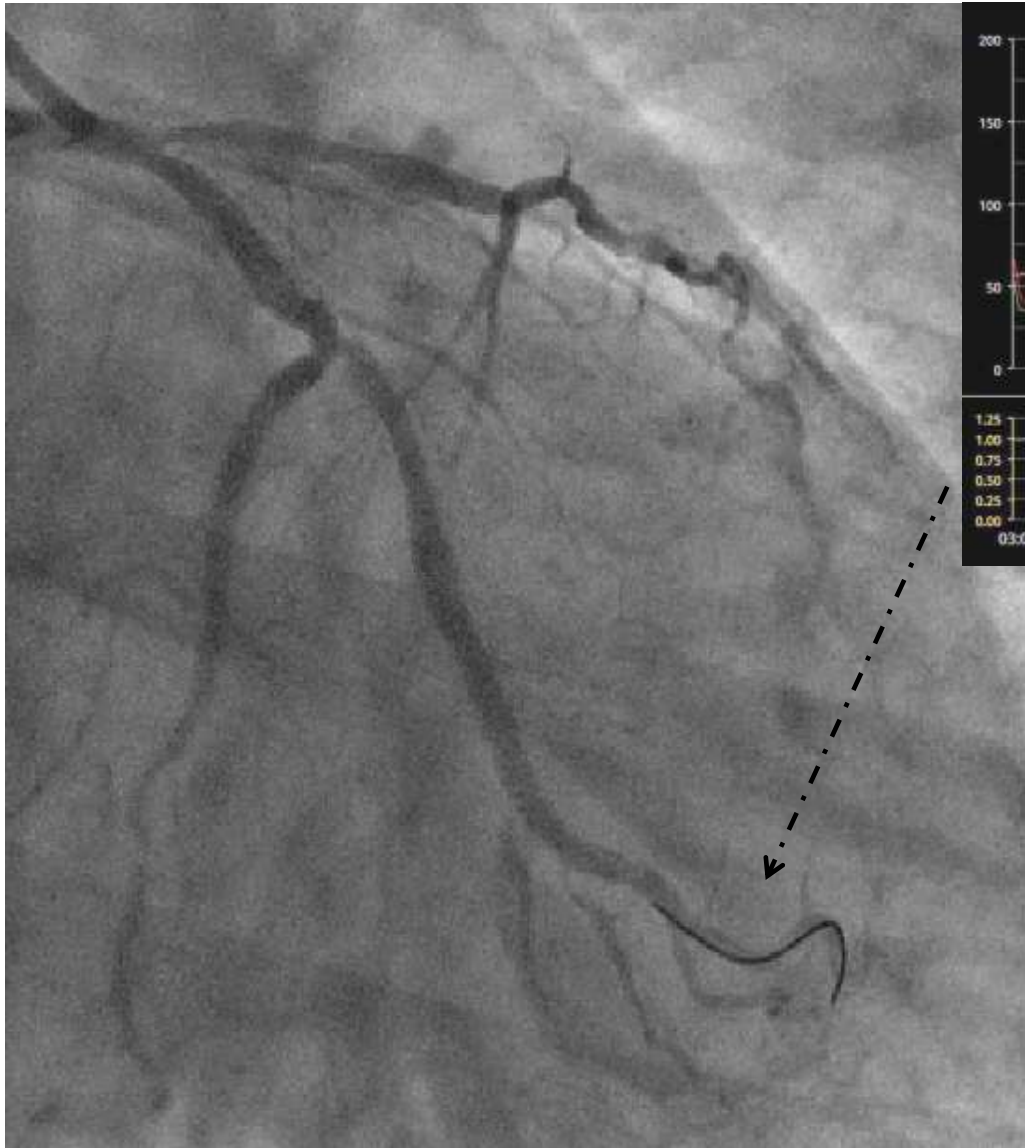
↓ Actual



Stent to the Distal Lesion and New FFR assessment



Distal FFR after OCT Optimised Stent Deployment to the Proximal and Distal lesion



4 FFR pull-backs, 3 adenosine syringes changed from iv pump, 2 pressure wires used
Approx. 25 more minutes and significant extra-cost added

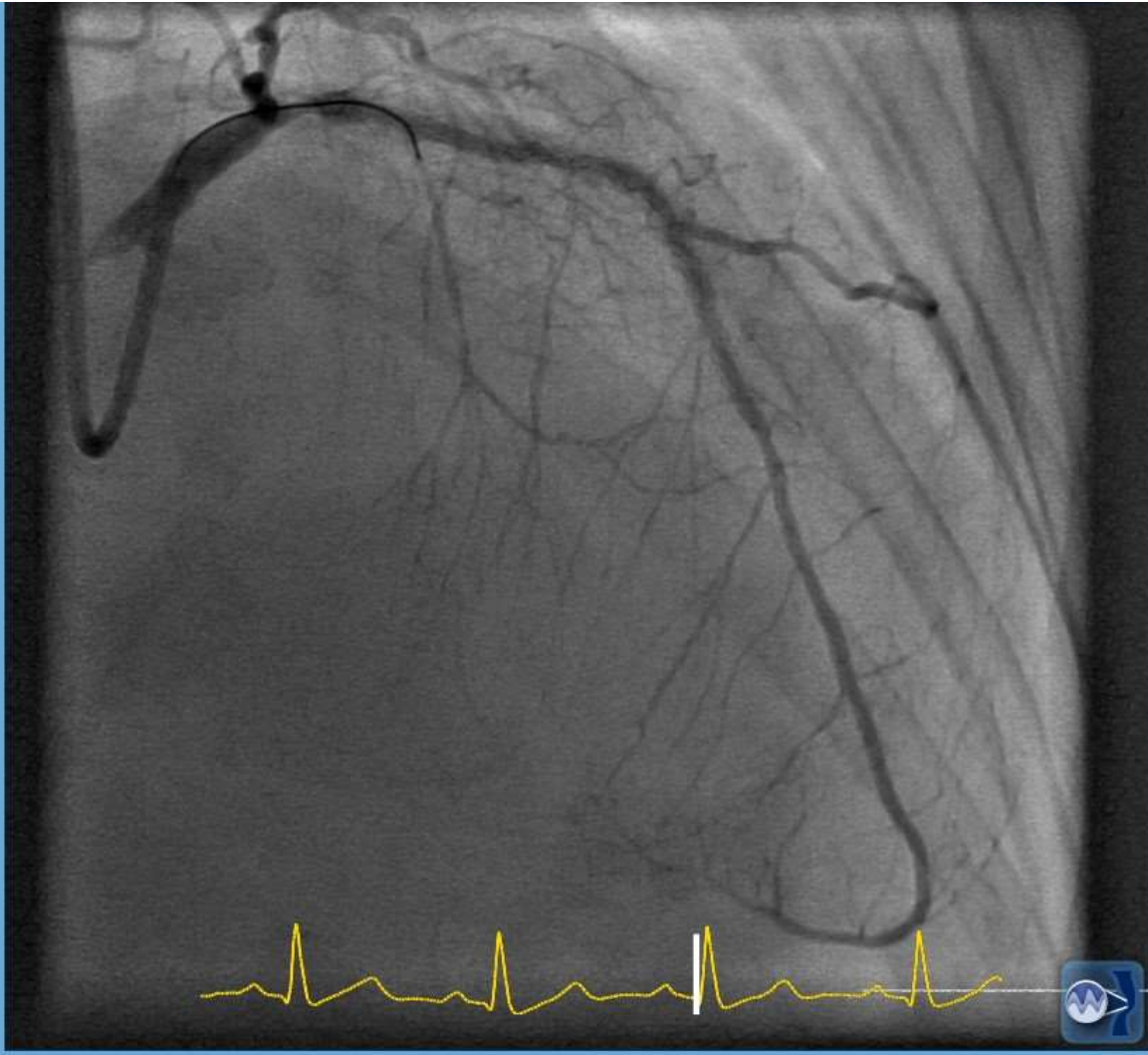
FFR in serial lesion assessment

- **Not possible** to independently interrogate tandem lesions with FFR
- 3-5 beat averaging means unable to demarcate beginning-end of stenosis clearly
- Not possible to visualize some stenoses

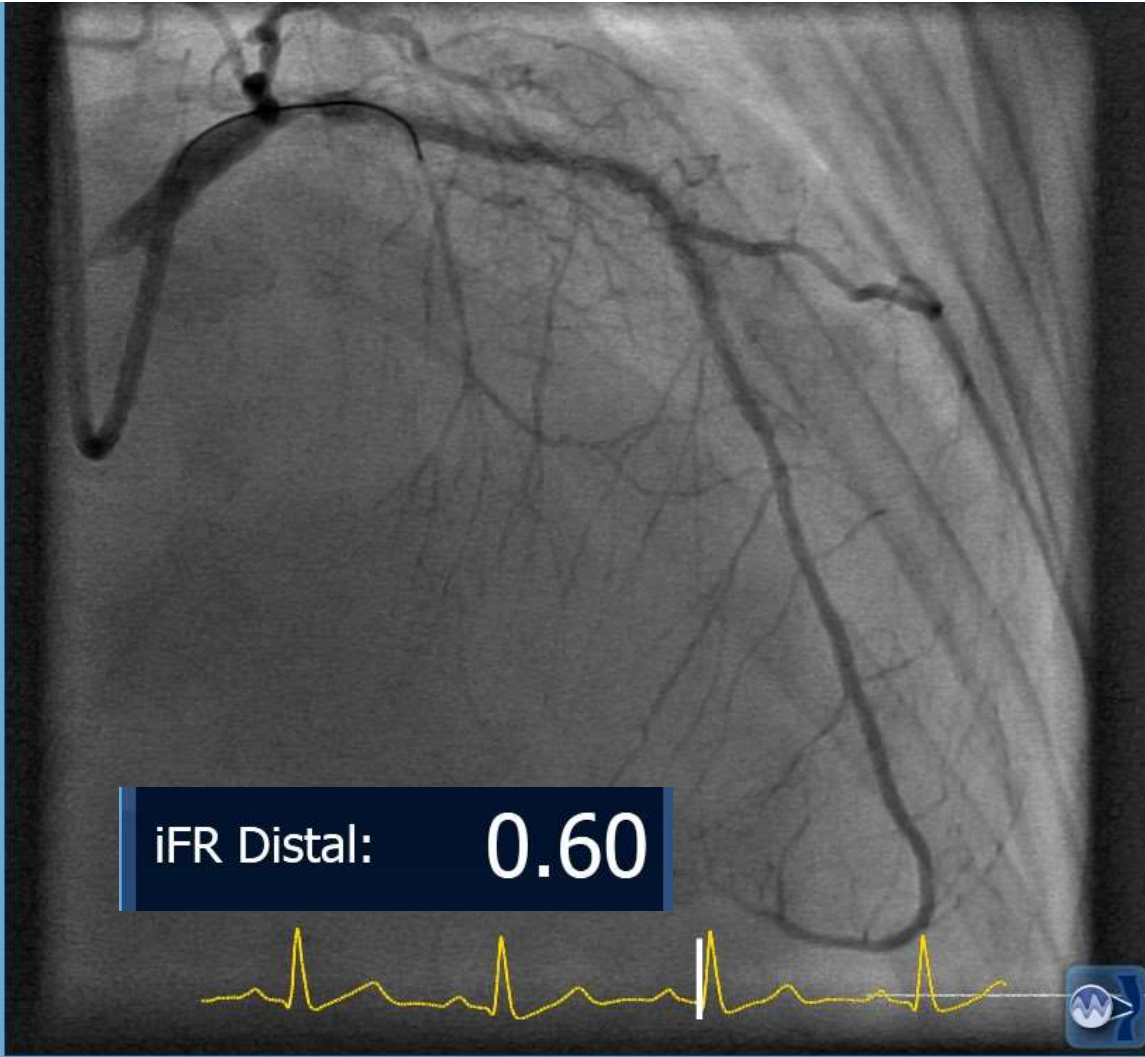
CASE 1 – Hammersmith Hospital

- 75 Male
- 6 month history of chest pain
- Presented with NSTEMI
- Troponin positive
- Preserved LV systolic function
- Normal Labs

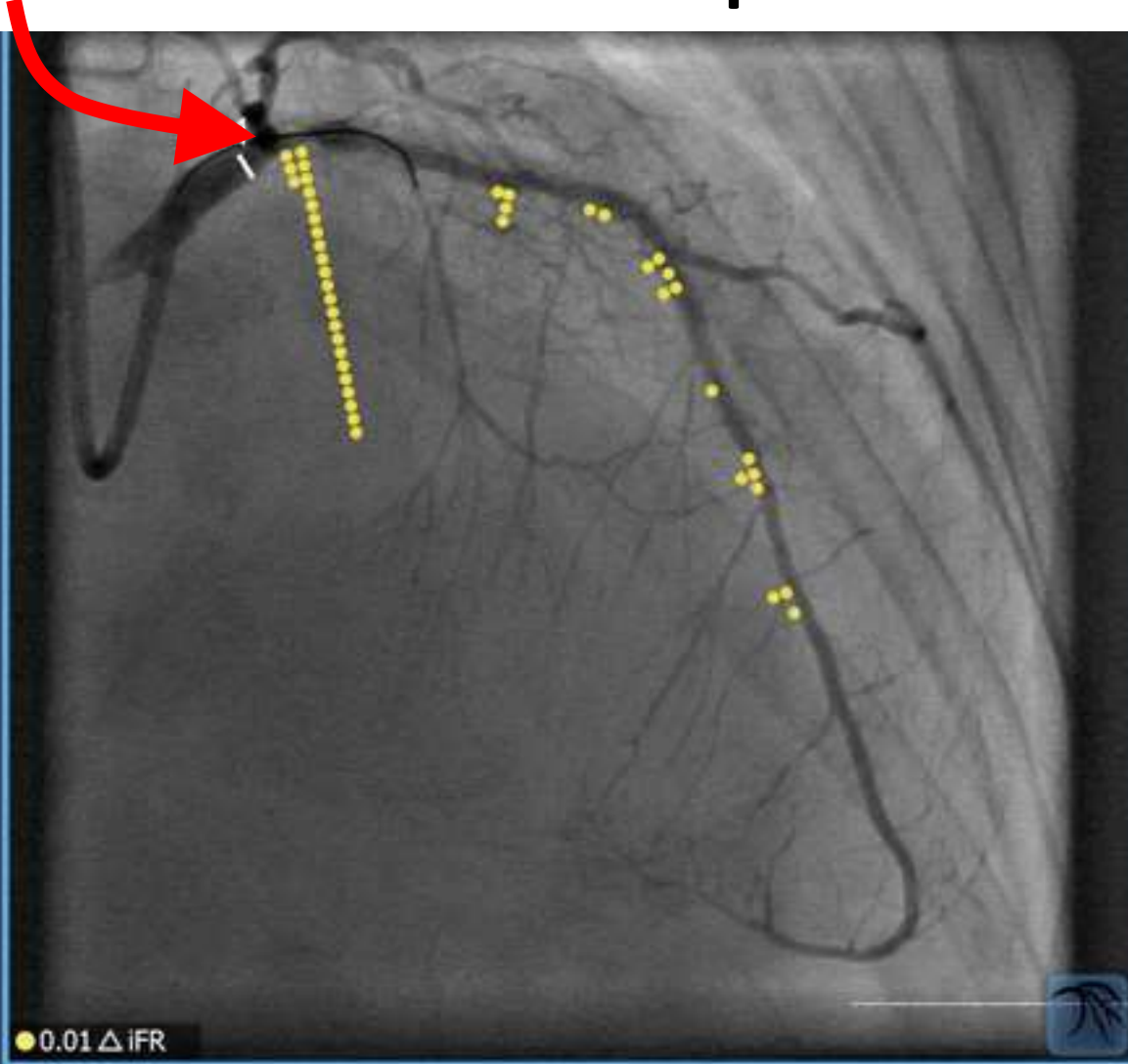
Is there a focal LAD lesion to treat?



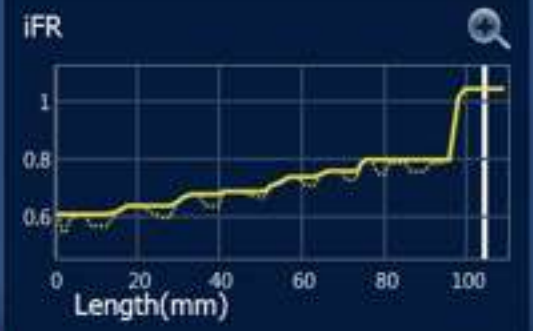
Is there a focal LAD lesion to treat?



Yes- focal lesion present

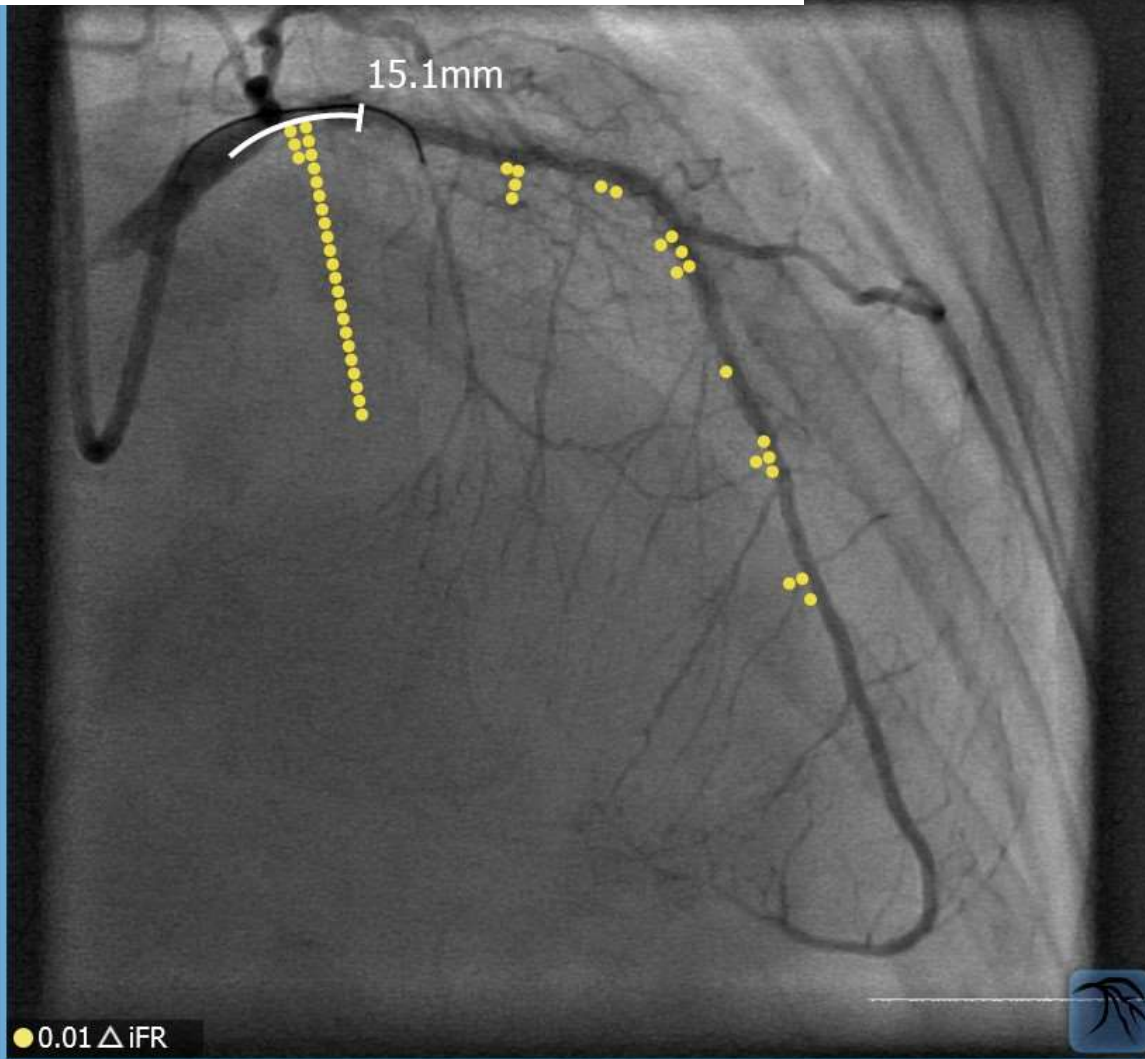


iFR Distal: 0.60



Navigation controls including a play/pause button, a sequence indicator "Seq 2/2", and a small tree icon.

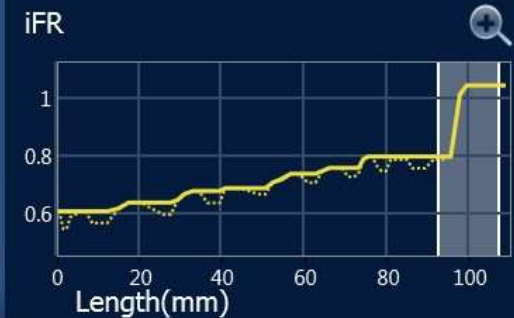
Calibrated length

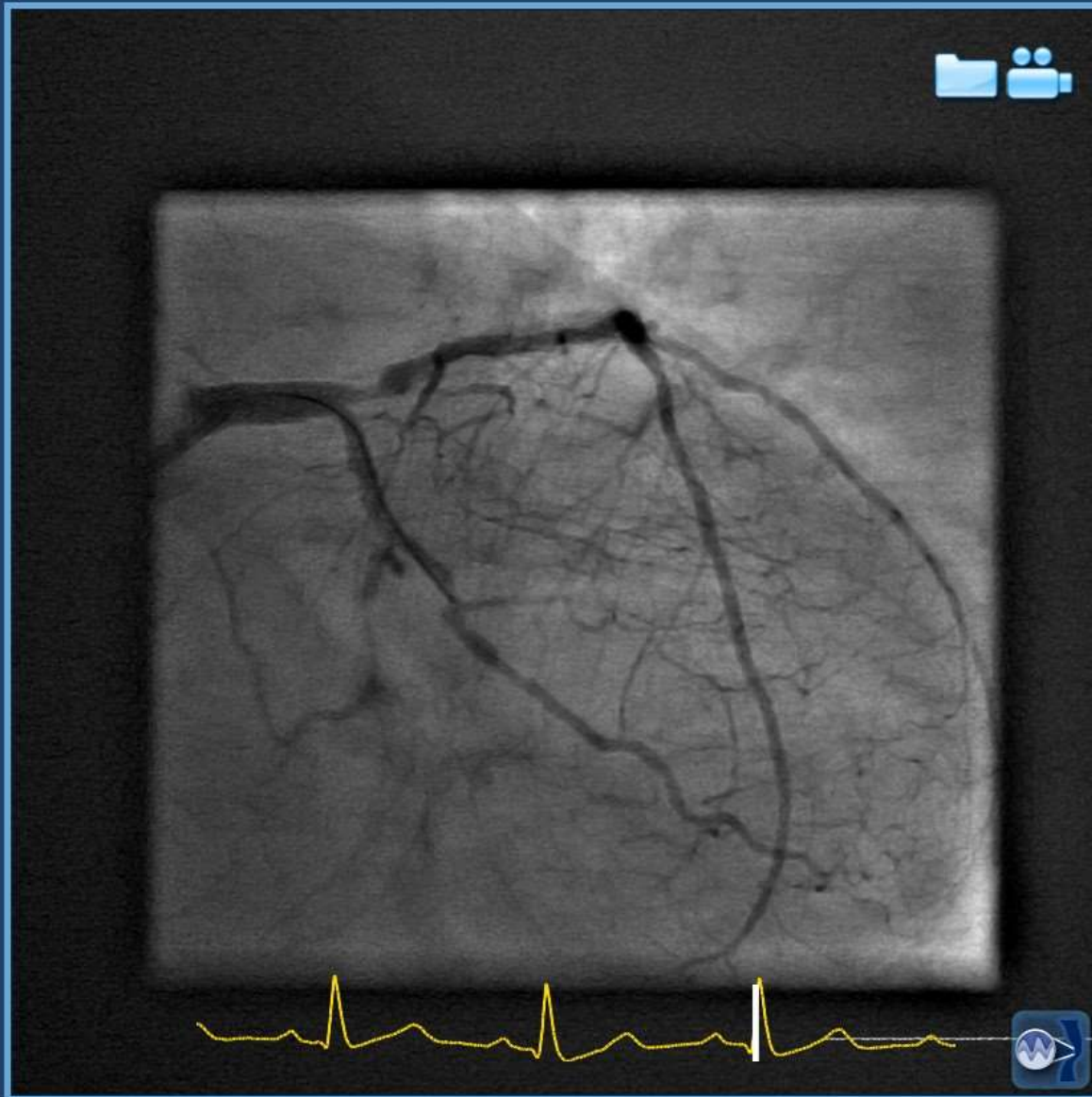


iFR Distal: 0.60

iFR drop
in selection : 0.25

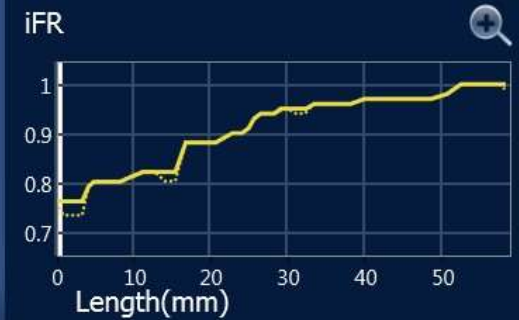
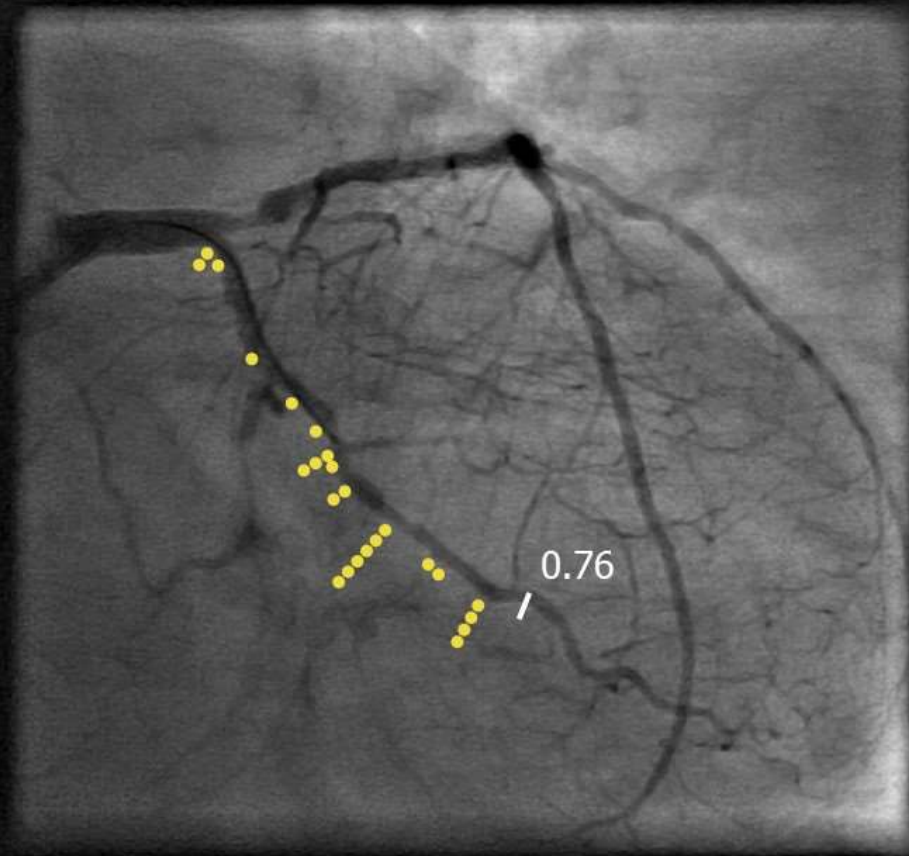
Length: 15.1mm





iFR Distal: 0.76

iFR at Cursor: 0.76

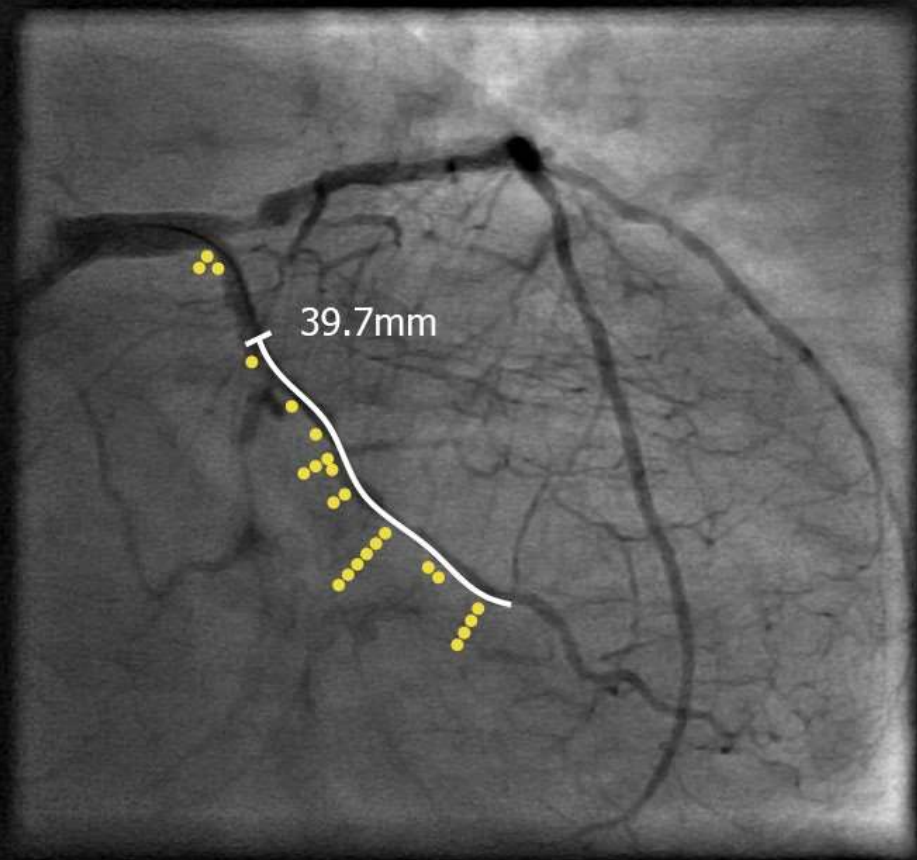


● 0.01 Δ iFR



Seq
1/2

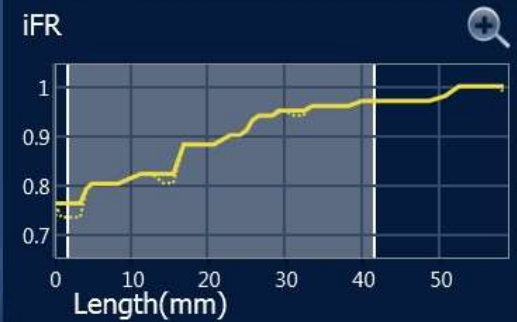
 **VOLCANO**
PRECISION GUIDED THERAPY



iFR Distal: **0.76**

iFR drop
in selection : **0.21**

Length: **39.7mm**



● 0.01 Δ iFR



Seq
1/2



  **TUESDAY 16 MAY 2017**  **11:30 -12:50**  **MAIN ARENA**

Late-breaking trials and trial update ▶



Chairpersons:

D. Capodanno , W. Wijns

Panellists:

V. Bapat , R. Byrne , R. Gao , P. Juni , U. Kaul , C. Lotan

Speakers:

T. Cuisset , R.J. De Winter , J. Escaned , T. Feldman

Theme / Topic:

Coronary Interventions, Interventions for Valvular Disease

Session format:

Hot Line / LBT

12:10

Safety of coronary revascularisation deferral based on iFR and FFR measurements in stable angina and acute coronary syndromes. A pooled patient-level analysis of DEFINE FLAIR and IFR SWEDEHEART trials

J. Escaned

Take homes from DEFINE-FLAIR and iFR SwedeHeart

- iFR is as safe as FFR to guide coronary revascularization decision-making
- iFR has fewer adverse side effects and symptoms
- iFR is quicker to perform