

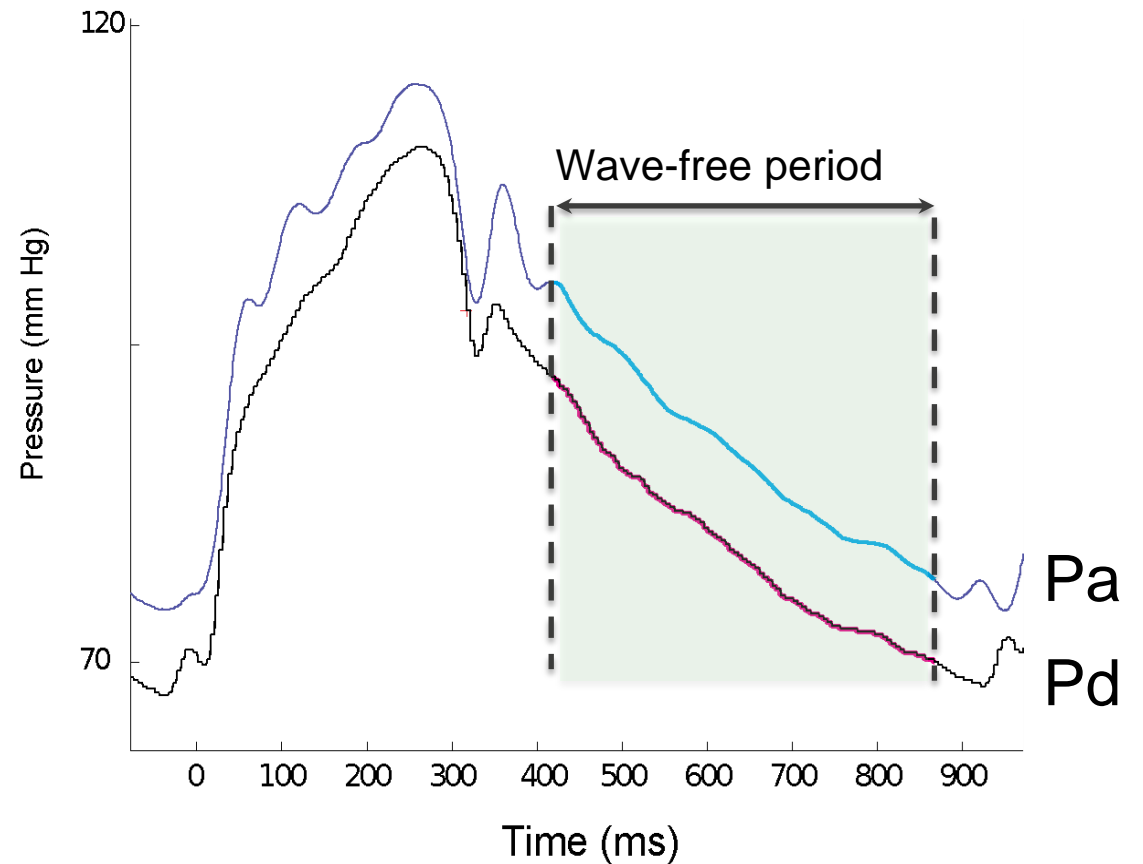
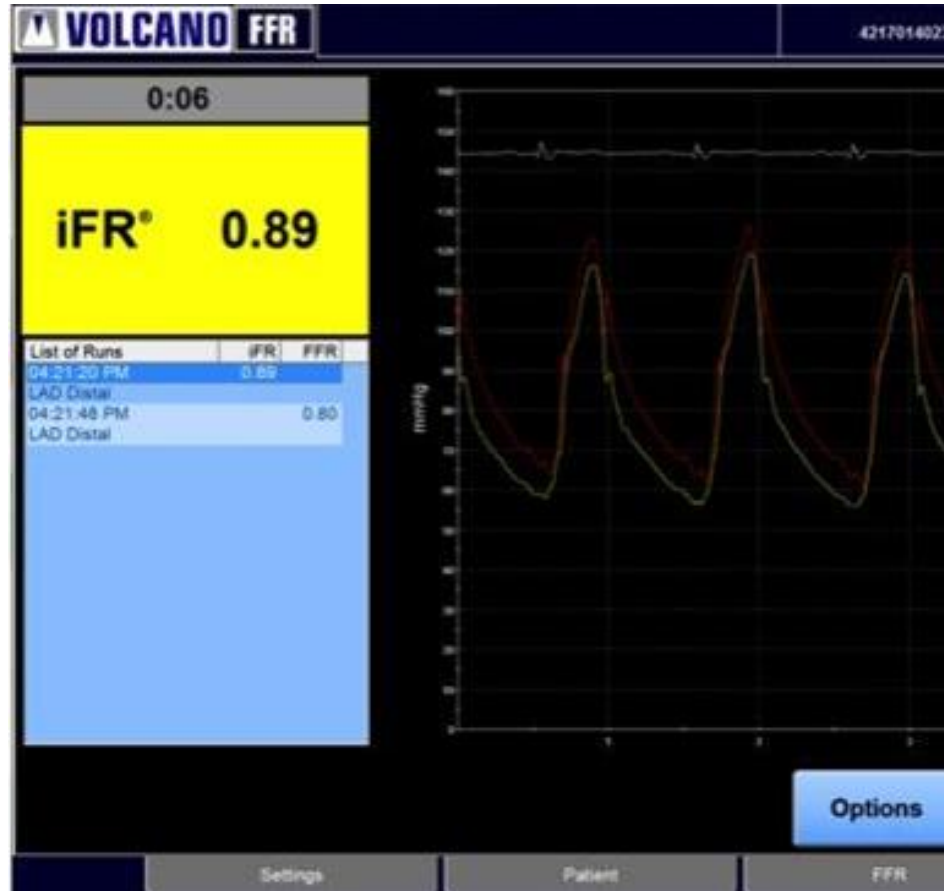
***iFR guided PCI
-Case review-***

The image shows the exterior of a modern, multi-story hospital building at dusk. The building is illuminated from within, with many windows glowing yellow. A logo featuring a heart and the year '1977' is visible on the left side of the building. The sky is a deep blue, and a road with white lane markings is in the foreground.

***Hitoshi Matsuo M.D.,
The Department of cardiovascular Medicine
Gifu Heart Center***

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 history



March 13th 2013 First measurement of iFR in GHC

April 23rd 2014 First enrollment to DEFINE FLAIR in GHC



Aug/23/2016, First use of Syncvision software in GHC



ADVISE

VERIFY

ADVISE REG

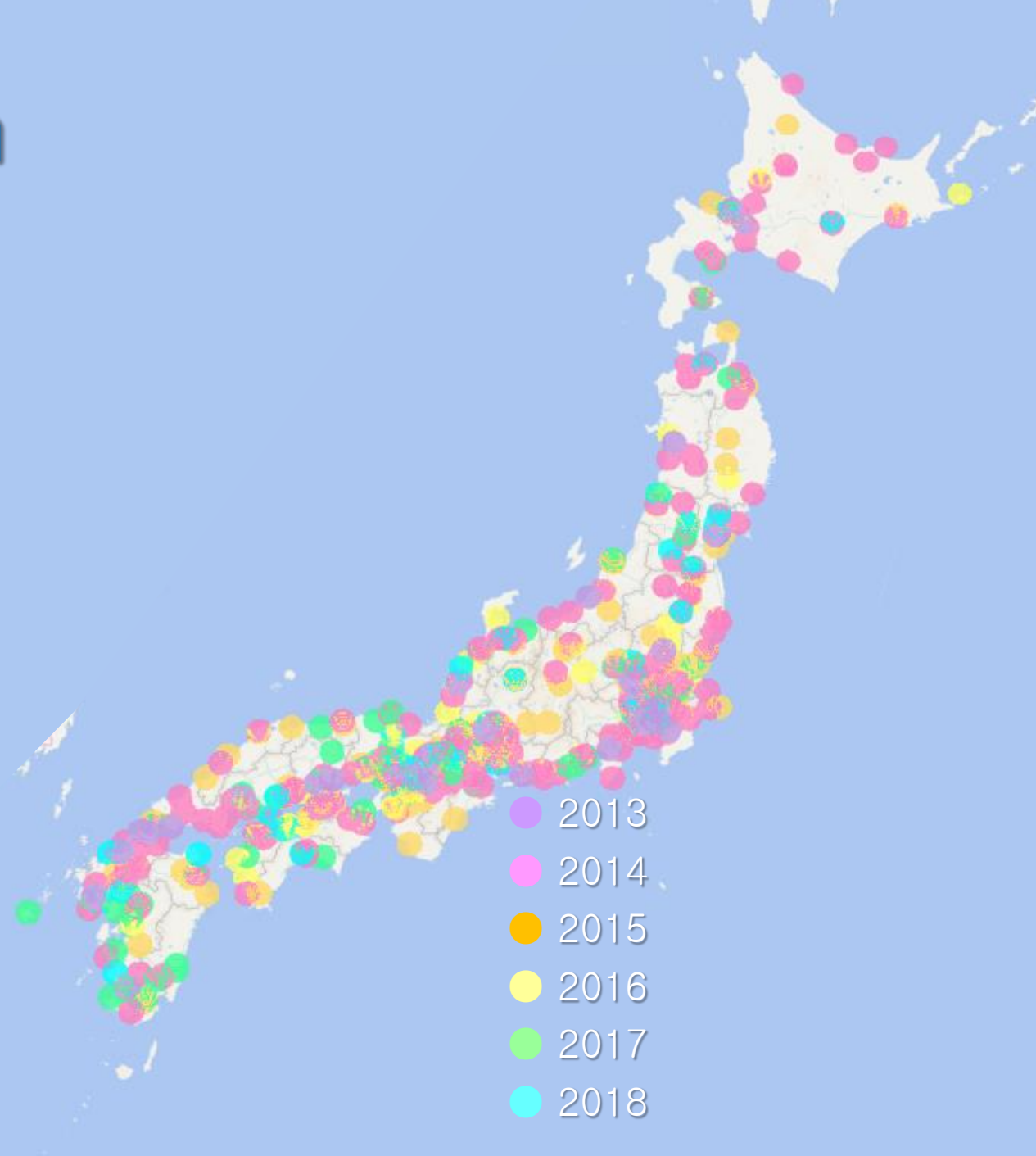
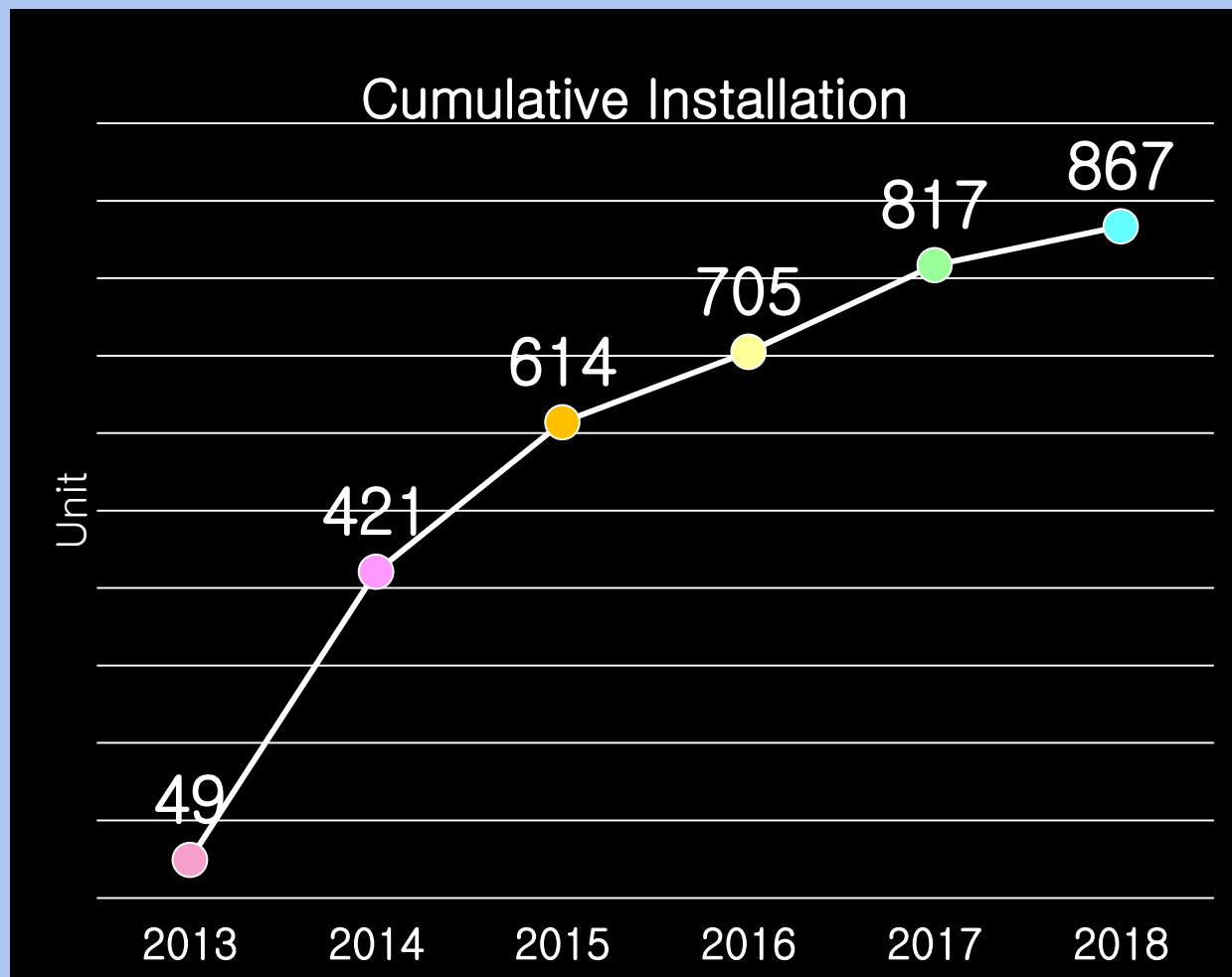
**RESOLVE
JUSTIFY-CFR
VU (PET)**

**ADVISE II
FORECAST
AMC (MPI)**

**SNUH
(PET)**

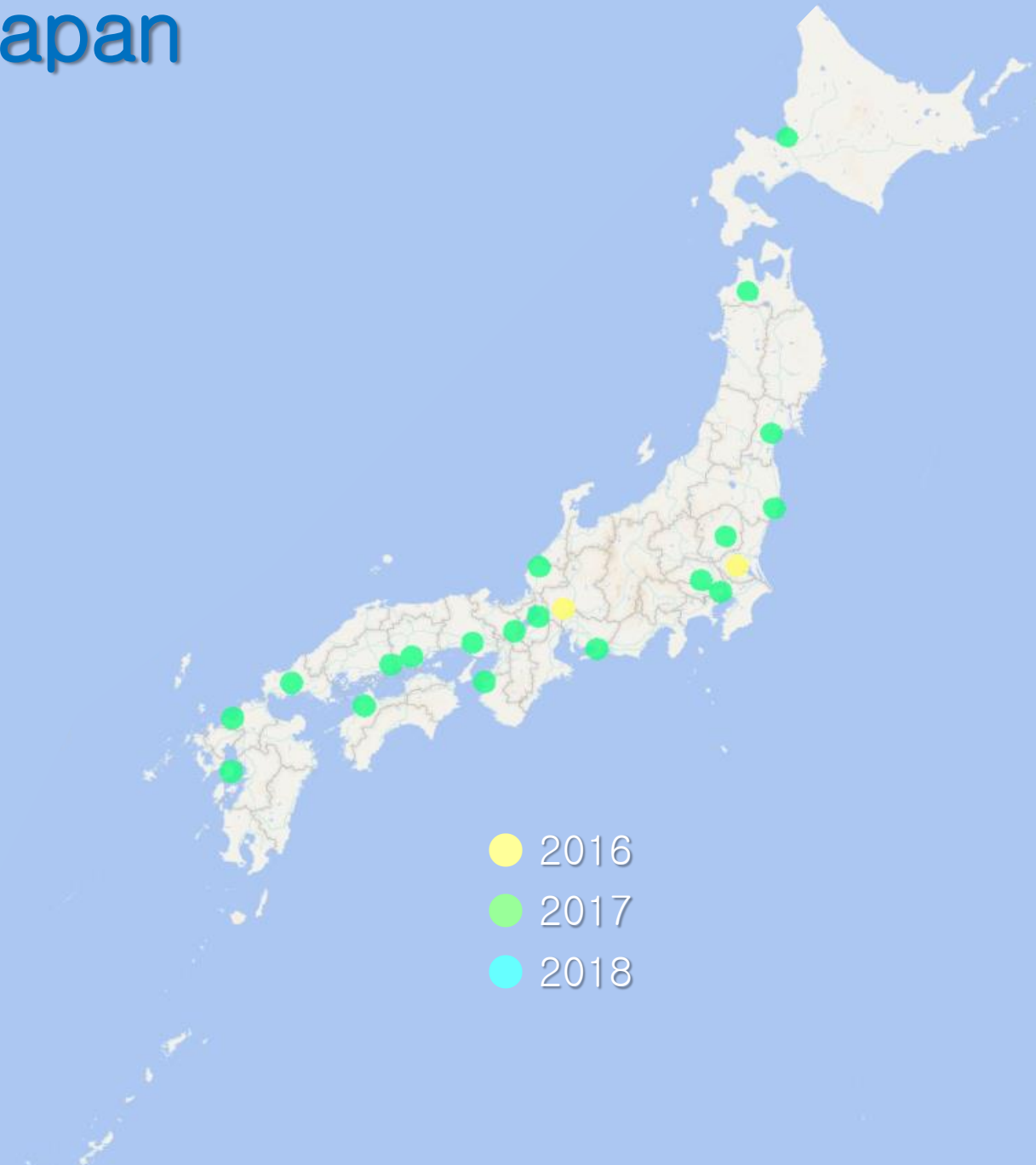
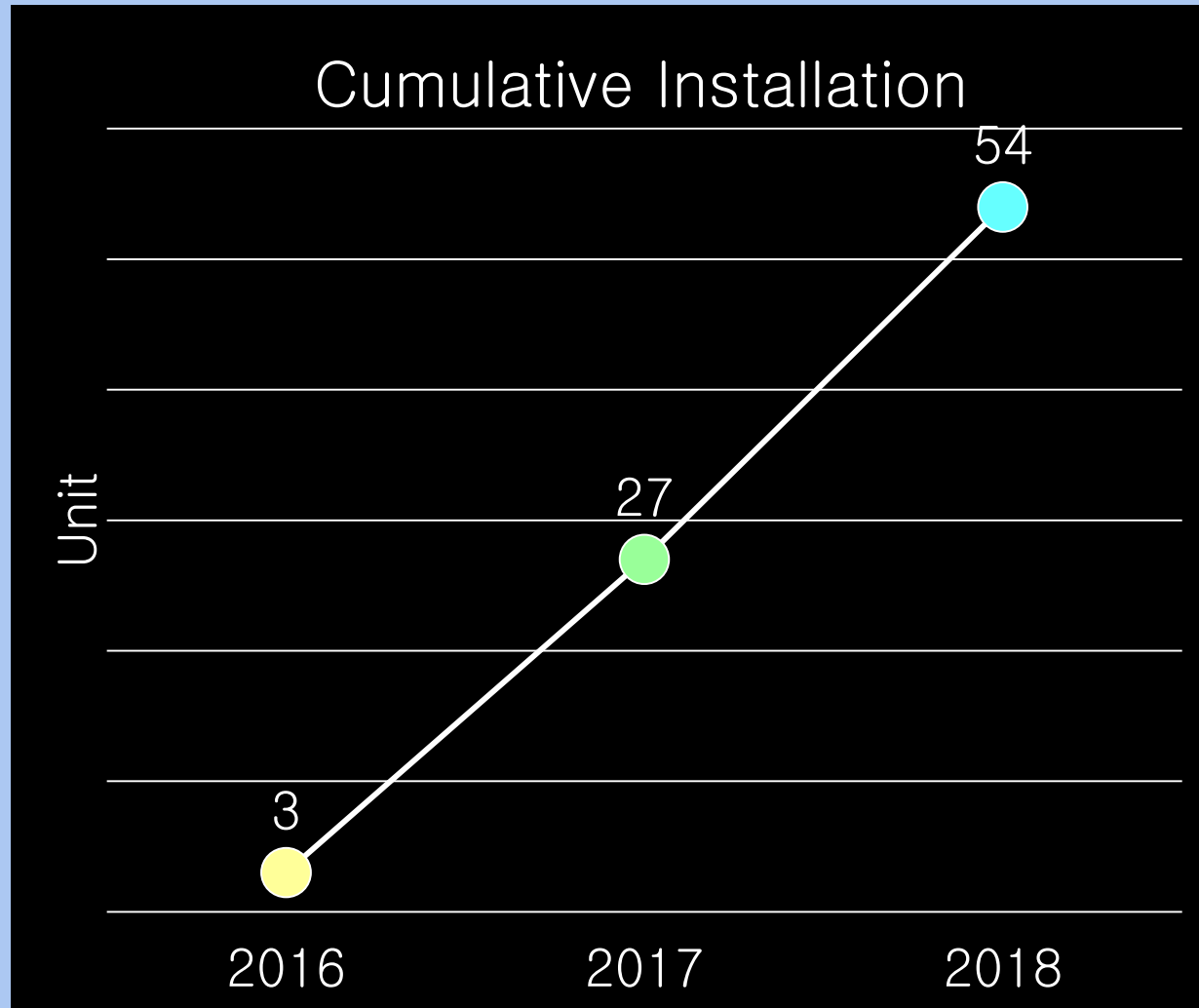
**DEFINE
FLAIR
iFR SWEDEHEART**

iFR Installation in Japan



(As of June 30, 2018)

SyncVision Installation in Japan



(As of June 30, 2018)

ESC Guideline of coronary revascularization (Neumann, Sousa-Uva et al. 2018)

Recommendations on functional testing and intravascular imaging for lesion assessment

Recommendations	Class ^a	Level ^b
When evidence of ischaemia is not available, FFR or iwFR are recommended to assess the haemodynamic relevance of intermediate-grade stenosis. ^{15,17,18,39}	I	A
FFR-guided PCI should be considered in patients with multivessel disease undergoing PCI. ^{29,31}	IIa	B
IVUS should be considered to assess the severity of unprotected left main lesions. ³⁵⁻³⁷	IIa	B

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FFR = fractional flow reserve; iwFR = instantaneous wave-free ratio; IVUS = intravascular ultrasound; PCI = percutaneous coronary intervention.

^aClass of recommendation.

^bLevel of evidence.

When evidence of ischemia is not available, FFR or iwFR are recommended to assess the hemodynamic relevance of intermediate grade stenosis.

FFR guided PCI should be considered in patients with multivessel disease undergoing PCI

iFR Pullback

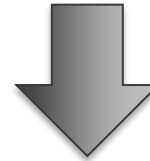
Resting physiological indices beyond spot measurement

Decision making at a vessel level

DEFINE FLAIR



iFR®
SWEDEHEART



Decision making available at a lesion level

**Pre-Angioplasty Instantaneous
Wave-Free Ratio Pullback Provides
Virtual Intervention and Predicts
Hemodynamic Outcome for Serial Lesions
and Diffuse Coronary Artery Disease**



Sukhjinder S. Nijjer, MB ChB,* Sayan Sen, MBBS, PhD,* Ricardo Petraco, MD,* Javier Escaned, MD, PhD,†
Mauro Echavarría-Pinto, MD,† Christopher Broyd, MBBS,* Rasha Al-Lamee, MBBS,* Nicolas Foin, PhD,*
Rodney A. Foale, MD,* Iqbal S. Malik, MBBS, PhD,* Ghada W. Mikhail, MBBS, MD,* Amarjit S. Sethi, MBBS, PhD,*
Mahmud Al-Bustami, MD,* Raffi R. Kaprielian, MBBS, MD,* Masood A. Khan, MB ChB, MA,*
Christopher S. Baker, MBBS, PhD,* Michael F. Bellamy, MBBS, PhD,* Alun D. Hughes, PhD,‡
Jamil Mayet, MB ChB, MD,* Darrel P. Francis, MB ChB, MA, MD,* Carlo Di Mario, MD, PhD,§
Justin E.R. Davies, MBBS, PhD*

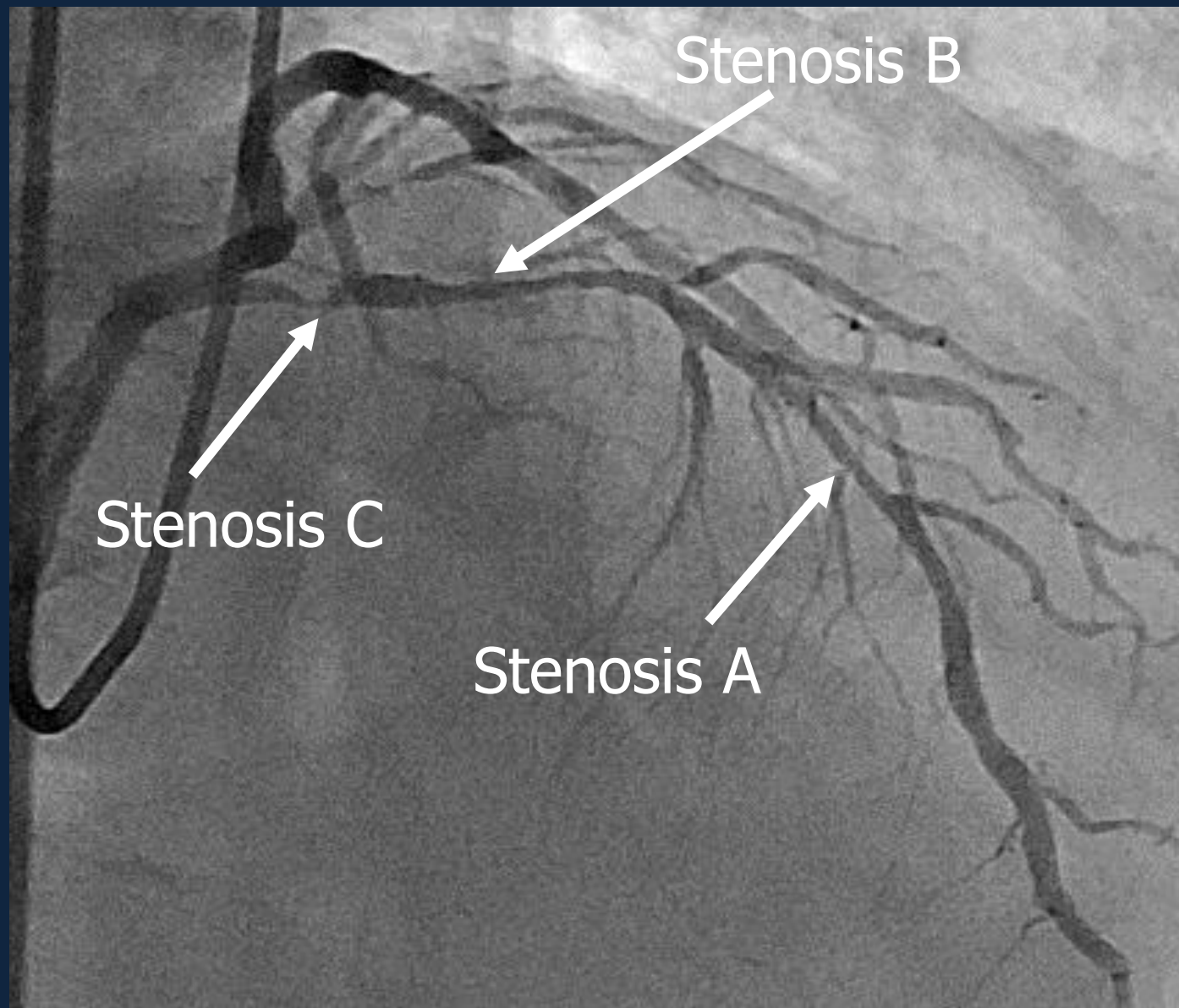
**Pre-Angioplasty Instantaneous
Wave-Free Ratio Pullback Predicts
Hemodynamic Outcome In Humans
With Coronary Artery Disease**



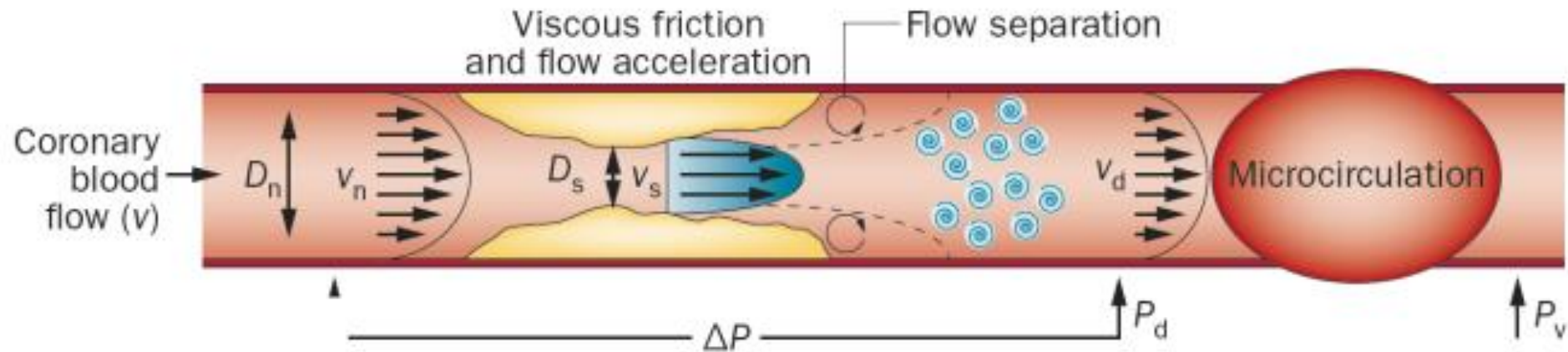
**Primary Results of the International Multicenter
iFR GRADIENT Registry**

Yuetsu Kikuta, MD,^{a,b,*} Christopher M. Cook, MBBS,^{a,*} Andrew S.P. Sharp, MD,^c Pablo Salinas, MD,^d
Yoshiaki Kawase, MD,^e Yasutsugu Shiono, MD, PhD,^a Alessandra Giavarini, MD,^f Masafumi Nakayama, MD, PhD,^g
Salvatore De Rosa, MD, PhD,^h Sayan Sen, MBBS, PhD,^a Sukhjinder S. Nijjer, MBChB, PhD,^a Rasha Al-Lamee, MD,^a
Ricardo Petraco, MD, PhD,^a Iqbal S. Malik, MBBS, PhD,^a Ghada W. Mikhail, MBBS,^a Raffi R. Kaprielian, MBBS, MD,^a
Gilbert W.M. Wijntjens, MD,ⁱ Shinsuke Mori, MD,^j Arata Hagikura, MD,^b Martin Mates, MD,^k Atsushi Mizuno, MD,^l
Farrel Hellig, MD,^m Kelvin Lee, MD,ⁿ Luc Janssens, MD,^o Kazunori Horie, MD,^p Shah Mohdnazri, MBBS,^q
Raul Herrera, MD,^d Florian Krackhardt, MD,^r Masahiro Yamawaki, MD,^l John Davies, MBBS, PhD,^q
Hideo Takebayashi, MD, PhD,^o Thomas Keeble, MD,^a Seiichi Haruta, MD, PhD,^b Flavio Ribichini, MD, PhD,^q
Ciro Indolfi, MD, PhD,^h Jamil Mayet, MBChB, MD,^a Darrel P. Francis, MB ChB, MA, MD,^a Jan J. Piek
Carlo Di Mario, MD, PhD,^f Javier Escaned, MD, PhD,^d Hitoshi Matsuo, MD, PhD,^{a,*} Justin E. Davies, N

Assesemnt of Tandem lesion

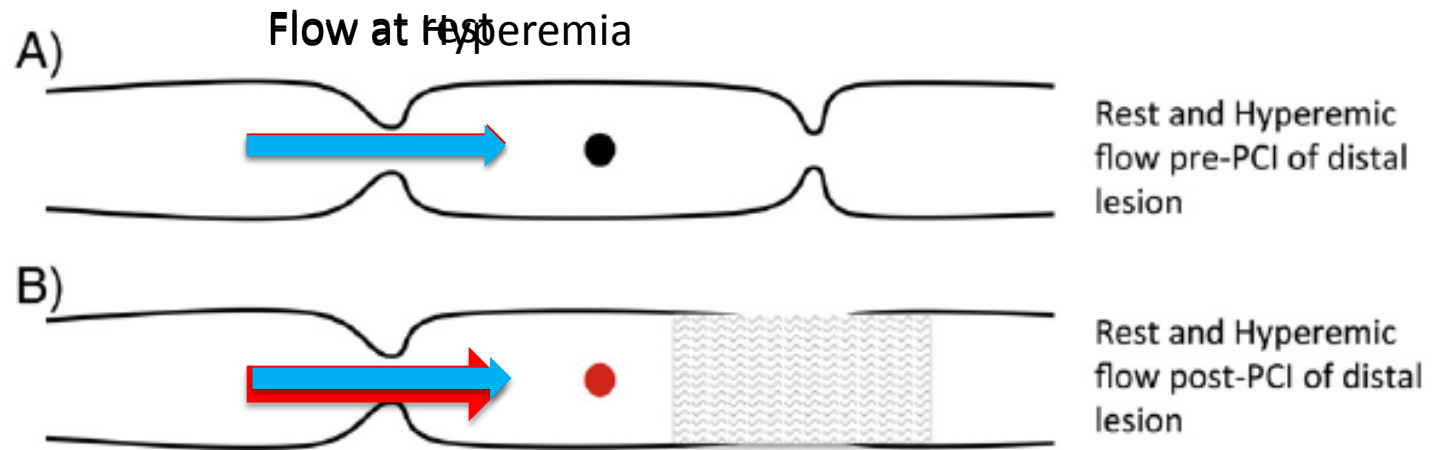
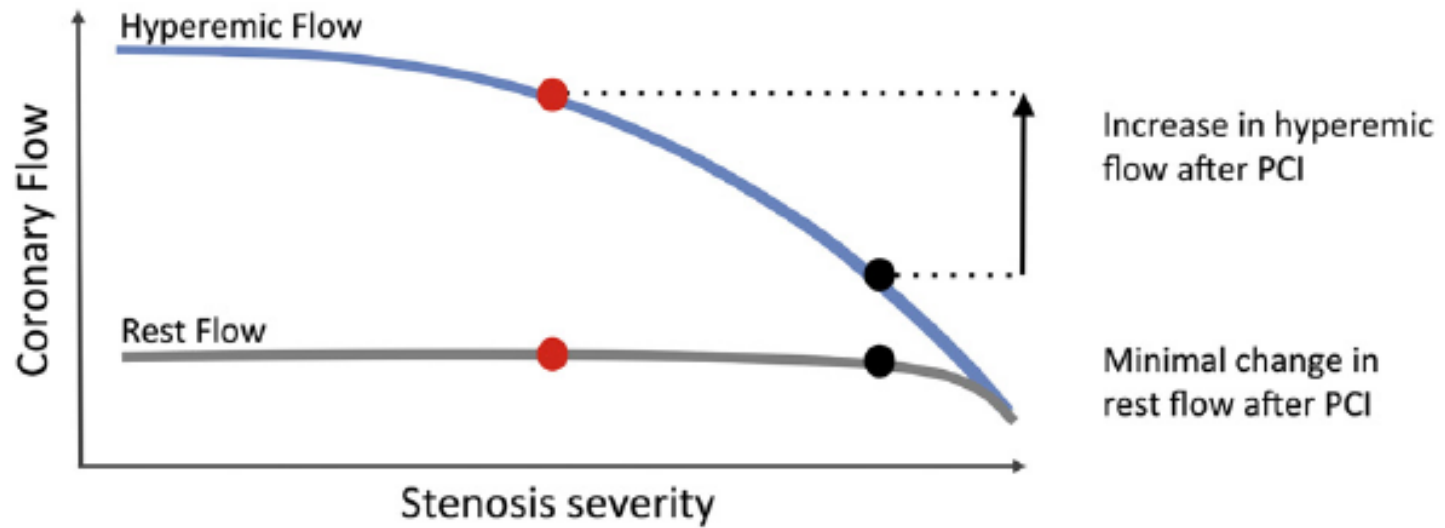


Pressure drop depends on Flow

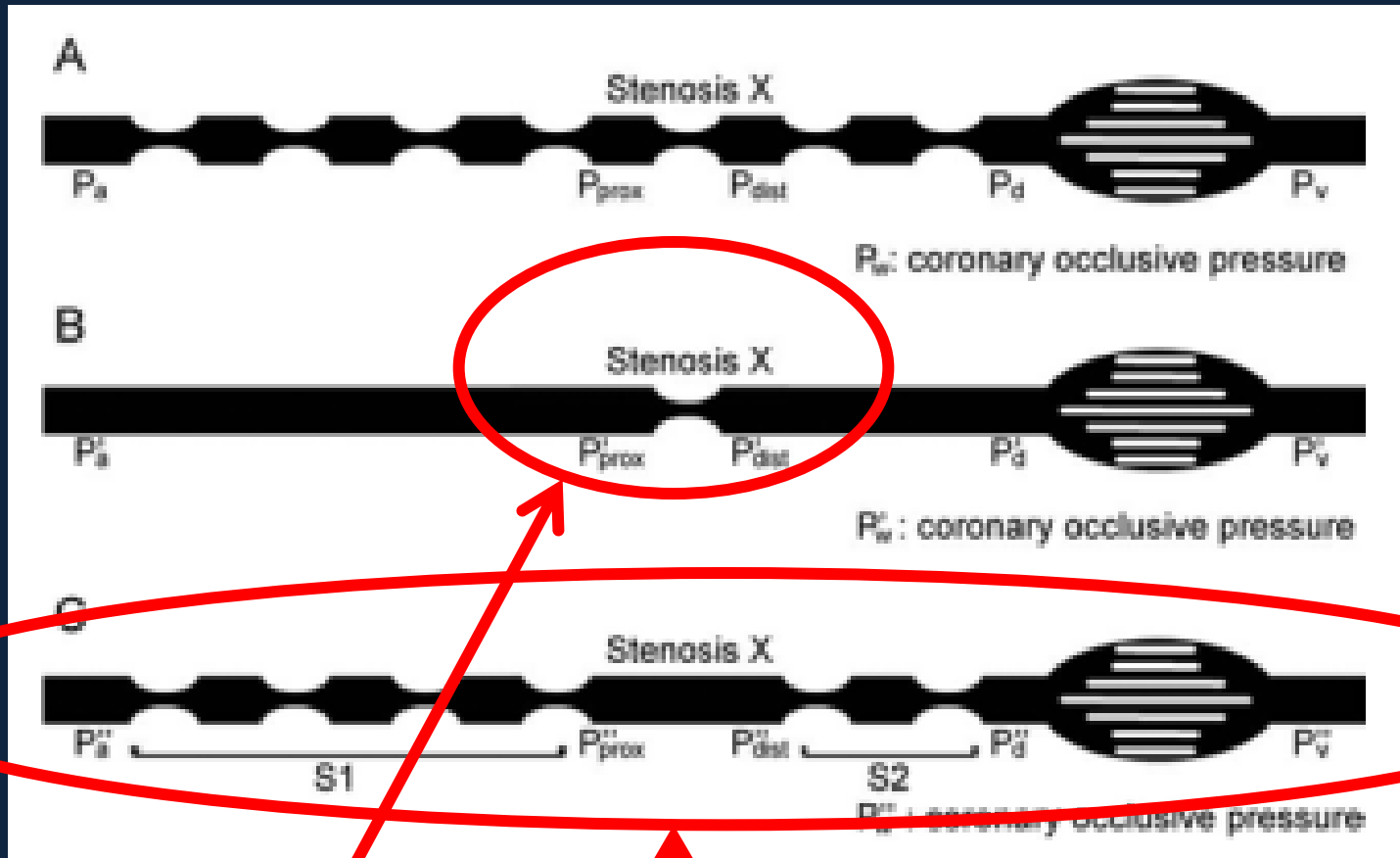


The general equation relating pressure loss, ΔP , to flow velocity, V , is:

$$\Delta P = FV + SV^2 \quad (1)$$

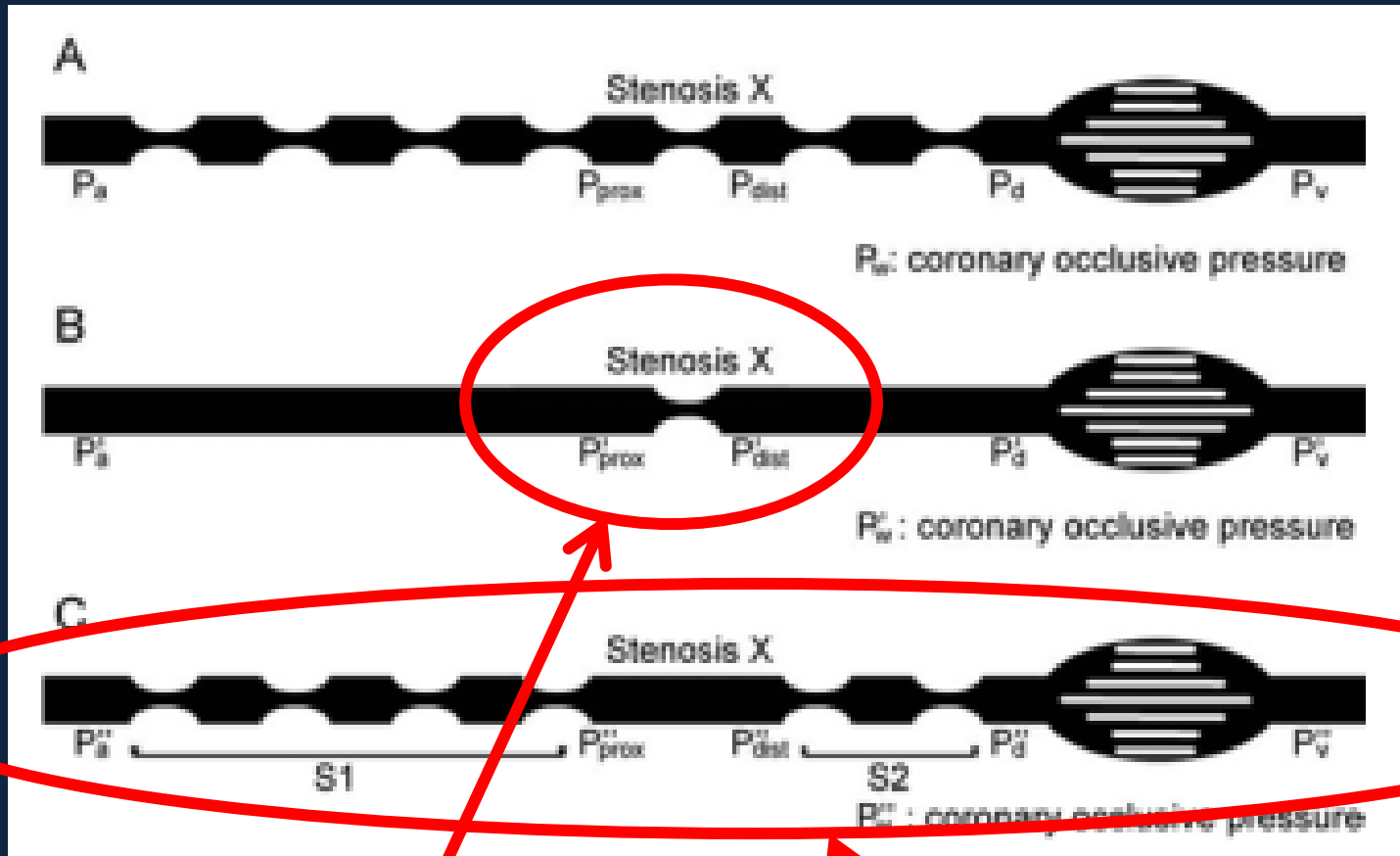


Model of multiple sequential stenosis



$$\begin{aligned}
 FFR(X-)_{pred} &= \frac{P_d - P_w}{P_a - P_{prox} + P_{dist} - P_w} + \frac{P_w(P_a - P_{prox} + P_{dist} - P_d)}{P_a(P_a - P_{prox} + P_{dist} - P_w)} \\
 &= \frac{P_d - P_w}{P_a - \Delta P - P_w} + \frac{P_w(P_a - \Delta P - P_d)}{P_a(P_a - \Delta P - P_w)} \quad (B)
 \end{aligned}$$

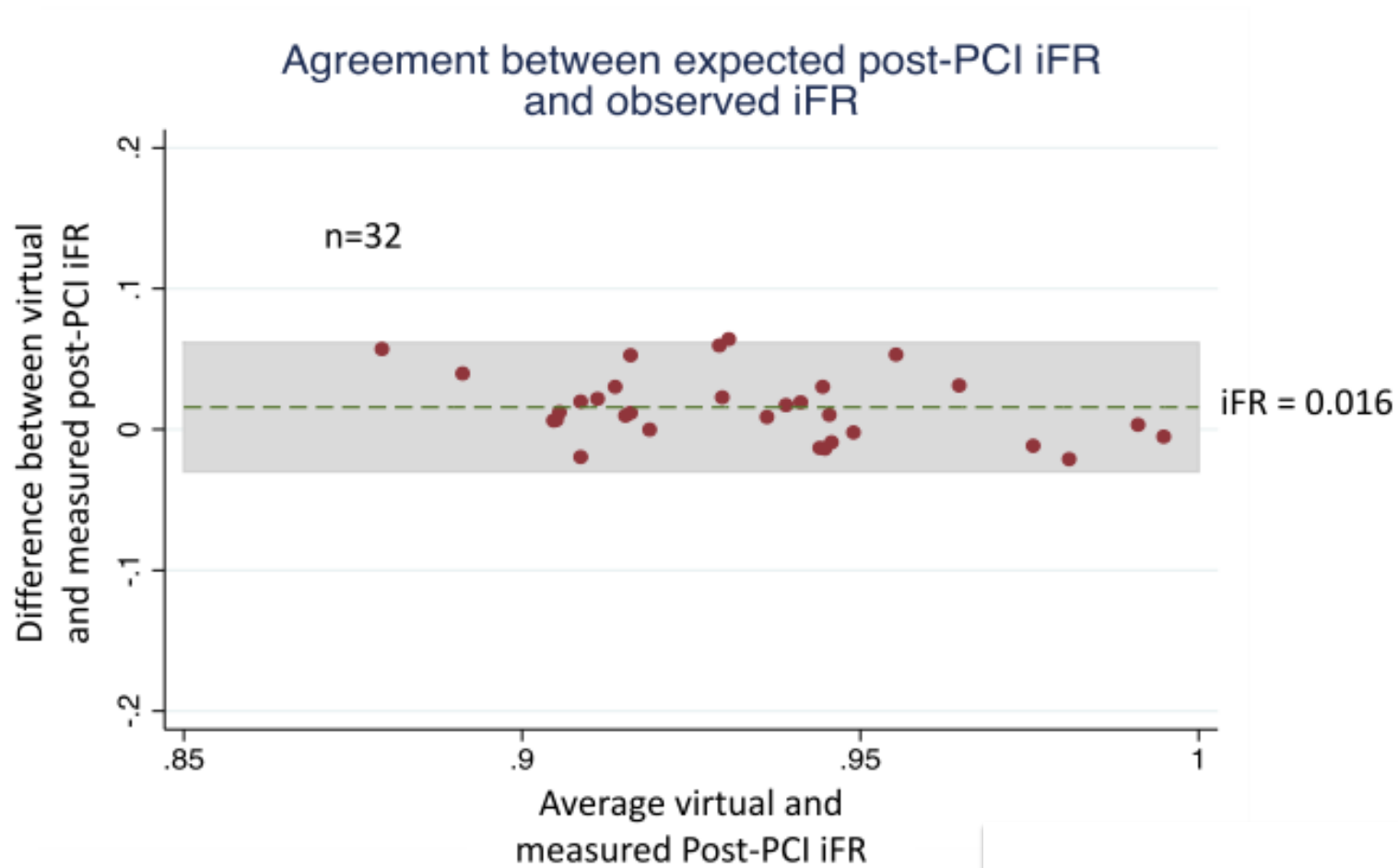
In Vitro Assessment of Mathematically-Derived FFR in Coronary Lesions With More Than Two Sequential Stenoses

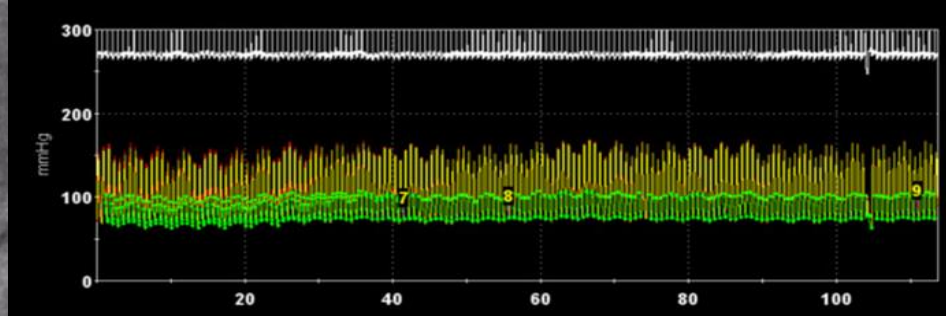
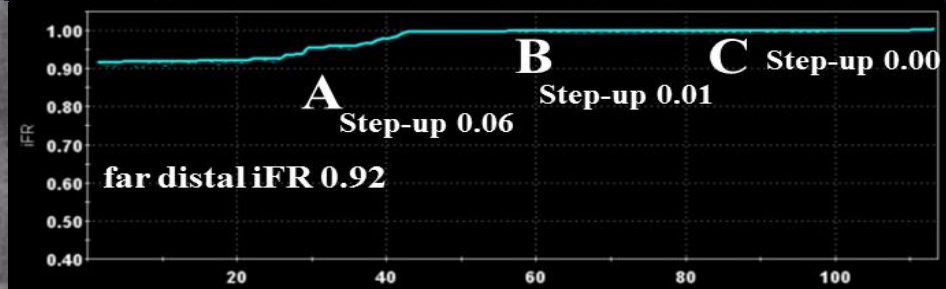
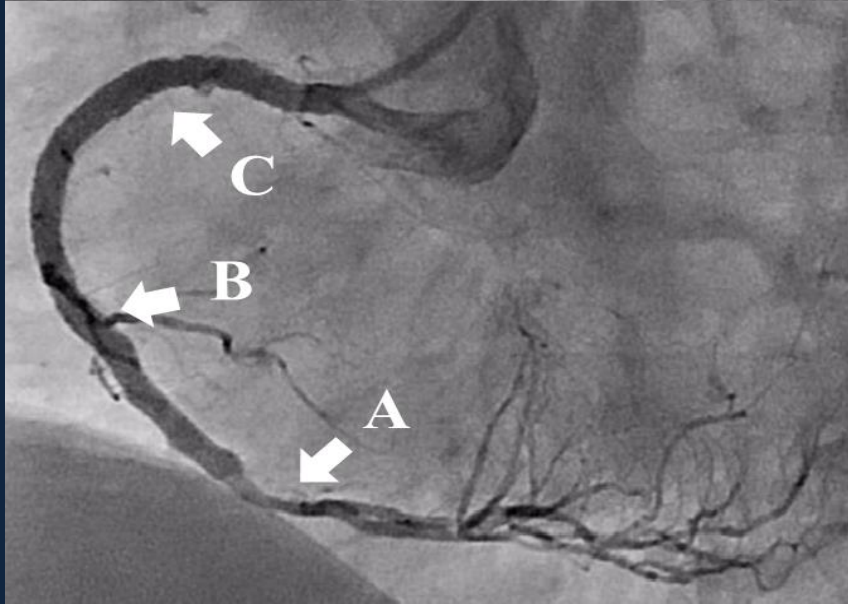
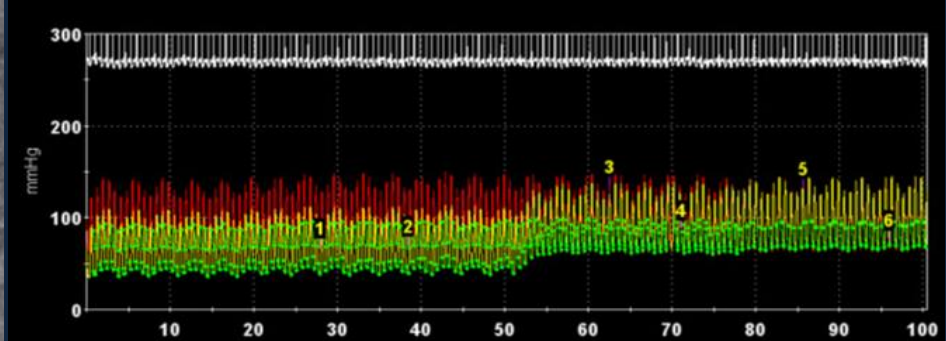
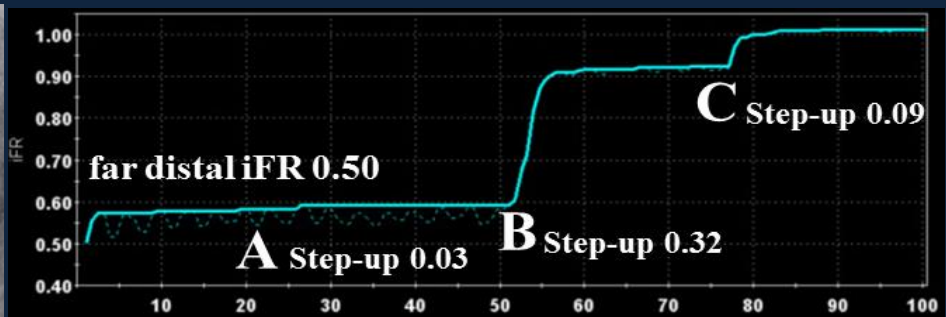
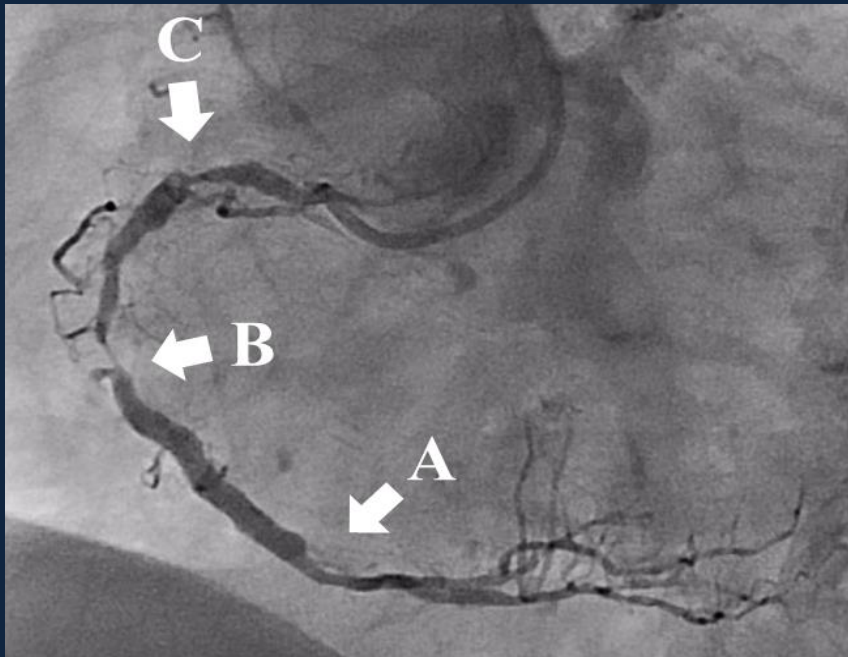


$$iFR(X-) = iFR_{pre} + \Delta iFR(X)$$

$$iFR(X)_{Pred} = 1 - \Delta iFR(X)$$

No systematic underestimation of lesion severity with iFR pullback

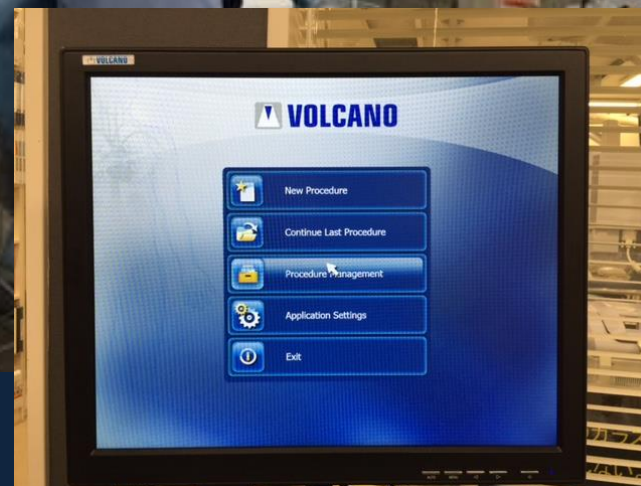




Matsuo H, Kawase Y. Cardiovasc Interv Ther. 2016 Jul;31(3):183-95.

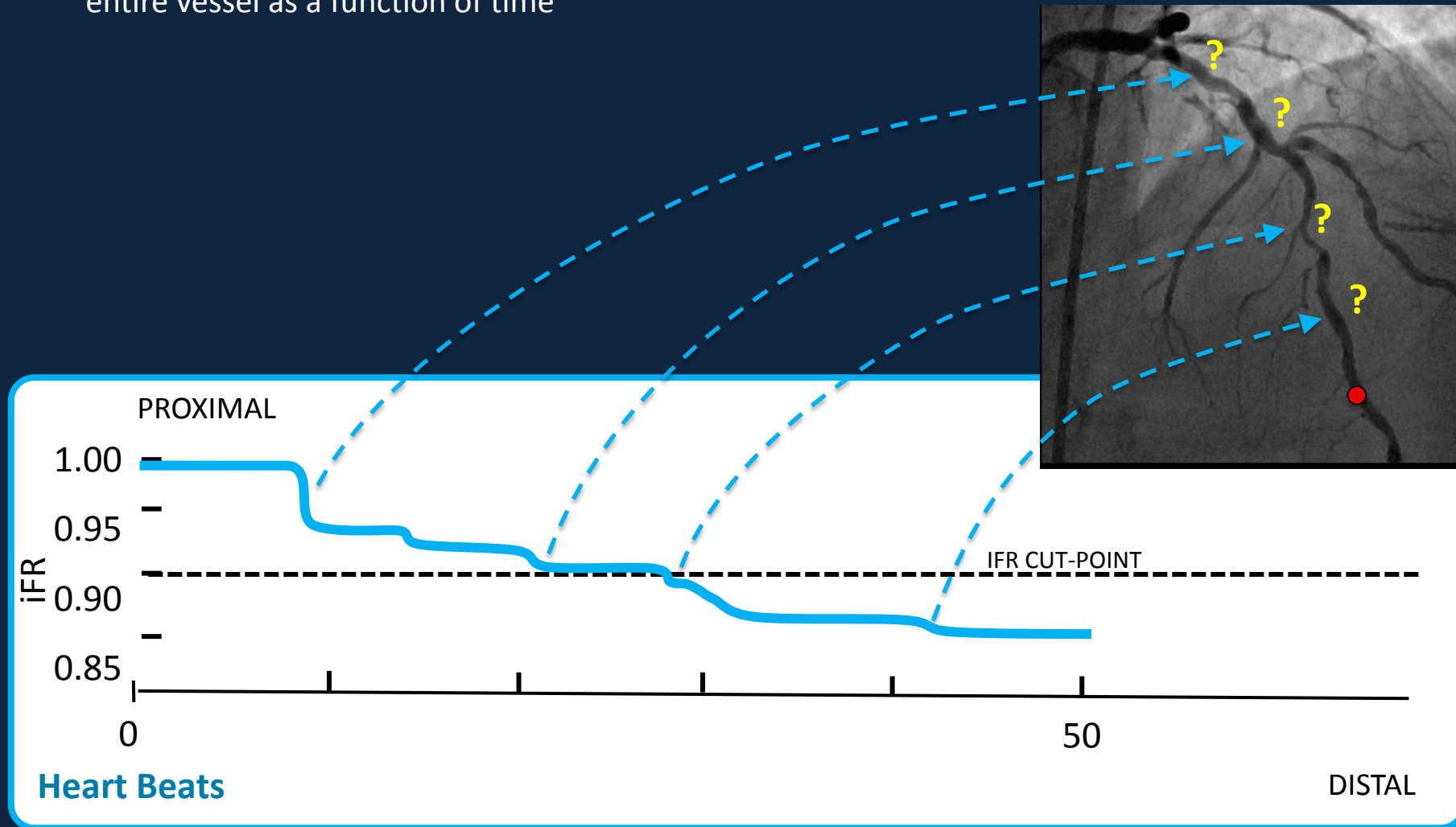


Aug/23/2016

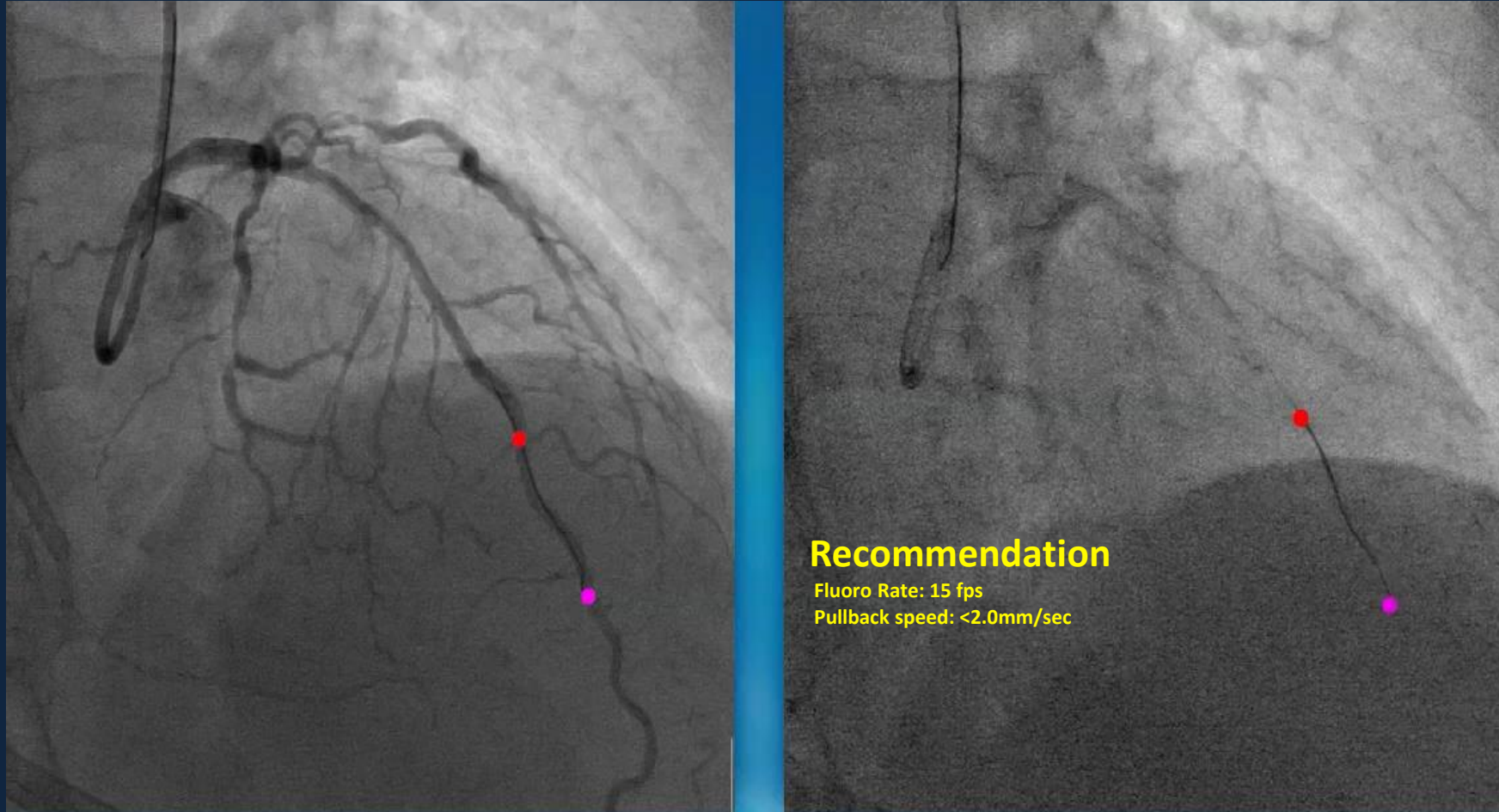


iFR pullback stenosis mapping

- Pressure Wire Pullback (“Scout”) produces a physiological map of the entire vessel as a function of time



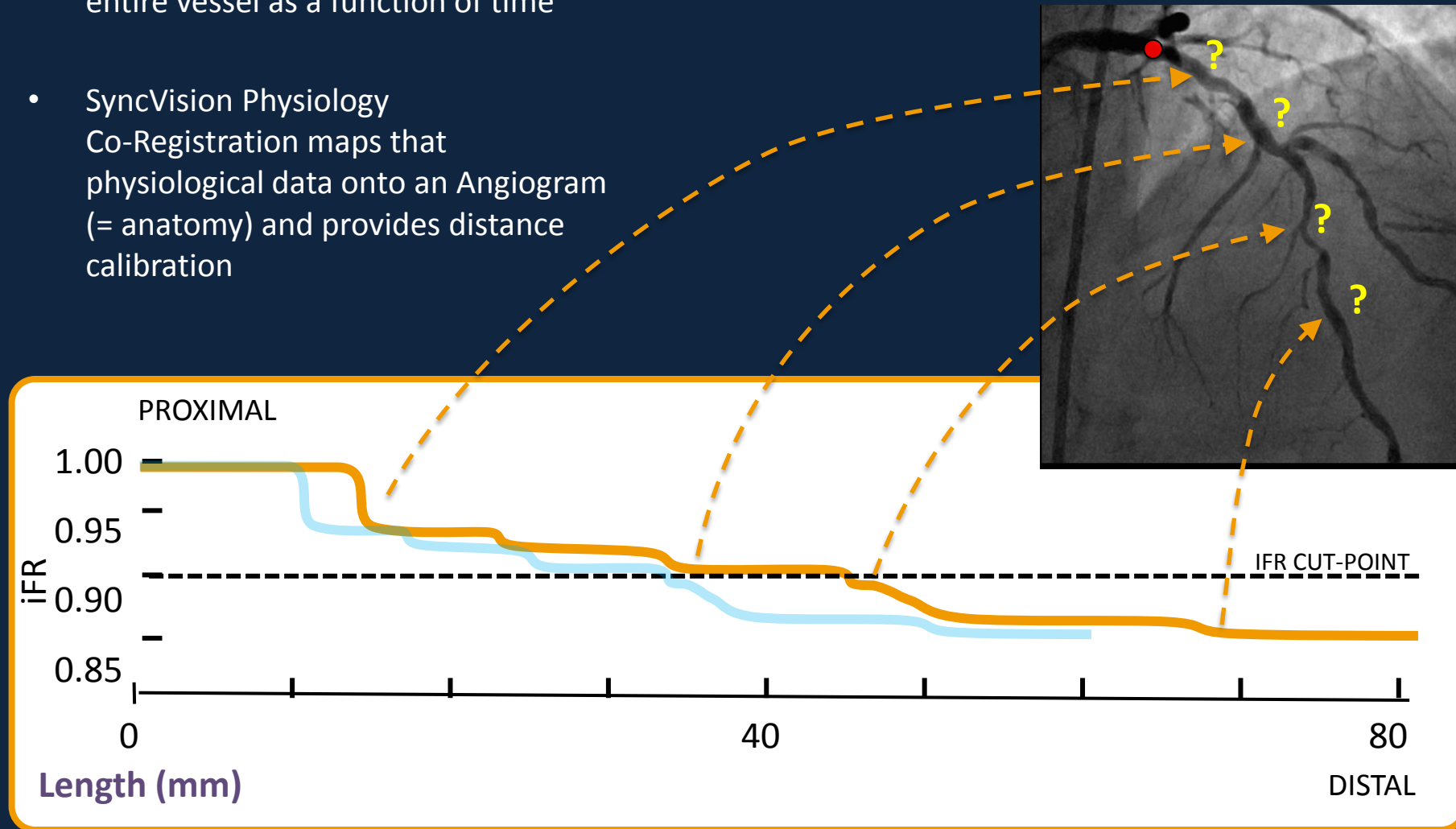
FFR/iFR mapping: How It Works...



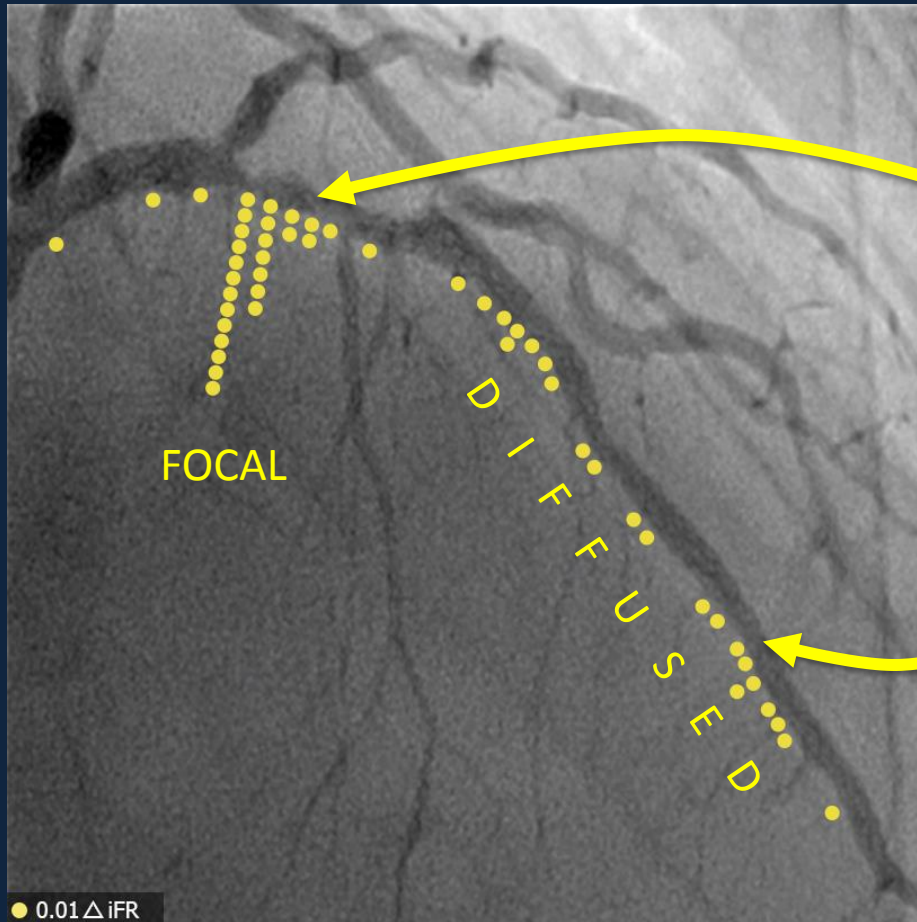
Dynamic calibration factor for each section of the roadmap allows accurate measurement even in cases of foreshortening based on known tip length
(accuracy <2.5mm)

iFR pullback stenosis mapping

- Pressure Wire Pullback (“Scout”) produces a physiological map of the entire vessel as a function of time
- SyncVision Physiology Co-Registration maps that physiological data onto an Angiogram (= anatomy) and provides distance calibration



iFR pullback mapping to identify focal and diffuse disease



FOCAL
(high pressure drop intensity)

DIFFUSED
(low pressure drop intensity)

Case-04 60's male Operator Dr MATSUO (multivessel disease)

- **Cinical diagnosis:** **#1 Angina pectoris**
 #2 Dyslipidemia

- **Present illness:**

Pt began to feel chest pain for 2 years.

He felt chest discomfort persisting several minutes during golf at January 20th 2019. This symptom relieved after sublingual NTG.

CCTA demonstrated severe 3VD.

Prior intervention : none

Coronary risk factor : DL, past smoking

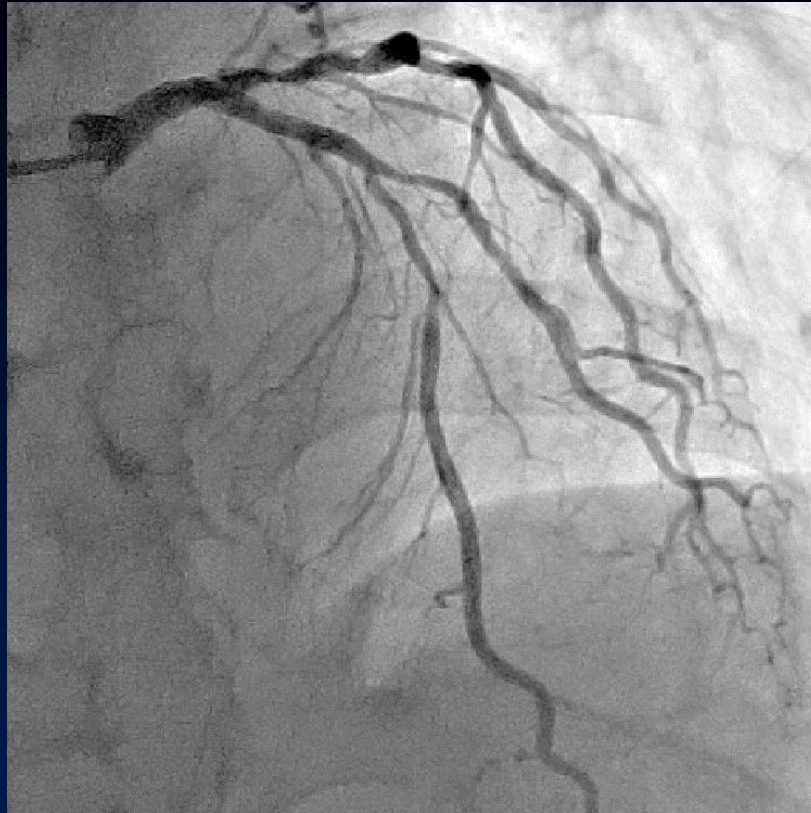
Blood test: Cre: 1.13, eGFR : 51 (categories:G3a)

Lipid profile: LDL-C: 71 (179)mg/dl, HDL-C: 29 (49)mg/dl, TG: 139 (175)mg/dl

Current medication: Clopidogrel (75mg), Aspirin (100mg), Vonoprazan (10mg)
Pitavastatin (2mg), Diltiazem (200mg), Carvedilol (2.5mg)

Cardiac echo: EF=76%, Normal wall motion, SVD(-)

Final CAG findings (2019/2/12): prox. RCA 50%, mid. LAD 75%, prox. LCX 90%

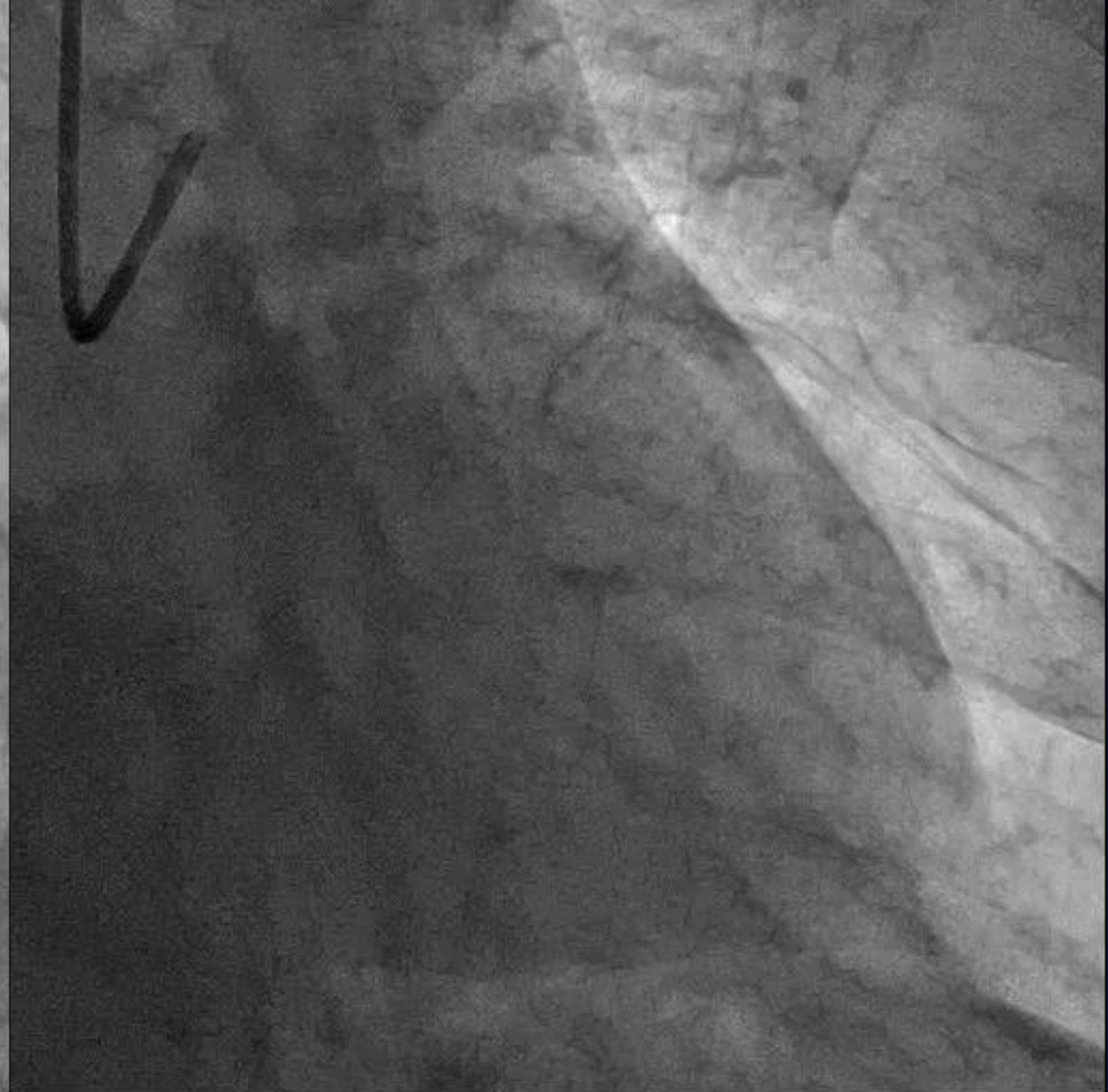
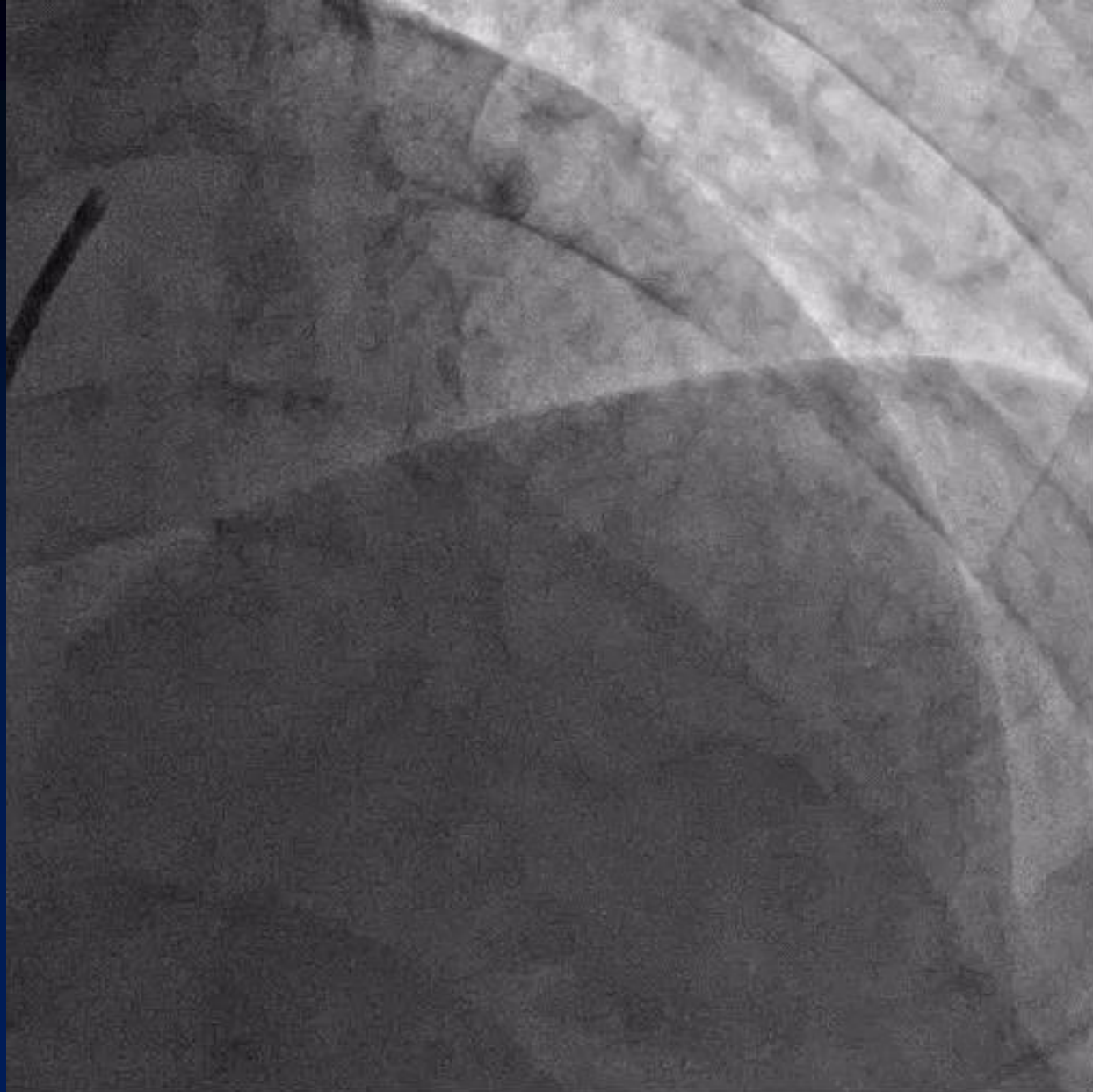


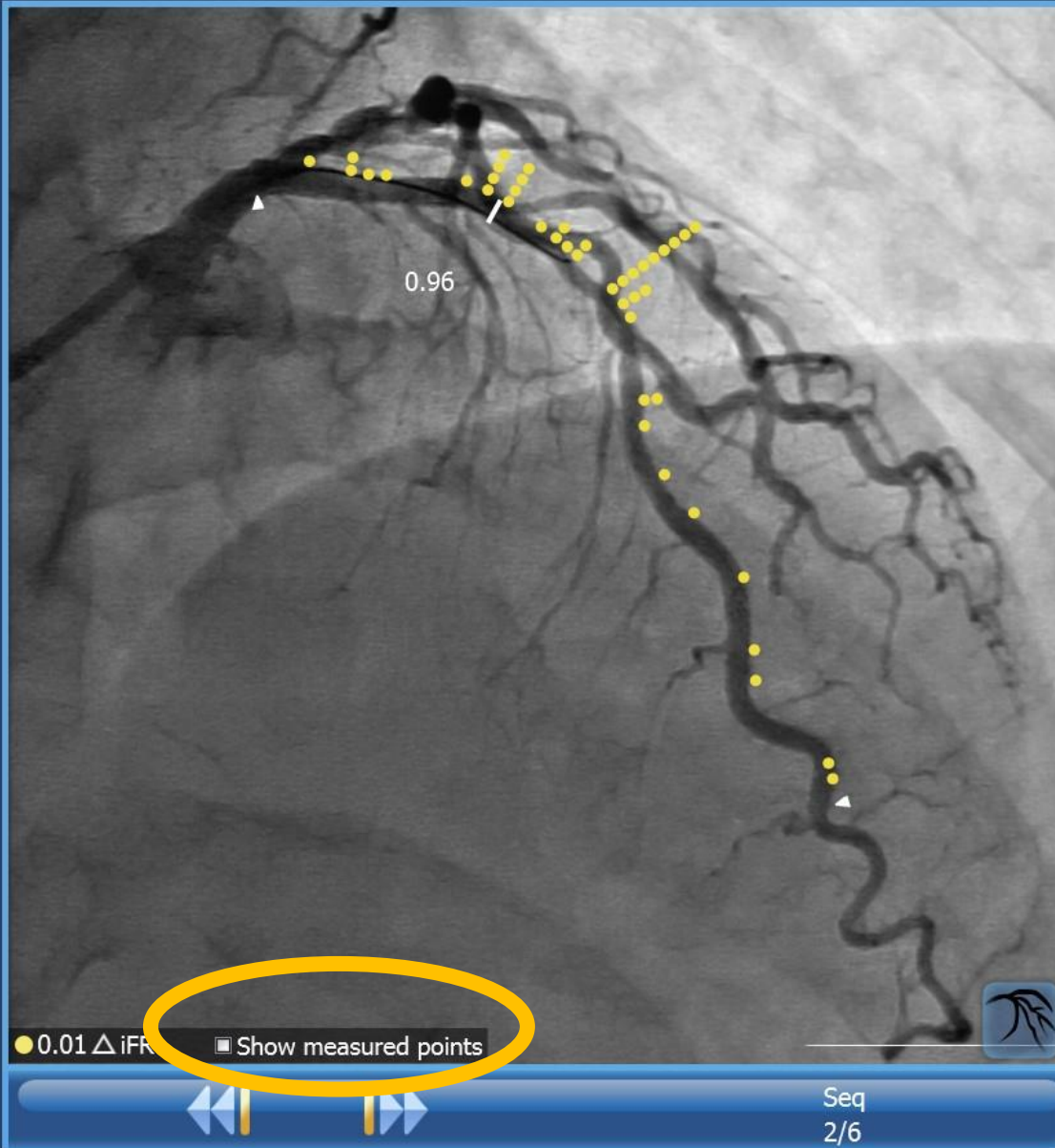
SYNTAX Score : 11

SYNTAXII Score : CABG or PCI

PCI SYNTAX ScoreII : 30.8, PCI 4 year Mortality : 7.3%

CABG SYNTAX ScoreII : 29.6, CABG 4 year Mortality : 6.6%

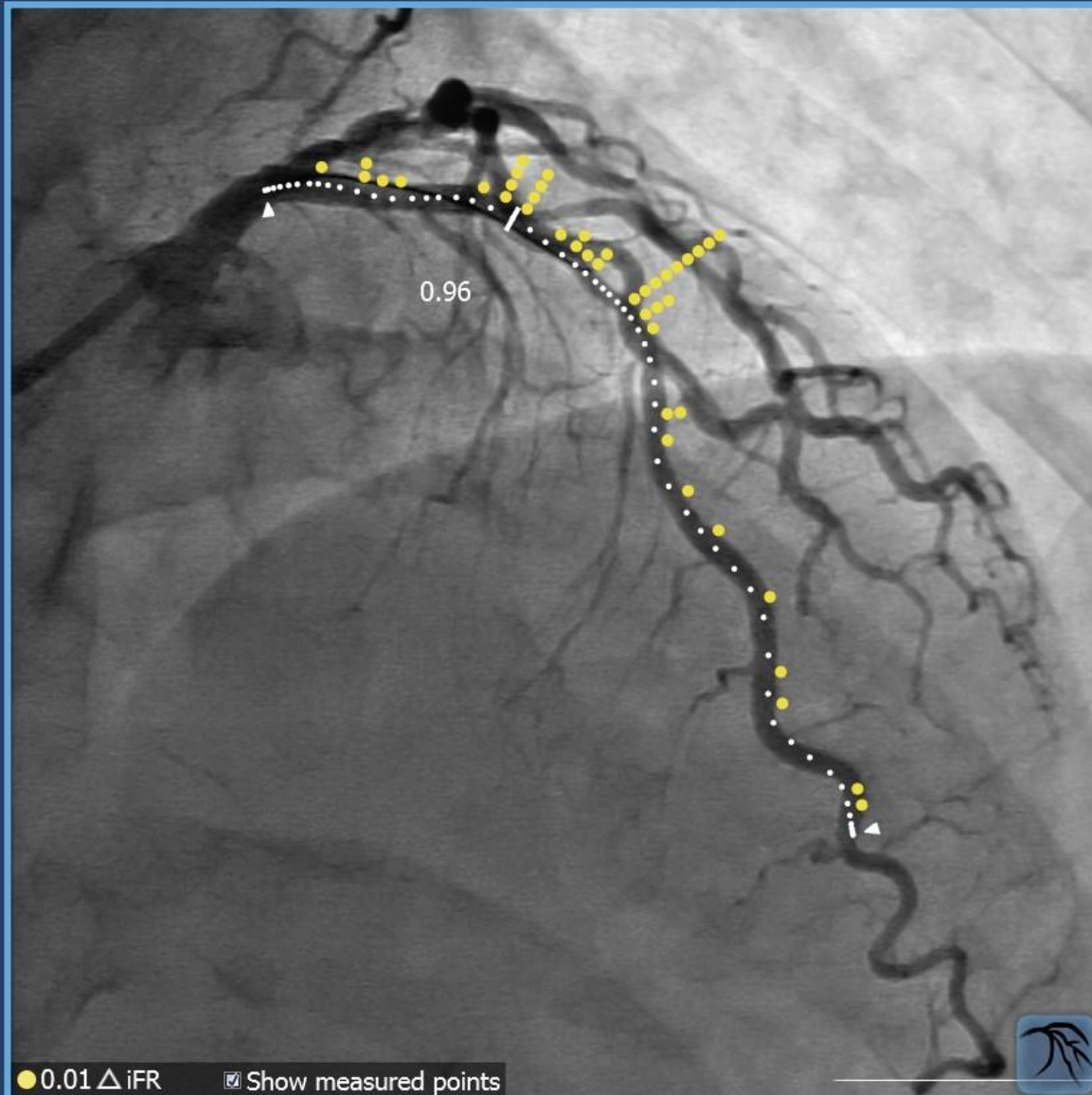




iFR Distal: 0.63

iFR at Cursor: 0.96





iFR Distal: 0.63

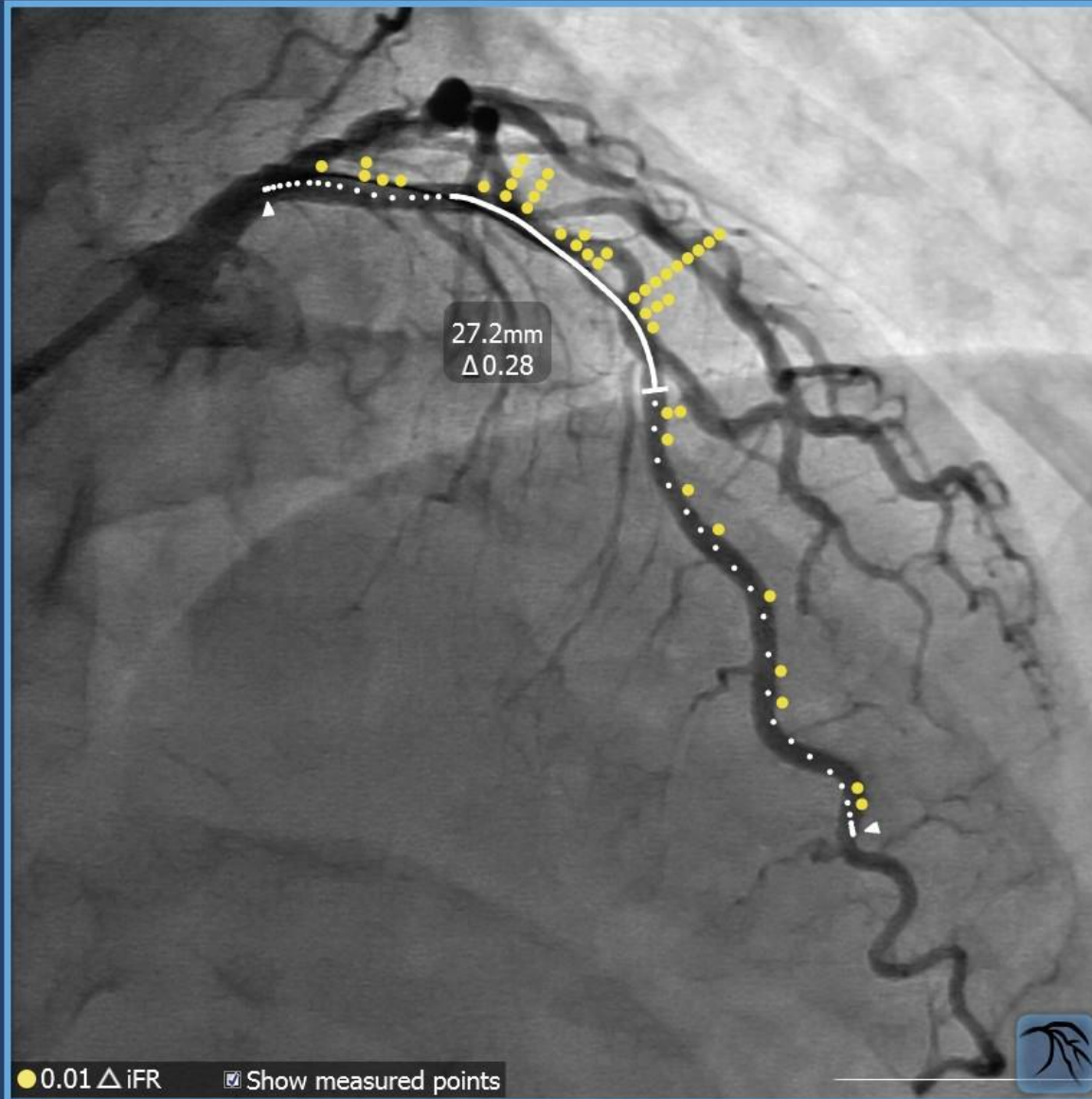
iFR at Cursor: 0.96



● 0.01 Δ iFR Show measured points

Navigation controls: back, forward, and a progress bar. Text: Seq 2/6





● 0.01 Δ iFR Show measured points

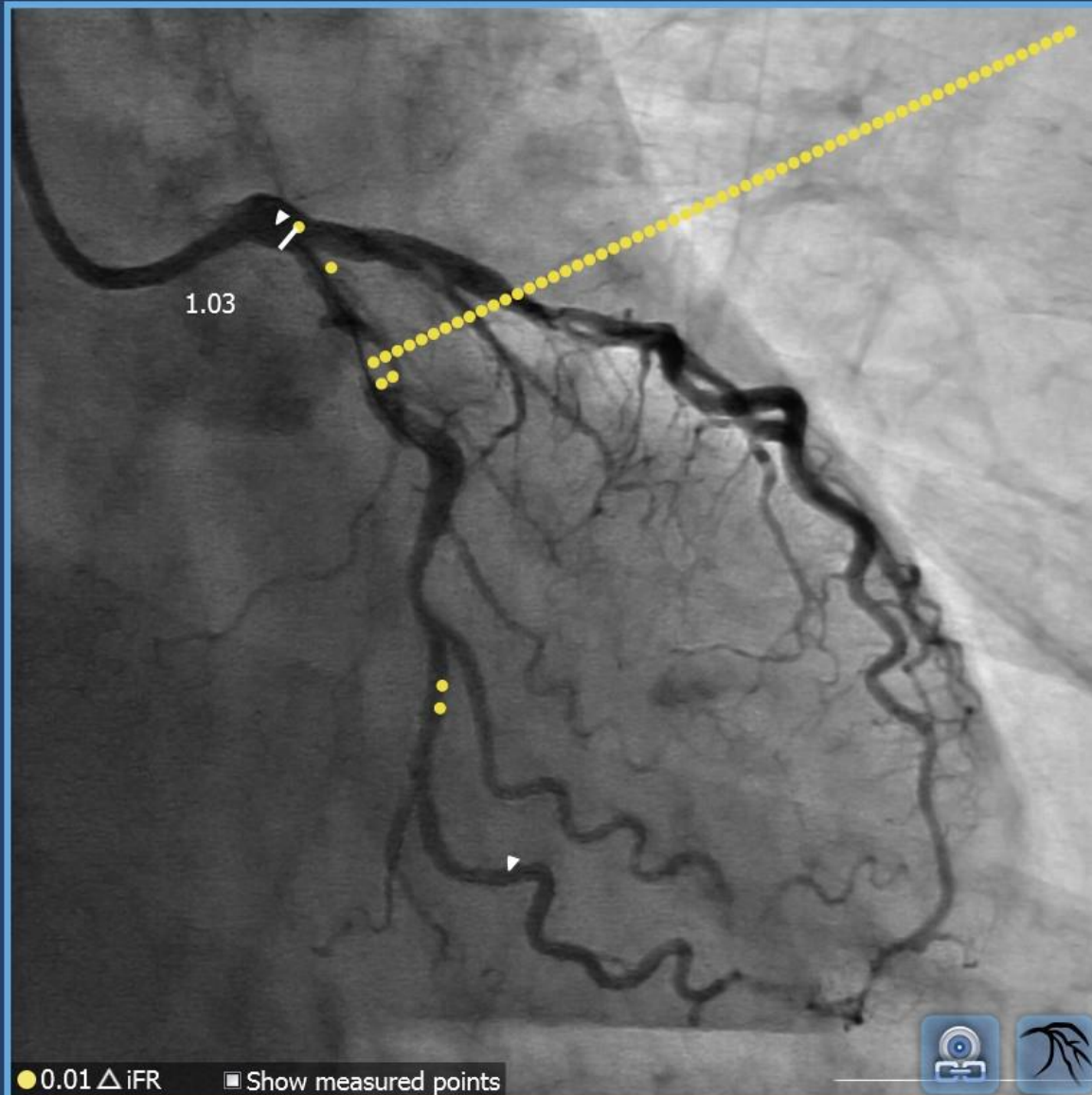
Navigation controls: back, forward, and sequence indicators. Seq 2/6

iFR Distal: 0.63

iFR Estimate: 0.91



Control buttons: a button with a catheter icon and a button with a plus sign and a ruler icon.



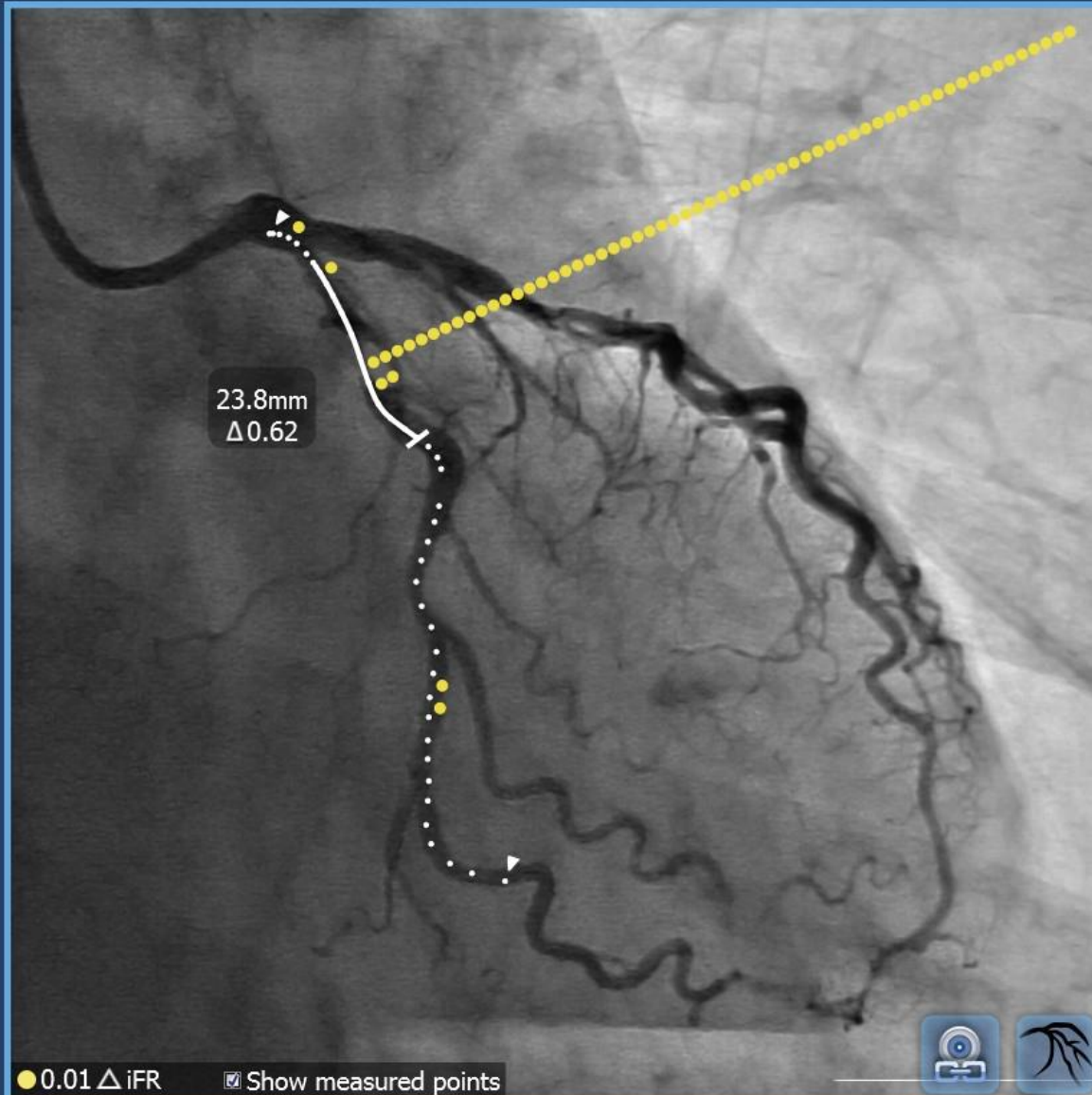
iFR Distal: 0.38
iFR at Cursor: 1.03



Marked points were filtered out of the calculation

Navigation controls: back, forward, and sequence indicator.

Seq 4/6



● 0.01 Δ iFR Show measured points



iFR Distal: 0.38
iFR Estimate: 1.00

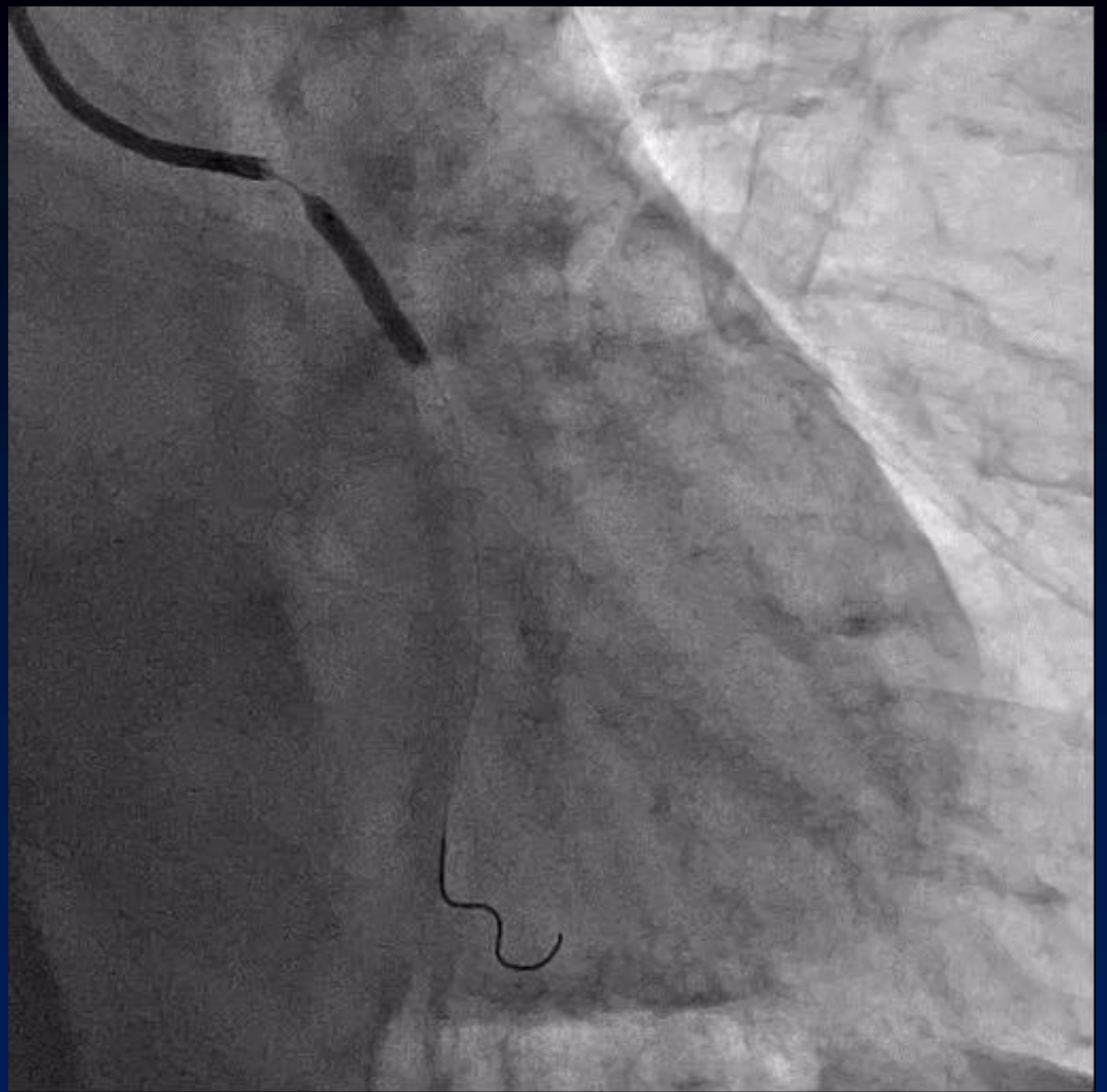
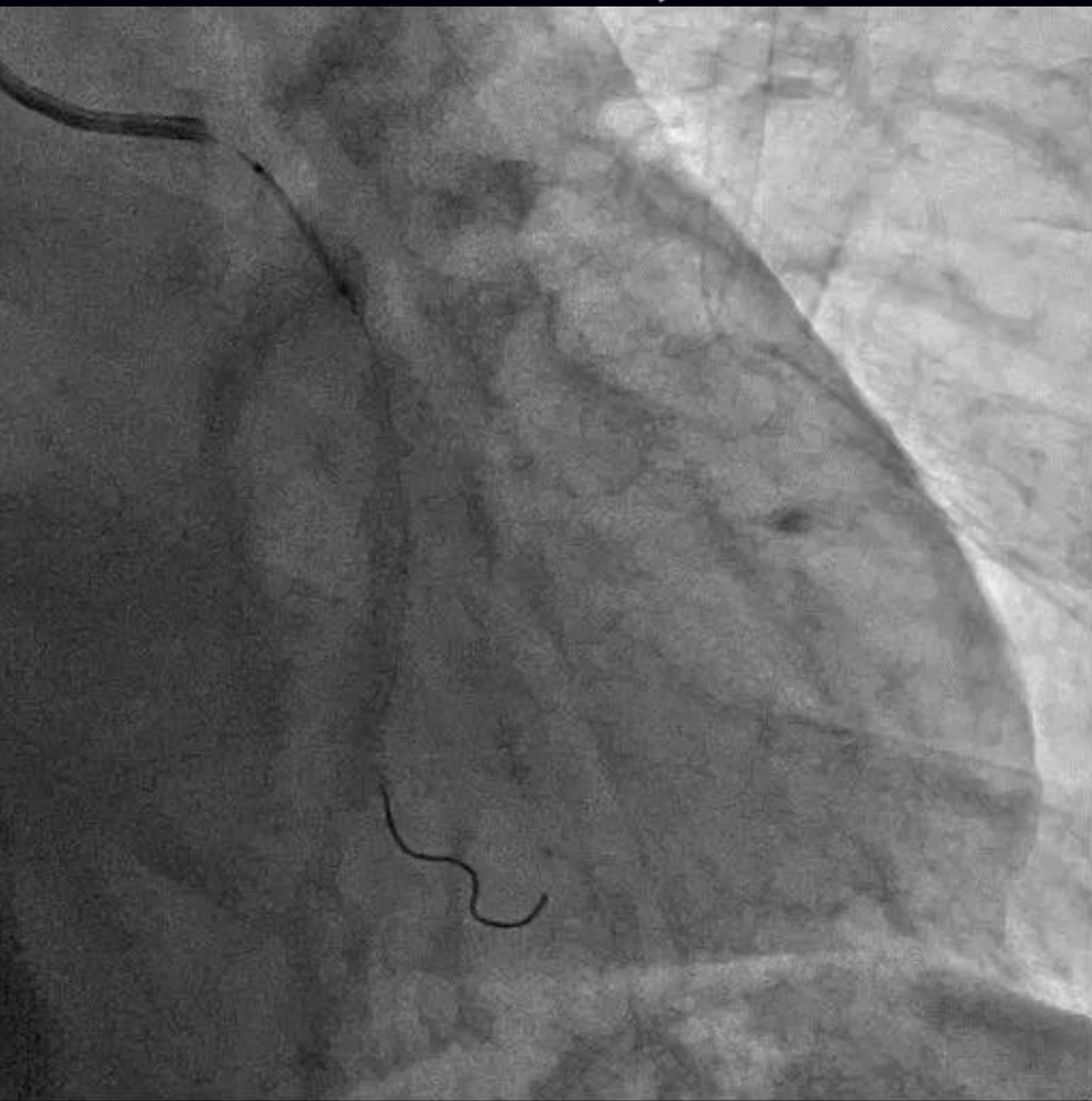


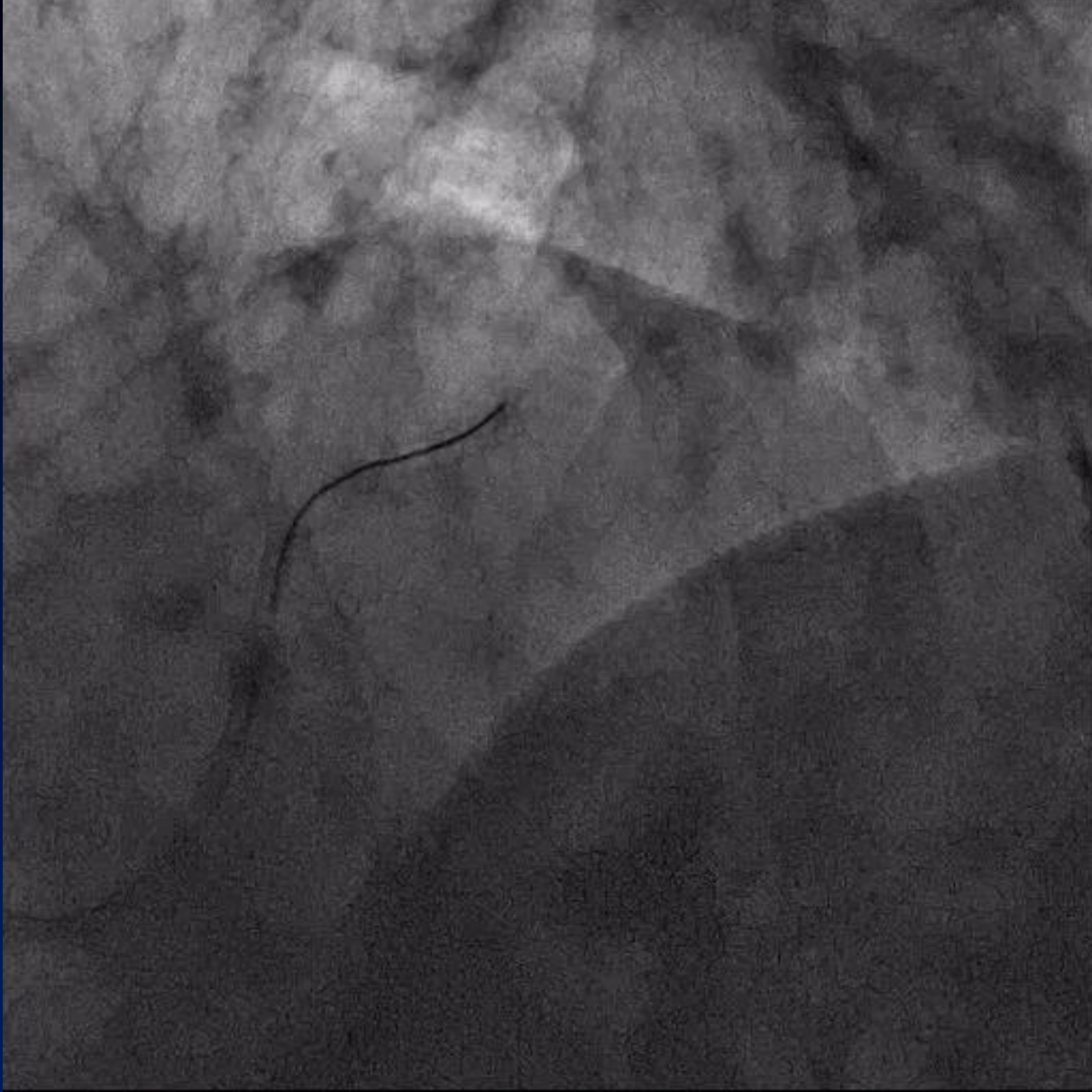
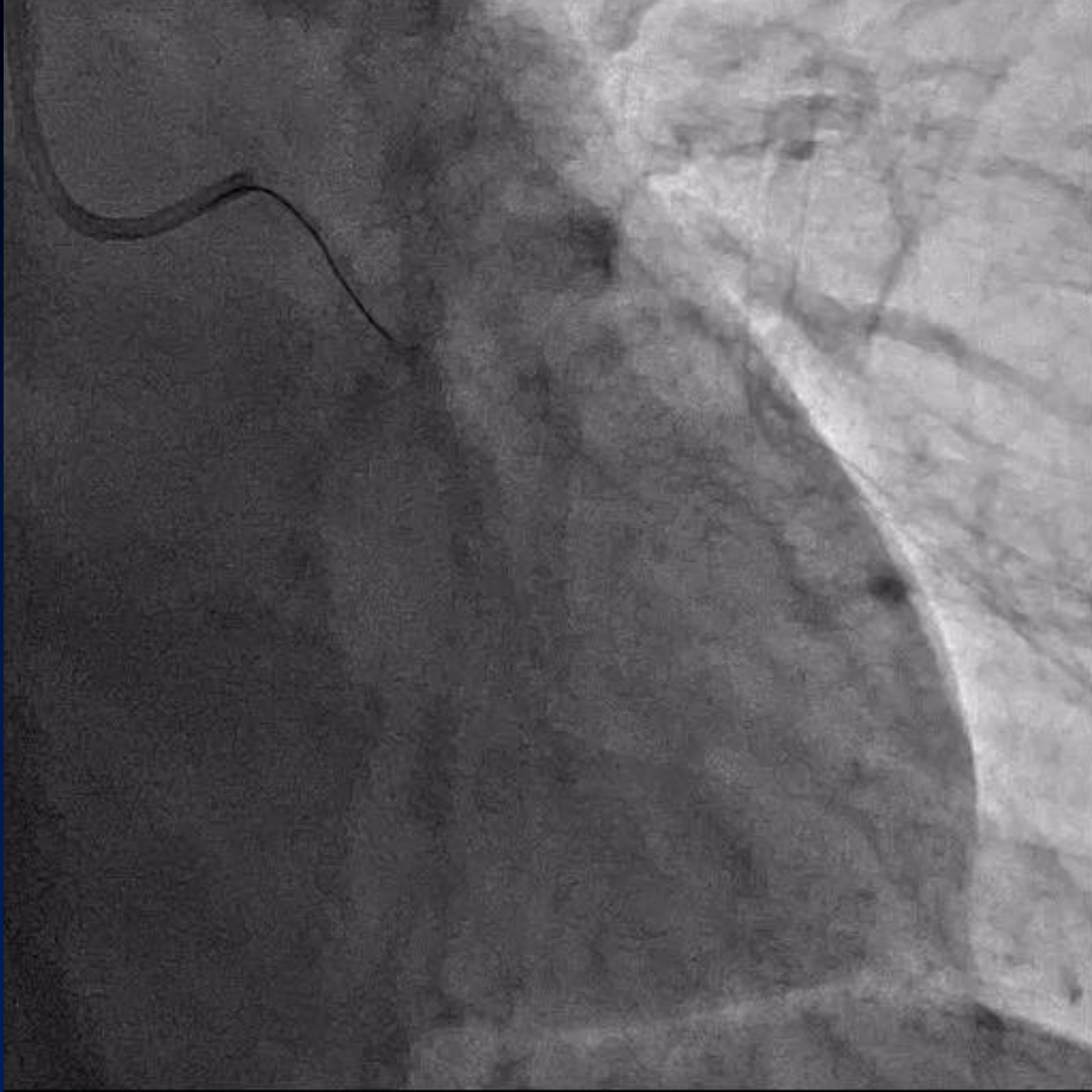
Marked points were filtered out of the calculation

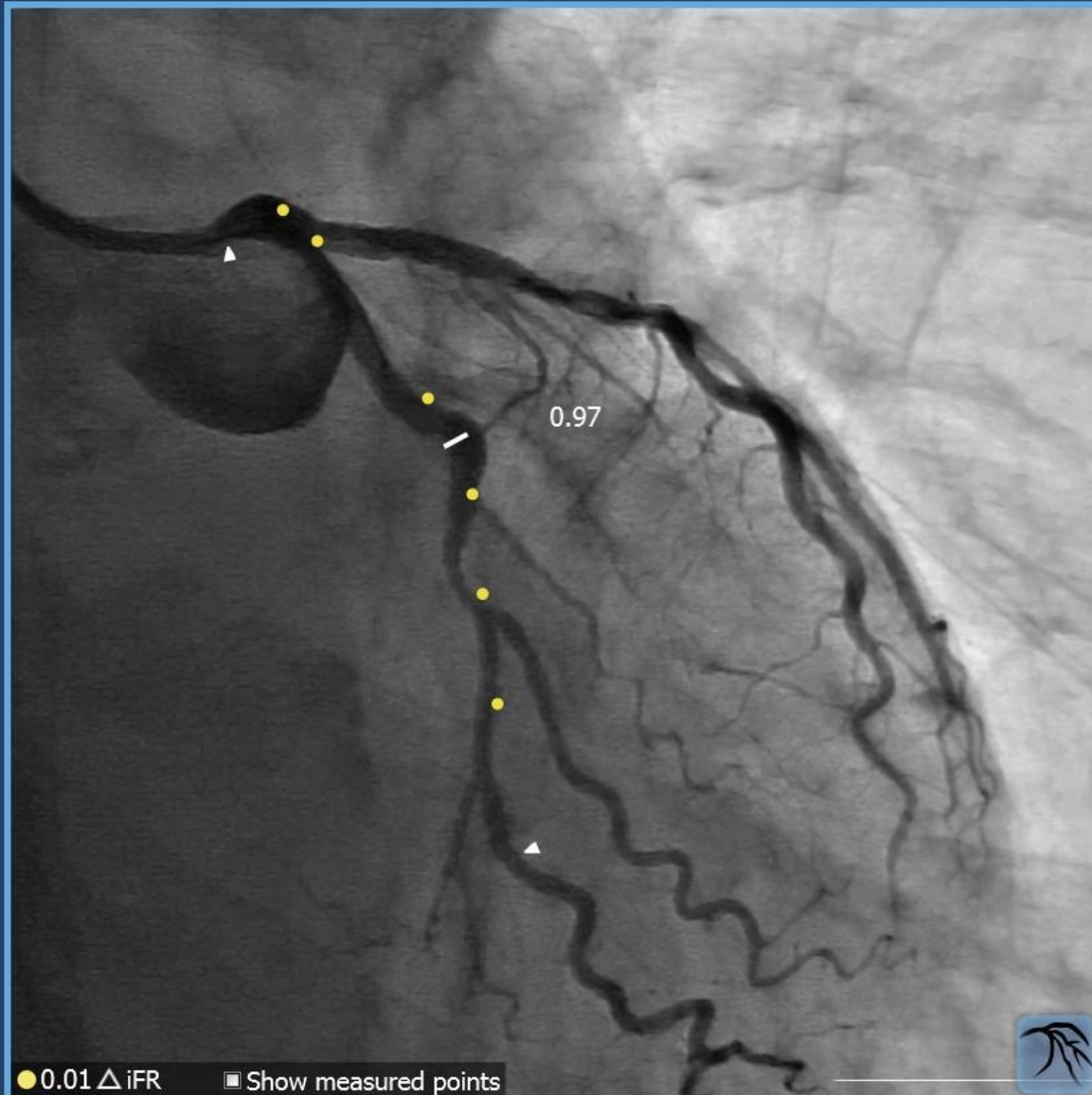


Navigation controls including a play/pause button, a sequence indicator 'Seq 4/6', and a progress bar.

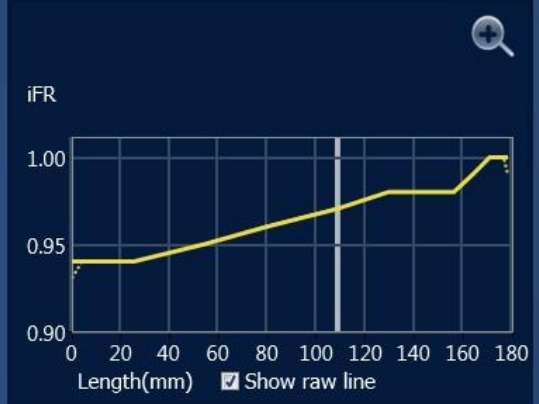
FRIENDS Live 2019 Mar.1-2, 2019







iFR Distal: 0.94
iFR at Cursor: 0.97

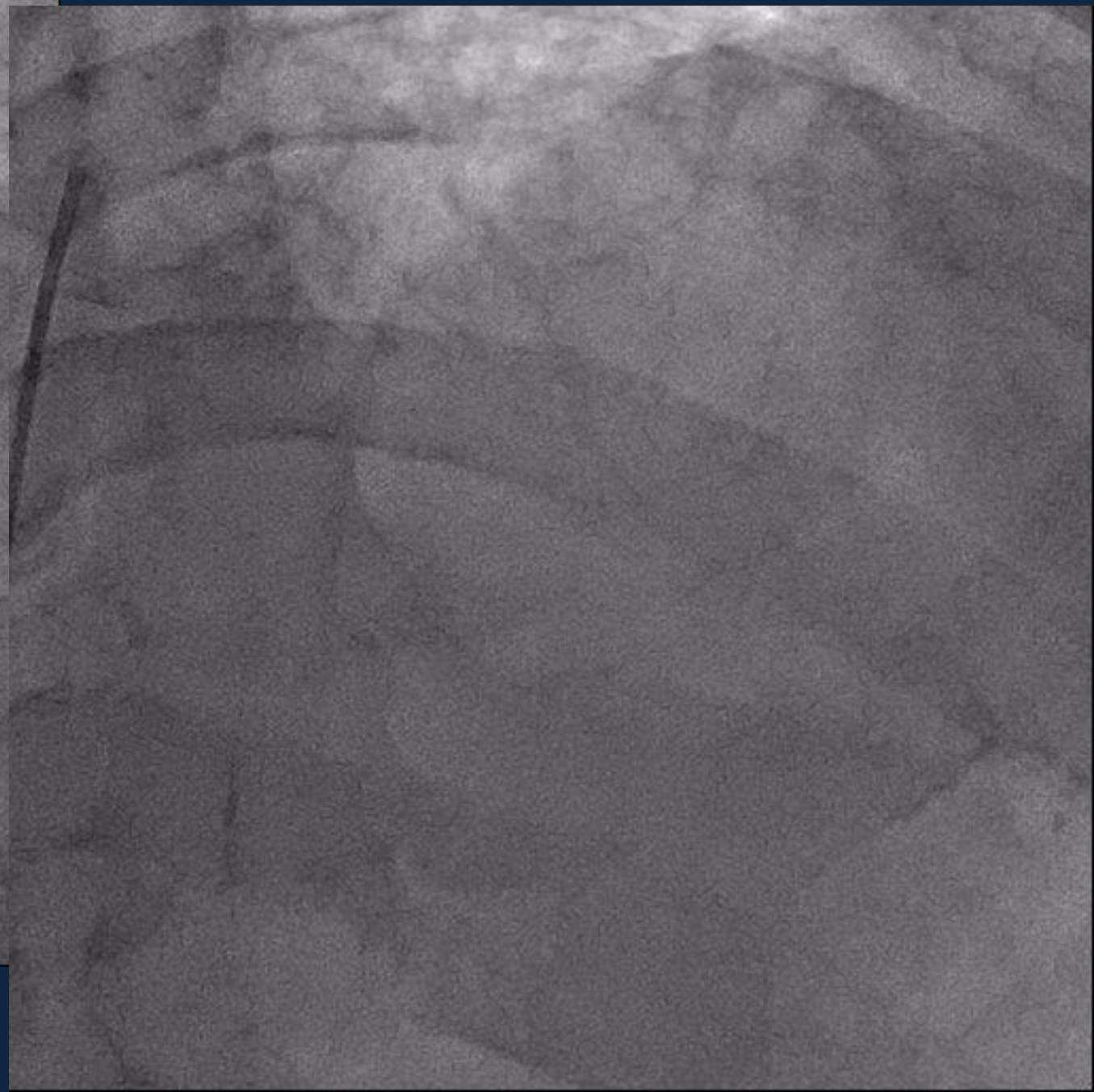


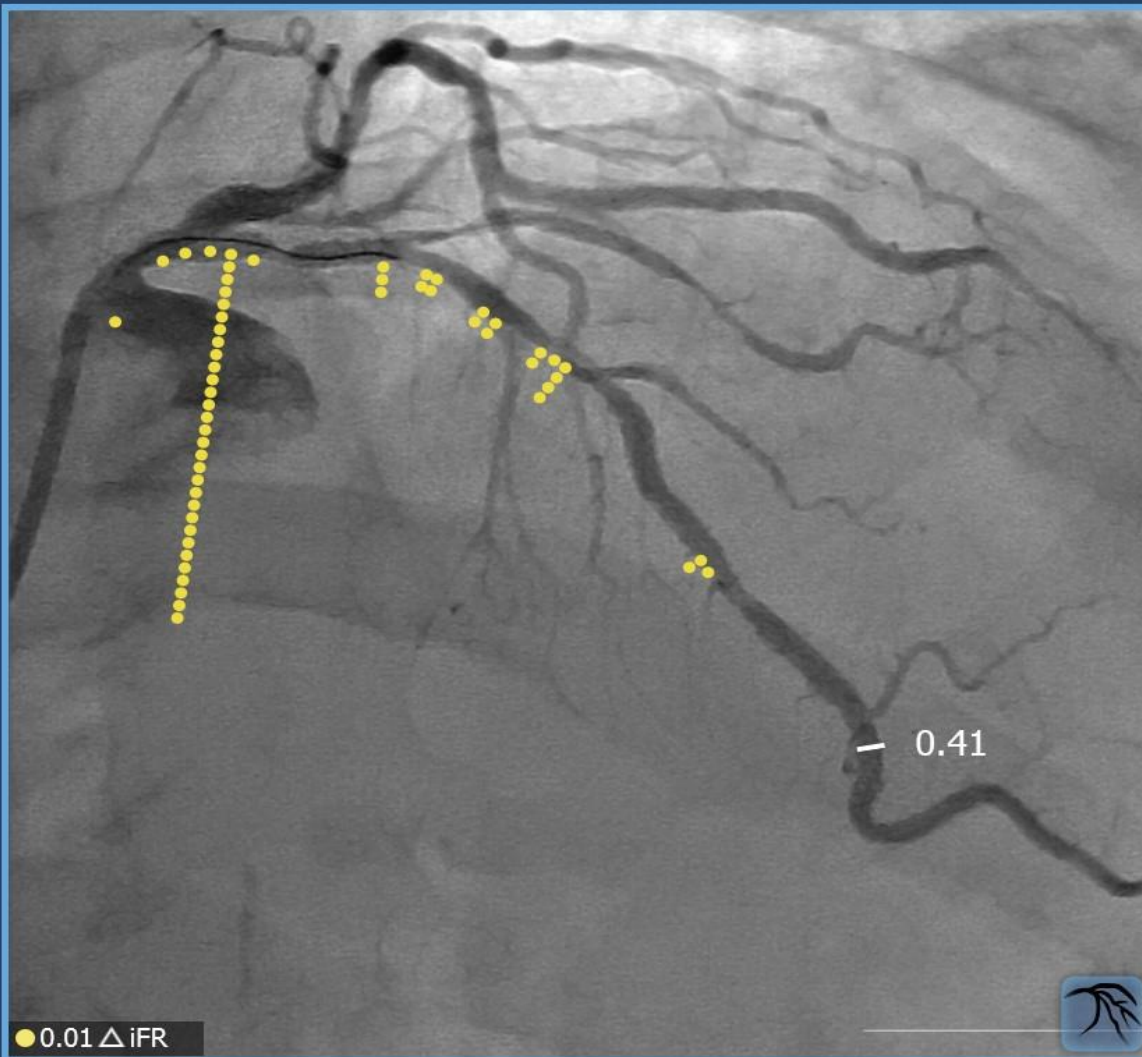
Navigation controls: back, forward, and a sequence indicator showing 'Seq 6/6'.

Control buttons: a button with a catheter icon and a button with a plus sign.

Case 2

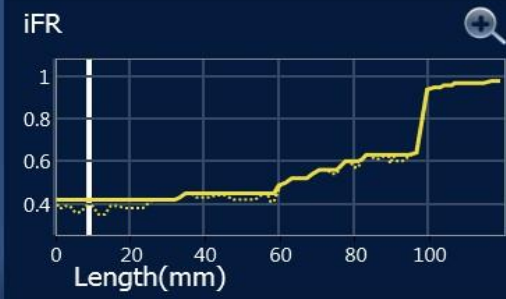
- 75 years old male
- Effort Angina
- PI: The patient was referred to our hospital due to the exaggerated chest pain during effort.
- Risk factors : past smoker, HT,DM,Dyslipidemia
- No prior intervention
- LVEF 60% CKD class 2
- Transient perfusion defect in anteroseptal wall by SPECT
- Angiography showed LAD proximal and mid stenosis.





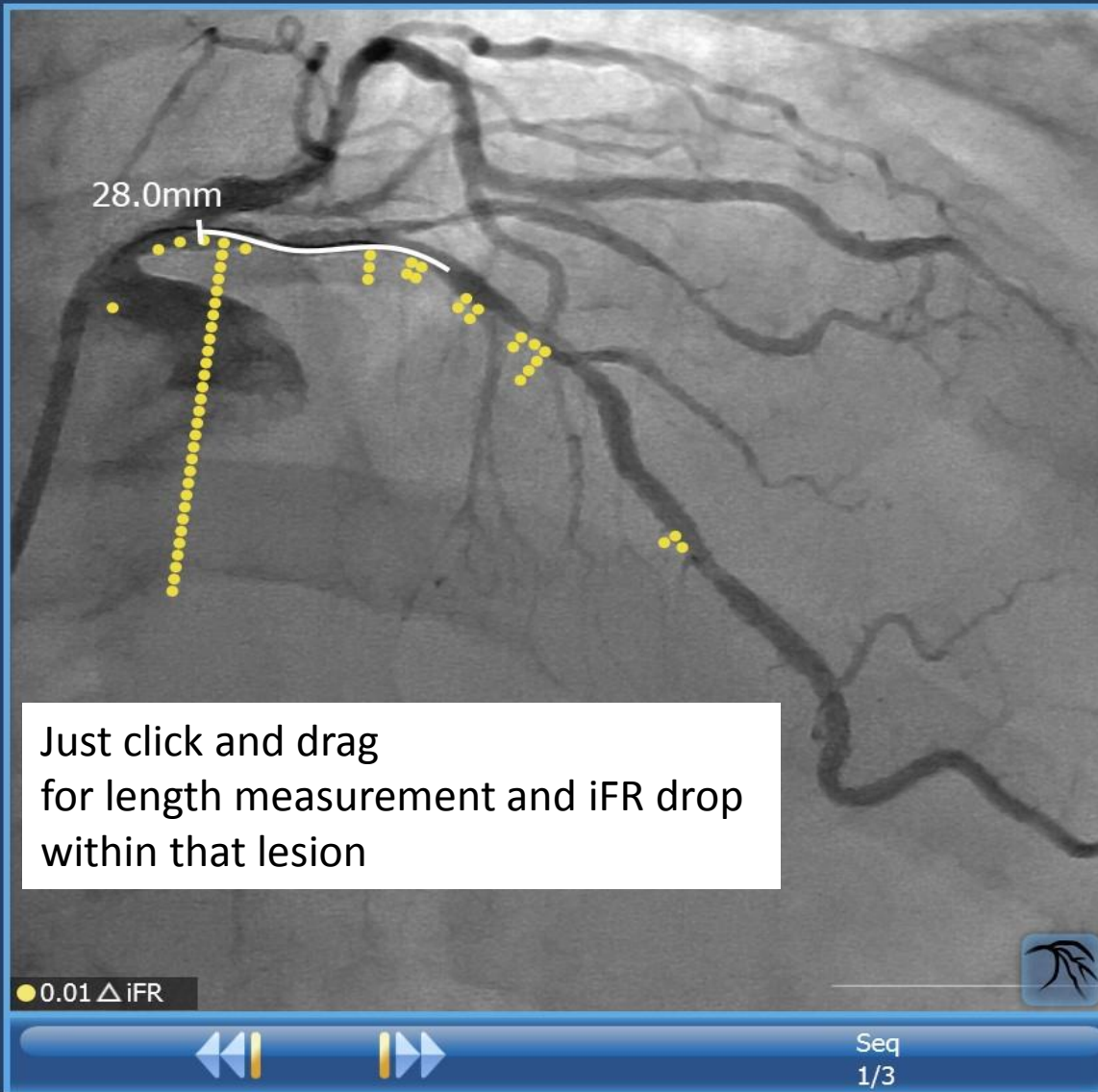
iFR Distal: 0.39

iFR at Cursor: 0.41



● 0.01 Δ iFR

Navigation controls including a play/pause button, a sequence indicator 'Seq 1/3', and a small tree icon.

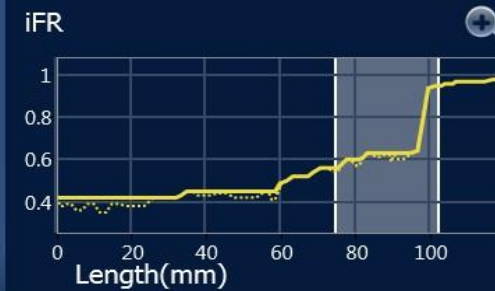


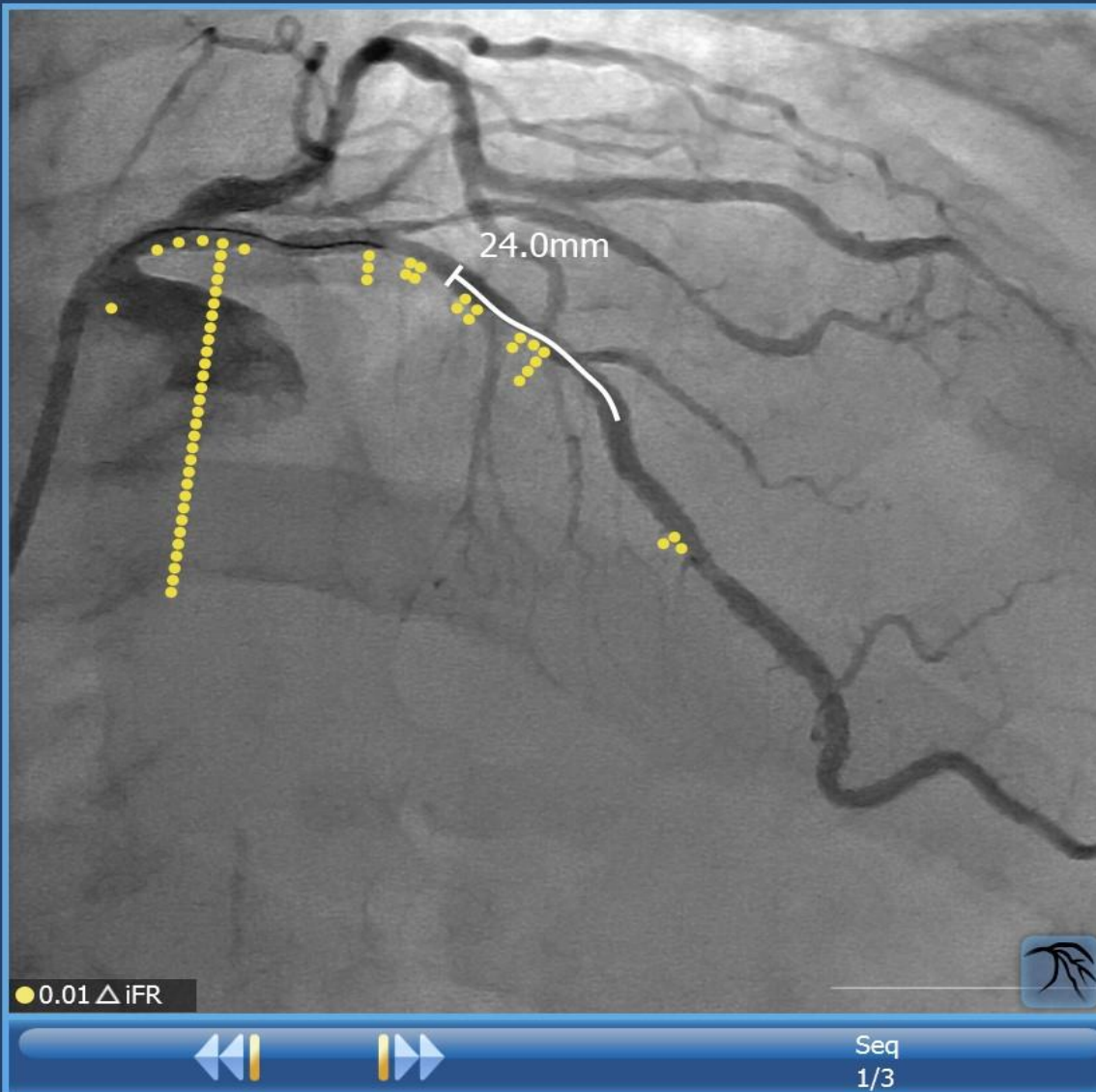
iFR Distal: 0.39

iFR drop
in selection : 0.39

Predicted iFR
0.78

Length: 28.0mm





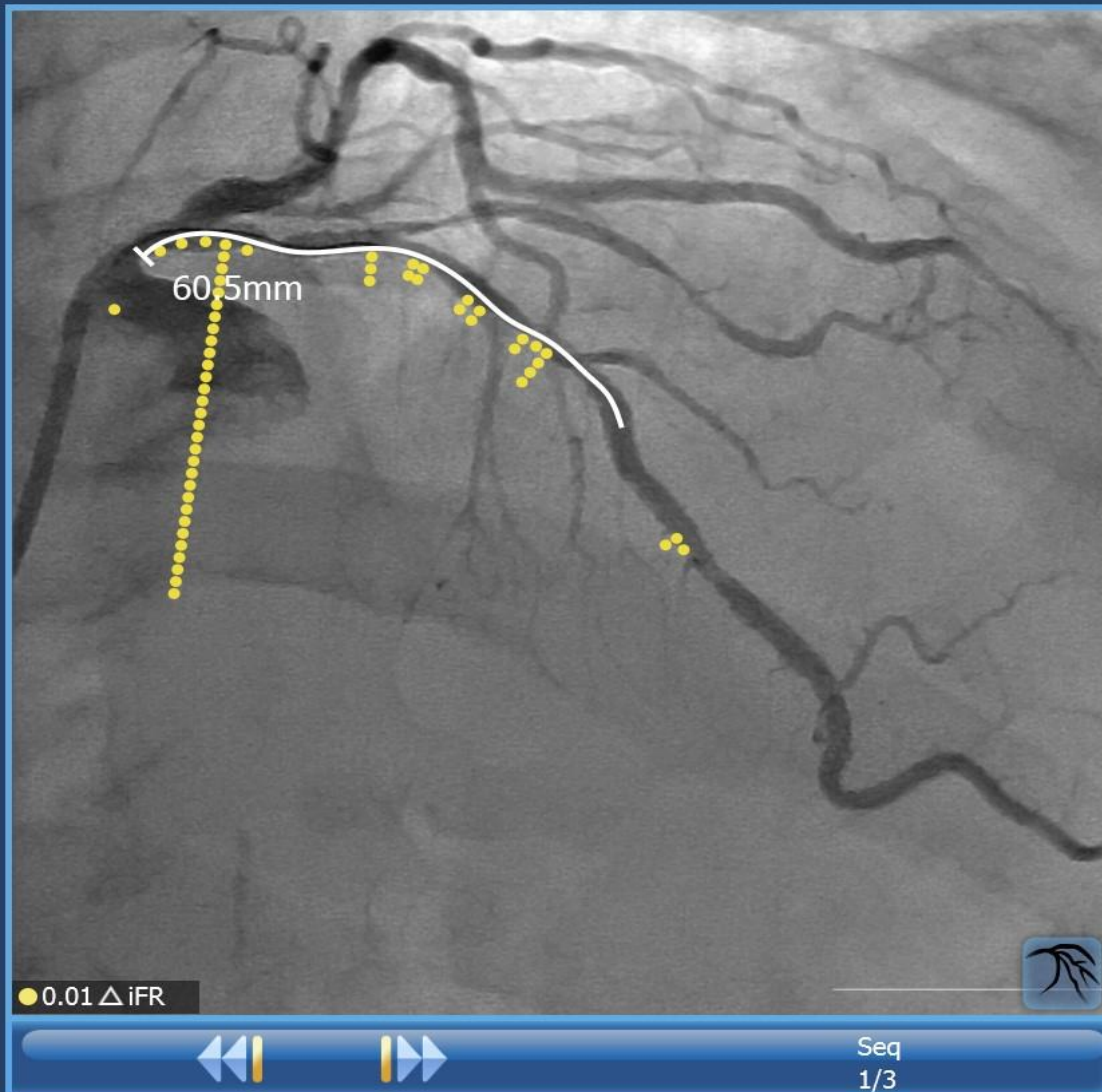
iFR Distal: 0.39

iFR drop
in selection : 0.11

Predicted iFR
0.50

Length: 24.0mm



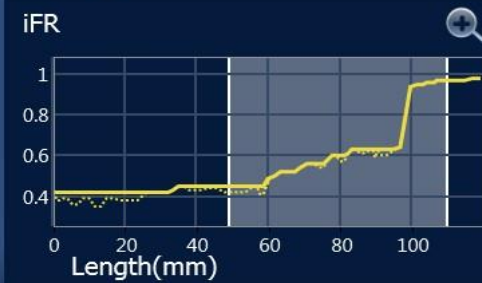


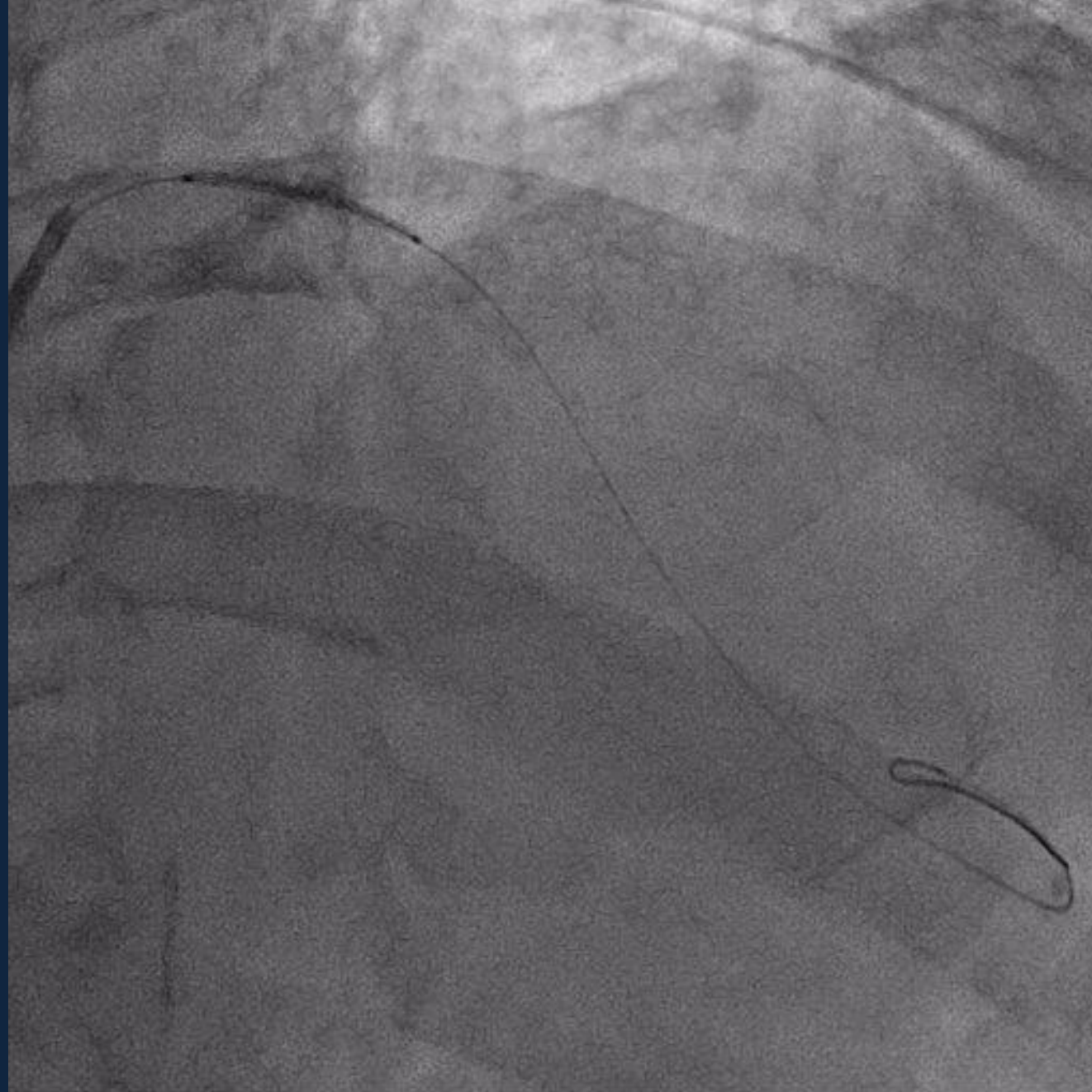
iFR Distal: 0.39

iFR drop
in selection : 0.52

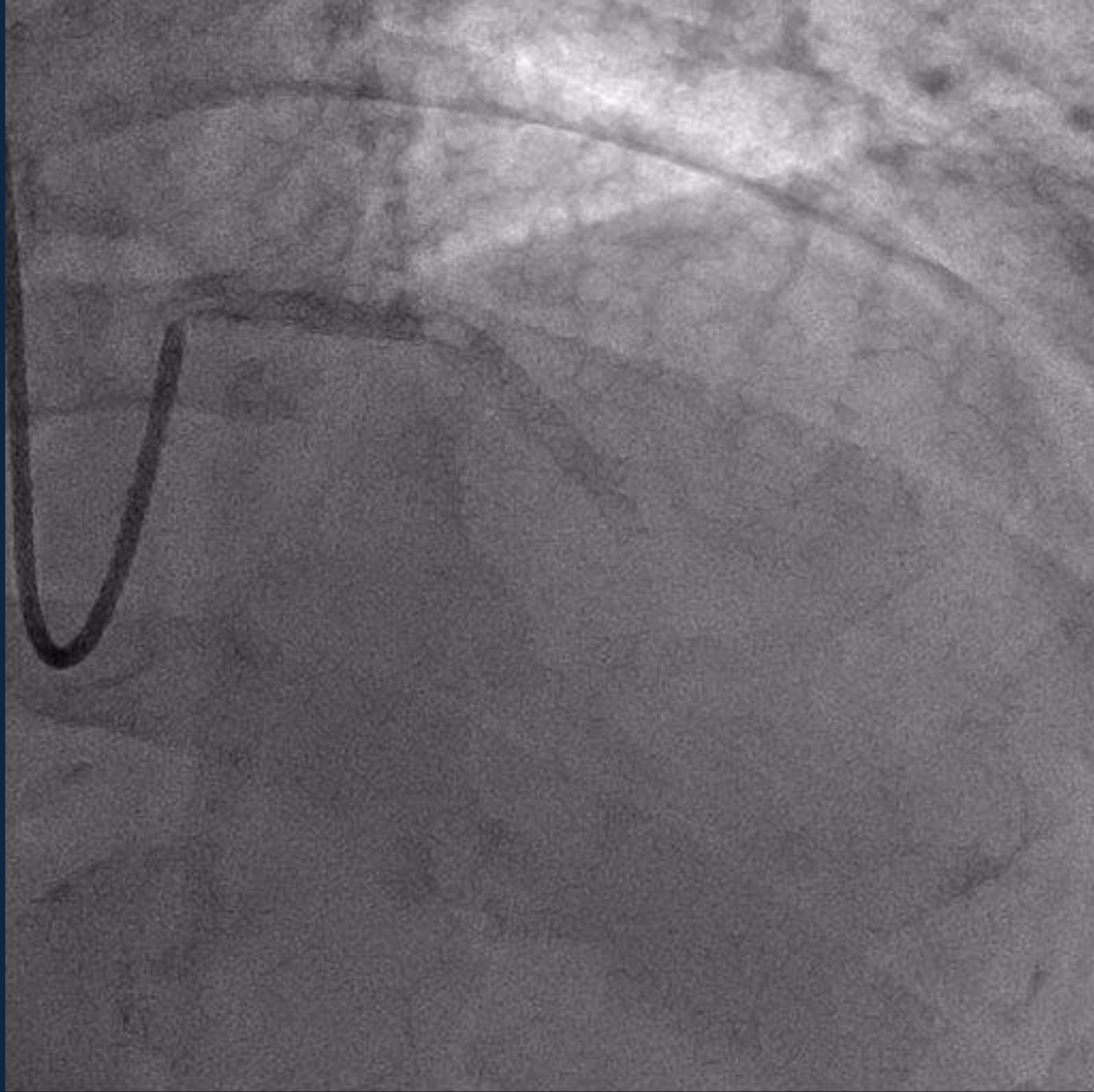
Predicted iFR
0.91

Length: 60.5mm





EES 3.5*28mm



3.0mm*28mm length EES

3.0mm*24mm length EES

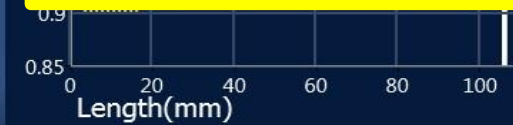


iFR Distal: 0.91

iFR at Cursor: 1.00

post iFR
0.91

Predicted iFR
0.91



Case6. K.T 66y.o male ID:233889

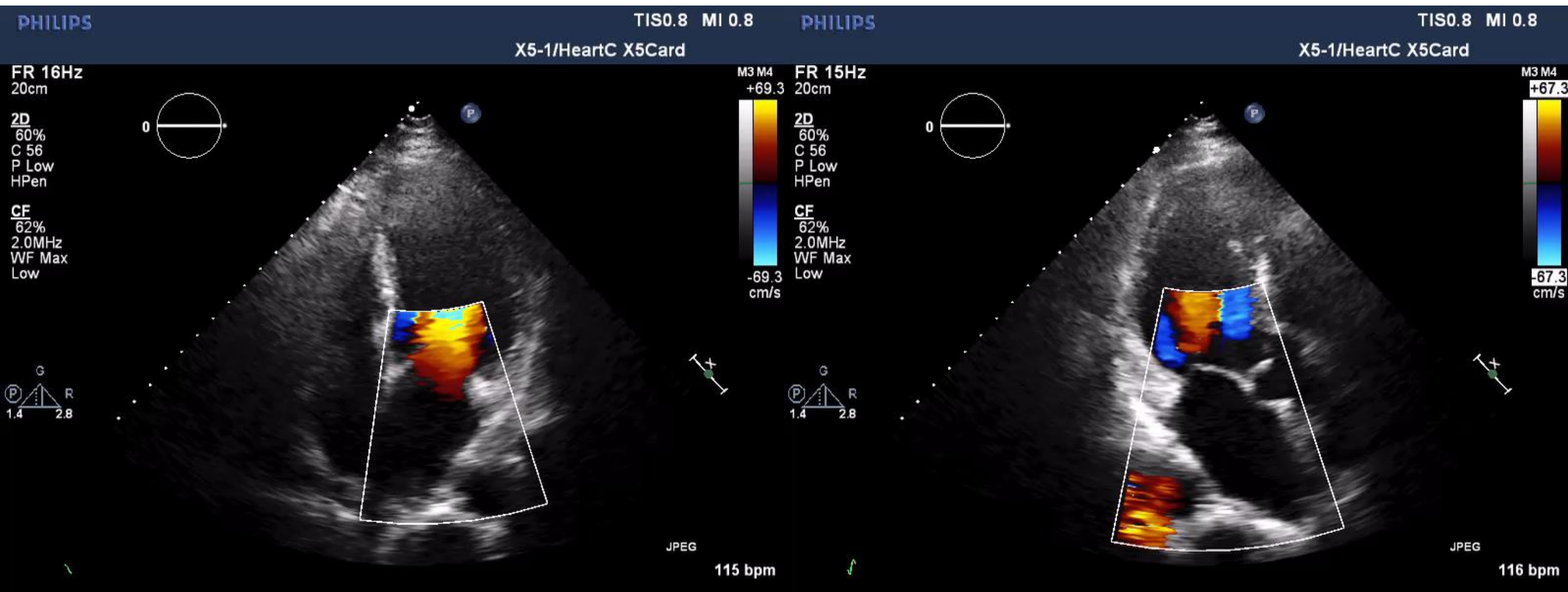
- Problem list

- #1. OMI (broad posteroinferior MI (LVEF 38%) ,stenting to LCX at 2015)
- #2. Post-infarct angina
- #3. Hypertension (Well controlled by medication)
- #4. dyslipidemia (LDL-C 80mg/dl under statin treatment)
- #5. CKD (Cr 1.37mg/dl, CCr 41ml/min)
- #6. smoking
- #7. chronic Af
- #8. Allergic dermatitis to anti-platelet agent (Clopitogrel, Prasgurel)

- PI

After treatment of PCI to LCX, pt did not feel any chest symptom until January 2018 when he started to feel anterior chest pain at rest and exertional dyspnea. Myocardial perfusion scintigraphy showed objective evidence of ischemia in antro-septal wall and persisten defect in posterior wall.

UCG



Myocardial perfusion imaging

Pat ID 00233889
 Sex MALE
 Limits D-SPECT-SDI
 TID 1.08
 SSS 23 SRS 25 SDS 3
 SS% 34 SR% 37 SD% 4

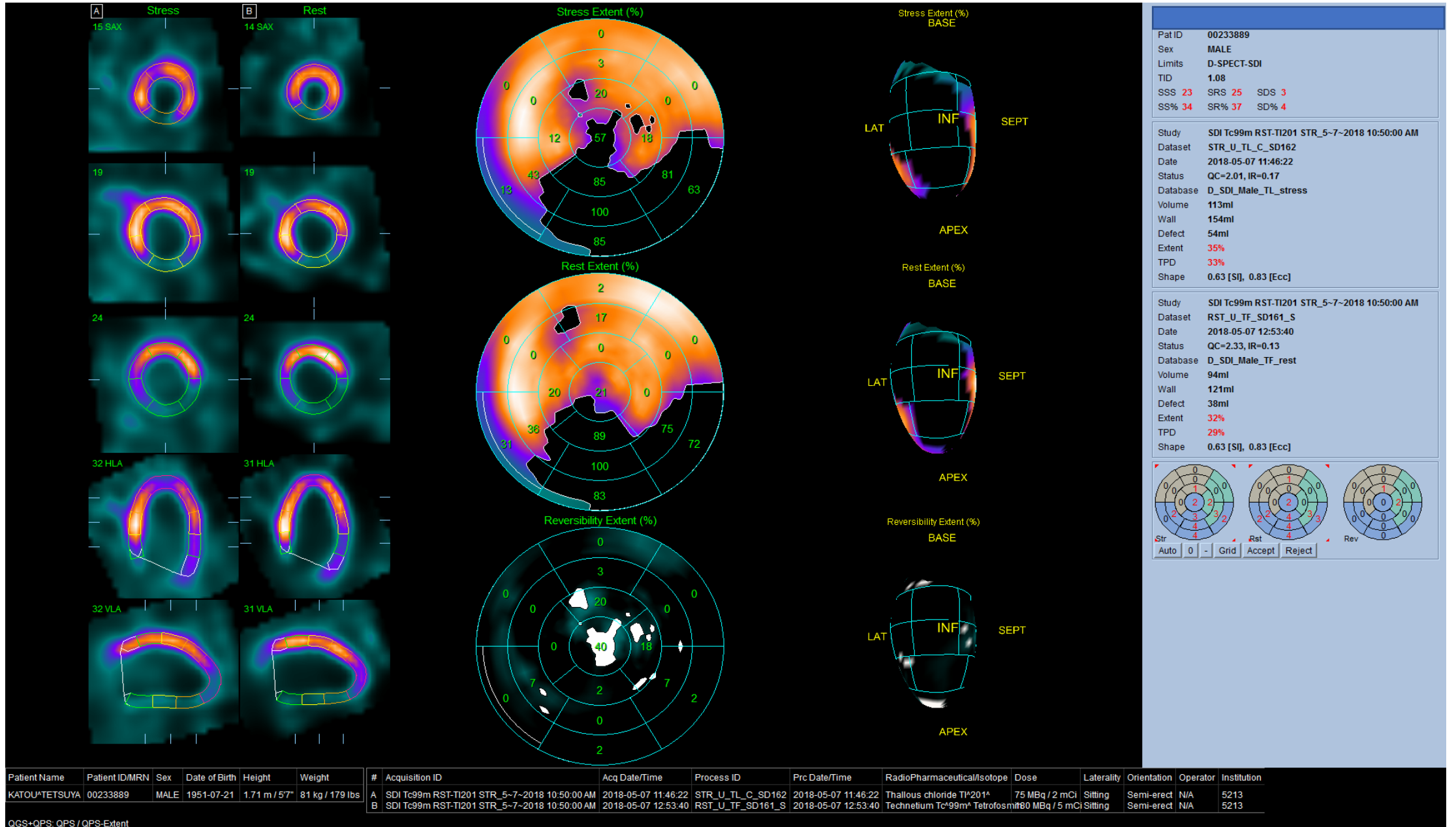
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 Dataset STR_U_TL_C_SD162
 Date 2018-05-07 11:46:22
 Status QC=2.01, IR=0.17
 Database D_SDI_Male_TL_stress
 Volume 113ml
 Wall 154ml
 Defect 54ml
 Extent 35%
 TPD 33%
 Shape 0.63 [SI], 0.83 [Ecc]

Study SDI Tc99m RST-TI201 STR_5-7-2018 10:50:00 AM
 Dataset RST_U_TF_SD161_S
 Date 2018-05-07 12:53:40
 Status QC=2.33, IR=0.13
 Database D_SDI_Male_TF_rest
 Volume 94ml
 Wall 121ml
 Defect 38ml
 Extent 32%
 TPD 29%
 Shape 0.63 [SI], 0.83 [Ecc]

Patient Name	Patient ID/MRN	Sex	Date of Birth	Height	Weight	#	Acquisition ID	Acq Date/Time	Process ID	Prc Date/Time	RadioPharmaceutical/Isotope	Dose	Laterality	Orientation	Operator	Institution
KATOU^TETSUYA	00233889	MALE	1951-07-21	1.71 m / 57"	81 kg / 179 lbs	A	SDI Tc99m RST-TI201 STR_5-7-2018 10:50:00 AM	2018-05-07 11:46:22	STR_U_TL_C_SD162	2018-05-07 11:46:22	Thallous chloride TI ²⁰¹ A	75 MBq / 2 mCi	Sitting	Semi-erect	N/A	5213
						B	SDI Tc99m RST-TI201 STR_5-7-2018 10:50:00 AM	2018-05-07 12:53:40	RST_U_TF_SD161_S	2018-05-07 12:53:40	Technetium Tc ^{99m} Tetrofosmit80 MBq / 5 mCi	Sitting	Semi-erect	N/A	5213	

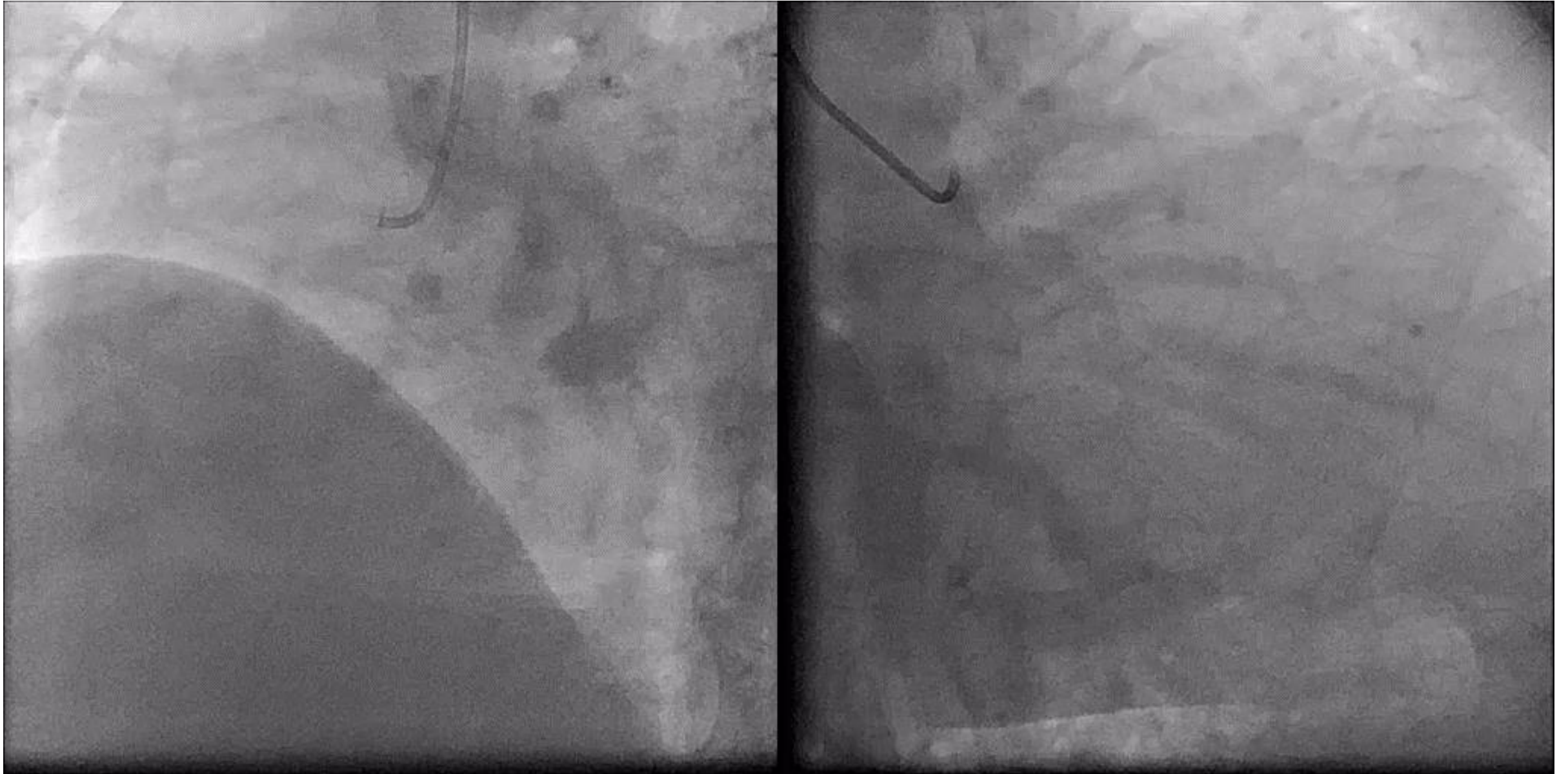
QPS: Splash / SPLASH-COOL

Myocardial perfusion imaging



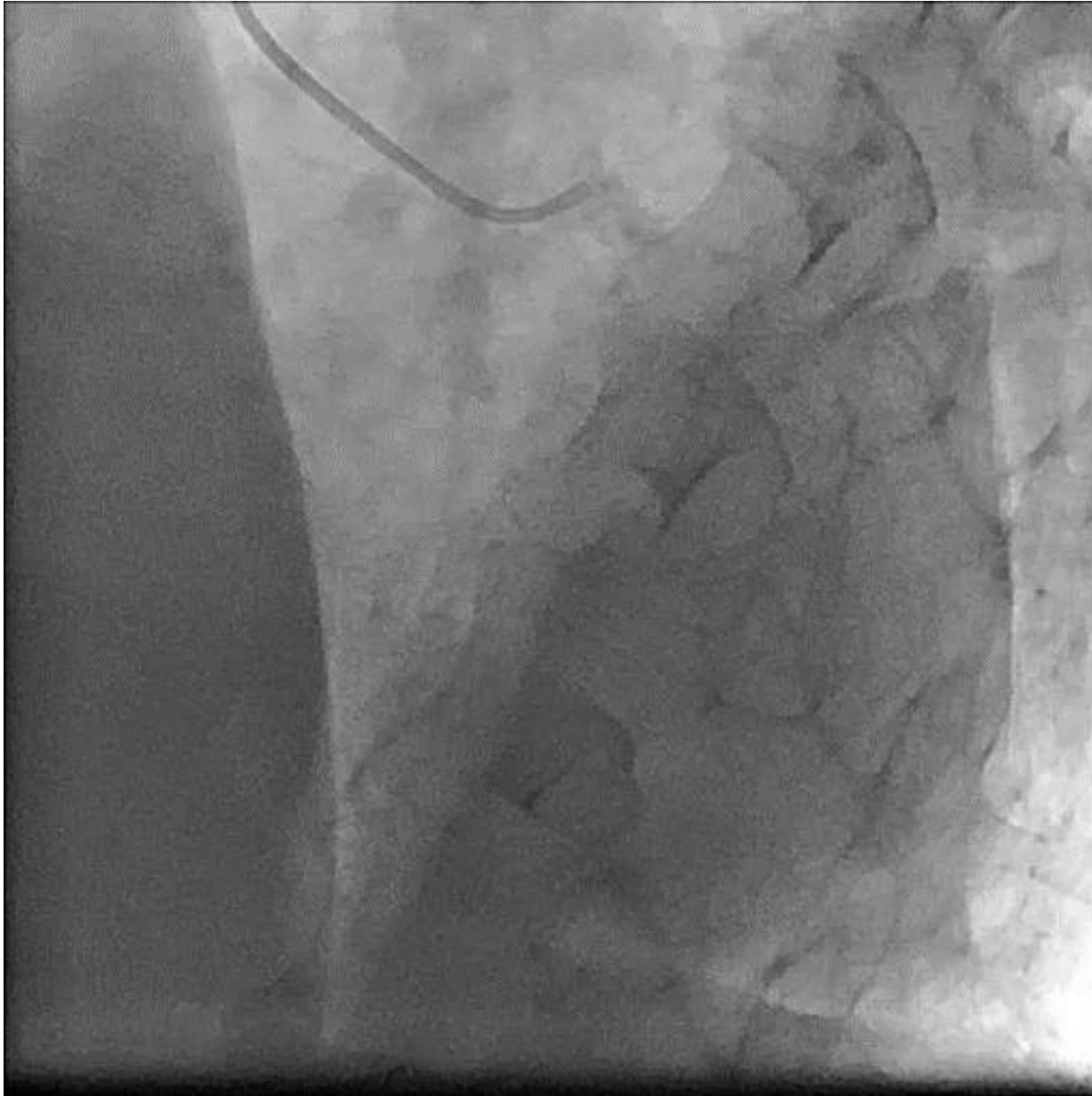
Patient Name	Patient ID/MRN	Sex	Date of Birth	Height	Weight	#	Acquisition ID	Acq Date/Time	Process ID	Prc Date/Time	RadioPharmaceutical/Isotope	Dose	Laterality	Orientation	Operator	Institution
KATOU^TETSUYA	00233889	MALE	1951-07-21	1.71 m / 5'7"	81 kg / 179 lbs	A	SDI Tc99m RST-TI201 STR_5-7-2018 10:50:00 AM	2018-05-07 11:46:22	STR_U_TL_C_SD162	2018-05-07 11:46:22	Thallous chloride Tl ²⁰¹ A	75 MBq / 2 mCi	Sitting	Semi-erect	N/A	5213
						B	SDI Tc99m RST-TI201 STR_5-7-2018 10:50:00 AM	2018-05-07 12:53:40	RST_U_TF_SD161_S	2018-05-07 12:53:40	Technetium Tc ^{99m} Tetrofosmin	80 MBq / 5 mCi	Sitting	Semi-erect	N/A	5213

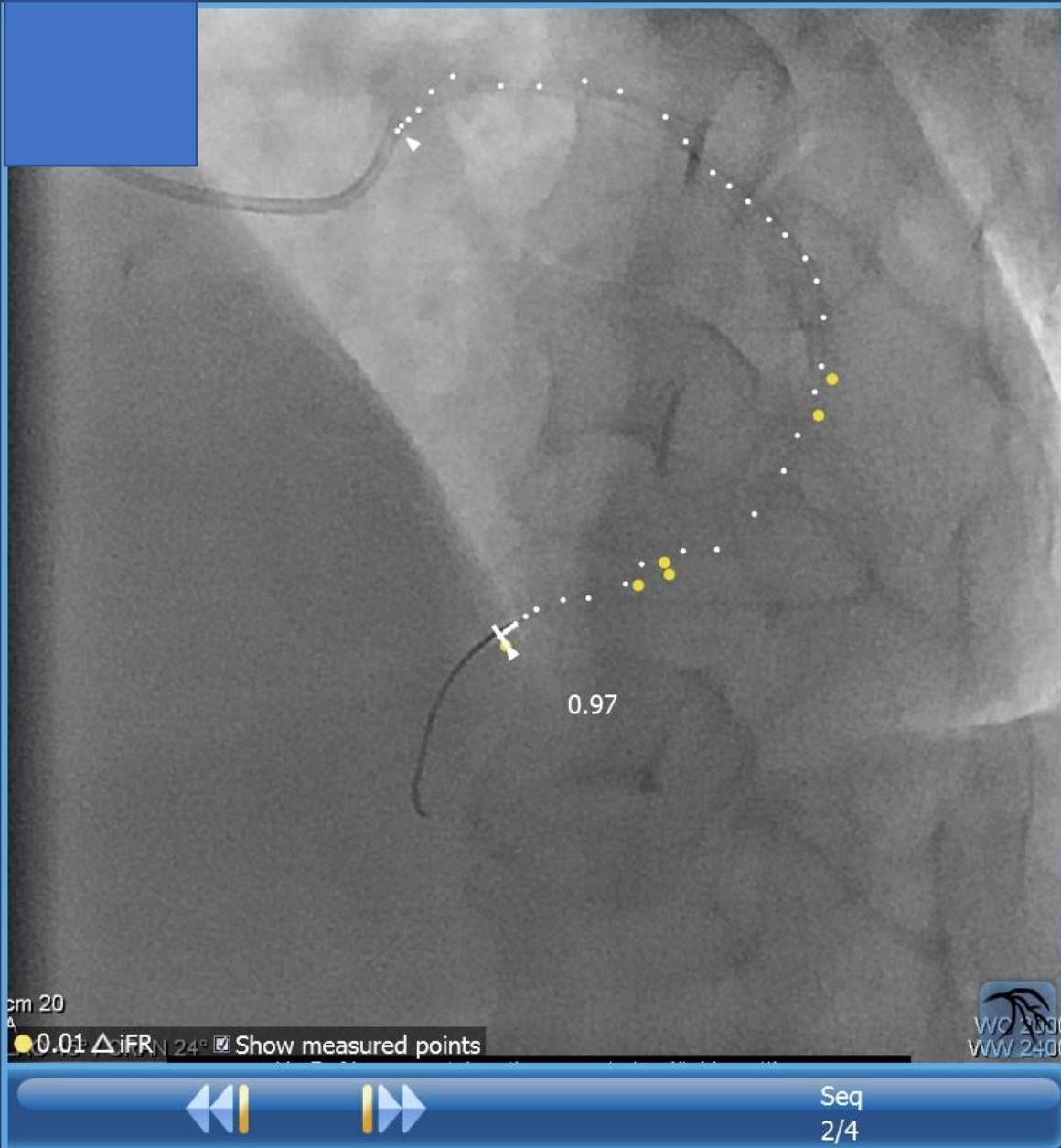
Coronary angiography : May. 15th,2018 ID:233889



Coronary angiography : May. 15th,2018

ID:233889

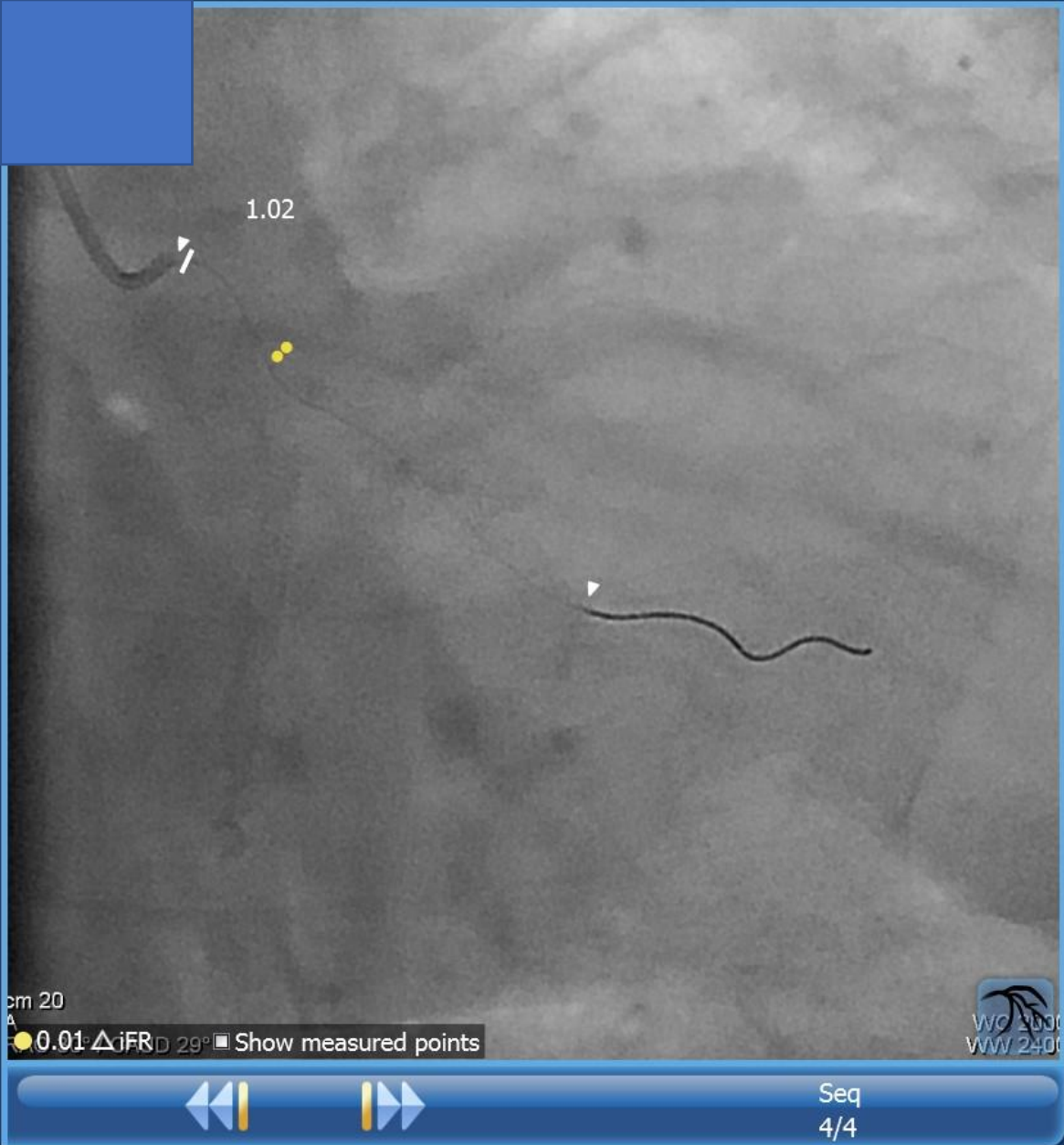




iFR Distal: 0.97

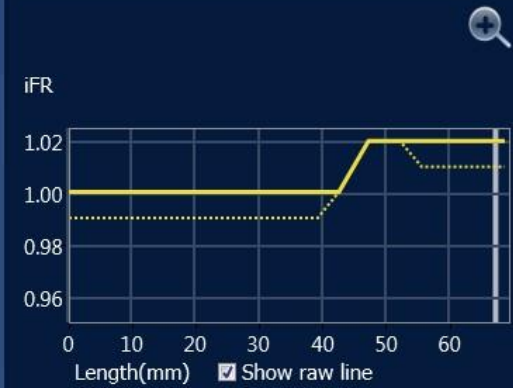
iFR at Cursor: 0.97





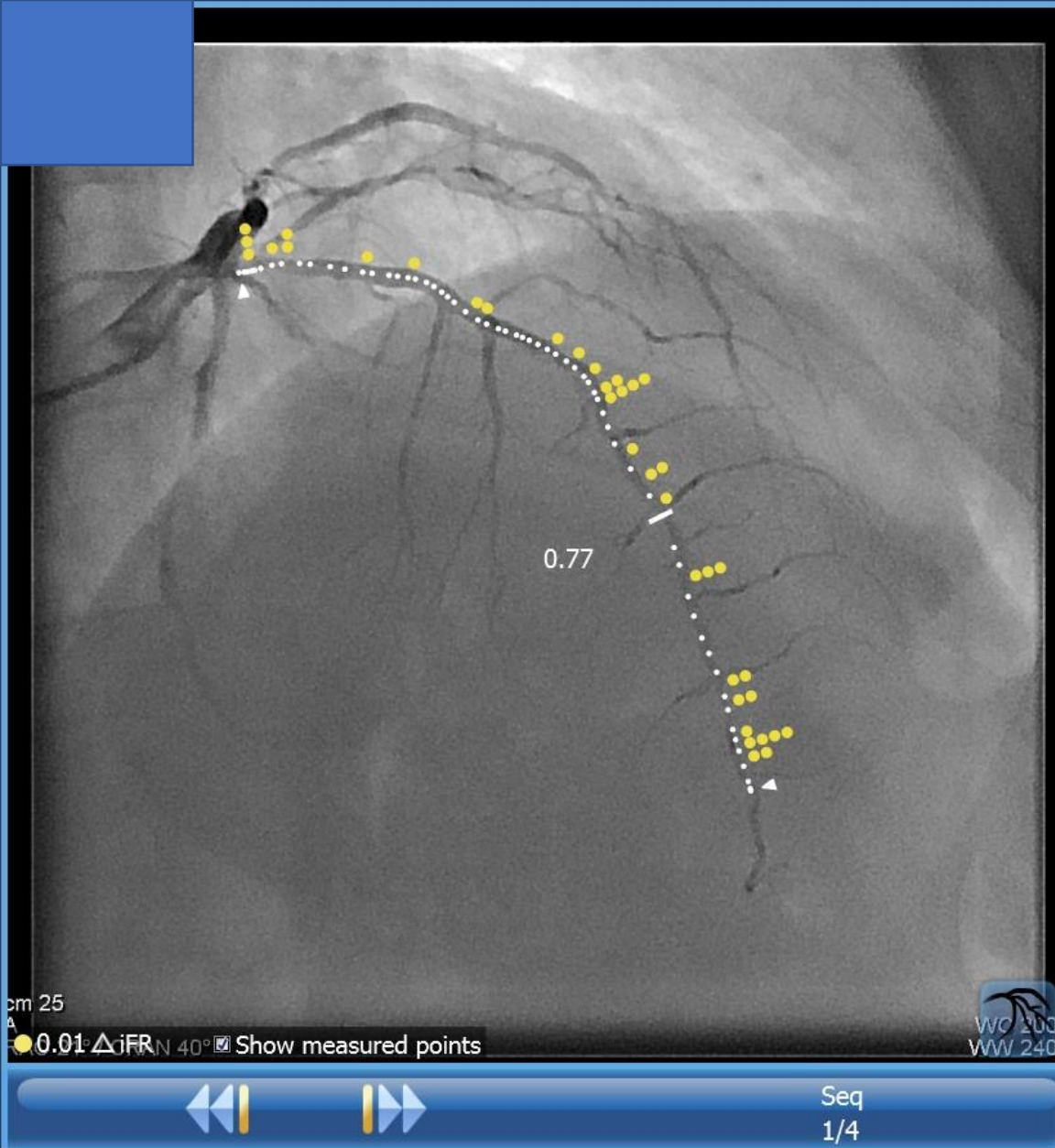
iFR Distal: 1.00

iFR at Cursor: 1.02



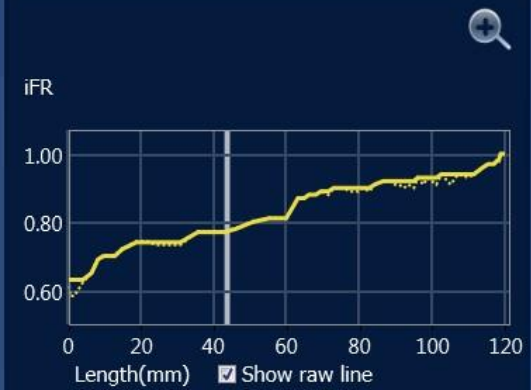
cm 20
A
● 0.01 ▲ iFR D 29° ■ Show measured points

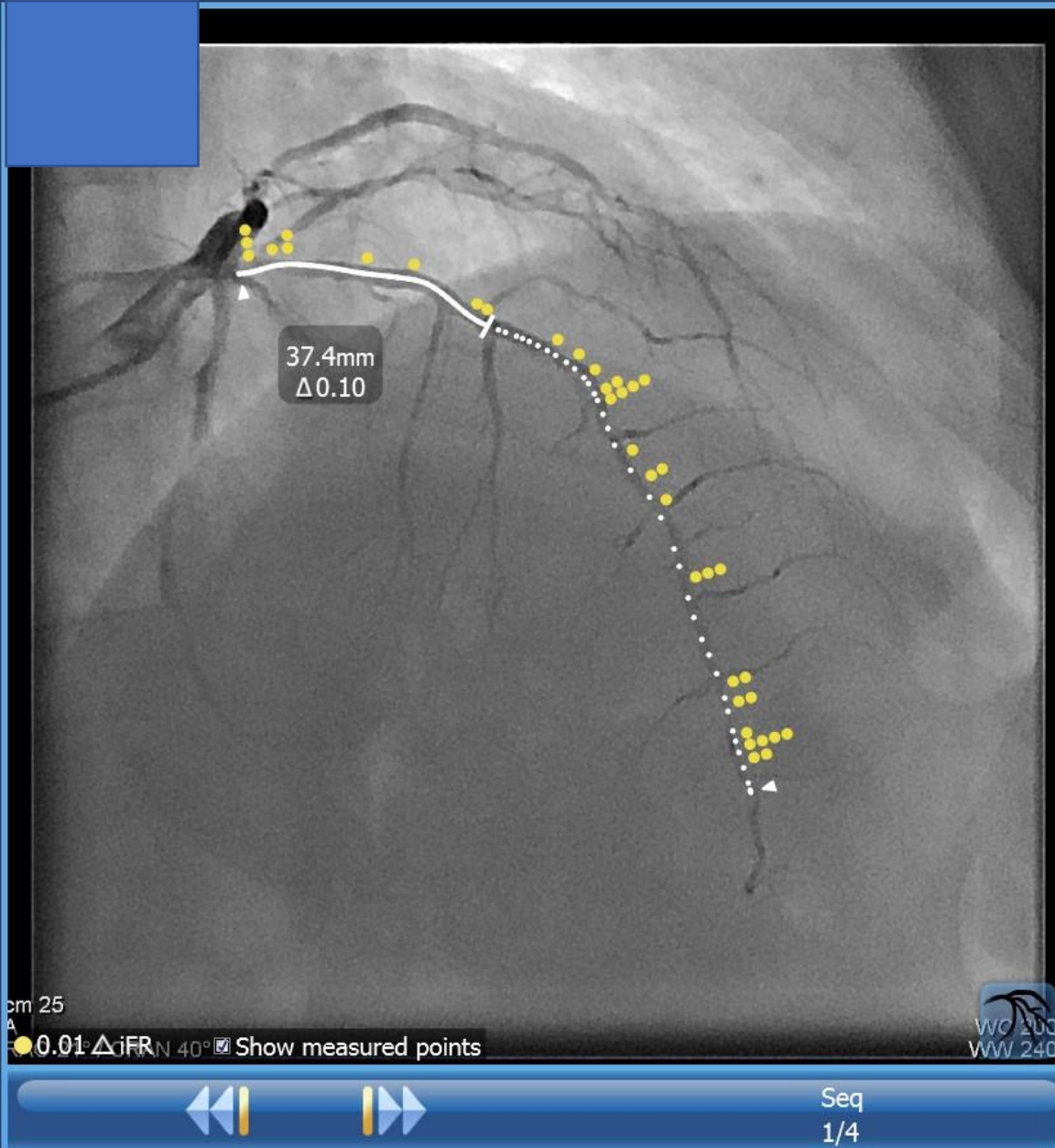
Seq
4/4



iFR Distal: 0.63

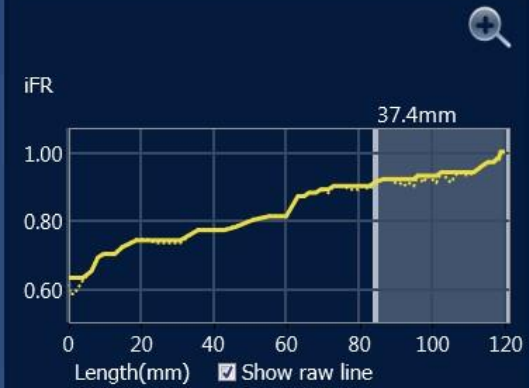
iFR at Cursor: 0.77

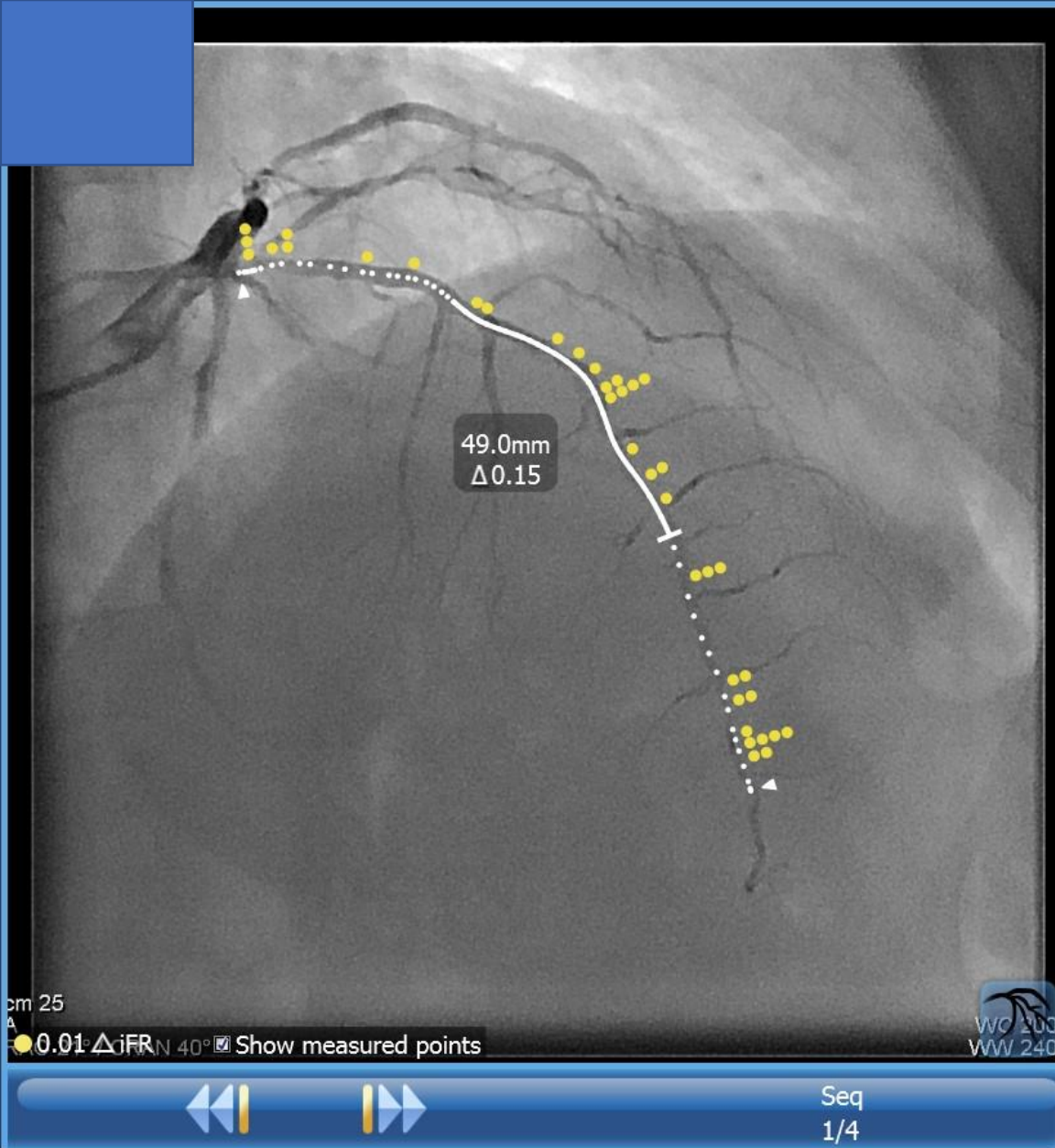




iFR Distal: 0.63

iFR Estimate: 0.73

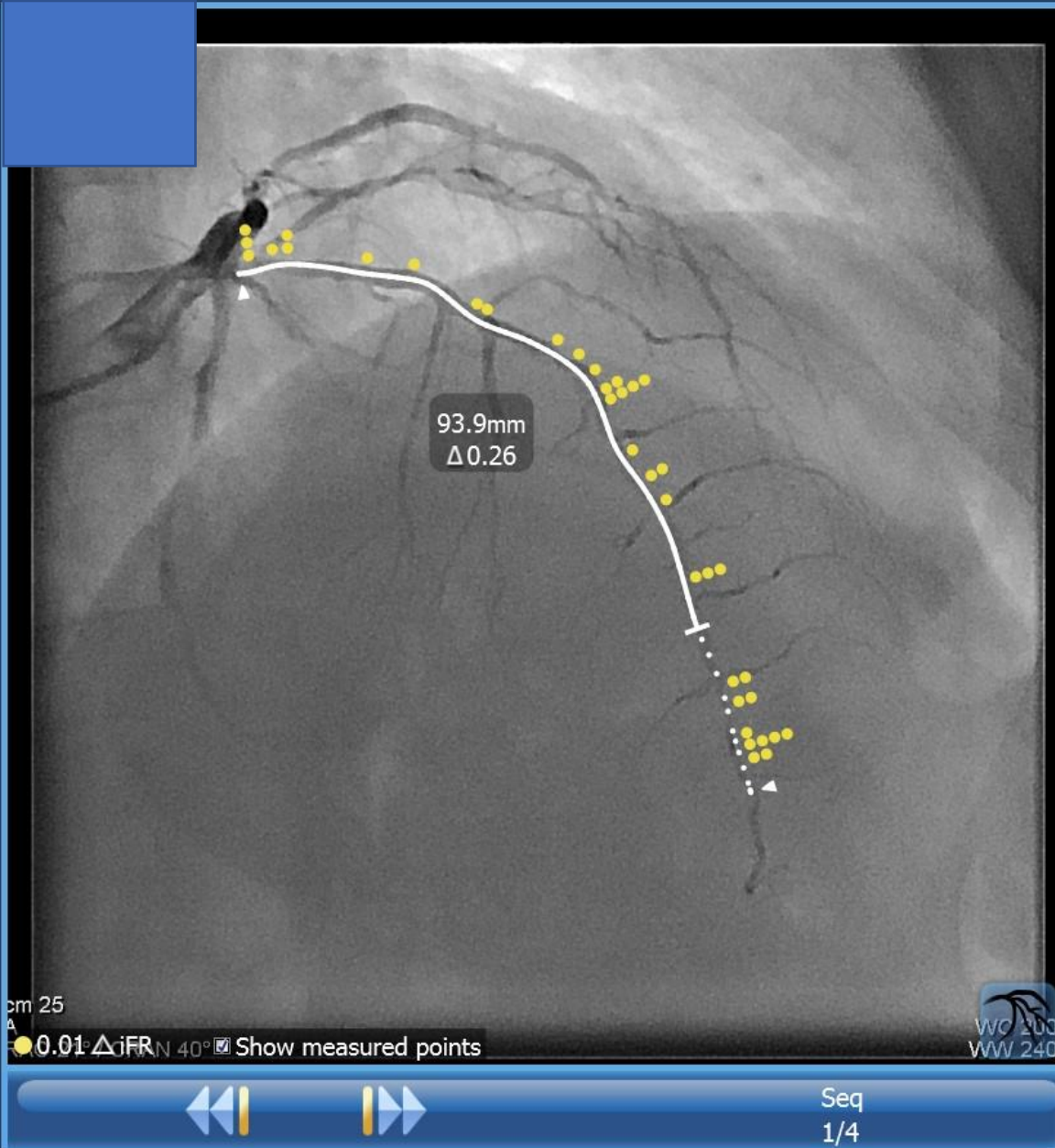




iFR Distal: 0.63

iFR Estimate: 0.78

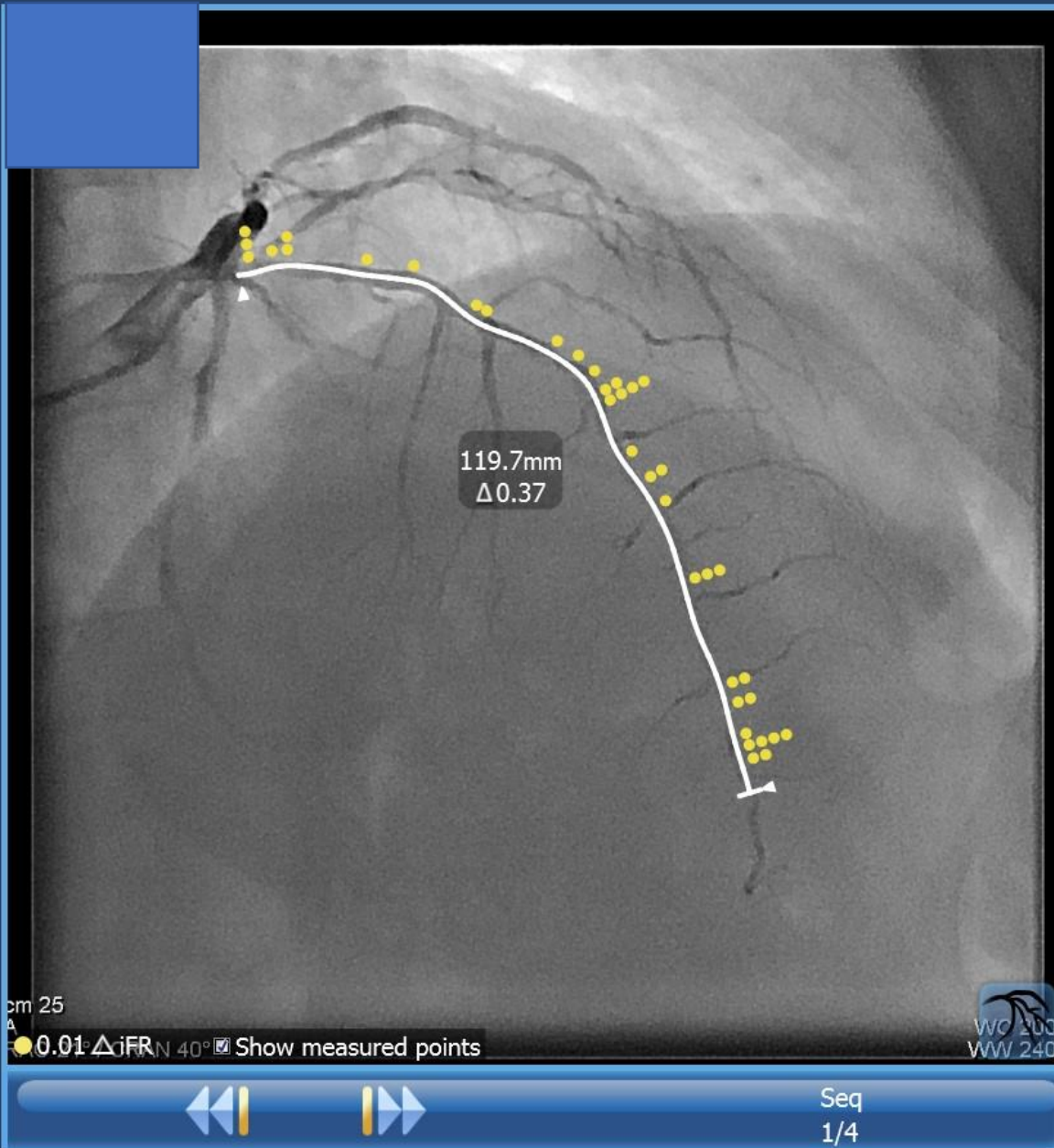




iFR Distal: 0.63

iFR Estimate: 0.89





iFR Distal: 0.63

iFR Estimate: 1.00



Take Home Messages

- iFR angiocoregistration software is very user friendly and make it possible to map the physiological severity of stenosis and offer easy planning of PCI to obtain the optimal result.

Thank you for your attention



御清聴ありがとうございました。

