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TCTAP 2014
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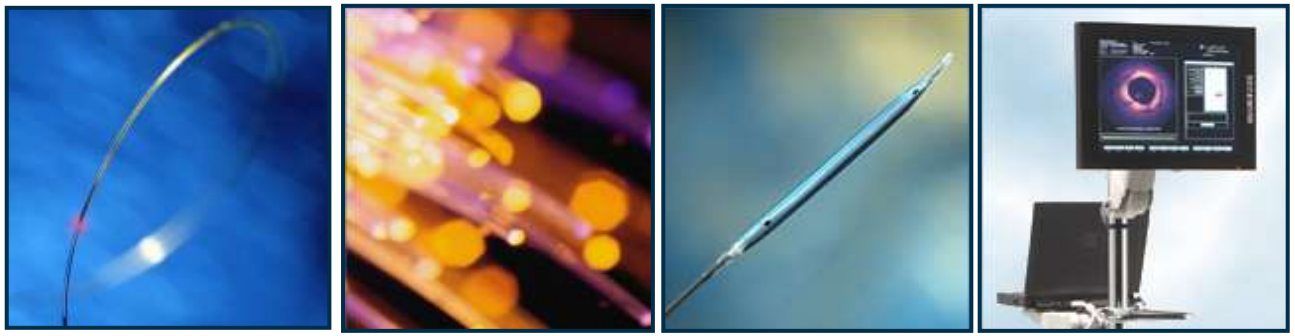
COEX, SEOUL, KOREA

Partnership Session with International Society
HKSTENT Session @TCTAP 2014

April 22 2014 18:16-18:36 Seoul, Korea

IVUS guided vs. OCT guided in current PCI practice



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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	Company
• Grant/Research Support	• St. Jude Medical, Terumo, Abbott Vascular
• Consulting Fees/Honoraria	• St. Jude Medical, Terumo
• Major Stock Shareholder/Equity	• No
• Royalty Income	• No
• Ownership/Founder	• No
• Intellectual Property Rights	• No
• Other Financial Benefit	• No

OCT vs. IVUS

	IVUS	OCT
Energy source	US	NIR laser
Resolution	100-200 um	10-20 um
Frame rate	30 fps	160 fps
Pullback velocity	0.5-2.0 mm/sec	0.5-40 mm/sec
Catheter type	RX 2.4 Fr.	RX 2.4 Fr.
Penetration depth	5 mm	1-2 mm
Scan diameter	20 mm	10 mm
Blood evacuation	-	Lactate Ringer and/or Contrast medium flush

Case 1: 64yo, M

Clinical diagnosis

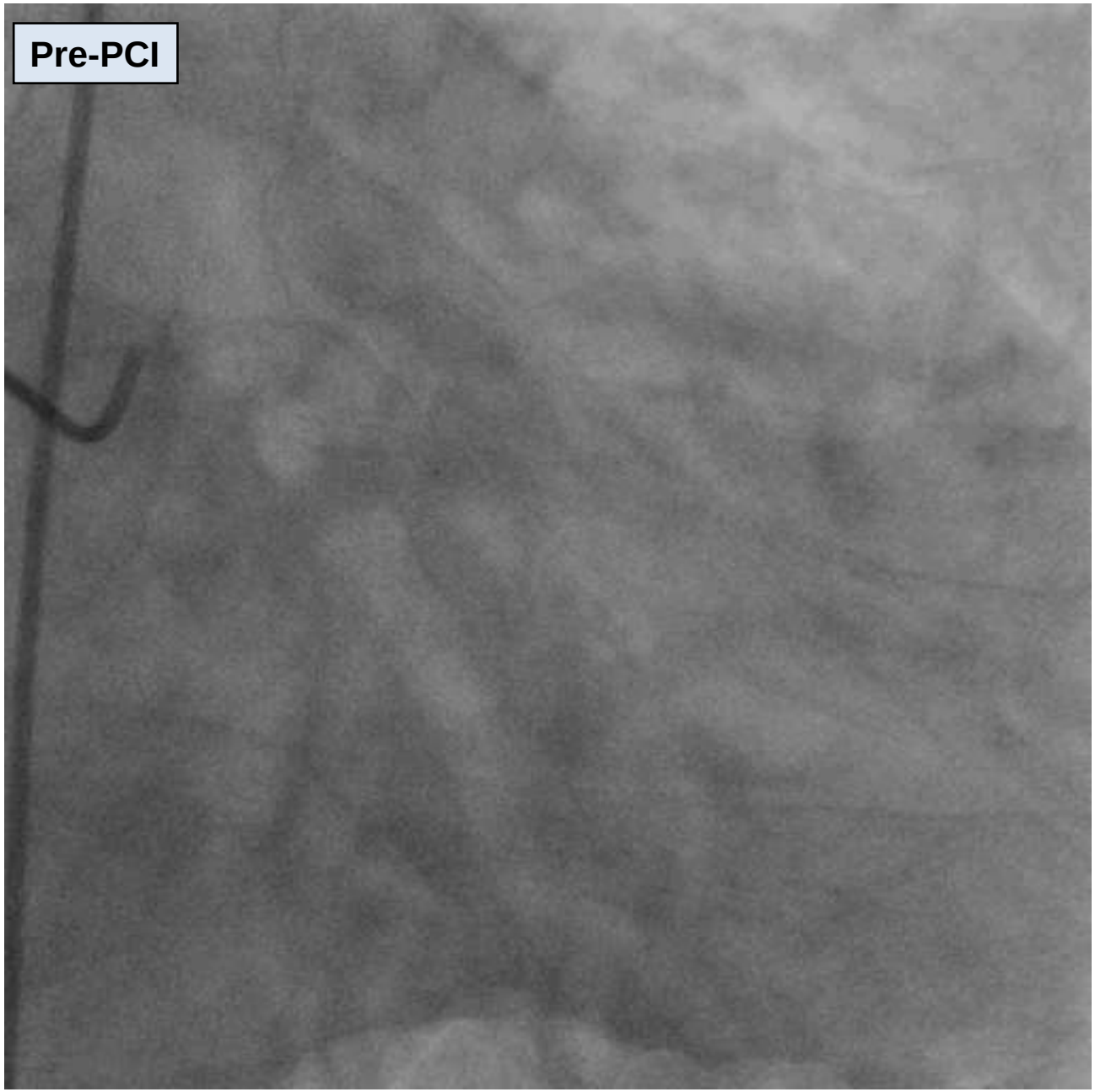
Non-ST Elevation MI

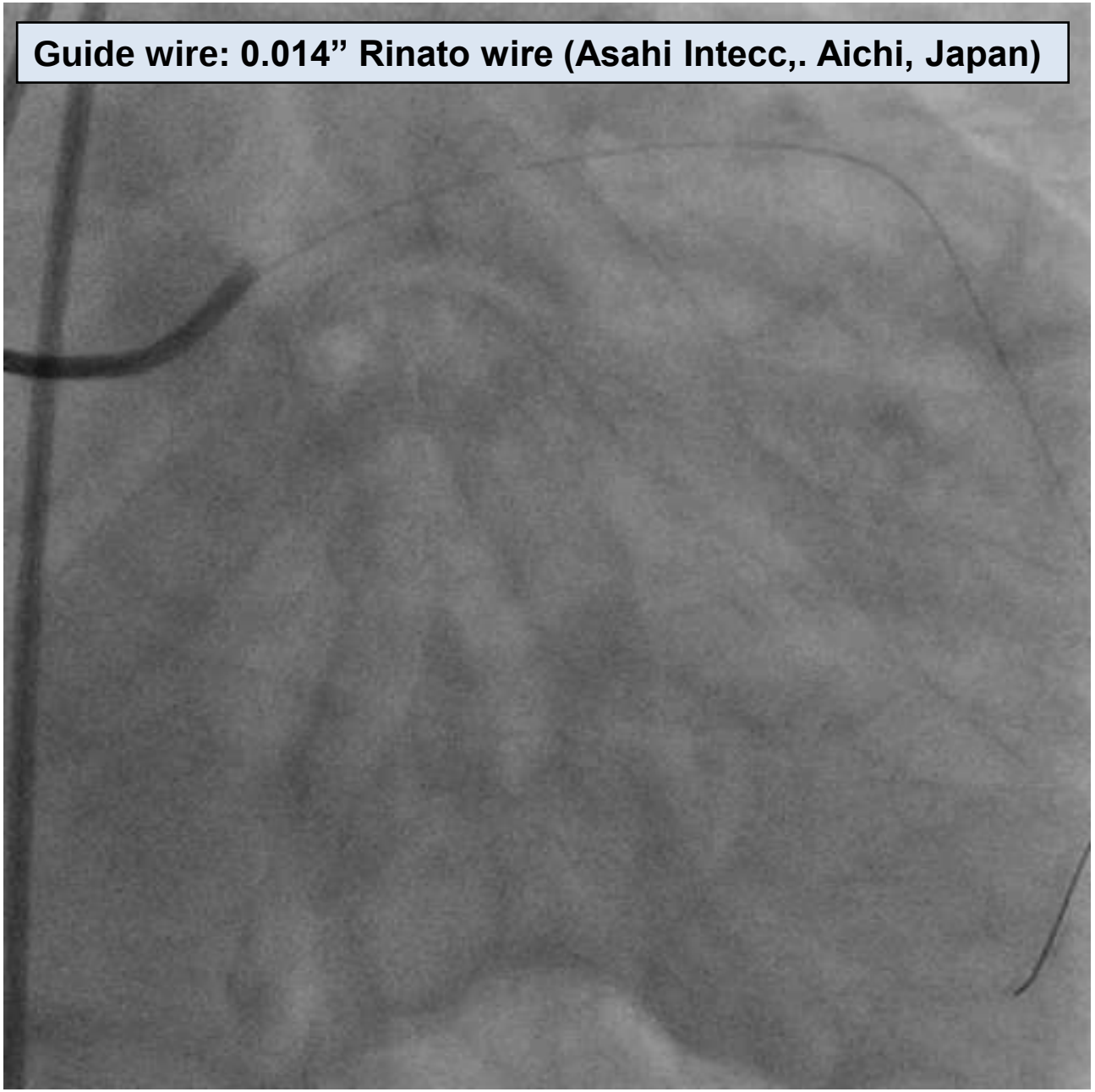
Clinical history and test results prior to catheterization

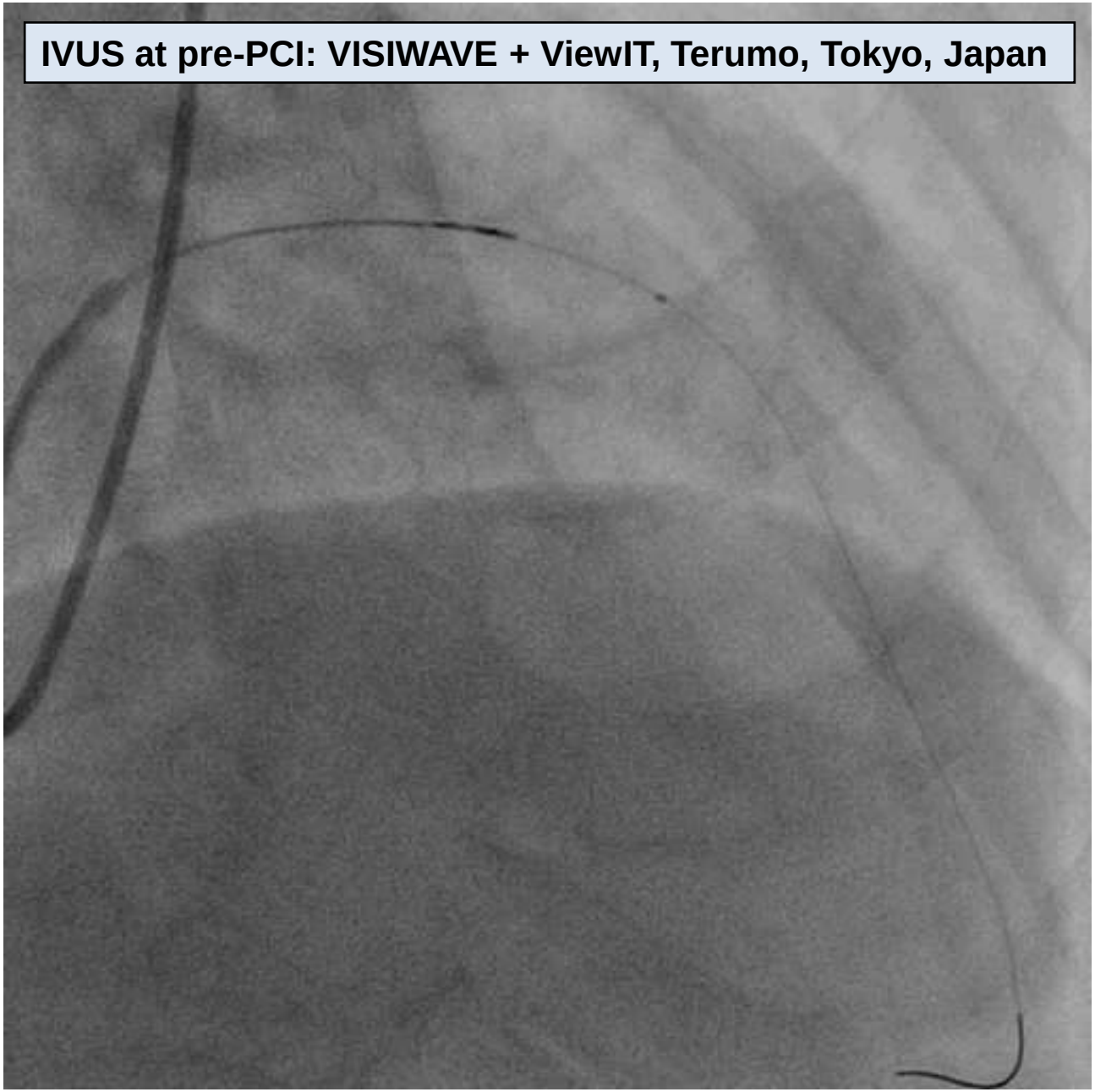
New-onset effort chest pain
ECG: $V_{4\text{-}6}$ ST depression
Labo: Troponin (+)
UCG: LV anteroseptal~apex = akinesis
Time between onset and catheterization = 3 hrs

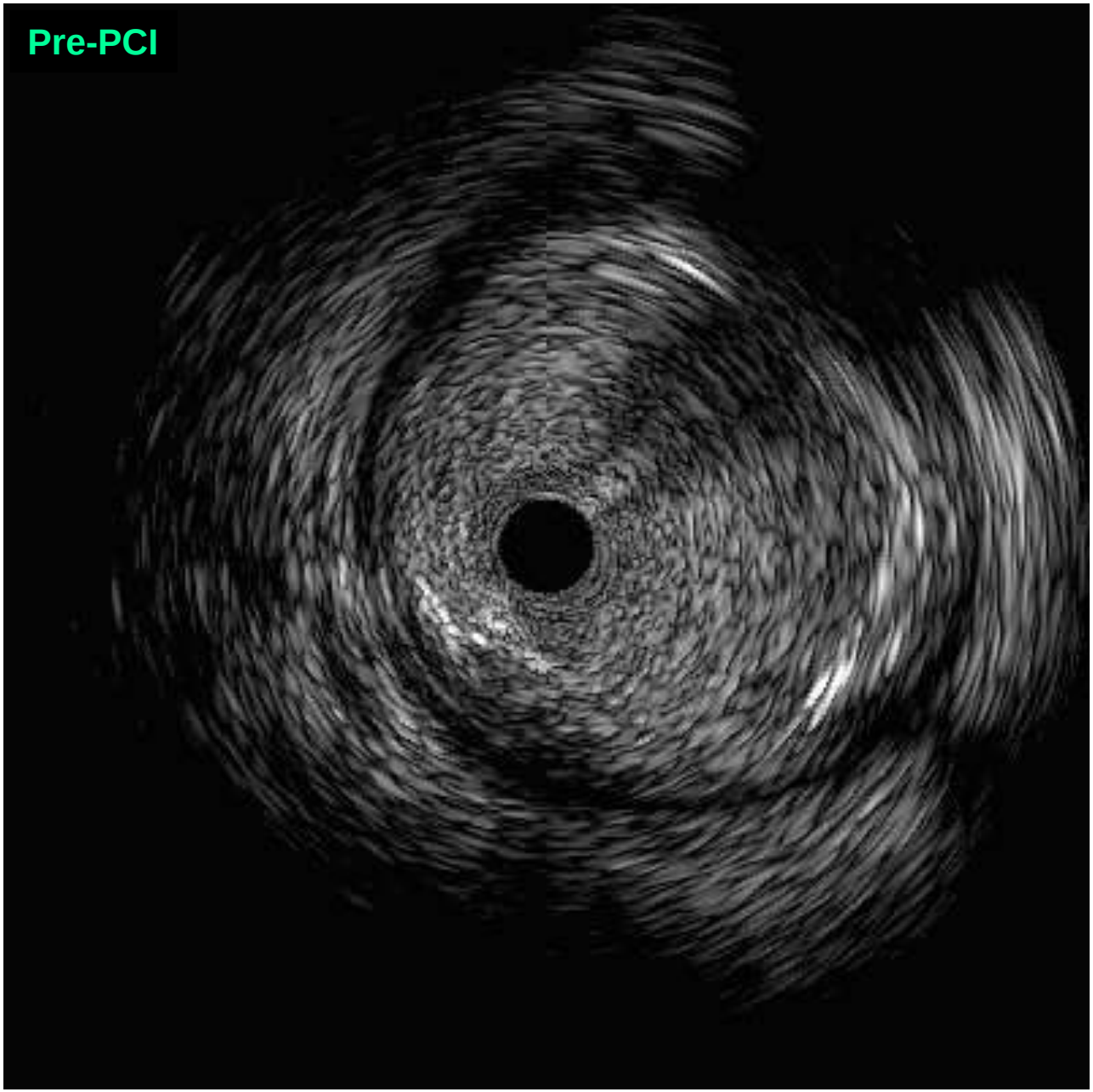
Coronary risk factors

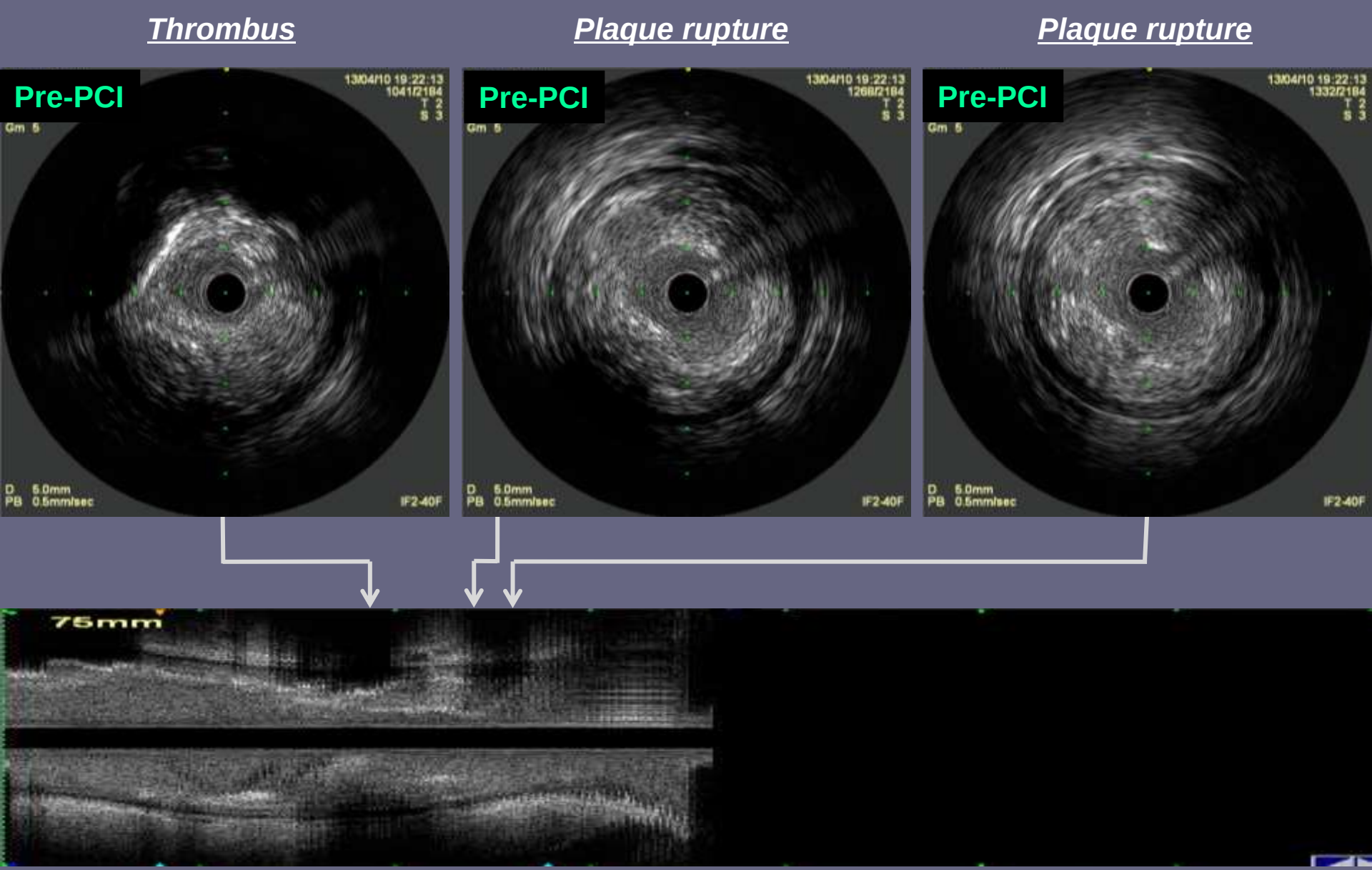
HT (+), DLP (-), DM (-), Obesity (-), Current smoker (+)


Pre-PCI

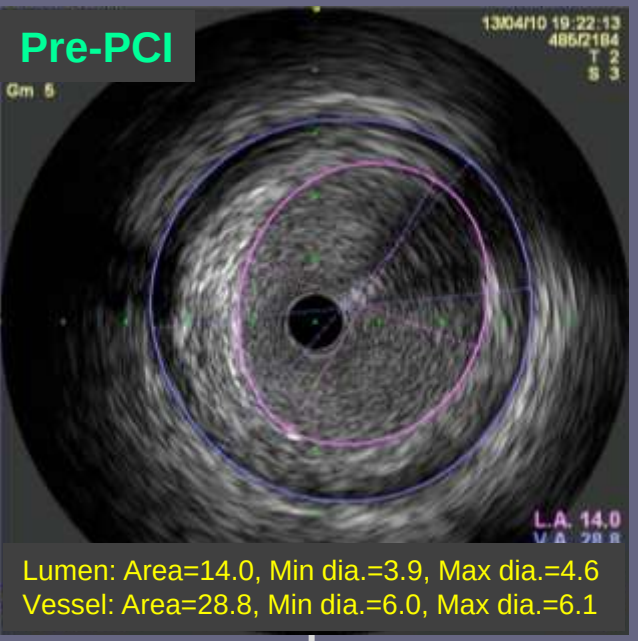

Guide wire: 0.014” Rinato wire (Asahi Intecc,. Aichi, Japan)


IVUS at pre-PCI: VISIWAVE + ViewIT, Terumo, Tokyo, Japan


Pre-PCI

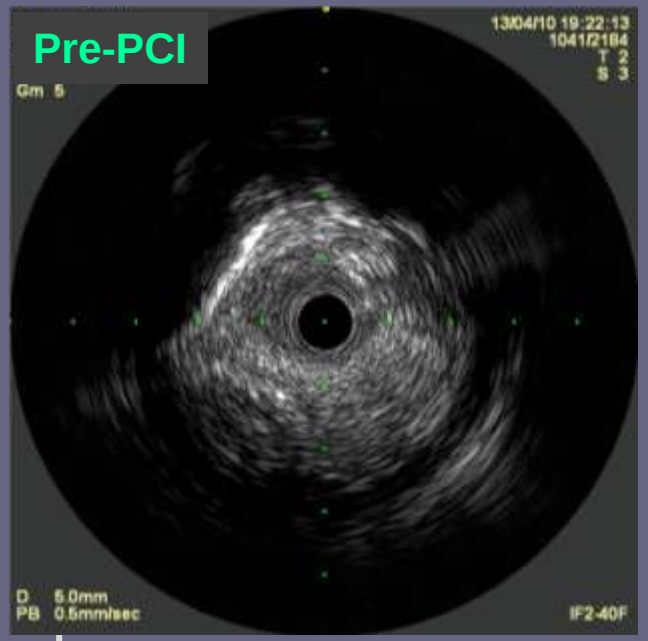

Thrombus
Plaque rupture
Plaque rupture
Pre-PCI
Pre-PCI
Pre-PCI
13/04/10 19:22:13
1041/2184
13/04/10 19:22:13
1268/2184
13/04/10 19:22:13
1332/2184
T 2
S 3
Gm 5
D 5.0mm
PB 0.5mm/sec
IF2-40F
75mm

Distal reference

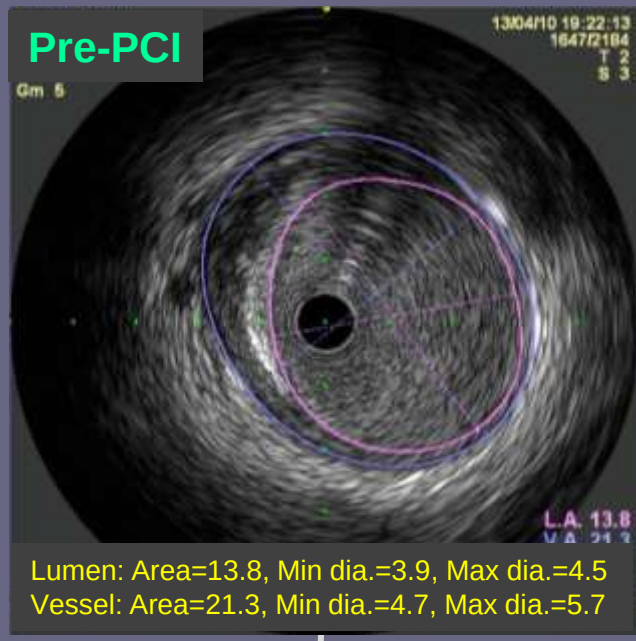


Lumen: Area=14.0, Min dia.=3.9, Max dia.=4.6
Vessel: Area=28.8, Min dia.=6.0, Max dia.=6.1

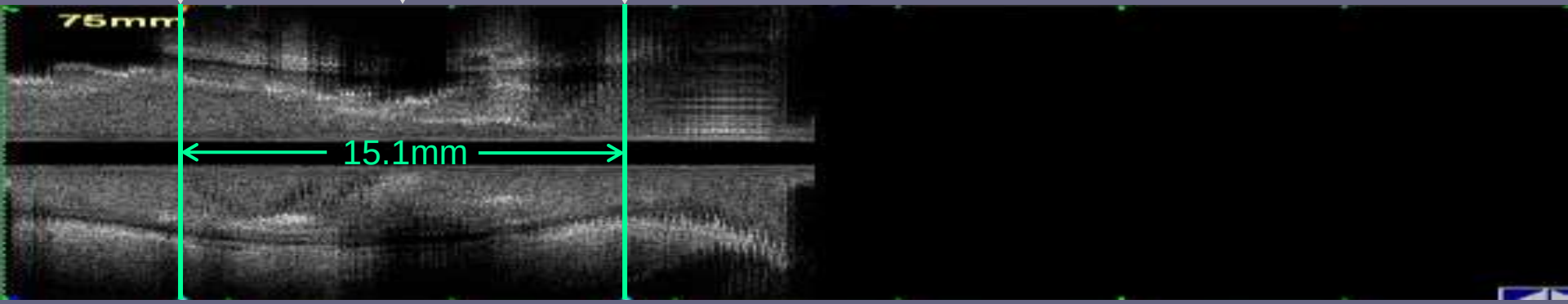
MLA site

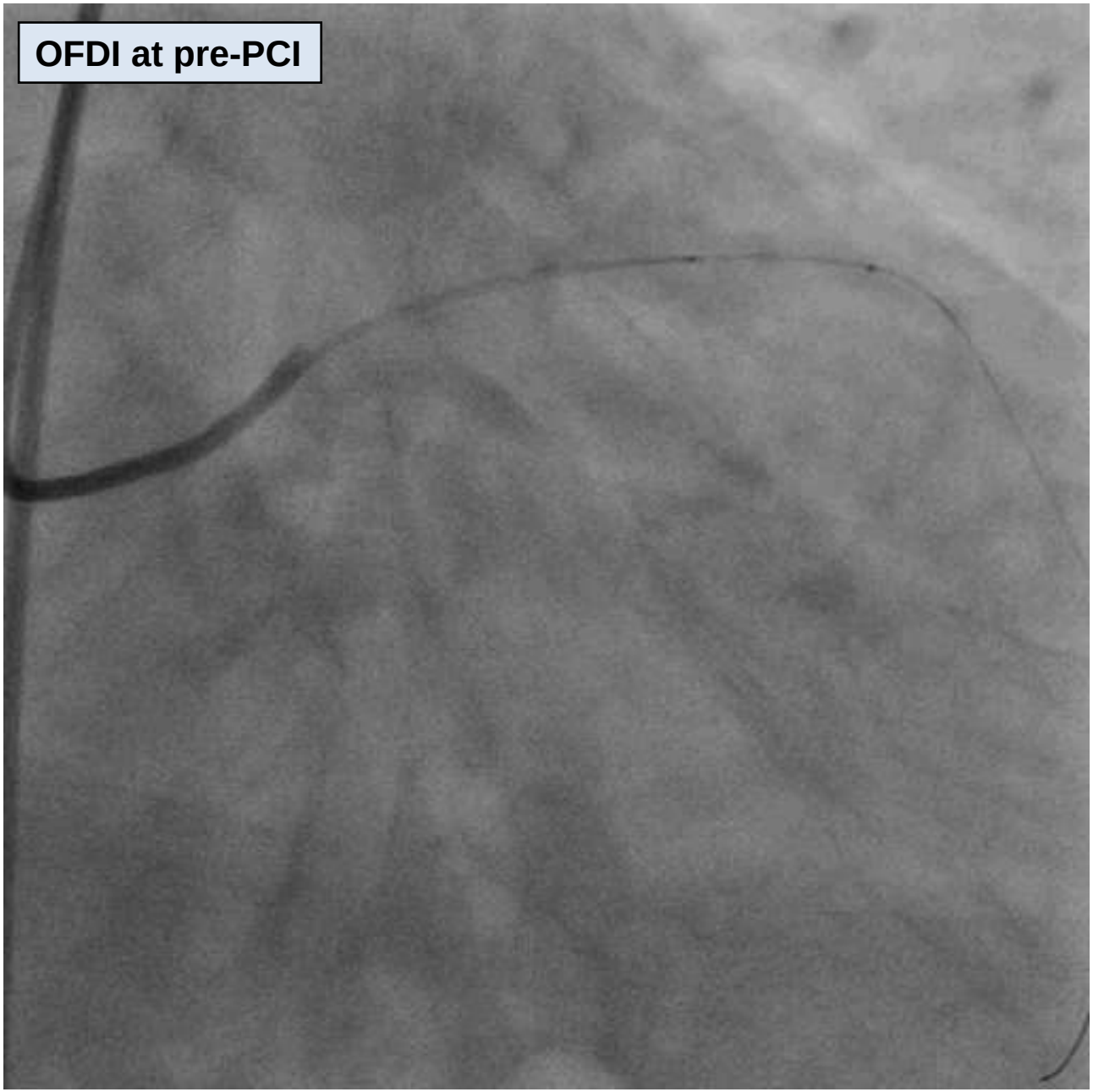


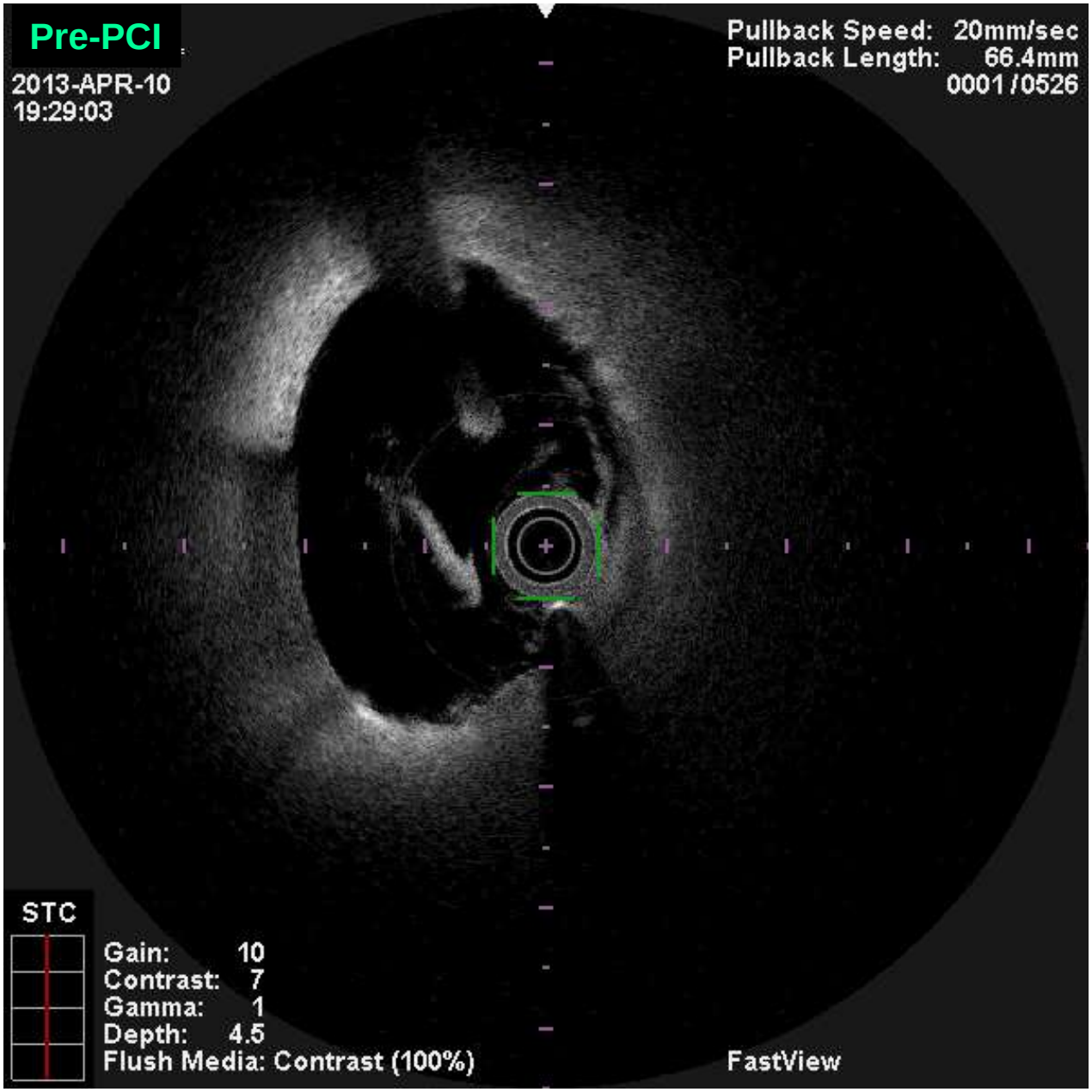
Proximal reference



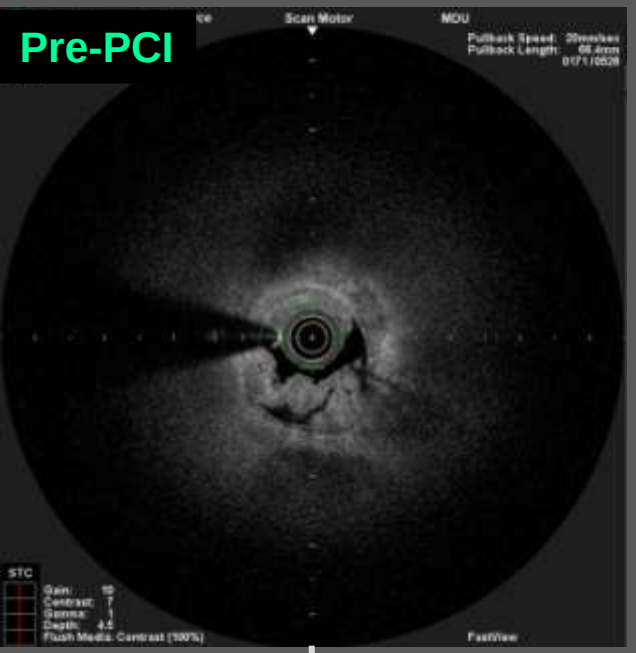
Lumen: Area=13.8, Min dia.=3.9, Max dia.=4.5
Vessel: Area=21.3, Min dia.=4.7, Max dia.=5.7



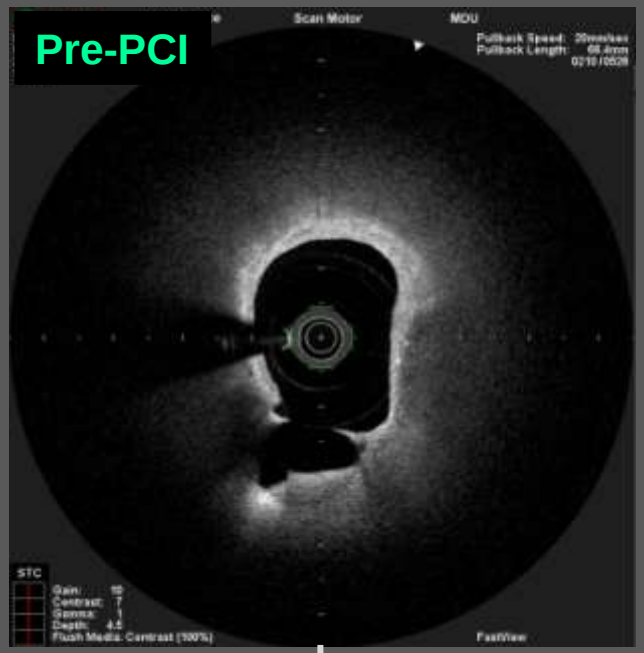

OFDI at pre-PCI


Pre-PCI
2013-APR-10
19:29:03
Pullback Speed: 20mm/sec
Pullback Length: 66.4mm
0001/0526
STC
Gain: 10
Contrast: 7
Gamma: 1
Depth: 4.5
Flush Media: Contrast (100%)
FastView

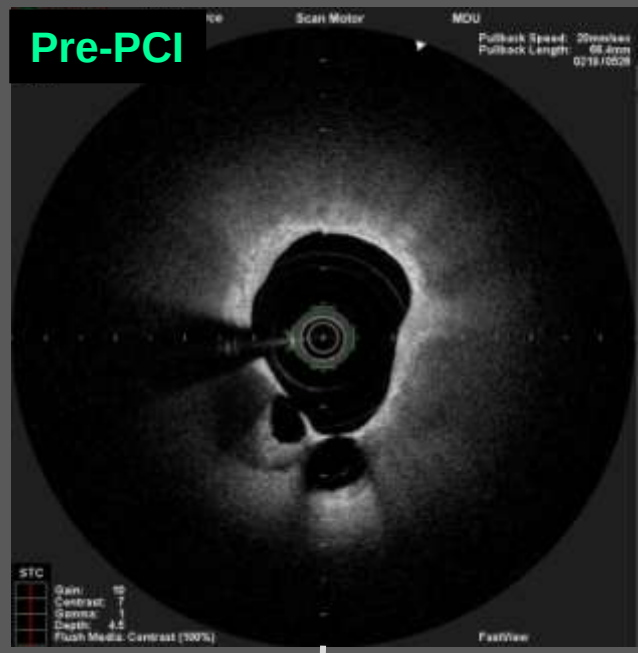
Thrombus

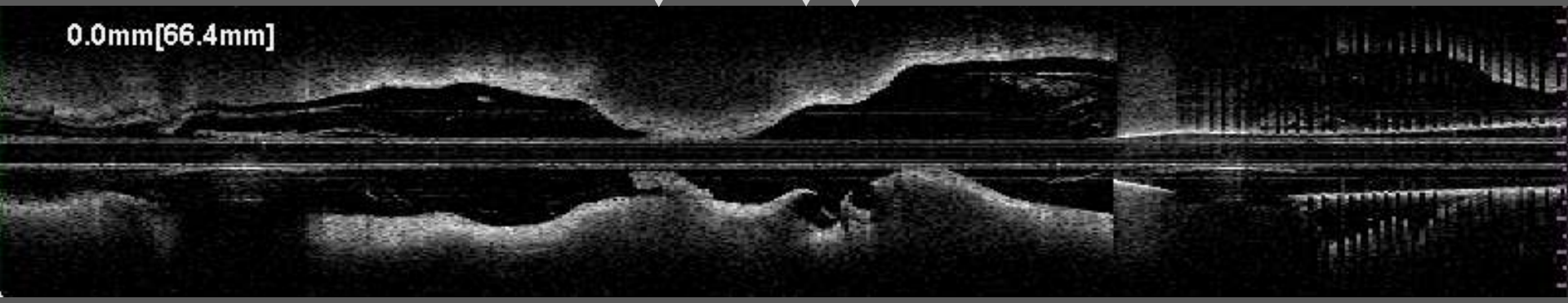


Plaque rupture

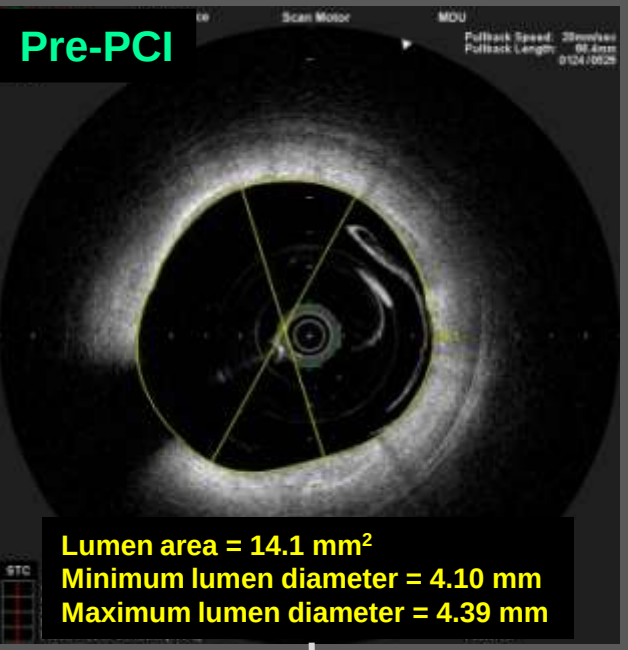


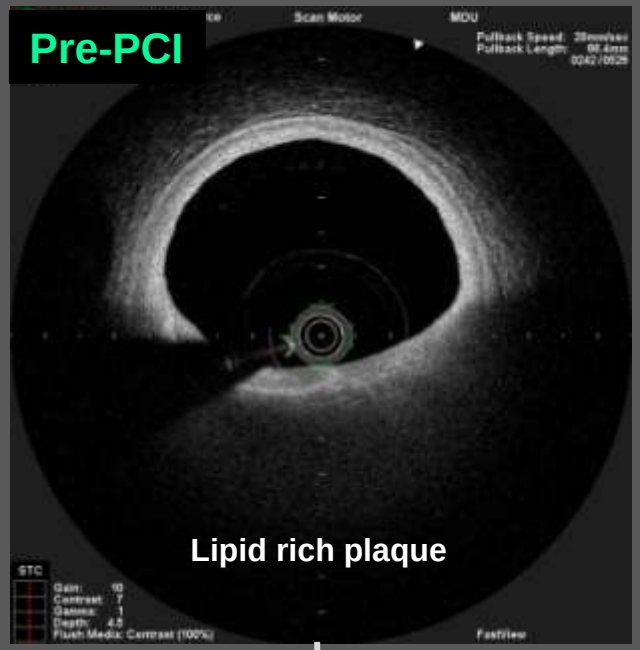
Plaque rupture



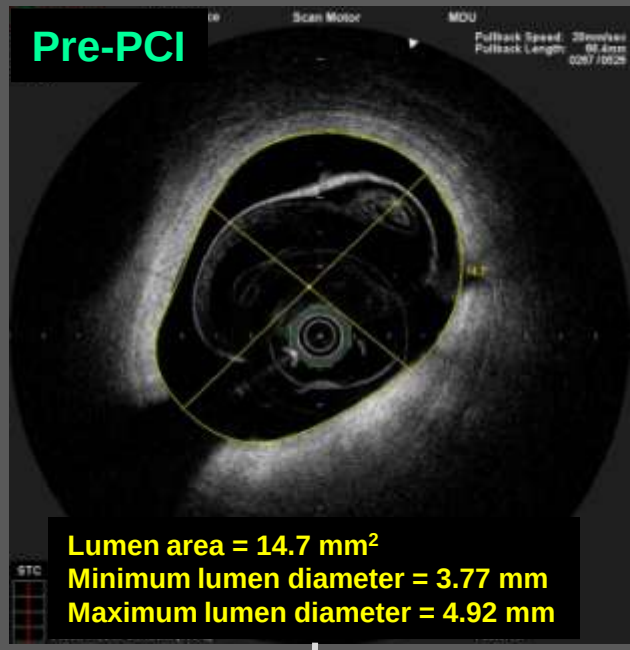


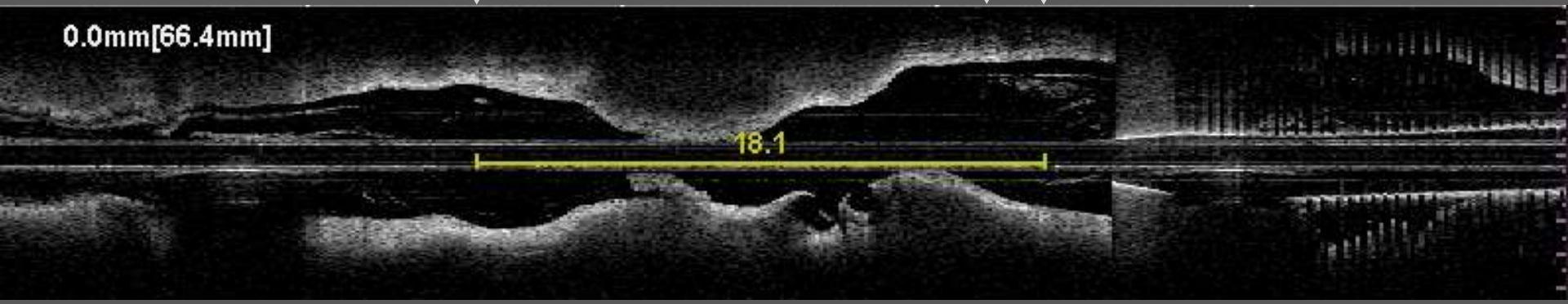
Distal reference





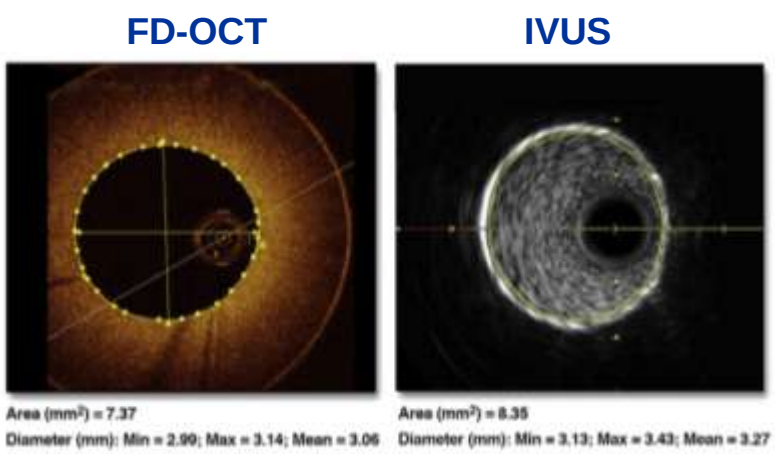
Proximal reference



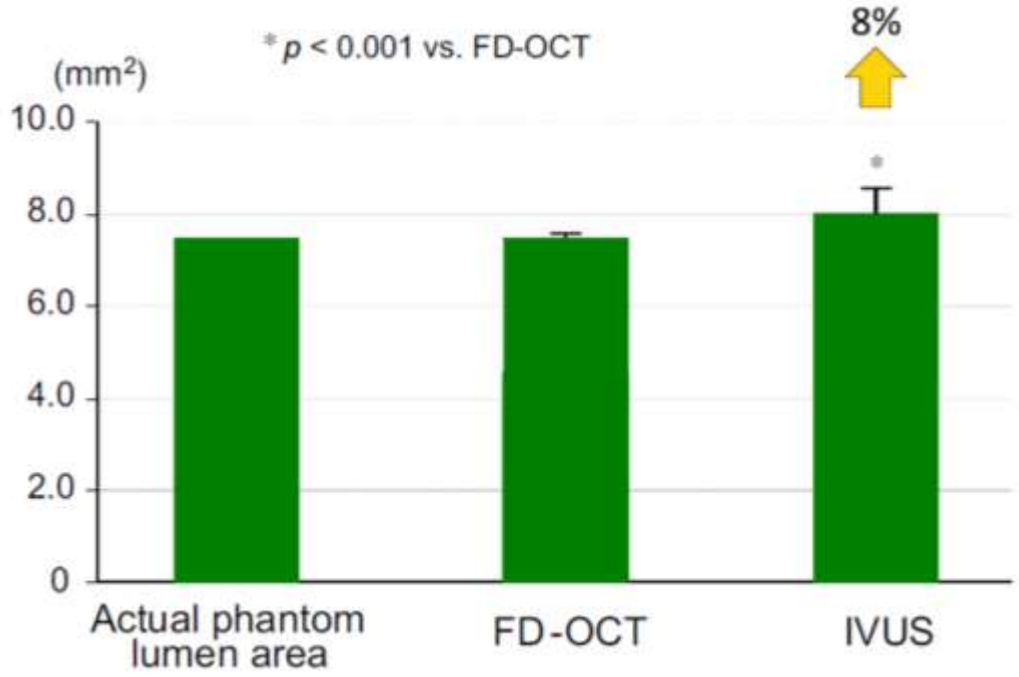


Accuracy of OCT measurement in phantom model

The accuracy of FD-OCT and IVUS measurements was evaluated by using in-vitro phantom model (n=15, in 5 catheter laboratories).



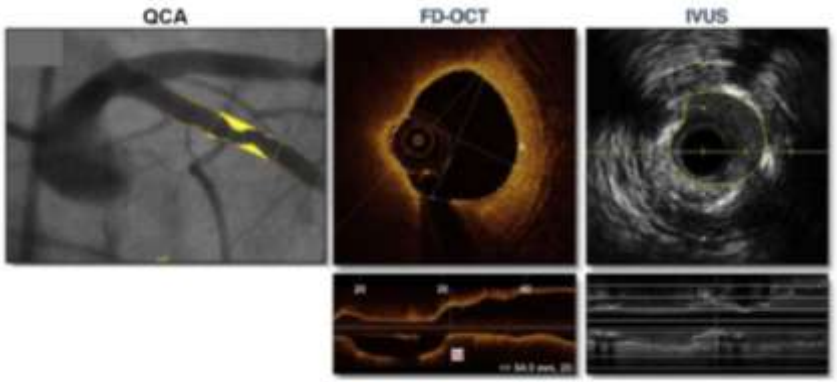
Measurement of Lumen Area in Phantom Model by FD-OCT and IVUS. In this representative cross-sectional image, the mean lumen diameter of IVUS was 3.27 mm, whereas that of FD-OCT was 3.06 mm, closer to true value (3.08 mm).



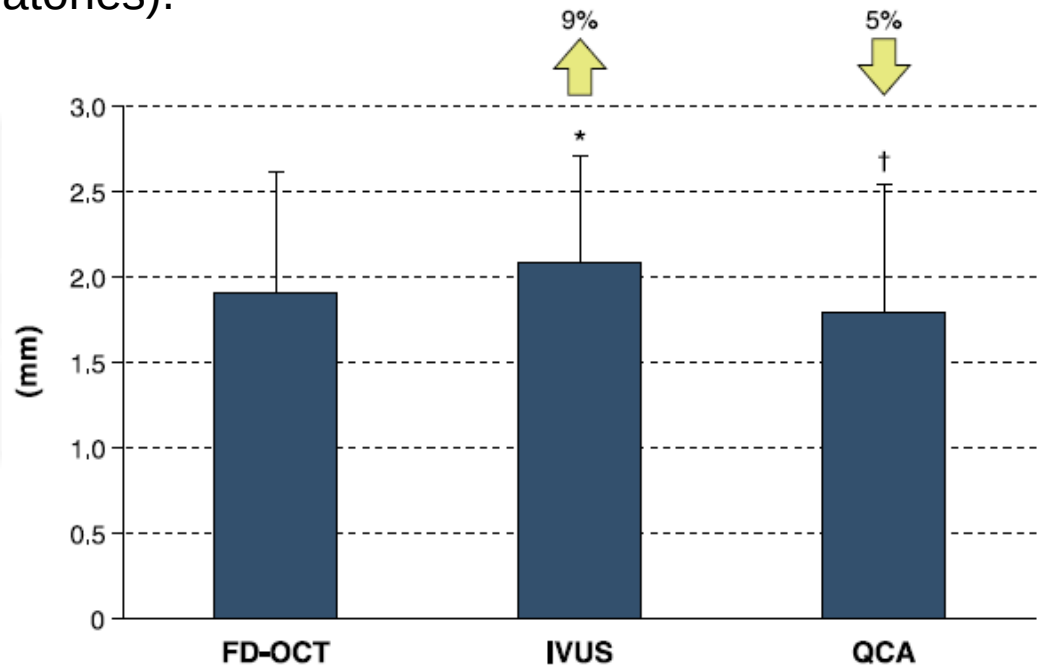
Conclusion: The mean of the lumen areas measured by FD-OCT was equal to the actual lumen area of the phantom model. The mean of the lumen areas by IVUS was greater than that by FD-OCT (relative reference 8%).

Accuracy of OCT measurement in vivo

The accuracy of FD-OCT and IVUS measurements was evaluated by using in-vivo in humans (n=100, in 5 catheter laboratories).



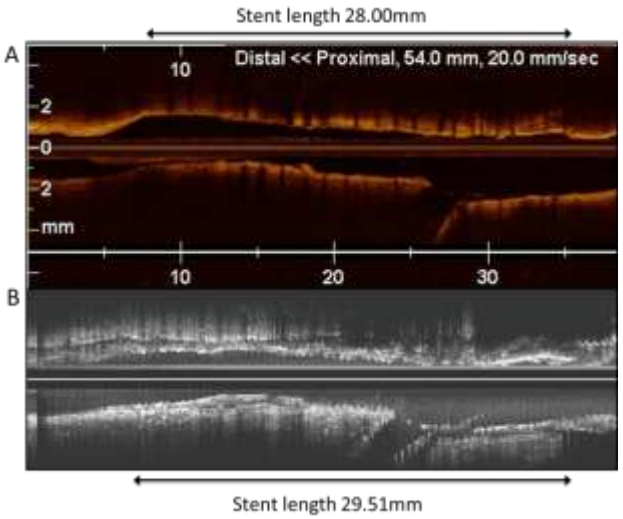
In Vivo Measurements of Lumen Dimensions by QCA, FD-OCT, and IVUS. In this representative case, frequency domain optical coherence tomography (FD-OCT) and intravascular ultrasound (IVUS) was performed for the proximal circumflex coronary artery stenosis of which minimum lumen diameter (MLD) was 1.59 mm in quantitative coronary angiography (QCA). MLA measured using FD-OCT and IVUS was 2.75 mm2 and 3.50 mm2 (MLD was 1.87 mm and 2.13 mm), respectively.



Conclusion: MLD by IVUS was greater than that by FD-OCT (relative reference 9%). MLD by QCA was smaller than that by FD-OCT (relative reference –5%).

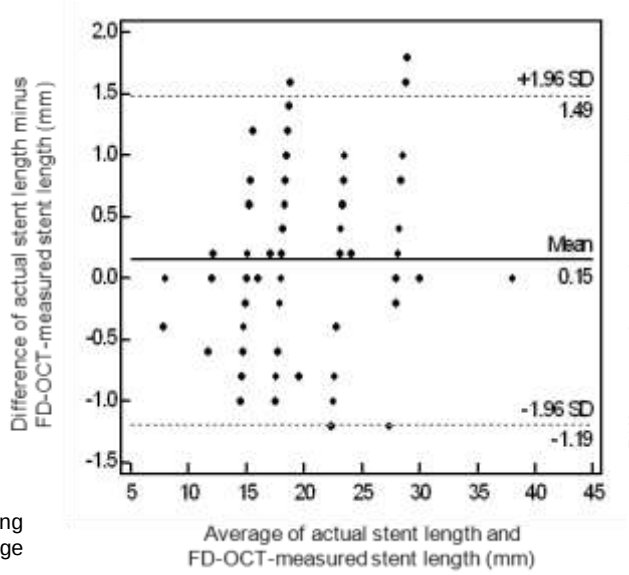
Accuracy of FD-OCT for longitudinal geometric measurement

FD-OCT and IVUS was performed in 77 patients who underwent stent implantation in the native coronary artery.

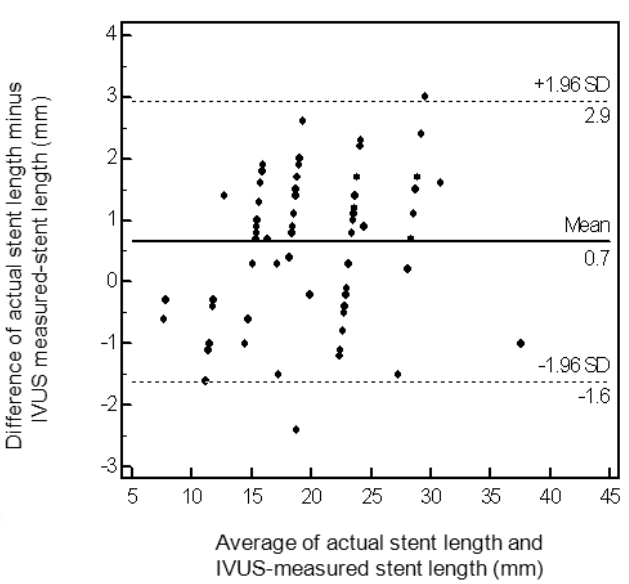


Correlation between FD-OCT and IVUS Pullbacks. Corresponding OCT longitudinal-view image (A), and IVUS longitudinal-view image (B) from a patient with stent implantation in LAD.

A. FD-OCT

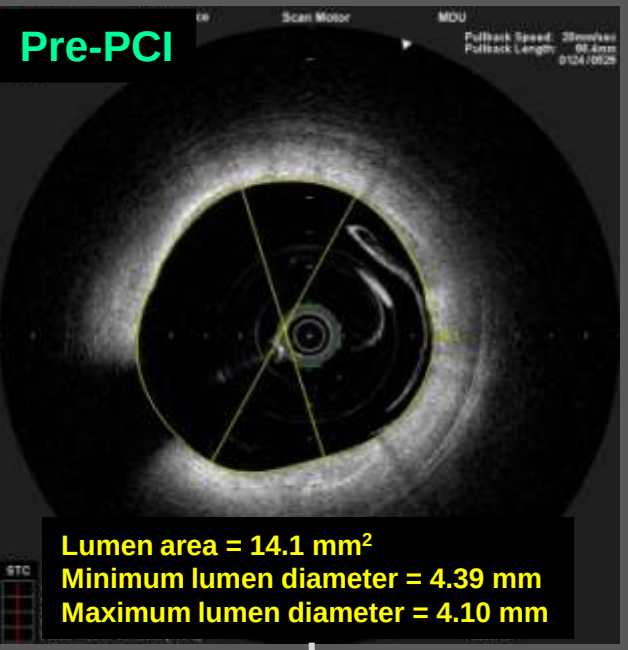


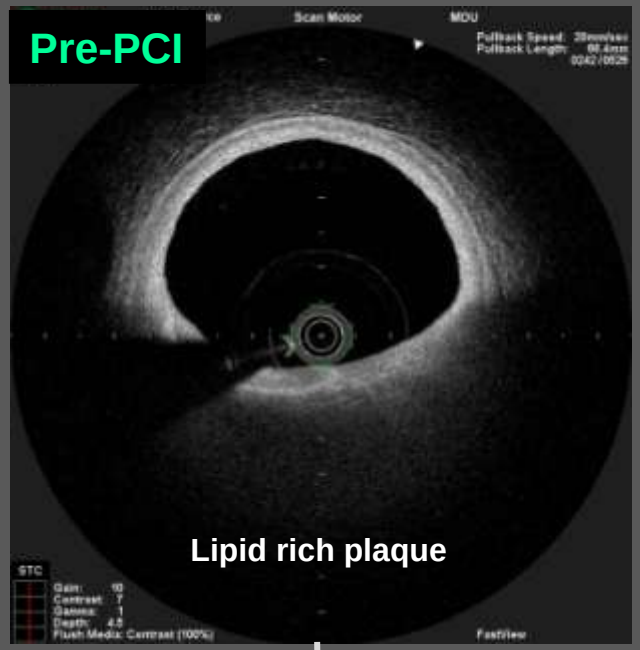
B. IVUS



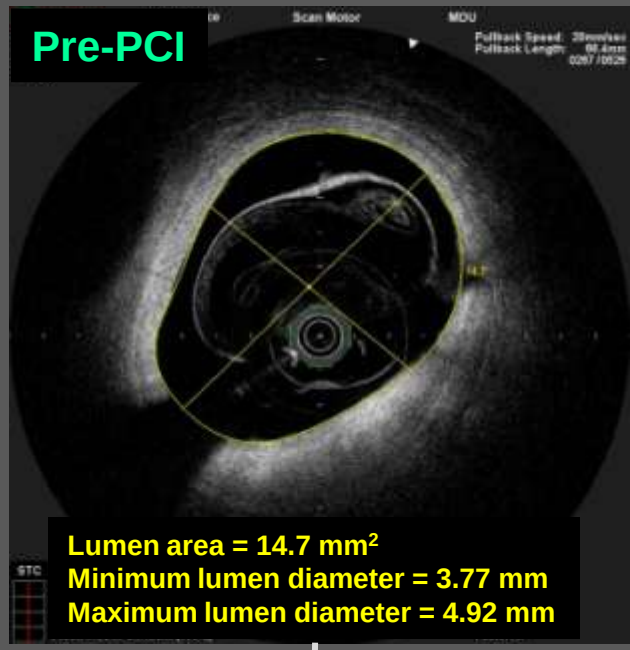
Conclusion: FD-OCT offered more accuracy than IVUS in longitudinal geometric measurement of coronary arteries.

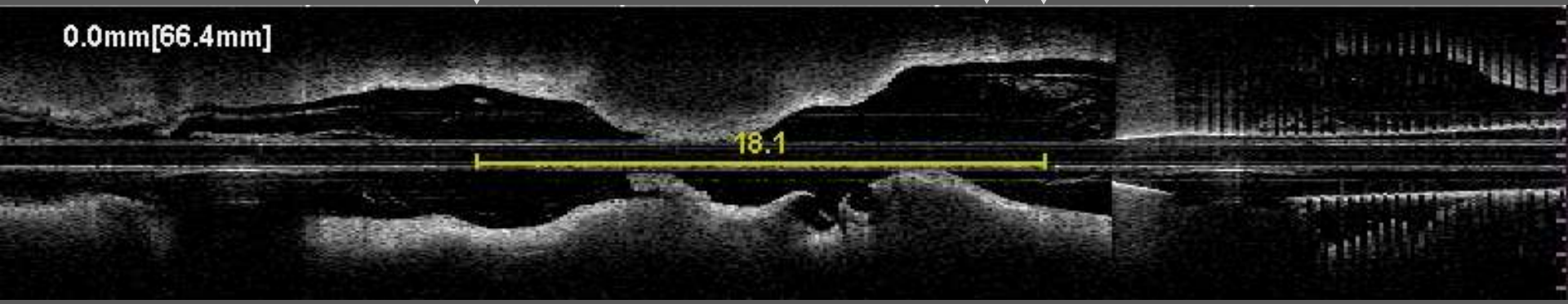
Distal reference





Proximal reference





Prediction of plaque progression

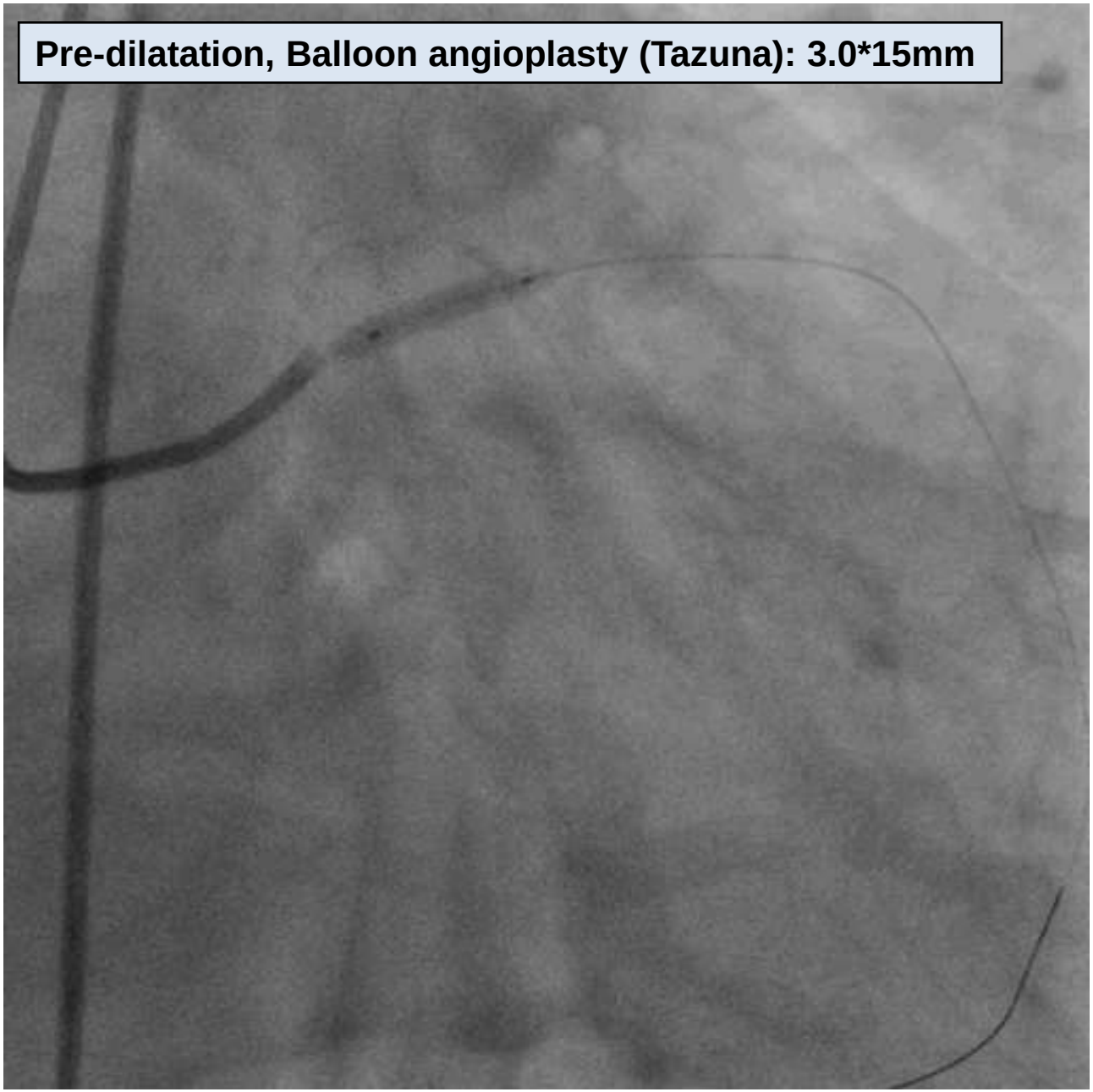
OCT was used to evaluate morphological characteristics of non-significant coronary plaques that develop rapid progression in 53 patients with coronary artery disease.

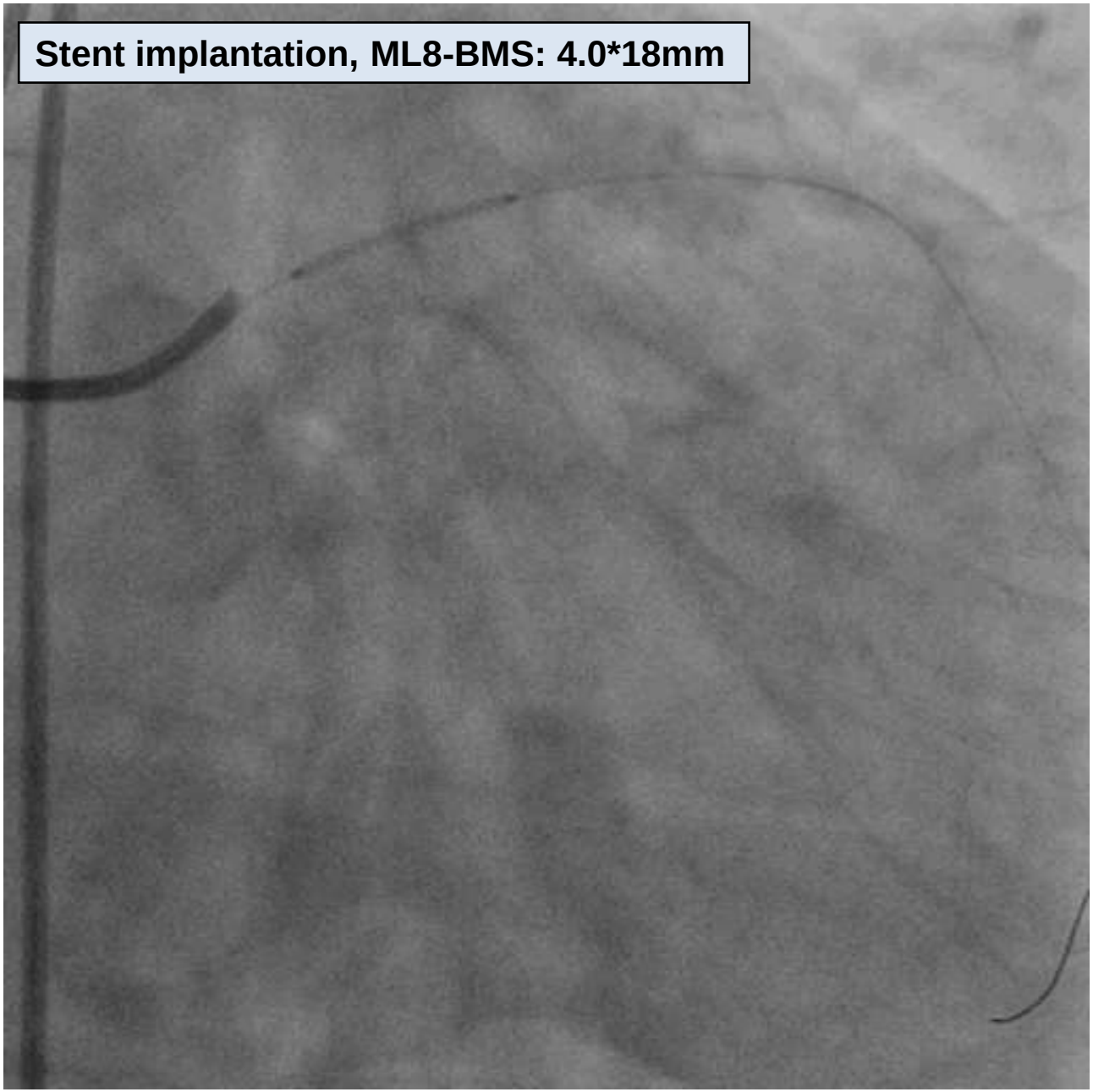
Progression (+)

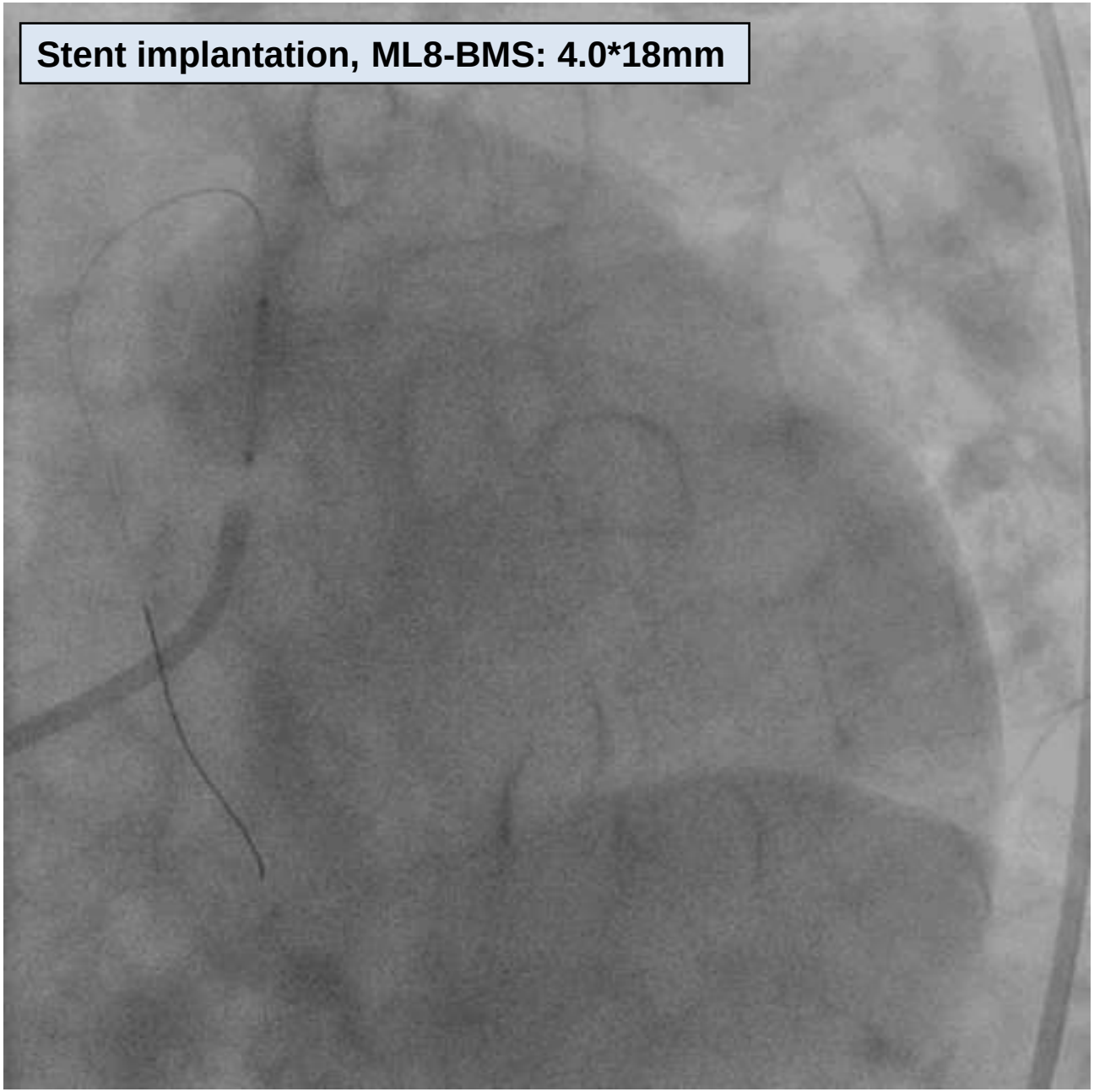
Increase in MLD of >0.4 mm on QCA during 7-month follow-up

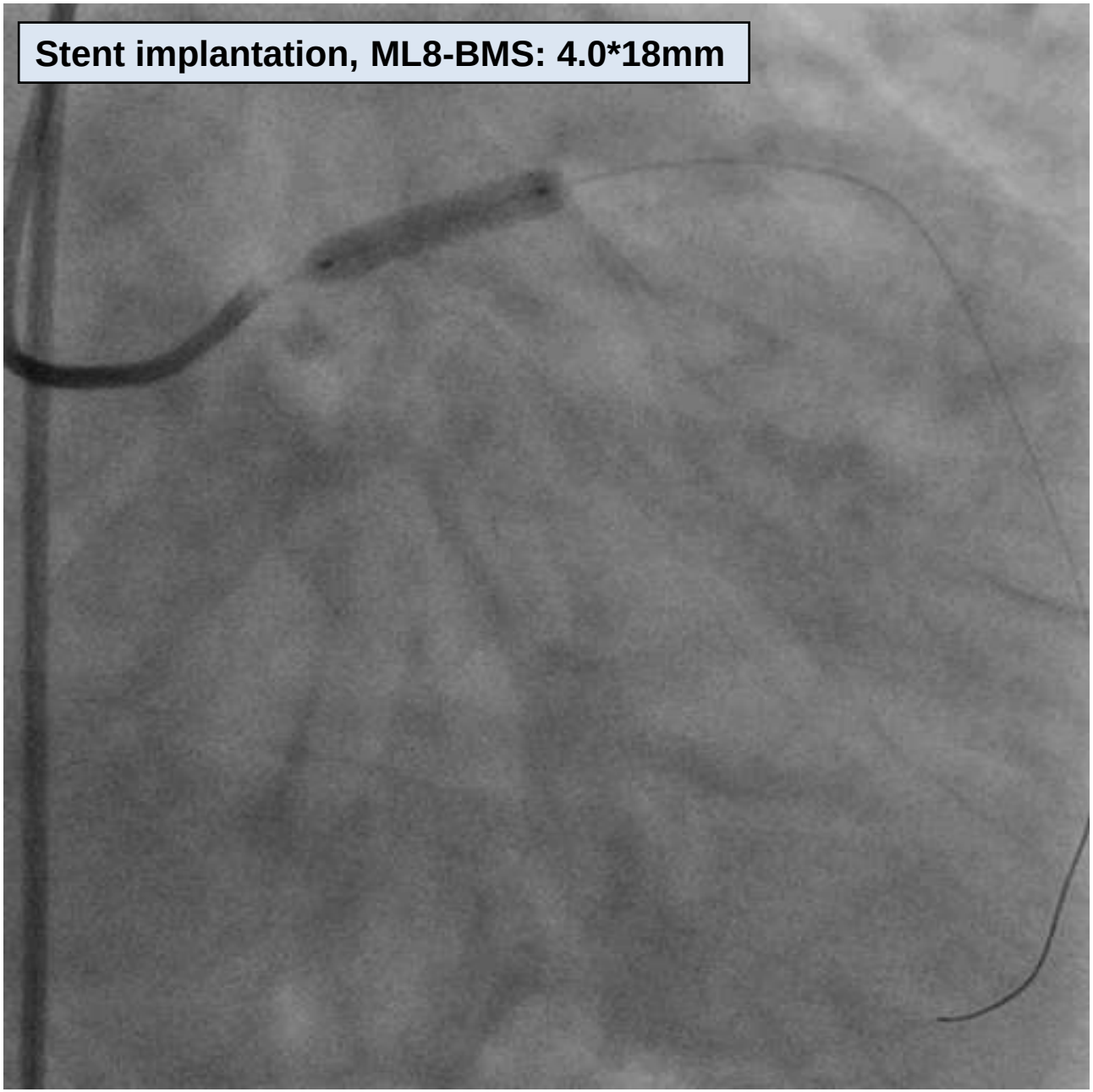
Progression (-)

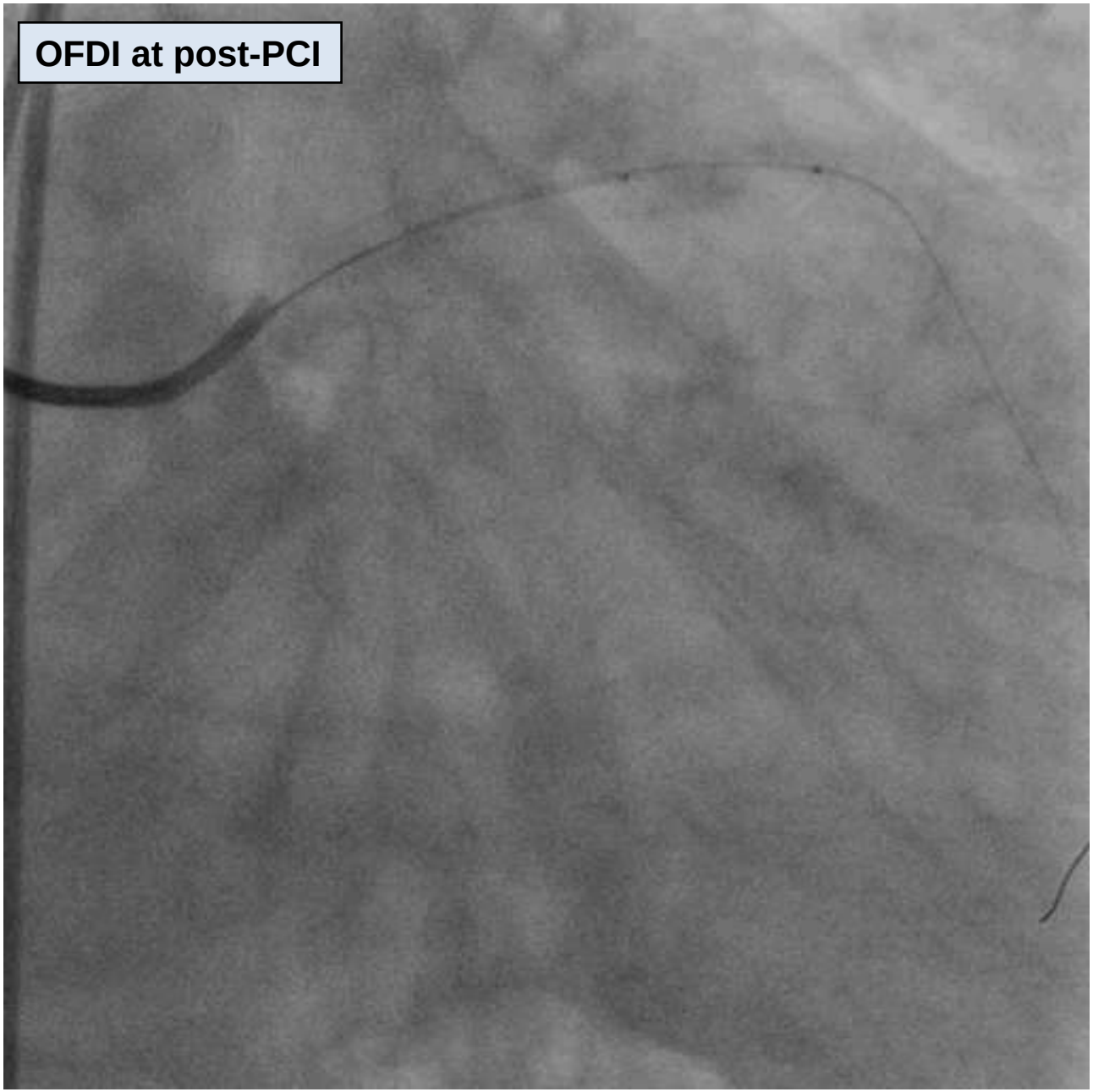
Conclusion: OCT-based complex characteristics of TCFA and microchannel were the potential predictors of subsequent plaque progression.

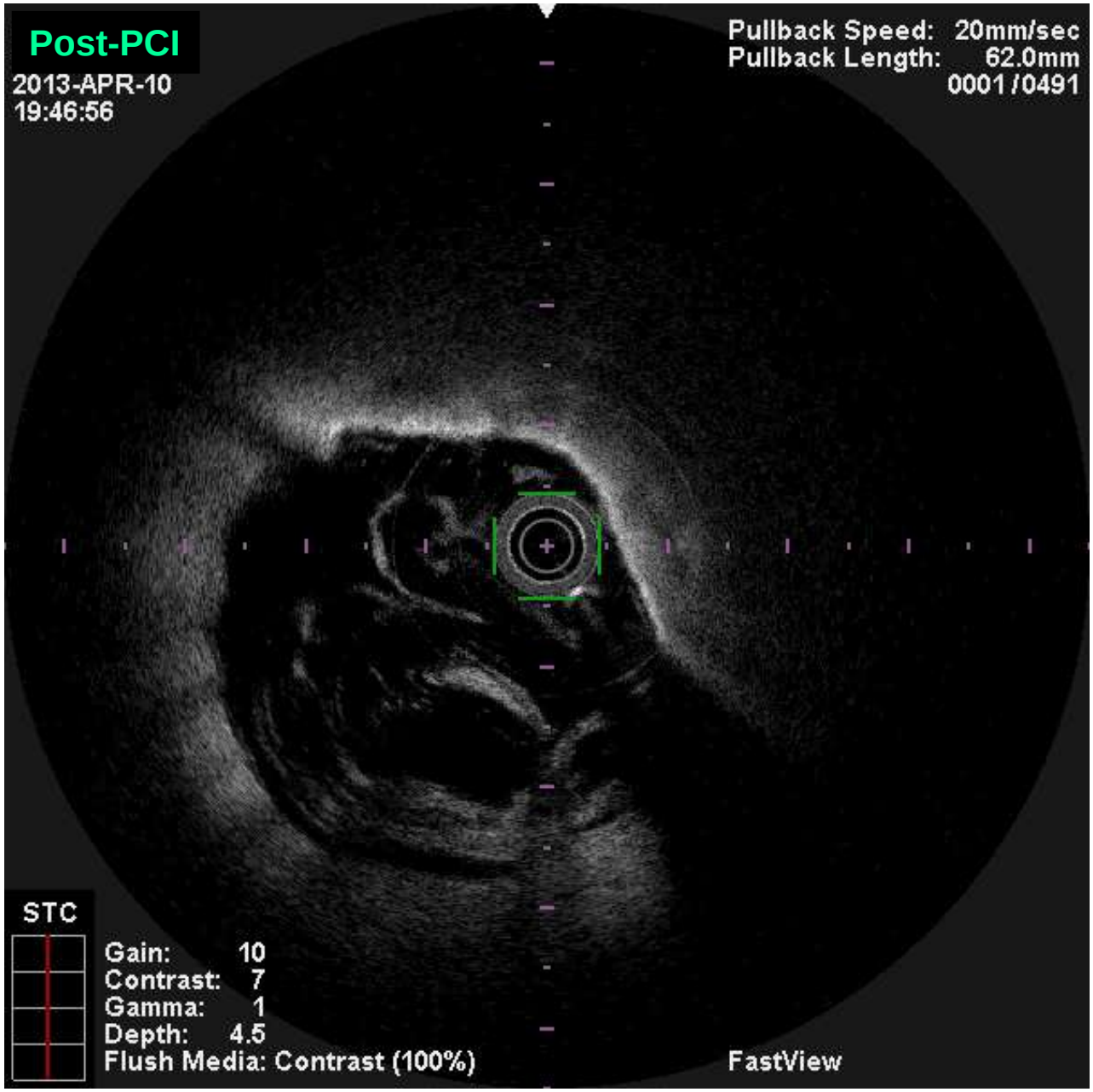

Pre-dilatation, Balloon angioplasty (Tazuna): 3.0*15mm

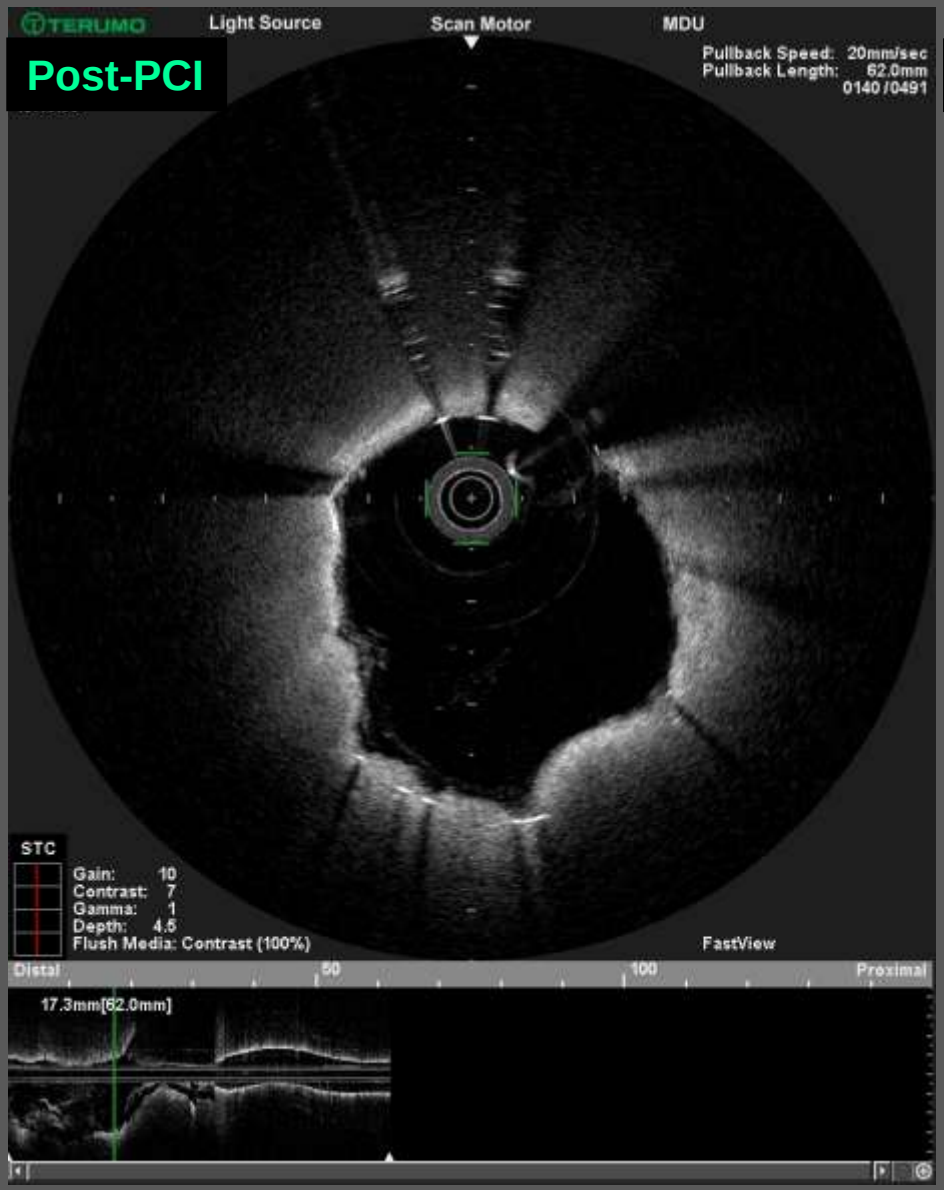

Stent implantation, ML8-BMS: 4.0*18mm

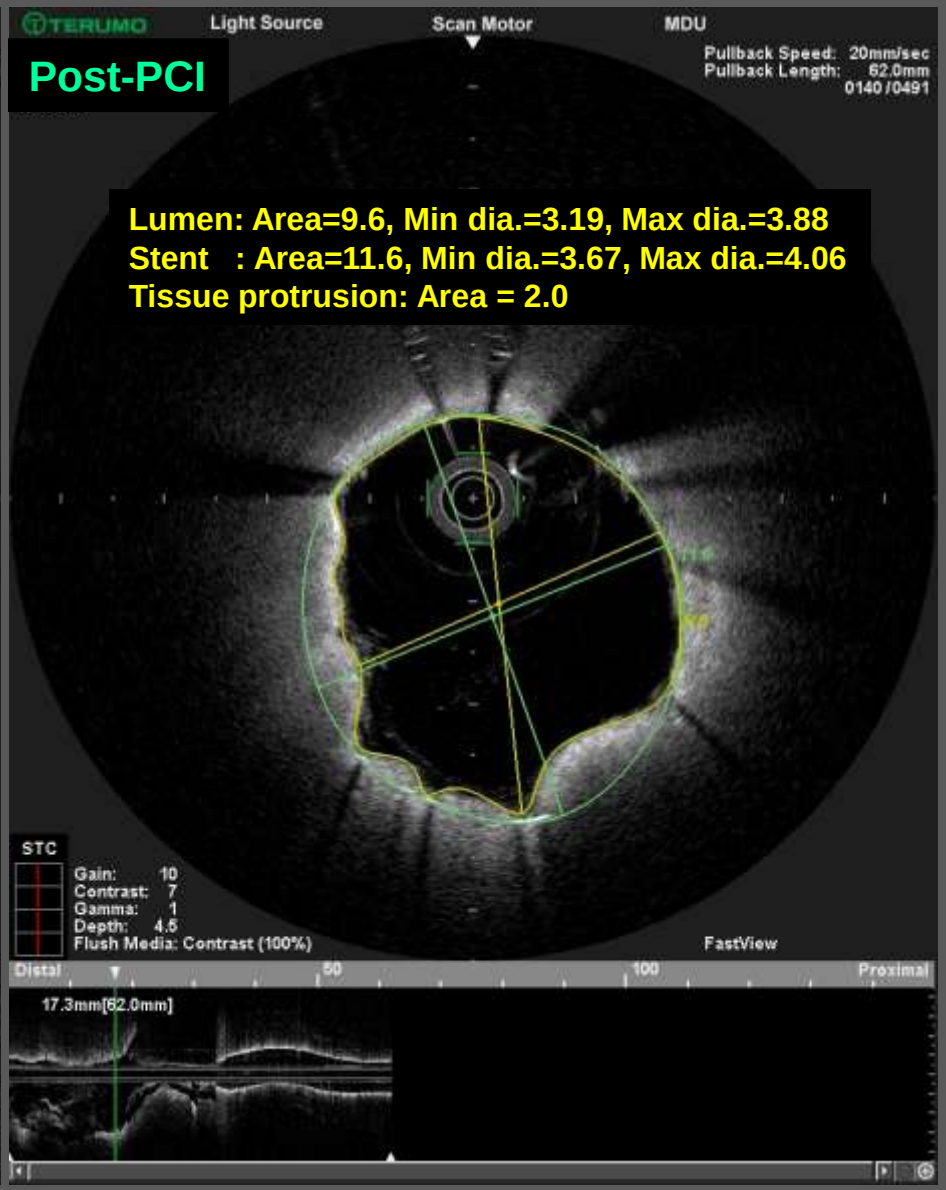

Stent implantation, ML8-BMS: 4.0*18mm

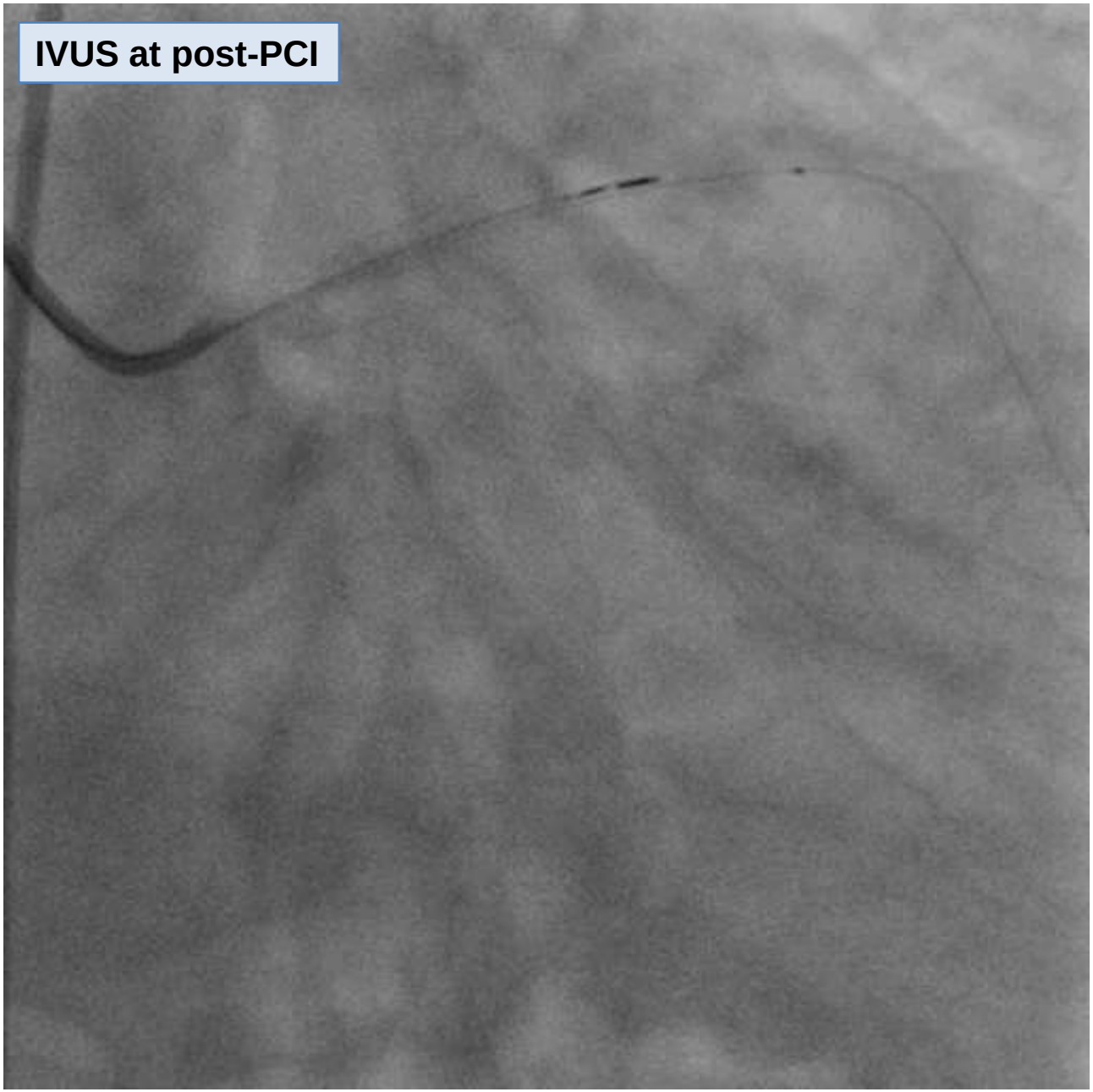

Stent implantation, ML8-BMS: 4.0*18mm

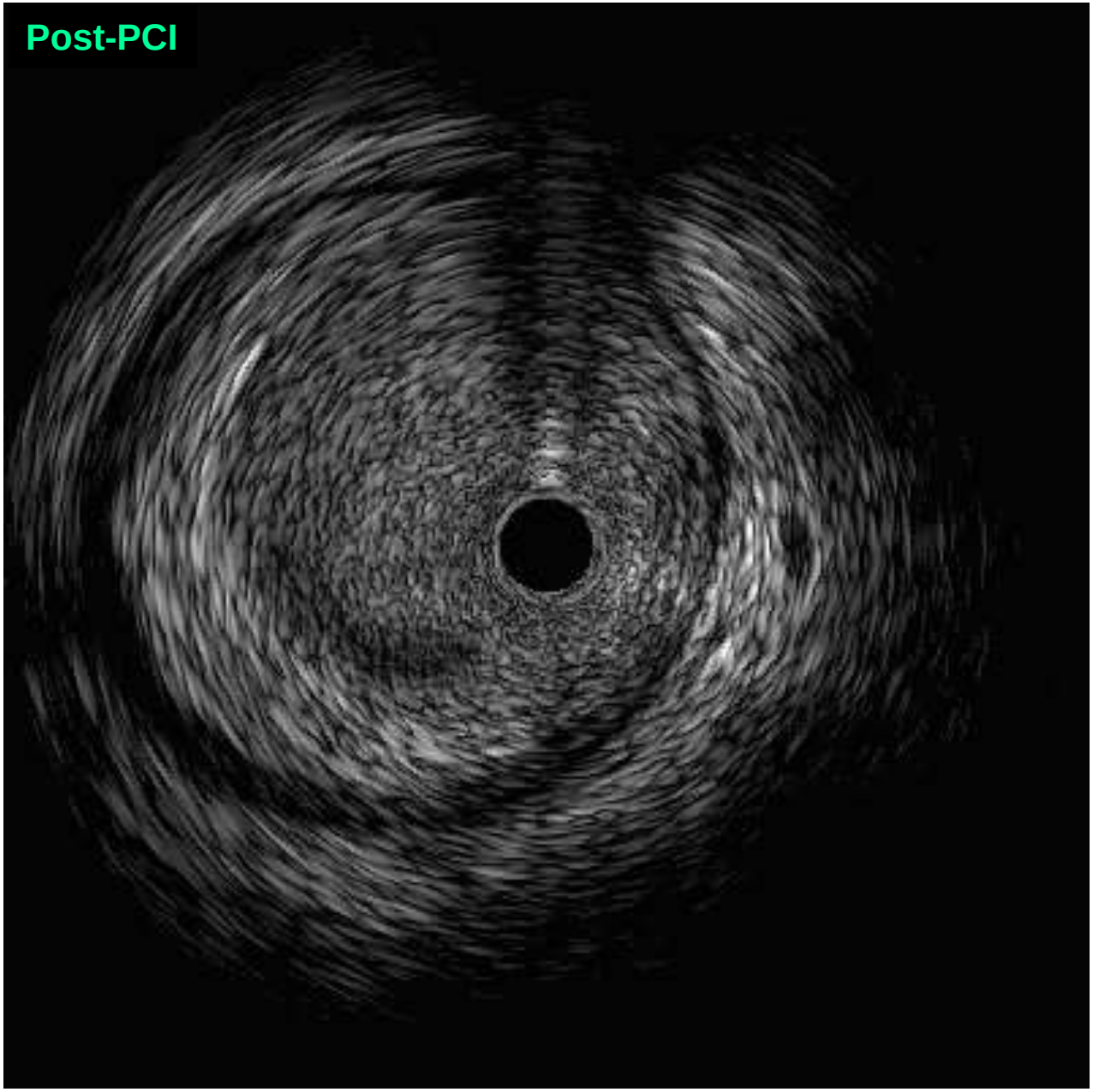

OFDI at post-PCI

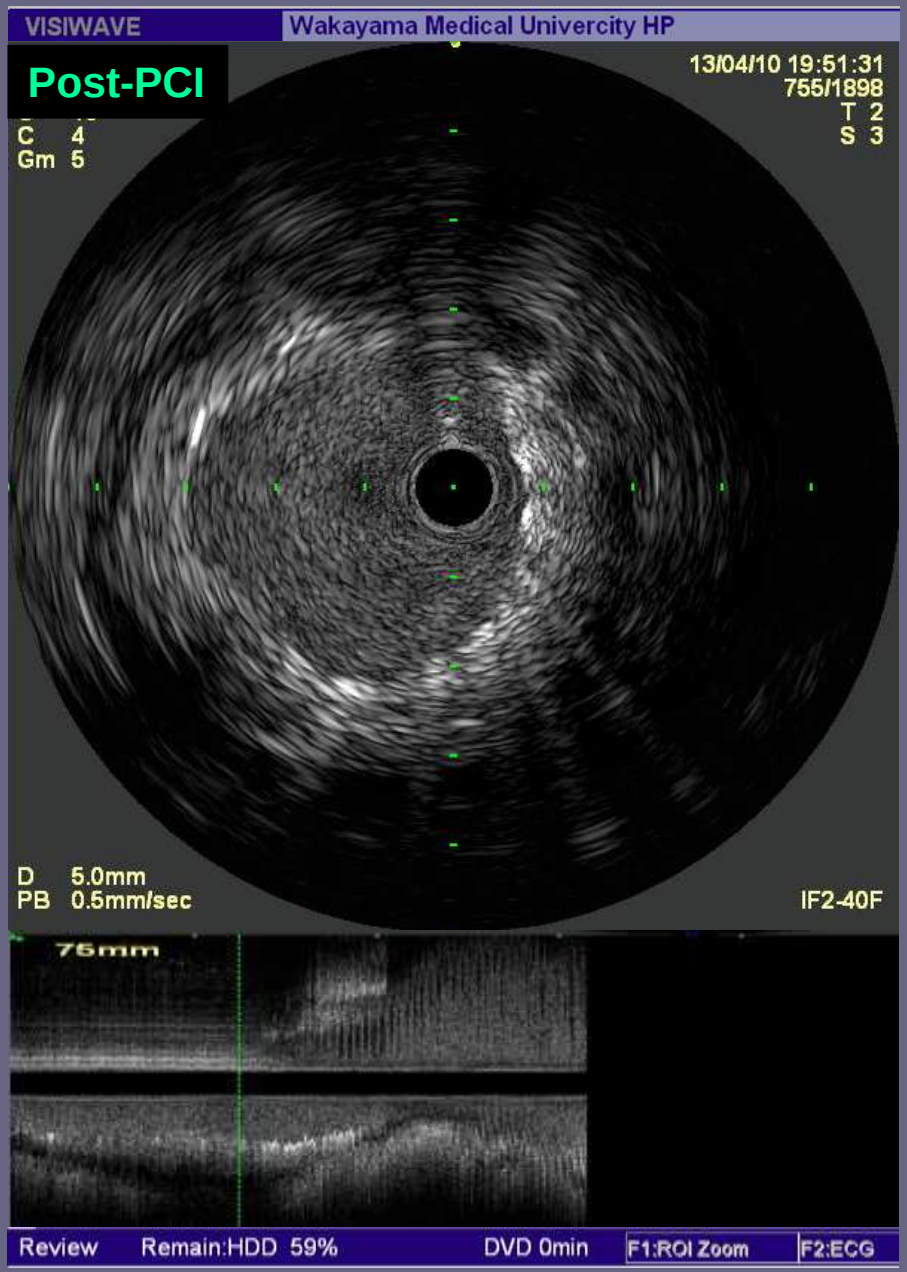

Post-PCI
2013-APR-10
19:46:56
Pullback Speed: 20mm/sec
Pullback Length: 62.0mm
0001/0491
STC
Gain: 10
Contrast: 7
Gamma: 1
Depth: 4.5
Flush Media: Contrast (100%)
FastView

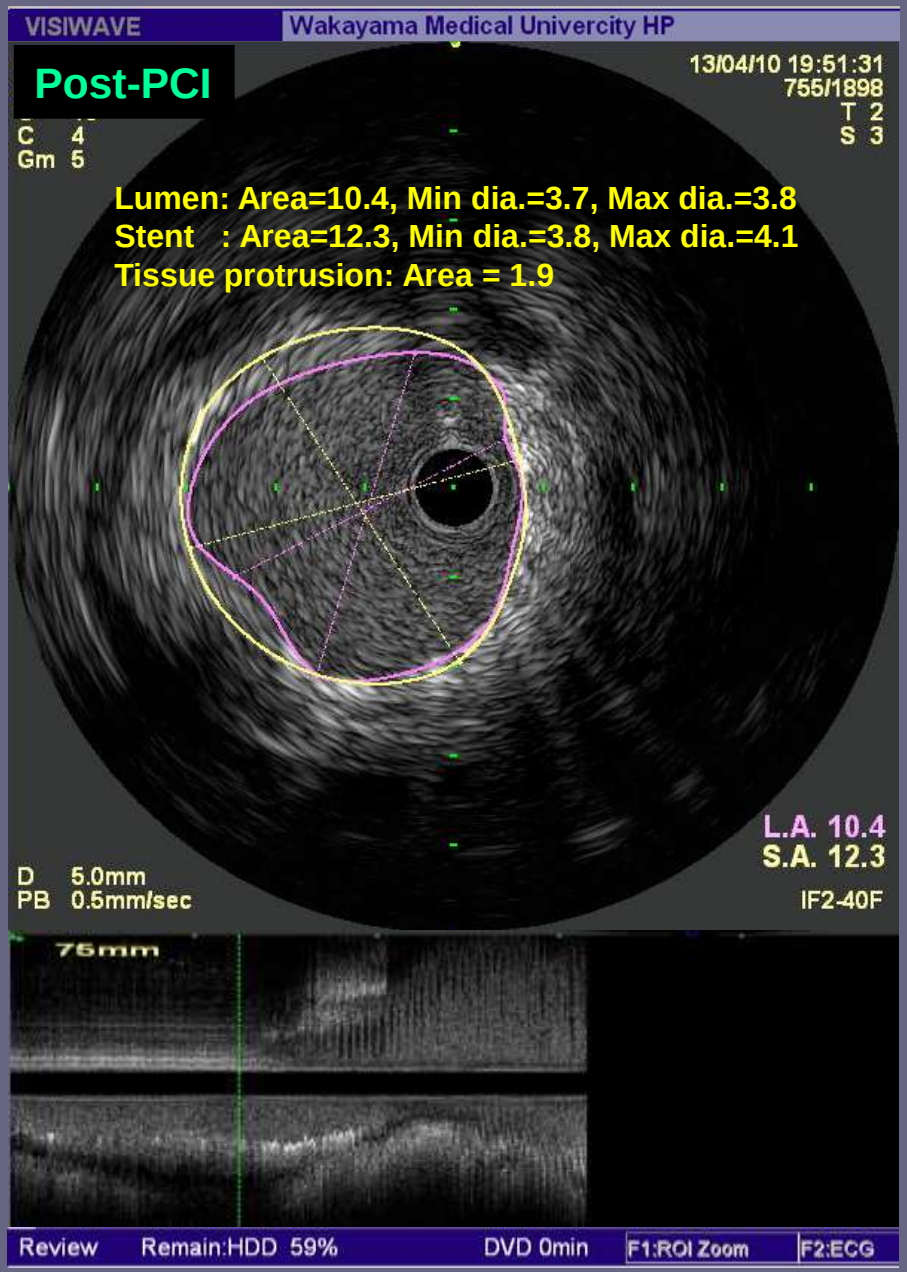

TERUMO
Light Source
Scan Motor
MDU
Post-PCI
Pullback Speed: 20mm/sec
Pullback Length: 62.0mm
0140 /0491
STC
Gain: 10
Contrast: 7
Gamma: 1
Depth: 4.5
Flush Media: Contrast (100%)
FastView
Distal
50
100
Proximal
17.3mm[62.0mm]

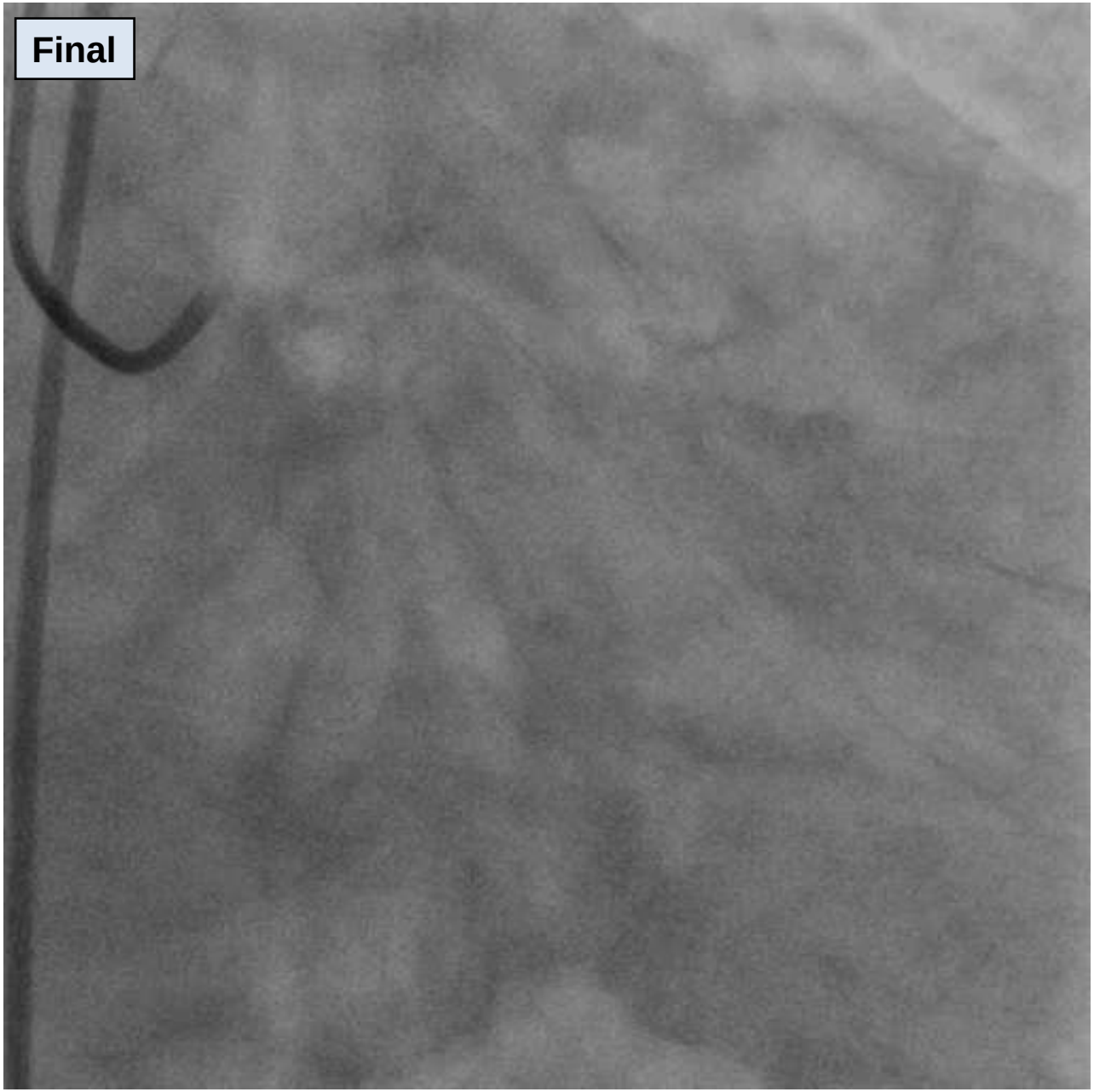

TERUMO
Light Source
Scan Motor
MDU
Post-PCI
Pullback Speed: 20mm/sec
Pullback Length: 62.0mm
0140 /0491
Lumen: Area=9.6, Min dia.=3.19, Max dia.=3.88
Stent : Area=11.6, Min dia.=3.67, Max dia.=4.06
Tissue protrusion: Area = 2.0
STC
Gain: 10
Contrast: 7
Gamma: 1
Depth: 4.5
Flush Media: Contrast (100%)
FastView
Distal
50
100
Proximal
17.3mm[62.0mm]


IVUS at post-PCI


Post-PCI


VISIWAVE
Wakayama Medical Univercity HP
Post-PCI
13/04/10 19:51:31
755/1898
T 2
S 3
C 4
Gm 5
D 5.0mm
PB 0.5mm/sec
IF2-40F
75mm
Review
Remain:HDD 59%
DVD 0min
F1:ROI Zoom
F2:ECG


VISIWAVE
Wakayama Medical Univercity HP
Post-PCI
13/04/10 19:51:31
755/1898
T 2
S 3
C 4
Gm 5
Lumen: Area=10.4, Min dia.=3.7, Max dia.=3.8
Stent : Area=12.3, Min dia.=3.8, Max dia.=4.1
Tissue protrusion: Area = 1.9
L.A. 10.4
S.A. 12.3
D 5.0mm
PB 0.5mm/sec
IF2-40F
75mm
Review
Remain:HDD 59%
DVD 0min
F1:ROI Zoom
F2:ECG


Final

Summary

- As compared with IVUS, OCT can provide more clear images of unstable plaque and stent struts.
- OCT measurements are well correlated with IVUS measurements.

Case 2: 89yo, M

Clinical diagnosis

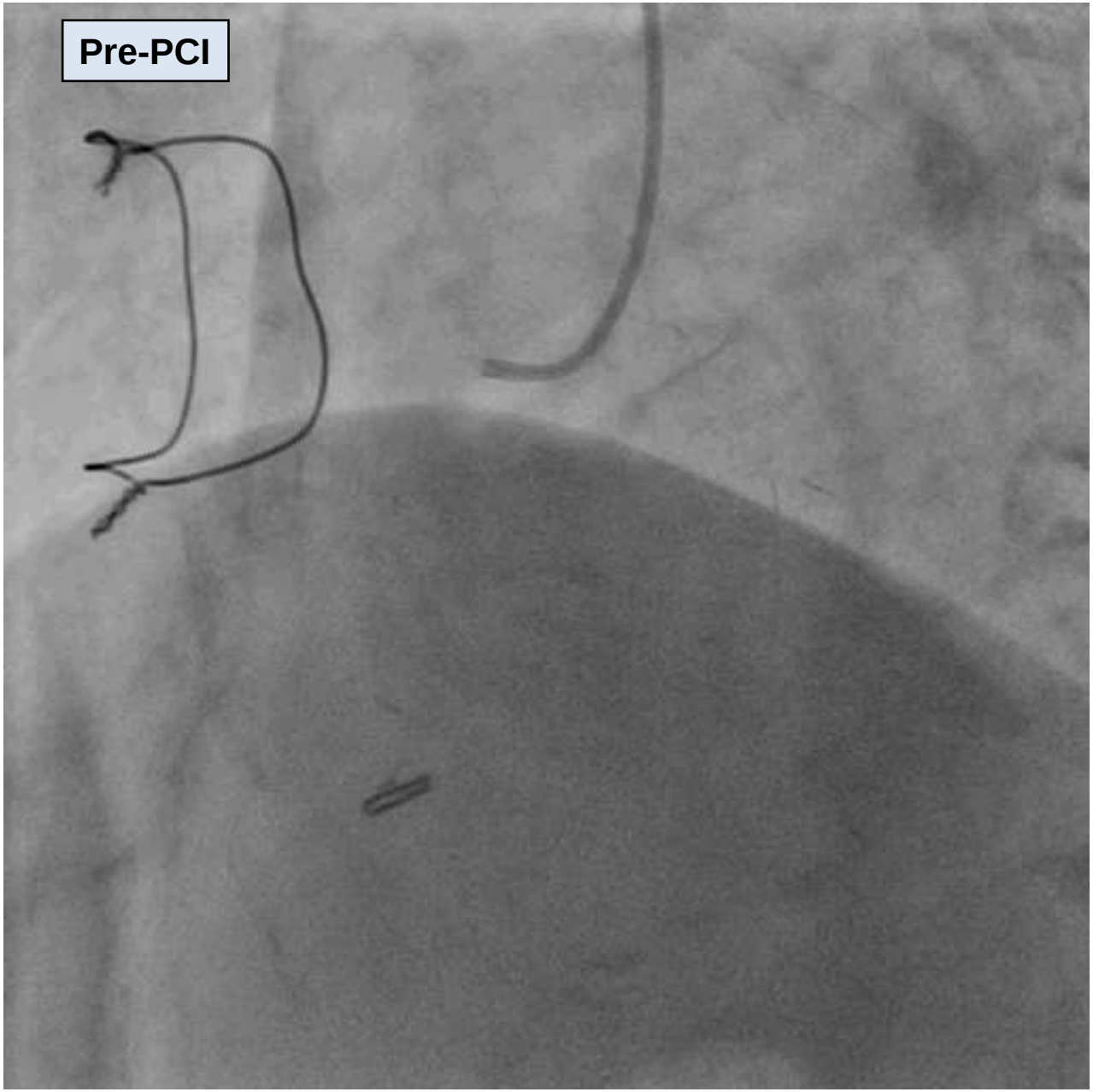
Unstable AP

Clinical history

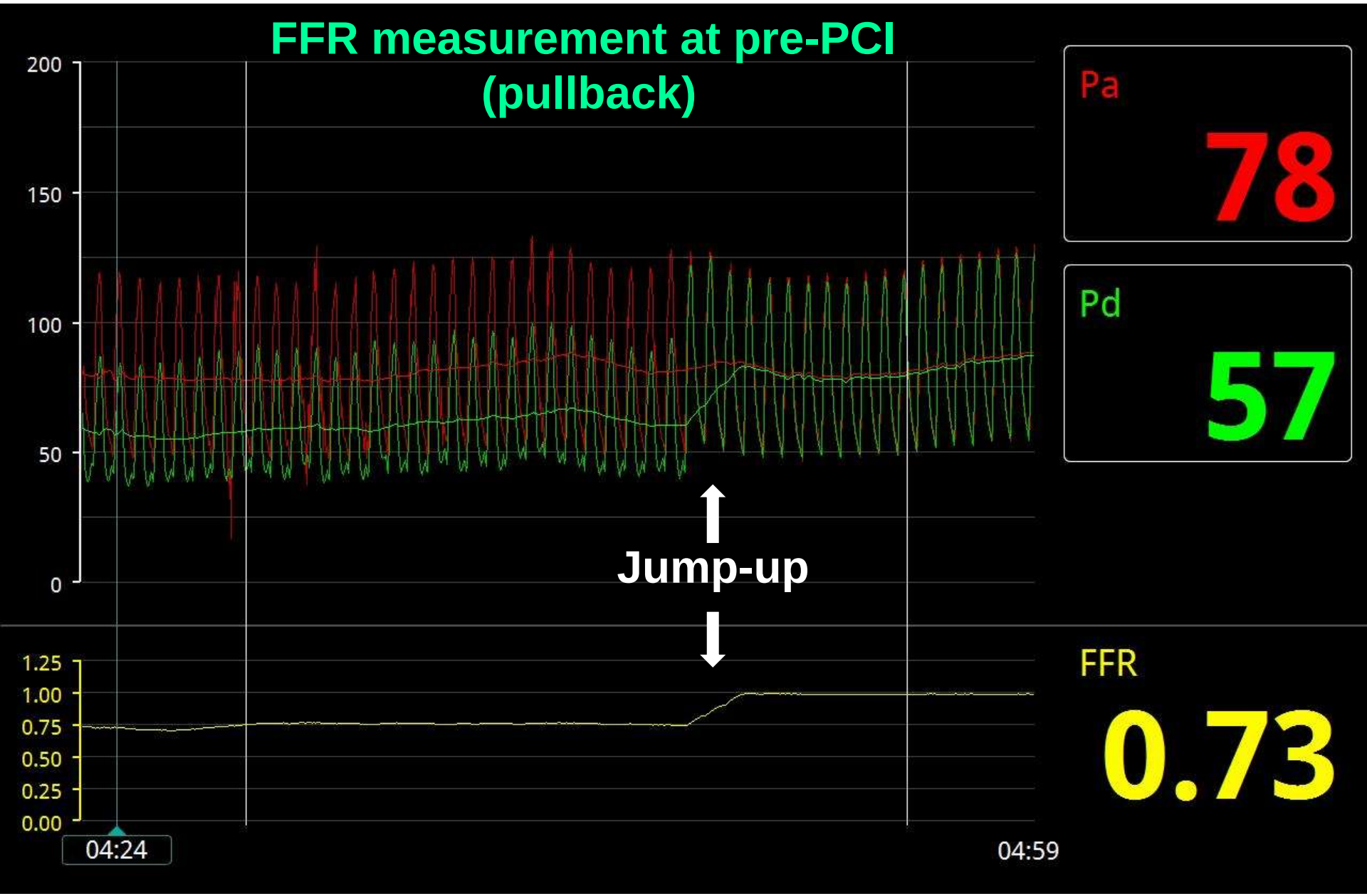
2002. Anterior-MI, CABG (LITA to LAD, SVG to Dx)
2013. *Chest pain with a crescendo pattern (more severe, prolonged, and increased frequency than previously).*

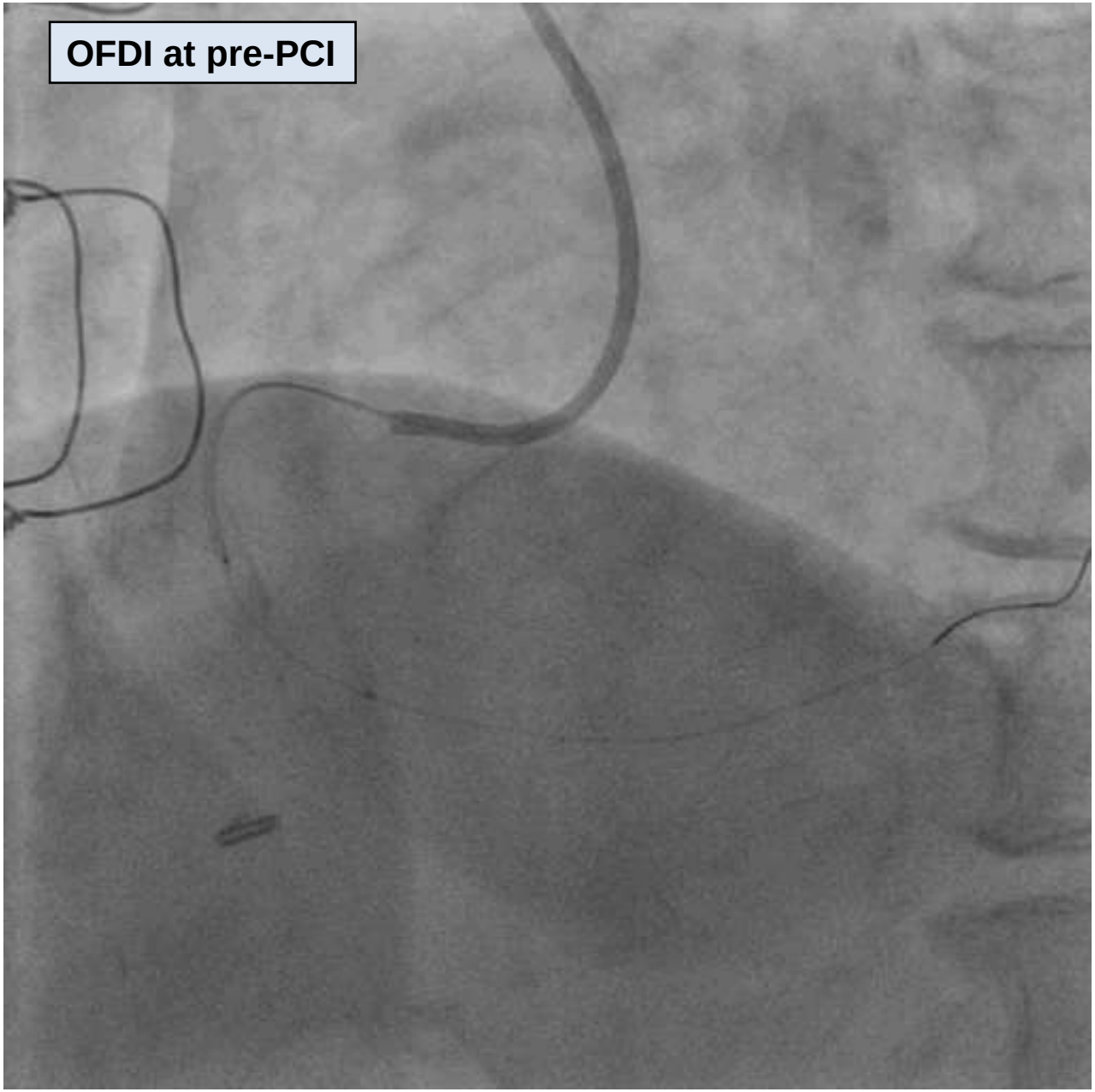
Coronary risk factors

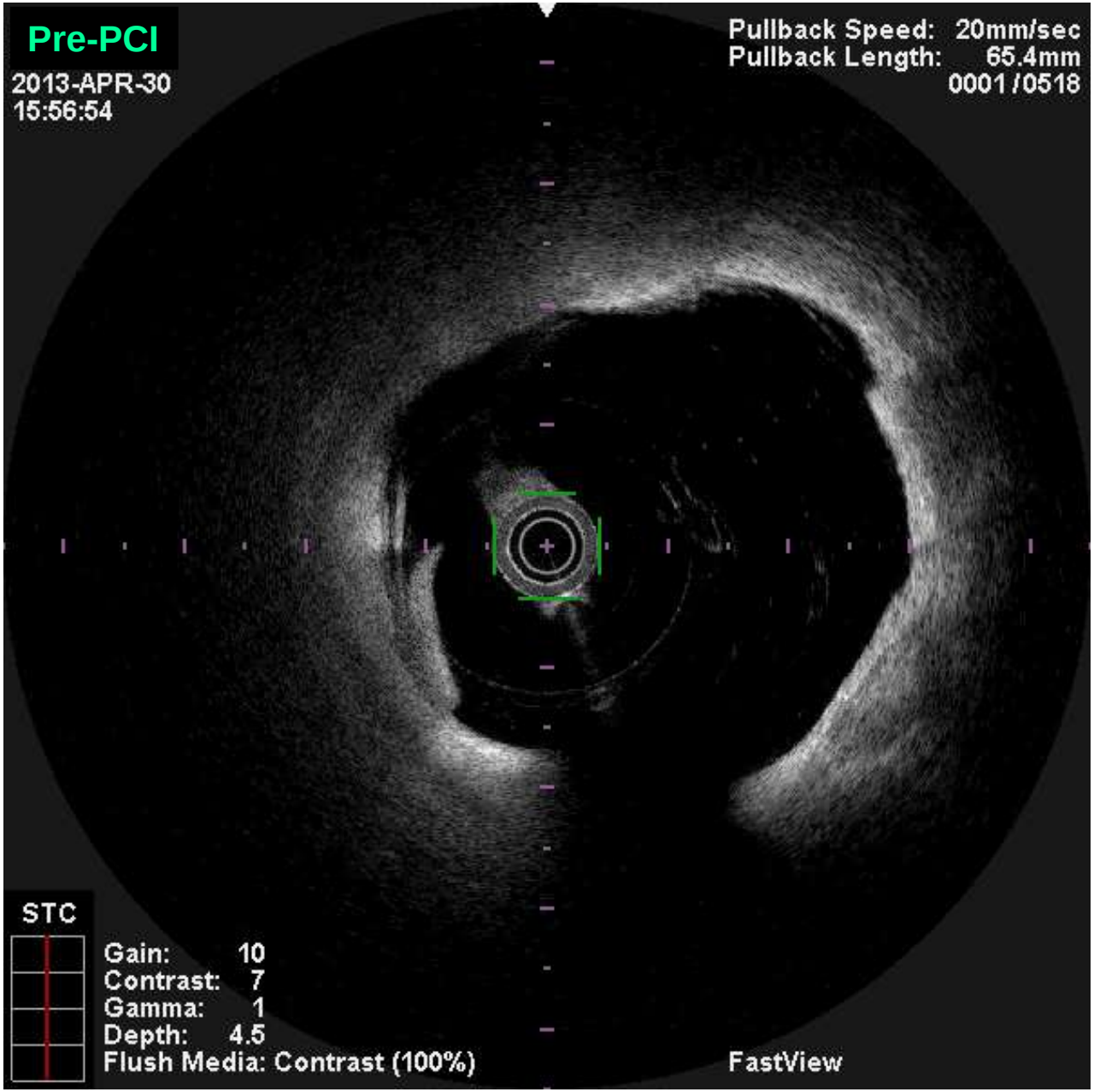
HT (+), DLP (-), DM (-), Obesity (-), Current smoker (-)


Pre-PCI

FFR measurement at pre-PCI (pullback)



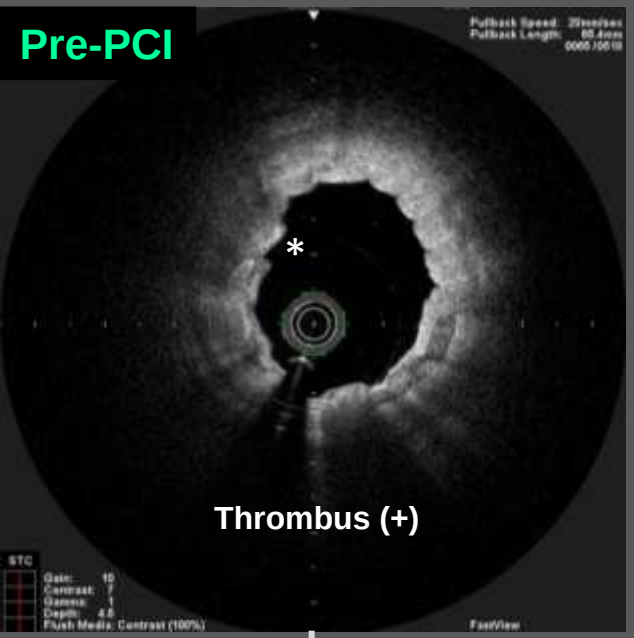

OFDI at pre-PCI

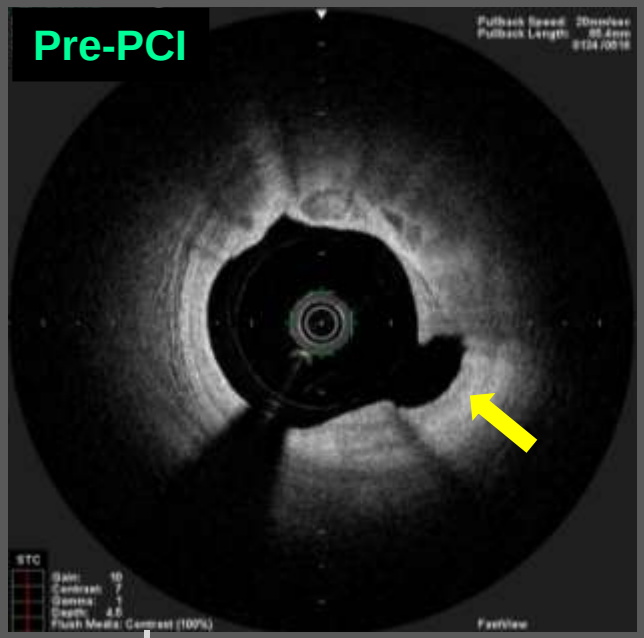

Pre-PCI
2013-APR-30
15:56:54
Pullback Speed: 20mm/sec
Pullback Length: 65.4mm
0001/0518
STC
Gain: 10
Contrast: 7
Gamma: 1
Depth: 4.5
Flush Media: Contrast (100%)
FastView

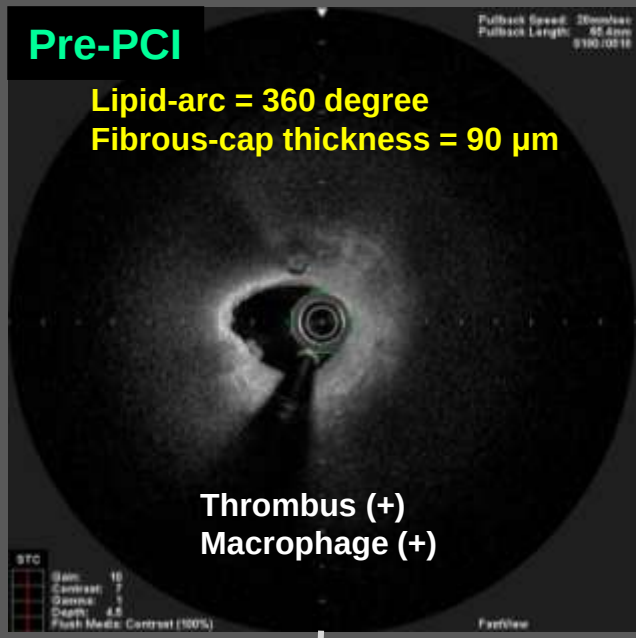
Vaso-spasum

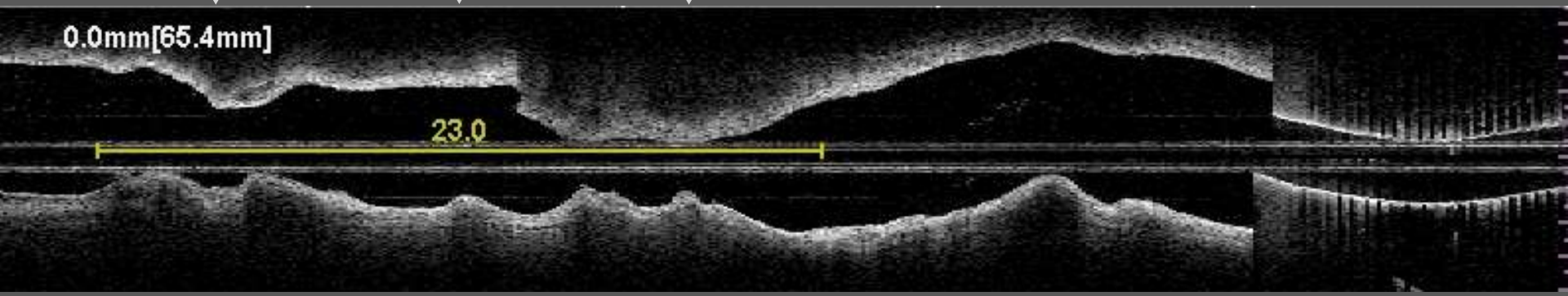
Plaque rupture

Lipid-rich plaque

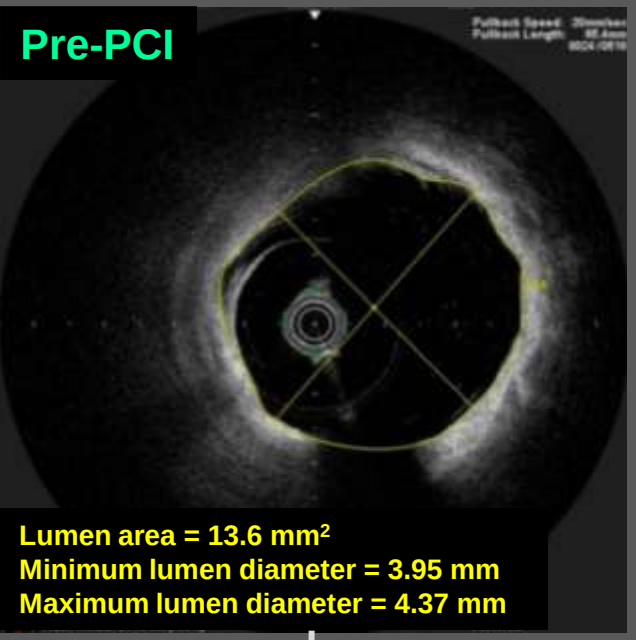






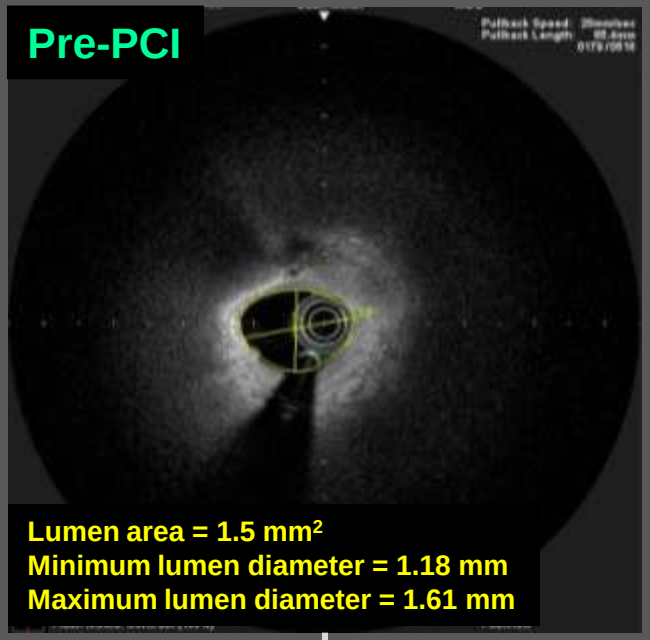


Distal reference



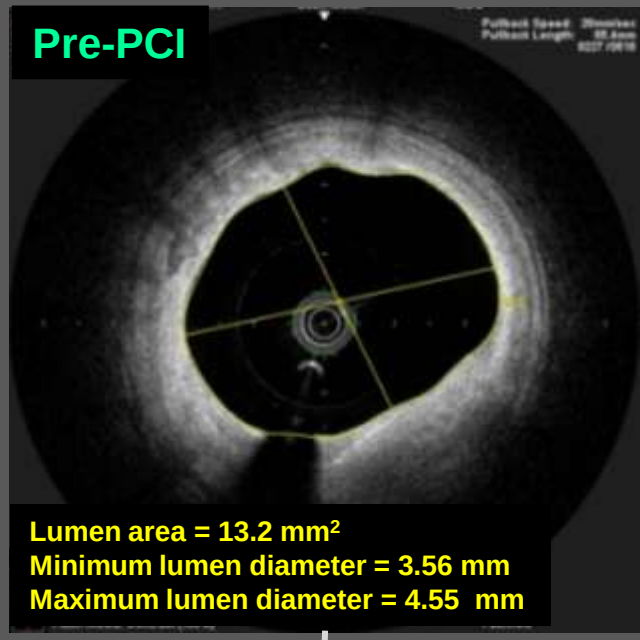
Lumen area = 13.6 mm²
Minimum lumen diameter = 3.95 mm
Maximum lumen diameter = 4.37 mm

Minimum lumen area site

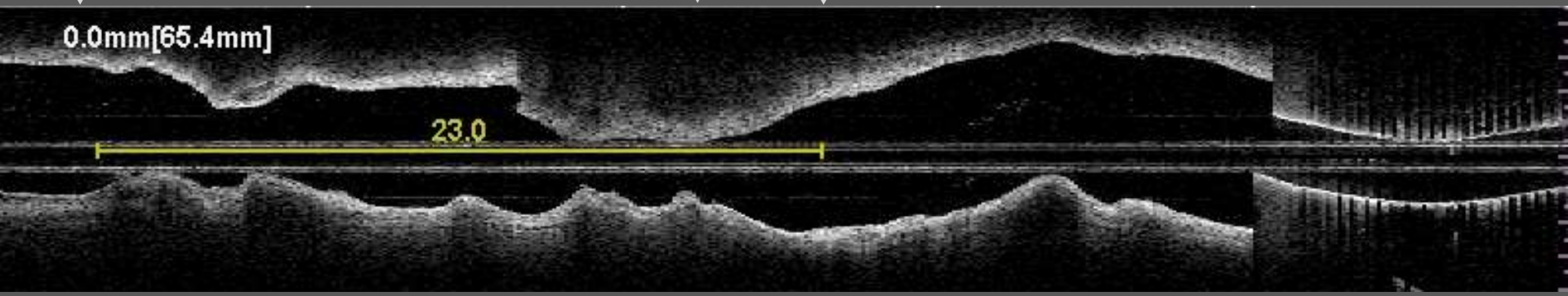


Lumen area = 1.5 mm²
Minimum lumen diameter = 1.18 mm
Maximum lumen diameter = 1.61 mm

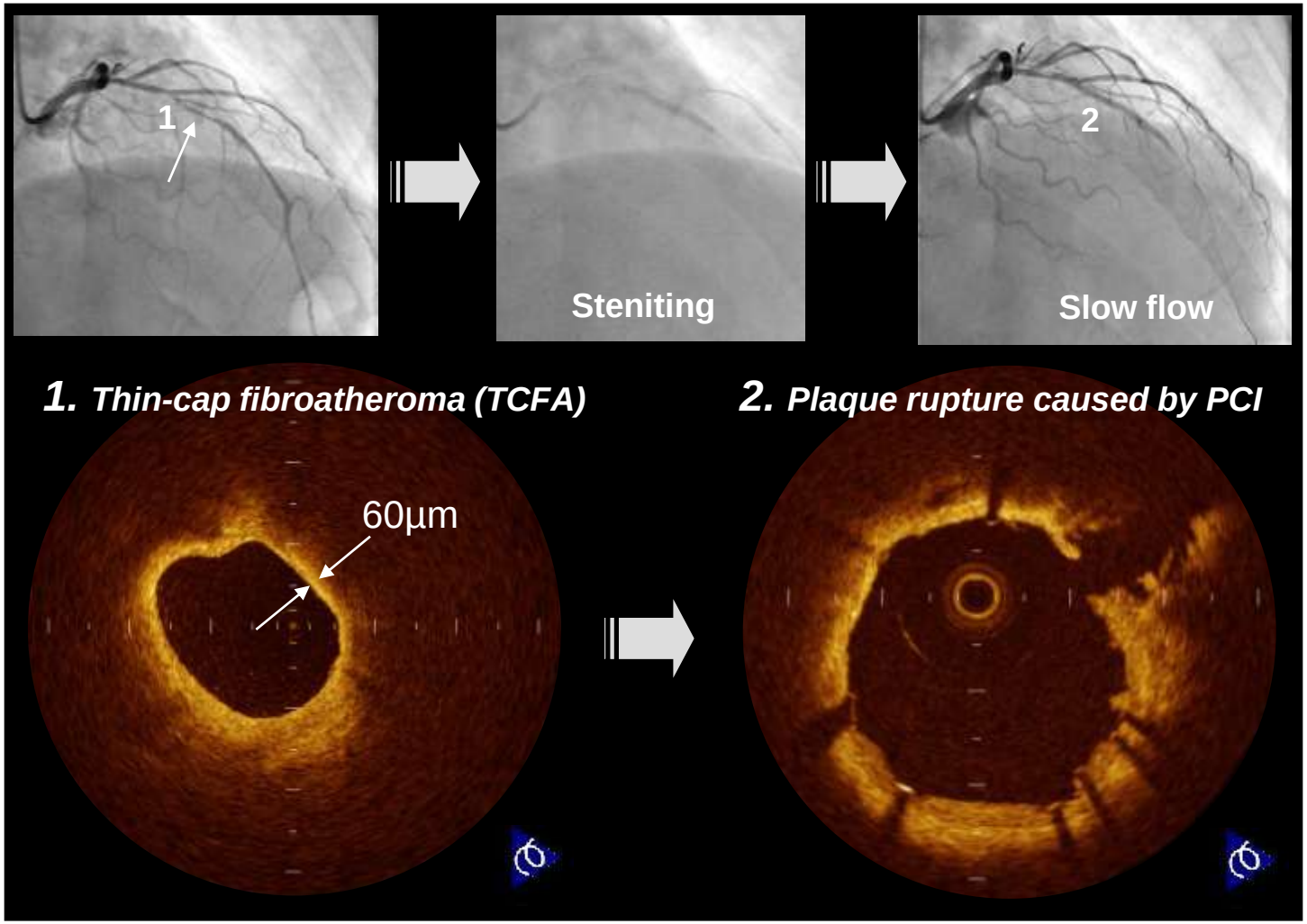
Proximal reference



Lumen area = 13.2 mm²
Minimum lumen diameter = 3.56 mm
Maximum lumen diameter = 4.55 mm



Prediction of angiographic no-reflow



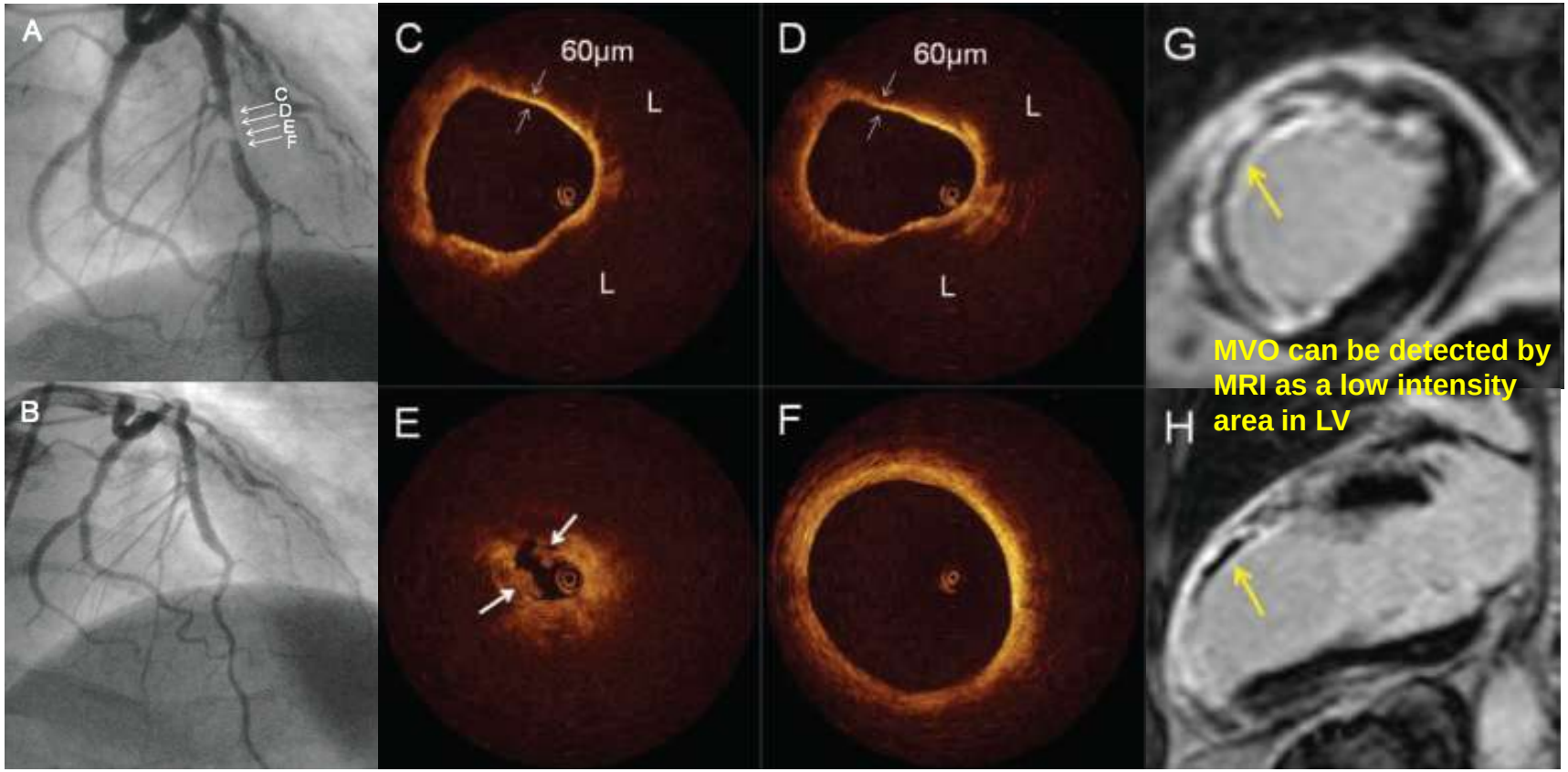
A 73-year-old male underwent PCI for the treatment of mid-LAD lesion (arrow).

In OCT image at pre-intervention, the culprit lesion presented lipid-rich plaque with thin-fibrous cap.

After stenting, angiogram showed no-reflow, and OCT disclosed plaque rupture behind stent.

TCFA is easy to be ruptured by PCI and has a high risk for coronary no-reflow.

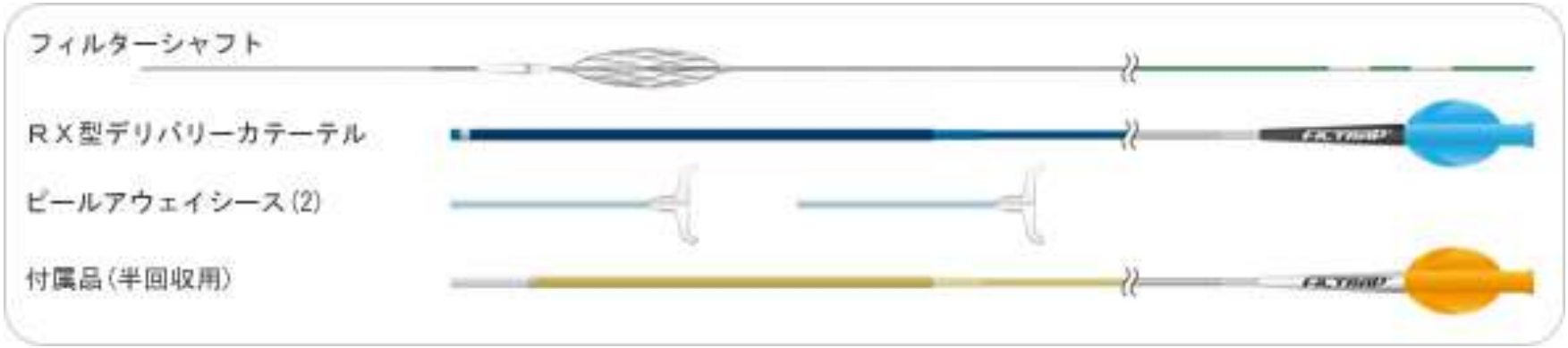
Prediction of microvascular obstruction

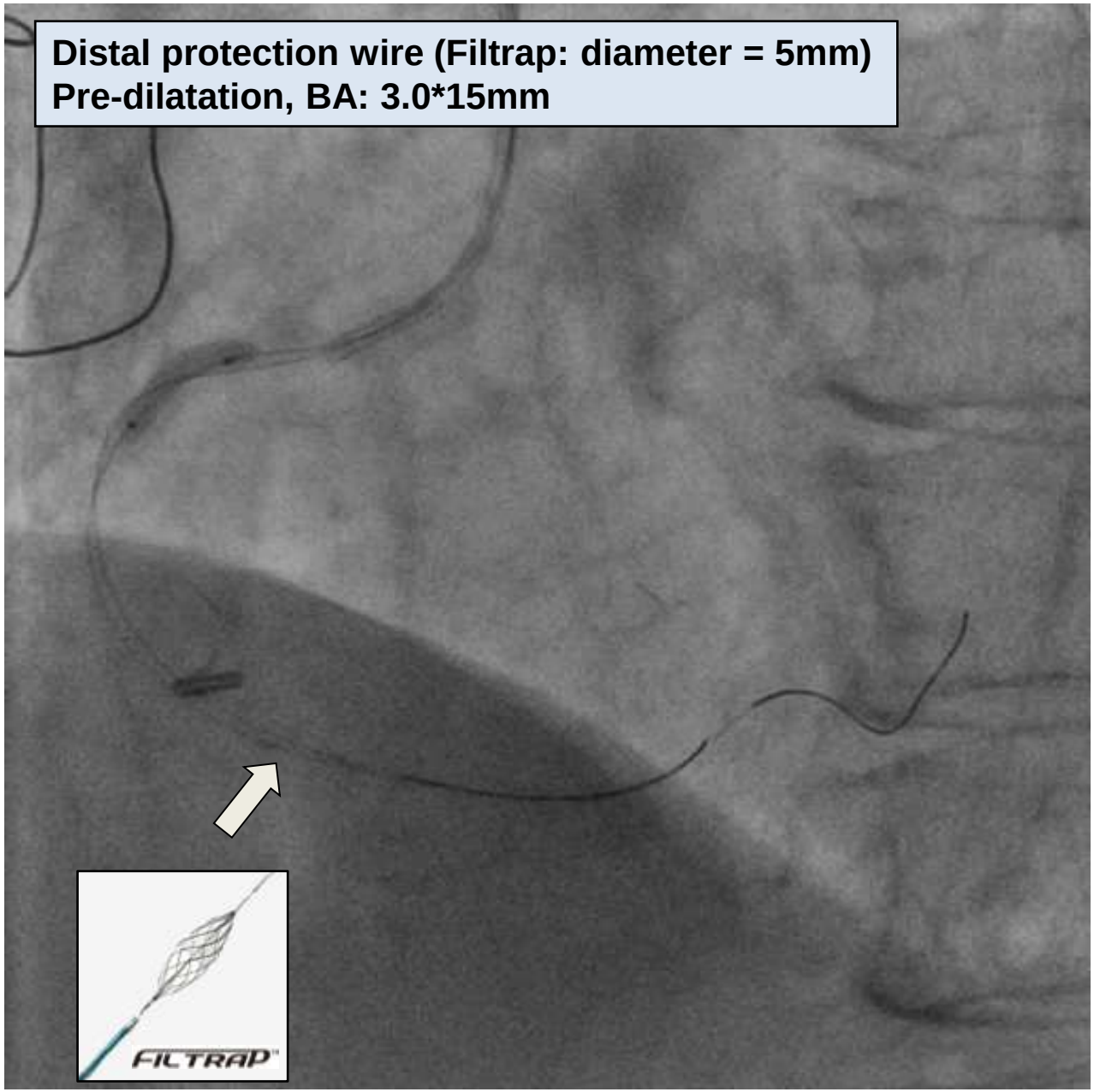


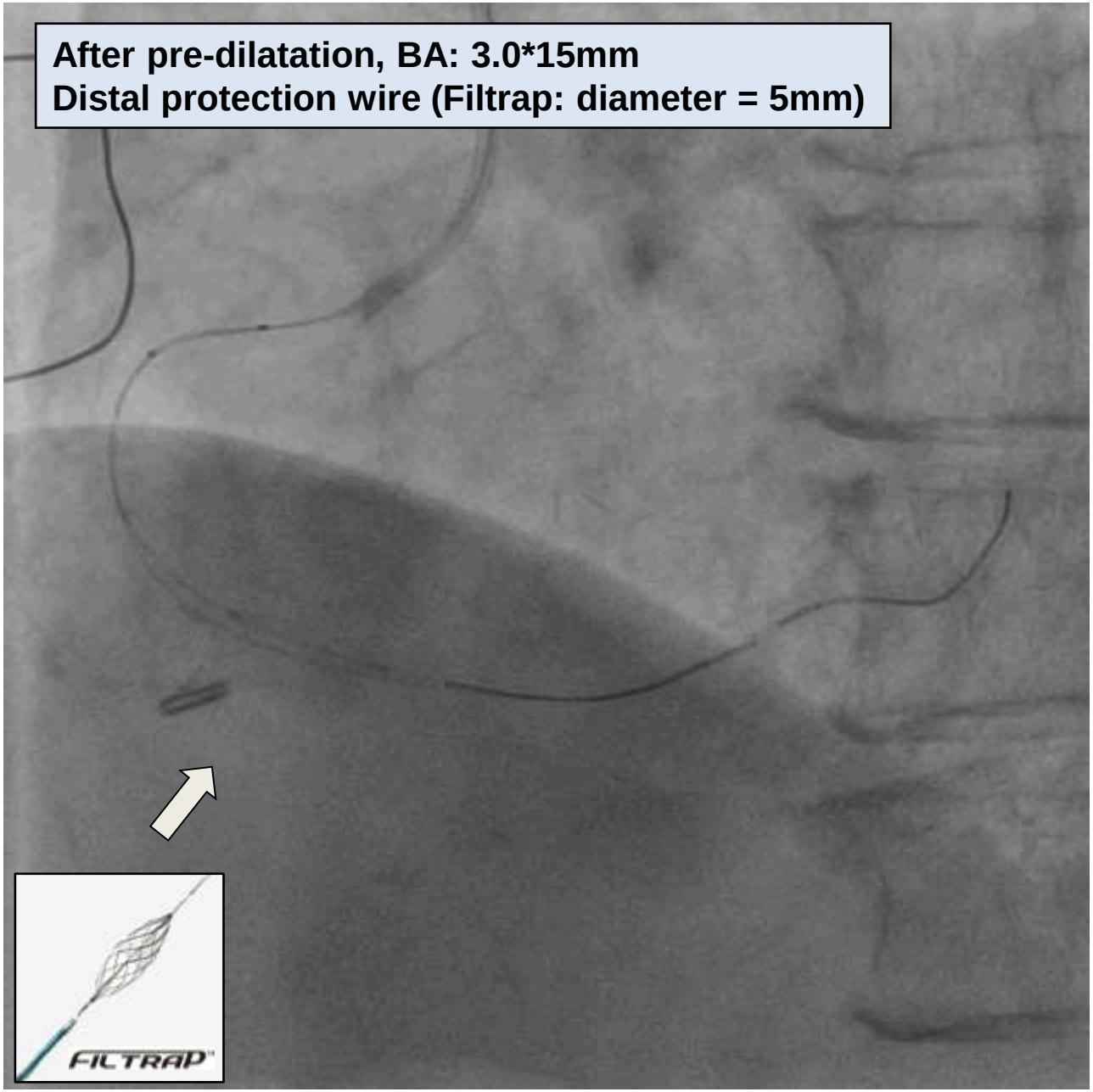
Angiography showed severe stenosis in mid LAD. OCT demonstrated TCFA and thrombi in the culprit lesion. After stenting, angiography showed adequate coronary flow in LAD. However, MRI disclosed MVO in the LAD territory. TCFA and thrombi are the predictors for MVO after PCI.

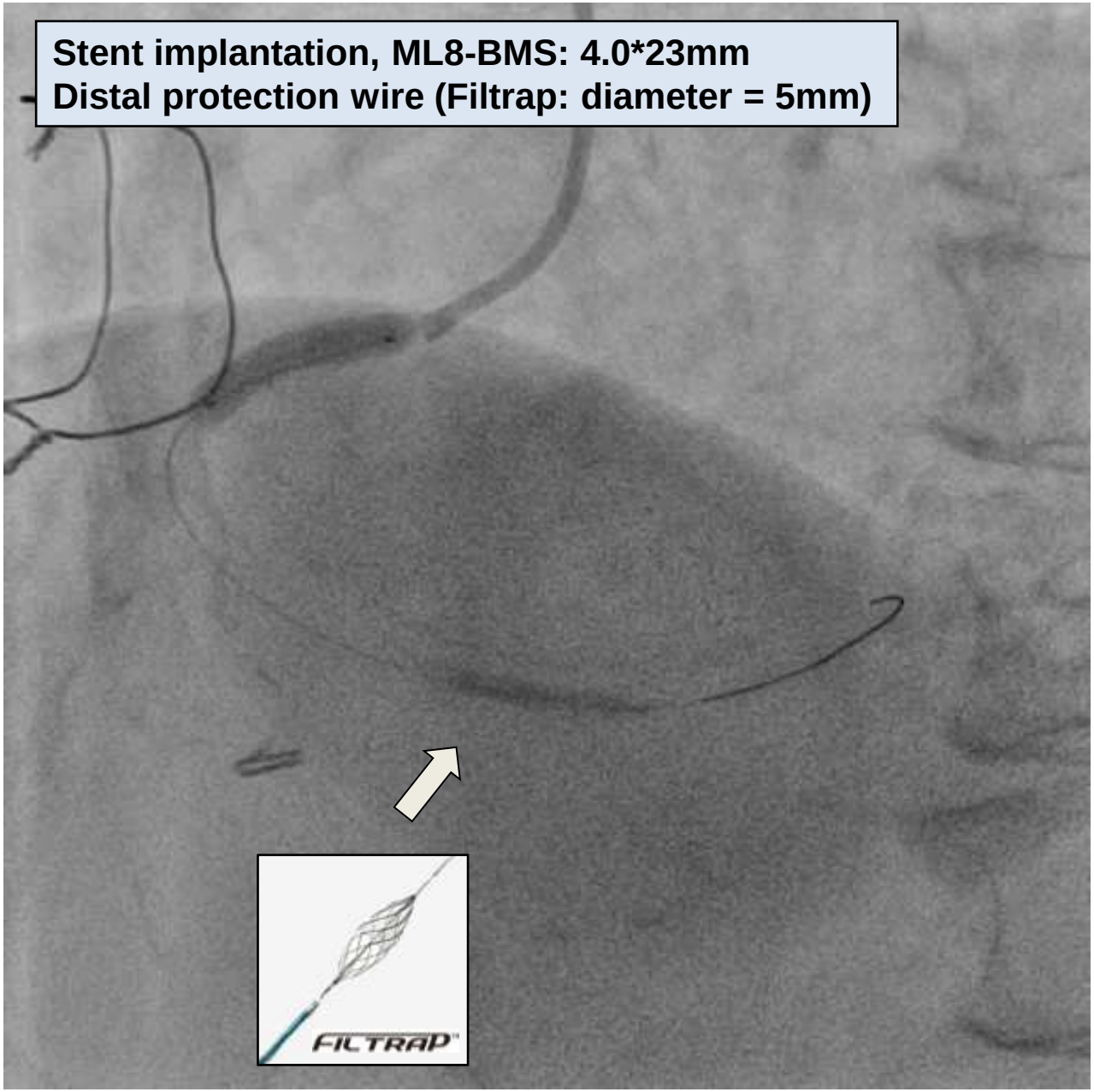
FILTRAP™

NIPRO

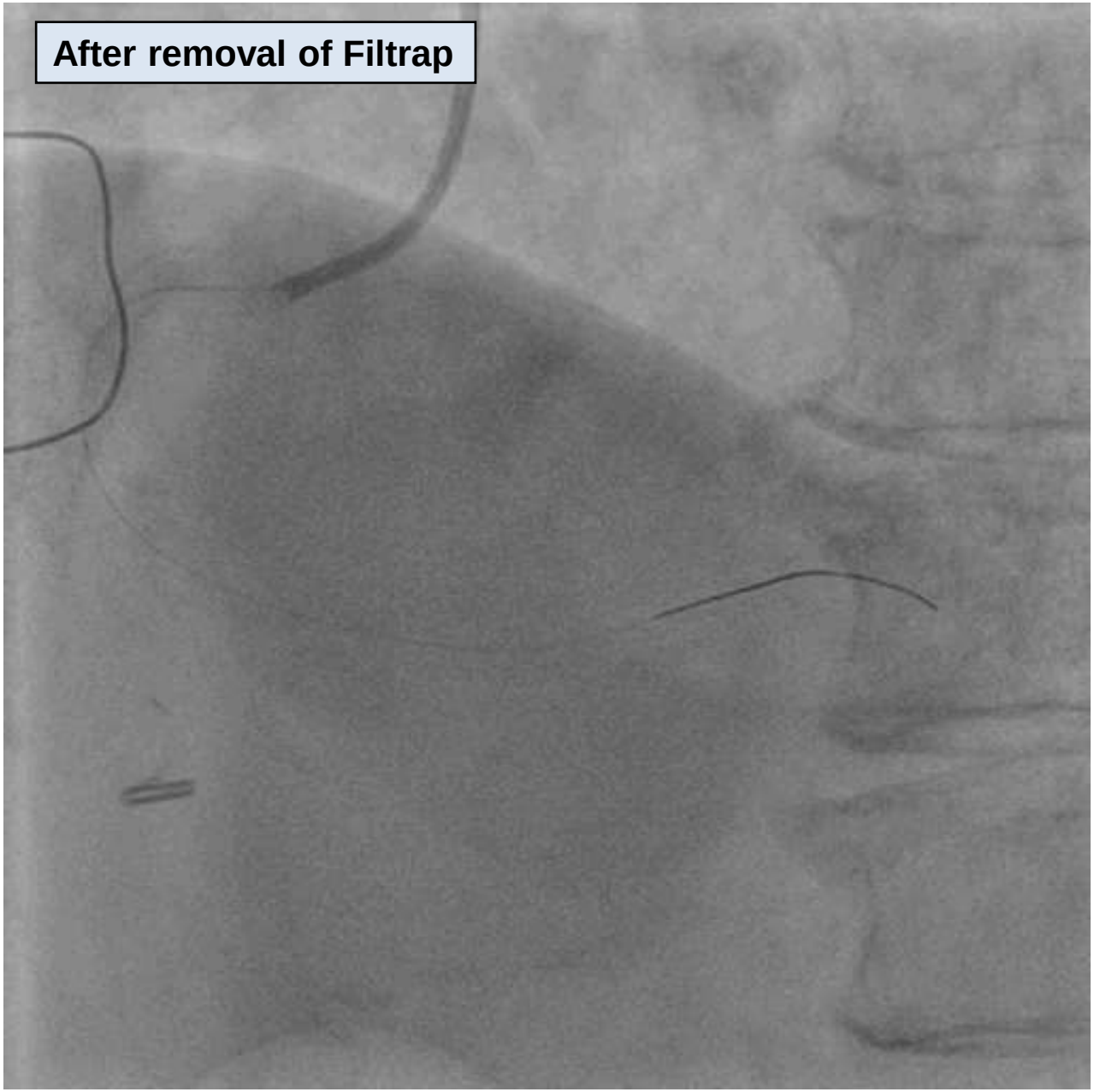


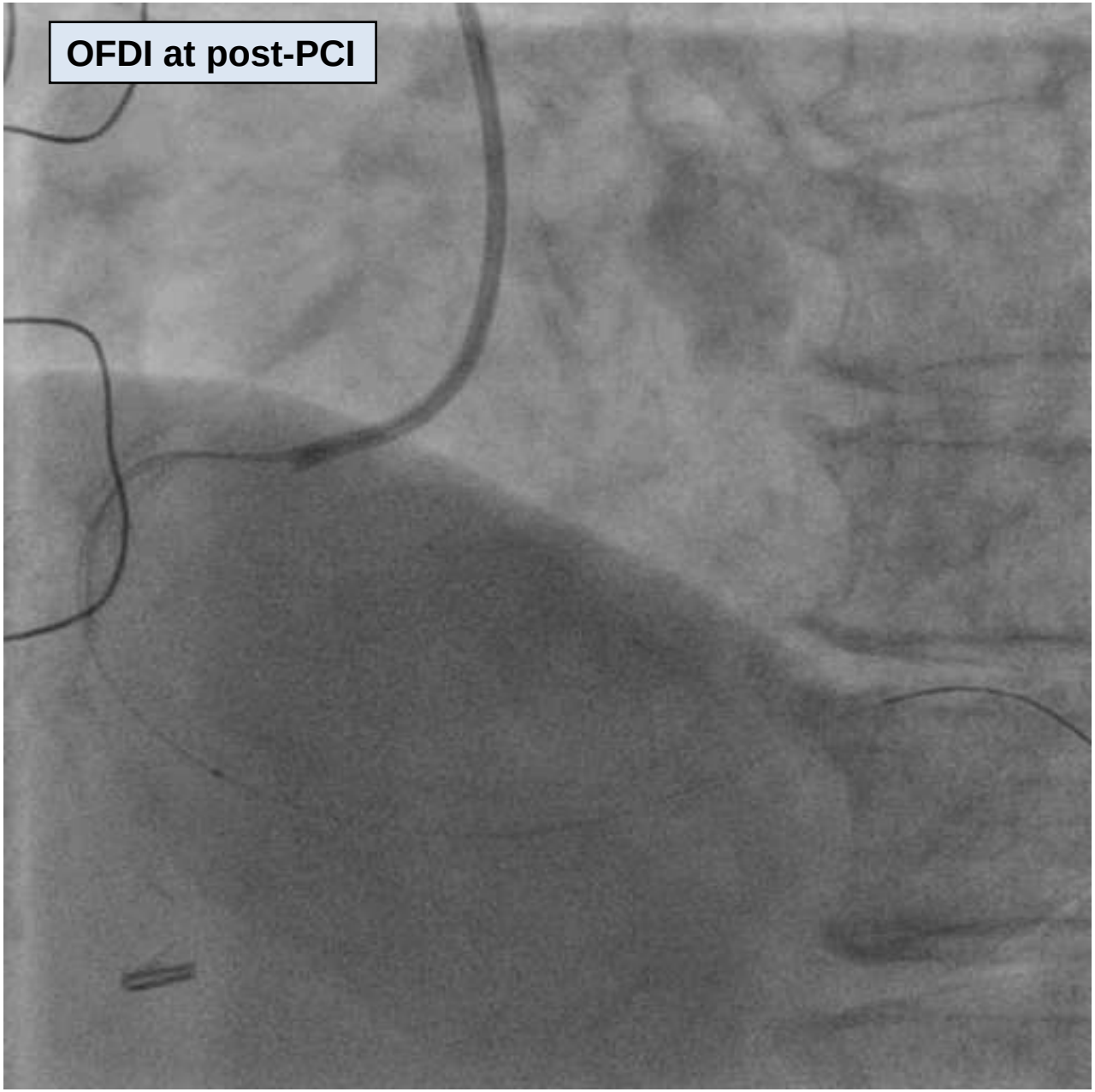

Distal protection wire (Filtrap: diameter = 5mm)
Pre-dilatation, BA: 3.0*15mm
FILTRAP

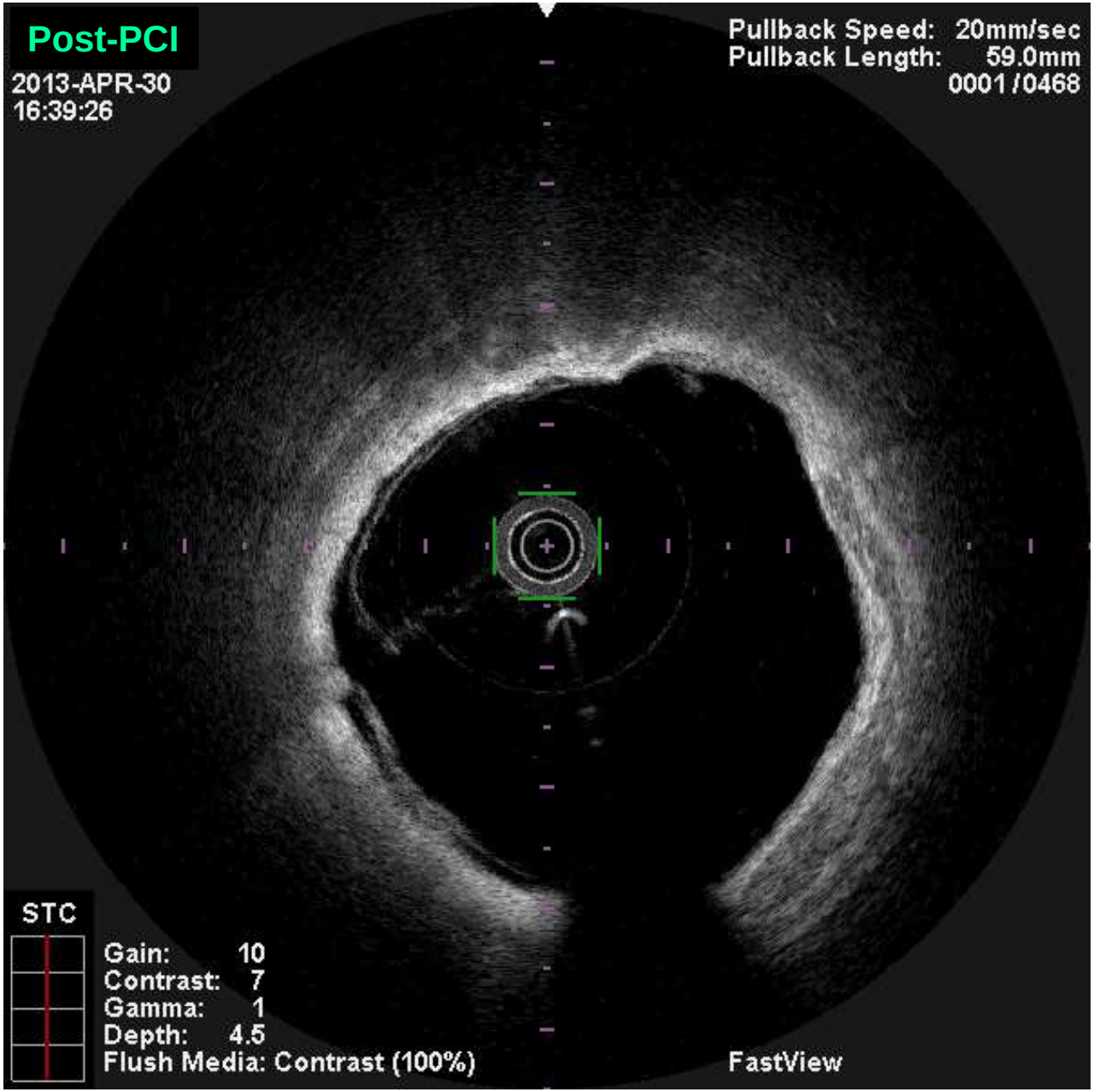

After pre-dilatation, BA: 3.0*15mm
Distal protection wire (Filtrap: diameter = 5mm)
FILTRAP


Stent implantation, ML8-BMS: 4.0*23mm
Distal protection wire (Filtrap: diameter = 5mm)
FILTRAP

After stenting, ML8-BMS: 4.0*23mm
Distal protection wire (Filtrap: diameter = 5mm)
Slow-flow

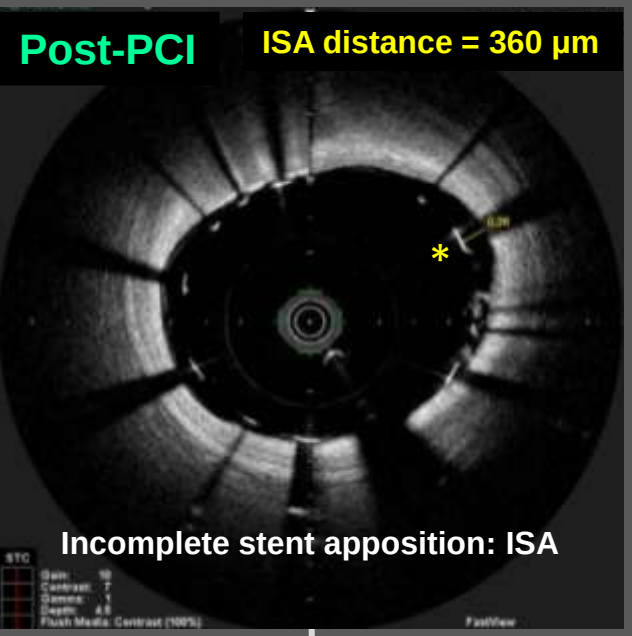

After removal of Filtrap

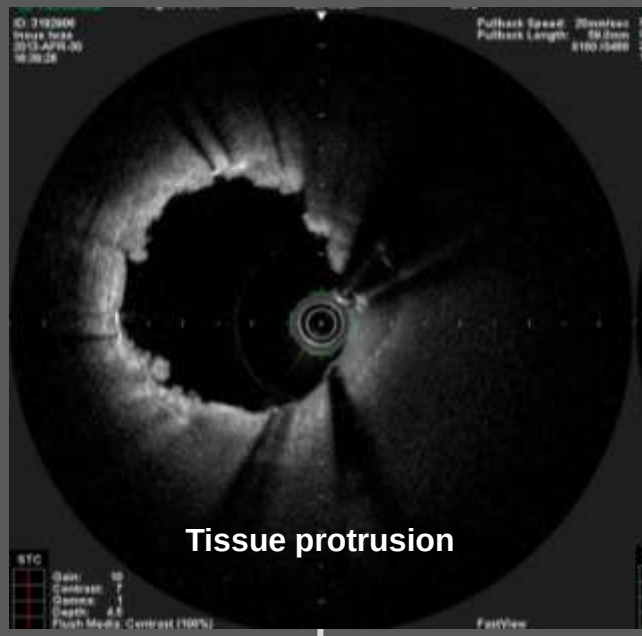

OFDI at post-PCI

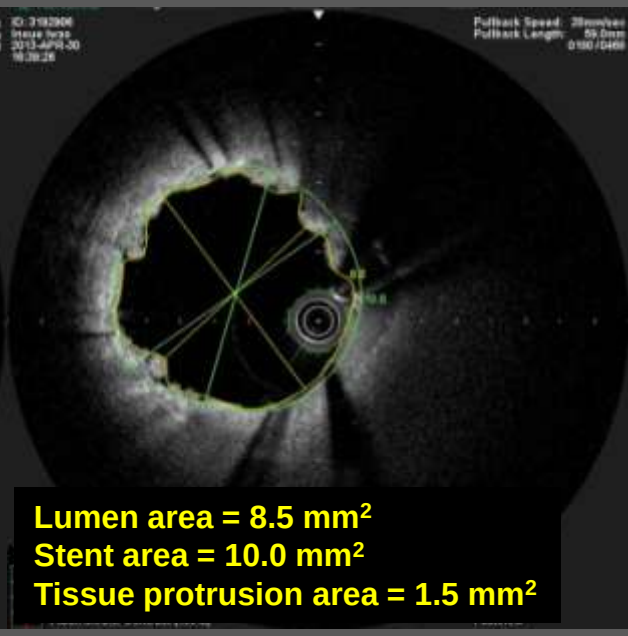

Post-PCI
2013-APR-30
16:39:26
Pullback Speed: 20mm/sec
Pullback Length: 59.0mm
0001/0468
STC
Gain: 10
Contrast: 7
Gamma: 1
Depth: 4.5
Flush Media: Contrast (100%)
FastView

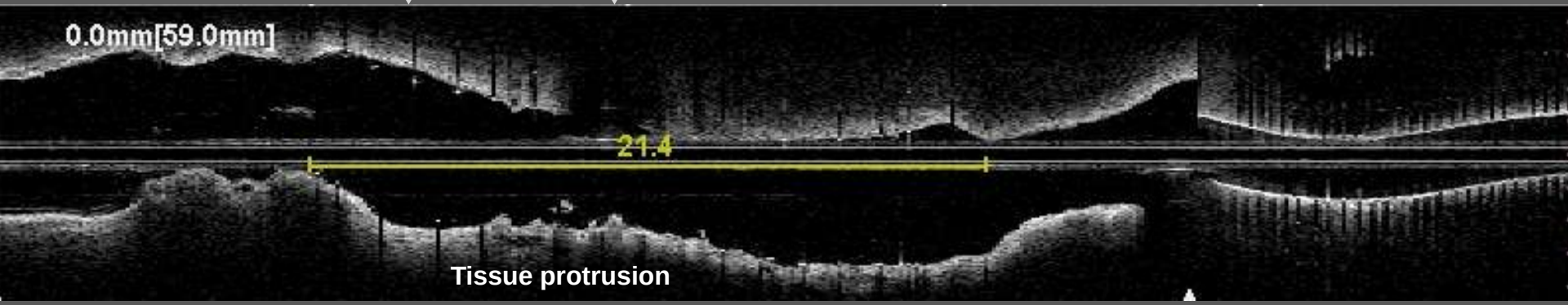
Incomplete stent apposition

Minimum lumen area site

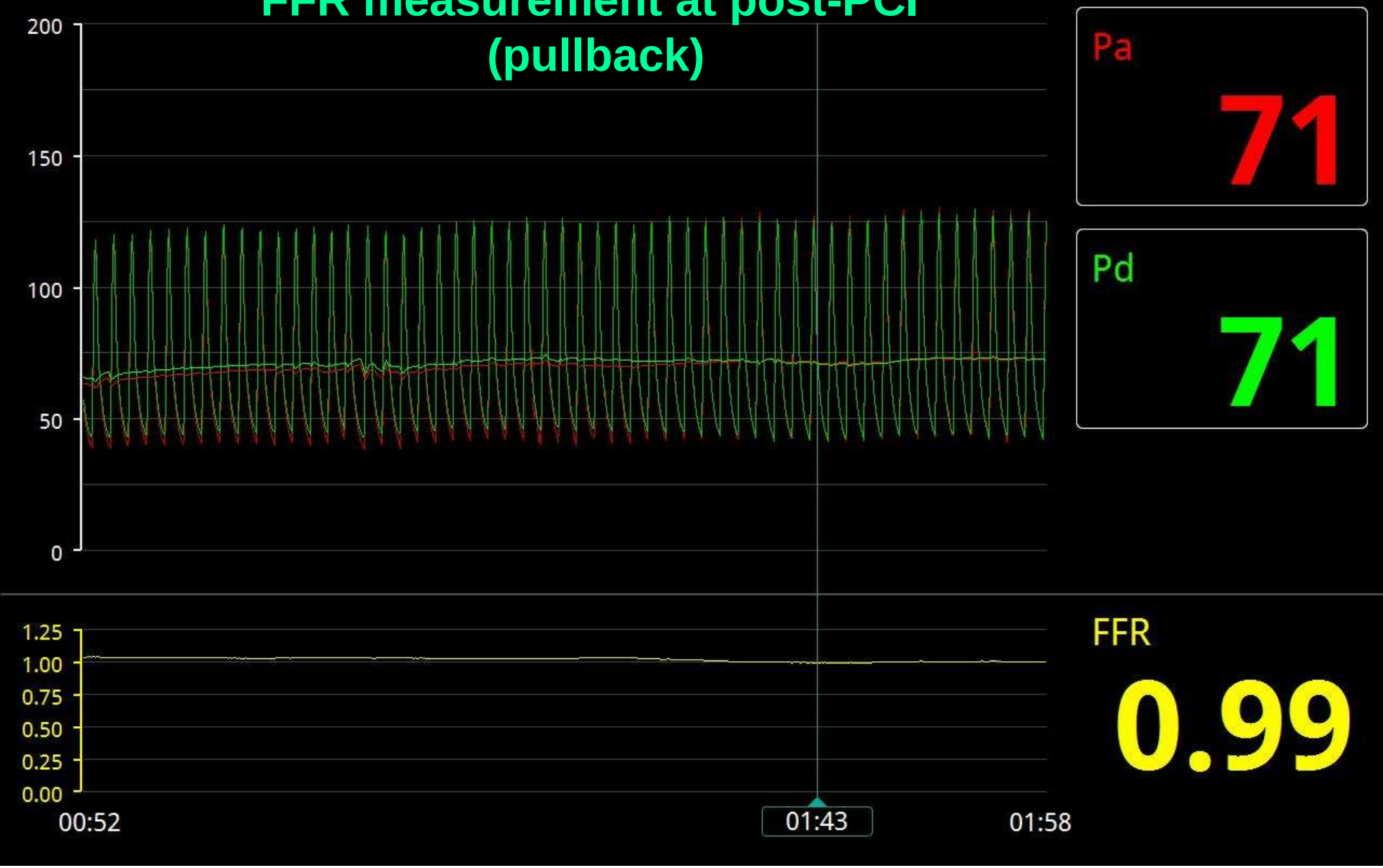


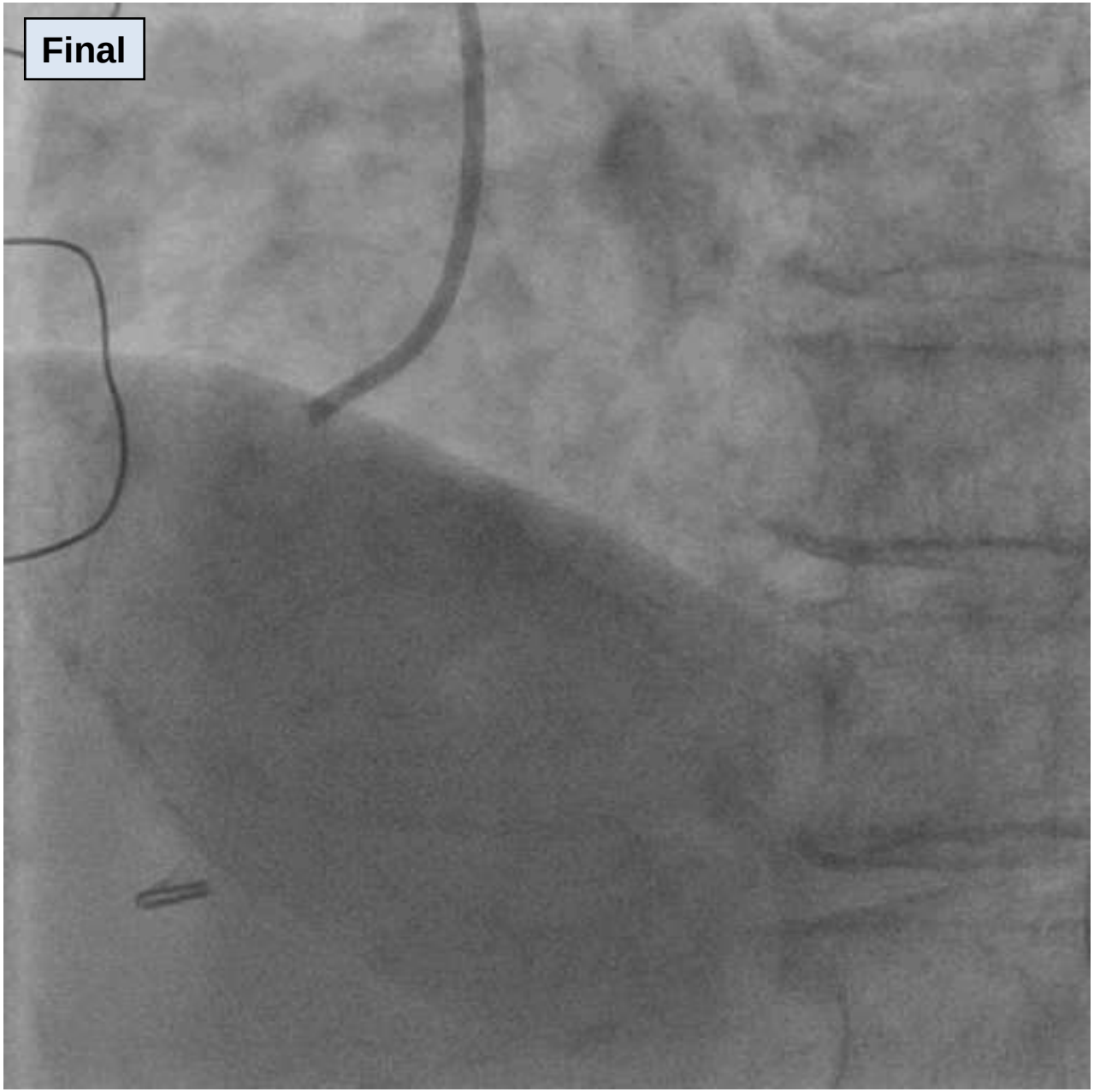






FFR measurement at post-PCI (pullback)




Final

Summary

- OCT can predict the high risk lesions for distal embolization and slow flow during PCI.

Case 3: 71yo, M

Clinical diagnosis

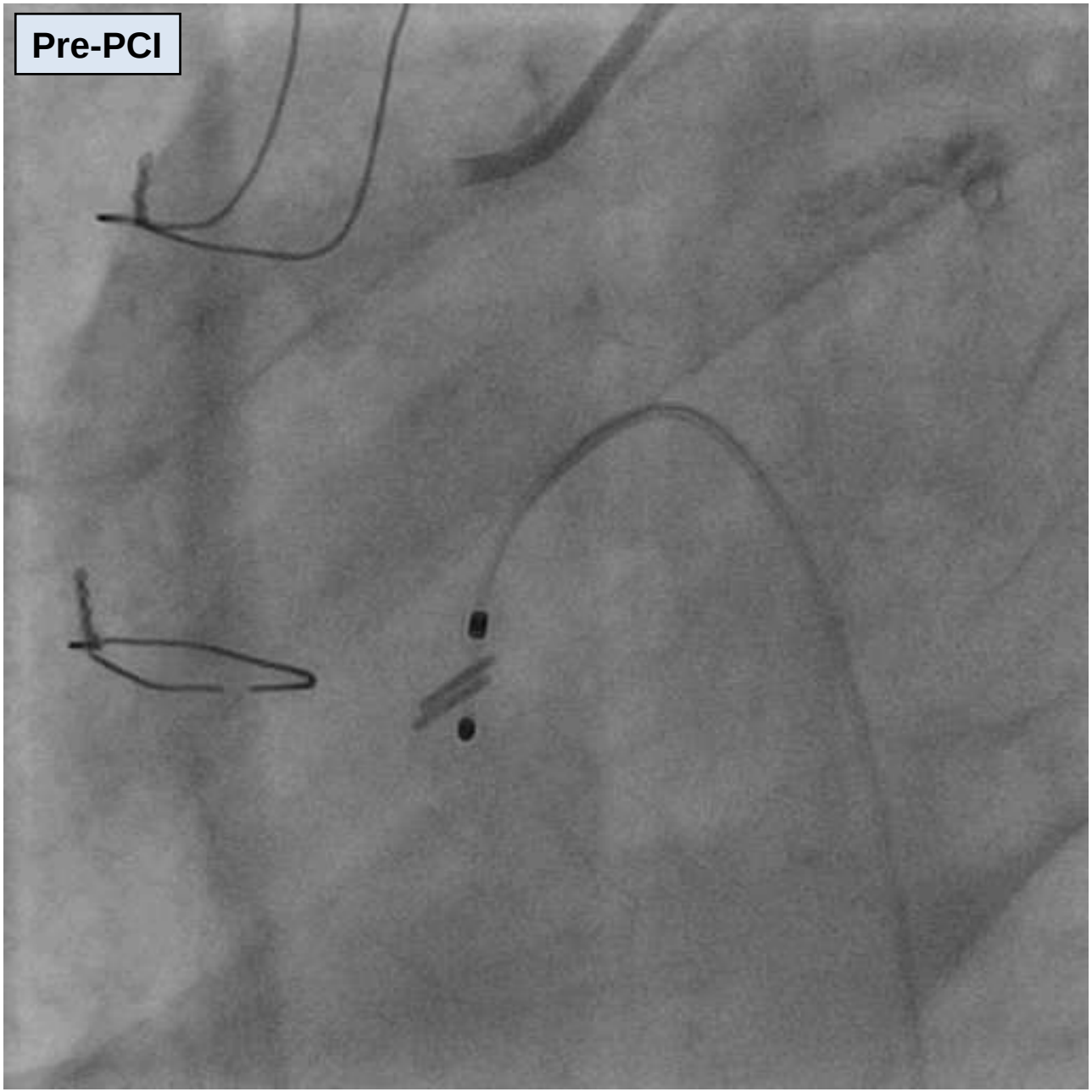
Stable AP, AF

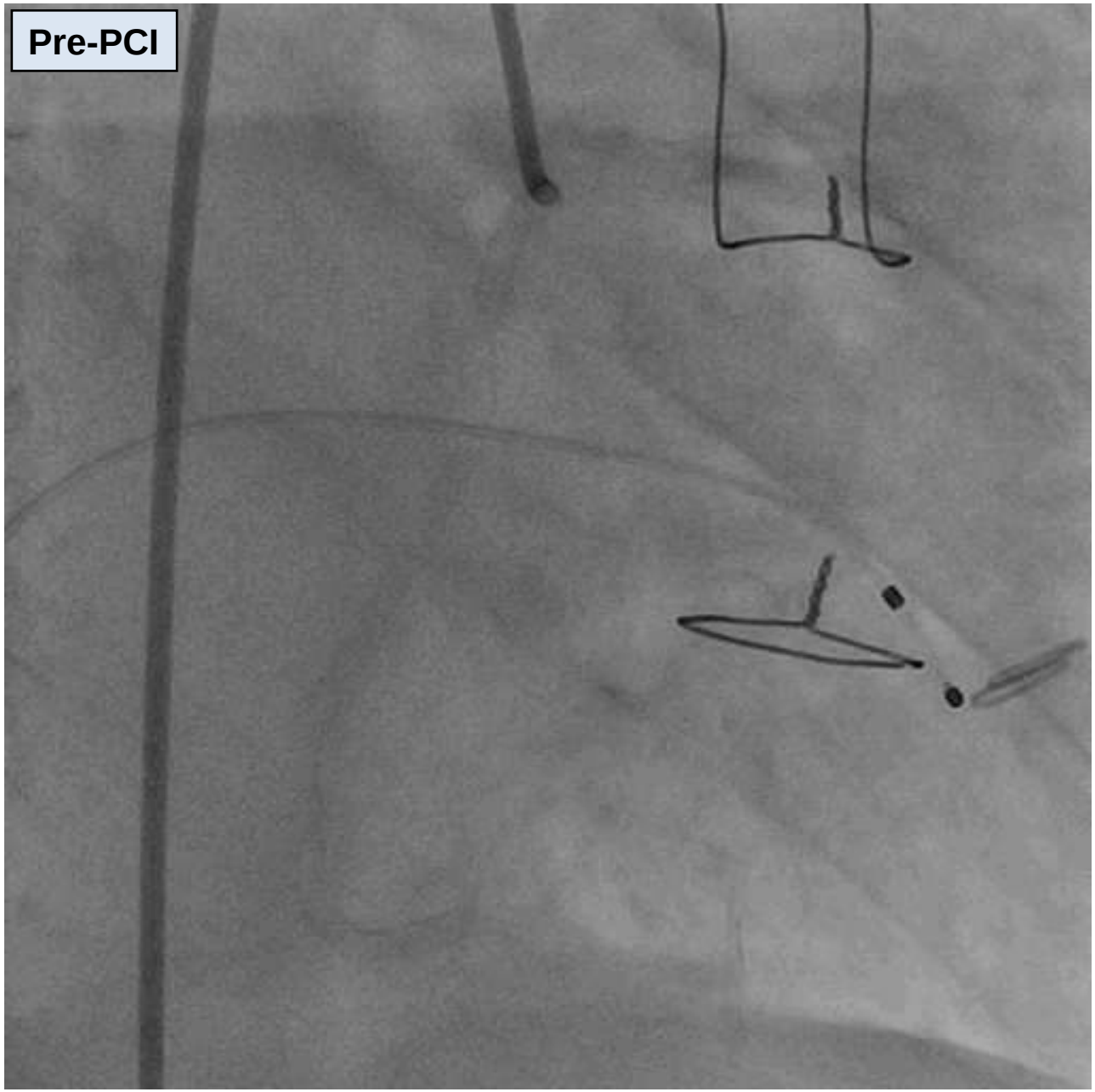
Clinical history

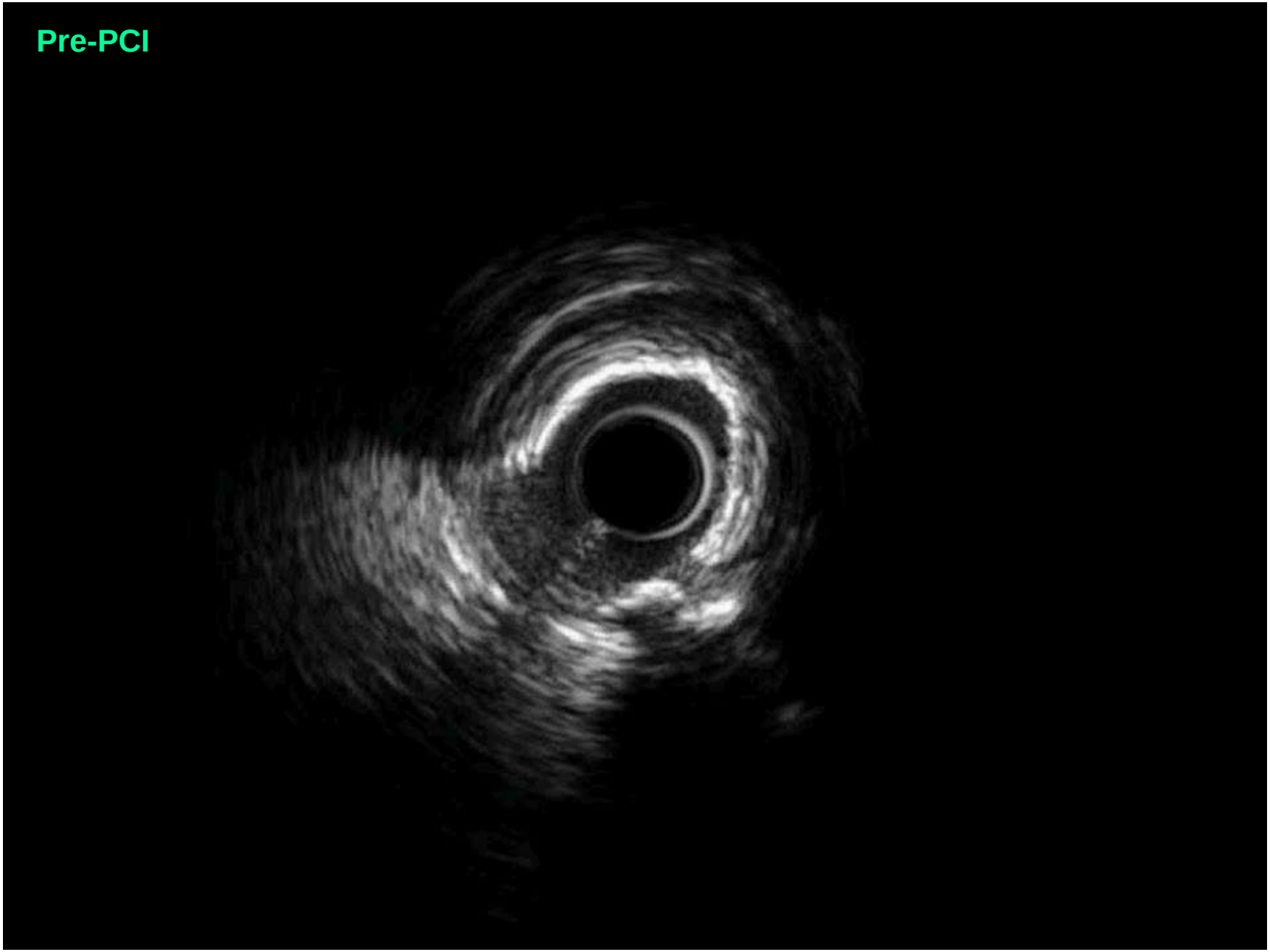
1978. CKD (Glomerular nephritis) ⇒ Hemodialysis
2003. Effort AP, LAD prox lesion, CABG (LITA to LAD)
2013. Scintiscan: LV inferior ischemia

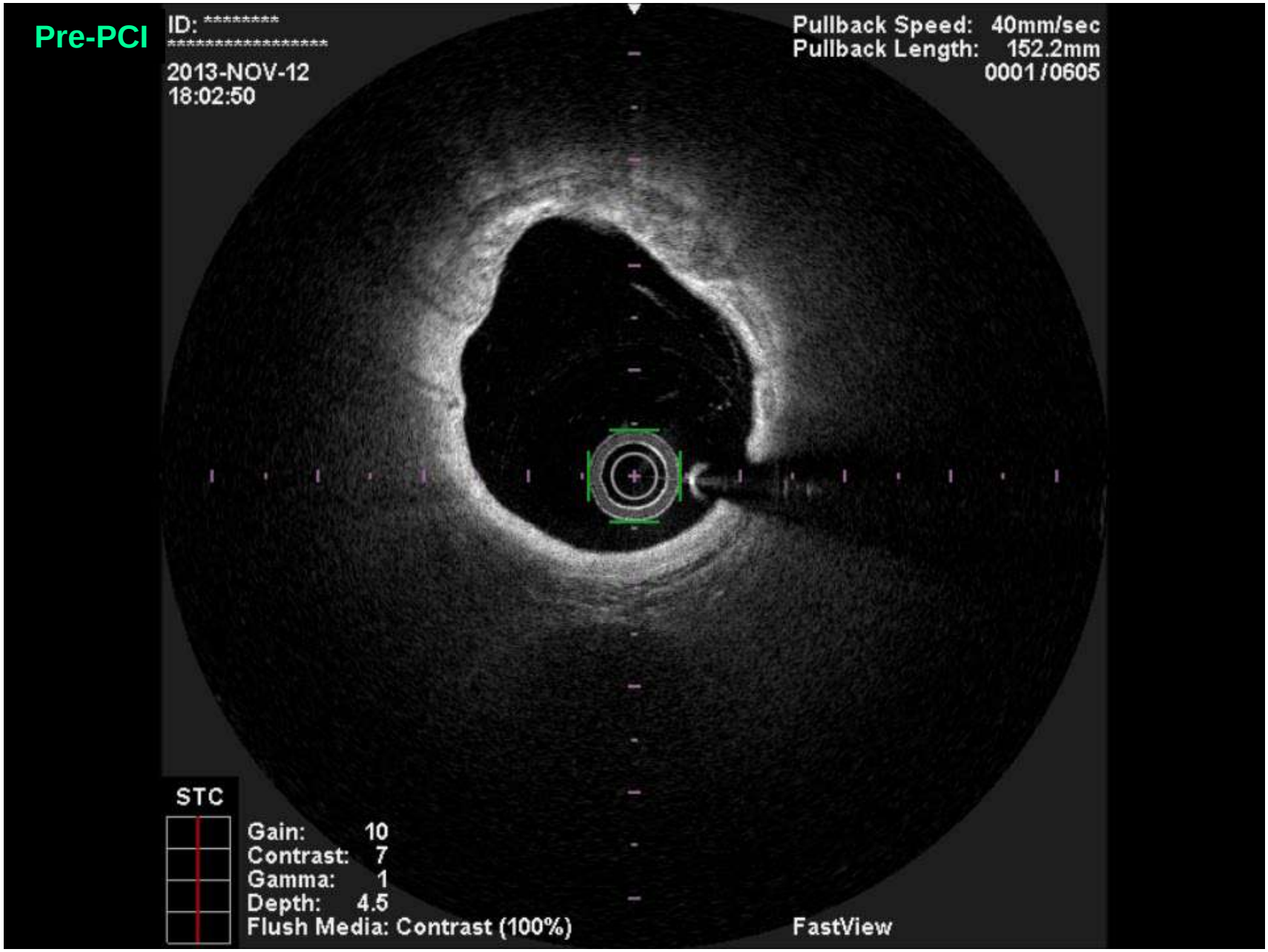
Coronary risk factors

HT (-), DLP (-), DM (-), Obesity (-), Smoker (+)

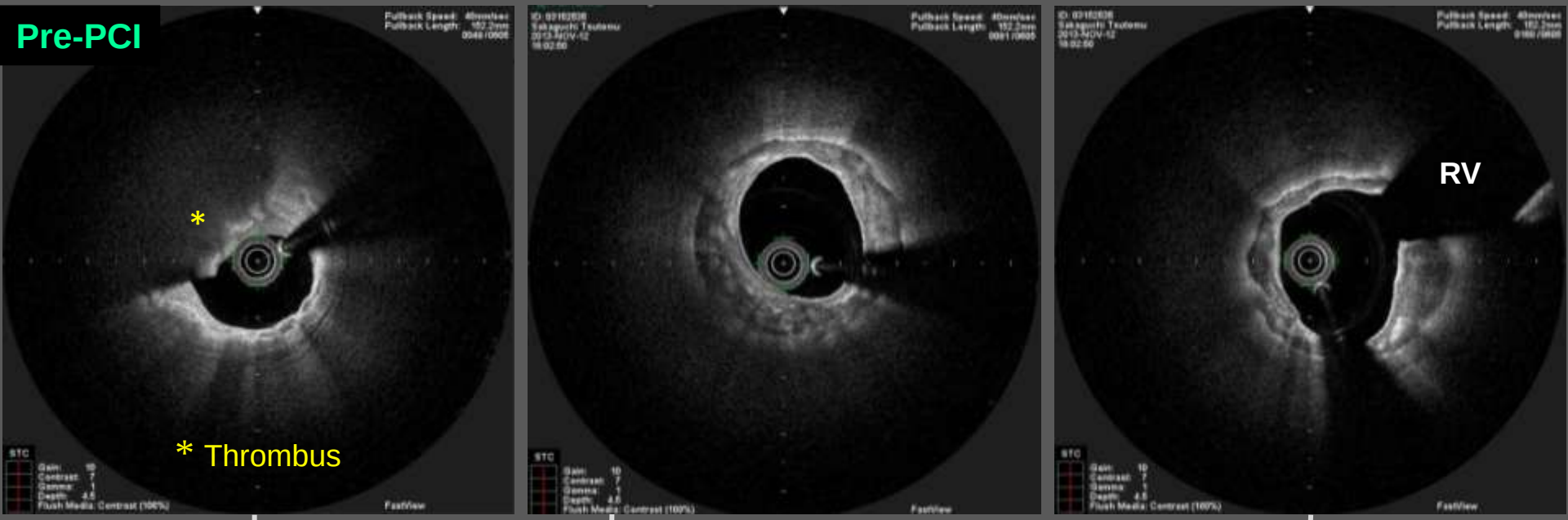

Pre-PCI

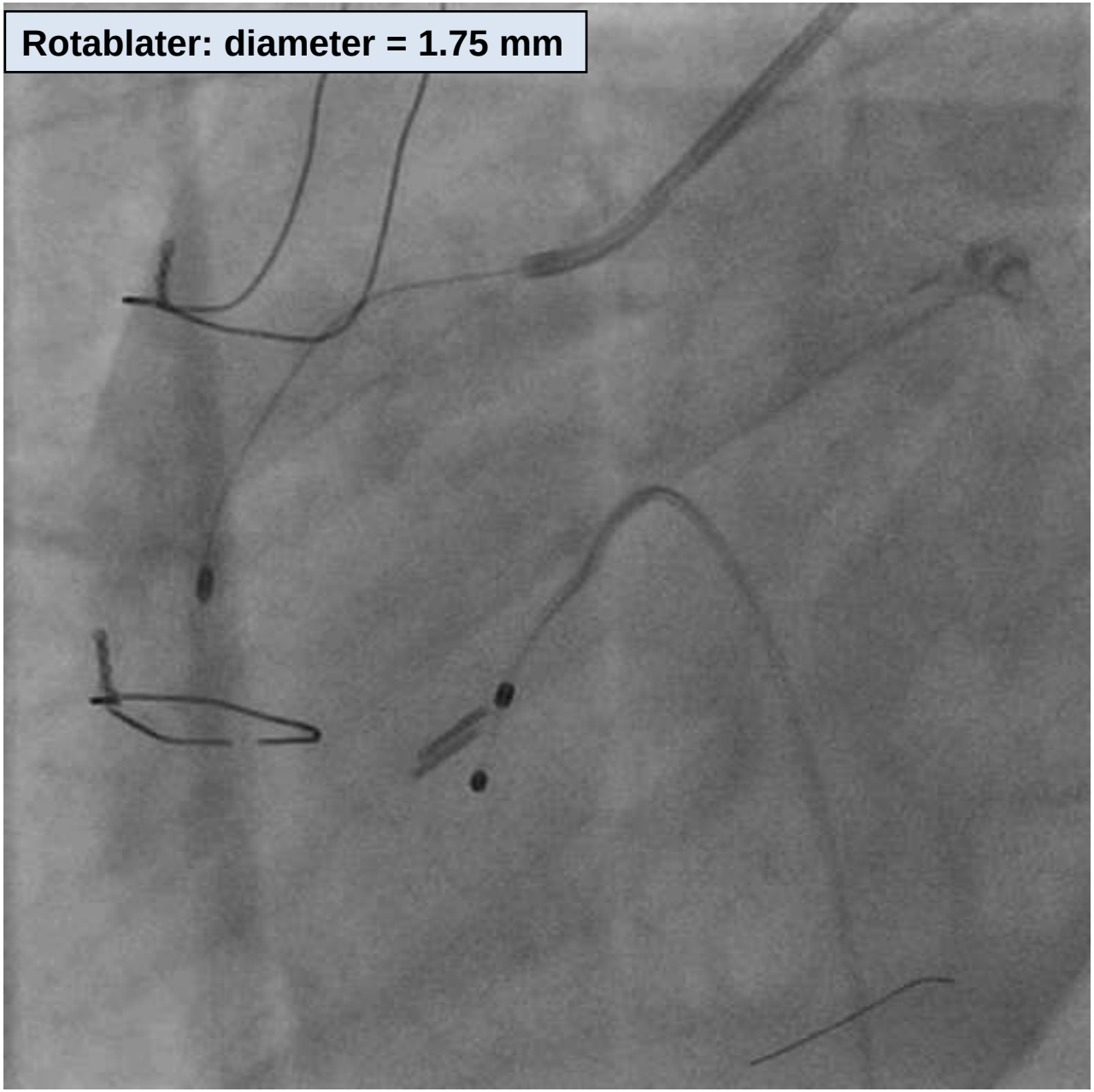

Pre-PCI


Pre-PCI

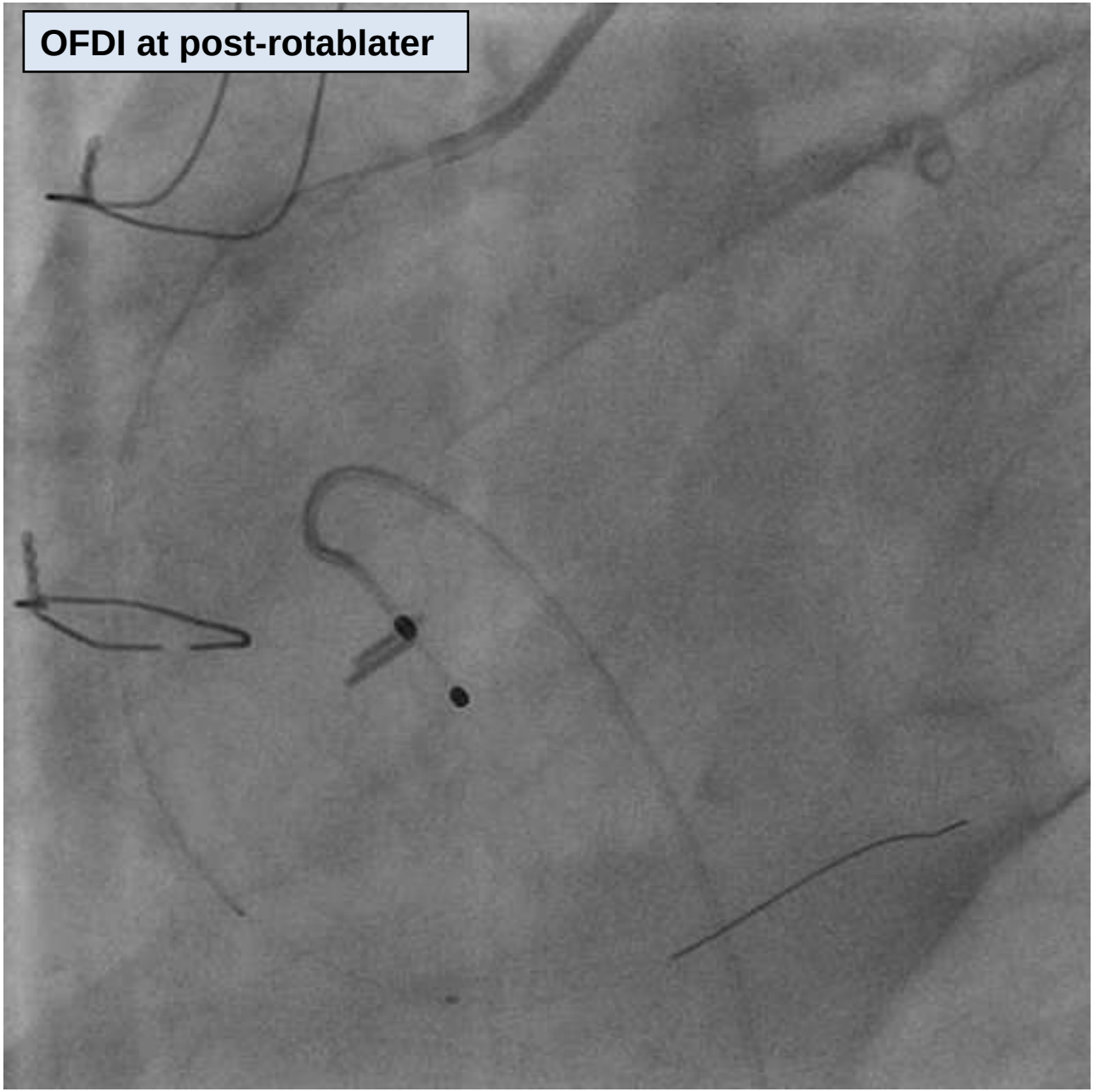

Pre-PCI
ID: ********
****
2013-NOV-12
18:02:50
Pullback Speed: 40mm/sec
Pullback Length: 152.2mm
0001/0605
STC
Gain: 10
Contrast: 7
Gamma: 1
Depth: 4.5
Flush Media: Contrast (100%)
FastView

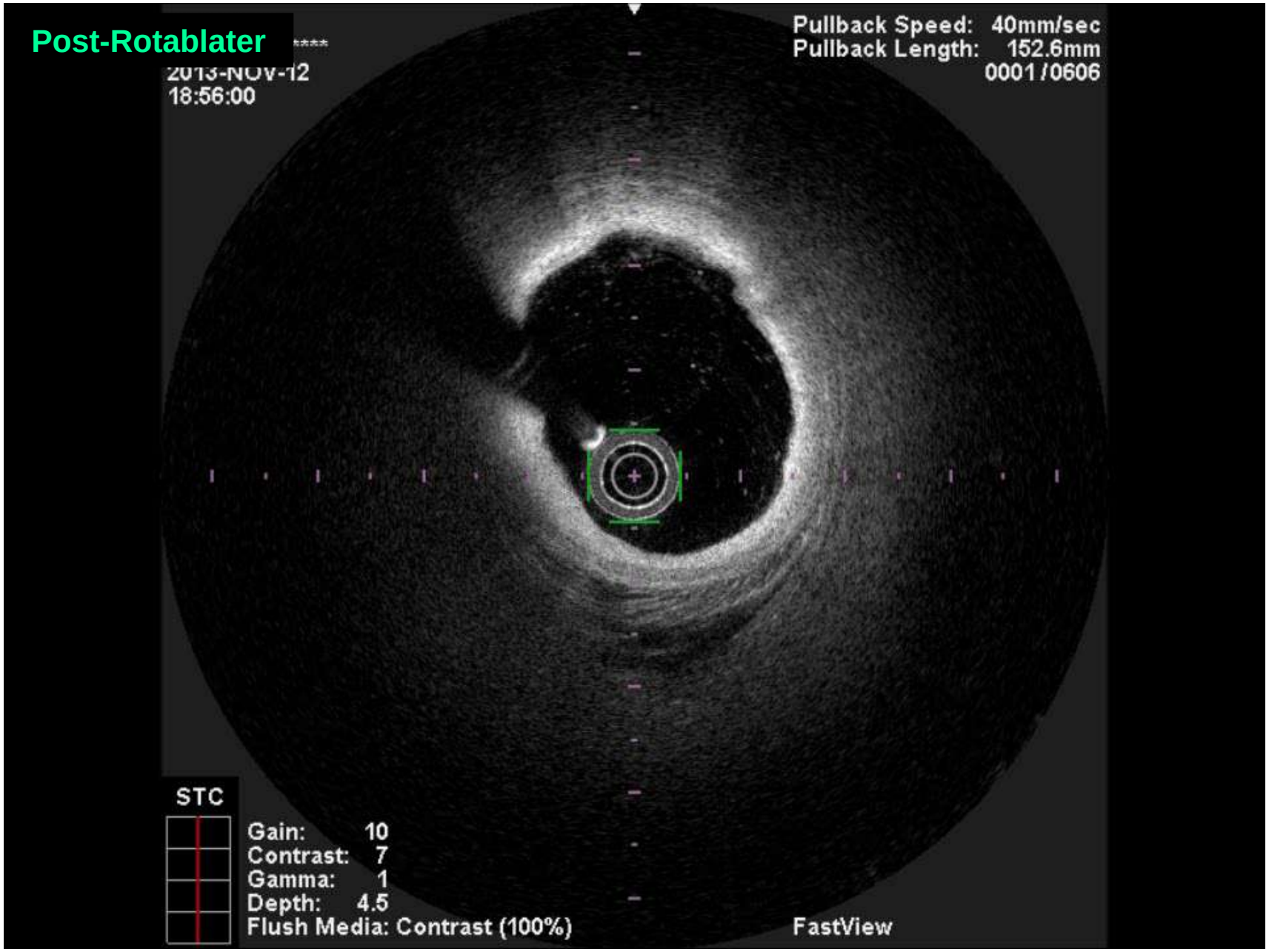
Minimum lumen area site ***Severe calcification*** ***Severe calcification***




Rotablater: diameter = 1.75 mm


Post-Rotablater

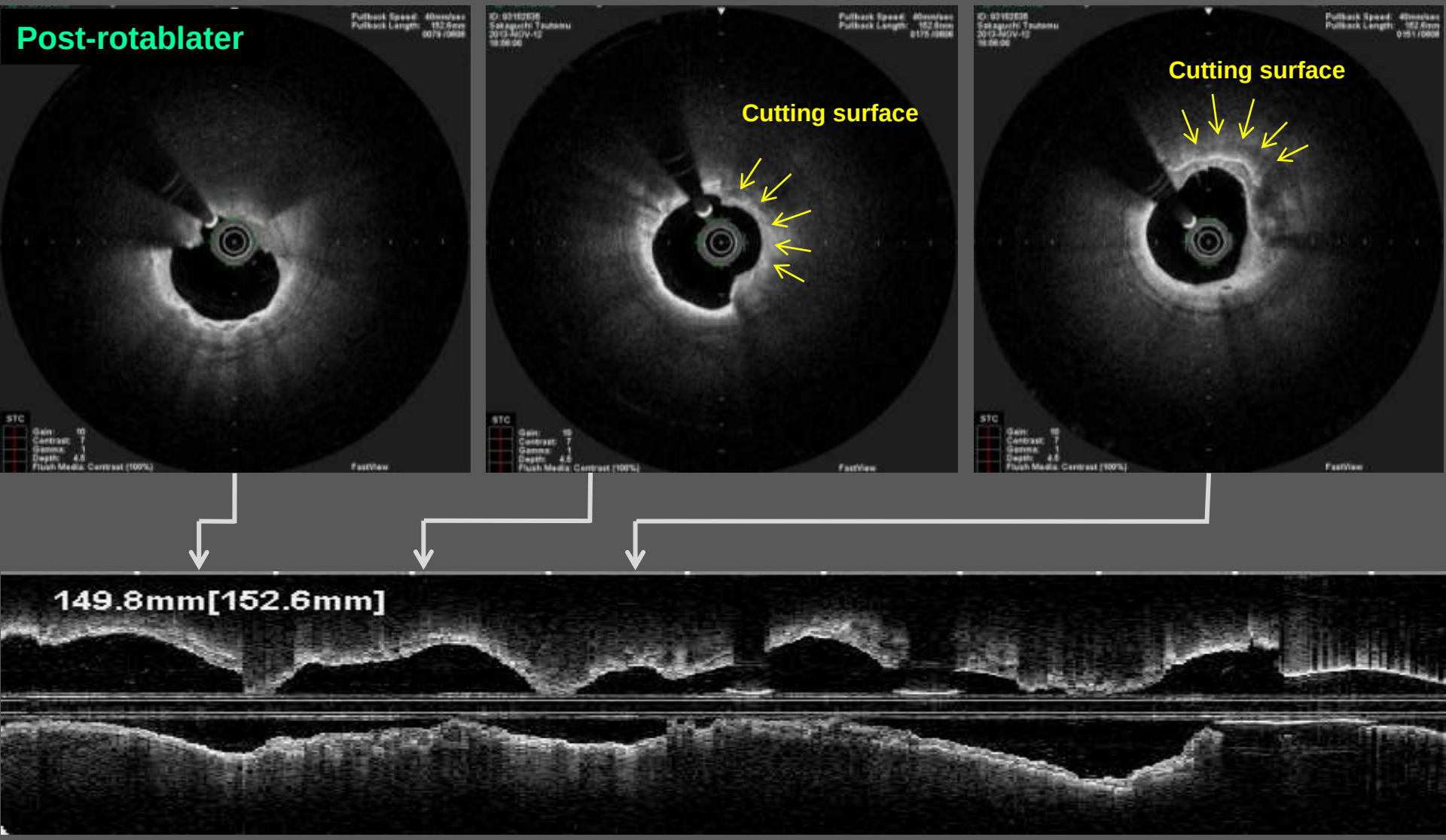

OFDI at post-rotablater

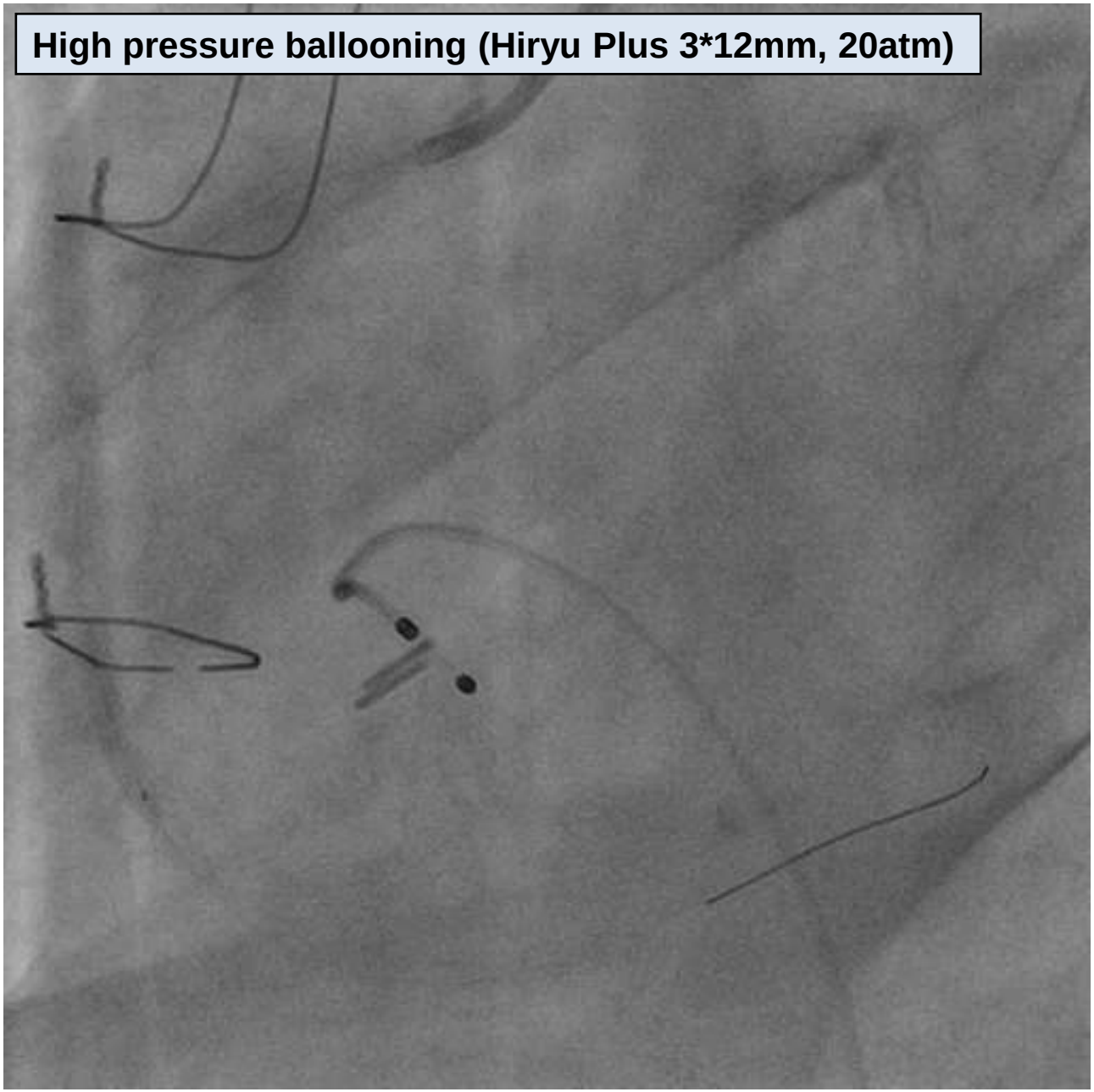

Post-Rotablater
2013-NOV-12
18:56:00
Pullback Speed: 40mm/sec
Pullback Length: 152.6mm
0001 /0606
STC
Gain: 10
Contrast: 7
Gamma: 1
Depth: 4.5
Flush Media: Contrast (100%)
FastView

Minimum lumen area site

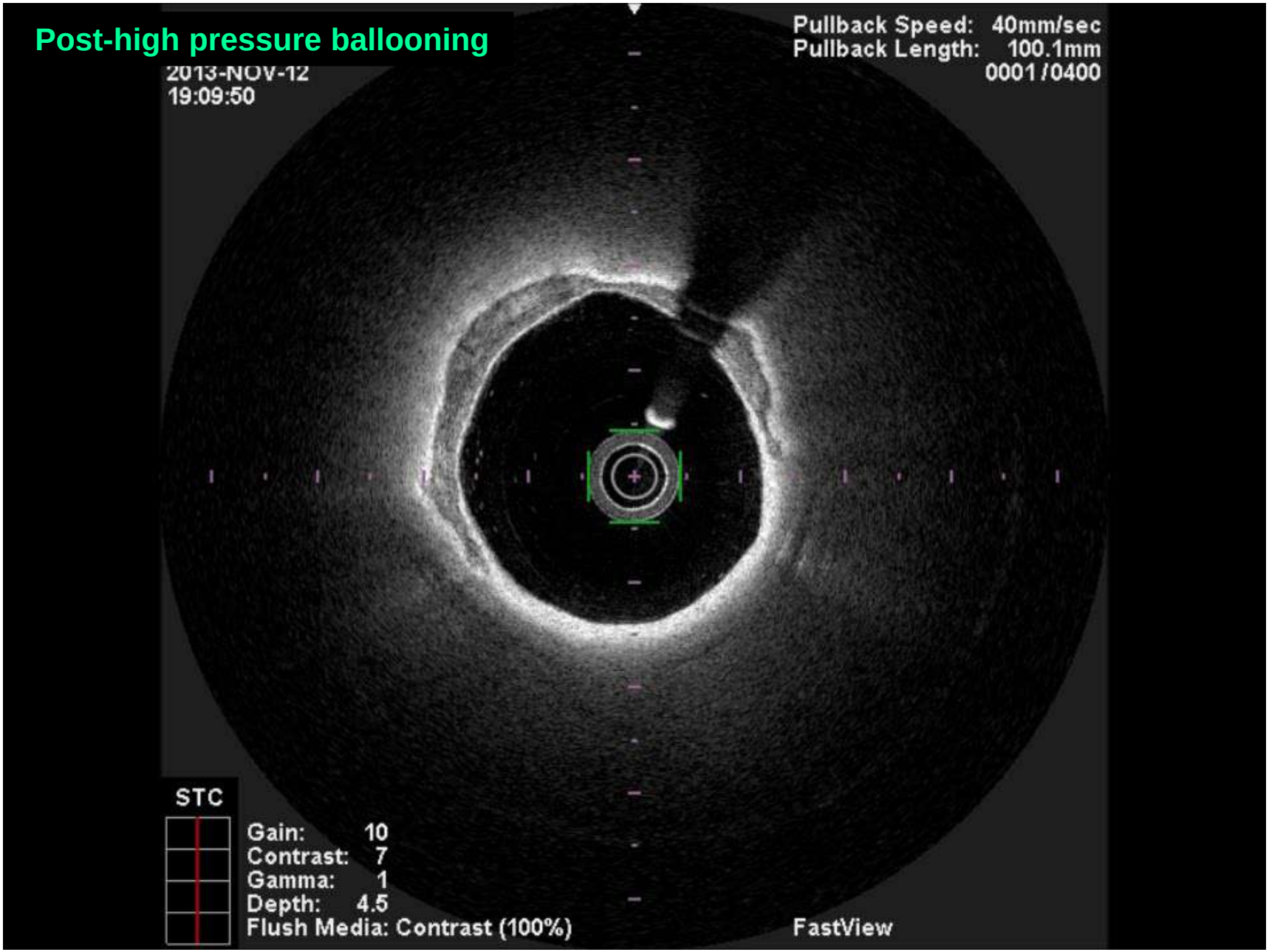
Calcification

Calcification




High pressure ballooning (Hiryu Plus 3*12mm, 20atm)

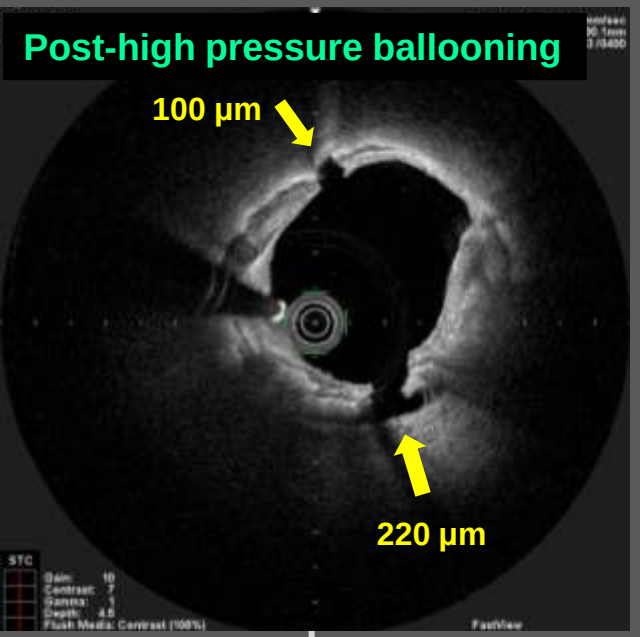

Post-high pressure ballooning

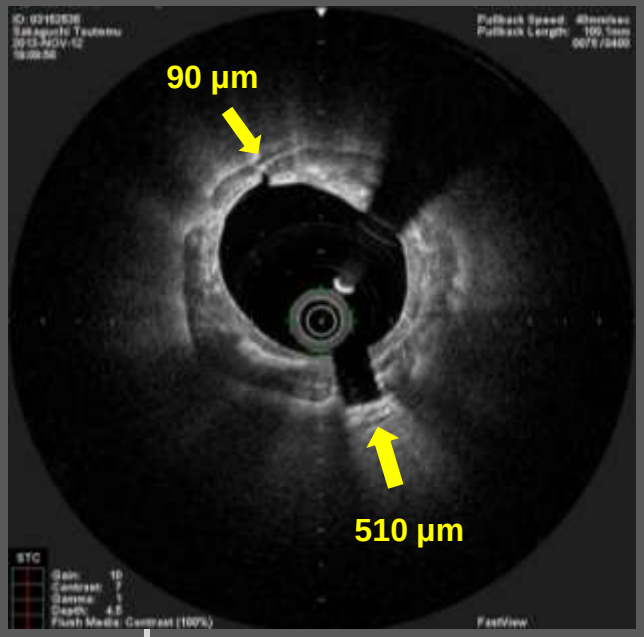

Post-high pressure ballooning
2013-NOV-12
19:09:50
Pullback Speed: 40mm/sec
Pullback Length: 100.1mm
0001/0400
STC
Gain: 10
Contrast: 7
Gamma: 1
Depth: 4.5
Flush Media: Contrast (100%)
FastView

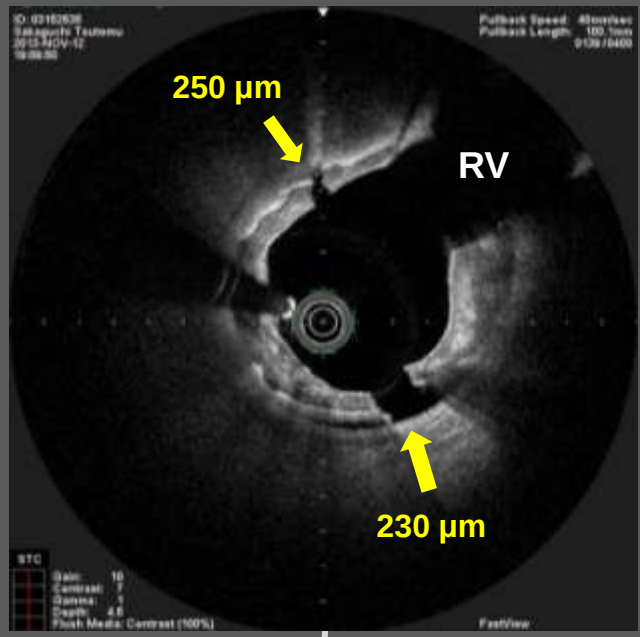
Broken calcium plate

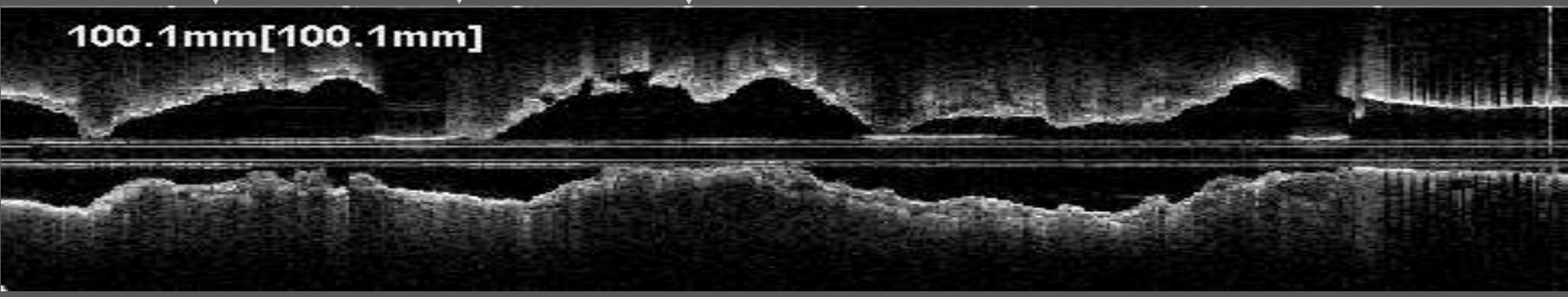
Broken calcium plate

Broken calcium plate



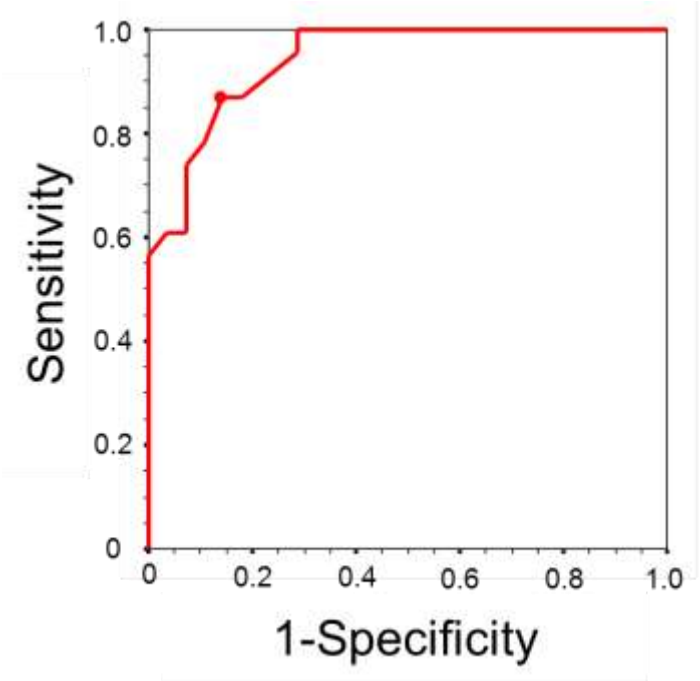






Prediction of calcium plate fracture by ballooning

OFDI was performed to assess vascular response immediately after high pressure ballooning in 51 patients with severe calcified coronary lesion.



Cut off = 505μm
AUC = 0.943

Sensitivity: 87%
Specificity: 86%

Conclusion. A calcium plate thickness < 505 μm was the corresponding cut-off value for predicting calcium plate fracture by high pressure ballooning

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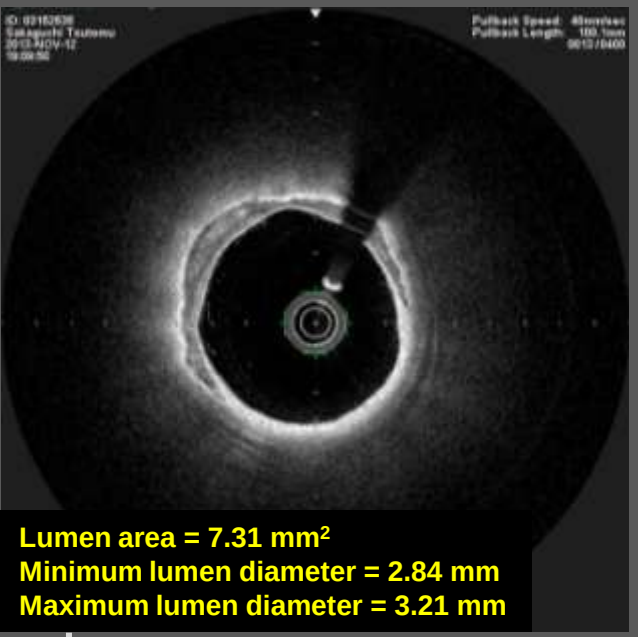
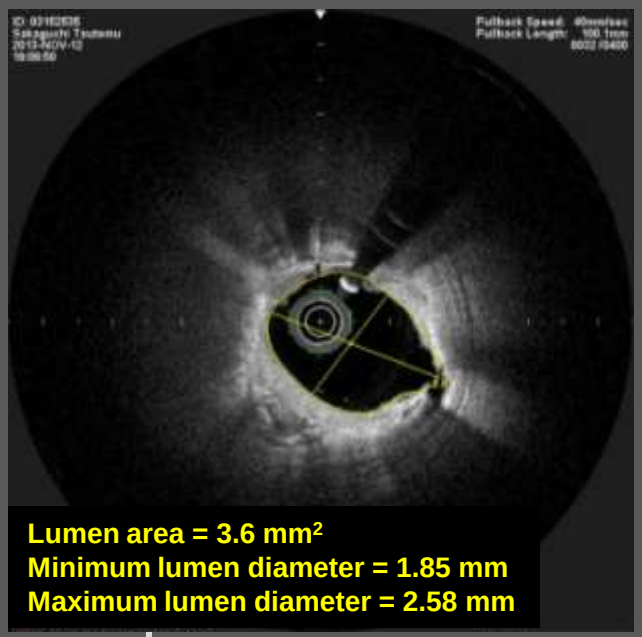
Distal reference



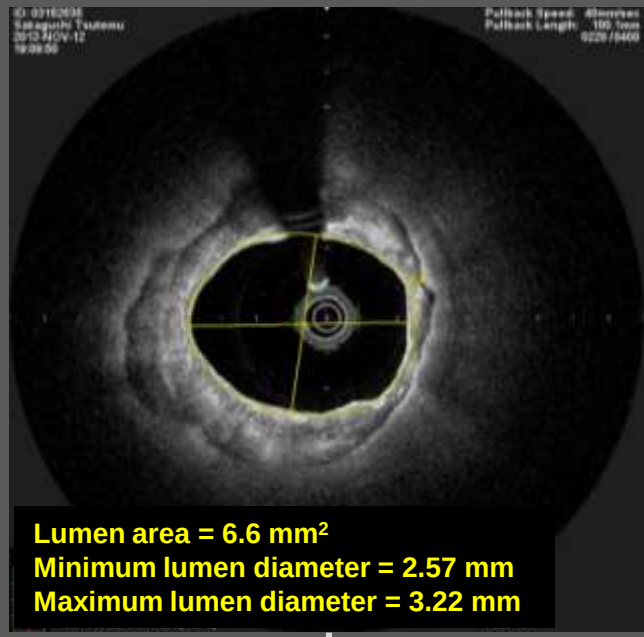
Lumen area = 7.31 mm²
Minimum lumen diameter = 2.84 mm
Maximum lumen diameter = 3.21 mm

Minimum lumen area site

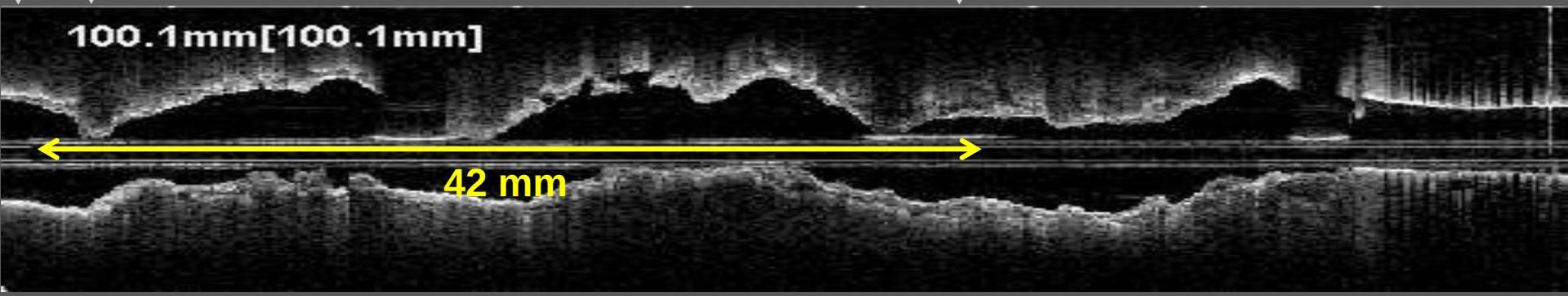


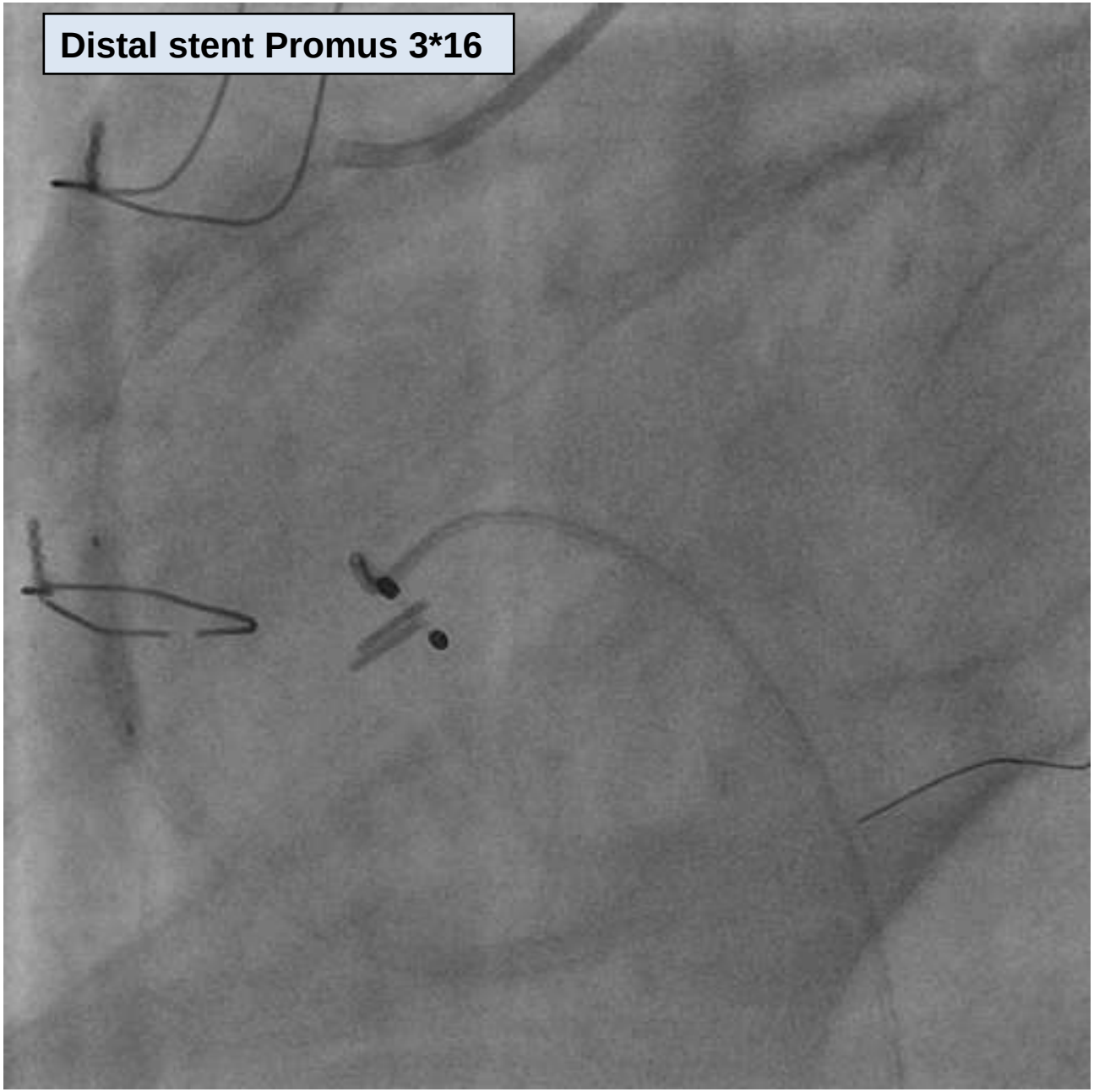
Lumen area = 3.6 mm²
Minimum lumen diameter = 1.85 mm
Maximum lumen diameter = 2.58 mm

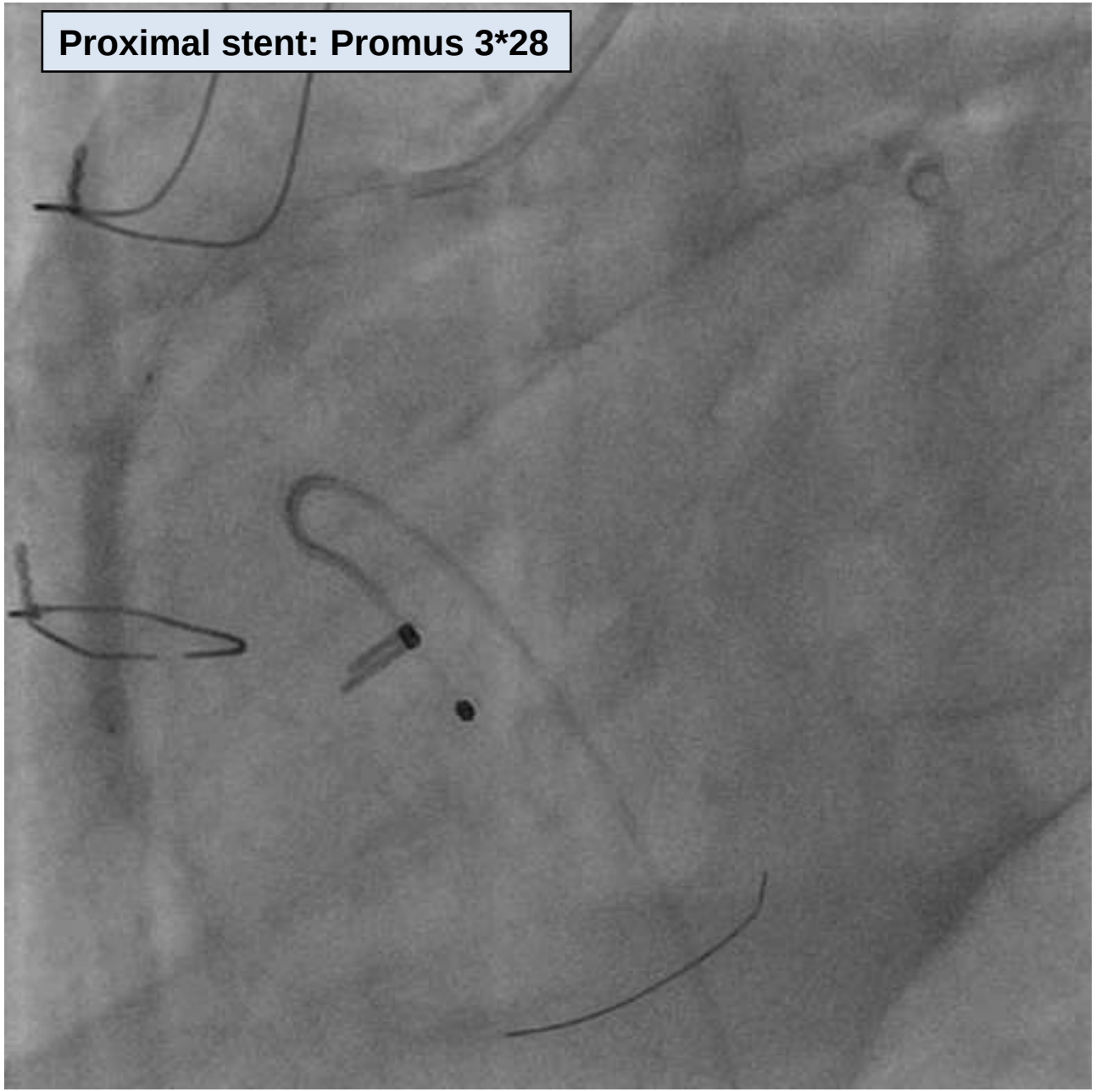
Proximal reference

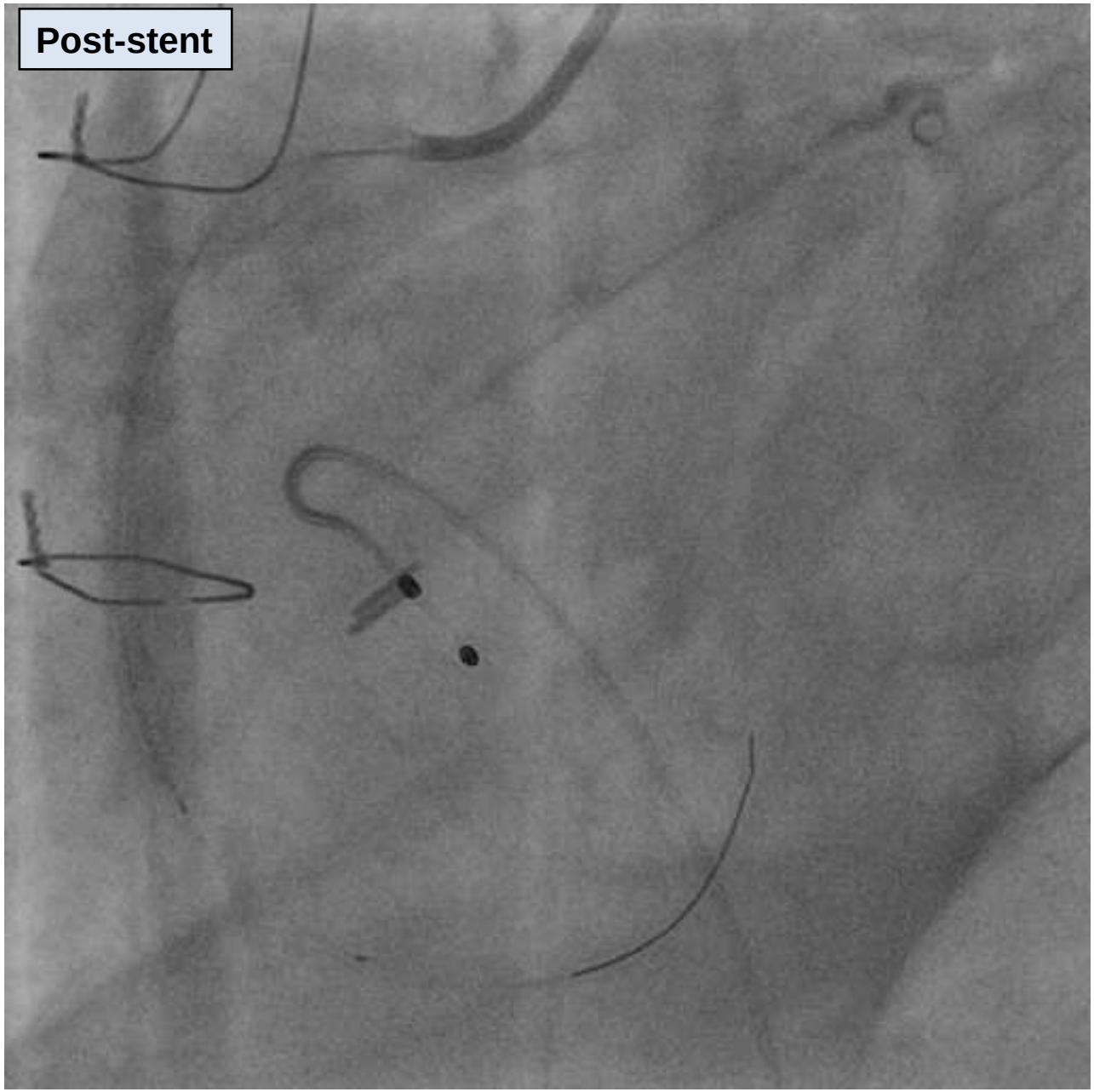


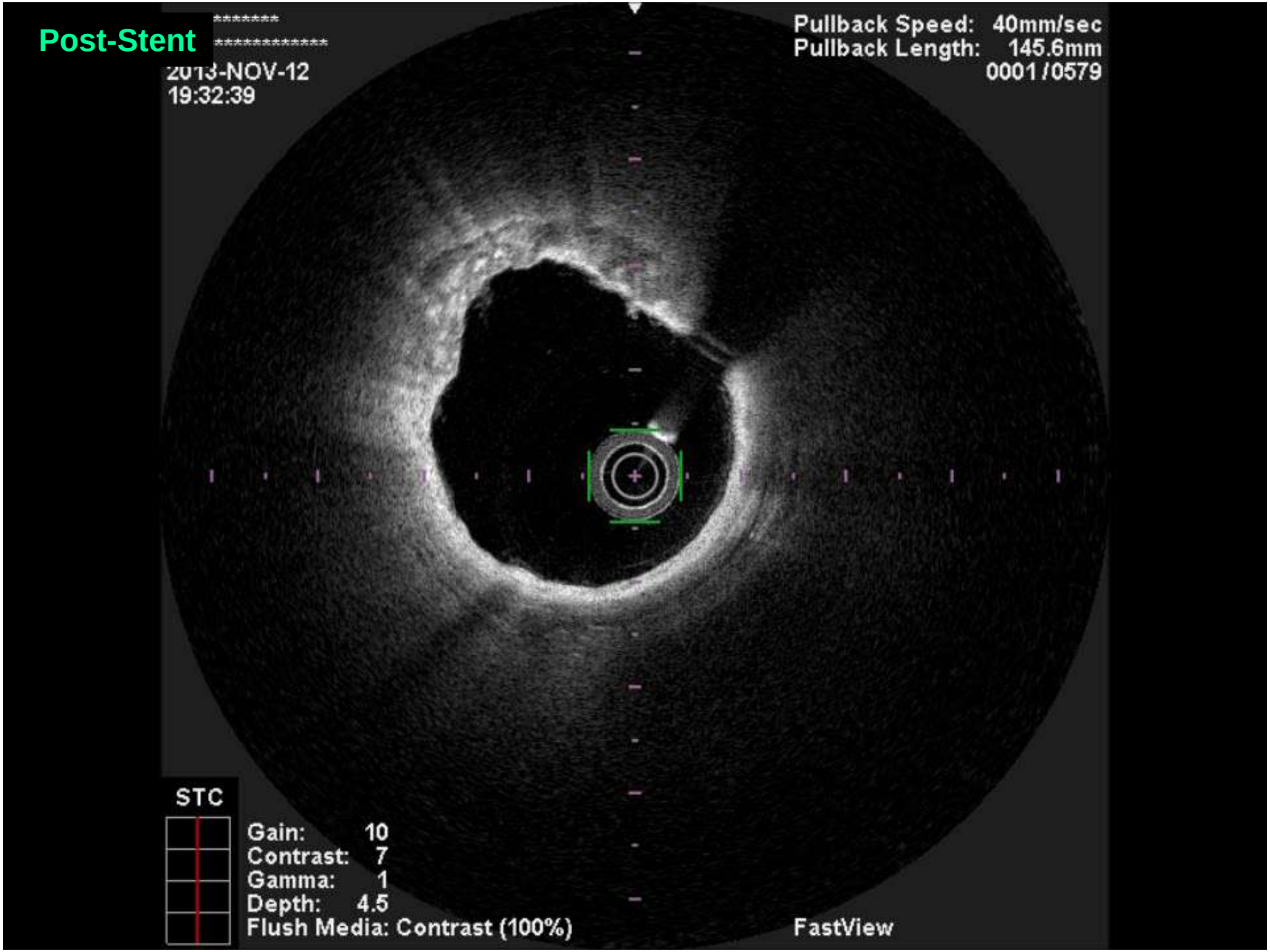
Lumen area = 6.6 mm²
Minimum lumen diameter = 2.57 mm
Maximum lumen diameter = 3.22 mm




Distal stent Promus 3*16


Proximal stent: Promus 3*28

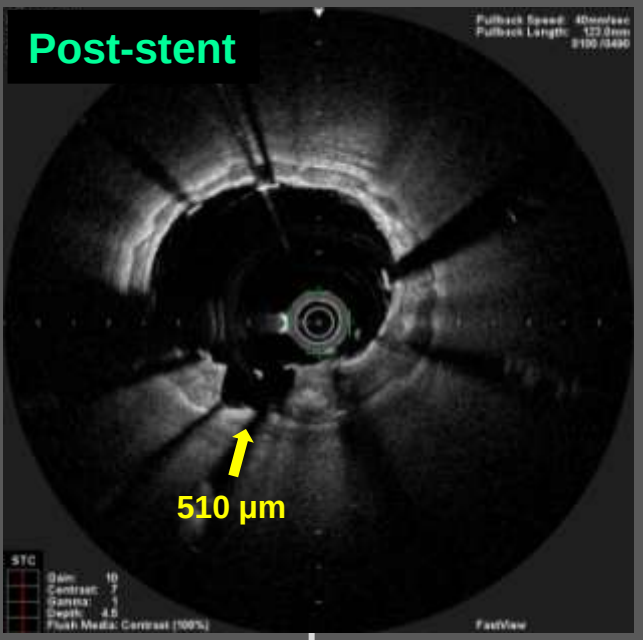

Post-stent

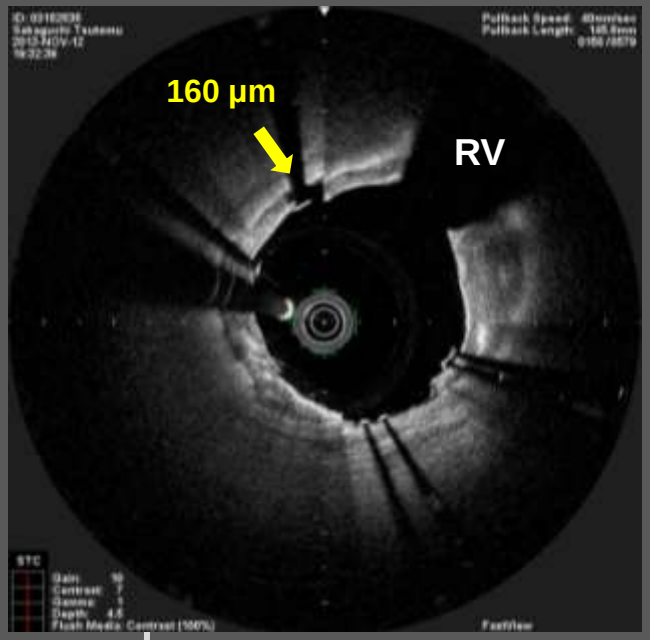

Post-Stent
2013-NOV-12
19:32:39
Pullback Speed: 40mm/sec
Pullback Length: 145.6mm
0001/0579
STC
Gain: 10
Contrast: 7
Gamma: 1
Depth: 4.5
Flush Media: Contrast (100%)
FastView

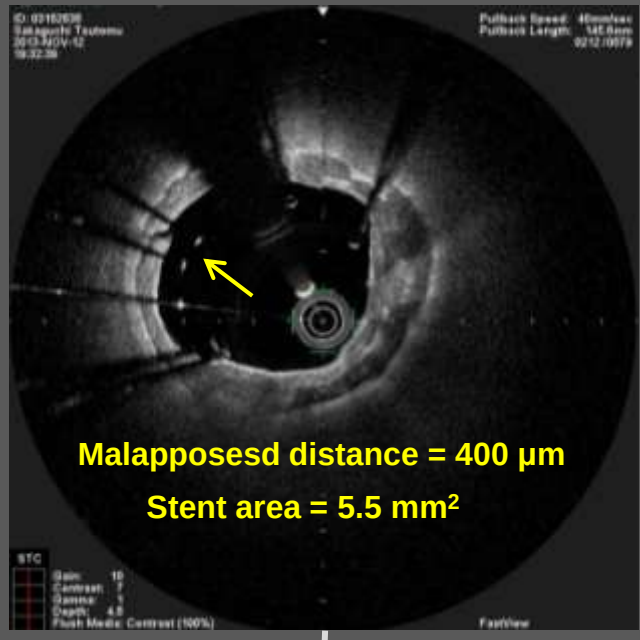
Broken calcium plate

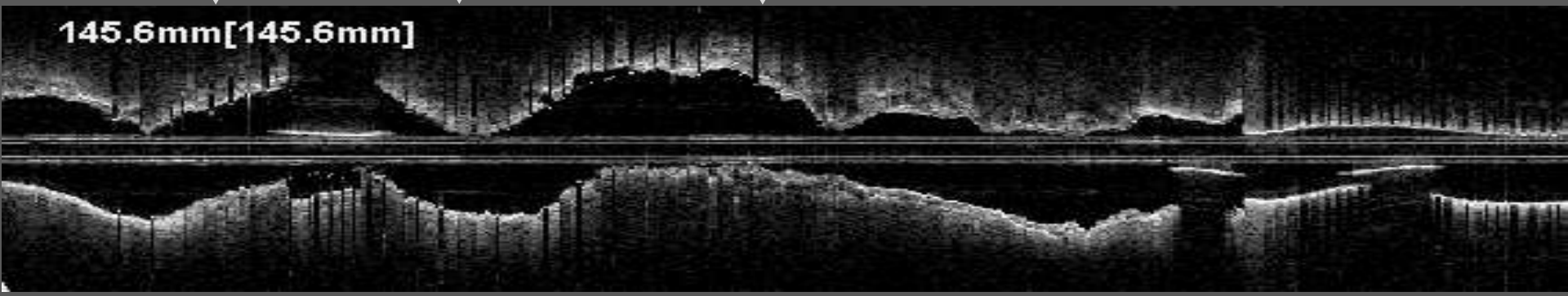
Broken calcium plate

Stent malappsoition



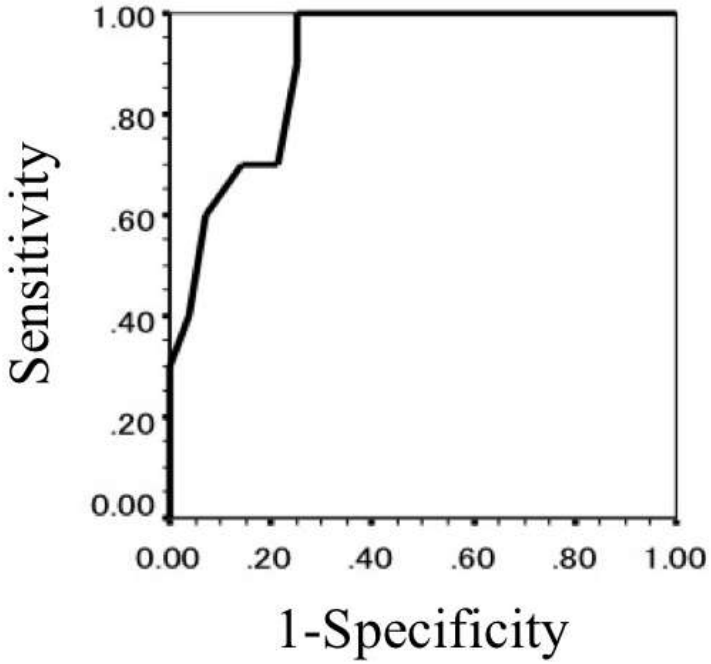






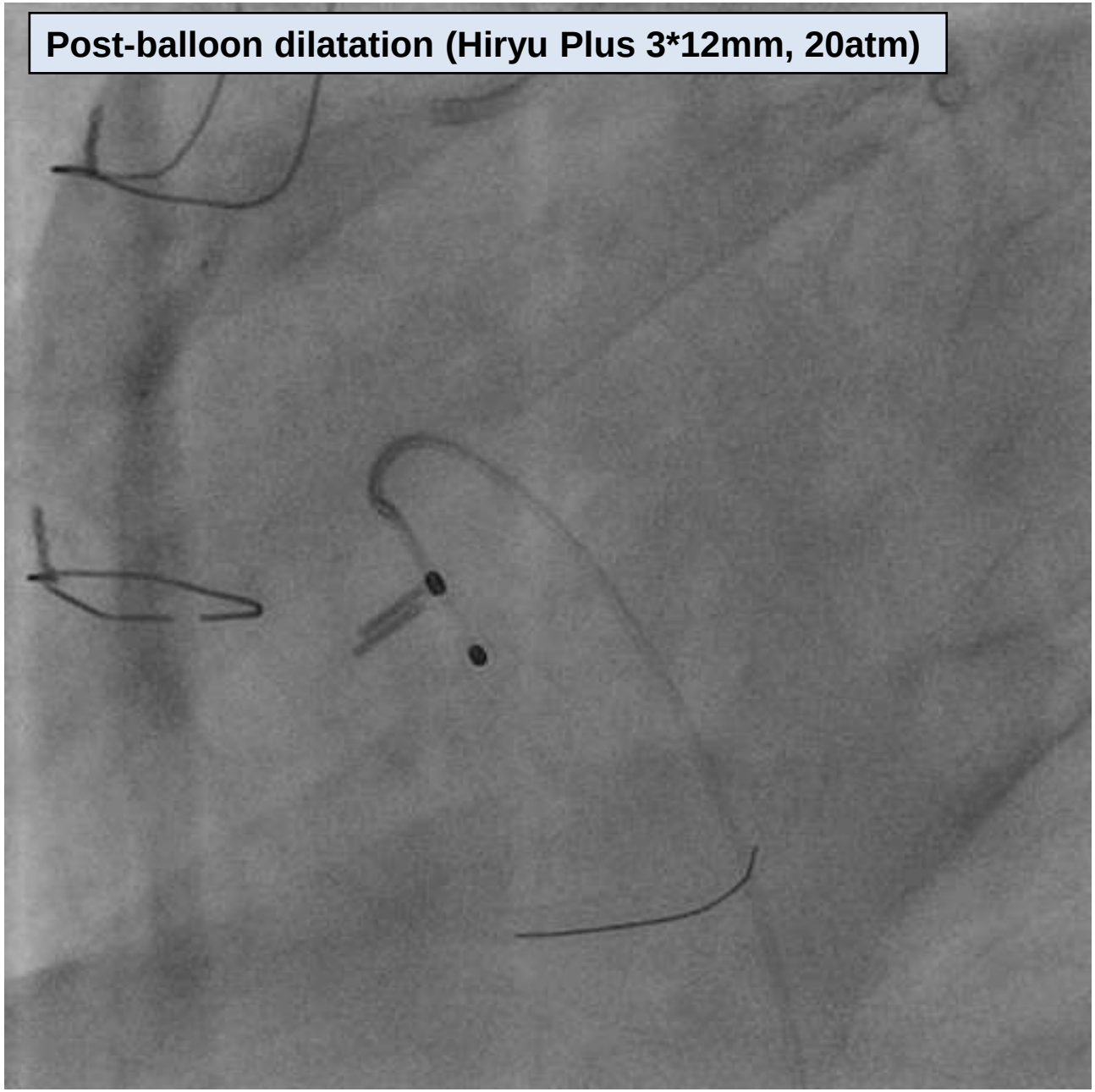
Resolution of stent malapposition in Xience

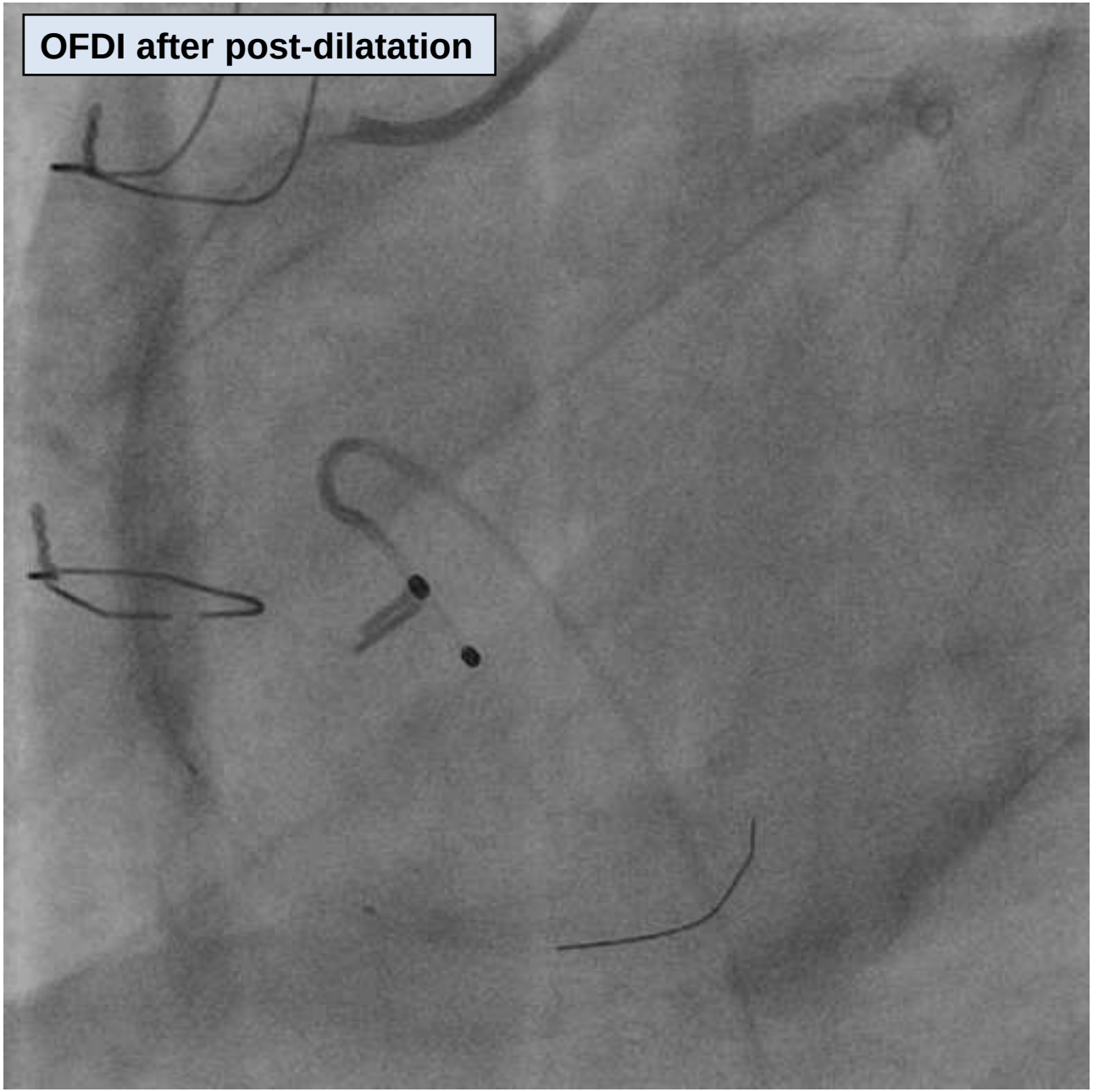
Serial OCT examination (post-stenting and 8-12 months follow-up) was performed to assess the change of stent malapposition of the 2nd generation EES.

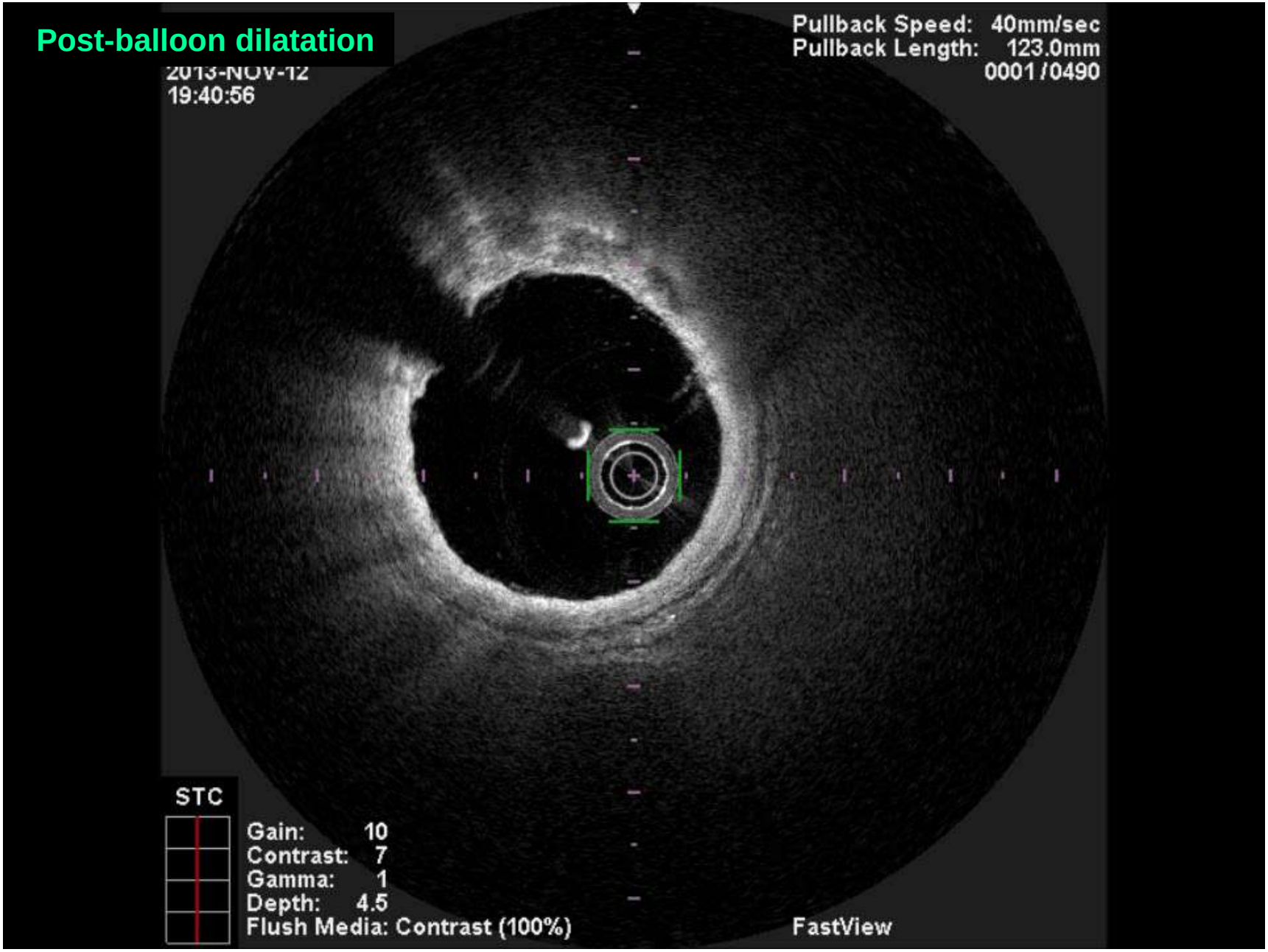


Cut-off value = 355μm
Sensitivity = 1.00
Specificity = 0.75

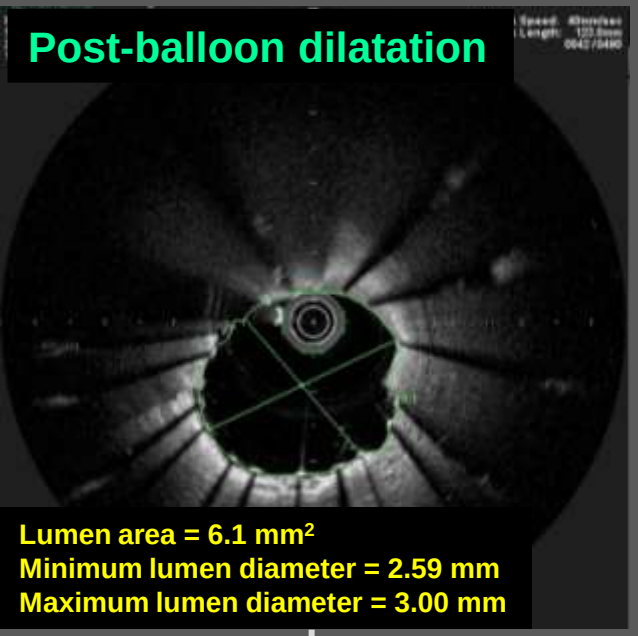
Conclusion. An S–V distance <355 μm was the corresponding cut-off value for a spontaneous resolution of malapposed strut after EES.


Post-balloon dilatation (Hiryu Plus 3*12mm, 20atm)

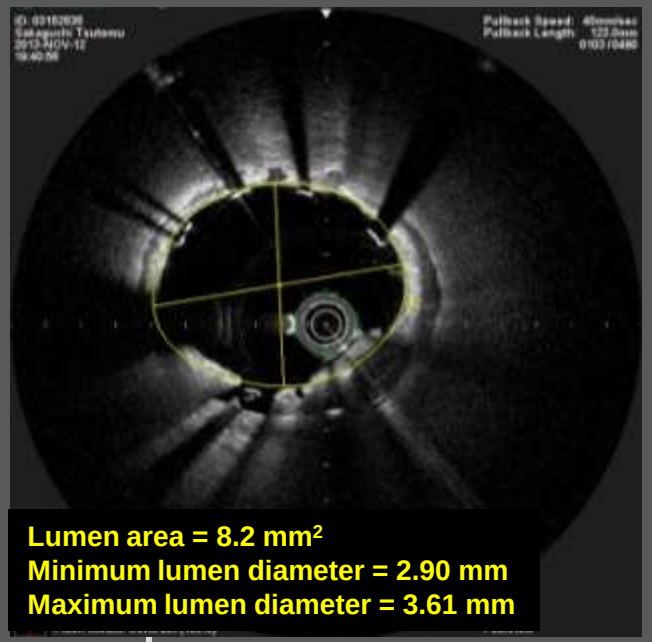

OFDI after post-dilatation


Post-balloon dilatation
Pullback Speed: 40mm/sec
Pullback Length: 123.0mm
0001 /0490
2013-NOV-12
19:40:56
STC
Gain: 10
Contrast: 7
Gamma: 1
Depth: 4.5
Flush Media: Contrast (100%)
FastView

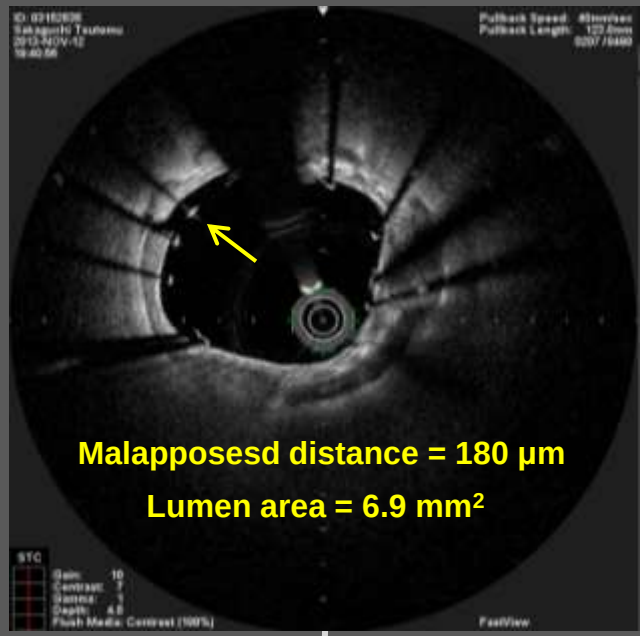
Minimum stent area site

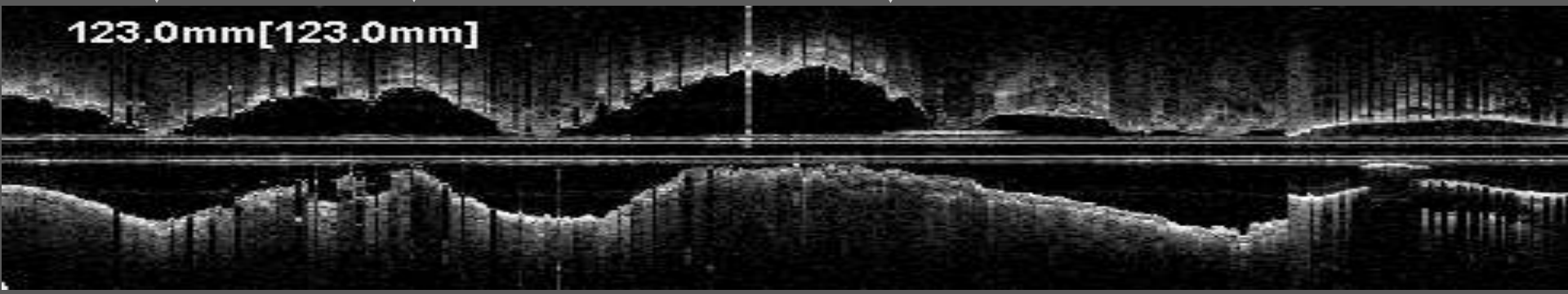


Maximum stent area site



Stent malapposition





Summary

- Unlike IVUS, OCT can visualize calcium location, thickness, arch, extent, and length.
- OCT allows us to assess the effects of lotablater atherectomy and high pressure ballooning in the calcified lesions.

Conclusion

- IVUS is the gold standard for guidance of PCI.
- OCT will catch up with IVUS soon.


FIN