

Fusion Tools for Bifurcation PCI; FFR, IVUS, or OCT - When and How?



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Bifurcation PCI

Wakayama Medical University





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

- **Grant/Research Support** : Abbott Vascular Japan
Boston Scientific Japan
Goodman Inc.
St. Jude Medical Japan
Terumo Inc.
- **Consulting Fees/Honoraria** : Daiichi-Sankyo Pharmaceutical Inc.
Goodman Inc.
St. Jude Medical Japan
Terumo Inc.



PCI for bifurcation lesions

- **Bifurcation lesion PCI might be 15-20% of all PCI cases in daily clinical practice, and complex procedure might be required sometimes.**

Lefevre T et al. Catheter Cardiovasc Interv 2000; 49:274–283.
Iakovou I et al. J Am Coll Cardiol 2005; 46:1446–1455.

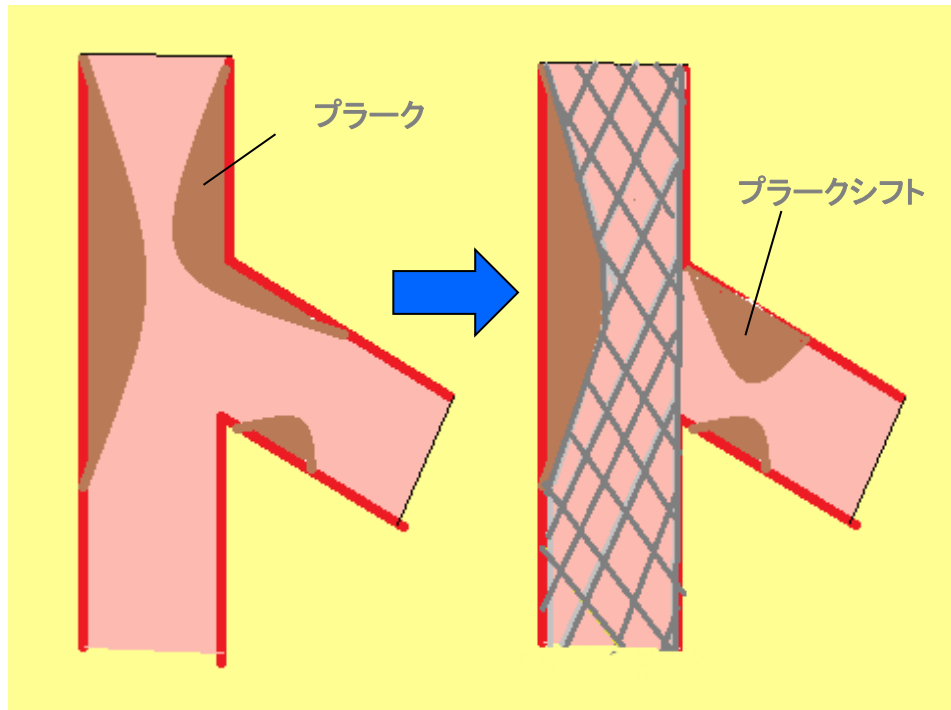
- **Higher risk for complications such as side branch occlusion, stent thrombosis, restenosis, etc. has been reported more frequently in bifurcation lesion PCI.**

Iakovou I et al. Jama 2005; 293 : 2126-2130.
Colombo A et al. Circulation 2004; 109 : 1244-1249.

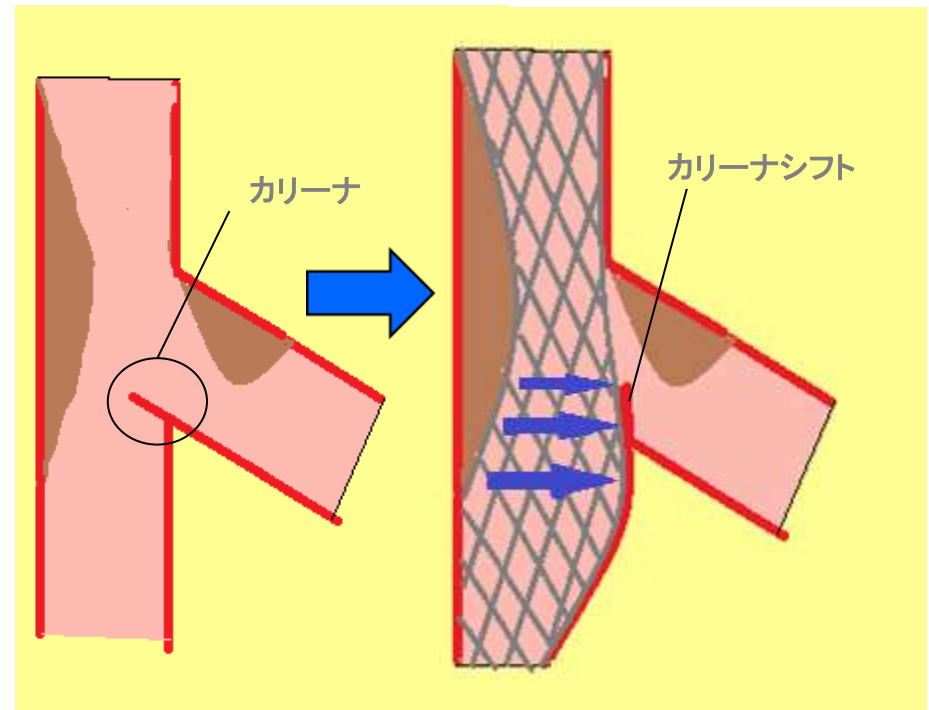


Mechanism of side branch occlusion after stenting

Although plaque shift, carina shift, side branch dissection, spasm, thrombus formation, etc. have been proposed as the cause of side branch occlusion, **plaque shift** and **carina shift** are thought to be main mechanisms of side branch occlusion .



Plaque shift



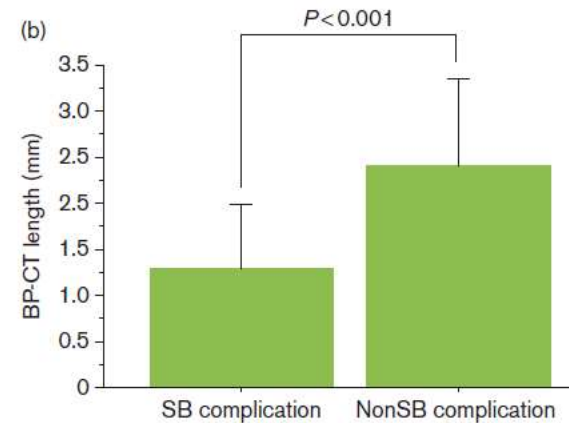
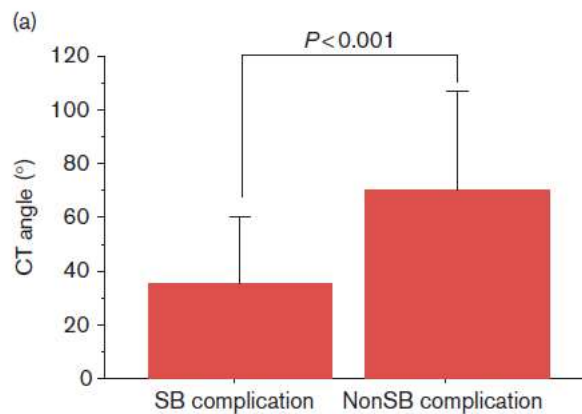
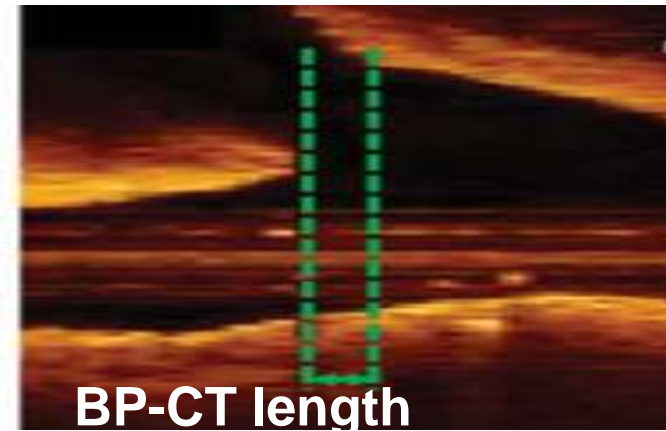
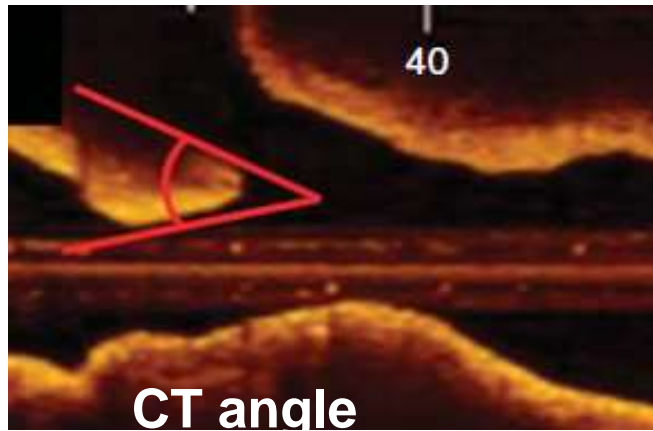
Carina shift



Prediction of side branch occlusion by OCT

Watanabe M et al. Coron Artery Dis 2014; 25: 321-329

Side branch occlusion might be occurred less frequently in cases with carina tip (CT) angle ≥ 50 degree and branch point to carina tip (BP-CT) length ≥ 1.7 mm



New Development in OCT



Re-crossing wire position in the jailed side branch can be easily identified by newly developed OCT software and improvement of side branch KBT procedure could be expected by the guidance of new OCT.



Case 85y.o., Male

Clinical Diagnosis

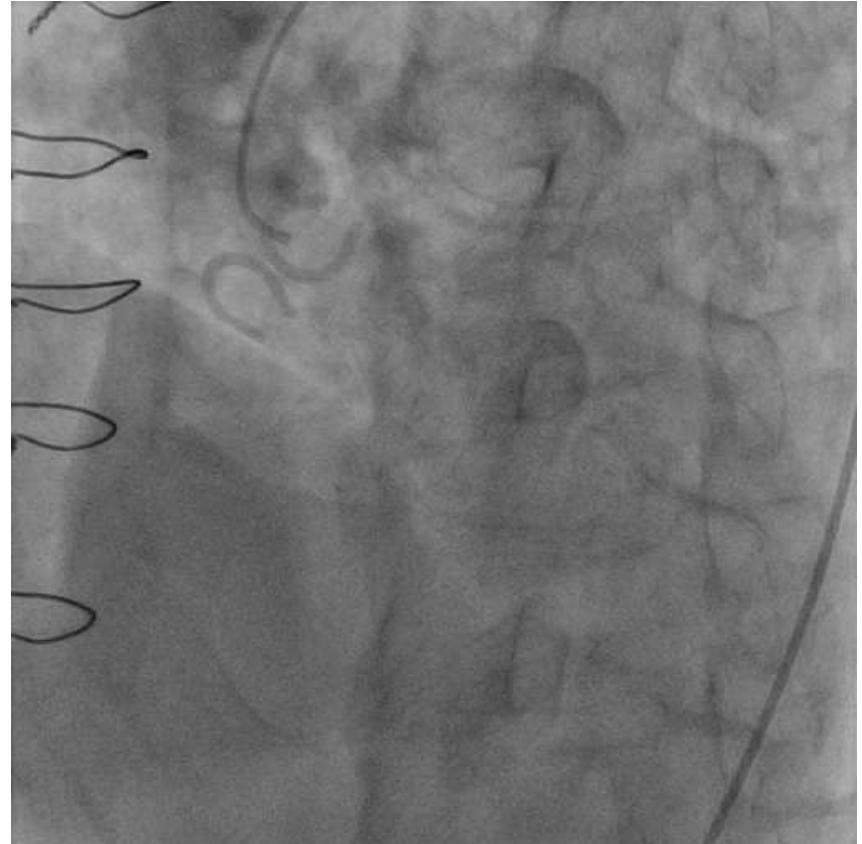
Effort AP

History

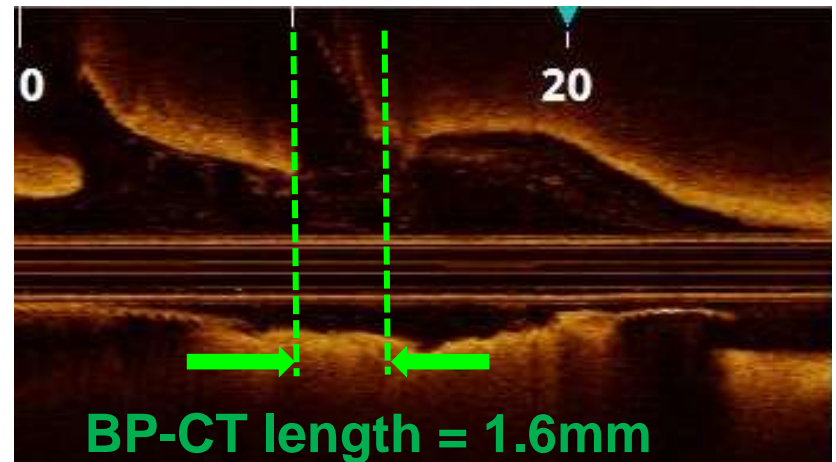
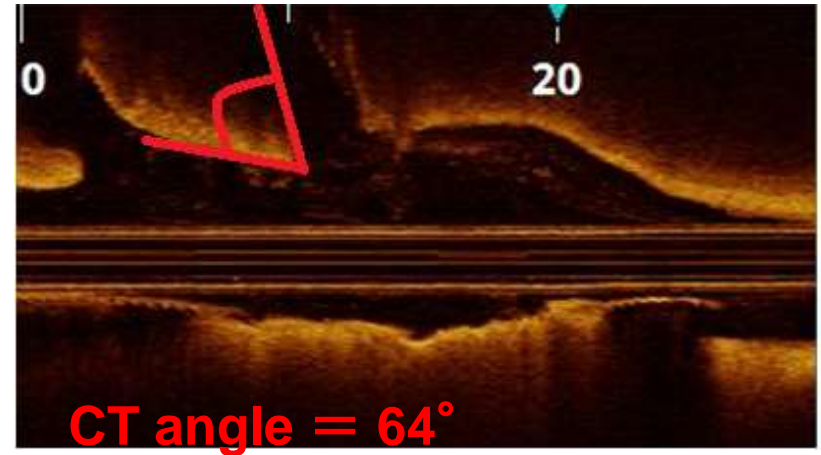
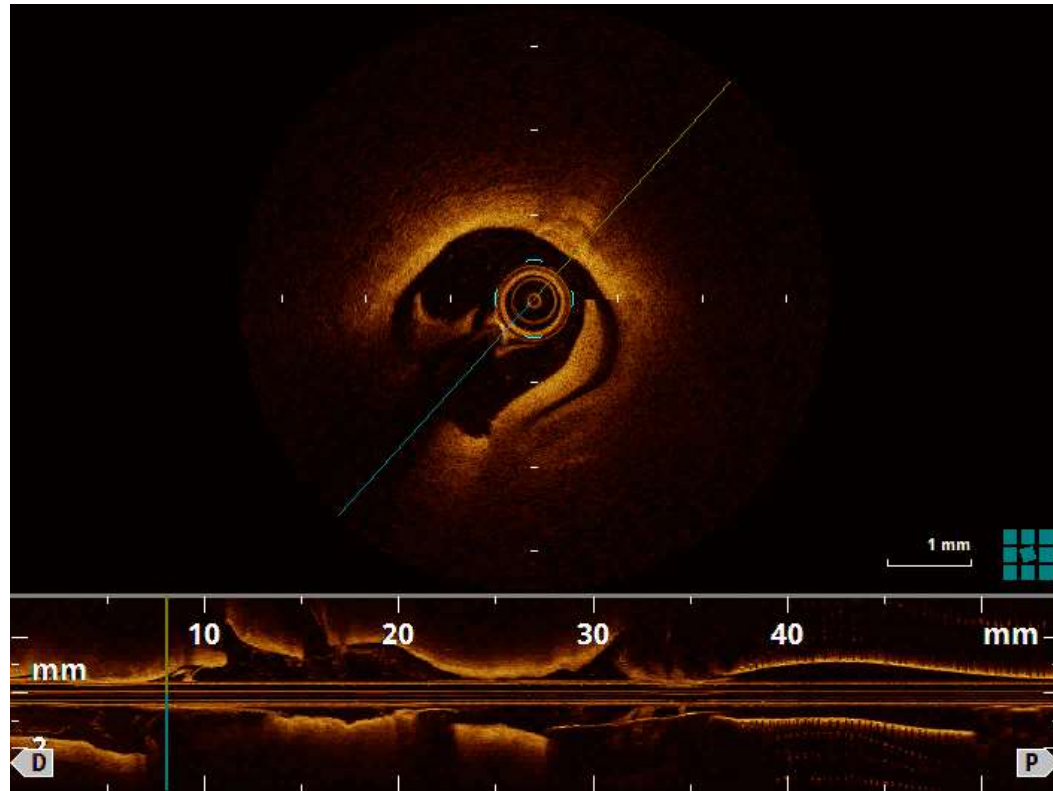
- 2012: CABG (SVG-LAD, SVG-DG) for unstable AP**
- 2014: Graft (SVG to LAD) stenosis by MDCT.**
- 2016: Effort AP for 2-5 min during exercise**



Coronary Angiography

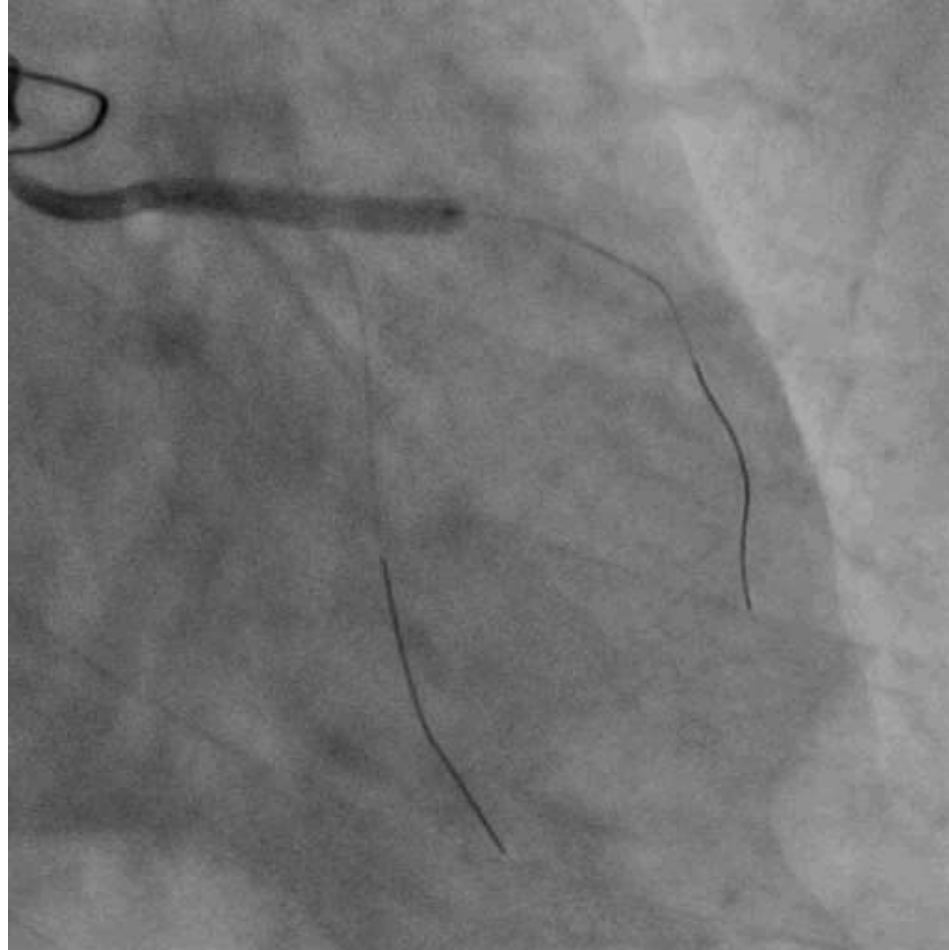


OCT before bifurcation stenting

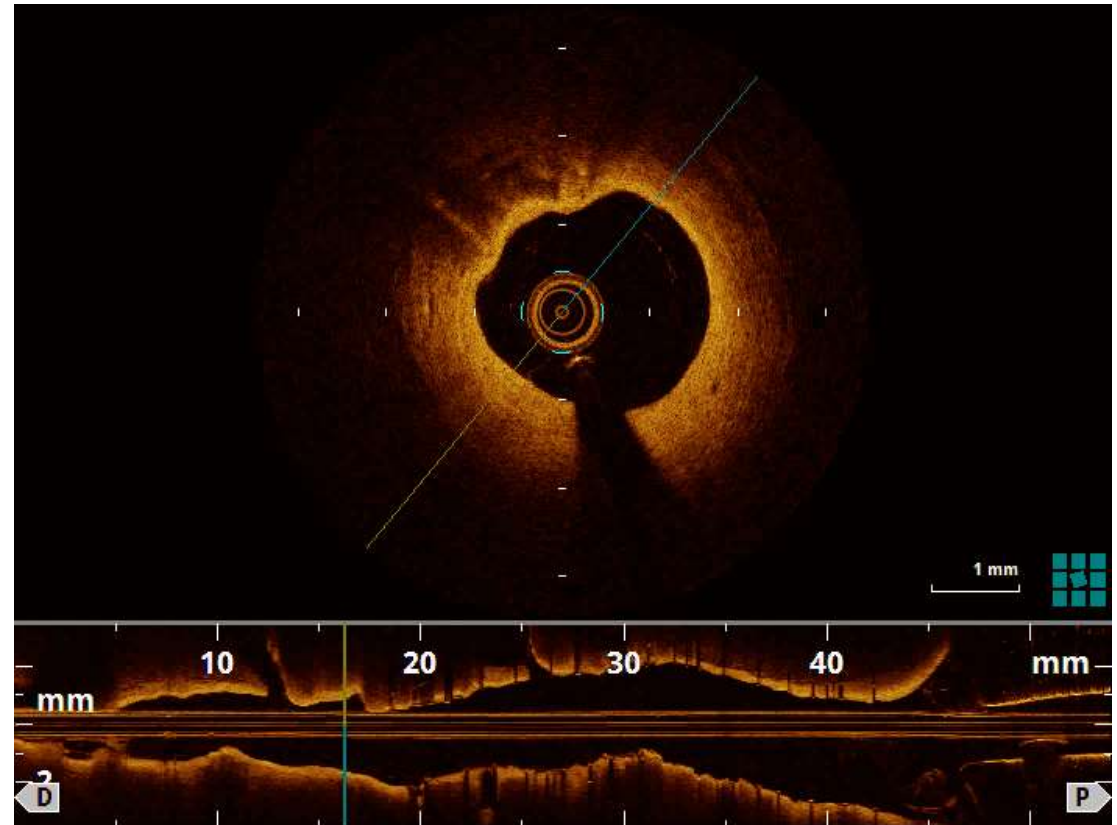
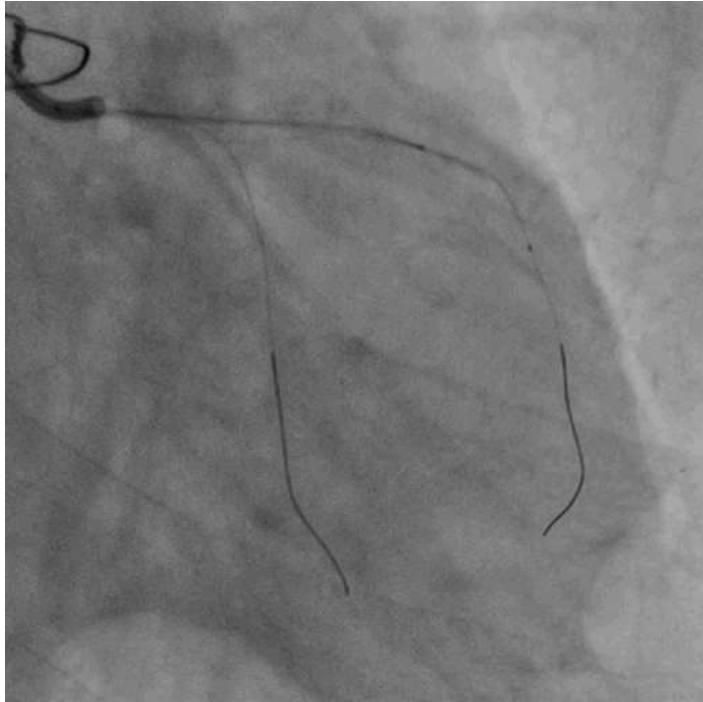


Bifurcation stenting

Xience Alpine 3.5 × 23mm



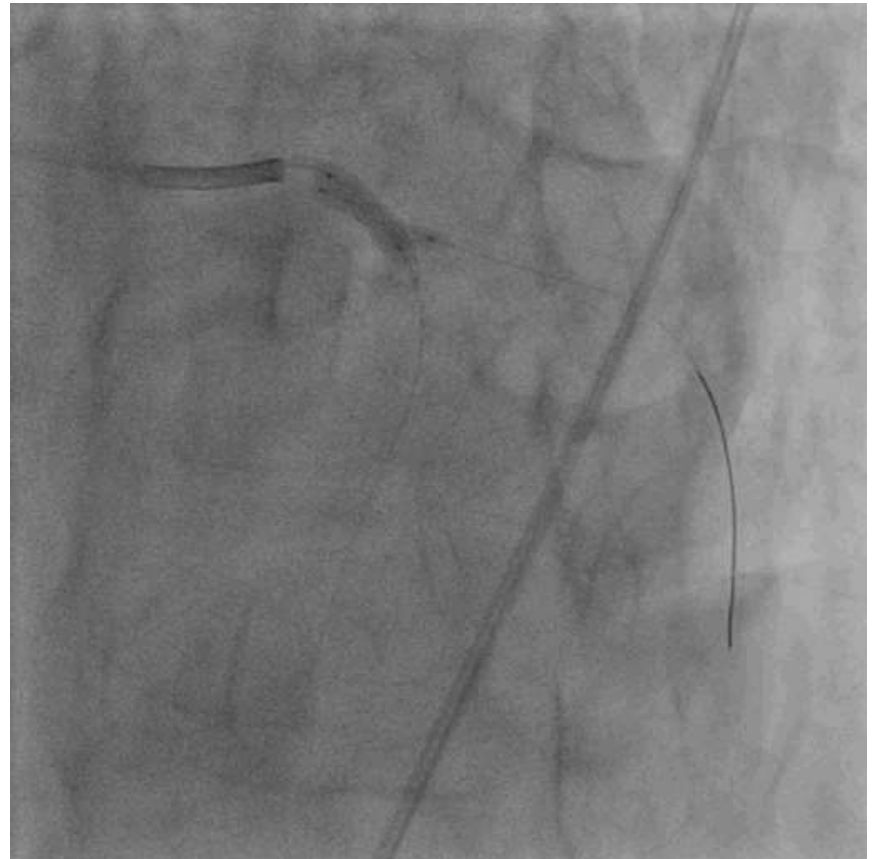
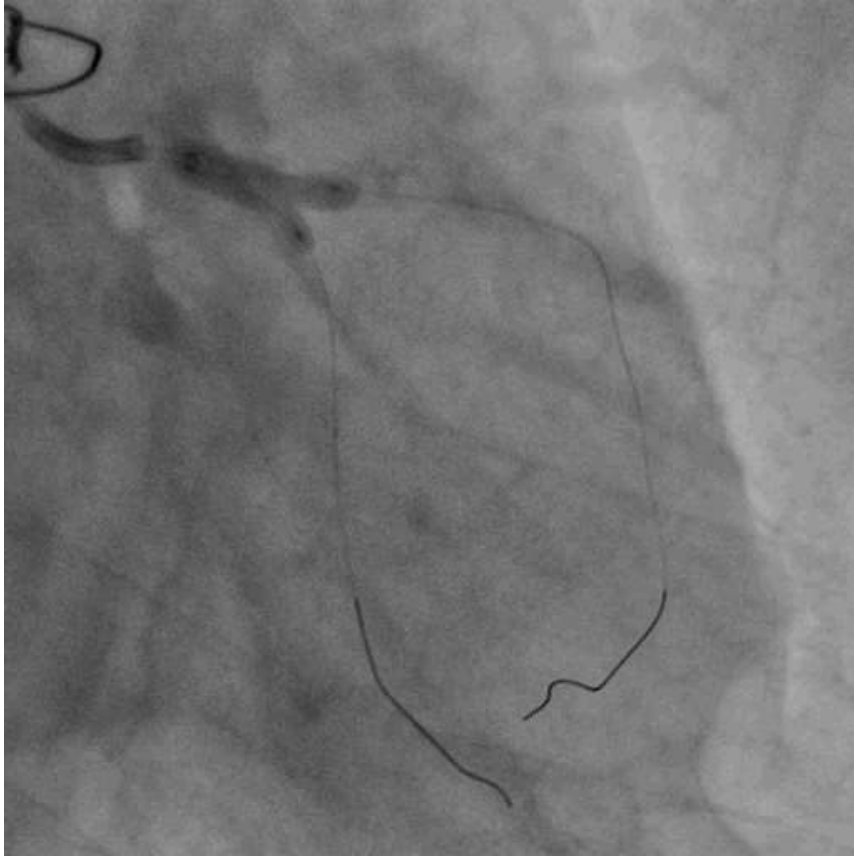
OCT after bifurcation stenting



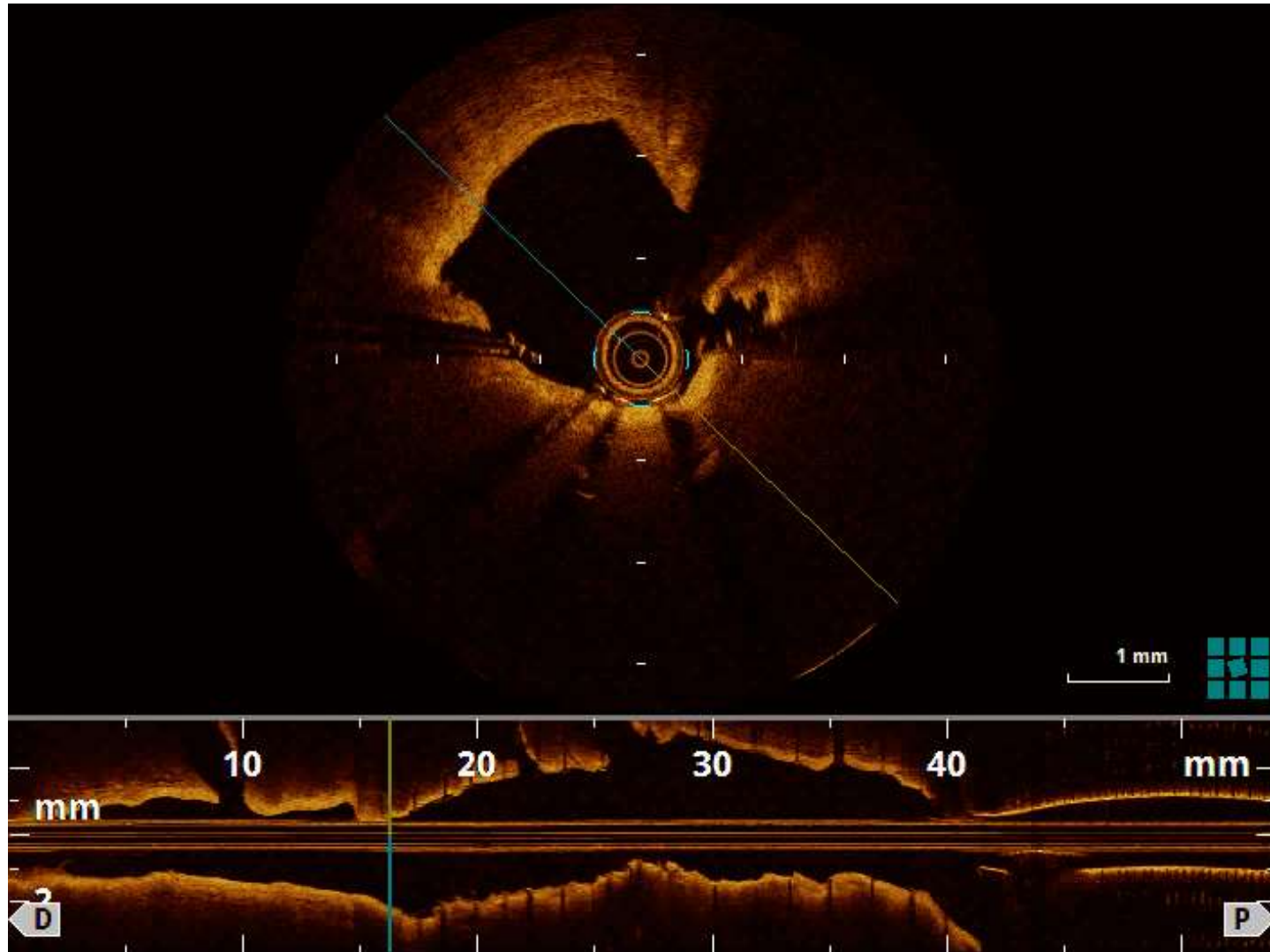
3D- OCT after re-wiring to the LCx



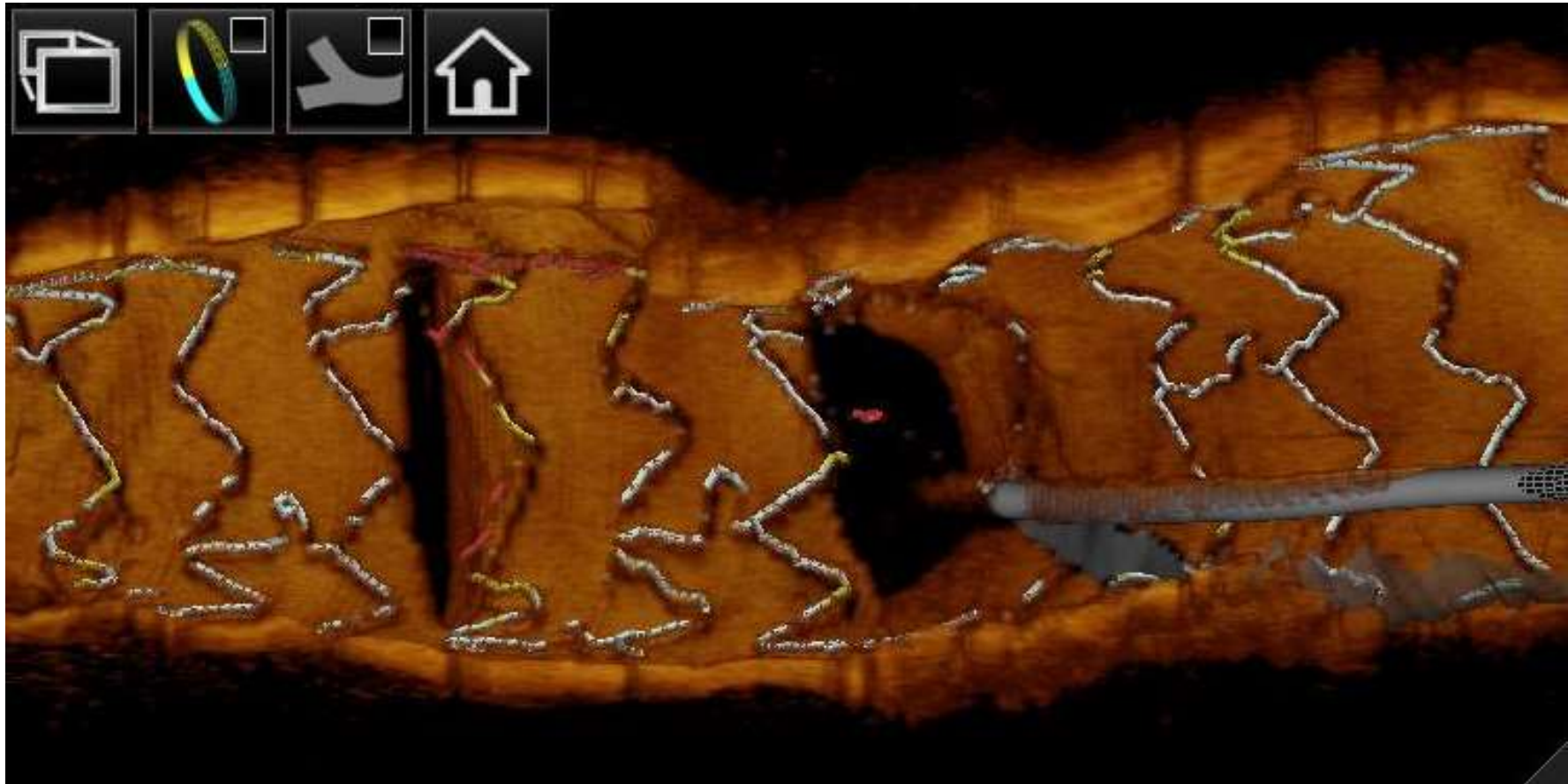
KBT



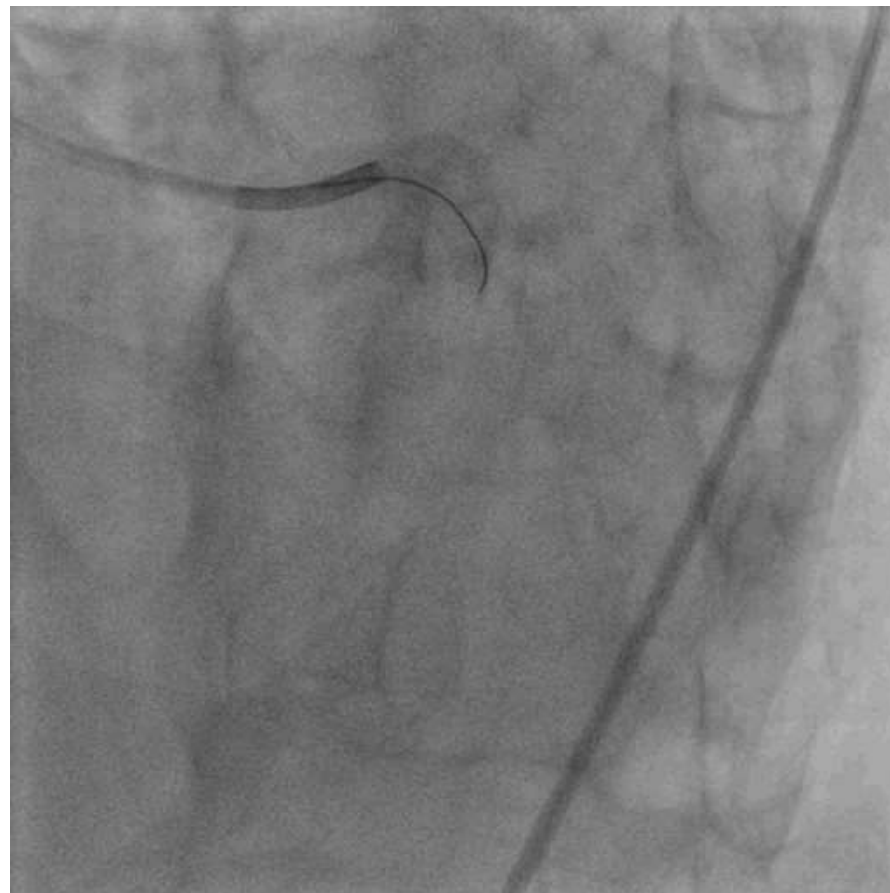
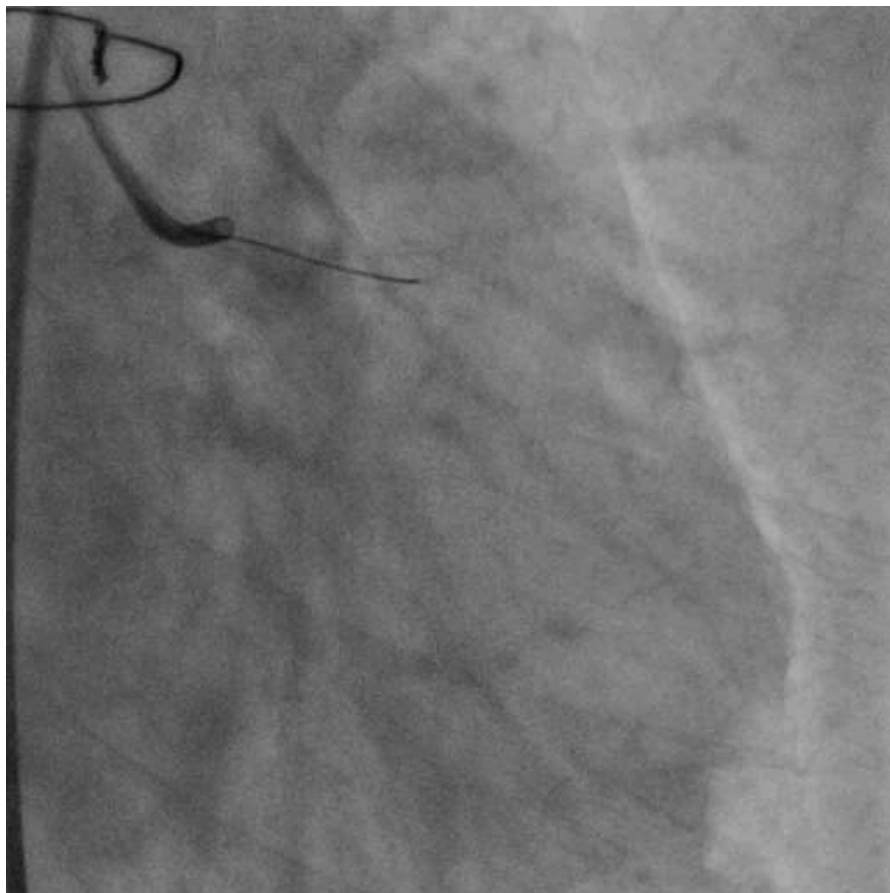
OCT after KBT



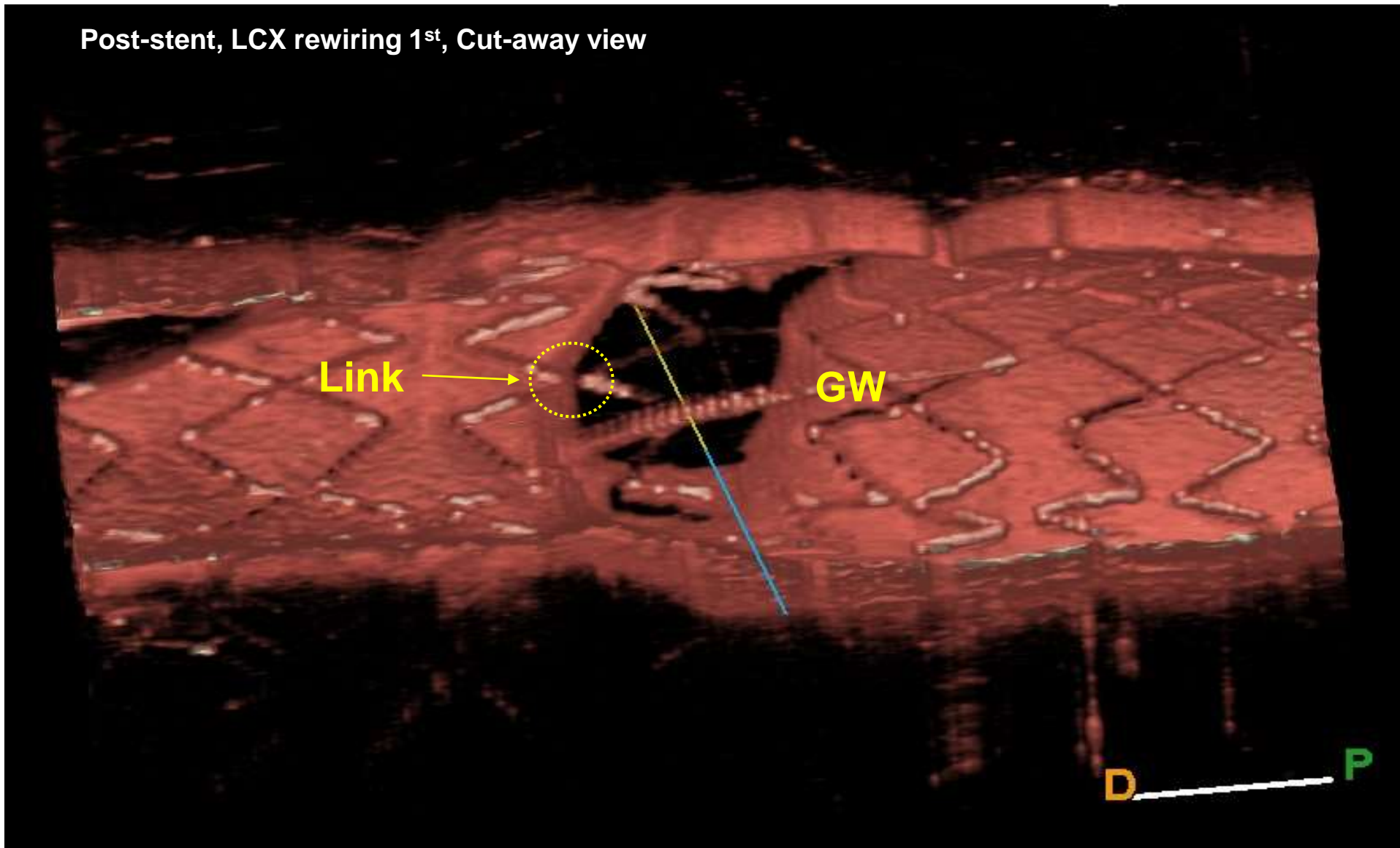
3D-OCT after KBT



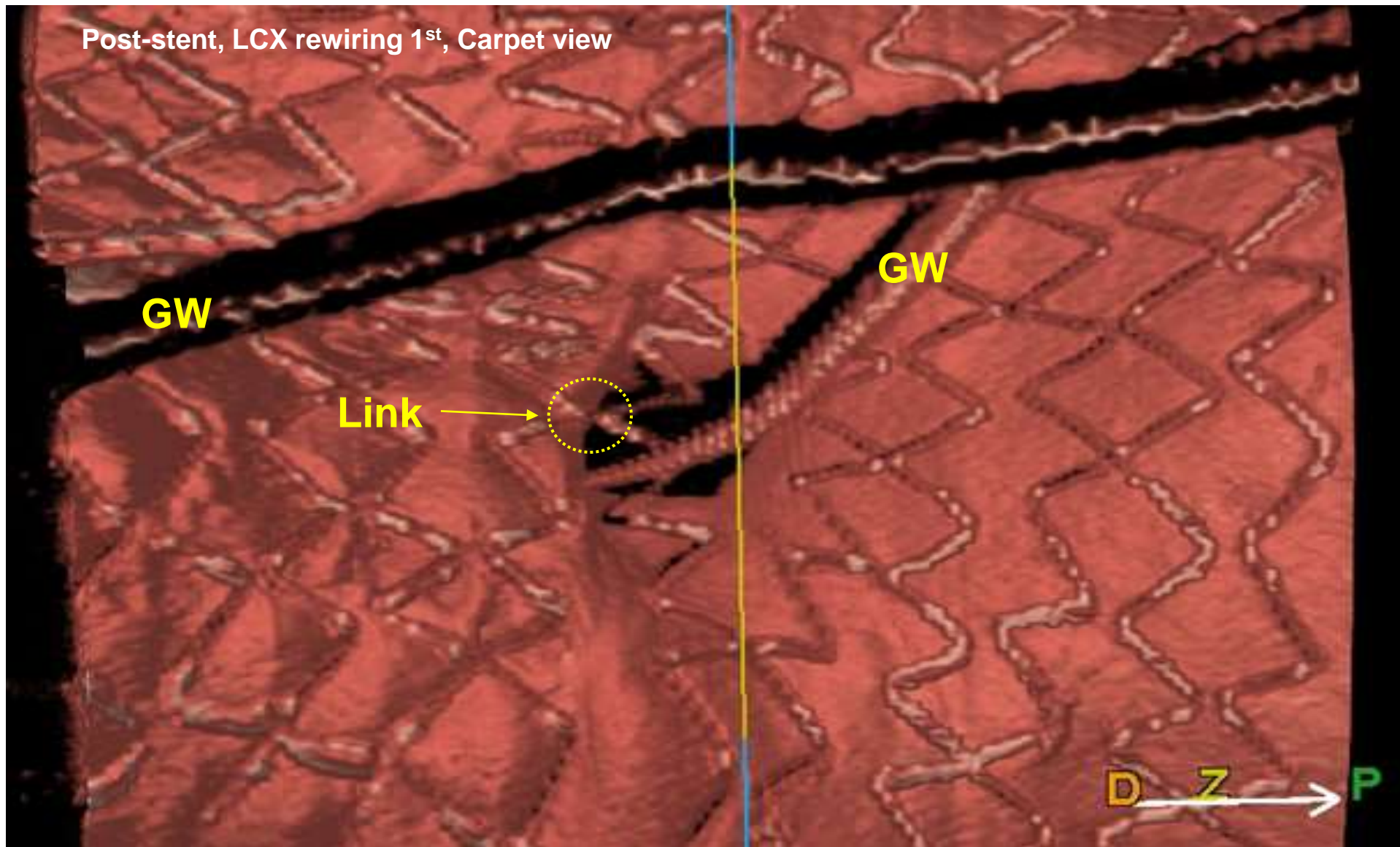
Final Angio

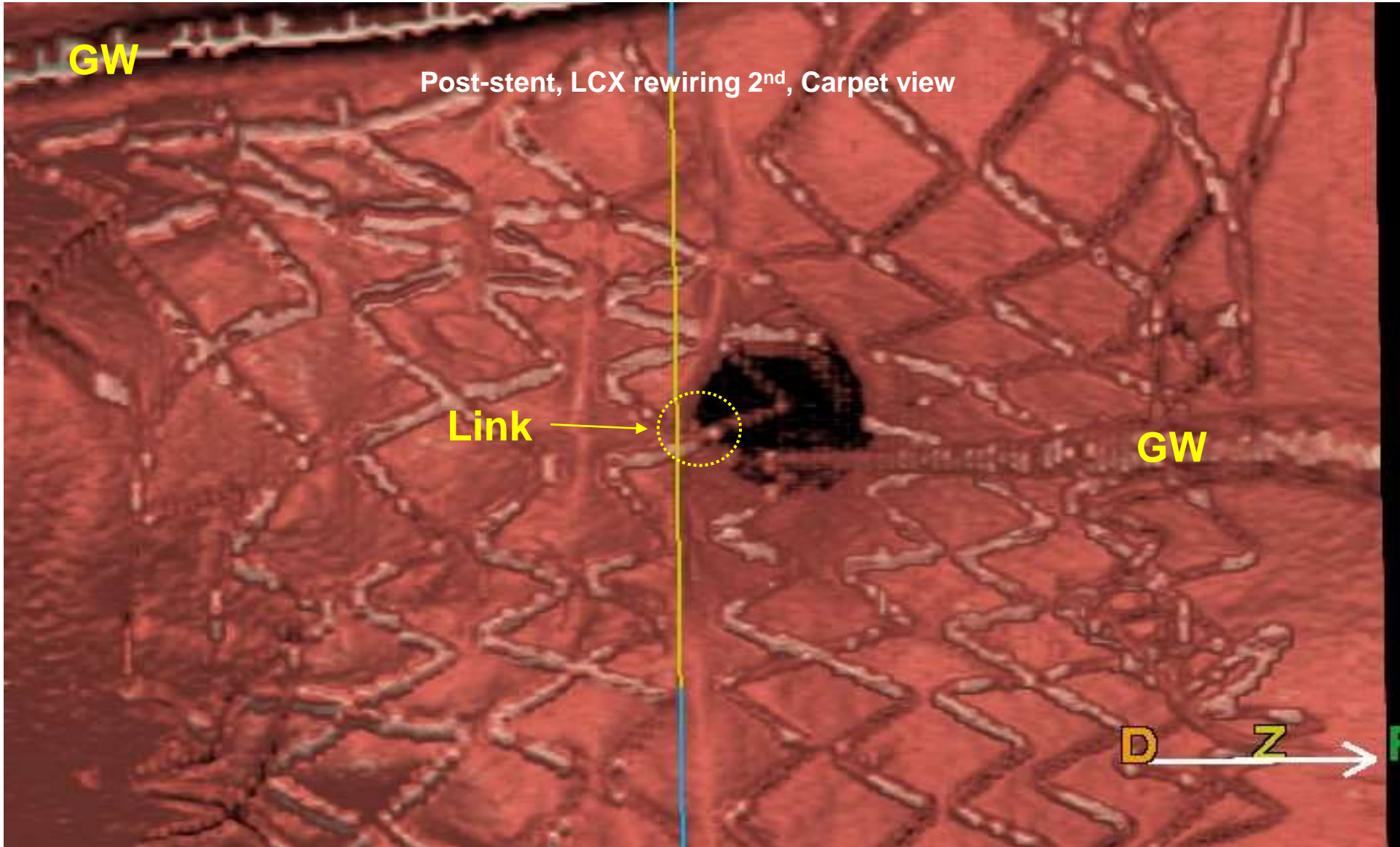


Post-stent, LCX rewiring 1st, Cut-away view



Post-stent, LCX rewiring 1st, Carpet view





3D optical coherence tomography: new insights into the process of optimal rewiring of side branches during bifurcational stenting

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Javaid Iqbal², MRCP

Takao Maeda¹, MD;

Patrick W. Serruys^{2,1}

Abstract

Aims: We describe three-dimensional optical coherence tomography (3D-OCT) guided bifurcation stenting and the clinical utility of 3D-OCT.

*1. Division of Cardiology
Ube, Japan; 2. Thoraxc*

T. Okamura and Y. Onu

GUEST EDITOR: Carl
Brompton Hospital, Lon

Methods and results: Twenty-two consecutive patients who underwent OCT examination to confirm the recrossing position after stent implantation in a bifurcation lesion were enrolled. Frequency domain OCT images were obtained to check the recrossing position and 3D reconstructions were performed off-line. The recrossing position was clearly visualised in 18/22 (81.8%) cases. In 13 cases, serial 3D-OCT could be assessed both before and after final kissing balloon post-dilation (FKBD). We divided these cases into two groups according to the presence of the link between hoops at the carina: free carina type (n=7) and connecting to carina type (n=6). All free carina types complied with the distal rewiring. The percentage of incomplete stent apposition (%ISA) of free carina type at the bifurcation segment after FKBD was significantly smaller than that of the connecting to carina type ($0.7\pm 0.9\%$ vs. $12.2\pm 6.5\%$, $p=0.0074$).

Conclusions: 3D-OCT confirmation of the recrossing into the jailed side branch is feasible during PCI and may help to achieve distal rewiring and favourable stent positioning against the side branch ostium leading to reduction in ISA and potentially better clinical outcomes.



Japanese registry for 3-D OCT guided LM bifurcation stenting

Study population

More than 300 LM bifurcation lesions

Primary endpoint

Frequency of re-wiring by 3-D OCT guidance:
re-wiring should be required again more than 30 % cases.

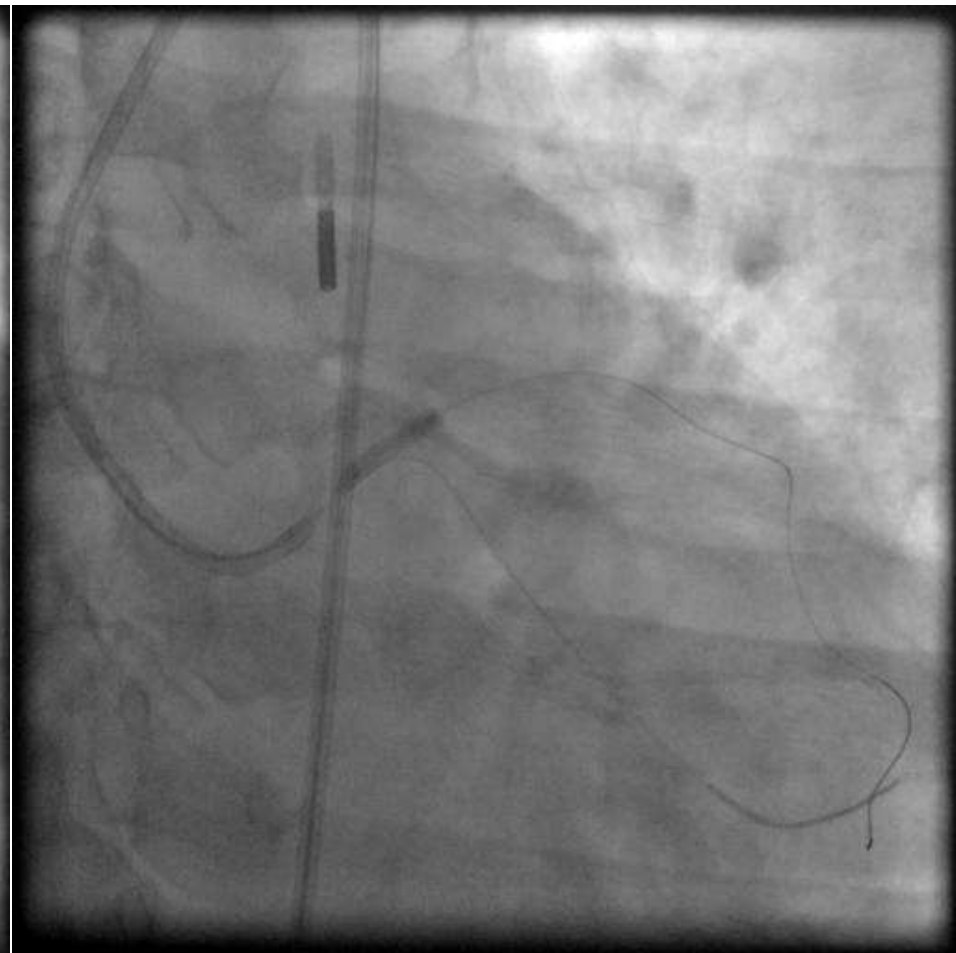
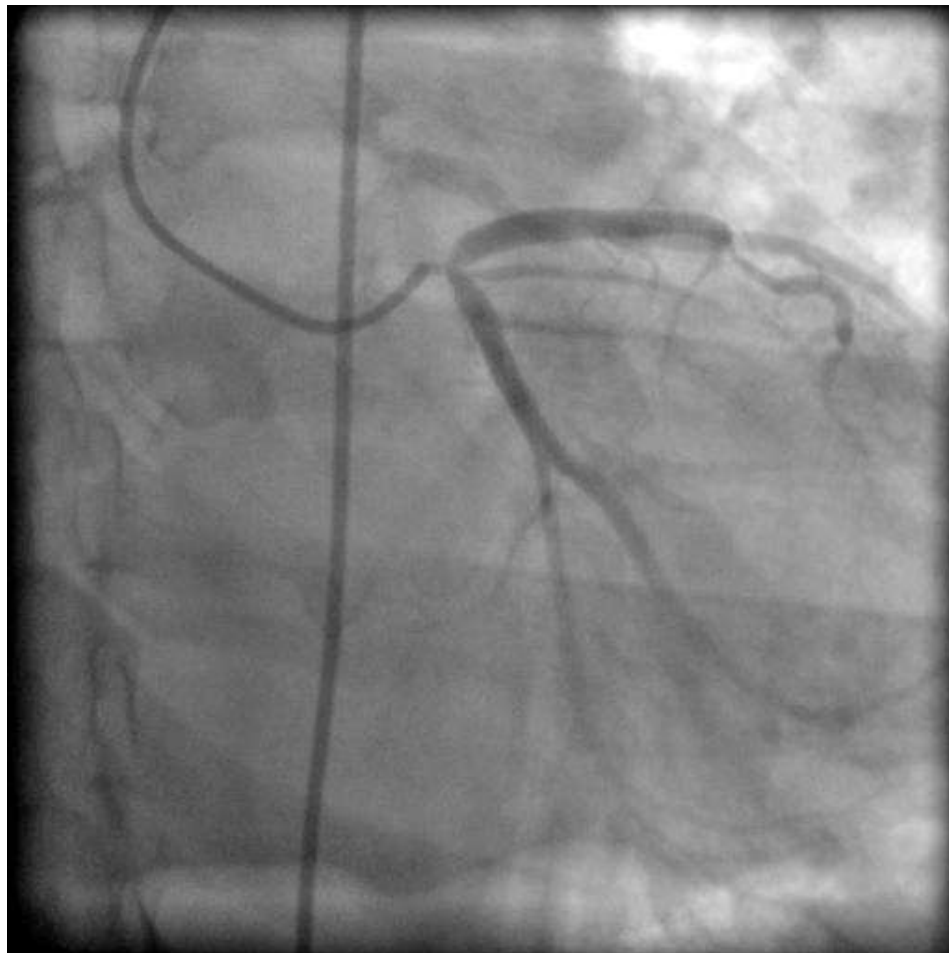
Secondary endpoint

Incidence of ISA:
MACE:

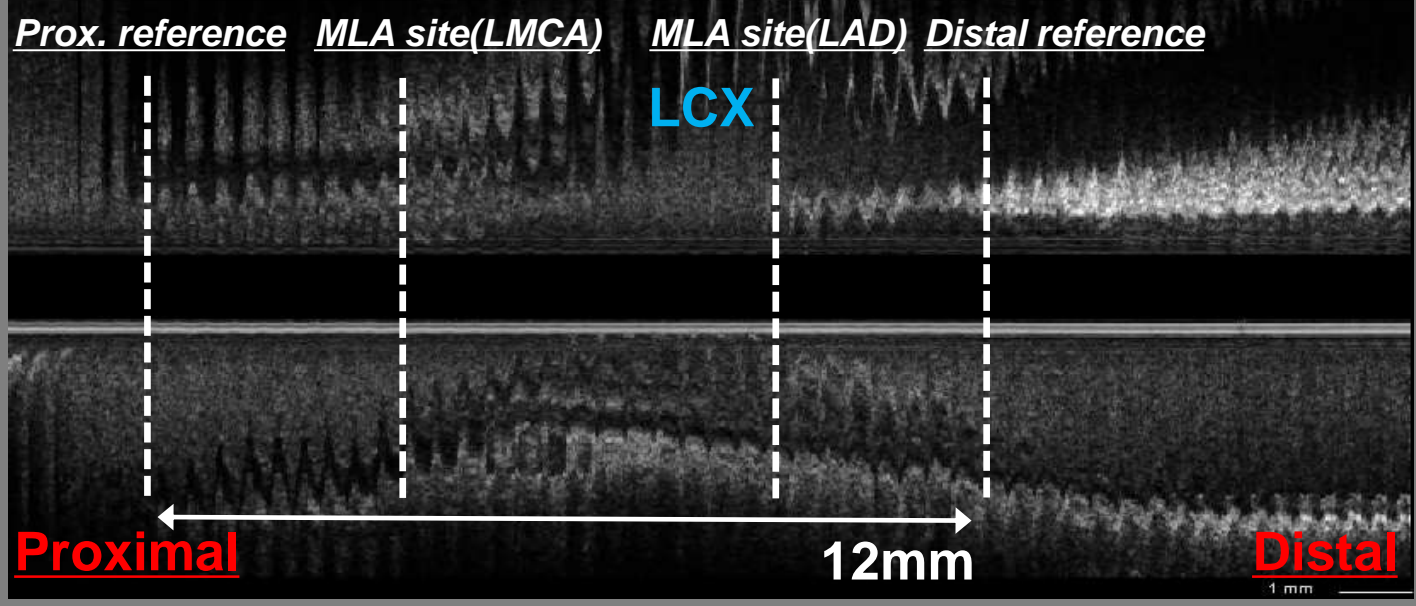
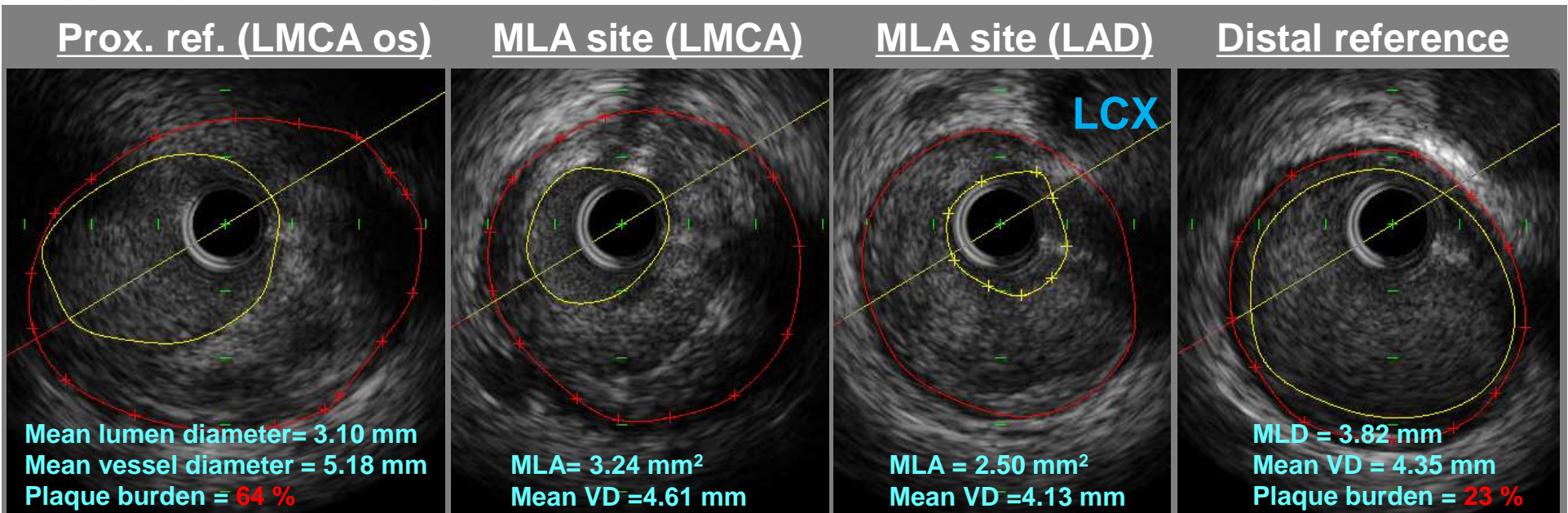


Control CAG

**Pre-dilatation
(Semi-compliant Balloon)
2.5x15mm, 12atm**



Post 2.5mm balloon

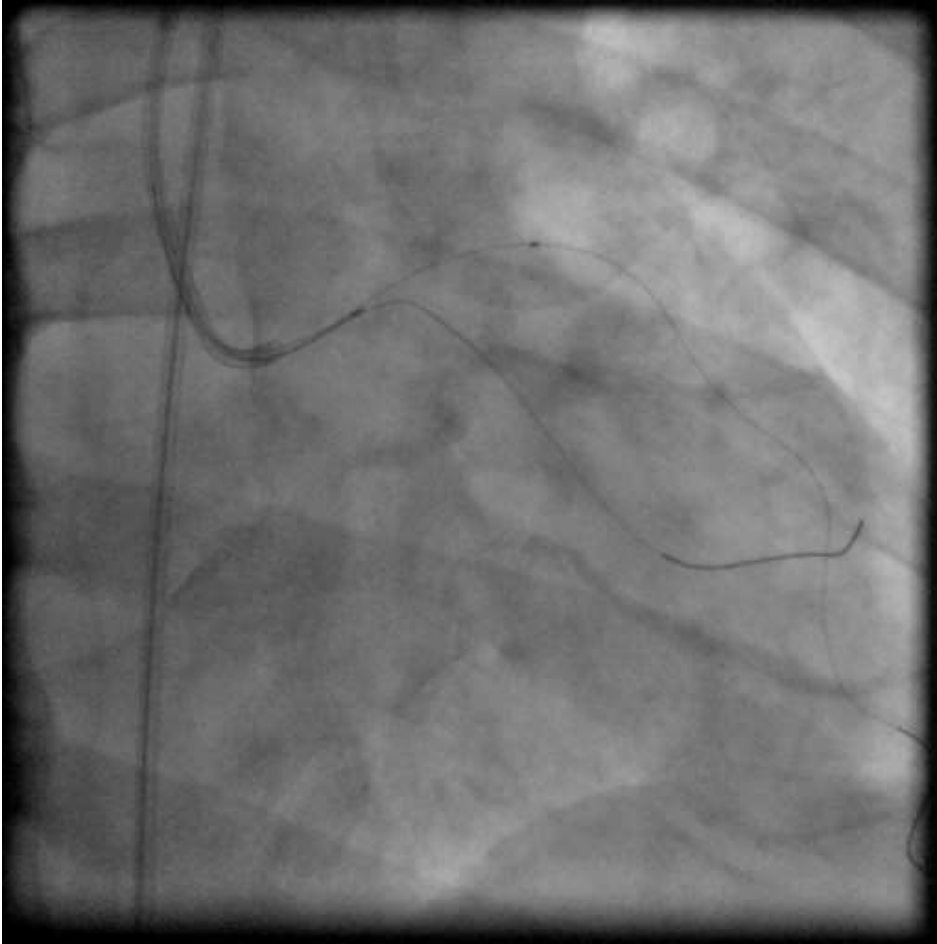


IVUS assessment

- Reference site
LAVA, Mean LD/VD
- MLA site
MLA/MLD



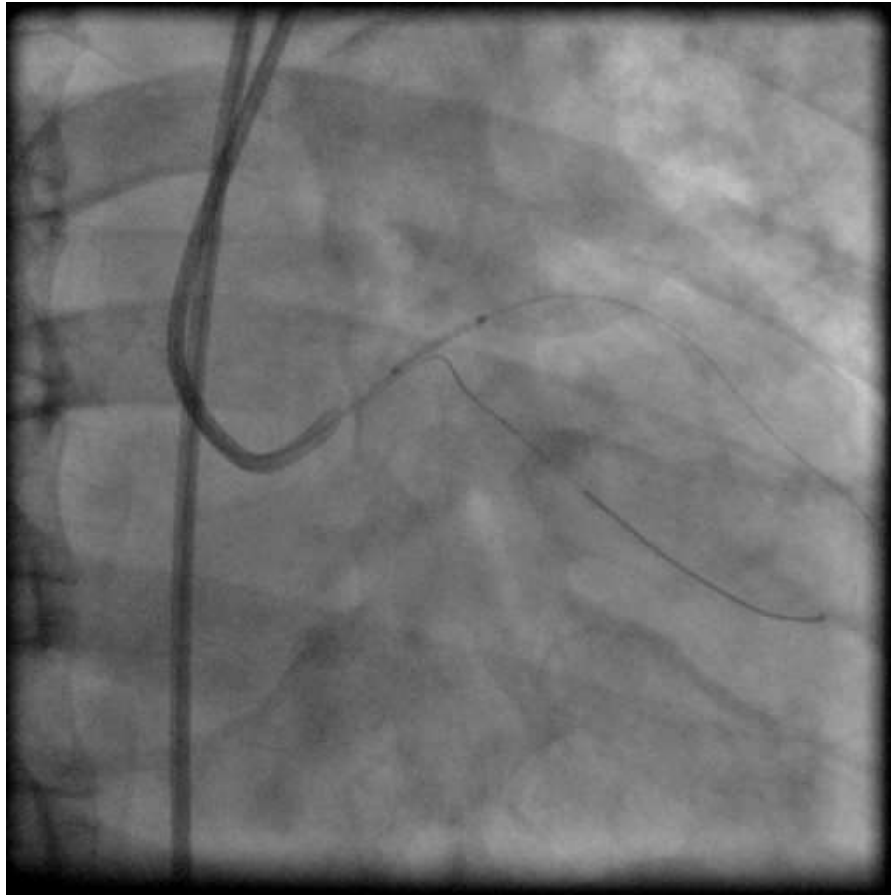
IVUS marking of LMCA ostium



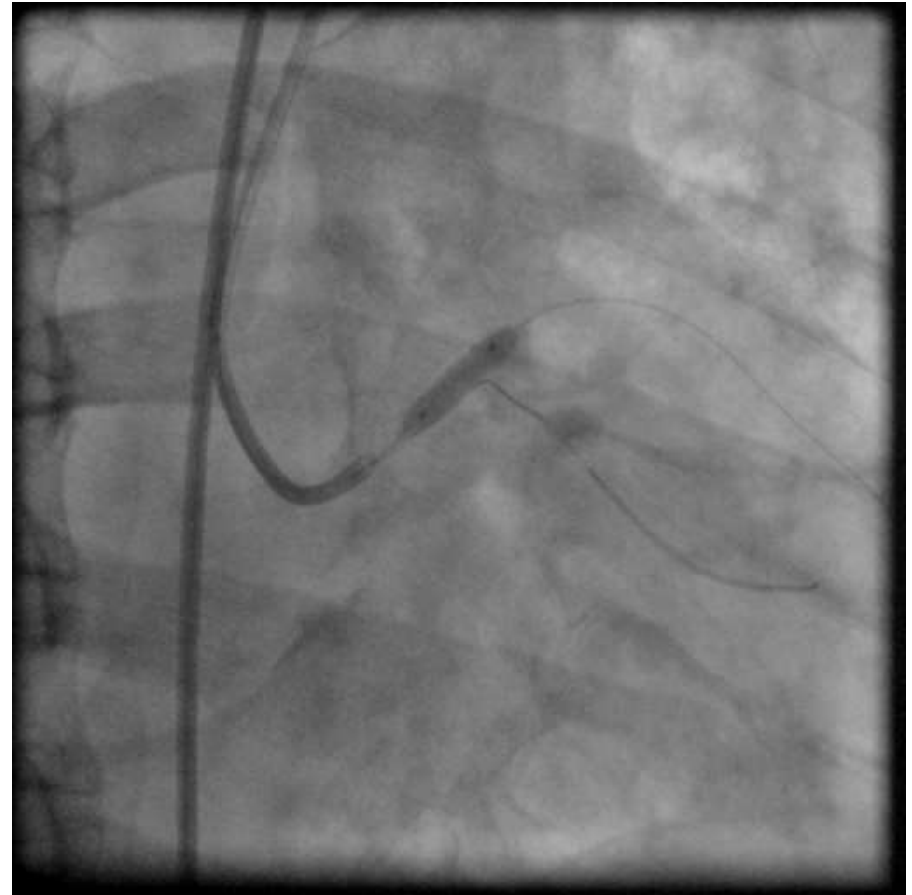
IVUS marking should be important to decide the stent delivery position.



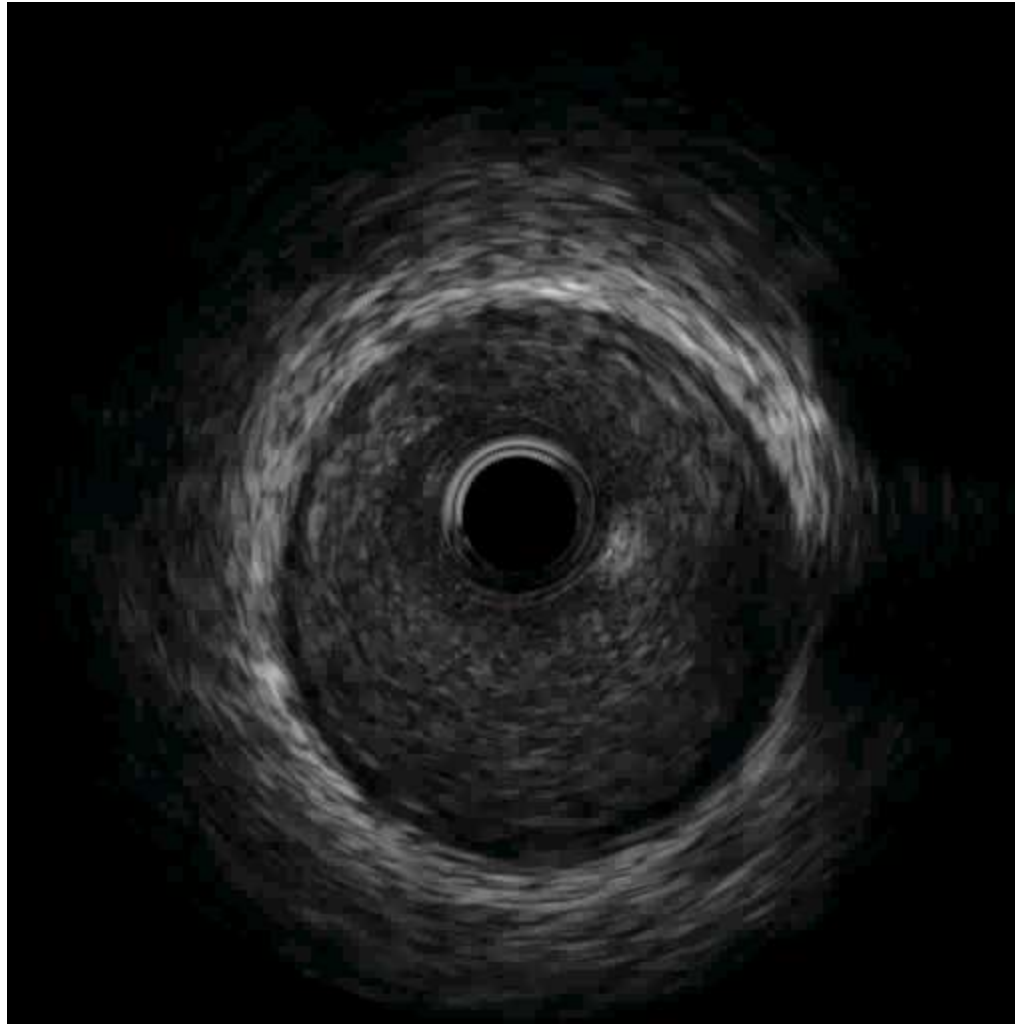
**Stent positioning
(EES 3.5 x 12mm)**



**Stent delivery
(EES 3.5 x 12mm, 14atm)**



IVUS after stent implantation



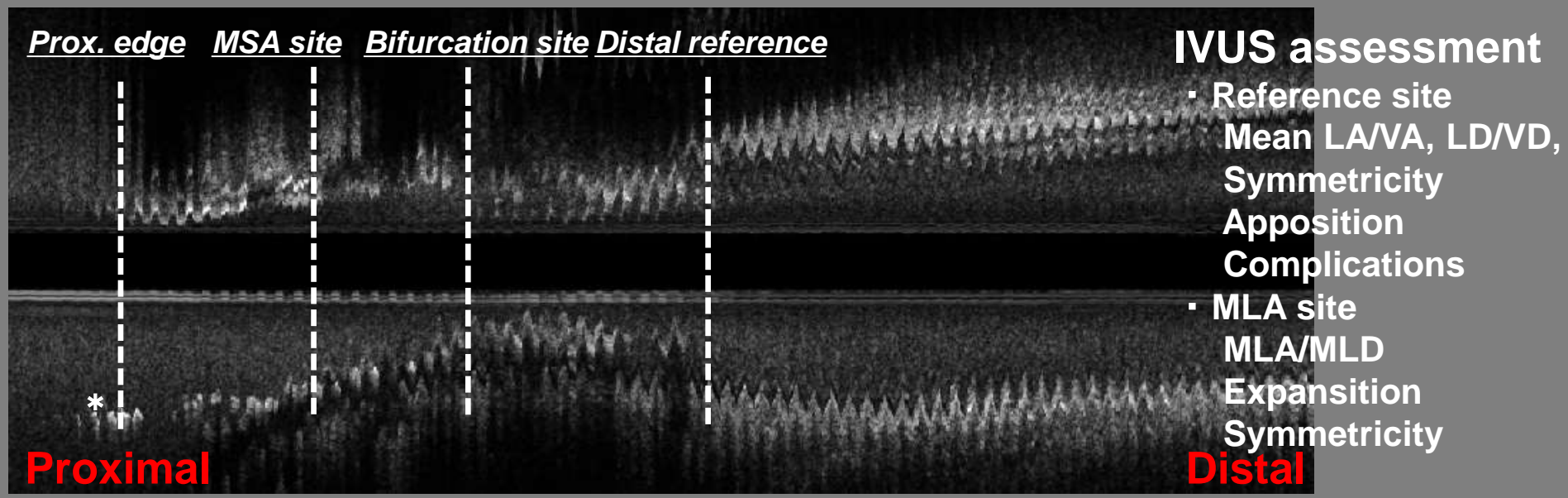
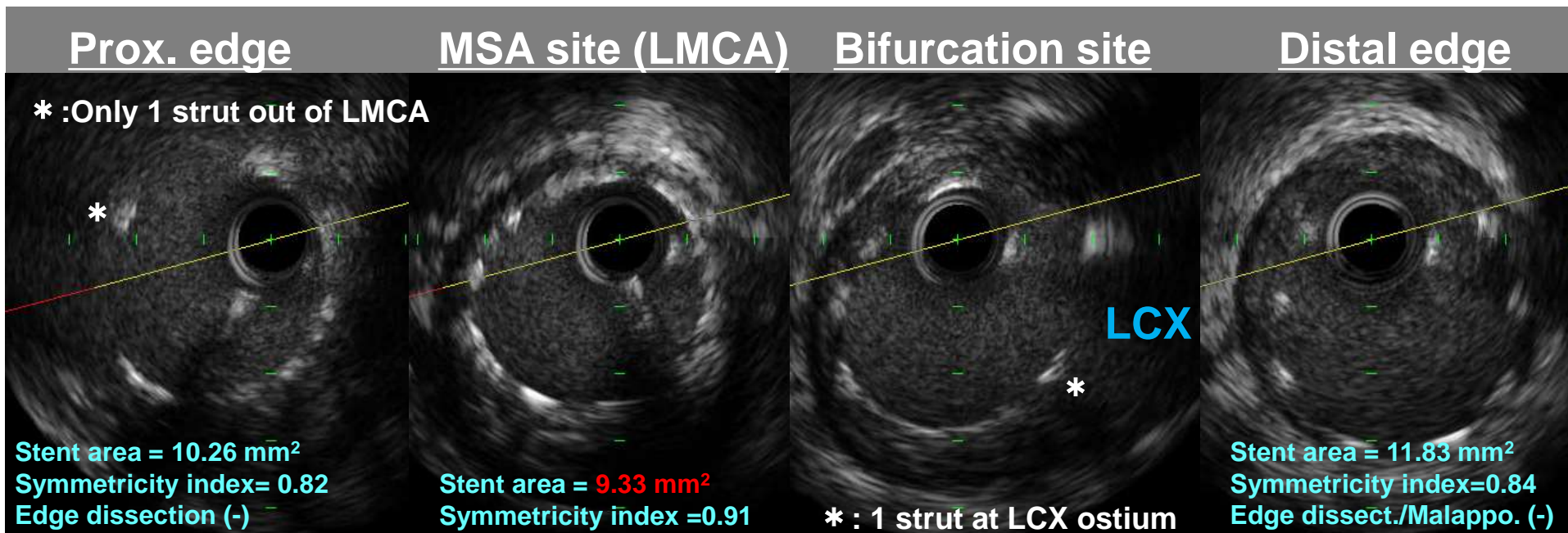
KBT
(Semi-compliant balloon)
3.5mm & 2.5 mm, 8atm



IVUS after KBT



Post KBT



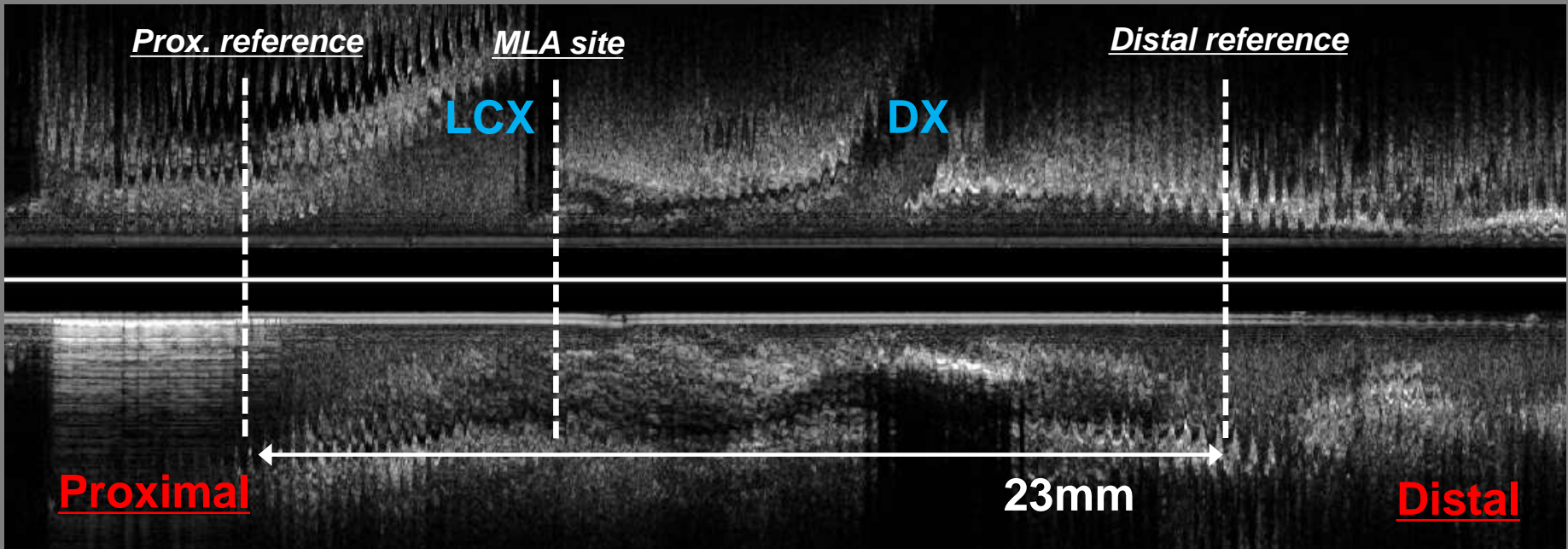
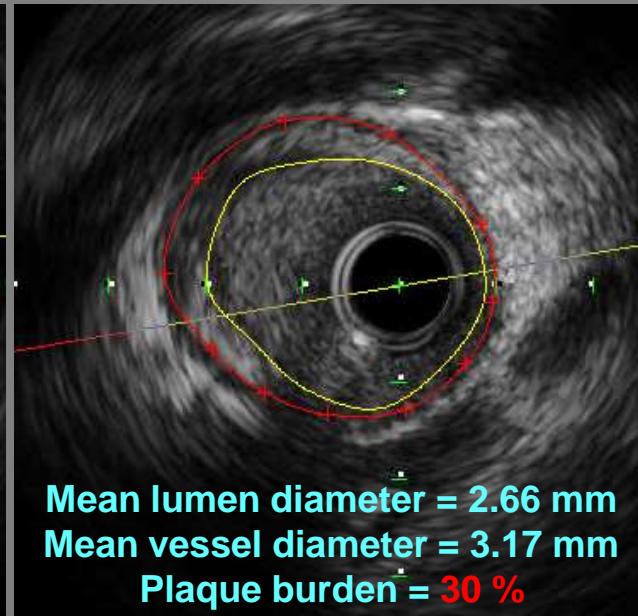
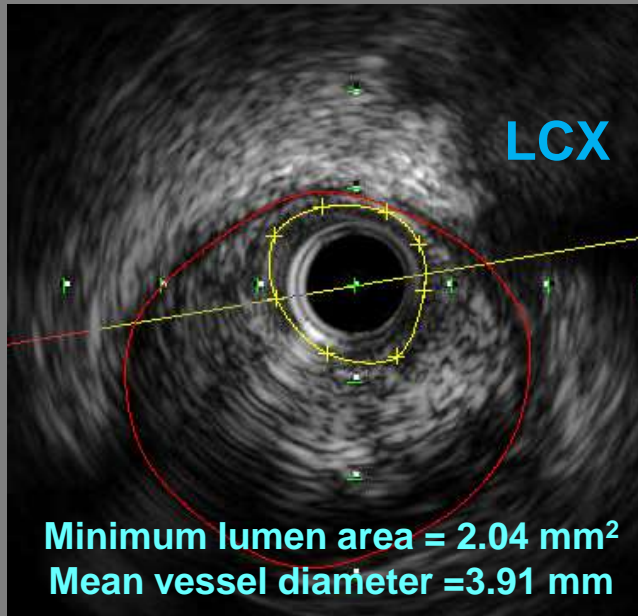
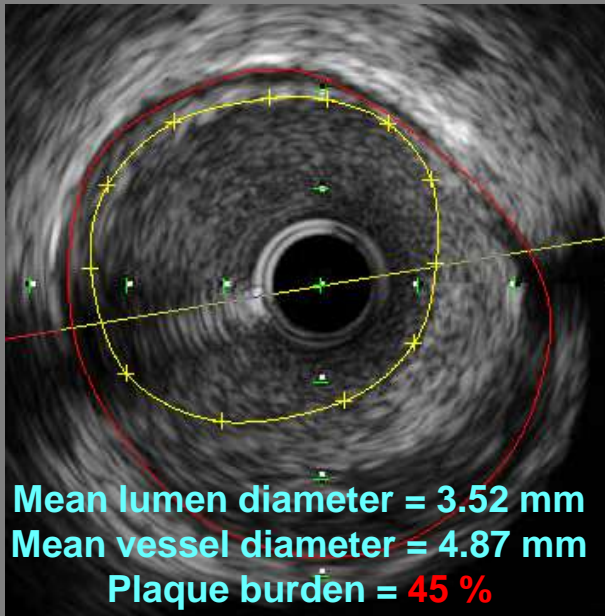
LCA: pre-PCI



Prox. reference

Minimum lumen area site

Distal reference

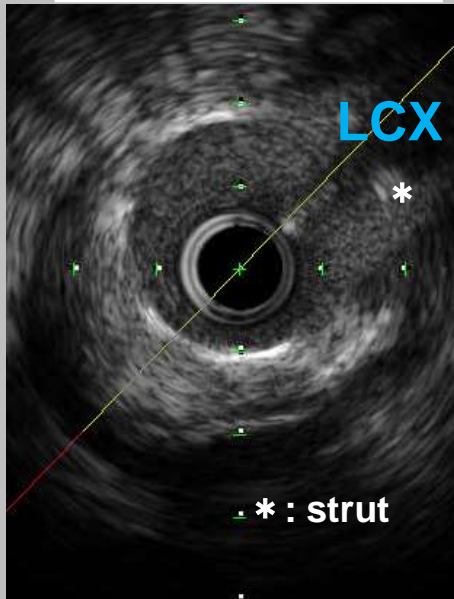


Post sten implantation

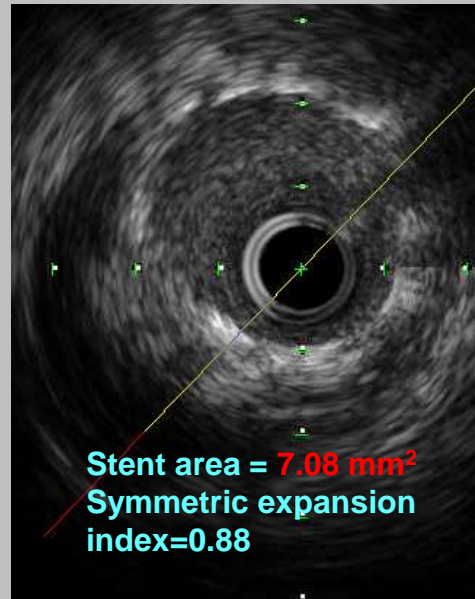
ISA site



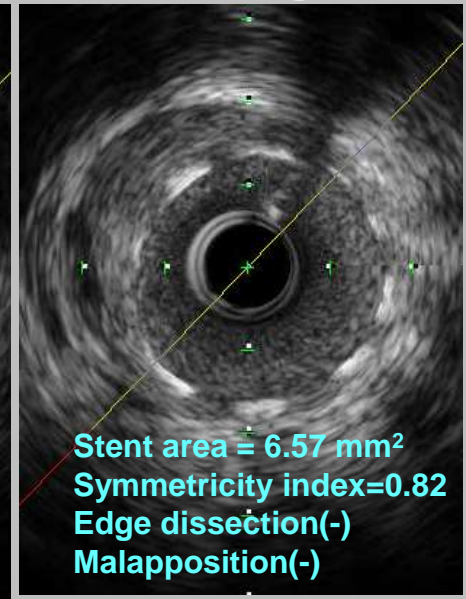
Bifurcation site



MSA site



Distal edge



Bifurcation site

Distal edge

Incomplete stent apposition site

MSA site

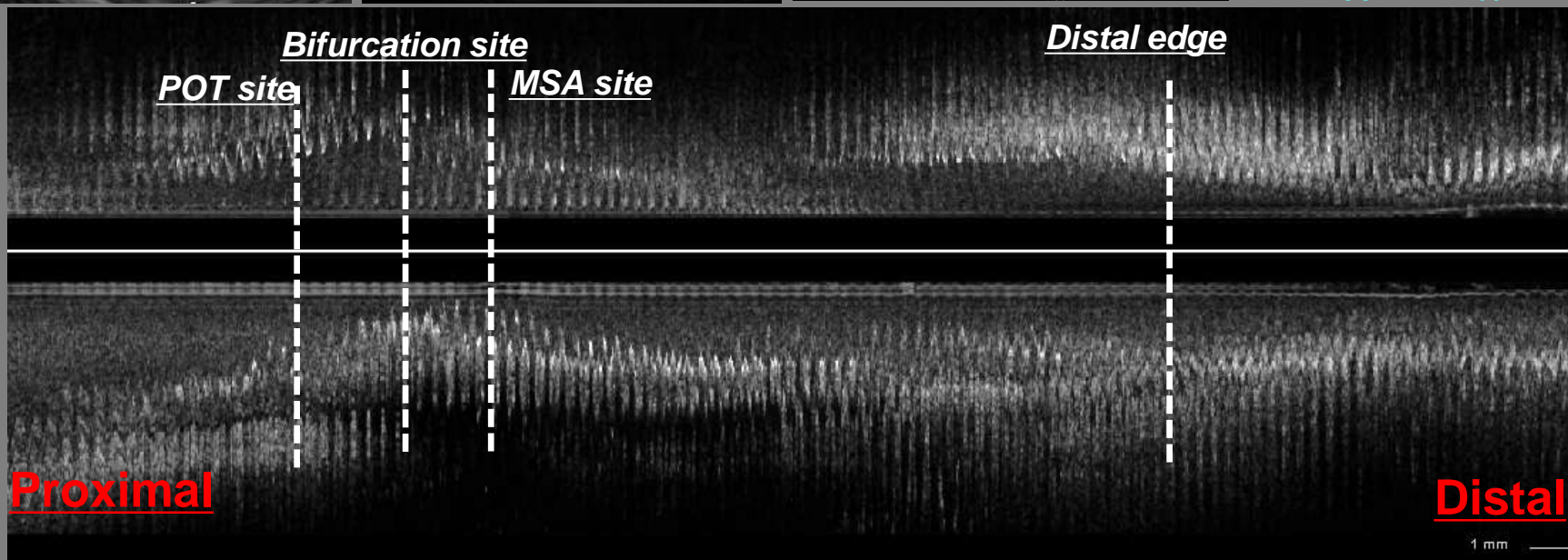
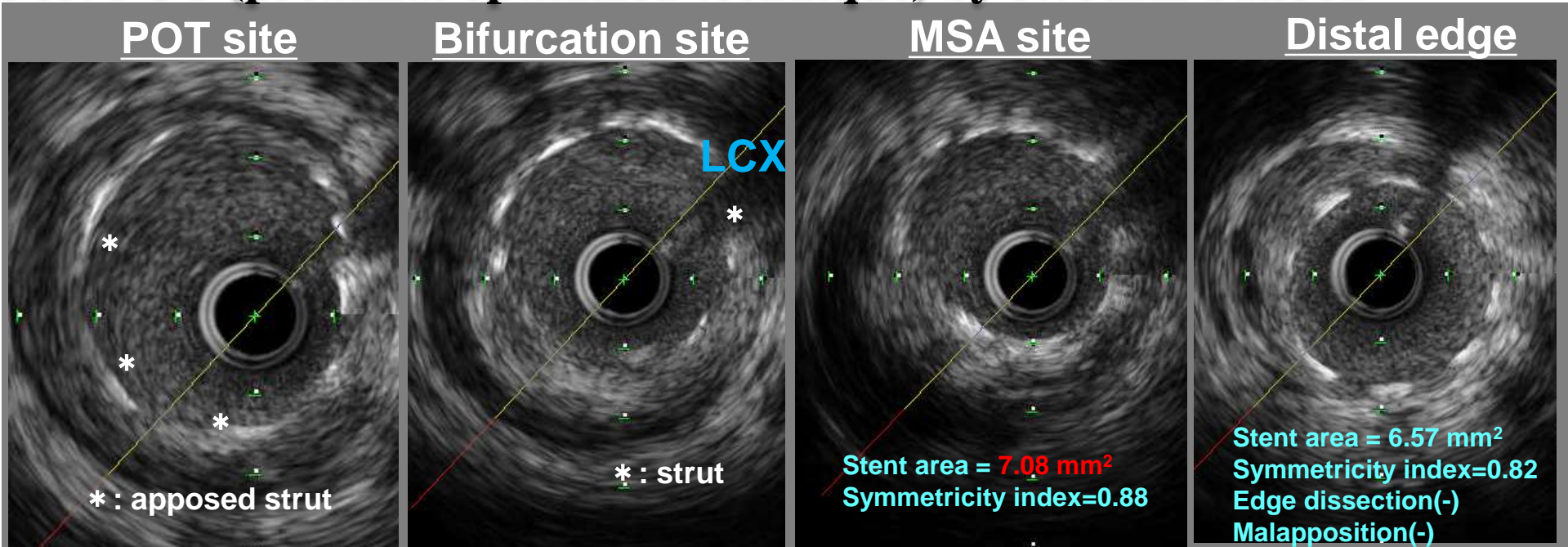
Proximal

Distal

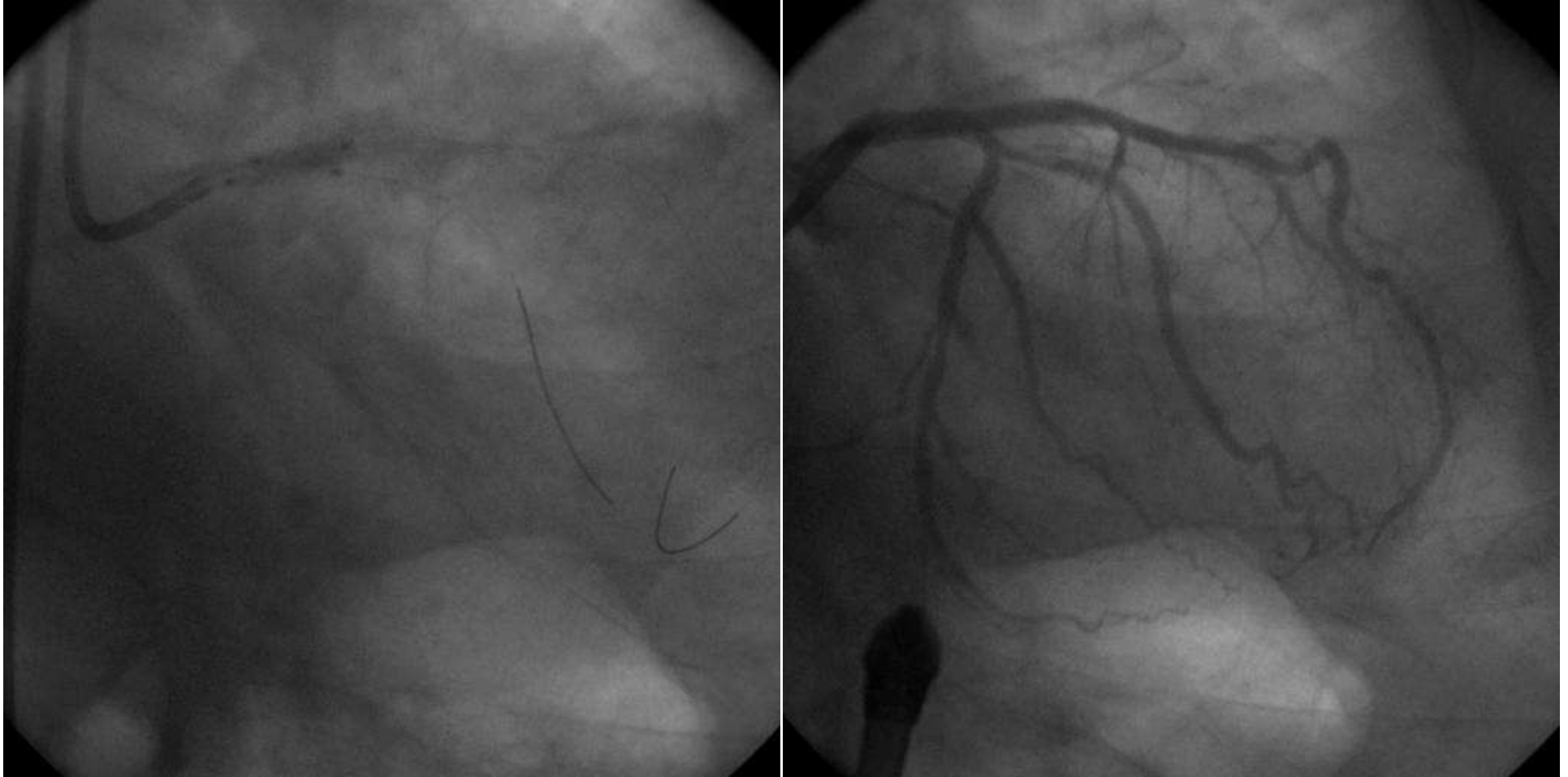
1 mm



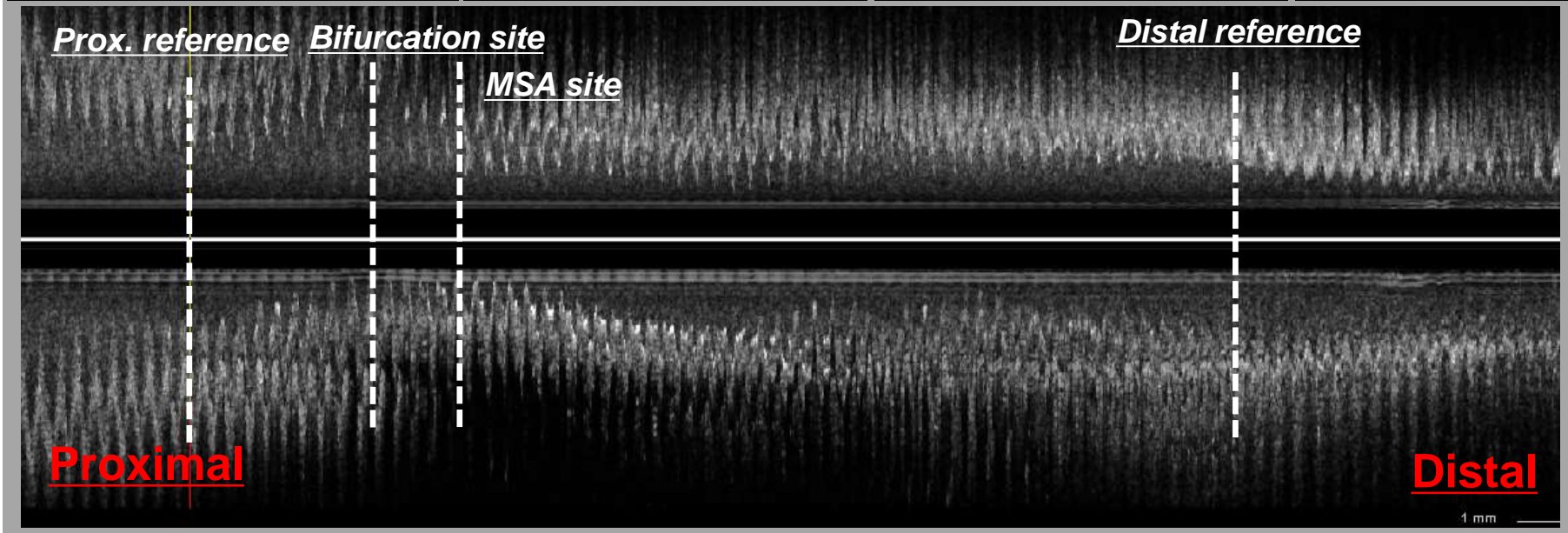
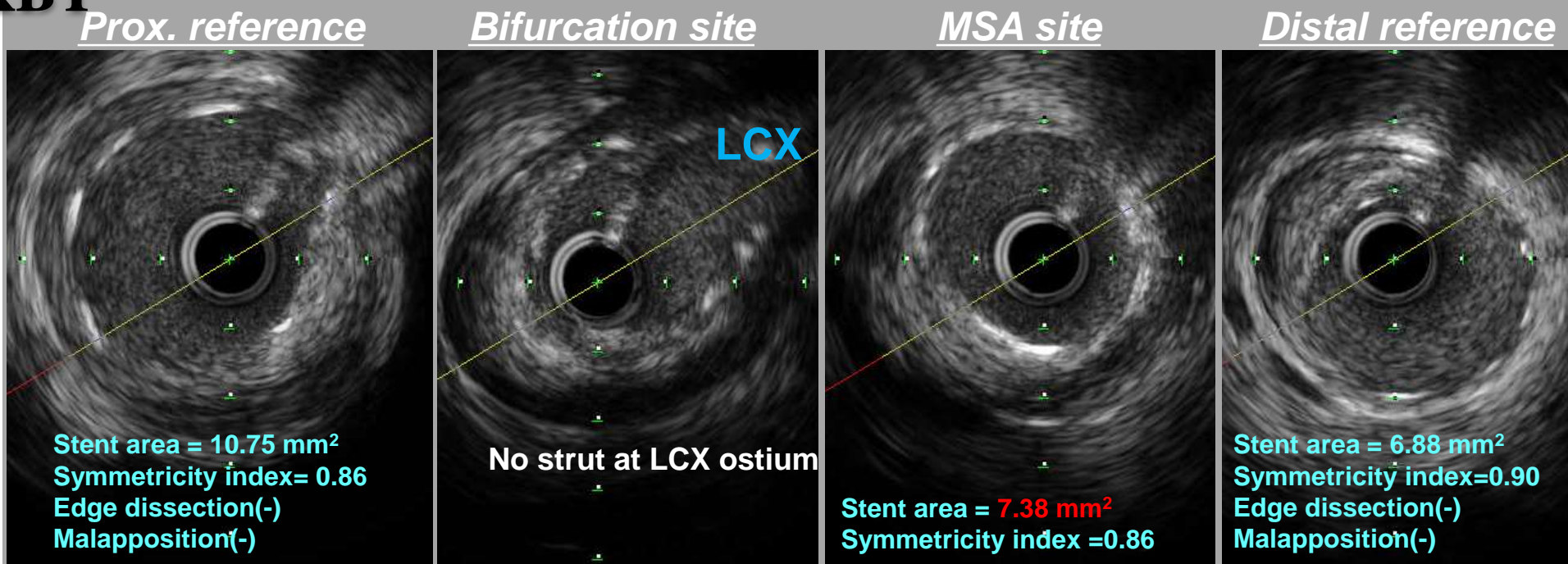
Post POT (proximal optimized technique) by 3.75mm balloon



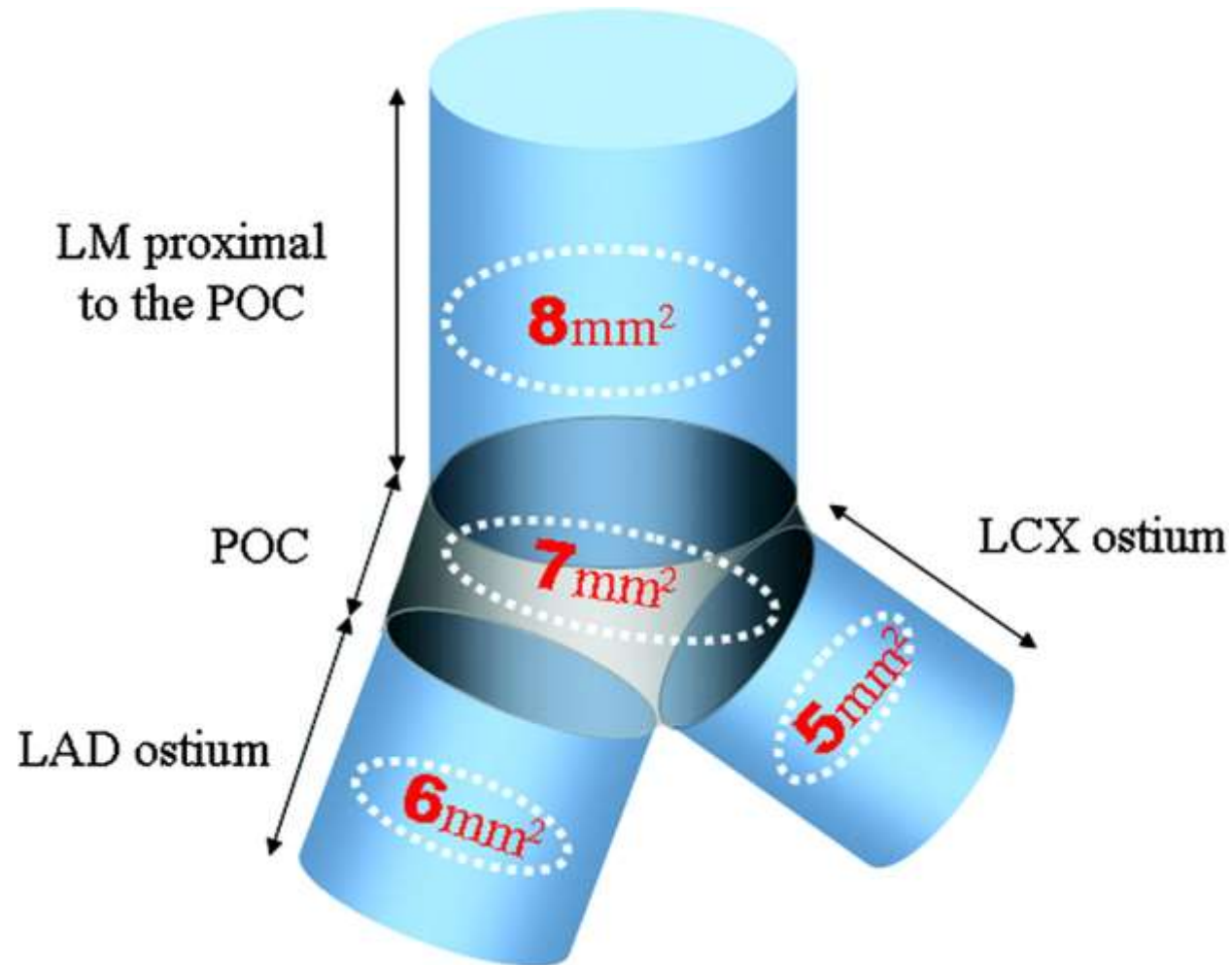
KBT with semi-compliant balloon 3.0mm and 2.25 mm, 8atm after POT



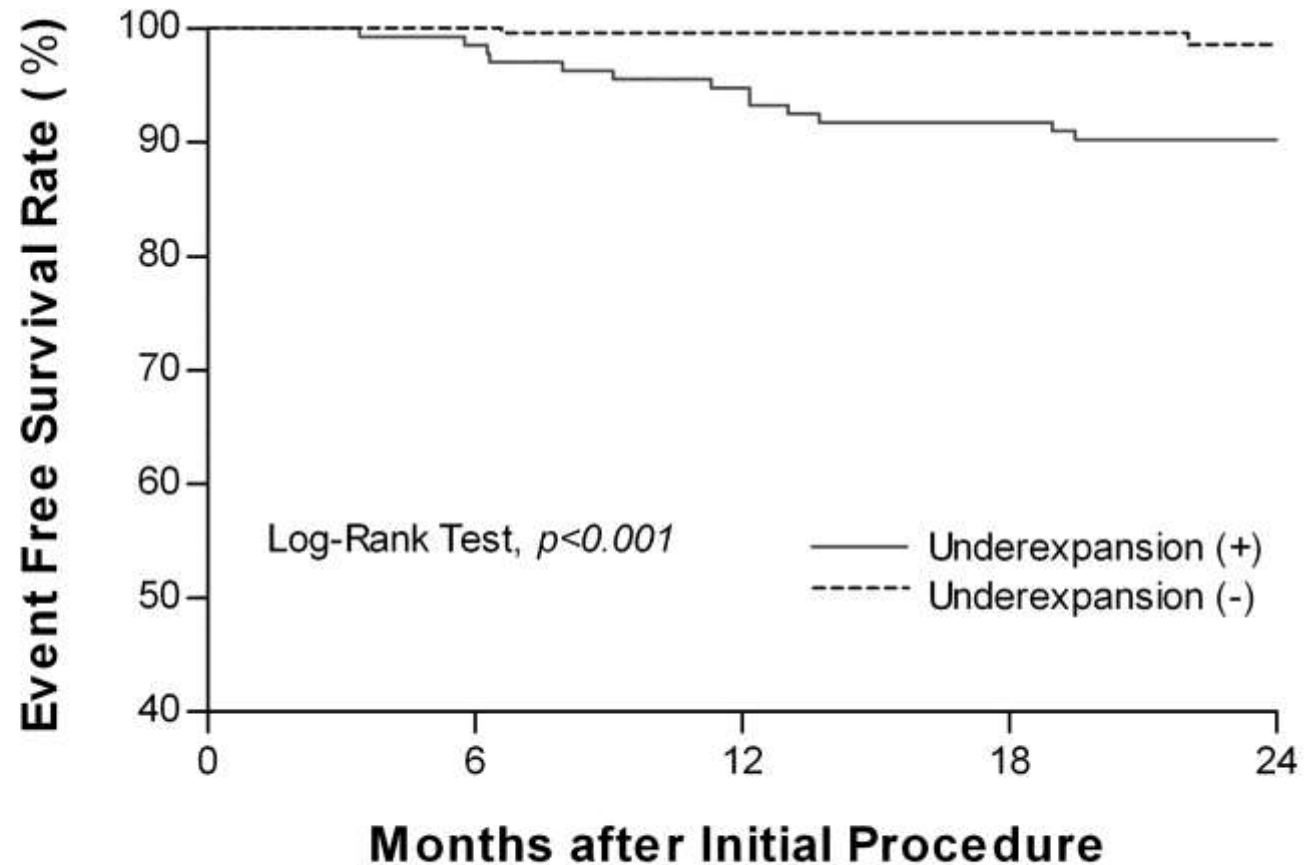
Post KBT



Minimal stent area (MSA) cutoff values for the prediction of angiographic in-stent restenosis (ISR)



Kaplan-Meier curve for MACE-free survival



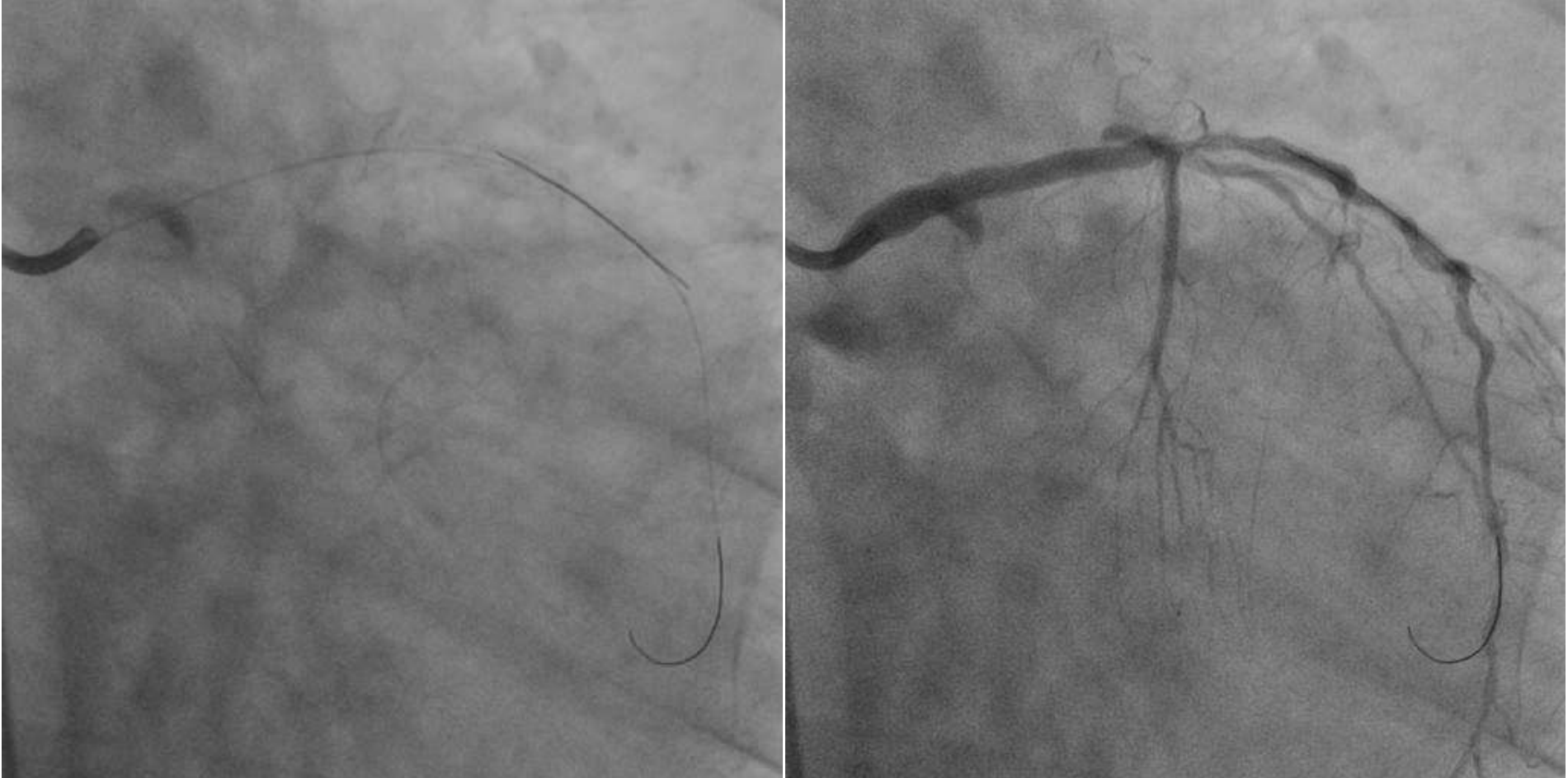
No. at risk

	0	6	12	18	24
Underexpansion (+)	133	131	126	121	75
Underexpansion (-)	260	260	255	246	129

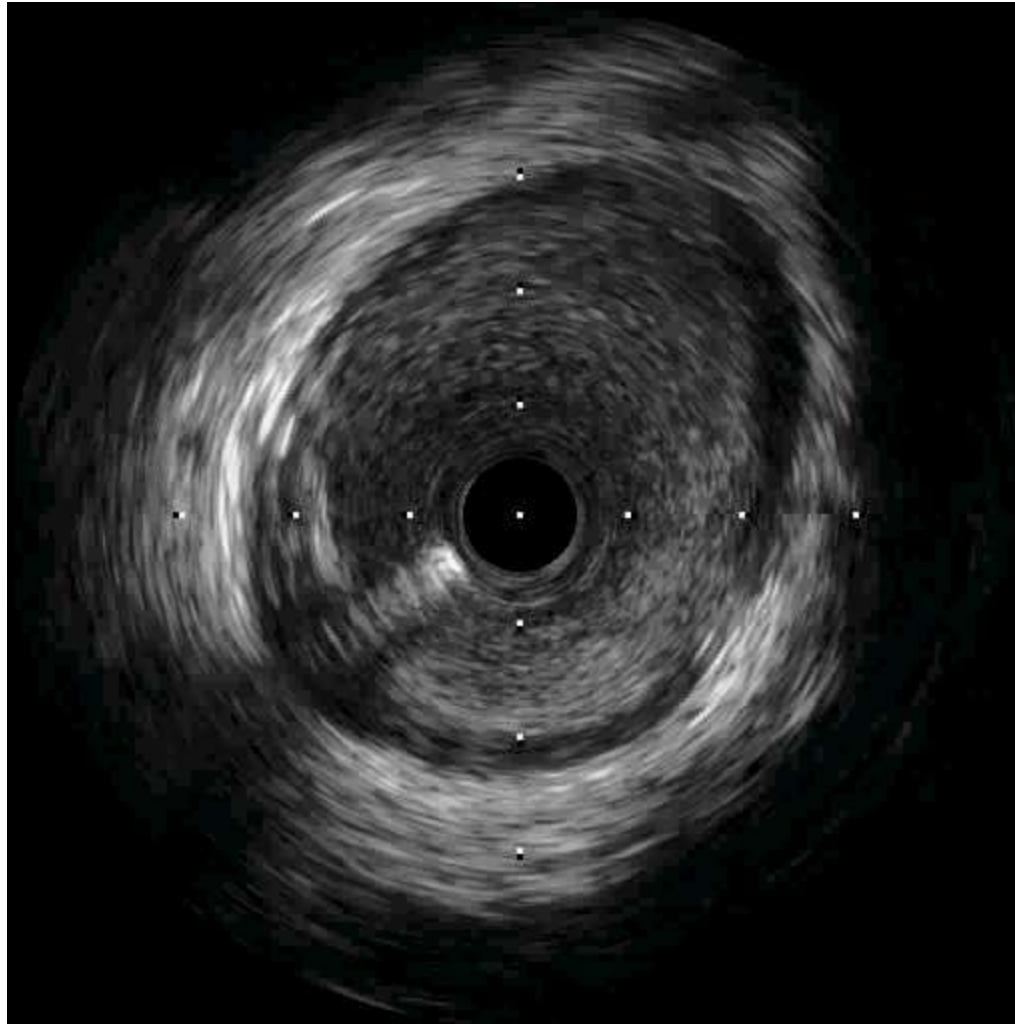


Patient complained severe chest pain, and became shock vital during procedure.

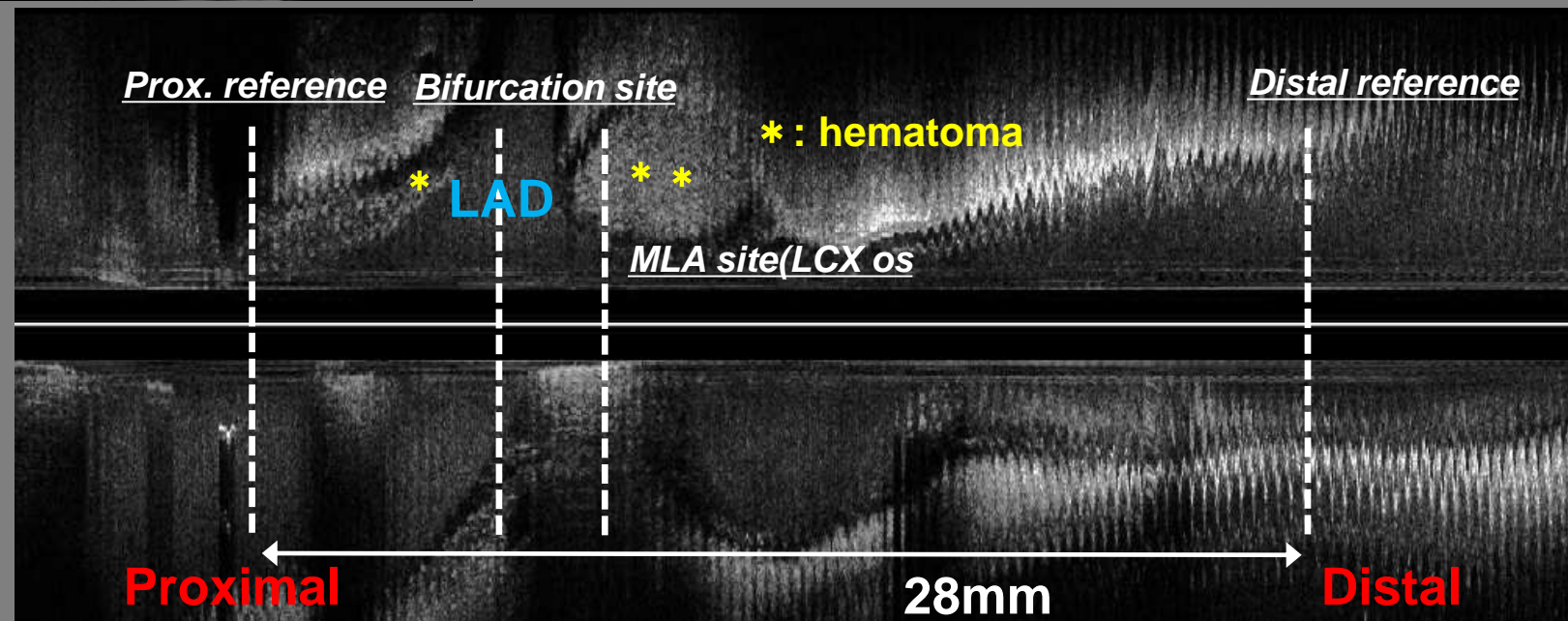
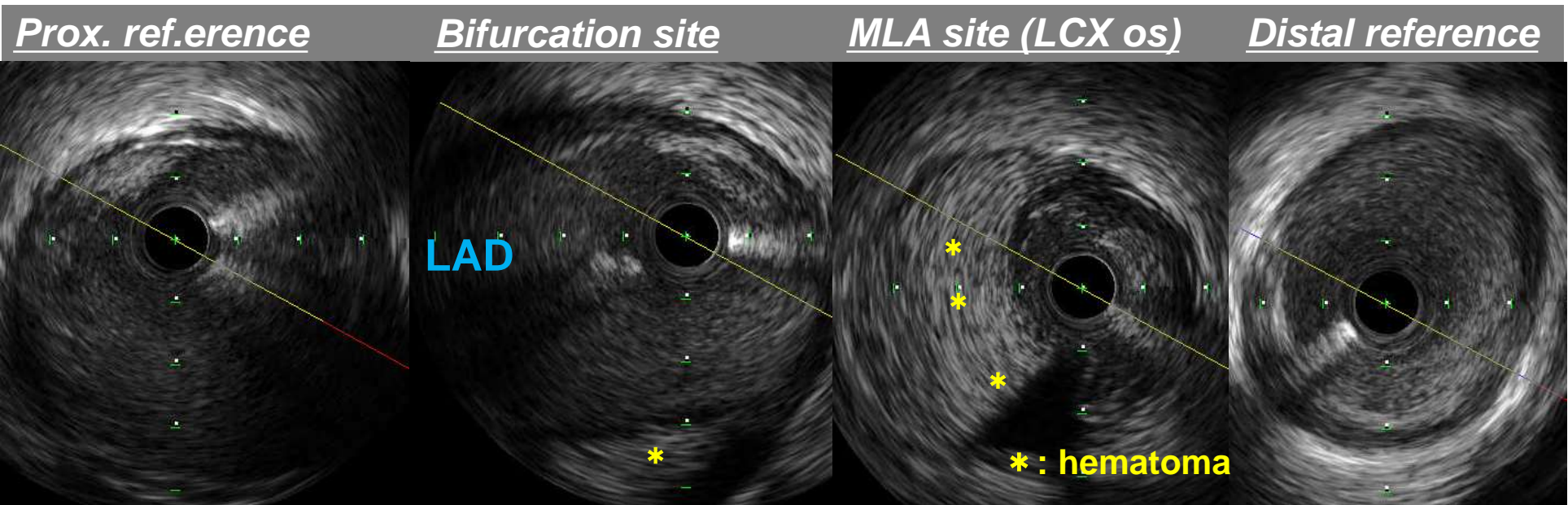
Coronary angiography after IABP.



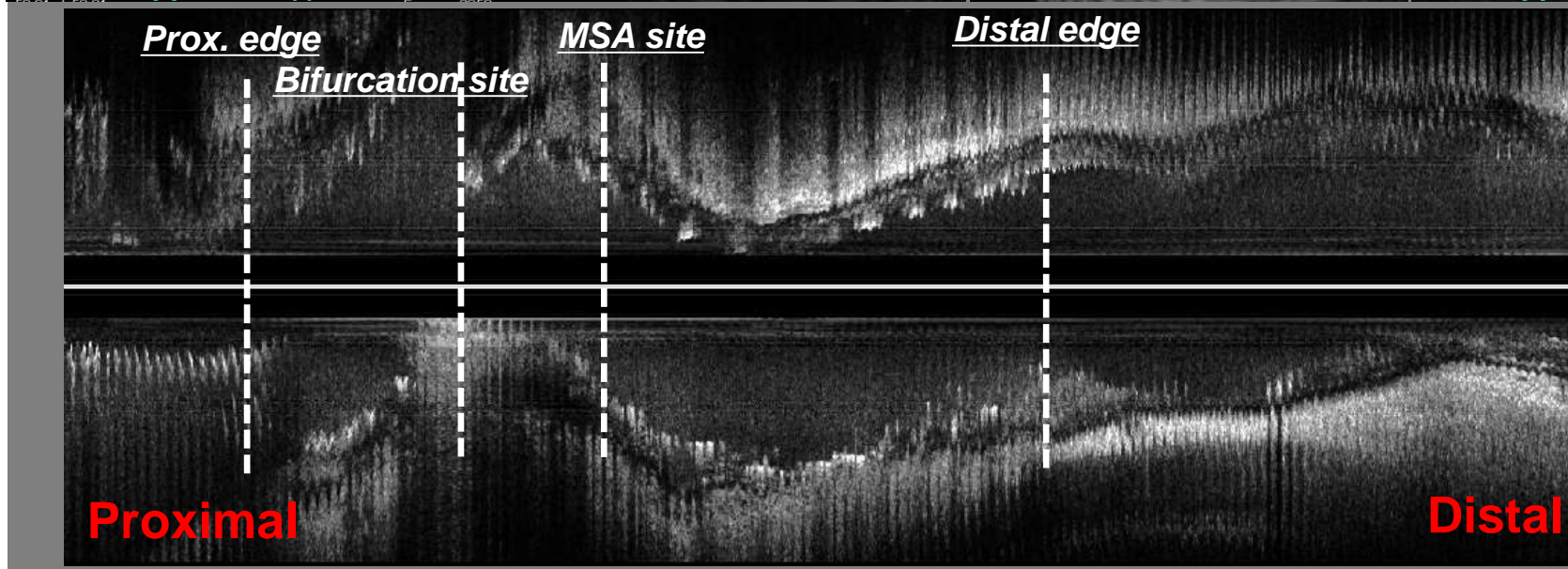
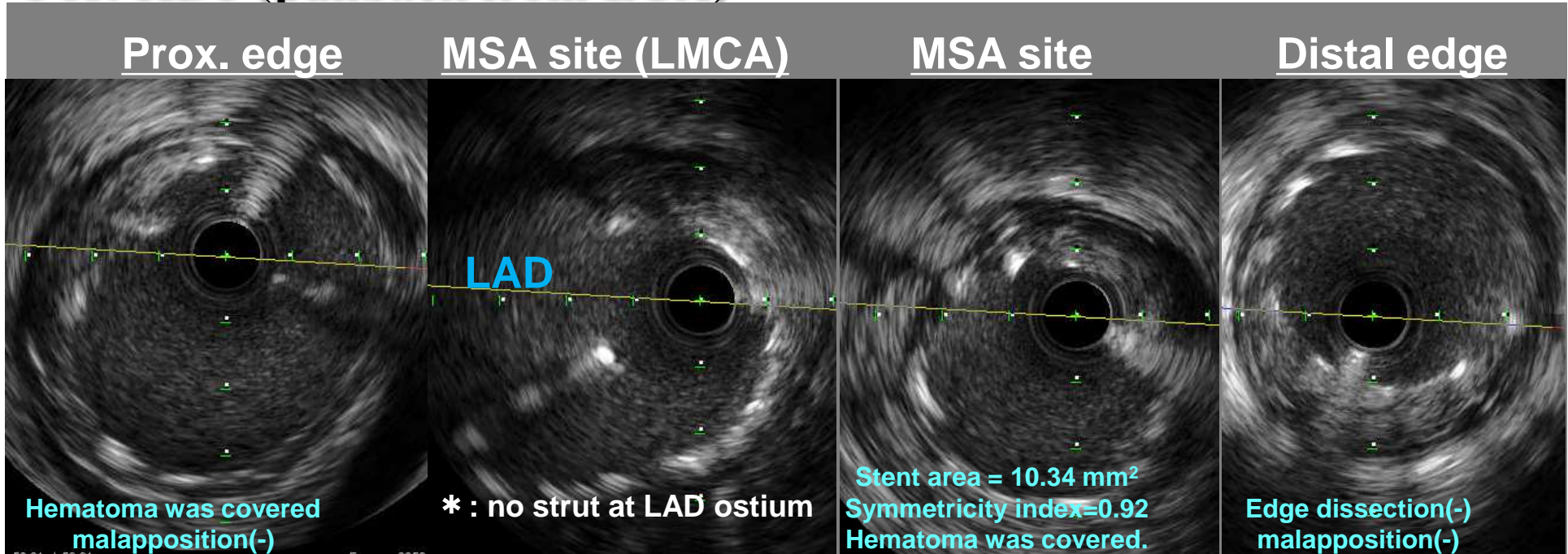
IVUS from LCX after 2.5mm ballooning



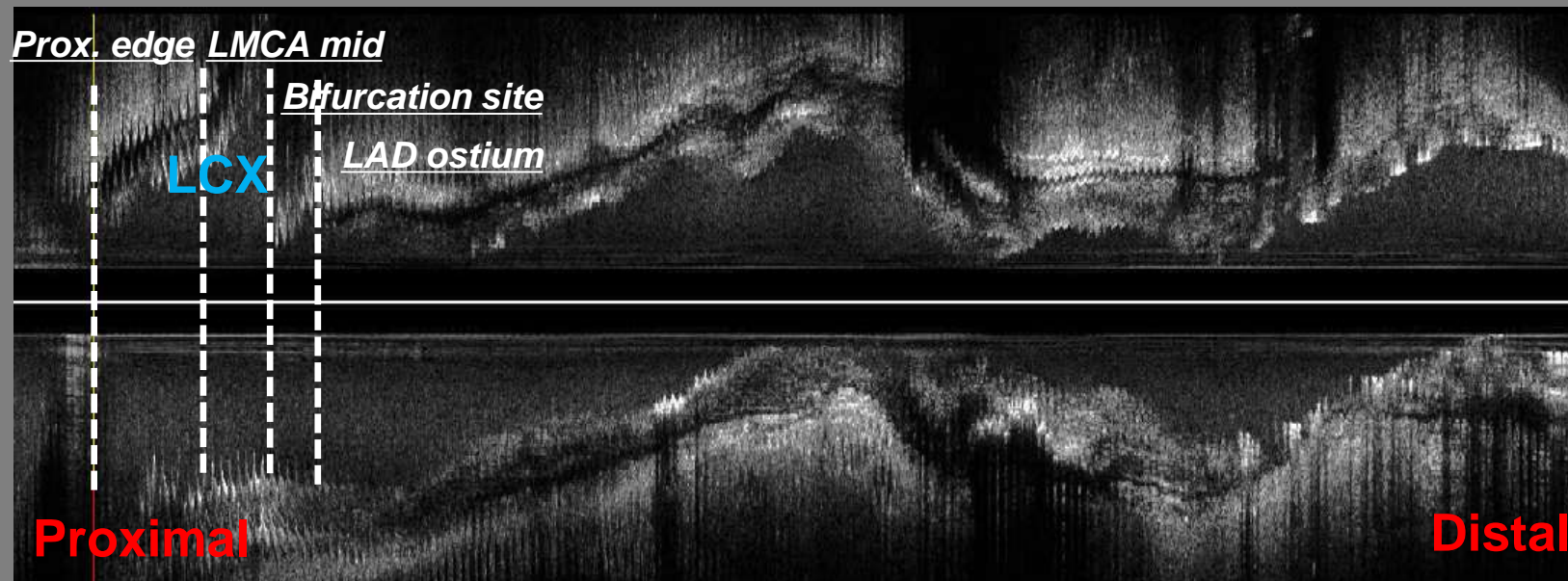
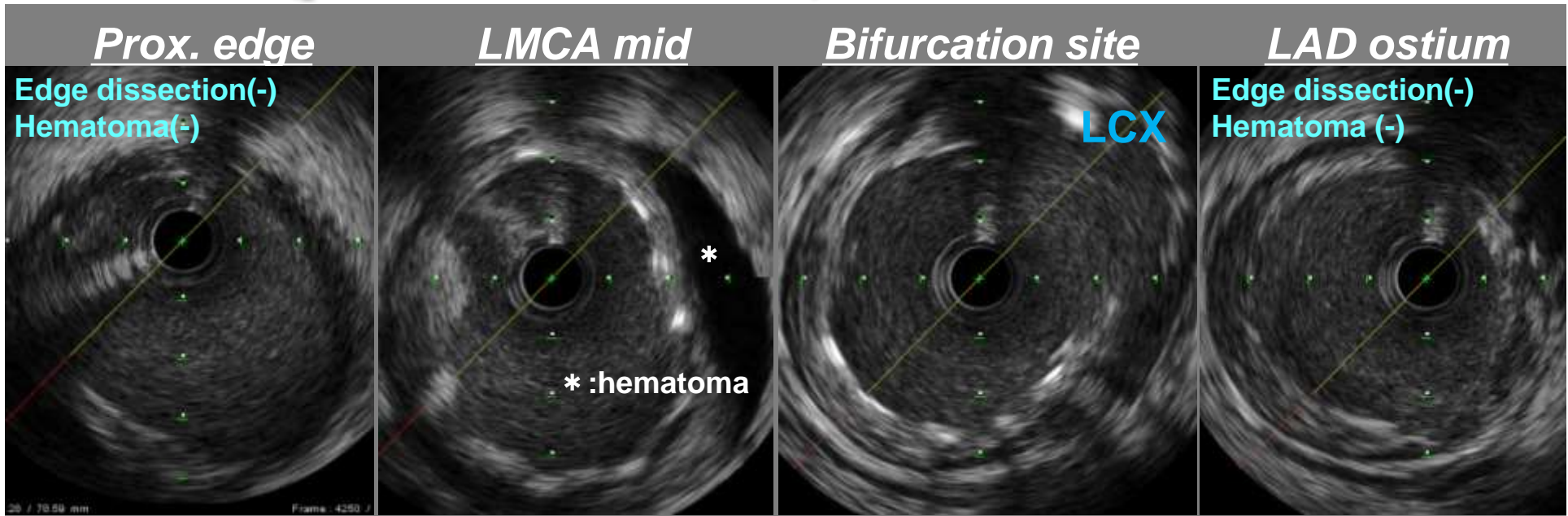
Pullback from mid LCX after 2.5mm balloon



Post KBT (pullback from LCX)

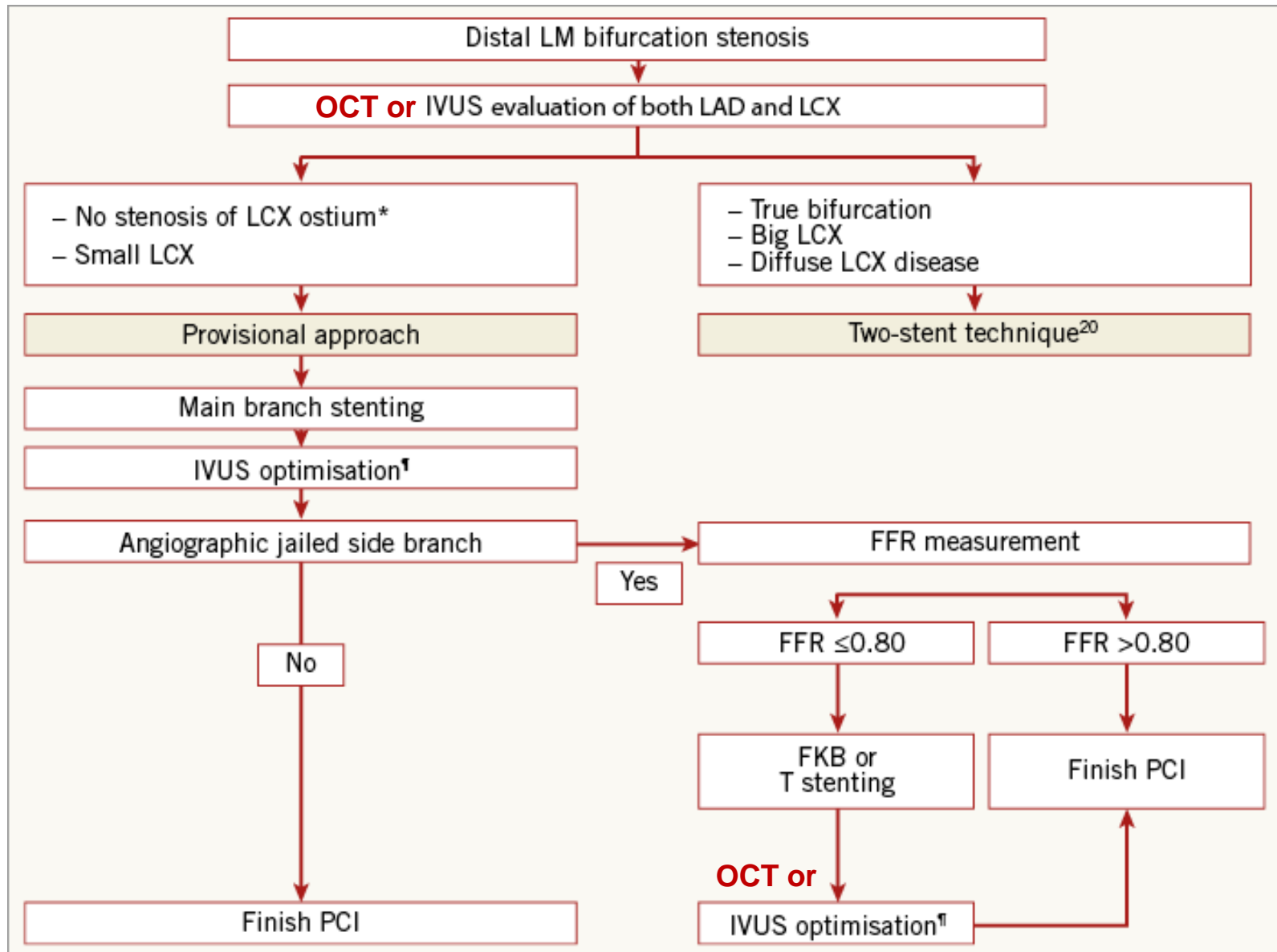


Post KBT (pullback from LAD)

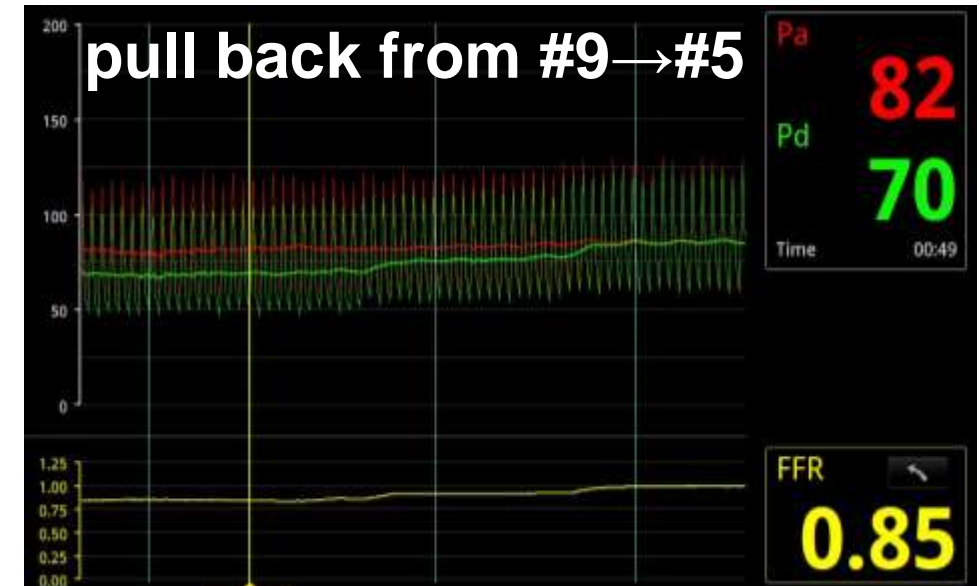
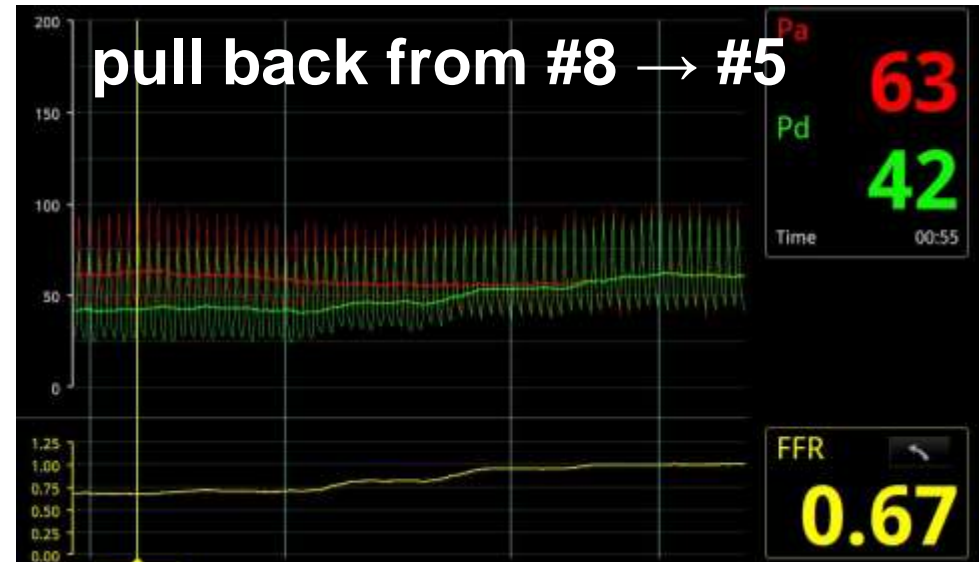
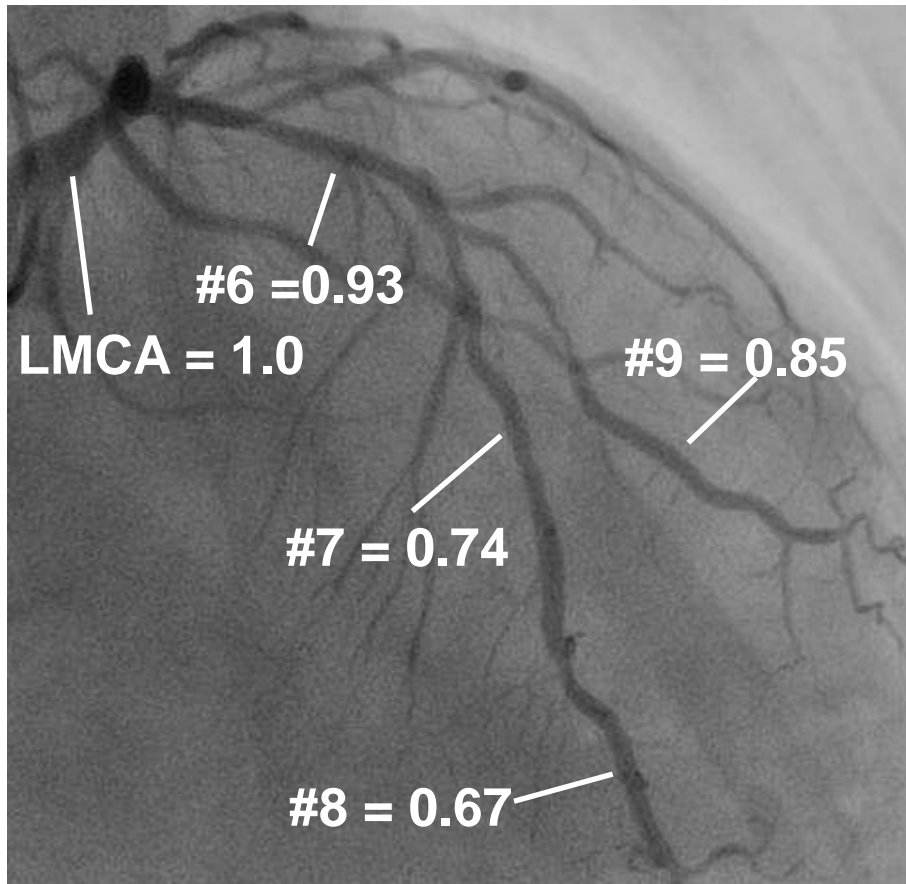


When and how to perform the provisional approach for distal LM stenting

Park SJ, et al. EuroIntervention 2015;11:V120-V124



FFR (Pre PCI)

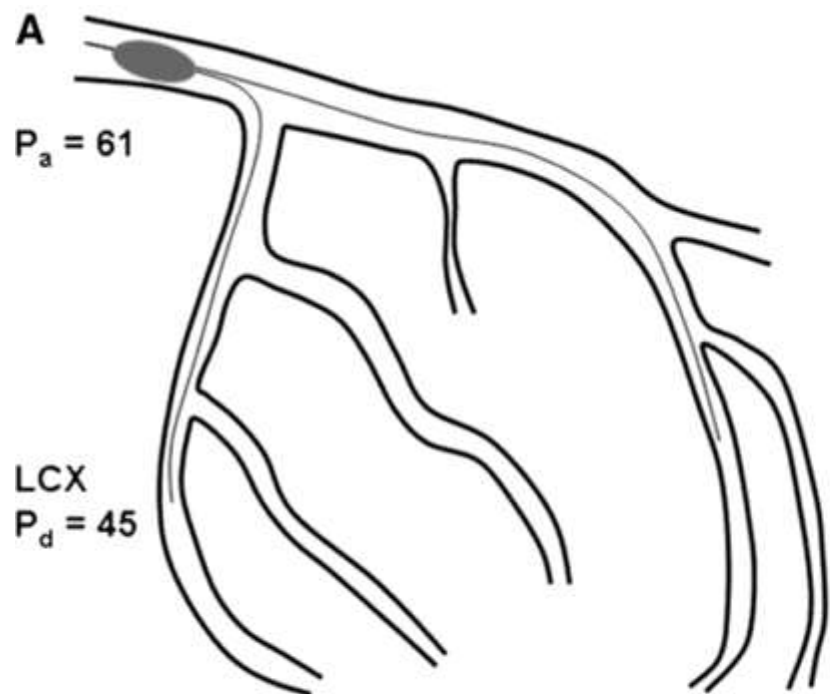


FFR : 0.67 (LAD) / 0.85 (Dx)
jump up at #6 (0.74 ⇒ 0.93)
jump up at #9 (0.85 ⇒ 0.93)

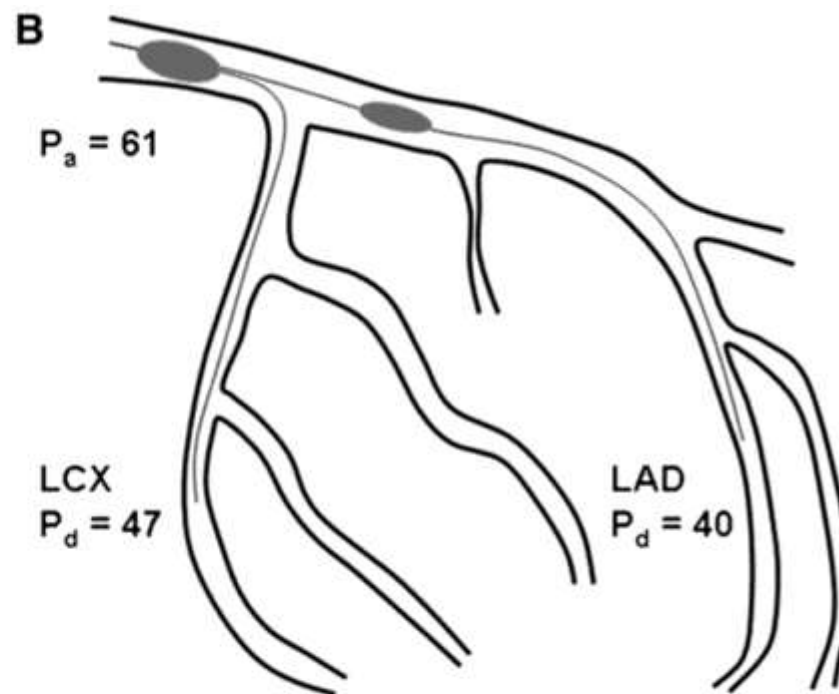
Overestimation of side branch stenosis by angiography



Schematic example of physiological measurements of LM stenosis with or without proximal LAD stenosis



$$FFR_{\text{true}} = 45/61 = 0.74$$



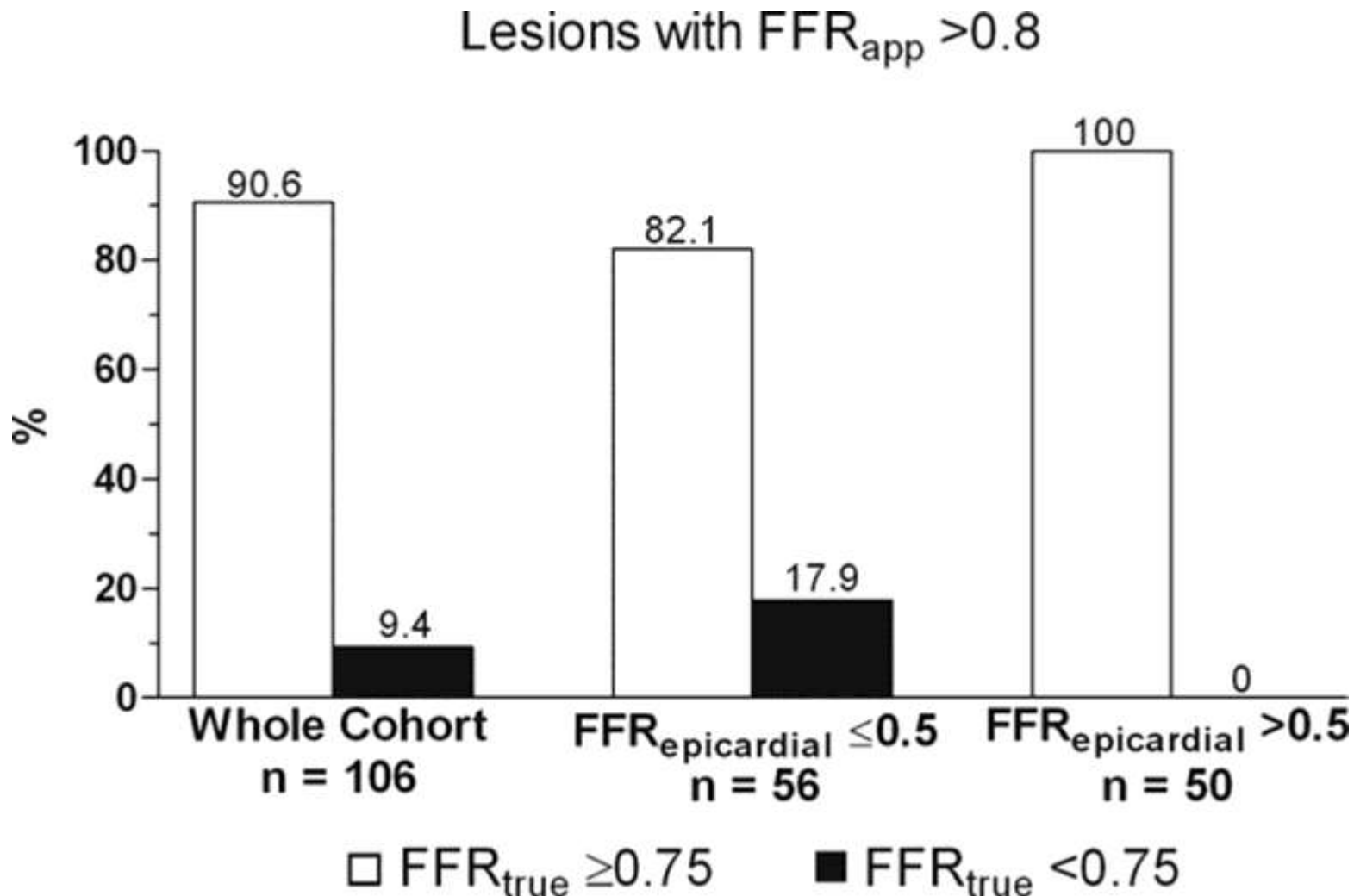
$$FFR_{\text{app}} = 47/61 = 0.77$$

$$FFR_{\text{epicardial}} = 40/61 = 0.66$$

FFR in LCx would be overestimated by the proximal LAD stenosis.



True FFR (FFR_{true}) in instances where FFR_{app} >0.8



In cases with FFR_{LAD} ≤ 0.5 , true FFR_{LCx} would be < 0.75 even if apparent FFR_{LCx} is > 0.8 .



Take home message

- **FFR measurement should be essential for deciding the bifurcation lesion treatment before or after stenting, and the underestimation of the lesion severity should be taken into account in the assessment of side branch stenosis.**
- **Pre-PCI lesion assessment by imaging may allow us to decide stent size, stent length and landing zone precisely.**
- **Imaging assessment during PCI should be essential to identify stent under-expansion, incomplete apposition or complications including stent edge dissection, intramural hematoma and so on.**
- **Confirmation of the final result of PCI by imaging should improve the prognosis of patients by avoiding acute or subacute stent thrombosis, restenosis or MACE.**

