8th Imaging and physiology summit 2015

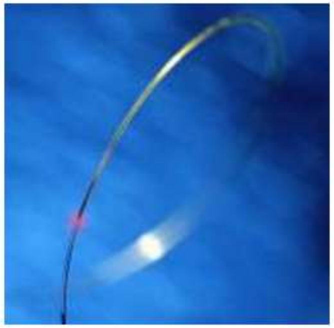
Dec/4/2015 2：30-2：40

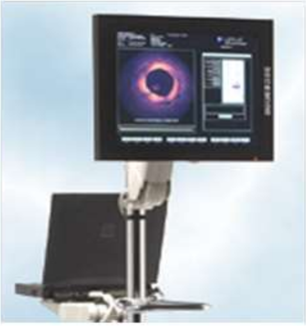
Grand Intercontinetal Seoul Parnas, Grand Ballroom 3, Level 5

Seoul, Korea

Imaging Workshop I: OCT

OCT-Guided Device Sizing and PCI Optimization



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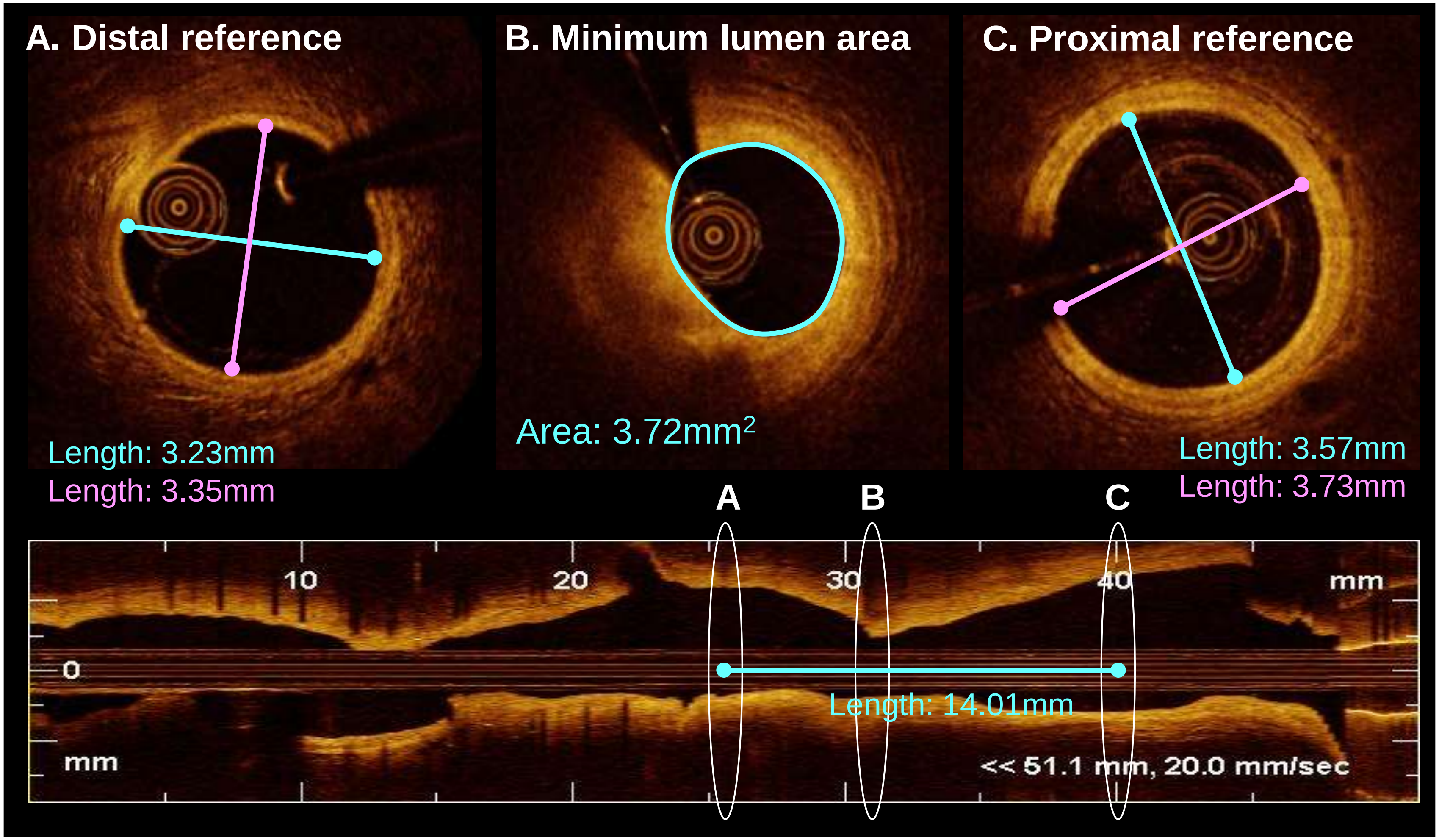
Disclosure Statement of Financial Interest

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, Sumitomo elec.
• Major Stock Shareholder/Equity	• No
• Royalty Income	• No
• Ownership/Founder	• No
• Intellectual Property Rights	• No
• Other Financial Benefit	• No

FD-OCT measurements at pre-intervention

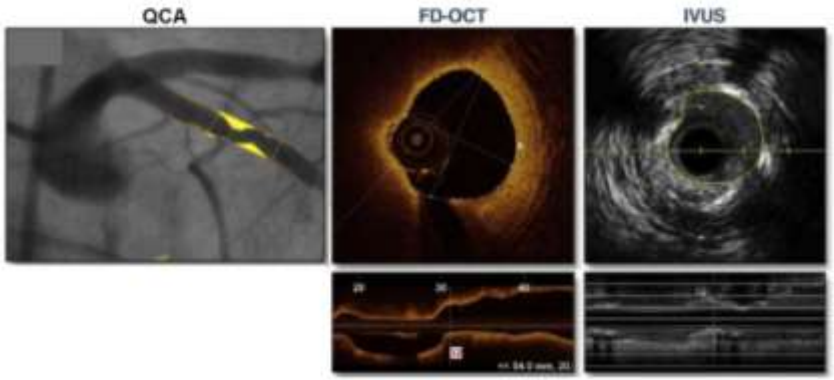


OCT criteria of optimal stent deployment

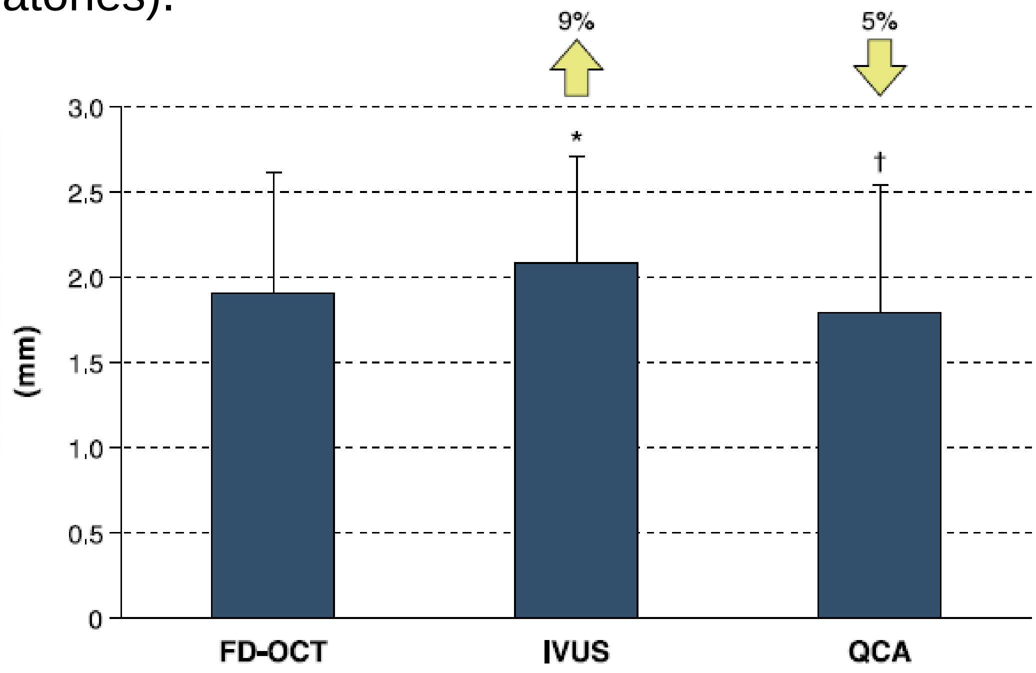
	OCT-guided PCI
Determination of stent diameter	• By measuring lumen diameter at distal reference site • Stent dimeter = 9% greater [quarter size up (0.25mm)] of lumen diameter at distal reference site
Reference site	• Most normal looking • No lipidic plaque
Determination of stent length	• By measuring distance from distal to proximal reference site
Goal of stent deployment	• In-stent minimal lumen area ≥ 90% of the average reference lumen area • Complete apposition of the stent over its entire length against the vessel wall • Symmetric stent expansion defined by minimum lumen diameter / maximum lumen diameter ≥ 0.7 • No plaque protrusion, thrombus, or edge dissection with potential to provoke flow disturbances

Accuracy of OCT measurement in vivo
OPUS-CLASS study

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%).

Stent diameter selection by OCT

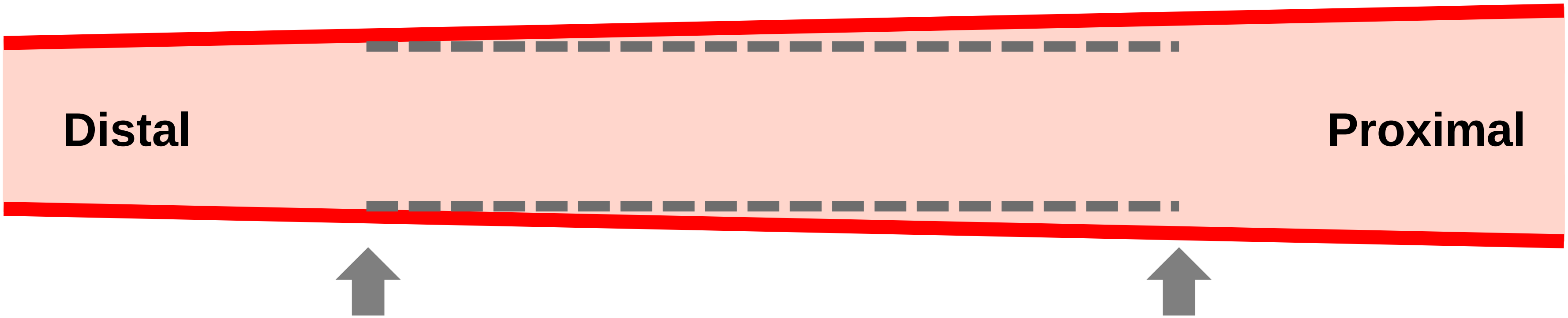
Lumen diameter at distal reference site		Stent diameter: Calculated	Stent diameter: Selected
2.0	→	2.18	2.25
2.25	→	2.45	2.5
2.5	→	2.72	2.75
2.75	→	3.00	3.00
3.0	→	3.27	3.25
3.25	→	3.54	3.54
3.5	→	3.81	3.75
3.75	→	4.09	4.0

9%* size-up

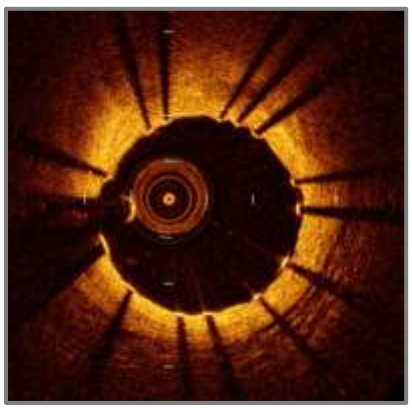
* OPUS-CLASS study

Quarter size up (0.25mm ↑)

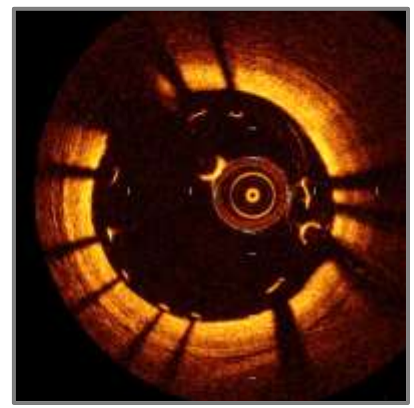
Post dilatation



Complete stent apposition



Incomplete stent apposition

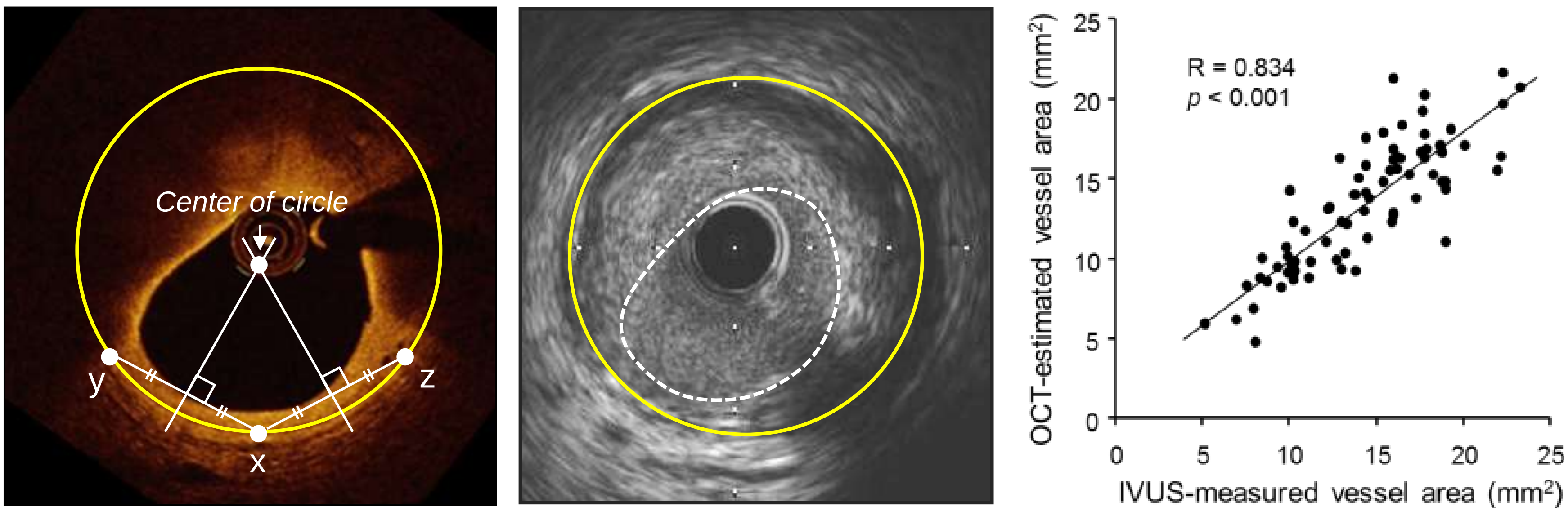


Post dilatation

Balloon diameter = 9% greater [quarter size up (0.25mm)] of lumen diameter at proximal reference site

Vessel circumference approximation in OCT

Feasibility of approximating algorithm of vessel circumference in OCT were evaluated in 80 coronary artery segments.



Three points (x, y, z) are placed on the visible circular arc. The central point (x) is connected with the other two points (y and z) by straight lines. Through the mid-point of each straight line, perpendicular line is drawn. Intersection of the two perpendicular lines is assumed to be the center of the circle. This makes circular approximation.

Conclusion: By approximating algorithm of vessel circumference, OCT can estimate vessel area in coronary arteries with lipidic plaque.

OCT criteria of optimal stent deployment

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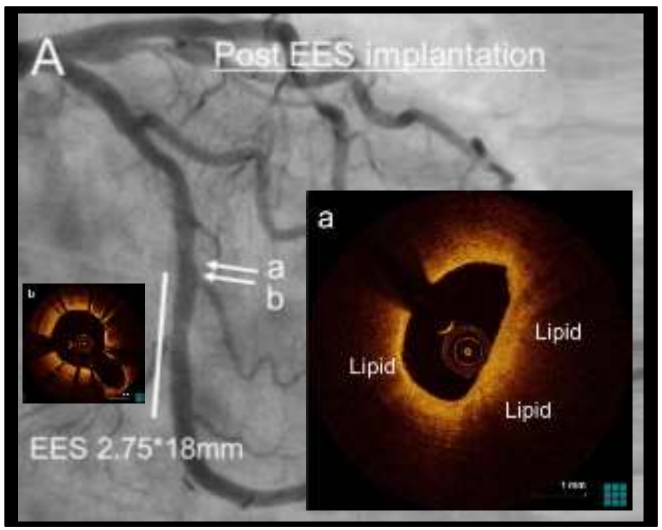
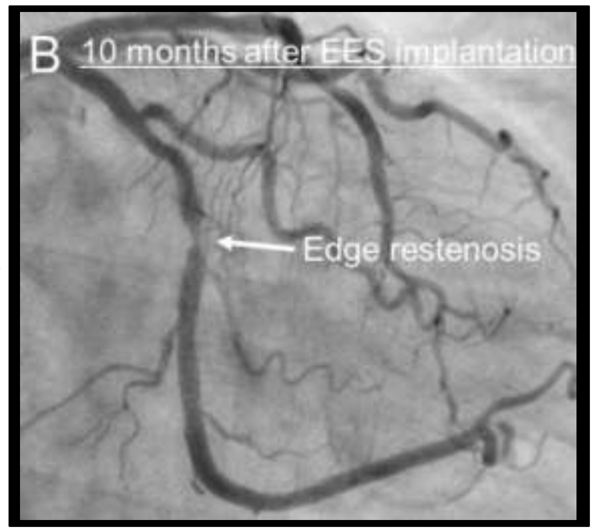
Late restenosis at stent edge landing zone

In 744 stent (EES) edge segments, OCT was used to evaluate morphological characteristics of the coronary plaques that developed stent edge restenosis.

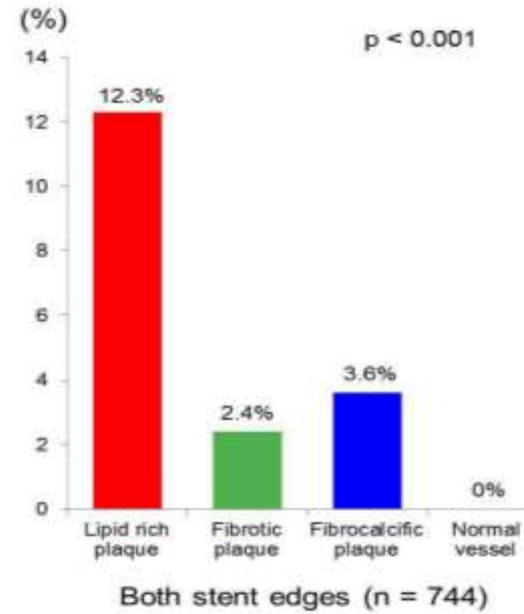
Post-stenting



10 months follow-up



Stent edge restenosis



(A) Immediately after EES implantation, OCT images showed lipid rich plaque at the proximal stent edge (a, b).
(B) At 10-month follow-up, angiography demonstrated stent edge restenosis at the proximal edge of the stent.

Conclusion: Lipidic plaque in the stent edge segments at post-PCI was a predictor of late stent edge restenosis.

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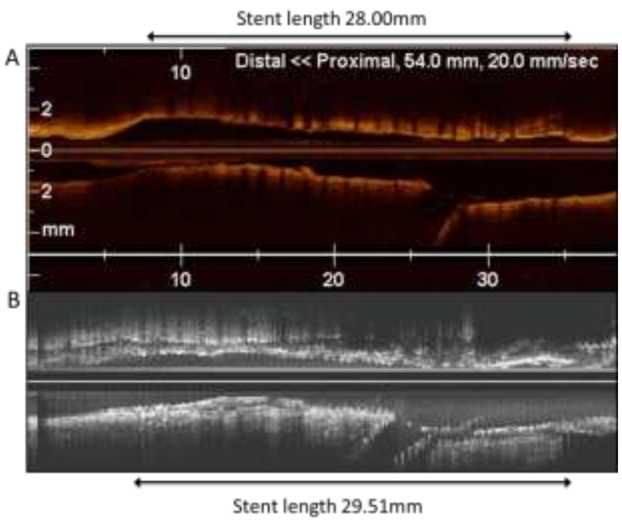
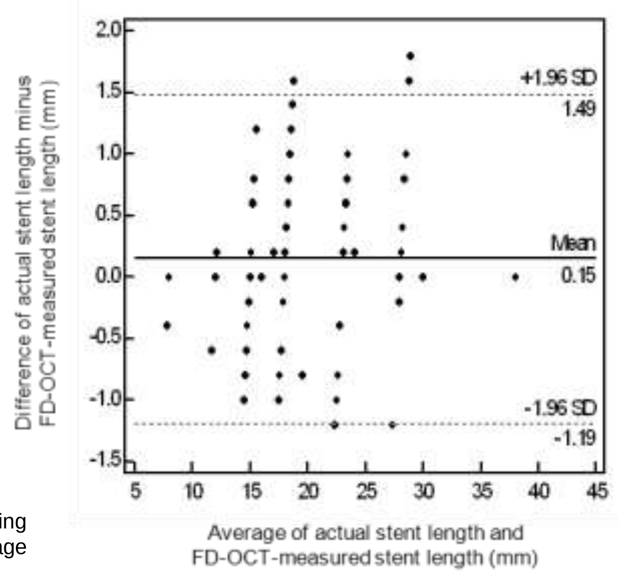
Accuracy of FD-OCT for longitudinal geometric measurement

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

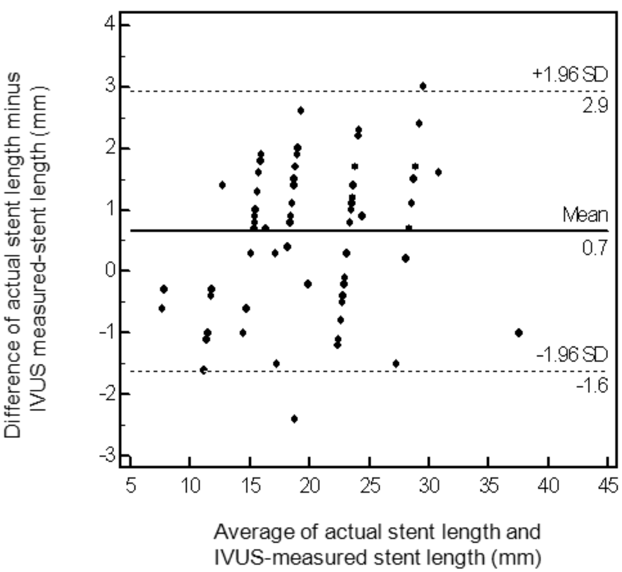


Correlation between FD-OCT and IVUS Pullbacks. Corresponding OCT longitudinal-view image (A), and IVUS longitudinal-view image (B) from a patient with stent implantation in LAD.

A. FD-OCT



B. IVUS



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

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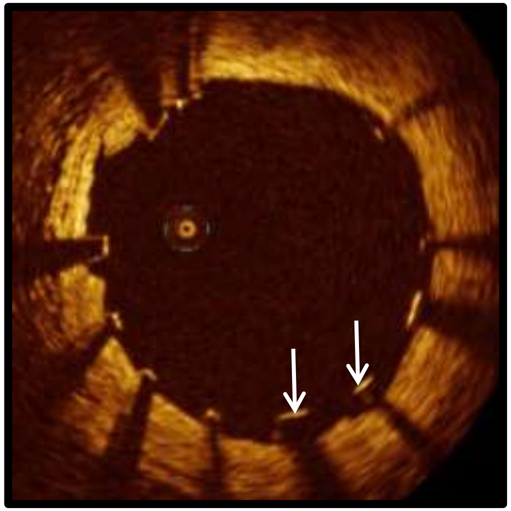
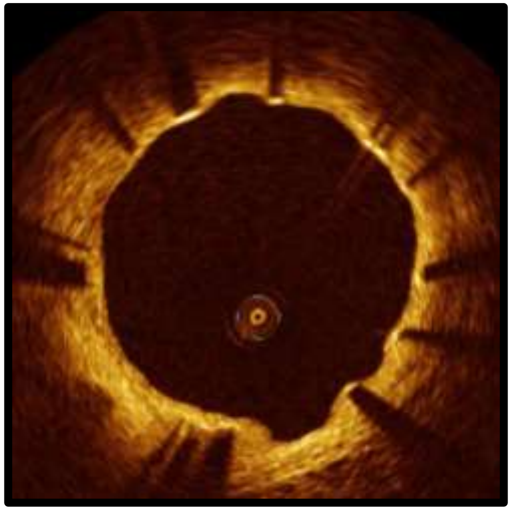
Resolution of stent malapposition in Xience

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 (n=38).

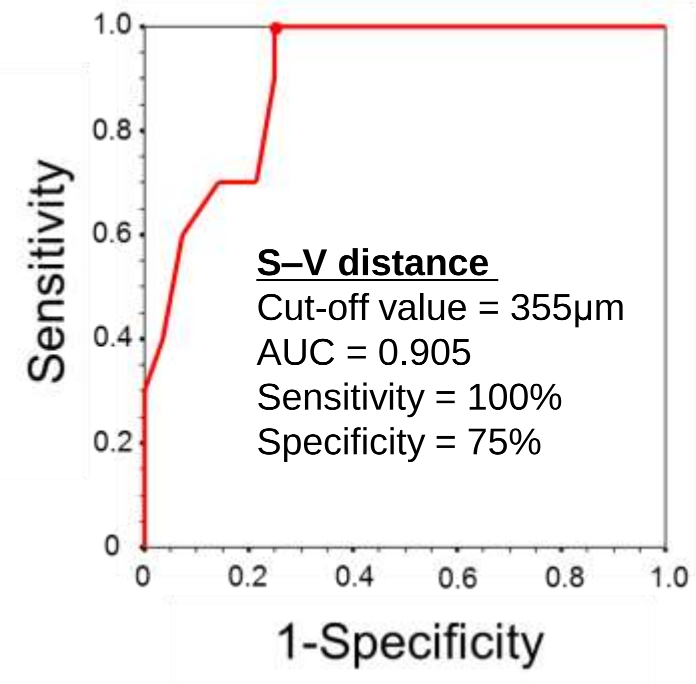
Post-stenting



Follow-up

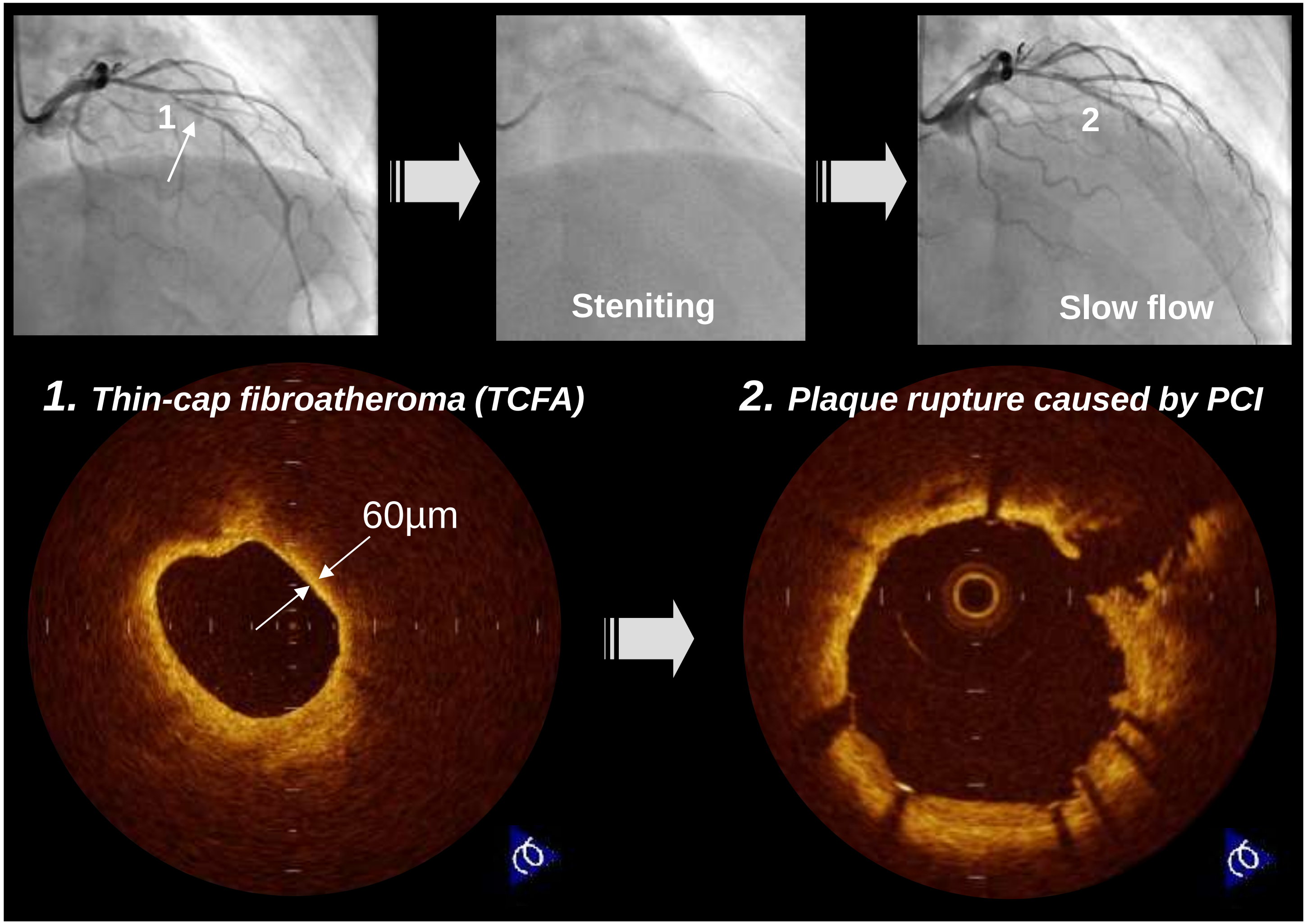


ISA at post-stenting (arrows) resolved at follow-up in EES [(A) Maximum ISA distance = 370 μm to 0 μm; ISA area = 0.71 mm^2 to 0 mm^2; intra-stent lumen area = 7.18 mm2 to 5.91 mm^2]



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

Prediction of angiographic no-reflow



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

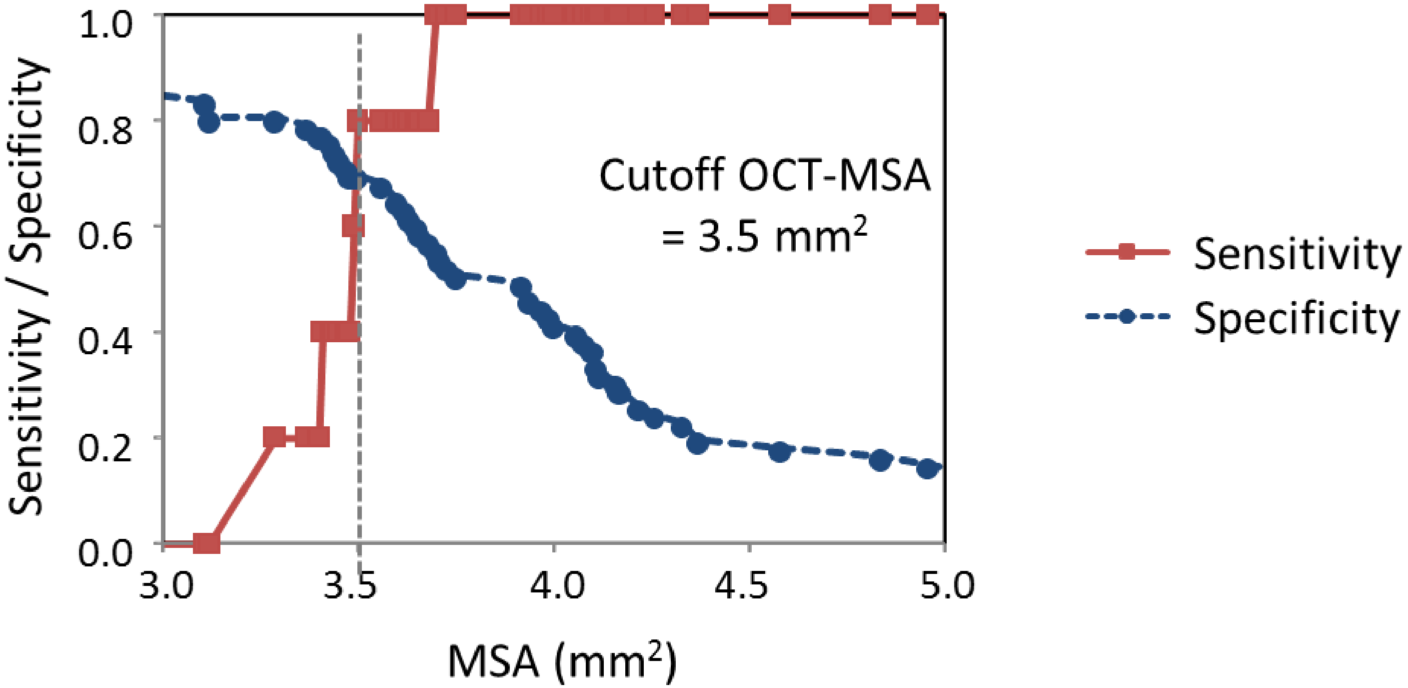
In OCT image at pre-intervention, the culprit lesion presented lipid-rich plaque with thin-fibrous cap.

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.

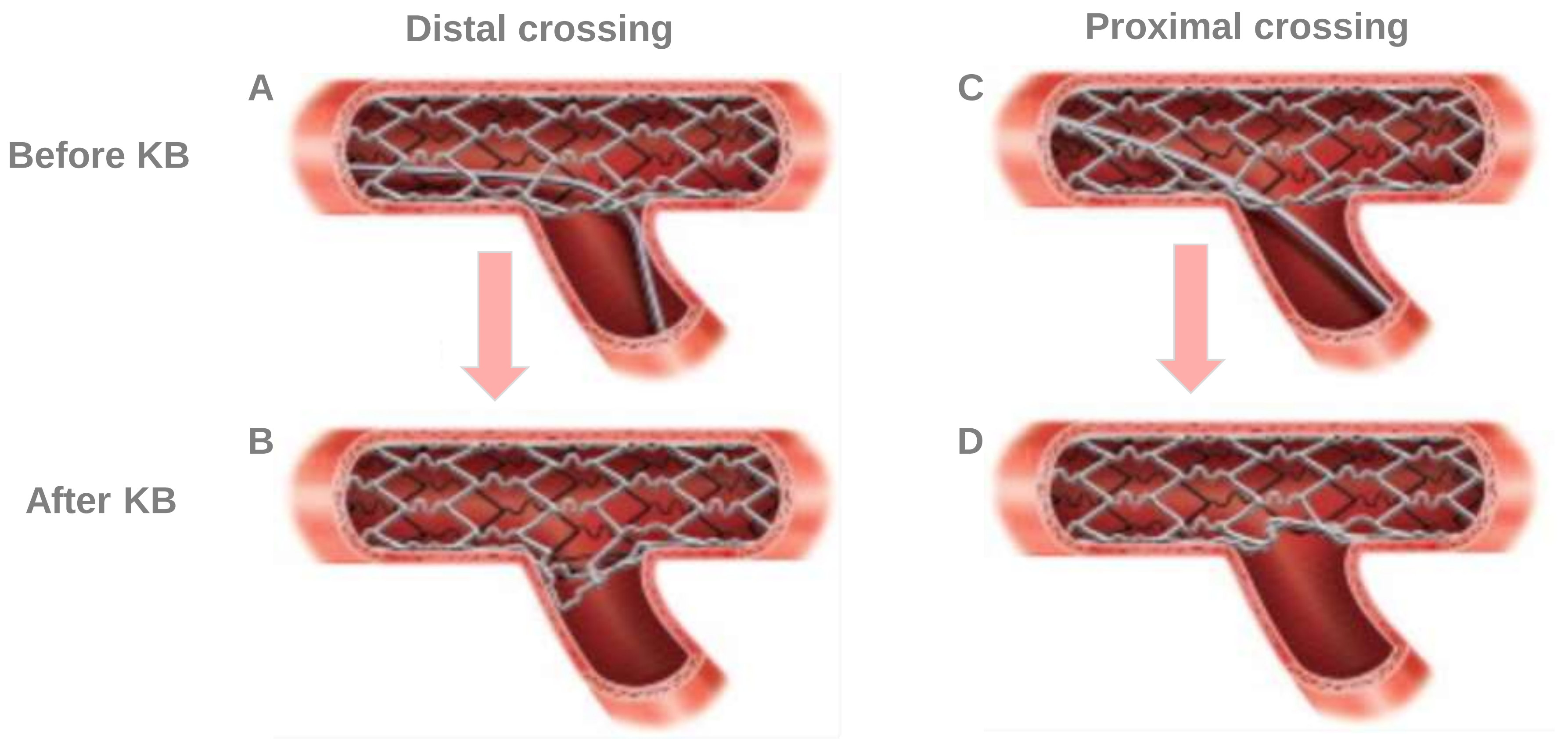
Optimal threshold for MSA in small DES

Relationship between OCT-measured post-intervention MSA and late (9M) ISR was assessed in 69 patients who underwent PCI with 2.5 mm-diameter EES.



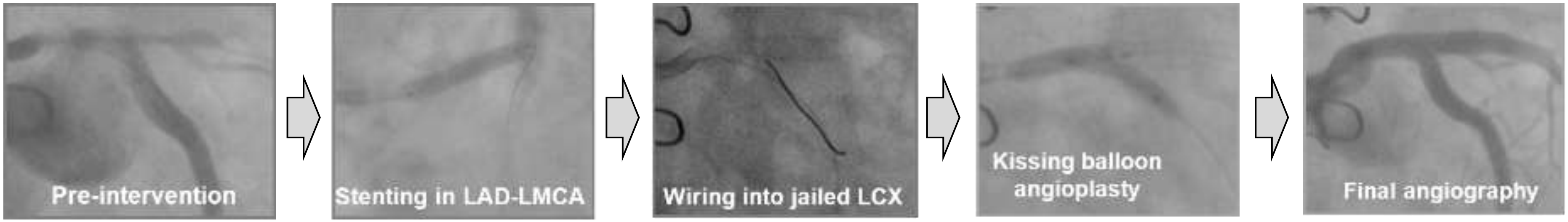
Conclusion: The post-intervention OCT-measured MSA of >3.5 mm^2 was the best cut-off to prevent late ISR after 2.5mm-diameter EES.

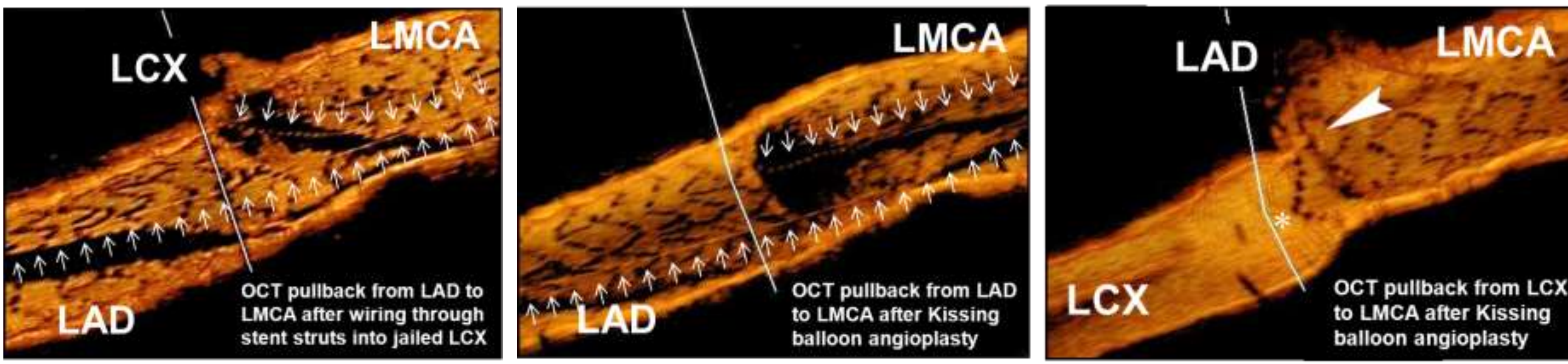
Influence of main vessel stent cell rewiring on stent deformation following KB angioplasty



Access to the side branch through the strut of a stent is usually possible through 2 or 3 different cells. The cell choice affects stent deformation. Bench testing has shown that wire crossing through the strut closest to the carina (A and B) provides better scaffolding of the origin of the side branch than proximal crossing that pushes the struts inward towards the main vessel lumen (C and D).

SJM 3D-OCT in bifurcation angioplasty

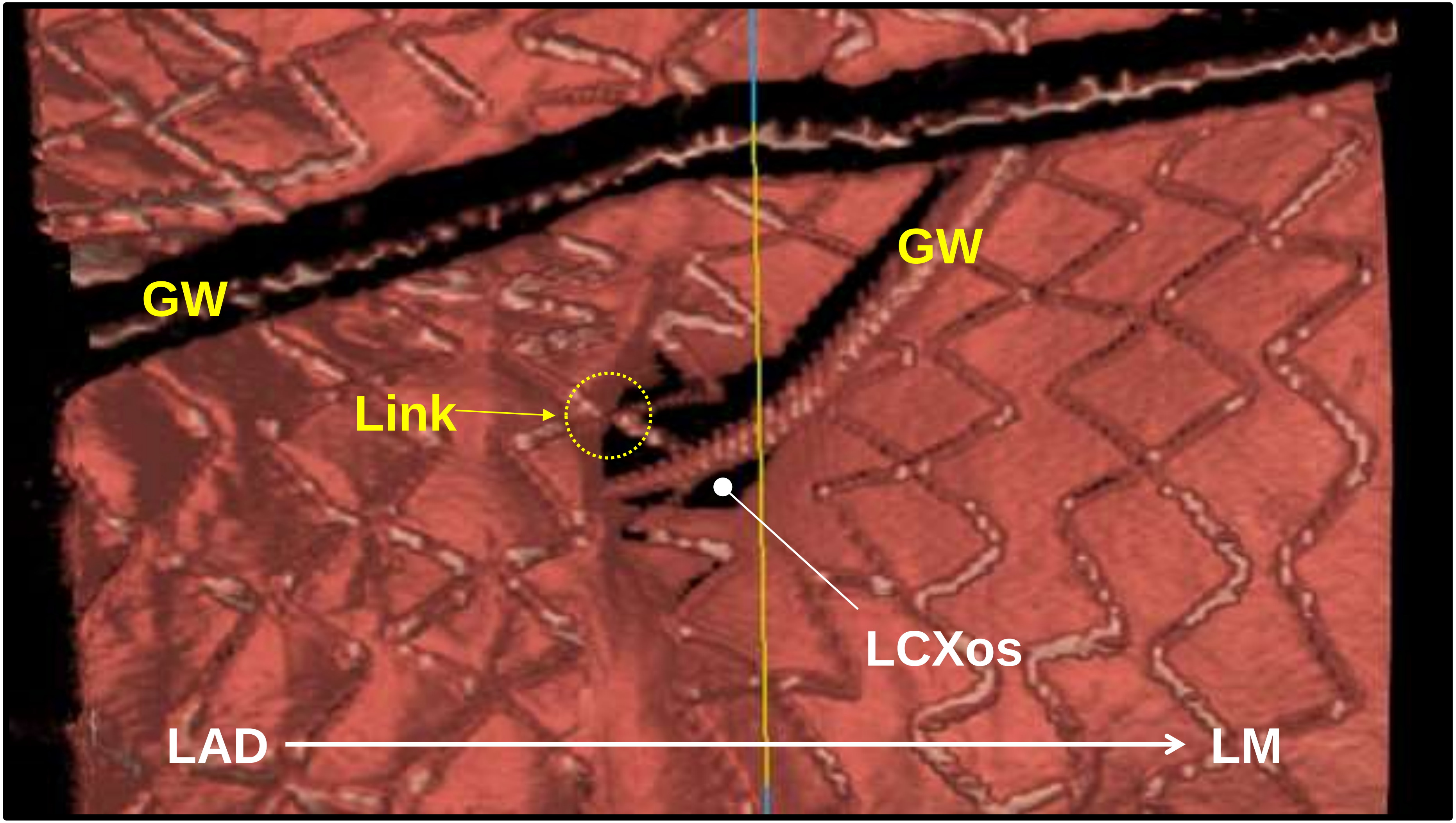




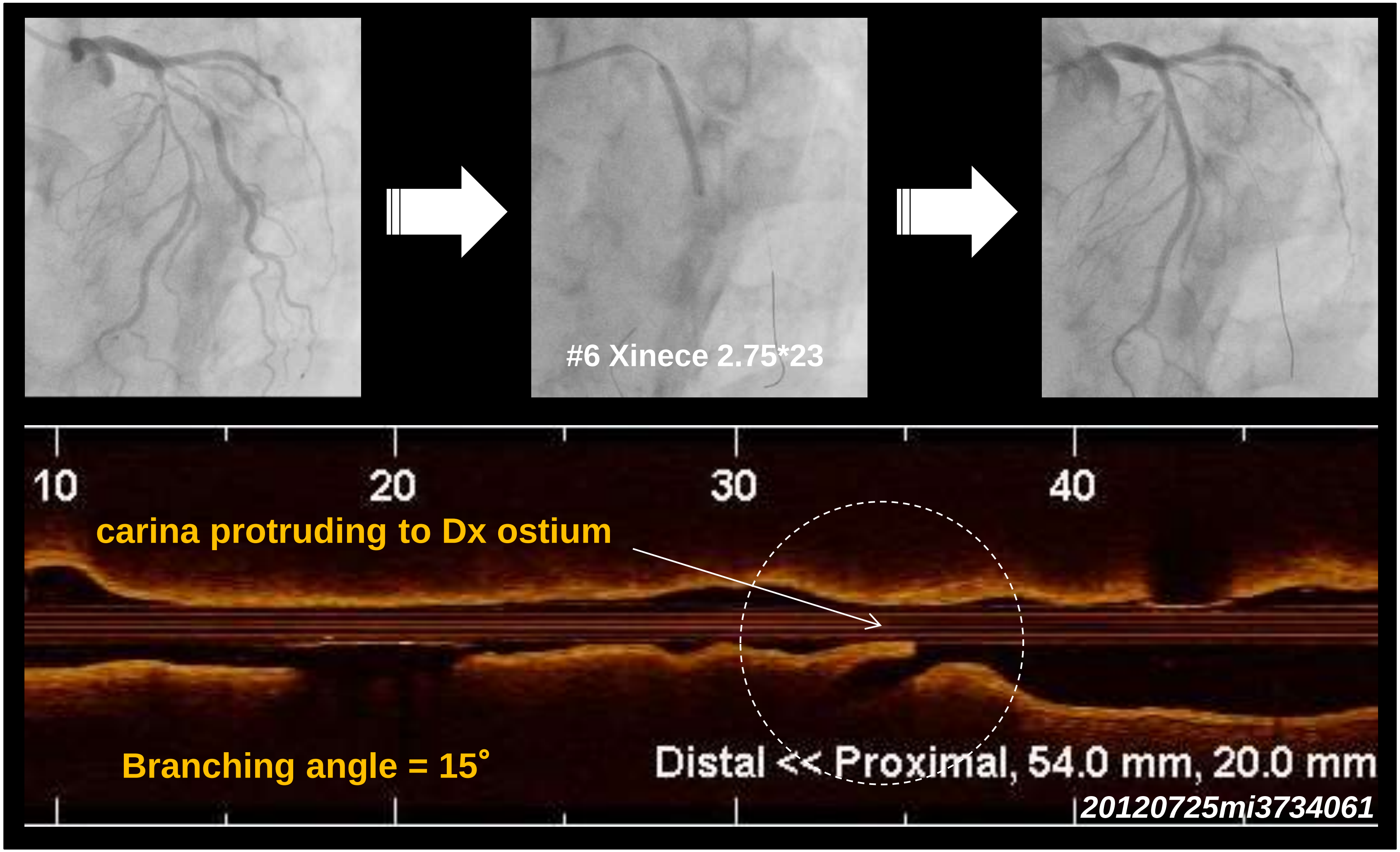
Left main bifurcation disease was treated with a single-stent technique across the left main coronary artery (LMCA) to the proximal left anterior descending coronary artery (LAD). Three-dimensional OCT imaging was useful to guide the rewiring through the distal compartment of the stent struts into jailed left circumflex coronary artery (LCA) after main branch stenting (arrows = guidewire). In addition, 3-dimensional OCT images demonstrated widely opened LCX ostium and well modified stent struts (*) without carina shift (arrow head) after kissing balloon angioplasty.

Terumo 3D-OCT: Carpet view

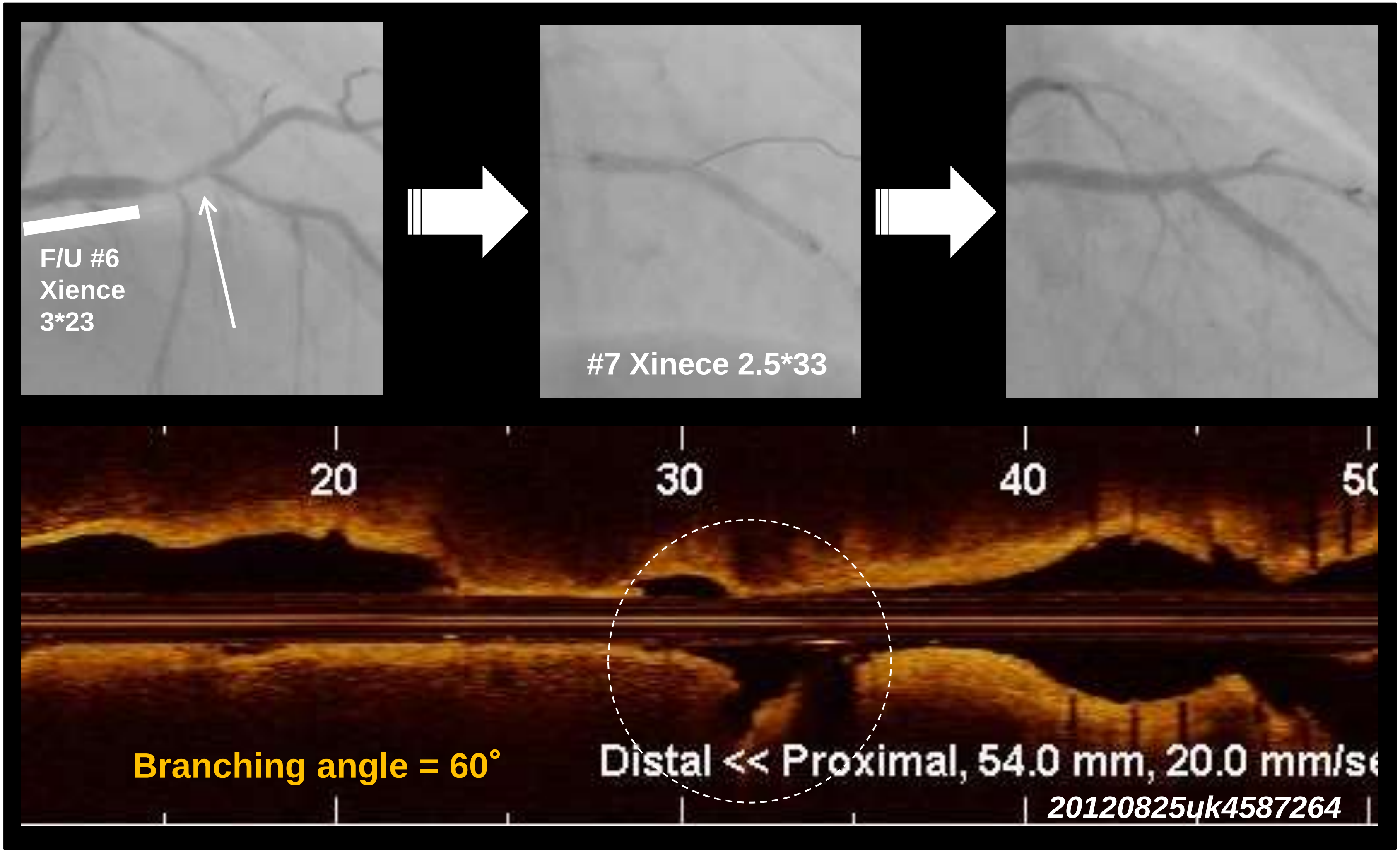
“Link” of stent struts at side branch ostium



Prediction of side-branch occlusion

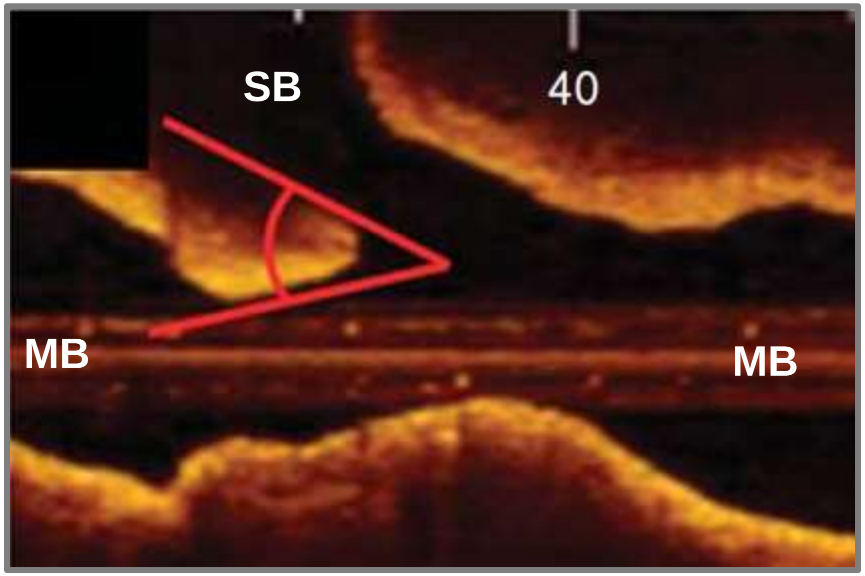


No side-branch occlusion



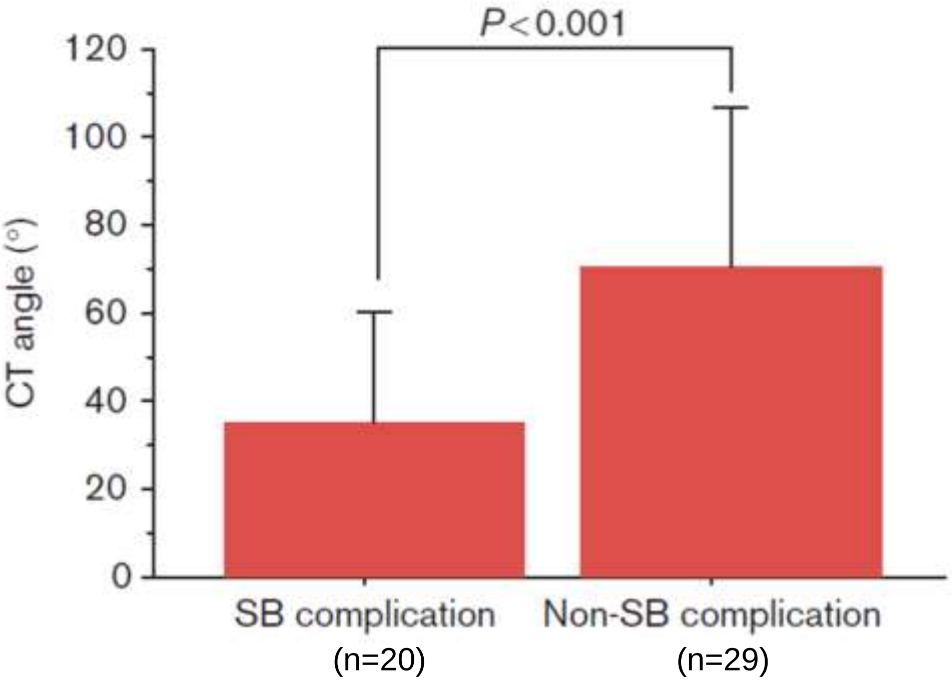
Carina tip angle (CT angle)

Pre-intervention OCT image



Carina tip angle (CT angle)

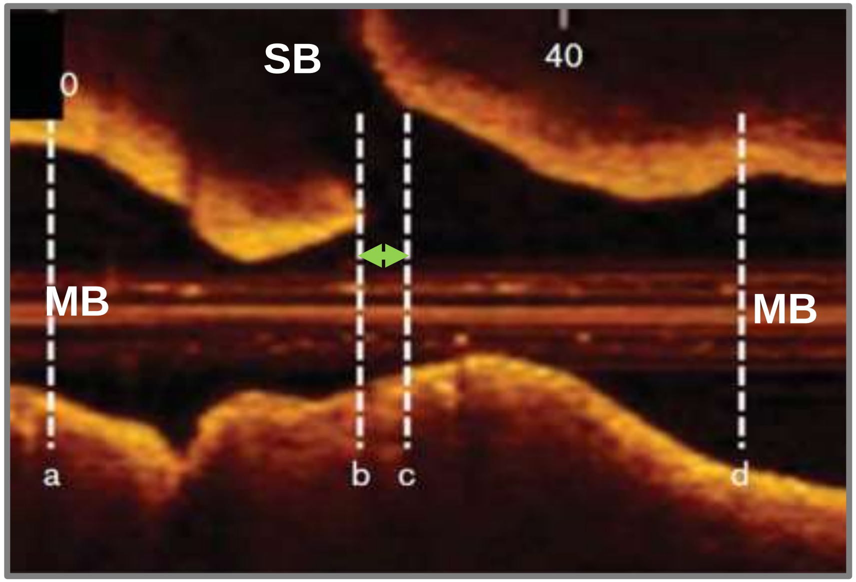
Post main vessel stent implantation



- The ROC curve indicated **CT angle of up to 50°** [area under the curve 0.81; 95% confidence interval: 0.68–0.93; sensitivity: 87%; specificity: 70%; positive predictive value: 66%; negative predictive value: 91%] as the best cutoff values for prediction of SB complication after main vessel stent implantation.

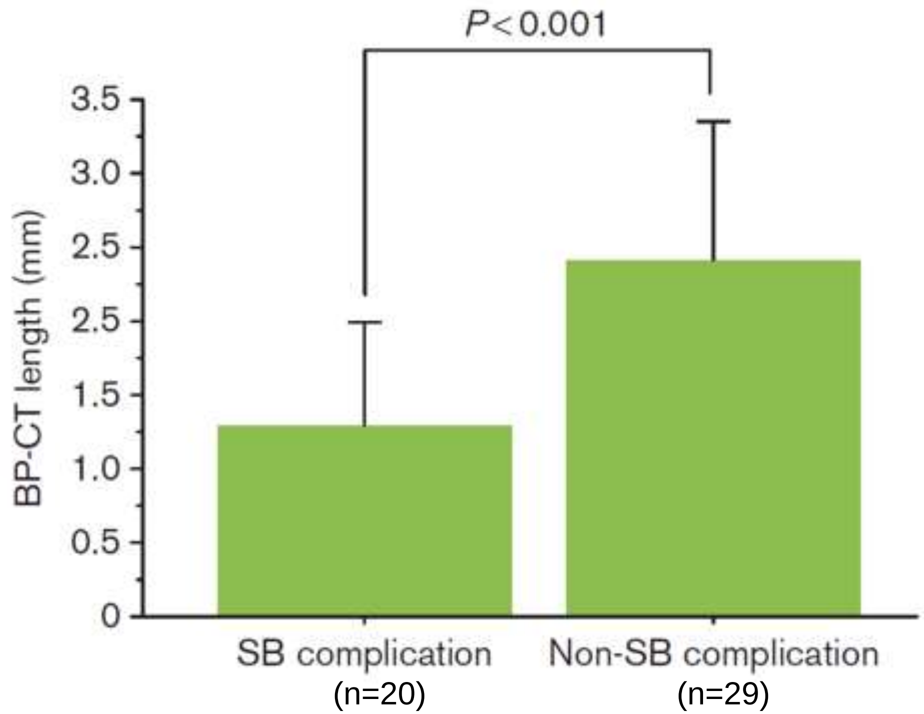
Branching point and the carina tip length (BP-CT length)

Pre-intervention OCT image



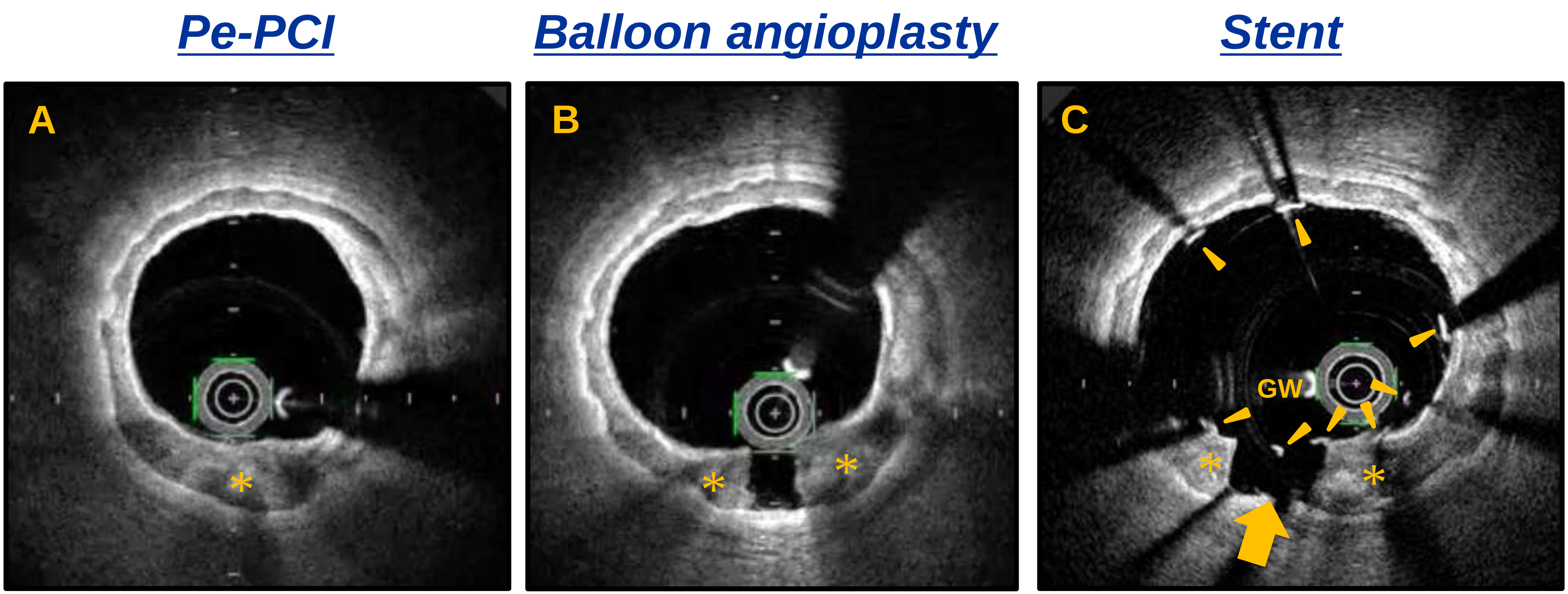
Branching point and the carina tip length (BP-CT length)

Post main vessel stent implantation



- The ROC curve indicated **BP-CT length of up to 1.70 mm** (area under the curve 0.84; 95% confidence interval: 0.74–0.95; sensitivity: 77%; specificity: 77%; positive predictive value: 71%; negative predictive value: 82%) as the best cutoff values for prediction of SB complication after main vessel stent implantation.

Calcium fracture

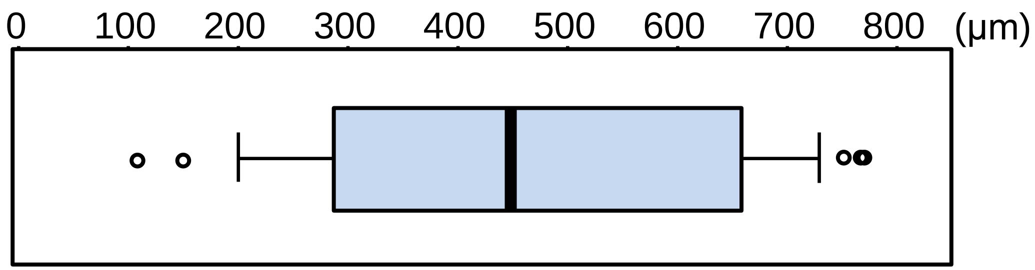


OCT before PCI (A) showed entire circumferential calcium. OCT after balloon angioplasty (B) and after PCI (C) demonstrated calcium fracture (6 o'clock). Thickness of the calcium fracture was 710 μm (arrow). Arrow heads = stent struts; Asterisk = Calcium; GW = guide wire.

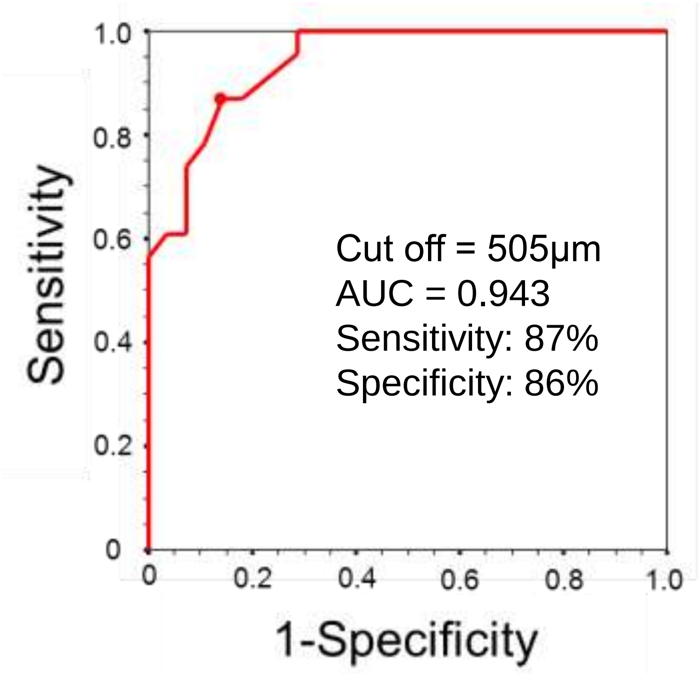
Prediction of calcium plate fracture by ballooning

OFDI was performed to assess vascular response immediately after high pressure ballooning in 61 patients with severe calcified coronary lesion.

Thickness distribution of calcium fracture



Median = 450μm; Lower quartile = 300μm; Upper quartile = 660μm; Minimum = 110μm; and Maximum = 770μm.



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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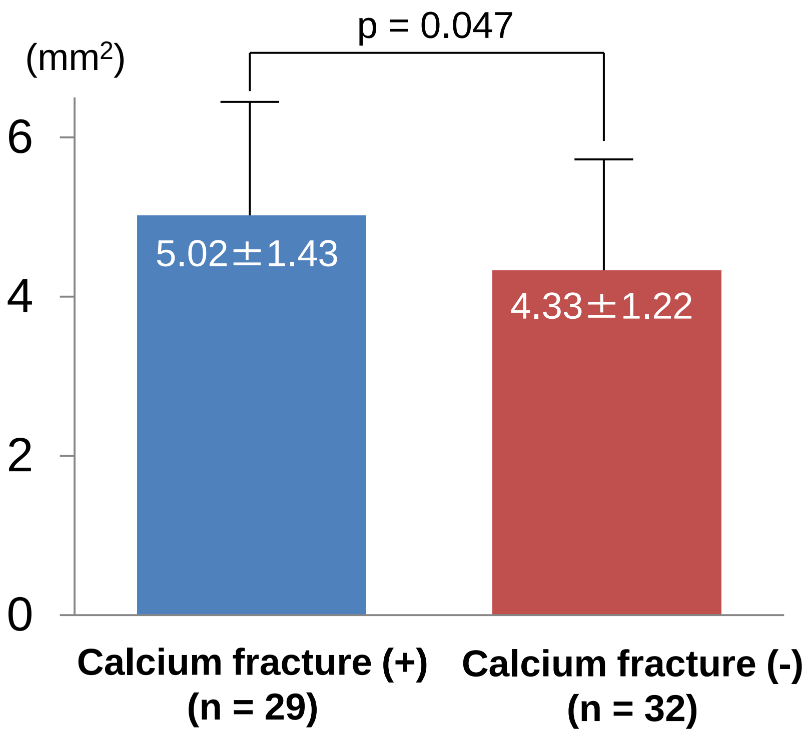
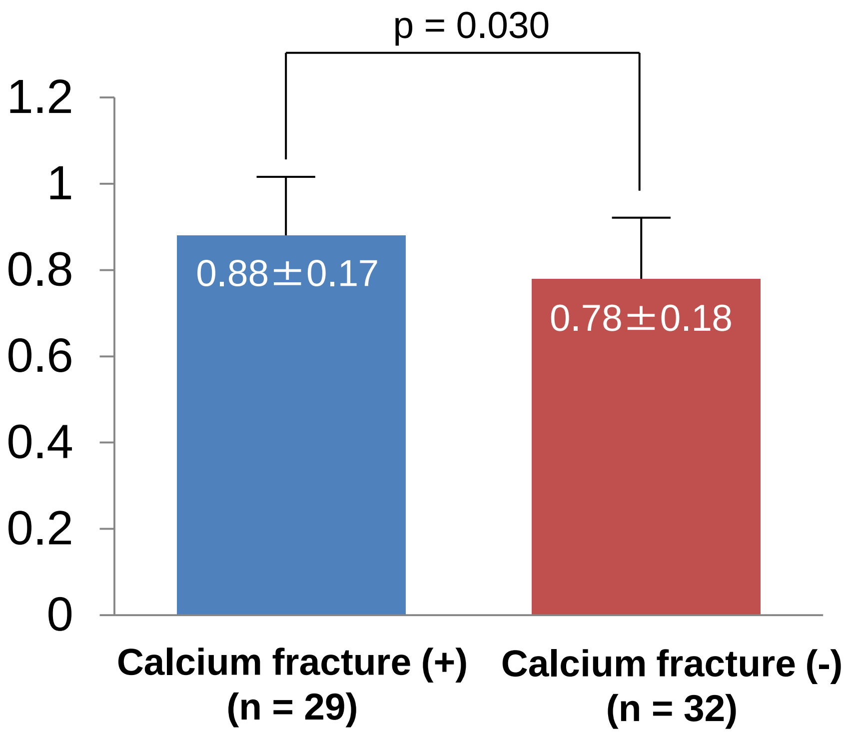
Stent expansion at post-PCI

Minimum stent area



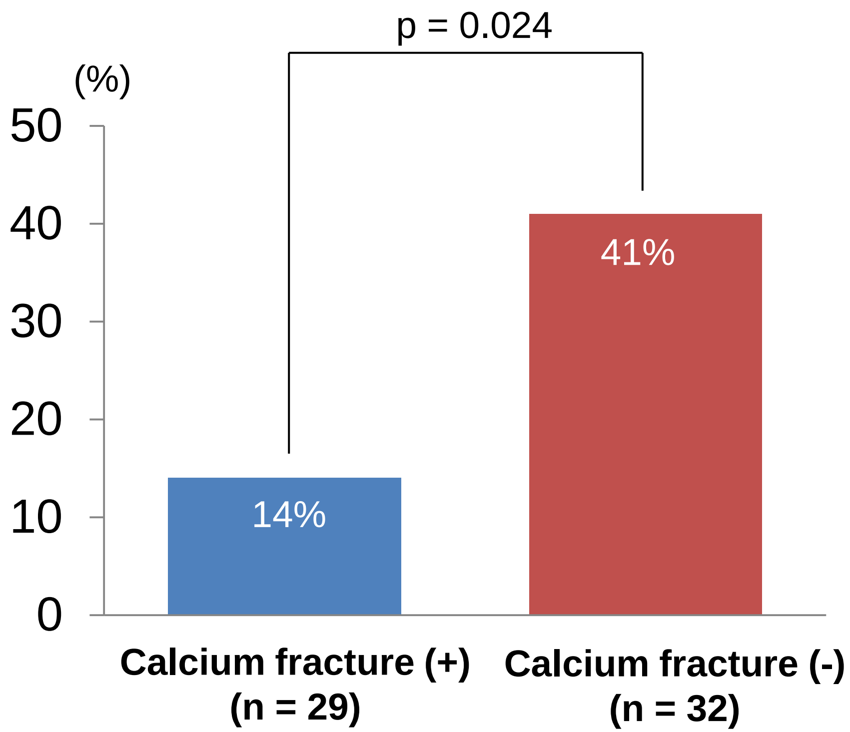
Stent expansion index



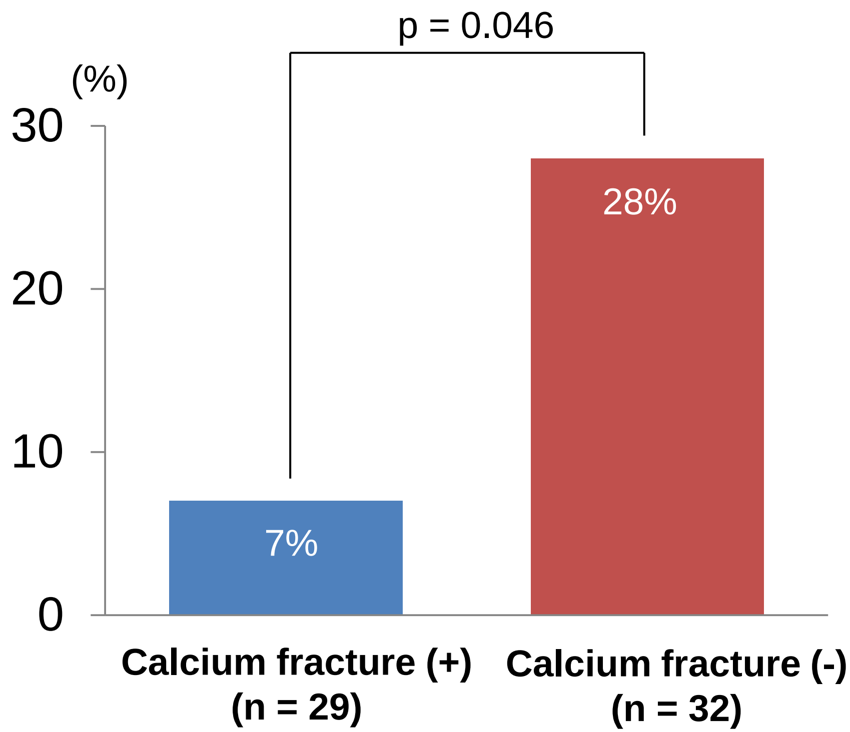
Minimum stent area and stent expansion index were significantly greater in the group with calcium fracture compared with the group without calcium fracture.

Restenosis and TLR at 10 months follow-up

Binary restenosis



Target lesion revascularization



The frequency of binary restenosis and target lesion revascularization was significantly lower in the group with calcium fracture compared with the group without calcium fracture.

Conclusion

- OCT is useful for device sizing and PCI optimization.

Thanks for your attention !