

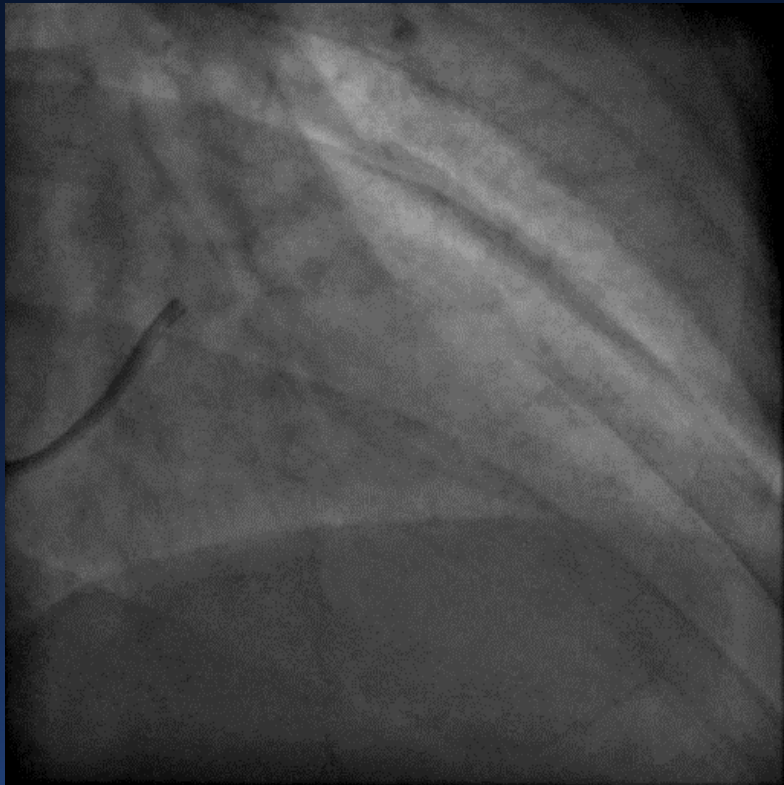
Relationship Between OCT-detected Layered Plaque and Acute Sidebranch Occlusion after Main Vessel Stenting in Coronary Bifurcation Lesions

Gary S. Mintz

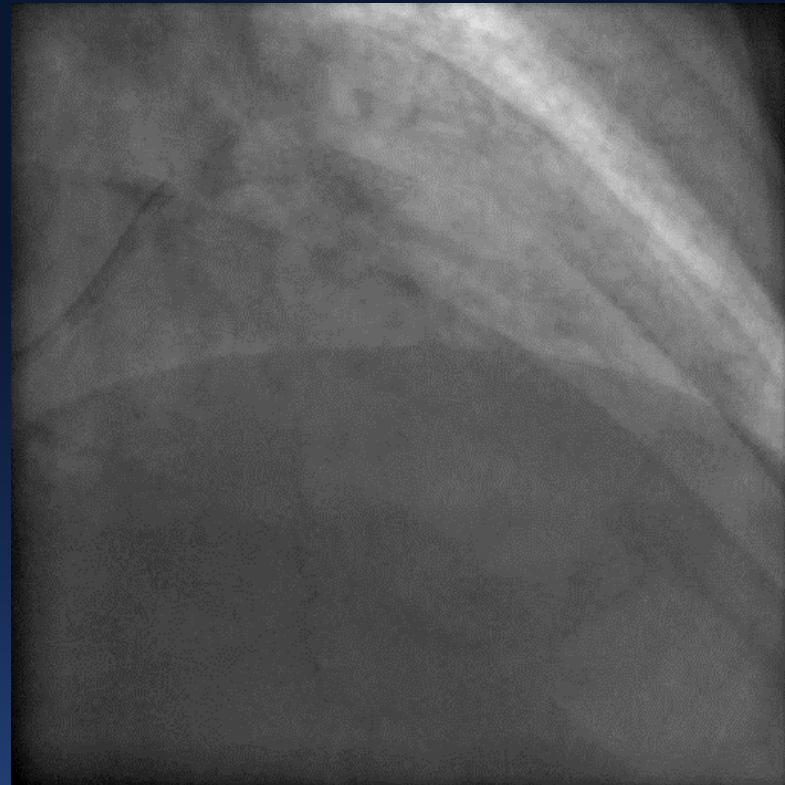
for

Akiko Maehara and Yang Cao

Pre-PCI Angiogram



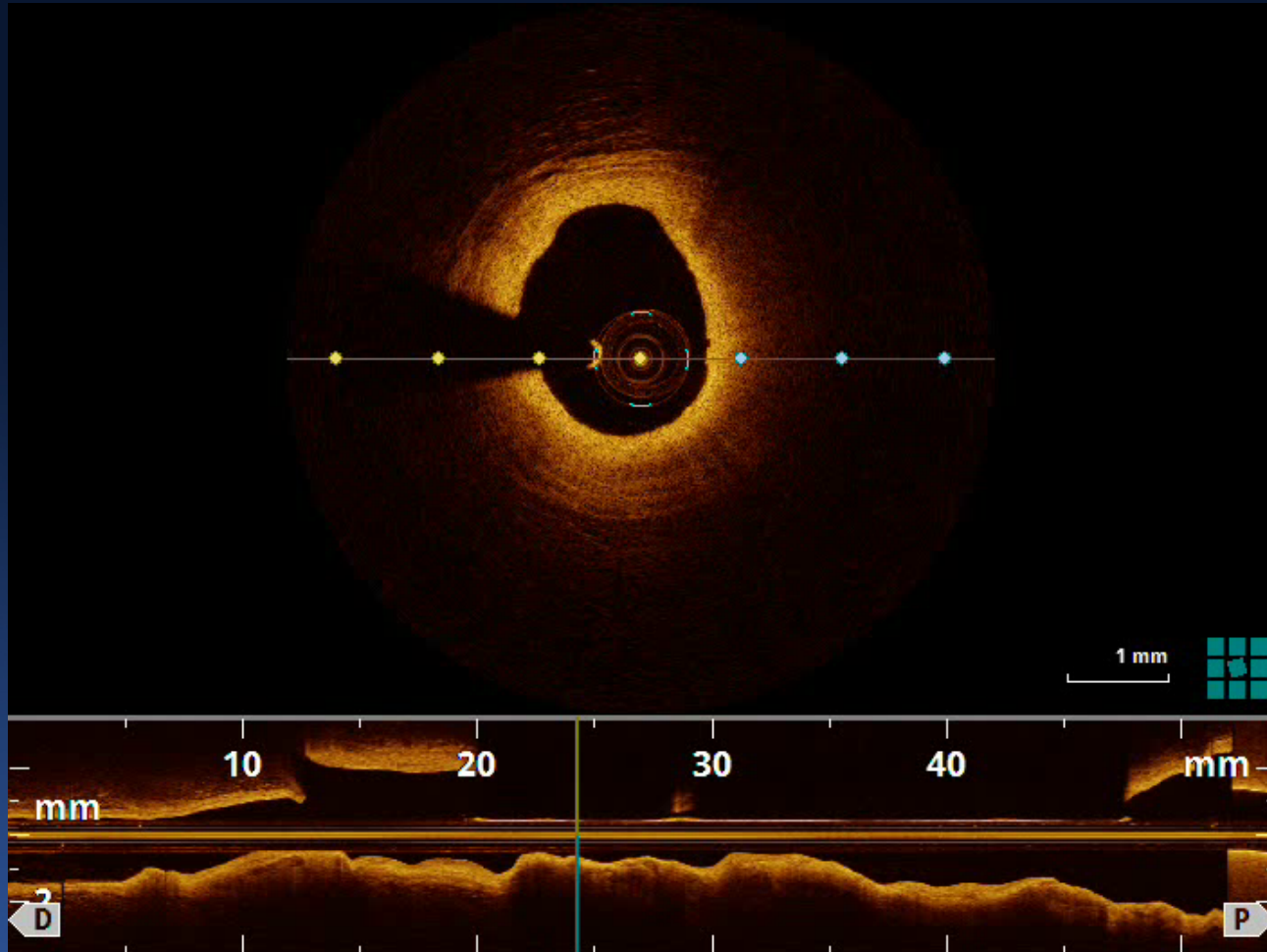
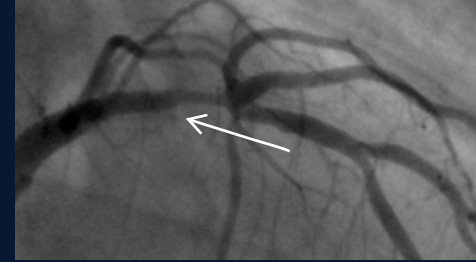
Final Angiogram



Pre-dilation with a 2.5*20mm balloon at unknown pressure.

3.0*24mm DES post-dilated with a 3.0*15mm balloon at 18 atm.

Pre-PCI OCT



This was a retrospective, single-center, observational study to evaluate the association between OCT-assessed plaque at a bifurcation and SB occlusion.

From October 2008 through May 2015, 440 patients with stable angina pectoris underwent PCI with OCT and IVUS before PCI.

The inclusion criteria of this study were: (1) MV diameter of ≥ 2.5 mm and SB diameter ≥ 1.5 mm by angiographic visual estimation; (2) PCI using single-stent crossover; and (3) pre-PCI OCT and IVUS pullback of MV from >5 mm distal to >5 mm proximal to the SB ostium.

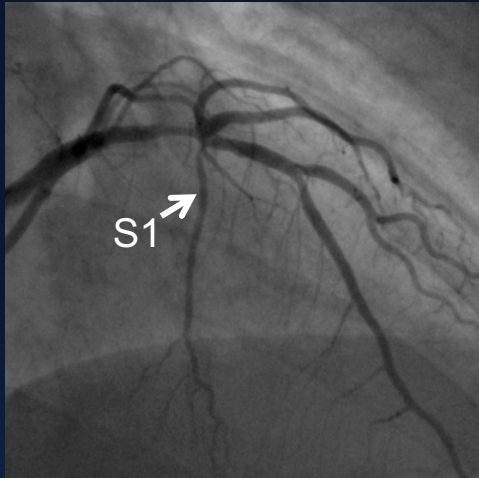
Patient Demographics

	Sidebranch Occlusion		p
	Yes (n=26)	No (n=181)	
Age, yrs	68.7 (60.3, 77.8)	65.9 (60.5, 73)	0.39
Male	15 (88.5)	148 (84.9)	0.63
Diabetes mellitus	11 (42.3)	61 (31.8)	0.28
Hypertension	20 (76.9)	118 (61.5)	0.13
Dyslipidemia	13 (50)	119 (61.9)	0.24
Current or former smoker	6 (23.1)	48 (25.0)	0.83
Renal insufficiency (eGFR<60 mL/min/1.73m ²)	1 (3.8)	4 (15.4)	0.57
Prior percutaneous coronary intervention	10 (38.5)	65 (33.9)	0.64
Prior myocardial infarction	4 (15.4)	52 (2.6)	0.20
Low-density lipoprotein cholesterol, mg/dL	106 (83, 122)	104 (83, 123)	0.55
High-sensitivity C-reactive protein	0.07 (0.001, 0.45)	0.08 (0.001, 0.2)	0.84
Statin usage at admission	14 (53.8)	109 (56.8)	0.78

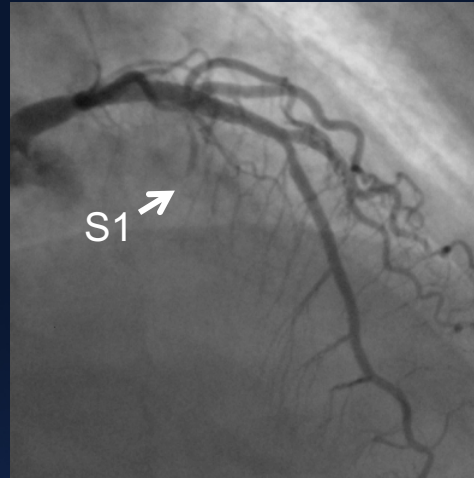
Procedural Details

	Sidebranch Occlusion		p
	Yes (n=26)	No (n=181)	
Mean MV stent diameter (mm)	3.3 (3.0, 3.5)	3.3 (3.0, 3.5)	0.99
Max MV stent diameter (mm)	3.5 (3.0, 3.5)	3.5 (3.0, 3.5)	0.81
MV stent length (mm)	35.5 (27, 52)	28 (23, 38)	0.01
Max pressure (atm)	15 (12, 18)	14 (13, 16)	0.69
DES	21 (80.8)	153 (84.5)	0.41

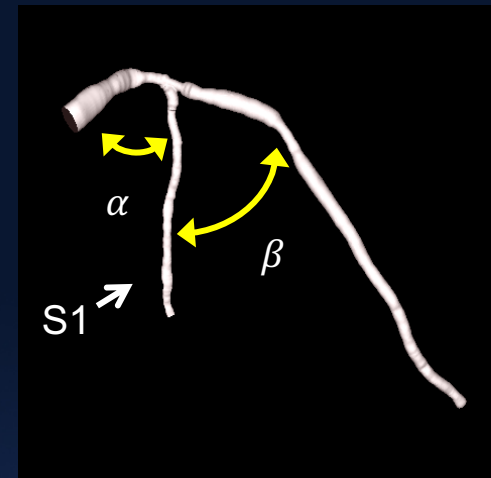
Pre



Post-stent



Pre 3D QCA



Proximal bifurcation angle (between the proximal MV and the SB) and distal bifurcation angle (between the distal MV and the SB) were measured using 3D reconstruction of two angiographic images separated by a viewing angle of $\geq 30^\circ$.

Angiographic Lesion Characteristics

	Sidebranch Occlusion		p
	Yes (n=26)	No (n=181)	
Target lesion location			0.87
LAD	17 (65.4)	116 (64.1)	
LCX	2 (7.7)	22 (12.2)	
RCA	7 (26.9)	45 (23.2)	
True bifurcation Medina 1,1,1; 1,0,1; or 0,1,1	21 (80.7)	98 (54.1)	0.01
Proximal bifurcation angle, °	126 (111, 145)	133 (116, 146)	0.13
Distal bifurcation angle, °	67 (61, 83)	56 (44, 74)	0.003

QCA

	Sidebranch Occlusion		
	Yes (n=26)	No (n=181)	p
Proximal main vessel			
Reference vessel diameter, mm	2.9 (2.6, 3.2)	2.9 (2.7, 3.3)	0.40
Minimum lumen diameter, mm	1.5 (1.2, 1.8)	1.8 (1.3, 2.3)	0.009
Diameter stenosis, %	49.1 (34.0, 59.8)	35.4 (19.9, 54.4)	0.04
Lesion length, mm	9.9 (6.9, 13.0)	8.9 (6.0, 12.9)	0.59
Polygon of confluence			
Reference vessel diameter, mm	2.6 (2.0, 3.2)	2.6 (2.2, 3.0)	0.75
Minimum lumen diameter, mm	1.1 (1.1, 1.7)	1.6 (1.2, 2.0)	0.004
Diameter stenosis, %	50.9 (37.9, 60.5)	38.2 (23.9, 50.9)	0.001
Lesion length, mm	3.1 (2.8, 3.2)	3.1 (2.7, 3.9)	0.62
Distal main vessel			
Reference vessel diameter, mm	2.3 (2.1, 2.6)	2.4 (2.1, 2.7)	0.63
Minimum lumen diameter, mm	1.5 (1.5, 1.8)	1.6 (1.2, 1.9)	0.21
Diameter stenosis, %	39.7 (18.6, 54.2)	33.5 (21.6, 46.7)	0.23
Lesion length, mm	9 (6.7, 14.5)	9.5 (6.9, 12.1)	0.95
Side branch			
Reference vessel diameter, mm	1.6 (1.5, 2.0)	1.8 (1.5, 1.9)	0.13
Minimum lumen diameter, mm	0.9 (0.8, 1.0)	1.1 (0.9, 1.4)	0.008
Diameter stenosis, %	52.0 (41.0, 55.7)	40.0 (26.3, 50.3)	0.0006
Lesion length, mm	9 (6.7, 14.5)	9.5 (6.9, 12.1)	0.95

IVUS Main Vessel Analysis

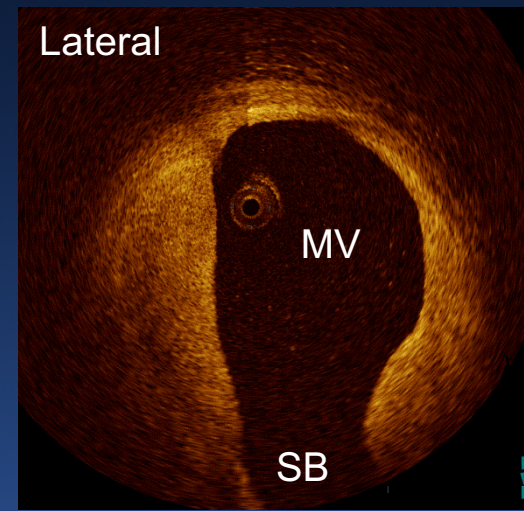
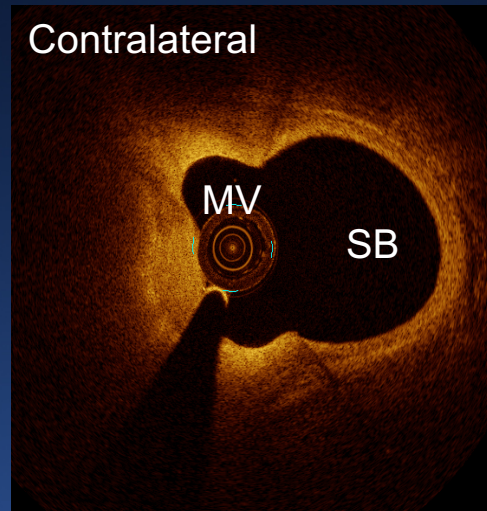
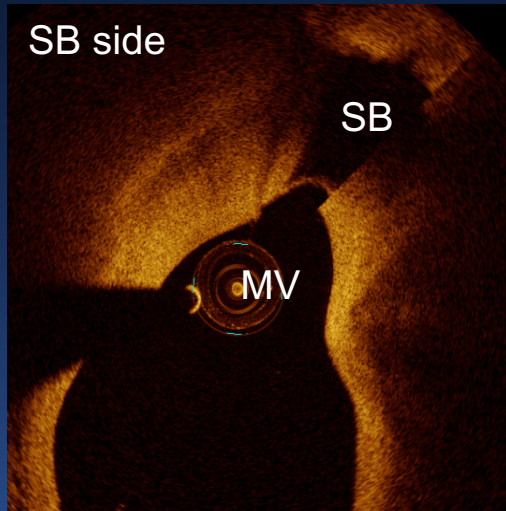
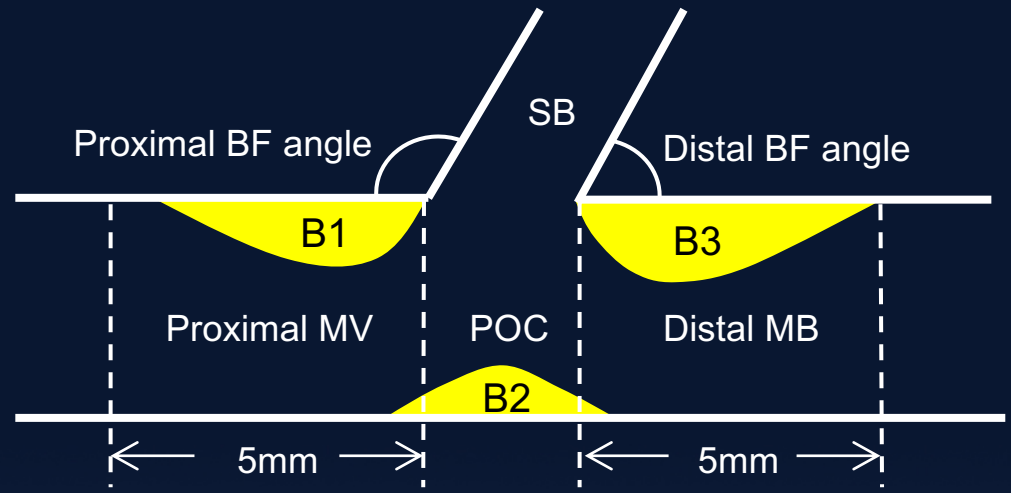
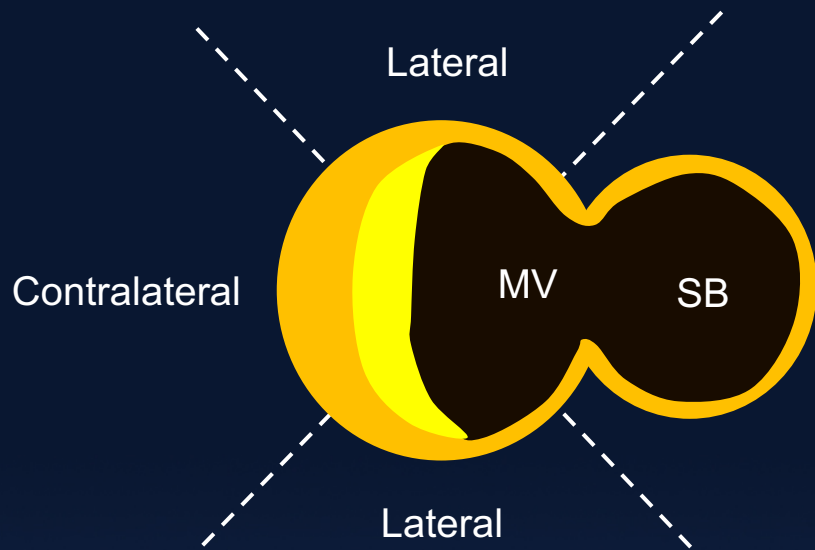
	Sidebranch Occlusion		p
	Yes (n=26)	No (n=181)	
Location of max PB			
Proximal 5 mm	19 (73.1%)	99 (54.7%)	
POC	3 (11.5%)	18 (9.9%)	0.13
Distal 5 mm	4 (15.4%)	64 (35.4%)	
Proximal main vessel			
Plaque burden, %	82.5 (75.7, 86.3)	74.5 (67.2, 83.3)	0.03
Lumen area, mm ²	2.5 (1.9, 3.3)	3.4 (2.3, 4.9)	0.03
Max PB in POC	78.4 (66.7, 82.3)	70.0 (57.9, 77.6)	0.02
Distal main branch			
Plaque burden, %	74.2 (66.0, 80.1)	71.4 (60.3, 81.3)	0.50
Lumen area, mm ²	2.5 (2.0, 3.8)	3.1 (2.1, 4.4)	0.20

PB=plaque burden

POC=polygon of confluence

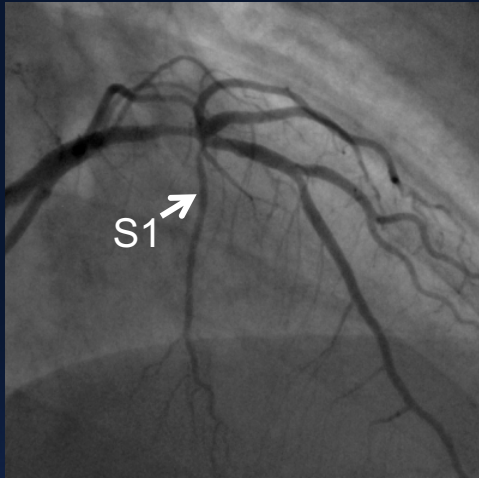
OCT Analysis - I

	Sidebranch Occlusion		p
	Yes (n=26)	No (n=181)	
Prevalence of plaque rupture	4 (15.4%)	23 (12.1%)	0.71
Prevalence of thin-cap fibroatheroma	6 (23.1%)	40 (22.1%)	0.91
Cap thickness, μm	88.5 (67, 130)	110 (70, 150)	0.10
Prevalence of lipidic plaque	125 (48.1%)	878 (48.5%)	0.90
Lipid volume index, degree \times mm			
Proximal segment	611 (545, 725)	409 (225, 678)	0.02
Distal segment	316 (201, 377)	361 (166, 558)	0.41
Prevalence of calcified plaque	67 (25.8%)	452 (25%)	0.78
Calcium volume index, degree \times mm			
Proximal segment	119 (69, 295)	169 (65, 332)	0.70
Distal segment	75 (51, 407)	106 (57, 251)	0.80

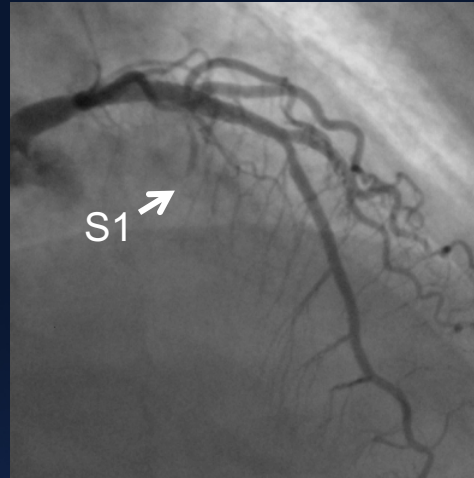


Layered plaque had a homogeneous intensity in a layered pattern with underlying lipidic or attenuated plaque having a different OCT intensity

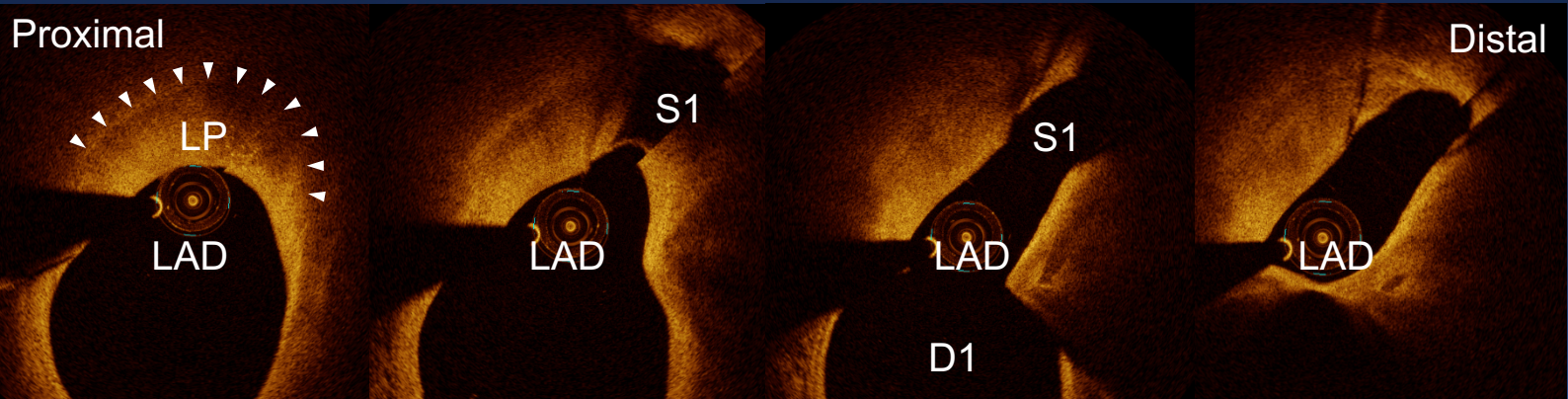
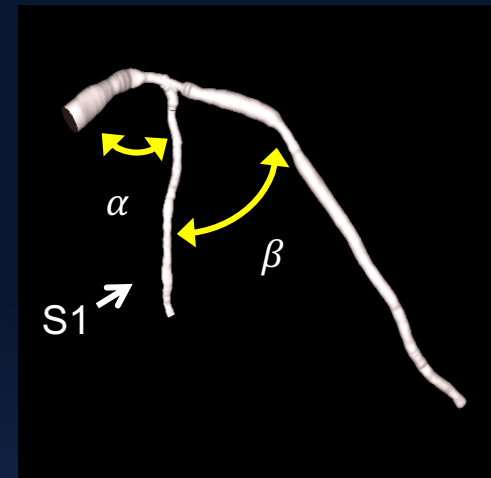
Pre



Post-stent



Pre 3D QCA

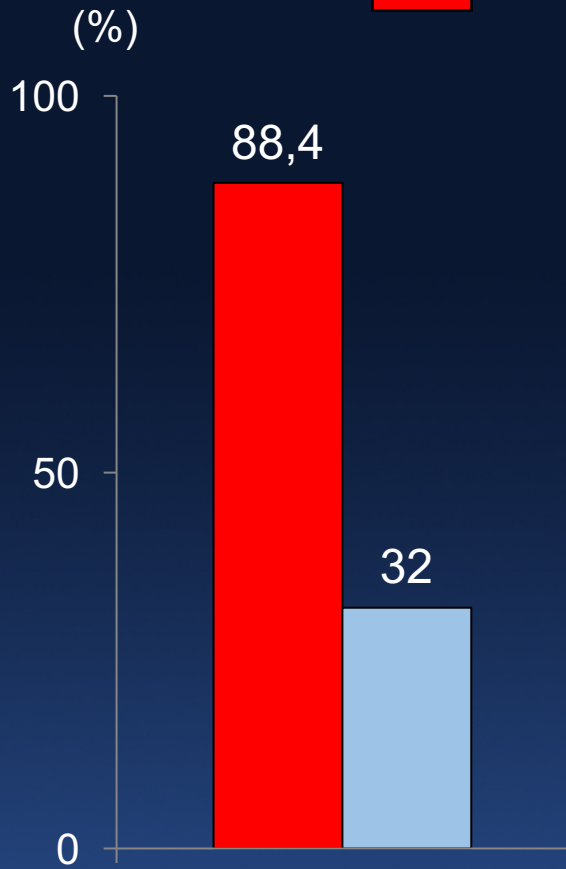


OCT Analysis - II

	Sidebranch Occlusion		p
	Yes (n=26)	No (n=181)	
Prevalence of layered plaque	23 (88.4%)	61 (33.7%)	<0.0001
Circumferential distribution of layered plaque			
SB side	17 (73.9%)	13 (21.3%)	
Lateral side	5 (21.7%)	26 (42.6%)	<0.0001
Contralateral side	1 (4.4%)	22 (36.1%)	
Longitudinal distribution of layered plaque			
Proximal segment	16 (69.6%)	23 (37.7%)	
POC	4 (17.4%)	20 (32.8%)	0.009
Distal segment	3 (13.0%)	18 (29.5%)	
Layered plaque length, mm	3.0 (2.5, 3.5)	2.5 (1.5, 3)	0.001
Maximum layered plaque area, mm ²	1.5 (1.1, 2.0)	1.2 (0.8, 1.7)	0.06
Maximum layered plaque thickness, mm	0.6 (0.5, 0.7)	0.5 (0.4, 0.6)	0.03

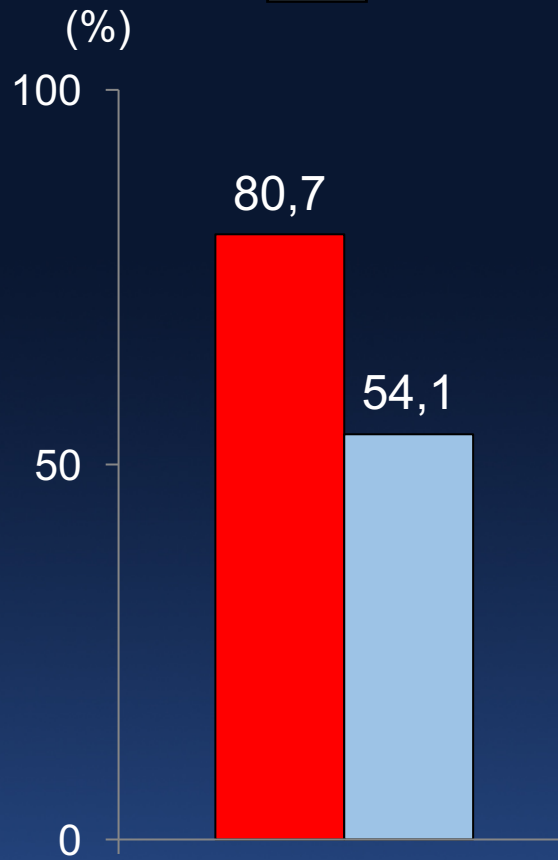
Independent Predictors of SB Occlusion

■ SB Occlusion ■ No SB Occlusion



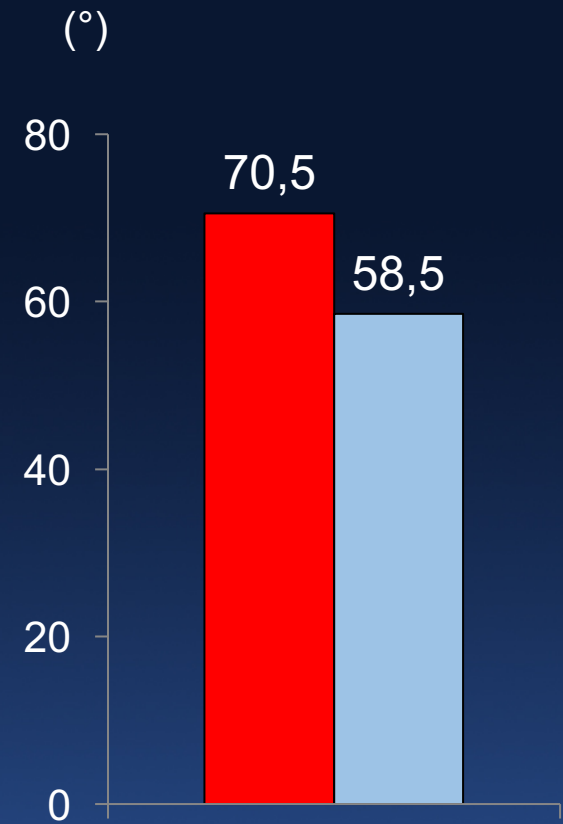
Layered plaque

OR 18.8 [5.1-68.8]
 $P < 0.0001$



True bifurcation

OR 4.9 [1.7-14.3]
 $P = 0.004$



Distal bifurcation angle

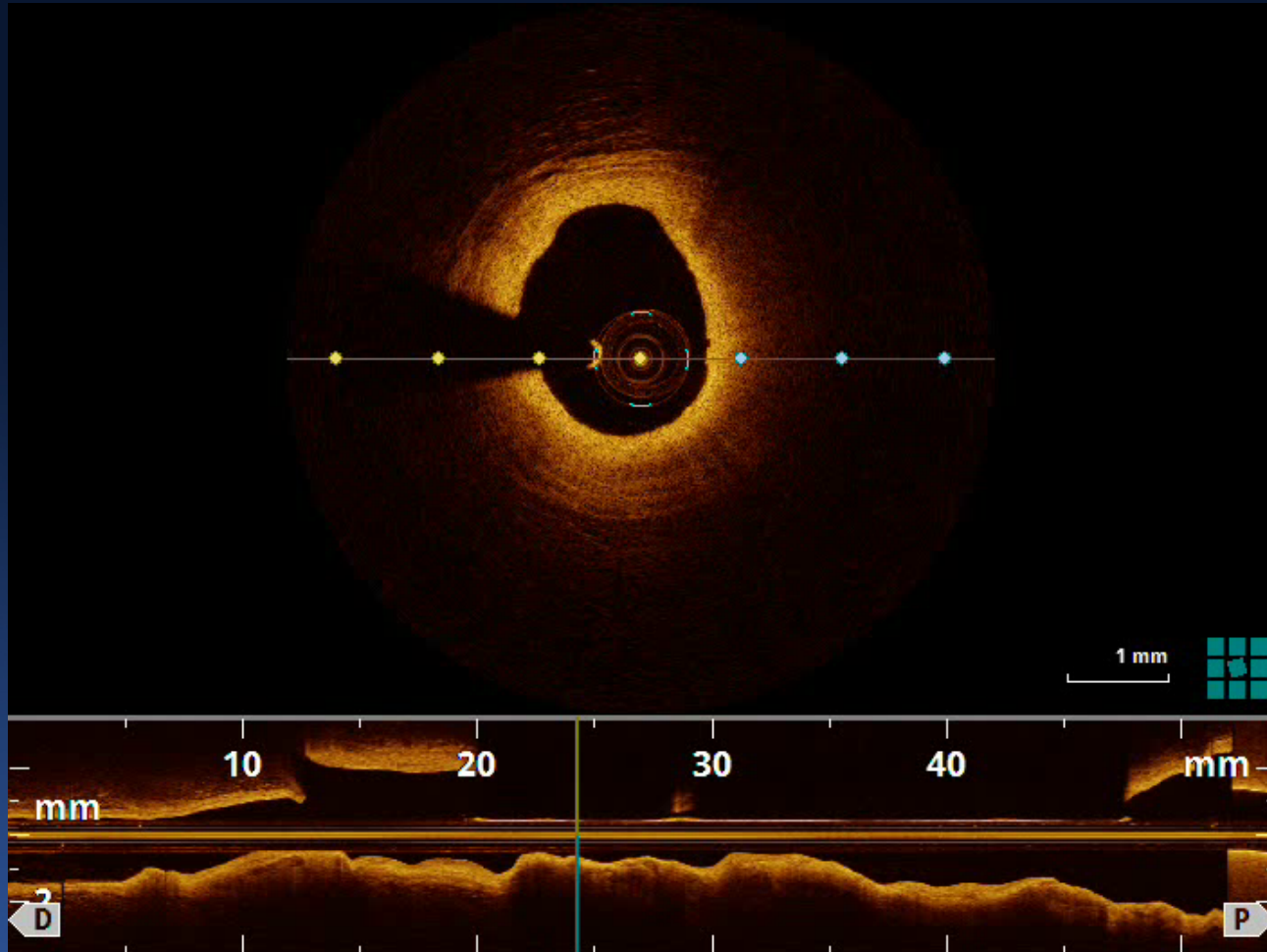
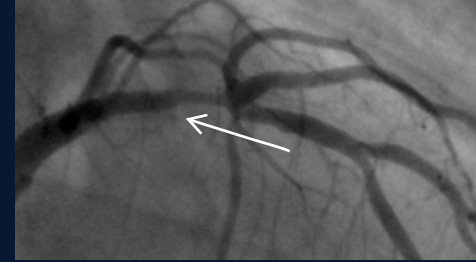
OR 1.0 [1.1-1.8]
 $P = 0.004$

- The best cutoff value for layered plaque length was 2.3 mm; PPV of 95.7%, NPV of 47.5%, sensitivity of 95.5%, AUC of 0.75
- The best cutoff value for maximum layered plaque thickness was 0.68 mm; PPV of 48%, NPV of 83.6%, AUC of 0.65
- The best cutoff value of the distal bifurcation angle from 3D angiographic analysis was 65.5°
- Maximum PB within the MV segment was not chosen as an independent predictor in the multivariate logistic regression model ($P=0.57$).

- Peak post-procedural CK-MB was higher in patients with SB occlusion compared to those without SB occlusion (27.0 [16.5, 43.5] vs 13.0 [10.0, 16.8] U/L, $P < 0.0001$) as was the prevalence of CK-MB $\geq 5 \times$ ULN (24% [6/25] vs 3.3% [6/181], $P < 0.0001$).
- However, the prevalence of SCAI defined peri-procedural MI was low and not statistically different (4.0% [1/25] vs 0.6% [1/181], $P = 0.11$) between the patients with vs without SB occlusion.

- An OCT-detected layered plaque was significantly associated with SB occlusion after single-stent crossover to treat a bifurcation lesion – especially, a layered plaque that was located at the SB side and in the proximal MV where layered plaques were also thicker and longer.
- Together with the presence of a layered plaque, a true bifurcation lesion (Medina 1,1,1; 1,0,1; or 0,1,1) and a larger distal bifurcation angle were all independent predictors of acute SB occlusion after crossover MV stenting.

Pre-PCI OCT



Final OCT

