Optimal MSA for LM Crush Technique:

New Criteria Any Difference in Any 2 Stent Technique?

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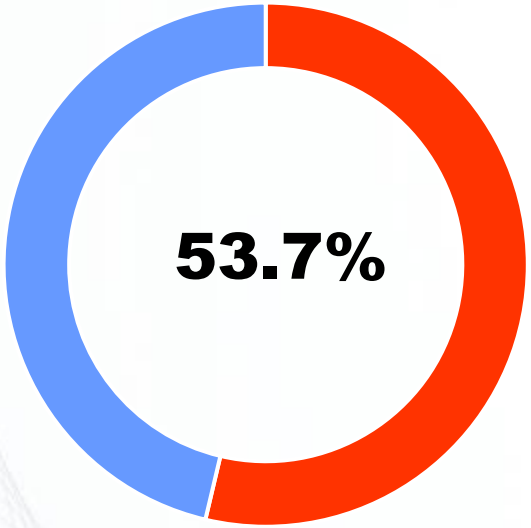
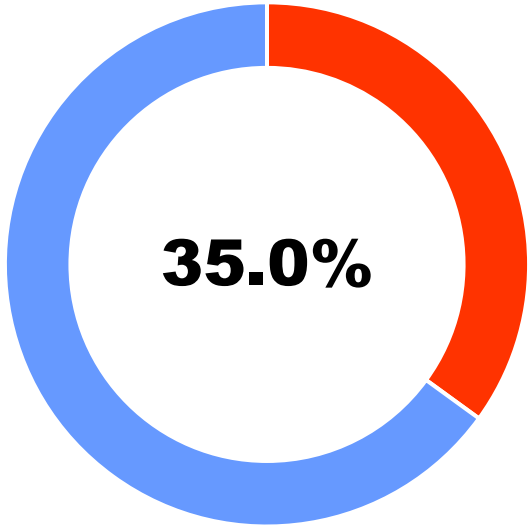
Two Stent Technique in Randomized Trials

PRECOMBAT Trial



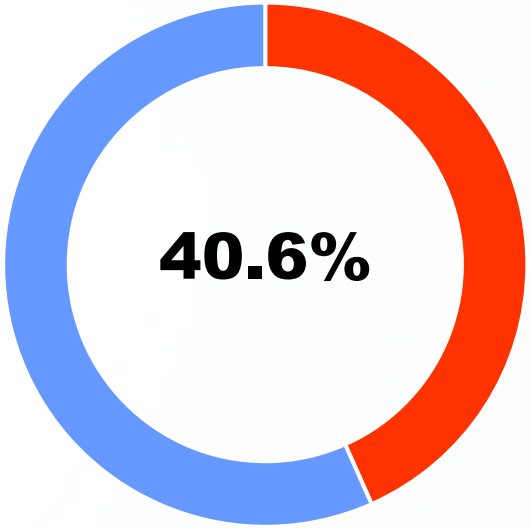
Crush Technique

EXCEL Trial



T Stenting

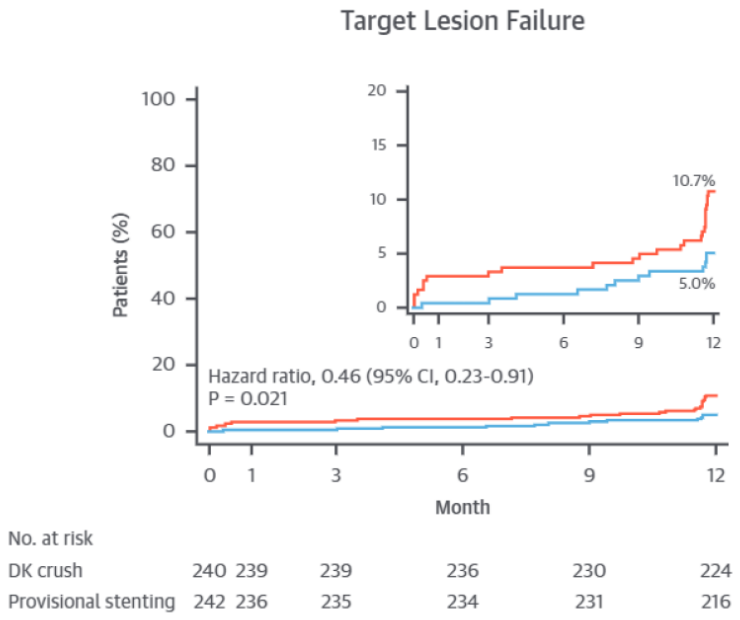
NOBLE Trial



Culotte

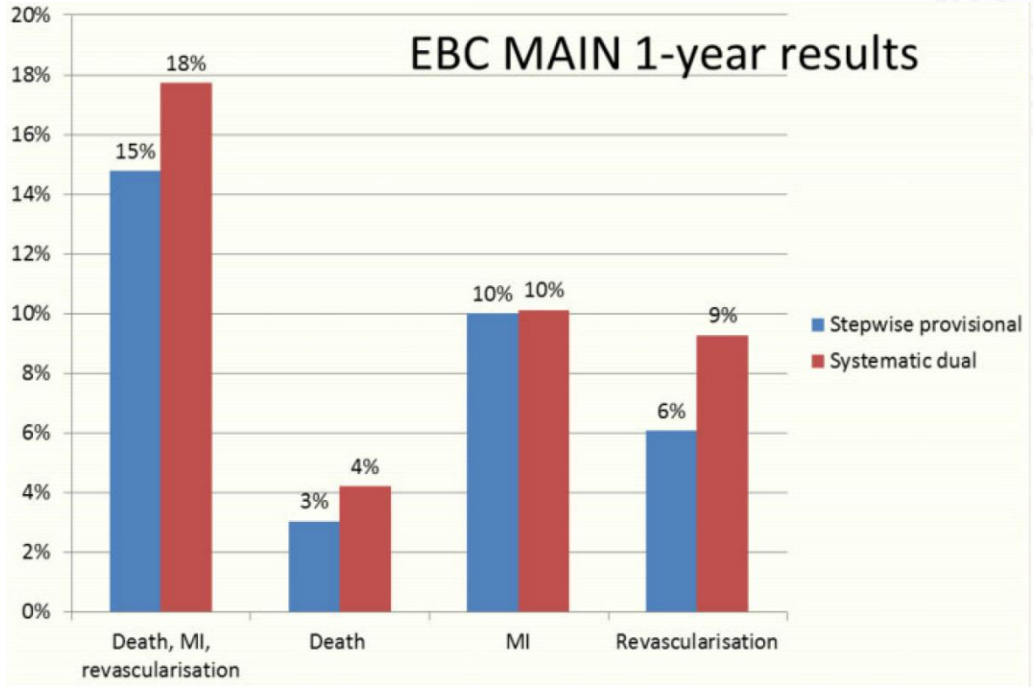
Randomized Trials For True LM Bifurcation

DK-CRUSH V Trial favored DK-CRUSH



Two Stenting: 47%
in Provisional Group

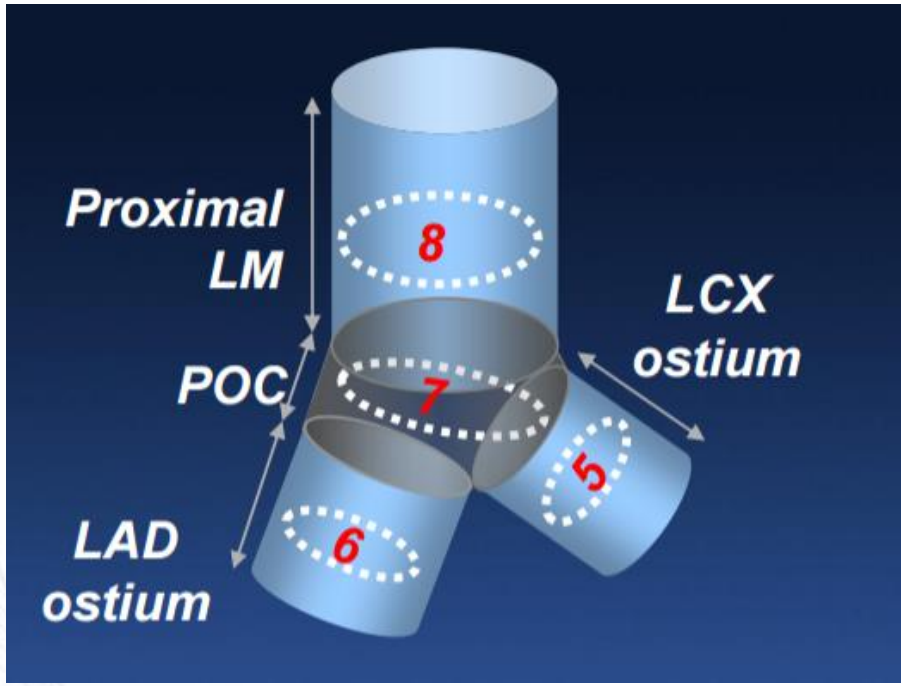
EBC-MAIN Trial favored One-Stenting

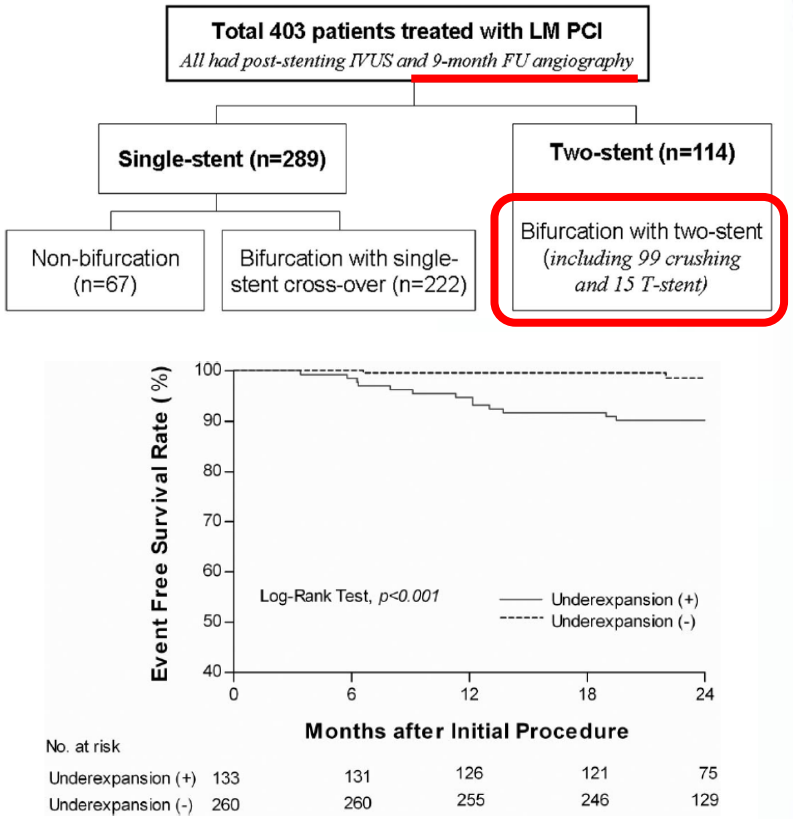


Two Stenting: 22%
in Provisional Group

LM IVUS MSA Criteria

Asan Medical Center Criteria

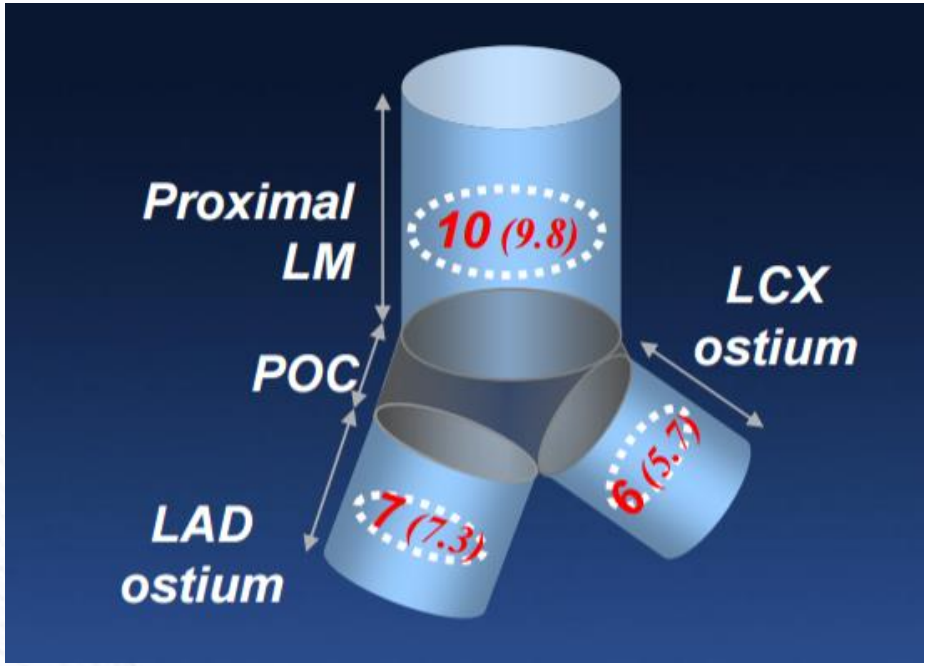




Kang SJ, et al. Circ Cardiovasc Interv 2011;4:562-9

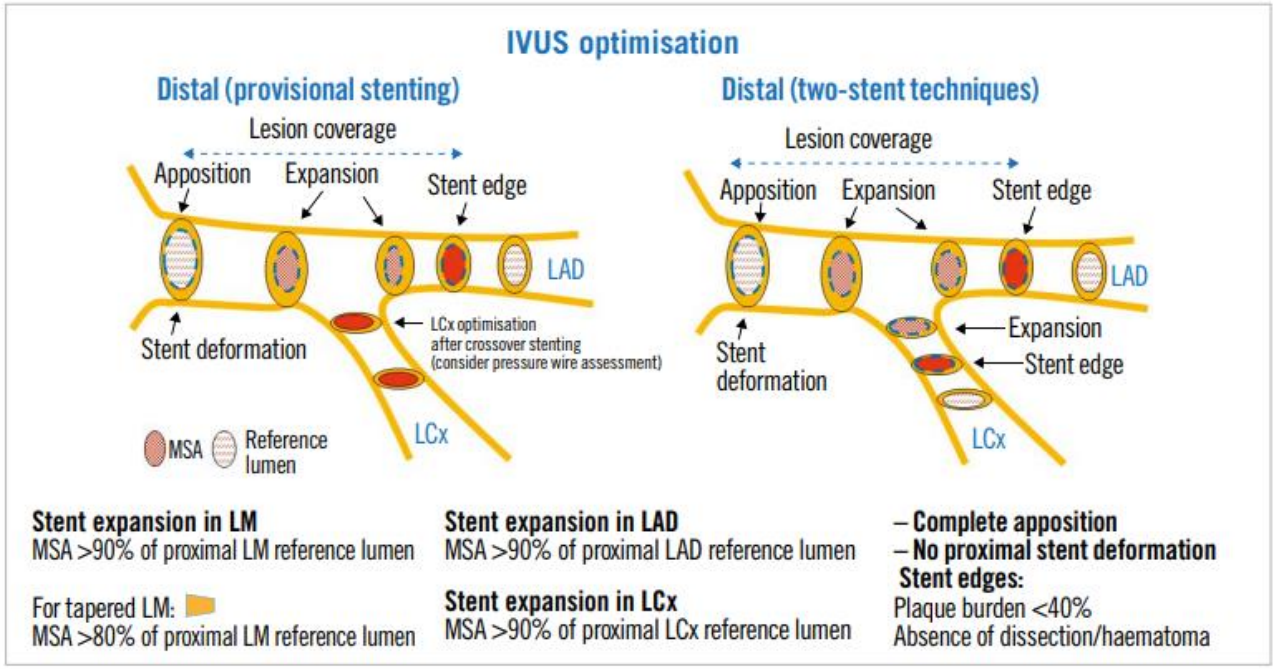
LM IVUS Optimization Criteria

EXCEL Criteria



EXCEL Trial Analysis
A. Maehara TCT 2018

Spain Registry Criteria

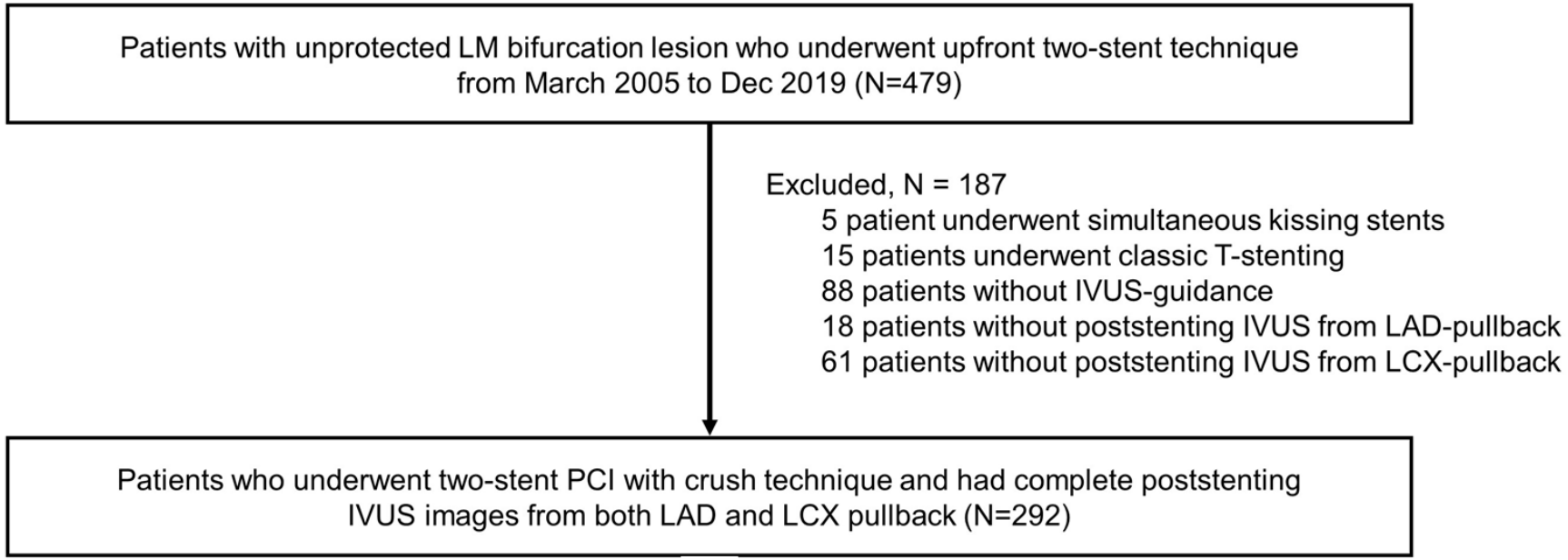


EuroIntervention. 2020 Jun 25;16(3):210-217

Optimal MSA Criteria For LM Crush Technique Based on Long-Term (5-Year) Clinical Outcomes

292 Patients
- Treated By Crush Technique
- Complete IVUS Imaging

35 MACES at 5 Years



Circulation Cardiovascular Intervention in Revision

Baseline Characteristics

Variables	Total (n = 292)	MACE (-) (n=257)	MACE (+) (n=35)	P value
Age, year	64.0 ± 9.9	64.2 ± 9.8	63.0 ± 10.3	0.50
Male sex	224 (76.7%)	197 (76.7%)	27 (77.1%)	>0.99
Current smoker	57 (19.5%)	46 (17.9%)	11 (31.4%)	0.10
Hypertension	194 (66.4%)	173 (67.3%)	21 (60.0%)	0.50
Diabetes	98 (33.6%)	83 (32.3%)	15 (42.9%)	0.29
Dyslipidemia	187 (64.0%)	166 (64.6%)	21 (60.0%)	0.73
LVEF, %	62.2	62.7	60.0	0.11
LVH	72 (25.8%)	57 (23.3%)	15 (44.1%)	0.02
2-vessel disease	163 (55.8%)	141 (54.9%)	22 (62.9%)	
3-vessel disease	129 (44.2%)	116 (45.1%)	13 (37.1%)	
Medina classification				0.71
1,1,1	222 (76.0%)	197 (76.7%)	25 (71.4%)	
0,1,1	49 (16.8%)	42 (16.3%)	7 (20.0%)	
1,0,1	12 (4.1%)	11 (4.3%)	1 (2.9%)	
1,1,0	9 (3.1%)	7 (2.7%)	2 (5.7%)	

Circulation Cardiovascular Intervention in Revision

Procedural Characteristics

Variables	Total (n = 292)	MACE (-) (n=257)	MACE (+) (n=35)	P value
Pre-lesion modification	252 (86.0%)	221 (86.0%)	30 (85.7%)	>0.99
Total stent number	2.7 ± 0.8	2.7 ± 0.8	2.7 ± 0.7	0.83
Main branch				
Number of stents	1.5 ± 0.7	1.6 ± 0.7	1.5 ± 0.6	0.75
Mean stent diameter, mm	3.6 ± 0.3	3.7 ± 0.3	3.6 ± 0.3	0.28
Length of stents, mm	28.0 ± 6.1	28.1 ± 6.2	27.5 ± 6.0	0.61
Post-dilation with NC balloon	260 (89.3%)	230 (89.8%)	30 (85.7%)	0.65
Post-dilation, balloon size	3.7 ± 0.4	3.7 ± 0.4	3.6 ± 0.4	0.21
Maximal applied pressure	20.6 ± 4.7	20.6 ± 4.6	20.7 ± 5.2	0.87
Side branch				
Number of stents	1.1 ± 0.4	1.1 ± 0.4	1.1 ± 0.4	0.92
Mean stent diameter, mm	3.1 ± 0.3	3.1 ± 0.3	3.1 ± 0.3	0.97
Length of stents, mm	21.8 ± 7.1	21.4 ± 7.0	24.3 ± 7.6	0.02
Post-dilation with NC balloon	245 (84.5%)	217 (84.8%)	28 (82.4%)	0.91
Post-dilation, balloon size	3.0 ± 0.3	3.1 ± 0.3	3.0 ± 0.3	0.05
Maximal applied pressure	17.8 ± 4.8	17.7 ± 4.8	18.7 ± 4.5	0.24
Final kissing balloon inflation	292 (100%)	257 (100%)	35 (100%)	>0.99
Second Generation DES	240 (82.2%)	212 (82.5%)	7 (80.0%)	>0.99

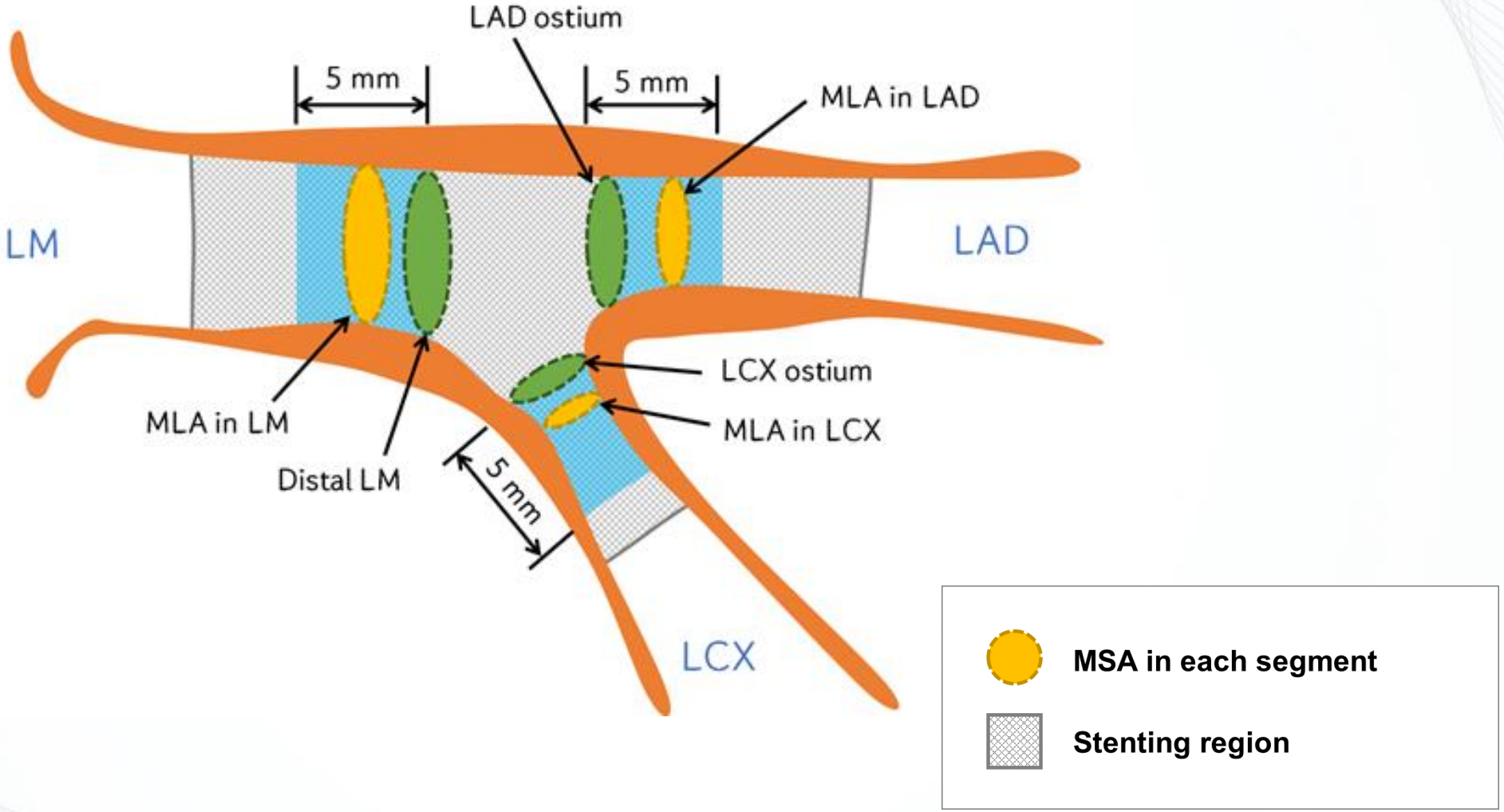
Circulation Cardiovascular Intervention in Revision

IVUS Findings

Variables	**Total (n = 292)**	**MACE (-) (n=257)**	**MACE (+) (n=35)**	P value
Distal LM				
MSA, mm^2	10.9 ± 2.2	11.0 ± 2.2	10.4 ± 2.0	0.14
EEM area at the MSA site, mm^2	23.8 ± 4.1	23.9 ± 4.2	22.9 ± 4.1	0.18
MSA < 11.8 mm^2	189 (64.7%)	163 (63.4%)	26 (74.3%)	0.28
Stent expansion index	46.4 ± 7.2	46.4 ± 7.3	46.0 ± 7.0	0.73
LAD ostium				
MSA, mm^2	8.2 ± 1.7	8.2 ± 1.7	7.6 ± 1.2	0.004
EEM area at the MSA site, mm^2	17.3 ± 3.4	17.4 ± 3.4	16.5 ± 3.2	0.11
MSA < 8.3 mm^2	161 (55.1%)	133 (51.8%)	28 (80.0%)	0.003
Stent expansion index	47.7 ± 7.6	47.8 ± 7.9	46.7 ± 5.7	0.27
LCX ostium, by LCX pullback				
MSA, mm^2	5.9 ± 1.4	6.0 ± 1.5	5.3 ± 1.1	0.007
EEM area at the MSA site, mm^2	13.2 ± 3.2	13.3 ± 3.0	12.8 ± 4.0	0.53
MSA < 5.8 mm^2	141 (48.3%)	116 (45.1%)	25 (71.4%)	0.006
Stent expansion index	45.7 ± 8.6	46.0 ± 8.5	43.4 ± 8.6	0.08

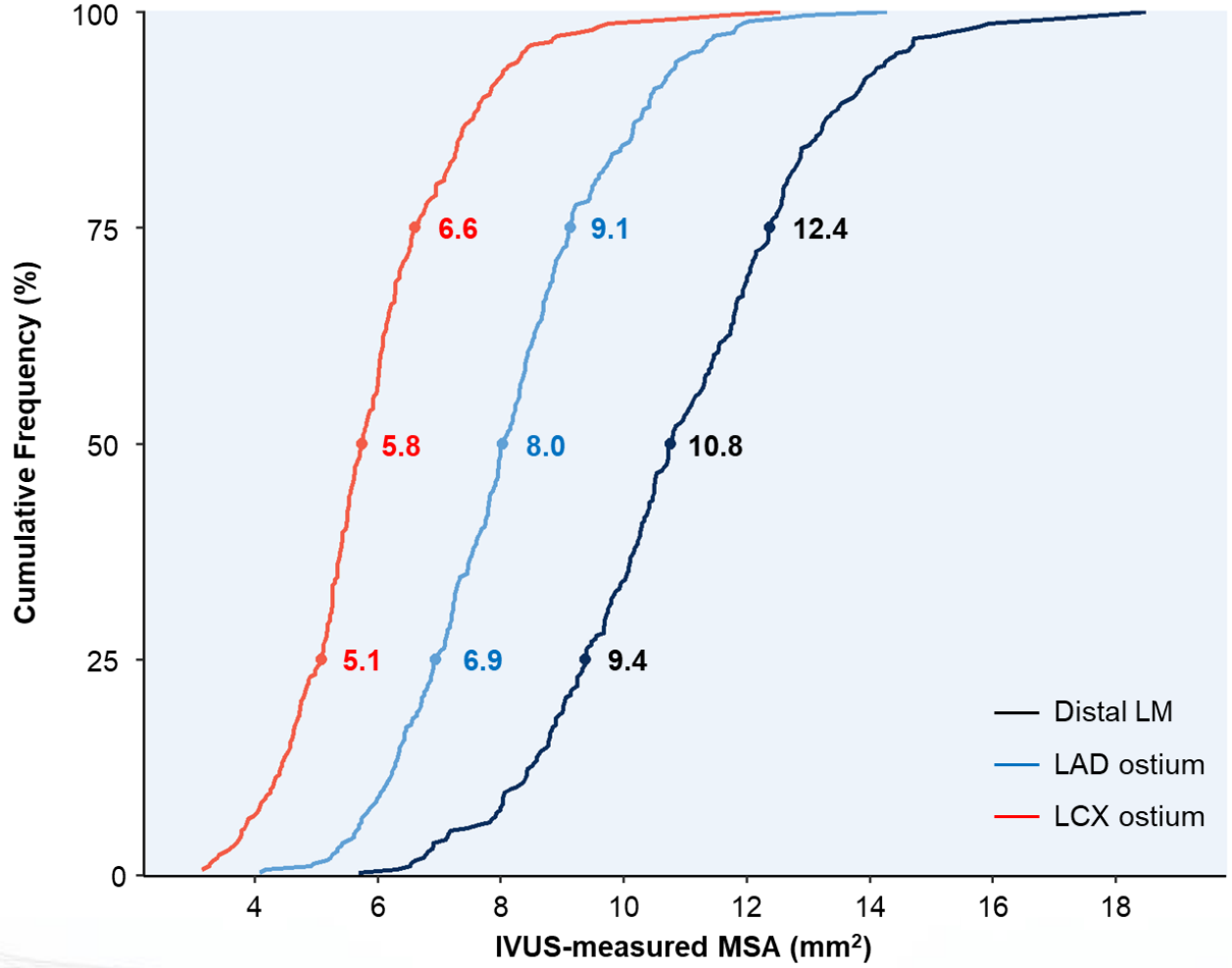
Circulation Cardiovascular Intervention in Revision

Distribution of MSA

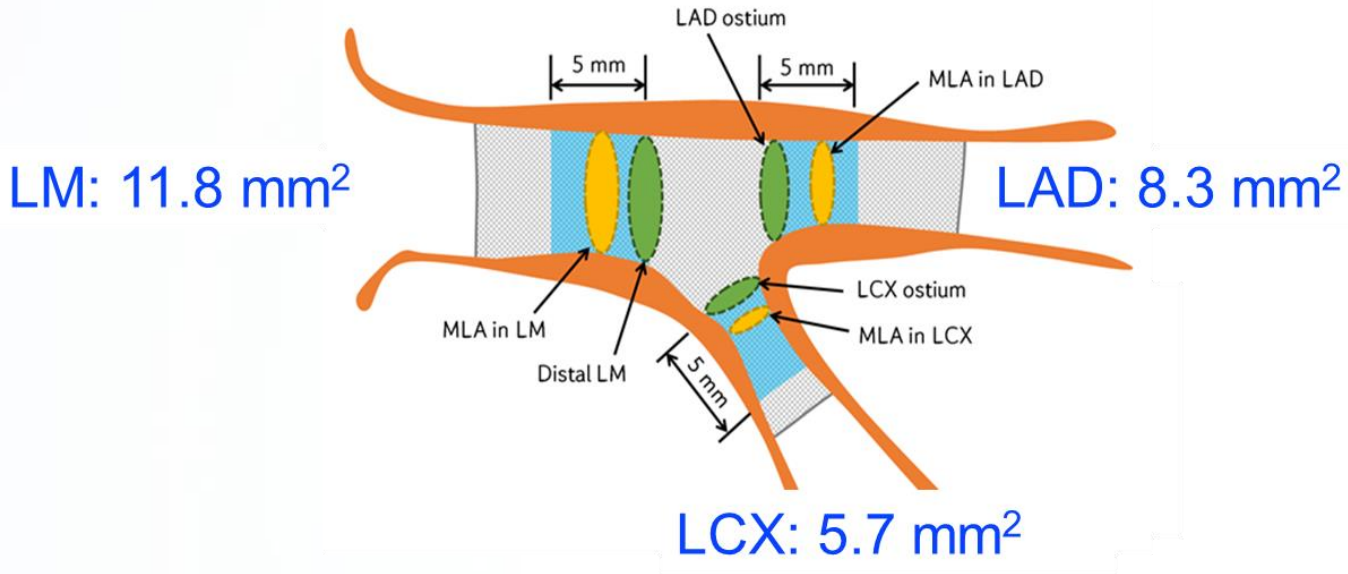


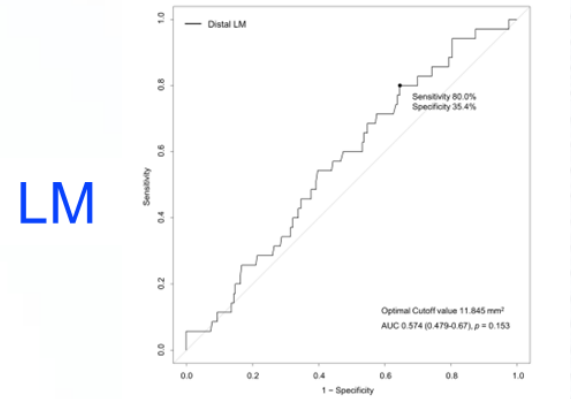
Circulation Cardiovascular Intervention in Revision

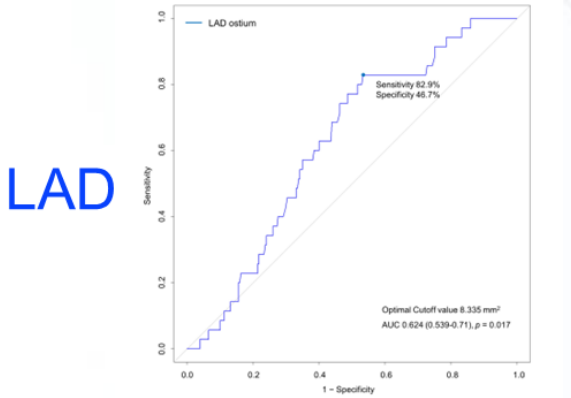
Distribution of MSA

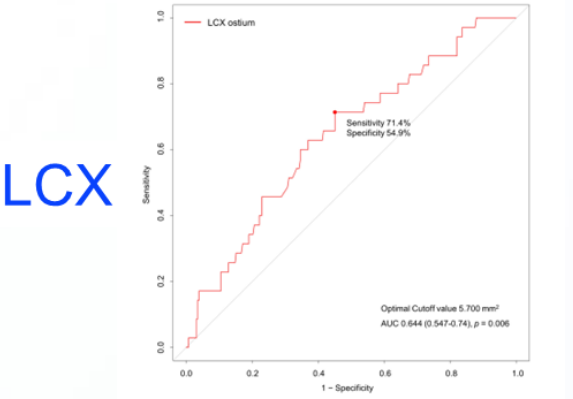


ROC Curve Analysis



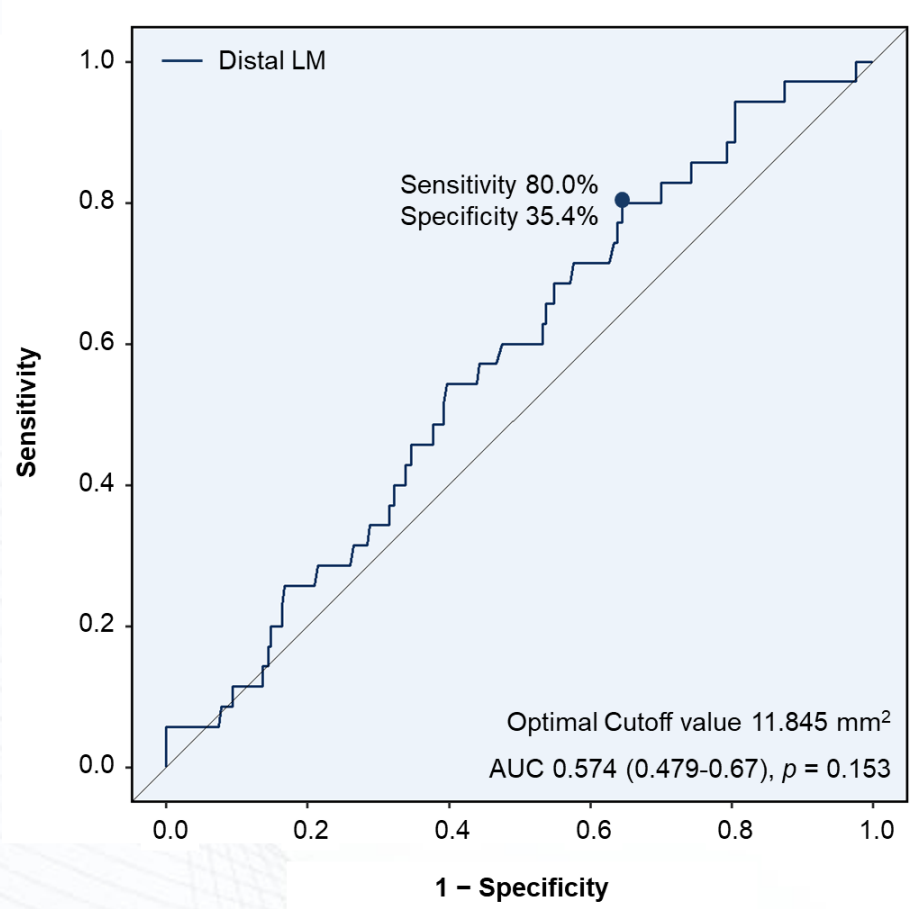


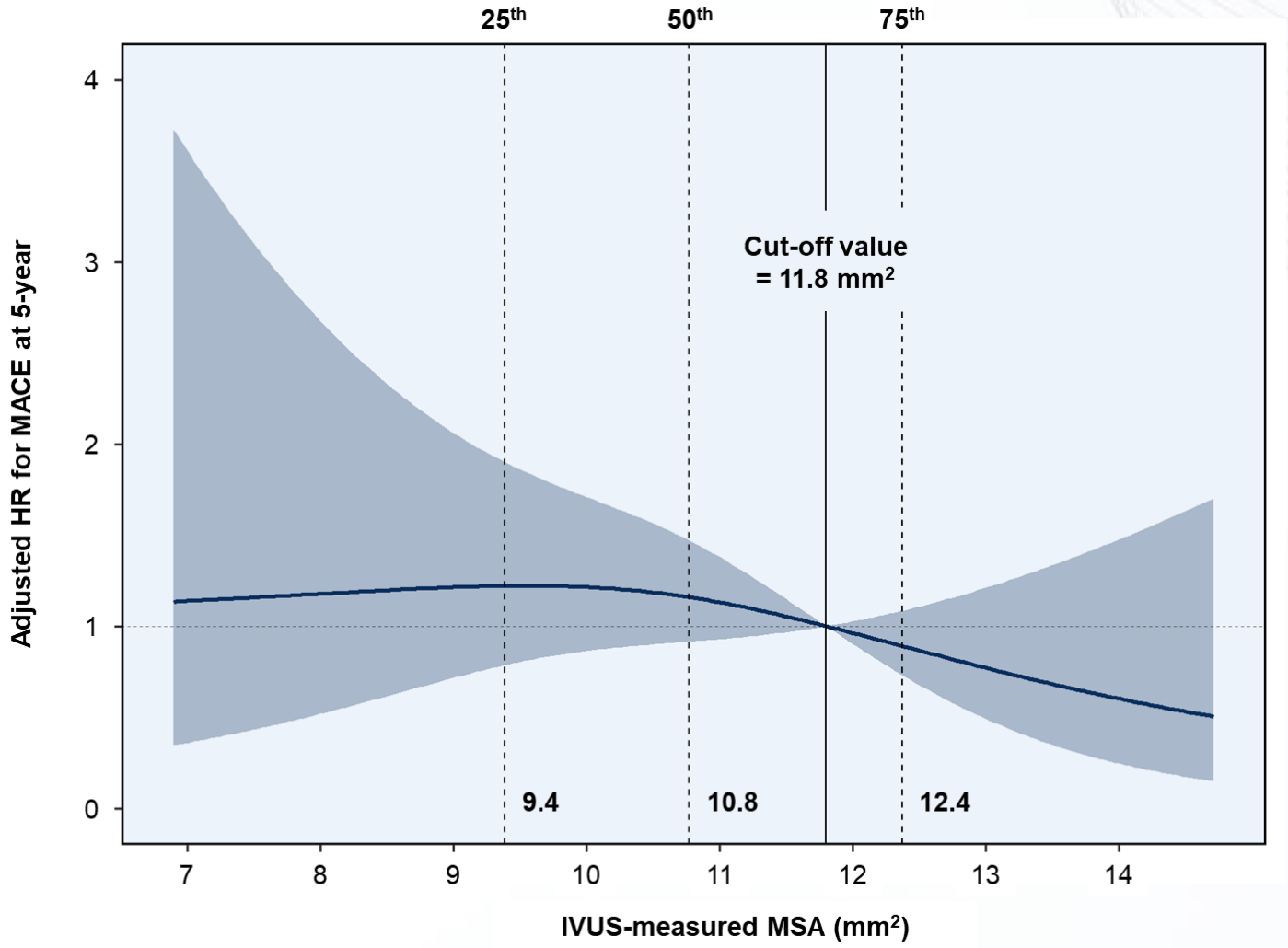




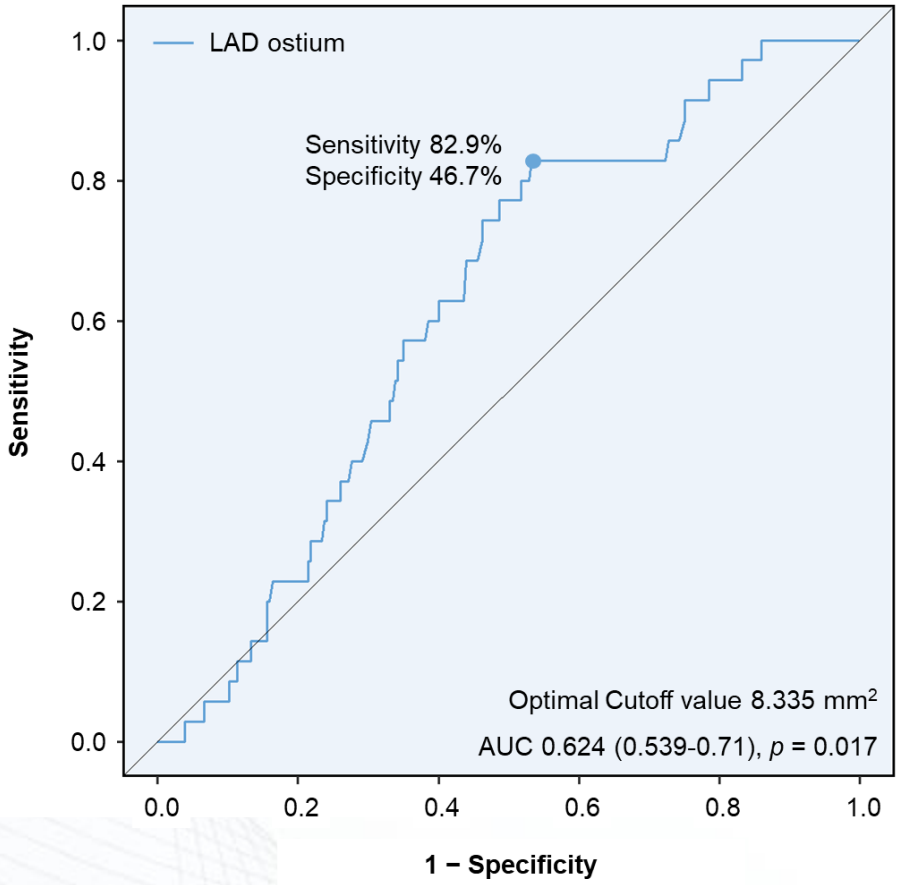
	Cutoff point	AUC (95% CI)	Sensitivity	Specificity	*P* value
IVUS-measured MSA (mm²)					
Distal LM	11.8	0.57 (0.48–0.67)	80.0%	35.4%	0.153
LAD ostium	8.3	0.62 (0.54–0.71)	82.9%	46.7%	0.017
LCX ostium, by LCX pullback	5.7	0.64 (0.55–0.74)	71.4%	54.9%	0.006

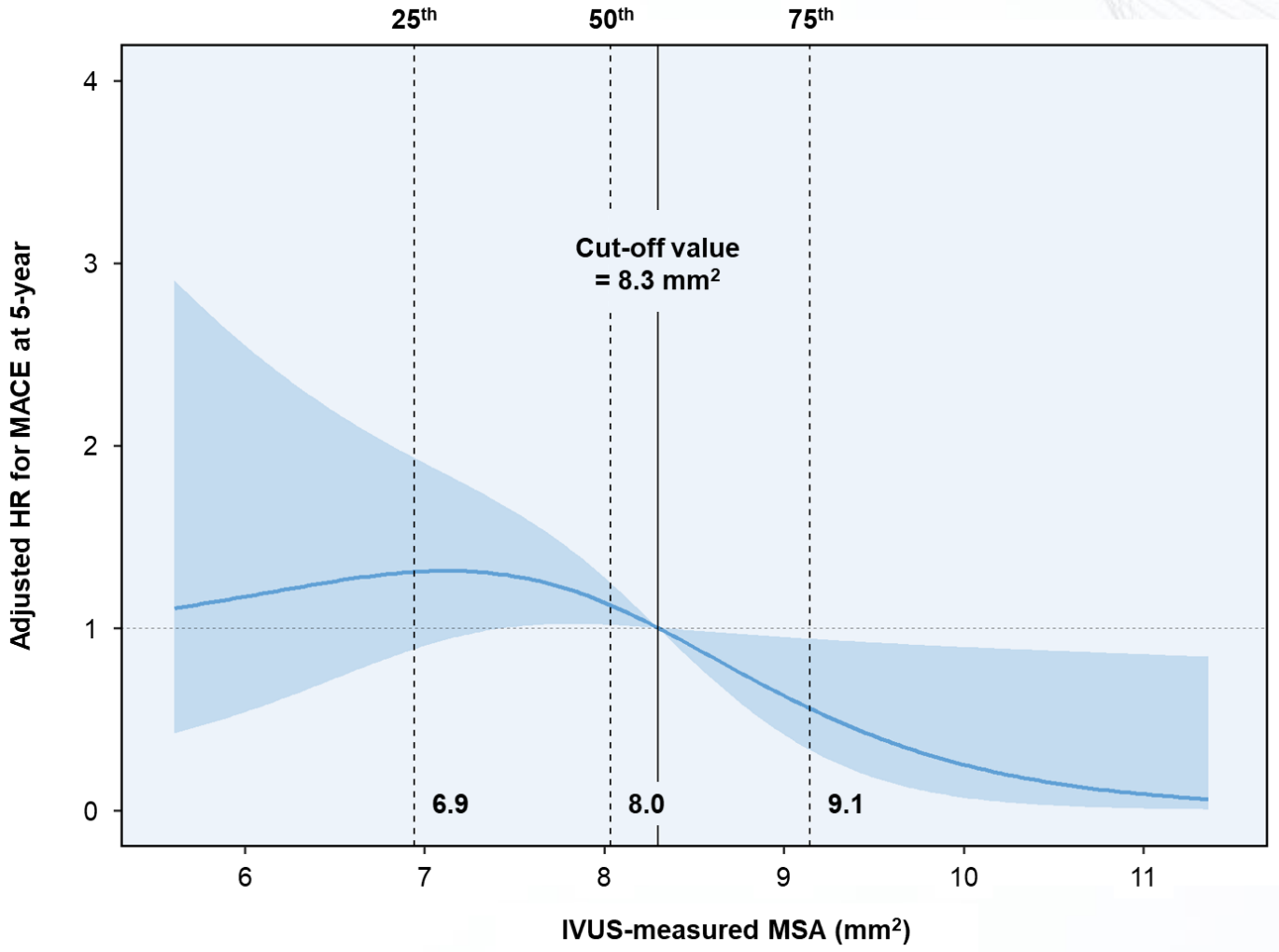
Relationship between distal LM MSA and MACEs



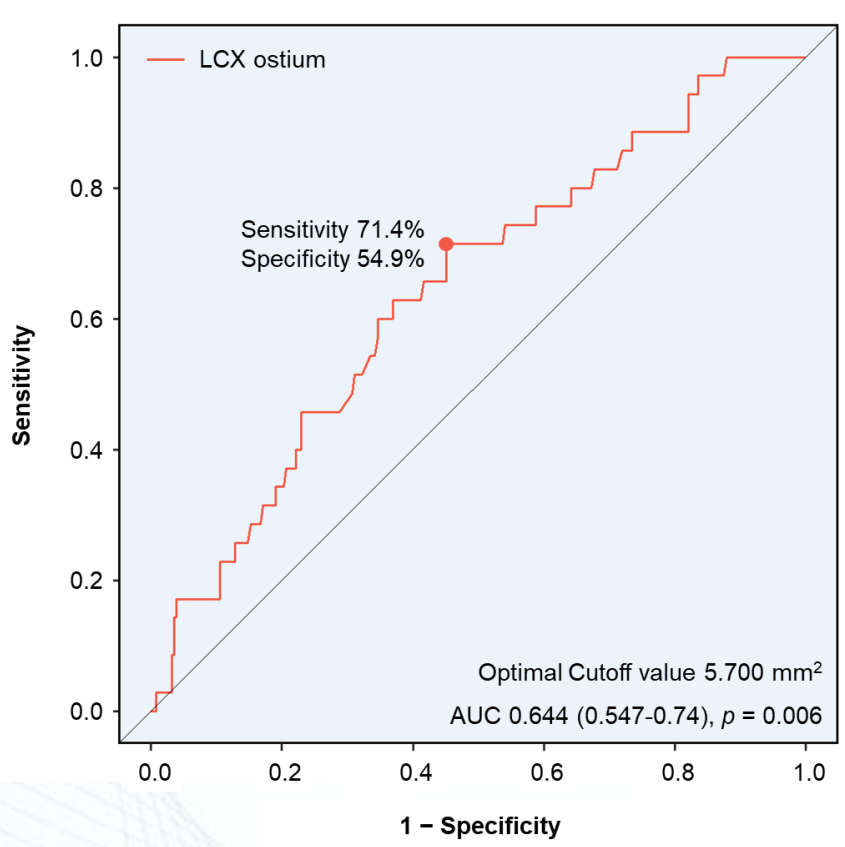


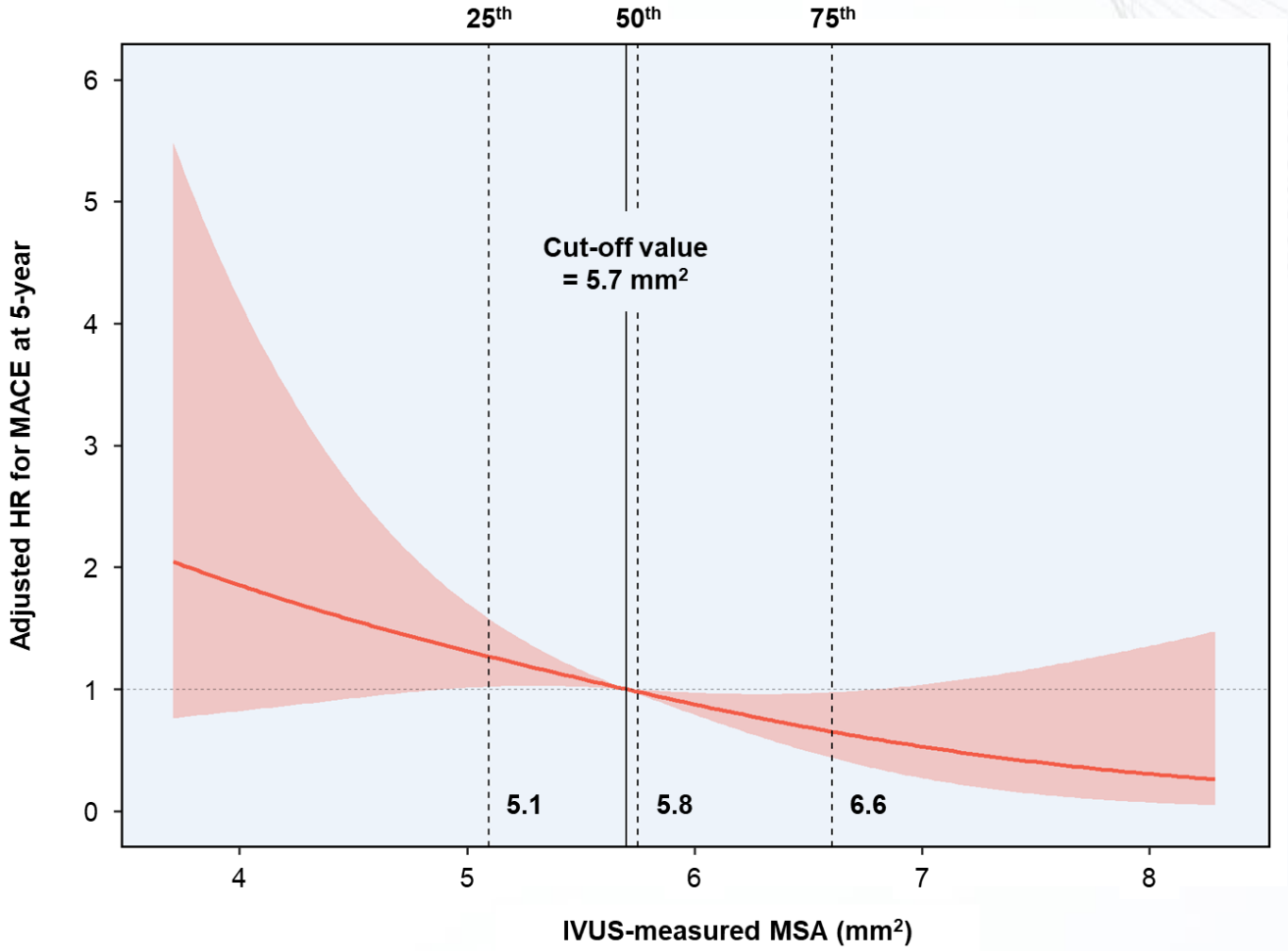
Relationship between LAD ostial MSA and MACEs



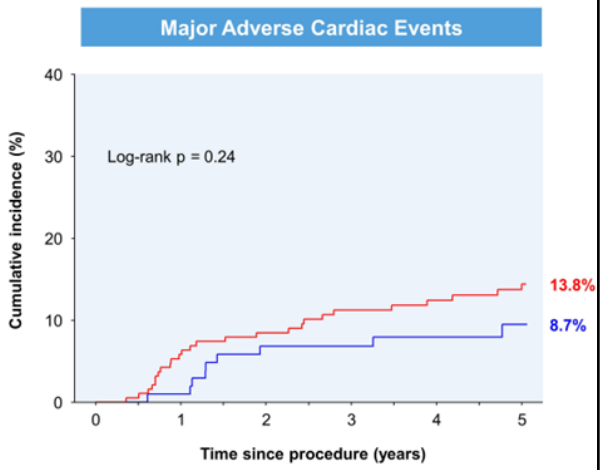


Relationship between LCX ostial MSA and MACEs

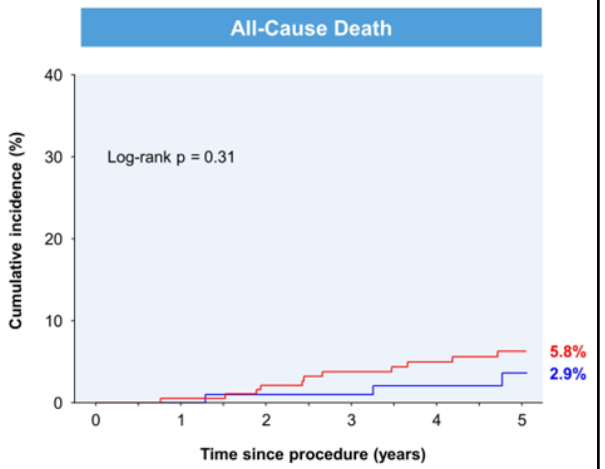




LM<11.8 mm^2: 64.7%

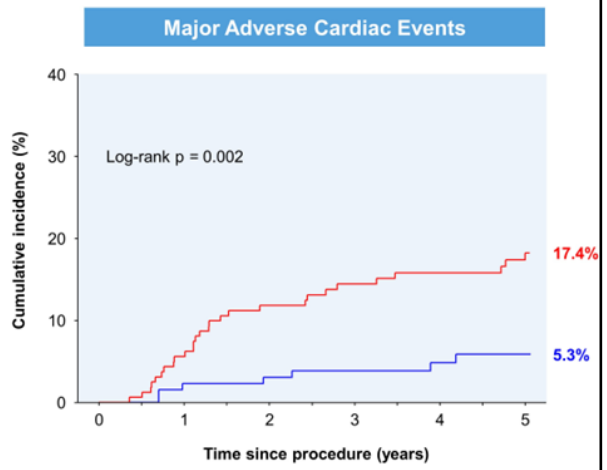


No. at risk						
LM MSA < 11.8 mm^2	189	178	173	155	141	125
LM MSA ≥ 11.8 mm^2	103	102	94	87	67	56

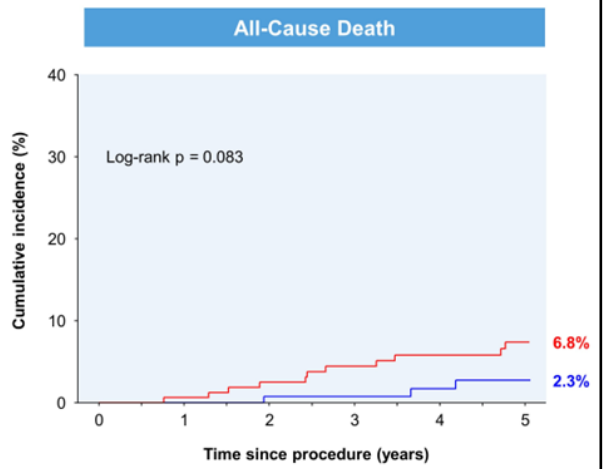


No. at risk						
LM MSA < 11.8 mm^2	189	188	185	168	152	135
LM MSA ≥ 11.8 mm^2	103	103	100	93	72	60

LAD<8.3 mm^2: 55.1%

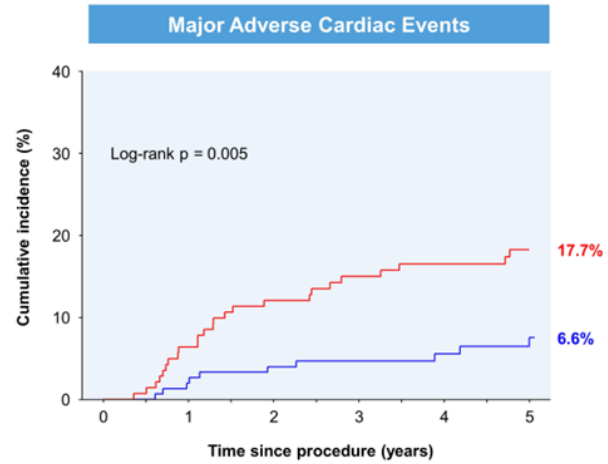


No. at risk						
LAD MSA < 8.3 mm^2	161	152	142	128	114	98
LAD MSA ≥ 8.3 mm^2	131	128	125	114	94	83

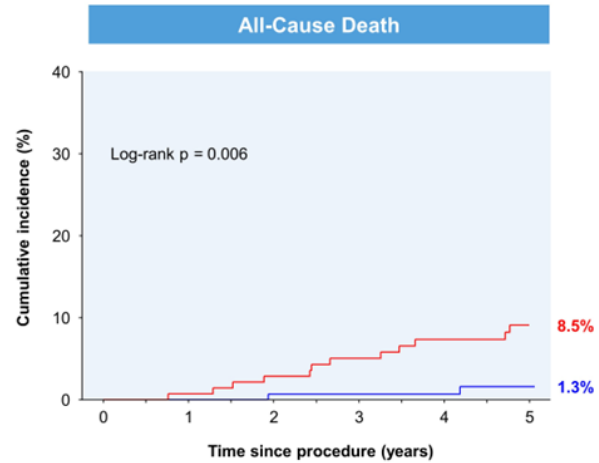


No. at risk						
LAD MSA < 8.3 mm^2	161	160	157	143	128	111
LAD MSA ≥ 8.3 mm^2	131	131	128	118	96	84

LCX<5.7 mm^2: 48.3%

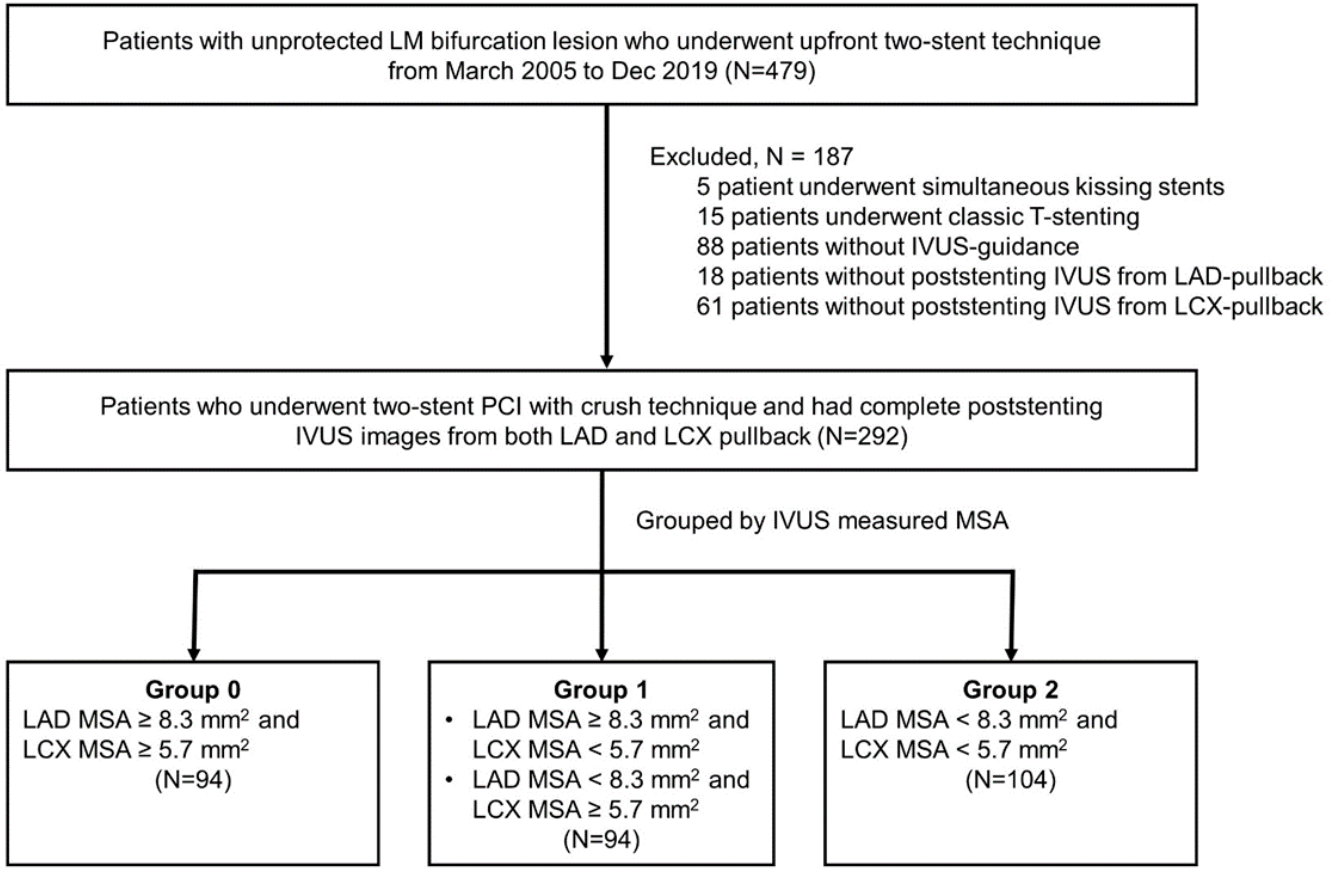


No. at risk						
LCX MSA < 5.7 mm^2	141	132	124	114	103	93
LCX MSA ≥ 5.7 mm^2	151	148	143	128	105	88



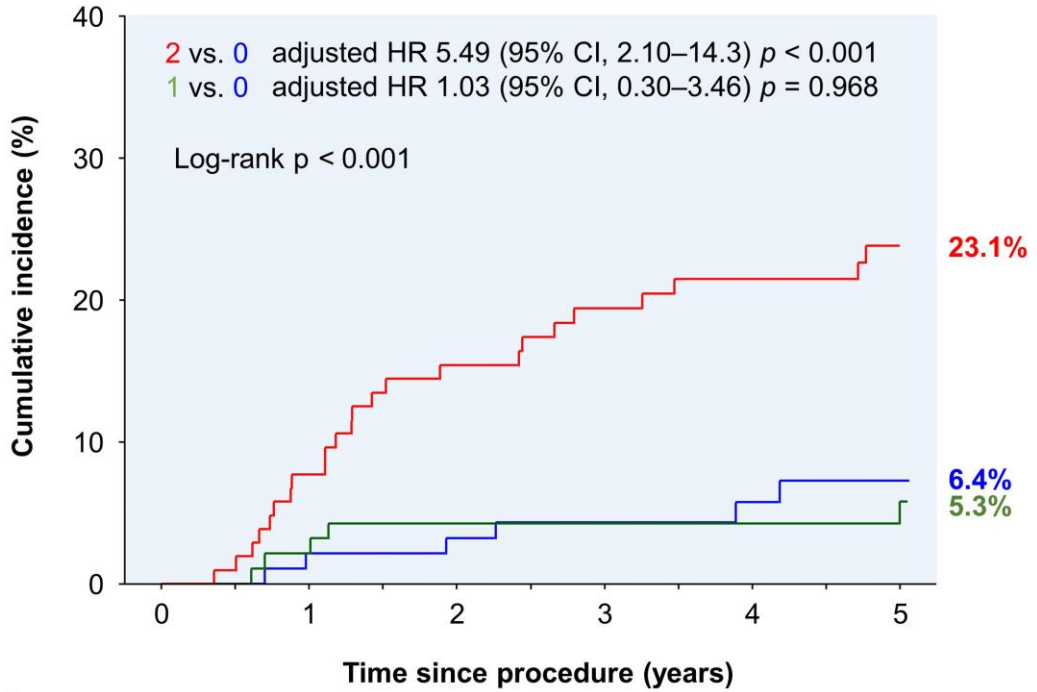
No. at risk						
LCX MSA < 5.7 mm^2	141	140	137	127	114	103
LCX MSA ≥ 5.7 mm^2	151	151	148	134	110	92

Incidence of Under-expansion of LM Segments and Outcomes



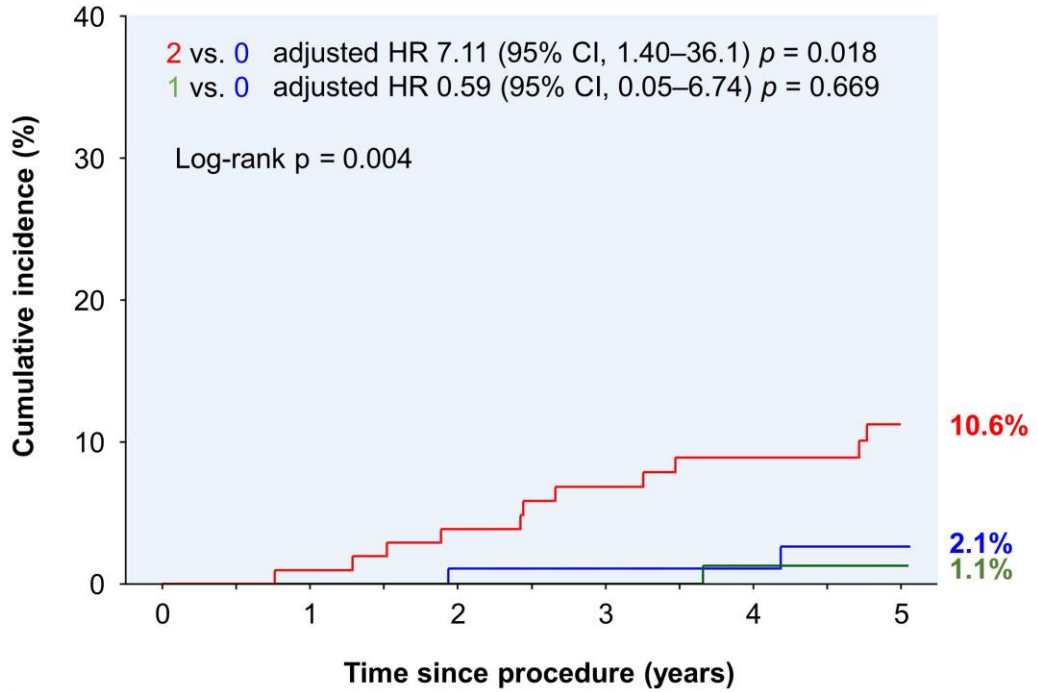
Incidence of Under-expansion of LM Segments and Outcomes

Major Adverse Cardiac Events



No. at risk						
Group 2	104	96	88	79	73	64
Group 1	94	92	90	84	71	63
Group 0	94	92	89	79	64	54

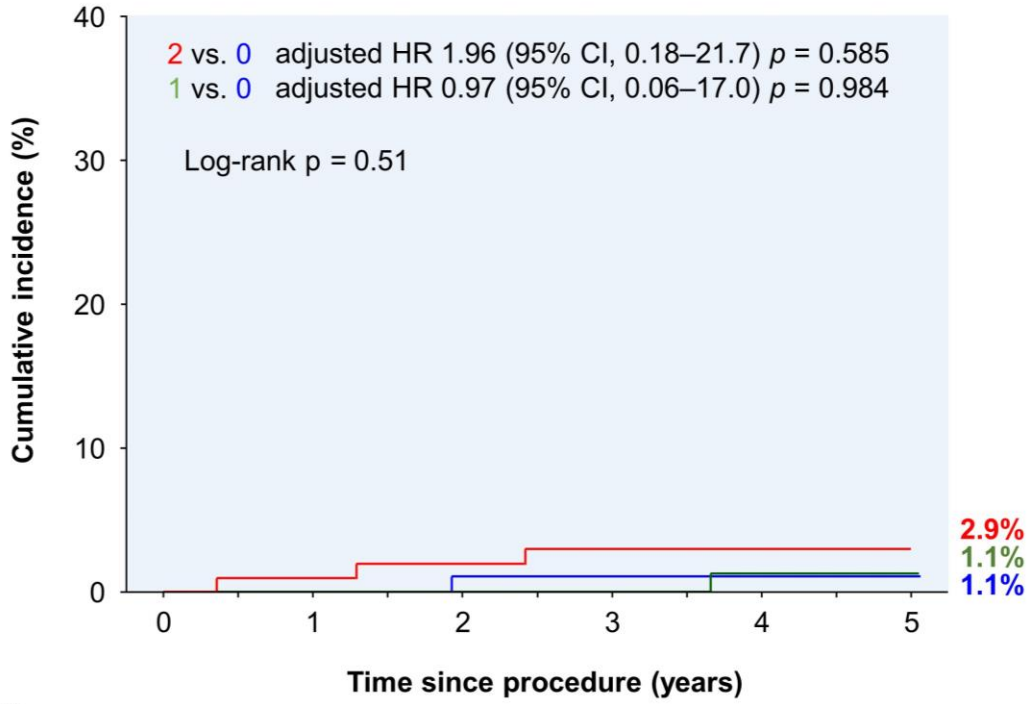
All-Cause Death



No. at risk						
Group 2	104	103	100	91	84	74
Group 1	94	94	94	88	74	66
Group 0	94	94	91	82	66	55

Incidence of Under-expansion of LM Segments and Outcomes

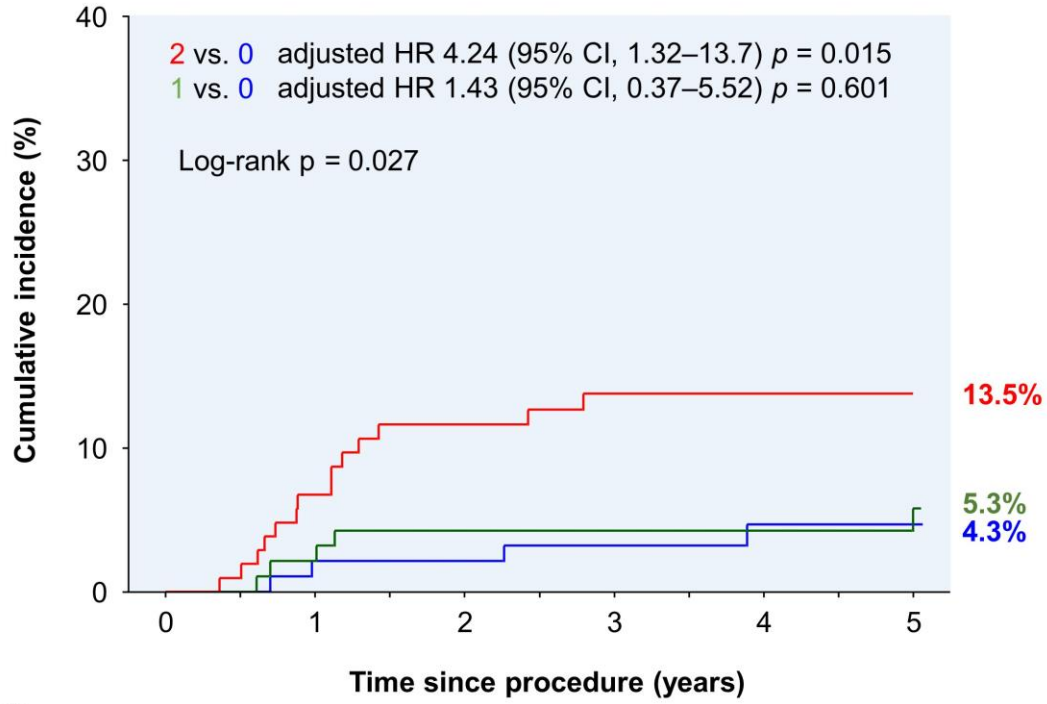
Myocardial Infarction



No. at risk

Group 2	104	102	98	89	82	72
Group 1	94	94	94	88	74	66
Group 0	94	94	90	81	65	54

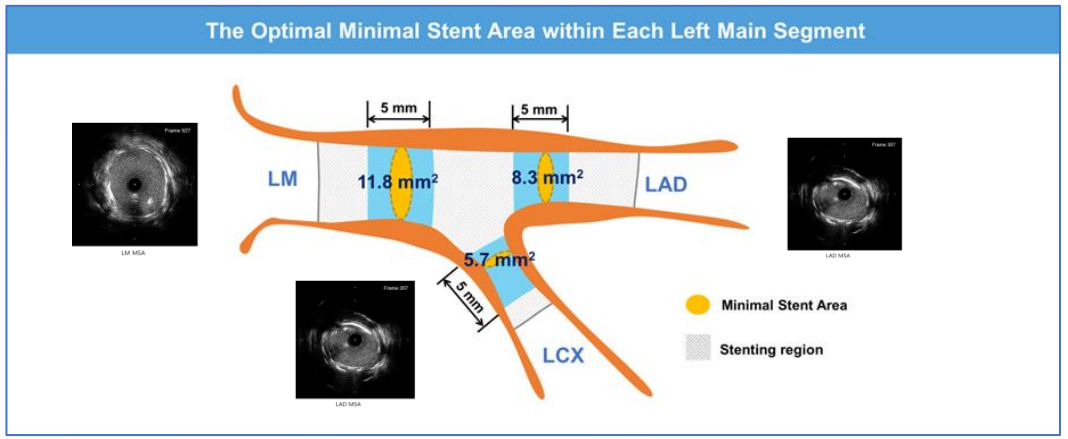
Target Lesion Revascularization

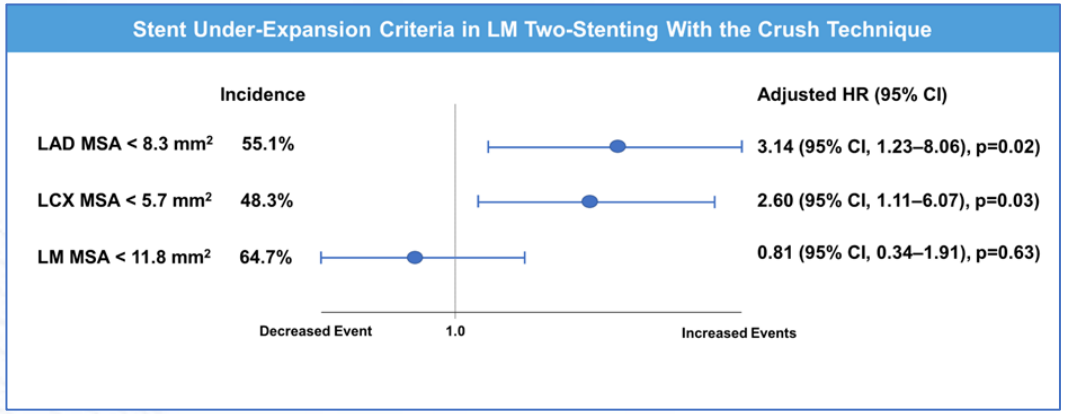


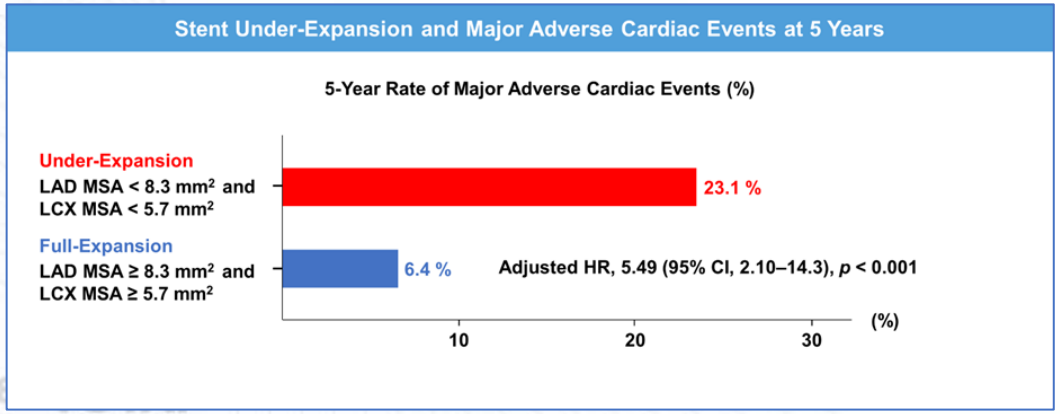
No. at risk

Group 2	104	96	88	79	73	64
Group 1	94	92	90	84	71	63
Group 0	94	92	90	80	65	55

Summary







- In patients undergoing LM two-stenting with the crush technique, The final IVUS-MSA within LAD and LCX ostium showed a linear relationship with the hazard of 5-year MACE: larger IVUS-MSA was associated with better clinical outcomes.
- The optimal IVUS-MSA criteria that predicted 5-year MACE on a segmental basis were 11.8 mm^2 for the distal LM, 8.3 mm^2 for the LAD ostium, and 5.7 mm^2 for the LCX ostium.
- Obtaining a sufficiently large MSA could be pivotal in preventing adverse clinical events in patients undergoing LM two-stenting procedures.
- Therefore, interventionist should make effort to achieve sufficient MSA under the IVUS guidance.