

Intravascular Ultrasound Pre- and Post-Intervention

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Disclosure Statement of Financial Interest

I, Soo-Jin Kang DO NOT have a financial interest/arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation

IVUS-MLA to Predict FFR

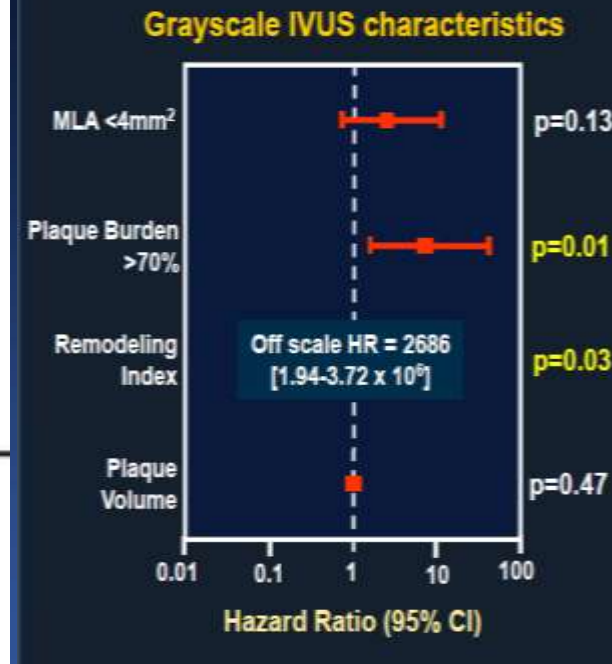
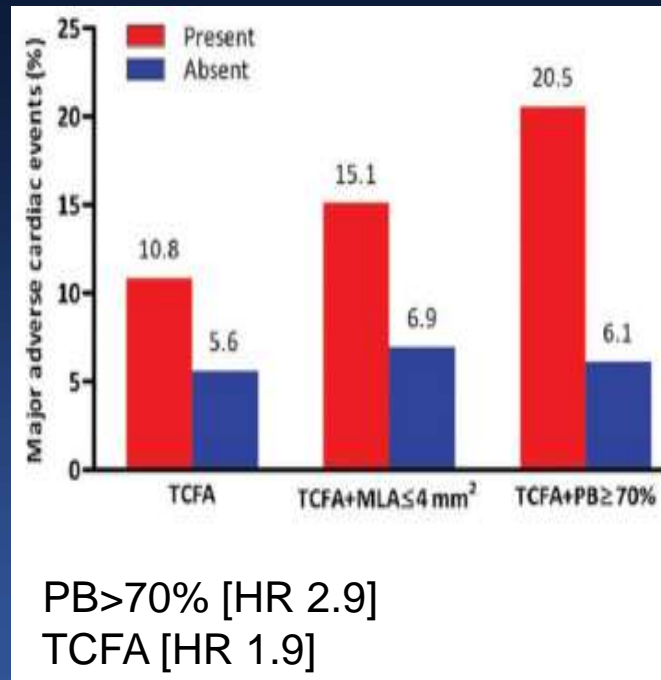
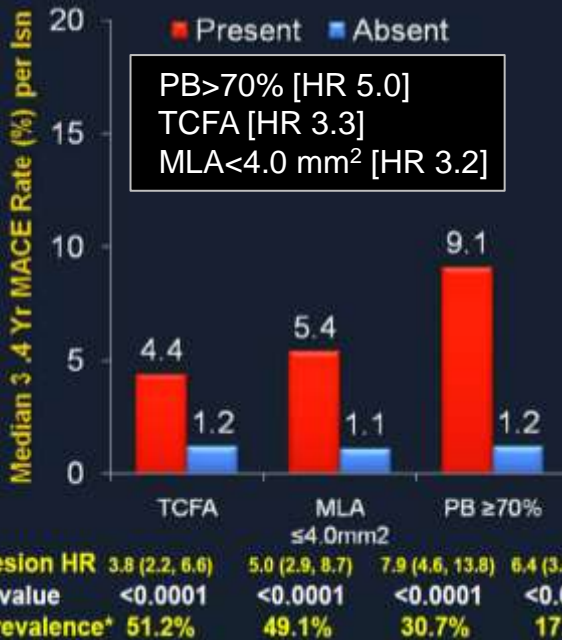
	N	FFR	RLA	MLA	AUC	Sens	Spec	PPV	NPV	Accu
Takaki (1999 Circ)	51	0.75	9.3	3.0	—	83%	92%	—	—	—
Briguori (2001 AJC)	53	0.75	7.8	4.0	—	92%	56%	38%	96%	64%
Ben-Dor (2012 *)	205	0.80	8.6	3.09	0.73	69%	72%	—	—	70%
Kang (2011 Circ int)	236	0.80	7.6	2.4	0.80	90%	60%	37%	96%	68%
Kang (2012 AJC)	784	0.80	8.2	2.4	0.77	84%	63%	48%	90%	69%
Koo (2011 JACC int)	267	0.80	6.8	2.75	0.81	69%	65%	27%	81%	67%
Gonzalo (2012 JACC)	47	0.80	7.1	2.36 IVUS	0.63	67%	65%	67%	65%	66%
Gonzalo (2012 JACC)	61	0.80	7.1	1.95 OCT	0.70	82%	63%	66%	80%	72%

Morphological Predictors of Non-Culprit related MACE

PROSPECT

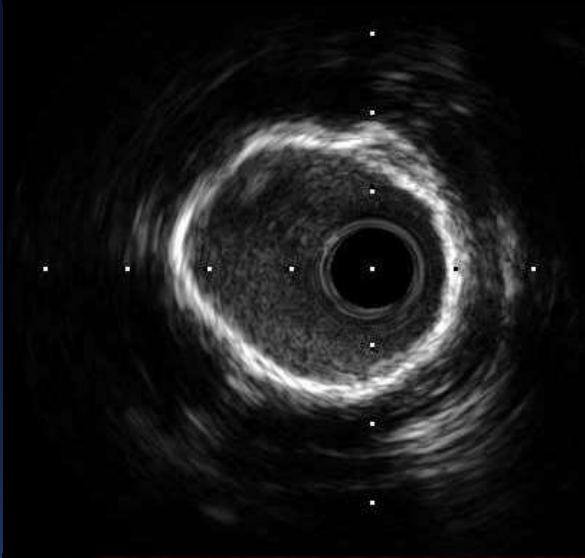
ATHEROREMO

VIVA

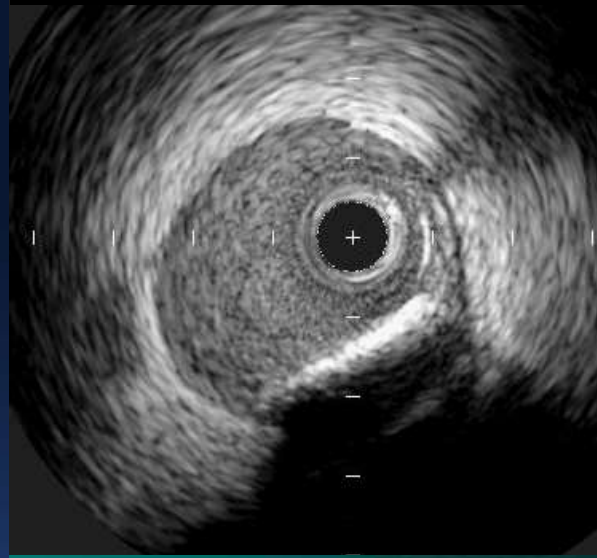


Evaluation of Calcified Lesions

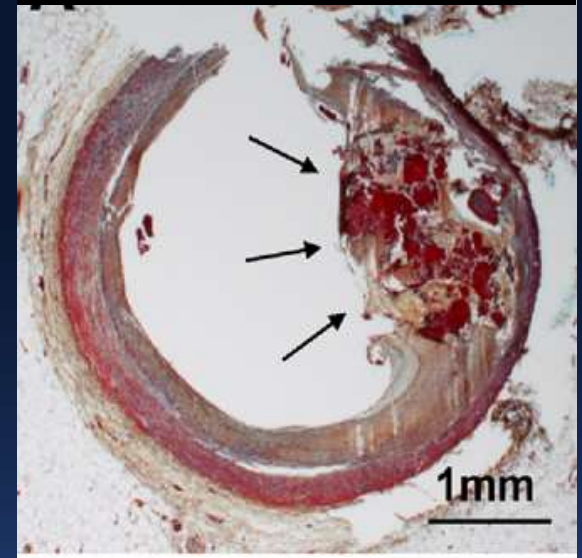
Superficial calcium



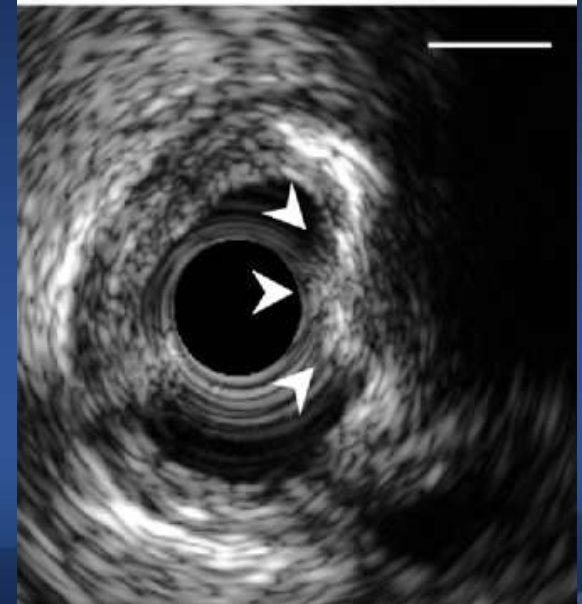
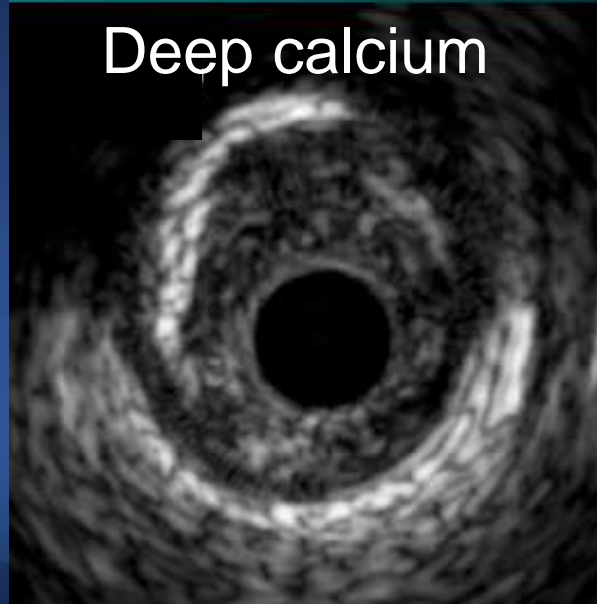
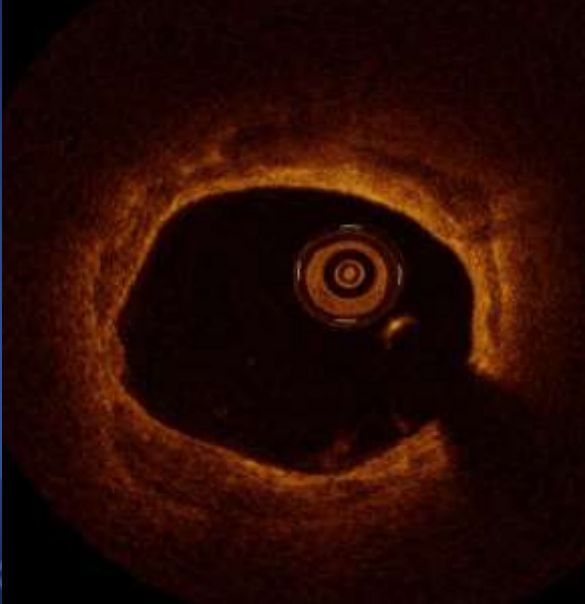
Superficial calcium



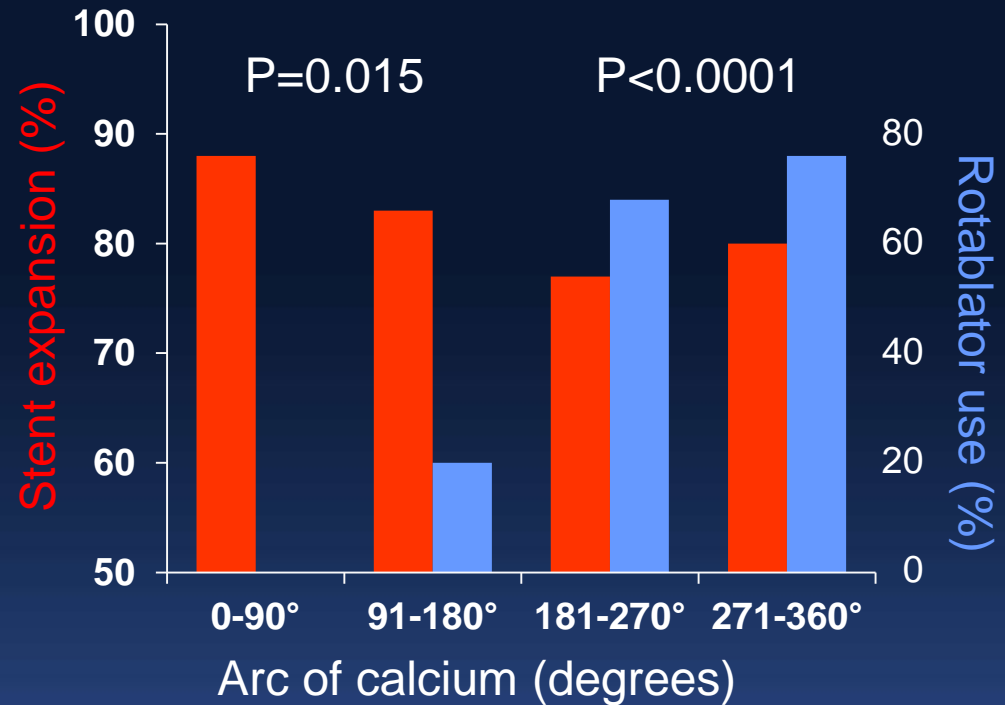
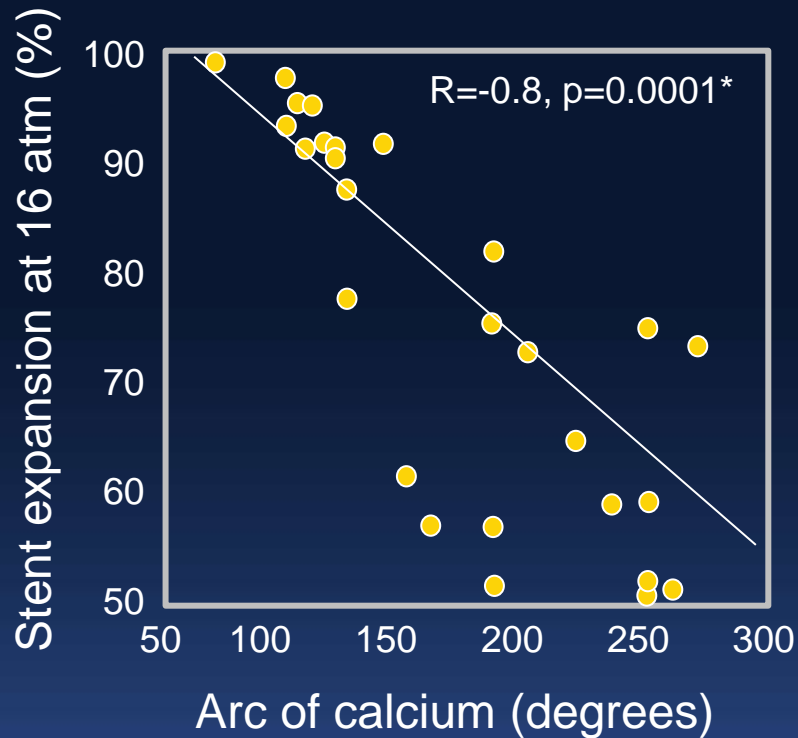
Calcified nodule



Deep calcium



Stent Expansion in Calcified Lesions



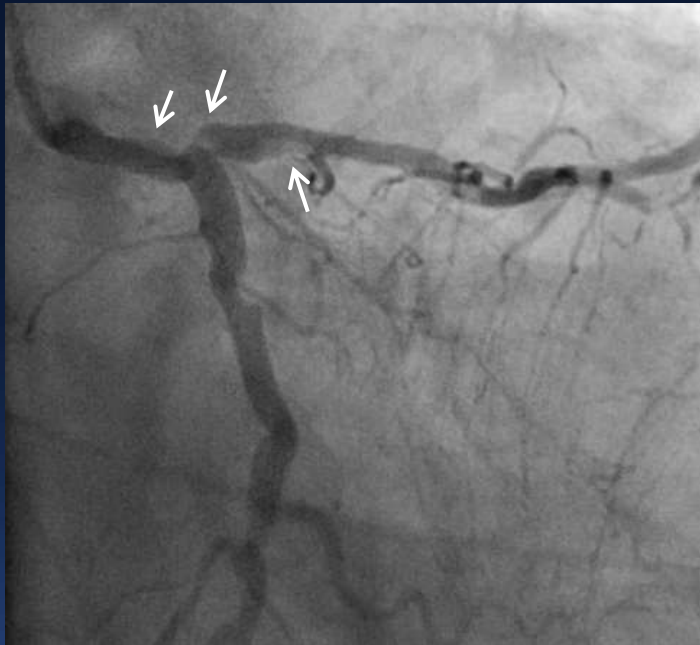
The greater calcium thickness, arc, and length, the greater is the likelihood of underexpansion

Vavarunakis et al. Catheter Cardiovasc Interv 2001;52:164-72

Hoffmann et al. Eur Heart J 1998;19:1224-31

Unusual Lesion Morphology

57-year old male with UA



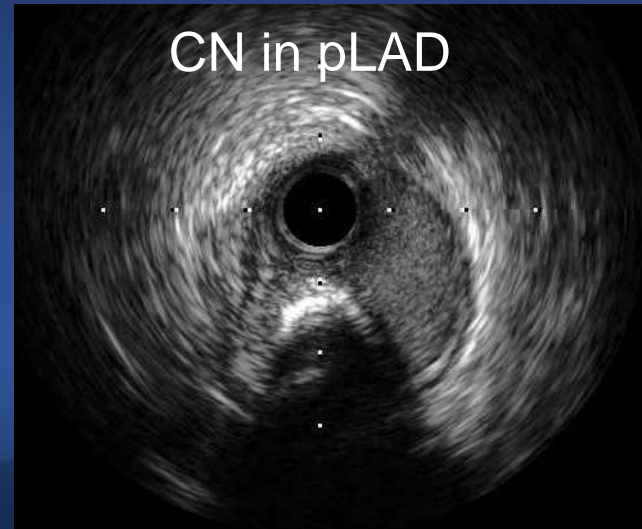
Thrombus in LM



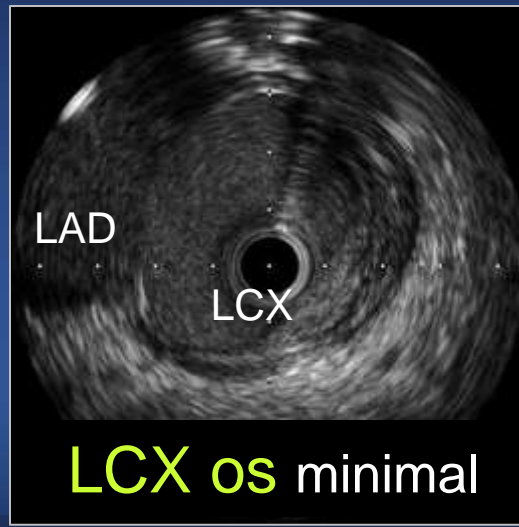
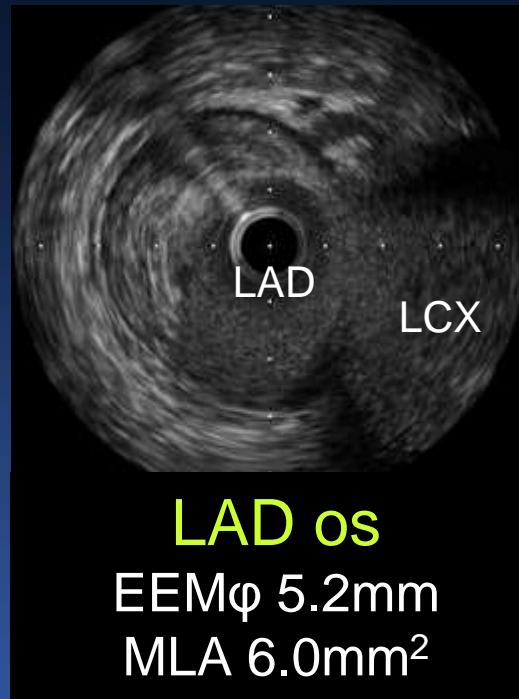
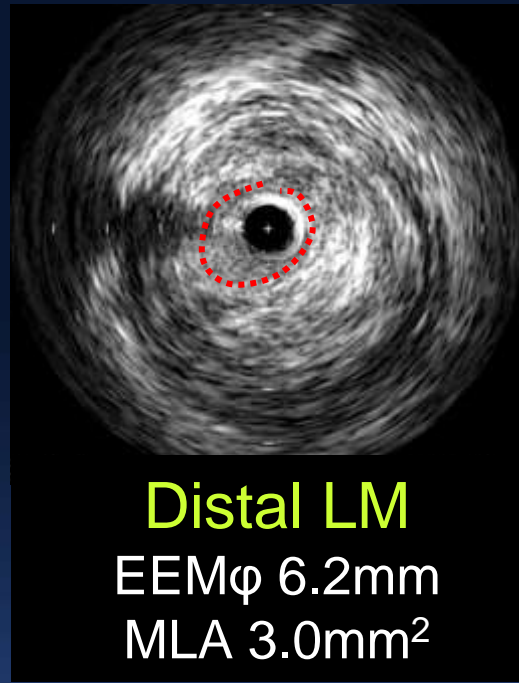
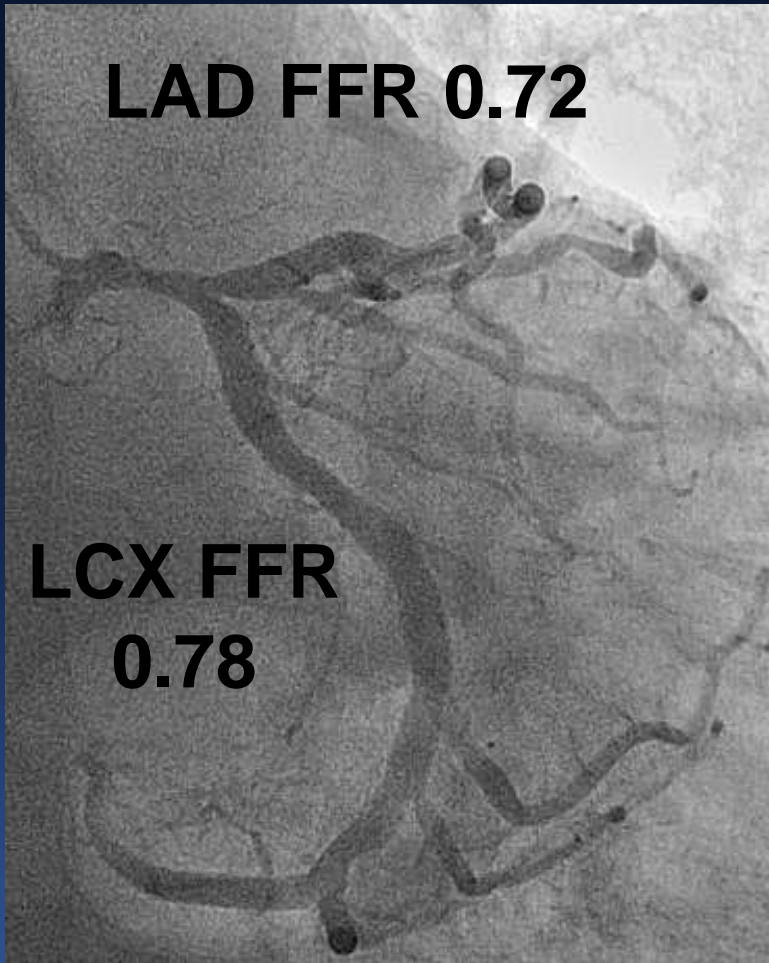
CN in LAD os



CN in pLAD



Stent Strategy for LM Bifurcation

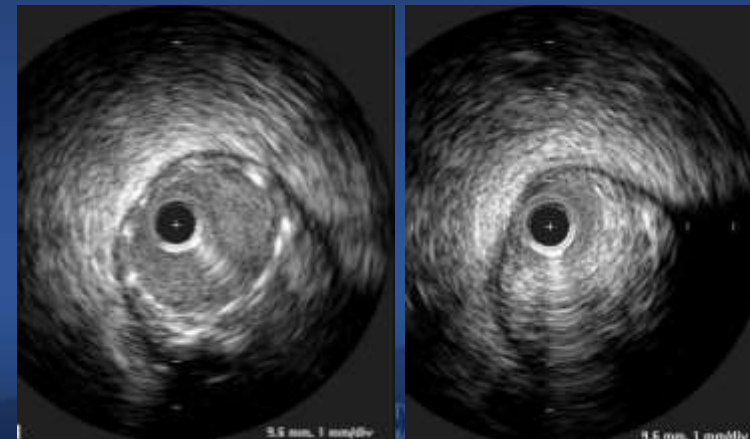
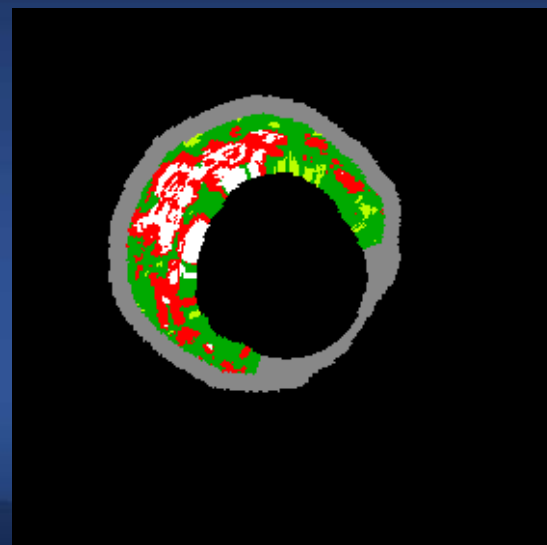
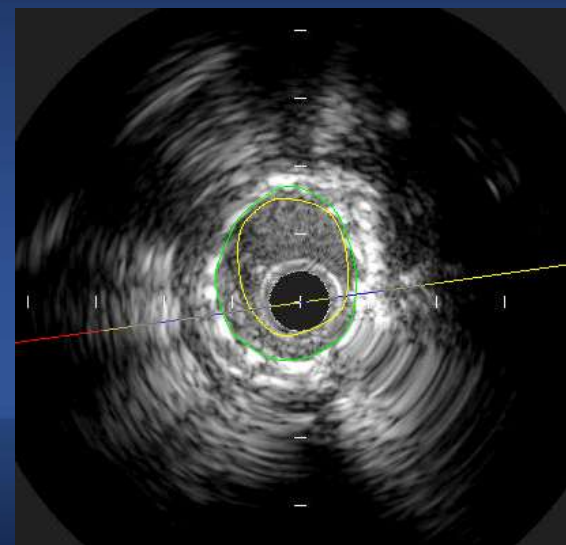
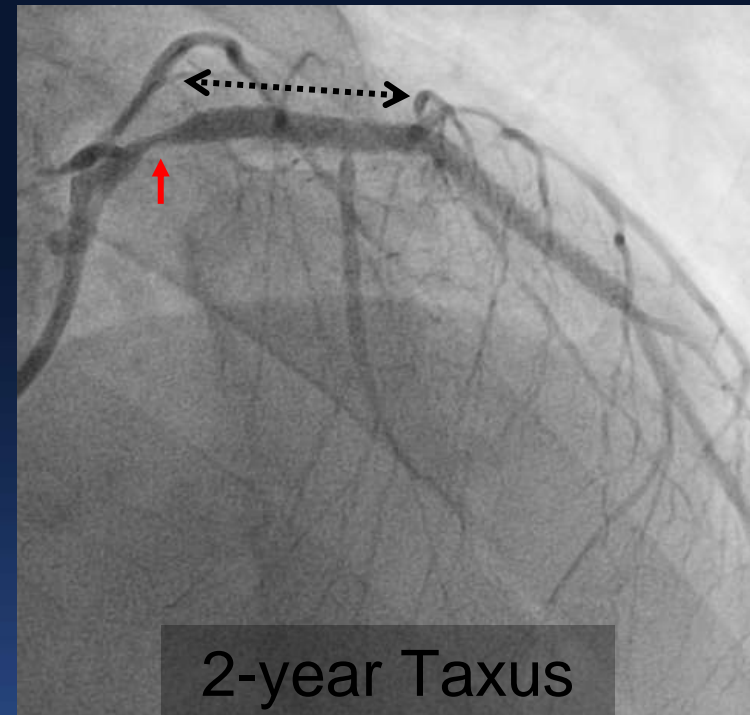
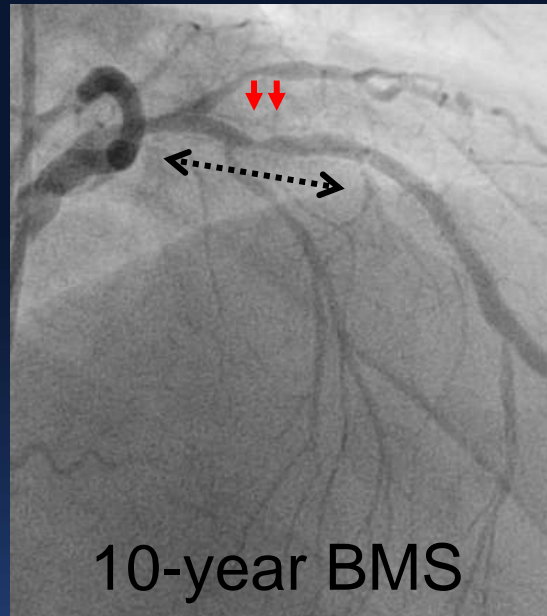
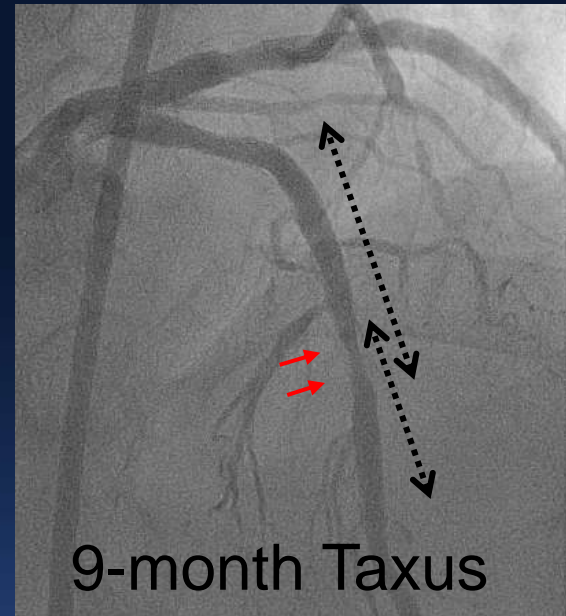


Mechanism of In-stent Restenosis

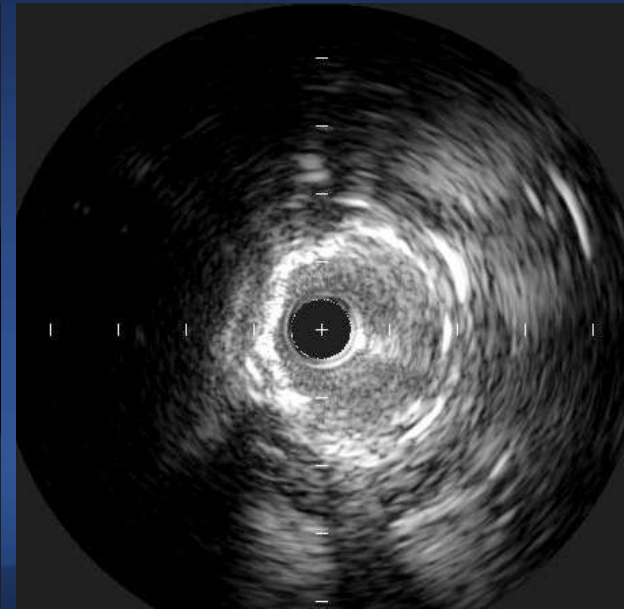
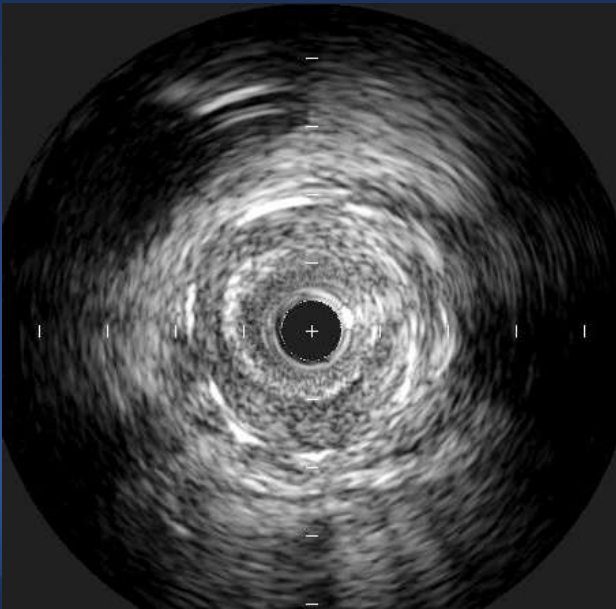
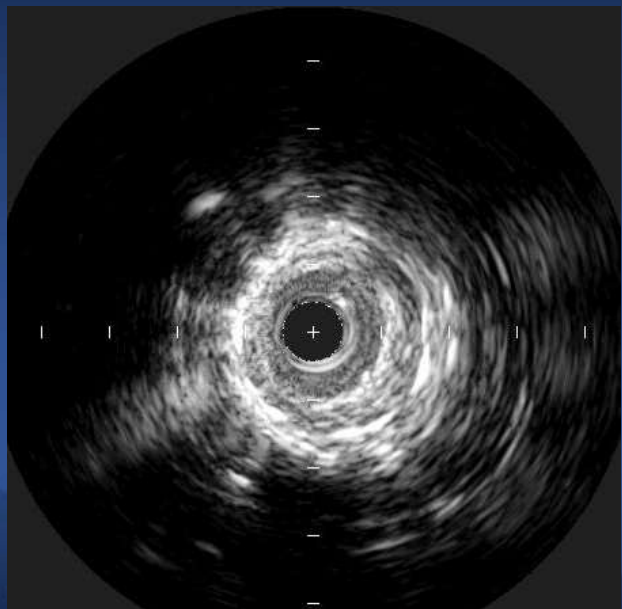
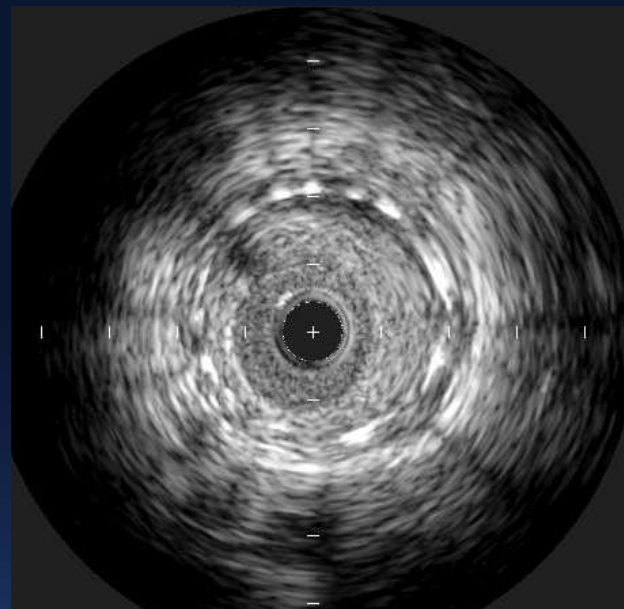
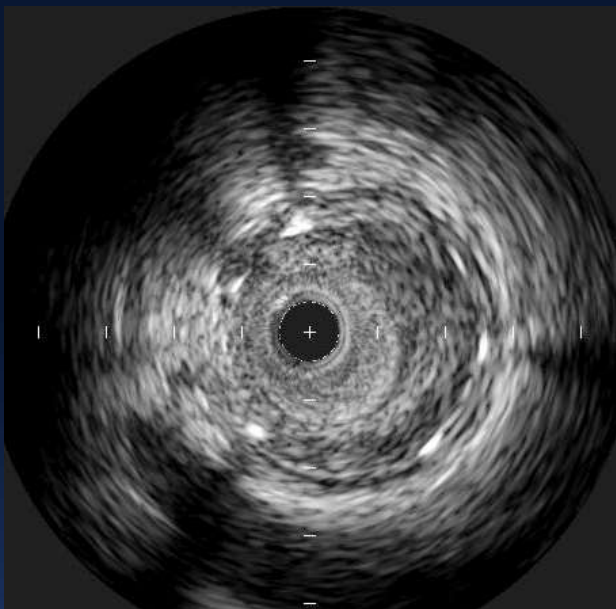
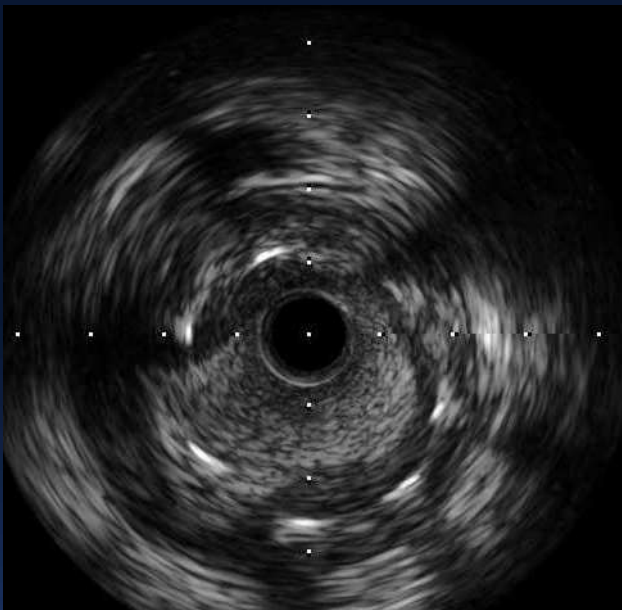
Underexpansion

Intimal HP

Edge Restenosis

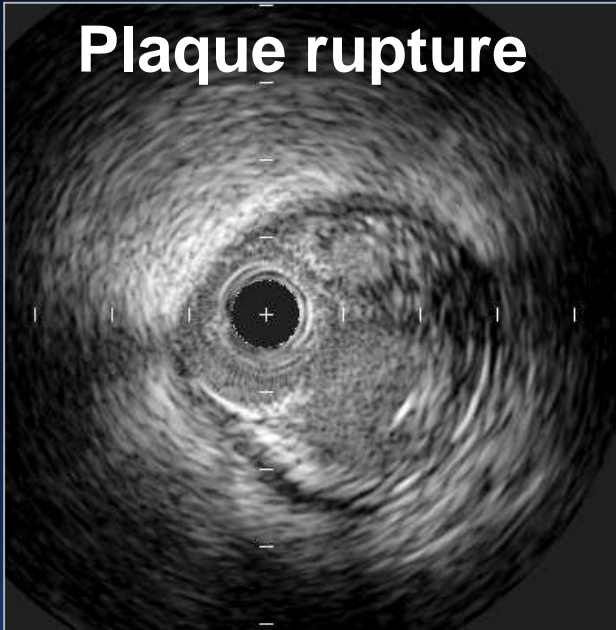


Neointimal Characterization by IVUS

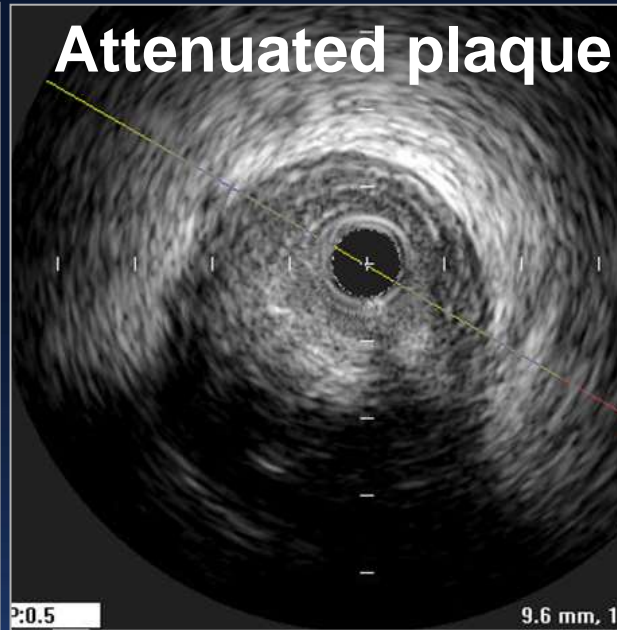


Predictor for Distal Embolization

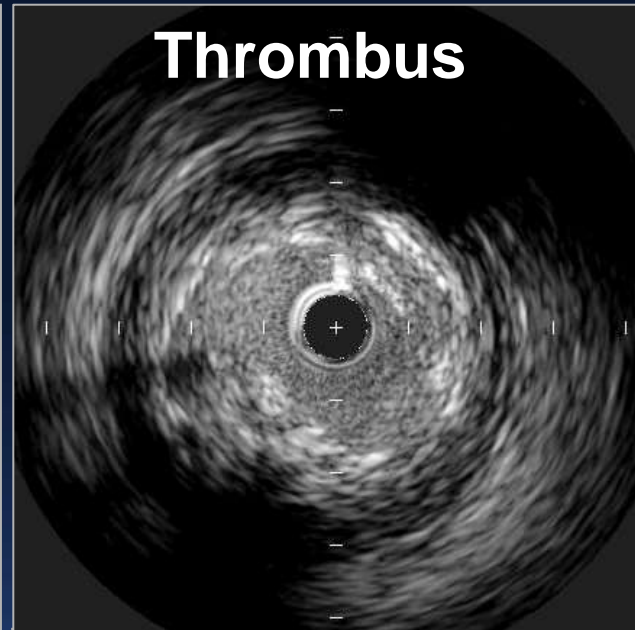
Plaque rupture



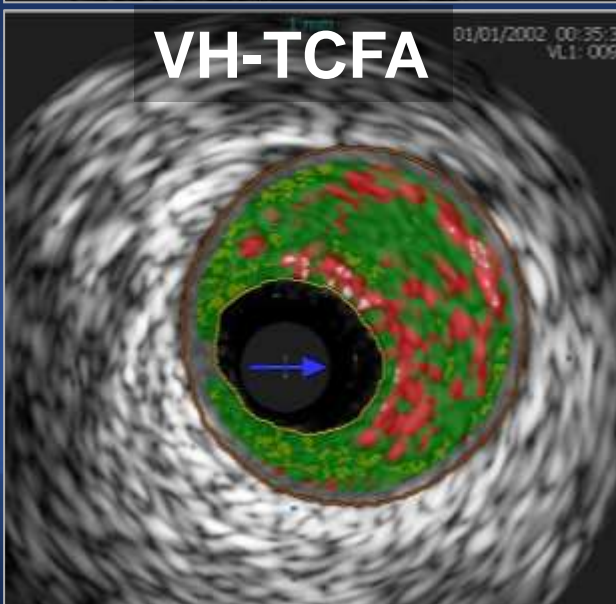
Attenuated plaque



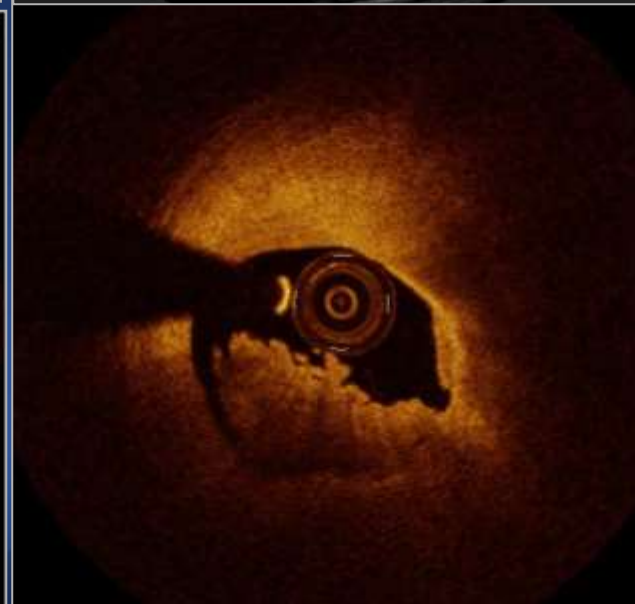
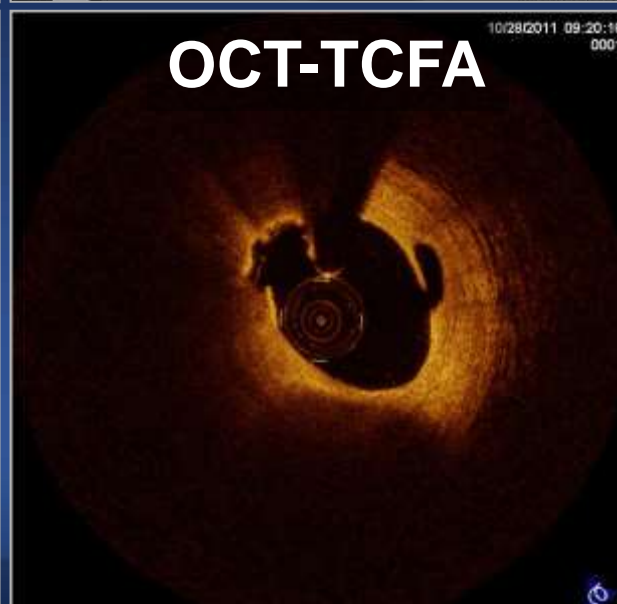
Thrombus



VH-TCFA

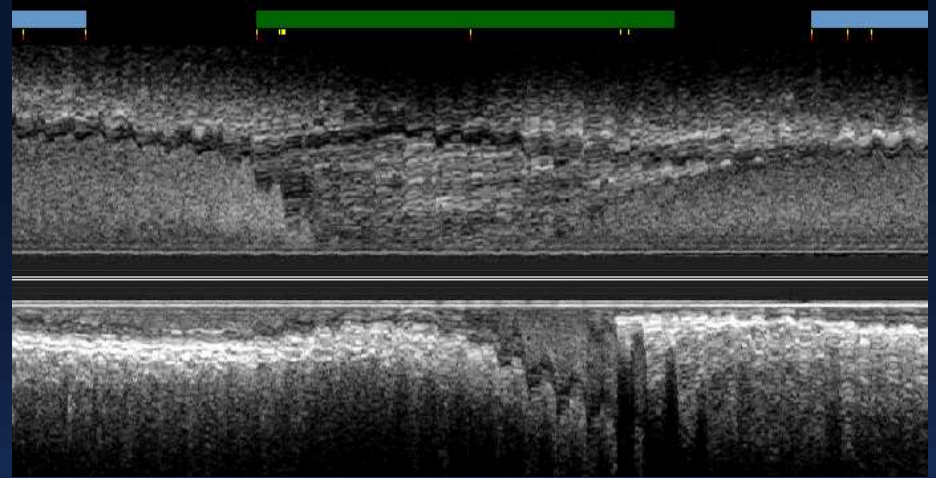


OCT-TCFA

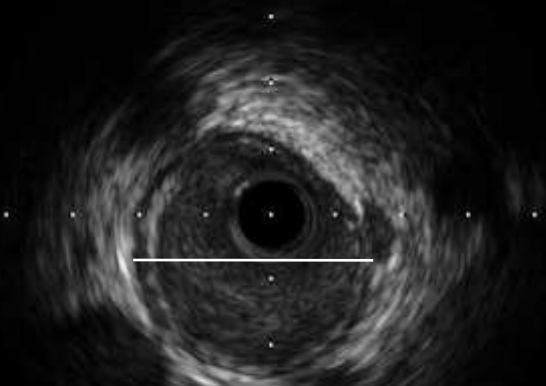


Device Sizing

LAD Promus 3.5x24mm

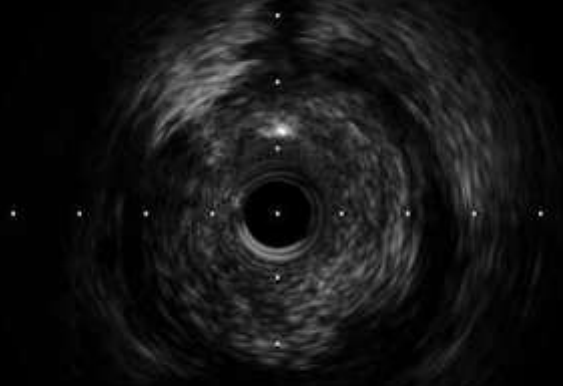


Distal ref

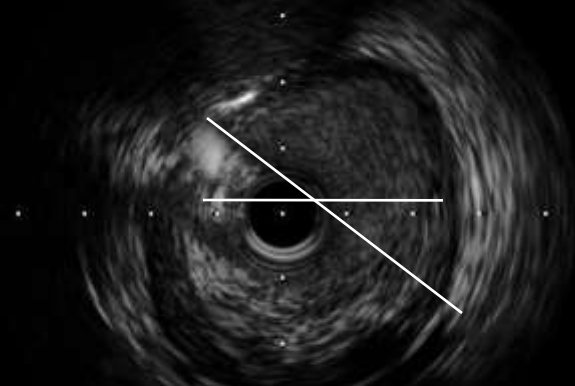


LumenØ 3.2mm
EEMØ 3.5mm

MLA site



Prox ref

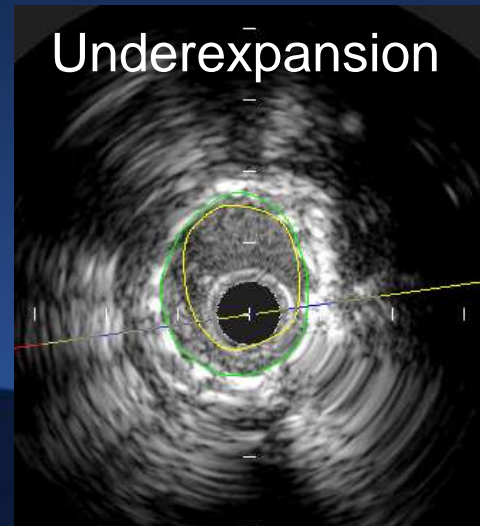


LumenØ 3.5mm
EEMØ 4.8mm

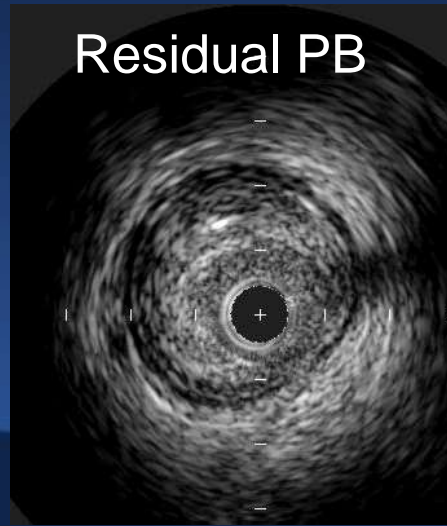
IVUS Mechanisms of DES Failure

	Early Thrombosis	Restenosis
Small MSA (Underexpansion)	<ul style="list-style-type: none"> •Fujii et al. JACC 2005;45:995-8 •Okabe et al., AJC 2007;100:615-20 •Liu et al. JACC Interv 2009;2:428-34 •Choi et al. Circ Interv 2011;4:239-47 	<ul style="list-style-type: none"> •Sonoda et al. JACC 2004;43:1959-63 •Hong et al. EHJ 2006;27:1305-10 •Doi et al. JACC Interv. 2009;2:1269-75 •Fujii et al. Circulation 2004;109:1085-8 •Kang et al. Circ Interv 2011;4:9-14 •Choi et al. AJC 2012;109:455-60 •Song et al. CCI in press
Inflow/outflow tract disease	<ul style="list-style-type: none"> •Fujii et al. JACC 2005;45:995-8 •Okabe et al., AJC 2007;100:615-20 •Liu et al. JACC Interv 2009;2:428-34 •Choi et al. Circ Interv 2011;4:239-47 	<ul style="list-style-type: none"> •Sakurai et al. AJC 2005;96:1251-3 •Liu et al. AJC 2009;103:501-6 •Costa et al. AJC 2008;101:1704-11

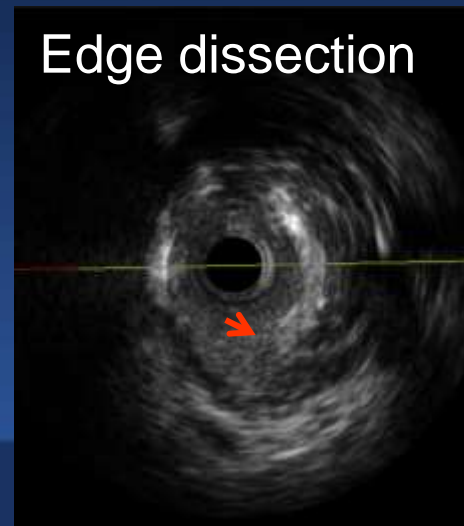
Underexpansion



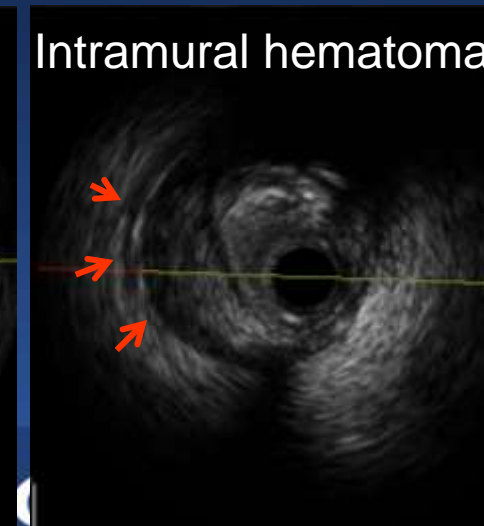
Residual PB



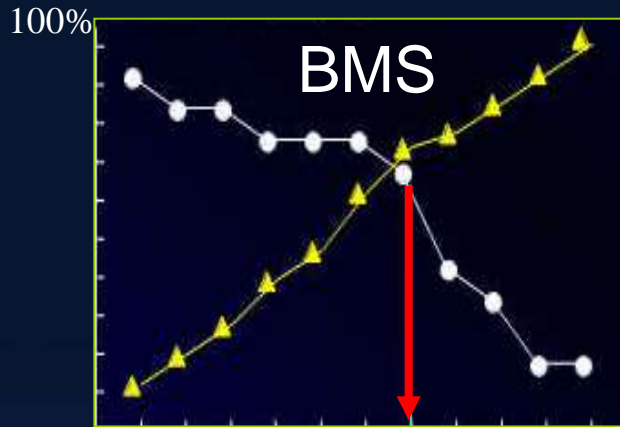
Edge dissection



Intramural hematoma

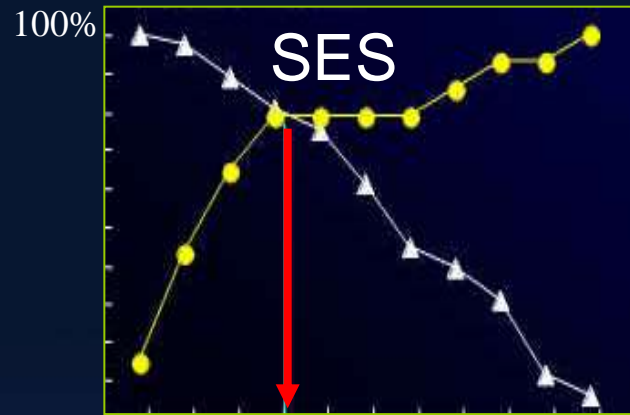


Underexpansion Predicts Restenosis



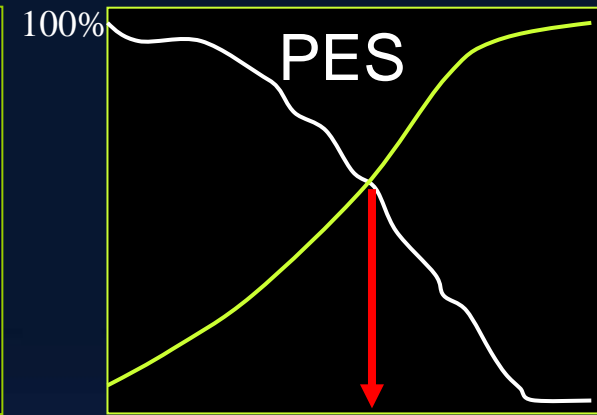
MSA 6.5mm²

Predictive value 56%



MSA 5.0mm²

Predictive value 90%

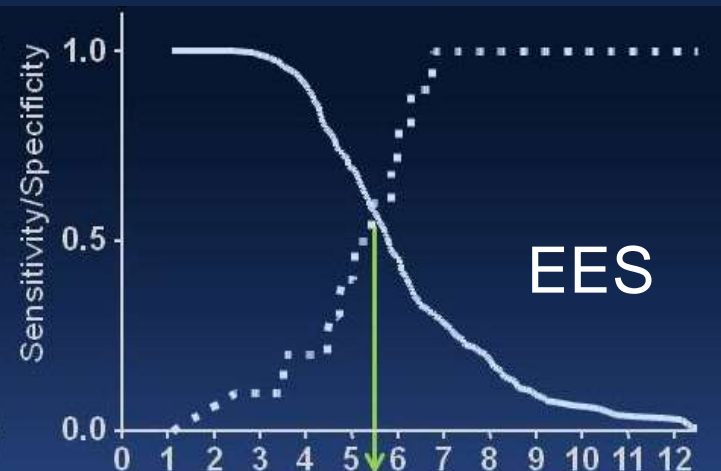


MSA 5.7mm²

*Eur Heart J 2006;27:1305-10
JACC Interv 2009;2:1269-75*



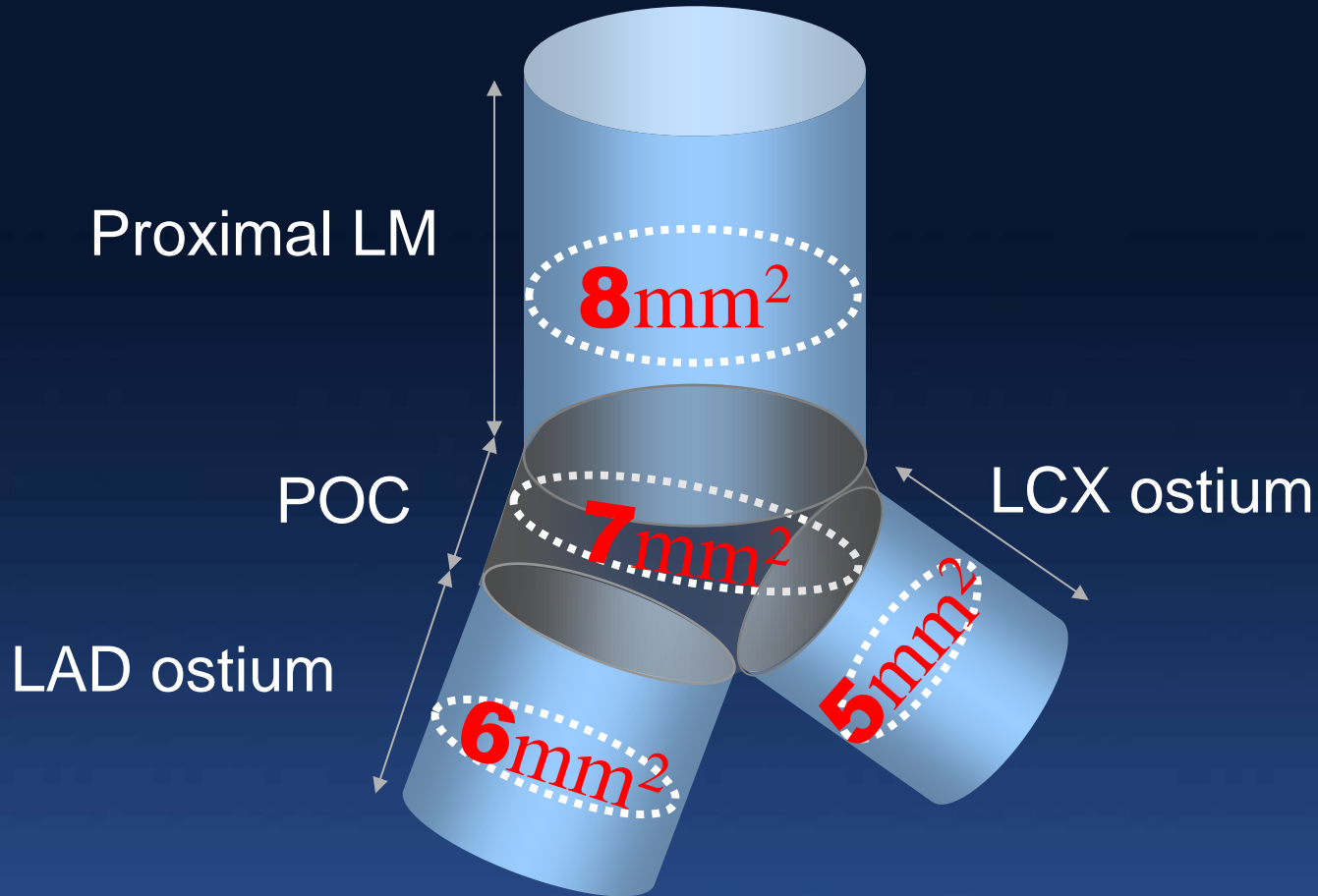
MSA 5.3mm²



MSA 5.4mm²

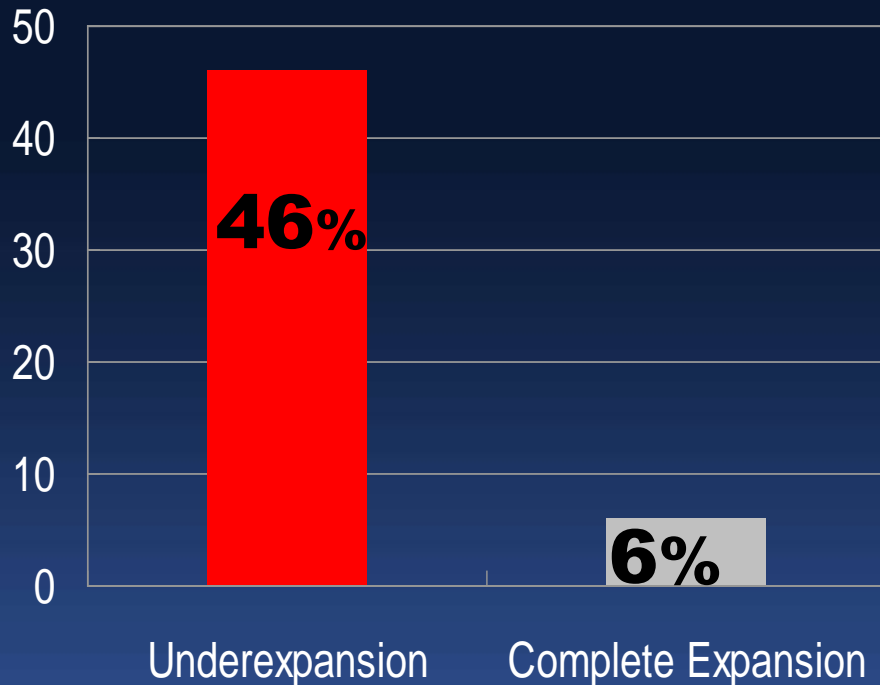
LM MSA Criteria

to predict 9-month ISR



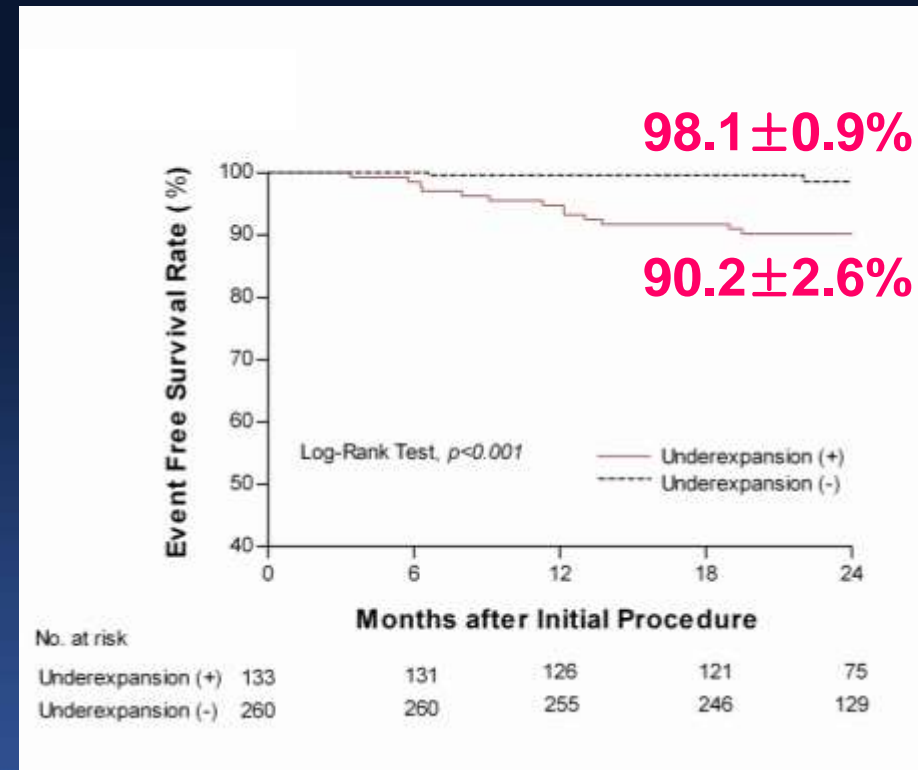
Two-Stent in LMCA Bifurcation

9-month ISR



 Any underexpansion
 No expansion

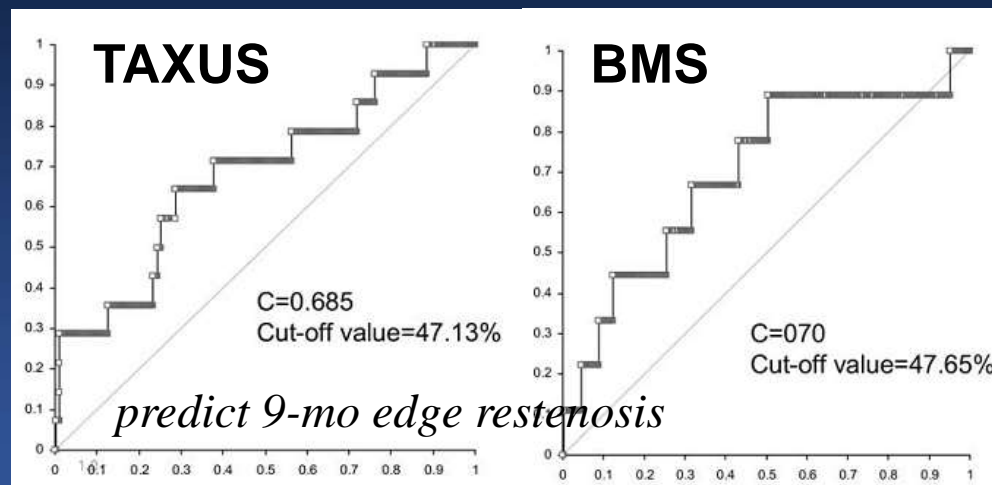
2-yr MACE-free Survival



Kang et al. Circ Cardiovasc Interv 2011 2011;4:1168-74

Residual Plaque Predicts Edge Restenosis

	Population	DES	F/U time	Predictor
SIRIUS¹	6 edge restenosis vs. 162 controls	SES	8 mo	Ref segment PB 60% vs. 41% (p<0.01)
TAXUS²	276 edge stenosis	PES	9 mo	Ref segment PB 47%

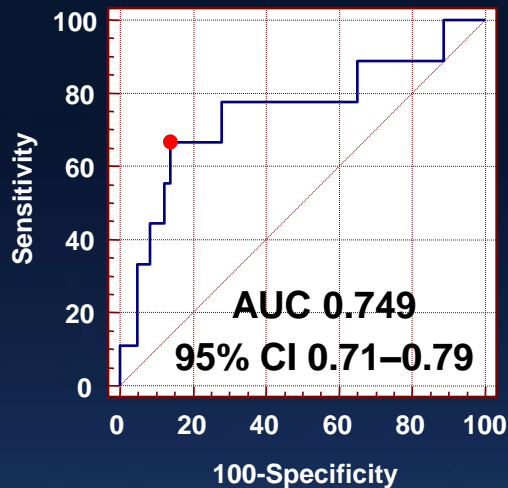


¹ Am J Cardiol 2005;96:1251-3

²Liu et al. Am J Cardiol 2009;103:501-6

Intravascular Ultrasound Predictors for Edge Restenosis After Newer Generation Drug-Eluting Stent Implantation

433 E-ZES

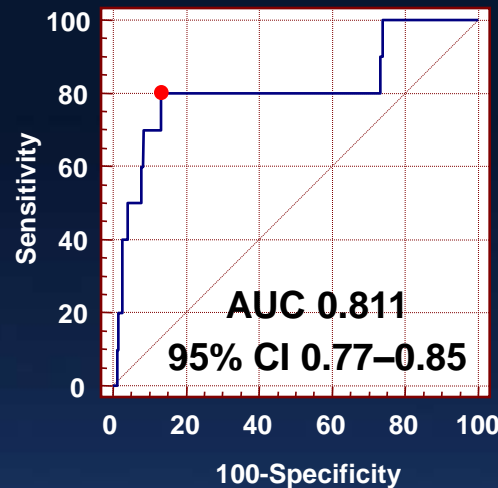


PB 56.3%

Sensitivity 67%

Specificity 86%

422 R-ZES

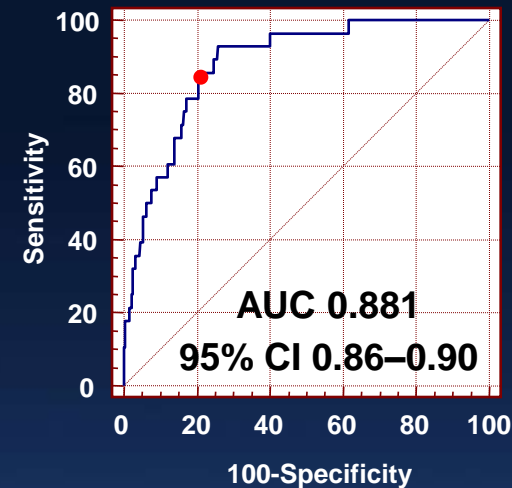


PB 57.3%

Sensitivity 80%

Specificity 87%

813 EES



PB 54.2%

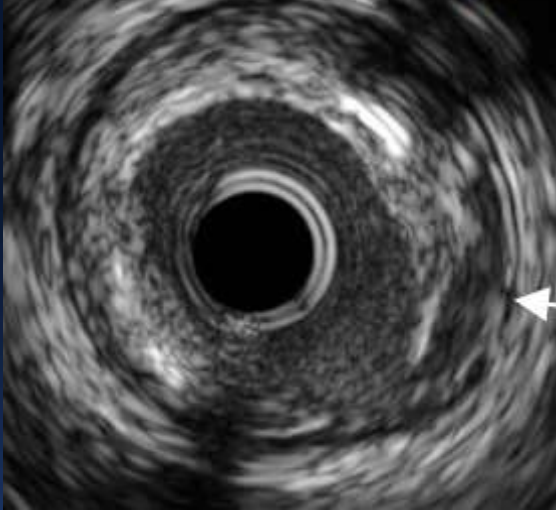
Sensitivity 86%

Specificity 80%

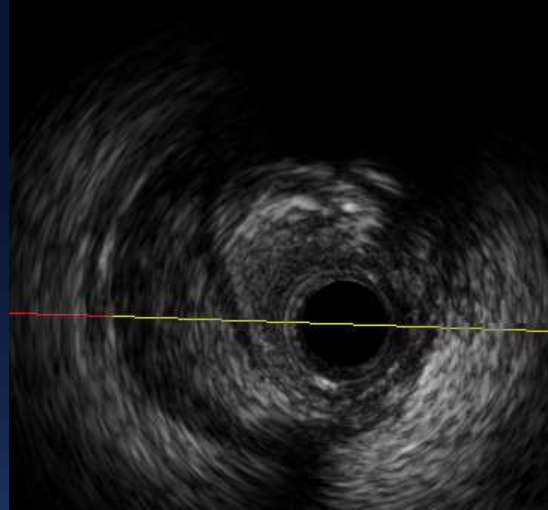
Reference segment residual PB < 55% is useful to determine the optimal landing site of stent deployment

IVUS-detected PCI Complication

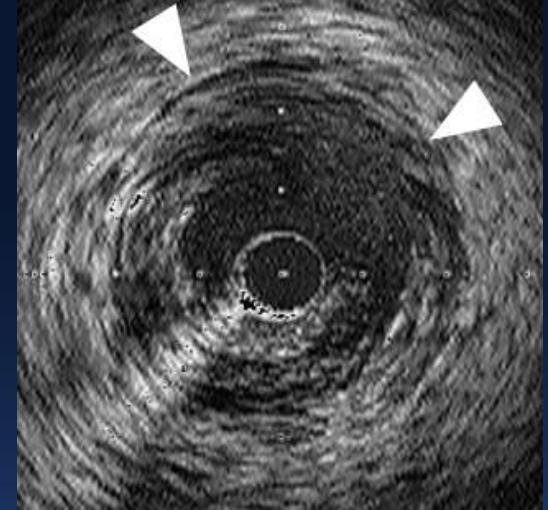
Dissection



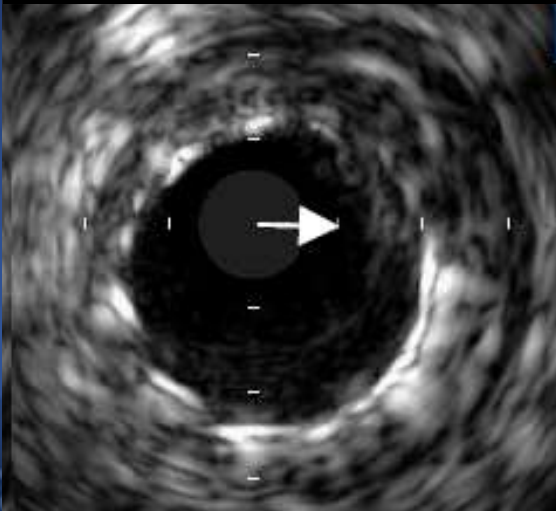
Hematoma



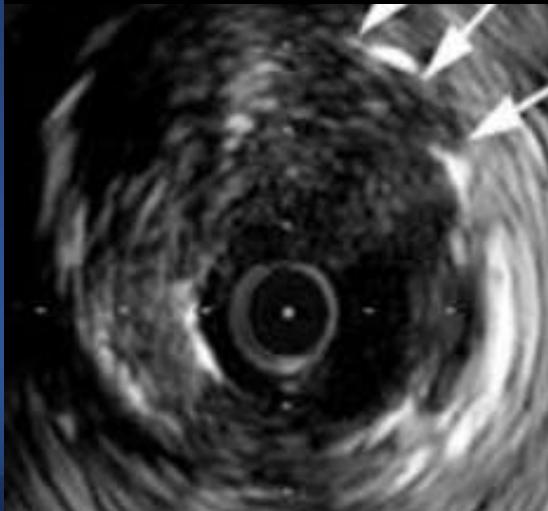
Perforation



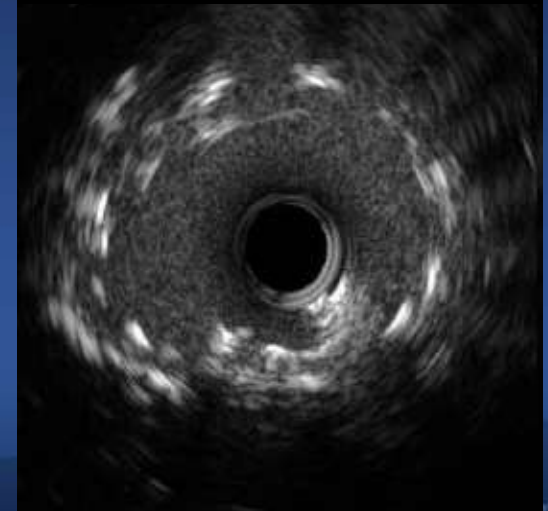
Plaque prolapse



Thrombosis



Deformation



Effect of Intravascular Ultrasound-Guided vs Angiography-Guided Everolimus-Eluting Stent Implantation

The IVUS-XPL Randomized Clinical Trial

Sung-Jin Hong, MD; Byeong-Keuk Kim, MD; Dong-Ho Shin, MD, MPH; Chung-Mo Nam, PhD; Jung-Sun Kim, MD; Young-Guk Ko, MD; Donghoon Choi, MD; Tae-Soo Kang, MD; Woong-Chol Kang, MD; Ae-Young Her, MD; Yonghoon Kim, MD; Seung-Ho Hur, MD; Bum-Kee Hong, MD; Hyuckmoon Kwon, MD; Yangsoo Jang, MD; Myeong-Ki Hong, MD, PhD; for the IVUS-XPL Investigators

- between Oct 2010-July 2014 at 20 centers in Korea
- 1400 pts with long lesions (>28mm stent length)
- randomly assigned to receive IVUS-guided (n=700) or angiography-guided (n=700) EES implantation
- primary end point: 1-year MACE (cardiac death, target lesion-related MI, or ischemia-driven TLR)

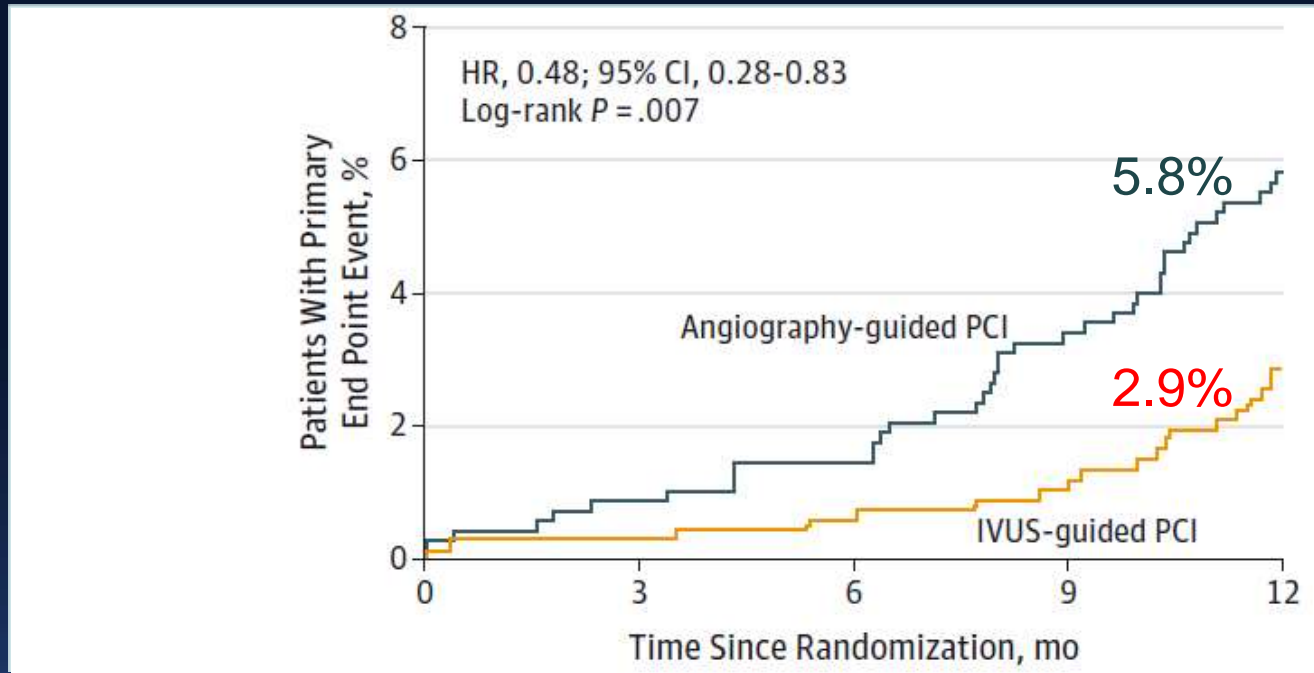
Hong SJ, Hong MK et al. JAMA 2015;10:1-9

Angiographic and Procedural Characteristics

	IVUS-guided	Angio-guided	p
Pre-PCI QCA-MLD, mm	0.83±0.42	0.82±0.43	0.56
Pre-PCI QCA-RVD, mm	2.89±0.45	2.85±0.45	0.13
Pre-PCI lesion length, mm	34.7±10.8	35.2±10.5	0.41
Post-dilatation, N (%)	534 (76%)	402 (57%)	<0.001
Final balloon size, mm	3.14 ±0.43	3.04 ±0.42	<0.001
Maximal inflation pressure, atm	16.5±4.1	15.9±4.1	0.05
Post-stenting QCA-MLD, mm	2.64±0.42	2.56±0.39	<0.001
Post-stenting QCA-RVD,mm	3.03±0.44	2.97±0.43	0.01
Total stent length, mm	39.3±13.1	39.2±12.3	0.90

Hong SJ, Hong MK et al. JAMA 2015;10:1-9

Kaplan-Meier Estimates of 1-year MACE



	IVUS-guided	Angio-guided	HR	p
Cardiac death	3 (0.4%)	5 (0.7%)	0.60 (0.14-2.52)	0.48
Target lesion-related MI	0 (0%)	1 (0.1%)		0.32
Ischemia-driven TLR	17 (2.5%)	33 (5.0%)	0.51 (0.28-0.91)	0.02
Stent thrombosis	2 (0.3%)	2 (0.3%)	1.00 (0.14-7.10)	1.0

Summary

- Pre-procedure IVUS can assess lesion severity, plaque vulnerability and risk for distal embolization
- IVUS is helpful to determine PCI strategy in complex lesion (bifurcation, calcified, ISR, etc.)
- IVUS is useful for device sizing
- To prevent stent failure, underexpansion and edge problems should be corrected post-stenting
- IVUS-guided optimization improves PCI outcome