

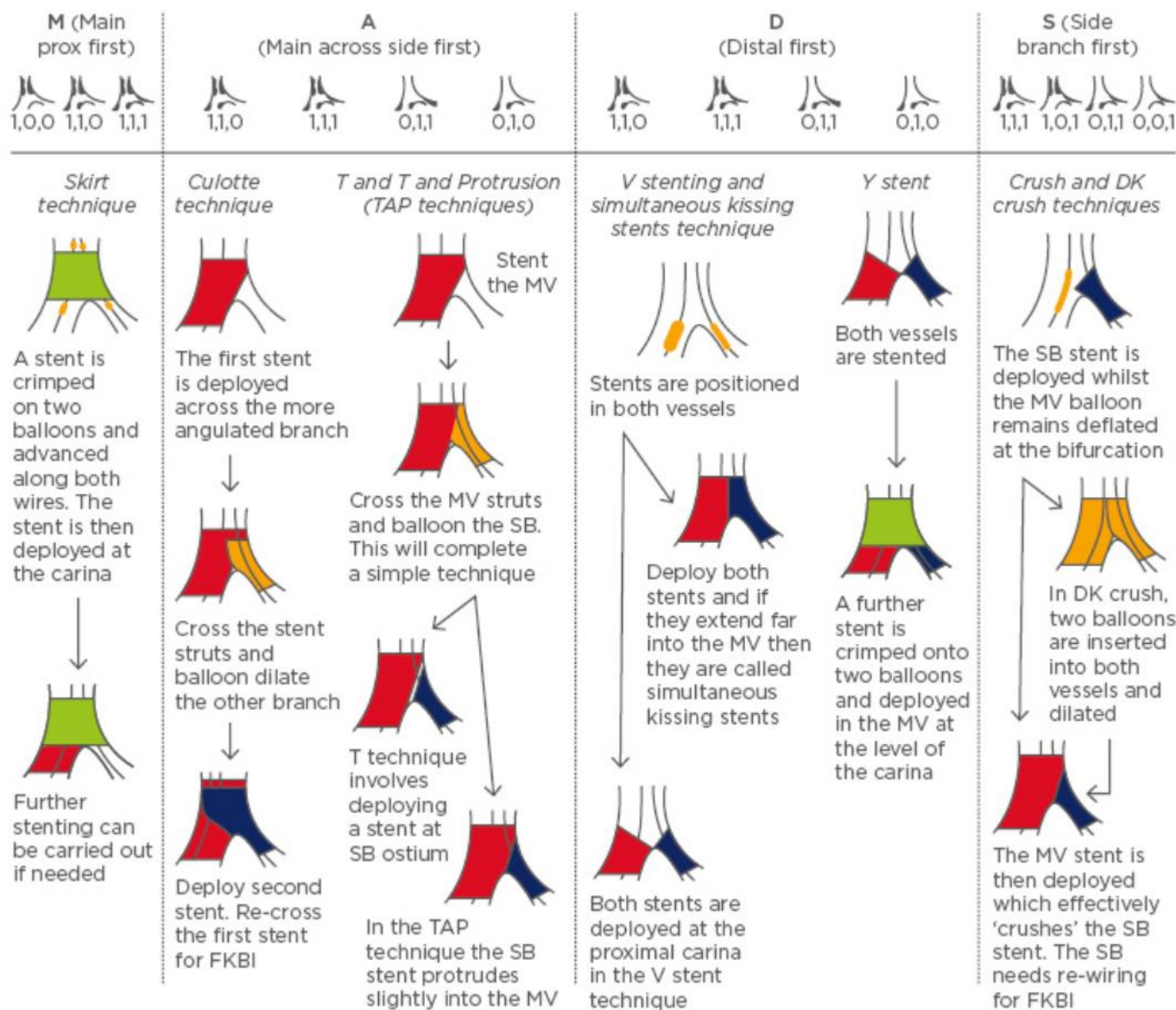
IVUS-Guided Percutaneous Coronary Intervention for Left Main and Bifurcation Lesion

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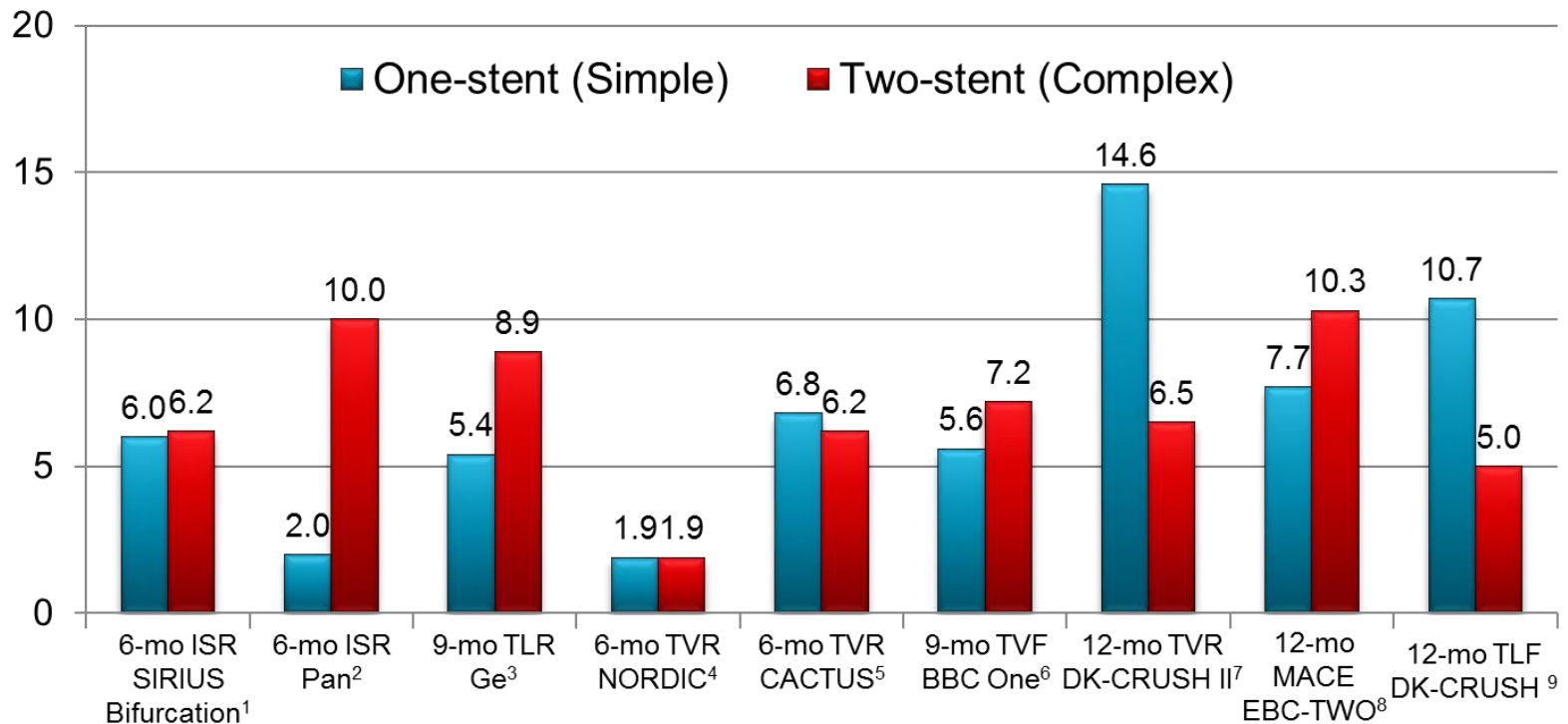
How many options for bifurcation lesions?



Bifurcation lesion is very unique lesion

For side branch lesion

- DES implantation is not better than angioplasty
- Angioplasty is not better than “leave it alone”



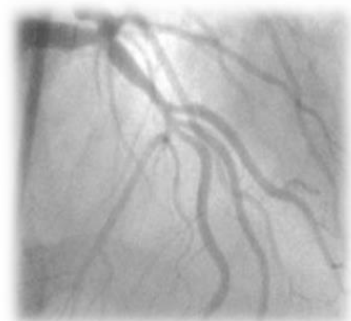
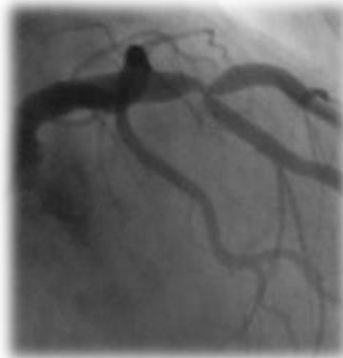
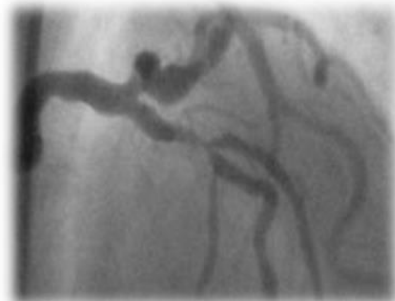
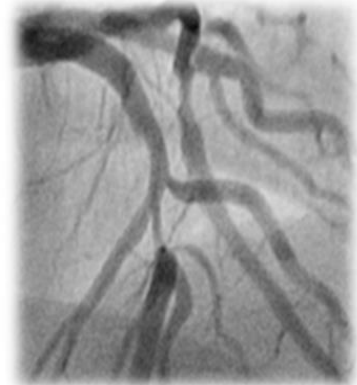
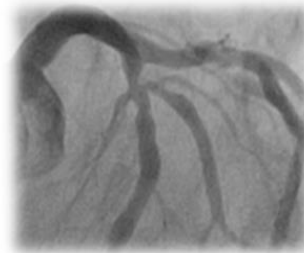
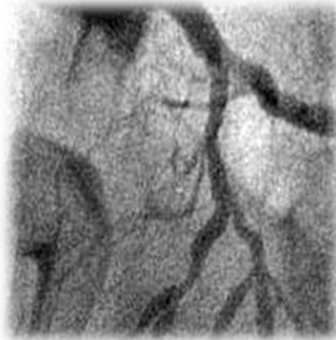
1. Colombo A, Circulation 2004
4. Steigen, Circulation 2006
7. Chen S, JACC 2011

2. Pan M, AHJ 2004
5. Colombo A, Circulation 2009
8. Hildick-Smith D, Circ CVI 2016

3. Ge, Colombo, Heart 2005
6. Hildick-Smith D. Circulation 2010
9. Chen S, JACC 2017

Limitation of angiographic assessment in Bifurcation lesions

- Overlapping mother and daughter vessel
→ Obscure the lesion and carina



Uniqueness of bifurcation lesions

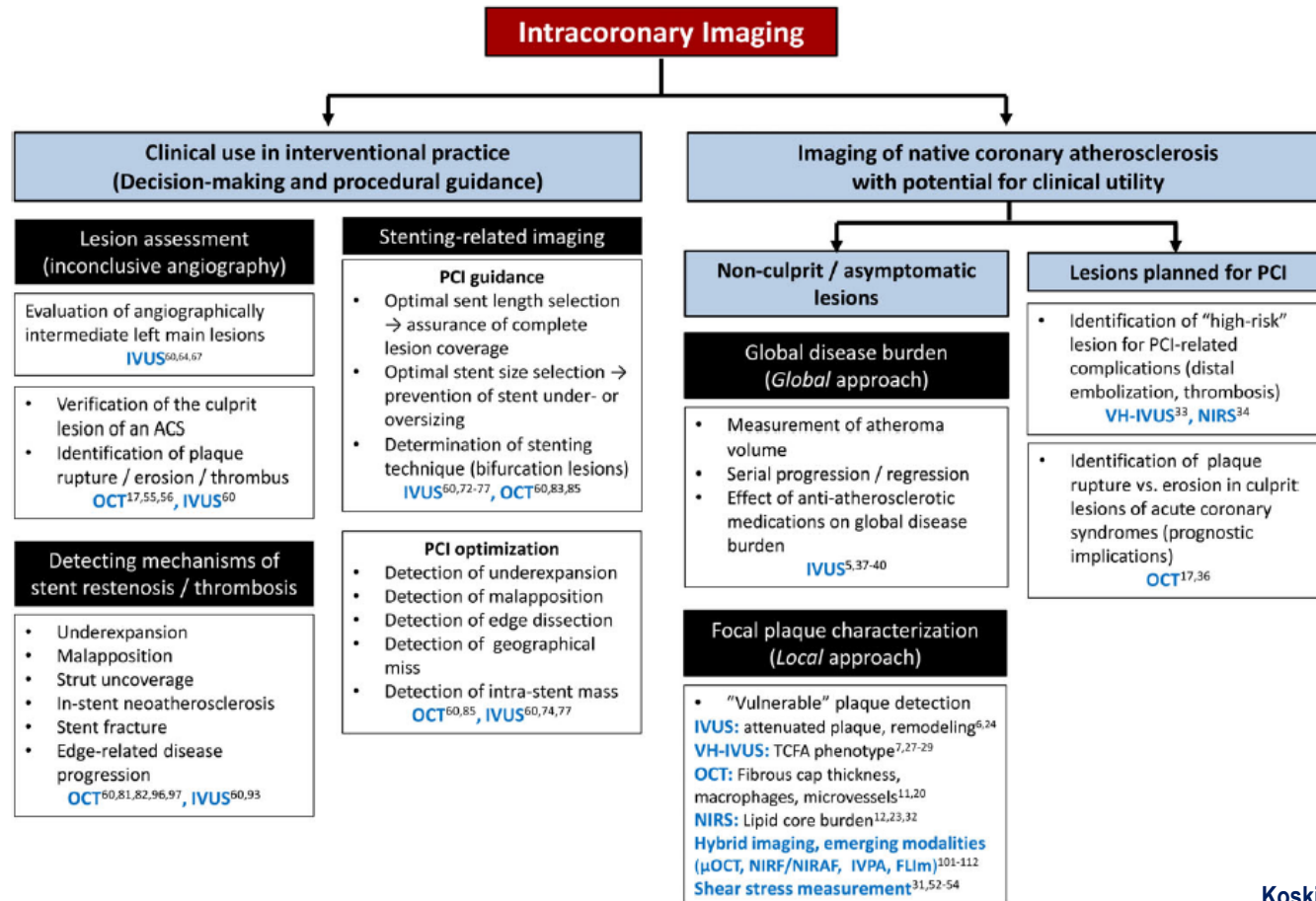
- Various vessel size, Various amount of supplying myocardium
- Side branch ostial lesion is unique
 - ✓ Underlying plaque → **Eccentric plaque**
 - ✓ Remodeling → **Negative remodeling**
 - ✓ Mechanism of side branch jailing after main vessel stenting



Carina shift, plaque shift, plaque prolapse, stents struts, thrombus....

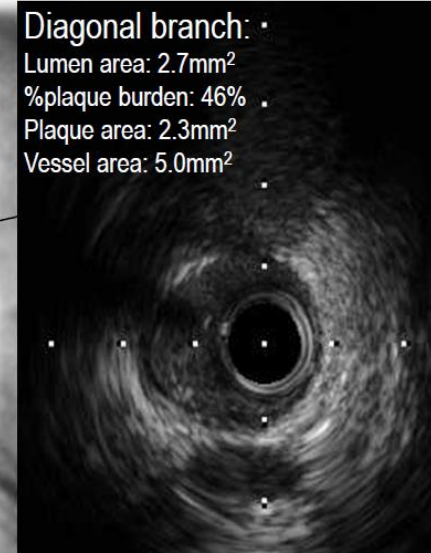
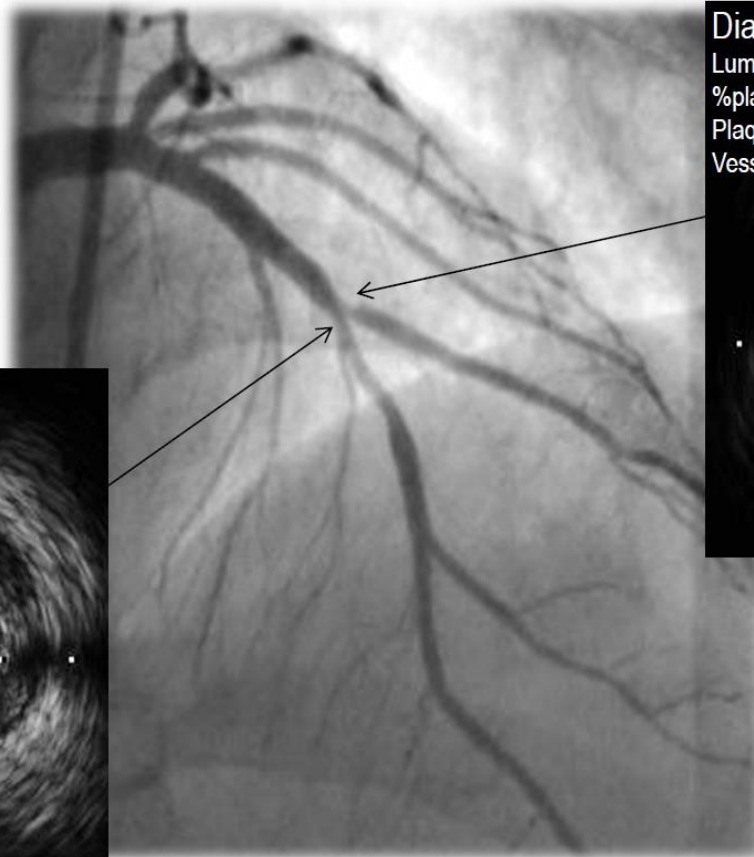
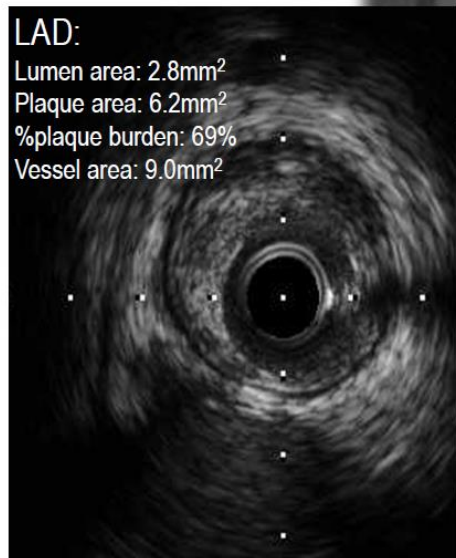
What can be guided by IVUS?

- **Key factors in bifurcation lesion treatment**
 - ✓ Determining anatomical configuration
 - ✓ Selecting Strategy
 - ✓ Assessing the final results



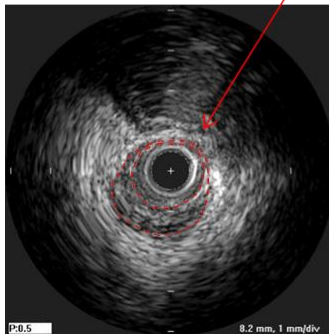
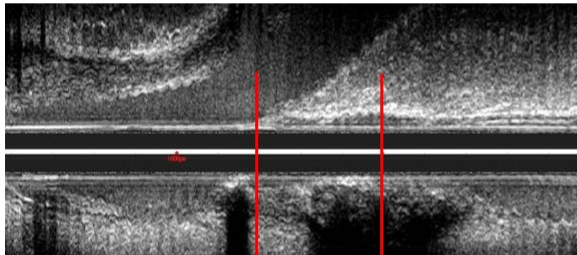
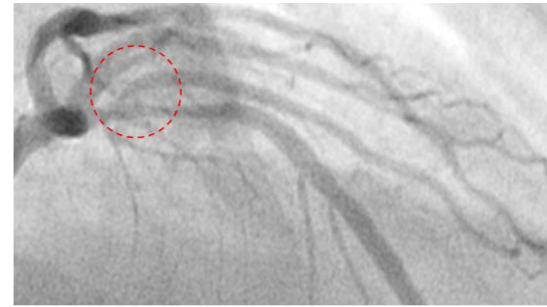
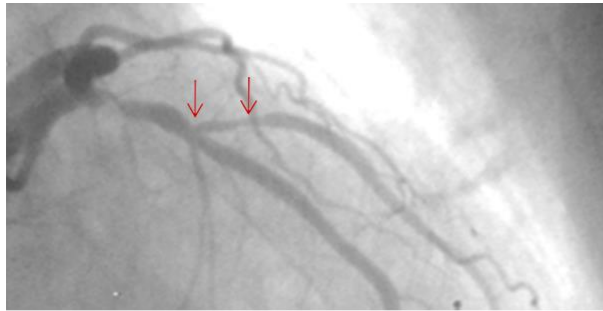
Pre-procedural IVUS assessment of the bifurcation lesion

Precise anatomical lesion assessment

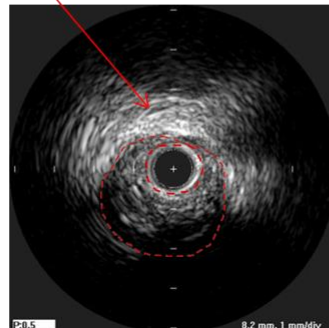


Pre-procedural IVUS assessment of the bifurcation lesion

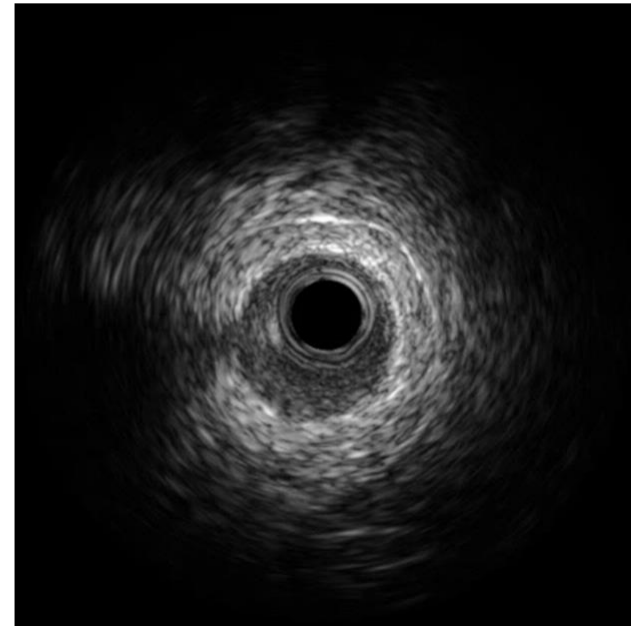
Mechanism of side branch stenosis



Plaque + Negative remodeling

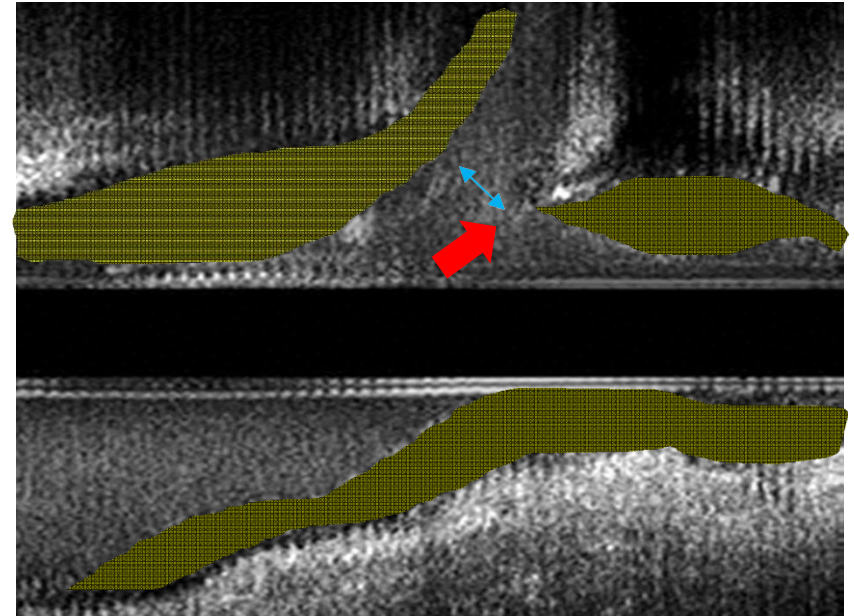
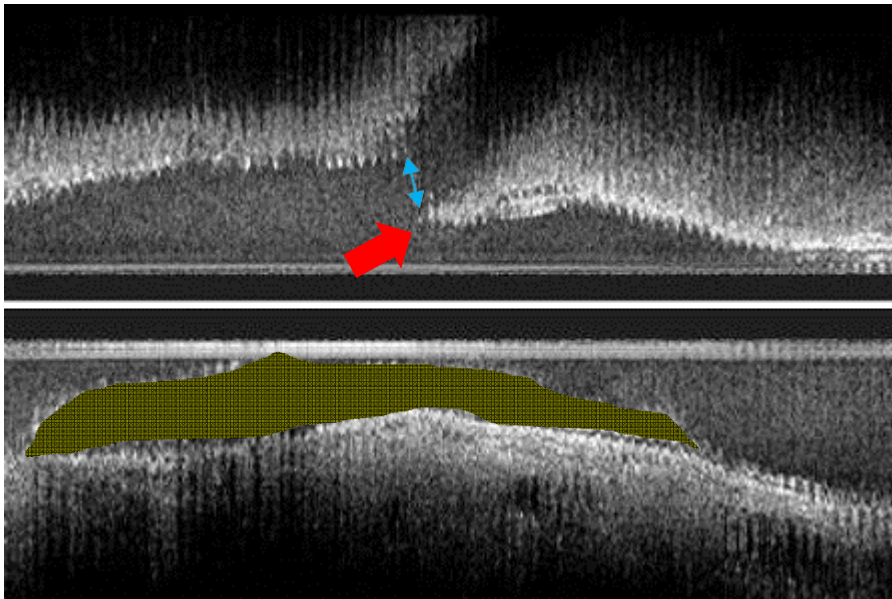


Plaque



Pre-procedural IVUS assessment of the bifurcation lesion

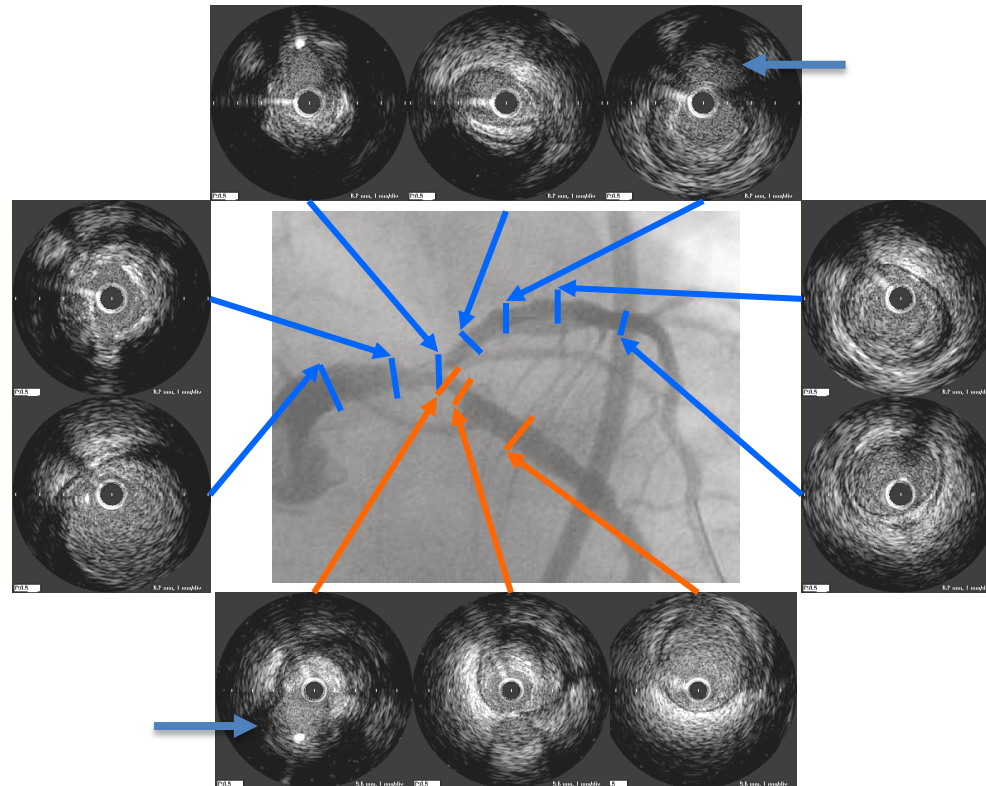
Importance of longitudinal view



- Geometry of bifurcation lesion
- Amount, character and distribution of plaque
- Location, length of carina
- Distance between carina and outer lumen of a side branch

Pre-procedural IVUS assessment of the bifurcation lesion

- Stent landing zone and reference analysis
- Measurement of the lesion length
- Detection of angiographically silent disease

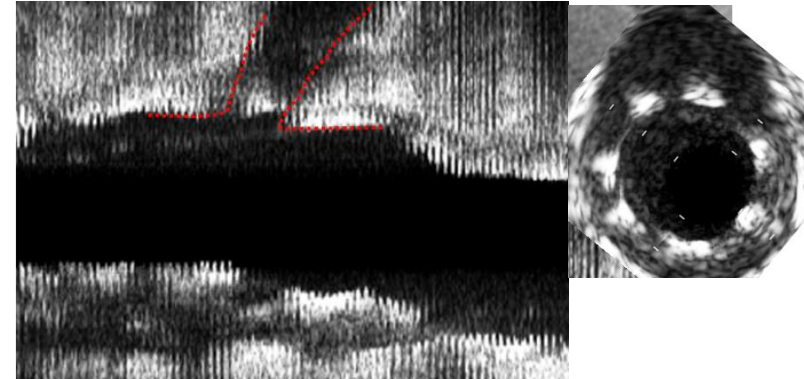
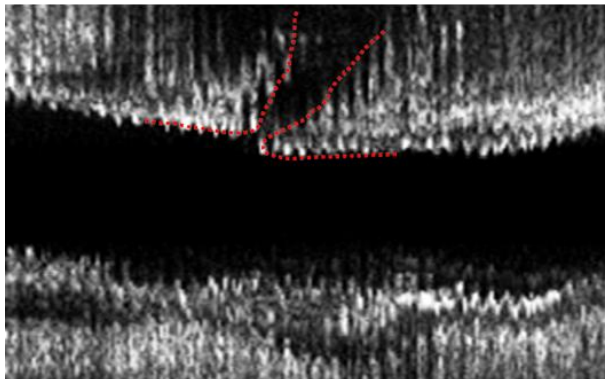
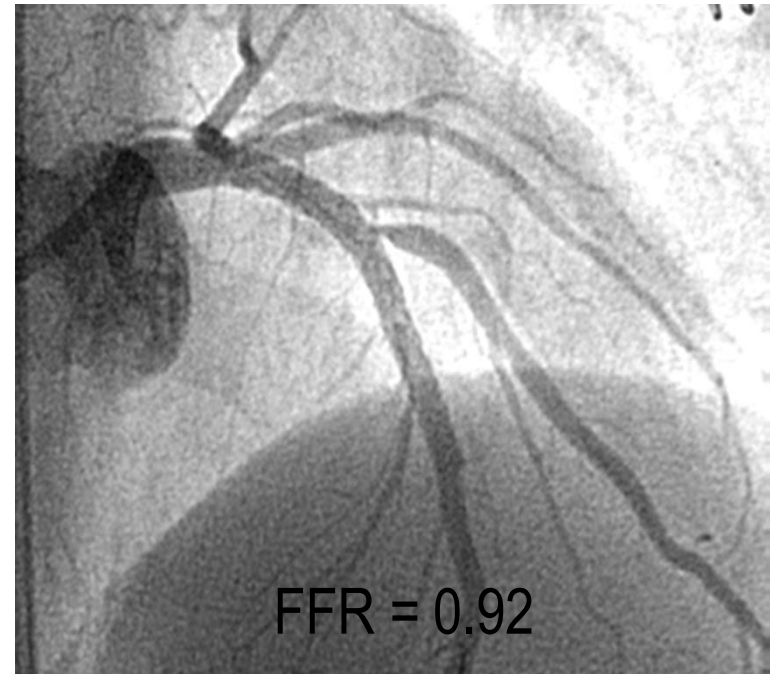
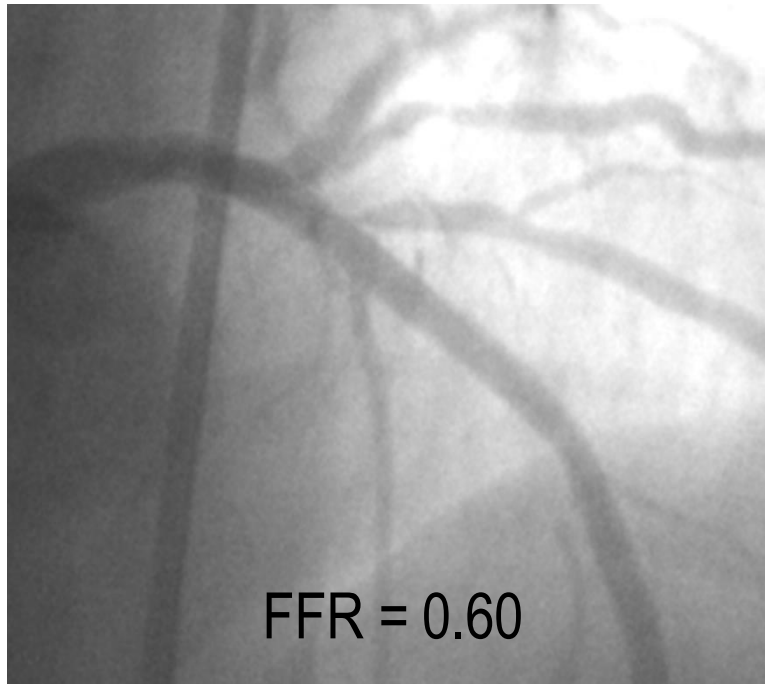


IVUS-Guided PCI For Bifurcation Lesion

- Pre-intervention
 - IVUS can provide detailed anatomical information which is very helpful to plan the intervention strategy
 - Longitudinal view is important to predict what will happen in side branch after main vessel stent implantation.

IVUS assessment of bifurcation during the procedure

True vs Pseudo-stenosis after MV stenting

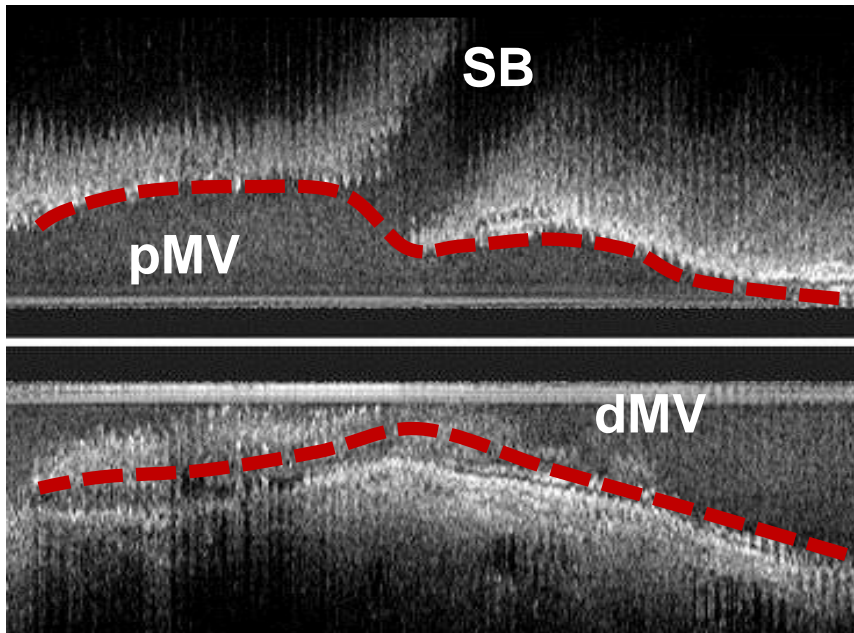


IVUS assessment of bifurcation during the procedure

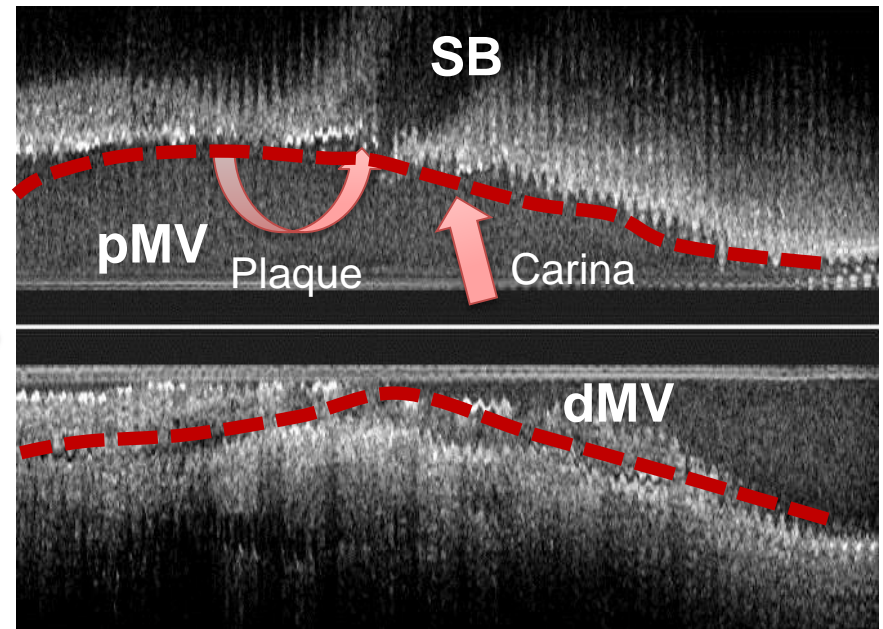
Under-expansion & Over-expansion

Simple stent cross-over is associated with proximal stent under-sizing and distal stent over-sizing

Optimal stenting



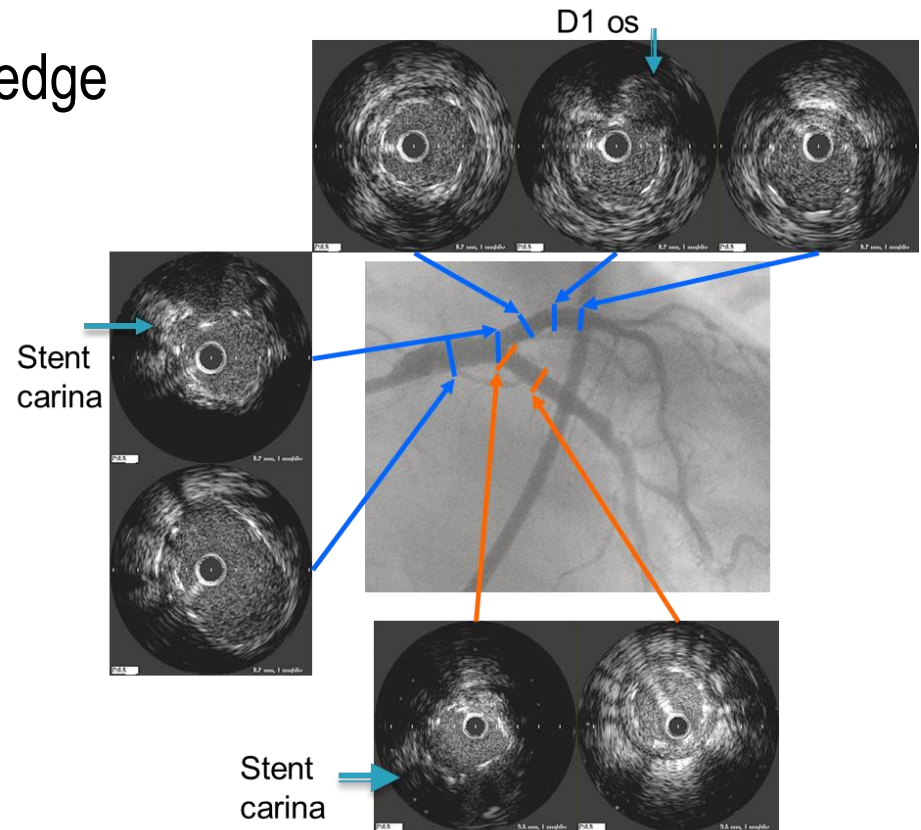
Stent overexpansion



pMV = proximal main vessel, dMV = distal main vessel, main branch, SB = side branch

Post-procedural IVUS assessment of the bifurcation lesion

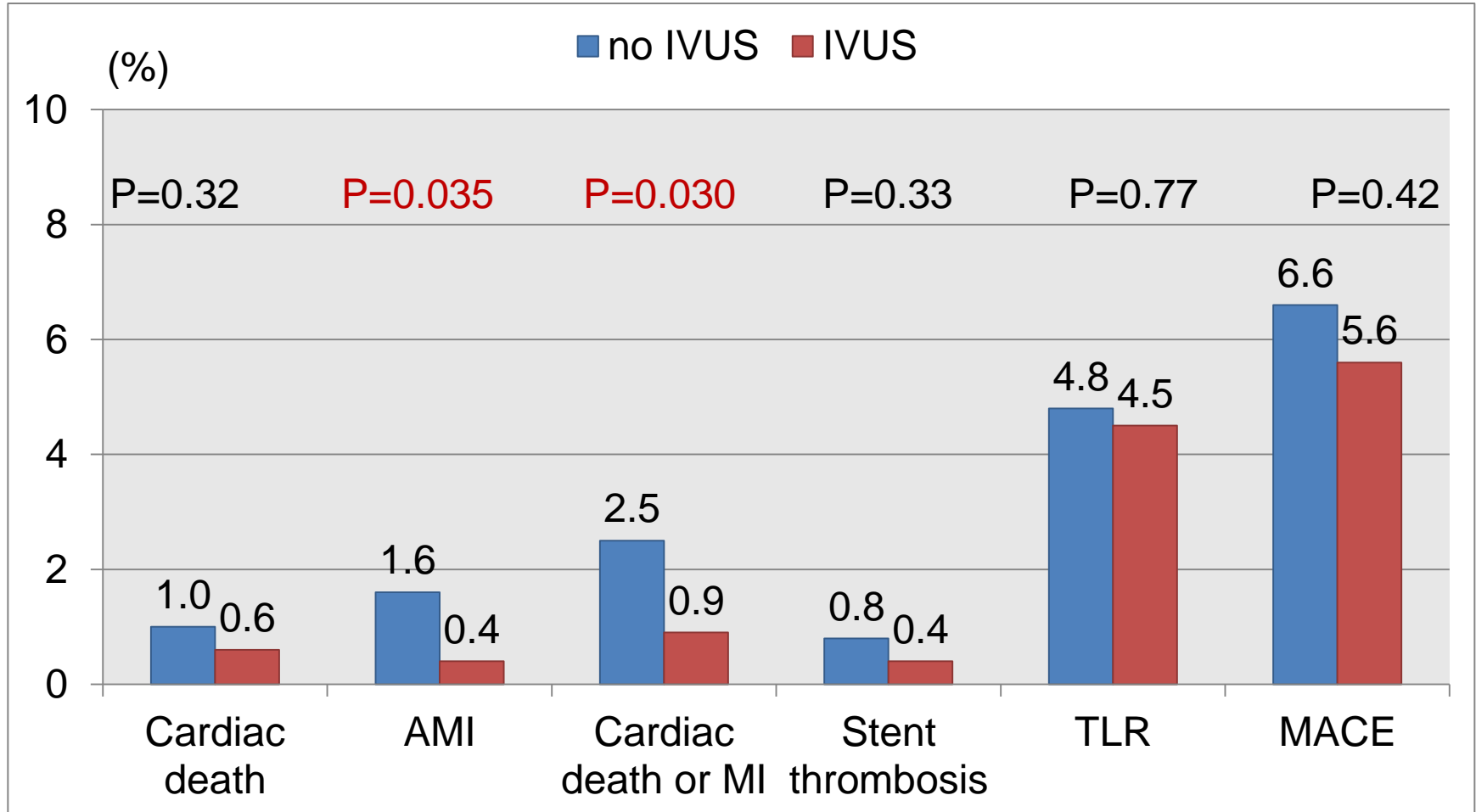
- Assessment and optimization of stent apposition and expansion
- Assessment of full lesion coverage by the stent
- Diagnosis and treatment of stent edge problems



Clinical outcome of IVUS-guided bifurcation PCI

Non-LM Bifurcation Stenting

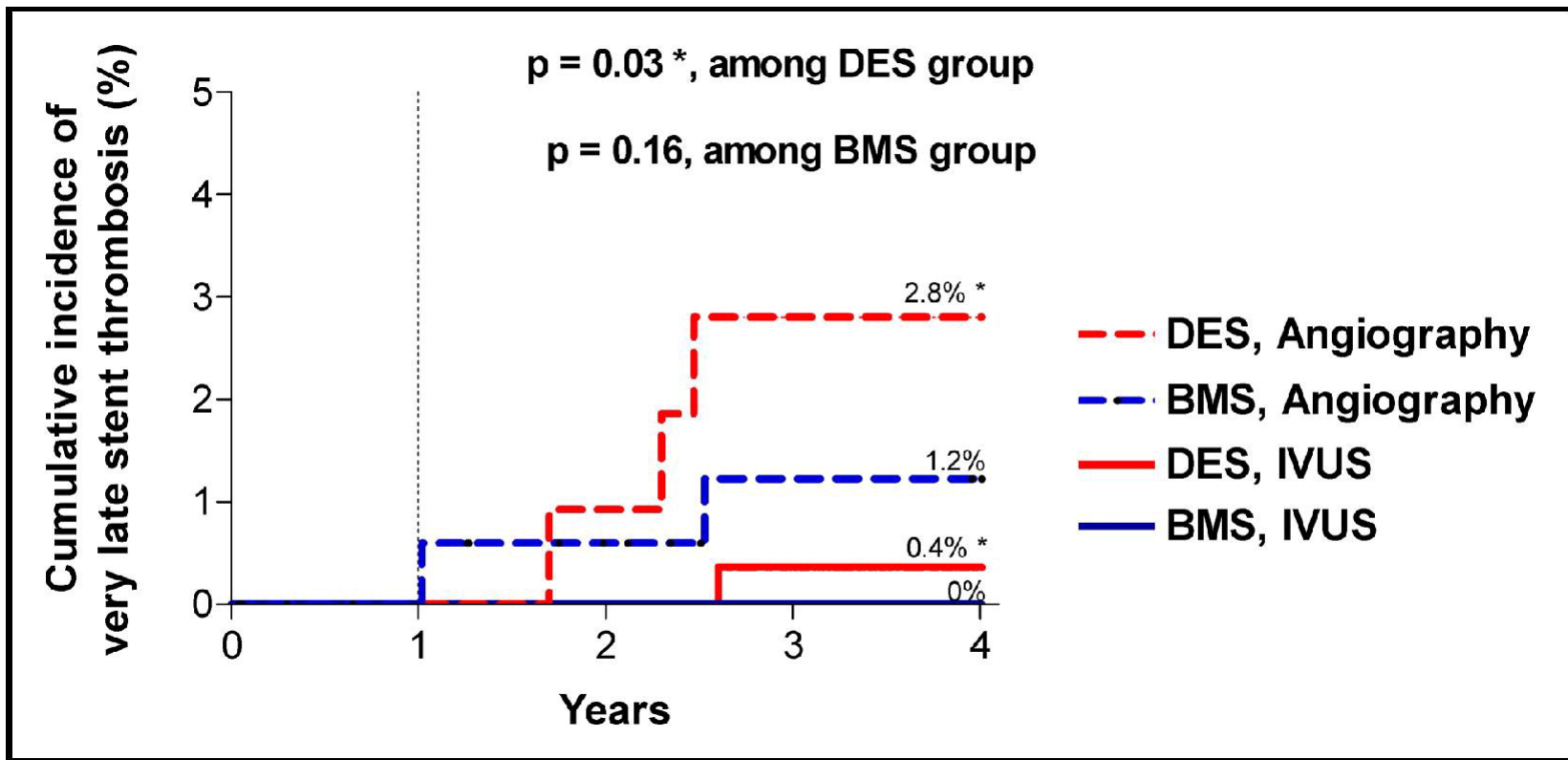
COBIS Registry N=1668, Median FU 22.4 months



Clinical outcome of IVUS-guided bifurcation PCI

Non-LM Bifurcation Stenting

AMC Registry N=758, Median FU 4 years

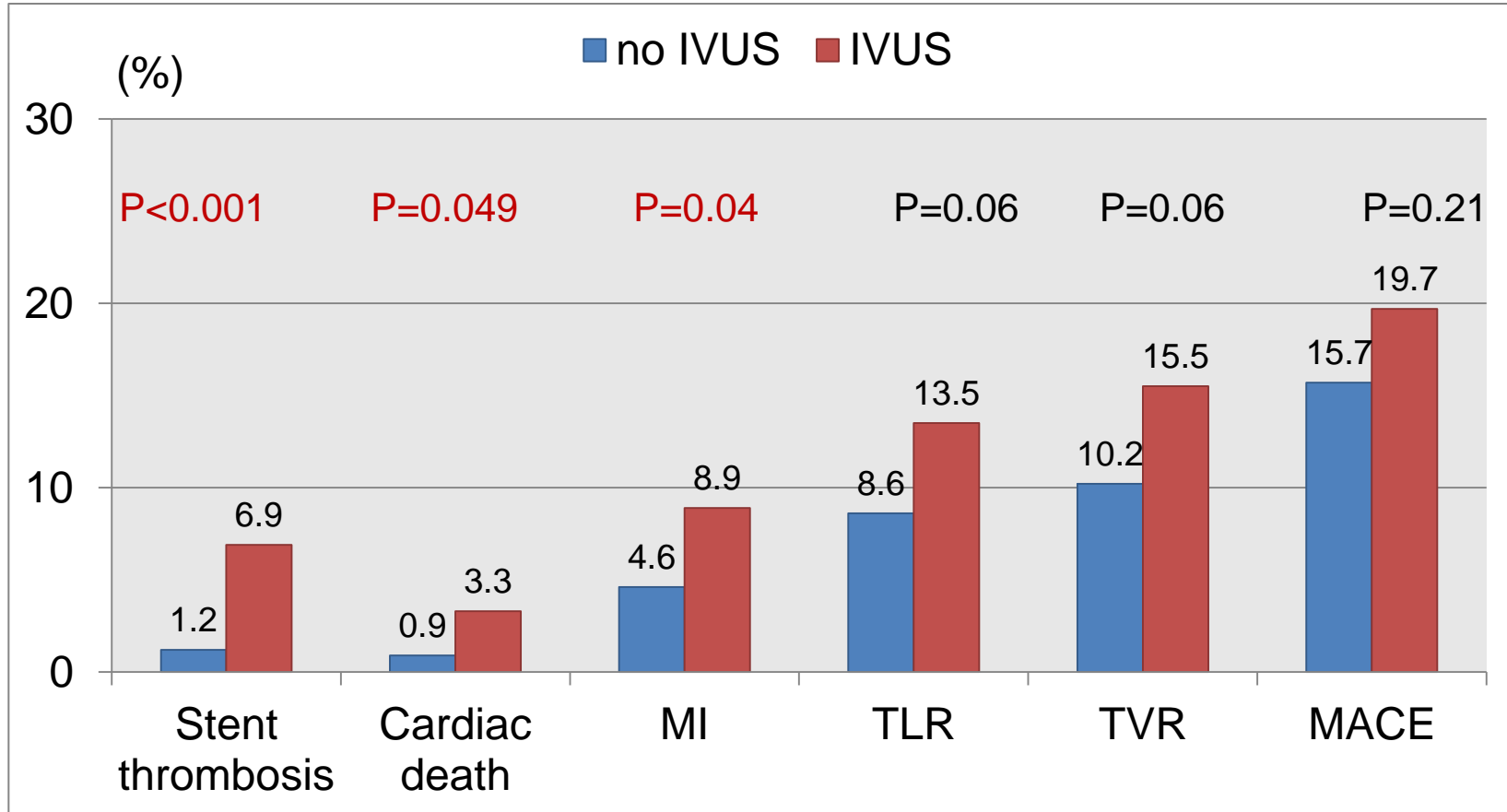


IVUS guidance reduced very late stent thrombosis in patients receiving DESs for non-LM bifurcation.

Clinical outcome of IVUS-guided bifurcation PCI

Non-LM Bifurcation Stenting

Chen et al, N=628 with 2-stent, FU 1 years



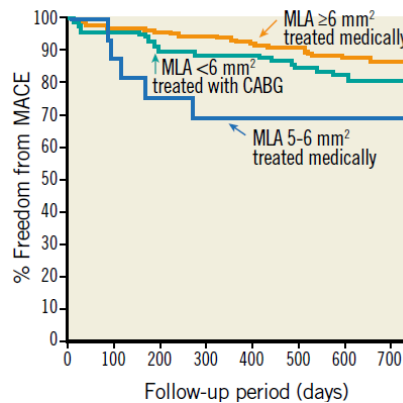
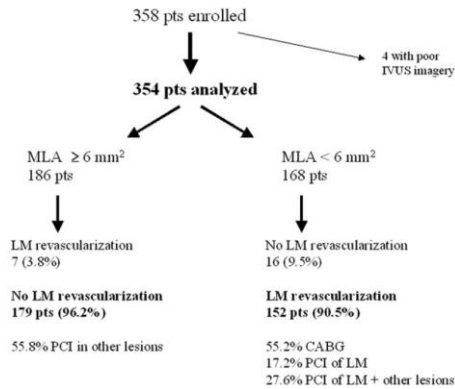
The IVUS-guided two-stent technique was associated with significantly reduced late stent thrombosis, with a resultant reduction in cardiac death, and MI.

IVUS-MLA in LM: Population dependent

[Pre-PCI IVUS MLA Cutoff Value]

[Western Country Population] → LITRO registry

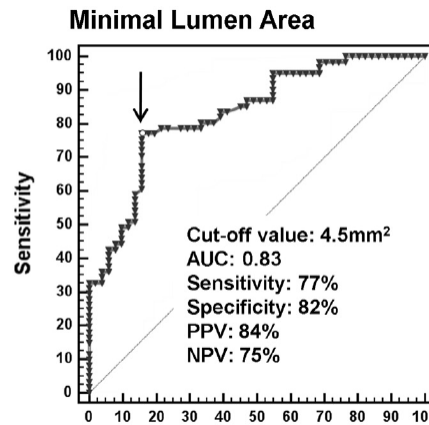
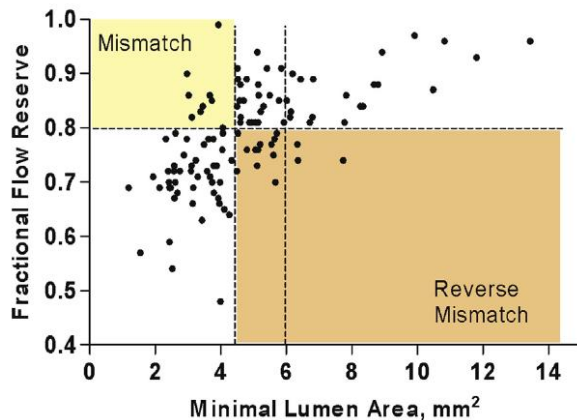
IVUS derived **MLA of $\geq 6 \text{ mm}^2$** identified candidates for **safe deferral** of LMCA revascularization



Update of the LITRO Registry in a presentation by de la Torre Hernandez at TCT2017
Gary S. Mintz, et al. Eurointervention, 2018

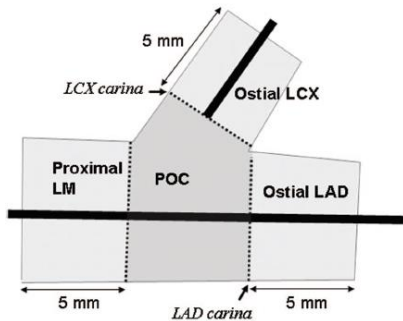
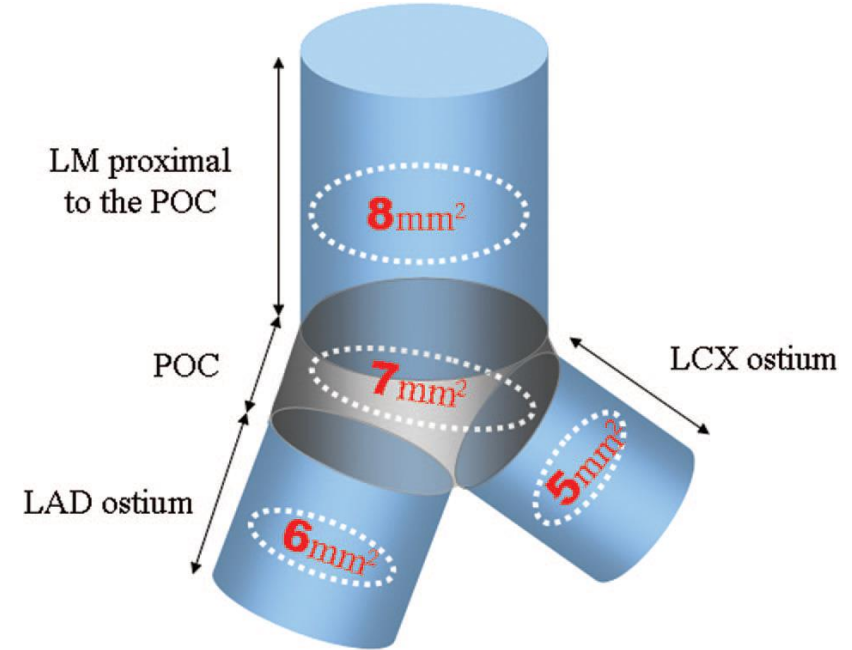
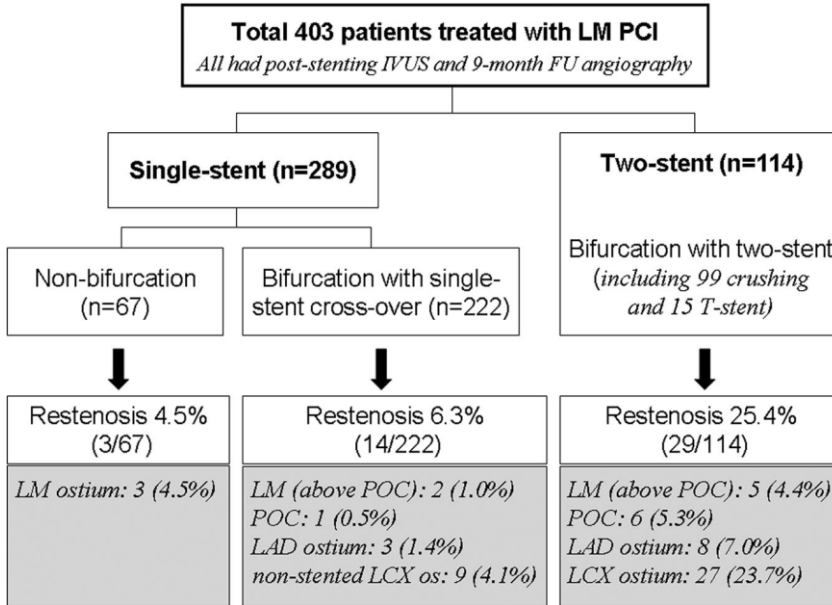
[Asian Population] → from AMC

In patients with **isolated ostial and shaft intermediate LMCA stenosis**, an IVUS-derived MLA of **$\leq 4.5 \text{ mm}^2$** is a useful index of an **FFR of ≤ 0.80** .



Post-PCI Optimization in LM

- IVUS predictors of in-stent restenosis (ISR) after LM bifurcation stenting



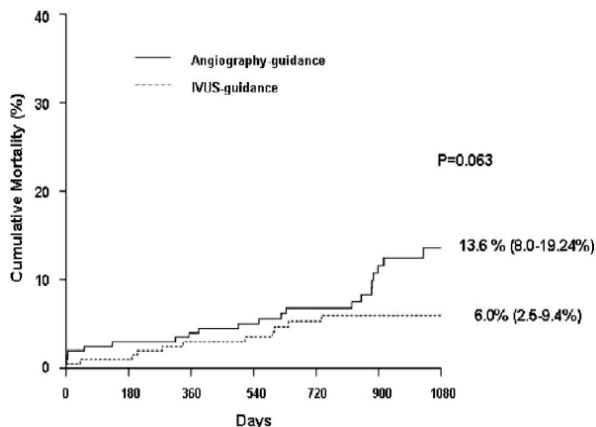
The MSA cut-offs that best predicted restenosis were 5.0 mm² (LCX ostial ISR), 6.3 mm² (LAD ostial ISR), 7.2 mm² (POC ISR), and 8.2 mm² (LMCA ISR above the POC).

Correcting underexpansion with these optimal IVUS criteria may reduce cardiac events

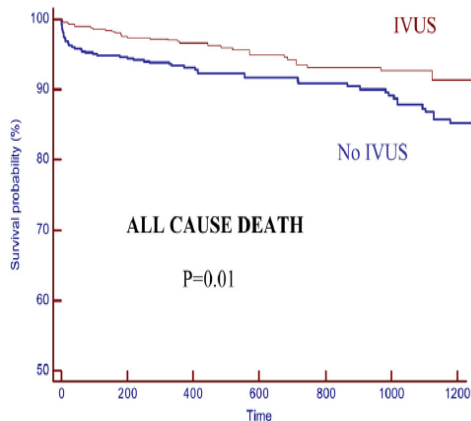
Abundant evidences favoring IVUS in LM PCI

[Clinical Outcome]

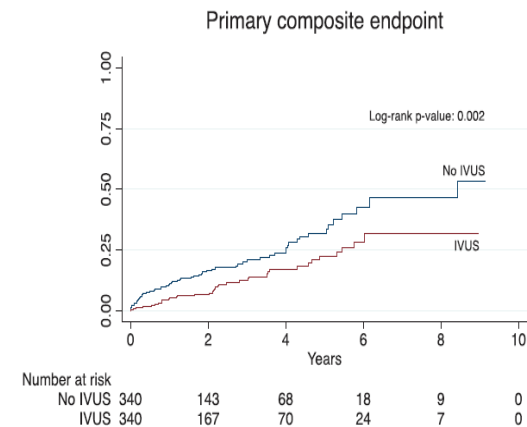
**MAIN-COMPARE Study
From Korea**



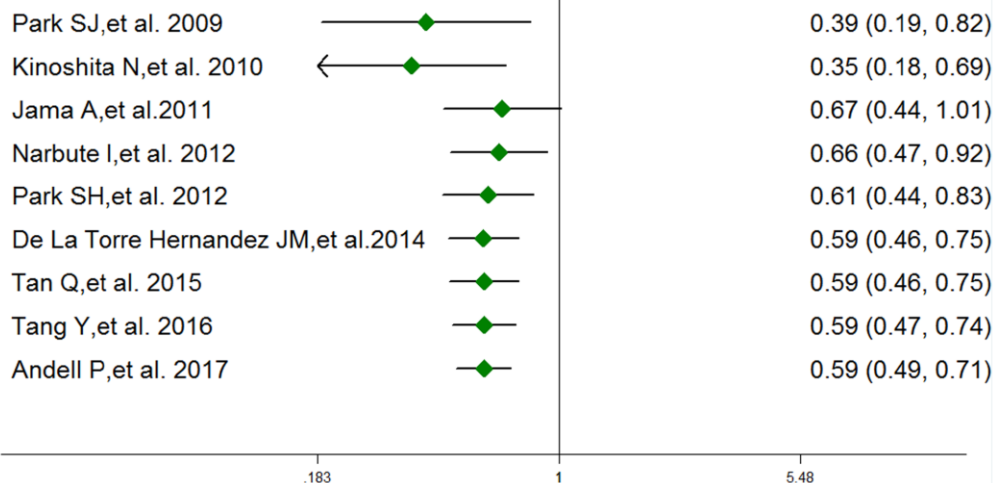
**IVUS-TRONCO-ICP Study
From Spain**



**SCAAR Study
From Sweden**



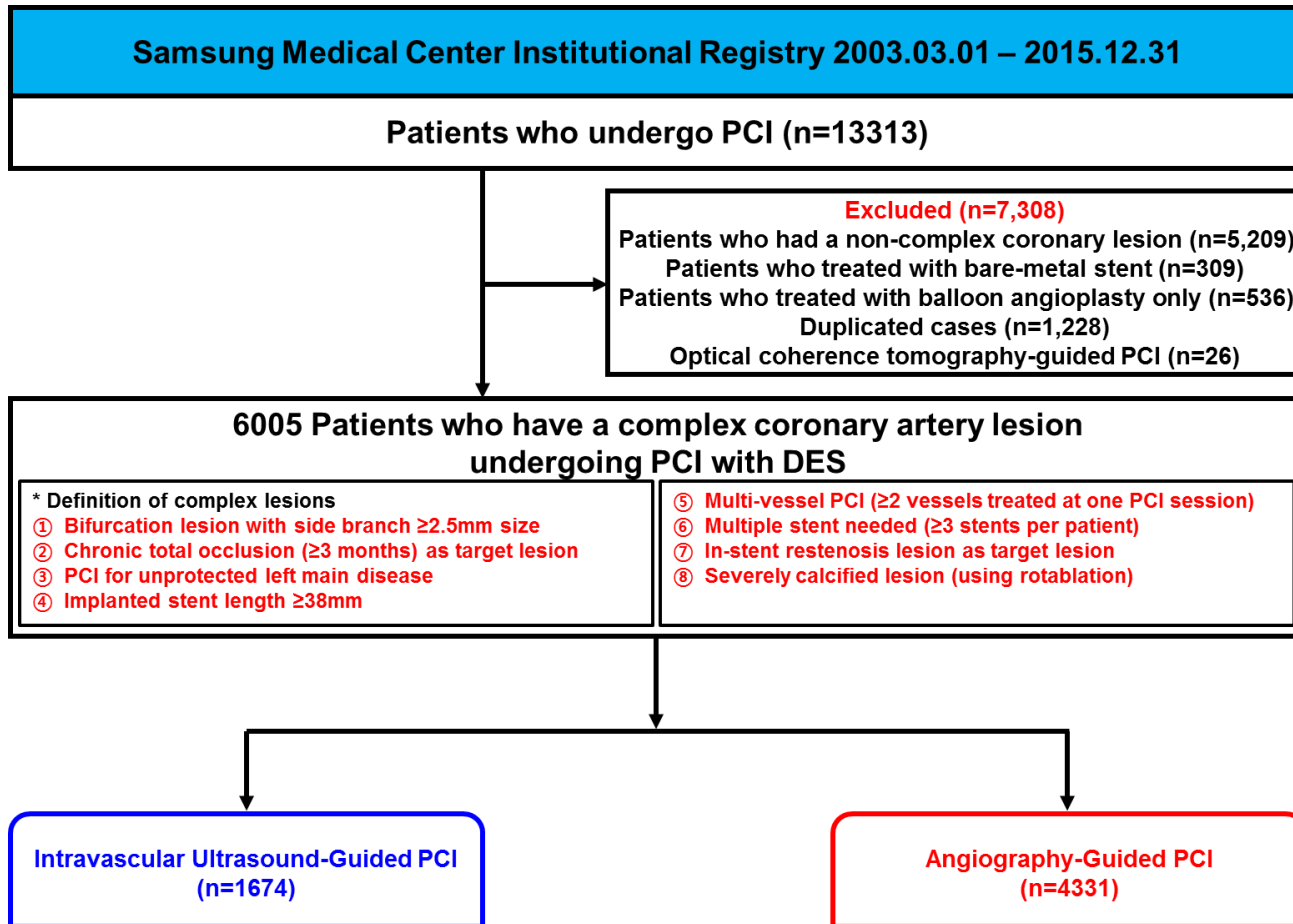
Meta-Analysis



IVUS-guided PCI in LM CAD significantly reduced the risks of all-cause death by ~40% compared with conventional angiography-guided PCI.

Park SJ, et al. *Circ Cardiovasc Interv*, 2009
de la Torre Hernandez, et al. *JACC:CVI*, 2014
Pontus A, et al. *Circ Cardiovasc Interv*, 2017
Ye, et al. *Plos One*, 2017

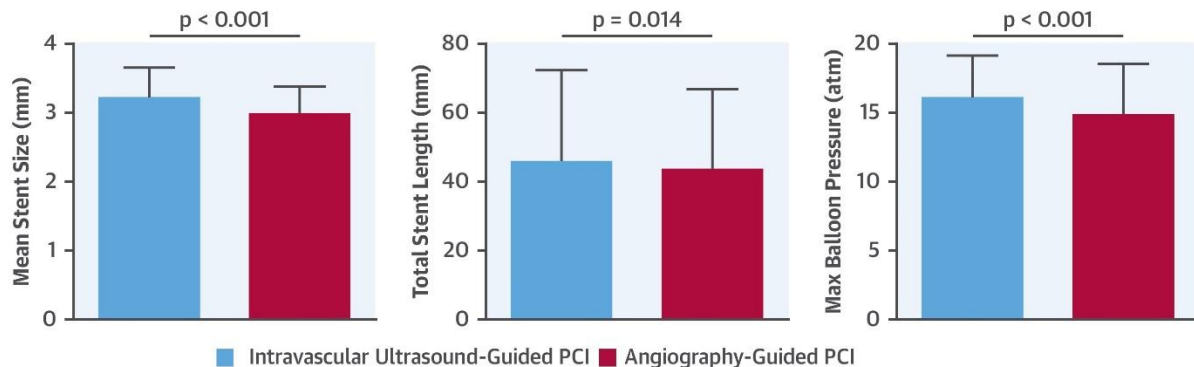
IVUS-Guided PCI for Complex lesions



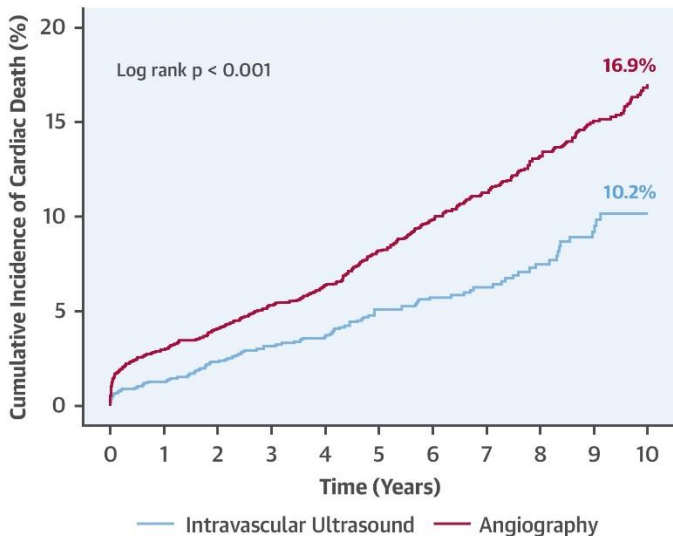
Primary Endpoint	Cardiac Death during 64 Months of Median Follow-up
Secondary Endpoint	All-cause death, myocardial infarction, ischemia-driven target lesion revascularization, stent thrombosis, and MACE*

CENTRAL ILLUSTRATION: Long-Term Clinical Outcomes Between IVUS-Guided and Angiography-Guided PCI for Complex Lesion

Procedural Factors



Clinical Outcomes



Lesion Type	OR (95% CI)
All Lesion	0.573 (0.460-0.714)
Bifurcation Lesion	0.682 (0.498-0.934)
Chronic Total Occlusion Lesion	0.670 (0.408-1.102)
Left Main Disease	0.203 (0.126-0.329)
Long Lesion	0.602 (0.450-0.804)
Multi-Vessel PCI	0.639 (0.473-0.864)
Multiple Stents Implantation	0.532 (0.332-0.855)
In-Stent Restenosis Lesion	0.837 (0.403-1.740)
Calcified Lesion	0.458 (0.052-4.012)

0.01 0.1 1 10
Favors Intravascular Ultrasound | Favors Angiography

Choi, K.H. et al. J Am Coll Cardiol Interv. 2019;12(7):607-20.

Summary

- IVUS provides a precise characterization of the extension and morphology of LM & Bifurcation lesions. This allows a proper planification of the PCI strategy.
- IVUS guidance facilitates the final optimization of the PCI results in LM & Bifurcation lesions.
- Pooled analysis of studies shows a significant and consistent clinical benefit of IVUS guidance.

Thank You For Your Attention !

Young Bin Song, MD

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