

# Evolution of Left Main Percutaneous Revascularization Advancement in Strategy and Method

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# Disclosure

Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below

<u>Affiliation/Financial Relationship</u>	<u>Company</u>
Grant/Research Support	Abbott Vascular, Boston Scientific, Medtronic CardioVascular, Medinol, Biotronik, Thoratec/St. Jude
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Ownership/Founder	None
Intellectual Property Rights	None
Other Financial Benefit	None

# LM Percutaneous Revascularization

## *Key Clinical Trials in Technique and Outcome*

- **Assessment of left main lesion significance**

LITRO Investigators. J Am Coll Cardiol 2011; Park et al. JACC Intv 2012

- ✓ • **Optimizing LM PCI technique**

Kang S et al. Circ Cardiovasc Interv 2011; Kang S et al. Circ Cardiovasc Interv 2011; Kang et al. CCI 2014; Tiroch et al. JACC Intv 2013; Mehilli et al. JACC 2013; Chen et al. JACC 2013

- **Clinical outcomes relative to surgical revascularization**

Boudriot et al. J Am Coll Cardiol 2011; Serruys P. SYNTAX 5-Year TCT2012; Capodanno et al, JACC 2011; Park et al. NEJM 2011; Ahn et al. JACC 2013; Naganuma et al. JACC Intv 2013; Bittl et al. Circulation 2013

- **Quality of life and cost outcomes with LM PCI**

Cohen D. CTO/LM Summit 2011; Wilson. JACC 2011

- **Risk stratification and modeling**

Garg et al. JACC 2011; Capodanno Int J Cardiol 2012; Capodanno JACC Intv 2011; Capodanno CCI 2011; Farooq et al. Lancet 2013

# Influence of PCI Technique on Clinical Outcomes



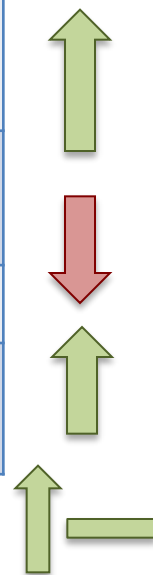
# Bifurcation Disease Strategy

- Extensive observational experience documents increased adverse events with 2-stent method compared with single stent technique\*

# Left Main Bifurcation Strategy

- Extensive observational experience documents increased adverse events with 2-stent method compared with single stent technique
- Temporal trends in LM PCI methods endorse these data

	<b>Wave 1, 1995-1998 N=260</b>	<b>Wave 2, 2003-2006 N=394</b>	<b>Wave 3, 2007-2010 N=470</b>
Left Main Stent Only	165 (65.0)	110 (28.0)	68 (14.5)
Simple Crossover	54 (20.8)	168 (42.7)	283 (60.3)
2-stent	37 (14.2)	115 (29.3)	108 (25.1)



# Left Main Strategy

- Extensive observational experience documents increased adverse events with 2-stent method compared with single stent technique\*
- Temporal trends in PCI methods endorse these data
- Still, when 2-stent method is required, technique is driven by operator/institutional preference than supportive data
  - SYNTAX (2-stents, 38%)  
~22% T-stenting, 11% Culotte, 8% Crush, 7% V stenting
  - ISAR LEFT MAIN II (2-stents, 36%)  
~30% Culotte (79%), 6% T-stent (18%), 1% Crush (4%)

# Left Main Strategy

## DK Crush

- Procedural
  - Facilitates sidebranch re-crossing after 2<sup>nd</sup> stent placement and KBT
  - Wire re-crossing for first kiss should be in proximal segment of sidebranch for carinal coverage (unlike distal in provisional approach)
- Clinical
  - Lower TLR compared with provisional and other 2-stent (Culotte) techniques
  - Higher ST compared with provisional technique
- In ULM, DK superior to Culotte for TLR-- especially in BA >70°-- and late ST
- Limited center trial experience with little external validation, variable technique between comparator arms (eg, KBT) and uncertain impact of angiographic surveillance



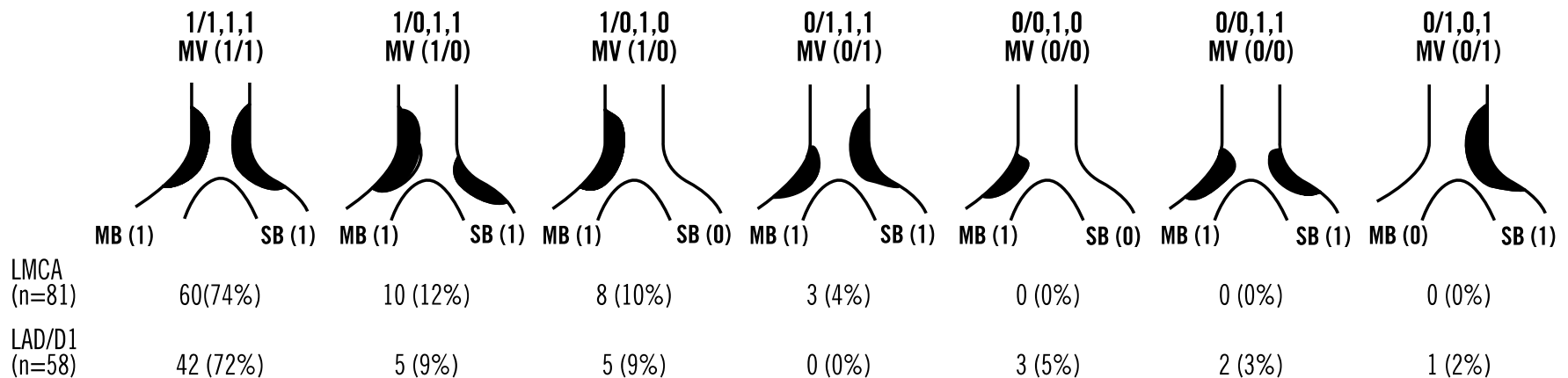
# Bifurcation Strategy

## *When Is a 2-stent Method Necessary?*

- **DEDICATED:** Extension of occlusive disease into sidebranch

# Plaque Distribution in LMCA

## Spatial Distribution of Plaque at Bifurcations



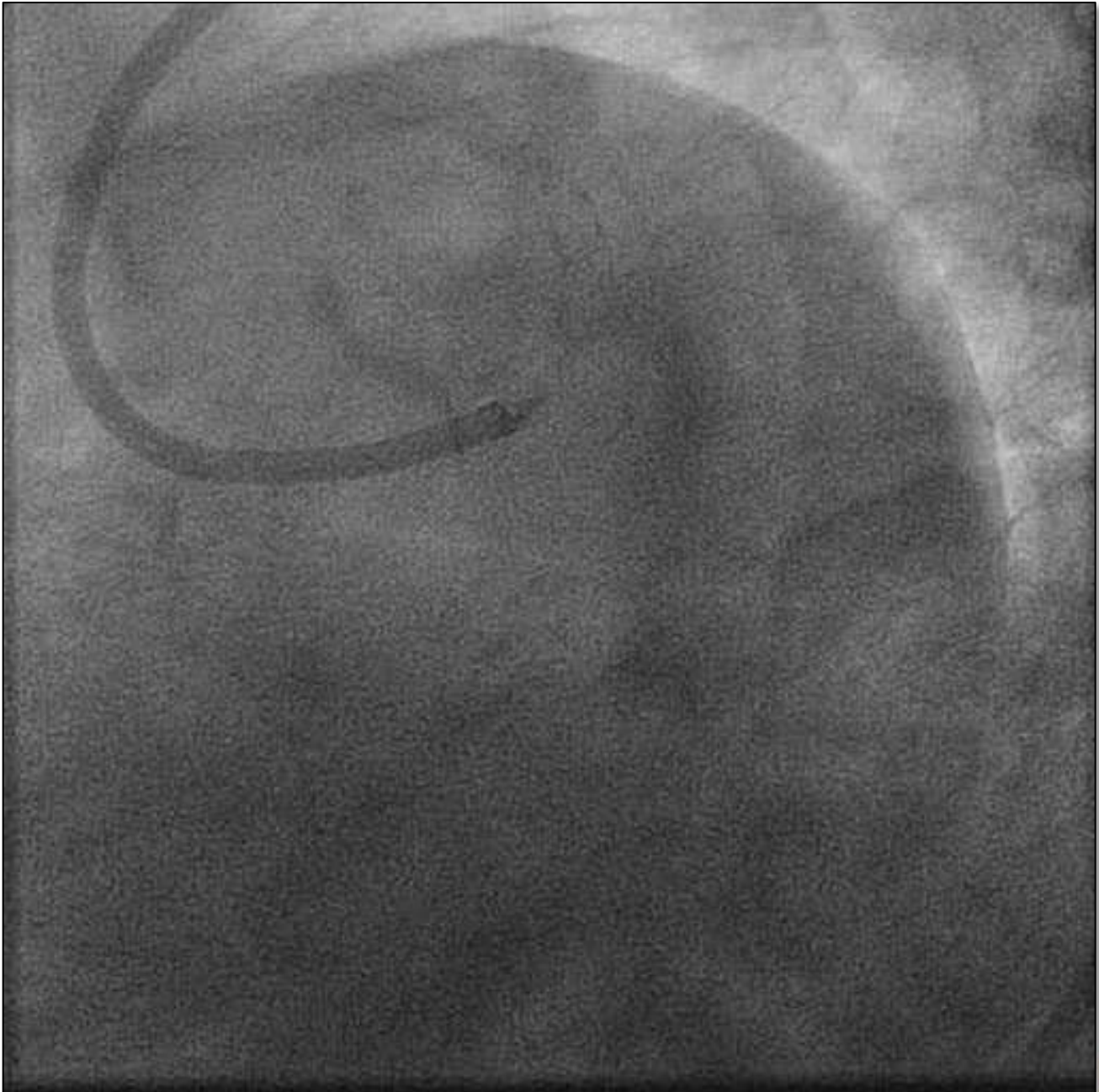
Absence of disease extending into both LAD and LCX occurs approximately 10% of time

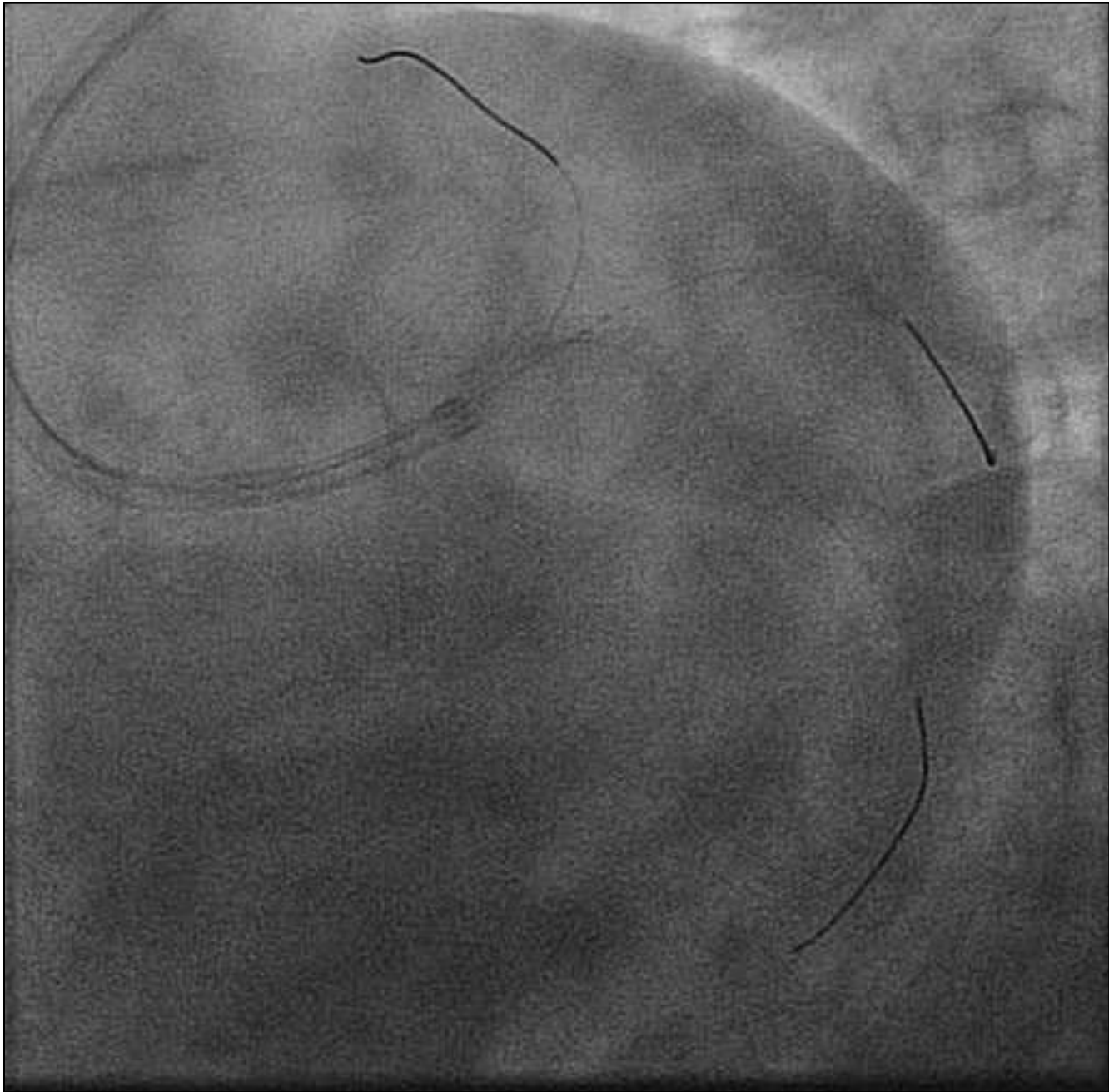
>90% of LMCA bifurcations had plaque extending from LMCA into the LAD, with 78% extension into the LCX (and LCX had less plaque and calcium)

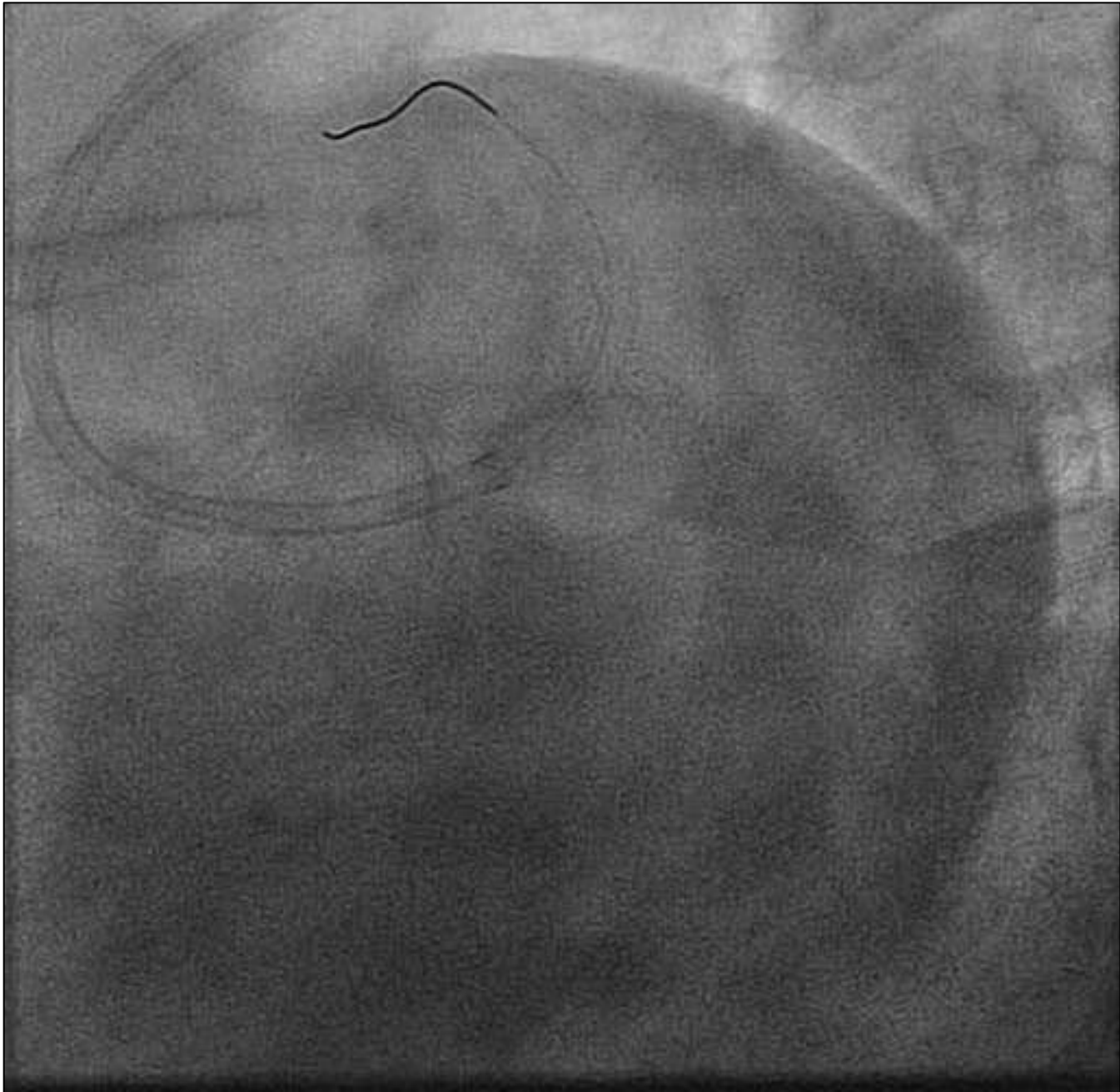
# Bifurcation Strategy

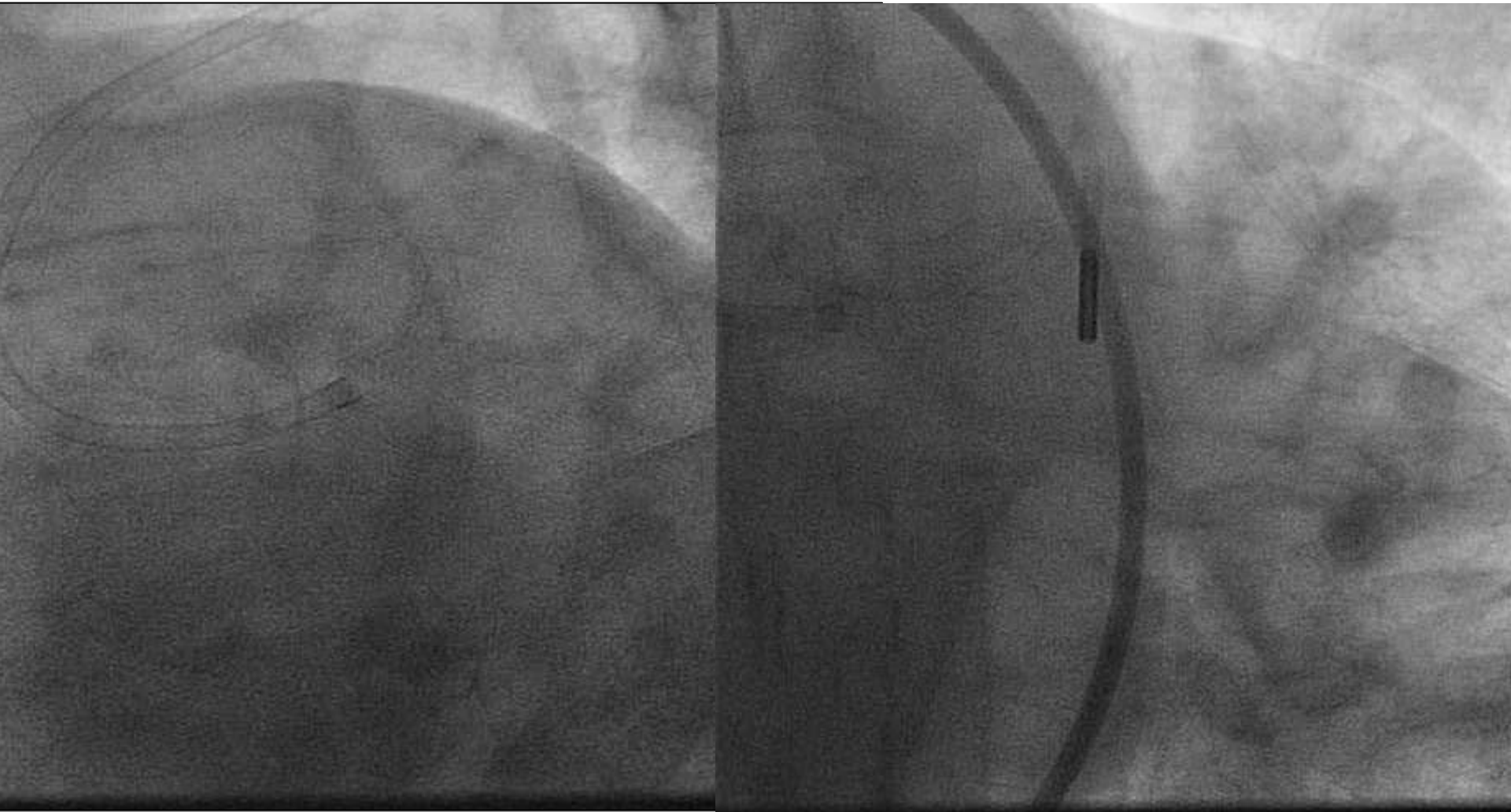
## *When Is a 2-stent Method Necessary?*

- **DEDICATED:** Extension of occlusive disease into sidebranch
- **DEDICATED/PROVISIONAL:** Shallow distal BA makes carinal shift and SB occlusion more probable









# Left Main Strategy

## *When Is a 2-stent Method Necessary?*

- DEDICATED: Shallow distal BA makes carinal shift and SB occlusion more probable
- DEDICATED: Extension of occlusive disease into sidebranch
- **PROVISIONAL:** Compromise of sidebranch after stenting main vessel

**KNOWN:** Hemodynamic assessment (FFR) frequently acceptable despite angiographic appearance

**KNOWN:** With single stent crossover, sidebranch luminal distortion and reduction in luminal area more common than exception\*

**UNCERTAIN:** Long-term outcome when FFR is above ischemic threshold but luminal compromise exists in left main bifurcation



# LM Bifurcation Angle and Influence on Stent Strategy

## Acute/Shallow Bifurcation Angle

- Precludes selected stent techniques (eg, T stenting) but favors others (Culotte, Crush) for adequate carinal coverage
- Necessitates increased stent cell size with methods such as Culotte or Crush

*Be very considerate of expansion limits and cell geometry specific to stent brands*

# LM Bifurcation Angle and Influence on Stent Strategy

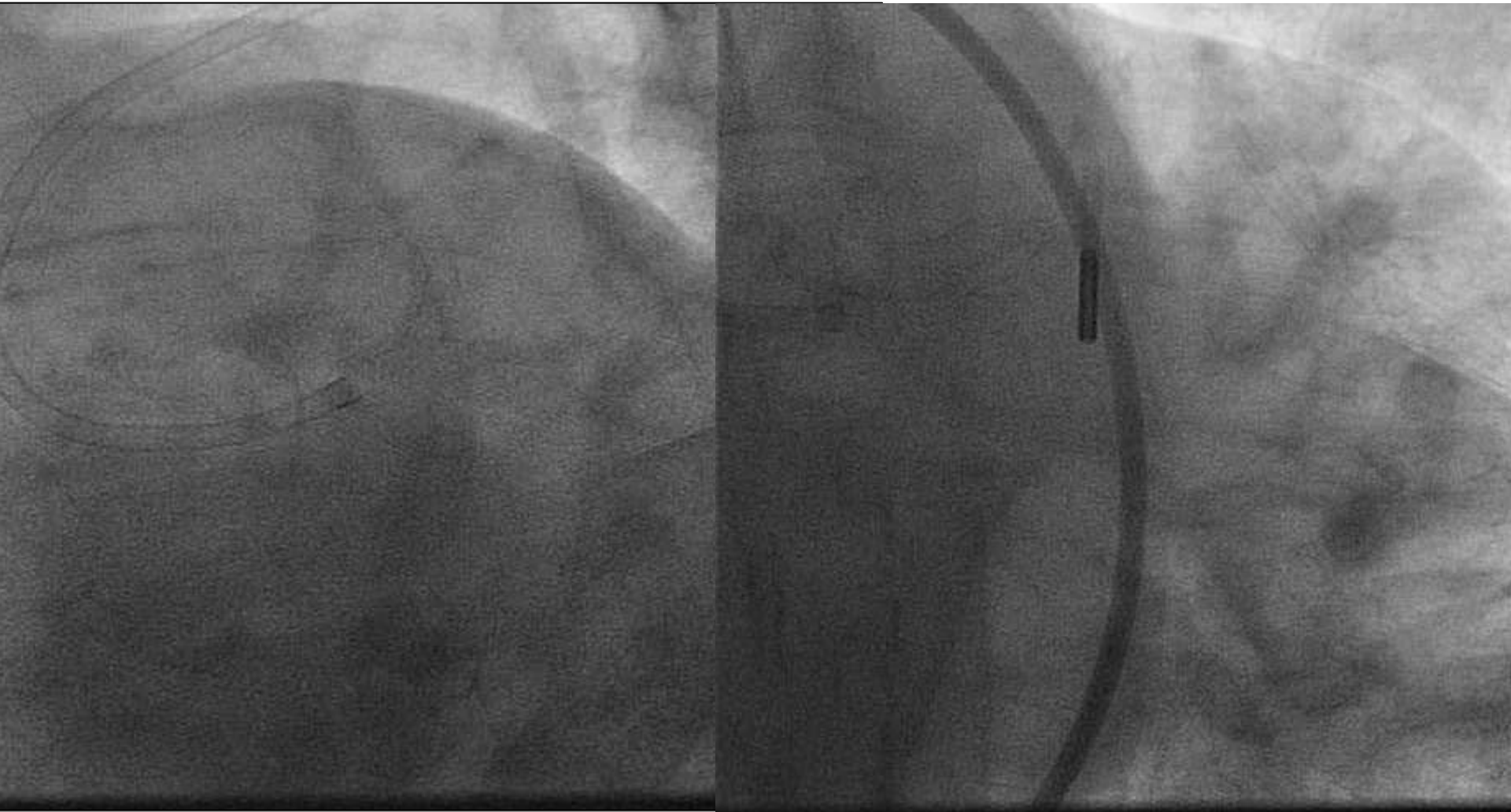
## Acute/Shallow Bifurcation Angle

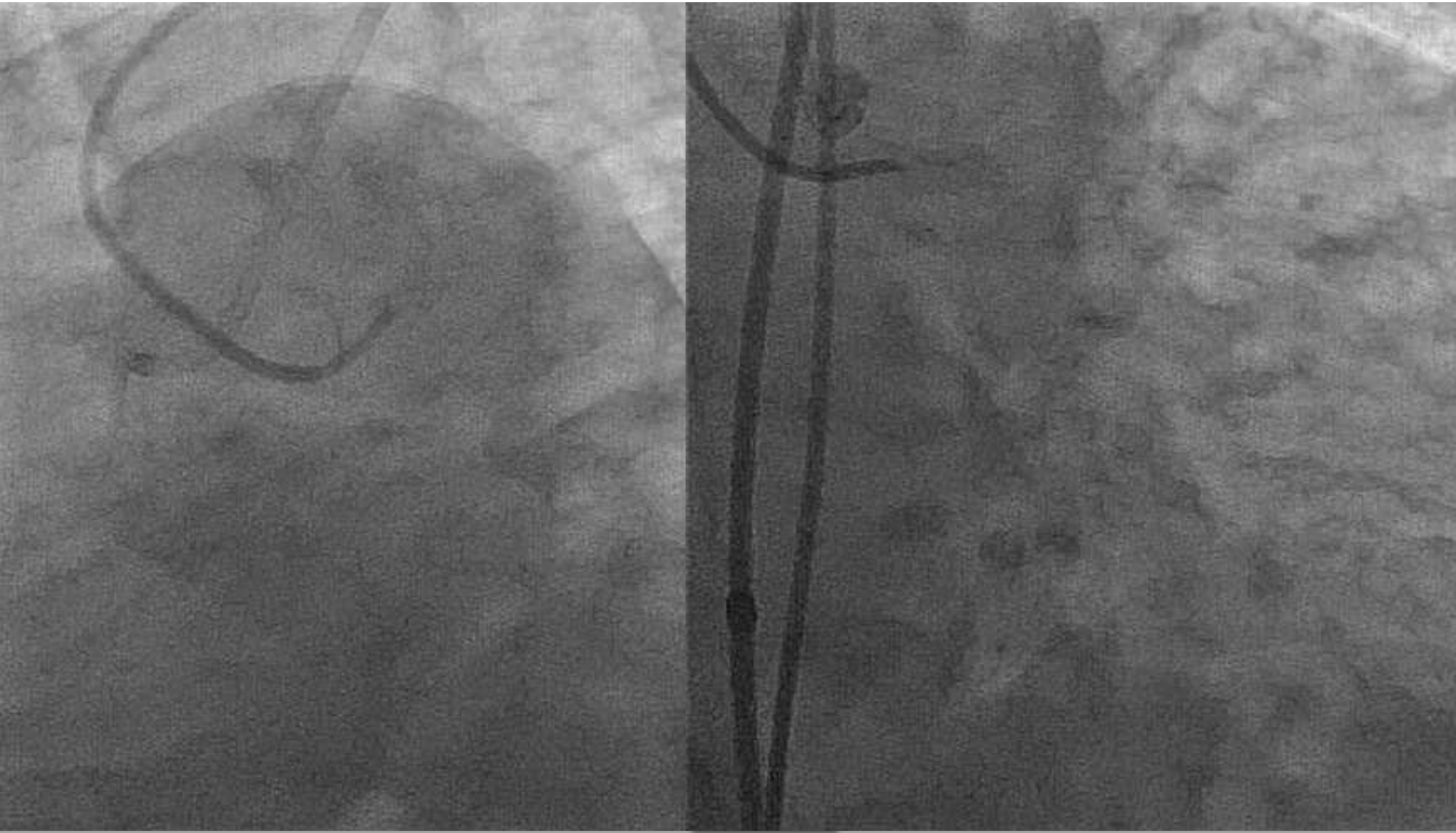
- Precludes selected stent techniques (eg, T stenting) but favors others (Culotte, Crush) for adequate carinal coverage
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## Wide Bifurcation Angle

- Steeper angles ( $>80^\circ$ ) prevent full strut expansion and apposition with Crush/Culotte methods and favor T, TAP

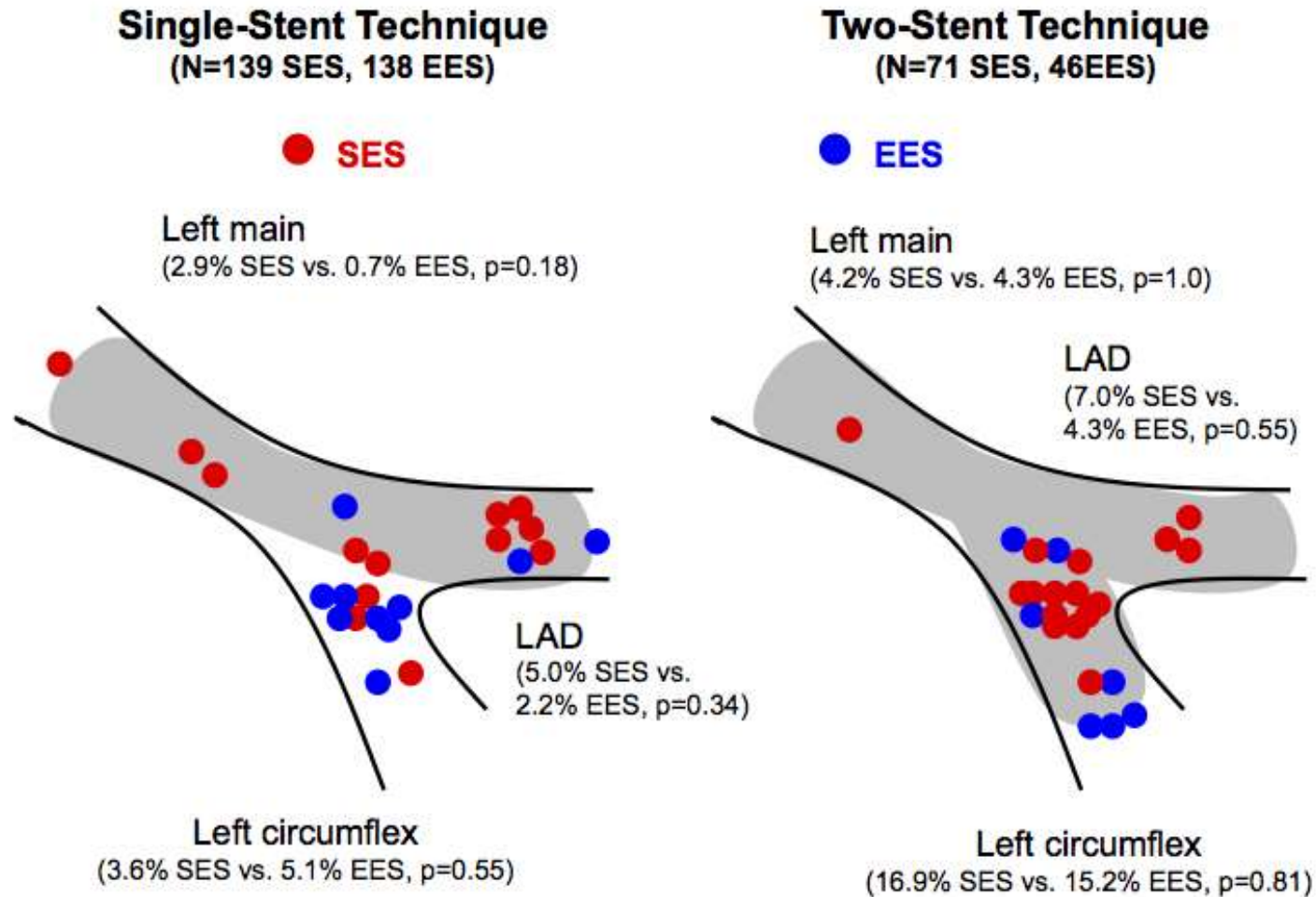
*What is the influence of changing the natural conformation of the left main bifurcation with PCI?<sup>1,2</sup>*





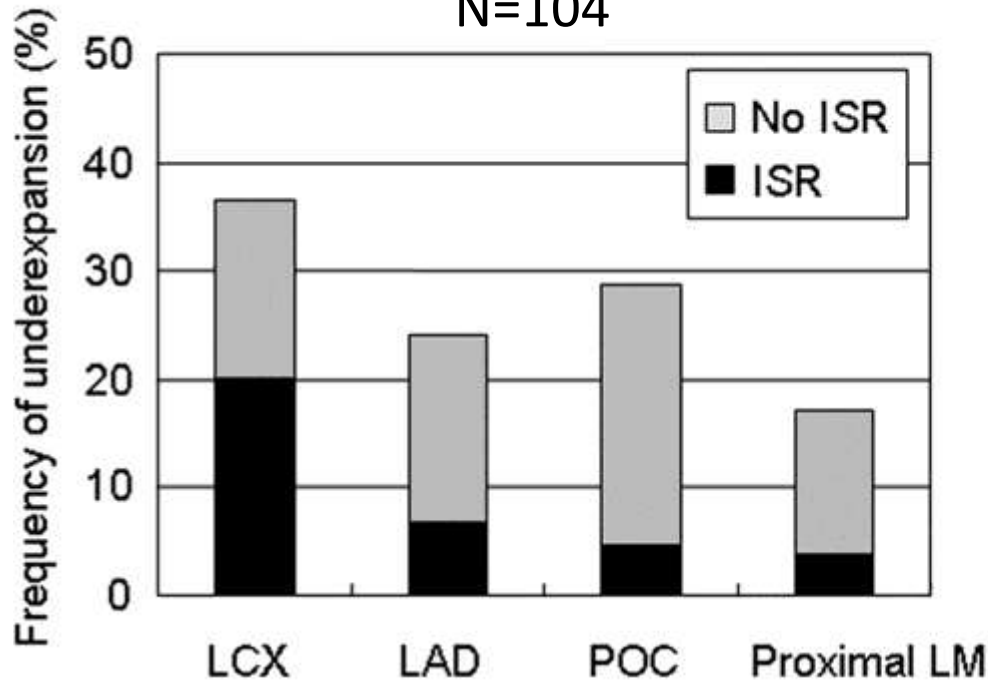
# PRECOMBAT 2

## Patterns of LM Restenosis with SES and EES

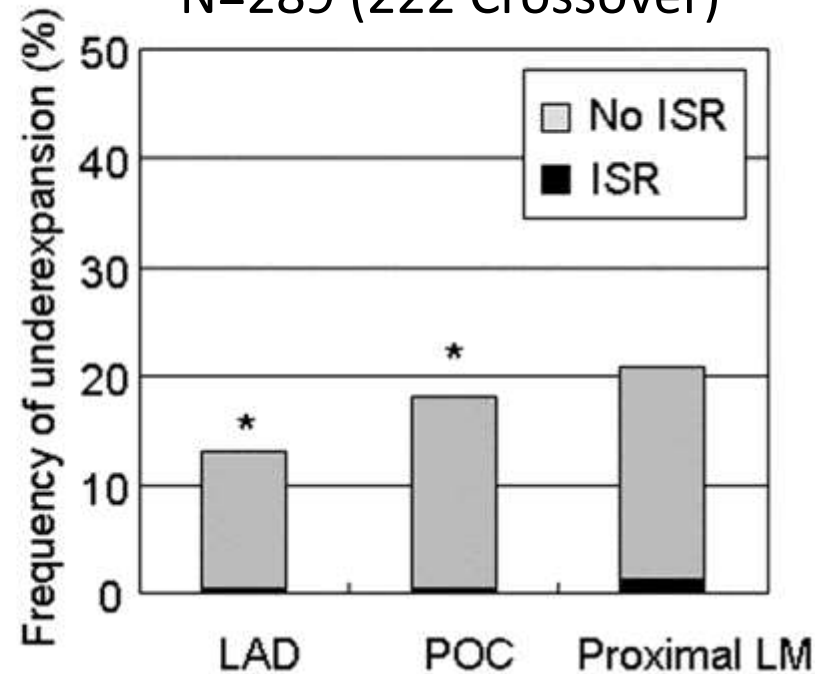


# Frequency of Stent Underexpansion 1 vs 2 Stent Techniques

2-Stent Cohort,  
N=104

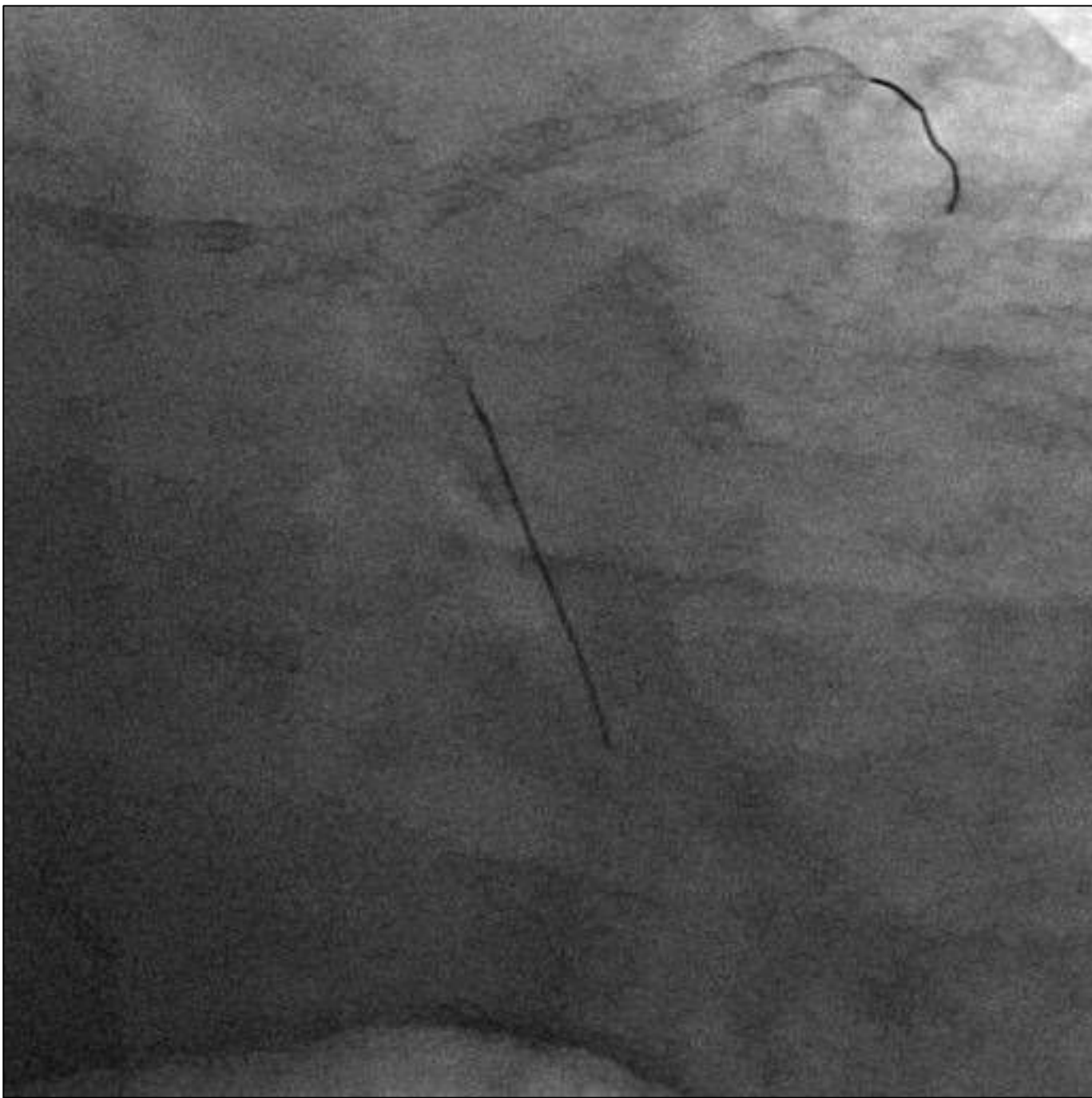


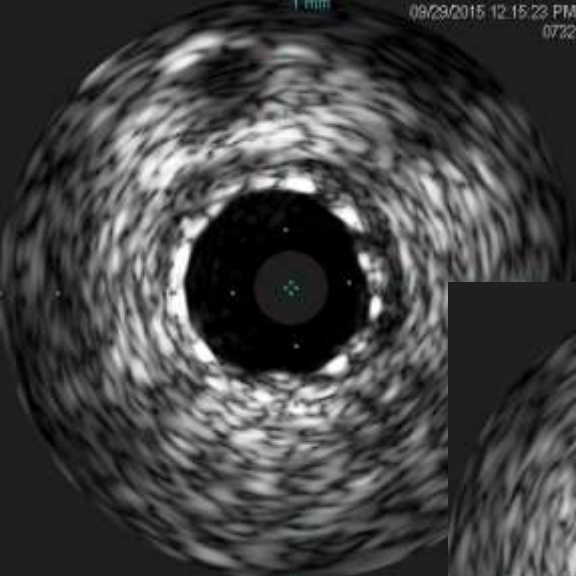
1-Stent Cohort,  
N=289 (222 Crossover)



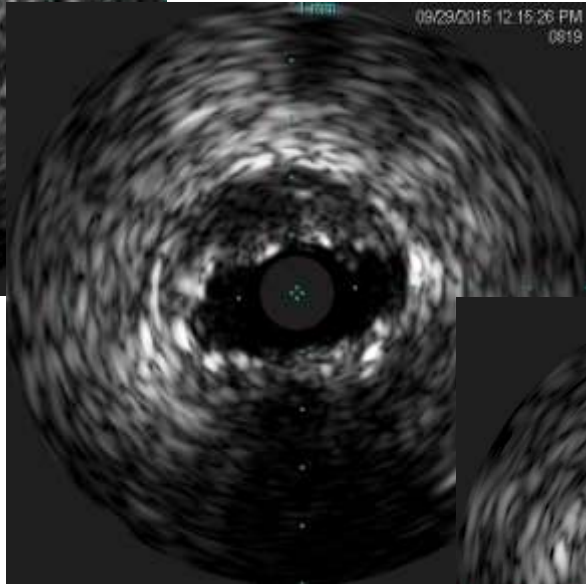
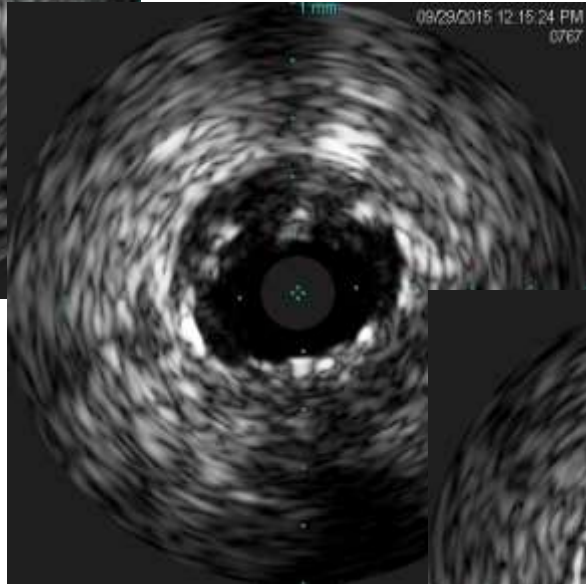
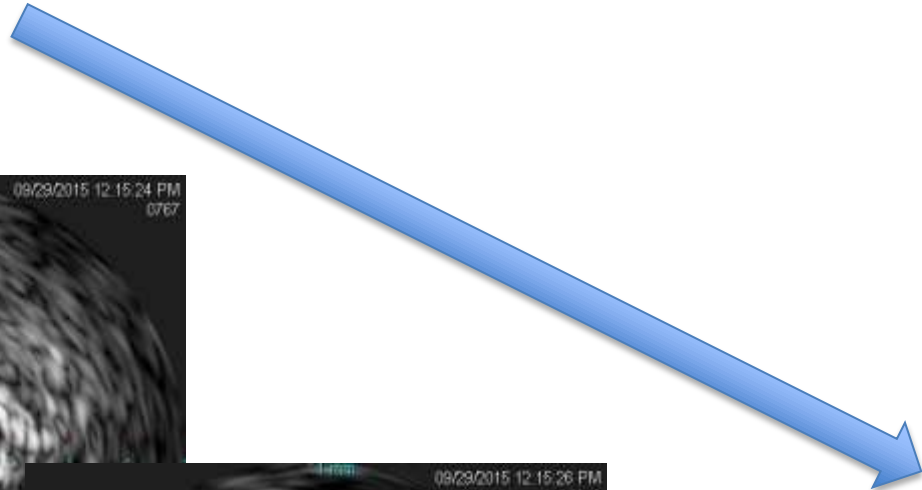
2-stent: LCX stent most frequently underexpanded and results in ISR more than half of cases

1-stent: Underexpansion is less common compared with 2 stent techniques with lower ISR

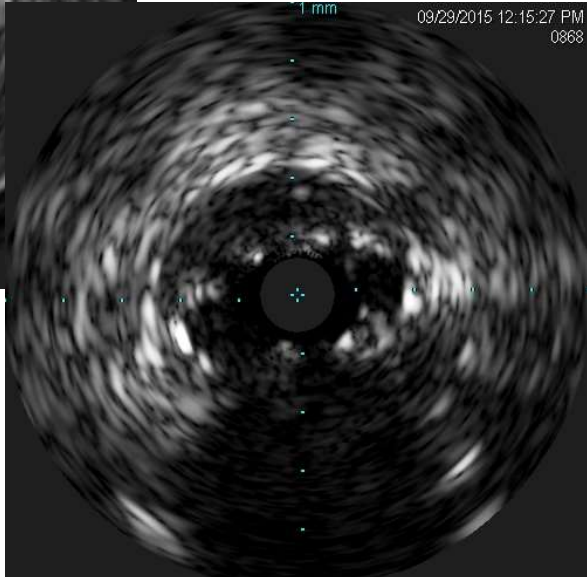




Distal

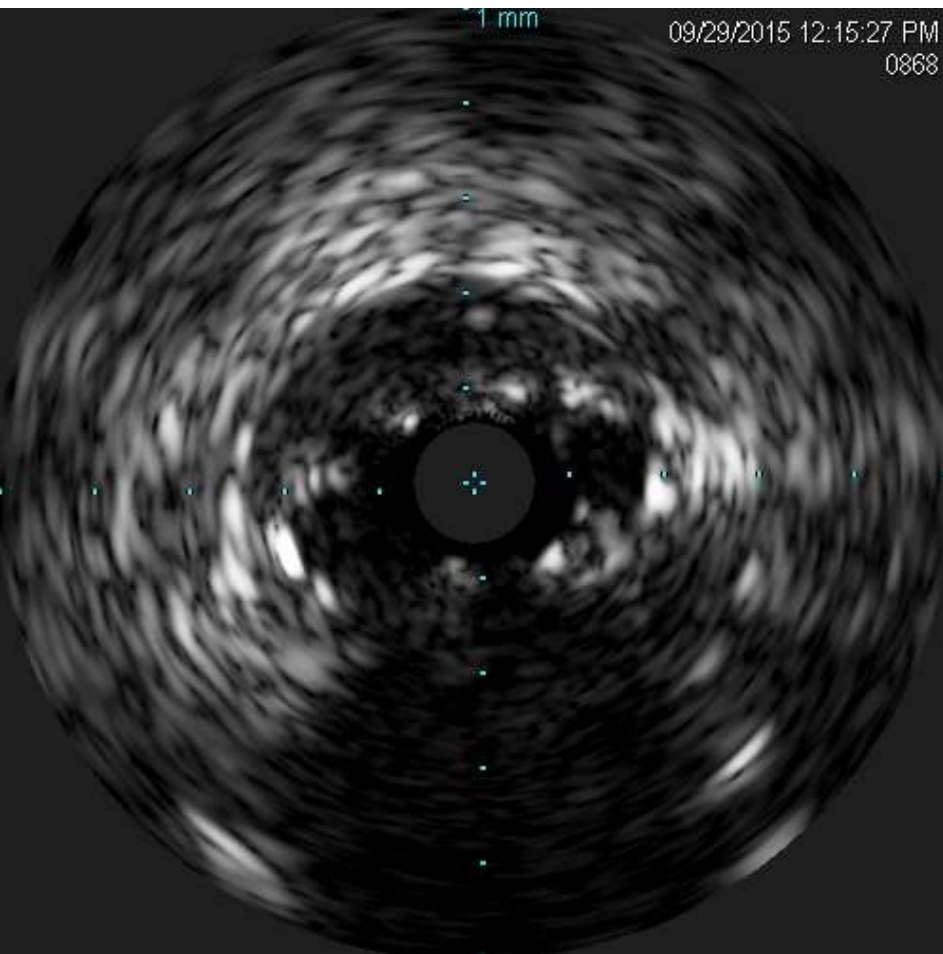


Proximal

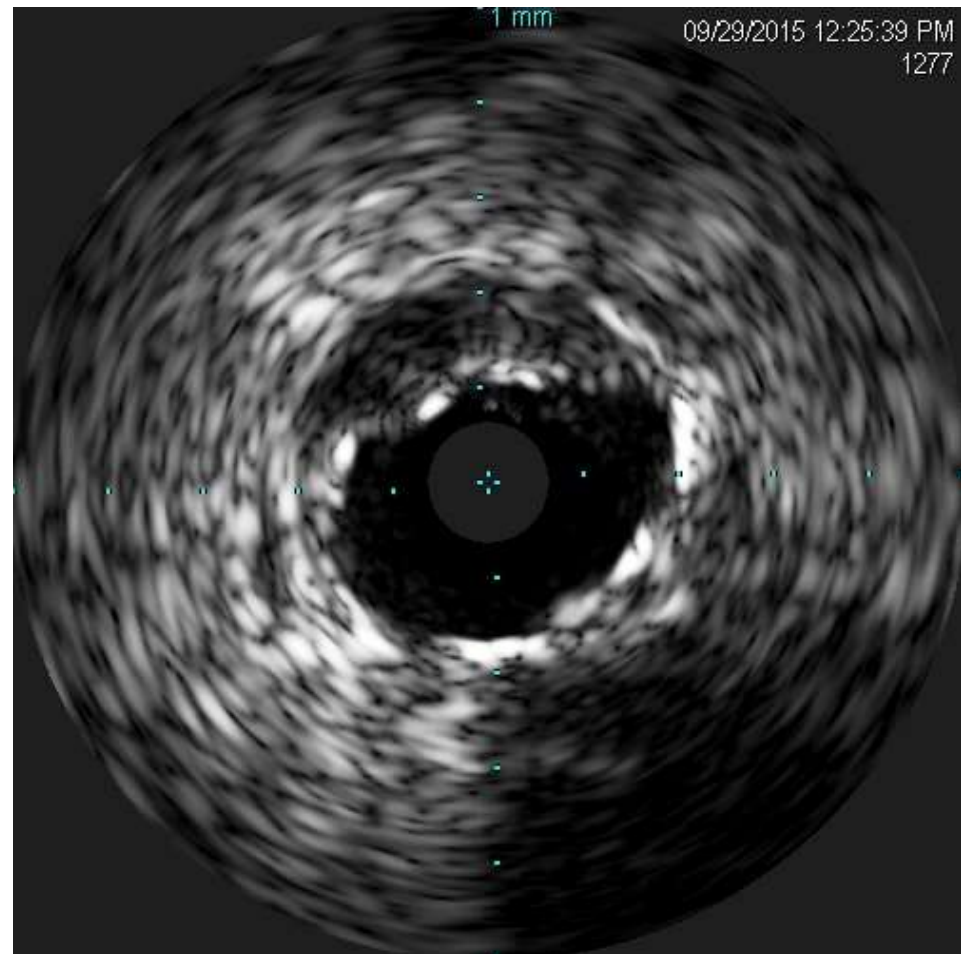




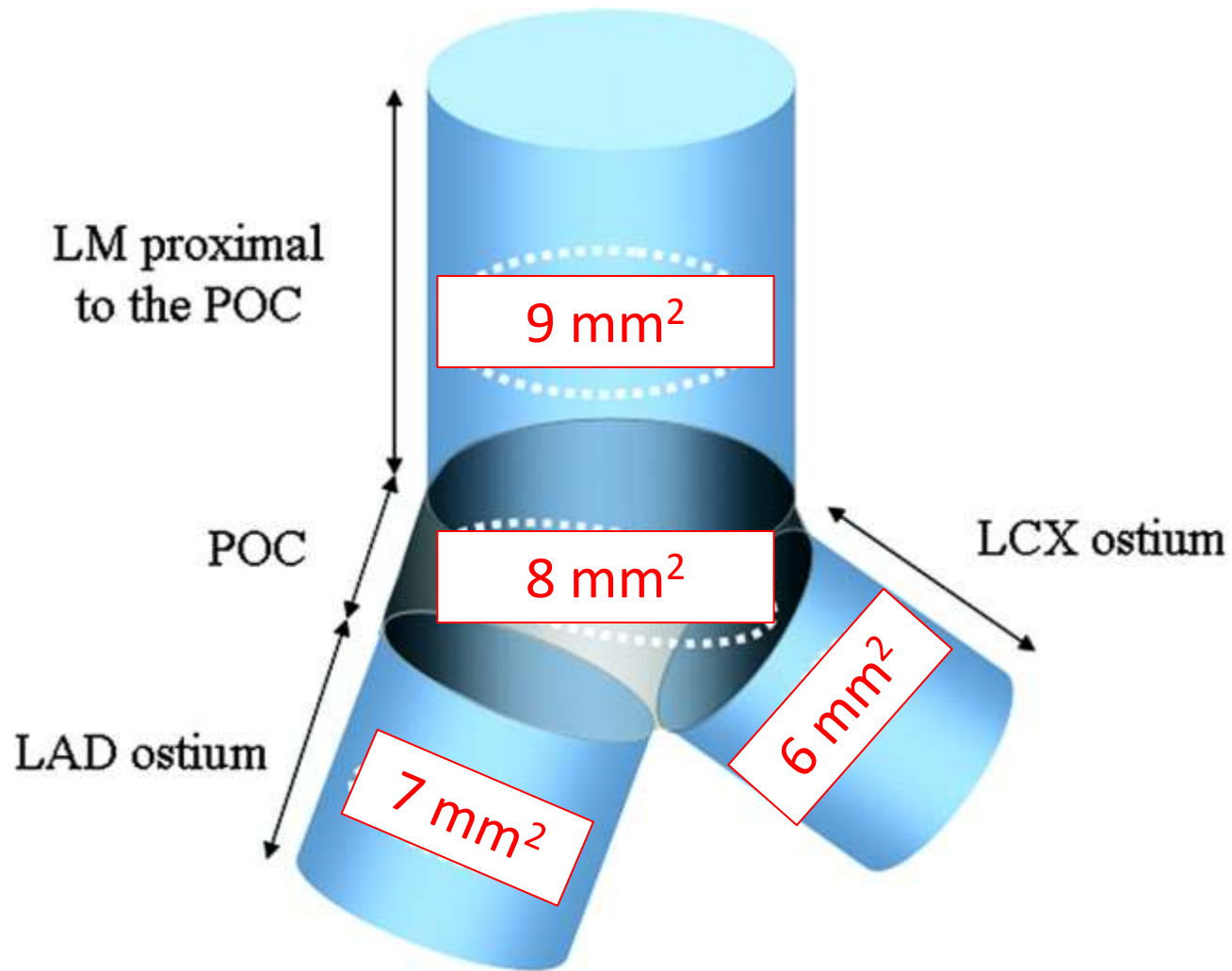
LCX ostium after high pressure sequential kissing inflation



LCX ostium after 2<sup>nd</sup> high pressure sequential kissing inflation



# Minimal stent area threshold values for the prediction of angiographic in-stent restenosis

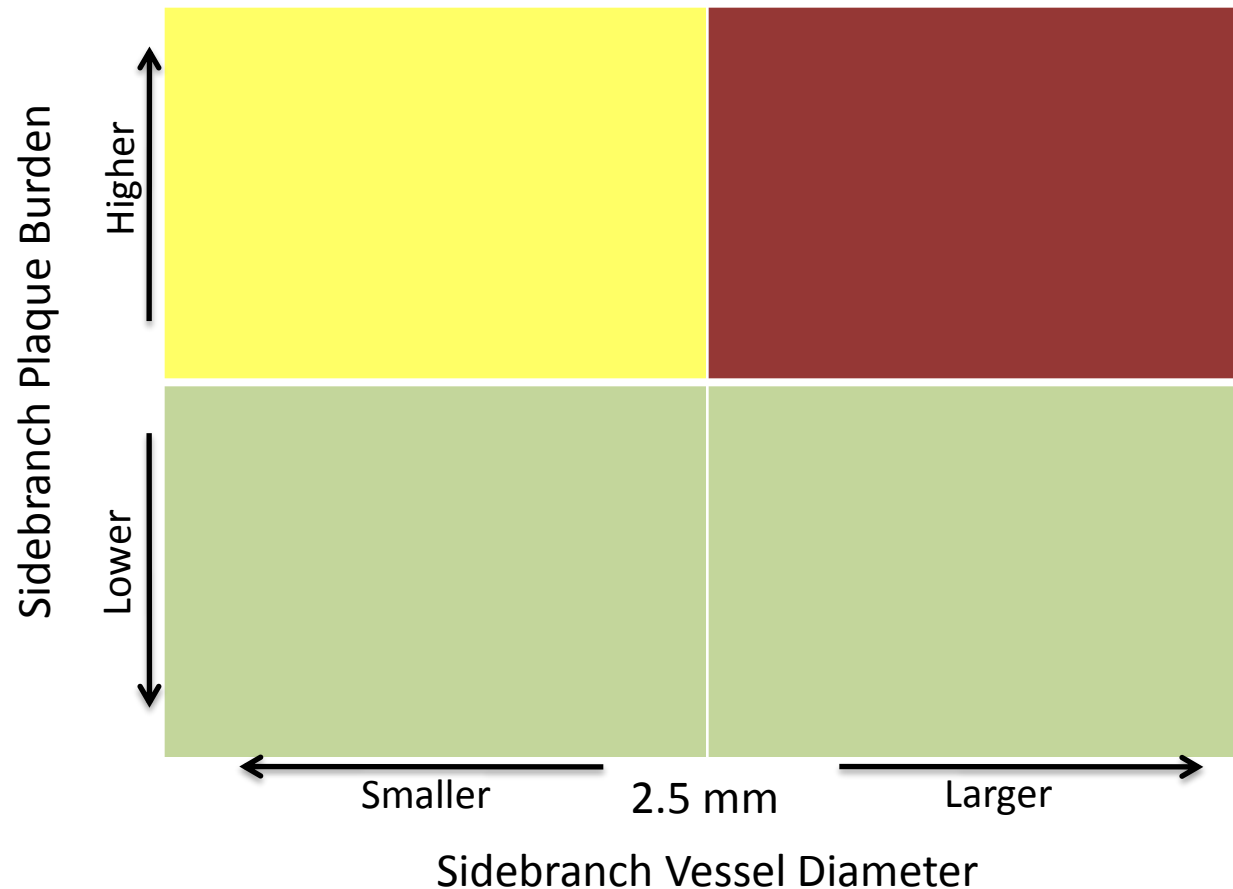


# Bioresorbable Scaffolding for Left Main Revascularization

- Potential merits of BRS more limited in left main indication
  - Recovery of vasomotion
  - Impediment to future revascularization
- ***“Taking everything into consideration, the use of BRS for the treatment of left main disease is presently generally not recommended....”<sup>2</sup>***
- Sidebranch dilation >2.5 mm, high pressure kissing balloon inflation
- Prolonged inflation/expansion
- Absence of radiopaque scaffolds for ostial positioning
- Consequences of stent thrombosis
- Emphasis on lesion preparation and imaging imperative

# Bioresorbable Scaffolding for Left Main Revascularization

## Considerations for Sidebranch Diameter and Plaque Burden



# The 'Indirects' of Bifurcation PCI

## *What is Needed, What is Nice to Have*

- As evidence consistently demonstrates equipoise between revascularization strategies, attention turns to important details of technique, APT, clinical surveillance...
- As with other bifurcation data, a single stent technique when feasible is associated with improved event free survival
- Imaging and hemodynamic assessment are imperative
- Outstanding issues in bifurcation strategy include
  - Role of kissing balloon dilation after single stent crossover
  - 2-stent technique
  - Lesion preparation to achieve acceptable luminal gain
- Failure to have complete resolution of these issues does not prohibit the advancement of bifurcation PCI, but can only further improve outcome