Integrated Use of FFR and IVUS in Non-LM Bifurcation PCI

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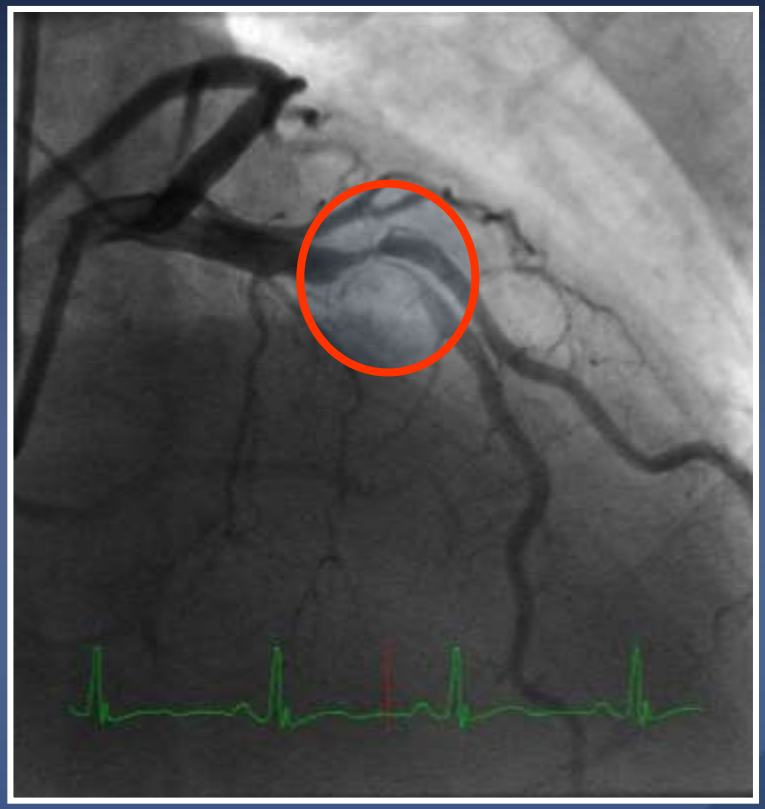
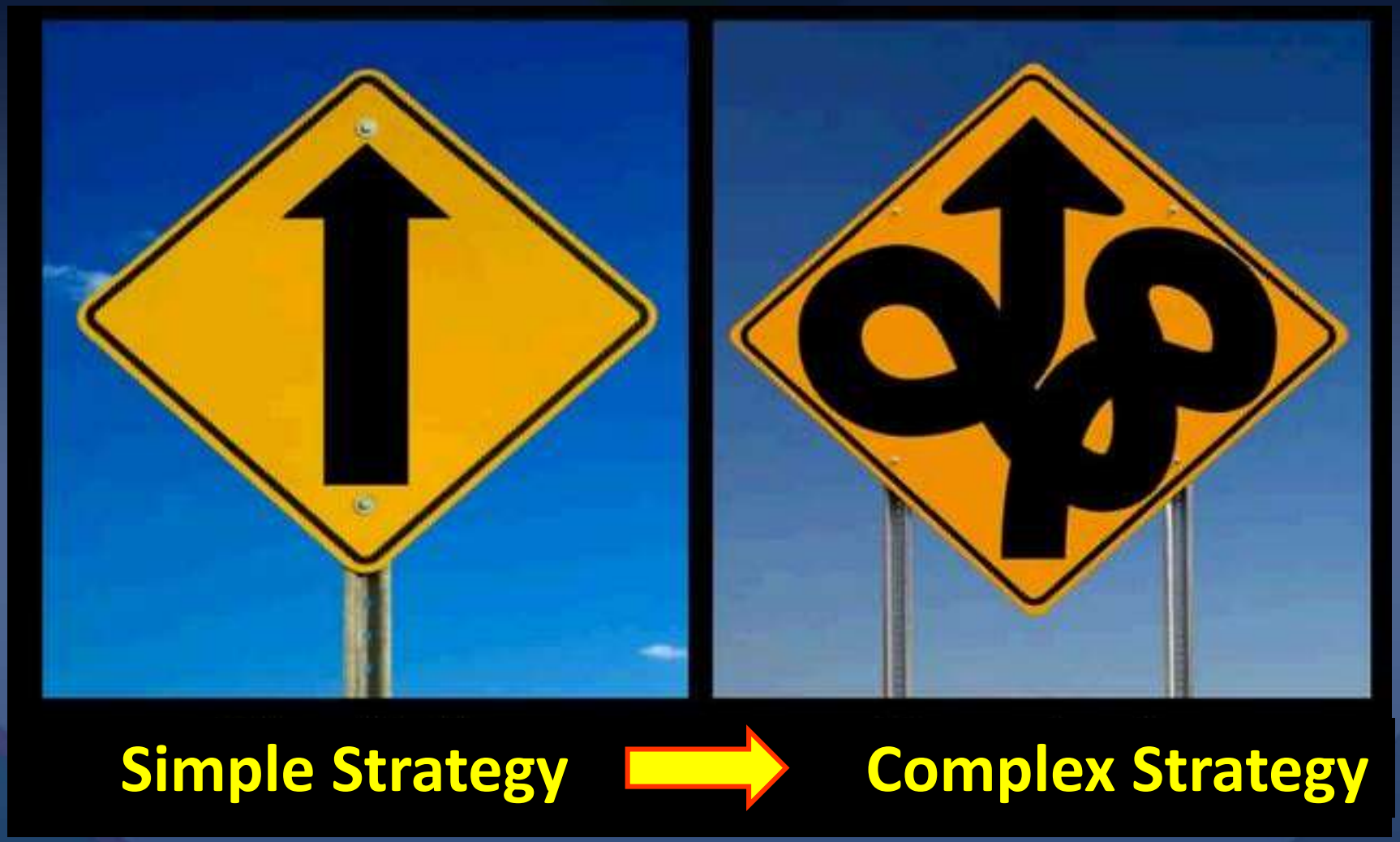
Bifurcation Lesions in the Contemprary PCI

Still a Challenge

- Require more time, anxiety, skill, and equipment (cost)
- Increased complications
  - ⬆ peri-procedural MIs,
  - ⬆ stent thrombosis, and
  - ⬆ restenosis
- Suboptimal angiographic outcomes (esp. side branch ostium)



Bifurcation PCI



CENTRAL ILLUSTRATION Simplified Approach to Treatment of Bifurcation Lesions

BIFURCATION LESION

Provisional 1-stent strategy

SB > 75% residual stenosis, dissection, decreased flow, ischemia

SB ≤ 75% residual stenosis, no dissection, normal flow, no ischemia

- T Stenting if entered a distal strut
- Tap or Culotte if entered a proximal strut

+ FFR

or

Leave alone if territory not big or FFR negative

POT-Side-POT or KBI

Upfront 2-stent strategy

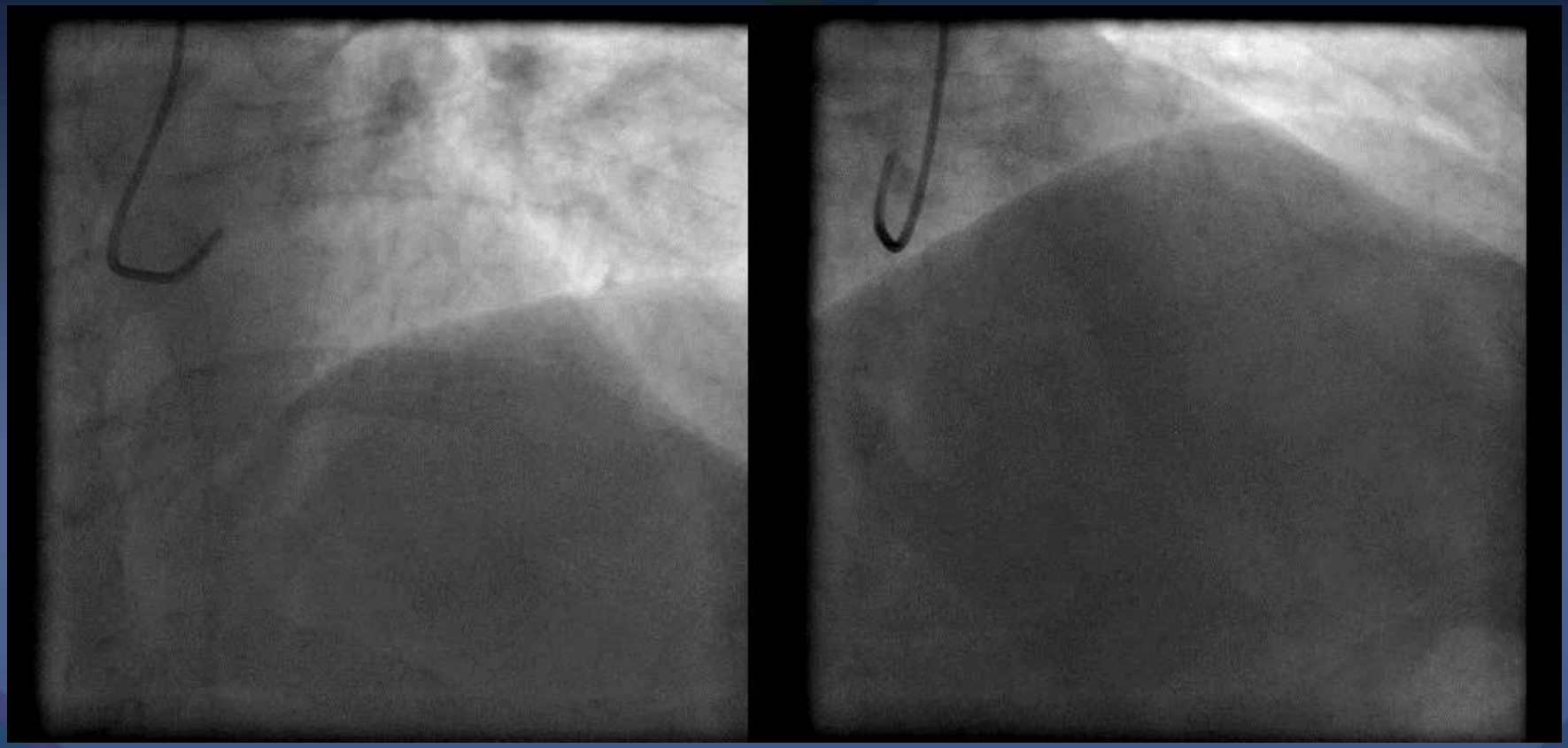
- Culotte Stenting (SB stent first with mandatory POT)
- Systematic T Stenting
- DK Crush Stenting with minimal MB protrusion; POT after MV stenting and after final KBI

Final Kissing Balloons

* Imaging encouraged in all bifurcation stenting, especially with LM stenting

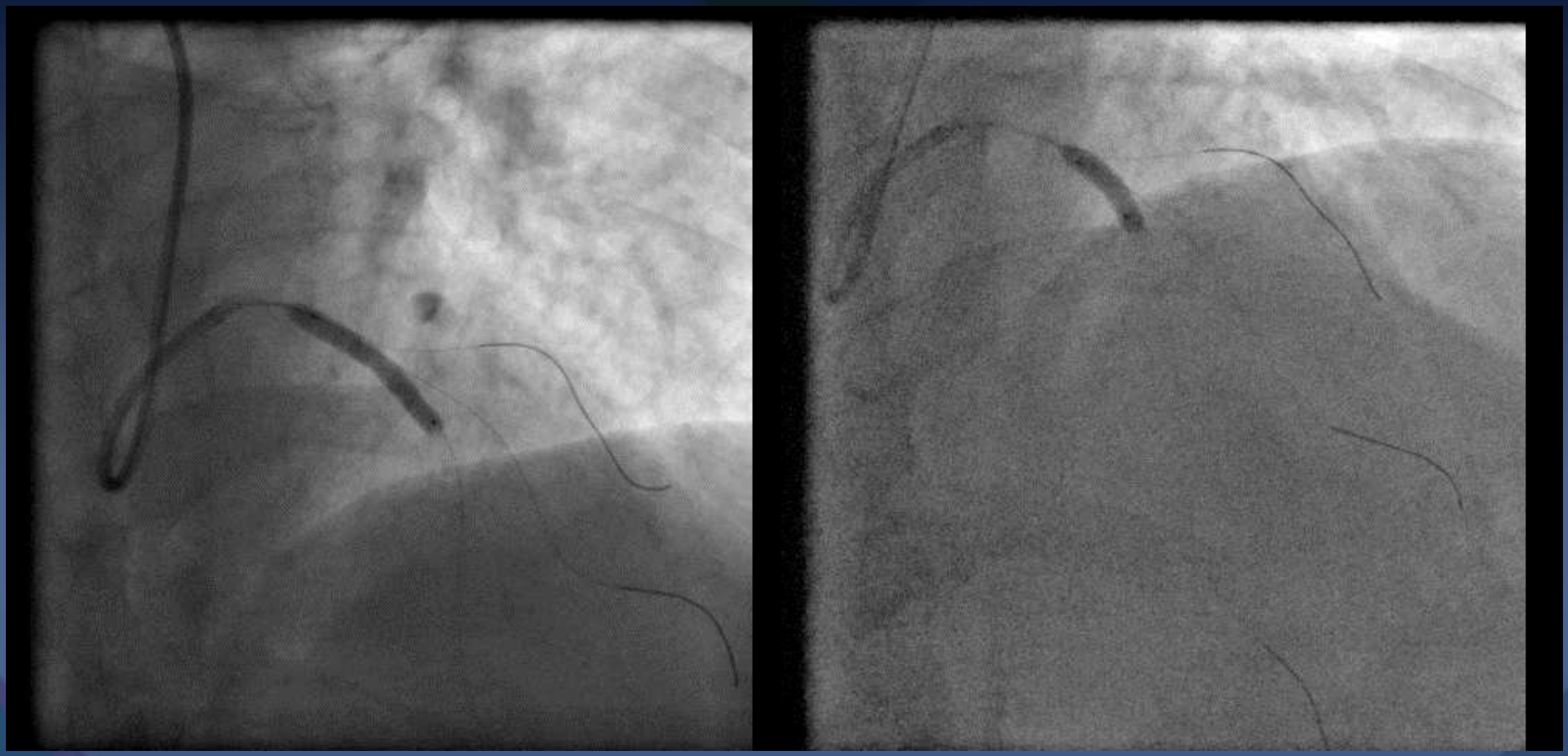
Sawaya, F.J. et al. J Am Coll Cardiol Intv. 2016;9(18):1861–78.

Diagnostic angiogram



LAD bifurcation with 2 DG branches

DES PCI (deployment)

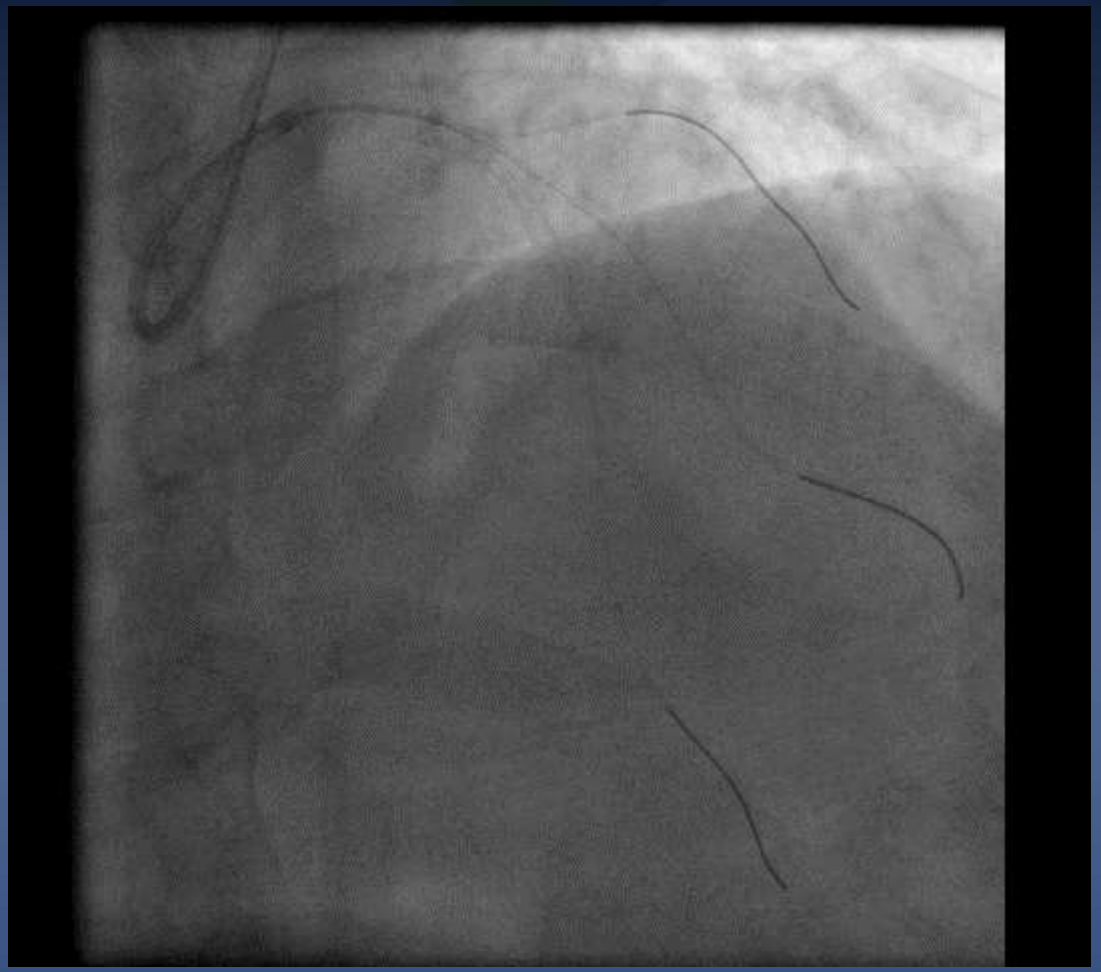


3.5x28 Xience @ 12atm

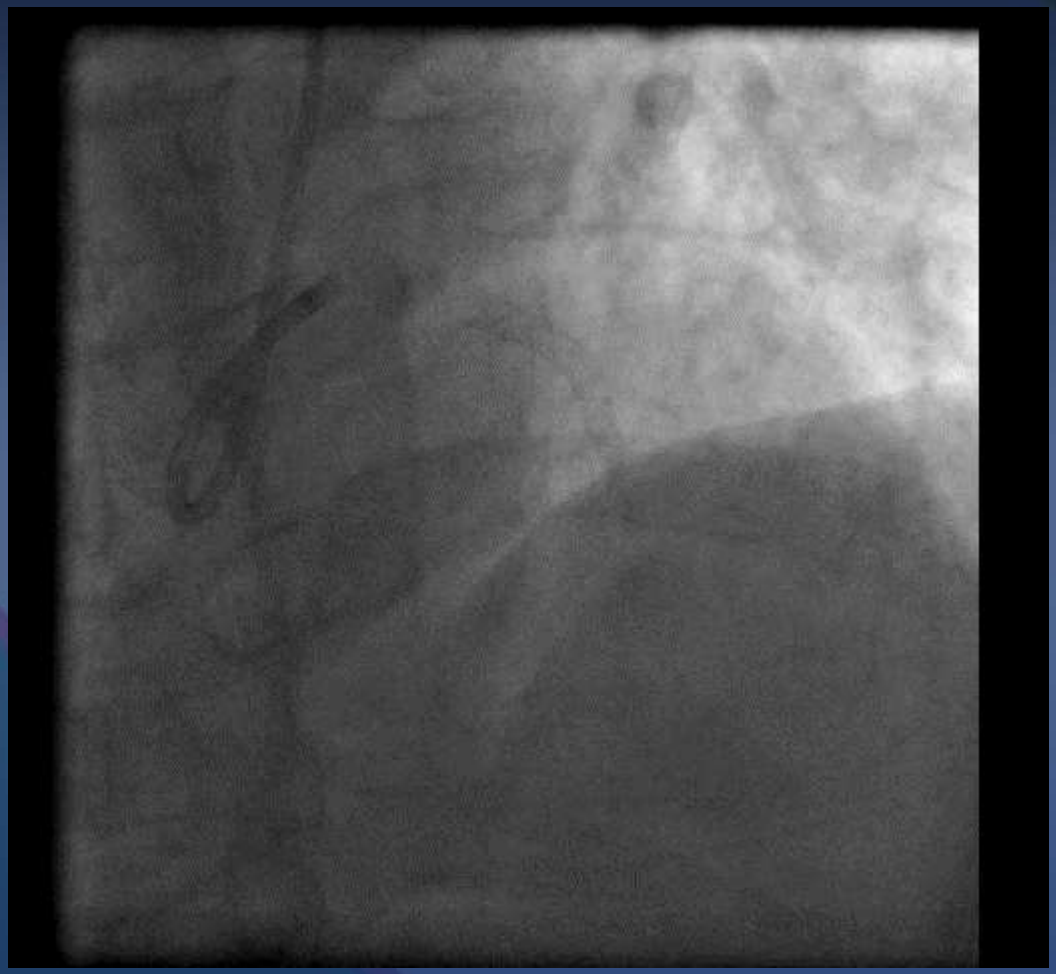
3.75x15 NC balloon @ 24atm

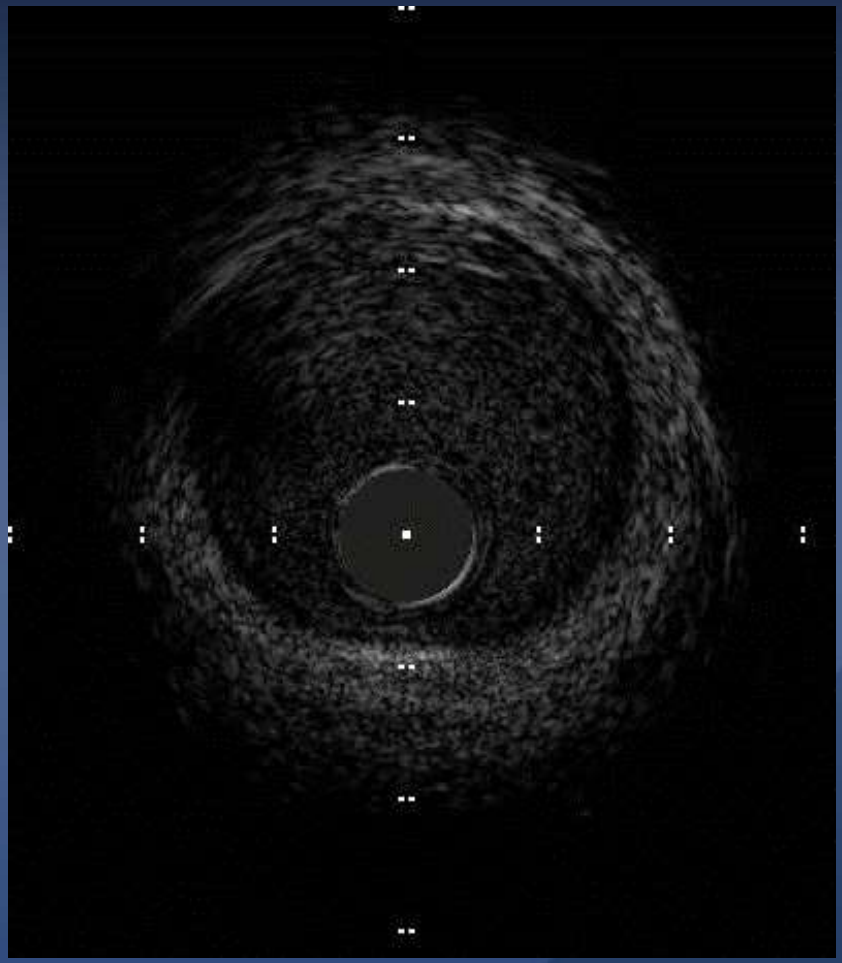
LAD stenting with 2 DG wire-protection

DES PCI (post-dilation)



Straightforward PCI:
Final angiogram



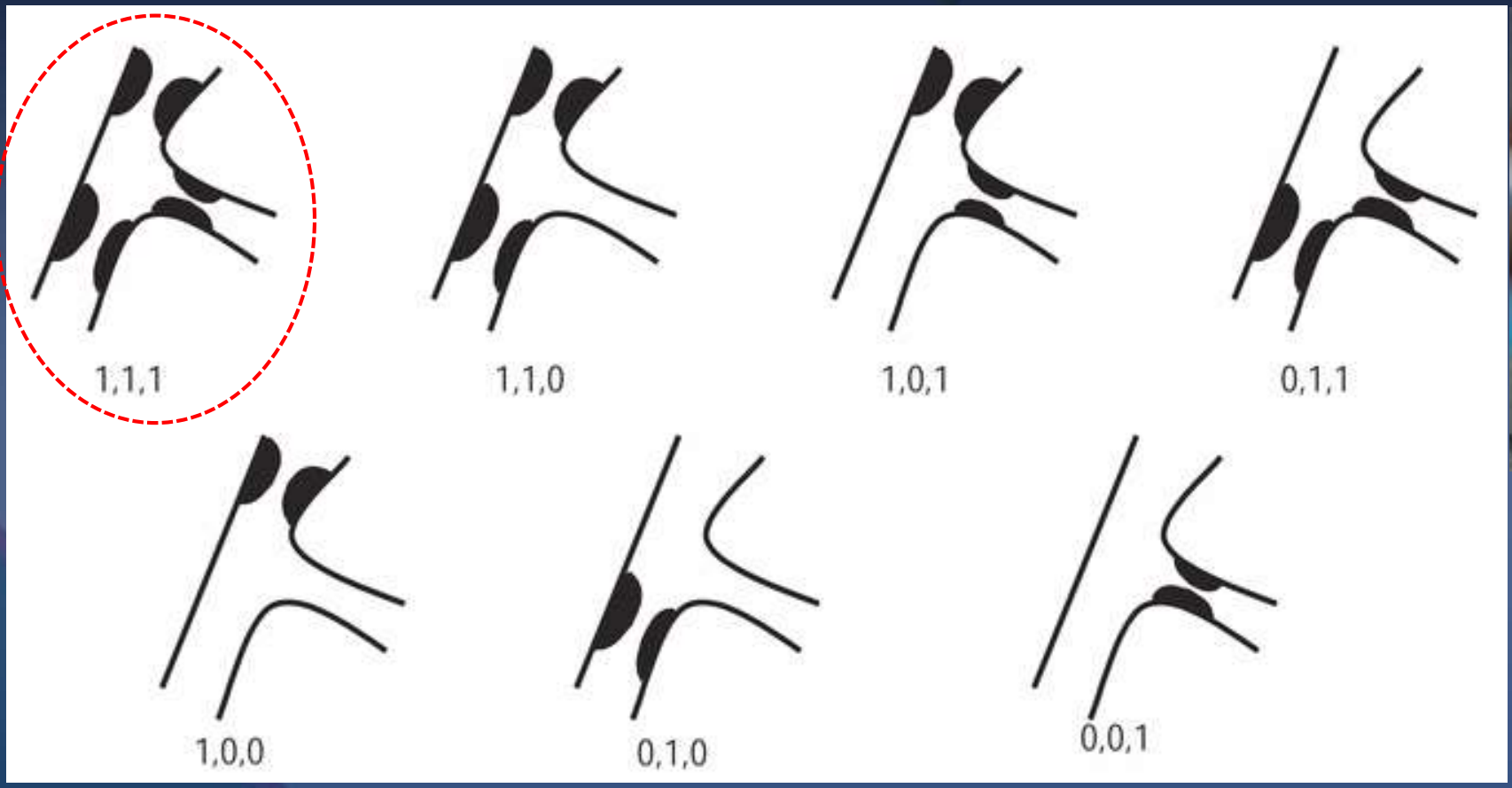


Contemporary Concept of Bifurcation PCI

- Anatomic Concept
- Functional Concept
- Imaging Concept

Anatomic Concept of Bifurcation PCI

Anatomic concept; the Medina classification



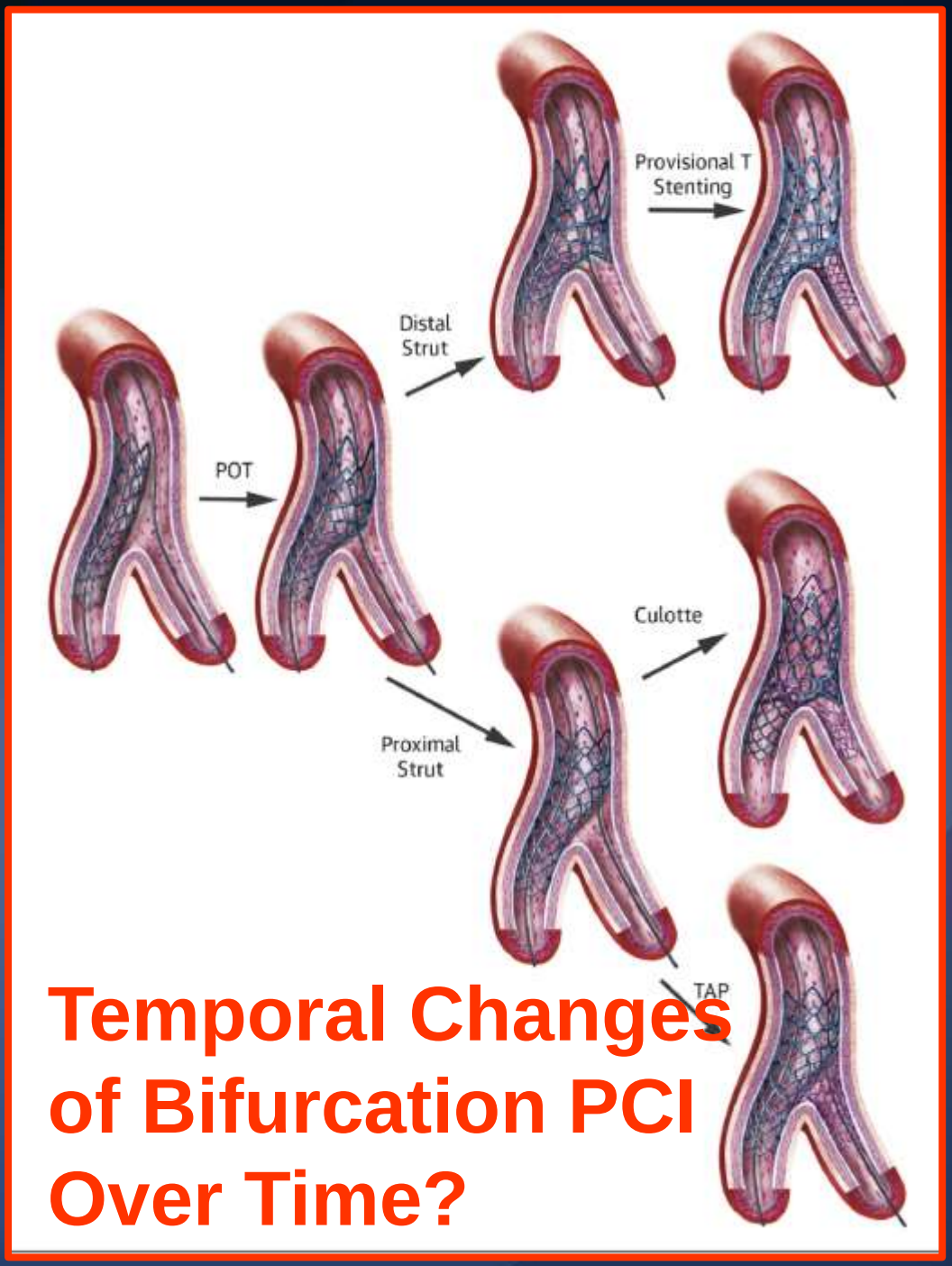
Alfonso Medina
1946-2017

The Medina classification can provide useful anatomic information to decide bifurcation PCI strategies.

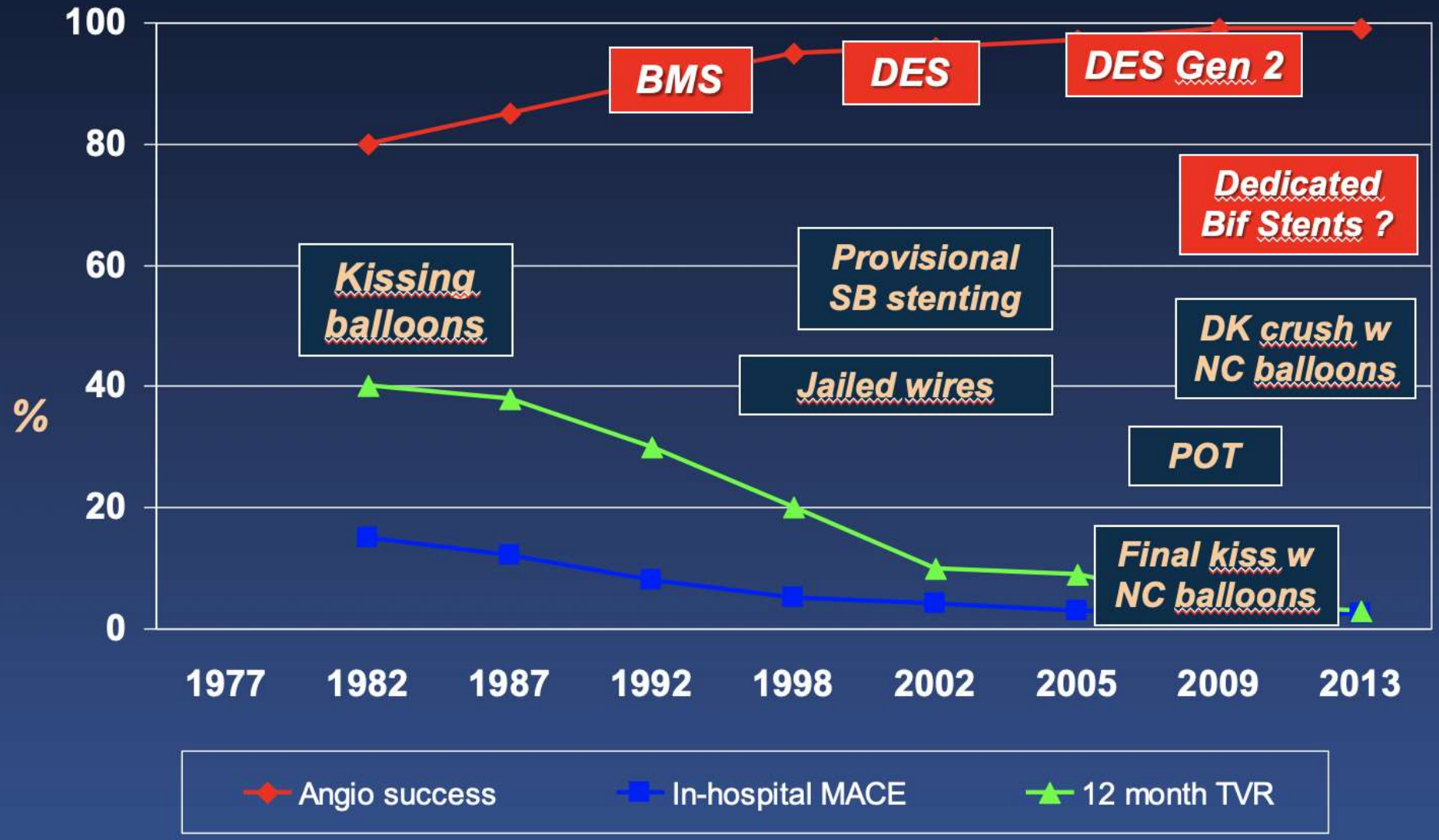
Anatomic Diversity of Bifurcation PCI

- **The approach is mainly dictated by the SB:**
  - **True vs. Non-true**
  - **Size of SB**
  - **Angle from MB**
  - **Extent and distribution of SB disease**
  - **How important the SB is for that patient and for that specific anatomy**

- Anatomic Concept
- Functional Concept
- Imaging Concept

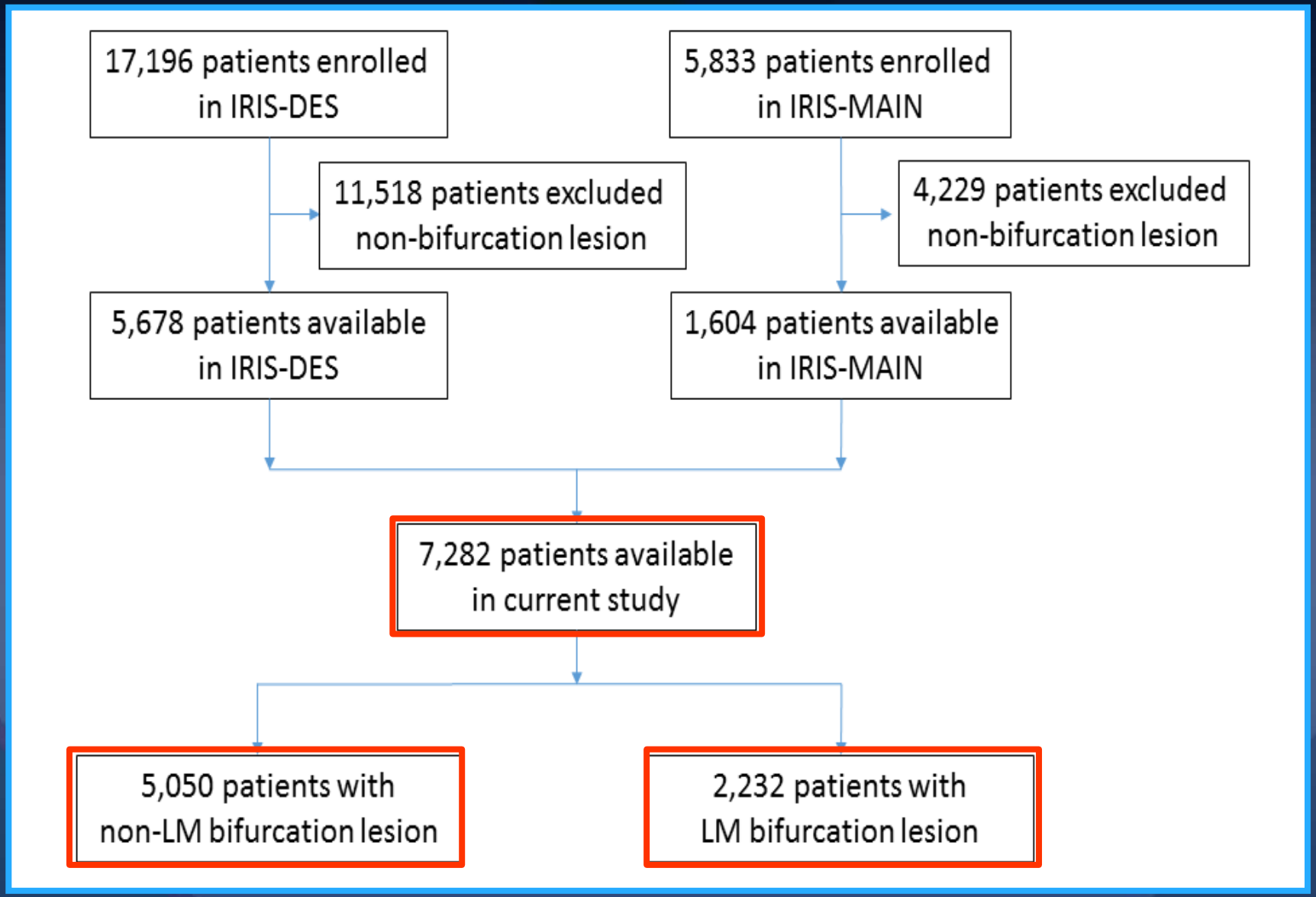


Evolution of Bifurcation Therapy



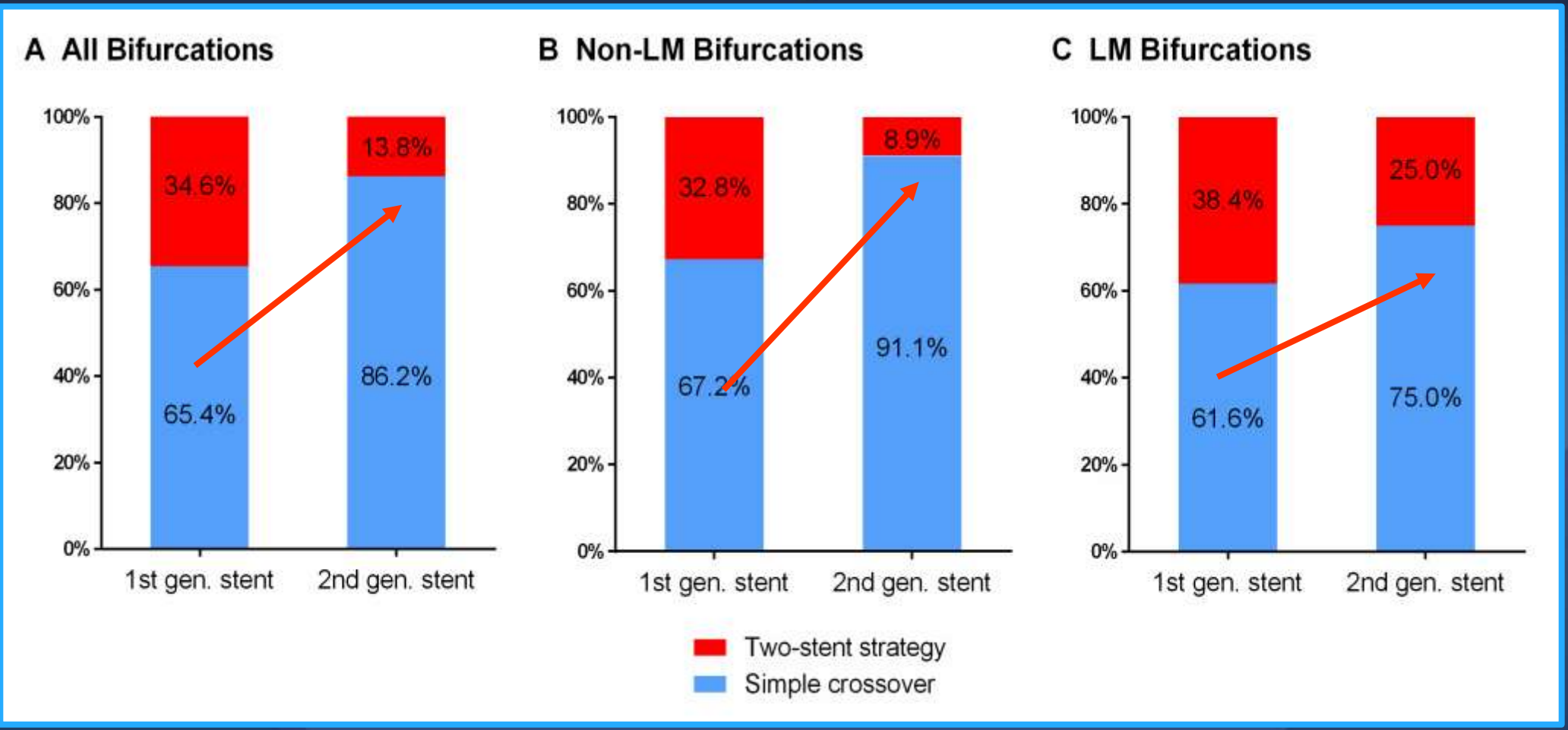
Courtesy of T. Lefevre

Merged Analyses of 2 Real-World PCI Registry



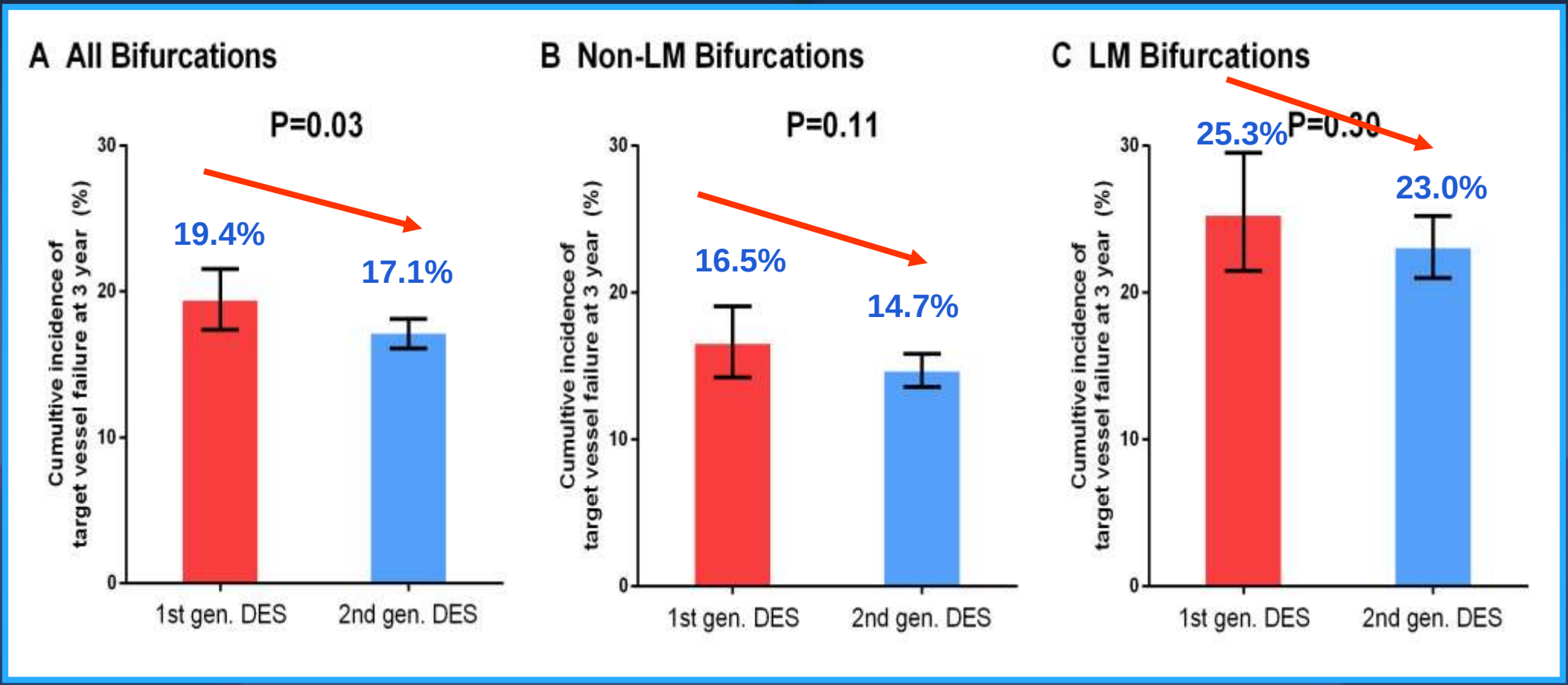
Kang SH, Park DW, Park SJ et al. Coron Artery Dis. 2018 Oct 26.

Simple vs. complex stent strategy
Over time from 1st-DES to 2nd-DES



Kang SH, Park DW, Park SJ et al. Coron Artery Dis. 2018 Oct 26.

Primary Outcome (Target-Vessel Failure)
Over time from 1st-DES to 2nd-DES



TVR: composite of cardiac death, target-vessel MI, clinical driven TVR

Kang SH, Park DW, Park SJ et al. Coron Artery Dis. 2018 Oct 26.

Temporal Changes of Bifurcation PCI

- Over time, bifurcation stenting strategy has been more simplified.
- Over time, outcomes of bifurcation PCI has been more improved.

“Simpler is Better” Approach Works !!!

With Aid of Functional and Imaging Concept and Tools

Functional Concept for Bifurcating PCI

DES PCI

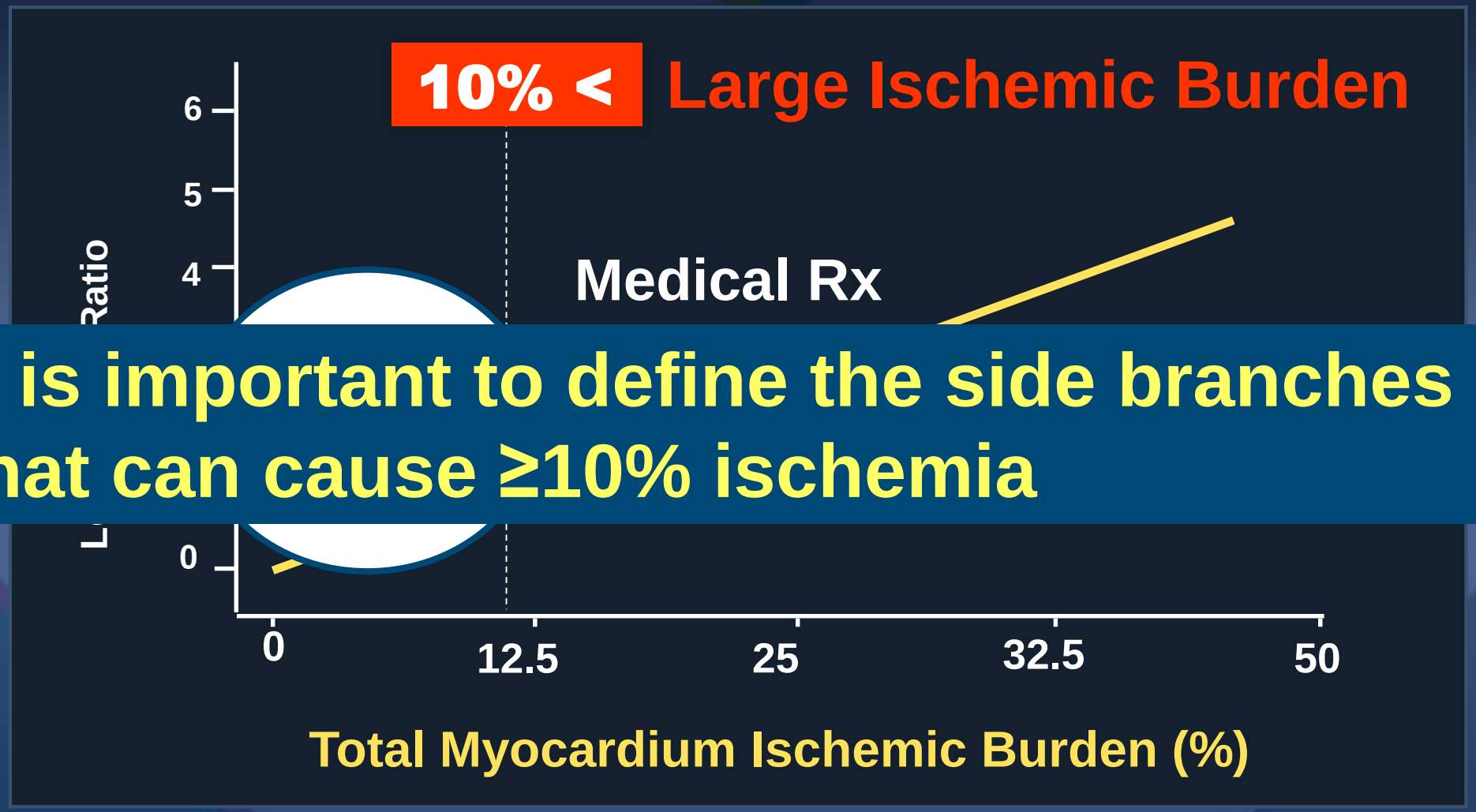
After LAD stent deployment

What Next?

Simple Question? Why FFR?

- Can avoid the complex and/or unnecessary PCI strategy and associated complications.
- Respect functional anatomy
- Simpler is almost better

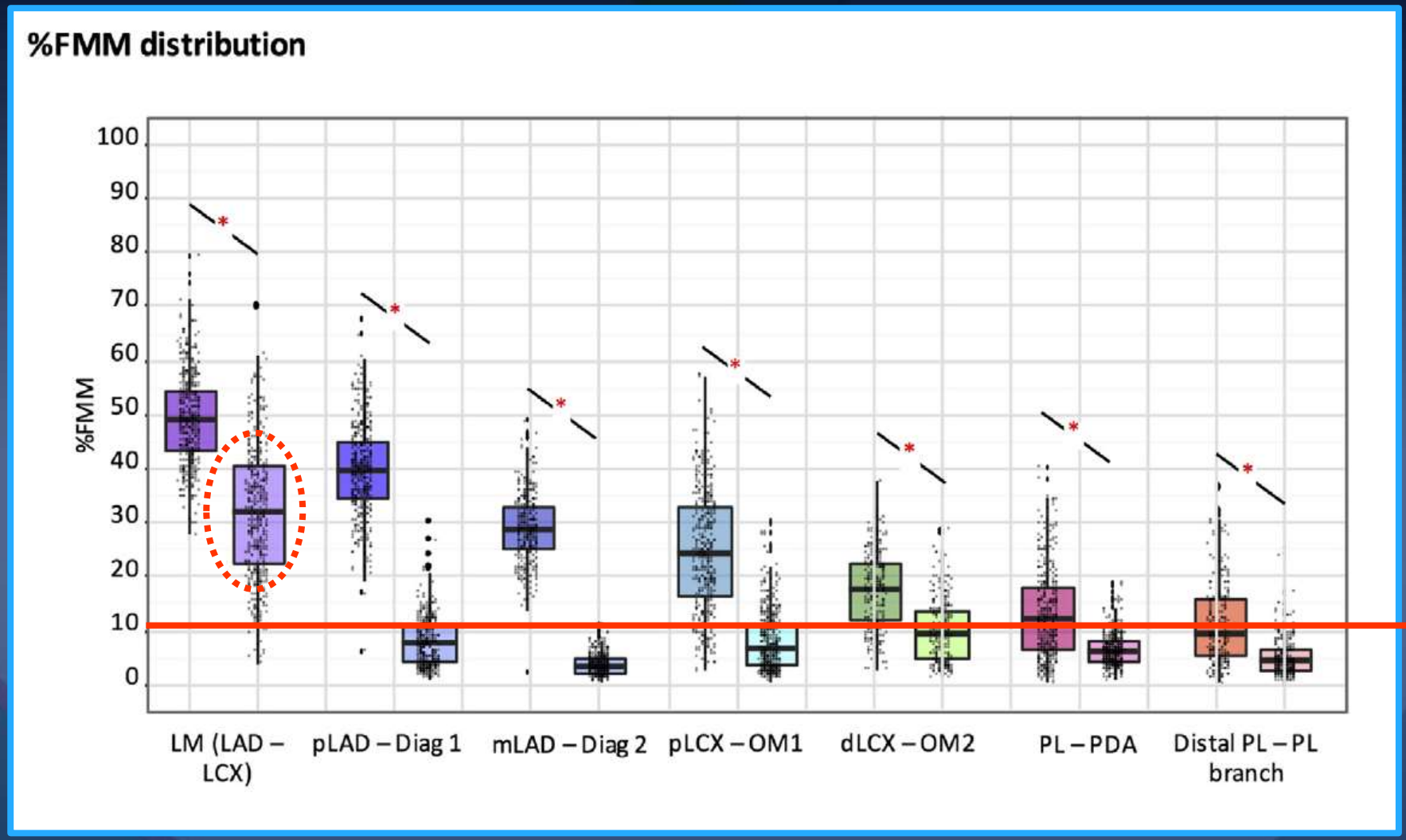
Survival Benefit
of Revascularization



It is important to define the side branches that can cause ≥10% ischemia

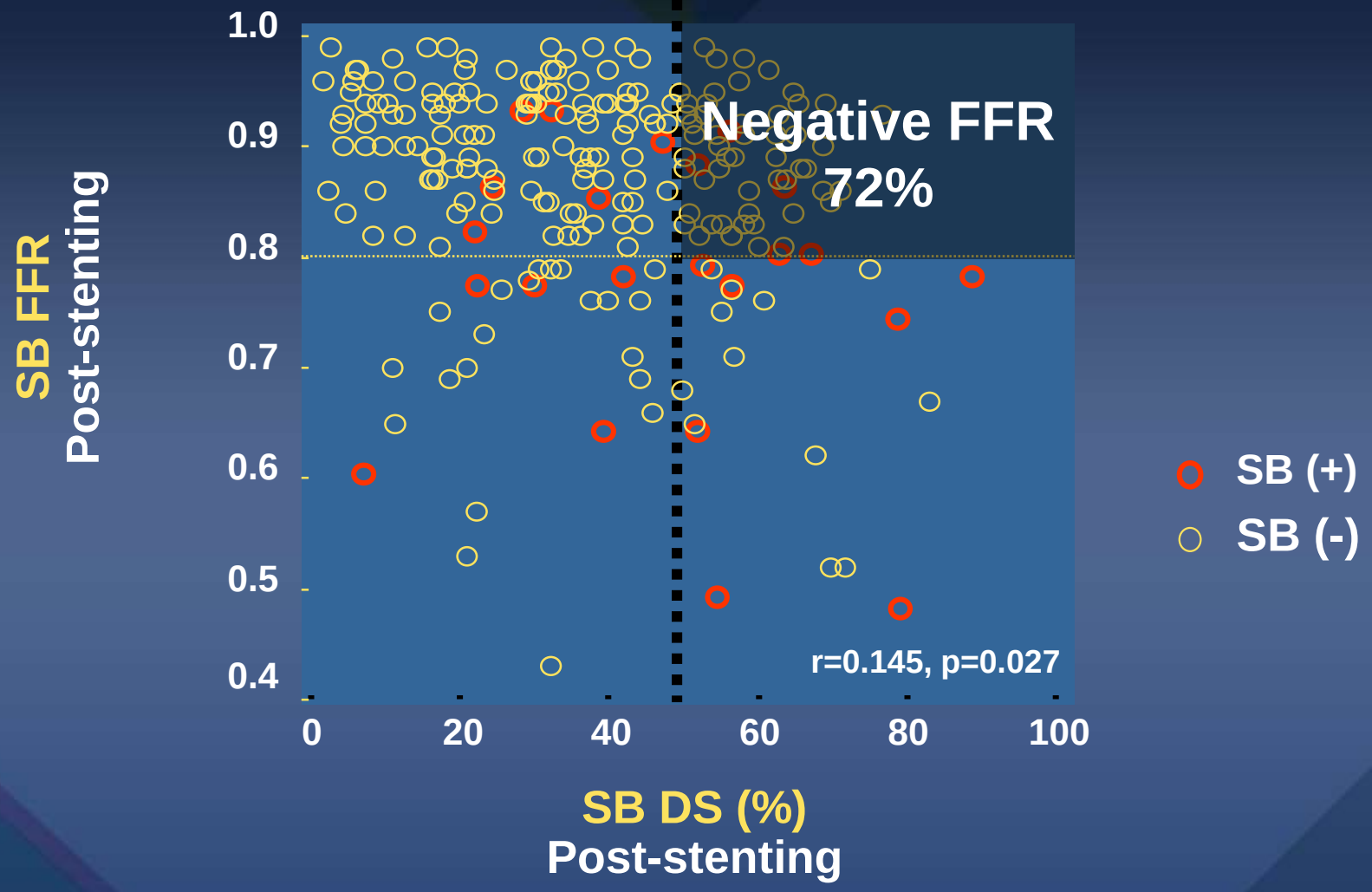
Hachamovitch R, Circulation. 2003;107:2900-2906

CT-FFR: Myocardial Mass >10%



Kim H.Y. et al. J Am Coll Cardiol Intv 2017;10:571–81

Side Branch FFR
After Main Branch PCI (n=232)



Ahn JM et al, JACC Cardiovasc Interv. 2011 Feb;5(2):155-61

Imaging Concept for Bifurcating PCI

Simple Question? Why IVUS?

- Pre-interventional IVUS change initial intended angio-guided stenting strategy and decide appropriate balloon, stent sizing and length (“Fine-Tuning”).

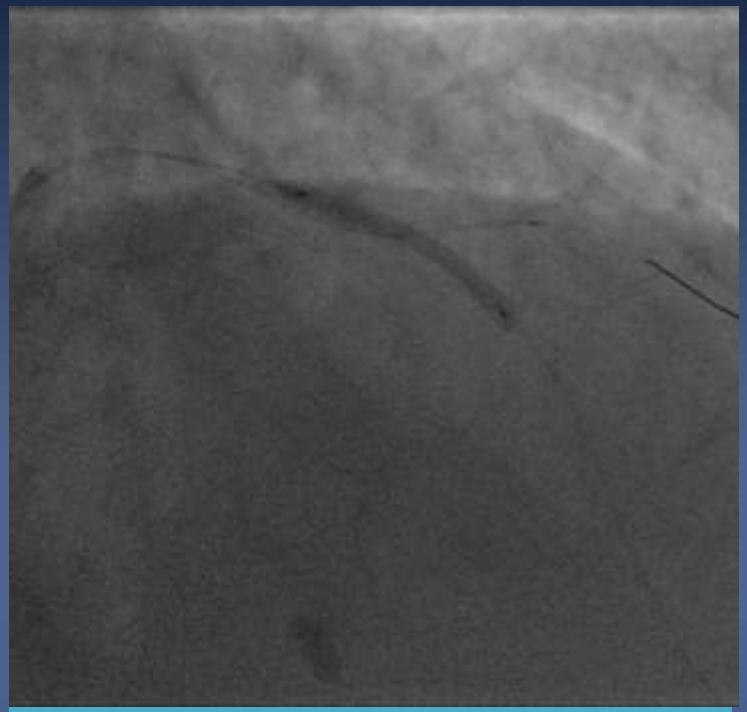
- Post-interventional IVUS confirm optimal stent expansion and complications in all segments of bifurcation.

Why Imaging Concept Is Important?

To Meet Contemporary Technical Concept of Bifurcating PCI and Procedural Optimization

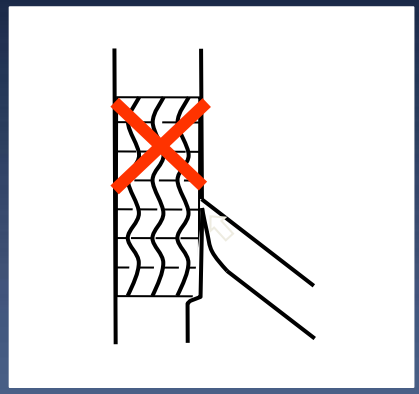
Bifurcation Stenting

Optimal Provisional Approach

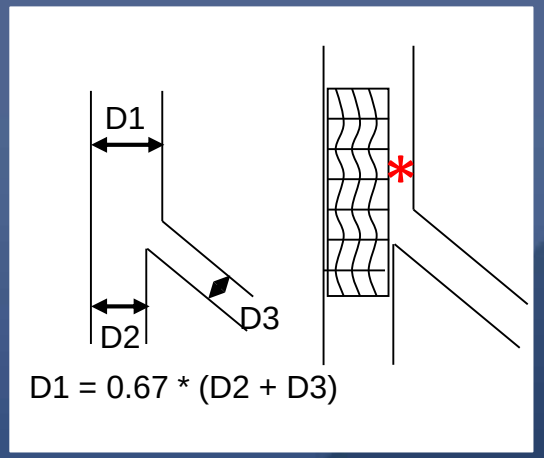


Predilation with 3.0 NC balloon
Xience DES 3.0x28 at 8atm

Sizing the MB stent based on the proximal MB can result in carina shift

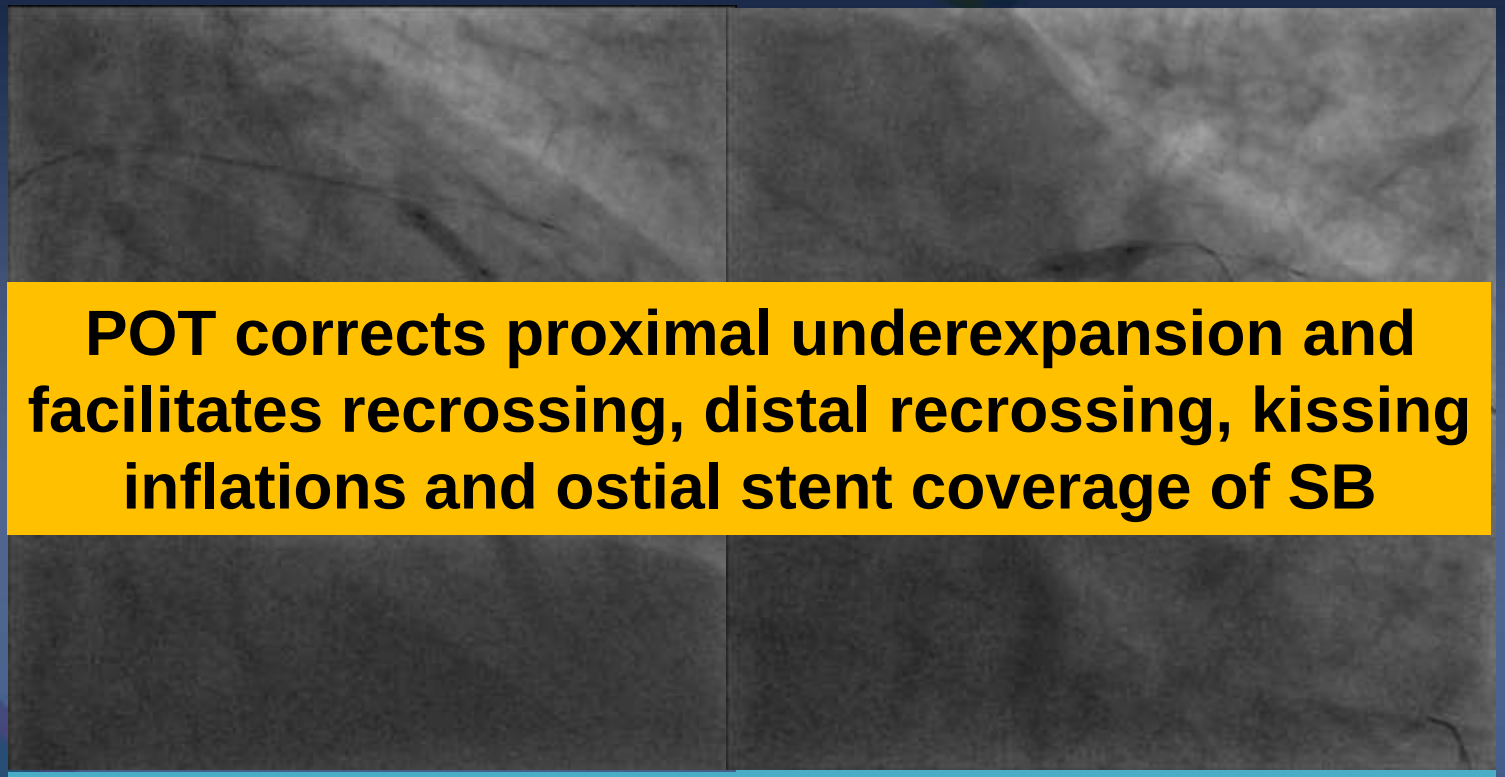


Sizing on the distal MB respects the bifurcation diameters and prevents carina shift



Bifurcation Stenting

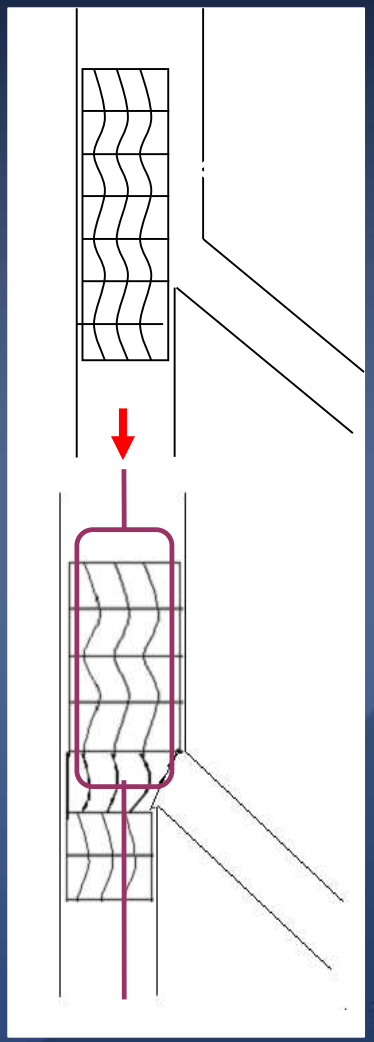
Optimal Provisional Approach



POT corrects proximal underexpansion and facilitates recrossing, distal recrossing, kissing inflations and ostial stent coverage of SB

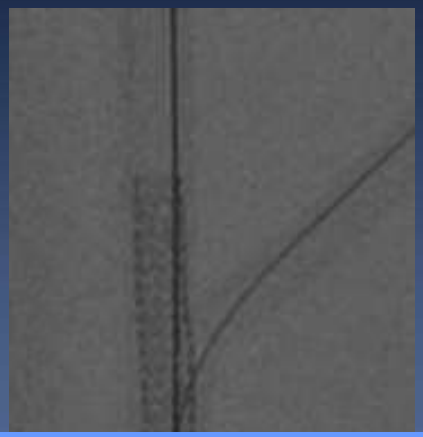
Postdilation with 3.0 NC balloon distally

POT with 3.5 NC balloon proximally

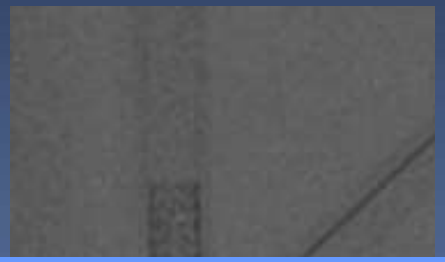


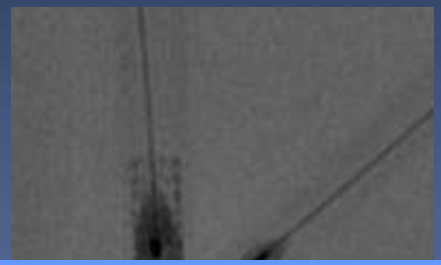
Bifurcation Stenting

Optimal Provisional Approach



When SB interveniton needed



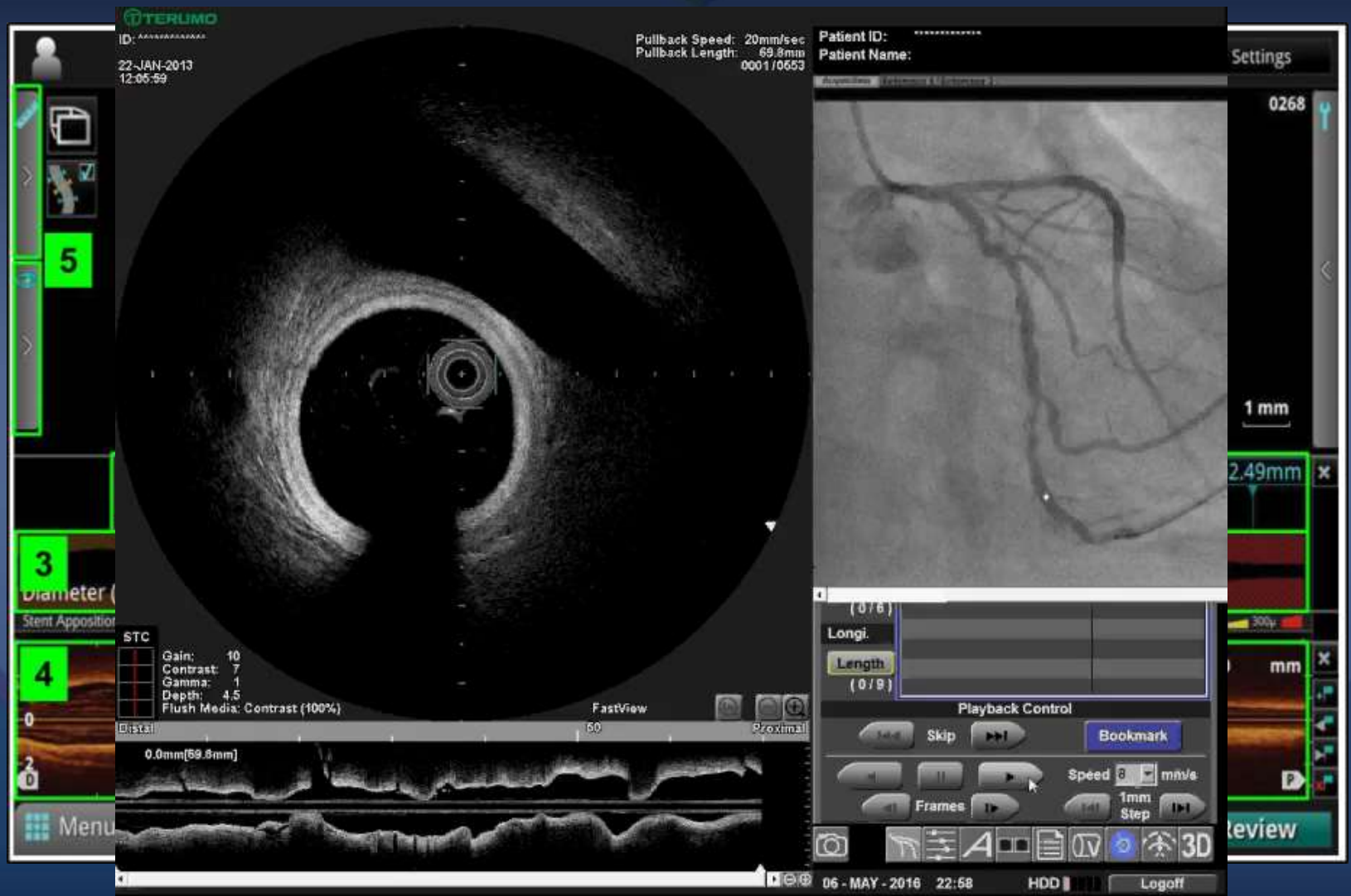


IVUS-Guided POT and Stent Sizing symmetrically expanded the proximal and bifurcation stent segments

Rewiring

Co-registration of OCT and angiography

- Use of on-line co-registration of OCT and angiography may facilitate a precise guidance of bifurcation PCI.



3-D OCT

IVUS Impact on Clinical Outcomes

Editorial

Intravascular Ultrasound–Guided Percutaneous Coronary Intervention for Left Main Disease

Does Procedural Fine-Tuning Make a Relevant Clinical Benefit?

Duk-Woo Park, MD, PhD; Seung-Jung Park, MD, PhD

Owing to the large area of jeopardized myocardium, left main coronary artery (LMCA) disease was associated with high morbidity and mortality and, thus, coronary artery bypass grafting has been the standard revascularization approach. However, over the several decades, there was a considerable evaluation in the field of percutaneous coronary intervention (PCI). Remarkable advancements in stent devices, technical refinement, and adjunctive medical therapy has led to improved PCI outcomes for unprotected LMCA disease.[1] Especially, with a widespread use of drug-eluting

in >70%, which was almost like the real-world practice.[1] For LMCA PCI, how does IVUS guidance make stenting procedure to be more optimal? First, IVUS provides more reliable information than angiography on lesion characteristics regarding lumen size, plaque characterization, and disease distribution.[8] Such precise imaging of LMCA lesion using pre-PCI IVUS may inform optimal stent sizing, length, and positioning. Second, especially for distal LMCA bifurcation lesions, IVUS may be helpful to decide stenting strategy. Selection of a provisional or complex stenting should be based on disease

Circ Cardiovasc Interv. 2017;10:e005293

Key Summary of Non-Left Main Bifurcation PCI

- Provisional stenting is now the preferred strategy for the treatment of non–left main coronary bifurcation lesions

- After the main vessel stenting:
  - The expansion of the proximal segment of the stent should be optimized – **IVUS/OCT**
  - The status of SB should be functionally assessed - **FFR**
- Treatment strategies:
  - Proximal optimization technique (POT) – **IVUS/OCT**
  - Kissing balloon inflation (KBI) - **FFR**

Take-Home Message : Non-LM Bifurcation PCI

- Bifurcation management requires flexibility in thought and techniques
- Physiology can help determine the strategy
- Imaging can help determine the strategy and optimization of results
- “KISSS” principle: Keep it simple, swift and safe

Supplementary Slides

KISSS-principle Keep it simple, swift and safe

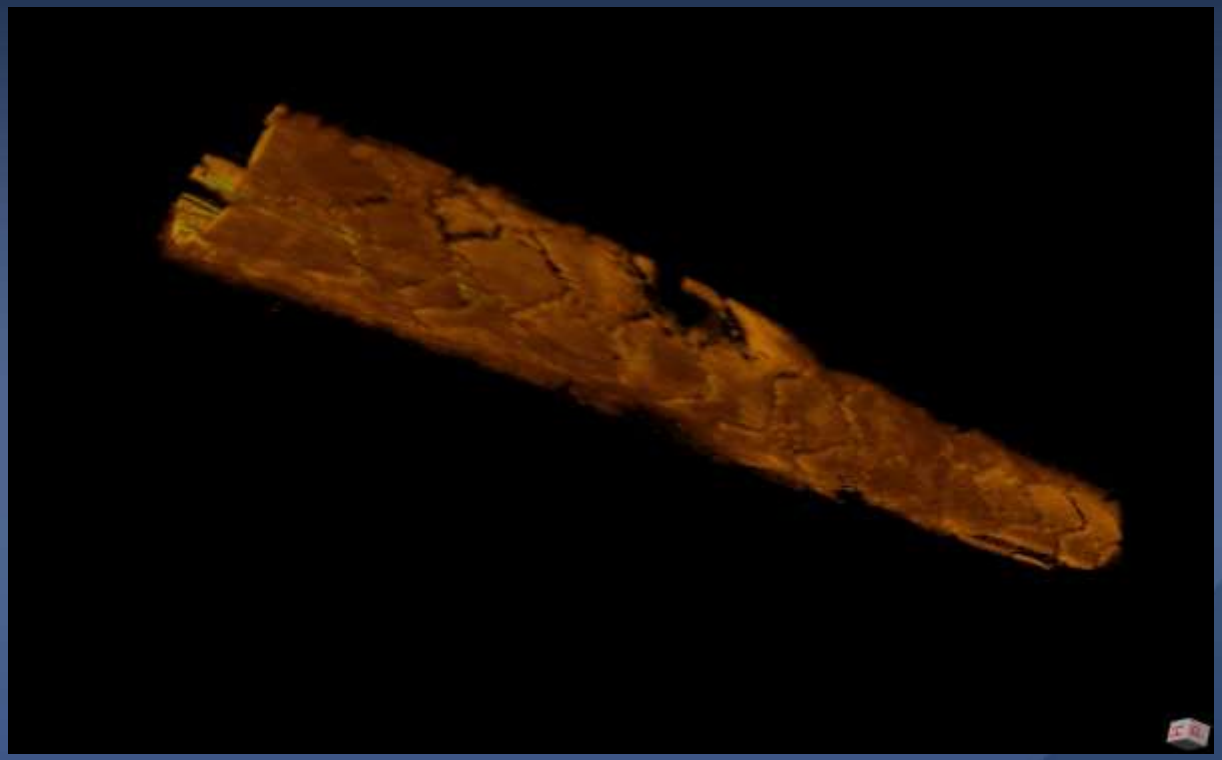
Always use two wires.

Implant the stent with focus on the distal diameter.

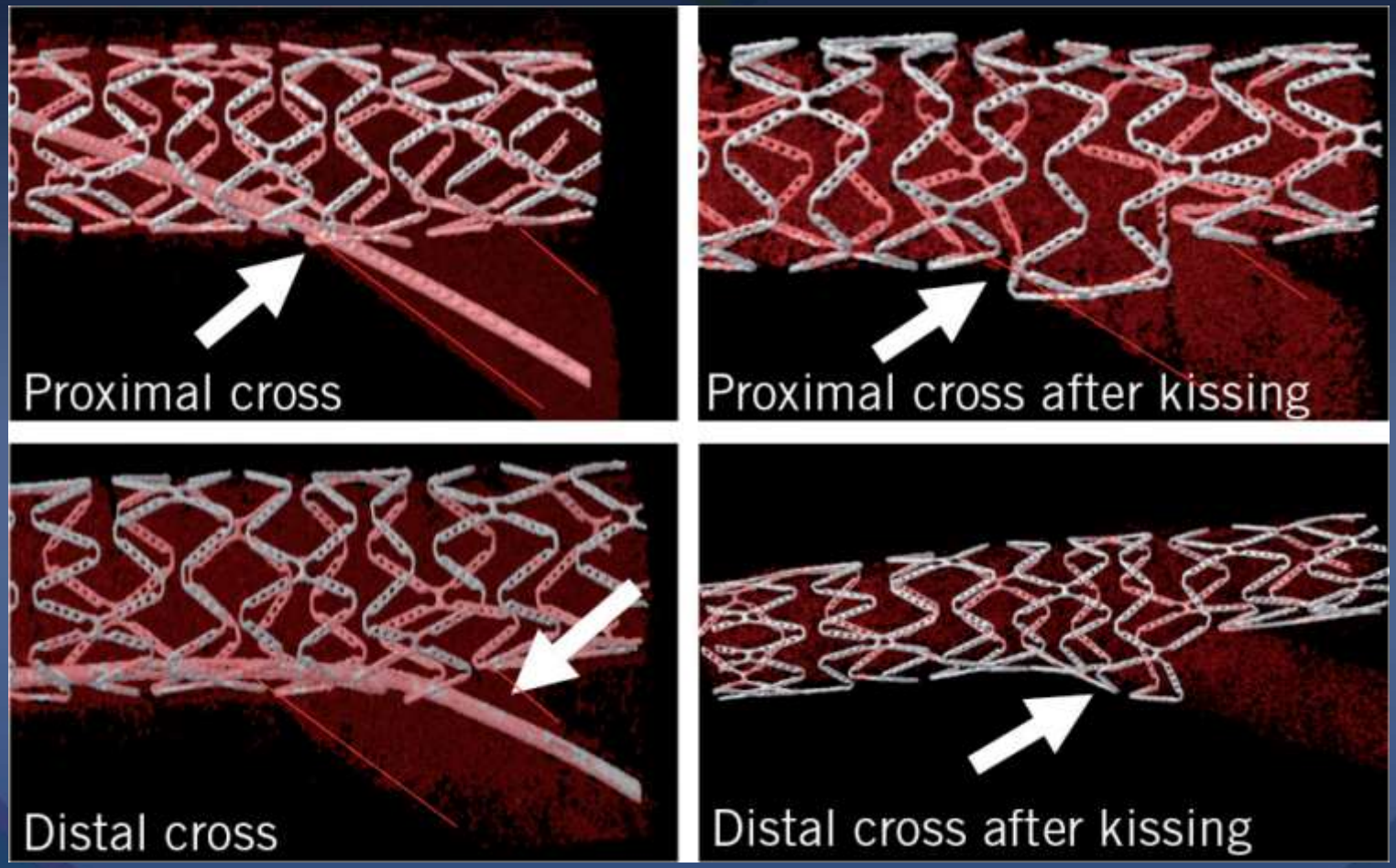
Finalize with a proximal optimisation dilatation (POT).

POT secures vessel tapering and good proximal stent apposition, opens struts towards the side branch

Rewire and treat SB only if needed.



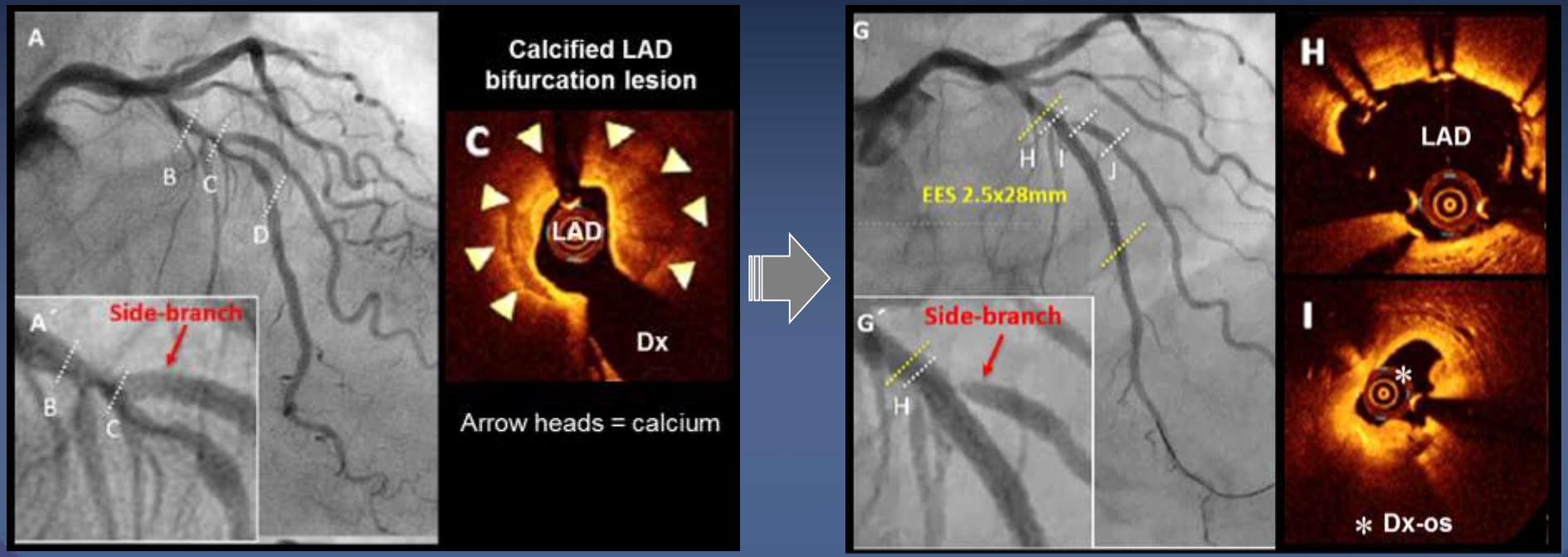
IVUS-Guided POT



Calcified plaque at bifurcation

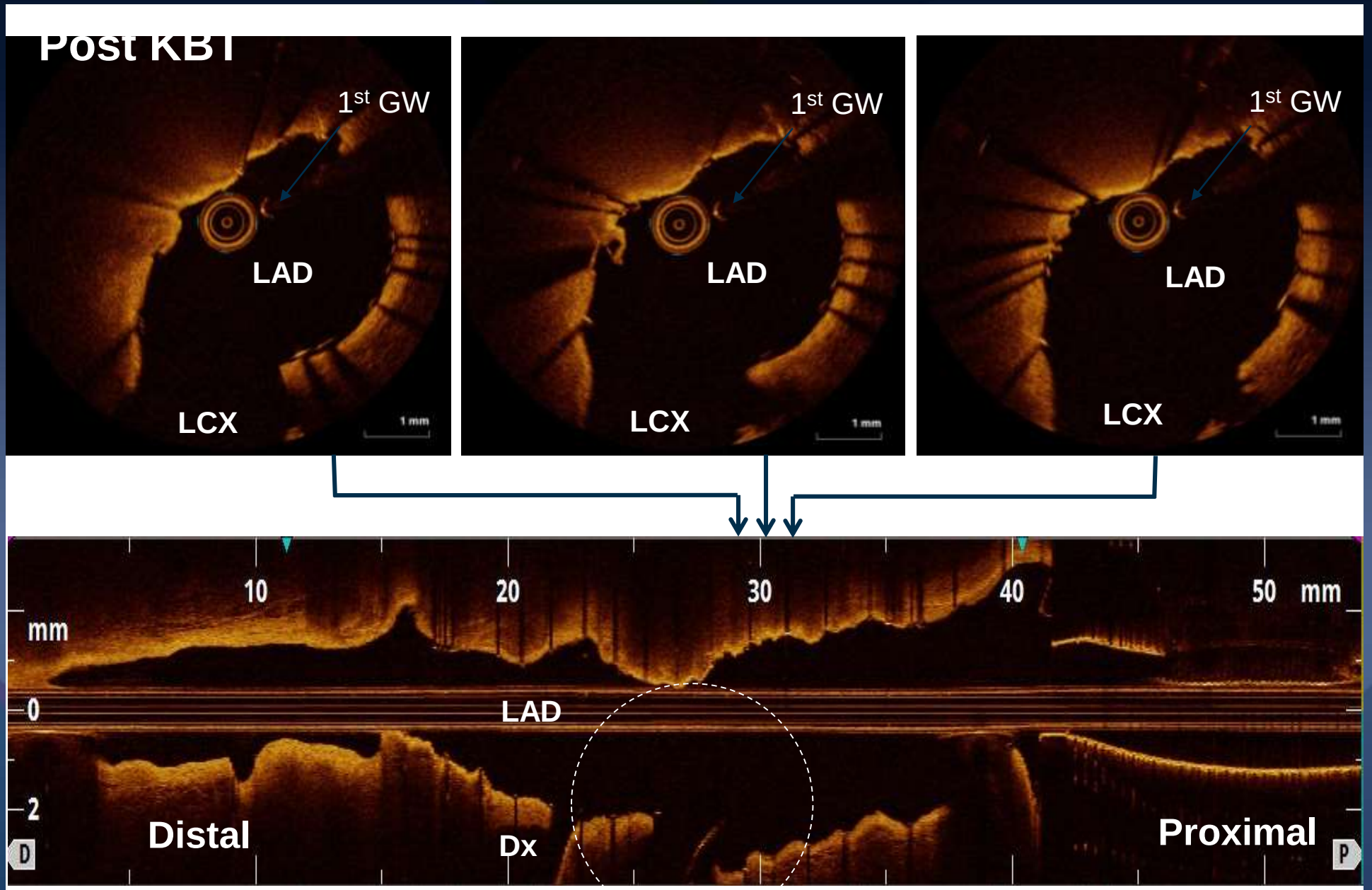
Pre-intervention

Post stent implantation in LAD



Angiography at pre-stent implantation showed LAD bifurcation lesion. OCT demonstrated severe calcification in the LAD bifurcation lesion (C). After stent implantation in LAD, angiography and OCT disclosed stenosis at side branch ostium.

Fujino et al. IJC 2014;176:1056–60


Post KBT
1st GW
LAD
LCX
1 mm
1st GW
LAD
LCX
1 mm
1st GW
LAD
LCX
1 mm
10
20
30
40
50
mm
mm
0
LAD
2
Distal
Dx
Proximal
D
P

Why We Need (Upfront) 2 Stent Strategies for Bifurcations

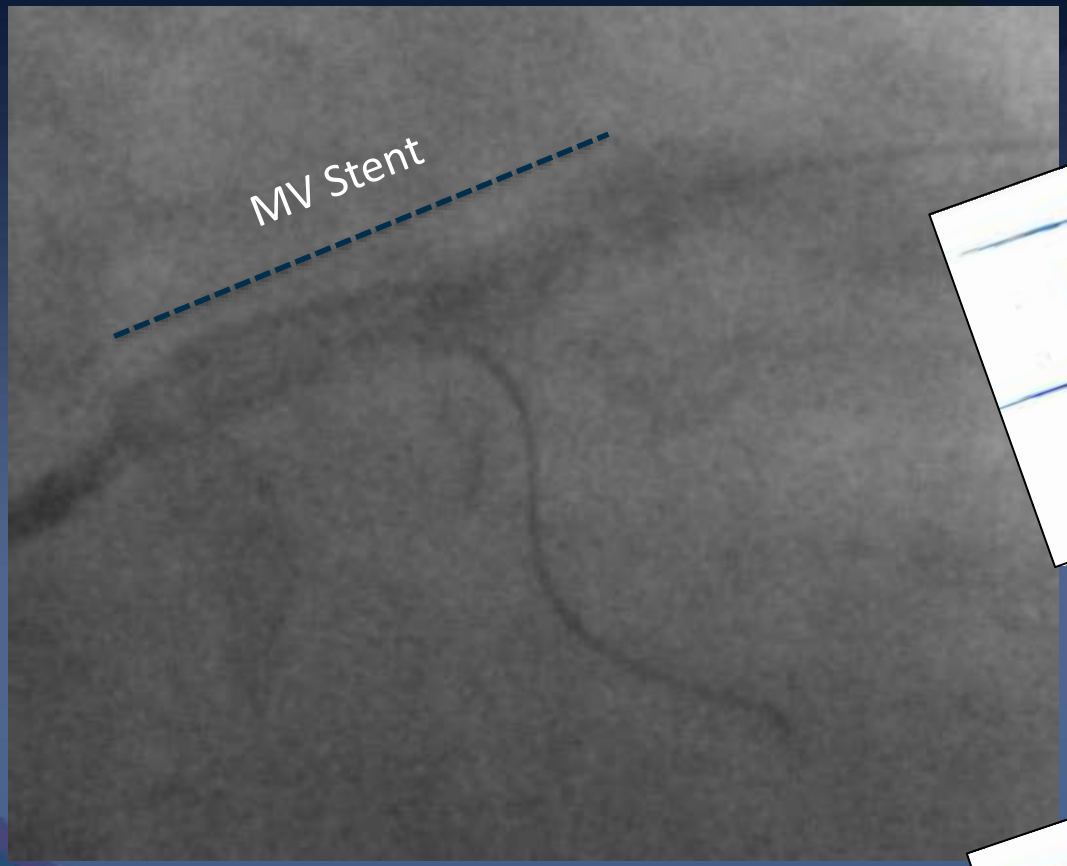
- Large SB with disease worthy of treatment in its own right
  - Remember: the LENGTH of the sidebranch i s a better measure of size due to underfilling!

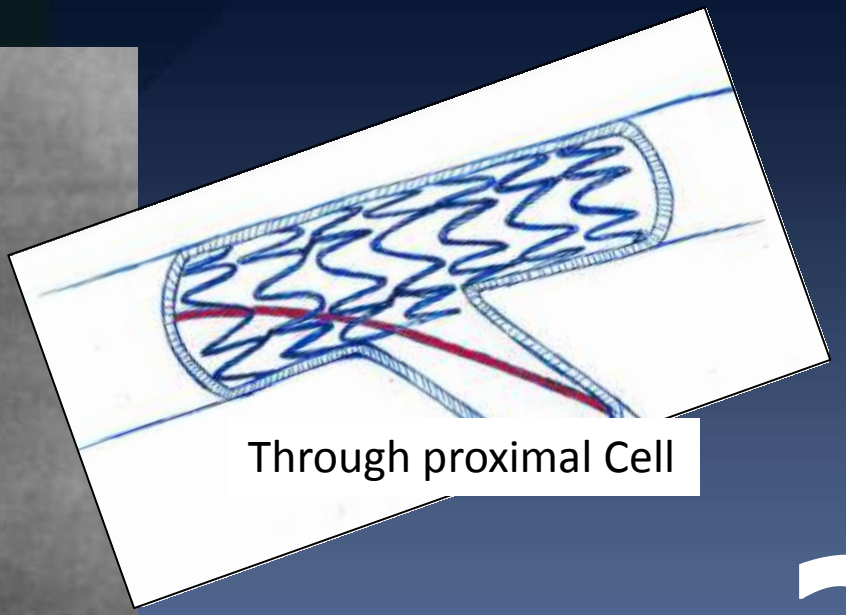
- Risk of SB closure during Main Vessel PCI
  - Stabilizing/treating SB first has advantages
  - Provisional strategies don’t always go as pla nned and TAP doesn’t always work

Any Different Outcomes ?
with Different 2 Stent Techniques

- Different Indications,
- Very Limited Data,
- Small Difference in Soft End Point (Late Loss, TLR, Branch Restenosis) without Any Hard Endpoint Difference (Death or MI).

Angiography is limited in recognizing a recrossing position…

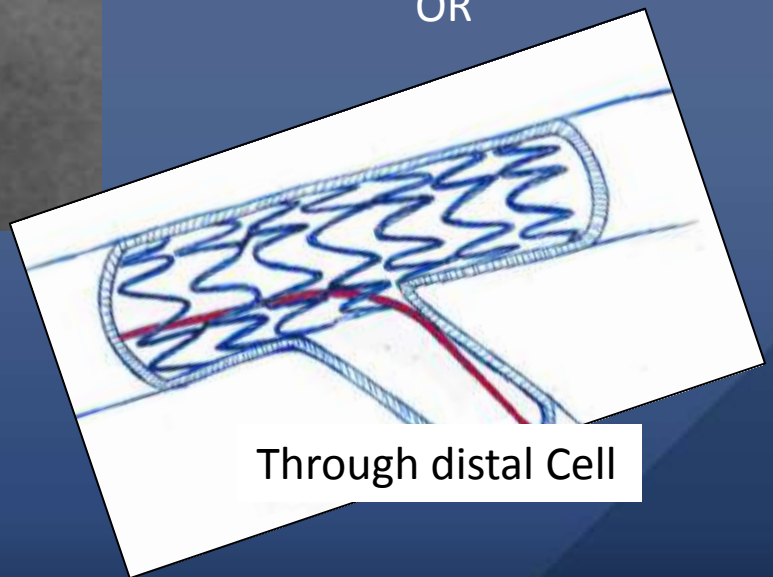




Through proximal Cell

?

OR



Through distal Cell

Practical Non-LM Bifurcation PCI Approach

How To Treat ?

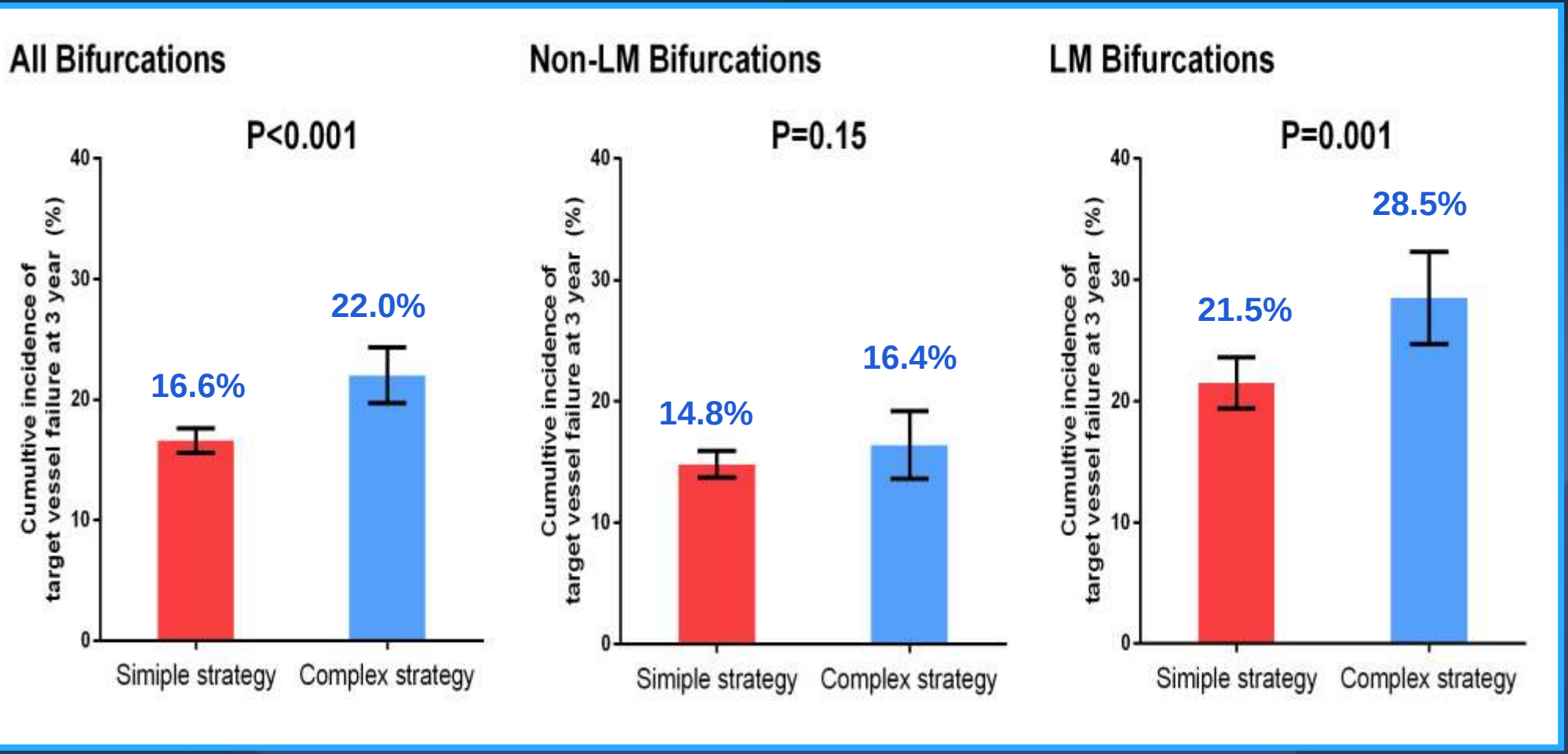
Provisional Stenting Is Always Enough	Any 2 Stent Technique

- Jailing Side Branch ? — It Would Be OK !
- How to Treat ?

Conceptual Keep-in-Mind;

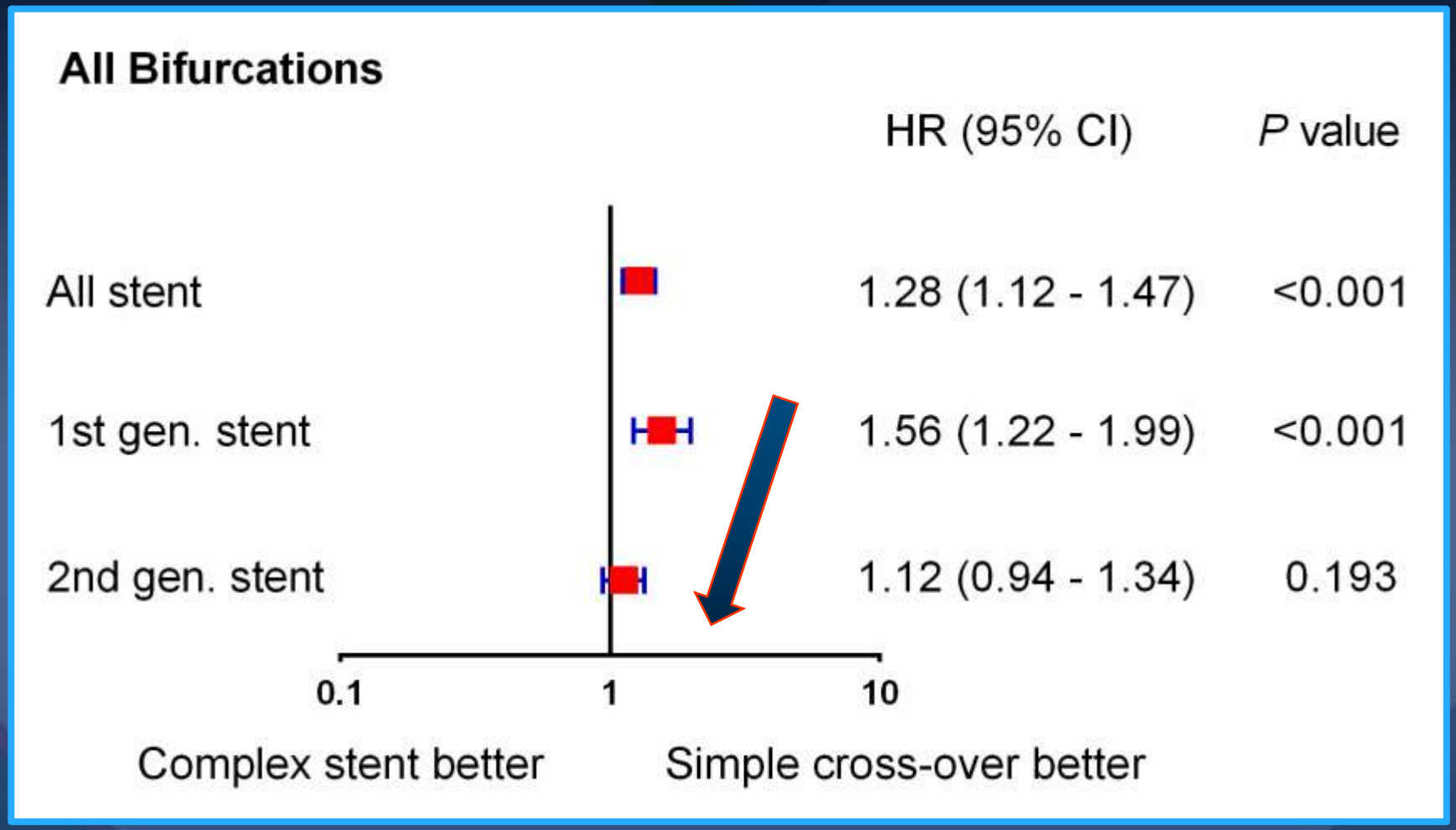
1. Long-term clinical outcomes are determined mostly by the status of MB.
2. Ensuring optimal results in the MB may be more important than optimizing the angiographic appearance of the SB.

Primary Outcome (Target-Vessel Failure)
According to Stenting Strategy



Kang SH, Park DW, Park SJ et al. Coron Artery Dis. 2018 Oct 26.

Adjusted HR for Target-Vessel Failure According to stent strategy over time



**Multivariable Cox regression models are adjusted for age, sex, diabetes, previous MI, previous PCI, chronic renal failure, clinical presentation, ejection fraction, bifurcation location, disease extent, and use of intravascular ultrasound.

Kang SH, Park DW, Park SJ et al. Coron Artery Dis. 2018 Oct 26.