Updated Techniques and Concepts 2021
for Complex Left Main PCI

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Efficacy Concerns of

PCI for LM Disease

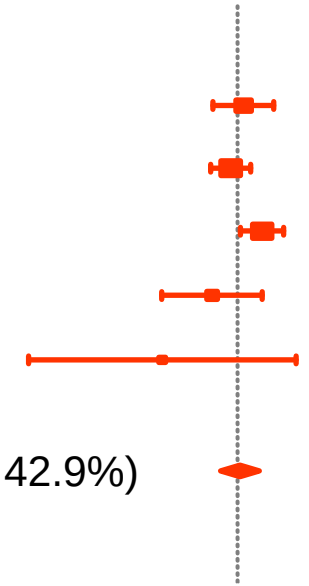
All Death

Updated Meta-analysis of LM DES vs. CABG Trials

5 RCTs, 4,612 pts, mean 5.6-year FU

Study and Year	PCI Events	PCI N	CABG Events	CABG N	Weight (%)	Relative risk [95% CI]
Risk of death						
NOBLE – 5 year, 2019	54	592	50	592	22.4	1.08 [0.75, 1.56]
SYNTAX – 10 year, 2019	93	357	98	348	32.9	0.93 [0.73, 1.18]
EXCEL – 5 year, 2019	119	948	89	957	31.3	1.35 [1.04, 1.75]
PRECOMBAT – 5 year, 2015	17	300	23	300	11.4	0.74 [0.40, 1.36]
Boudriot – 1 year 2011	2	100	5	101	2.0	0.40 [0.08, 2.03]
REML model for all studies (Q=7.28, df=4, p for heterogeneity=0.12; I^2 = 42.9%)						1.03 [0.82, 1.30]

P overall effect = 0.78



0.04 0.2 1 5 25

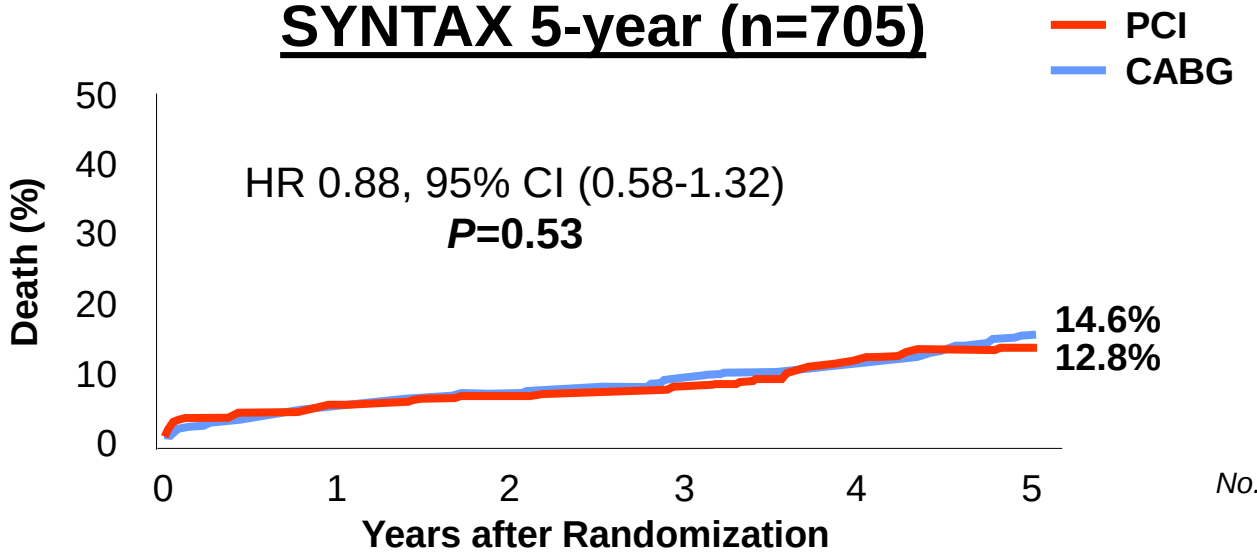
DES better < Relative risk > CABG better

Moderate heterogeneity due to EXCEL. If EXCEL removed:

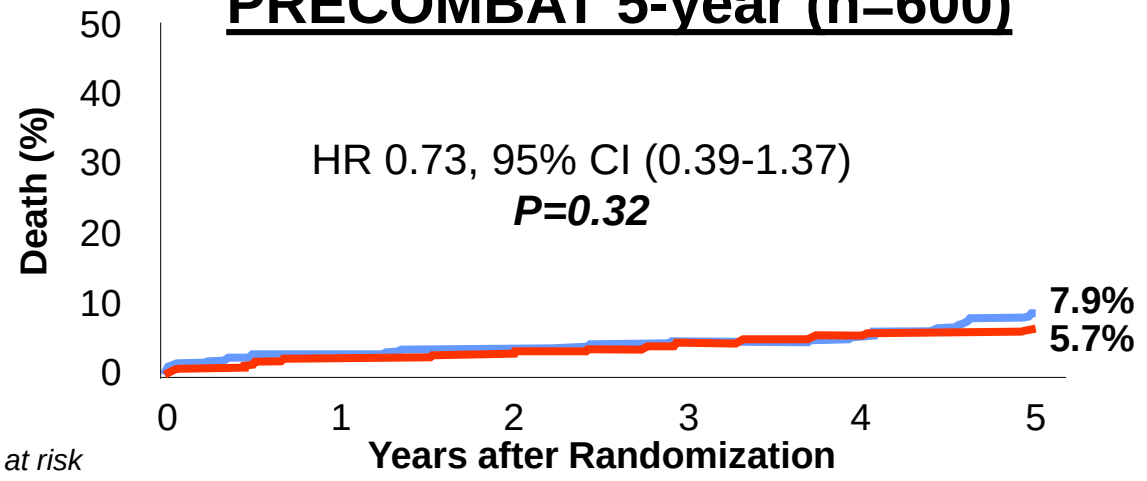
RR 0.93, 95% CI 0.77–1.13; P= 0.47; I^2 = 0.0%

All Death after LM DES vs CABG (n=4,394)

SYNTAX 5-year (n=705)



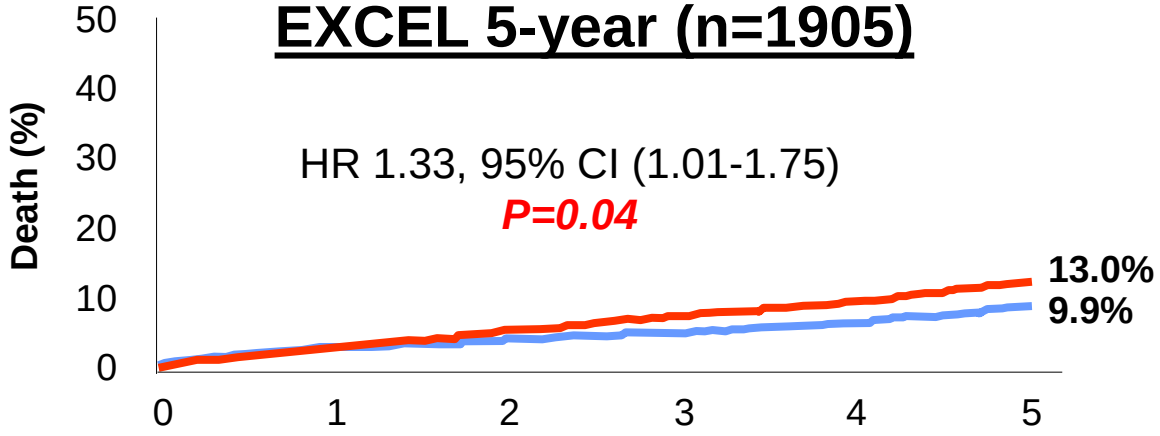
PRECOMBAT 5-year (n=600)



No. at risk

PCI	300	292	289	283	277	262
CABG	300	291	288	281	273	252

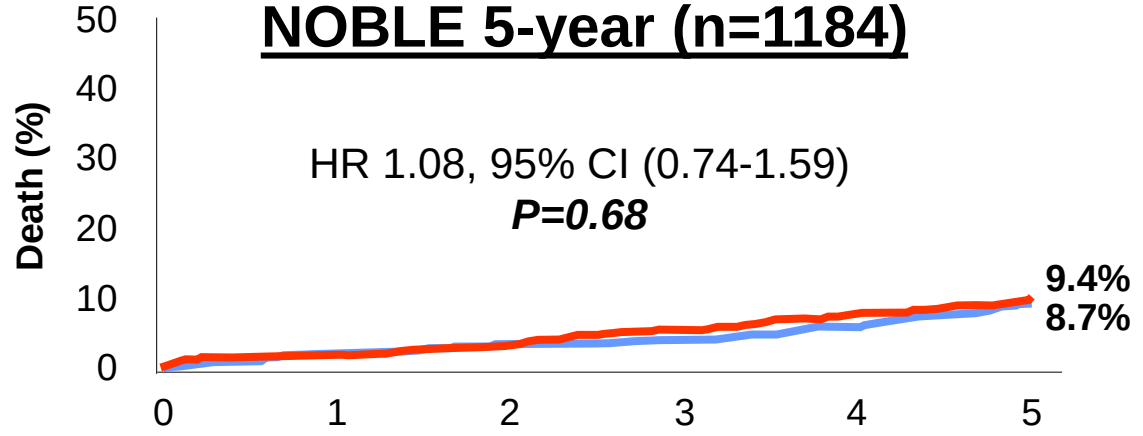
EXCEL 5-year (n=1905)



No. at risk

PCI	948	902	868	841	810	545
CABG	957	889	865	844	815	596

NOBLE 5-year (n=1184)



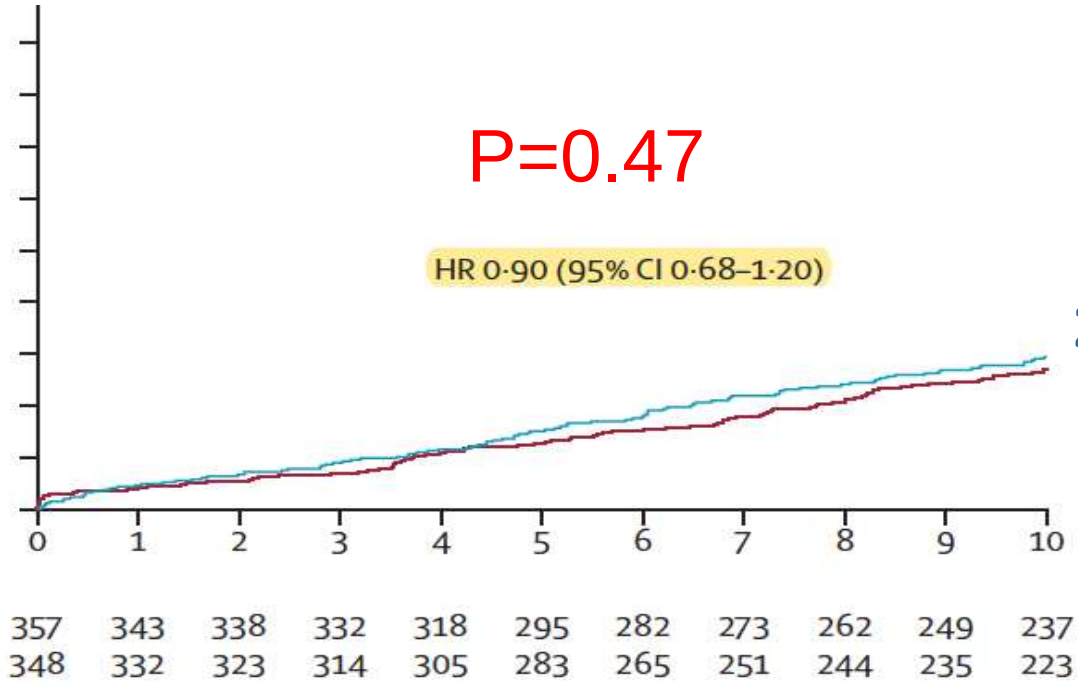
No. at risk

PCI	592	585	577	563	541	409
CABG	592	579	573	569	547	432

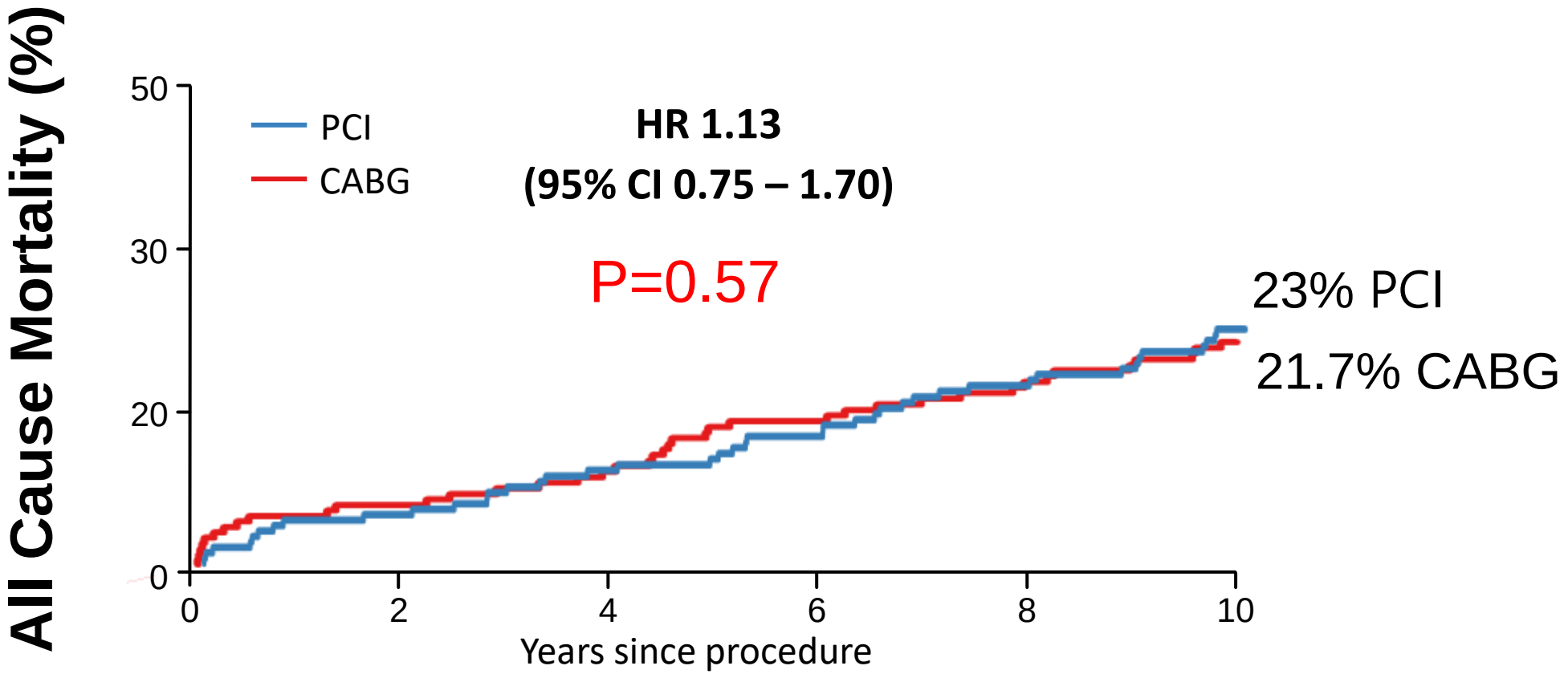
Morice MC et al. *Circulation* 2014;129:2388-94; Ahn JM et al. *JACC* 2015;65:2198–206
Stone GW et al. *NEJM* 2019:381:1820-30; Holm NR et al. Lancet 2019:on-line

SYNTAX 10-year : All Death

Left main disease



PRECOMBAT 10-year : All Death



Consensus of PCI vs. CABG in Left Main Disease, *2021*

1. PCI with DES showed ***similar mortality and serious composite outcome*** compared to CABG.
2. PCI with DES was associated with ***a higher risk of repeat revascularization and a lower risk of stroke*** compared to CABG.

ESC Guidelines 2018
Elective PCI for LM Stenosis

	CABG		PCI	
Recommendation according to extent of CAD	**Class**	**Level**	**Class**	**Level**
LM disease a SYNTAX score ≤ 22	**I**	**A**	**I**	**A**
LM disease a SYNTAX score 23 -32	**I**	**A**	**IIa**	**A**
LM disease a SYNTAX score > 32	**I**	**A**	**III**	**B**

Reference; SYNTAX Study, PRECOMBAT study, MAINCOMPARE registry study and Meta-Analysis. *Patrick, SW et al, NEJM. 2009 March 5;360(10), Park SJ et al, NEJM. 2011 May 5;364(18):1718-27, Levin GN et al. ACC/AHA guidelines. JACC 2011;58:44-122, Capodanno et al, JACC 2011;58:1426-32*

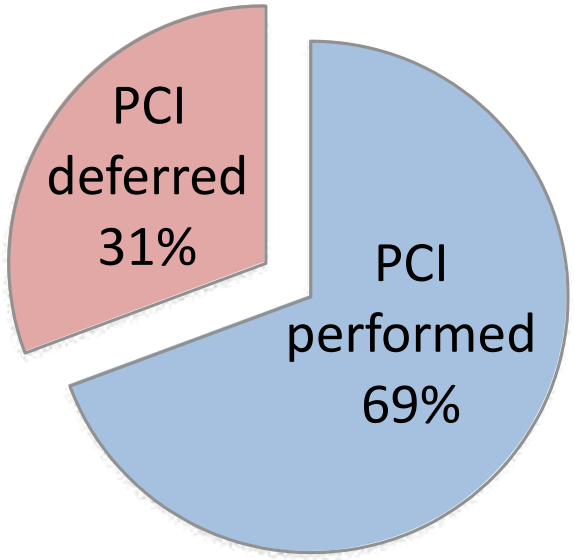
Complexity of LM Disease ?

Is *Syntax Score Representative*
for Complexity of LM Disease and
Predictive for Late Clinical Outcomes ?

Impact of iFR/FFR
on PCI

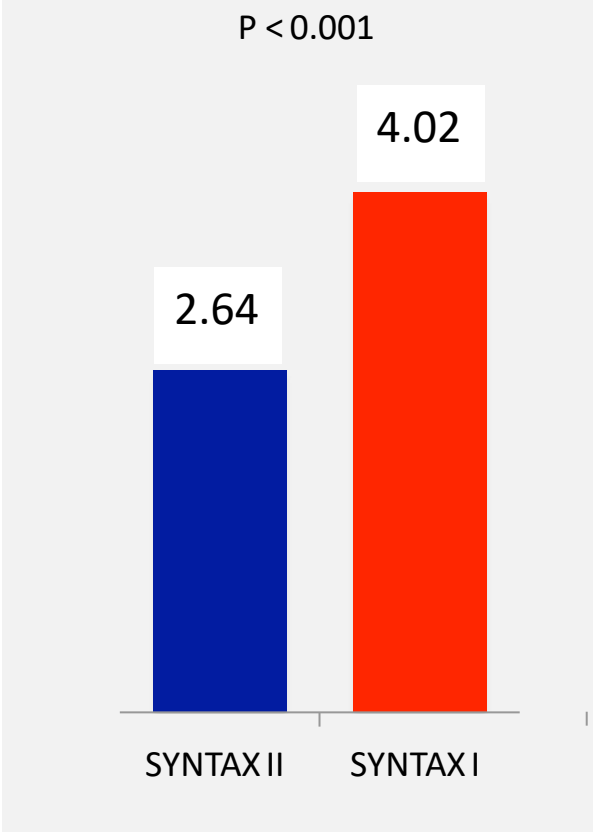
Impact of iFR/FFR on PCI

Lesion evaluated by iFR/FFR interrogation (n=1177)

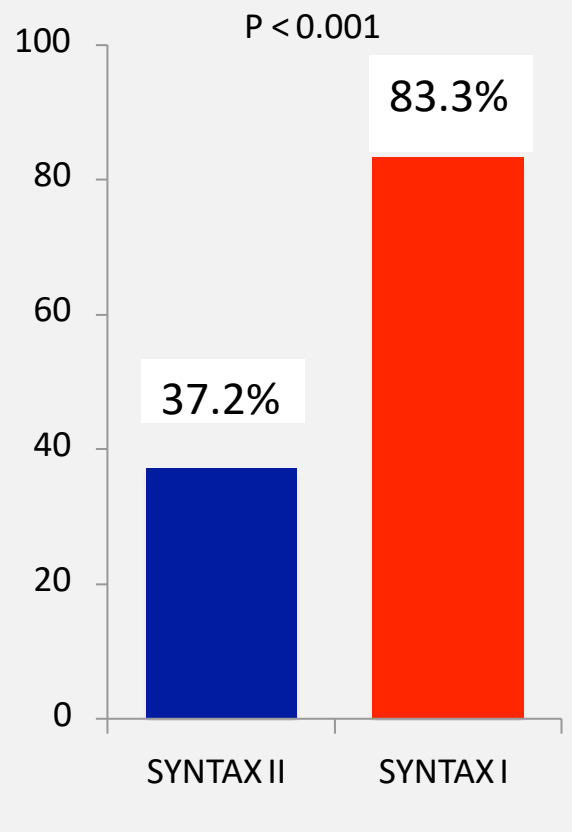


SYNTAX II

Lesions treated per patient (n) in SYNTAX II and SYNTAX I

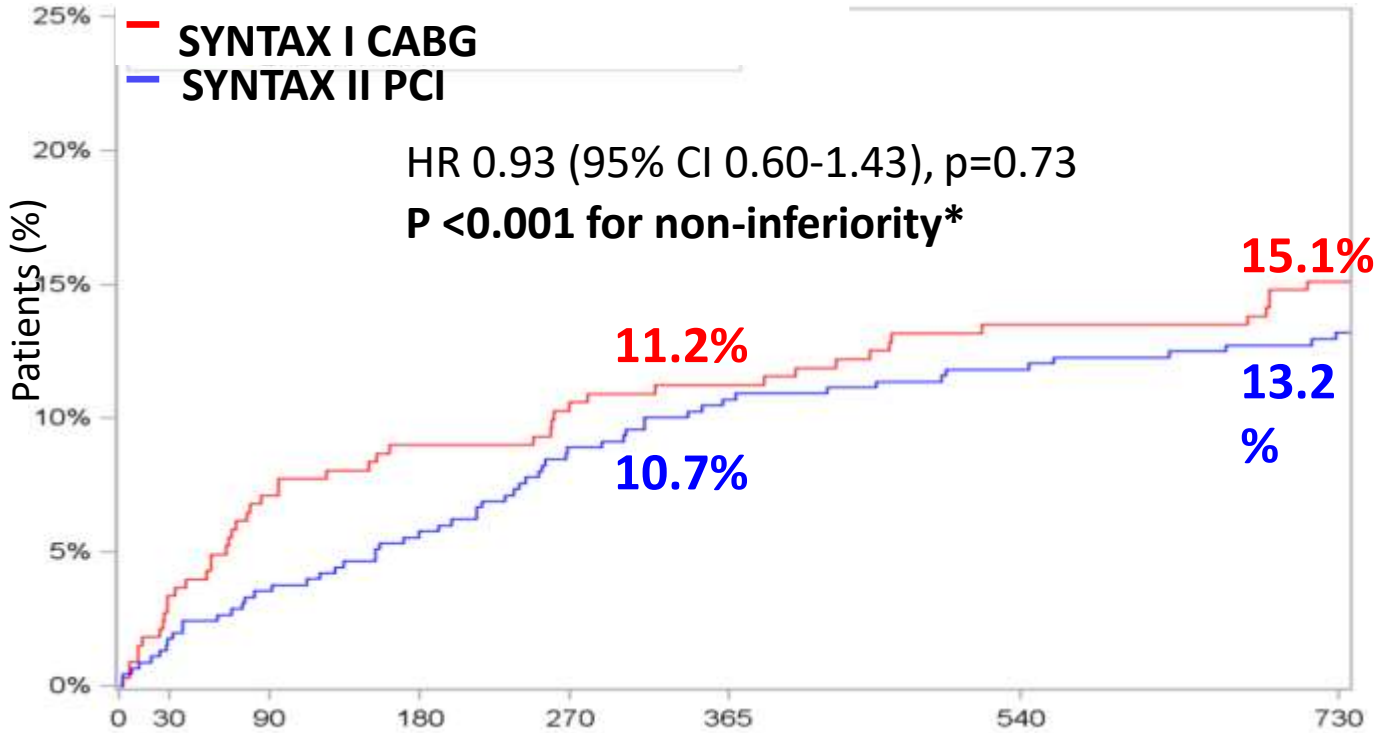


Cases of 3-vessel PCI (%) in SYNTAX II and SYNTAX I



Escaned J, Banning A, Serruys PW. Eur Heart J. 2017 Nov 7;38(42):3124-3134.

A composite of
All death, stroke, any MI, and any revascularization
PCI vs. CABG at 2 years



Number at risk							
SYNTAX I CABG	334	313	295	289	279	277	268	263
SYNTAX II PCI	454	442	433	422	407	399	391	347

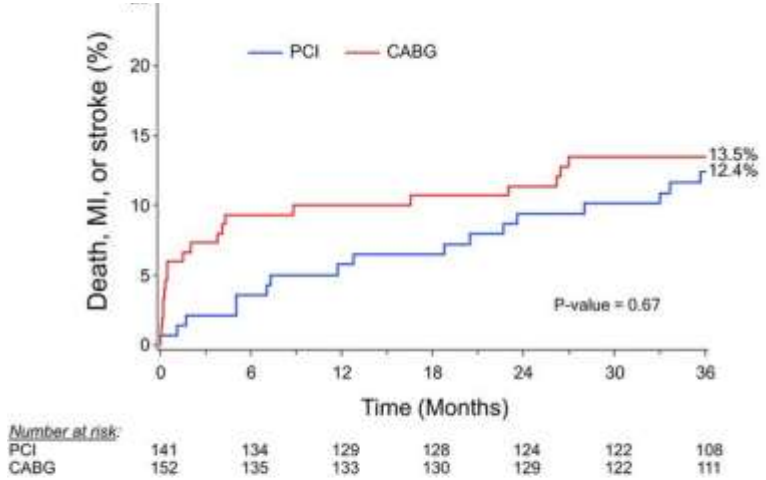
Escaned J, Banning A, Serruys PW. Eur Heart J. 2017 Nov 7;38(42):3124-3134.

Complexity of LM Disease ?

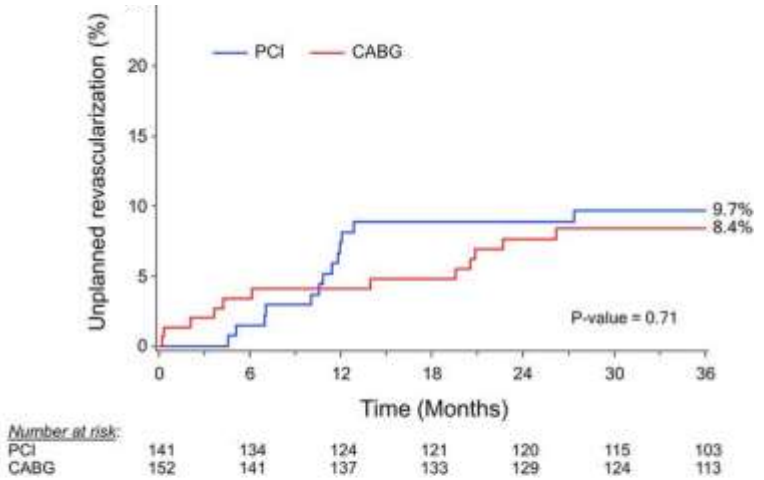
1. ***Location of Disease***
2. ***Feasibility of PCI***

Ostial/Shaft LM PCI at 3 Years

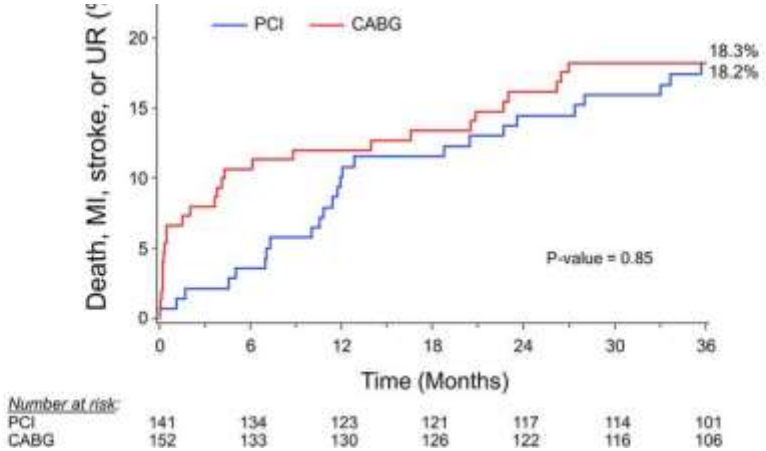
Death, MI, or Stroke (%)



Unplanned Revascularization



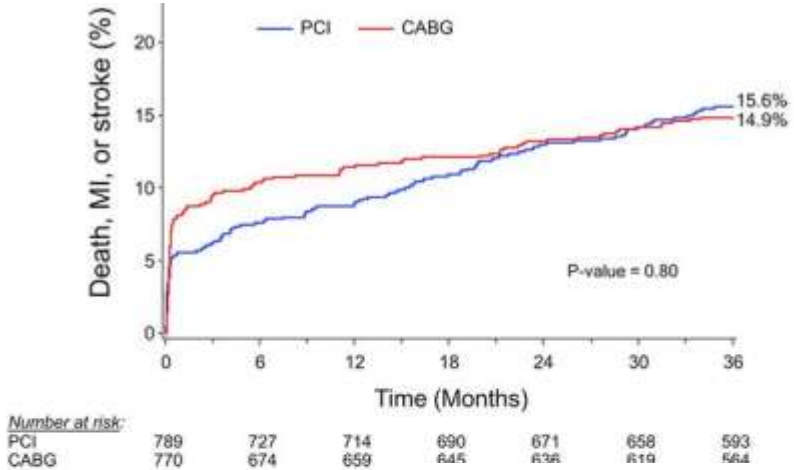
Death, MI, Stroke, or UR (%)



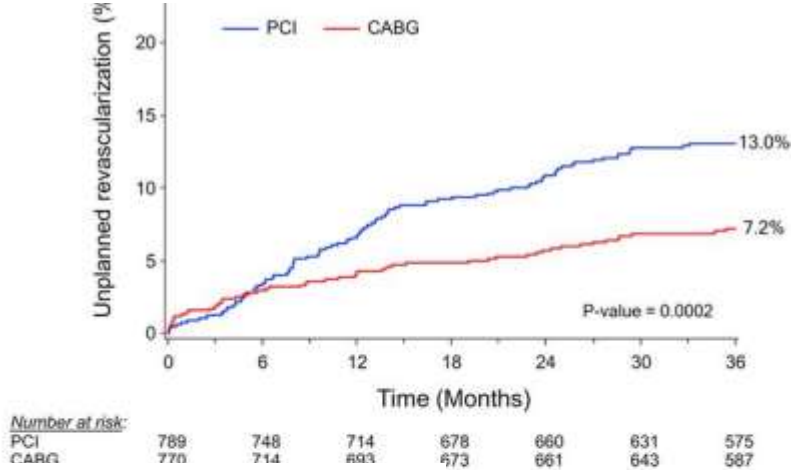
Anthony H. Gershlick et al. JCIN 2018;11:1224-1233 from Meta-Analysis from SYNTAX, BEST and PRECOMBAT

Distal Bifurcation LM PCI at 3 Years

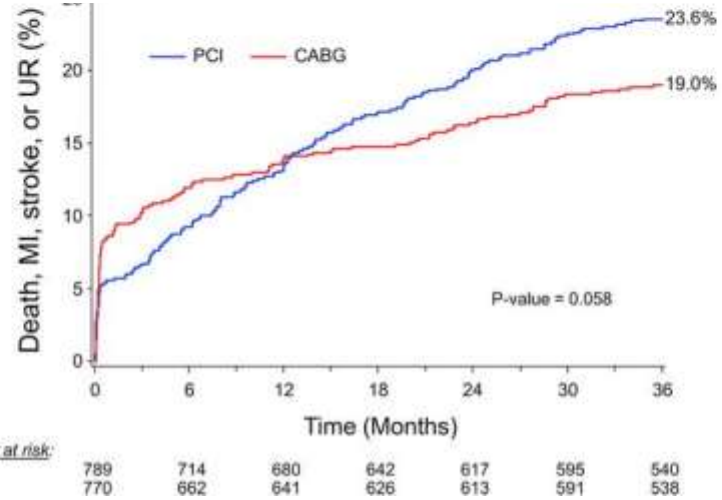
Death, MI, or Stroke (%)



Unplanned Revascularization



Death, MI, Stroke, or UR (%)



Anthony H. Gershlick et al. JCIN 2018;11:1224-1233 from Meta-Analysis from SYNTAX, BEST and PRECOMBAT

Treatment Issue of LM Disease

1. Isolated Ostial and/or Shaft LM Diseases Are Not Surgical Disease Any More. PCI Would Be Better!
2. In Ture Bifurcation Disease, Provisional Stent or Upfront 2 Stents That's the Issue.

LM Bifurcation PCI

1 Stent	***Normal or Small Diminutive LCX (<2.5 mm),***
2 Stents	***True Bifurcation Disease, Large LCX (>2.5 mm)***

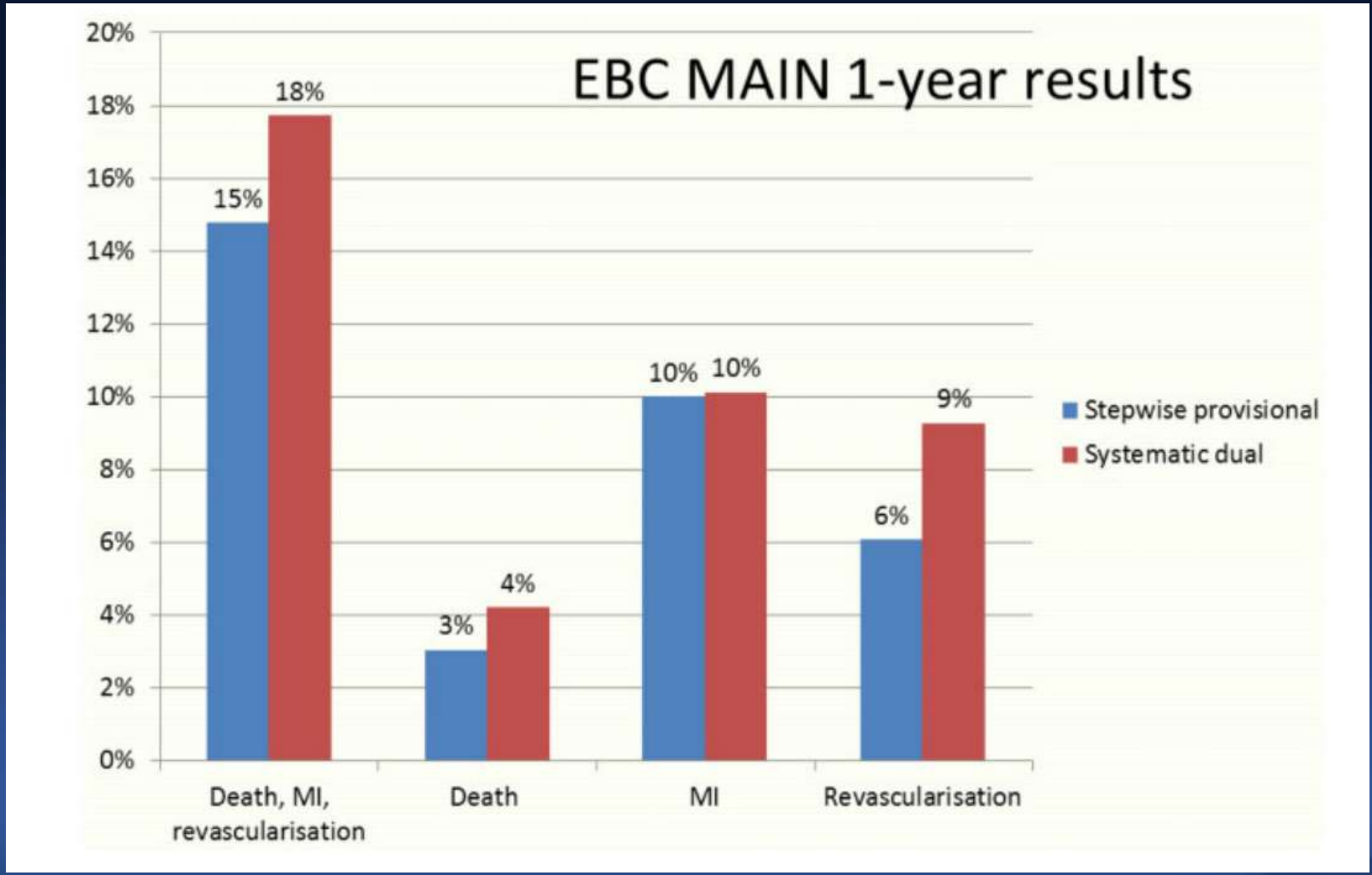
Park SJ, Textbook of Bifurcation Stenting 2007

Ture LM Bifurcation PCI
Technique

1. Provisional One stent ?
2. Two stents ?

EBC MAIN, RCT for True LM Disease (n=467)

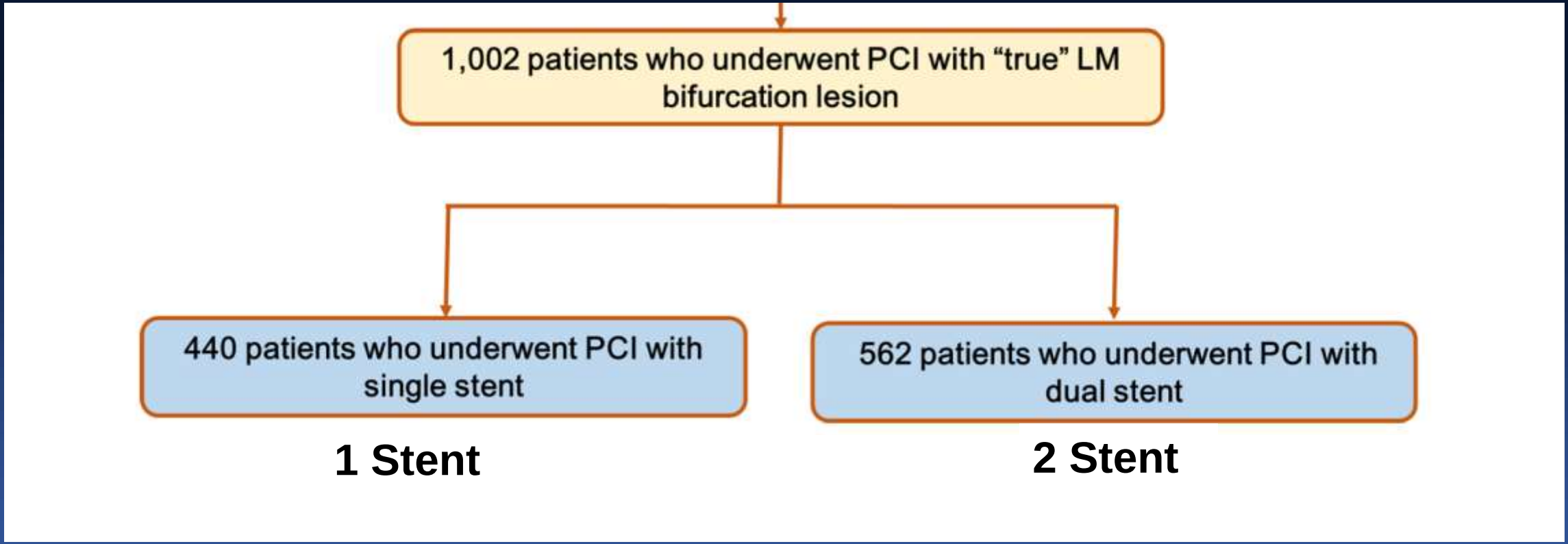
Provisional vs. Upfront 2 Stents



European Heart Journal (2021) 00, 1–11 doi:10.1093/eurheartj/ehab283

True LM Bifurcation (n=1,002)

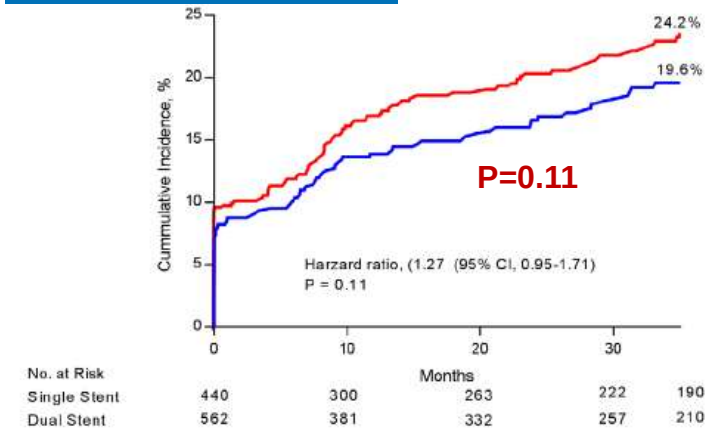
From IRIS LM Registry (n=23,129)



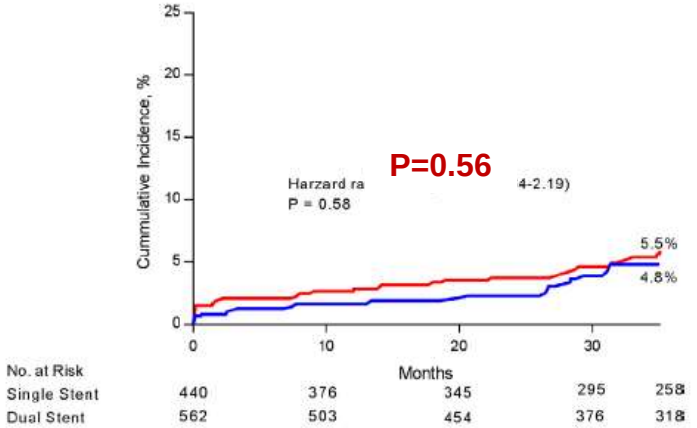
Cheol Hyun Lee, et al. Catheter Cardiovasc Interv. 2021;97:776–785.

1 Stent vs. Upfront 2 Stents
IPTW Adjusted

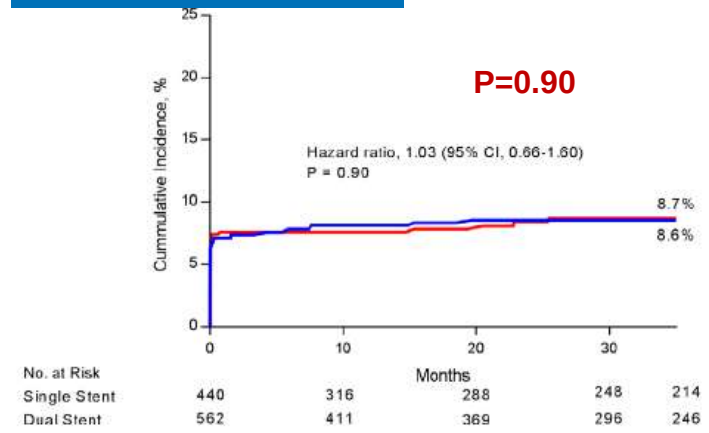
TVF



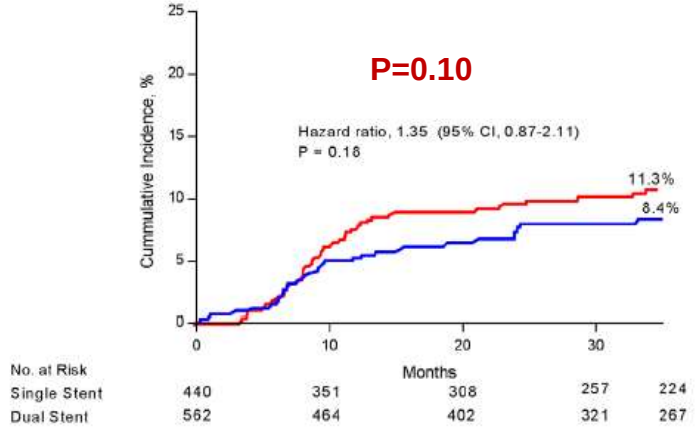
Death



MI



Revascularization

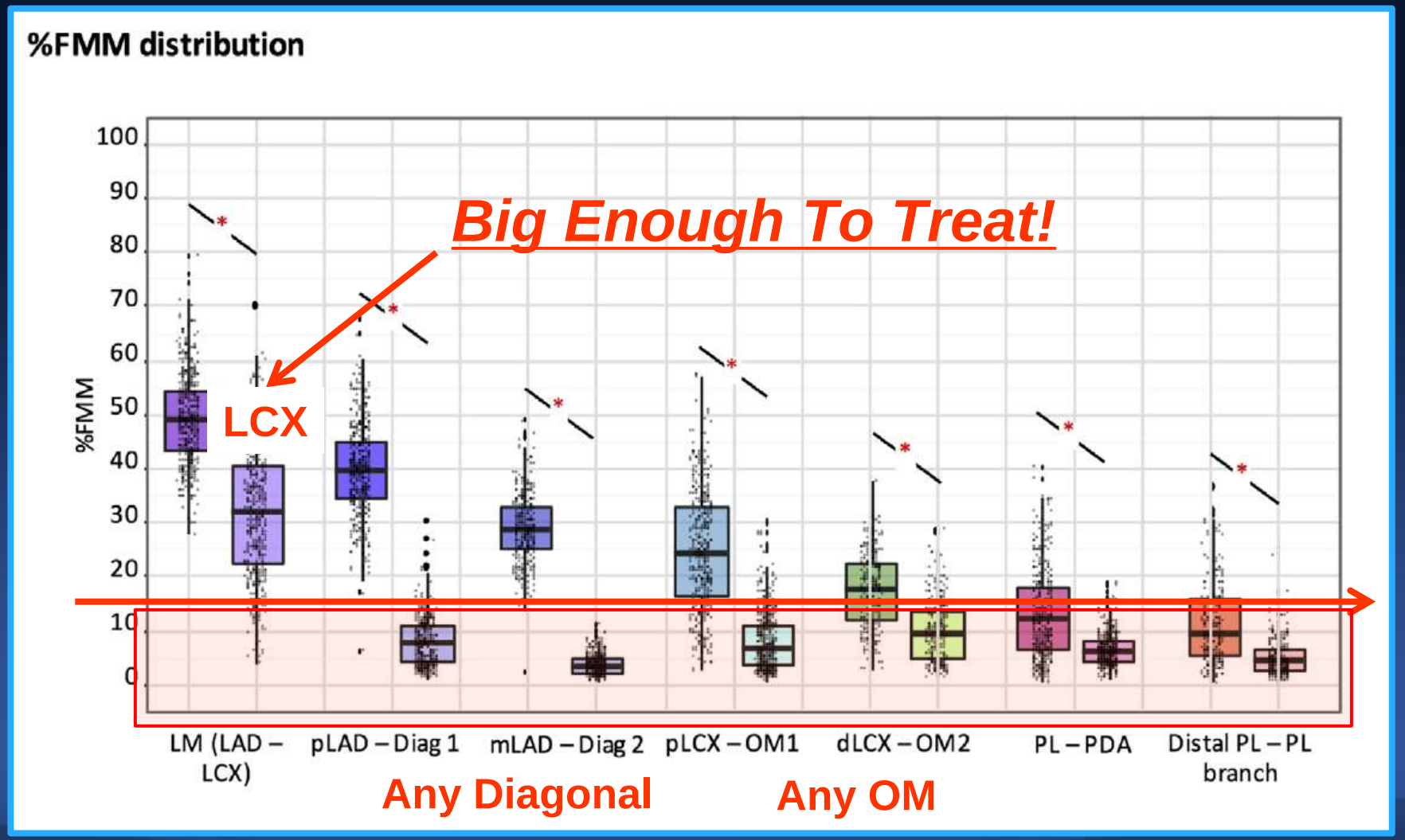


Cheol Hyun Lee, et al. Catheter Cardiovasc Interv. 2021;97:776–785.

LM Bifurcation PCI

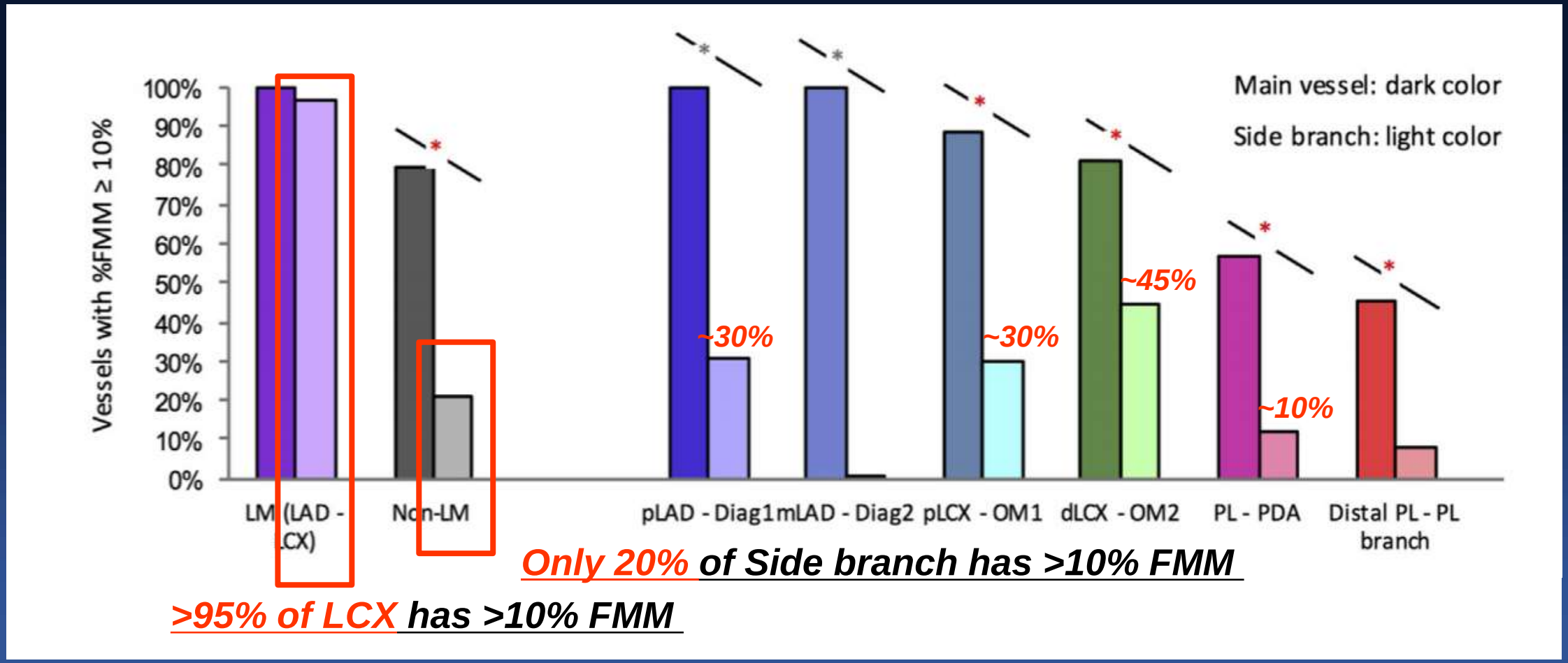
Basic Concept

Only Left Circumflex Artery Has Myocardial Mass >10%, by CT-FFR



Kim HY, et al. JACC Intv 2017;10:571–81

Frequency of Main Vessel or Side Branch
Supplying %FMM ≥10%



Kim HY, et al. JACC Intv 2017;10:571–81

LM Bifurcation PCI
Basic Concept

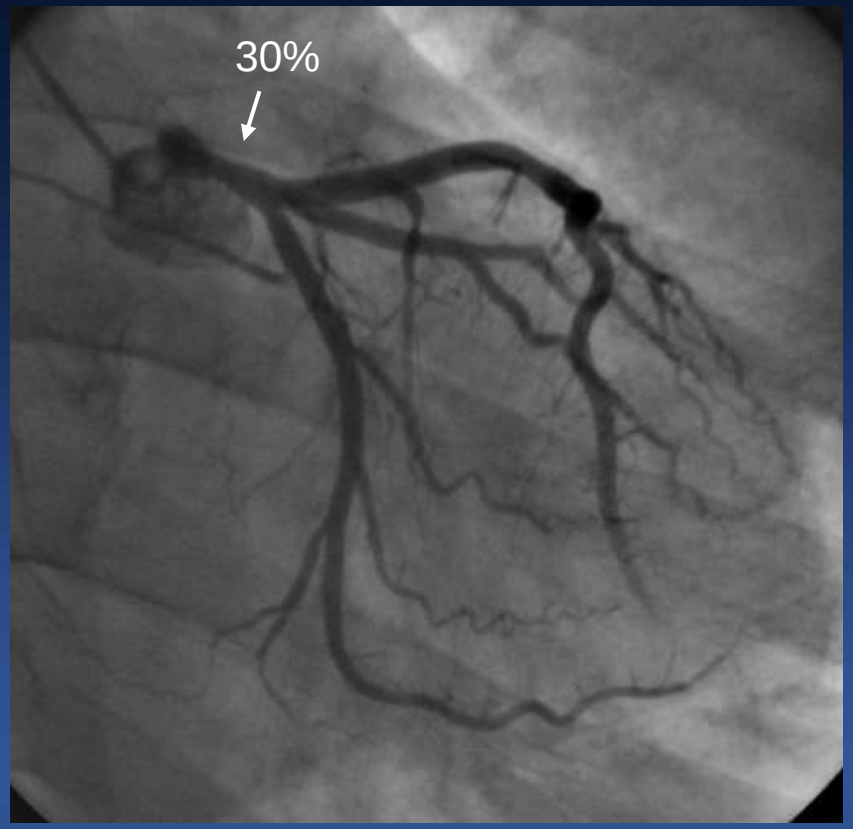
1. ***Left Circumflex Artery Is Usually Big Enough to Treat !***

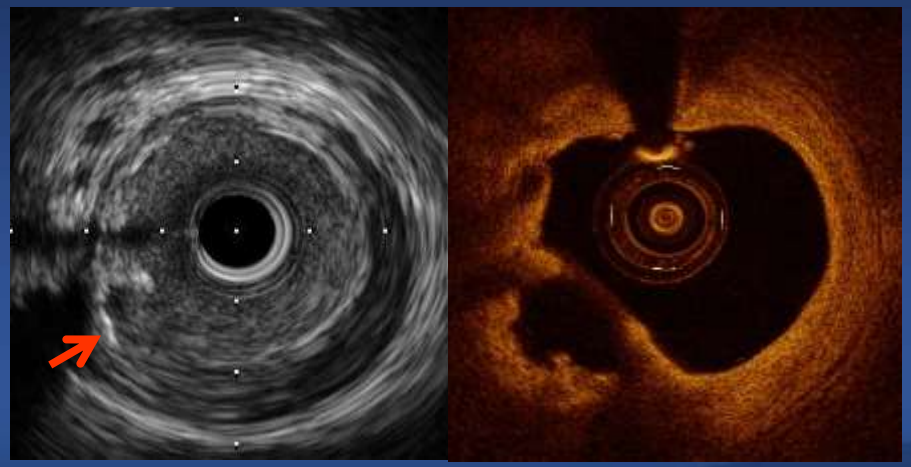
LM Bifurcation PCI
Basic Concept

1. *Left Circumflex Artery Is Usually Big Enough to Treat !*
2. ***To Treat or Not to Treat ; FFR Guided Decision Making***

Reverse Mismatch

Insignificant Stenosis,
Positive FFR, 0.70



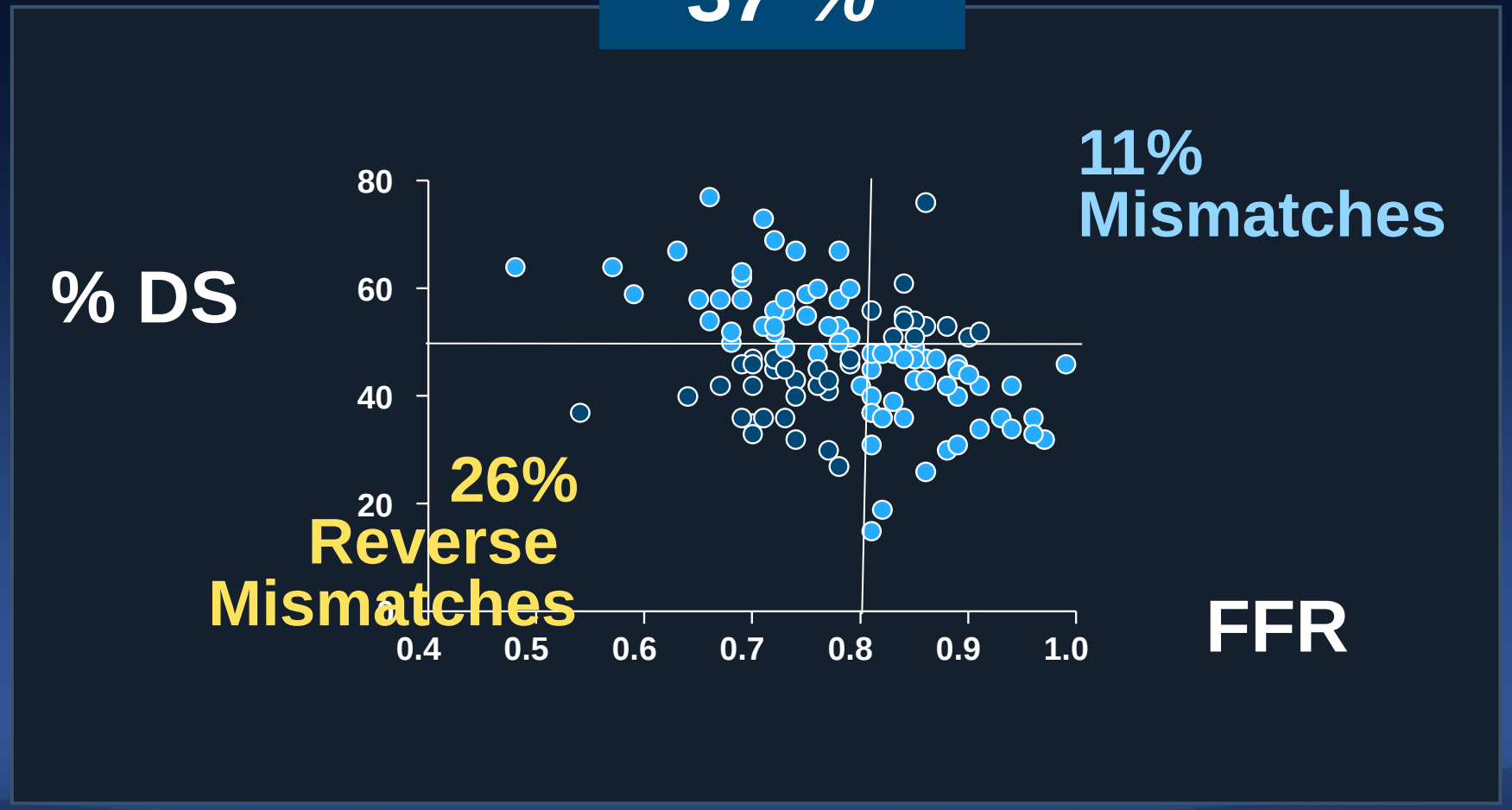


Plaque Rupture, MLA 6.2mm²

Mismatches

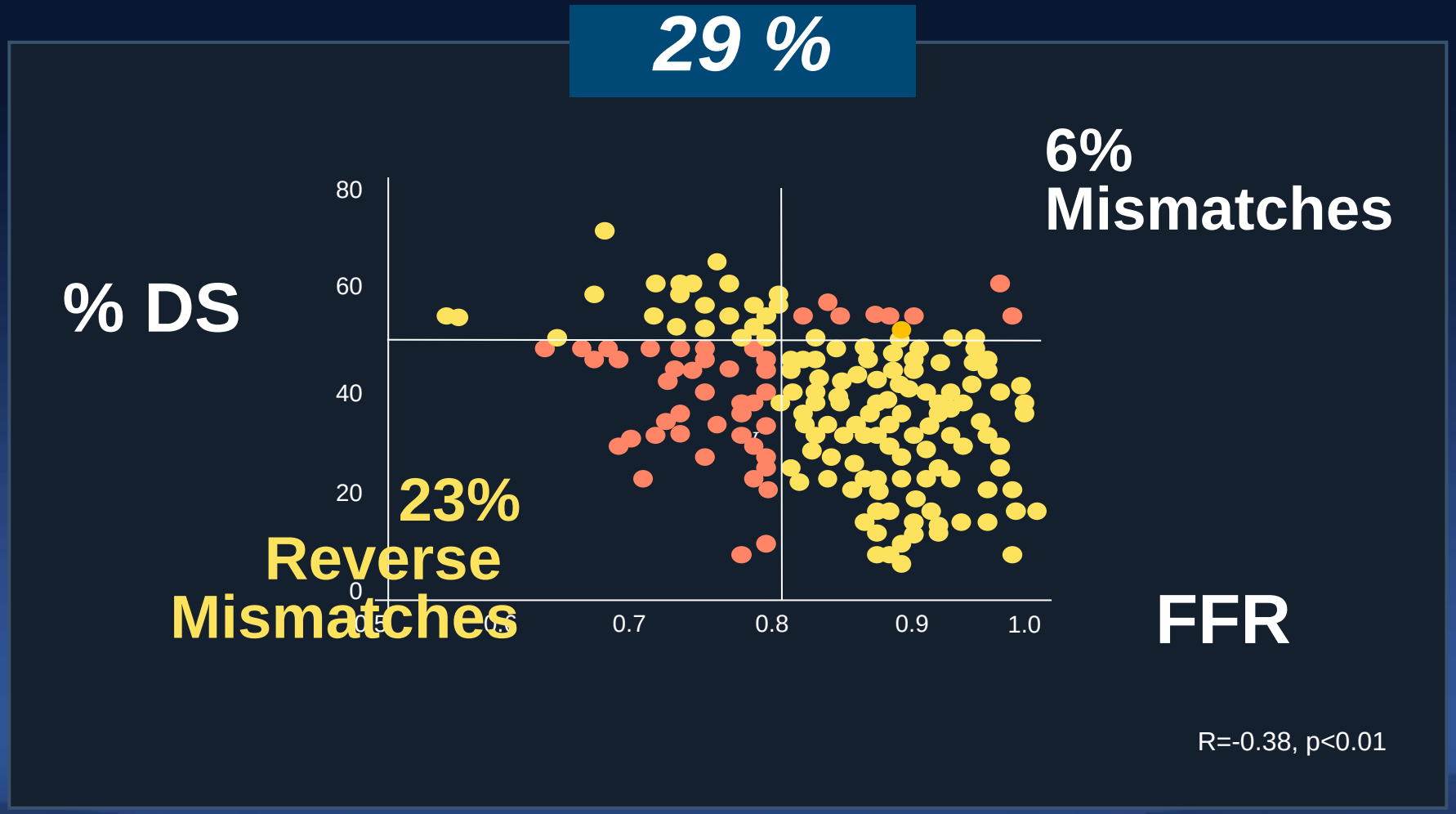
Intermediate ***Ostial/Shaft*** LM Disease,

37 %



Park SJ et al. *JACC Interv, 2014;7(8):868-874*

Mismatches with Downstream Disease

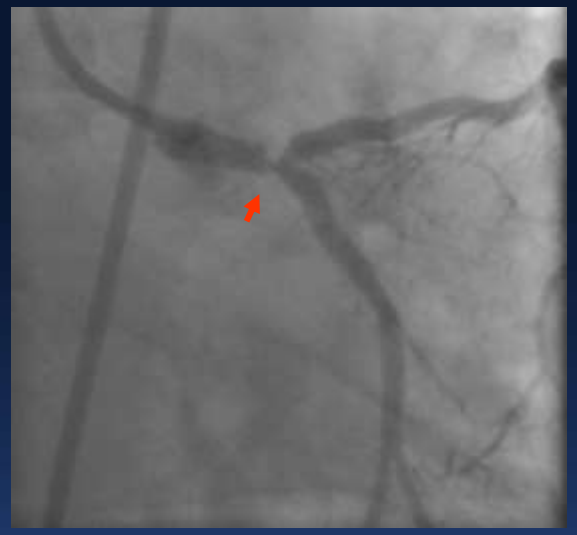


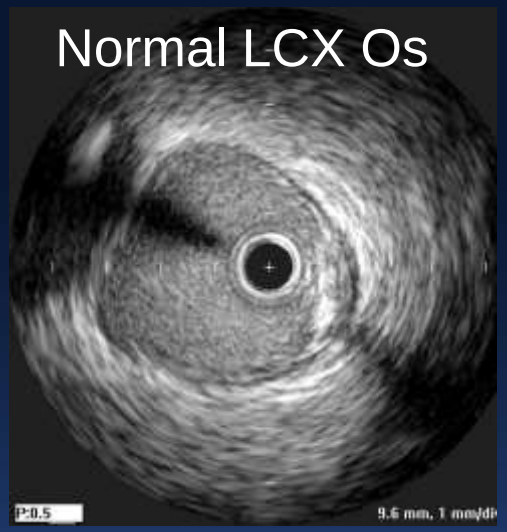
Hamilos M et al. *Circulation 2009;120:1505-1512*

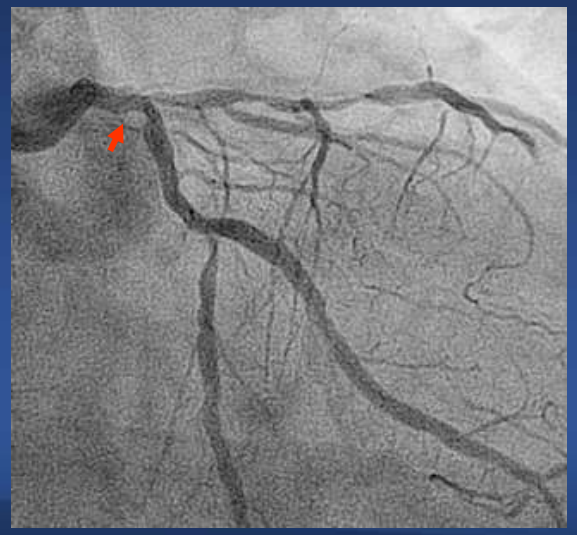
LM Bifurcation PCI
Basic Concept

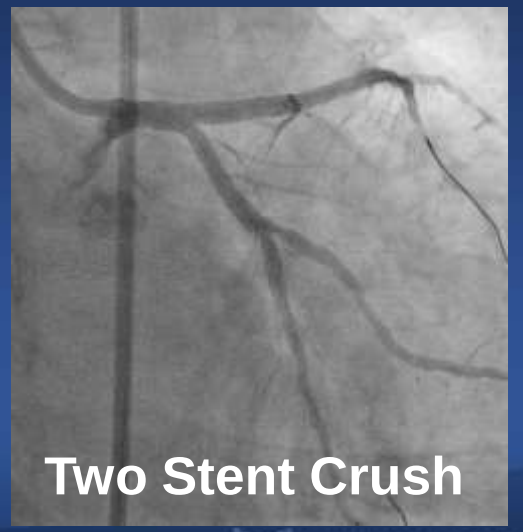
1. *Left Circumflex Artery Is Usually Big Enough to Treat !*
2. *To Treat or Not to Treat ; FFR Guided Decision Making*
3. *IVUS Guided Decision Making*

1 or 2 Stents
According to LCX Disease Status by IVUS









LM Bifurcation PCI

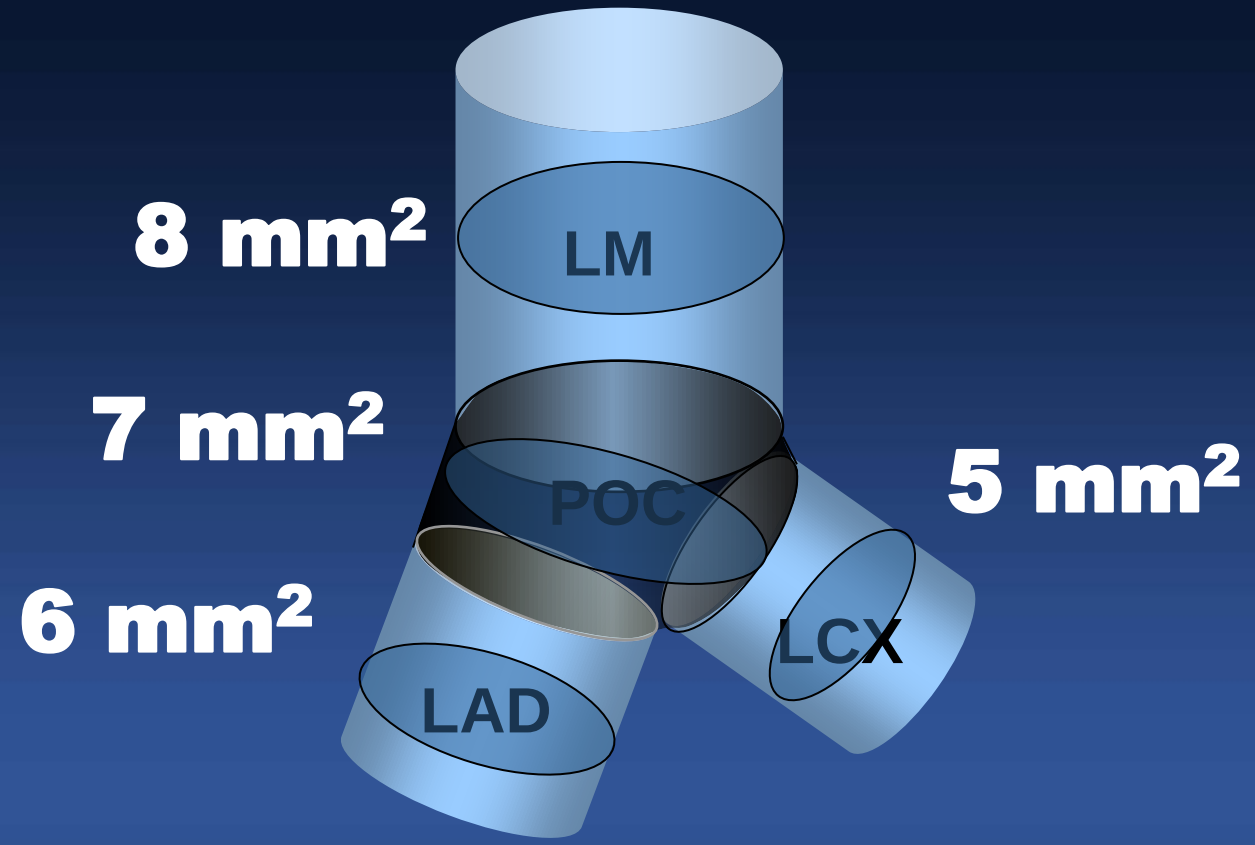
Basic Concept

1. *Left Circumflex Artery Is Usually Big Enough to Treat !*
2. *To Treat or Not to Treat ; FFR Guided Decision Making*
3. *IVUS Guided Decision Making and IVUS Guided Final Optimization*

Any **2 Stent Techniques**

- Mini-crush (or step crush),
- DKC
- T-stent, modified T-stent or TAP
- Culotte
- V-stent
- Y-stent (SKS-simultaneous kissing stents)

Effective Stent Area (5,6,7,8 mm^2) by IVUS Can Make A Good Clinical Outcomes, Restenosis Rate < 5% and TLR < 2%



LM Bifurcation PCI
Basic Concept

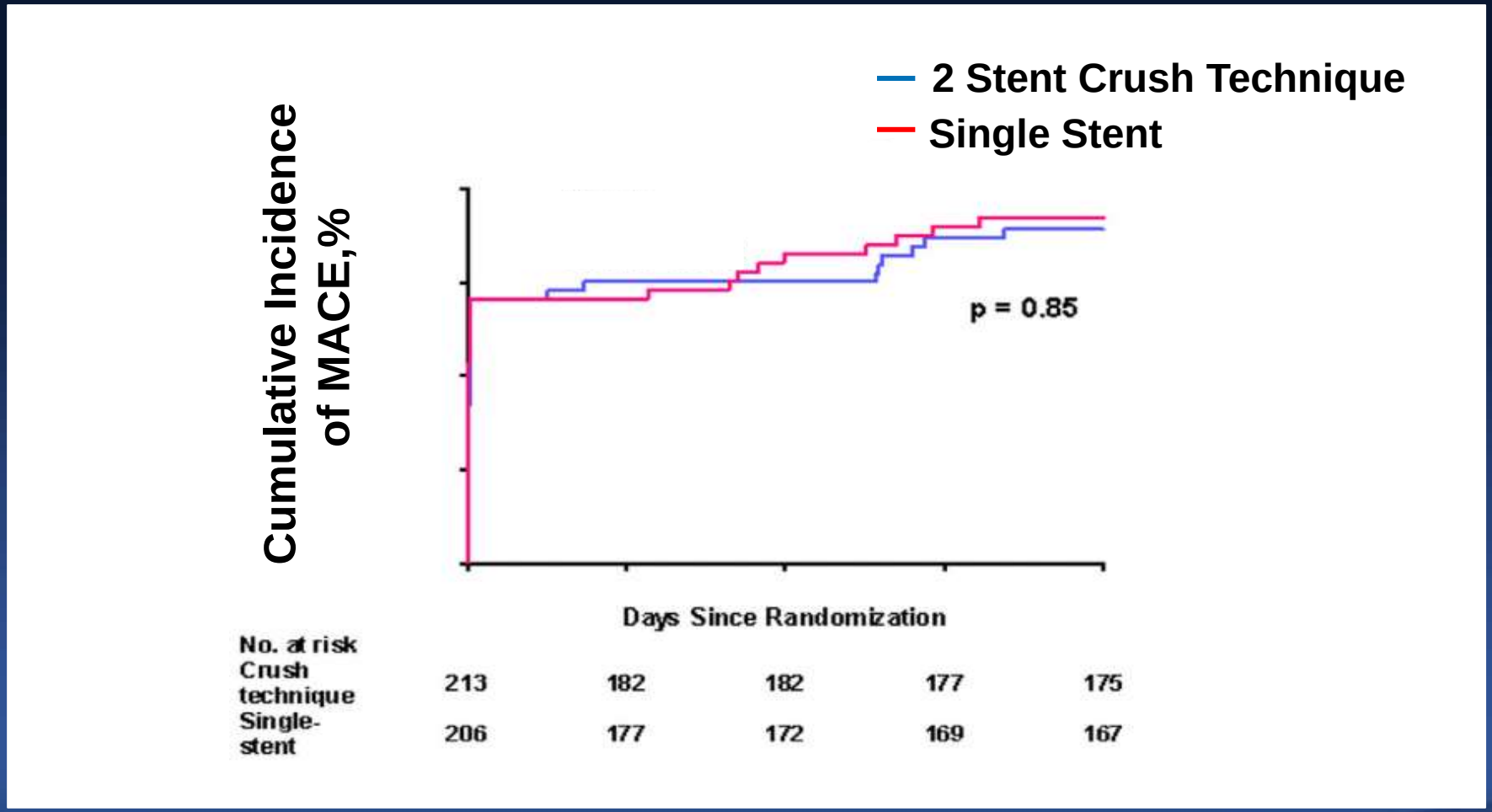
1. ***Left Circumflex Artery Is Usually Big Enough to Treat !***
2. ***To Treat or Not to Treat ; FFR Guided Decision Making***
3. ***IVUS Guided Decision Making and IVUS Guided Final Optimization***

True LM Bifurcation PCI
Recent Concept

Upfront 2 Stent Strategies

Are Safe and Good !!

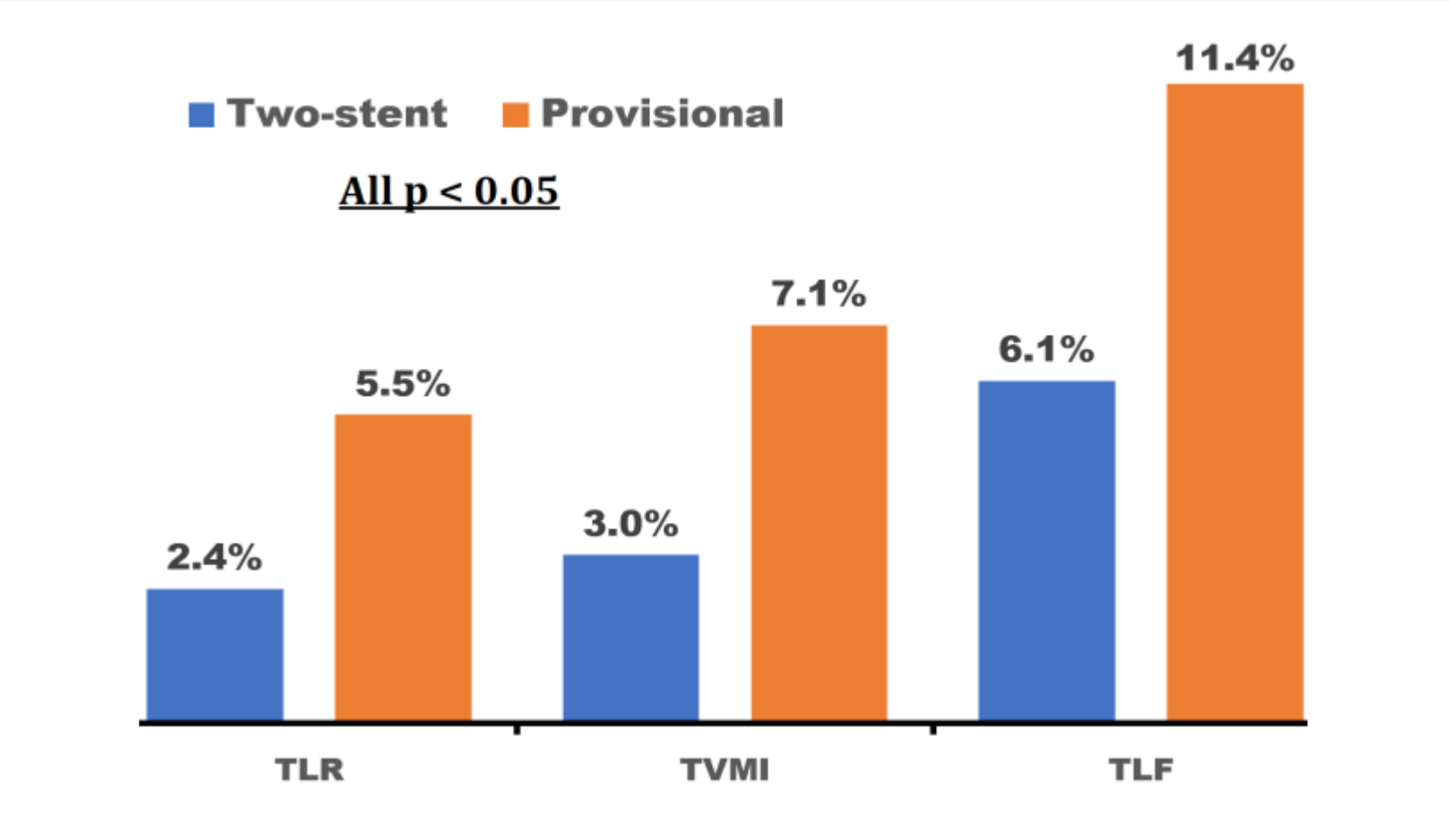
1 or 2 Stent Technique
Are Both Good !



Kim YH, Park SJ, et al. JACC Interv. 2015 April 20;8(4):550-60, PERFECT Randomized Studies

2 Stent Is Better than Provisional 1 Stent

For All Complex Bifurcations (RVD>2.5mm)



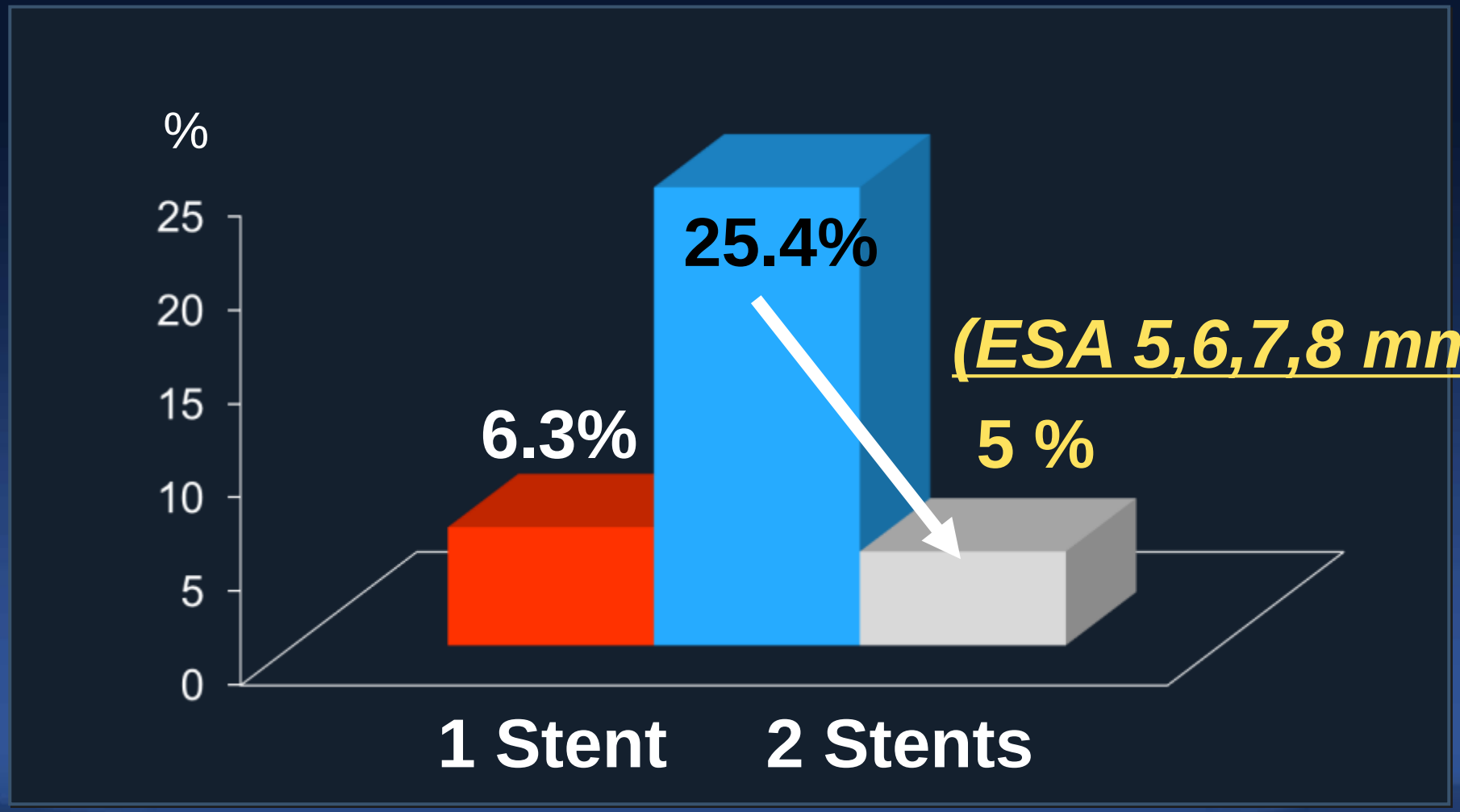
Zhang, et al. Eur H J 2020, Definition II Randomized Study

If There Are LCX Disease, (True Bifurcation Disease)

1. ***Upfront 2 Stent Strategies***
   Are Recommended for LM Bifurcations.
2. Large LCX Disease Is Worthy of Treatment.
3. We Can Avoid Risk of SB closure.
4. Clinical Outcomes of 2 Stents Are Good.

Zhang JJ, Ye F, Xu K, et al. Eur Heart J 2020;Jun 26 (DEFINITION 2)
Kim YH, Park SJ, et al. JACC Interv. 2015 April 20;8(4):550-60 (CROSS)

LM Bifurcation PCI
Restenosis at 2 year

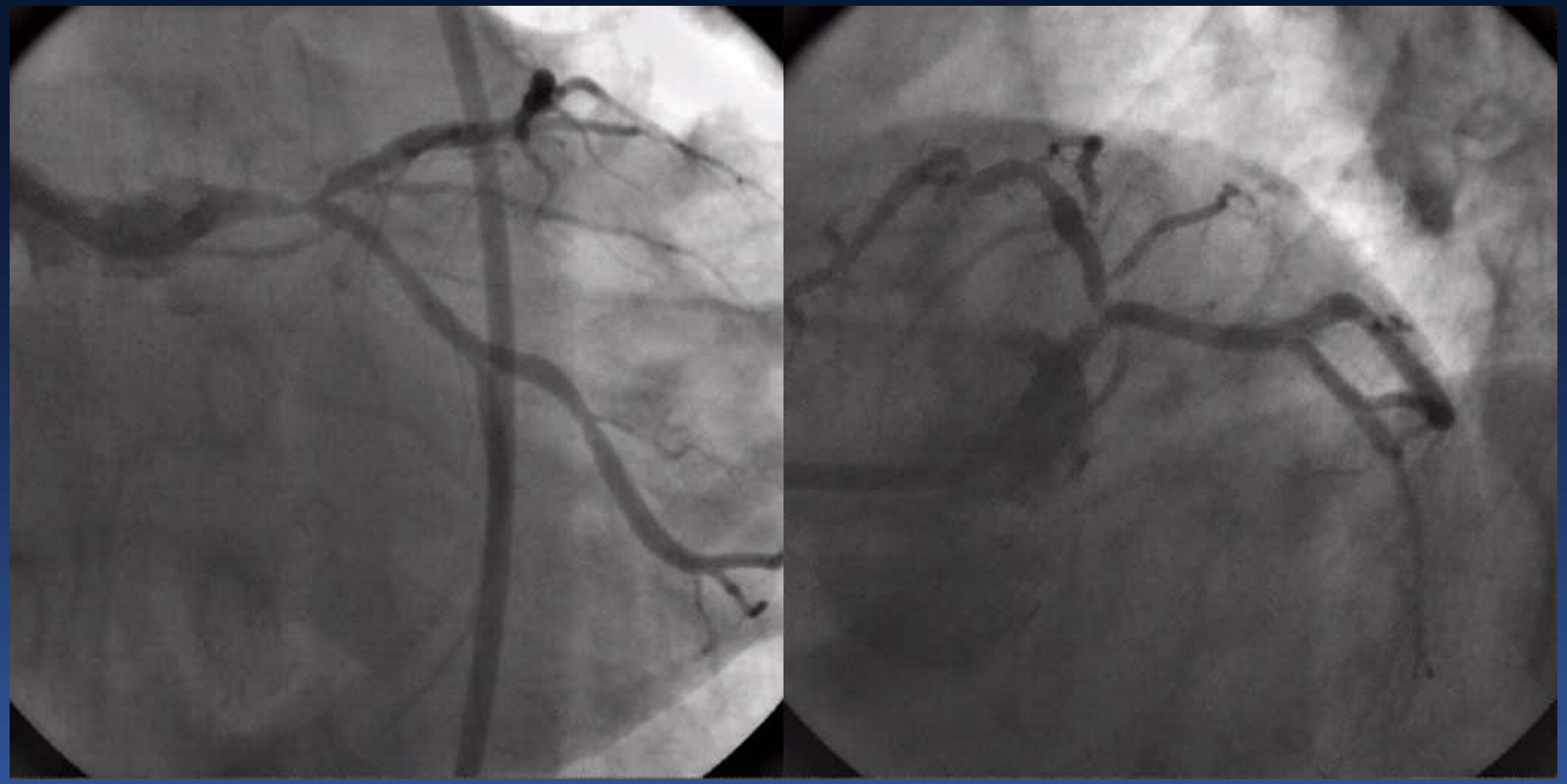


LM Bifurcation PCI
Technique

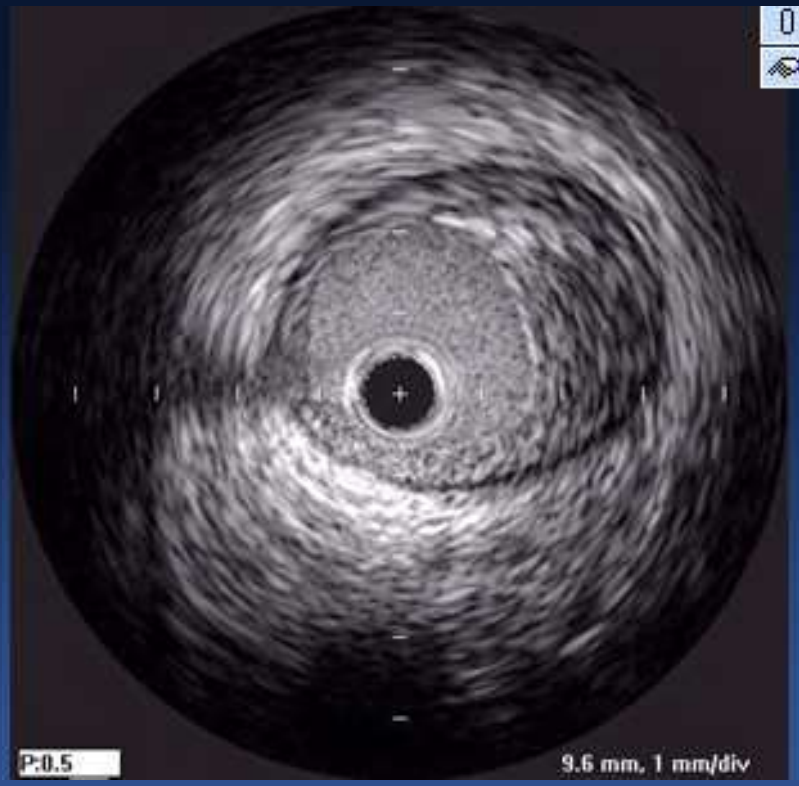
***Effective IVUS Stent Area** Is Most Important Determinant factor for Good Clinical Outcomes.*

1 Stent Cross Over for Normal LCX

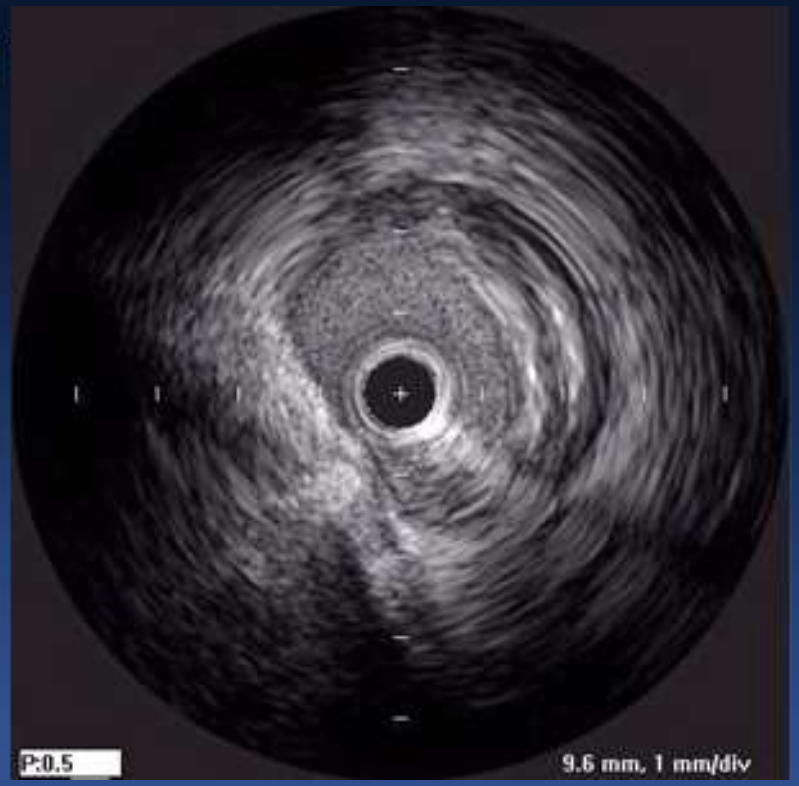
72/M, Unstable angina,



IVUS

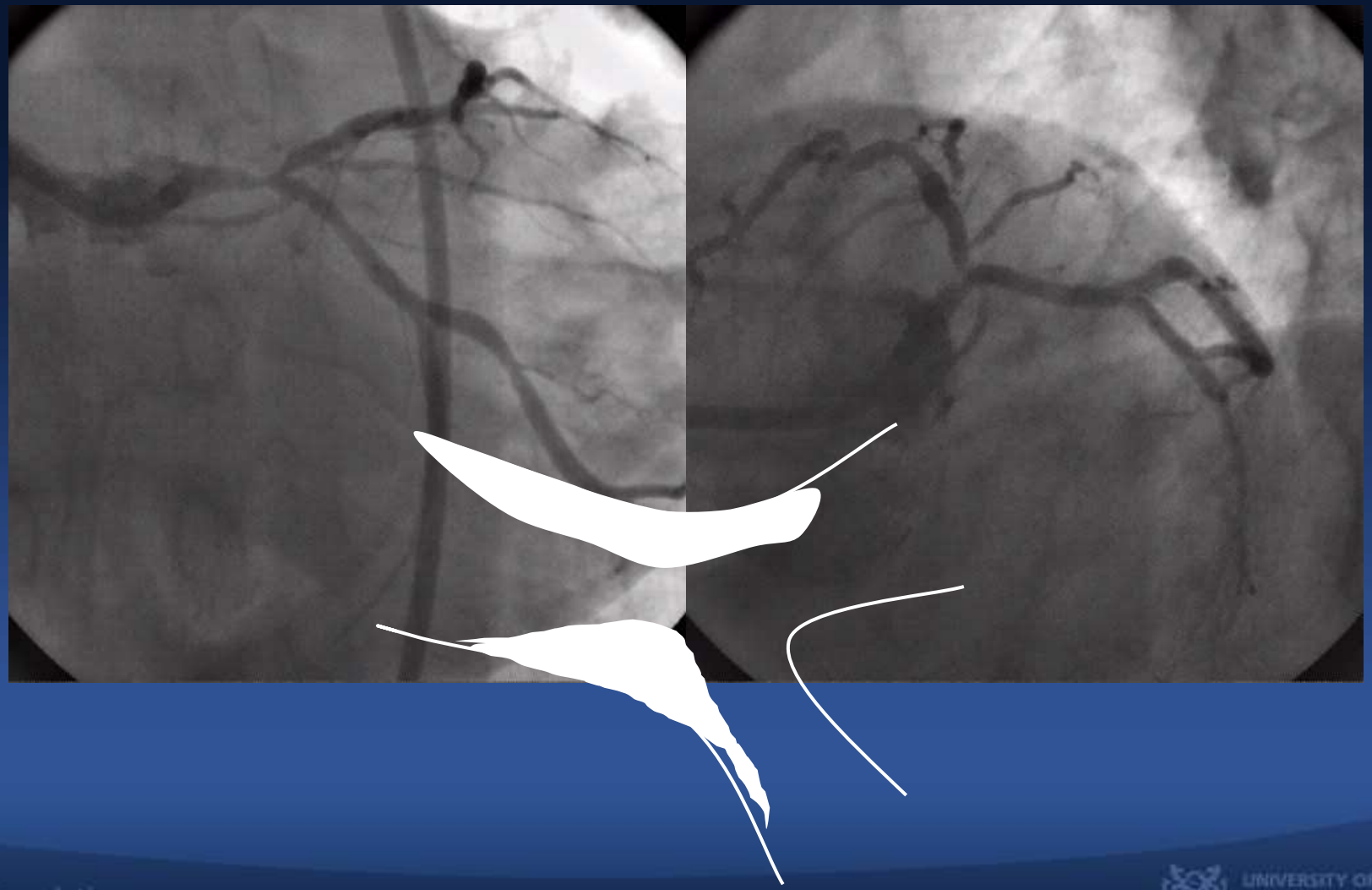


LAD Ostium

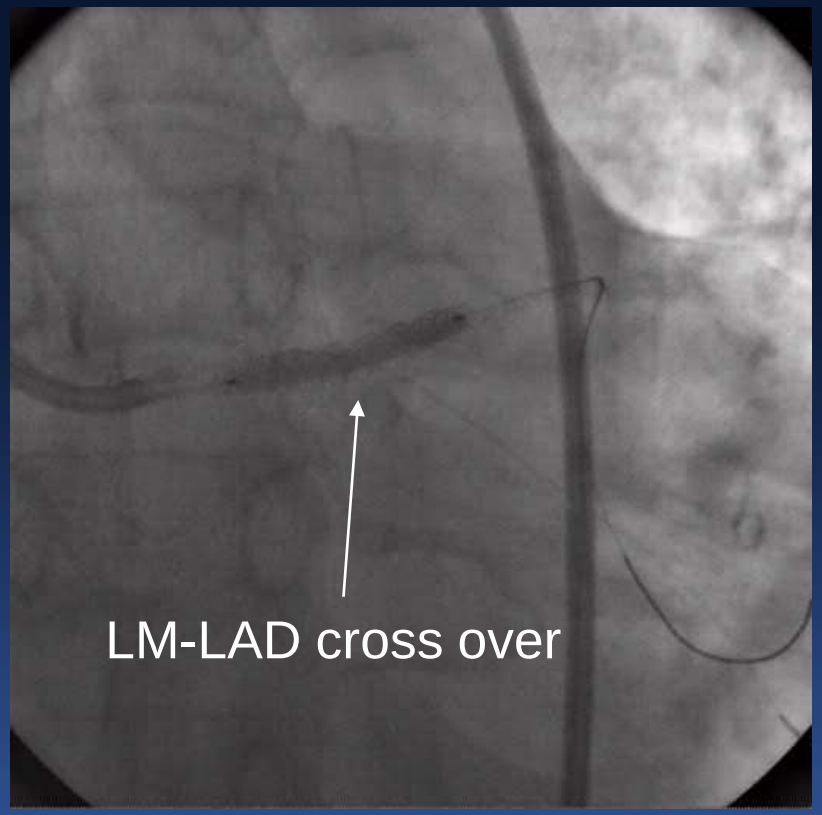


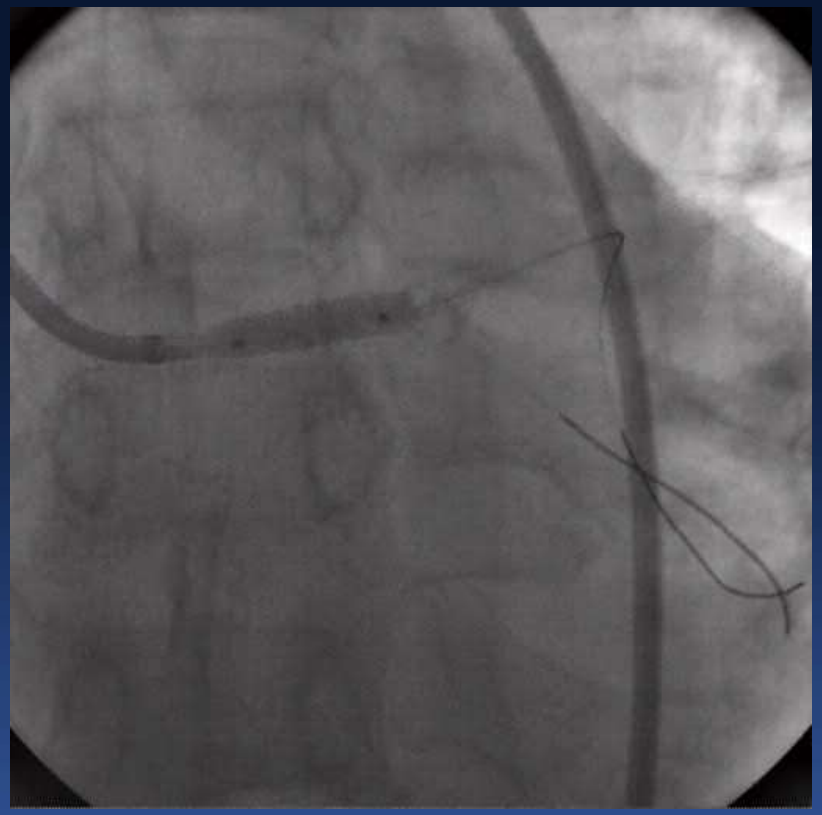
LCX Ostium
Minimal-disease

72/M, Unstable angina,



1 Stent

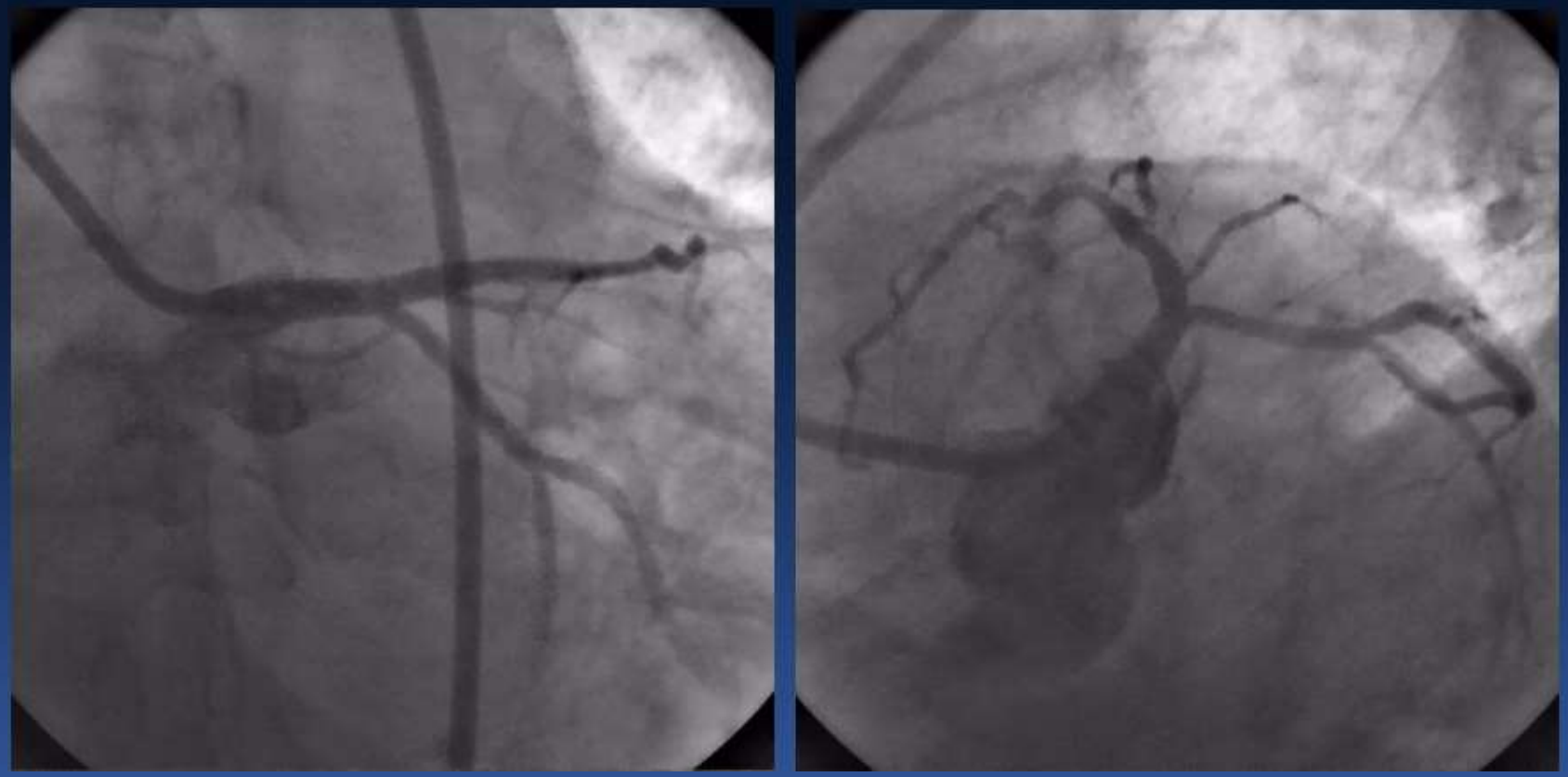




DES 3.5 × 23 mm

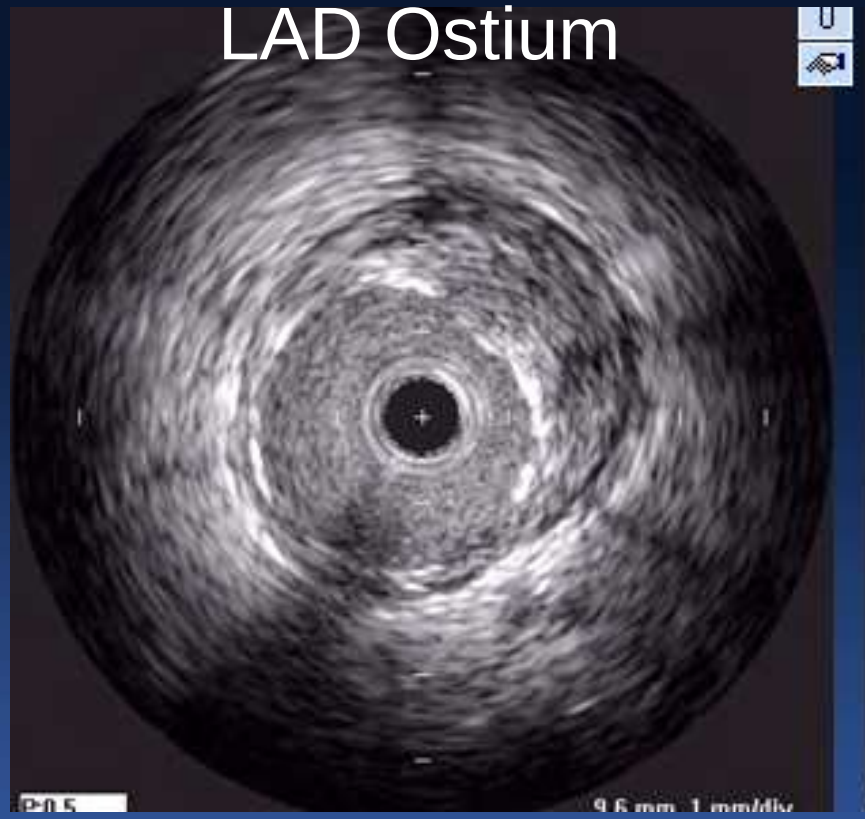
Additional high pressure Inflation with 4.0 mm non-compliant balloon

Angiographic Result Is Perfect !



No significant compromise of LCX ostium.

Post stent-IVUS

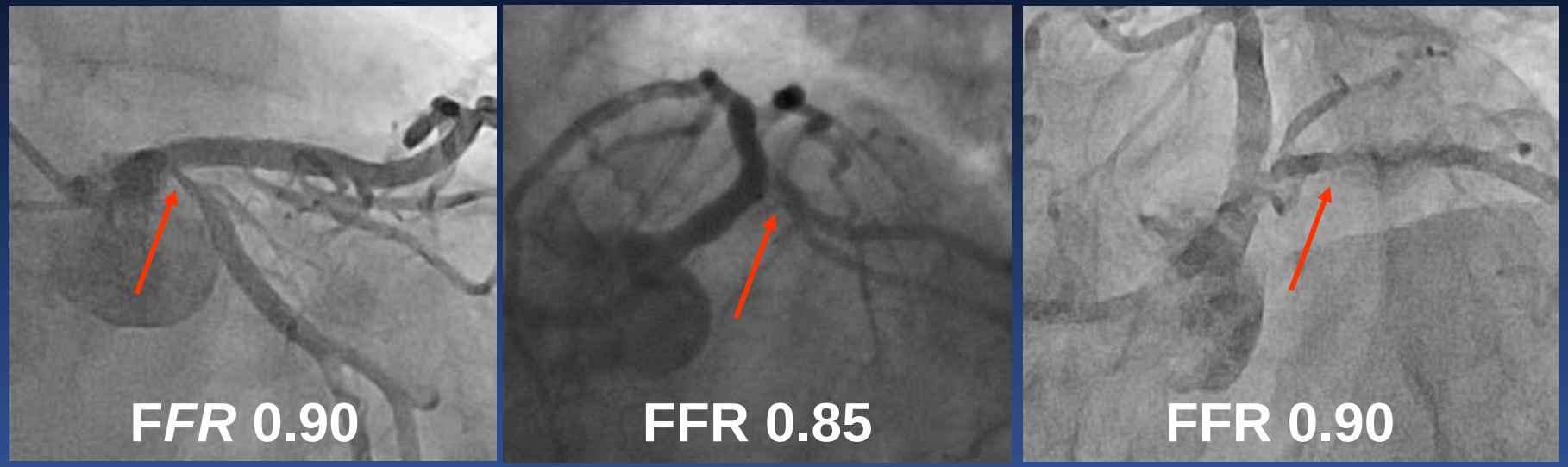


Good Stent Expansion
Stent Area 6.2 mm^2

No Carina Shift
MLA 4.7 mm^2

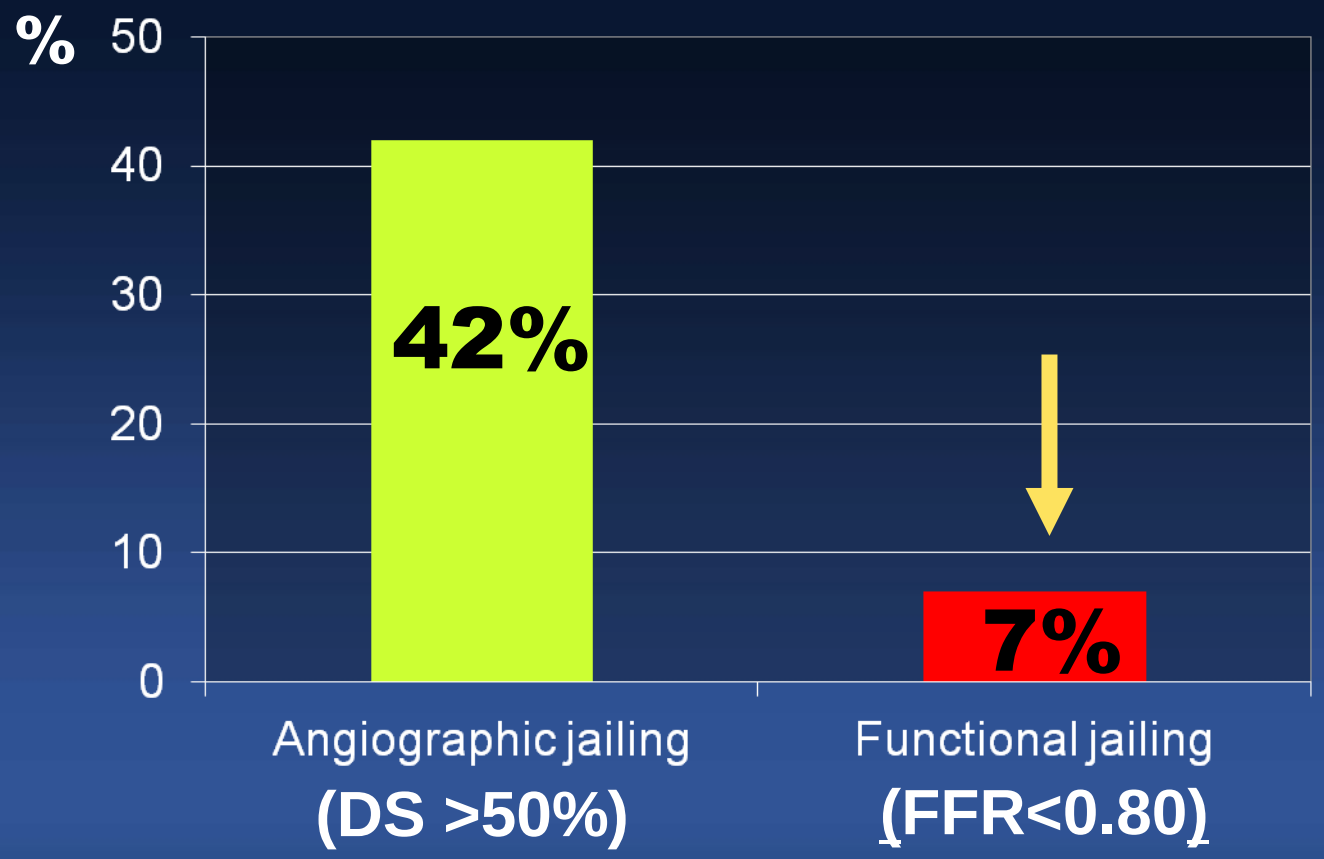
Many Cases of Mismatches
Angiographic Morphology and Presence of Ischemia

Jailing LCX After Main Stent Cross-Over



Just Defer or
Final Kissing Balloon ?

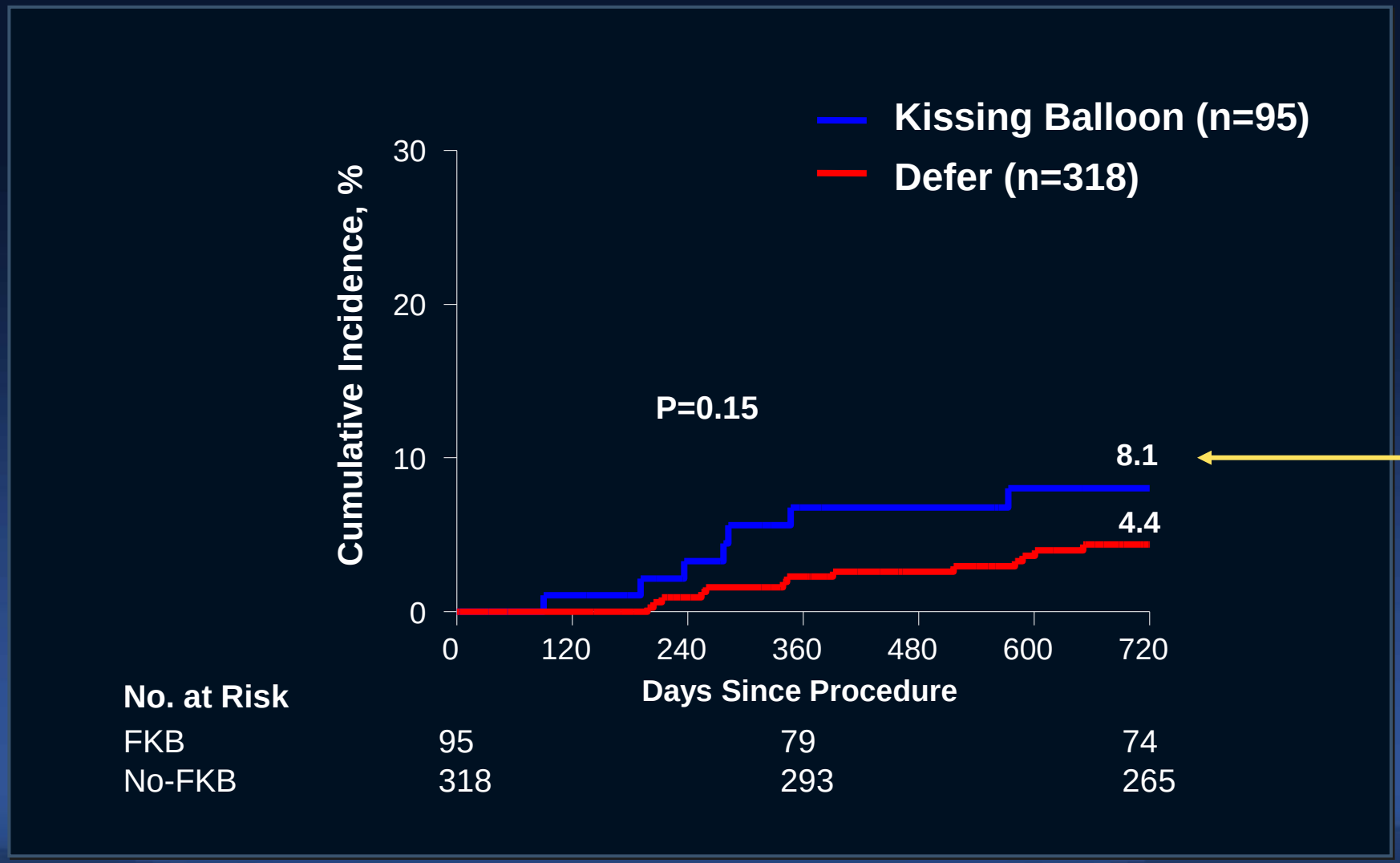
Functionally Significant LCX Jailing Is Only 7%



Kang SJ, Catheterization and Cardiovascular Interventions. 2014;83(4):545-52.

Left Main-TLR *at 2 Years*

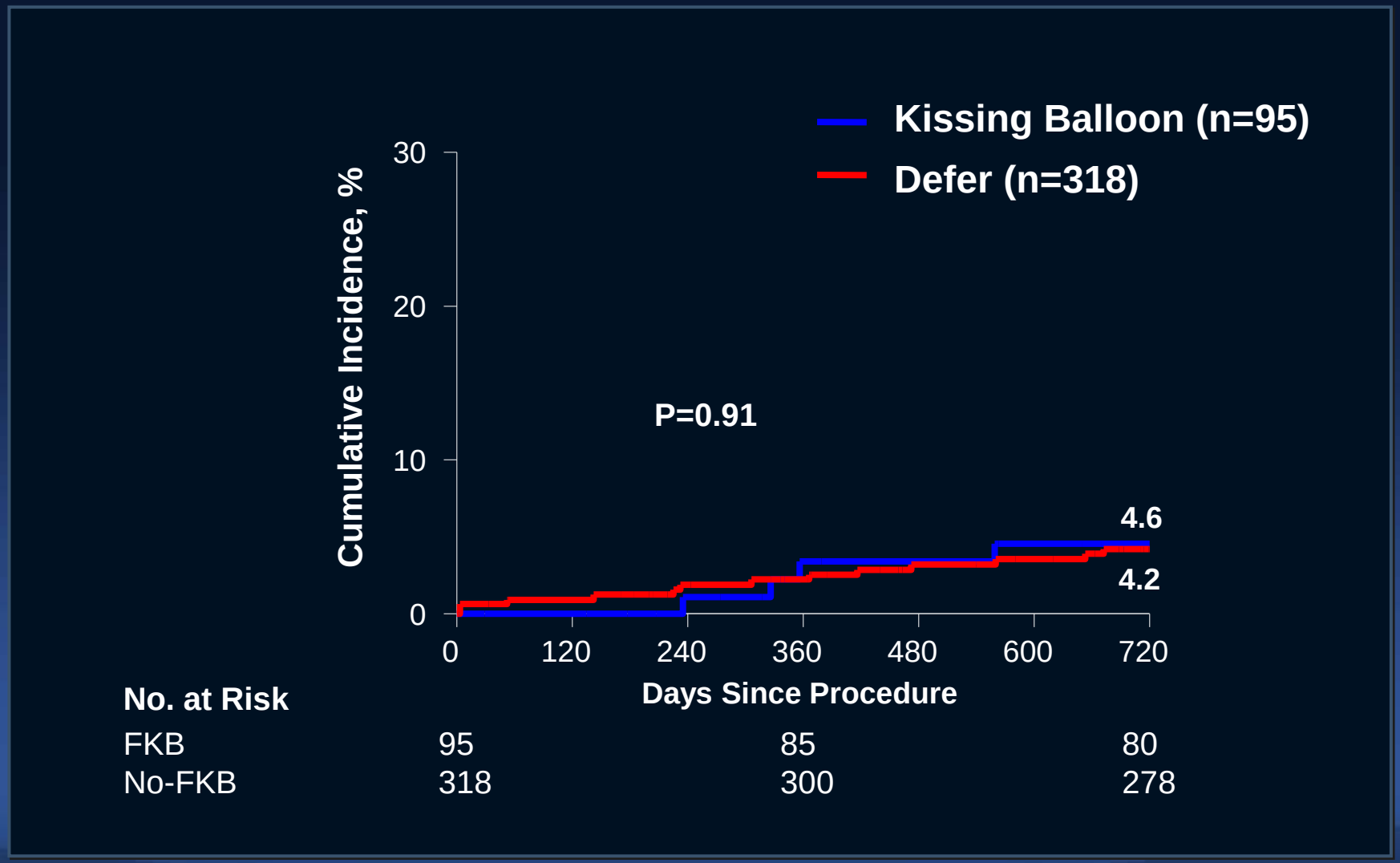
Final Kiss May Increase TLR ??



Ahn JM et al, AJC 2017 15;119(4):528-534.

Death or MI at 2 Years

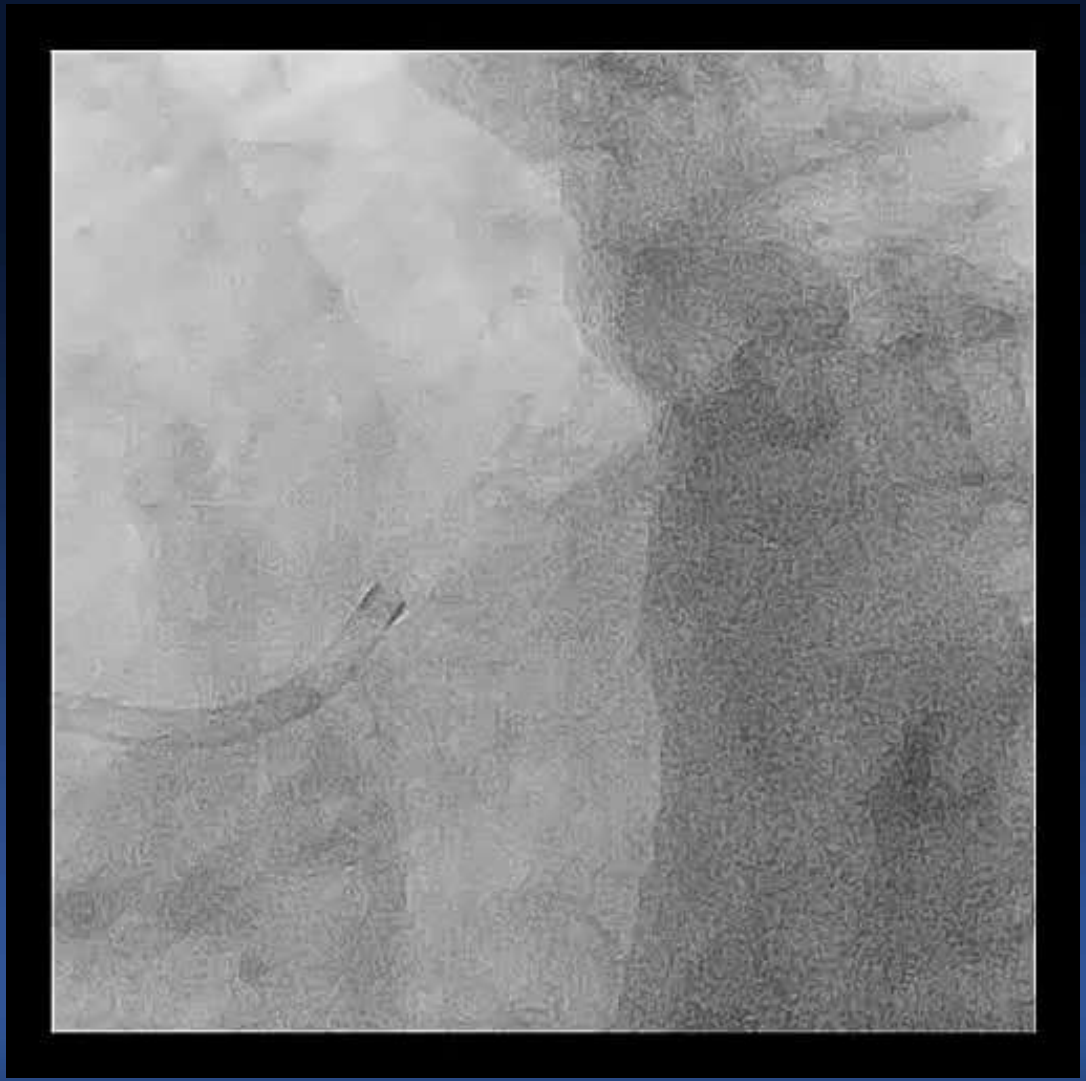
Just Defer Is Safe and Good !

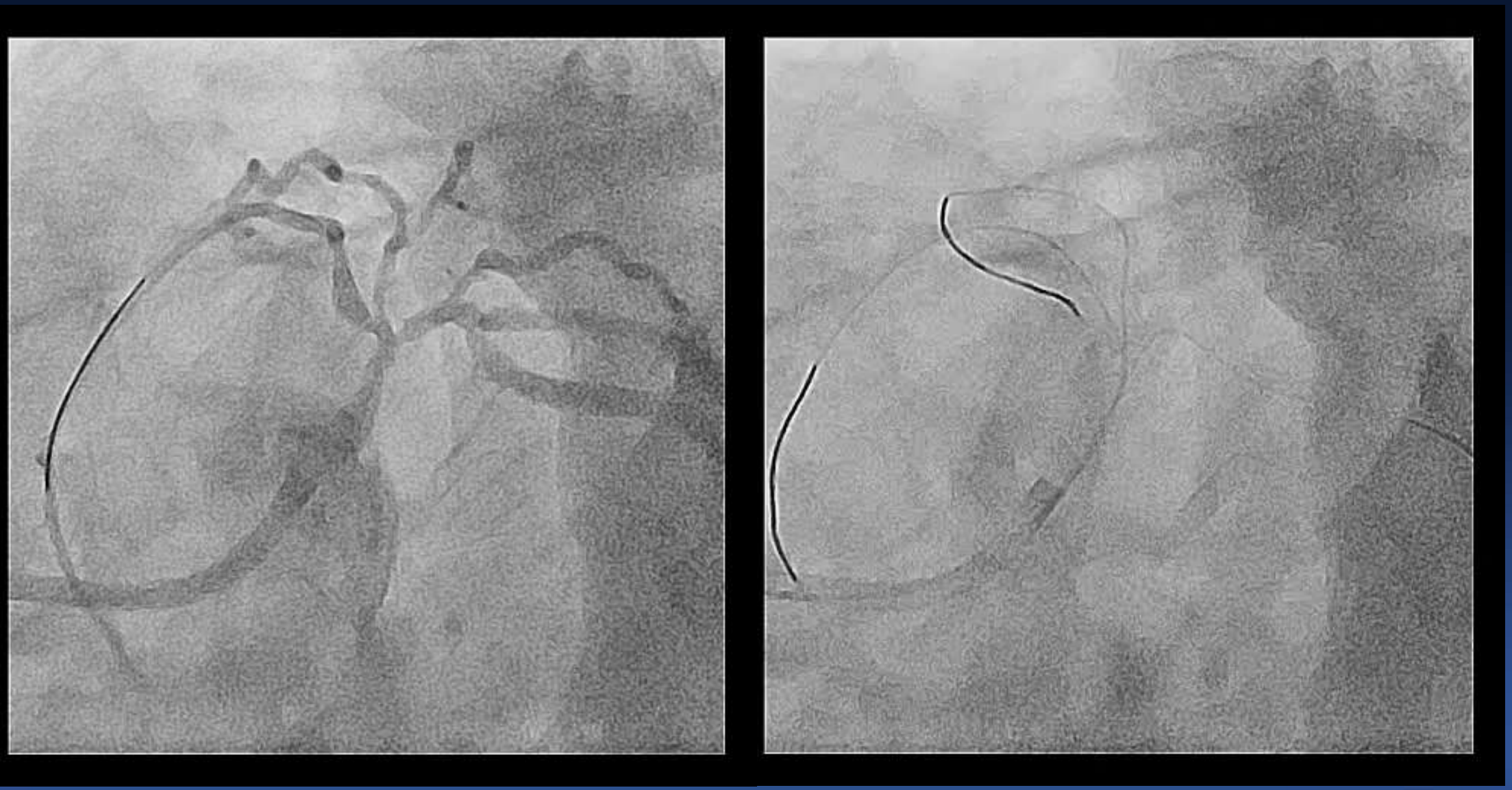


Ahn JM et al, AJC 2017 15;119(4):528-534.

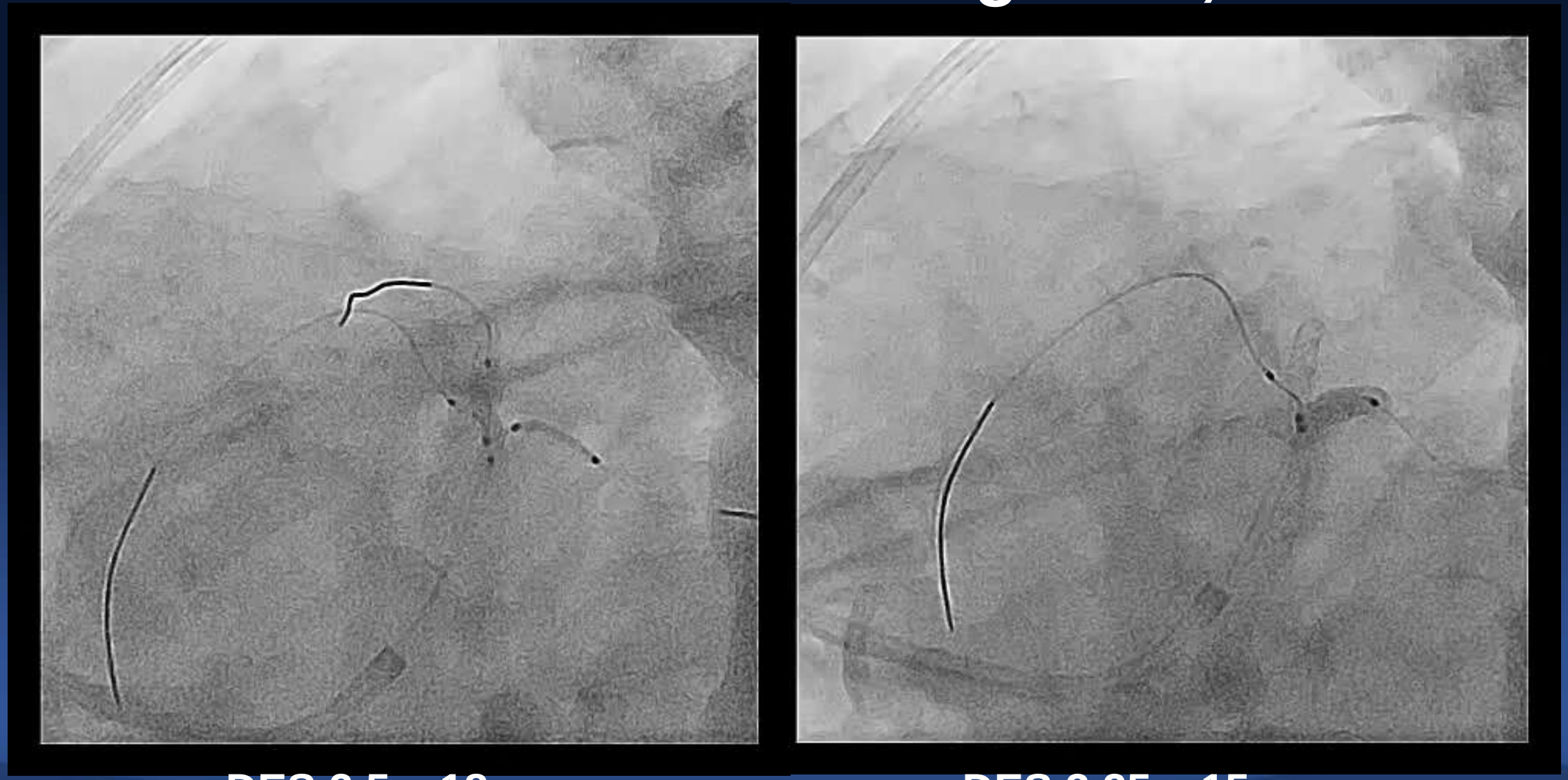
Upfront 3 Stents

LM Trifurcation





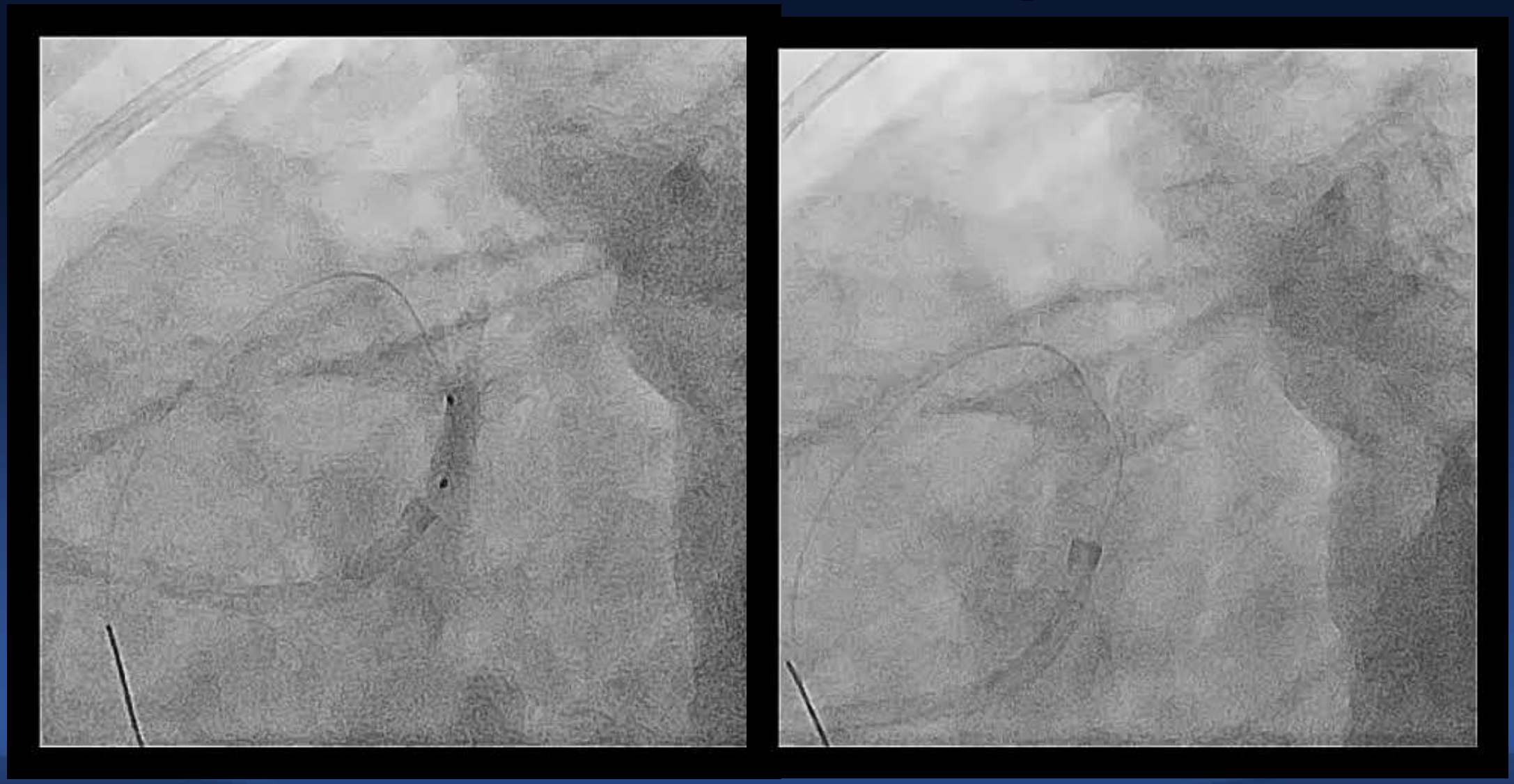
2 Branches Stenting First,



DES 2.5 x 18 mm

DES 3.25 x 15 mm

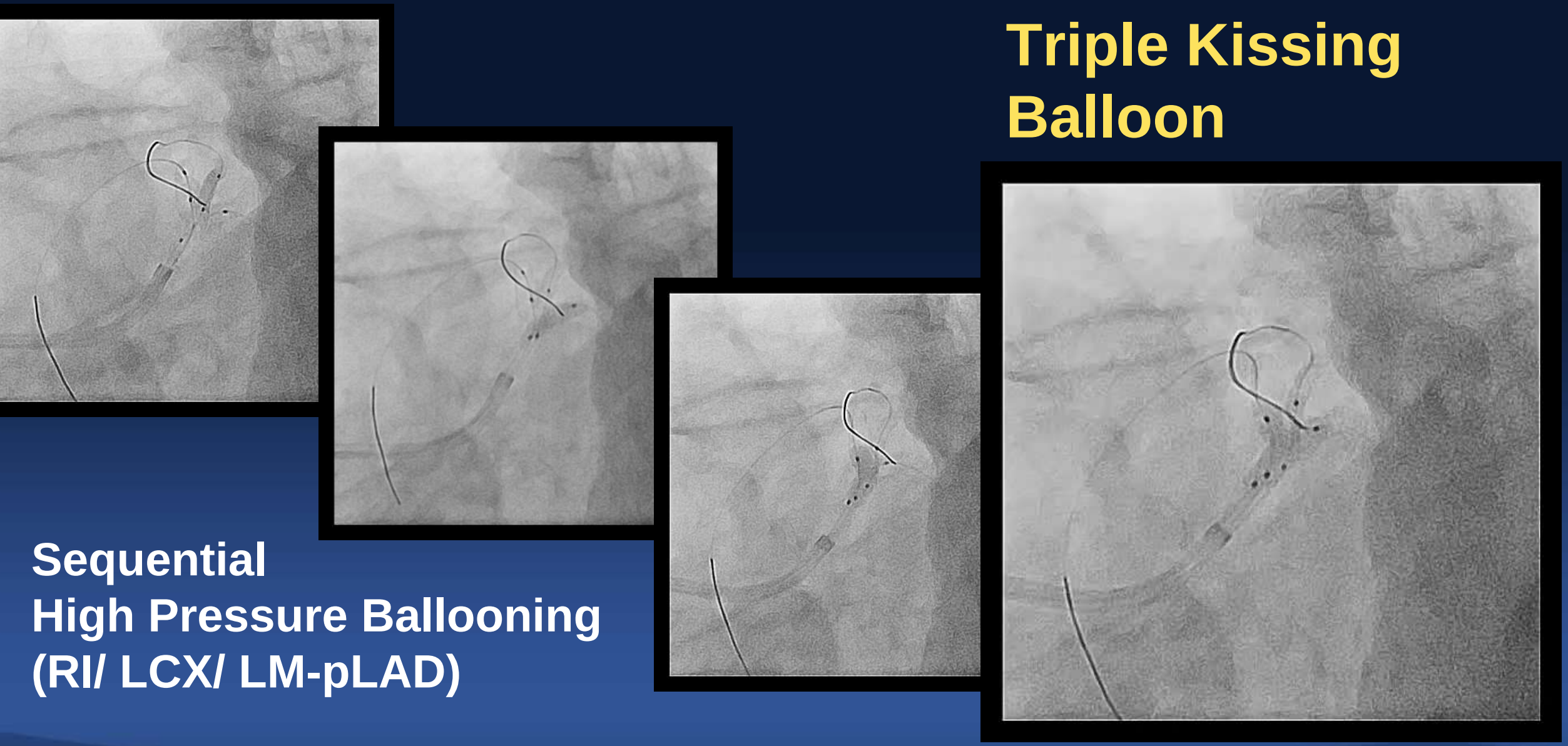
Balloon Crushing



LM-LAD Stenting

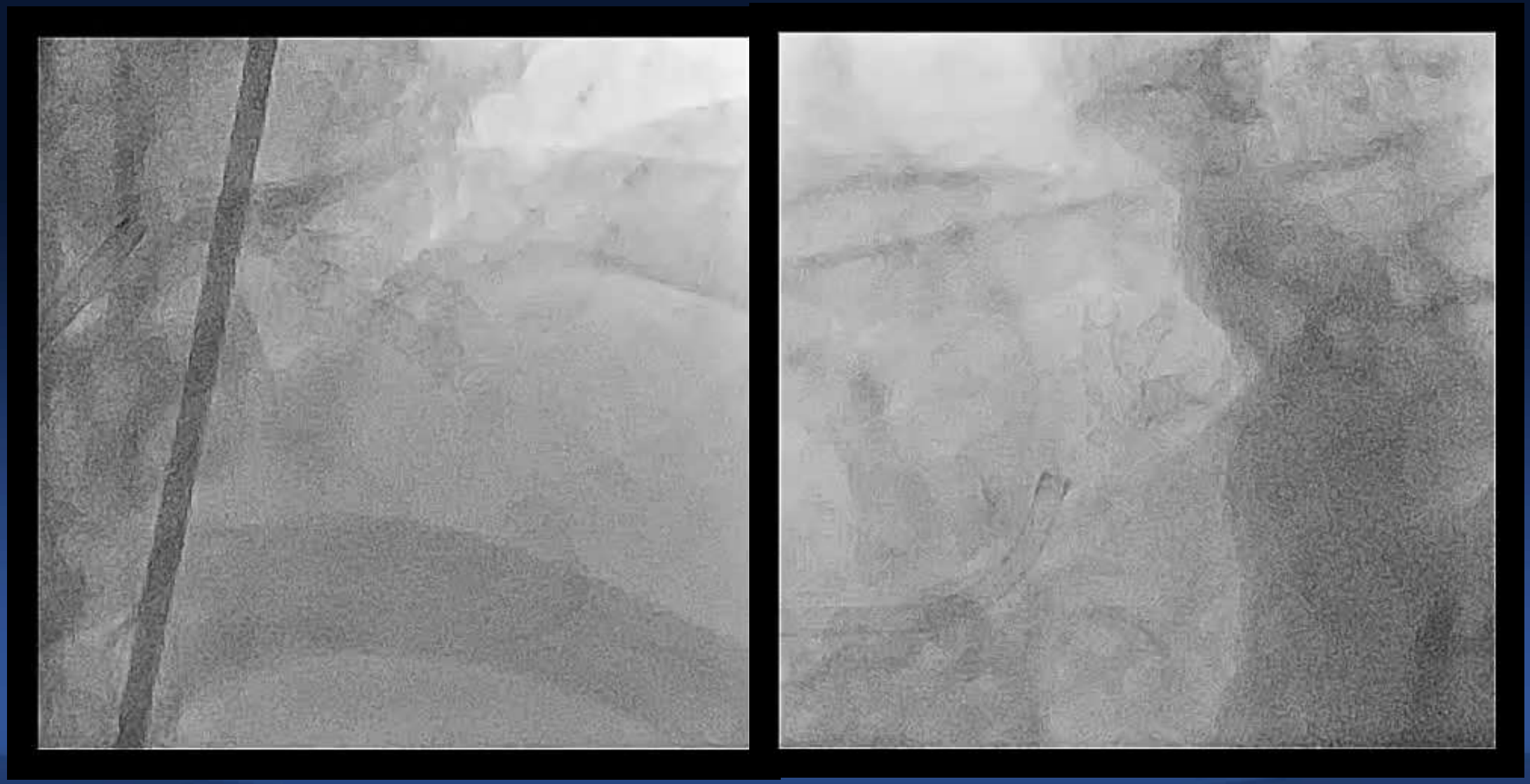
Long DES 3.5 x 38 mm

Triple Kissing Balloon



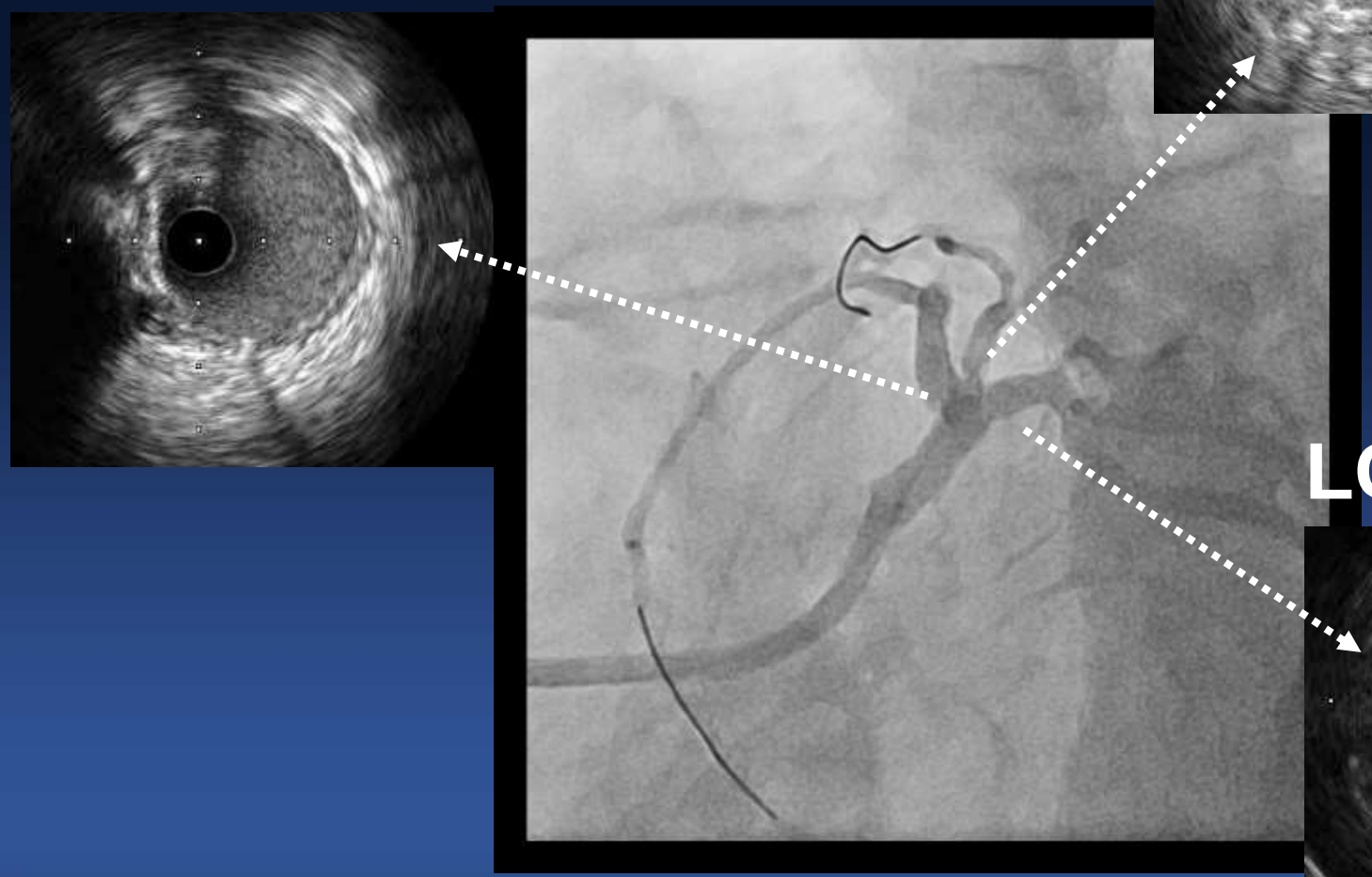
Sequential
High Pressure Ballooning
(RI/ LCX/ LM-pLAD)

Upfront 3 Stent for Trifurcation



Ramus 3.1 mm^2

LAD 7.9 mm^2



LCX 6.7 mm^2

What Really Matter in LM Bifurcation PCI ; *Concept or Technique ?*

Reasonable Treatment Strategy,
(Good Concept with Good Technique)
Can Make A Good Clinical Outcomes !