The 14th consensus document from the European Bifurcation Club

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No conflict of interest to declare

The Official Journal of EuroPCR and the European Association of Percutaneous Coronary Interventions (EAPCI)

CORONARY INTERVENTIONS

Percutaneous coronary intervention for obstructive bifurcation lesions: the 14th consensus document from the European Bifurcation Club

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Abstract

The European Bifurcation Club recommends an approach to a bifurcation stenosis which involves careful assessment, planning and a sequential provisional approach. In the minority of lesions where two stents are required, careful deployment and optimal expansion are essential to achieve a long-term result.

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Volume 15 Number 1

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METRICS

Dimensions Badge

EBC glossary

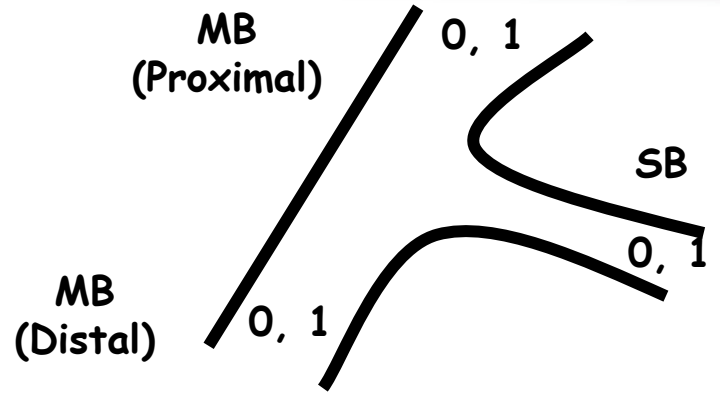
How to define a bifurcation lesion ?

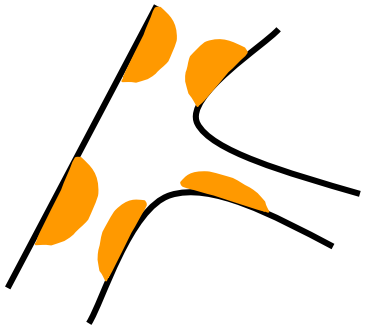
- A coronary artery narrowing occuring adjacent to, and/or involving, the origin of a significant side branch

- A significant SB is a branch that you don't want to loose in the global context of a particular patient

Y. Louvard Catheter Cardiovasc Interv. 2008 Feb 1;71:175-83

Medina Classification





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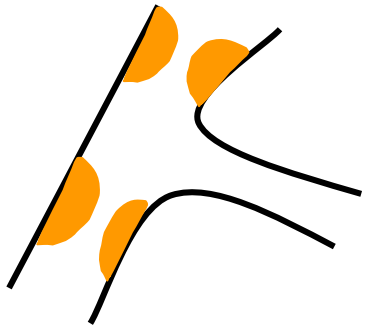

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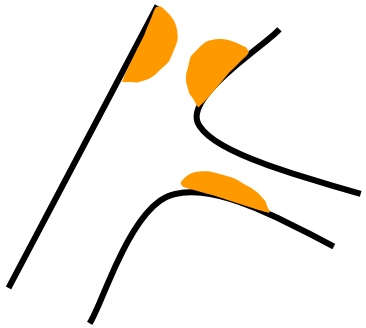

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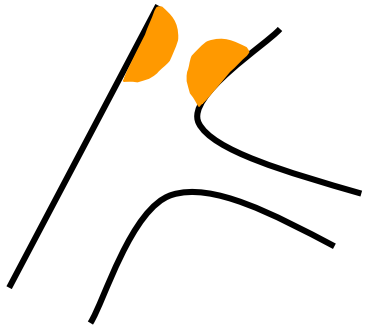

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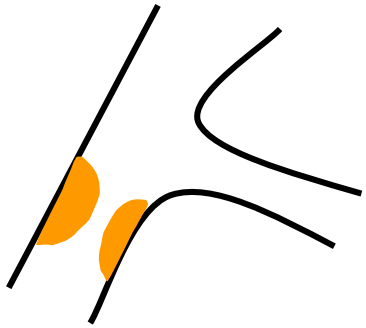
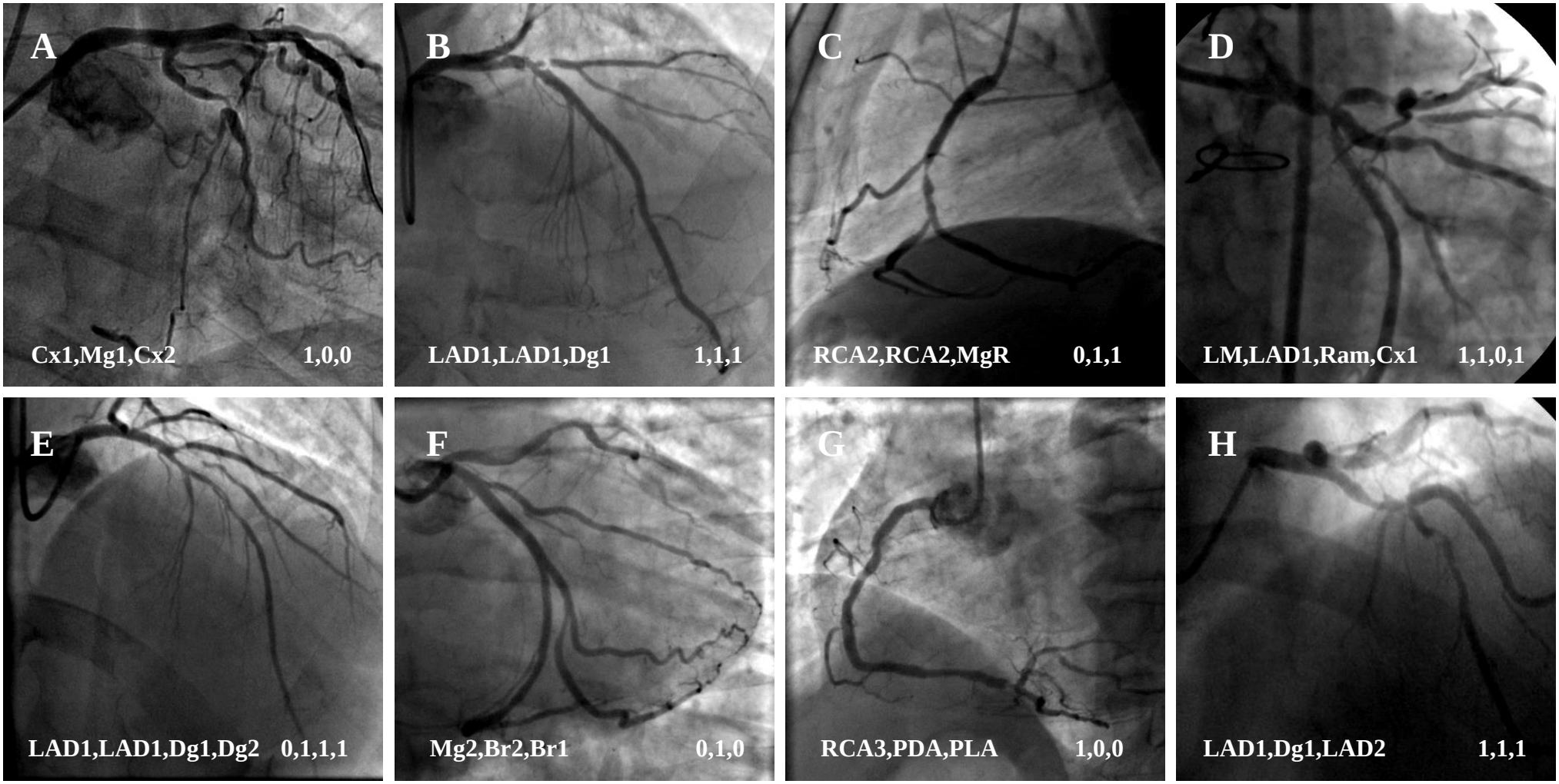


0,1,0

0,0,1

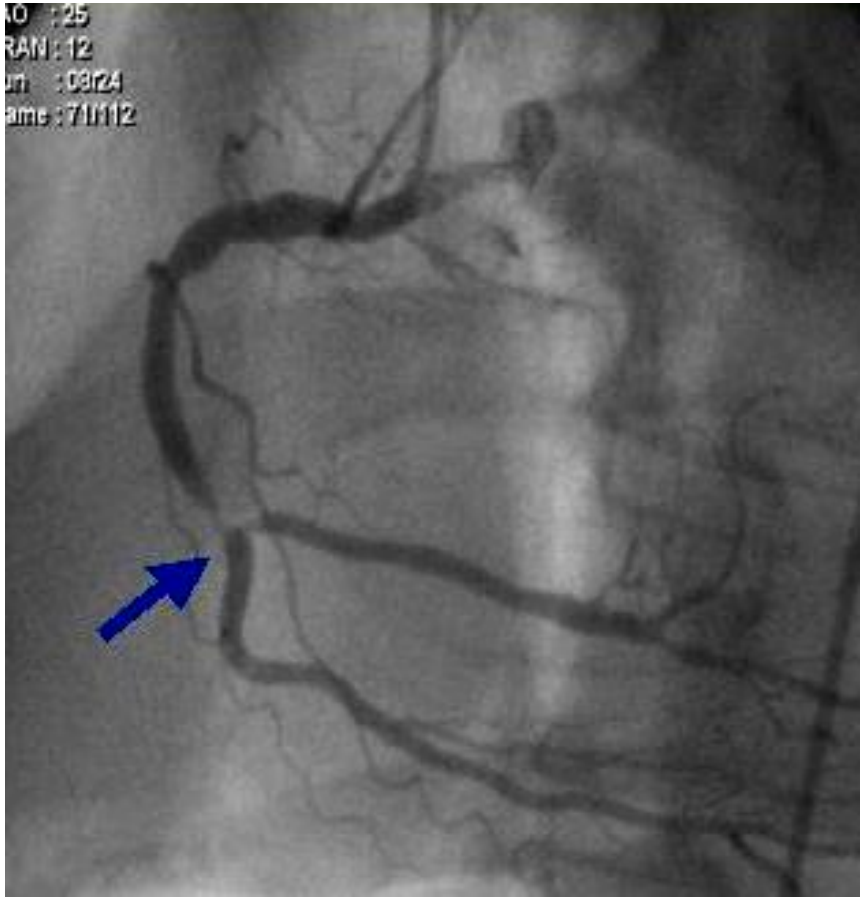
Figure 1

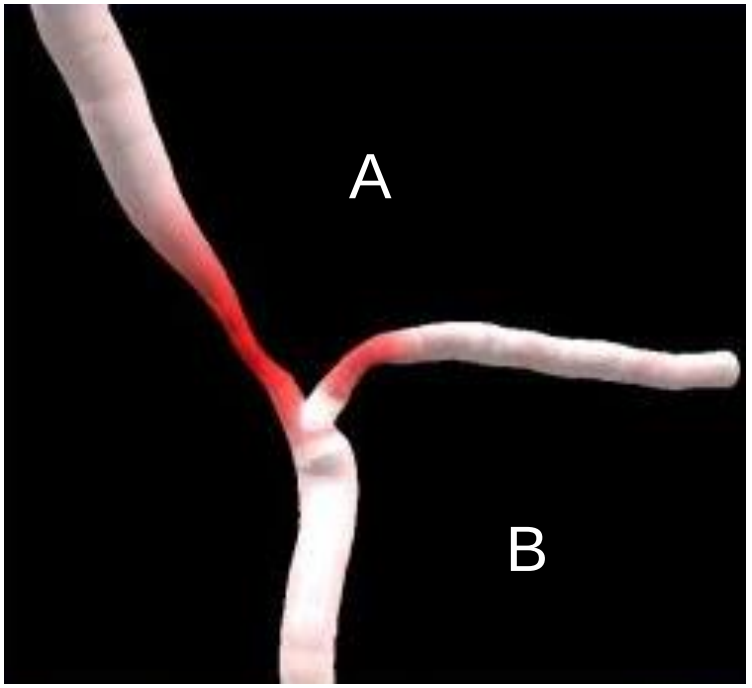
How to name a bifurcation lesion ?



Y. Louvard Catheter Cardiovasc Interv. 2008 Feb 1;71:175-83

Bifurcation angles





A= Access
B= Between

Dvir et al, EBC

Catheterization and Cardiovascular Interventions 71:175–183 (2008)

Classification of Coronary Artery Bifurcation Lesions and Treatments: Time for a Consensus!

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Background: Percutaneous coronary intervention (PCI) of coronary bifurcation lesions remains a subject of debate. Many studies have been published in this setting. They are often small scale and display methodological flaws and other shortcomings such as inaccurate designation of lesions, heterogeneity, and inadequate description of techniques implemented. **Methods:** The aim is to propose a consensus established by the European Bifurcation Club (EBC), on the definition and classification of bifurcation lesions and treatments implemented with the purpose of allowing comparisons between techniques in various anatomical and clinical settings. **Results:** A bifurcation lesion is a coronary artery narrowing occurring adjacent to, and/or involving, the origin of a significant side branch. The simple lesion classification proposed by Medina has been adopted. To analyze the outcomes of different techniques by intention to treat, it is necessary to clearly define which vessel is the distal main branch and which is (are) the side branche(s) and give each branch a distinct name. Each segment of the bifurcation has been named following the same pattern as the Medina classification. The classification of the techniques (MADS: Main, Across, Distal, Side) is based on the manner in which the first stent has been implanted. A visual presentation of PCI techniques and devices used should allow the development of a software describing quickly and accurately the procedure performed. **Conclusion:** The EBC proposes a new classification of bifurcation lesions and their treatments to permit accurate comparisons of well described techniques in homogeneous lesion groups.

Key words: bifurcation lesions; QCA; classification of bifurcation lesions; classification of treatments

EXPERT REVIEW
CORONARY INTERVENTIONS

Quantitative angiography methods for bifurcation lesions: a consensus statement update from the European Bifurcation Club

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This document is endorsed by the EAPCI.

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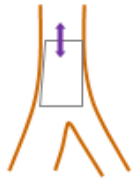
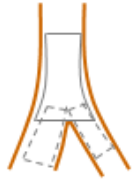
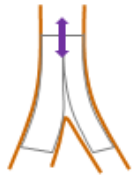
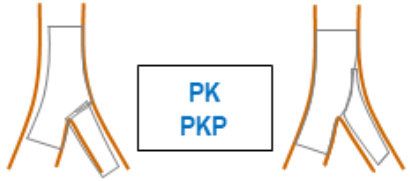
EAPCI review co-ordinator: Ron Waksman[20], MD

Document reviewers: Hector-M. Garcia-Garcia[20], MD, PhD; Armin Arbab-Zadeh[21], MD

1. Academic Medical Center, University of Amsterdam, Amsterdam, the Netherlands; 2. Cardialysis BV, Rotterdam, the Netherlands; 3. Erasmus Medical Center, Rotterdam, the Netherlands; 4. Cardiovascular Research Foundation, New York,

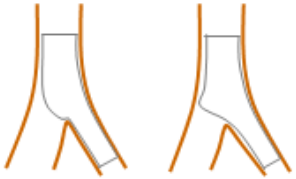
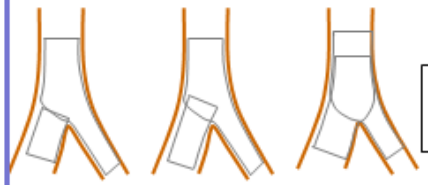
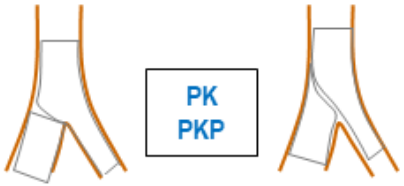
EuroIntervention 2017;13:115-123 published online January 2017

New MADS

	M Main prox. first	**A** Main Across side first (Provisional)	**D** Double prox. lumen	**S** Side branch first
1st stent	 PM stenting	 MB cross-over stenting		 SB ostial stenting
Ballooning	 Skirt (K)	 POT; Side-branch dilation; Kissing S PS PK PSP PKP		S K  Balloon SB crush
2nd-3rd stent, (and further ballooning)	 Extended skirt (K)	 T; TAP; Culotte K KP	 V / SKS	 PK PKP Intentional T stenting; Step/DK crush
Dedicated Device:	Axxess	Bioss LIM, Xposition Stentys, Nile SIR		Capella Side-Guard

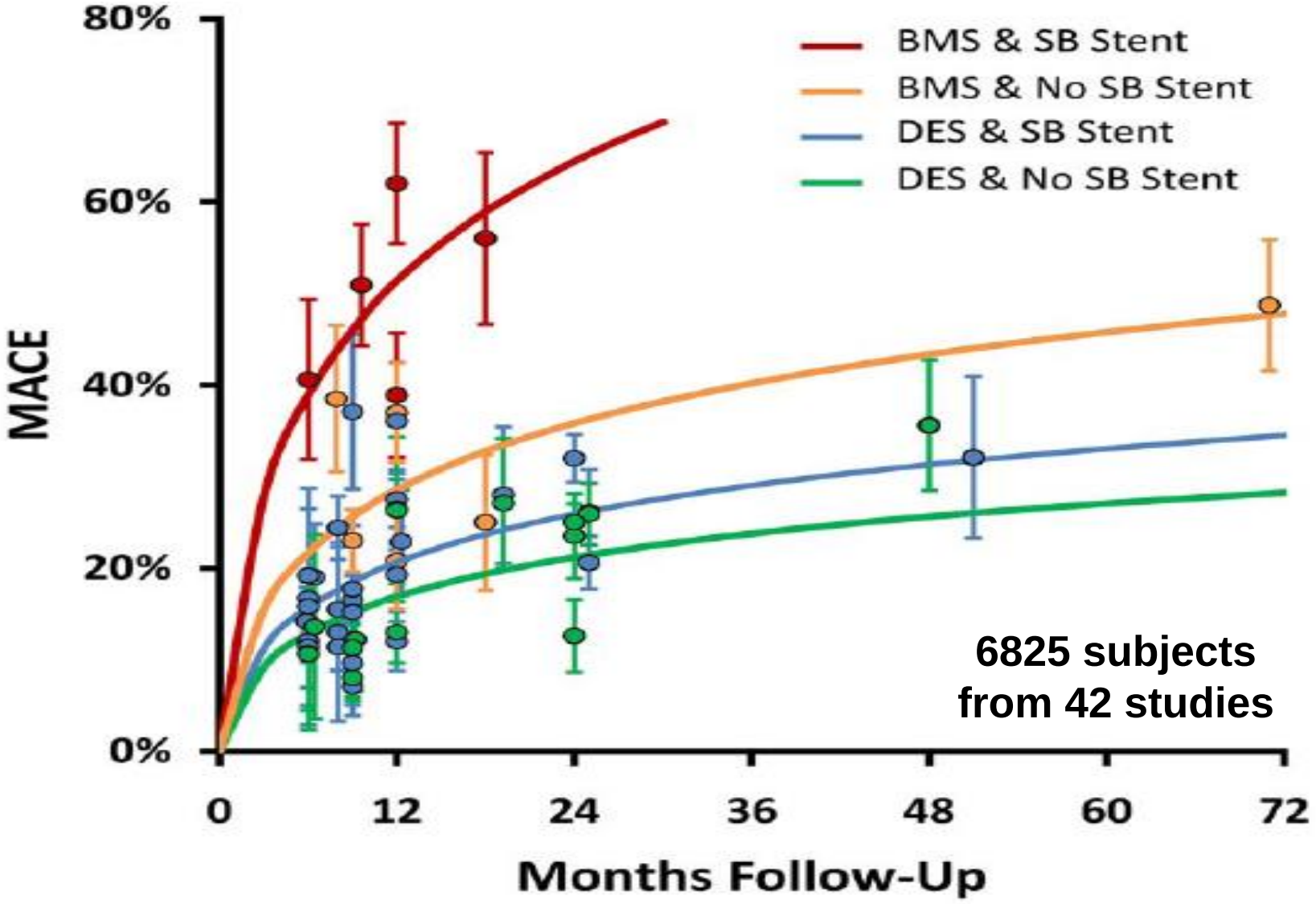
Burzotta Louvard 2019

New MADS

Inverted		Inverted A Across distal main first (Inverted Provisional)		DM Distal Main first
1st stent		 MB to SB stenting		 DM ostial stenting
Ballooning		 POT Kissing PS PK PSP PKP		S K  Balloon DM crush
2nd stent (and further ballooning)		 Inv. T Inv. TAP Inv. Culotte K KP		 PK PKP Inv. Intentional T stenting Inv. Step / DK crush
Dedicated Device:		Tryton		

Use of a provisional SB stenting strategy is one of the fundamental philosophies of the EBC

Long-term risk of clinical events from stenting SB of coronary bifurcation lesions with DES / BMS: meta-analysis

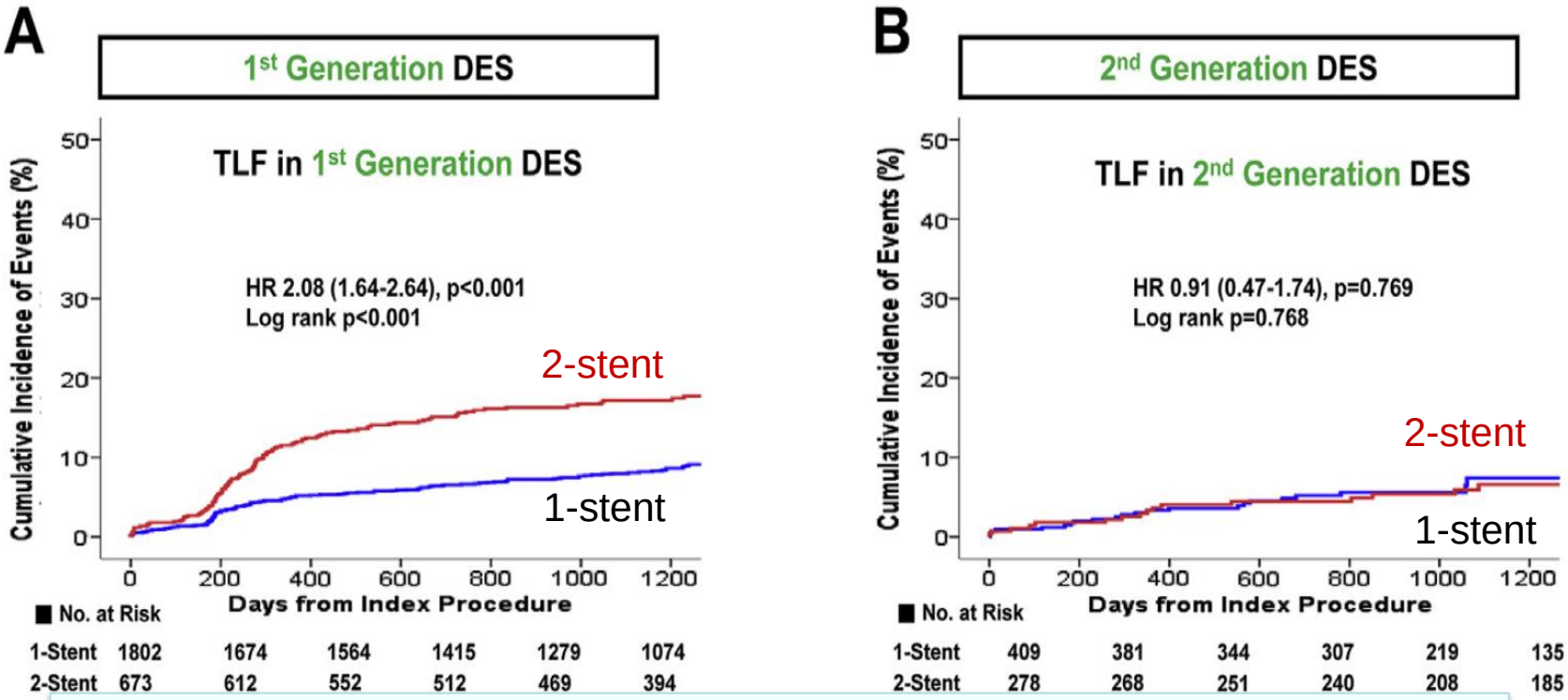


Zamani,_Catheter Cardiovasc Interv._2011 Feb 1;77(2):202-12

Korean Bifurcation Pooled Cohorts

Impact of 2nd generation DES

- 2,897 patients from COBIS II, 265 patients from EXCELLENT registry and RESOLUTE-Korea registry



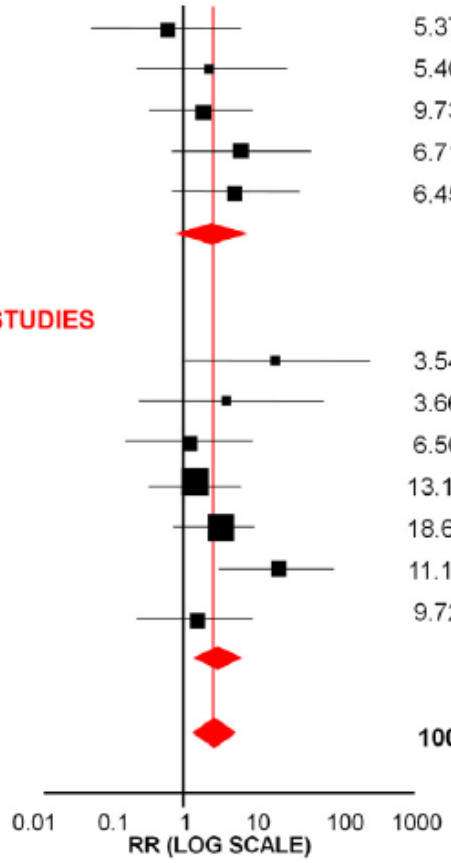
In this era of 2nd generation DES, 2-stent technique is safe.

Lee JM, Kim HS, JACC CVI 2015

Late Thrombosis After 2 Versus 1 DES in the Treatment of Coronary Bifurcations. Meta-analysis of Randomized and Observational Studies

A DES Thrombosis

Study	Year	DDS	SDS	Weight*	RR (random) 95% CI
RANDOMIZED, CONTROLLED TRIALS					
NORDIC	2008	1/196	2/199	5.37%	0.50 (0.04–5.55)
Ferenc et al.	2008	2/101	1/101	5.40%	2.00 (0.18–21.71)
CACTUS	2009	3/177	2/173	9.73%	1.46 (0.24–8.66)
BBC-ONE	2010	5/249	1/248	6.71%	4.97 (0.58–42.31)
DK-CRUSH-II	2011	4/185	1/185	6.45%	4.00 (0.45–35.44)
META-ANALYSIS		**15/908**	**7/906**		**2.01 (0.77–5.23)**
Cochrane Q: 2.46 (p: 0.651) I^2: 0%					
NONRANDOMIZED, OBSERVATIONAL STUDIES					
Ge et al.	2007	3/57	0/117	3.54%	14.24 (0.74–271.13)
Di Mario et al.	2007	4/109	0/38	3.66%	3.19 (0.17–57.92)
ARTS II	2007	1/61	4/263	6.50%	1.07 (0.12–9.47)
COBIS	2010	2/292	9/1376	13.17%	1.04 (0.22–4.82)
J-CYPHER	2011	3/263	10/1870	18.64%	2.13 (0.59–7.70)
J-PMS	2011	4/37	2/263	11.12%	14.21 (2.69–74.92)
Assali et al.	2011	2/141	3/260	9.72%	1.23 (0.21–7.27)
META-ANALYSIS		**19/960**	**27/4187**		**2.55 (1.13–5.78)**
Cochrane Q: 8.06 (p: 0.234) I^2: 25.57%					
META-ANALYSIS		**34/1868**	**35/5093**	**100%**	**2.31 (1.33–4.03)**
Cochrane Q: 10.65 (p: 0.473) I^2: 0%					

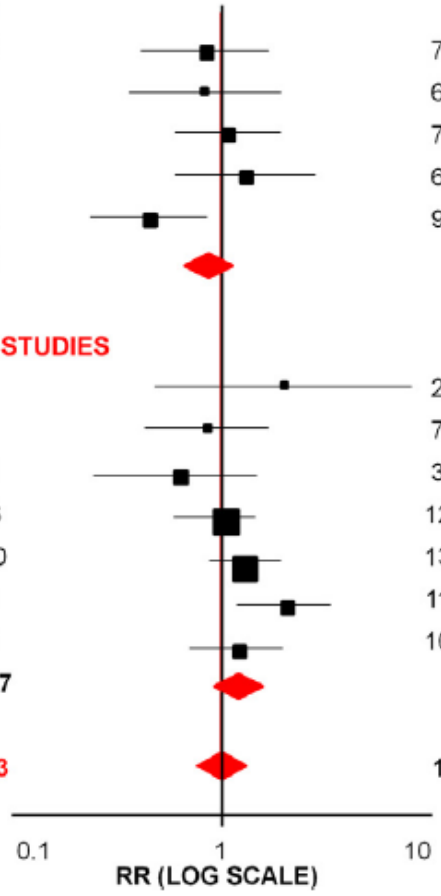


Zimarino J Am Coll Cardiol Intv 2013

Late Thrombosis After 2 Versus 1 DES in the Treatment of Coronary Bifurcations. Meta-analysis of Randomized and Observational Studies

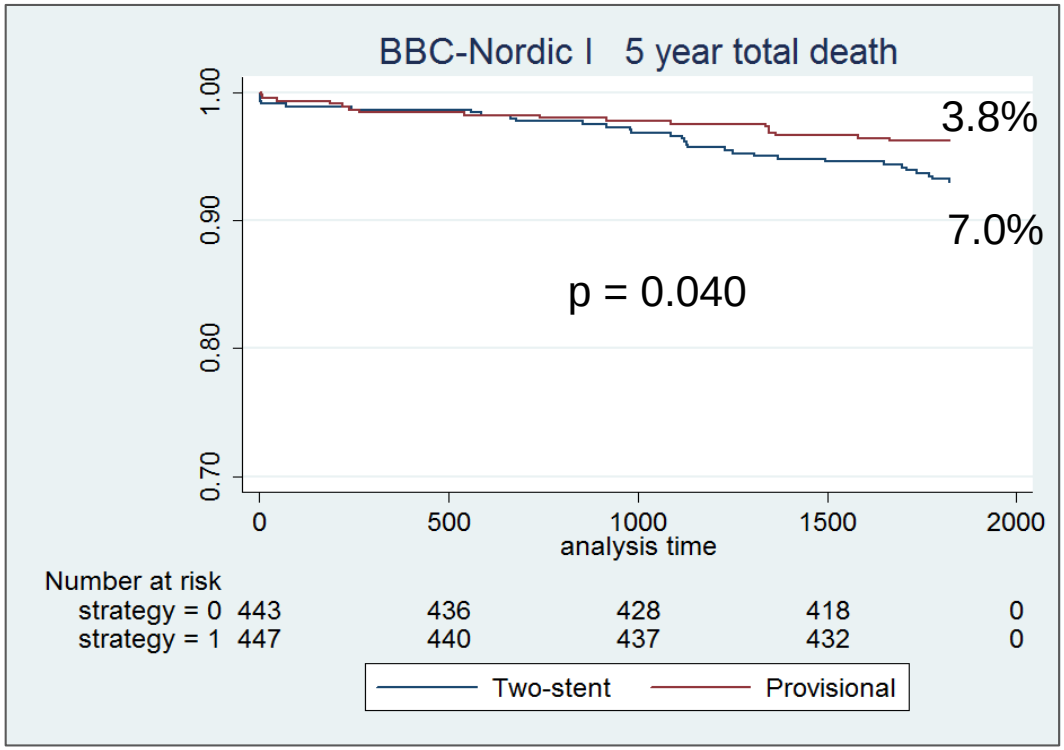
D TVR

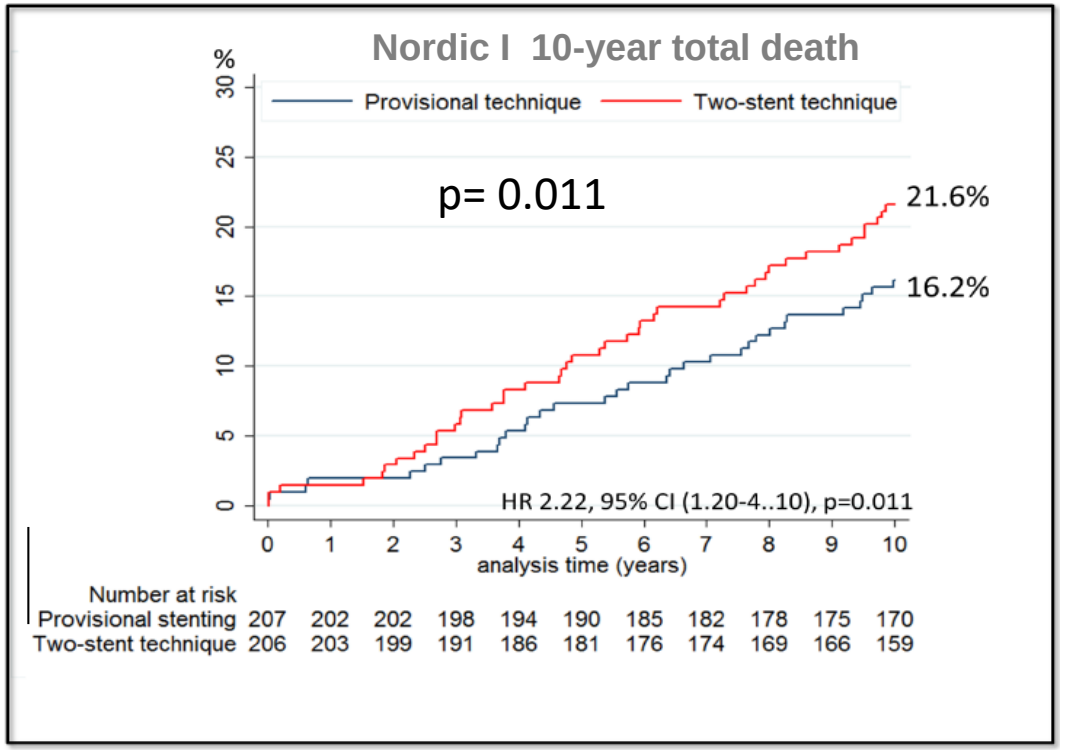
Study	Year	DDS	SDS	Weight*	RR (random) 95% CI
RANDOMIZED, CONTROLLED TRIALS					
NORDIC	2008	12/196	15/199	7.84%	0.81 (0.39–1-69)
Ferenc et al.	2008	9/101	11/101	6.47%	0.81 (0.35–1.88)
CACTUS	2009	14/177	13/173	7.95%	1.05 (0.50–2.17)
BBC-ONE	2010	13/249	10/248	6.84%	1.29 (0.57–2-17)
DK-CRUSH-II	2011	12/185	27/185	9.23%	0.44 (0.23–0-85)
META-ANALYSIS		**60/908**	**76/906**		**0.80 (0.55–1.17)**
Cochrane Q: 5.08 (p: 0.279) I^2: 21.27%					
NONRANDOMIZED, OBSERVATIONAL STUDIES					
Ge et al.	2007	10/90	2/37	2.53%	2.05 (0.47–8.93)
Di Mario et al.	2007	20/109	8/38	7.85%	0.87 (0.41–1.81)
ARTS2	2007	3/61	26/263	3.82%	0.49 (0.15–1.59)
COBIS	2010	17/292	83/1376	12.32%	0.96 (0.58–1.60)
J-CYPHER	2011	20/263	111/1870	13.60%	1.28 (0.81–2.02)
J-PMS	2011	12/37	43/263	11.51%	1.98 (1.15–3.40)
Assali et al.	2011	15/141	25/260	10.04%	1.11 (0.60–2.03)
META-ANALYSIS		**97/852**	**298/ 3847**		**1.27 (0.85–1-90)**
Cochrane Q: 7.80 (p: 0.252) I^2: 23.09%					
META-ANALYSIS		**157/1901**	**374/5013**	**100 %**	**1.02 (0.80–1.30)**
Cochrane Q: 16.86 (p: 0.119) I^2: 34.77%					



Zimarino J Am Coll Cardiol Intv 2013

Nordic and BBC1 study long-term outcome (death)





from Miles Behan

from Terje Steigen EBC 2017

Randomized study comparing Double Kissing Crush with Provisional Stenting for treatment of coronary bifurcation lesions: DK-CRUSH-II

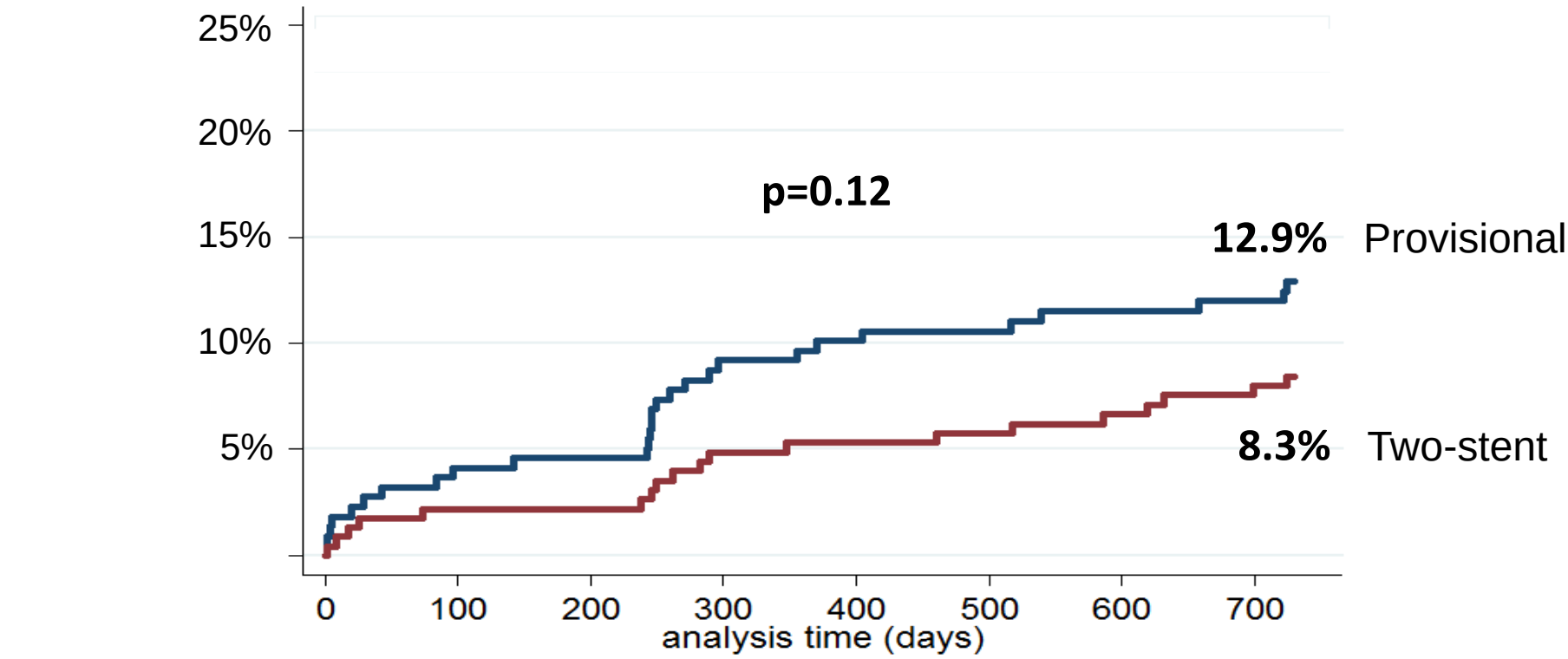
Clinical outcome (2)

	DK Group (n = 185)	PS Group (n =185)	p Value
Procedural success	179 (96.8)	173 (93.5)	0.217
At 6-month			
Cardiac death	1 (0.5)	2 (1.1)	1.000
MI	6 (3.2)	4 (2.2)	0.751
CABG	0 (0)	1 (0.5)	0.500
TLR	2 (1.1)	6 (3.2)	0.284
TVR	3 (1.6)	8 (4.3)	0.220
MACE	6 (3.2)	11 (5.9)	0.321
Stent thrombosis definite	4 (2.2)	1 (0.5)	0.372
At 12-month			
Cardiac death	2 (1.1)	2 (1.1)	1.000
MI	6 (3.2)	4 (2.2)	0.751
CABG	0 (0)	1 (0.5)	0.500
TLR	8 (4.3)	24 (13.0)	0.005
TVR	12 (6.5)	27 (14.6)	0.017
MACE	19 (10.3)	32 (17.3)	0.070
Stent thrombosis	5 (2.7)	2 (1.1)	0.449
Definite	4 (2.2)	1 (0.5)	0.372
Possible	1 (0.5)	1 (0.5)	1.000

Follow-up coronary angiography at 8 months

SL Chen J. Am. Coll. Cardiol. 2011;57;914-920

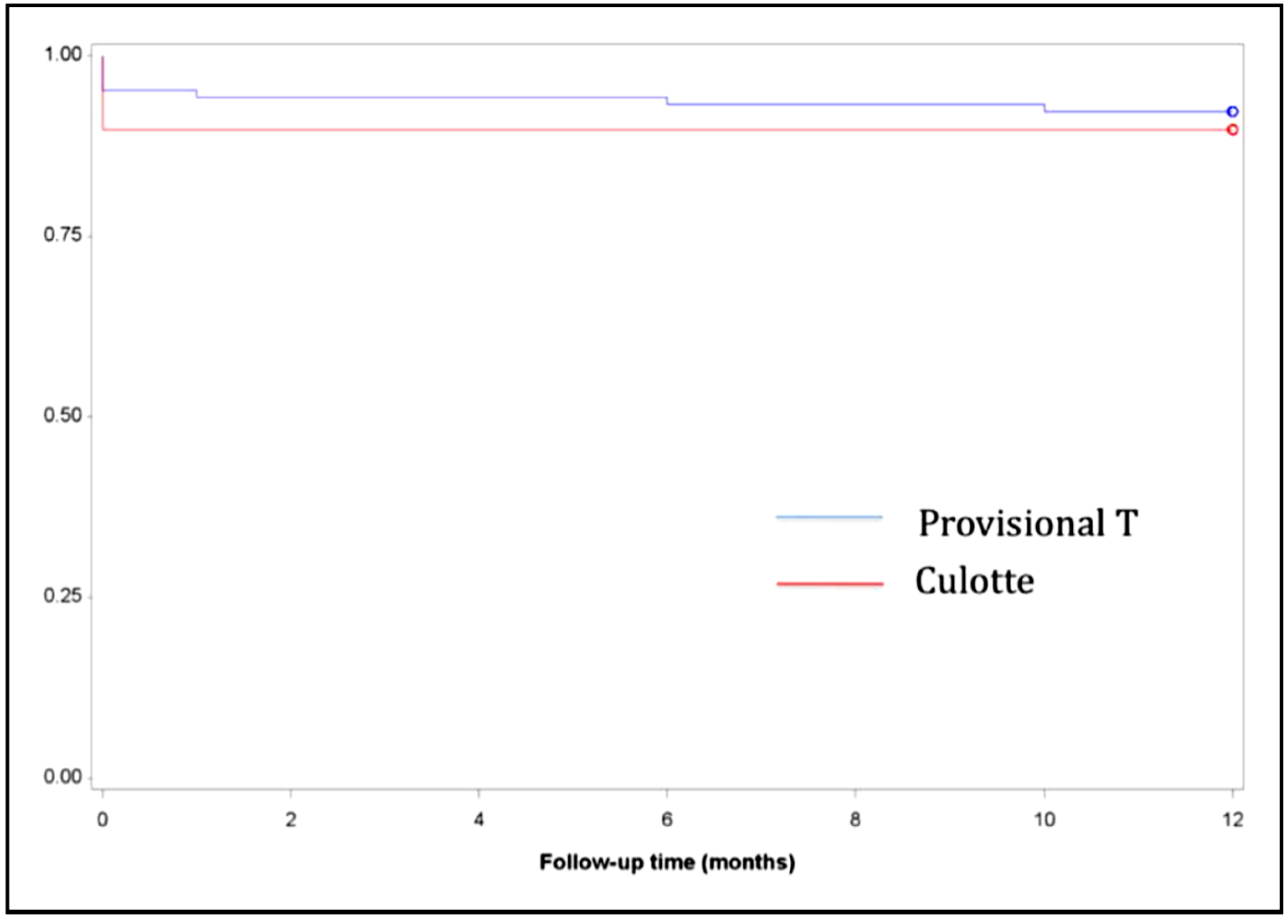
Two-year MACE



MACE: cardiac death, non-procedural myocardial infarction, target lesion revascularization and definite stent thrombosis

The EBC TWO study: randomized comparison of Provisional T-Stenting vs a systematic 2 stent Culotte strategy in large caliber true bifurcations

All-cause death, MI, and TVR

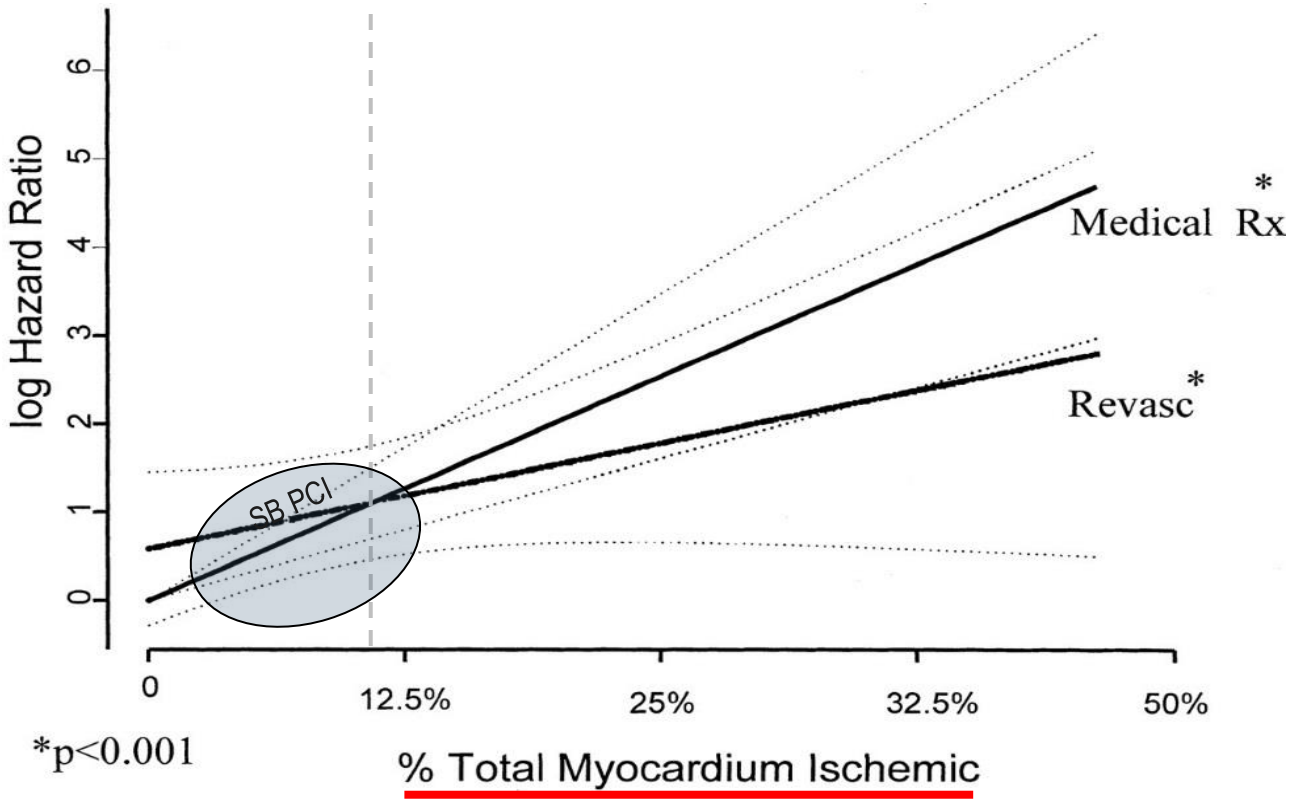


Hildick-Smith, Circ Cardiovasc Interv. 2016;9:e003643

Assessing the importance of the SB

Which side branch deserves stent implantation?

- In terms of ischemia at risk, revascularization is better than medical treatment when moderate to severe ischemia exists. Therefore, it is important **to define the side branches that can cause ≥10% ischemia**



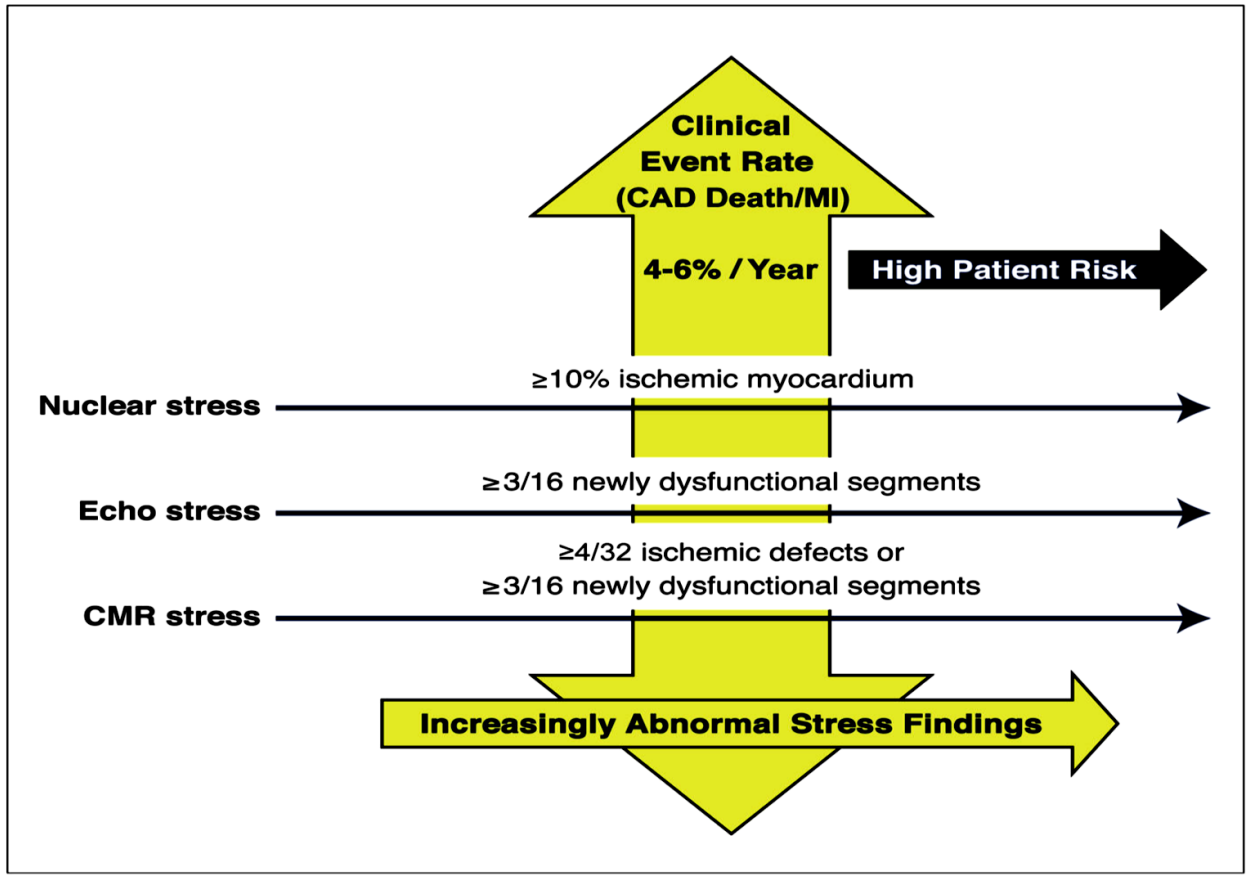
Hachamovitch, Circulation 2003

2014 ESC/EACTS Guidelines onmyocardial revascularization

Extent of CAD (anatomical and/or functional)		Class[b]	Level[c]	References
For prognosis	Left main disease with stenosis >50%[a]	I	A	108,134,135
	Any proximal LAD stenosis >50%[a]	I	A	94,108,135,136
	Two-vessel or three-vessel disease with stenosis > 50%[a] with impaired LV function (LVEF<40%)[a]	I	A	93,94,108,112, 121,135,137–142
	Large area of ischaemia (>10% LV)	I	B	54,91,97,99,143,144
	Single remaining patent coronary artery with stenosis >50%[a]	I	C	
For symptoms	Any coronary stenosis >50%[a] in the presence of limiting angina or angina equivalent, unresponsive to medical therapy	I	A	54,96,105,108, 118–120,145

European Heart Journal August 29, 2014

Comparative definitions for moderate-severe ischemia in stress nuclear, echocardiography, and magnetic resonance imaging

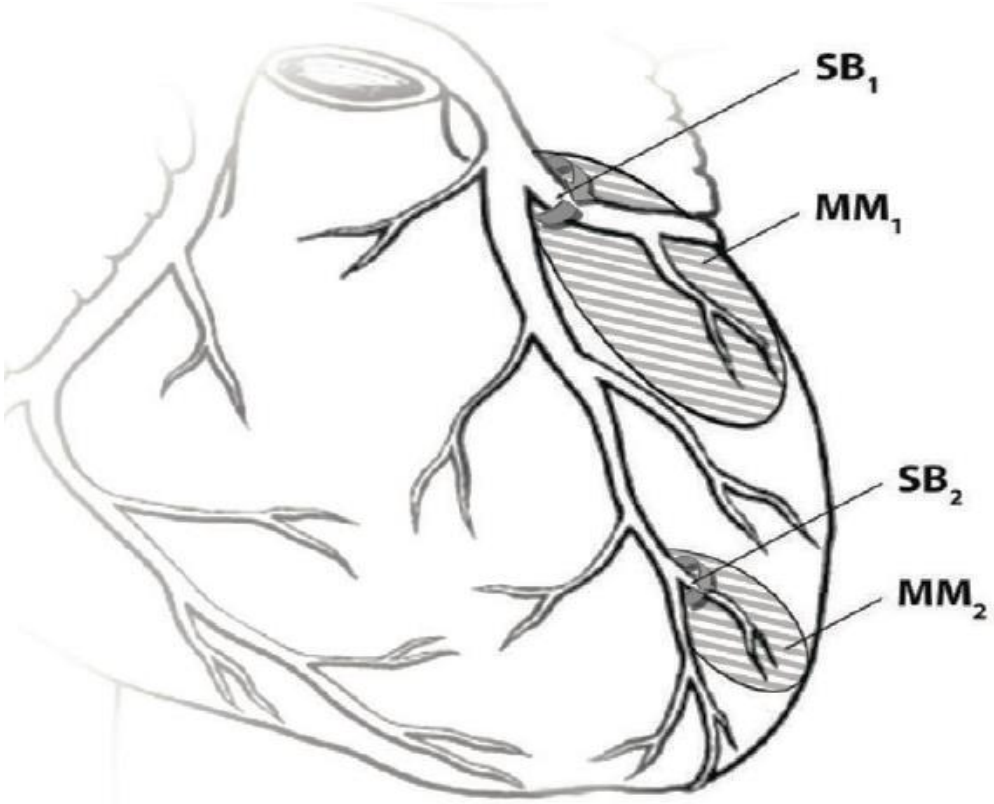


Comparable multimodality estimates of moderate-severe ischemia using risk-based thresholds of CAD death or MI rates of 4% to 6%/year

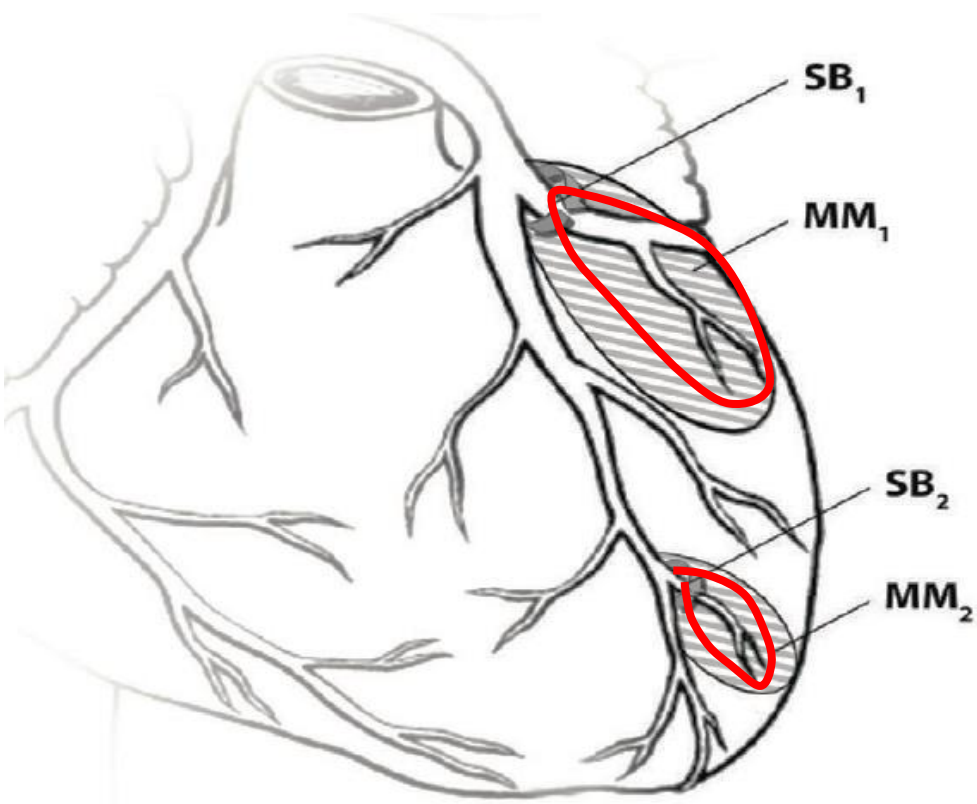
Shaw, JACC Cardiovasc Imaging. 2014 June ; 7(6): 593–604

Relation of angiographic SB calibre to myocardial mass: a proof of concept myocardial infarct index

A schematic of the relation between SB lumen CSA and perfused myocardial mass



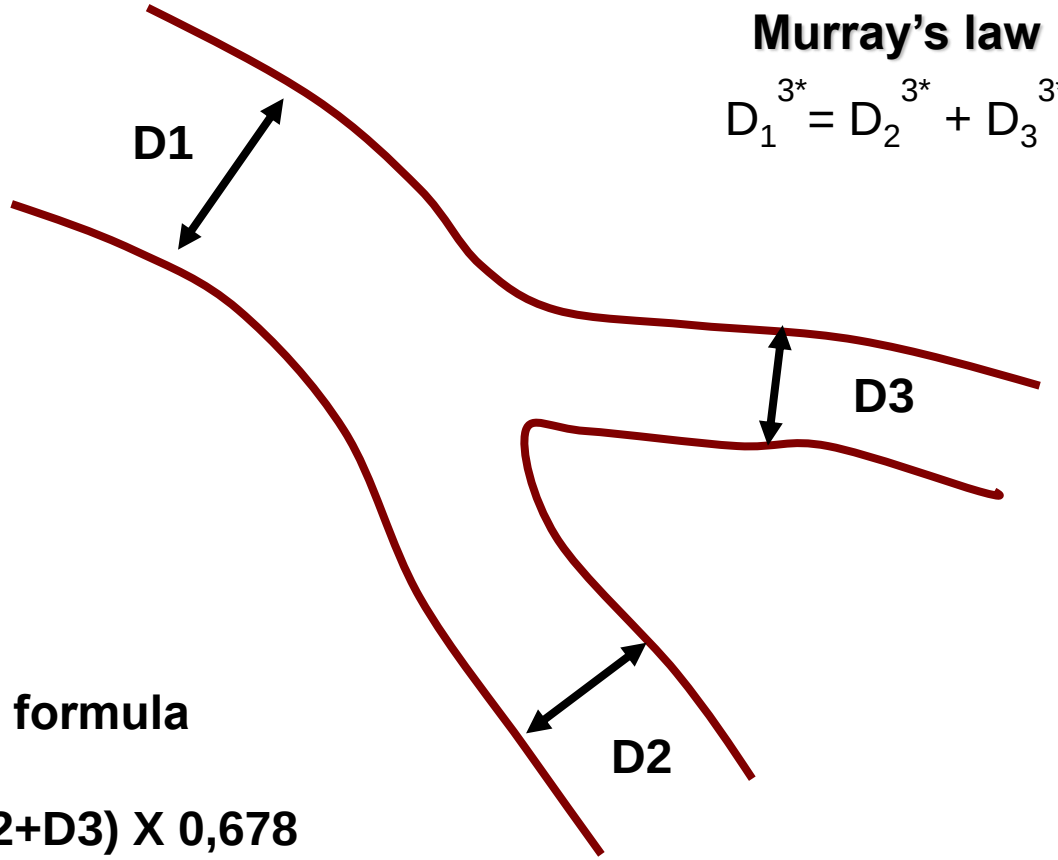
Myocardial Mass At Risk (MMAR)
or Fractional Myocardial Mass (FMM)



Myocardial ischemia

GS. Kassab, D. Bhatt, T. Lefevre, Y. Louvard, EI 2011;8:1461-1463

Structure-function scaling laws of vascular trees

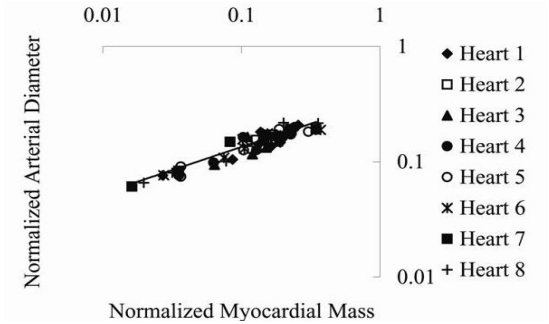


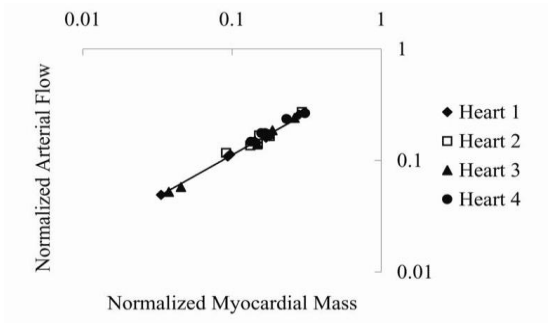
Murray's law

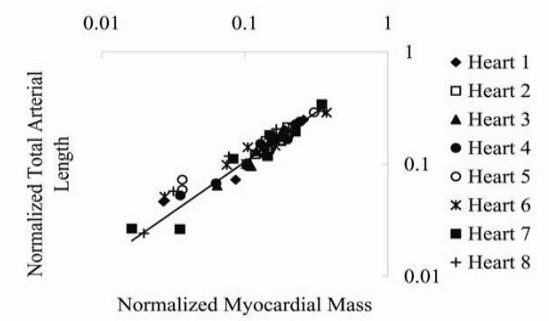
$$D_1^{3*} = D_2^{3*} + D_3^{3*}$$

Finet's formula

D1= (D2+D3) X 0,678







* 2.3 **(Huo-Kassab)**

Adapted from G. Kassab

Identification of Coronary Artery Side Branch Supplying Myocardial Mass That May Benefit From Revascularization

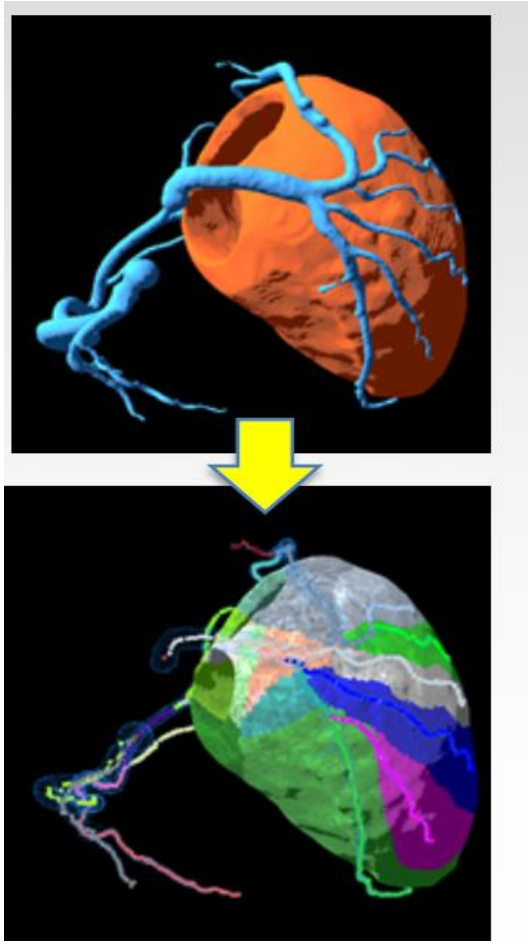
Multivariate Generalized Estimating Equations Modeling for Prediction of %FMM >10%

	Odds Ratio ± SE	p Value
Side branch length ≥73 mm	41.9 ± 2.1	<0.001
Left main bifurcation	345.2 ± 2.9	<0.001
Reference vessel diameter ≥2.68 mm	1.5 ± 1.9	0.73
Left ventricular mass >104.8 g	1.4 ± 1.8	0.61
Fractional flow reserve <0.80	2.3 ± 2.2	0.24

Multivariate generalized estimating equations modeling was performed using optimal cutoffs of each parameters predicting FMM >10%. The respective c-statistics of left main bifurcation, reference vessel diameter >2.68 mm, left ventricular mass >104.8 g, and FFR <0.80 were 0.820, 0.734, 0.609, and 0.526 ($p < 0.05$, all)

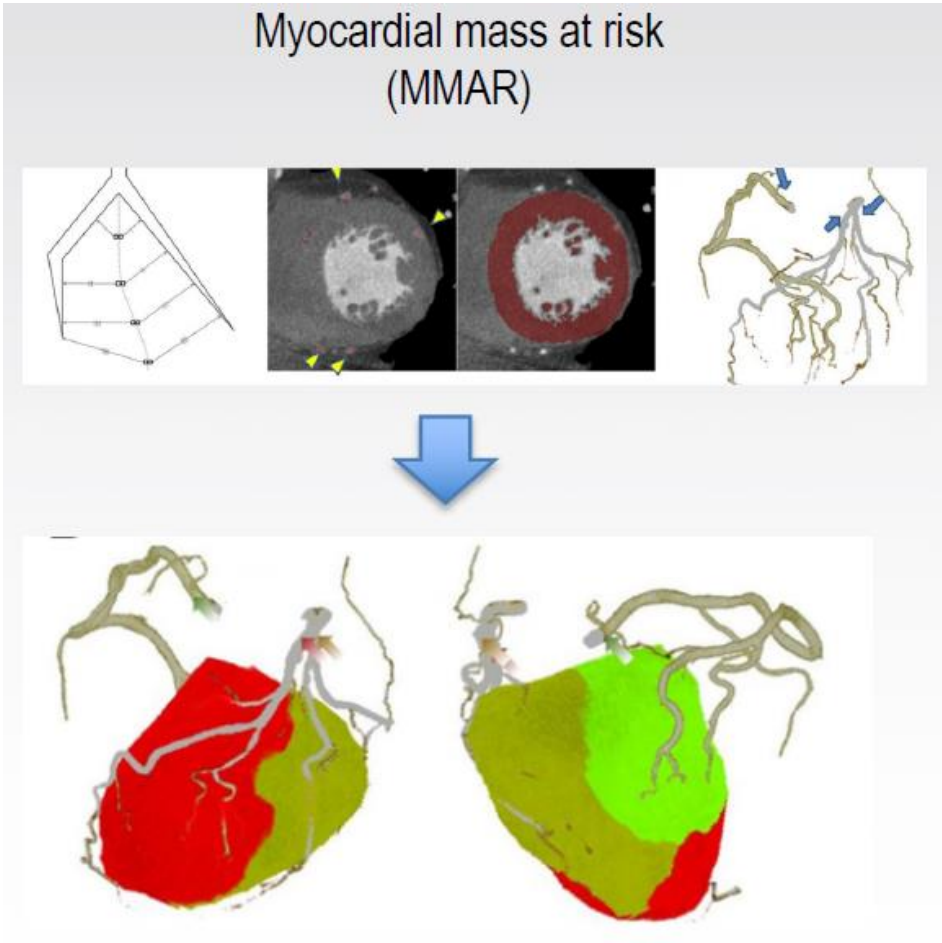
HY Kim, J Am Coll Cardiol Intv 2017;10:571–81

Myocardial segmentation techniques with CT scan



Fractional Myocardial Mass (FFM)

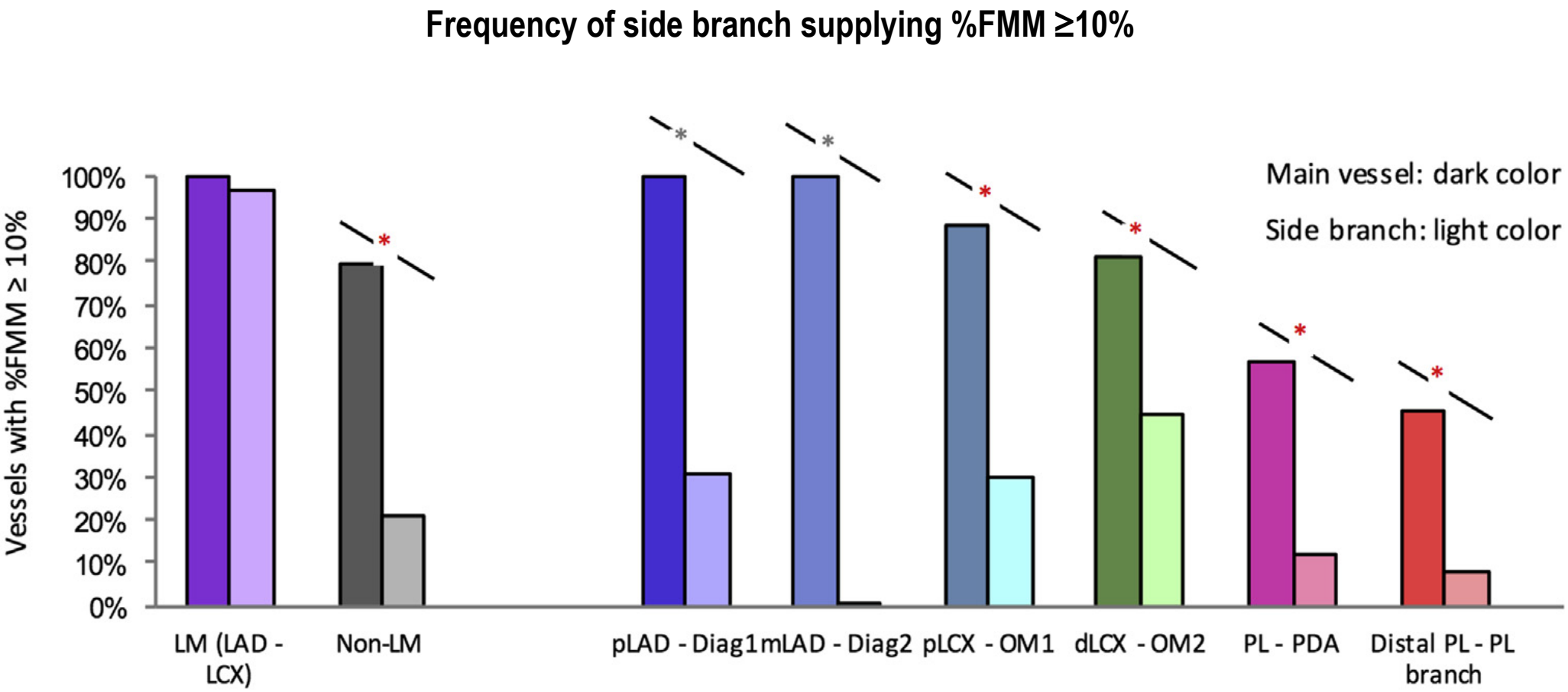
- Myocardial mass supplied by a specific vessel
- **Calculated from vessel length in CT**
- FMM was computed using stem and crown model based on allometric system



HY Kim, JACC Cardiovasc Interv 2017

Sumitsuji, Cardiovasc Interv and Ther 2015

Identification of coronary artery SB supplying myocardial mass that may benefit from revascularization



Only 1 out of every 5 non-LM SB supplies %FMM ≥10%

HY Kim, JACC Cardiovasc Interv 2017

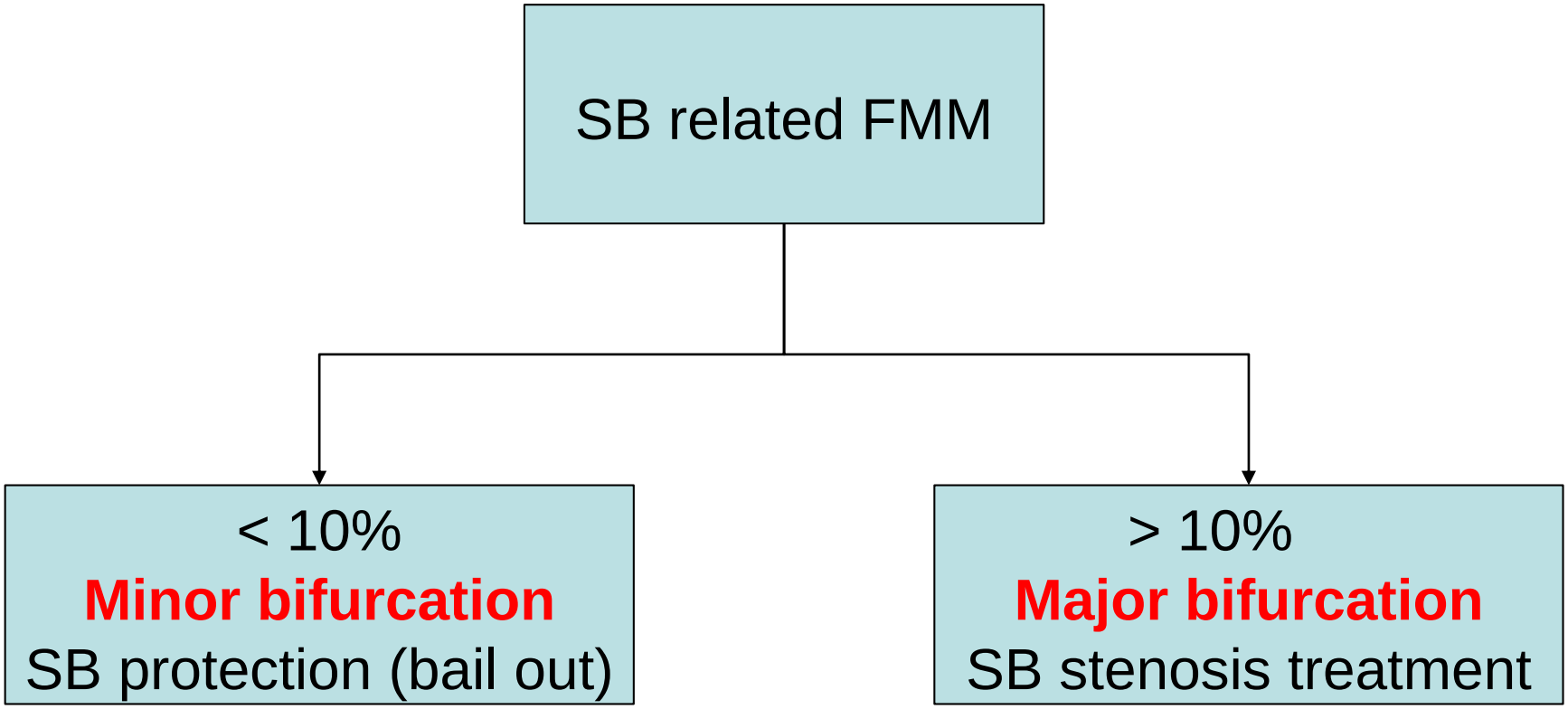
Modified SNUH score (Diagonal branches)

Variables	Description	Score
Size	Vessel diameter ≥ 2.5mm	1
Number	Number of diagonal branches = 1	2
	Number of diagonal branches = 2	1
	Number of diagonal branches ≥ 3	0
Ubiety	Left dominant or Apical area reaching OM branch	-1*
Highest	No branch below the target branch in proximal to mid LAD	1

*If total score is 0, then -1 is not added (The lowest total score is 0

Courtesy of BK Koo

Do we have a new coronary bifurcation stenosis definition ?



Provisional stenting strategy step by step

Predictors and Outcomes of SB Occlusion After Main Vessel Stenting in Coronary Bifurcation Lesions Results From the COBIS II Registry

Lesion and Procedural Characteristics

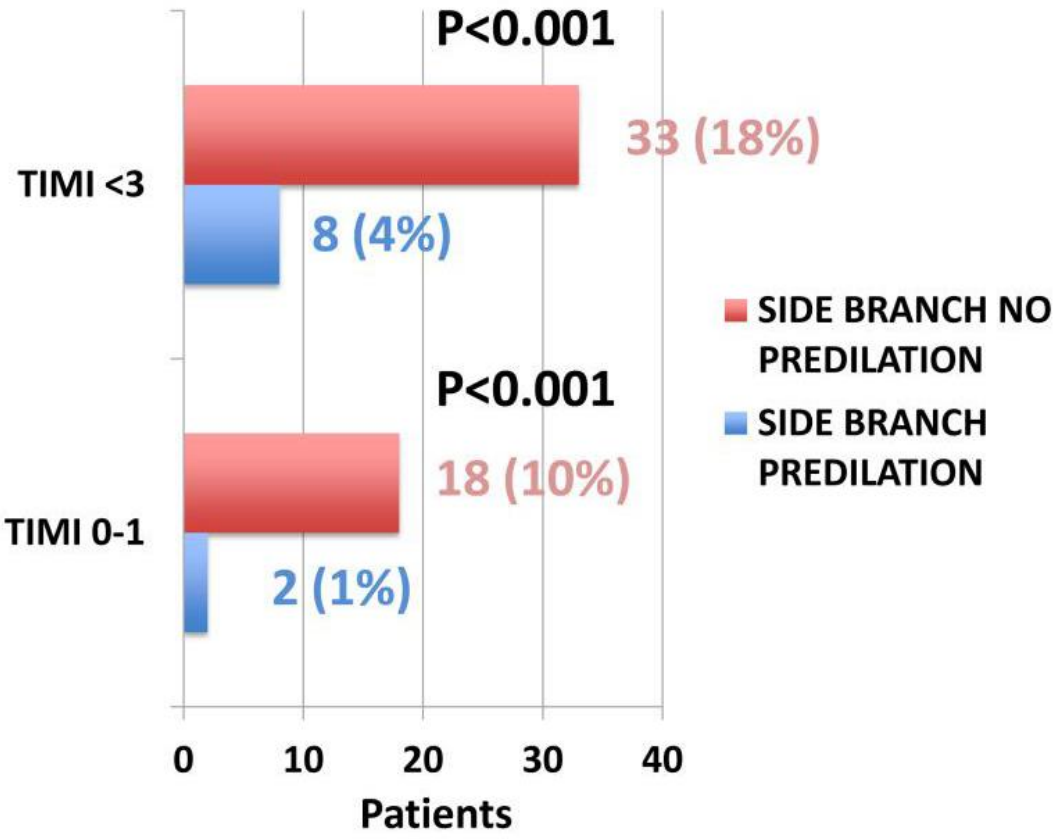
Characteristic	SB Occlusion (n = 187)	No SB Occlusion (n = 2,040)	p Value
Bifurcation location			<0.001
Left main bifurcation	14 (7.5)	556 (27.3)	
LAD/diagonal	124 (66.3)	1,124 (55.1)	
LCX/OM	32 (17.1)	272 (13.3)	
RCA bifurcation	17 (9.1)	88 (4.3)	
Medina classification			<0.001
1.1.1	97 (51.9)	567 (27.8)	
1.0.1	21 (11.2)	136 (6.7)	
0.1.1	21 (11.2)	198 (9.7)	
1.0.0	19 (10.2)	297 (14.6)	
1.1.0	25 (13.4)	355 (17.4)	
0.1.0	4 (2.1)	462 (22.6)	
Zotarolimus-eluting stent	23 (12.3)	234 (11.5)	
Everolimus-eluting stent	26 (13.9)	246 (12.1)	
Other drug-eluting stents	6 (3.2)	49 (2.4)	
Jailed wire in the SB	123 (65.8)	1,237 (60.6)	0.17
SB pre-dilation before MV stenting	61 (32.6)	437 (21.4)	<0.001
Guidance of intravascular ultrasound	52 (27.8)	772 (37.8)	0.007
MV stent diameter, mm (range)	3.0 (3.0–3.5)	3.0 (3.0–3.5)	0.04
MV stent length, mm (range)	24.0 (20.0–30.0)	24.0 (18.0–30.0)	0.21
MV stent maximal pressure, atm (range)	12.0 (10.0–14.0)	14.0 (10.0–16.0)	<0.001
MV stent/artery ratio (range)	1.2 (1.1–1.3)	1.2 (1.1–1.3)	0.63

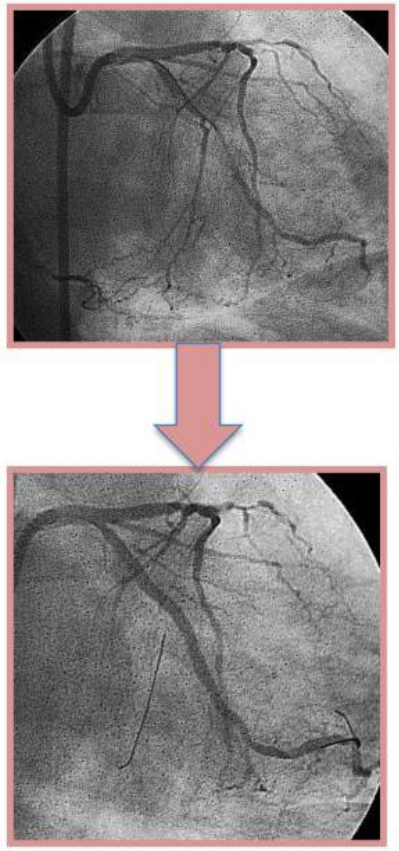
Patients with recovery of the occluded SB had jailed wire in the SB more frequently than those without recovery of the occluded SB (74.8% vs. 57.8%, p < 0.02)

SB occlusion
wo JW = 7%
w JW = 9%

Hahn, J Am Coll Cardiol 2013;62:1654–9

Assessment of side branch predilation before a provisional T-stent strategy for bifurcation lesions. A randomized trial

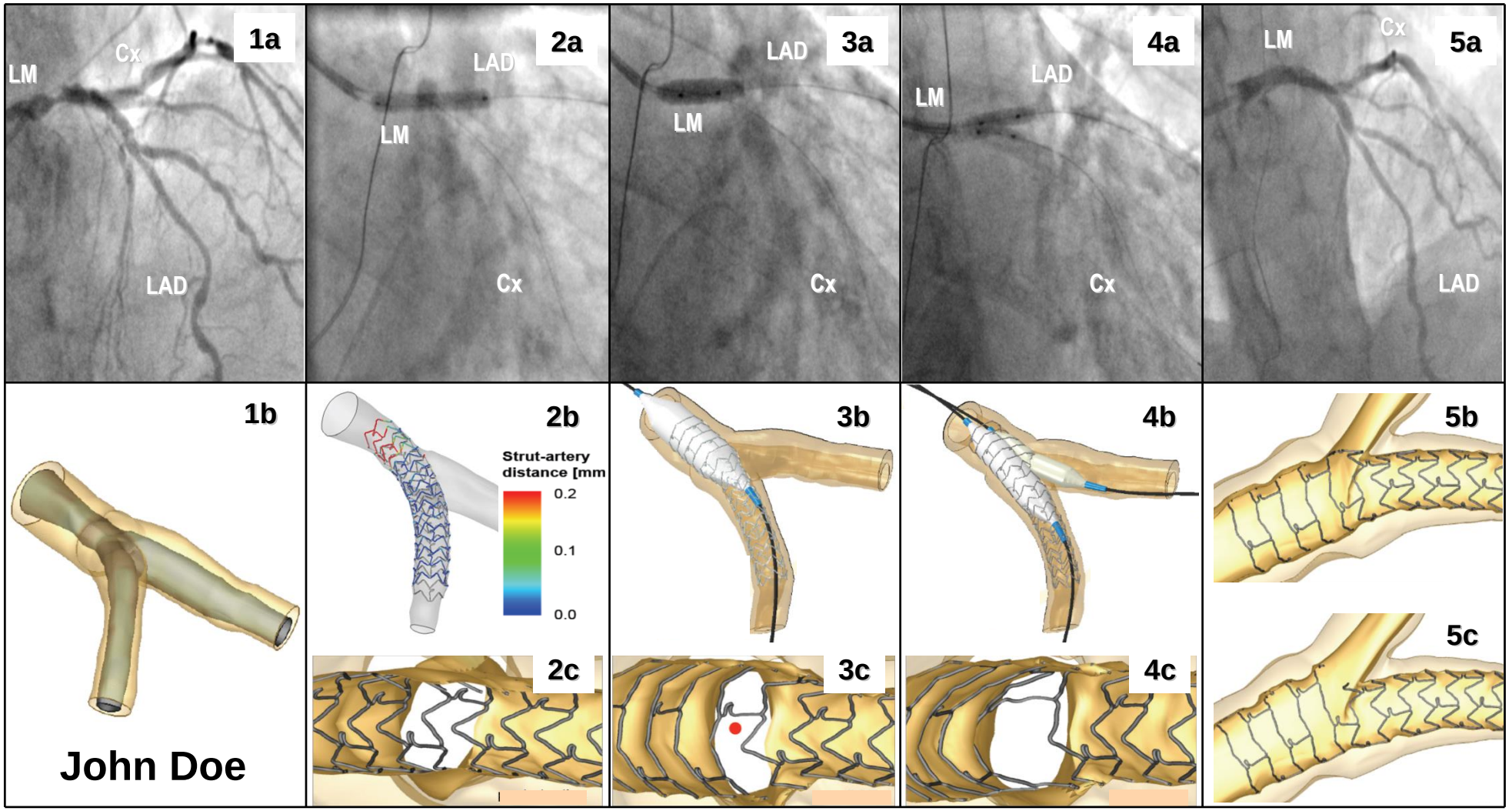




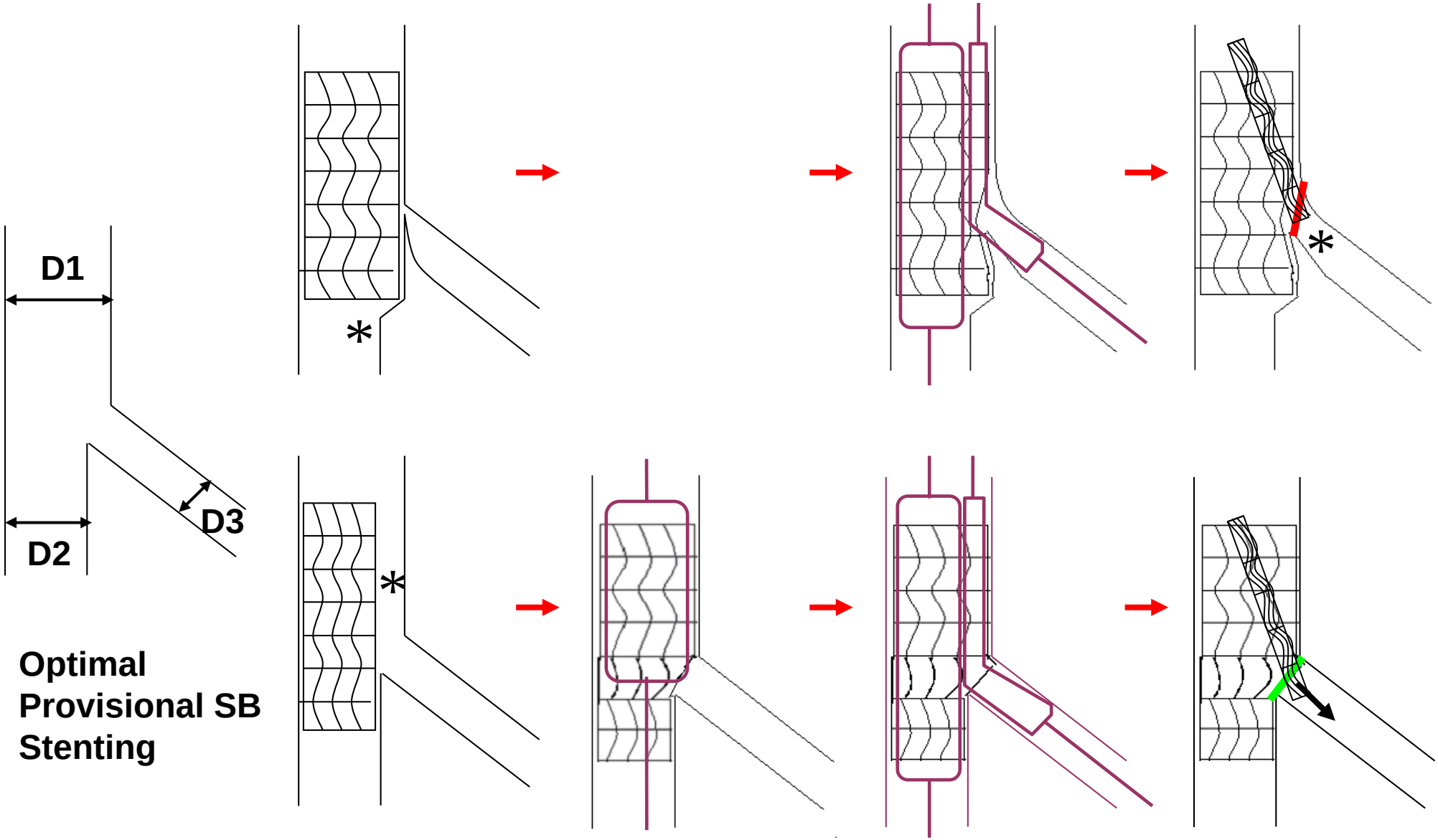
Pan, Am Heart J. 2014 Sep;168(3):374-80.

EBC 2012: stimulation era

Provisional stenting strategy



Stent diameter



Optimal Provisional SB Stenting

POT

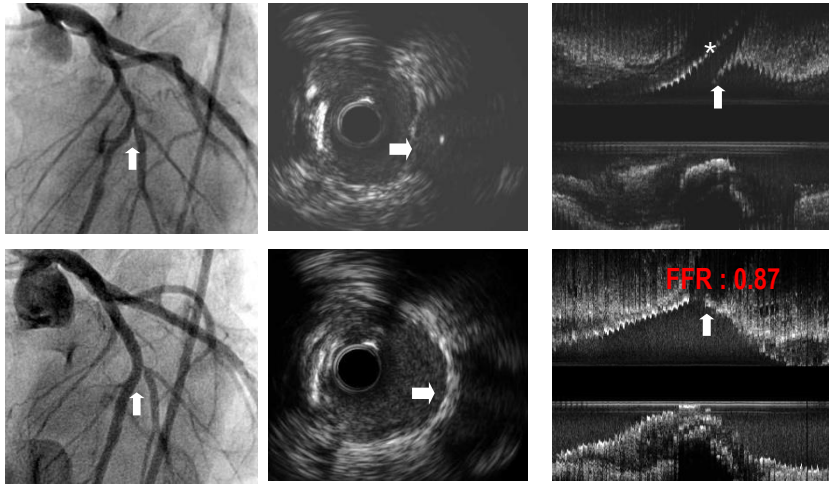
Independant predictors of SB occlusion

Variable	Odds Ratio (95% CI) (range)	p Value
Pre-procedural %DS of the SB ≥50%	2.34 (1.59–3.43)	<0.001
Pre-procedural %DS of the proximal MV ≥50%	2.34 (1.57–3.50)	0.03
SB lesion length	1.03 (1.003–1.06)	<0.001
Acute coronary syndrome	1.53 (1.06–2.19)	0.02
Left main lesions (vs. non-left main lesions)	0.34 (0.16–0.72)	0.005

Hahn, J Am Coll Cardiol 2013;62:1654–9)

IVUS findings of Carina shift vs. Plaque shift

carina shift



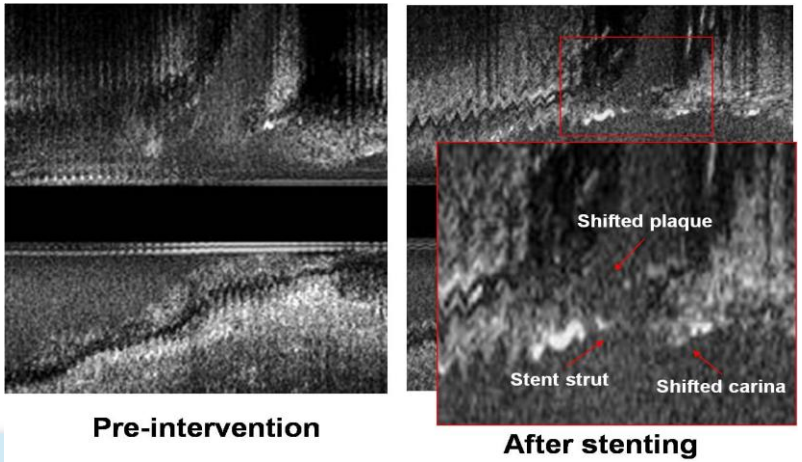
Angiogram | Cross-sectional IVUS | Longitudinal IVUS

Before MB stent

After MB stent

* : A 0.014 inch coronary wire

Both plaque shift and carina shift ➔ Aggravation of SB luminal narrowing after MB stent implantation



Pre-intervention | After stenting

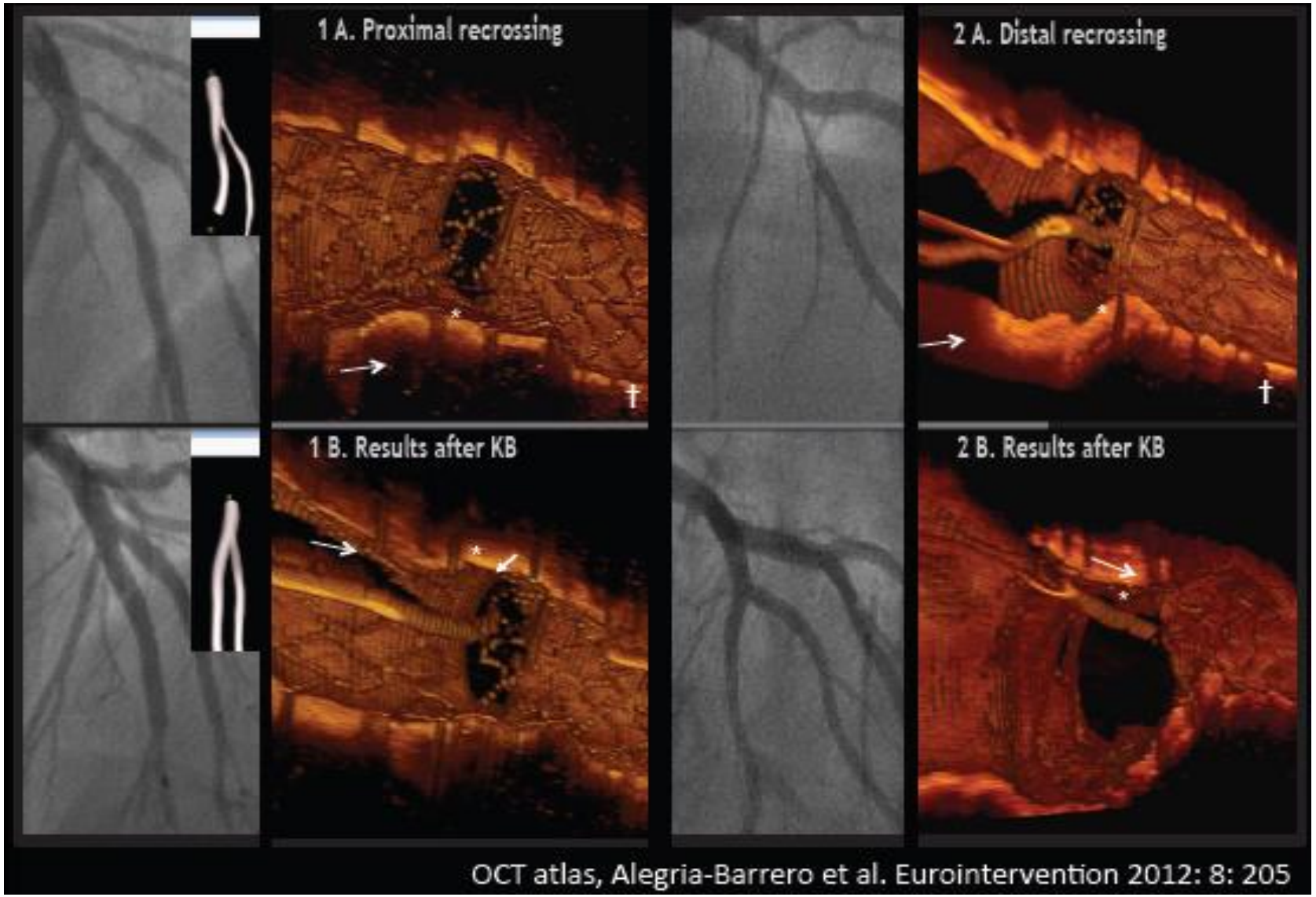
COBIS II POT Study: Clinical outcomes

- Patients with **SB diameter ≥ 2.5 mm in core-lab QCA (N=1,191)**
- Propensity score-matching population

	POT (n=204)	No POT (n=665)	HR (95% CI)	p value
MACE	**6 (2.9)**	**78 (11.7)**	**0.25 (0.11-0.60)**	**0.002**
All-cause death	7 (3.4)	25 (3.8)	0.97 (0.41-2.33)	0.95
Cardiac death	1 (0.5)	9 (1.4)	0.37 (0.05-2.97)	0.35
Myocardial infarction	0	12 (1.8)	-	-
Stent thrombosis	2 (1.0)	8 (1.2)	0.98 (0.20-4.77)	0.98
TLR	5 (2.5)	61 (9.2)	0.27 (0.10-0.69)	**0.006**
MV, proximal	**3 (1.5)**	**40 (6.0)**	**0.25 (0.07-0.82)**	**0.02**
MV, distal	**4 (2.0)**	**47 (7.1)**	**0.28 (0.10-0.80)**	**0.02**
SB	4 (2.0)	35 (5.3)	0.37 (0.13-1.09)	0.07
Both vessels	5 (2.5)	48 (7.2)	0.34 (0.13-0.88)	**0.03**

Preliminary analysis:, HC. Gwon at EBC 2016

Proximal vs distal recrossing toward side branch



COBIS II

FKB during 1-stent techniques

- Treated with 1-stent techniques: N=1,901
- Final kissing ballooning (FKB): N=620
- Propensity score-matched analysis: N=545 pairs

Clinical data	Adjusted HR (95% CI)	p Value
MACE	0.50 (0.30-0.85)	0.01
Cardiac death	0.50 (0.11-2.29)	0.37
MI	0.18 (0.01-20.4)	0.48
Stent thrombosis, definite or probable	0.77 (0.17-3.45)	0.73
TLR	0.51 (0.28-0.91)	0.02
Main vessel	0.51 (0.28-0.93)	0.03
Side branch	0.57 (0.24-1.37)	0.21

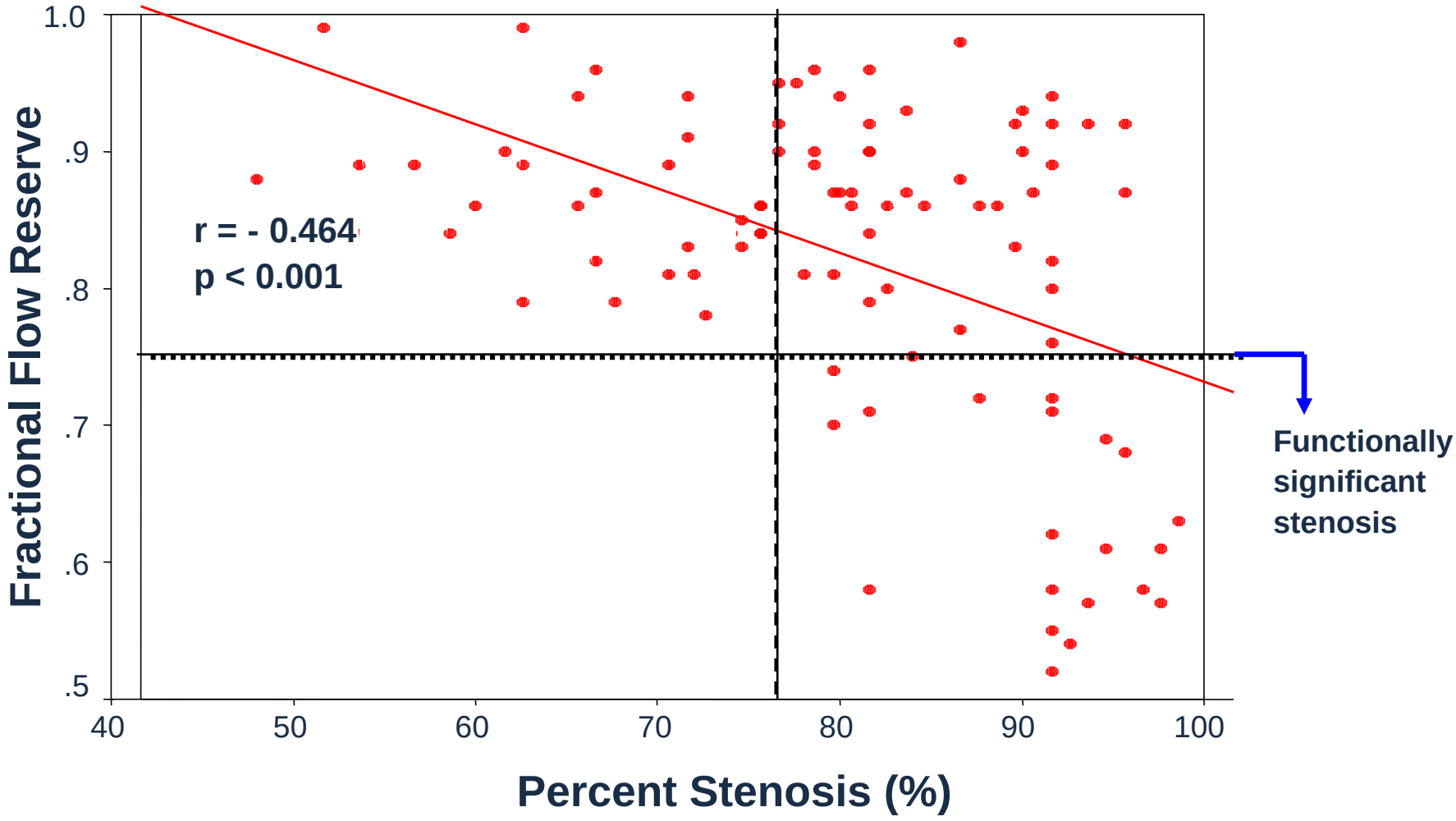
QCA data (mm)	FKB	Non-FKB	p Value
Main vessel			
Proximal MLD	3.27	3.04	<0.001
Middle MLD	2.86	2.72	<0.001
Distal MLD	2.83	2.73	0.04
Side branch			
Ostial MLD	1.85	1.36	<0.001
Distal MLD	2.15	1.99	0.04

When you stent a bifurcation lesion with a large SB, FKB will achieve a better MV stent expansion, which will reduce the risk of TLR.

Yu CW, Yang JH, Gwon HC, JACC CVI 2015

Significant Post Stenting SB Stenosis: QCA vs FFR

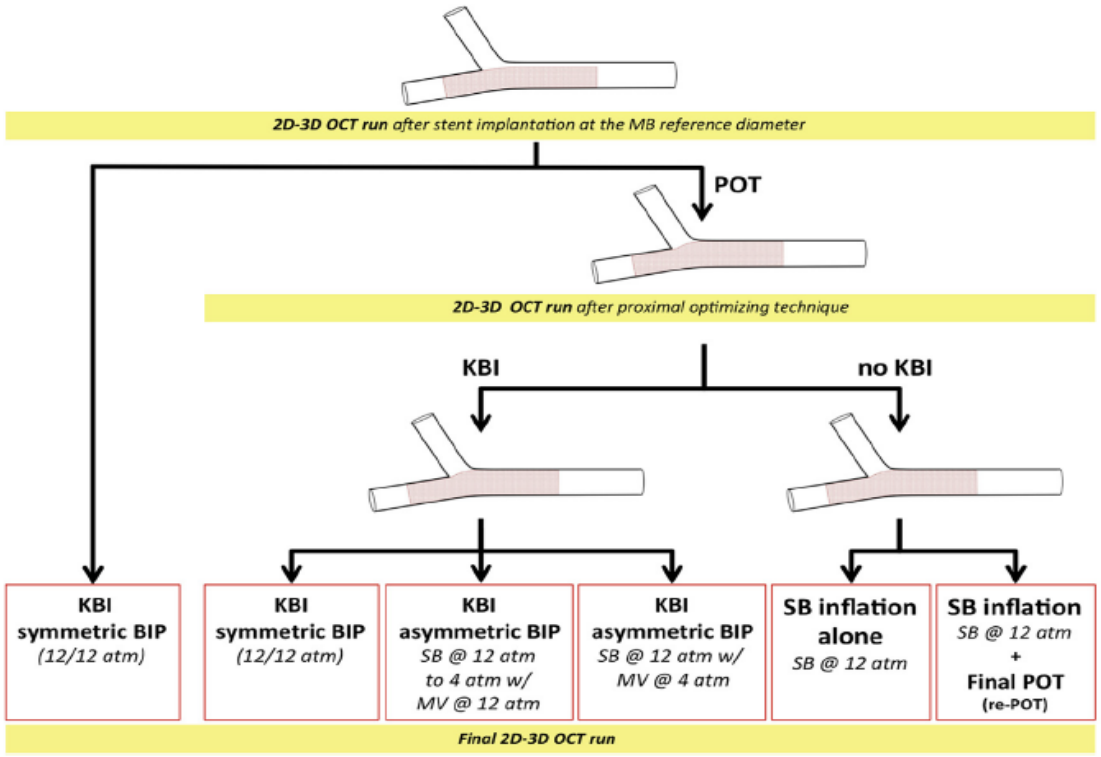
(jailed side branch lesions, n=94)

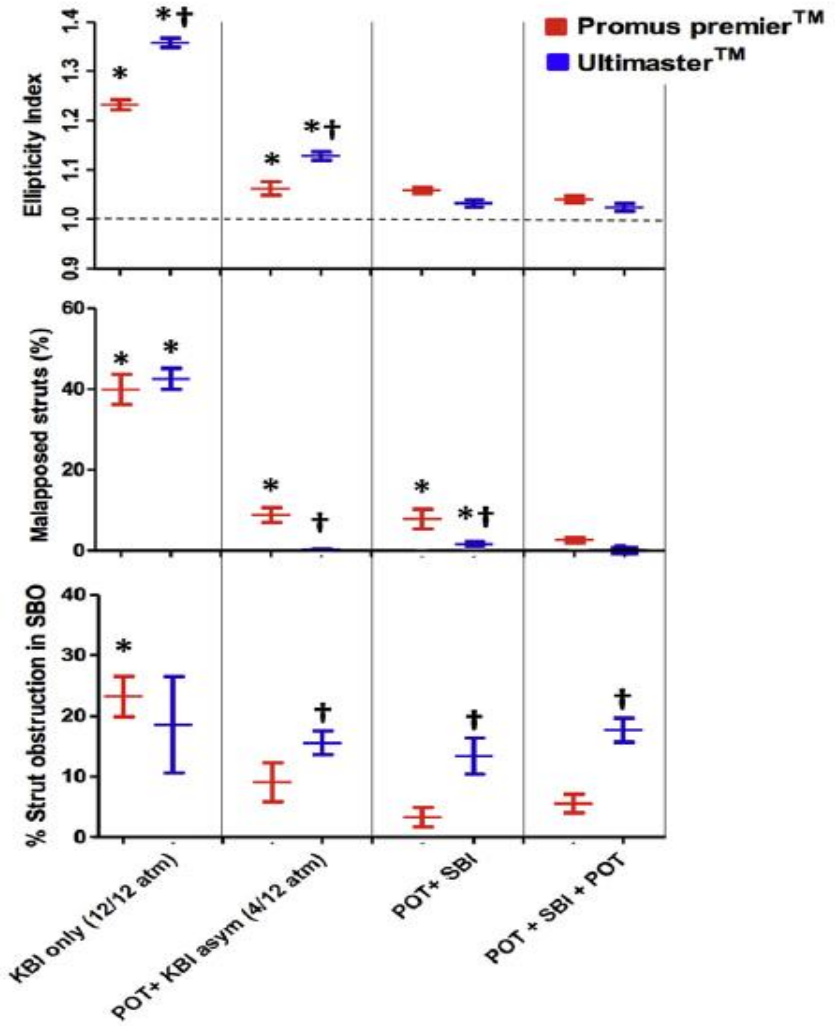


Bon-Kwon Koo et al JACC 2005; 46: 633-7

POT-Side-POT as an alternative to FKBI?

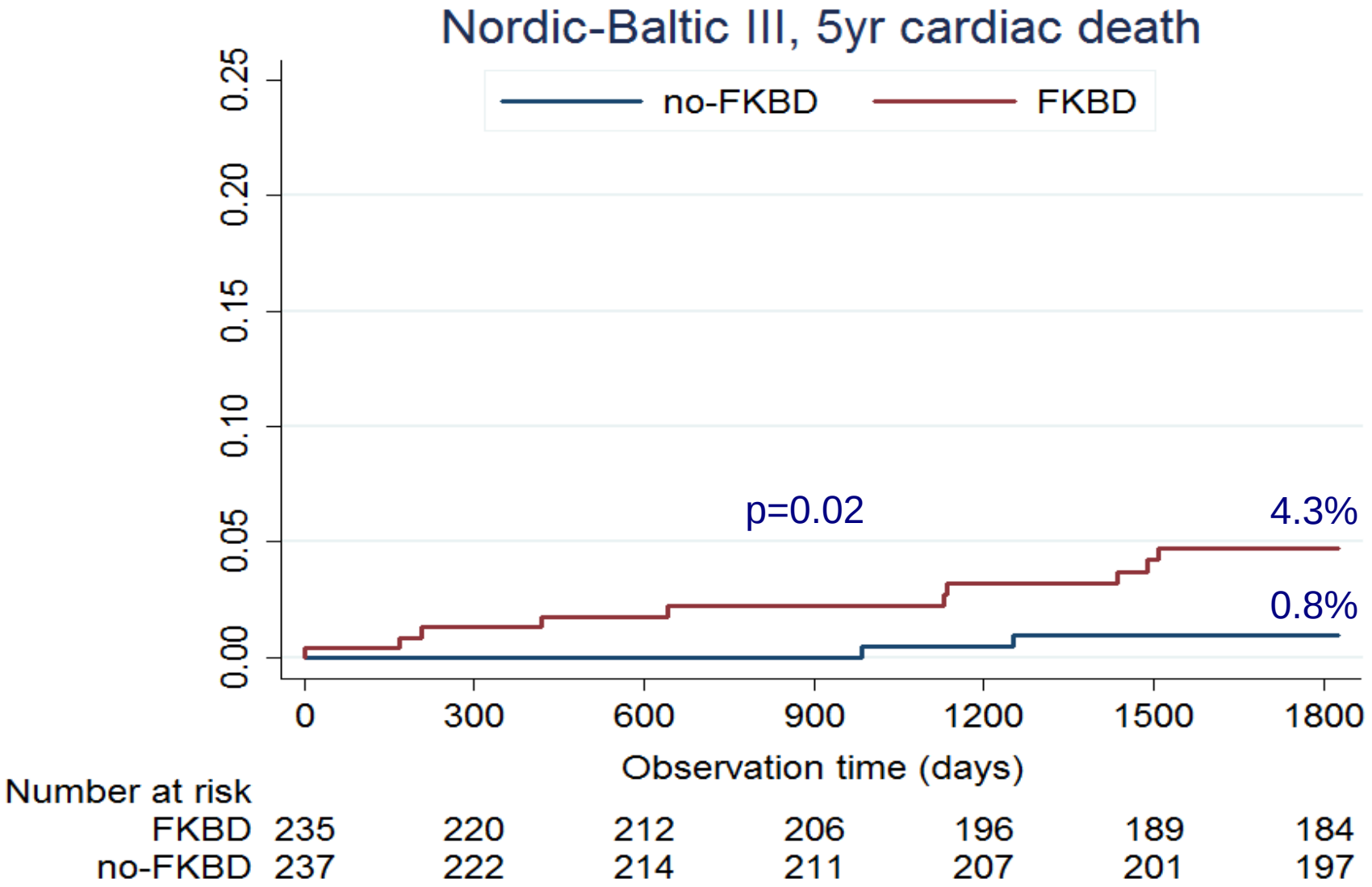
POT-Side-POT is better in the bench test



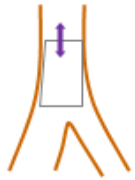
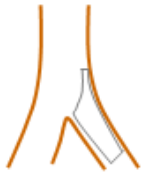
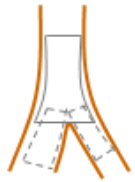
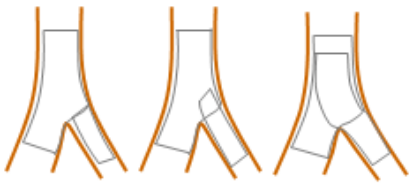
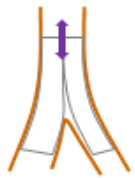
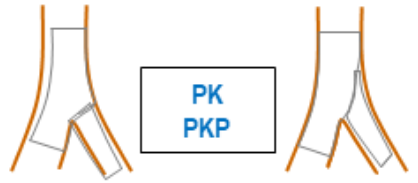


Finet G, JACC CVI 2015

Nordic-Baltic Bifurcation Study III

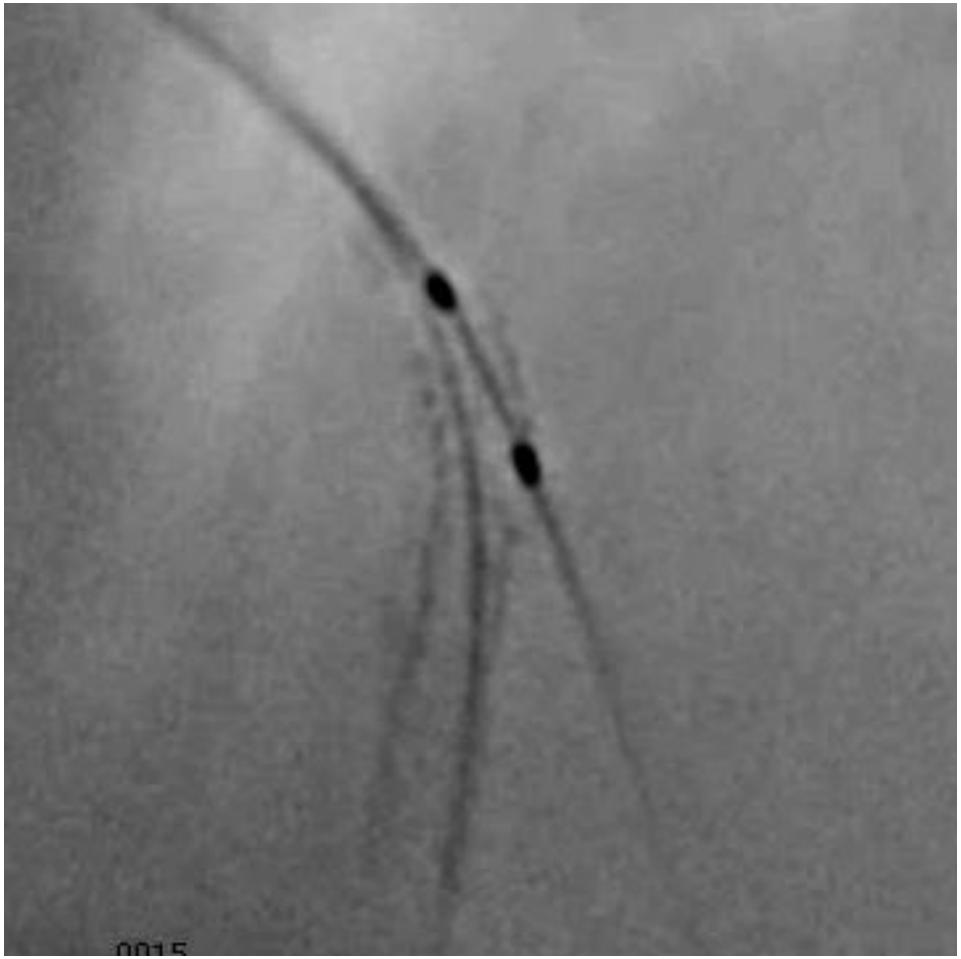


SB stenting

	M Main prox. first	**A** Main Across side first (Provisional)	**D** Double prox. lumen	**S** Side branch first
1st stent	 PM stenting	 MB cross-over stenting		 SB ostial stenting
Ballooning	 Skirt (K)	 POT / Side-branch dilation / Kissing S PS PK PSP PKP		S K  Balloon SB crush
2nd-3rd stent, (and further ballooning)	 Extended skirt (K)	 T / TAP / Culotte K KP	 V / SKS	PK PKP  Intentional T stenting / Step/DK crush
Dedicated Device:	Axxess	Bioss LIM, Xposition Stentys, Nile SIR		Capella Side-Guard

T or TAP stenting ?

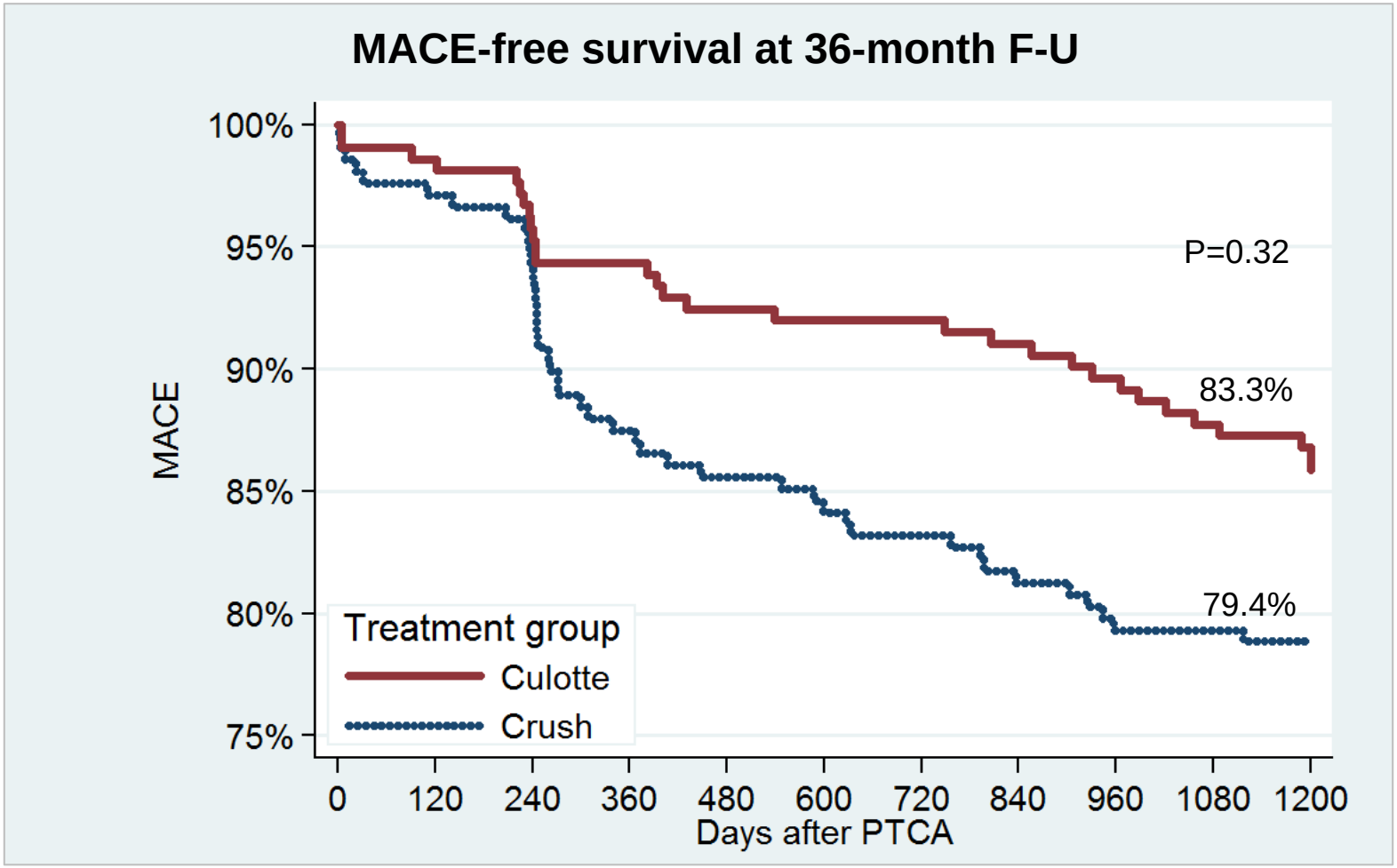
T



TAP

EBC recommendations on elective use of two stent techniques in bifurcations.

Nordic bifurcation II



Kervinen et al. JACC Cardiovasc Interv 11: 1160-5, 2013

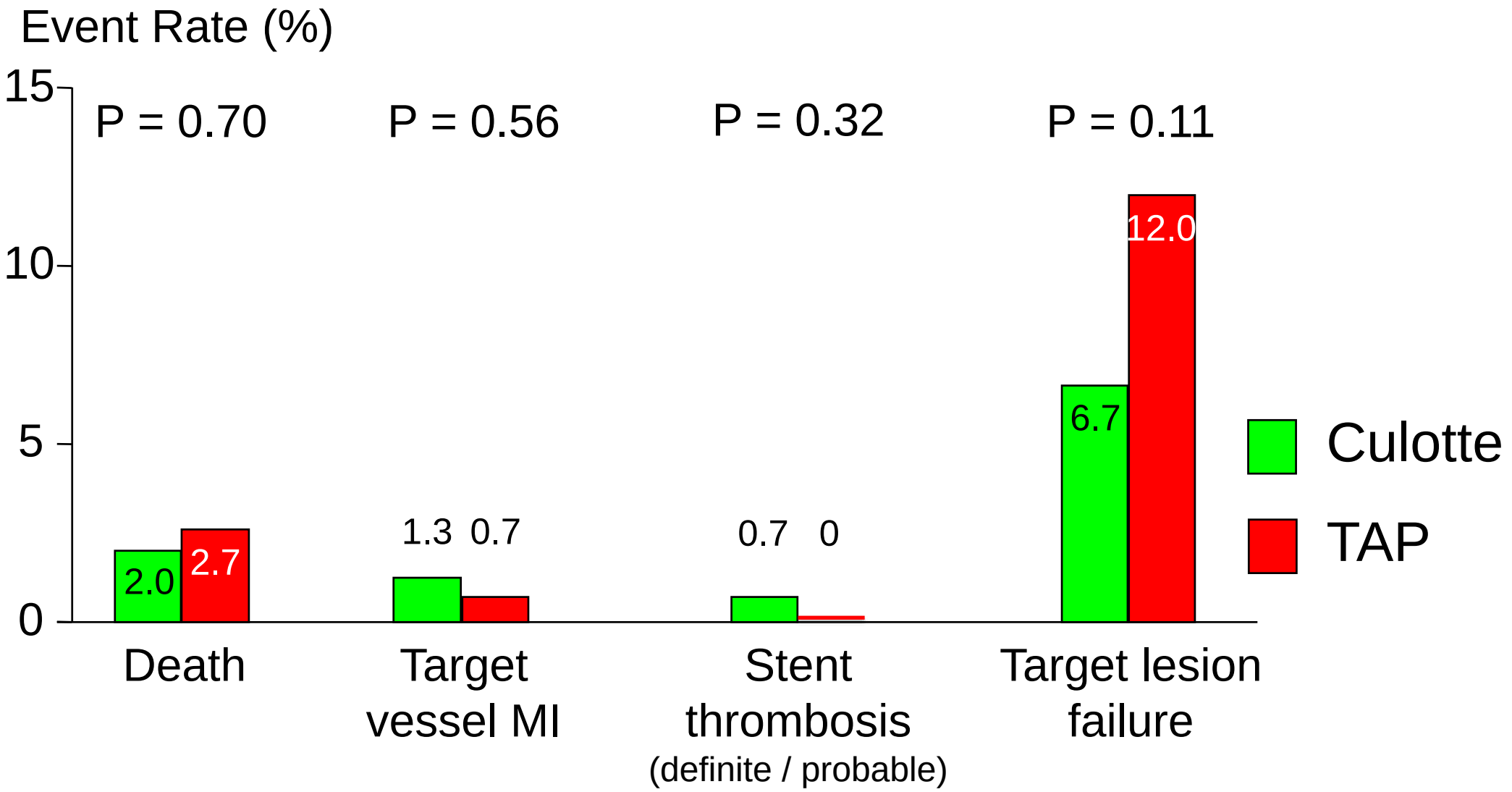
DKCRUSH-III

Clinical follow-up (at 12-month)

	DK crush (n=210)	Culotte (n=209)	p
Composite MACE, n(%)	13(6.2)	34(16.3)	0.001
Cardiac death	2(1.0)	2(1.0)	1.000
MI	7(3.3)	11(5.3)	0.377
TLR	5(2.4)	14(6.7)	0.037
TVR	9(4.3)	23(11.0)	0.016
For non-left main	0	4(1.9)	0.061
For left main	9(4.3)	20(9.6)	0.036
CABG	2(1.0)	0	0.499
Stent thrombosis, n(%)	1(0.5)	2(1.0)	0.623
Definite	0	2(1.0)	0.248
Probable	0	0	NS
Possible	1(0.5)	0	1.000

SL. Chen, J Am Coll Cardiol. 2013 Apr 9;61(14):1482-8

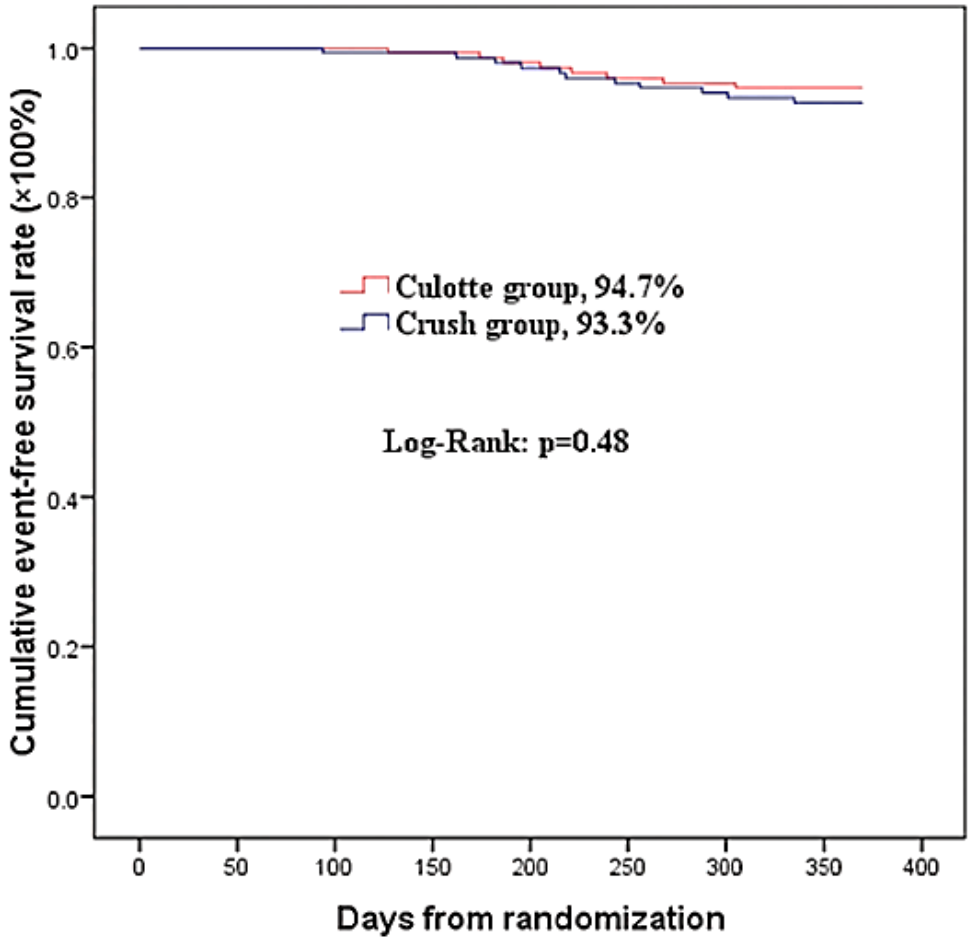
Clinical outcome at 1 year



M. Ferenc, Eur Heart J, 2016 Dec 1;37(45):3399-3405

Randomized Comparison of the Crush Versus the Culotte Stenting for Coronary Artery Bifurcation Lesions

Major adverse cardiac event-free survival rate at 12 months



Original Colombo crush

Original Chevalier culotte (main first)

Zheng Chin Med J 2016;129:505-10

Intracoronary imaging

CORONARY INTERVENTIONS
EXPERT REVIEW

Joint consensus on the use of OCT in coronary bifurcation lesions by the European and Japanese bifurcation clubs

Yoshinobu Onuma[1], MD, PhD; Yuki Katagiri[2], MD; Francesco Burzotta[3], MD; Niels Ramsing Holm[4], MD; Nicolas Amabile[5], MD, PhD; Takayuki Okamura[6], MD, PhD; Gary S. Mintz[7], MD; Olivier Darremont[8], MD; Jens Flensted Lassen[9], MD, PhD; Thierry Lefèvre[10], MD; Yves Louvard[10], MD; Goran Stankovic[11], MD, PhD; Patrick W. Serruys[12]*, MD, PhD

1. Thoraxcenter, Erasmus Medical Center, Rotterdam, the Netherlands; 2. Academic Medical Centre, University of Amsterdam, Amsterdam, the Netherlands; 3. Institute of Cardiology, Catholic University of the Sacred Heart, Rome, Italy; 4. Department of Cardiology, Aarhus University Hospital, Skejby, Aarhus, Denmark; 5. Cardiology Department, Institut Mutualiste Montsouris, Paris, France; 6. Department of Medicine and Clinical Science, Yamaguchi University Graduate School of Medicine, Ube, Japan; 7. Cardiovascular Research Foundation, New York, NY, USA; 8. Clinique St. Augustin, Bordeaux, France; 9. Department of Cardiology, The Heart Centre, Rigshospitalet, University of Copenhagen, Copenhagen, Denmark; 10. Ramsay Générale de Santé - Institut Cardiovasculaire Paris Sud, Hopital Privé Jacques Cartier, Massy, France; 11. Department of Cardiology, Clinical Center of Serbia, and Medical Faculty, University of Belgrade, Belgrade, Serbia; 12. International Centre for Circulatory Health, NHLI, Imperial College London, London, United Kingdom

EuroIntervention 2019;14:e1568-e1577 published online jaa November 2018 ■ publis

EXPERT REVIEW
CORONARY INTERVENTIONS

Intravascular ultrasound in the evaluation and treatment of left main coronary artery disease: a consensus statement from the European Bifurcation Club

Gary S. Mintz[1], MD; Thierry Lefevre[2], MD; Jens F. Lassen[3], MD; Luca Testa[4], MD; Manuel Pan[5], MD; Jag Singh[6], MD; Goran Stankovic[7], MD; Adrian P. Banning[8]*, MD

1. Cardiovascular Research Foundation, New York, NY, USA; 2. Ramsay Générale de Santé, Institut Cardiovasculaire Paris Sud, Massy, France ; 3. Department of Cardiology, The Heart Centre, Rigshospitalet, University of Copenhagen, Copenhagen, Denmark; 4. Department of Cardiology, IRCCS Policlinico S. Donato, San Donato Milanese, Milan, Italy; 5. Department of Cardiology, Reina Sofia Hospital, University of Cordoba (IMIBIC), Cordoba, Spain; 6. Division of Cardiology, Department of

EuroIntervention 2018;14:e467-e474 published online jaa April 2018 ■ published

The Left Main

EuroIntervention 2018;14:112-120

EXPERT REVIEW
CORONARY INTERVENTIONS

Percutaneous coronary intervention in left main coronary artery disease: the 13th consensus document from the European Bifurcation Club

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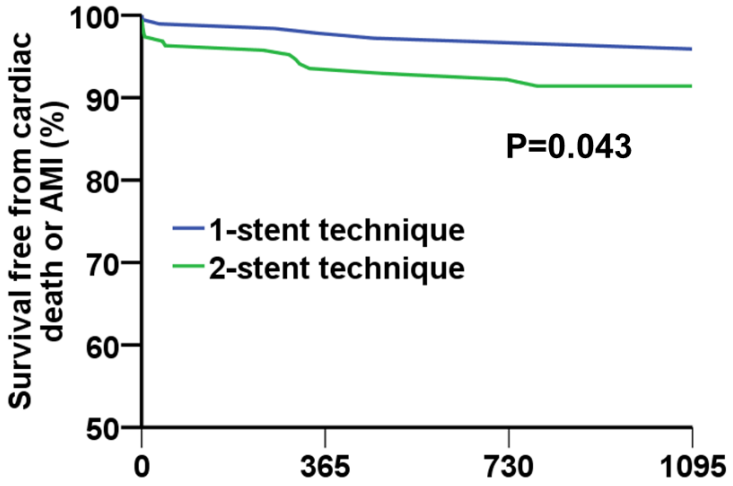
The complete list of references is published online at: http://www.pcronline.com/eurointervention/134th_issue/16

COBIS II

1-stent vs. 2-stent in left main bifurcation

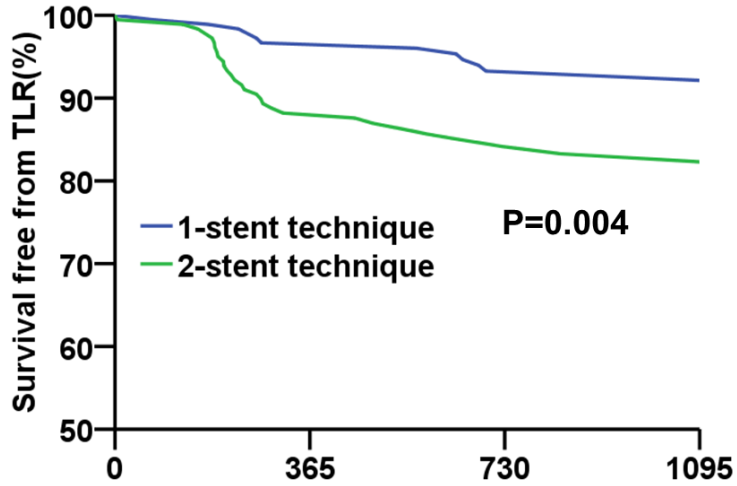
PS-matched population

Cardiac death or MI



No. at risk				
1-stent	192	169	136	79
2-stent	192	164	127	73

Target Lesion Revascularization



No. at risk				
1-stent	192	165	129	77
2-stent	192	149	109	66

The conservative provisional approach is still the standard strategy to treat left main bifurcation.

Song YB, Gwon HC, JACC CVI 2014

DK Crush V conclusion

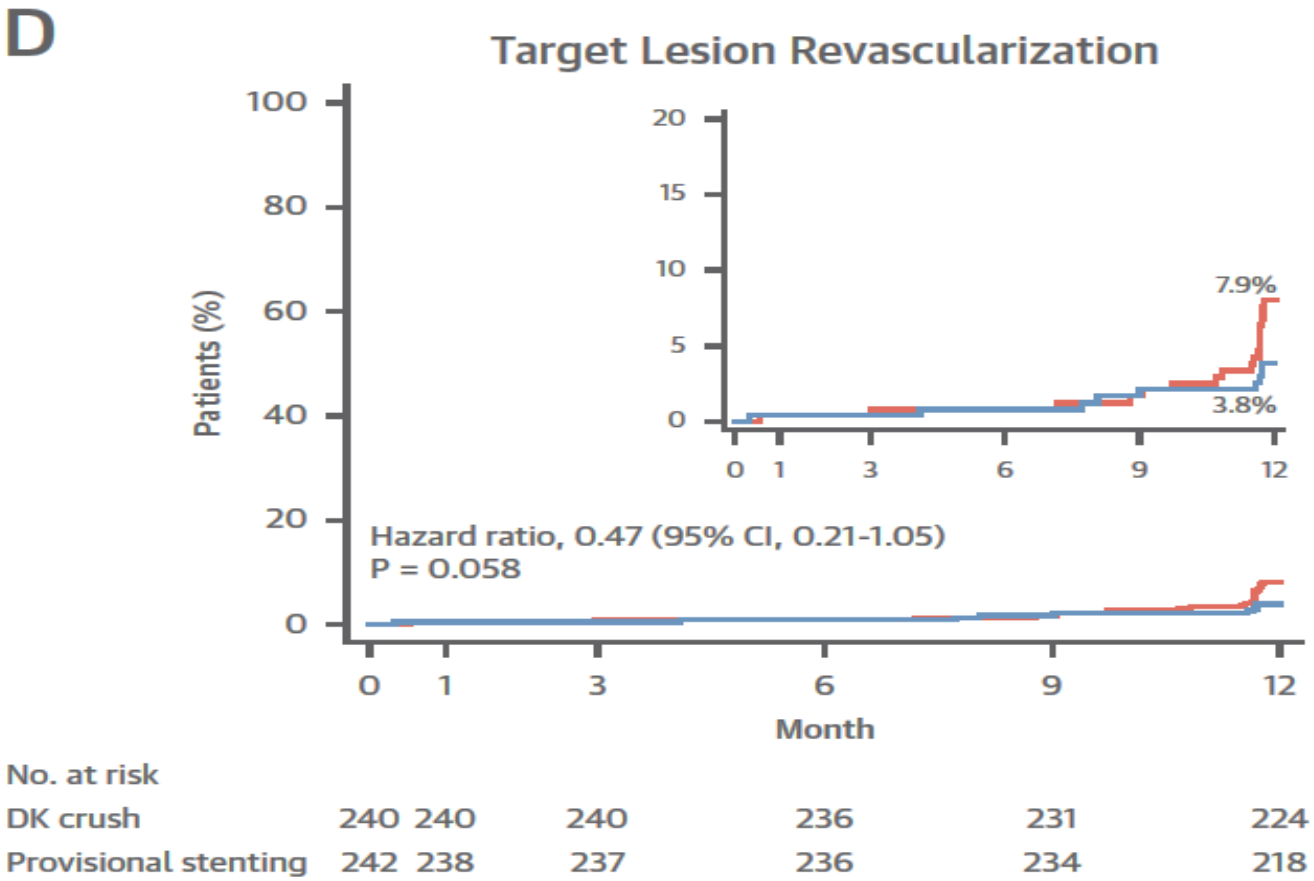
In the present multicenter randomized trial, a planned DK crush 2-stent strategy reduced TLF at 1-year compared with a PS strategy in patients with **true distal LM bifurcation lesions**

Chen SL, J Am Coll Cardiol 2017;70:2605–17

ESC-EACTS 2018 recommendations

Recommendations	Class[a]	Level[b]
Stent implantation in the main vessel only, followed by provisional balloon angioplasty with or without stenting of the side branch, is recommended for PCI of bifurcation lesions.[654–658]	I	A
Percutaneous revascularization of CTOs should be considered in patients with angina resistant to medical therapy or with a large area of documented ischaemia in the territory of the occluded vessel.[629,659–663]	IIa	B
In true bifurcation lesions of the left main, the double-kissing crush technique may be preferred over provisional T-stenting.[620]	IIb	B

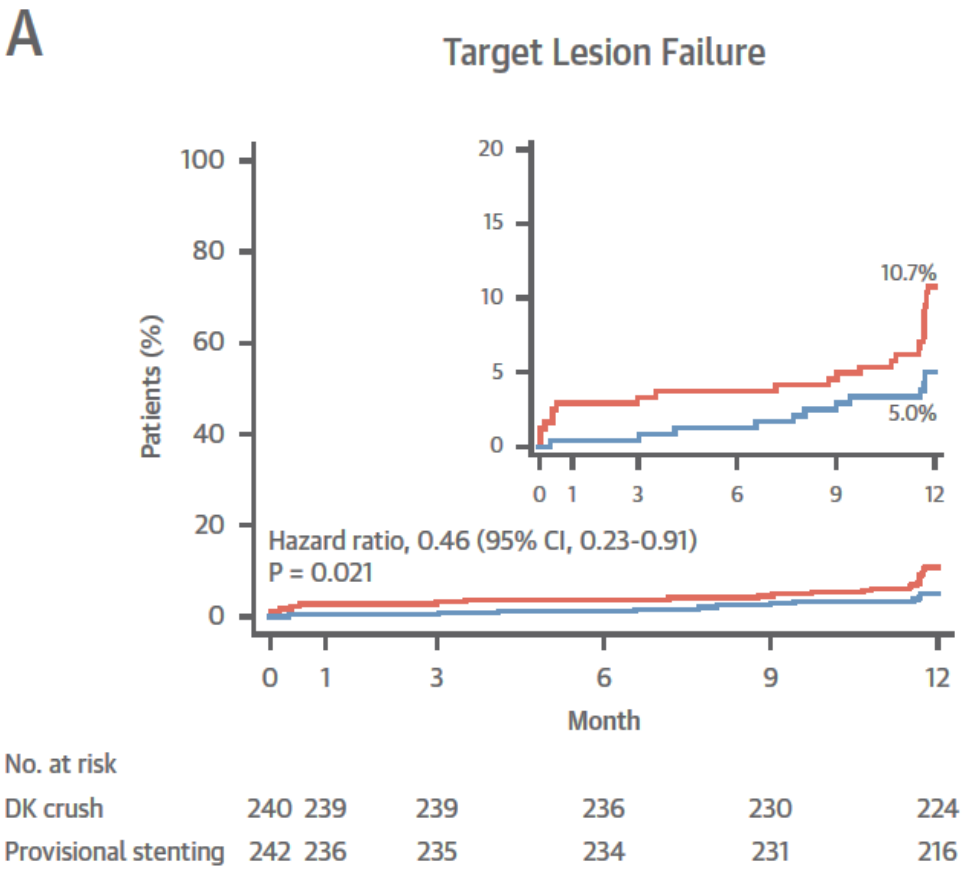
DKCrush vs Provisional stenting for LM distal bifurcation lesions (1,1,1-0,1,1): DKCRUSH-V randomized trial

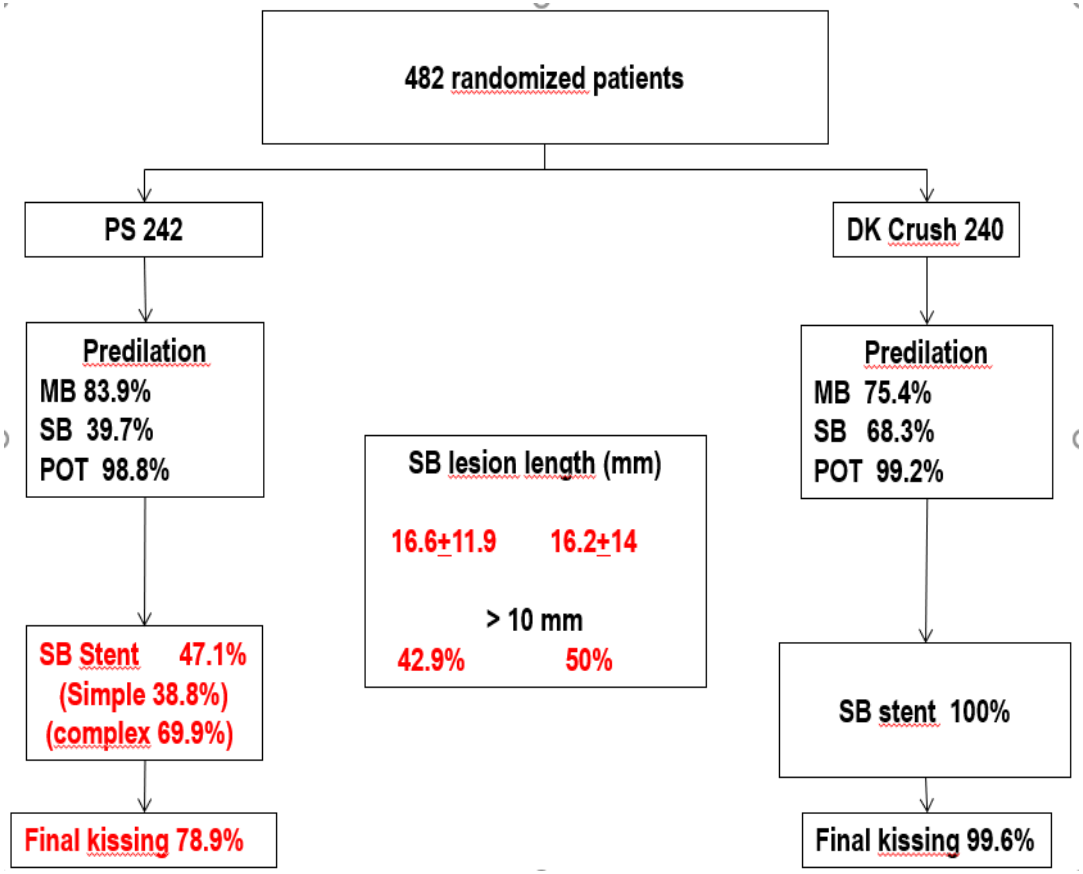


Angiographic FU in 65.3% and 66.3% at 367±49 days and 371 ± 52 days, in PS and DK-Crush respectively

Chen, J Am Coll Cardiol 2017;70:2605–17

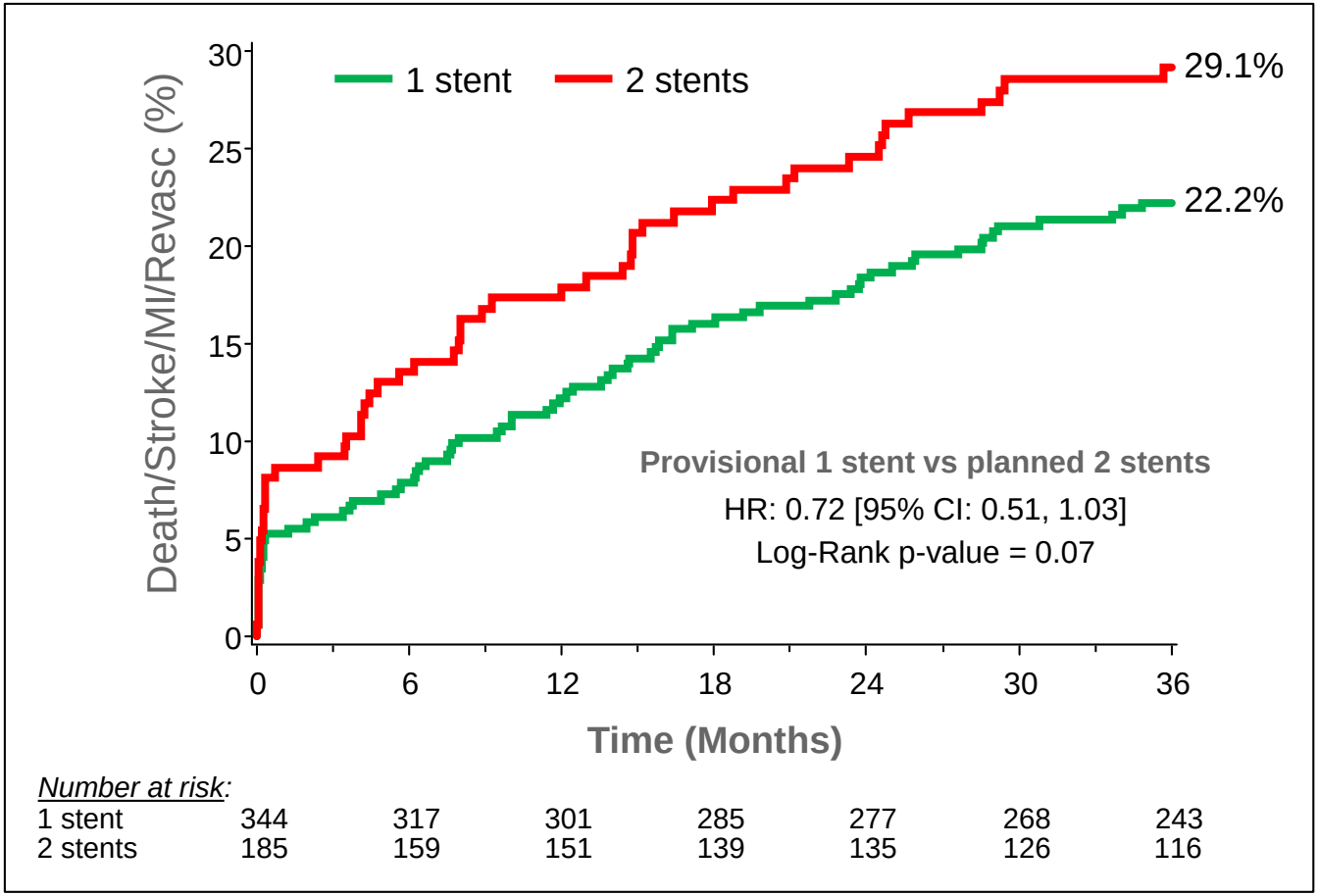
Treatment in DK Crush V





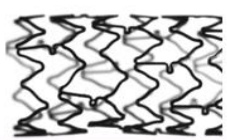
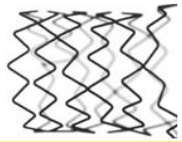
Chen, J Am Coll Cardiol 2017;70:2605–17

Death, MI, Stroke or IDR Through 3 Years



Kandzari TCT 2017

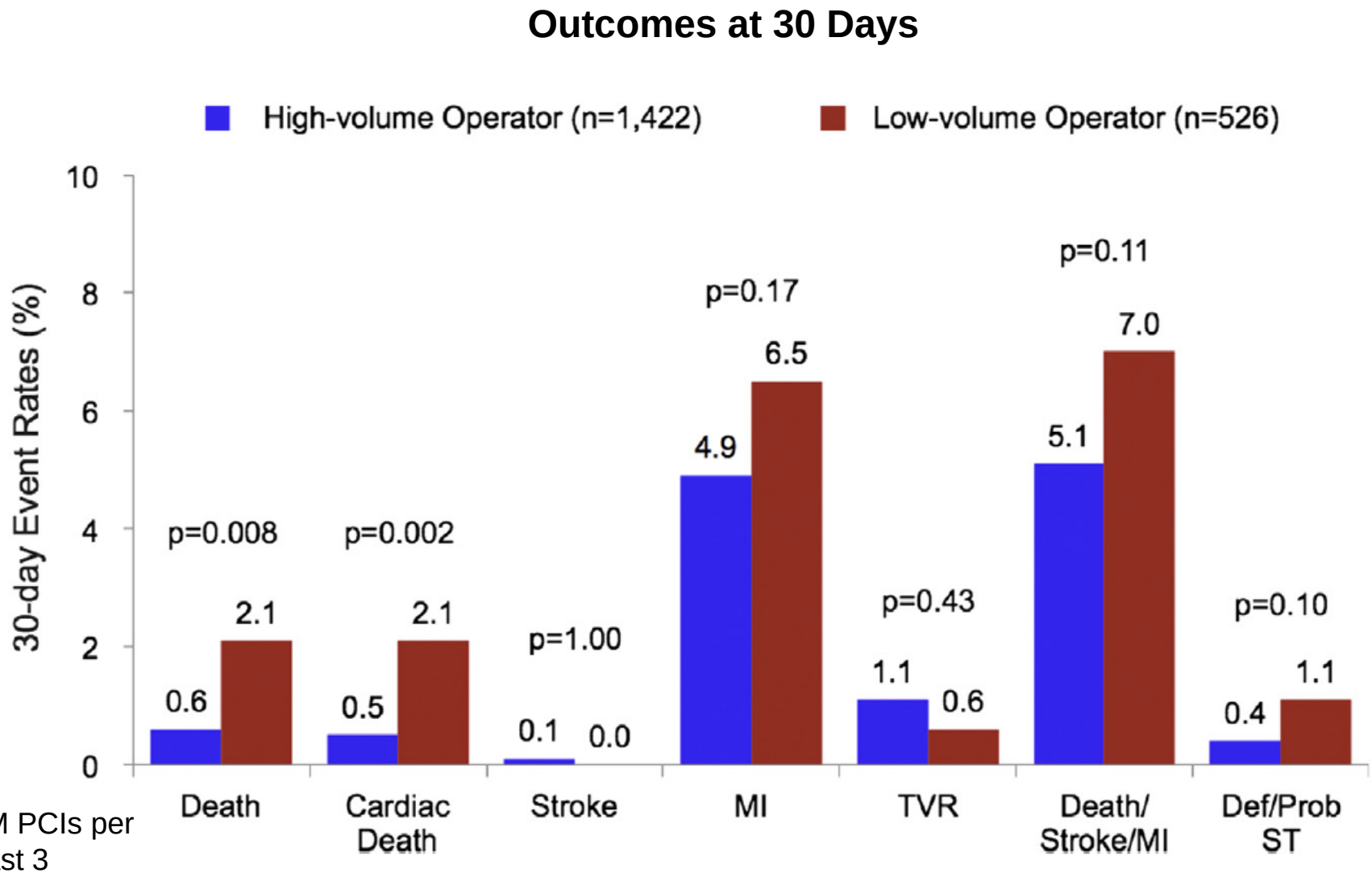
DES Designs Overexpansion

Balloon Max Size		 Synergy	 Xpedition	 Res. Onyx	 Ultimaster	 BioMatrix A	 Orsiro
4.0	2.25	Small vessel (8 crowns, 2-4 connectors) *Expansion: 3.6mm*	Small vessel (6 crowns, 3 connectors) *Expansion: 4.1mm*	Small vessel workhorse (6.5 crowns, 2 connectors) *Expan: 3.3mm*	Small vessel (8 crowns, 2 connectors) *Expansion: 4.3mm*	Small vessel (6 crowns, 2 connectors) *Expansion: 4.1mm*	Small vessel (6 crowns, 3 connectors) *Expansion: 4.0mm*
	2.50						
5.0	2.75			Medium vessel workhorse (8.5 crowns, 2 connectors) *Expansion: 4.4mm*			
	3.00	Workhorse (8 crowns, 2-4 connectors) *Expansion: 4.2mm*					
	3.50		Large vessel (9 crowns, 3 connectors) *Expansion: 5.6mm*	Large vessel (9.5 crowns, 2.5 connectors) *Expansion: 5.6mm*	Large vessel (8 crowns, 2 connectors) *Expansion: 5.8mm*	Large vessel (9 crowns, 3 connectors) *Expansion: 5.9mm*	Large vessel (6 crowns, 3 connectors) *Expansion: 5.3mm*
6.0	4.00	Large vessel (10 crowns, 2-5 connectors) *Exp: 5.7mm*					
	4.50			Extra-Large vessel (10.5 crowns, 2.5 connectors) *Expansion: 6.0mm*			
	5.00						

- *Expansion : inner stent MLD excluding struts*
- *Max balloon size : Maverick 6.0mm at 14 ATM*

Foin, Ng, 2016

Impact of operator experience and volume on outcomes after LMCA PCI



At least 15 LM PCIs per year for at least 3 consecutive years

Bo Xu, J Am Coll Cardiol Intv 2016;9:2086–93