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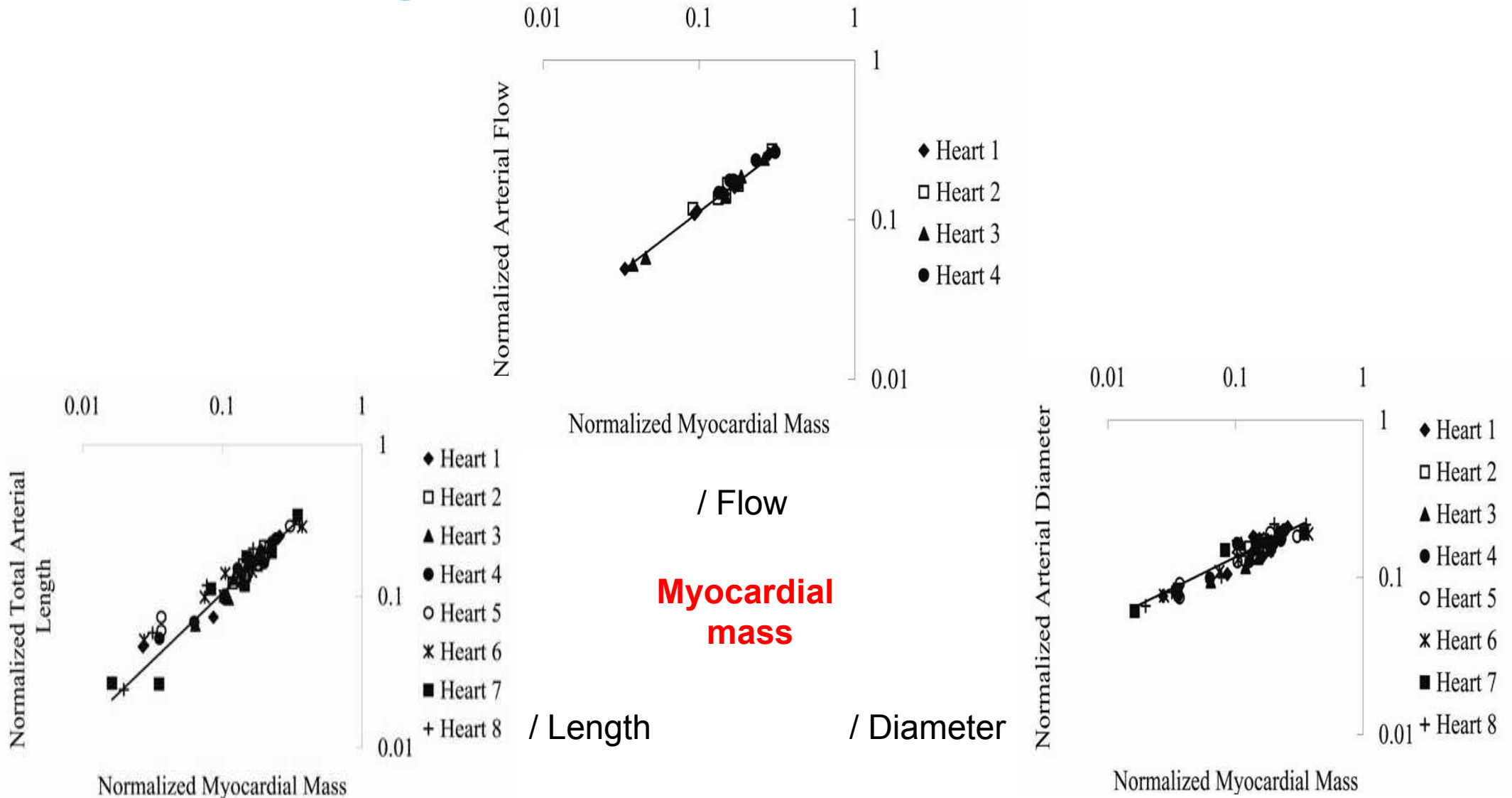
European Guidelines for Treatment of Bifurcation Coronary Lesions

Y. Louvard, ICPS, Massy, France

TCT Asia Pacific 2010

No conflict of interest to declare

Side branch diameter and length can both be used as surrogates for volume of muscle at risk



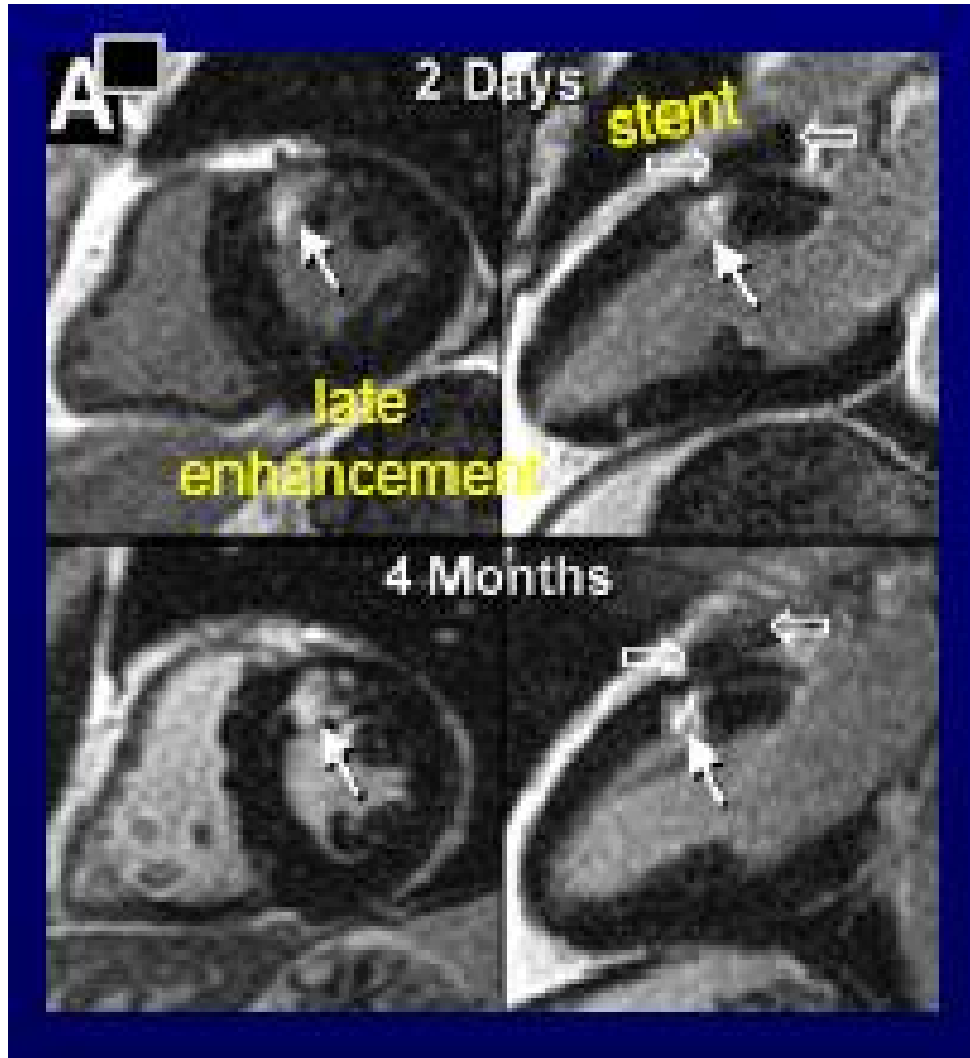
SB diameter as an index of MI

$$\% \text{Infarct}_{\text{artery}} = M_{\text{SB}} / M_{\text{MP}} \times 100 = \\ (\text{CSA}_{\text{SB}} / \text{CSA}_{\text{MP}})^{4/3} \times 100$$

where SB-Side branch; MP-Most proximal artery (e.g., LAD, LCx or RCA)

- **A quantitative relation between SB diameter/area and %Infarct** (relative to main artery or entire heart) exists in swine hearts and needs to be established in patients
- **Correlate with clinical biomarkers** (biological, molecular, imaging, etc.)

Microinfarction after minor SB occlusion



Side branch < 1,5 mm / CK 260 U/l

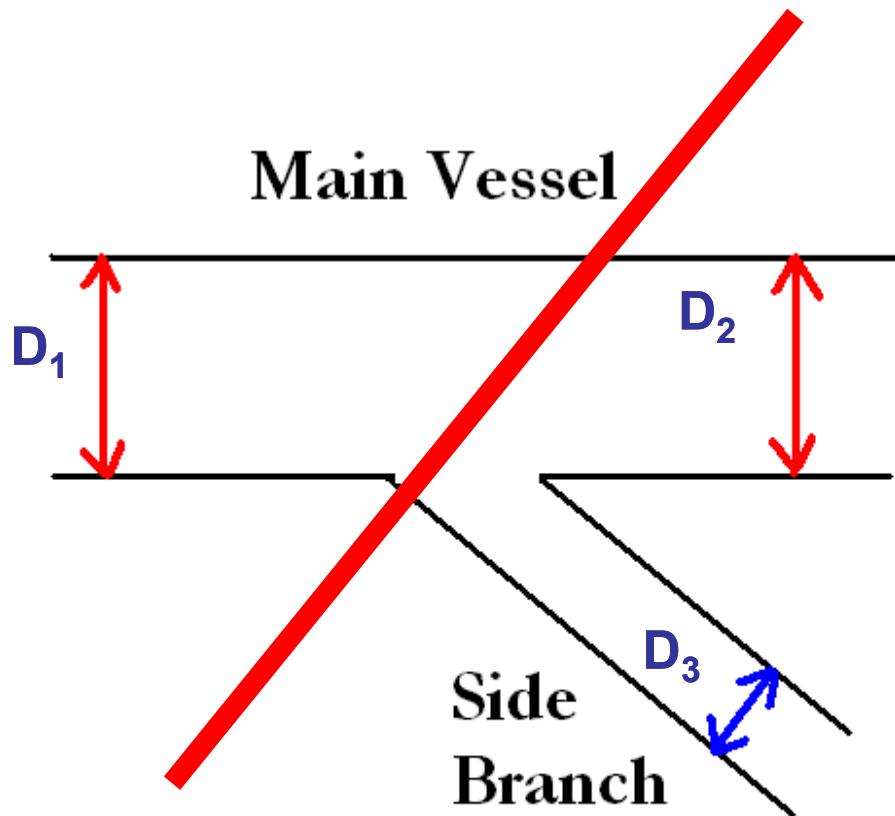
How to Define a Bifurcation Lesion ?

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

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

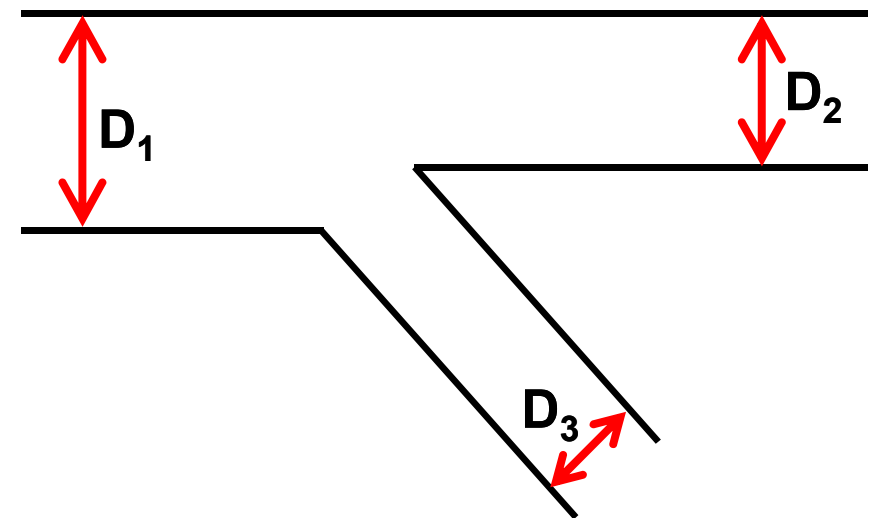


Bifurcation branching law (Murray)

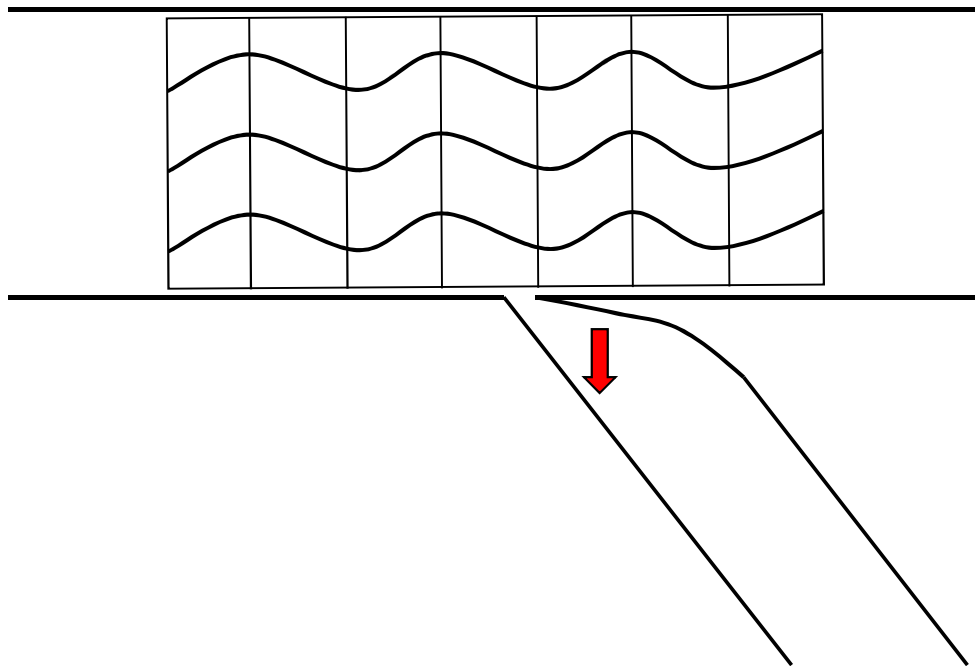


Finet's law

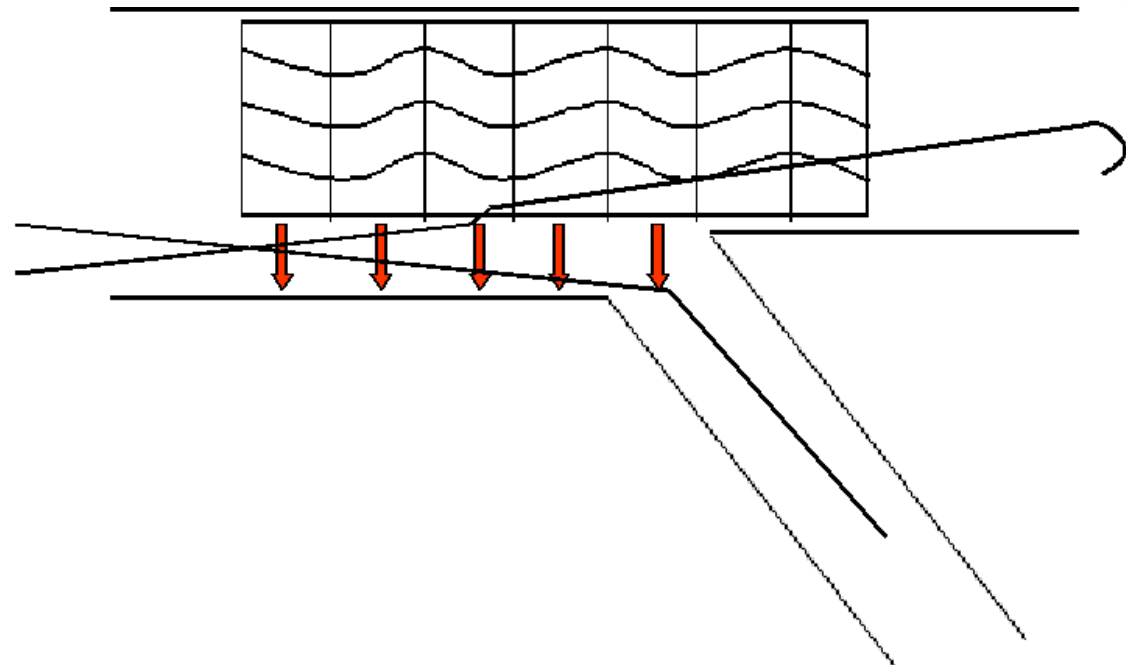
$$D_1 = 0.67(D_2 + D_3)$$



Branching law and main vessel stenting

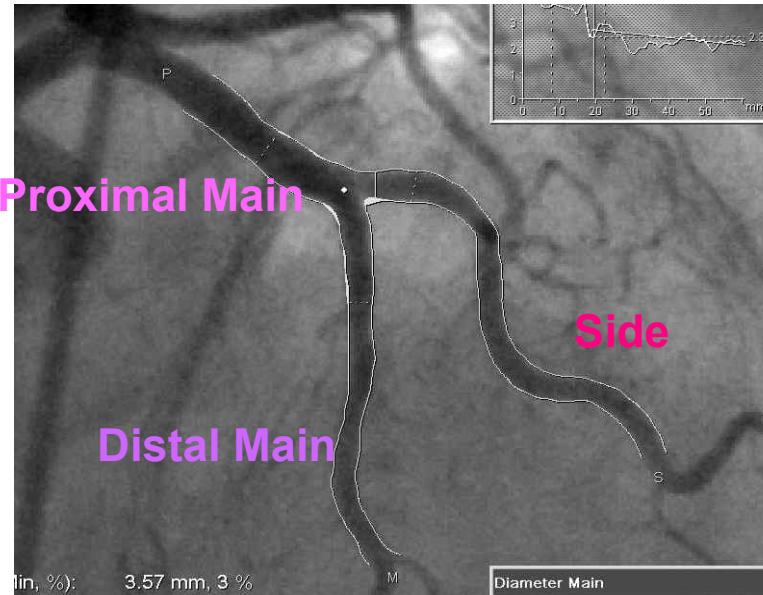


In single stent techniques, the primary stent should be sized according to the distal main vessel diameter

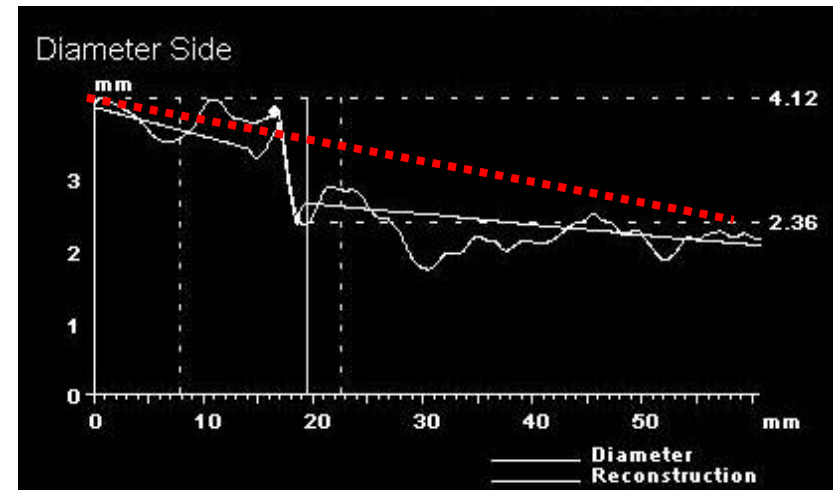
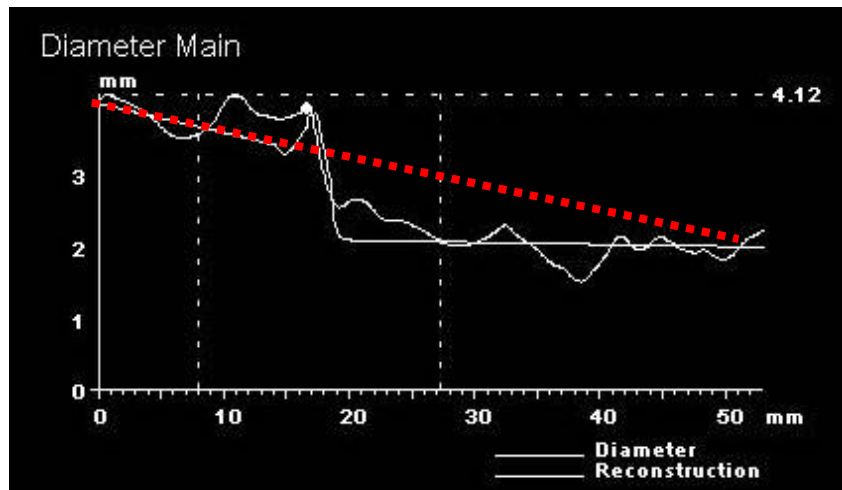


Postdilatation, or kissing balloon inflations, are required to optimise the proximal main vessel stent diameter

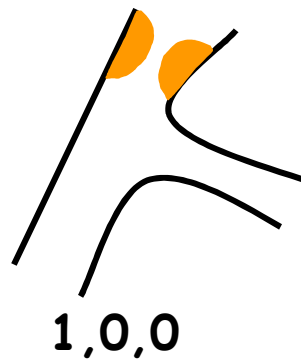
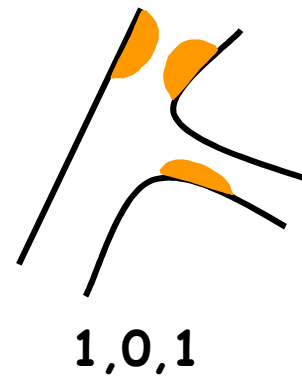
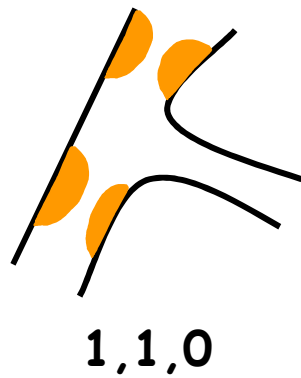
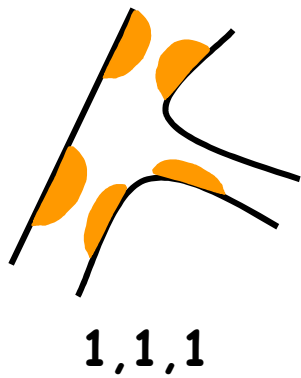
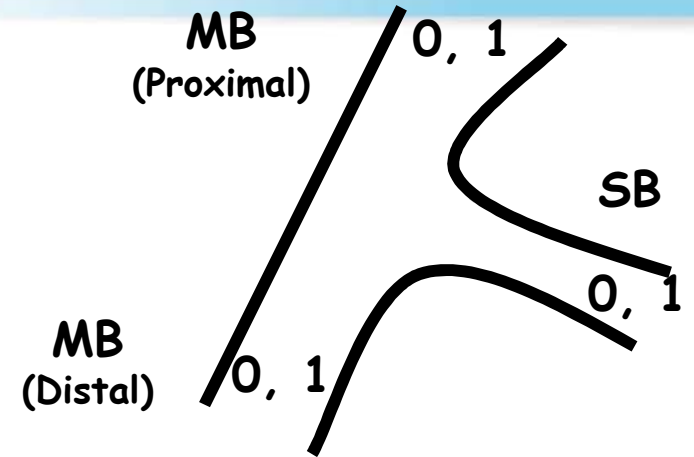
Fractal geometry and QCA



Reference diameter function is not linear

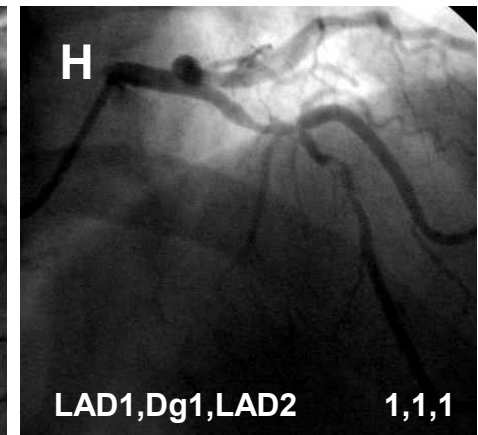
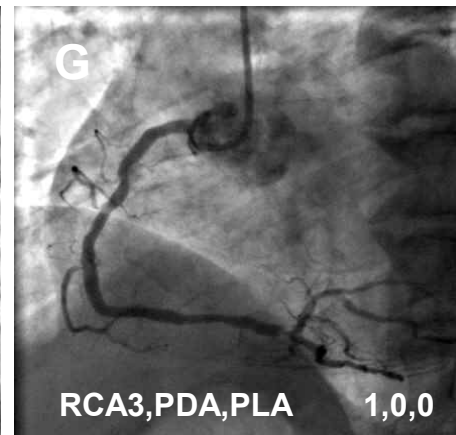
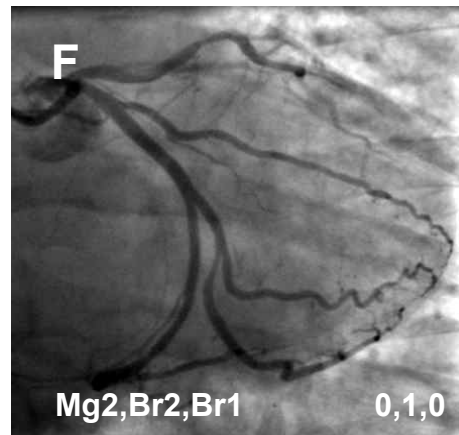
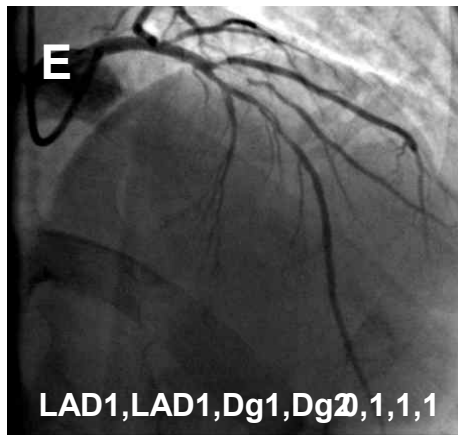
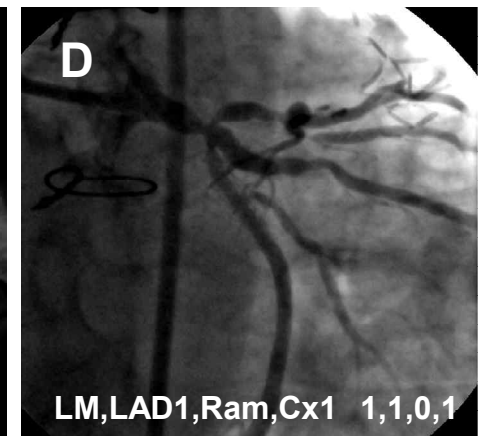
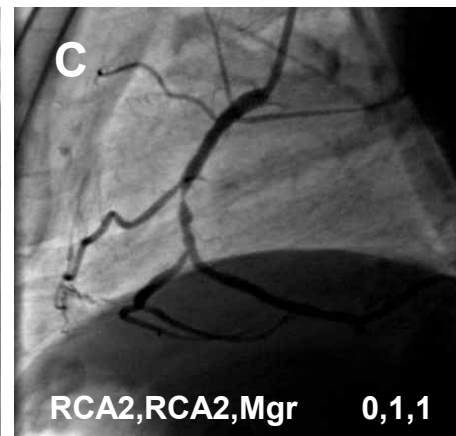
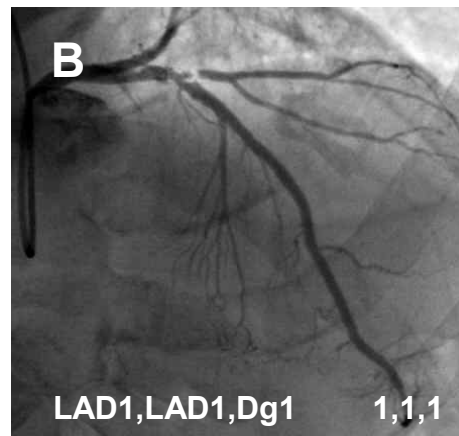
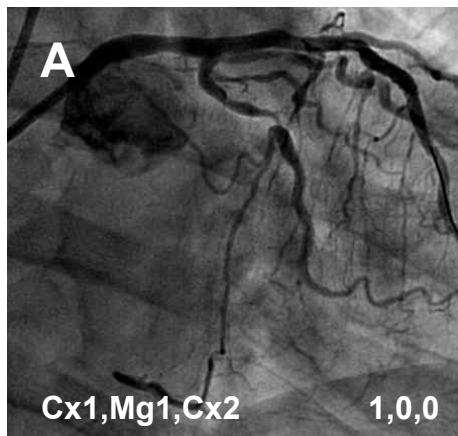


Medina Classification



Name the bifurcation

- Why ?:
- for Medina classification (which branch is the SB ?)
 - for stenting technique definition
 - for intention to treat analysis



MADS classification of bifurcation stenting techniques

	M Main prox. first	A Main A cross side first	D Distal first	S Side branch first		
1 Stent	 PM stenting	 MB stenting across SB	 DM stenting	 SB ostial stenting		
After balloon	 Skirt	 MB stenting + SB balloon	 $\frac{1}{2}$ V	 SB minicrush	 SB crush	
2 Stents		 Elective T stenting	 V stenting	 Syst. T Stenting	 Minicrush	 Crush
3 Stents	 Extended V	 Culotte	 Trousers legs and seat			

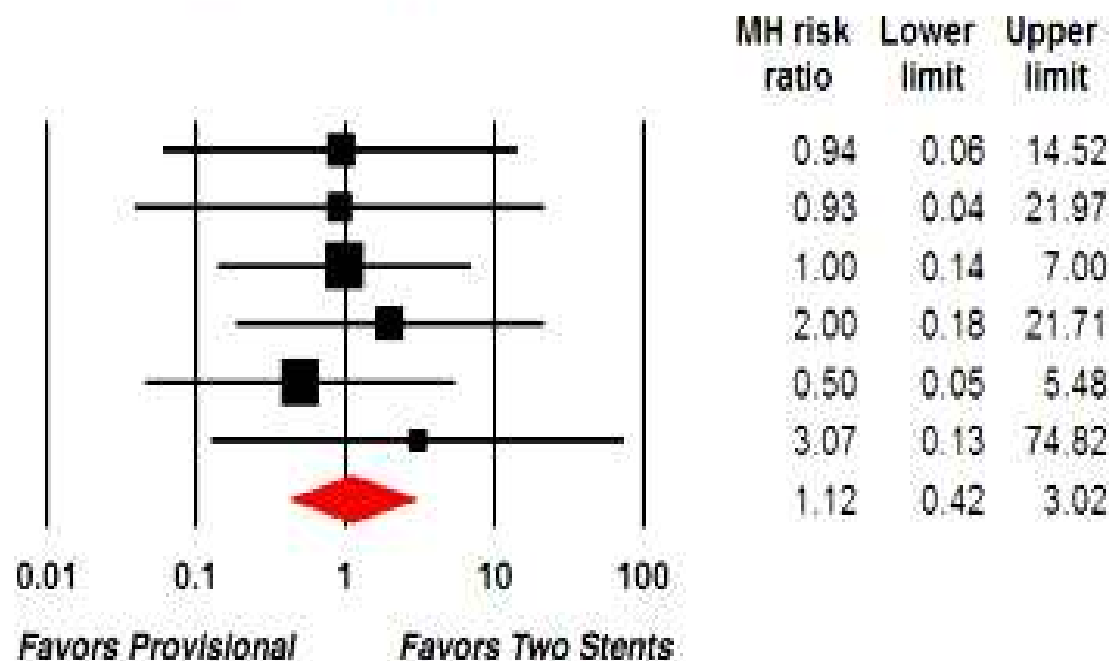
Bifurcation Stenting with DES: A Meta-Analysis

A.

Death

Study	Year	Events / Total	
		Provisional	Two stents
Pan et al.	2004	1 / 47	1 / 44
Colombo et al.	2004	0 / 22	1 / 63
NORDIC	2006	2 / 207	2 / 206
Ferenc et al.	2008	2 / 101	1 / 101
BBC ONE	2008	1 / 250	2 / 250
CACTUS	2009	1 / 173	0 / 177
Overall		7 / 800	7 / 841

MH risk ratio and 95% CI



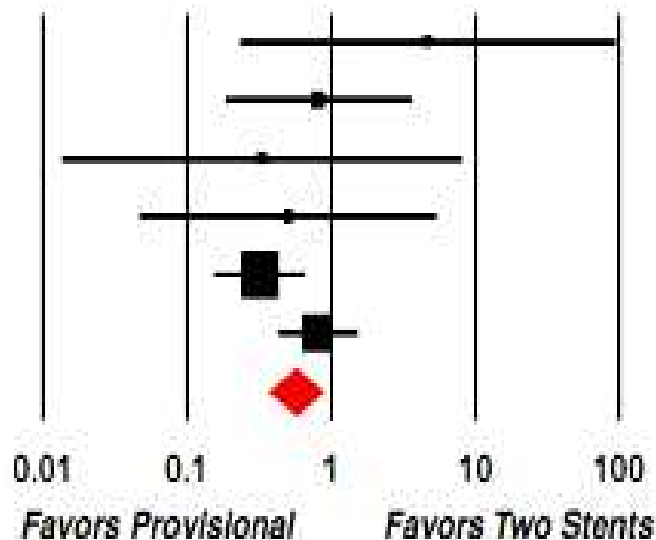
Test for heterogeneity: $Q=1.1$, $df=5$, $P=0.96$ $I^2=0\%$
 Test for overall effect: $Z=0.23$, $P=0.82$

Fixed Effects Model

Bifurcation Stenting with DES: A Meta-Analysis

B. Myocardial Infarction

Study	Year	Events / Total		MH risk ratio and 95% CI		
		Provisional	Two stents	MH risk ratio	Lower limit	Upper limit
Pan et al.	2004	2 / 47	0 / 44	4.69	0.23	95.00
Colombo et al.	2004	2 / 22	7 / 63	0.82	0.18	3.65
NORDIC	2006	0 / 207	1 / 206	0.33	0.01	8.10
Ferenc et al.	2008	1 / 101	2 / 101	0.50	0.05	5.43
BBC ONE	2008	9 / 250	28 / 250	0.32	0.15	0.67
CACTUS	2009	15 / 173	19 / 177	0.81	0.42	1.54
Overall		29 / 800	57 / 841	0.57	0.37	0.87



Test for heterogeneity: $Q=5.72$, $df=5$, $P=0.33$ $I^2=13\%$

Test for overall effect: $Z=-2.50$, $P=0.01$

Fixed Effects Model

Bifurcation Stenting with DES: A Meta-Analysis

C.

TLR

Study	Year	Events / Total		MH risk ratio and 95% CI	Statistics for each study		
		Provisional	Two stents		MH risk ratio	Lower limit	Upper limit
Pan et al.	2004	1 / 47	2 / 44		0.47	0.04	4.98
Colombo et al.	2004	1 / 22	6 / 63		0.48	0.06	3.75
NORDIC	2006	4 / 207	2 / 206		1.99	0.37	10.75
Ferenc et al.	2008	11 / 101	9 / 101		1.22	0.53	2.82
BBC ONE	2008	14 / 250	18 / 250		0.78	0.40	1.53
CACTUS	2009	11 / 173	13 / 177		0.87	0.40	1.88
Overall		42 / 800	50 / 841		0.91	0.61	1.35

Test for heterogeneity: $Q=2.2, df=5, P=0.82, I^2=0\%$
 Test for overall effect: $Z= -0.49, P=0.63$

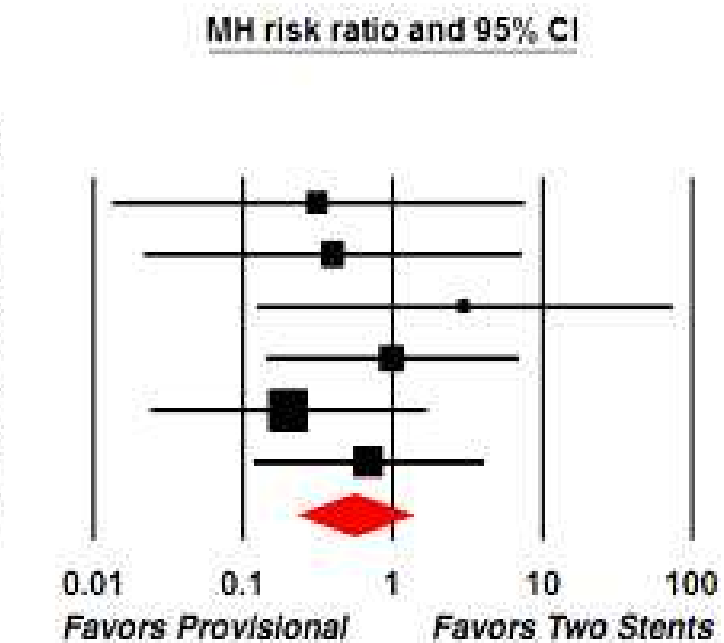
0.01 0.1 1 10 100
 Favours Provisional Favours Two Stents

Fixed Effects Model

Bifurcation Stenting with DES: A Meta-Analysis

E. Stent Thrombosis

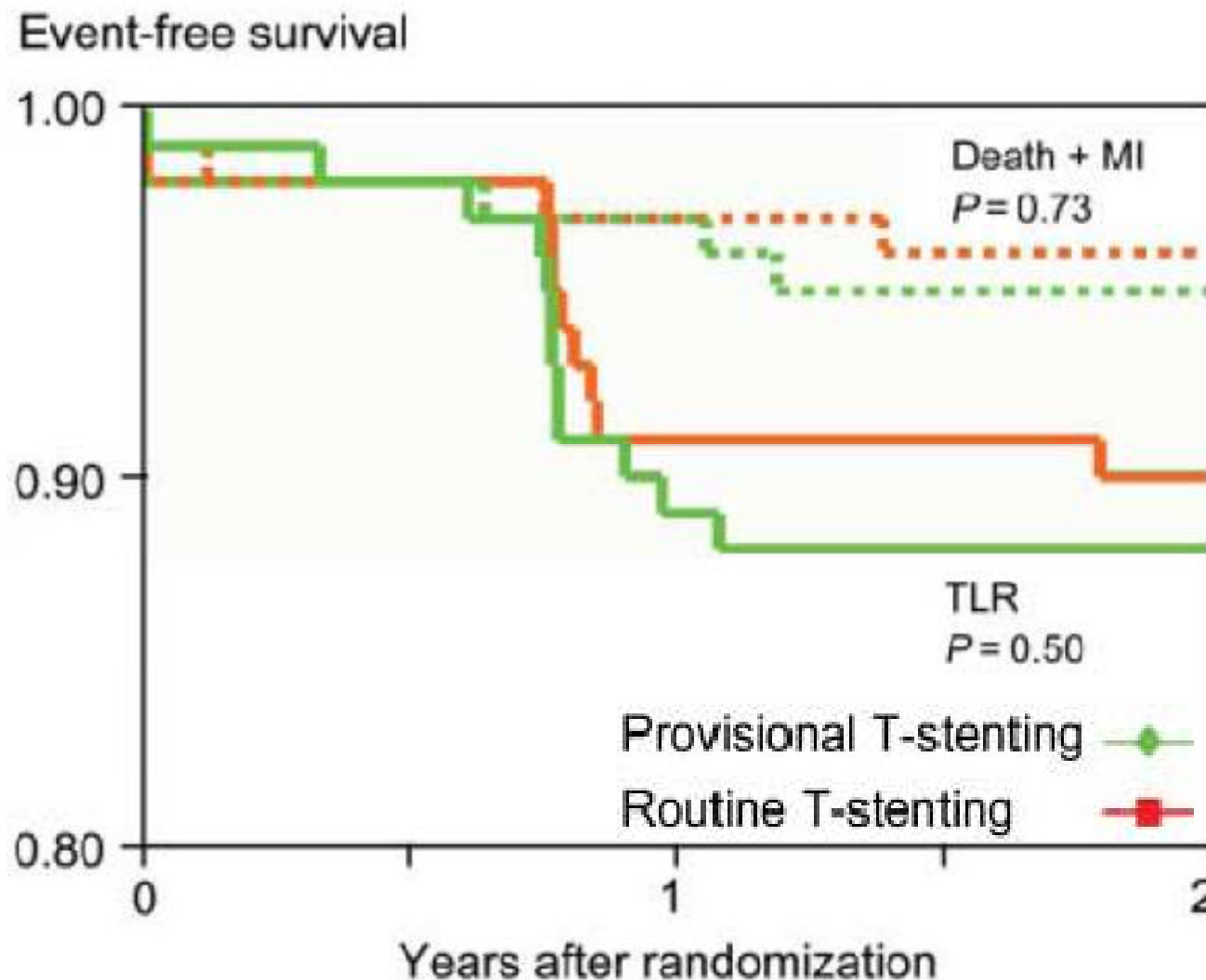
Study	Year	Events / Total		MH risk ratio and 95% CI		
		Provisional	Two stents	MH risk ratio	Lower limit	Upper limit
Pan et al.	2004	0 / 47	1 / 44	0.31	0.01	7.47
Colombo et al.	2004	0 / 22	3 / 63	0.40	0.02	7.40
NORDIC	2006	1 / 207	0 / 206	2.99	0.12	72.87
Ferenc et al.	2008	2 / 101	2 / 101	1.00	0.14	6.96
BBC ONE	2008	1 / 250	5 / 250	0.20	0.02	1.70
CACTUS	2009	2 / 173	3 / 177	0.68	0.12	4.03
Overall		6 / 800	14 / 841	0.56	0.23	1.35



Test for heterogeneity: $Q=2.2$, $df=3$, $P=0.52$ $I^2=0\%$
 Test for overall effect: $Z= -0.76$, $P=0.45$

Fixed Effects Model

Randomized trial on routine vs. Provisional T-stenting in the treatment of de novo coronary bifurcation lesions (BBK)



More stent thrombosis with complex techniques ?



Predictors of LST / VLST

Multivariable analysis

LST / VLST in 67 lesions among 16,801 lesions treated exclusively by Cypher

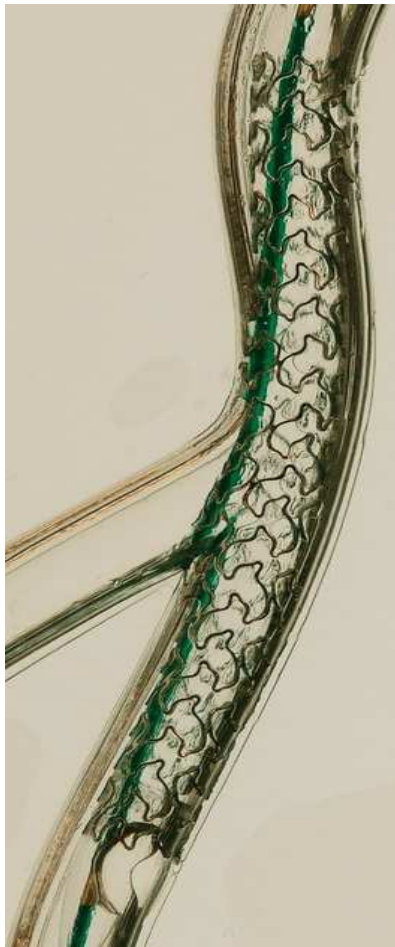
Factors	R.R.	95% C.I.	P Value
Hemodialysis	1.91	(1.29 - 2.65)	0.002
ESRD (e-GFR < 30/Non-HD)	1.81	(1.2 - 2.65)	0.007
Two stents for bifurcation	1.81	(1.17 - 2.59)	0.01

Those variables with p value < 0.1 in the univariable analysis were incorporated into the multivariable model.

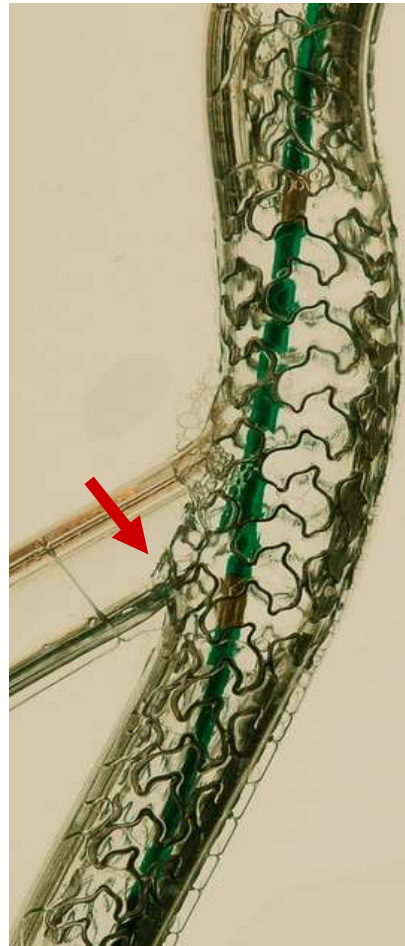
Provisional SB stenting



POT* technique



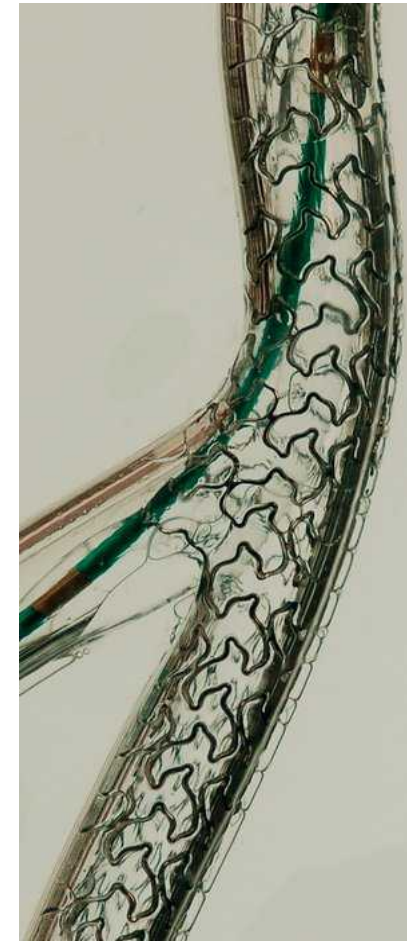
3.0 x 20mm



**Balloon
3.5 x 8mm**



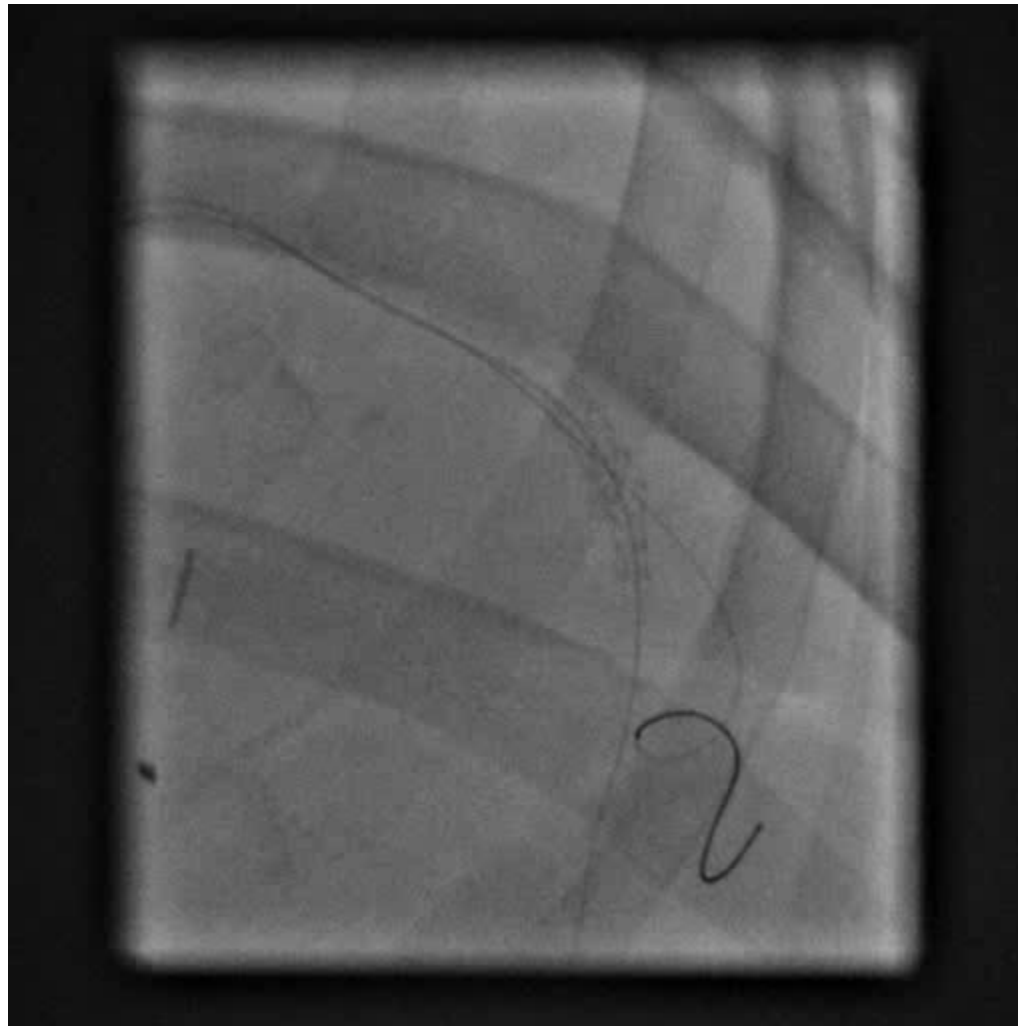
**Carenal cell
entry**



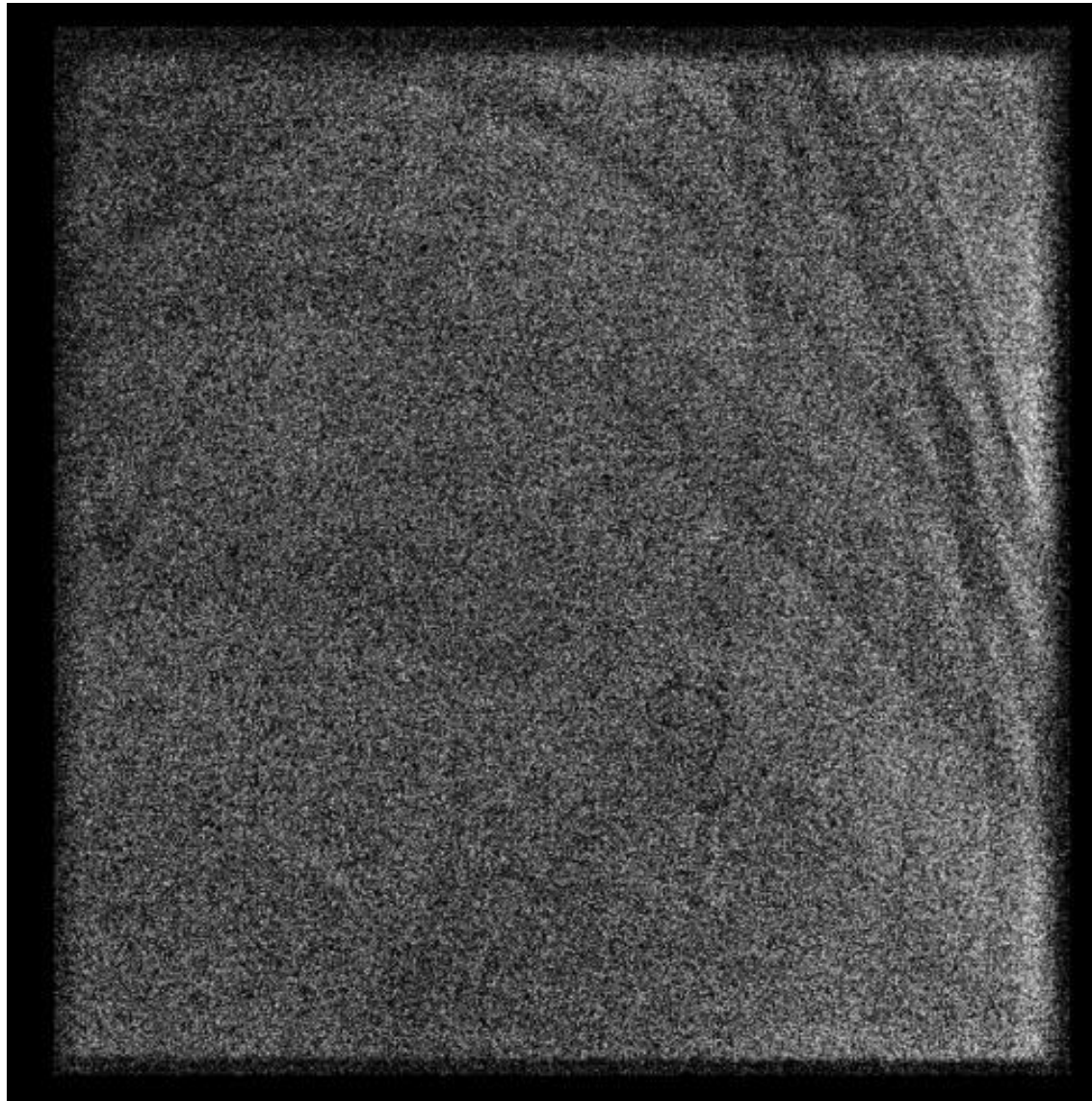
Post kissing

The POT technique should be used in any case of difficulty recrossing into a side branch with either a wire or balloon

Provisional SB stenting



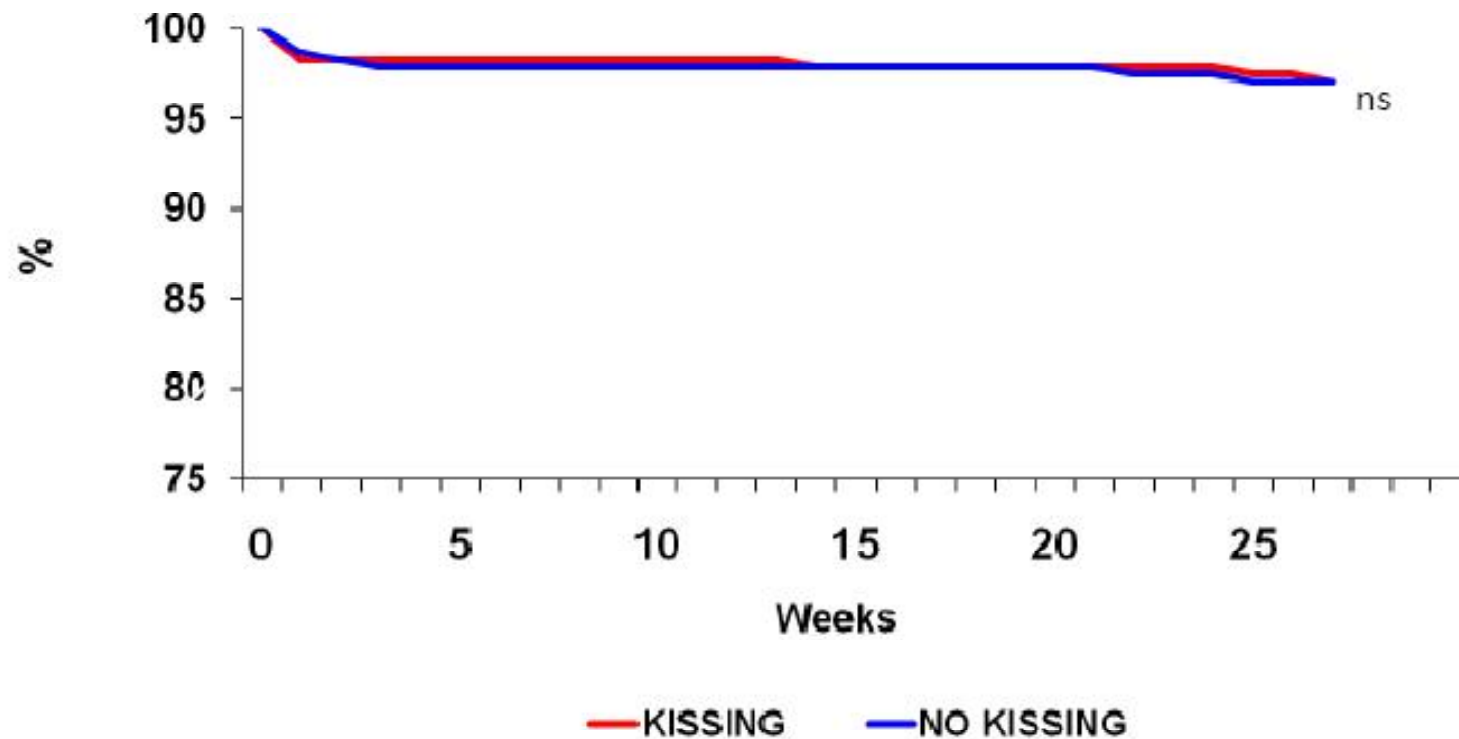
Provisional SB stenting



NORDIC III

Primary end point event free survival

MACE (cardiac death, index lesion MI, TLR, stent thrombosis)

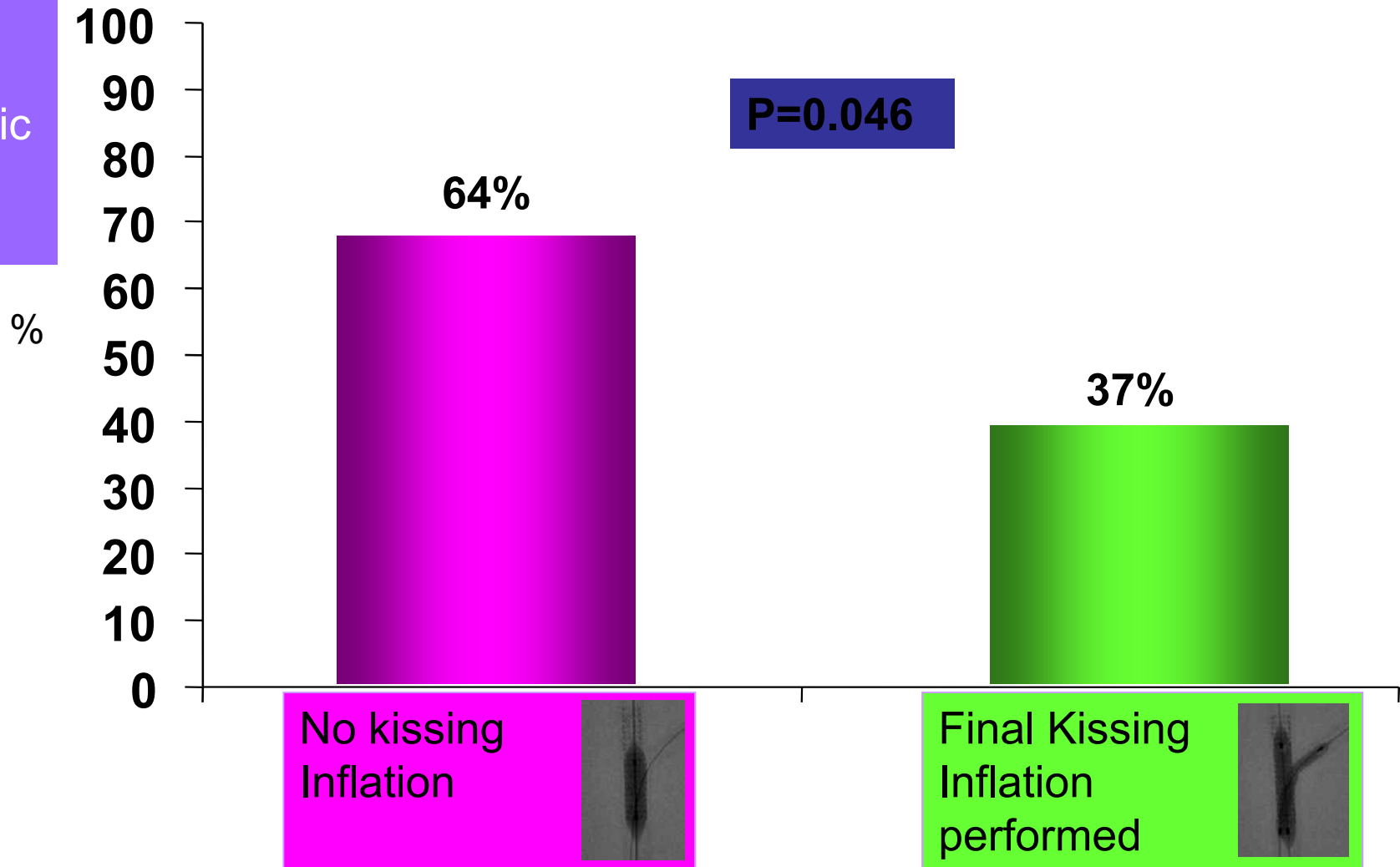


Value of kissing inflations in simple stenting

- Systematic kissing: no advantage / no harm
- When using a single stent technique, in the absence of kissing balloon inflations, the proximal main vessel stent should be postdilated to an appropriate diameter.
- Kissing balloon inflations, or pressure wire interrogation, should be used when an angiographically significant (>75%) side branch lesion remains after main vessel stenting.

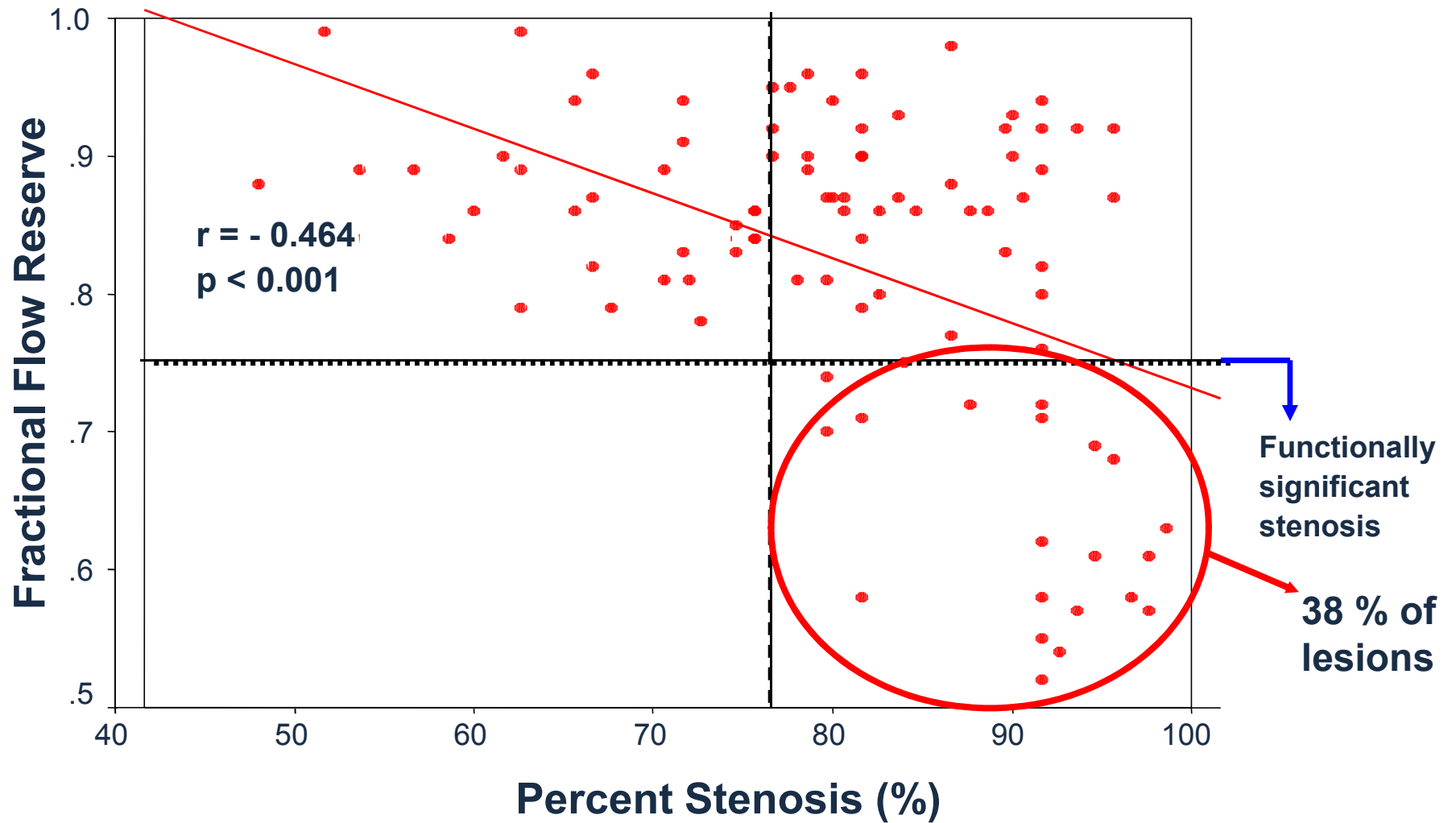
SEA-SIDE: PROCEDURAL PREDICTORS OF POST-PCI INDUCIBLE ISCHEMIA

≥1 mm ST-depression @ ergometric test within 5 days

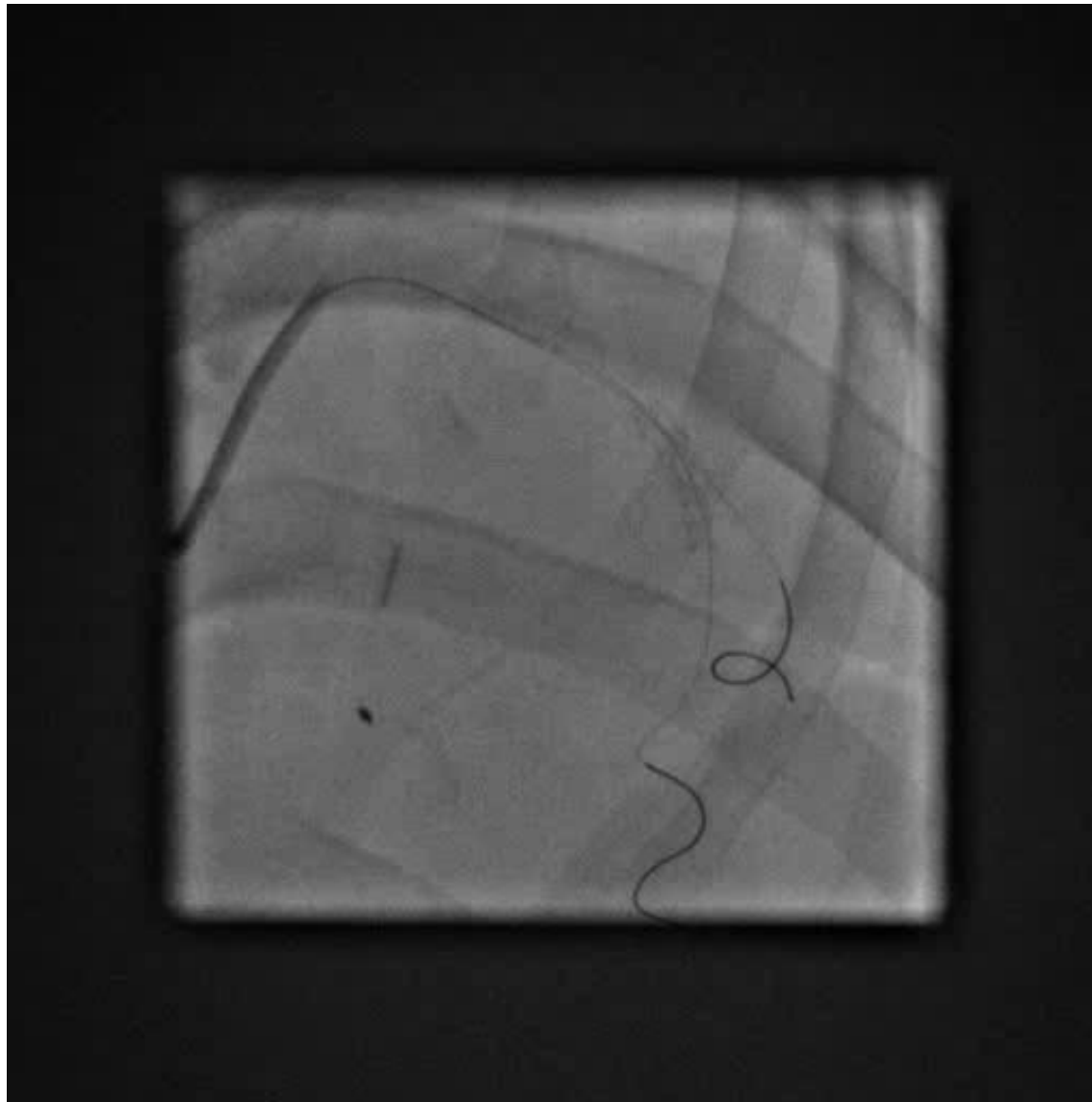


Significant Post Stenting SB Stenosis:QCA vs FFR

(jailed side branch lesions, n=94)



Provisional SB stenting

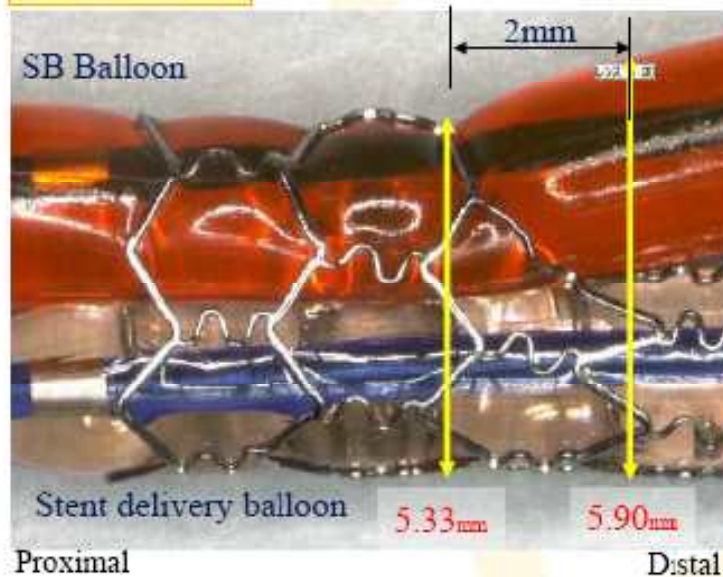


Non compliant high pressure balloons for kissing

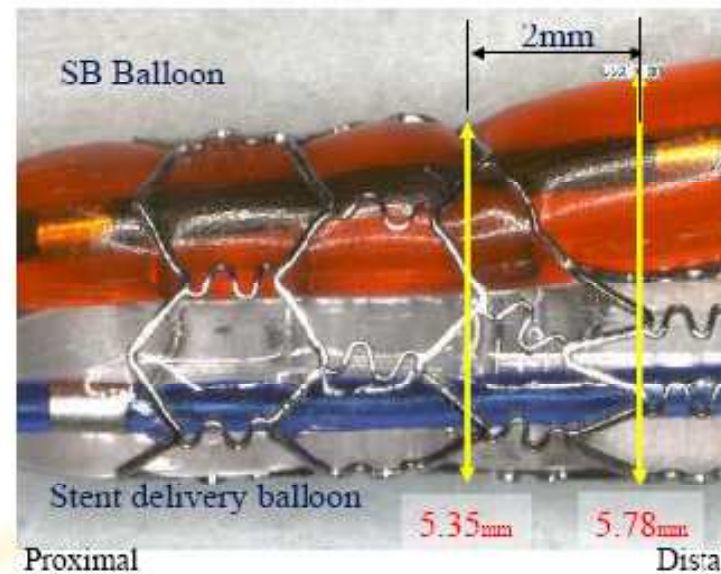


Results

Cypher
(J&J)



Semi-Compliant Balloon
(Ryujin Plus, Terumo)



Non-Compliant Balloon
(Hiryu, Terumo)

When to use two stents ?

- Provisional T stenting remains the gold standard technique for most bifurcations.
- Large side branches with ostial disease extending >5mm from the carina are likely to require a two-stent strategy.
- Side branches whose access is particularly challenging should be secured by stenting once accessed.

Which 2 stent technique ?



Influence of Bifurcation Angle

Y-Shape



- ✓ Cush
- ✓ MiniCrush
- ✓ Culotte
- ✗ T Stenting

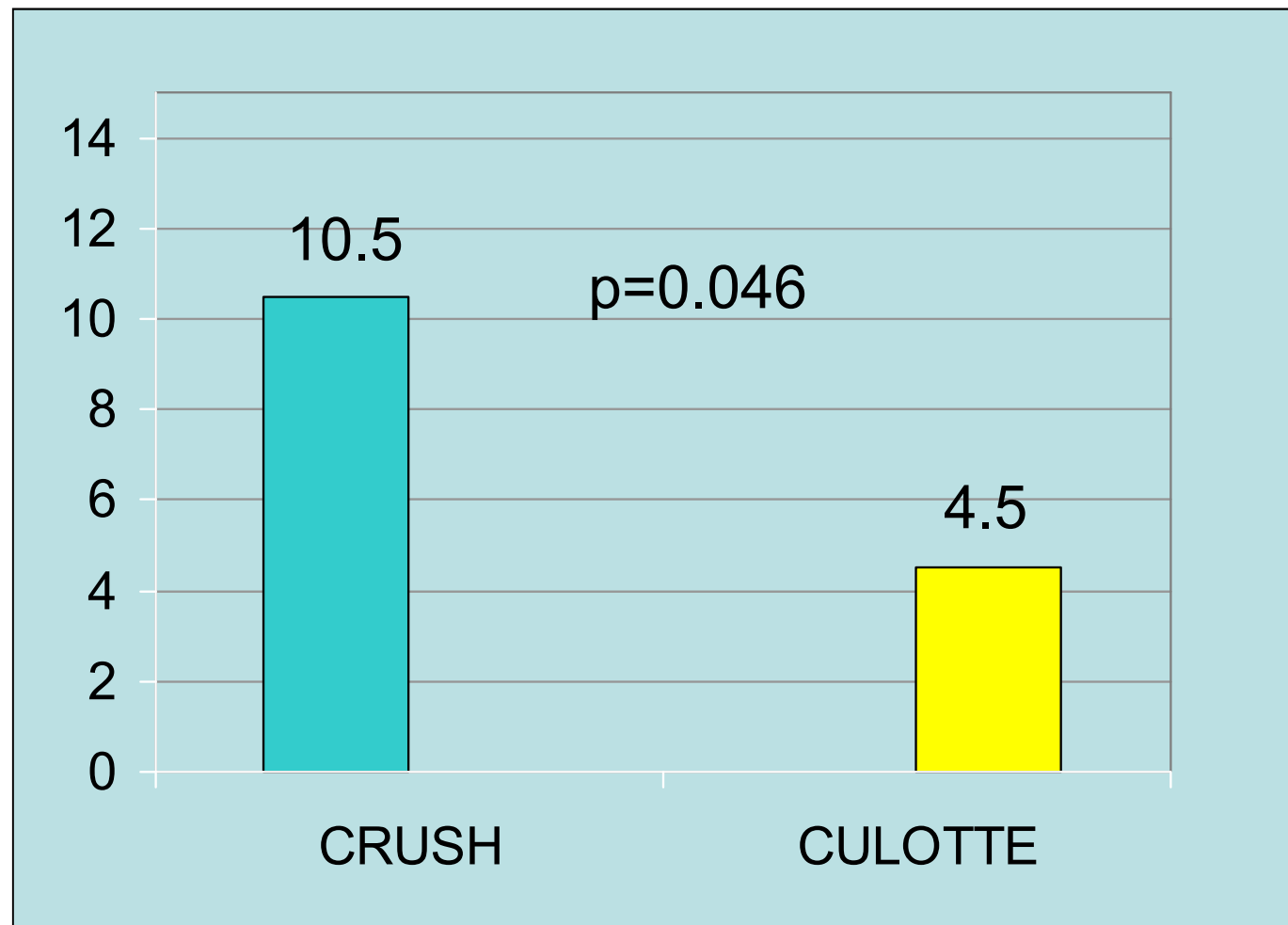
T-Shape



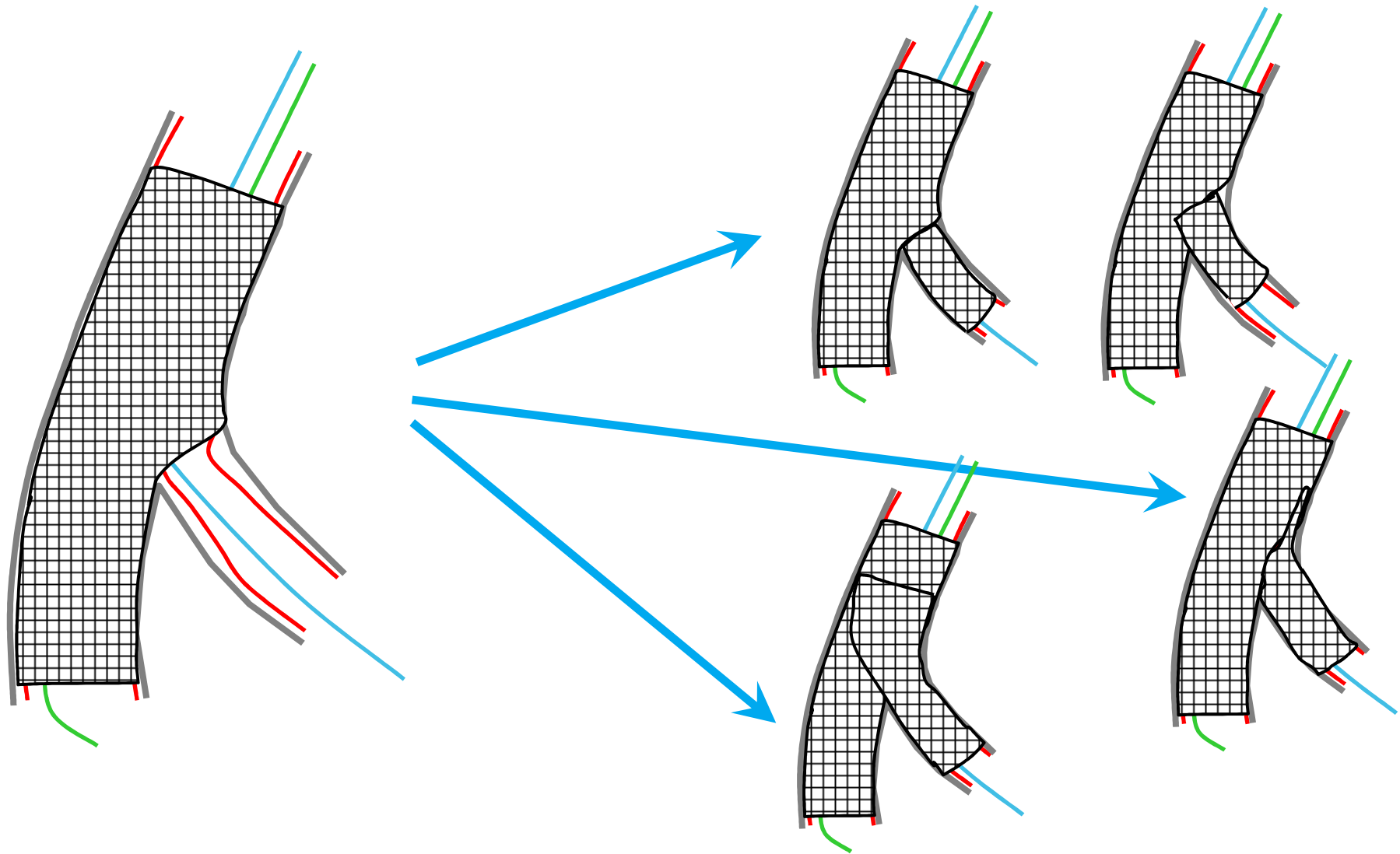
- ✓ T Stenting
- ✗ Cush
- ✓ MiniCrush
- ✗ Culotte

Nordic II

Rate of main vessel and/or side branch in-stent diameter stenosis >50% at 8 months follow-up



Provisional Side Branch Stenting

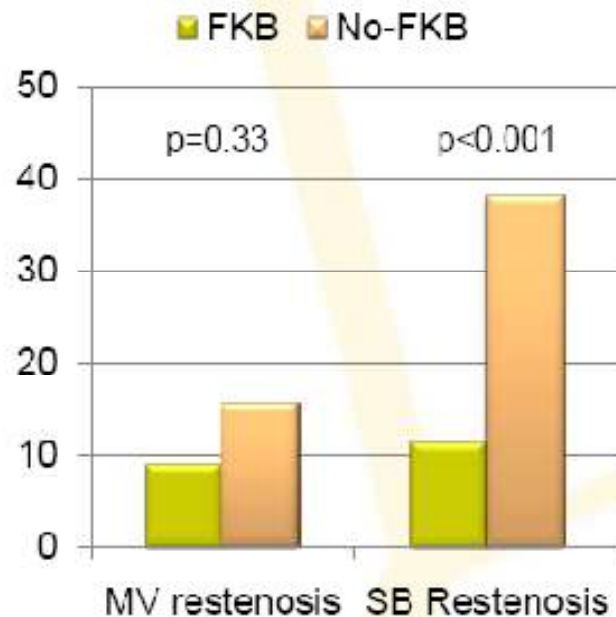


Mandatory final kissing in complex techniques

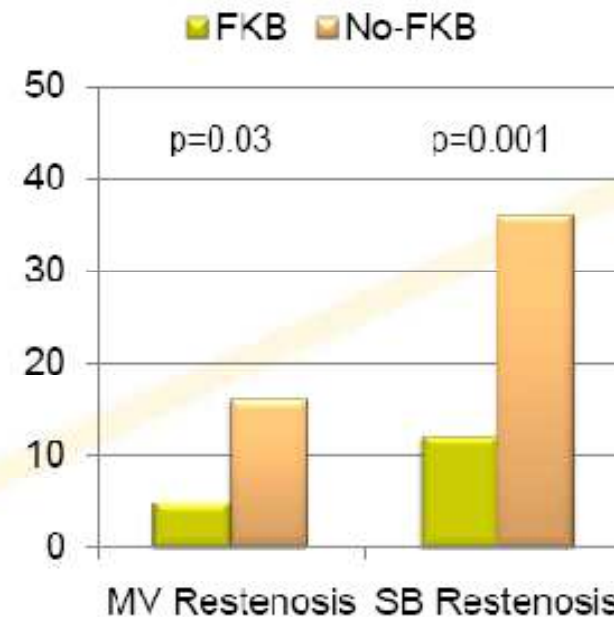


Final Kissing Ballooning Is Important in 2-Stent Technique

Crush Technique¹



Crush and Provision-T Technique²



1. Ge L, JACC 2005

2. Colombo A, CACTUS, Circulation 2009

Future of bifurcation stenting ?

- **Dedicated bifurcation stent systems remain limited but are likely ultimately to prevail (David Hildick-Smith)(BBC 1).**
- **“Bifurcation treatment without permanent implants = No discussions on bifurcation techniques” (Biodegradable stents)(Leif Thuesen)(NORDIC)**

Conclusions

- Provisional SB stenting strategy is the gold standard: POT
- No advantage, no harm of **systematic** final KB: result, SB size, FFR ... non compliant balloons ?
- When using 2 stents ? With a mandatory kissing
 - long SB lesions (> 3 mm, > 5 mm ?)
 - but why not provisional strategy ?
 - very difficult SB access: SB first ?
- When not to using SB stent first ? : Wide B angle
- Dedicated stents: randomized studies / biodegradable stents !

Consensus from the 5th European Bifurcation Club meeting

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The authors have no conflict of interest to declare.

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