

# **Doença coronária complexa:**

## **Doença em bifurcação: classificações, técnicas de tratamento**

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# **Conflitos de Interesse:**

**Não há conflitos de interesse  
para essa apresentação**

# Bifurcation definition

- There is no clearcut definition to define when a side branch is big enough to create a « bifurcation »
- 2 mm in diameter is the most frequent threshold
- The length of the branch has to be considered
- « a branch we don't want to lose »

**Consequence:** prevalence may vary as there is a part of subjectivity...

# Bifurcation lesions are frequent...

## Research Registry

	Pre-SES Group (n=450)	SES Group (n=508)	P
Treated vessel			
Left anterior descending, %	59	59	0.8
Left circumflex, %	33	32	0.7
Right coronary artery, %	34	39	0.2
Left main coronary, %	2	3	0.6
Bypass graft, %	2	3	0.2
Lesion type			
Type A, %	20	22	0.4
Type B1, %	32	31	0.7
Type B2, %	50	49	0.8
Type C, %	30	43	<0.01
Glycoprotein IIb/IIIa inhibitor, %	33	19	<0.01
Clopidogrel prescription, months±SD	2.9±2.0	4.0±2.0	<0.01
Bifurcation stenting, %	8	16	<0.01

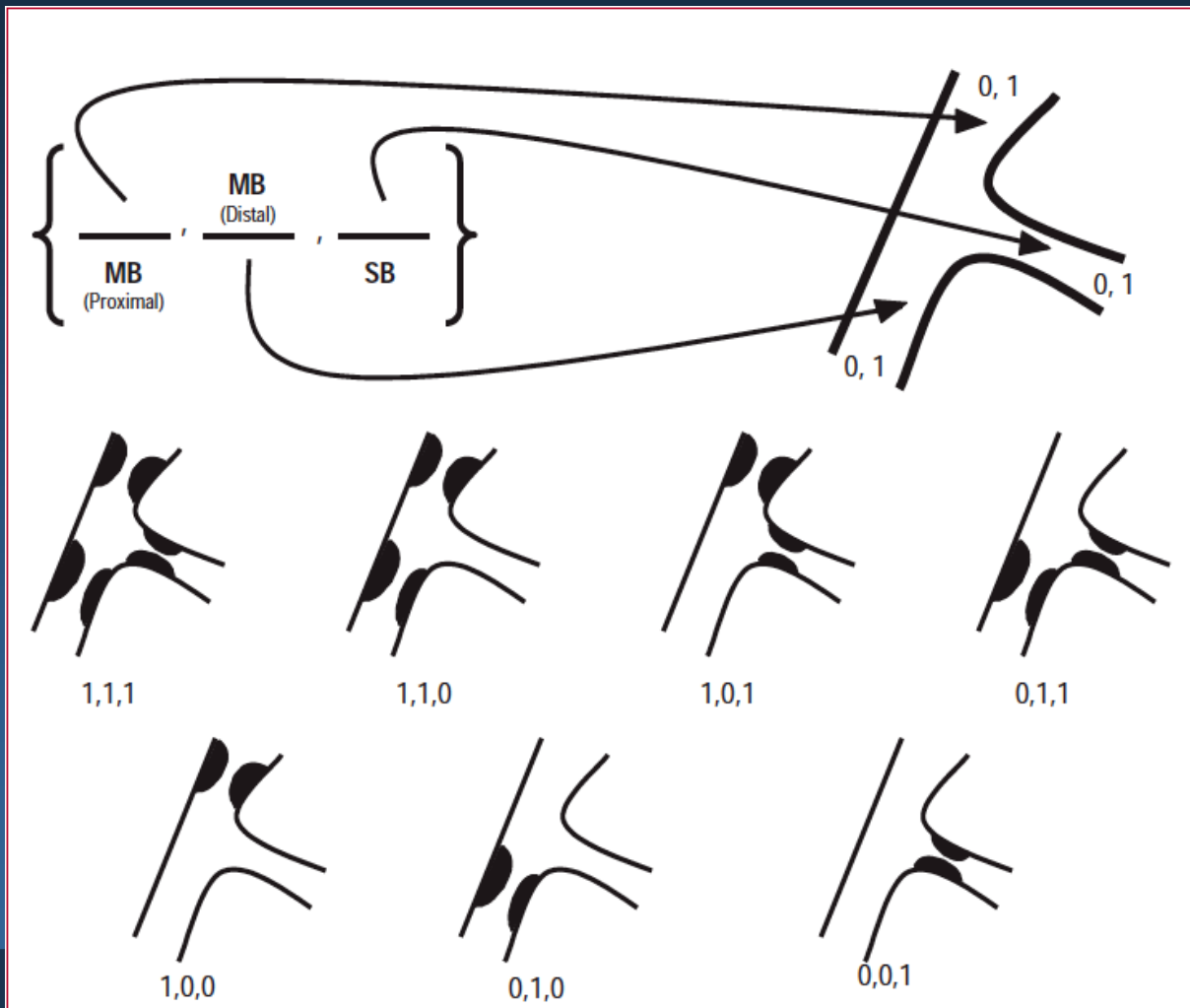
## ...and more frequent in MVD

	ARTS II	Reality	Syntax
<b>≥1 bifurcation lesion/pt</b>	<b>53%</b>	<b>52%</b>	<b>64%</b>
<b>Bifurcation lesions/lesion</b>	<b>22%</b>	<b>22%</b>	<b>23%</b>

*Tsuchida et al, EHJ 2007*  
*Lefèvre et al, ECCO 2008*  
*Serruys et al, ESC 2008*

# Medina classification

(The recognized one today)



# Practical key points I

- **Pre-intervention assessment:**
  - Type of bifurcation (true?)
  - Diameters
  - Plaque distribution (taking account limitations of 2D angio imaging)
  - Angle

**Mandatory to include these parameters as well as the global context of the patient in strategy making process**

# Practical key points II

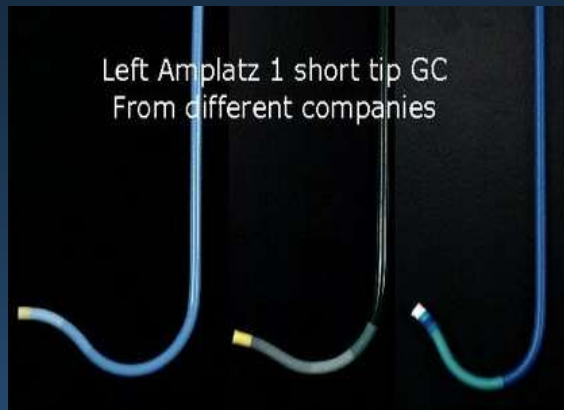
- **During interventions:**
  - Select appropriate working views
  - Select appropriate material
  - Do not overestimate the severity of SB stenosis and its clinical impact
  - Never compromise main branch result because of « cosmetic » SB result



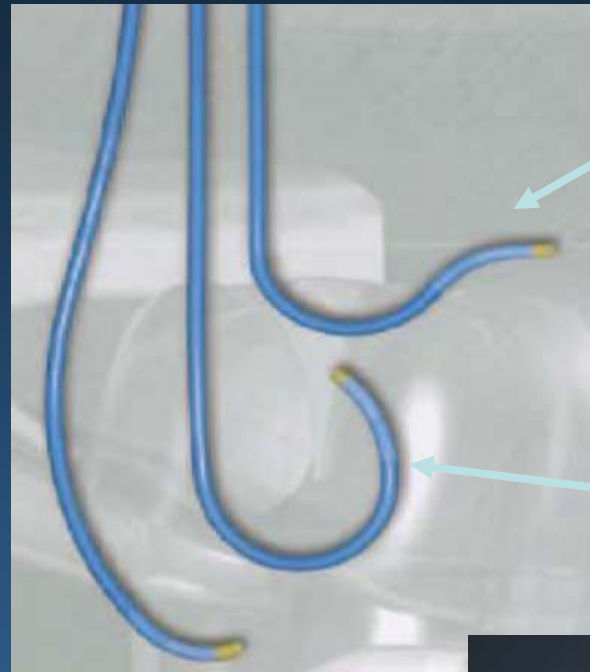
# Device selection

- Guiding catheter: 6F, 7F, 8F
  - => Good backup :
    - XB, EBU, Amplatz for left coronary artery
    - Amplatz, XBRCA, 3D, Hockey Stick for the right coronary artery)
- Guidewires: coiled, hydrophilic coated

# Guiding catheter: support



**Amplatz Left 1 or 0.75  
short tip for RCA**



**XBRCA**

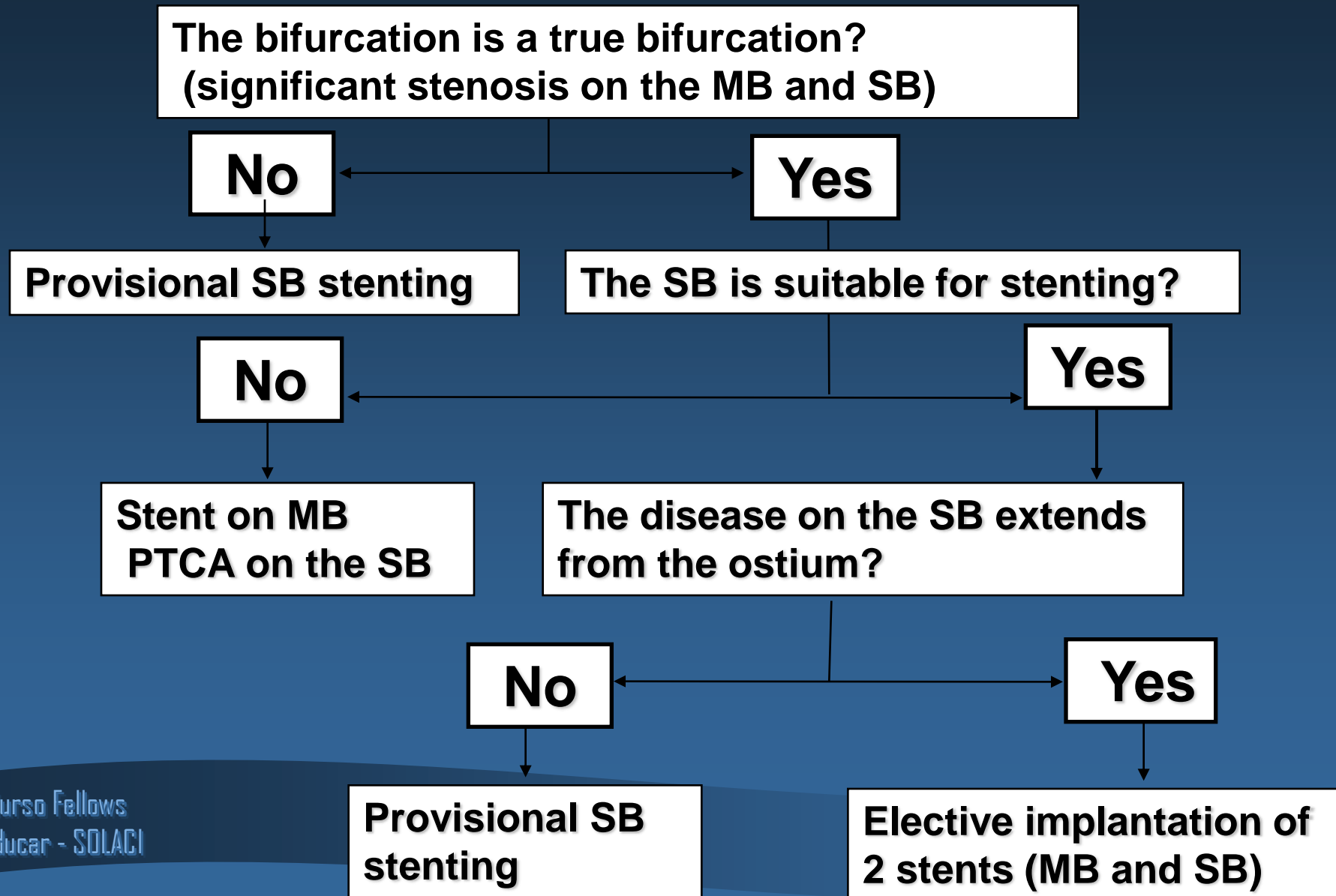


**Judkins right  
for RCA**

**3D right  
for RCA**



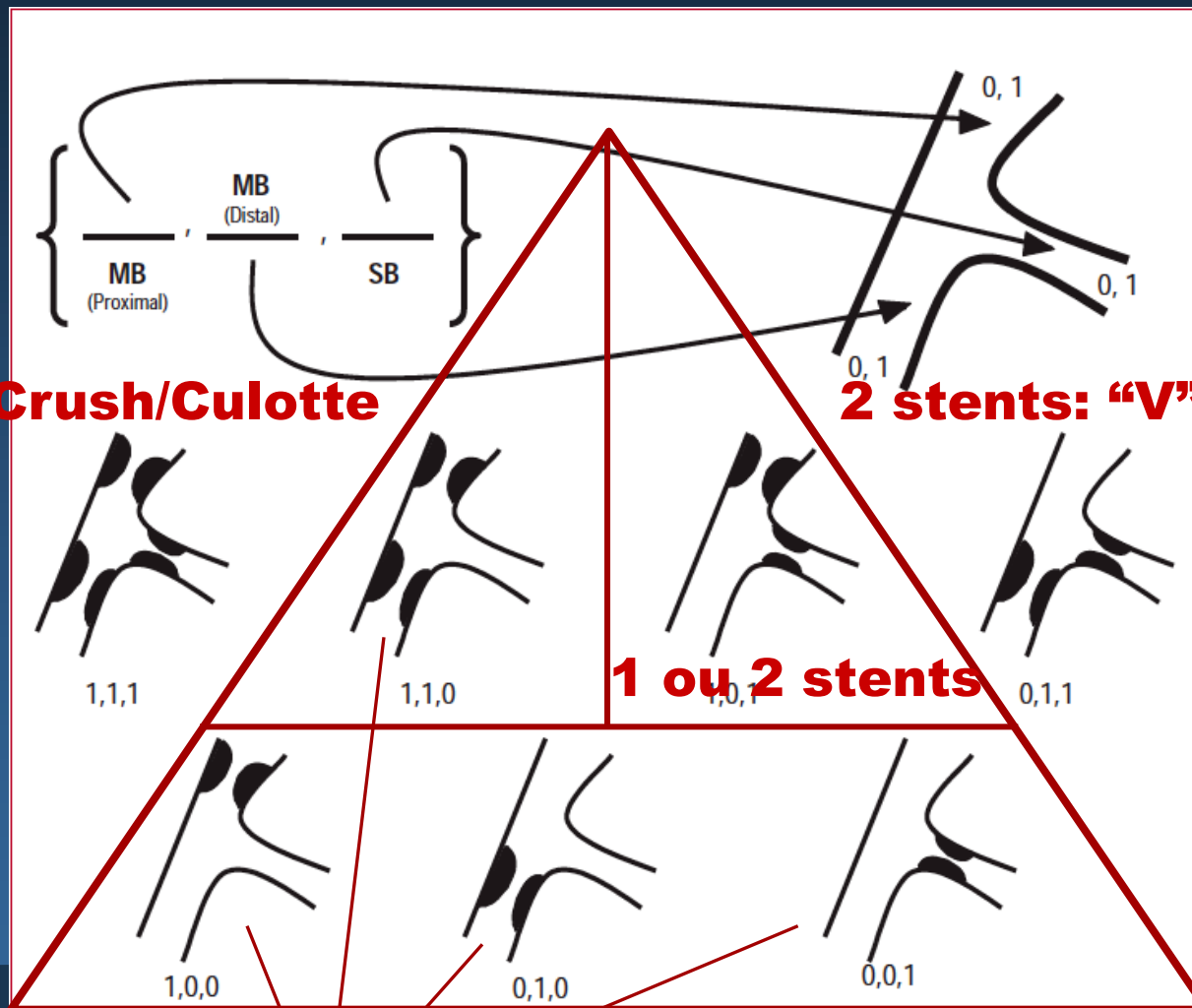
# Approach to bifurcational lesions (1 or 2 stents)



# Medina classification => bifurcation stenting

**2 stents: Crush/Culotte**

**2 stents: "V"**



# Provisional stenting

## Should we use a jailed wire?

- Yes, if risk for SB occlusion
- Yes, if significant SB which plans to rewire/dilate

1. Keeps the side branch open
2. Is a good marker of SB to rewire
3. Modifies favorably the angle between both branches

# Risk factors for side branch occlusion

- **Shallow take-off angle ( $< 60^\circ$  )**
- **Extensive side-branch plaque/calcium**
- **Extensive main-branch plaque/calcium**

# Predictors of Peri-procedural MI (any lesion – with or without bifurcation)

## Procedure related

- SB occlusion (OR 1.7 - 7.9)
- Slow flow (OR 4.5 – 5.8)
- Dissection (OR 1.2 – 1.8)
- Distal embolisation (OR 4.4 – 6.0)
- Atherectomy (CAVEAT-I)
- Stents (OR 1.2 v poba)
- Multivessel Rx
- Number of stents
- Number of inflations
- Max balloon pressure
- etc

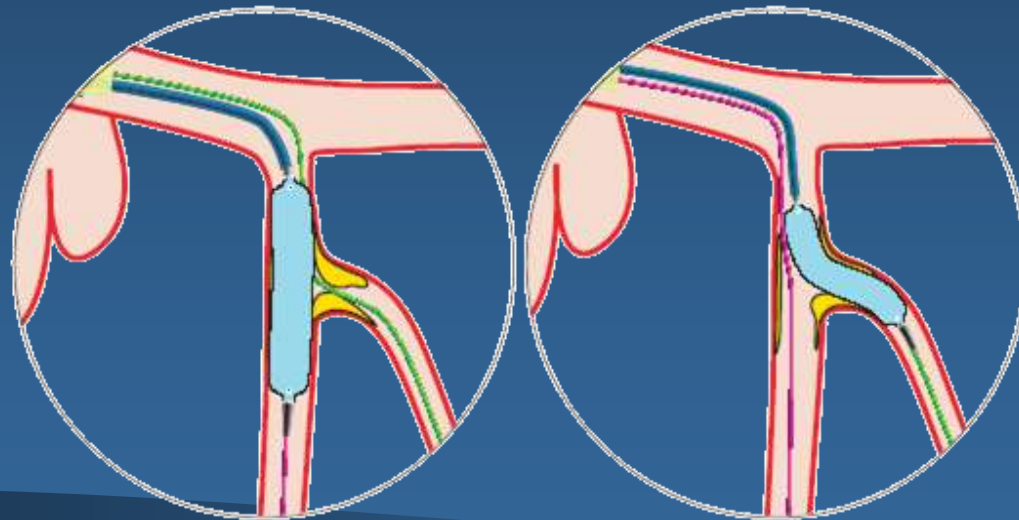
# Provisional stenting

**Should we predilate the SB? Avoid...**

**Yes, if severe lesion involving a large side branch where the risk of side-branch occlusion is high and the likelihood of successful side-branch reaccess is low**



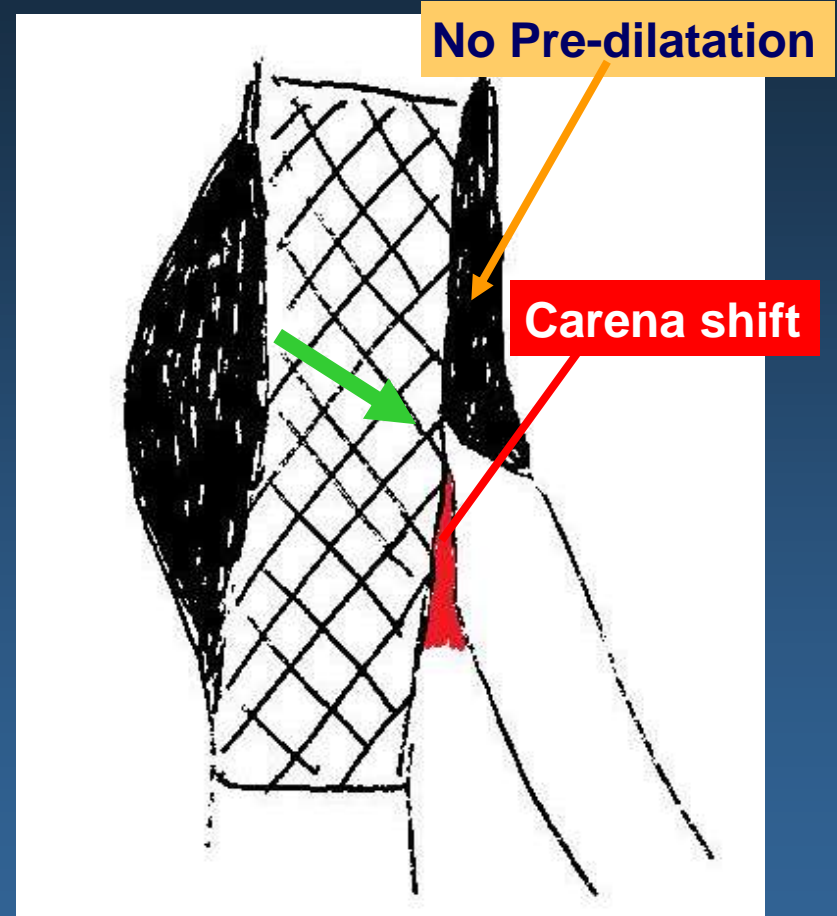
**Simple**





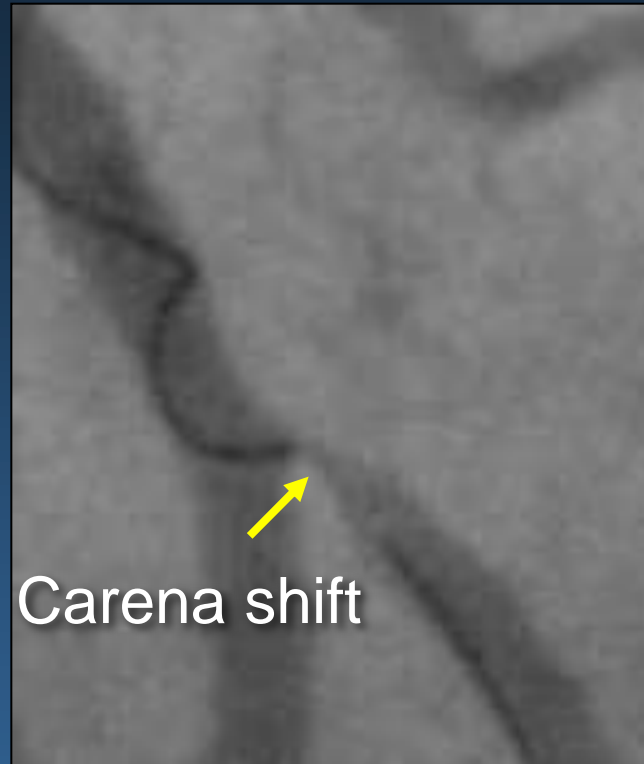
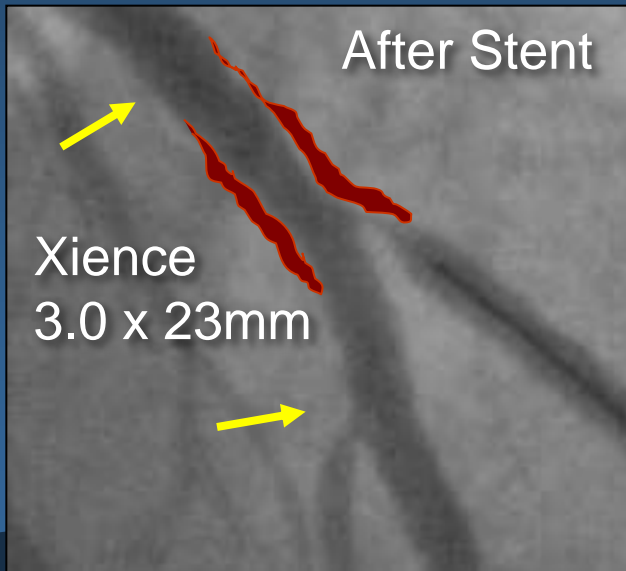
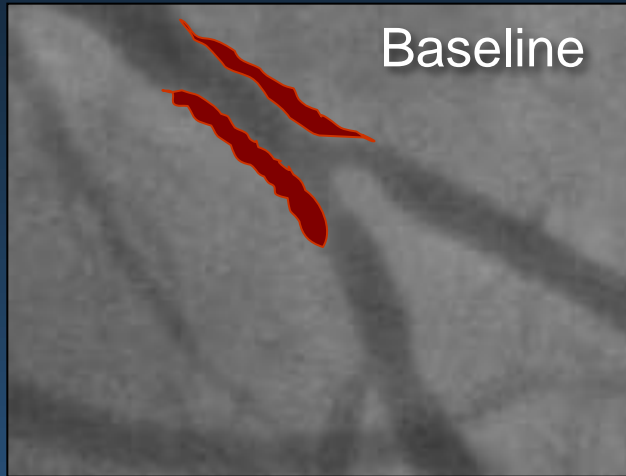
# True bifurcation (1,1,1)

- We should **avoid side branch pre-dilation** and **take advantage of the carena shift**
- the guidewire (GW) will cross the stent strut **exactly at the carena**

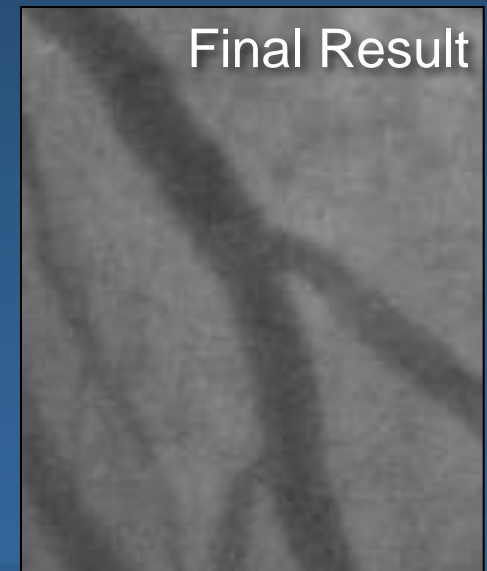
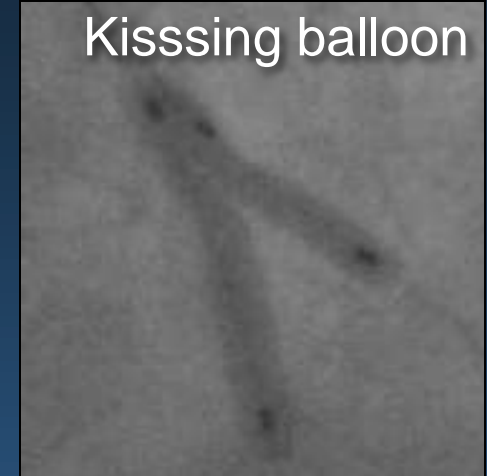


Post MB stenting

# True bifurcation (1,1,1)

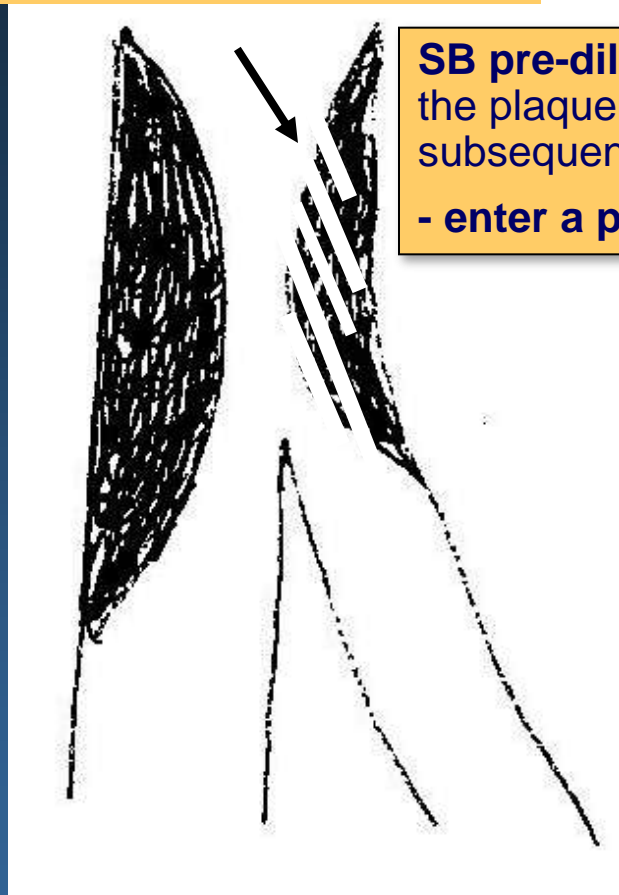


During guidewire exchange (before kissing), the **tip of the wire is at the carina (shifted)**



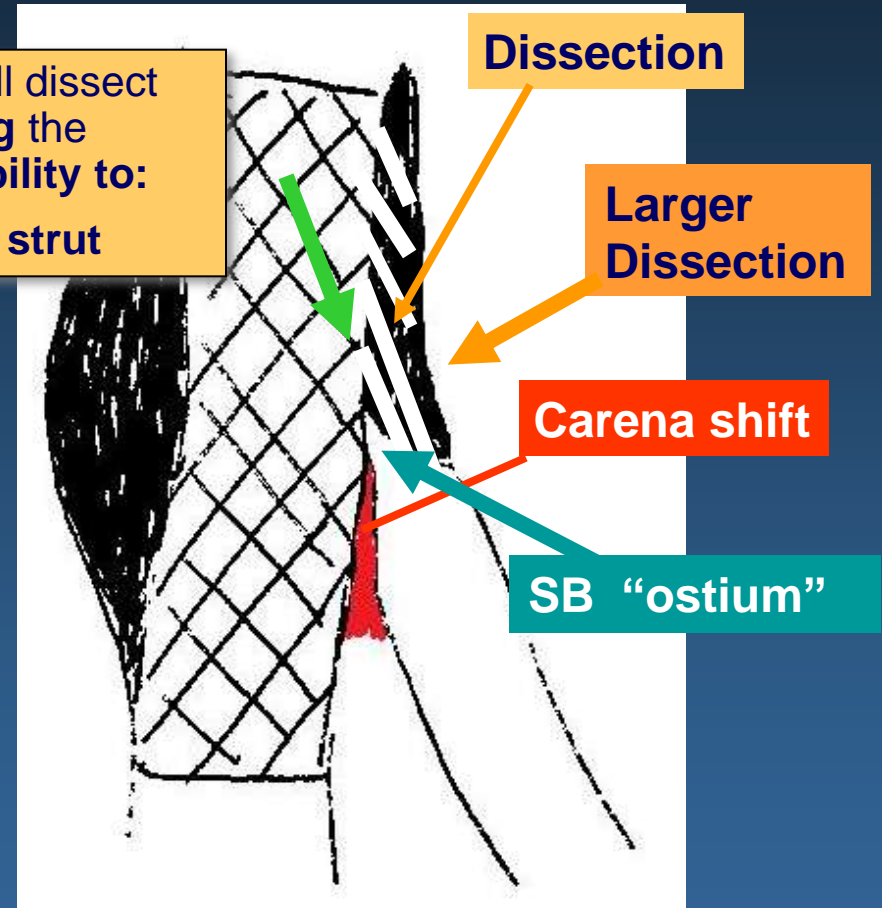
# True bifurcation (1,1,1)

Pre-dilatation => Dissection



Pre

SB pre-dilation will dissect the plaque **creating** the subsequent **possibility** to:  
- enter a proximal strut

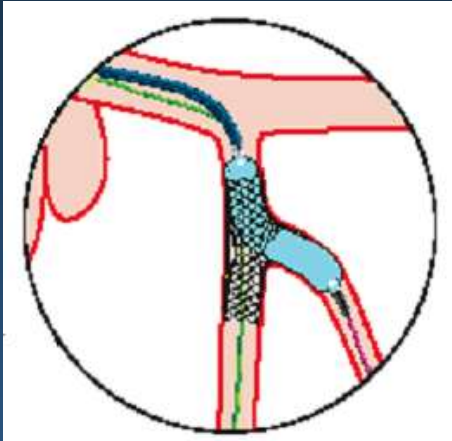


Post MB stenting

In the case of significant SB dissection after SB predilatation it could be preferable to switch to a different strategy and stent the SB first

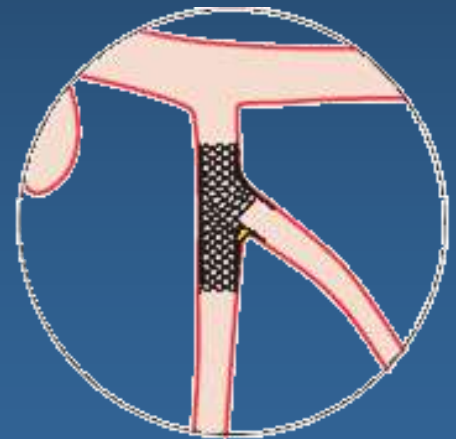
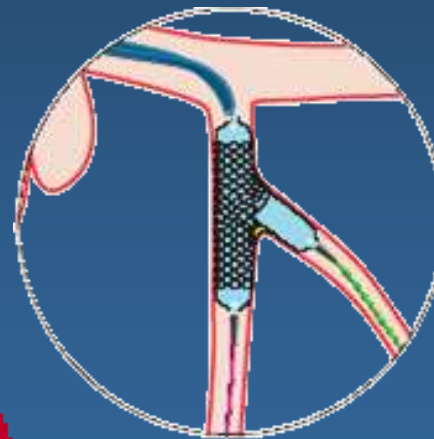
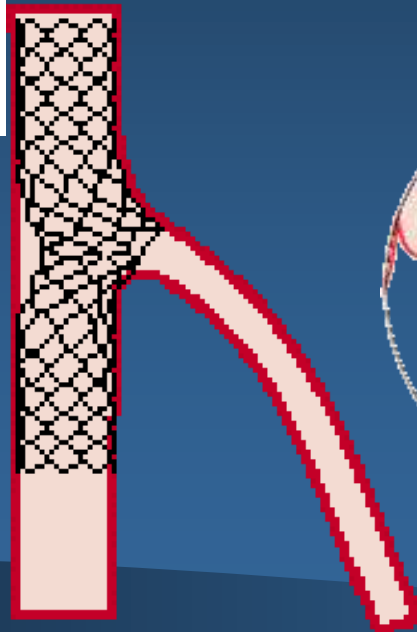
# Provisional Stenting

## Role of final “kissing balloon”



Radial stent  
dislodgement  
after PTCA in  
the side branch

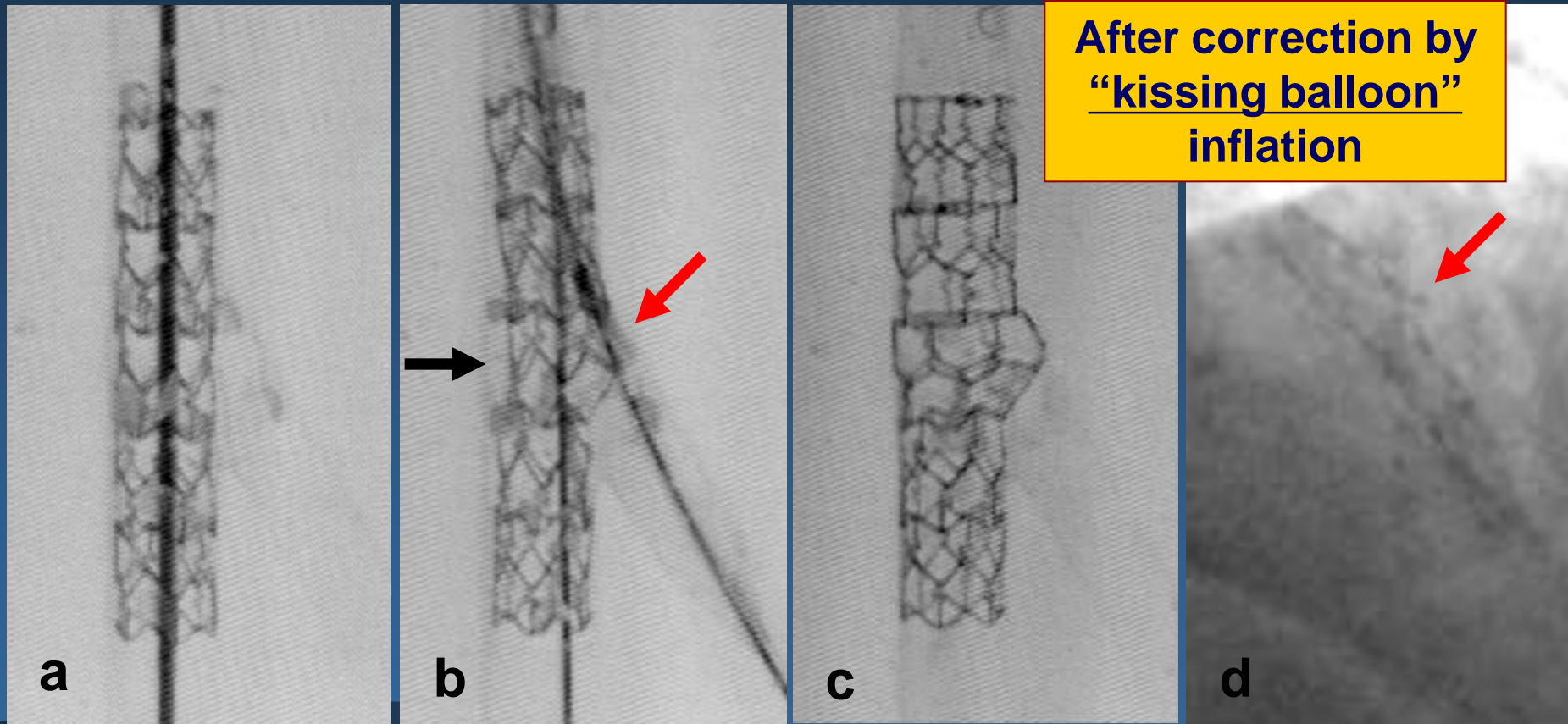
Always perform final  
“kissing balloon” inflation to  
correct stent dislodgement



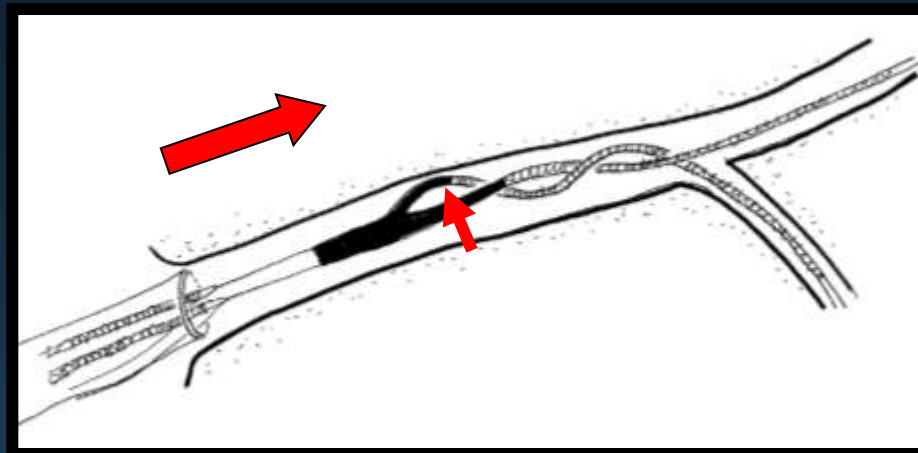
# Provisional stenting

## Role of final “kissing balloon”

Lessons from bench testing:  
Stent Deformation may be an advantage ...



# Wire wrap issue



## 1. Prevention

- ✓ Wire the most difficult branch first
- ✓ Wire the second branch with limited rotation
- ✓ Avoid wire wrap on the table

## 2. Recognize wire wrap before pushing hard !

- ✓ Visible on fluoroscopy
- ✓ Resistance to advance the device: wire wrap?

## 3. Solve the problem

- ✓ Pull back one wire up to the tip of the balloon or catheter and re-wire with limited rotation
- ✓ Add a third wire in the main or side branch



# Failure to reaccess after stenting

- **With wire:**

- Same approach than before stenting
- If negative: carena shaping
- Be careful with stiffer wires (risk of SB ostium dissection)

- **With balloon:**

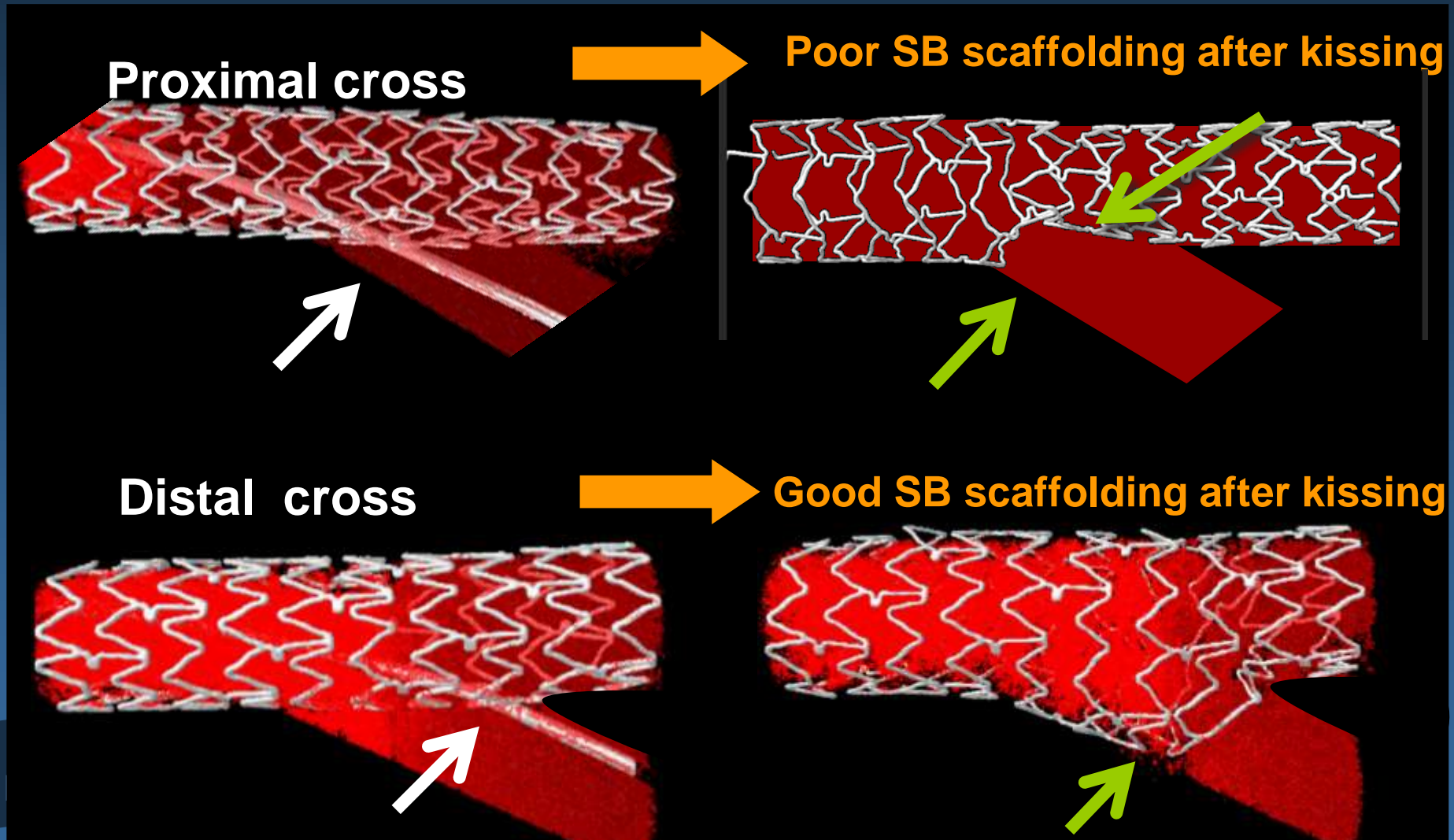
- Smallest balloon
- Consider possible « understrut track » of the wire
- If negative: carena shaping

- **With stent:**

- larger balloon, higher pressure

# Better provisional T stenting

Wire SB through the most distal cell





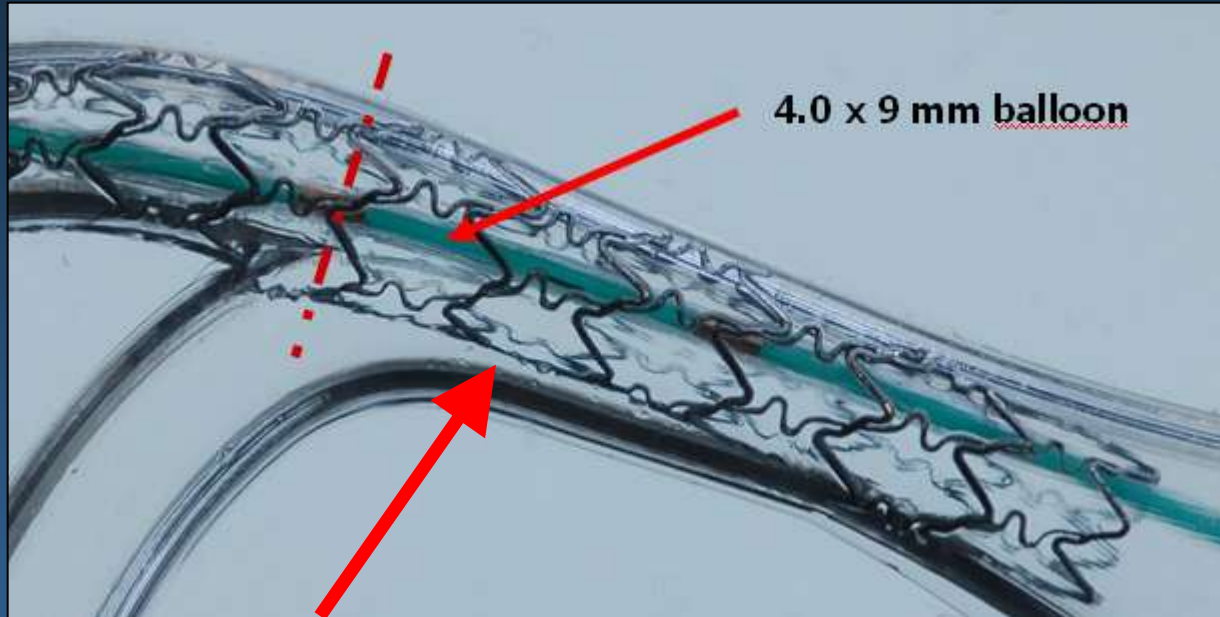
# Shape the carena

- **Dedicated balloon:** spherical balloon as a prekissing technique
- **Or the « POT »:** short oversized balloon

## Indications:

- failure to rewire or to reaccess with balloon
  - => better apposition
  - => easier access to distal cell
- or systematic if you like it...

# Proximal optimisation technique (POT)



**Risk of understrut track when rewiring**

**Oversized short balloon with distal marker at the carina level**

# POT



**Easier distal cell crossing for kissing optimisation**

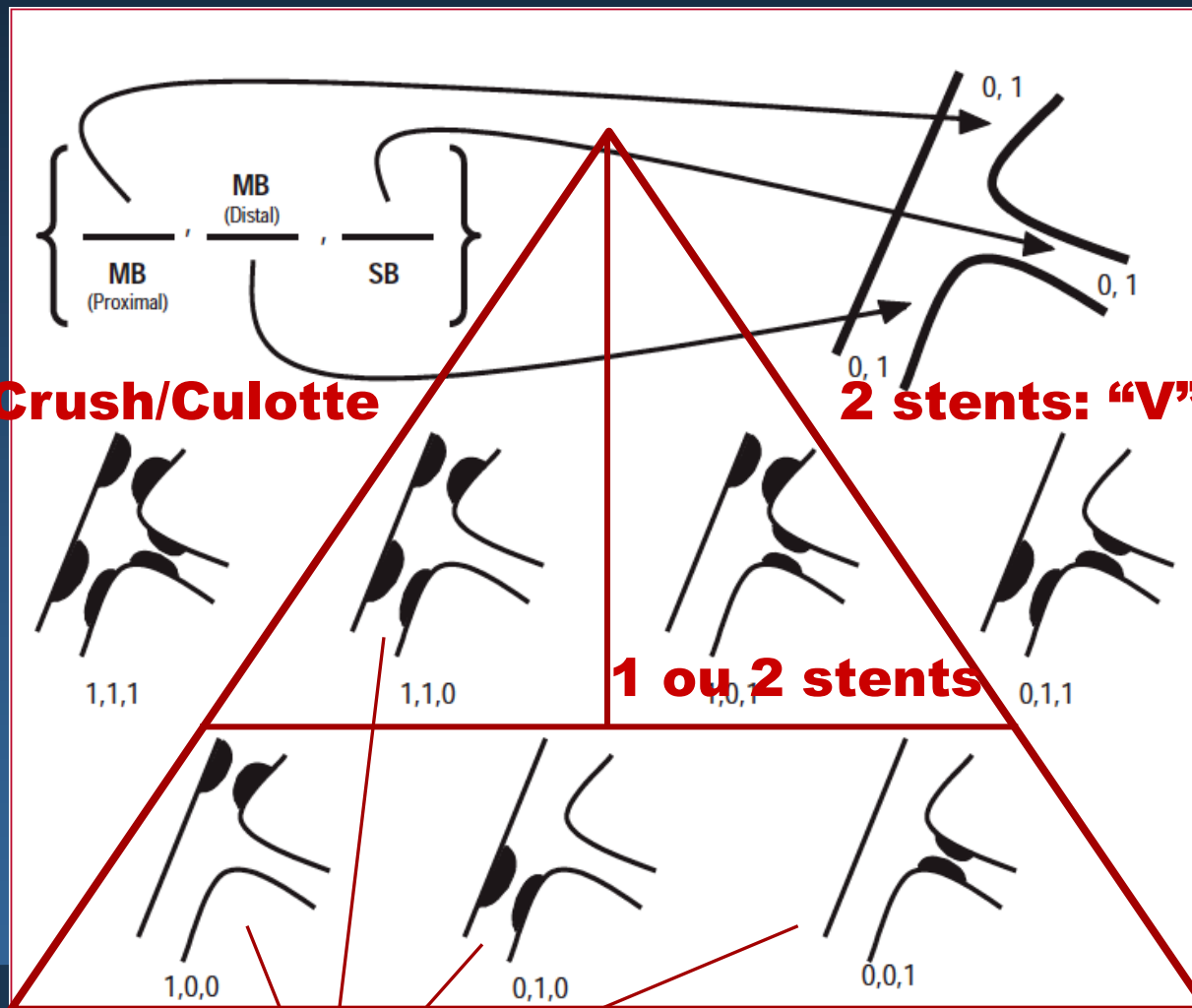
# Appropriate ballooning

- Low profile balloons (preferably 6F KB compatible)
- Sized to distal reference diameters (1:1)
  - Non compliant?
- MB balloon first inflated at high pressure
- Inflation of the SB balloon at high pressure successively
- Final kissing at nominal pressure
- Simultaneous deflation

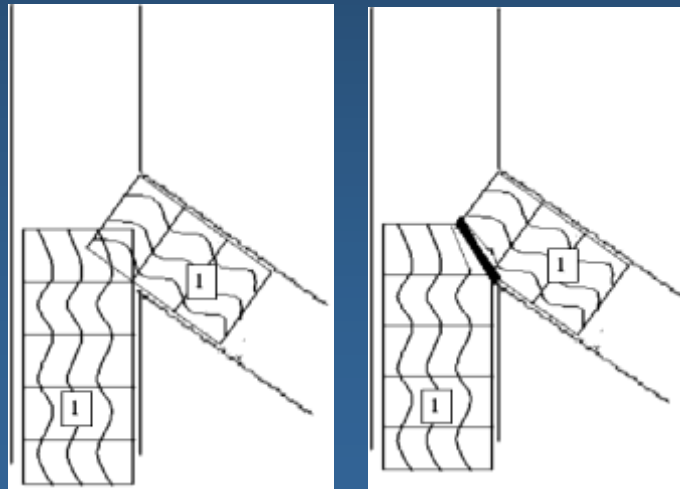
# Medina classification => bifurcation stenting

**2 stents: Crush/Culotte**

**2 stents: "V"**

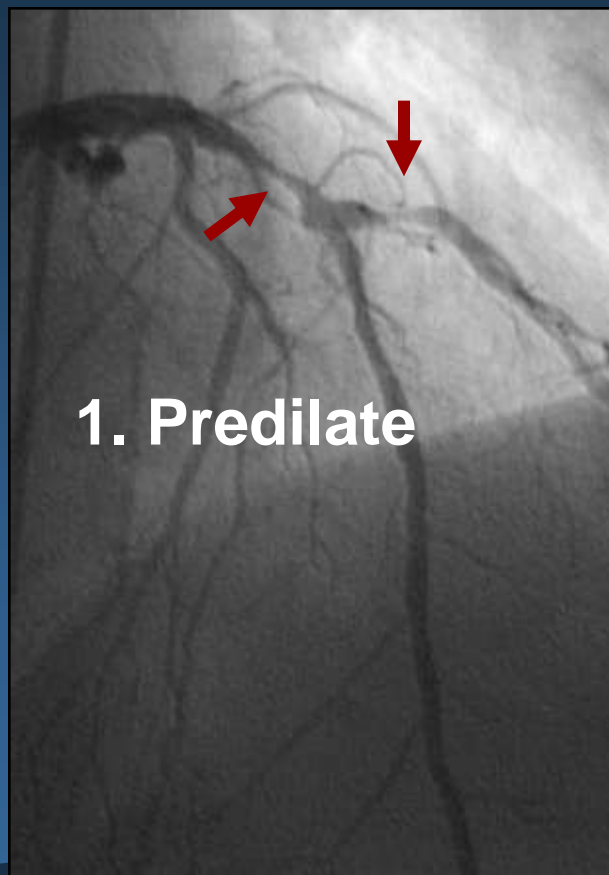


## 2 stents: V « touching stents »



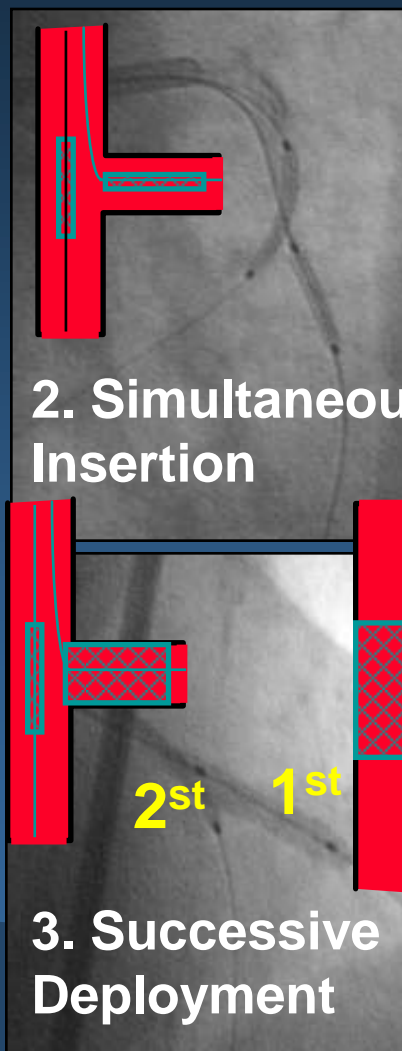
# 2 stents: Crush (modified “T” stenting)

Simultaneous insertion, successive deployment



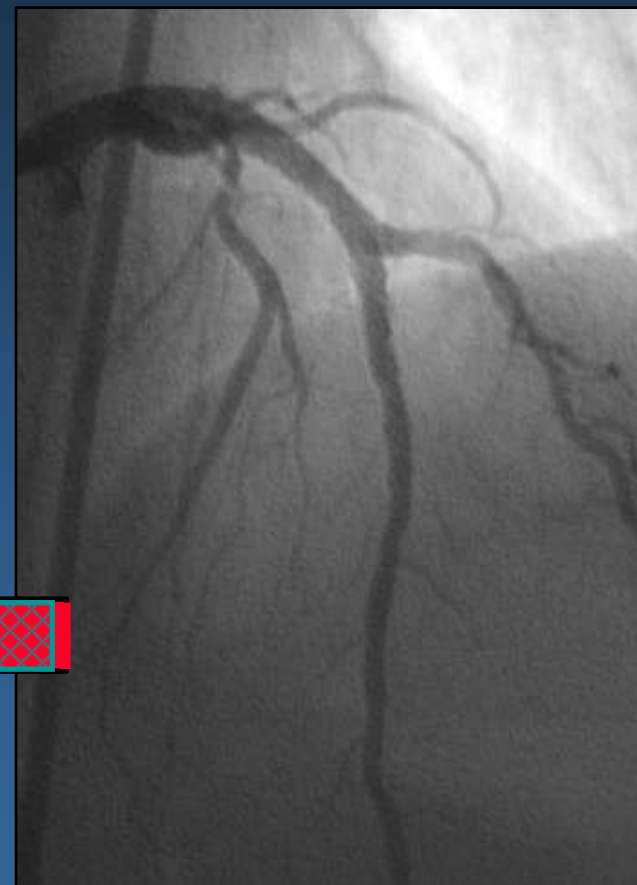
1. Predilate

Pre Treatment



2. Simultaneous Insertion

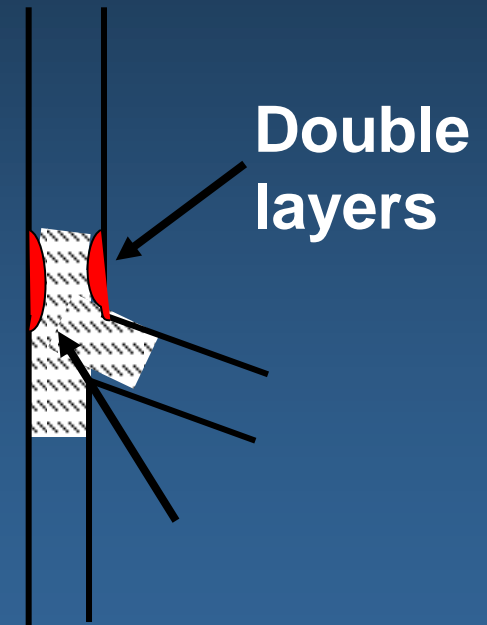
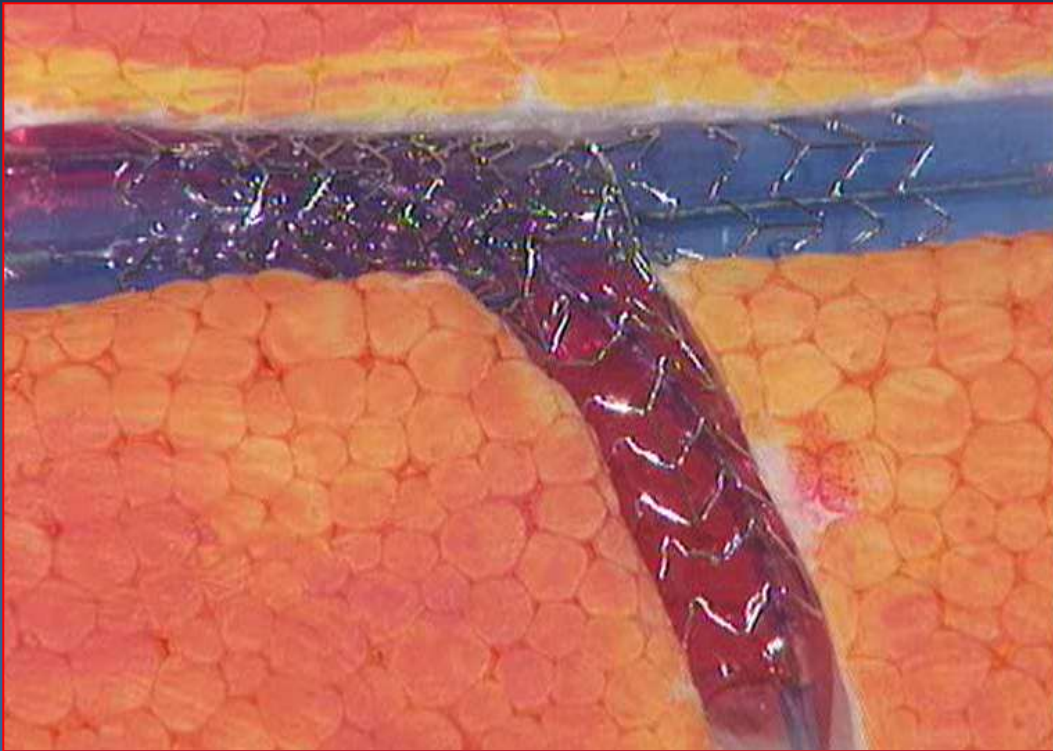
3. Successive Deployment



After Treatment



# 2 stents: Culotte (complex technique with many steps)



Limitations due to  
stent cell diameter?

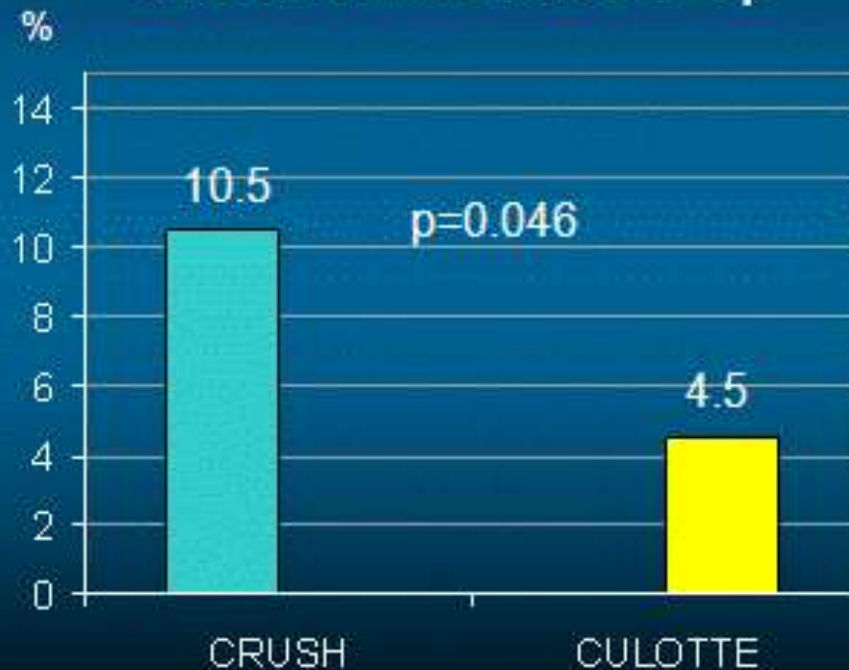


# Large randomized trials (350-500 patients)

	N	Stent type	Design	Kissing ballon	Main EP	Outcome
NORDIC I	413	Cypher	Provisional T vs. any 2 SES technique	100% intended	Death MI –ST TVR	1 vs 2 stent approaches equivalent
CACTUS	350	Cypher	Provisional T vs. crush	90% <sub>(simple)</sub> vs. 92% <sub>(complex)</sub>	Death MI TVR	Crush ~ = provisional T
BBC I	500	Taxus	Provisional T vs. crush/ culotte	30% <sub>(simple)</sub> vs. 89% <sub>(complex)</sub>	Death MI TVF	Provisional T best strategy
NORDIC II	424	Cypher	Crush vs. Culotte	100% intended	Death MI – ST TVR	Equivalent (less RS in SB with culotte)

# NORDIC-II

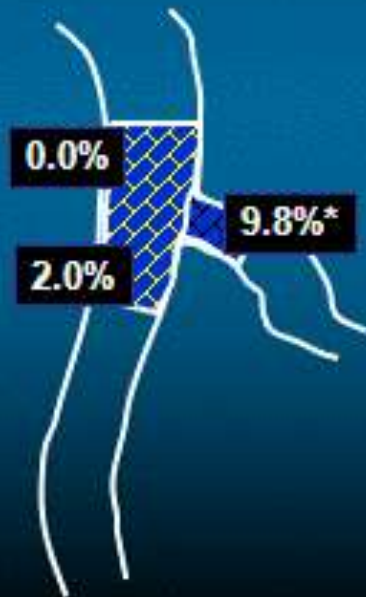
Rate of main vessel and/or side branch  
in-stent diameter stenosis >50%  
at 8 months follow-up



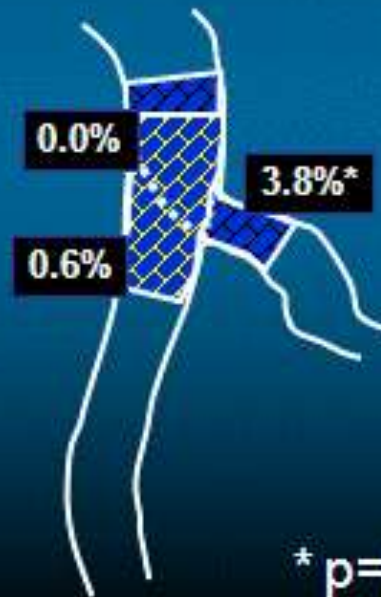
# NORDIC-II

## Localization of in-stent restenosis at 8 months follow-up

CRUSH

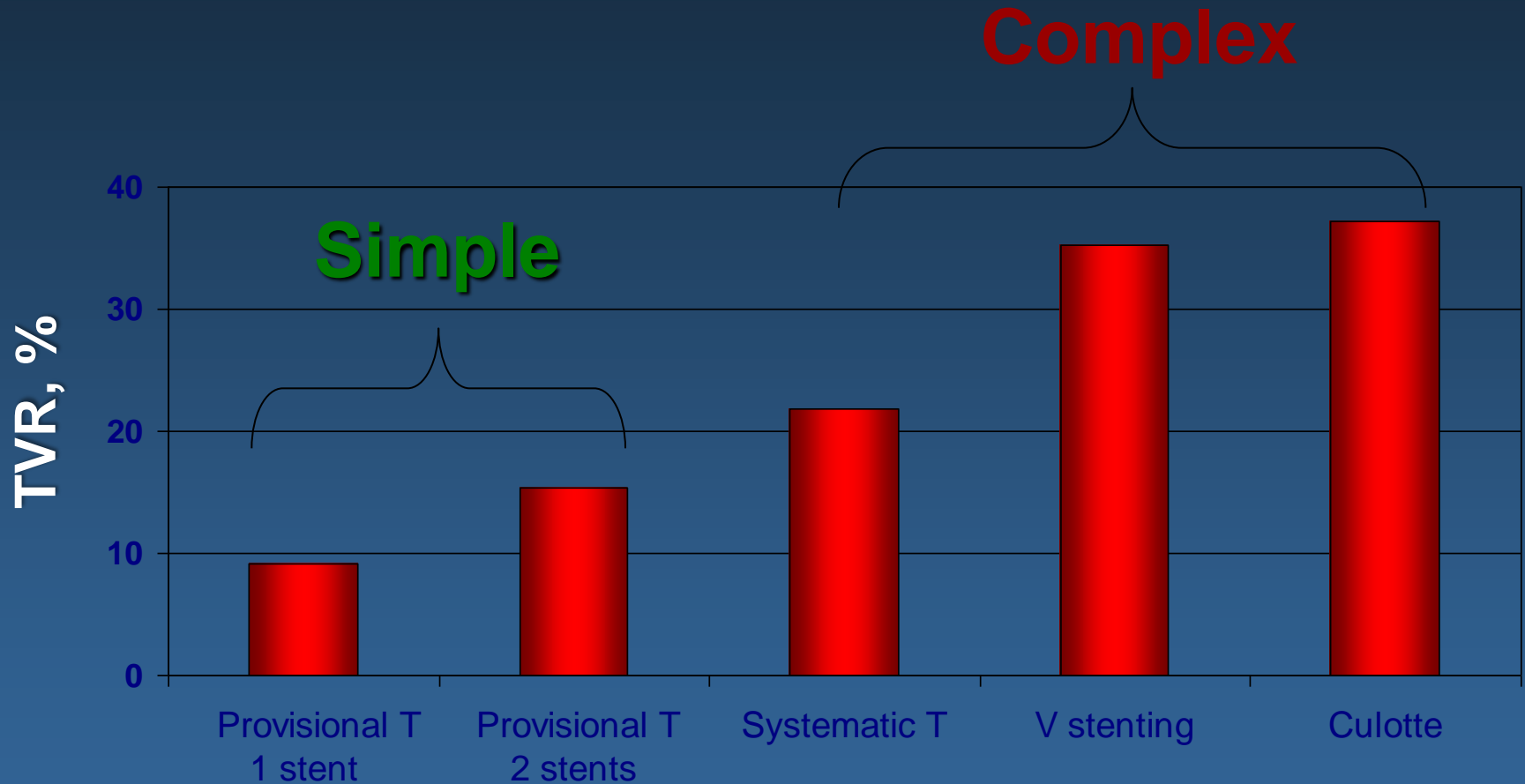


CULOTTE

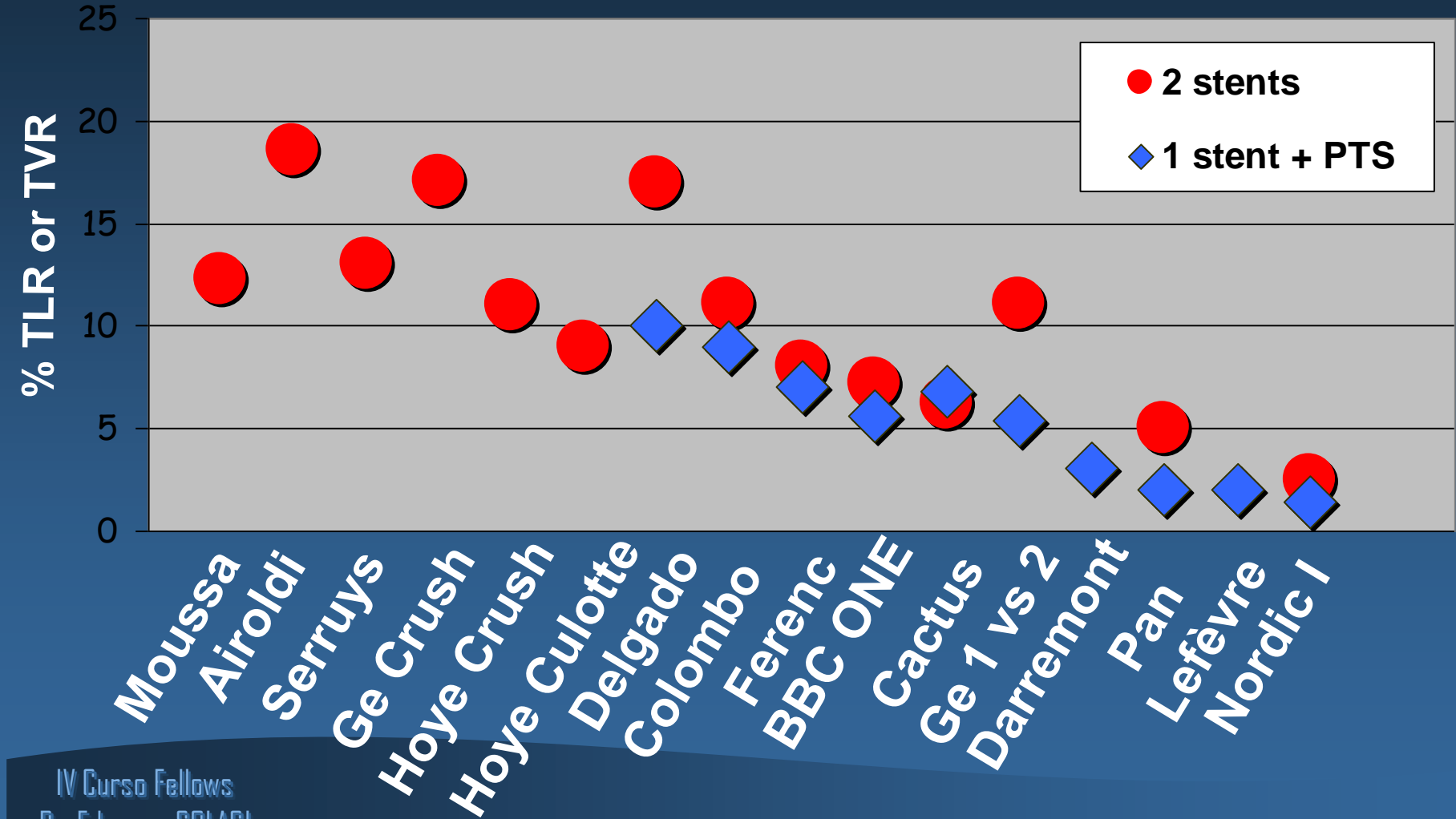


\*  $p=0.04$

# TVR and Treatment Type (BMS)



# Low Rate of Reintervention with DES



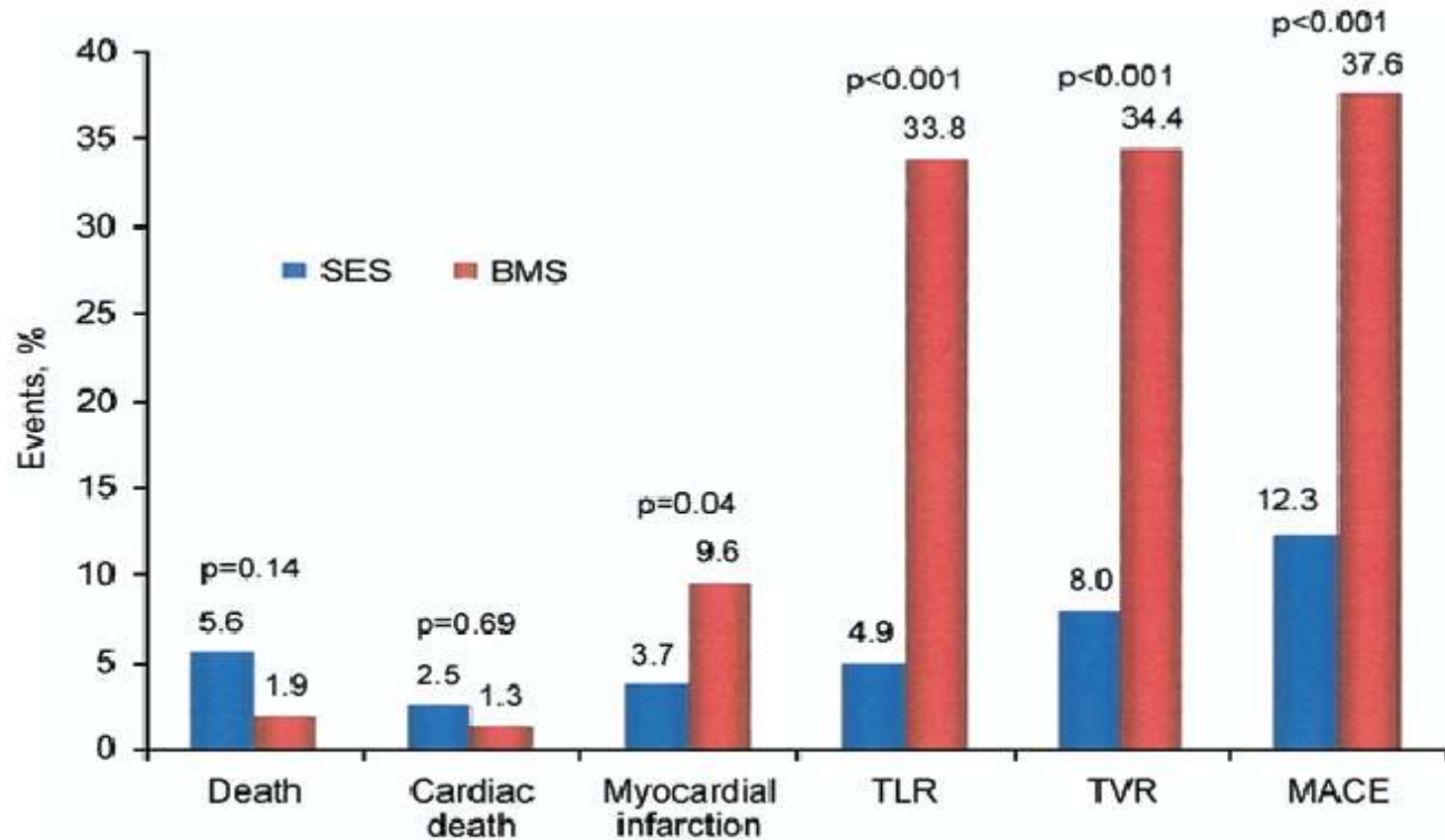
# DES vs BMS

## **Comparison of sirolimus-eluting and bare metal stents in coronary bifurcation lesions: Subgroup analysis of the Stenting Coronary Arteries in Non-Stress/Benestent Disease Trial (SCANDSTENT)**

Leif Thuesen, MD,<sup>a</sup> Henning Kelbæk, MD,<sup>b</sup> Lene Kløvgaard, RN,<sup>b</sup> Steffen Helqvist, MD,<sup>b</sup> Erik Jørgensen, MD,<sup>b</sup> Samir Aljabbari, MD,<sup>b</sup> Lars R. Krusell, MD,<sup>a</sup> Gunnar V.H. Jensen, MD,<sup>c</sup> Hans E. Bøtker, MD,<sup>a</sup> Kari Saunamäki, MD,<sup>b</sup> Jens F. Lassen, MD,<sup>a</sup> and Anton van Weert, PhD,<sup>d</sup> for the SCANDSTENT Investigators *Skejby, Copenhagen and Roskilde, Denmark; and Leiden, The Netherlands*

- 126 patients coronary bifurcation disease
- Sirolimus eluting stent vs BMS
- Sub-study of larger SES vs BMS trial
- One or more stent including MV
- Primary end point was difference in minimal luminal diameter
- Secondary end point was difference in death, MI or target vessel revasc in addition to late lumen loss

# SCANDSTENT



**Figure 1**

**MACE Within 3 Years After Stent Implantation**

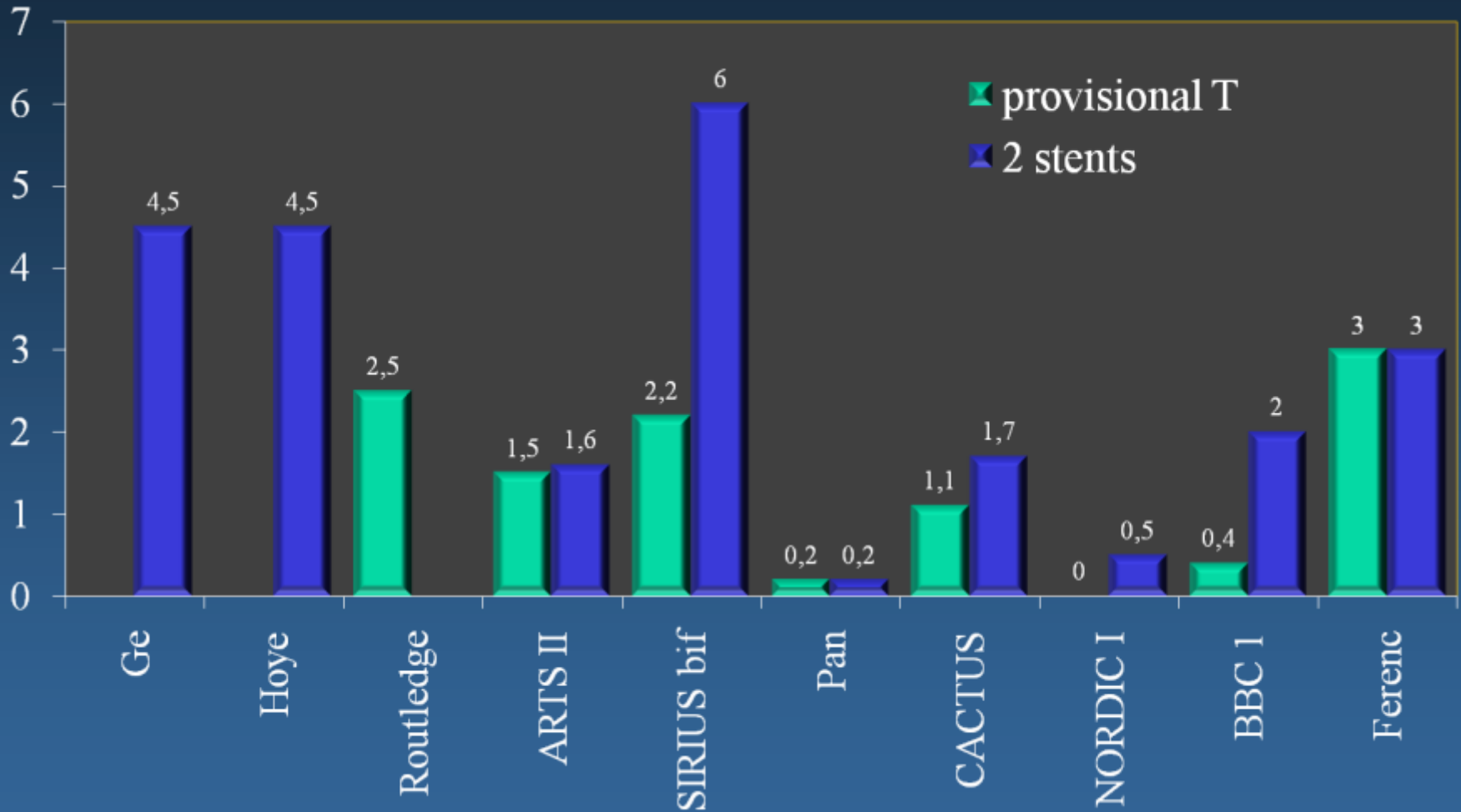


# Bifurcation as a risk factor for ST (in evaluations of multivariate predictors)

	N	RR	95% CI	FU
Iakovou et al JAMA 2005	2229	5.96	1.90 – 18.68	Subacute
Iakovou et al JAMA 2005	2229	8.11	2.50 – 26.26	Late
Ong et al JACC 2005	1017	3.00	1.30 – 6.80	Late
Kuchulakanti et al Circulation 2006	2974	4.40	1.96 – 10.00	6 months
Hwang & Koo TCT 2006		10.21	4.75 – 21.92	Late



# ST after DES for bifurcations



**Registries**

**Randomized trials**

## CACTUS trial

Coronary Bifurcation Application of the Crush Technique Using Sirolimus-Eluting stents

### *Final kissing balloon inflation*

	YES	NO	P value
Myocardial infarctions	7.5% (24/319)	29.0% (9/31)	<0.0001
Stent thrombosis	0.9% (3/319)	6.5% (2/31)	0.06

# Randomized trials

If you can use only 1 stent , you should

If you must use 2 stents, you may

...true for both safety and efficacy

# Bifurcation Lesions

I IIa IIb III



**Provisional side-branch stenting should be the initial approach** in patients with bifurcation lesions when the side branch is not large and has only mild or moderate focal disease at the ostium.

I IIa IIb III



It is reasonable to use elective double stenting in patients with complex bifurcation morphology involving a large side branch where the risk of side-branch occlusion is high and the likelihood of successful side-branch reaccess is low.

# Coronary Stents

**I IIa IIb III**



Before implantation of DES, the interventional cardiologist should discuss with the patient the need for and duration of DAPT and the ability of the patient to comply with and tolerate DAPT.

**I IIa IIb III**



**PCI/STEMI**

DES is useful as an alternative to BMS to reduce the risk of restenosis in cases in which the risk of restenosis is increased and the

patient is likely to be able to tolerate and comply with prolonged DAPT.

**I IIa IIb III**

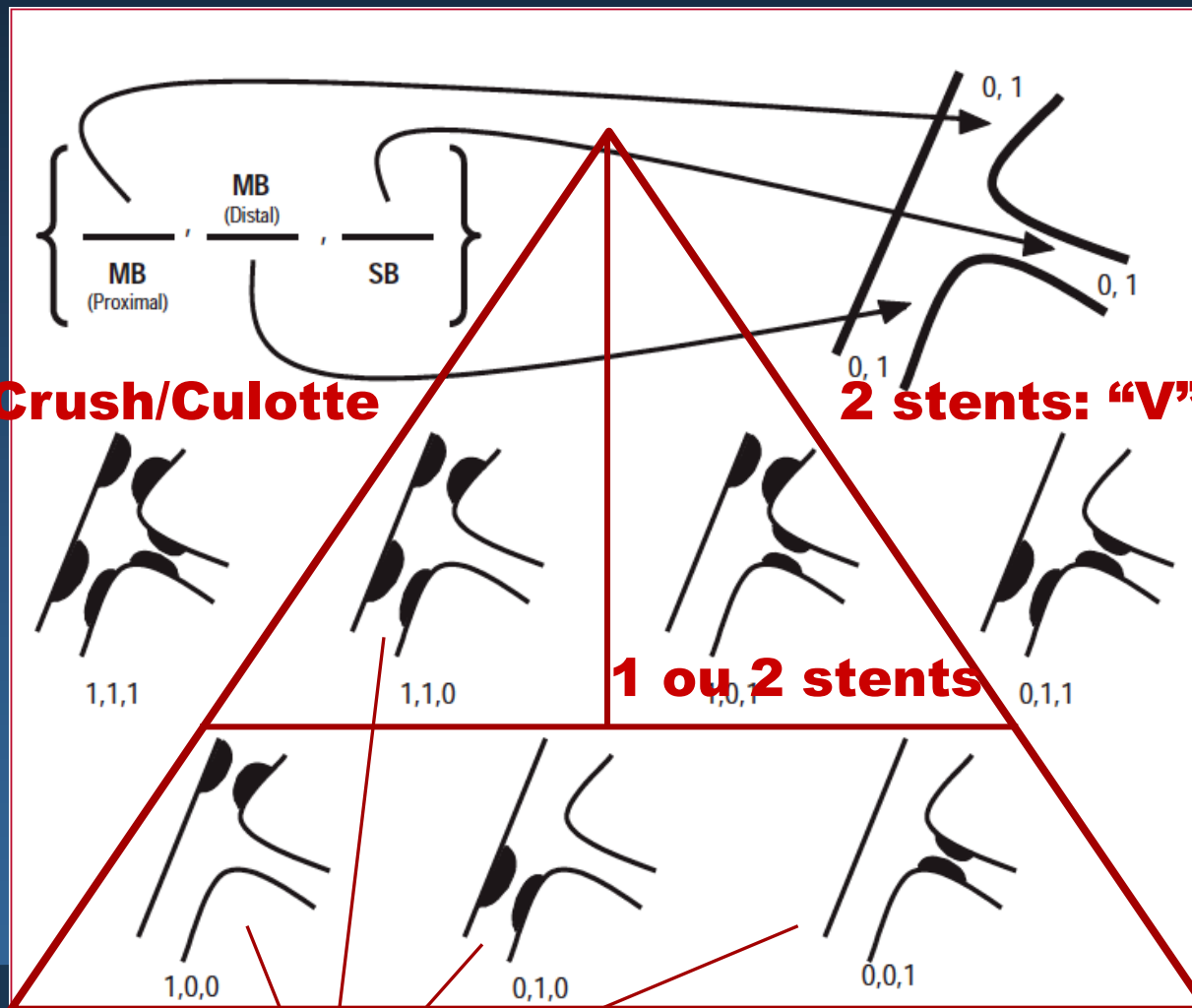


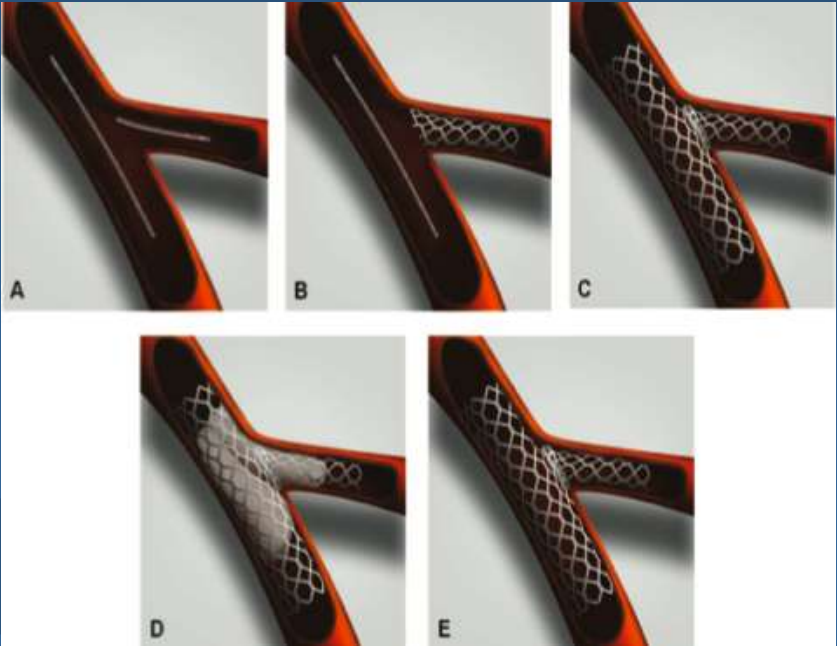
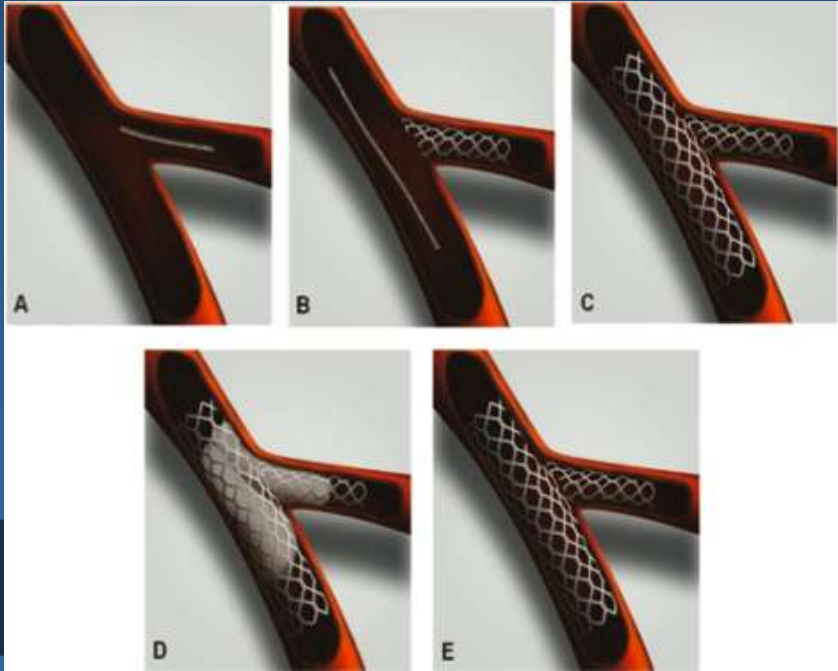
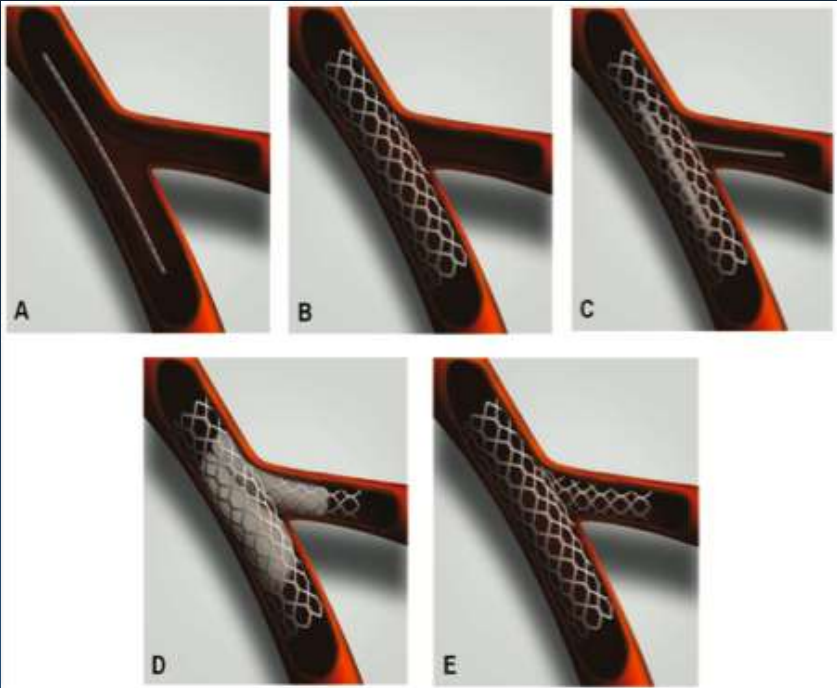
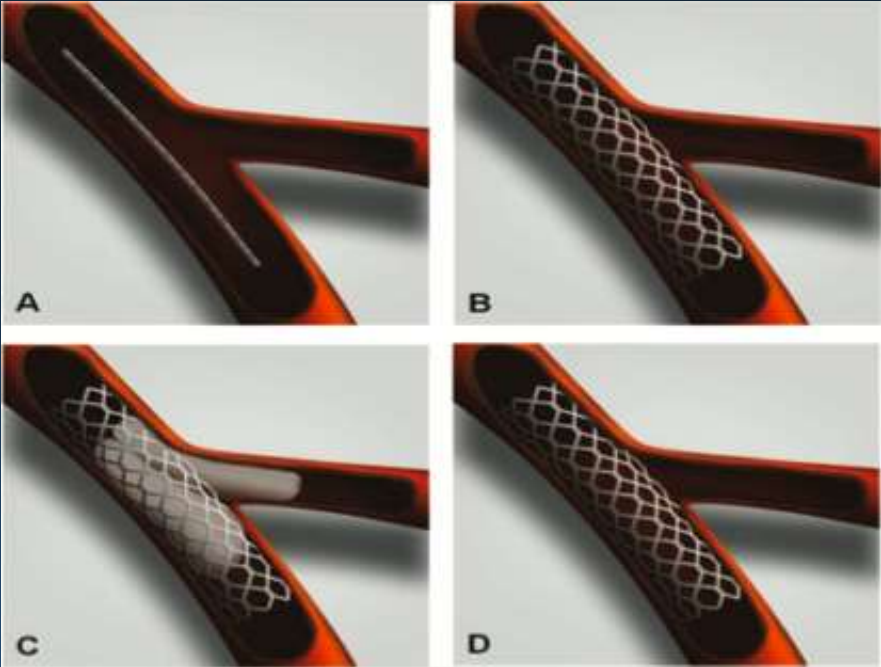
**UA/NSTEMI**

# Medina classification => bifurcation stenting

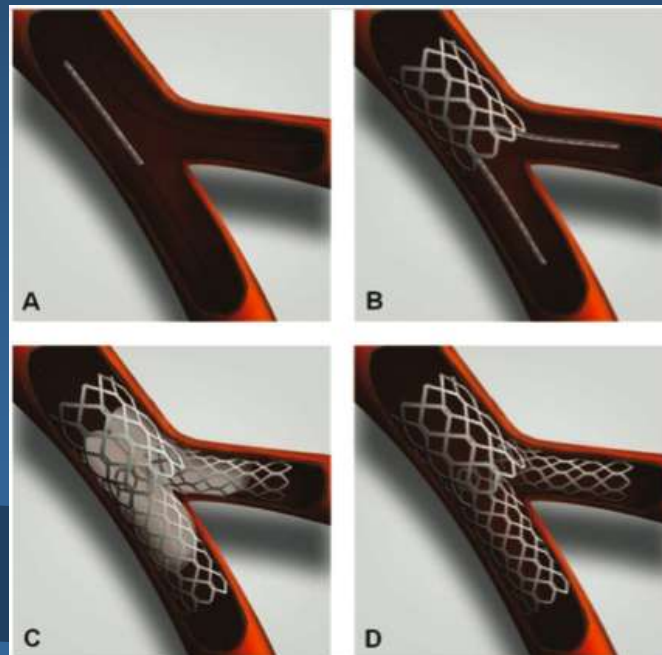
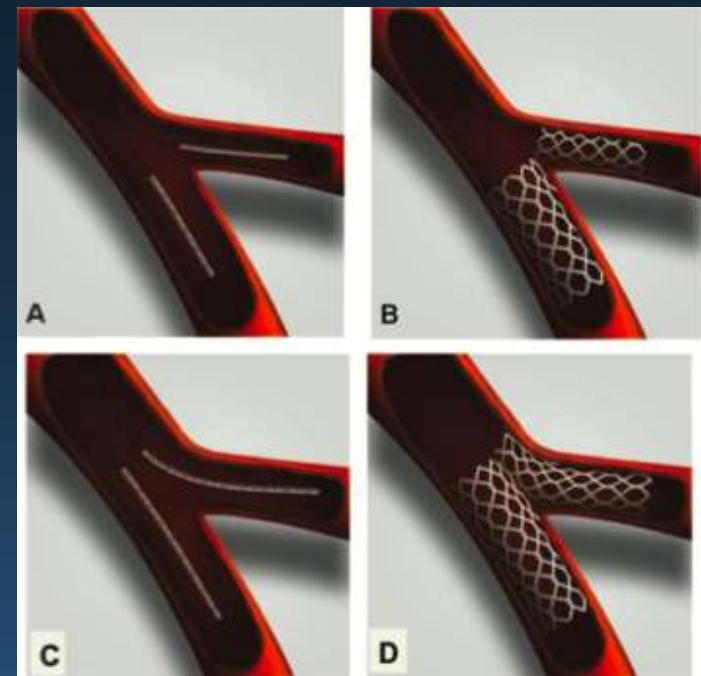
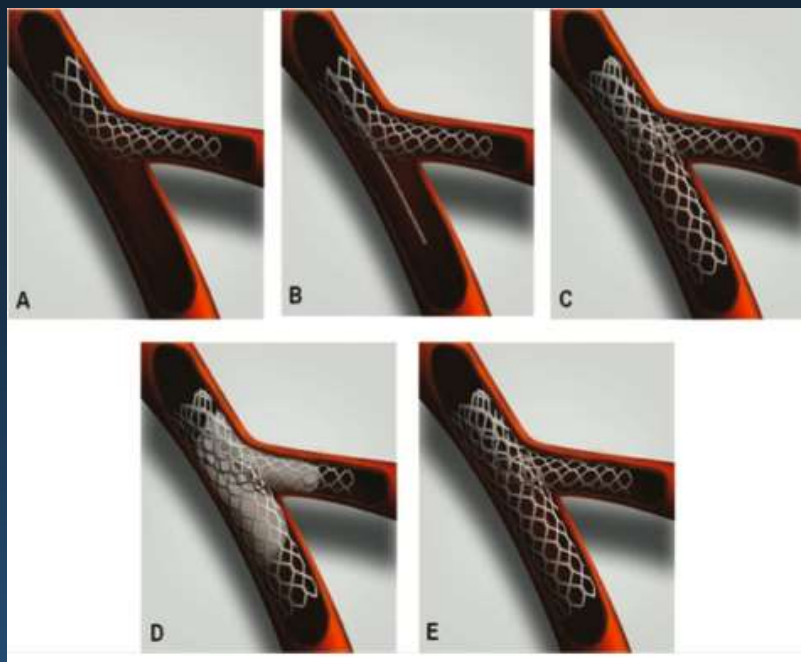
**2 stents: Crush/Culotte**

**2 stents: "V"**









# Bifurcation treatment in the era of DES

## Conclusions

- Treatments are not equivalent: Simple is better than **Complex** when possible (in the majority of cases)
- **More Complex** techniques with DES (**Culotte and Crushing**) are associated with a increased risk of non-Q wave MI, TVR and post procedure stent thrombosis even after final “kissing balloon” probably due to:
  - Risk of incomplete stent apposition
  - Multiple layers of DES
  - Delayed healing

# Conclusions

- Works with appropriate materials
- Protect the side branch with a wire if needed/possible, particularly complex lesions
- Single stent is optimal, with a provisional T stent strategy (30% require a second stent due to dissection, TIMI 2, residual >50%)
- Kissing balloon is highly desirable/recommended
- DES outcomes are superior to BMS



