



# Optimizing technique of bifurcation stenting

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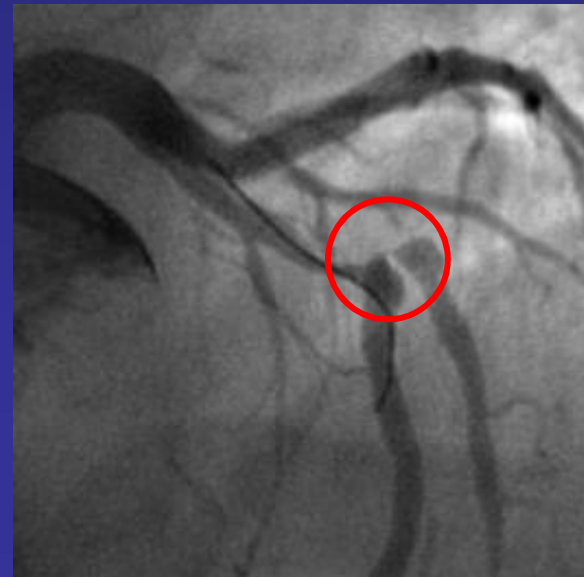
Castle Hill Hospital  
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# Conflicts of interest

**I have no conflict of interest with respect  
to this presentation**

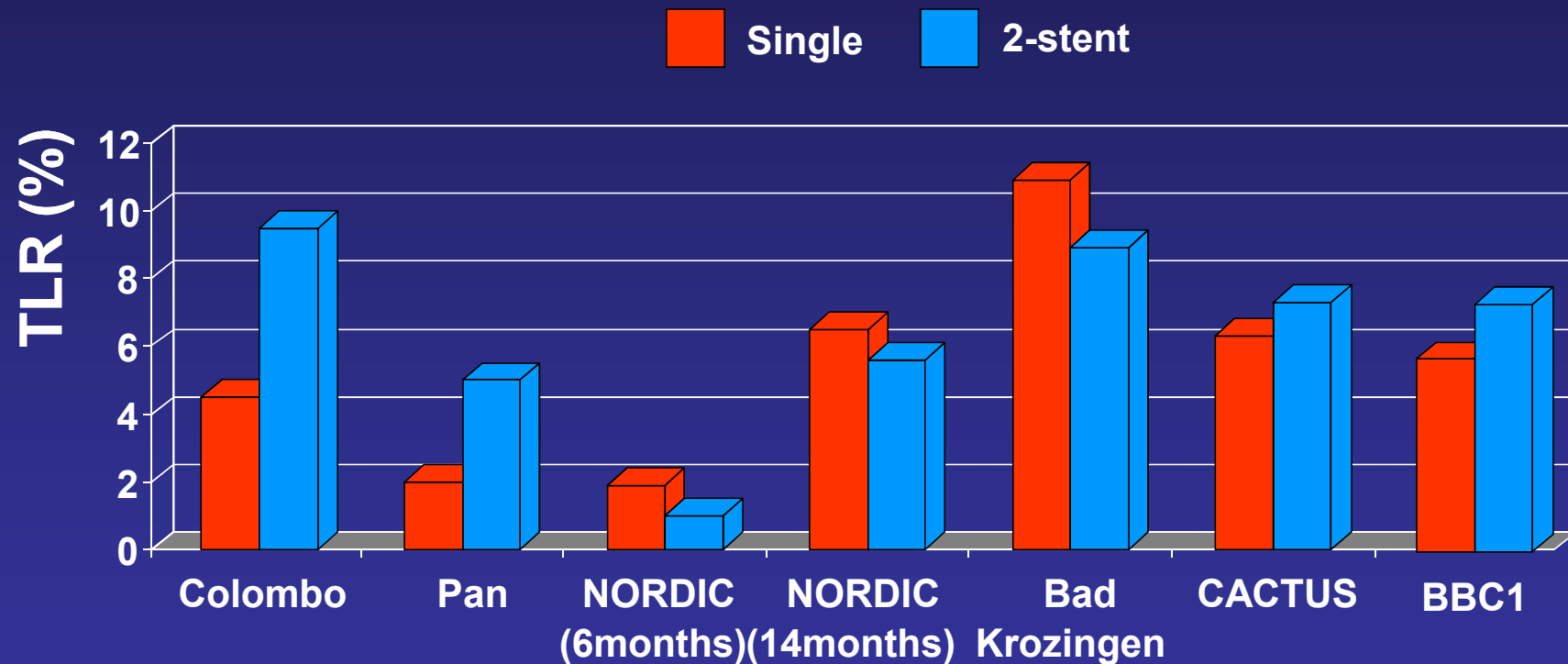
# The challenge of bifurcations

- Heterogeneous group
  - Variable plaque distribution
  - Extent of side branch disease
  - Size of vessels
  - Variable angulation



# Provisional stenting

- Randomised studies have shown that the majority of bifurcation lesions can be successfully treated with 1 stent



*Colombo et al Circ 2004; Pan et al AHJ 2004; Steigen et al Circ 2006; Jensen et al Eurointervention 2008; Ferenc et al EHJ epub 2008; Colombo et al; Hildick-Smith at TCT 2008*

# Wire the side branch

- Compromise of SB occurs to some extent unpredictably

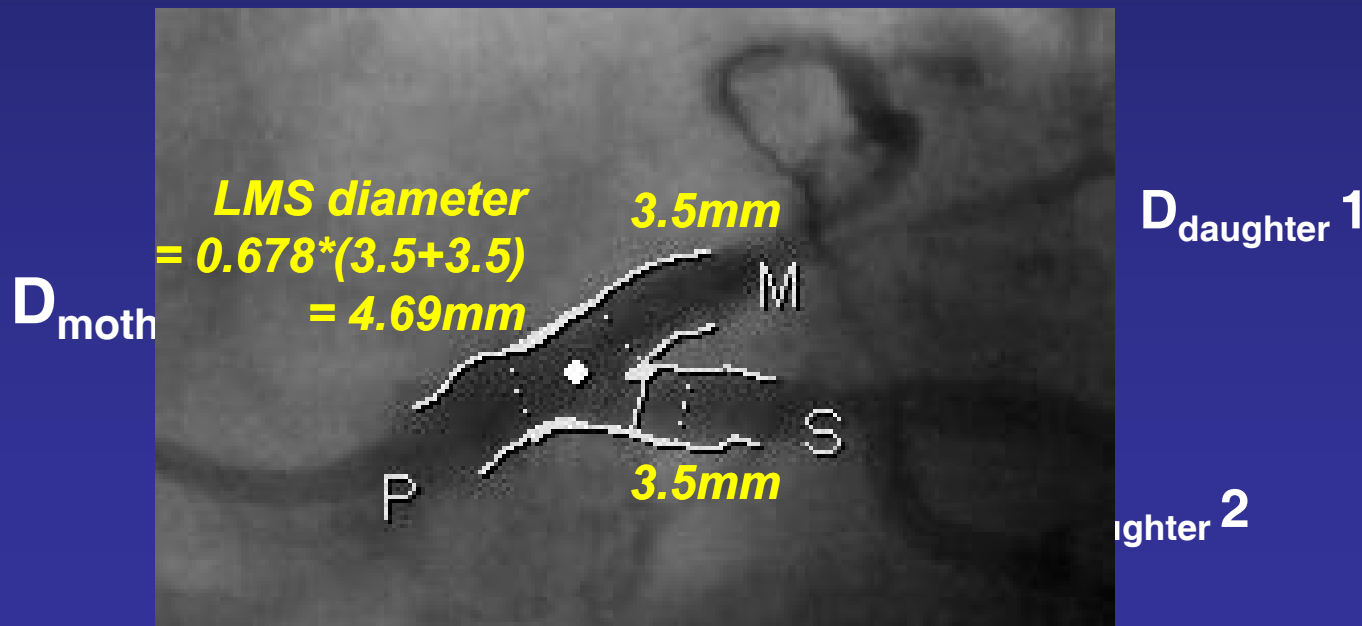
## Predictors of Side Branch Failure Insights from the TULIPE Study (n=186)

	Success	Failure	p value
Age (years)	66 ± 11	57 ± 8	0.0007
MB ref diameter (mm)	3.1 ± 0.4	2.8 ± 0.3	0.0085
SB ref diameter (mm)	2.5 ± 0.5	2.2 ± 0.3	0.0413
Final kissing balloon (%)	98.1	76.5	0.0019
<b>Jailed wire (%)</b>	<b>92.9</b>	<b>71.4</b>	<b>0.031</b>

# Choice of stent size

- The proximal reference diameter is always larger than the distal reference diameter

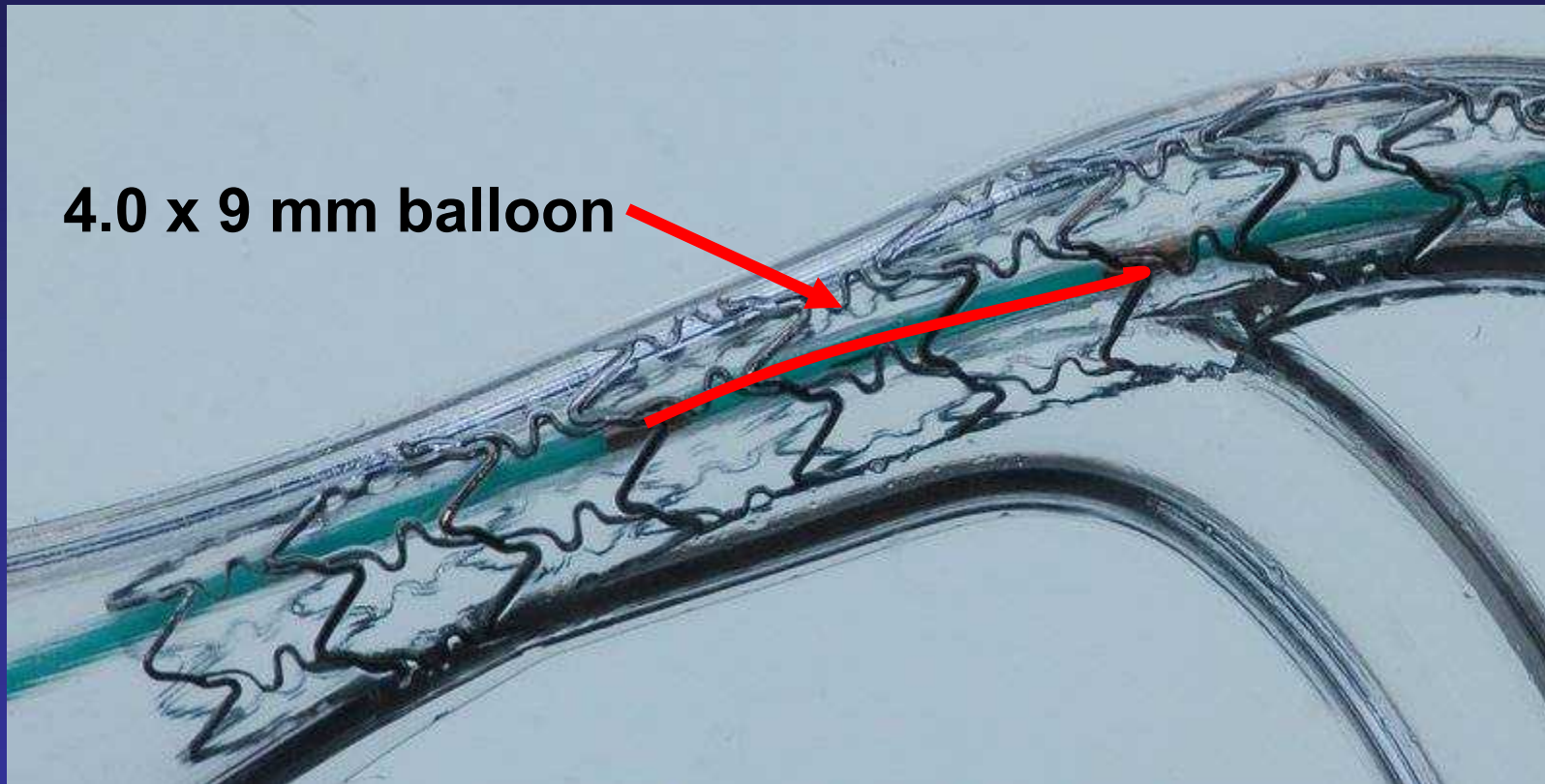
$$D_{\text{mother}} = 0.678 * (D_{\text{daughter 1}} + D_{\text{daughter 2}})$$



# Optimization of stent result

1. Choose the stent diameter related to the size of the distal main vessel
2. The proximal part of the stent is then post-dilated (proximal optimisation technique (POT))
  - Optimise stent apposition in the proximal MV
  - Facilitates a “distal” cross as opposed to a proximal one to improve scaffolding of the ostium of the side branch

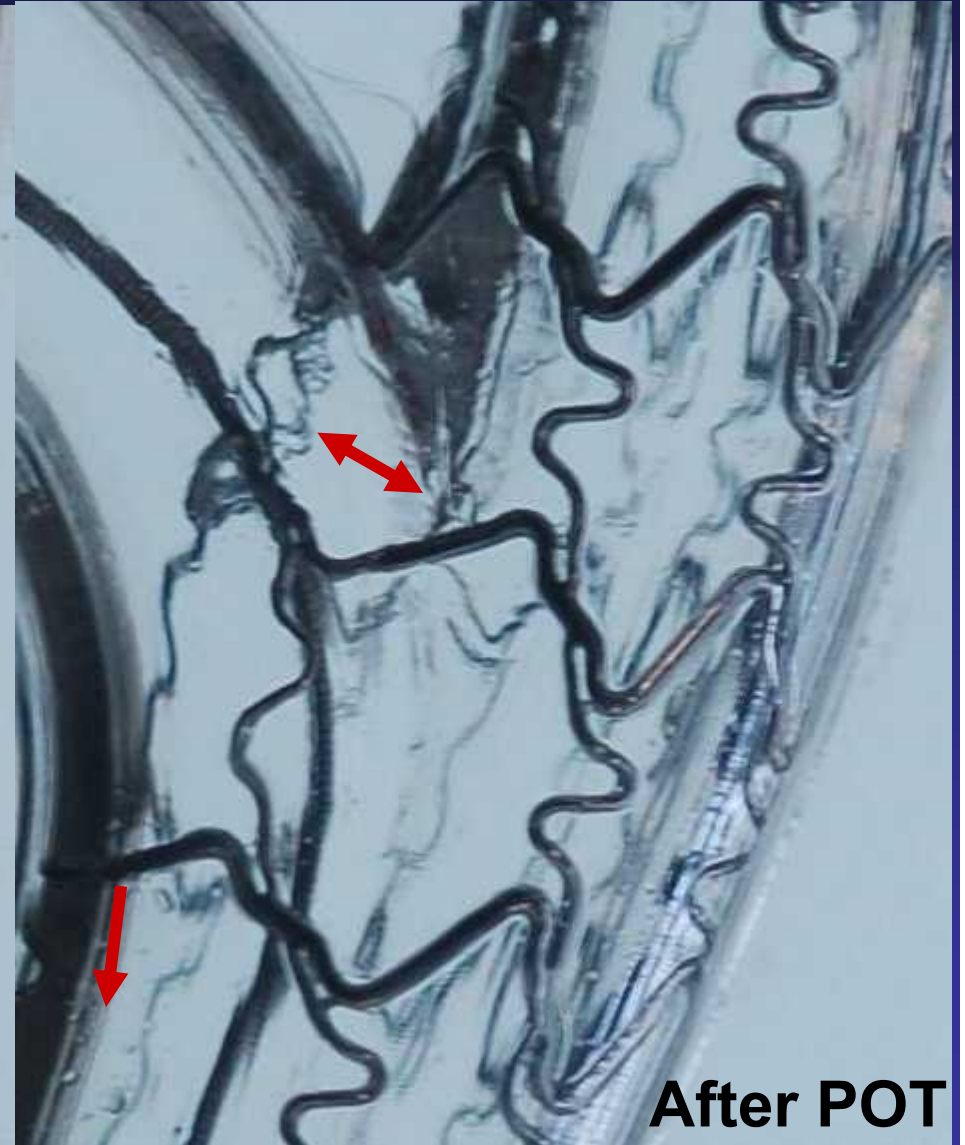
# Proximal Optimization Technique (POT)



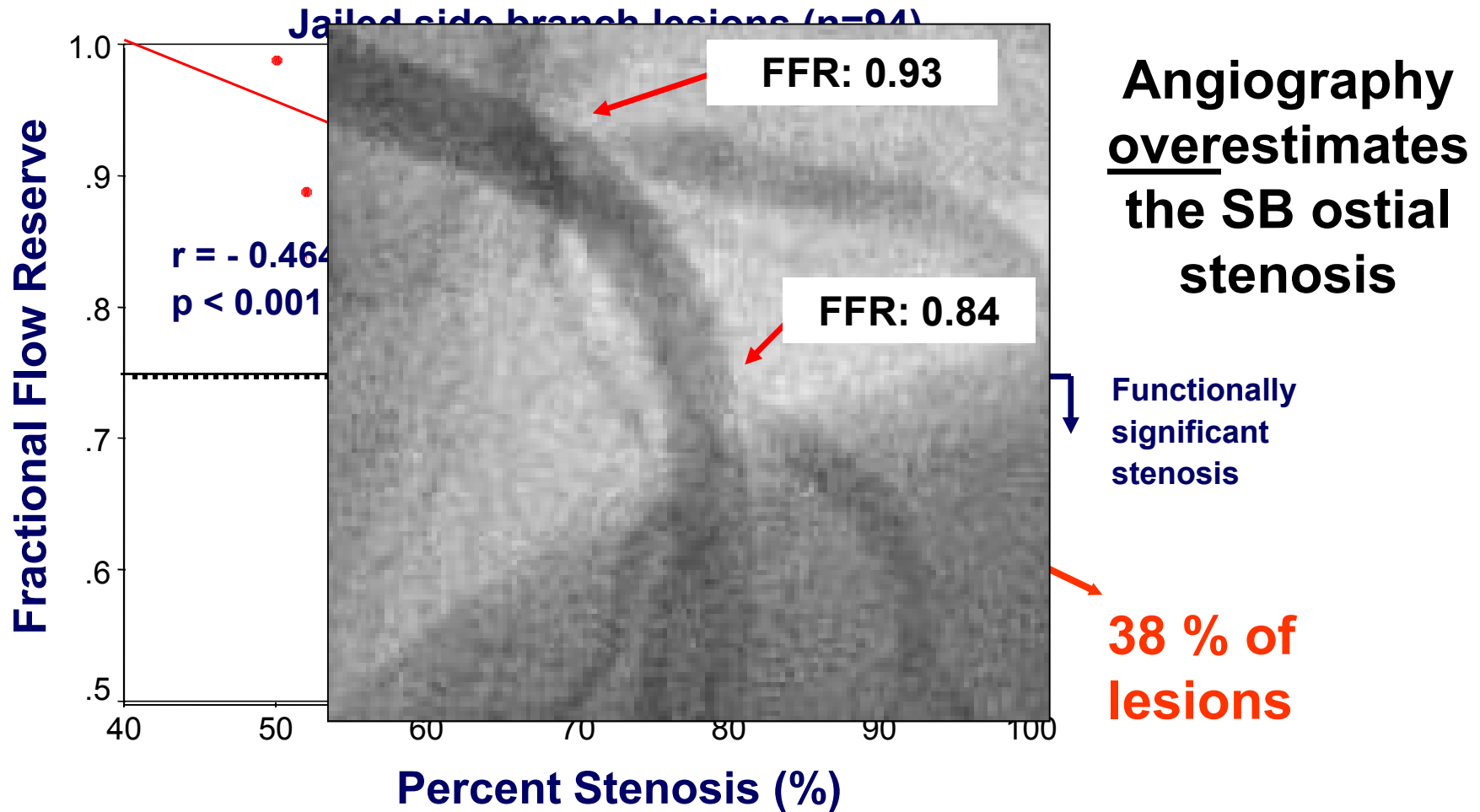
Courtesy of Dr Olivier Darremont



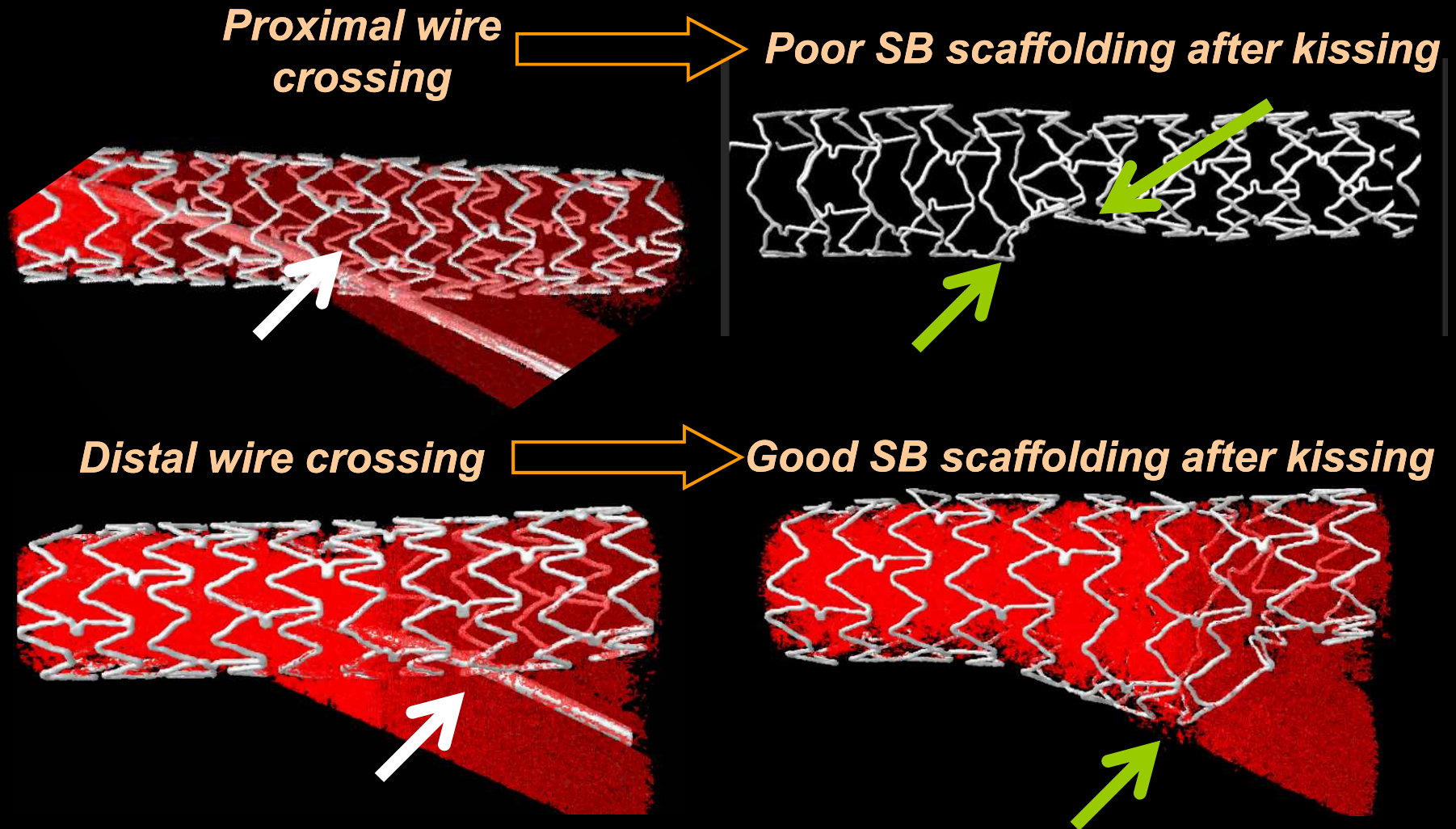
# POT technique



# The side branch



# Relationship of wire crossing to side branch scaffolding



*Courtesy of Dr John Ormiston*

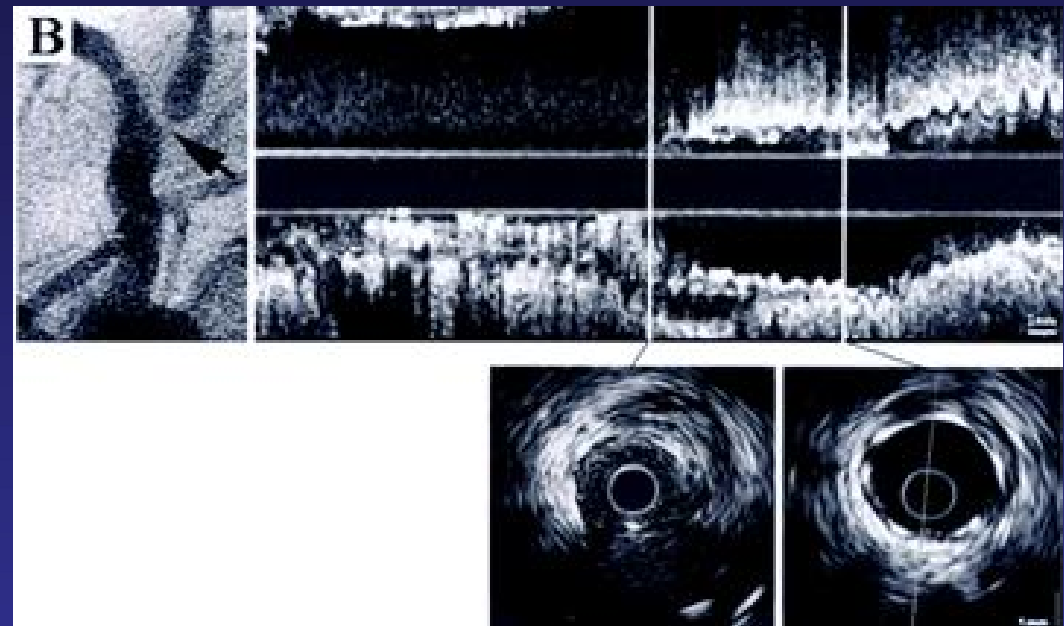
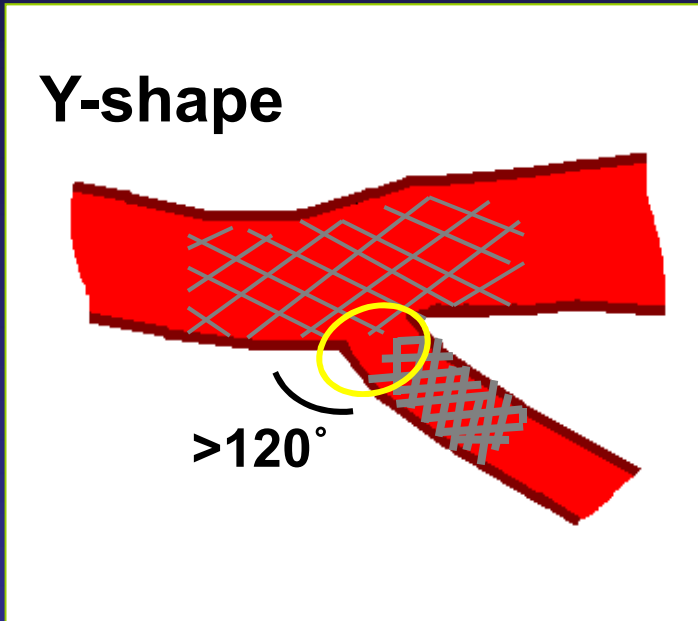
# Side branch lesions are usually relatively short

	TULIPE	Colombo	NORDIC	Bad Krozingen
Patients (n)	187	85	207*	101*
Reference diameter (mm)	2.7 ± 0.4	2.1 ± 0.3	2.6 ± 0.4	2.39 ± 0.31
<b>Lesion length (mm)</b>	<b>5.6 ± 4.2</b>	<b>5.3 ± 4.2</b>	<b>6.0 ± 4.8</b>	<b>10.4 ± 4.1</b>
Stenosis (%)	52 ± 17	52 ± 19	46 ± 26	53 ± 24

*\* Results for the provisional stenting group*

Brunel et al CCI 2006;68:67-73; Colombo et al Circulation 2004;109:1244-49;  
Steigen et al Circulation 2006;114:1955-61; Ferenc et al EHJ epub 2008

# Assess the angulation



Y-shape incidence ~ 75%

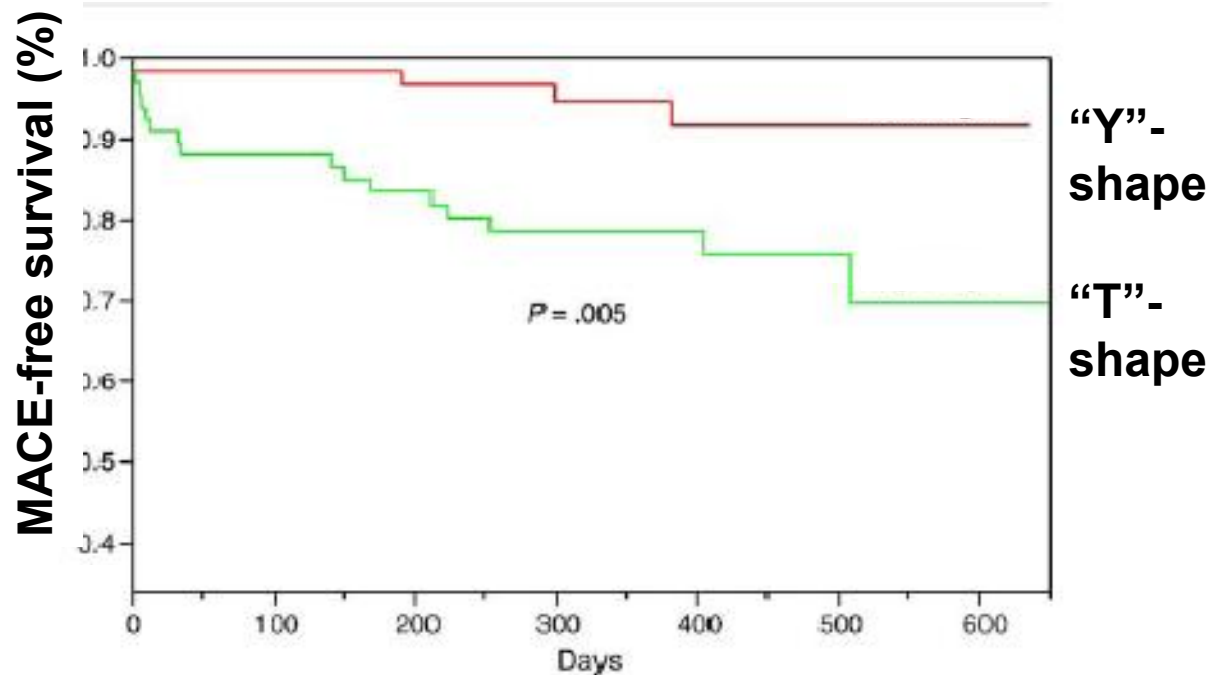
- ✓ Culotte
- ✓ Crush
- ✓ Mini crush

Ostial restenosis was associated with incomplete coverage

✗ T-stent

# Crush stenting: influence of bifurcation angle

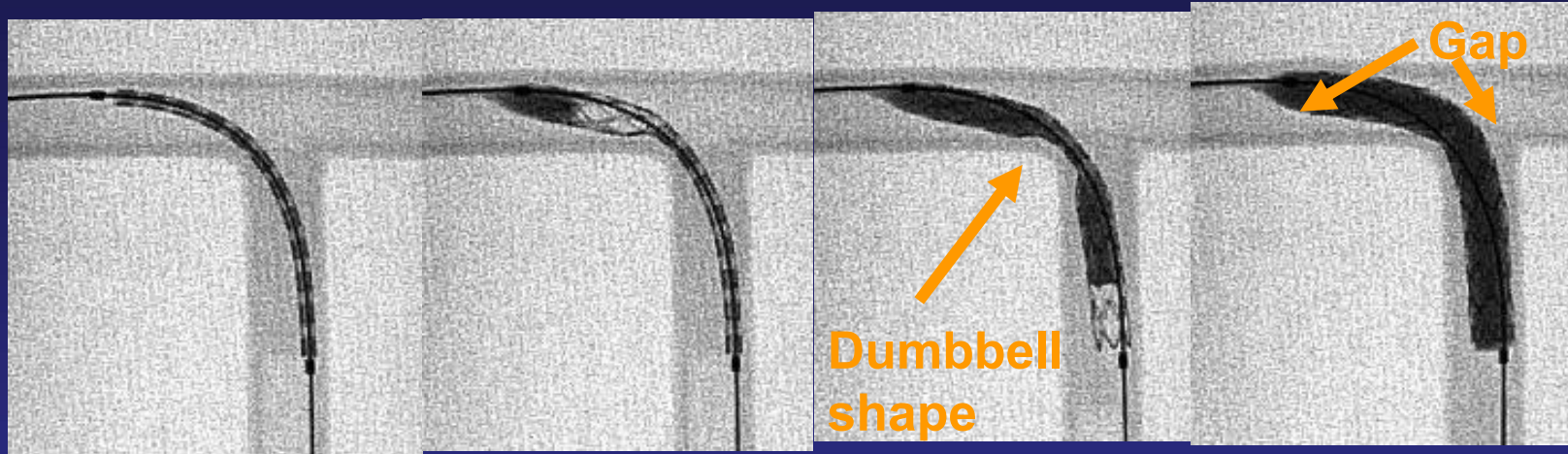
Influence of bifurcation angle on outcome following use of the crush technique



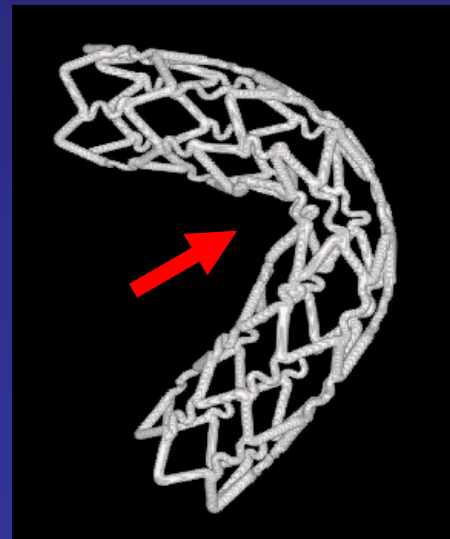
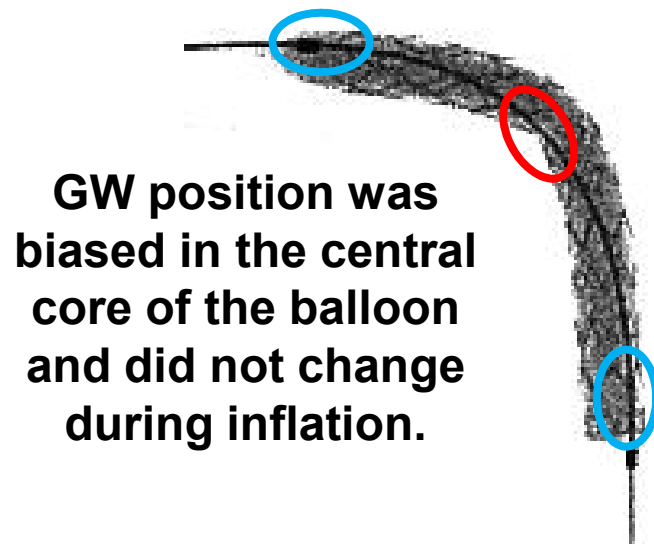
# Culotte stenting

Independent predictors of binary restenosis	Odds ratio (95% CI)	p value
Age (increase of 10 years)	2.38 (1.21-4.96)	0.01
<b>Bifurcation angle (increase of 10°)</b>	<b>1.53 (1.04-2.23)</b>	<b>0.03</b>
Baseline main vessel DS (increase of 10%)	1.47 (1.03-2.09)	0.03
SB ref. vessel diameter (decrease by 1mm)	31.83 (1.71-592.77)	0.02
Kissing balloon post-dilatation	0.37 (0.13-1.10)	0.07

# Stents don't like large bends



**Maximal inflation pressure**



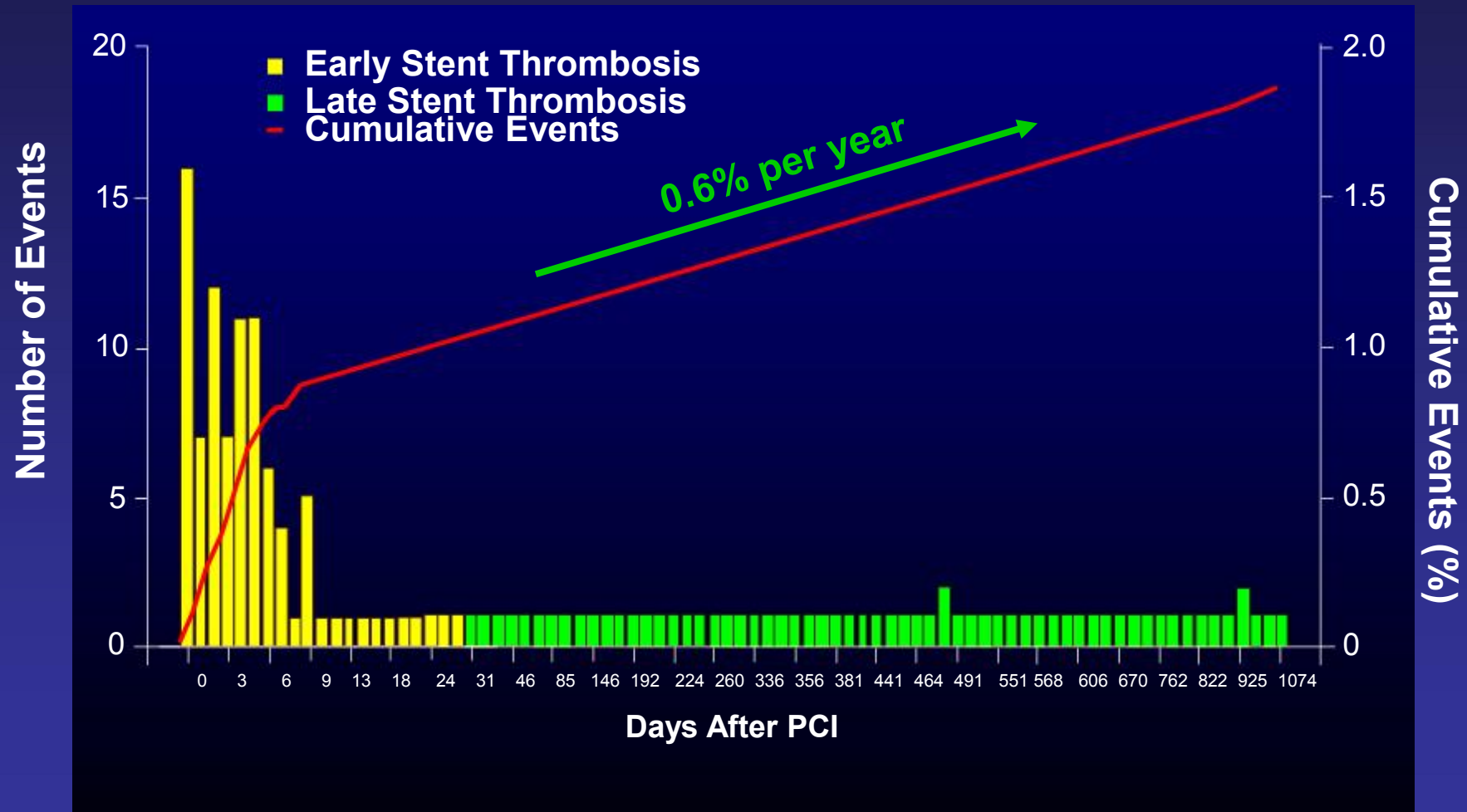
Courtesy of Dr Murasato



# Choice of stenting strategy: the importance of angulation

	T-shape bifurcation	Y-shape bifurcation
T-stenting	✓	X
Crush	X	✓
Culotte	X	✓
Mini-crush	✓	✓

# Bern/Rotterdam Experience: Occurrence of ST



# Bern/Rotterdam experience

	ST (n = 152)	No ST (n = 7,994)	P- value
<b>Age (years)</b>	<b>60.3 ± 12.0</b>	<b>62.5 ± 11.5</b>	<b>0.01</b>
Male	76%	74%	0.78
Hypertension	41%	46%	0.29
Family history	29%	28%	0.79
Current smoking	38%	37%	0.87
Dyslipidaemia	49%	50%	0.74
Diabetes	19%	16%	0.32
Renal failure	6%	4%	1.00
LVEF (%)	52 ± 12	55 ± 12	0.07
<b>ACS at presentation</b>	<b>71%</b>	<b>59%</b>	<b>0.02</b>
<b>Bifurcation treatment</b>	<b>28%</b>	<b>16%</b>	<b>0.003</b>
<b>Number of stents per patient</b>	<b>2.35 ± 1.73</b>	<b>1.95 ± 1.22</b>	<b>&lt;0.0001</b>
<b>Total stent length per patient (mm)</b>	<b>42.3 ± 34.0</b>	<b>35.8 ± 25.1</b>	<b>0.002</b>
<b>Avg stent diameter / patient (mm)</b>	<b>2.83 ± 0.35</b>	<b>2.93 ± 1.44</b>	<b>0.48</b>

# Pre-Procedure Characteristics

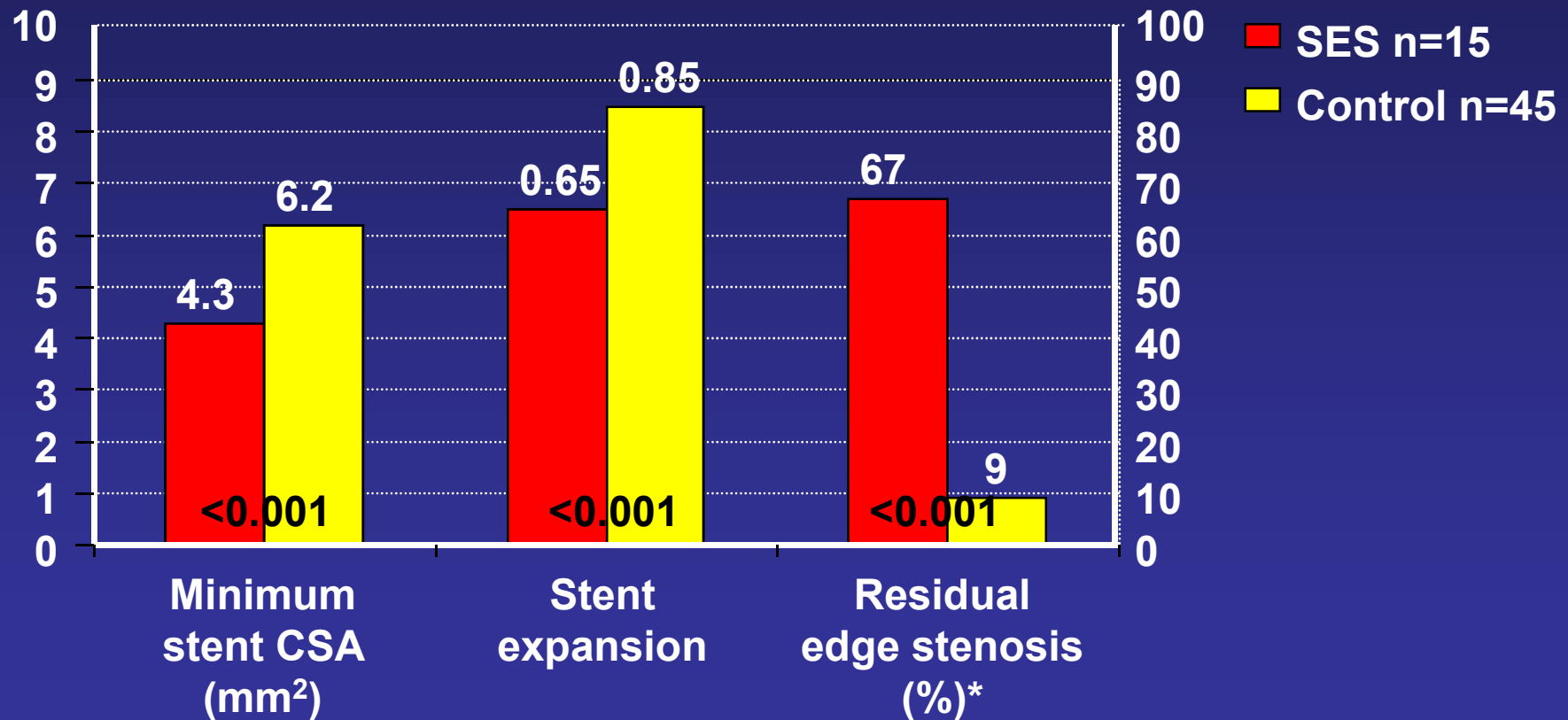
	Early ST	Late ST	p-Value
Treated Vessel			
LMCA (%)	0.0	2.0	-
LAD (%)	54.0	54.0	0.989
LCA (%)	19.0	10.0	0.092
RCA (%)	27.0	33.0	0.378
SVG (%)	0.0	2.0	-
B2/C Lesions (%)	91.0	81.0	0.089
<b>Bifurcation (%)</b>	<b>36.0</b>	<b>13.0</b>	<b>0.002</b>
Diameter Stenosis (%)	17.0	19.0	0.740
Lesion Length (mm)	13.36	13.83	0.940
MLD (%)	0.41	0.57	0.465
MLD (excl total occlusion) (mm)	0.33	0.53	0.332
RVD (mm)	0.53	0.43	0.041

Daemen J., et al., *Lancet* 2007; 369: 667–78.

# IVUS predictors of DES thrombosis

2,575 pts treated with 4,722 SES

21 (0.8%) had ST within 30 days, 15 had IVUS



\* Residual edge stenosis = edge lumen CSA <4.0mm<sup>2</sup> and plaque burden >70%

Fujii et al JACC 2005;45:995-8

# IVUS

- Registry data of 884 patients undergoing IVUS-guided PCI compared with the same number treated with angiography-guided PCI
- Routine use of IVUS was shown to:
  - reduce the rate of subacute stent thrombosis (0.5% versus 1.4%,  $p=0.045$ )
  - reduce the cumulative stent thrombosis at 12 months (0.7% versus 2.0%,  $p=0.014$ )

# Final kissing balloon post-dilatation

- Mandatory when using a 2-stent strategy
- Significant reduction in MV and SB restenosis
- Must be performed optimally using appropriately sized balloons:
  - Sequential high pressure balloon dilatation of the SB stent then MV stent
  - Finalise with lower pressure kissing balloon dilatation
  - Evaluate with IVUS



# Is there a role for dedicated bifurcation stents?

**Need to prove themselves:**

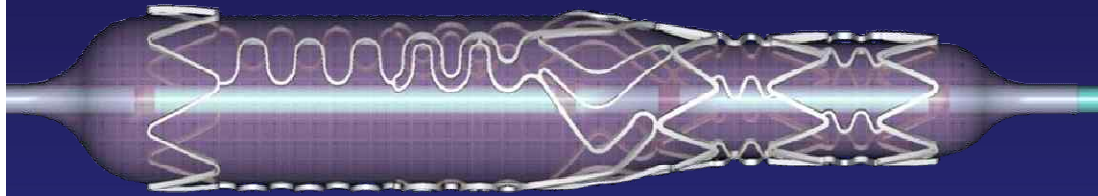
- **Safety and efficacy**
- **Ease of use / deliverability**
- **Cost effectiveness**

**May have a “niche” role**

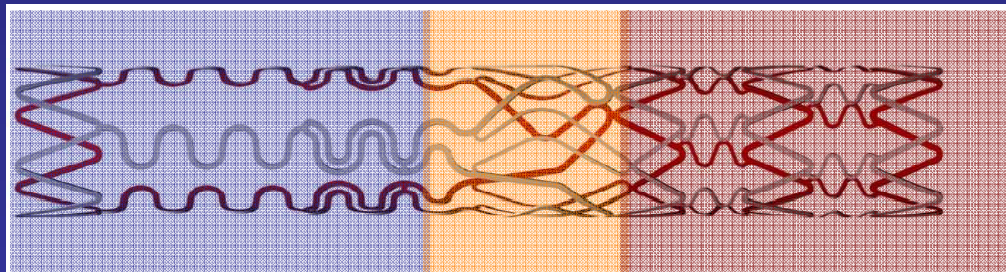


# Tryton side branch stent

## Stepped balloon



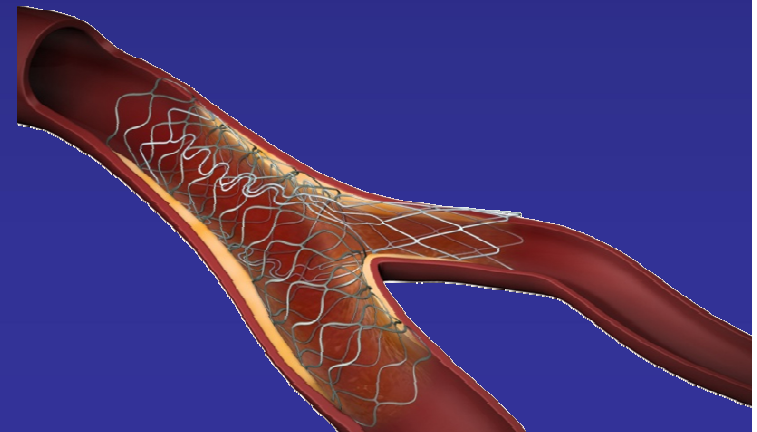
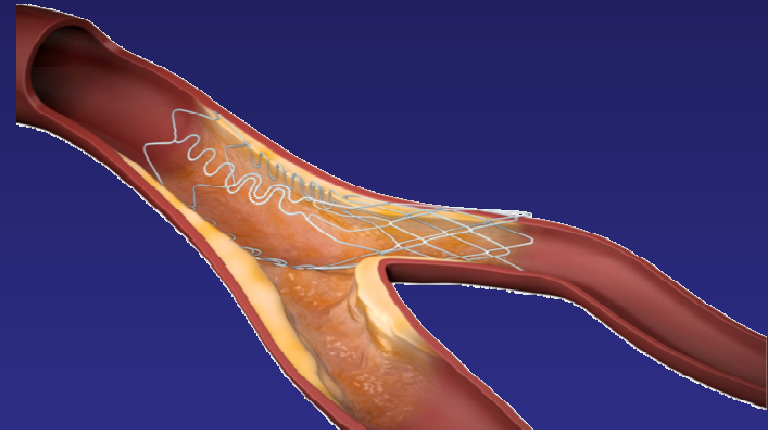
Main vessel      Transition zone      Side branch



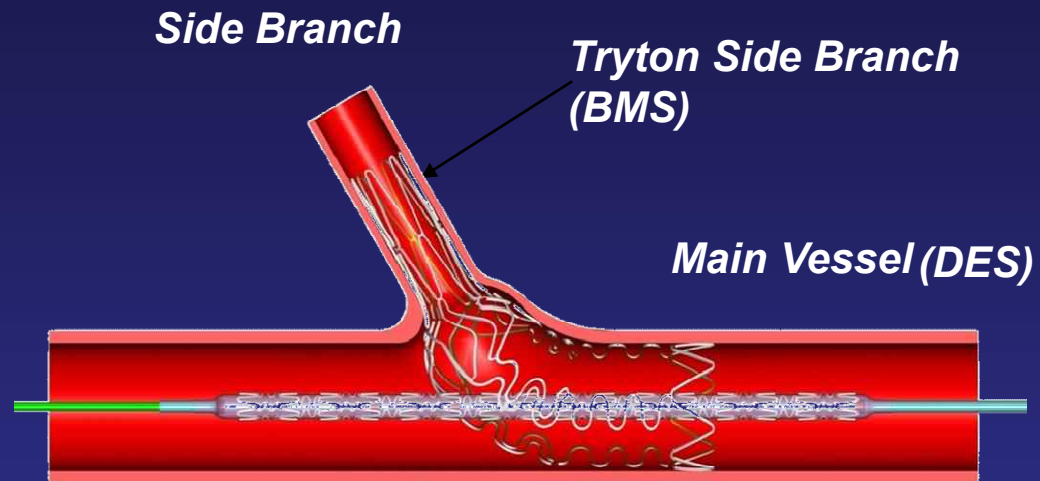
3 Fronds

- Minimal Coverage

Wedding Band



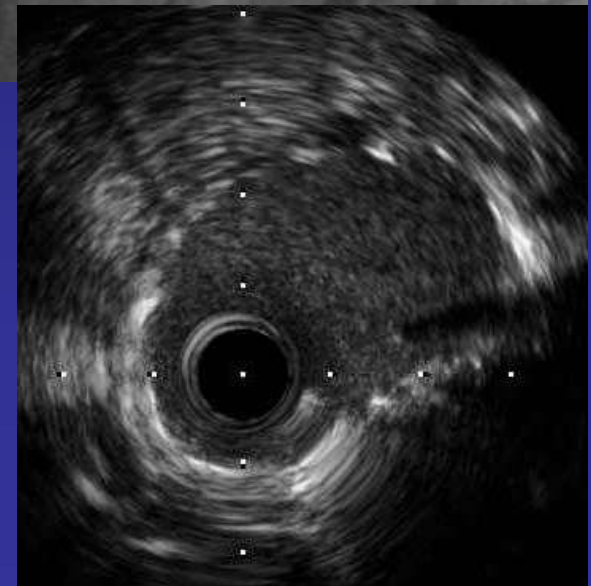
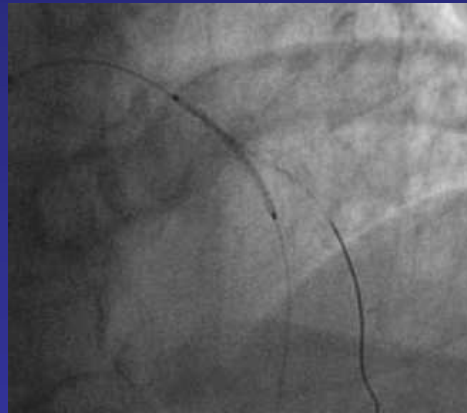
# Tryton FIM



- **Six Month Results**

- Low TLR: 3%
- Low Late Loss:
  - Main Vessel (Proximal):  $0.25 \pm 0.43$  mm
  - Main Vessel (Distal):  $0.00 \pm 0.31$  mm
  - Side Branch:  $0.17 \pm 0.35$  mm

# Tryton



# Summary and Conclusions

- To optimize the results of bifurcation stenting, consideration should be given to:
  - The **relative size** of the vessels: optimize the dilatation of the proximal main vessel
  - The **angulation**: especially when the SB is to be stented
- High pressure kissing balloon post-dilatation can help provide some scaffolding of the SB ostium, and is mandatory if a 2-stent technique is used
- There is evidence for the role of adjunctive devices to guide therapy:
  - **FFR** assessment of the SB
  - **IVUS** to ensure optimal stent expansion

**Thankyou!**

