



Approaches for bifurcation intervention according to the lesion characteristics

Angela Hoye MB ChB, PhD

Castle Hill Hospital
Kingston-upon-Hull, UK

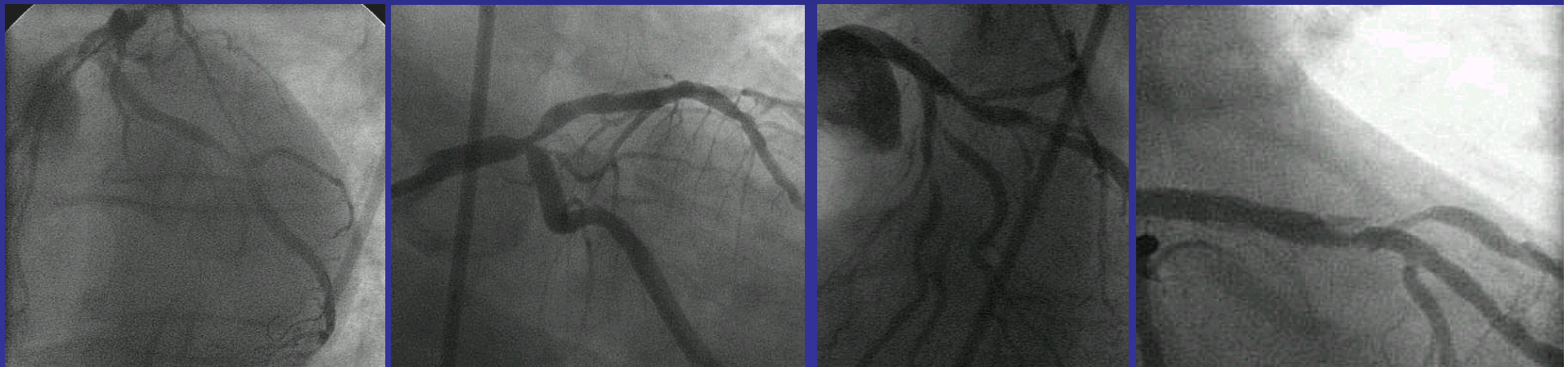
Disclosure Statement of Financial Interest

Within the past 12 months, I have received consulting fees / honoraria from the following:

- Cordis, Johnson & Johnson*
- Abbott Vascular*
- The Medicines Company*
- Boston Scientific*

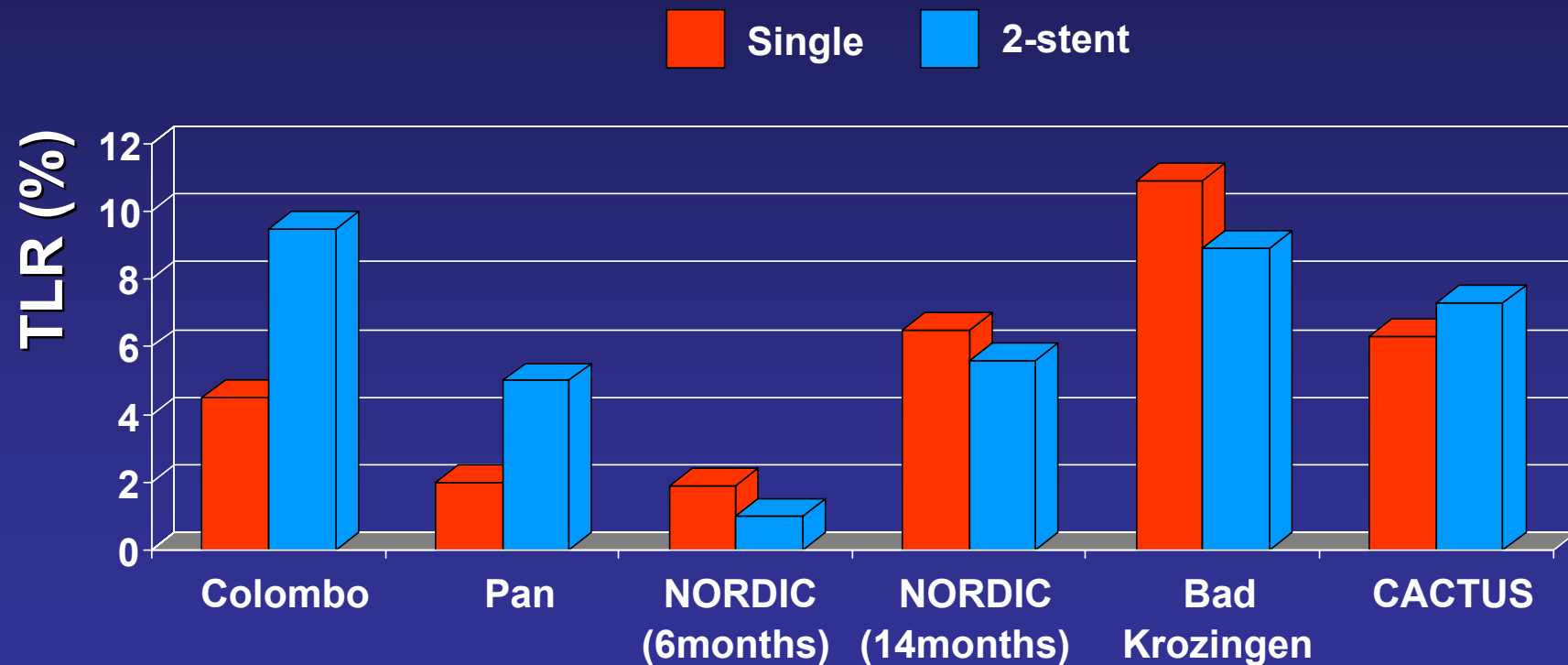
The challenge of bifurcations

- **Bifurcation lesions are common**
 - SYNTAX 73% patients were treated for a bifurcation
- **Increased risk of MACE**
- **Heterogeneous lesion subtype**
 - Size of vessels
 - Variable plaque distribution
 - Extent of side branch disease
 - Variable angulation



Provisional stenting

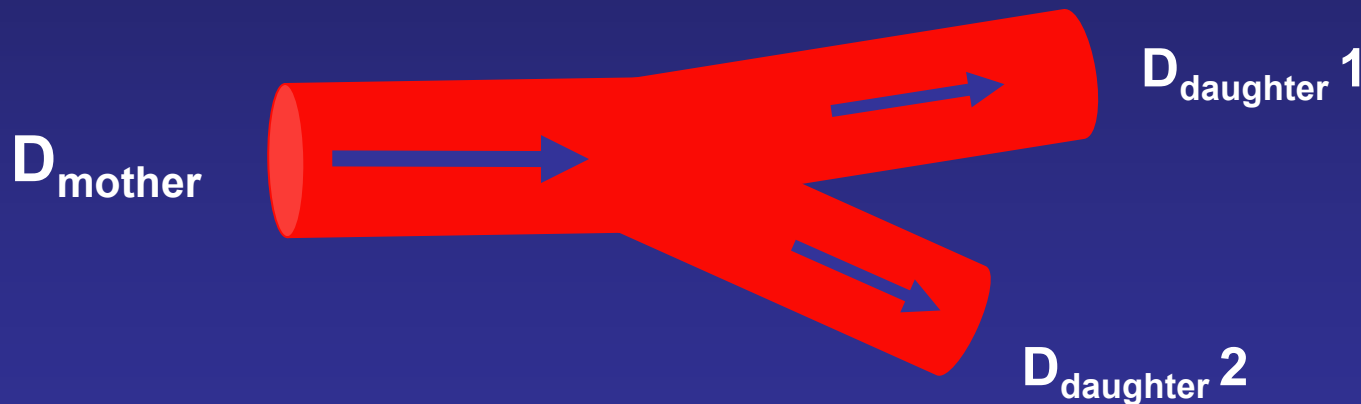
- Randomised studies have shown that the majority of bifurcation lesions can be successfully treated with 1 stent



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

Approach to optimal provisional stenting: choice of stent size

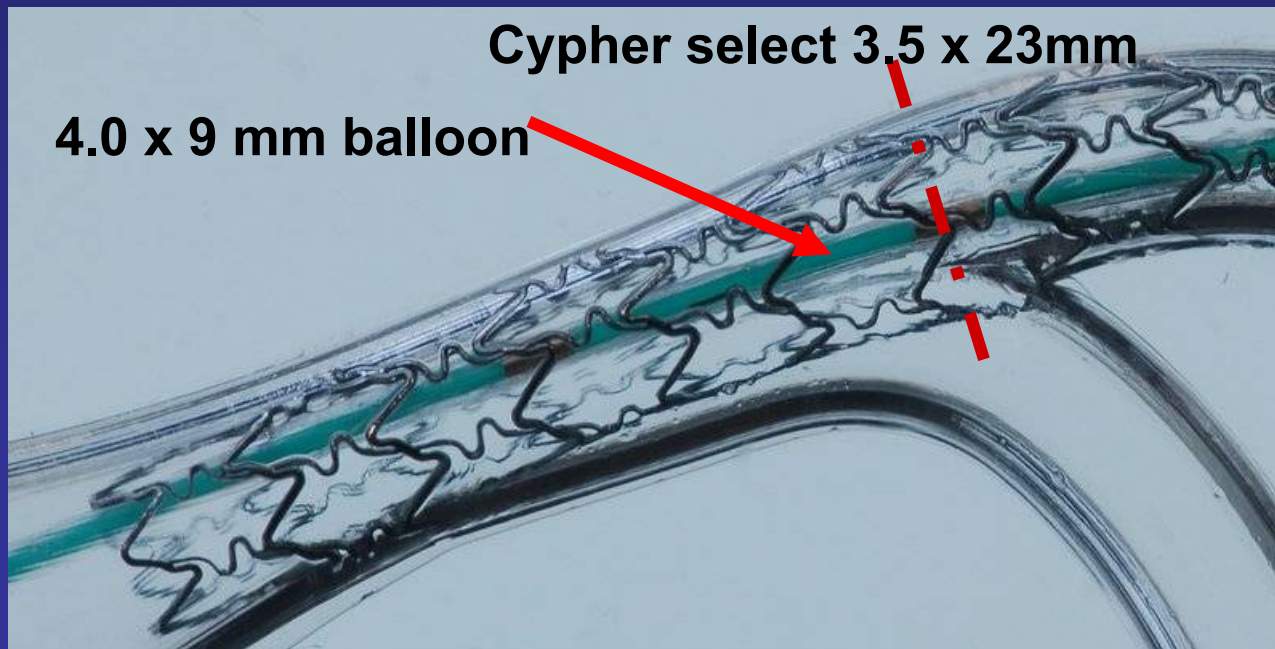
- The proximal reference diameter is always larger than the distal reference diameter



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

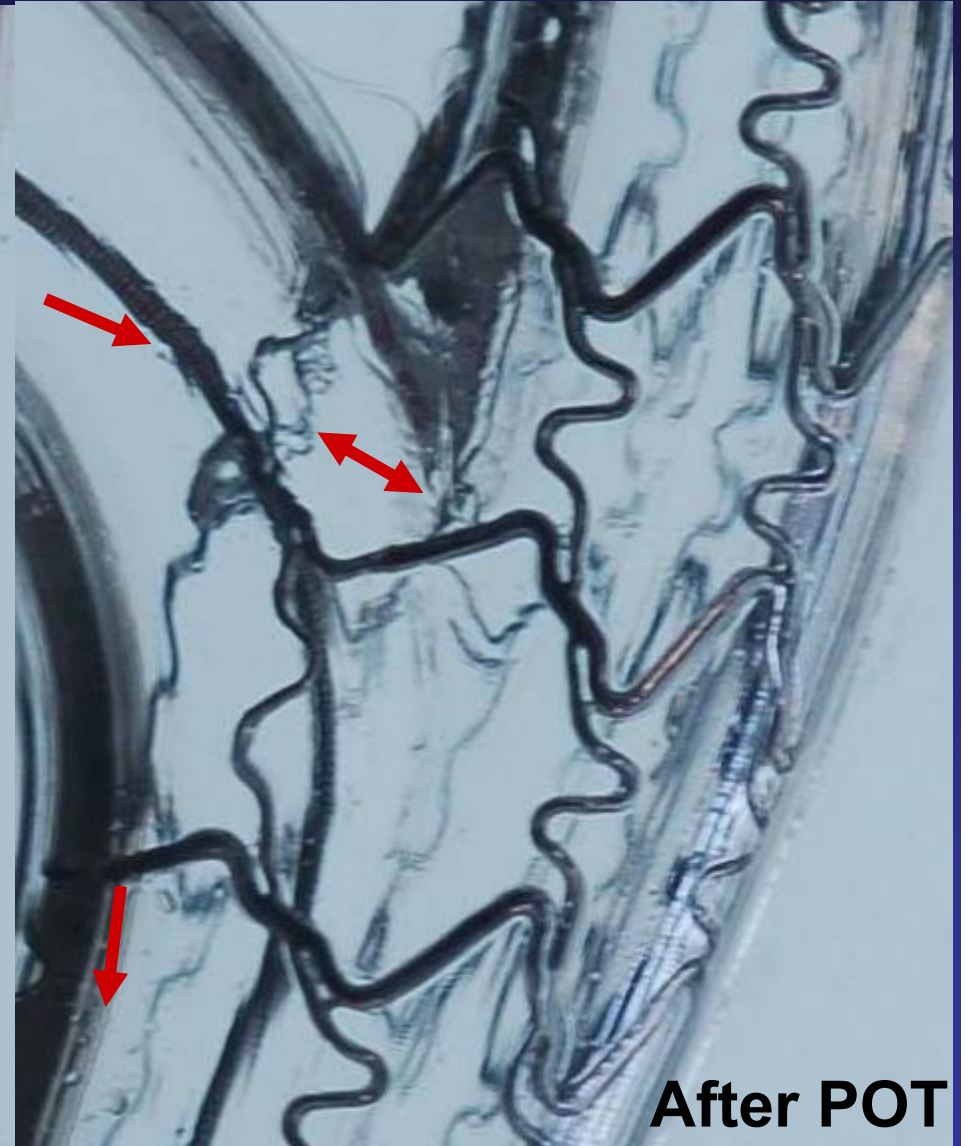
Proximal Optimization Technique (POT)

- Recommendation is to choose stent diameter related to the size of the distal main vessel
- The proximal part of the stent is then post-dilated (proximal optimisation technique (POT))



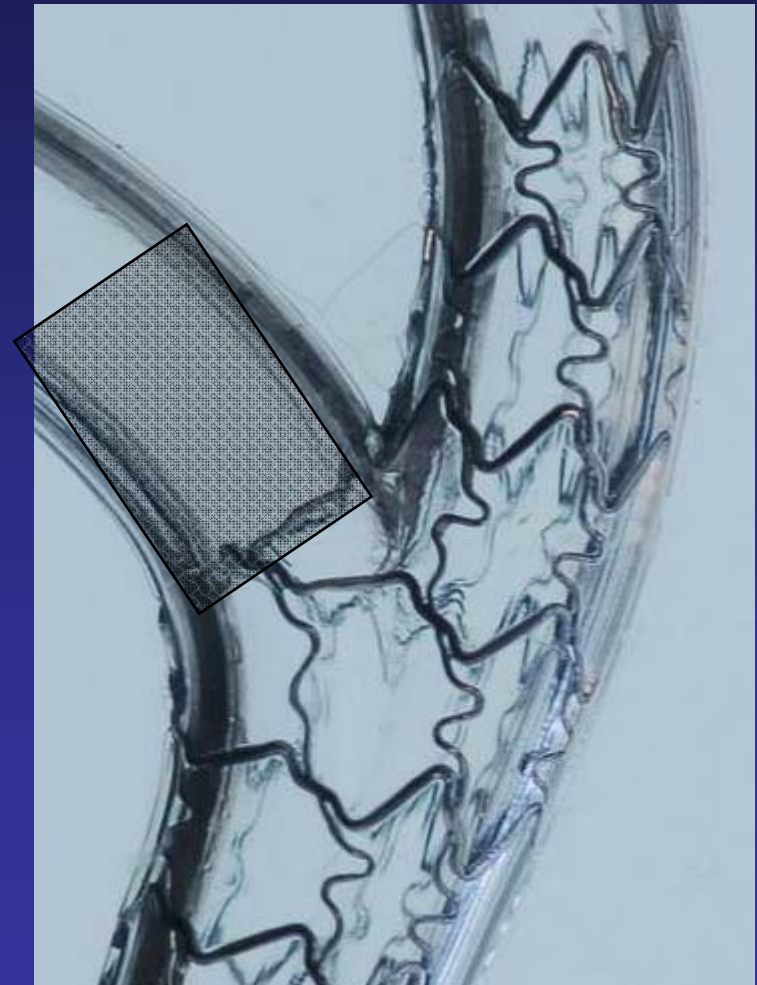
Courtesy of Dr Olivier Darremont

POT technique



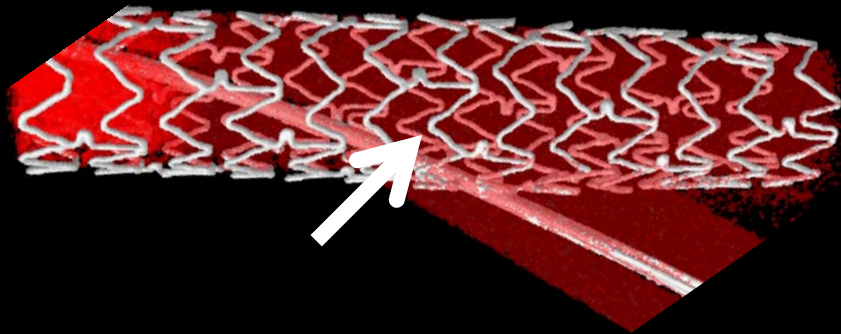
Proximal optimisation technique

- Supports SB scaffolding
- Facilitates complete coverage of SB ostium with a second stent (where necessary)
- Assists a “distal” cross as opposed to a proximal one to improve scaffolding of the side branch

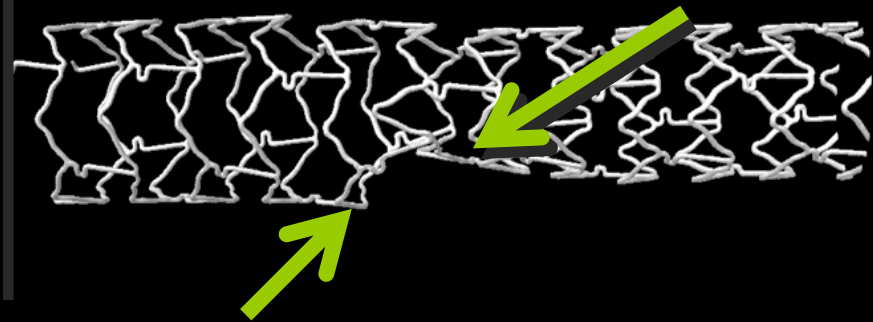


Relationship of wire crossing to side branch scaffolding

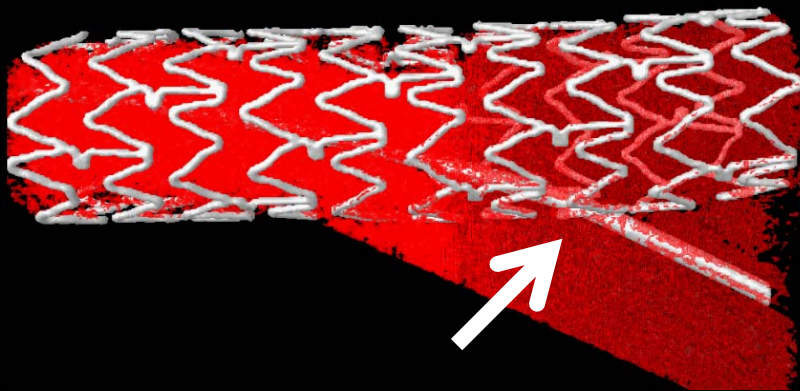
Proximal wire crossing



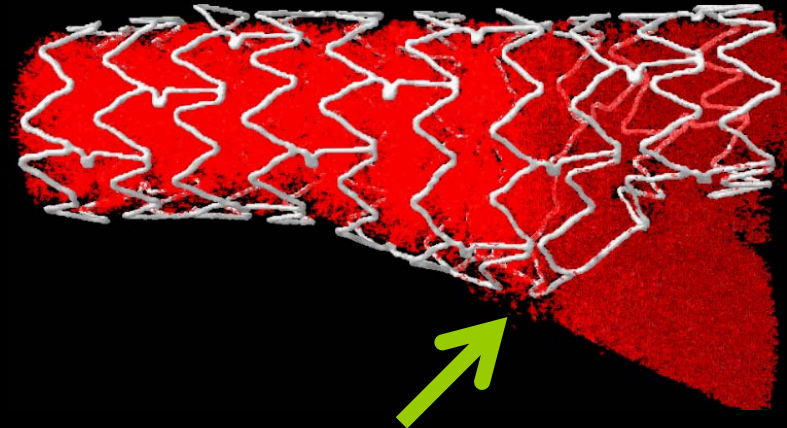
Poor SB scaffolding after kissing



Distal wire crossing



Good SB scaffolding after kissing



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 ±

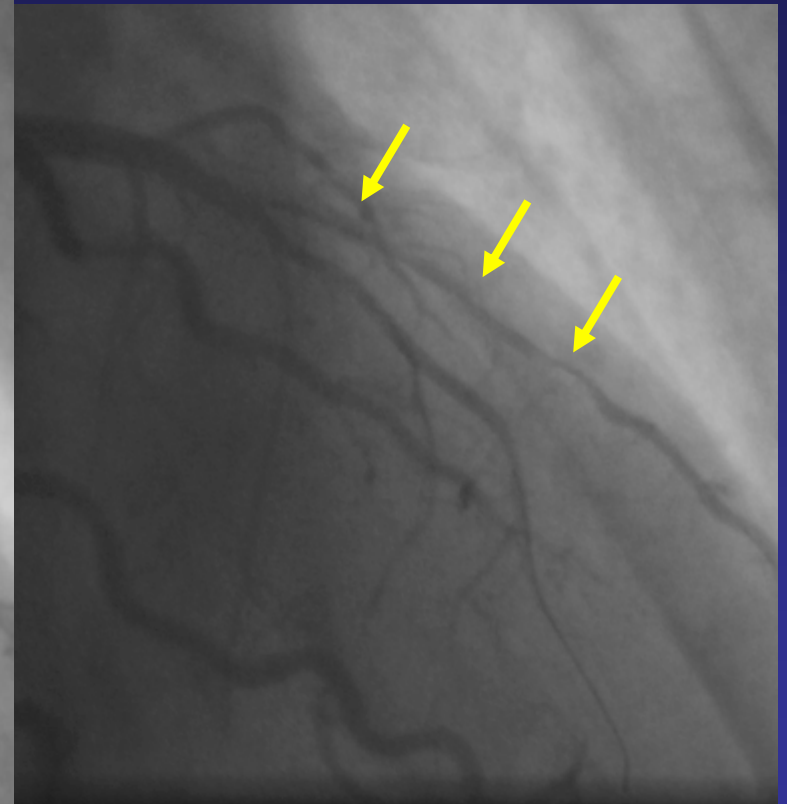
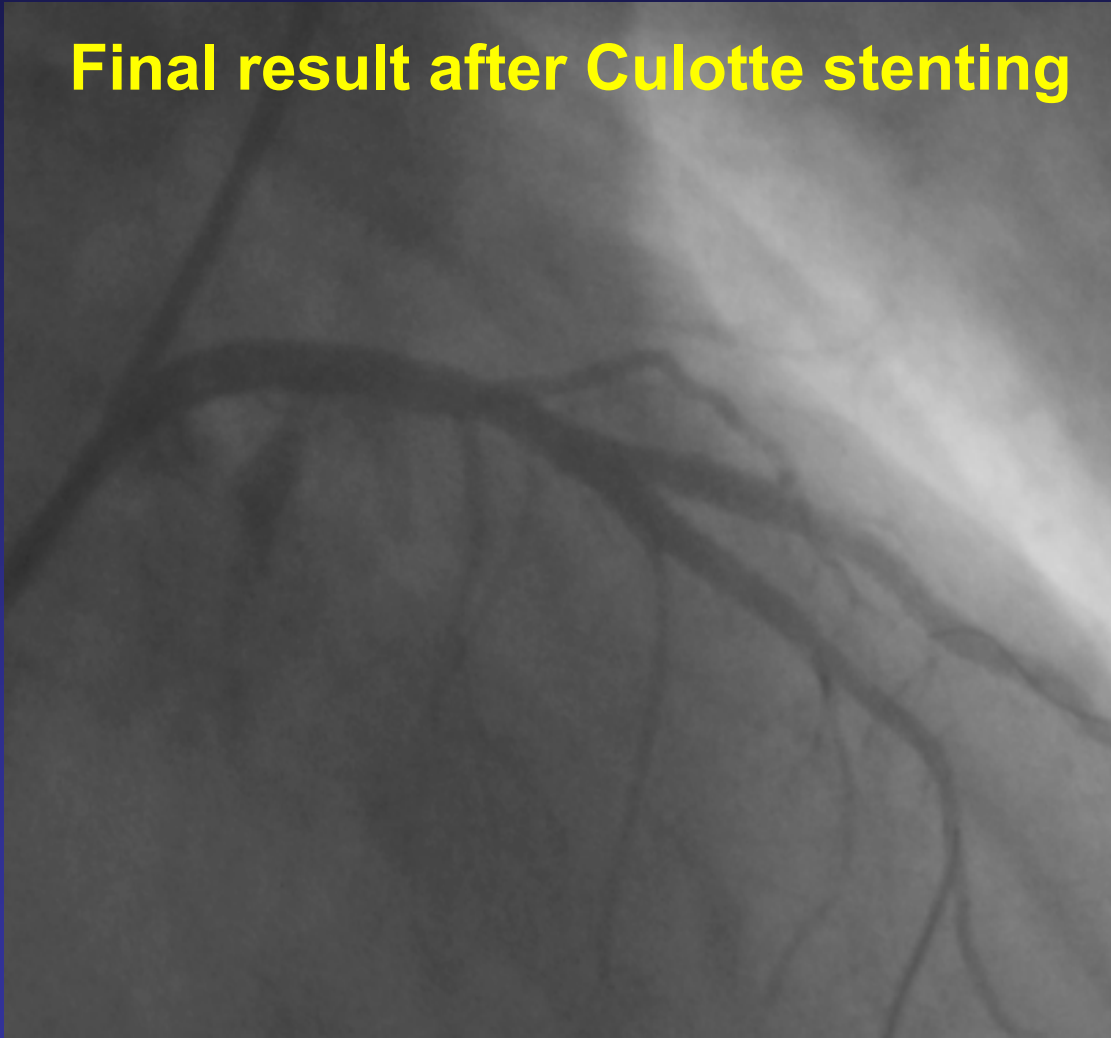
May be some situations to consider a 2-stent strategy from the outset

** 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

More complex bifurcation

Final result after Culotte stenting



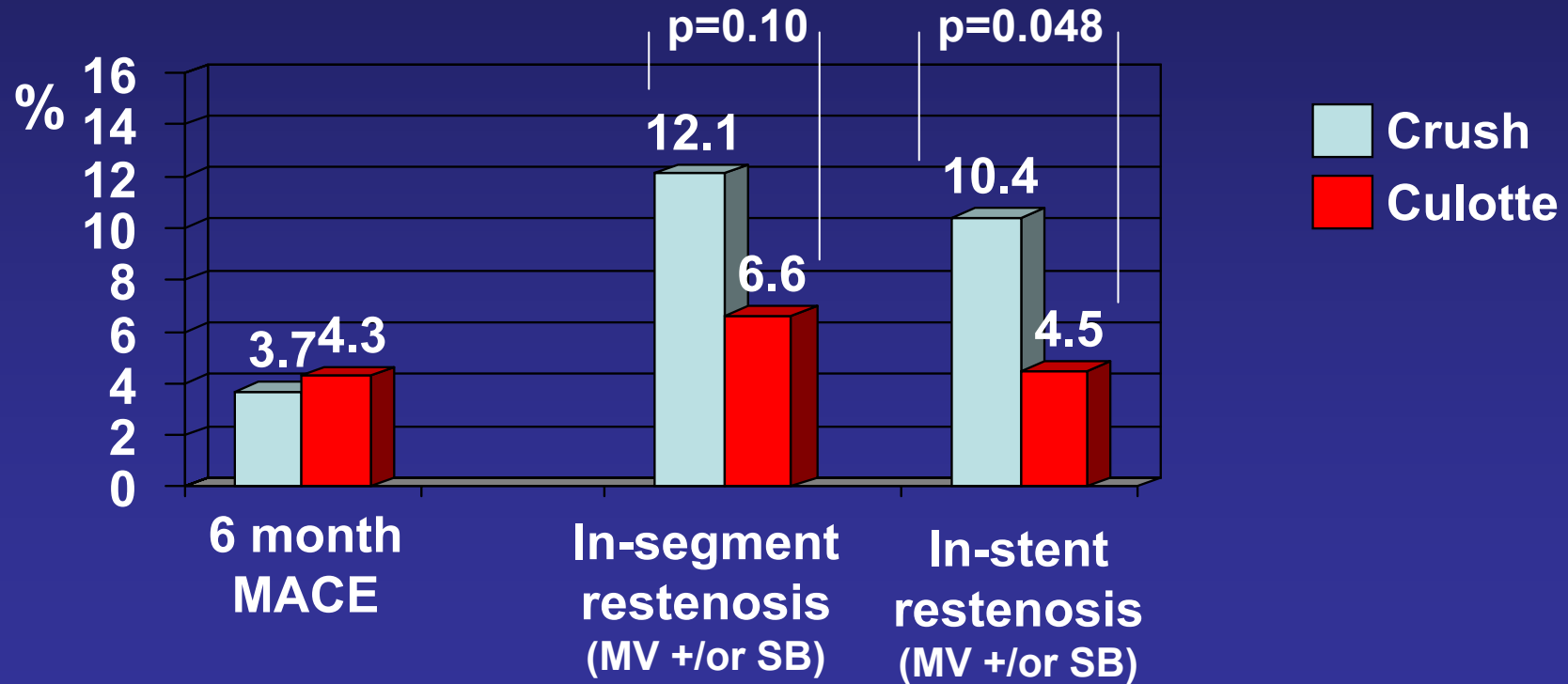
2-stent strategy: which method?

	No. pts	MV binary restenosis (%)	SB binary restenosis (%)	MACE (%)
Crush	231	9	25	16% at 9 months
Mini crush	45	12	2	16% at 8 months
SKS	100	-	-	10% at 6 months
Culotte	23	19	13	15% at 8 months

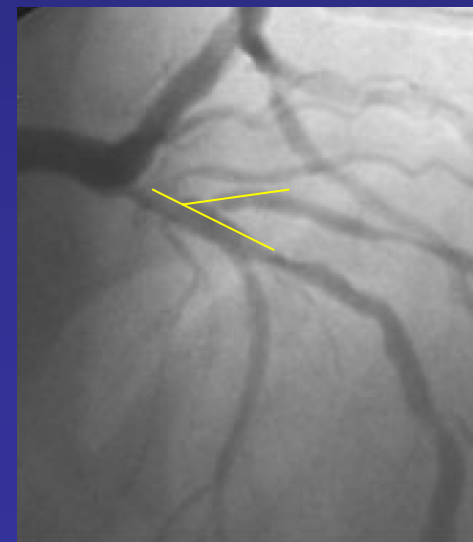
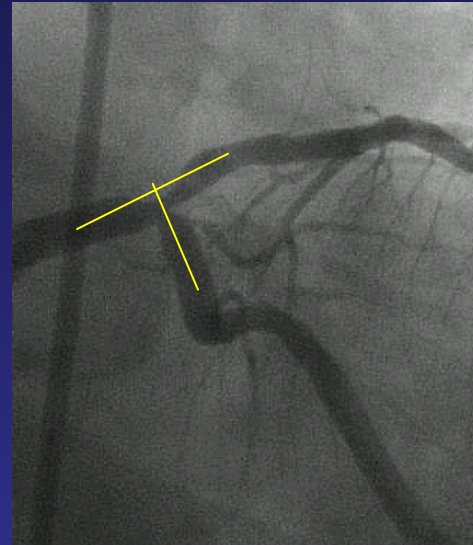
Hoye et al JACC 2006;47, Galassi et al CCI 2007 epub, Sharma et al AJC 2004;94, Hoye et al Int J Cardiovasc Interv 2005;7

2-stent strategy: which method?

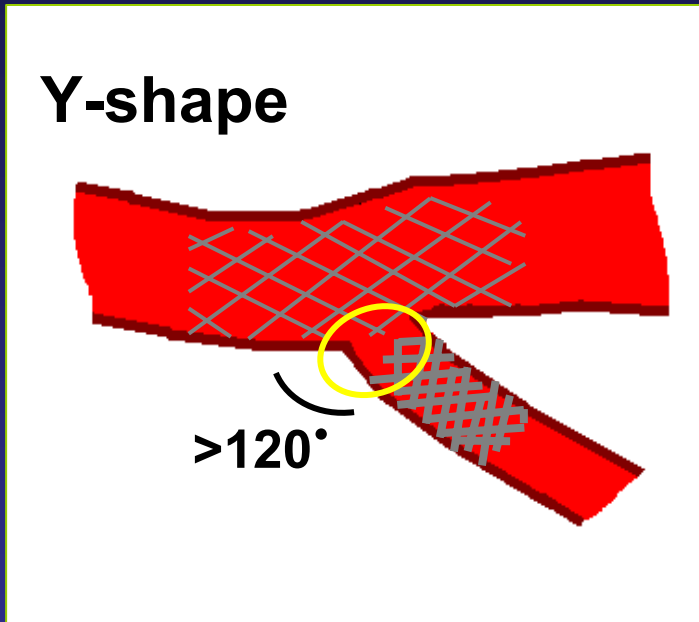
- 424 patients randomised to Crush versus Culotte stenting



How do I decide which strategy to employ?

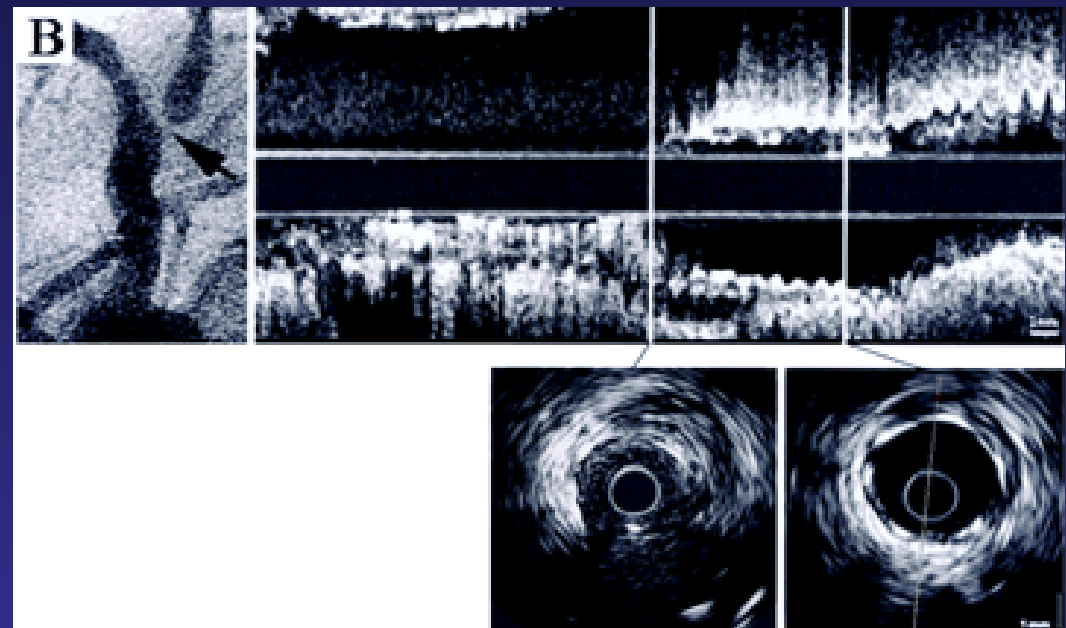


Assess the angulation



Y-shape incidence ~ 75%

- ✓ Culotte
- ✓ Crush

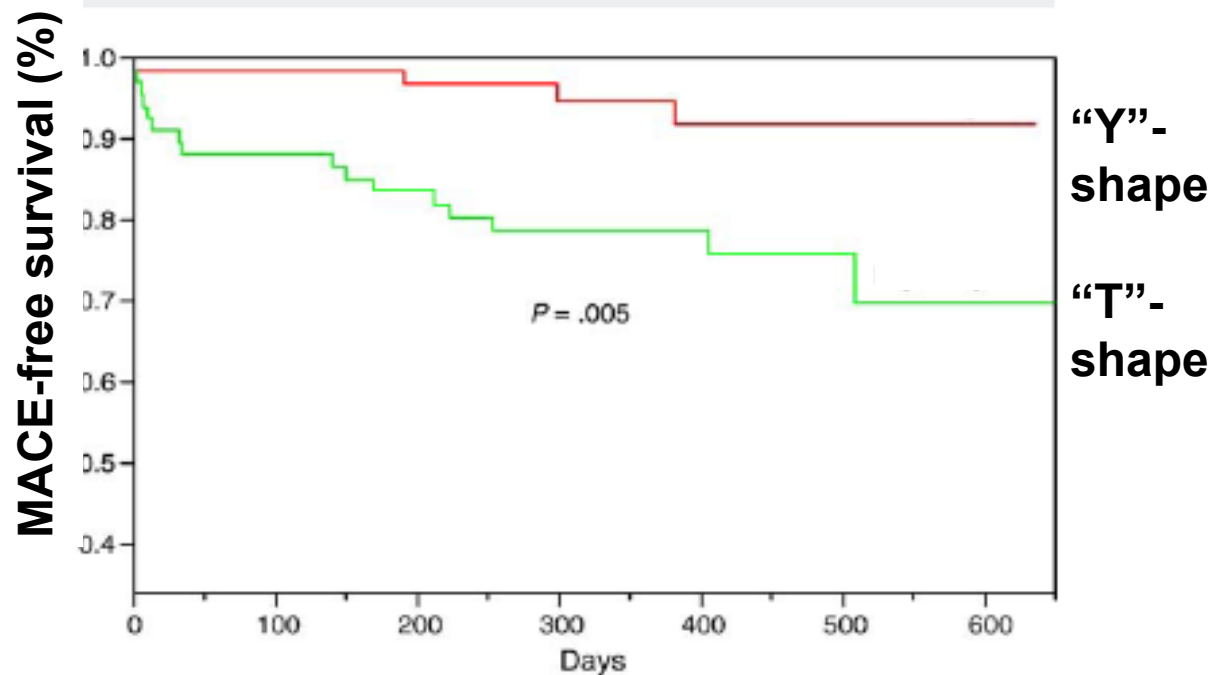


Ostial restenosis was associated with incomplete coverage

✗ T-stent

Crush stenting: influence of bifurcation angle

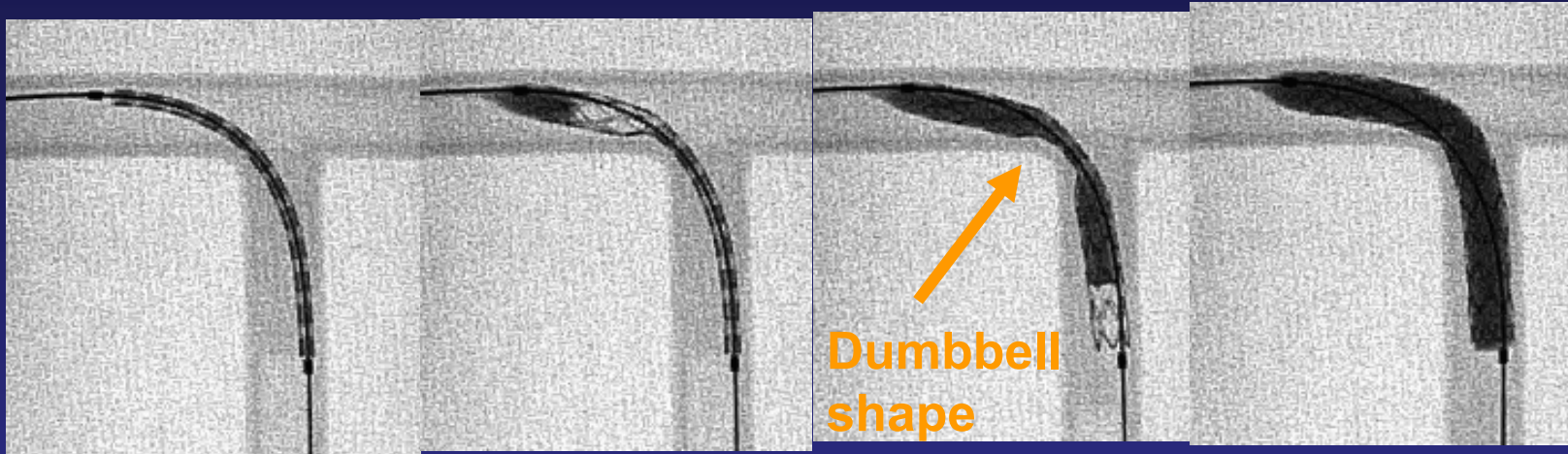
Influence of bifurcation angle on outcome following use of the crush technique



Culotte stenting

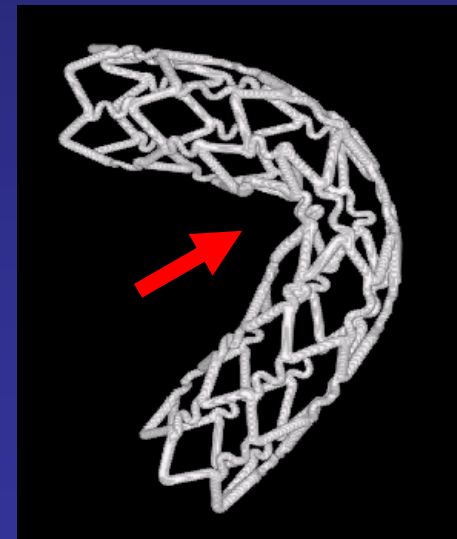
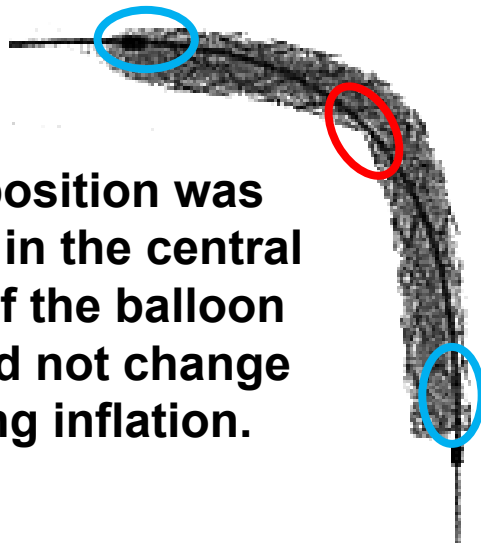
Independent predictors of binary restenosis	Odds ratio (95% CI)	p value
Age (increase of 10 years)	2.38 (1.21-4.96)	0.01
Bifurcation angle (increase of 10°)	1.53 (1.04-2.23)	0.03
Baseline main vessel DS (increase of 10%)	1.47 (1.03-2.09)	0.03
SB ref. vessel diameter (decrease by 1mm)	31.83 (1.71-592.77)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

Stents don't like large bends



Maximal inflation pressure

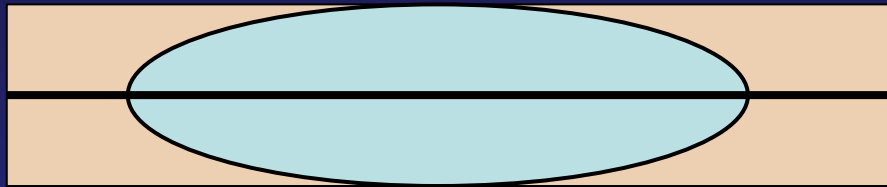
GW position was biased in the central core of the balloon and did not change during inflation.



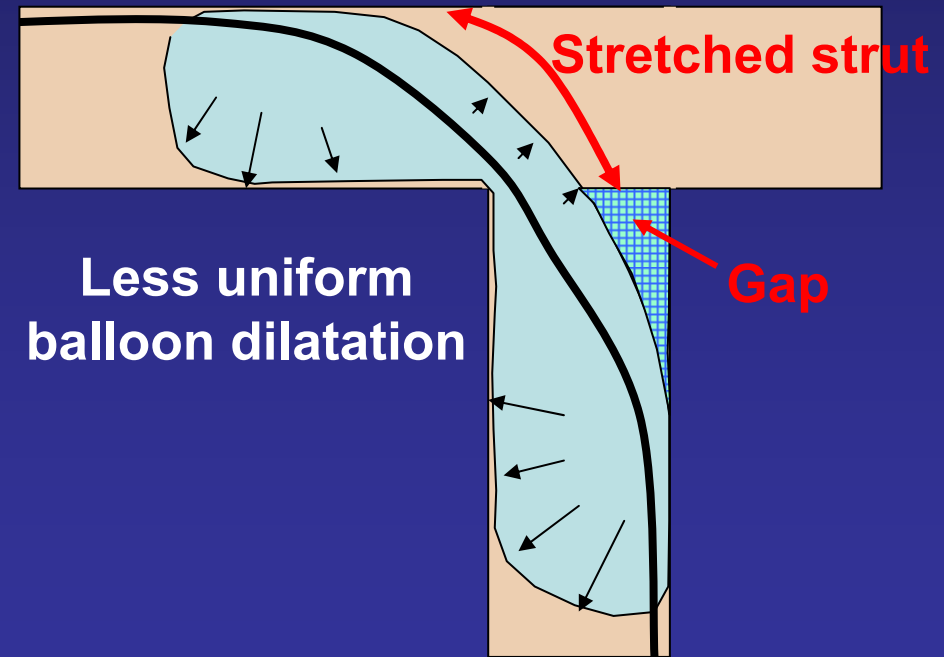
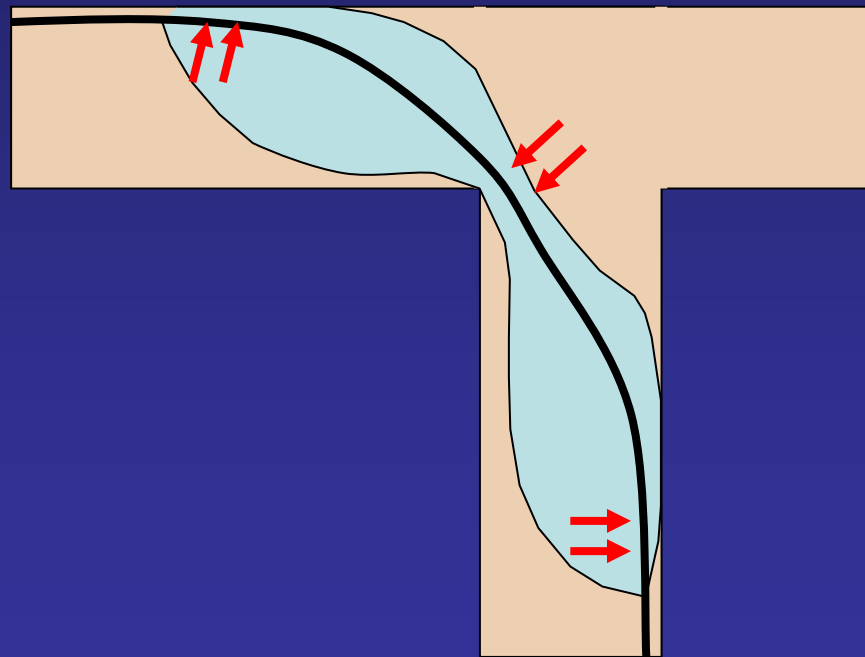
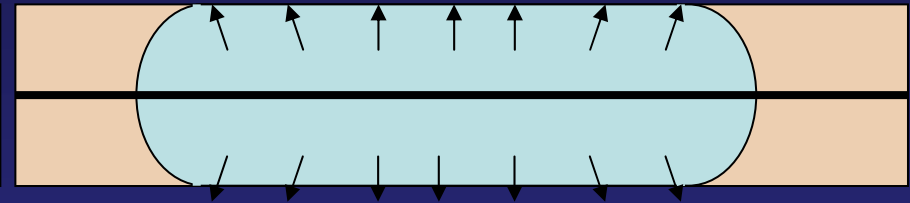
Courtesy of Dr Murasato

Potential problem with stenting high-angled lesions

Initial phase of inflation



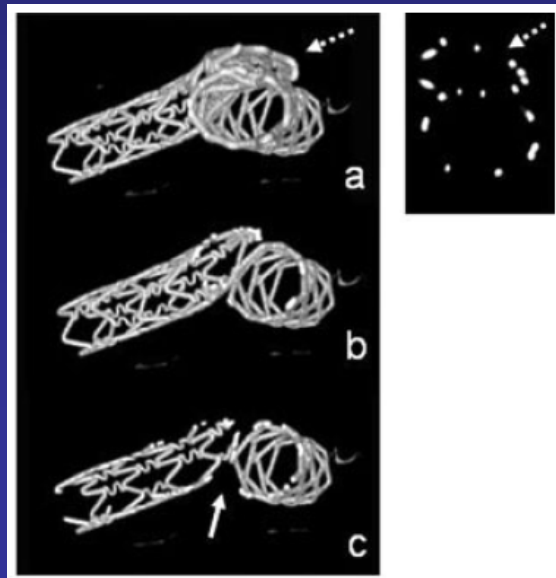
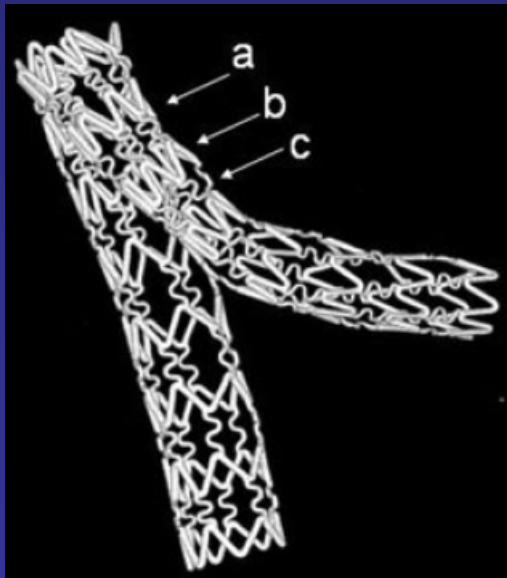
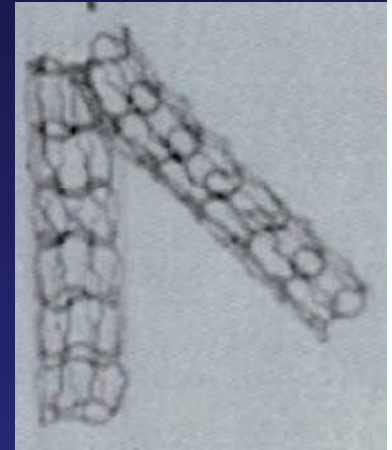
Maximal inflation pressure



Does hinge motion cause stent fracture of the stretched struts?

Other strategies

- **V-stenting:** useful for only the very small number of bifurcations that involve significant disease in the SB and distal MB only (Medina 0.1.1)
- **Kissing stents:**



Other strategies

- **Recent focus has been paid to the mini-crush technique**
 - Relatively quick and easy to perform
 - Suitable technique irrespective of angle
- But.....**



Mini-crush: results

- Registry data of 457 patients

	No. pts	9 month angio FU		2 years
		MV binary restenosis (%)	SB binary restenosis (%)	MACE (%)
Mini crush	199	12	9	21
T-stent 1-stent	170	17	21*	26
T-stent 2-stents	88	19	19**	26

* p≤0.001, **p≤0.01

Choice of stenting strategy: the importance of angulation

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

- All these techniques can be used if the SB requires stenting in a provisional strategy

Kissing balloon post-dilatation

Main vessel		Kissing balloon dilatation	No kissing balloon dilatation	p value
FU angiography, n (%)		94 (77%)	92 (77%)	1.0
Reference diameter (mm)		2.78 ± 0.61	2.64 ± 0.57	0.1
Pre	MLD (mm)	0.97 ± 0.53	0.89 ± 0.52	0.3
	DS (%)	66 ± 17	66 ± 18	0.7
	Lesion length (mm)	14.84 ± 10.40	15.97 ± 10.55	0.5
Post	MLD (mm)	2.89 ± 0.54	2.55 ± 0.53	<0.001
	DS (%)	12 ± 9	14 ± 9	0.2
FU	MLD (mm)	2.64 ± 0.81	2.21 ± 0.75	<0.001
	DS (%)	20 ± 20	26 ± 19	0.04
Late loss (mm)		0.26 ± 0.65	0.35 ± 0.64	0.3
Binary restenosis rate (%)		6 (6%)	11 (12%)	0.2

Kissing balloon post-dilatation

Side branch	Kissing balloon dilatation	No kissing balloon dilatation	p value
Follow-up angiography n (%)	94 (77%)	92 (77%)	1.0
Reference diameter (mm)	2.45±0.53	2.32±0.49	0.1
Pre MLD (mm)	0.90±0.53	0.88±0.52	0.8
DS (%)	63±21	62±20	0.8
Lesion length (mm)	9.01±6.06	8.97±6.03	1.0
Post MLD (mm)	2.43±0.53	2.10±0.44	<0.00001
DS (%)	13±9	18±10	<0.0001
FU MLD (mm)	2.18±0.71	1.52±0.86	<0.00001
DS (%)	21±18	41±32	<0.00001
Late loss (mm)	0.24±0.50	0.58±0.77	<0.001
Binary restenosis rate (%)	9 (10%)	38 (41%)	<0.00001



Summary & conclusions

- **Provisional stenting strategy is appropriate for the majority of bifurcations**
- **But consider a 2-stent strategy if the SB is important and heavily diseased**
- **Choice of 2-stent strategy depends on the degree of angulation**
- **Become familiar with 1 or 2 stenting techniques**
- **Optimal kissing balloon post-dilatation is mandatory when 2-stents are implanted**