

Classic crush is enough!

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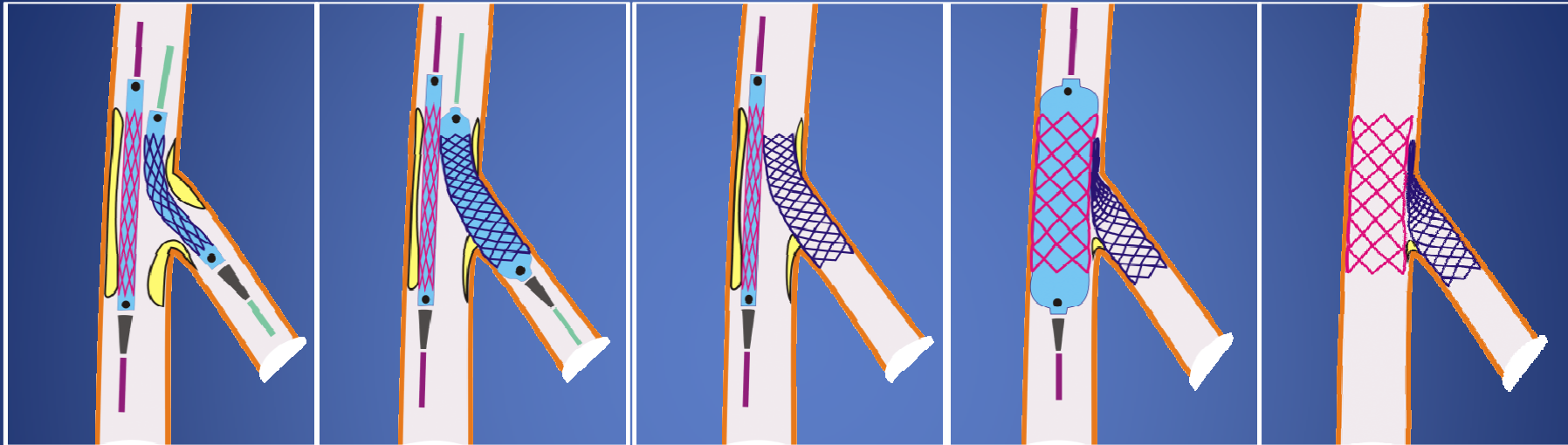


**I have no conflicts of interest
related to this presentation**

Classic crush is enough!

- It is challenging to treat bifurcation lesions that involve a sizeable side branch that subtends an important volume of myocardium
- Severe disease (ie long length of disease) of such an important side branch is (probably) best treated with a 2-stent strategy
- Crush stenting:
 - Straightforward to learn
 - “Quick and simple”
 - Ensures complete lesion coverage with scaffolding of the side branch ostium

Crush is easy!



- $\geq 7F$ guide
- Wire both vessels
- Pre-dilate as necessary
- Position both stents
- Inflate SB stent, then remove the balloon \pm wire
- Inflate the MV stent thereby “crushing” the SB stent

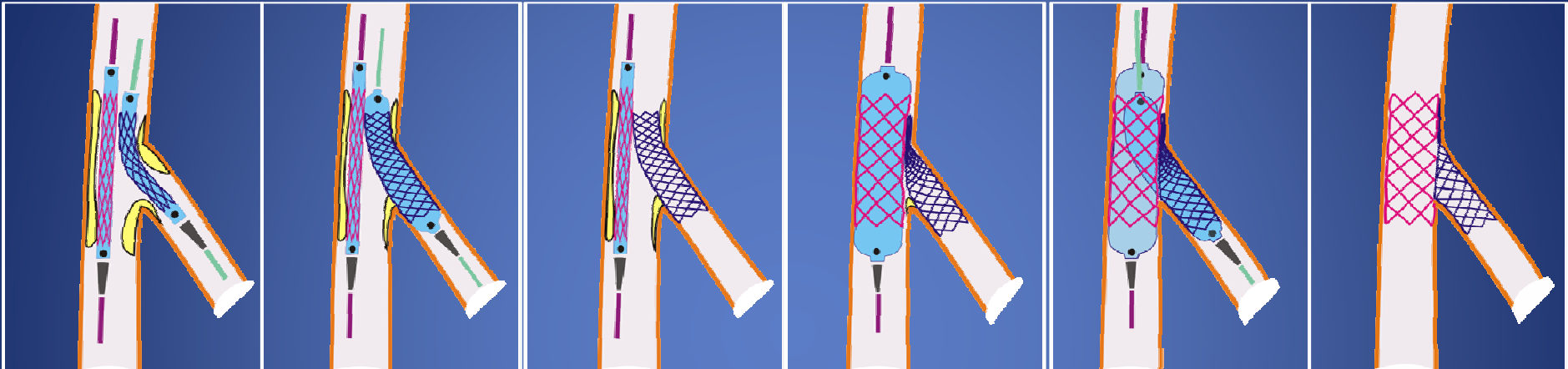
Crush stenting: angiographic FU

Main vessel		Kissing balloon dilatation	No kissing balloon dilatation	p value
Follow-up 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	<0.0001
	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

Crush stenting: angiographic FU

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	<0.0000001
	DS (%)	21 ± 18	41 ± 32	<0.000001
Late loss (mm)		0.24 ± 0.50	0.58 ± 0.77	<0.001
Binary restenosis rate (%)		9 (10%)	38 (41%)	<0.000001

Crush is easy!

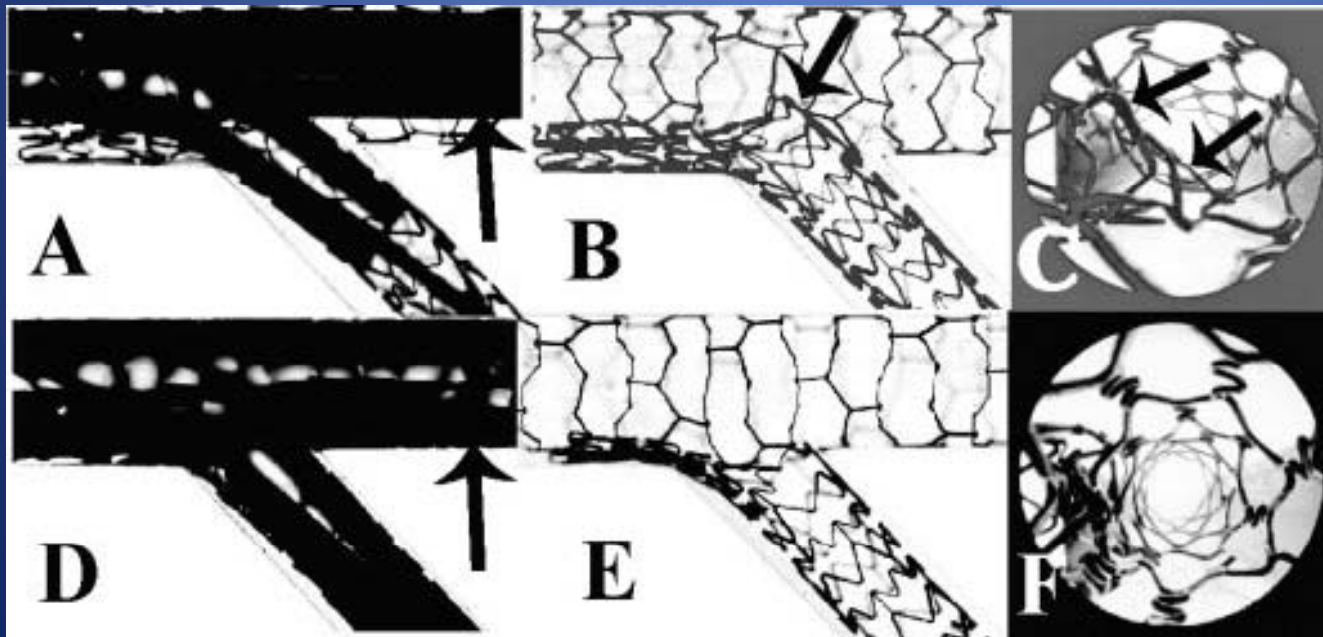


- $\geq 7F$ guide
- Wire both vessels
- Pre-dilate as necessary
- Position both stents
- Inflate SB stent, then remove the balloon \pm wire
- Inflate the MV stent thereby “crushing” the SB stent
- Final kissing balloon inflation

Bench testing: the importance of balloon size

A: the balloon in the MV is smaller than the stent diameter, and causes distortion of the MV stent (**B**, arrow). **C:** endoscopic view of the main branch showing the distortion (arrows)

D: kissing balloon inflation with an appropriately sized MV balloon, corrects the distortion. **F:** endoscopic view of undistorted MV stent



The “refined” crush technique

Tips and tricks to facilitate optimal FKBD:

- After the MV stent has been deployed, perform high pressure post-dilatation of the proximal part of the MV stent to “enlarge” the cells as much as possible to facilitate re-wiring of the SB
- Use non-compliant balloons and sequential high pressure balloon inflation (SB then MV) before a low pressure FKBD
- ?Avoid using stents with a closed cell design

Classic crush is enough!





COURAGE

I know it can't possibly work but I WANNA DO IT ANYWAY

Classical crush compared with DK crush: DK-crush I study

	Crush N=156	DK crush N=155	P
FKBD (%)	76	100	
Results at 8 months			
Death (%)	1.7	0.6	0.5
Q-wave MI (%)	3.5	1.2	0.7
Non-Q MI (%)	11.1	9.1	0.9
Stent thrombosis (%)	3.2 (5.1% without FKBD)	1.3	1.0
TLR (%)	18.9	9.0	0.03
MACE (%)	24.4	11.4	0.02

Classical crush compared with DK crush: DK-crush I study

8 month FU	Crush (overall) N=135	Crush no kiss N=30	Crush + kiss N=105	DK crush N=130	P
MV restenosis (%)	3.7	10.0	1.8	2.3	0.5
SB restenosis (%)	24.4	36.6	20.9	12.3	0.01

	Crush	DK crush	P
Results at 24 months			
TLR (%)	23.4	11.4	0.02
MACE (%)	29.9	18.1	0.04

- The clinical results favour DK-Crush, driven by less restenosis and TLR

Classical crush compared with DK crush

- But.....

	Crush (overall)	Crush no kiss	Crush + kiss	DK crush	p
No. Balloons	2.2 ± 0.8	2.1 ± 0.7	2.2 ± 0.9	2.5 ± 0.7	<0.01
Contrast volume (mls)	108 ± 72	88 ± 60	117 ± 75	130 ± 79	0.04
Procedure time (mins)	35 ± 18	35 ± 18	34 ± 19	47 ± 24	<0.001

DK-crush I study

- Lack of FKBD was an independent predictor of TLR and stent thrombosis
- Unsatisfactory FKBD was evident in 27.6% crush (compared with 6.3% DK-crush)

Can we take measures to ensure delivery of optimal FKBD during classical crush stenting?

DK-crush I study

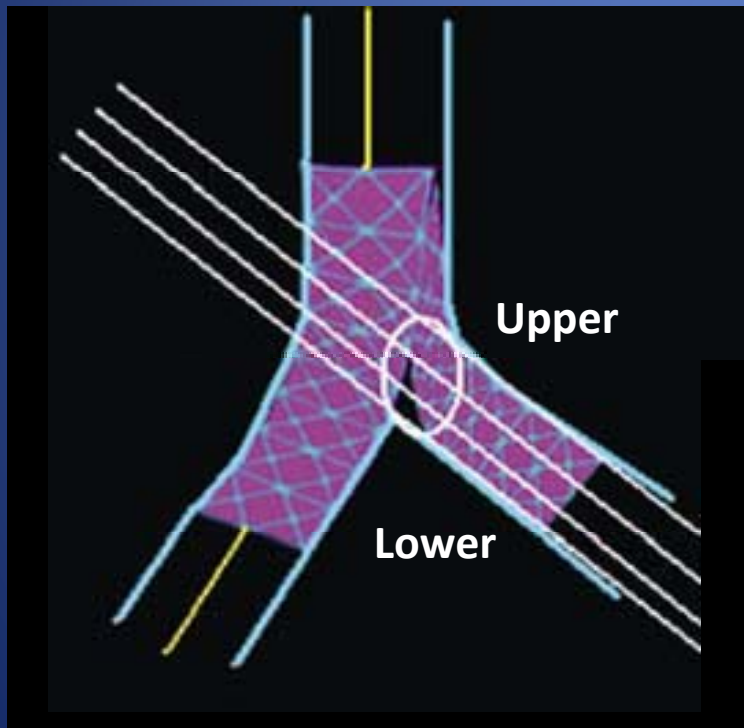
- Independent predictors of FKBD
 - Lesion location
 - MV stent length
 - Post-PCI SB MLD
 - Bifurcation angle

	Crush no kiss	Crush + FKBD
Bifurcation angle (°)	46 ± 14	56 ± 25
SB stent diameter (mm)	2.59 ± 0.33	2.84 ± 0.39

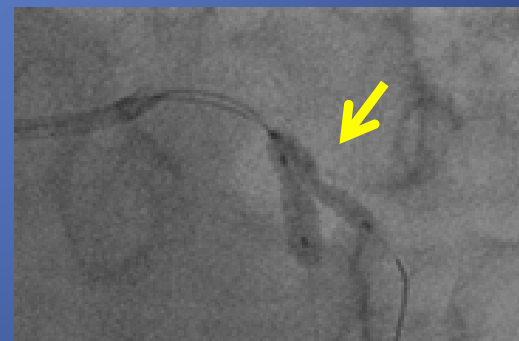
Avoid classical crush in very narrow angled lesions and lesions with a relatively small diameter SB

The “refined” crush technique

- The site of SB re-wiring is of paramount importance
- 213 patients treated with Crush and FKBD



- Defined “kissing unsatisfied” as a $\geq 20\%$ diameter stenosis in the balloon



The “refined” crush technique

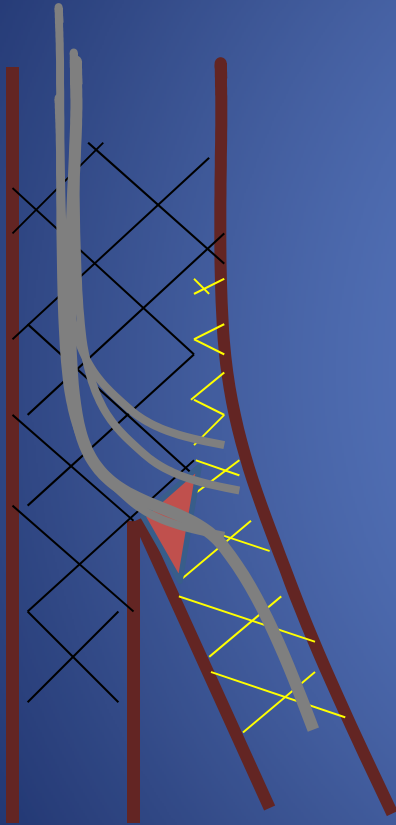
	Upper group	Middle group	Lower group	P value
No. Lesions	148	26	52	
Bifurcation angle (°)	56 ± 25	48 ± 22	47 ± 17	0.03
FKBI (%)	100	100	70	<0.001
Kissing unsatisfied by IVUS (%)	5.4	3.9	33.3	<0.001

The “refined” crush technique

- Independent predictors of SB restenosis
 - Kissing unsatisfied (HR 1.65 95% CI 1.33–2.09, $p < 0.001$)
 - Re-wiring position (HR 2.34 95% CI 1.78–4.33, $p < 0.001$)
- Independent predictors of kissing unsatisfied
 - SB stent expansion (OR 3.12 95% CI 2.88-5.06, $p = 0.01$)
 - Re-wiring position (OR 0.46 95% CI 0.34–0.87, $p = 0.001$)

- 1. Avoid “low” re-wiring near the carina**
- 2. Ensure optimal SB stent expansion**

The influence of the angle

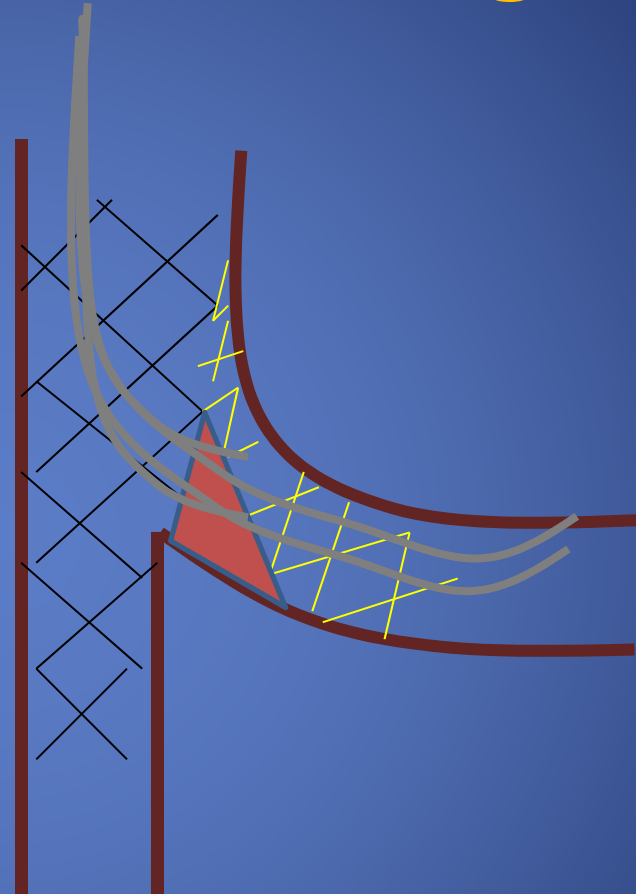
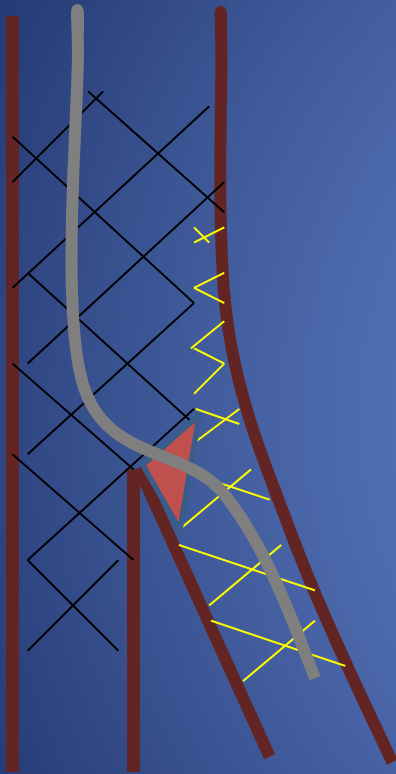


Lesions with a narrow angle

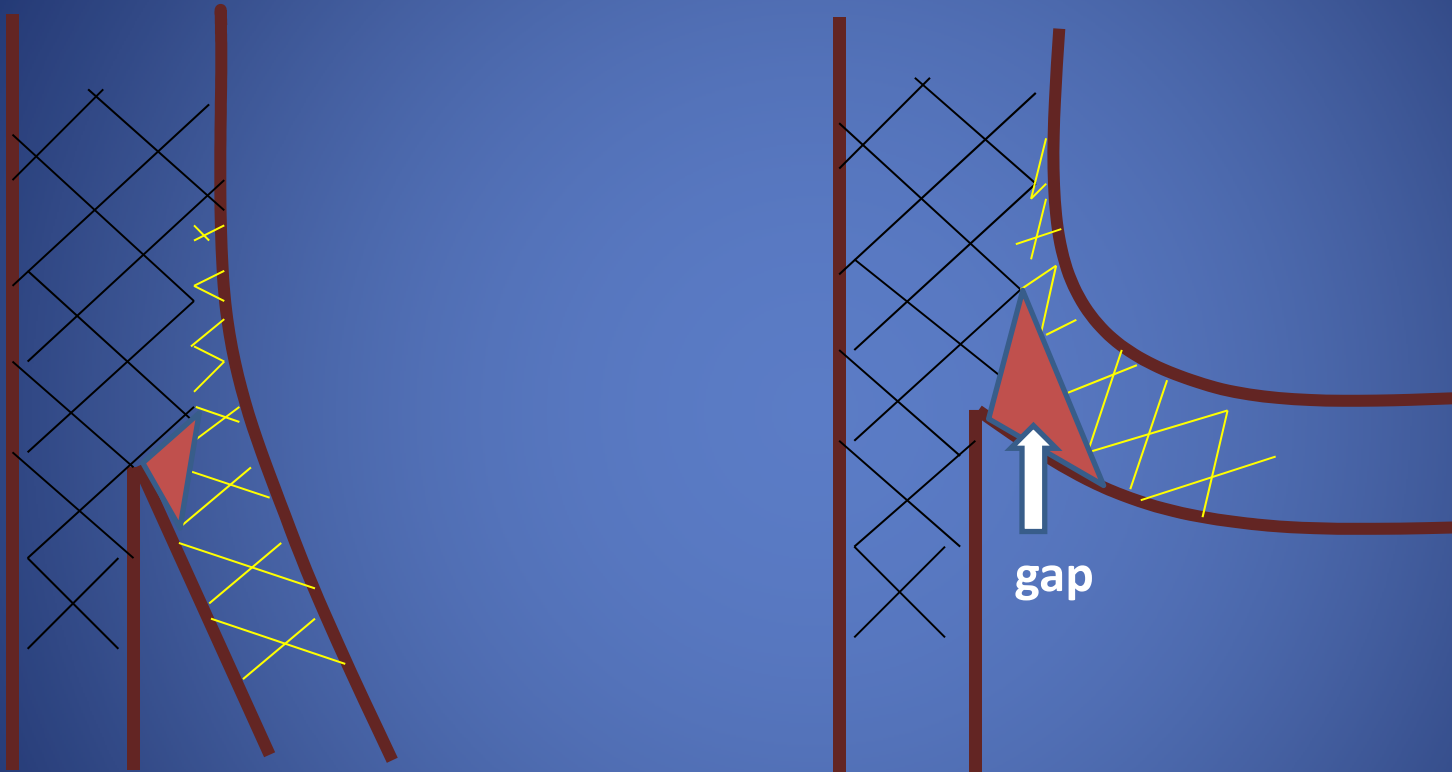
- Extremely difficult to wire in any position other than near the carina

Avoid Classical crush for lesions with a shallow angle

The influence of the angle

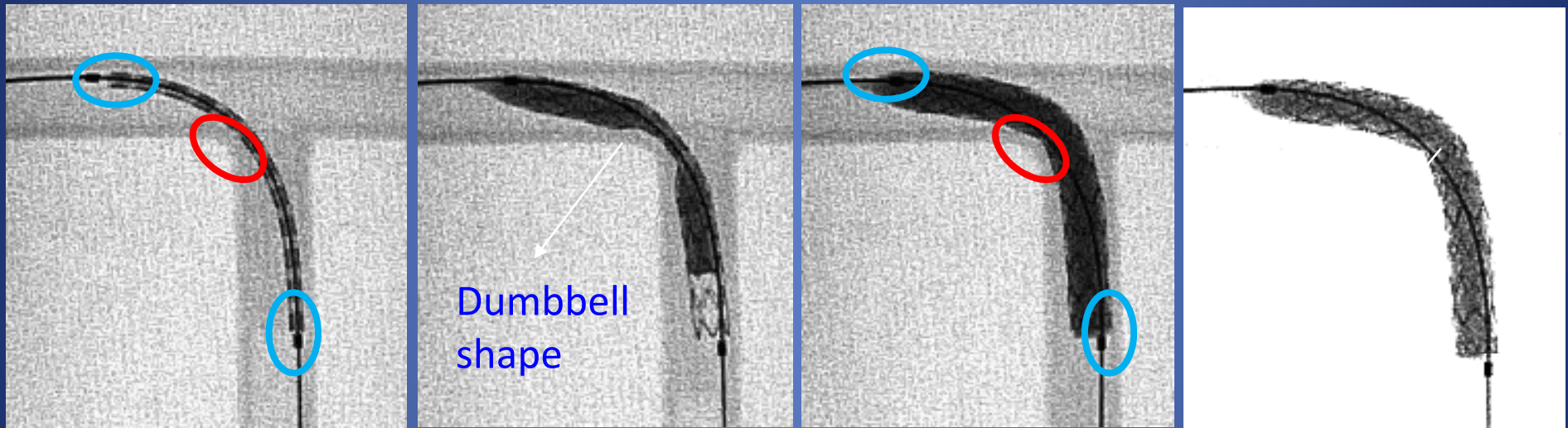


The influence of the angle



**There may be less scaffolding of the SB ostium when using this technique in high angled lesions
- This will apply to DK-Crush as well**

The influence of the angle: high angle lesions

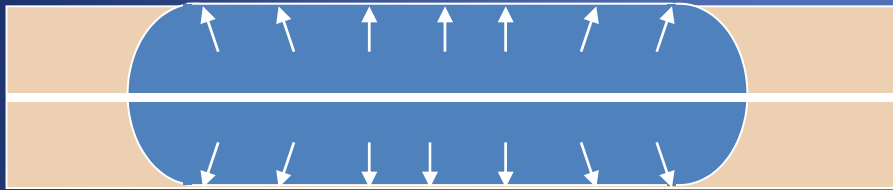


Guidewire bias

GW position did not change during inflation.

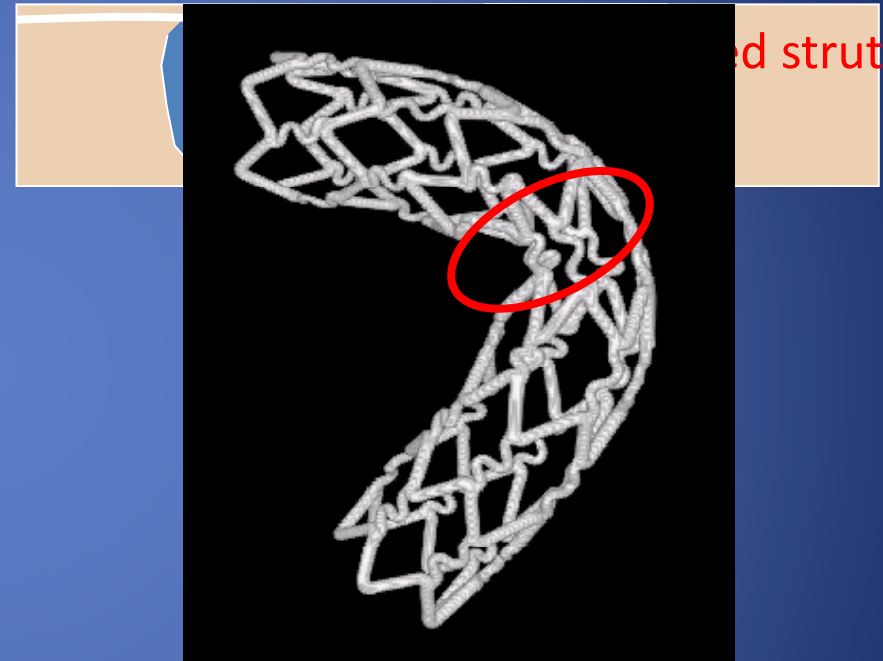
Courtesy of Dr Y Murasato

The influence of the angle: high angle lesions



Uniform balloon dilatation
at maximal inflation

**Avoid Classical
crush for lesions
with a high angle**



Balloon dilatation is not uniform
Proximal and distal: overdilatation
Middle segment: restricted

This cannot be corrected with increased inflation pressure

Conclusions

- “Classical” crush is easy to learn and quick to perform
- The results of “Classical” crush are highly dependent on achievement of good quality FKBD
- FKBD can be (reliably) performed with appropriate lesion selection and a few “tips and tricks”
 - Post-dilatation of the proximal MV stent to facilitate wire re-crossing into the SB



Always kiss....

Conclusions

- High pressure sequential balloon dilatation followed by FKBD using appropriately sized balloons

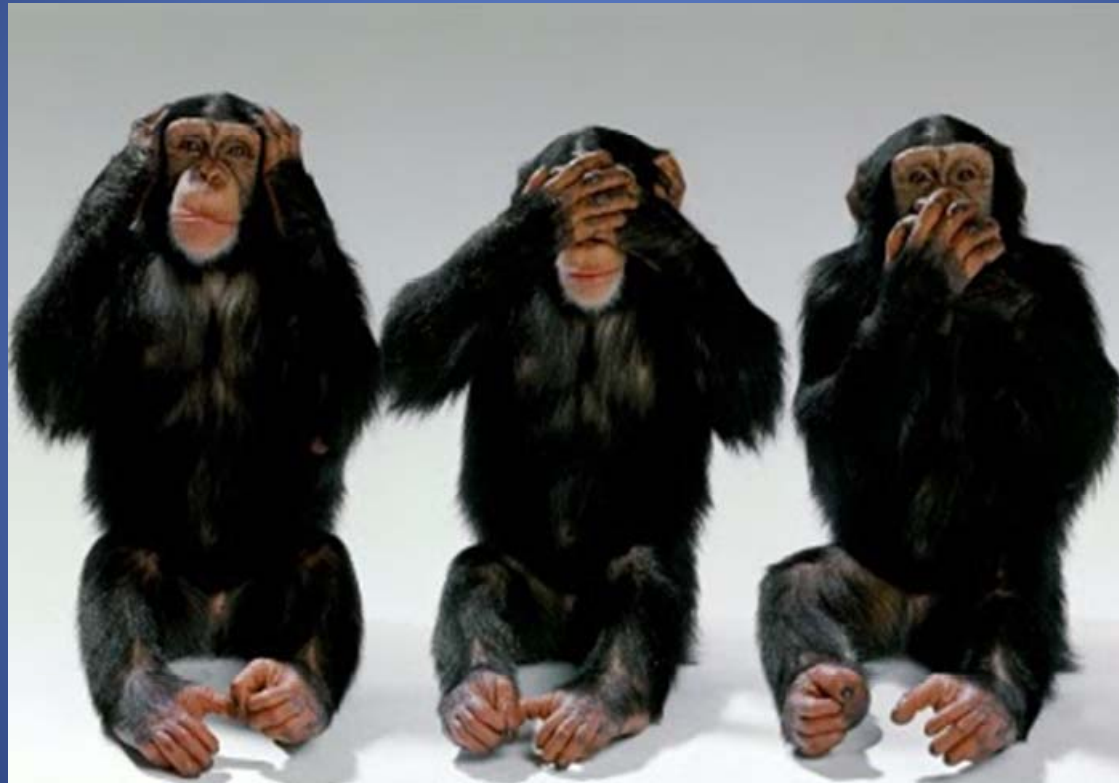


Use high pressure

Conclusions

- Avoid re-crossing near to the bifurcation carina
- Avoid using Classic crush in shallow angled bifurcations: increased chance of failed FKBD
- Avoid using Classic crush in high angled lesions: unable to fully expand the stent at the SB ostium
- Reserve Classical crush for large diameter SB (preferably >2.75mm)
- DK crush involves the use of more balloons (expensive), and a longer procedure time with a higher radiation dose and increased contrast volume

It is not the technique that is at fault, it is understanding when/how it should be applied



Thankyou!!!