

Session IV : Bifurcation

Optimal Kissing Balloon Inflation



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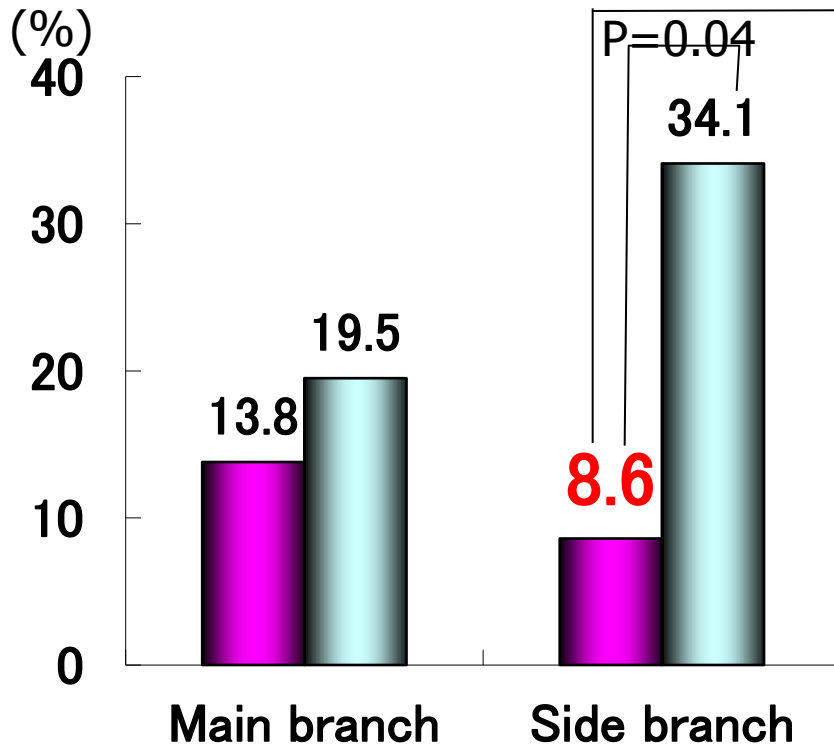
What is the role of kissing balloon inflation in the bifurcation intervention?

- To keep the access route to the SB
- To prevent SB narrowing and restenosis
- To make a bigger lumen in the proximal MV
- To assure the stent apposition
- To correct the stent deformation

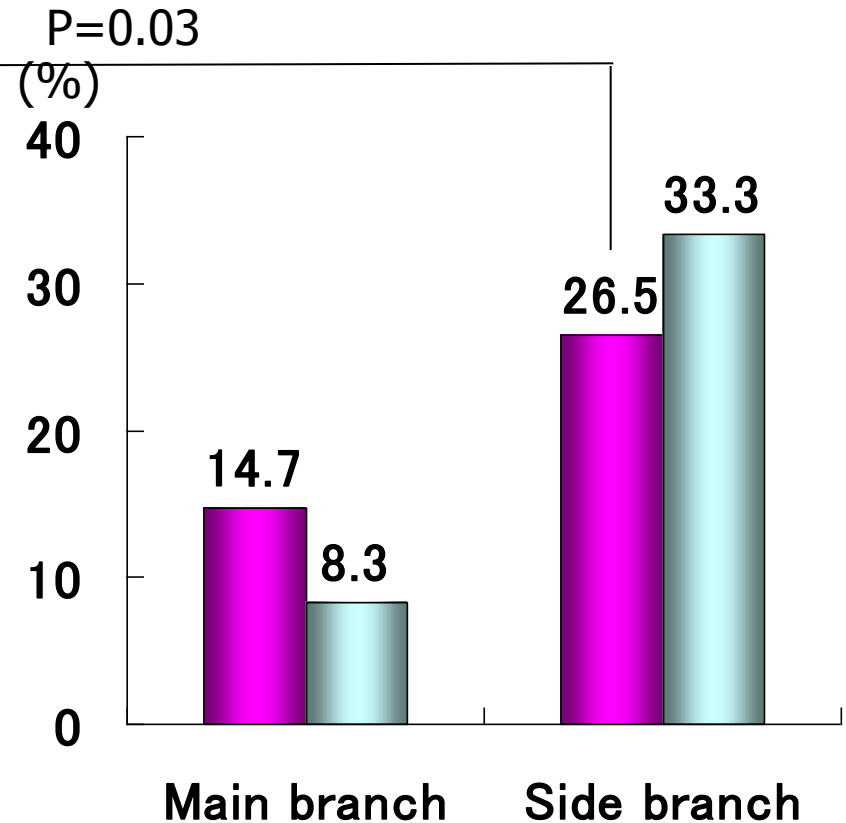


Effect of KBI on restenosis in 2-stent technique

Crush stent



T-stent

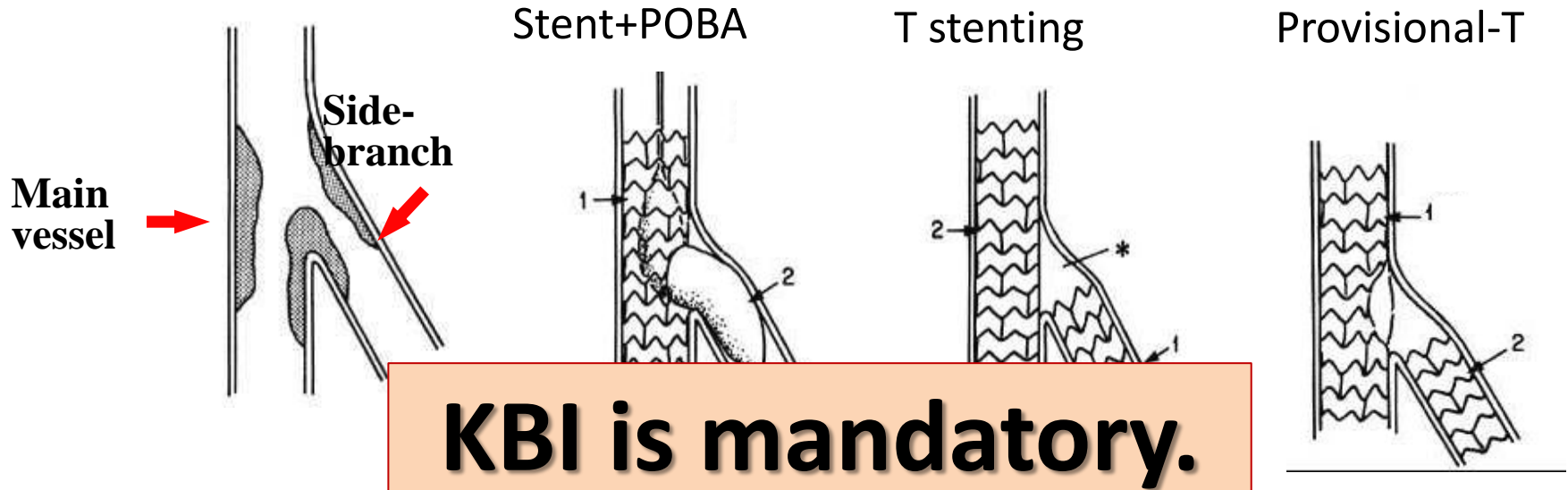


Final KBT group
No final KBT group

Culotte stenting: Predictors of binary restenosis

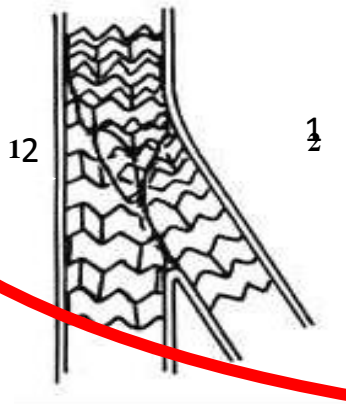
Variable	Odds ratio (95% CI)	P-value
Proximal main vessel		
Reference vessel diameter decrease by 1 mm	4.55 (0.17–123.36)	0.37
Baseline stenosis increase by 10%	0.91 (0.67–1.23)	0.54
Distal main vessel		
Reference vessel diameter decrease by 1 mm	0.10 (0.00–3.17)	0.19
Baseline stenosis increase by 10%	1.47 (1.03–2.09)	0.03
Side branch vessel		
Reference vessel diameter decrease by 1 mm	31.83 (1.71–592.77)	0.02
Baseline stenosis increase by 10%	0.97 (0.82–1.15)	0.75
Kissing balloon post-dilatation	0.37 (0.13–1.10)	0.07

Various Techniques for Stenting Bifurcation Lesions

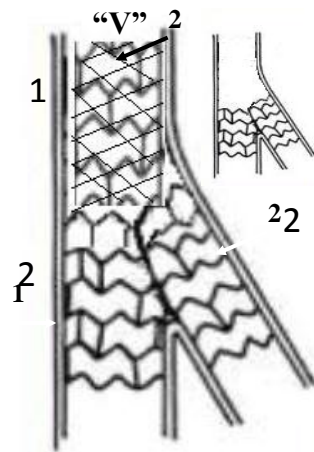


KBI is mandatory.

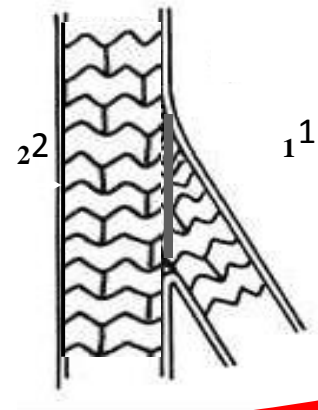
Culotte



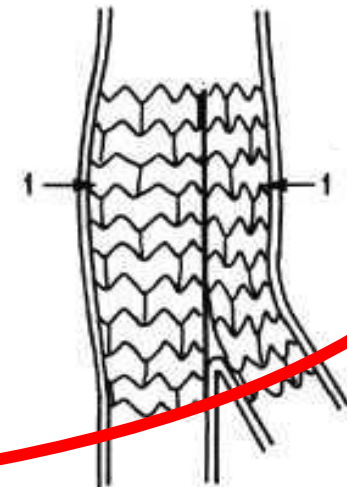
Y or V



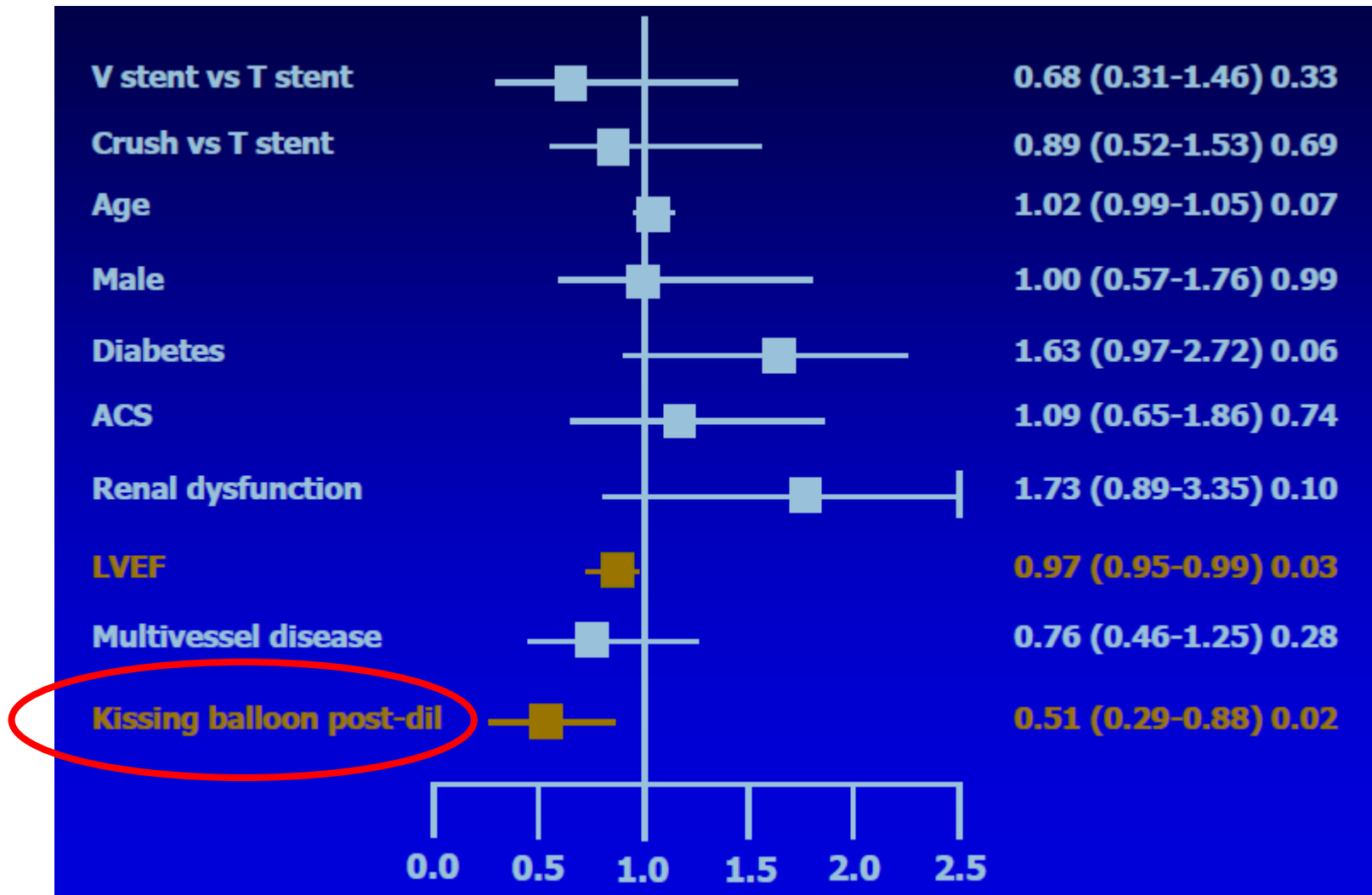
Crush



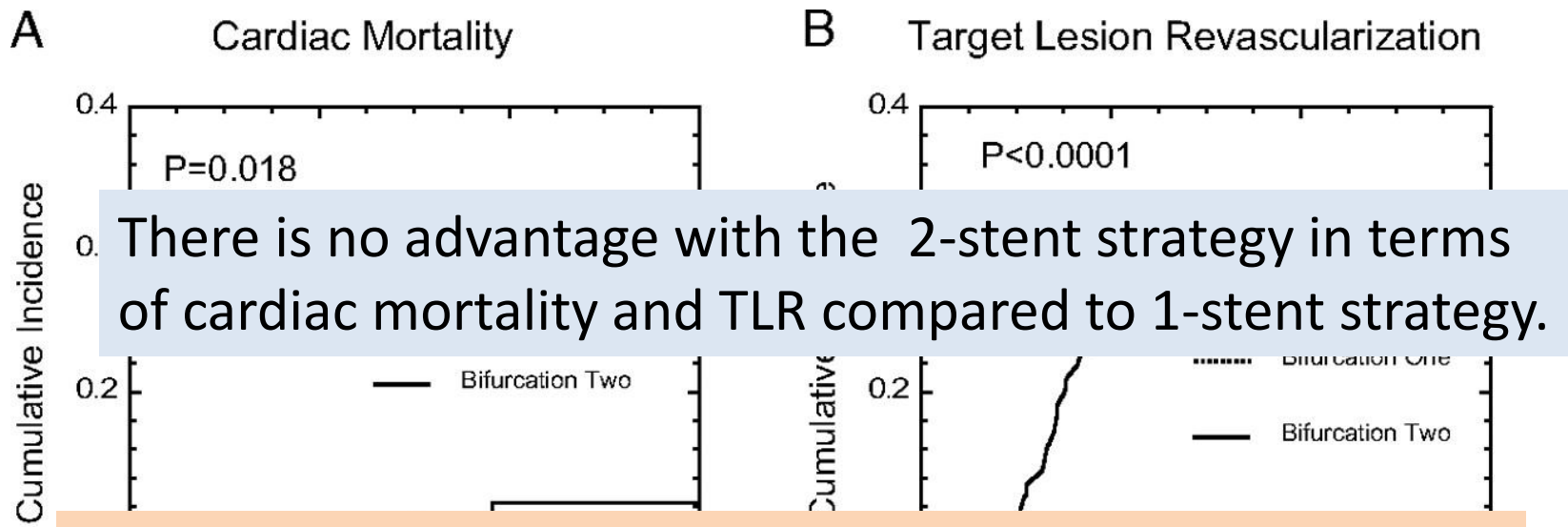
Kissing



2Y clinical outcome of GISE survey on unprotected LMCA



J-Cypher registry in unprotected LM

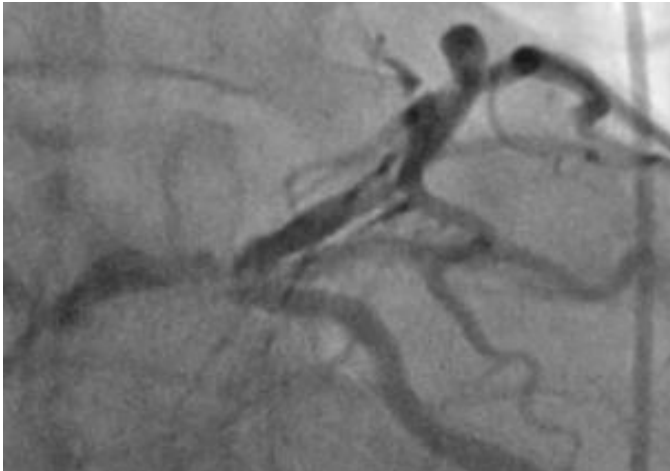


Should we increase the cross-over stenting followed by KBI in the unprotected LMCA?

		3.9	4.9	5.5		5.6	7.6	11.1
Bifurcation One	Incidence (%)				Incidence (%)			
	No. at risk	261	242	180	86	261	229	161
					76			
Bifurcation Two	Incidence (%)				24.6	30.9	30.9	
	No. at risk	119	105	86	52	119	81	62
					37			

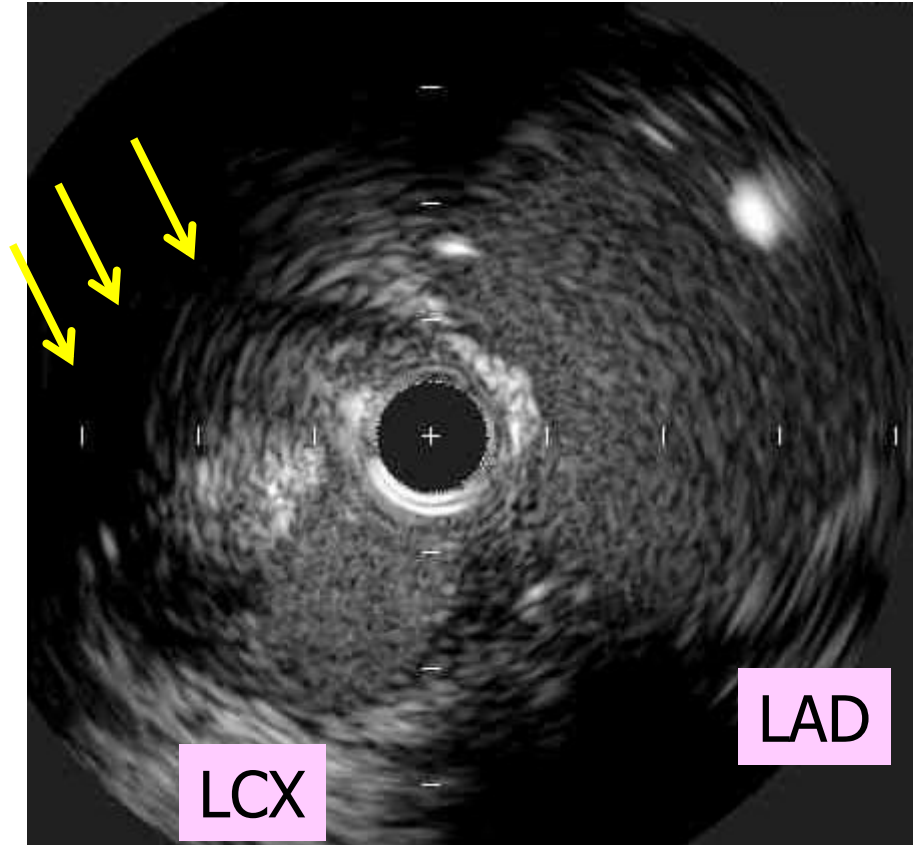
Cross-over stenting in LMCA – LAD followed by KBI

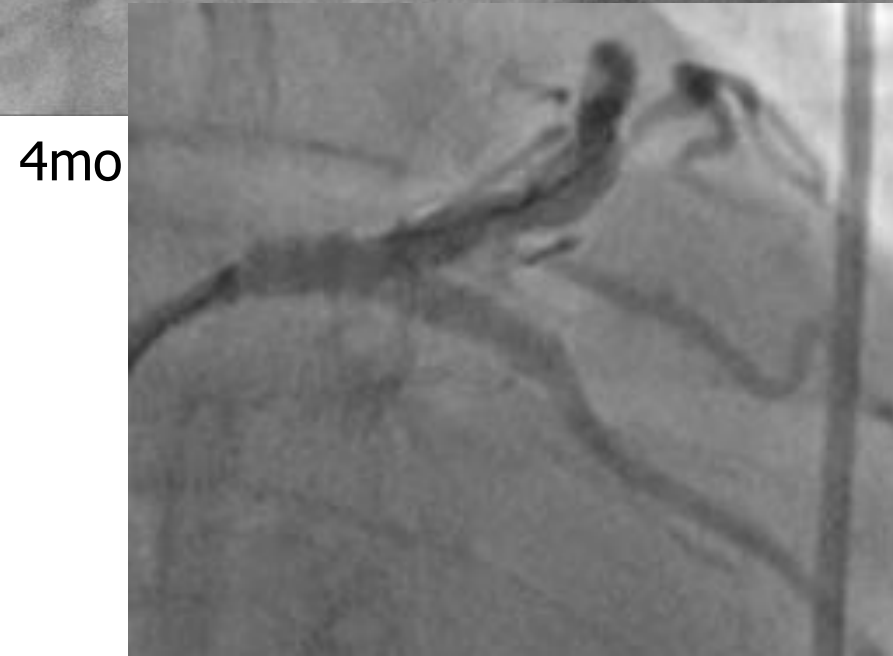
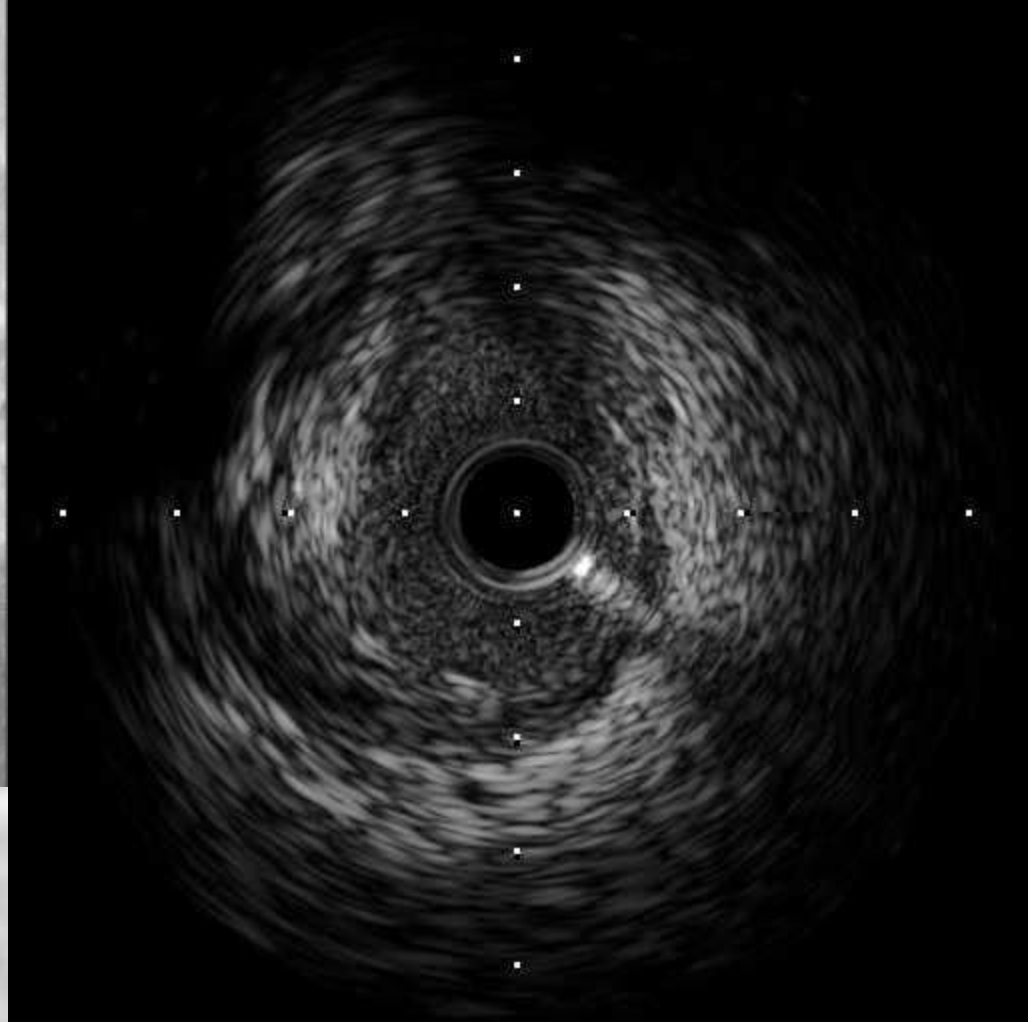
65y.o. M, HT
(1-1-1) lesion



Taxus Liberte 3.5/24

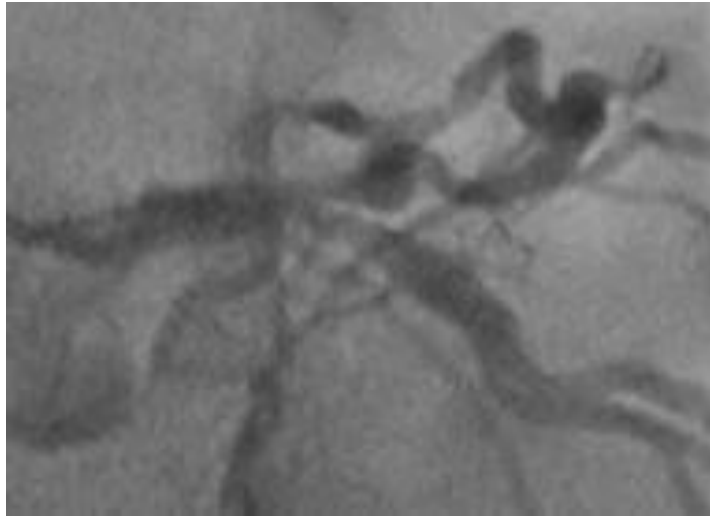
Final IVUS





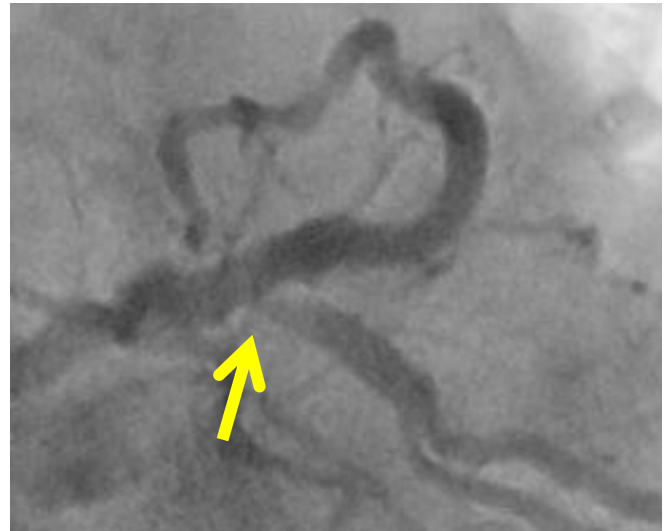
LCXOS: Cypher SP 3.5/13 (TAP)
LMOS: Cypher SP 3.5/ 8

76y.o. F, HT, DM HLP
(1-1-1) lesion



Xience V 3.0/23


4mo F/U



Culotte stenting
Xience V 3.5/12

Before Culotte stenting

After Culotte stenting

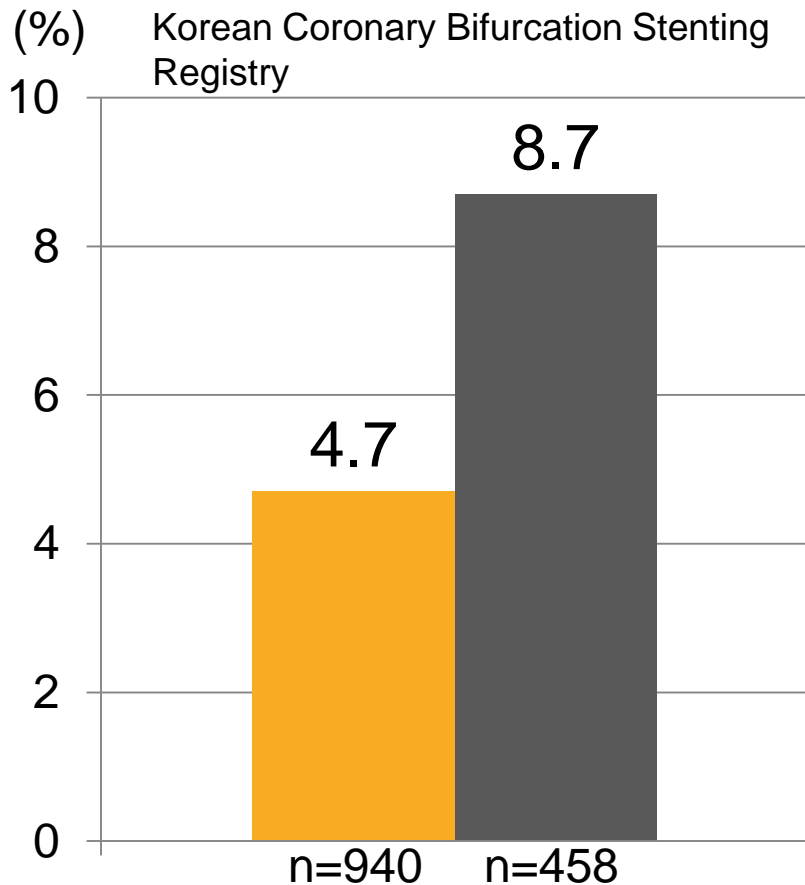


KBI does not always promise the SB patency in complex lesions (i.e. rich plaque burden, hard calcification).

Hard calcification at the LCXOS limited the stent expansion even after high pressure ballooning.

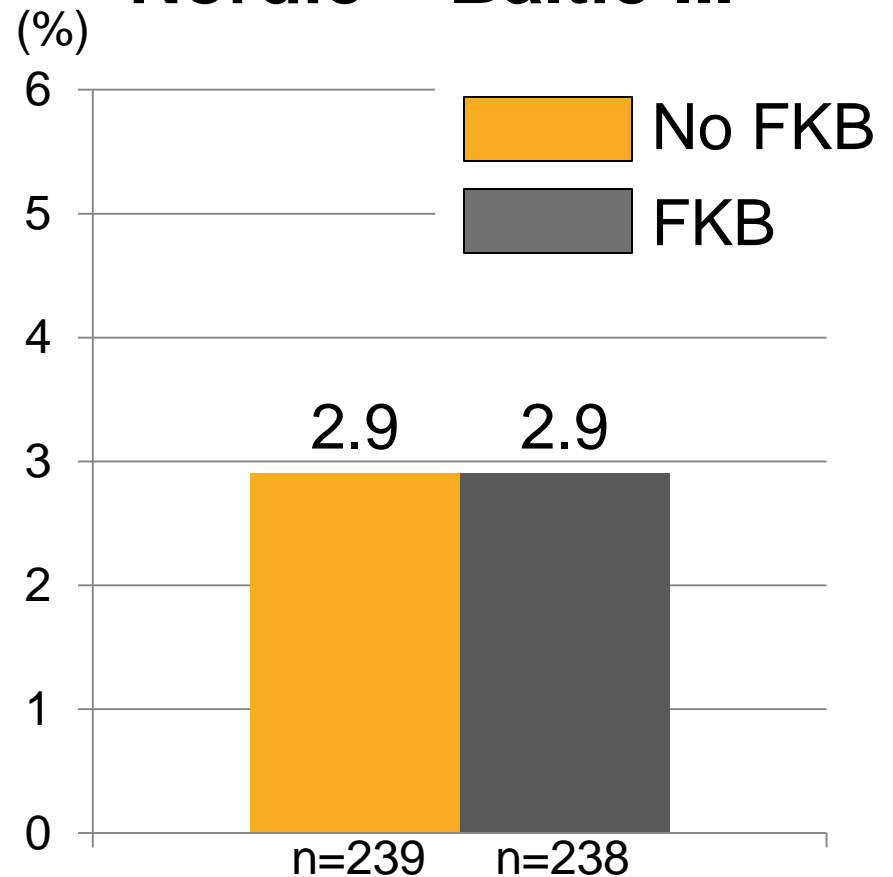
Ineffectiveness of FKB on the MACE in 1-stent strategy

COBIS



Gwon HC, ACC 2009

Nordic – Baltic III

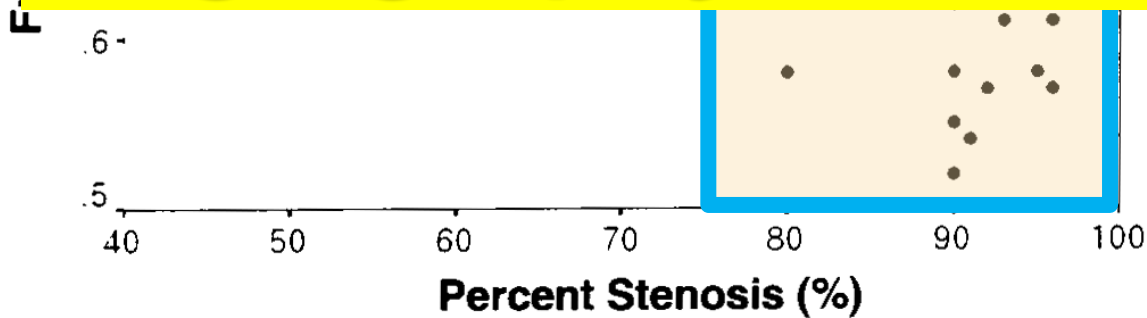


Niemela M, Circulation 2010

Physiological assessment of the jailed side branch using fractional flow reserve



Overtreatment of the SB in angiography-based PCI?

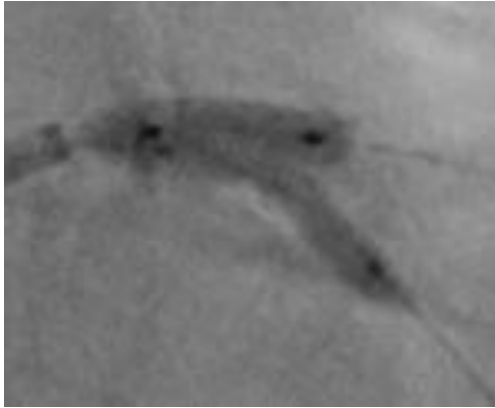


Balloon overlapping style in KBT

- Which balloon overlapping style is ideal for the proximal vessel dilation?

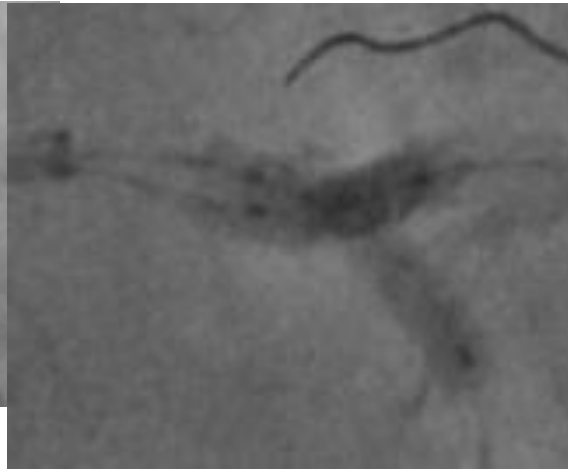
Case 1

Lateral position



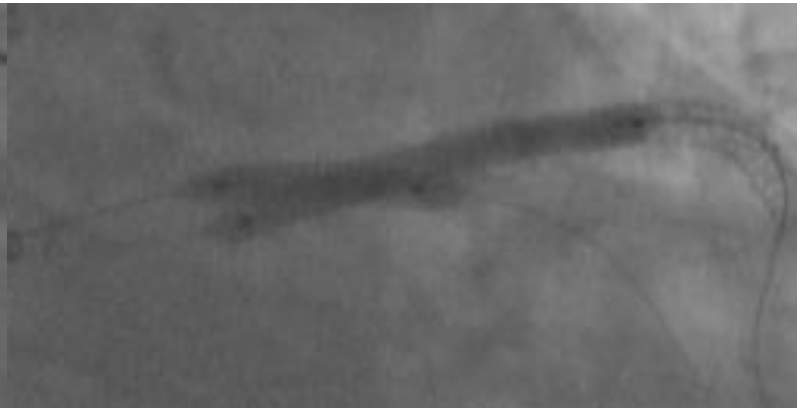
Case 2

X-shape



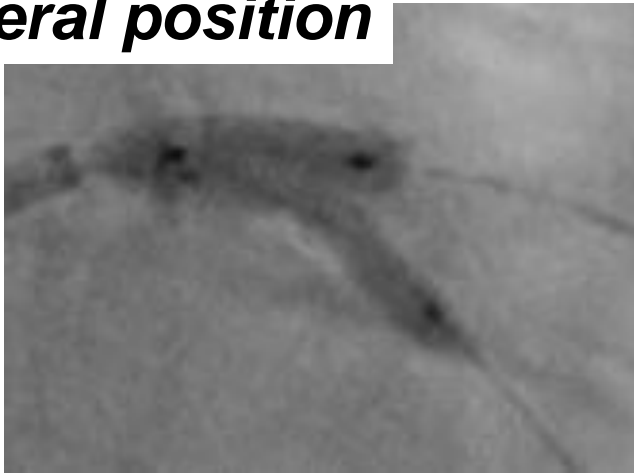
Case 3

Long overlapping with X-shape

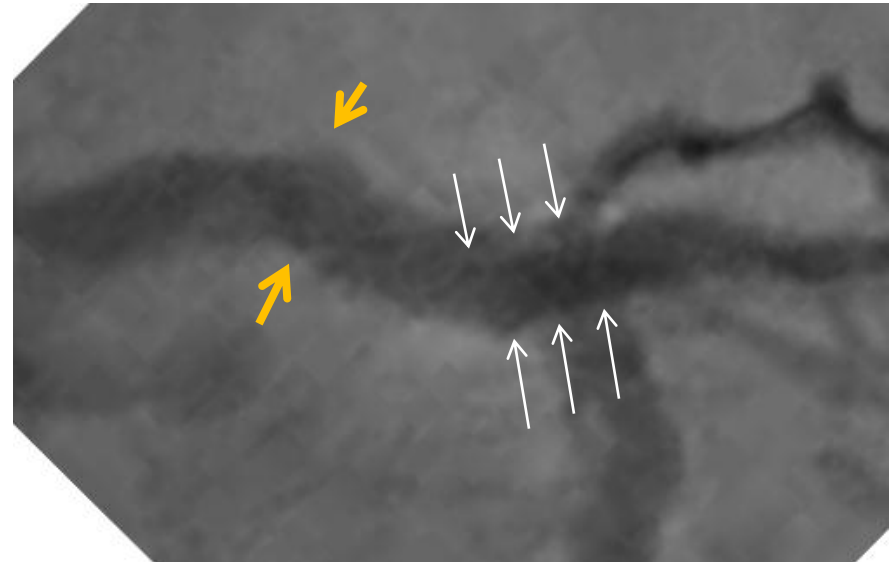
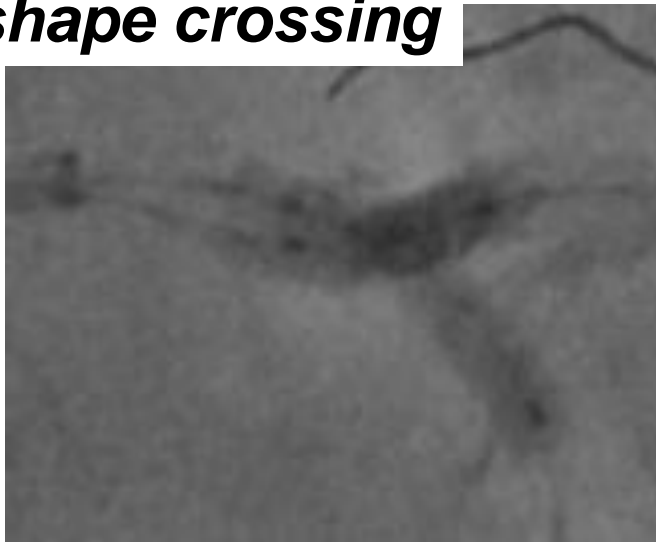


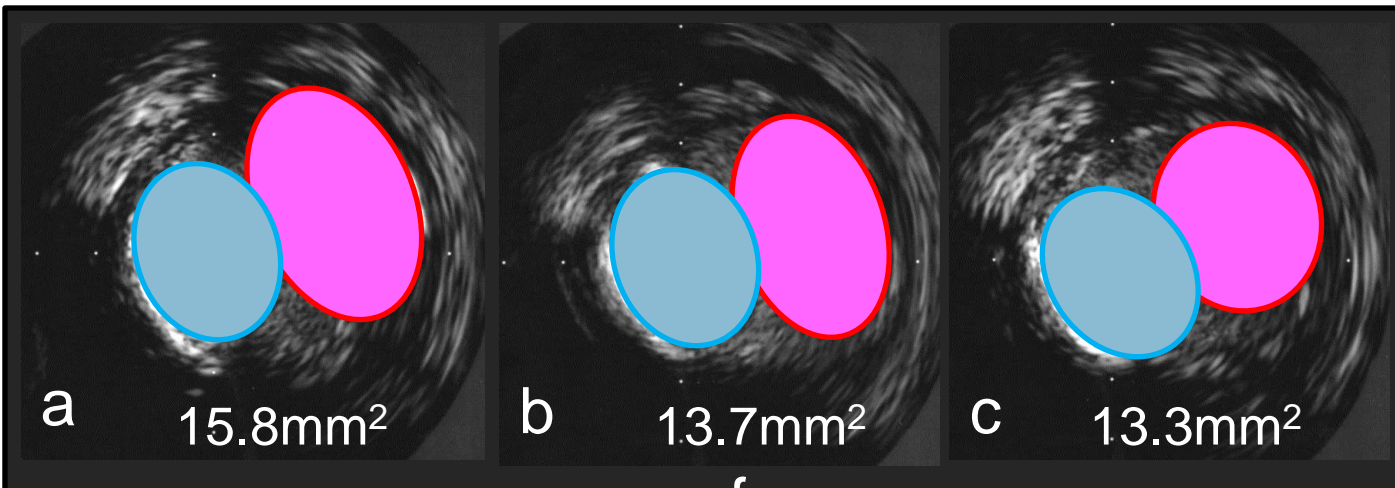
Difference in proximal MV expansion

Lateral position

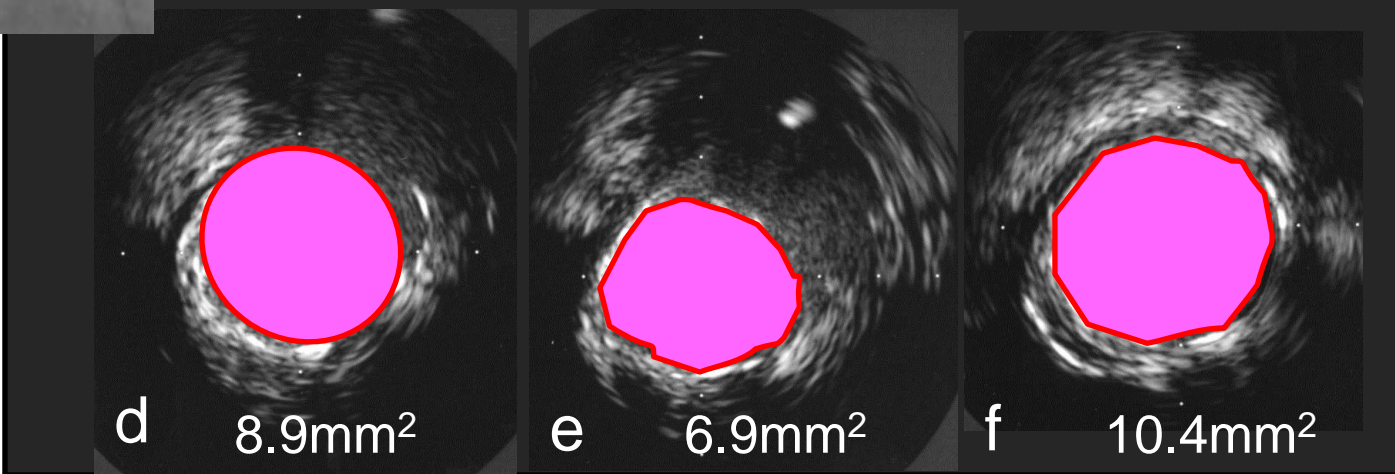


X-shape crossing

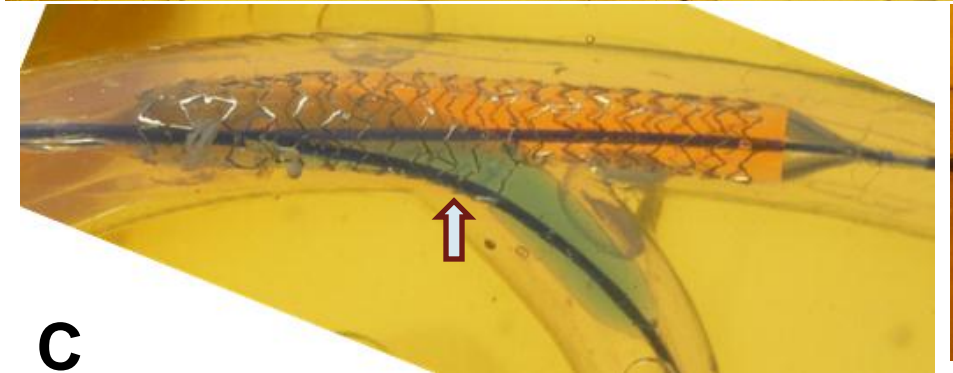
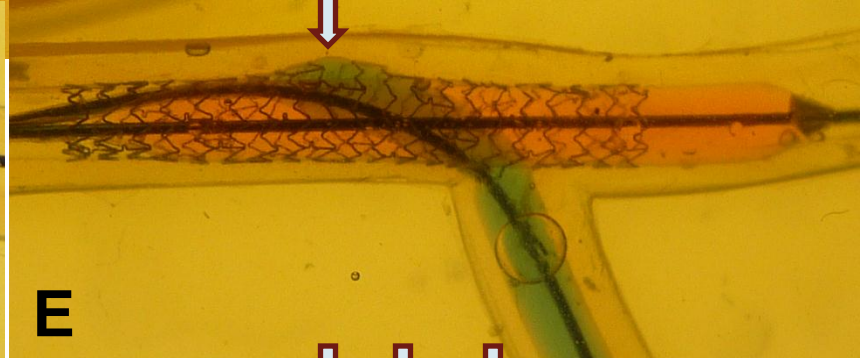
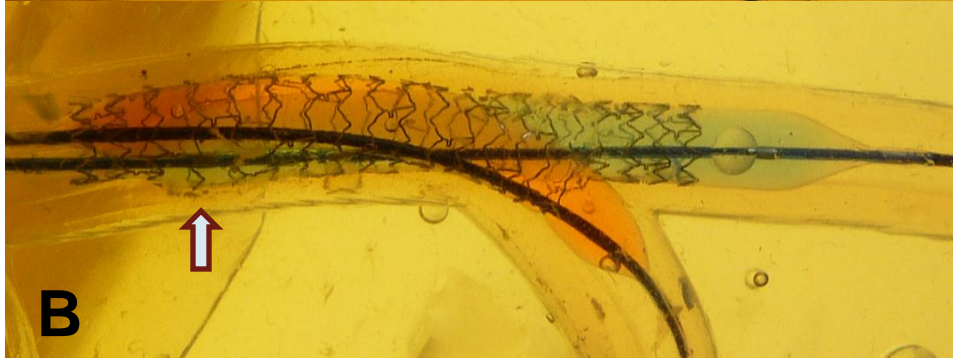




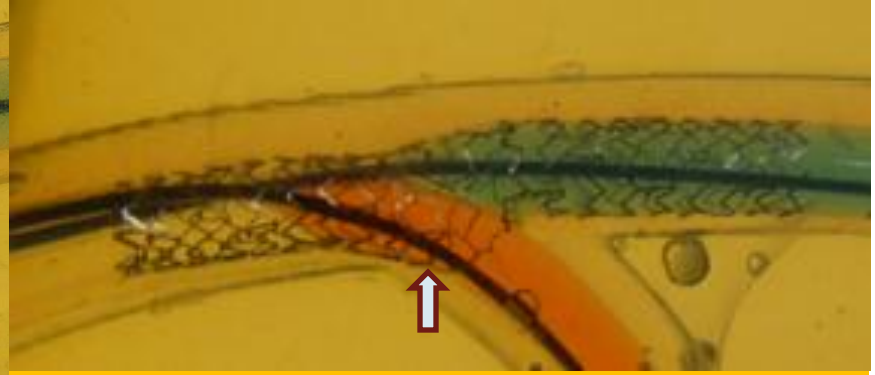
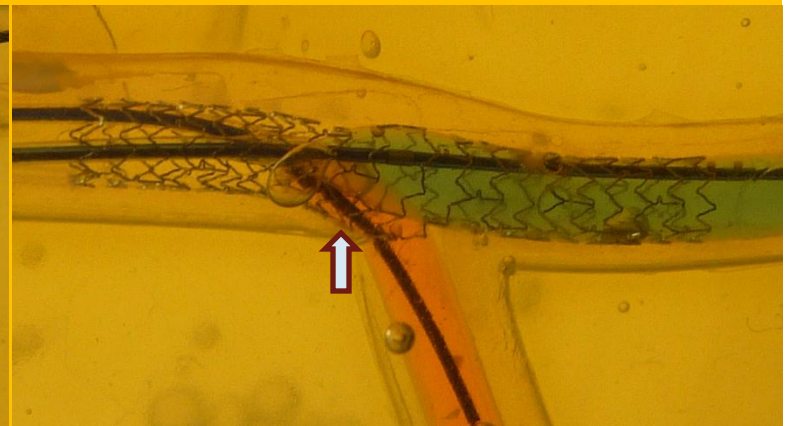
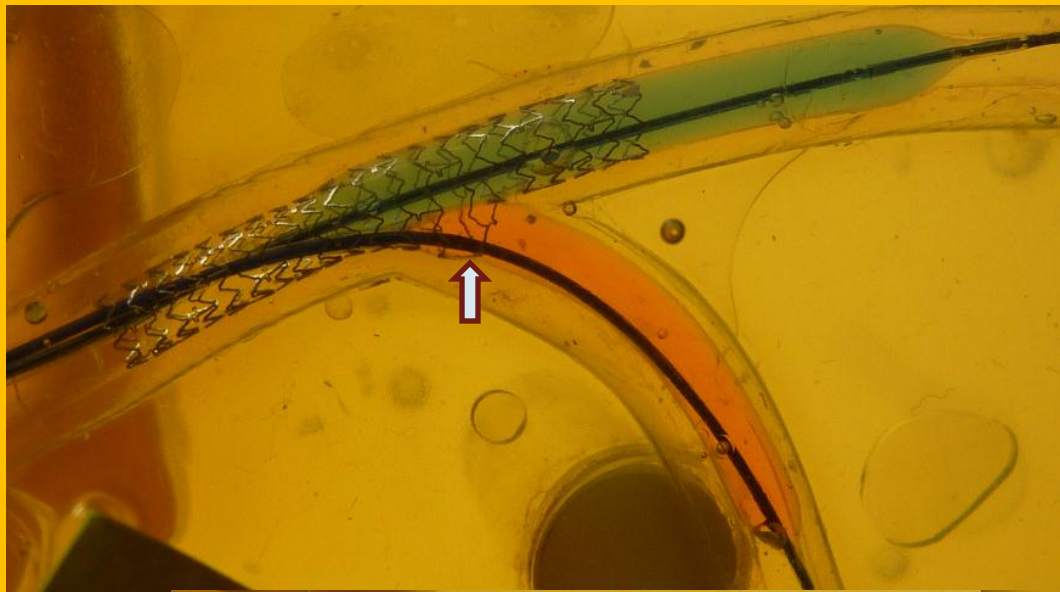
***Long overlapping
with X-shape***



Various configurations of the proximal MV stent which are dependent on the operator's decision.

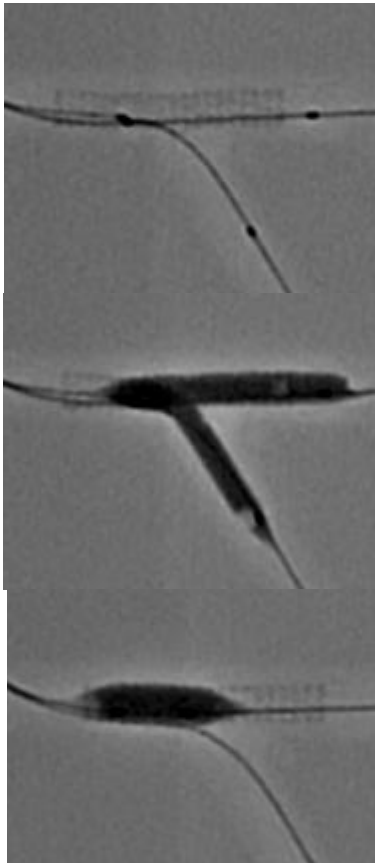


Optimal results for the bifurcation are obtained by minimal overlapping.



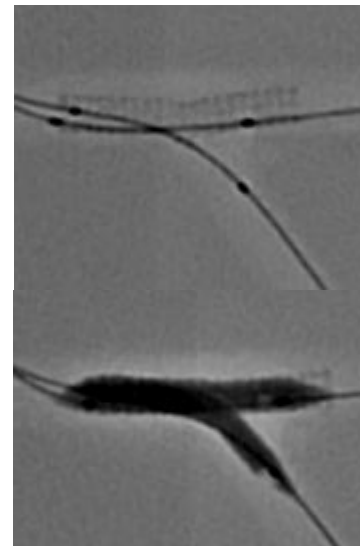
Two overlapping styles in KBT

Minimal overlapping + Proximal large ballooning



- ML Vision 3.5/28, 14atm
- SB Ryujin 3.0/20, 12atm
- KBT (6atm)
MV Ryujin 3.5/20
SB Ryujin 3.0/20
- prox MV
Quntum Maverick II
4.5/8, 12atm

Long overlapping

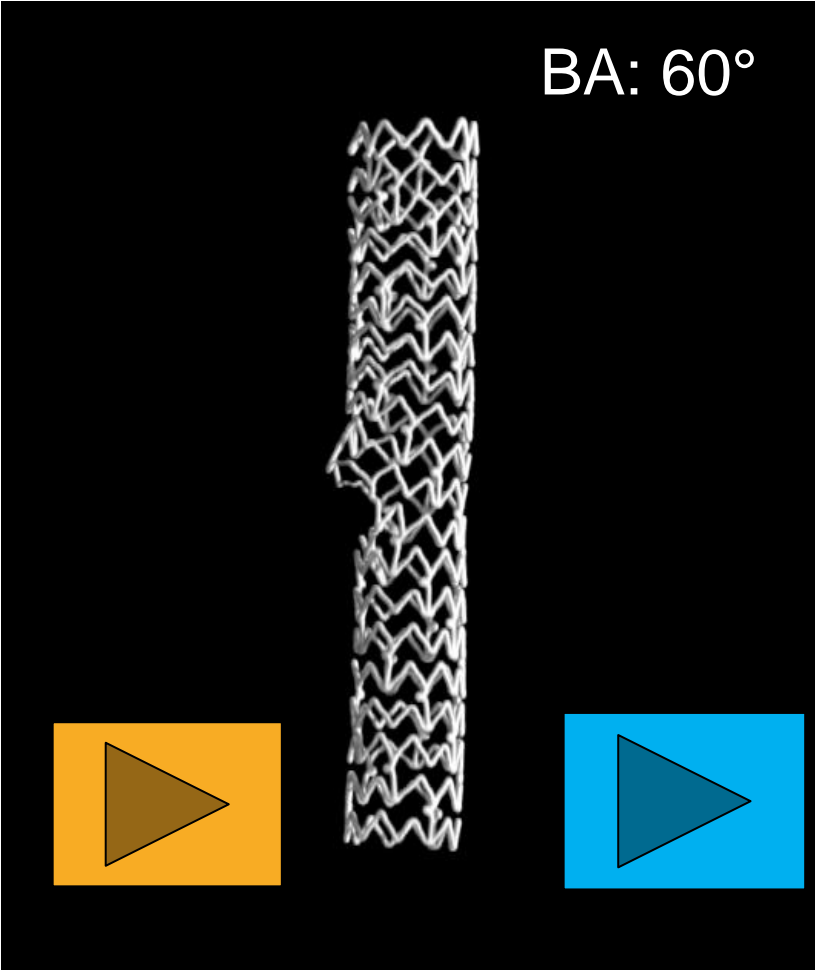


- ML Vision 3.5/28, 14atm
- SB Ryujin 3.0/20, 12atm
- KBT (6atm)
MV Ryujin 3.5/20
SB Ryujin 3.0/20

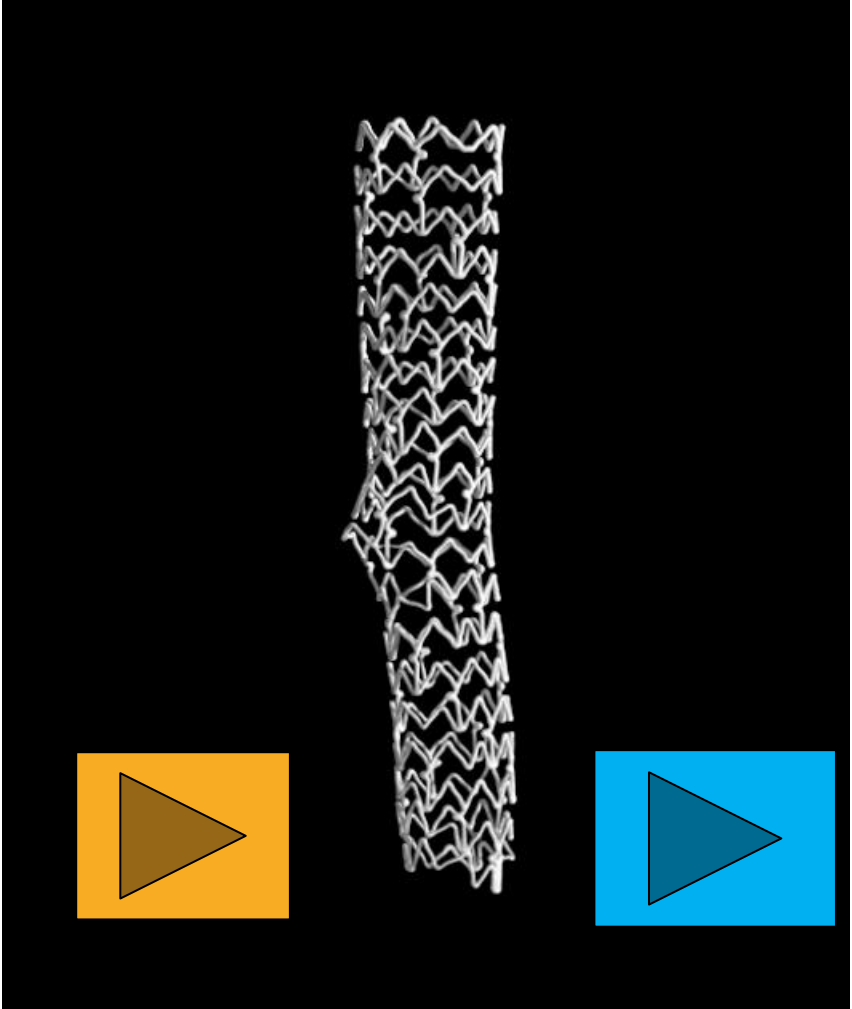
Mitsudo's law

$$3.5^2 + 3.0^2 = 4.6^2$$

Minimal overlapping +
Proximal large ballooning

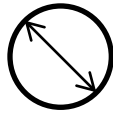


Long overlapping

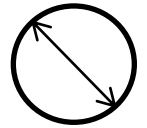


Diastolic peak flow

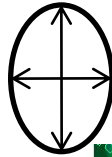
(a) Circle $\phi 4\text{mm}$



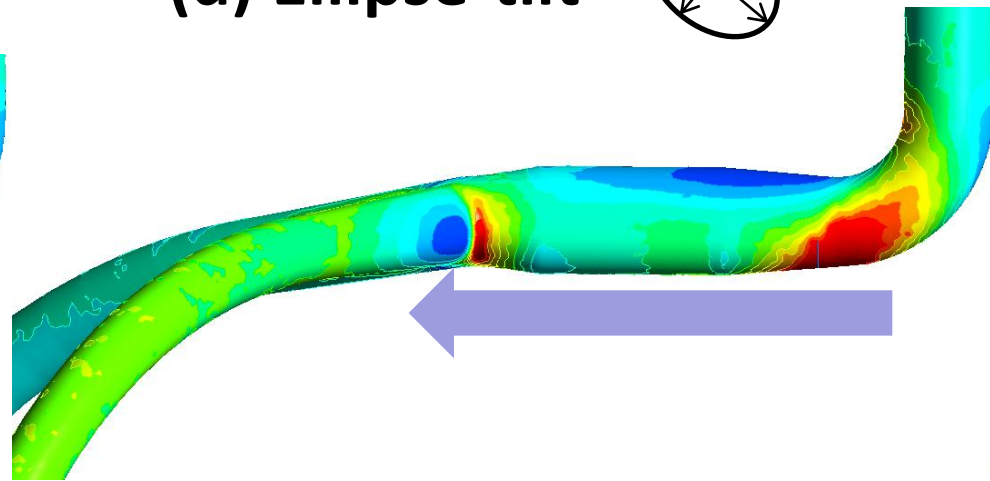
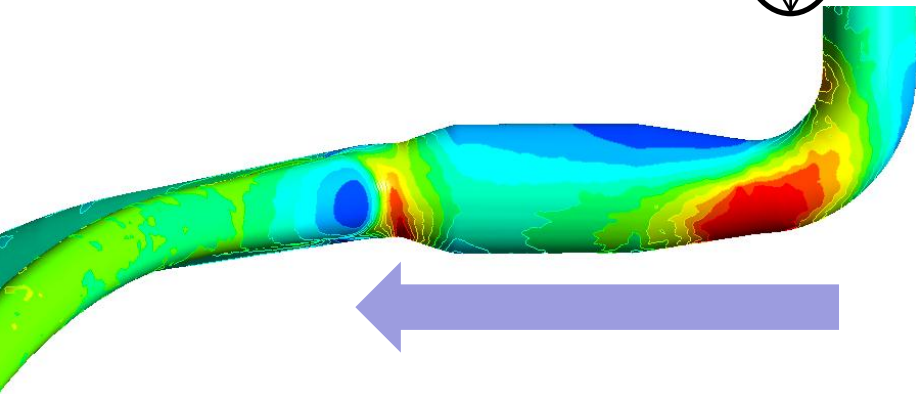
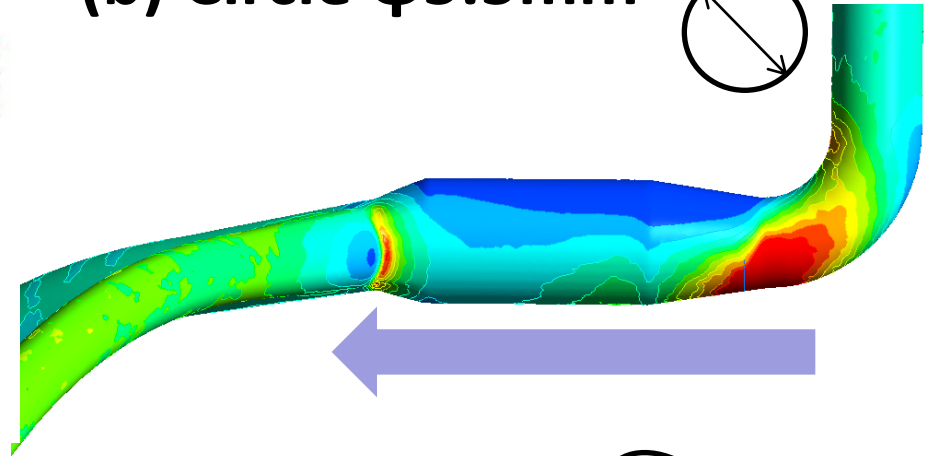
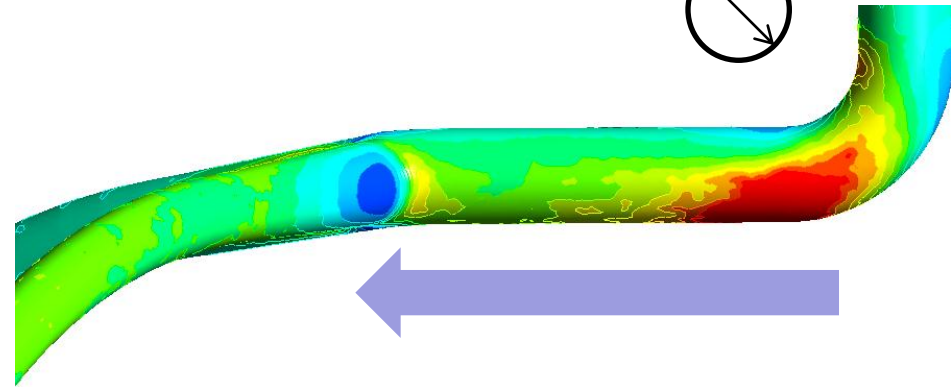
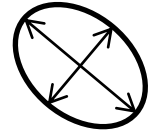
(b) Circle $\phi 5.5\text{mm}$



(c) Ellipse-longitude

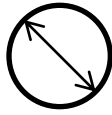


(d) Ellipse-tilt

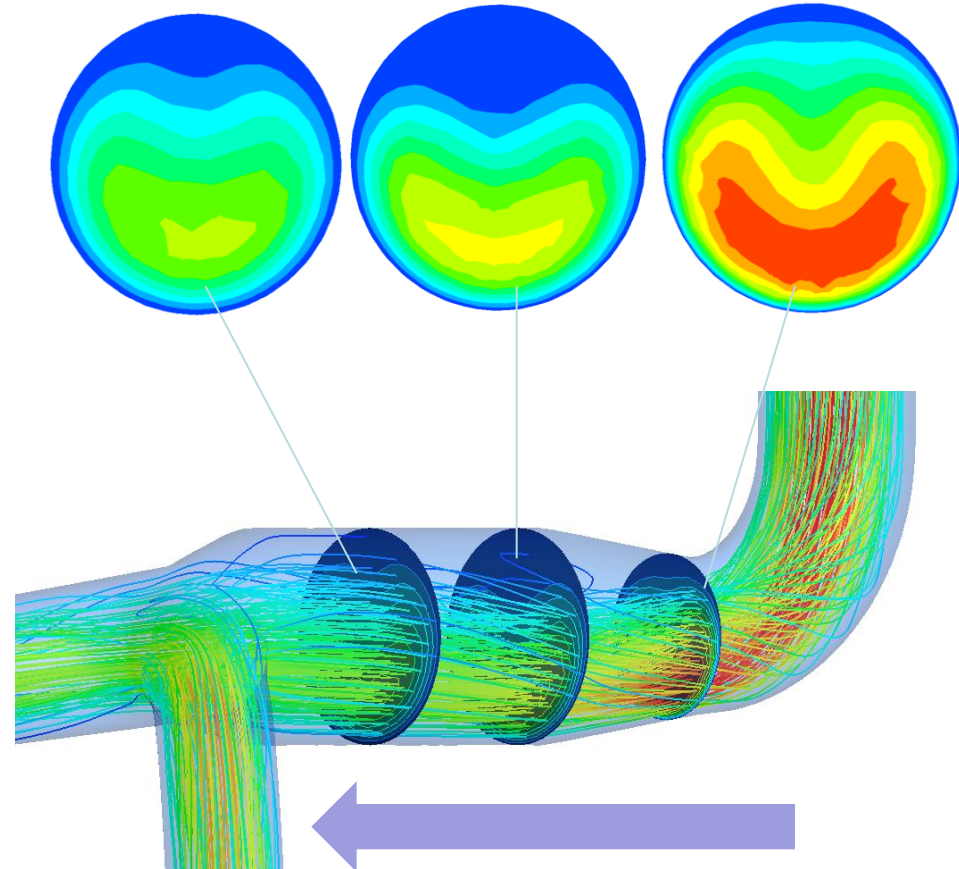
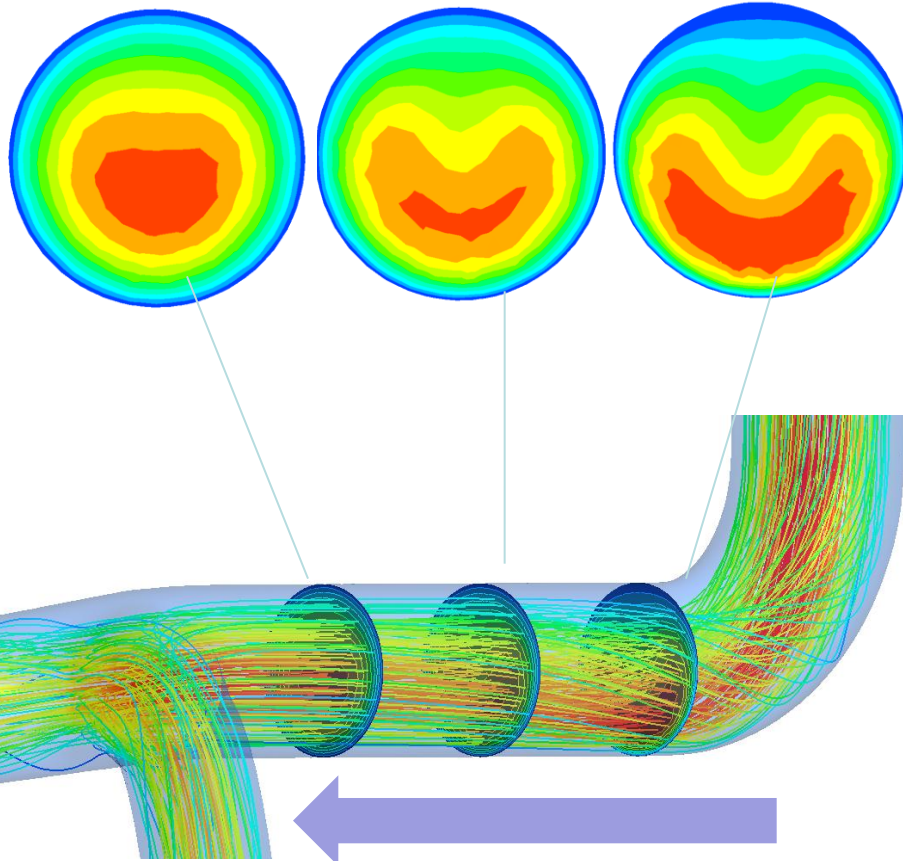
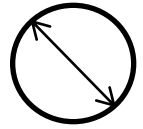


Diastolic peak flow

(a) Circle $\phi 4\text{mm}$



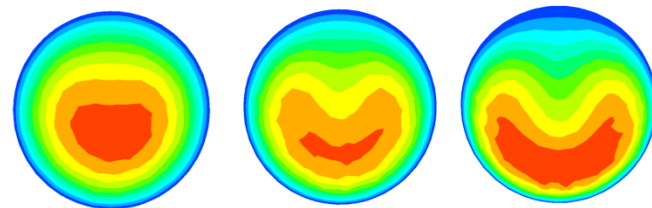
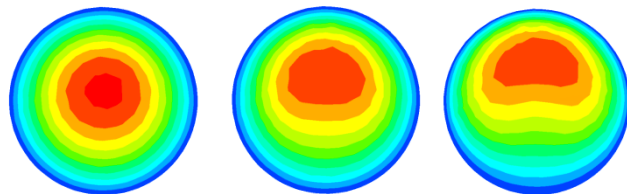
(b) Circle $\phi 5.5\text{mm}$



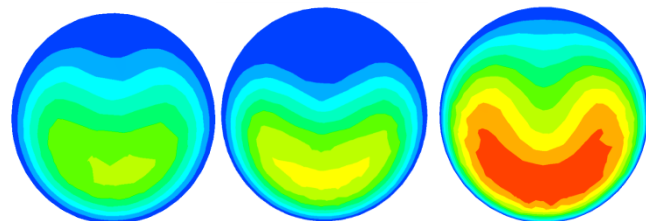
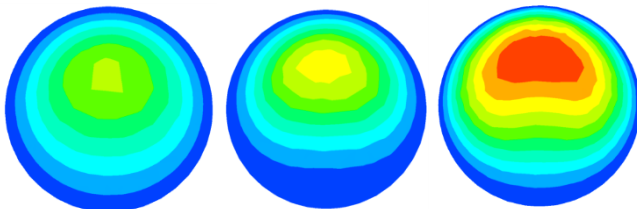
Systolic flow

Diastolic peak flow

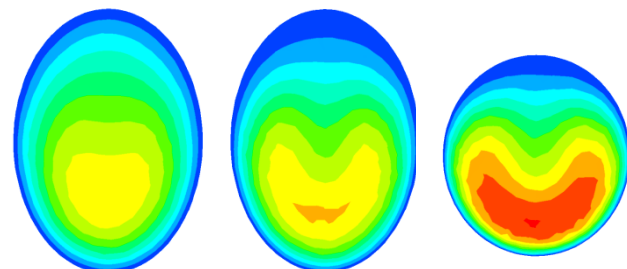
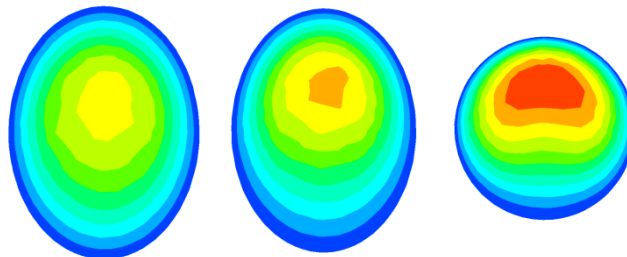
Circle
 $\phi 4\text{mm}$



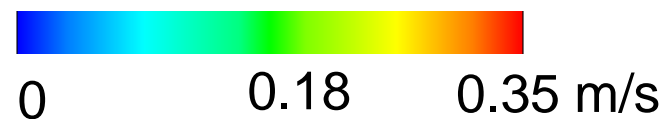
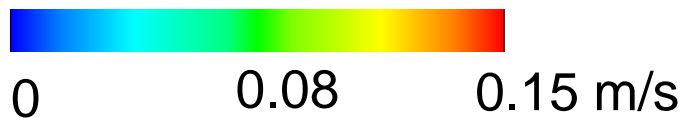
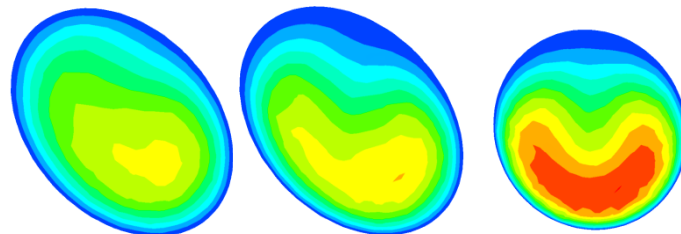
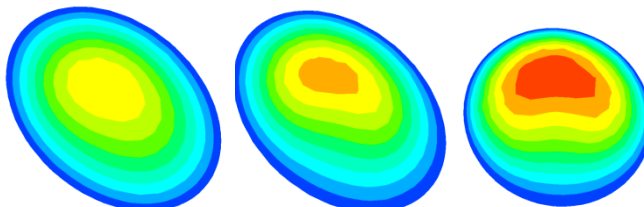
Circle
 $\phi 5.5\text{mm}$

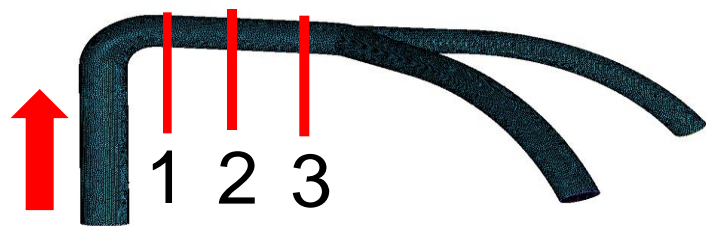


Ellipse-
longitude

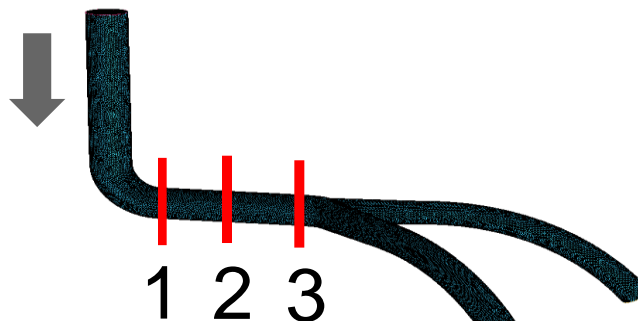
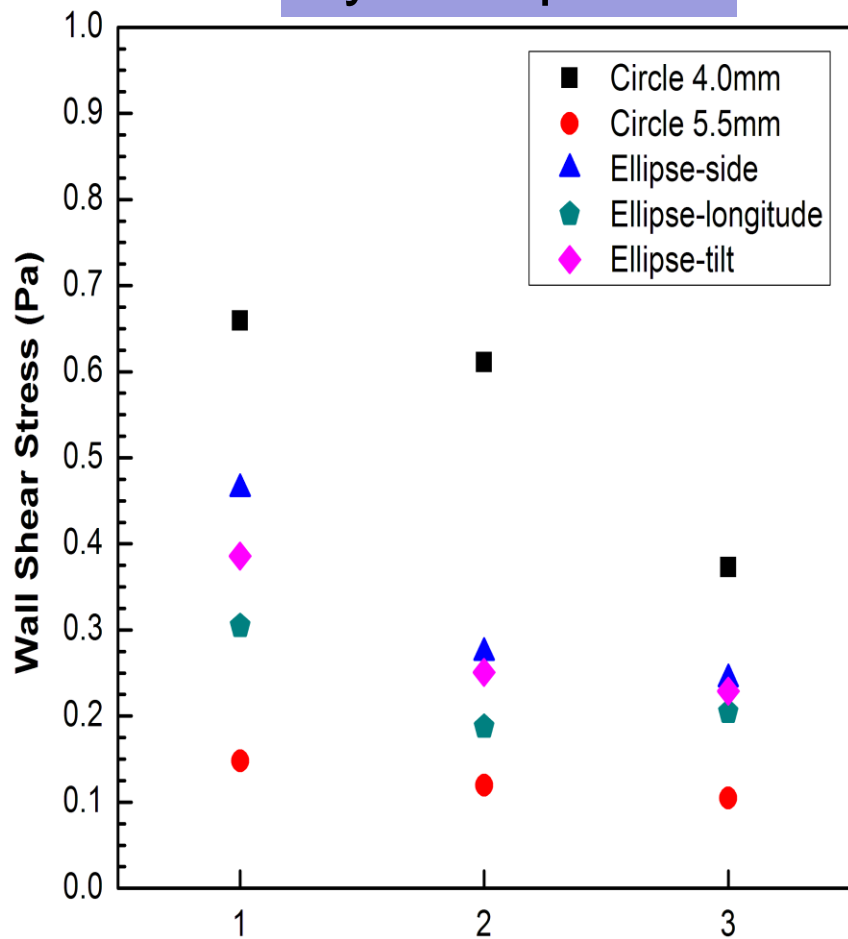


Ellipse-
tilt

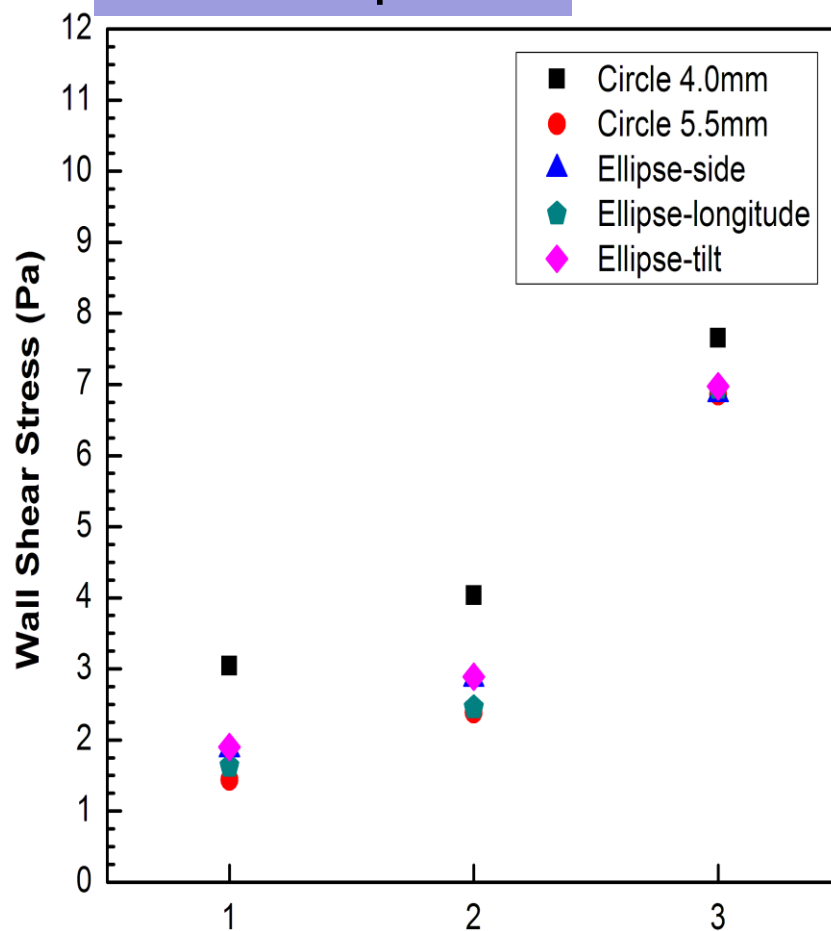




Systolic phase



Diastolic phase



Multi-scale analysis

Quantification of coronary artery bifurcations according to mother-vessel diameter
Values obtained on quantitative coronary bifurcation angiography

	For all
# of bifurcation	173
D_m (mean \pm SD)	3.339 \pm 0.948
$D_{d\text{-larger}}$ (mean \pm SD)	2.708 \pm 0.774
$D_{d\text{-smaller}}$ (mean \pm SD)	2.236 \pm 0.689
Reduction in mm (mean \pm SD)	0.631 \pm 0.365
% reduction	18.9
Mean ratio	0.678

Variables are presented as mean \pm SD

D in mm

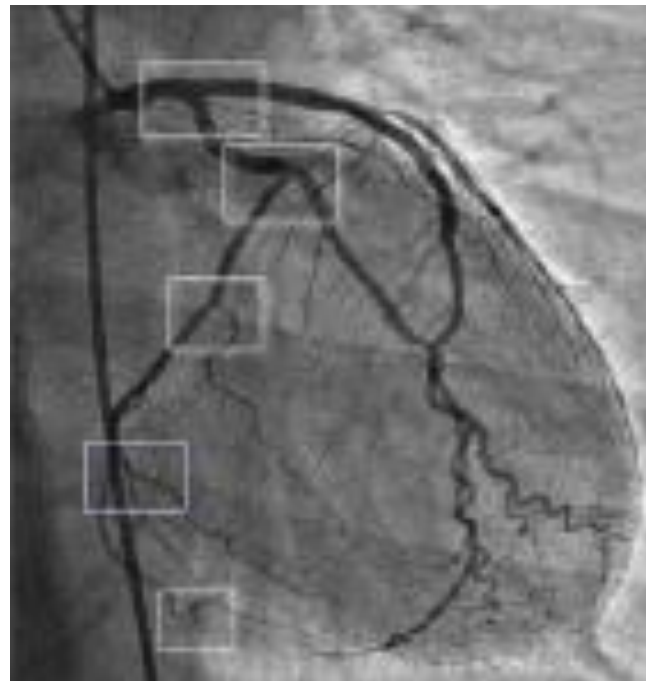
D_m : Diameter of the mother vessel

$D_{d\text{-larger}}$: Diameter of the larger daughter vessel

$D_{d\text{-smaller}}$: Diameter of the smaller daughter vessel

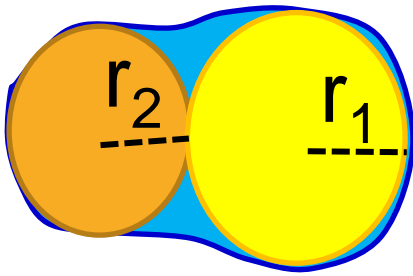
Reduction: difference between the diameter of mother vessel and the diameter of the larger daughter vessel

Ratio: $D_m / (D_{d\text{-larger}} + D_{d\text{-smaller}})$

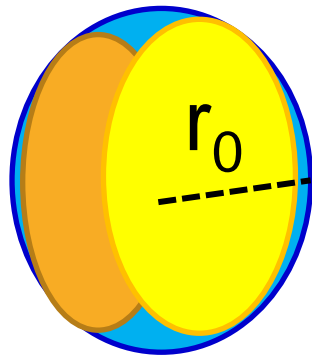
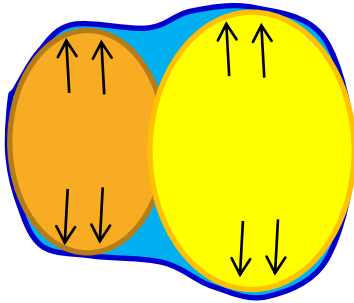


$$R = \frac{D_{\text{mother}}}{D_{\text{daughter 1}} + D_{\text{daughter 2}}}$$

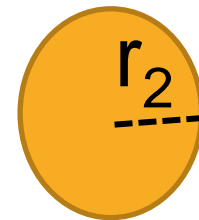
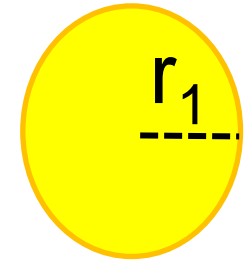
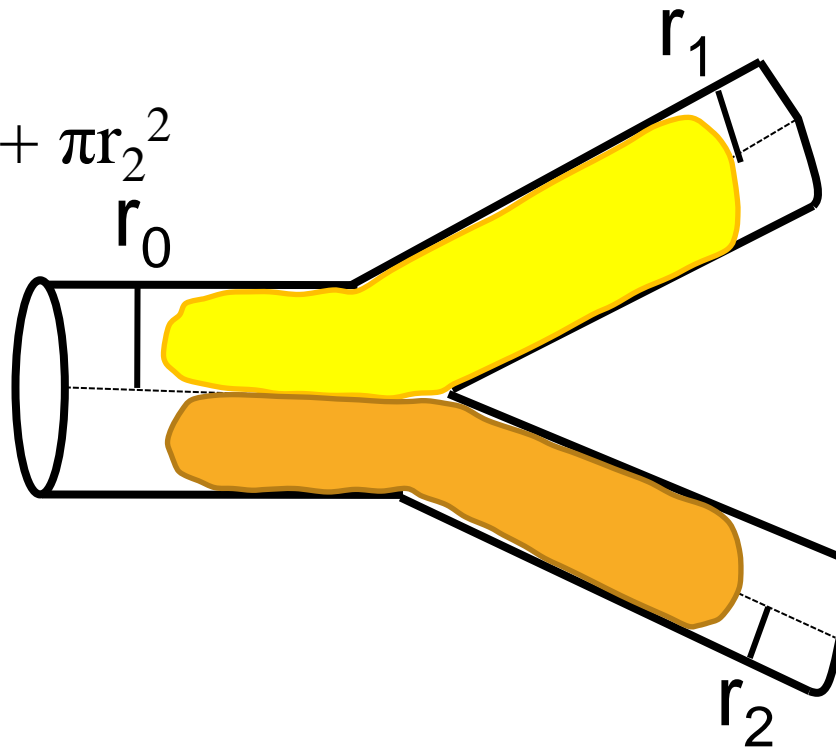
Kissing balloon inflation



$$\text{PMV area} = \pi r_1^2 + \pi r_2^2$$



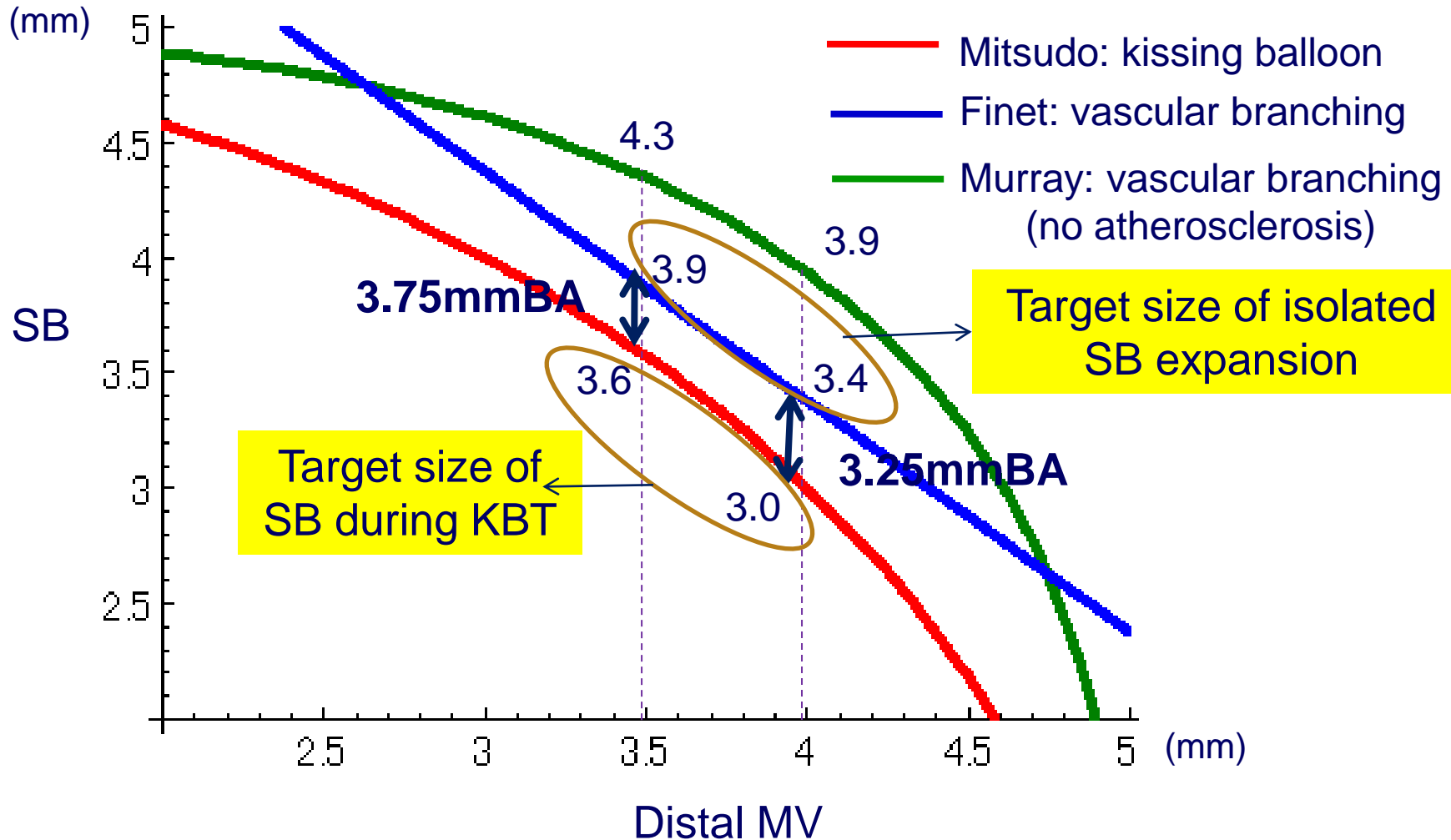
$$\pi r_0^2 = \pi r_1^2 + \pi r_2^2$$



Mitsudo's formula

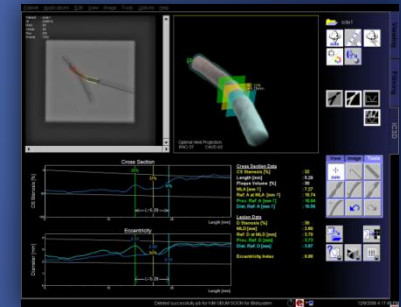
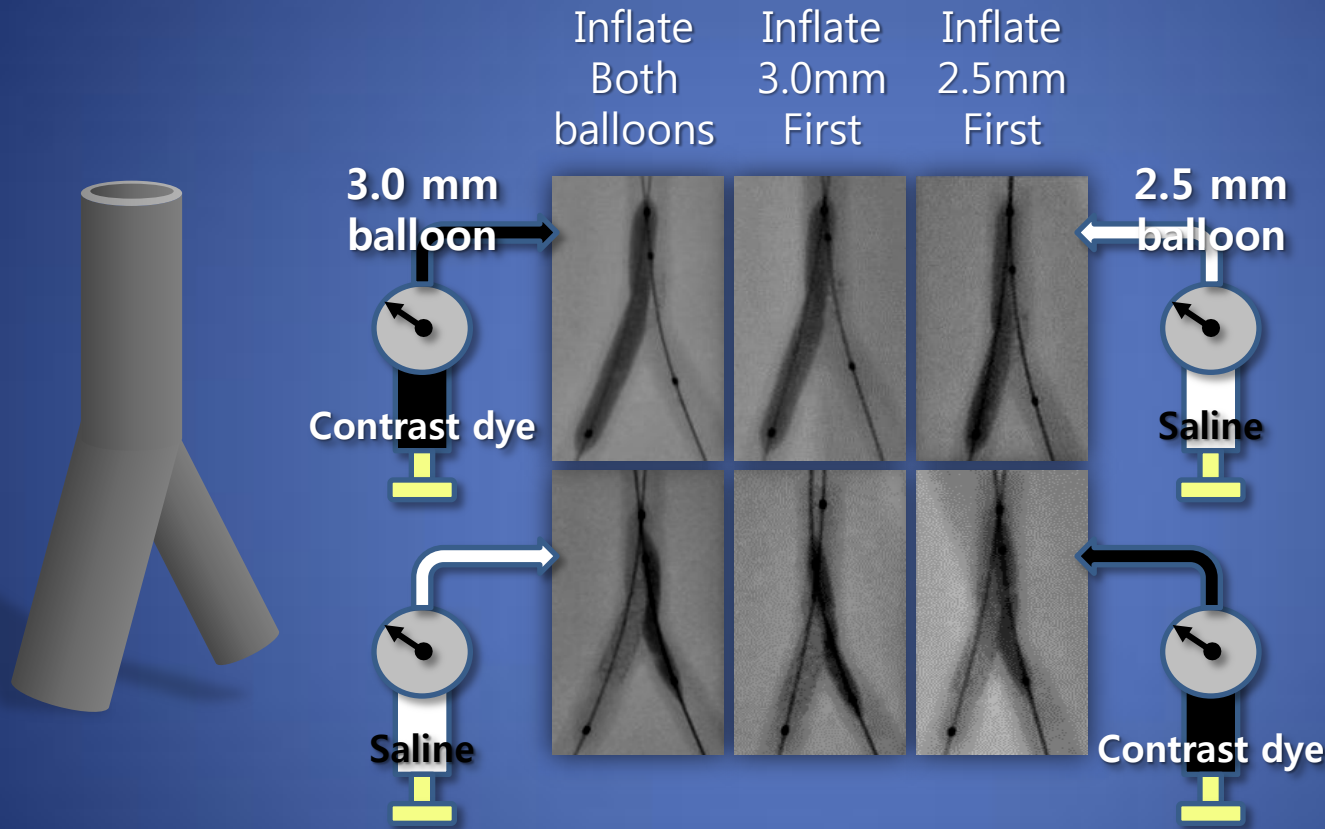
$$r_0^2 = r_1^2 + r_2^2$$

How to decide balloon size proximal MV 5mm



KBI procedure - phantom study

Oh SJ, CVIT 2009



Plexiglass tube
 MB : 3.0mm Ø
 SB : 2.5mm Ø
 Angle : 30°

3.0mm Ø TAXUS™ stents (Boston Scientific®) used
 Repeated three times
 ARTIS ZEE (SIEMENS, Germany)
 GALAXY iLAB (Boston Scientific, USA)

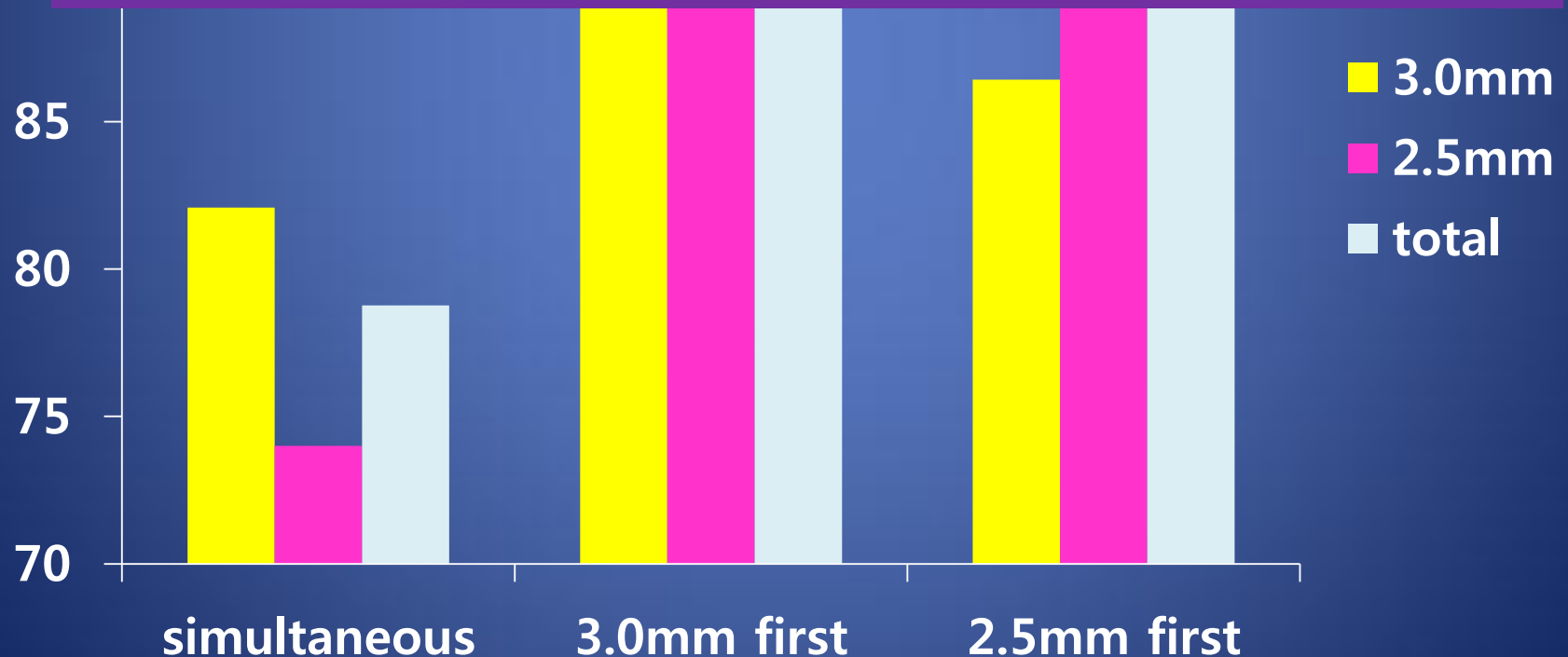
I3CD
 Analyzed at :
 Proximal portion
 Side branch ostium
 Distal portion

Acquired area (% expansion of the reference)

Oh SJ, CVIT 2009

(%)
100

- Single simultaneous kissing ballooning results in under-expansion of the SB balloon.
- SB ballooning prior to KBI can resolve this issue.



The relation between the place of GW cross and stent deformation after KBT

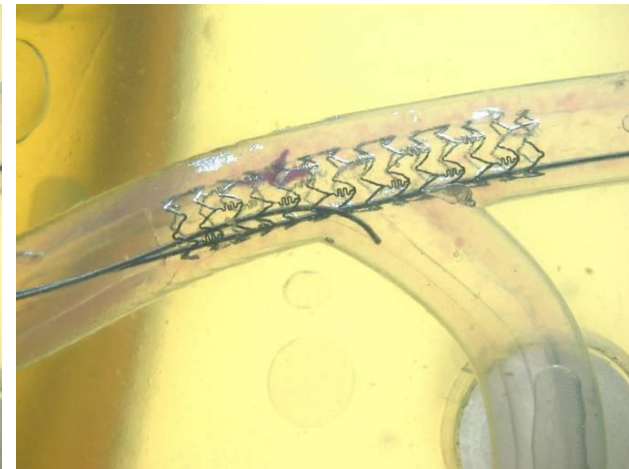
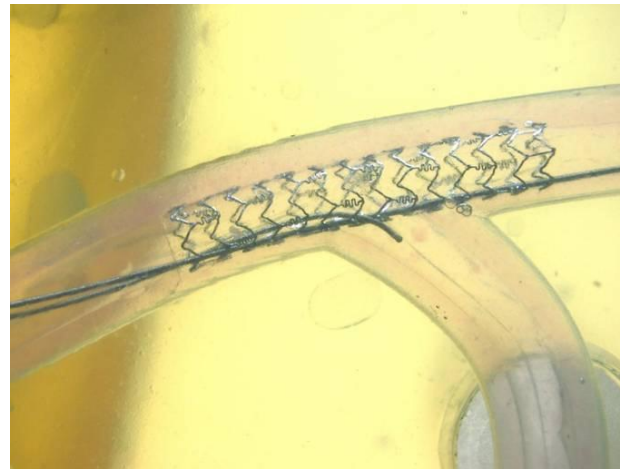
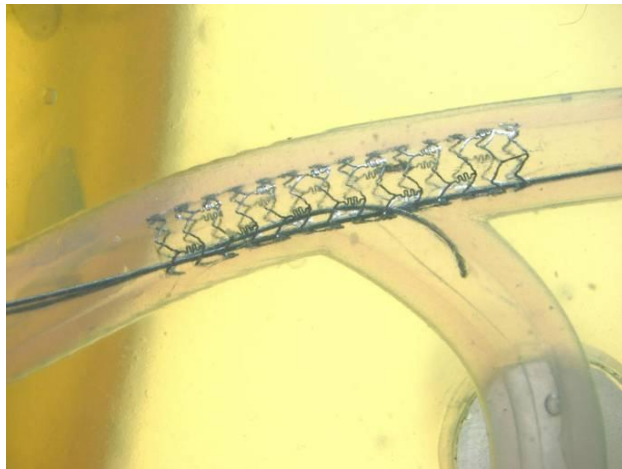
Murasato Y, Colombo A, Moussa I

“Tips and Tricks in Interventional Therapy of Coronary Bifurcation Lesions

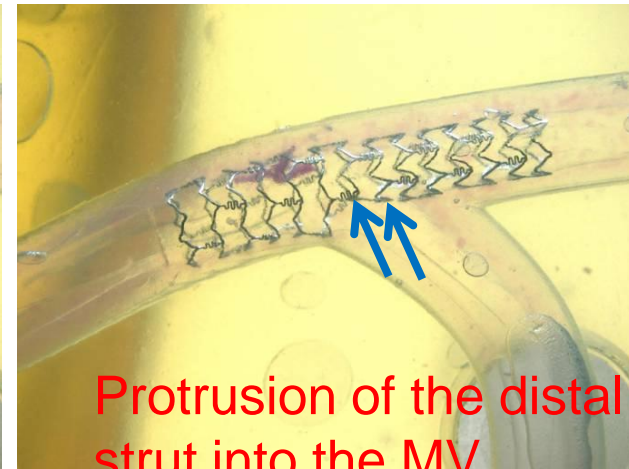
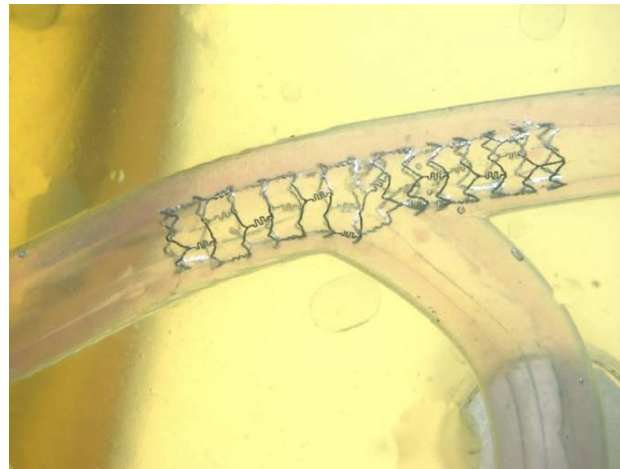
Distal strut

Mid strut

Proximal strut



Scaffolding at the SB ostium

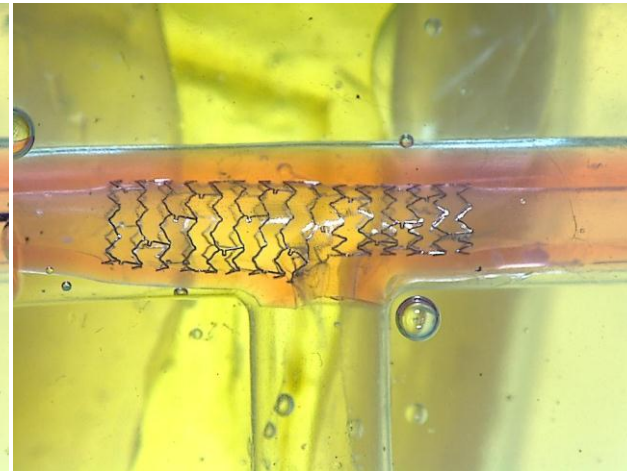
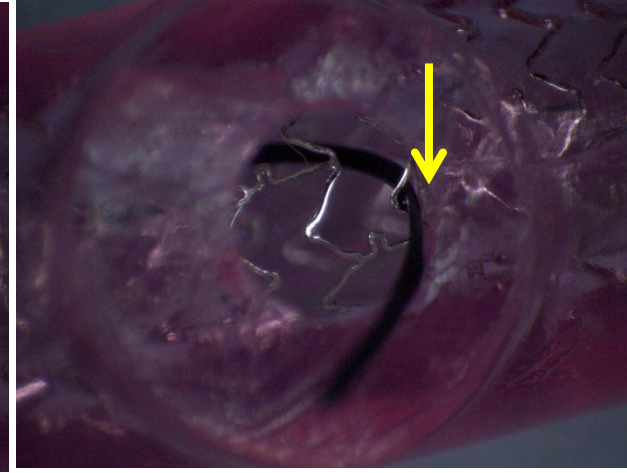
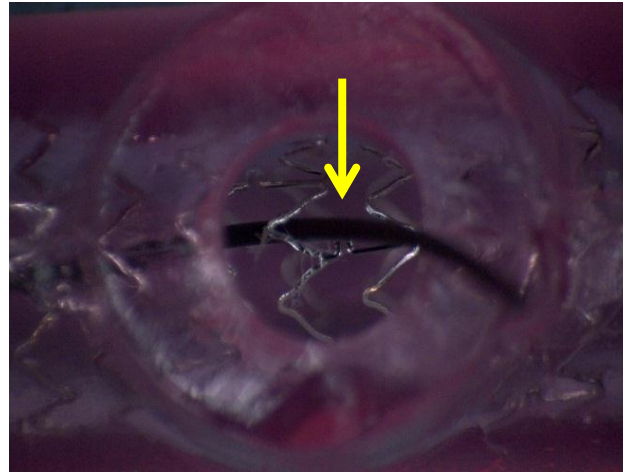
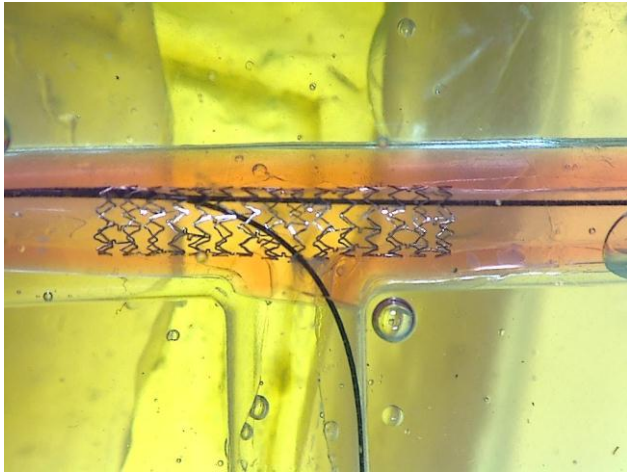


Protrusion of the distal strut into the MV

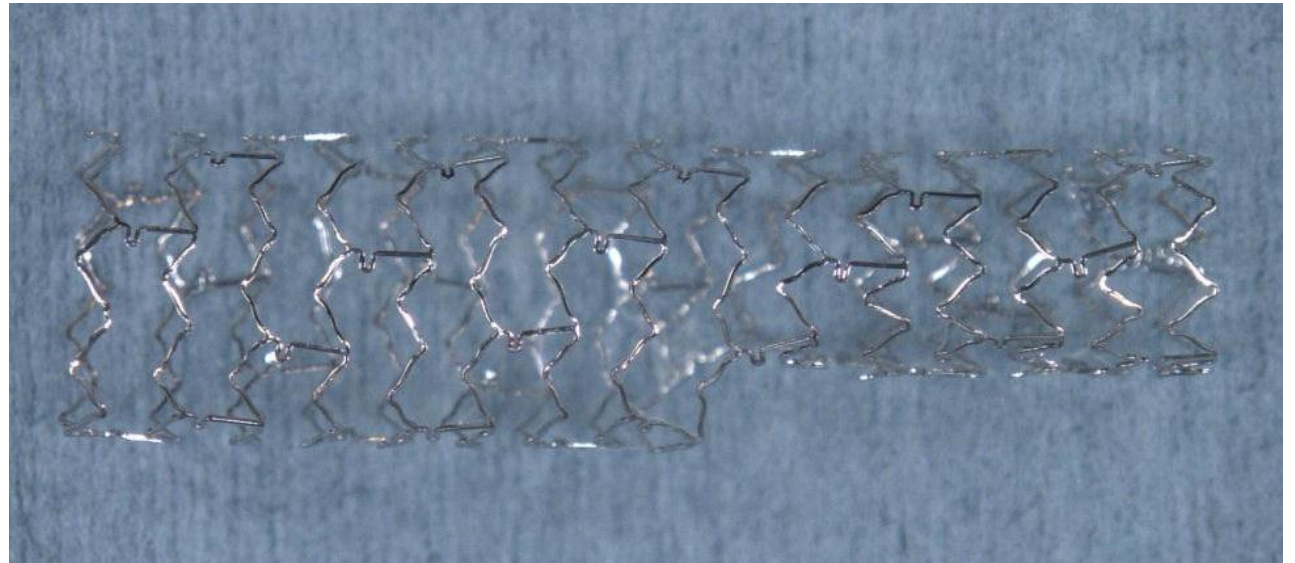
GW recross position

Central cell

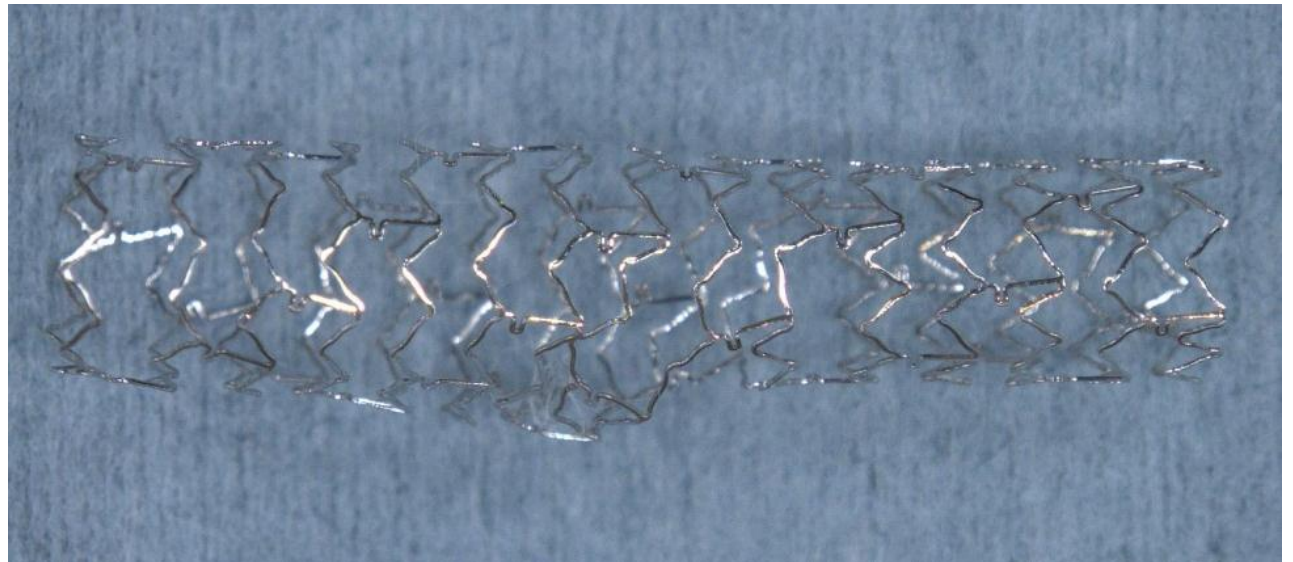
Distal cell



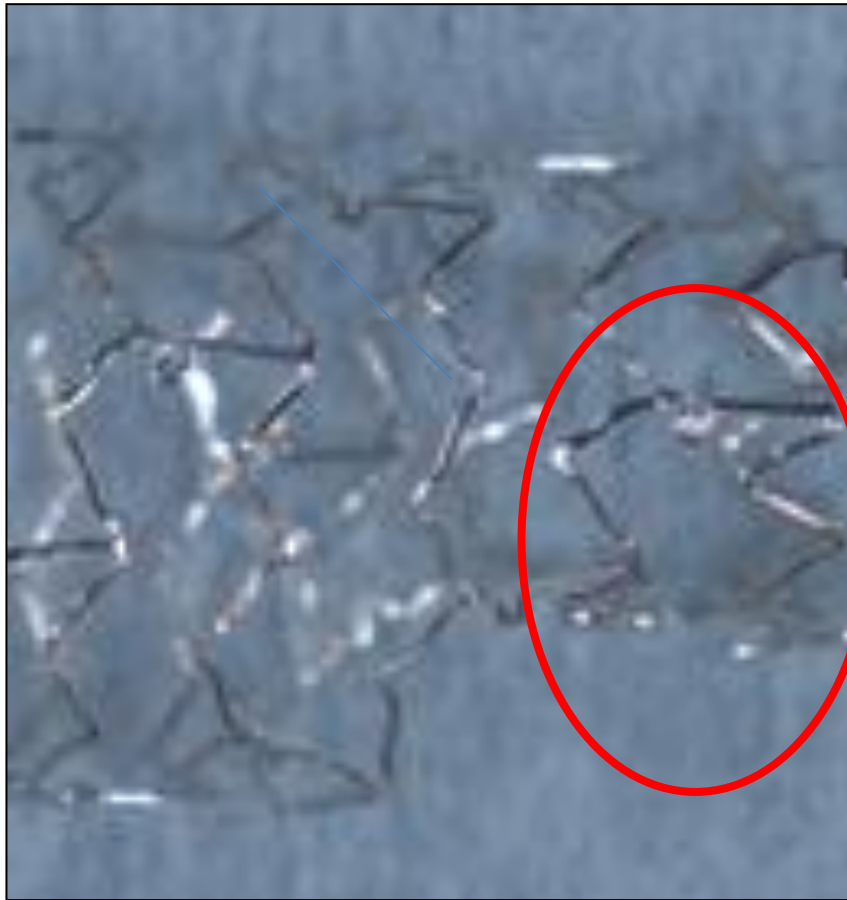
**GW recross
Central cell**



Distal cell



Central cell



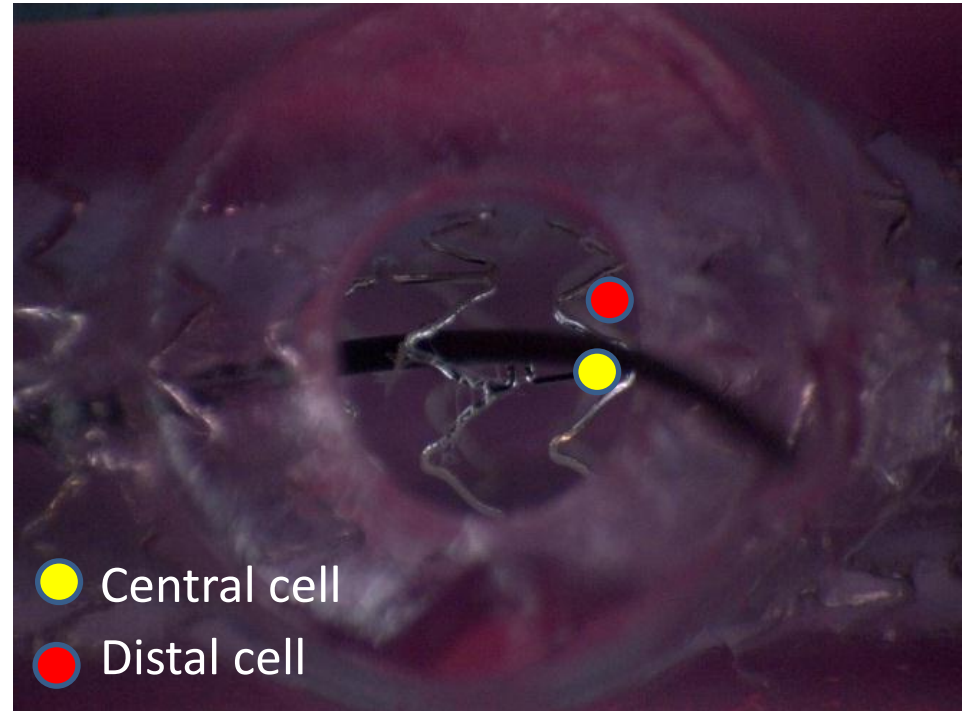
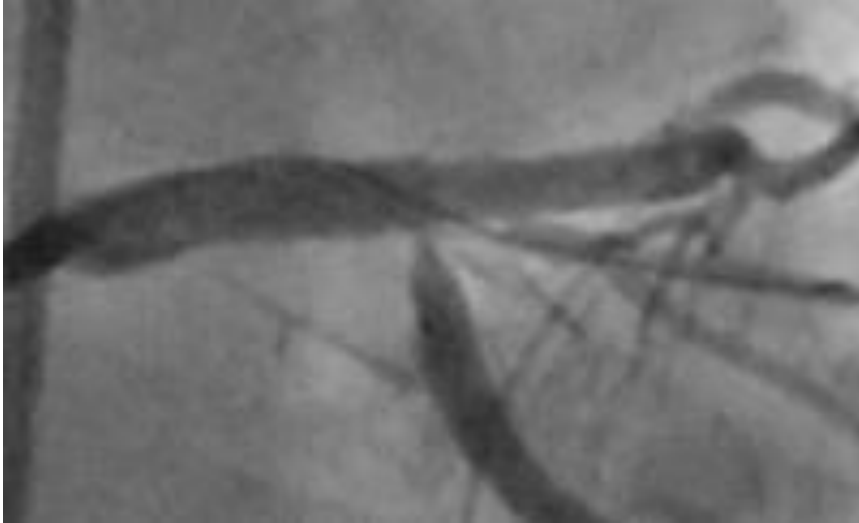
Distal cell

Severe deformation
of the proximal cell

Stretched expansion
of the distal cell

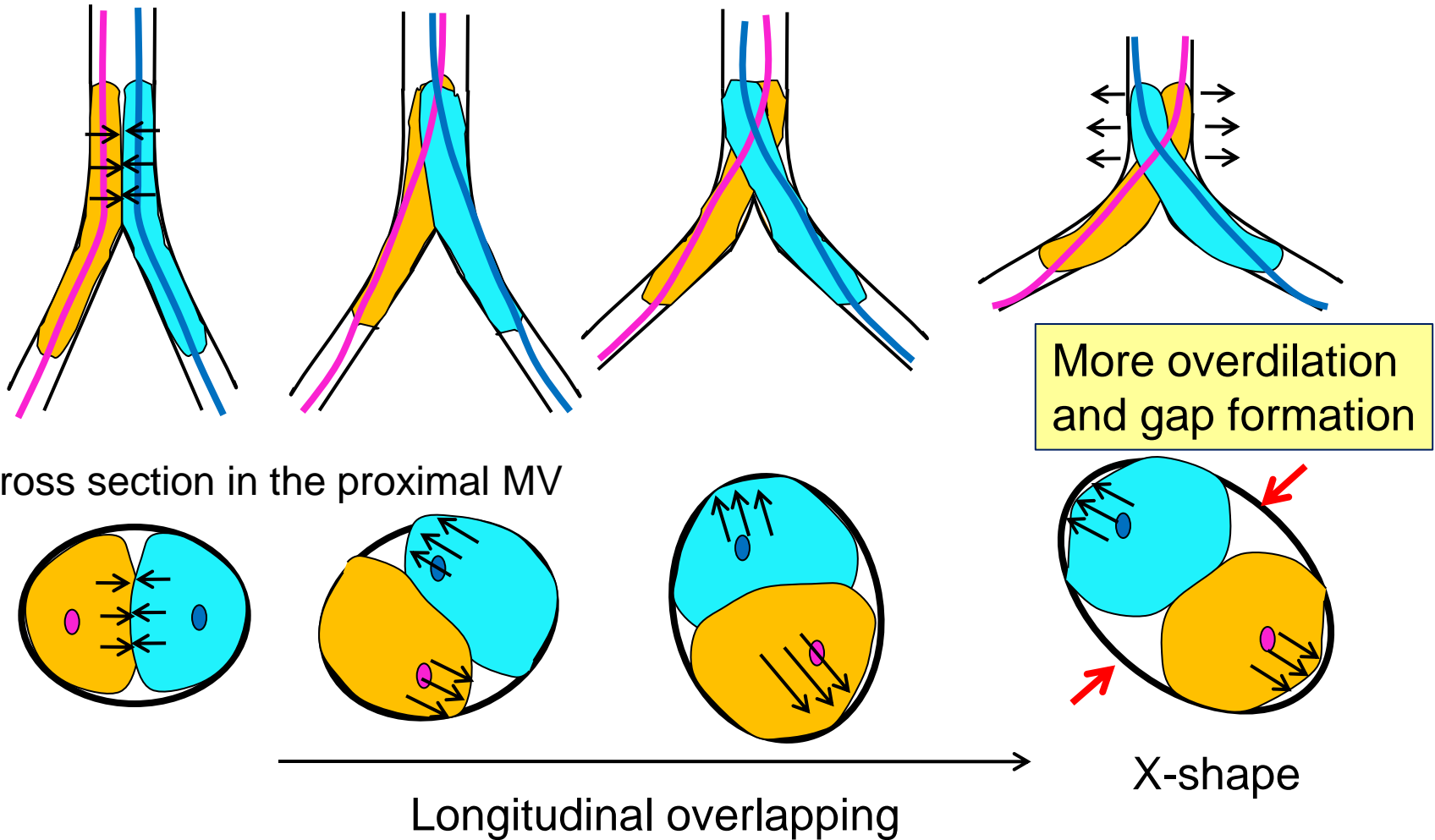


Can we distinguish the real GW crossing point in the clinical setting?



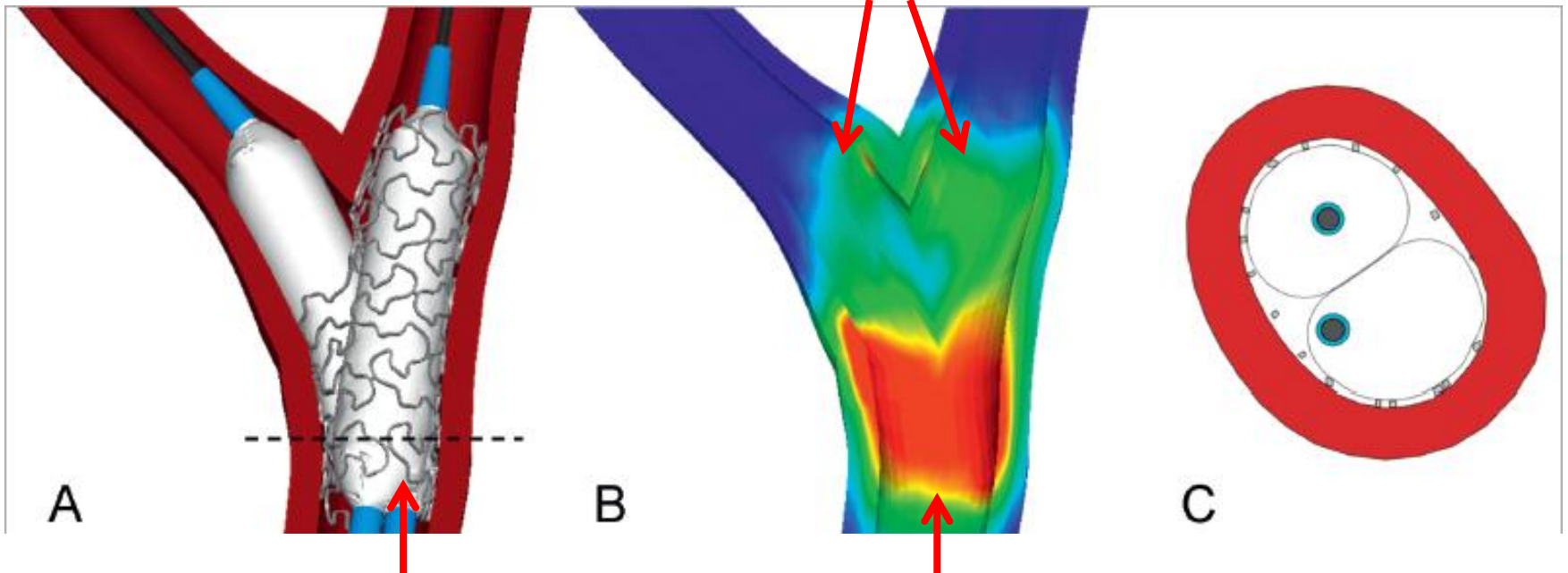
Excessive distal positioning of the GW has a potential risk of stent deformation.

Relationship between bifurcation angle and vessel dilation in the proximal MV



Computer simulation of wall stress during KBI

Low wall stress



A

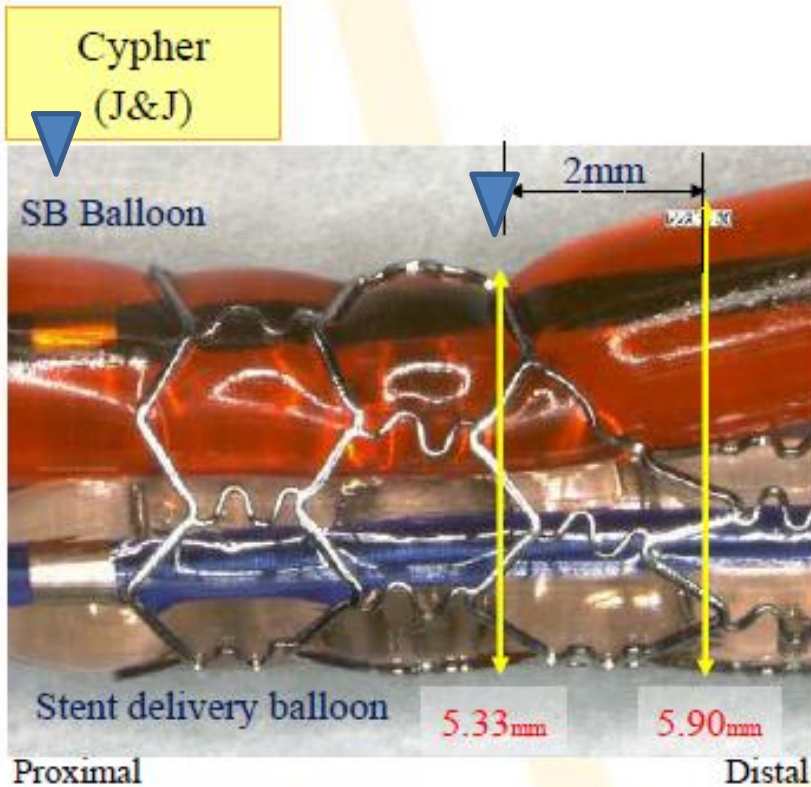
Longitudinal overlapping

B

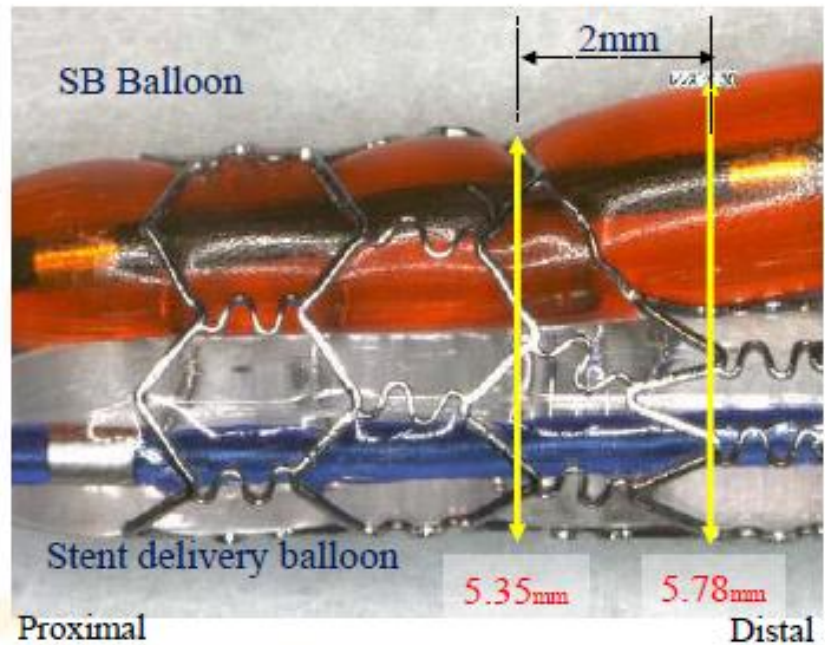
High wall stress may lead to arterial injury.

C

Semi-compliant vs. non-compliant balloon



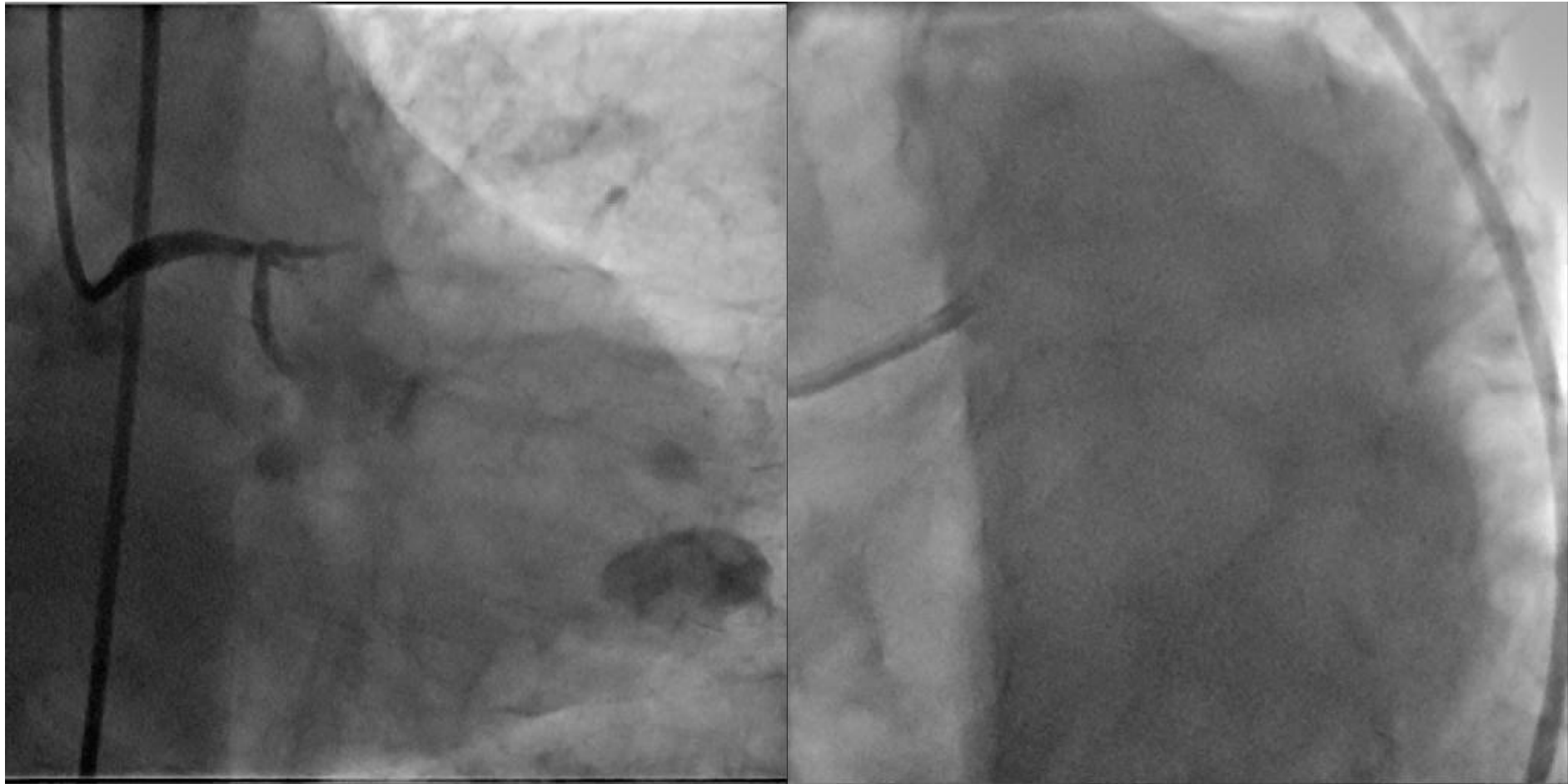
Semi-Compliant Balloon
(Ryujin Plus, Terumo)



Non-Compliant Balloon
(Hiryu, Terumo)

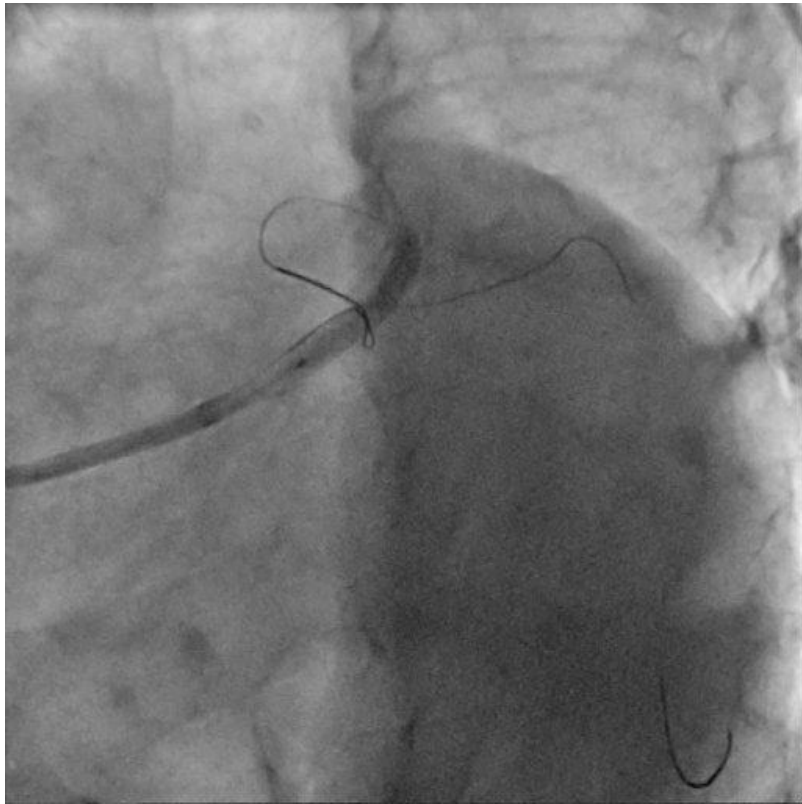
Risk of edge dissection

Case: 78y.o., male, UAP

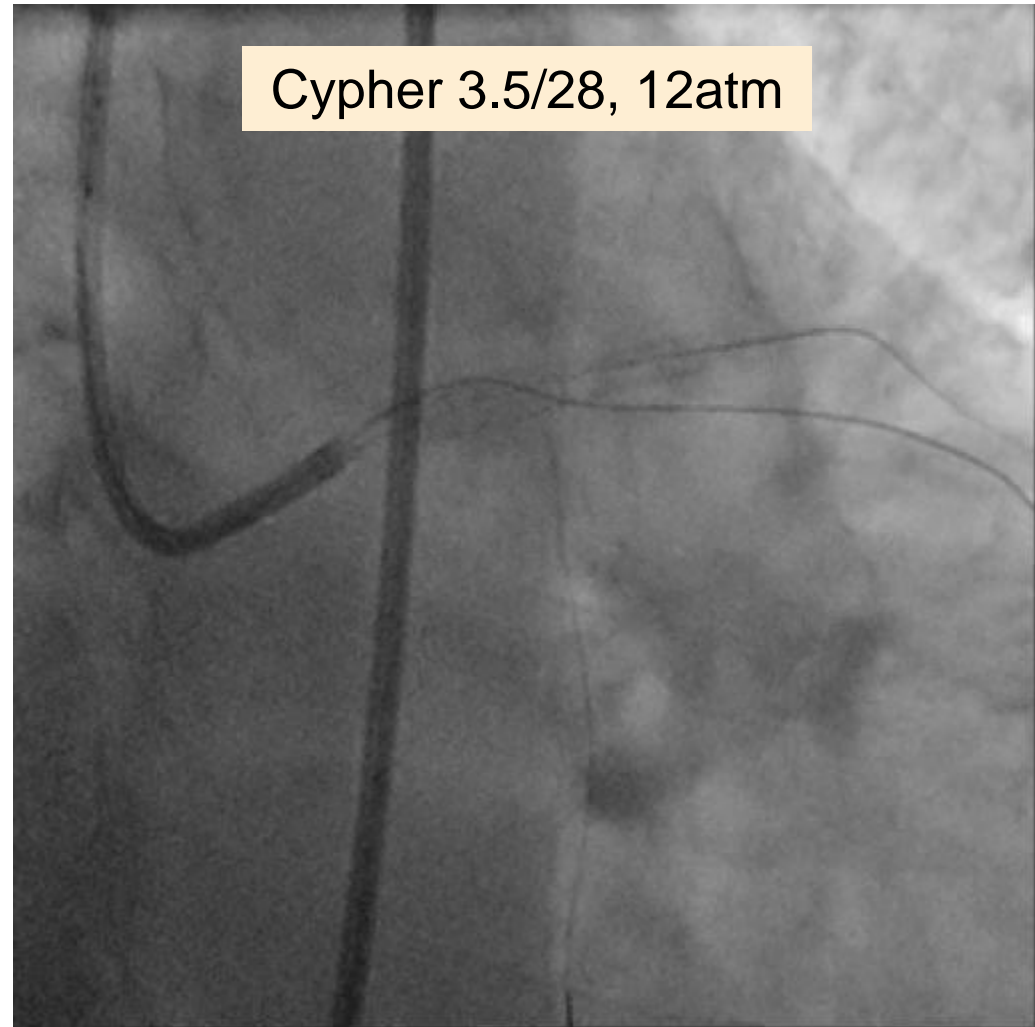


Crossover stenting in LM-LAD

Predilatation



Mercury 2.5/14, 12atm

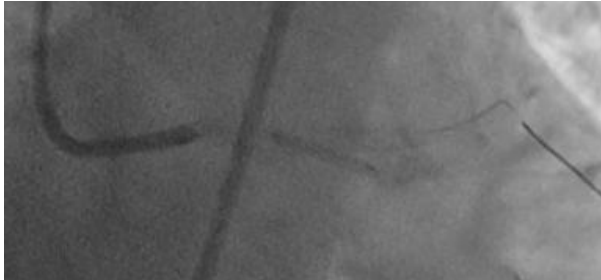


Cypher 3.5/28, 12atm

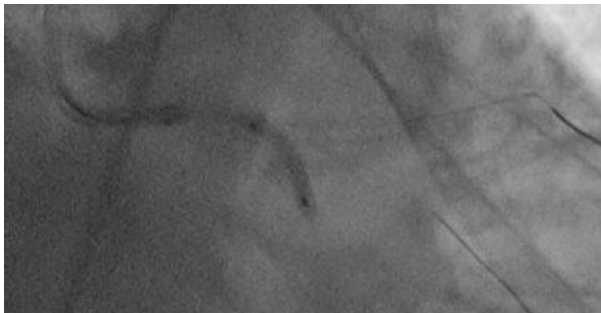
Severe narrowing in LCX and IM due to carina shift

High pressure ballooning in each branch

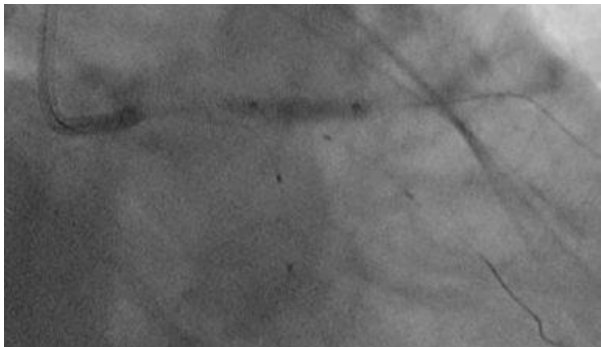
1 IM: Ikazuchi X 2.0/15, 12atm



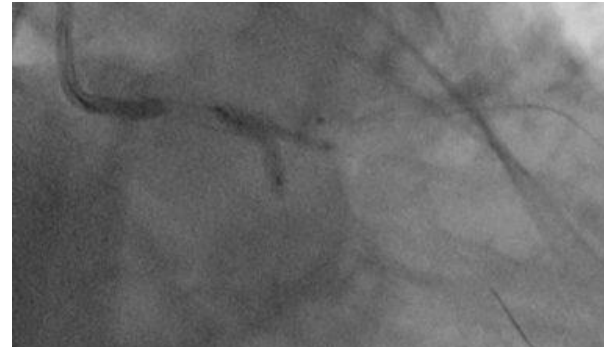
2 LCX: Mercury 2.5/14, 18atm



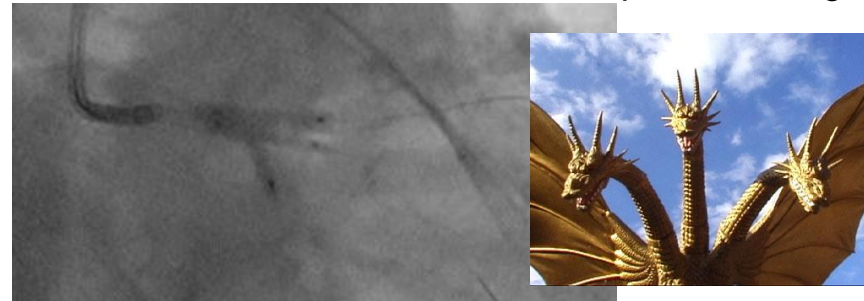
3 LAD: NC Mercury 3.0/15, 20atm



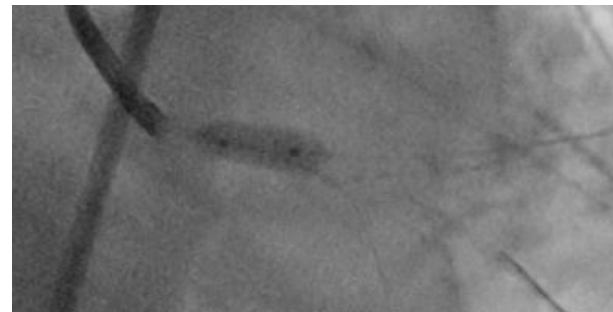
4 KBT between LCX and IM (10atm)



5 **KGT** (6atm) **King Ghidra Technique**,
simultaneous triple ballooning



6 Proximal LMCA ballooning

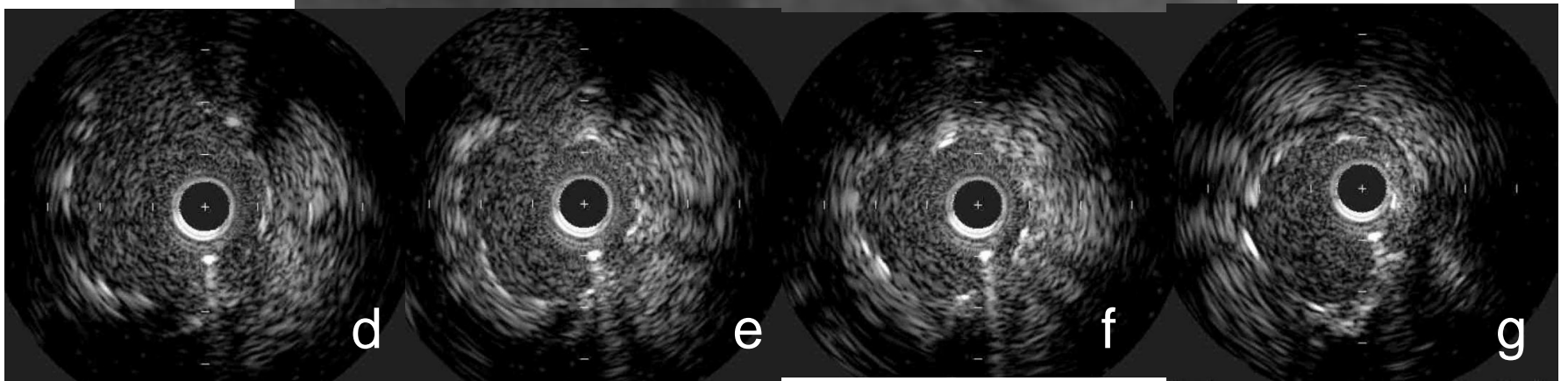
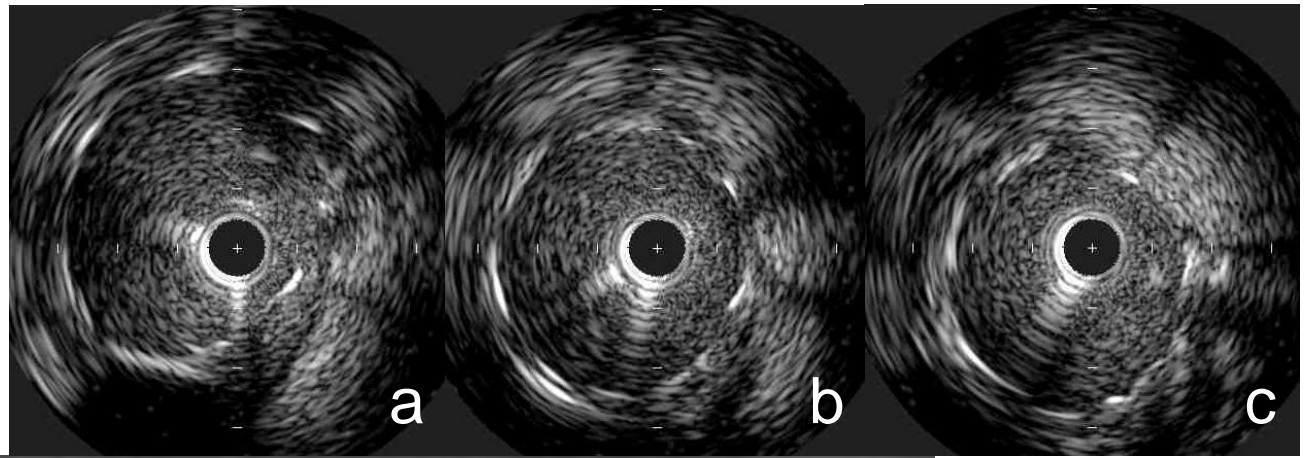


Voyager NC 4.0/8, 20atm

Final CAG

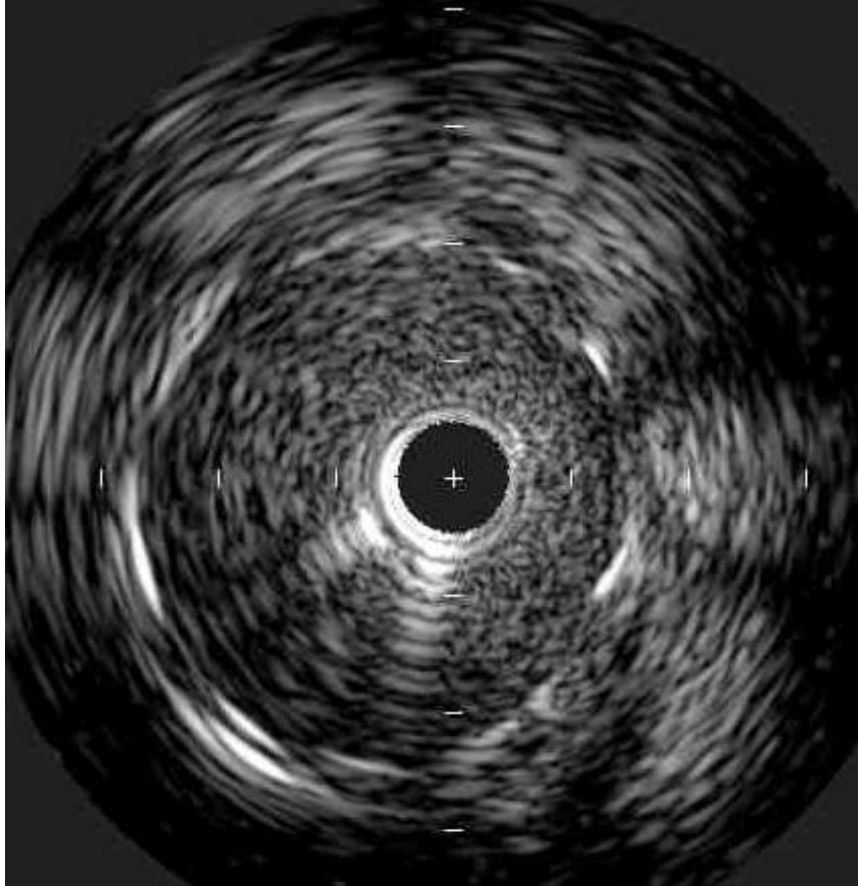


IVUS

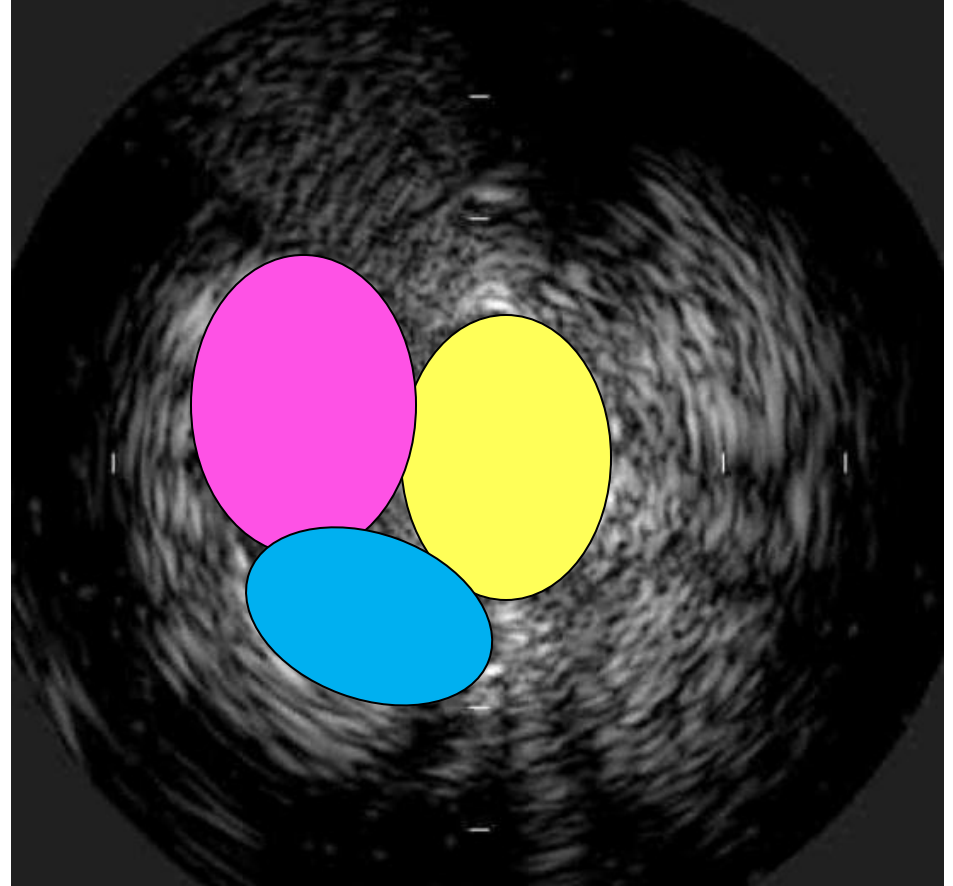


Comparison of stent configuration

Proximal LMCA



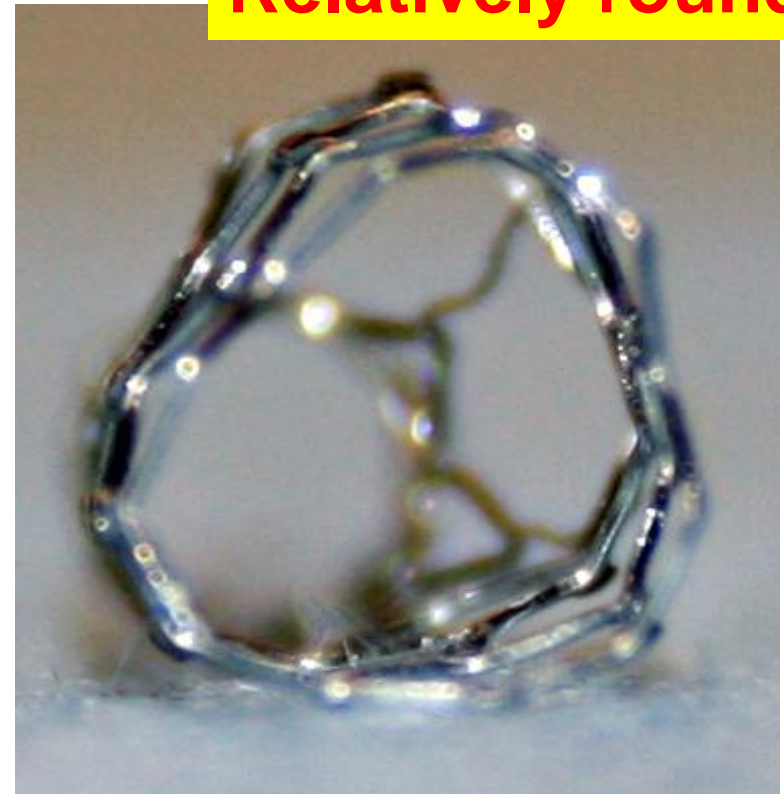
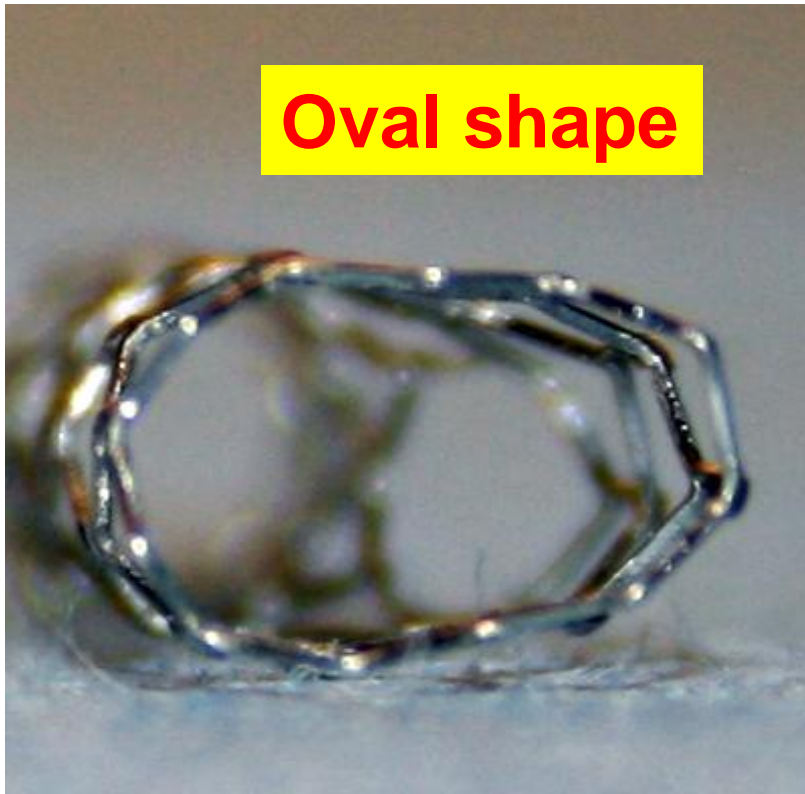
Distal LMCA (KGT site)



Comparison between KBT and KGT

KBT

KGT (triple simultaneous ballooning)



Take home messages (1)

- The KBI is mandatory in the complex 2-stent deployment.
- The efficacy of KBI in the 1-stent strategy is still debatable. Appropriate indication for the SB treatment is necessary.
- Simultaneous triple ballooning in the trifurcation lesion is feasible and effective.

Take home messages (2)

- The following optimal KBI techniques may improve the prognosis.
 - Balloon size should be selected according to the vascular branching laws.
 - Minimal balloon overlapping prevents deformation or overdilation of the proximal MV stent.
 - Stepwise ballooning is ideal for adequate expansion of the SB.
 - Distal position of the SB GW recrossing is preferable, however, excessive distal positioning of the GW has a potential risk of stent deformation.



**Be a good kisser!
Thank you for your
attention.**

Kimt G, Kuss