

TCTAP Fellowship Course

" Left Main & Bifurcation: From Accurate Diagnosis to Treatment"

Lessons of Bifurcation Stenting from the Bench Test

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Disclosure

- There is no conflict of interest.

Why is bench testing necessary for the bifurcation intervention?

- Stent distortion
- Scaffolding, gap formation



9 Bench Testing of Coronary Bifurcation Stenting Techniques: How Is It Done? Does It Help Technical Decision Making?

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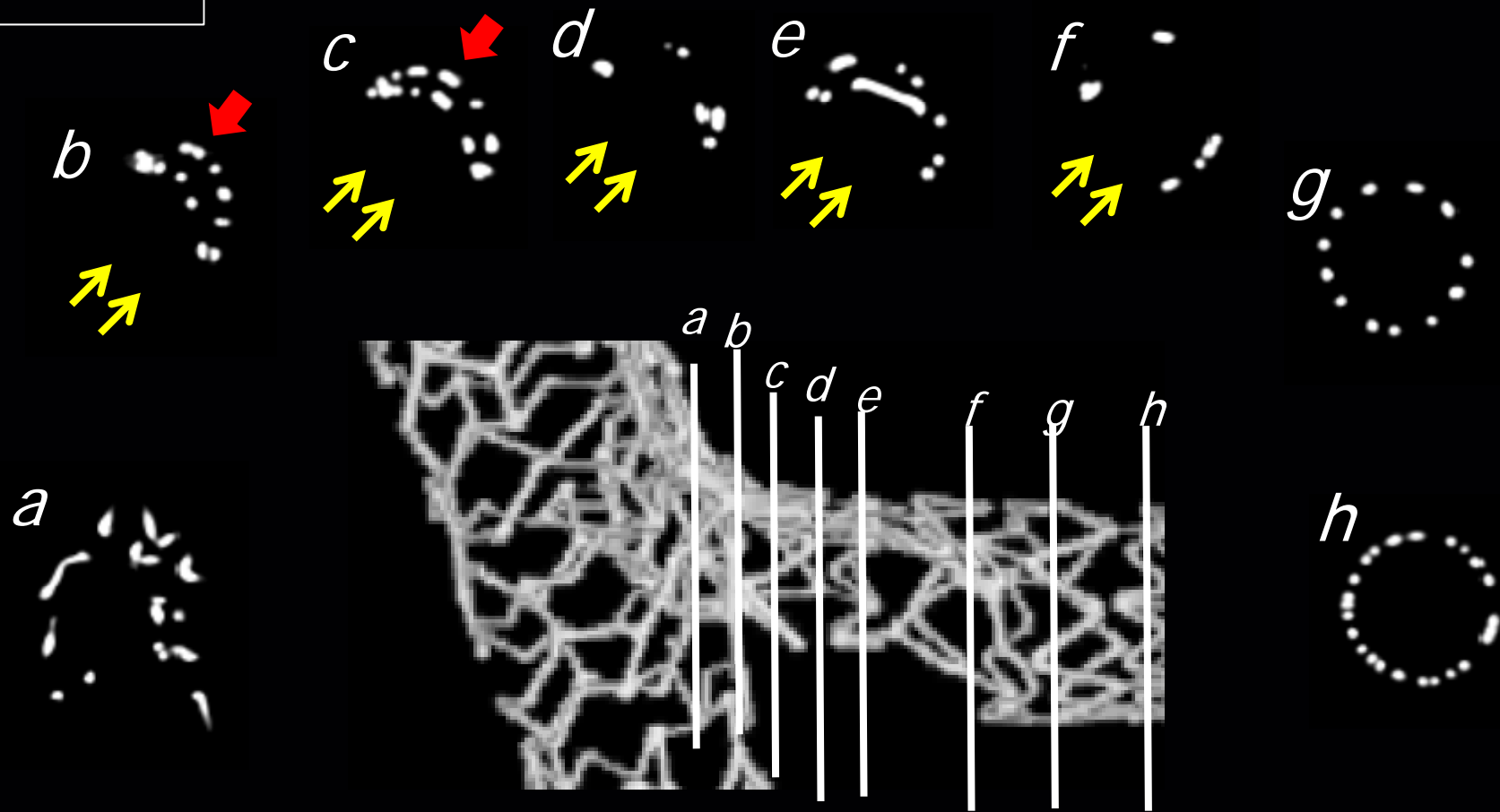
Colombo A, Moussa I, “Tips and Tricks in Interventional Therapy of Coronary Bifurcation Lesions”

WHY IS BENCH TESTING OF CORONARY BIFURCATION STENTING TECHNIQUES IMPORTANT?

PCI for coronary bifurcation lesions has been associated with high restenosis rates in the bare metal stent (BMS) era (1); however, the introduction of drug-eluting stents (DES) have led to significant reduction in restenosis and target lesion revascularization in bifurcation lesions

Comparison in resolution for bifurcation analysis

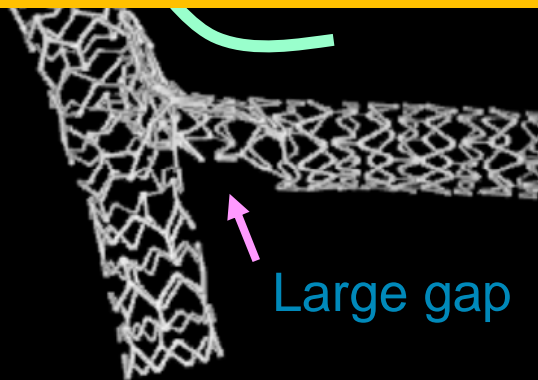
MFCT



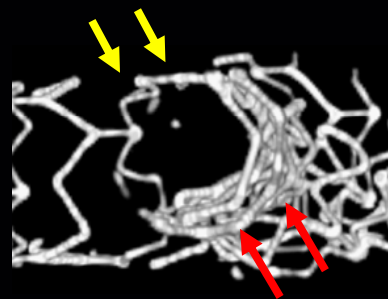
IVUS

Absence of strut?

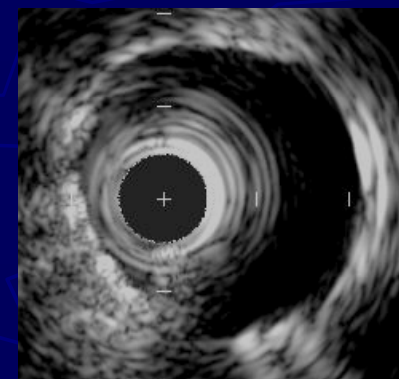
IVUS does not have a good enough resolution to analyze SB ostium accurately compared with MFCT images.



Large gap

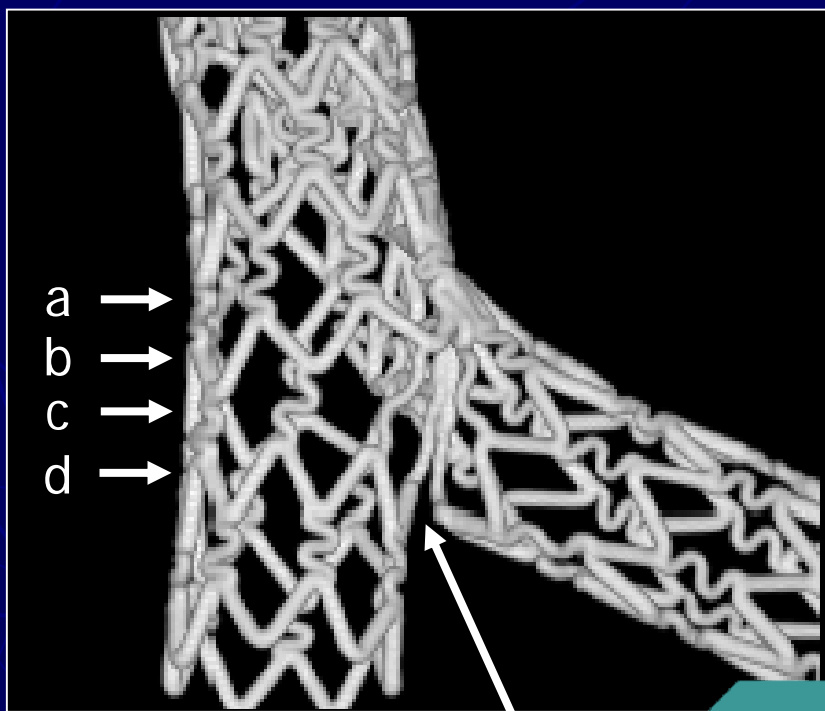


Micro focus CT

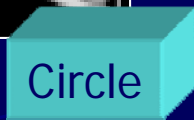


Crush stenting with Bx Velocity

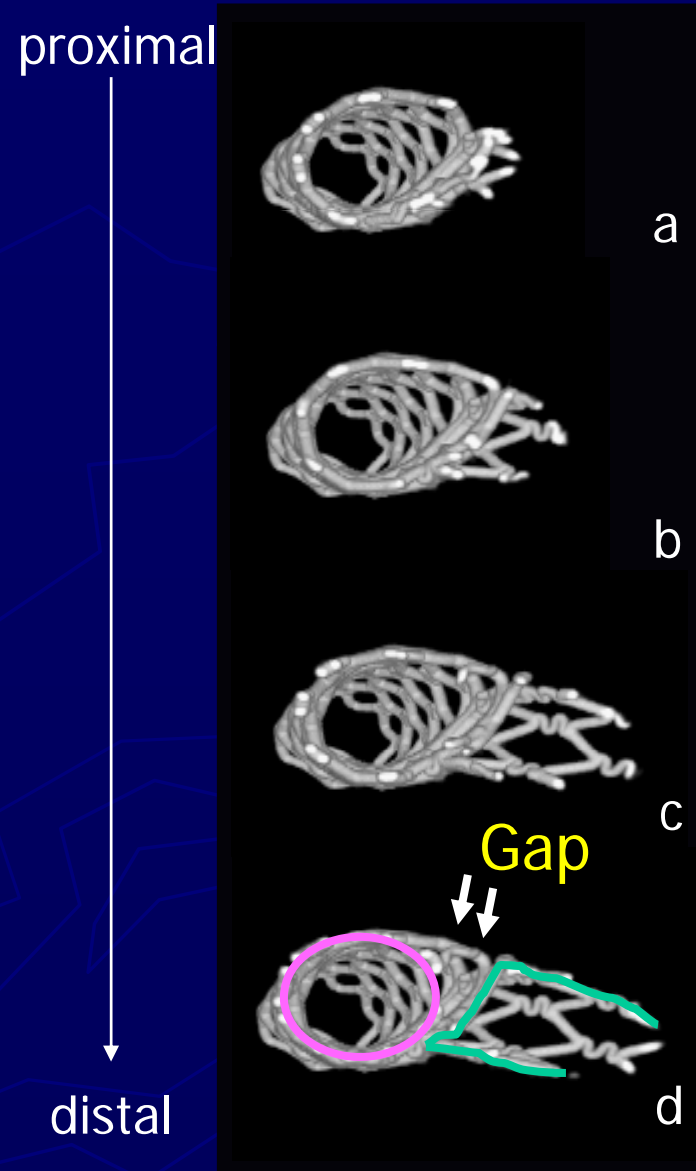
(1) LAD stent over LCX stent



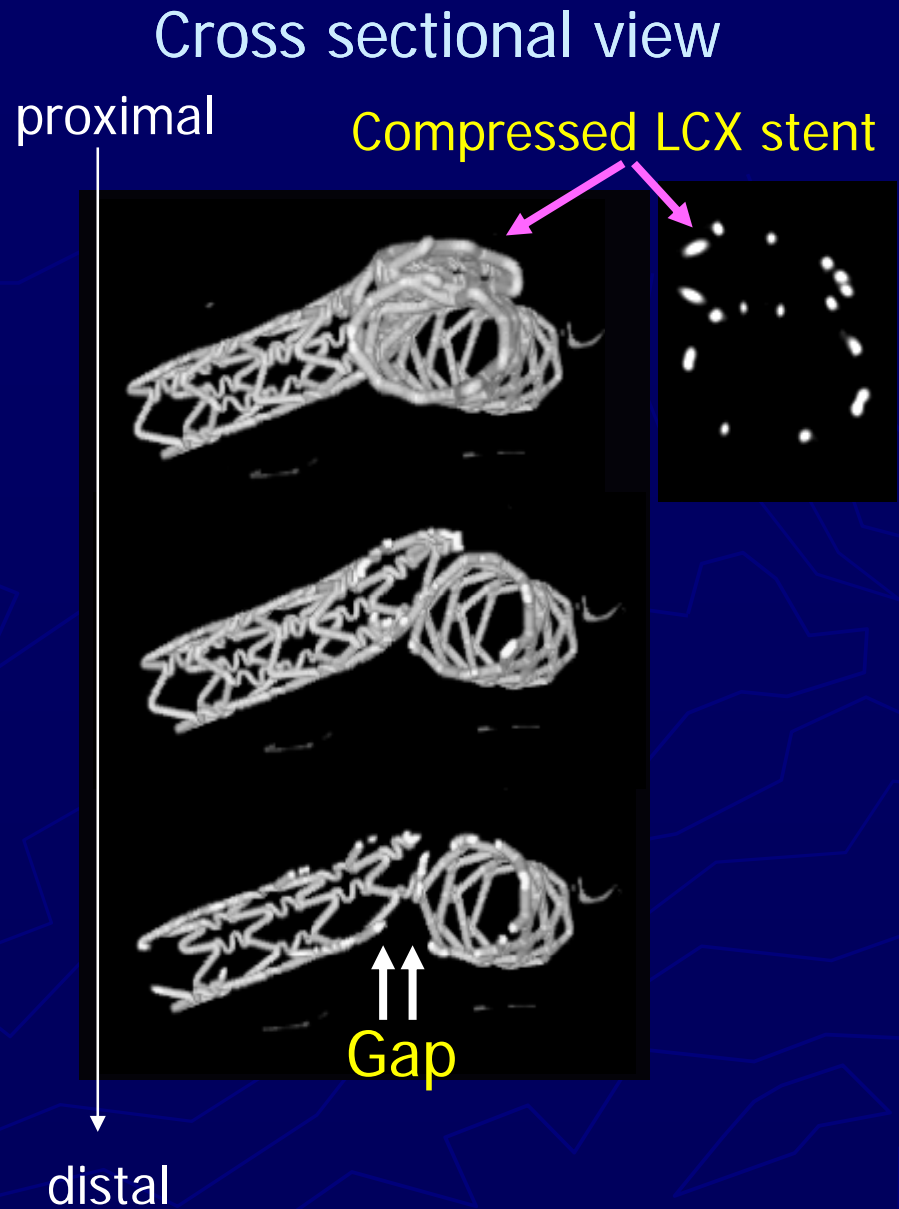
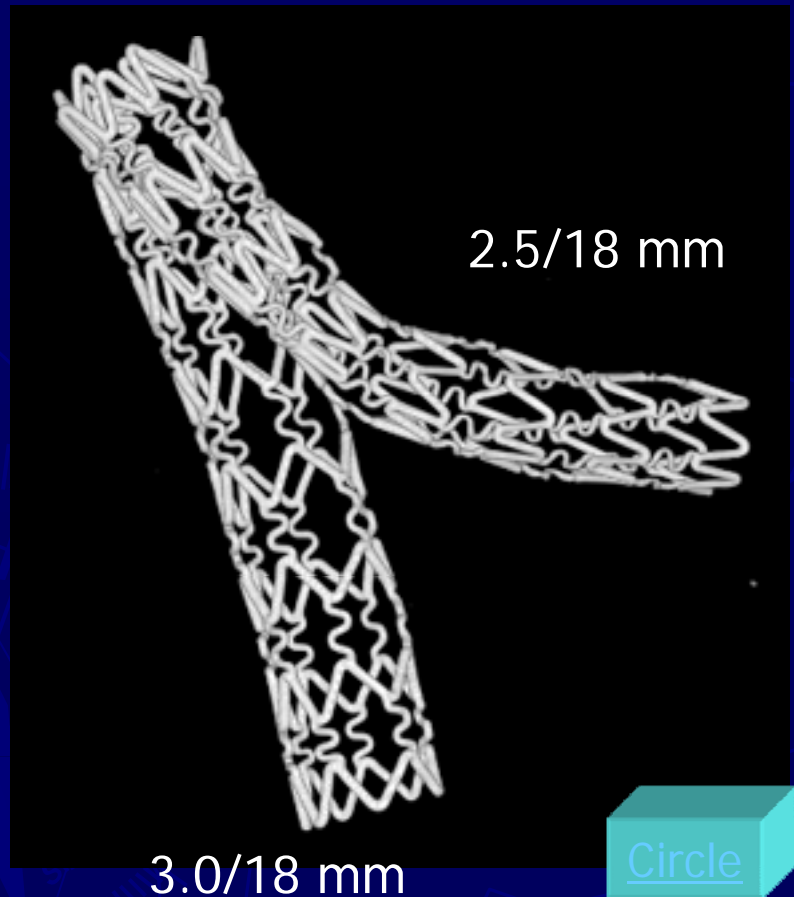
Gap between the two stents



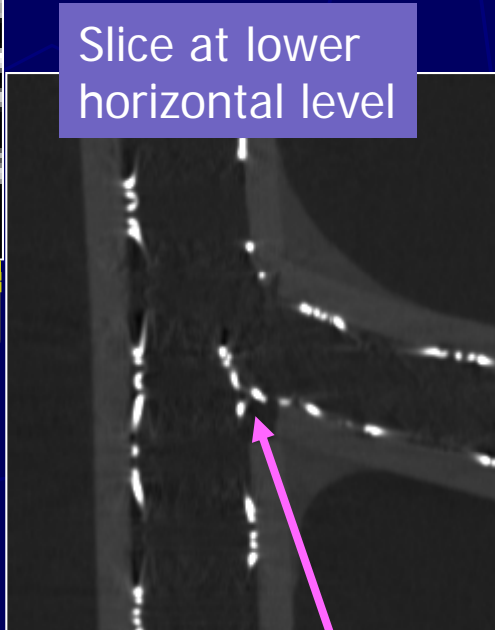
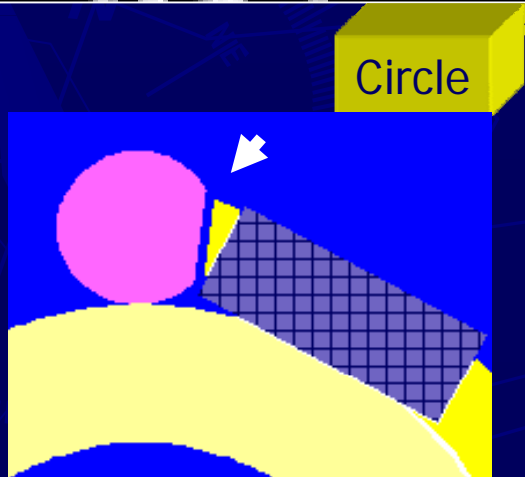
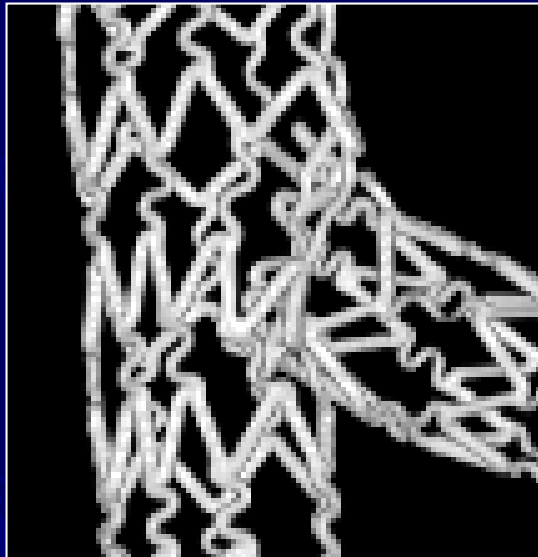
Cross sectional view



Kissing stenting

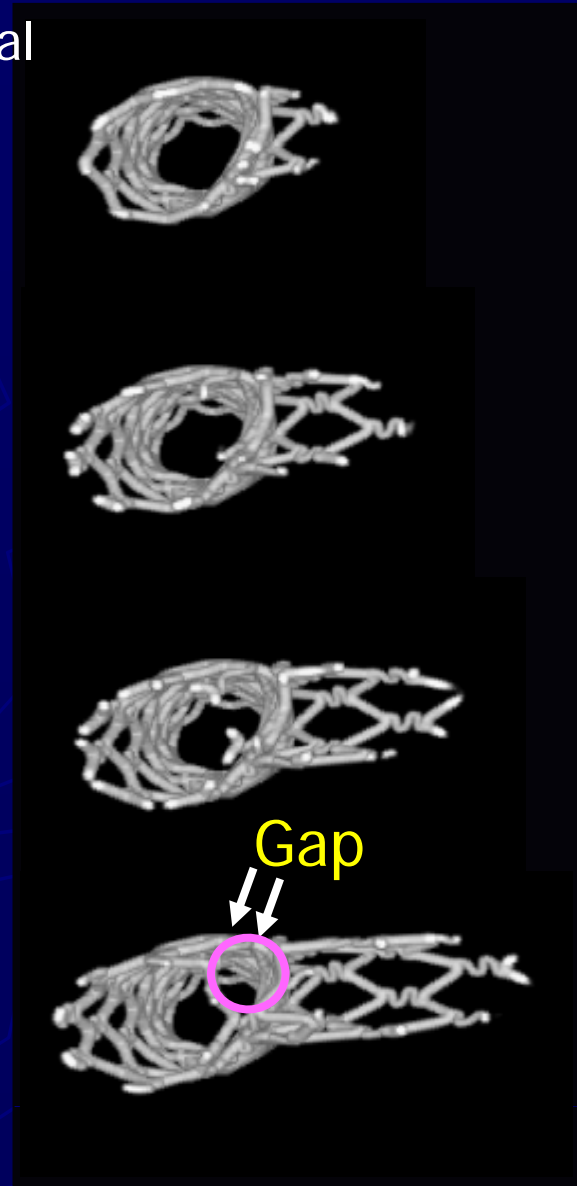


Modified T-stenting



Cross sectional view

proximal



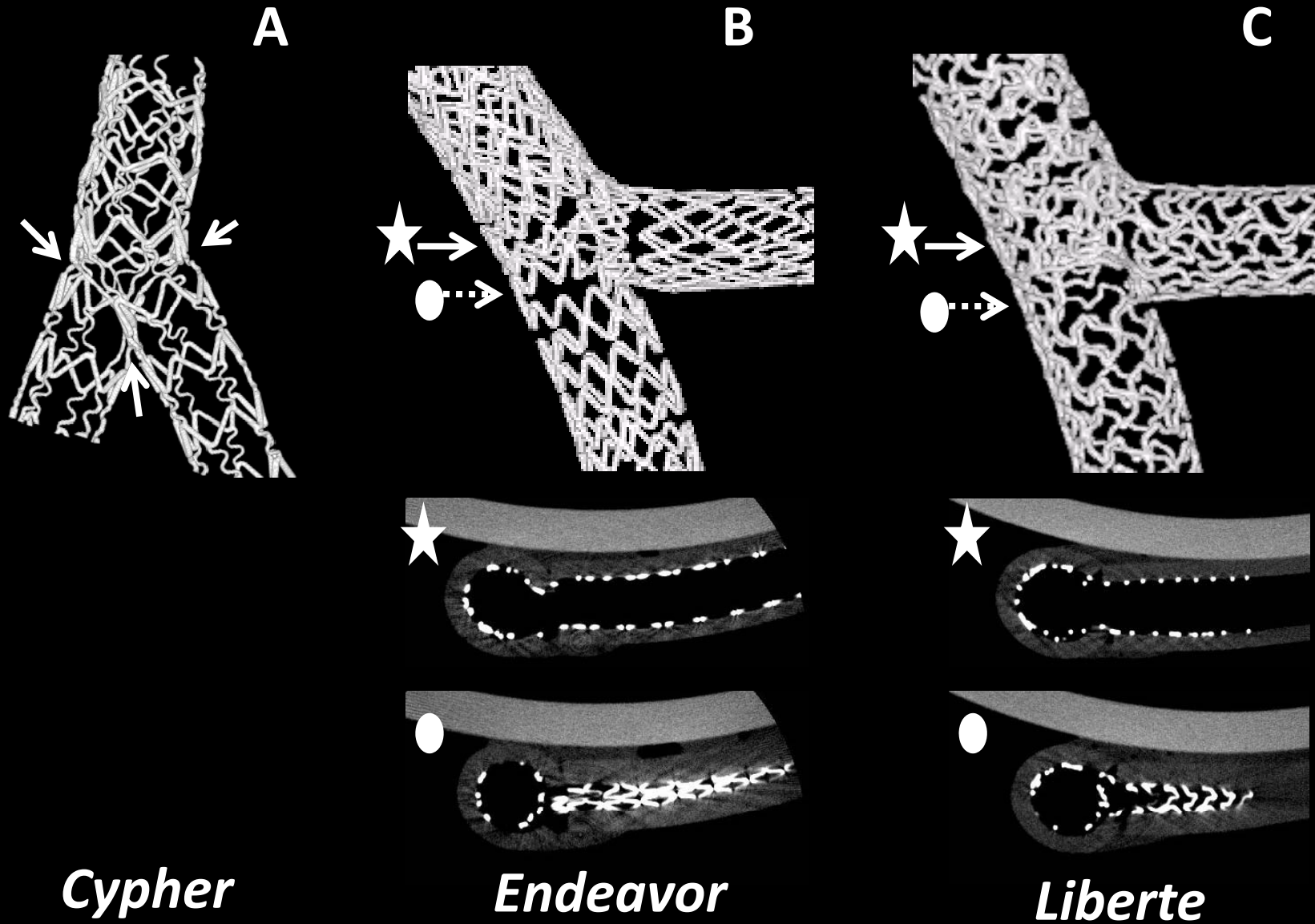
Gap

distal

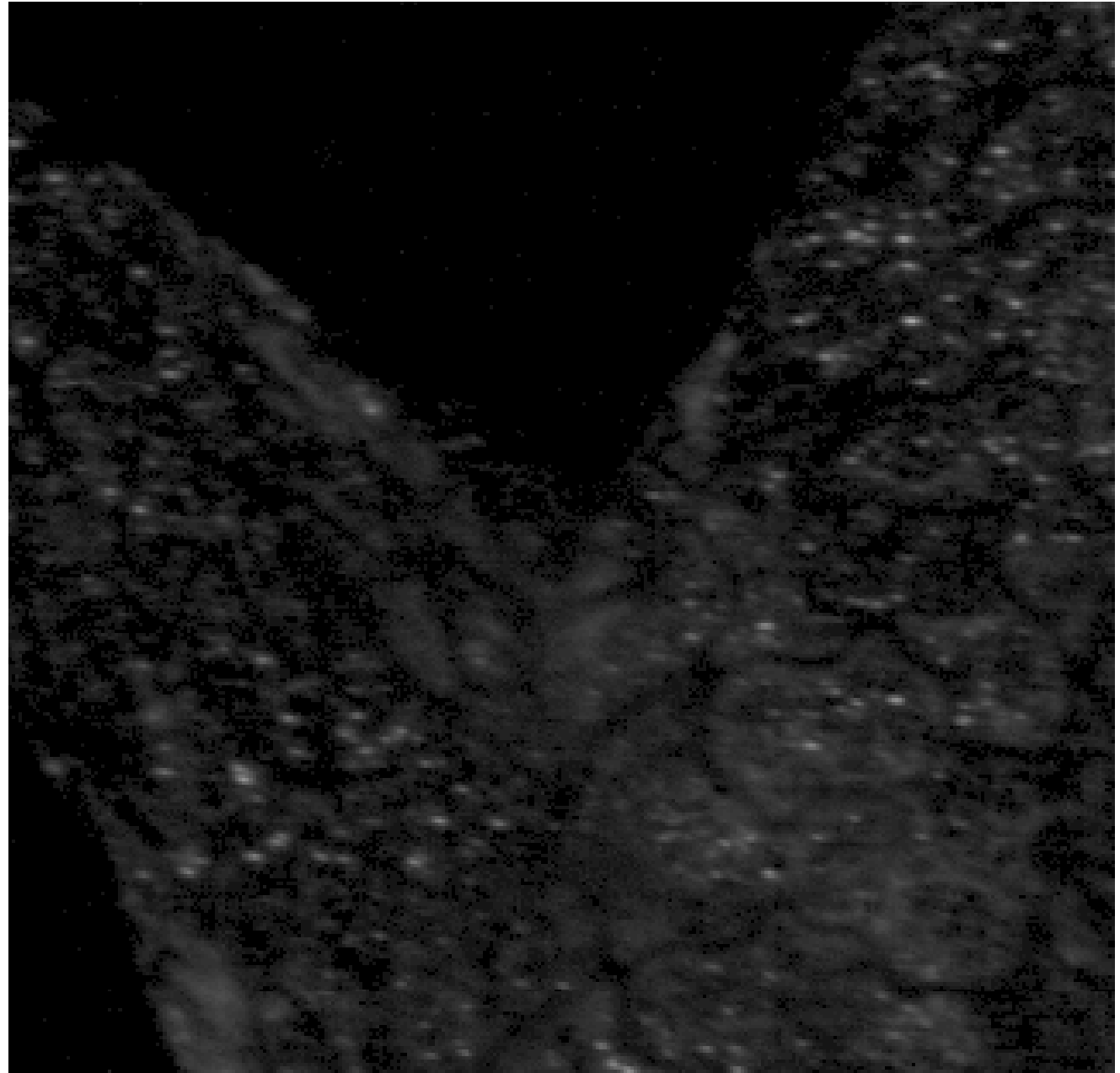
Metallic carina

Culotte stenting

Murasato Y, Colombo A, Moussa I, Tips and Tricks in Interventional Therapy of Coronary Bifurcation Lesions



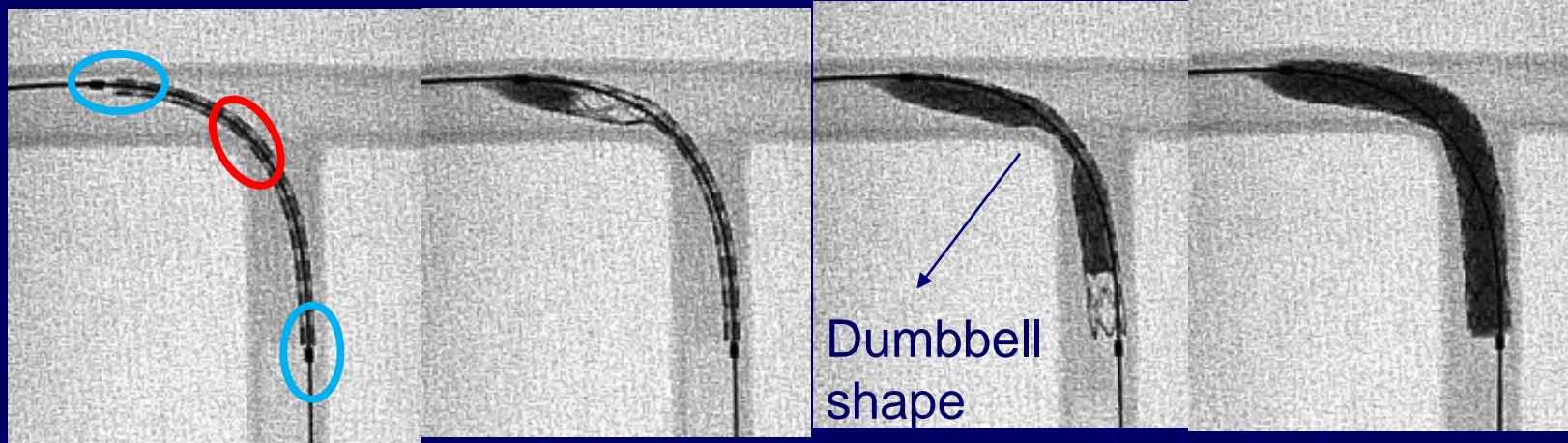
**Flow retardation
in carina after
Culotte stenting**



Murasato Y, Iwasaki K et al. J Interv Cardiol, 2010

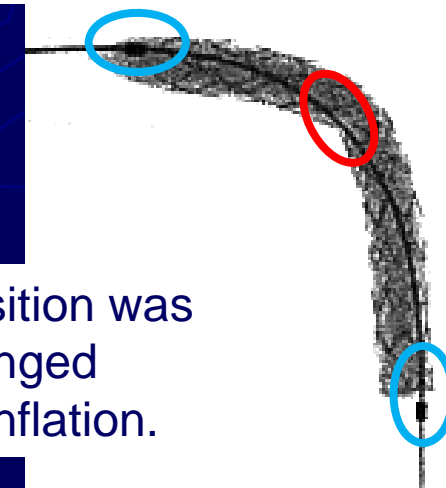
Side branch stenting from main vessel (1)

Right bifurcation angle

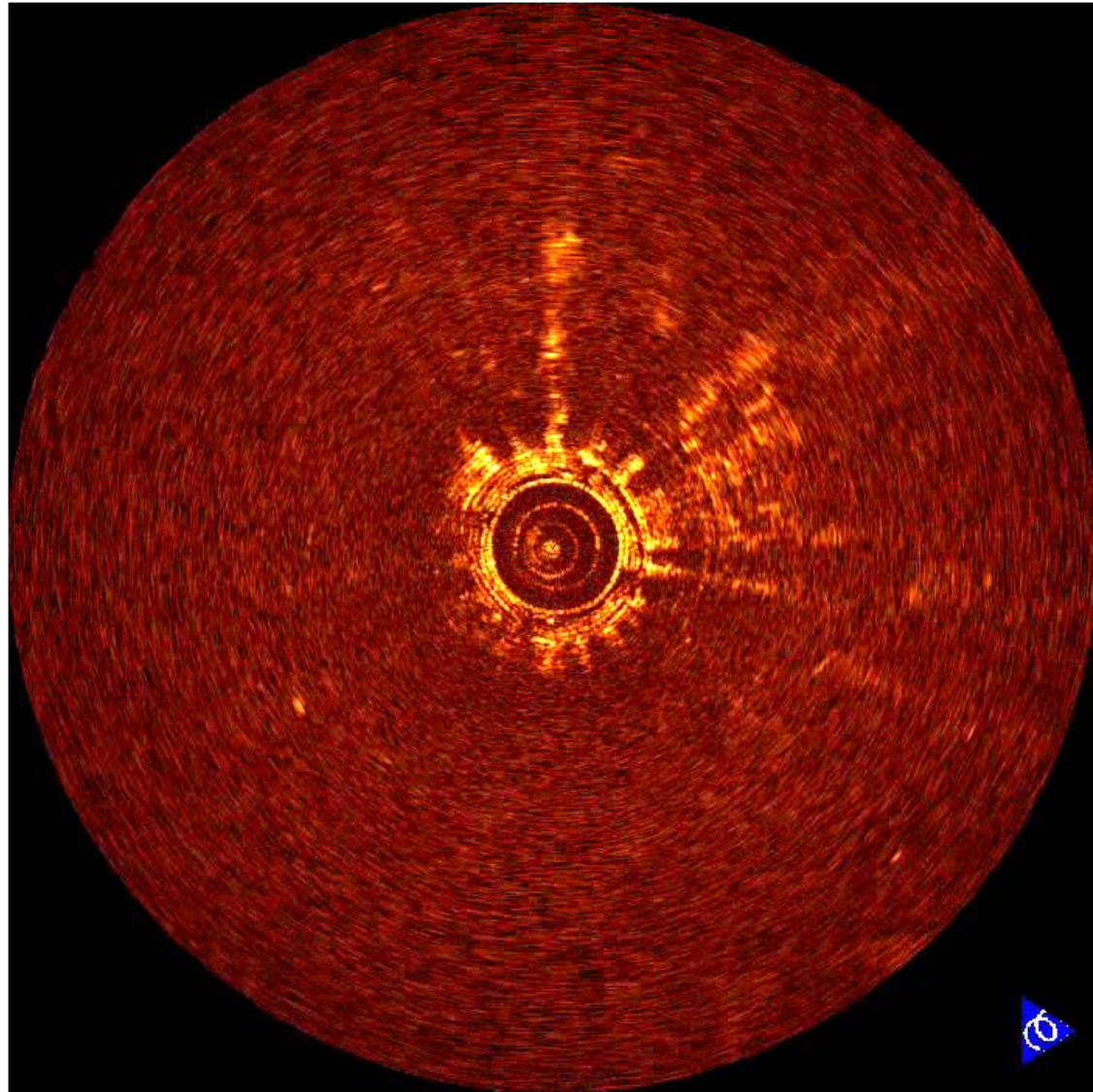
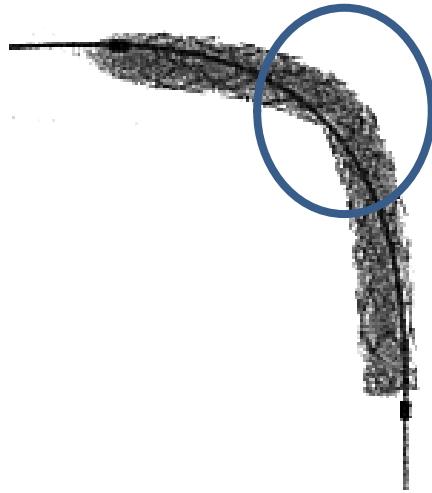


Maximal inflation pressure

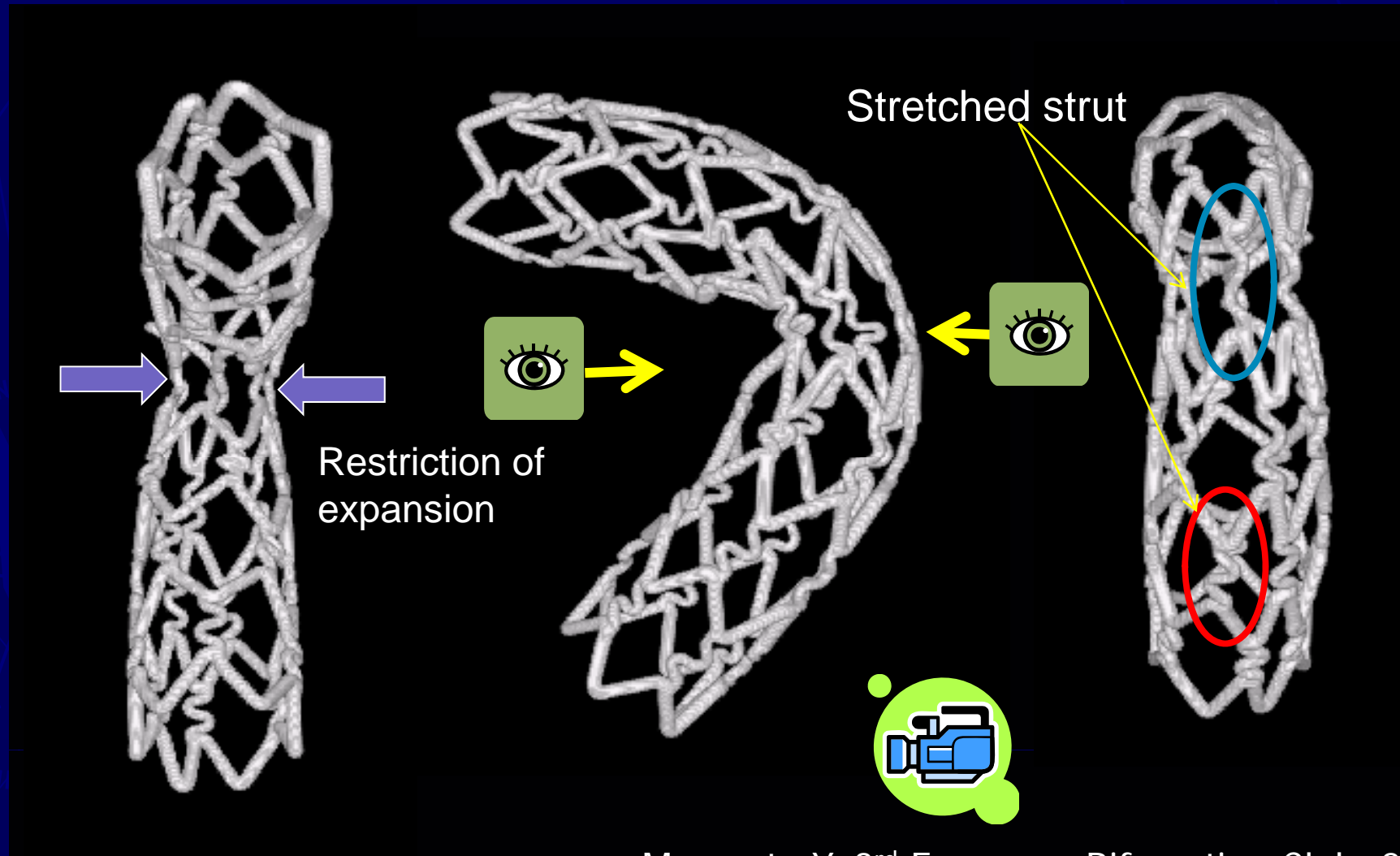
GW position was not changed during inflation.



Deviated position of the GW during balloon dilation in the right-angled bifurcation



Distortion of Bx Velocity stent deployed at extreme angle

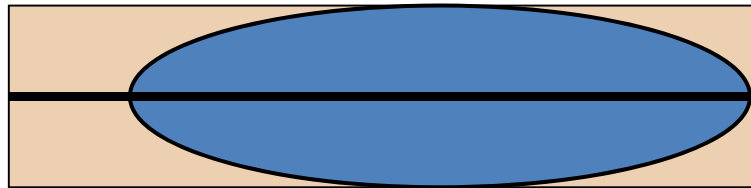


Potential problem with stenting from LMCA to LCX

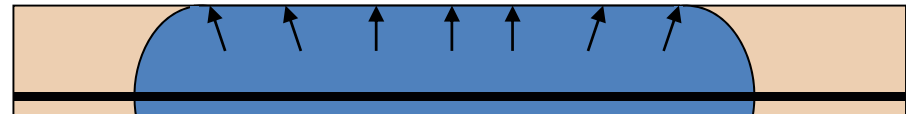
Murasato Y, Colombo A, Moussa I, Tips and Tricks in Interventional Therapy of Coronary Bifurcation Lesions

Straight vessel

a. Initial phase of inflation



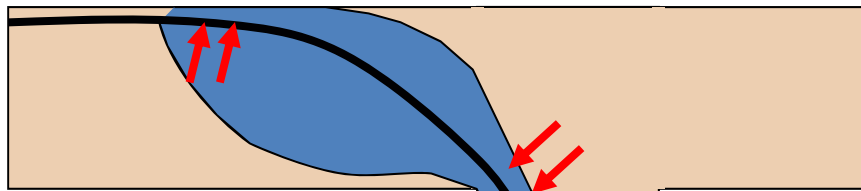
b. Maximal inflation pressure



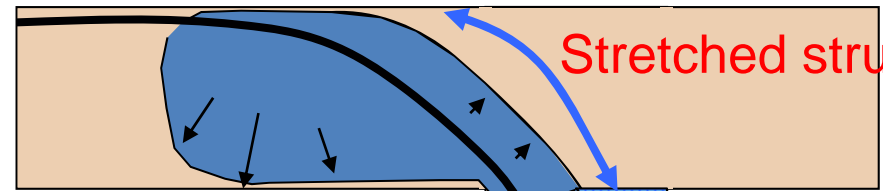
Hinge motion may cause fracturing in the structure of the stretched struts of the LCX stent at the ostium.

LMCA bifurcation

a.



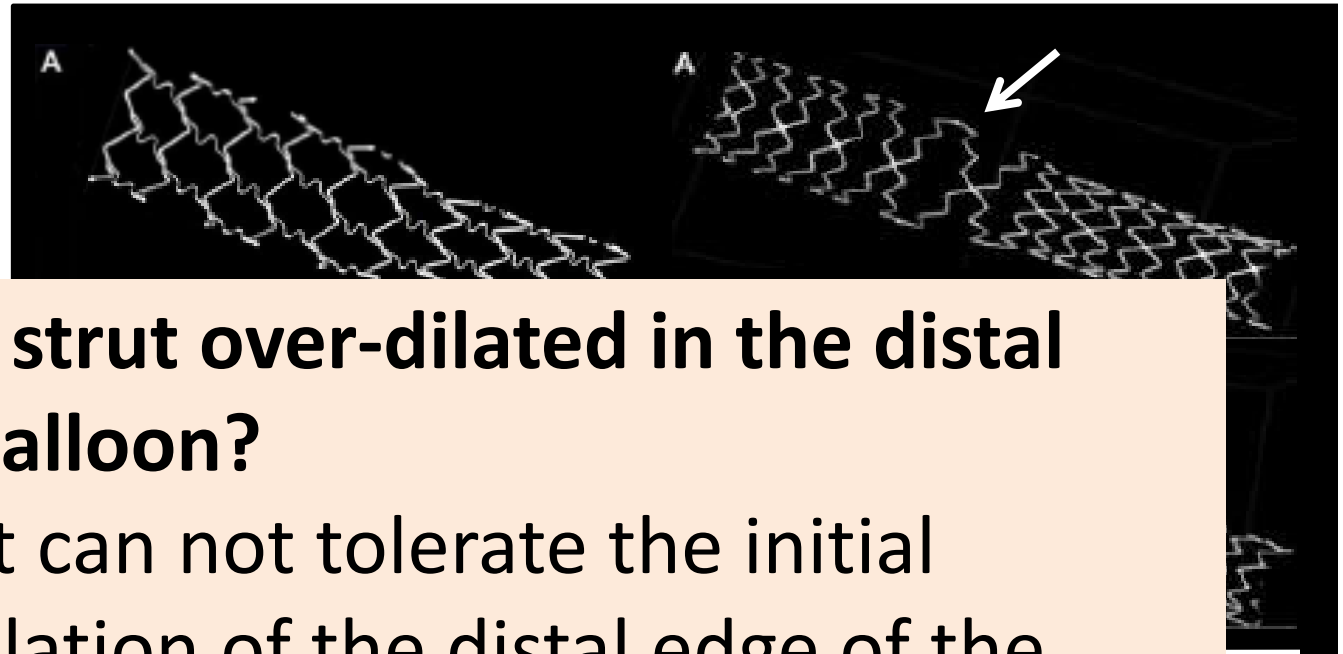
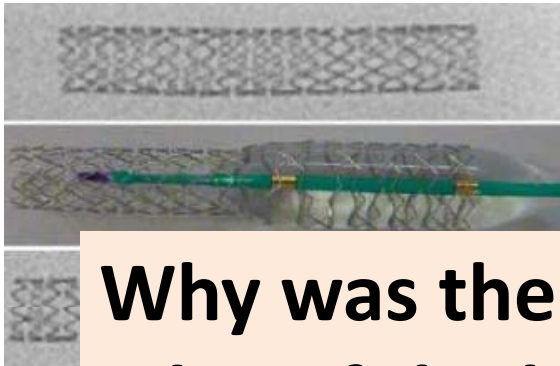
GW position:
 proximal: outside
 middle: inside
 distal: outside
 Balloon: Dumbbell shape



GW position: no change
 Balloon dilatation:
 less uniform
 proximal: overdilatation
 middle: restricted
 distal: overdilatation
 Gap: side branch ostium

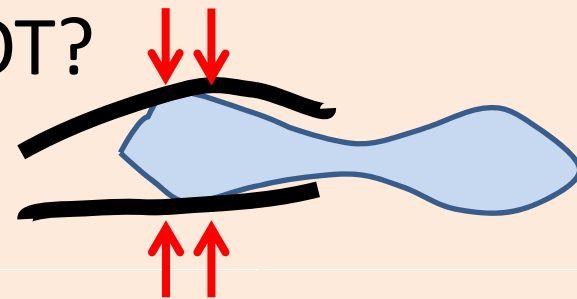
Gap

Strut deformation induced by partial over-sized dilation



Why was the strut over-dilated in the distal edge of the balloon?

- 2-link stent can not tolerate the initial extreme dilation of the distal edge of the balloon (dog-bone phenomenon).
- 2-link stent: not ideal for POT?



prox. → dist.

prox. → dist.

prox. → dist.

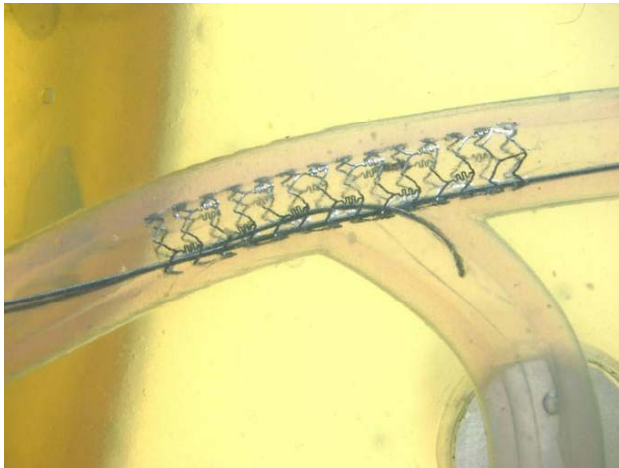
prox. → dist.

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

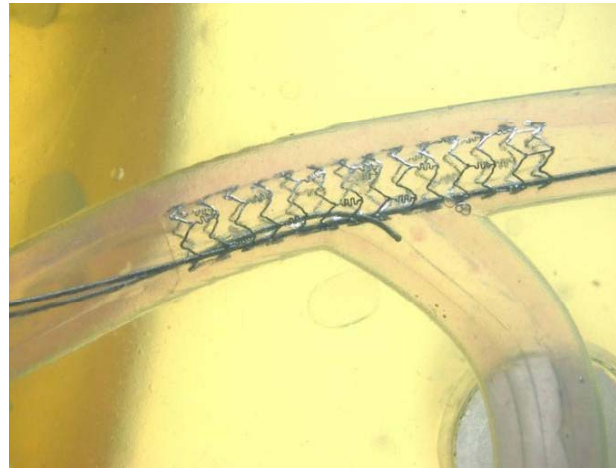
Murasato Y, Colombo A, Moussa I

“Tips and Tricks in Interventional Therapy of Coronary Bifurcation Lesions

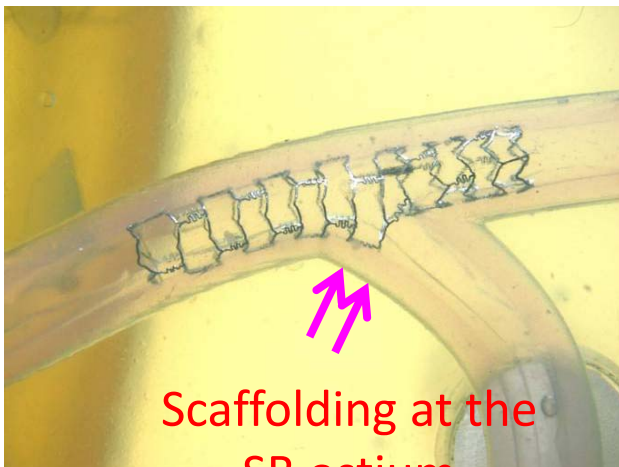
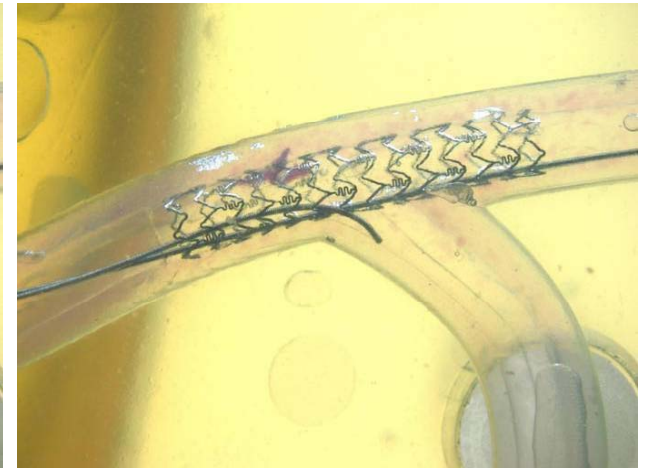
Distal strut



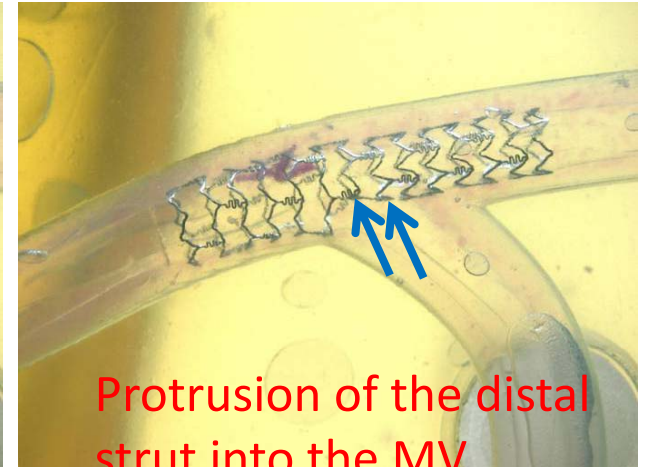
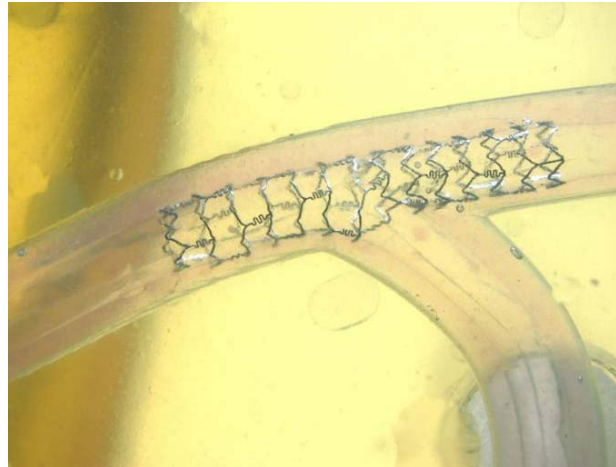
Mid strut



Proximal strut



Scaffolding at the
SB ostium

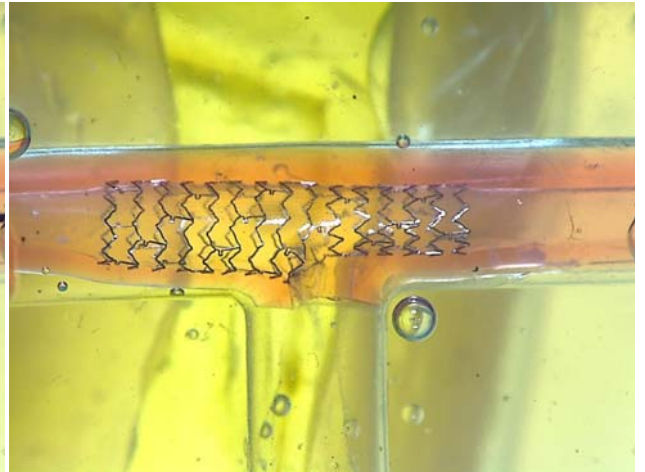
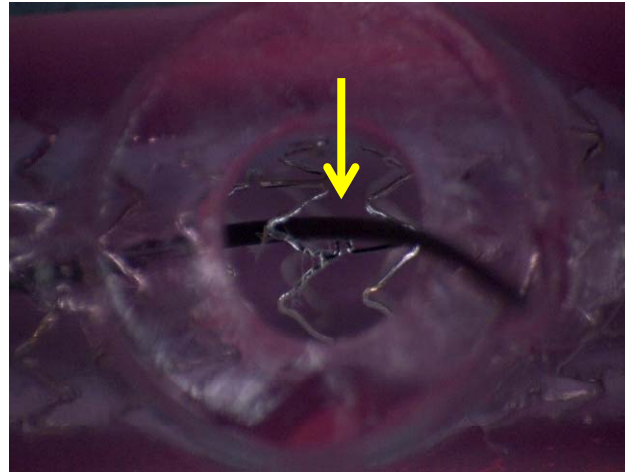
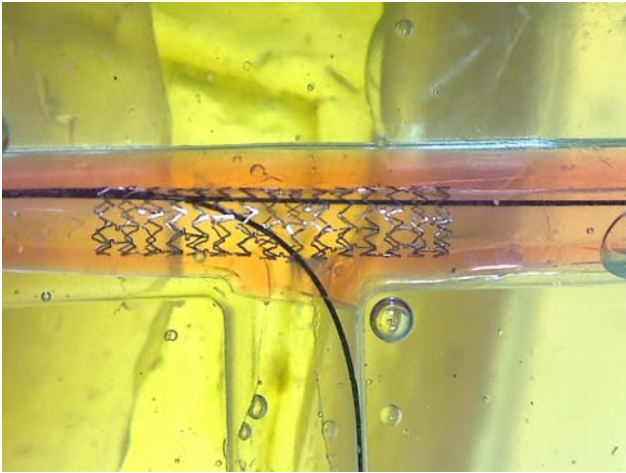


Protrusion of the distal
strut into the MV

GW recross position

Central cell

Distal cell

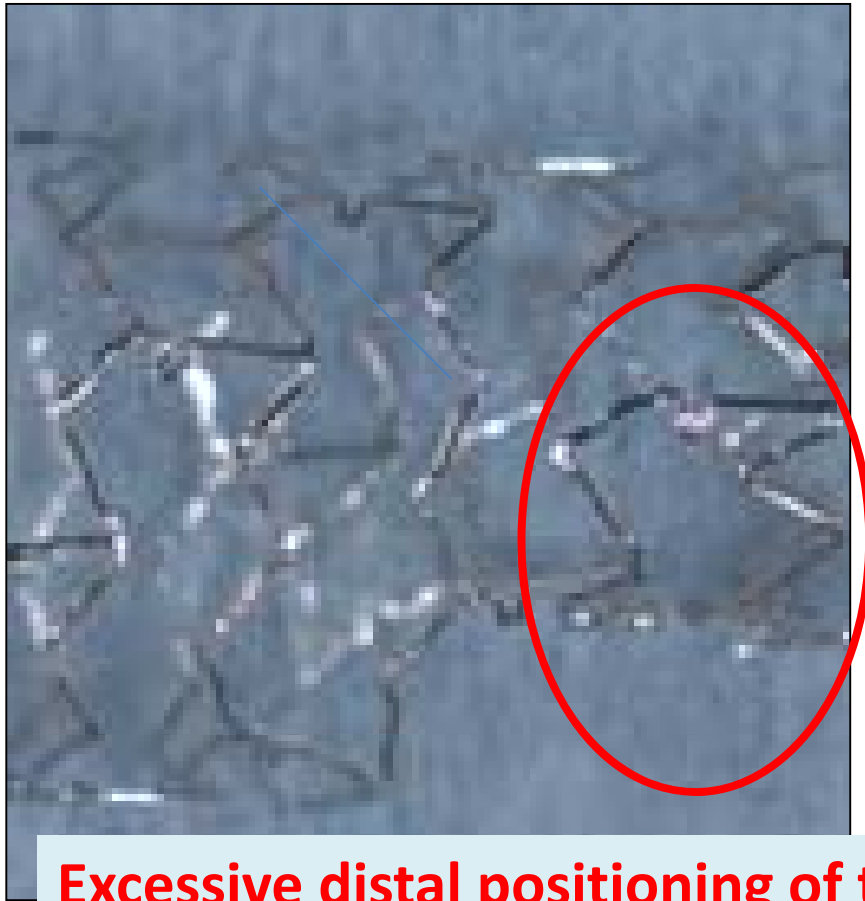


Central cell

Distal cell

Severe deformation
of the proximal cell

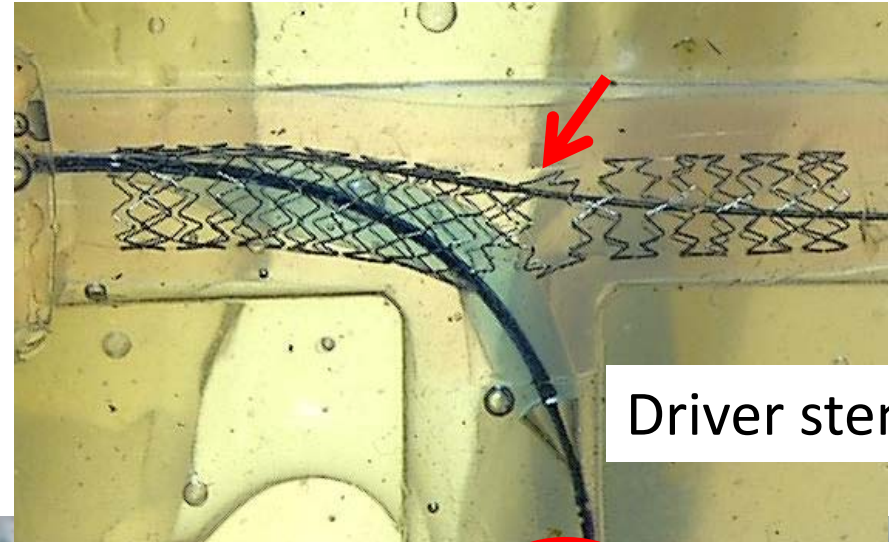
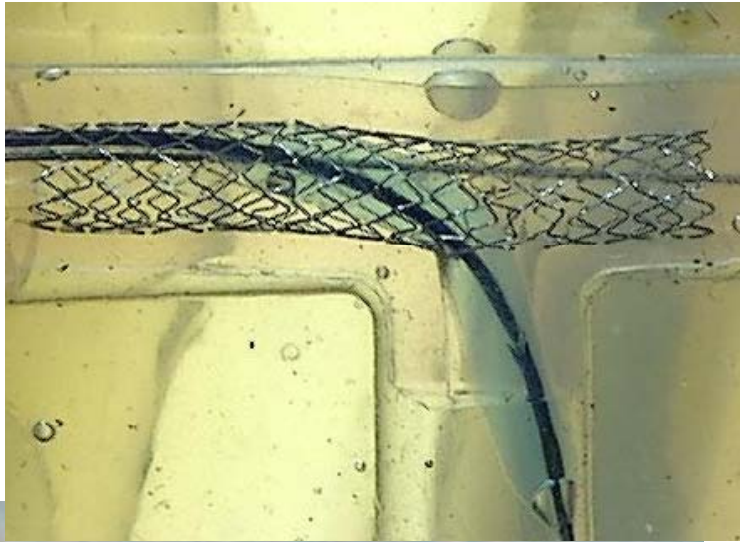
Stretched expansion
of the distal cell



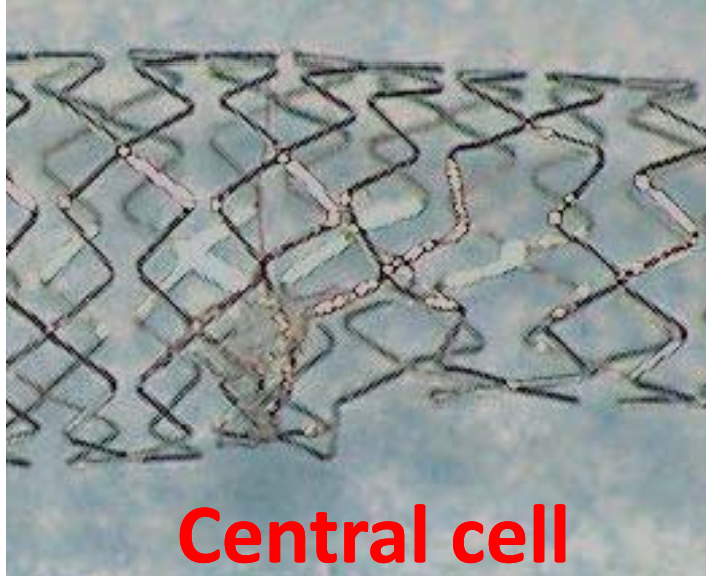
Excessive distal positioning of the GW has a potential risk of stent deformation.

ML Vision stent

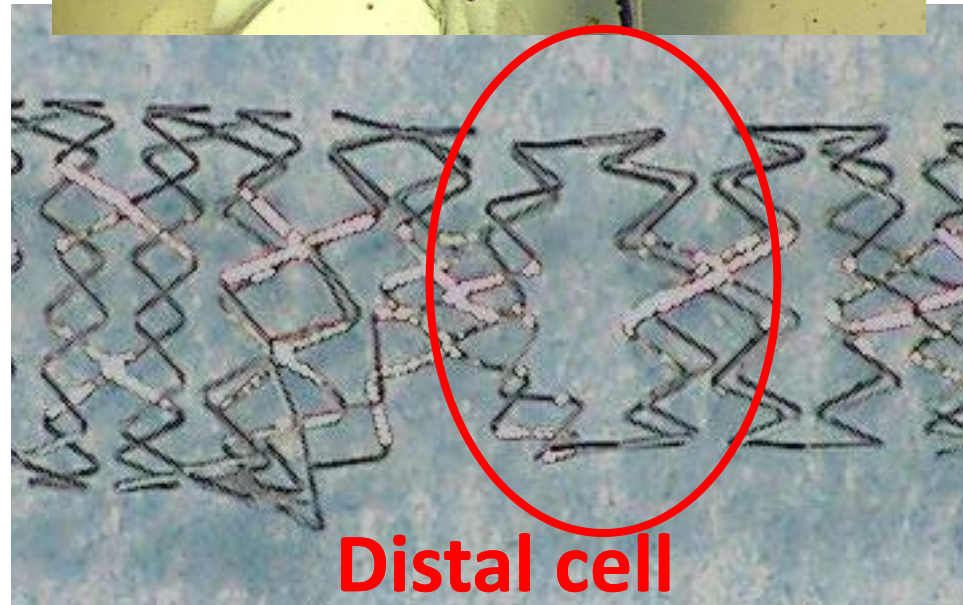
More serious stent deformation in 2-link stent with the GW crossed through the extremely distal cell



Driver stent

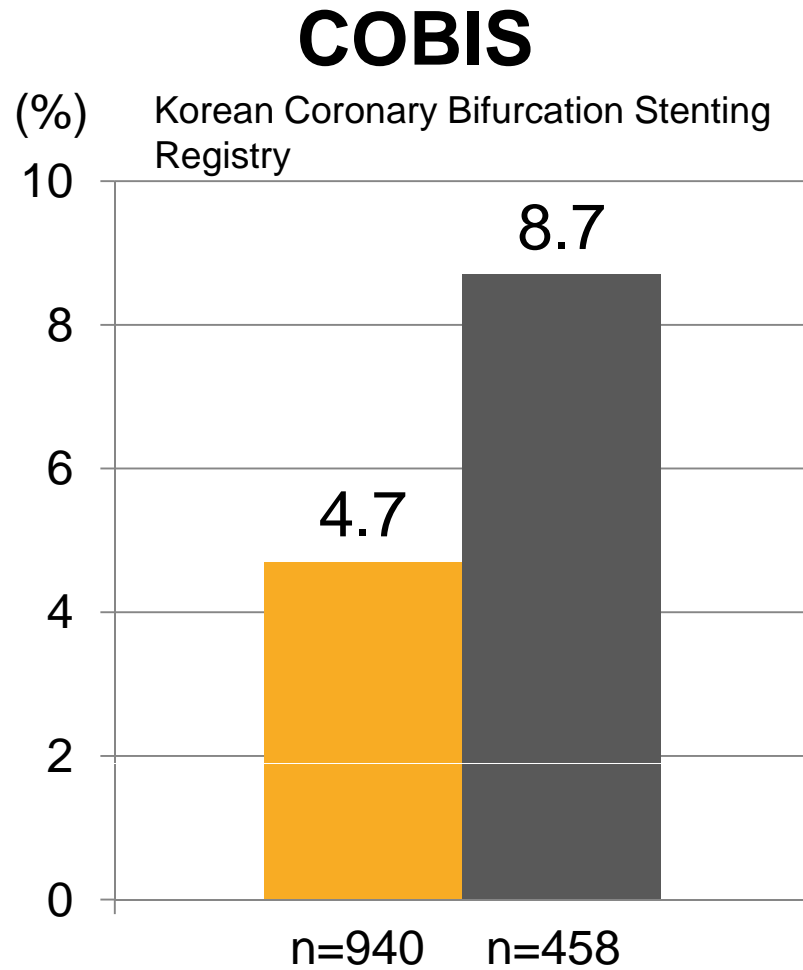


Central cell

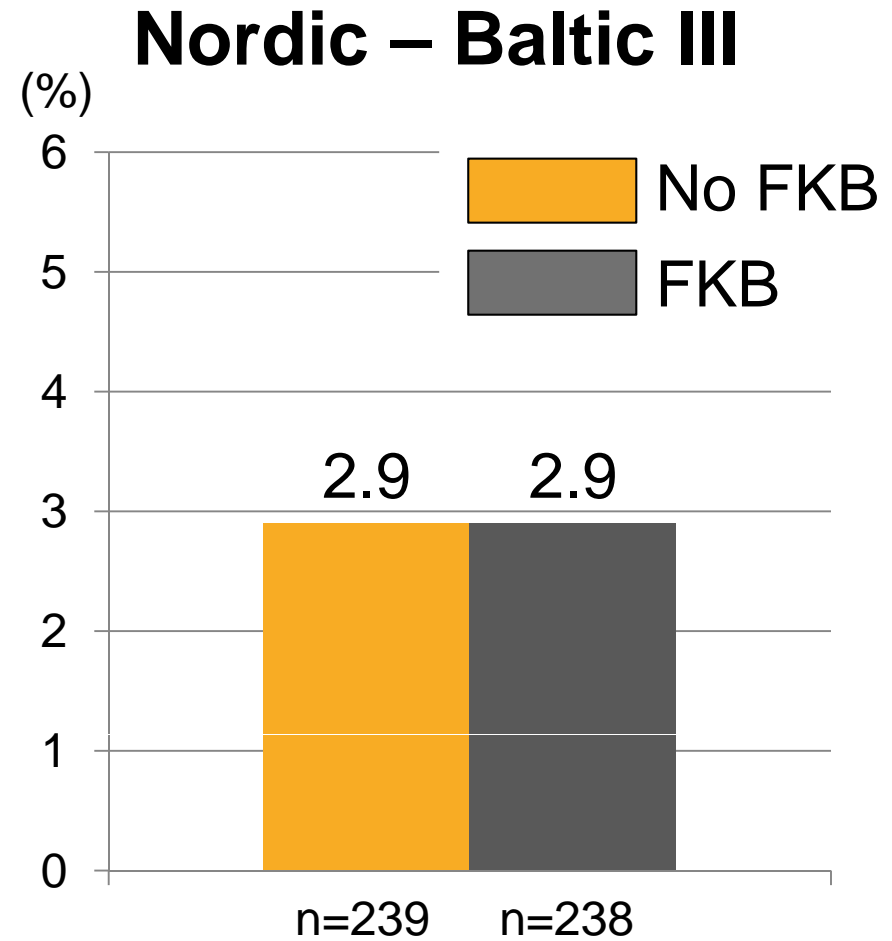


Distal cell

Ineffectiveness of FKB on the MACE in 1-stent strategy

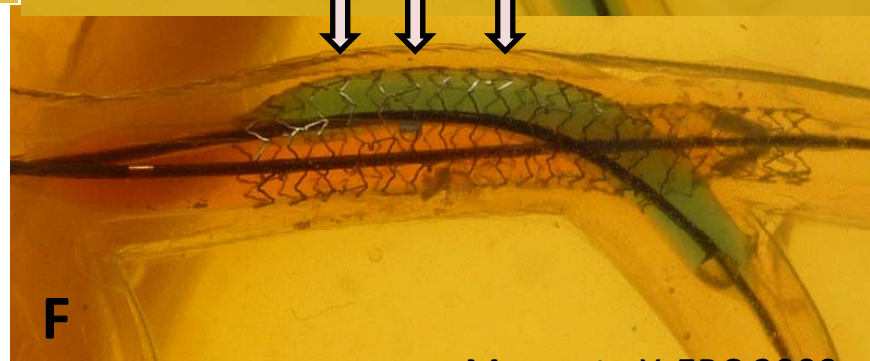
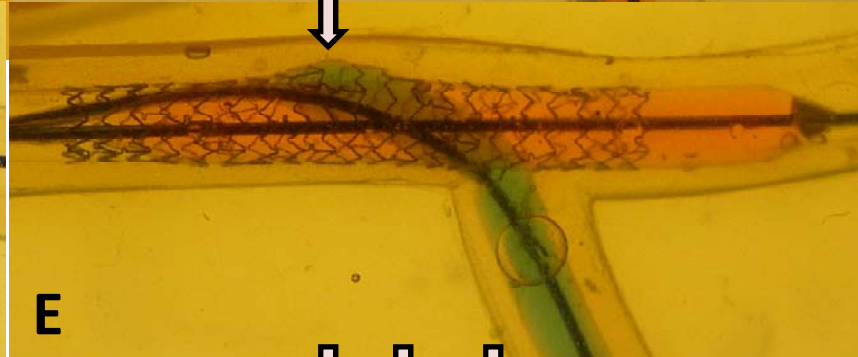
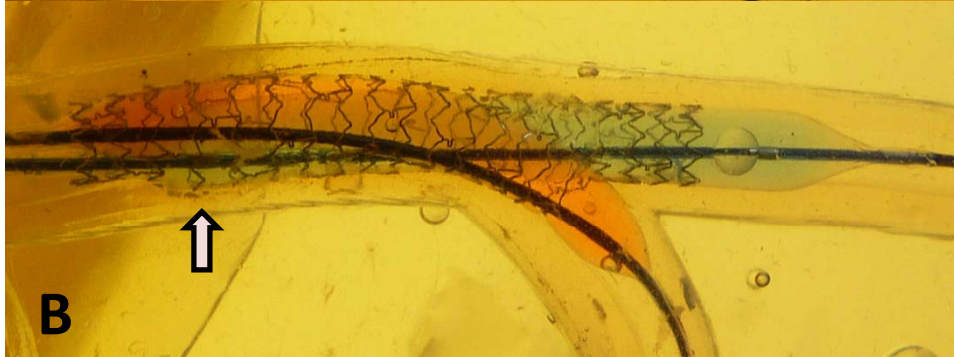
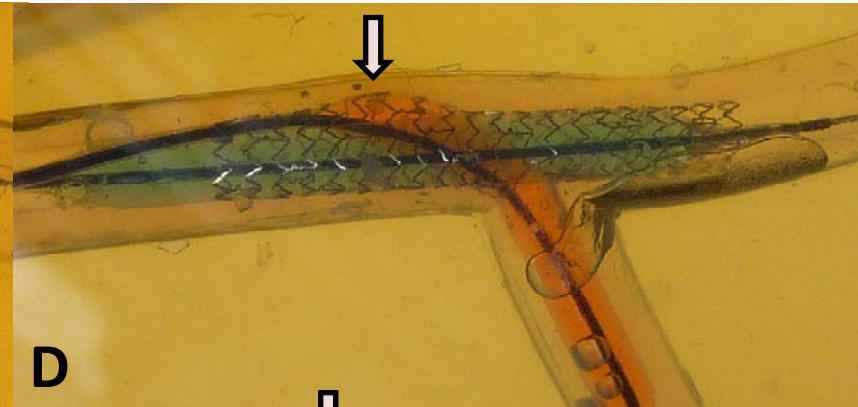
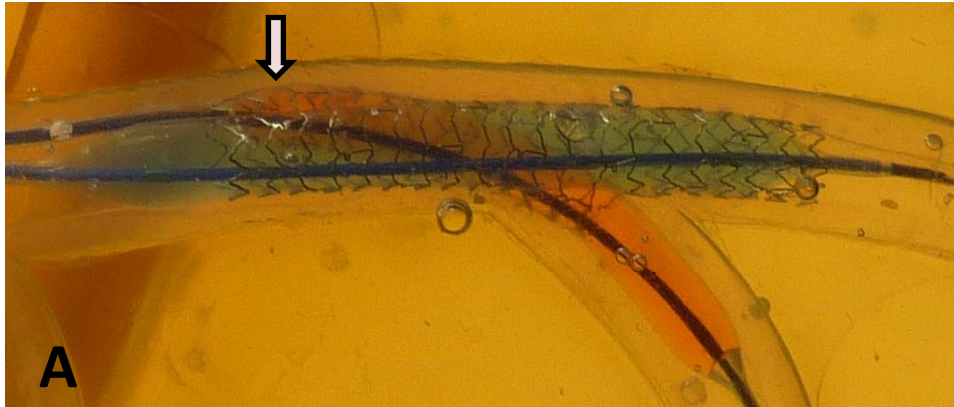


Gwon HC, ACC 2009



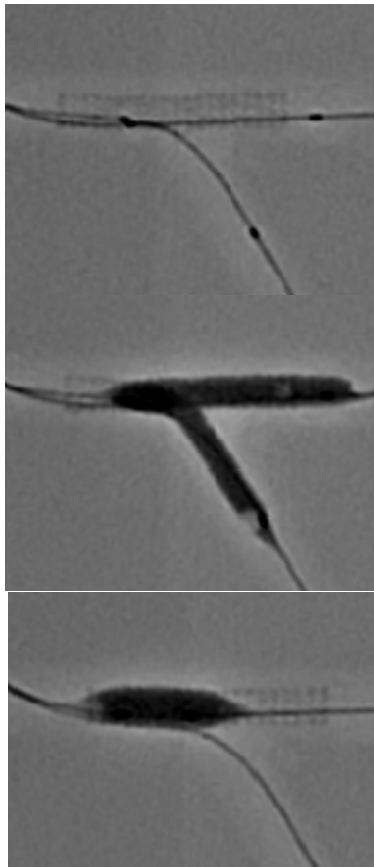
Niemela M, Circulation 2010

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



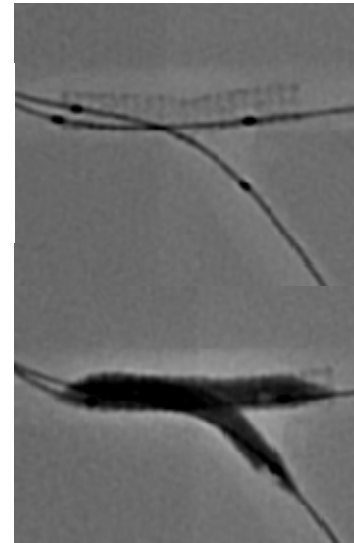
Two overlapping styles in KBT

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
Qantum Maverick II
4.5/8, 12atm

Long overlapping

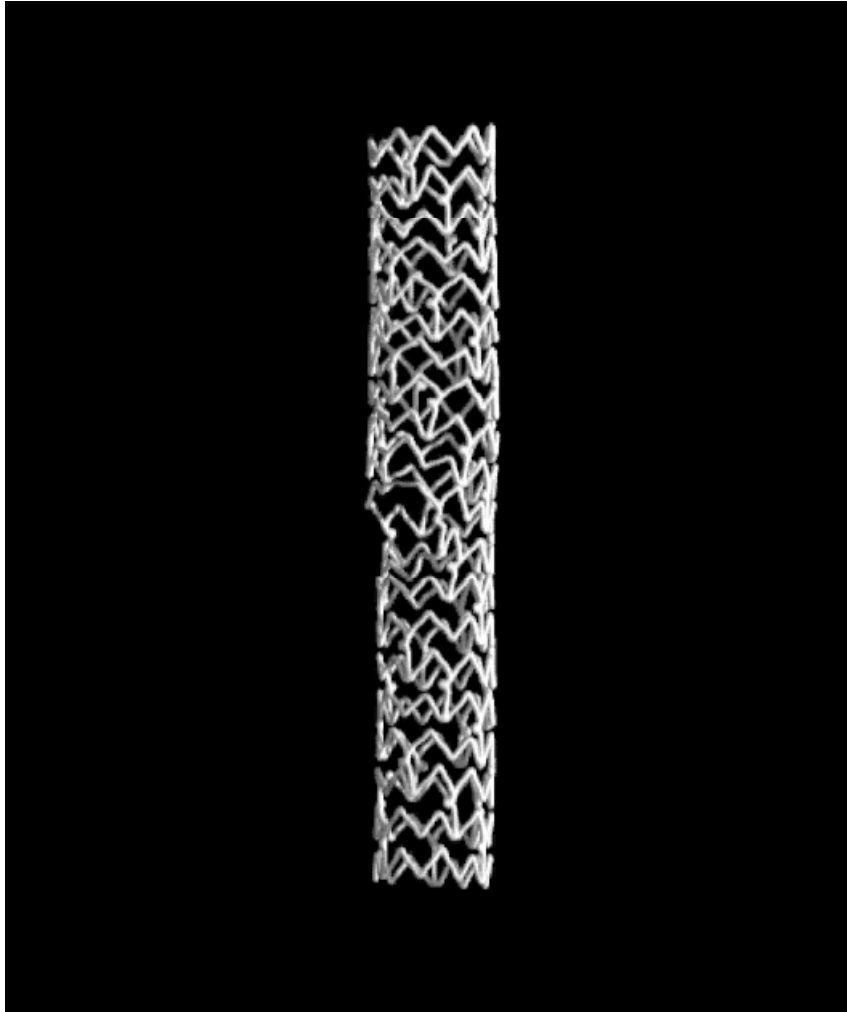


- ML Vision 3.5/28, 14atm
- SB Ryujin 3.0/20, 12atm
- KBT (6atm)
MV Ryujin 3.5/20
SB Ryujin 3.0/20

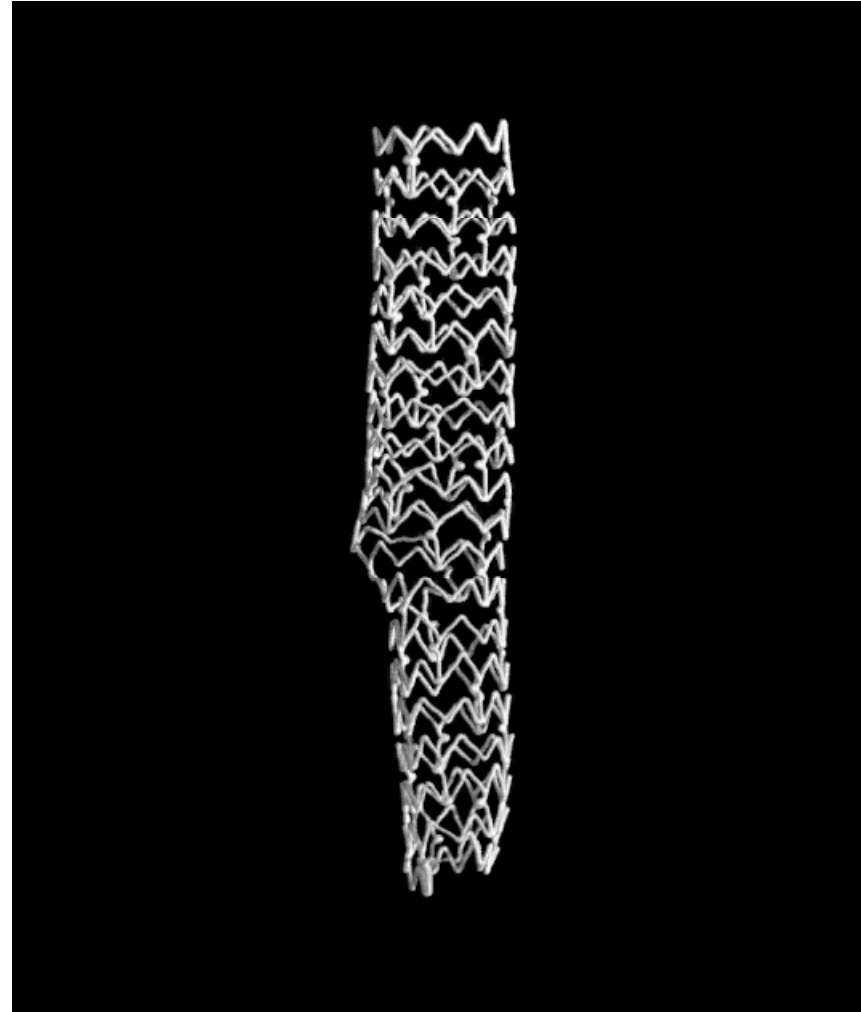
Mitsudo's law

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

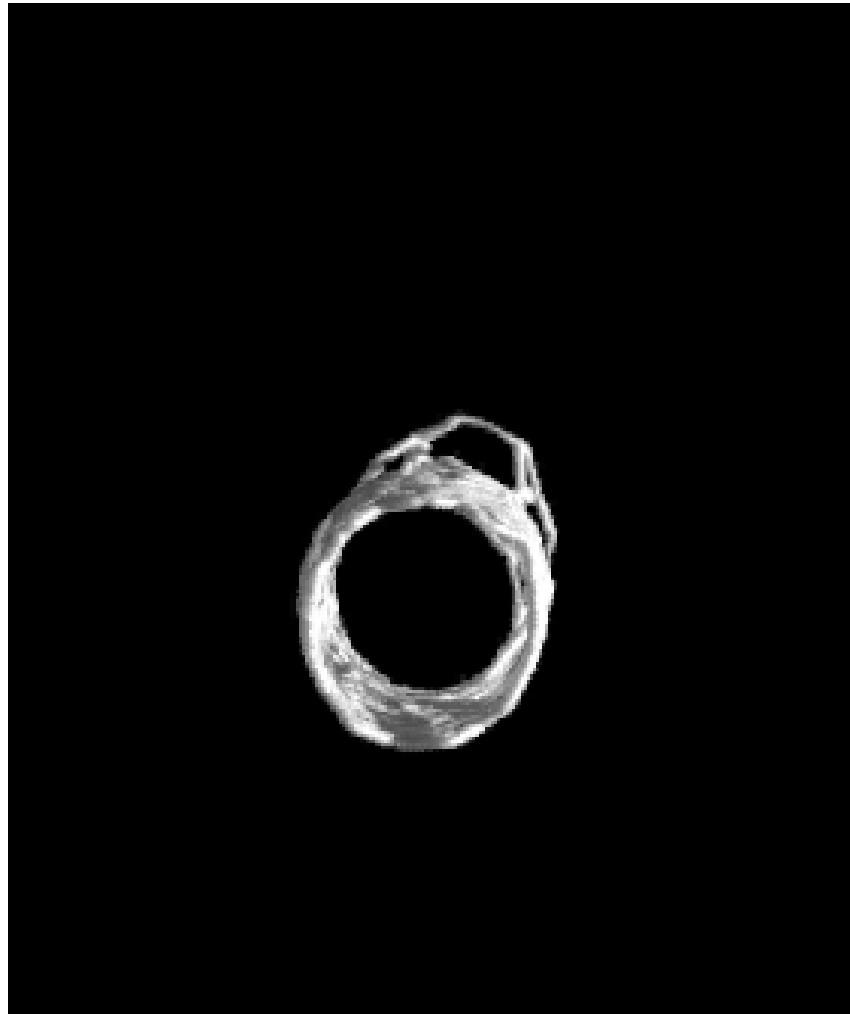
Minimal overlapping +
Proximal large ballooning



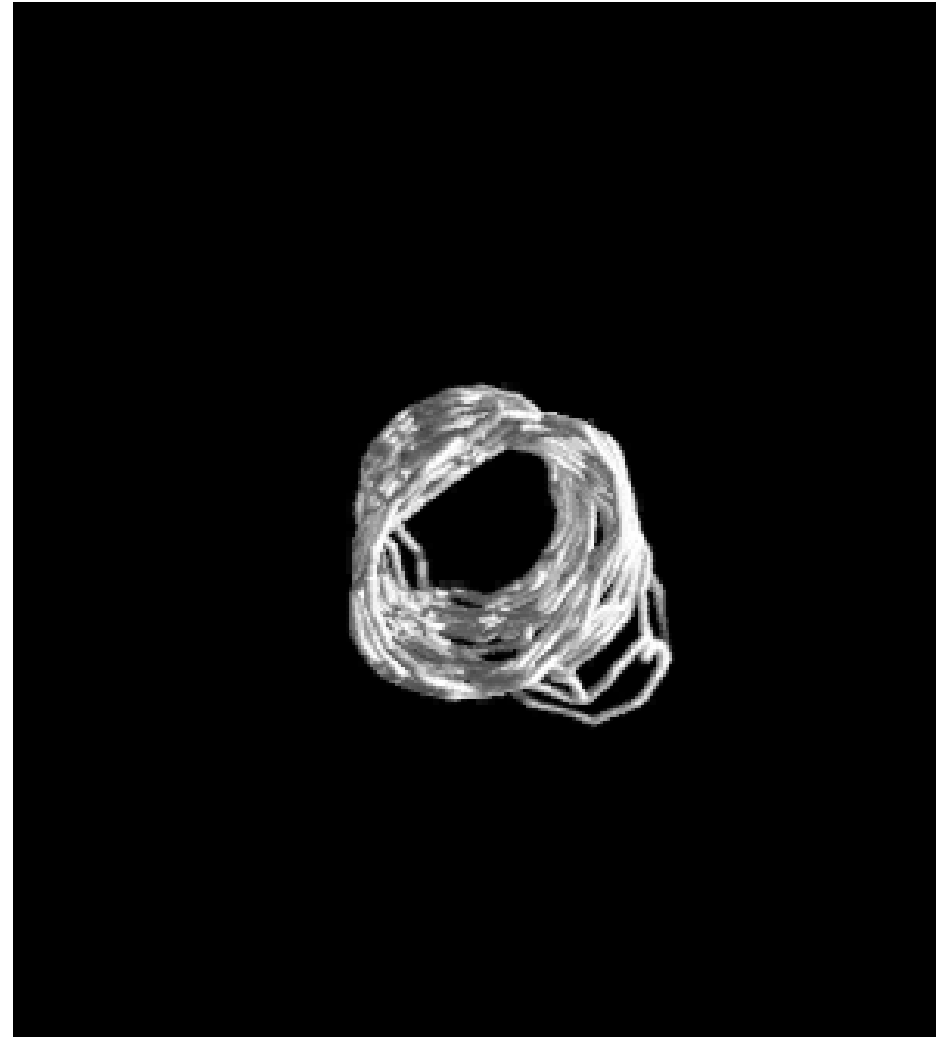
Long overlapping



Minimal overlapping +
Proximal large ballooning

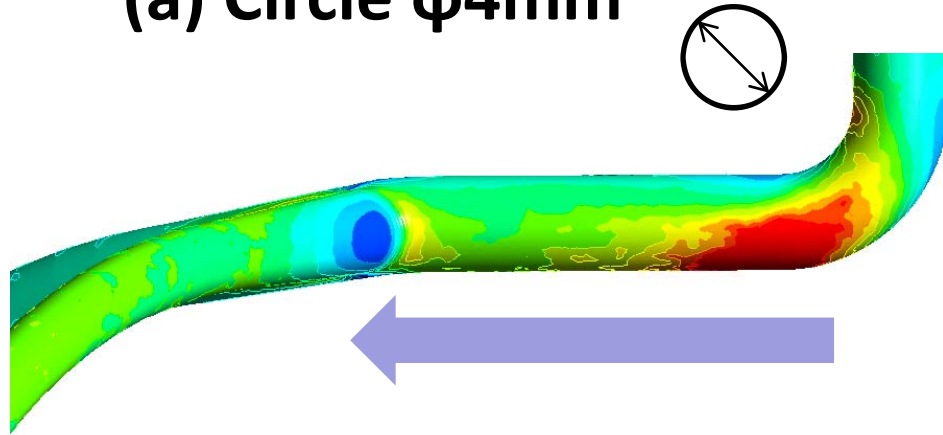


Long overlapping

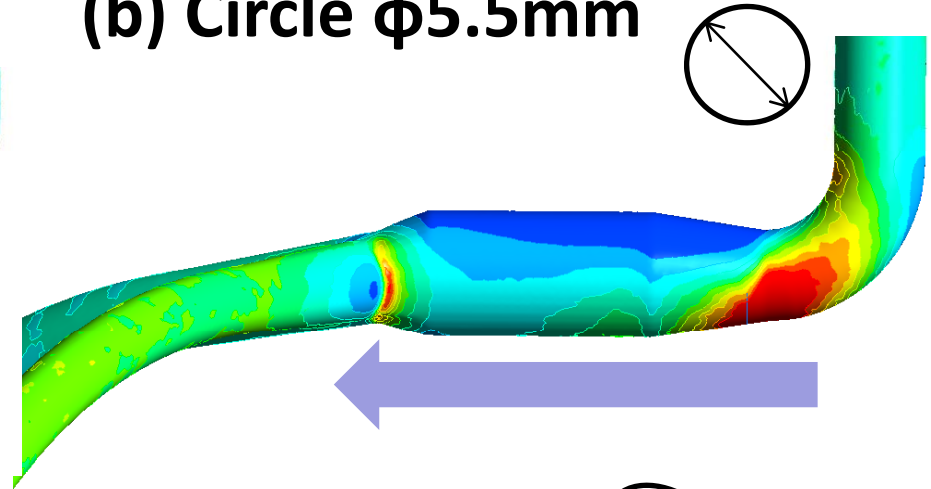


Diastolic peak flow

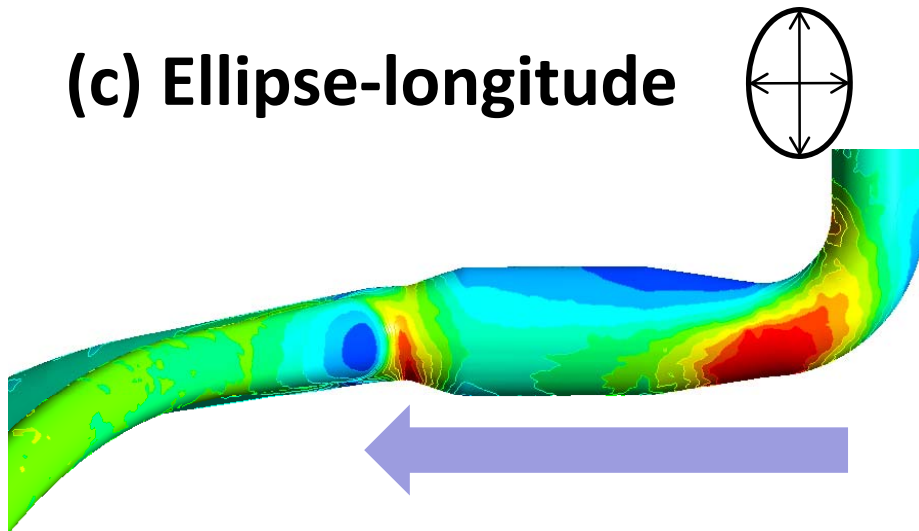
(a) Circle $\phi 4\text{mm}$



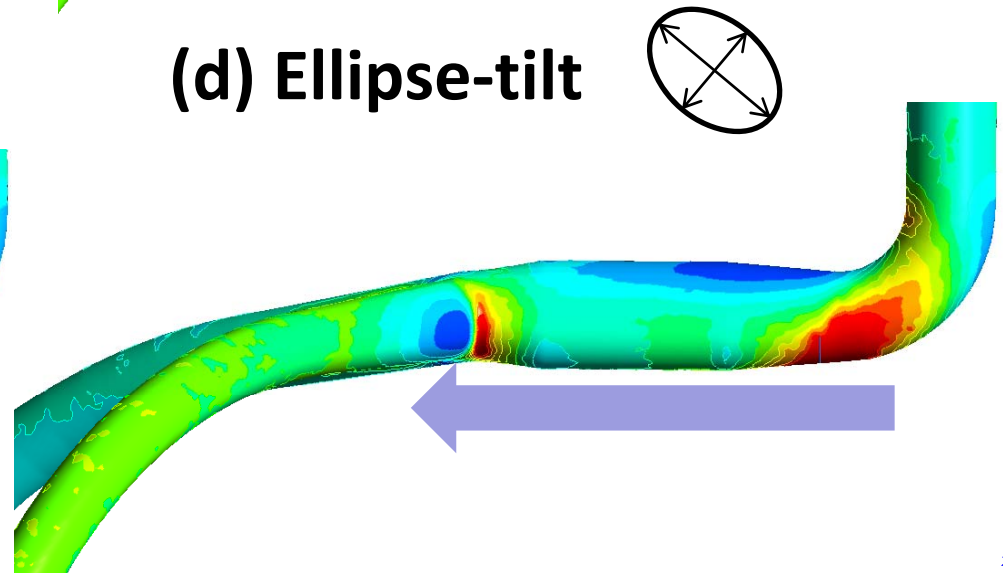
(b) Circle $\phi 5.5\text{mm}$



(c) Ellipse-longitude

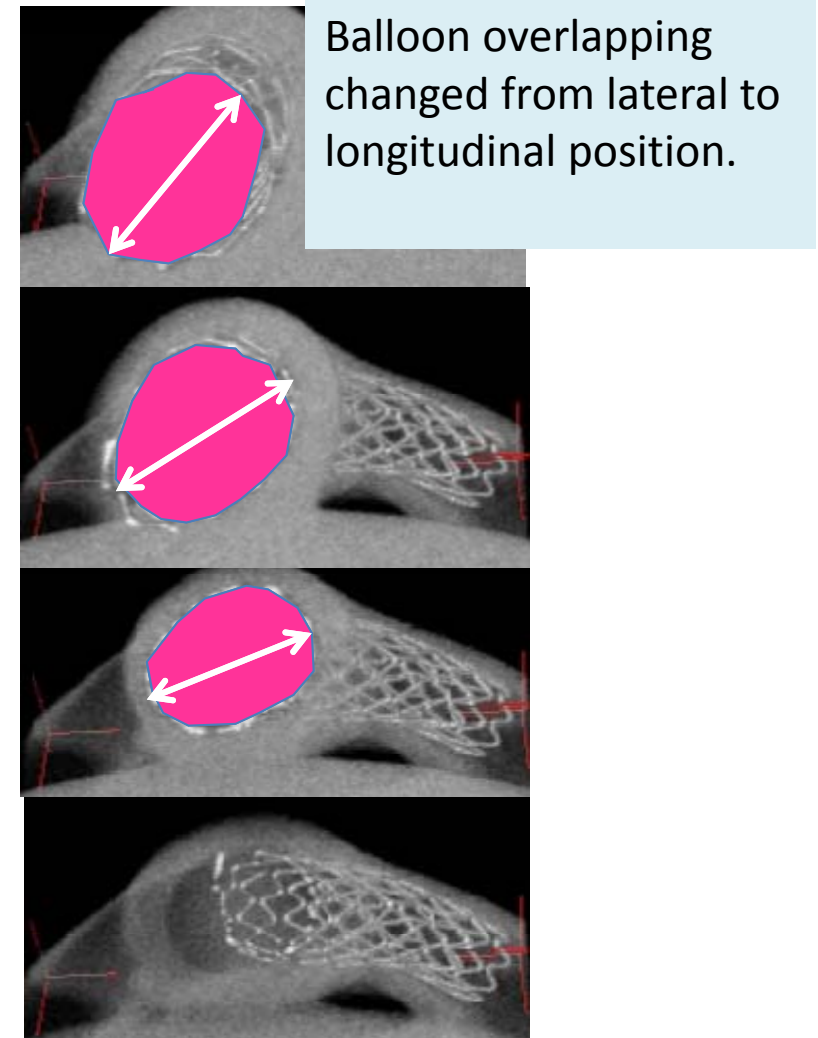
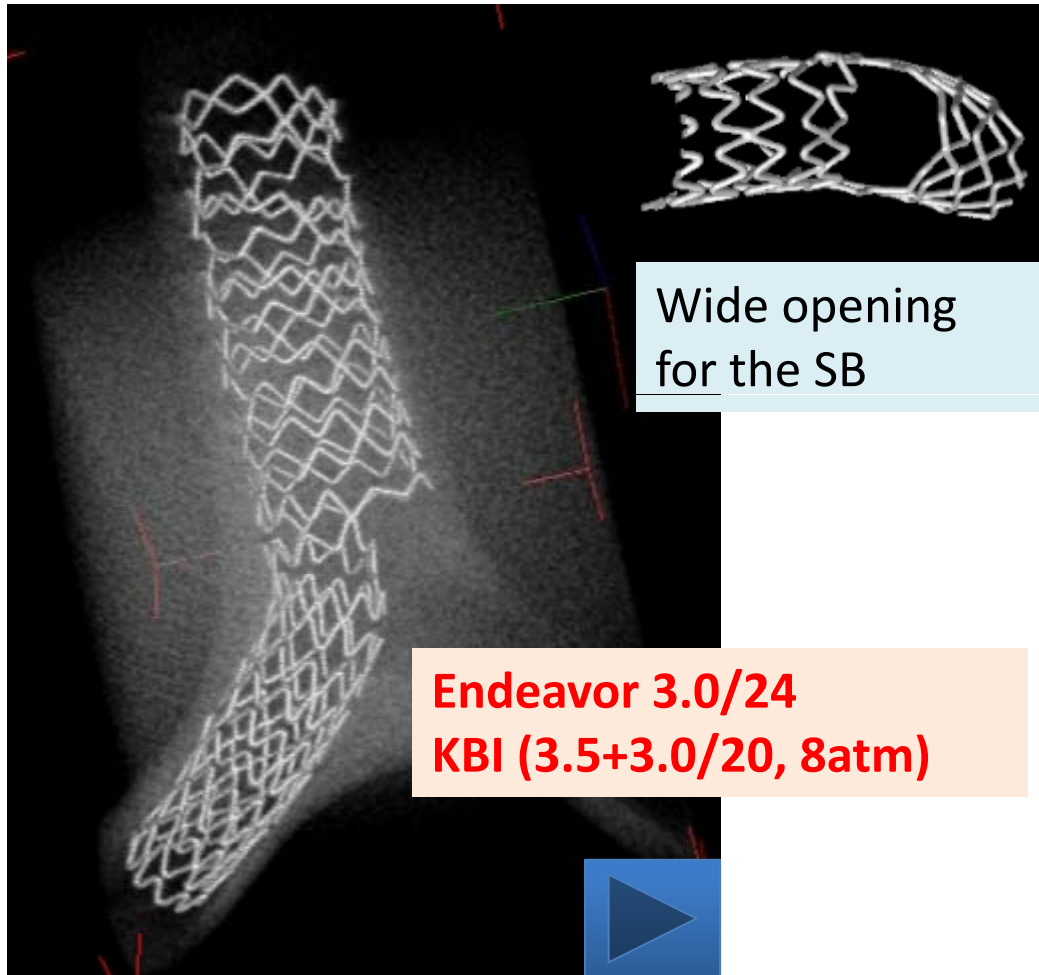


(d) Ellipse-tilt



Which is more suitable, 2-link or 3-link?

Cross sectional view



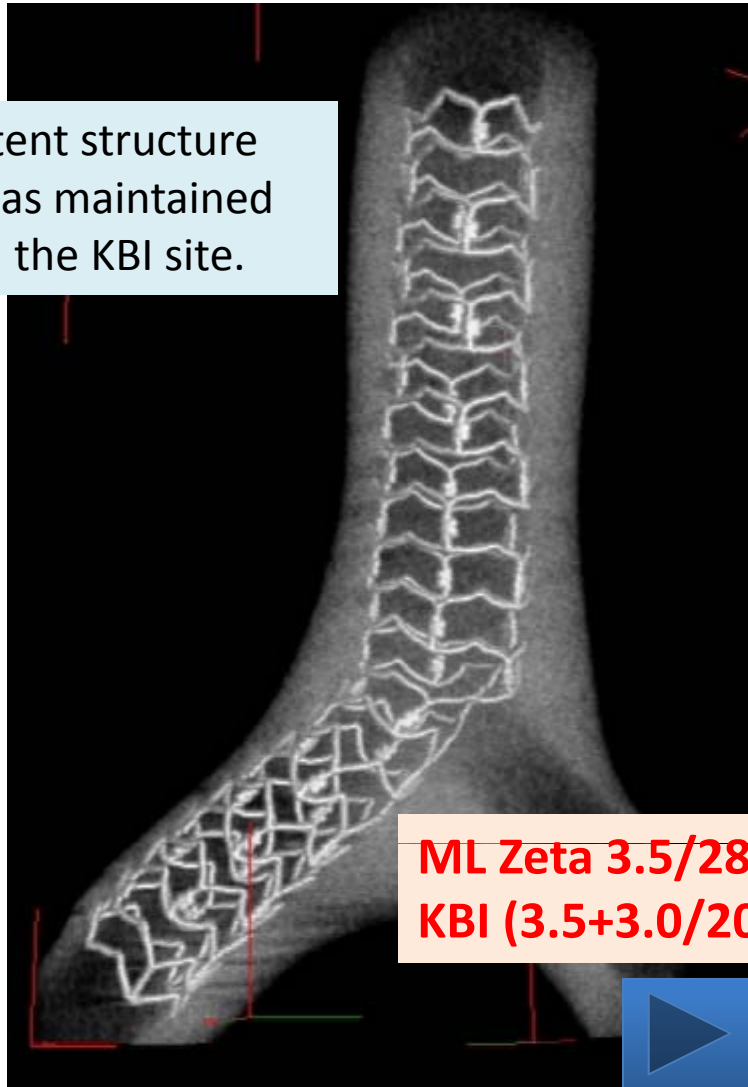
3D, Y-shape model

Murasato Y, Euro PCR 2010

Which is suitable, 2-link or 3-link?

Murasato Y, Euro PCR 2010

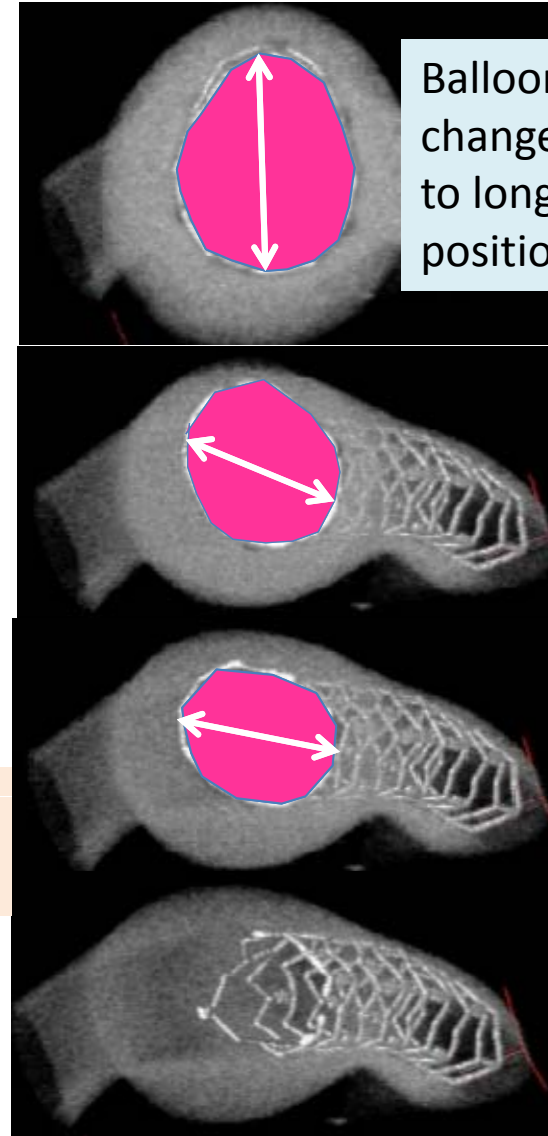
Stent structure was maintained in the KBI site.



ML Zeta 3.5/28
KBI (3.5+3.0/20, 8atm)

3D, Y-shape model

Cross sectional view



Balloon overlapping changed from lateral to longitudinal position.

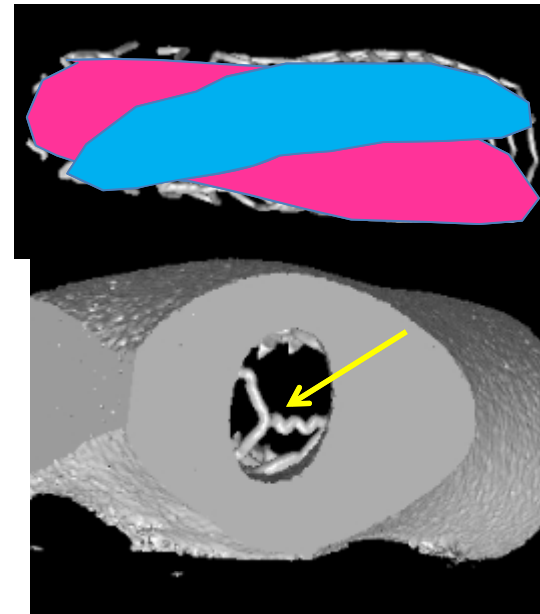
Which is suitable, 2-link or 3-link?

Murasato Y, Euro PCR 2010



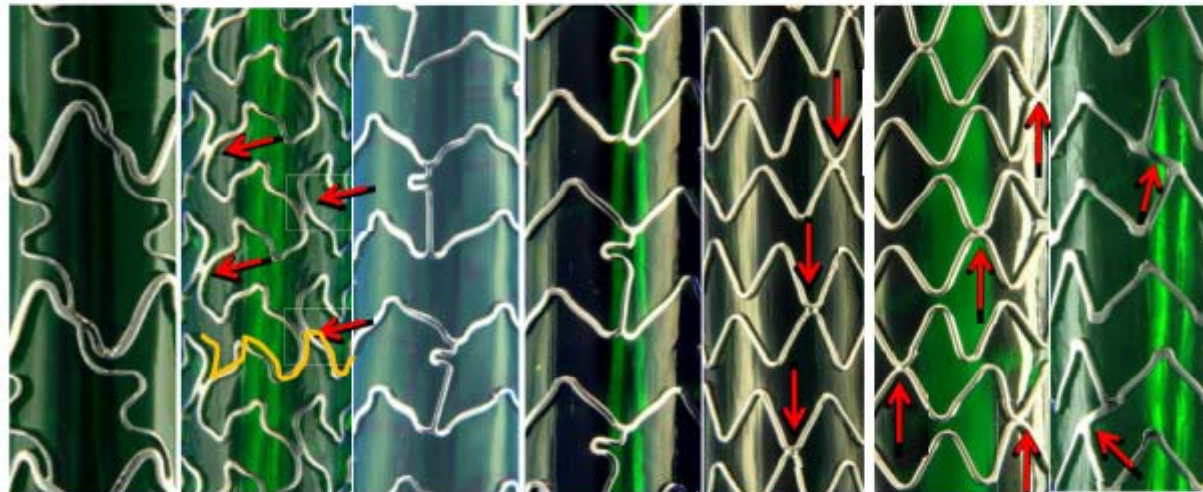
ML Zeta 3.5/28
KBT (3.5+3.0/20, 8atm)

SB orifice

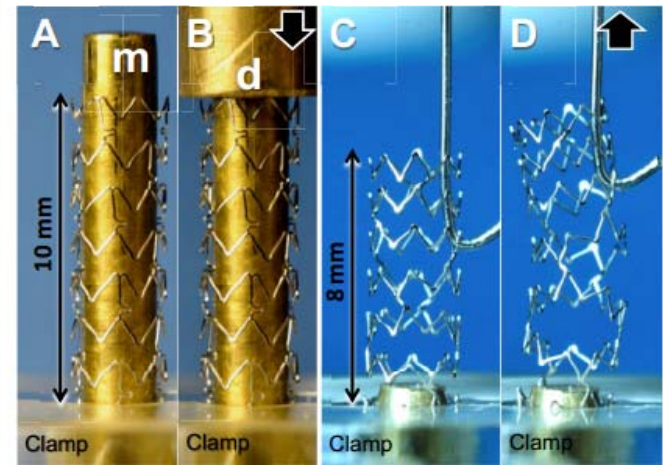


When the vertical link was in the SB ostium, the jailed strut remained at the site where the SB balloon crossed over the MV balloon.

Longitudinal stent deformation



Cypher Select	Liberte	Vision Xience V	MultiLink 8 Xience Prime	Driver Endeavor	Integrity Resolute	Omega Promus Elem
Stainless steel	Stainless steel	Cobalt Chromium	Cobalt Chromium	Cobalt Chromium	Cobalt Chromium	Platinum Chromium
140 μ	100 μ	81 μ	81 μ	91 μ	91 μ	81 μ
6	3	3	3	2	2	2

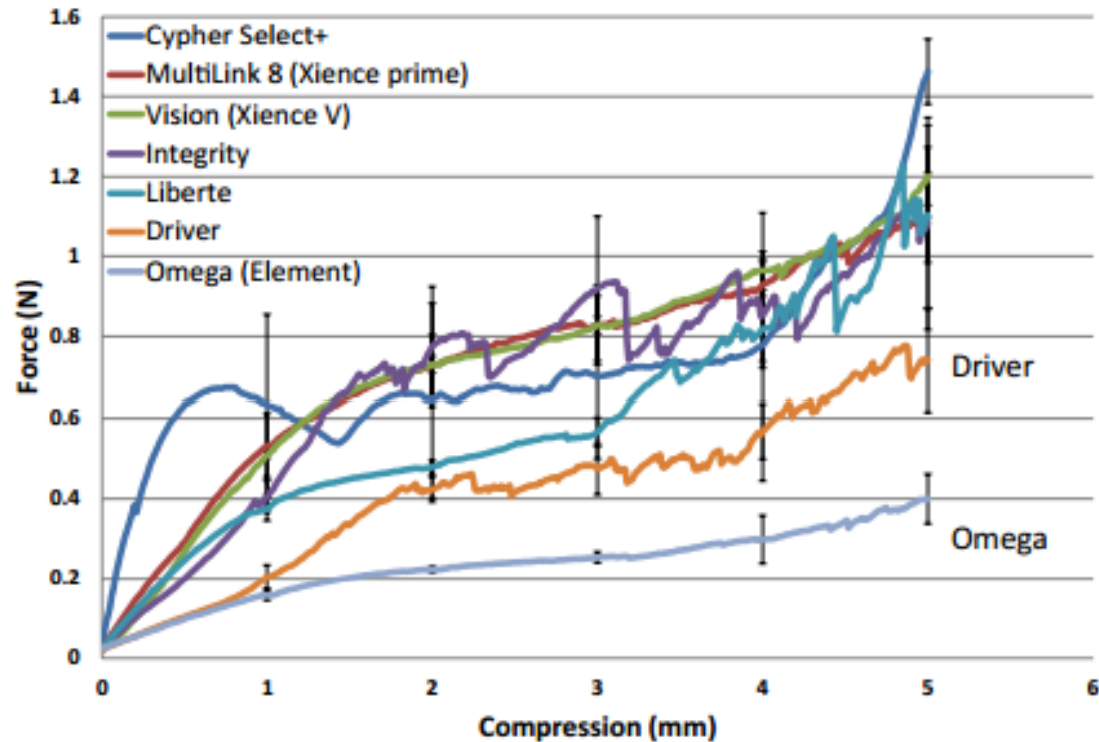
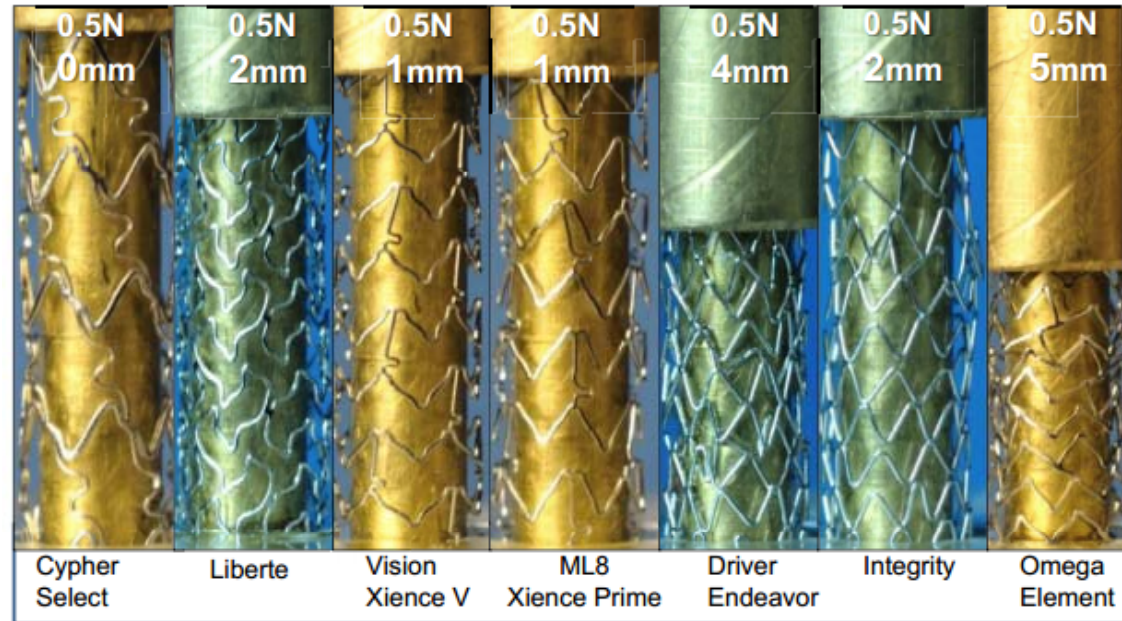


Compression and stretch test

Compression test

Weakness:

1. Element
2. Driver
3. Liberte, Integrity
4. ML8, Vision
5. Cypher

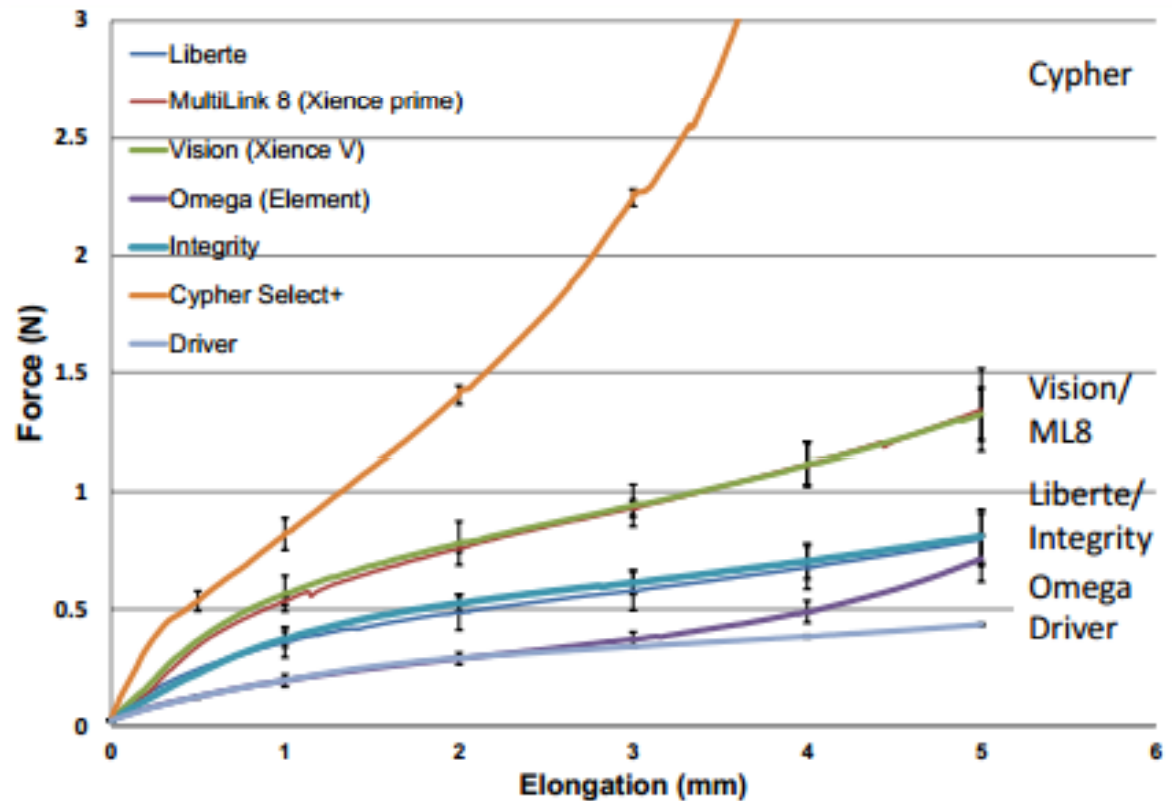
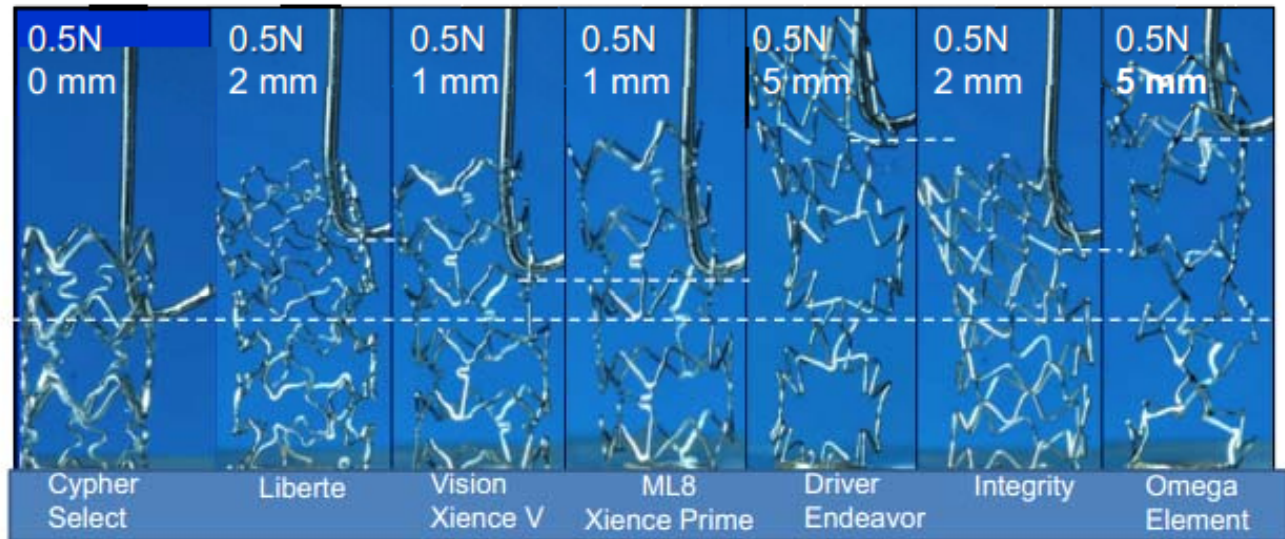


Stretch test

Weakness:

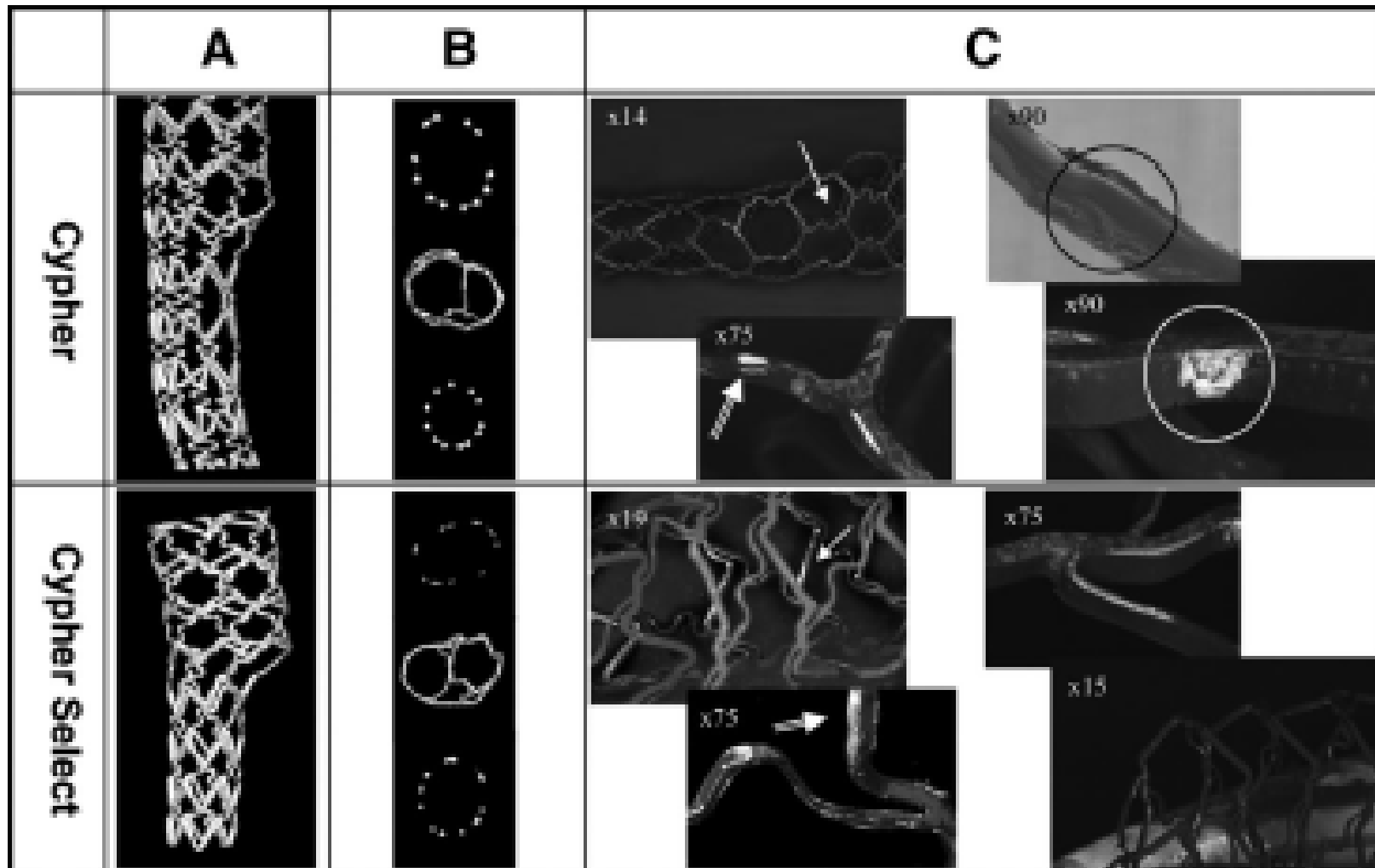
1. Element, Driver
2. Liberte, Integrity
3. ML8, Vision
4. Cypher

Elongation with 0.5 N force



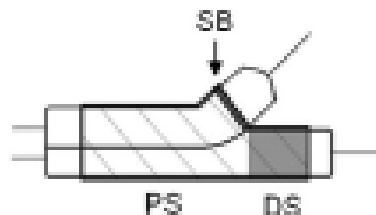
Deformation of stent and polymer damage after KB inflation

Guérin P. Circ Cardiovasc Interv, 2010, 3, 120

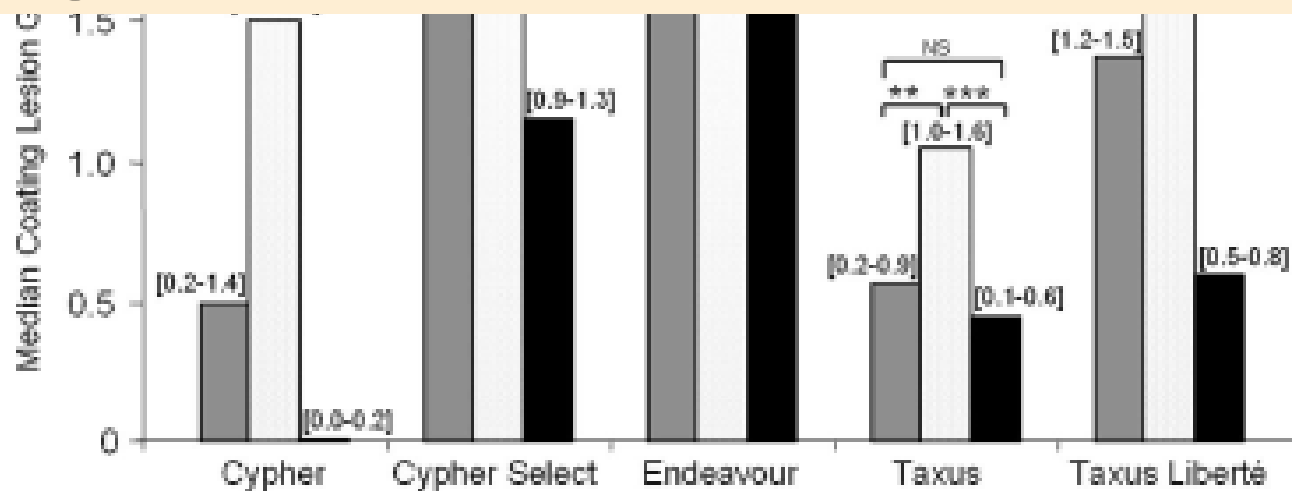


Polymer lesion after KBI

Guérin P. Circ Cardiovasc Interv, 2010, 3, 120



The improvement in expansion and access abilities may result in the increase in polymer damage as reversed results.



Summary

- Bench testing using high-resolution imaging devices can provide useful information in the complicated bifurcation intervention.
- Any 2-stent technique has the limitation to cover the carinal area.
- Bifurcation angle and balloon overlapping style have great effect on the stent configuration produced by kissing inflation.
- Distal position of the SB GW recrossing is preferable, however,

Thank you for your attention!

- Longitudinal deformation is likely to occur in 2-link stents.
- Overdilation of the DES may reduce its efficacy due to the polymer damage, widely spread cell area, and dispersed drug concentration. It also leads to generation of low shear stress which may produce future atherosclerosis or stent thrombosis.