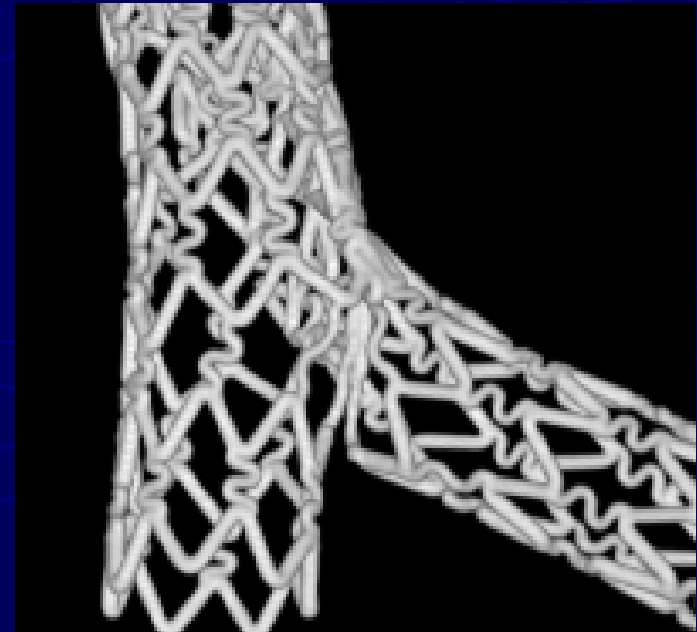


3-dimensional Computed Tomographic Imagings of Bifurcation Stenting

Yoshinobu Murasato MD, PhD

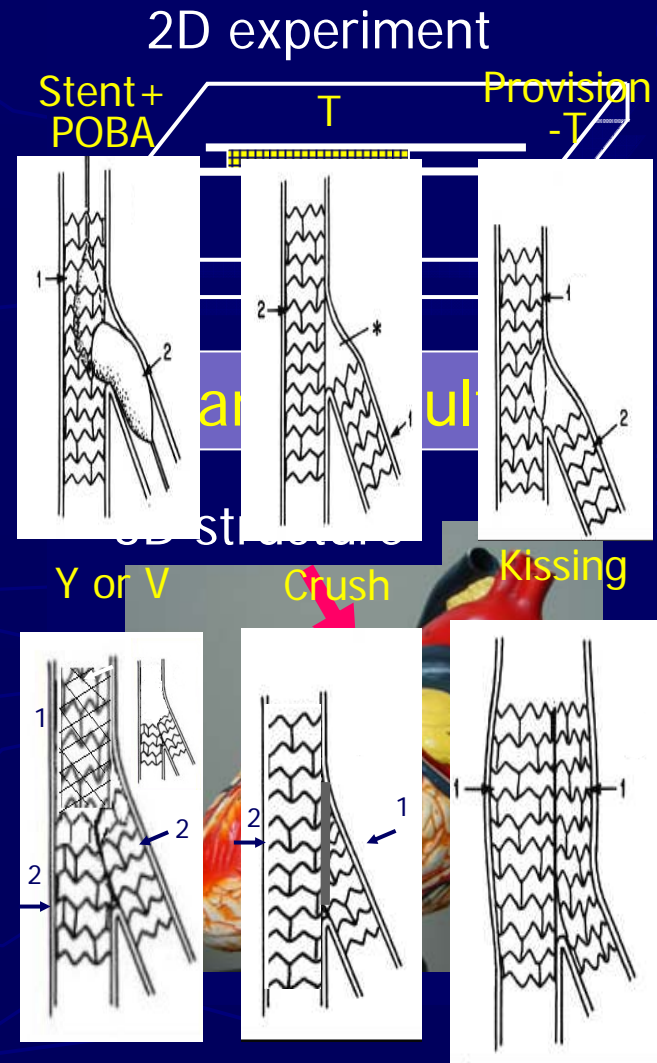
Division of Cardiovascular Medicine,
Chikuho Social Insurance Hospital



Coronary Physiology & Imaging Summit 2007, February 10

Background

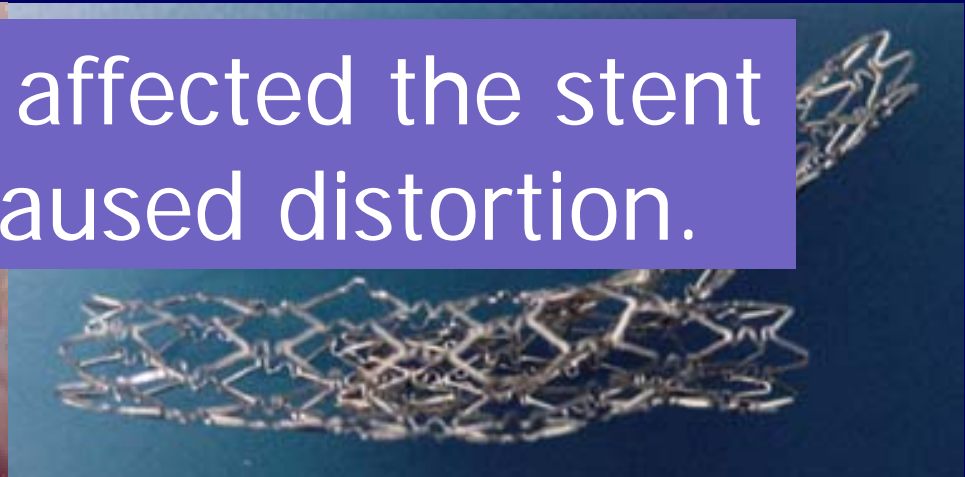
- ▶ In the drug-eluting stent era, various stenting techniques have been proposed for the treatment of left main coronary artery (LMCA) bifurcation.
- ▶ However, these techniques have not yet been investigated systematically in a 3-dimensional (3D) structure.



Crush stenting in swine LCX bifurcation

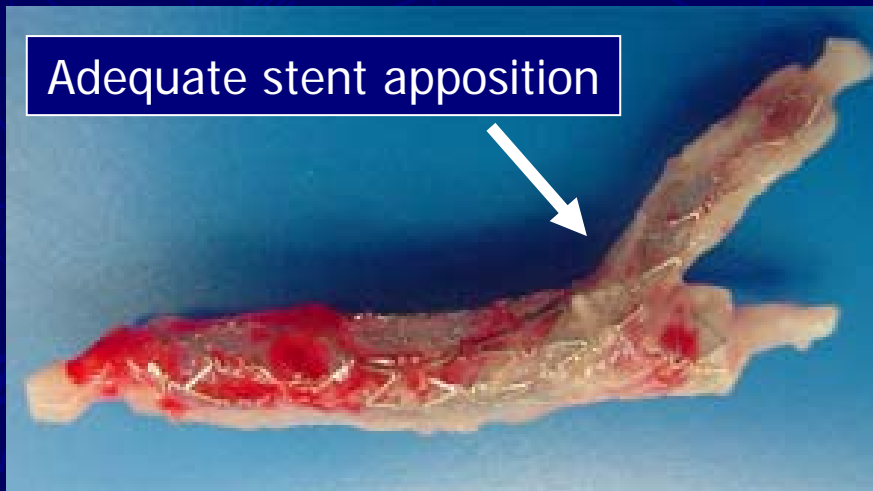
Final kissing balloon inflation (+)

Real 3D structure affected the stent expansion and caused distortion.

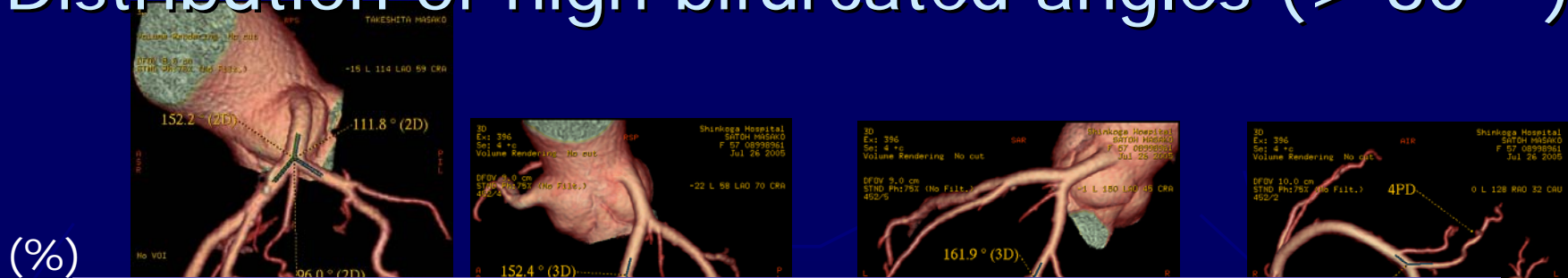


However, the crushed stent was rather squeezed at the ostium and extended proximally from lateral to myocardial site.

Adequate stent apposition

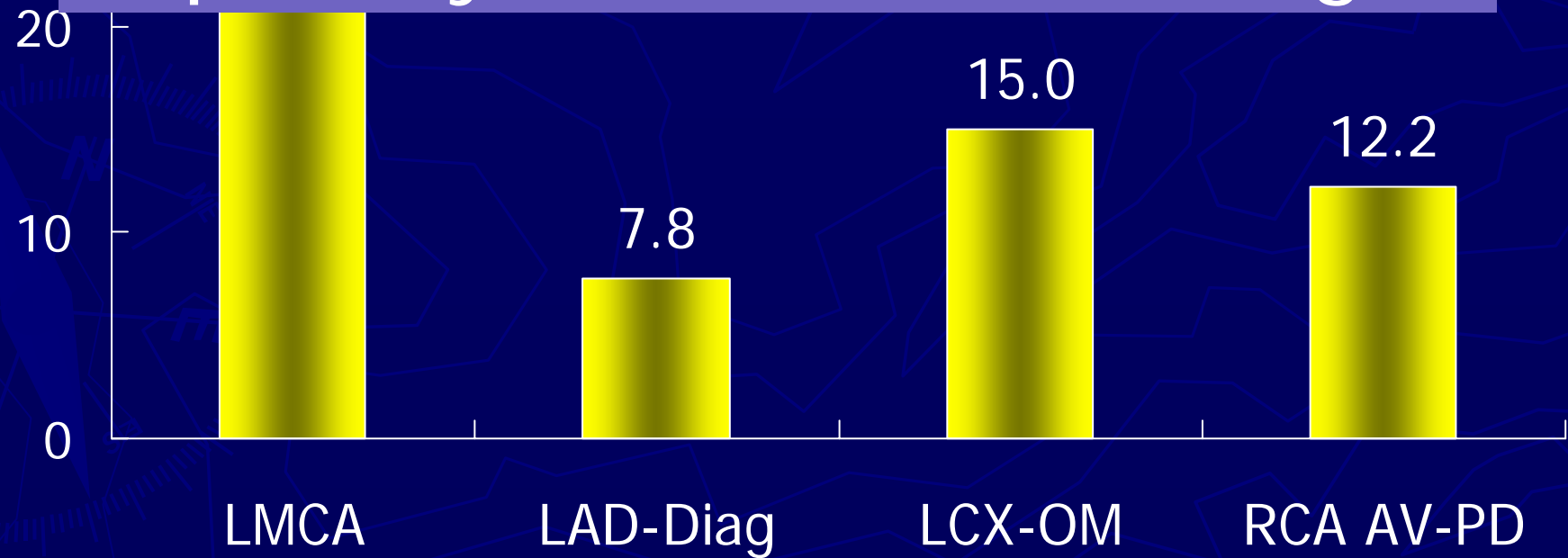


Distribution of high bifurcated angles ($> 80^\circ$)



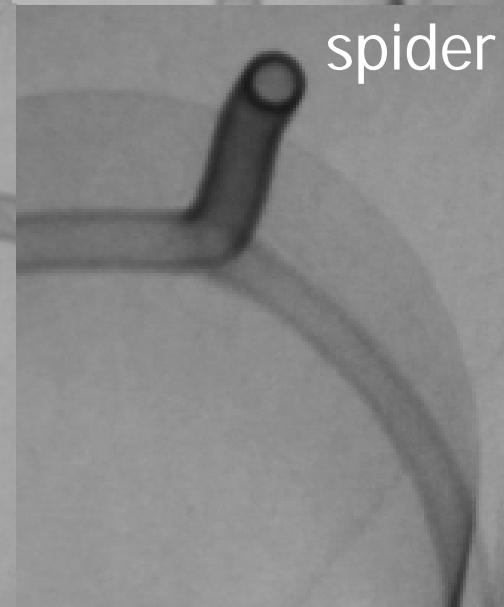
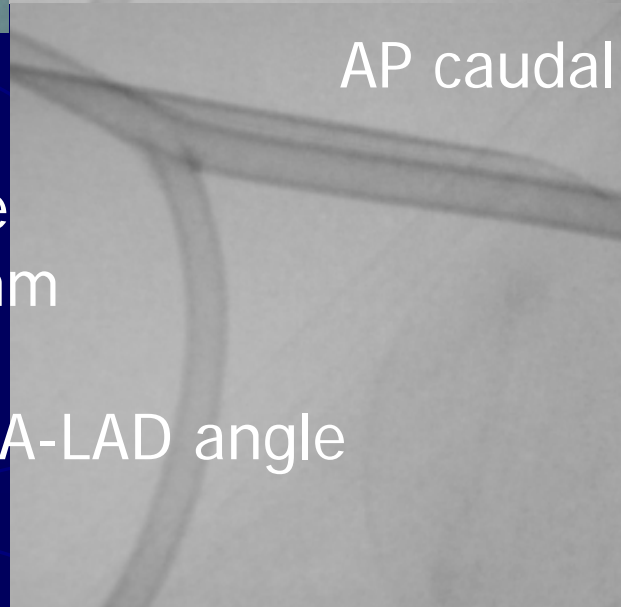
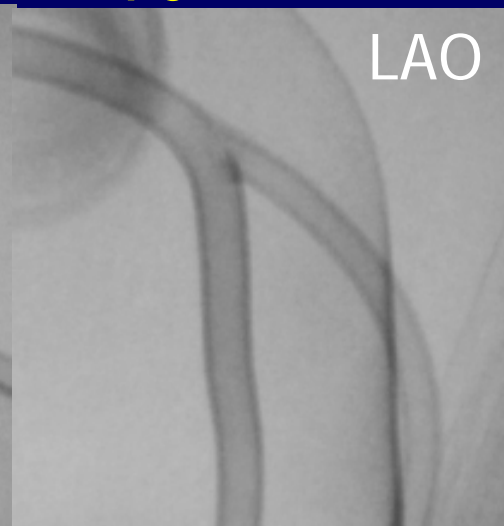
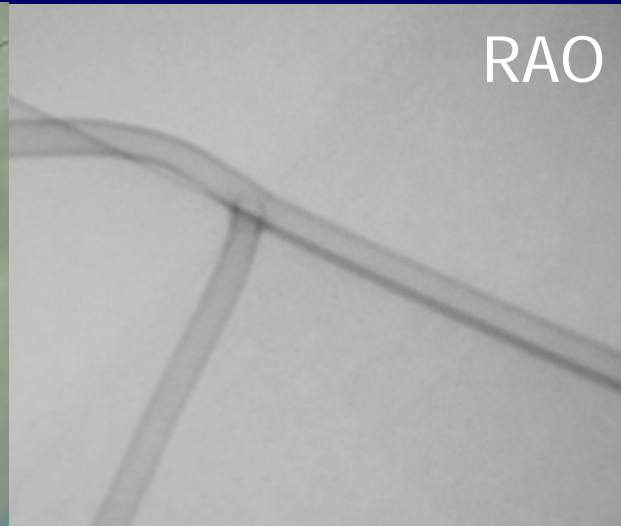
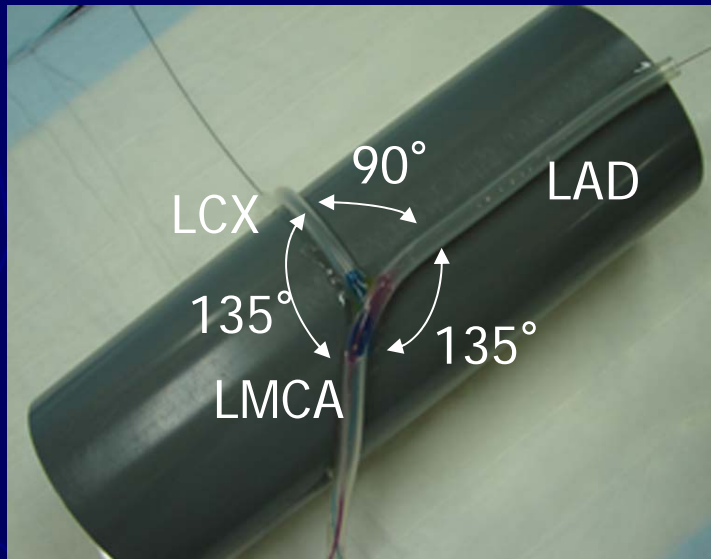
(%)
30

LMCA bifurcation has an especially wide bifurcated angle.



3-dimensional LMCA bifurcation model

Fluoroscopy



Column: Ø7.5cm
polyvinyl chloride
LMCA-LAD tube: Ø4.0mm
LCX tube: Ø3.0mm
LMCA-LCX angle = LMCA-LAD angle
LAD-LCX angle = 90 °

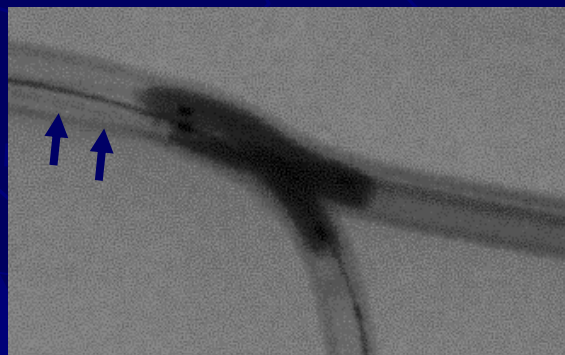
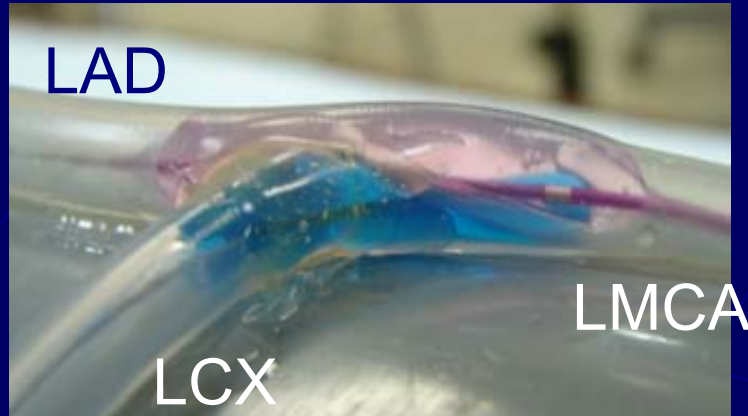
Methods

- ▶ The following stentings were performed in the LMCA bifurcation model:
 - Crush stenting with final kissing balloon inflation
 - Modified crush technique with double kissing balloon inflation (DK crush stenting)
 - Kissing stenting
 - Modified T-stenting
- ▶ High-resolution computed tomographic (CT) observations were performed to investigate the following aspects:
 - Stent expansion
 - Stent deformation
 - Stent apposition to the vessel
 - Gap formation

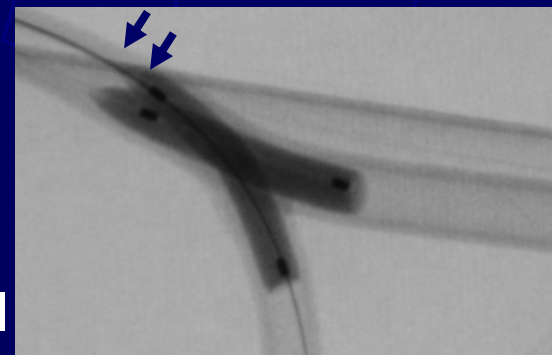
Balloon overlapping inside distal LMCA

1. LAD balloon over LCX balloon

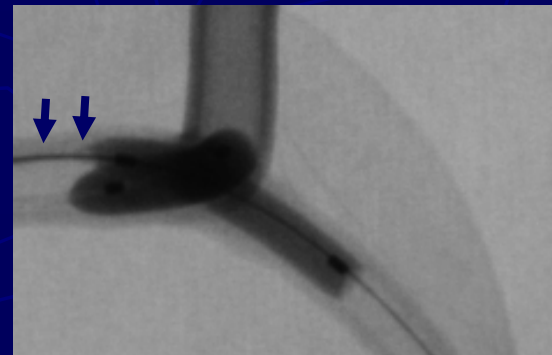
2. LCX balloon over LAD balloon



AP caudal



Spider



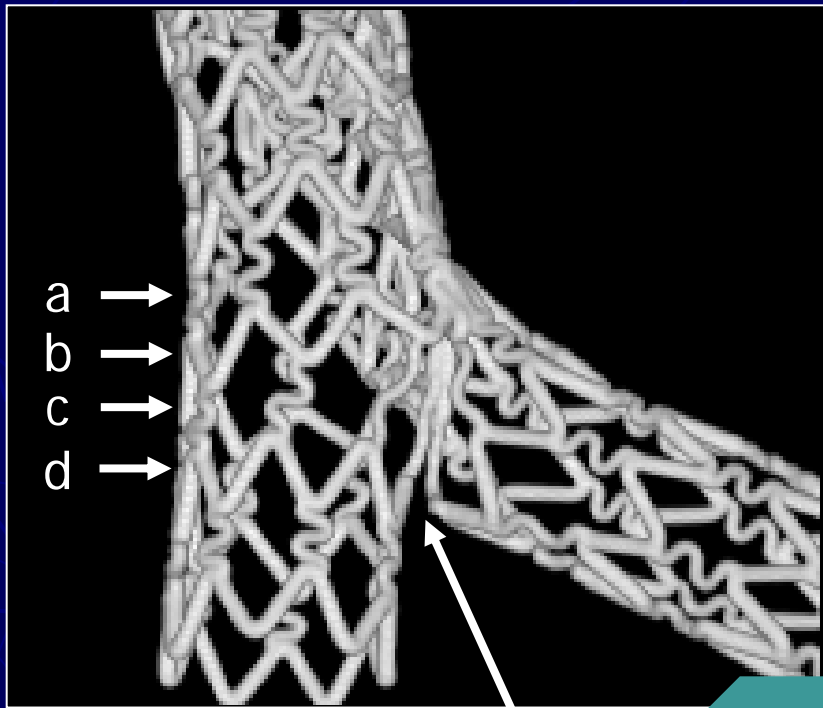
Red: LAD balloon
(Arashi 3.5/20)
Blue: LCX balloon
(Ryujin 3.0/20)

Crush stenting

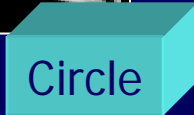


Crush stenting with Bx Velocity

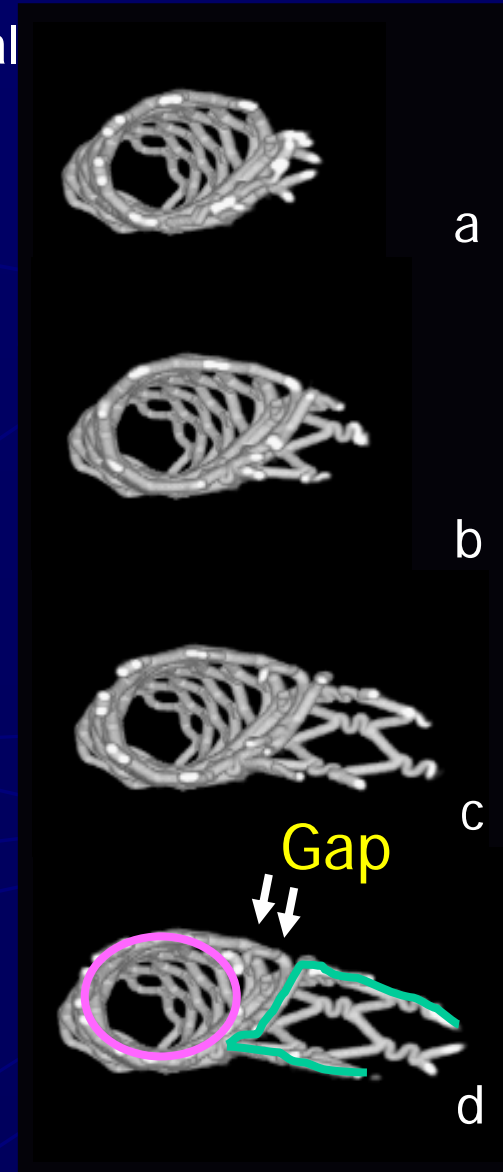
(1) LAD stent over LCX stent



Gap between the two stents



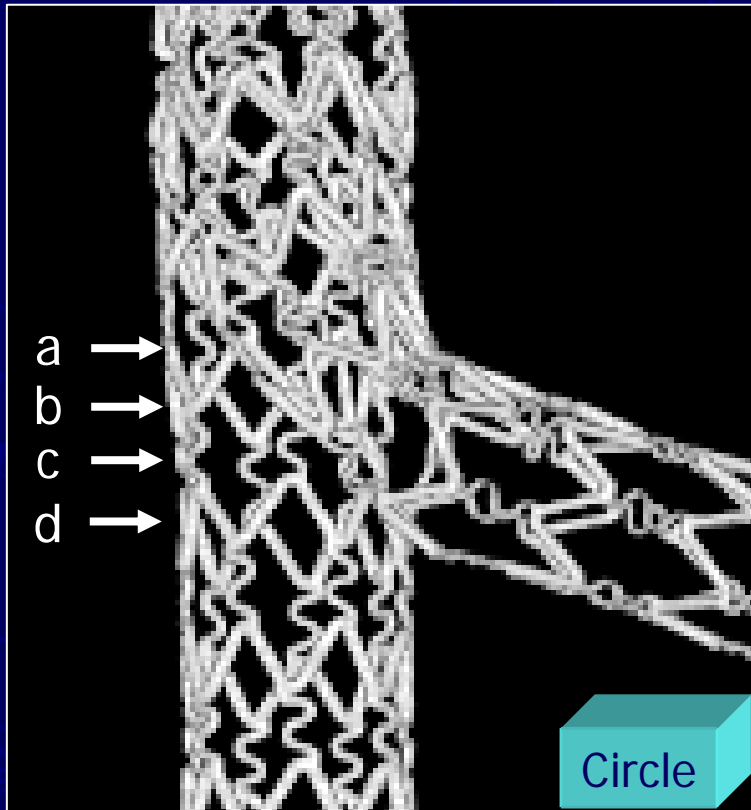
Cross sectional view
proximal



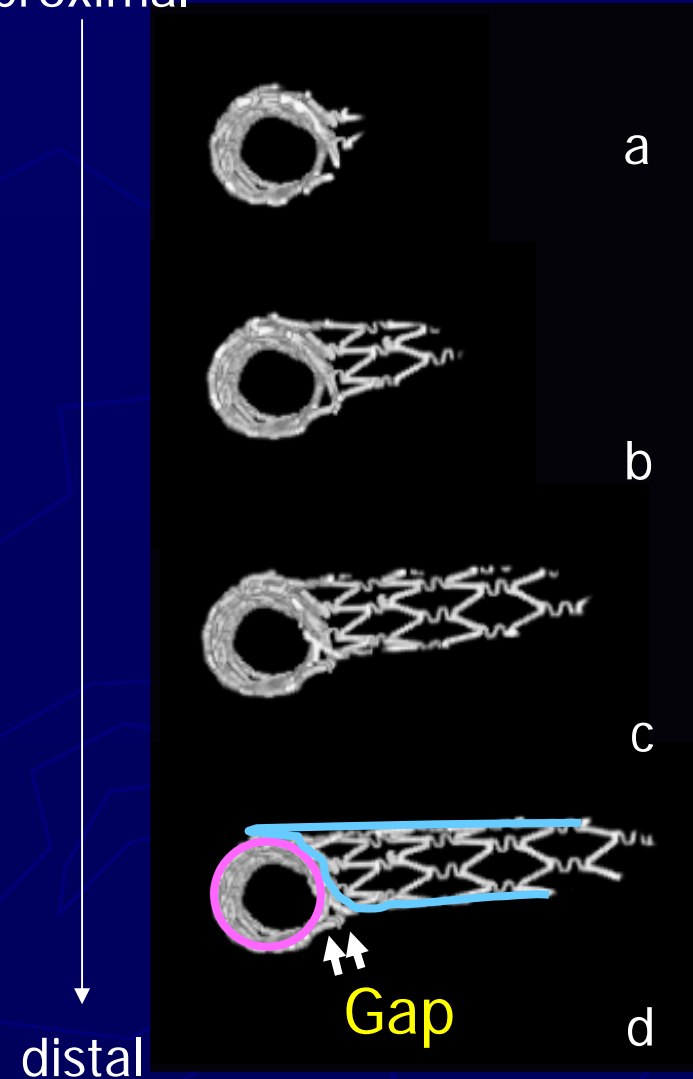
distal

Crush stenting with Bx Velocity

(2) LCX stent over LAD stent



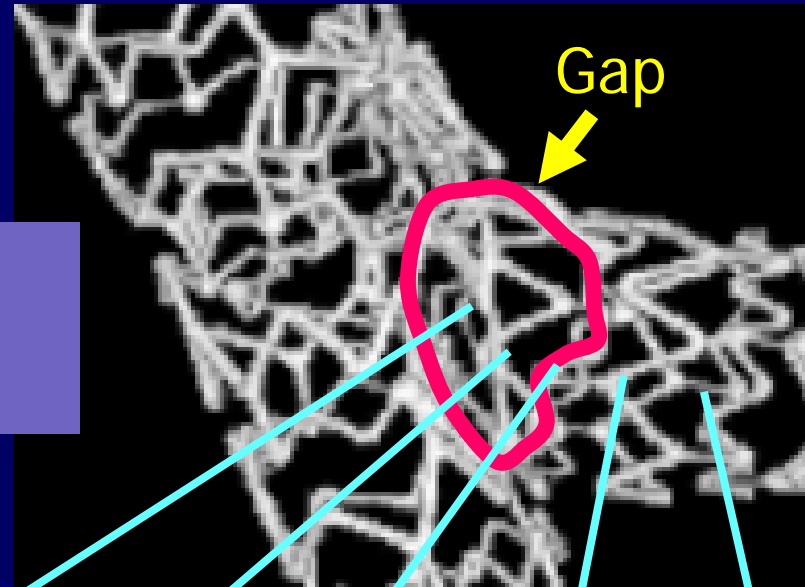
Cross sectional view
proximal



Crush stenting with Express II

Magnified view of the SB ostium

The gap at the SB ostium was larger compared with crush stenting with Bx velocity stent.



Absence of the strut



SB stent

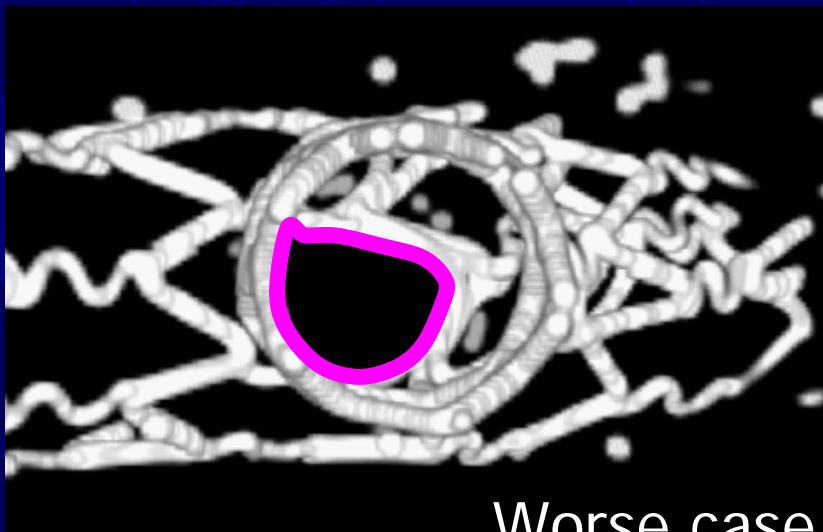
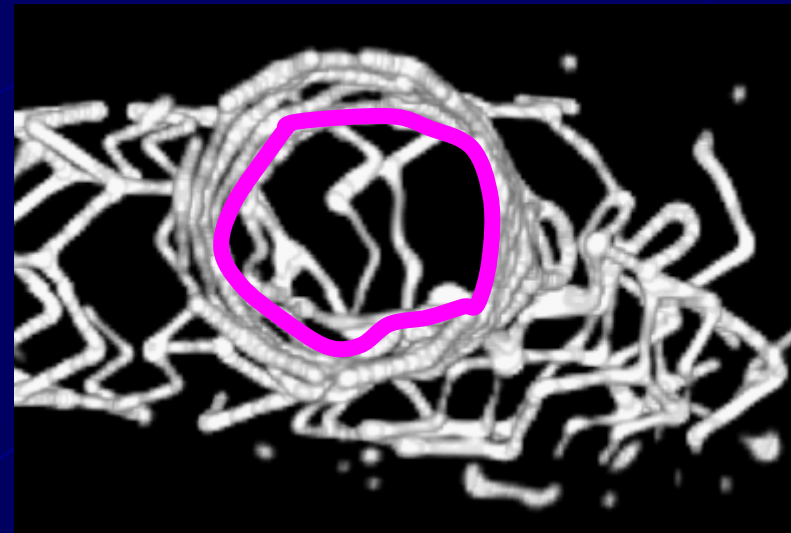
MV stent

Strut configuration of MV stent at SB ostium

Bx Velocity



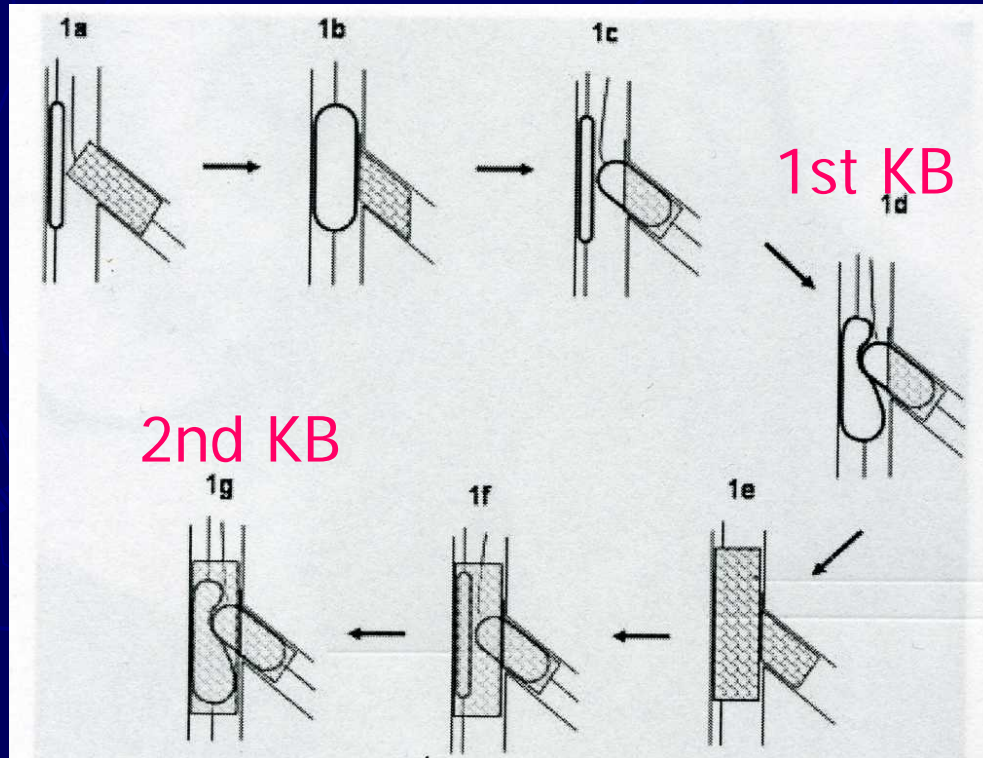
Express II



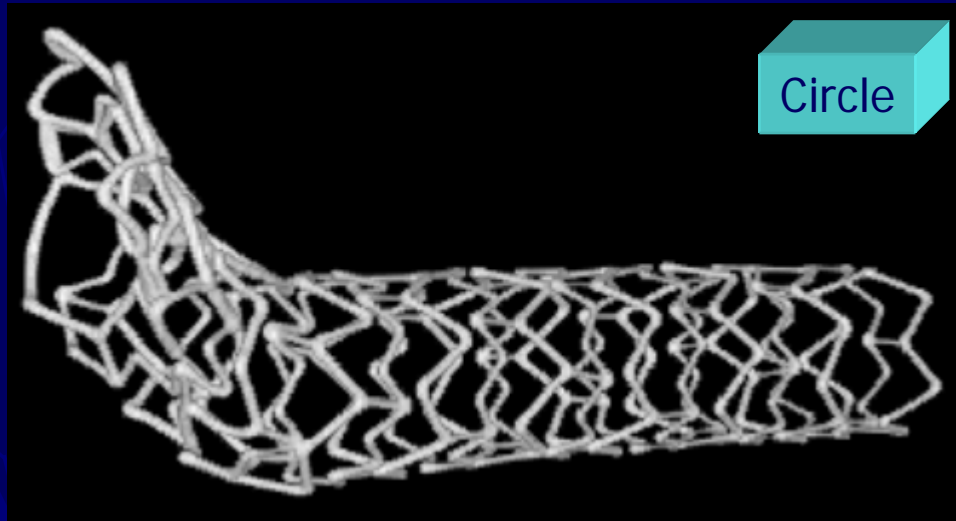
DK crush stenting

► Advantages

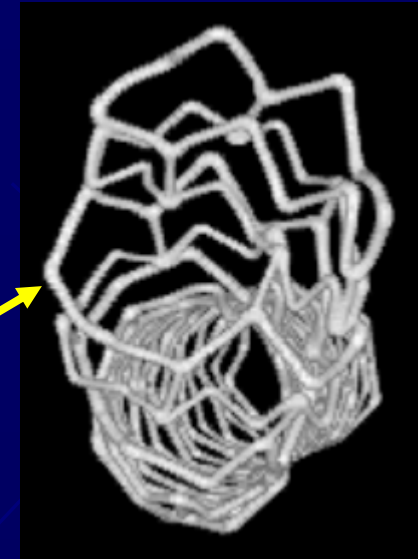
- Widely opened strut of the SB stent by first KB
- Easy re-crossing of the guide wire and the balloon system before second KB
- Good apposition of the stent to the vessel at the SB ostium



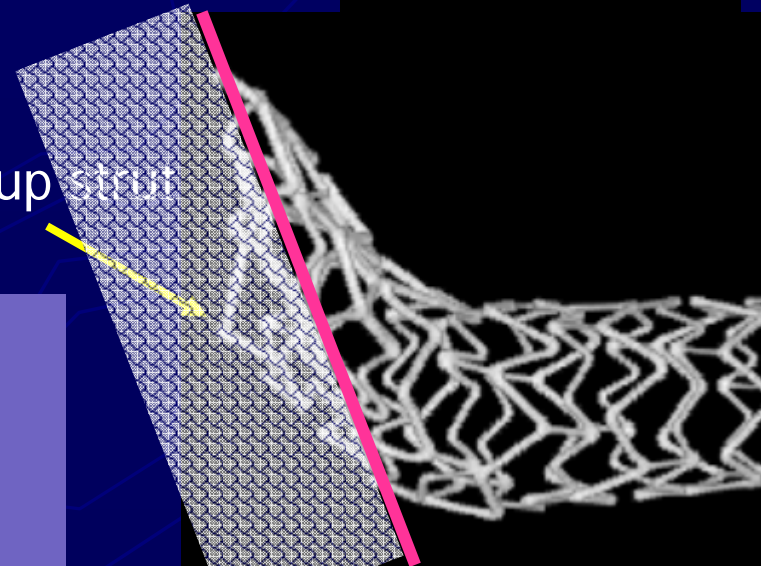
DK crush stenting After first KB inflation



Dilated strut



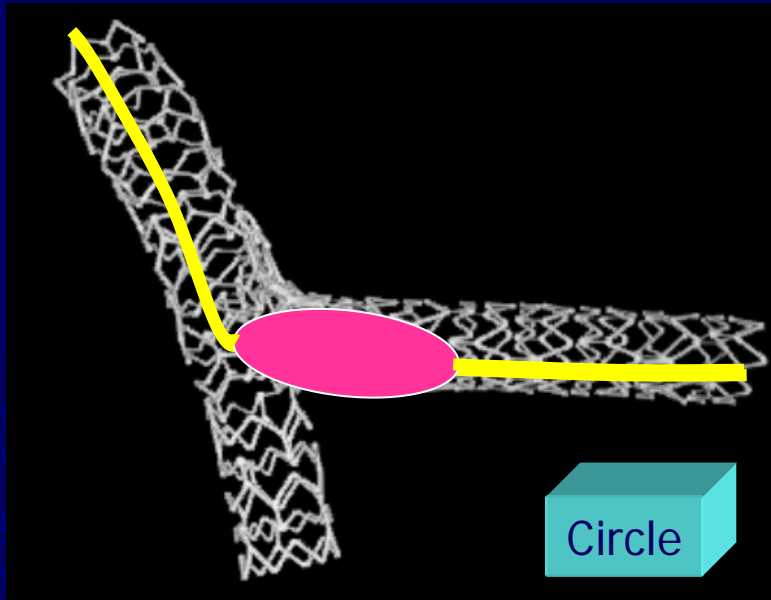
Raised up strut



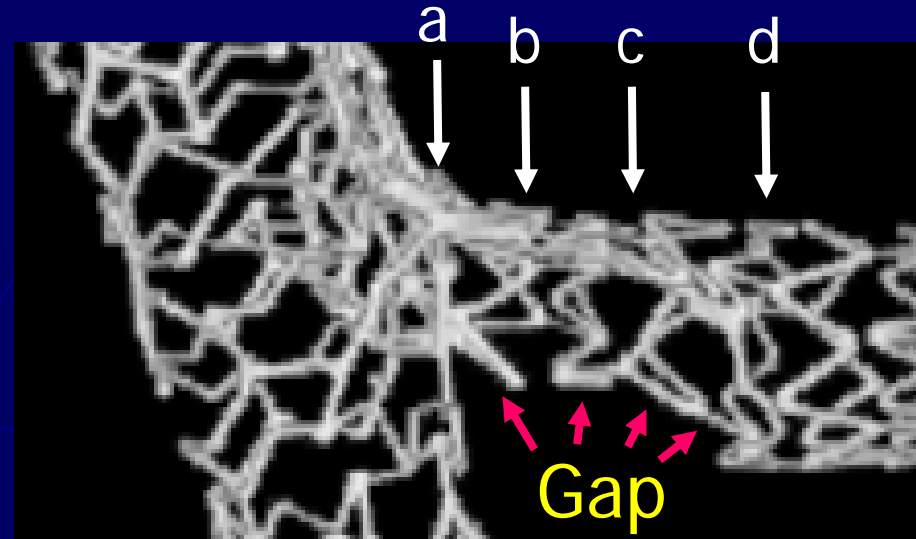
After MV stenting, is it possible to keep the dilated shape of the strut by first KB inflation?
Maybe, but it has a low probability.

MV vascular bed

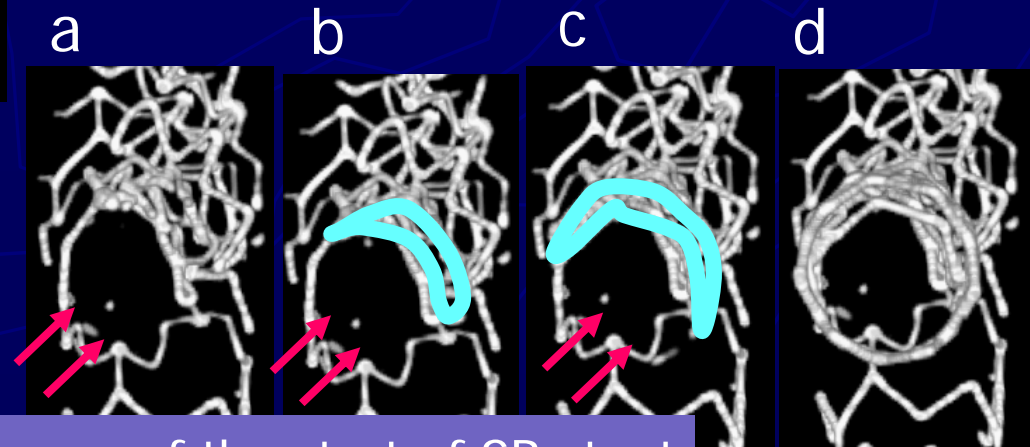
Crush stenting Worse case



Magnified view of the SB ostium



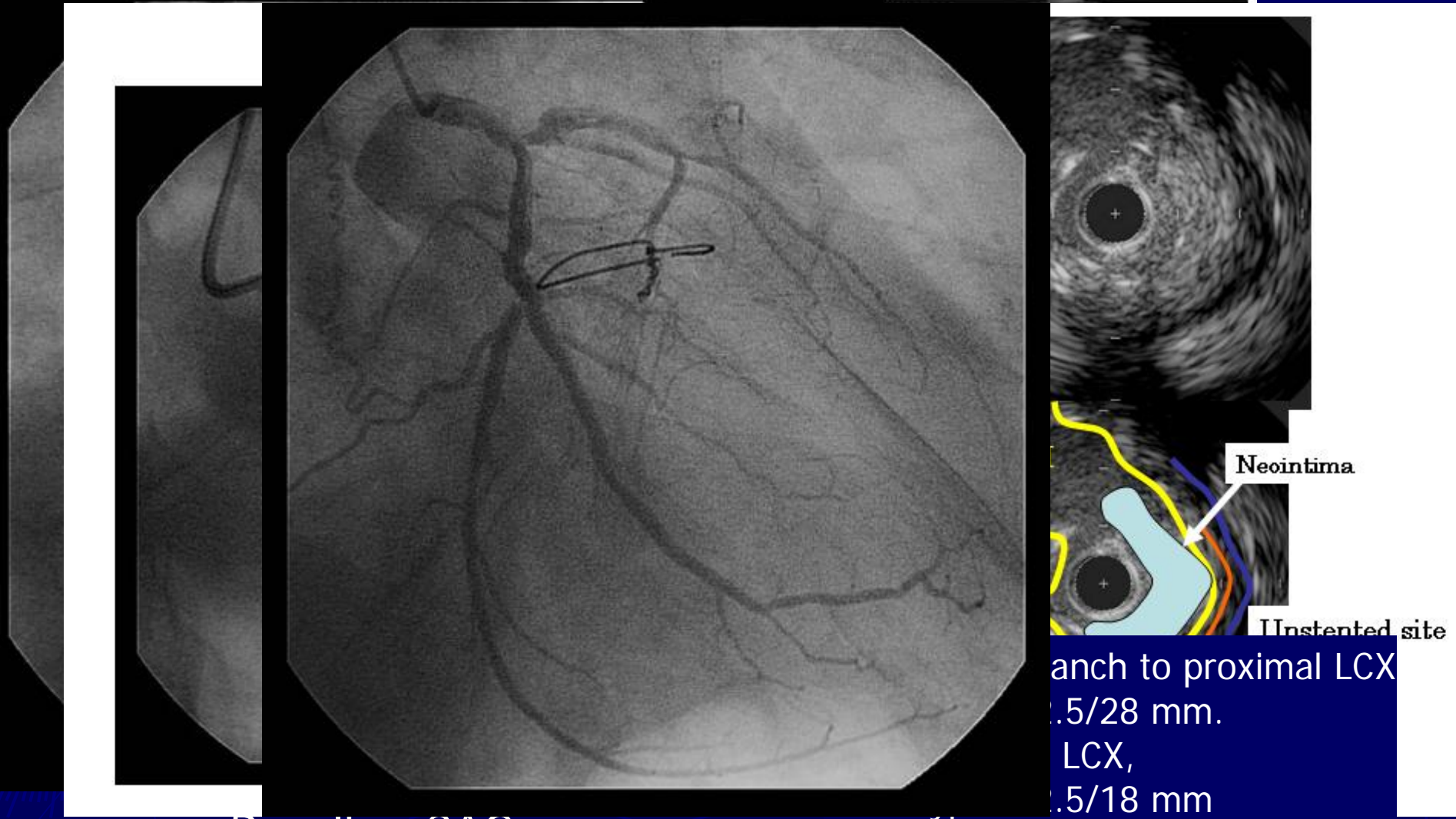
Cross sectional view



Absence of the strut of SB stent

63 y.o. Male, CTO in LCX

P/S CABG (LITA-LAD, Ao-SVG-RCA: recurrent degenerative lesions)

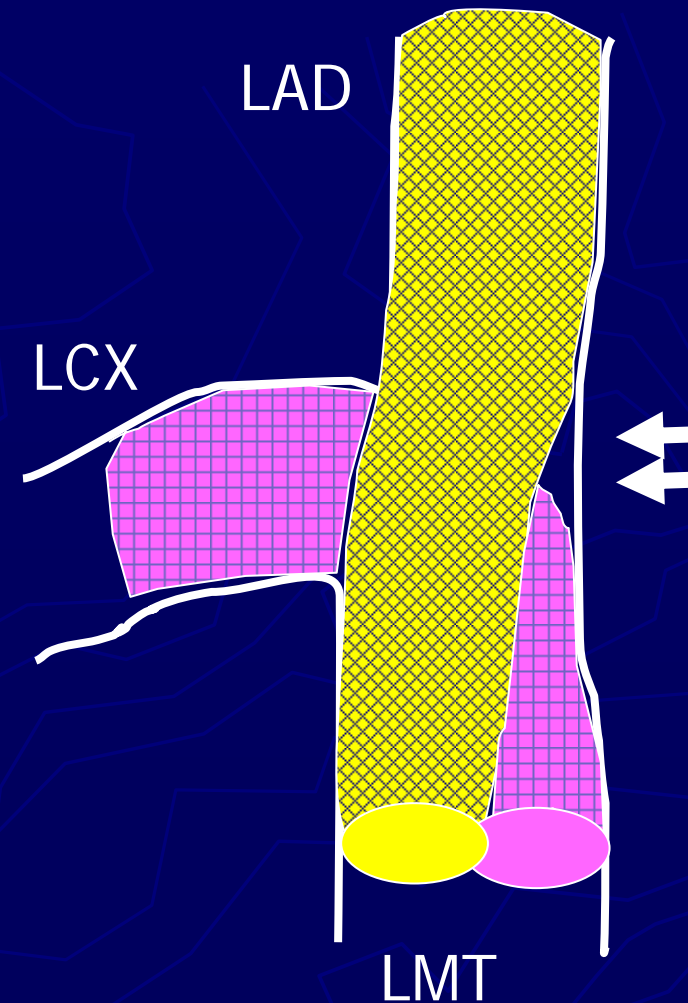
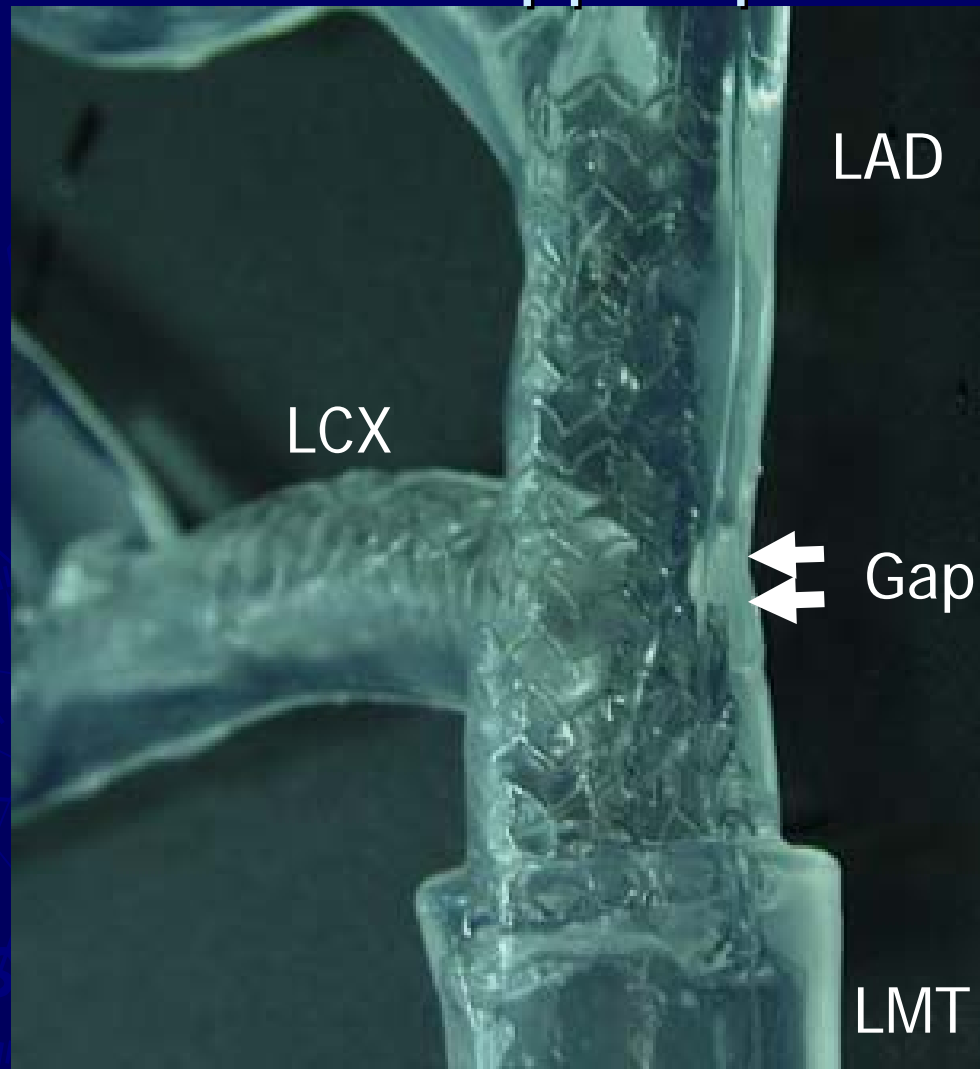


Baseline CCTA pre-iliac to Mo follow up at the proximal site.
DKA after pre-iliac to Mo follow up

Kissing stenting



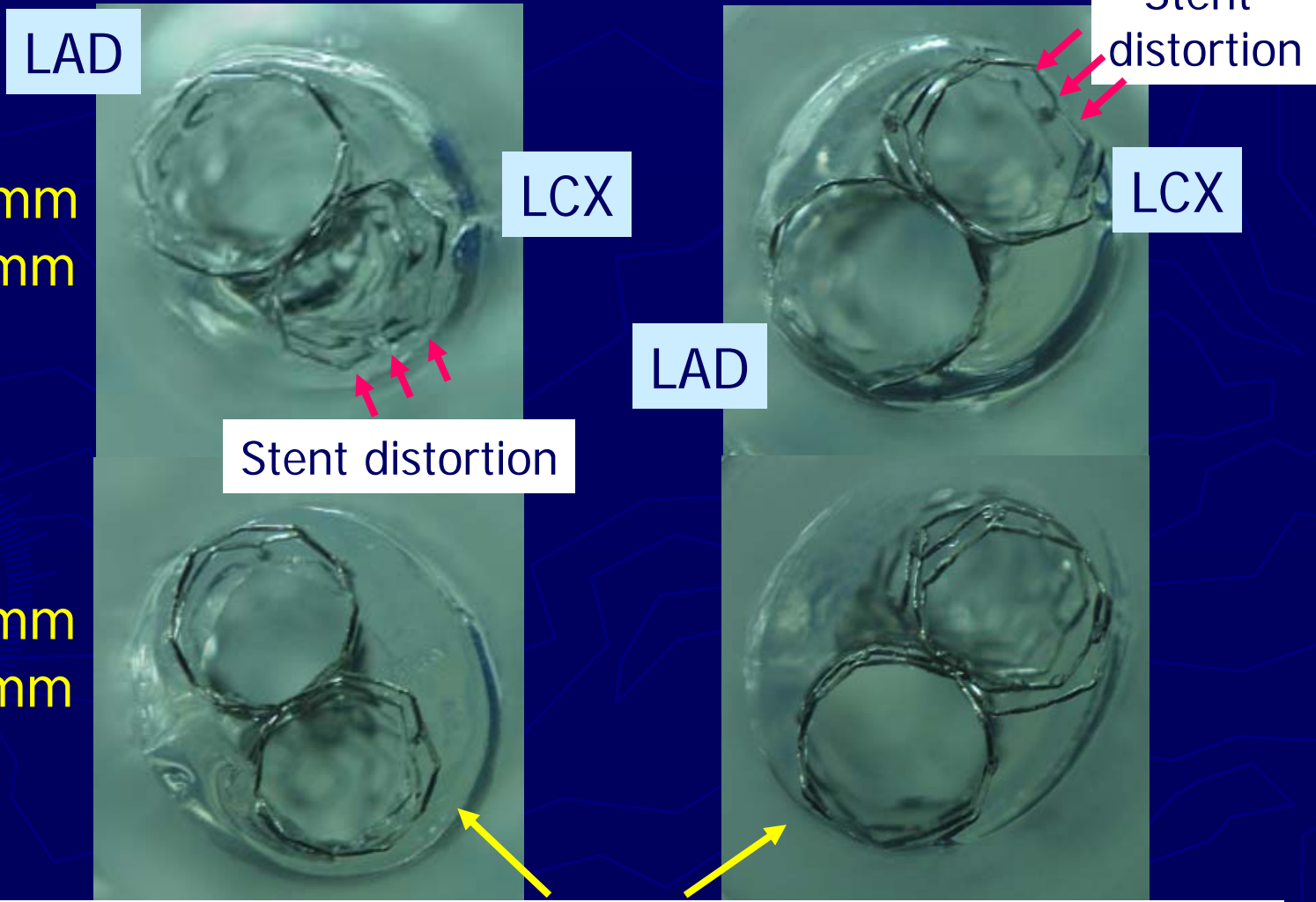
Stent overlapping created a gap beneath the overlapped portion of the stent.



Kissing stenting using different size stents produced compression of the LCX stent at distal LM.

LAD over LCX

LCX over LAD



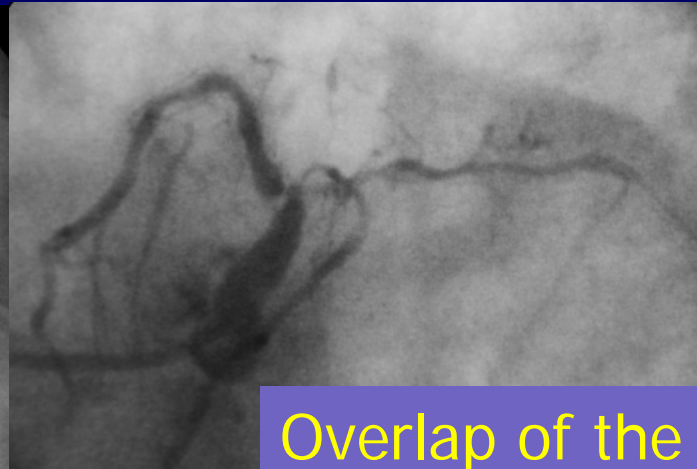
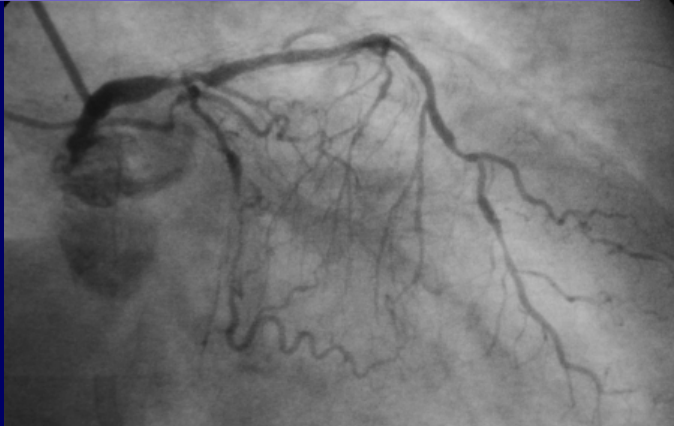
LAD: 3.5mm
LCX: 3.0mm

LAD: 3.0mm
LCX: 3.0mm

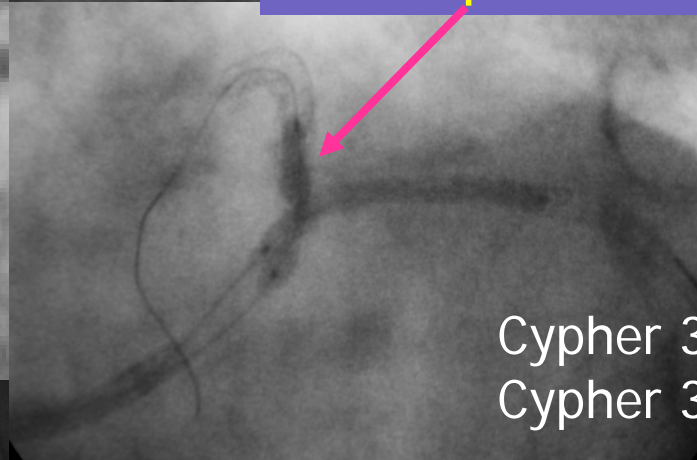
Murasato Y.
J Inv Cardiol.
2006, 18 :E279

No remarkable difference in stent expansion between LAD and LCX

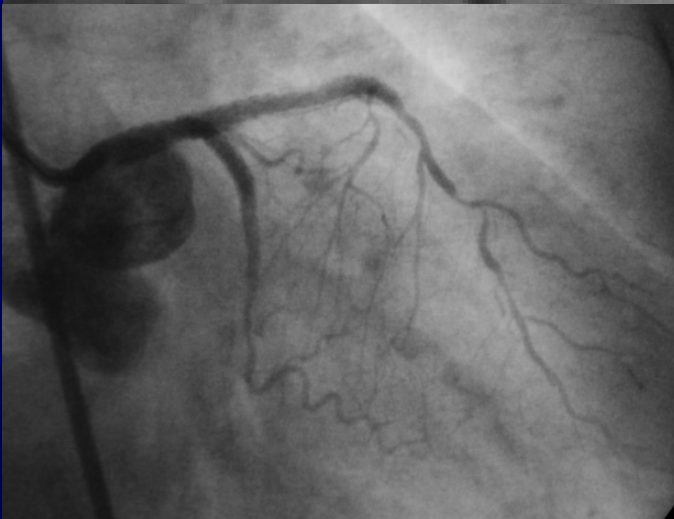
75 y.o. Female, Unstable AP



Overlap of the two stents

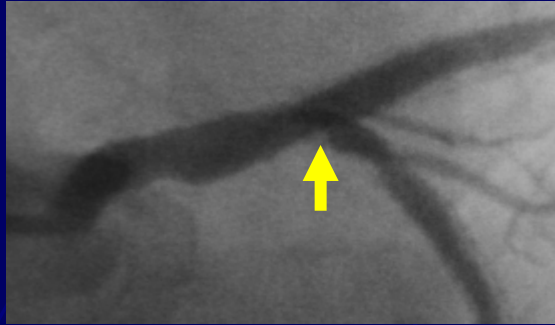


Cypher 3.5/23
Cypher 3.0/28



6-Mo follow up

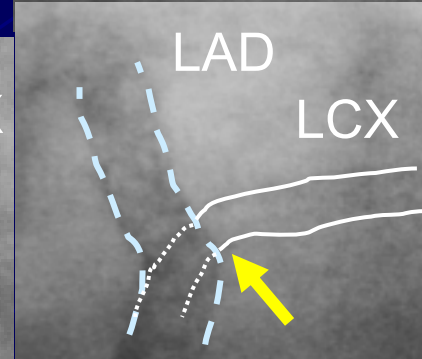
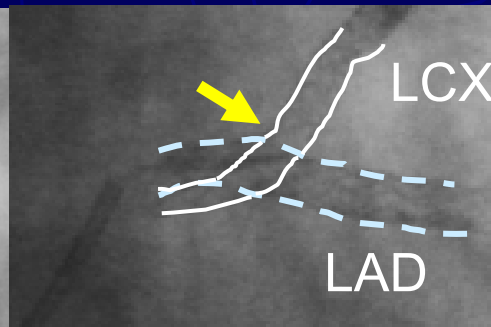
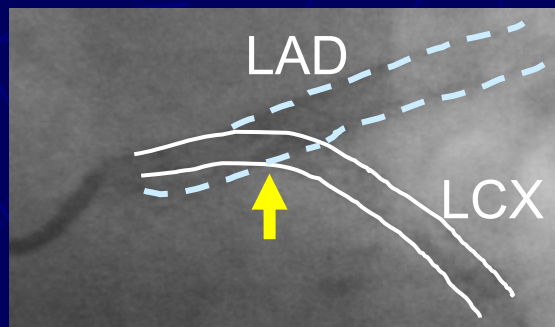
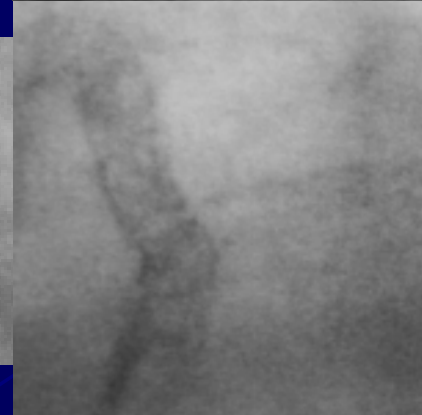
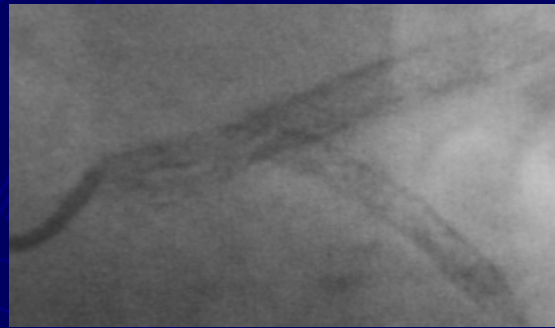
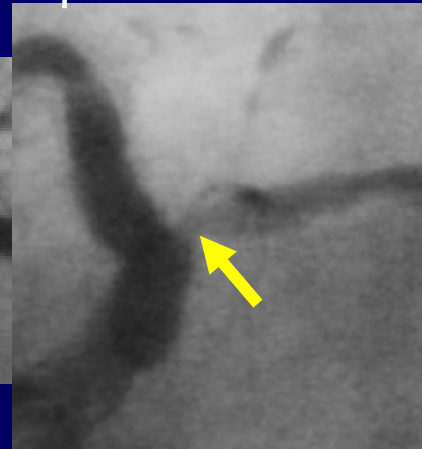
A-P caudal



RAO cranial



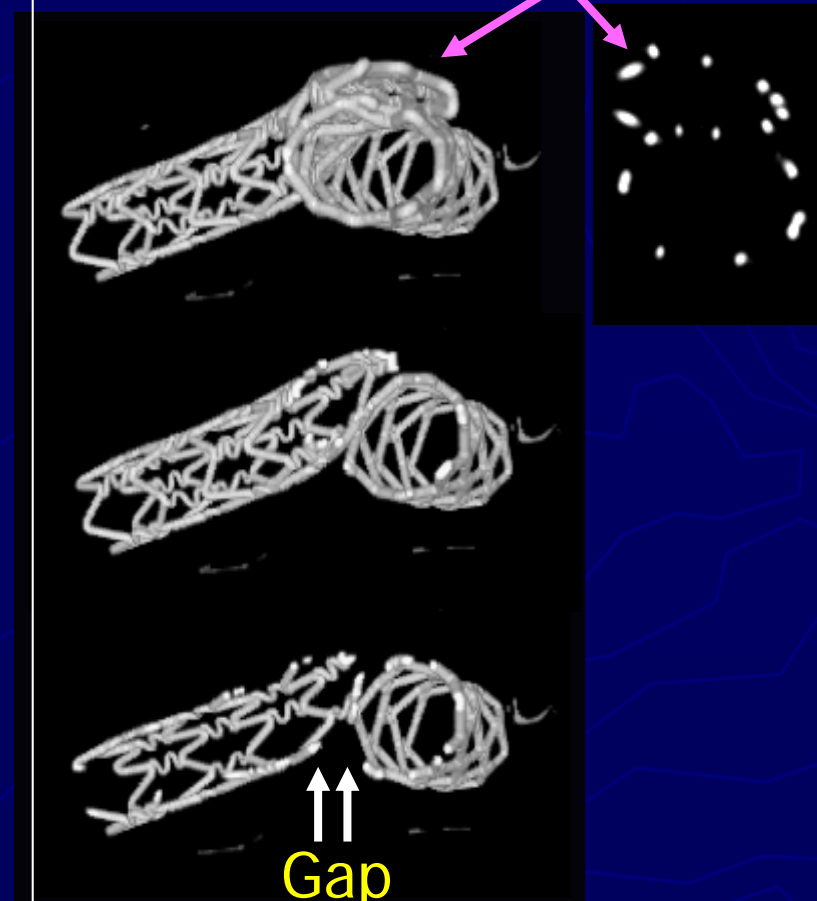
Spider



Kissing stenting

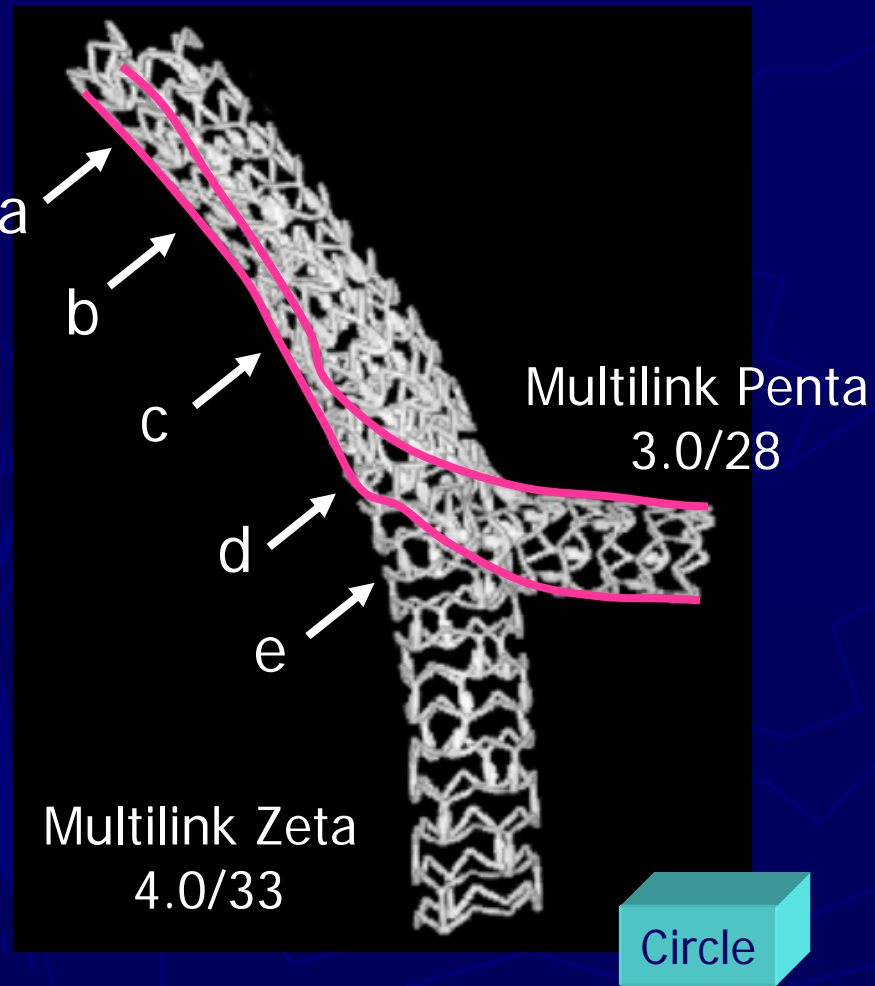


Cross sectional view
proximal **Compressed LCX stent**

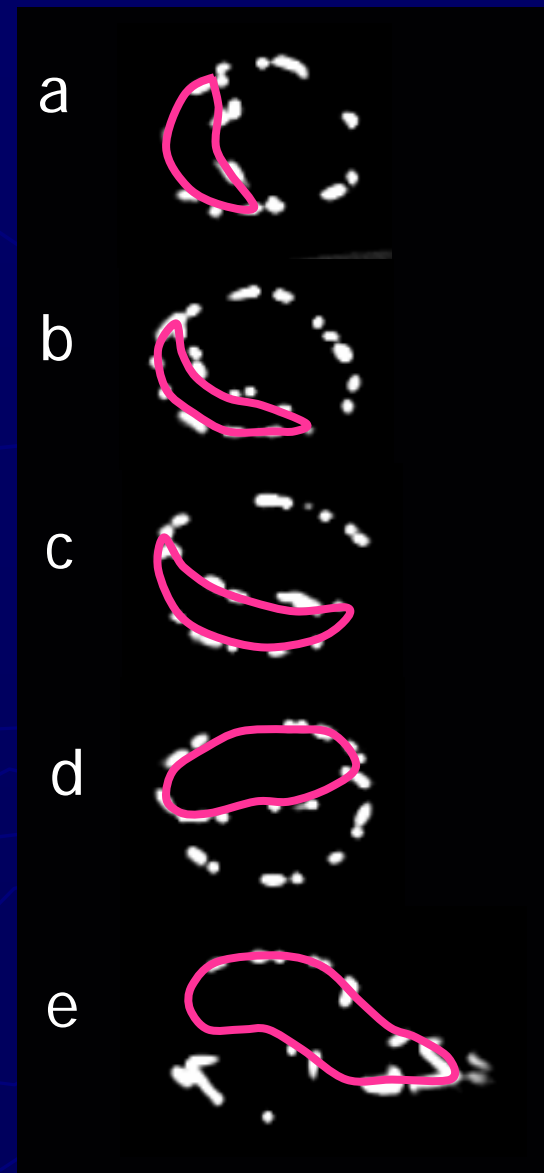


distal

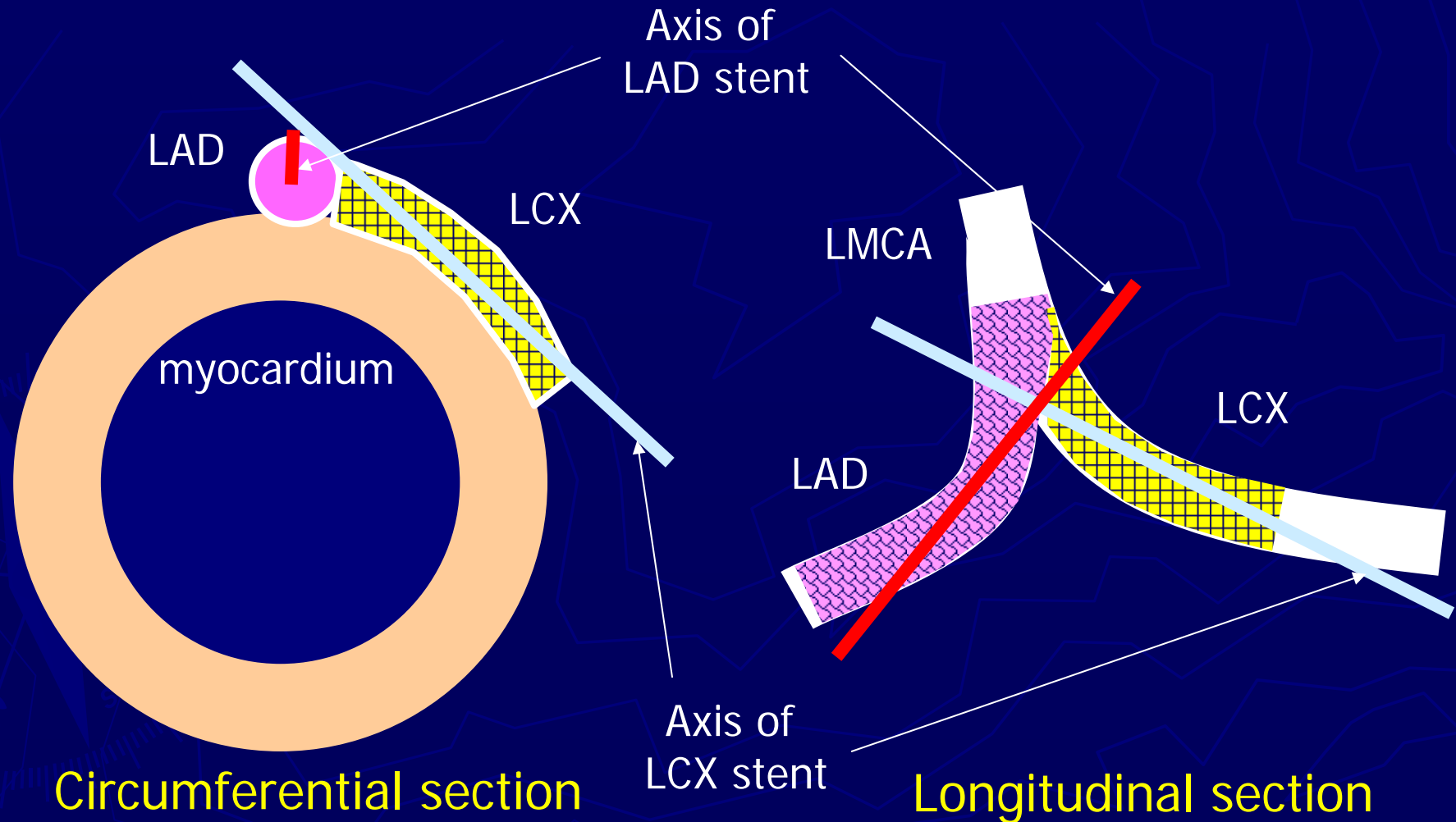
Long kissing stenting in LMCA



Cross sectional view



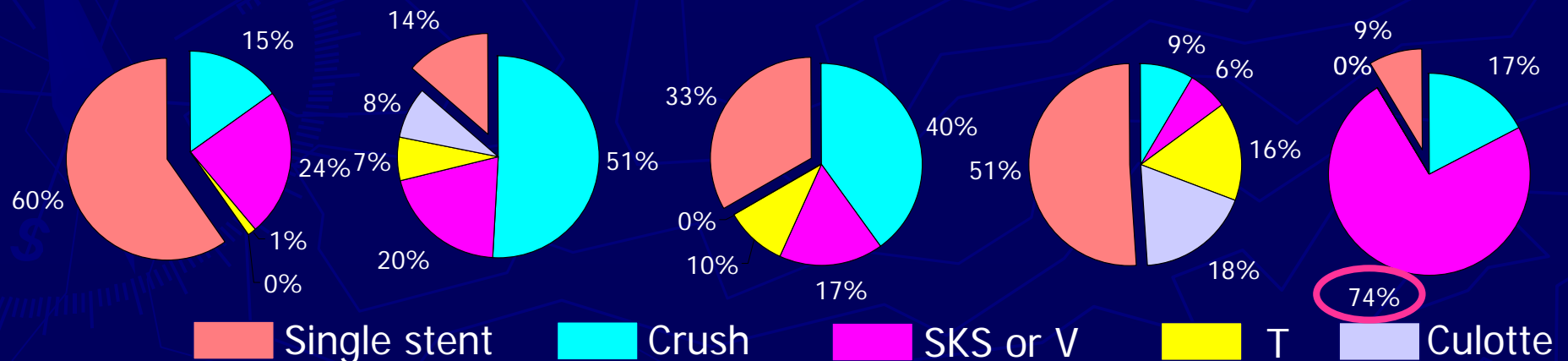
Differences in both longitudinal and circumferential axes between LAD and LCX cause overlapping of stent system in distal LMCA.



PCI with DES deployment for LMCA

1. JACC 2005, 45, 351
2. Circulation 2005, 111, 791
3. JACC 2006, 47, 864
4. JACC 2006, 47, 1530
5. JACC 2006, 47, 871

	Park ¹	Chieffo ²	Lee ³	Valgimigli ⁴	Price ⁵
F/U periods	12Mo	6Mo	12Mo	20Mo	12Mo
Cardiac mortality	0%	3.5%	4.0%	NR	2.0%
Restenosis	7.0%	14.1%	NR	8%	44.0%
TLR	2.0%	12.9%	10.0%	DLMD 13% NDLMD 3%	38.0%

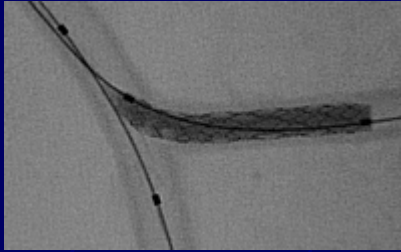


Modified T-stenting

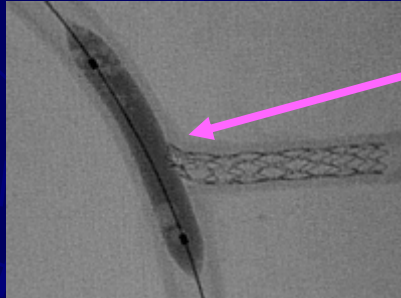


Modified T-stenting

1. Stent implantation in LCX

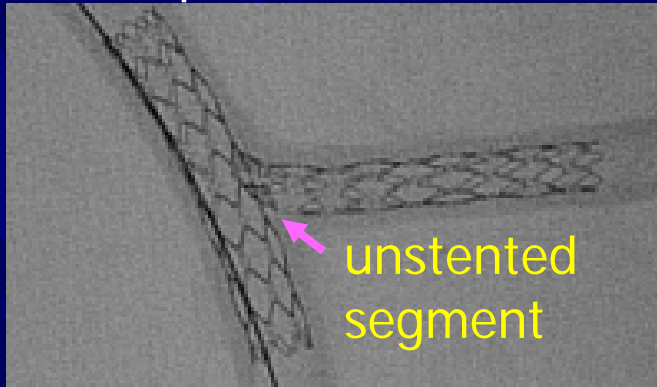


2. Balloon inflation in LM-LAD



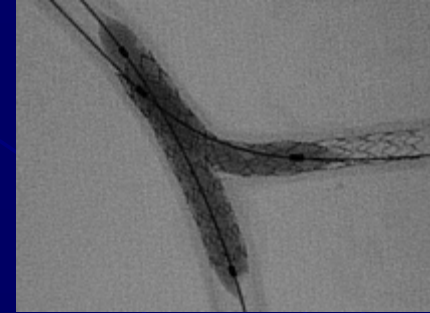
Stent distortion

3. Stent implantation in LM-LAD

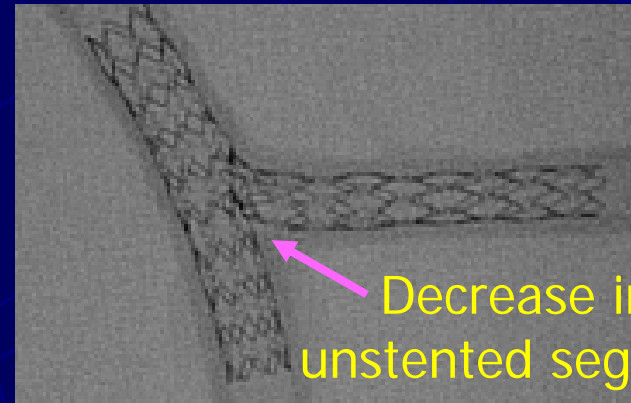


unstented segment

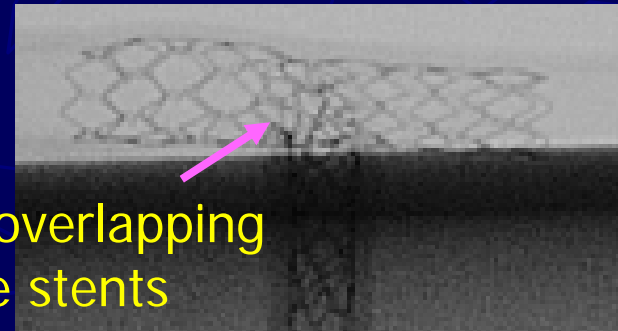
4. Recross GW into the orifice of LCX stent and kissing balloon inflation



5. Final fluoroscopy

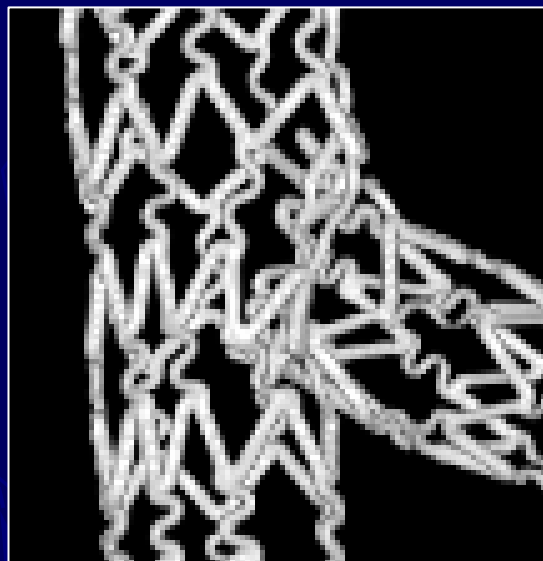


Decrease in unstented segment



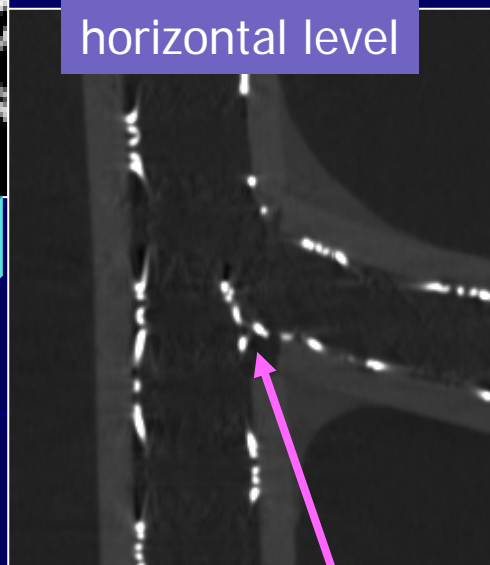
Minimum overlapping of the stents

Modified T-stenting



Circle

Slice at lower horizontal level

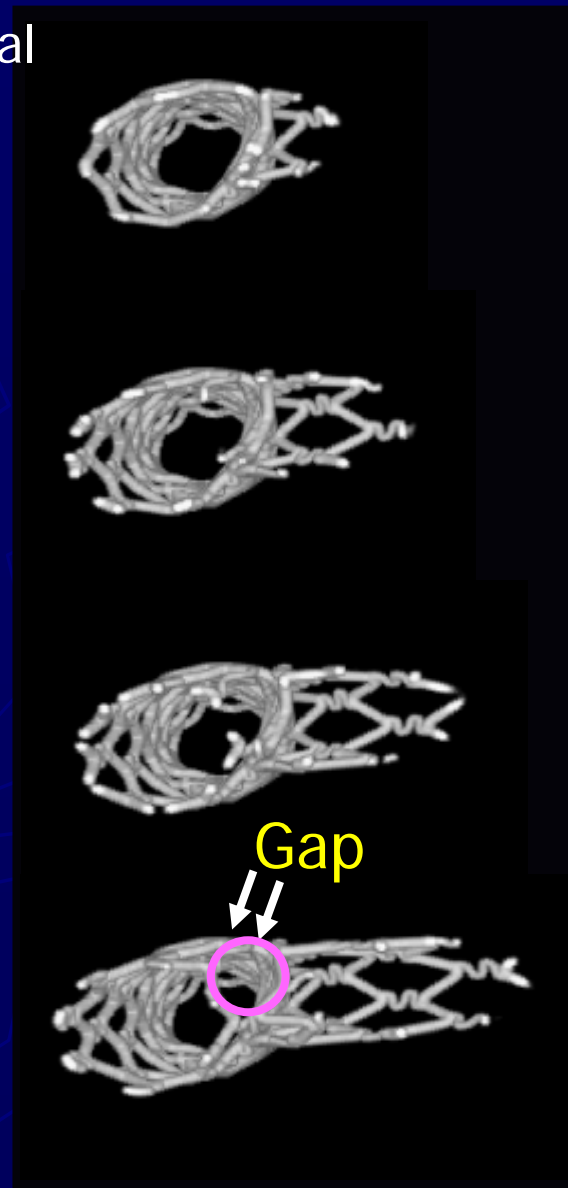


Metallic carina

proximal

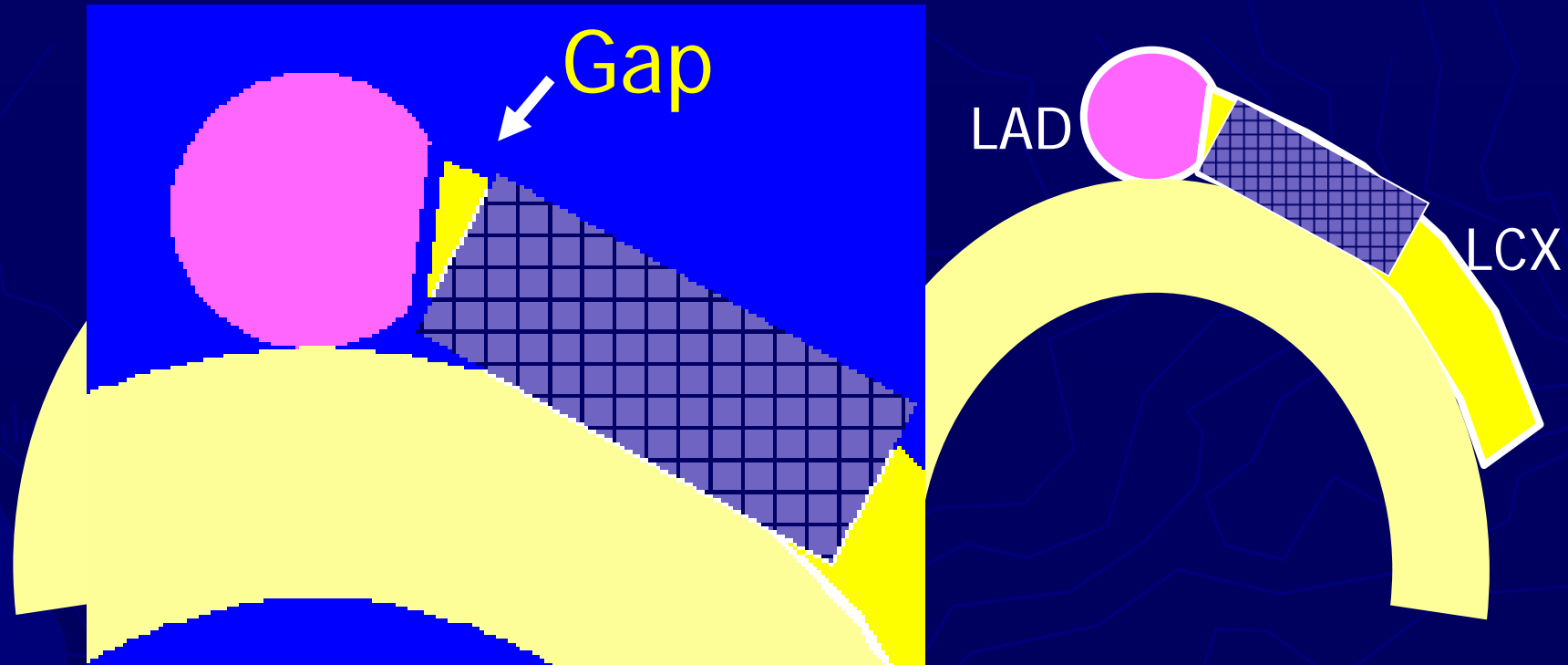
distal

Cross sectional view



Gap

The gap at the epicardial site is likely to be generated in a 3D structure.



The protrusion of the LCX stent is confirmed at the positioning.

However, the LCX stent is stretched straight after its dilation.

IVUS like view (1)

- ▶ The consecutive cross sectional view is available.
- ▶ View from distal site of the side branch to the main vessel with 0.1mm slice.



- ▶ Can you reconstruct this 3-D image accurately?

IVUS like view (2)

Incomplete crush

Absence of the strut

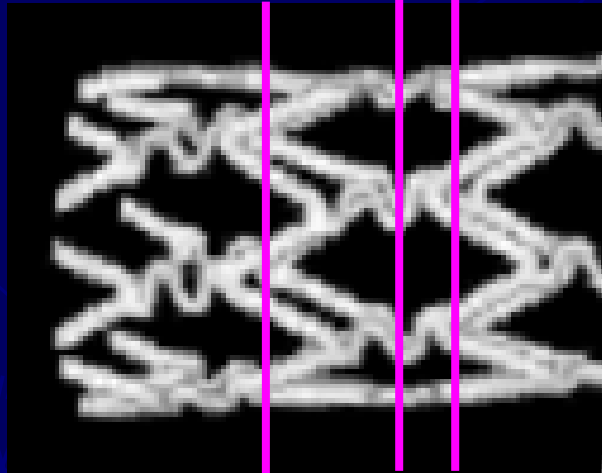


Distribution of stent strut

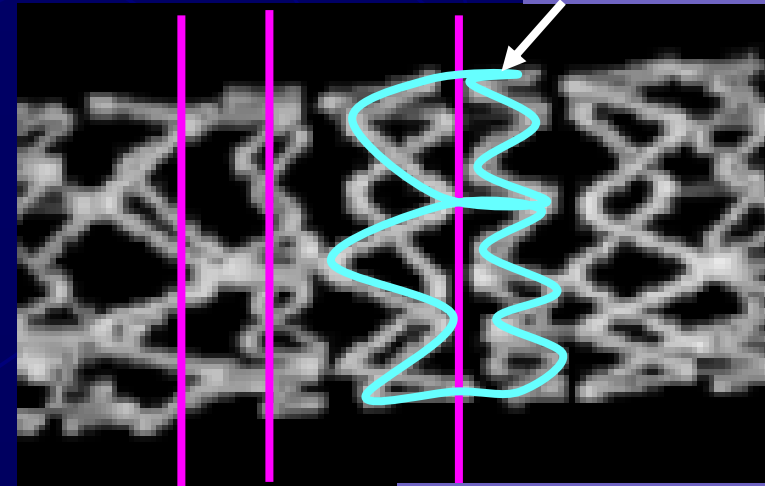
Cypher

Taxus Express

a b c



a b c



Dilated cell

Absence of strut



a

b

c



a

b

c

Conclusion

- ▶ In each double stenting on a 3-dimensional LMCA bifurcation model, the style of stent overlap greatly affects stent expansion, distortion and the potential for gap formation.
- ▶ 3-D CT imaging is very useful for analyzing the condition of the double stenting in detail.



Both plays are attractive. However, the cooperation is necessary for "Ren-jishi".