

Le plus important est invisible

- Something precious is always behind the scene -

Satoru Mitomo M.D.

Director of CCI Unit : New Tokyo Hospital ; Tokyo

Sunao Nakamura MD, PhD

President : New Tokyo Hospital ; Tokyo

Professor of Advanced Cardio-Vascular Medicine : Kumamoto University

Senior Consultant : National Cardiovascular Center Japan

FACC, FAHA, FESC, FSCAI

Le plus important est invisible

One Passage

It is only with the heart
that one can see rightly;
What is essential is invisible
to the eye.



Antoine de Saint-Exupéry
1900~1944

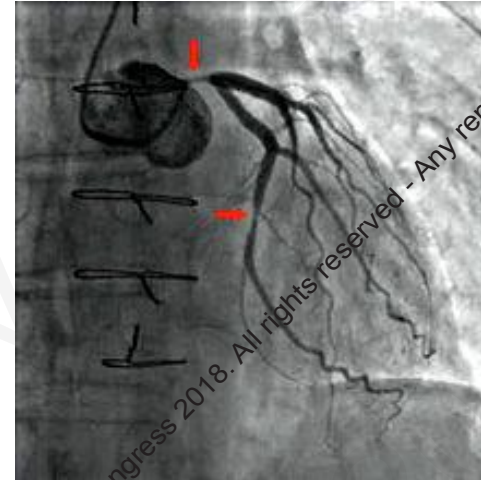
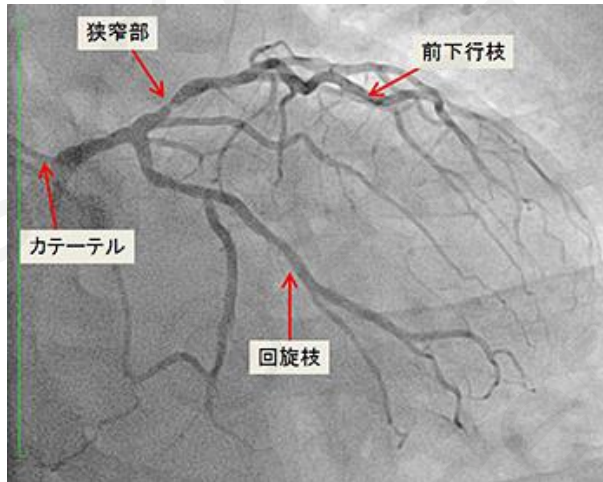
The Little Prince



Something precious is always behind the scene

About LMT PCI

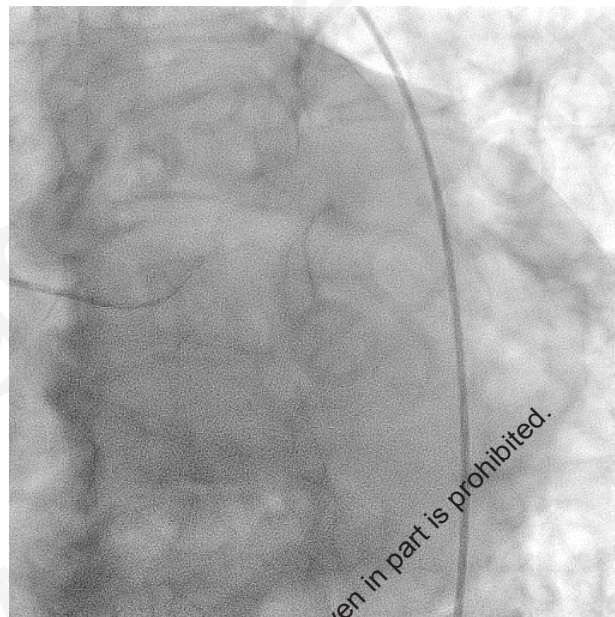
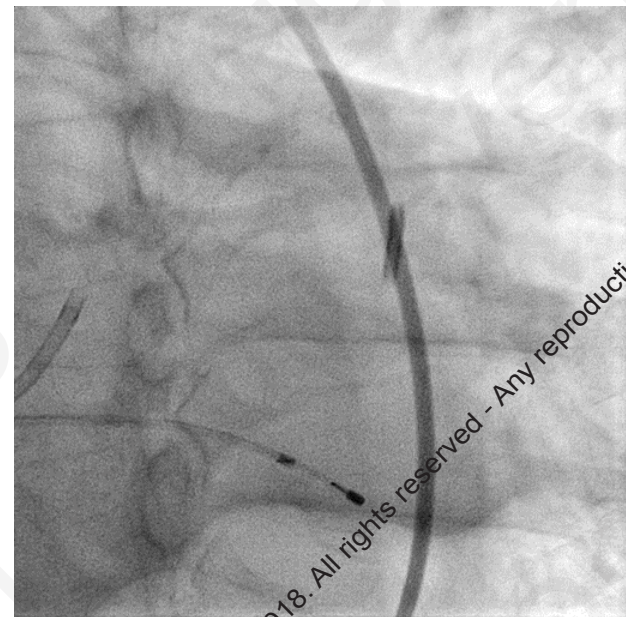
- Already our regular practice ??? -
- Any technical limitation ??? -



2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

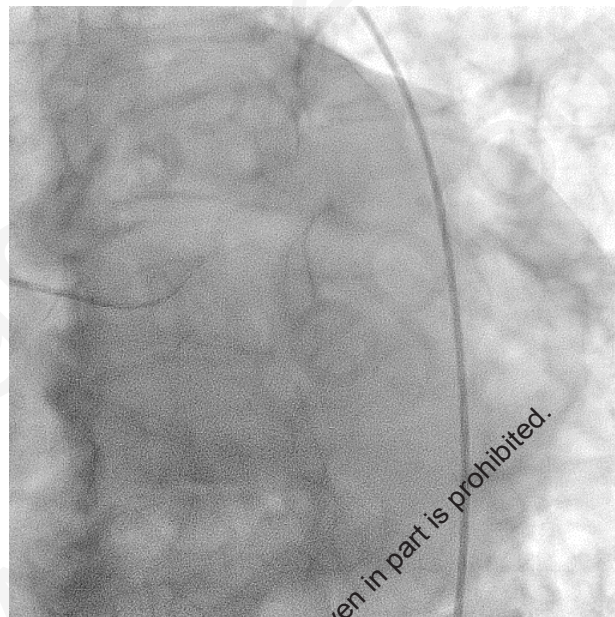
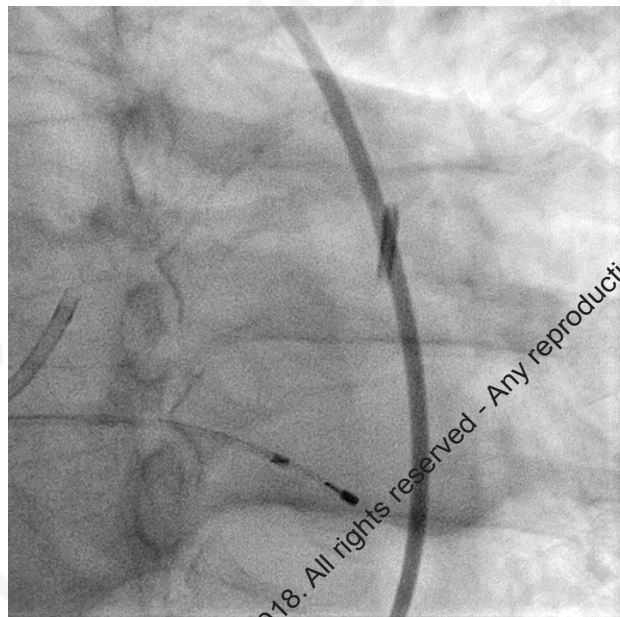
Pre



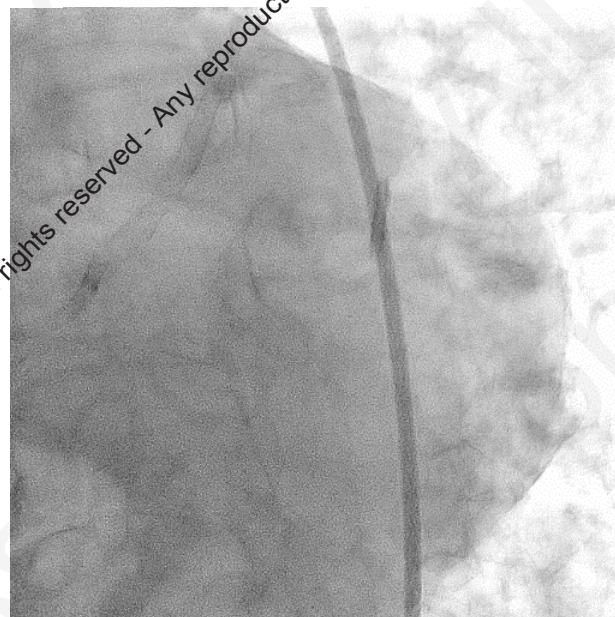
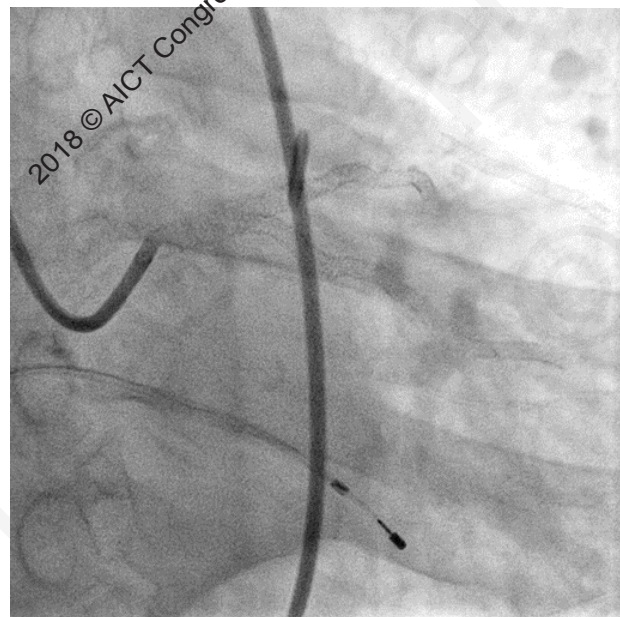
2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

Pre



Post

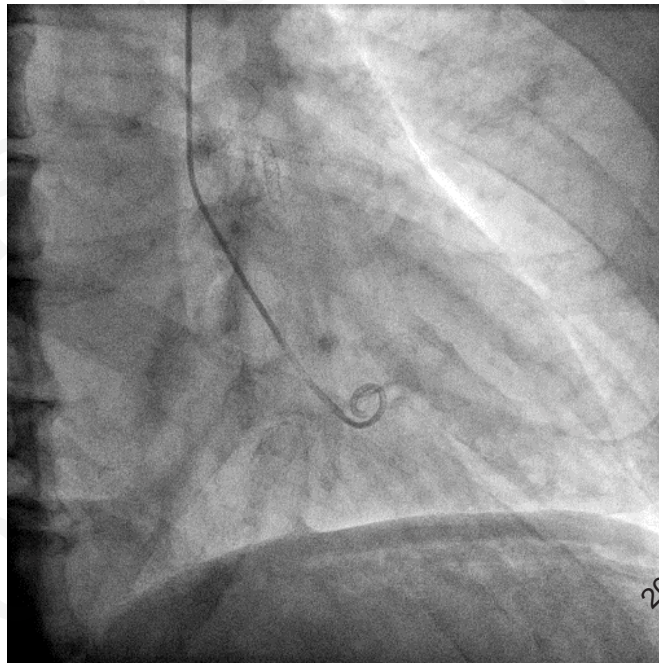
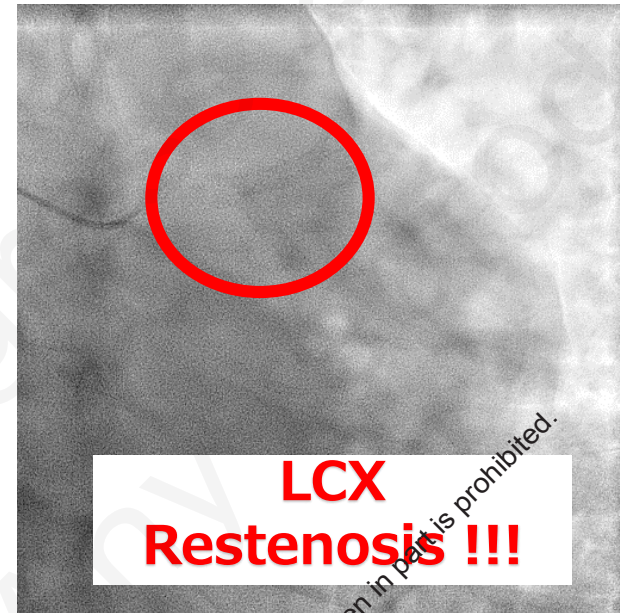
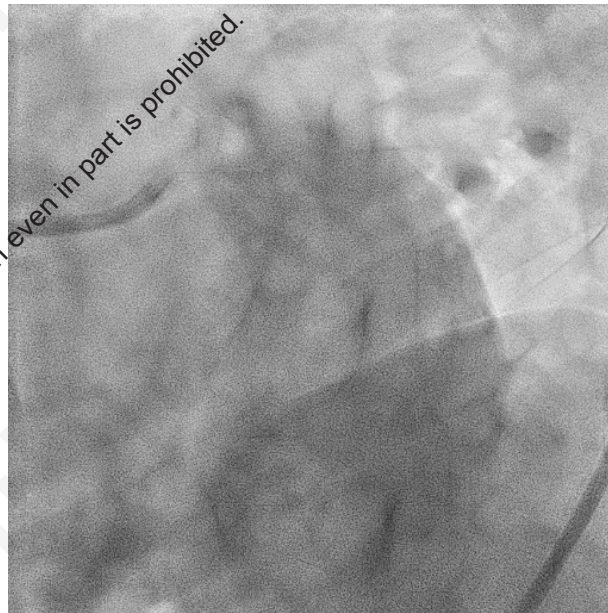
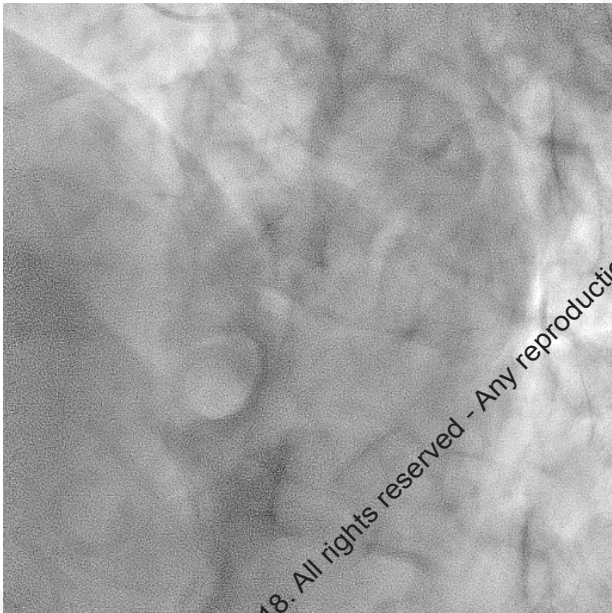


2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

Pre

Post

9M F/U



EF: 66%

No change: pre and post

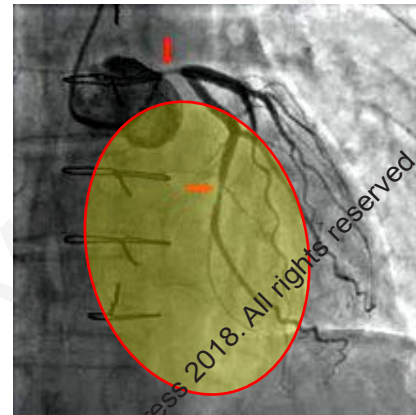
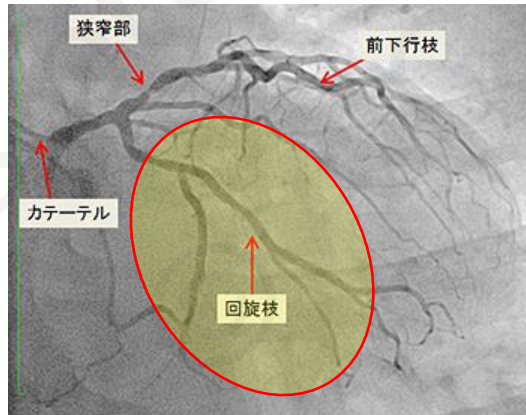
Patients: No Symptom

What should we do next ???

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

About LCX

- Lesson from MITO registry - ???
- Meaning of LCX - ???



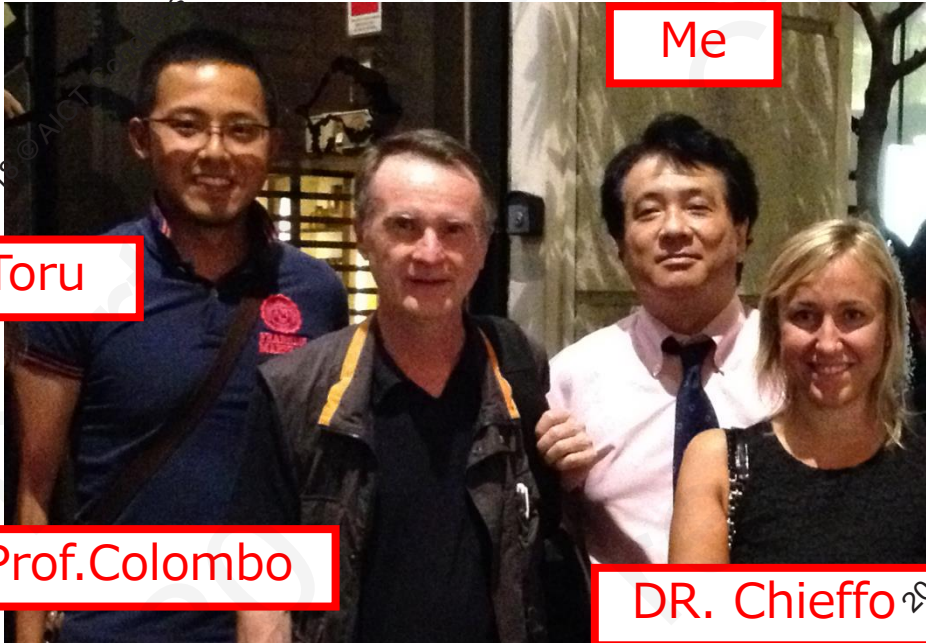
2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

The Milan and New-Tokyo (MITO) Registry

2002 April- 2016 Jun

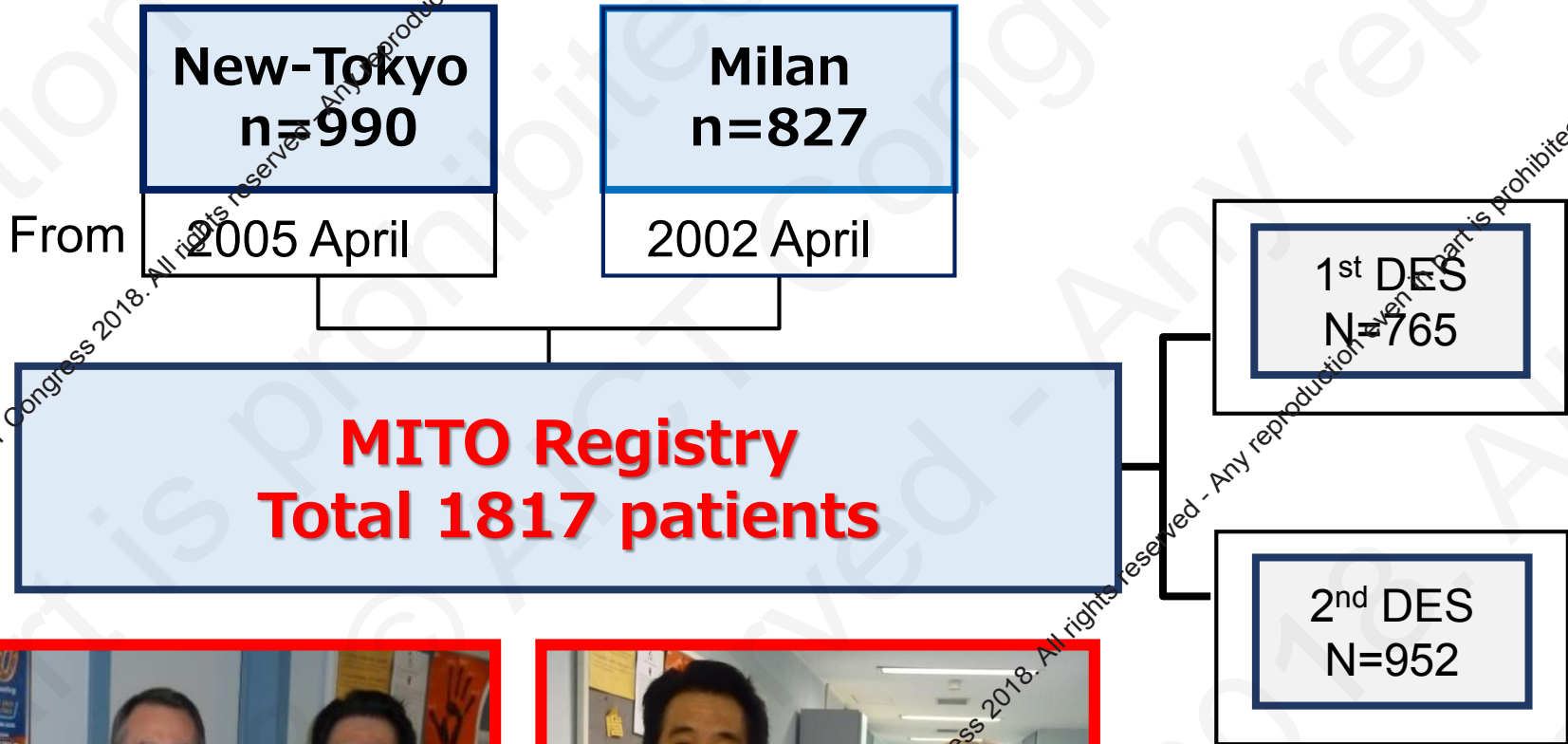
Among LMT PCI, some specific cases are still challenged with restenosis and MACE. Seeking for solution of these unsolved challenges, we decided to conduct data review of our own cases. Under the guidance of Prof. Antonio Colombo and Dr. Alaide Chieffo, our staff compiled data of our hospital and that of Milan as **MITO Registry**.



The Milan and New-Tokyo (MITO) Registry

2002 April- 2016 Jun

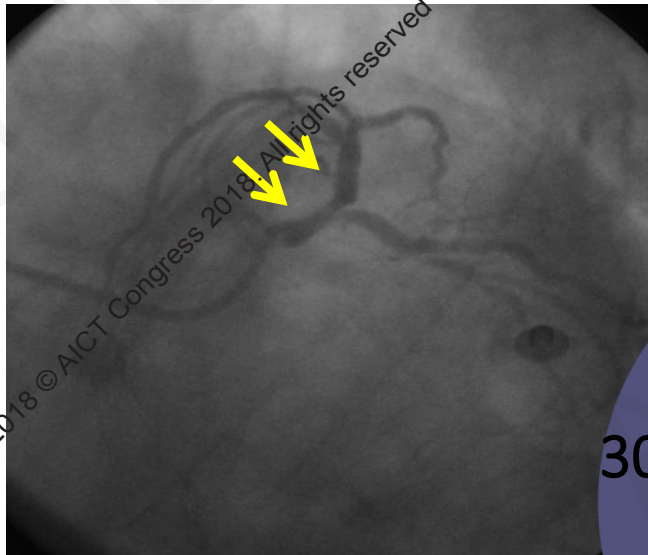
23



The impact of Main Branch Restenosis on Long Term Mortality Following Drug-eluting Stent Implantation in Patients with De Novo Unprotected Distal Left Main Bifurcation Coronary Lesions: The MILan and New-TOKyo (MITO) Registry

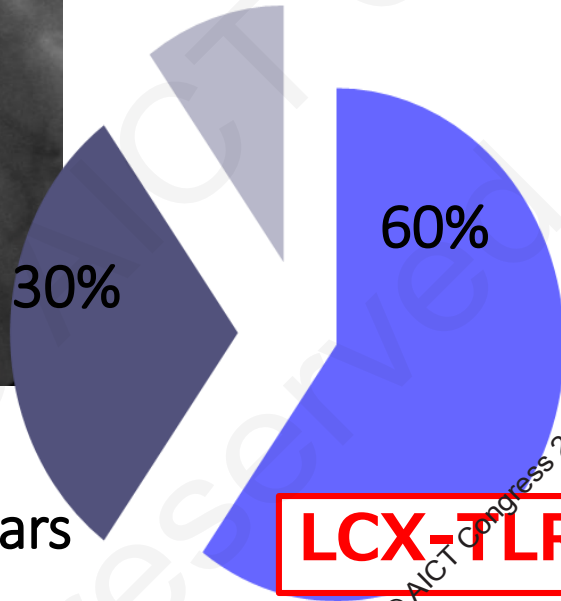
Catheter Cardiovasc Interv. 2013 Sep 2 by K.Takagi, S.Nakamura A.Colombo et.al

Distal LMT-LAD ISR



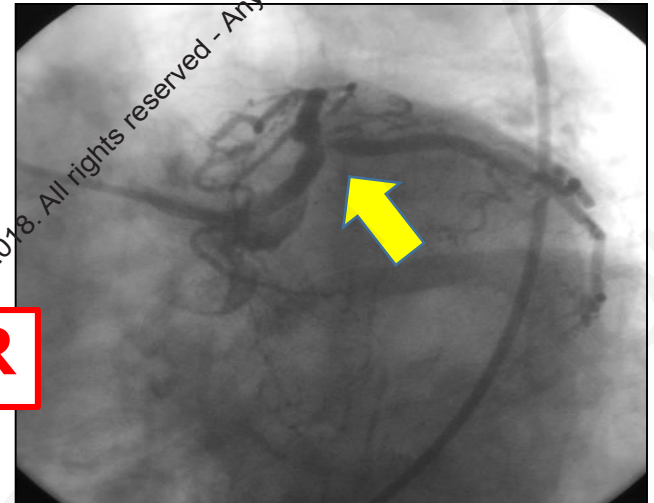
LAD-TLR
9.2% at 2-years

Both LAD and LCX-TLR



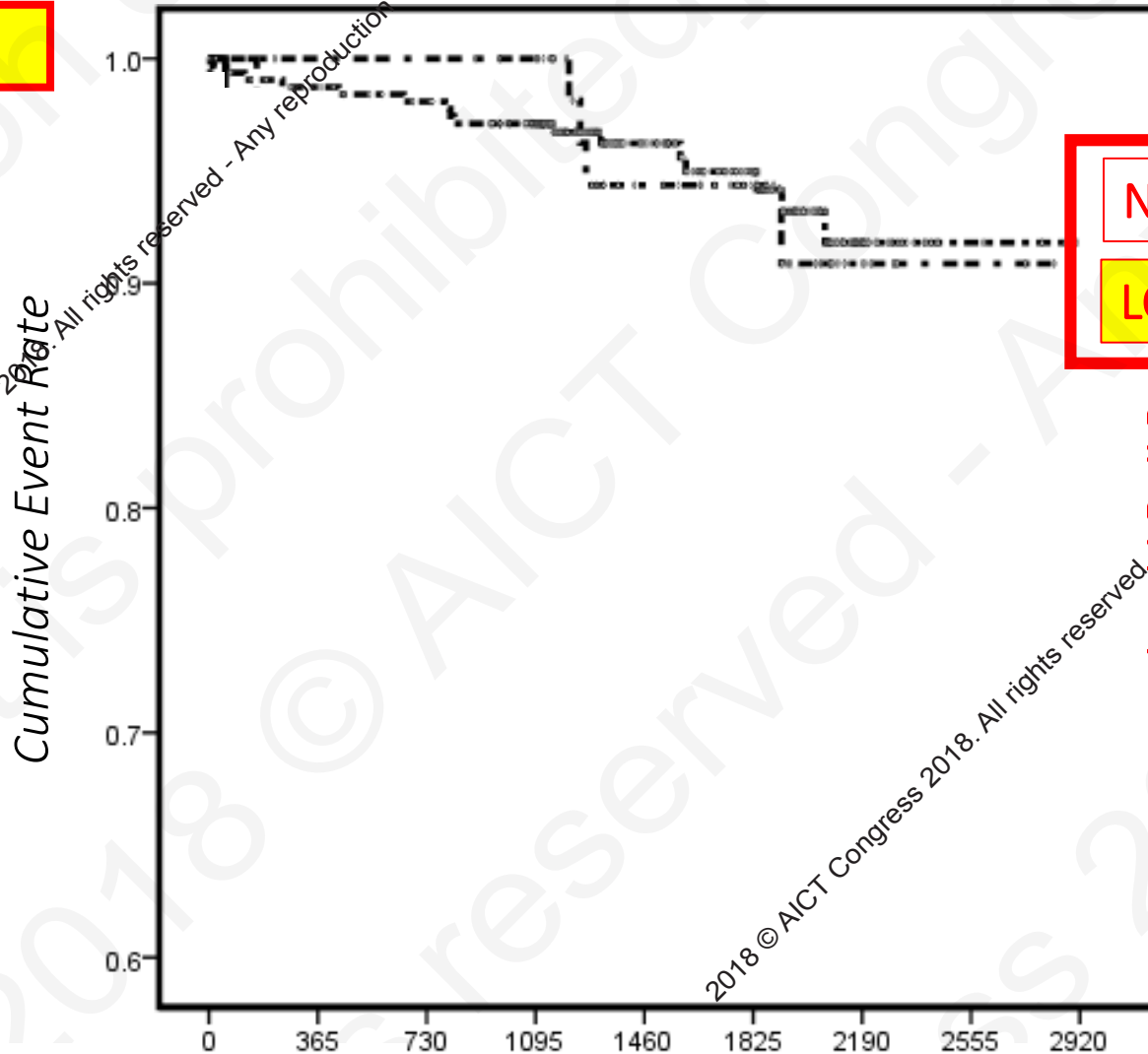
LCX-TLR

LCx ostial ISR alone



Kaplan Meier 8-year patients survival

n=753



No restenosis N=318

LCX-ISR alone N=64

Days Since PCI

Lesson 1 : MITO registry

Among restenosis after LMT PCI, restenosis at LCX ostium is not directly link to fatal prognosis in most of the cases. Therefore our focus should be shift to restenosis at LM toward LAD, which strongly affect on patients' fatal prognosis.



Kensuke Takagi M.D. FACC

Catheter Cardiovasc Interv. 2013 Sep 2

Circ Cardiovasc Interv. 2016

1 stent vs 2 stent -

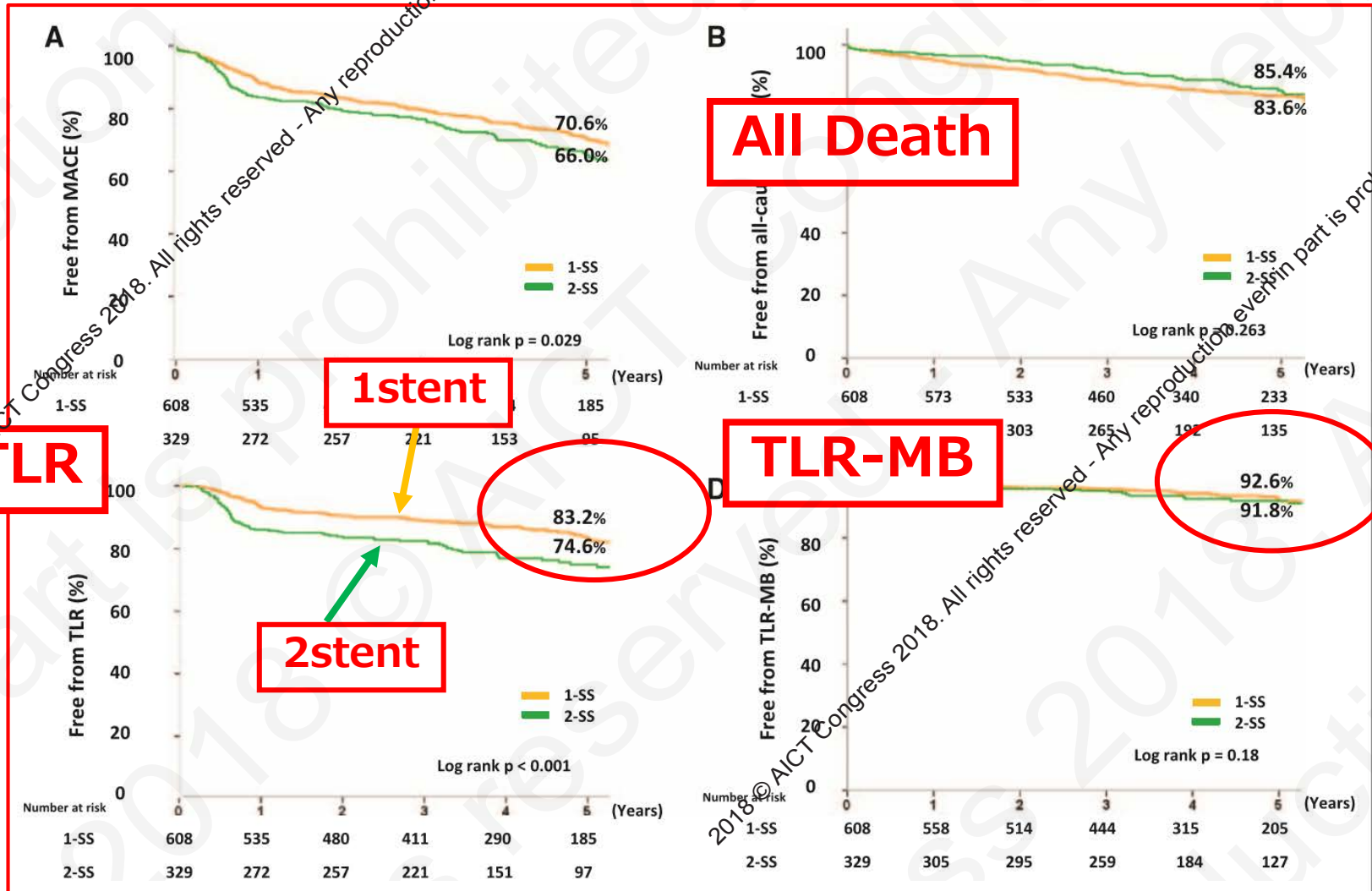
in the era of 2nd generation DES

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

Comparison Between 1- and 2-Stent Strategies in Unprotected Distal Left Main Disease The Milan and New-Tokyo Registry

Circ Cardiovasc Interv. 2016 by K.Takagi, S.Nakamura A.Colombo et.al



Comparison Between 1- and 2-Stent Strategies in Unprotected Distal Left Main Disease The Milan and New-Tokyo Registry

Circ Cardiovasc Interv. 2016 by K.Takagi, S.Nakamura A.Colombo et.al

Table 3. Clinical Outcome According to Stent Strategy in Unprotected Distal Left Main Patients

Event at Follow-Up	1-stent (n=108)	2-stent (n=108)	HR, 95% CI; P Value	Adjusted HR, 95% CI; P Value
MACE	180 (29.6)	126 (38.3)	1.29, 1.03–1.62; 0.03	1.19, 0.92–1.54; 0.20
All-cause death	101 (16.6)	48 (14.6)	0.82, 0.58–1.16; 0.26	0.88, 0.60–1.29; 0.53
Cardiac death	52 (8.6)	18 (5.5)	0.60, 0.35–1.02; 0.06	0.52, 0.29–0.92; 0.03
TLR	96 (15.8)	92 (28.0)	1.91, 1.43–2.54; <0.001	1.59, 1.15–2.20; 0.005
TLR-MB	44 (7.2)	37 (11.2)	1.35, 0.84–2.10; 0.18	1.05, 0.64–1.72; 0.86
TLR-SB	63 (10.4)	76 (23.1)	2.38, 1.71–3.33; <0.001	1.94, 1.33–2.82; 0.001
MI	21 (3.5)	9 (2.8)	0.73, 0.33–1.59; 0.42	0.53, 0.23–1.24; 0.14
Definite/probable ST	11 (1.8)	6 (1.8)	0.99, 0.37–2.69; 0.99	0.86, 0.29–2.62; 0.80

CI indicates confidential interval; HR, hazard ratio; MACE, major adverse cardiovascular events; MB, main branch; MI, myocardial infarction; SB, side branch; ST, stent thrombosis; and TLR, target lesion revascularization.

The 2-SS might have been caused by the high development of SB restenosis mostly of the ostium of the LCx. ,
However overall this had little impact on long-term mortality.

Lesson 2 : MITO registry

The 2 Stent Strategy might have been caused by the high development of SB restenosis mostly of the ostium of the LCx even in the era of 2nd generation DES. However overall this had little impact on long-term mortality.



Kensuke Takagi M.D. FACC

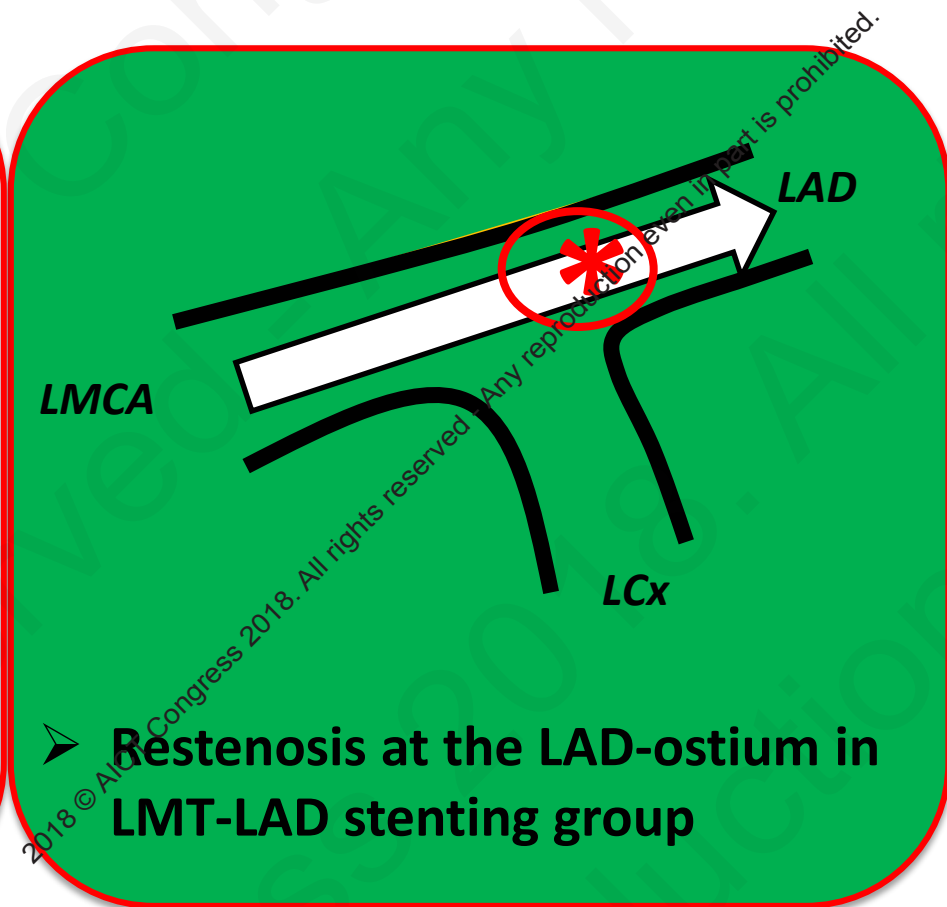
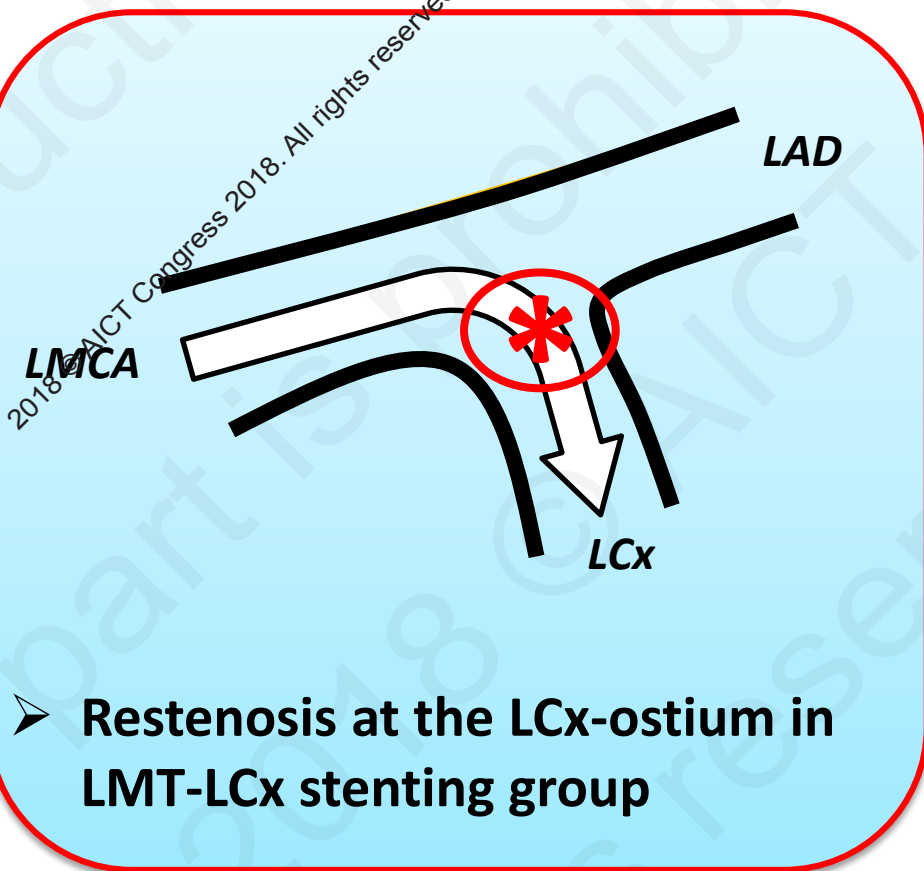
Catheter Cardiovasc Interv. 2013 Sep 2

Circ Cardiovasc Interv. 2016

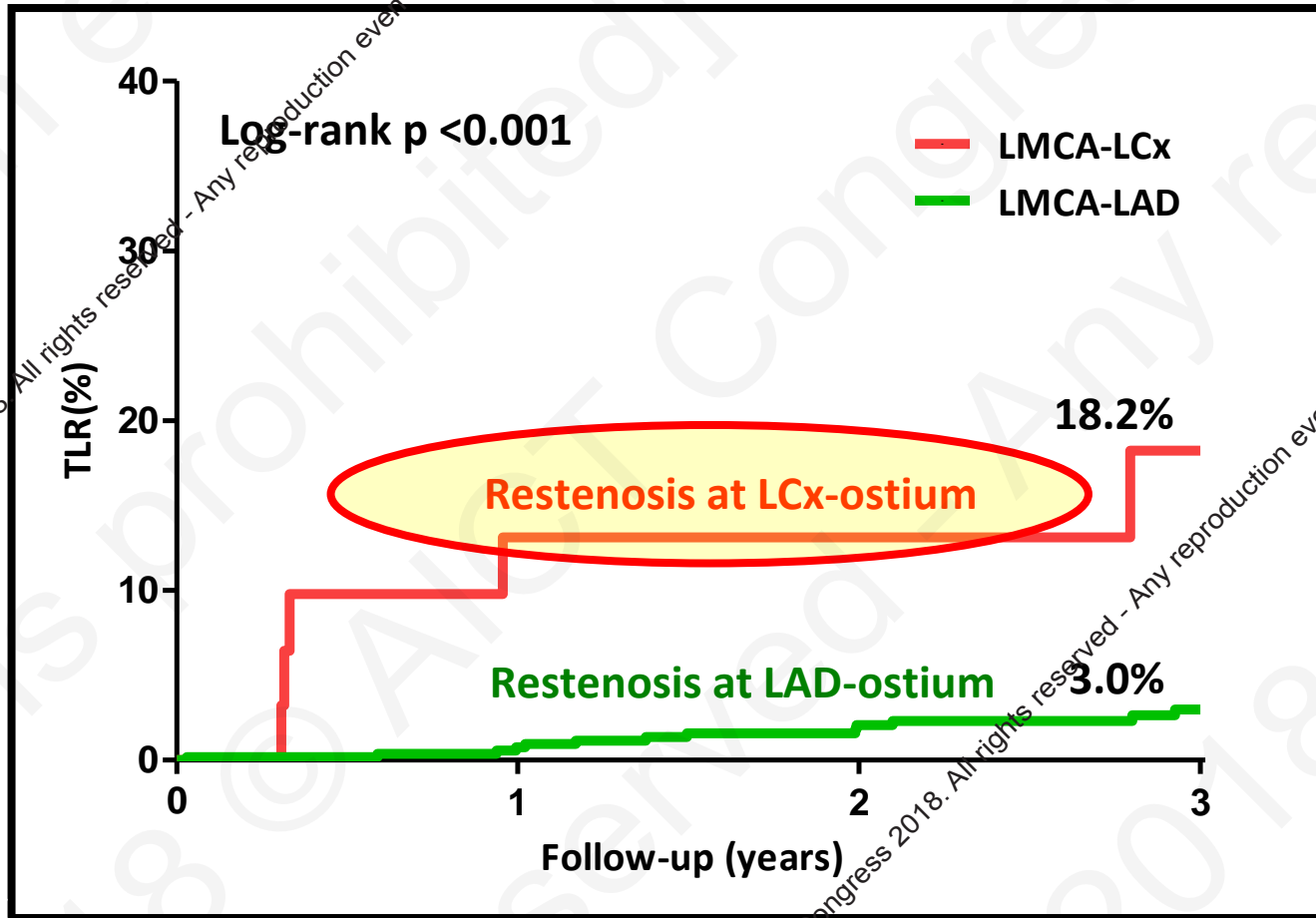
Long-term Clinical Outcome of Single-stent Crossover Technique from Unprotected Left Main Coronary Artery to the Left Circumflex Artery

Naganuma T, Chieffo Alaide, Nakamura S, Colombo A, et al. Catheter Cardiovasc Interv. 2013

Comparison of LCX ost and LAD ost after Stenting



Cumulative event rate of TLR at 3 years F/U



LMCA-LCx 31

27

23

15

LMCA-LAD

553

512

400

279

Lesson 3

LCX ostium itself independently shows high restenosis rate in patients with LMT-PCI.



Toru Naganuma M.D., FACC, FESC

Catheter Cardiovasc Interv. 2013

JACC cardiovascular imaging vol. 7 2014

Delayed Disruption of a Bioresorbable Vascular Scaffold

JACC: CARDIOVASCULAR IMAGING, VOL. 7, NO. 8, 2014

AUGUST 2014:843-50

Toru Naganuma, MD

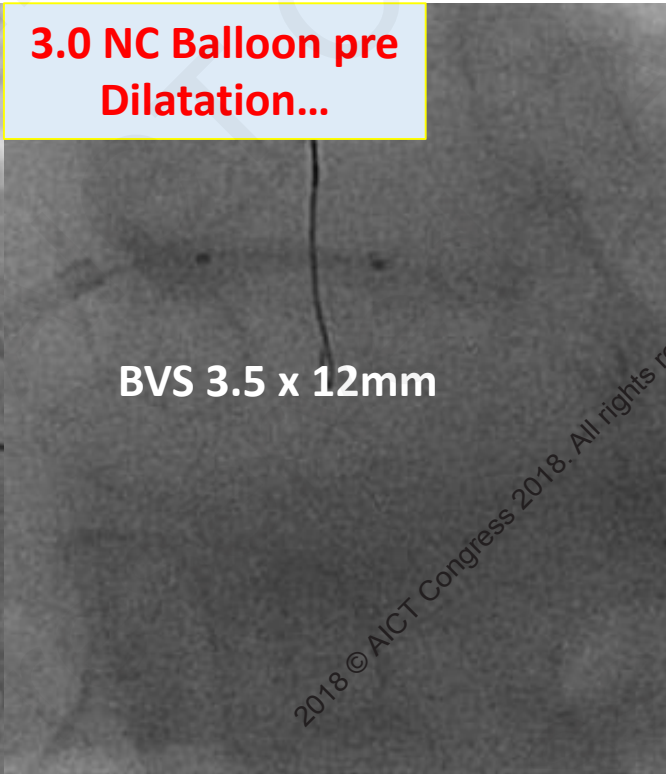
Antonio Colombo, MD*

*EMO-GVM Centro Cuore Columbus

Previous DES



3.0 NC Balloon pre Dilatation...



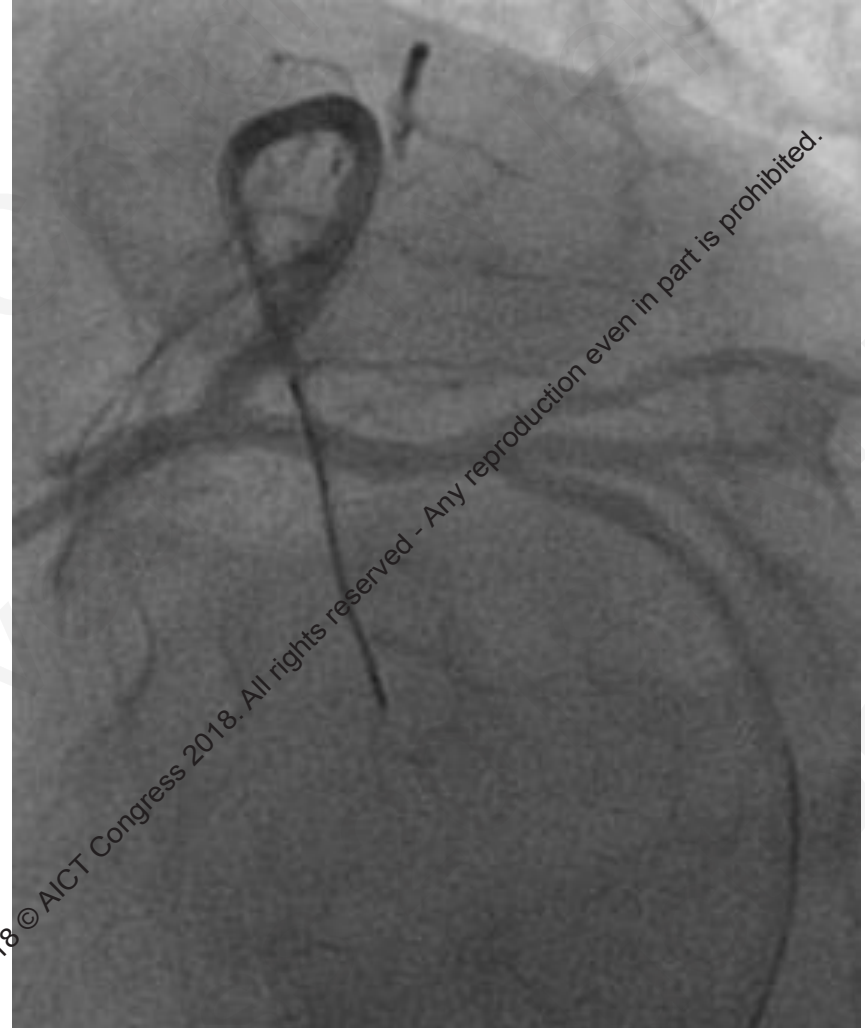
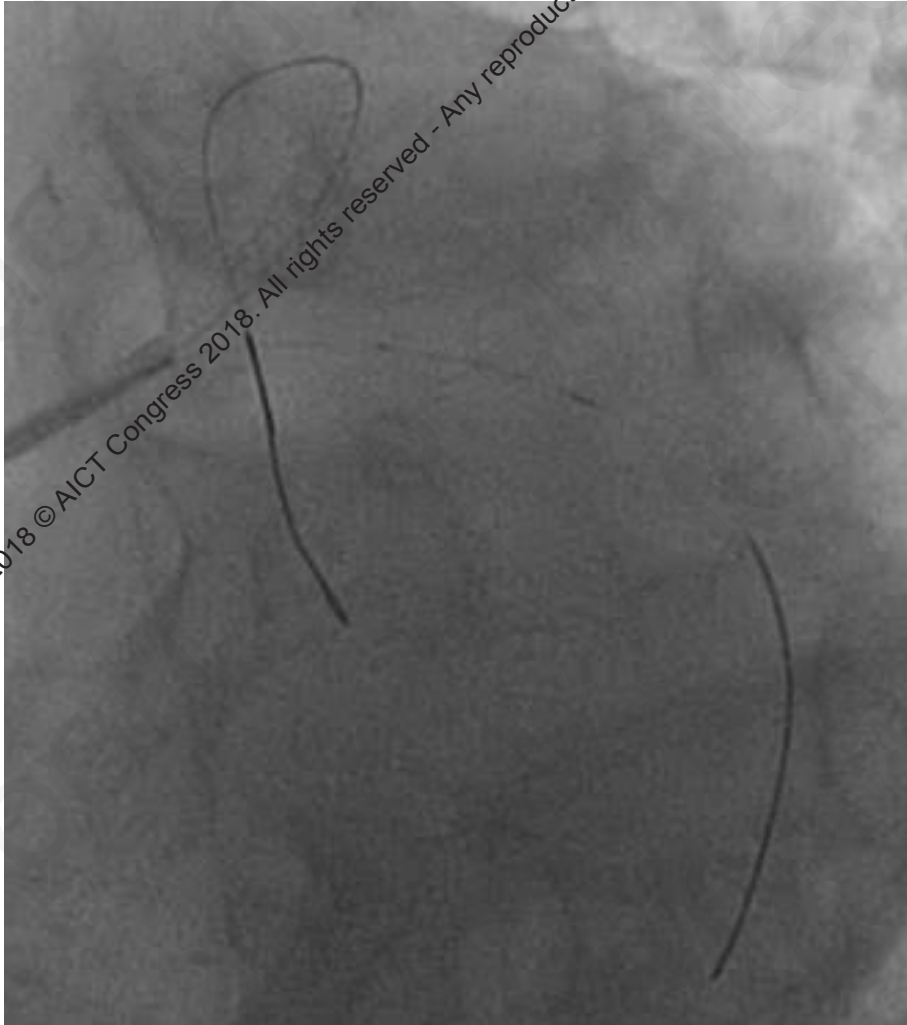
BVS 3.5 x 12mm

3.5mm NC balloon



Delayed Disruption of a Bioresorbable Vascular Scaffold

Final Angiogram

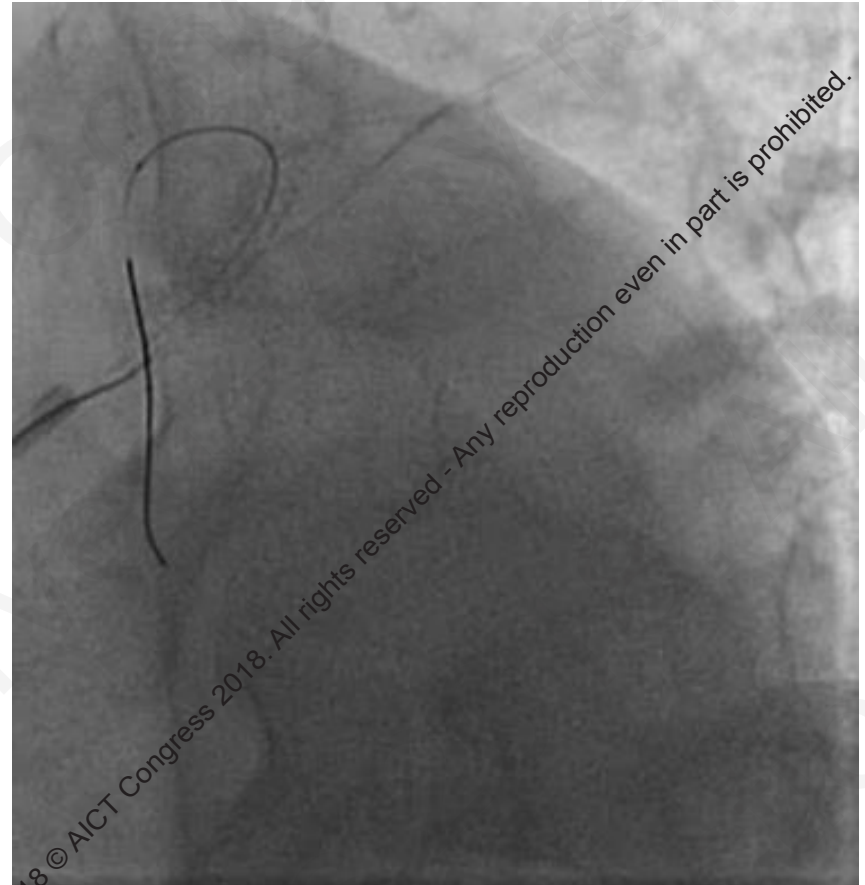


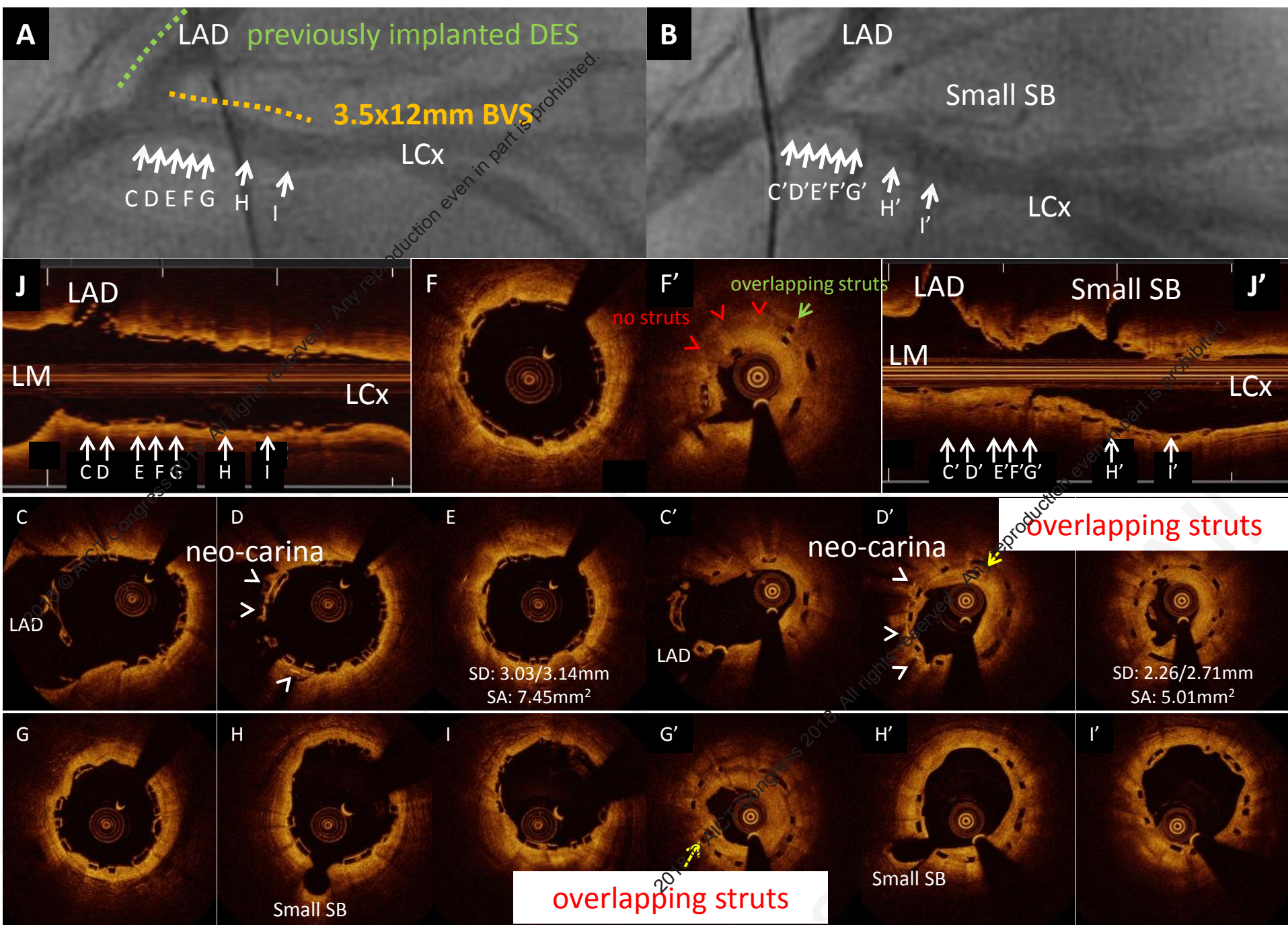
2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

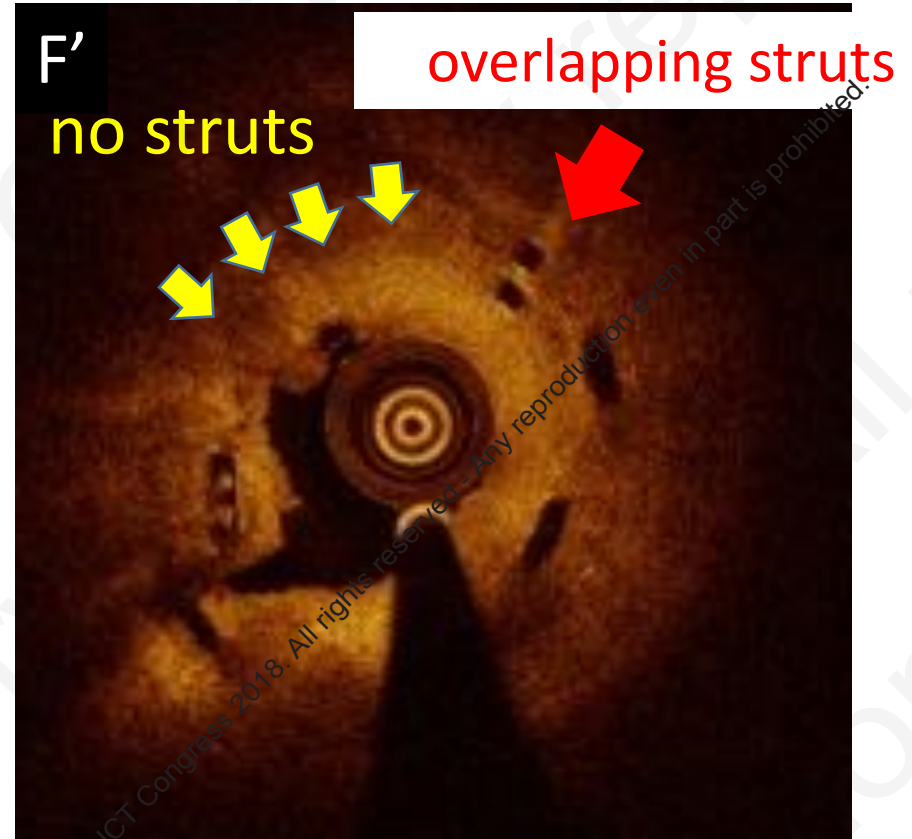
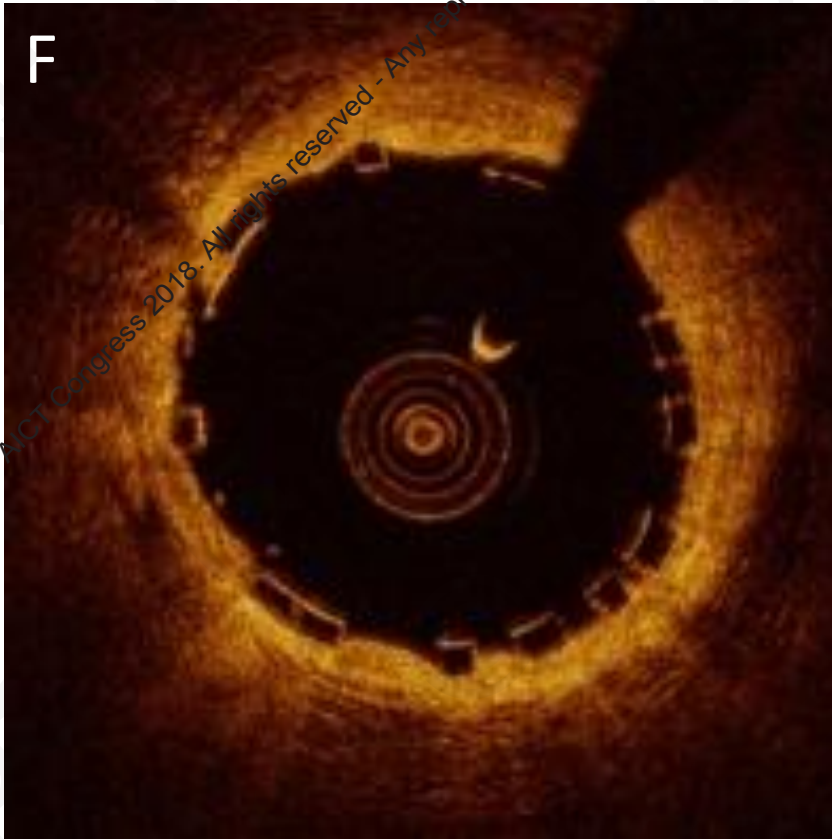
Delayed Disruption of a Bioresorbable Vascular Scaffold

Only 6 month later...Severe Restenosis in LCX ost.





BVS may not be an optimistic solution for an ostial LCX lesion



2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

Lesson 4

Implantation of BVS at ostium of LCX
may be problematic.



Toru Naganuma M.D., FACC, FESC

JACC cardiovascular imaging vol. 7 2014

Do not chase to much !!

“LCX” is a different animal

This is very unique part of coronary artery !!!

So called, **HINGE POINT...**

But point is “moving and Twitching”

And not so much important as compared with LAD and RCA for keeping Ejection fraction of the patient's HEART.

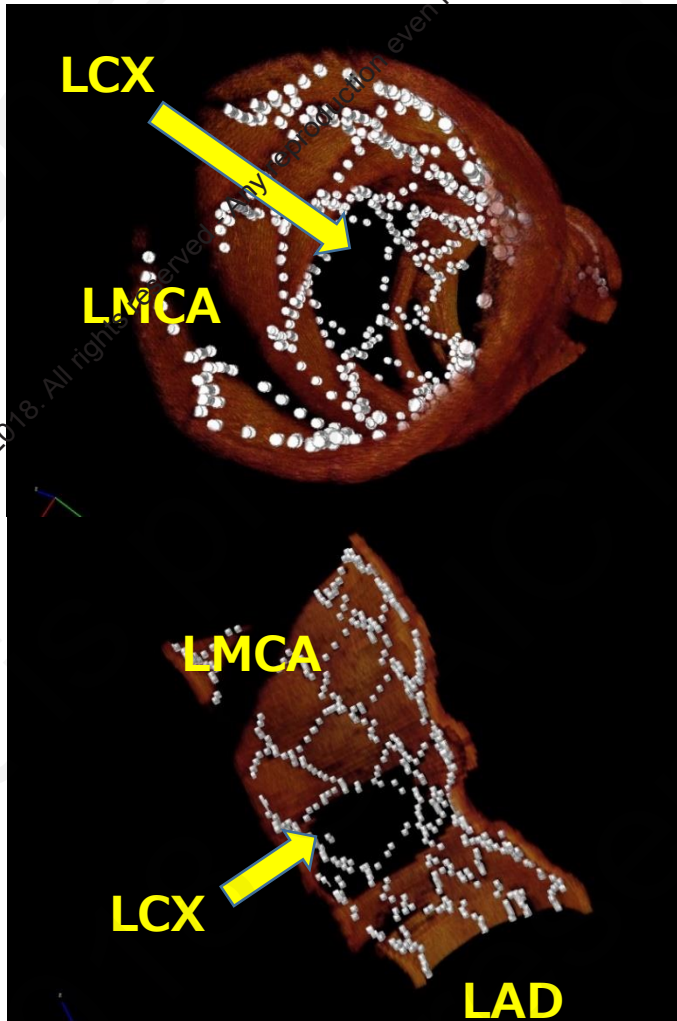
..... LCX is not directly relevant to the patient prognosis

- About Endothelial activation -

Let's think about 2 stent techniques
Is it related with restenotic event ??



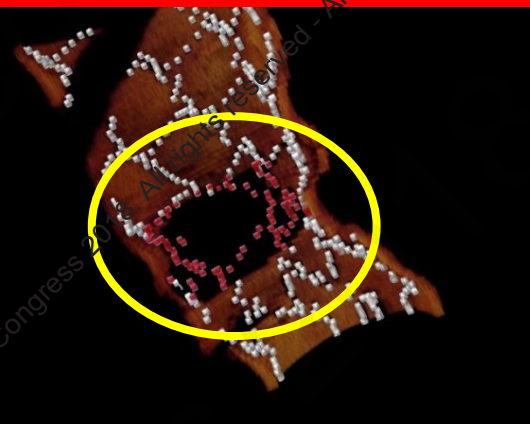
3D OCT Image After SES Implant. with inappropriate KBT



Malapposed stent struts



Malapposed stent struts



OCT Assessment of LCX ostium at F/U

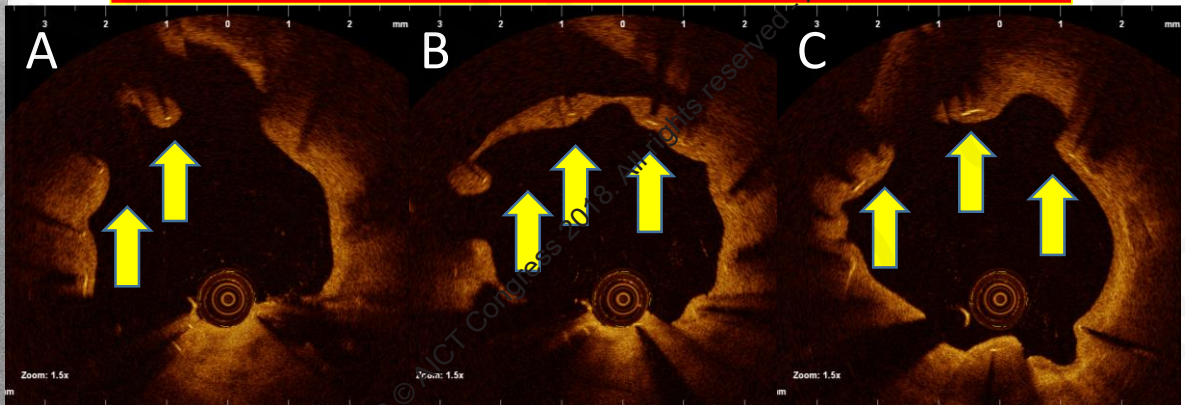
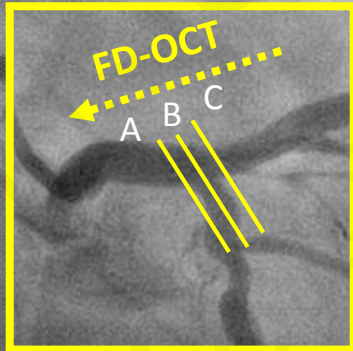
Post PCI

malapposed stent struts



9M follow-up

Neointimal proliferation over the malapposed stent struts

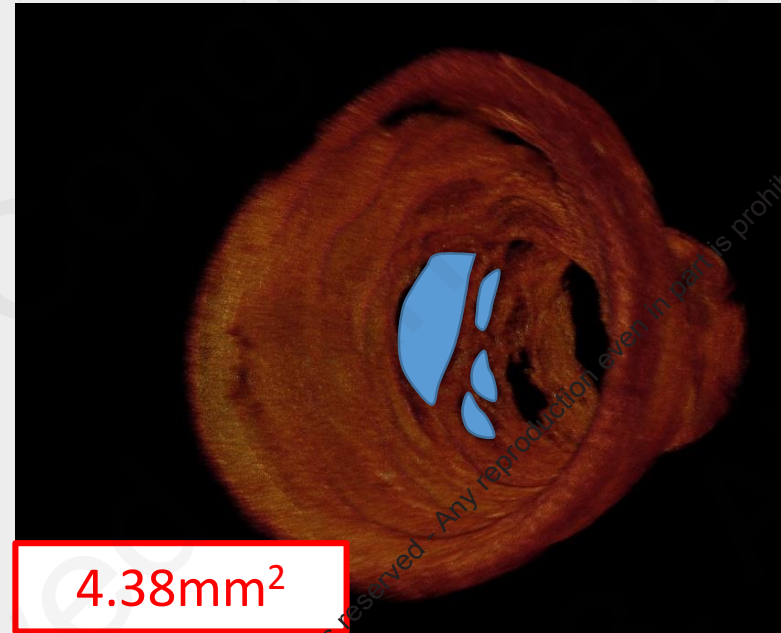


Area Narrowing of LCX ostium by 3D-OCT

Post PCI



Follow-up



We calculated area narrowing(%) with this formula

$$\text{Area Narrowing (\%)} = \frac{\text{Area (post)} - \text{Area (follow-up)}}{\text{Area (post)}} \times 100$$

Area Shrinkage of LCX Ostium

Sirolimus-Eluting Stent

Cypher: Johnson and Johnson



Image provided courtesy of Cordis Corporation.

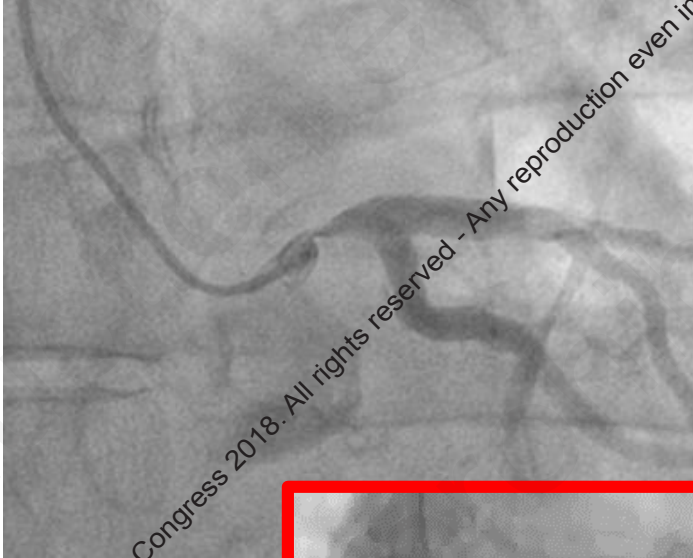
Everolimus-Eluting Stent

Xience V: abott vascular



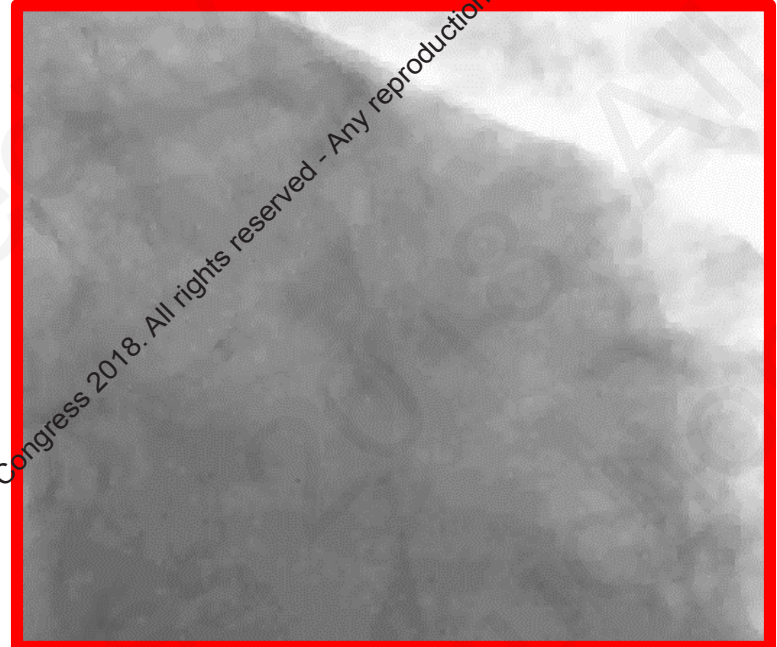
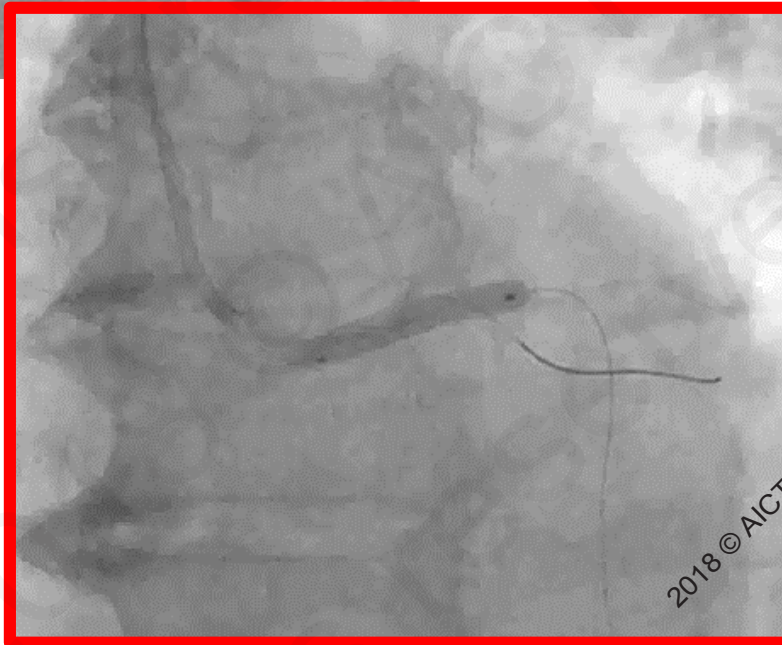
	SES (n=10)	EES (n=15)	p Value
Post-PCI			
LCX ostium area, mm ²	5.41 ± 1.81	5.14 ± 2.59	0.785
9M follow-up			
LCX ostium area, mm ²	3.52 ± 1.03	4.46 ± 2.59	0.220
Area Shrinkage (%)	32.4 ± 15.73	9.78 ± 23.08	0.013

Case: LMT ost.~body stenosis: EES single crossover stenting without KBT



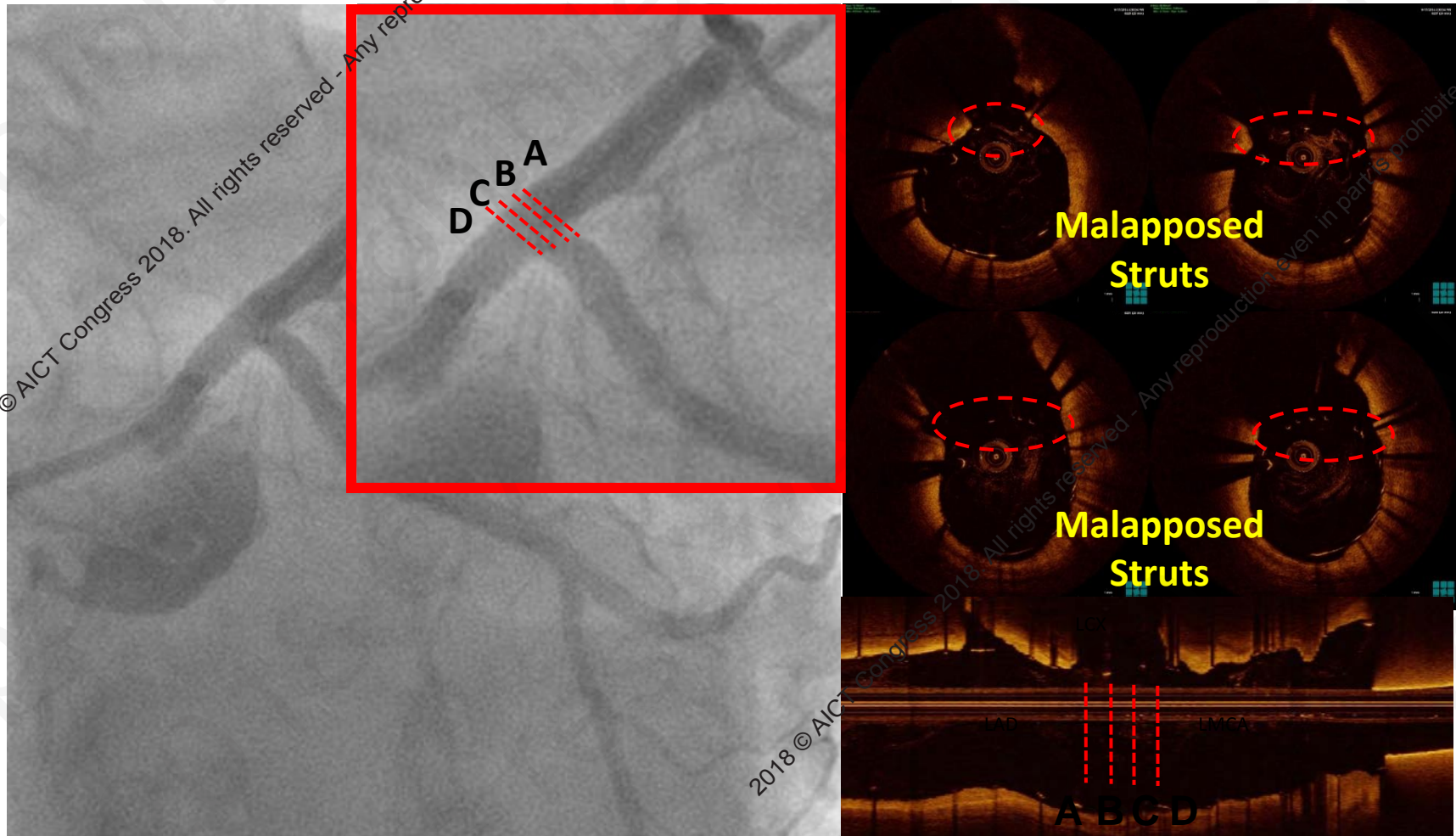
LMT Ost~Body Lesion

**Single Stenting with Xience
POT, Full Cover W/O KBT**



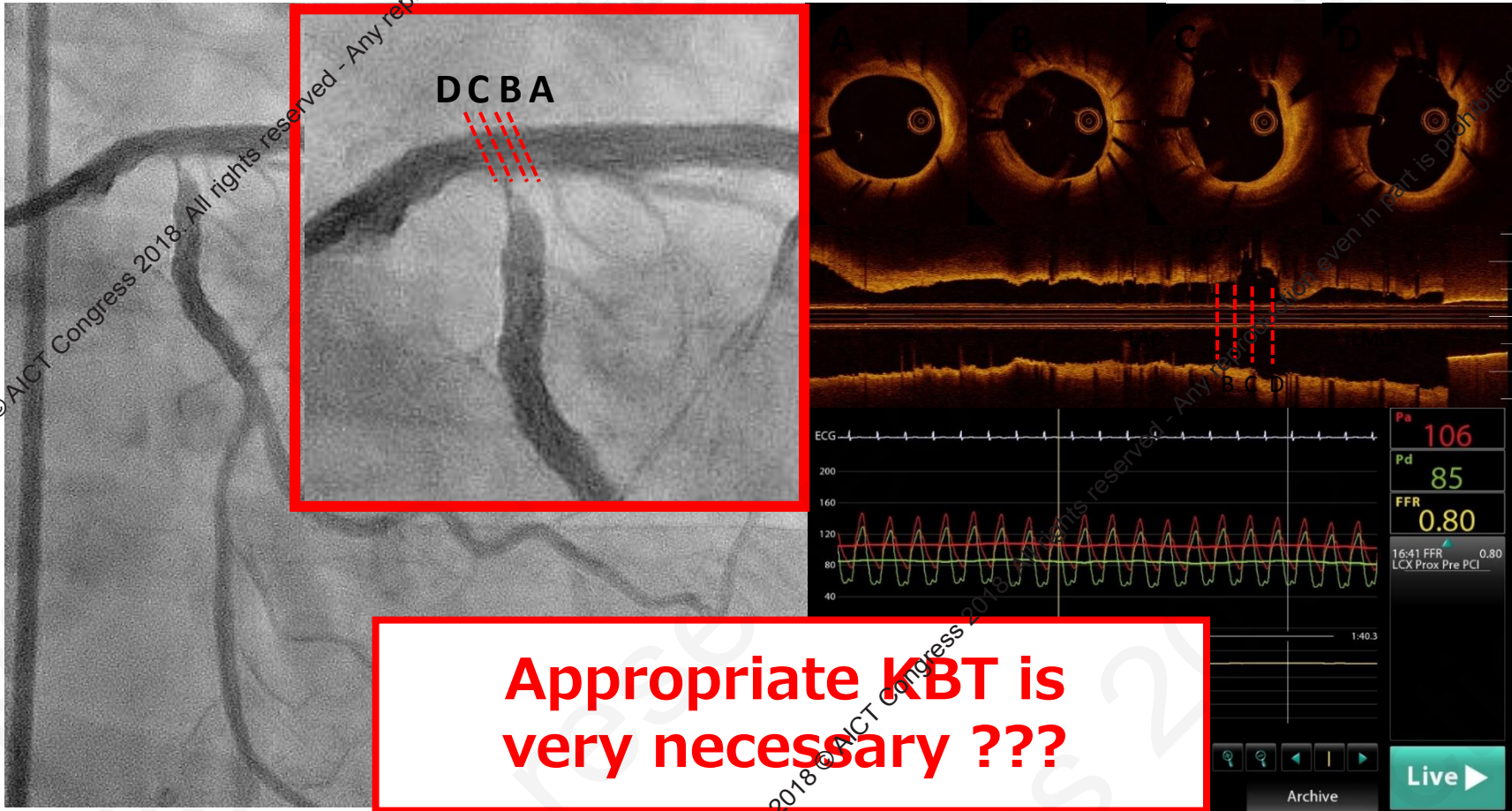
Case: LMT ost. ~ body stenosis: EES single crossover stenting without KBT

OCT Findings : without KBT !!!



Case: LMT ost. ~ body stenosis: EES single crossover stenting without KBT

At F/U Restenosis at LCX Ost !!!



Appropriate KBT is very necessary ???

Lesson 5 : MITO registry

Finishing the case with optimum KBT is very indispensable for LMT bifurcation PCI

Future Endotherialization for the coverage of these jailed struts.



Yusuke Fujino M.D. FACC. FESC

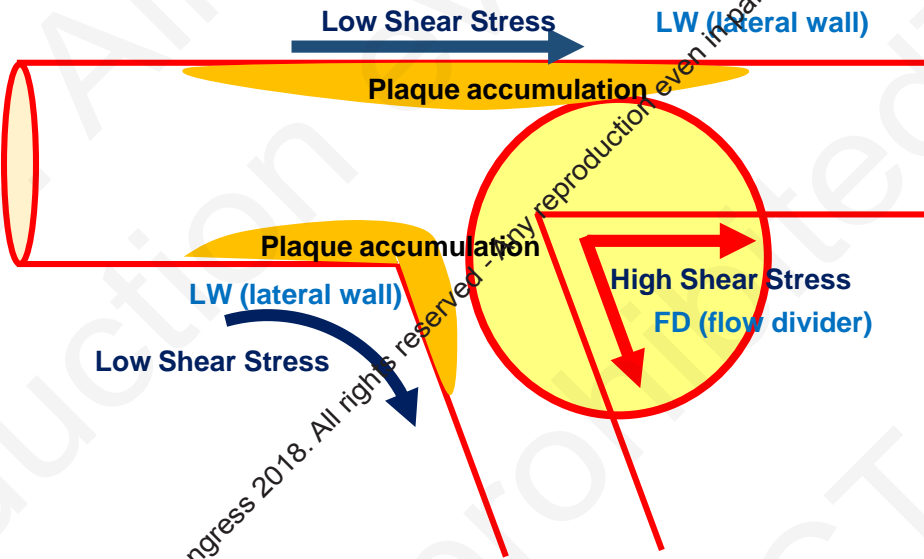
JACC Imaging Vol 7 No.8 2014

Why Endothelialization so frequent in LCX ost. ??

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

Physiological Condition (Non-stent)



After Stent Implantation (non-physiological)

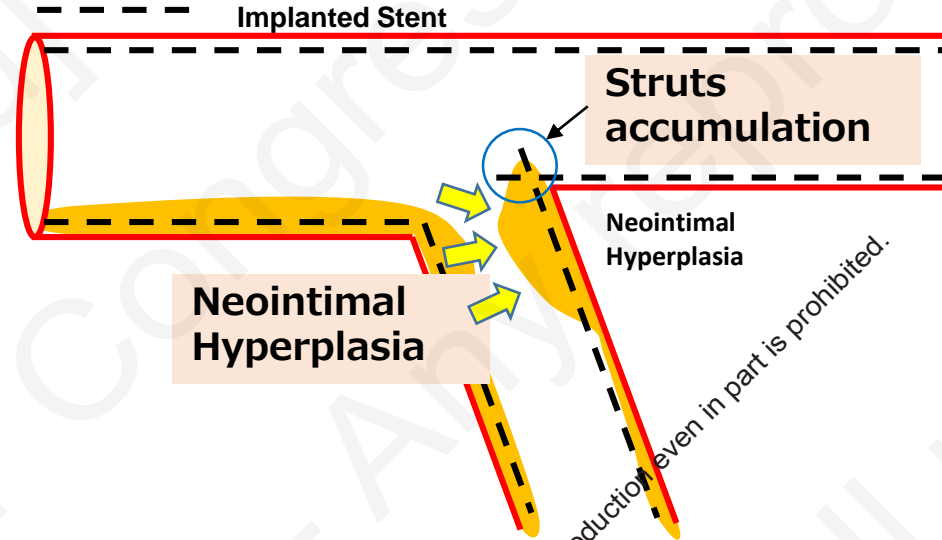
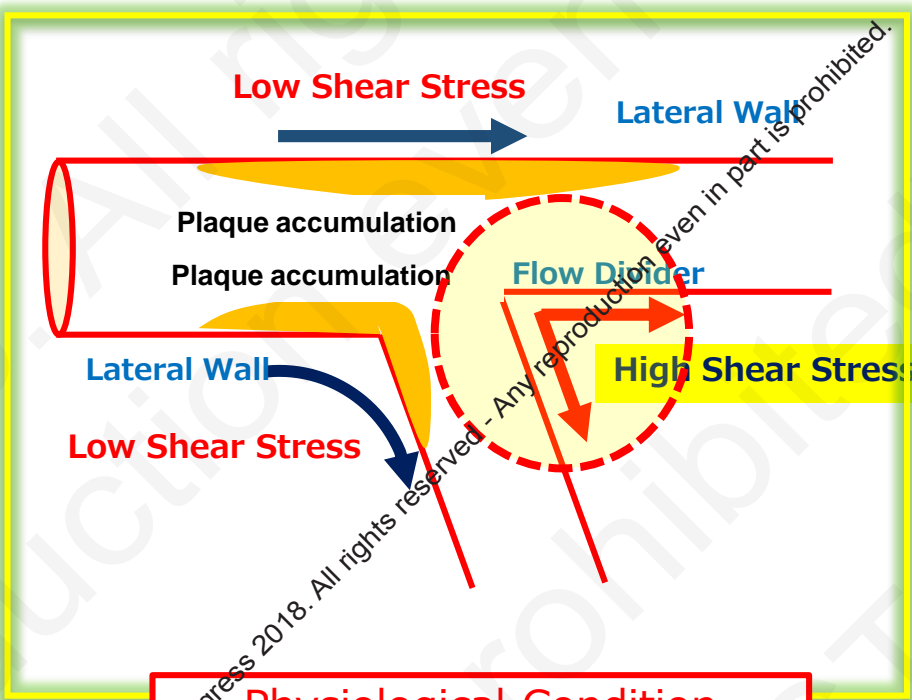


Table 4
OCT findings in the flow divider and lateral wall.

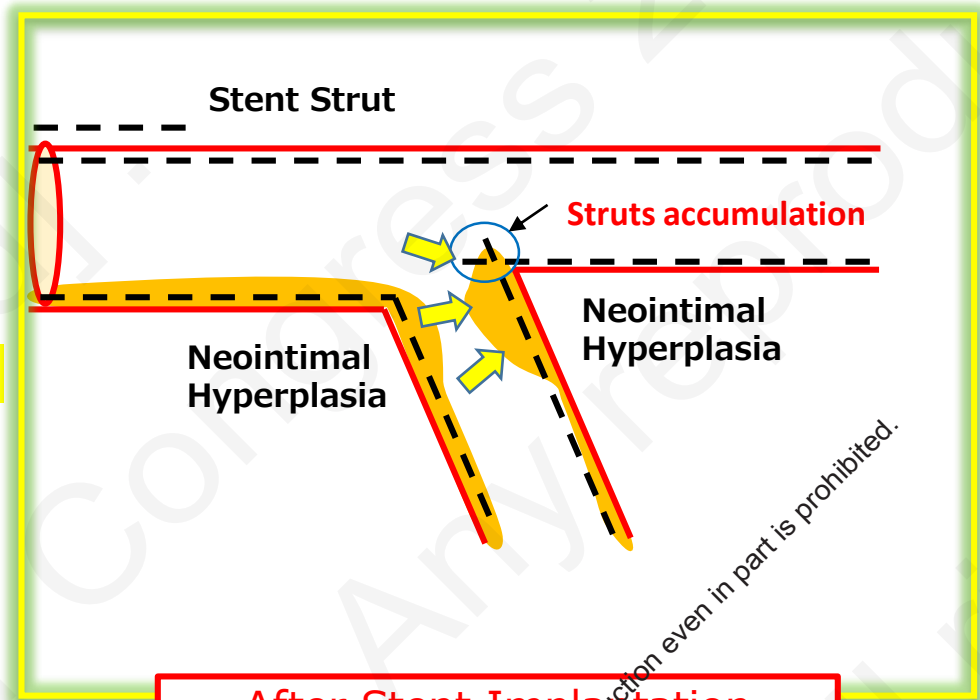
	FD (N = 22)	LW (N = 22)	p-Value
Chords numbers	180.25 (178.00, 181.67)	179.75 (178.33, 182.00)	0.79
Analyzed struts	32.50 (30.00, 39.00)	23.50 (21.00, 30.00)	<0.001
Analyzed struts/cross-sections	5.42 (5.00, 6.50)	3.92 (3.50, 5.00)	<0.001
Uncovered struts (%)	11.32 (0.00, 19.44)	0.00 (0.00, 4.55)	<0.001
Uncovered, nonmalapposed struts (%)	8.97 (0.00, 16.13)	0.00 (0.00, 4.55)	<0.001
Uncovered, malapposed struts (%)	0.00 (0.00, 3.23)	0.00 (0.00, 0.00)	0.016
NIH thickness (mm)	0.31 (0.19, 0.47)	0.15 (0.09, 0.31)	<0.001
Malapposition area (mm ²)	0.00 (0.00, 0.07)	0.00 (0.00, 0.03)	0.004
NIH area (mm ²)	1.03 (0.56, 1.80)	0.75 (0.41, 1.44)	<0.001

Values are Median (IQR)

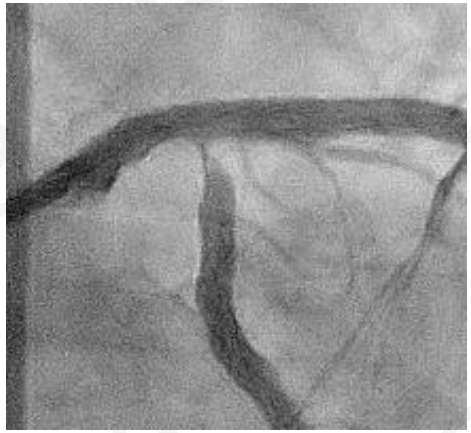
FD = flow divider; LW = lateral wall; NIH = neointimal hyperplasia



Physiological Condition
(No Stent)



After Stent Implantation
(non-physiological)



**Why ? Restenosis
so frequent in LCX**

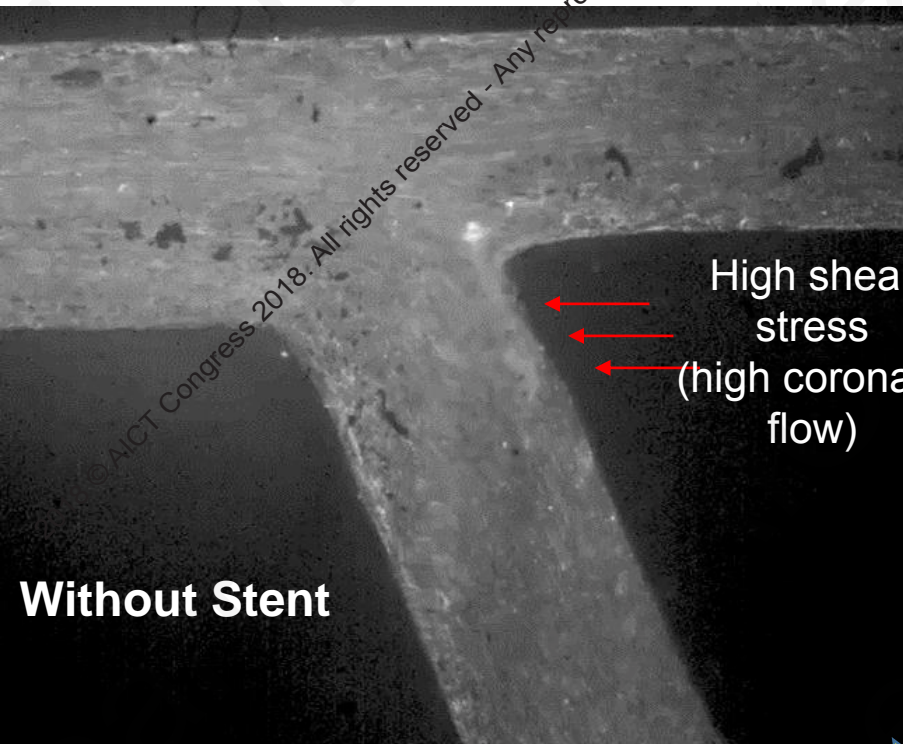
2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

Experimental model to study flow pattern

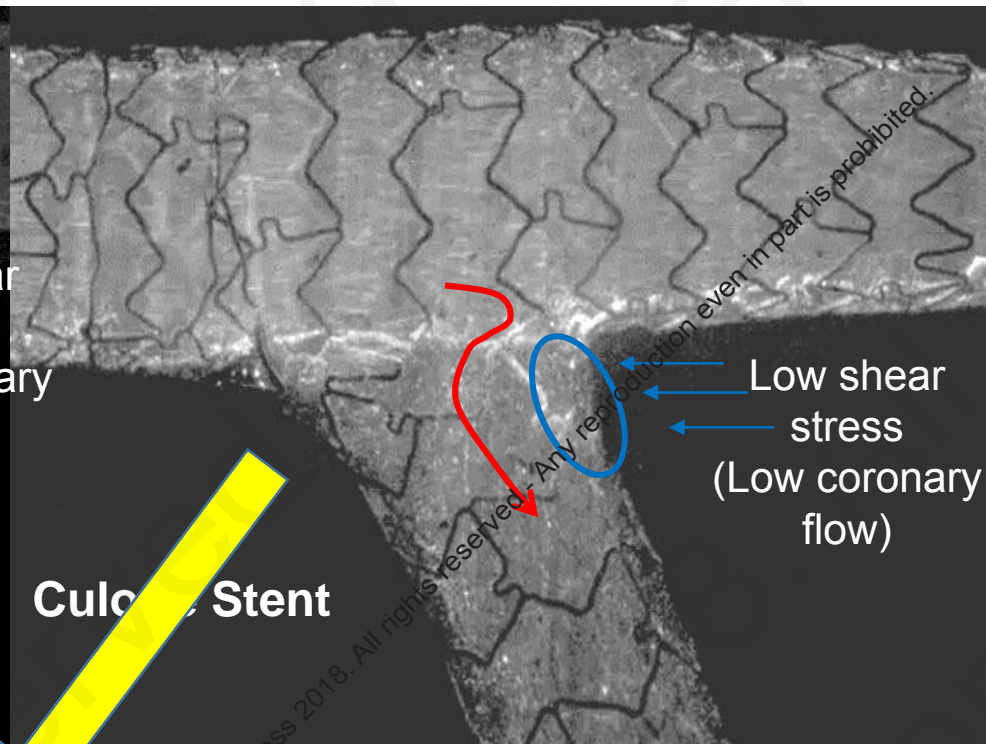
Without stent placement

Blood flow at carina is quite fast.



After stent implantation

Flow is delayed, causing turbulence.

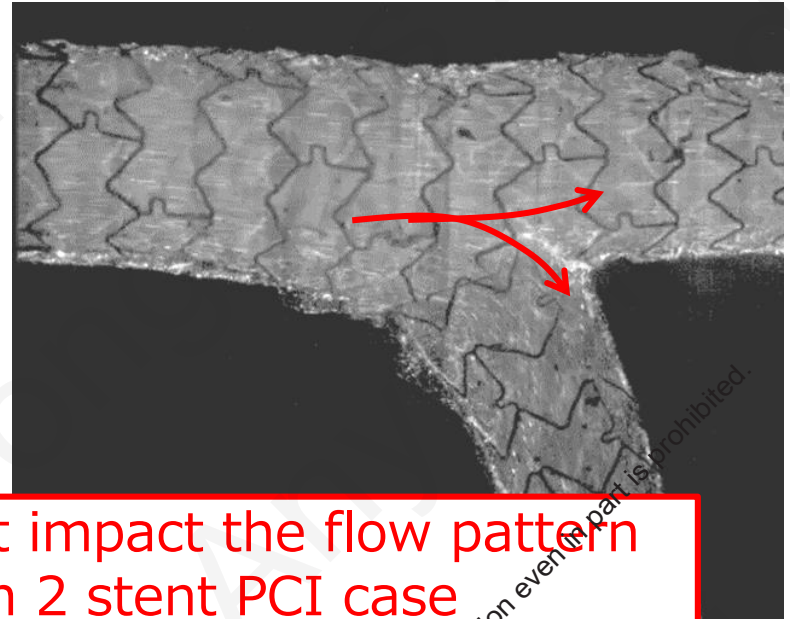


This is so-called low shear stress status. It is speculated that stent struts remaining at orifice of circumflex negatively affect the flow.

Without stent

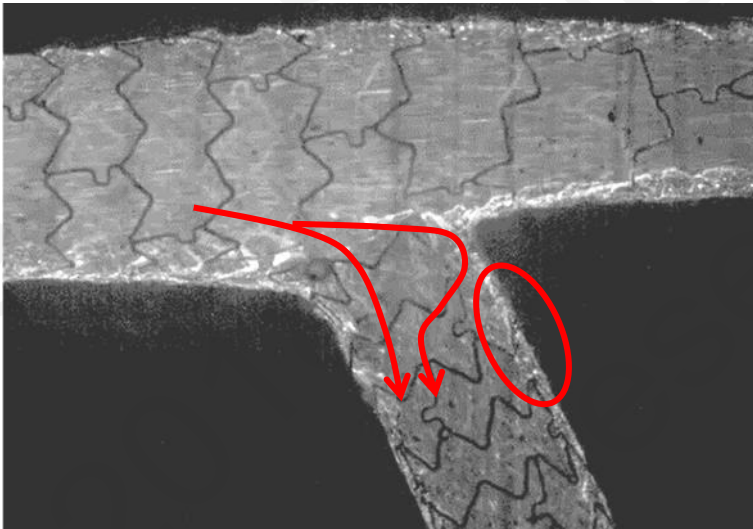


T- stent

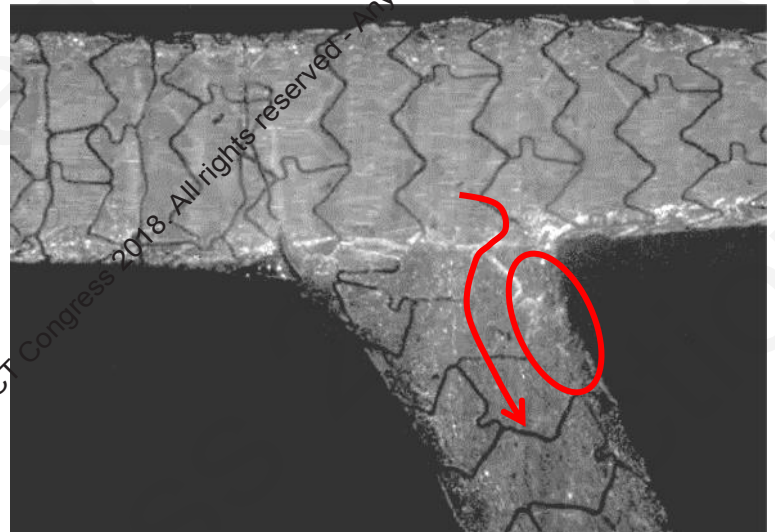


Accumulated stent struts might impact the flow pattern then progress the NIH in 2 stent PCI case

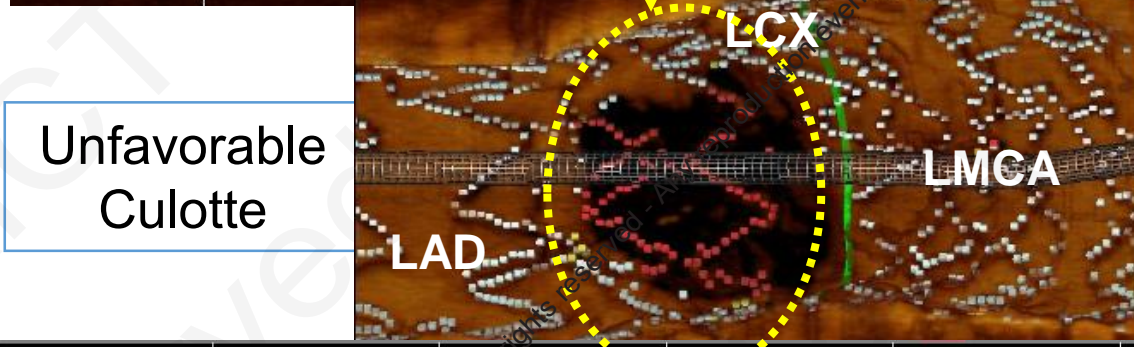
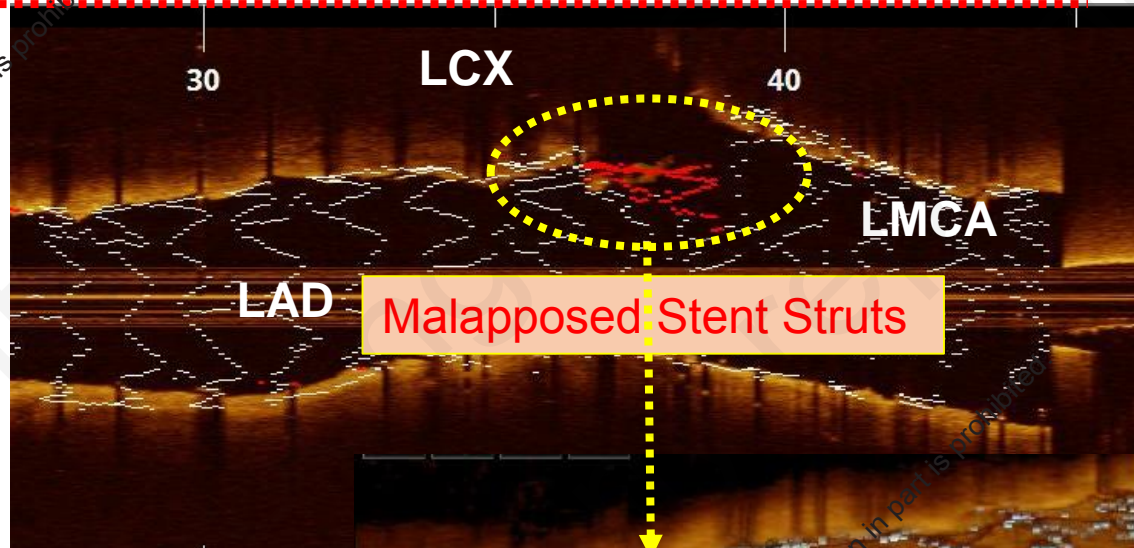
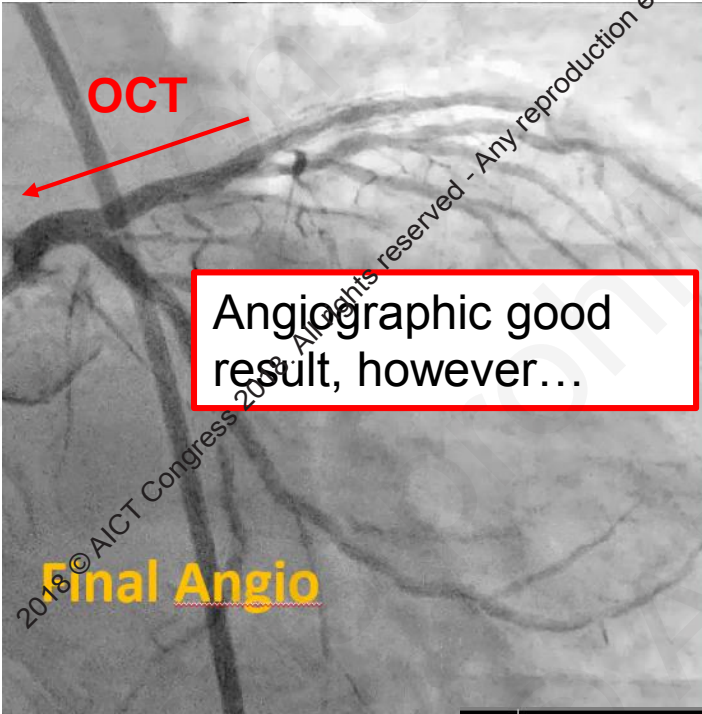
Crush stent



Culottes stent



Favorable or Unfavorable Culotte in LM



Unfavorable Culotte

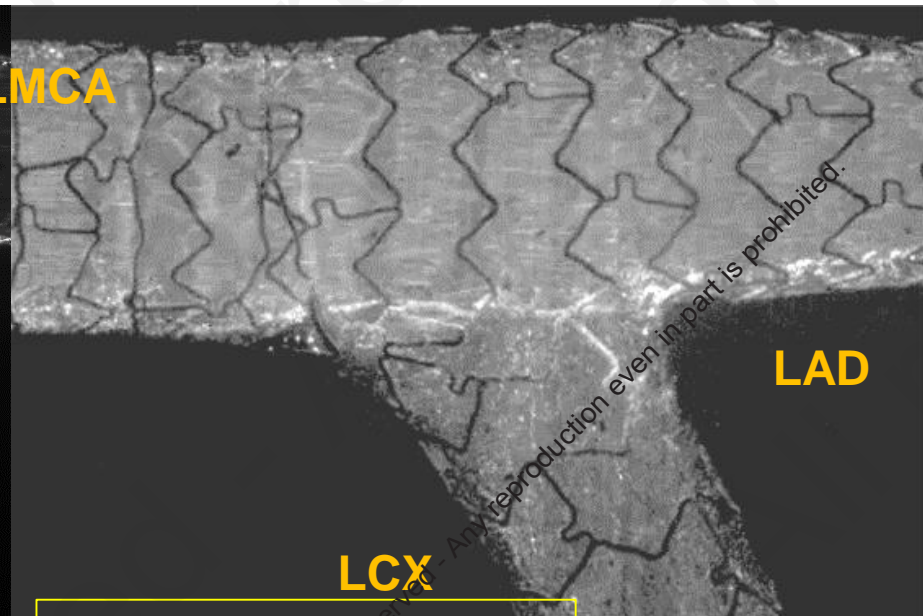
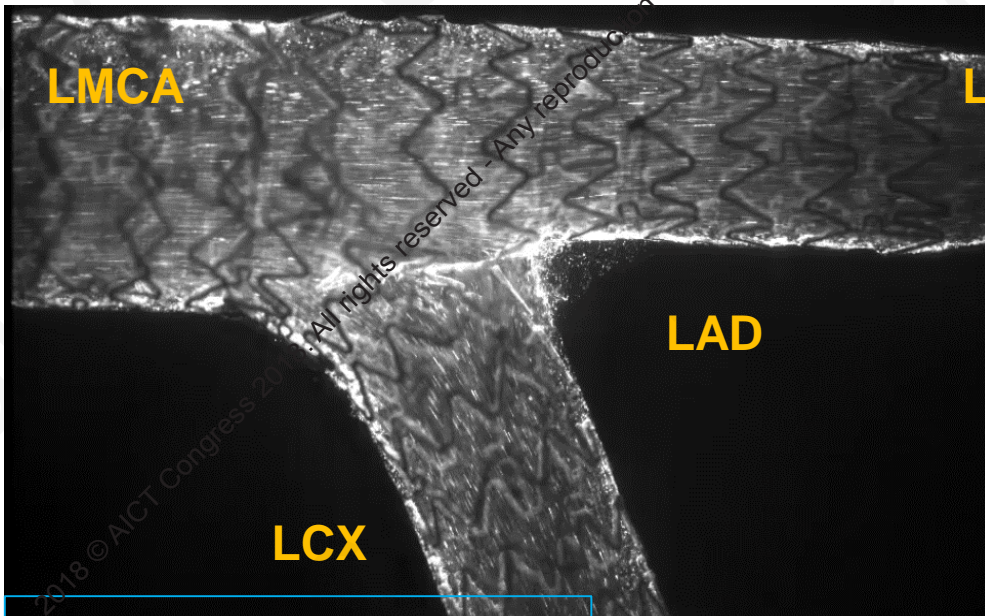
Favorable Culotte



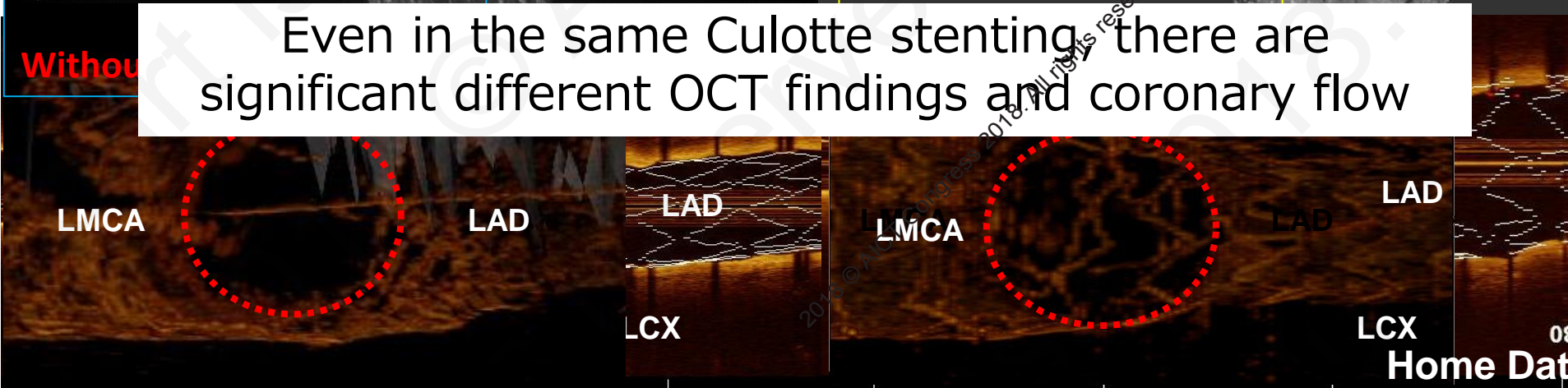
Flow dynamics after Culotte Stent

Favorable Culotte

Unfavorable Culotte



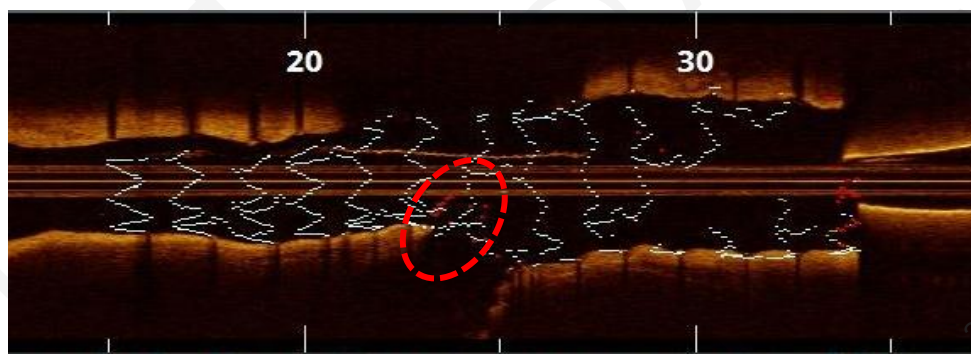
Even in the same Culotte stenting, there are significant different OCT findings and coronary flow



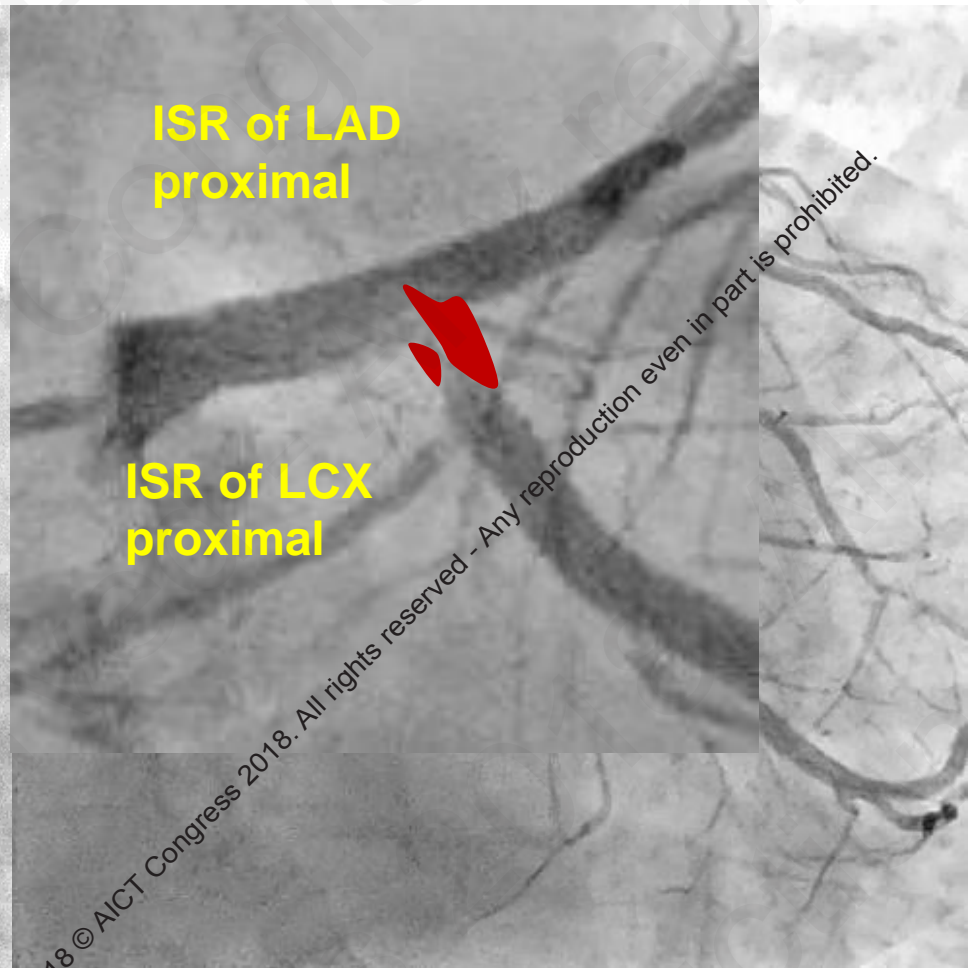
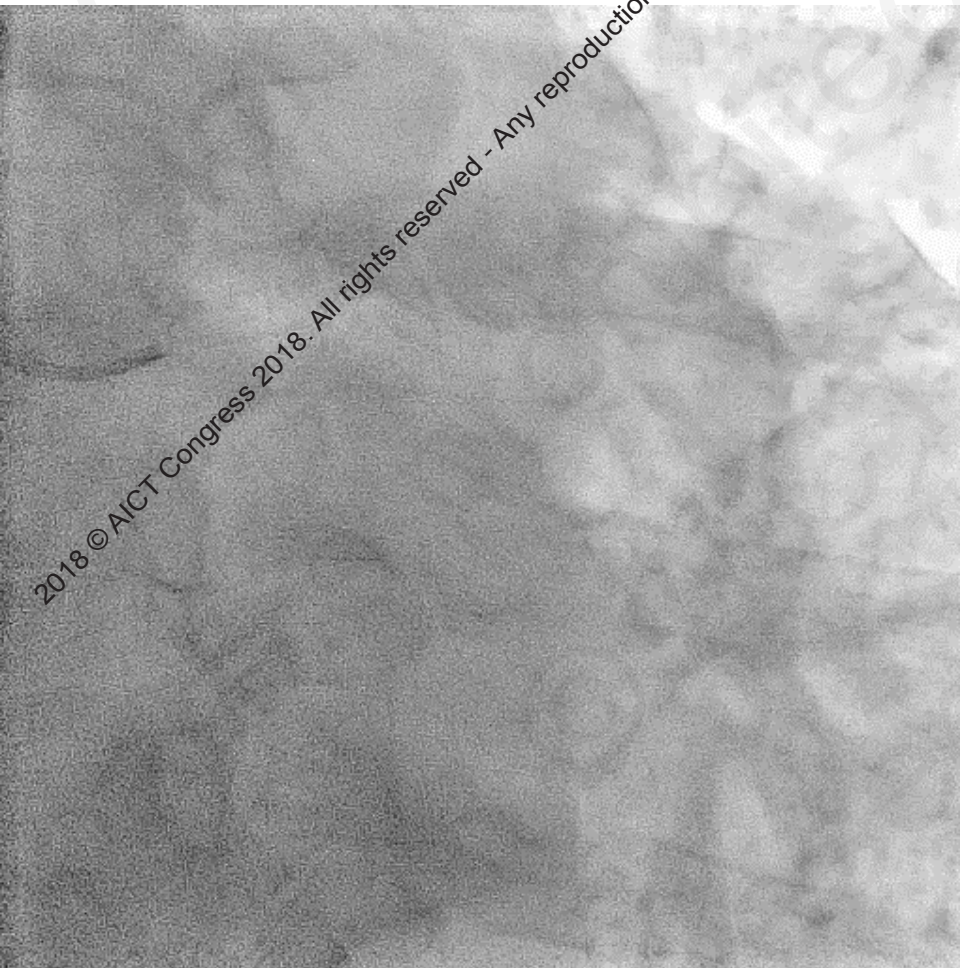
OCT

TAP stenting

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.



Follow-up CAG after PCI



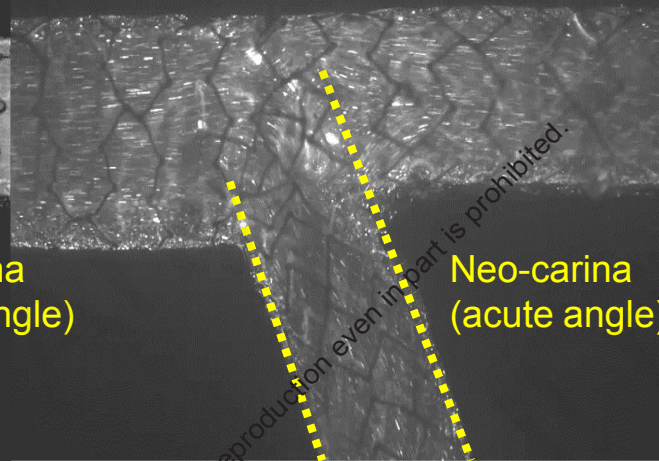
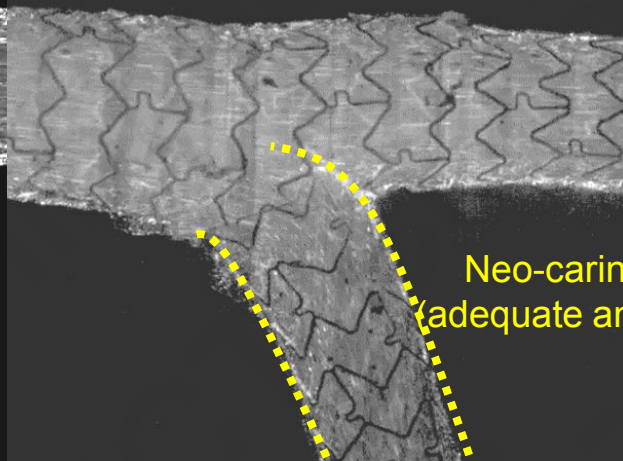
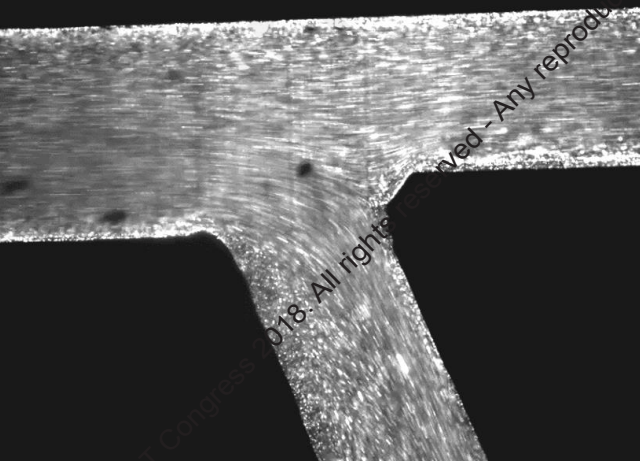
Without stent placement
Blood flow at carina is quite fast.

Unfavorable TAP stent
Flow is roiling, causing turbulence.

<non stenting>

<Ideal TAP technique>

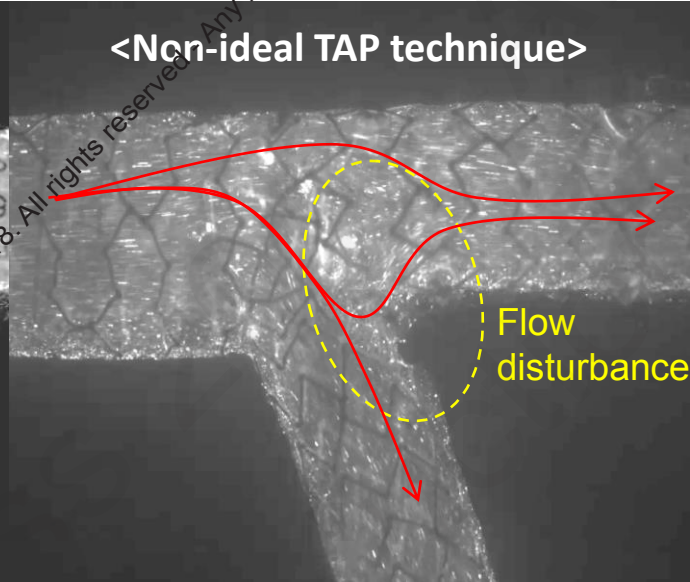
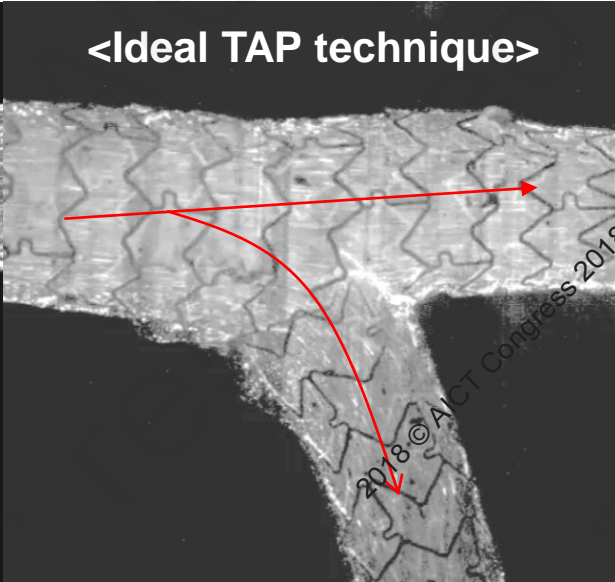
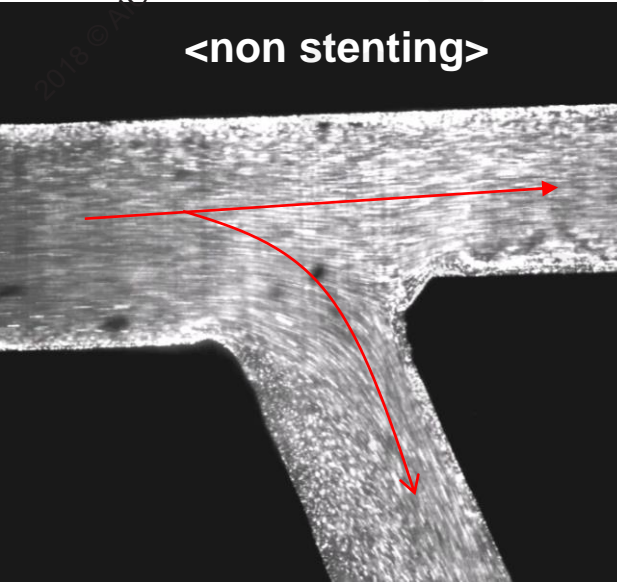
<Non-ideal TAP technique>



<non stenting>

<Ideal TAP technique>

<Non-ideal TAP technique>



Lesson 6 : MITO registry

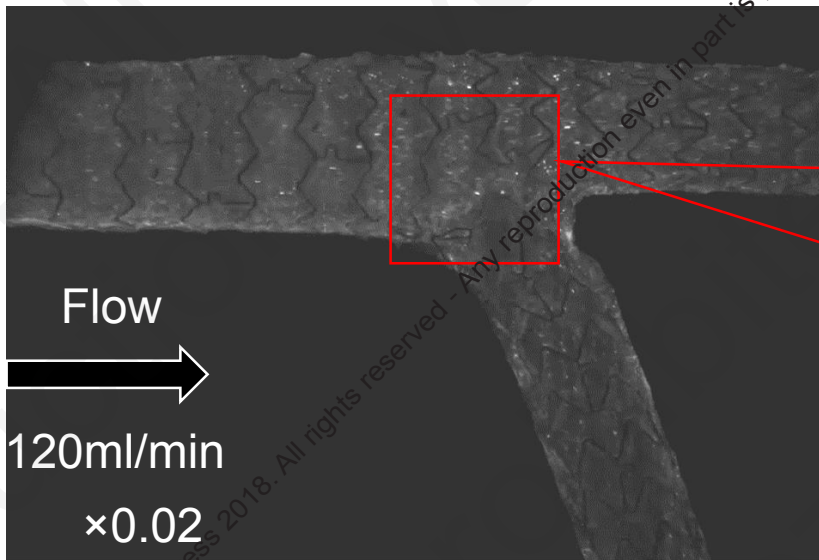
Depending on which double stenting technique is used, flow of CX would be different, and... even whether favorable stenting is achieved or not makes flow pattern different.



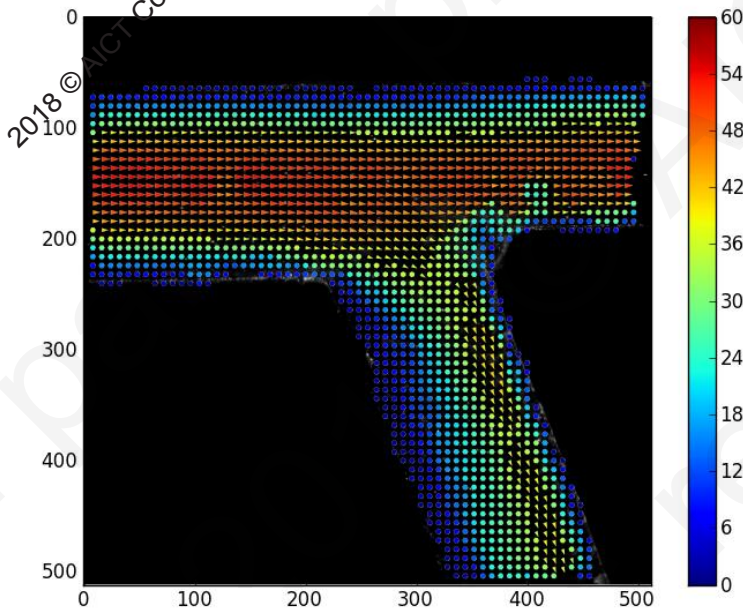
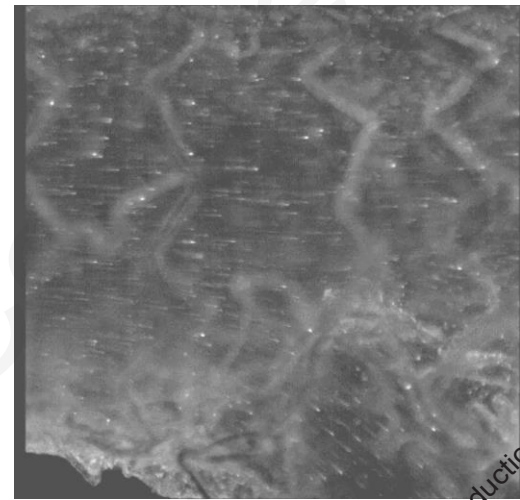
Yusuke Fujino M.D. FACC. FESC

JACC Imaging Vol 7 No.8 2014

Quantification of wall shear stress



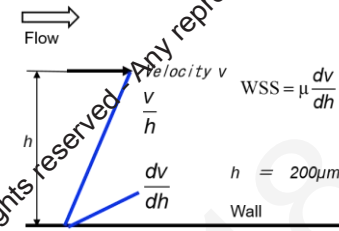
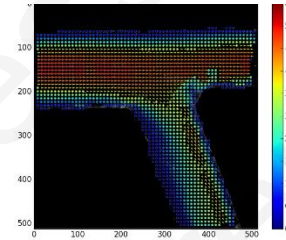
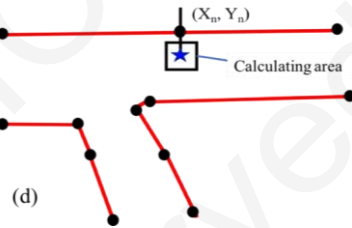
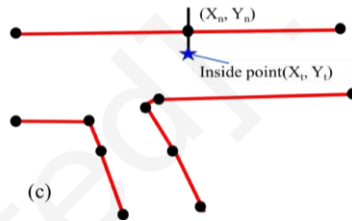
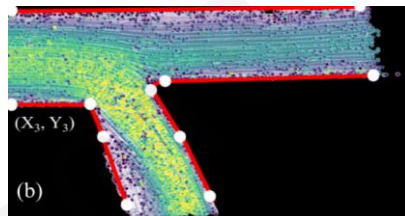
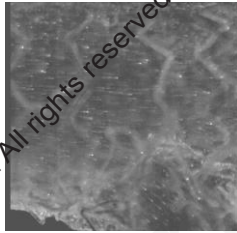
➤ PTV (Particle Tracking Velocimetry)



Experimental conditions

Viscosity coefficient	3.48 mPa · s
Density	1218 kg/m ³
Inlet flow	120 mL/min
Particle size	10 μm
Liquidity shooting (fps)	2000
PTV shooting (fps)	8000
Laser Wavelength	532 nm
Laser oscillation	Contiuity

Work flow of quantification of WSS



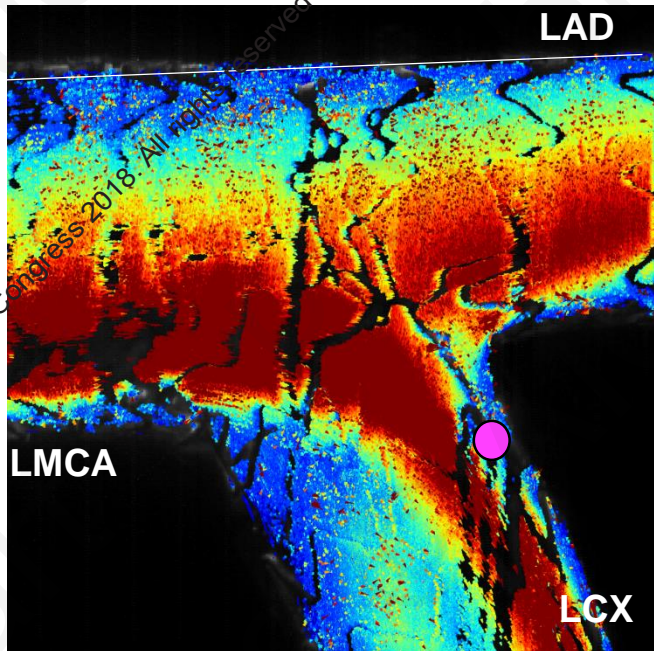
2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

Flow dynamics after Culotte Stent

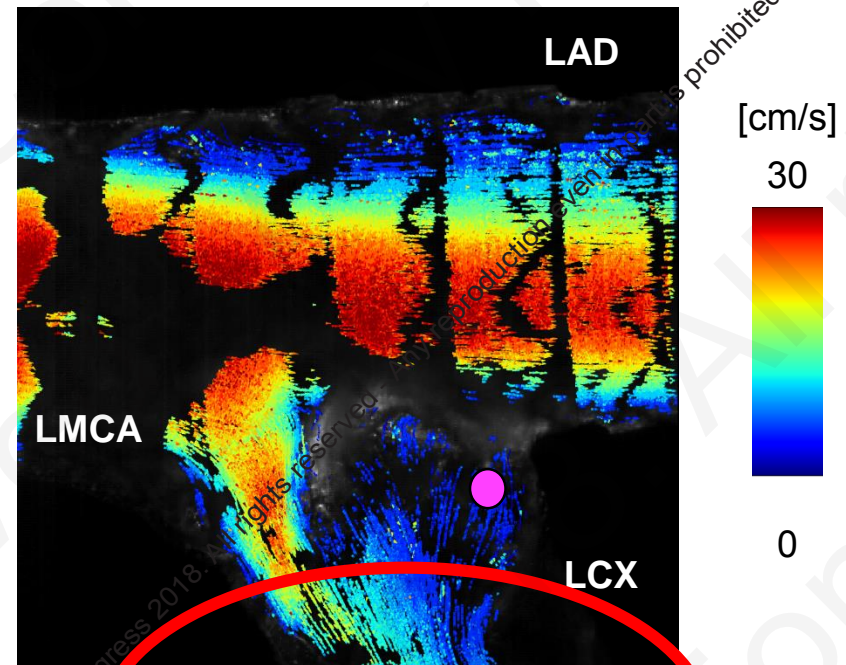
- Comparative study with Favorable or Unfavorable Culotte ?? -

Favorable Culotte



WSS 0.32 [Pa]

Unfavorable Culotte



WSS 0.02 [Pa]

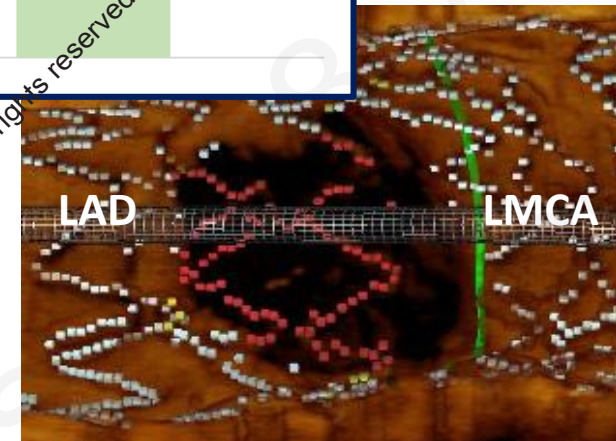
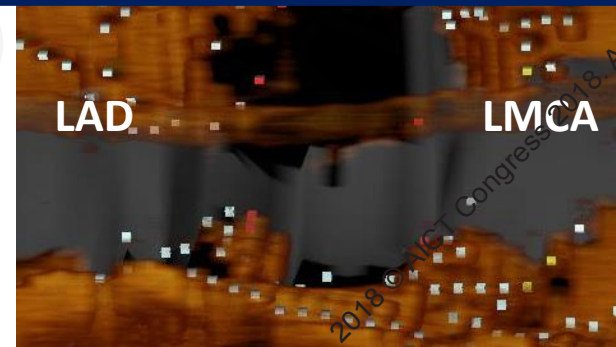
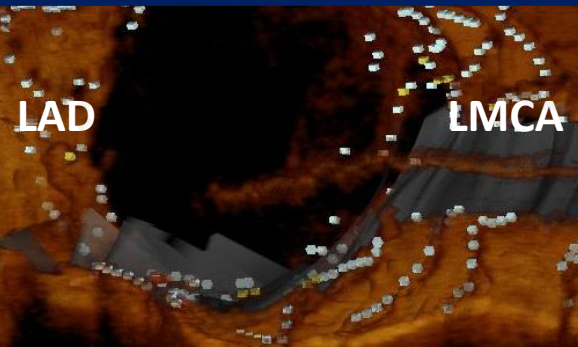
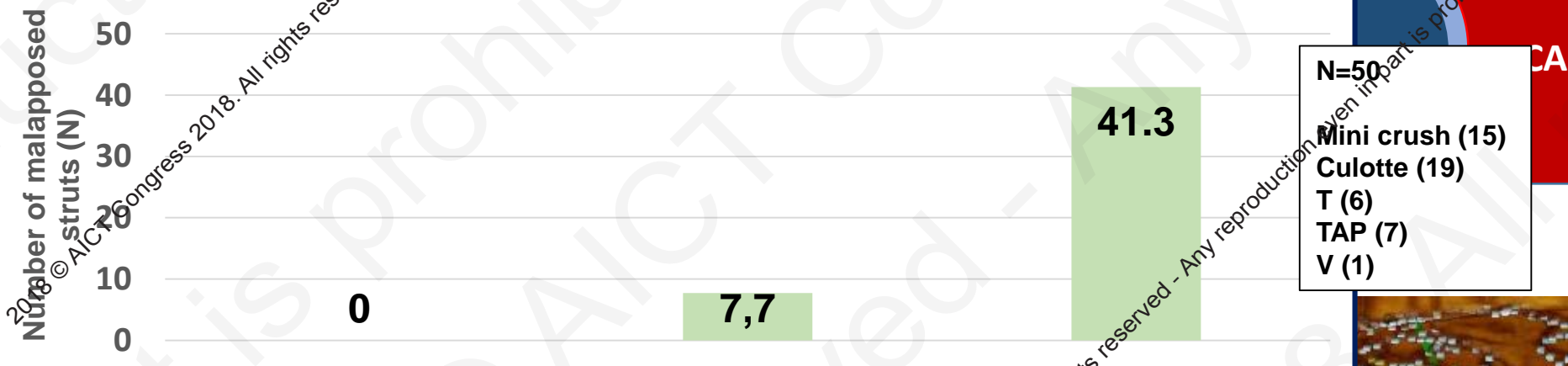
Impact of malapposed stent struts on LCX TLR -2 stent technique (N=50)-

No malapposed stent struts (N=25)

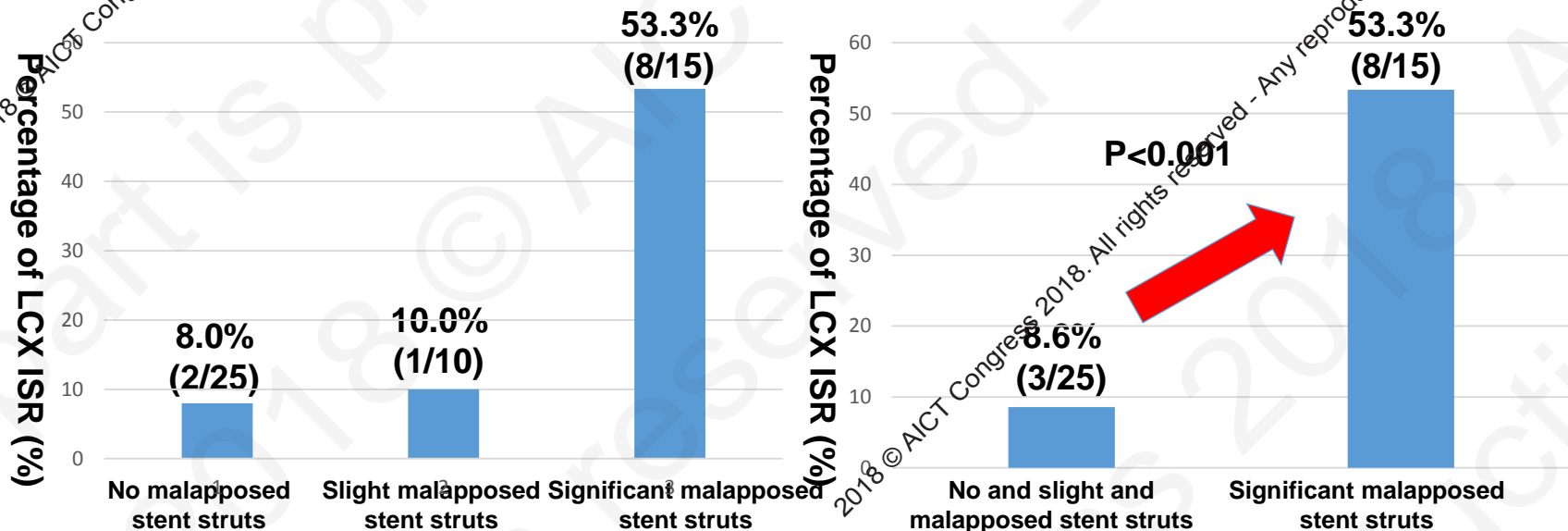
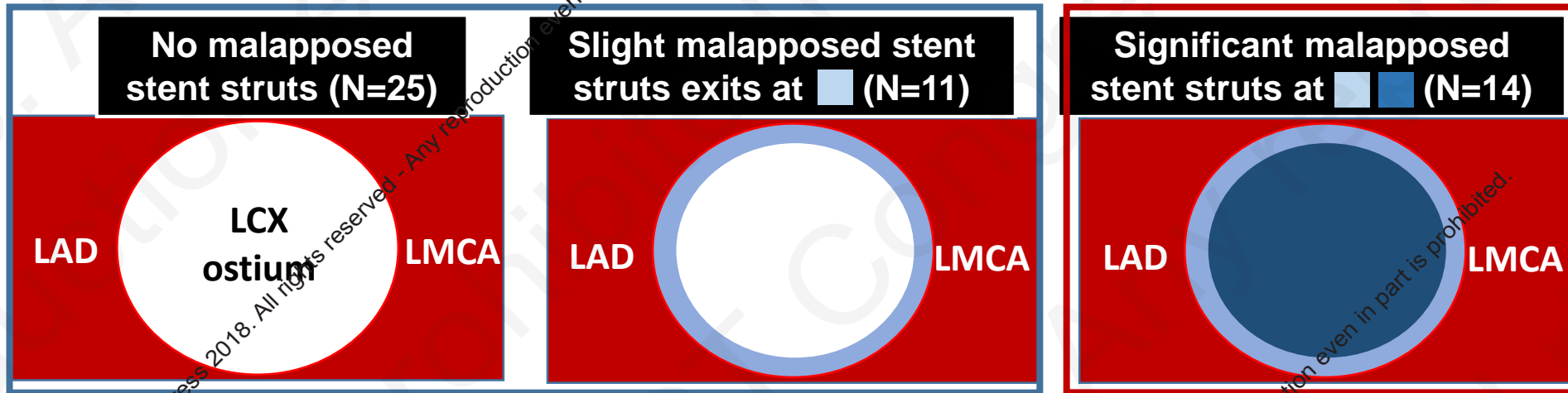
Slight malapposed stent struts exits at ■ (N=11)

Significant malapposed stent struts at ■ ■ (N=14)

Number of malapposed struts at LCX ostium



Impact of malapposed stent struts on LCX TLR -2 stent technique (N=50)-



My Message

1. Focus on LAD stenting !!,
Do not chase to much LCX!!
2. Better to do KBT !! (We need more Data)
3. Imaging Device is necessary !!
4. If you can finish One stent ,
You have a big advantage in terms of restenosis.
5. If you can not avoid Two stenting strategy,
You need to optimize the apposition of stent strut.

**There is never that practicing
witchcraft and sorcery was simple**

- Harry Potter



There is never that LMT PCI was simple

- Sunao Nakamura



2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

2018 © AICT Congress 2018. All rights reserved. Any reproduction even in part is prohibited.

14th

AICT

ASIAN INTERVENTIONAL CARDIOVASCULAR THERAPEUTICS
THE OFFICIAL CONGRESS OF APSIC

7 - 9th September 2018

Hong Kong

Convention and Exhibition Centre (HKCEC)

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.

2018 © AICT Congress 2018. All rights reserved - Any reproduction even in part is prohibited.