

**Real-Practice Concerns of LM PCI**

# **Restoring Patency in the Left Main Artery: In-Stent Restenosis Management**

**Yoshinobu Murasato, MD, PhD**

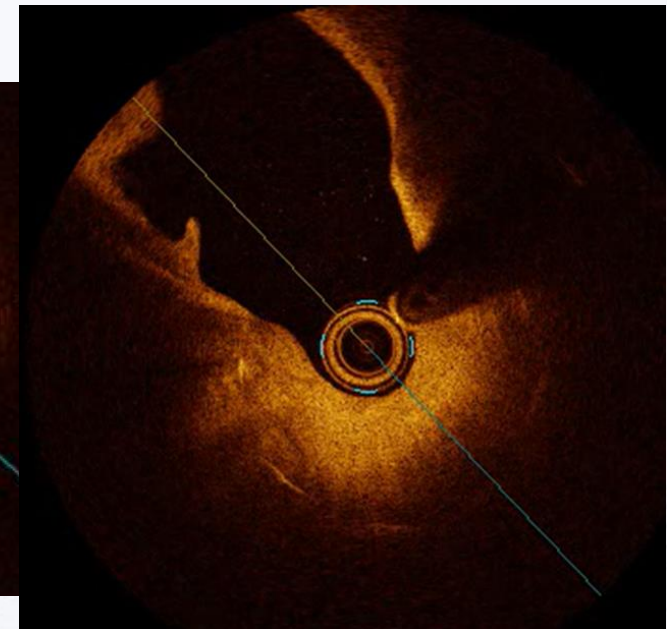
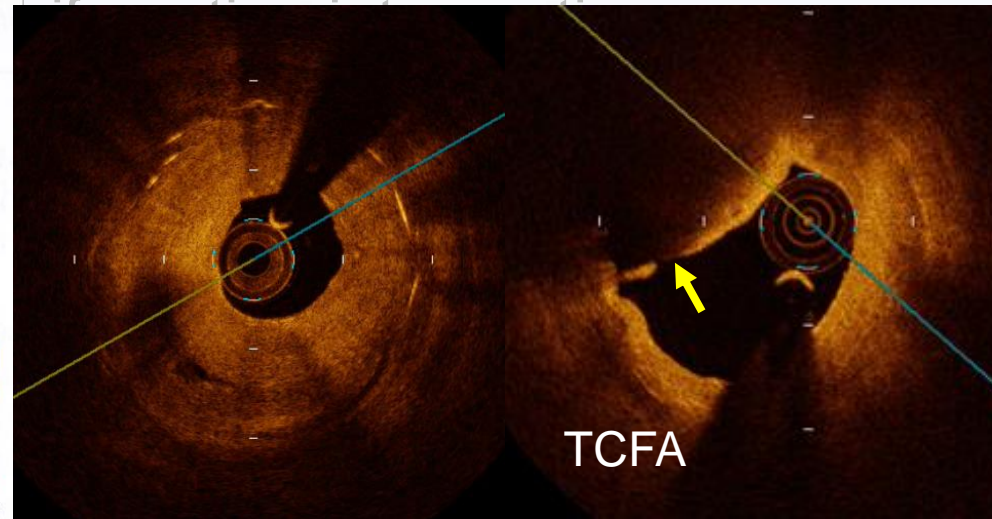
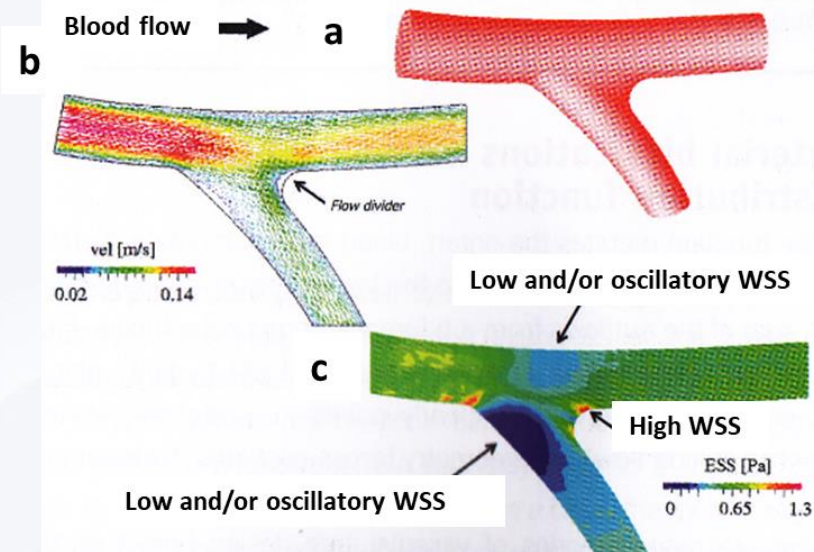
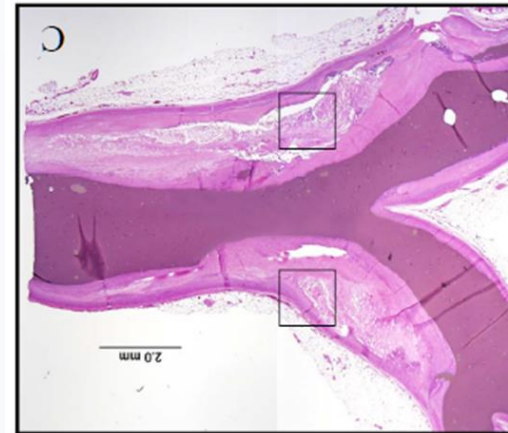
**Department of Cardiology,  
National Hospital Organization Kyushu Medical Center,  
Fukuoka, Japan**

# Disclosure

- The author has no financial conflicts of interest to disclose concerning the presentation.

# Mechanism of in-stent restenosis in coronary bifurcation

- Intimal hyperplasia
  - Neo-atherosclerosis
  - Organized thrombus accumulation
  - Intra-plaque hematoma
- due to low shear stress & high axial wall stress



Intimal hyperplasia

Neo-atherosclerosis

Organized thrombus accumulation

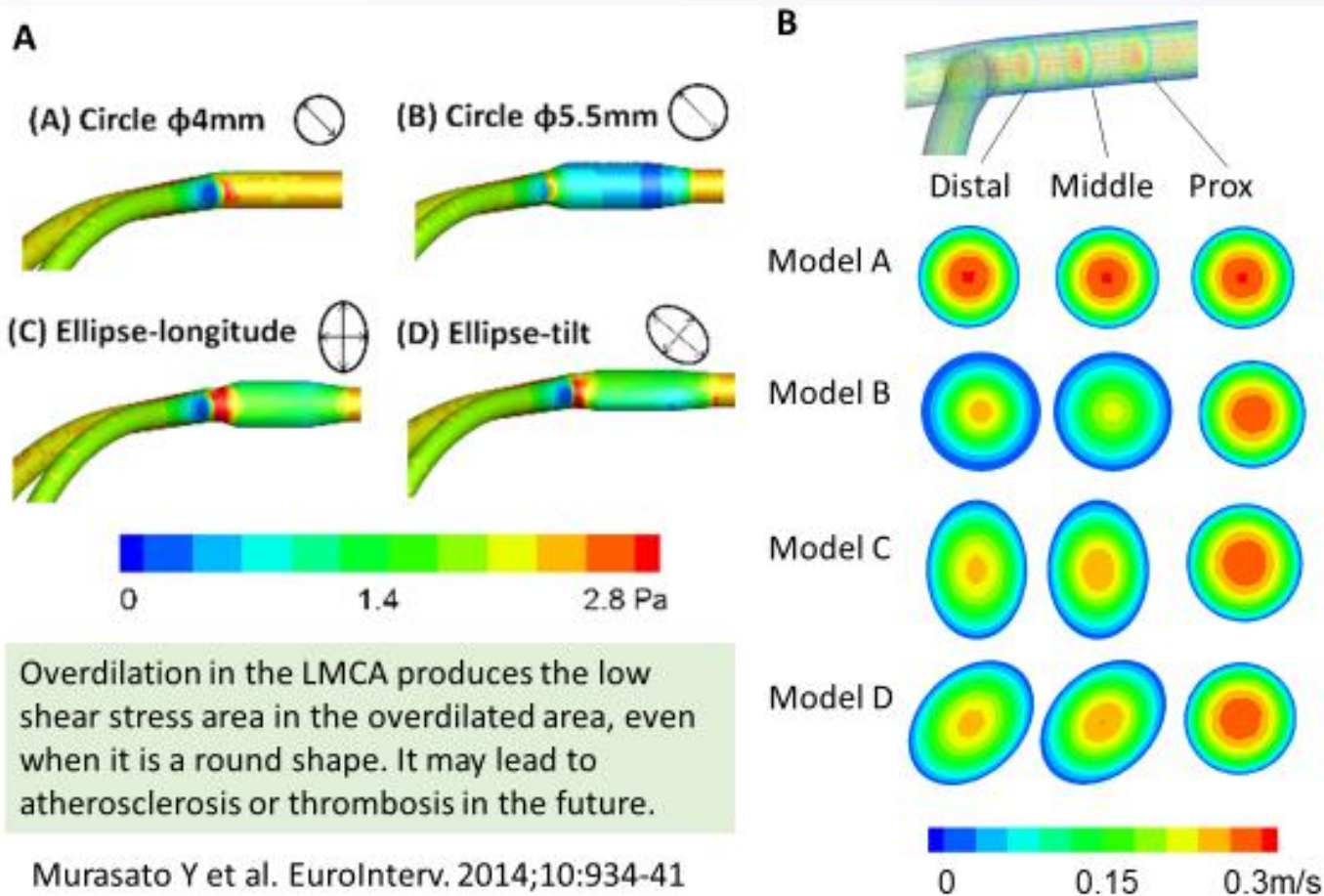
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exhausted by suboptimal  
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to vascular branching law.

- ✓ Jailed strut
- ✓ Malapposition
- ✓ Metal overlapping
- ✓ Metallic carina: non-centralized position

- Calcified nodule

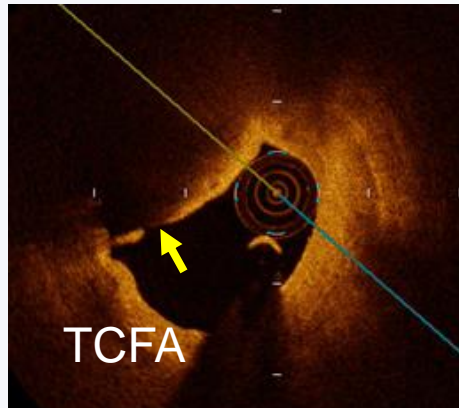


**Finet's law**

$$MV = 0.678 \times (SB + MB)$$

# Optimal pretreatment according to ISR tissue characteristics

## 1. Soft tissue



Neo-atherosclerosis

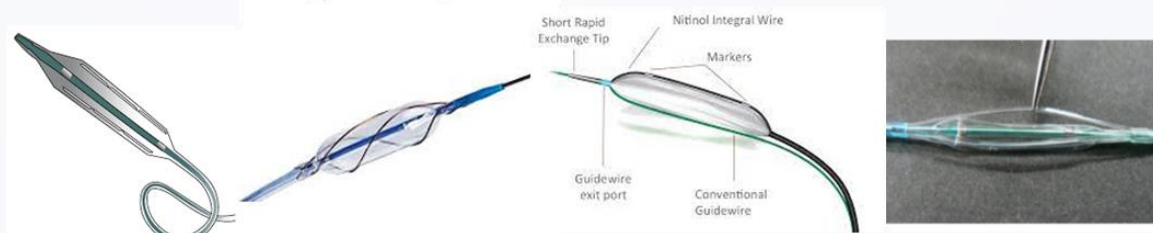
### Scoring balloon

Wolverine

Angiosculpt

Scoreflex

NSE

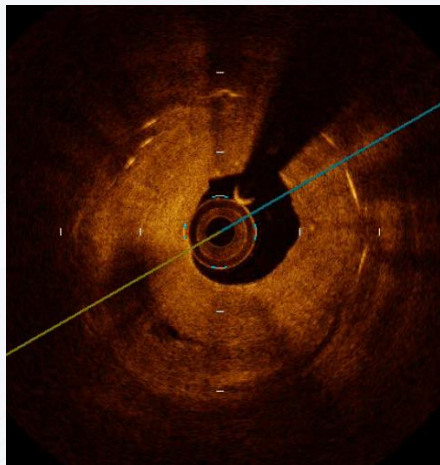


Controlled dissection

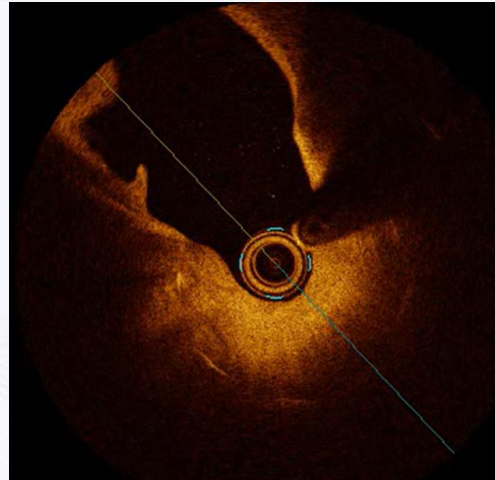
Sufficient lumen dilation with low pressure



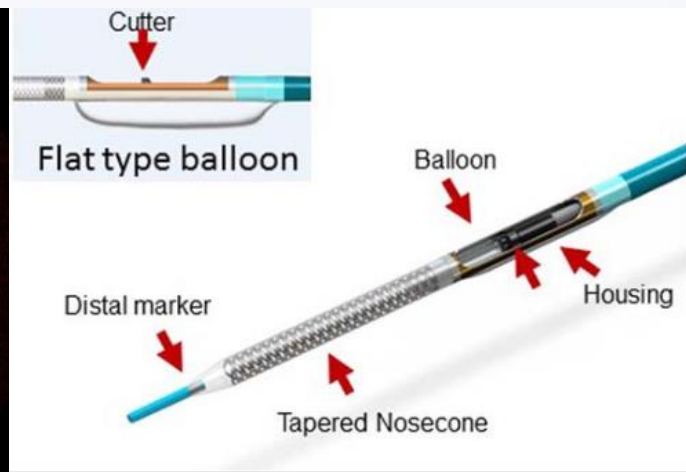
## 2. Large amount of hard tissue



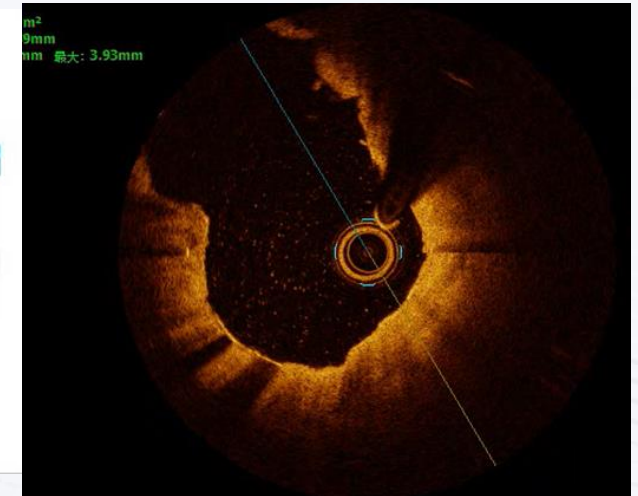
Intimal hyperplasia



Organized thrombus accumulation

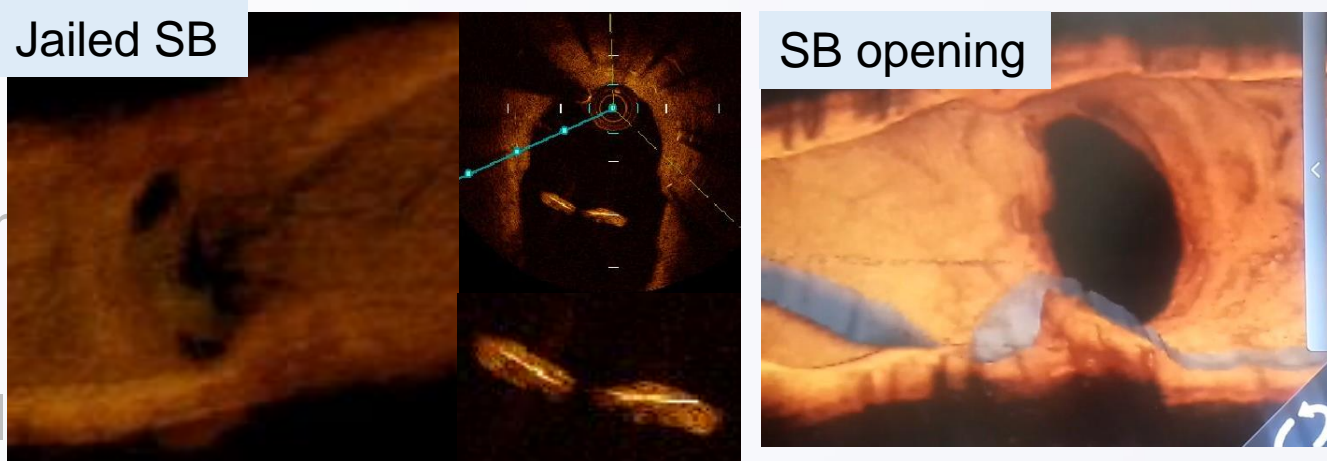


### Directional coronary atherectomy



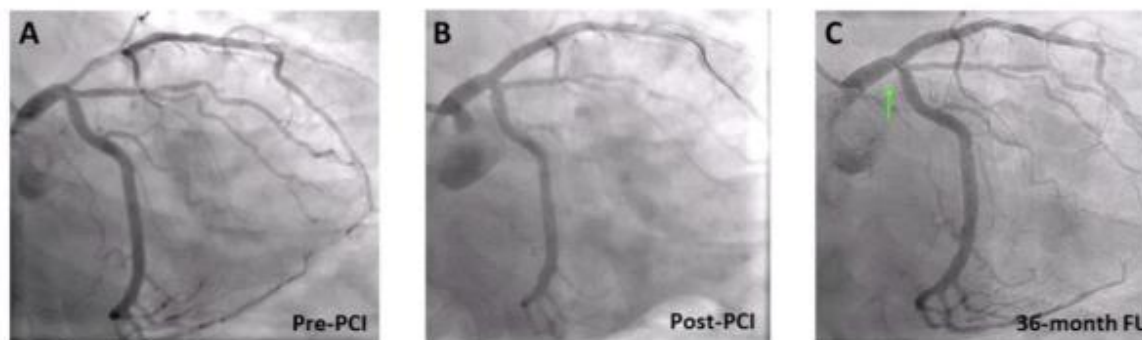
# Mechanism of in-stent restenosis in coronary bifurcation

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- due to low shear stress & high axial



exhausted by suboptimal bifurcation intervention inconsistent to vascular branching law.

- Mechanical stimulation of the stent
  - ✓ Jailed strut **Fenestrated restenosis**
  - ✓ Malapposition
  - ✓ Metal overlapping
  - ✓ Metallic carina: non-centralized position
- Calcified nodule



# Mechanism of in-stent restenosis in coronary bifurcation

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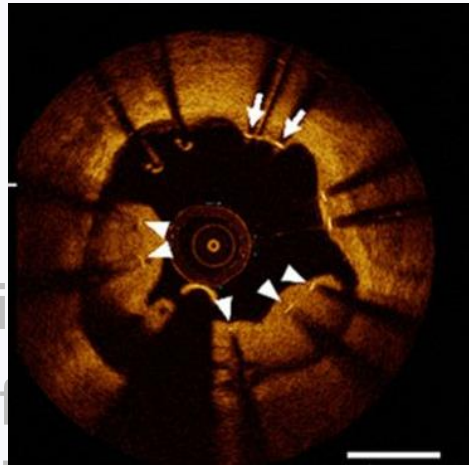
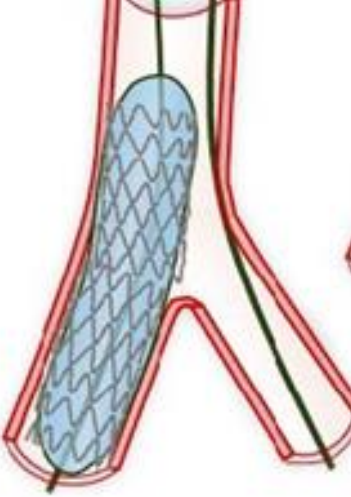
- Organize

- Intra-plac

due to low

exhausted

inconsistent to vascular branching law.



- Mechanical stimulation of the stent

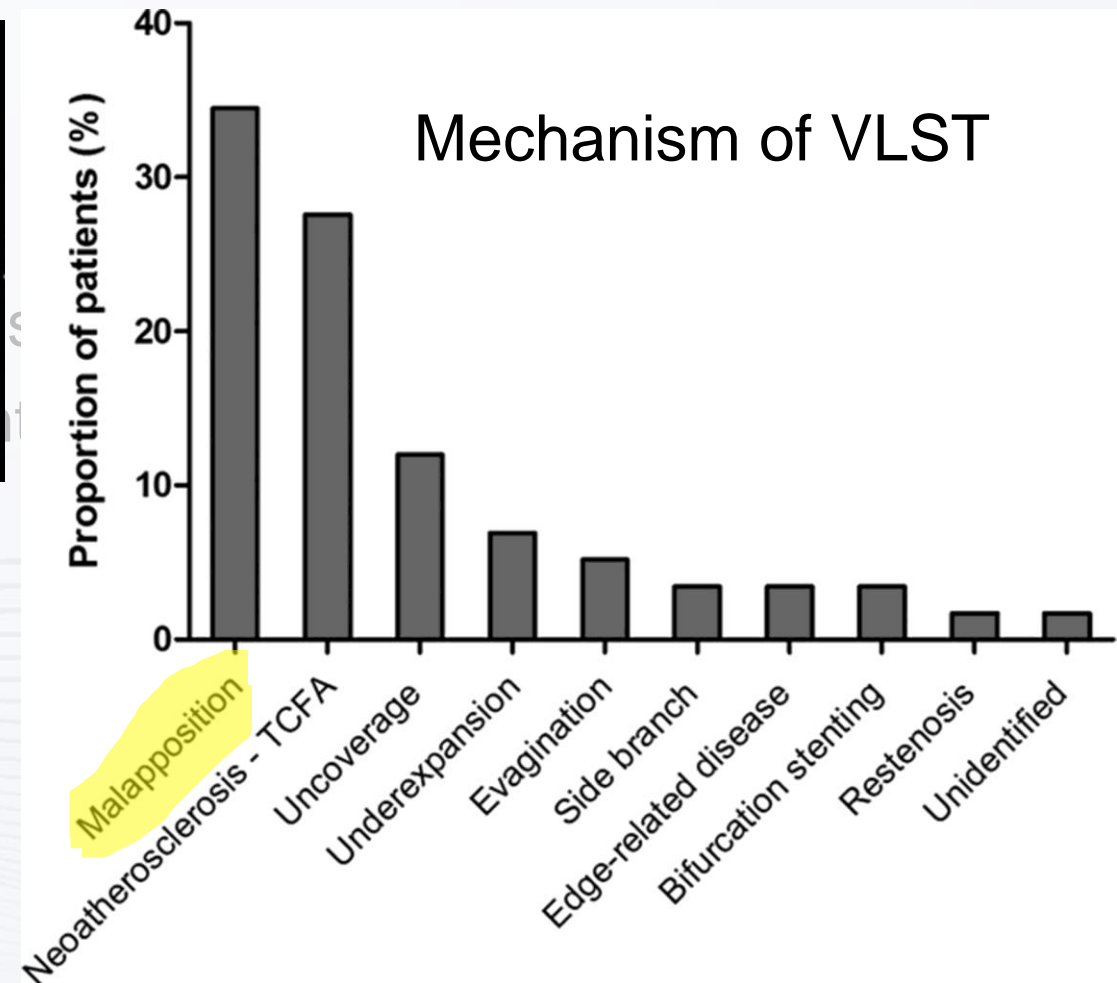
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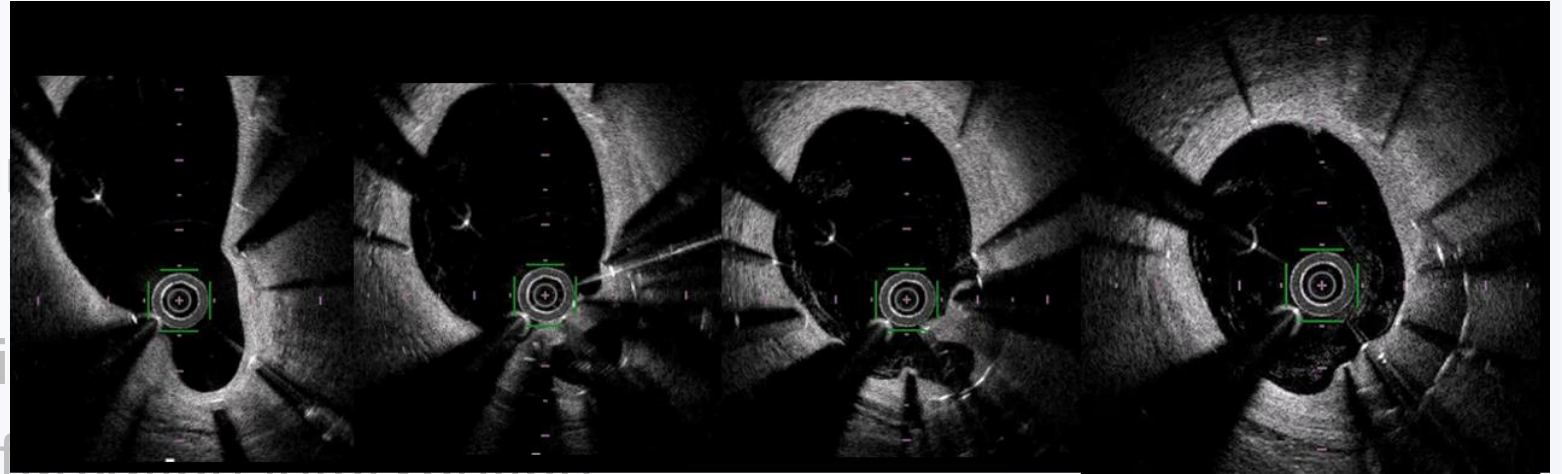
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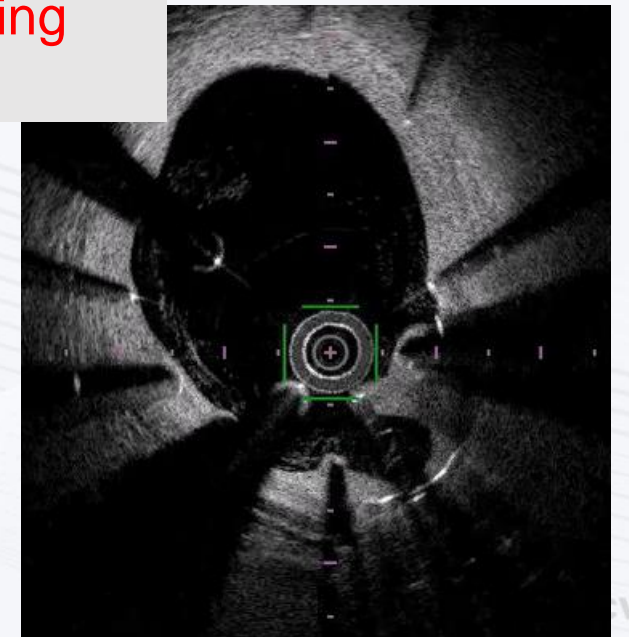
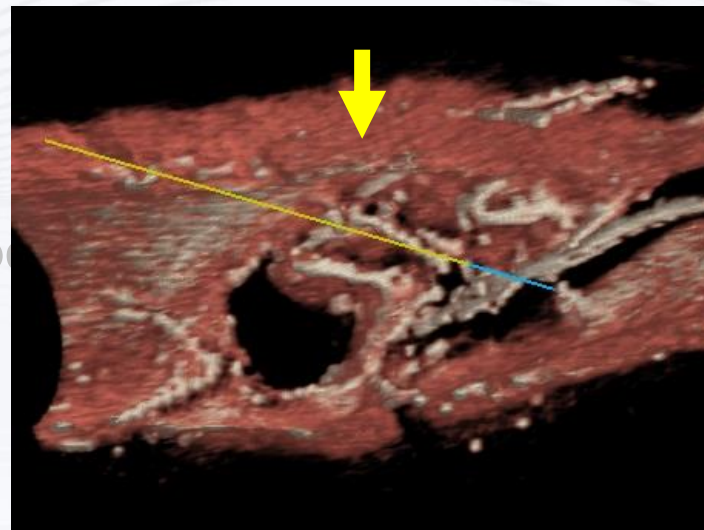
Taniwaki M et al. Circulation. 2016;133:650-60.

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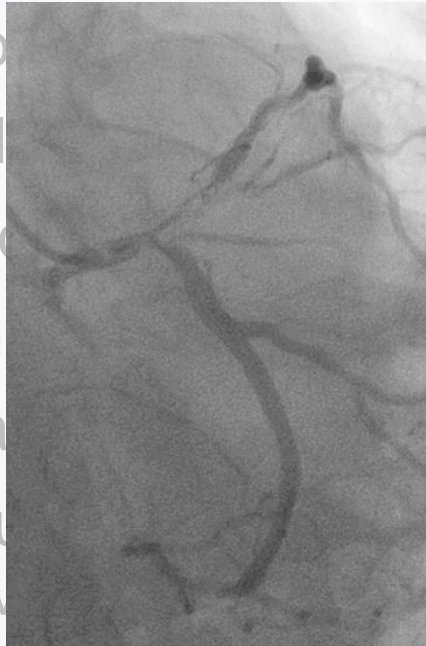
9Y F/U after crush stenting  
SB ostial restenosis



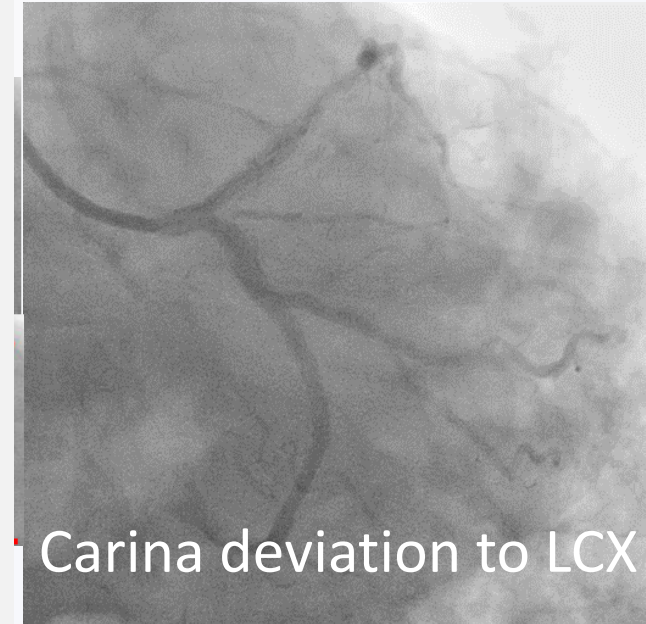
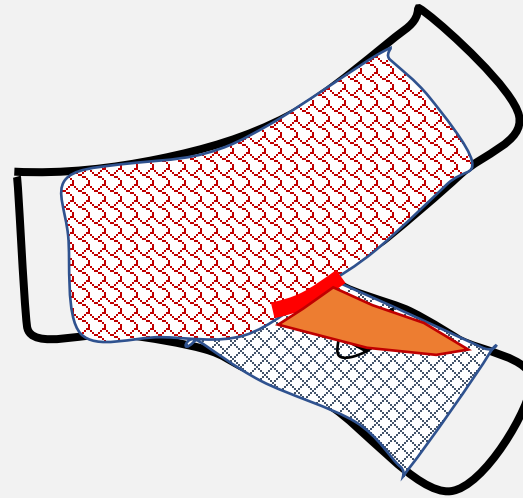


# Mechanism of in-stent restenosis in coronary bifurcation

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  - Organized thrombus
  - Intra-plaque hemorrhage
- due to low shear stress  
exhausted by stent  
inconsistent to vessel

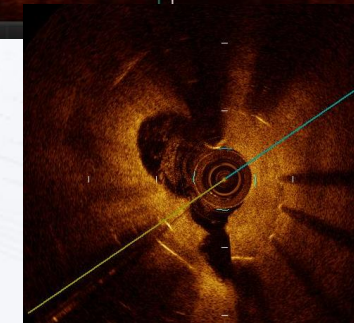
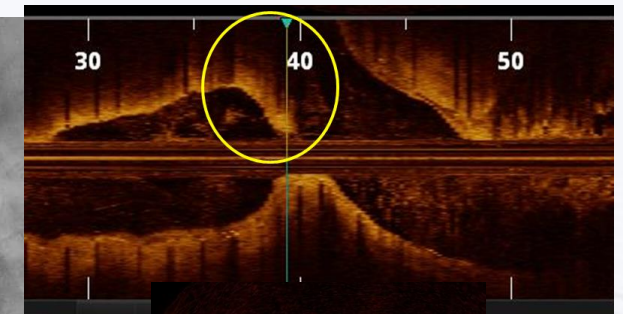
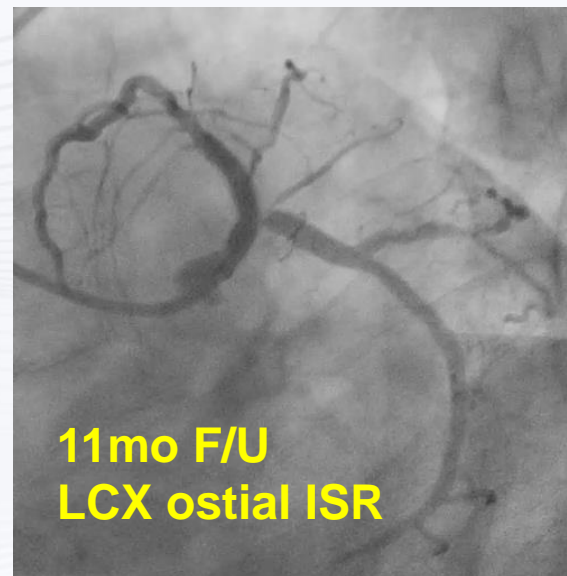


Restenosis in LCXOS



Carina deviation to LCX!

- Mechanical stimulation of the stent
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- Calcified nodule



# Mechanism of in-stent restenosis in coronary bifurcation

- Intimal hyperplasia

- Necrosis

- Organized thrombus

- Intraluminal thrombus

due to

exhaustion

incomplete

- Mechanical

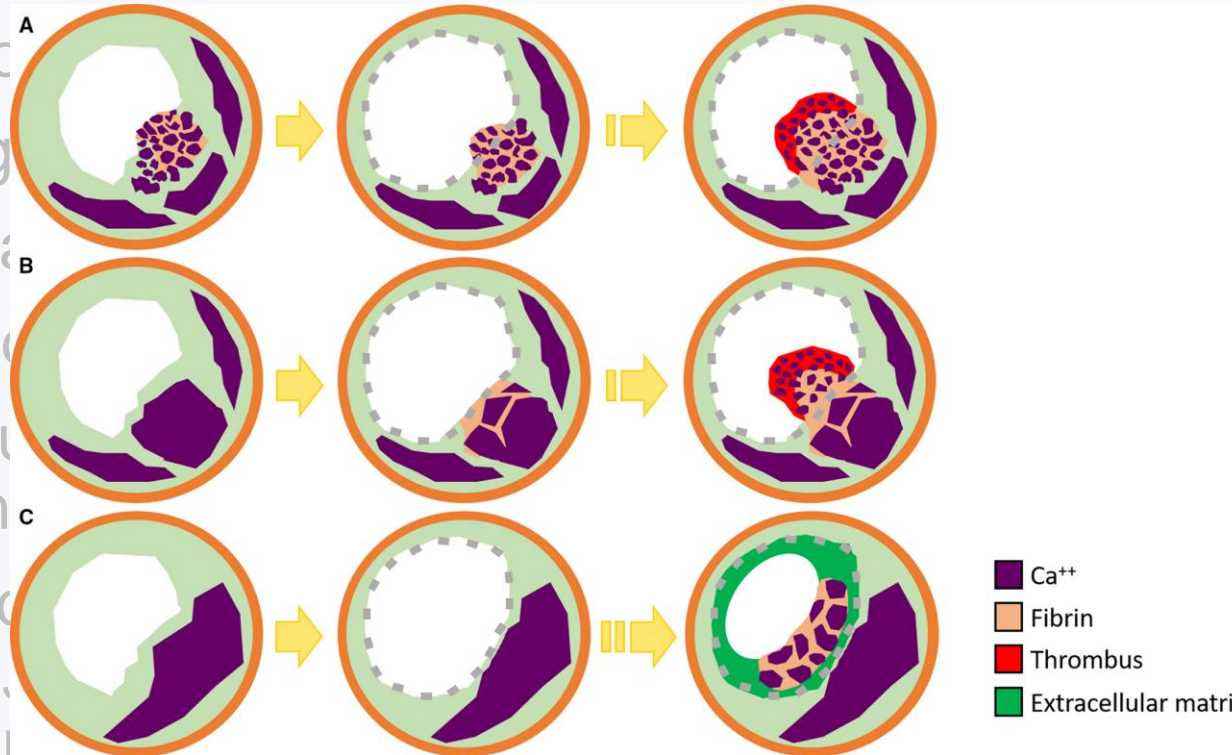
✓

✓

✓ Metal overlapping

✓ Metallic carina: non-centralized position

- Calcified nodule

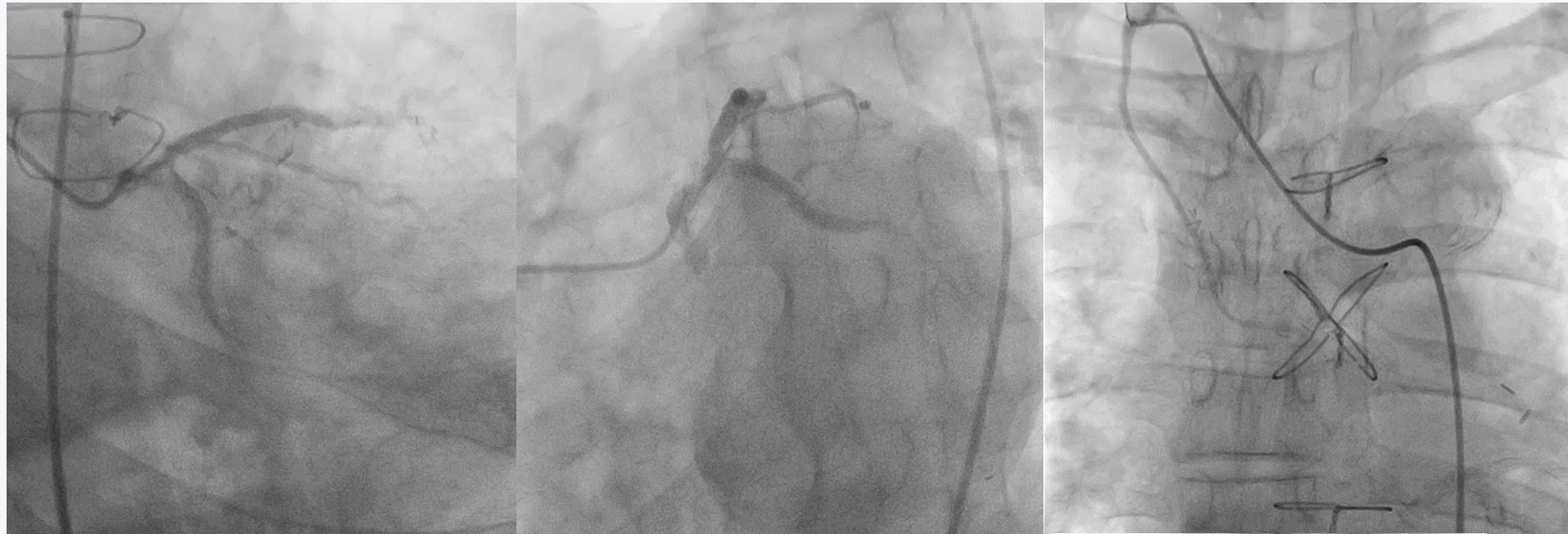


- a. Stenting on the fragmented Ca
- b. Ca protrusion from nodular Ca
- c. Calcification of ISR tissue

Risk: 1. Hemodialysis Nakamura N et al. J Am Heart Assoc. 2020;9:e016595.  
 2. Prior CABG Wolny R et al. Catheter Cardiovasc Interv. 2021;98:483-491.

# Case: 73y.o. Male, UAP, CKD on HD, prior CABG 14Y before

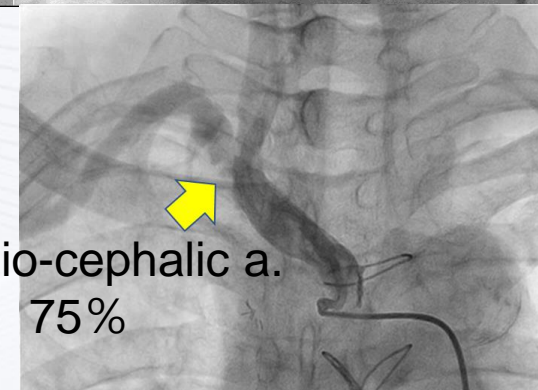
8Y before: middle LCX stenting with PES, 4Y before: LM-LAD stenting with EES  
ISR after T-stenting in LM bifurcation 4mo before in another hospital



Suboptimal stent expansion in LM and LCX in previous PCI.

LAD was protected by RITA, however blood flow to LAD was insufficient due to 75% stenosis in brachiocephalic artery and A-V shunt formation for hemodialysis in rt upper extremity.

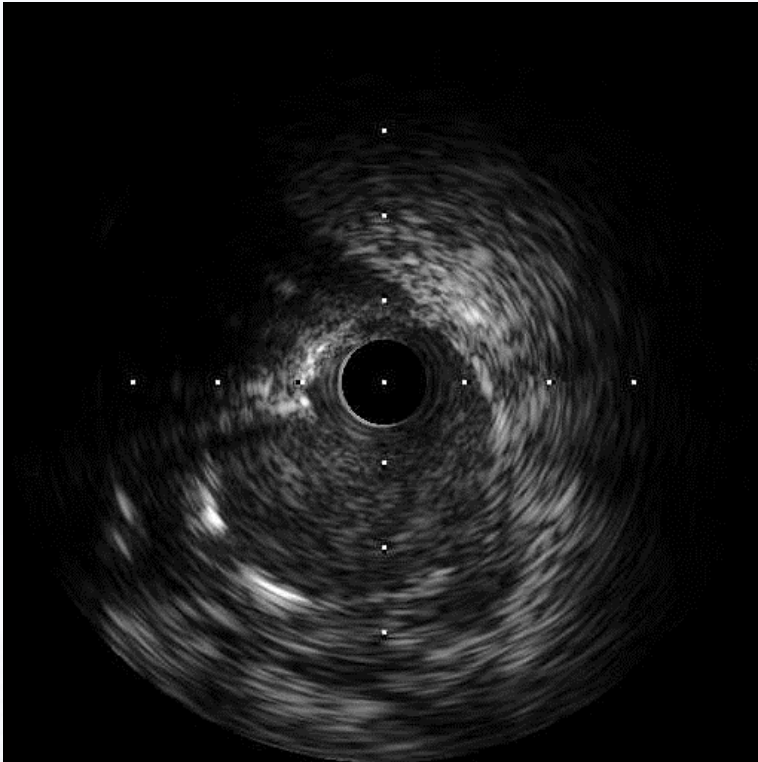
Brachio-cephalic a.  
75%



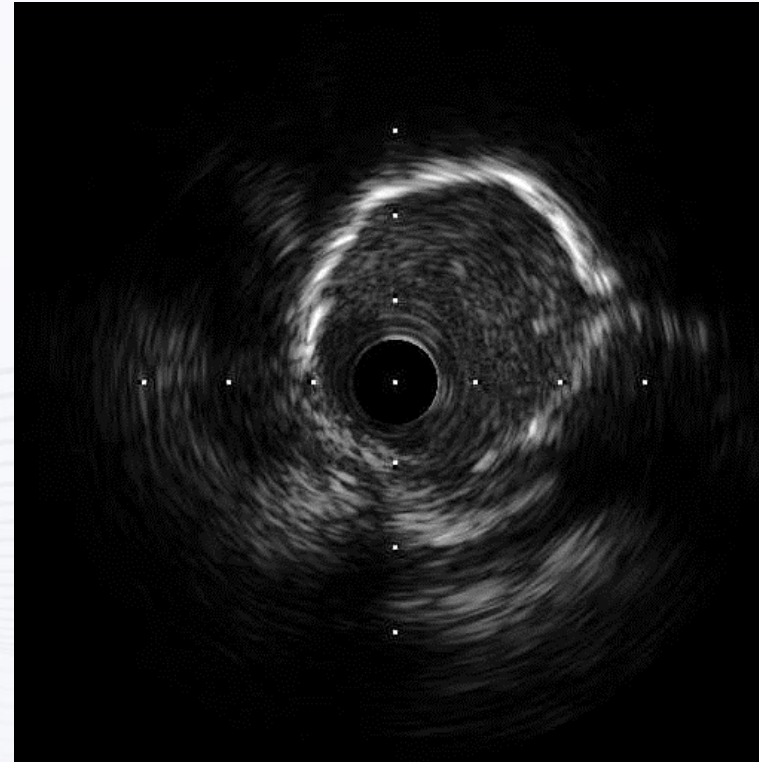
# Pre-PCI IVUS

Calcified nodule in both LAD and LCX ostium and concentric calcified lesion with the underexpanded stent in LM bifurcation.

LCX - LM



LAD - LM



# Rotational atherectomy in LM-LCX

GW bias to the LCX lateral side worked well for the effective calcification debulking.



Rotablator 1.5mm,  
180,000rpm



Rotablator 2.0mm,  
180,000rpm

# Preparative balloon dilation

To gain more lumen in the calcified lesion according to vascular branching law.

$$\text{Finet's law: } (3.0 + 3.5) \times 0.678 = 4.4$$

LCX dilation

Kissing balloon

POT



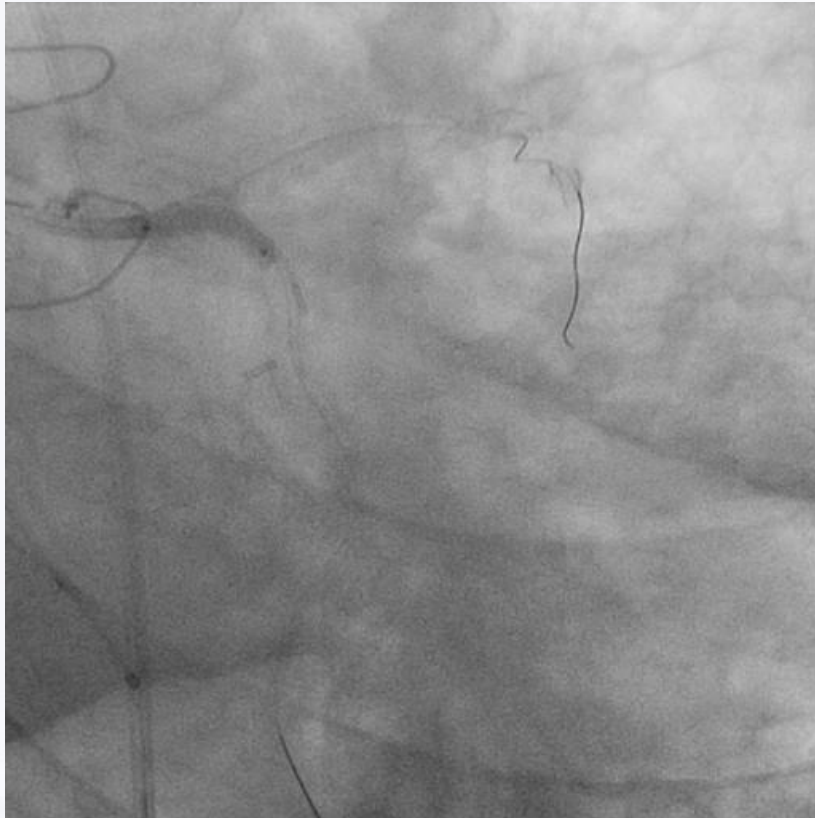
Kunai 3.0/13

LAD: LifespeaHP 3.5/12  
LCX: Kunai 3.0/13

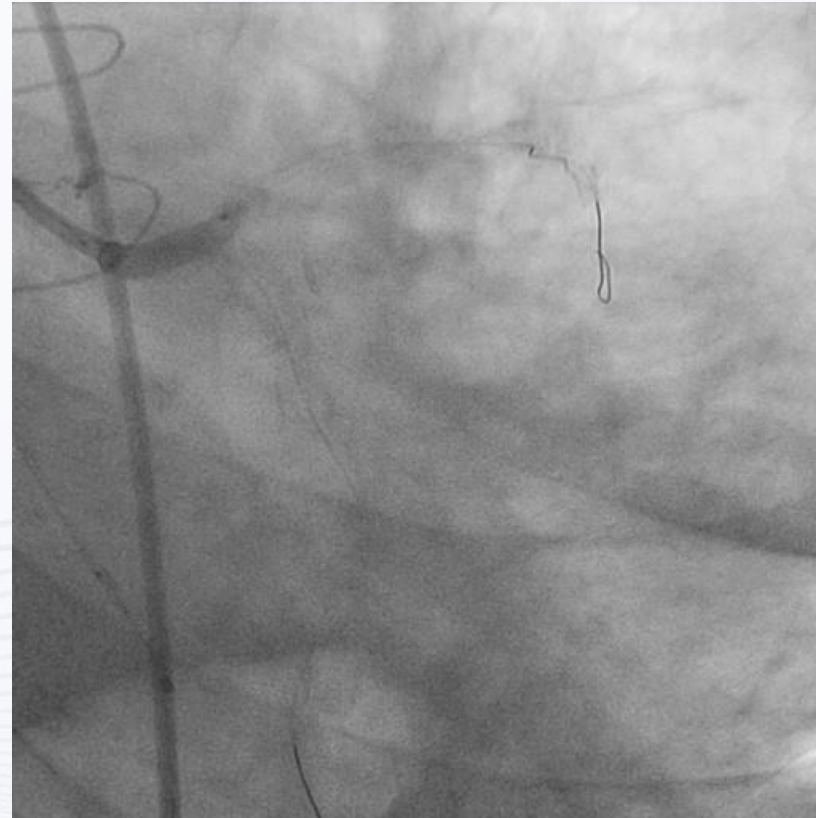
Hiryu plus 4.5/6

# DCB treatment

Sufficient lumen gain could weave additional stenting, which allowed DCB treatment.



LM-LCX: Sequent please 3.5/15



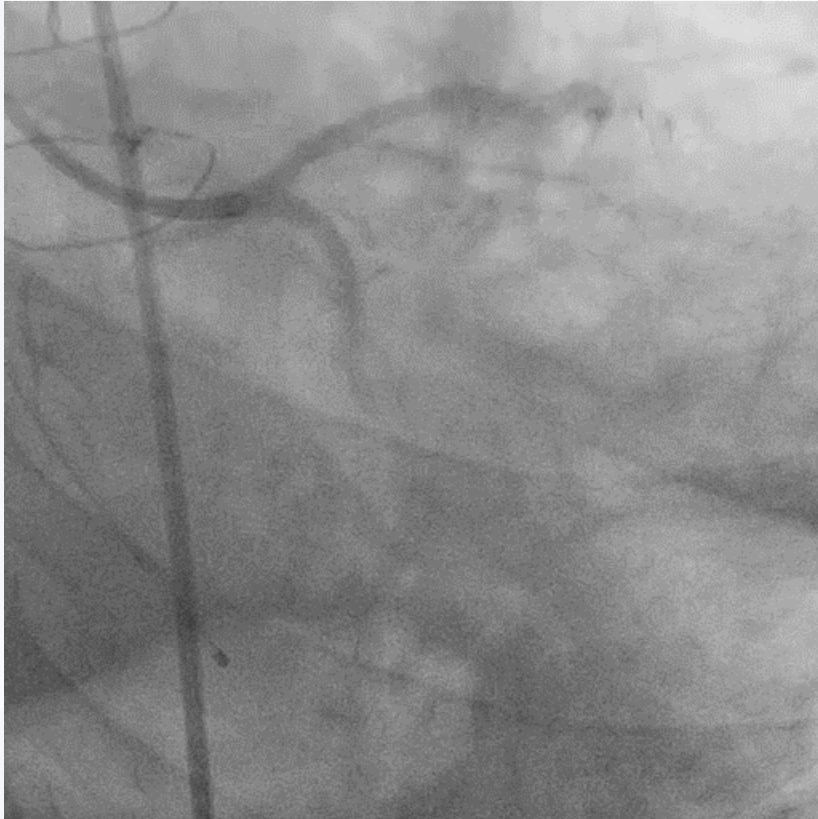
LM-LAD: Sequent please 4.0/20

# Final CAG & IVUS

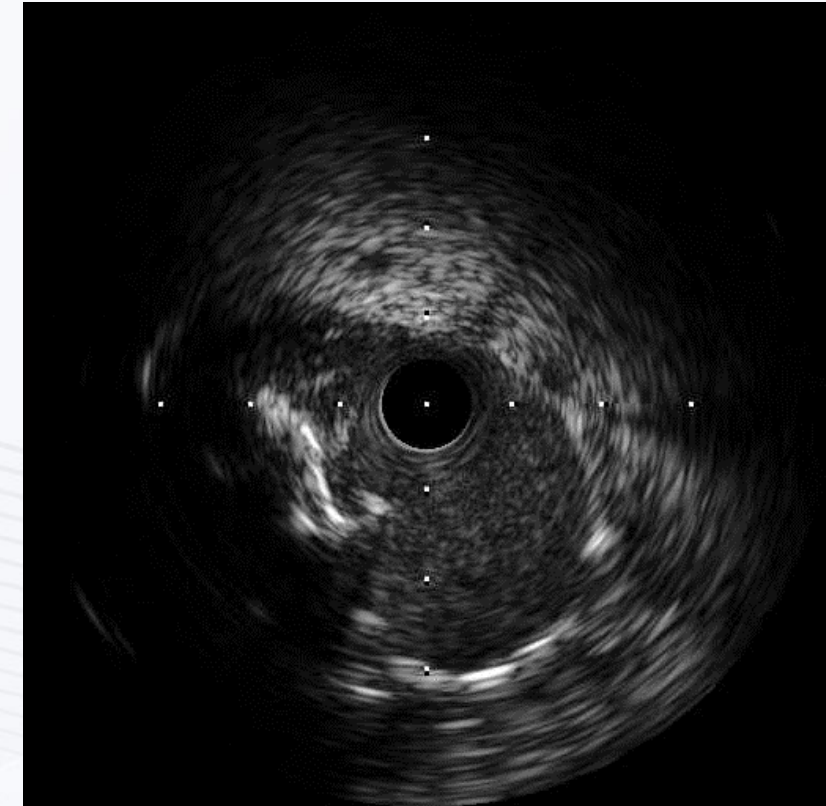
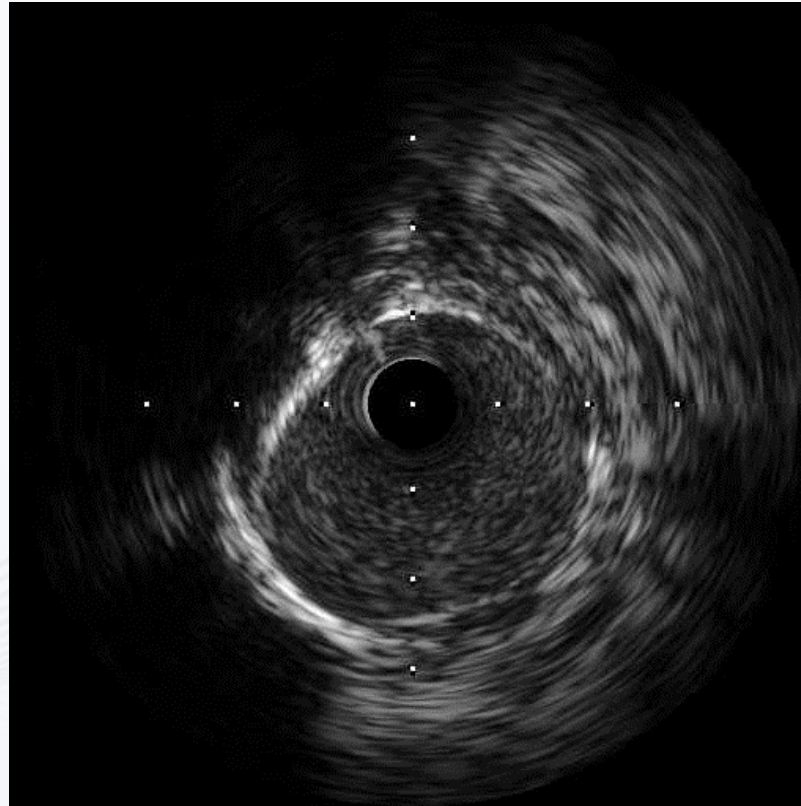
Sufficient lumen gain and stent dilation were confirmed.

The symptom was relieved after the PCI. There has not been no cardiac event for 3 years.

LCX - LM



LAD - LM





# Conclusion

## My philosophy of Management of LM In-stent Restenosis

1. Restoration of optimal lumen according to vascular branching law
2. Effective debulking or modification of in-stent tissue
  - Soft plaque: scoring balloon
  - Rich fibrous plaque: DCA
  - Calcification: RAS/OAS/IVL
3. Less additional stenting
4. DCB: firstly considered
5. Relocation of carina on neutral position
6. Complete removal of jailed struts under the imaging guidance: 3D-OCT guidance favorable

Thank you for your attention!