

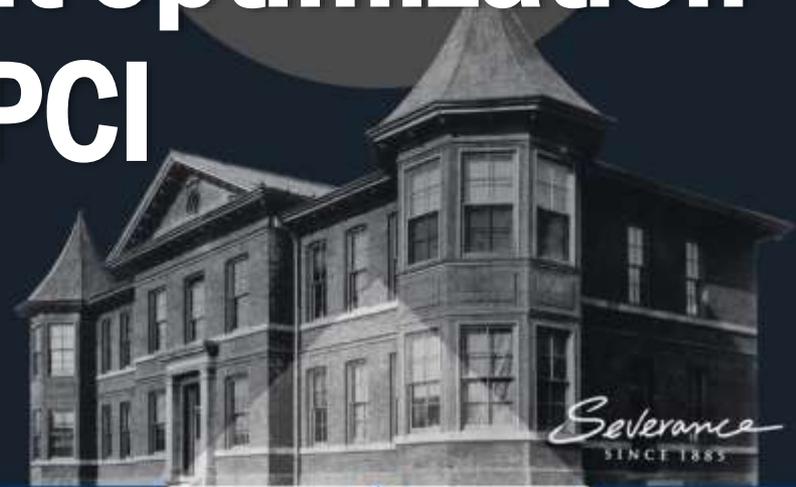


YONSEI  
UNIVERSITY

# Importance of stent optimization in CTO-PCI

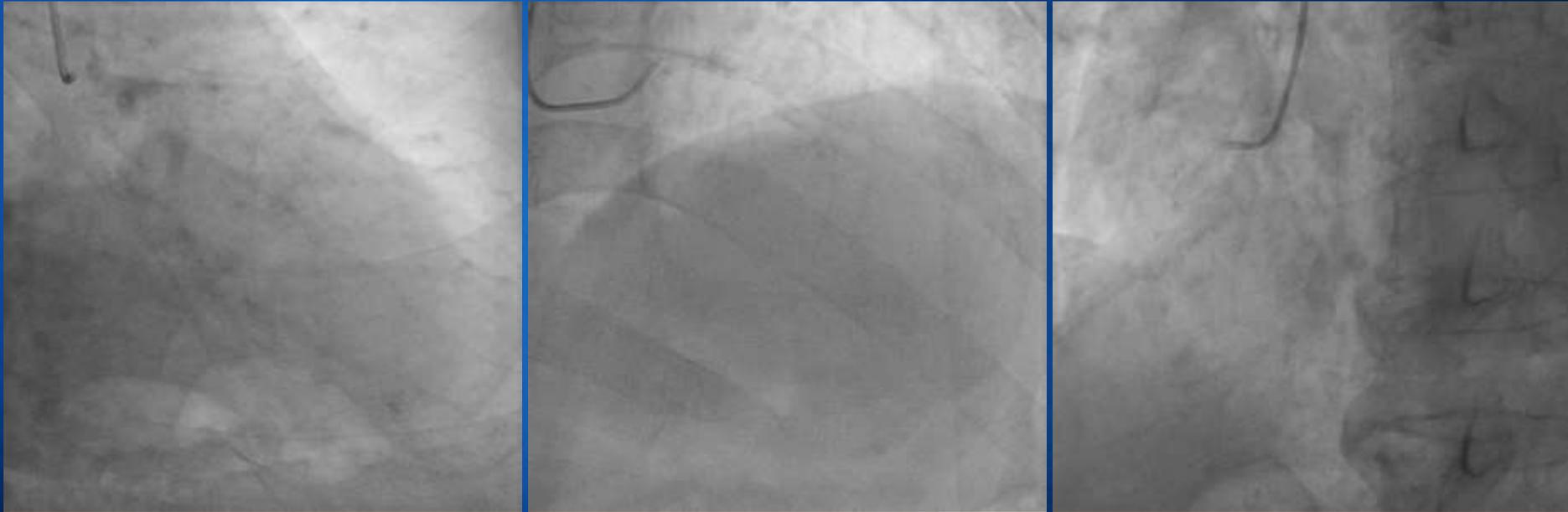
**Byeong-Keuk Kim, MD, PhD**

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Severance Cardiovascular Hospital,  
Yonsei University College of Medicine

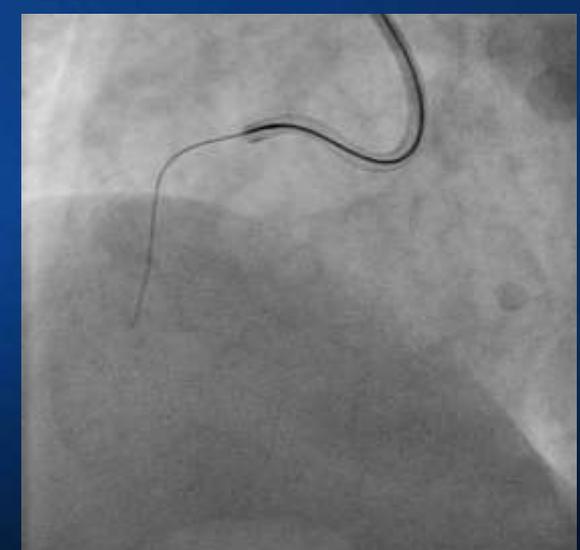
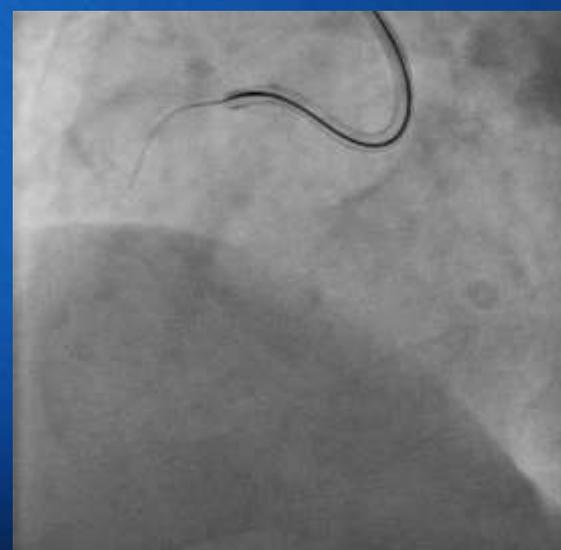
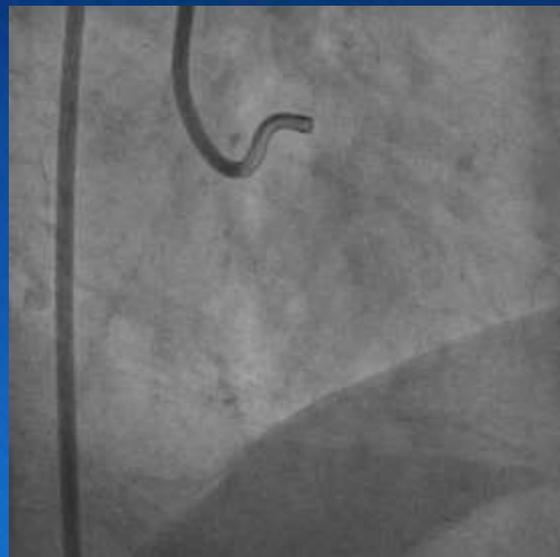


## Case 1. M/79, RCA-CTO

- C.C : Chest pain (for 5 months)
- Clinical diagnosis : Stable angina, HTN
- TTE : RWMA s thinning at RCA territory (EF=48%)
- Diagnostic CAG



# Start antegrade CTO-PCI



Corsair c XT-R

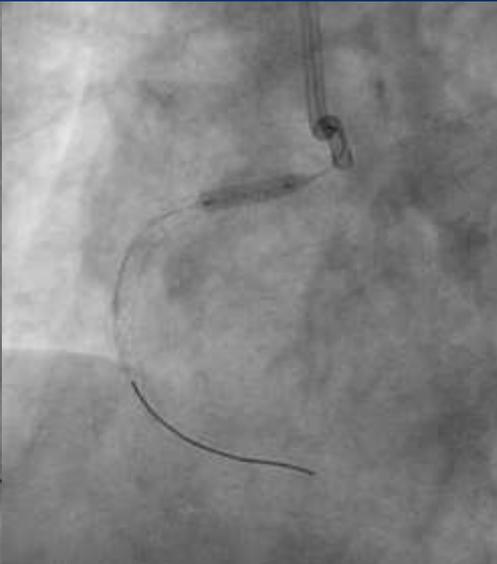
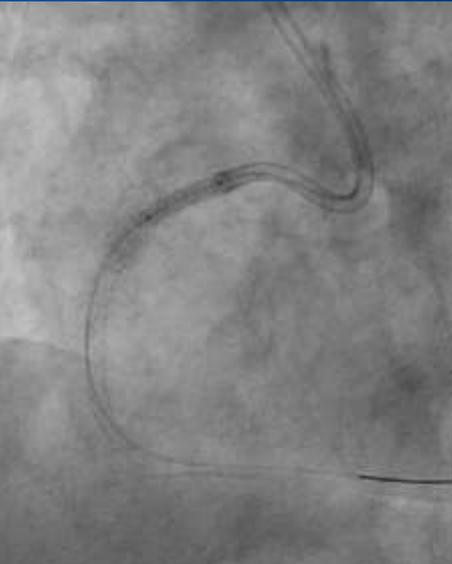
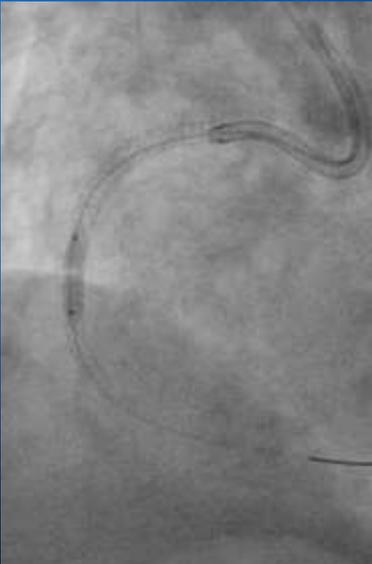
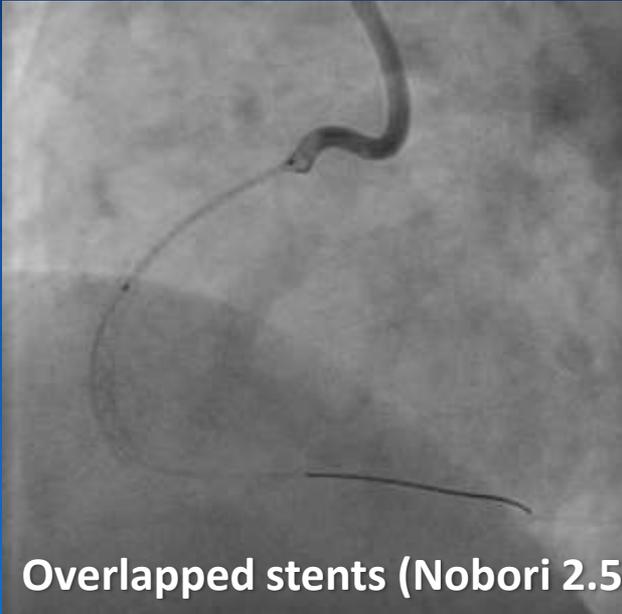
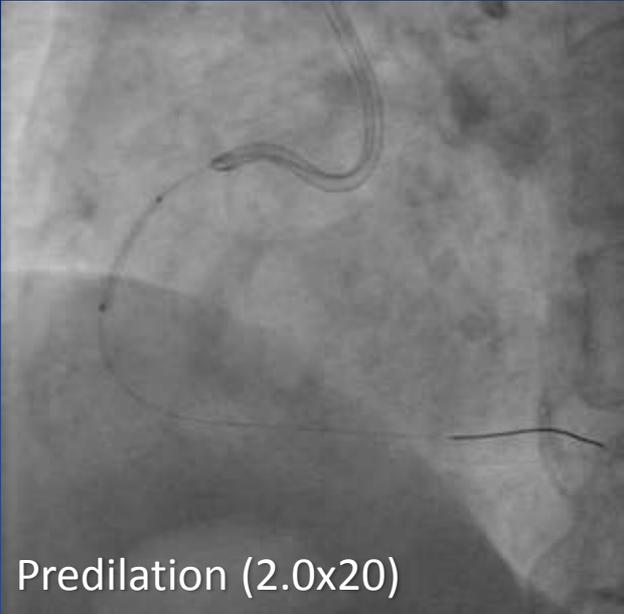
→

XT-R, GAIA 1<sup>st</sup>

→

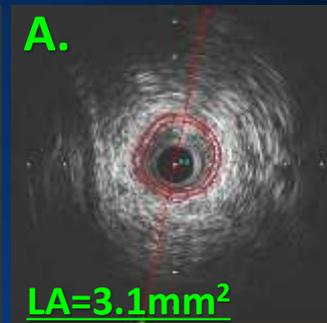
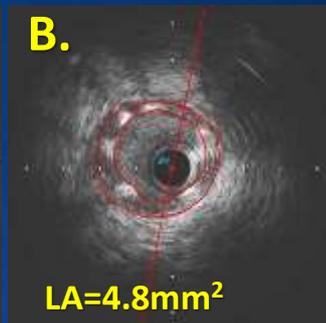
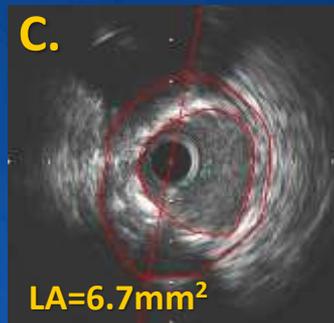
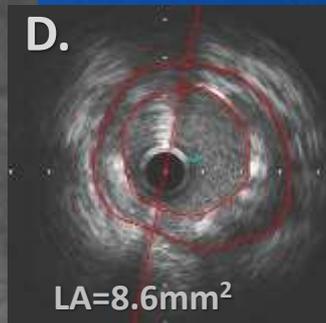
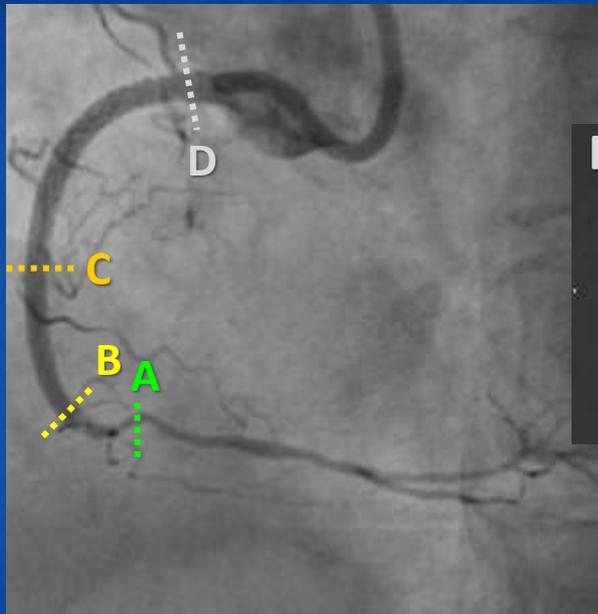
Successful lesion passage

# Stenting & post-dilation @ p-RCA CTO



High-pressure post-balloon; NC-balloon (3.0\*12, 24 atm)

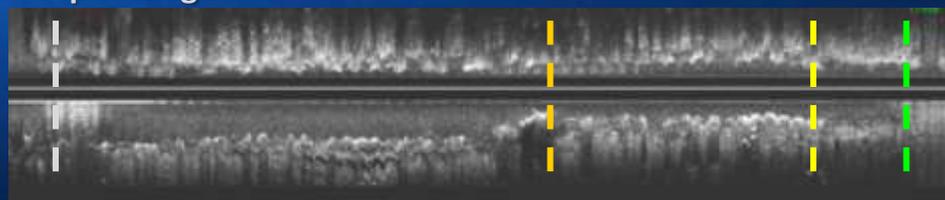
# Post-procedural IVUS



**D.** LA<sub>prox edge</sub>

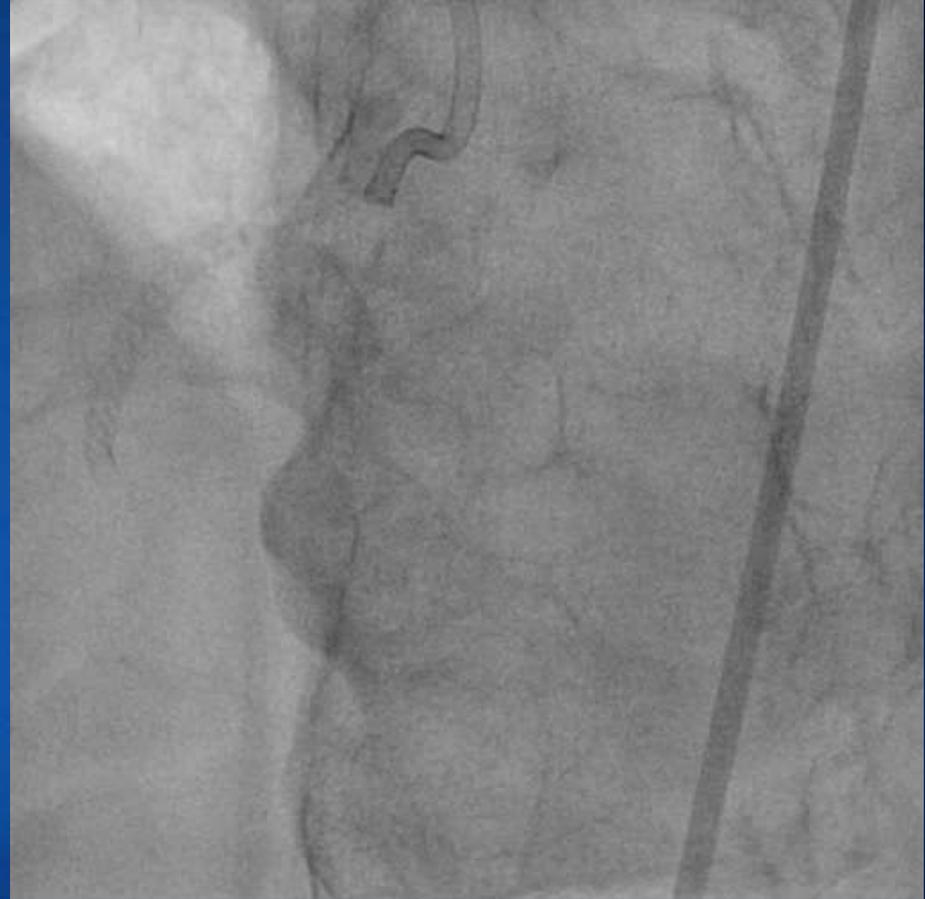
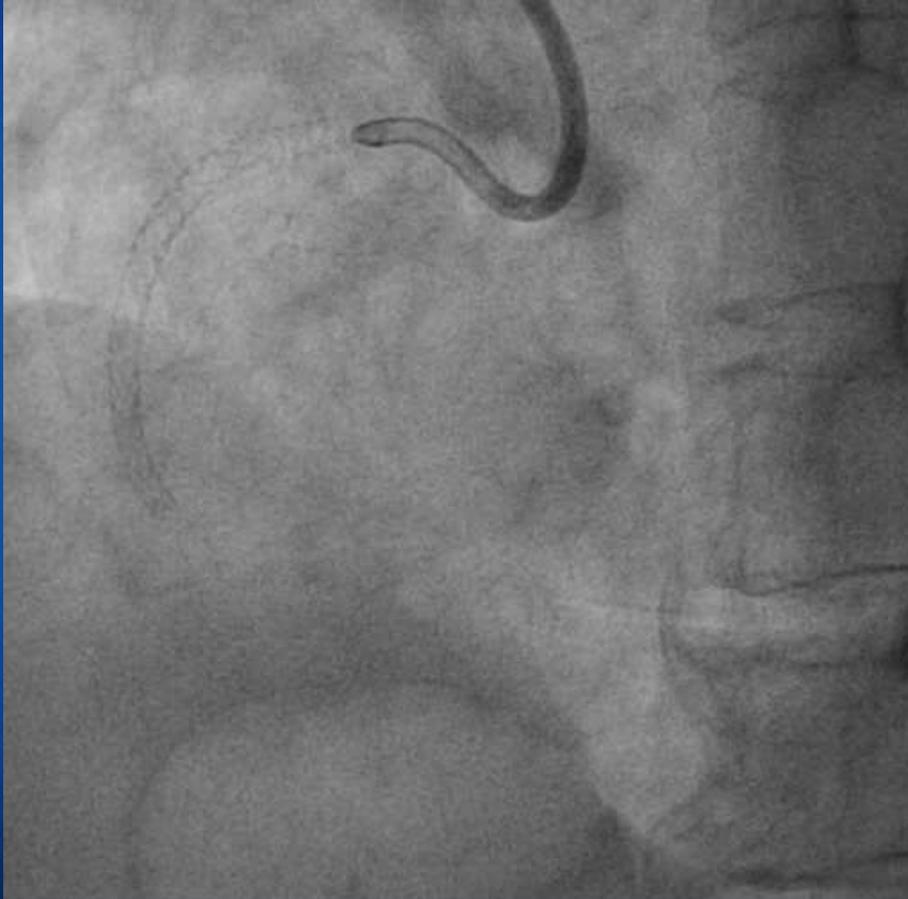
**C.** MSA

**B.** LA<sub>distal edge</sub>



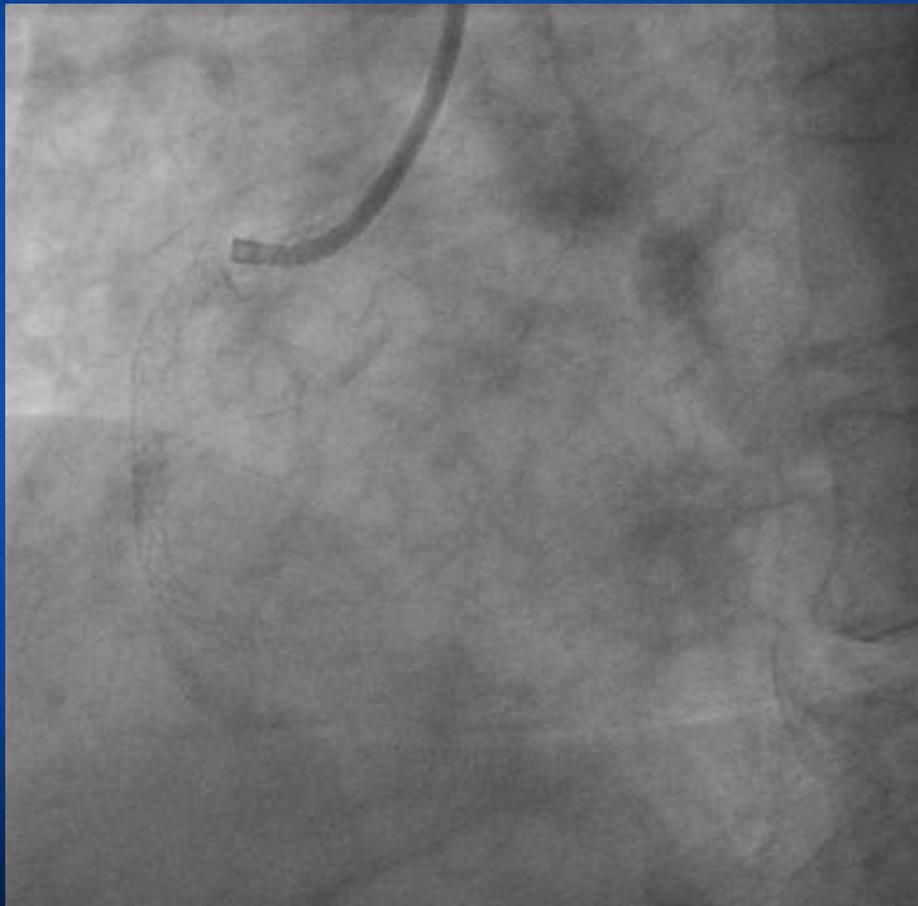
**A.** LA<sub>distal</sub>  
(LA at distal reference)

# Final angiography



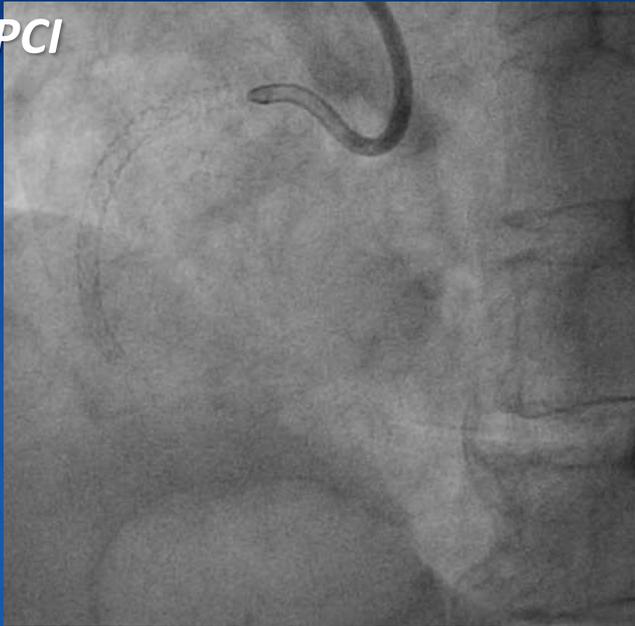
- Successful PCI c stents @ p-& m-RCA (Novori 3.0x24, 2.5x28)
- Diffuse lumen narrowing @ d-RCA lesion

# 12-month follow-up CAG s chest pain

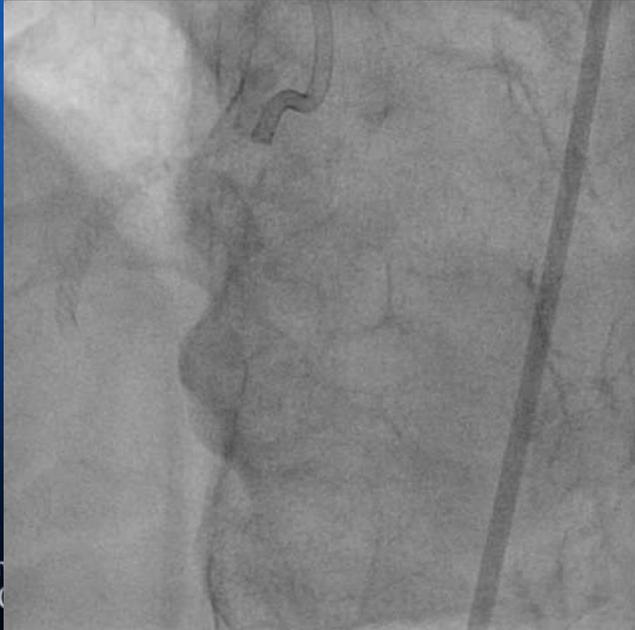
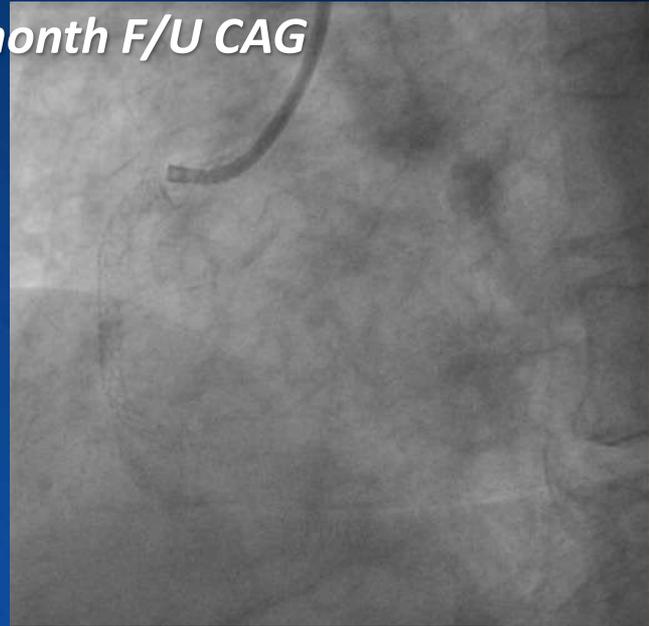


# Comparison between post-PCI and 12-month follow-up

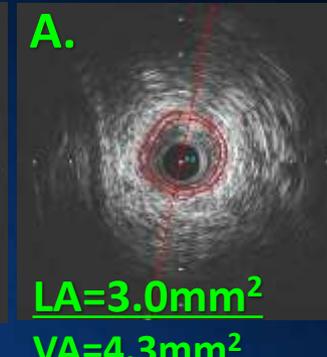
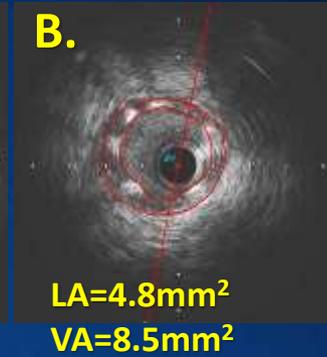
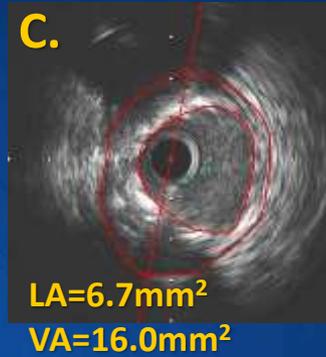
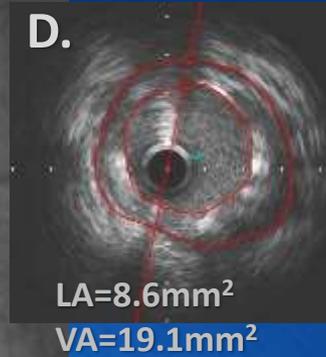
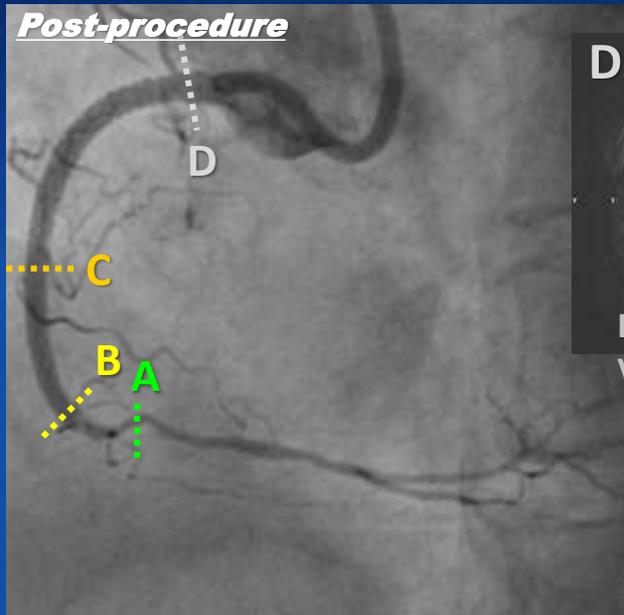
*Post-PCI*



*12-month F/U CAG*



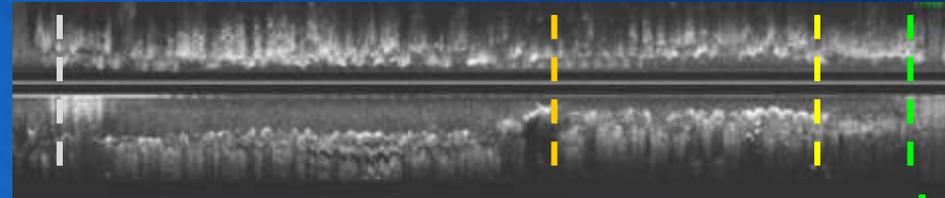
# Post-procedural & 12-month follow-up IVUS



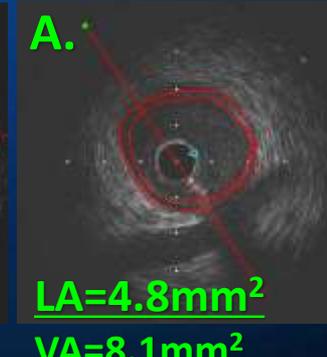
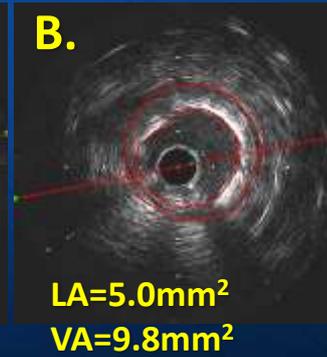
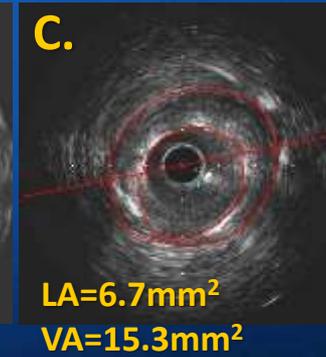
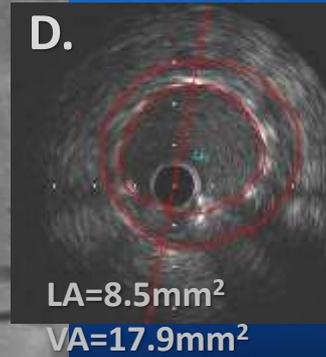
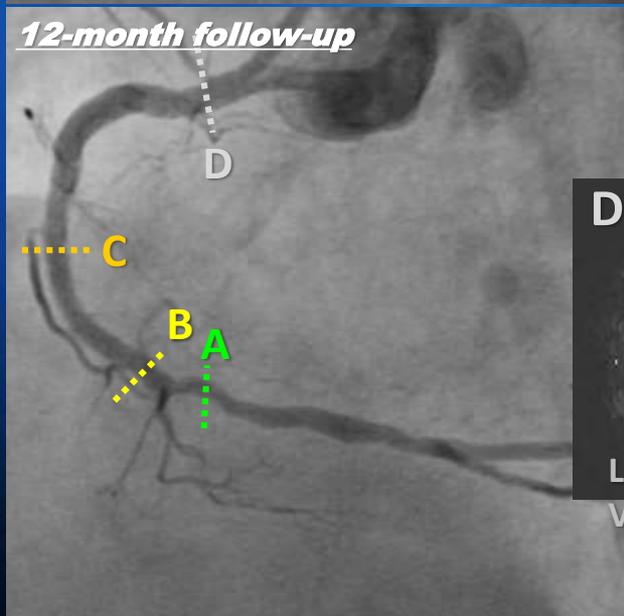
**D.** LA<sub>prox edge</sub>

**C.** MSA

**B.** LA<sub>distal edge</sub>



**A.** LA<sub>distal</sub>  
(LA at distal reference)



# How to improve clinical outcomes of complex lesions?



Imaging guidance

Improved  
clinical outcomes

## *IVUS-guided*

- Precise lesion evaluation
- Adequate expansion (greater MLD)
- Detection of complication

**Stent Optimization** plays a major role in improving clinical performance.



# Clinical outcomes of stent optimization in complex lesions

- Comprehensive analysis of individual patient-level randomized trials targeting diffuse long or CTO lesions

## IVUS-guided PCI in diffuse long or CTO lesions

From RESET, CTO-IVUS, IVUS-XPL, ULTRA-ZET trials  
(N = 1,396)

Stent-optimization group  
(N = 818)

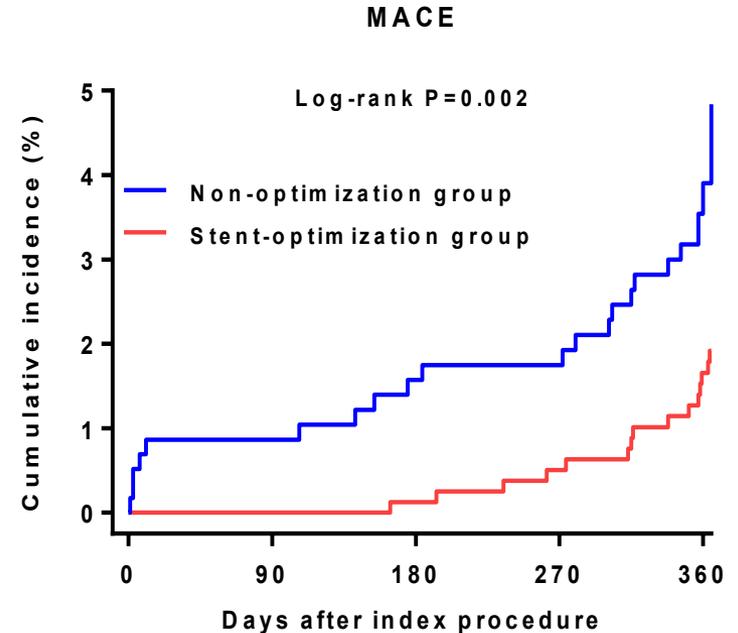
Non-optimization group  
(N = 578)

### Stent optimization criteria

MSA  $\geq 5.5 \text{ mm}^2$  or 80% of mean reference lumen area

### MACE

Cardiac death, MI, stent thrombosis, or TVR



	0	90	180	270	360
Non-optimization	578	562	556	553	532
Stent-optimization	818	800	794	784	763



# Clinical outcomes of stent optimization in CTO ?

## IVUS-guided PCI in CTO lesions

From RESET, CTO-IVUS, IVUS-XPL, ULTRA-ZET trials

(N = 231)

### Stent optimization criteria;

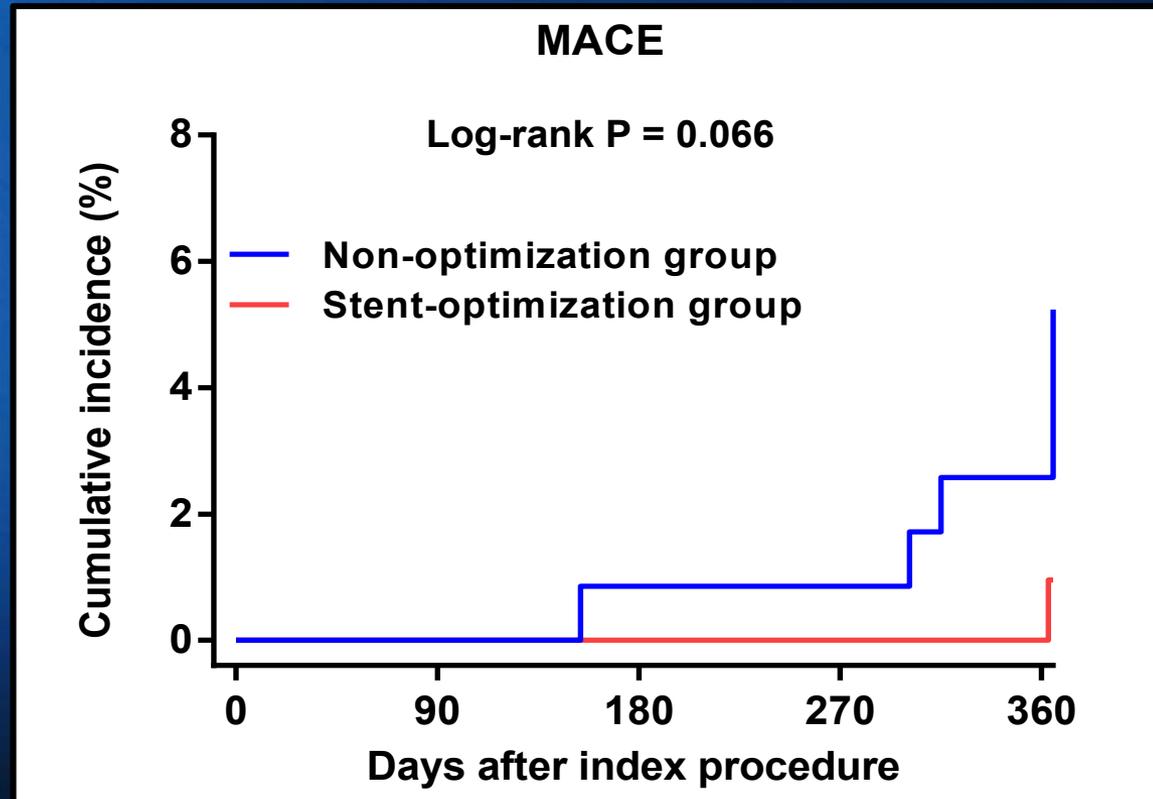
MSA  $\geq 5.5 \text{ mm}^2$  or 80% of mean reference lumen area

**Stent-optimization  
group  
(N = 113)**

**Non-optimization  
group  
(N = 118)**

### MACE;

Cardiac death, MI, stent thrombosis, or TVR



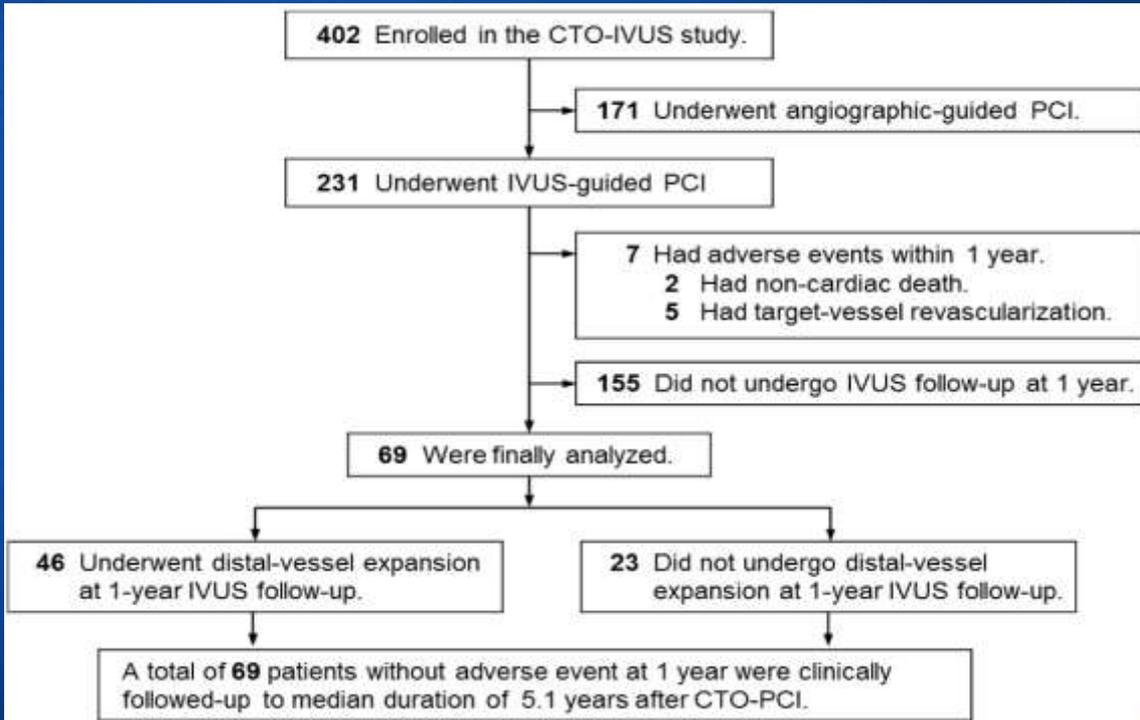
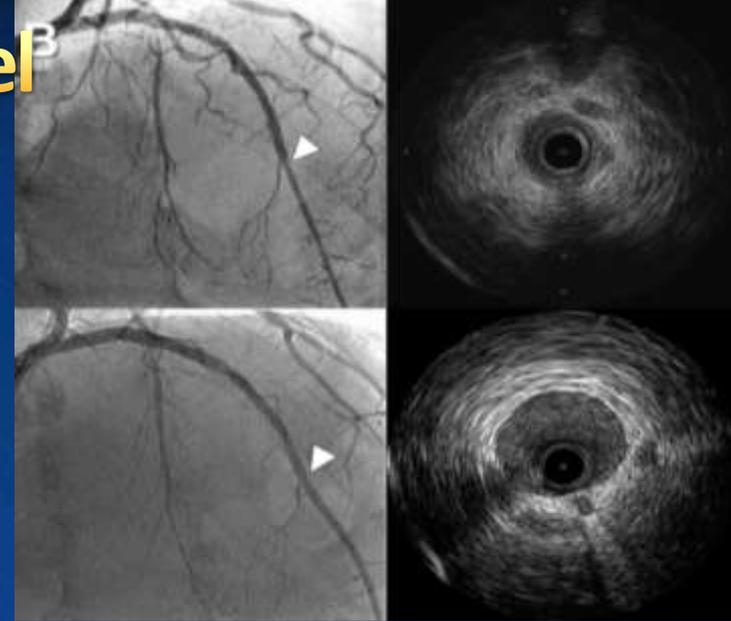
# Other role of stent optimization in CTO?



- Due to long-term reduced flow and negative remodeling of the vessels, Distal segments of CTO was shrunken.
- After successful opening of CTO, Morphologic changes of shrunken distal segments of CTO occurred.

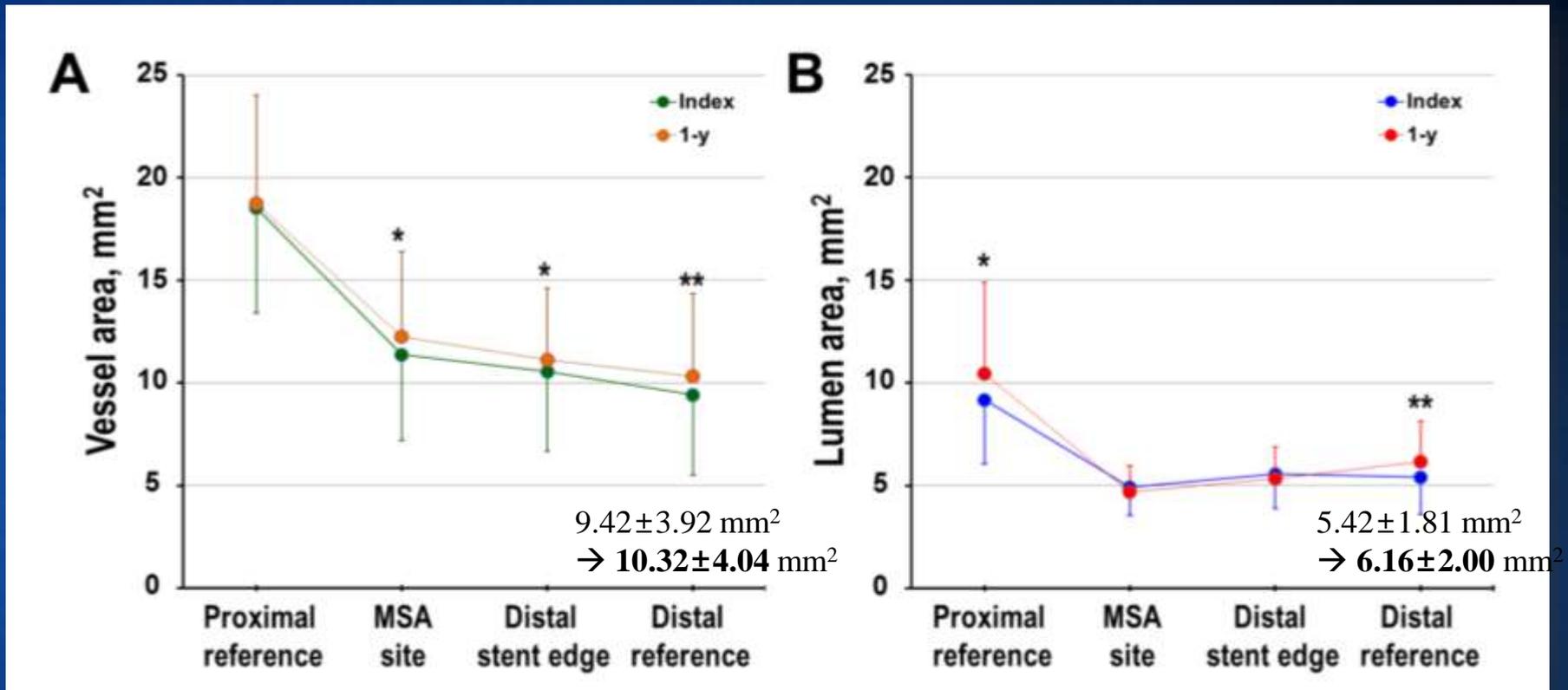
**Data regarding those clinical implications is limited, especially in the new-generation DES era.**

# Stent Optimization & distal-vessel expansion after successful CTO intervention in CTO-IVUS trial



- From the CTO-IVUS randomized trial, **serial matching IVUS analyses between index PCI and 1-year fu** were performed in **69 patients with new-generation DESs.**

# Serial IVUS from index PCI to 1-year follow-up



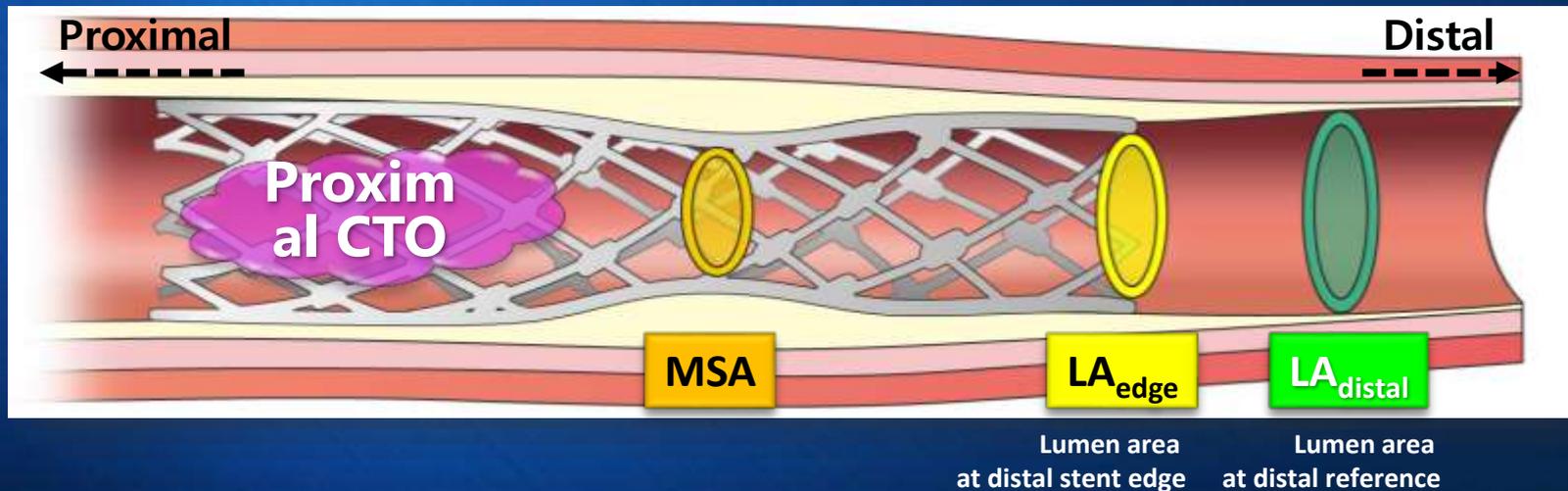
- **Incidence of distal-vessel expansion** (any increase of lumen area at distal reference (LA<sub>distal</sub>) on 1-year IVUS follow-up, expansion ratio > 1.0)  
; **Distal-vessel expansion group 67%** (identified in 46 pts)

- Reference sites - at the most visually normal and largest lumen sites, with the least plaque burden and within 10 mm of the proximal or distal stent edge
- \*p<0.005 and \*\*p<0.001 by paired-t-test between index PCI and 1-year follow-up.



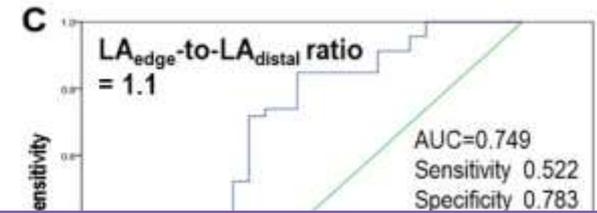
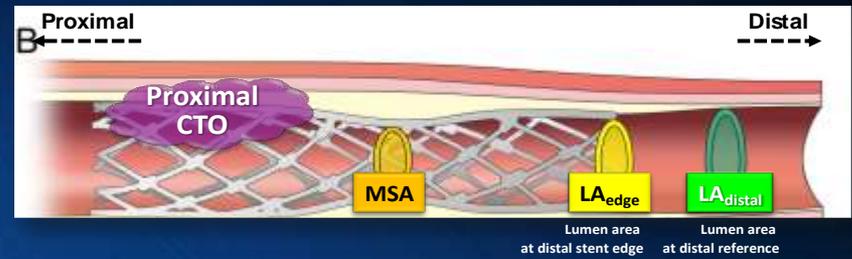
# Predictors for distal-vessel expansion (at 1 year) ?

1. **Proximal CTO location** (vs. mid-to-distal CTO), OR=3.42, P=0.036
2. **Smaller  $LA_{distal}$**  at index PCI OR=0.73, P=0.043
3. **Optimization parameters**  $LA_{distal}$ ; LA at distal reference /  $LA_{edge}$ ; LA at distal stent edge
  - ① **MSA-to- $LA_{distal}$  ratio**
  - ②  **$LA_{edge}$ -to- $LA_{distal}$  ratio**

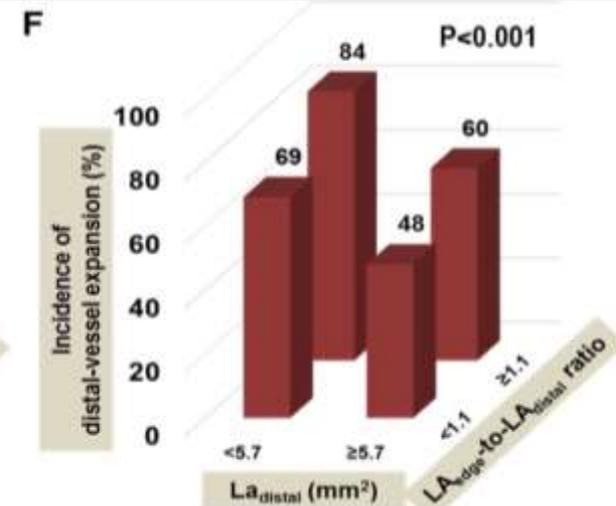
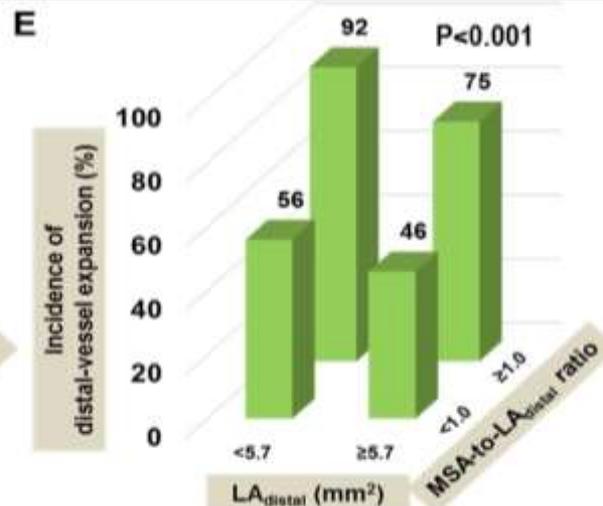
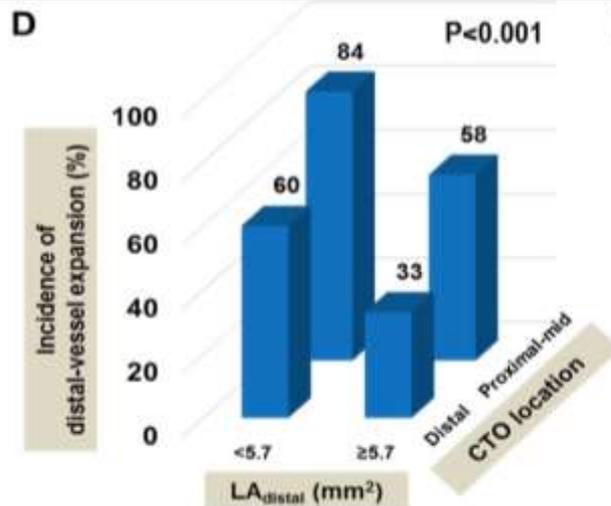


# Cut-off values & distal vessel expansion according to predictors

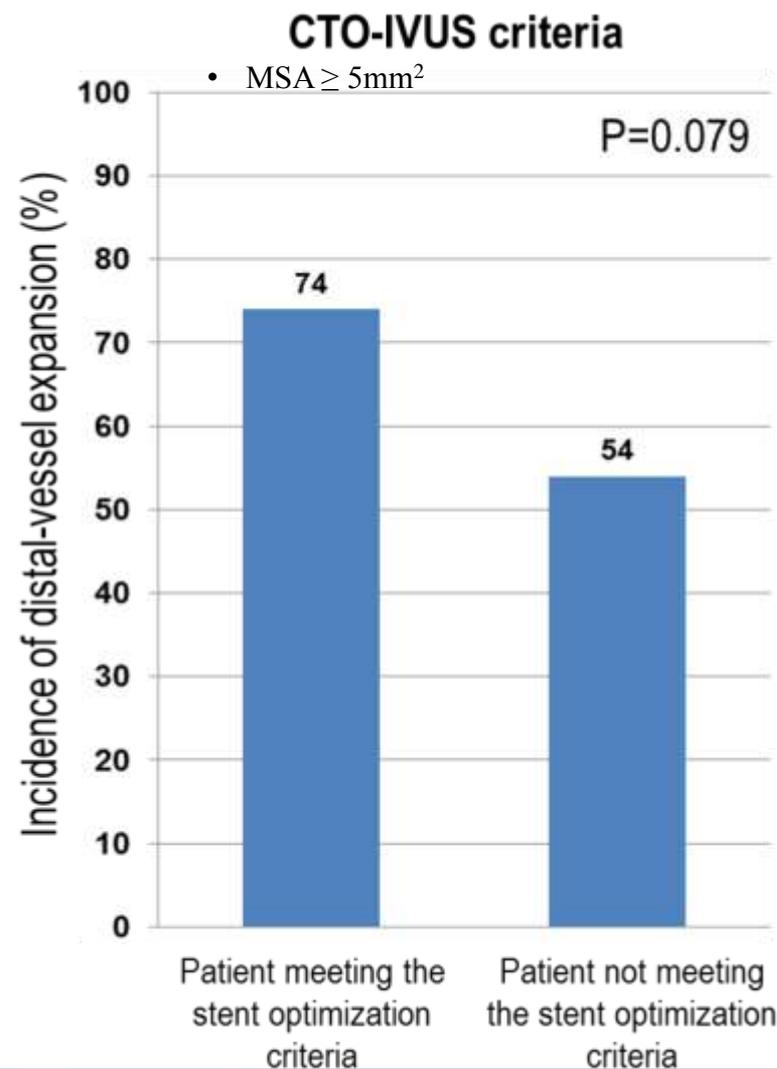
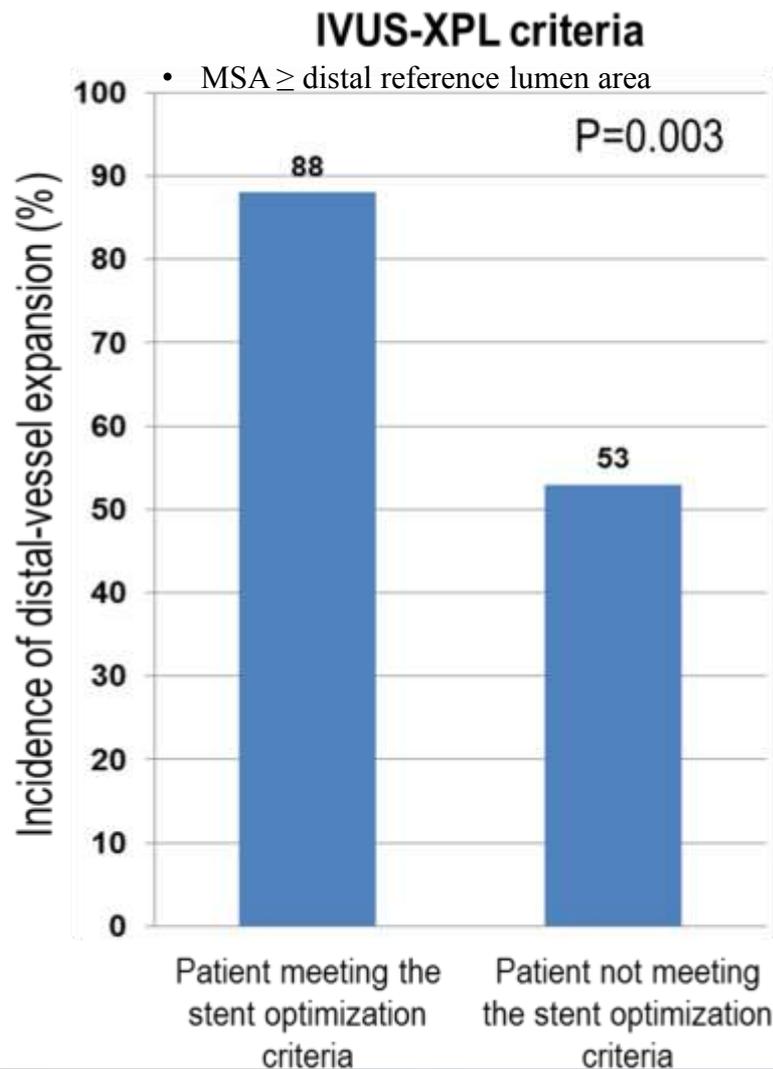
1. **Smaller  $LA_{distal}$**  at index PCI OR=0.73, P=0.043
2. **Proximal CTO location** (vs. mid-to-distal CTO), OR=3.42, P=0.036
3. **Optimization parameters** **MSA-to- $LA_{distal}$  ratio** /  **$LA_{edge}$ -to- $LA_{distal}$  ratio**



The incidence of distal vessel expansion was highest for CTO with an  $LA_{distal} < 5.7$  mm<sup>2</sup> and proximal location,  $MSA/LA_{distal} \geq 1$ , or  $LA_{edge}/LA_{distal} \geq 1.1$  (→ Greater MSA or distal edge SA than distal reference LA).



# Association of stent optimization and follow-up distal-vessel expansion



# Stent Optimization in CTO-PCI

- For the clinical improvement after CTO-PCI, the attainment of stent optimization is the most essential.
- For stent optimization of CTO lesions, we should understand the **vascular responses of occluded CTO segment**.
  - After opening CTO with new-generation DES, two-thirds of patients exhibited distal vessel expansion on 1-year follow-up IVUS.
  - Expansion determinants were a **proximal CTO**, **lower LA<sub>distal</sub>**, and **larger stent areas relative to the LA<sub>distal</sub>** (modifiable procedural predictors).
- **Optimal stent-sizing and post-dilation based on IVUS information** could cause the attainment of stent optimization, the favorable vascular responses, and resultant of the long-term clinical success.