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# Mechanism of Stent Thrombosis: OCT Findings

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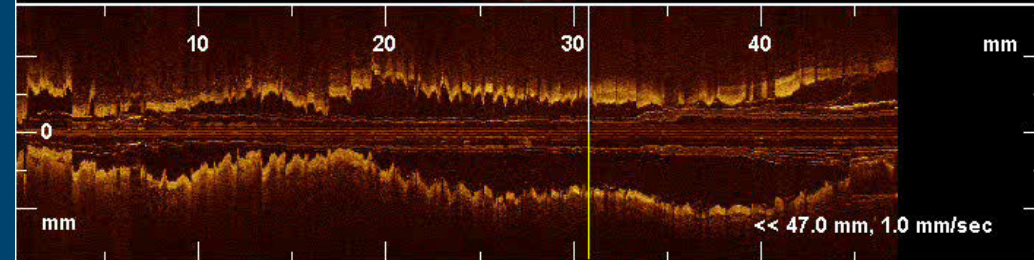
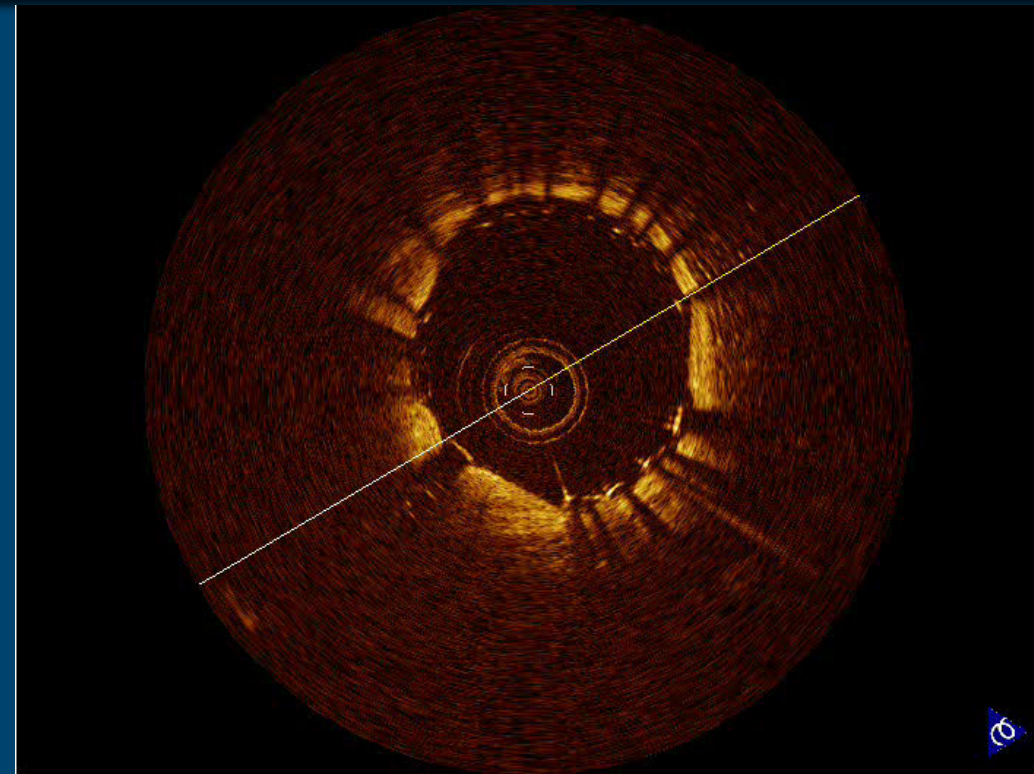
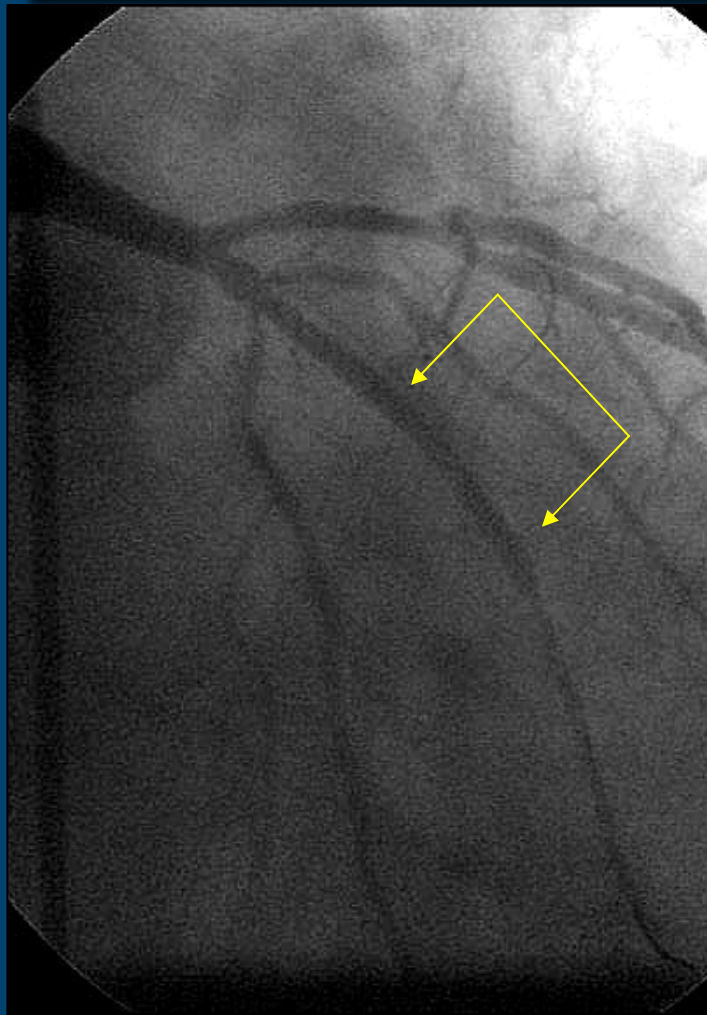
# Background

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- FDA Recommended duration of dual antiplatelet therapy: 3 mo for SES and 6 mo for PES
- Late stent thrombosis has been reported to be associated with increased mortality and morbidity
- Stent thrombosis is probably caused by delayed reendothelialization
- OCT is a novel imaging modality with a high resolution ( $\sim 10 \mu\text{m}$ ), which might be useful to study surface coverage

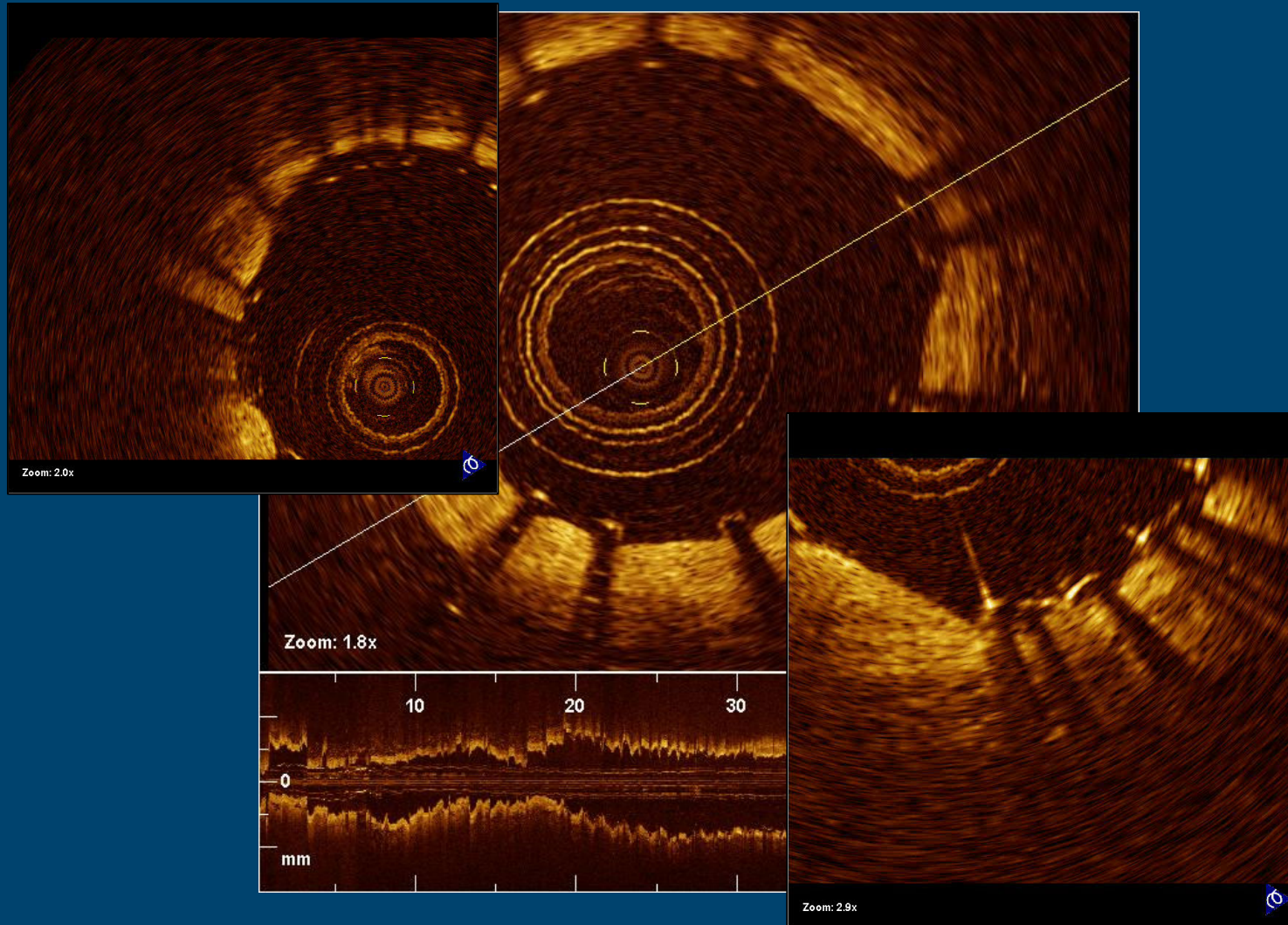


# Stent: Acute OCT finding

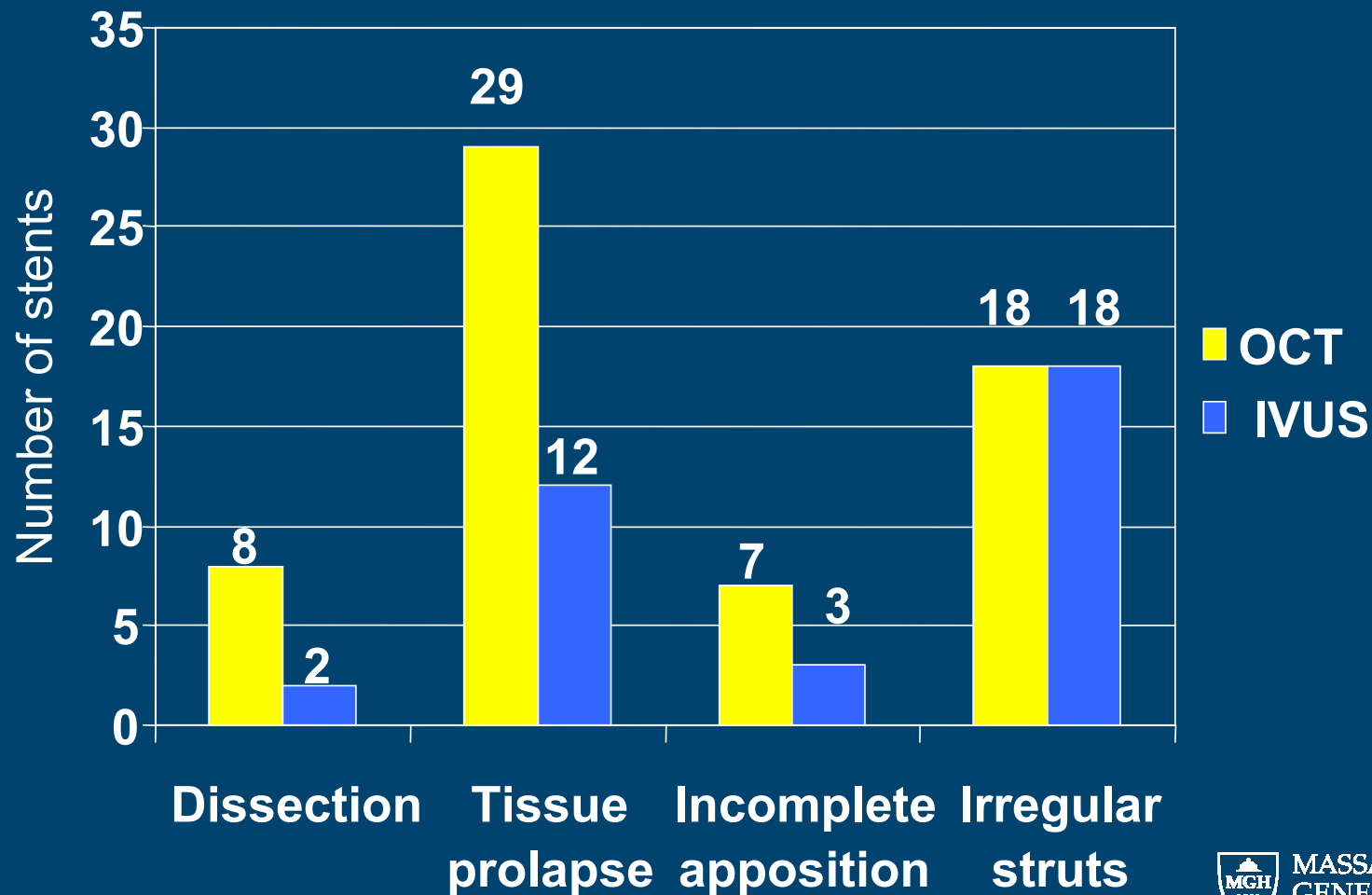




# DES: Acute OCT finding



# Comparison of OCT and IVUS Findings Post Stenting

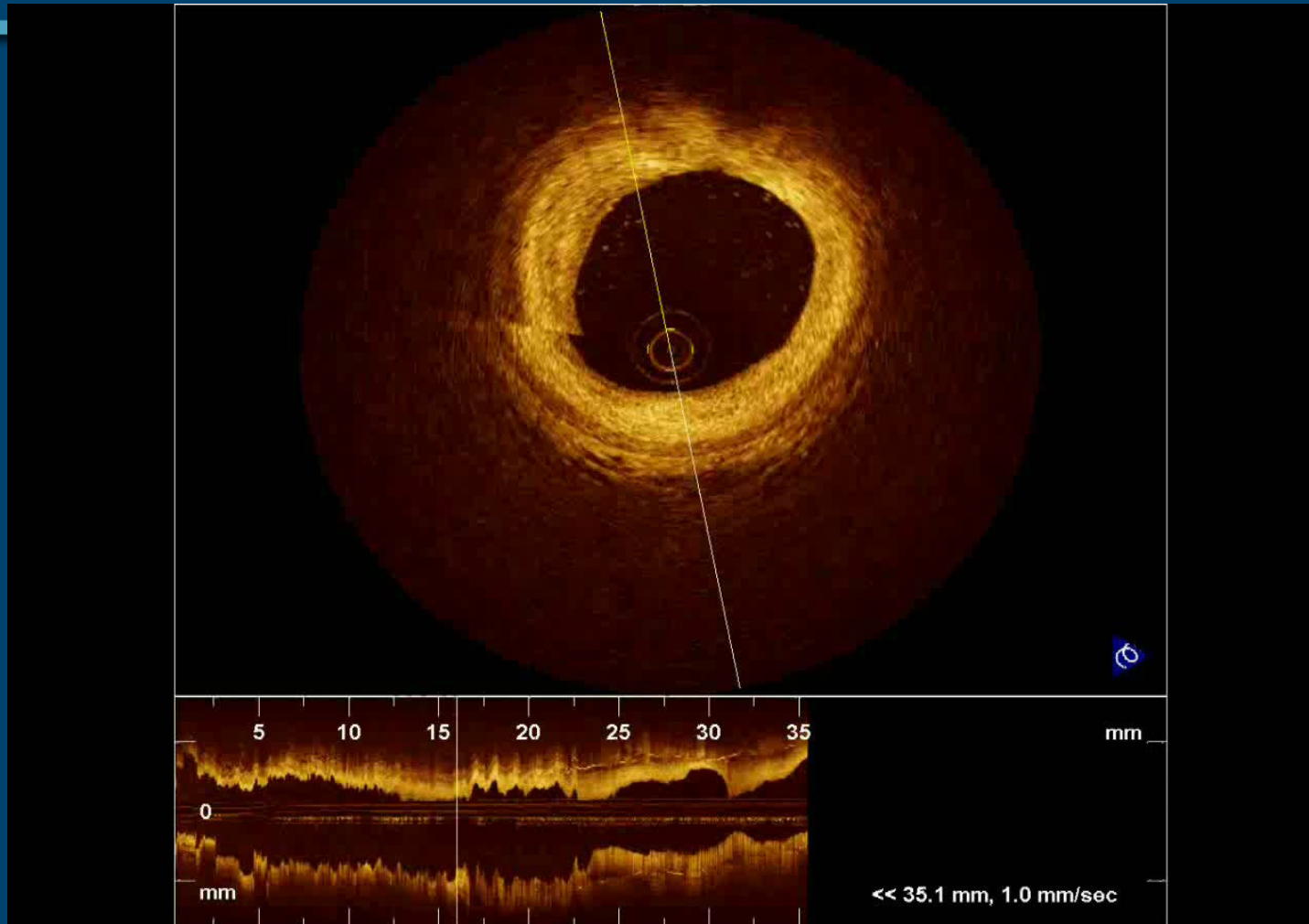


Bouma, Jang, Heart 2003



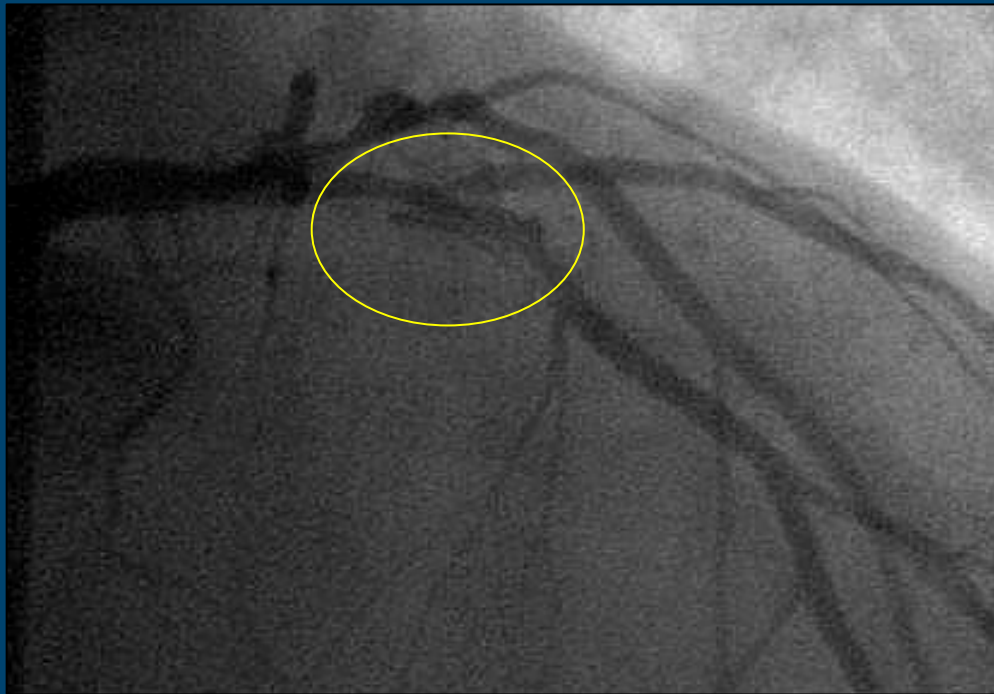
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# BMS Follow up (thick NIH)



# ISR after bifurcation stenting

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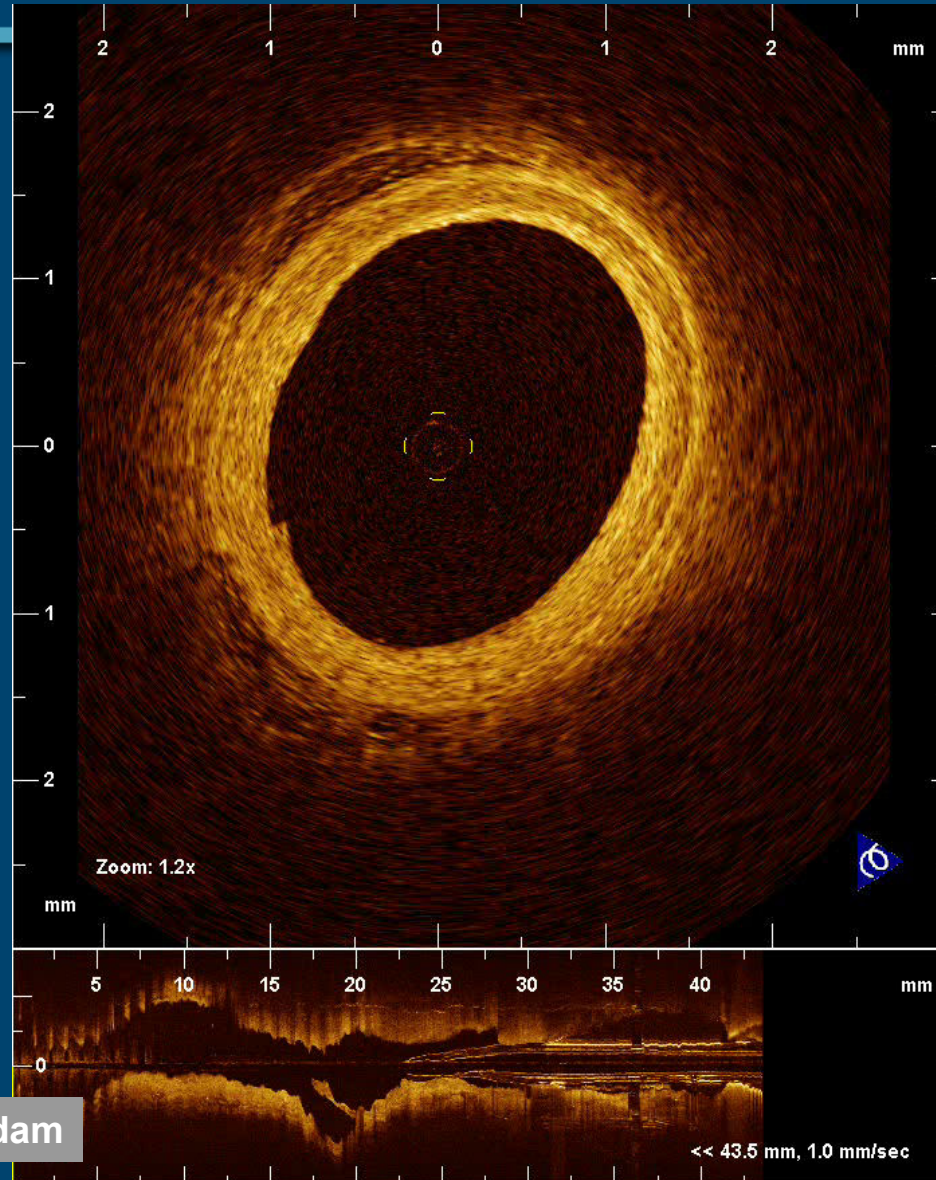
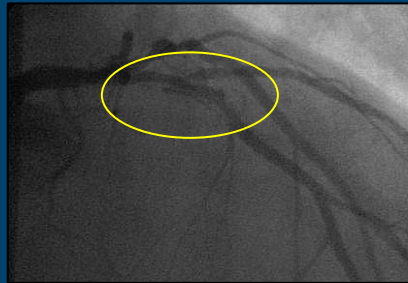
Courtesy of E. Regar, Rotterdam



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# ISR after bifurcation stenting



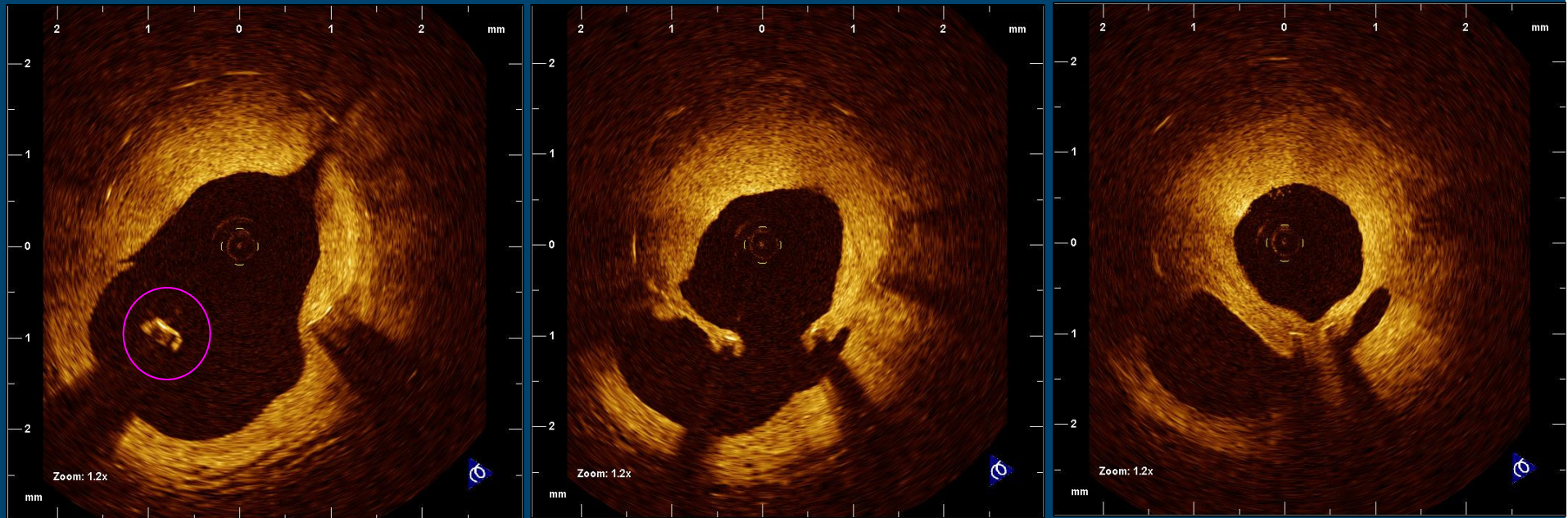
Courtesy of E. Regar, Rotterdam

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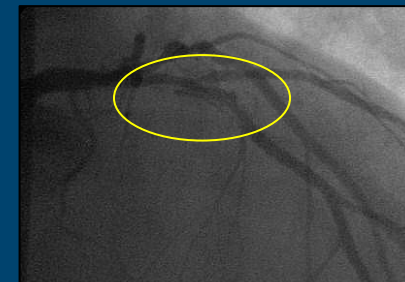
<< 43.5 mm, 1.0 mm/sec



# ISR after bifurcation stenting



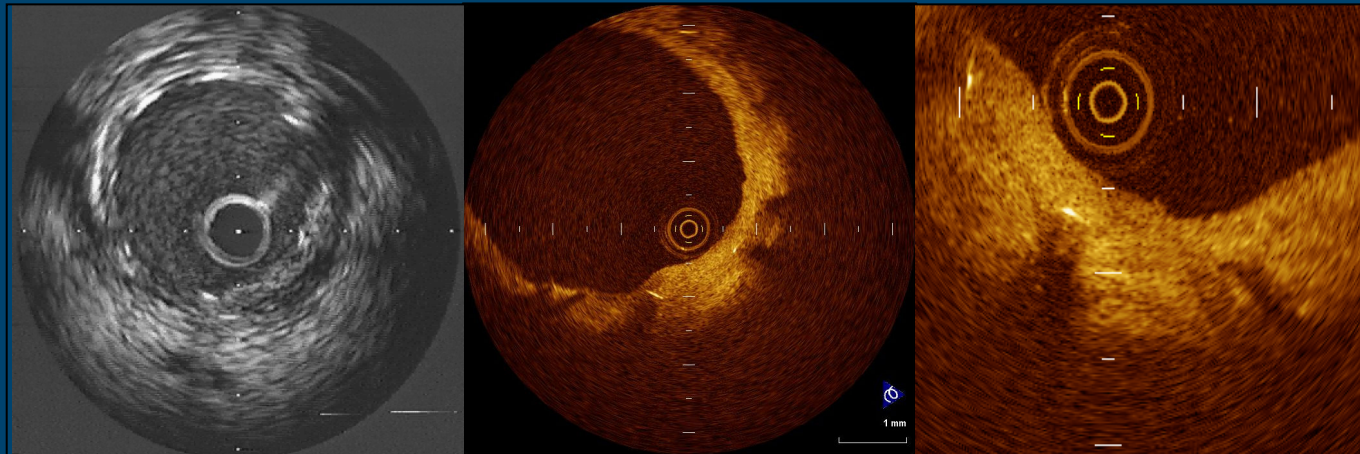
Courtesy of E. Regar, Rotterdam



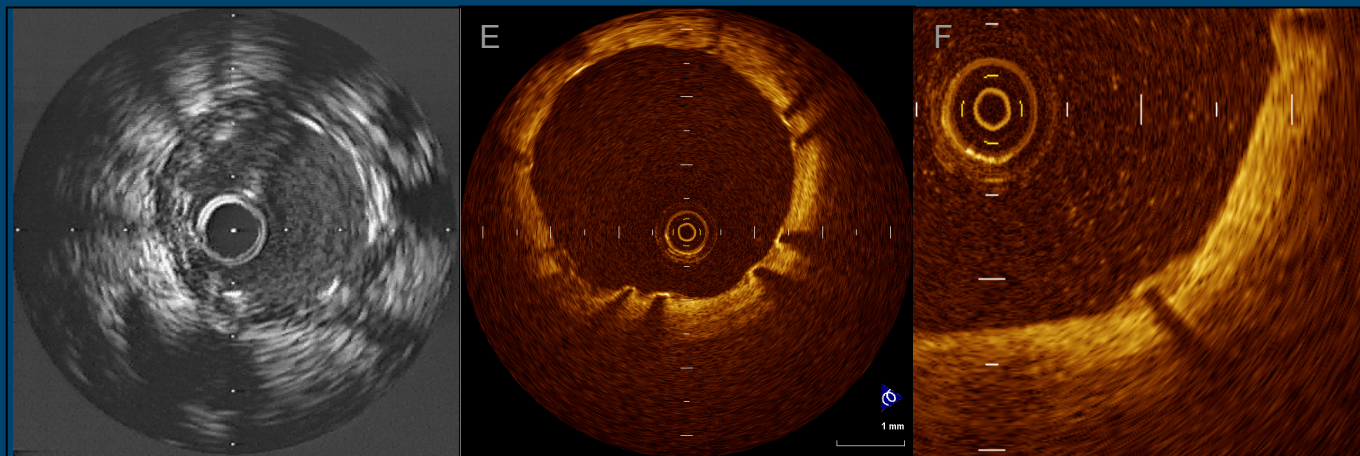
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# OCT: Neointima at 2m FU

**BMS**



**DES**



# Aim of the study

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- To study SES strut coverage and malapposition using OCT at 3 mo
- Compare OCT findings between ACS and stable coronary syndrome



# Method

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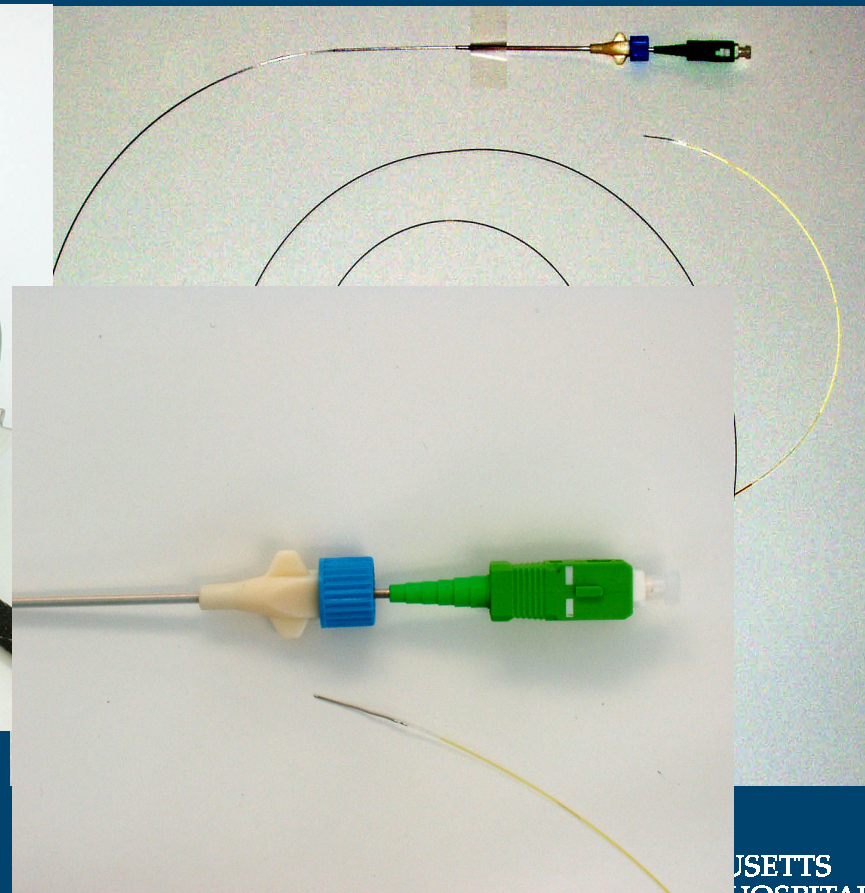
- 21 patients with SES in the native coronary arteries  
: 9 ACS and 12 stable angina
- 3 mo f/u catheterization including OCT
- OCT system: M2 LightLab, 0.014 inch image wire, occlusion balloon, motorized pull back at 1.0 mm/s (axial resolution 15  $\mu$ m)
- Image acquisition: 15 frames/s





# OCT system ( LightLab)

ImageWire<sup>®</sup>



# Analysis

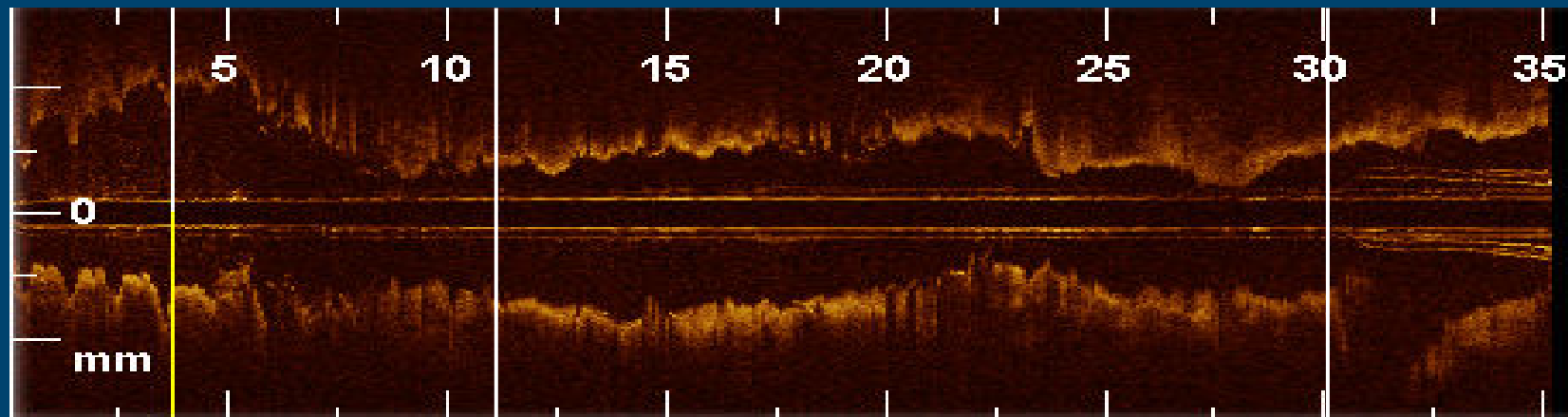
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- Image analysis: 1 mm interval (every 15 frames)
- % NIH area =  $([\text{stent area} - \text{lumen area}] / \text{stent area}) \times 100$
- Definitions:
  - NIH: thickness inside stent struts
  - Covered: NIH thickness  $> 10 \mu\text{m}$
  - Malapposition: maximum distance  $> 160 \mu\text{m}$
  - Thrombus: protruding mass



# Analysis

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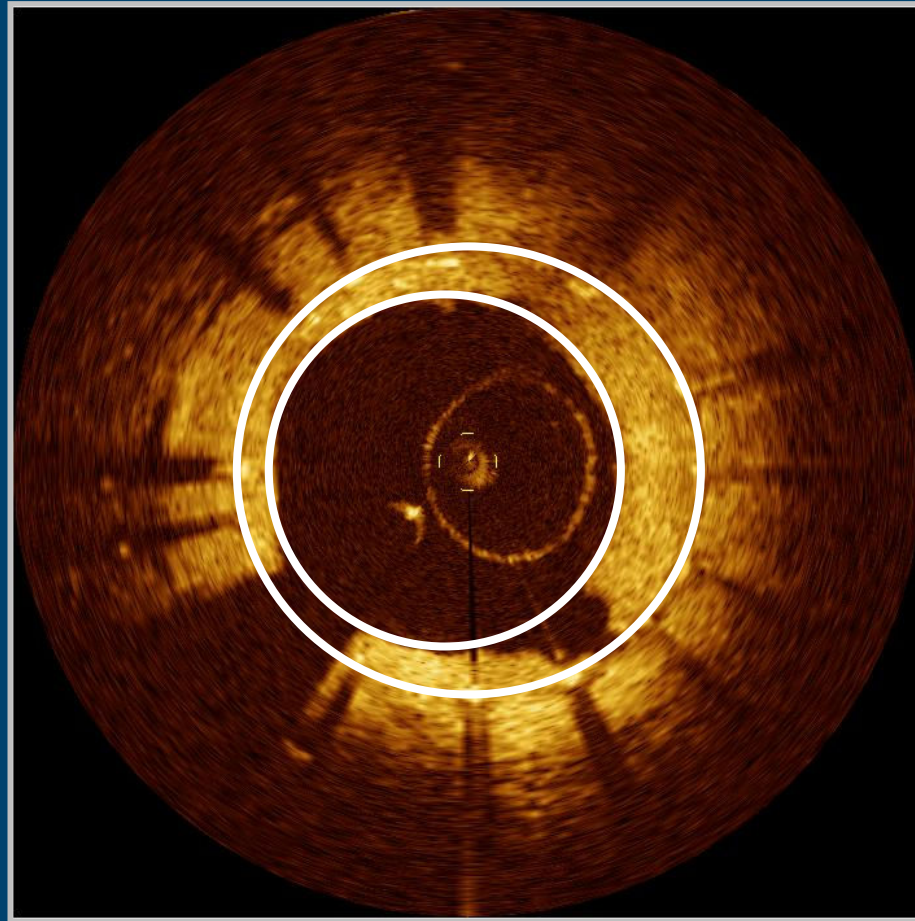
Every 15 frames (1 mm interval)



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# Analysis

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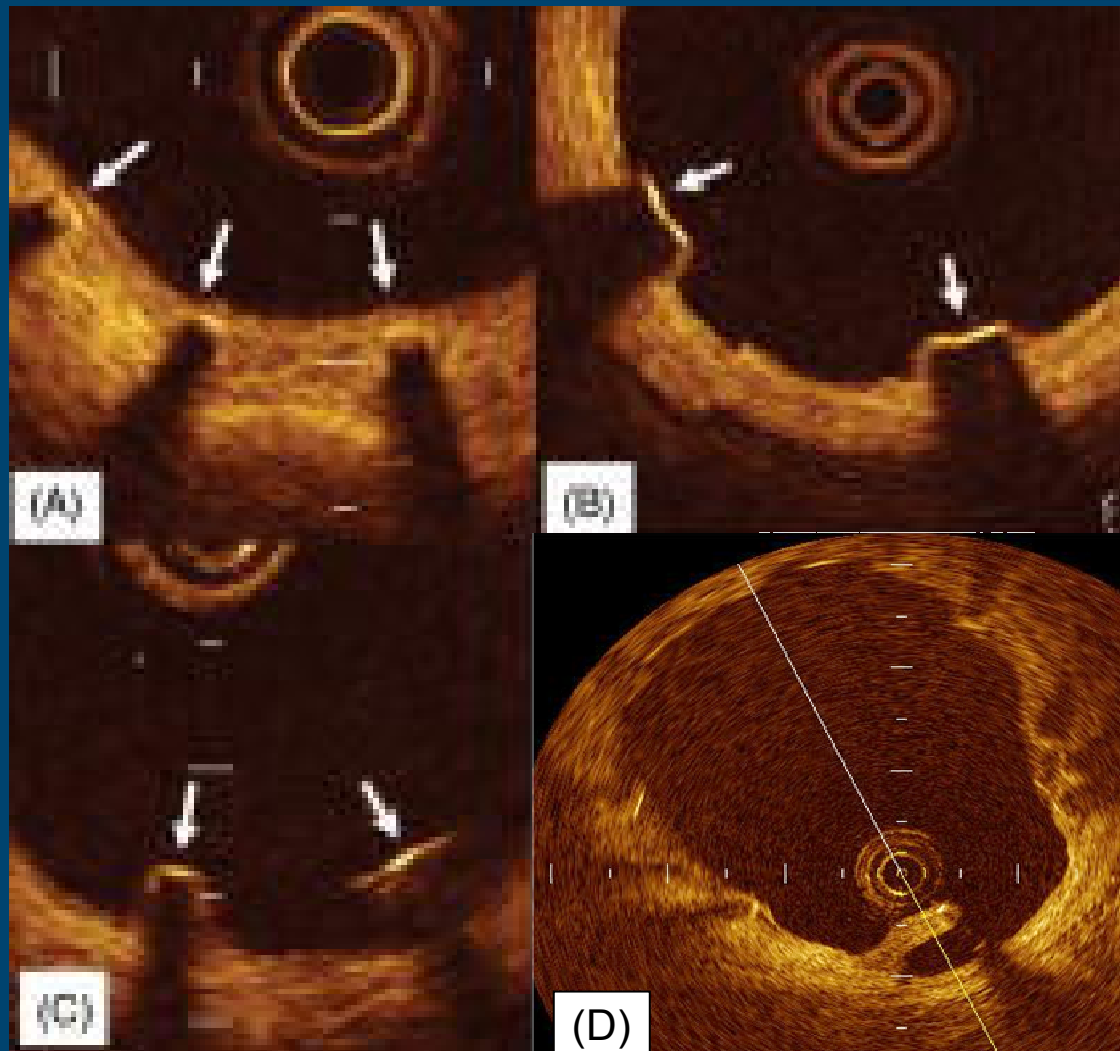


$$\% \text{ NIH area} = ([\text{stent area} - \text{lumen area}] / \text{stent area}) \times 100$$





# Stent Struts: OCT findings



**A: well apposed and covered**

**B: well apposed, not covered**

**C: malapposed, not covered**

**D: malapposed, but covered**

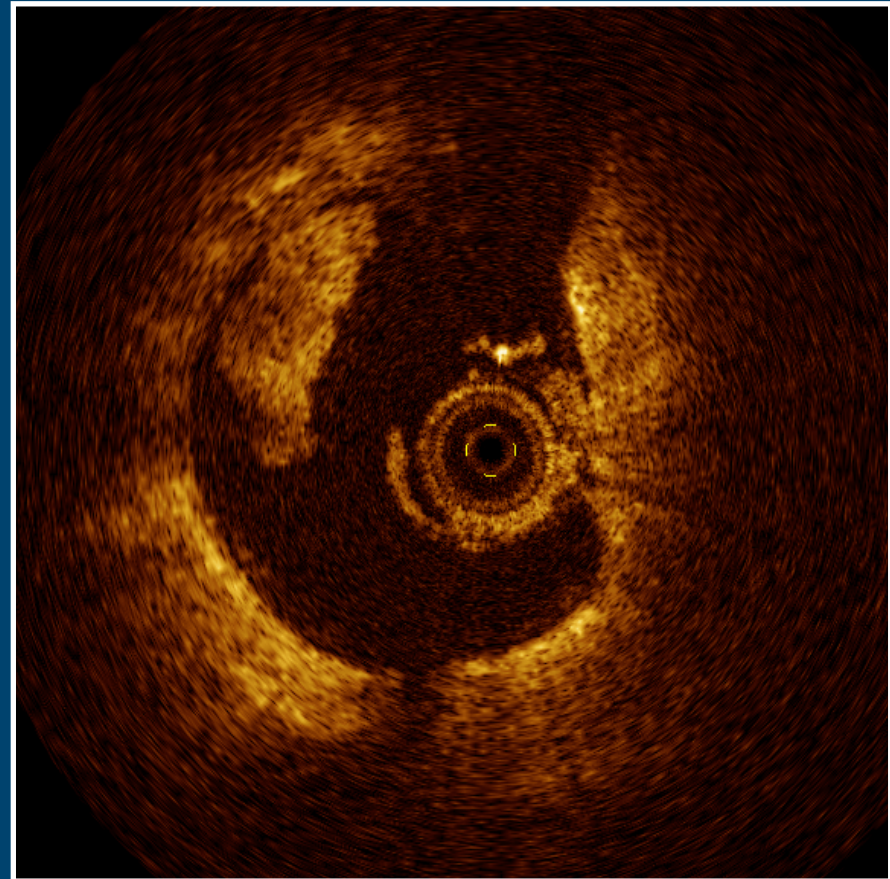
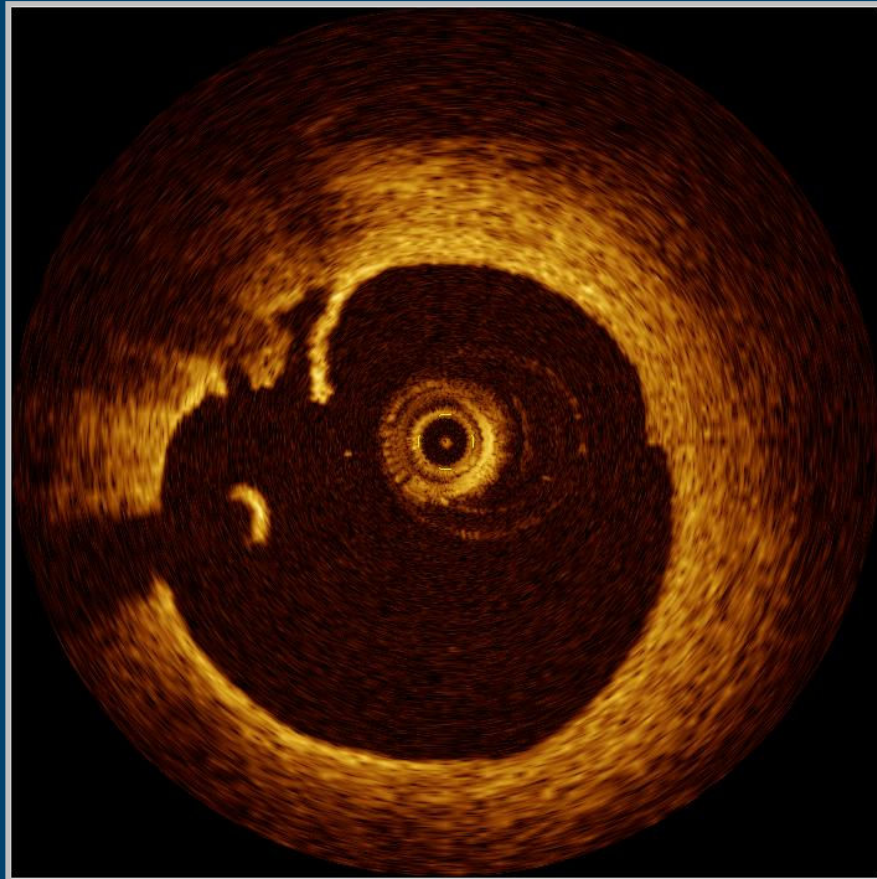


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# Thrombus

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# Results: Angiographic Findings

	ACS	Non-ACS	P value
RD (mm)	2.9 $\pm$ 0.3	2.7 $\pm$ 0.3	0.15
Lesion length (mm)	18.1 $\pm$ 10.9	27.3 $\pm$ 13.7	0.06
MLD (mm)	3.1 $\pm$ 0.4	2.9 $\pm$ 0.4	0.20
ISR @ 3 mo	0	0	
Thrombus @ 3 mo	0	0	



# Results: OCT Findings

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- 662 images
  - 23 inadequate images
  - 64 overlapping segments
  - 8 side branches

→ **Final 567 images (= 4516 struts)**

**Uncovered struts: 15% (21/21 pts)**

**Malapposed struts: 16% (20/21 pts)**

**Uncovered + malapposed: 6% (20/21 pts)**

**Average NIH thickness: 29  $\mu\text{m}$  (> 100  $\mu\text{m}$ : 7%)**

**Average % NIH area: 10%**



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# Results: OCT findings

	ACS	Non-ACS	P value
Struts/images	1616/203	2900/364	
Uncovered struts	18%	13%	0.0001
Malapposed	19%	14%	0.0001
Uncovered + malapposed	8%	5%	0.0039
NIH thickness ( $\mu\text{m}$ )	27.6 $\pm$ 40.9	30.1 $\pm$ 40.8	0.049
%NIH area	9.2 $\pm$ 3.6	10.6 $\pm$ 3.9	0.0001
Stent area ( $\text{mm}^2$ )	9.3 $\pm$ 2.4	8.6 $\pm$ 2.0	0.0001
Lumen area ( $\text{mm}^2$ )	8.5 $\pm$ 2.2	7.7 $\pm$ 1.8	0.0001
Thrombi	3	0	

# Limitations

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- Small sample size
- Non randomized
- NIH  $< 10 \mu\text{m}$  would not be detected with OCT.
- Non longitudinal study  $\rightarrow$  timing of NIH not known



# Conclusion

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- Small % of SES struts not covered and malapposed after 3 months.
- % of non covered and/or malapposed struts was higher in pts with ACS.
- Clinical significance of these findings still not known.



# Thank You







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# Cypher Evaluation by OCT

	3 mo	6 mo	12 mo
<b>NIH thickness (um)</b>	<b>29</b>	<b>52-96</b>	<b>107</b>
<b>Uncovered struts</b>	<b>15%</b>	<b>7-10%</b>	<b>5%</b>
<b>Malapposed struts</b>	<b>16%</b>	<b>1%</b>	<b>0.2%</b>
<b>Uncovered+malapposed</b>	<b>6%</b>	<b>1%</b>	<b>0.2%</b>

Takano M. AJC 2007;99:1033

Matsumoto D. EHJ 2007;28:961. EHJ 2007:28:673 (Abstr)



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