Optical Coherence Tomography (OCT) What do you need to see

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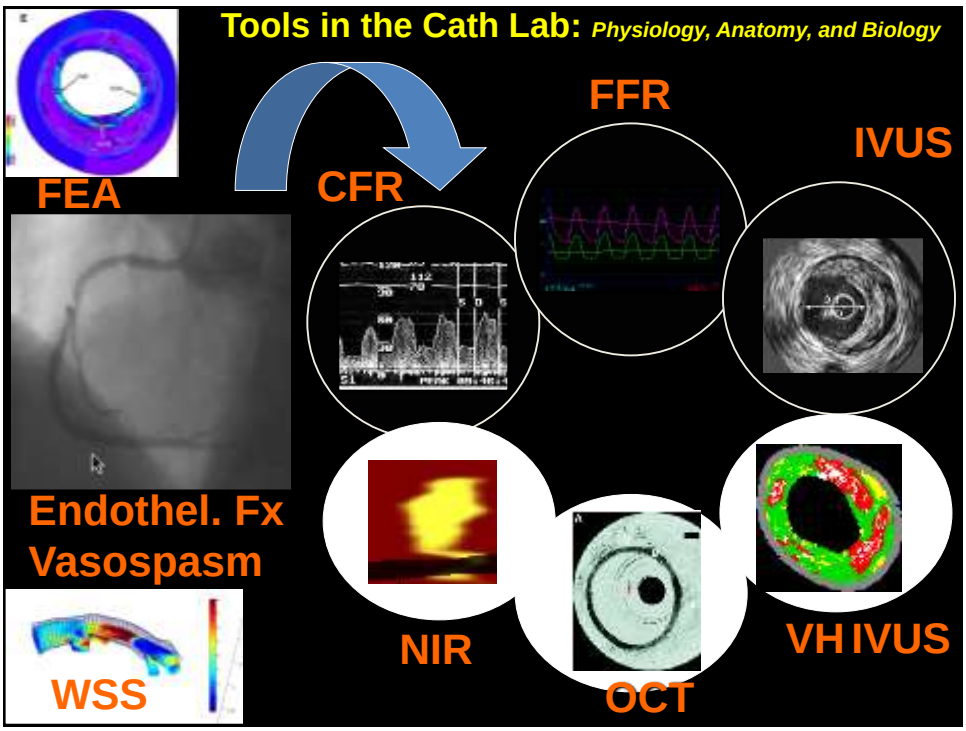
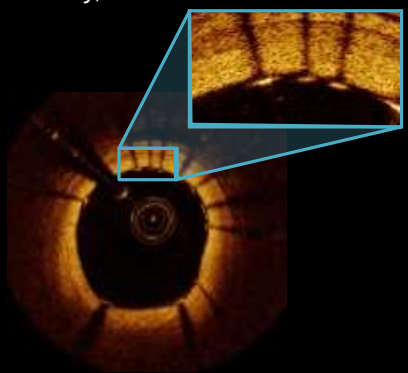


Optical Coherence Tomography

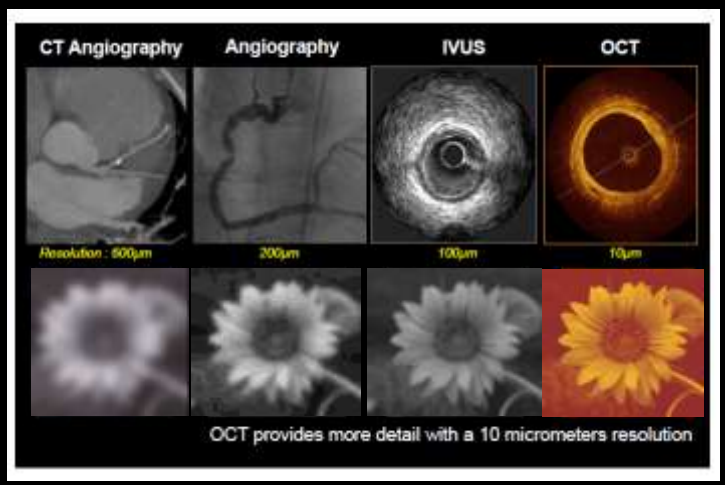
Optical coherence tomography (OCT) is an optical imaging modality that uses near-infrared light reflectance to produce high-resolution *in vivo* images of vessel anatomy, tissue microstructure and stents.

Key Features:

- Uses light, instead of ultrasound
- 10x higher resolution than IVUS
- Fast image acquisition – 20x faster than IVUS
- Images acquired are sharp, detailed and easier to interpret



Images: Drs. Grube, Buellesfeld, Guerkens and Mueller, Helios Heart Center, Siegburg, Germany



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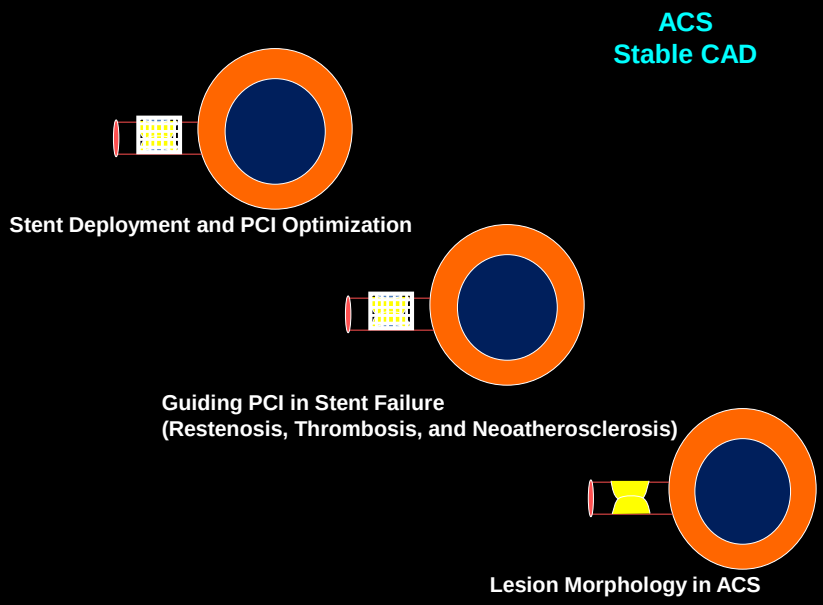
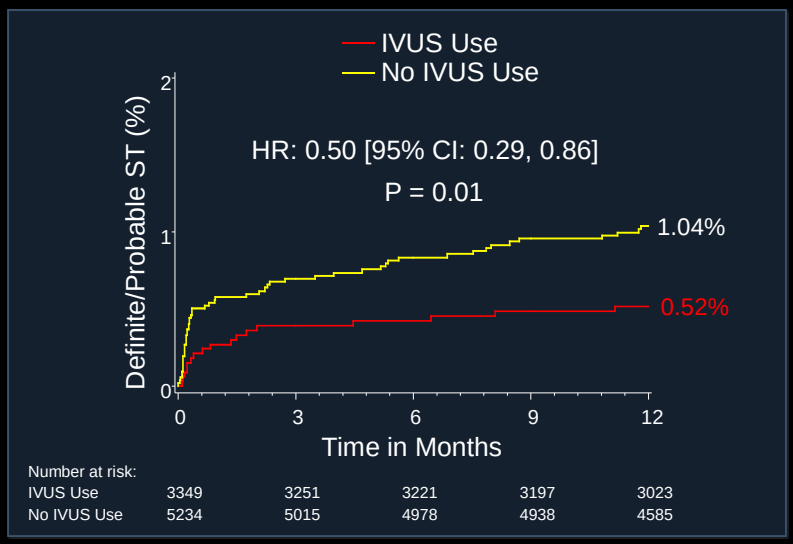
Intravascular Imaging for PCI Guidance and Optimization in 2018…

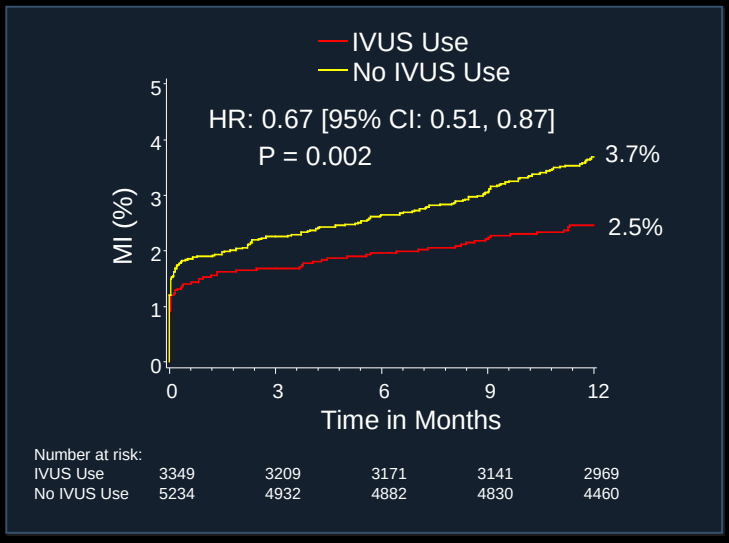


Relationship between IVUS Use and Definite/Probable Stent Thrombosis within 1 year



Witzenbichler B et al. Circulation 2014;129:463-70

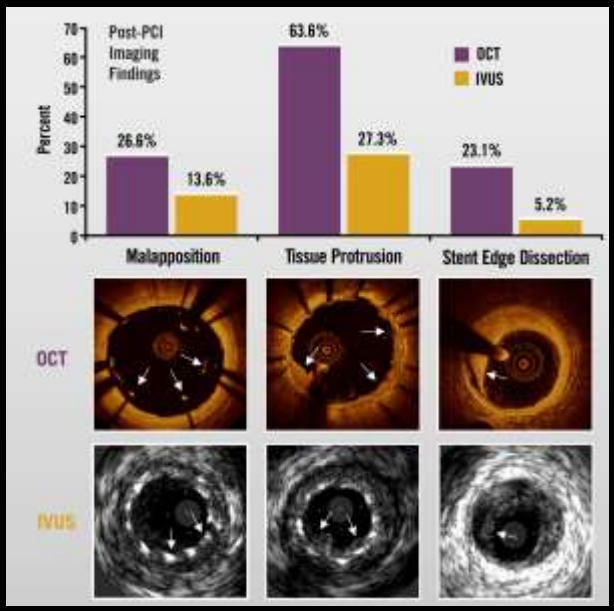
Relationship between IVUS Use and MI within 1 year



IVUS vs OCT

	IVUS / VH-IVUS	OCT
Technical Characteristics		
Technique	**Ultrasound**	**Optic: near-infrared light**
Axial Resolution	100-200 μm	10-20 μm
Lateral Resolution	200-300 μm	20-100 μm
Penetration Depth	4-8 mm	1-1.5 mm
Acquisition Rate / Frame Rate	30 frames/sec	100 frames/sec*
Auto-pullback Speed	1-3 mm/sec	20 mm/sec*

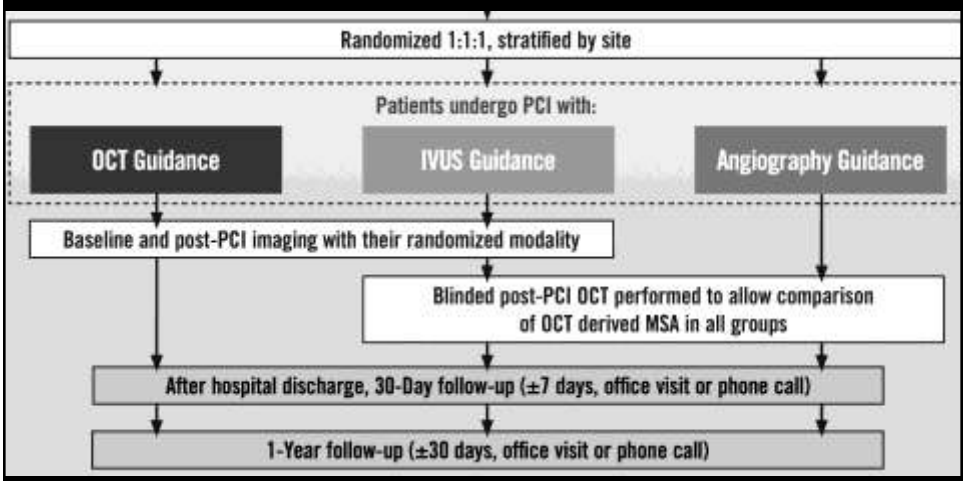
ILUMIEN II



Stone G et al. TCT 2014

ILUMIEN III- Optimize PCI

N=420 pts undergoing PCI, multicenter Study



ILUMIEN III- Optimize PCI
Primary Endpoints

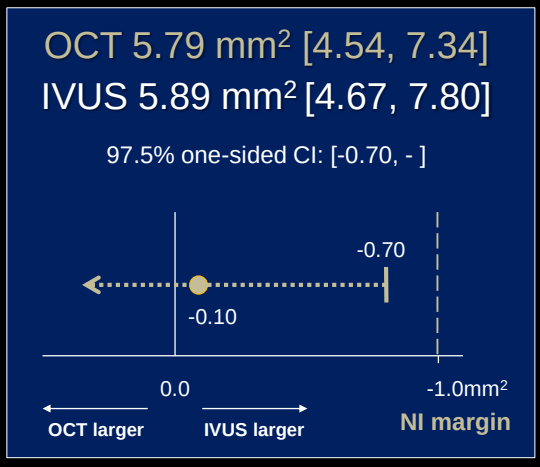
Primary Efficacy Endpoint (powered)

- Post-PCI MSA assessed by OCT in each randomized arm, measured at the independent OCT core laboratory blinded to imaging modality assignment. Testing will be done in a hierarchal manner as follows:
  1. Non-inferiority of OCT guided stenting to IVUS guided stenting
  2. Superiority of OCT guided stenting to Angiography guided stenting
  3. Superiority of OCT guided stenting to IVUS guided stenting

Primary Safety Endpoint (non-powered)

- Procedural MACE defined as procedural complications (angiographic dissection, perforation, thrombus, and acute closure) requiring active interventions (prolonged balloon inflations, additional stent implantation, or pericardiocentesis)

Primary Endpoint
Final post-PCI MSA by OCT



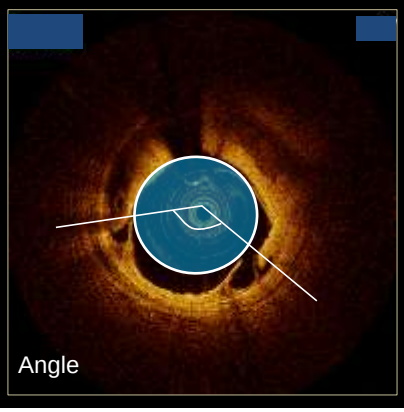
$P_{noninferiority} = 0.001$

Secondary Endpoints

	OCT (n=140)	IVUS (n=135)	Angio (n=140)	*P* OCT vs IVUS	*P* OCT vs Angio
Minimal stent area, mm^2	5.79 [4.54,7.34]	5.89 [4.67,7.80]	5.49 [4.39, 6.59]	0.42	0.12
Min stent expansion, %	88 ± 17	87 ± 16	83 ± 13	0.77	0.02
Mean stent expansion, %	106 [98, 120]	106 [97, 117]	101 [92, 110]	0.63	0.001
Expansion					
- Optimal (>95%)	26%	25%	17%	0.84	0.07
- Acceptable (90 - <95%)	16%	12%	3.7%	0.42	0.0008
- Unacceptable (<90%)	59%	63%	79%	0.45	0.0002

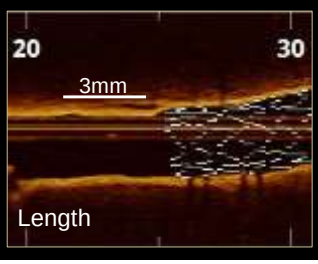
Dissections

	OCT (n=140)	IVUS (n=135)	Angio (n=140)	*P* OCT vs IVUS	*P* OCT vs Angio
Dissection, any	28%	40%	44%	0.04	0.006
Major	14%	26%	19%	0.009	0.25
Minor	14%	13%	25%	0.84	0.02



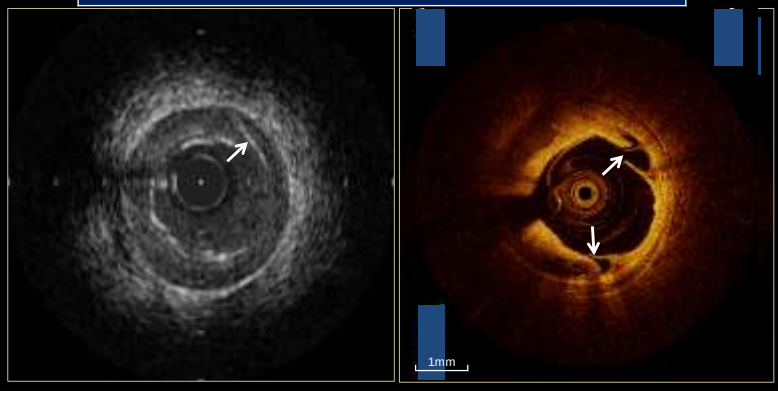
Major Dissection

1) Angle >60°
2) Length >3 mm



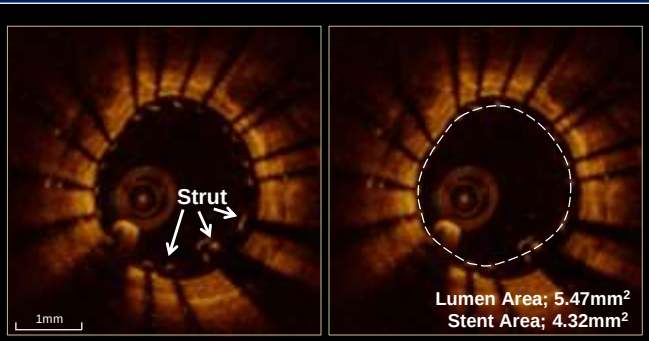
Dissection Detection in the IVUS arm: OCT vs. IVUS

	IVUS (n=140)	OCT (n=135)	*P* OCT vs IVUS
Dissection, any	16%	40%	<0.0001
Major	11%	26%	<0.0001
Minor	5.1%	13%	0.03



Malapposition

	OCT (n=140)	IVUS (n=135)	Angio (n=140)	*P* OCT vs IVUS	*P* OCT vs Angio
Malapposition, any	41%	38%	59%	0.62	0.002
Major	11%	21%	31%	0.02	<0.0001
Minor	31%	18%	28%	0.01	0.60

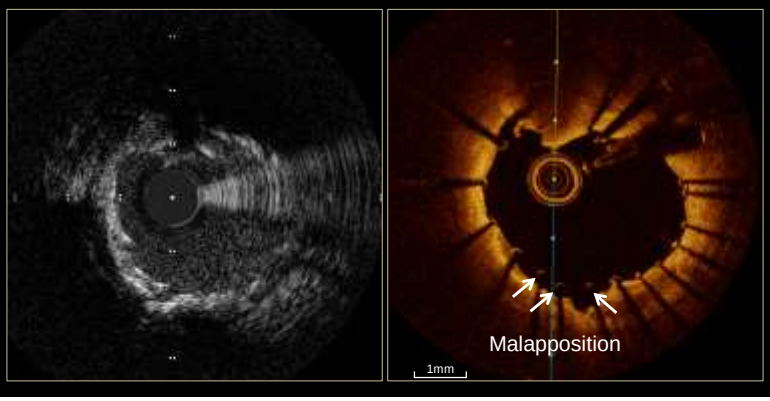


Major

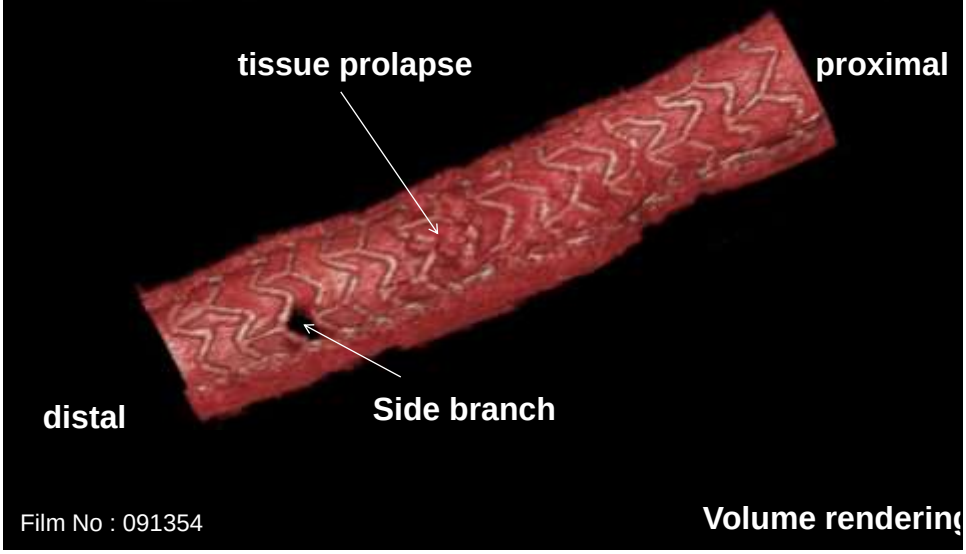
Strut(s) >0.2 mm from vessel edge and stent underexpansion

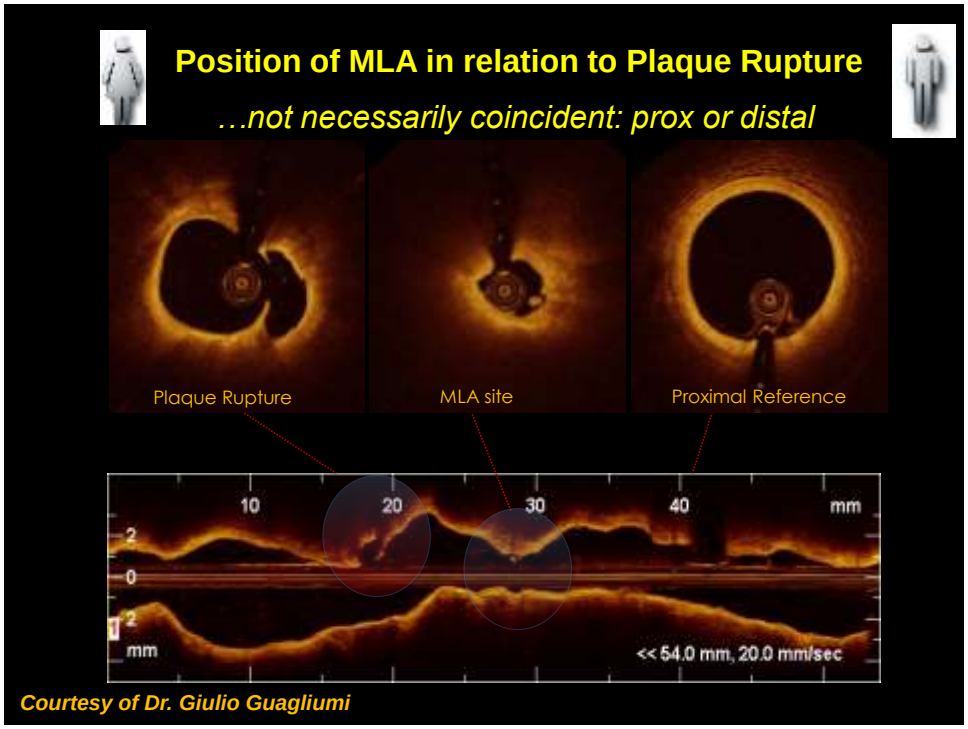
Malapposition Detection in the IVUS arm: OCT vs. IVUS

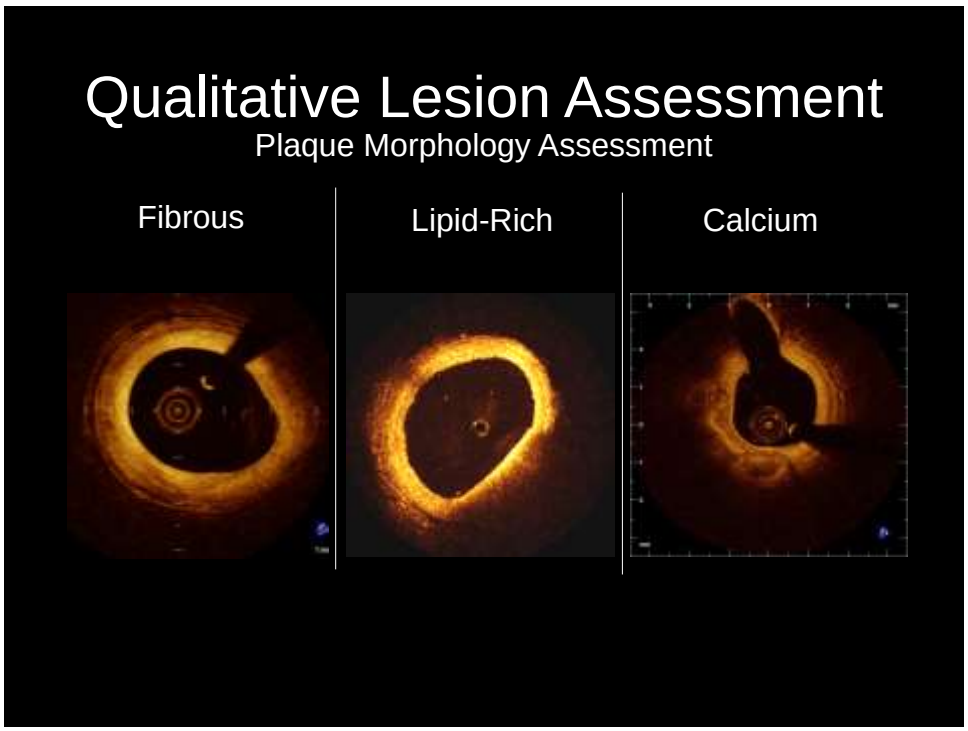
	IVUS (n=140)	OCT (n=135)	*P* OCT vs IVUS
Malapposition, any	19%	39%	0.0002
Major	14%	21%	0.06
Minor	5.0%	18%	0.003



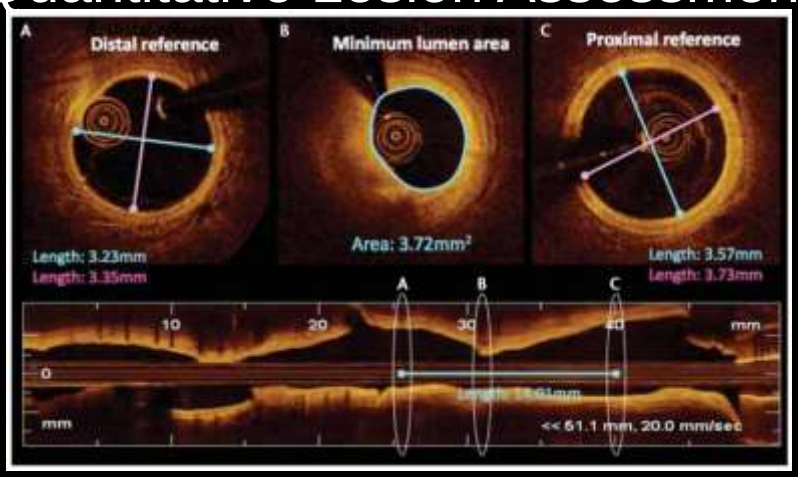
OCT 3D reconstruction




Position of MLA in relation to Plaque Rupture
…not necessarily coincident: prox or distal
Plaque Rupture
MLA site
Proximal Reference
10
20
30
40
mm
2
0
2
mm
<< 54.0 mm, 20.0 mm/sec
Courtesy of Dr. Giulio Guagliumi

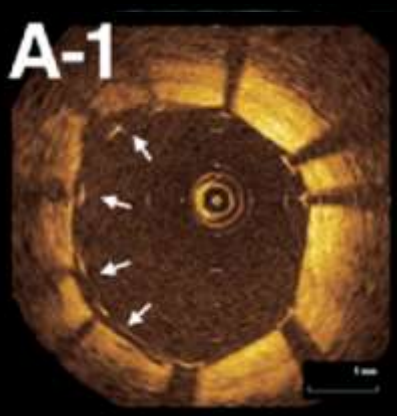

Qualitative Lesion Assessment
Plaque Morphology Assessment
Fibrous
Lipid-Rich
Calcium

Quantitative Lesion Assessment



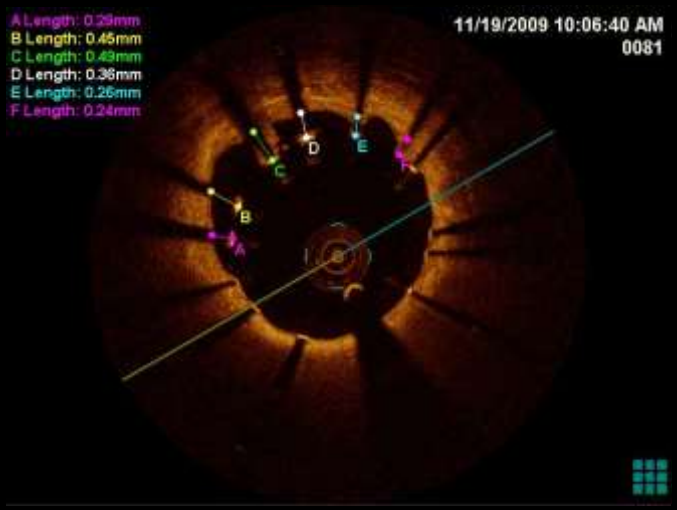
Cilingiroglu M, Feldman MD. *Cardiovasc Interv Today* 2011.

Stent Apposition Assessment: OCT vs. IVUS

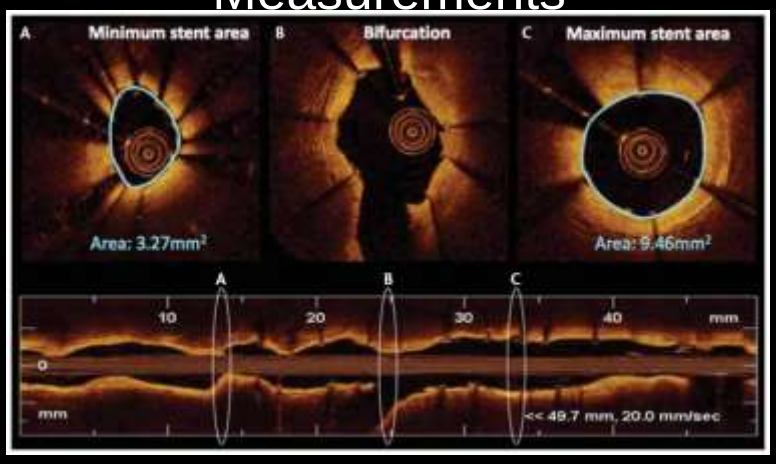


Kubo et al. *J Am Coll Cardiol Img* 2008;1(4):475-84.

Stent Apposition Assessment



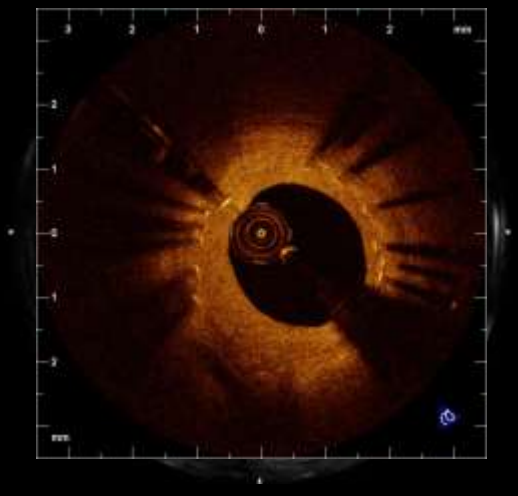
Stent Expansion: Stent Area Measurements



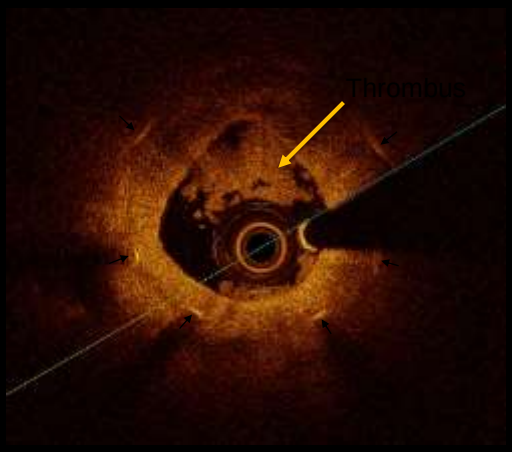
Cilingiroglu M, Feldman MD. *Cardiovasc Interv Today* 2011.

Dissection Assessment: OCT vs. IVUS

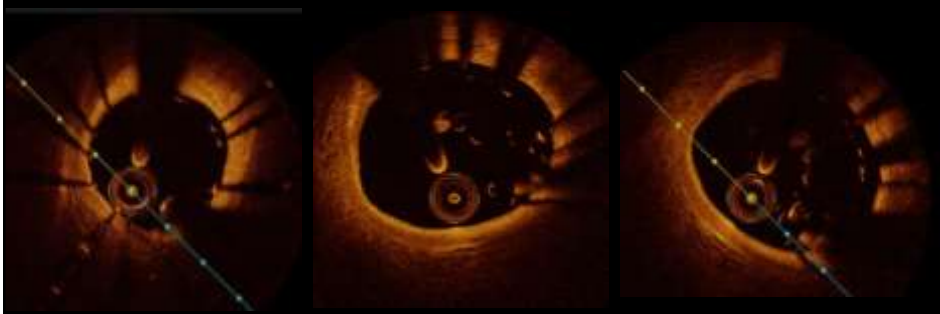
In-Stent Restenosis (ISR)



Late Stent Thrombosis



Bad surprise on OCT



Distal → Proximal

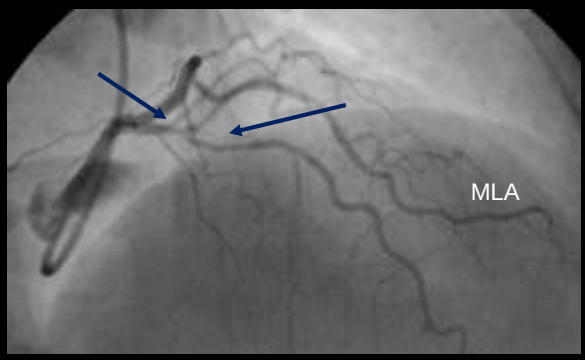
Stent crushed against the vessel wall

Conclusions

- OCT-guided PCI using a specific EEL-based stent optimization strategy was non-inferior to IVUS-guided PCI for achieving MSA.
- OCT-guided PCI resulted in superior stent expansion and procedural success compared to angiography-guided PCI.
- OCT-guided PCI resulted in the fewest untreated major dissections and areas of major stent malapposition.

Thank you

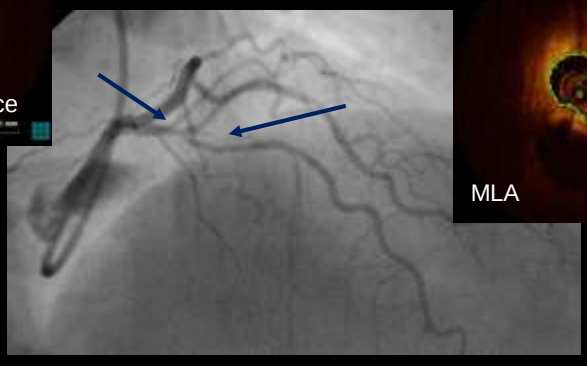
- **Female, 72 years old,**
- **Admission: effort / rest angina,**

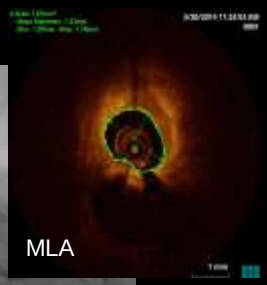


Intermediate 60% narrowing in the prox LAD

MLA=1,87 mmq

FD-OCT





Significant narrowing with 1.8 mm^2 MLA at OCT

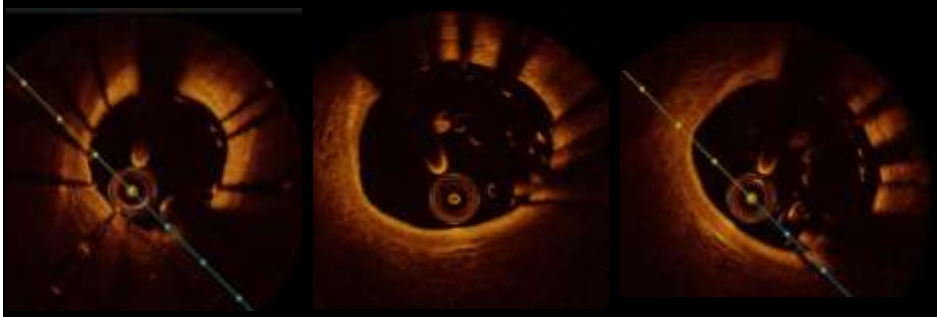
MLA=1,87 mmq

PTCA done with DES 2,5x28mm

POT on prox LAD (after LAD-Diag rewiring)

Apparently good result

Bad surprise on OCT



Distal → Proximal

Stent crushed against the vessel wall

How to fix it?

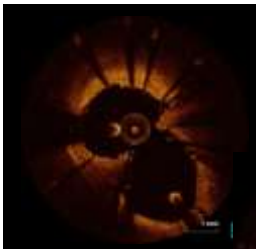
Strategy: Opening of Diagonal ostium with POBA followed by DES deployment (2.5 x 23mm).

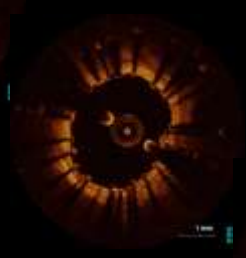
DES (2.5 x 23mm), positioning in the LAD-Diagonal

Kissing balloon

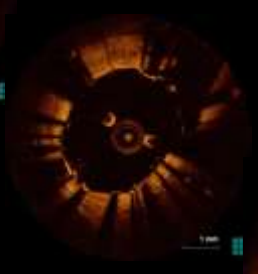
Final angio

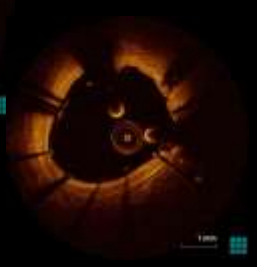
Bifurcation LAD/Diag





LAD ostium





Final OCT

distal→prox

→ → → → → → → → → → → → → → → → → → →