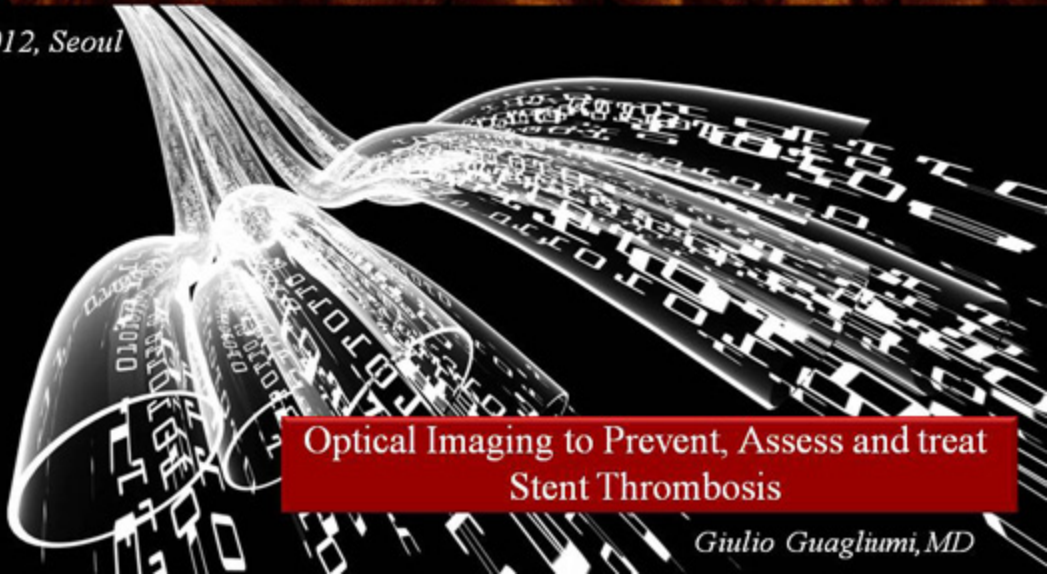
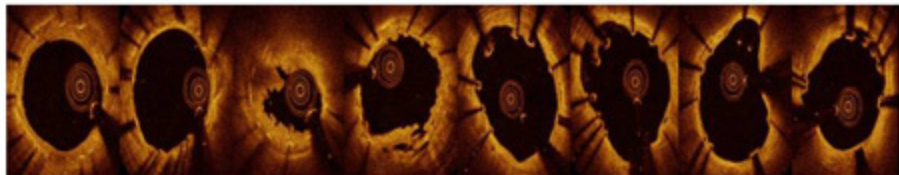


TCTAP 2012, Seoul



**Optical Imaging to Prevent, Assess and treat
Stent Thrombosis**

Giulio Guagliumi, MD



Disclosure Statement of Financial Interest

Within the past 24 months, I have had a financial interest/arrangement or affiliation with the organization(s) listed below.

Affiliation/Financial Relationship

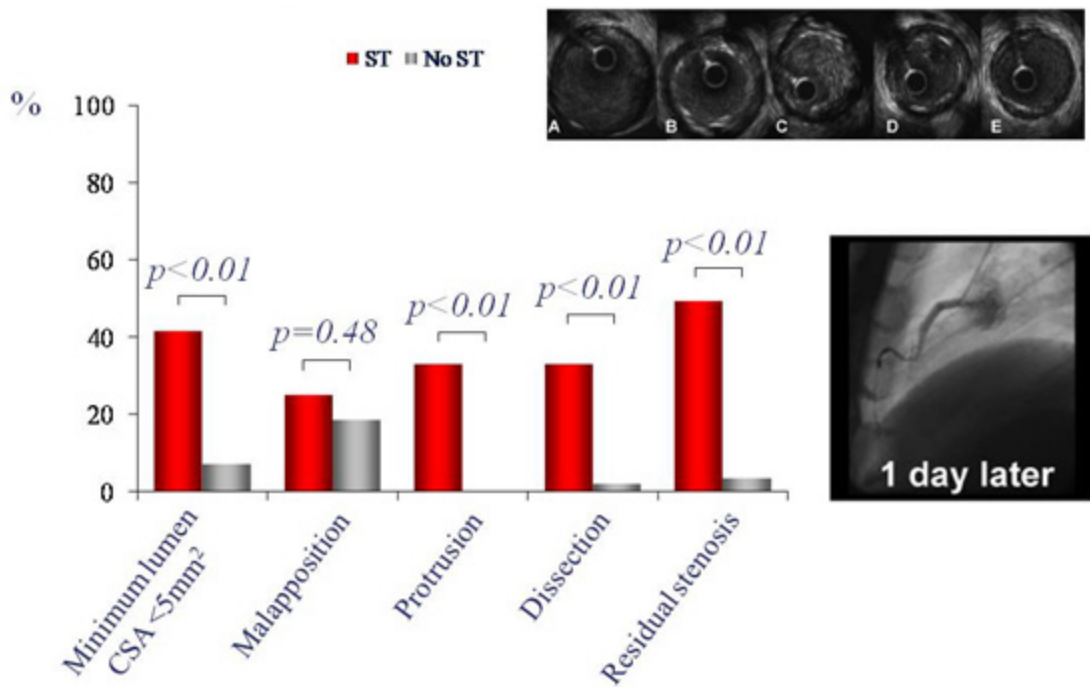
Grant/Research Support

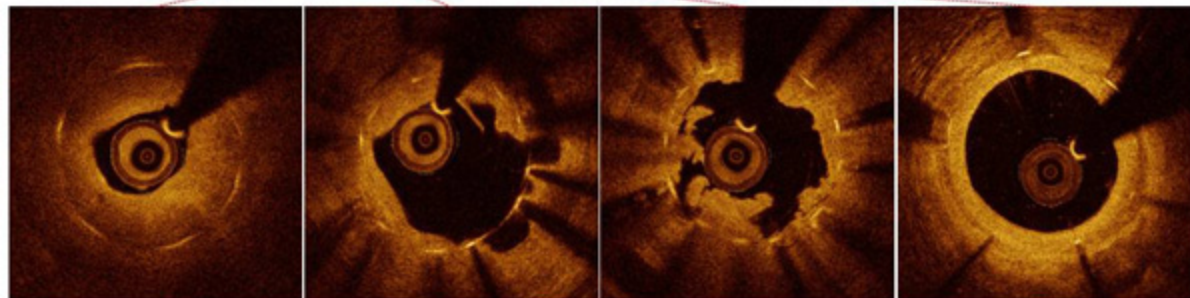
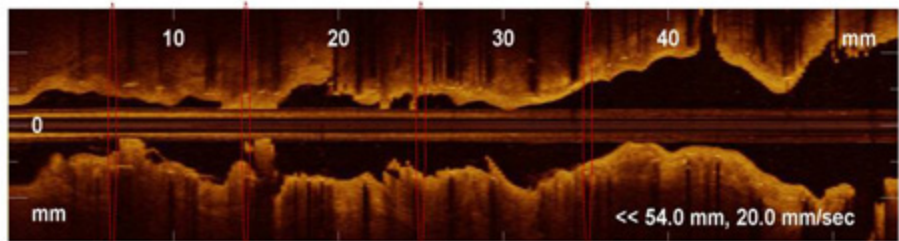
Consulting Fees/Honoraria

Company

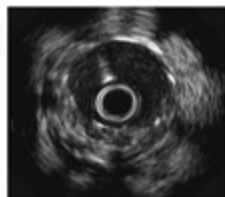
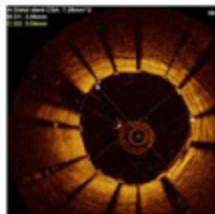
- Medtronic, Abbott, Boston Scientific, LightLab
- Boston Scientific, Volcano, Cordis, Astra Zeneca, St. Jude

IVUS Findings of Early Stent Thrombosis in STEMI

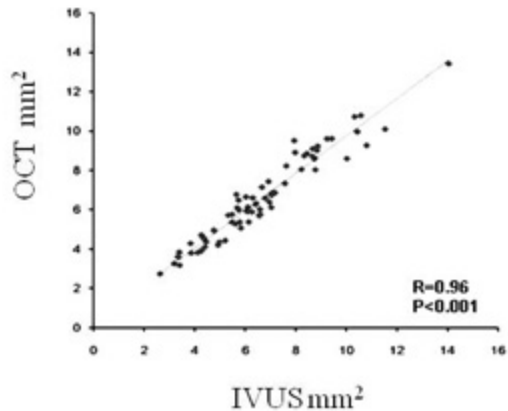




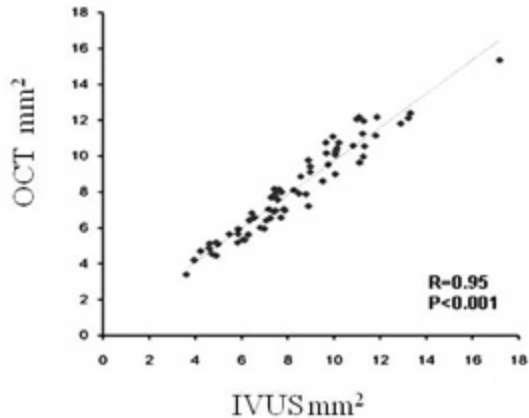
Comparison of FD-OCT and IVUS Imaging



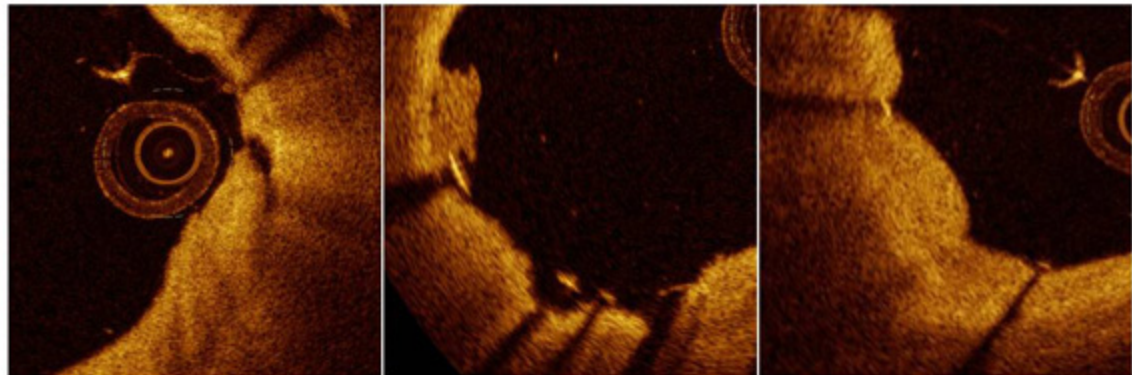
Minimum Stent Area



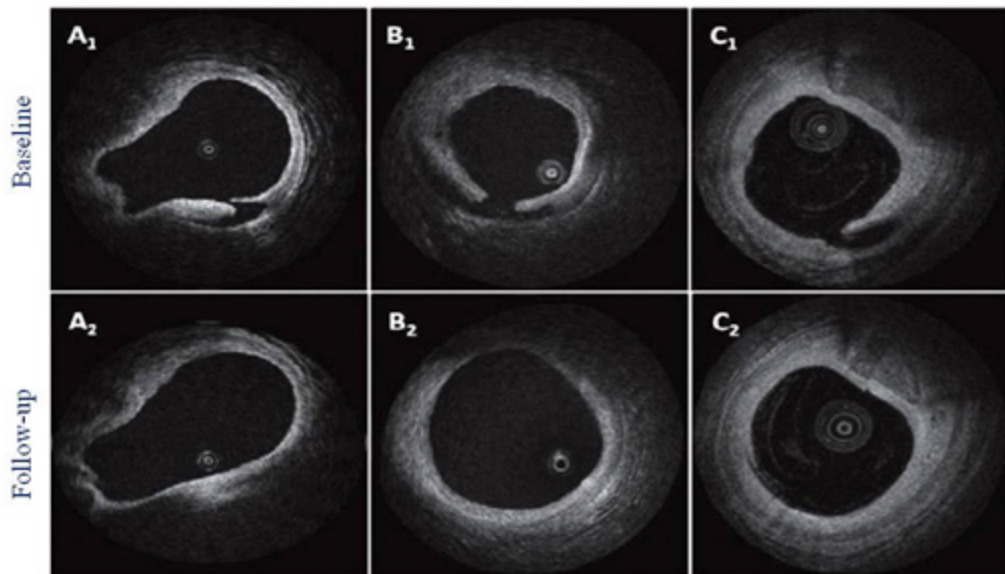
Mean Stent Area



Variables: Dissection, Malapposition, Plaque protrusion



Natural History Of OCT Detected Edge Dissections 12 Months Following DES Implantation



Edge Dissections (within 5 mm)

Not angiographically visible

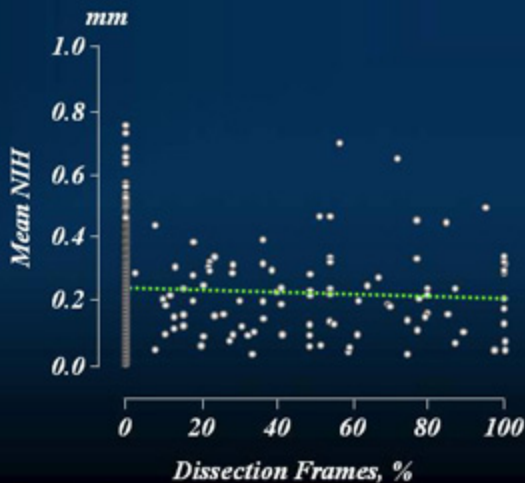
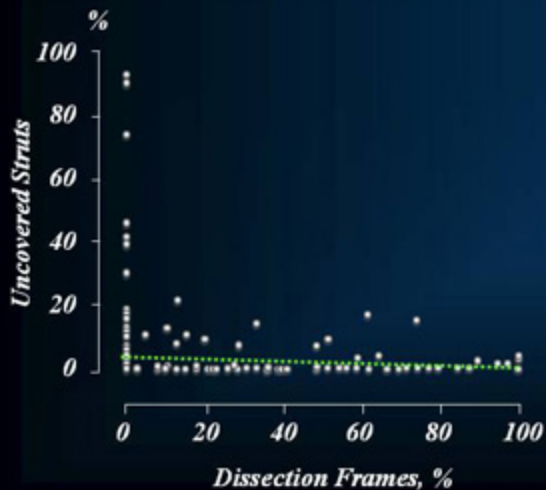
	Median (IQR)
Length, mm	2.9 (1.6-4.3)
False Lumen, max width mm	0.97 (0.87-1.25)
Extended to media n, %	10 (50%)
Involving at least 2 quadrants n, %	4 (20%)

12 Month FU

- NO ST or TLR
- 90% completely healed
- Not healed: ≥ 4.3 mm longitudinally

Impact of Plaque Dissection Post Stent Implantation

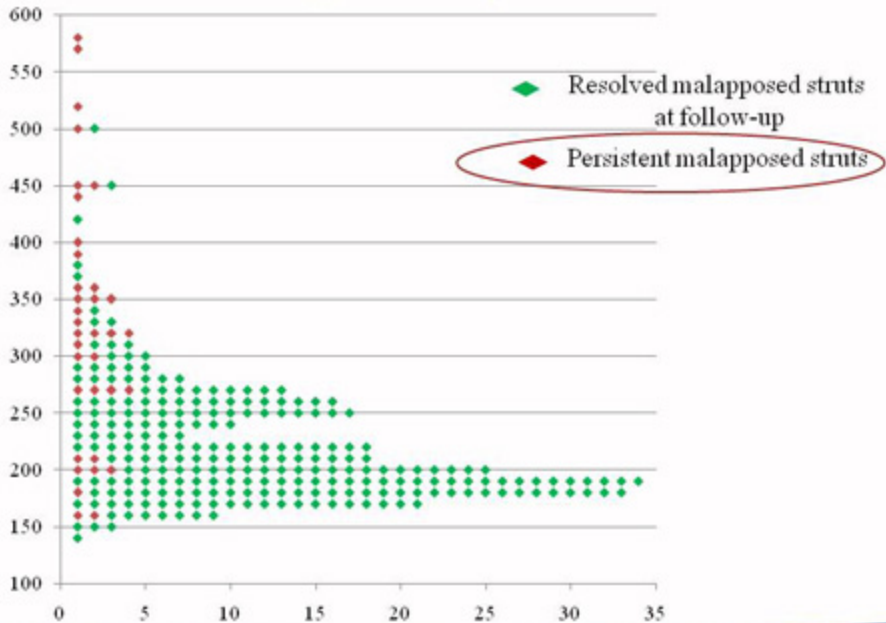
6 months FU n = 312

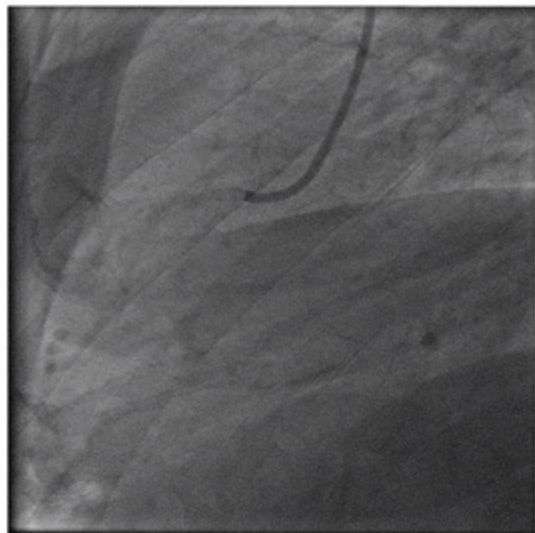
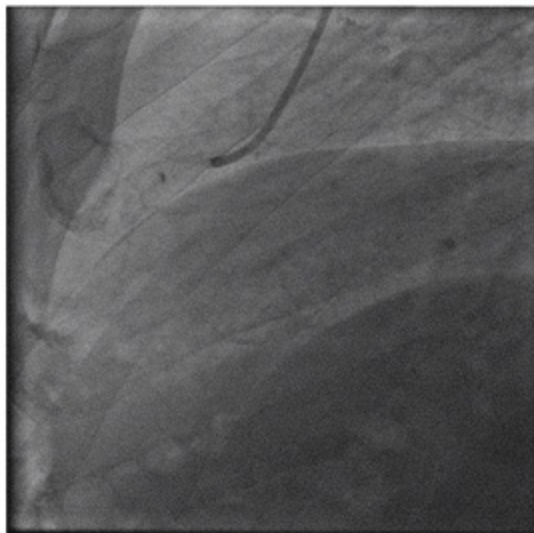


Strut Apposition and Thrombus Formation after SES Implantation

	10 Months FU		<i>P</i>
	Well apposed (<i>n</i> =548)	ISA (<i>n</i> =68)	
Presence and absence of thrombus			
Thrombus, n (%)	11 (2.0)	14 (20.6)	<0.001
No thrombus, n (%)	537 (98.0)	54 (79.4)	-

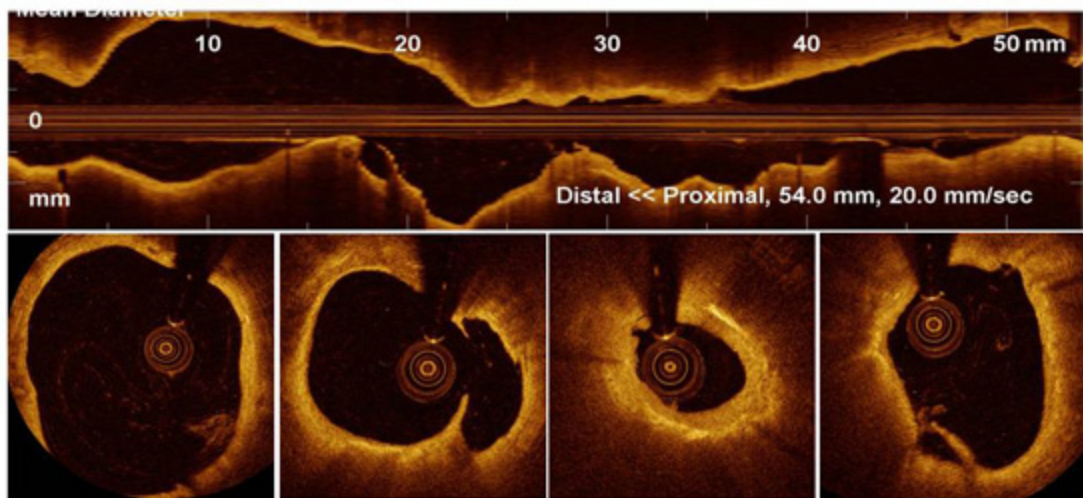
Distance between the malapposed strut and vessel wall immediately after implantation





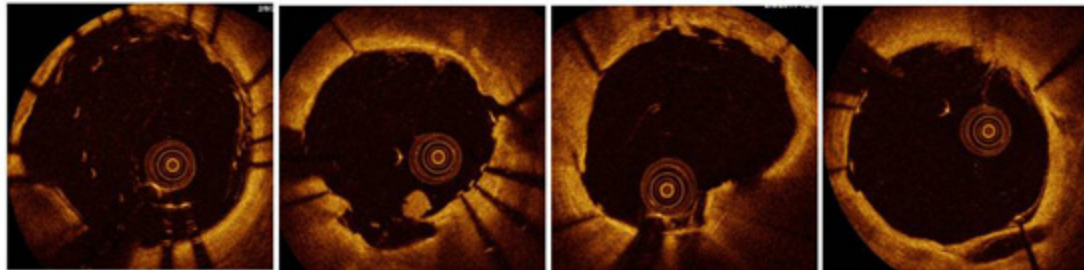
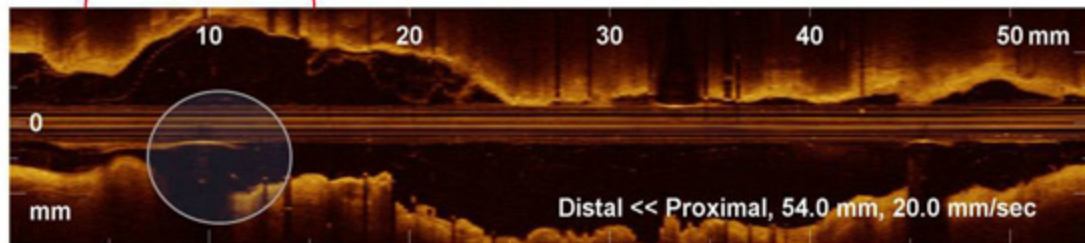
Landing Zone Aneurysm

Ruptured Plaque + stenosis

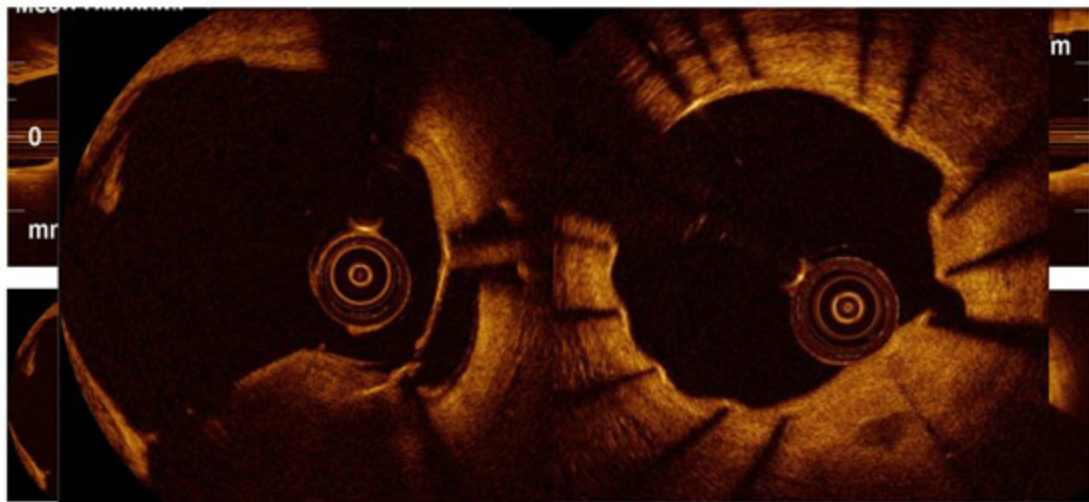


Immediately post stent implantation

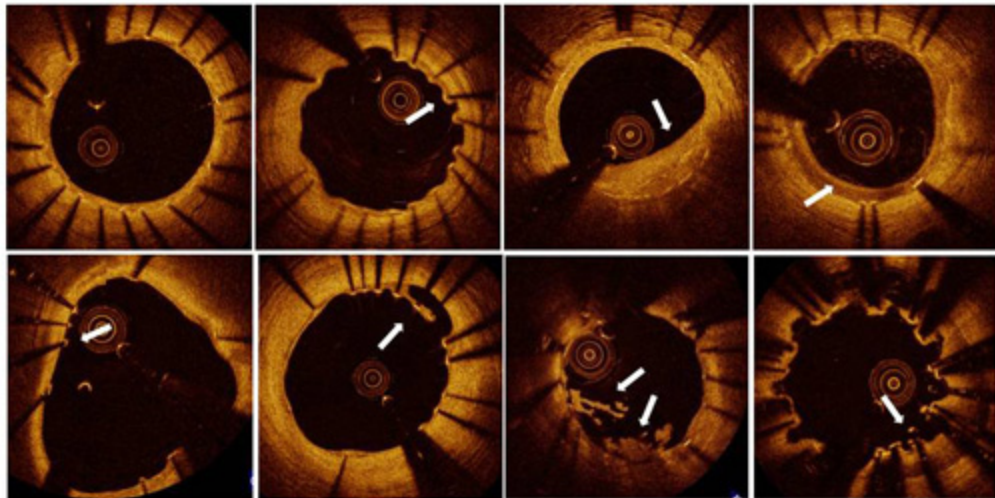
Cluster of large malapposed struts



9 Months FU, Asymptomatic

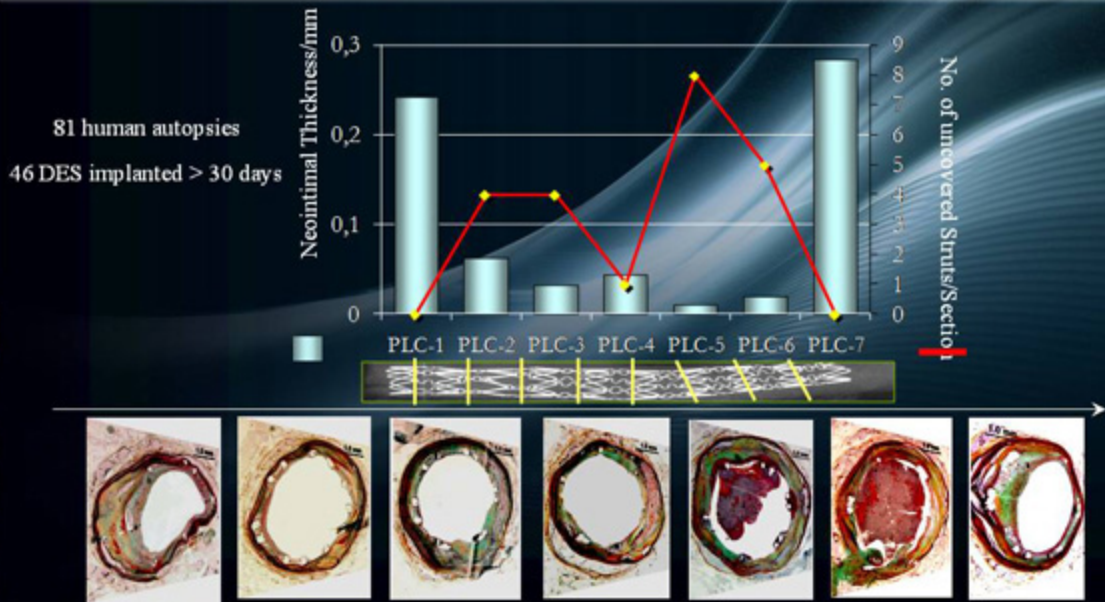


Stent vessel interactions in follow up



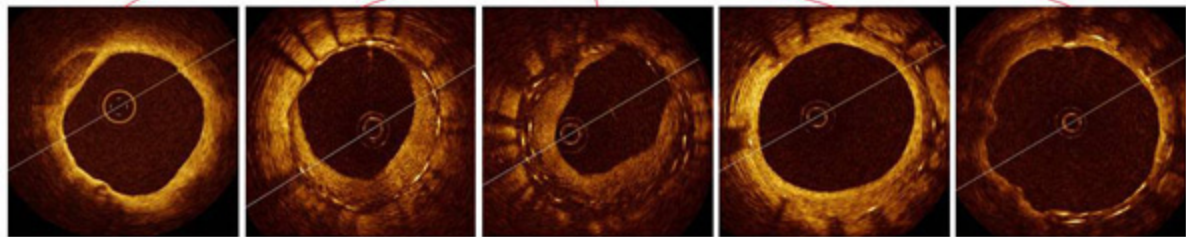
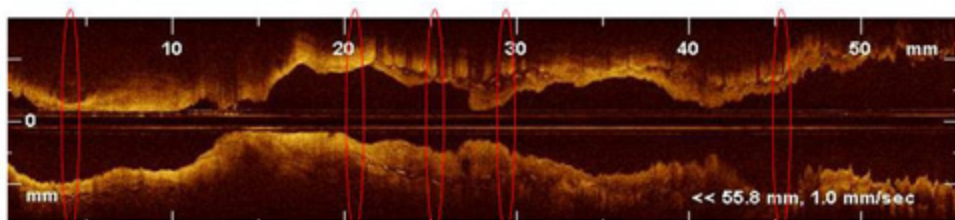
Histological Predictor of Stent Thrombosis: Endothelial Coverage

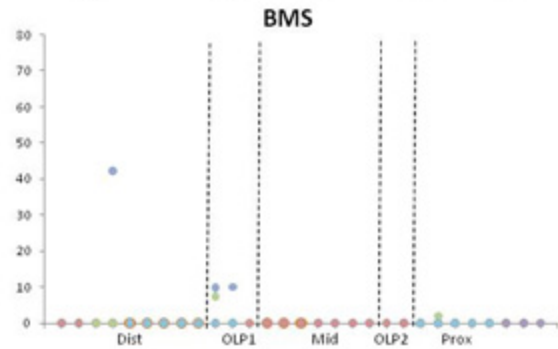
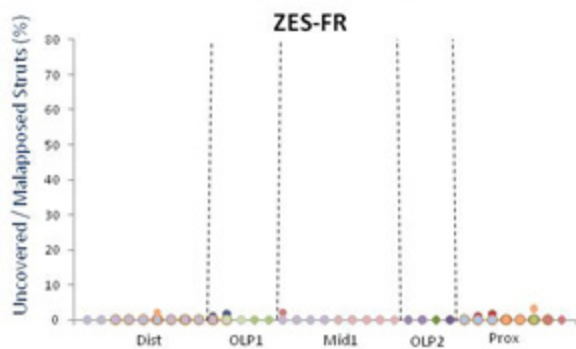
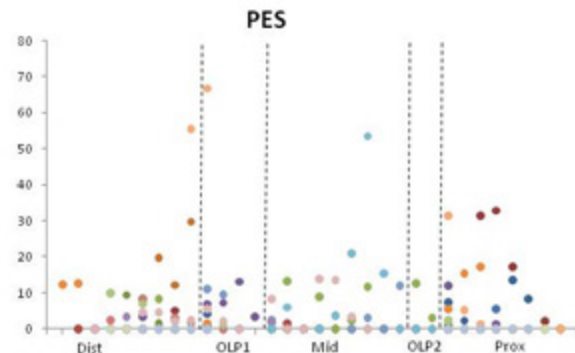
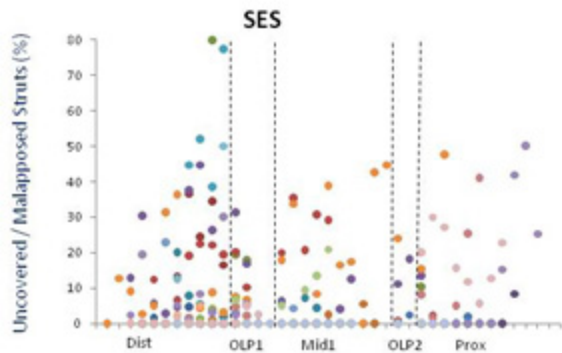
Ratio of uncovered/total stent struts per section > 30%: **OR for thrombus 9.0 (95% CI 3.5 to 22)**



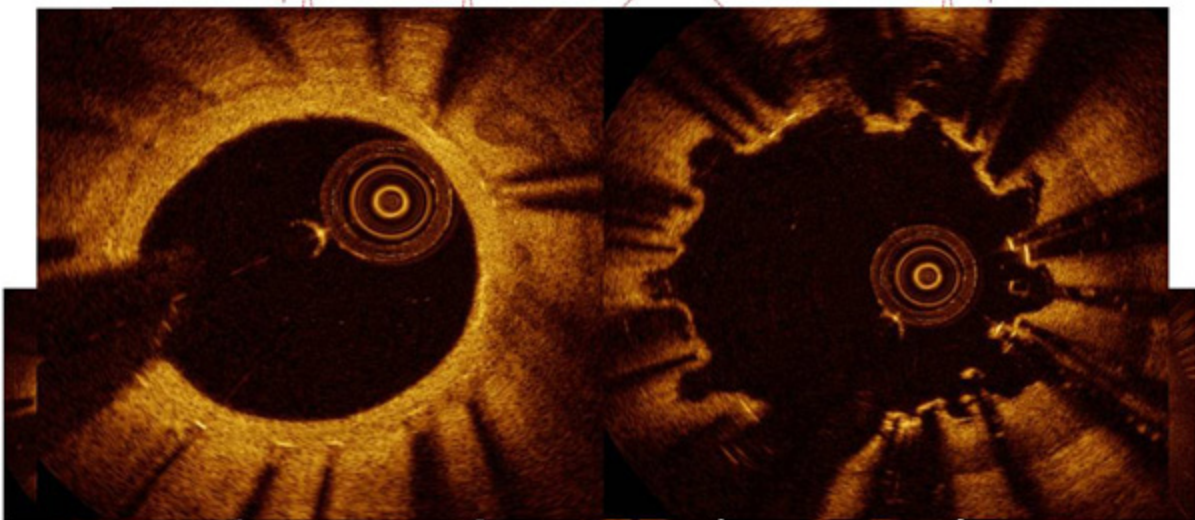
OCT provides images of tissue pathology in-situ and in real time

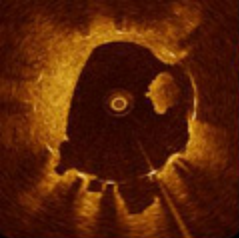
Stent 20 mm length: 6-7 Histology sections, 60-200 with OCT





PERMANENT POLYMER DES





DES with Definite MI due to LST: Thr Asp +OCT +IVUS
Median time to presentation 615 days (1-3 Q 394-1186)

Multivariate Predictors of Late Stent Thrombosis in DES

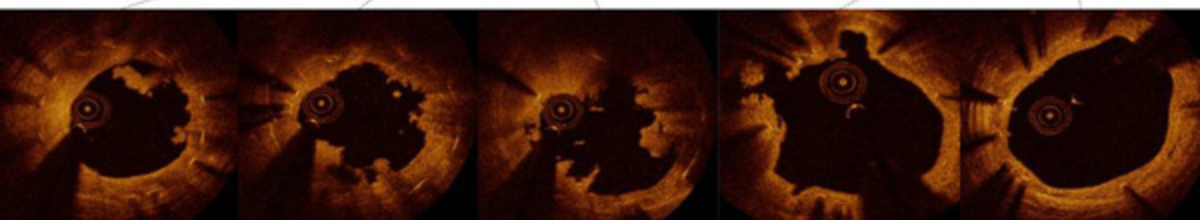
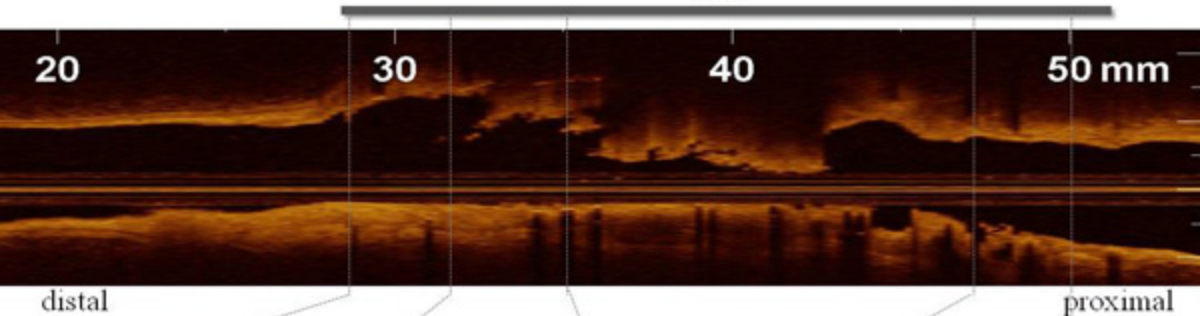
Variable	OR [95% CI] per 0.01 increase	P
Length of segments with uncovered struts, mm (OCT)	2.46 [1.29-9.78]	0.008
Remodeling index (IVUS)	1.06 [1.03-1.19]	0.003

Matched for: stent type, similar EEM CSA (p= 0.49) and LCSA (p=0.96) of the IVUS reference segment

VLST OCT analysis

immediately after thrombus aspirations

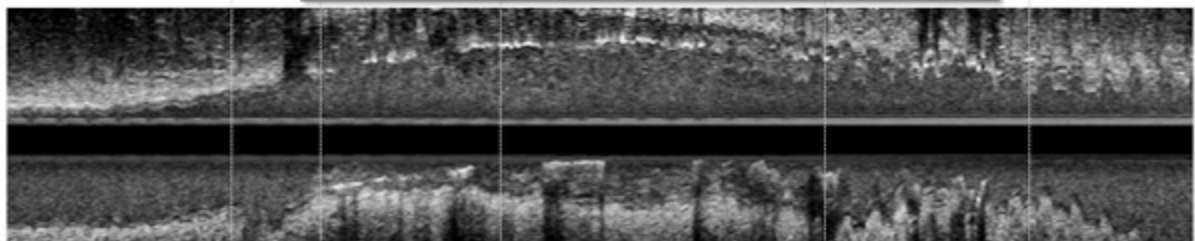
SES



VLST IVUS analysis

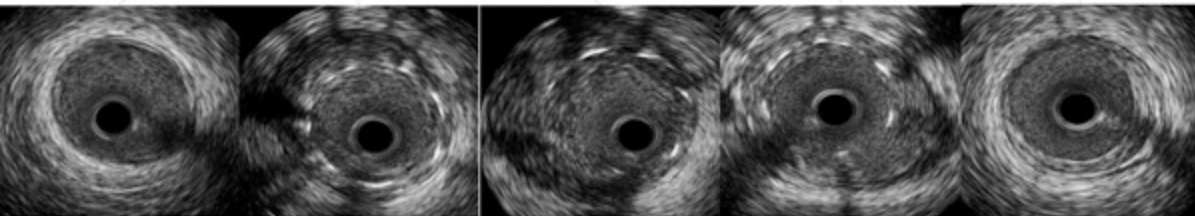
immediately after thrombus aspirations

SES



distal

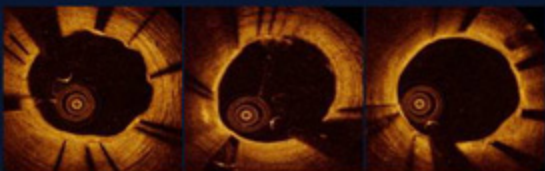
proximal



OCT-Based Studies: 1st and 2nd generation DESElective FU

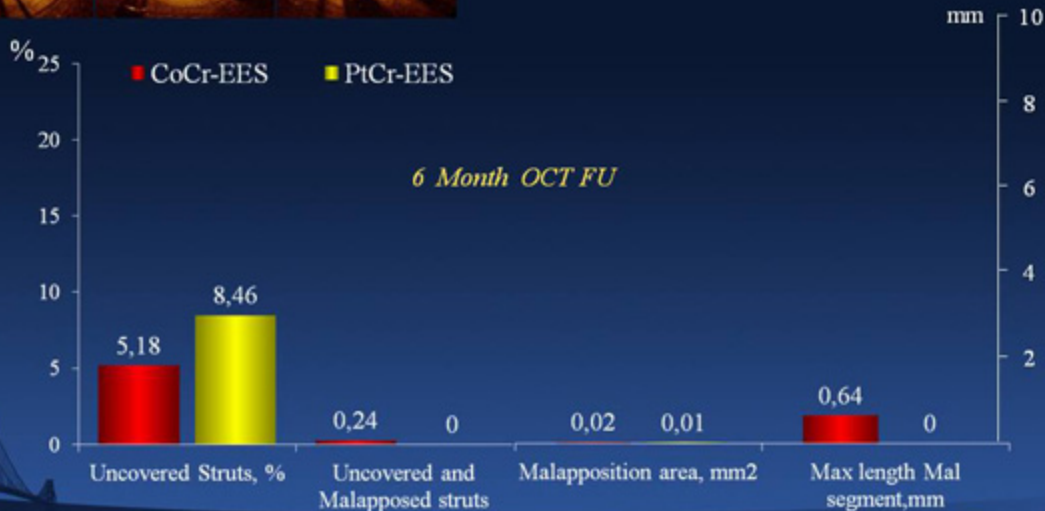
	N Patients	N Stents	Cohort	FU Time Months	% OCT FU	Publication	% Uncovered struts
ODESSA							
SES, PES vs ZES FR	66	163	Long lesions	6	97%	<i>JACC Interv</i>	8 vs 4 vs 0.1
HORIZONS-OCT							
PES	89	146	STEMI	13	97%	<i>Circulation</i>	5.7
Kim							
SES vs ZES FR	68	68	Stable, ACS	9		<i>Heart</i>	12.3 vs 0.3 %
Miyoshi							
PES vs SES	27	54	Same vessel	6	100%	<i>Circ J</i>	6.6 vs 12.3%
OCT EVEREST							
CoCr vs PICr EES	42	44	Stable, ACS	6	91%	<i>CathCard Int</i>	5.9 vs 8.5%
RESOLUTE ALL							
ZES SR vs EES	58	107	All comers	13		<i>Eur Heart J</i>	7.4 vs 5.8%

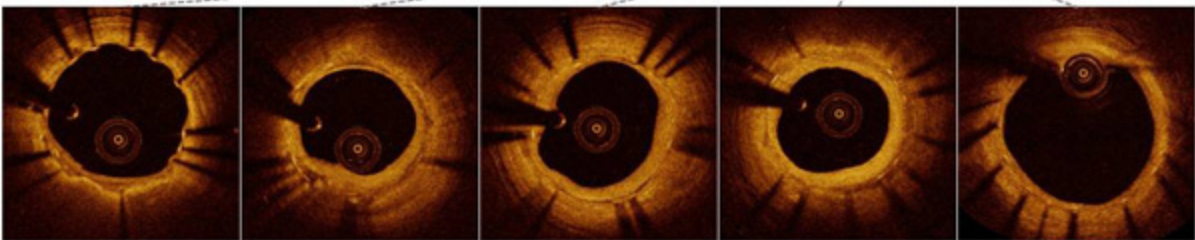
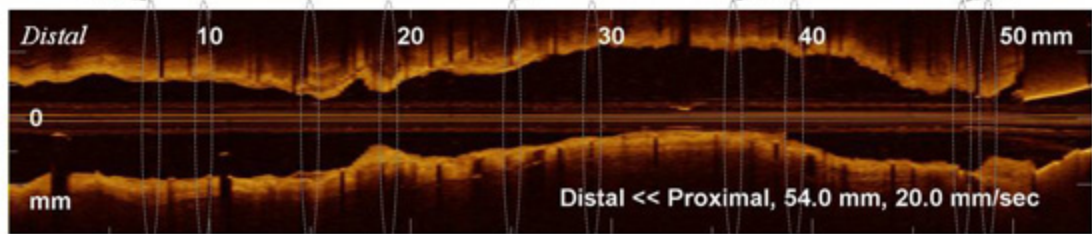
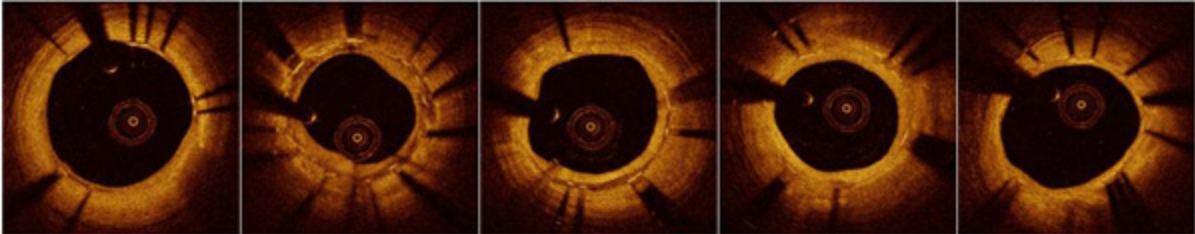
Impact of Novel Stent Alloys on Human Vascular Response to EES



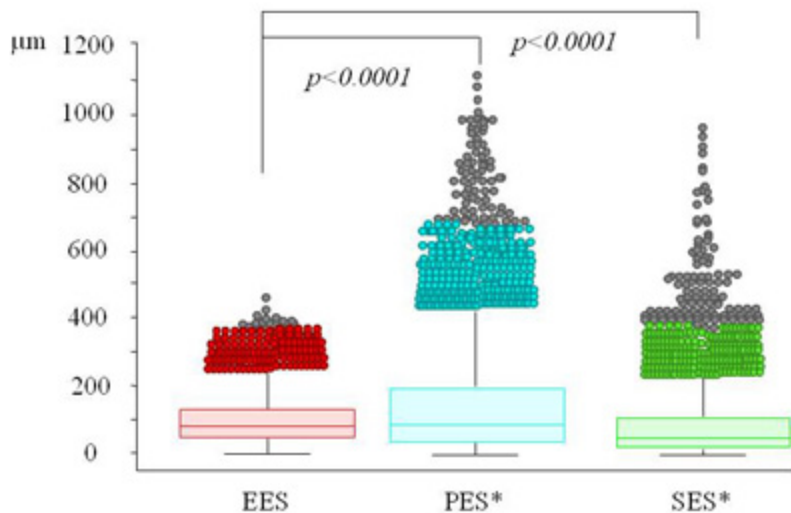
Stent Eccentricity index CoCr-EES : 0.91

PtCr-EES : 0.92





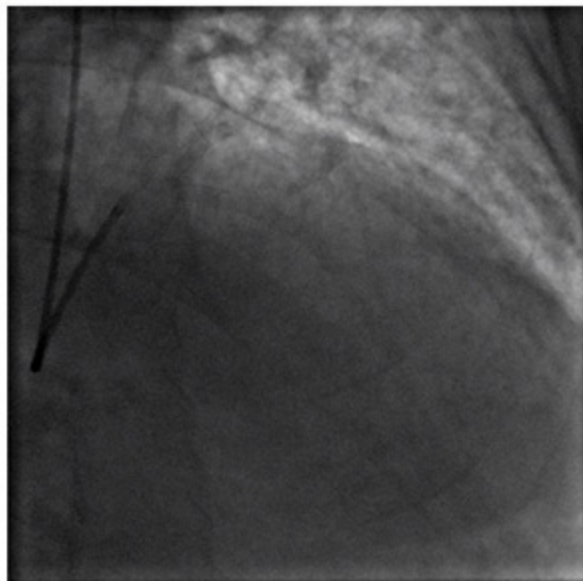
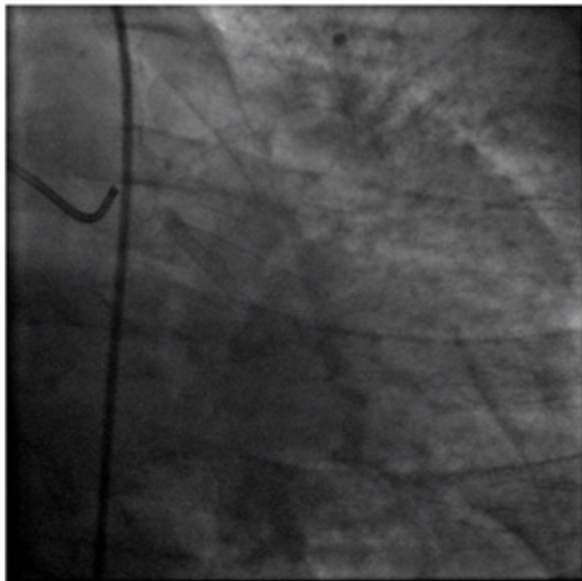
Distribution of neointimal thickness (NIT) of EES, PES and SES

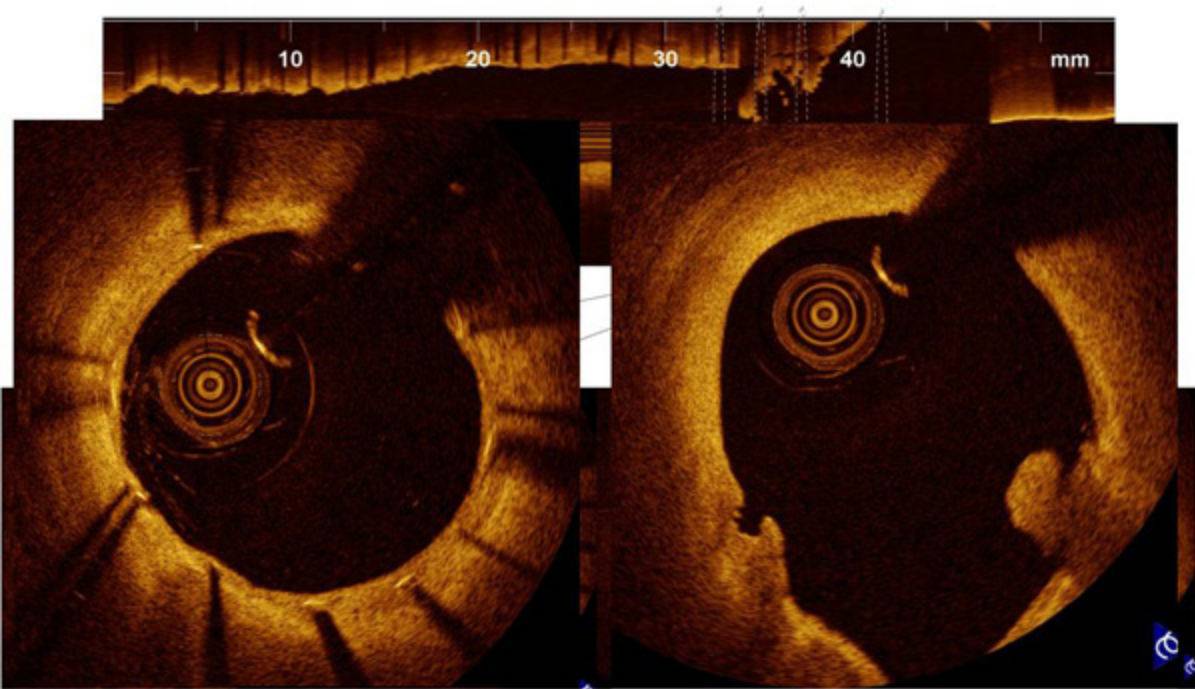


*Data cited from Miyoshi et al.

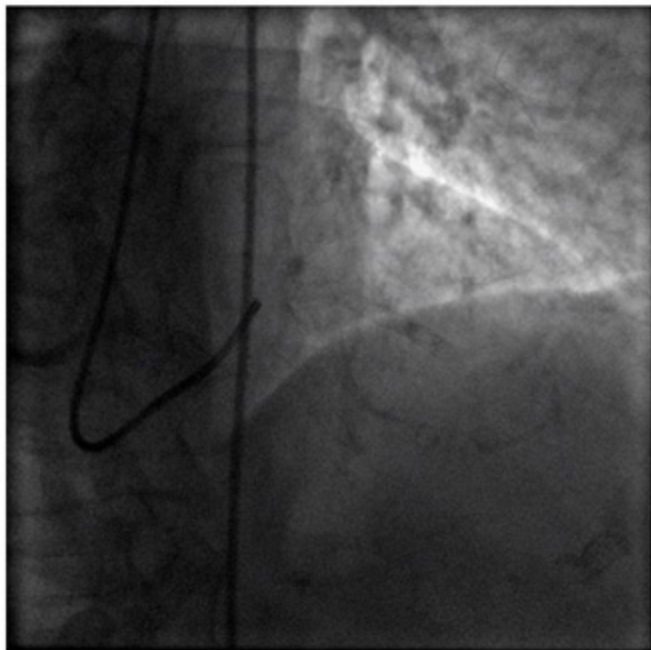
OCT to Understand and Fix Causes of DES Failure

Anterior STEMI 2 YRS after DES Implantation





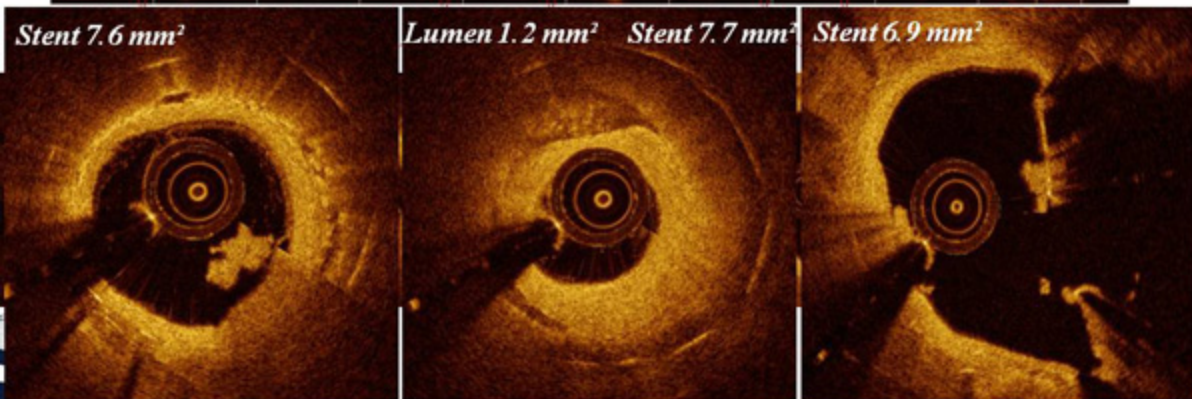
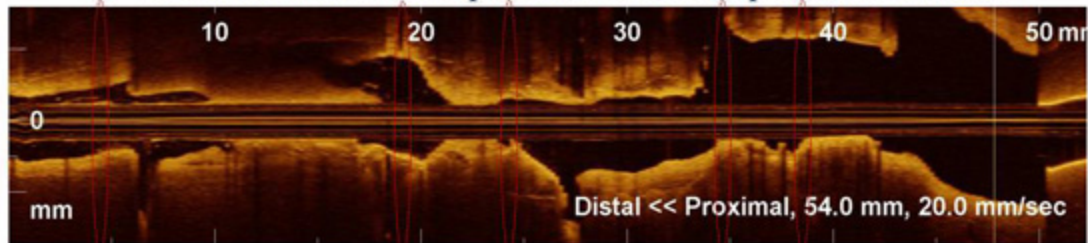
STEMI: Very Late ST, 6 yrs after DES



Ospedali Riuniti di Bergamo

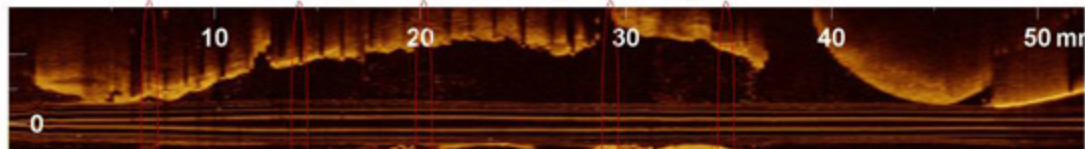
LST: OCT to Understand and Fix Causes of DES Failure

1st Generation DES: Underexpansion, Restenosis, Lipid Laden Neointima

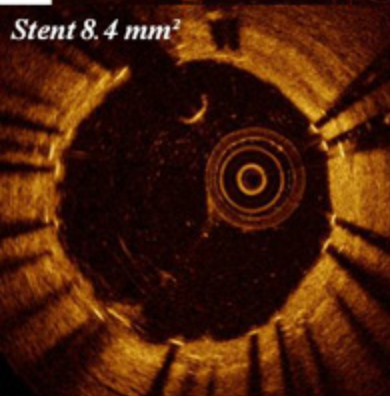


OCT to Understand and Fix Causes of DES Failure

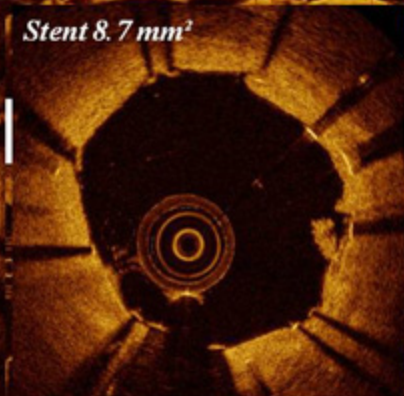
Last generation DES Implant and Optimization



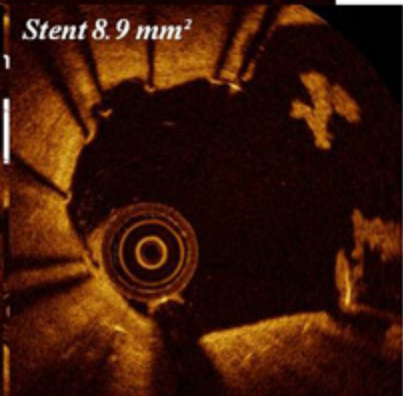
Stent 8.4 mm²



Stent 8.7 mm²

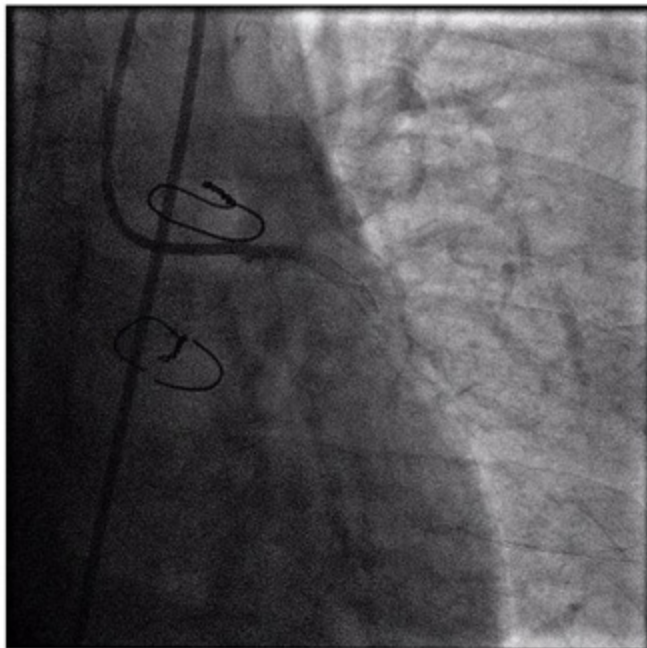


Stent 8.9 mm²



♂ 57 yr, Very Late DES Thrombosis

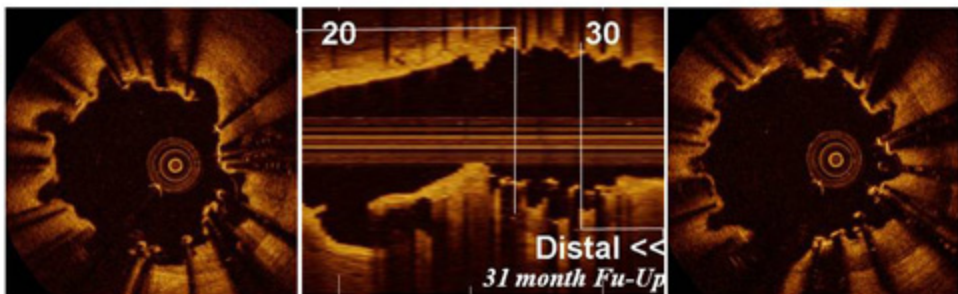
31 mos after implantation



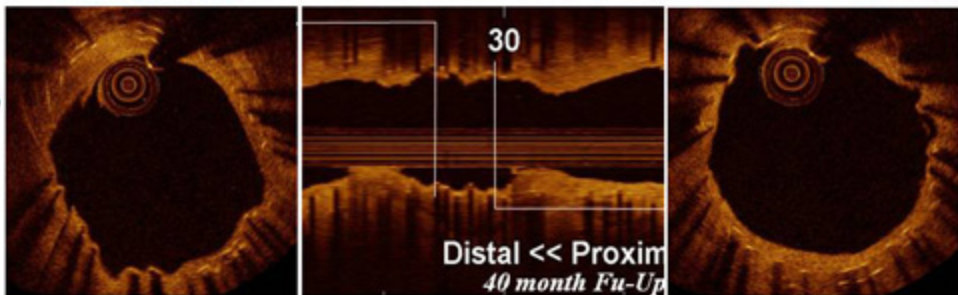
Ospedali Riuniti di Bergamo, Jan 2011 on ASA

DES Acquired Aneurysm treated at 31 month with BMS

Before BMS

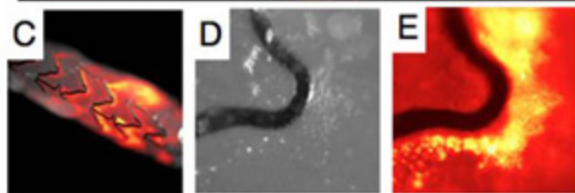
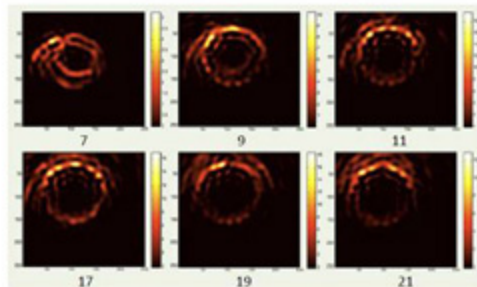
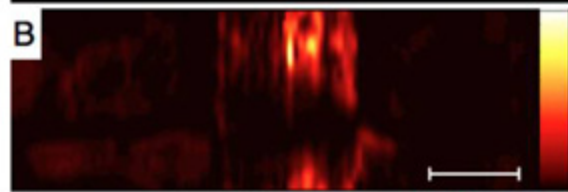
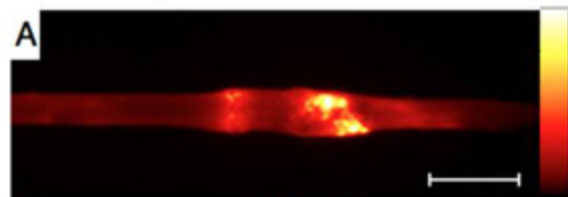
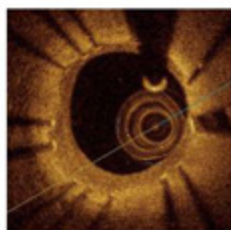
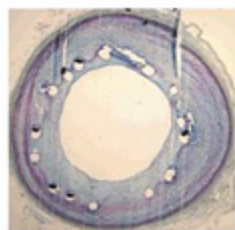


9 mos Fu-Up

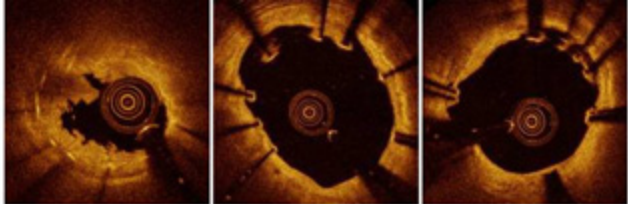


New Combined Informations

High-magnification NIRF image



Conclusions



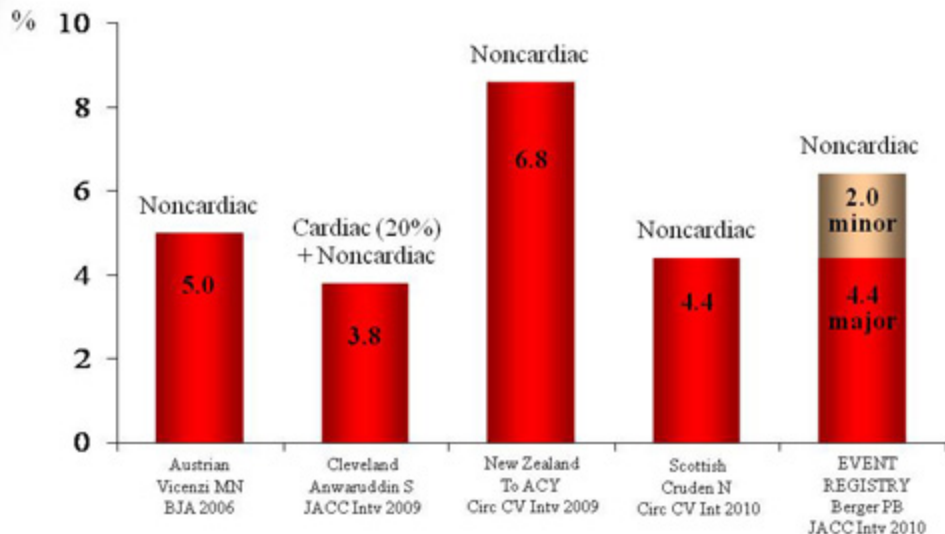
Optical Imaging to Prevent , Assess and Treat Stent Thrombosis

- Full vessel scan in few seconds (important during urgent interventions , ie: LST)
- Highly sensitive for thrombus
- Accurate to detect and quantify malapposition, lack of coverage, lipid laden neointima, new plaque rupture, toxic vessel responses, all possible causes of stent failure.
- Able to detect segmental cluster of uncovered and malapposed struts
- Useful to inform on residual thrombus, and to guide the most appropriate intervention based on specific causes of LST or type of ISR, evaluating the following stent responses

Critical Needs: automatic measurement of clustering of uncovered/malapposed struts, tissue textile characterization, detection of inflammation (combined light technologies)



Incidence of surgery within 1 year after coronary stenting



Intracranial Hemorrhage 2 months after DES
LCx Taxus TM 2.5 x20 mm

