

Clinical Utility of multiple imaging modalities

7:00-7:10

Yoshinobu Onuma MD

Evelyn Regar, MD, PhD

Patrick W Serruys MD, PhD

Thorax centre, Erasmus MC



Invasive/ Non-invasive imaging in cathlab



Resolution (μm)	10-20	80-150	200	300	300	200
Time aspect I	Real-time	Real-time	Real-time			Real-time
Time aspect II	2-50 sec	20-50 sec				30 sec
Type of scan source	IR-light	Ultrasound	X-rays	X-rays	Magnetic rays	Visible light
Imaging target	Layer	Layer	Bloodflow	Density	Density	Surface
		VH, LipiScan		+/- non-invasive FFR		

Comparison of intravascular ultrasound versus angiography-guided drug-eluting stent implantation: a meta-analysis of one randomised trial and ten observational studies involving 19,619 patients

Yaojun Zhang^{1,2}, MD, PhD; Vasim Farooq², MBChB, MRCP; Hector M. Garcia-Garcia², MD, PhD; Christos V. Bourantas², MD, PhD; Nailiang Tian¹, MD; Shengjie Dong³, MSc; Minghui Li¹, PhD; Shaohua Yang¹, MD; Patrick W. Serruys², MD, PhD; Shao-Liang Chen^{1*}, MD, PhD

Angiography alone versus angiography plus optical coherence tomography to guide decision-making during percutaneous coronary intervention: the Centro per la Lotta contro l'Infarto-Optimisation of Percutaneous Coronary Intervention (CLI-OPCI) study

Francesco Prati^{1,2*}, MD; Luca Di Vito², MD, PhD; Giuseppe Biondi-Zoccai^{2,3}, MD; Michele Occhipinti^{2,4}, MD; Alessio La Manna⁴, MD; Corrado Tamburino⁴, MD; Francesco Burzotta⁵, MD, PhD; Carlo Trani⁵, MD; Italo Porto⁵, MD; Vito Ramazzotti¹, MD; Fabrizio Imola¹, MD; Alessandro Manzoli¹, MD; Laura Materia², PharmD; Alberto Cremonesi⁶, MD; Mario Albertucci², MD

The remained question is which imaging technology is going to guide the interventional cardiologist.

Is there any benefit of multiple imaging?

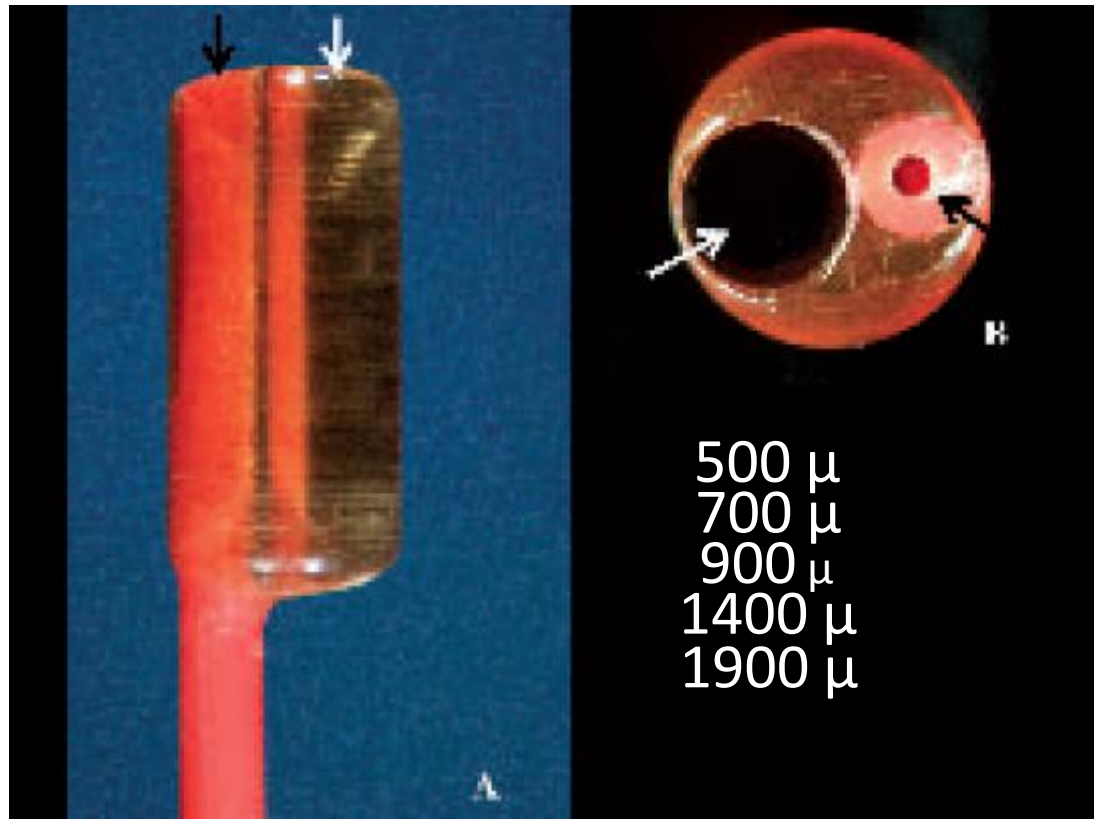
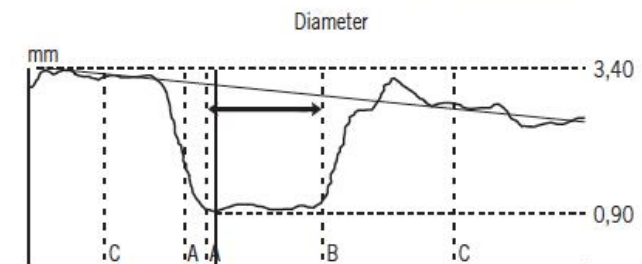
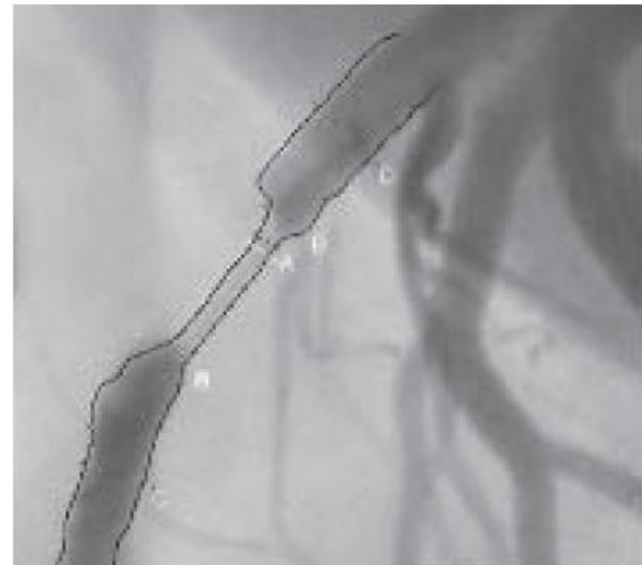
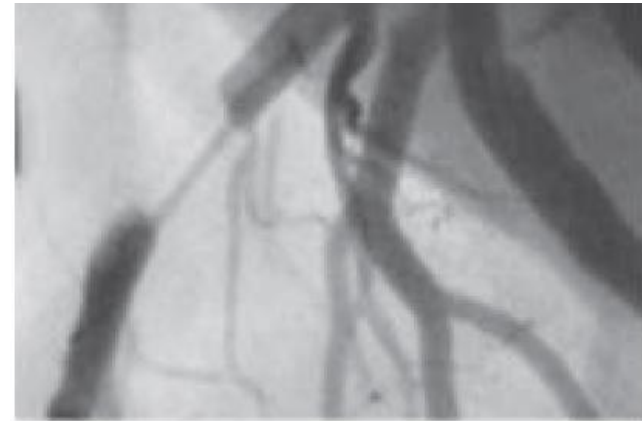
Multimodality imaging

- **Preprocedural Sizing of vessel
(IVUS, OCT and angiography)**
- **Plaque characterization
(Combination of IVUS-VH + OCT)**
- **Bifurcation (2D + 3D-OCT)**

In vivo validation of a novel three-dimensional quantitative coronary angiography system (CardiOp-B™): comparison with a conventional two-dimensional system (CAAS II™) and with special reference to optical coherence tomography

Keiichi Tsuchida, MD, PhD; Willem J. van der Giessen, MD, PhD; Mark Patterson, MRCP; Shuzou Tanimoto, MD; Héctor M. García-García, MD, MSc; Evelyn Regar, MD, PhD; Jurgen M. R. Ligthart, BSc; Anne-Marie Maugenest; Gio Maatrijk; Jolanda J. Wentzel, PhD; Patrick W. Serruys*, MD, PhD, FACC, FESC

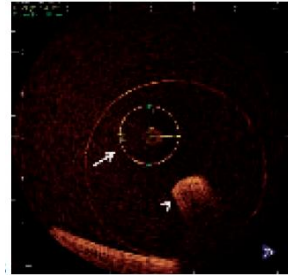
Thoraxcenter, Erasmus Medical Center, Rotterdam, The Netherlands



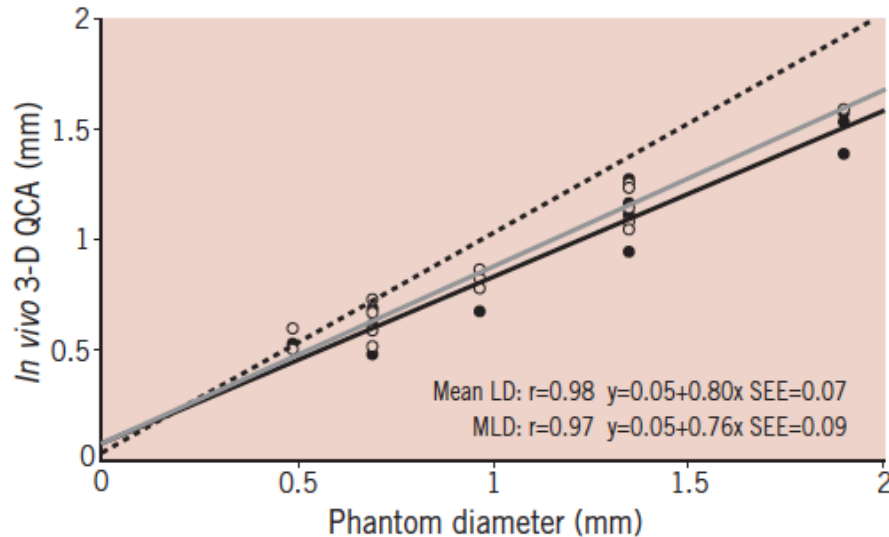
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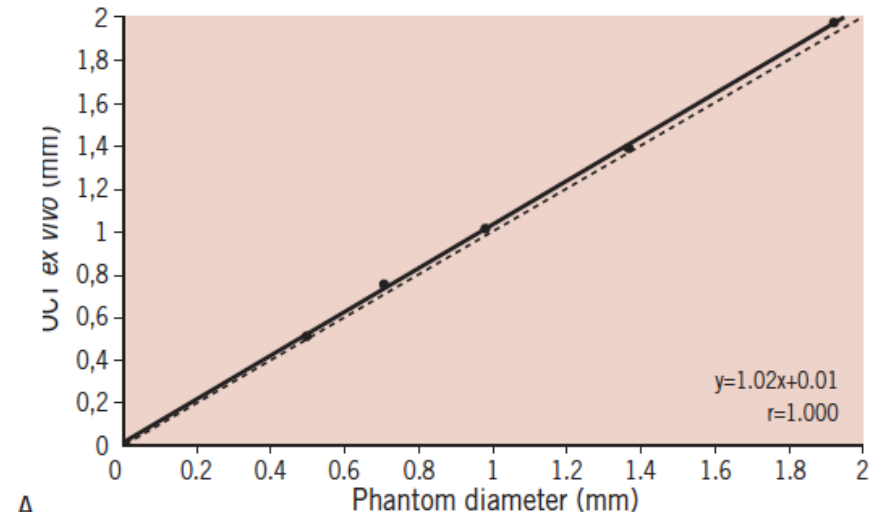
Thoraxcenter, Erasmus Medical Center, Rotterdam, The Netherlands



QCA underestimates the lumen dimension.



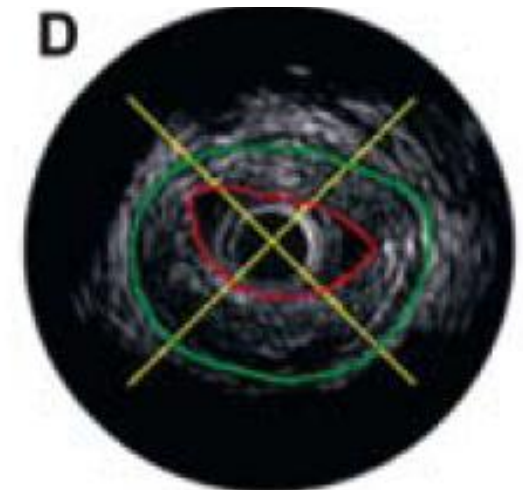
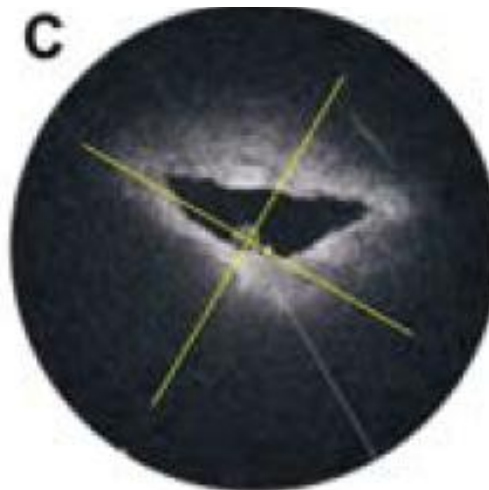
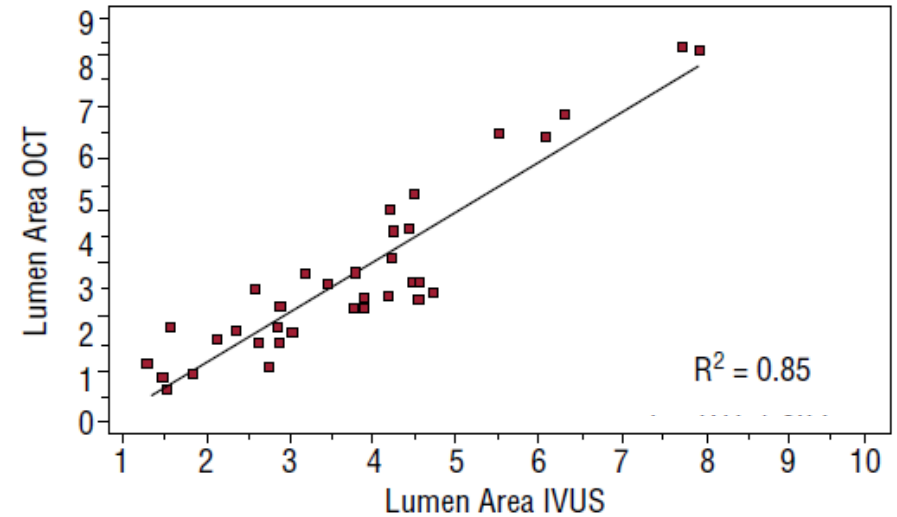
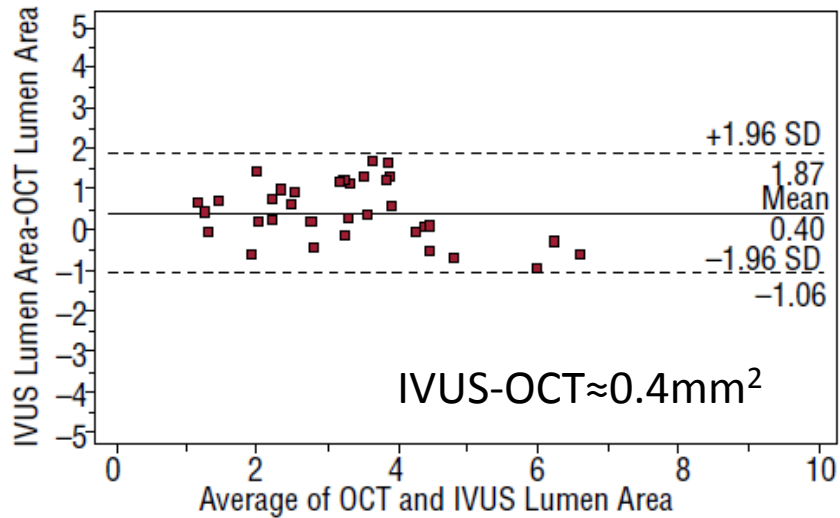
OCT provides the correct lumen dimension.



B

A

Quantitative Ex Vivo and In Vivo Comparison of Lumen Dimensions Measured by Optical Coherence Tomography and Intravascular Ultrasound in Human Coronary Arteries

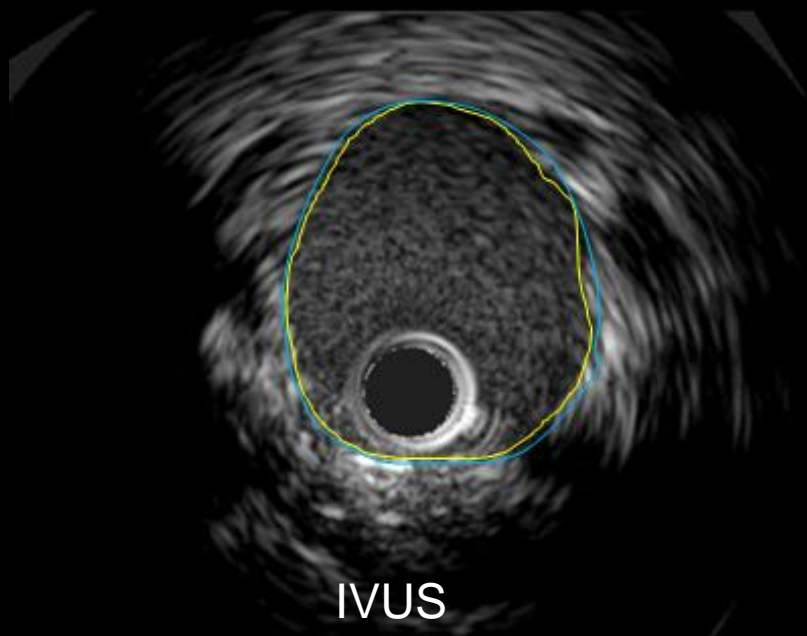


First-in-man evaluation of intravascular optical frequency domain imaging (OFDI) of Terumo: a comparison with intravascular ultrasound and quantitative coronary angiography

Takayuki Okamura¹, MD, PhD; Yoshinobu Onuma¹, MD; Héctor M. García-García², MD, PhD; Robert-Jan M van Geuns¹, MD, PhD; Joanna J. Wykrzykowska¹, MD; Carl Schultz¹, MD, PhD; Willem J van der Giessen¹, MD, PhD; Jurgen Ligthart¹, BSc; Evelyn Regar¹, MD, PhD; Patrick W Serruys^{1*}, MD, PhD

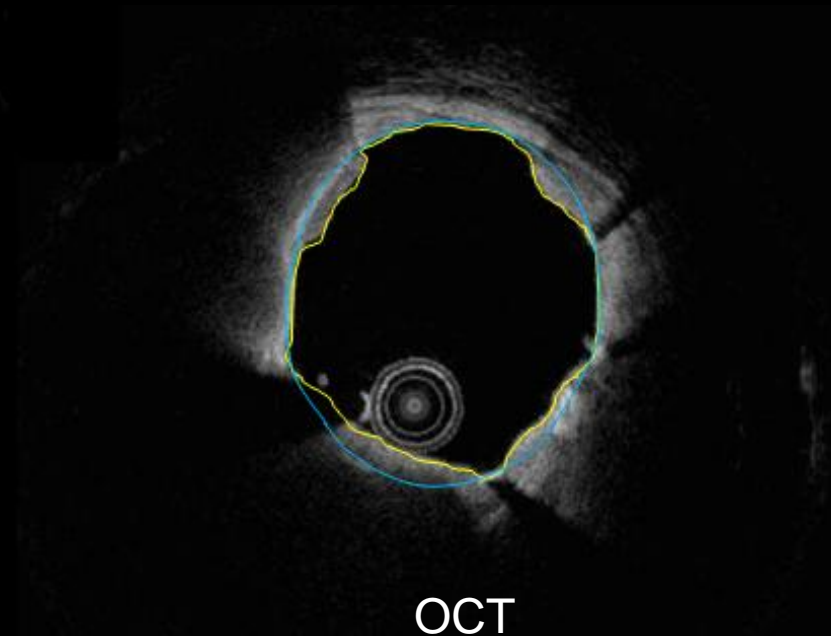
1. Thoraxcenter, Erasmus MC, Rotterdam, The Netherlands; 2. Cardialysis BV, Rotterdam, The Netherlands

In-vivo Comparison between IVUS vs. OFDI Quantitative assessment



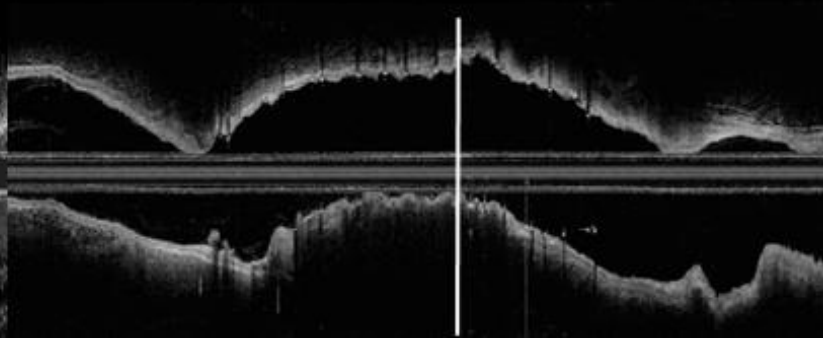
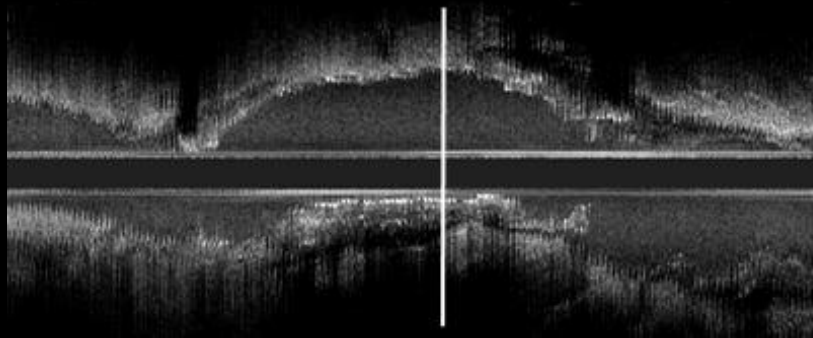
SA 9.70 mm²
LA 9.10 mm²

1mm



SA 9.69 mm²
LA 8.72 mm²

1mm



First-in-man evaluation of intravascular optical frequency domain imaging (OFDI) of Terumo: a comparison with intravascular ultrasound and quantitative coronary angiography

Takayuki Okamura¹, MD, PhD; Yoshinobu Onuma¹, MD; Héctor M. García-García², MD, PhD; Robert-Jan M van Geuns¹, MD, PhD; Joanna J. Wykrzykowska¹, MD; Carl Schultz¹, MD, PhD; Willem J van der Giessen¹, MD, PhD; Jurgen Ligthart¹, BSc; Evelyn Regar¹, MD, PhD; Patrick W Serruys^{1*}, MD, PhD

1. Thoraxcenter, Erasmus MC, Rotterdam, The Netherlands; 2. Cardialysis BV, Rotterdam, The Netherlands

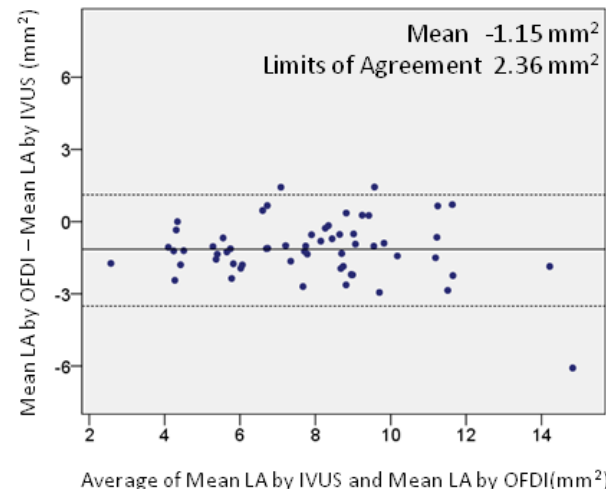
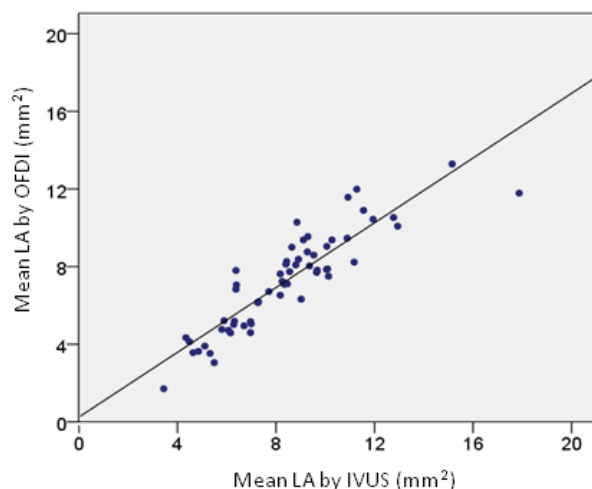
In-vivo Comparison between IVUS vs. OFDI

Quantitative assessment

	OFDI	IVUS	<i>p</i> value
<i>Non-stented segment (n=40)</i>			
Mean lumen area, mm ²	7.04 ± 2.74	8.54 ± 2.96	<0.001
Minimal lumen area, mm ²	5.53 ± 3.34	6.68 ± 3.27	<0.001

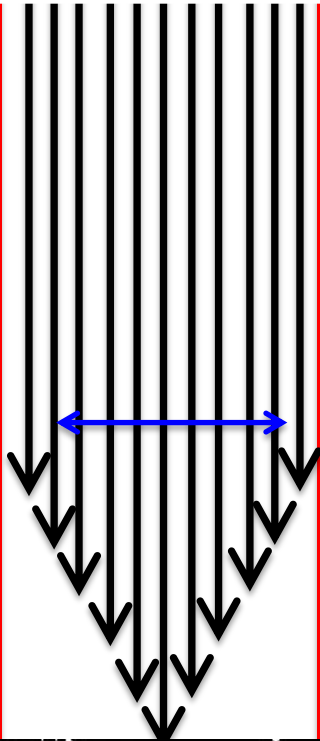
n=59

y = 0.8343x + 0.2481, r² = 0.8001, p<0.001



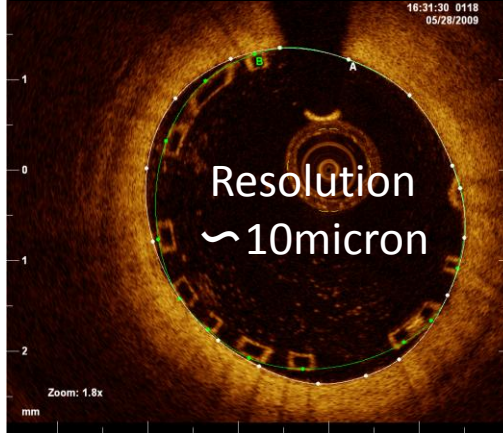
QCA

Vessel wall

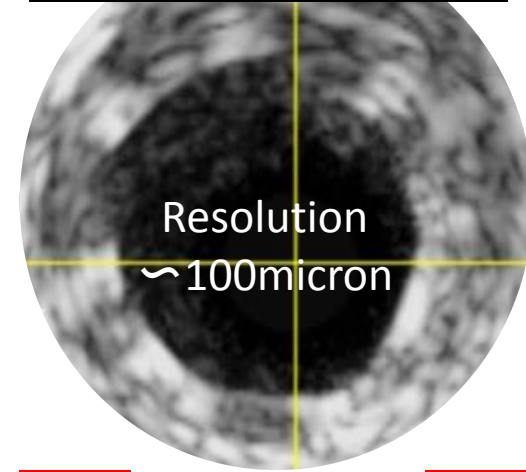


Vessel wall

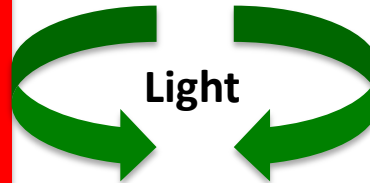
OCT



IVUS

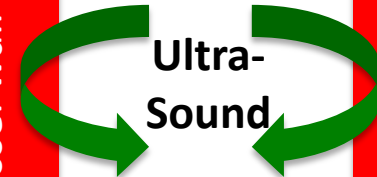


Vessel wall



Vessel wall

Vessel wall



Vessel wall



3.0 mm

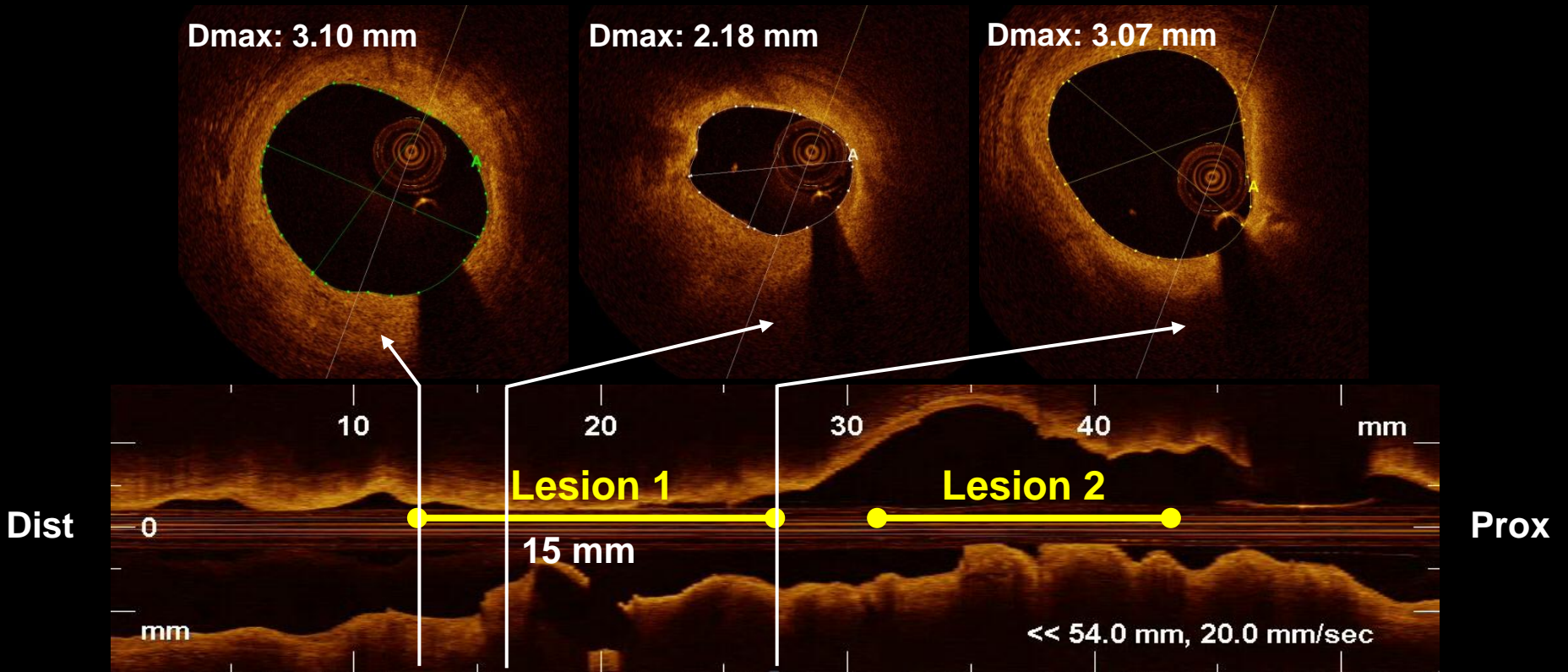


3.2 mm

2.8 mm

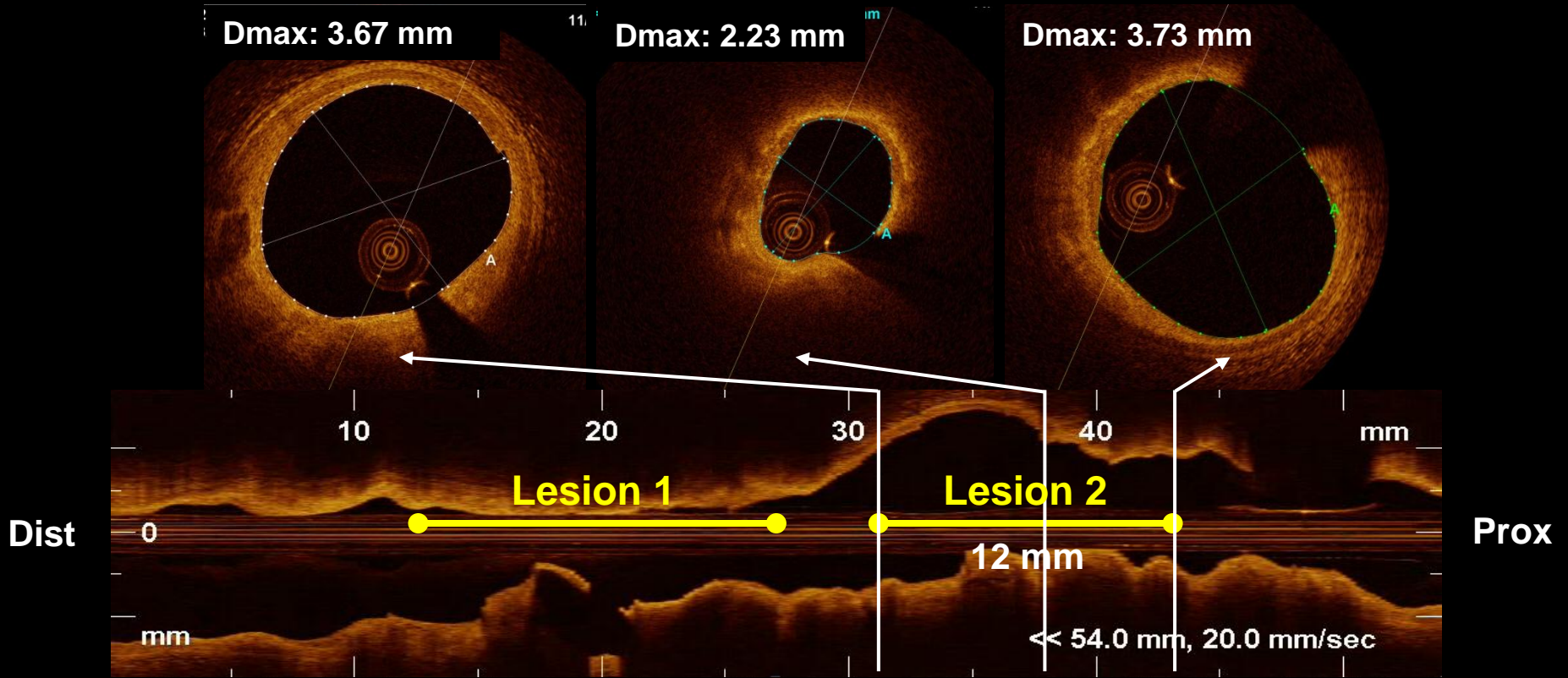
**Pre-procedure
Area assessment
IVUS > OCT = real value > QCA**

Vessel sizing



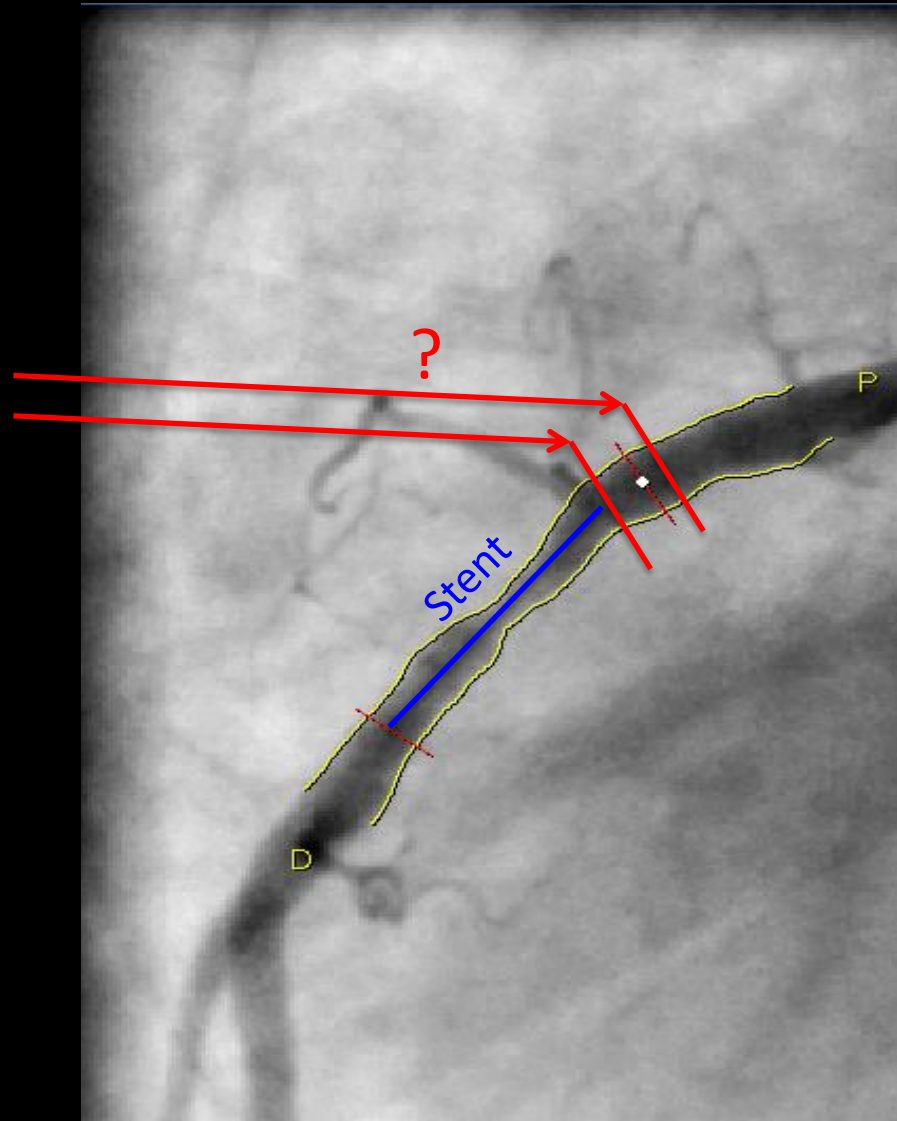
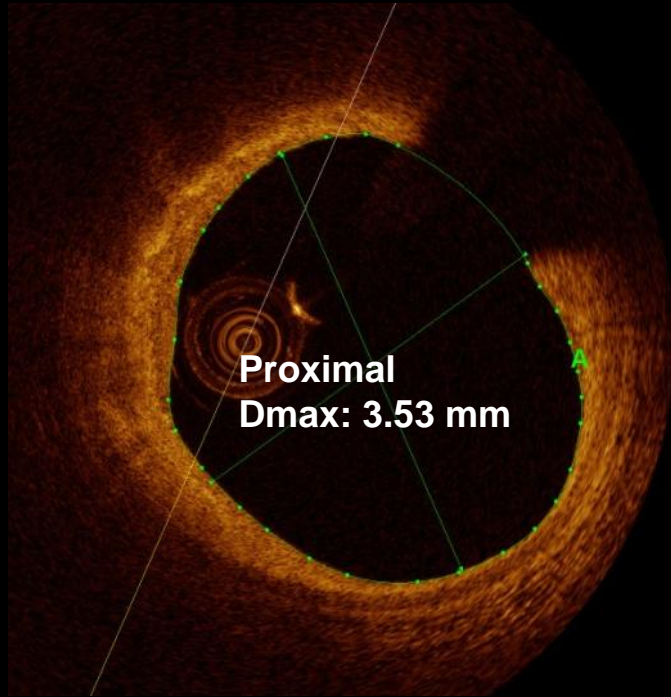
**Stent:
3.0x15 mm**

Vessel sizing



Stent:
3.5x12 mm

However, coregistration with OCT and Angiogram is necessary...



However, coregistration with OCT and Angiogram is necessary...

Erasmus MC
Creating

OptoCAT 1 (prototype version, not for clinical decision making) -- Medis medical imaging systems bv

Setting Calibration T/O Help

Medis 3D/fluora/b-oc/ang001.aod.ora

Program: [Progress Bar] 100%

Slices: 271 Subsample: 1 Pullback speed: 20 Frame rate: 300 OCT to Angio Register Reset

Medis

Proximal transversal view

Distal transversal view

Short Diam: 0.00 Long Diam: 0.00 Area: 0.00

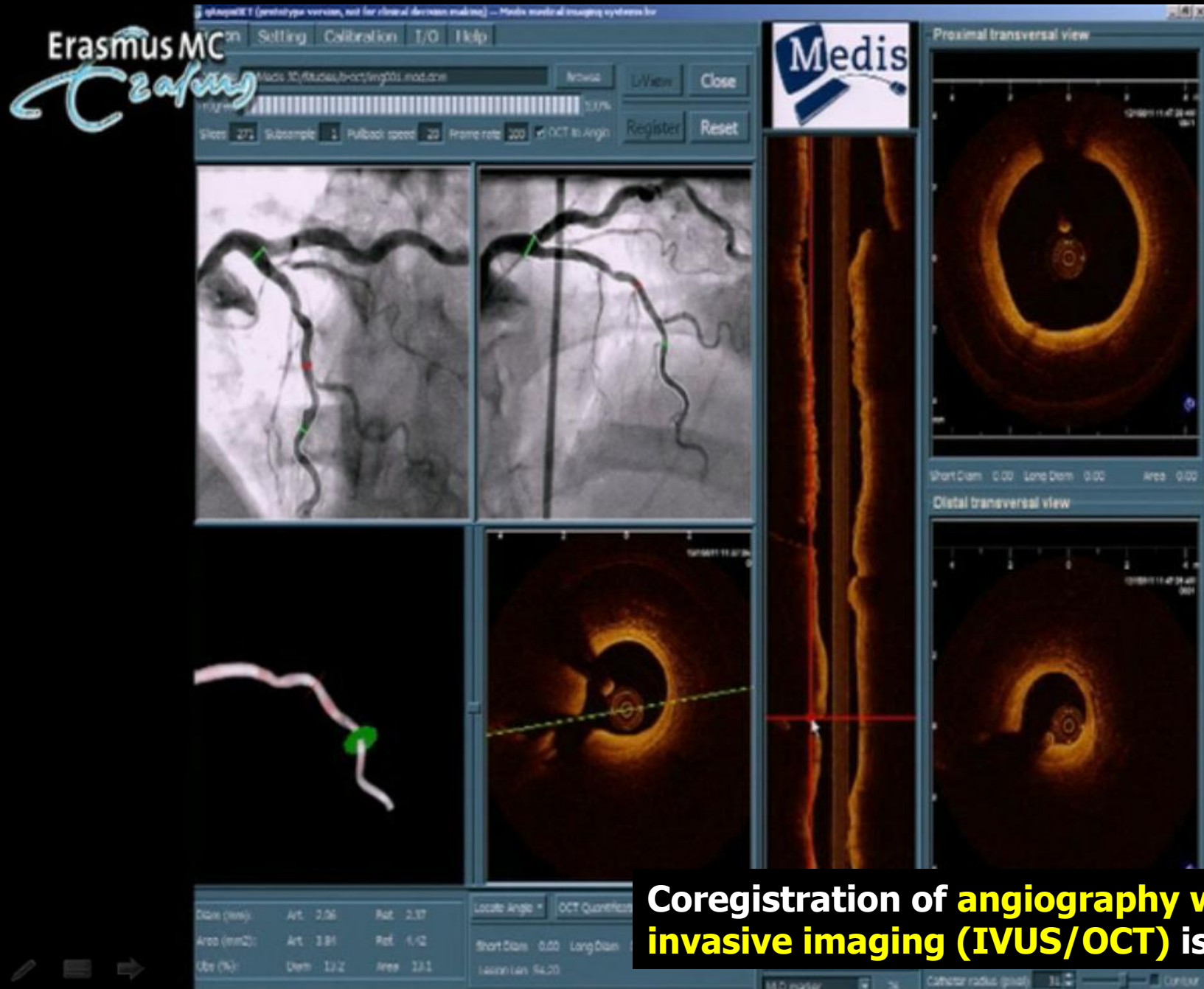
Short Diam: 0.00 Long Diam: 0.00 Area: 0.00

Diam (mm):	Art: 2.68	Ref: 2.76
Area (mm ²):	Art: 2.08	Ref: 2.98
labe (Dx):	Diam: 4.7	Area: 4.9

Locate Angle: 1	OCT Quantification	Clear Quantification
Short Diam: 0.00	Long Diam: 0.00	Area: 0.00
Lesion Len: 84.00		

Collector radius (pixel): 31.00

However, coregistration with OCT and Angiogram is necessary...



Multimodality imaging during PCI

- **Preprocedural Sizing of vessel**
(IVUS, OCT and angiography)
- **Plaque characterization**
(Combination of IVUS-VH + OCT)
- **Bifurcation (2D + 3D-OCT)**

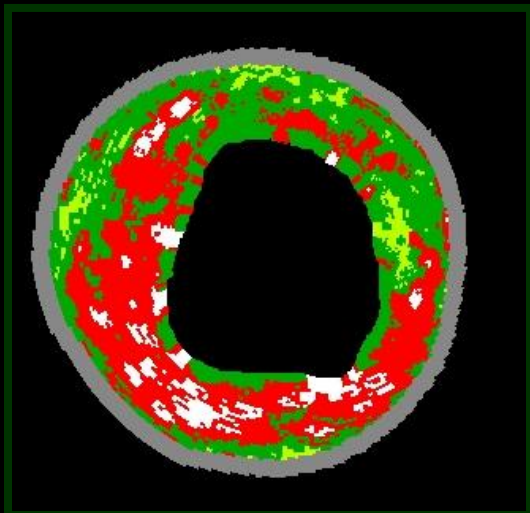
IVUS-VH DETECTION OF NON-CULPRIT LESION RELATED EVENTS

THE NEW ENGLAND JOURNAL OF MEDICINE

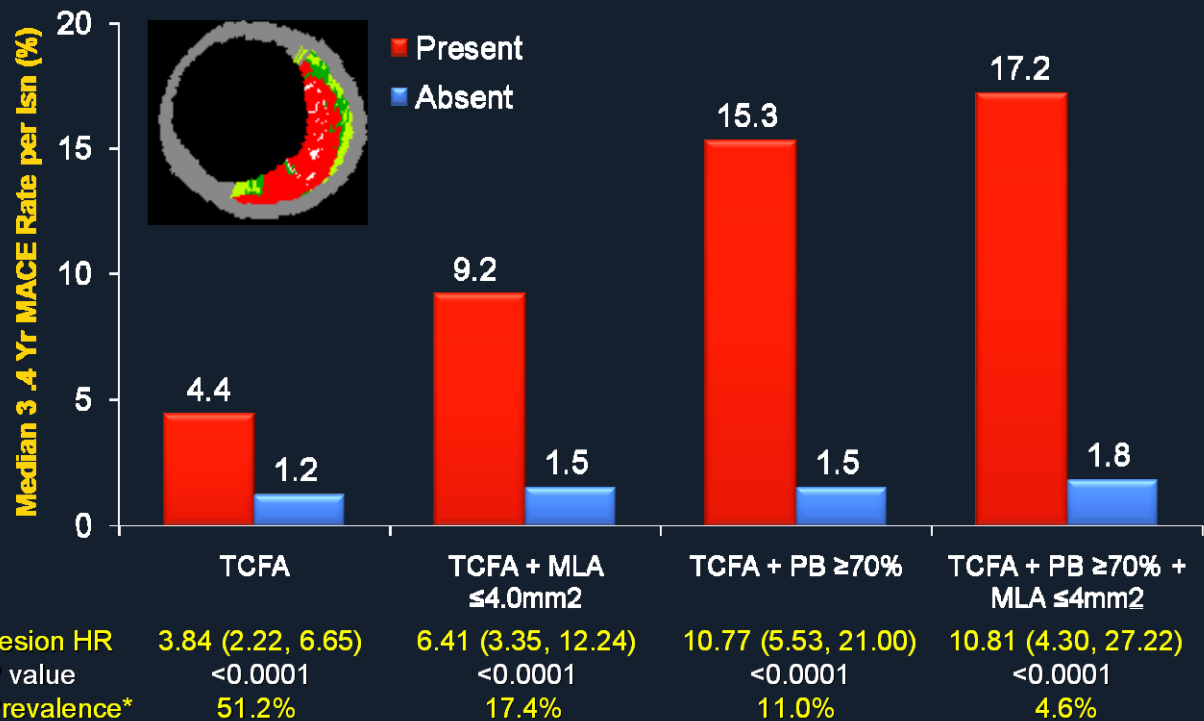
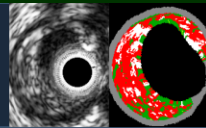
ORIGINAL ARTICLE

A Prospective Natural-History Study of Coronary Atherosclerosis

Gregg W. Stone, M.D., Akiko Maehara, M.D., Alexandra J. Lansky, M.D., Bernard de Bruyne, M.D., Ecaterina Cristea, M.D., Gary S. Mintz, M.D., Roxana Mehran, M.D., John McPherson, M.D., Naim Farhat, M.D., Steven P. Marso, M.D., Helen Parise, Sc.D., Barry Templin, M.B.A., Roseann White, M.A., Zhen Zhang, Ph.D., and Patrick W. Serruys, M.D., Ph.D., for the PROSPECT Investigators*



PROSPECT: VH-TCFA and Non-Culprit Lesion Related Events

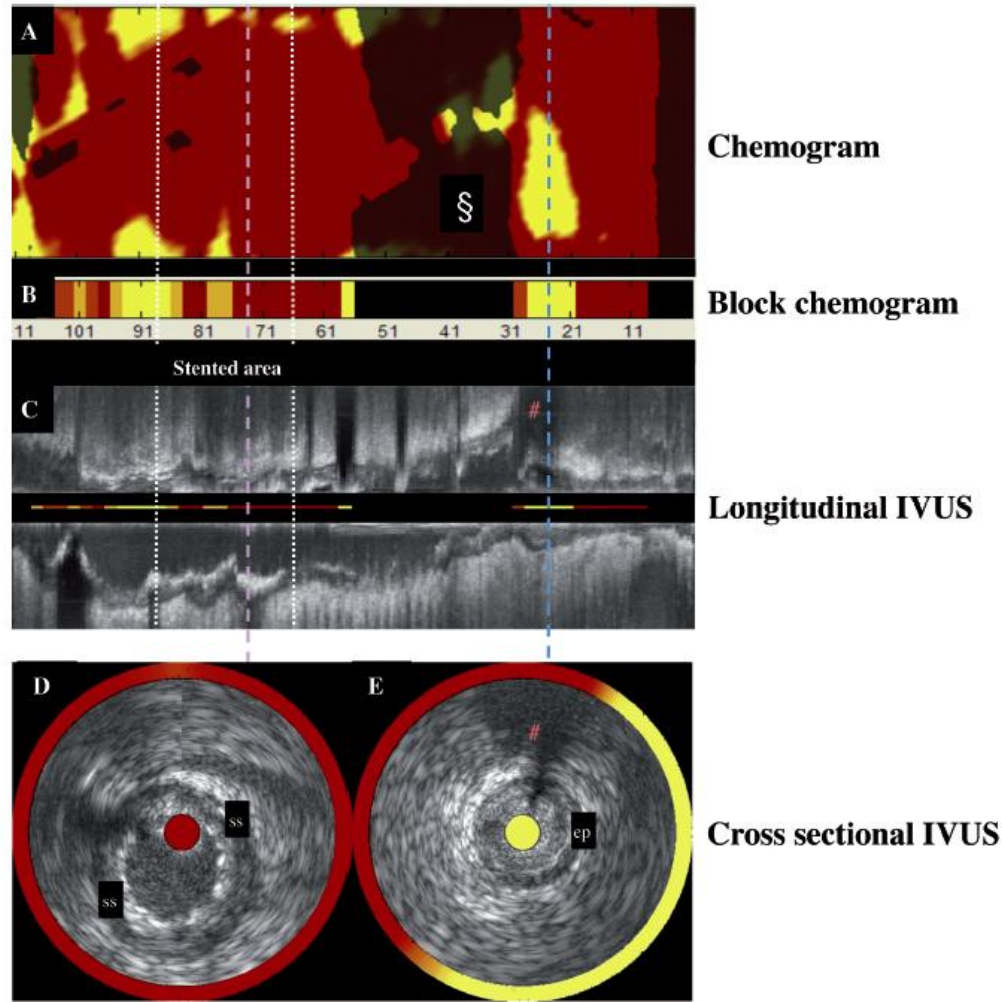


*Likelihood of one or more such lesions being present per patient. PB = plaque burden at the MLA

January 20, 2011

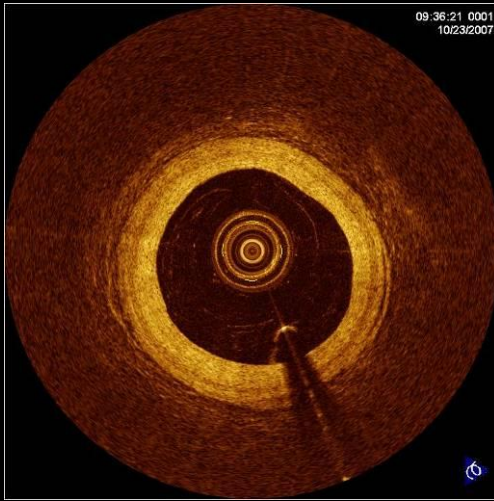
First use in patients of a combined near infra-red spectroscopy and intra-vascular ultrasound catheter to identify composition and structure of coronary plaque

Scot Garg¹, MBChB, MRCP; Patrick W. Serruys¹, MD, PhD; Martin van der Ent¹, MD, PhD; Carl Schultz¹, MD, PhD; Frits Mastik²; Gijs van Soest²; Antonius F.W. van der Steen², MSc, PhD; Mark A. Wilder³; James E. Muller³, MD; Evelyn Regar^{1*}, MD, PhD

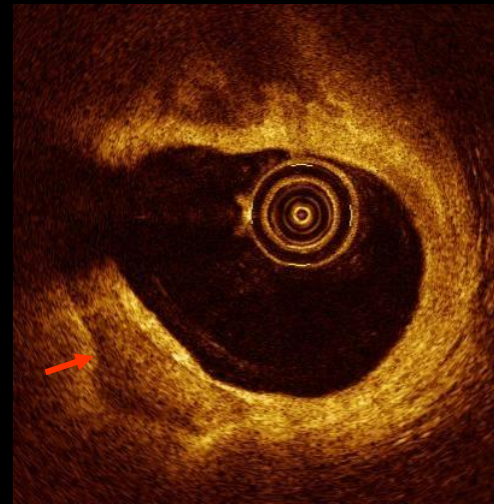


Plaque characterization

O.H. M4 09



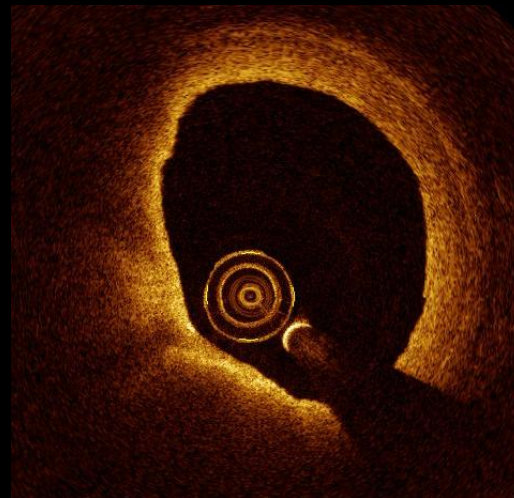
Mild intimal thickening



Calcified plaque



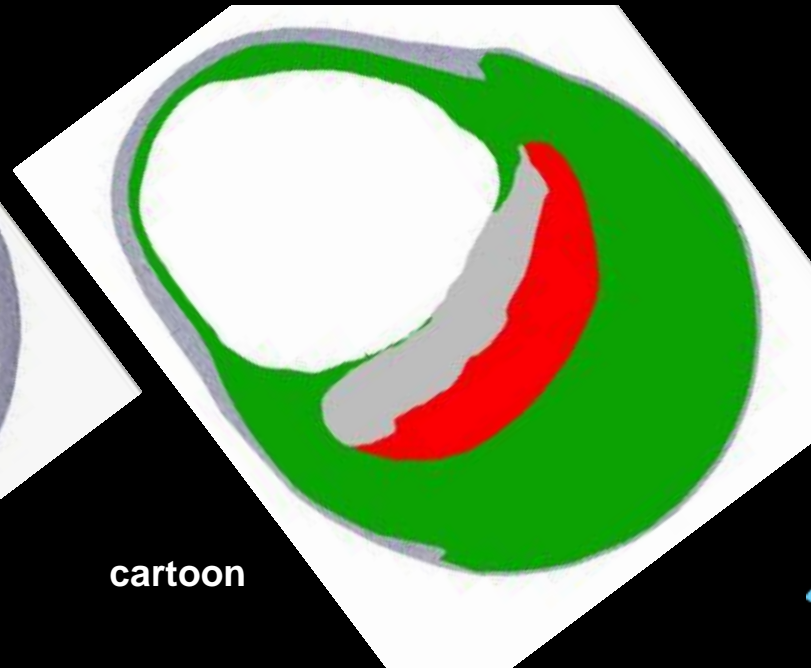
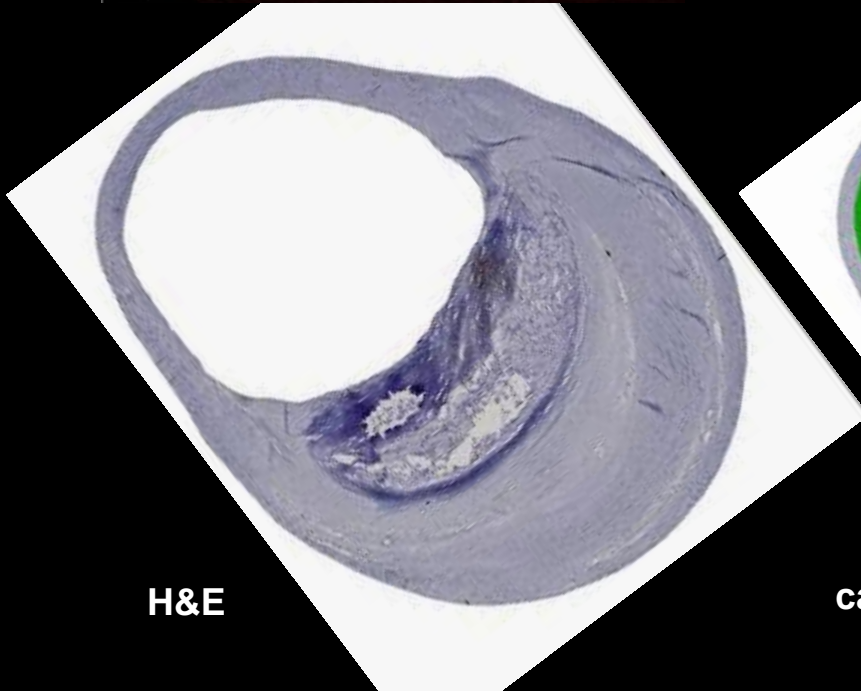
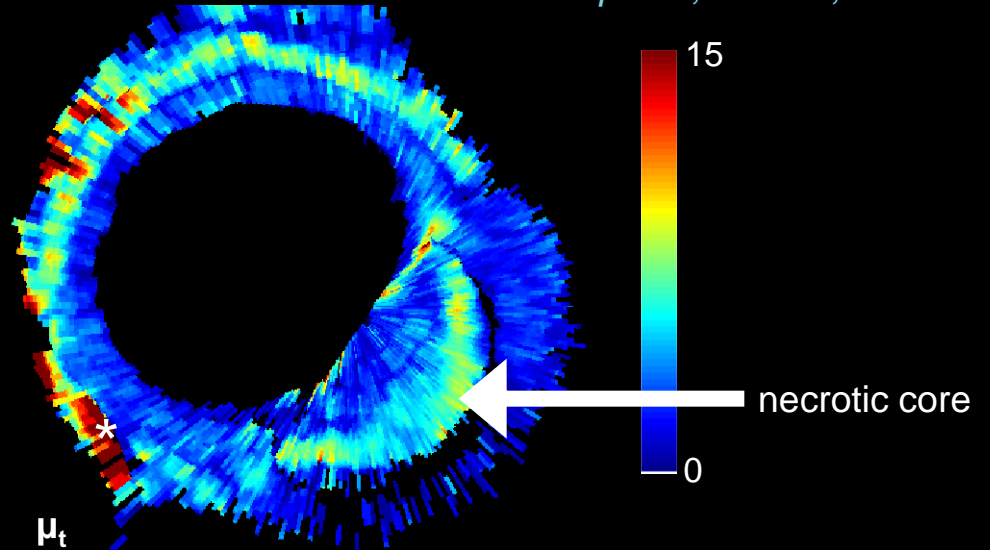
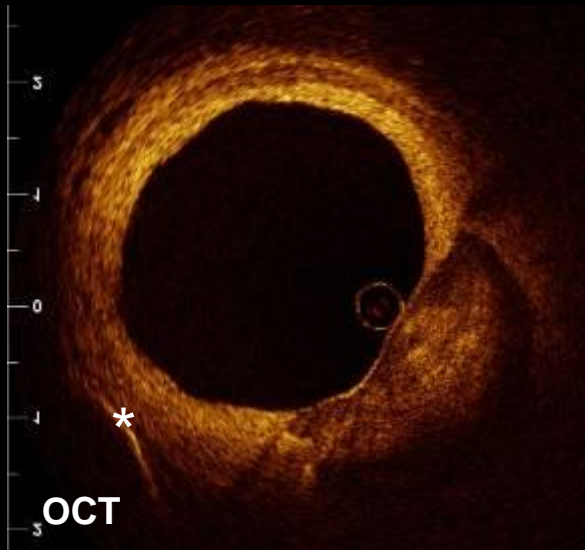
Fibro-fatty



Lipid pool

Intracoronary optical attenuation imaging

Van Soest et al *J. Biomed. Opt.* 15, 011105, 2010



- collagen/SMC
- early necrotic core
- late necrotic core
- lipid pool
- calcification
- haemorrhage

Erasmus MC

Value of combined assessment of OCT/IVUS-GS/IVUS-VH

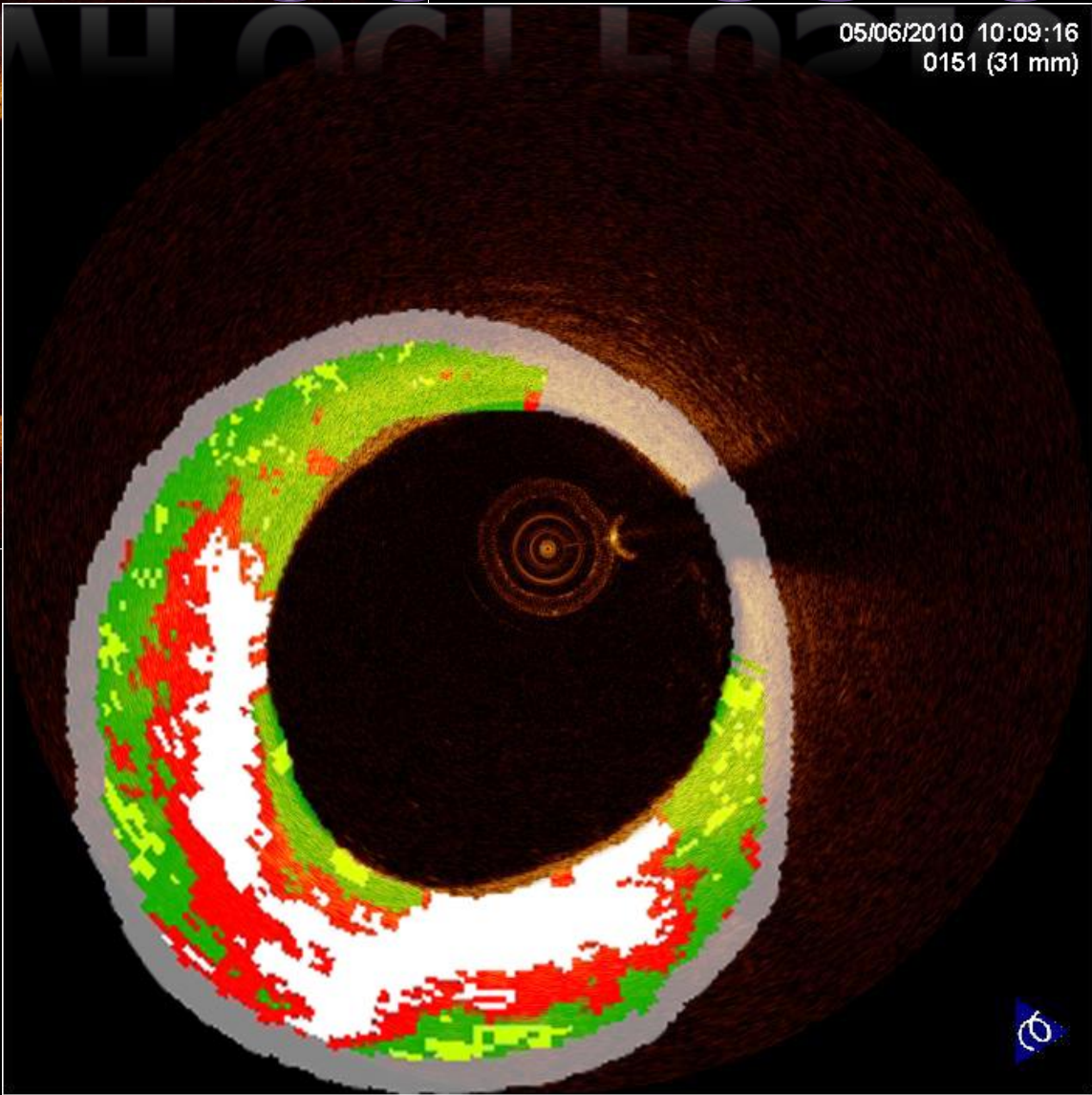
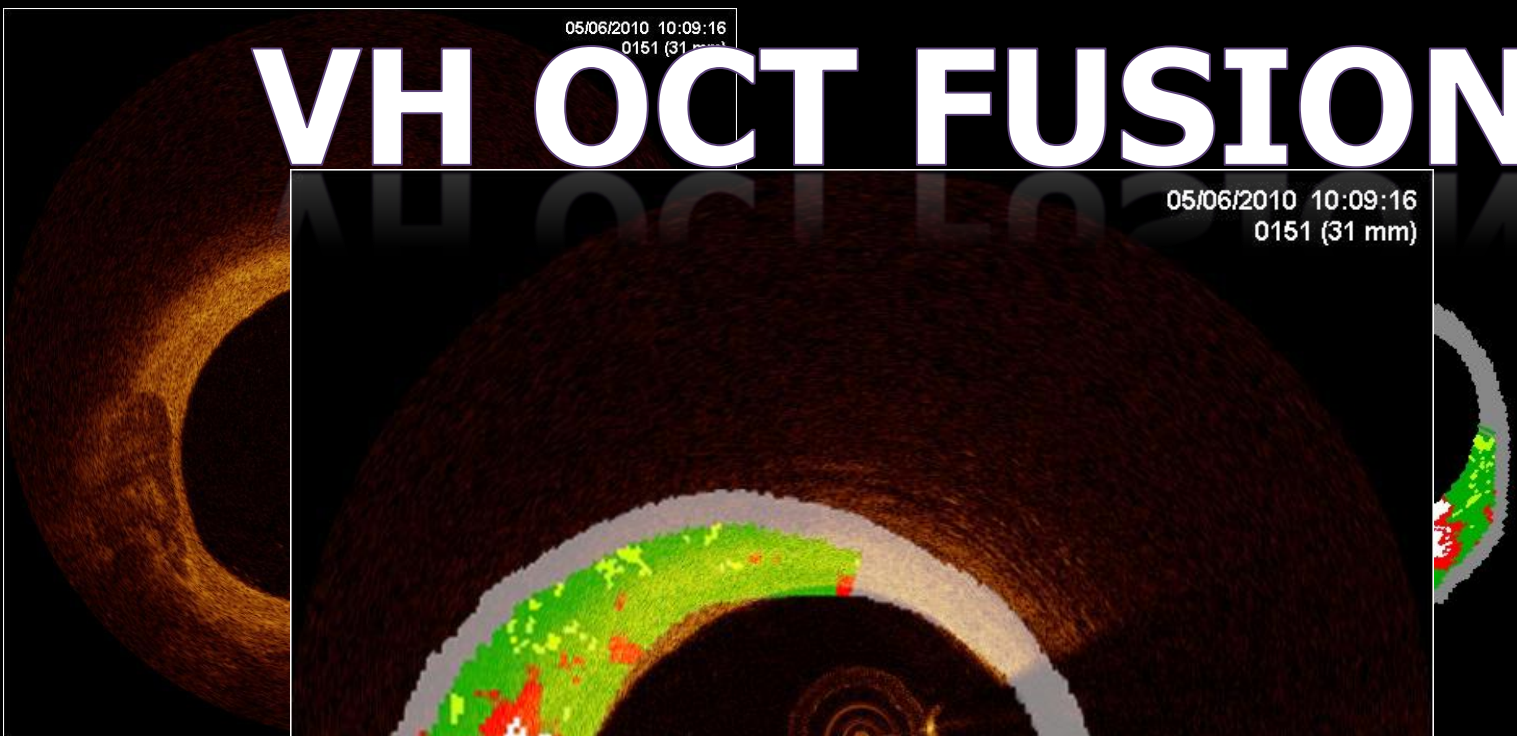
Vulnerable plaque feature	OCT	IVUS-VH
Fibrous cap thickness	+	-
Detailed surface morphology	+	-
Visualisation of total plaque burden	+/-	+
Plaque composition (deep)	-	+
Differentiation lipid vs. calcium (deep)	-	+

These two are complementary...

05/06/2010 10:09:16
0151 (31 mm)

VH OCT FUSION

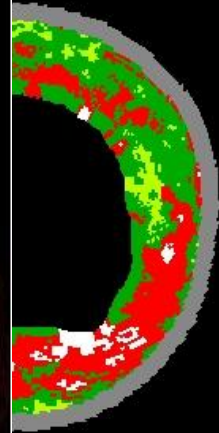
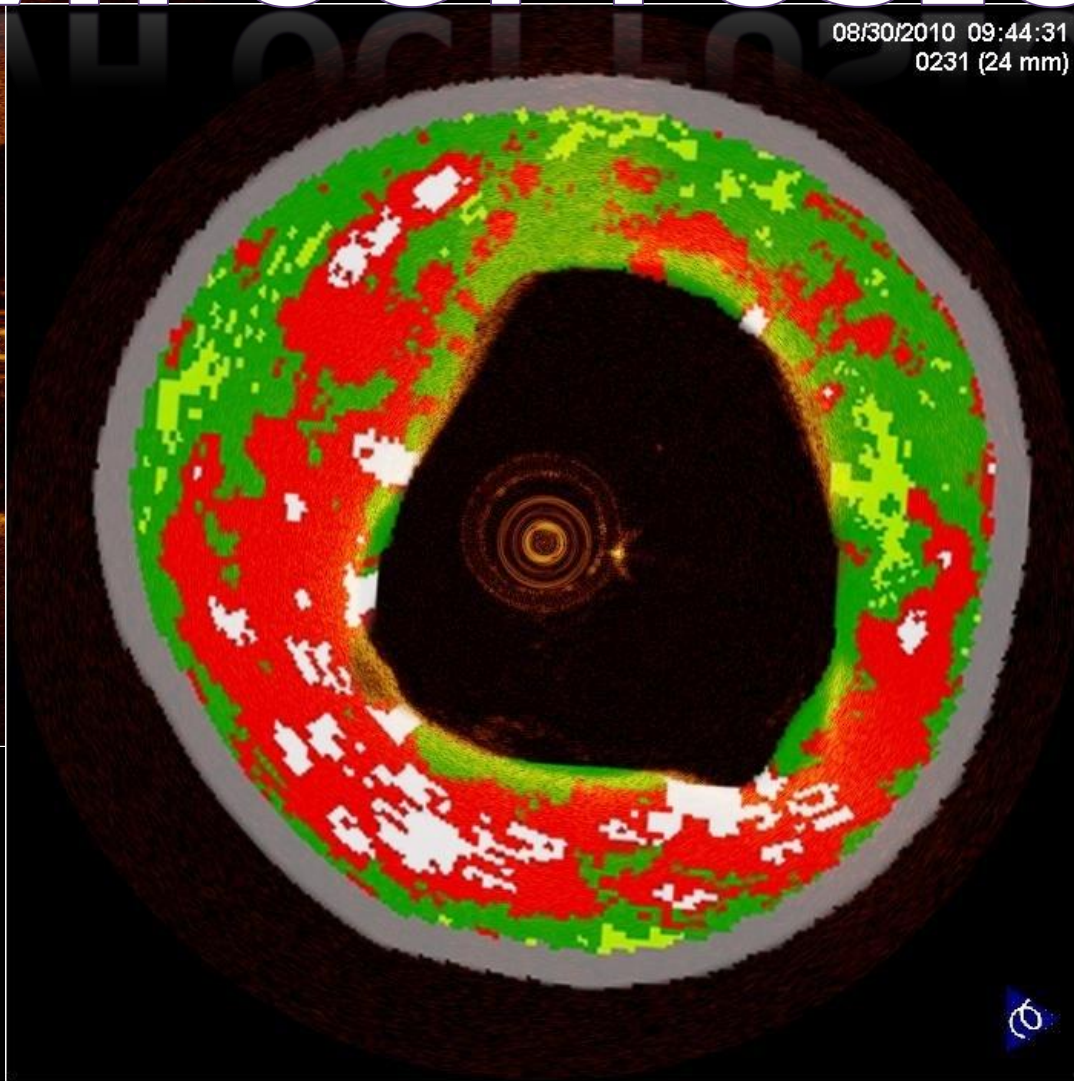
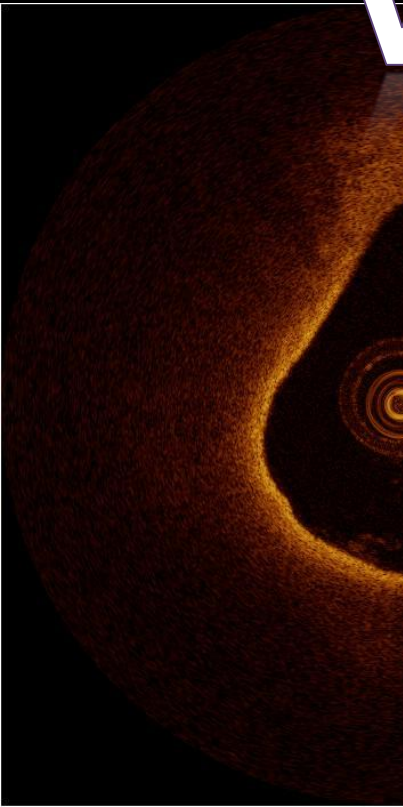
05/06/2010 10:09:16
0151 (31 mm)



VH OCT FUSION

08/30/2010 09:44:31
0231 (24 mm)

08/30/2010 09:44:31
0231 (24 mm)



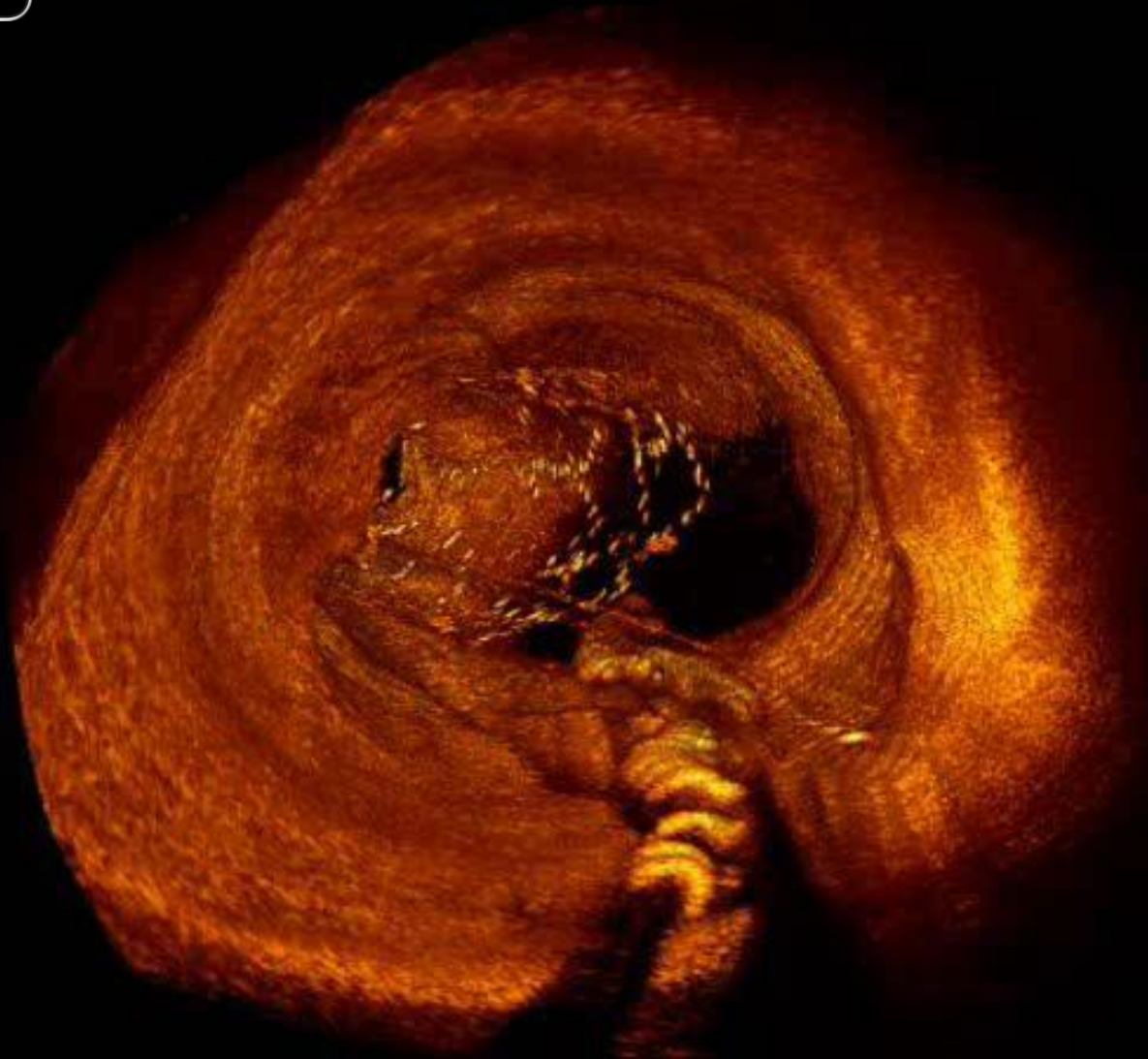
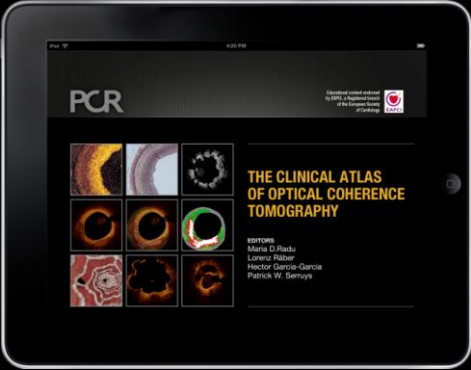
Erasmus MC



Multimodality imaging during PCI

- **Preprocedural Sizing of vessel
(IVUS, OCT and angiography)**
- **Plaque characterization
(Combination of IVUS-VH + OCT)**
- **Bifurcation (2D + 3D-OCT)**

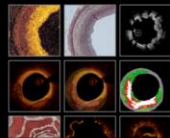
- **Online-3D visualizations of The Jailed SideB Ostium**



Online 3-D reconstruction Importance of Distal Cell Re-Crossing in Bifurcation Stenting

PCR

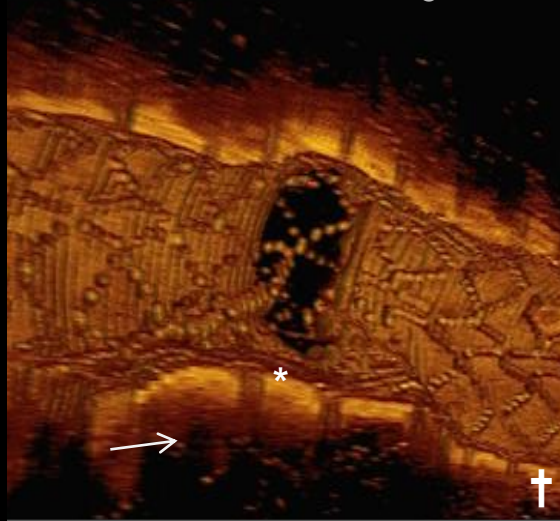
Medical content not
to be used for
diagnosis or
treatment



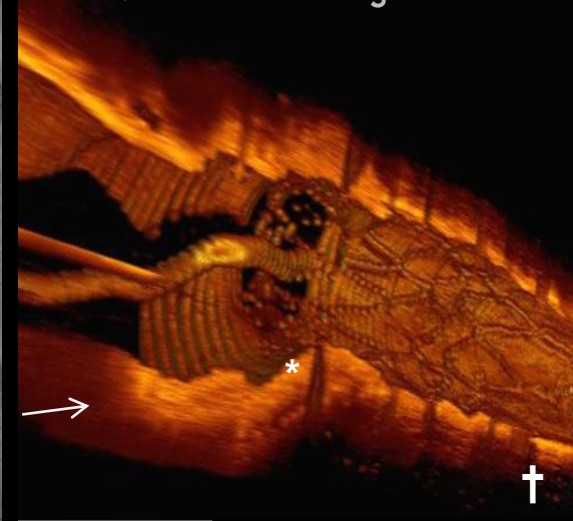
THE CLINICAL ATLAS
OF OPTICAL COHERENCE
TOMOGRAPHY

EDITORS
Mihai D. Radu
Lorena Riber
Hector Garcia-Garcia
Patricia W. Kaminski

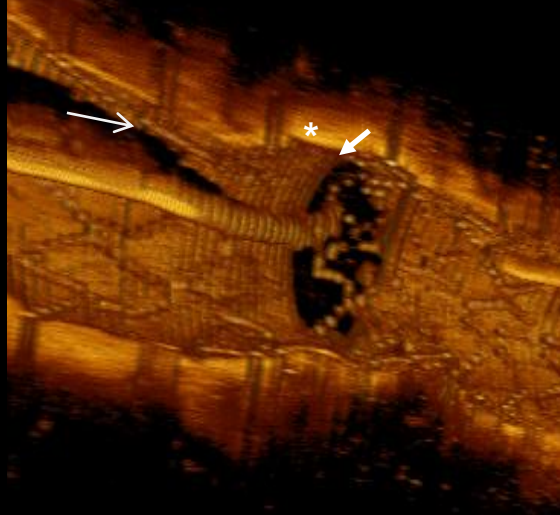
1 A. Proximal recrossing



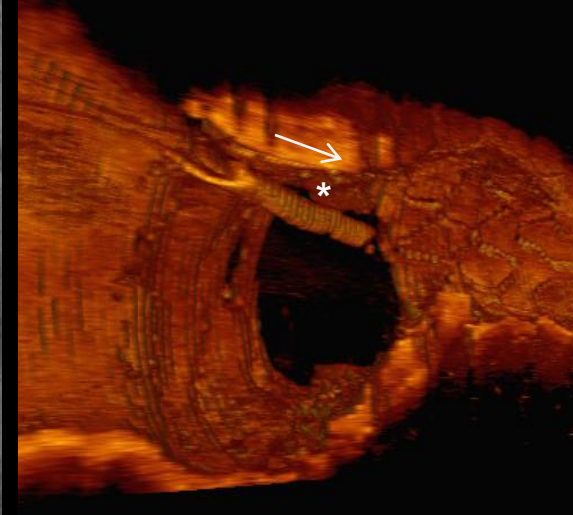
2 A. Distal recrossing



1 B. Results after KB



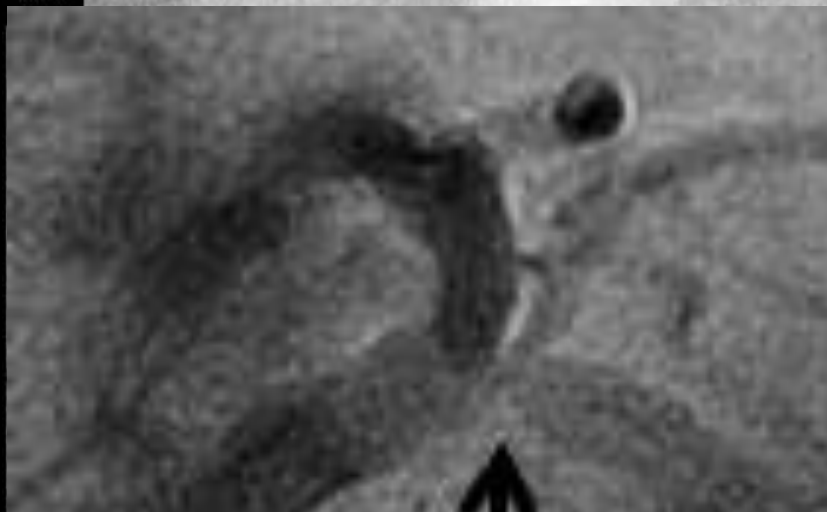
2 B. Results after KB



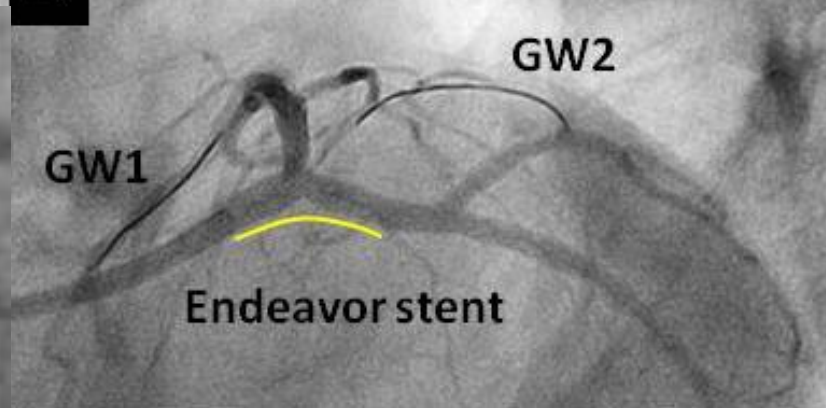
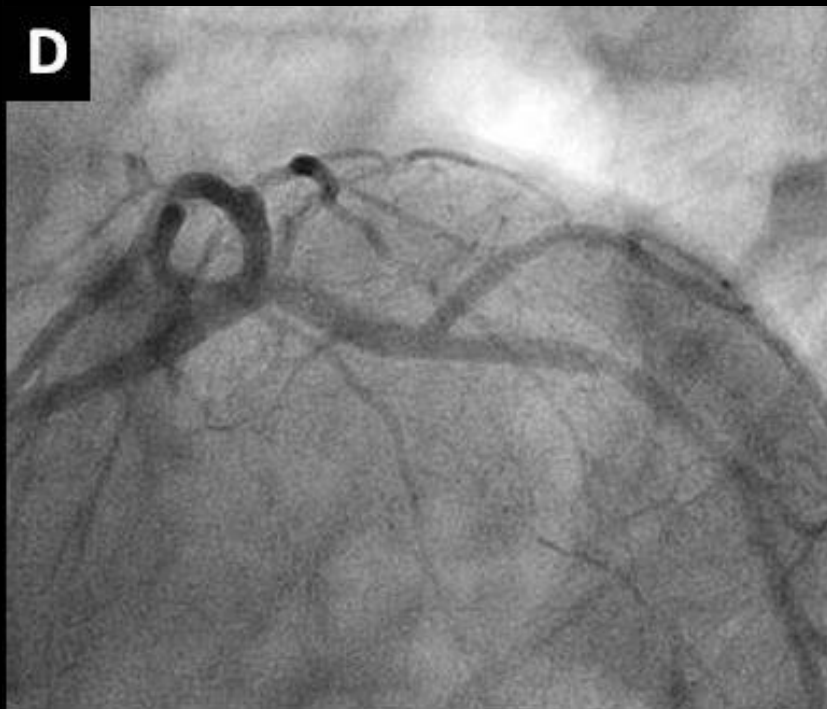
Three-dimensional Optical Coherence Tomography Assessment of Coronary Wire Re-crossing Position **during** Bifurcation Stenting

Takayuki Okamura, MD*, Jutaro Yamada, MD, Tomoko Nao, MD, Takeshi Suetomi, MD, Takao Maeda, MD, Kohzoh Shiraishi, MD, Toshiro Miura, MD, Masunori Matsuzaki, MD

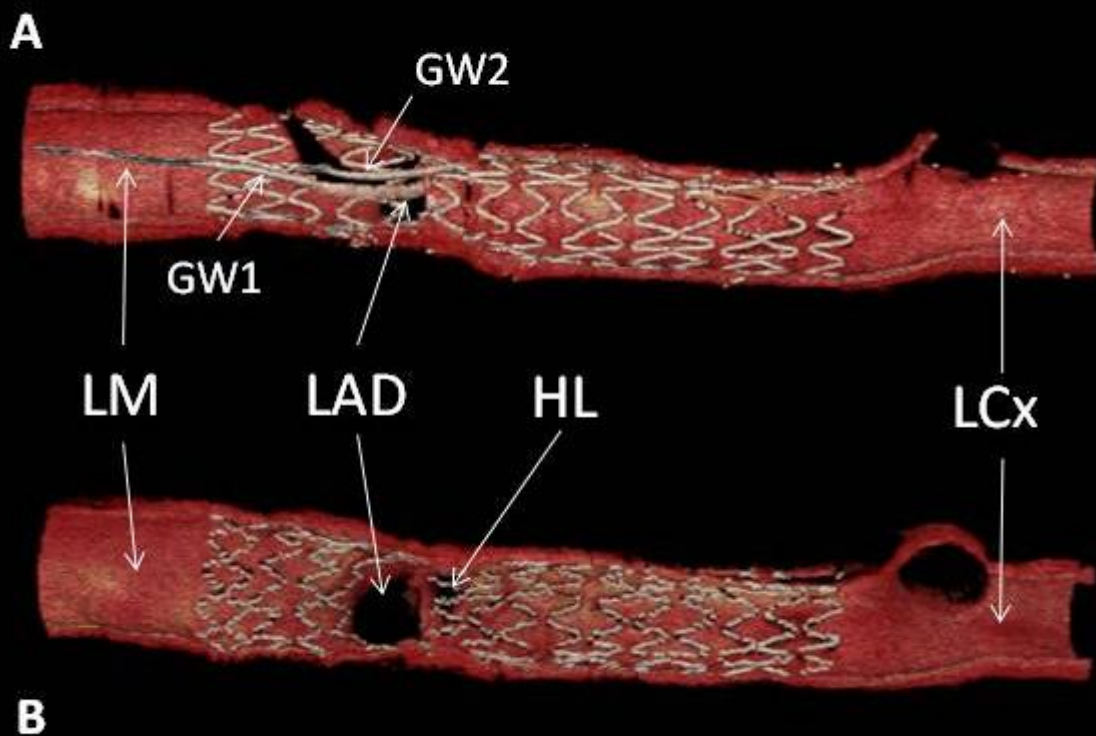
Division of Cardiology, Department of Medicine and Clinical Science, Yamaguchi University Graduate School of Medicine, Ube, Japan

A

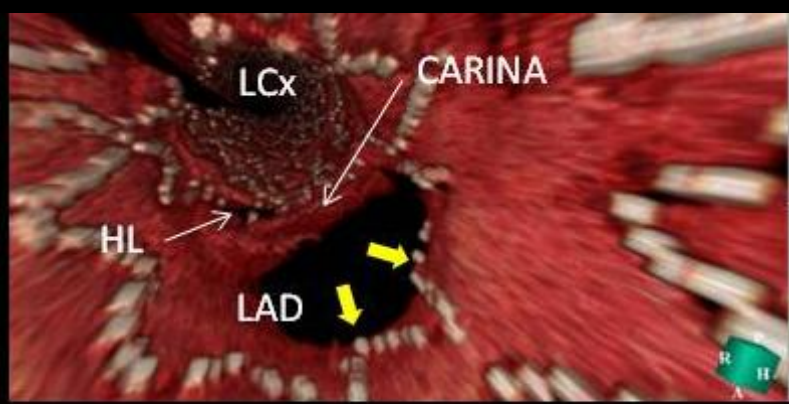
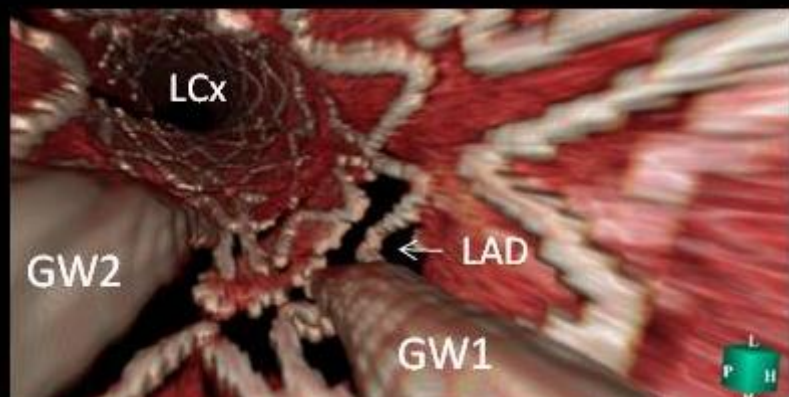
Napkin-ring Narrowing at the ostium of LCx (0,0,1)

B**D**

LONGITUDINAL CUT-AWAY VIEW



FLY THROUGH VIEW FROM LM



Multimodality imaging

- **Preprocedural OCT will provide us an accurate lumen area and lesion length. Compared to the other modalities, OCT lumen measurement is larger than QCA but smaller than IVUS (IVUS > OCT = real value > QCA)**
- **Coregistration of OCT/IVUS and angiogram might be optimal for sizing of the vessel**
- **In plaque characterization, OCT and IVUS(VH) is complementary and the fusion of two modalities might enhance understanding of plaque characteristics (Plaque burden + cap thickness measurement)**
- **3D on-line OCT in addition to 2D OCT can be used to optimize bifurcation stenting.**