OCT-guided PCI Comparison with IVUS-guided

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Disclosure Statement of Financial Interest

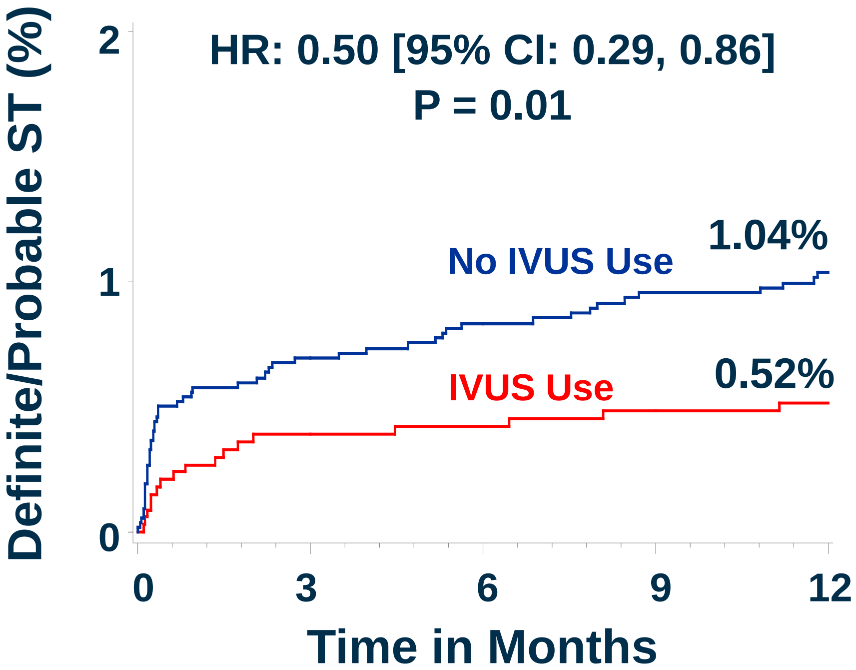
Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below.

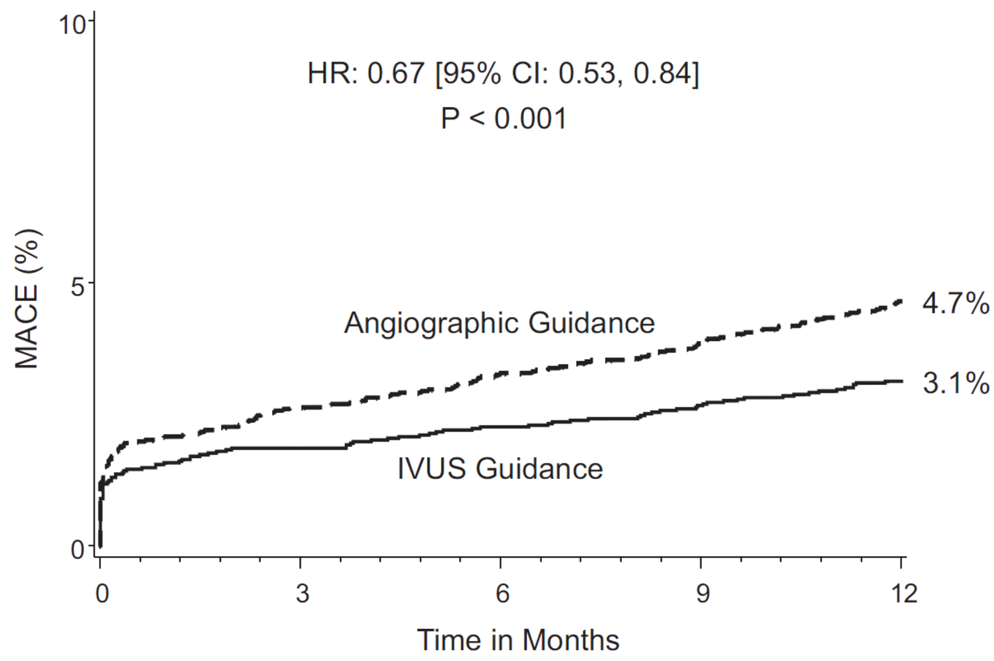
Affiliation/Financial Relationship

- **Grant/Research Support** : Abbott Vascular Japan
  Boston Scientific Japan
  Goodman Inc.
  St. Jude Medical Japan
  Terumo Inc.
- **Consulting Fees/Honoraria** : Daiichi-Sankyo Pharmaceutical Inc.
  Goodman Inc.
  St. Jude Medical Japan
  Terumo Inc.

IVUS- vs. angio-guided PCI with DES

In assessment of dual antiplatelet therapy with drug-eluting stent (ADAPT-DES) substudy, IVUS guidance compared with angiography in 8,583 ‘all-comers’ pts at 11 international centers.

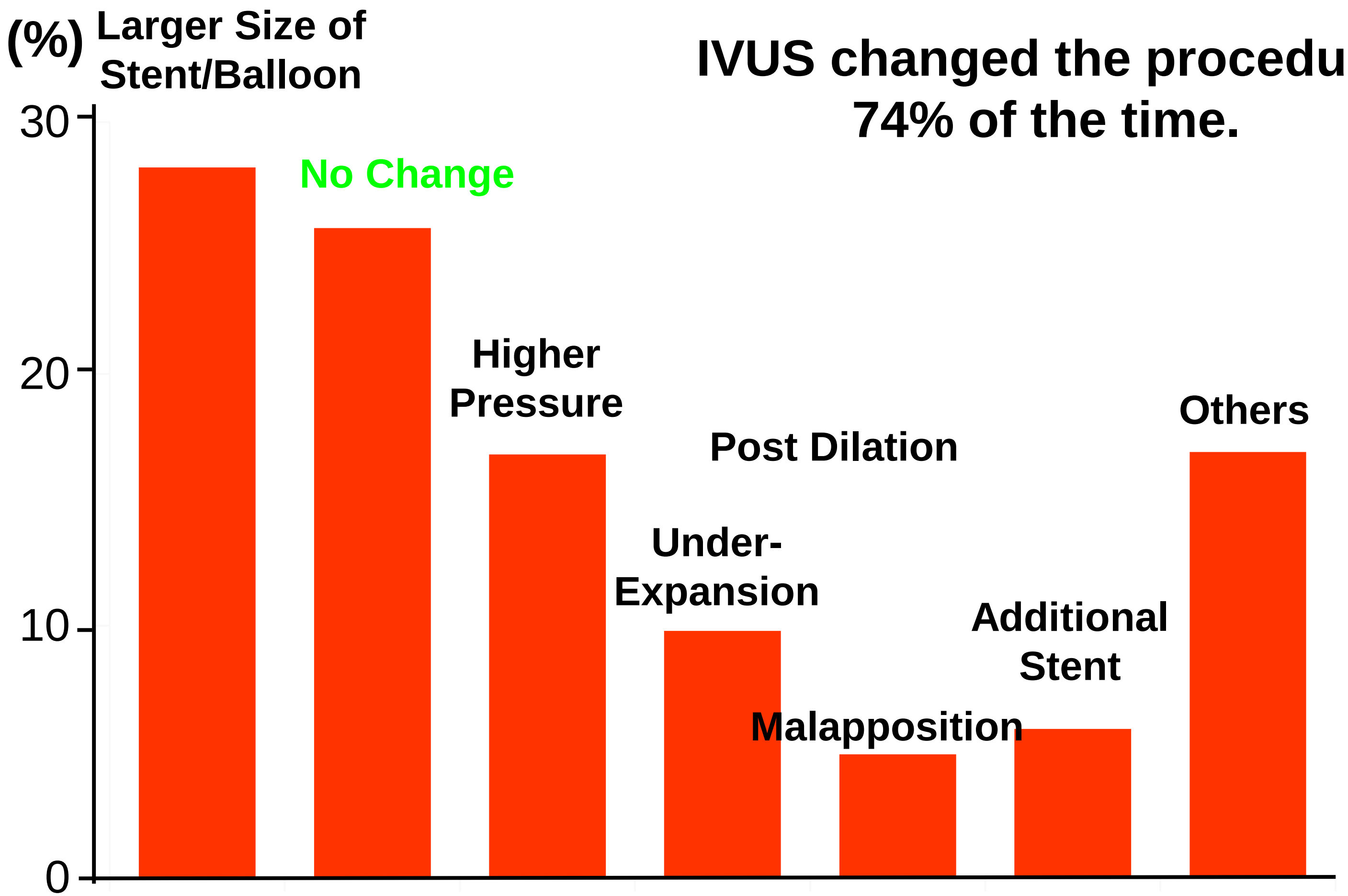




Conclusion: Compared with angiography, IVUS guidance reduces ST in addition to MI and MACE within 1 year after DES implantation.

Witzenbichler B et al. Circulation 2014;129:463-470.

How IVUS changed the procedure in ADAPT-DES substudy



IVUS changed the procedure 74% of the time.

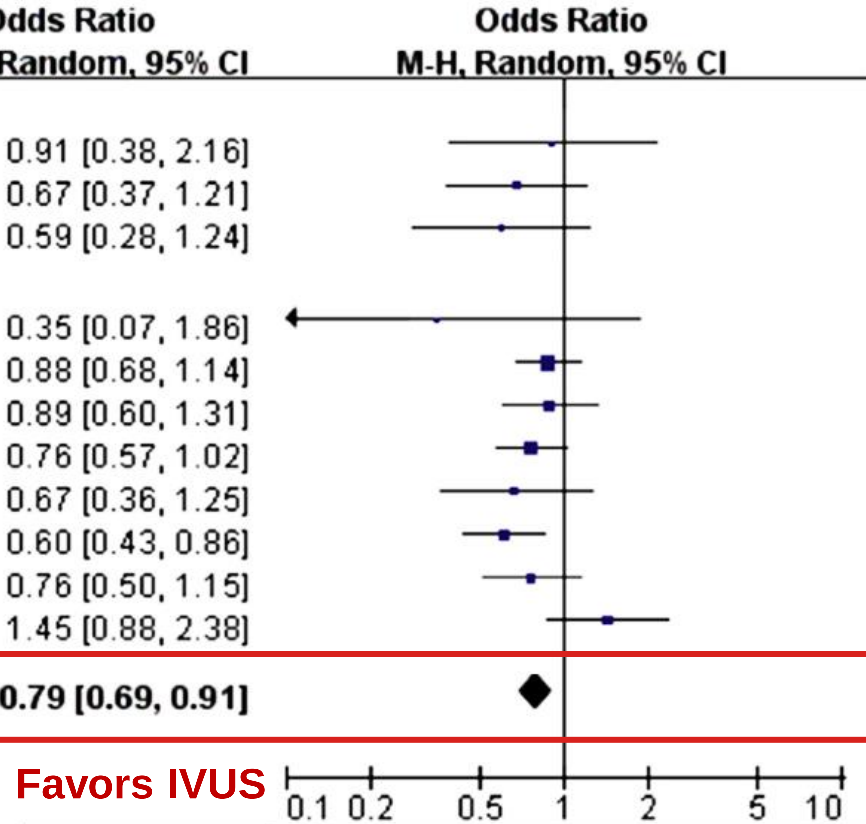
Witzenbichler B et al. Circulation 2014;129:463-470.

IVUS- vs. angio-guided PCI with DES

A meta-analysis of randomized trials and observational studies

MACE

Study or Subgroup	IVUS Events	IVUS Total	Angiography Events	Angiography Total	Odds Ratio M-H, Random, 95% CI
1.1.1 Randomized studies					
HOME DES IVUS	11	105	12	105	0.91 [0.38, 2.16]
AVIO	24	142	33	142	0.67 [0.37, 1.21]
RESET	12	269	20	274	0.59 [0.28, 1.24]
1.1.2 Non-randomized studies					
Agostoni	2	24	7	34	0.35 [0.07, 1.86]
Roy	128	884	143	884	0.88 [0.68, 1.14]
COBIS	53	487	59	487	0.89 [0.60, 1.31]
MATRIX	85	631	148	873	0.76 [0.57, 1.02]
Youn	16	125	39	216	0.67 [0.36, 1.25]
IRIS-DES	54	1616	88	1628	0.60 [0.43, 0.86]
Chen	51	324	60	304	0.76 [0.50, 1.15]
EXCELLENT	34	619	31	802	1.45 [0.88, 2.38]
Total (95% CI)		**5226**		**5749**	**0.79 [0.69, 0.91]**



IVUS-guided DES implantation is associated with significantly lower rates of adverse clinical events compared with angiography guidance.

Jang JS, et al., JACC interv 2014; 7:233–43

Intracoronary imaging & physiology in ESC guideline 2014

Recommendations	Class[a]	Level[b]	Ref.[c]
FFR to identify haemodynamically relevant coronary lesion(s) in stable patients when evidence of ischaemia is not available.	I	A	50,51,713
FFR-guided PCI in patients with multivessel disease.	IIa	B	54
IVUS in selected patients to optimize stent implantation.	IIa	B	702,703,706
IVUS to assess severity and optimize treatment of unprotected left main lesions.	IIa	B	705
IVUS or OCT to assess mechanisms of stent failure.	IIa	C	
OCT in selected patients to optimize stent implantation.	IIb	C	

Eur Heart J. 2014;35:2541-2619

OCT- vs. angio-guided PCI with DES or BMS

The retrospective Centro per la Lotta contro l'Infarto-Optimisation of Percutaneous Coronary Intervention (CLI-OPCI) study

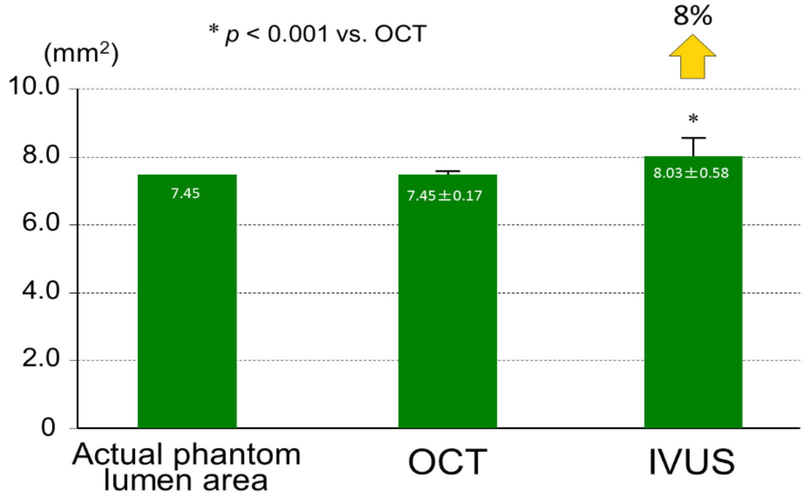
Events at 1-year follow-up	Angiographic guidance group (n=335)	Angiographic plus OCT guidance group (n=335)	*p*-value
Death	23 (6.9%)	11 (3.3%)	0.035
Cardiac death	15 (4.5%)	4 (1.2%)	0.010
Myocardial infarction	29 (8.7%)	18 (5.4%)	0.096
Target lesion repeat revascularisation	11 (3.3%)	11 (3.3%)	1.0
Definite stent thrombosis	2 (0.6%)	1 (0.3%)	1.0
Cardiac death or myocardial infarction	43 (13.0%)	22 (6.6%)	0.006
Cardiac death, myocardial infarction, or repeat revascularisation	50 (15.1%)	32 (9.6%)	0.034

The use of OCT can improve clinical outcomes of patients undergoing PCI.

Prati F, et al., EuroIntervention 2012;8:823-829

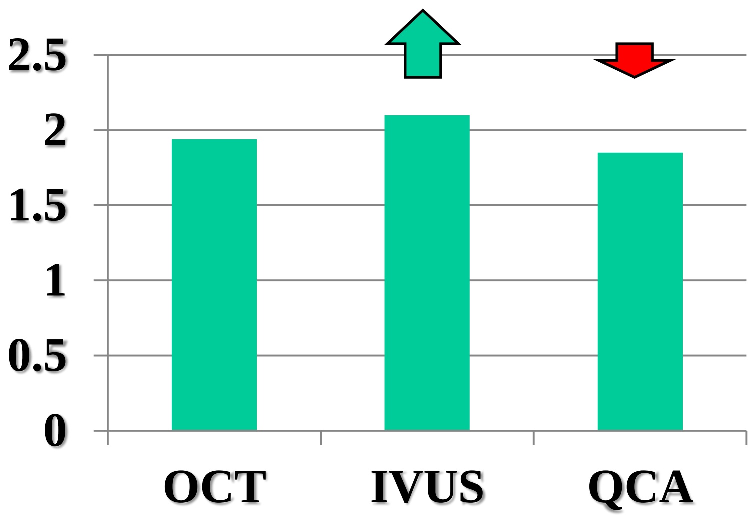
Comparison of measurements (OCT, IVUS & QCA)

(OPUS-CLASS study)

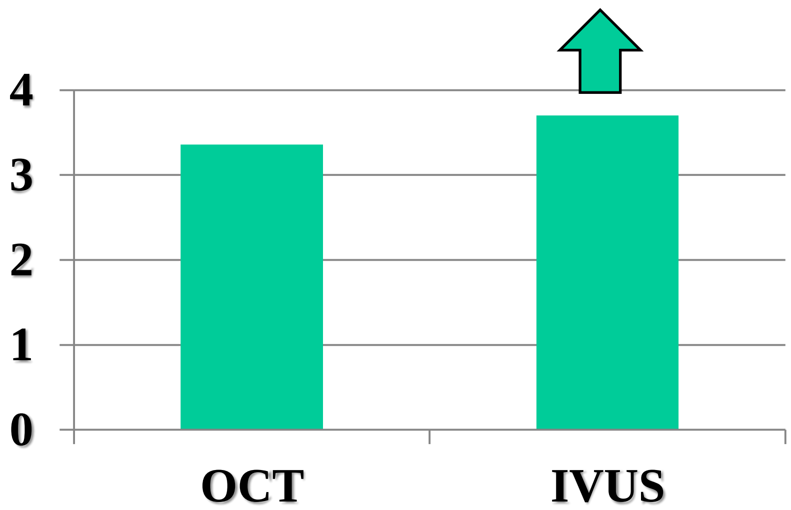


MLD

MLA



1.94±0.70 mm **2.10±0.59 mm** **1.85±0.77 mm**



3.36±2.28mm² **3.70±2.04mm²**

Kubo T, Akasaka T, et al. JACC Cardiovasc Img. 2013;6:1095-1104

European Heart Journal - Cardiovascular Imaging Advance Access published September 15, 2015

European Heart Journal – Cardiovascular Imaging
doi:10.1093/ehjci/jev229

Multi-laboratory inter-institute reproducibility study of IVOCT and IVUS assessments using published consensus document definitions

Edouard Gerbaud[1], Giora Weisz[2,3], Atsushi Tanaka[1], Manabu Kashiwagi[1],
Take
Meli
Mire
Akik

Aims The aim of this study was to investigate the reproducibility of intravascular optical coherence tomography (IVOCT) assessments, including a comparison to intravascular ultrasound (IVUS). Intra-observer and inter-observer variabilities of IVOCT have been previously described, whereas inter-institute reliability in multiple laboratories has never been systematically studied.

Methods and results In 2 independent laboratories with intravascular imaging expertise, 100 randomized matched data sets of IVOCT and IVUS images were analysed by 4 independent observers according to published consensus document definitions. Intra-observer, inter-observer, and inter-institute variabilities of IVOCT qualitative and quantitative measurements vs. IVUS measurements were assessed. Minor inter- and intra-observer variability of both imaging techniques was observed for detailed qualitative and geometric analysis, except for inter-observer mixed plaque identification on IVUS ($\kappa = 0.70$) and for inter-observer fibrous cap thickness measurement reproducibility on IVOCT (ICC = 0.48). The magnitude of inter-institute measurement differences for IVOCT was statistically significantly less than that for IVUS concerning lumen cross-sectional area (CSA), maximum and minimum lumen diameters, stent CSA, and maximum and minimum stent diameters ($P < 0.001$, $P < 0.001$, $P < 0.001$, $P = 0.02$, $P < 0.001$, and $P = 0.01$, respectively). Minor inter-institute measurement variabilities using both techniques were also found for plaque identification.

Conclusion In the measurement of lumen CSA, maximum and minimum lumen diameters, stent CSA, and maximum and minimum stent diameters by analysts from two different laboratories reproducibility of IVOCT was more consistent than that of IVUS.

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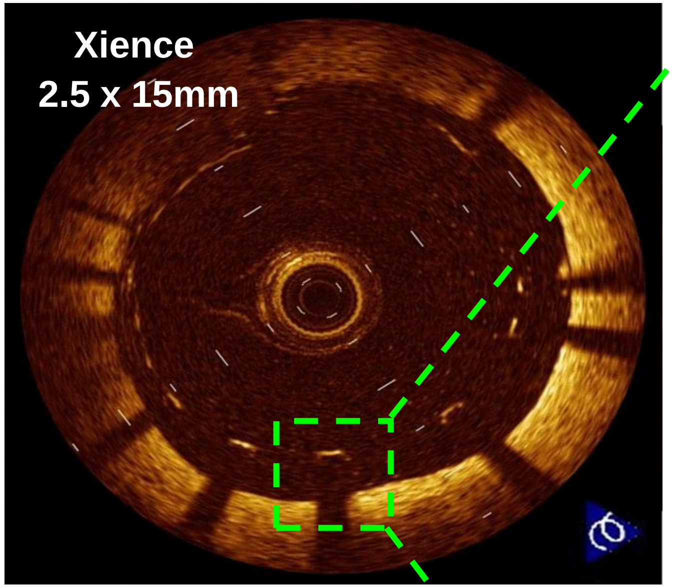
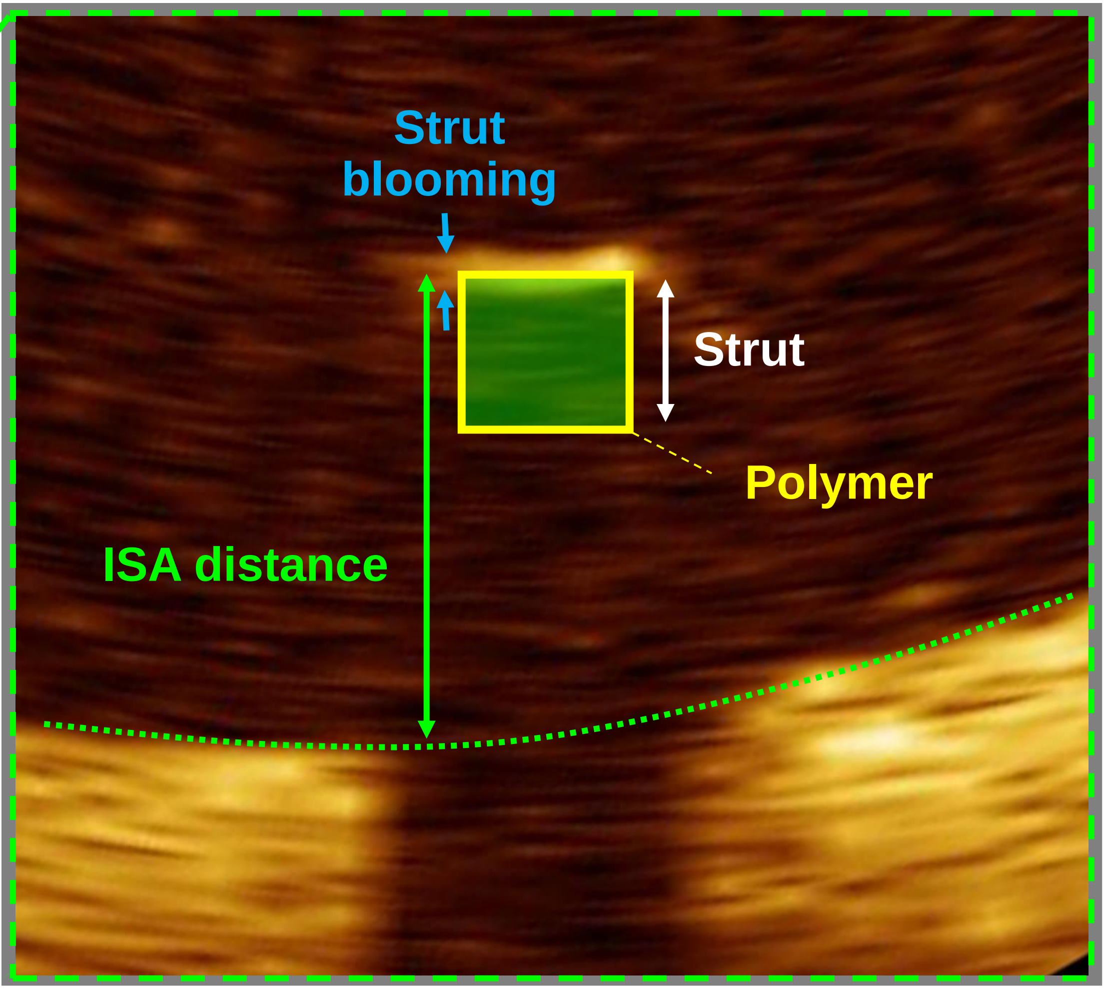
Definition of incomplete stent appostion (ISA)

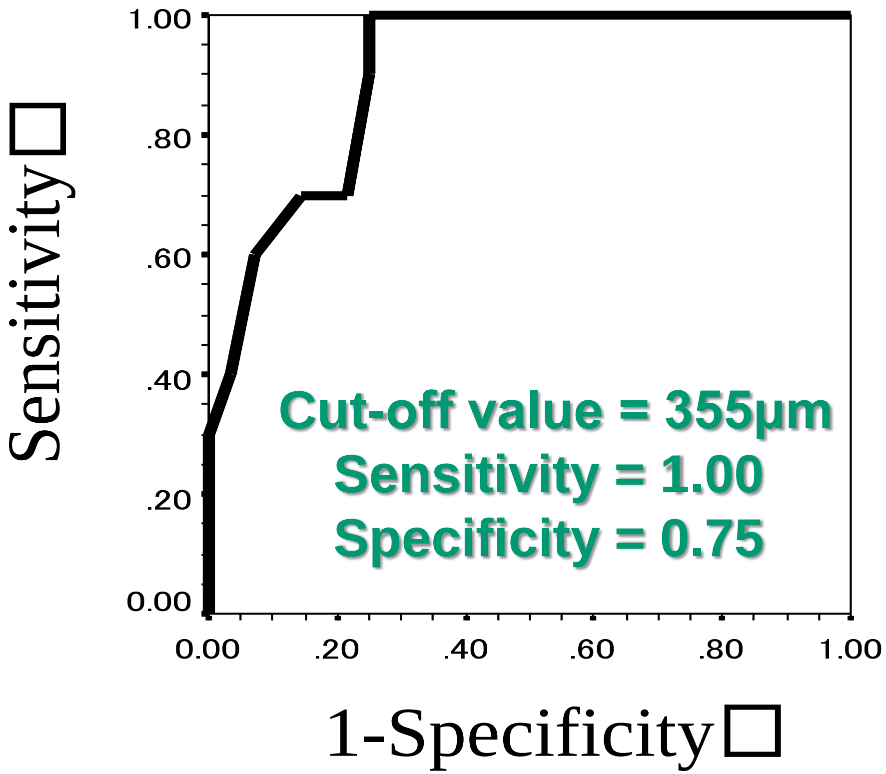




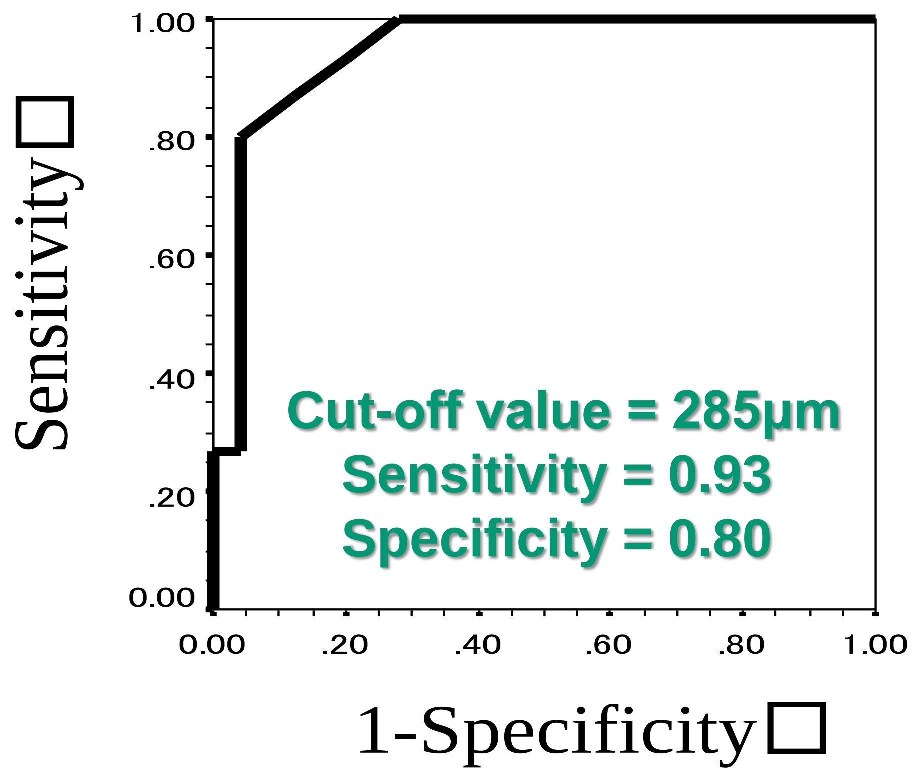
ISA was defined as a ISA distance of >100 μm in EES and >170 μm in SES.

ROC curve analysis of maximum ISA distance for predicting persistent ISA (Subanalysis of RESET study)

EES



SES

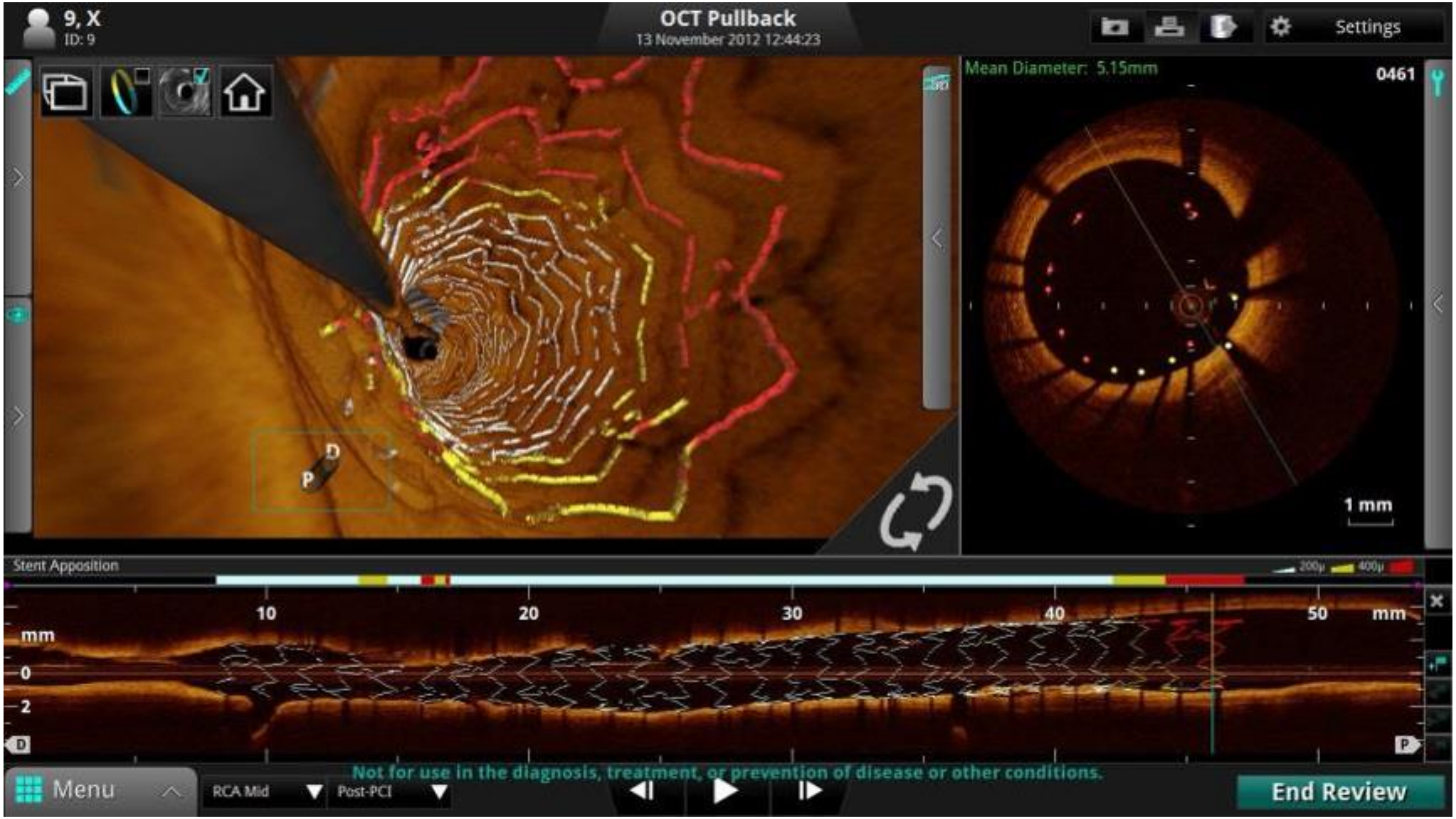


ROC curve analysis identified a maximum ISA distance of EES > 355μm with as separating persistent from resolved ISA (sensitivity 100%, specificity 75%, area under the curve = 0.905; 95%CI, 0.812 to 0.999).

ROC curve analysis identified a maximum ISA distance of SES > 285μm with as separating persistent from resolved ISA (sensitivity 93%, specificity 80%, area under the curve = 0.947; 95%CI, 0.878 to 1.015).

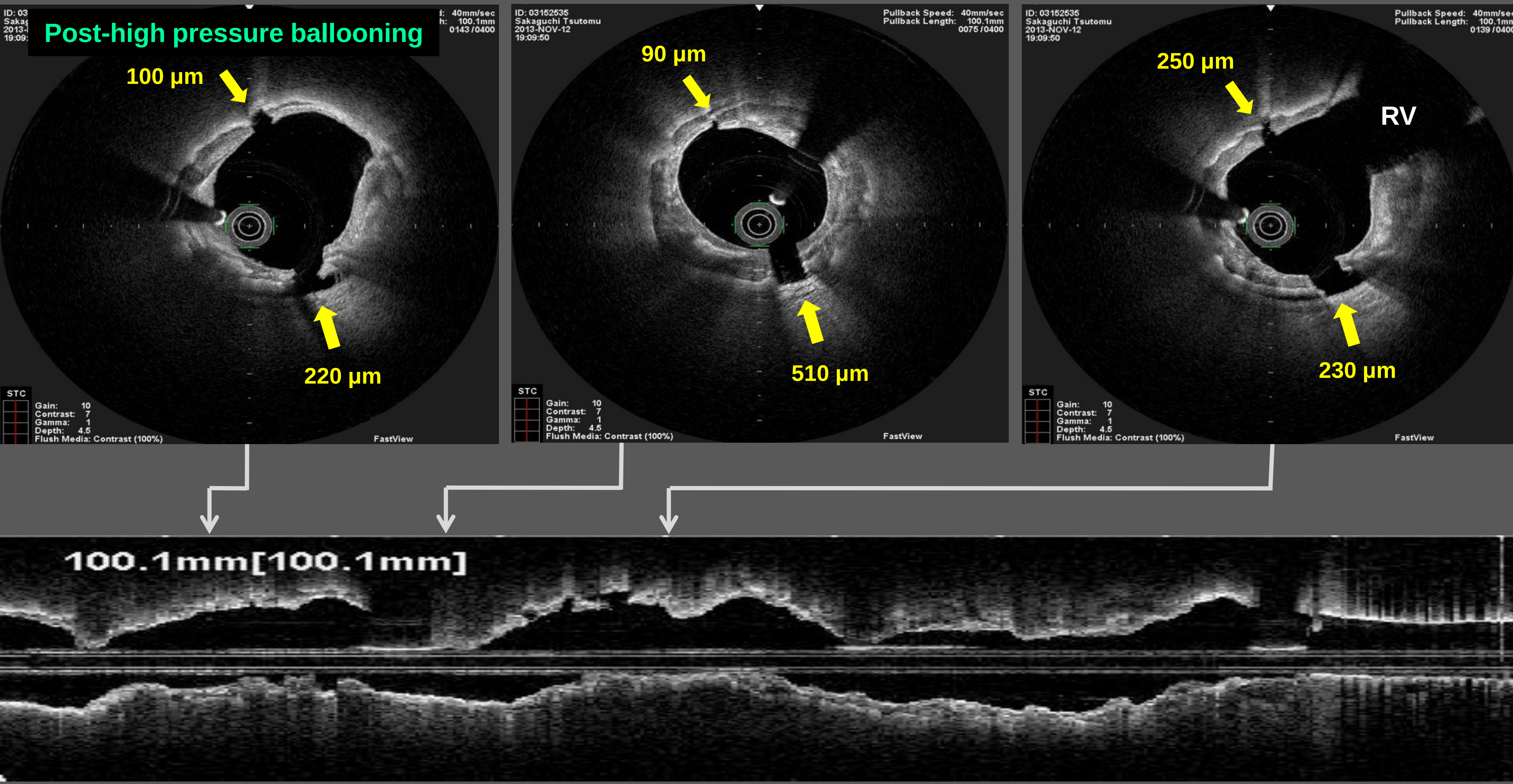
Shimamura K. et al, Eur Heart J CV Imaging 2015;16:23-28

New Development in OCT

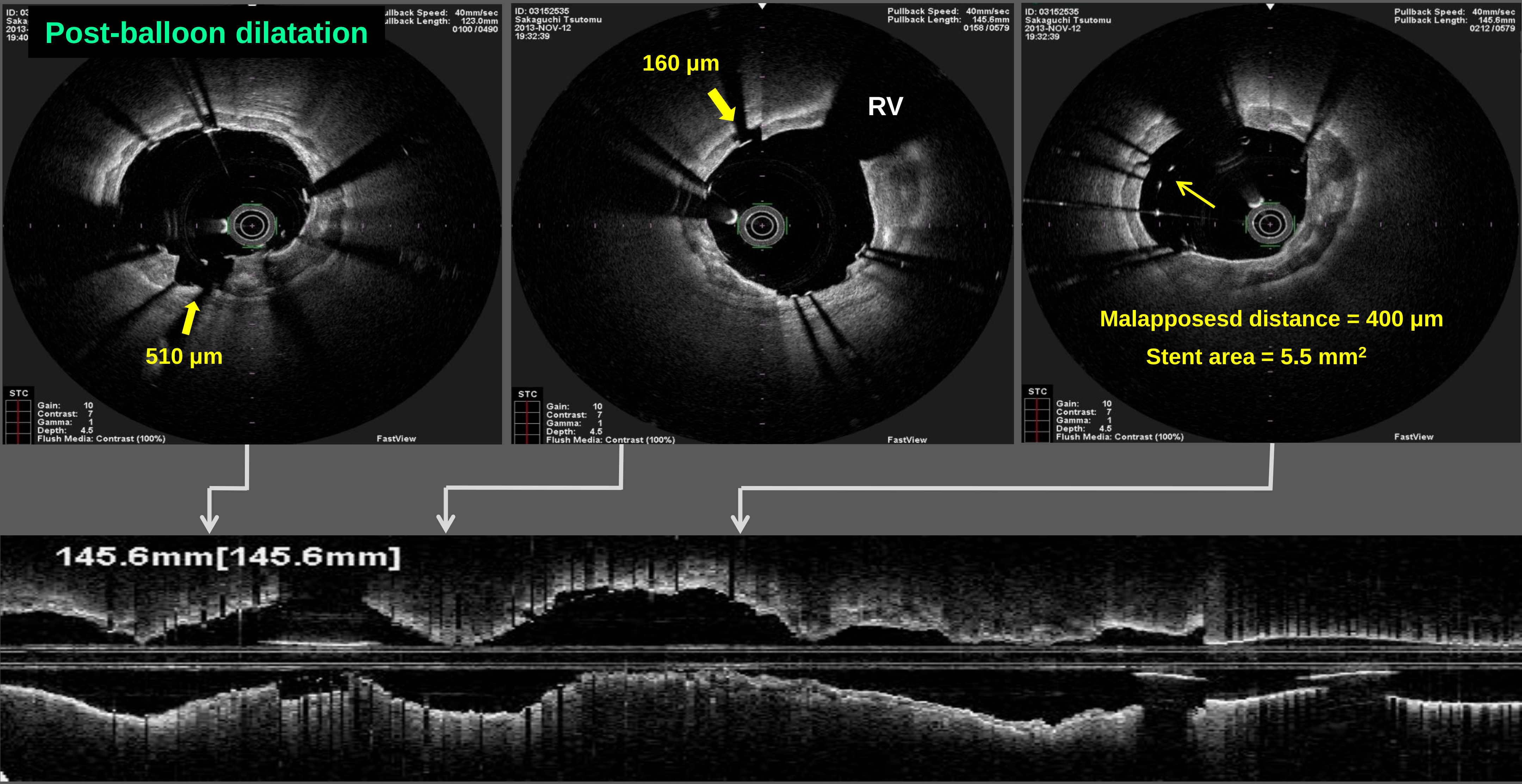


3-D reconstruction and auto-demonstration of incomplete apposition of stent can be demonstrated as fly through image by new OCT.

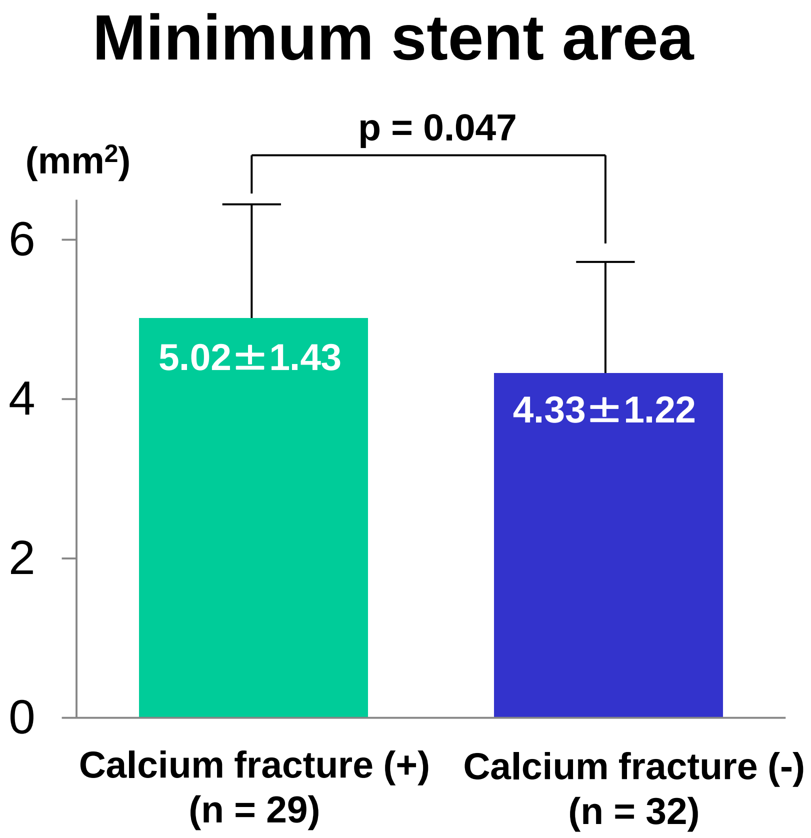
Broken calcium plate *Broken calcium plate* *Broken calcium plate*

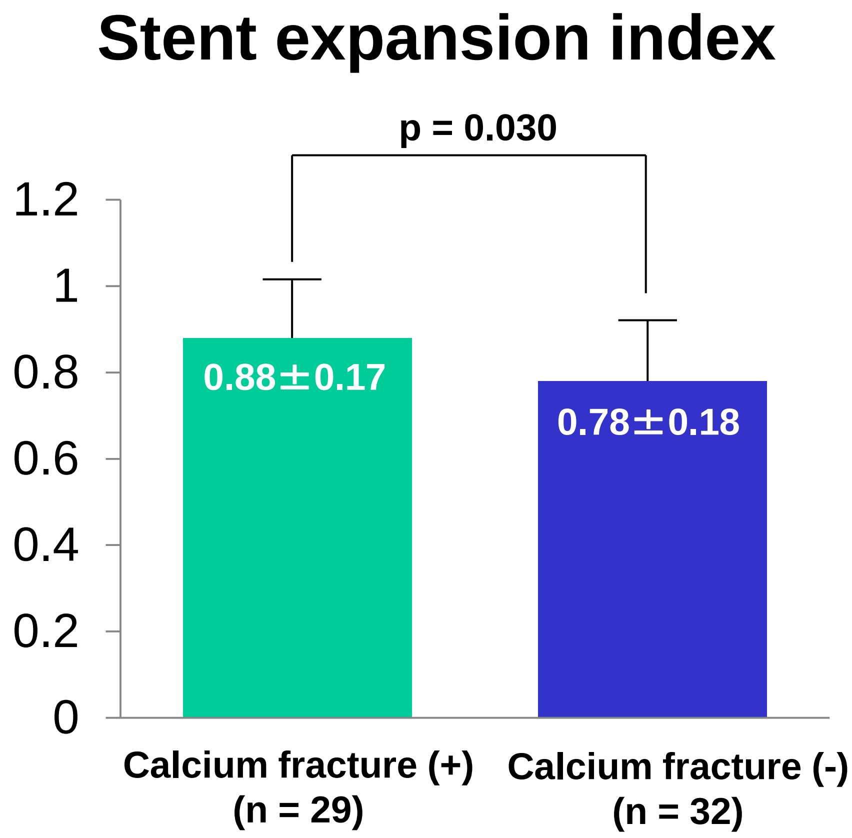


Broken calcium plate   Broken calcium plate   Stent malappsoition



Stent expansion at post-PCI

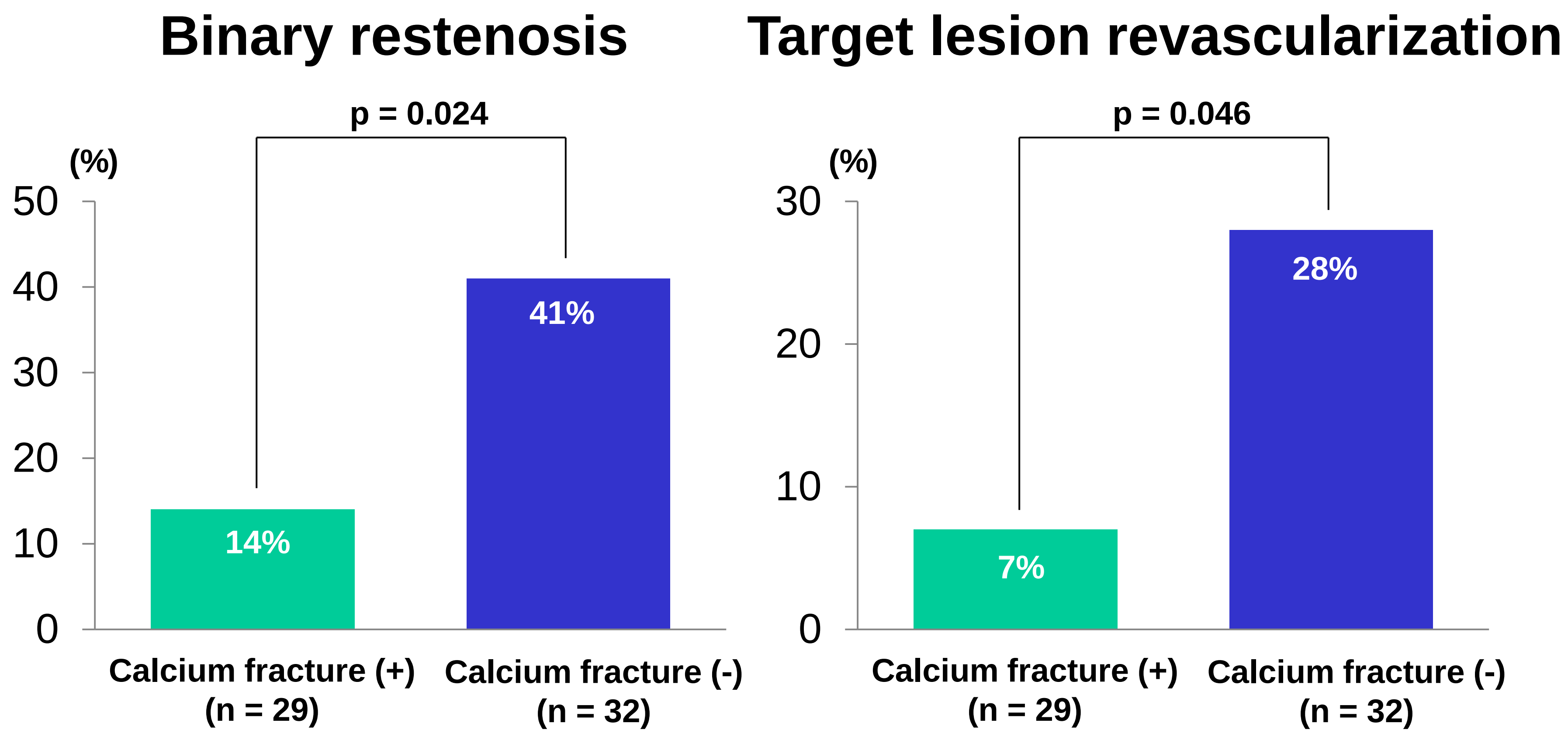




Minimum stent area and stent expansion index were significantly greater in the group with calcium fracture compared with the group without calcium fracture.

Kubo, Akasaka et al. JACC Imag 2015;8:1228-9

Restenosis and TLR at 10 months follow-up



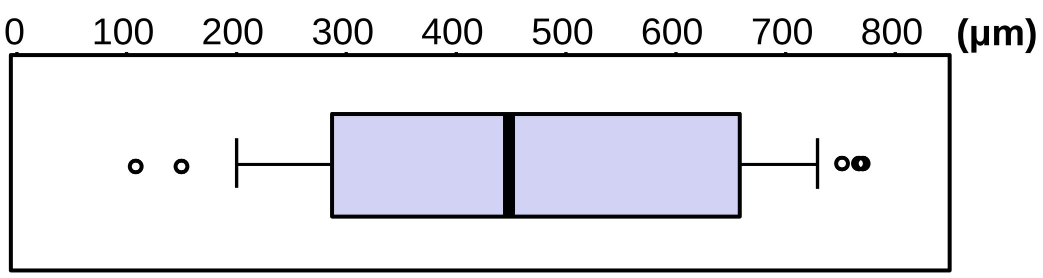
The frequency of binary restenosis and target lesion revascularization was significantly lower in the group with calcium fracture compared with the group without calcium fracture.

Kubo, Akasaka et al. JACC Imag 2015;8:1228-9

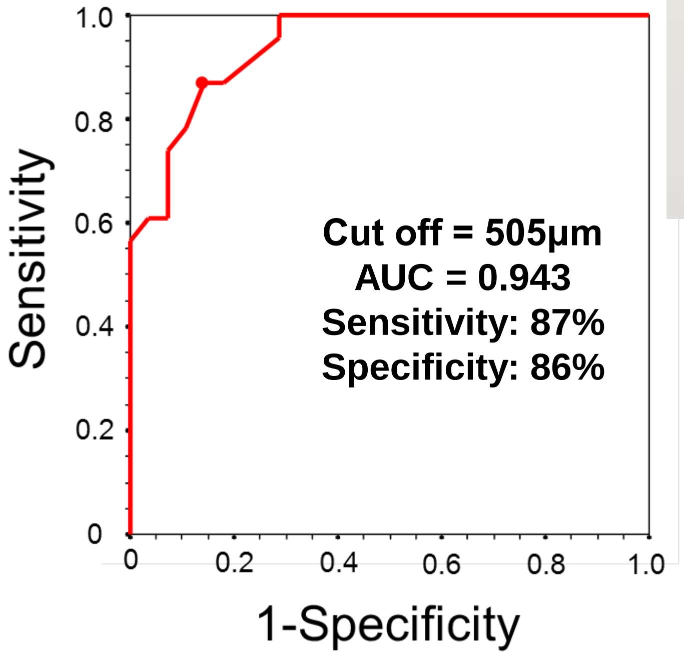
Prediction of calcium plate fracture by ballooning

OFDI was performed to assess vascular response immediately after high pressure ballooning in 61 patients with severe calcified coronary lesion.

Thickness distribution of calcium fracture



Median = 450μm; Lower quartile = 300μm; Upper quartile = 660μm; Minimum = 110μm; and Maximum = 770μm.

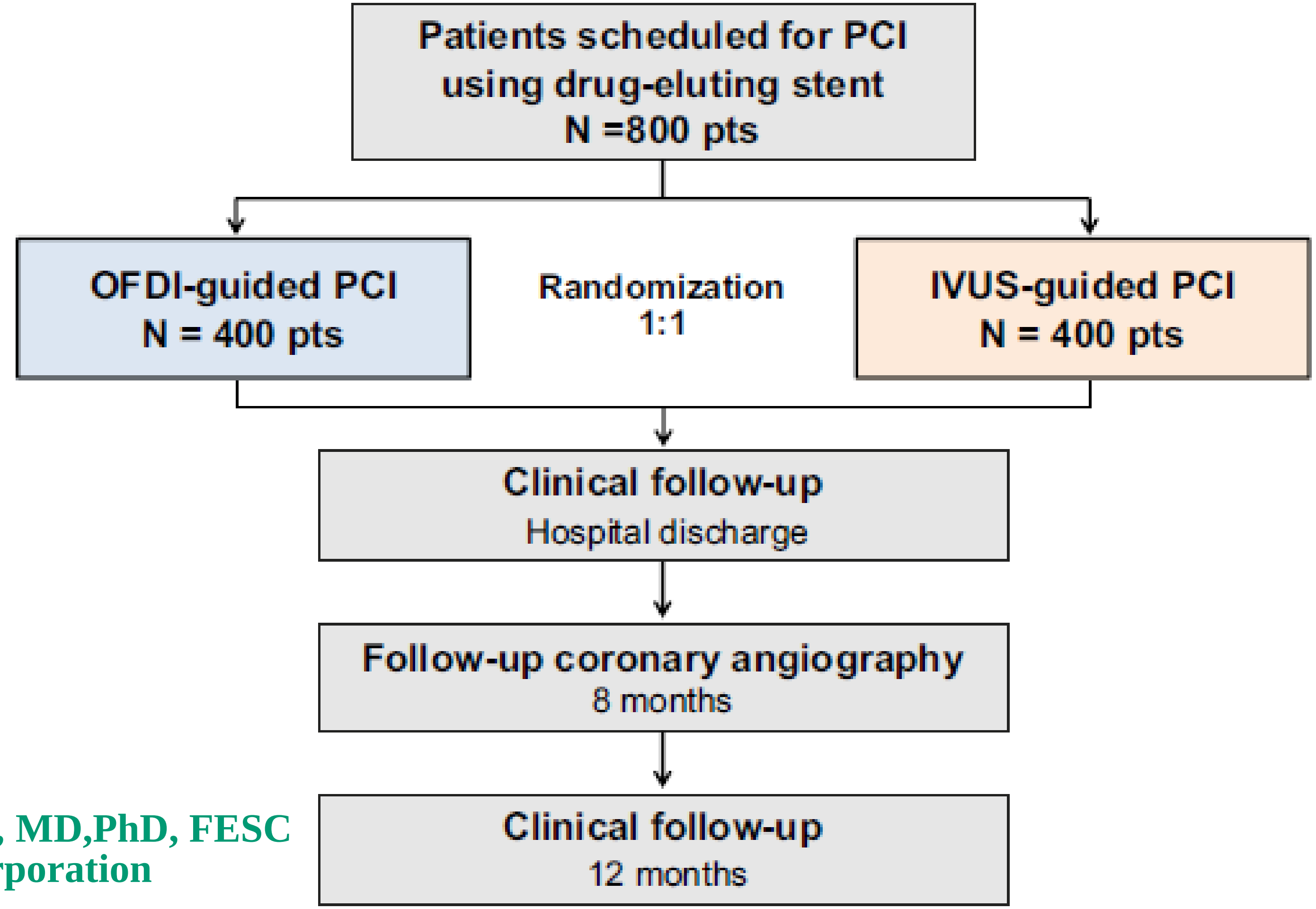


Conclusion: A calcium plate thickness < 505 μm was the corresponding cut-off value for predicting calcium plate fracture by high pressure ballooning.

Kubo, Akasaka et al. JACC Imag 2015;8:1228-9

The OPINION study design

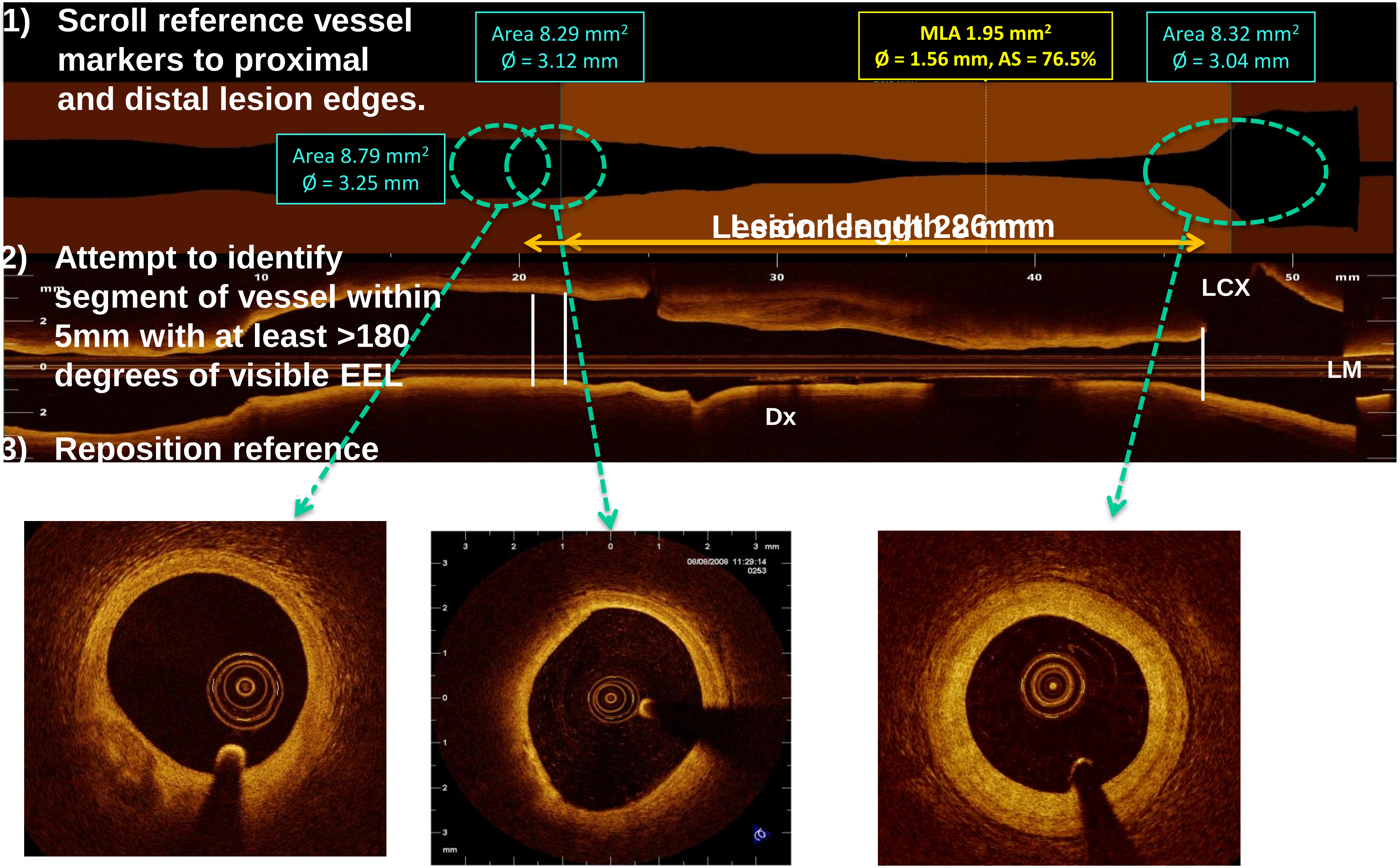
Prospective, multi-center (n=42), randomized (1:1) non-inferiority trial comparing OFDI-guided PCI with IVUS-guided PCI



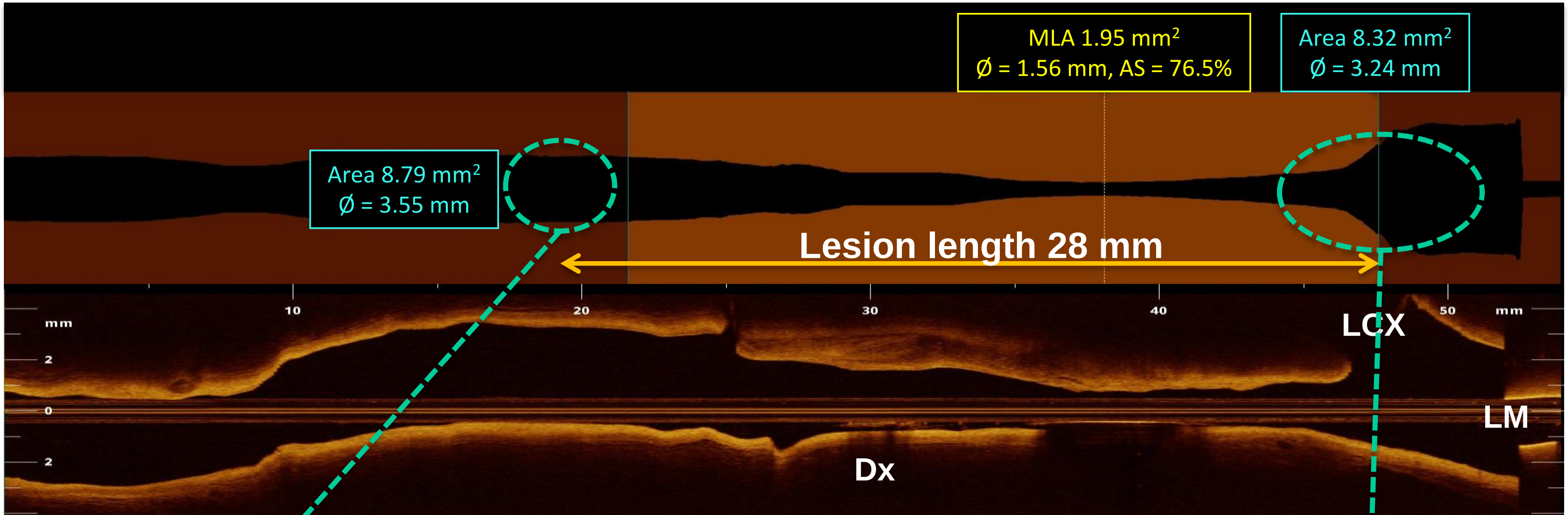
PI: Takashi Akasaka, MD,PhD, FESC
Sponsor: Terumo corporation

Kubo T, et al. J Cardiol 2016;68:455-460

How to identify reference segments; stent length

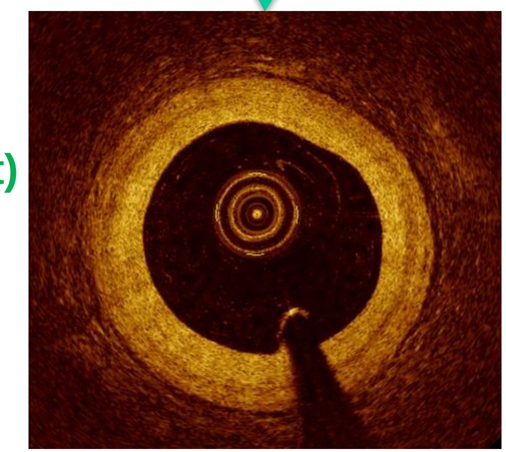


How to identify the EEL; stent diameter



Most normal looking site

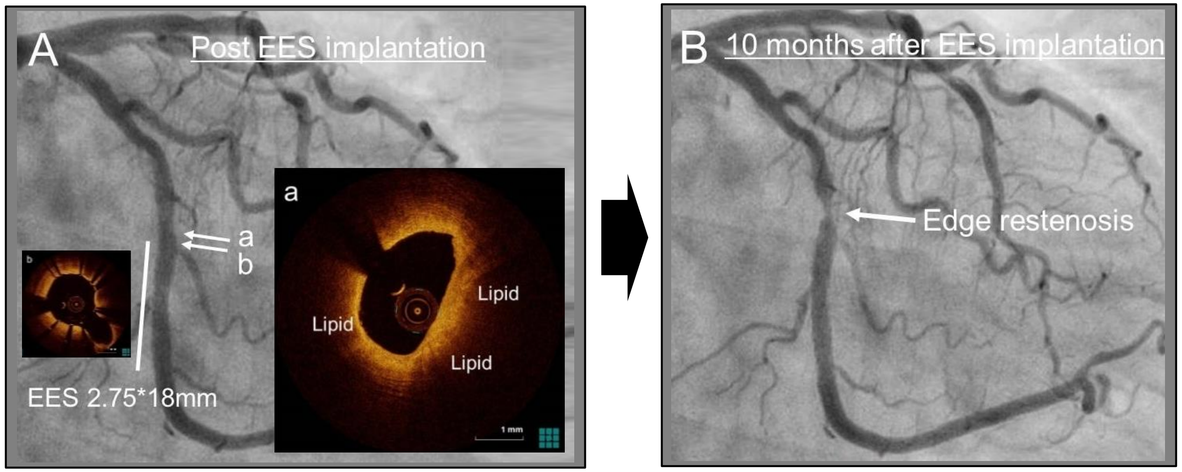
- Largest reference lumen (prox or dist)
- Mean lumen diameter or area



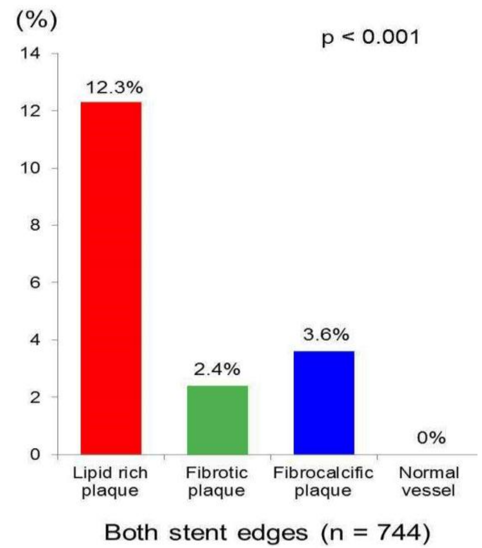
Precursor lesion of stent edge restenosis

In 744 stent (EES) edge segments, OCT was used to evaluate morphological characteristics of the coronary plaques that developed stent edge restenosis.

Post-stenting　　10 months follow-up



Stent edge restenosis



(A) Immediately after EES implantation, OCT images showed lipid rich plaque at the proximal stent edge (a, b).
(B) At 10-month follow-up, angiography demonstrated stent edge restenosis at the proximal edge of the stent.

Conclusion: Lipidic plaque in the stent edge segments at post- PCI was a predictor of late stent edge restenosis.

Ino Y, et al. Cric CV Interv 2016;9:e004231
DOI:10.1161/CIRCINTERVENTIONS.116.004231.

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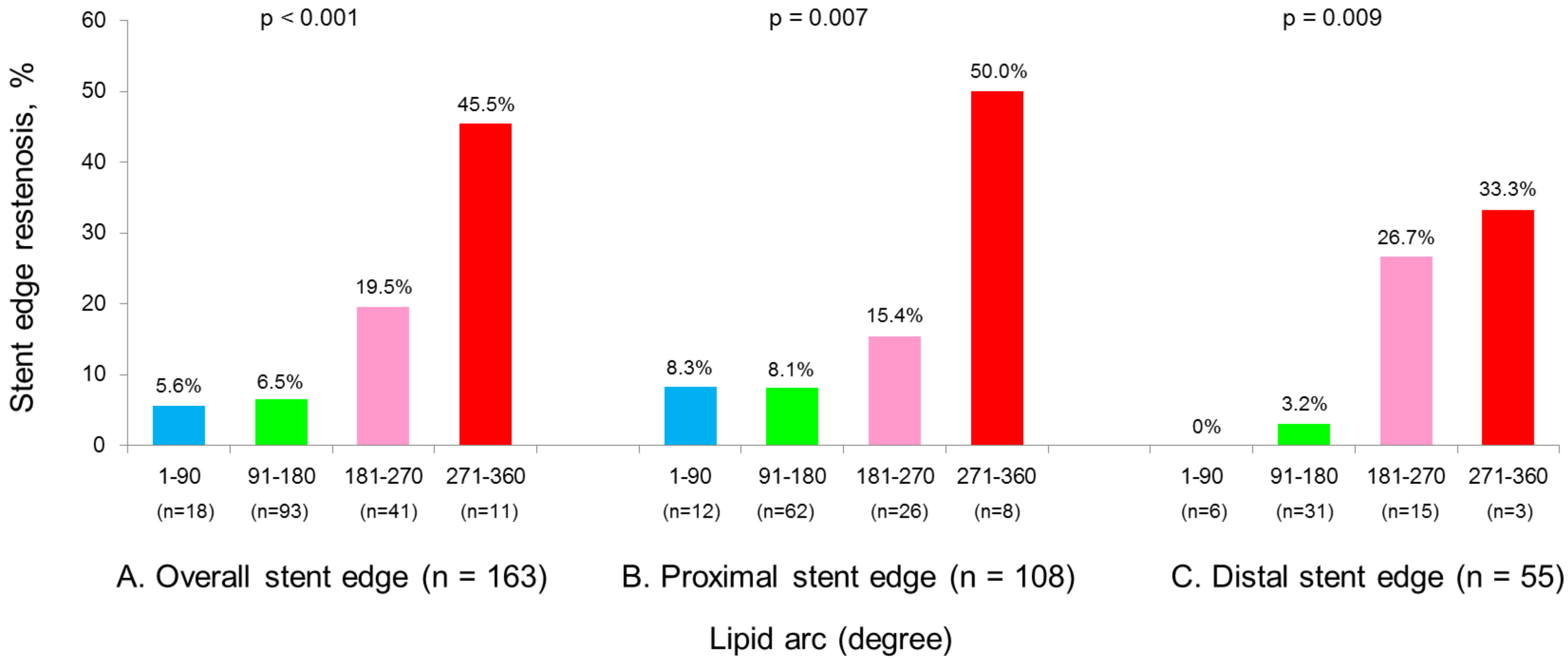
Relation between lipid arc in stent edge at the time of PCI & frequency of SER at 9-12 months follow-up



Within lepidic plaques, stent edge restenosis could be identified more frequently in cases with grater lipid arc at the stent edge.

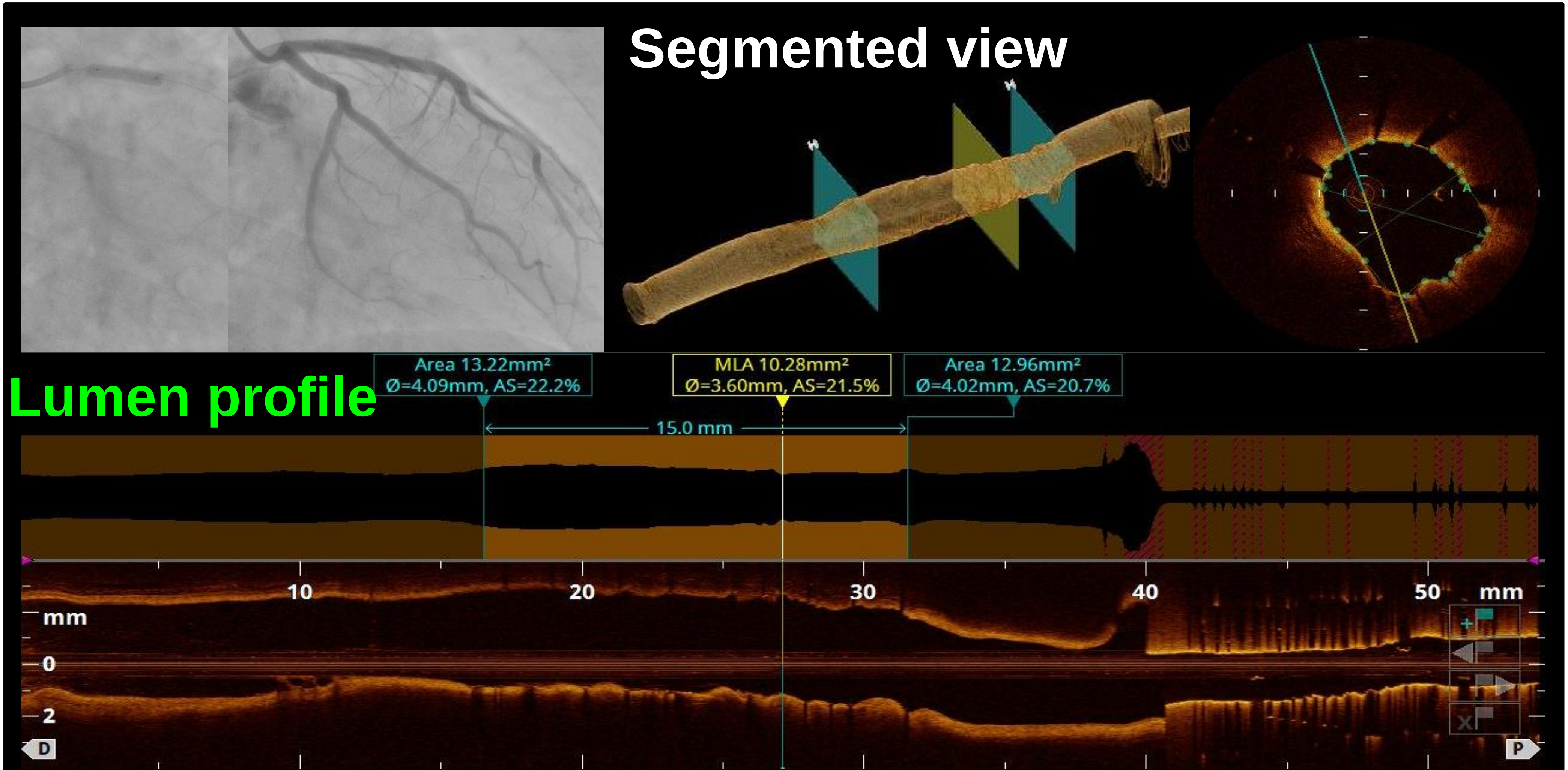
Ino Y, et al. Cric CV Interv 2016;9:e004231
DOI:10.1161/CIRCINTERVENTIONS.116.004231.

Multivariate logistic regression analysis of independent predictors for stent edge restenosis

	Odds ratio	95% CI	*p*-value
Lipidic plaque in stent edge segment	5.99	2.89-12.81	<0.001
Tissue protrusion	1.58	0.53-4.05	0.384
Stent area at stent border	1.12	0.81-1.51	0.487
Minimum lumen area	0.642	0.42-0.96	0.029
Ratio of stent area at stent border to averaged lumen area in stent edge segment	0.58	0.11-2.62	0.491

Ino Y, et al. Cric CV Interv 2016;9:e004231
DOI:10.1161/CIRCINTERVENTIONS.116.004231.

Post-PCI assessment, #6 90%, (MultiLink 4.0×15mm)

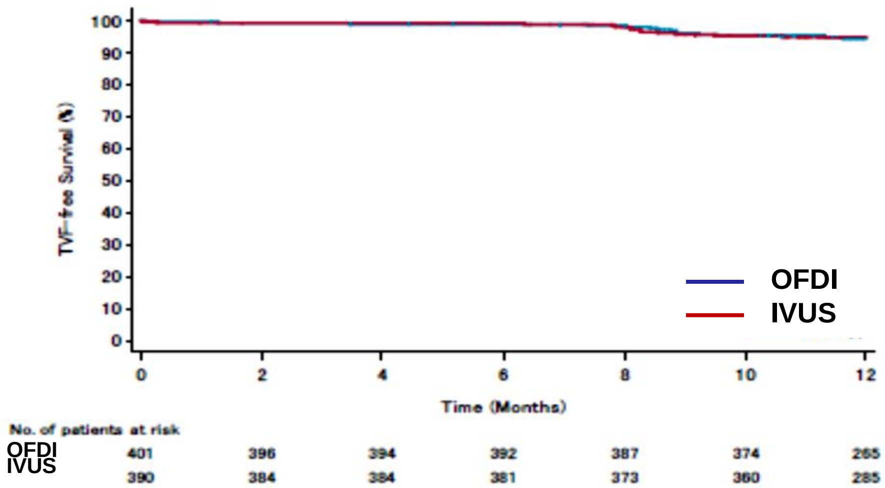


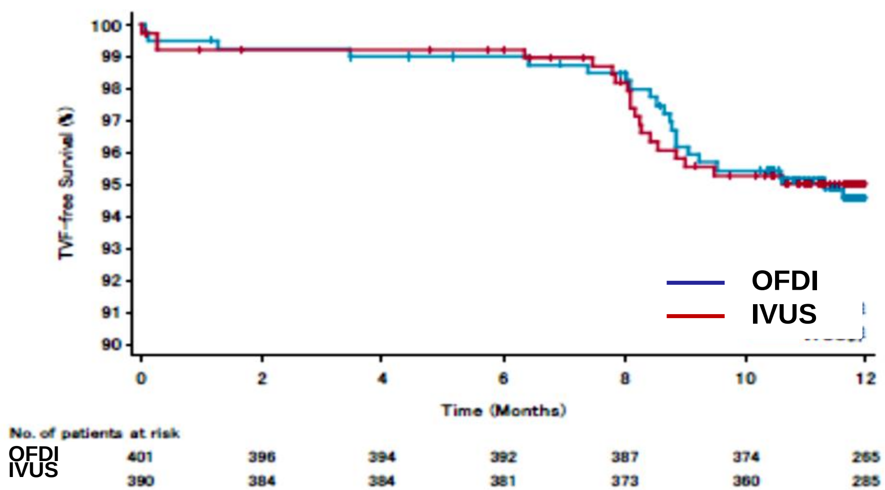
OFDI and IVUS criteria of optimal stent deployment

	OFDI-guided PCI	IVUS-guided PCI
Reference site	• **Most normal looking** • **No lipidic plaque**	• Largest lumen • **Plaque burden < 50%**
Determination of stent diameter	• By measuring **lumen** diameter at proximal and distal reference sites	• By measuring **vessel** diameter at proximal and distal reference sites
Determination of stent length	• By measuring distance from distal to proximal reference site	
Goal of stent deployment	• **In-stent minimal lumen area ≥ 90% of the average reference lumen area** • Complete apposition of the stent over its entire length against the vessel wall • Symmetric stent expansion defined by minimum lumen diameter / maximum lumen diameter ≥ 0.7 • No plaque protrusion, thrombus, or edge dissection with potential to provoke flow disturbances	

Kubo T, et al. J Cardiol 2016;68:455-460

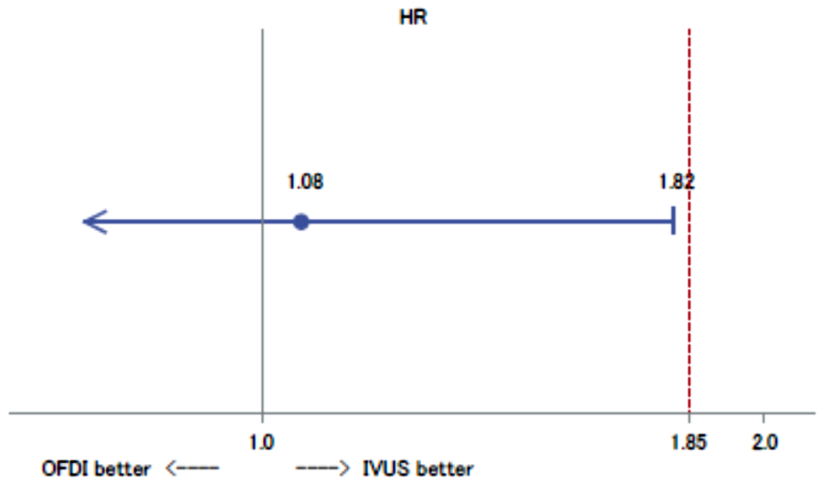
TVF





	Event number / study patient	(%)	HR	95 % CI	HR: 95 % CI	P value
OFDI	21/412	(5.1)	1.08	(0.58, 2.01)	1.82	0.0446
IVUS	19/405	(4.7)	1.00			

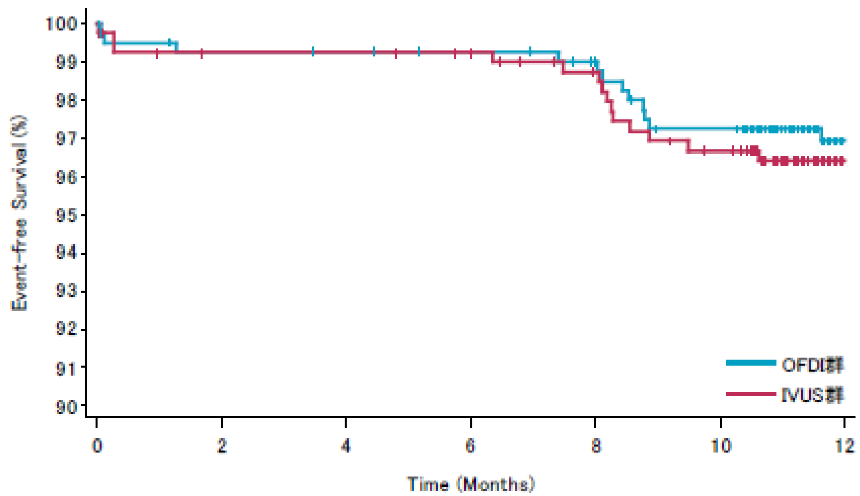
HR for upper limit of non-inferiority; 1.85



Kubo T, Akasaka T, et al. Eur Heart J. 2017;38:accepted

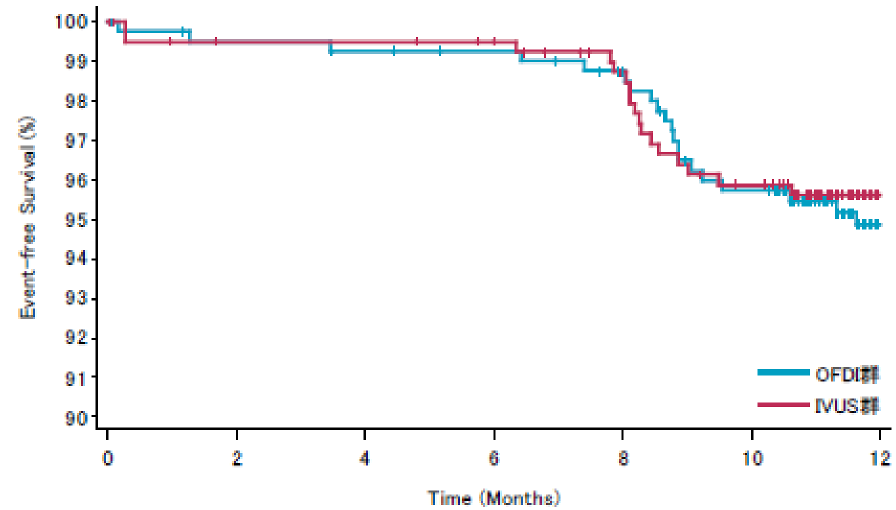
MACE, TVR, CVI and RF

MACE (Cardiac death, MI, TLR)



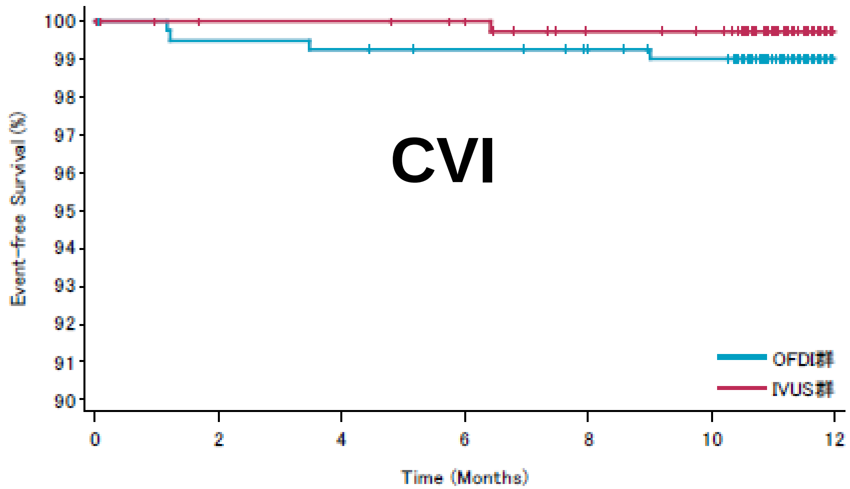
No. of patients at risk							
OFDI群	412	401	400	398	393	384	276
IVUS群	405	392	392	389	383	373	291

TVR



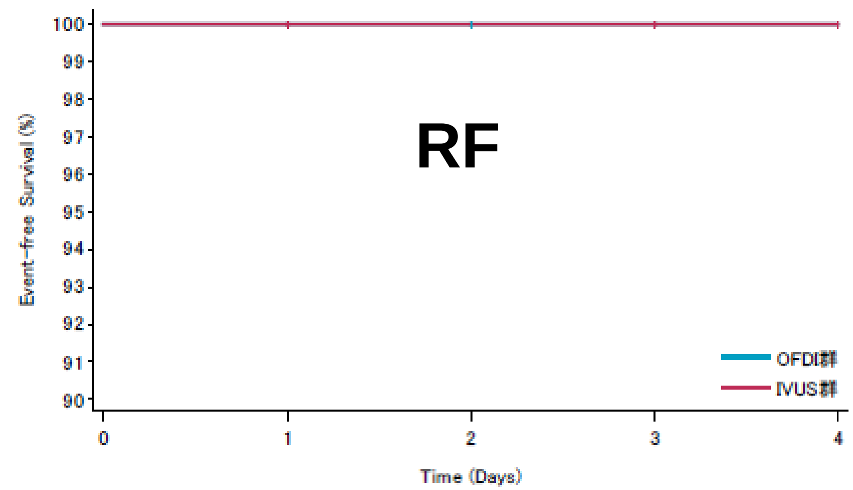
No. of patients at risk							
OFDI群	412	402	400	398	392	378	269
IVUS群	405	393	393	390	382	369	291

CVI



No. of patients at risk							
OFDI群	412	403	402	400	396	393	284
IVUS群	405	395	395	392	386	384	301

RF



No. of patients at risk					
OFDI群	412	412	408	406	405
IVUS群	405	405	401	401	400

Kubo T, et al. 2017;38:3139-3147

European Heart Journal (2017) **0**, 1–9
doi:10.1093/eurheartj/ehx351

CLINICAL RESEARCH
Interventional cardiology

Optical frequency domain imaging vs. intravascular ultrasound in percutaneous coronary intervention (OPINION trial): one-year angiographic and clinical results

Takashi Kubo[1], Toshiro Shinke[2], Takayuki Okamura[3], Kiyoshi Hibi[4], Gaku Nakazawa[5], Yoshihiro Morino[6], Junya Shite[7], Tetsuya Fusazaki[6], Hiromasa Otake[2], Ken Kozuma[8], Tetsuya Ioji[9], Hideaki Kaneda[9], Takeshi Serikawa[10], Toru Kataoka[11], Hisayuki Okada[12], and Takashi Akasaka[1]*; on behalf of the OPINION Investigators[†]

…ased, high-resolution intravascular imaging … imaging technique for guiding percutane-… …iority of OFDI-guided PCI compared with

…trolled, non-inferiority study to compare …generation drug-eluting stent. The primary … death, target-vessel related myocardial infarction, and ischaemia-driven target vessel revascularization until 12 months after the PCI. The major secondary endpoint was angiographic binary restenosis at 8 months. We randomly allocated 829 patients to receive OFDI-guided PCI ($n = 414$) or IVUS-guided PCI ($n = 415$). Target vessel failure occurred in 21 (5.2%) of 401 patients undergoing OFDI-guided PCI, and 19 (4.9%) of 390 patients undergoing IVUS-guided PCI, demonstrating non-inferiority of OFDI-guided PCI to IVUS-guided PCI (hazard ratio 1.07, upper limit of one-sided 95% confidence interval 1.80; $P_{non\text{-}inferiority} = 0.042$). With 89.8% angiographic follow-up, the rate of binary restenosis was comparable between OFDI-guided PCI and IVUS-guided PCI (in-stent: 1.6% vs. 1.6%, $P = 1.00$; and in-segment: 6.2% vs. 6.0%, $P = 1.00$).

Conclusion The 12-month clinical outcome in patients undergoing OFDI-guided PCI was non-inferior to that of patients undergoing IVUS-guided PCI. Both OFDI-guided and IVUS-guided PCI yielded excellent angiographic and clinical results, with very low rates of 8-month angiographic binary restenosis and 12-month target vessel failure.

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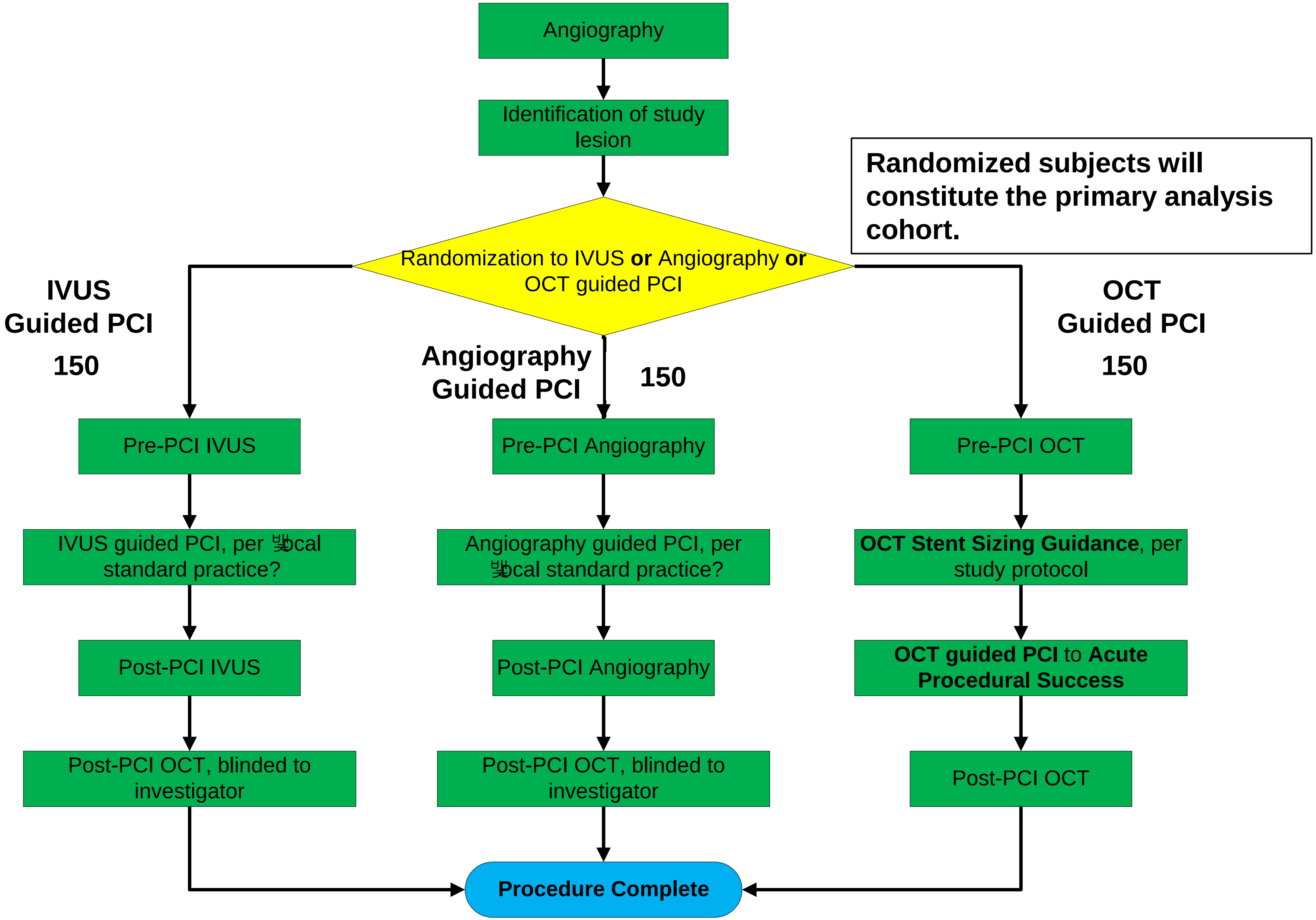
ILUMIEN III : OPTIMIZE PCI (Study Protocol)



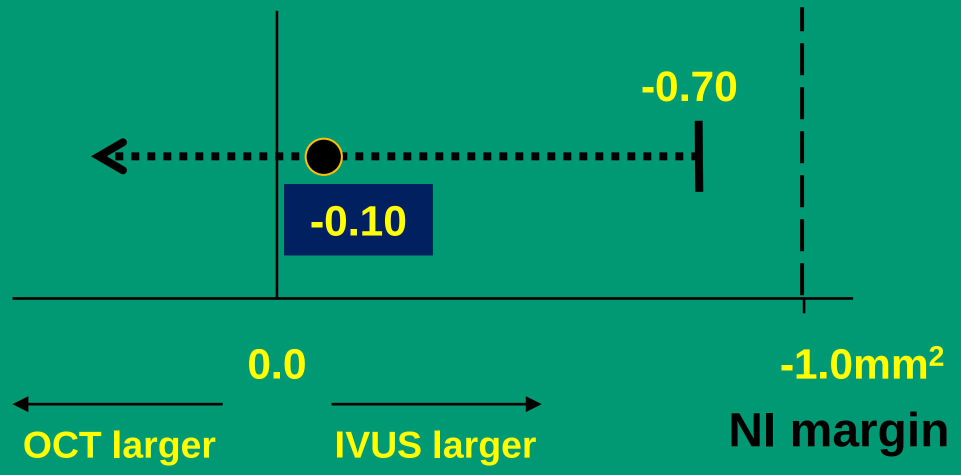
Primary Endpoint

Final post-PCI MSA by OCT

OCT 5.79 mm^2 [4.54, 7.34]

IVUS 5.89 mm^2 [4.67, 7.80]

97.5% one-sided CI: [-0.70, -]



$P_{noninferiority} = 0.001$

Optical coherence tomography compared with intravascular ultrasound and with angiography to guide coronary stent implantation (ILUMIEN III: OPTIMIZE PCI): a randomised controlled trial

Ziad A Ali, Akiko Maehara, Philippe Généreux, Richard A Shlofmi
Fernando Alfonso, Habib Samady, Takashi Akasaka, Eric B Carlsc
Ori Ben-Yehuda, Gregg W Stone, for the ILUMIEN III: OPTIMIZE P

Summary

Background Percutaneous coronary intervention (PCI) is most commonly guided by angiography alone. Intravascular ultrasound (IVUS) guidance has been shown to reduce major adverse cardiovascular events (MACE) after PCI, principally by resulting in a larger postprocedure lumen than with angiographic guidance. Optical coherence tomography (OCT) provides higher resolution imaging than does IVUS, although findings from some studies suggest that it might lead to smaller luminal diameters after stent implantation. We sought to establish whether or not a novel OCT-based stent sizing strategy would result in a minimum stent area similar to or better than that achieved with IVUS guidance and better than that achieved with angiography guidance alone.

Methods In this randomised controlled trial, we recruited patients aged 18 years or older undergoing PCI from 29 hospitals in eight countries. Eligible patients had one or more target lesions located in a native coronary artery with a visually estimated reference vessel diameter of 2·25–3·50 mm and a length of less than 40 mm. We excluded patients with left main or ostial right coronary artery stenoses, bypass graft stenoses, chronic total occlusions, planned two-stent bifurcations, and in-stent restenosis. Participants were randomly assigned (1:1:1; with use of an interactive web-based system in block sizes of three, stratified by site) to OCT guidance, IVUS guidance, or angiography-guided stent implantation. We did OCT-guided PCI using a specific protocol to establish stent length, diameter, and expansion according to reference segment external elastic lamina measurements. All patients underwent final OCT imaging (operators in the IVUS and angiography groups were masked to the OCT images). The primary efficacy endpoint was post-PCI minimum stent area, measured by OCT at a masked independent core laboratory at completion of enrolment, in all randomly allocated participants who had primary outcome data. The primary safety endpoint was procedural MACE. We tested non-inferiority of OCT guidance to IVUS guidance (with a non-inferiority margin of 1·0 mm²), superiority of OCT guidance to angiography guidance, and superiority of OCT guidance to IVUS guidance, in a hierarchical manner. This trial is registered with ClinicalTrials.gov, number NCT02471586.

Findings Between May 13, 2015, and April 5, 2016, we randomly allocated 450 patients (158 [35%] to OCT, 146 [32%] to IVUS, and 146 [32%] to angiography), with 415 final OCT acquisitions analysed for the primary endpoint (140 [34%] in the OCT group, 135 [33%] in the IVUS group, and 140 [34%] in the angiography group). The final median minimum stent area was 5·79 mm² (IQR 4·54–7·34) with OCT guidance, 5·89 mm² (4·67–7·80) with IVUS guidance, and

Interpretation OCT-guided PCI using a specific reference segment external elastic lamina-based stent optimisation strategy was safe and resulted in similar minimum stent area to that of IVUS-guided PCI. These data warrant a large-scale randomised trial to establish whether or not OCT guidance results in superior clinical outcomes to angiography guidance.

guidance.

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(Prof M A Leesar MD)

Intracoronary imaging & physiology in ESC guideline 2014

Recommendations	Class[a]	Level[b]	Ref.[c]
FFR to identify haemodynamically relevant coronary lesion(s) in stable patients when evidence of ischaemia is not available.	I	A	50,51,713
FFR-guided PCI in patients with multivessel disease.	IIa	B	54
IVUS in selected patients to optimize stent implantation.	IIa	B	702,703,706
IVUS to assess severity and optimize treatment of unprotected left main lesions.	IIa	B	705
IVUS or OCT to assess mechanisms of stent failure.	IIa	C	
OCT in selected patients to optimize stent implantation.	IIa	C	

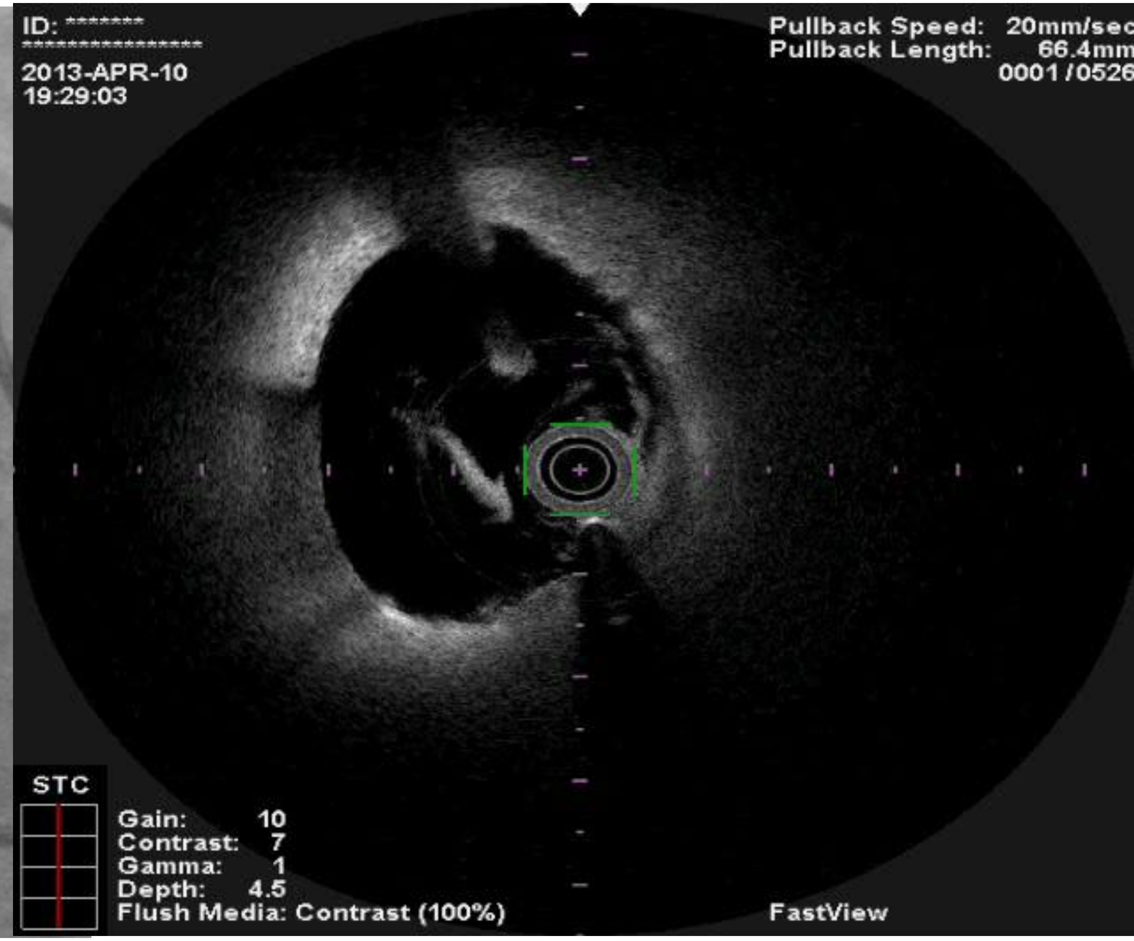
Eur Heart J. 2014;35:2541-2619

Imaging-guided PCI in daily practice
Wakayama Medical university

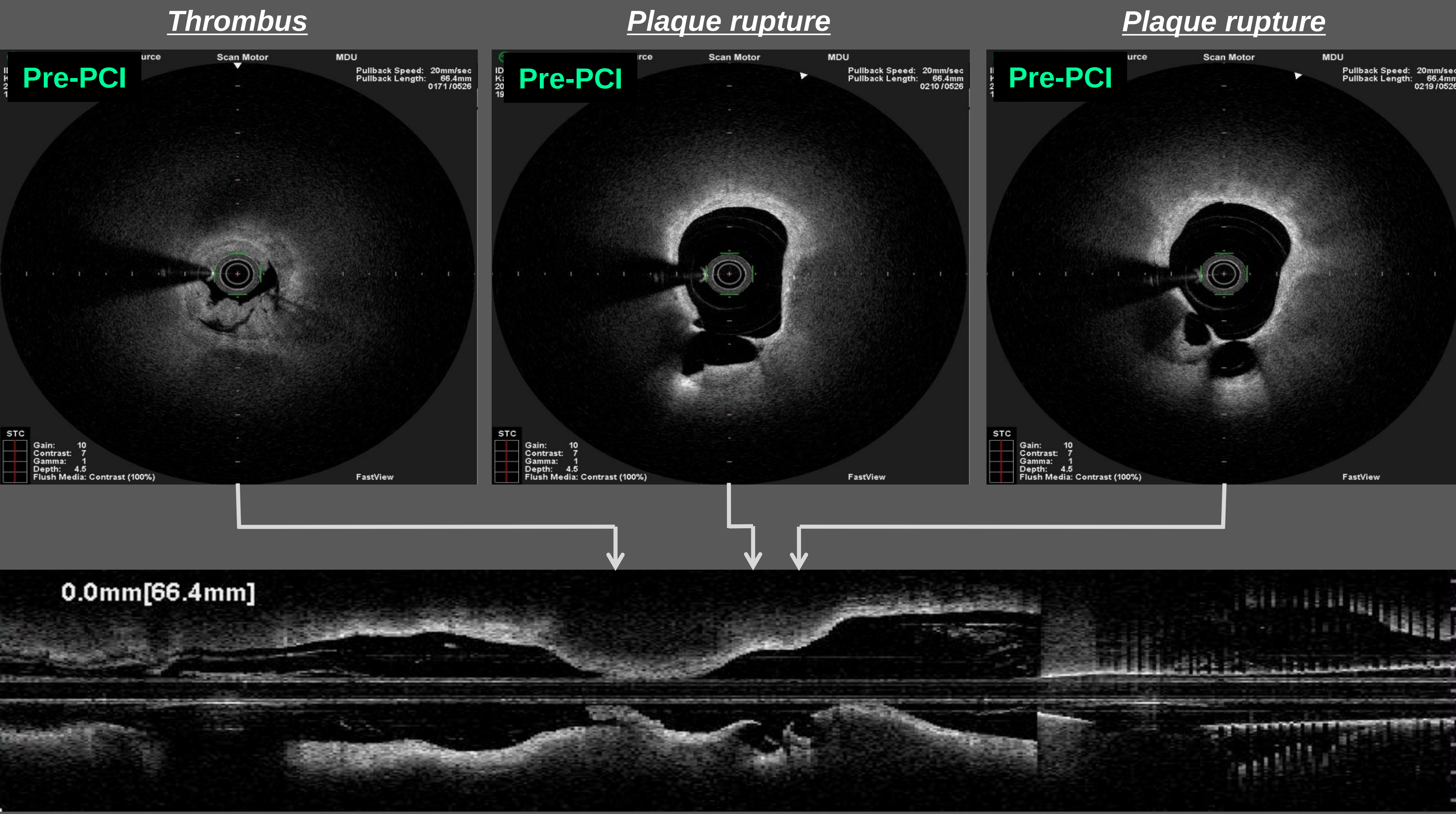
- **IVUS-guided PCI (20-30%):** LM･RCA orifice lesions
  CTO
  CKD
  Others

- **OCT-guided PCI (70-80%):** Almost all lesion (except for CTO)
  Severe calcification
  ACS
  Instent restenosis
  BRS implantation
  LM-Bifurcation

Pre-PCI OFDI (65 y.o. male, UAP)



OFDI at culprit site



Demonstration of various causes in ACS

Plaque rupture

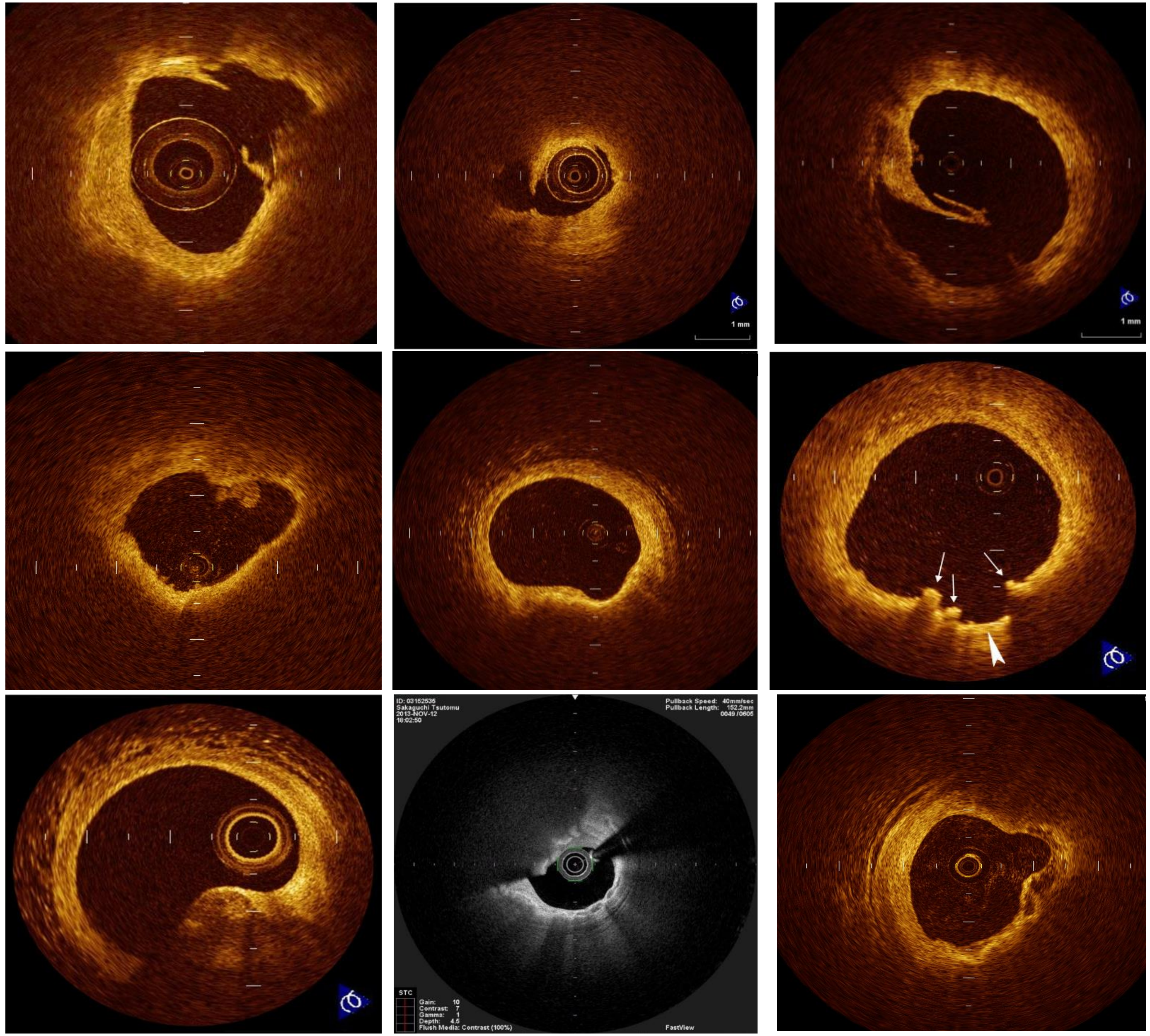
60 – 70 %

Plaque erosion

20 – 30 %

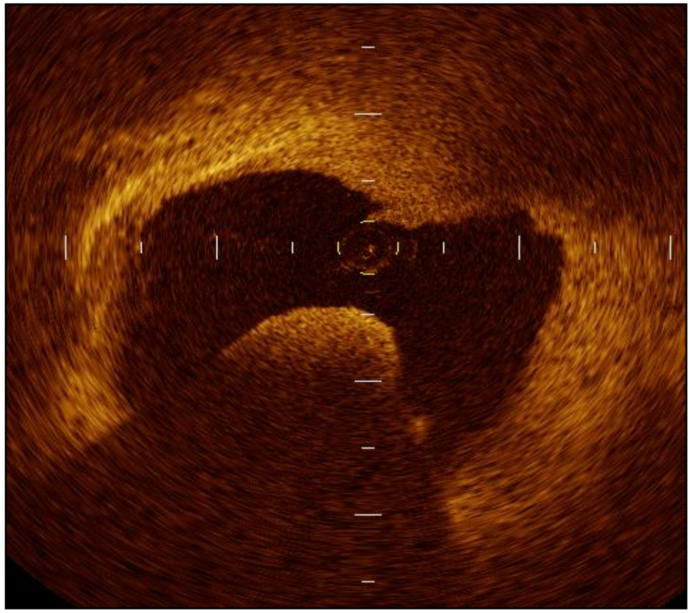
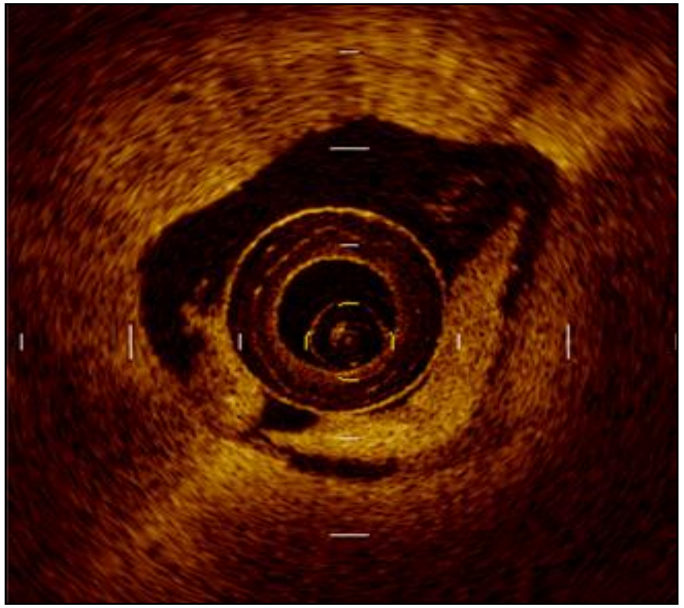
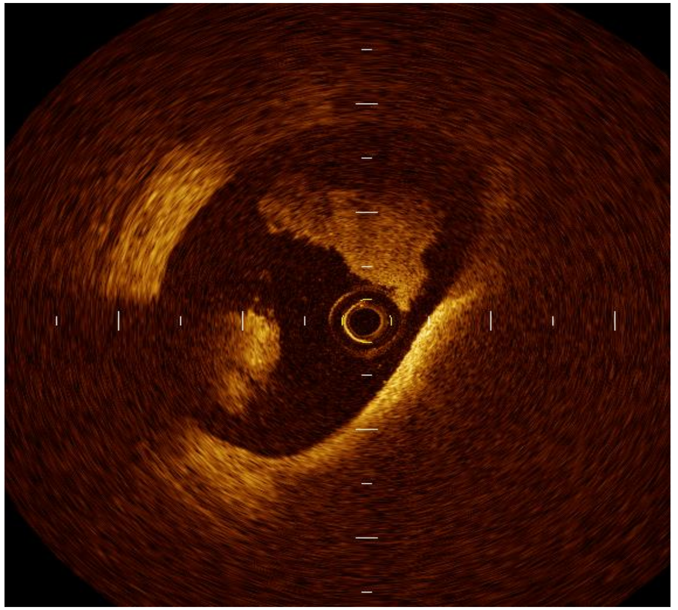
Calcified nodule

5 – 6 %



Kubo T, Akasaka T, et al. J Am Coll Cardiol 2007;50:933-939

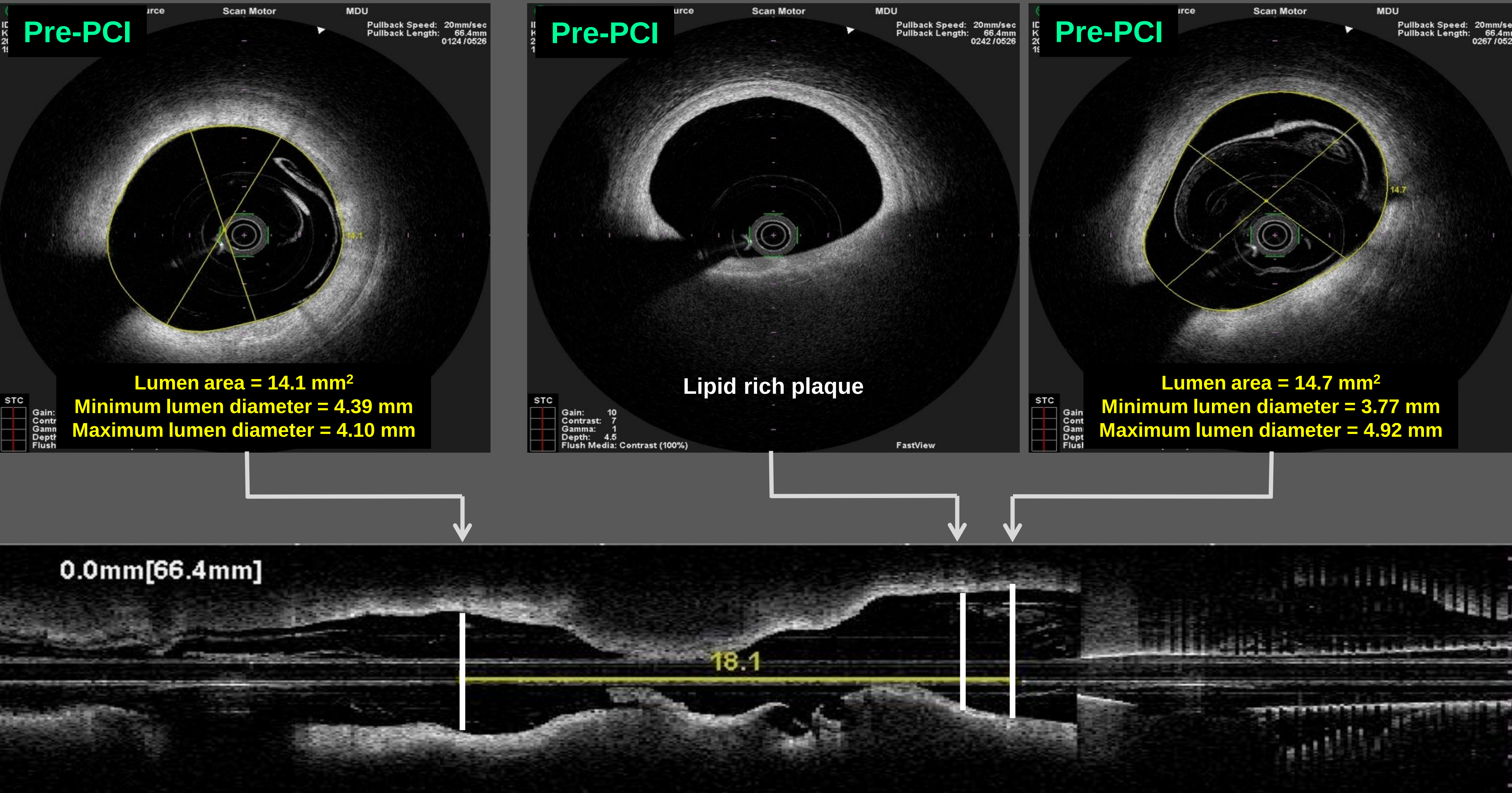
Red & white thrombus

Red thrombus	White thrombus	Mixed thrombus
		
Protrusion mass with shadow	Protrusion mass without shadow	Protrusion mass with & without shadow

Kume T, Akasaka T, et al. (Am J Cardiol 97:1713-1717, 2006)
Kubo T, Akasaka T, et al. (J Am Coll Cardiol 50:933-939,2007)

OFDI at reference site

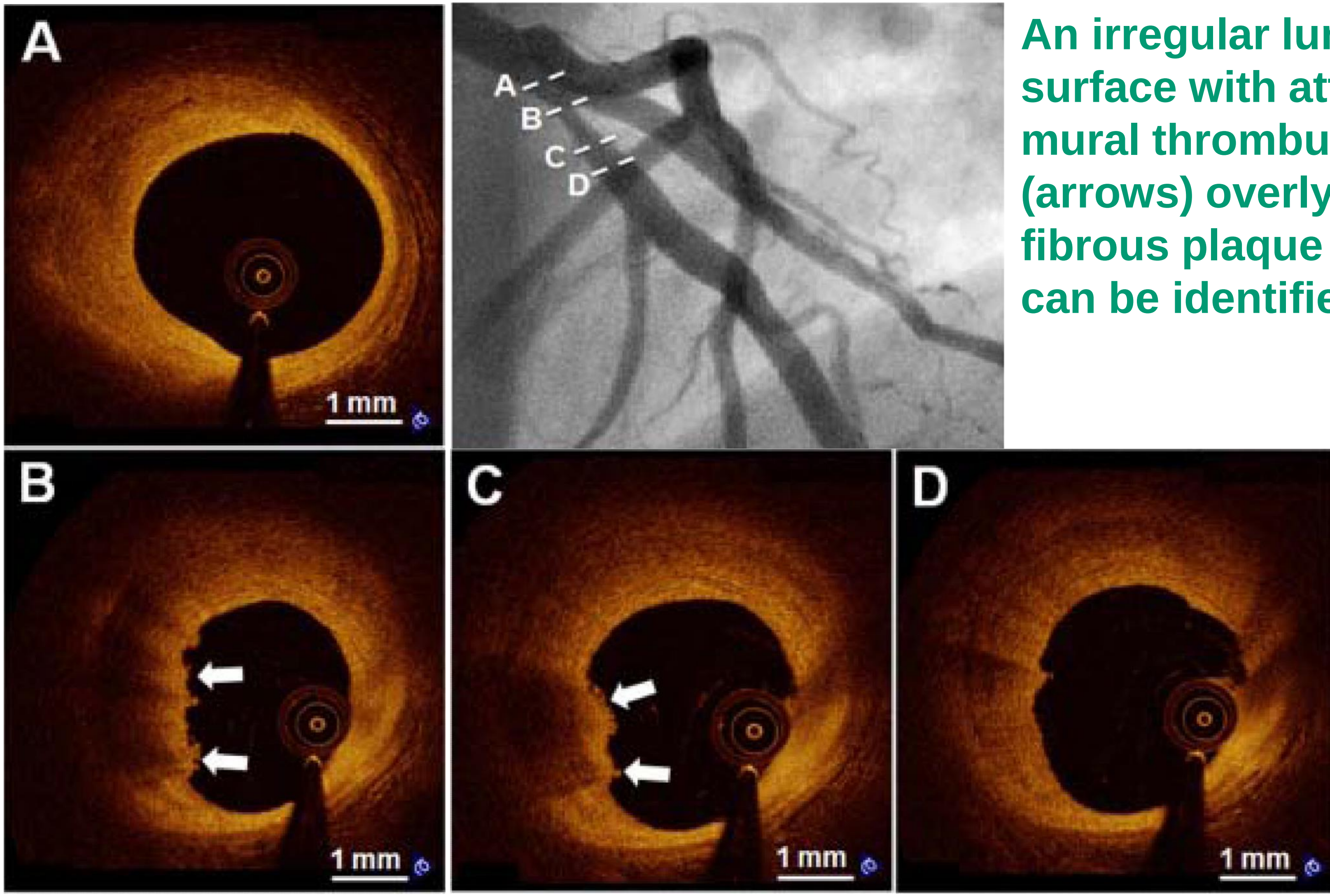
Distal reference ***Proximal reference***



Scroll to identify the most normal looking site as the reference site

Representative case of definite OCT-erosion

Jia H, et al. J Am Coll Cardiol 2007;50:933–999

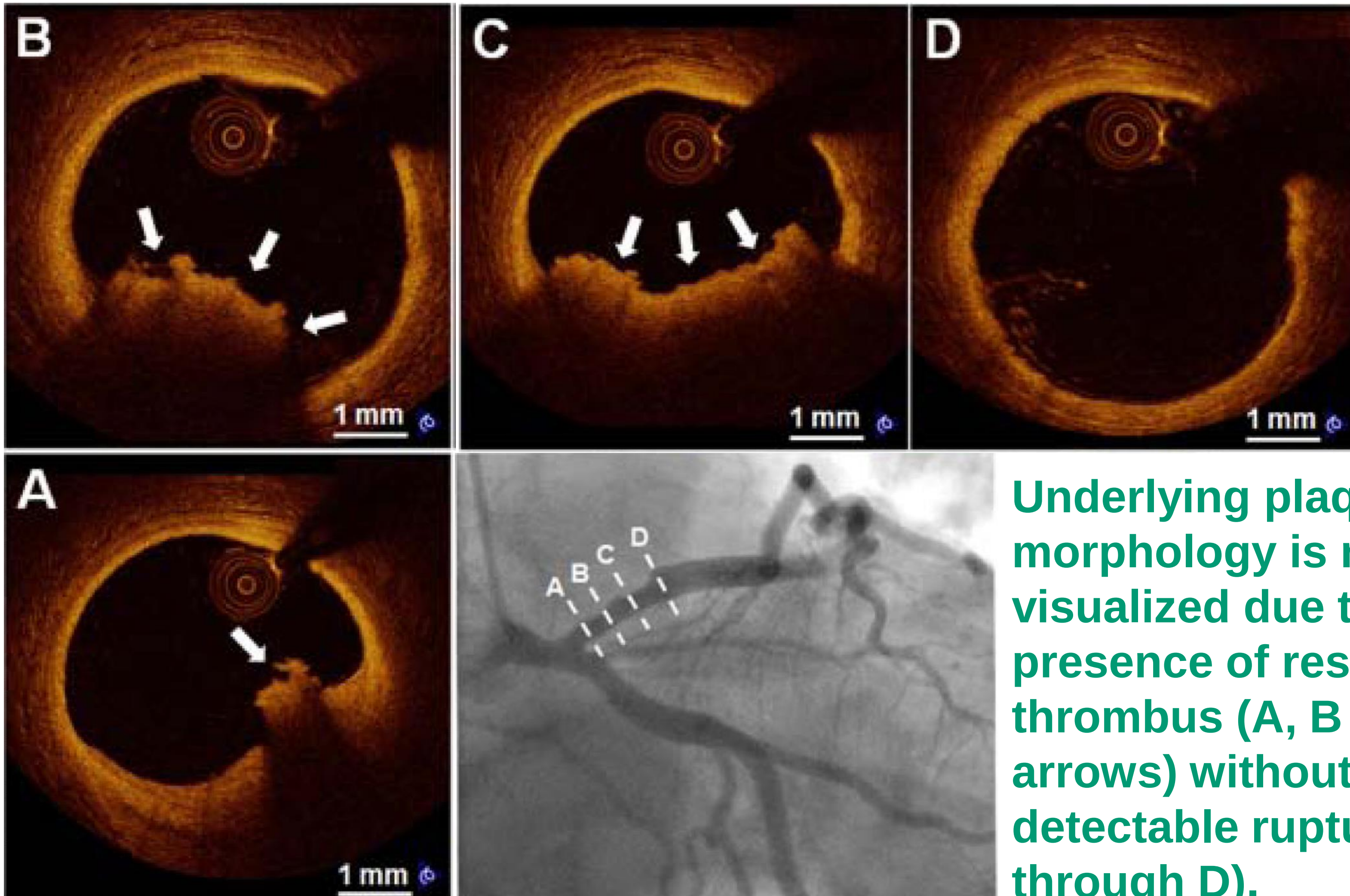


An irregular lumen surface with attached mural thrombus (arrows) overlying a fibrous plaque (B,C) can be identified.

≒ MI with non-obstructive coronary artery disease (MINOCA)

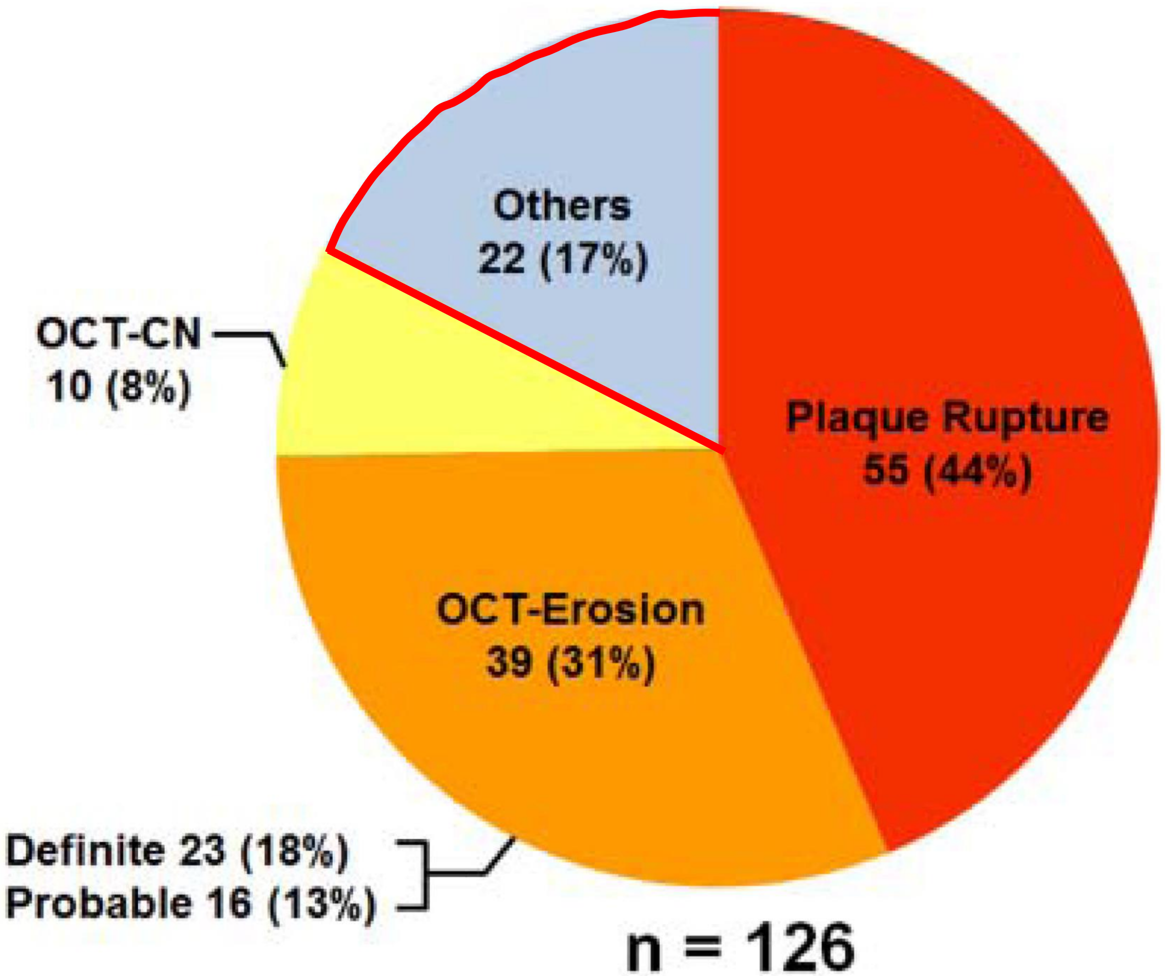
Representative case of probable OCT-erosion

Jia H, et al. J Am Coll Cardiol 2007;50:933–999



Underlying plaque morphology is not well visualized due to the presence of residual red thrombus (A, B and C, arrows) without any detectable rupture (A through D).

Incidence of plaque rupture, erosion and calcified nodule in 126 lesions in pts with ACS



Jia H, et al. J Am Coll Cardiol 2007;50:933–999

Acute coronary syndromes without coronary plaque rupture

Nat Rev Cardiol 2016;13:257-265

Siddak S. Kanwar[1], Gregg W. Stone[2], Mandeep Singh[3], Renu Virmani[4], Jeffrey Olin[1], Takashi Akasaka[5] and Jagat Narula[1]

Abstract | The latest advances in plaque imaging have provided clinicians with opportunities to treat acute coronary syndrome (ACS) and provide individualized treatment recommendations based not only on clinical manifestations, angiographic characteristics, and biomarker data, but also on the findings of plaque morphology. Although a substantial proportion of ACS events originate from plaques with an intact fibrous cap (IFC), clinicians predominantly equate ACS with plaque rupture arising from thin-cap fibroatheromas. In this Review, we discuss the recent advances in our understanding of plaque morphology in ACS with IFC, reviewing contemporary data from intravascular imaging. We also explore whether use of such imaging might provide a roadmap for more effective management of patients with ACS.

coronary plaques leads
am, and is responsible

syndrome (ACS),
cap rupture

- Advances in plaque imaging have allowed clinicians to treat patients with ACS based not only on clinical manifestations, angiographic characteristics, and biomarker data, but also on plaque morphology
- The use of optical coherence tomography without angiographically obvious plaque rupture can assist in identification and characterization of the culprit lesion plaque morphology
- Conservative pharmacologic treatment without revascularization might be appropriate in some patients with an intact fibrous cap

European Heart Journal (2017) **38**, 792–800
doi:10.1093/eurheartj/ehw381

FAST **TRACK CLINICAL RESEARCH**
ESC Hot Line

Acute coronary syndromes

Effective anti-thrombotic therapy without stenting: intravascular optical coherence tomography-based management in plaque erosion (the EROSION study)

Haibo Jia[1†], Jiannan Dai[2†], Jingbo Hou[1†], Lei Xing[2], Lijia Ma[1], Huimin Liu[1], Maoen Xu[1], Yuan Yao[1], Sining Hu[1], Erika Yamamoto[2], Hang Lee[3], Shaosong Zhang[1], Bo Yu[1]*, and Ik-Kyung Jang[2]*

ogy and therefore may
onary syndrome (ACS)
antation.

CS including ST-segment
ectomy was performed.
sidual diameter stenosis
. OCT was repeated at
of thrombus volume at
ath, recurrent ischaemia
ible OCT images, plaque
erosion was identified in 103 (25.4%) patients. Sixty patients enrolled and 55 patients completed the 1-month follow-up. Forty-seven patients (47/60, 78.3%; 95% confidence interval: 65.8–87.9%) met the primary endpoint, and 22 patients had no visible thrombus at 1 month. Thrombus volume decreased from 3.7 (1.3, 10.9) mm^3 to 0.2 (0.0, 2.0) mm^3. Minimal flow area increased from 1.7 (1.4, 2.4) mm^2 to 2.1 (1.5, 3.8) mm^2. One patient died of gastrointestinal bleeding, and another patient required repeat percutaneous coronary intervention. The rest of the patients remained asymptomatic.

Conclusion For patients with ACS caused by plaque erosion, conservative treatment with anti-thrombotic therapy without stenting may be an option.

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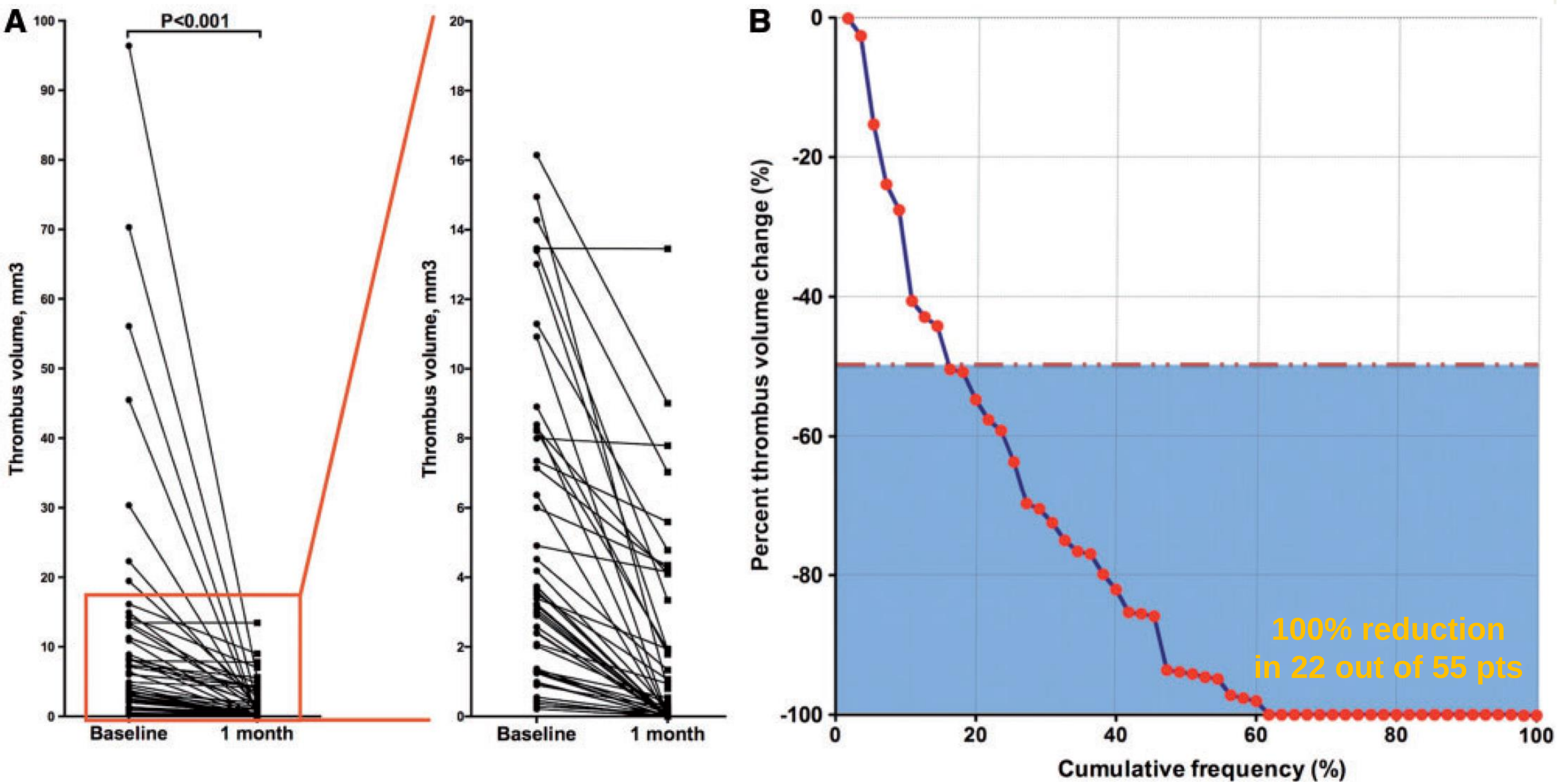
Changes in thrombus volume in ACS with plaque erosion

Absolute volume change

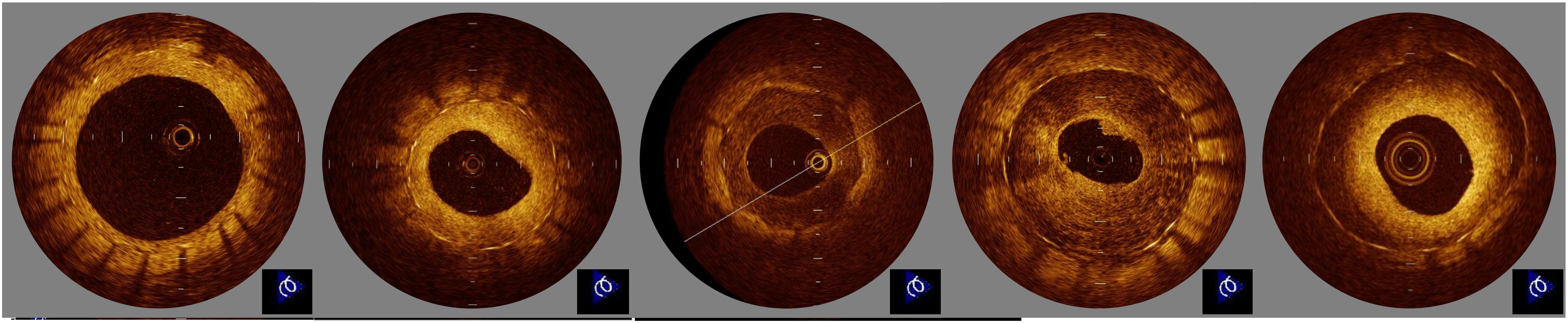
Percent thrombus volume reduction



Wakayama Medical University

Neointimal tissue characterization by OCT

Homogeneous *Heterogeneous* *Layered*



Neointimal tissue has very thin & uniform optical properties with backscattering pattern.

Restenotic tissue has uniform optical properties and dose not show focal variations in backscattering pattern.

Restenotic tissue has focally changing optical properties and show various backscattering patterns.

Restenotic tissue consists of concentric layers with different optical properties: an adluminal high scattering layer & adluminal low scattering layer.

Although no data showing the relation between OCT-findings & histology in detail, there is a data demonstrating the effect of DCB according to OCT finding.

Association between restenotic tissue morphology and acute/mid-term results

Tissue structure									
	Homogenous type			Heterogenous type			Layered type		
	PCB (n=55)	POBA (n=27)	P value	PCB (n=20)	POBA (n=8)	P value	PCB (n=71)	POBA (n=33)	P value
Acute gain mm	1.14±0.53	0.90±0.56	0.060	1.25±0.58	1.21±0.38	0.885	1.20±0.58	1.14±0.60	0.597
Late loss mm	0.25±0.50	0.70±0.58	0.000	0.45±0.72	0.84±0.85	0.234	0.23±0.60	0.61±0.69	0.005
Net gain mm	0.90±0.61	0.20±0.67	0.000	0.80±0.69	0.38±0.98	0.208	0.98±0.73	0.53±0.63	0.003
ISR n (%)	11 (20.0)	15 (55.6)	0.002	7 (35.0)	3 (37.5)	1.000	16 (22.5)	13 (39.4)	0.100
TLR n (%)	7 (12.7)	10 (37.0)	0.019	5 (25.0)	3 (37.5)	0.651	14 (19.7)	12 (36.4)	0.089

Acute gain = (post-procedural – pre-procedural) MLD

Late loss = (post-procedural - follow-up) MLD

Net gain = (follow-up - pre-procedural) MLD

Tada T, et al. Eur Heart J Cardiovasc Img. 2014;15:307-315

Association between restenotic tissue morphology and acute/mid-term results

Tissue backscatter	High backscatter			Low backscatter		
	PCB (n=81)	POBA (n=40)	P value	PCB (n=65)	POBA (n=28)	P value
Acute gain mm	1.12±0.50	0.97±0.58	0.139	1.26±0.62	1.17±0.54	0.476
Late loss mm	0.23±0.51	0.73±0.70	0.000	0.31±0.66	0.59±0.62	0.059
Net gain mm	0.90±0.61	0.25±0.67	0.000	0.96±0.76	0.58±0.70	0.027
ISR n (%)	16 (19.8)	21 (52.5)	0.000	18 (27.7)	10 (35.7)	0.467
TLR n (%)	11 (13.6)	17 (42.5)	0.001	15 (23.1)	8 (28.6)	0.606

Acute gain = (post-procedural – pre-procedural) MLD

Late loss = (post-procedural - follow-up) MLD

Net gain = (follow-up - pre-procedural) MLD

Tada T, et al. Eur Heart J Cardiovasc Img. 2014;15:307-315

European Heart Journal – Cardiovascular Imaging (2014) **15**, 307–315
doi:10.1093/ehjci/jet165

Association between tissue characteristics evaluated with optical coherence tomography and mid-term results after paclitaxel-coated balloon dilatation for in-stent restenosis lesions: a comparison with plain old balloon angioplasty

Takeshi Tada[1]*, Kazushige Kadota[1], Shingo Hosogi[2], Koshi Miyake[1], Hideo Amano[1], Michitaka Nakamura[1], Yu Izawa[1], Shunsuke Kubo[1], Tahei Ichinohe[1], Yusuke Hyoudou[1], Haruki Eguchi[1], Yuki Hayakawa[1], Suguru Otsuru[1], Daiji Hasegawa[1], Yoshikazu Shigemoto[1], Seiji Habara[1], Hiroyuki Tanaka[1], Yasushi Fuku[1], Harumi Kato[1], Tsuyoshi Goto[1], and Kazuaki Mitsudo[1]

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Received 14 May 2013; revised 13 August 2013; accepted after revision 16 August 2013; online publish-ahead-of-print 15 September 2013

Aims Morphological assessment of neointimal tissue using optical coherence tomography (OCT) is important for clarifying the pathophysiology of in-stent restenosis (ISR) lesions. The aim of this study was to determine the impact of OCT findings on recurrence of ISR after paclitaxel-coated balloon (PCB) dilatation compared with plain old balloon angioplasty (POBA).

Methods and results Between July 2008 and May 2012, we performed percutaneous coronary intervention for 214 ISR lesions using POBA + PCB (146 lesions, PCB group) or POBA only (68 lesions, POBA group). Morphological assessment of neointimal tissue using OCT, including assessment of restenotic tissue structure and restenotic tissue backscatter, was performed. We examined the association between lesion morphologies and mid-term (6–8 months) results including ISR and target lesion revascularization (TLR) rates. Both ISR and TLR rates of lesions with a homogeneous structure were significantly lower in the PCB group than those in the POBA group (ISR: 20.0 vs. 55.6%, $P = 0.002$, TLR: 12.7 vs. 37.0%, $P = 0.019$), but there was no difference between the two groups in ISR and TLR rates of lesions with a heterogeneous or layered structure. Both ISR and TLR rates of lesions with high backscatter were significantly lower in the PCB group than those in the POBA group (ISR: 19.8 vs. 52.5%, $P < 0.001$, TLR: 13.6 vs. 42.5%, $P = 0.001$), but there was no difference between the two groups in ISR and TLR rates of lesions with low backscatter.

Conclusion Morphological assessment of ISR tissue using OCT might be useful for identifying ISR lesions favourable for PCB dilatation.

Keywords optical coherence tomography • in-stent restenosis lesion • paclitaxel-coated balloon

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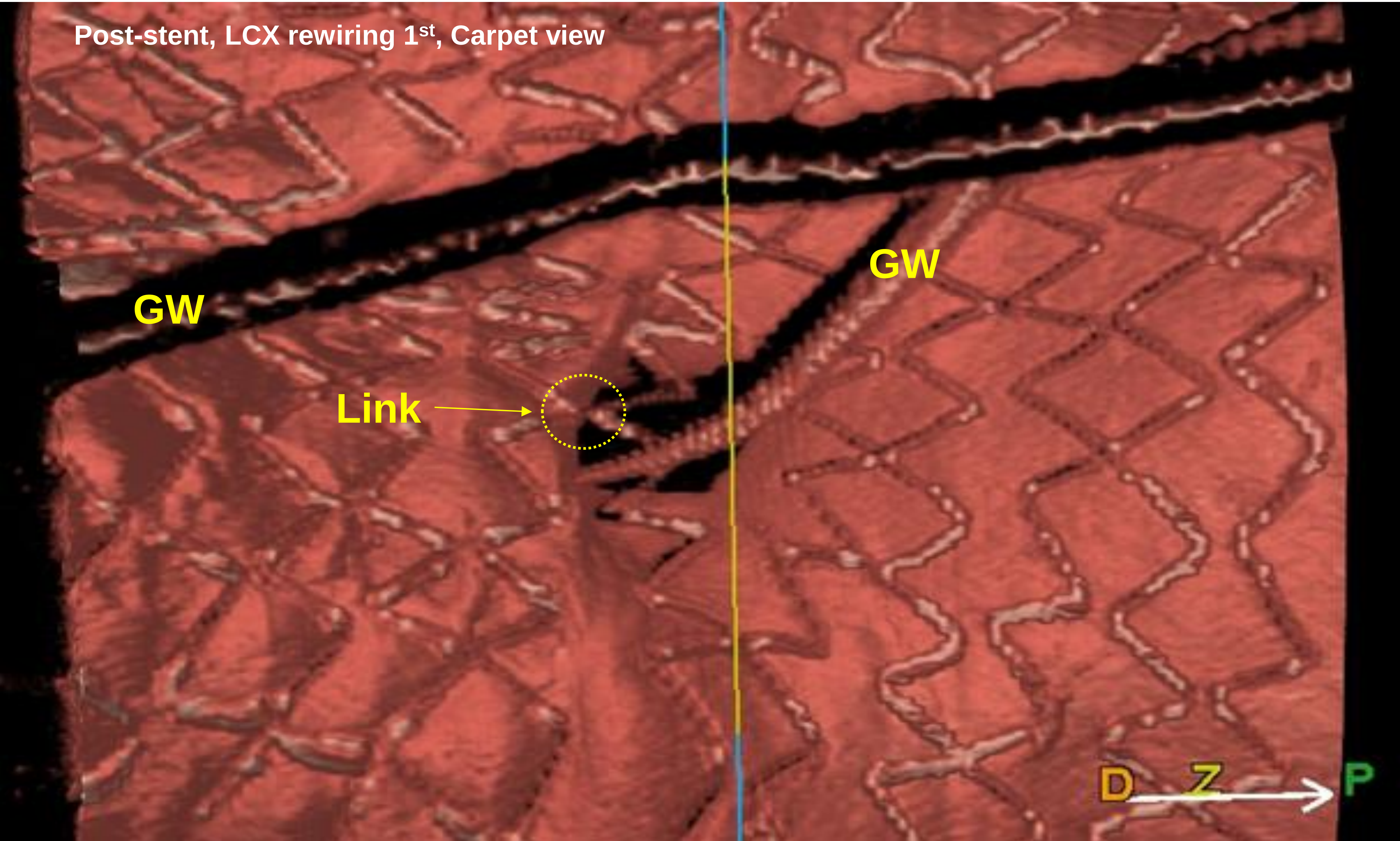
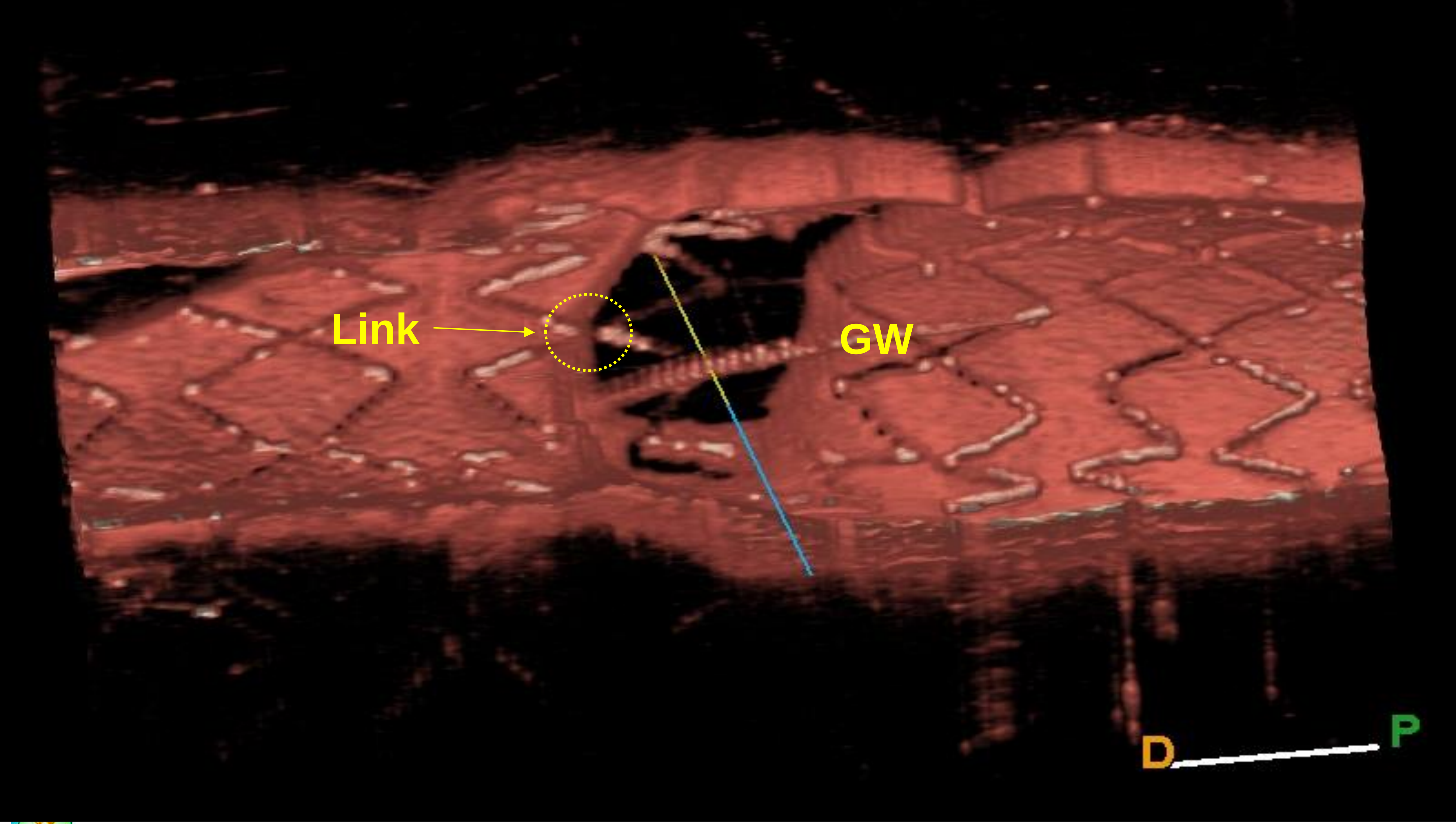
New Development in OCT

Re-crossing wire position in the jailed side branch can be easily identified by new OCT and improvement of side branch KBT procedure could be expected by using new OCT.


Post-stent, LCX rewiring 1st, Carpet view
GW
GW
Link
D
Z
P

Post-stent, LCX rewiring 1st, Cut-away view



3D optical coherence tomography: new insights into the process of optimal rewiring of side branches during bifurcational stenting

Takayuki Okamura[1]*, MD, PhD; Yoshinobu Onuma[2], MD; Jutaro Yamada[1], MD, PhD;
Javaid Iqbal[2], MRCP, PhD; Hiroki Tateishi[1], MD, PhD; Tomoko Nao[1], MD, PhD; Takamasa Oda[1], MD;
Takao Maeda[1], MD; Takeshi Nakamura[1], MD; Toshiro Miura[1], MD, PhD; Masafumi Yano[1], MD, PhD;
Patrick W. Serruys[2], MD, PhD, FESC, FACC

1. Division of Cardiology, Departm…
Ube, Japan; 2. Thoraxcenter, Erasm…

T. Okamura and Y. Onuma have co…

GUEST EDITOR: Carlo Di Mario…
Brompton Hospital, London, United…

Abstract

Aims: We describe three-dimensional optical coherence tomography (3D-OCT) guided bifurcation stenting and the clinical utility of 3D-OCT.

Methods and results: Twenty-two consecutive patients who underwent OCT examination to confirm the recrossing position after stent implantation in a bifurcation lesion were enrolled. Frequency domain OCT images were obtained to check the recrossing position and 3D reconstructions were performed off-line. The recrossing position was clearly visualised in 18/22 (81.8%) cases. In 13 cases, serial 3D-OCT could be assessed both before and after final kissing balloon post-dilation (FKBD). We divided these cases into two groups according to the presence of the link between hoops at the carina: free carina type (n=7) and connecting to carina type (n=6). All free carina types complied with the distal rewiring. The percentage of incomplete stent apposition (%ISA) of free carina type at the bifurcation segment after FKBD was significantly smaller than that of the connecting to carina type (0.7±0.9% vs. 12.2±6.5%, p=0.0074).

Conclusions: 3D-OCT confirmation of the recrossing into the jailed side branch is feasible during PCI and may help to achieve distal rewiring and favourable stent positioning against the side branch ostium, leading to reduction in ISA and potentially better clinical outcomes.

Japanese registry for 3-D OCT guided LM bifurcation stenting

Study population (Final)

More than 300 LM bifurcation lesions

Primary endpoint

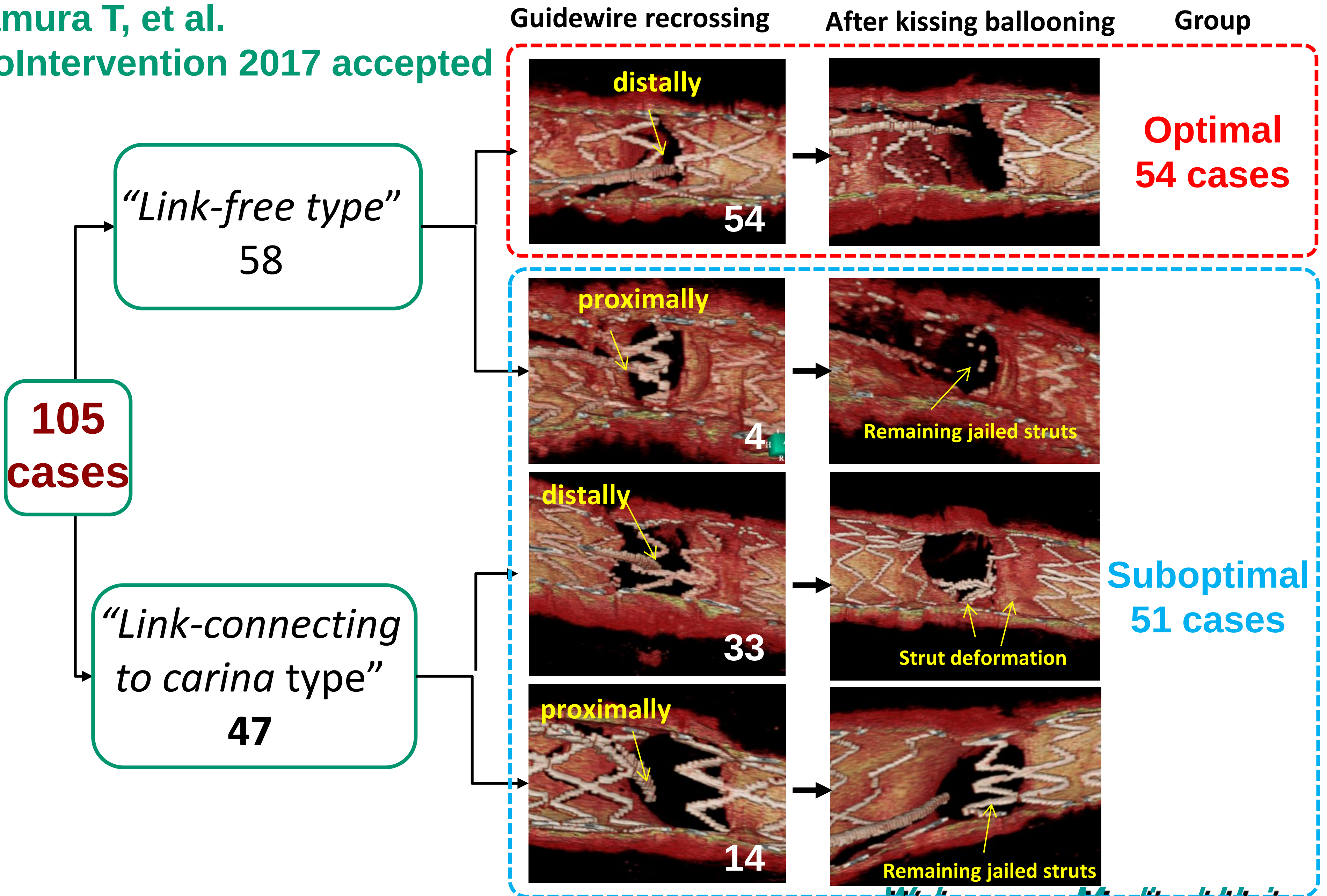
Frequency of re-wiring by 3-D OCT guidance:
re-wiring should be required again more than 30 % cases.

Secondary endpoint

Incidence of ISA:
MACE:

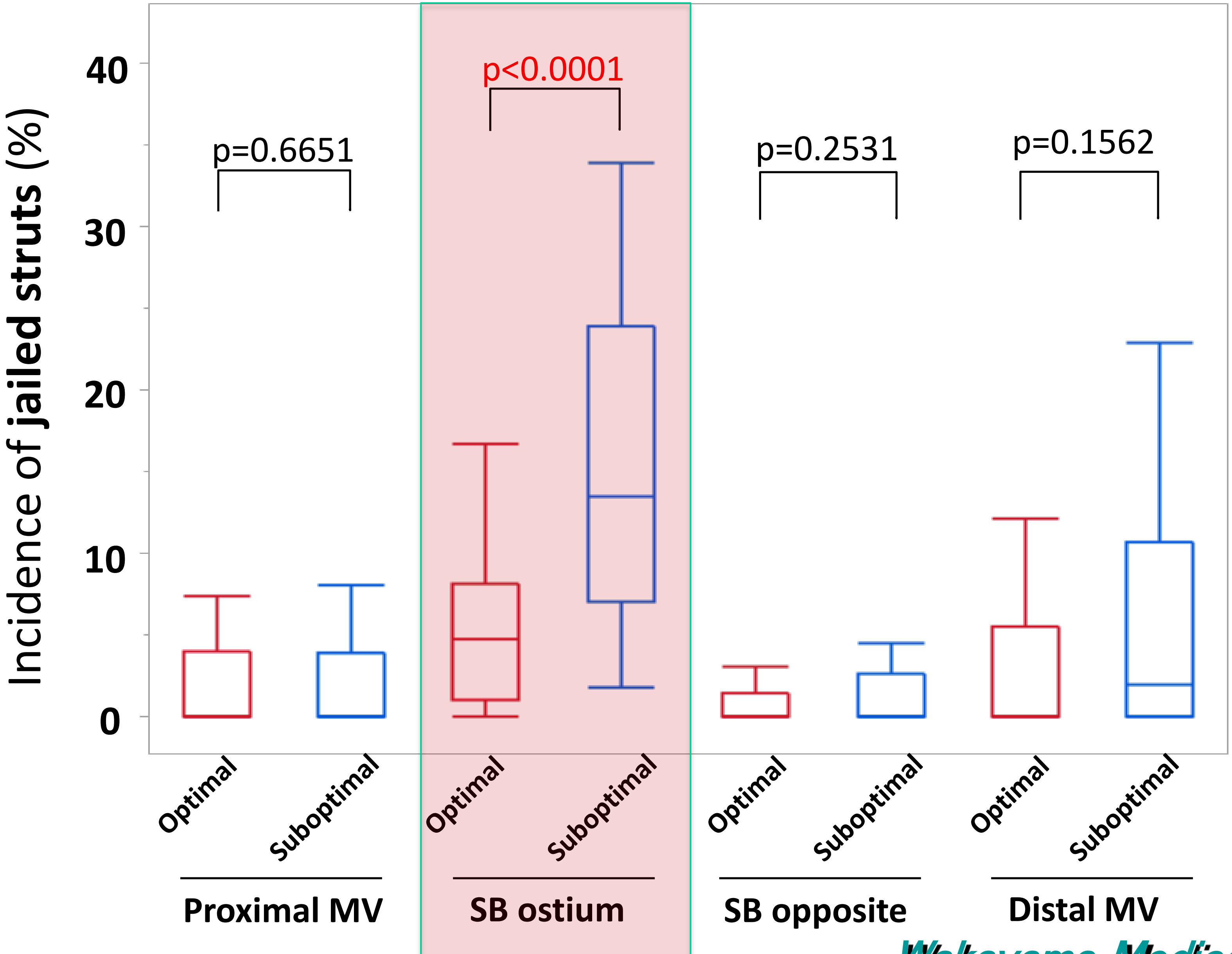
Frequency of jailing configuration & GW rewiring position

Okamura T, et al.
EuroIntervention 2017 accepted



Incidence of ISA at each segment

Okamura T, et al. EuroIntervention 2017 accepted



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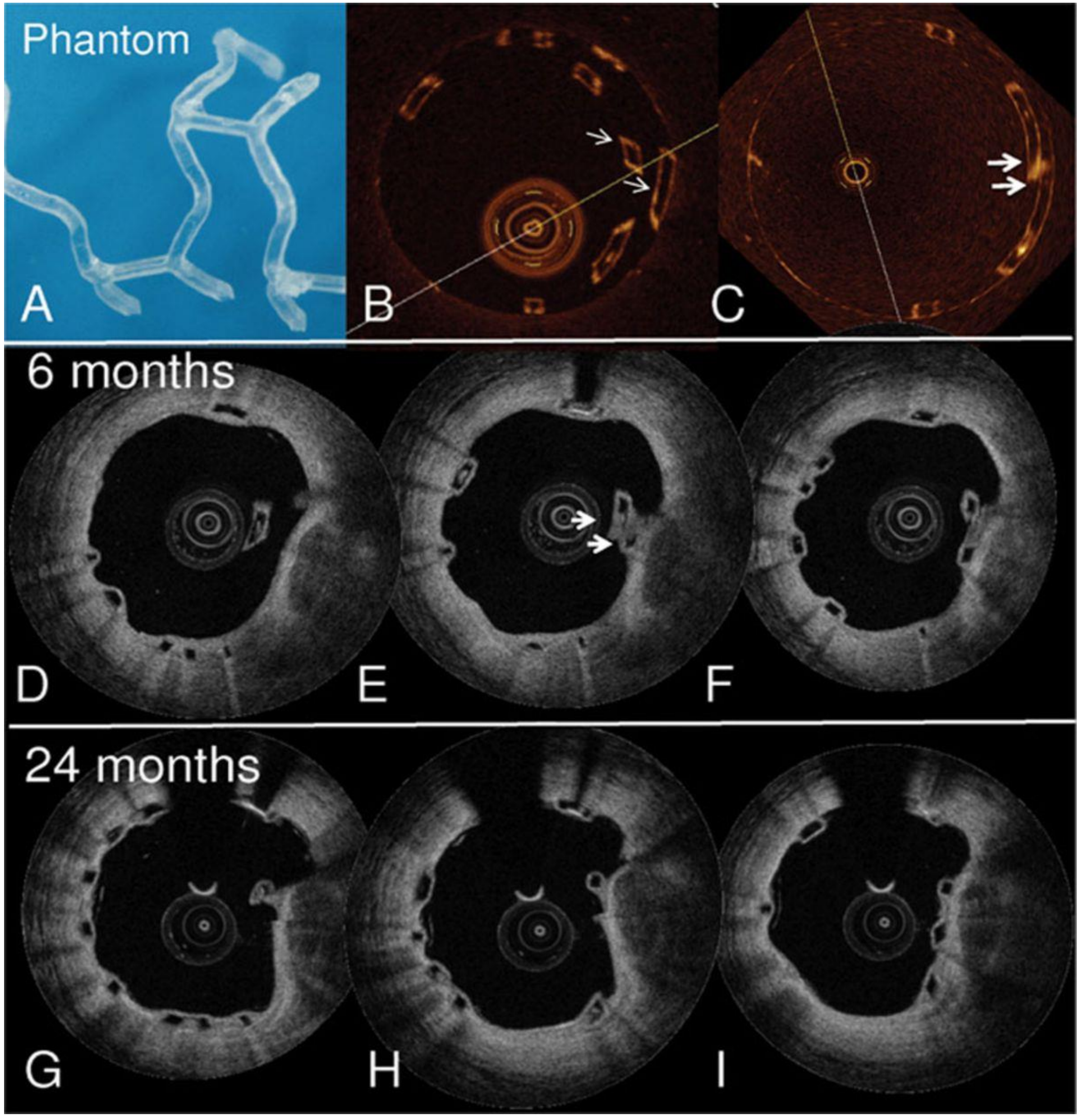
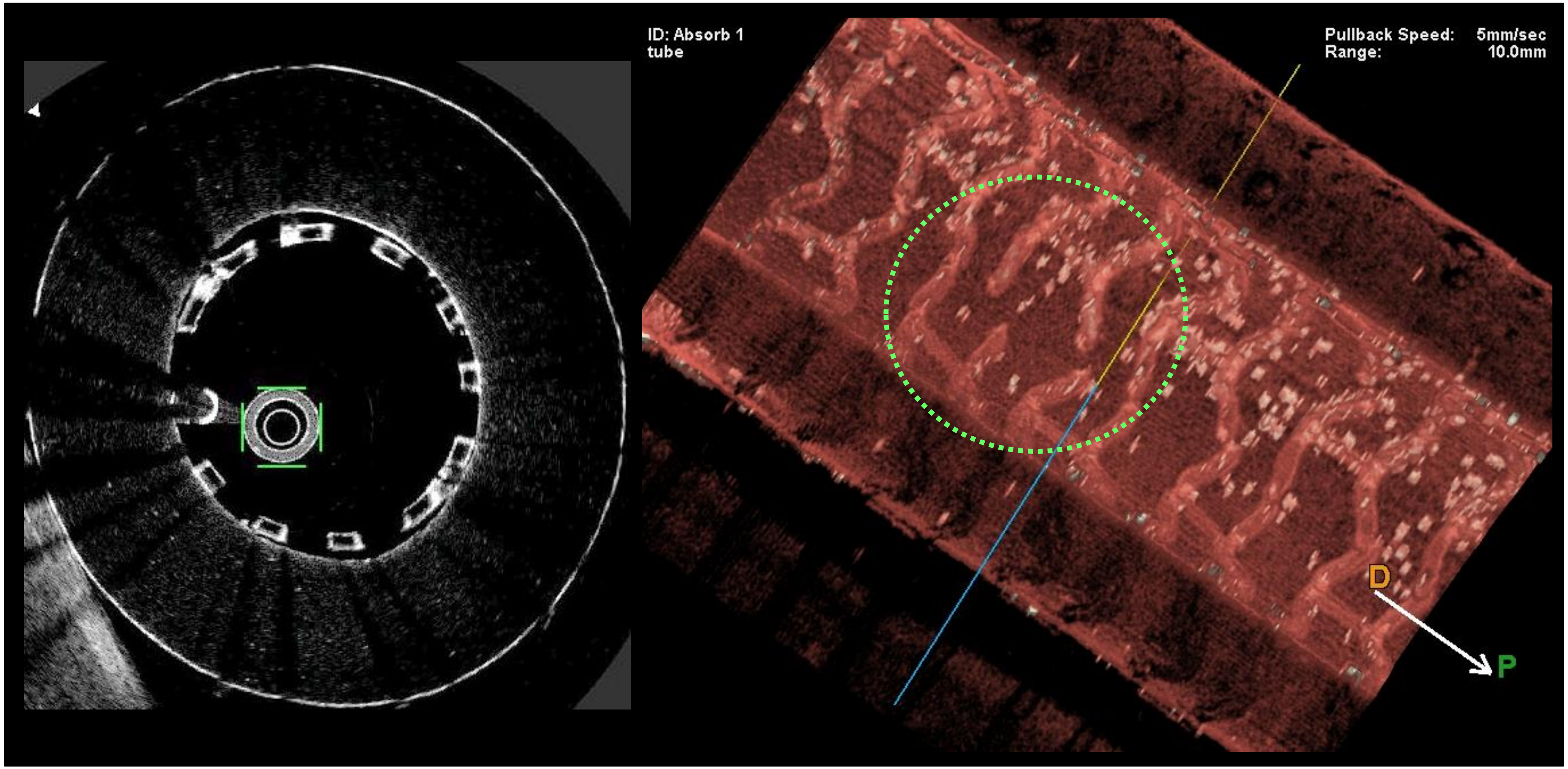
Assessment of BVS by OFDI



Ormiston J A et al. Circ Cardiovasc Interv 2012;5:620-632

BVS damage grade 1: Discontinuity



Take home message

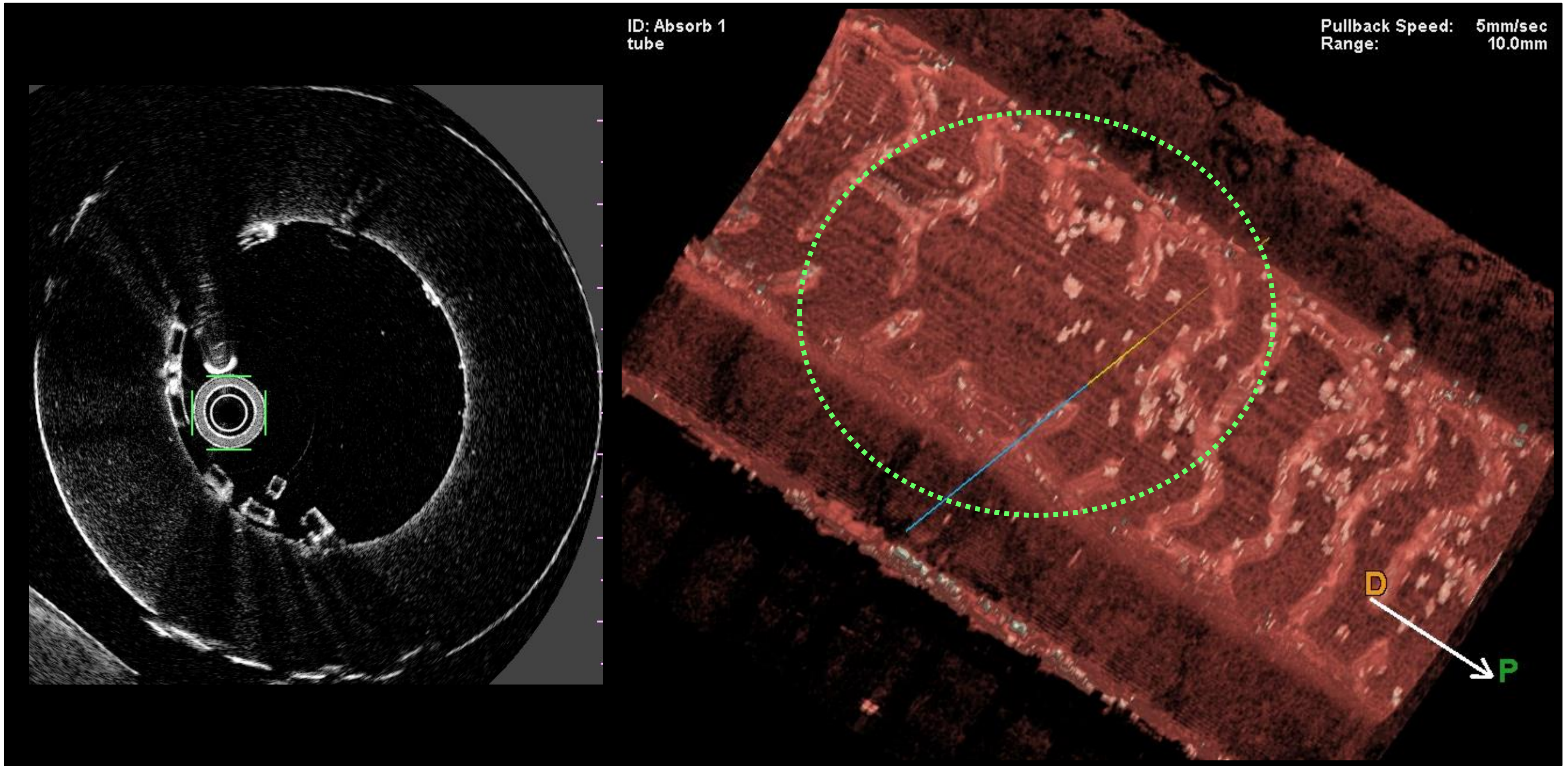
Can OCT replace IVUS in daily practice ?

- **Similar to IVUS, OCT-guided PCI could be useful to improve the result of PCI and clinical outcomes and class IIa recommendation might be expected in OCT-guided PCI in the near future., although there are several advantages and disadvantages in IVUS and OCT.**

- **OCT can replace IVUS in almost all cases in daily practice except for several specific cases such as LM or RCA orifice lesion, CTO, CKD, and so on.**

- **OCT may have advantages to know the pathophysiology of ACS, instent restenosis, severe calcified lesion, BRS implantation, etc., and 3-D reconstruction may improve bifurcation lesion treatment.**

BVS damage grade 3: Deficiency



Prediction of side branch occlusion by OCT

Watanabe M et al. Coron Artery Dis 2014; 25: 321-329

Side branch occlusion might be occurred less frequently in cases with carina tip (CT) angle≧50 degree and branch point to carina tip(BP-CT) length≧1.7mm