MT2

Imaging & Physiology Summit 2010 in Soul

#1. Basics of Image Interpretation: IVUS/VH/OCT

Clinical Application of OCT in Stent Evaluation

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MD, PhD, FACC

Toyohashi Heart Center

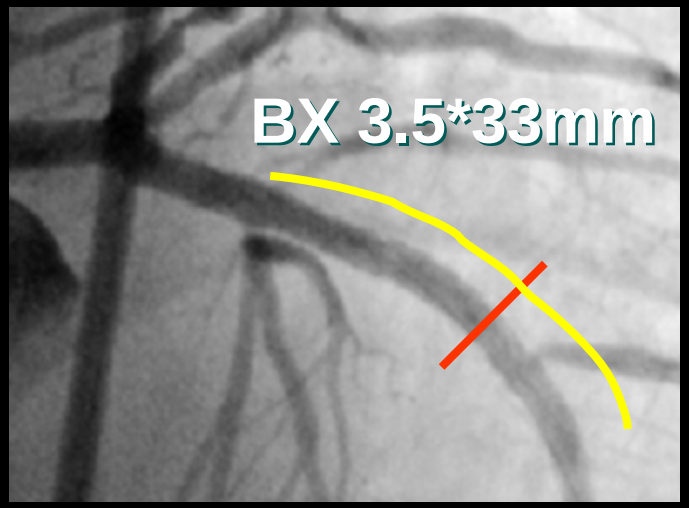
슬라이드 1

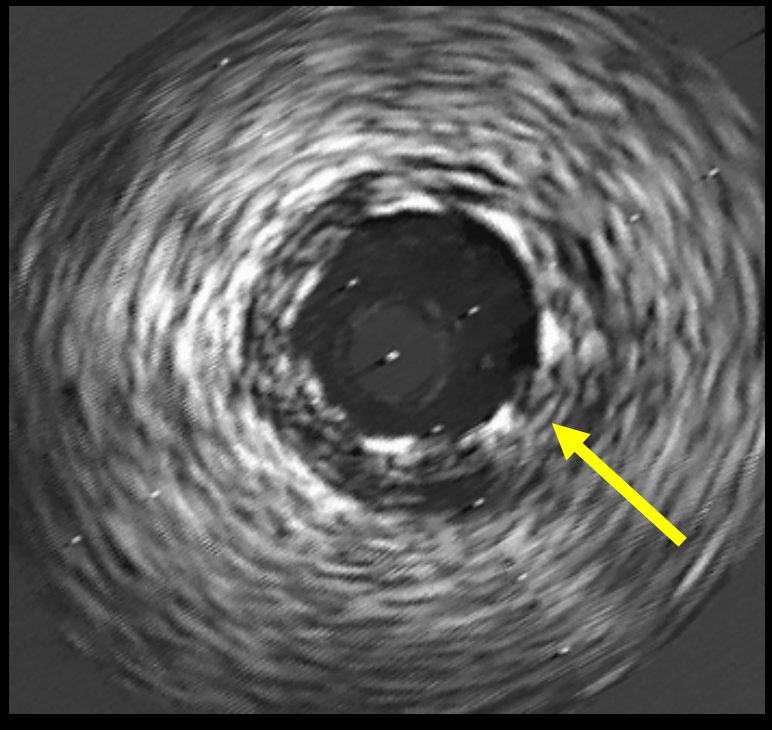
MT2 Mitsu, 2005-11-19

Stent implantation

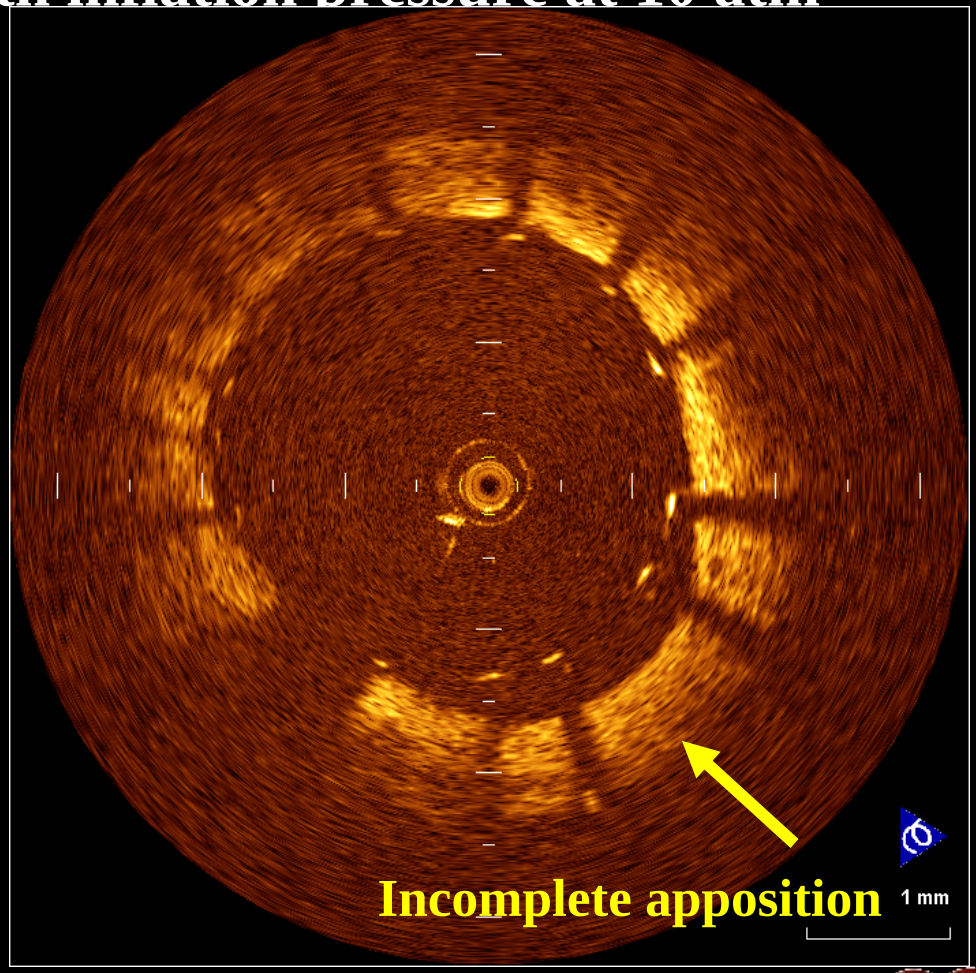
Stent Apposition

Incomplete apposition





After stenting of the mid-LAD with inflation pressure at 10 atm



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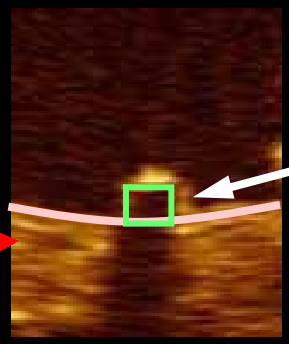
OCT Image of Implanted stent Just after Deployment

✓ Apposition of stent strut to the vessel wall is evaluated by measuring the distance between the strut surface and adjacent vessel surface.

Complete stent apposition (CSA)



✓ Near infrared light used in OCT cannot penetrate the metallic stent strut, so stent struts are visualized as linear reflection and typical dorsal shadowing.

Incomplete stent apposition (ISA)

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Original Contribution

Accuracy and Reproducibility of Stent-Strut Thickness Determined by Optical Coherence Tomography

Mitsuyasu Terashima, MD, Sudhir Rathore, MD, MRCP(UK), Yasuyoshi Suzuki, BS, Yoshiaki Nakayama, BS, §Hideaki Kaneda, MD, Kenya Nasu, MD, Maoto Habara, MD, Osamu Katoh, MD, Takahiko Suzuki, MD

Jornal of Invasive Cardiology 2009;21:602–605

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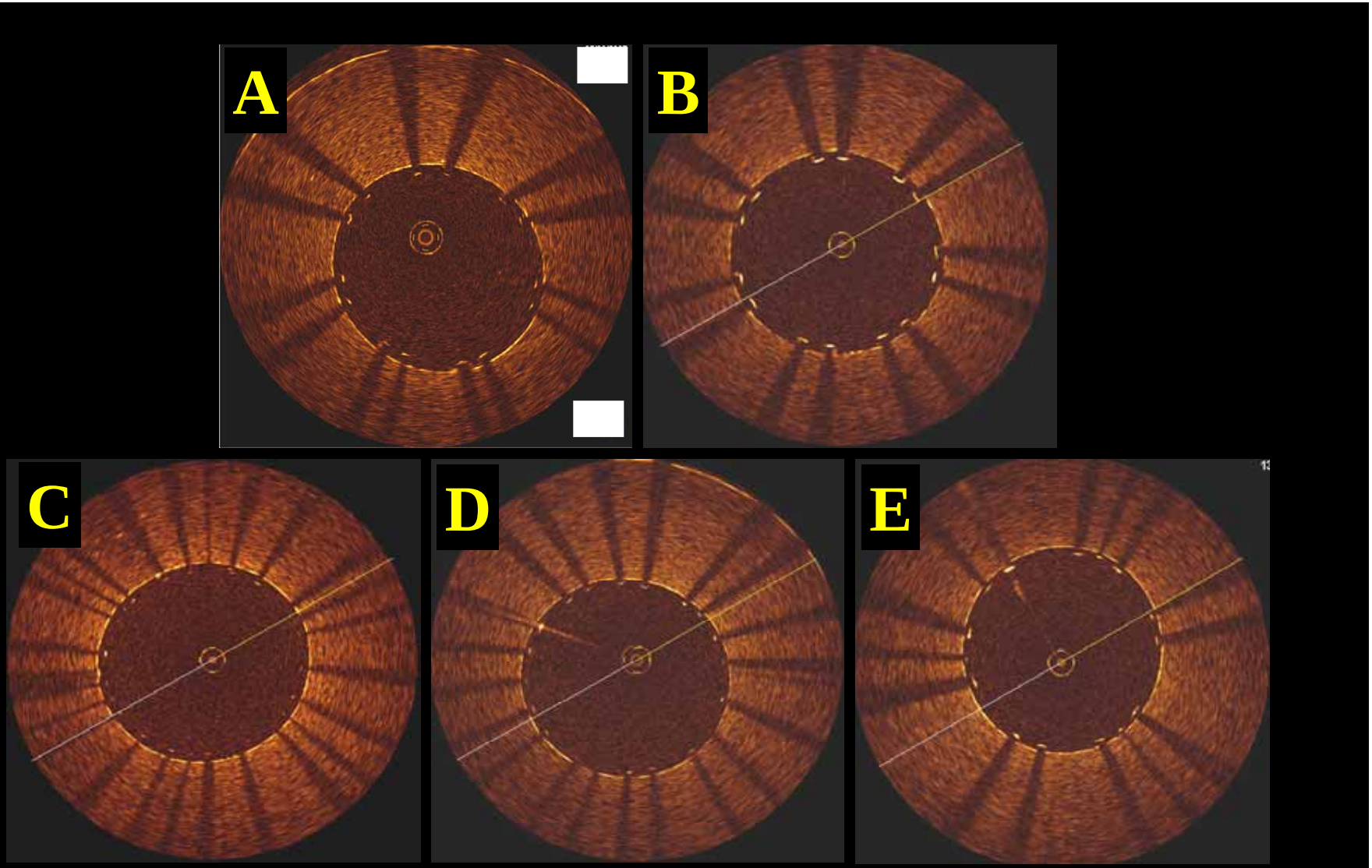

Fig. 3: Cross sectional optical coherence tomography images of individual stents implanted in the phantom model
A: Bx Velocity™ stent, B: Cypher™ stent, C: Express2™ stent, D: Driver™ stent, E: Vision™ stent

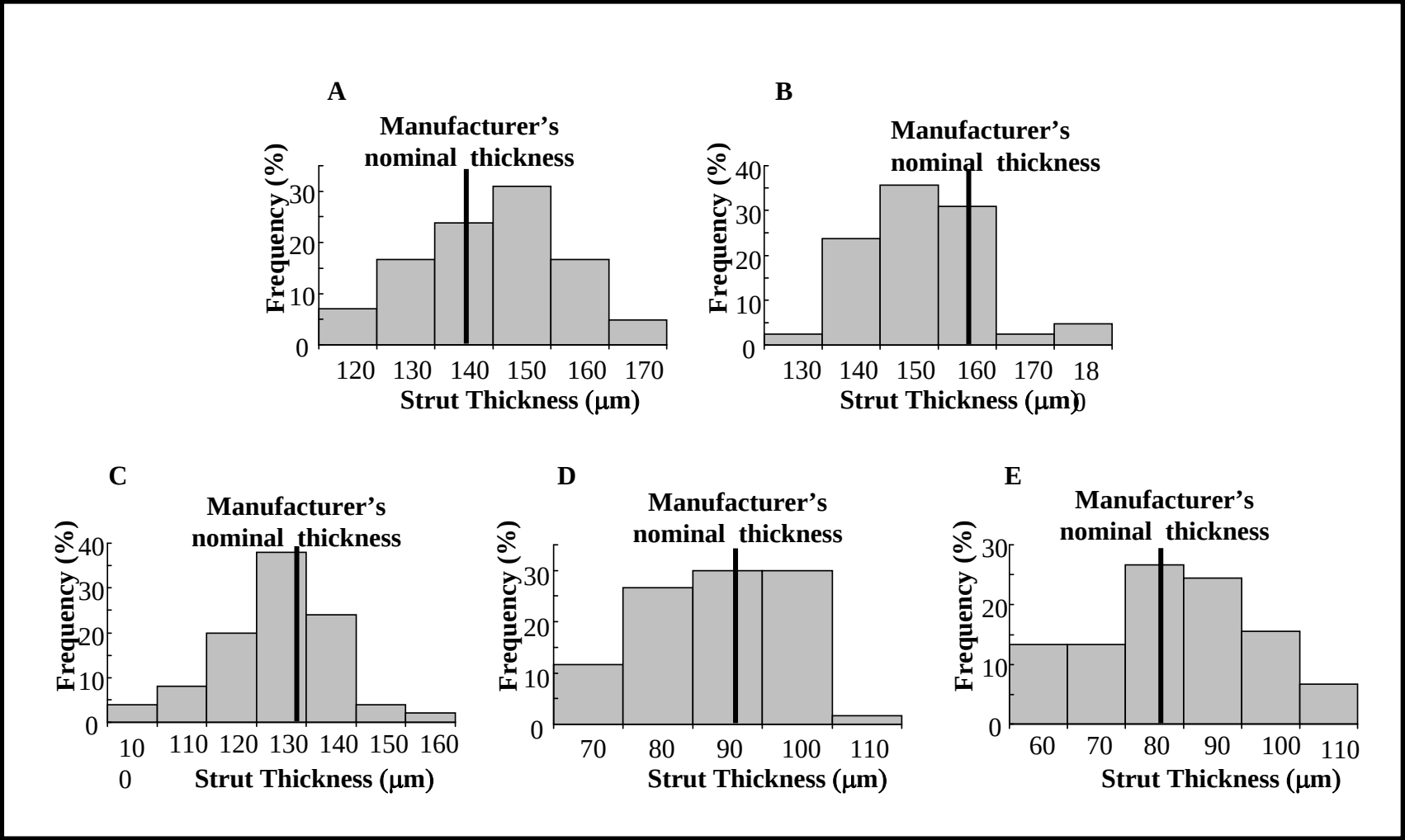

Fig. 4: Histograms of measurements of individual stents
A: Bx Velocity™ stent, B: Cypher™ stent, C: Express2™ stent, D: Driver™ stent, E: Vision™ stent

Jornal of Invasive Cardiology 2009;21:602–605

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Table 1. Measured and Manufacturers' nominal strut thickness

Type of stent	Number	Measured Thickness (mm)	95% CI (mm)	Manufacturer's nominal thickness (mm)	Difference (mm)
Bx-Velocity	42	145 ± 13	141 to 149	140 (0.0055 inch)	+5 ± 13
Cypher	42	152 ± 11	149 to 155	160 (0.0055 inch + polymer)	-8 ± 11
Express	50	129 ± 12	126 to 132	132 (0.0052 inch)	-3 ± 12
Driver	60	88 ± 10	86 to 91	91 (0.0036 inch)	-3 ± 10
Vision	45	84 ± 14	79 to 88	81 (0.0032 inch)	3 ± 14

Jornal of Invasive Cardiology 2009;21:602–605

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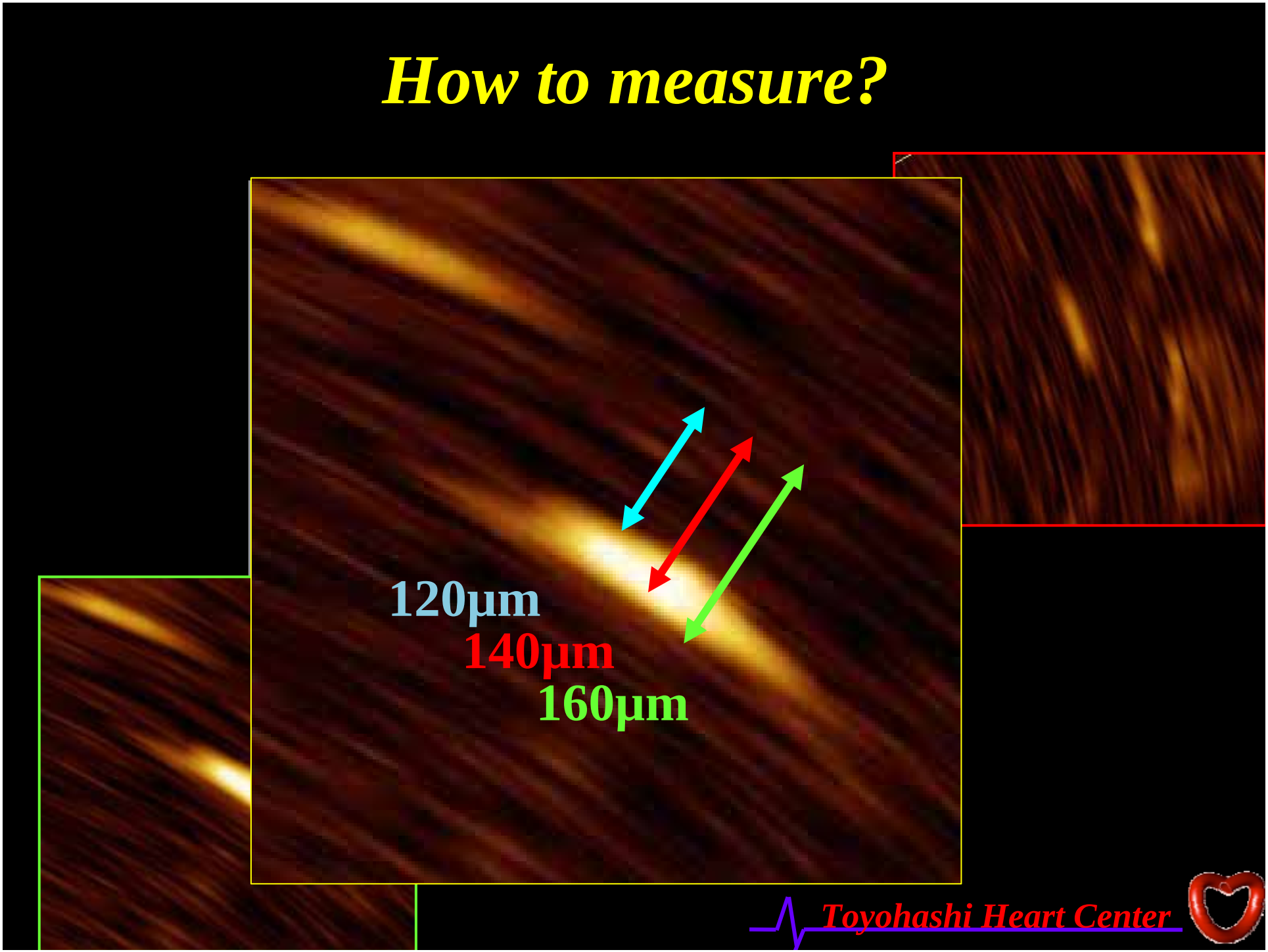
How to measure?



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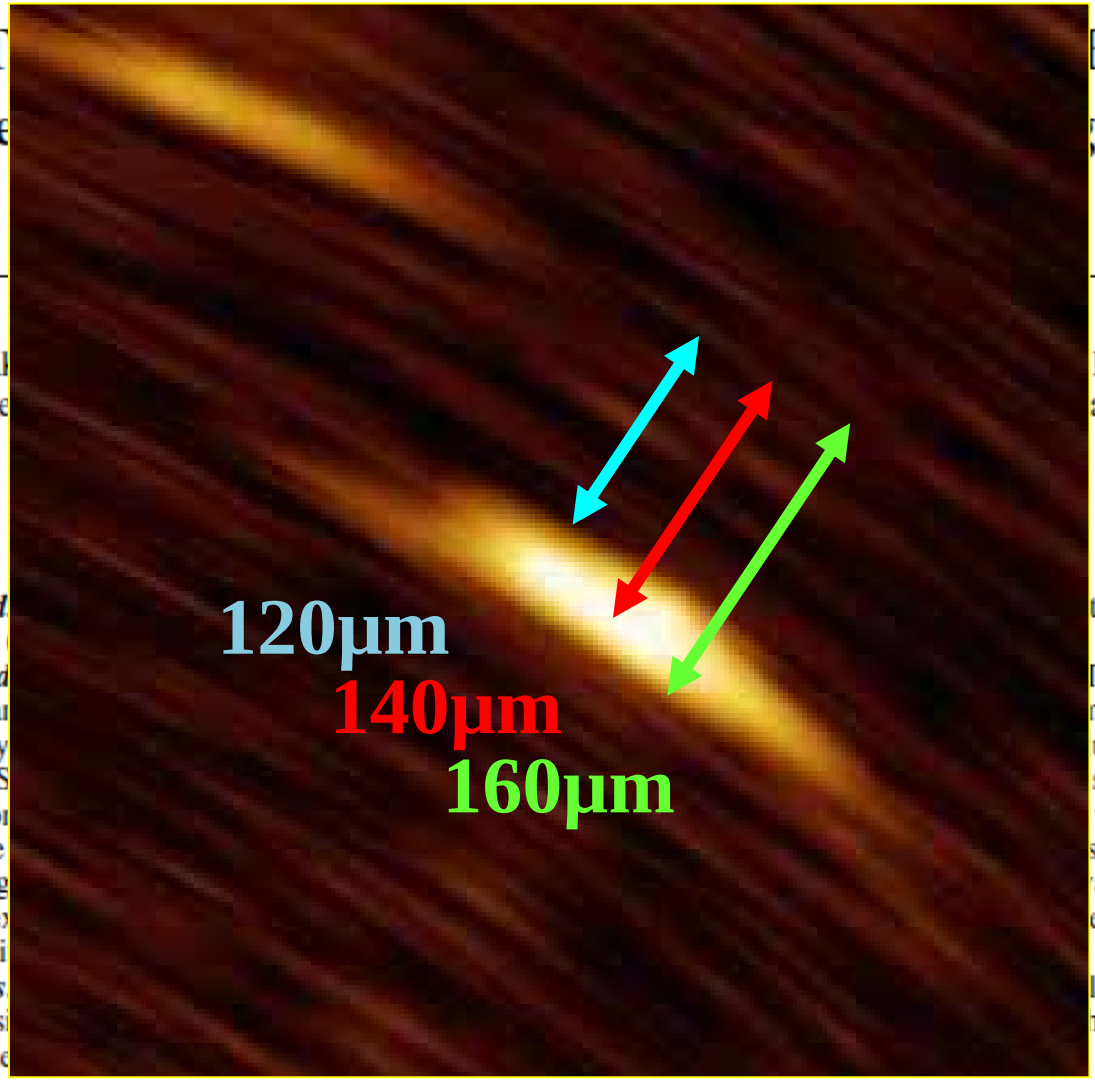
ORIGINAL ARTICLE Cardiovascular Intervention *Circ J* 2009; **73:** 1841–1847

Factors T… Evaluation of Ste… graphy

Tak… MD;
Yusuke… ato, MD;

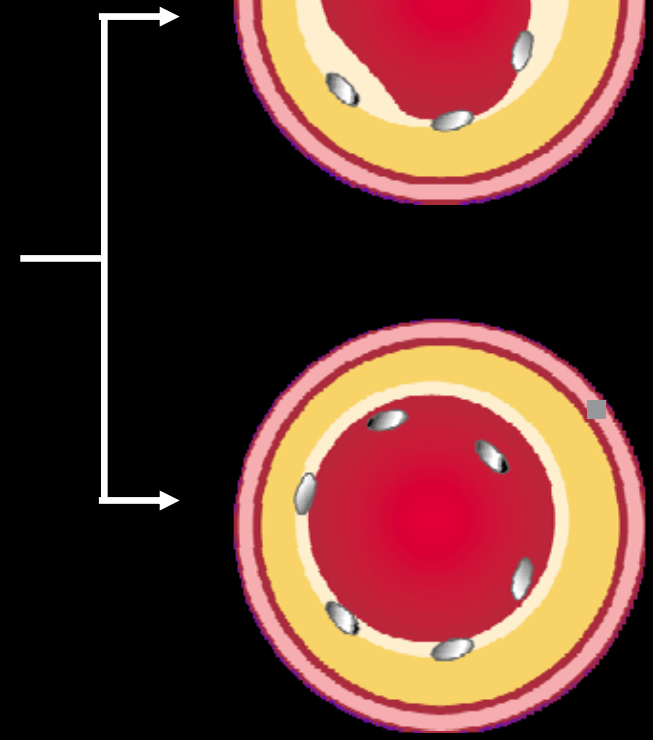


Background …tical coherence tomography (…
Methods and …Γ under various conditions a… models were examined by… uation of stent apposition. S… stent shadow). The precisio… wire was positioned in the… sitioned eccentrically using… values under all conditions e… el wall surface coincided wi…
Conclusions …ly with a lower frame acquisi… e stent surface should be m…

Key Words: Imaging; Percutaneous coronary intervention (PCI); Optical coherence tomography (OCT)

Fates of Incomplete Apposition

- Baseline Incomplete Apposition



- Healed/Resolved Incomplete Apposition
- Preserved Incomplete Apposition

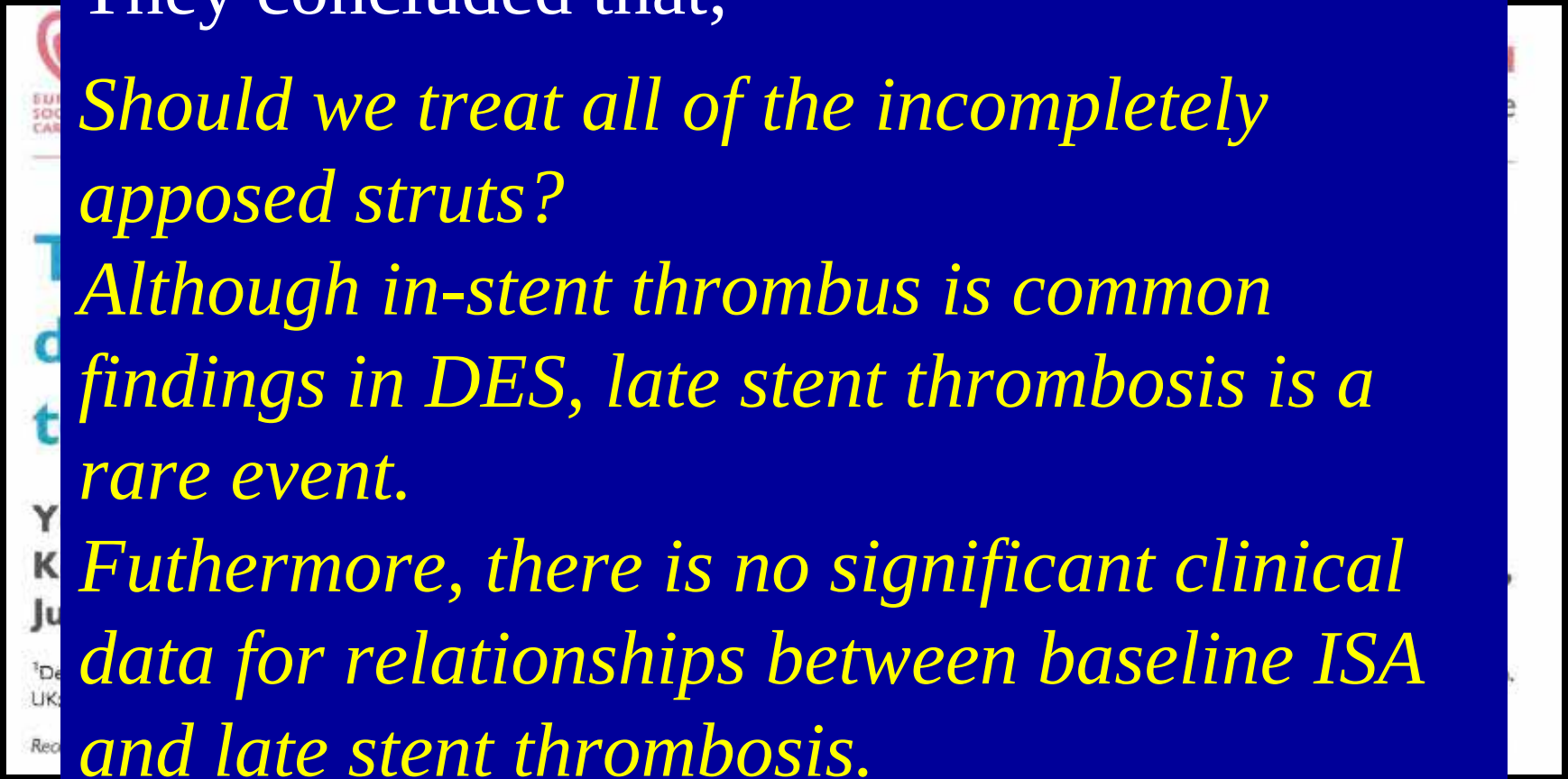
They concluded that;

Should we treat all of the incompletely apposed struts?

Although in-stent thrombus is common findings in DES, late stent thrombosis is a rare event.

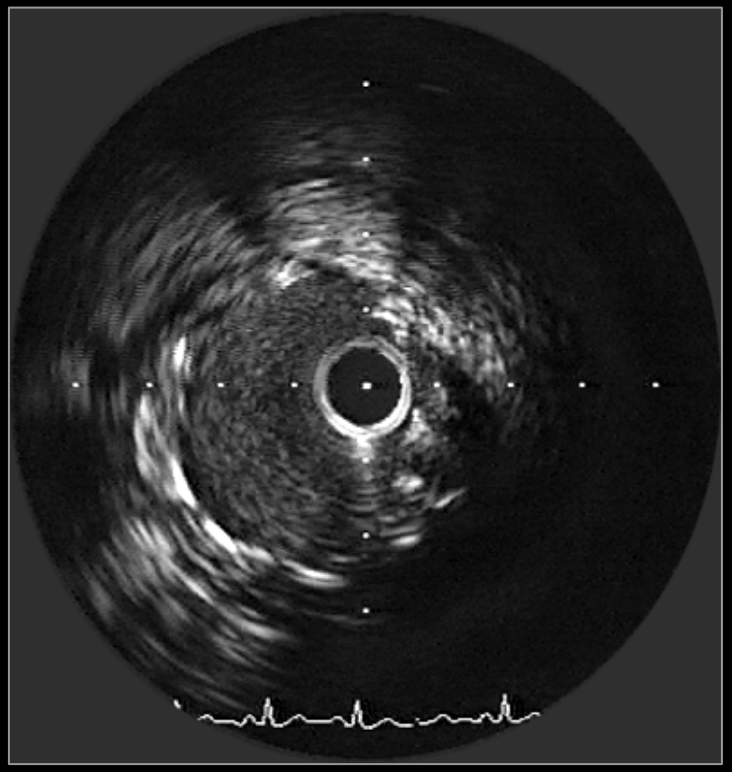
Futhermore, there is no significant clinical data for relationships between baseline ISA and late stent thrombosis.

Then, is there any acceptable indication for treatment of ISA?

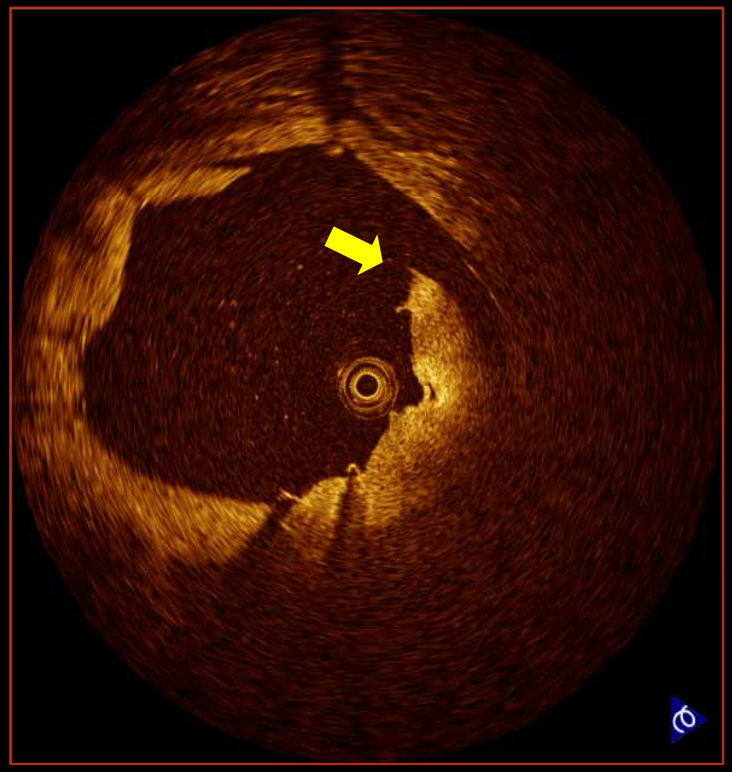


Flap / Dissection

IVUS



OCT



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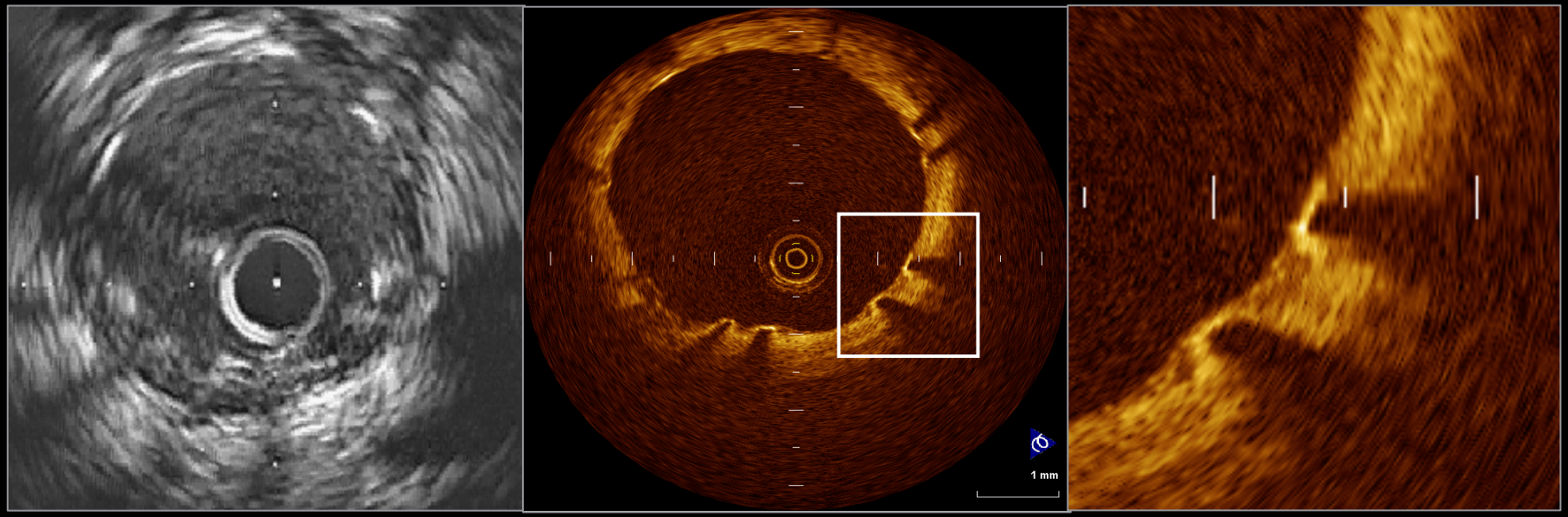
Chronic Vascular Responses to Coronary Stenting by Optical Coherence Tomography

Neointimal Coverage of Stent struts

IVUS and OCT image of SES at 3-month follow-up



✓ **OCT provides detailed visualization of the individual stent struts and a thin neointimal layer over DES struts that IVUS can not detect.**

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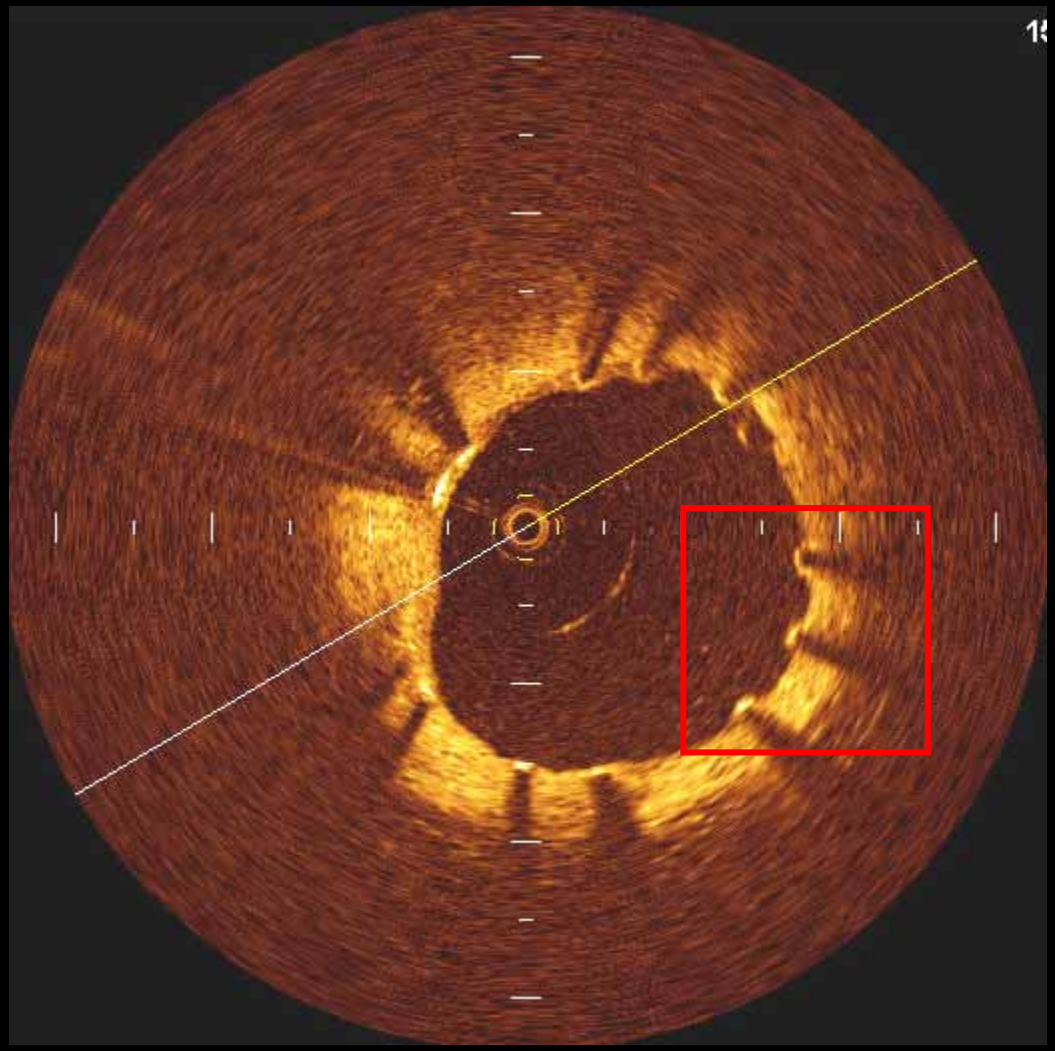
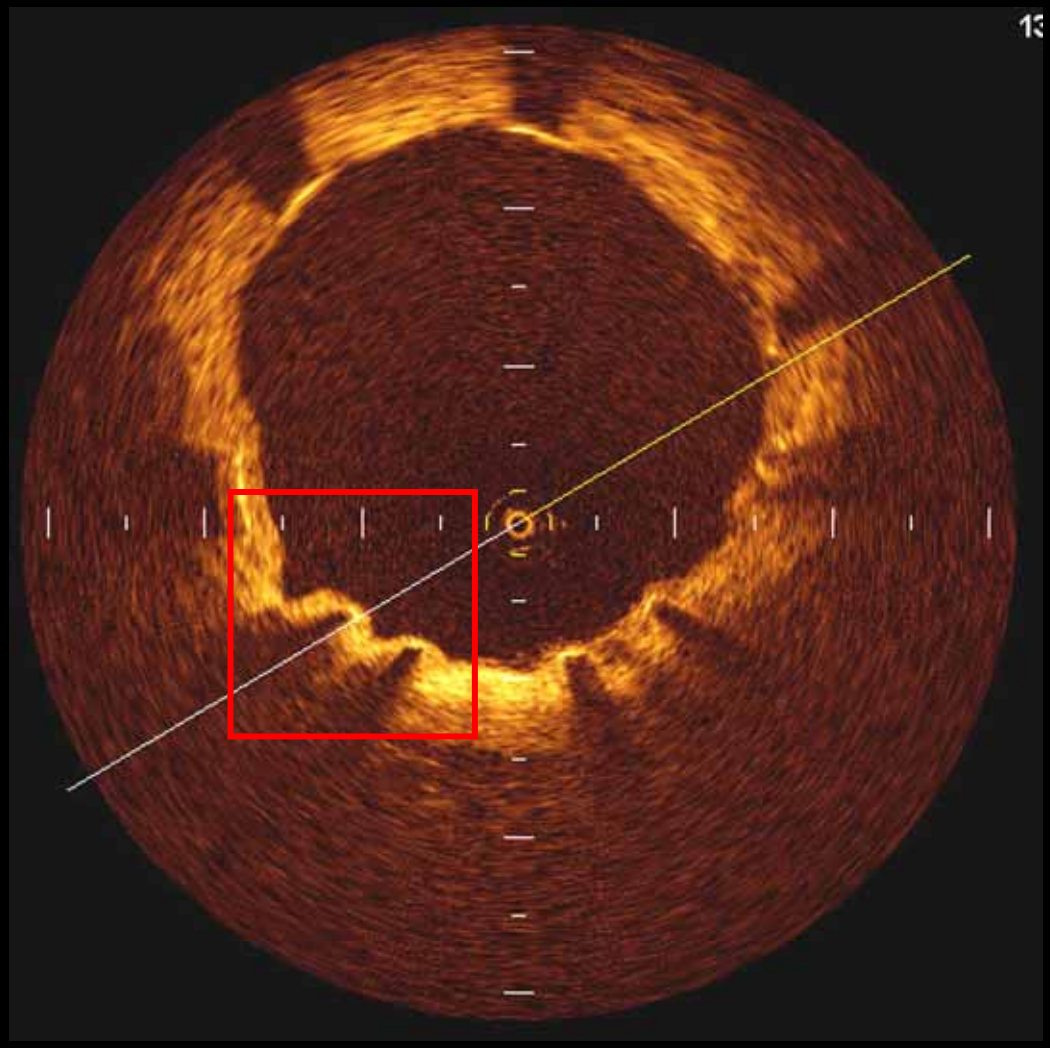
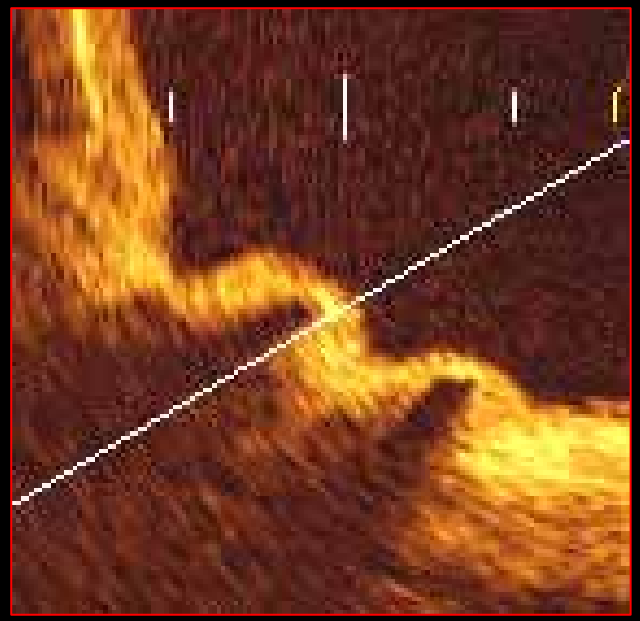
Classification of Neointimal Coverage
~ Morphology ~

Intimal Stent Strut Coverage Type 1 & 2



Intimal Stent Strut Coverage Type 3





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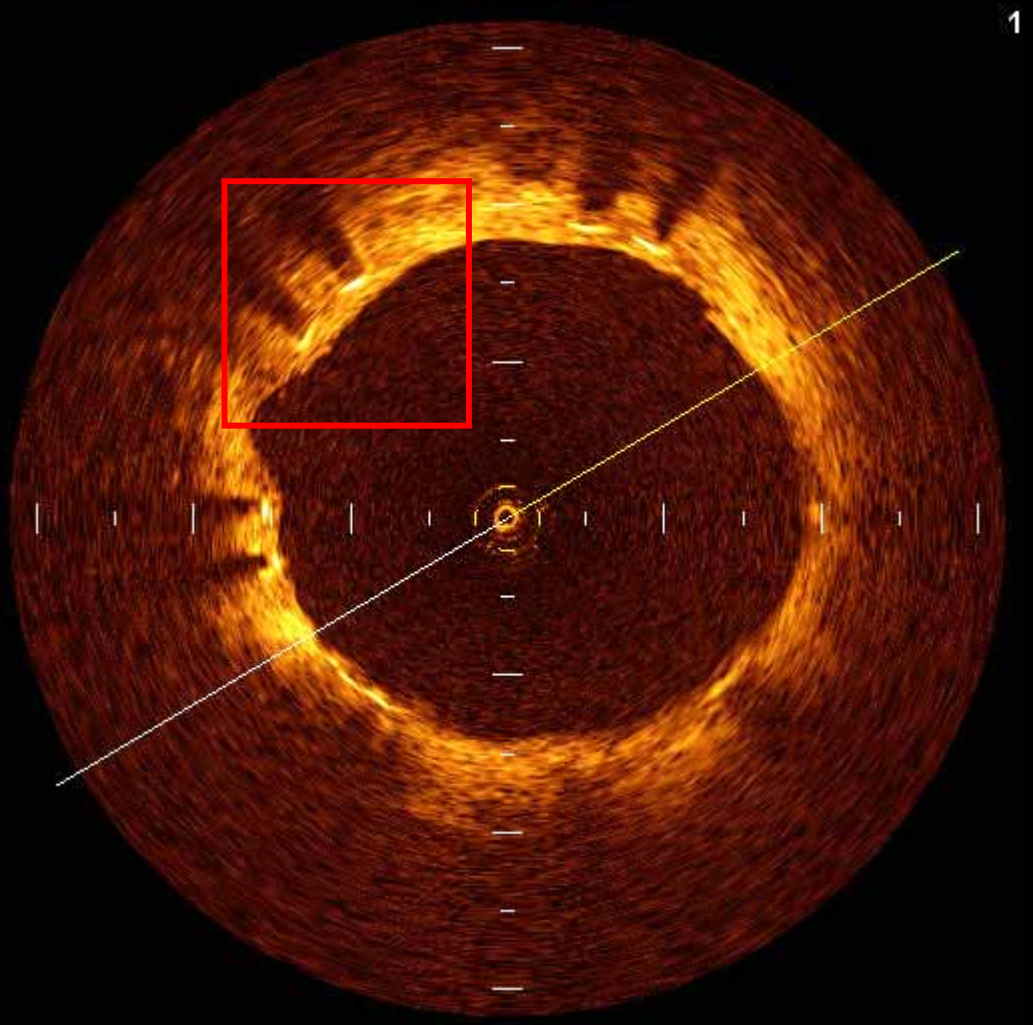
Intimal Stent Strut Coverage Type 4



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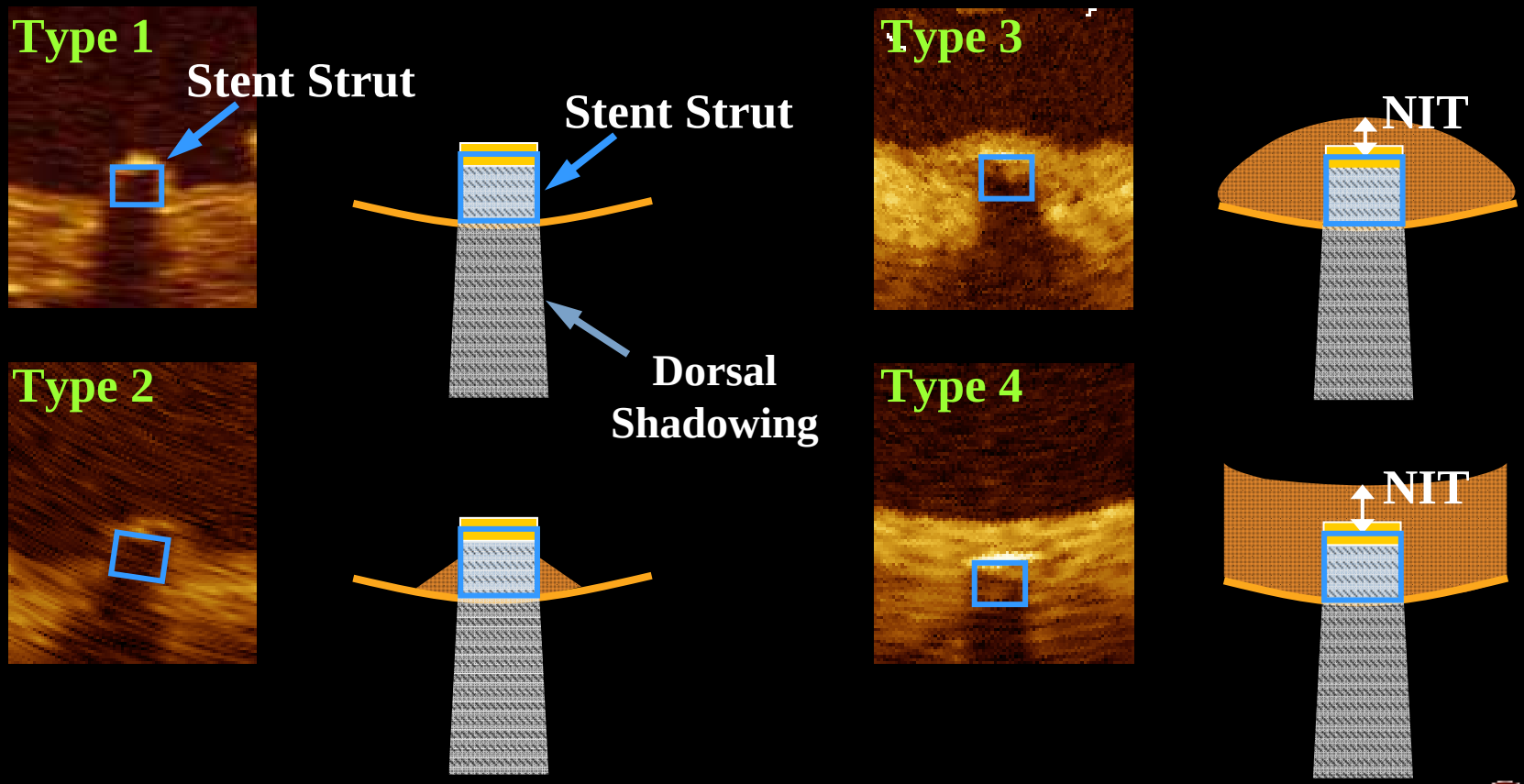
Definition of Neointimal Coverage of Struts

Uncovered Struts

Covered Struts



Ito t, et al, 2006 ACC

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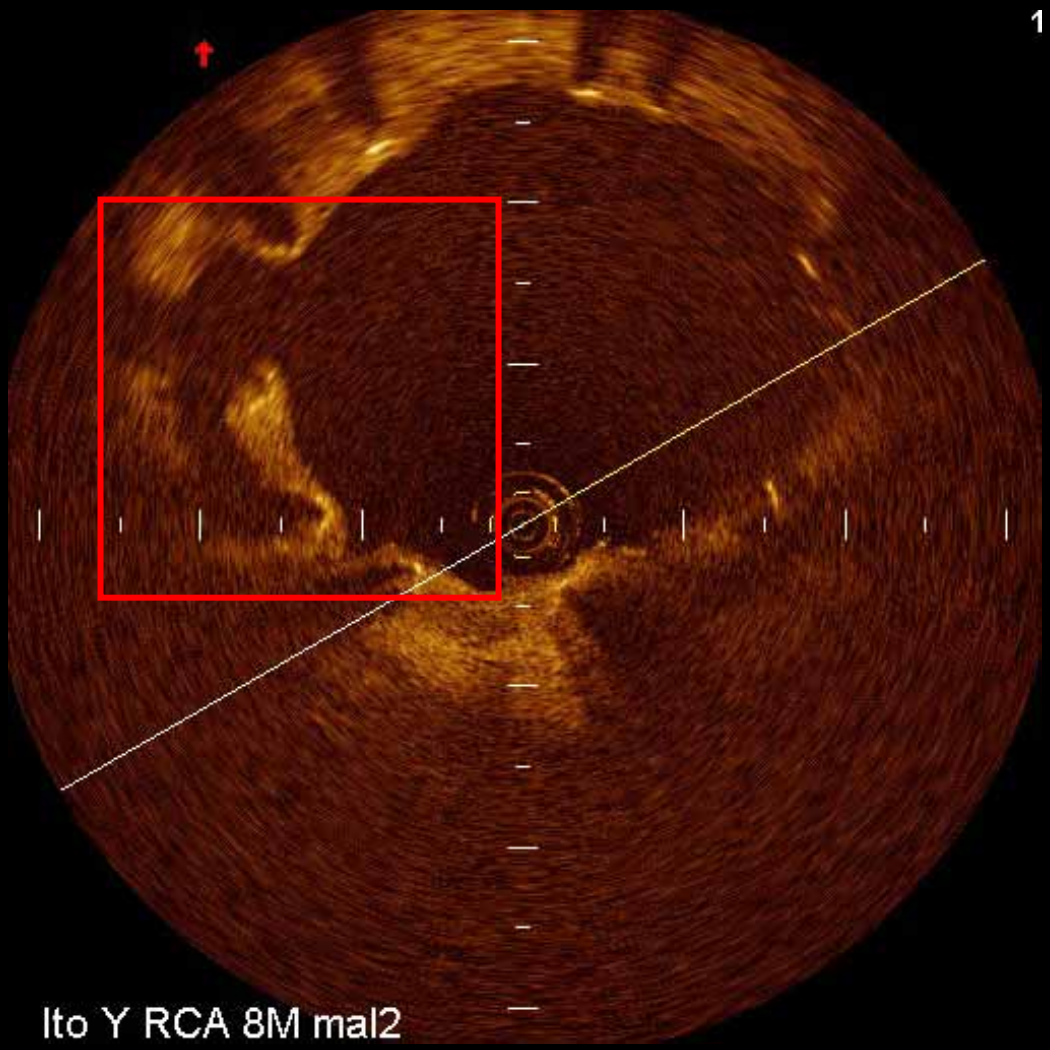
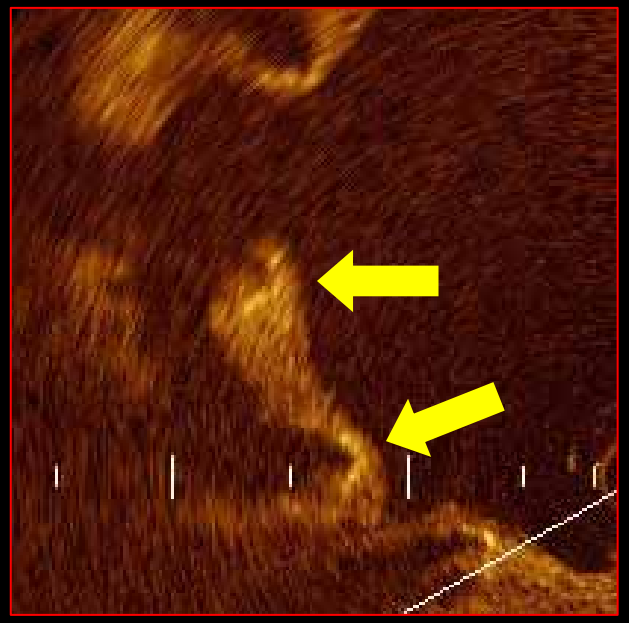
Intimal Coverage of unapposed Stent Strut





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Catheterization and Cardiovascular Interventions 72:237–247 (2008)

Interventional Rounds

Optical Coherence Tomography: High Resolution Intravascular Imaging to Evaluate Vascular Healing after Coronary Stenting

Giulio Guagliumi, MD and Vasile Sirbu, MD

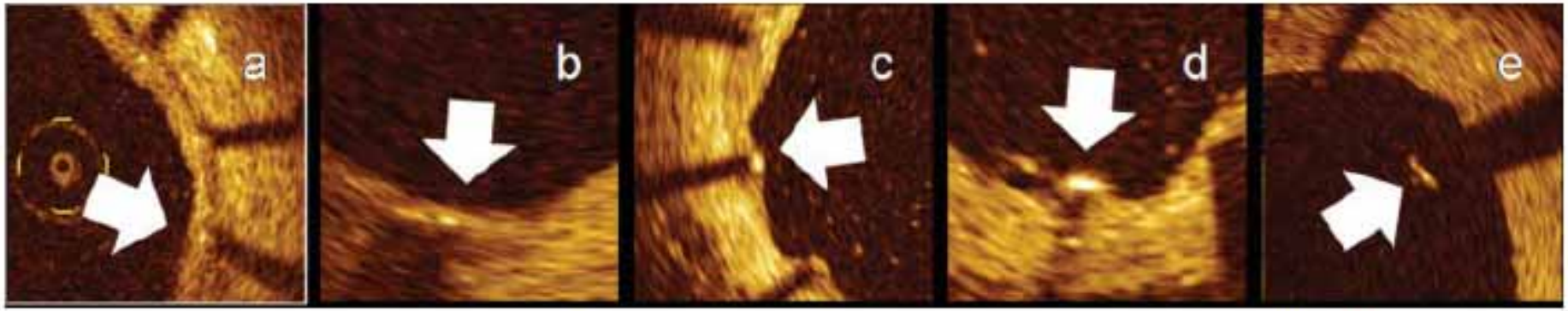


Fig. 2. Classification of strut apposition by OCT. Frames a–e represent Types I, II, IIIa, IIIb, and IV, respectively. (a) Totally embedded strut (Type I). (b) Embedded subintimally without disruption of lumen contour (Type II). (c) Completely embedded with disruption of lumen contour (Type IIIa). (d) Partially embedded with extension of strut into lumen (Type IIIb). (e) Complete strut malapposition (blood able to exist between strut and lumen wall) (Type IV).

Classification of Neointimal Coverage of Strut

by Kobe University

(1) Well apposed with neointima
(2) Well apposed without neointima
(3) Malapposed with neointima
(4) Malapposed without neointima
(5) Side branch orifice with neointima
(6) Side branch orifice without neointima

注： Malapposition:
Incomplete Stent Apposition (ISA)

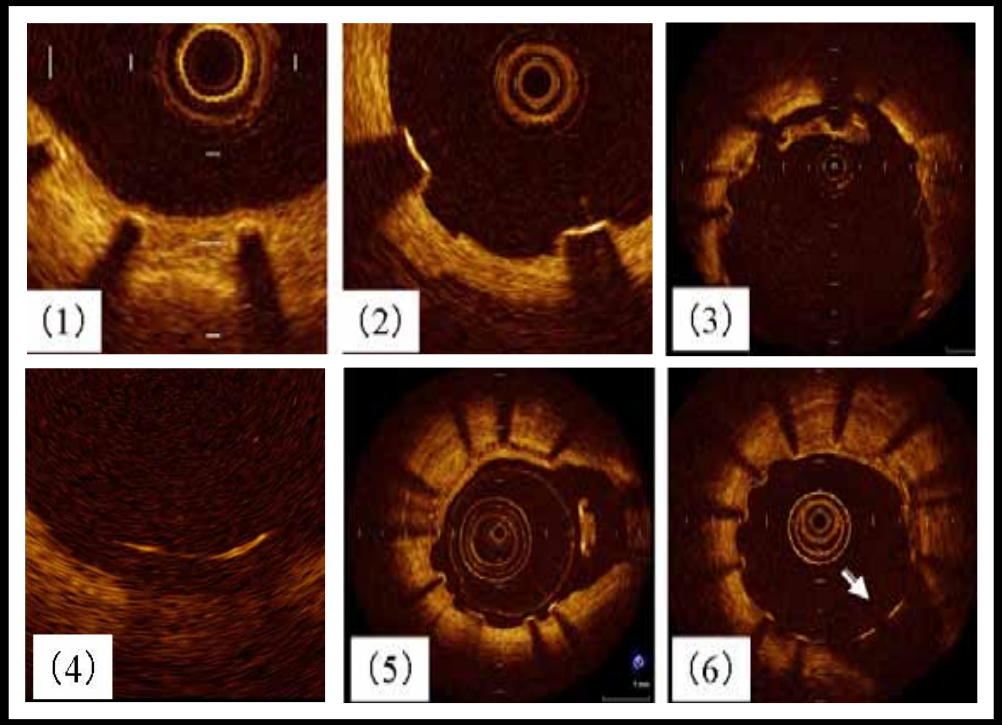
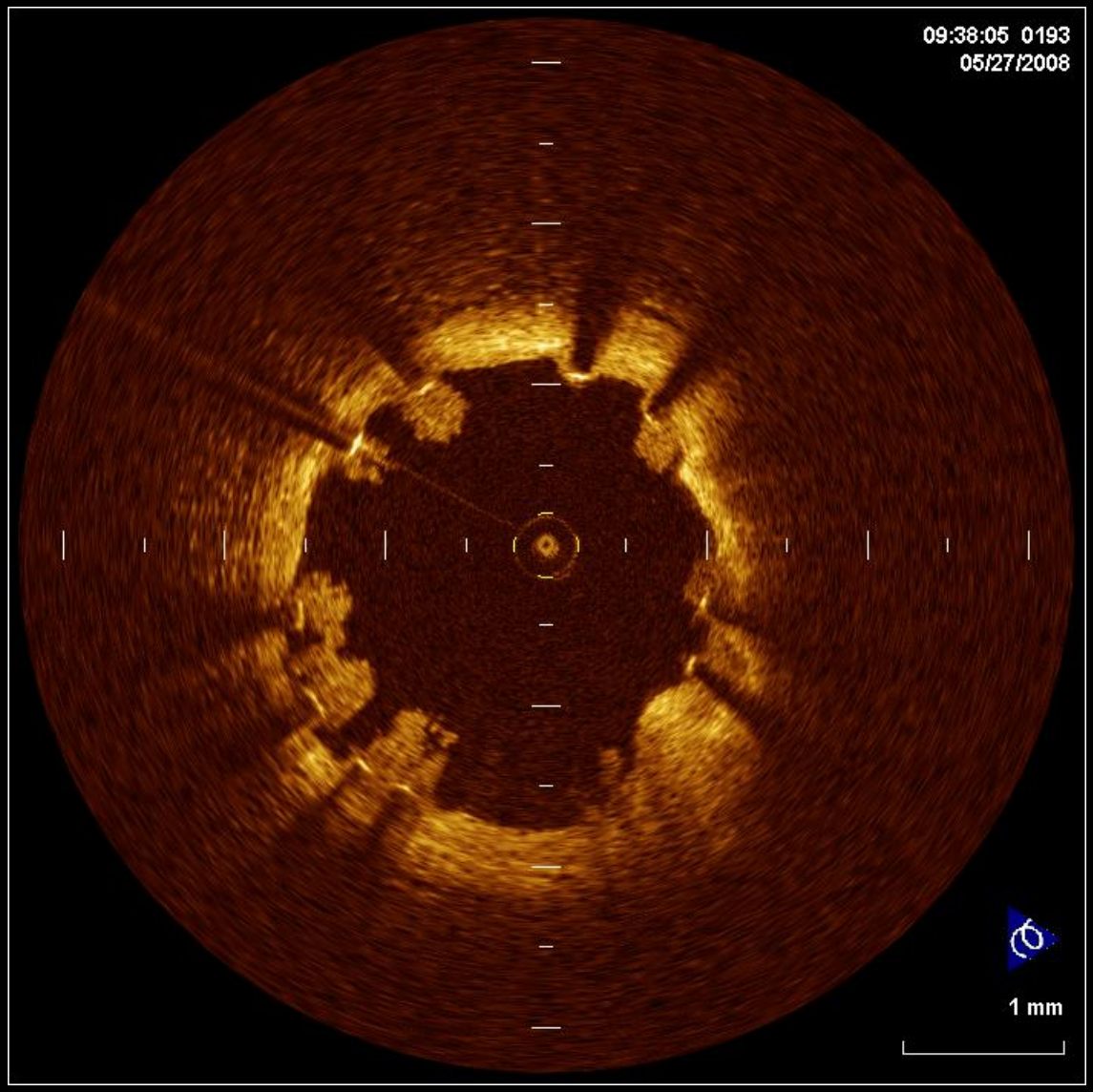


Fig. Images of stent in chronic phase

OCT用語集より改変

Is the scientific consensus of OCT findings obtained?

How about this? No1



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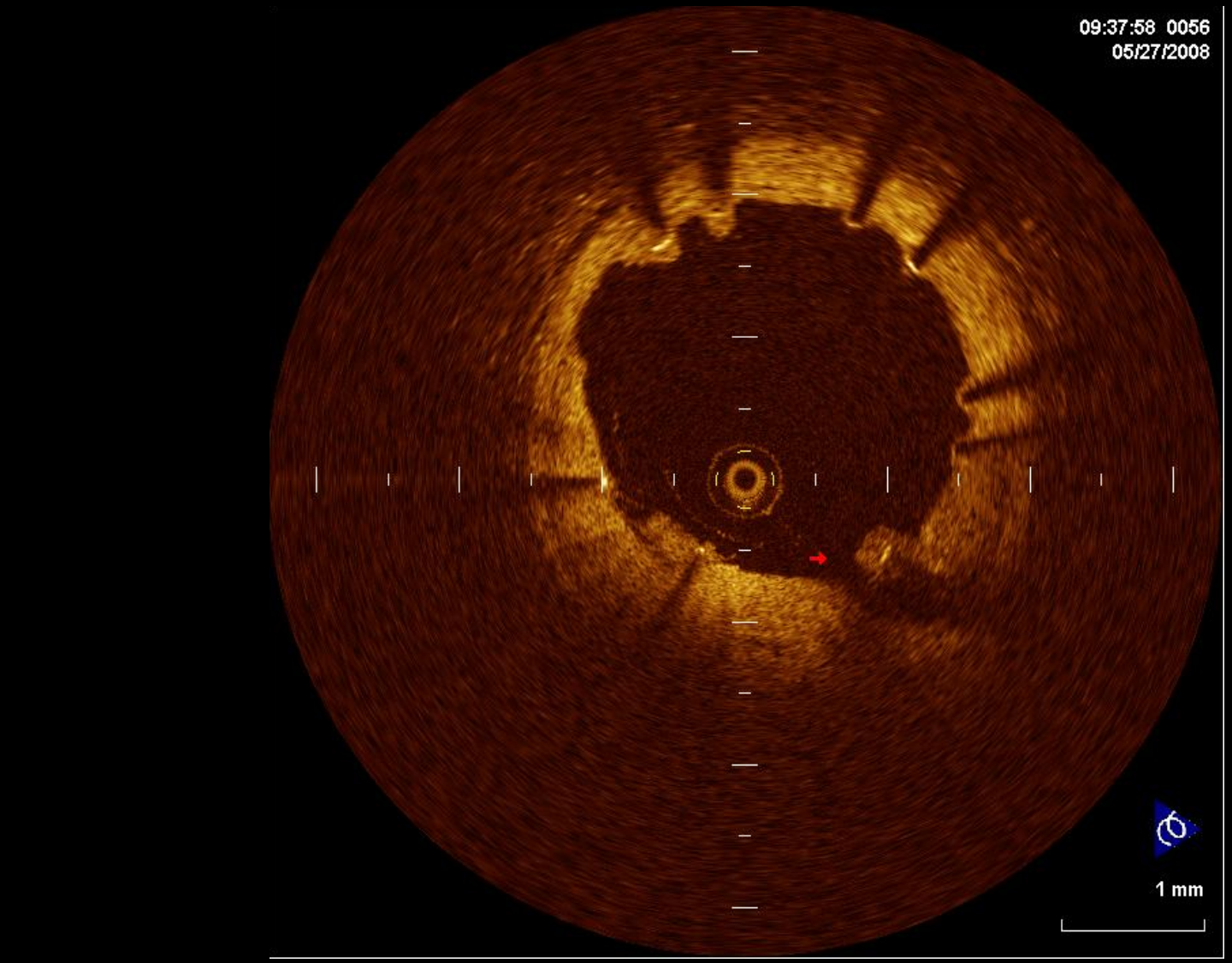
How about this? No2



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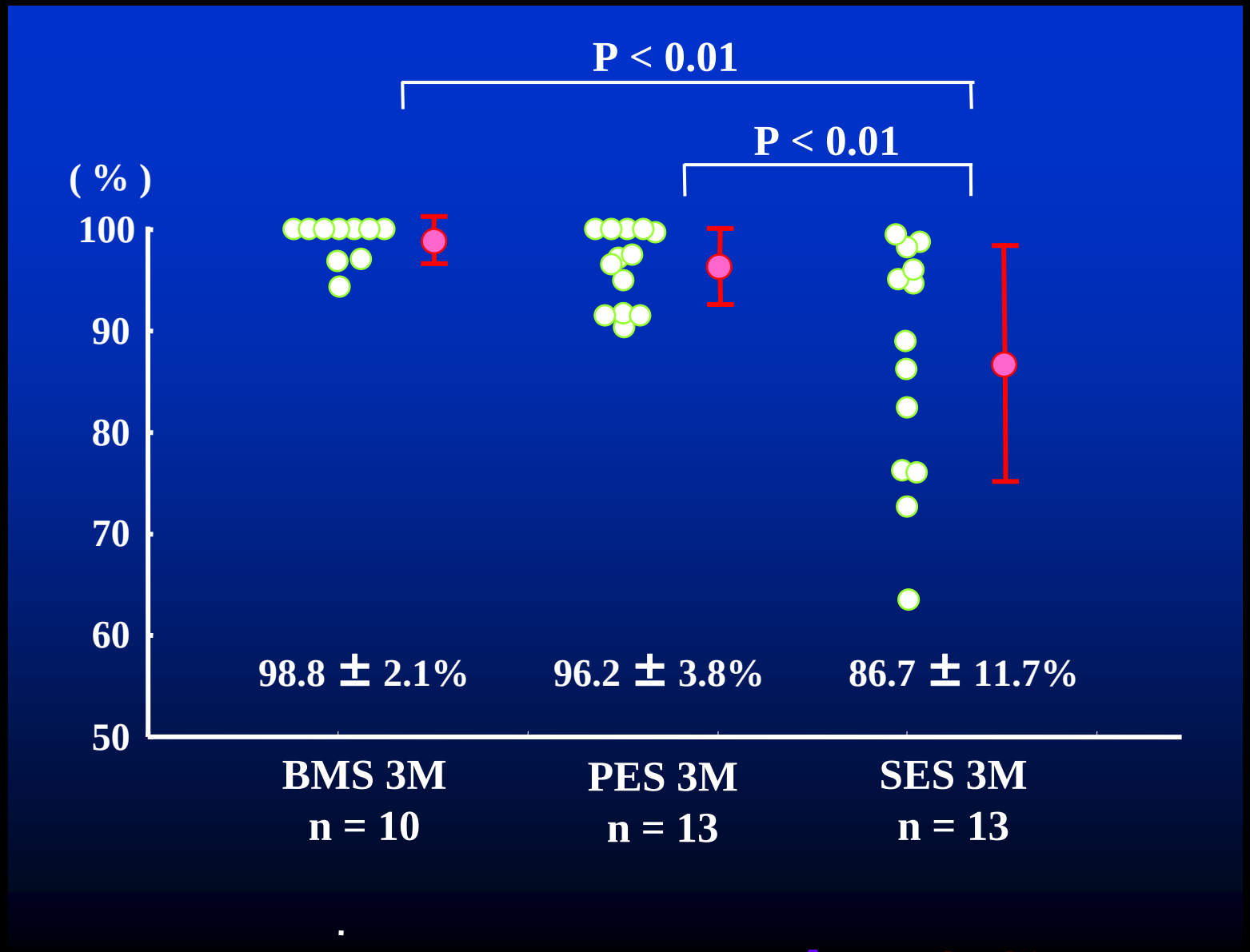
Comparison of Neointimal Growth between Paclitaxel-Eluting Stent, Sirolimus-Eluting Stent, and Bare-Metal Stent

Frequencies of Covered Strut / Stents



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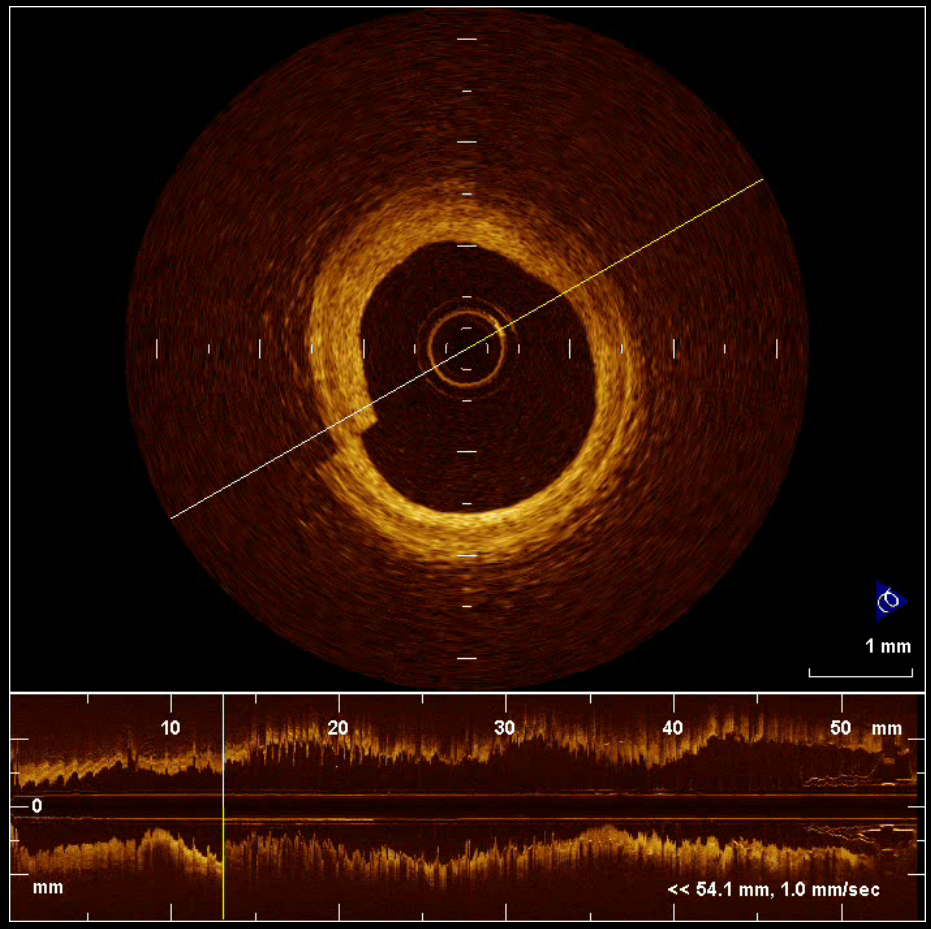
CASE: BMS, SES and PES
~ 4-month f/u ~

Distal



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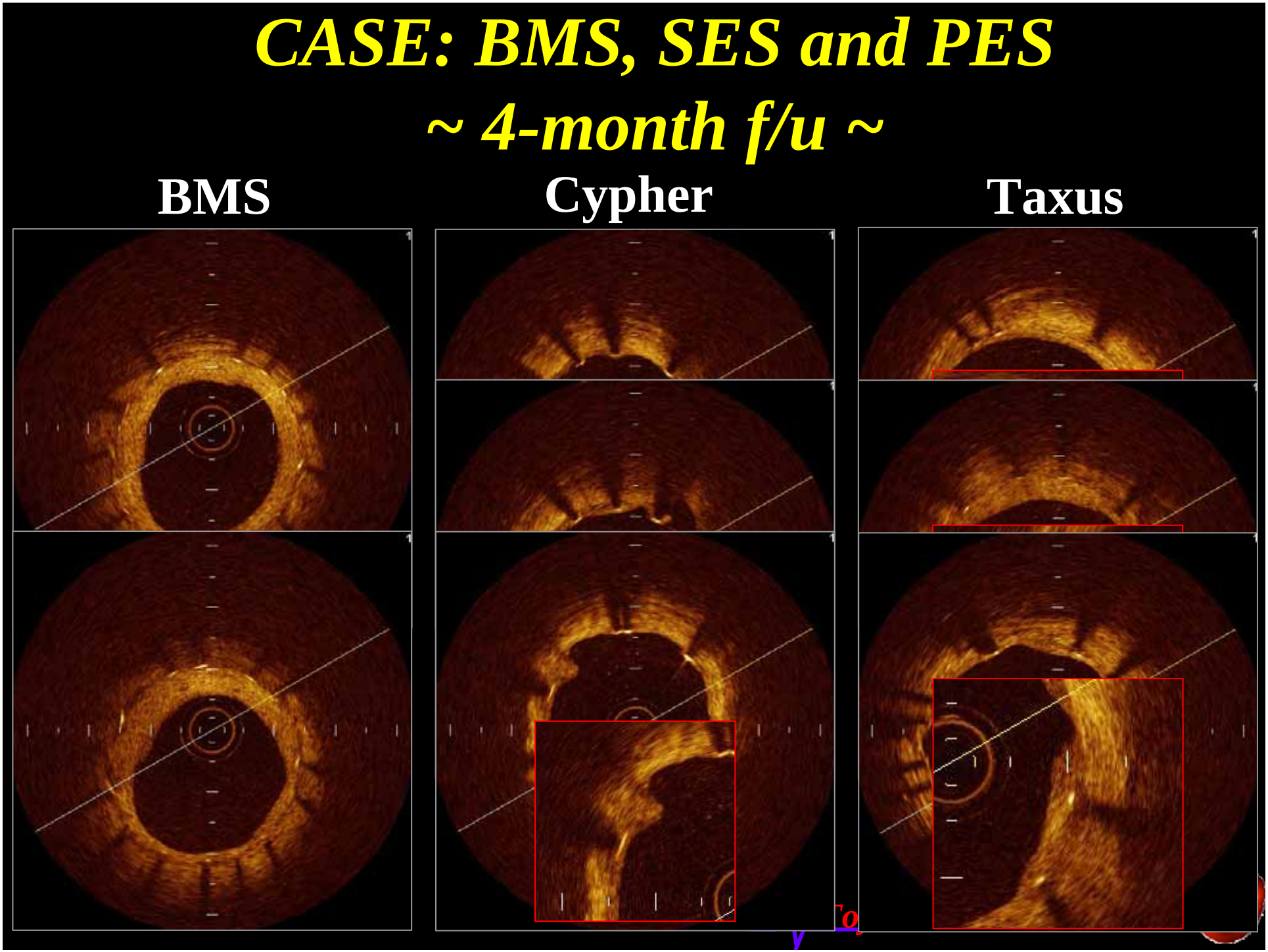
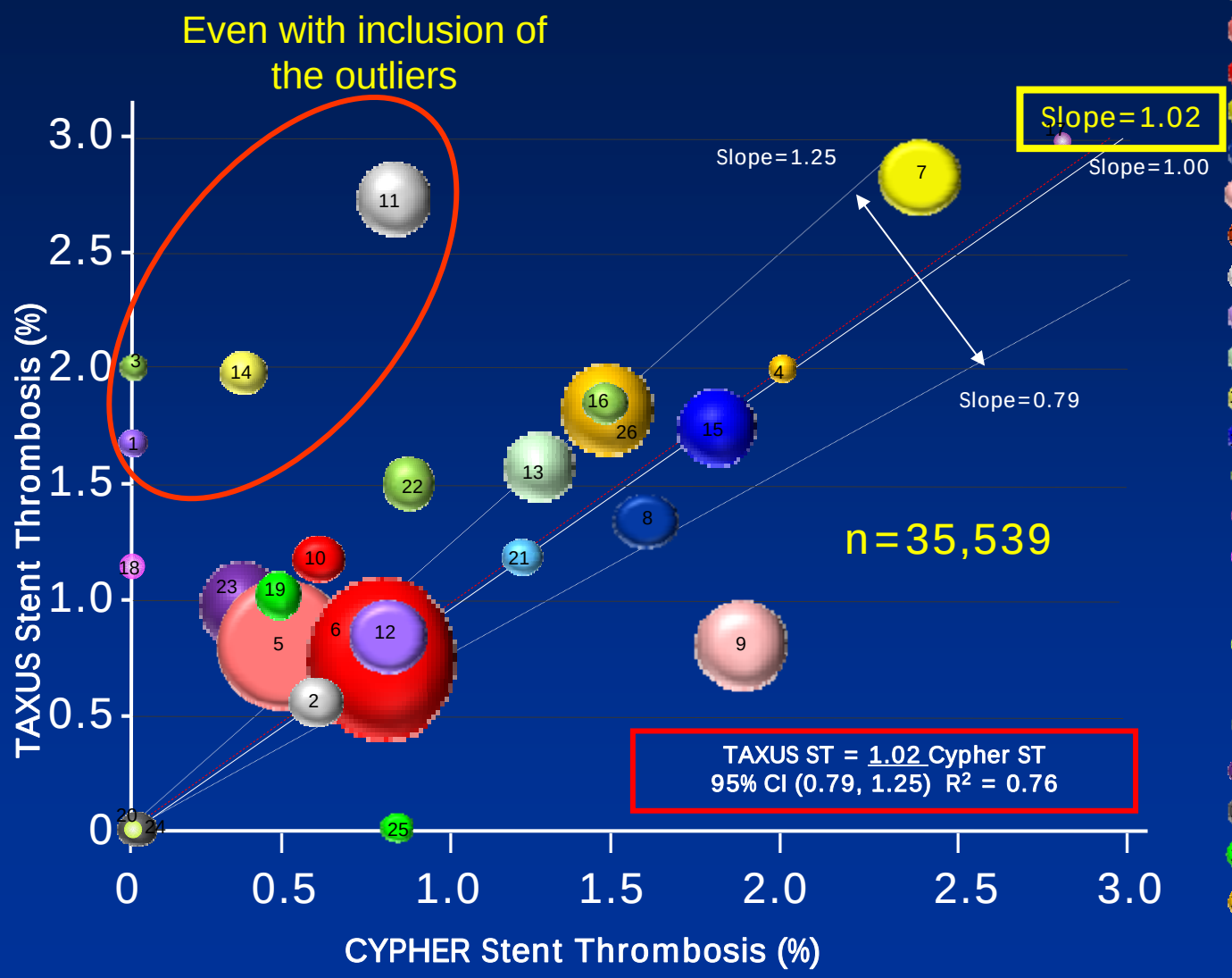
CASE: BMS, SES and PES
~ 4-month f/u ~



26トライアル＆レジストリのhead-to-headデータ (n>35,000) を全て見ると、ステント血栓症に差がないことが分かる

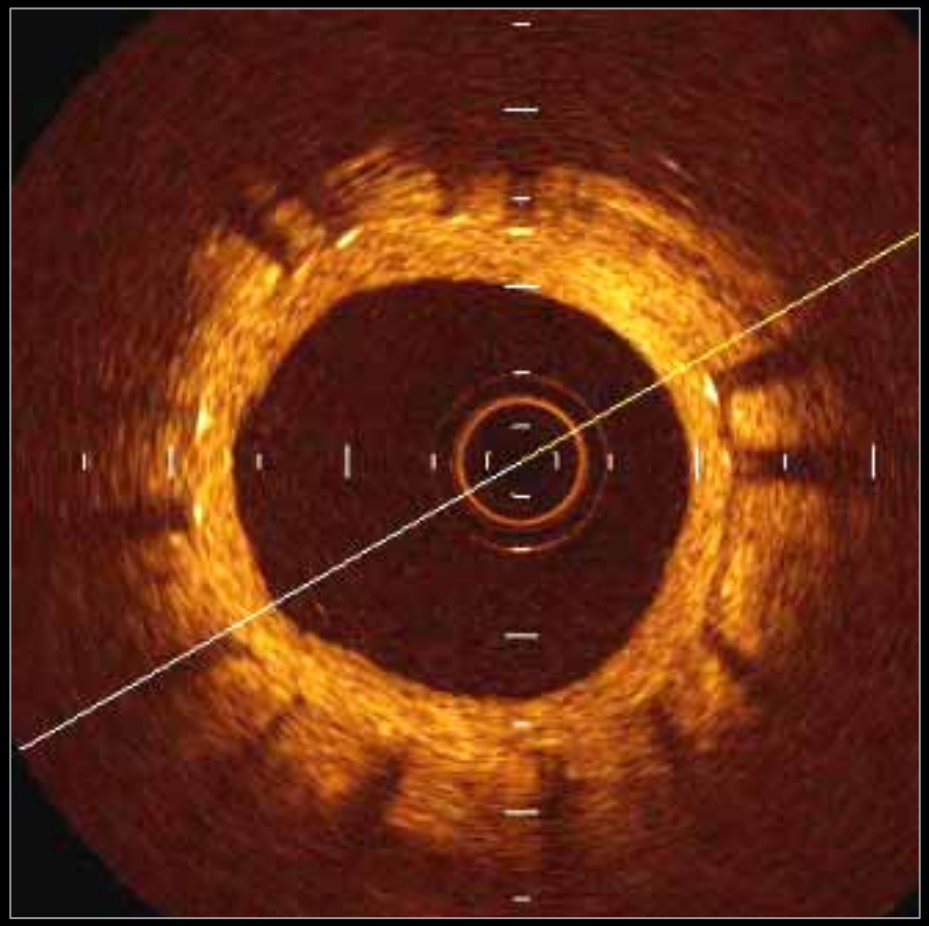


1	I-DIABETES	n=250
2	I-SMART	n=360
3	I-DESIRE	n=200
4	TAXI	n=202
5	DEScover	n=6,509
6	S.T.E.N.T.	n=10,159
7	SIRTAX	n=1,012
8	MILAN	n=529
9	C & T Reward	n=2,769
10	CORPAL	n=652
11	REALITY	n=1,353
12	TC-WYRE	n=1,558
13	REAL	n=1,676
14	LONG DES II	n=500
15	SORT OUT II	n=2,098
16	BASKET	n=545
17	Cervinka	n=70
18	Di Lorenzo	n=180
19	Han YL	n=416
20	Petronio	n=100
21	PROSIT	n=308
22	Zhang	n=449
23	T-SEARCH/RESEARCH	n=1,084
24	DIABETES I, II	n=160
25	RESEARCH Long	n=122
26	TAXUS Meta / Cypher Meta	n=2,278

Trials excluded in analysis: SOLACI (ST not reported) ARRIVE I / II, e-Cypher, TAXUS V and SISR (differences in protocol definitions).

Characteristics of Neointima
~ intensity, pattern ~

Usual Neoitima of BMS



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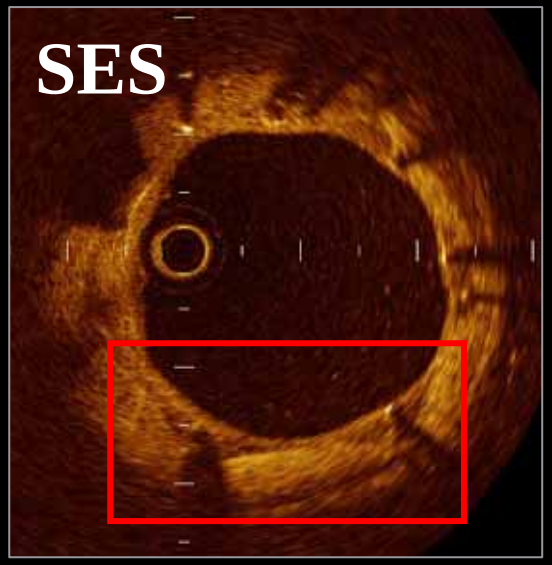
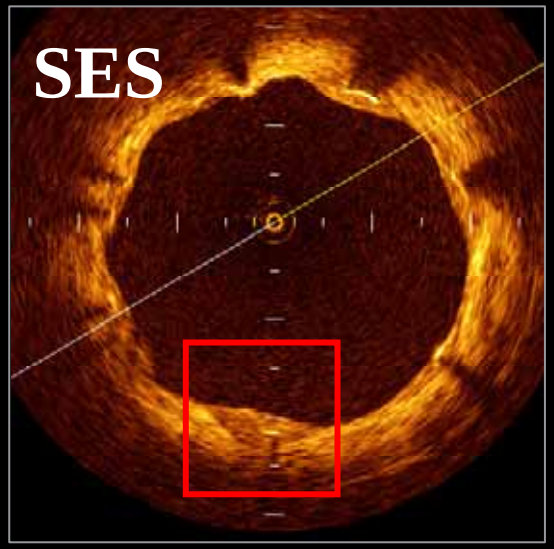
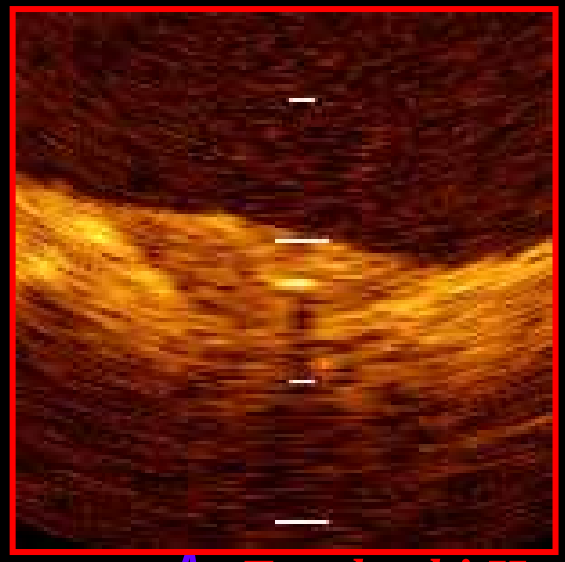
Common findings in 1st generation DES







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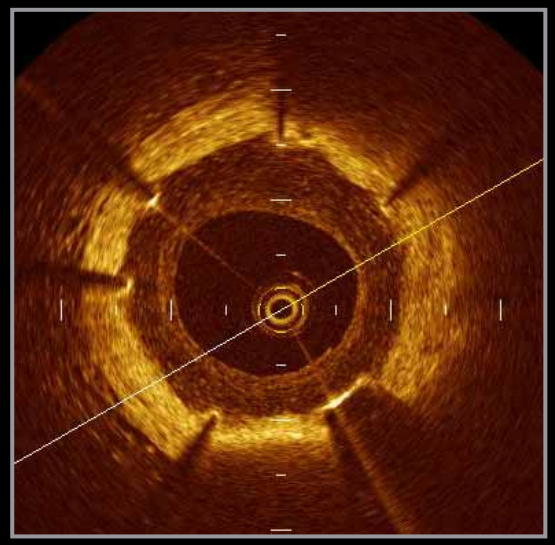
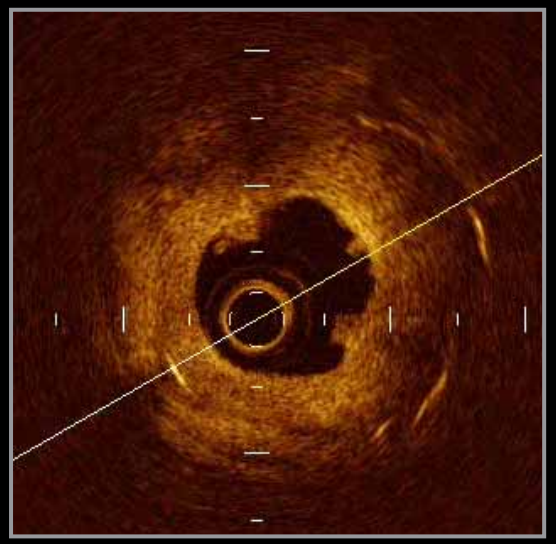
Heterogeneous neointima of 1st generation DES

Layered **Mosaic**

PES



SES



SES

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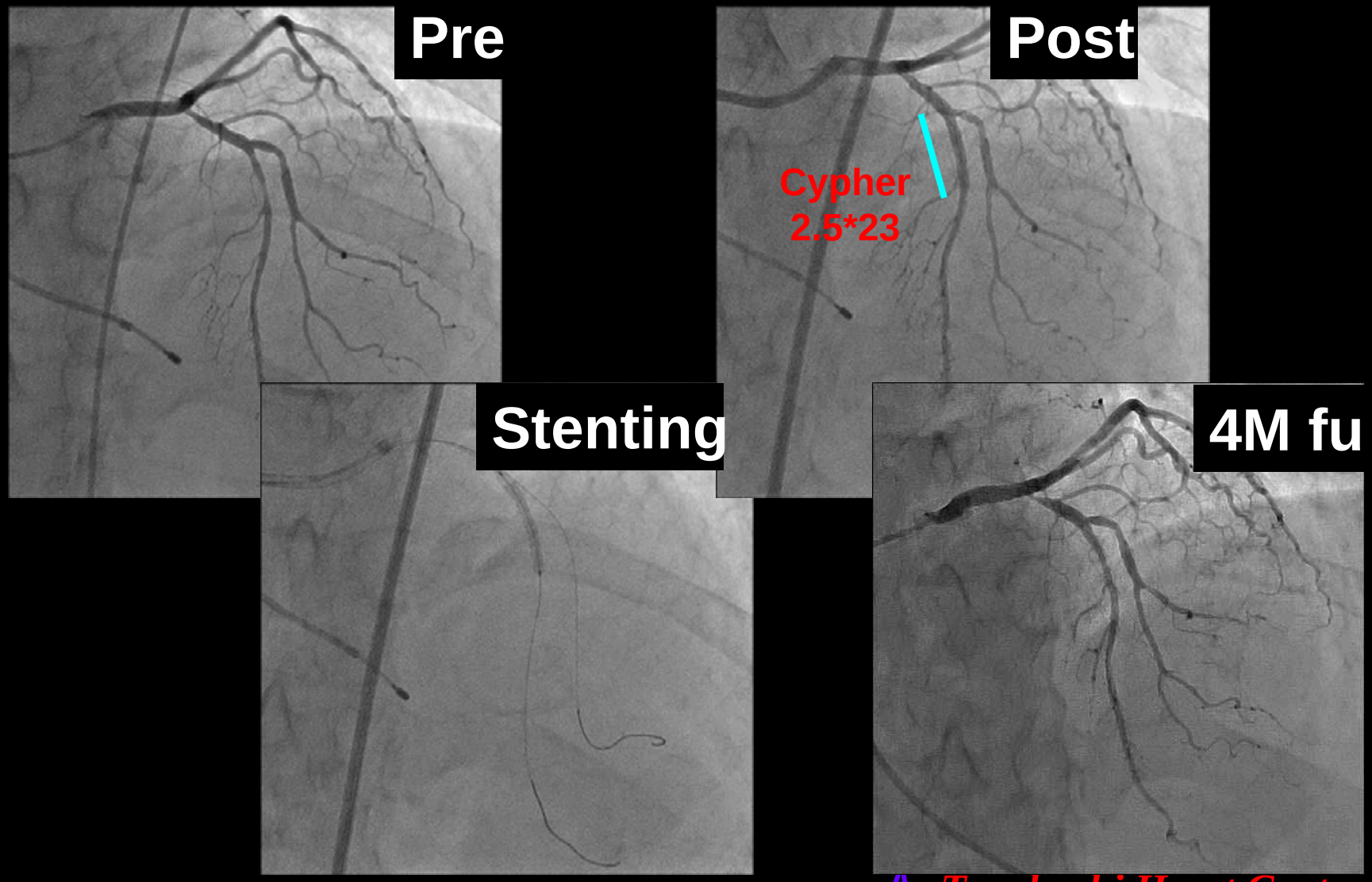
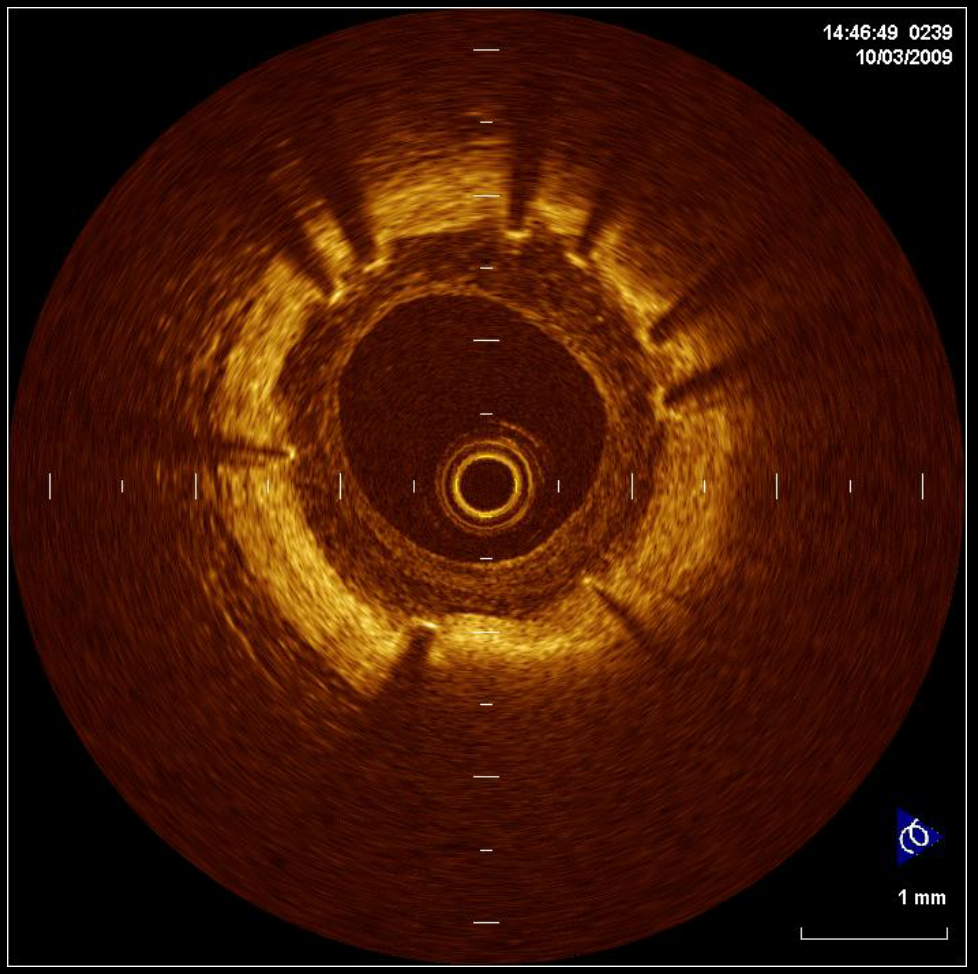
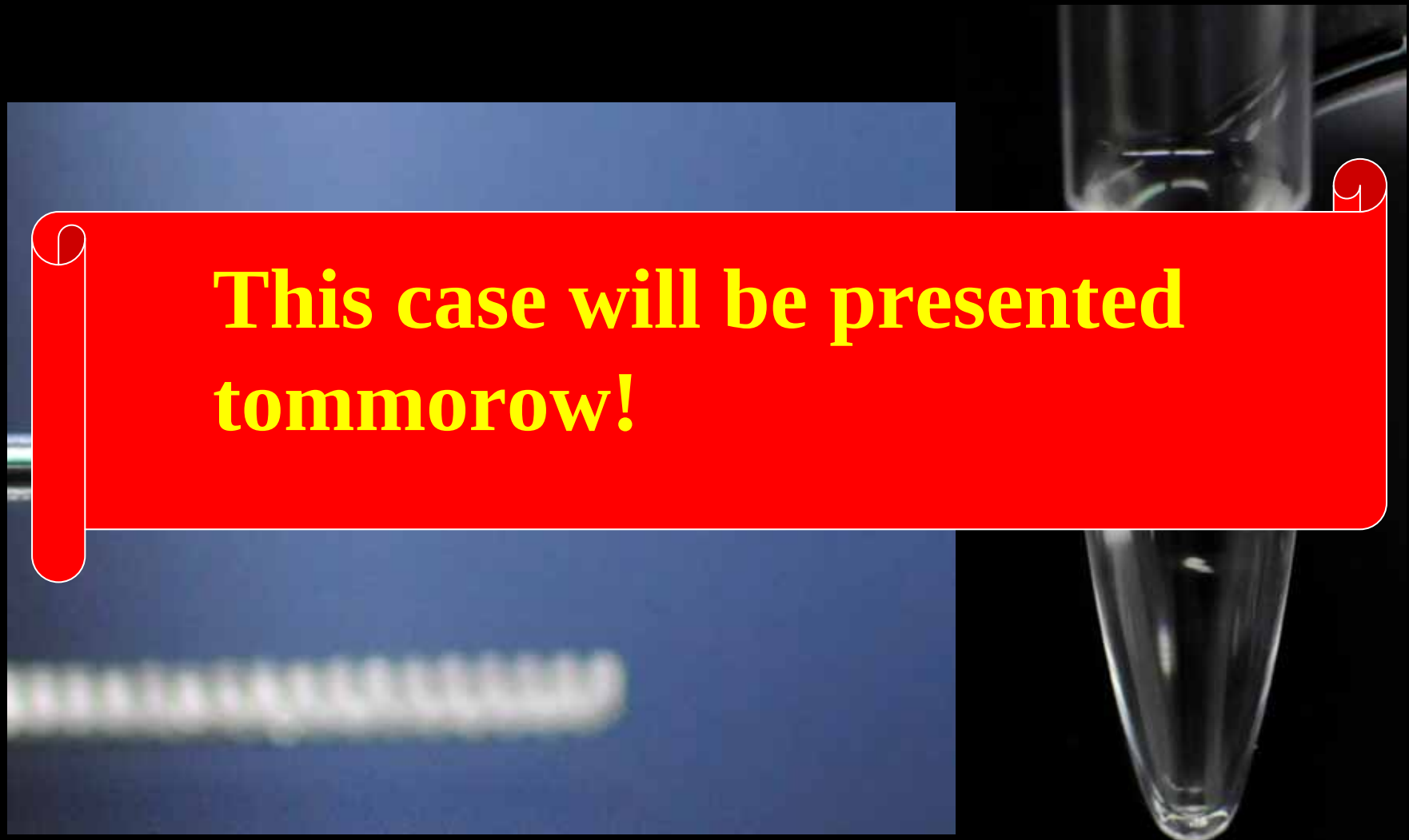
59 y.o. male



Case 2: OCT at 4 months fu



Specimen Retrieved by DCA

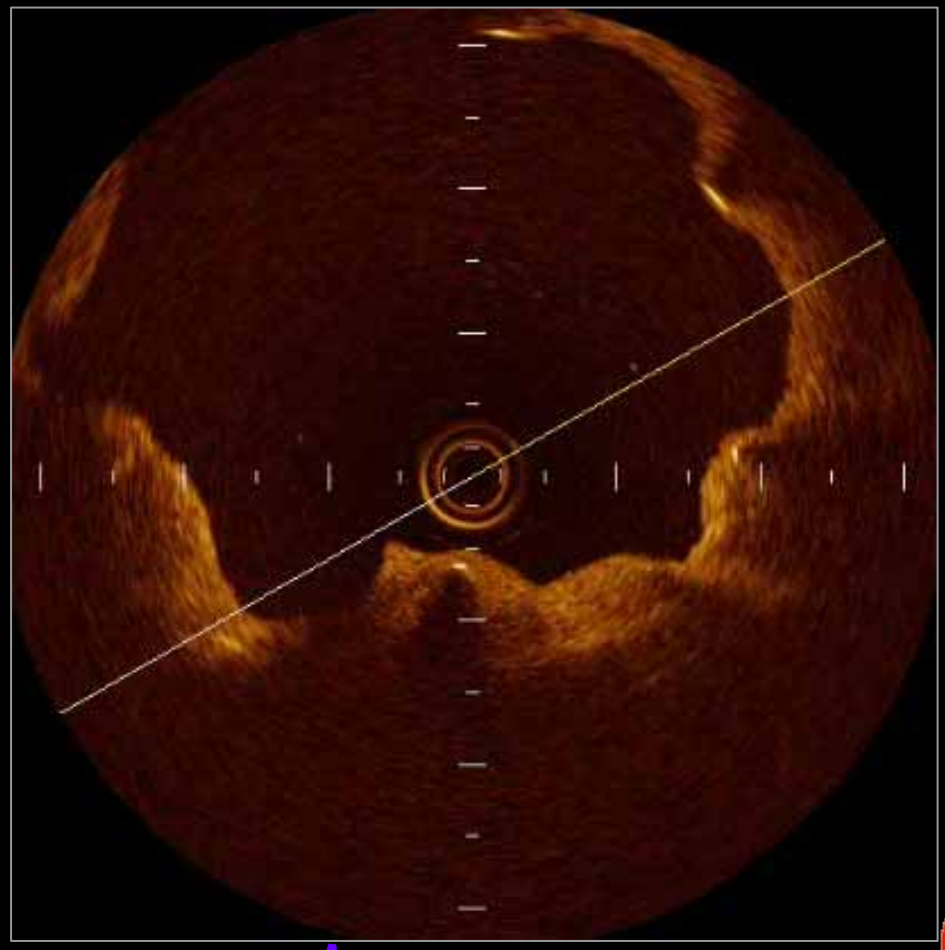


This case will be presented tommorow!

Anomalous pattern of Neointima

Peri-stent staining

Peri-strut ulcer like apperance / Peri-strut halo



➢ **Neointima following stent implantation have various patterns of morphology or characteristics (intensity, etc).**

Question ?

Which patterns are safe (protective for stent thrombosis)?

Which patterns are dangerous?

Which patterns are within the acceptable range?

Summary

✓ **OCT provides various information and new aspects of implanted stents.**

✓ **Unfortunately, consensus of definition of OCT findings has not been obtained. Therefore, interpretation of the study using OCT requires attention.**

✓ **Lager population study should be required to clarify the relationships between OCT findings and clinical outcomes after achieving consensus standard of OCT findings.**

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