

BRS Failure: Insights from Imaging

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BRS failure: Imaging findings

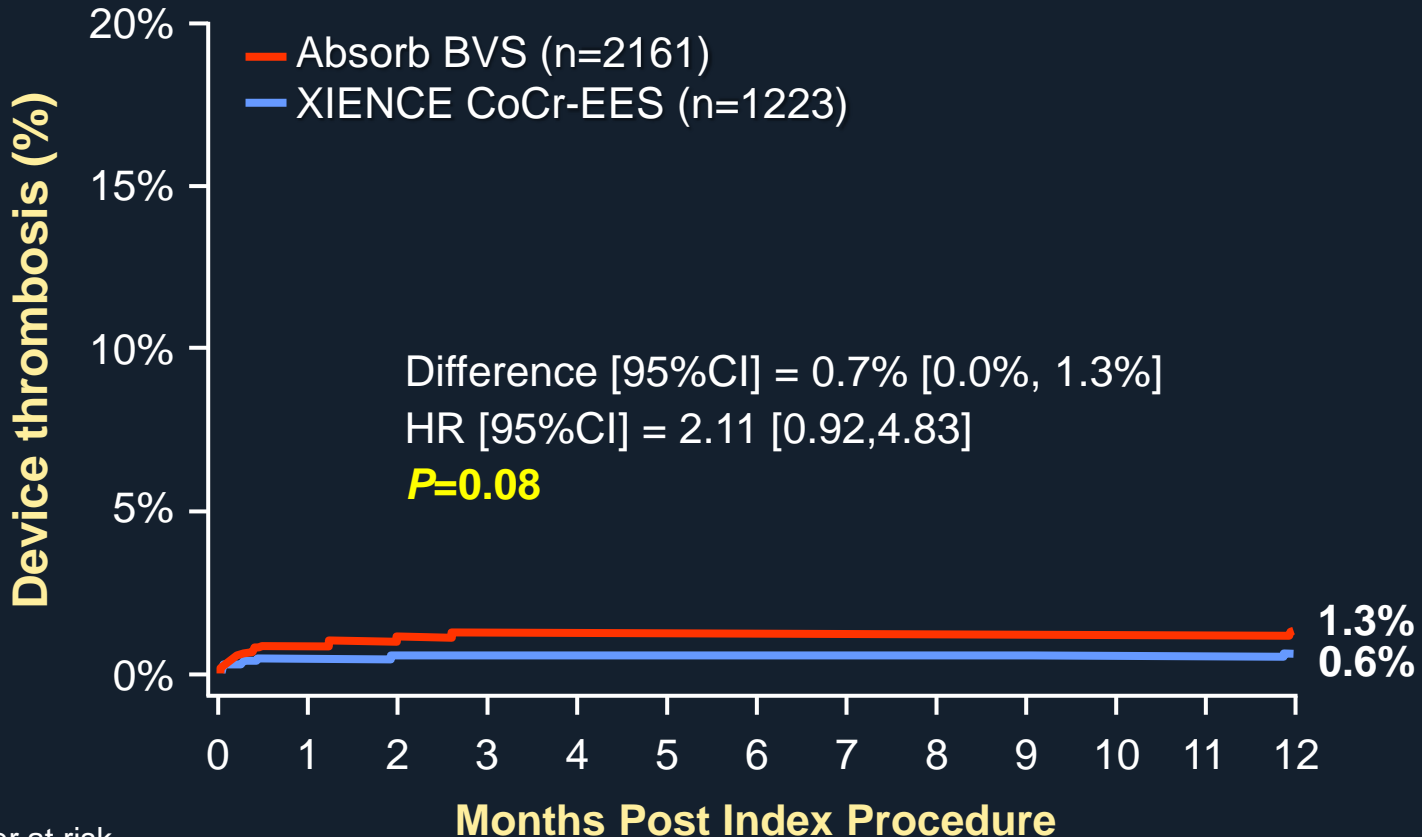
- **Early Thrombosis**
- **Acute disruption**
- **Very late Scaffold thrombosis**
 - **Late discontinuities (Intravascular or intraluminal Dismantling)**
- **Restenosis**
- **Neointimal hyperplasia**
- **Others (Aneurysm)**



ABSORB 1-Year Meta-analysis

ABSORB II, ABSORB III, ABSORB Japan, ABSORB China

Device Thrombosis (Def/Prob) (pooled)



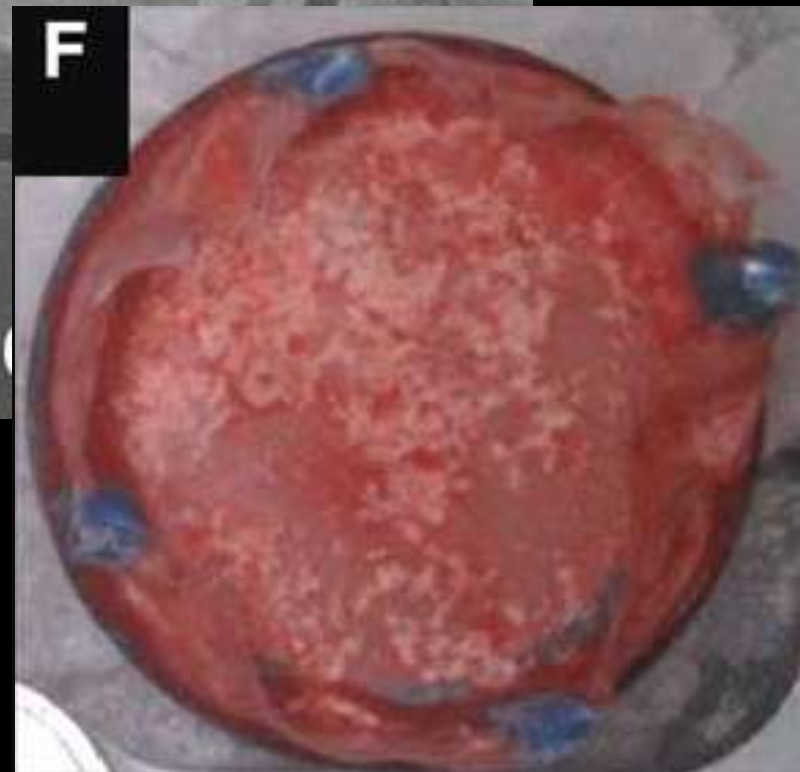
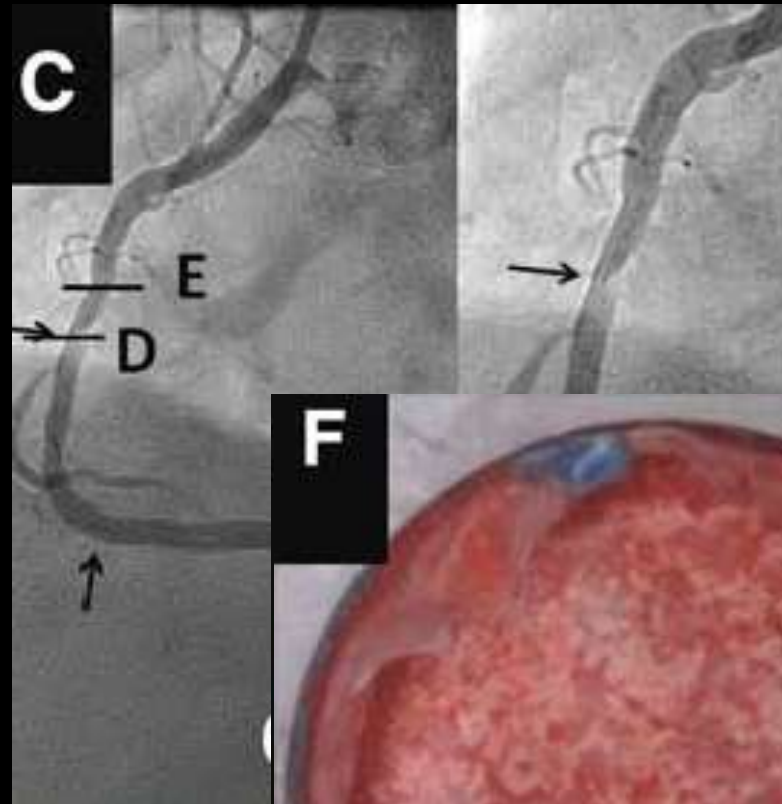
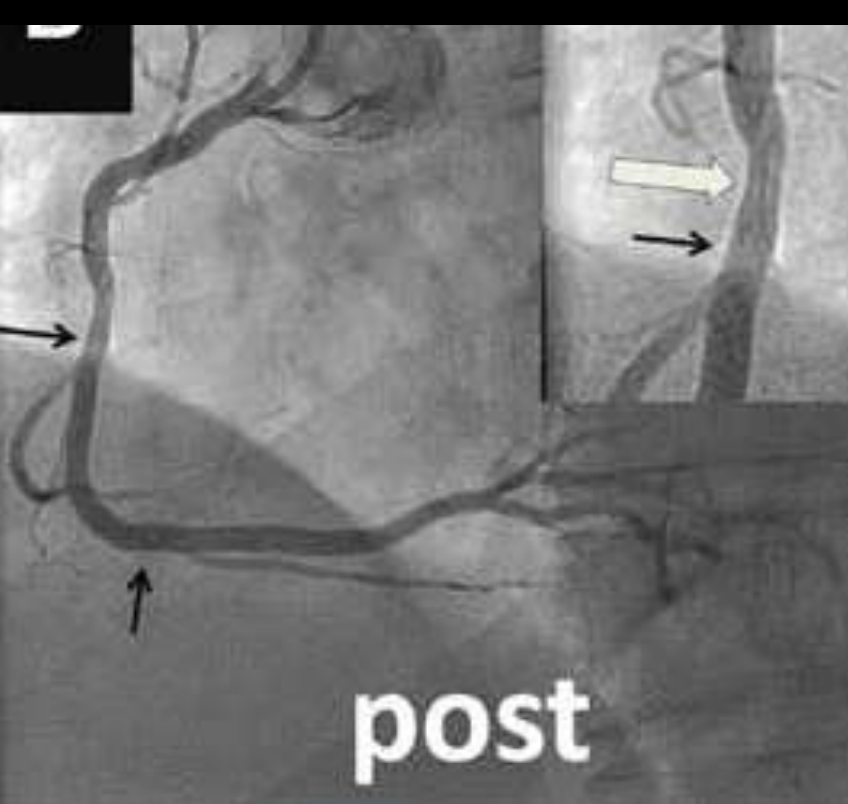
Number at risk		Months Post Index Procedure					
	0	1	2	3	12		
Absorb BVS	2161	2128			2114	2108	2098
XIENCE CoCr-EES	1223	1213			1207	1200	1197

What is the reported rate of Early Scaffold Thrombosis?

Ishibashi et al. EuroIntervention Updated

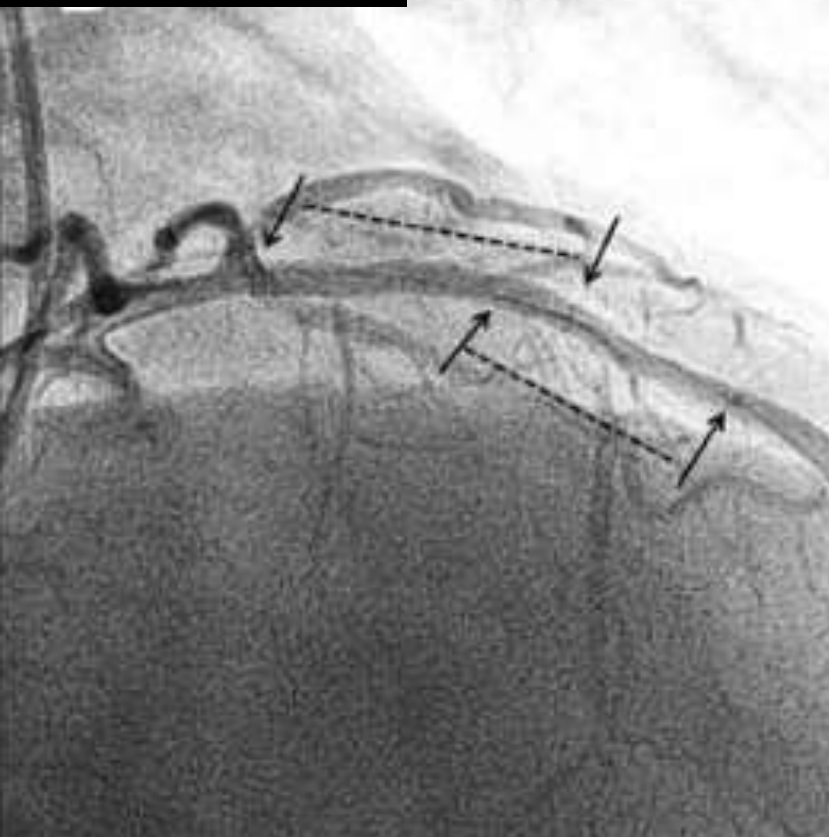
Study	Indication	N	Acute ST N (%)	Subacute ST, N (%)	Early ST, N (%)	Imaging	
Abizaid et al, ABSORB EXTEND	SAP	512	0	2 (0.4%)	2 (0.4%)	OCT 14 cases	SAP/UAP 0.3%
Serruys et al., ABSORB B	SAP	101	0	0	0	IVUS/OCT	
Onuma et al., ABSORB A	SAP	30	0	0	0	IVUS/OCT	
CORONARY CTO	SAP	35	0	0	0	IVUS/OCT	
Serruys et al., ABSORB II	SAP / UAP	335	1 (0.3)	1 (0.3)	2 (0.6)	IVUS	
ASSURE registry	SAP / UAP	183	0	0	0	-	
BVS EXPAND	SAP / UAP	200	0	0	0	-	
ABSORB Japan	SAP / UAP	226	0	3 (1.1%)	3 (1.1%)	IVUS/OCT	
ABSORB III	SAP / UAP	1322	2 (0.2%)	12 (0.9%)	14 (1.1%)	-	
ABSORB China	SAP / UAP	238	0	1 (0.4%)	1 (0.4%)	-	
Gori et al	ACS	150	1 (0.7%)	1 (0.7%)	2 (1.4%)	-	ACS 1.0%
POLAR ACS	ACS	100	0	0	0	-	
Kajiya et al.	STEMI	11	0	0	0	-	STEMI 1.5%
Diletti et al., BVS STEMI	STEMI	49	0	0	0	OCT	
Kocka et al., PRAGUE-19	STEMI	41	0	1 (2.4%)	1 (2.4%)	OCT	
Wiebe et al.	STEMI	25	0	0	0		
Ielasi et al., RAI registry	STEMI	74	0	1(1.4%)	1(1.4%)	OCT/IVUS 4.4%	
TROFI II	STEMI	95	0	1 (1.1%)	1 (1.1%)	OCT	
BVS Examination	STEMI	290	NA	NA	6 (2.1%)	-	
Kraak et al., AMC Single Centre	All-comers	135	0	3 (2.2%)	3 (2.2%)	IVUS 5%/OCT 20%	All-comer 1.0%
ABSORB FIRST	All-comers	800	0	2 (0.3%)	2 (0.3%)	OCT	
Azzalini et al.	All-comers	339	0	4 (1.2%)	4 (1.2%)	-	
EVERBIO II	All-comers	78	0	0	0	-	
GABI-R	All-comers	1536	7 (0.5%)	8 (0.5%)	15 (1.0%)	-	
Capodanno et al., GHOST-EU registry	All-comer	1189	5 (0.4%)	11 (0.9%)	16 (1.3%)	IVUS 14%/OCT 14%	
	Average F/U: 7.1 Months	8094	16 (0.2%)	50 (0.6%)	66 (0.8%)		

#1 Acute scaffold thrombosis: Proximal landing at plaque

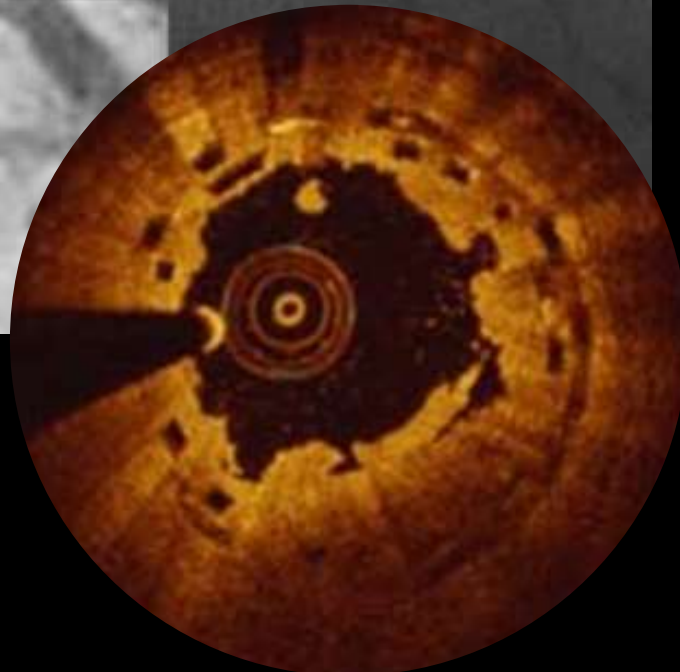
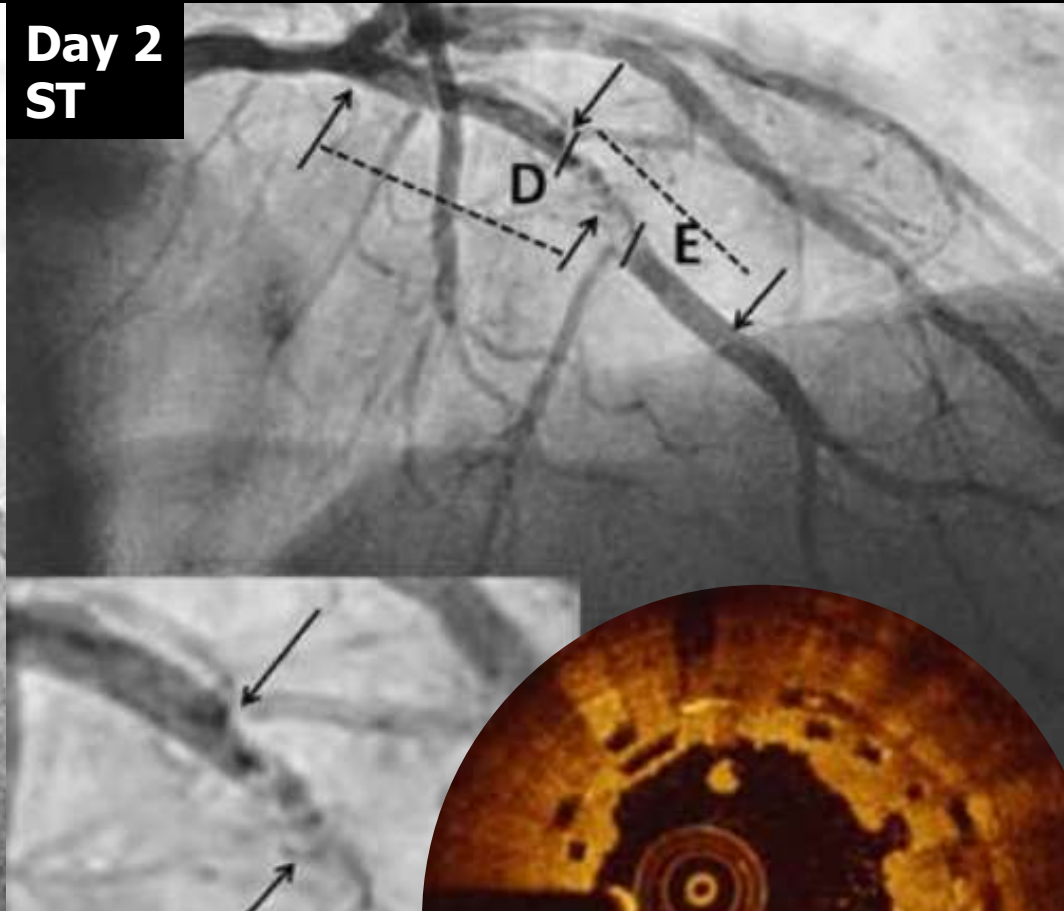


#2 Early scaffold thrombosis: Overlap

Post procedure



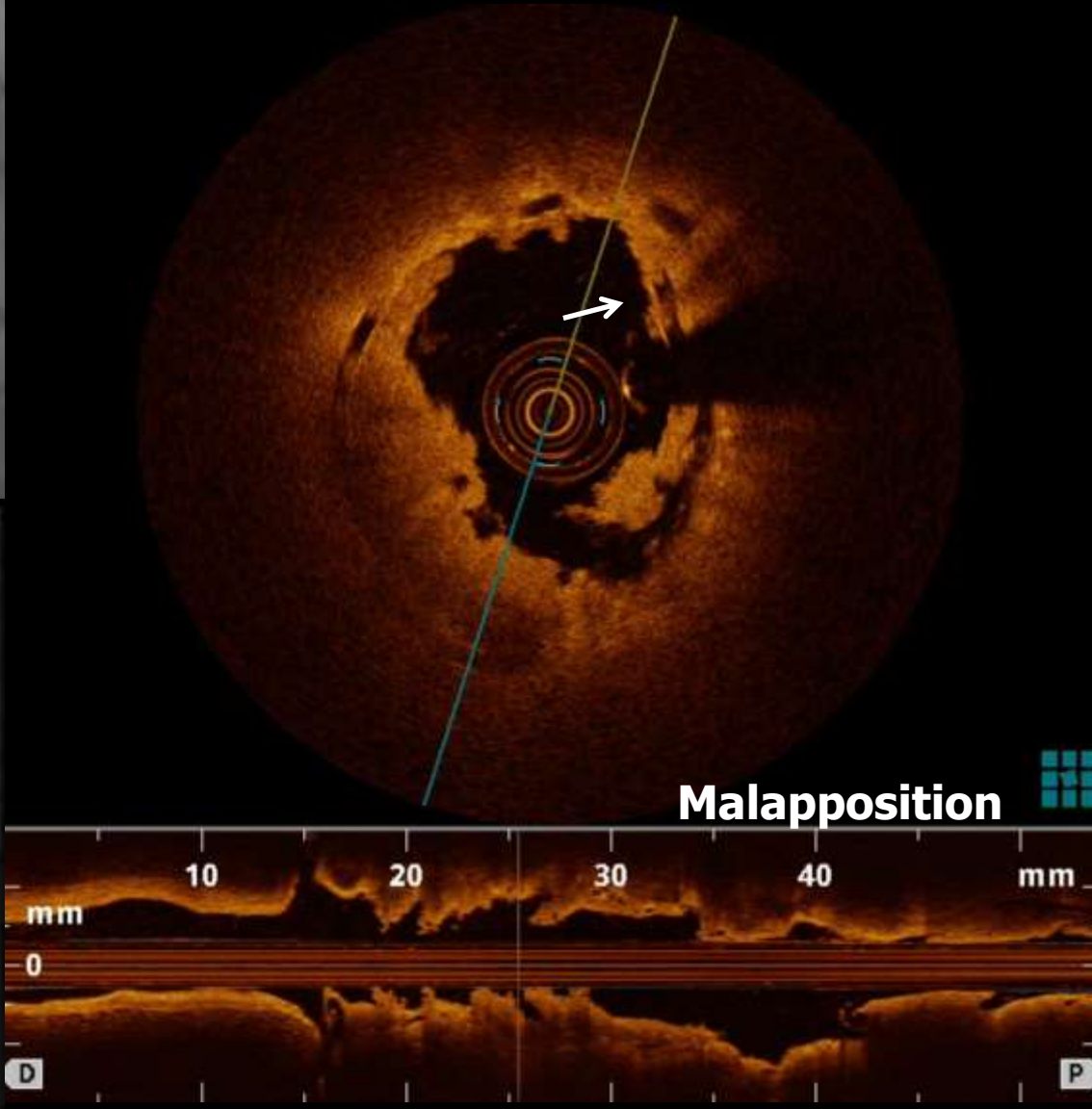
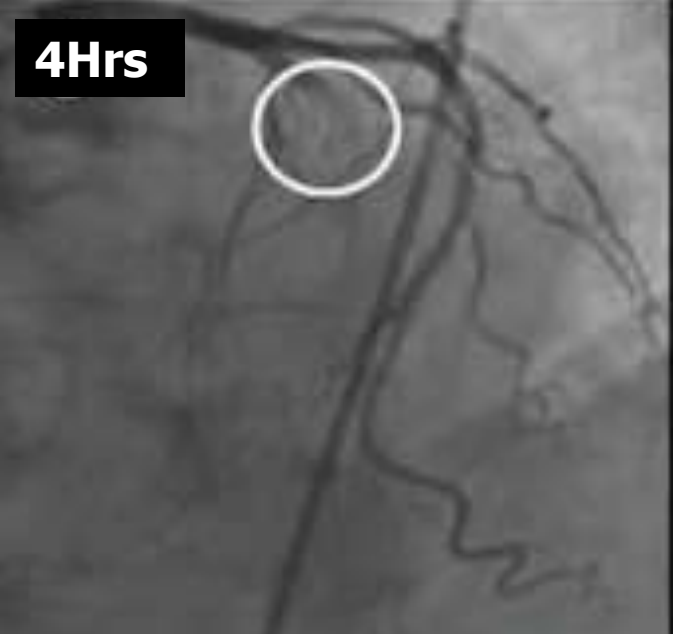
Day 2
ST



#3. Acute scaffold thrombosis: Malapposition

80 yo male presenting with Non-STEMI

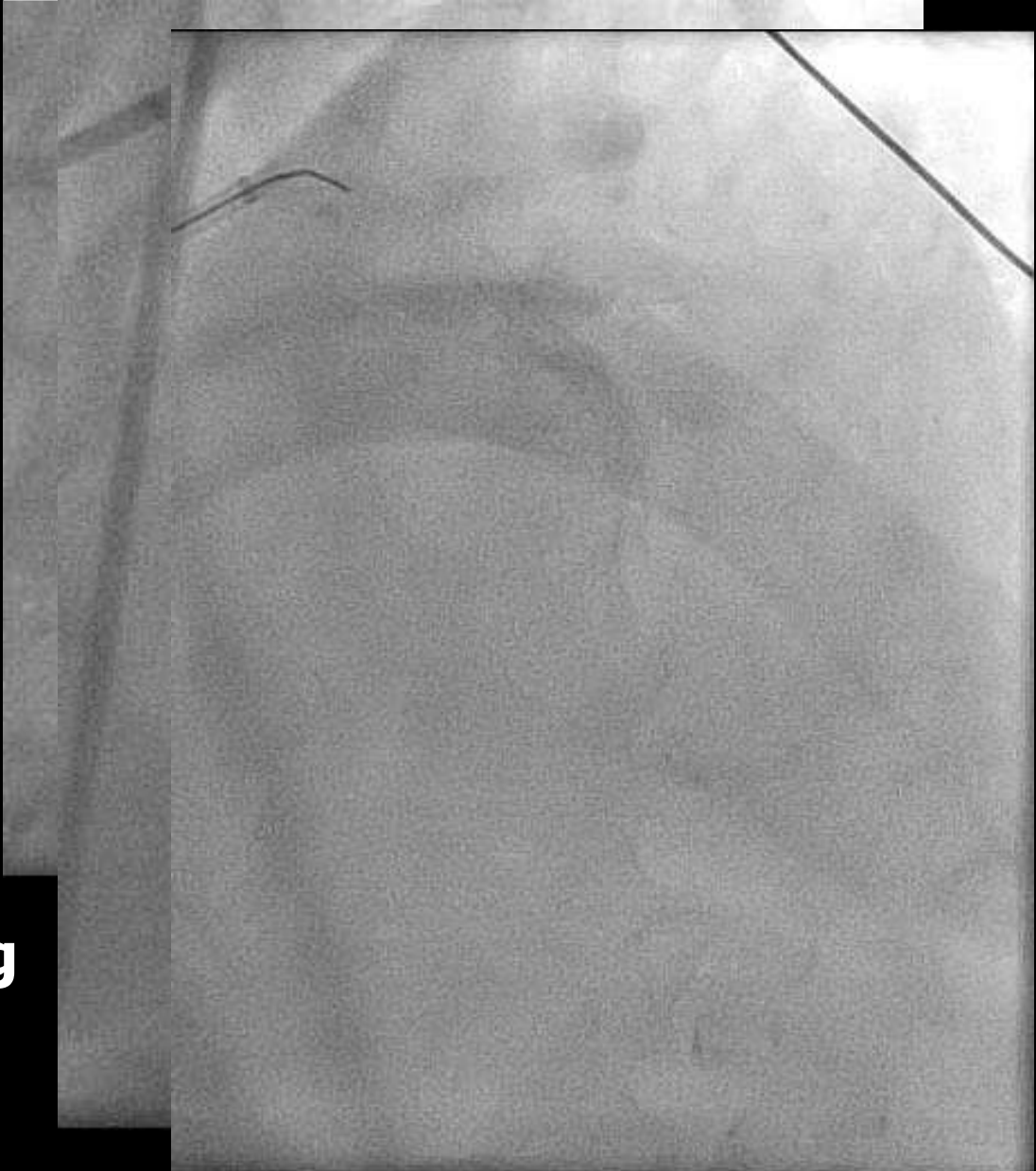
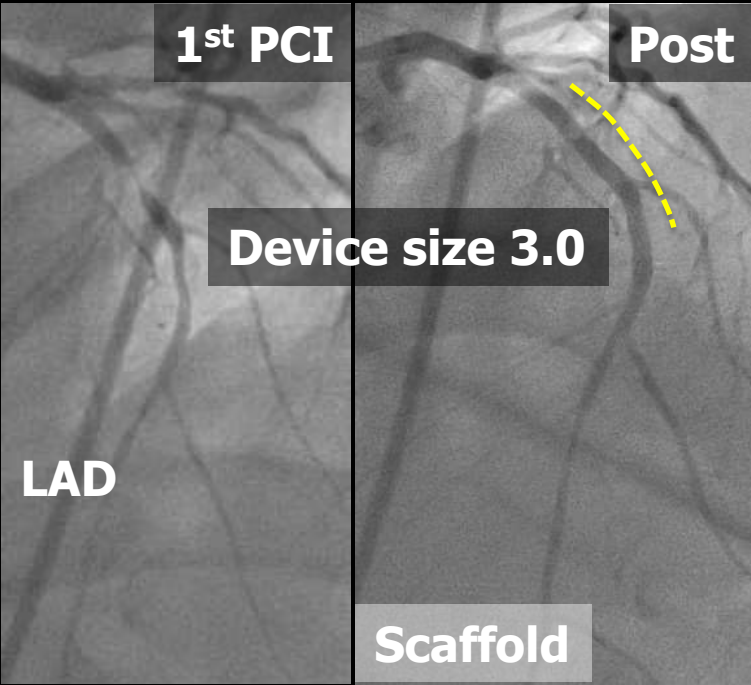
Jaguszewski et al. EHJ



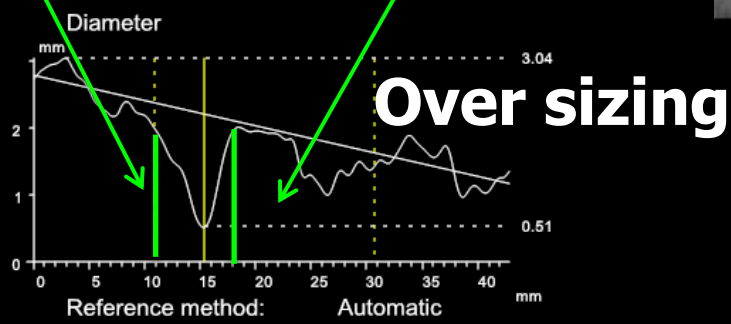
#4 Subacute scaffold thrombosis: Oversizing

Sabate et al. 2015 EHJ (TROFI II)

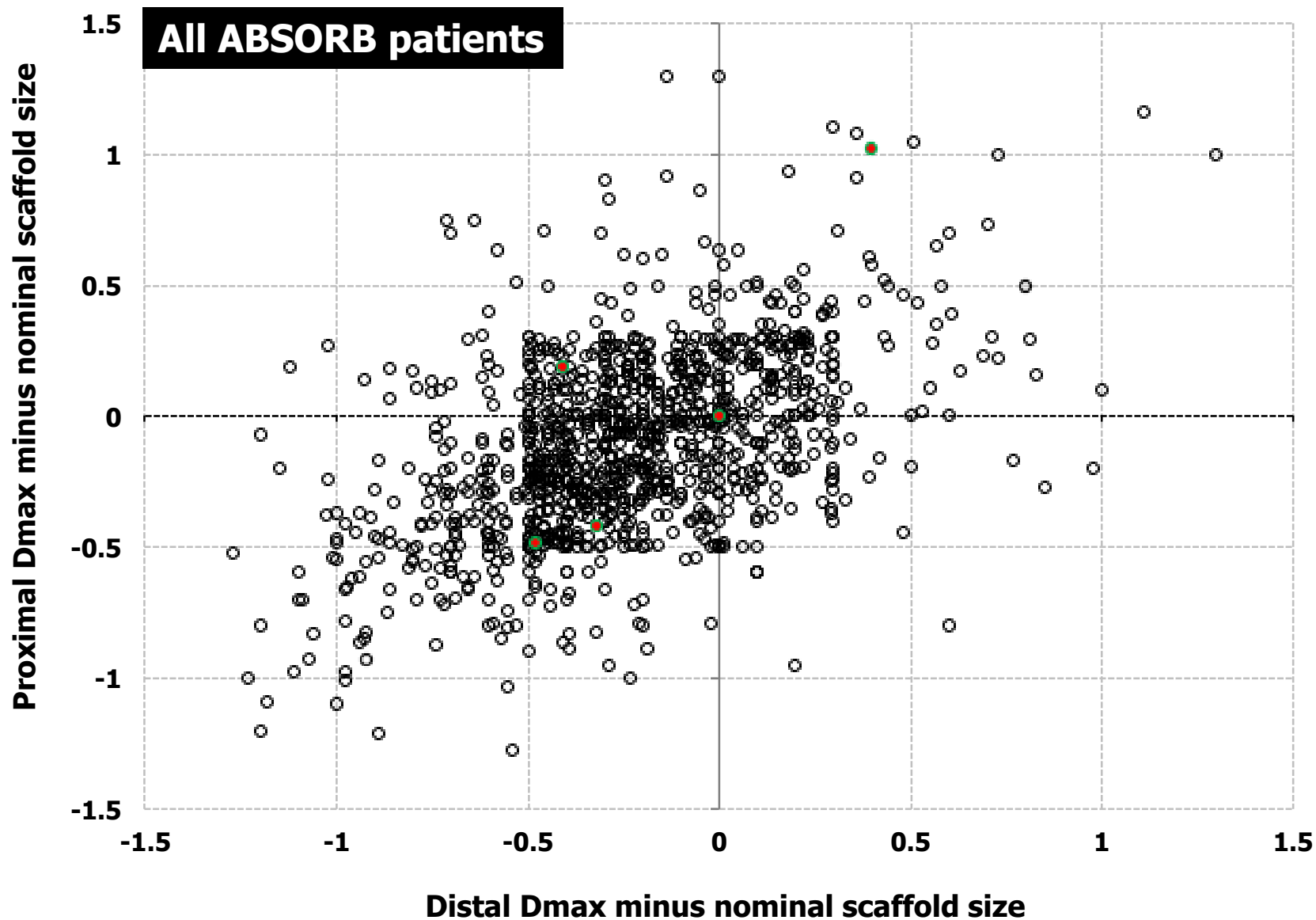
6 days
Sub-acute Scaffold Thrombosis



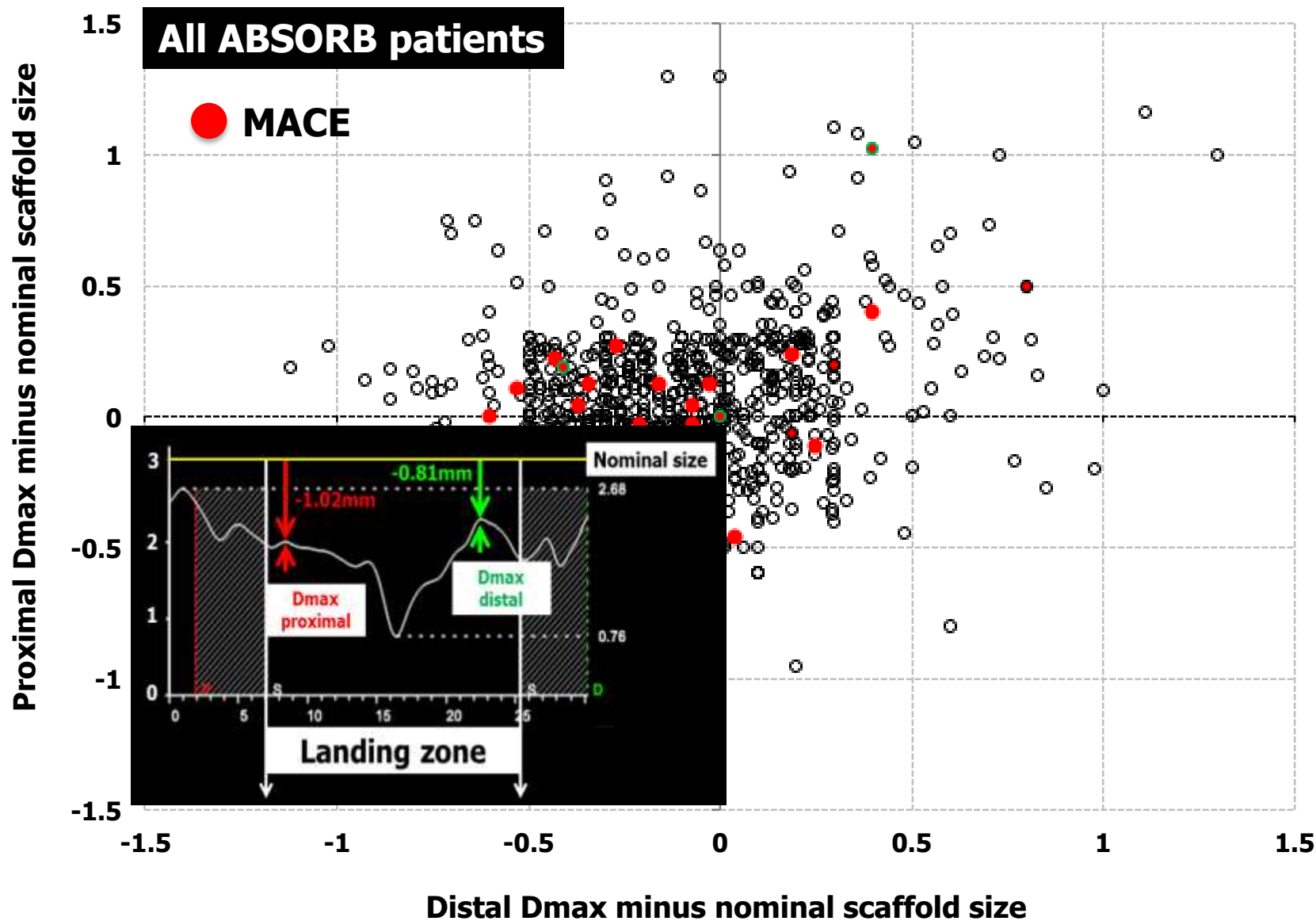
Proximal Dmax 1.9753
Distal Dmax 2.0492



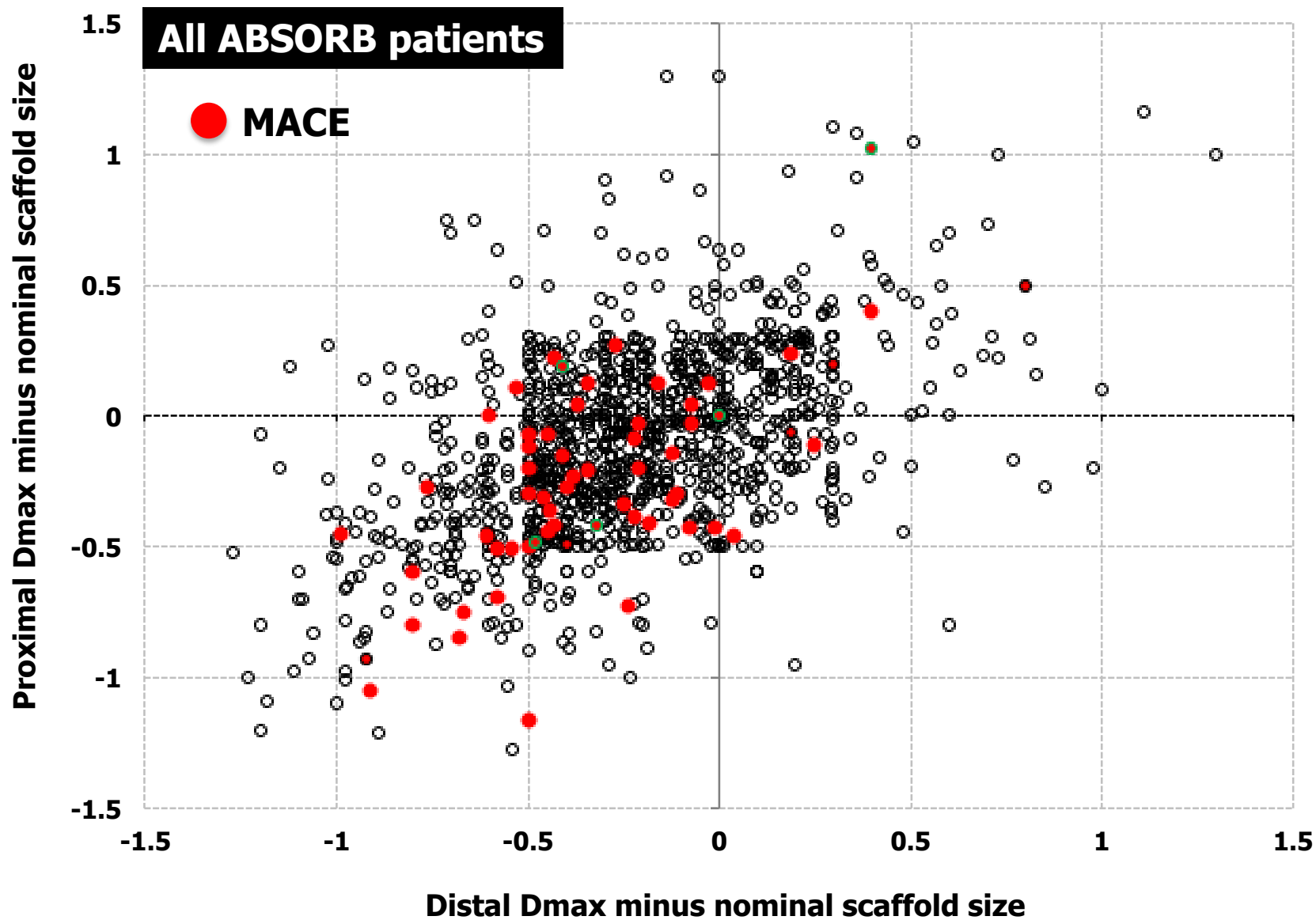
Distribution of Dmax Prox and Dmax Distal related to the nominal device size in the **ABSORB II, Extend and B (n=1248)**



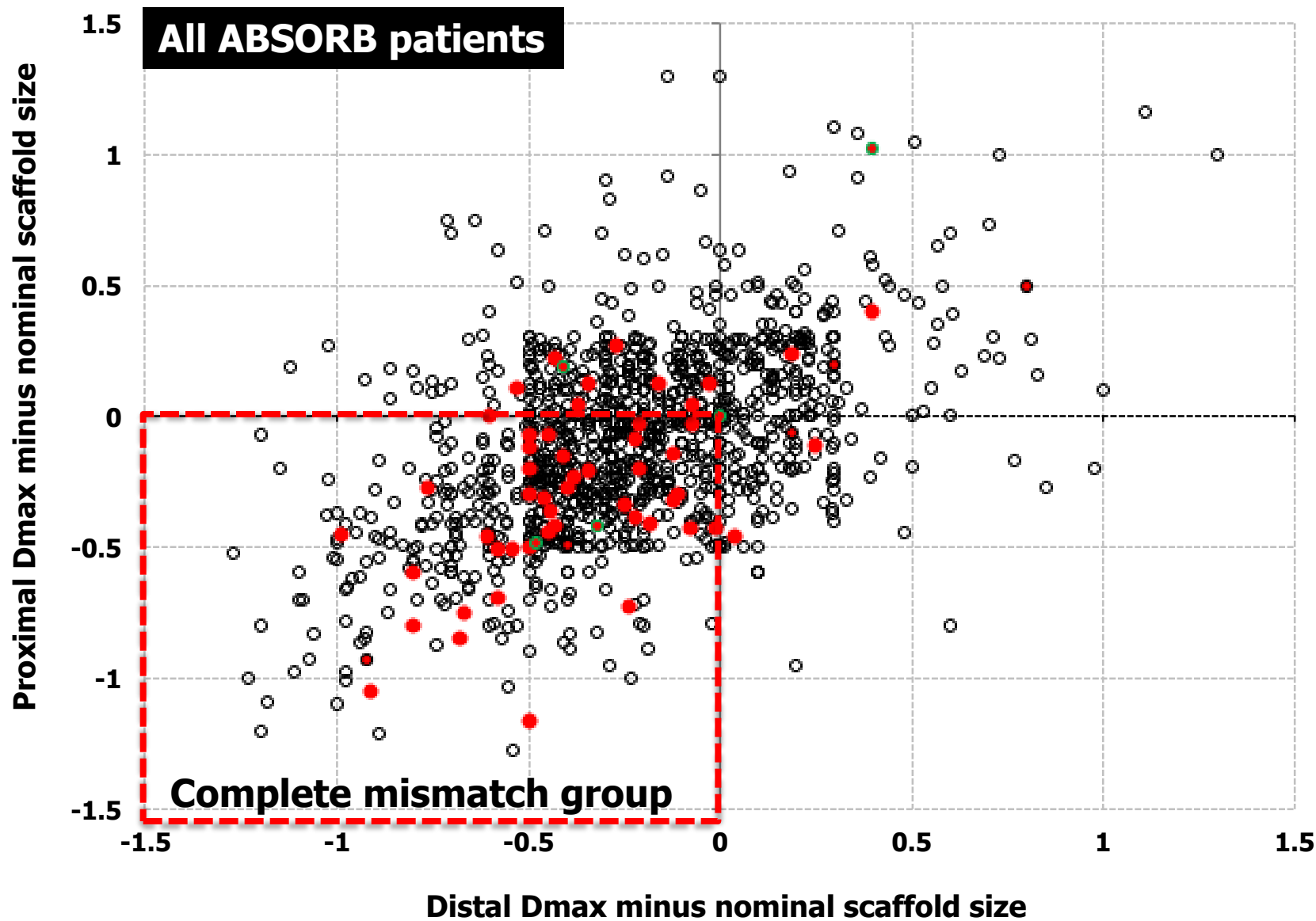
Distribution of Dmax Prox and Dmax Distal related to the nominal device size in the **ABSORB II, Extend and B (n=1248)**



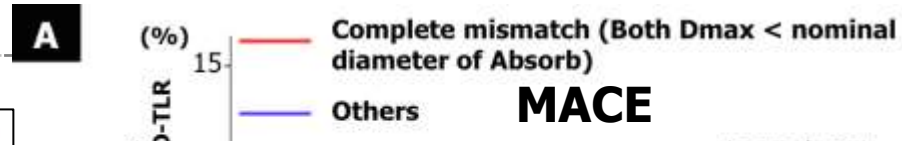
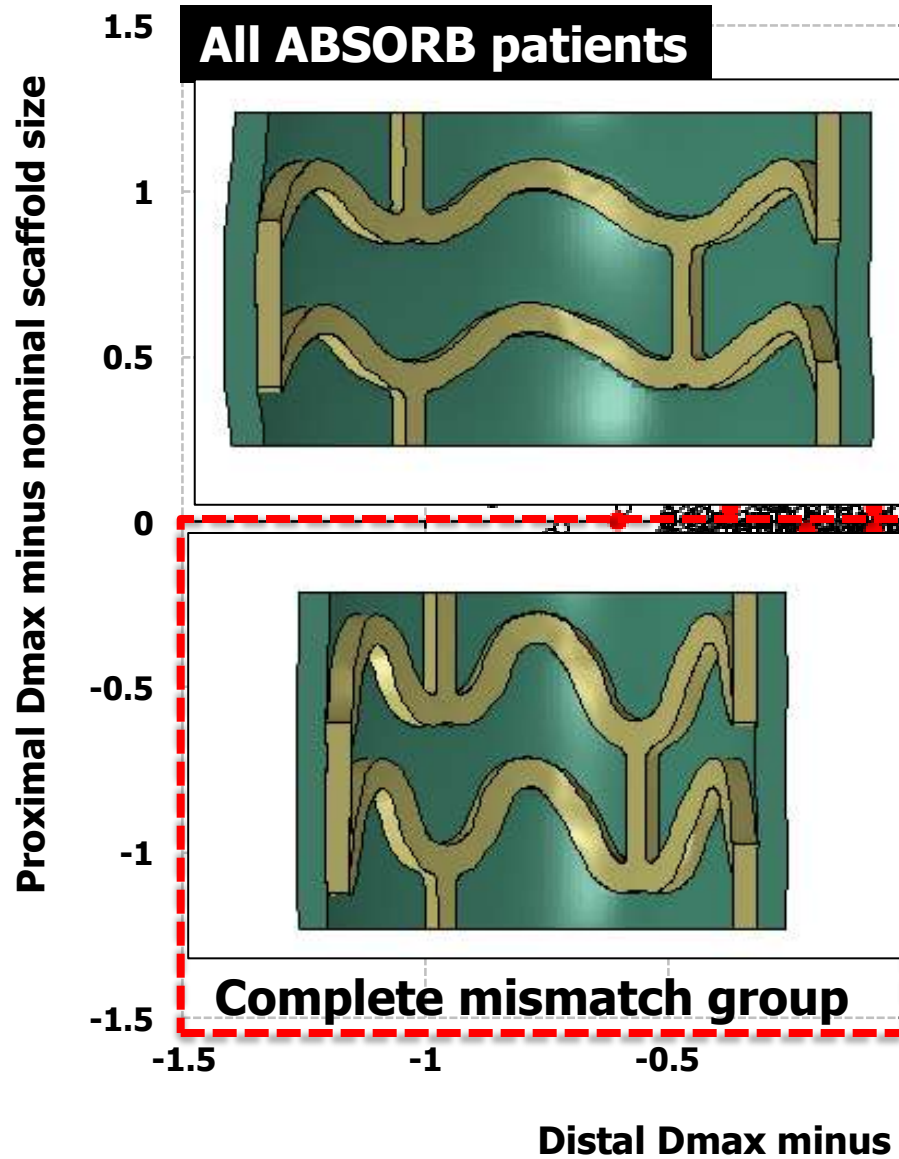
Distribution of Dmax Prox and Dmax Distal related to the nominal device size in the **ABSORB II, Extend and B (n=1248)**



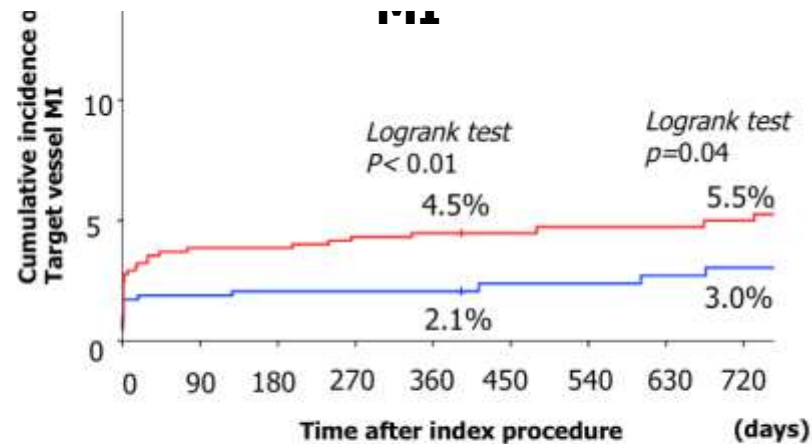
Distribution of Dmax Prox and Dmax Distal related to the nominal device size in the ABSORB II, Extend and B (n=1248)



Distribution of Dmax Prox and Dmax Distal related to the nominal device size in the ABSORB II, Extend and B (n=1248)



The implantation of a "large" Absorb scaffold in a relatively small vessel had a higher risk of MACE at 1 year. The selection of nominal scaffold size below the diameter of both proximal and distal Dmax might lead to a denser polymer surface pattern, which could be associated with MI after procedure.



Number at risk (days)	0	37	194	393	758
Group A	649	626	624	620	613
Group B	583	572	571	571	566

BRS failure: Imaging findings

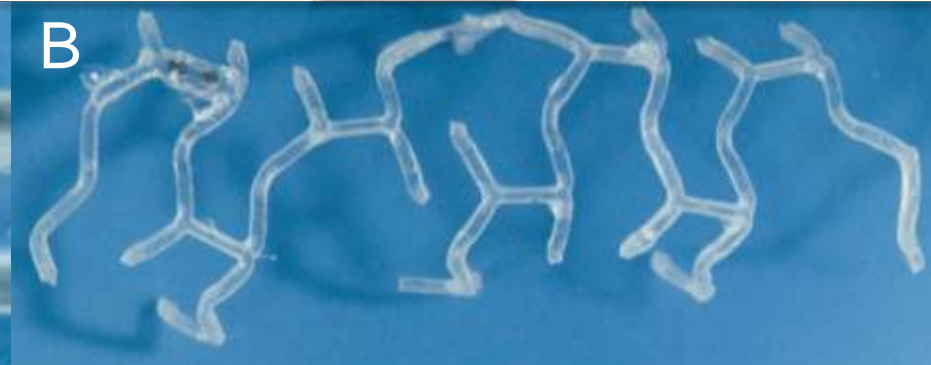
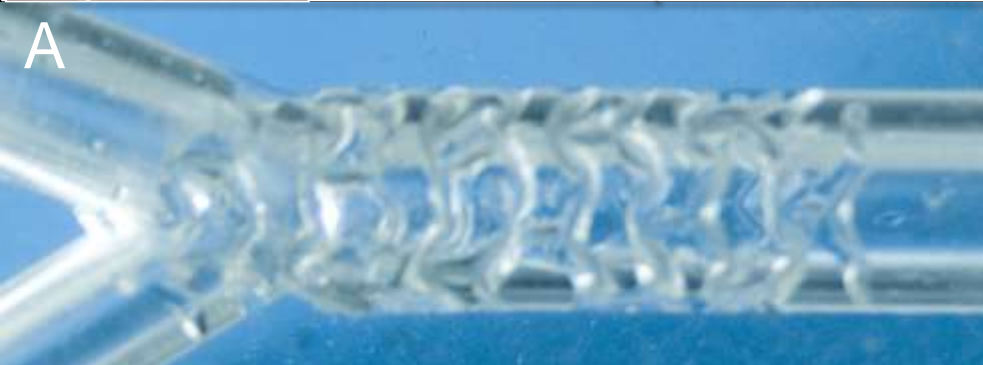
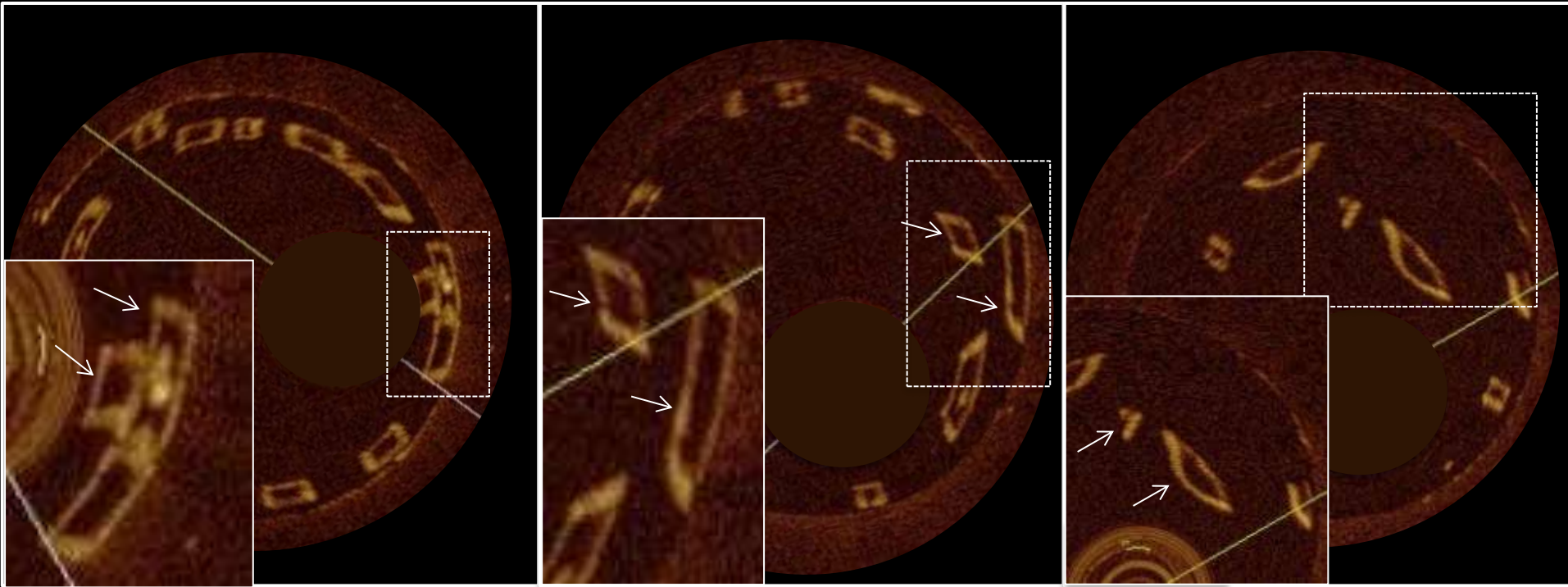
- **Early Thrombosis**
- **Acute disruption**
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- **Others (Aneurysm)**

3 criteria to judge acute disruption on OCT

Stacked Struts

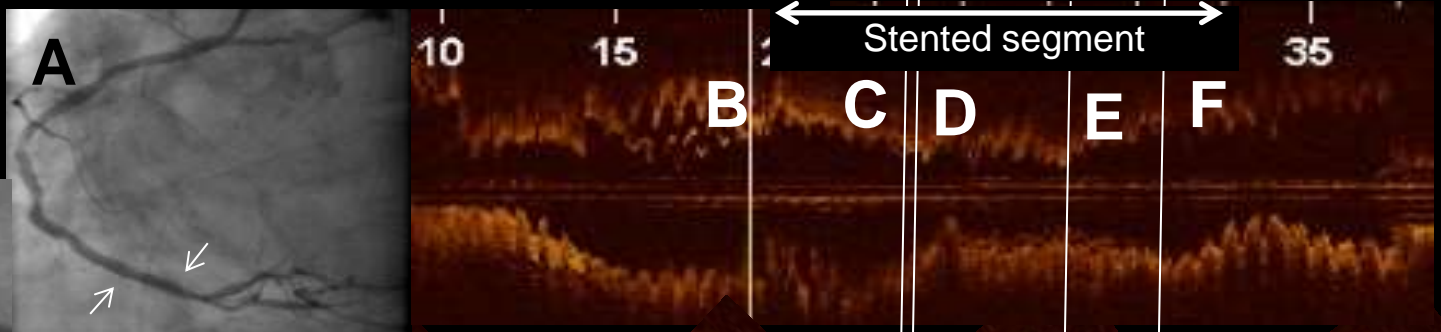
Overhang Struts

**Isolated &
Centered Strut**

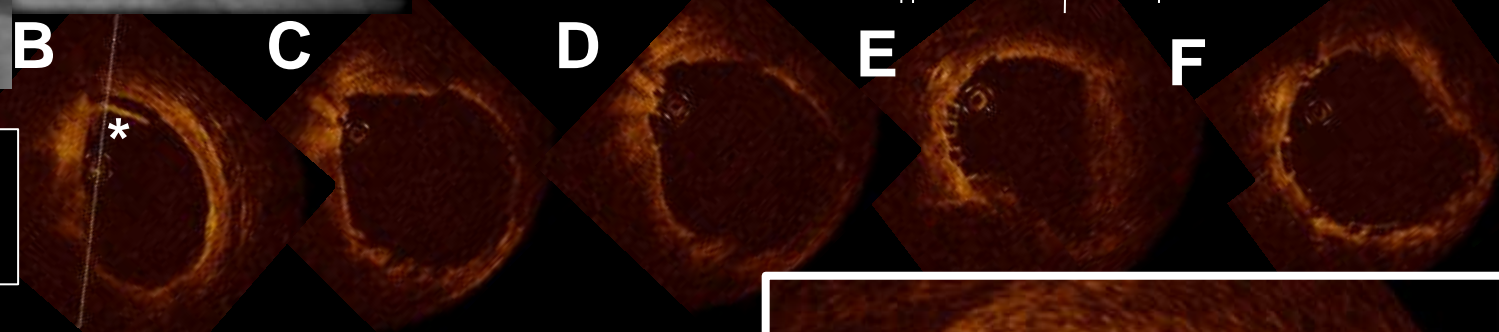


#1. Suspected Acute disruption: Cohort A

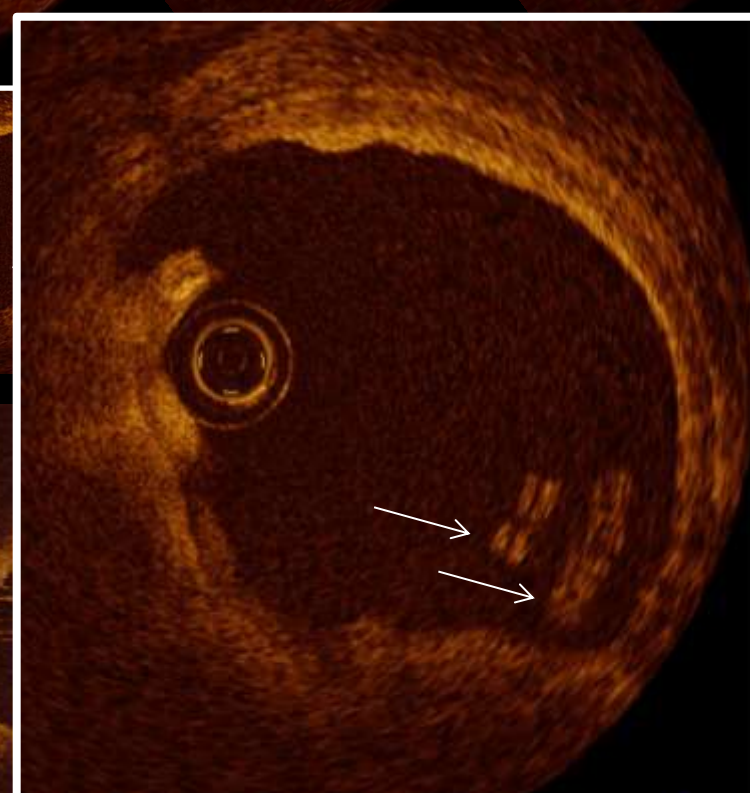
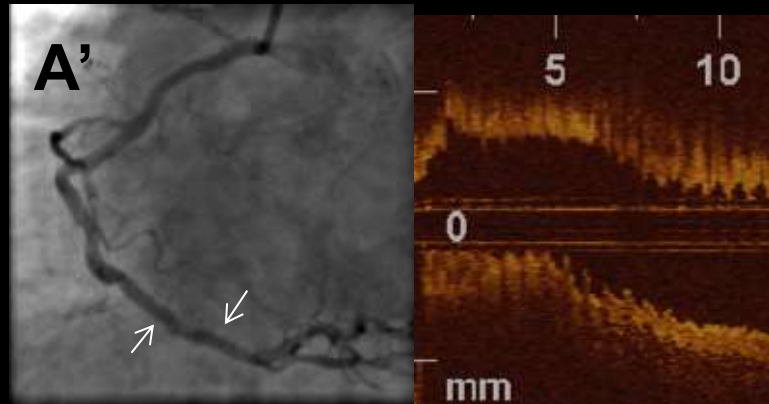
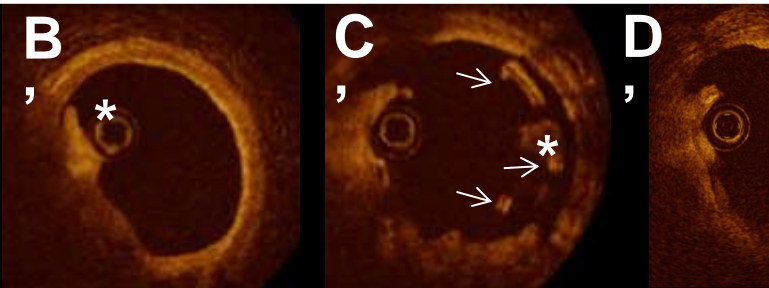
OCT before
post dil



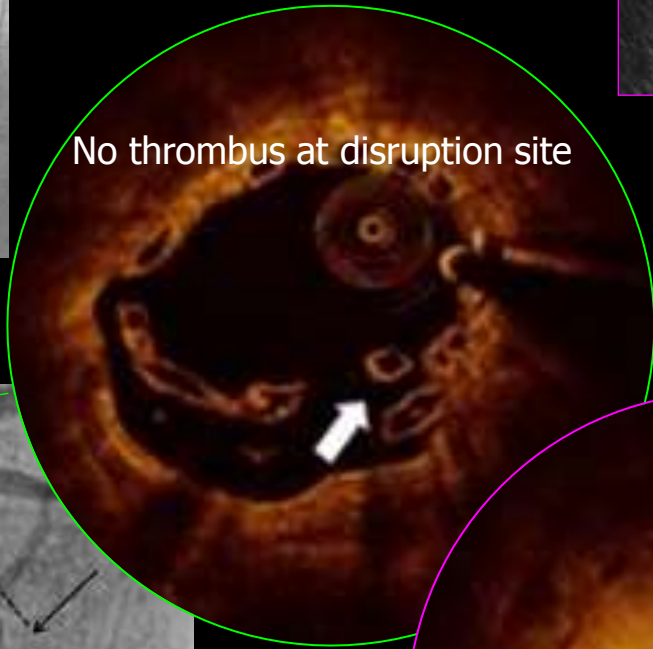
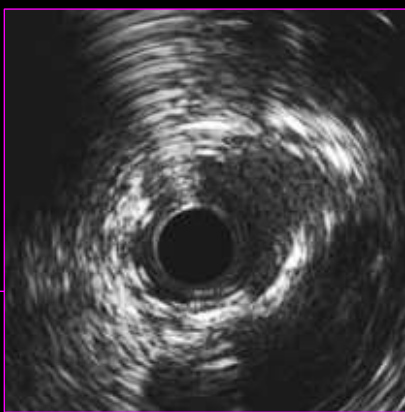
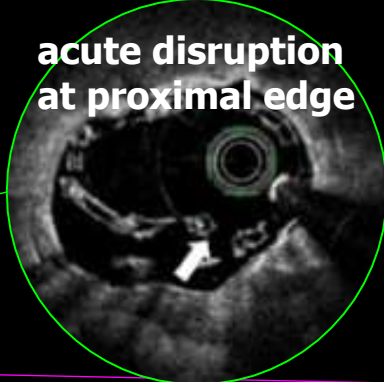
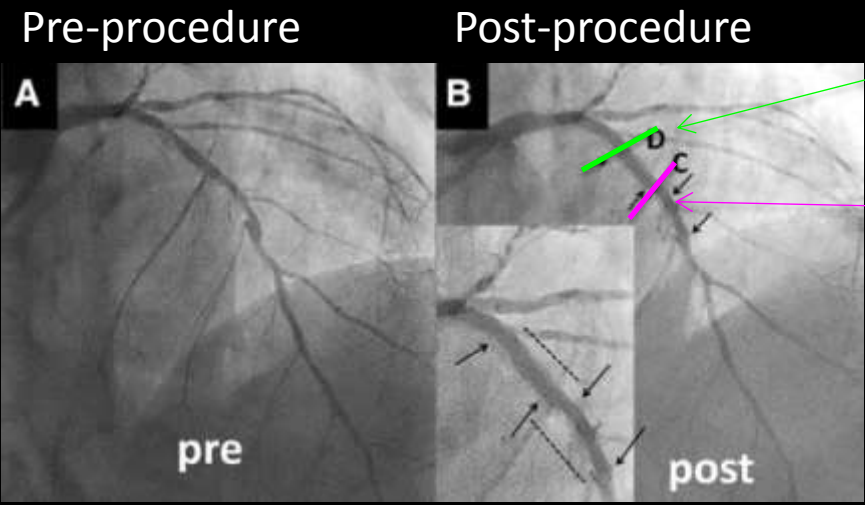
Post dilatation with
a 3.5 mm compliant
balloon at 18 atm



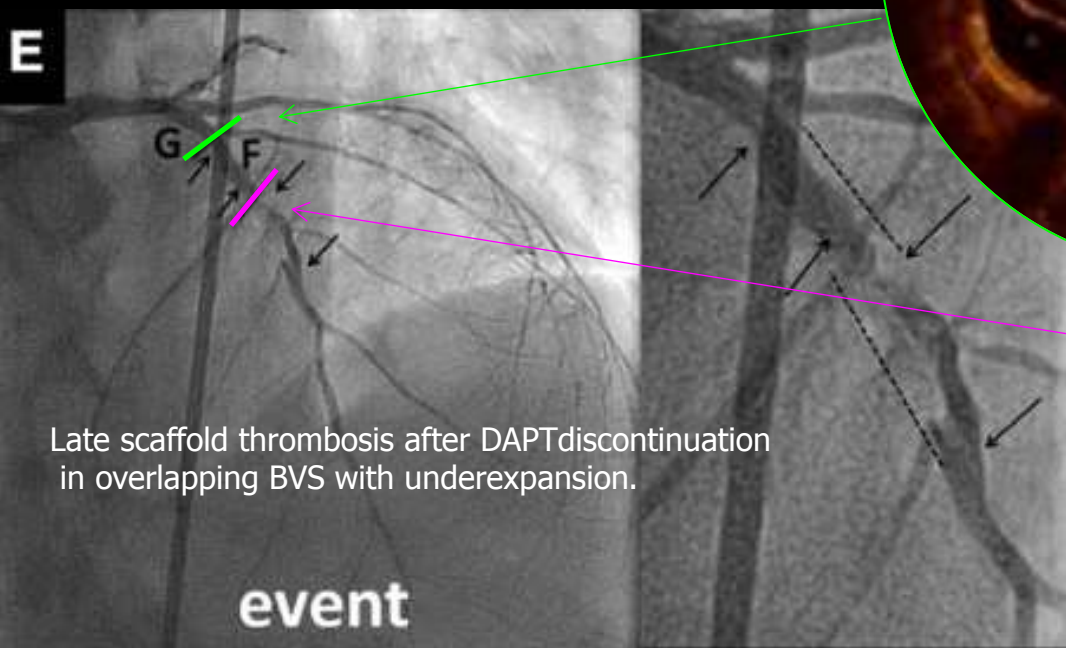
42 days
after
procedure



**#2. Acute disruption and Late Thrombosis
-161 days after implantation, 2 days after
cessation of DAPT**



Scaffold thrombosis on 161 days



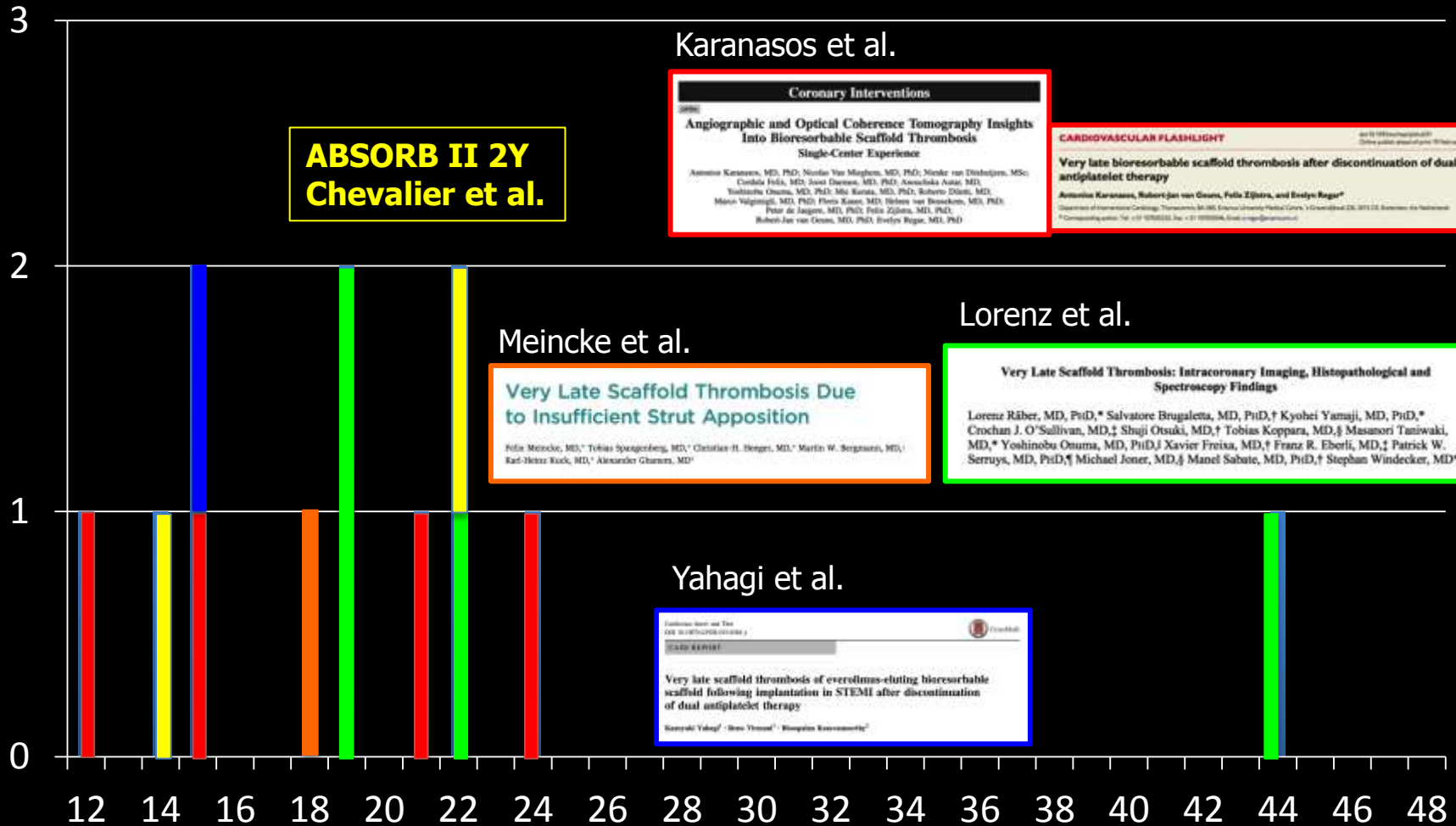
Late scaffold thrombosis after DAPT discontinuation in overlapping BVS with underexpansion.

BRS failure: Imaging findings

- **Early Thrombosis**
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- **Restenosis**
- **Neointimal hyperplasia**
- **Others (Aneurysm)**

What is the reported incidence of very late thrombosis? (n=12 – denominator unknown)

Number



**ABSORB II 2Y
Chevalier et al.**

Karanasos et al.

Coronary Interventions
Angiographic and Optical Coherence Tomography Insights Into Bioreabsorbable Scaffold Thrombosis: Single-Center Experience
Antonios Karanasos, MD, PhD; Nicolas Van Mieghem, MD, PhD; Mieke van Diekesteijn, MSc; Cordula Fedt, MD; Jozsef Dancos, MD, PhD; Anandakrishnan Arora, MD; Yoshitaka Otsuka, MD, PhD; Miki Kanata, MD, PhD; Roberto Elliott, MD; Marco Valgimigli, MD, PhD; Pietro Kastr, MD; Tahereh van Boven-Arnou, MD, PhD; Peter de Jaegere, MD, PhD; Felix Zijlstra, MD, PhD; Robert-Jan van Geuns, MD, PhD; Evelyn Regue, MD, PhD

CARDIOVASCULAR FLASHLIGHT
Very late bioreabsorbable scaffold thrombosis after discontinuation of dual antiplatelet therapy
Antonios Karanasos, Robert-Jan van Geuns, Felix Zijlstra, and Evelyn Regue*
Department of Interventional Cardiology, Thoraxcenter, Erasmus University Medical Center, 3000 DR, 3015 ZB, Rotterdam, the Netherlands
*Corresponding author: Tel: +31 78 626333; Fax: +31 78 626306; Email: ar.eg@erasmusmc.nl

Meincke et al.

Very Late Scaffold Thrombosis Due to Insufficient Strut Apposition
Felix Meincke, MD,* Tobias Spangenberg, MD,* Christian-H. Heeger, MD,* Martin W. Bergmann, MD,* Karl-Heinz Kuck, MD,* Alexander Ghanem, MD*

Lorenz et al.

Very Late Scaffold Thrombosis: Intracoronary Imaging, Histopathological and Spectroscopy Findings
Lorenz Rieber, MD, PhD,* Salvatore Brugaletta, MD, PhD,† Kyohci Yamaji, MD, PhD,* Crochran J. O'Sullivan, MD,‡ Shuji Otsuka, MD,† Tobias Koppa, MD,§ Masanori Taniwaki, MD,* Yoshinobu Ozuma, MD, PhD,‡ Xavier Freixa, MD,† Franz R. Eberli, MD,‡ Patrick W. Serruys, MD, PhD,¶ Michael Joner, MD,§ Manel Sabate, MD, PhD,† Stephan Windecker, MD*

Yahagi et al.

Very late scaffold thrombosis of everolimus-eluting bioreabsorbable scaffold following implantation in STEMI after discontinuation of dual antiplatelet therapy
Kenzoichi Yahagi*, Hironori Yamada†, Hisayuki Kawasumi†

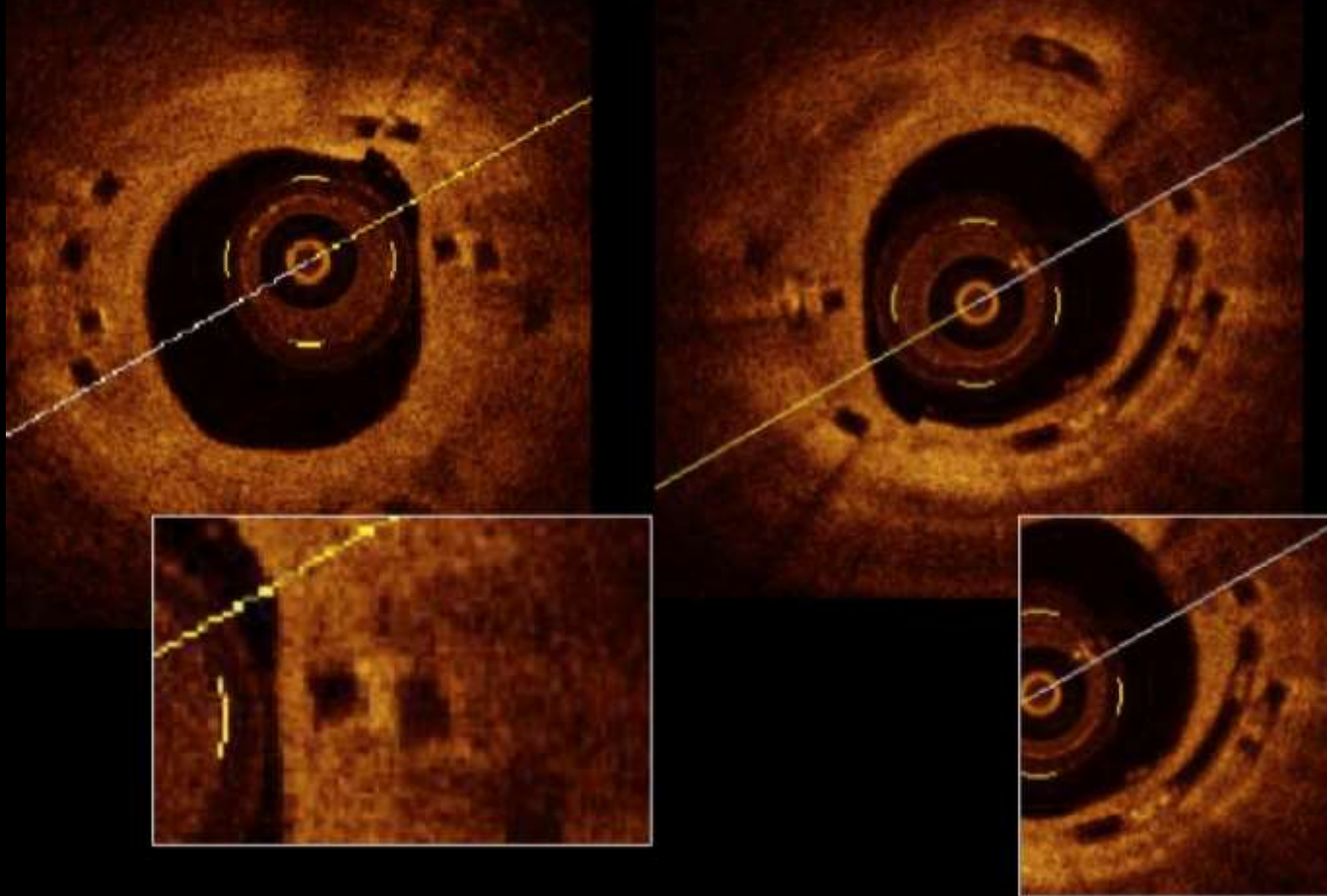
Follow-up duration (months)

Imaging findings associated with Late/very late scaffold thrombosis

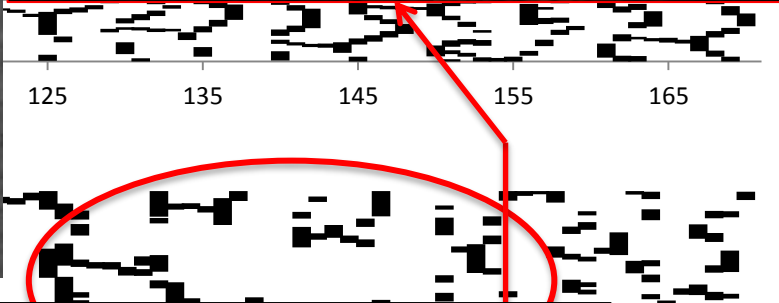
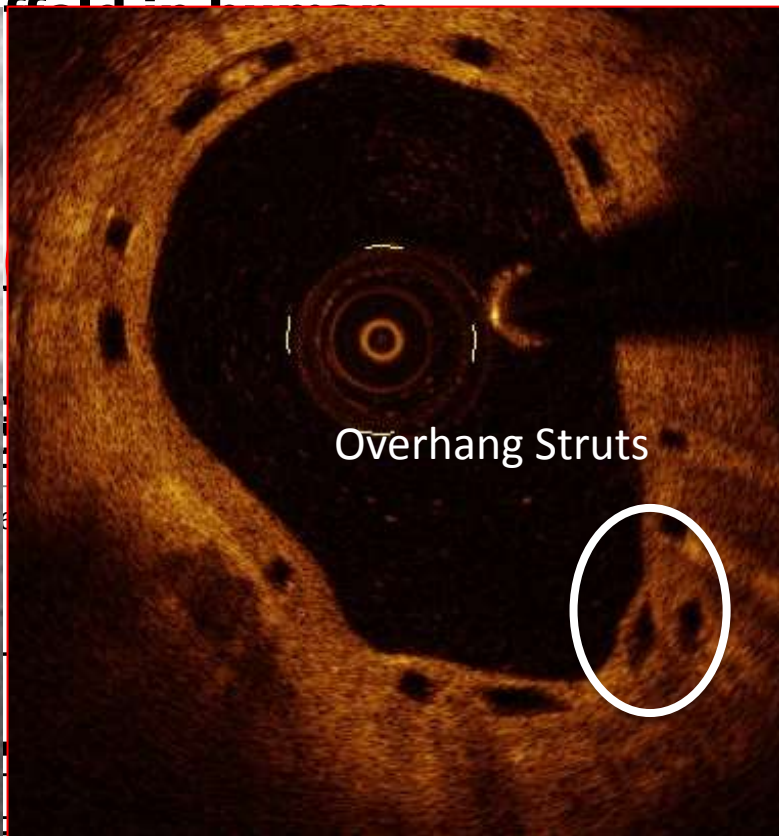
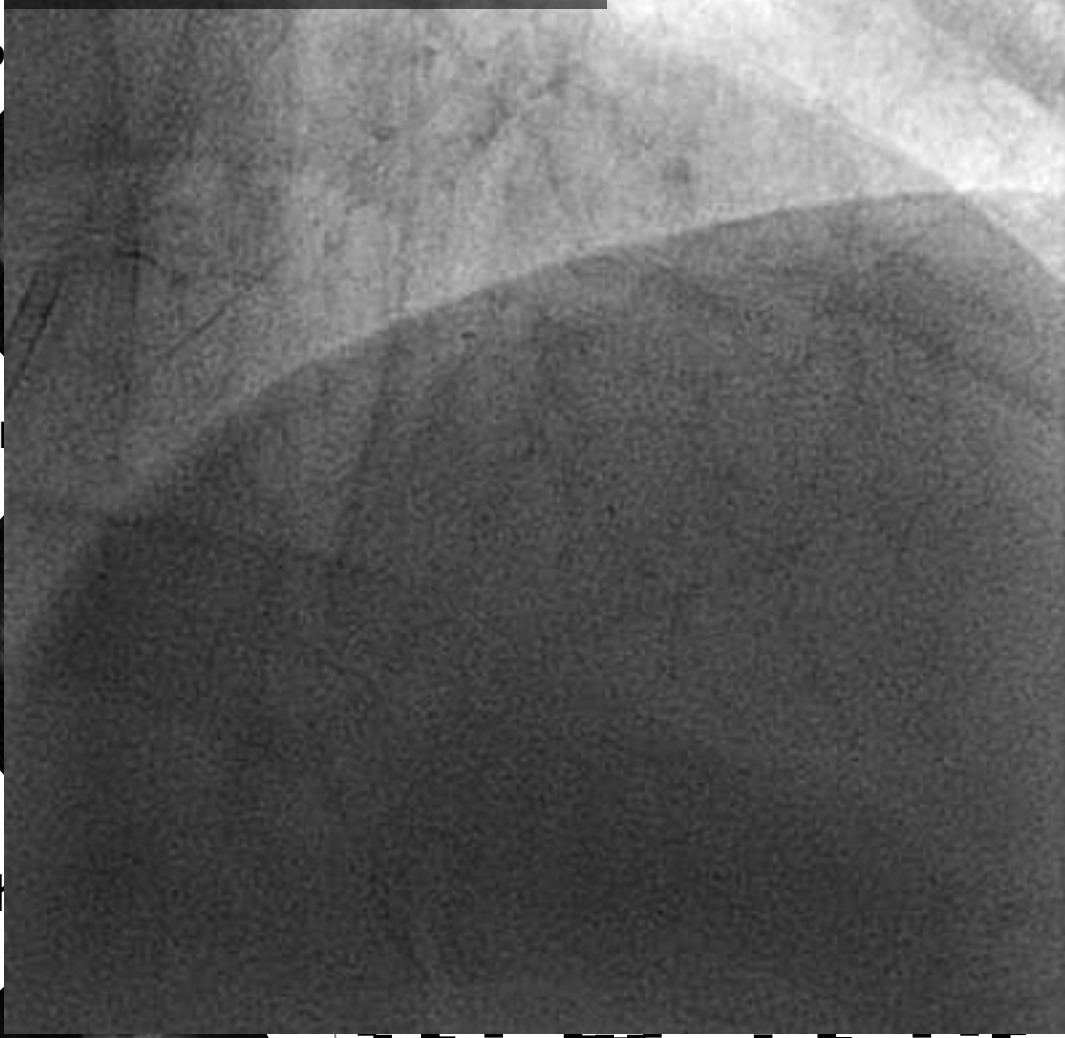
Reported imaging findings associated with Late/very late scaffold thrombosis	N
Malapposition	8
Discontinuity	5
Uncovered Struts	4
Under-expansion	3
Restenosis	1
Incomplete coverage	1

Criteria of late discontinuities are the same with acute disruption. But the findings should be absent at baseline and present at FUP

Stacked Struts, overhang struts or isolated centered strut



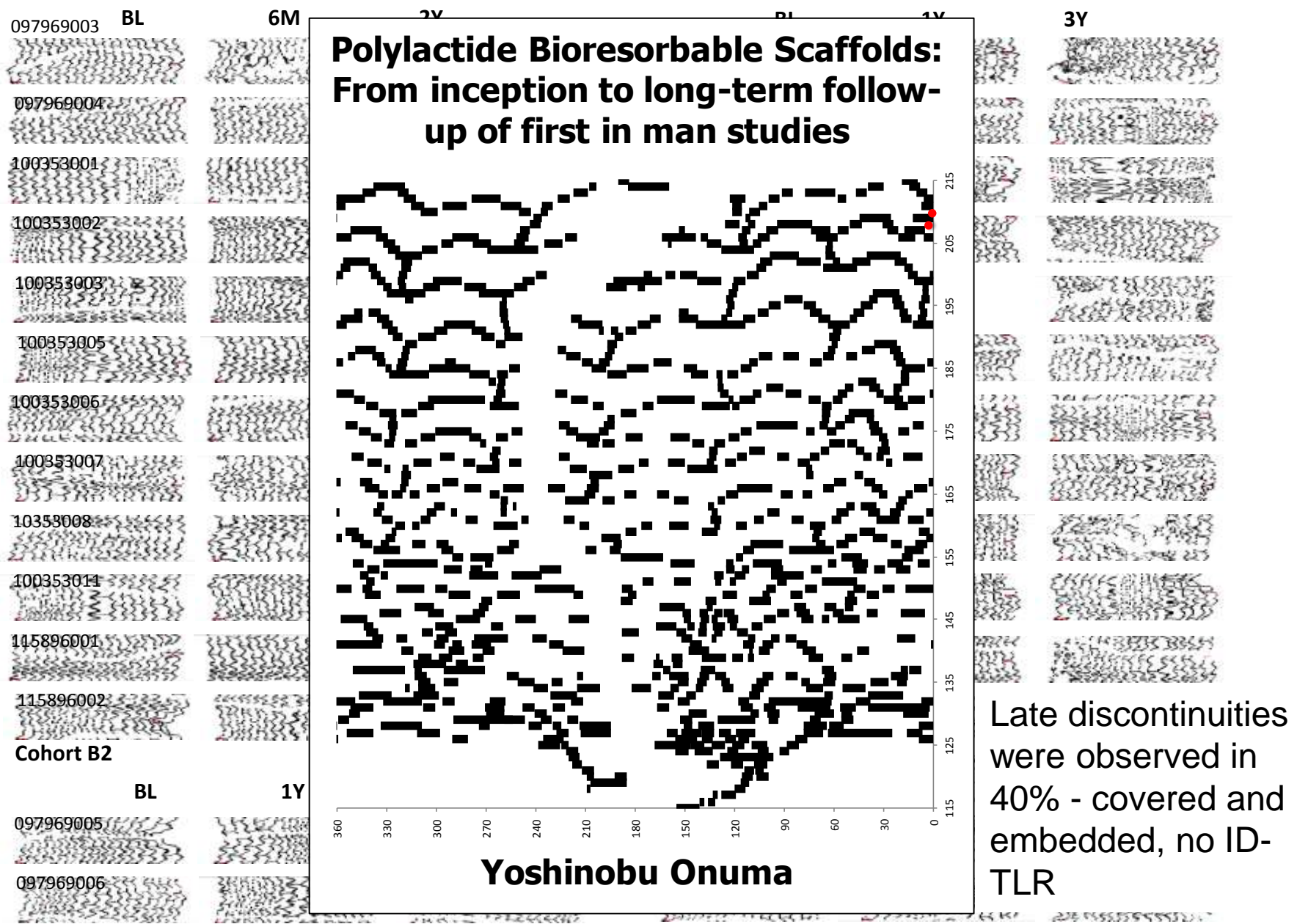
Angiography at 3 years



Late discontinuity is expected phenomenon related to bioresorption.

118 128 138 148 158 168 178 188 198 208

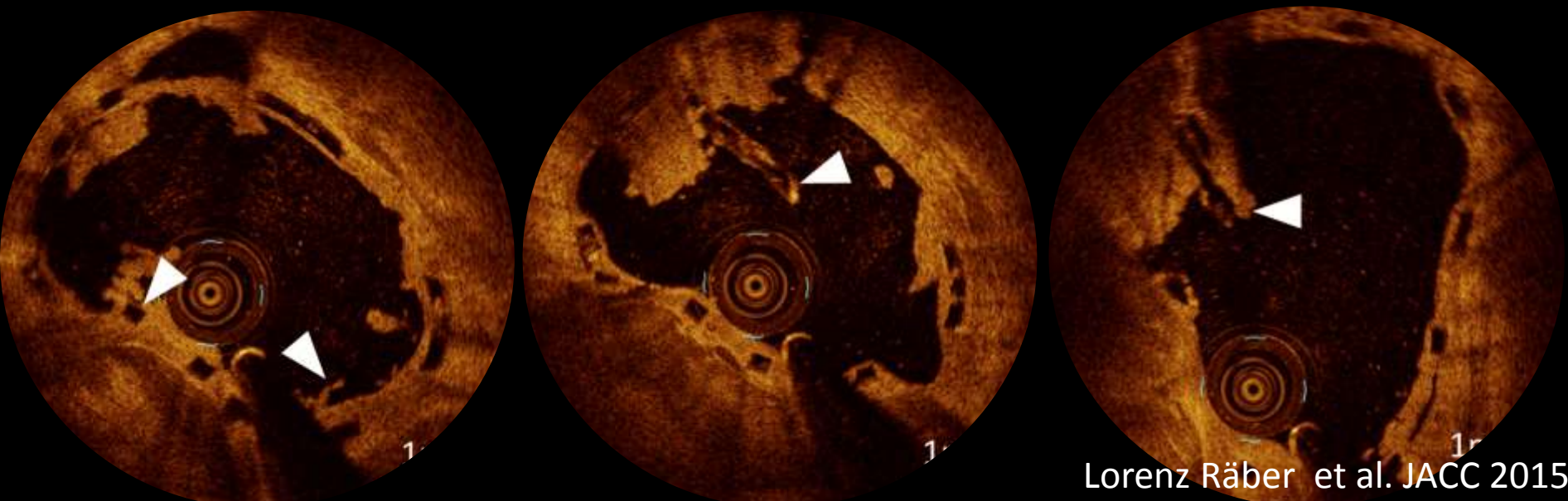
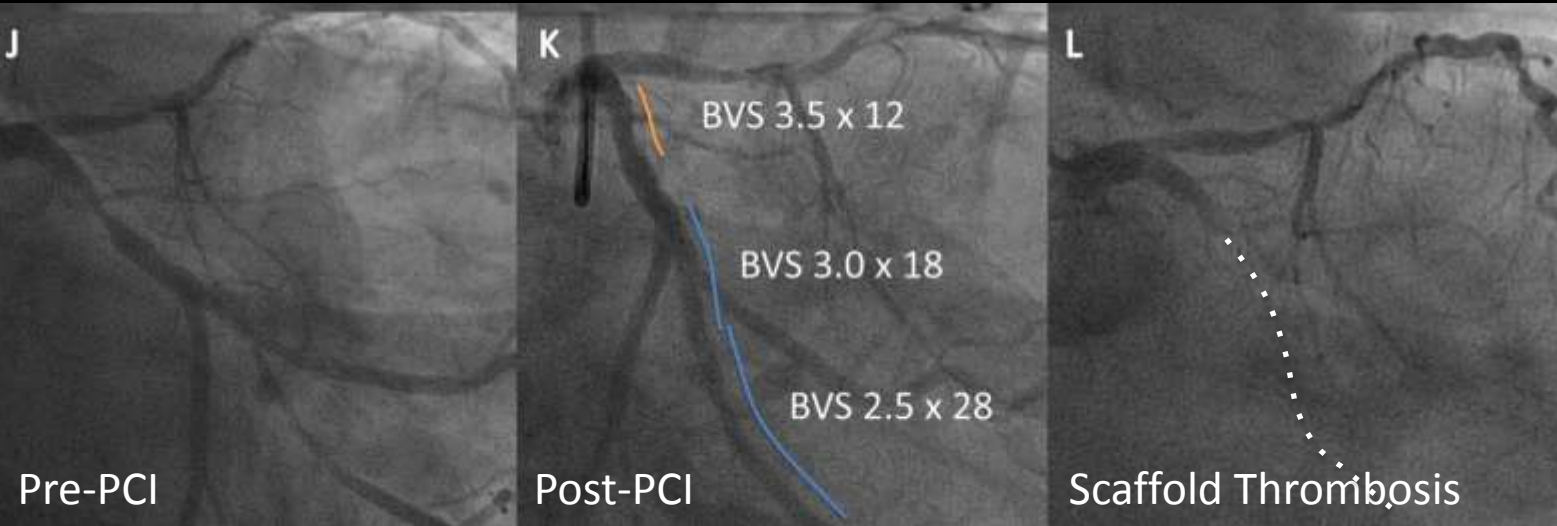
Assessment of OCT late discontinuities in Cohort B1/B2



#1 VLST with Late discontinuity and Uncovered struts

The cause for thrombus formation was late scaffold strut discontinuity with the particular finding of a long scaffold strut freely floating in the lumen. Uncovered struts were frequently observed (10%) and the majority of struts were covered by thrombus.

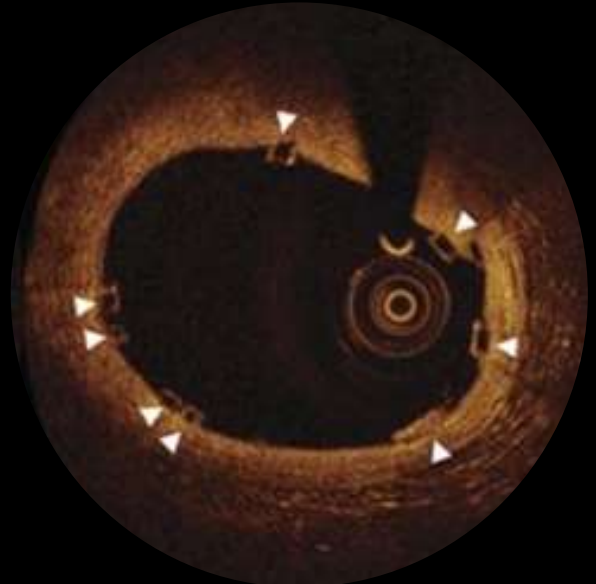
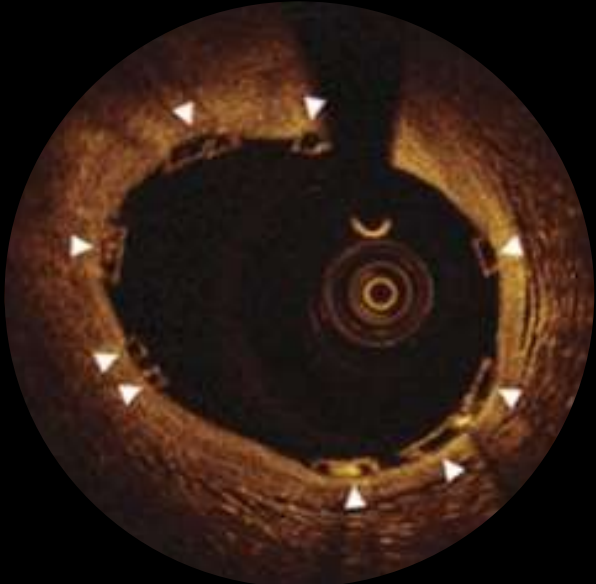
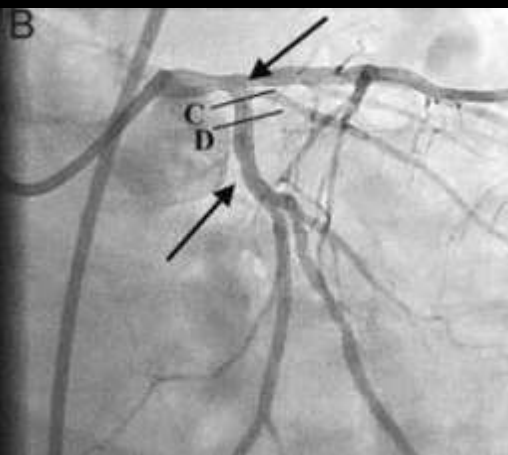
VLST at 19 months



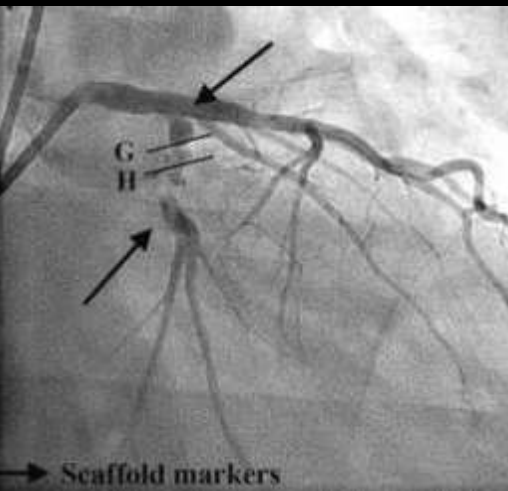
#2 VLST at 2 years with late discontinuities

Karanasos A et al. Eur Heart J 2014;35:1781.

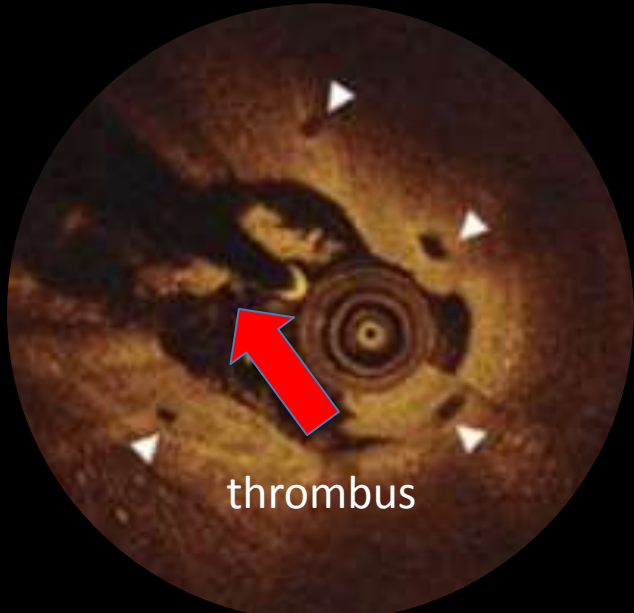
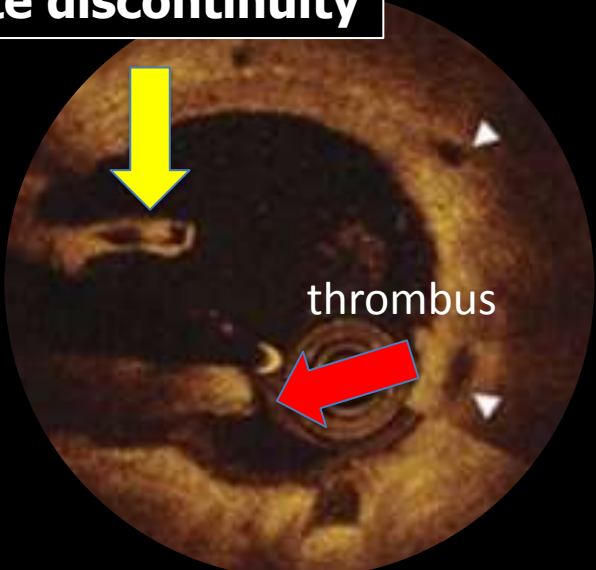
Post-procedure



Scaffold thrombosis



late discontinuity



BRS complications: Imaging findings

- **Early Thrombosis**
- **Acute disruption**
- **Very late Scaffold thrombosis**
 - **Late discontinuities (Intravascular or intraluminal Dismantling)**
- **Restenosis/ Neoatherosclerosis**
- **Others (Aneurysm)**

Overview of Restenosis/ID-TLR

last update: 5th Feb 2016

NA: not available

Trial name	Follow-up period (M)	Patient number	Binary restenosis (%) (in-segment)	ID-TLR (%)
ABSORB Japan	12	272	1.9	2.6
EVERBIO II	9	75	10.7	10.0
TROFI II	6	95	0.0	1.1
Absorb Cohort B	36	101	5.9	7.0
ABSORB II	12	335	NA	1.2
ABSORB EXTEND	12	512	NA	1.8
GHOST-EU	6	1189	NA	2.5
BVS-RAI	7.3	122	NA	4.1
BVS EXAMINATION	12	290	NA	1.7
BVS STEMI first	1	49	0.0	0.0
AMC registry	6	135	5.0	6.3
ASSURE registry	12	183	2.8	2.8
GABI-R (euroPCR 2015)	1	1536	NA	NA
POLAR ACS	12	100	0.0	1.0
Prague 19	6	40	0.0	2.5
ABSORB III	12	1322	0.0	3.0
ABSORB China	12	238	3.9	2.5
CTO ABSORB	6	35	5.7	0.0
Robaei et al	12	100	3.0	4.0
Costopoulos et al CCI	6	92	NA	3.3
Costpoulos et al CRM	12	108	NA	0.9
Gori et al	12	75	4.0	9.3
Jagszewski et al	4.9	98	NA	2.0
Kajiya et al	1.77	11	NA	NA
Mattesini et al	8.5	35	NA	0.0
Ojeda et al	13	42	4.8	2.4
Weibe et al	4.4	25	0.0	0.0

Total population

Average FUP

Weighted average

Binary Restenosis

1565

11.8 M

3.21%

ID-TLR

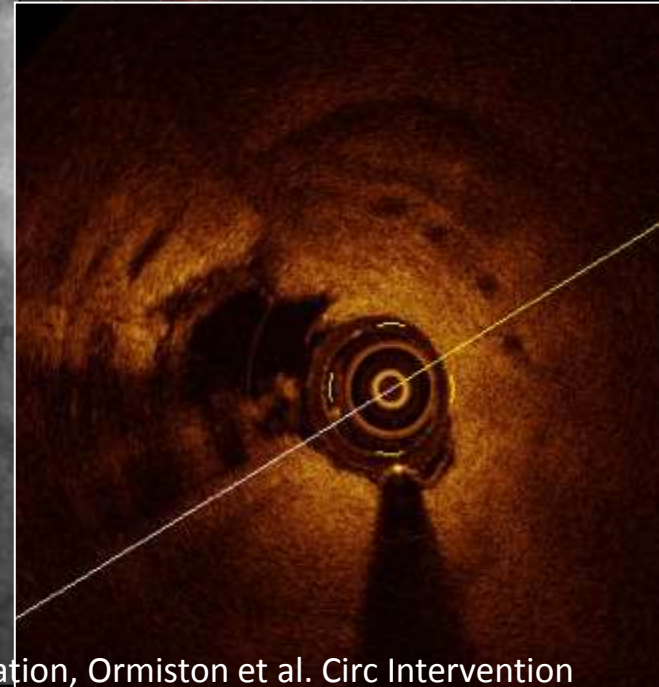
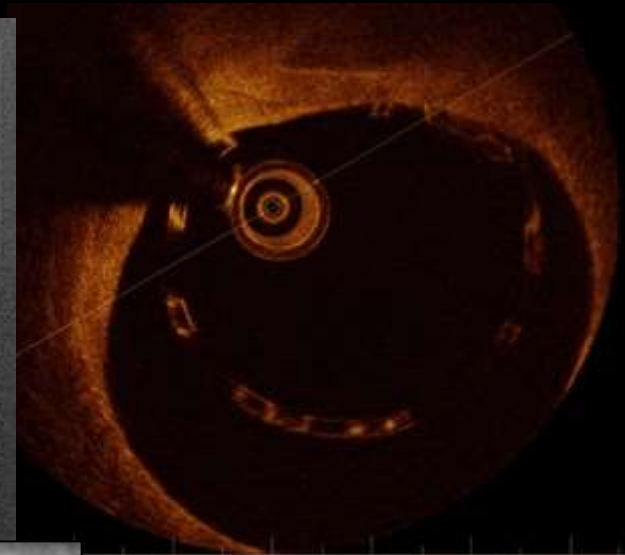
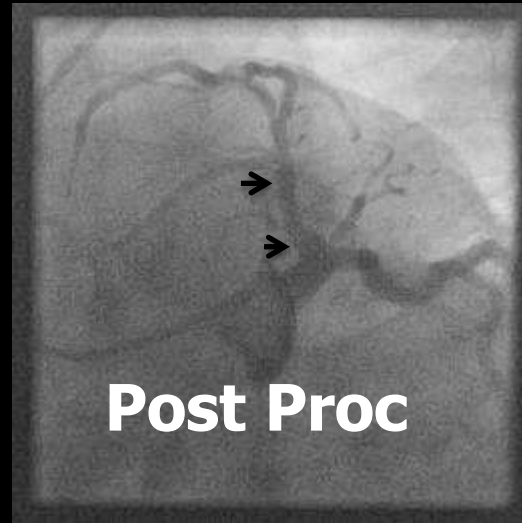
5668

10.3 M

2.73%

Early (<6M), late (6-12M) and very late (>12M) angiographic scaffold restenosis in the ABSORB cohort B trial

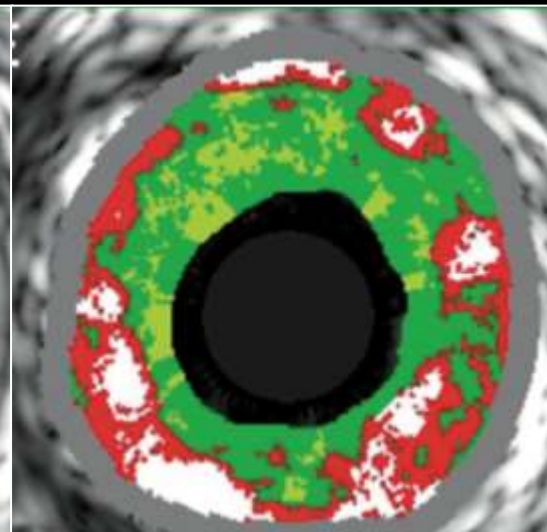
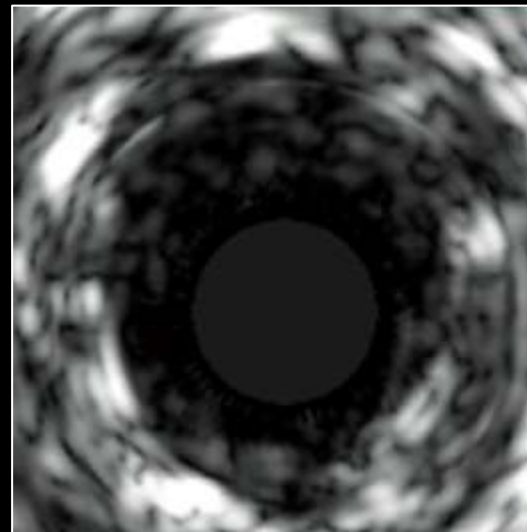
- Myocardial bridge
- Proximal geographic miss
- **Malapposition**
- Late restenosis and scaffold area



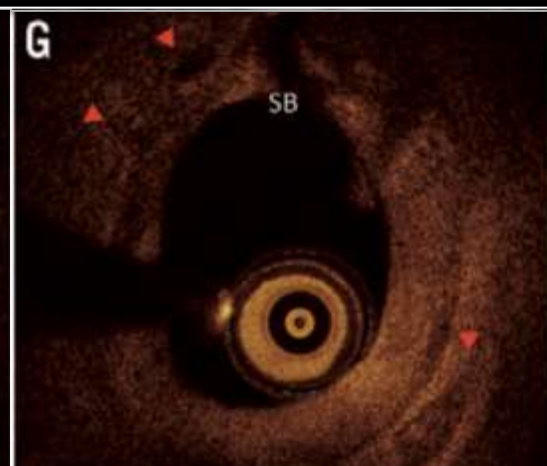
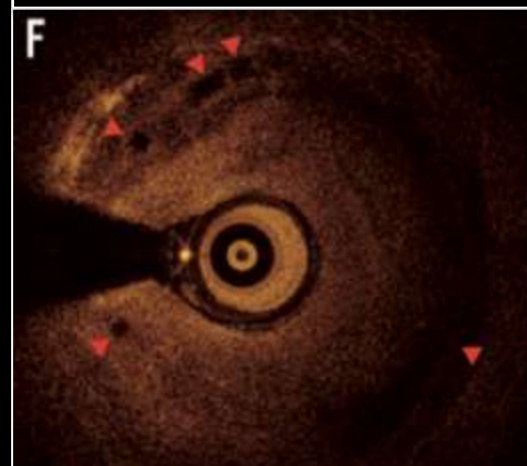
#1. Late ISR day 354 due to neointimal hyperplasia

Type 1C ISR

(QCA MLD: 0.79 mm, %DS: 64.0%, LL: 1.58 mm)

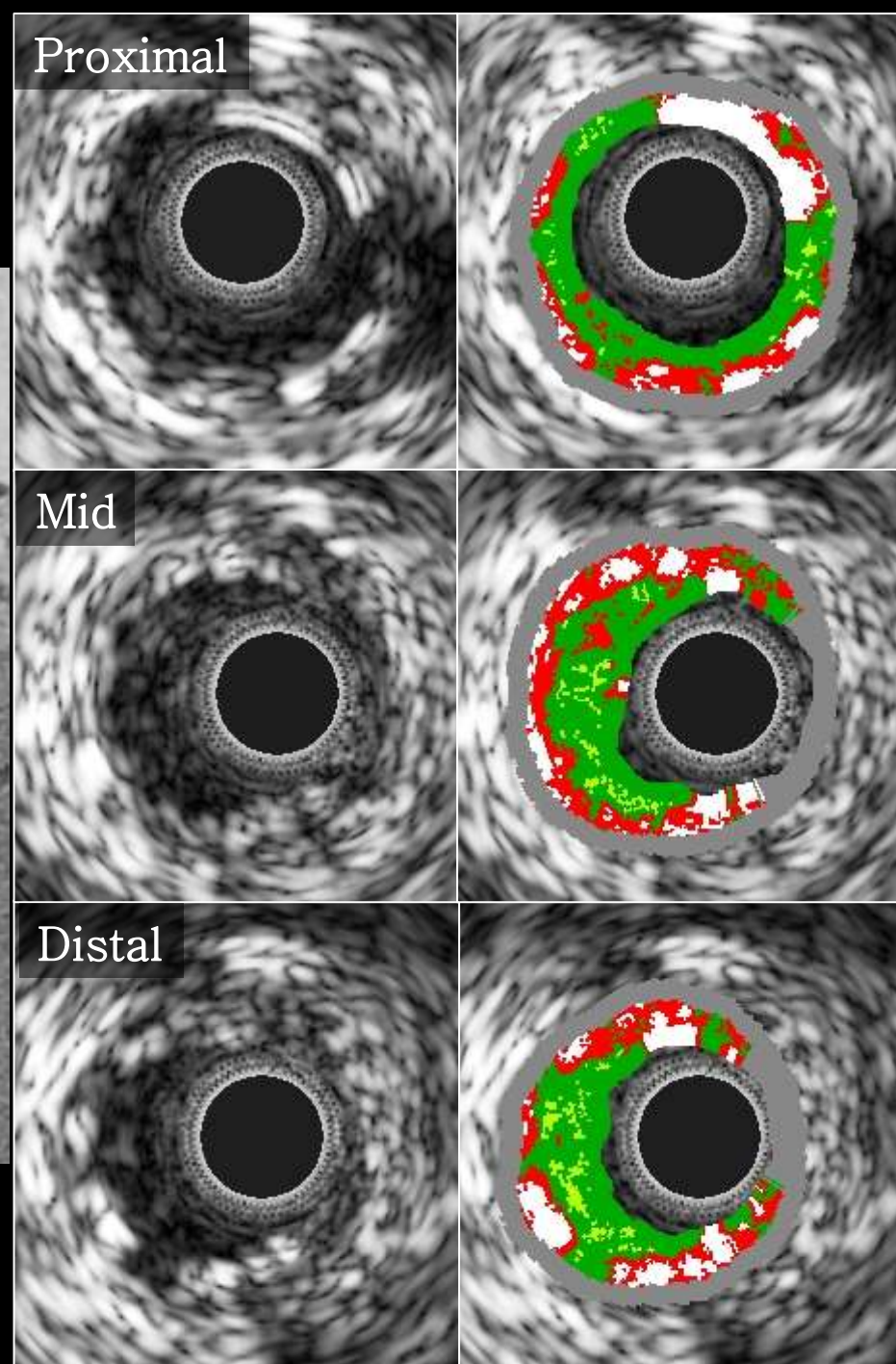
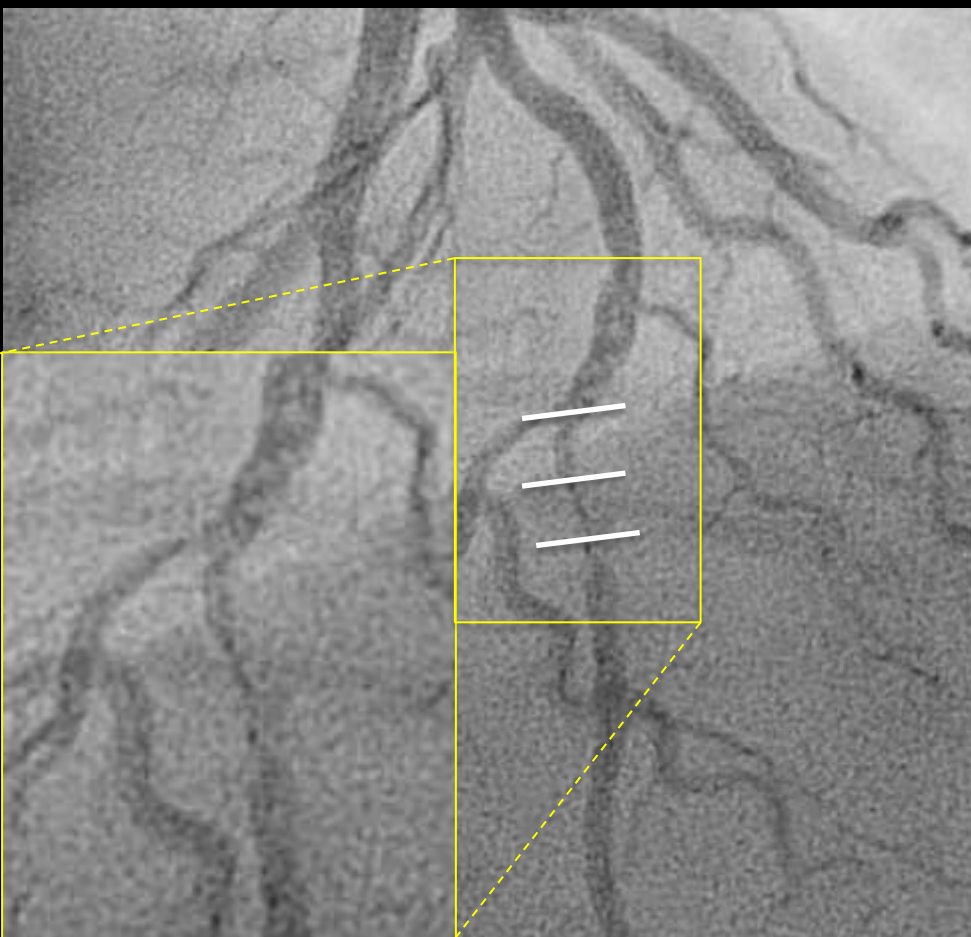


Intra-scaffold tissue was documented as fibrous.



#2. Very late ISR on day 833 in Absorb Cohort B

Nakatani et al. EI 2014



**Type 1B ISR at the distal margin of the scaffold segment
QCA MLD: 0.72 mm, %DS: 63.7% and
LL: 1.38 mm)**

Neoatherosclerosis

Neoatherosclerosis as the Cause of Late Failure of a Bioresorbable Vascular Scaffold



Andrea Mangiameli, MD,* Yohei Ohno, MD,* Guilherme F. Attizzani, MD,* Davide Capodanno, MD, PhD,* Corrado Tamburino, MD, PhD*

D

E

D: Neointimal rupture (white arrow) with mural thrombus (red asterisk)

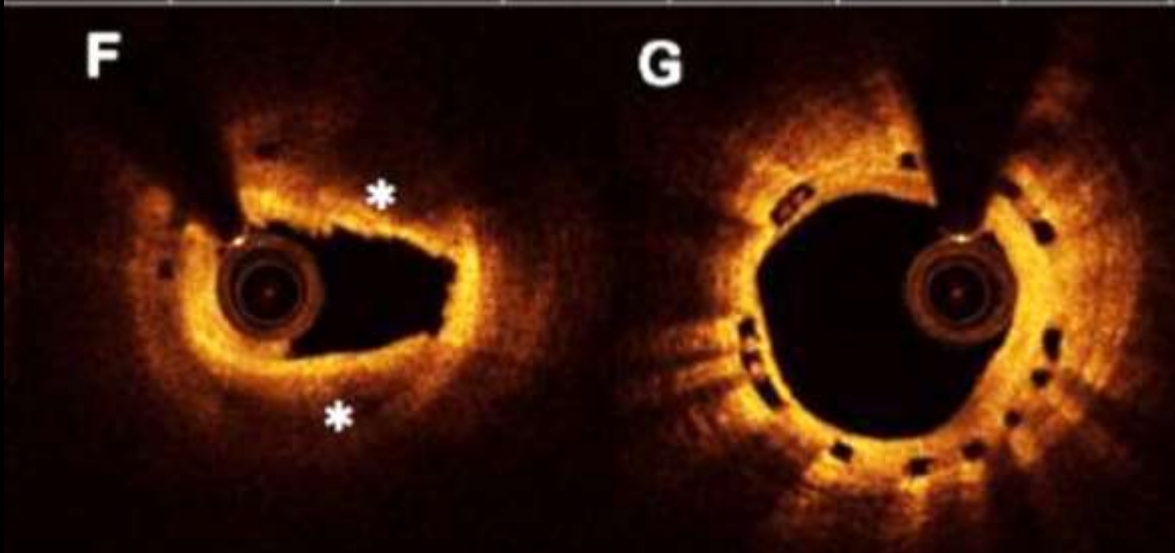
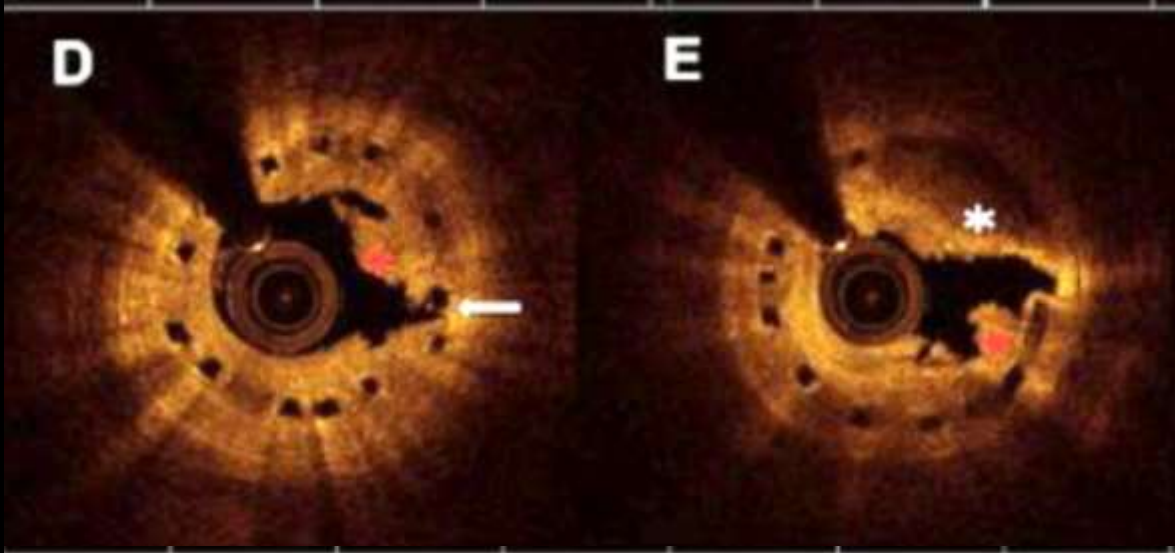
E: Highly attenuating area

F

G

F: Marked shadowing of the scaffold struts

G: Normal pattern of neointima

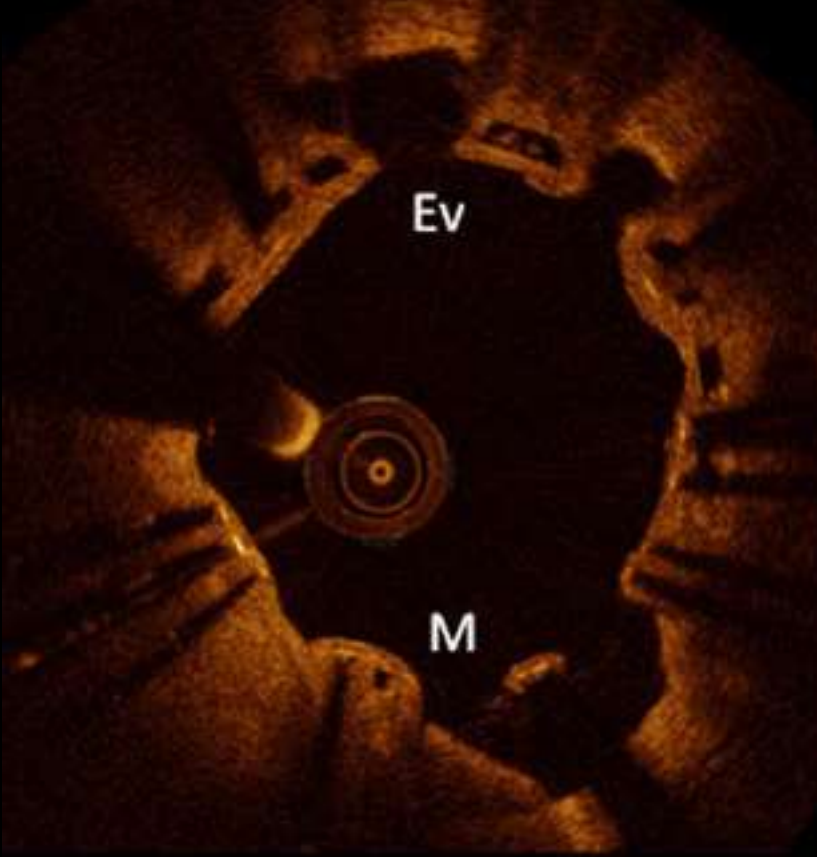
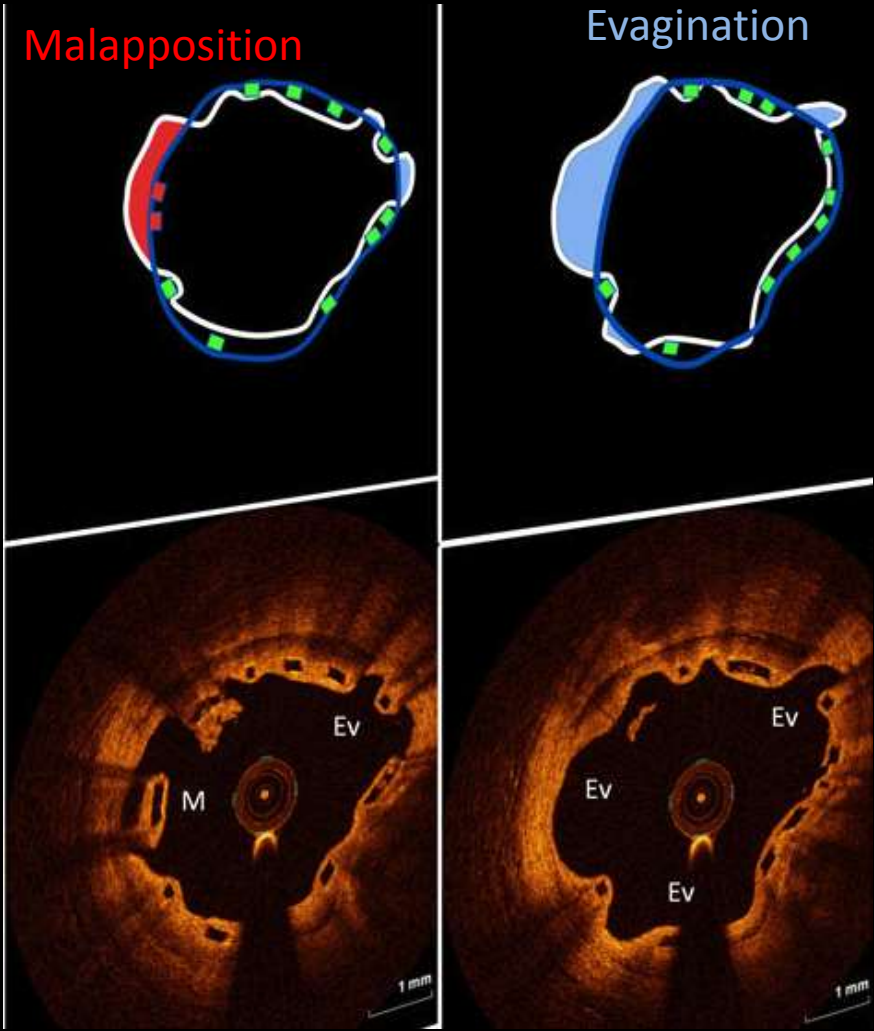


BRS complications: Imaging findings

- **Early Thrombosis**
- **Acute disruption**
- **Very late Scaffold thrombosis**
 - **Late discontinuities (Intravascular or intraluminal Dismantling)**
- **Restenosis/ Neoatherosclerosis**
- **Evagination/ Aneurysm**

Evagination at 12 M FUP

Gori et al. EHJ 2015

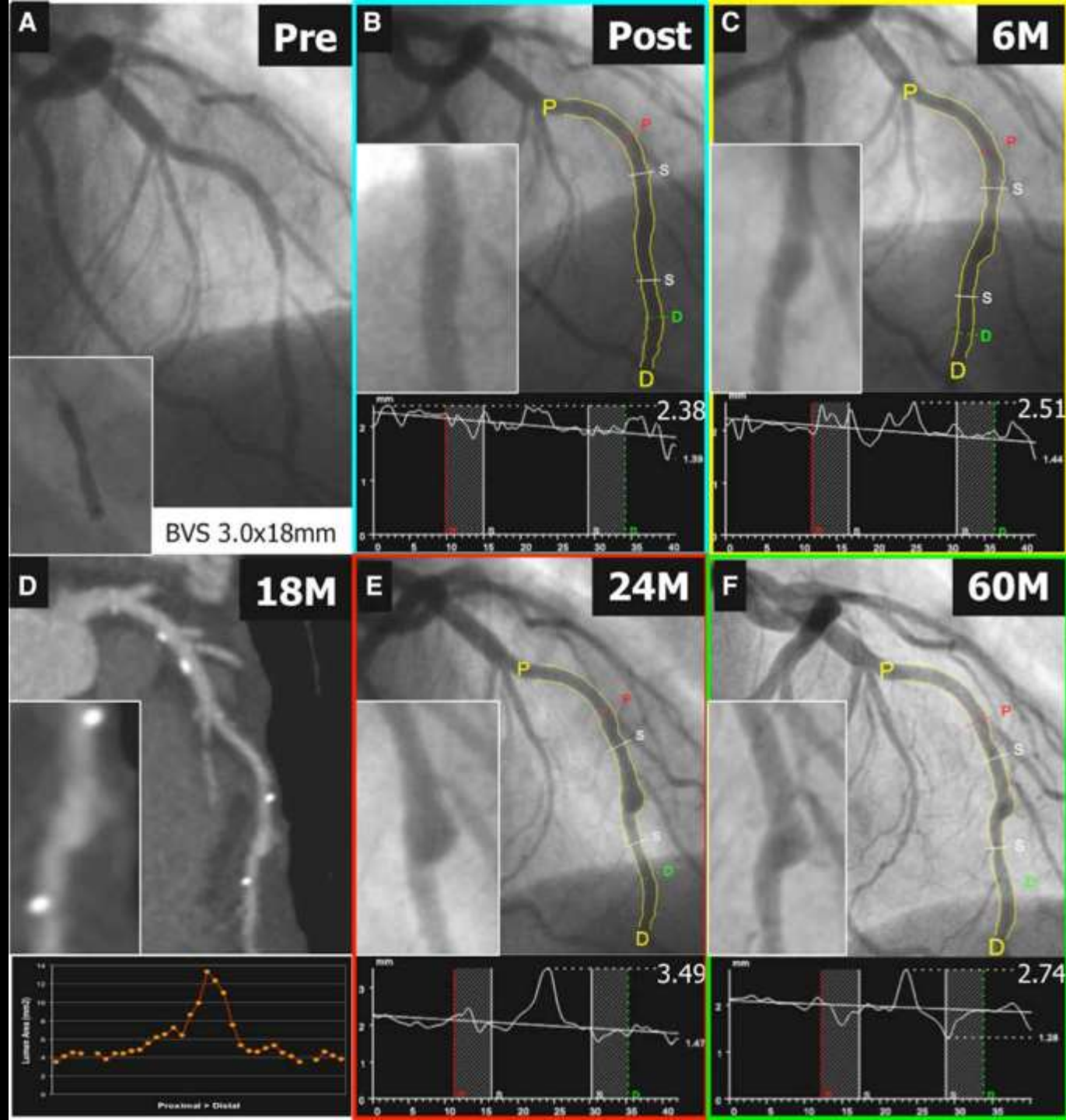


Out of 90 pts, 55 (54%) of the BVS (50(56%) of the patients) had at least one evagination (6.1+6.2 evaginations per BVS).

Case of Aneurysm

**Mechanism:
Unknown**

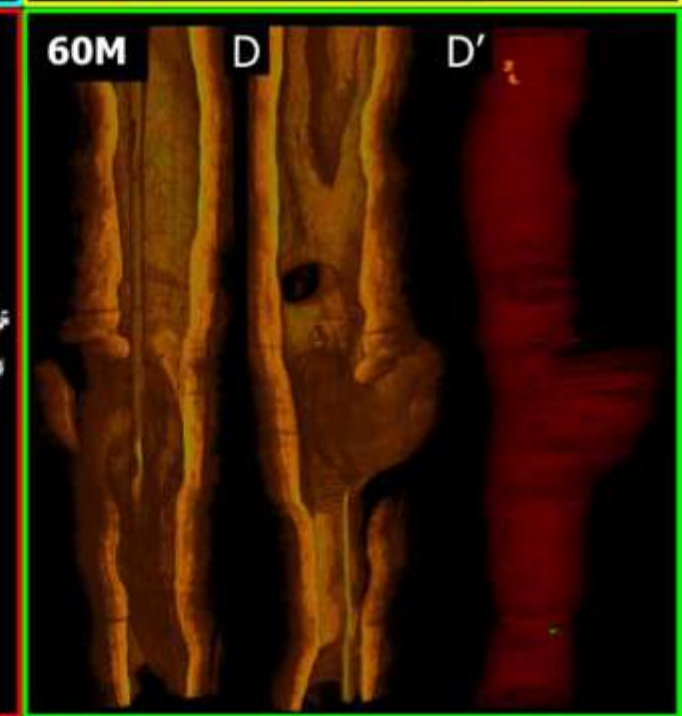
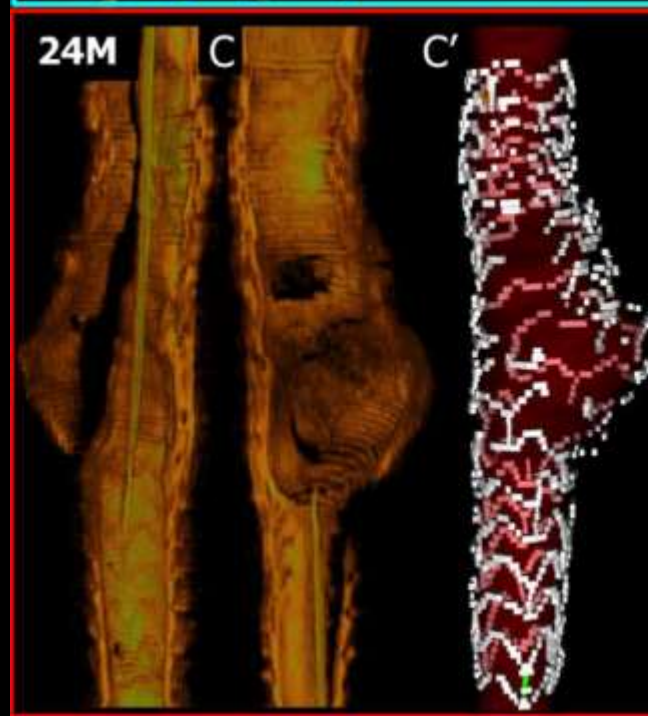
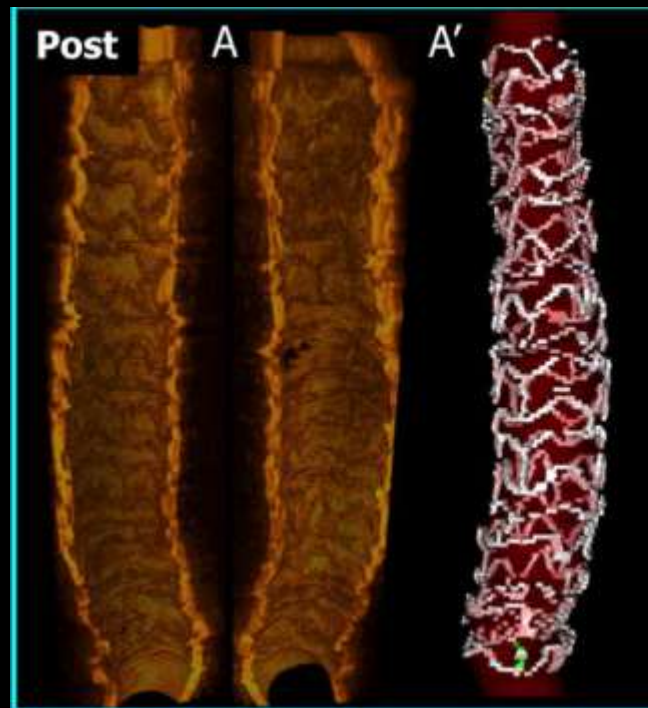
**However, implies
localized
inflammatory
response with
involvement of
matrix metalloproteinase.**



Case of Aneurysm

**Mechanism:
Unknown**

**However, implies
localized
inflammatory
response with
involvement of
metalloproteinase.**



Conclusion

- **Malapposition, scaffold edge landing on plaque, overlap, device-vessel size mismatch and underexpansion are frequently observed in cases of early scaffold thrombosis.**
- **Acute disruption is caused by overexpansion and could relate to scaffold thrombosis.**
- **Late discontinuities are common and benign phenomenon associated with bioresorption (40%). Late discontinuities are however frequently observed in cases of late/very late scaffold thrombosis. It remains unclear whether it is the cause of thrombosis or not. Further research is needed to investigate what impacts the differential outcomes of late discontinuities.**
- **Reported causes of restenosis in the Absorb are not different from those of drug-eluting metallic stent.**
- **OCT-defined neo-atherosclerosis warrants further investigation.**
- **Due to a lack of systematic and serial imaging, it remains unclear how much additional risks will be associated with each imaging abnormality.**

BRS Failure: Insights from Imaging

Yoshinobu Onuma^{1,2}

Yohei Sotomi³

Patrick W. Serruys⁴

1. Thorax Centre Erasmus MC, Rotterdam,

2 Cardialysis B.V., Rotterdam

3. Academisch Medisch Centrum, Amsterdam

4. International Centre for Cardiovascular Health, Imperial College, London

BRS failure: imaging

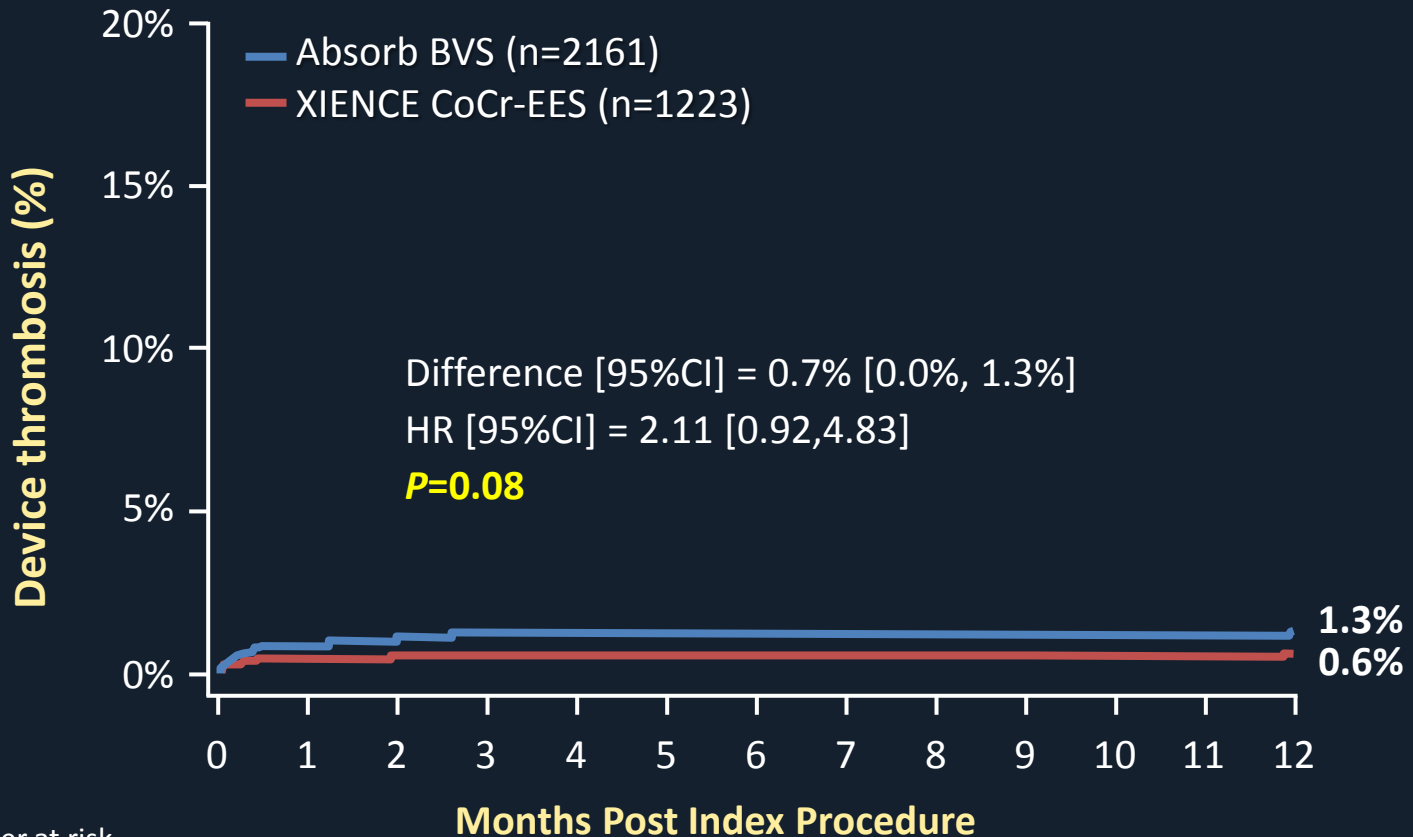
- **Early Thrombosis**
- **Acute disruption**
- **Very late Scaffold thrombosis**
 - **Late discontinuities (Intravascular or intraluminal Dismantling)**
- **Restenosis**
- **Neointimal hyperplasia**
- **Others (Aneurysm)**



ABSORB 1-Year Meta-analysis

ABSORB II, ABSORB III, ABSORB Japan, ABSORB China

Device Thrombosis (Def/Prob) (pooled)



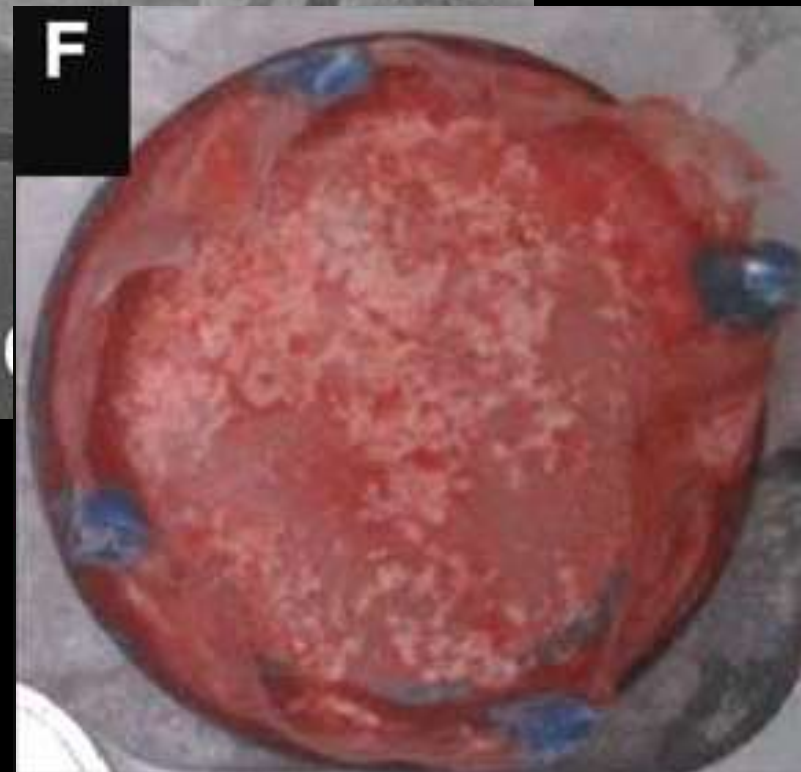
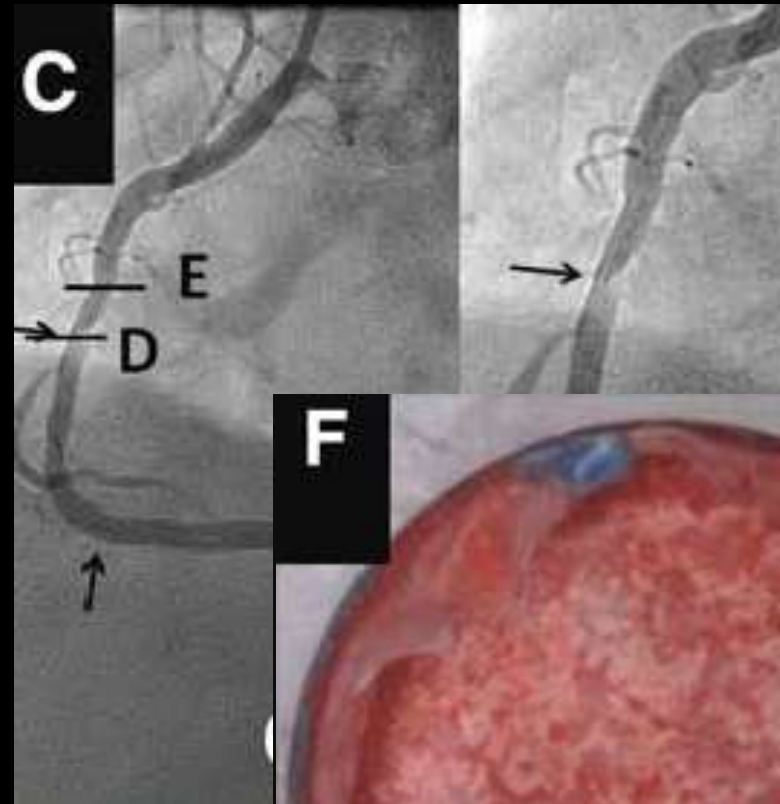
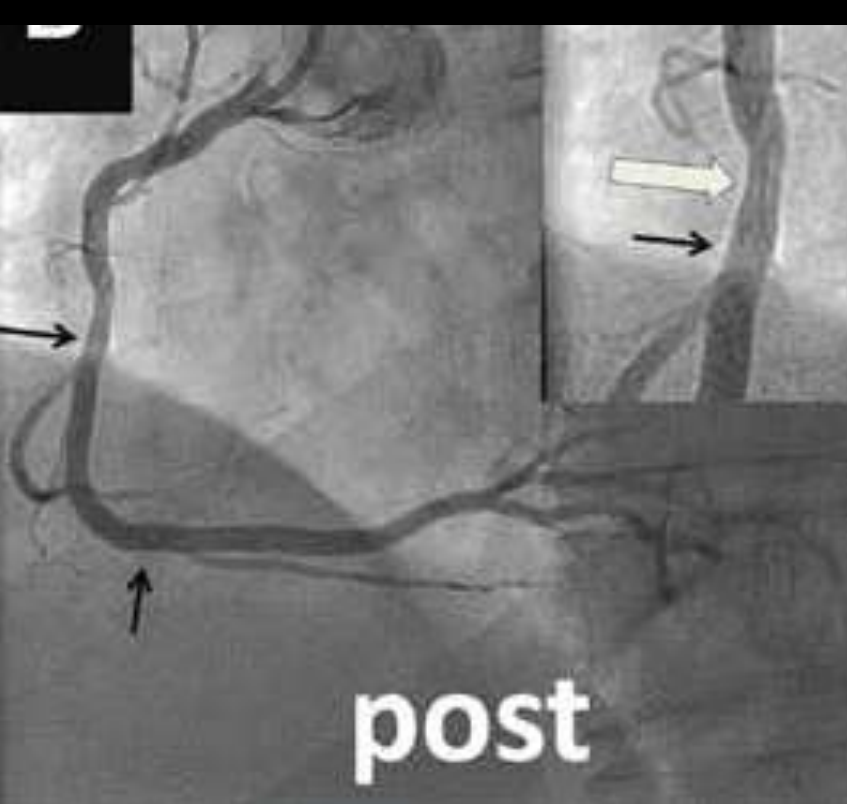
Number at risk		Months Post Index Procedure				
Absorb BVS	2161	2128		2114	2108	2098
XIENCE CoCr-EES	1223	1213		1207	1200	1197

What is the reported rate of Early Scaffold Thrombosis?

Ishibashi et al. EuroIntervention Updated

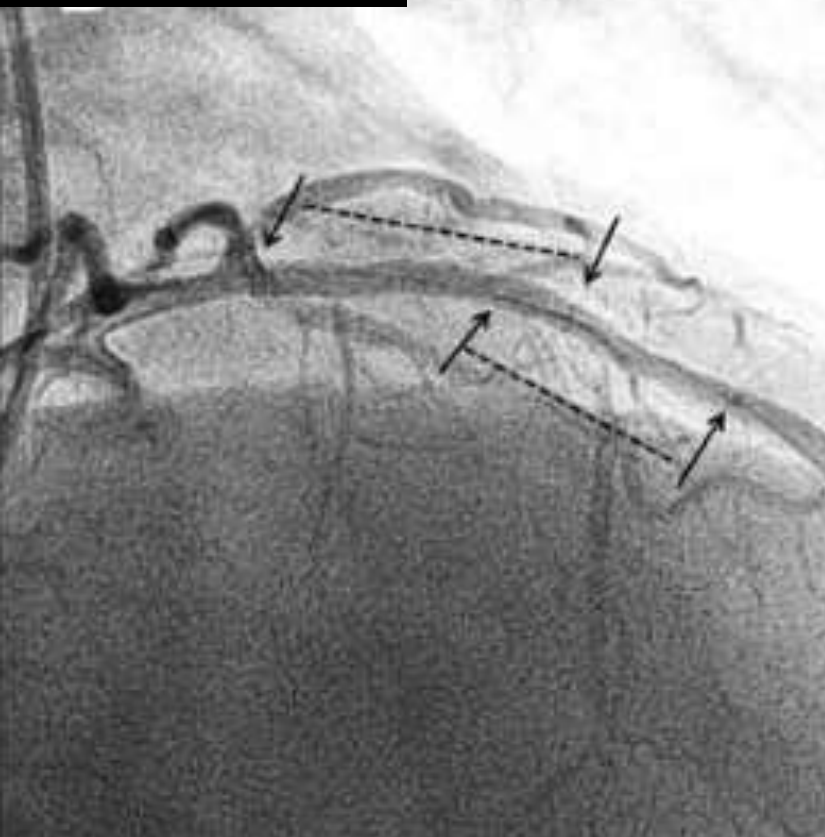
Study	Indication	N	Acute ST N (%)	Subacute ST, N (%)	Early ST, N (%)	Imaging	
Abizaid et al, ABSORB EXTEND	SAP	512	0	2 (0.4%)	2 (0.4%)	OCT 14 cases	SAP/UAP 0.3%
Serruys et al., ABSORB B	SAP	101	0	0	0	IVUS/OCT	
Onuma et al., ABSORB A	SAP	30	0	0	0	IVUS/OCT	
CORONARY CTO	SAP	35	0	0	0	IVUS/OCT	
Serruys et al., ABSORB II	SAP / UAP	335	1 (0.3)	1 (0.3)	2 (0.6)	IVUS	
ASSURE registry	SAP / UAP	183	0	0	0	-	
BVS EXPAND	SAP / UAP	200	0	0	0	-	
ABSORB Japan	SAP / UAP	226	0	3 (1.1%)	3 (1.1%)	IVUS/OCT	
ABSORB III	SAP / UAP	1322	2 (0.2%)	12 (0.9%)	14 (1.1%)	-	
ABSORB China	SAP / UAP	238	0	1 (0.4%)	1 (0.4%)	-	
Gori et al	ACS	150	1 (0.7%)	1 (0.7%)	2 (1.4%)	-	ACS 1.0%
POLAR ACS	ACS	100	0	0	0	-	
Kajiya et al.	STEMI	11	0	0	0	-	STEMI 1.5%
Diletti et al., BVS STEMI	STEMI	49	0	0	0	OCT	
Kocka et al., PRAGUE-19	STEMI	41	0	1 (2.4%)	1 (2.4%)	OCT	
Wiebe et al.	STEMI	25	0	0	0		
Ielasi et al., RAI registry	STEMI	74	0	1(1.4%)	1(1.4%)	OCT/IVUS 4.4%	
TROFI II	STEMI	95	0	1 (1.1%)	1 (1.1%)	OCT	
BVS Examination	STEMI	290	NA	NA	6 (2.1%)	-	
Kraak et al., AMC Single Centre	All-comers	135	0	3 (2.2%)	3 (2.2%)	IVUS 5%/OCT 20%	All-comer 1.0%
ABSORB FIRST	All-comers	800	0	2 (0.3%)	2 (0.3%)	OCT	
Azzalini et al.	All-comers	339	0	4 (1.2%)	4 (1.2%)	-	
EVERBIO II	All-comers	78	0	0	0	-	
GABI-R	All-comers	1536	7 (0.5%)	8 (0.5%)	15 (1.0%)	-	
Capodanno et al., GHOST-EU registry	All-comer	1189	5 (0.4%)	11 (0.9%)	16 (1.3%)	IVUS 14%/OCT 14%	
	Average F/U: 7.1 Months	8094	16 (0.2%)	50 (0.6%)	66 (0.8%)		

#1 Acute scaffold thrombosis: Proximal landing at plaque

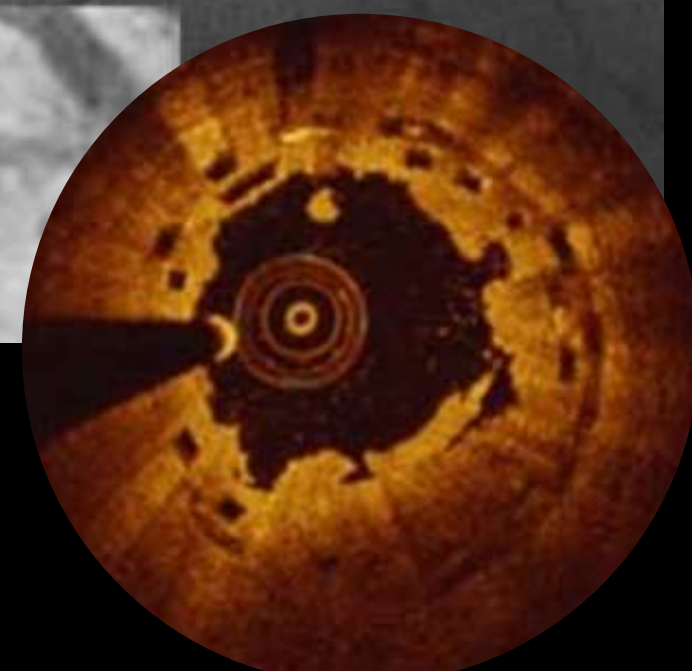
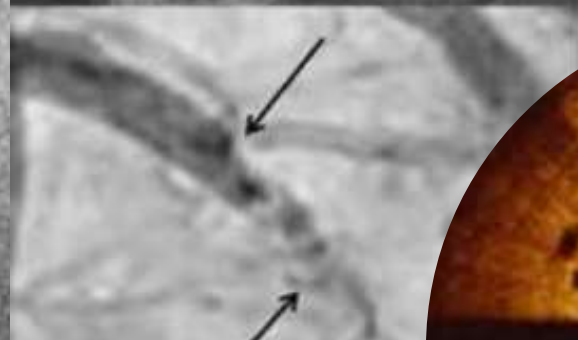
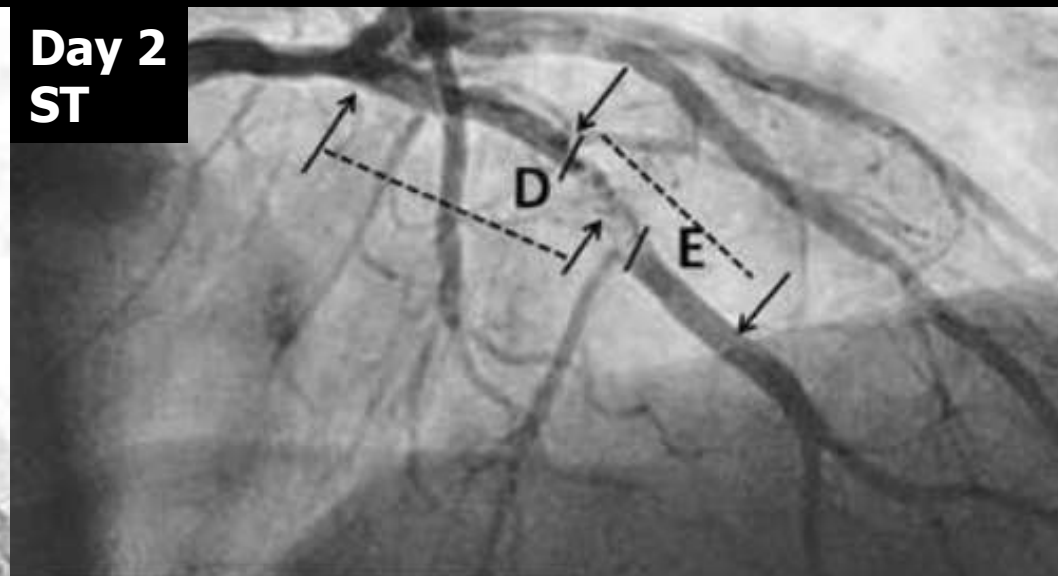


#2 Early scaffold thrombosis: Overlap

Post procedure



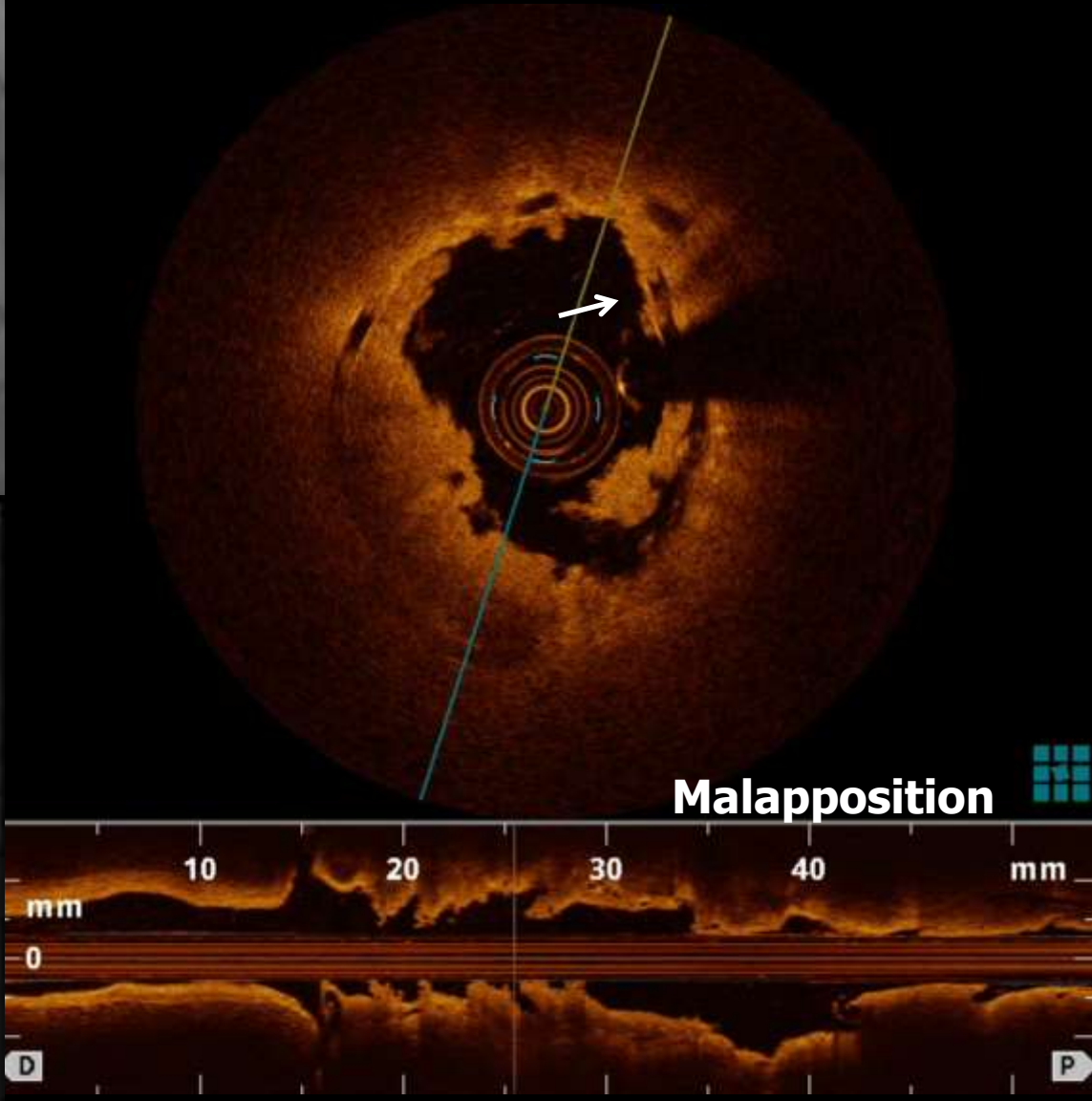
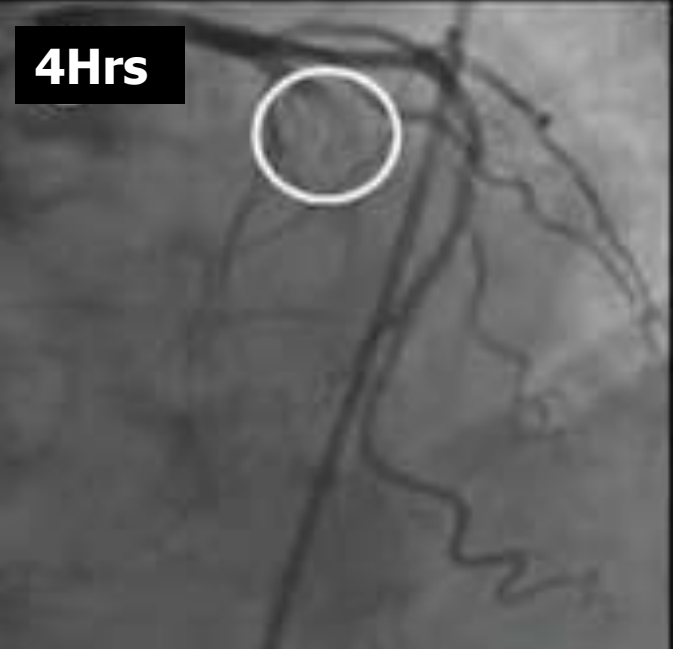
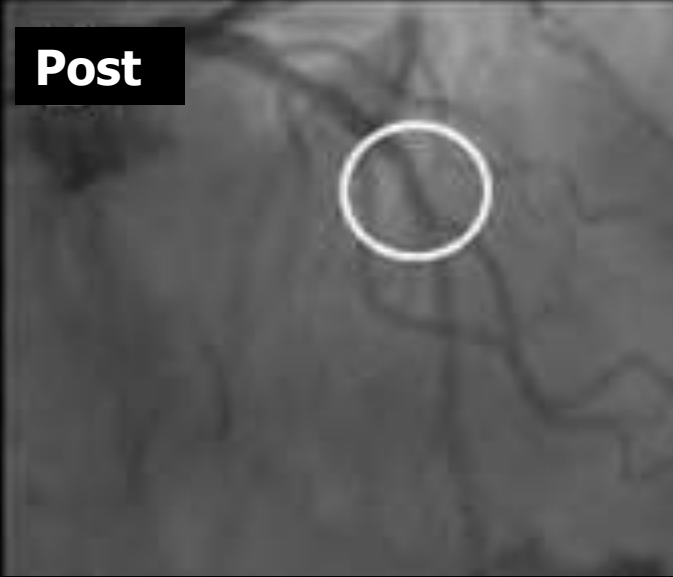
Day 2
ST



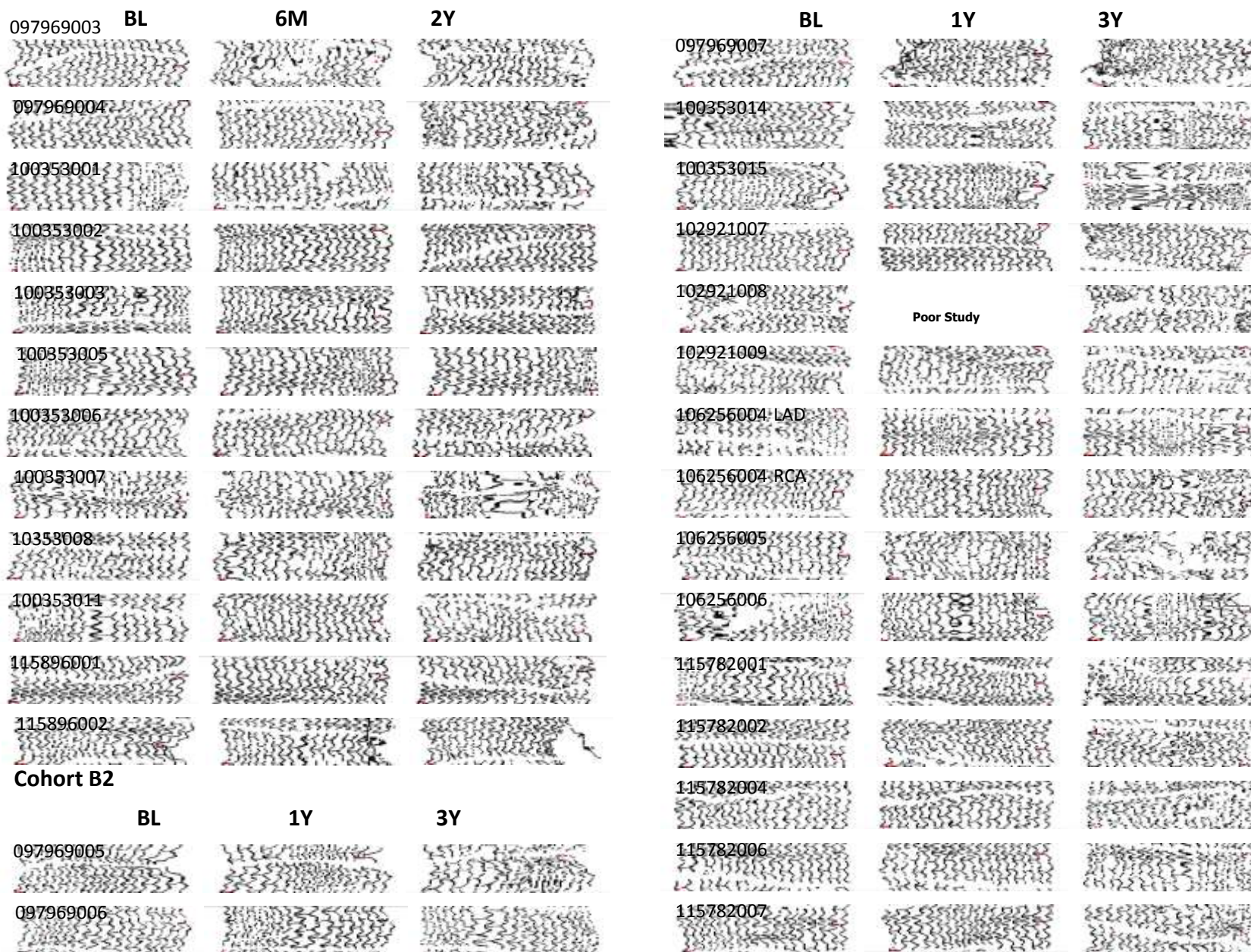
#3. Acute scaffold thrombosis: Malapposition

80 yo male presenting with Non-STEMI

Jaguszewski et al. EHJ



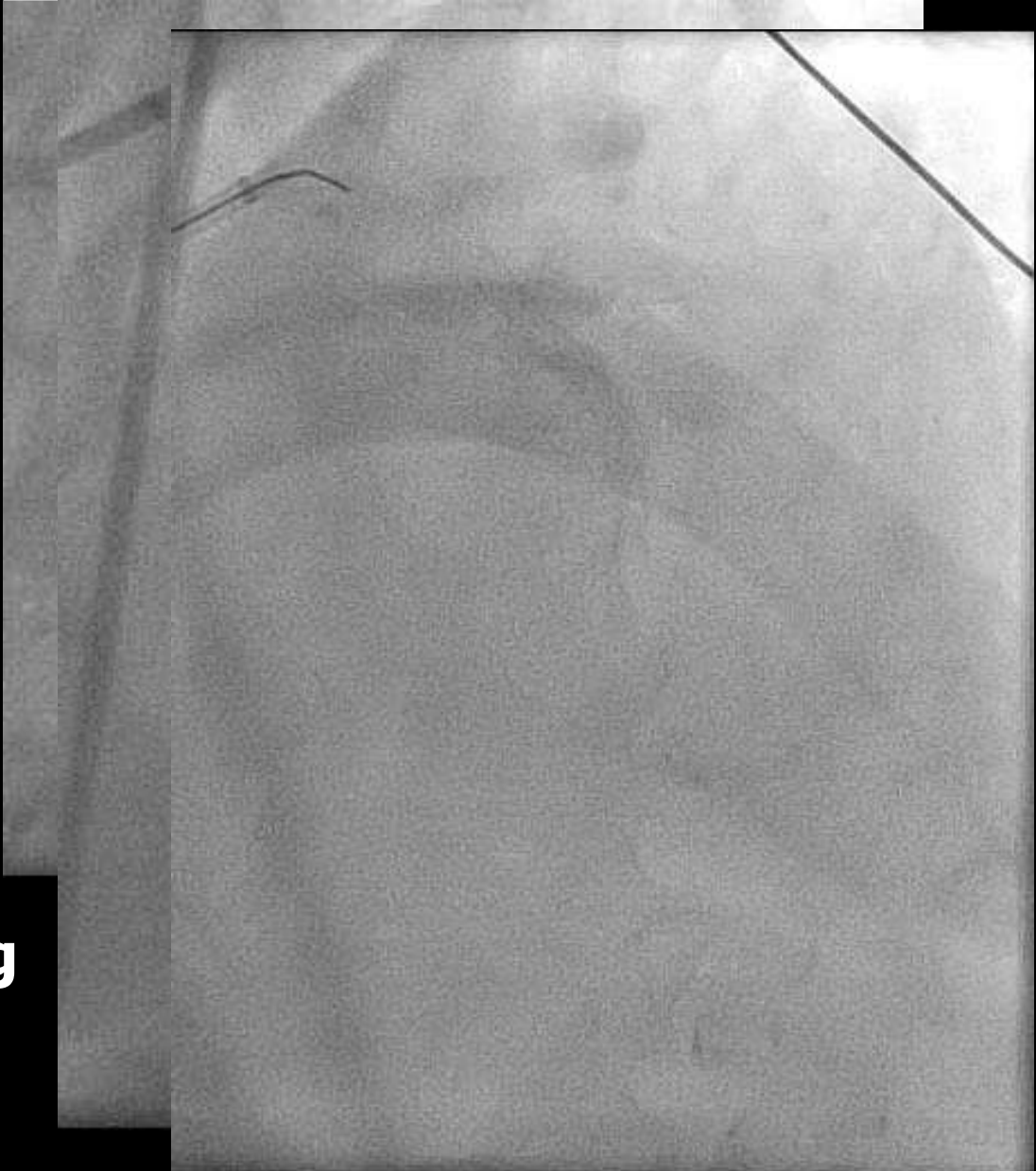
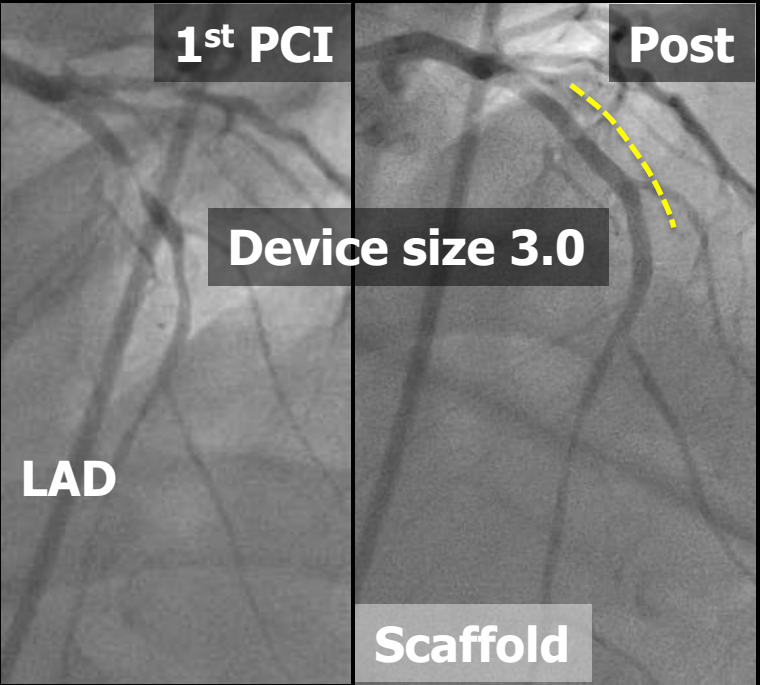
Assessment of OCT late discontinuities in Cohort B1/B2



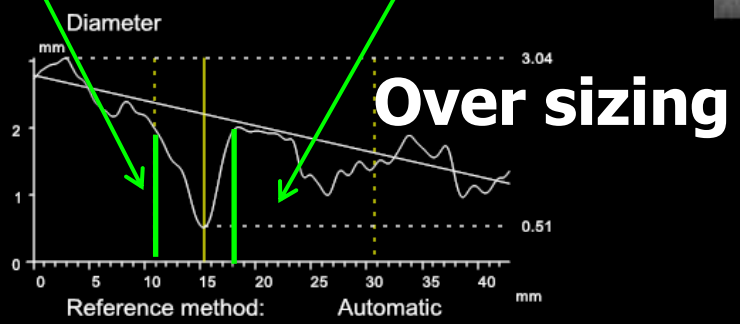
#4 Subacute scaffold thrombosis: Oversizing

Sabate et al. 2015 EHJ (TROFI II)

6 days
Sub-acute Scaffold Thrombosis



Proximal Dmax 1.9753
Distal Dmax 2.0492



BRS failure: imaging

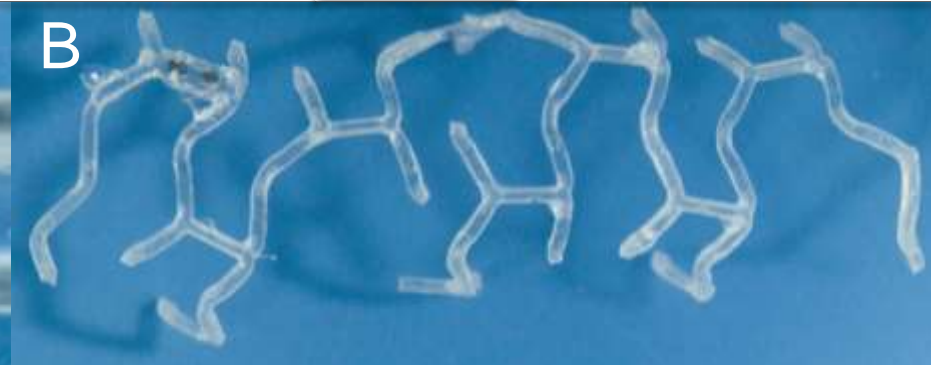
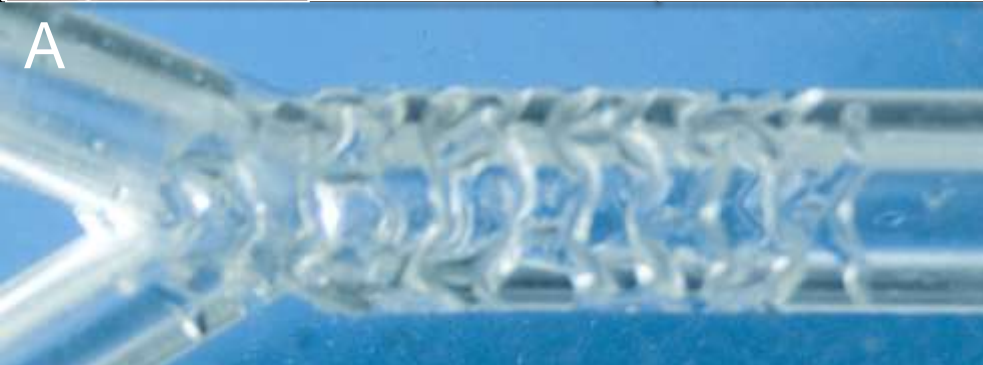
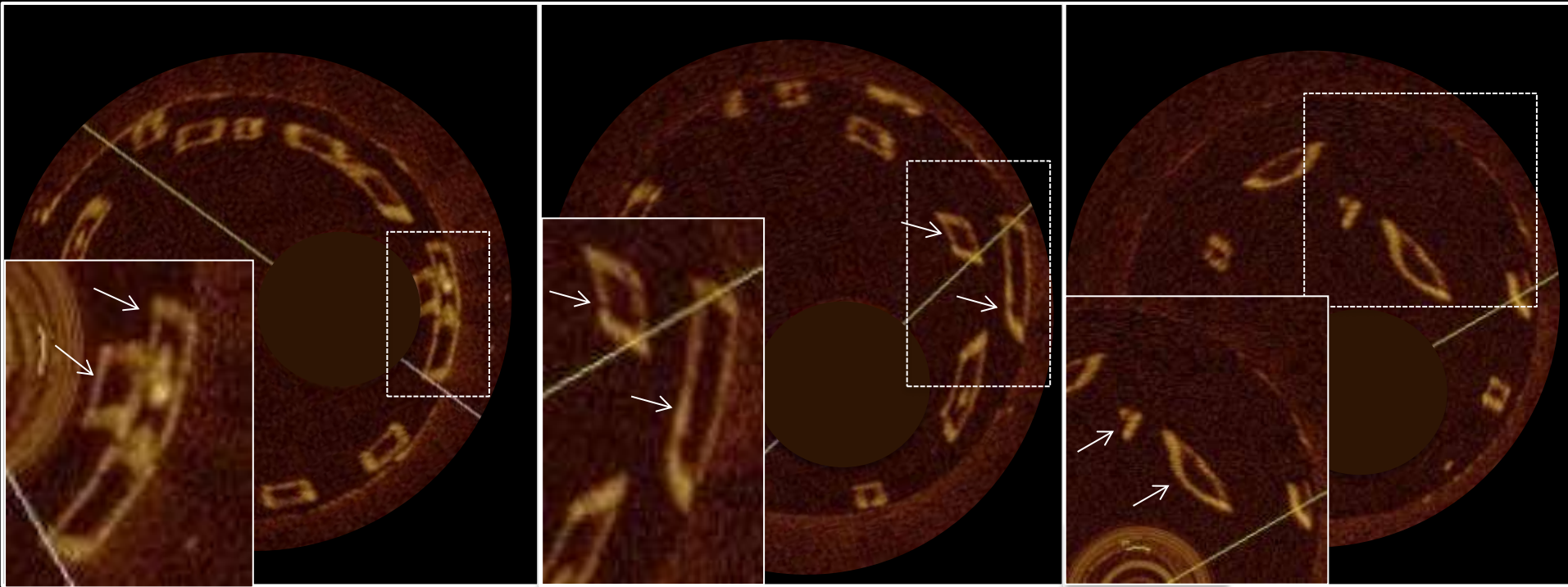
- **Early Thrombosis**
- **Acute disruption**
- **Very late Scaffold thrombosis**
 - **Late discontinuities (Intravascular or intraluminal Dismantling)**
- **Restenosis**
- **Neoatherosclerosis**
- **Others (Aneurysm)**

3 criteria to judge acute disruption on OCT

Stacked Struts

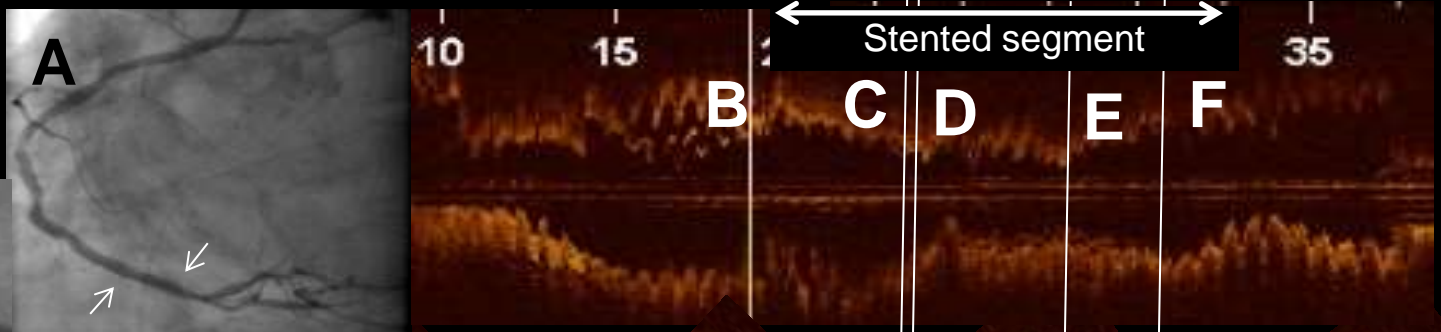
Overhang Struts

**Isolated &
Centered Strut**

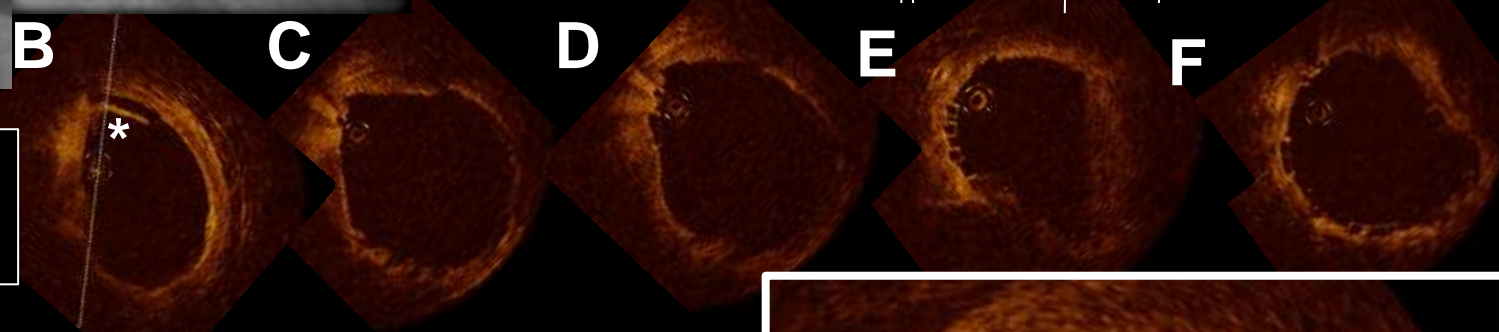


#1. Suspected Acute disruption: Cohort A

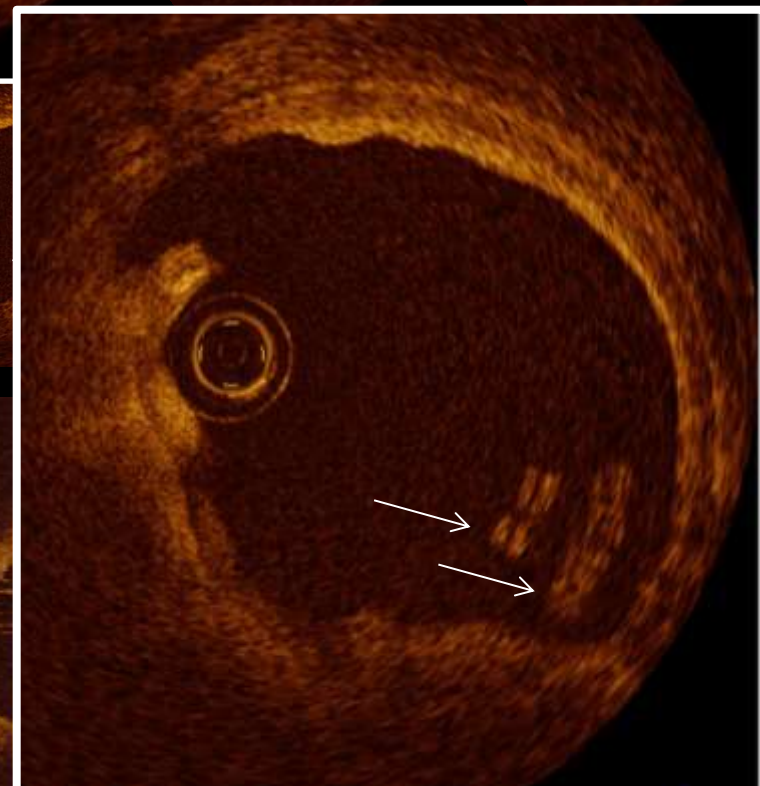
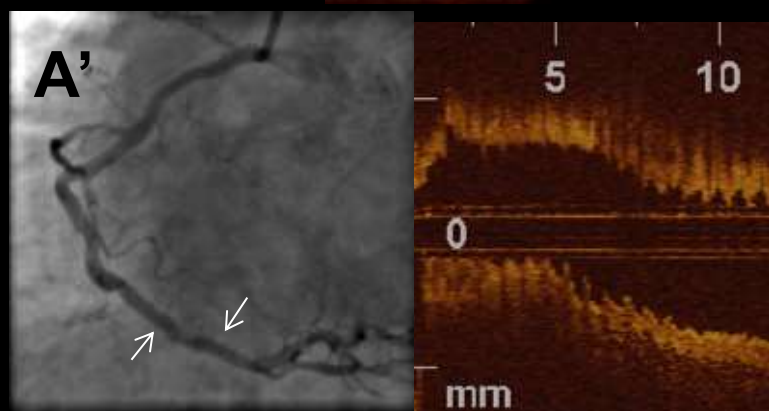
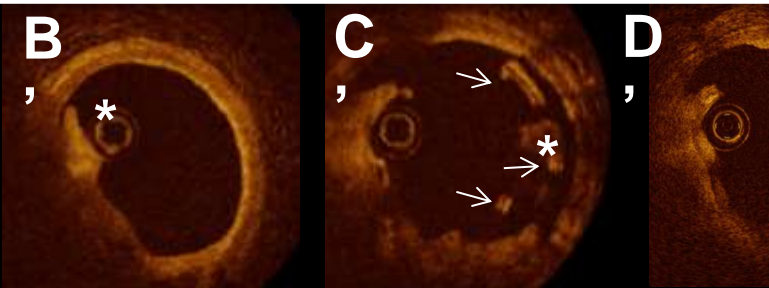
OCT before
post dil



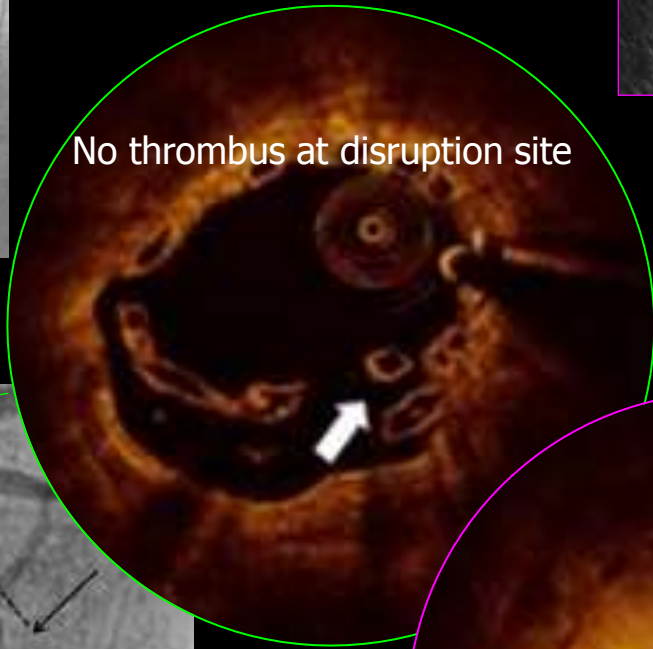
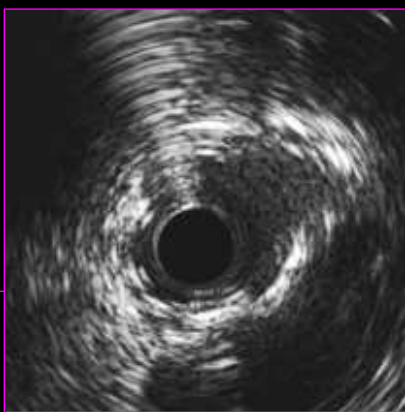
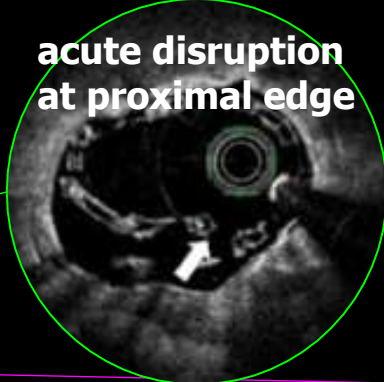
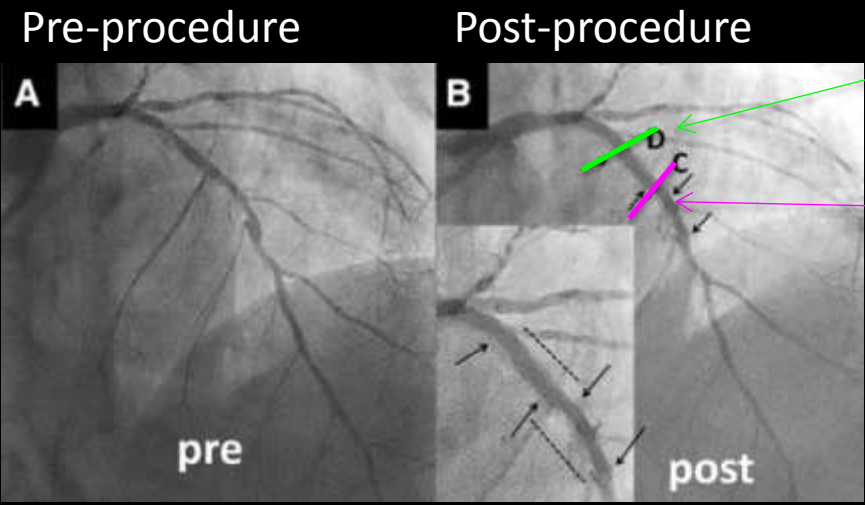
Post dilatation with
a 3.5 mm compliant
balloon at 18 atm



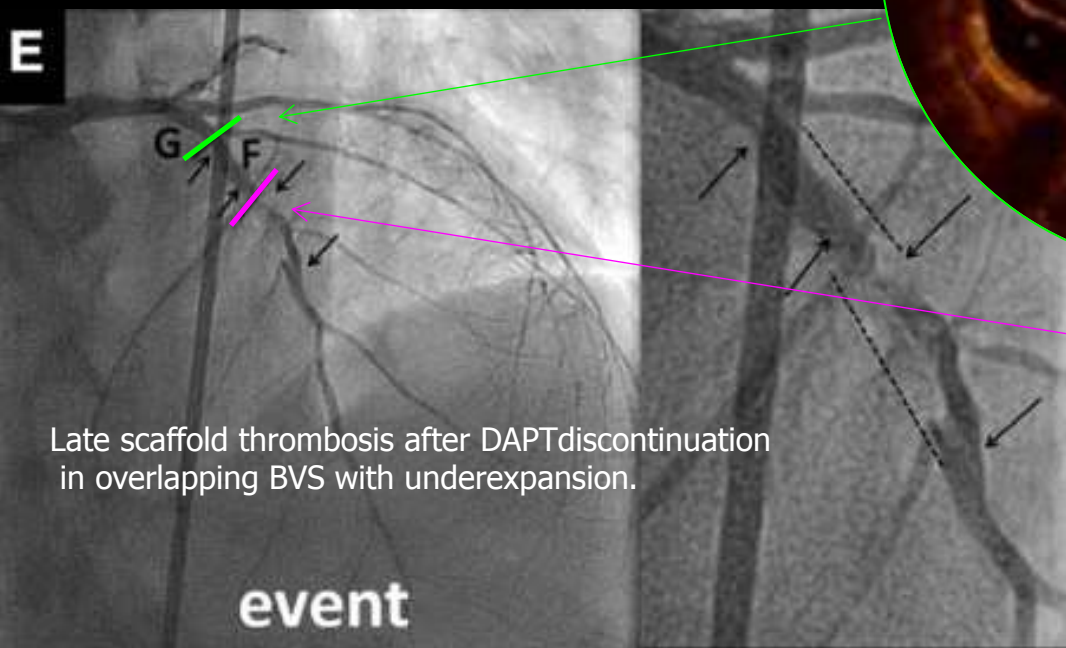
42 days
after
procedure



**#2. Acute disruption and Late Thrombosis
-161 days after implantation, 2 days after
cessation of DAPT**

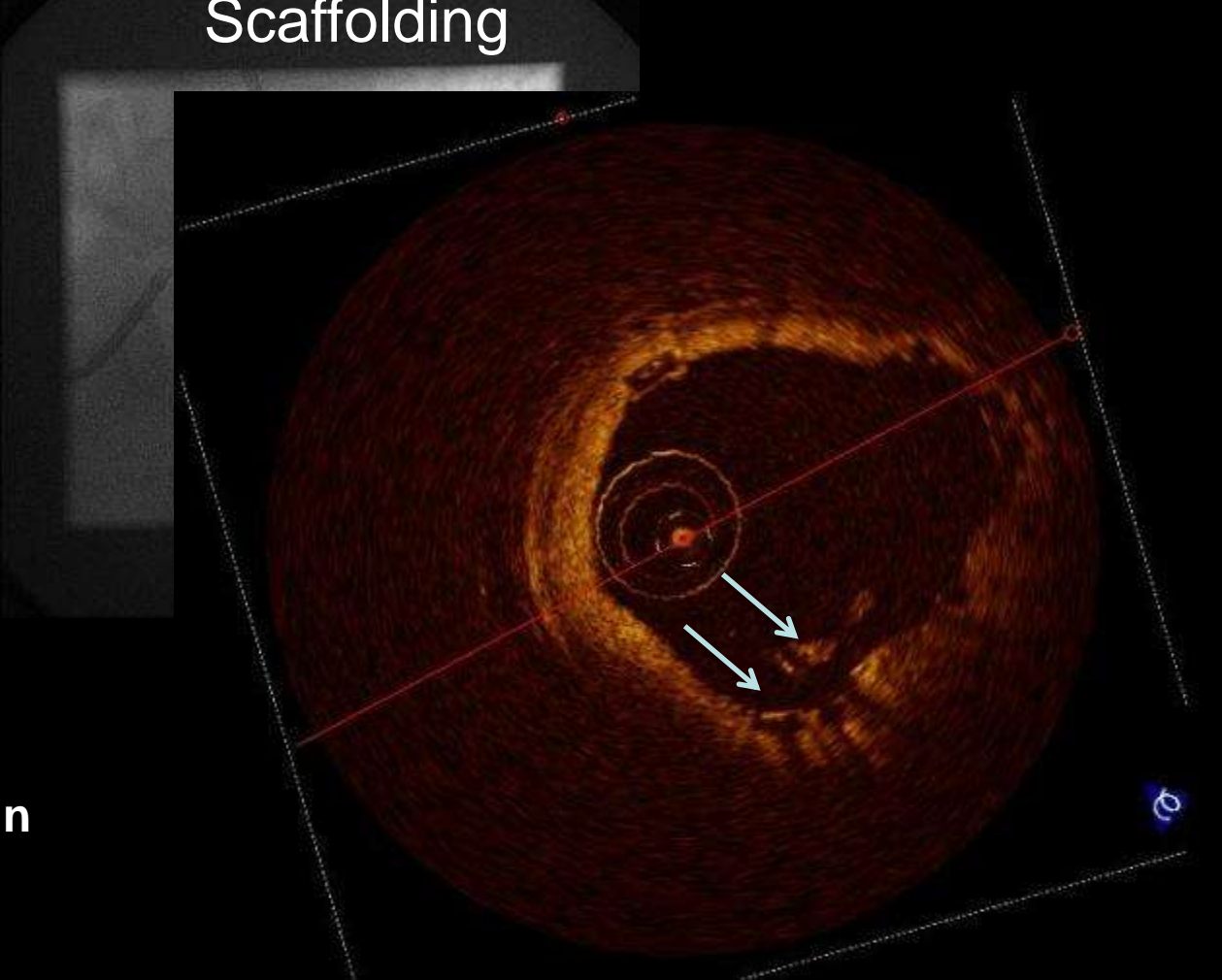
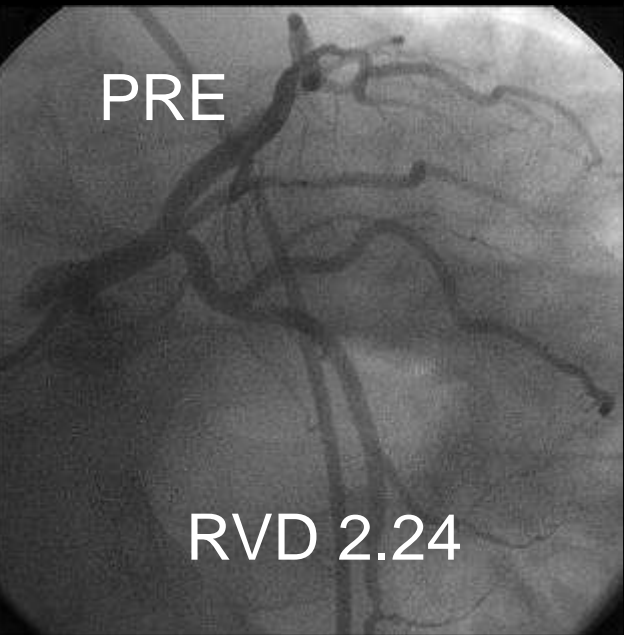


Scaffold thrombosis on 161 days

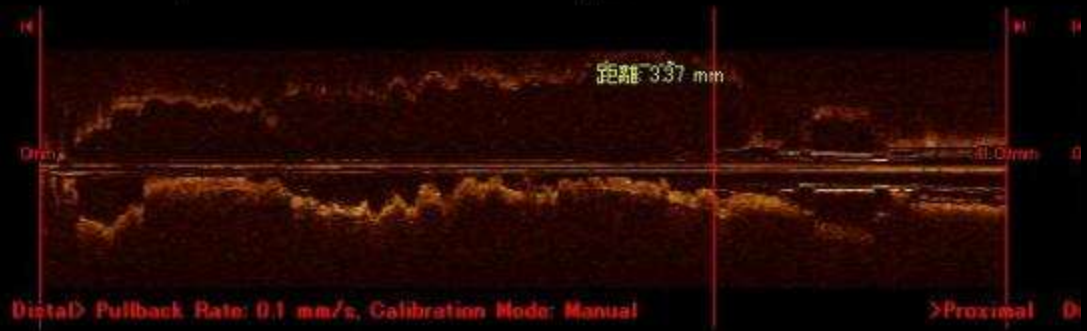


Late scaffold thrombosis after DAPT discontinuation in overlapping BVS with underexpansion.

#3. Worsening of acute disruption by imaging follow-up Scaffolding



At baseline, acute disruption was observed in a few cross sections (small disruption)

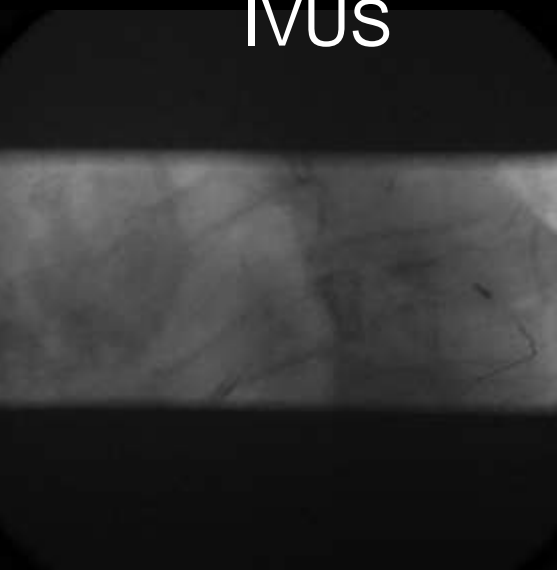


#3. Worsening of acute disruption by imaging follow-up 6M FUP (Asymptomatic)

OCT



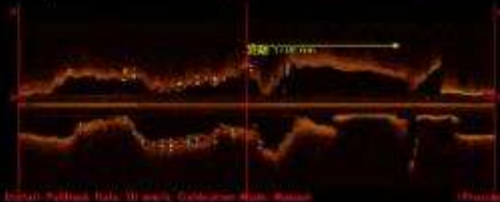
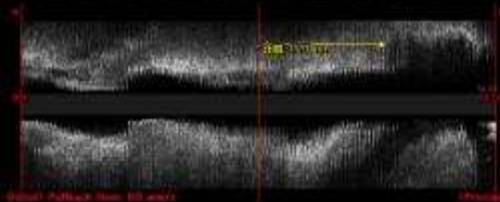
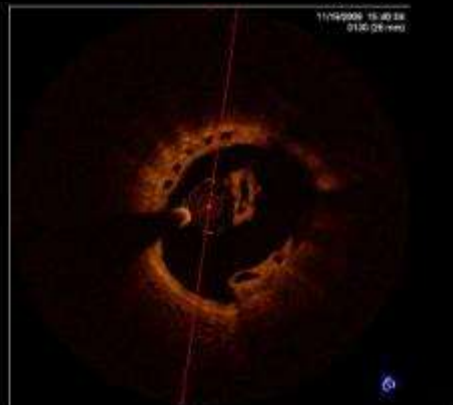
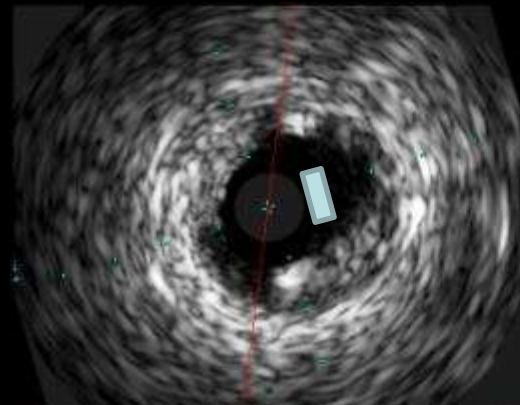
IVUS



15 min.



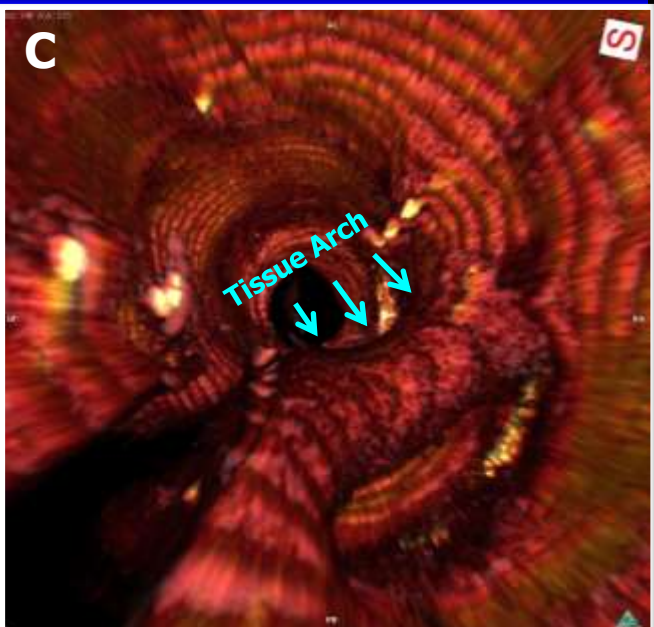
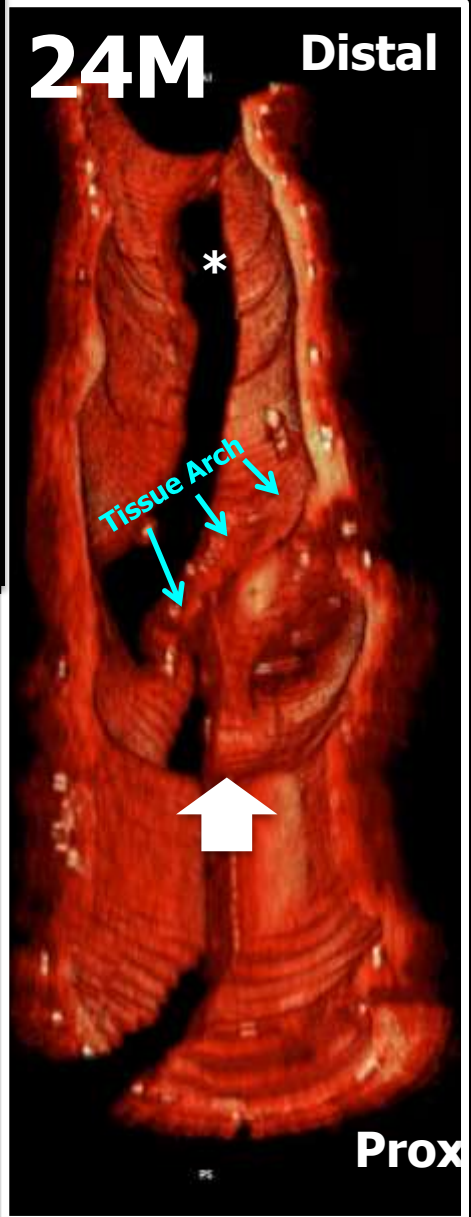
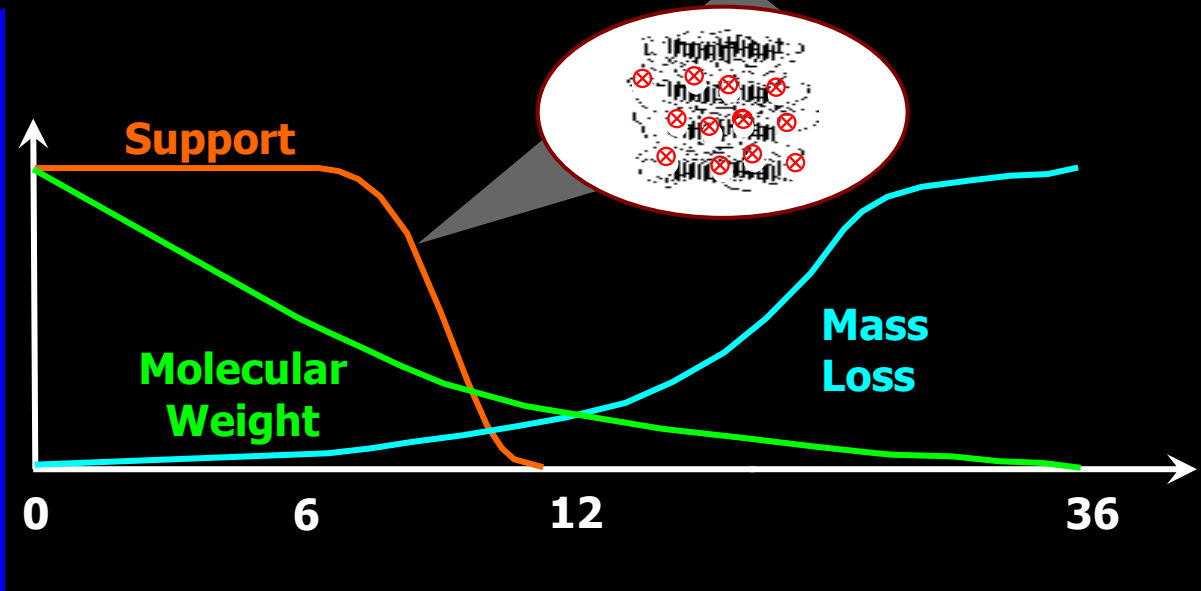
**Lifting of a strut at 6M
- Presumably iatrogenic**



#3. Worsening of acute disruption by imaging follow-up

Iatrogenic lifting of a strut at 6M and subsequent formation of tissue arch at 24M

Onuma et al. JACC intervention 2014

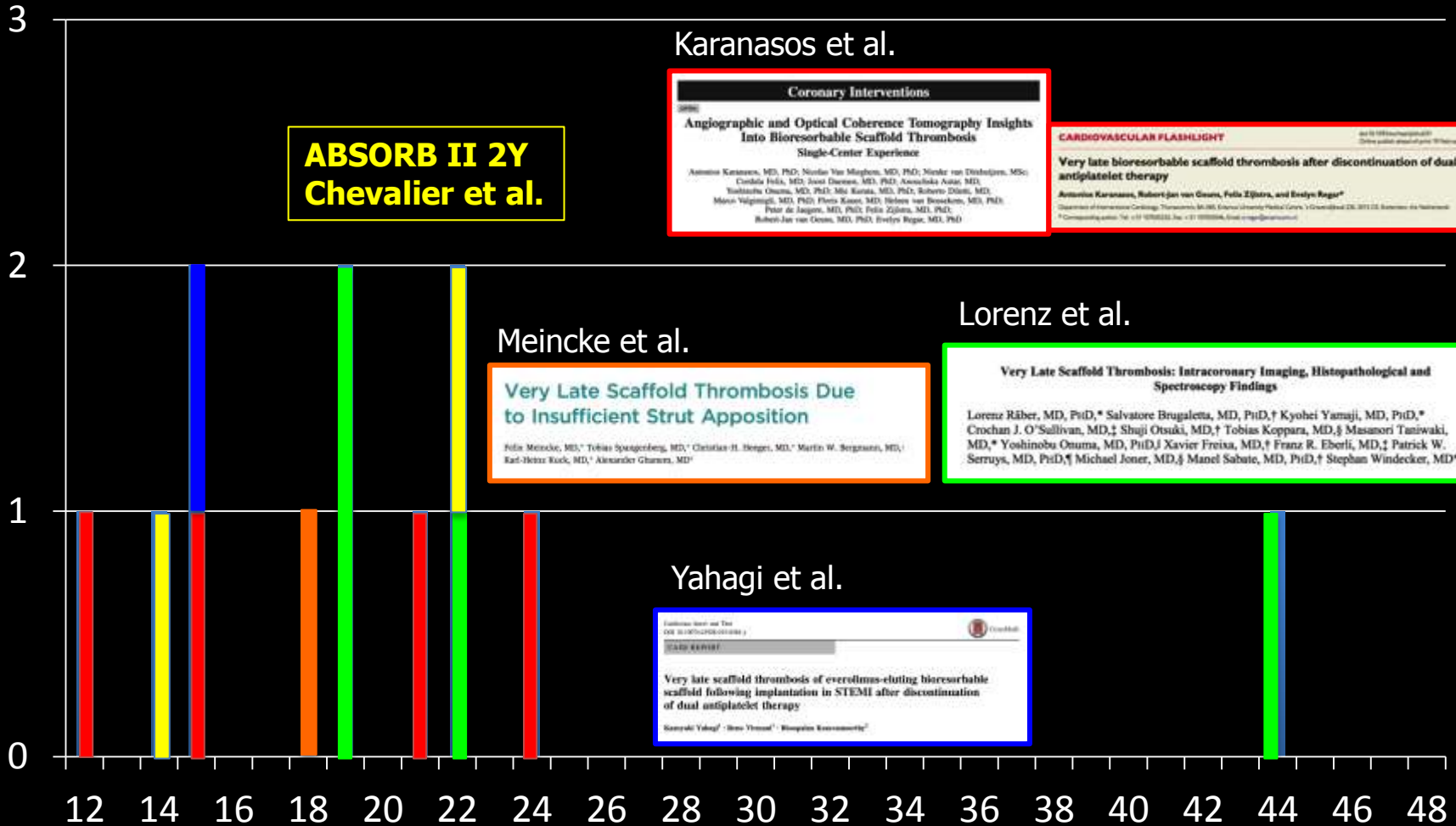


BRS failure: imaging

- **Early Thrombosis**
- **Acute disruption**
- **Very late Scaffold thrombosis**
 - **Late discontinuities (Intravascular or intraluminal Dismantling)**
- **Restenosis**
- **Neoatherosclerosis**
- **Others (Aneurysm)**

What is the reported incidence of very late thrombosis? (n=12 – denominator unknown)

Number



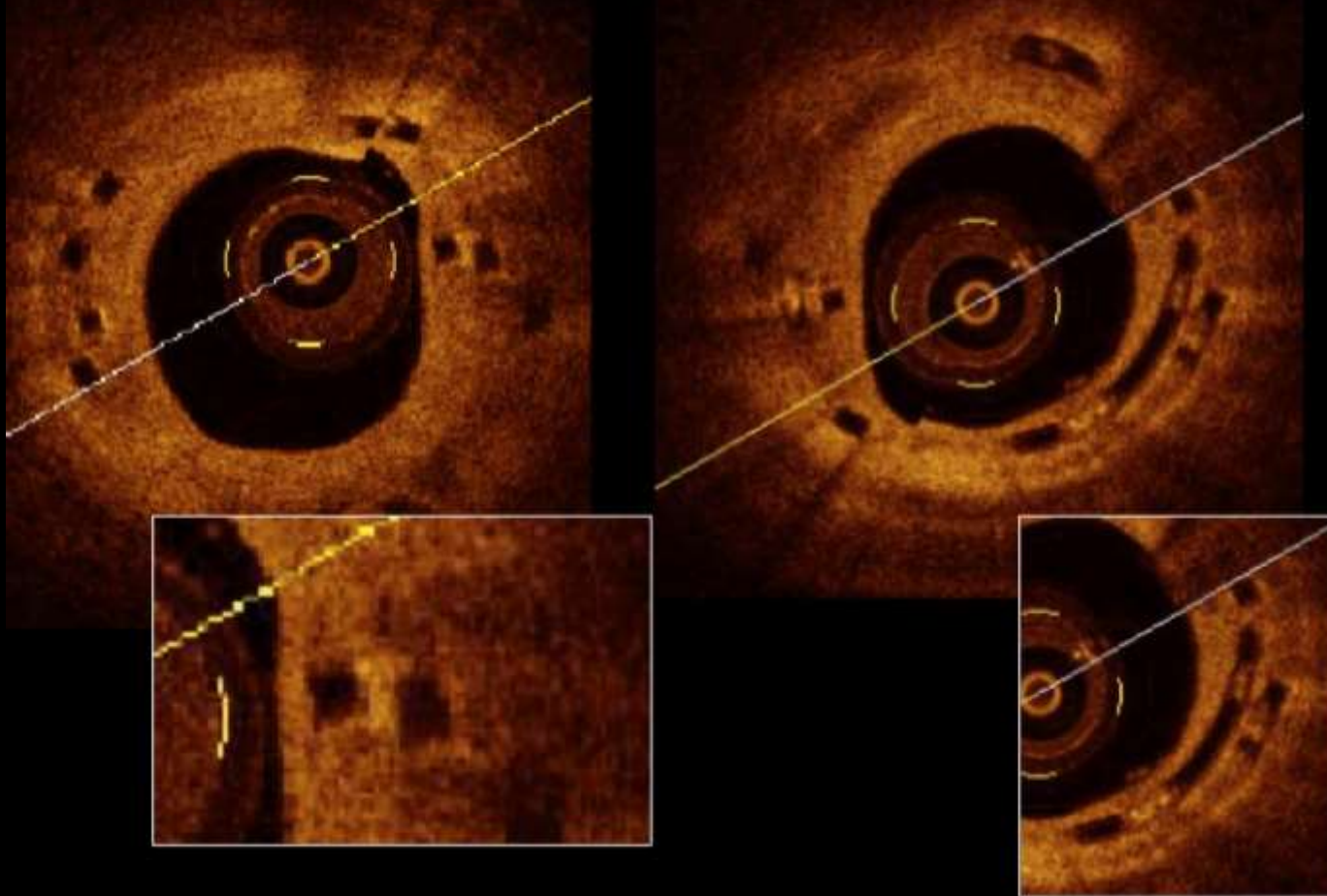
Follow-up duration (months)

Imaging findings associated with Late/very late scaffold thrombosis

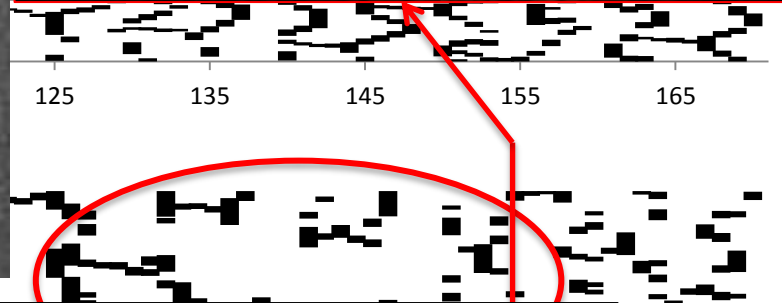
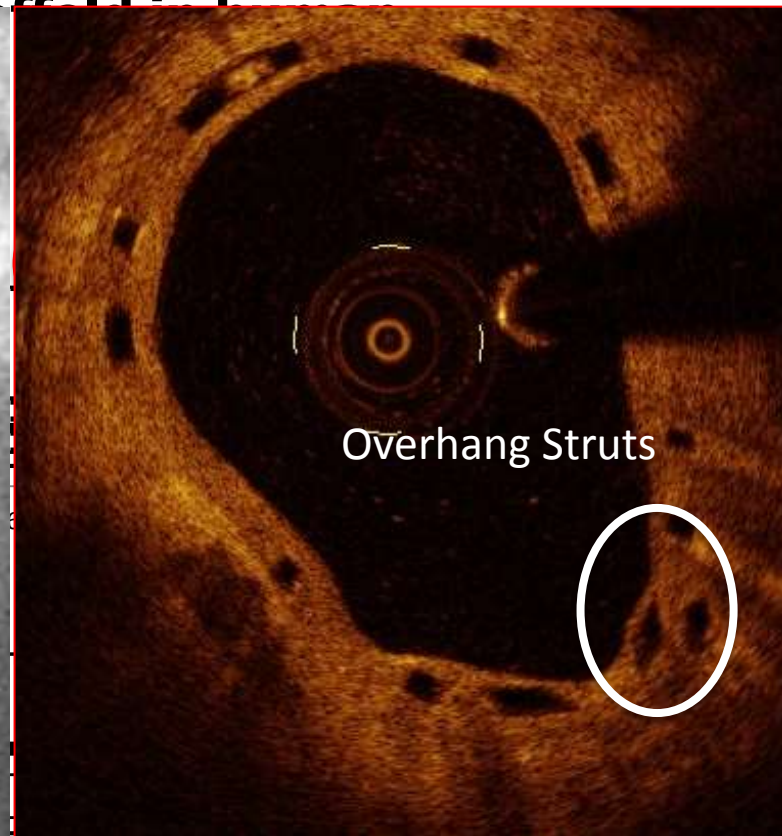
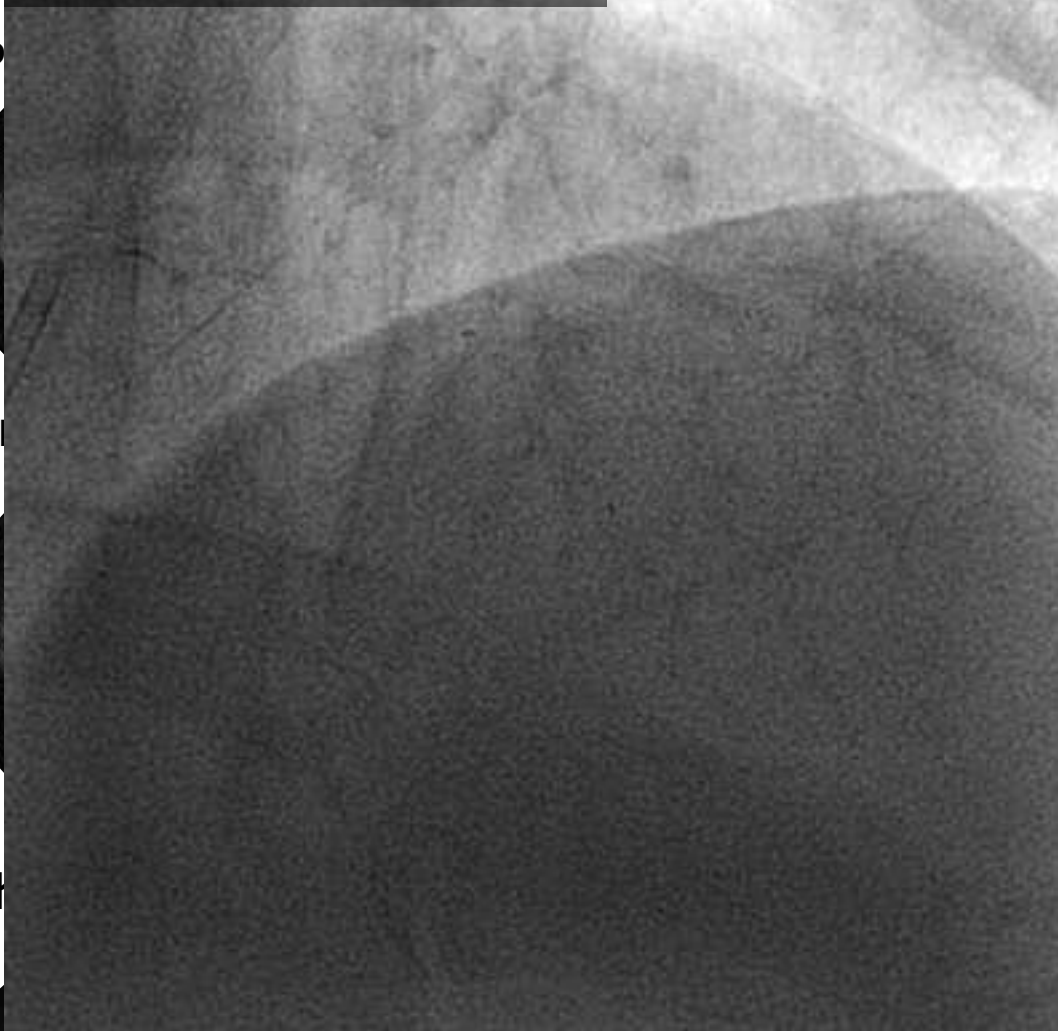
Reported imaging findings associated with Late/very late scaffold thrombosis	N
Malapposition	8
Discontinuity	5
Uncovered Struts	4
Under-expansion	3
Restenosis	1
Incomplete coverage	1

Criteria of late discontinuities are the same with acute disruption. But the findings should be absent at baseline and present at FUP

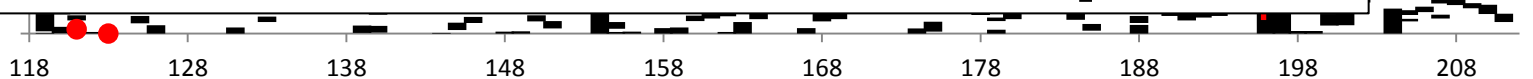
Stacked Struts, overhang struts or isolated centered strut



Angiography at 3 years



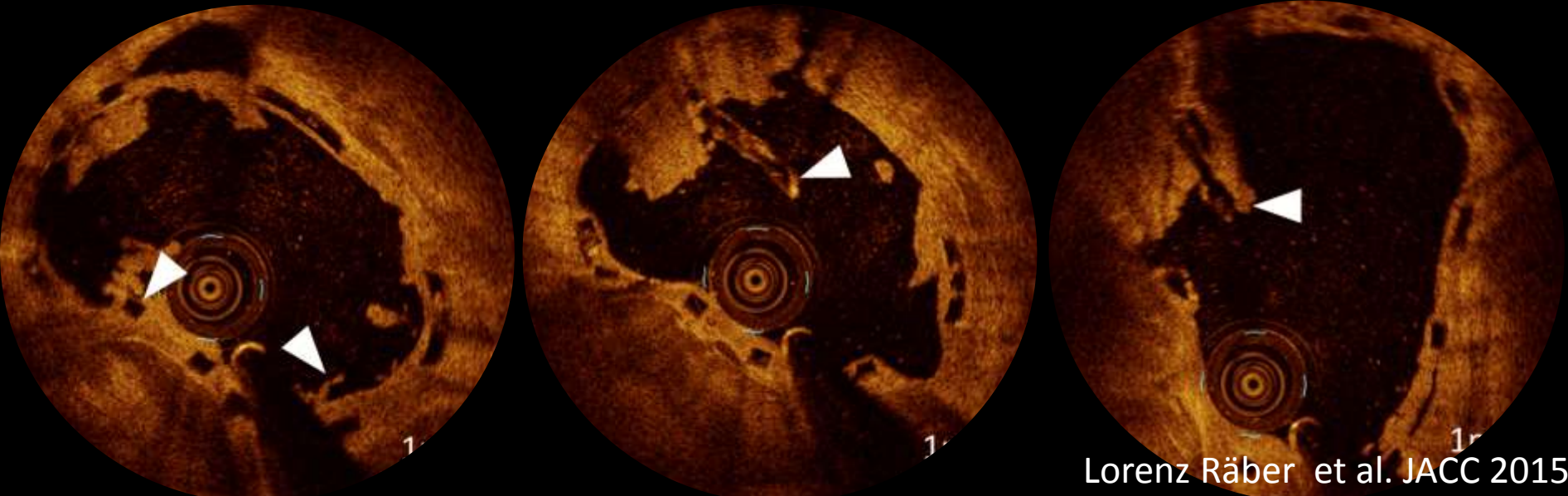
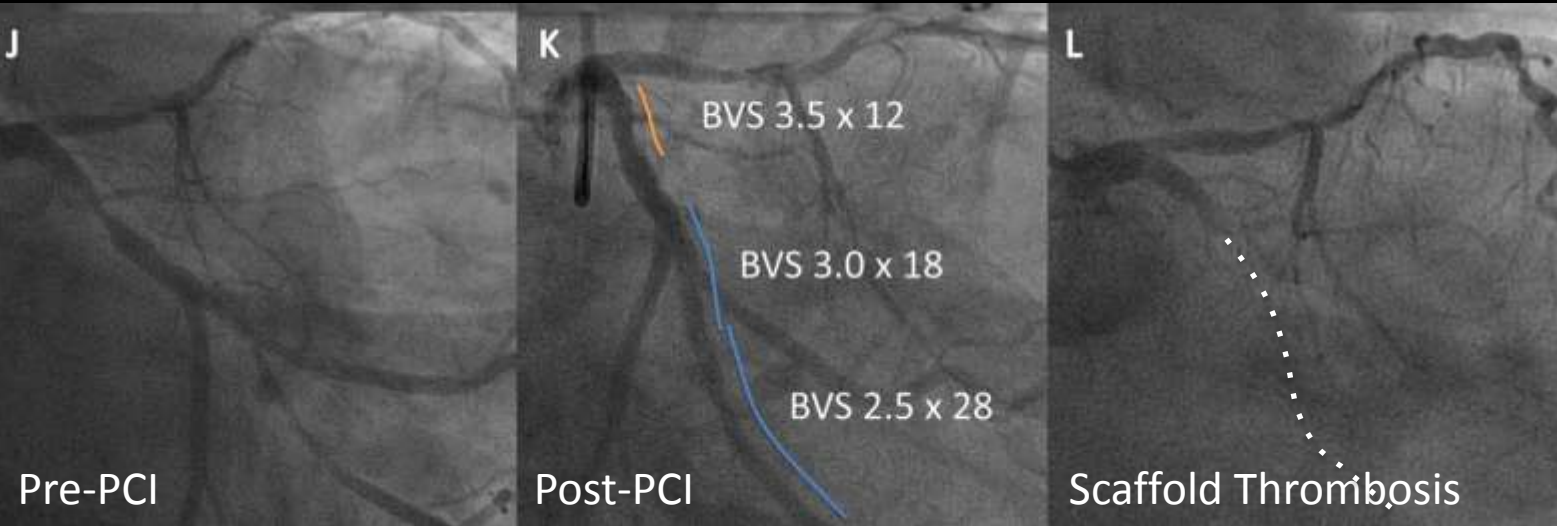
Late discontinuity is expected phenomenon related to bioresorption.



#2 VLST with Late discontinuity and Uncovered struts

The cause for thrombus formation was late scaffold strut discontinuity with the particular finding of a long scaffold strut freely floating in the lumen. Uncovered struts were frequently observed (10%) and the majority of struts were covered by thrombus.

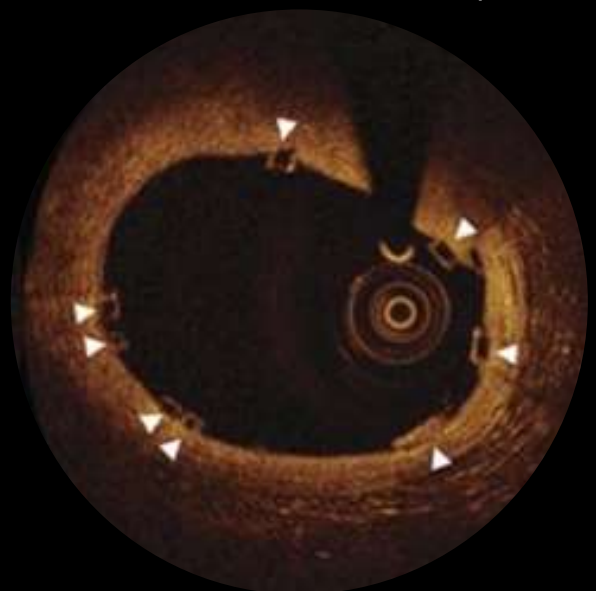
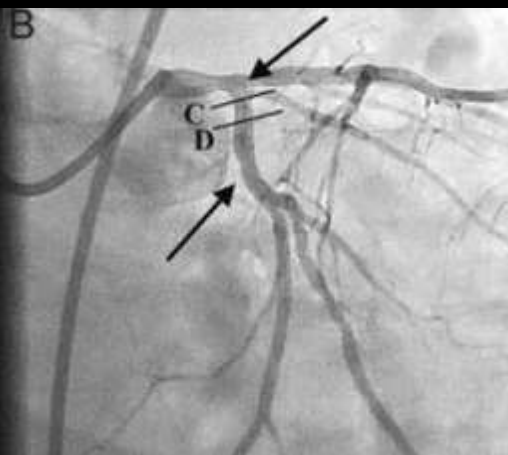
VLST at 19 months



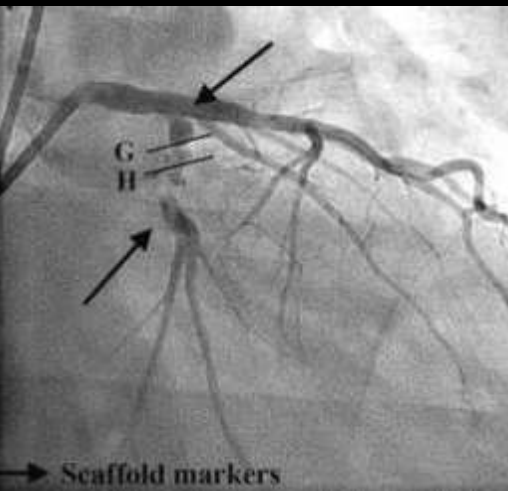
#3 VLST at 2 years with late discontinuities

Karanasos A et al. Eur Heart J 2014;35:1781.

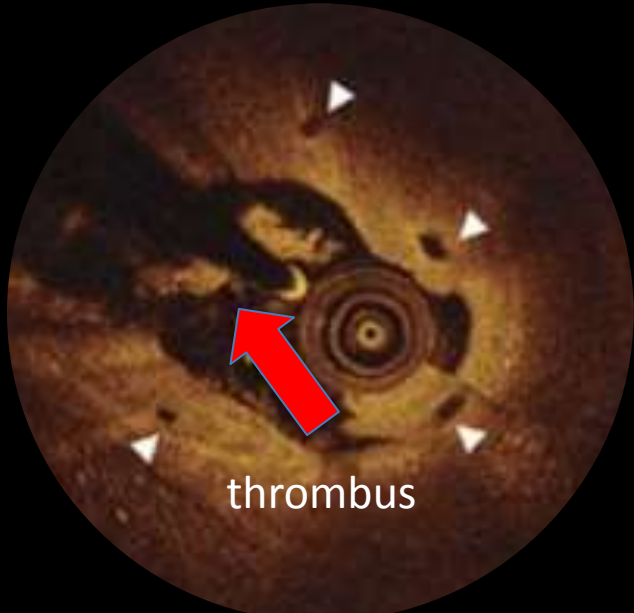
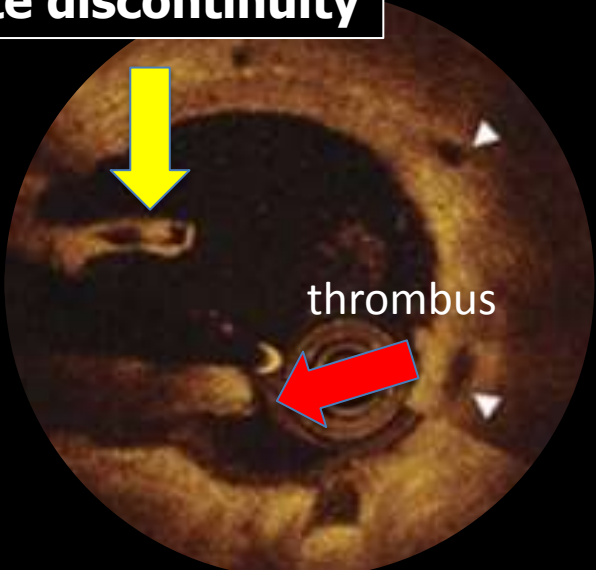
Post-procedure



Scaffold thrombosis



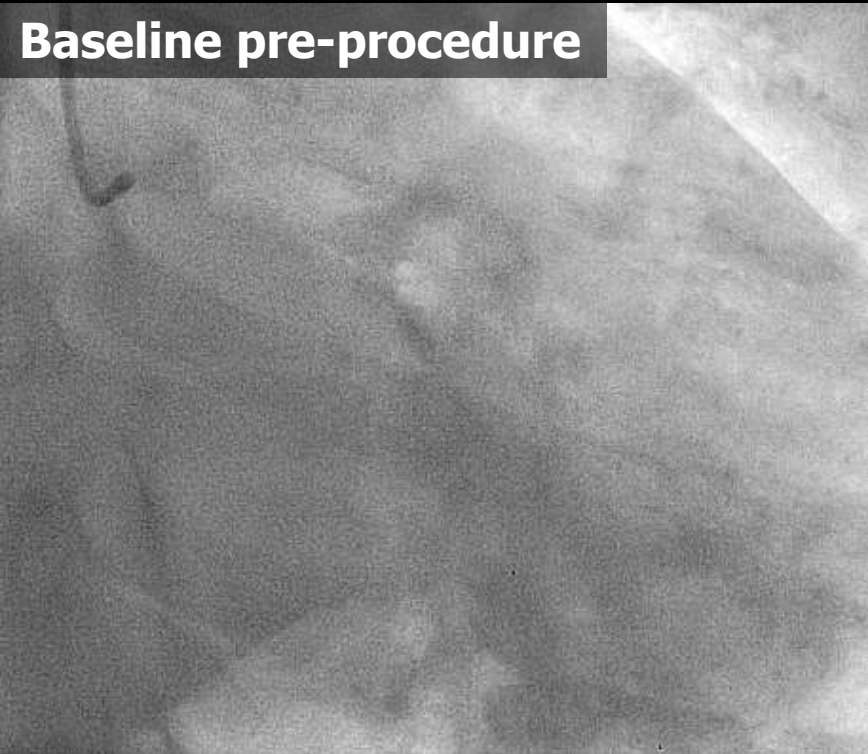
late discontinuity



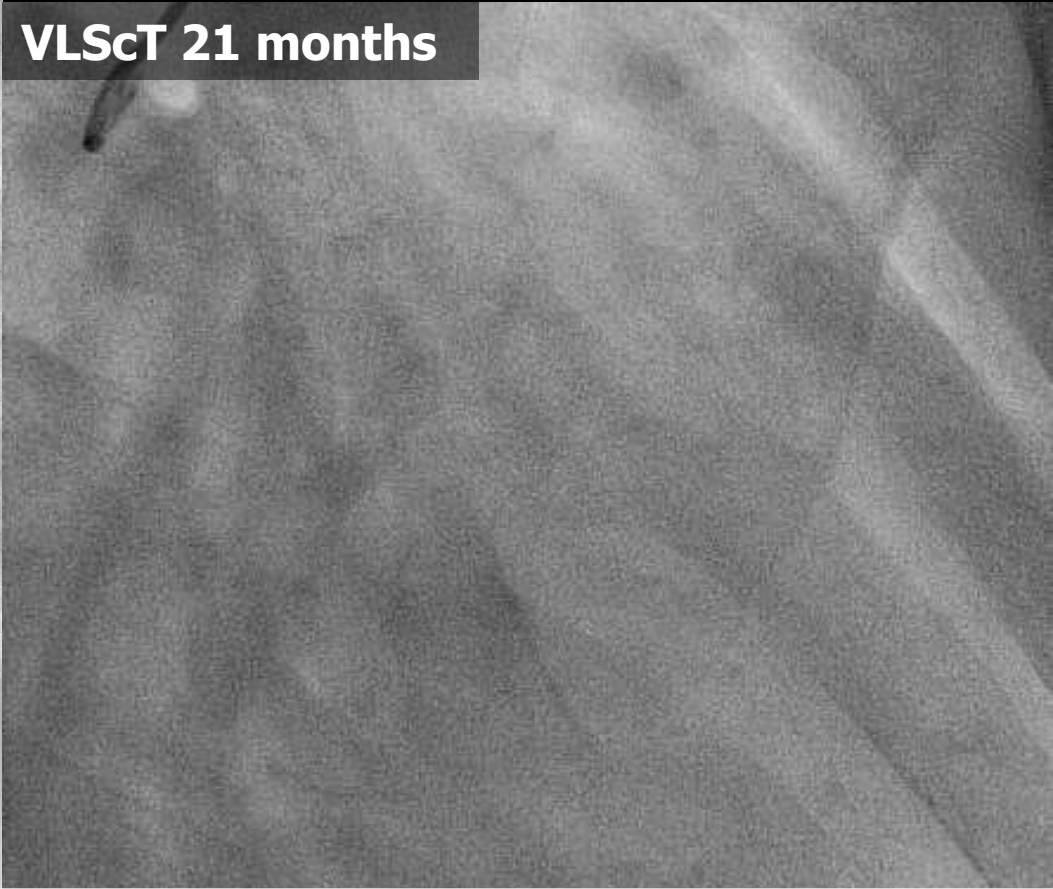
#4 VLST at 2 years with late discontinuities

Räber et al. JACC 2015, Courtesy of Dr. Sabate

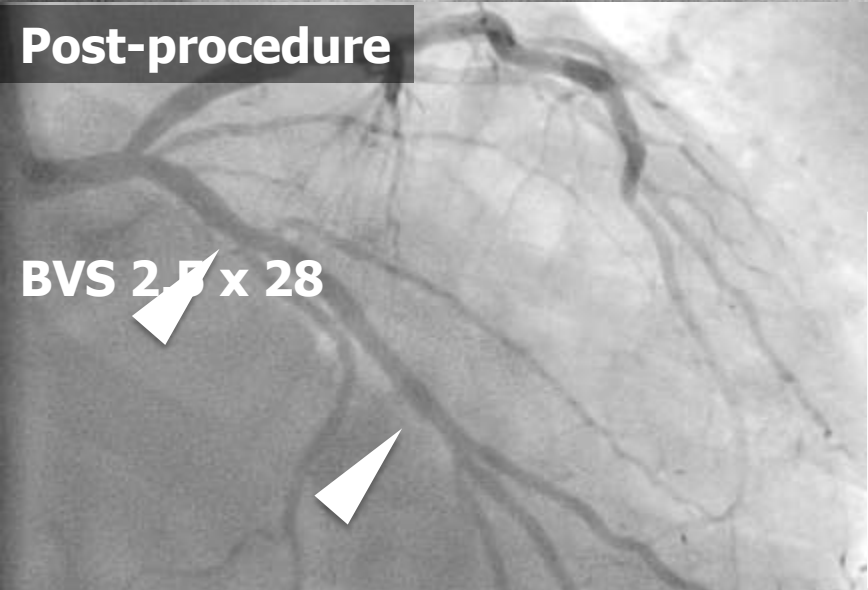
Baseline pre-procedure



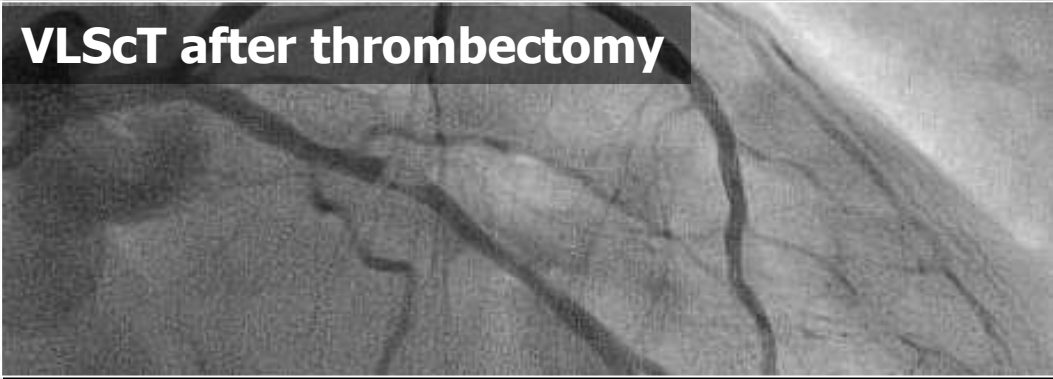
VLScT 21 months



Post-procedure



VLScT after thrombectomy



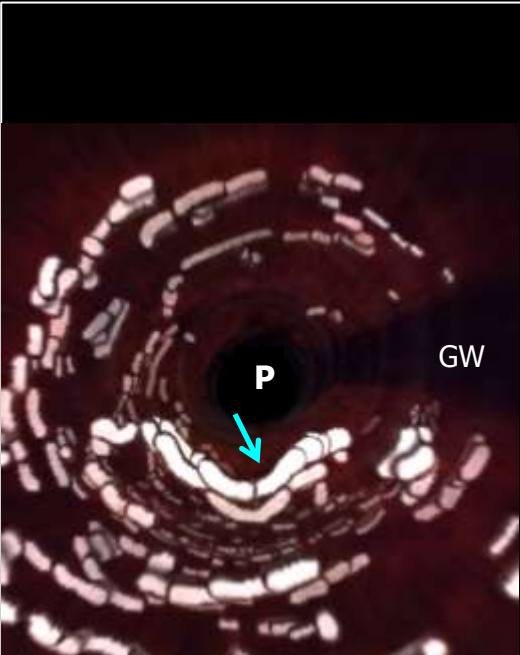
#3 VLST at 2 years with late discontinuities

Räber et al. JACC 2015, Courtesy of Dr. Sabate

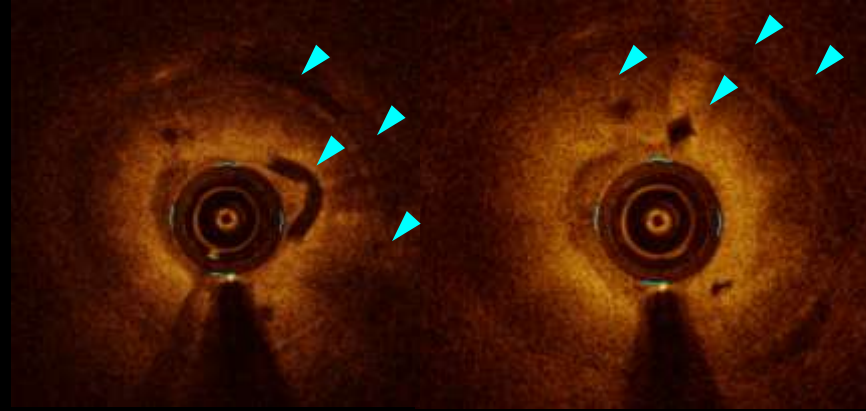
Proximal



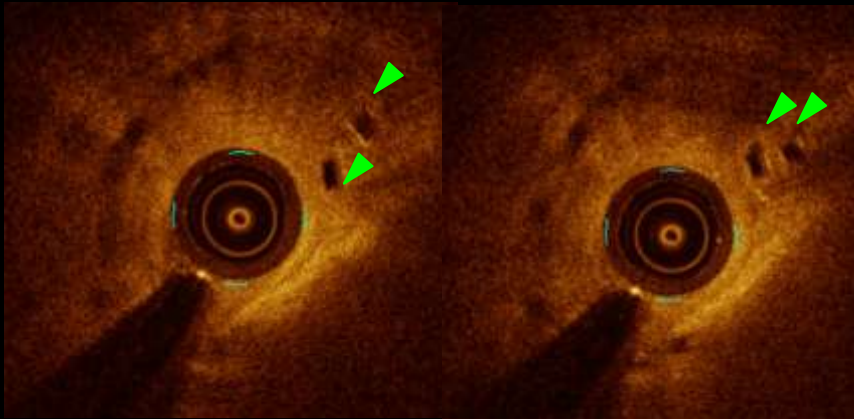
Distal



Proximal discontinuity (Overhung struts)



Distal discontinuity (Overhung struts)



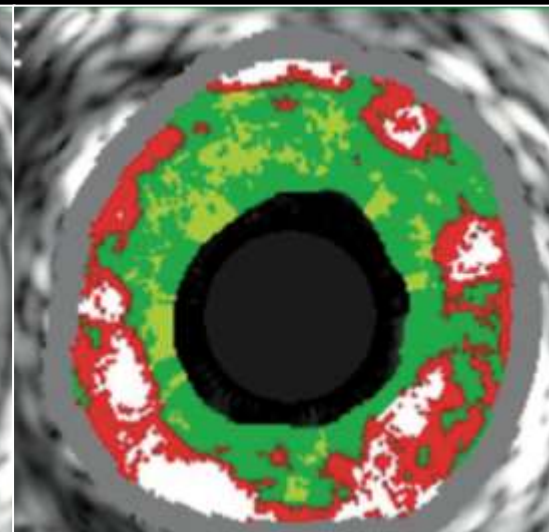
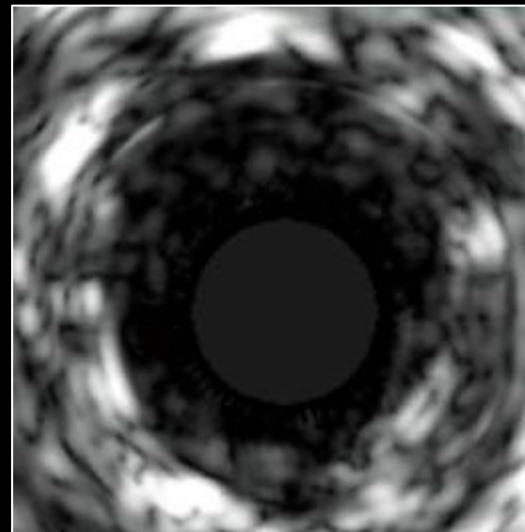
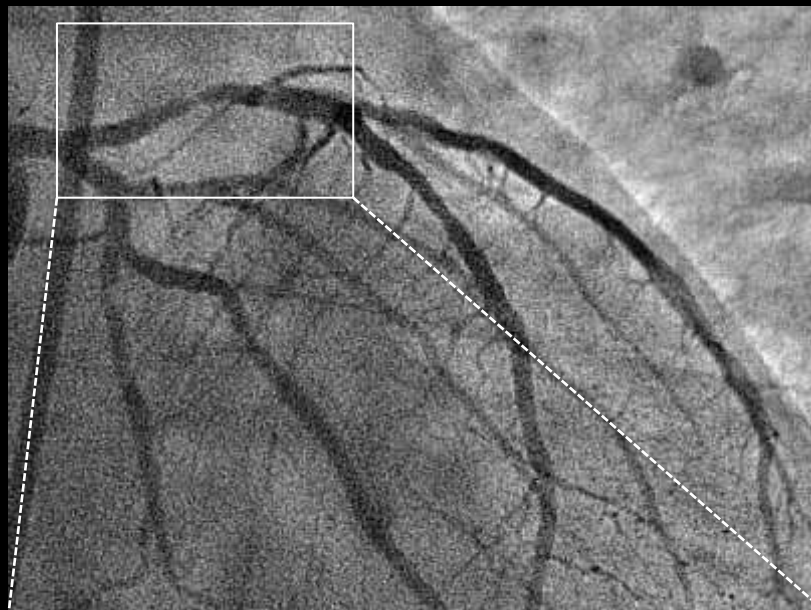
BRS failure: imaging

- **Early Thrombosis**
- **Acute disruption**
- **Very late Scaffold thrombosis**
 - **Late discontinuities (Intravascular or intraluminal Dismantling)**
- **Restenosis/ Neoatherosclerosis**
- **Others (Aneurysm)**

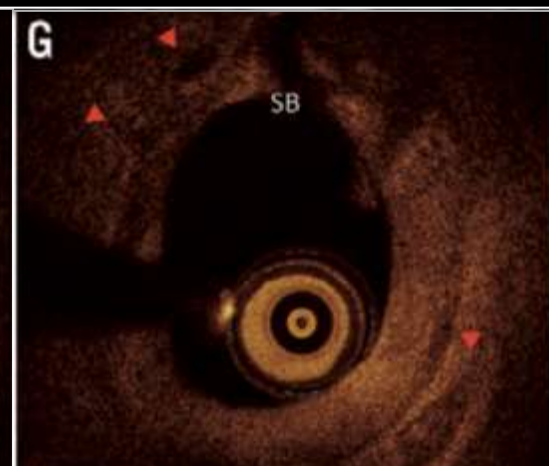
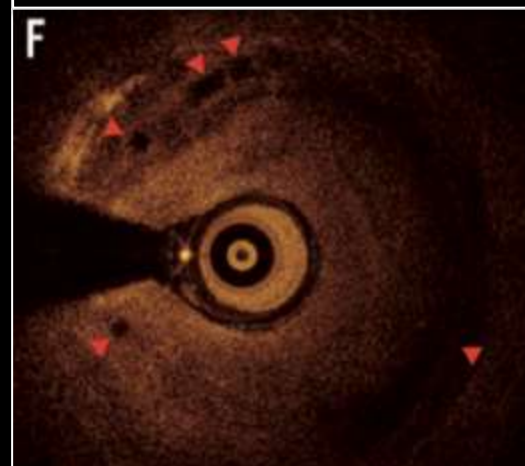
#1. Late ISR day 354 due to neointimal hyperplasia

Type 1C ISR

(QCA MLD: 0.79 mm, %DS: 64.0%, LL: 1.58 mm)

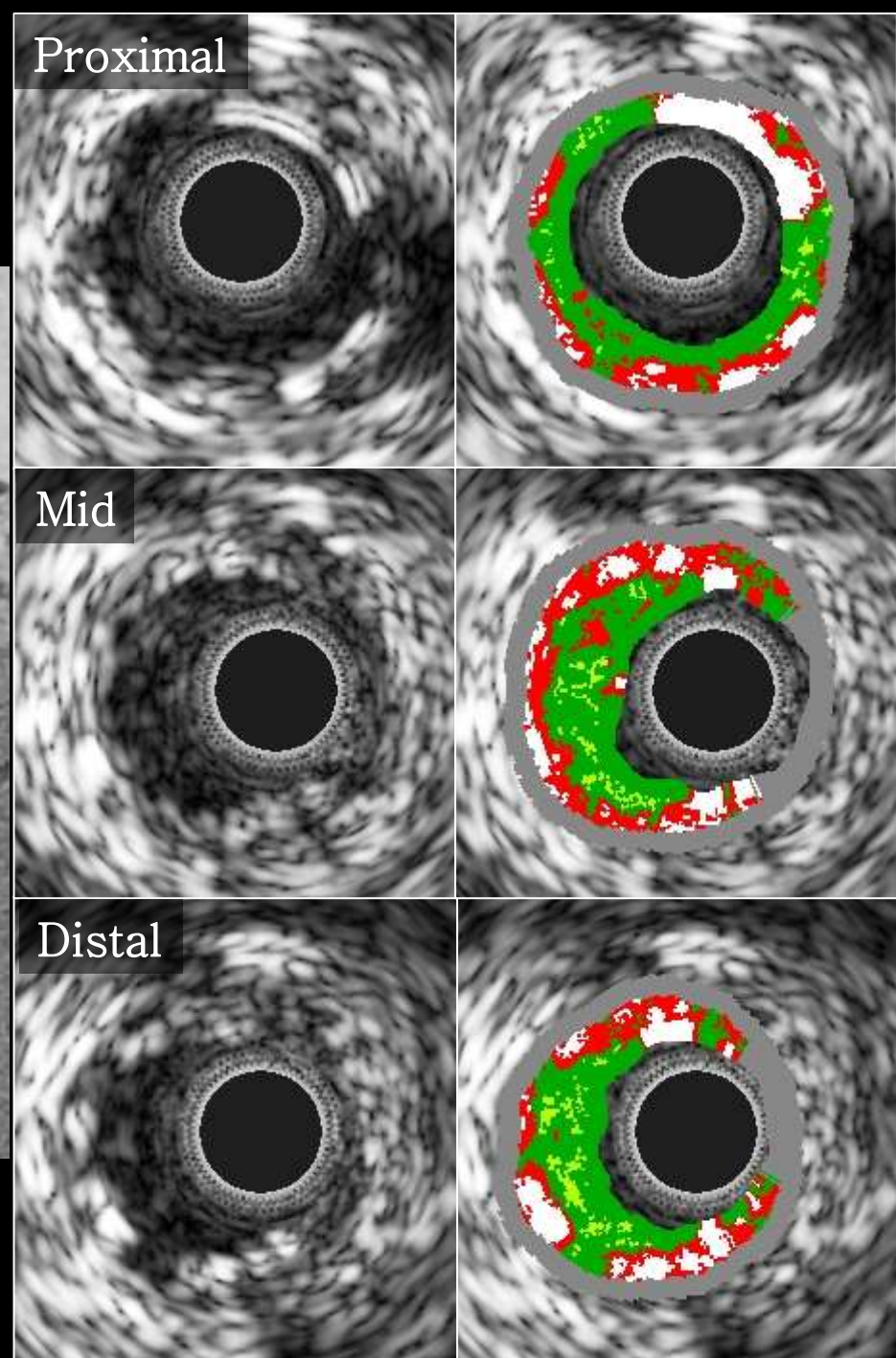
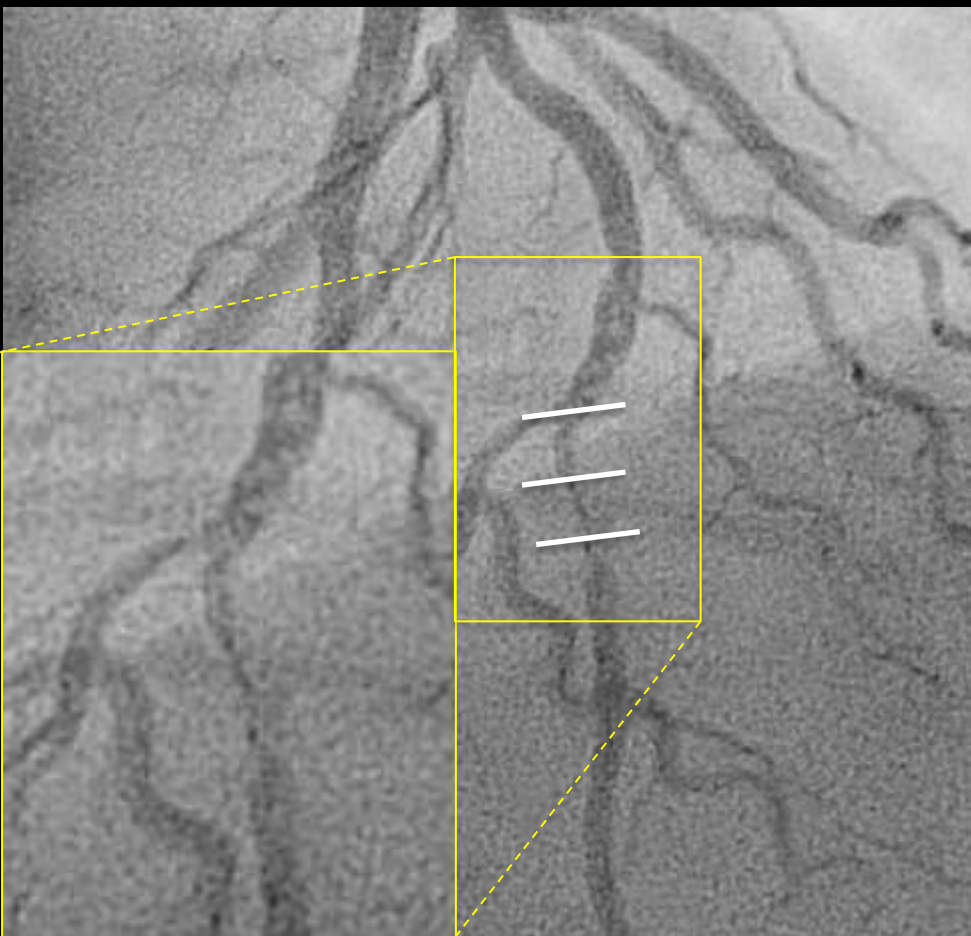


Intra-scaffold tissue was documented as fibrous.



#2. Very late ISR on day 833 in Absorb Cohort B

Nakatani et al. EI 2014



**Type 1B ISR at the distal margin of the scaffold segment
QCA MLD: 0.72 mm, %DS: 63.7% and
LL: 1.38 mm)**

Neoatherosclerosis

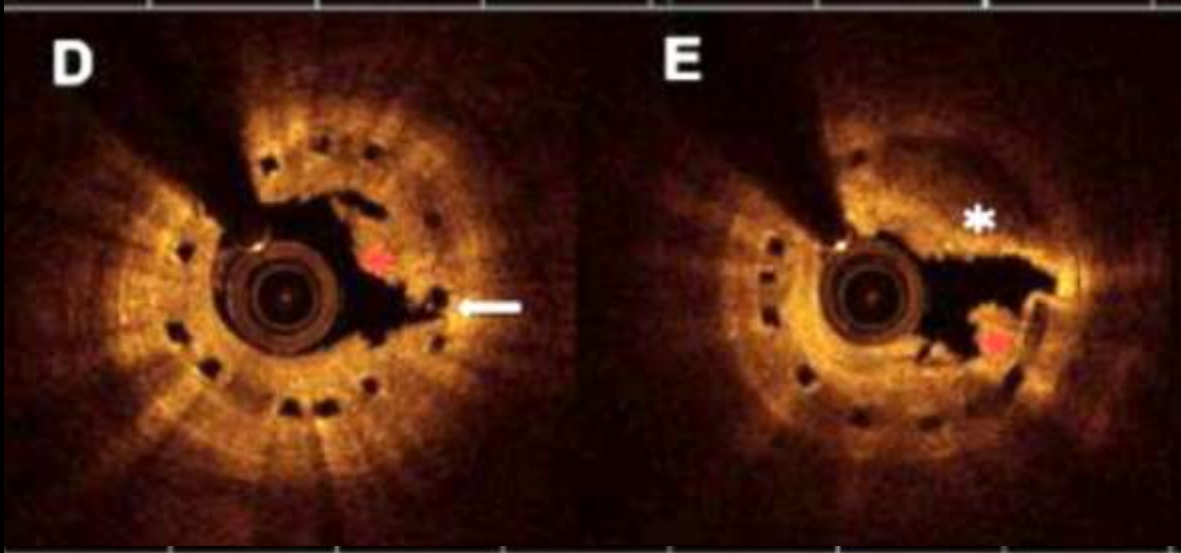
Neoatherosclerosis as the Cause of Late Failure of a Bioresorbable Vascular Scaffold



Andrea Mangiameli, MD,* Yohei Ohno, MD,* Guilherme F. Attizzani, MD,* Davide Capodanno, MD, PhD,* Corrado Tamburino, MD, PhD*

D

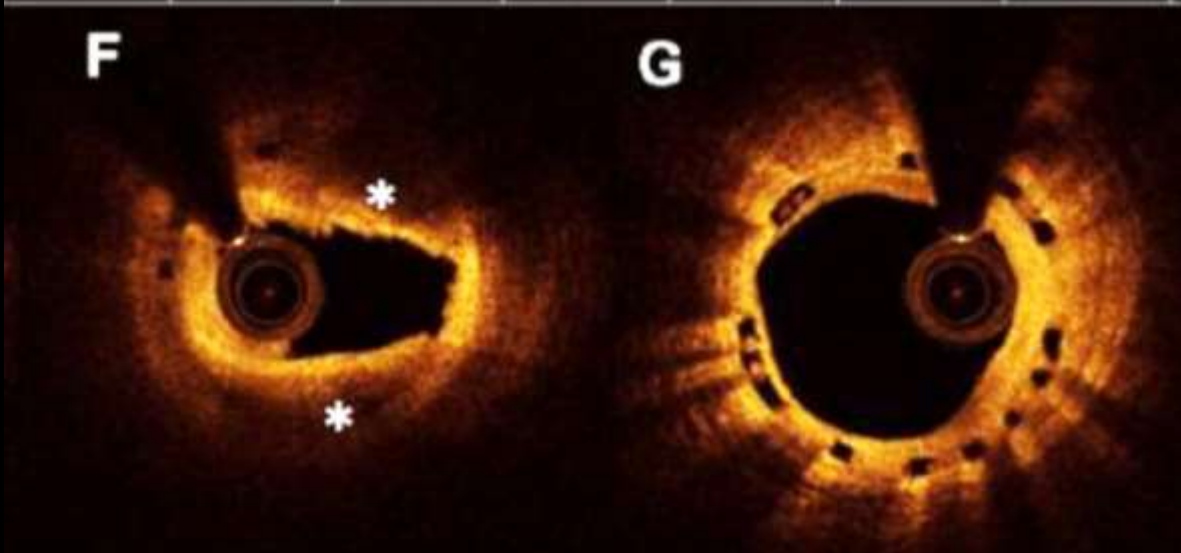
E



D: Neointimal rupture (white arrow) with mural thrombus (red asterisk)

F

G



E: Highly attenuating area

F: Marked shadowing of the scaffold struts

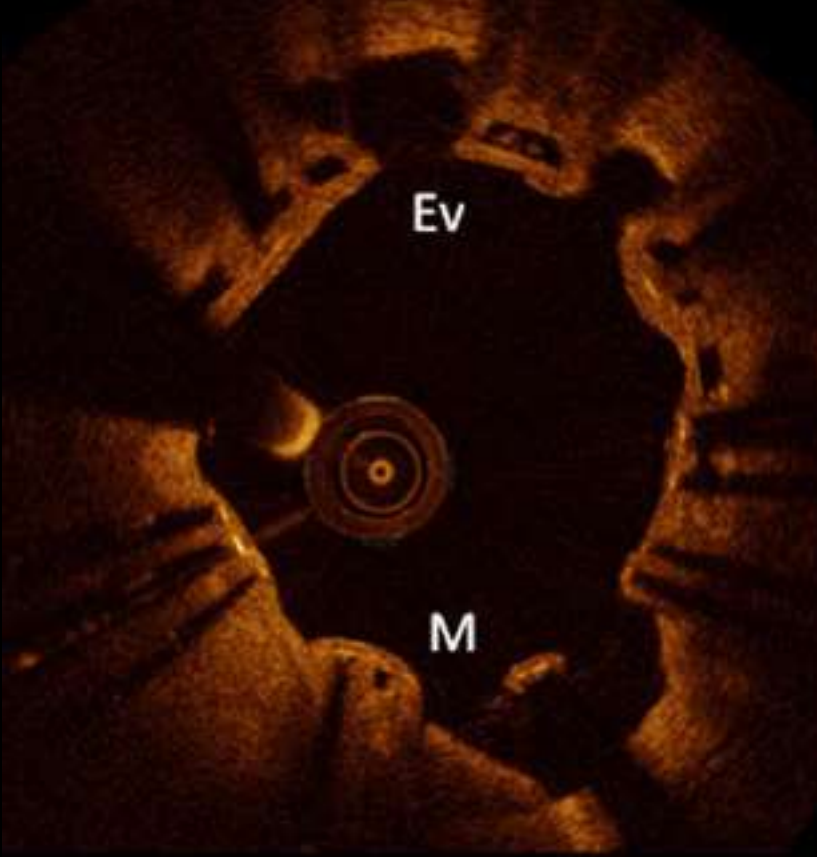
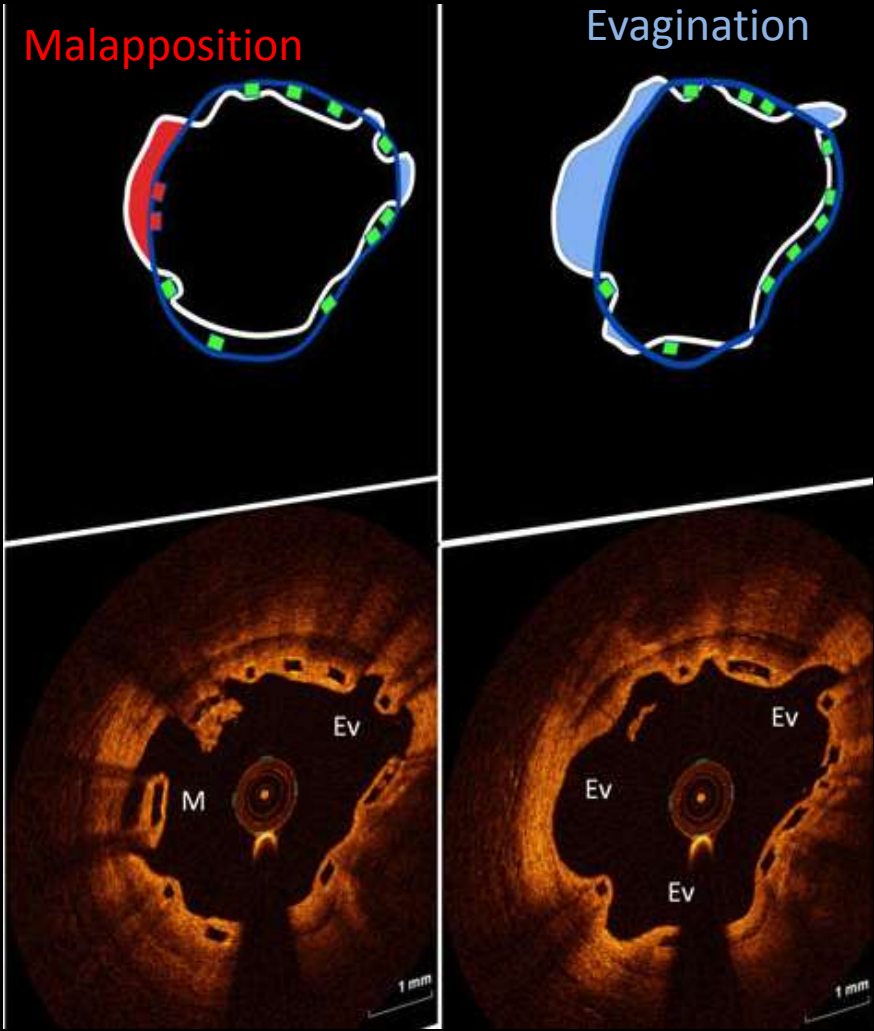
G: Normal pattern of neointima

BRS failure: imaging

- **Early Thrombosis**
- **Acute disruption**
- **Very late Scaffold thrombosis**
 - **Late discontinuities (Intravascular or intraluminal Dismantling)**
- **Restenosis/ Neoatherosclerosis**
- **Evagination/ Aneurysm**

Evagination at 12 M FUP

Gori et al. EHJ 2015

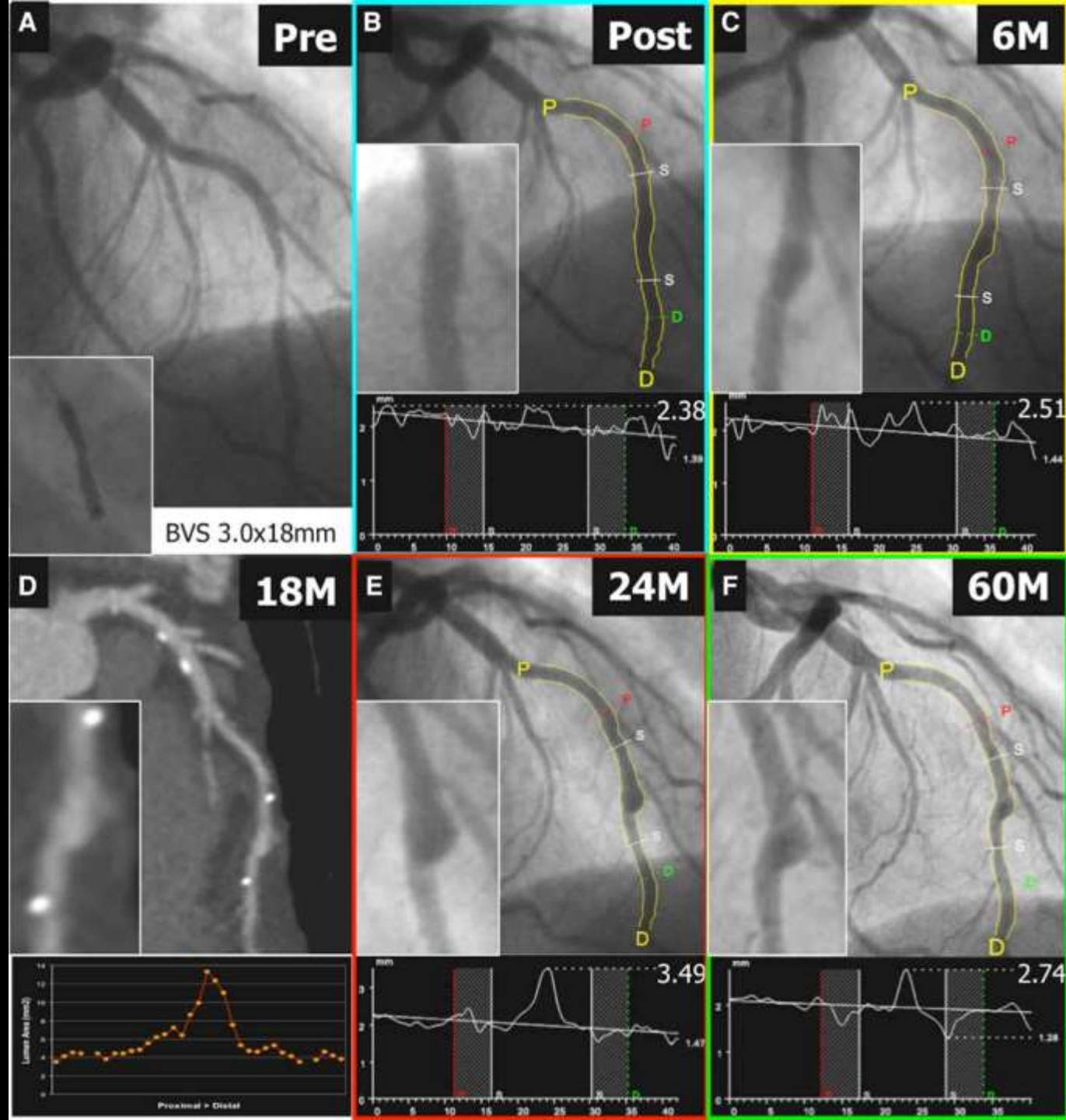


Out of 90 pts, 55 (54%) of the BVS (50(56%) of the patients) had at least one evagination (6.1+6.2 evaginations per BVS).

Case of Aneurysm

**Mechanism:
Unknown**

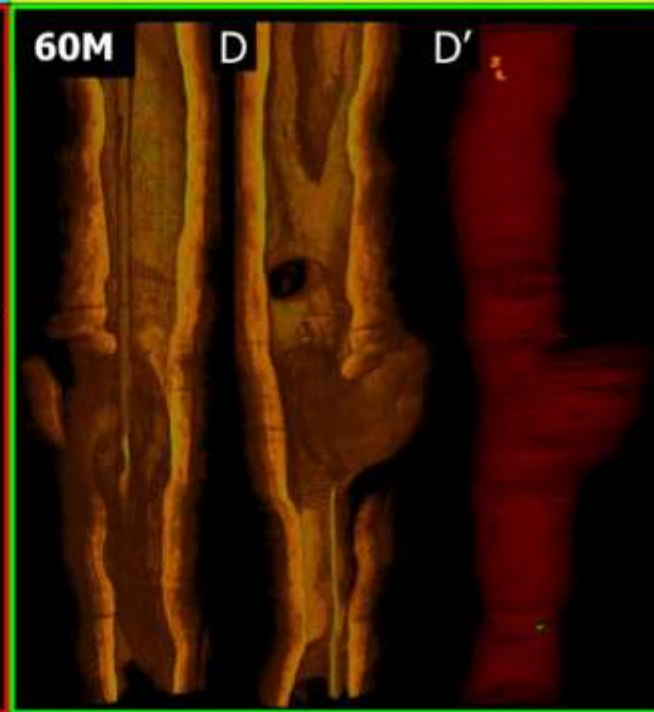
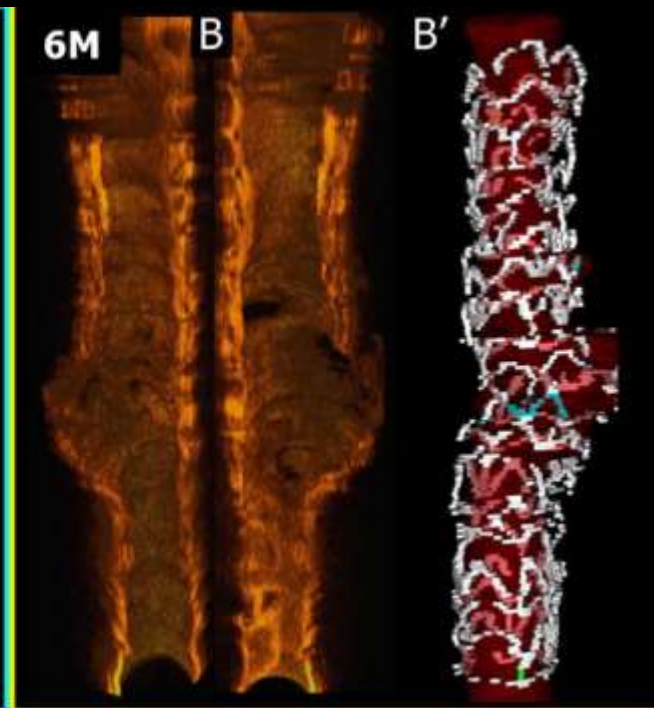
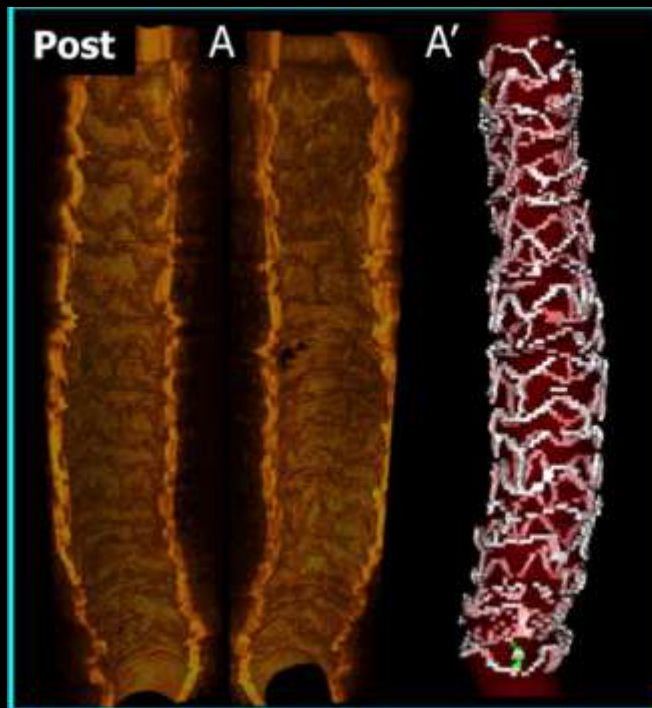
**However, implies
localized
inflammatory
response with
involvement of
matrix metalloproteinase.**



Case of Aneurysm

**Mechanism:
Unknown**

**However, implies
localized
inflammatory
response with
involvement of
metalloproteinase.**



Conclusion

- **Malapposition, scaffold edge landing on plaque, overlap, device-vessel size mismatch and underexpansion are frequently observed in cases of early scaffold thrombosis.**
- **Acute disruption could relate to scaffold thrombosis. It can be worsened by follow-up procedure.**
- **Late discontinuities are frequently observed in cases of late/very late scaffold thrombosis.**
- **It appears that the fate of late discontinuities varies from scaffold thrombosis to no events (well covered). Further research is needed to investigate what impacts the differential outcomes of late discontinuities.**
- **Reported causes of restenosis in the Absorb is not different from those of drug-eluting metallic stent.**
- **Anecdotal case of OCT-defined neo-atherosclerosis warrants further investigation.**
- **Due to a lack of systematic and serial imaging, it remains unclear how much additional risks will be associated with each imaging abnormality.**