

Case Based Hot Topics

Modifica della placca e DCB

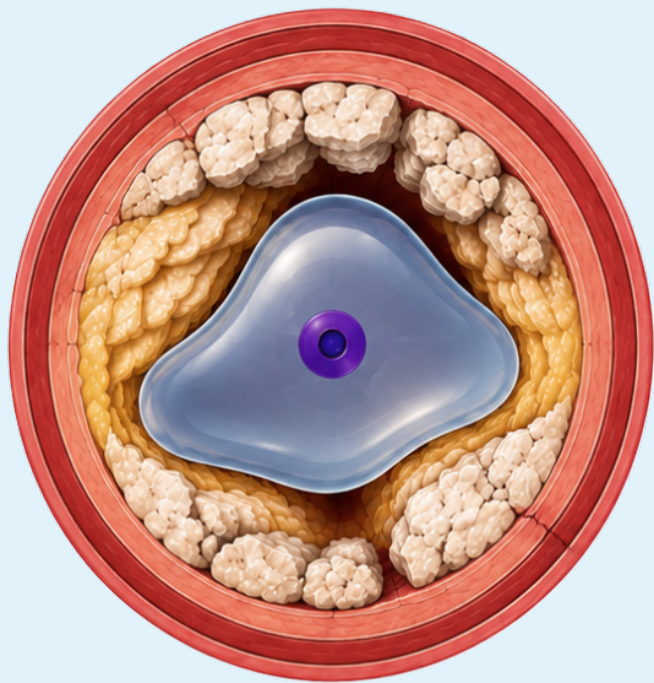
Gianluca Massaro, M.D., Ph.D., FESC



- Plaque modification: why?
- Is there any difference between plaque type and DCB?
- Calcified plaque and DCB
- Clinical Cases

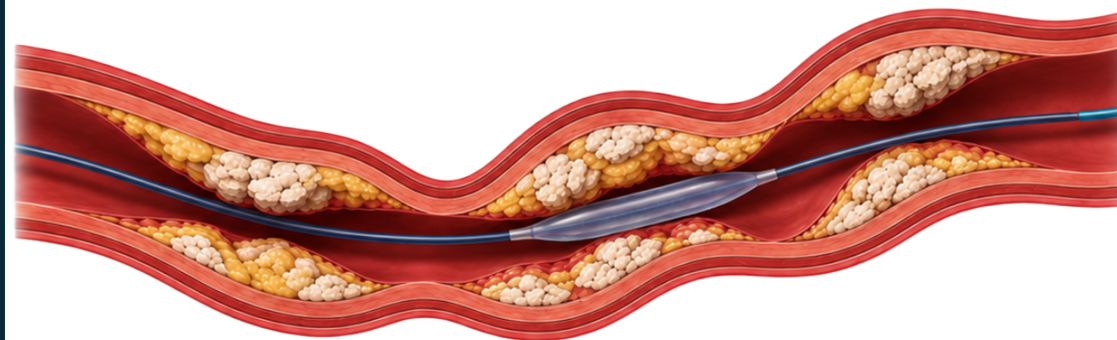


Plaque modification: why?



The plaque alters the compliance and the lumen.

Plaque modification increases the degree of balloon apposition and ensures uniform local drug distribution



Lesion preparation reduces the damage to the drug coating of the balloon during balloon transport to the lesion and thus decreases the amount of drug loss



Lesion preparation: what matters?

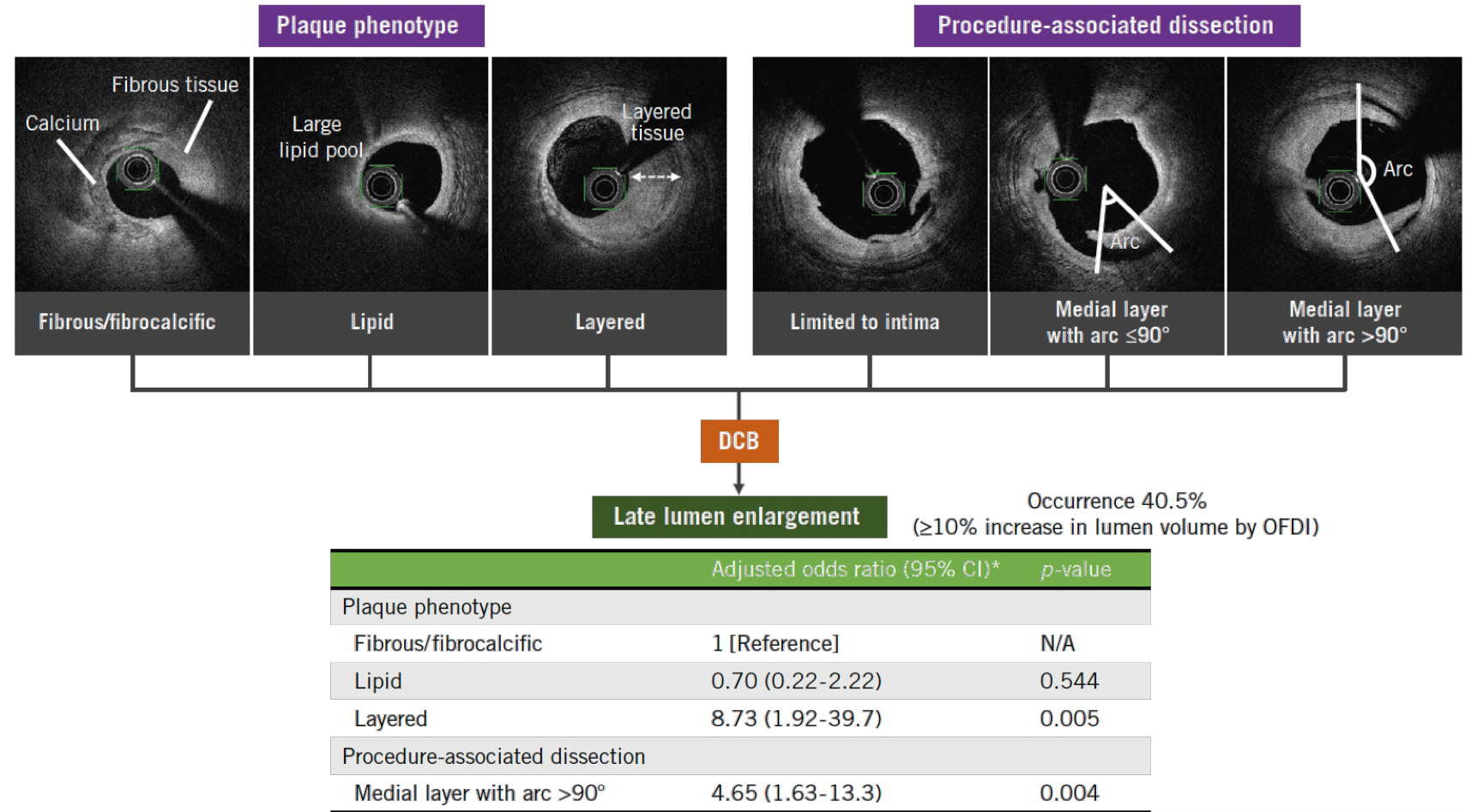
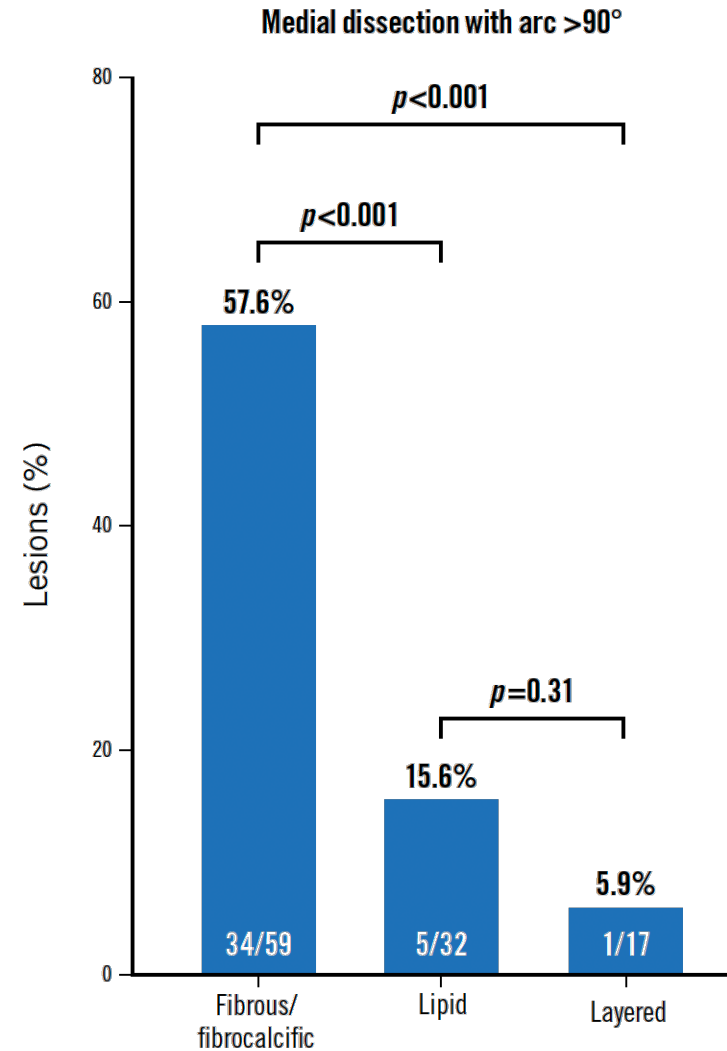
Predictors of late lumen enlargement after drug-coated balloon angioplasty for *de novo* coronary lesions

Masaya Yamamoto*, MD; Hisao Hara, MD, PhD; Shuji Kubota, MD; Yukio Hiroi, MD, PhD

- 108 lesions (83 pts) treated with PCB
- OFDI guidance after PCI and follow-up (median 6.1 m)
- LLE defined as a >10% increase in lumen volume



Predictive lesion characteristics for late lumen enlargement following DCB angioplasty.

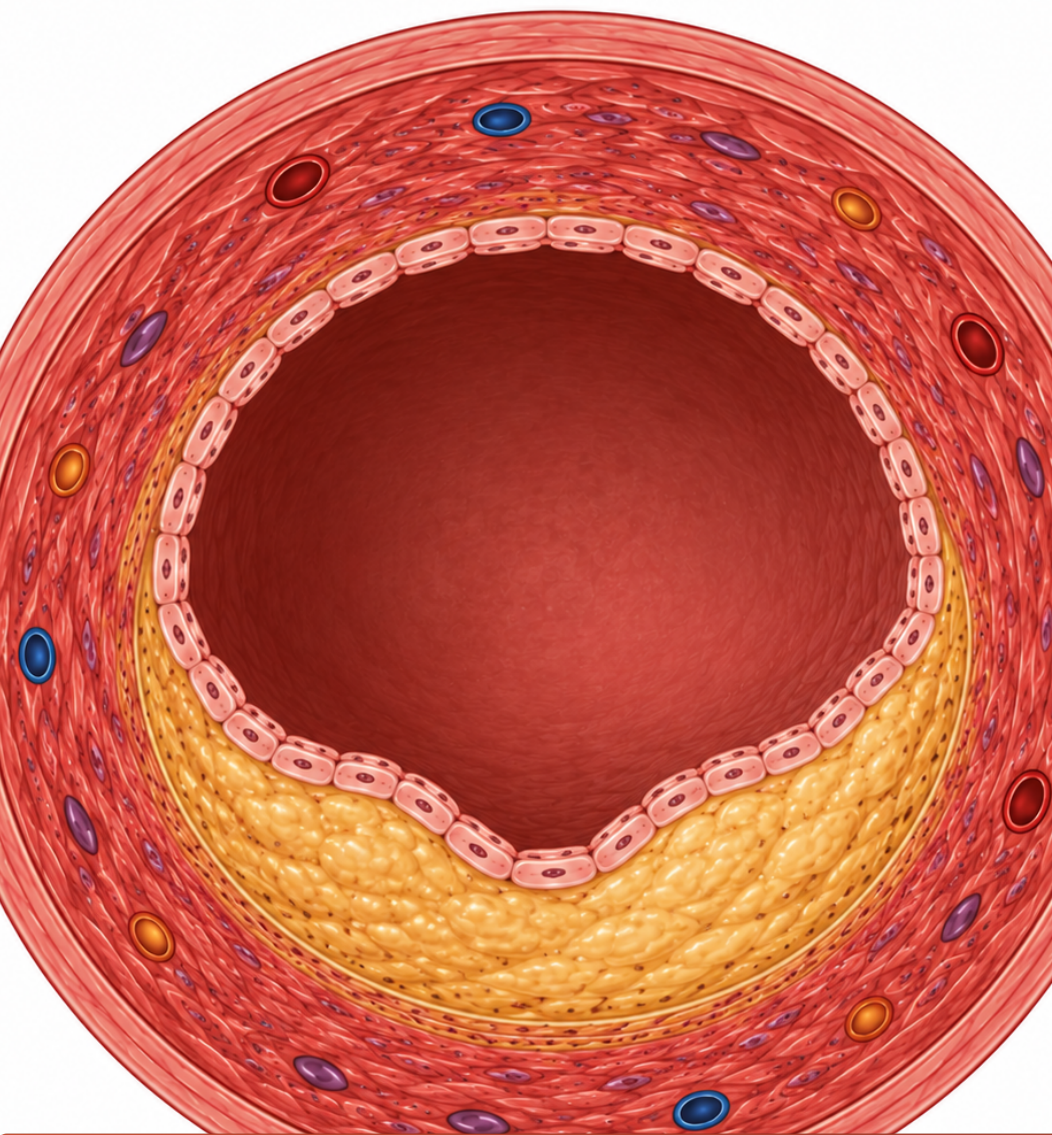


Masaya Yamamoto *et al.* • *EuroIntervention* 2024;20:602-612 • DOI: 10.4244/EIJ-D-23-00849

*Odds ratio adjusted for age, acute lumen gain, plaque phenotype, and procedure-associated medial dissection with an arc >90°. CI: confidence interval; DCB: drug-coated balloon; N/A: not applicable; OFDI: optical frequency domain imaging

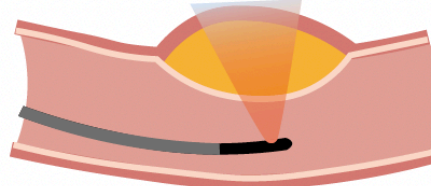
Is there any difference between plaque type and DCB?

Lipidic Plaque

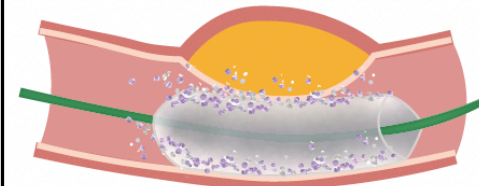


DEBuT-LRP study.

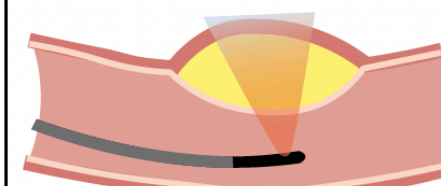
IVUS-NIRS at baseline identifies a lipid-rich plaque



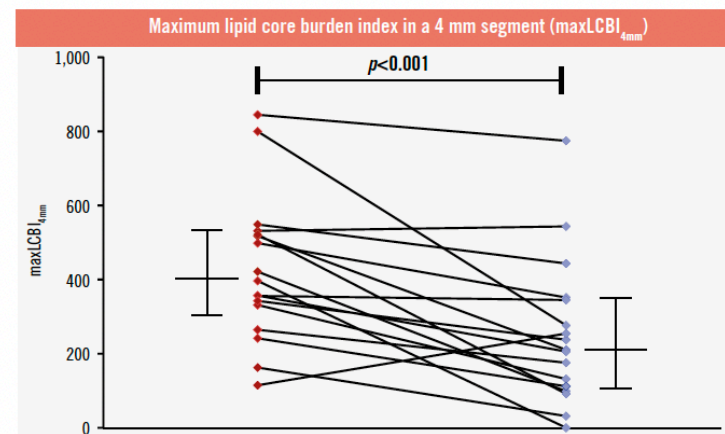
Paclitaxel-coated balloon (PCB) treatment of lipid-rich plaque



9-month IVUS-NIRS shows lower maxLCBI_{4mm} in PCB-treated plaque



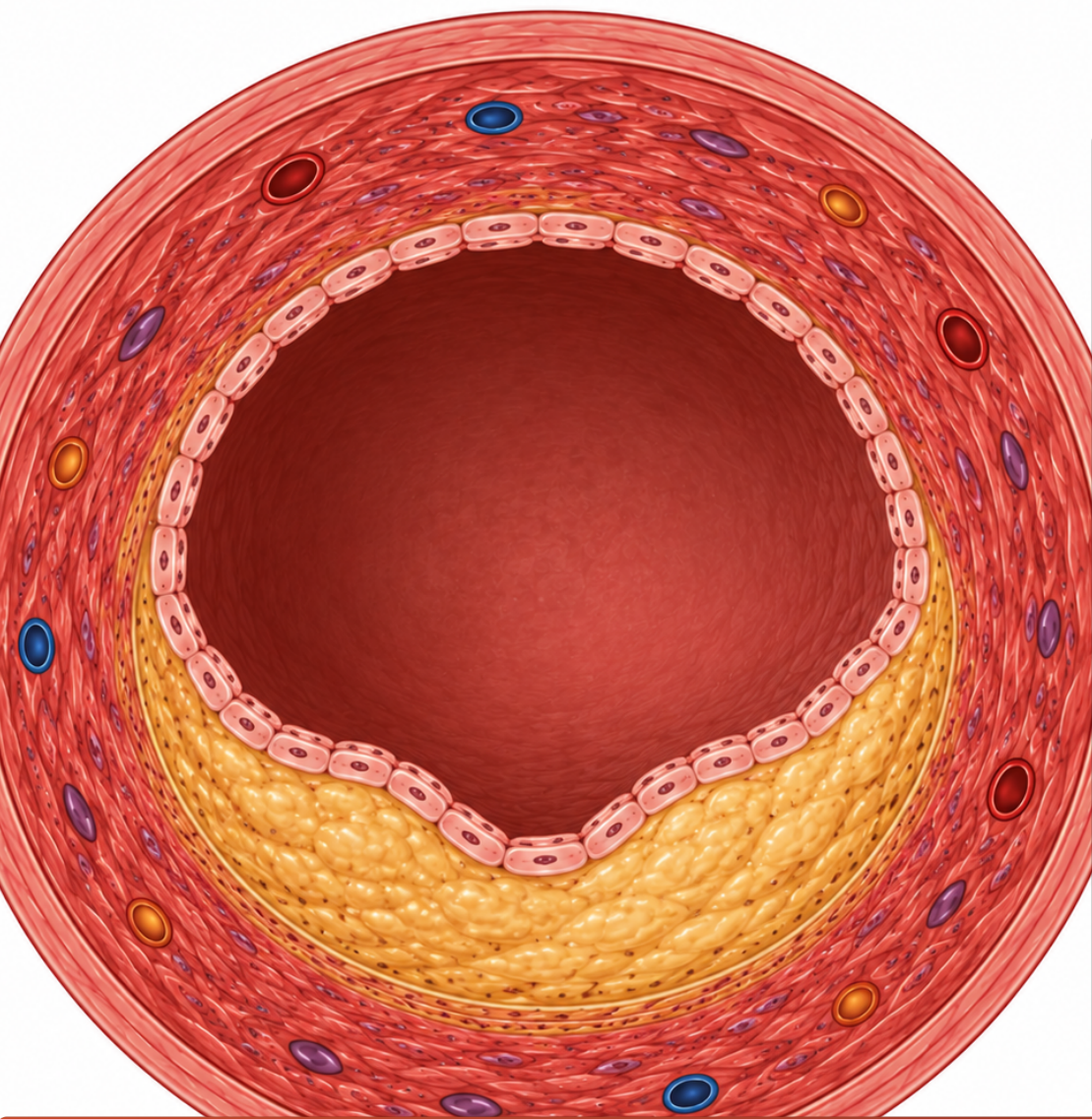
Baseline
maxLCBI_{4mm} 397



9-month
maxLCBI_{4mm} 211

Is there any difference between plaque type and DCB?

Lipidic Plaque

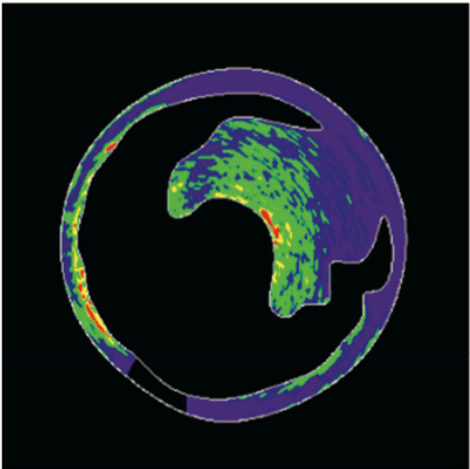
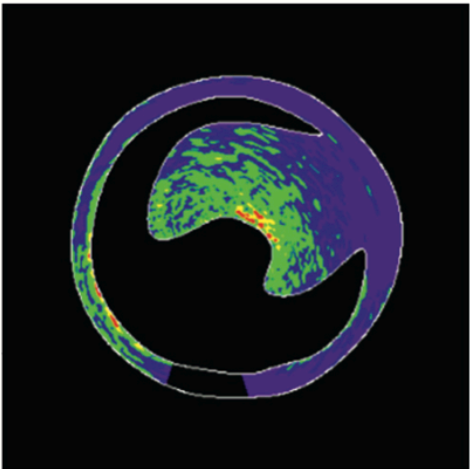
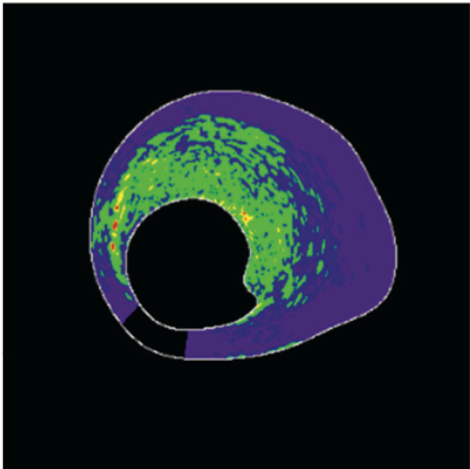


Aspect	Paclitaxel	Sirolimus
Mechanism of Action	Non-uniform (crystalline, lipophilic), potential for distal embolization	Cytostatic and immunosuppressive; inhibits mTOR pathway and cell-cycle transition (G1/S), reducing proliferation and inflammation
Distribution in Vessel Wall	Non-uniform distribution, potential embolization	Homogeneous distribution, lower embolization risk
Stable Fibrocalcific Plaque	Preferred; uneven distribution might limit efficacy	Effective; uniform penetration, inflammatory control
Lipid-rich Plaque	Reduced effectiveness due to poor distribution and inflammation	Enhanced effectiveness; uniform distribution, anti-inflammatory properties
Vulnerable Plaque (thin-cap fibroatheroma)	Limited efficacy; increased inflammation risk	Superior; stabilizes plaque due to anti-inflammatory effects
Plaque with Thrombus	Limited; risk of inflammation and embolization	Preferred; anti-inflammatory and stabilizing properties
Clinical Recommendations	Stable lesions, restenosis, fibrocalcific plaques	Unstable, inflammatory, lipid-rich, thrombotic lesions

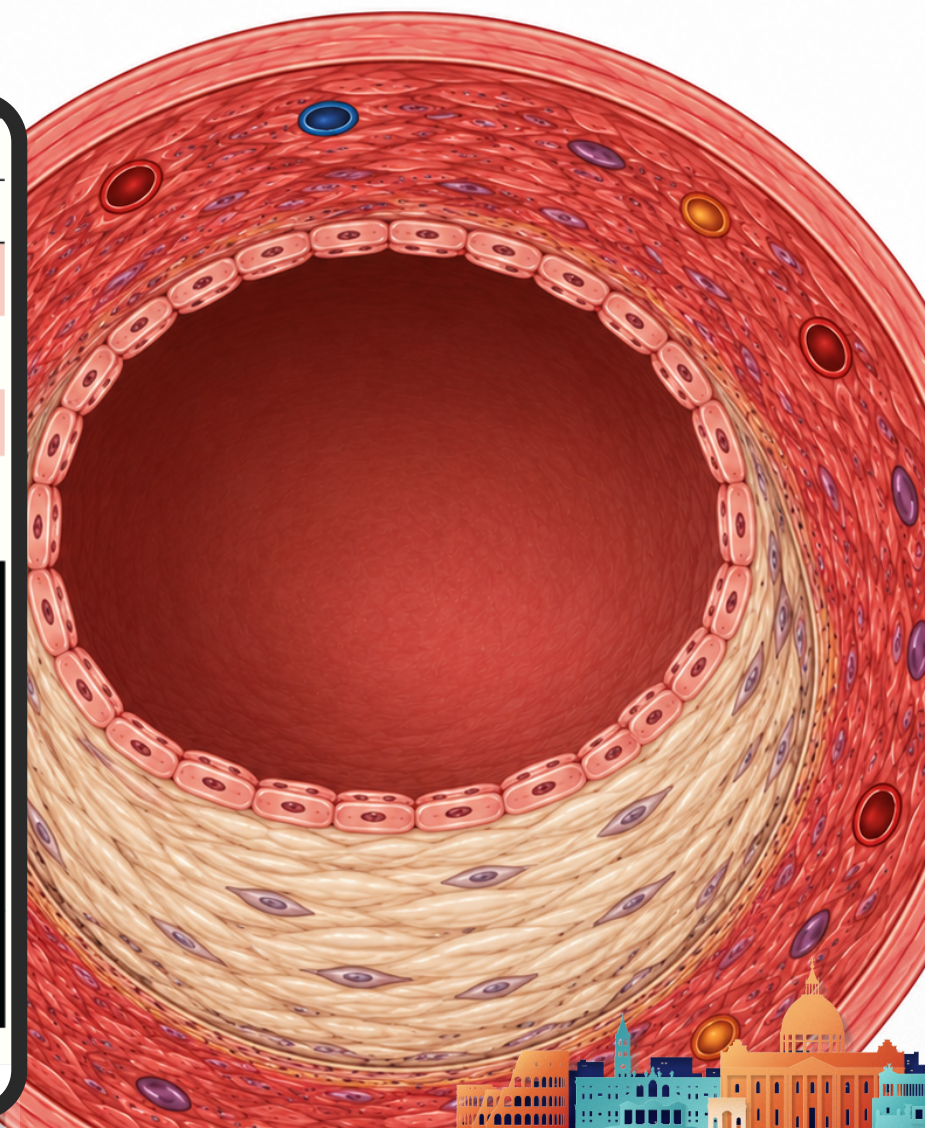
Is there any difference between plaque type and DCB?

Fibrotic Plaque

	Area – %			
	Before POBA	After POBA	After DCB	<i>p</i> value
Calcification	100	100 (37.5, 350.0)	100 (50.0, 275.0)	.81
Dense fibrosis	100	83.1 (56.0, 125.0)	85.5 (49.4, 133.2)	.068
Fibrosis	100	79.7 (61.6, 98.9)*	83.4 (66.2, 98.9)†	< .001
Lipid pool	100	91.3 (79.4, 118.2)	93.7 (65.8, 111.2)	.18



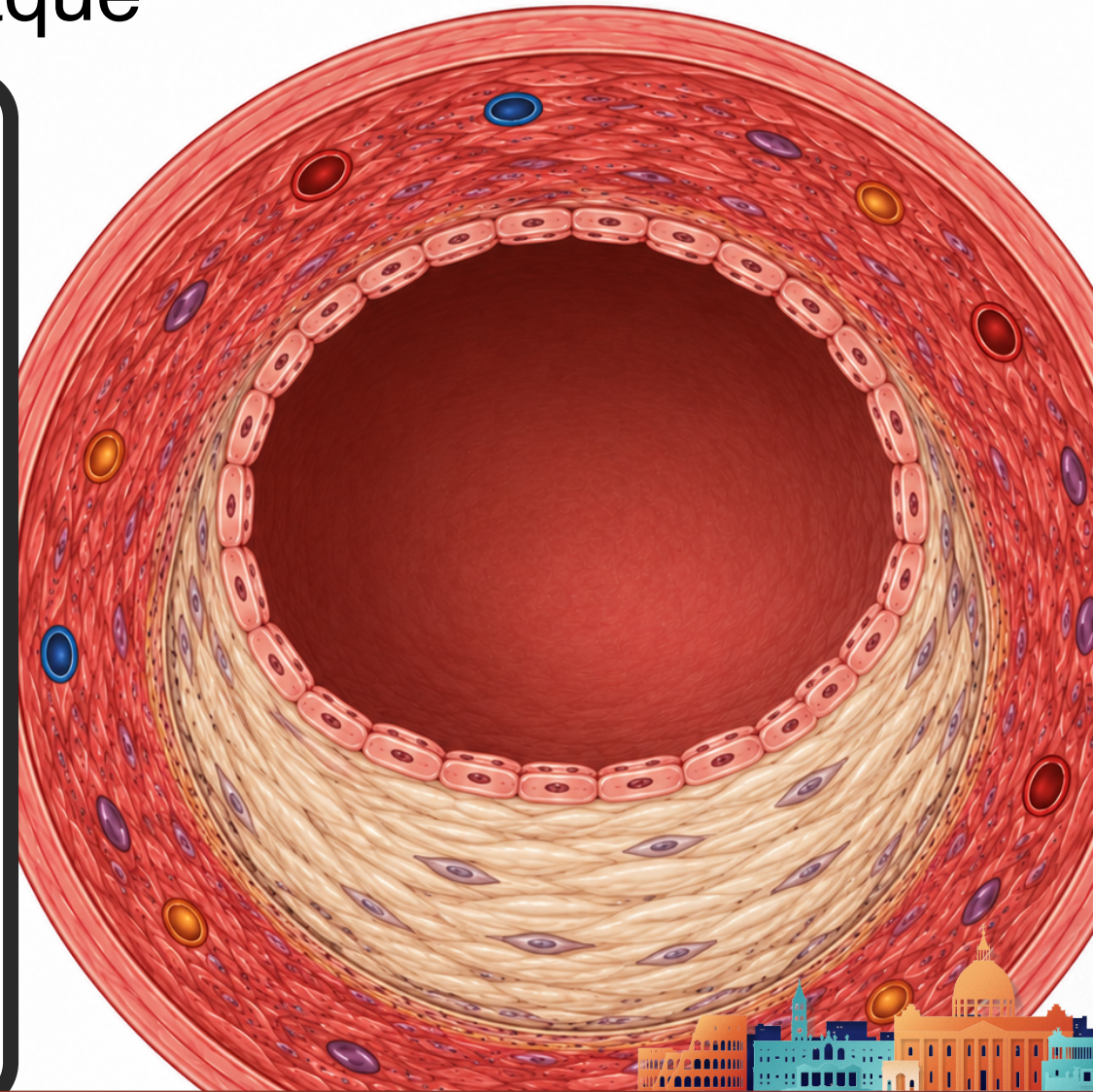
Before POBAAfter POBAAfter DCB



Is there any difference between plaque type and DCB?

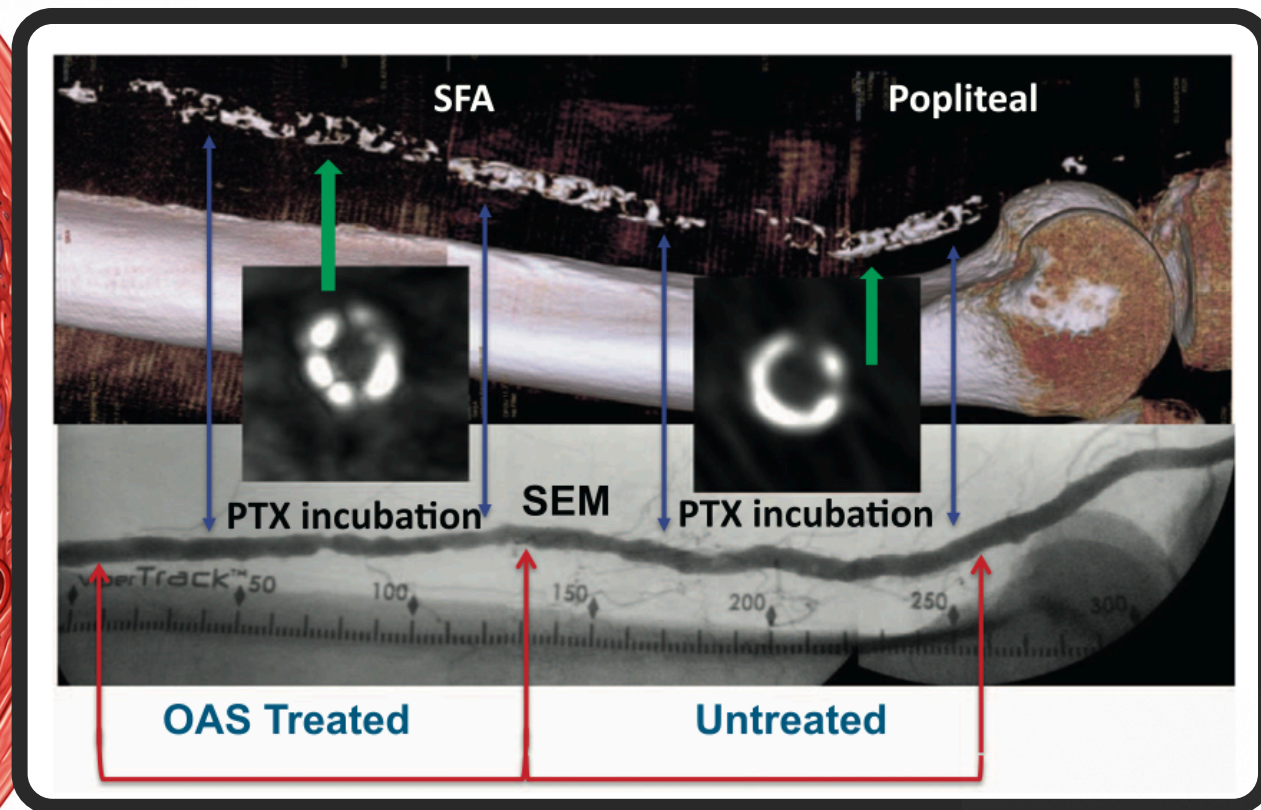
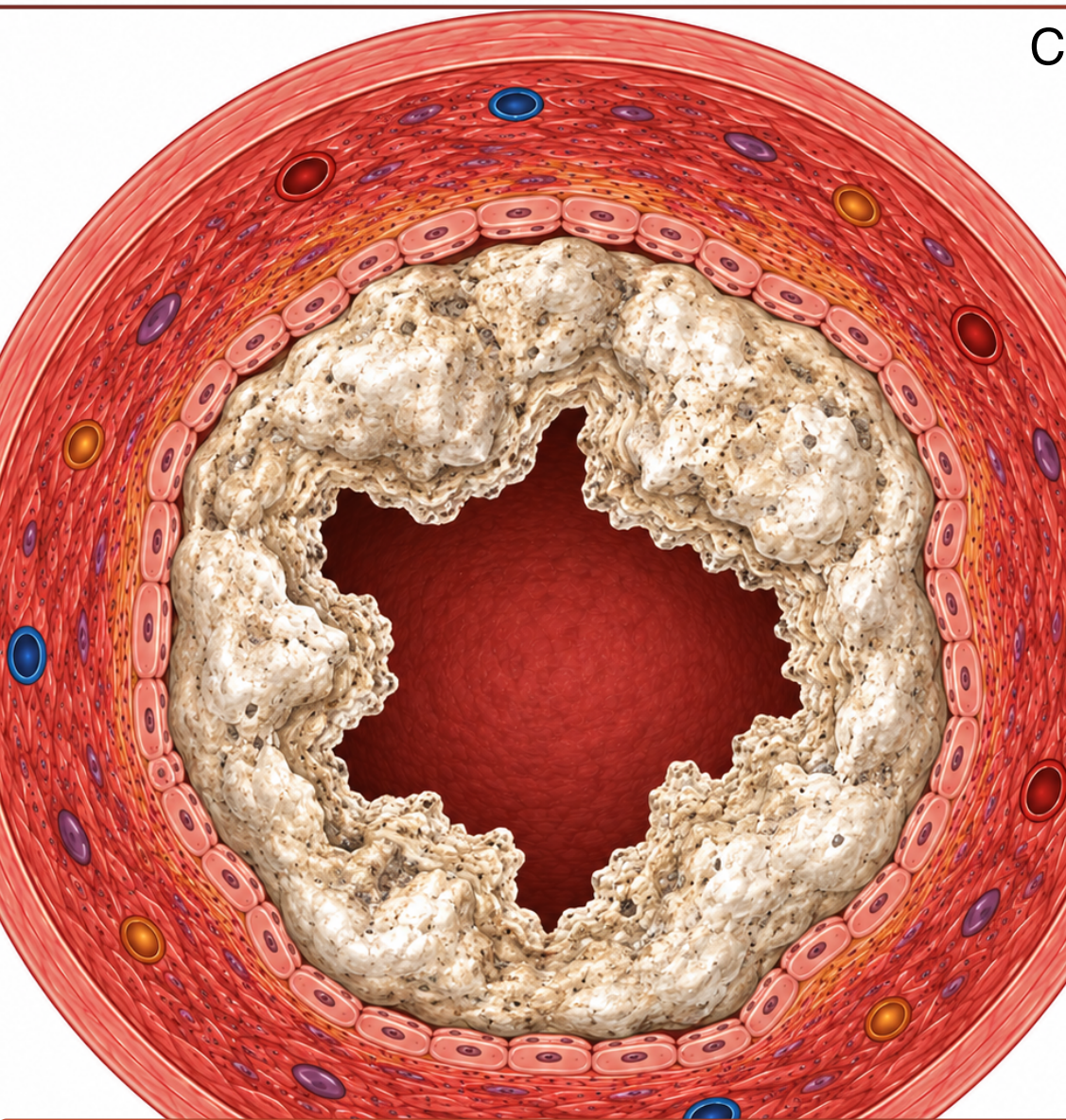
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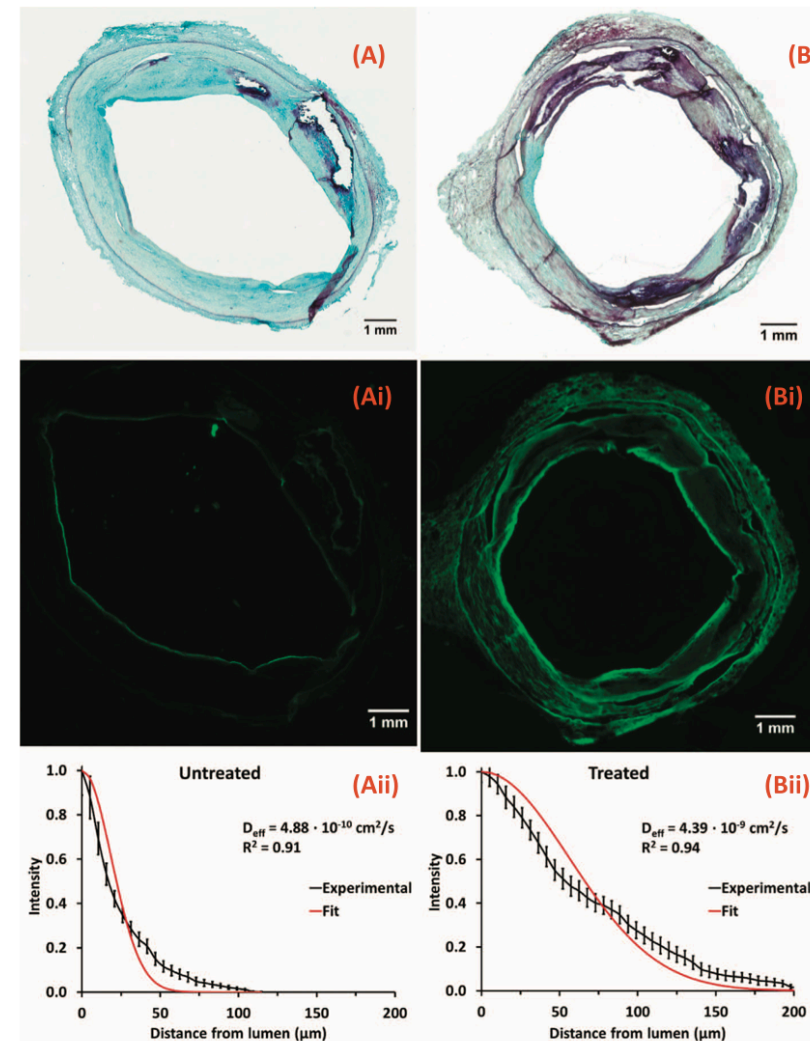
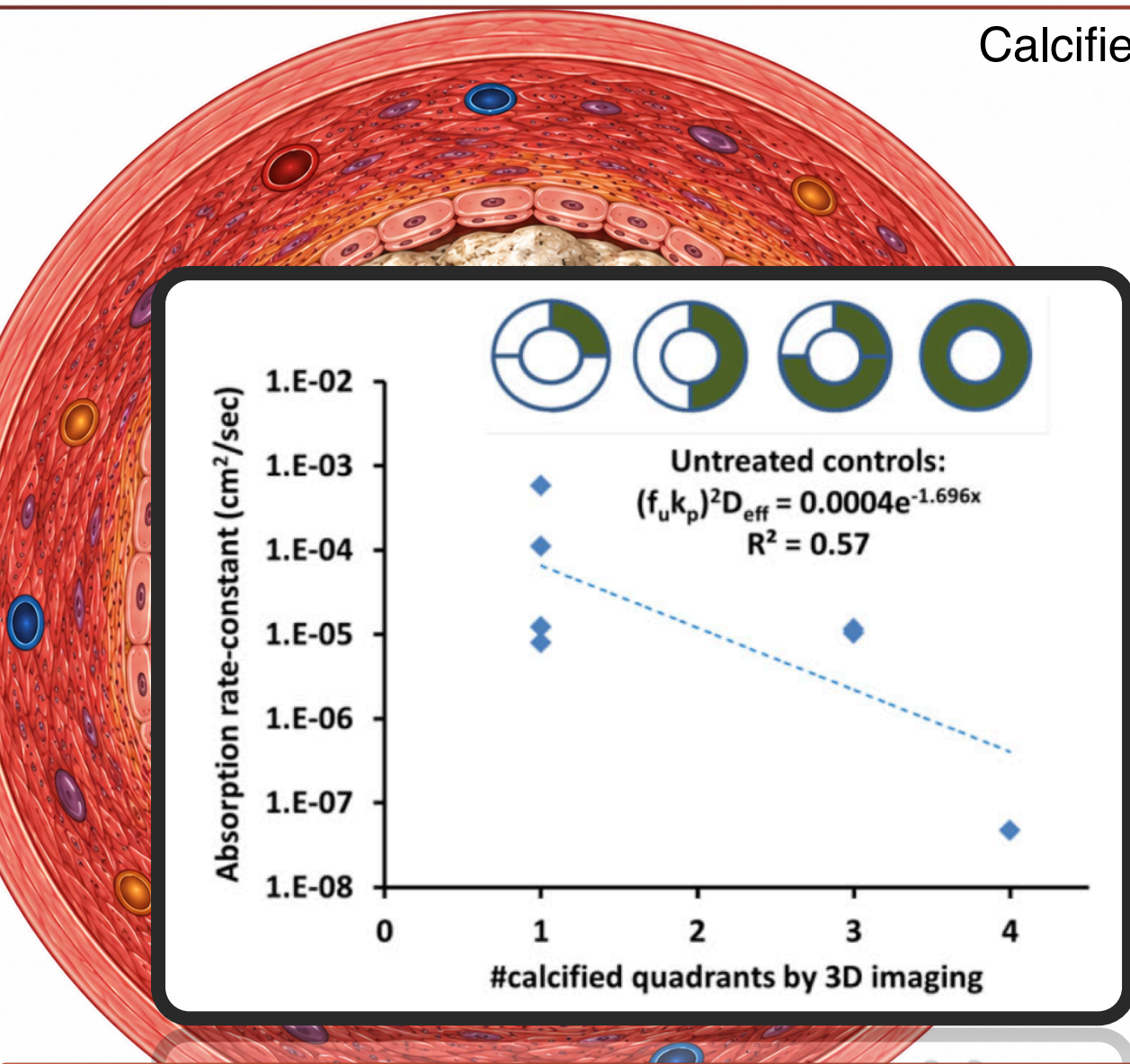
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Calcified Plaque



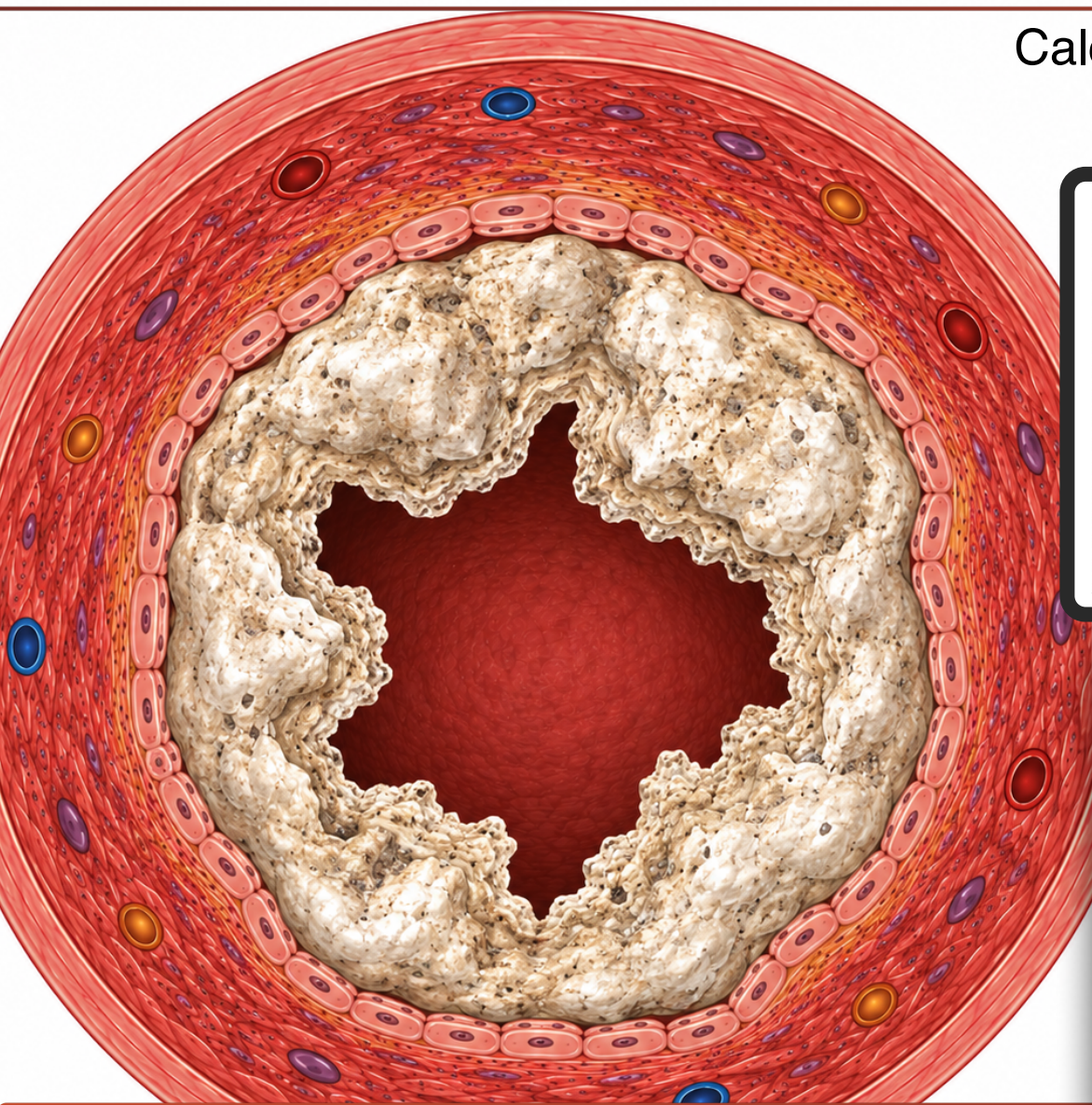
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Calcified Plaque



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Calcified Plaque



Cardiovasc Intervent Radiol (2014) 37:898–907
DOI 10.1007/s00270-014-0904-3



CLINICAL INVESTIGATION

ARTERIAL INTERVENTIONS

Calcium Burden Assessment and Impact on Drug-Eluting Balloons in Peripheral Arterial Disease

F. Fanelli · A. Cannavale · M. Gazzetti ·
P. Lucatelli · A. Wilderk · C. Cirelli ·
A. d'Adamo · F. M. Salvatori

GROUP	GRADE	LENGTH
1 a	0 – 90 °	< 3 cm
1 b		> 3 cm
2 a	90 – 180 °	< 3 cm
2 b		> 3 cm
3 a	180 – 270 °	< 3 cm
3 b		> 3 cm
4 a	270 – 360 °	< 3 cm
4 b		> 3 cm

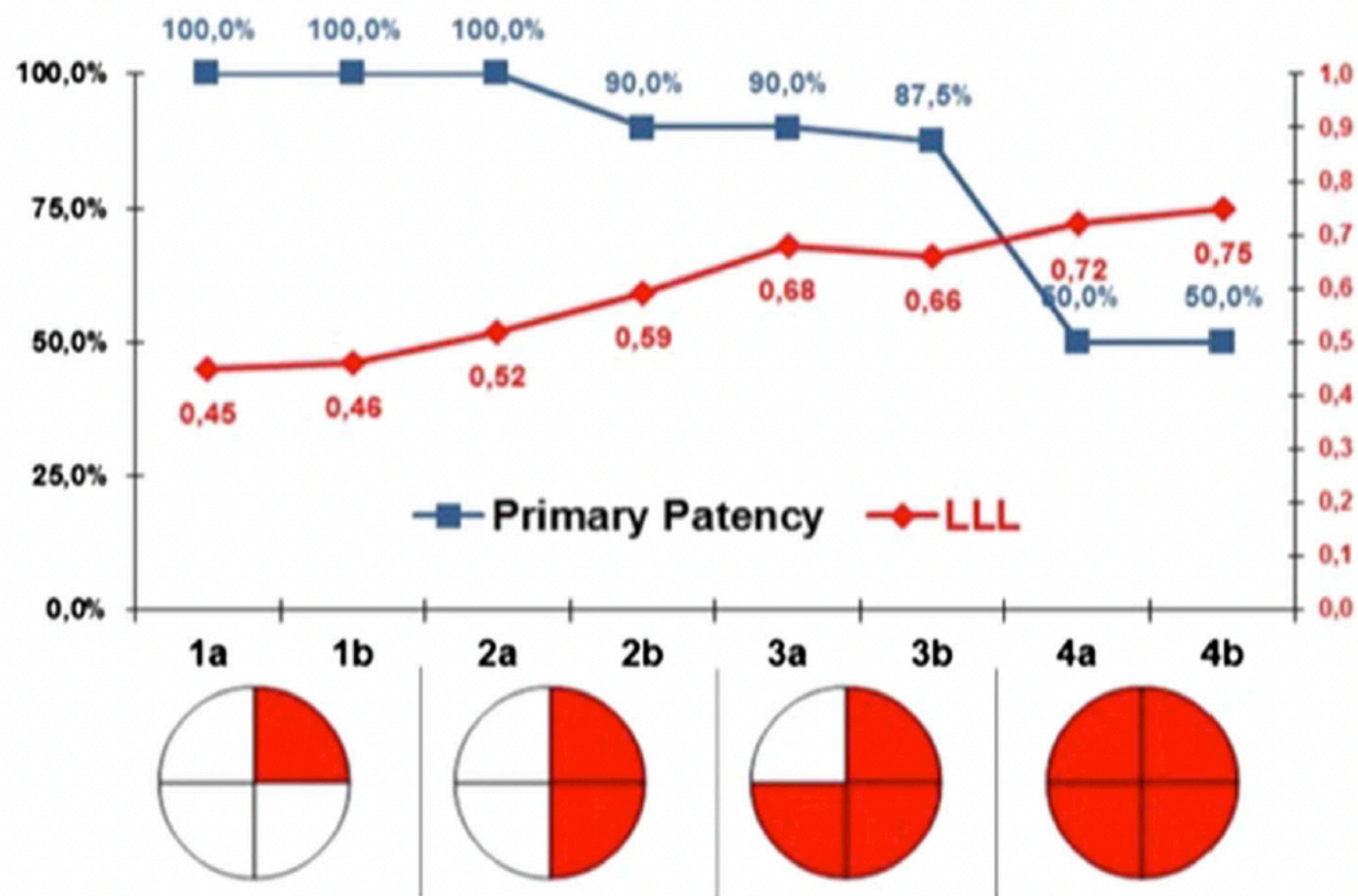
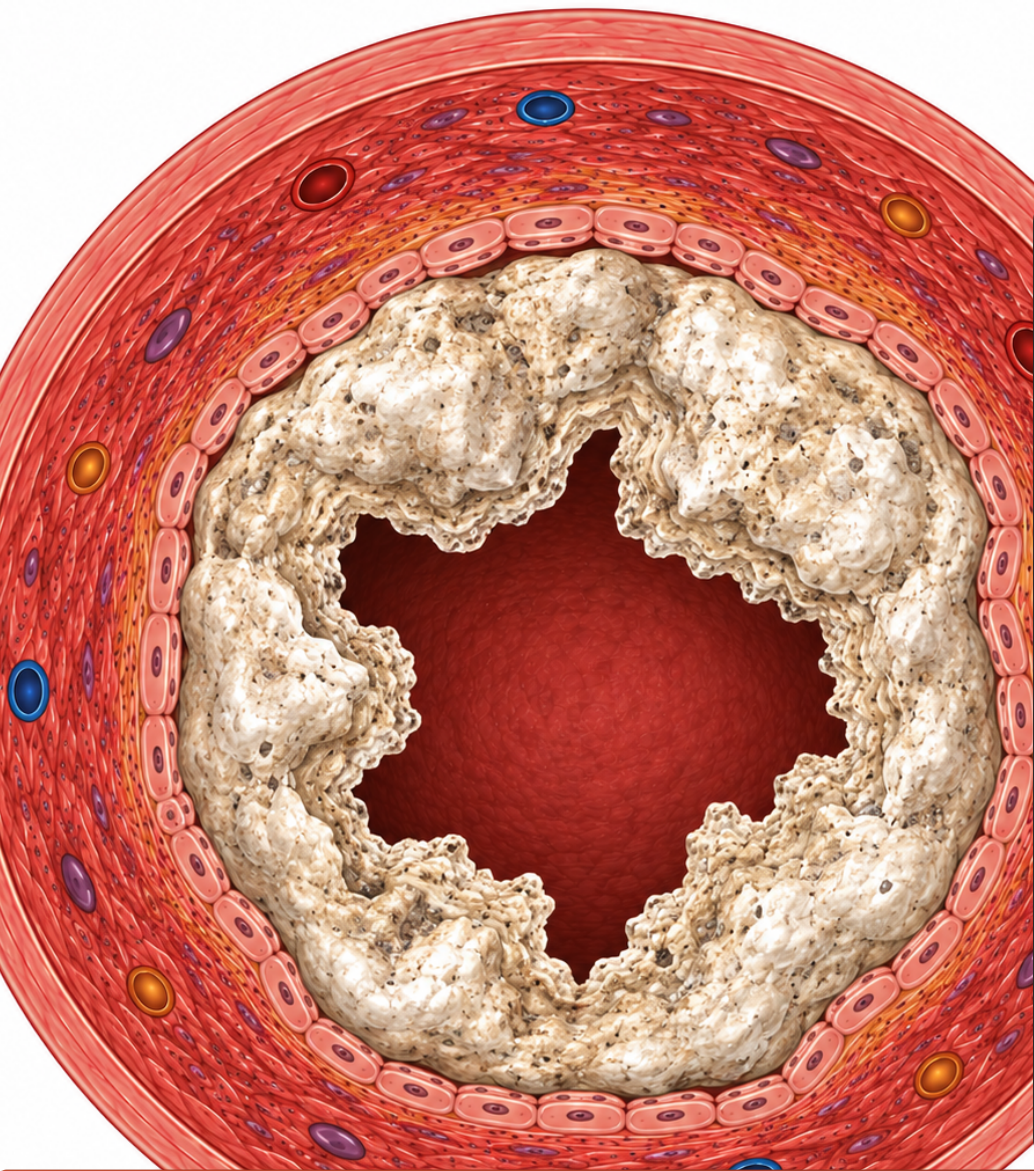
Efficacy of the treatment can be limited by calcification



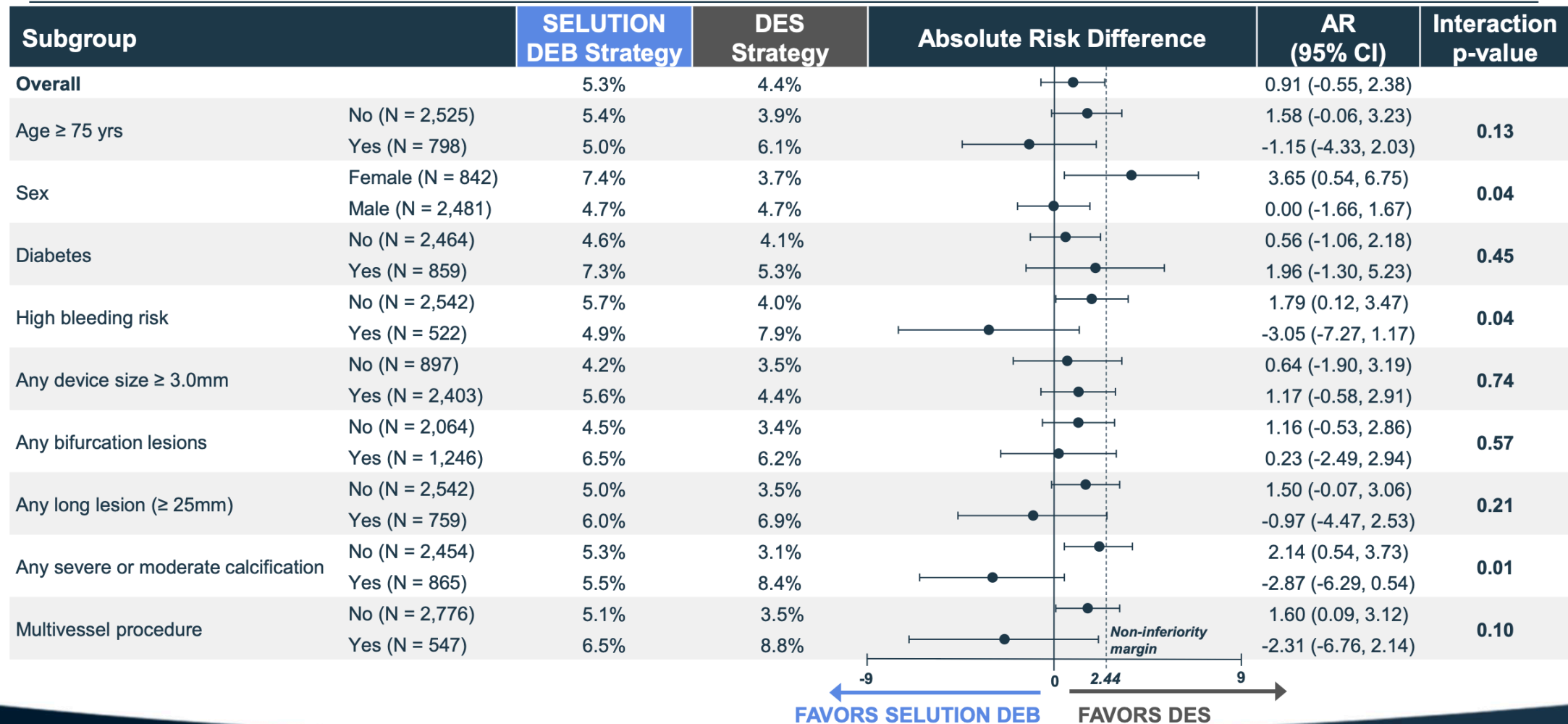
Is there any difference between plaque type and DCB?

PLATFORM OF LABORATORIES FOR ADVANCES IN CARDIAC EXPERIENCE

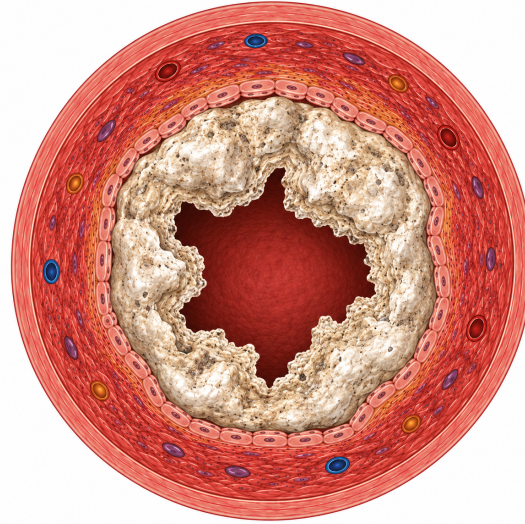
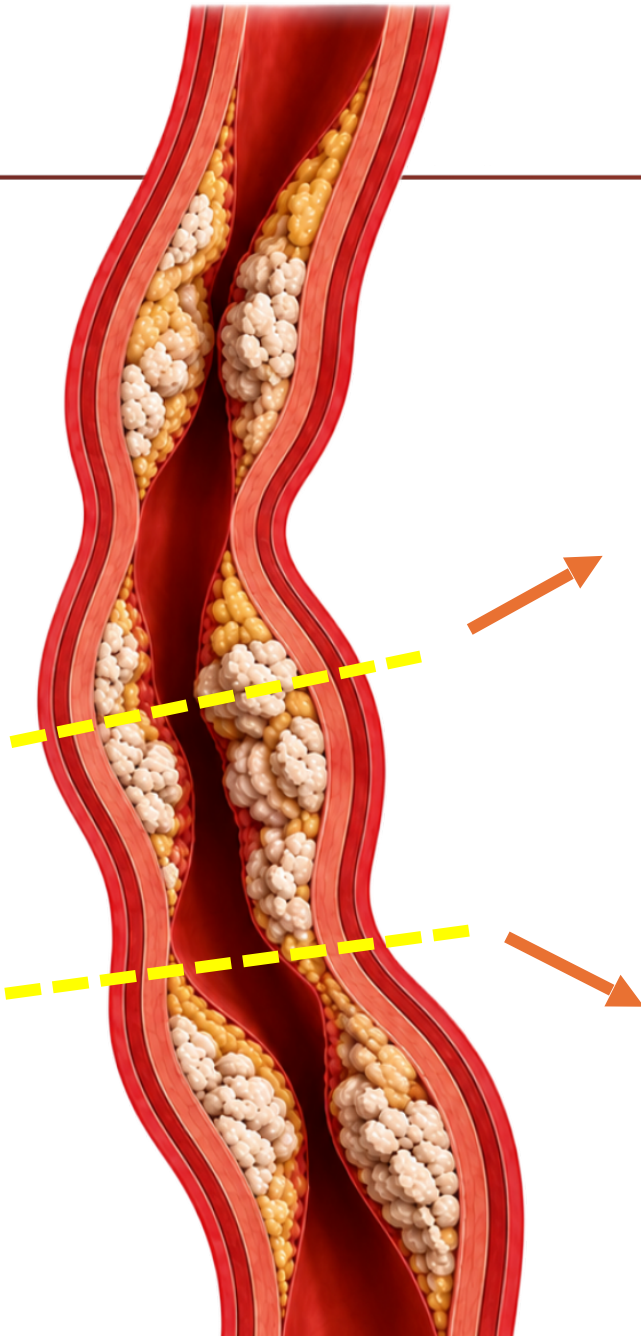
Calcified Plaque



Subgroup Analysis of TVF



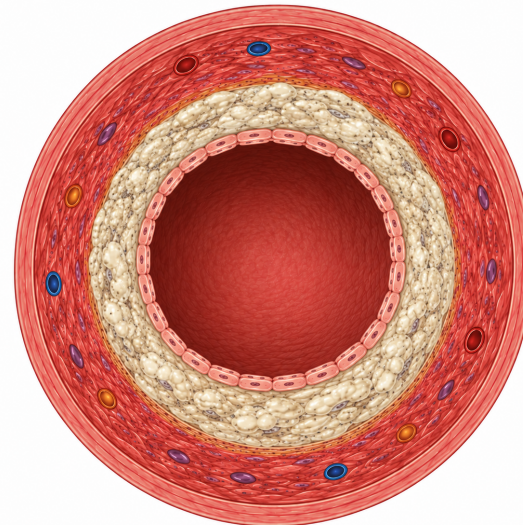
Lesion Preparation in Calcified Plaque



A matter of «Volume»

Plaque debulking

- Rotational Atherectomy
- Orbital Atherectomy
- ELCA



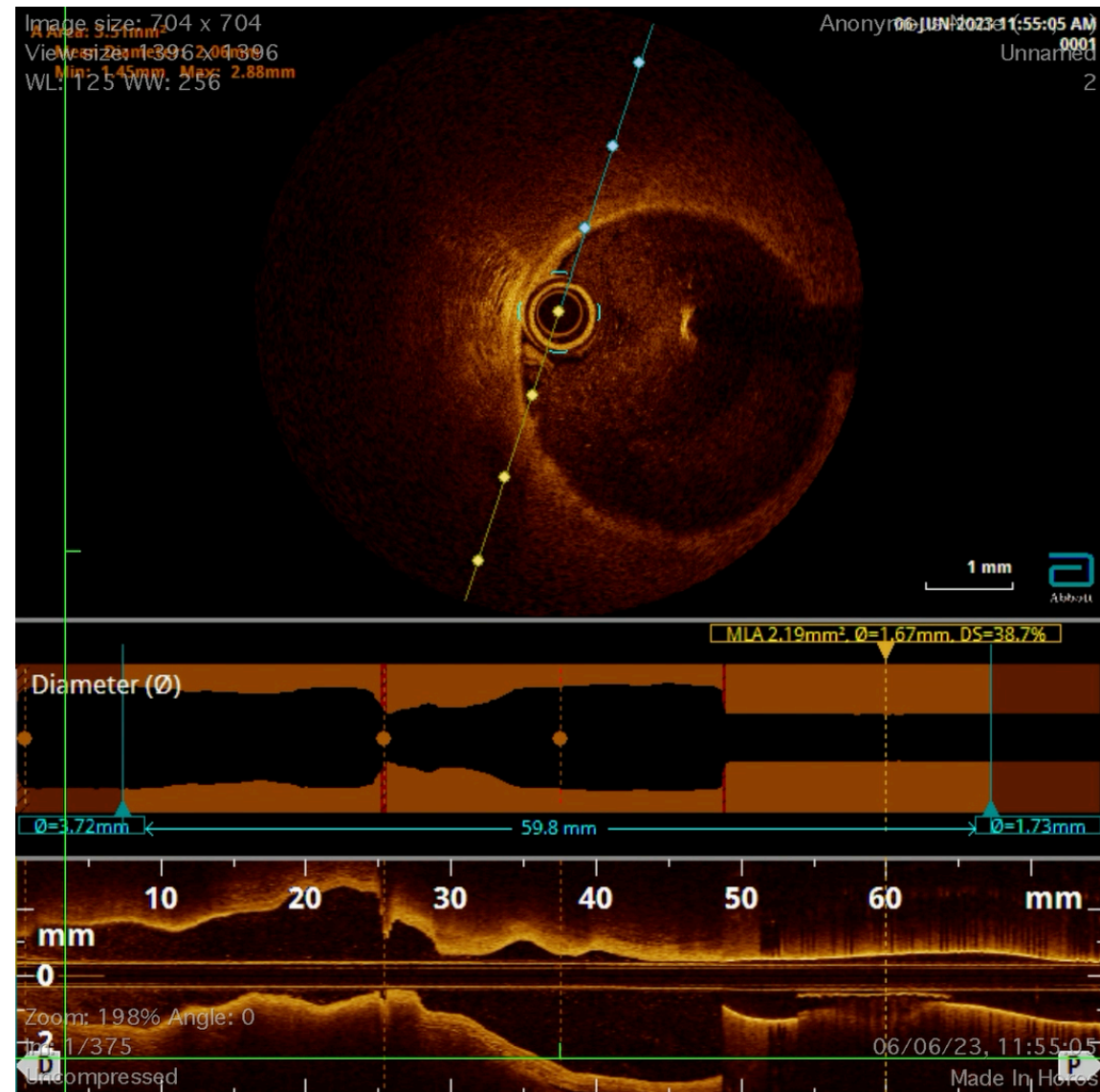
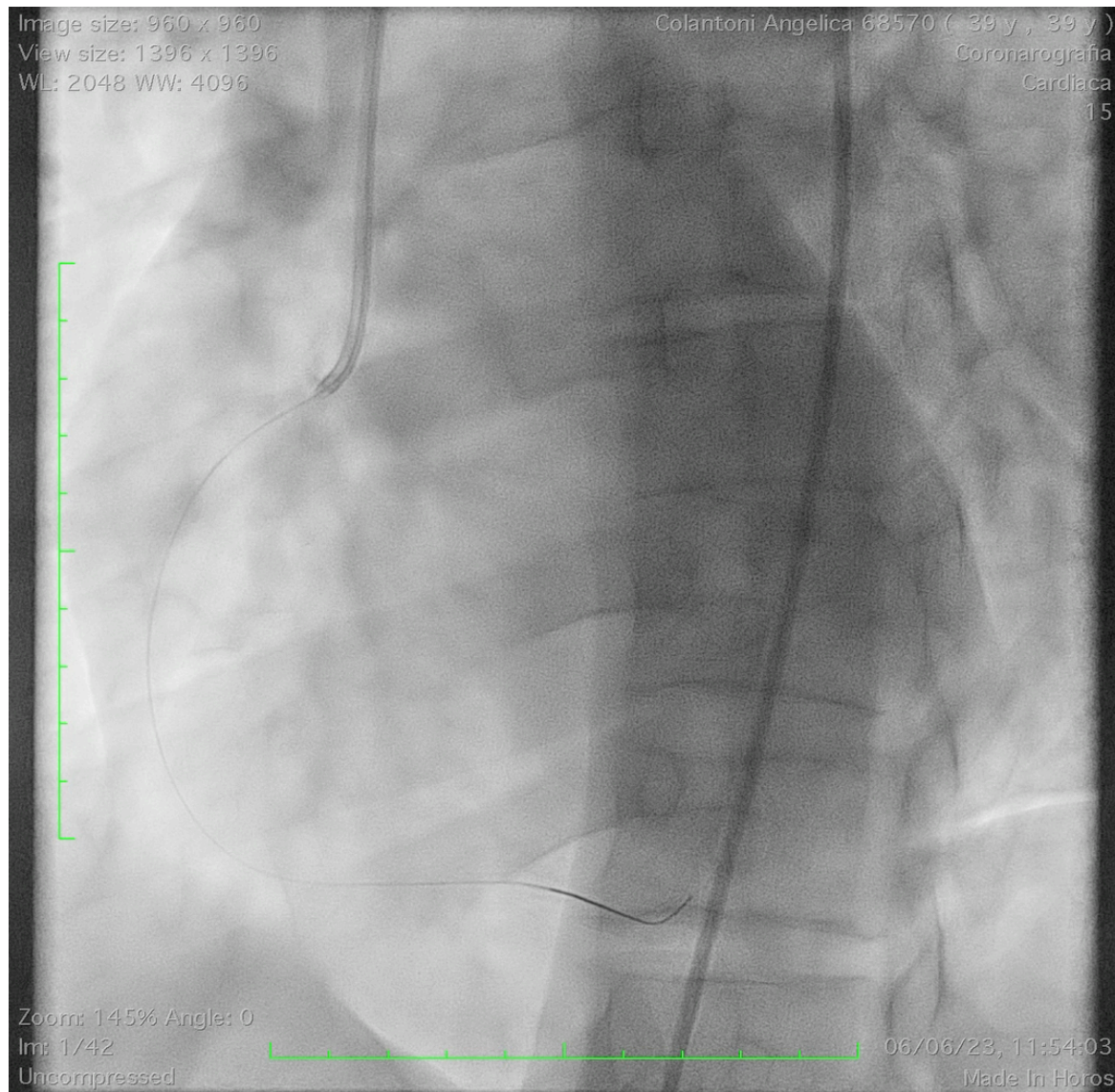
A matter of «Compliance»

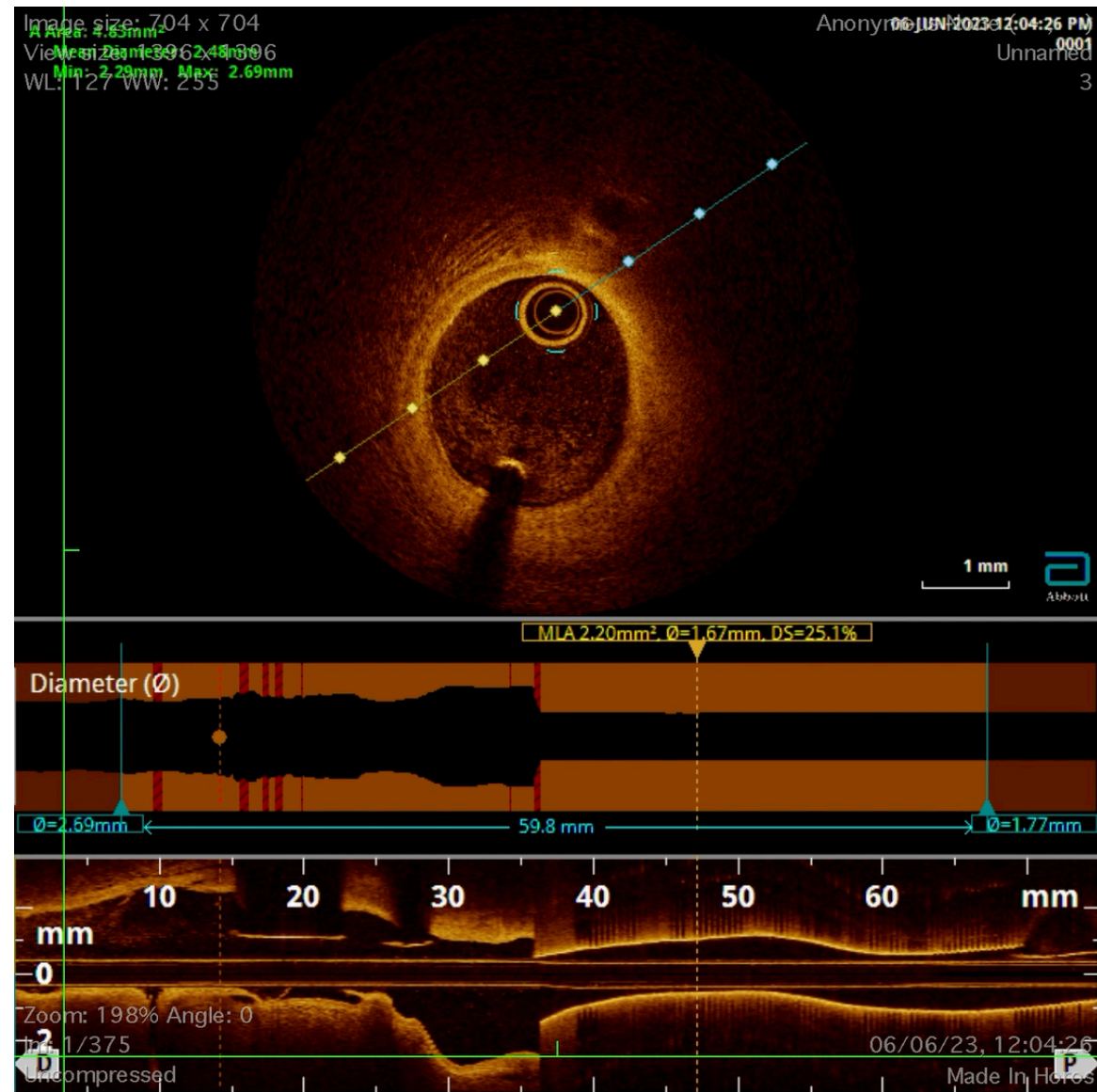
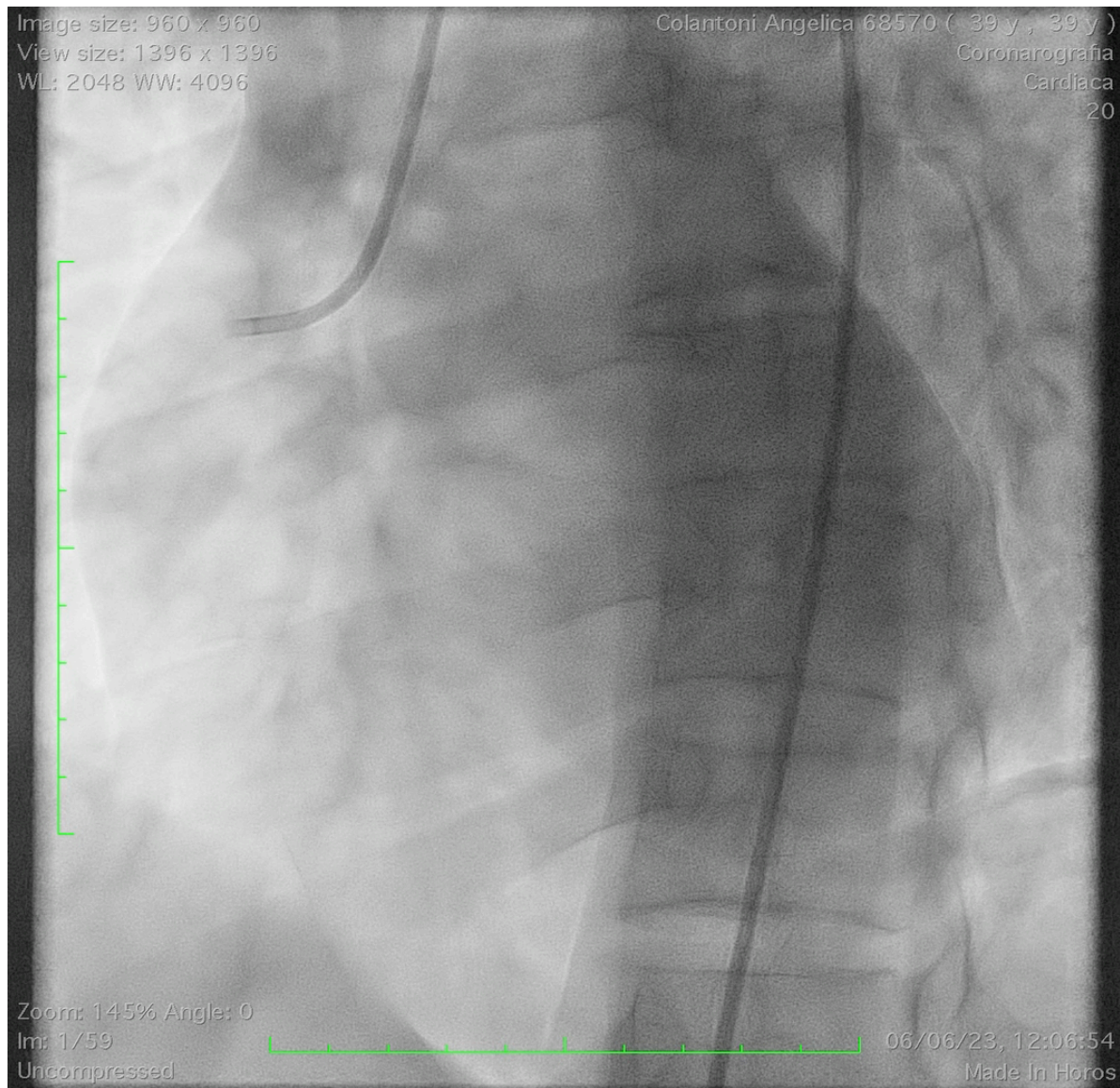
**Plaque
modification &
debulking**

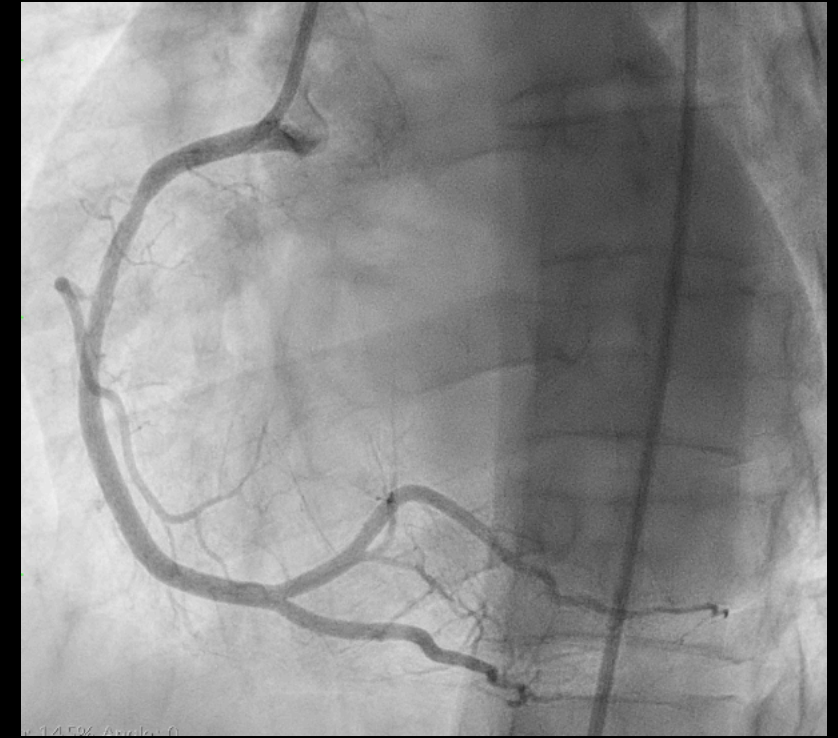
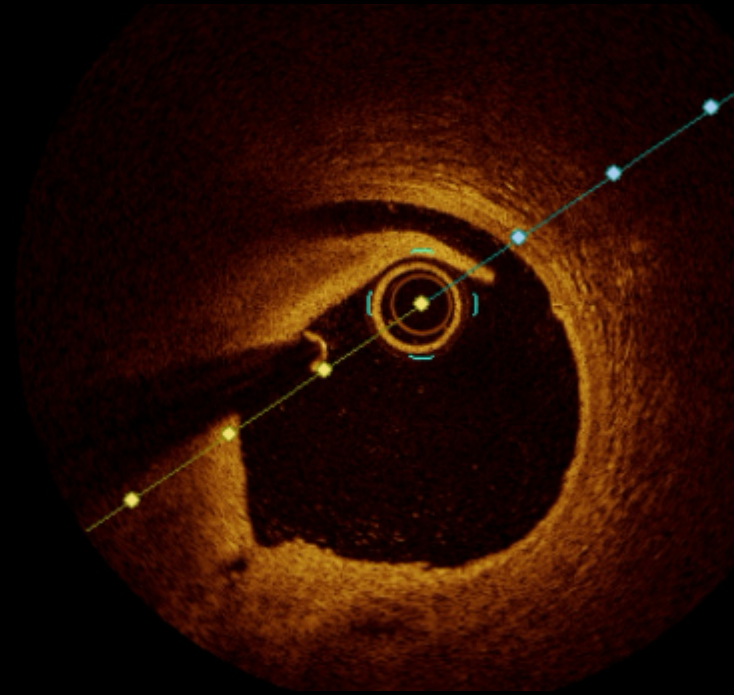
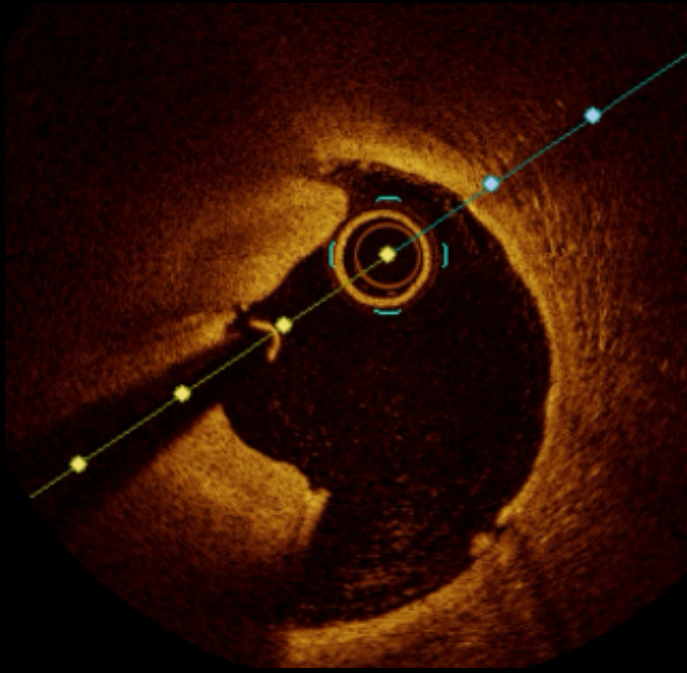
- IVL
- NC/OPN/cutting/
scoring balloon
- Orbital Atherectomy
- ELCA



Managing dissections post pre-dil







What would you do now?

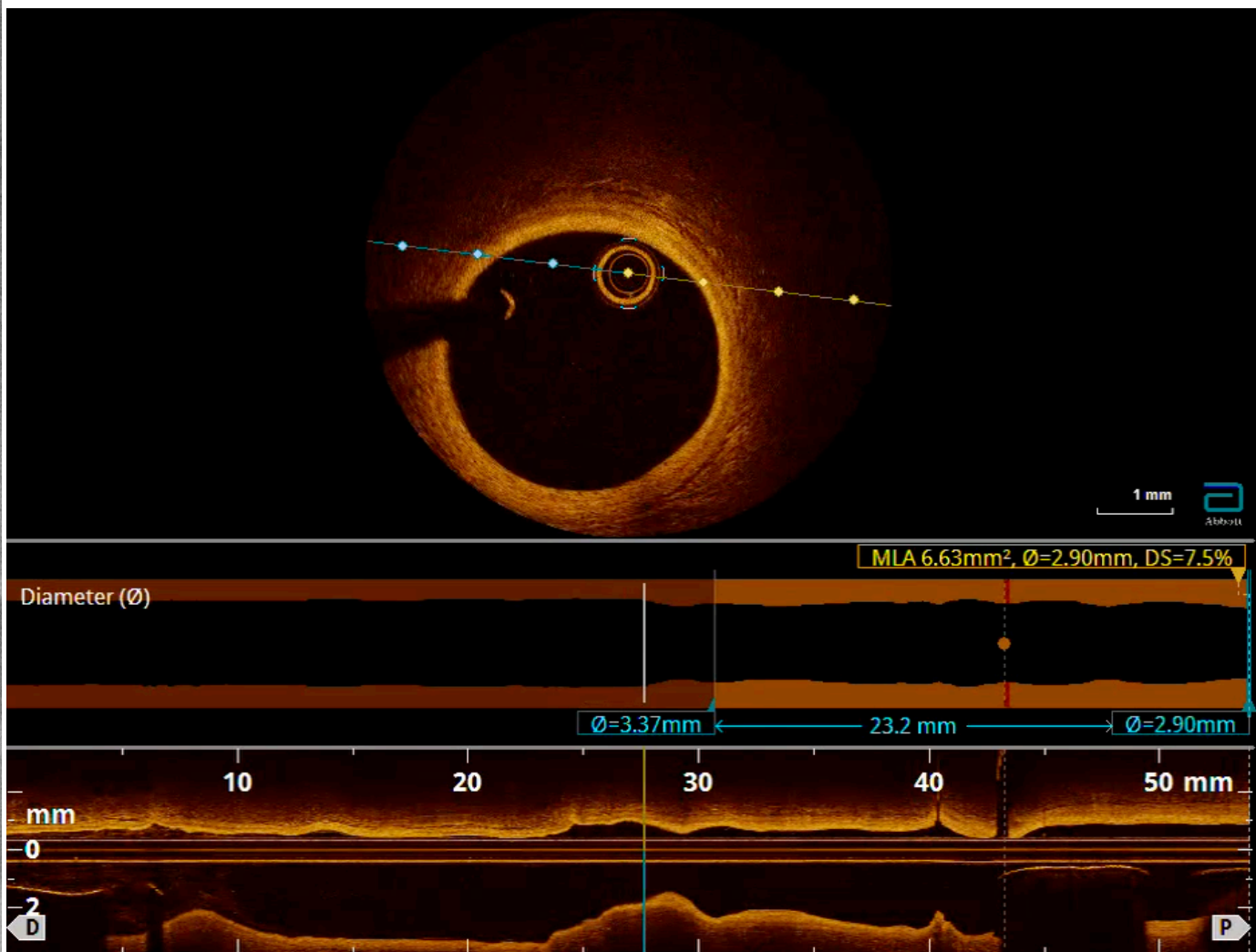
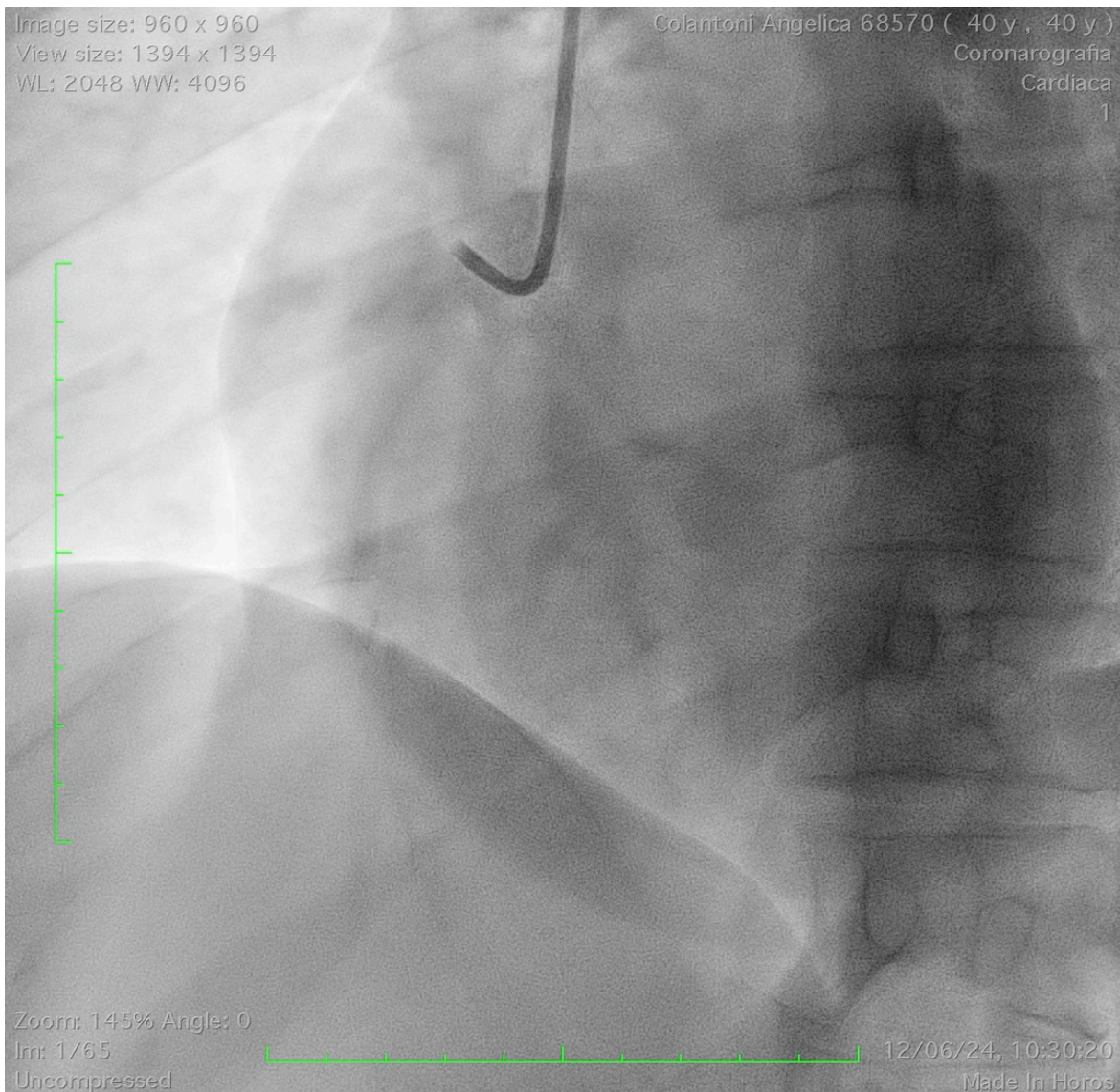
A: Stent

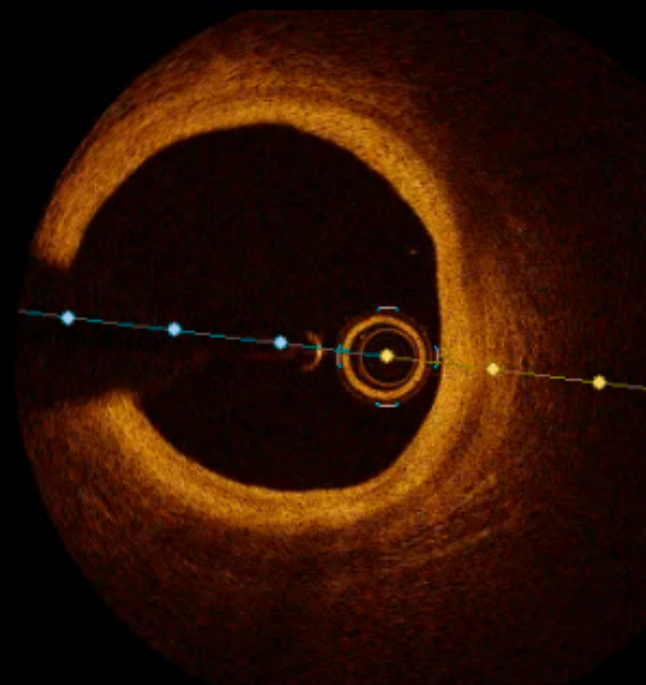
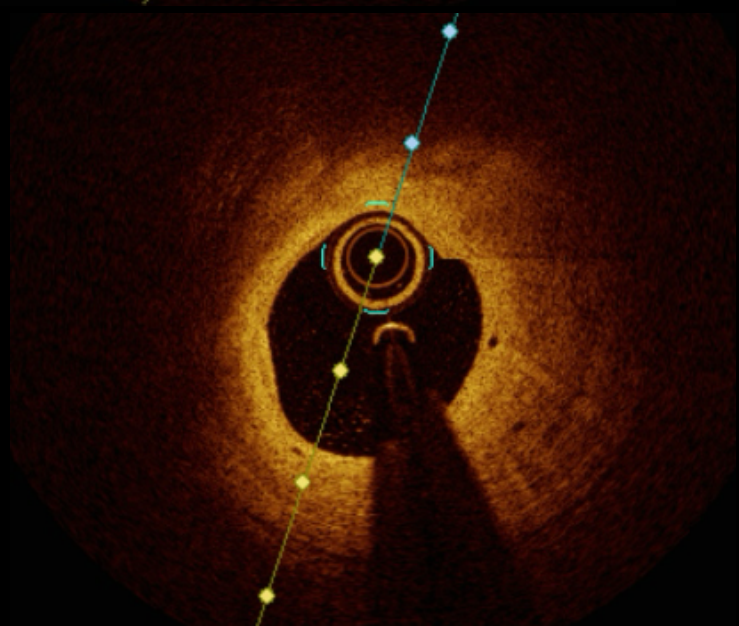
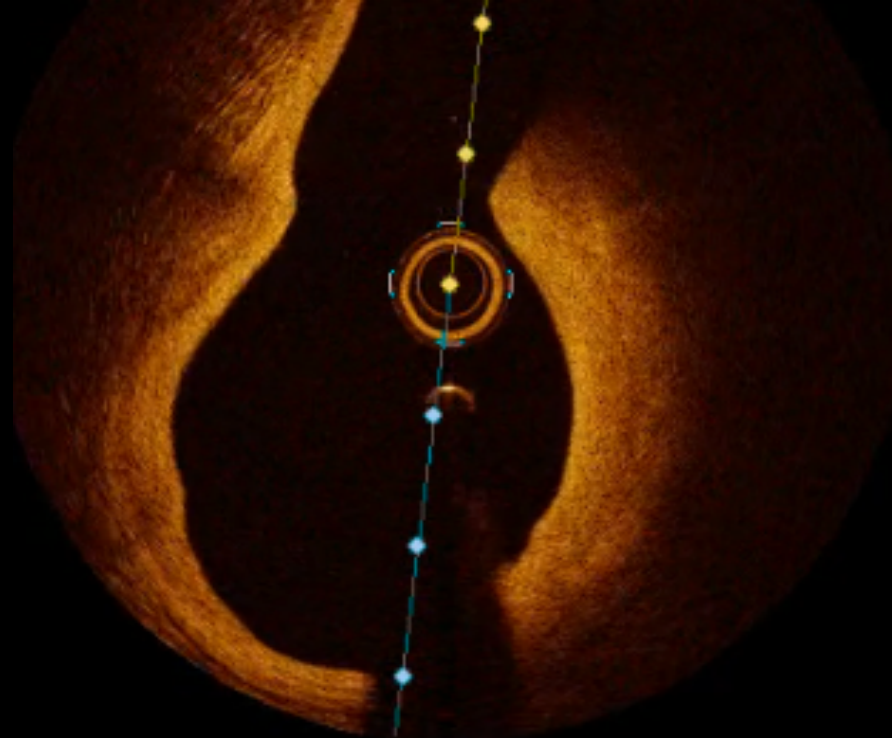
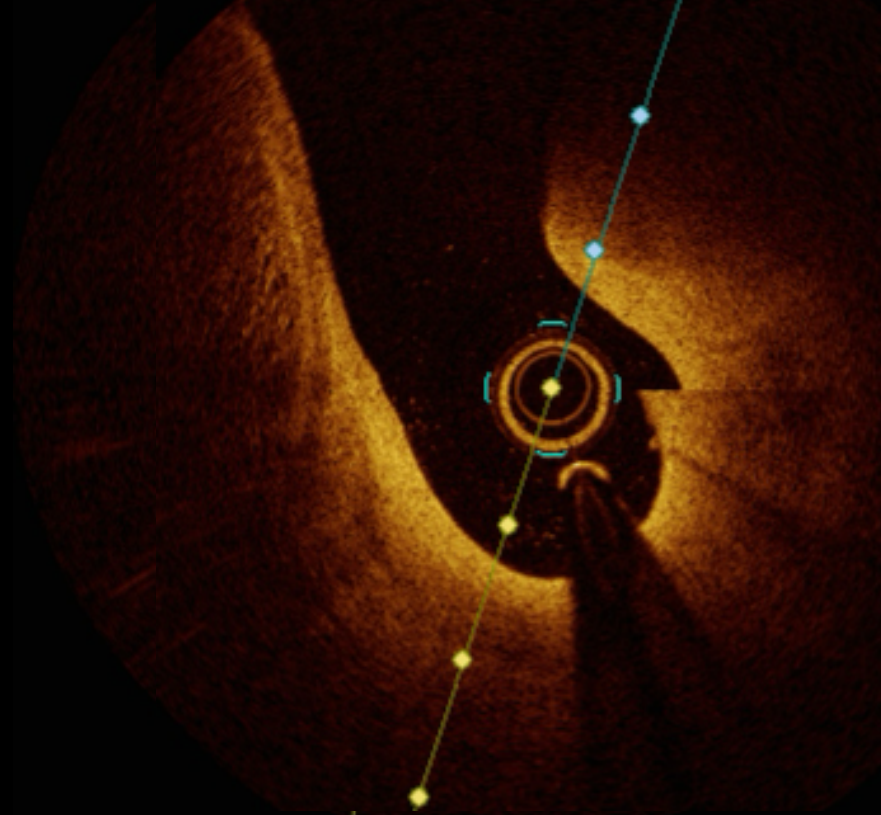
B: stop, angiographic re-evaluation

C: stop, clinical monitoring

D: other

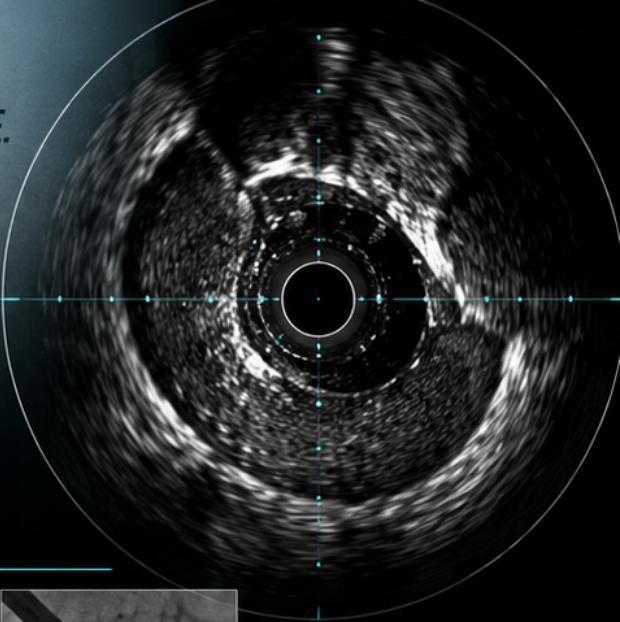






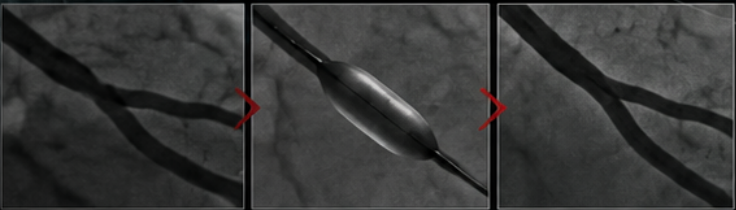


THE MISSION IS CLEAR.
THE STRATEGY IS PRECISE.
NO STENT. JUST RESULTS.



IVUS GUIDED

MLA	5.8 mm ²
EEM CSA	18.6 mm ²
PB	70%
STENOSIS	87%



DCB ONLY
DRUG COATED BALLOON
LEAVE NOTHING BEHIND

PREPARE > OPTIMIZE > DELIVER

IVUS, Calcium and DCB

MISSION: NO STENT POSSIBLE

DCB STRATEGY. IVUS GUIDANCE. SUPERIOR OUTCOMES.



IVUS GUIDED
PRECISION



DCB DELIVERY
EFFICACY



NO STENT
LEFT BEHIND



BETTER OUTCOMES
BY DESIGN

CLINICAL CASE



PATIENT

Male, 71 years old



COMORBIDITIES

- Hypertension
- Dyslipidemia



PAST CARDIAC HISTORY

Multiple previous coronary angiographies with stenting of the LAD and LCx.



SYMPTOM

Stable effort angina (CCS class II–III)



OTHER FINDINGS

Resting ECG: no acute ischemic changes.
Echocardiogram: LVEF 55%, no significant valvular disease.



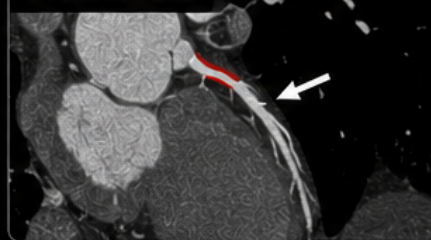
SYMPTOM ANGINA ON EXERTION

Chest discomfort during moderate exertion (e.g., walking uphill or climbing stairs).



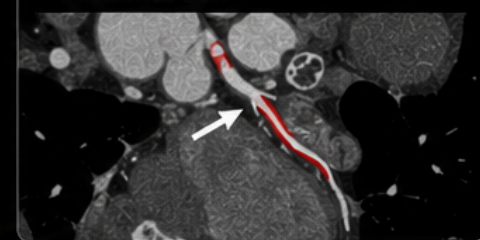
CT CORONARY ANGIOGRAPHY

Proximal LAD



Significant stenosis of the proximal LAD.

Proximal LCx



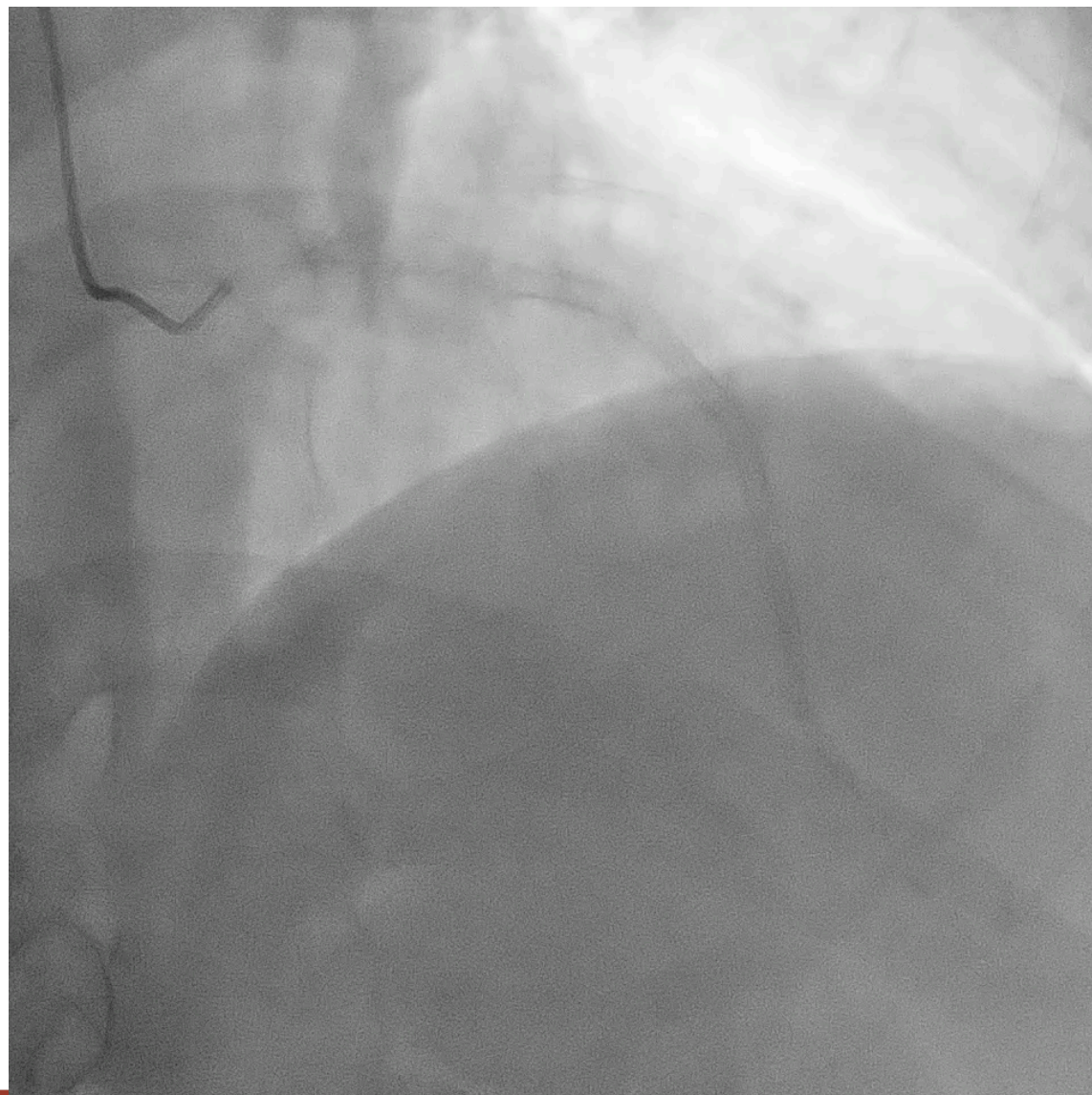
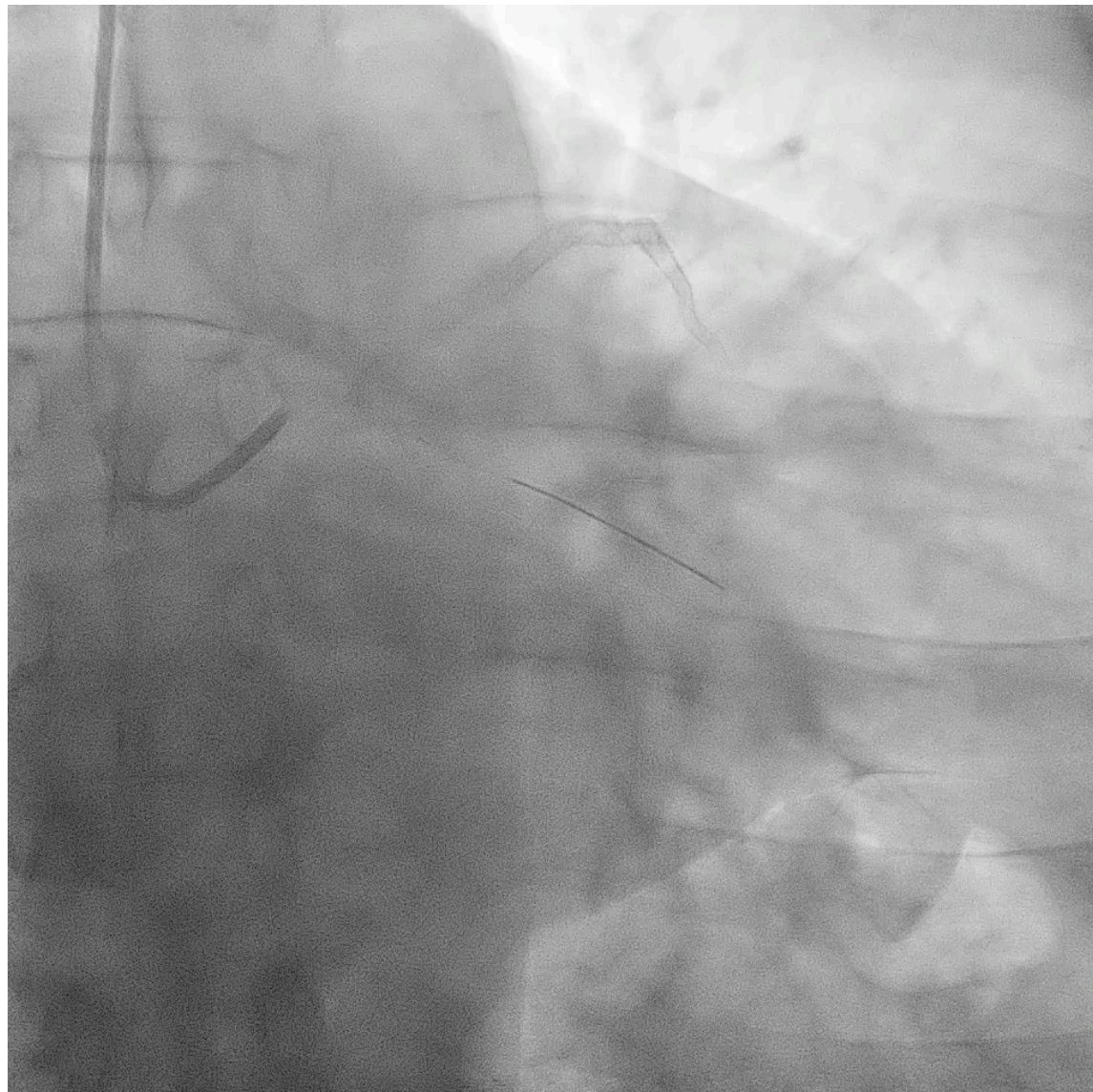
Significant stenosis of the proximal LCx.



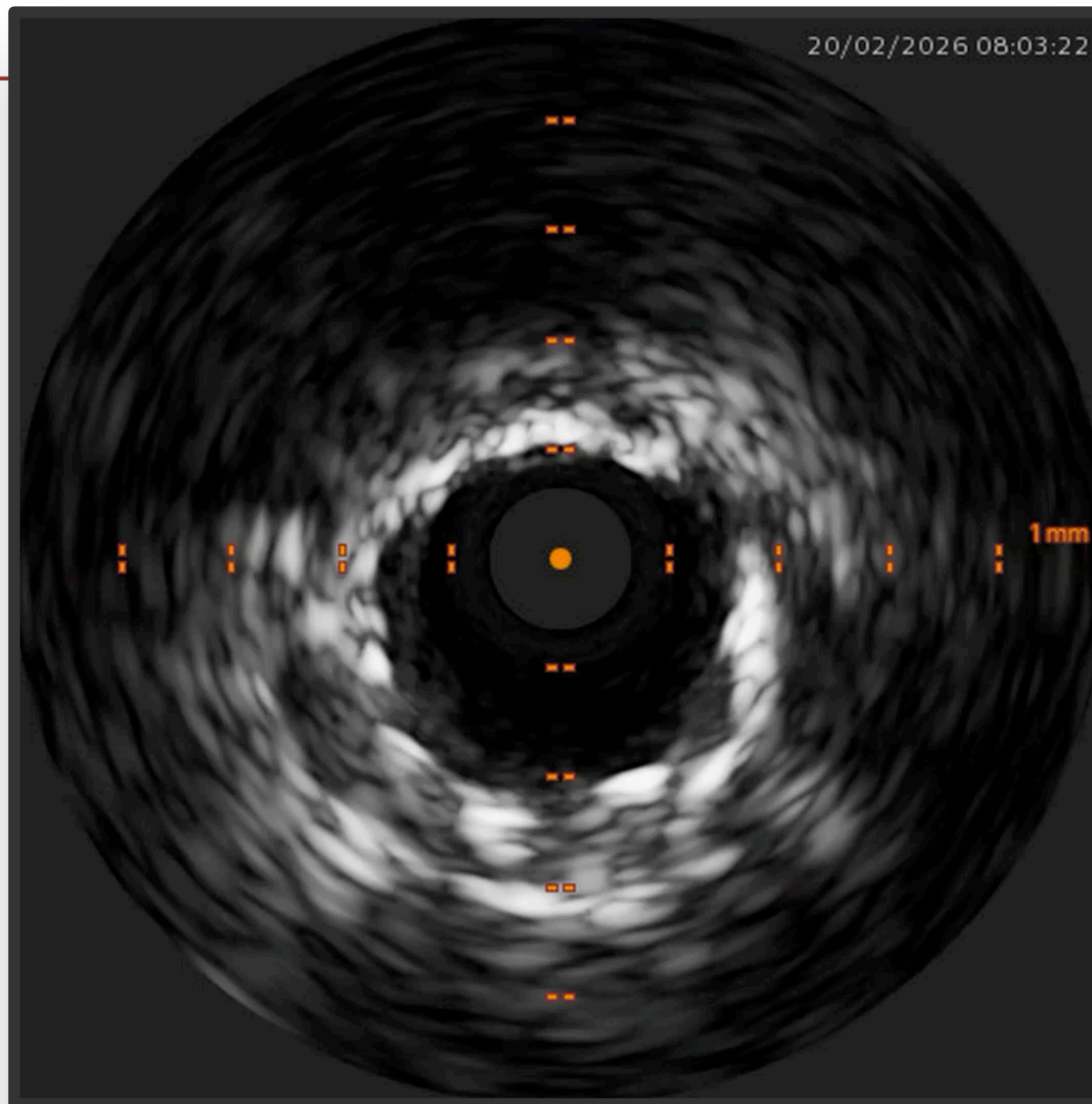
SUMMARY

CT coronary angiography shows significant stenoses in the proximal LAD and proximal LCx.

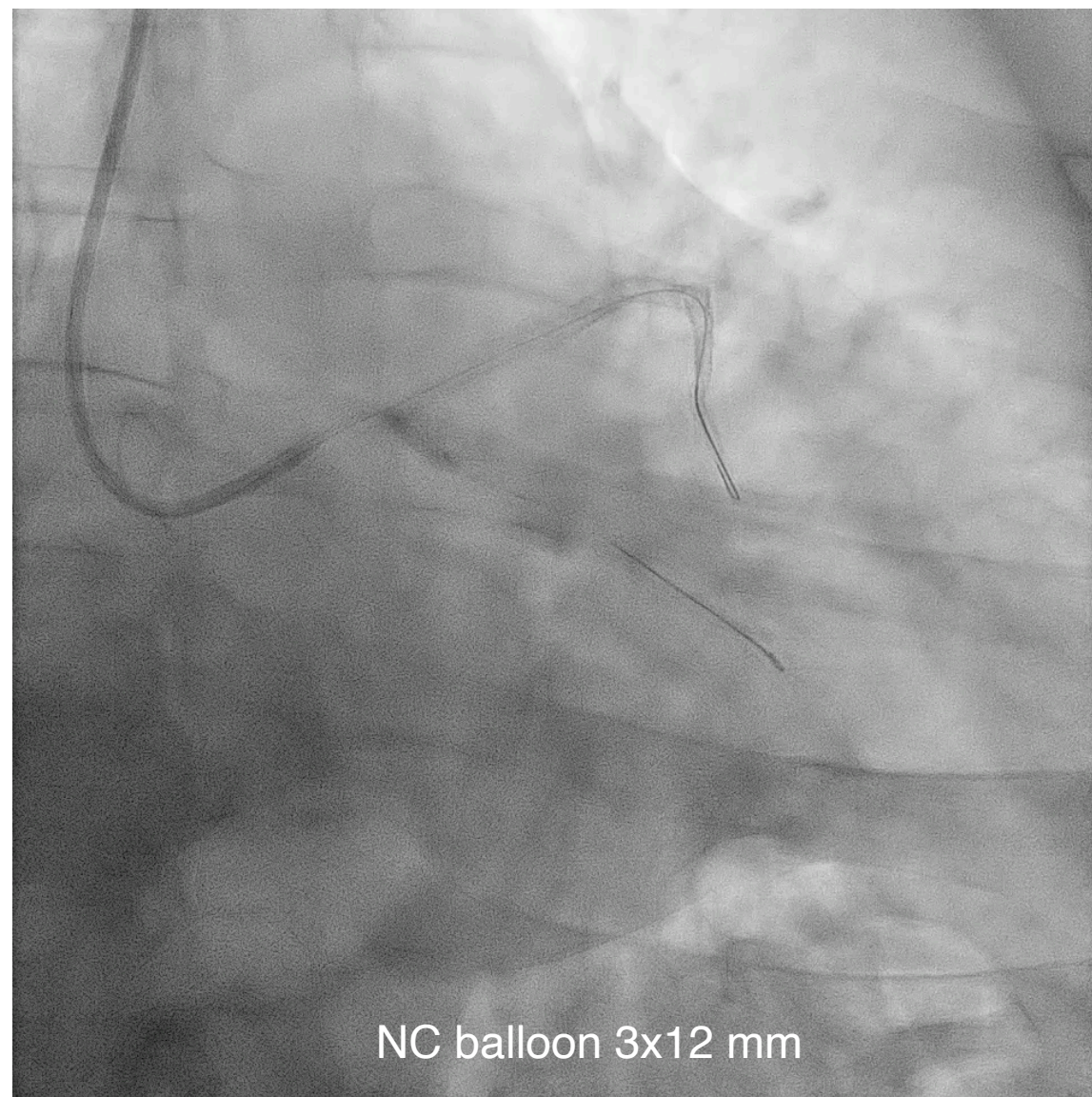
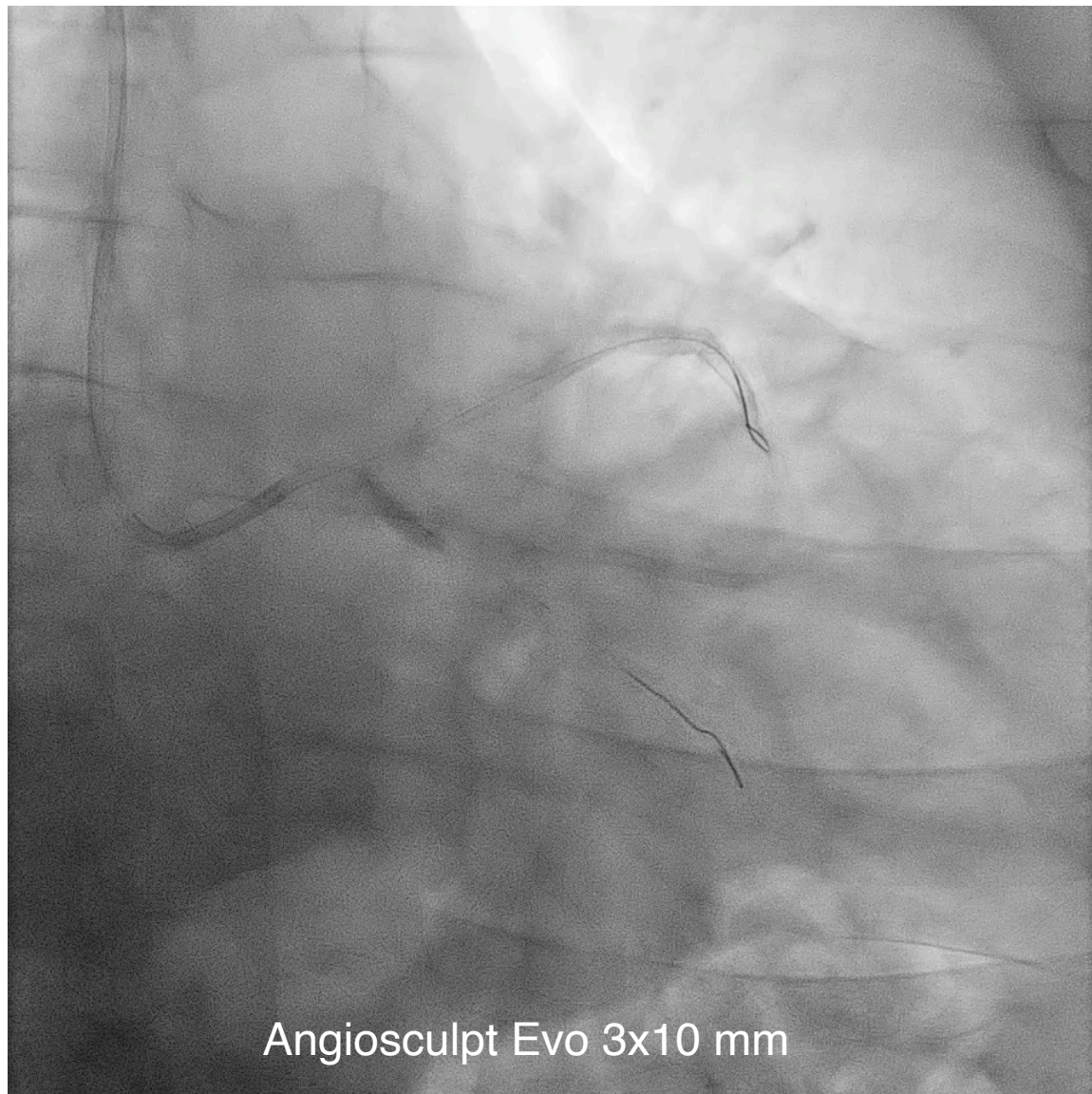
Coronary angiography



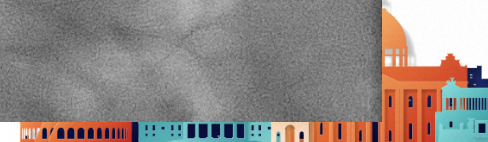
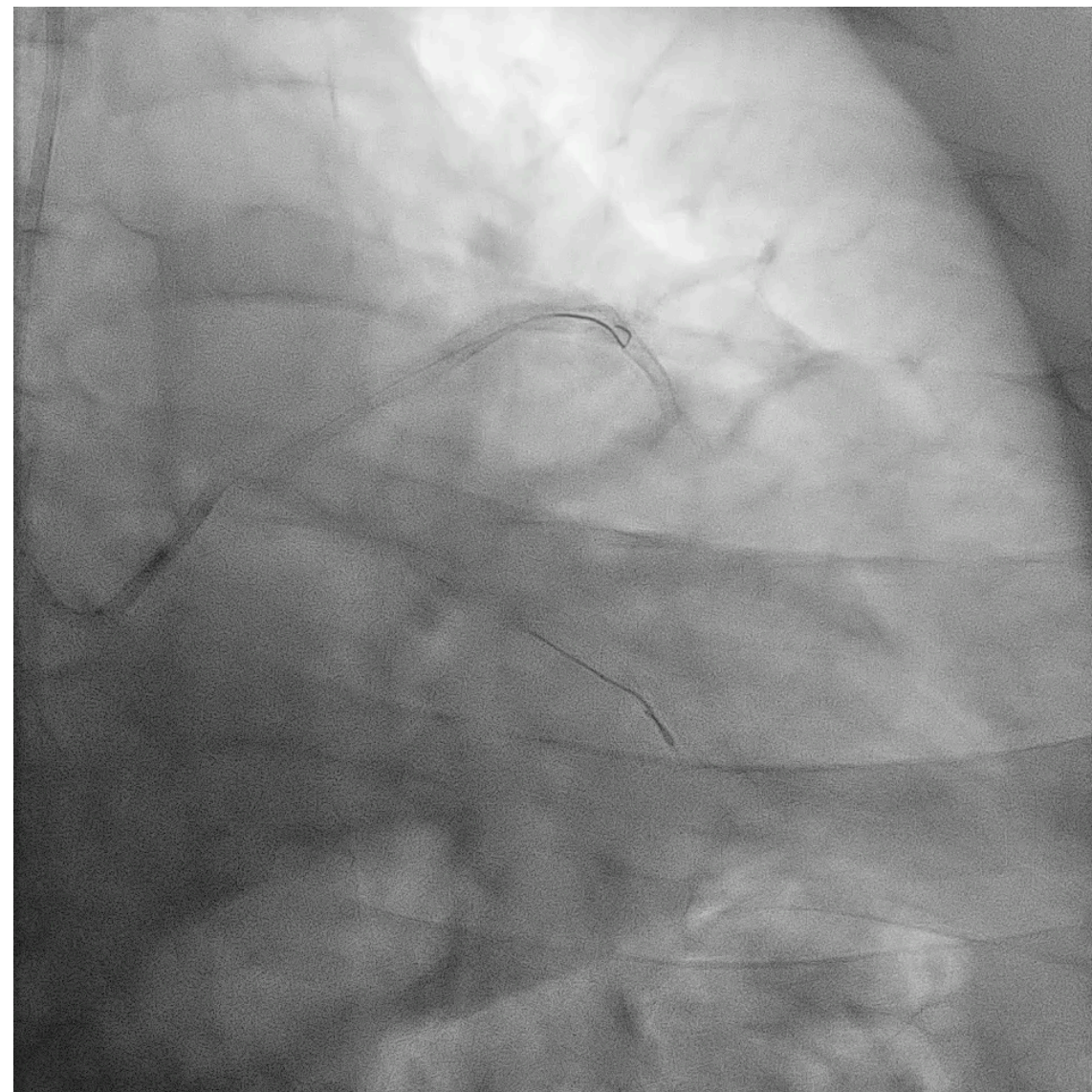
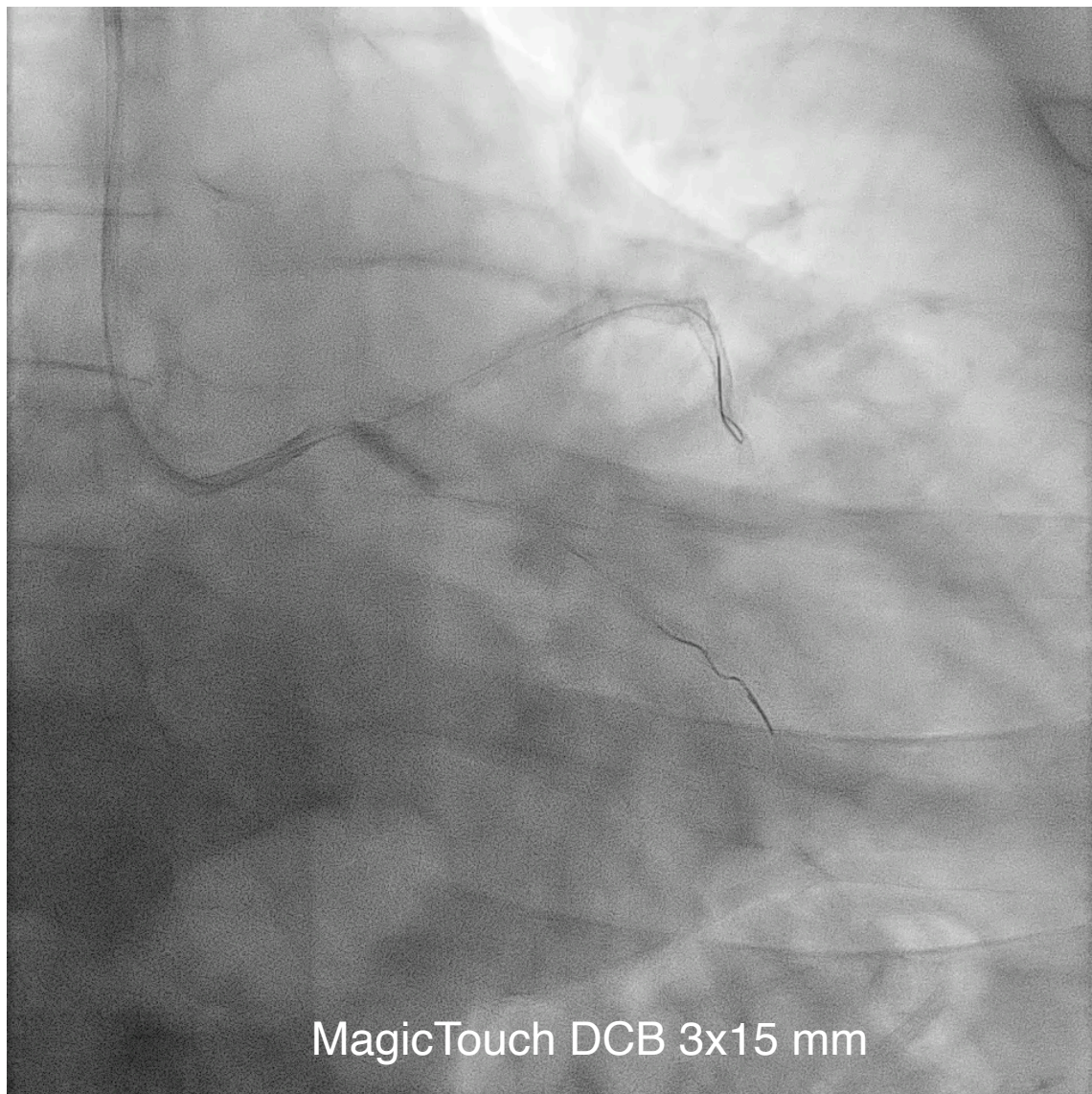
IVUS on LAD



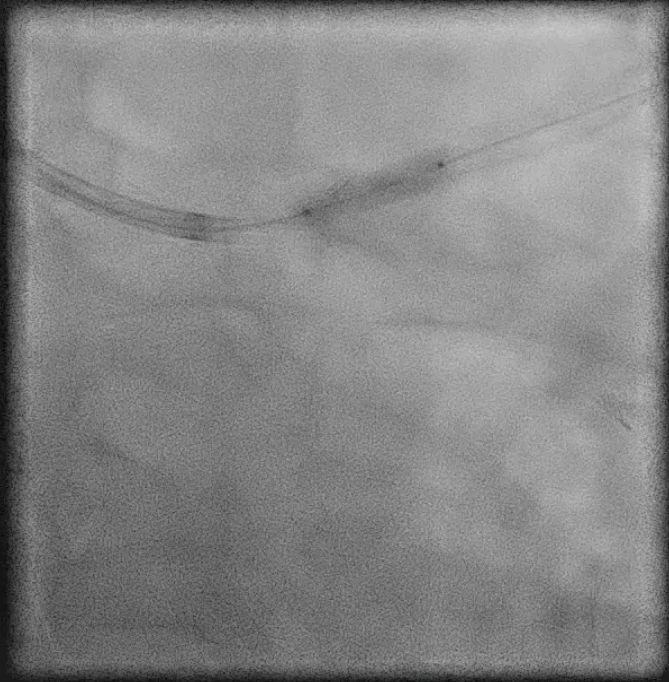
Coronary angiography



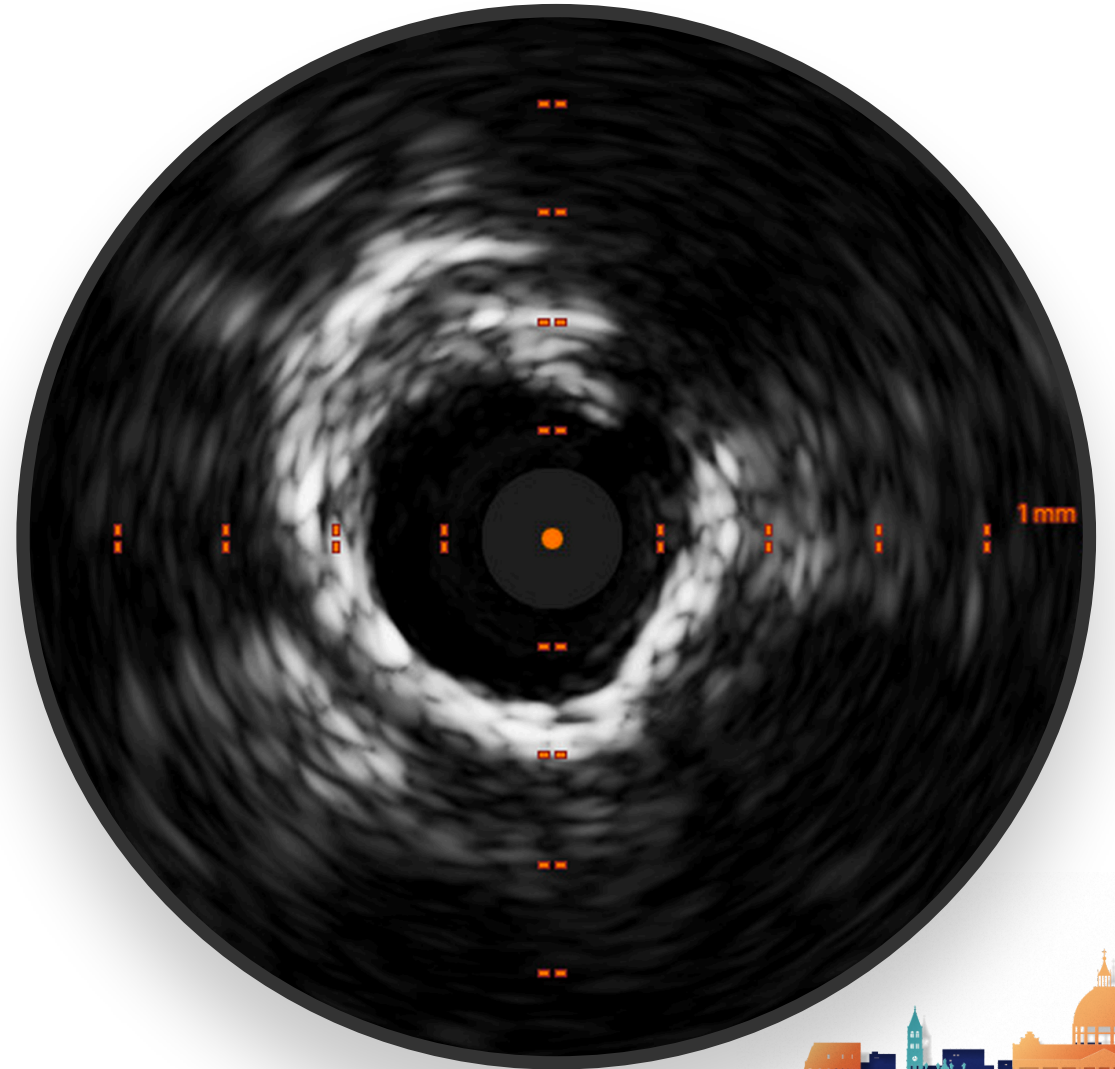
Coronary angiography



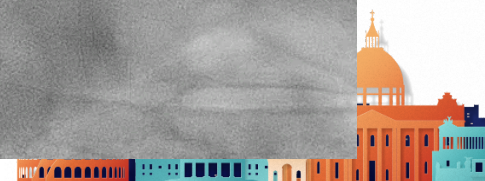
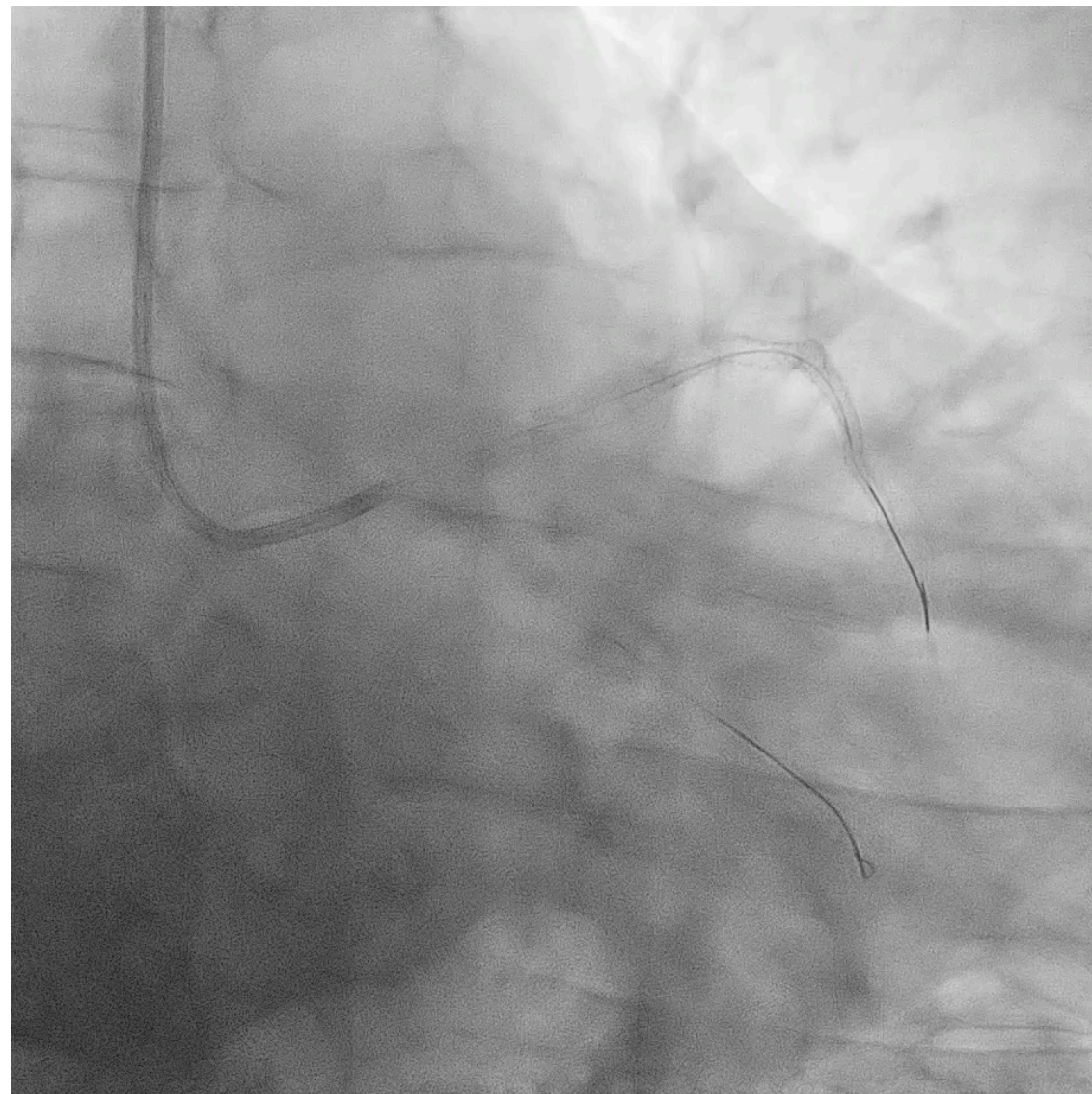
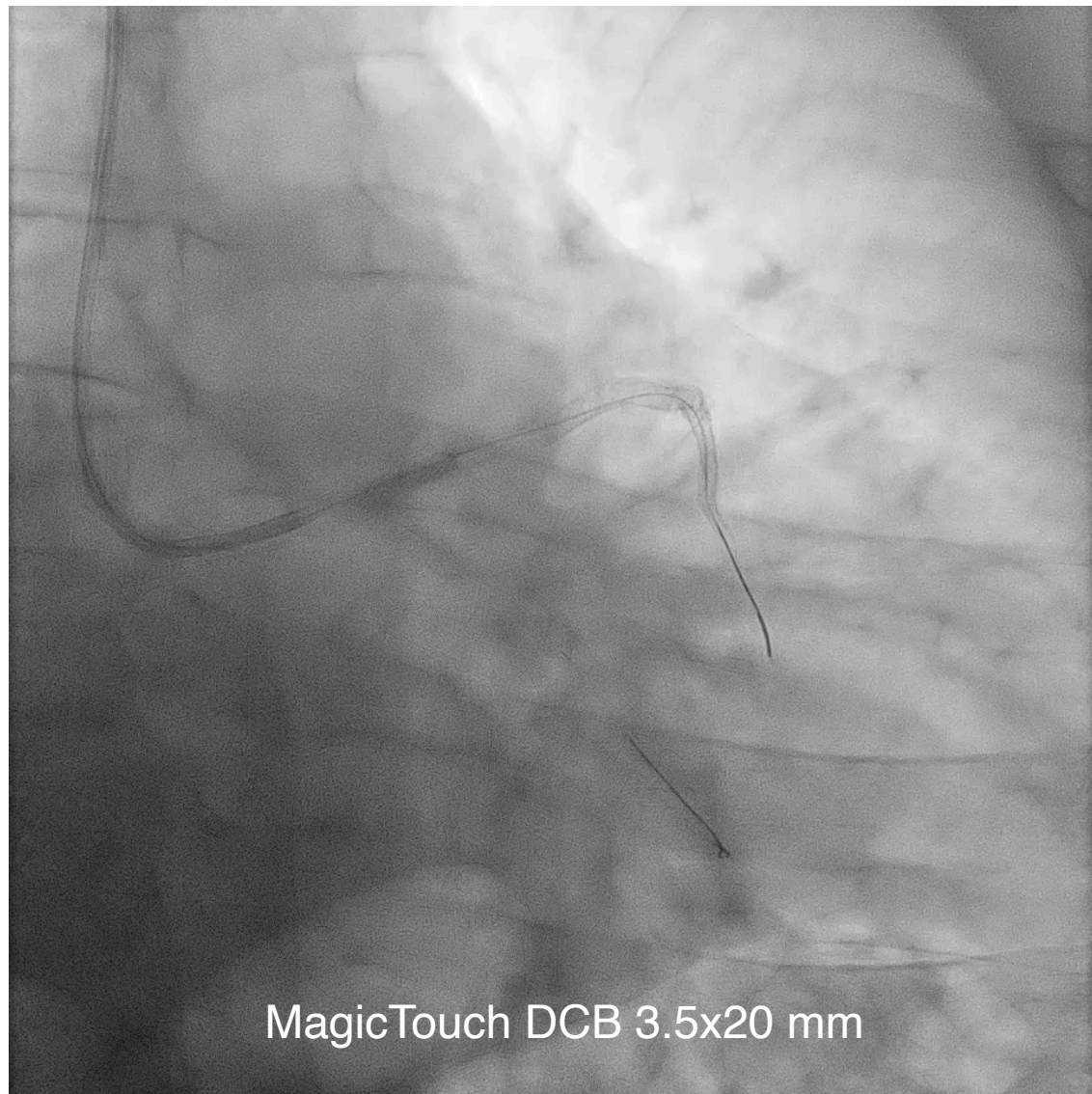
Coronary angiography



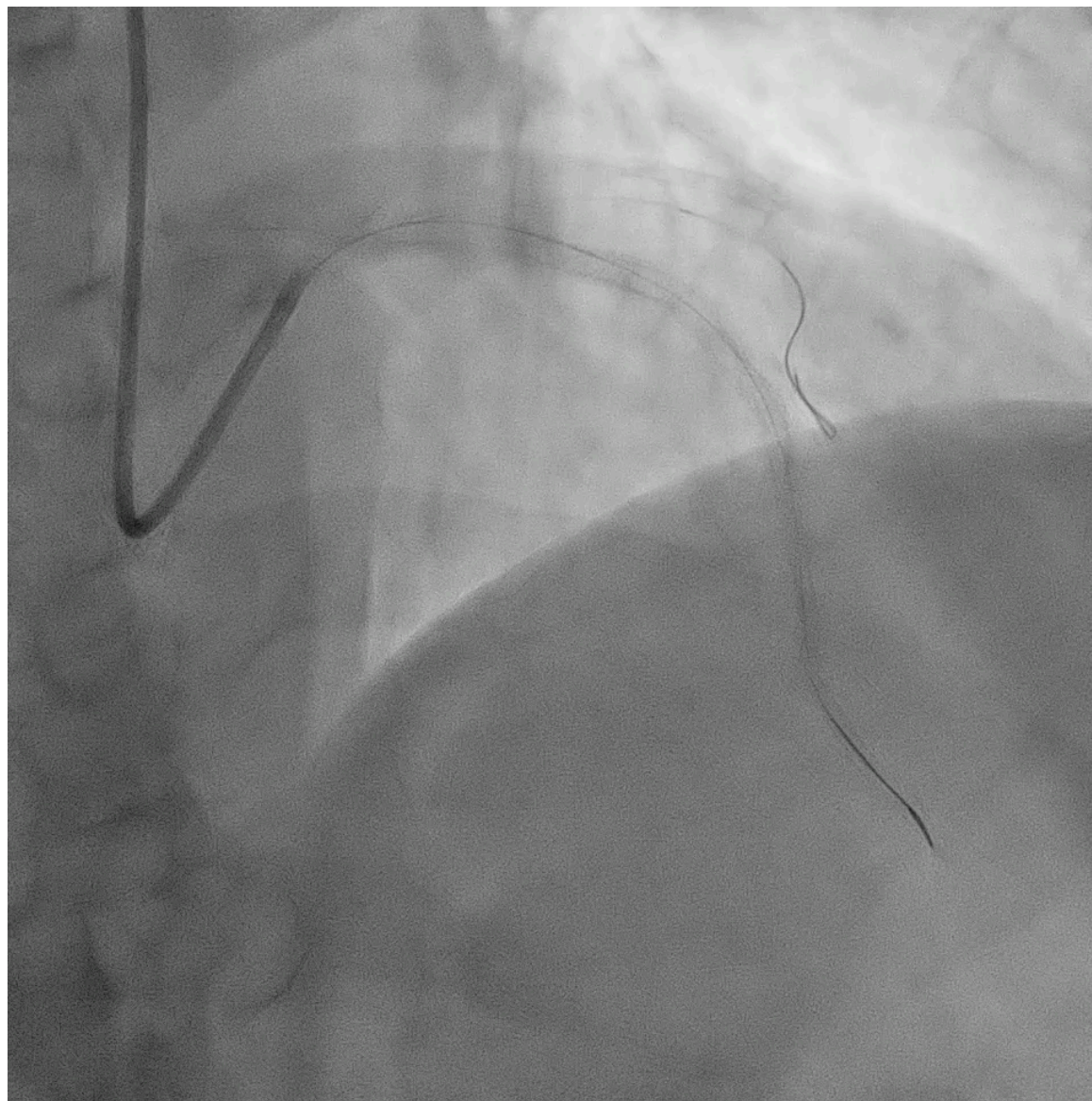
IVL Shockwave 3.5x12 mm
NC Emerge 3.5x12 mm



Coronary angiography



Coronary angiography



CASO CLINICO



PAZIENTE

Uomo, 71 anni



FATTORI DI RISCHIO

- Dislipidemia
- Ipertensione arteriosa



ANAMNESI CARDIOLOGICA

Nessuna cardiopatia
nota in anamnesi.



QUADRO CLINICO

Dispnea da sforzo
(NYHA II)



ESAMI ESEGUITI

ECG: ritmo sinusale,
nessuna alterazione
acuta del tratto ST-T.



SINTOMO
DISPNEA
DA SFORZO

Dispnea per sforzi
moderati (es. salire
una rampa di scale
o camminare in salita).



SCINTIGRAFIA MIOCARDICA DA SFORZO

Stress



Rest



Polar Map (Stress)



Difetto di perfusione reversibile in sede laterale.

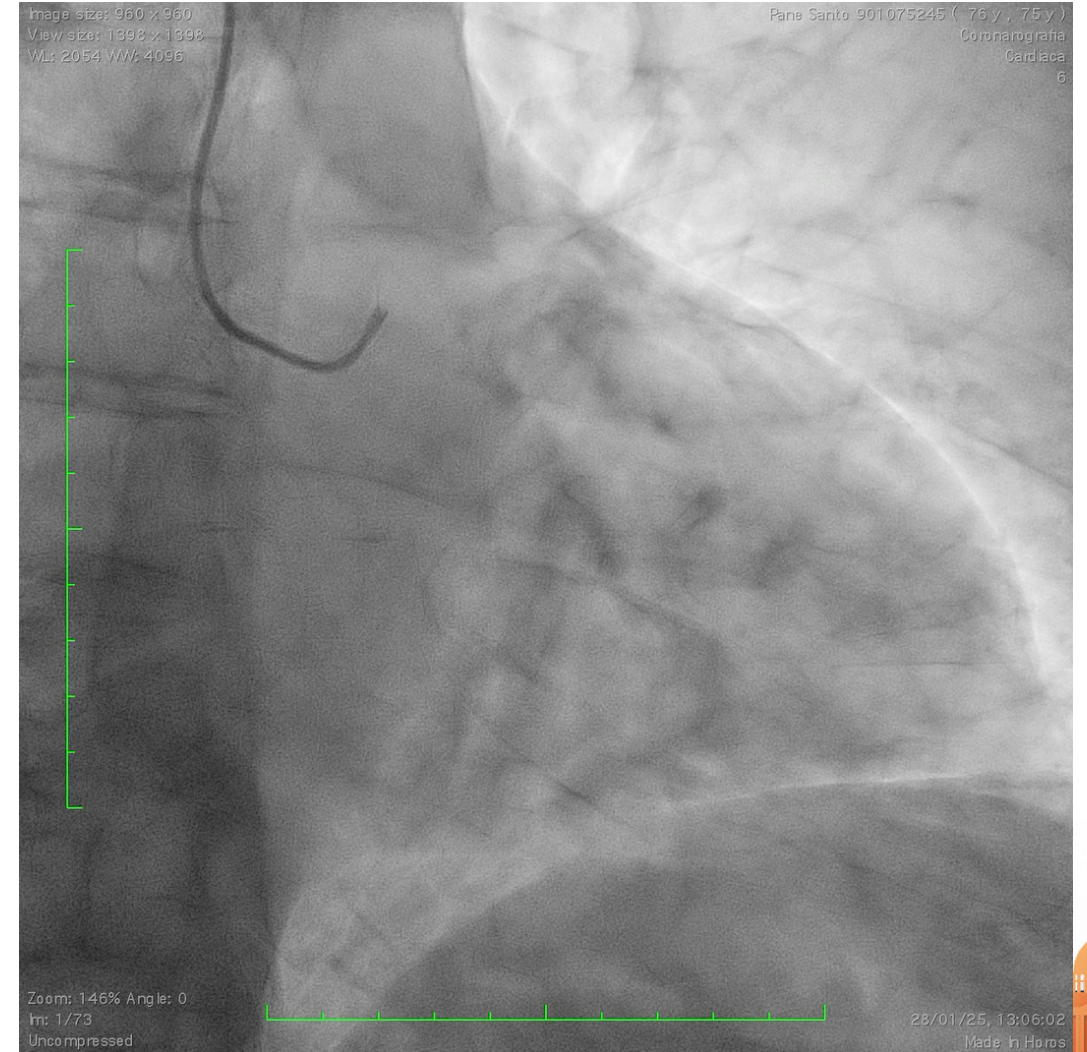
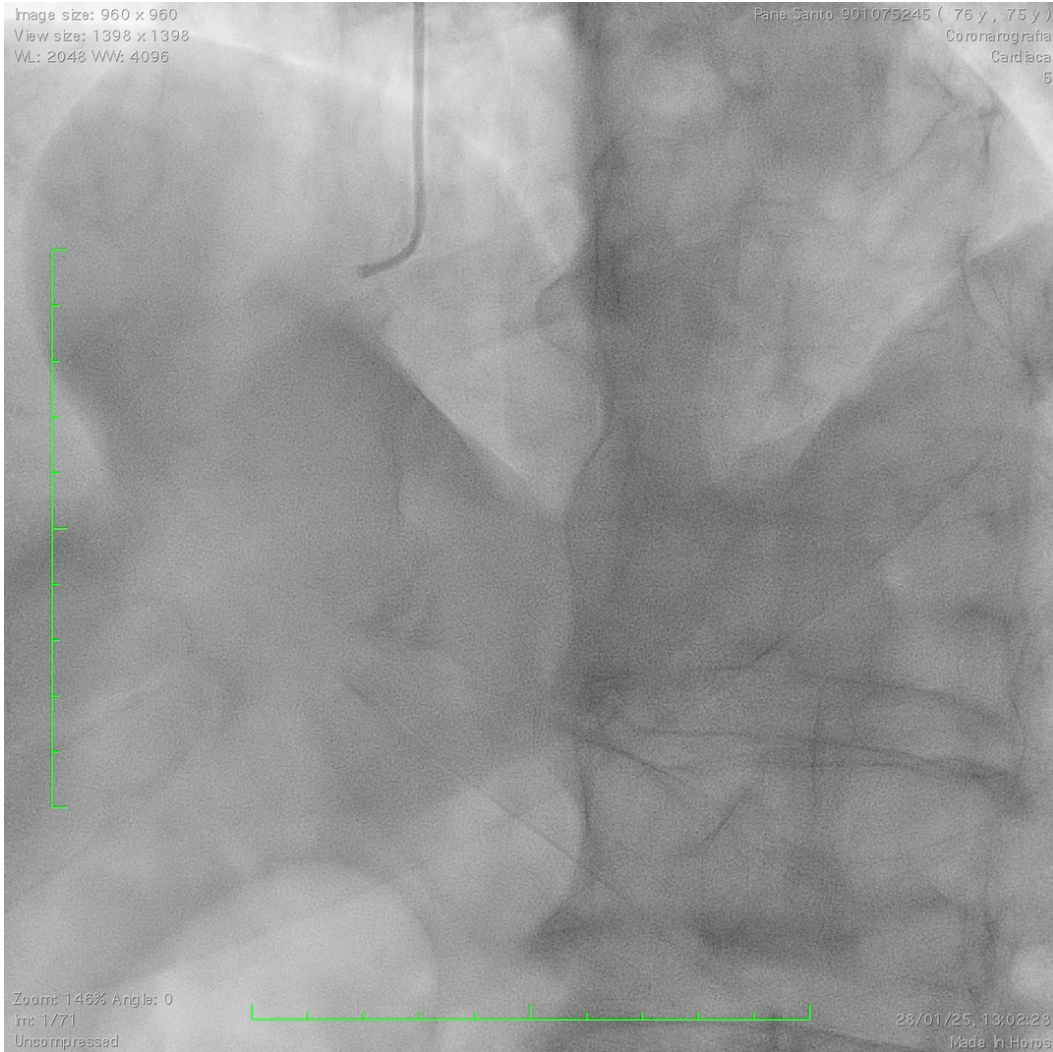
SCINTIGRAFIA POSITIVA



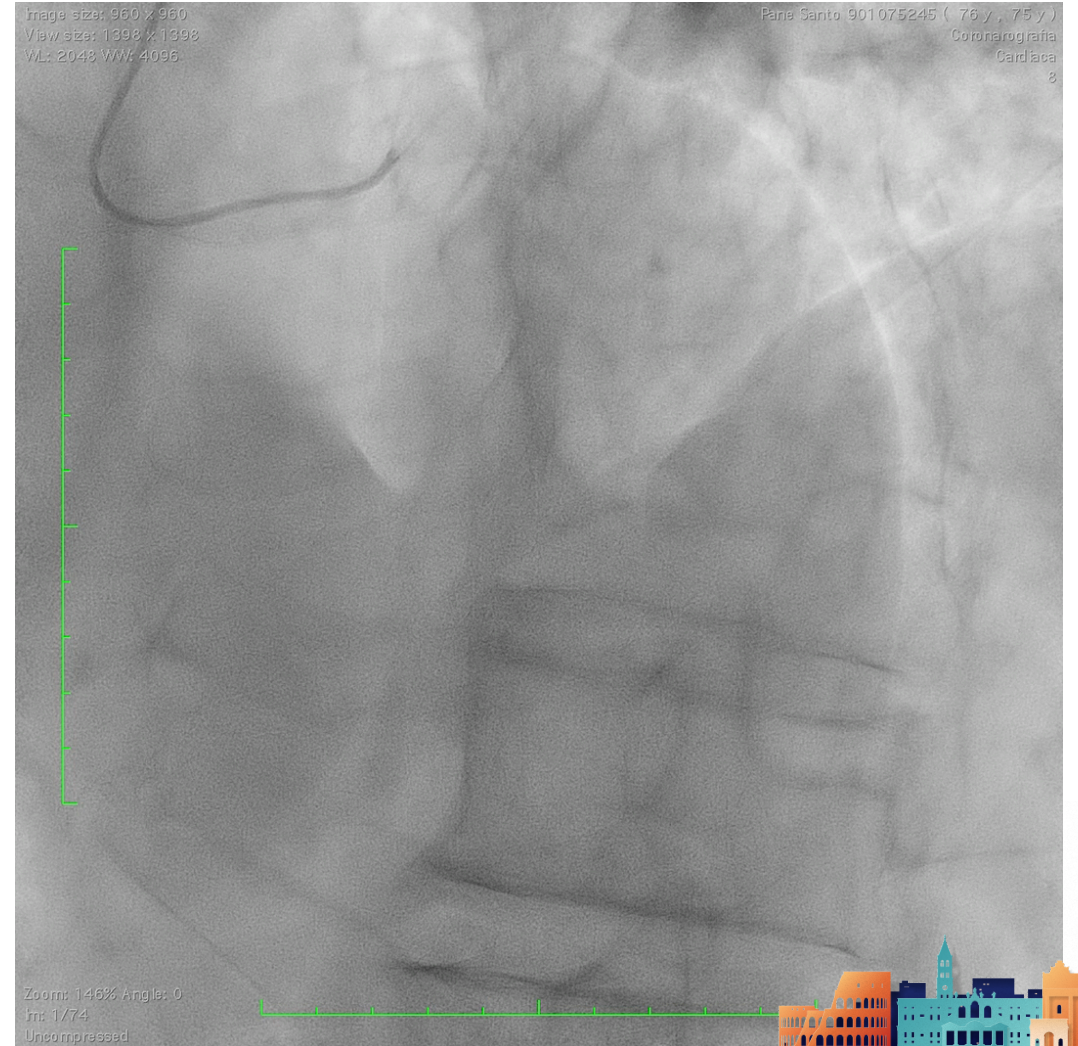
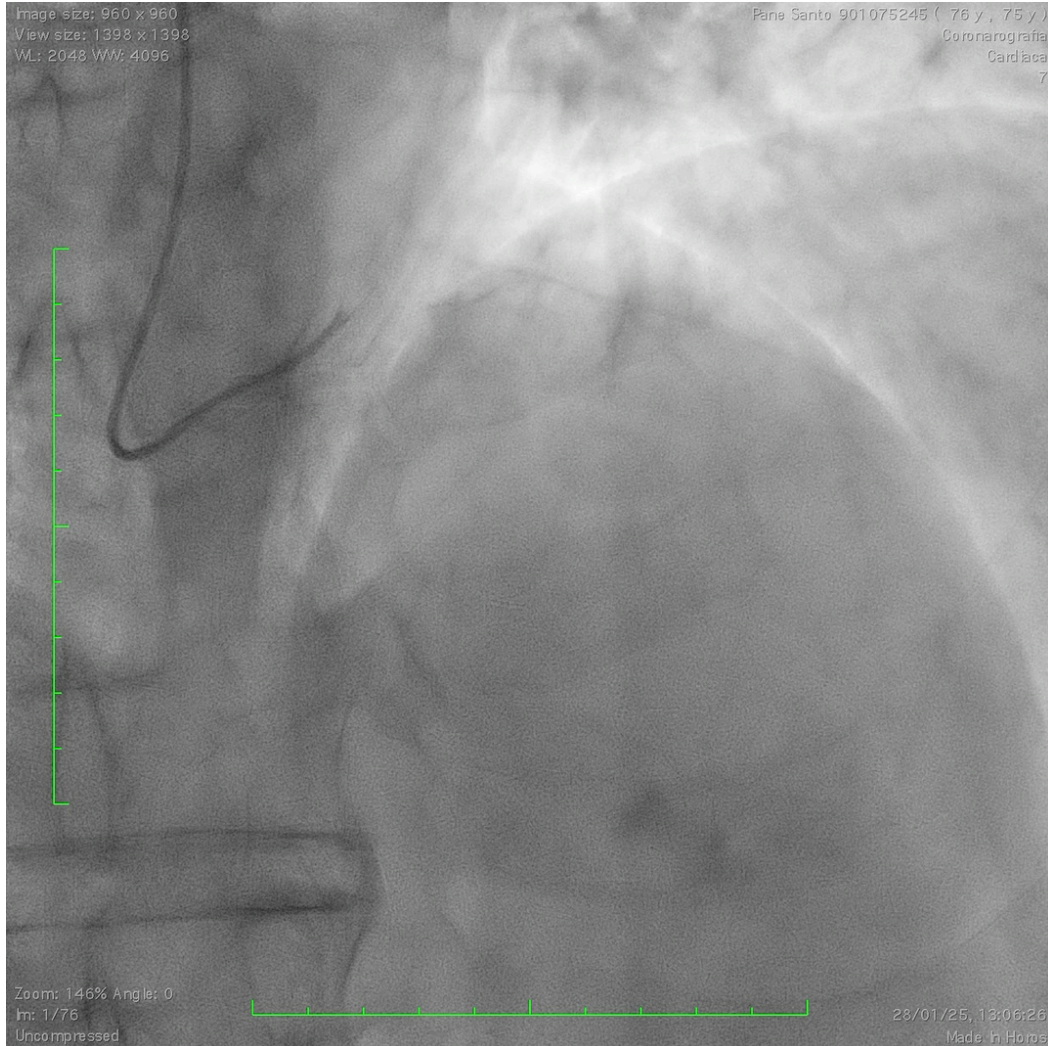
SINTESI

Paziente di 71 anni con fattori di rischio cardiovascolare,
sintomatico per dispnea da sforzo. Scintigrafia miocardica positiva in sede laterale.

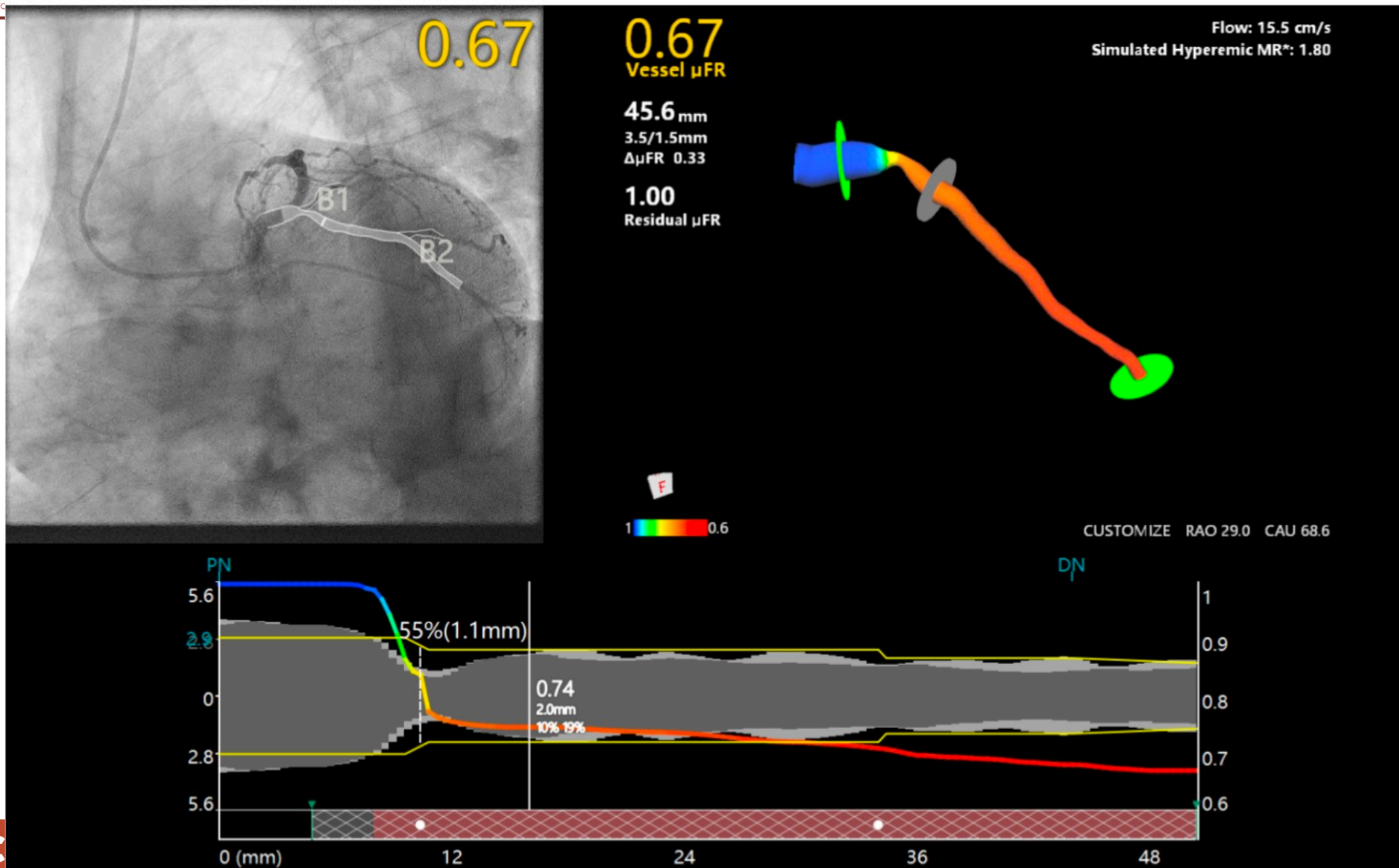
Coronary angiography



Coronary angiography



μFR-3D Results

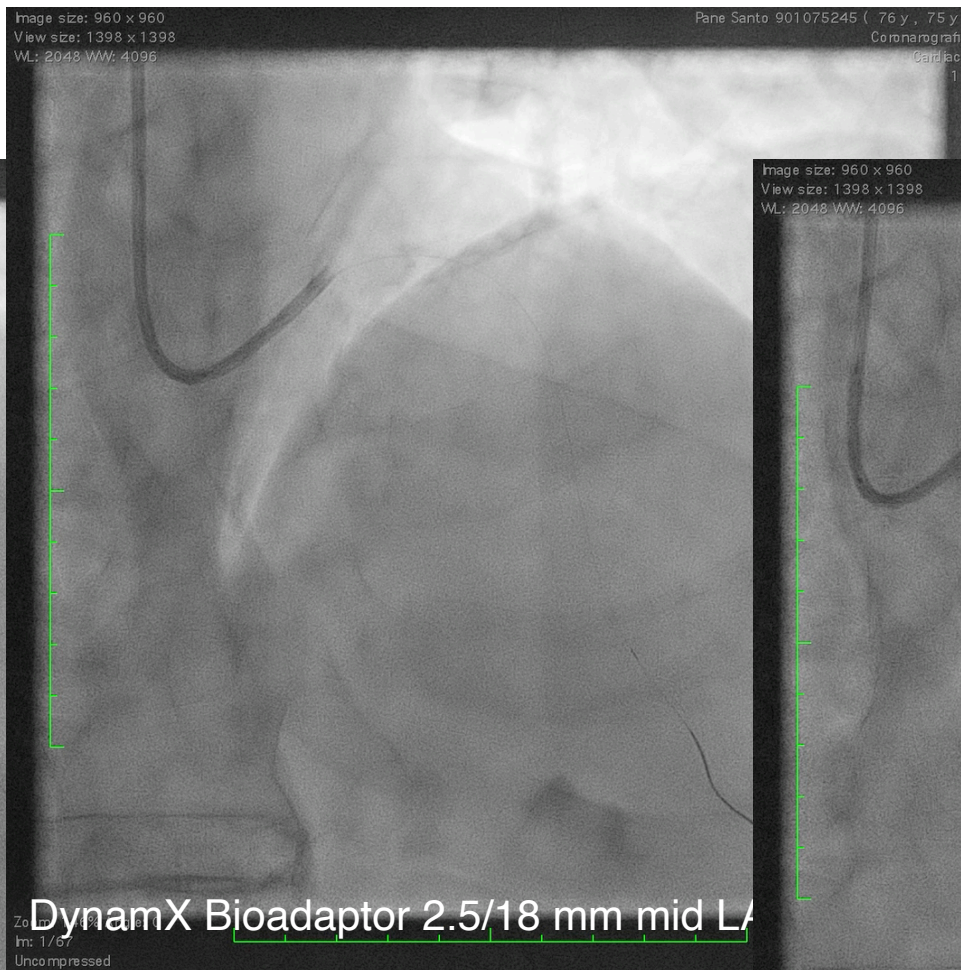


Coronary angioplasty

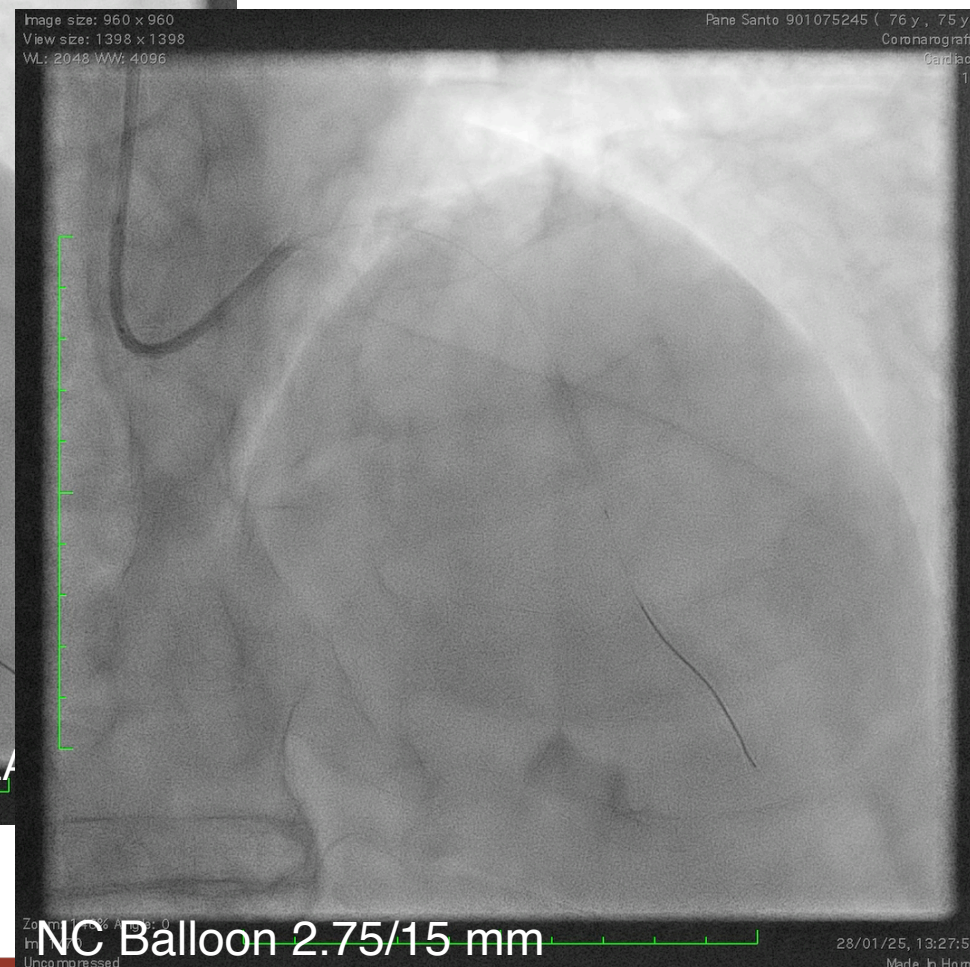
- LAD



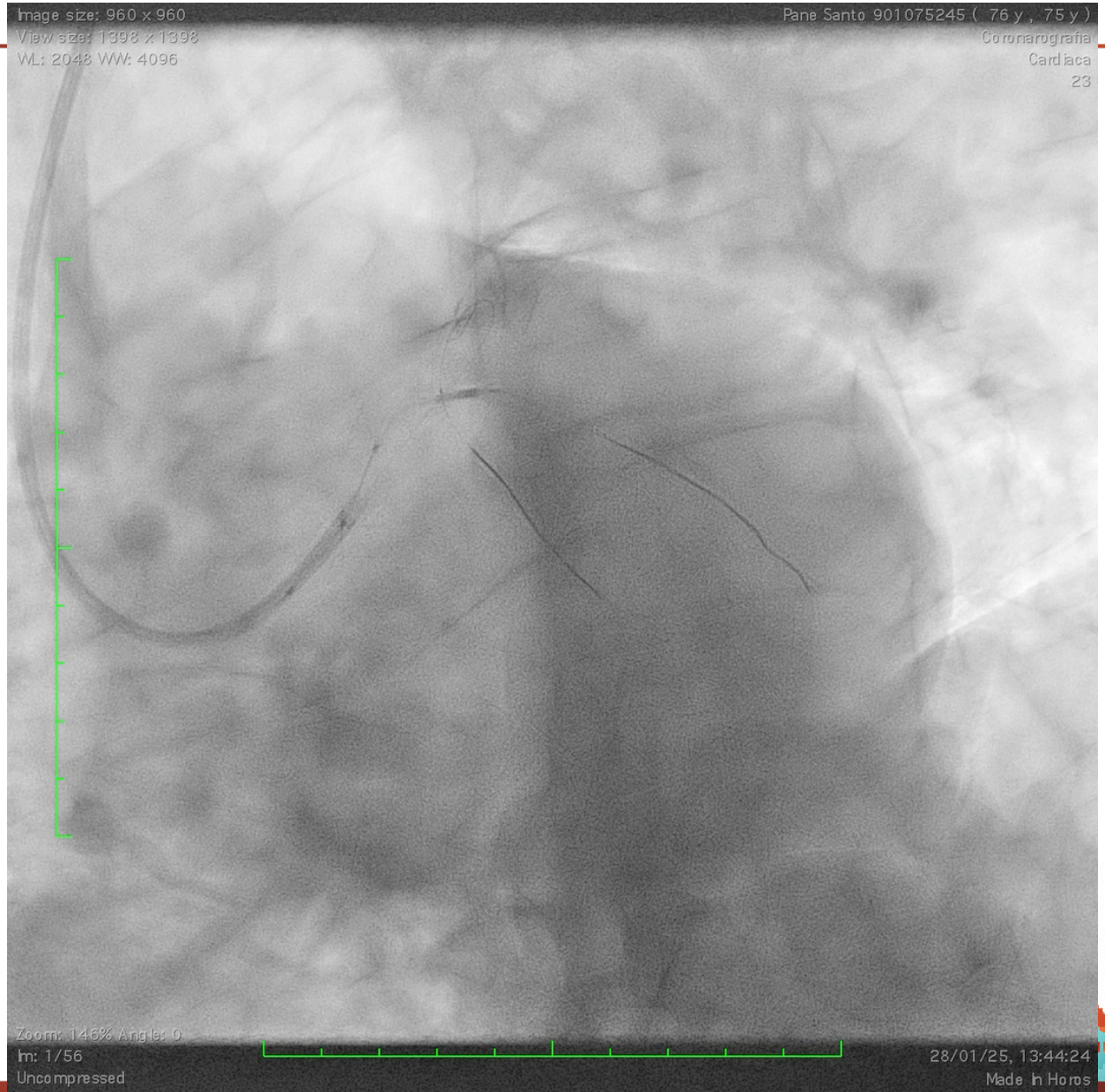
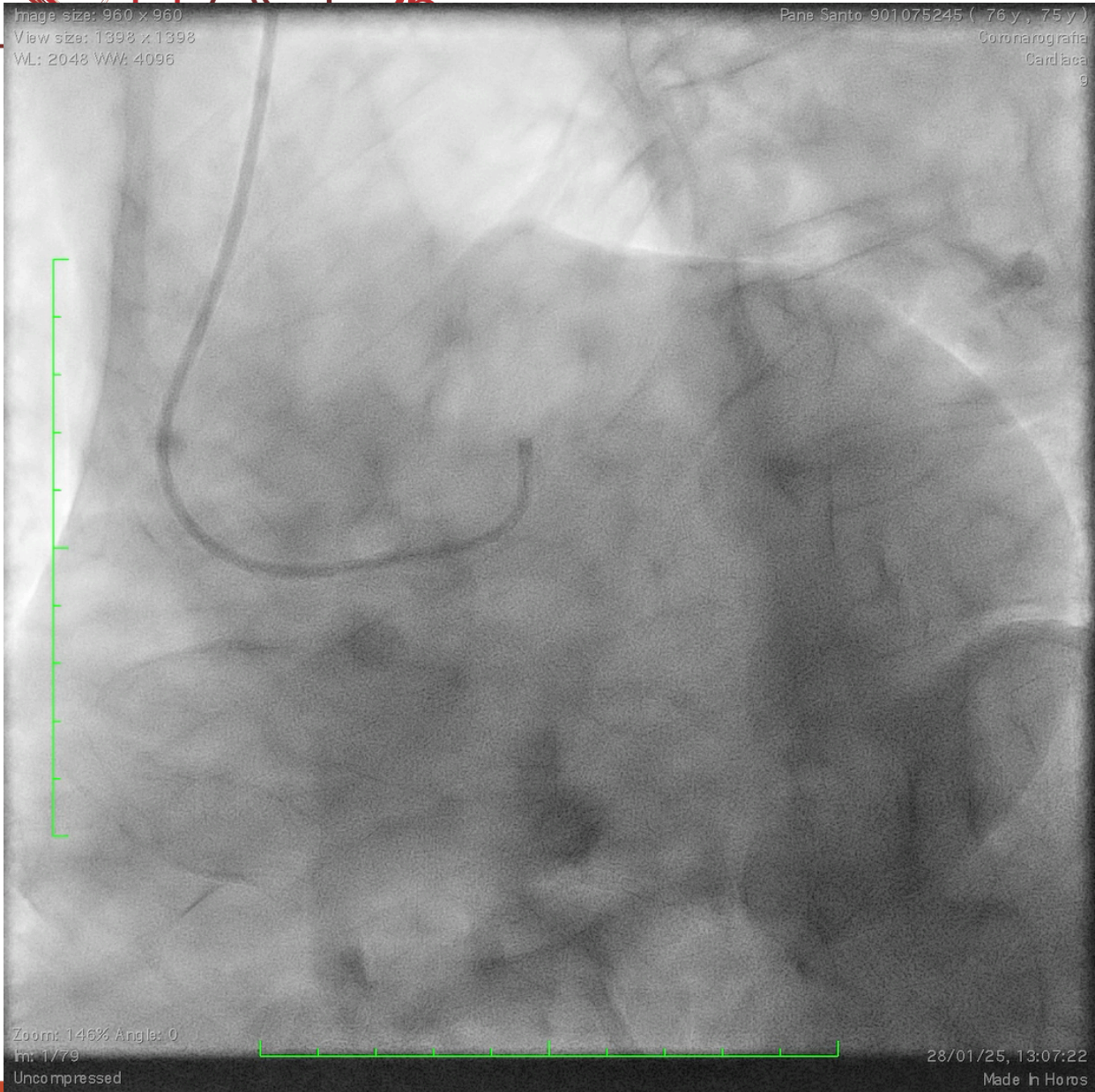
SC Balloon Emerge 2.5/15 mm



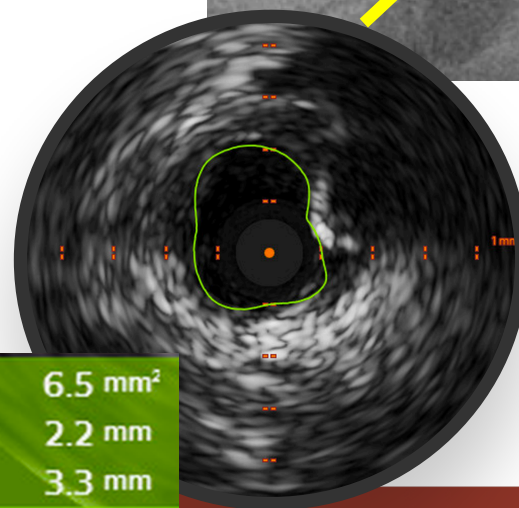
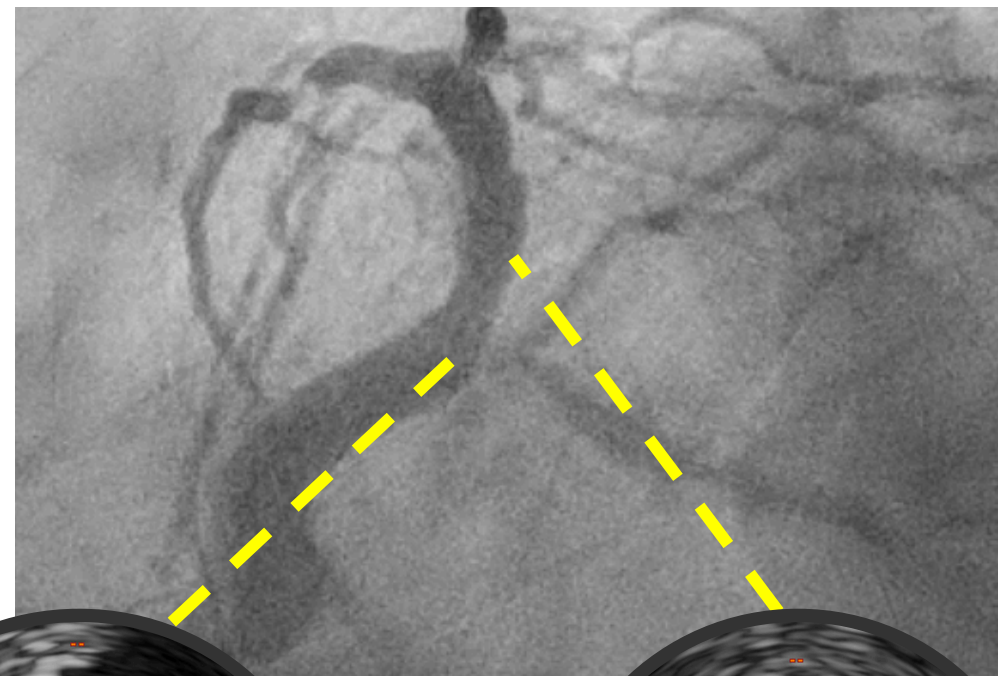
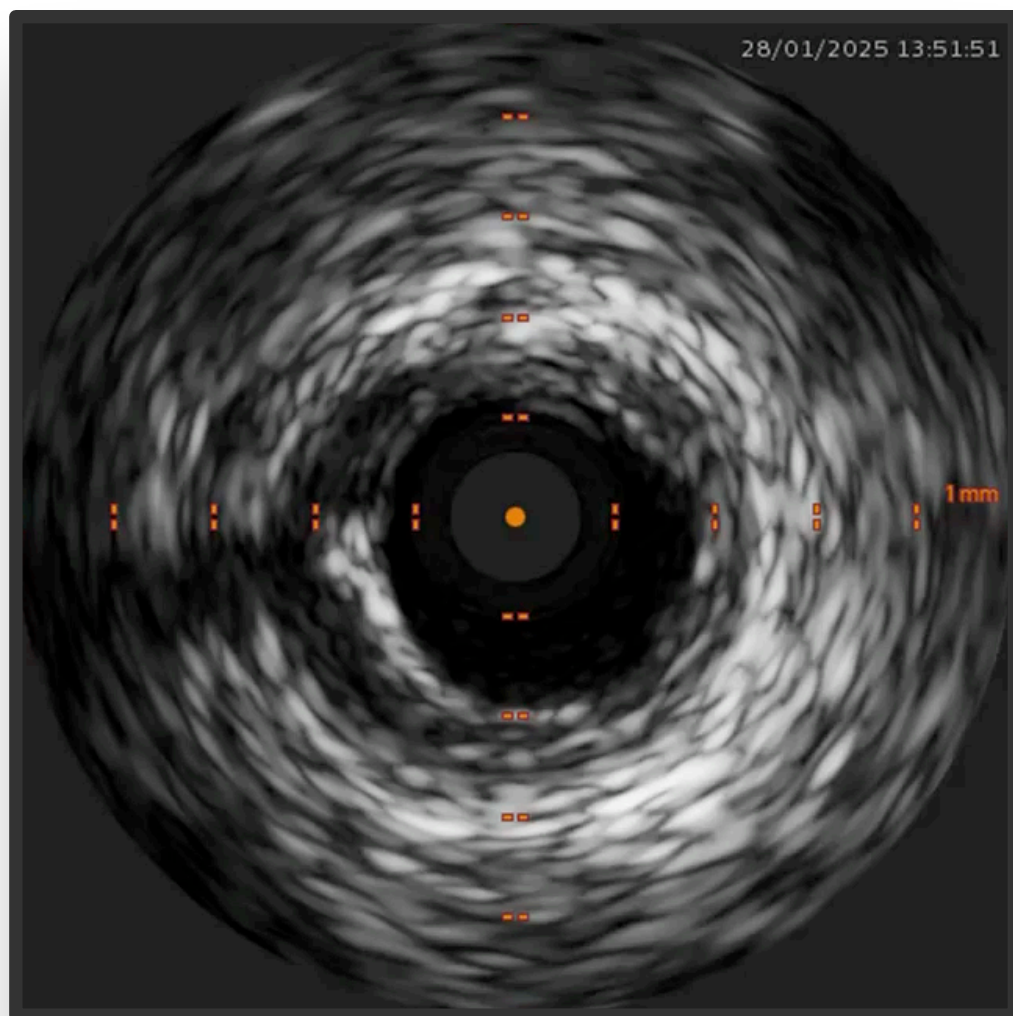
DynamX Bioadaptor 2.5/18 mm mid LAD



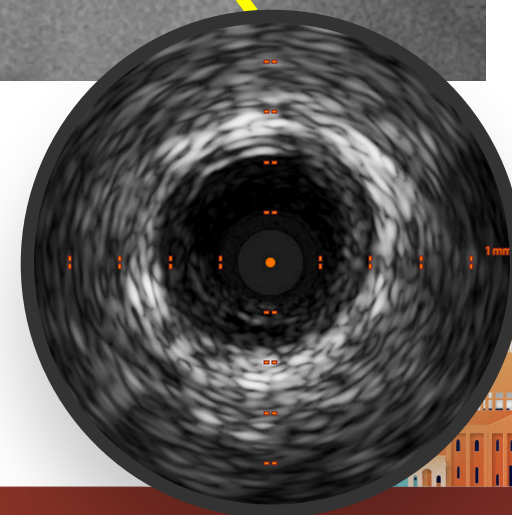
NC Balloon 2.75/15 mm



IVUS ON LM-LAD



6.5 mm²
MIN DIA 2.2 mm
MAX DIA 3.3 mm





**WHICH
STRATEGY?**

Two Main Issues

TYPE OF STENOSIS

- **IVUS do not cross**
- **Calcium at angioCT**

SITE OF STENOSIS

- **Ostial lesion**
- **bi(tri)furcation (Medina 0,0,1)**
- **LM involvement?**

How common is true LCx ostial lesion?

- *Angio* → 12-15%
- *Imaging* → 1-6%

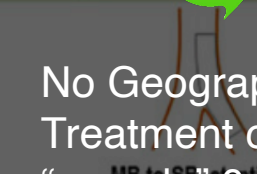


SITE OF STENOSIS: ISOLATED OSTIAL LCx

Inverted Provisional

Inverted A
Across the first (Inverted Provisional)

- No Geographic miss
- Treatment of “pseudo” 0,0,1



POT Kissing

PS
PK
PSP
PKP

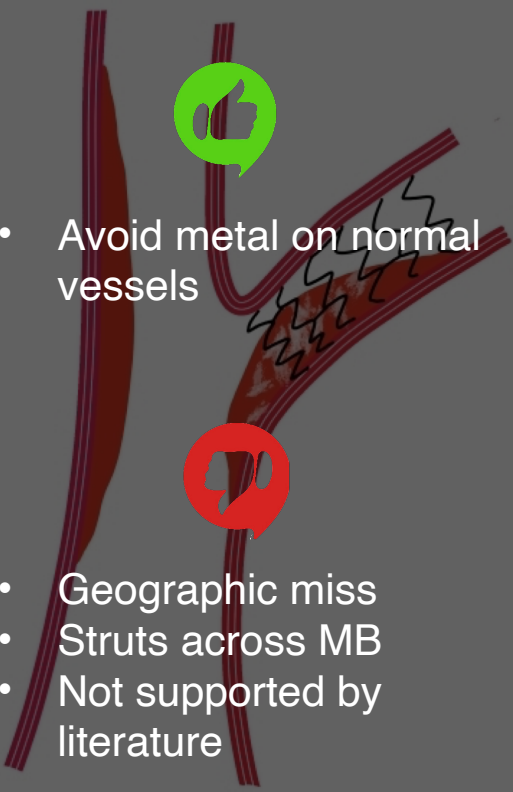
- Difficult to accept
- MB treated as SB

Inverted T Inverted TAP Inverted Culotte

KP

“Nailing the ostium”

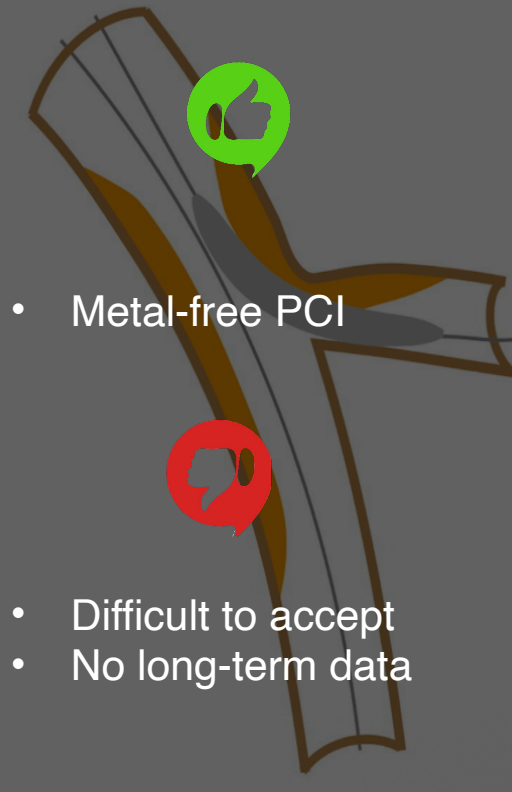
- Avoid metal on normal vessels



- Geographic miss
- Struts across MB
- Not supported by literature

DCB on SB

- Metal-free PCI

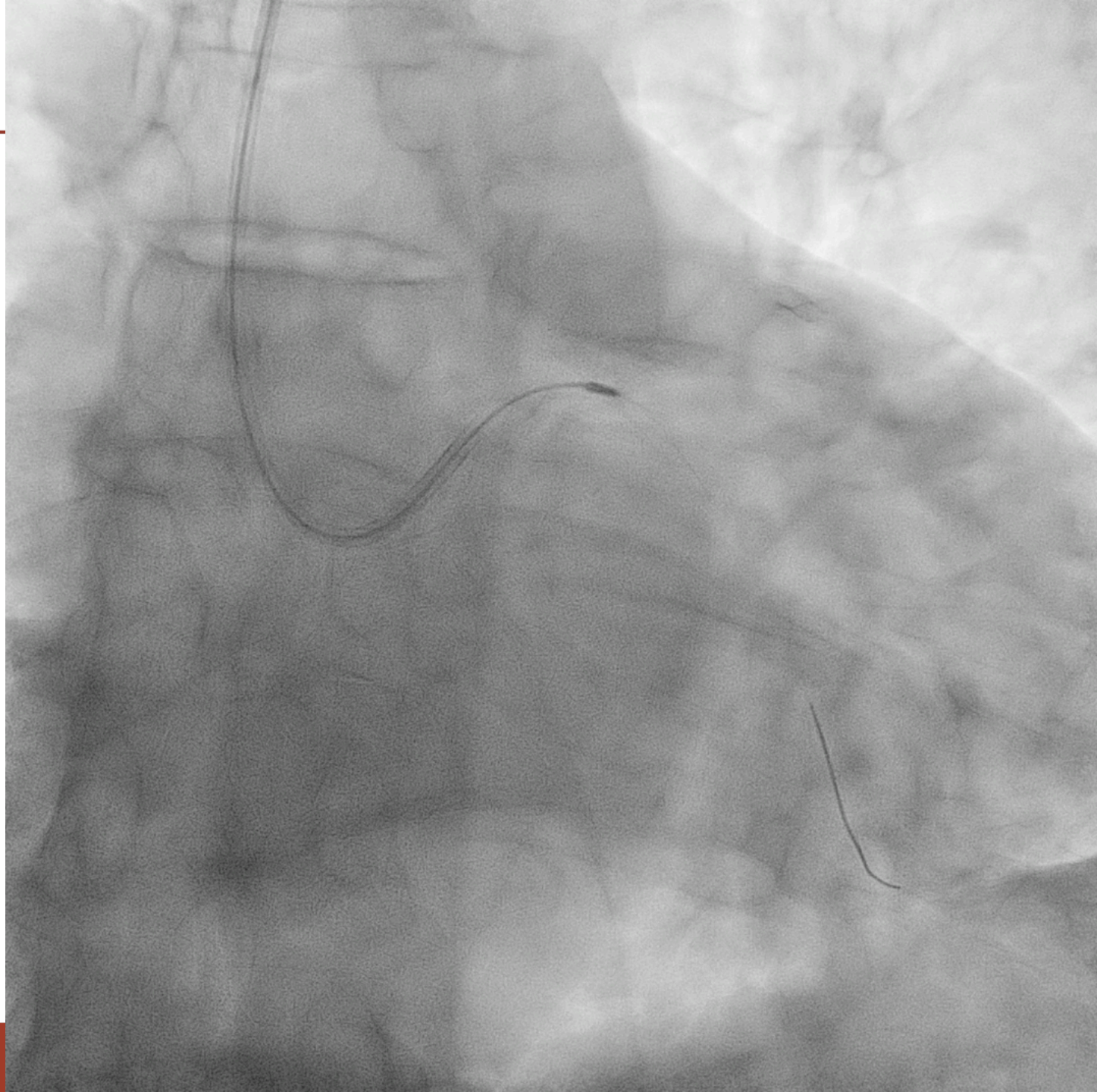


- Difficult to accept
- No long-term data

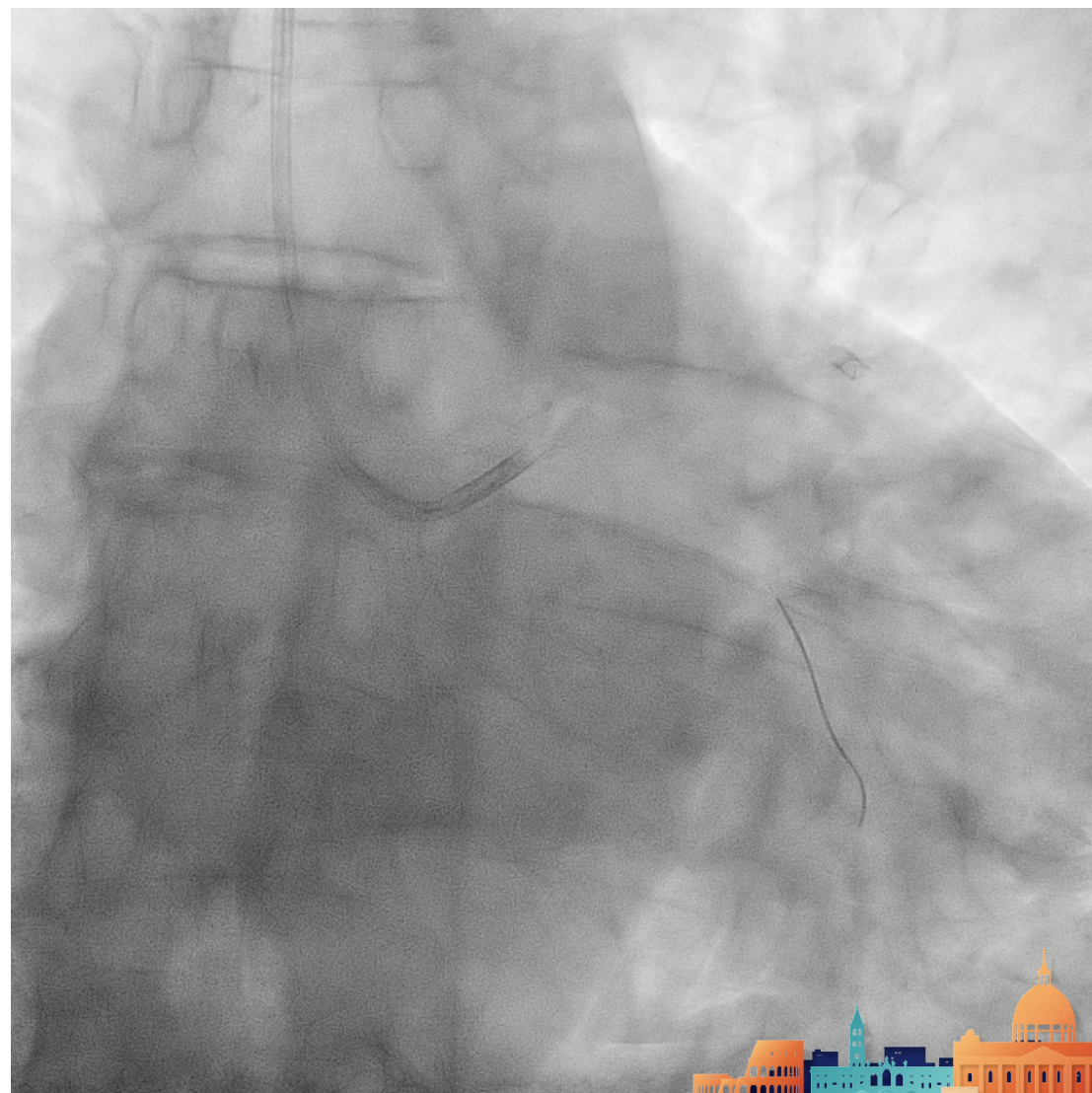
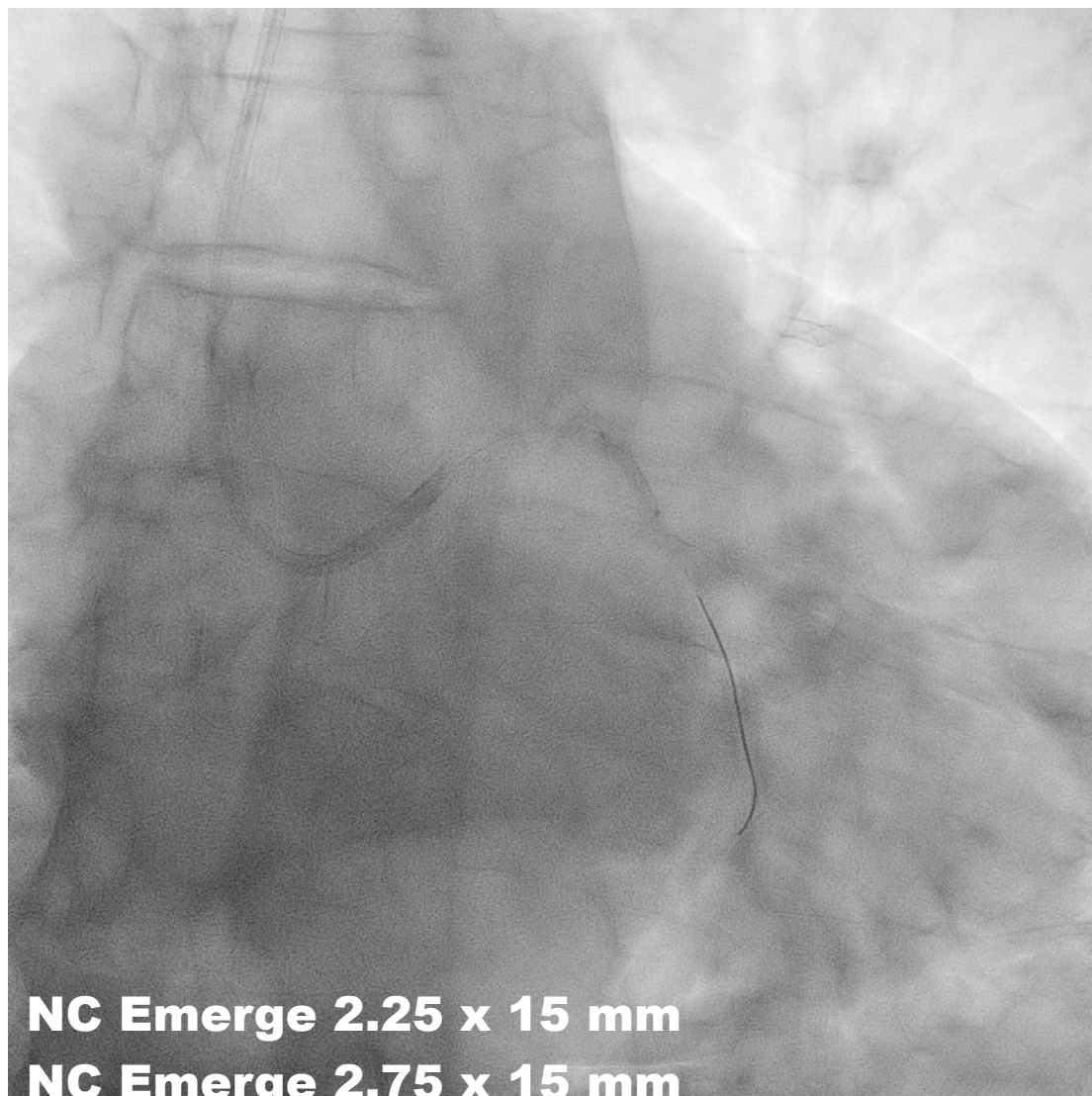


CORONARY ANGIOPLASTY

- **Samurai guidewire in LCx**
- **Exchange with Rotawire ES
using a Corsair Pro MC**
- **Rotational atherectomy with
1.25 mm RotaPro**



CORONARY ANGIOPLASTY

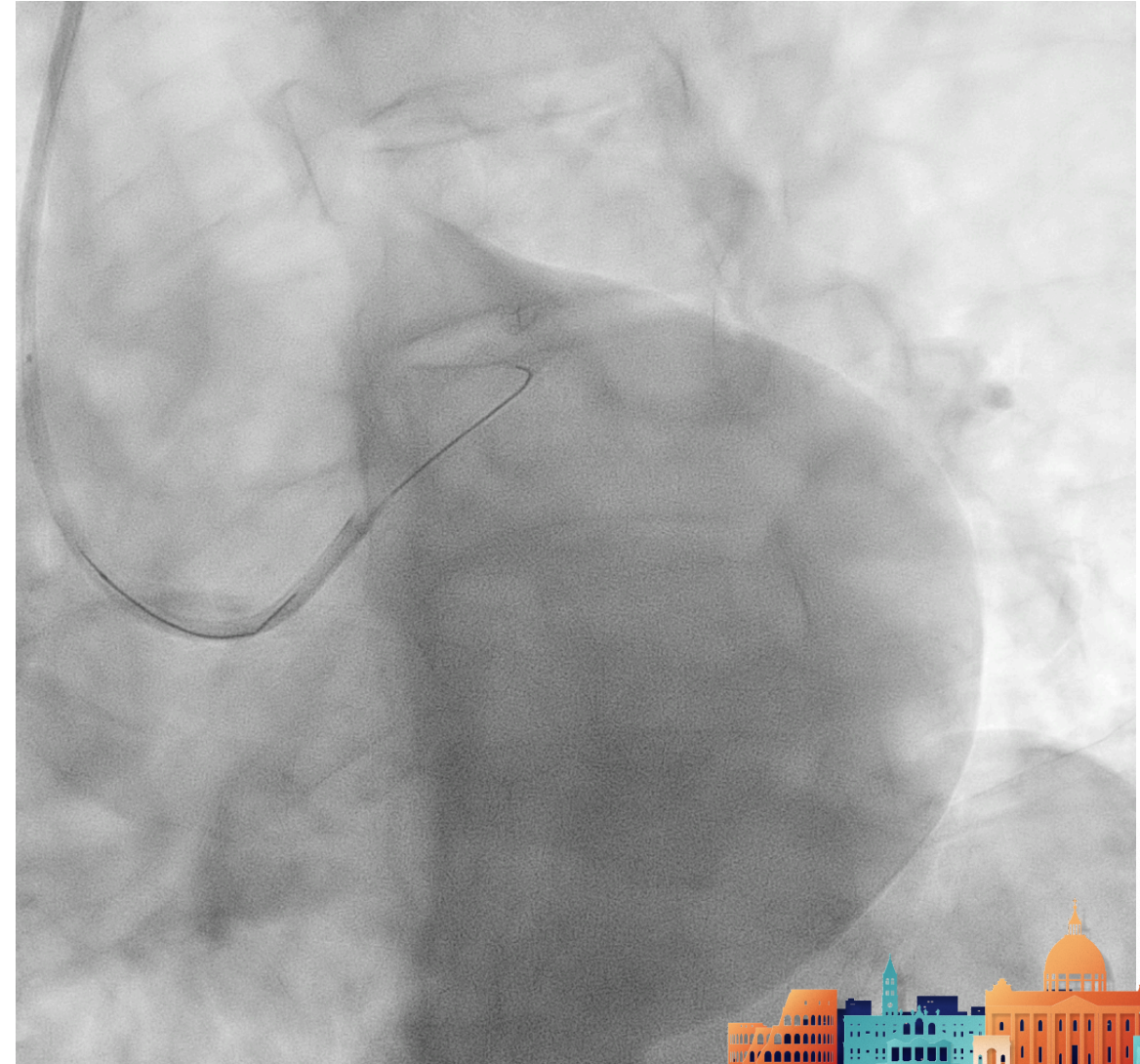


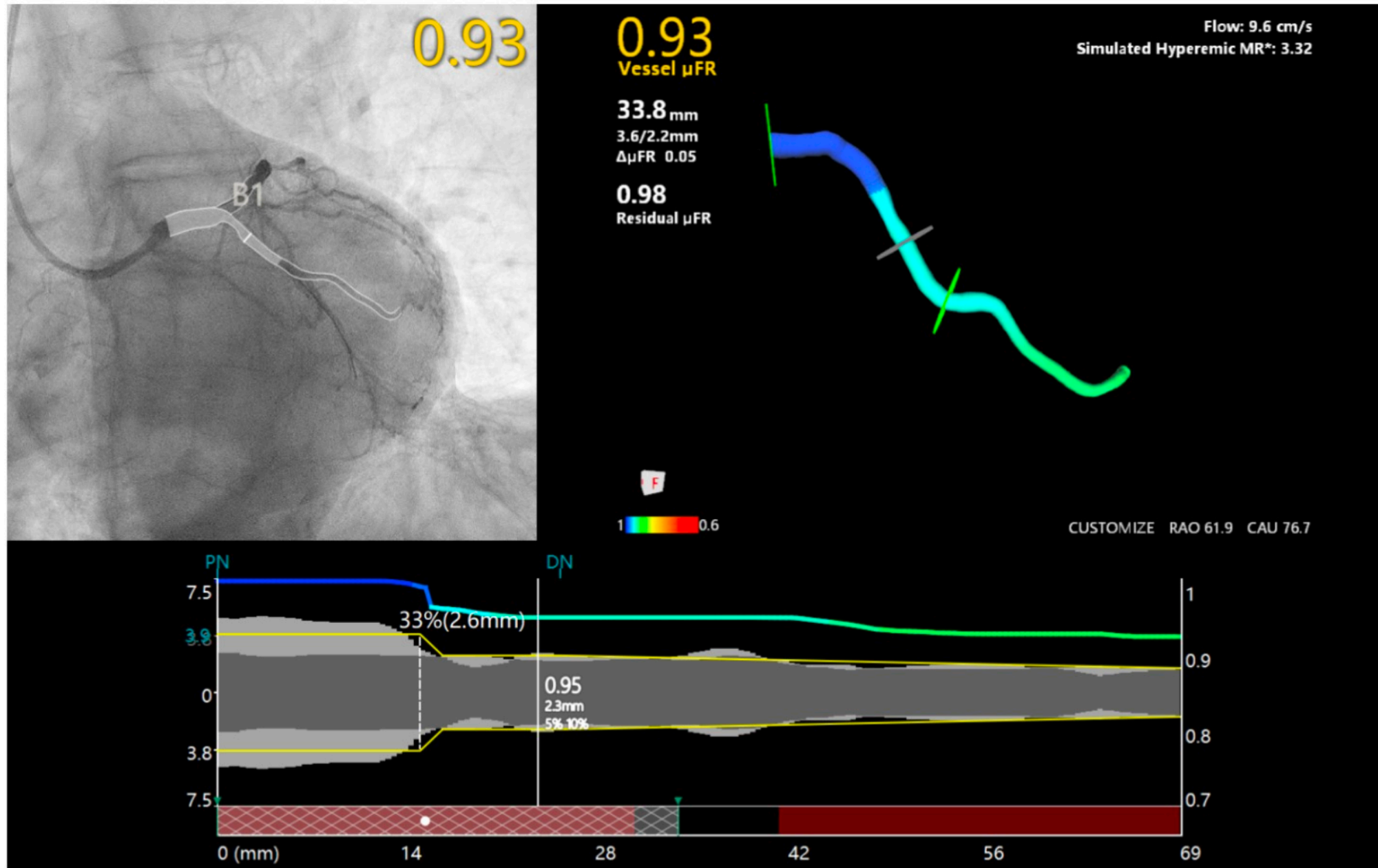
CORONARY ANGIOPLASTY

- **IVL with a Shockwave 2.5 x 12 mm balloon**
- **SeQuent Please NEO 2.75 x 20 mm, nominal pressure for 60 seconds**



FINAL RESULT



μ FR-3D Results

Conclusions

Plaque modification is a necessary step in DCB angioplasty.

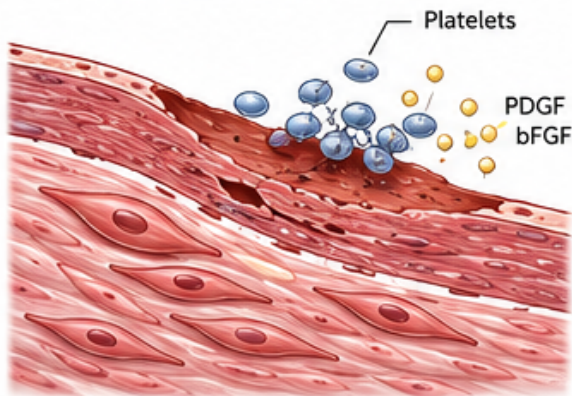
The efficacy of the treatment and the action of the drug may vary depending on the degree and type of plaque modification.

In calcified lesions, both debulking and improved vascular compliance enhance the penetration and action of the drug.



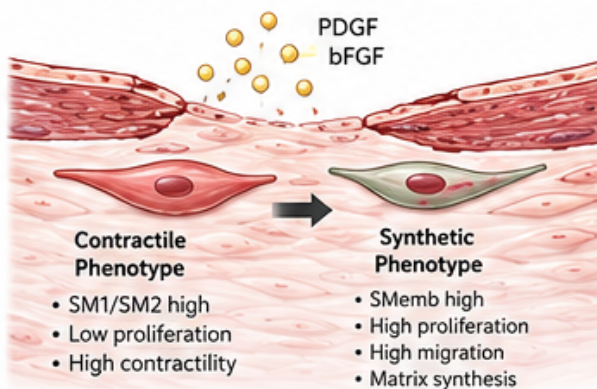
Lesion Preparation

1 INITIAL VESSEL DAMAGE AND ACTIVATION



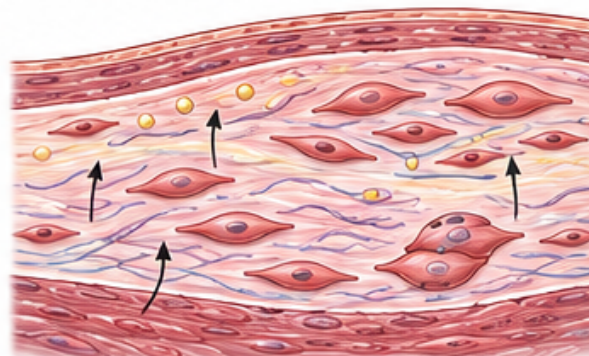
- **Endothelial Denudation:** The protective inner lining (endothelium) is stripped away.
- **Medial/Intimal Splitting:** The internal elastic lamina (IEL) often fractures, stretching the underlying medial tissue.
- **Platelet Aggregation:** Platelets immediately adhere to the injured area, releasing powerful mitogens like PDGF and bFGF.

2 SMC PHENOTYPIC MODULATION (THE SWITCHING PHASE)



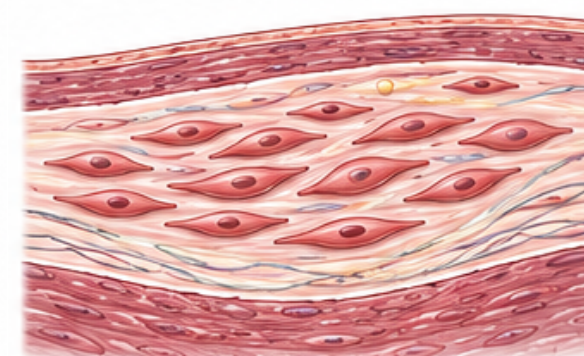
- In response to the mechanical trauma and growth factors, SMCs undergo phenotypic modulation.
- They switch to an immature, synthetic phenotype.
- They downregulate contractile proteins (SM1/SM2) and upregulate embryonic forms like SMemb.
- In this synthetic state, SMCs lose their ability to contract but become highly mobile, proliferative, and capable of synthesizing extracellular matrix components like collagen.

3 SMC MIGRATION AND PROLIFERATION (NEOINTIMAL FORMATION)



- Synthetic SMCs migrate from the media through the disrupted IEL into the intima.
- They proliferate in response to mitogens (PDGF, bFGF, TGF- β , etc.).
- They synthesize extracellular matrix (collagen, proteoglycans, fibronectin), forming the neointima.
- This neointimal hyperplasia is the primary cause of restenosis.

4 REDIFFERENTIATION AND REMODELING (THE STABILIZATION PHASE)



- Over time, SMCs may undergo redifferentiation, regaining a more contractile phenotype.
- The neointima matures, with increased collagen deposition and extracellular matrix organization.
- Vessel remodeling (positive or negative) continues, influencing long-term lumen size.

TIME: MINUTES

HOURS TO DAYS

DAYS TO WEEKS

WEEKS TO MONTHS

Drug delivery

1 ARRESTING THE SMC CELL CYCLE

DCB drugs halt the rapid multiplication (hyperplasia) of synthetic SMCs triggered by balloon injury.

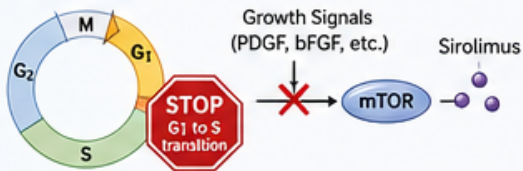
Paclitaxel (Microtubule Stabilization)

Binds to tubulin and prevents disassembly of microtubules, freezing SMCs in the M-phase (mitosis) of the cell cycle.



Sirolimus / Limus Drugs (mTOR Inhibition)

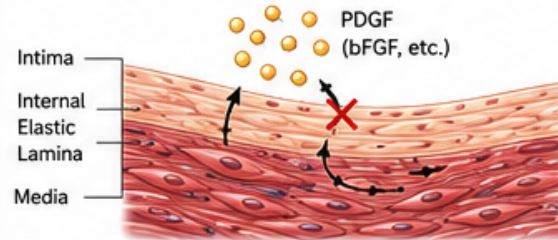
Inhibits the mTOR pathway, blocking the transition of SMCs from the G1 to the S-phase, turning off the growth signals.



RESULT: SMC proliferation is severely blunted, suppressing the formation of an obstructive neointima (scar tissue).

2 INHIBITING SMC MIGRATION (CHEMOTAXIS)

DCB drugs prevent SMCs from migrating from the media into the intima to build scar tissue.



Cytoskeletal Disruption

By altering microtubule and actin filament dynamics, DCB drugs paralyze the cellular "machinery" that SMCs use to move.



Blocked Receptors

The drugs dampen the cells' sensitivity to powerful local chemical attractants like PDGF.

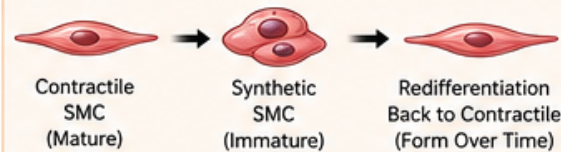


RESULT: SMCs remain largely trapped in the medial layer, preventing them from migrating inward to narrow the vessel lumen.

3 MODIFYING PHENOTYPIC TRANSITION AND MATRIX RELEASE

DCBs modulate SMC behavior and matrix secretion, leading to a more stable vessel wall.

Phenotypic Transition (Not Completely Blocked)



Suppressed Matrix Secretion

DCB drugs heavily restrict the release of extracellular matrix (collagen, fibronectin, proteoglycans).



Controlled Redifferentiation

By slowing the initial hyperactive phase, the drugs allow the vessel wall to stabilize, encouraging the remaining SMCs to return to a mature, non-dividing state.

RESULT: Less scar tissue (neointima) is formed and the vessel wall matures into a stable, quiescent structure.

4 PRESERVING LONG-TERM VASCULAR GEOMETRY (POSITIVE REMODELING)

DCBs provide a temporary therapy with a lasting biological impact—without leaving a permanent cage.

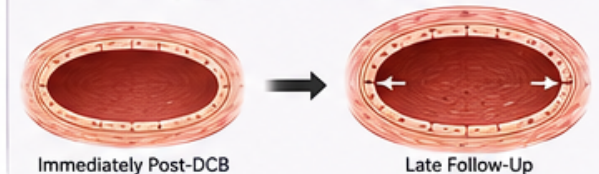
The "Wash-In" Phase

The drug is transferred within 30–60 seconds of inflation using a lipophilic excipient (carrier) that helps the drug stick to the tissue and persist in the vessel wall for 30–90 days.



Late Positive Remodeling

Once the drug naturally dissipates, the artery retains its natural mechanical properties. The vessel can dynamically dilate over time (positive remodeling) rather than being rigidly constrained by metal.



RESULT: The vessel maintains or improves its lumen over time, promoting better long-term vascular health and function.

