

Calcified Lesion and OCT

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Coronary Calcification

- **Alkaline phosphatase** is central to early calcium deposition and has been proposed as a molecular marker of vascular calcification.
- **Vascular smooth muscle cells** (VSMCs) produce matrix vesicles, which regulate mineralization in the vascular intima and media.
- 2 types of CAC are **intima** (atherosclerosis) and **medial artery calcification** (advanced age, DM and CKD).

Demer LL, Tintut Y. Circulation 2008;117:2938–48.

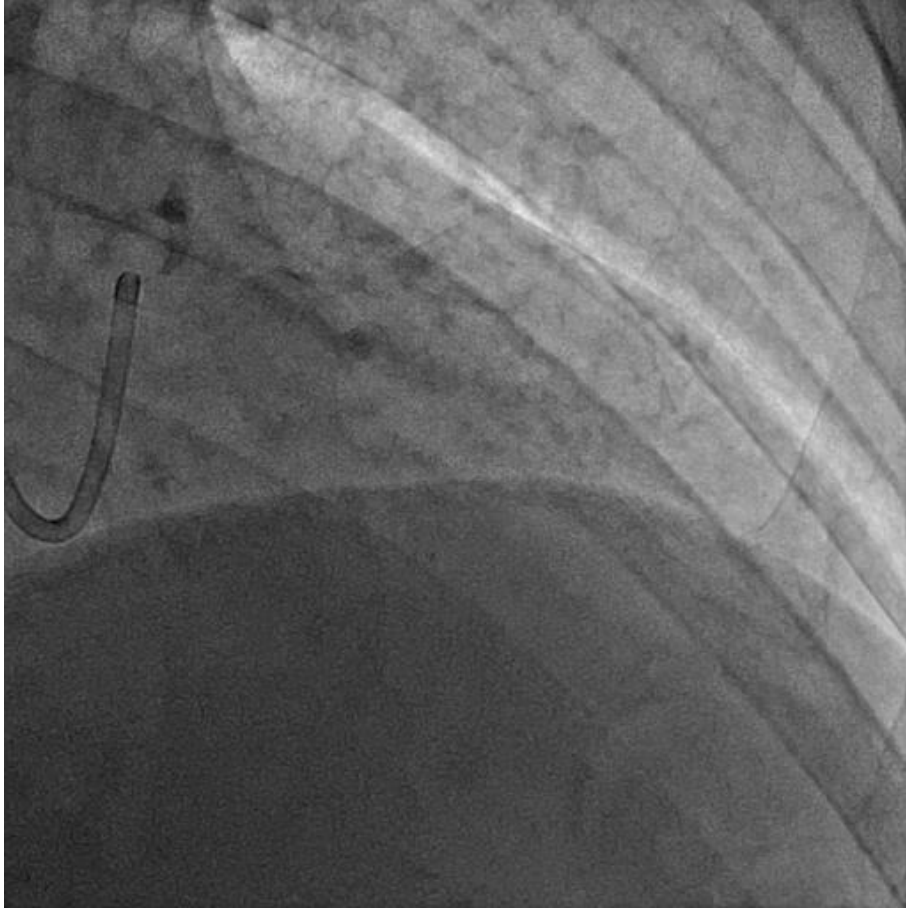
Johnson RC, et al. Circ Res 2006;99:1044–59.

Abedin M, et al. Arterioscler Thromb Vasc Biol 2004;24:1161–70.

Challenges of Calcified Lesions

- **Coronary artery calcification increases the likelihood of failure and complications.**
- **PCI for calcification increases the risk for dissection, acute vessel closure, MI and restenosis.**

Case 1- Coronary Angiography



Failure of 1.5x15 balloon to pass the lesion

Coronary Angiography

Case 2



Case 3



OCT catheter passed the lesion

What is an Appropriate Strategy ?

- **Simple Balloon**
- **Cutting Balloon**
- **Rotational Atherectomy**

Possible Role of OCT in Calcified Lesion

● Pre-PCI

- Evaluation of lesion characteristics

● During PCI

- Guidance for plaque modification
- Guidance for stenting
 - ✓ Stent sizing, apposition, expansion
 - ✓ Periprocedural complication

● Follow-Up Assessment

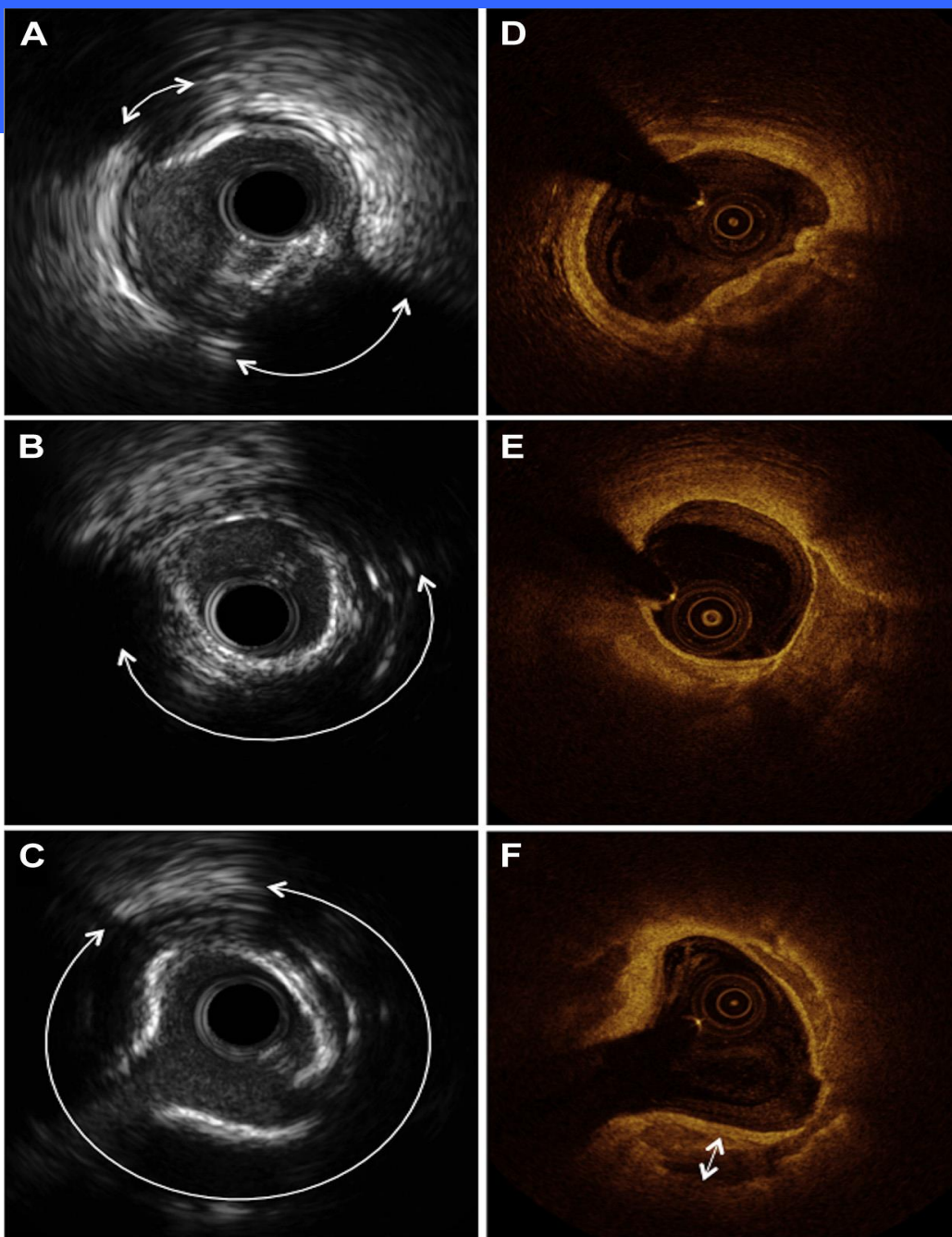
- Long-term stent evaluation

IVUS vs. OCT

- Approximately 25% of severely calcified lesions are completely missed by angiography.
- IVUS is more accurate than angiography for CAC detection, with sensitivity of 90% to 100% and specificity of 99% to 100%.
- The sensitivity (95% to 100%) and specificity (97% to 100%) of OCT for CAC rival that of IVUS.

Madhavan MV, et al. J Am Coll Cardiol 2014;63:1703–14

IVUS vs. OCT

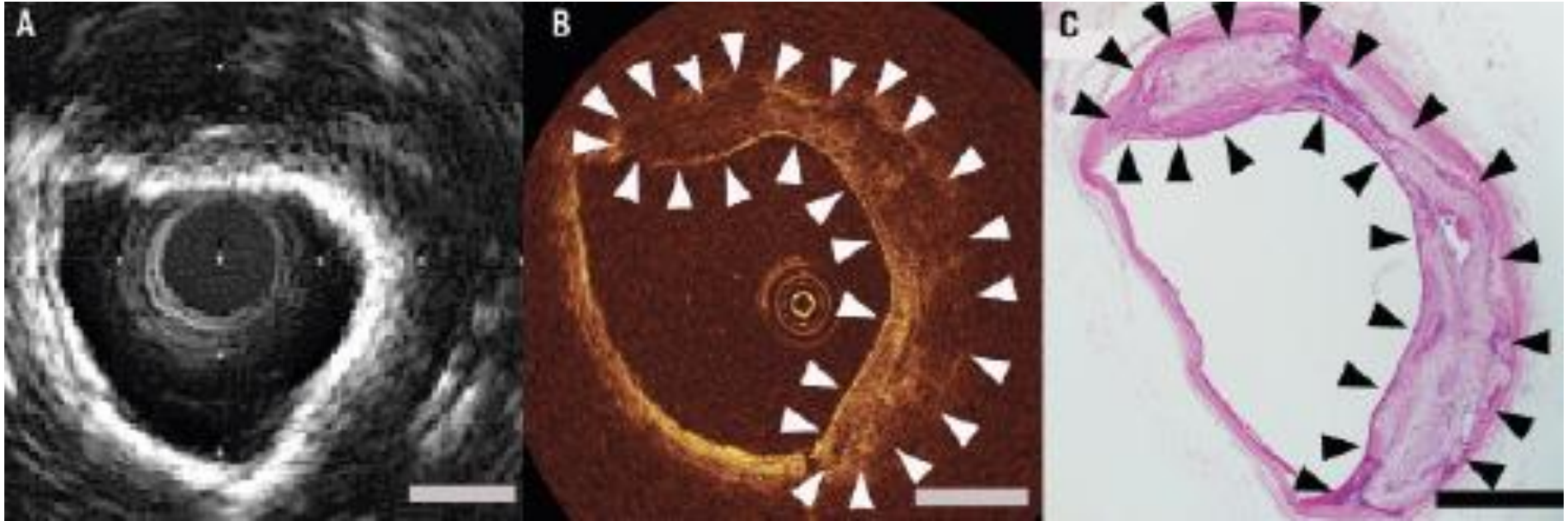


IVUS does not penetrate calcium, calcium thickness cannot be determined, and volume cannot be calculated.

Because light can penetrate calcium, **OCT** can in many cases assess calcium thickness and measure calcium volume

Madhavan MV, et al. J Am Coll Cardiol
2014;63:1703-14

OCT is better tool to evaluate calcium than IVUS

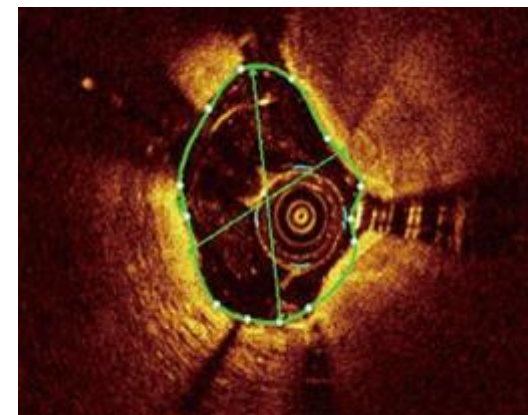
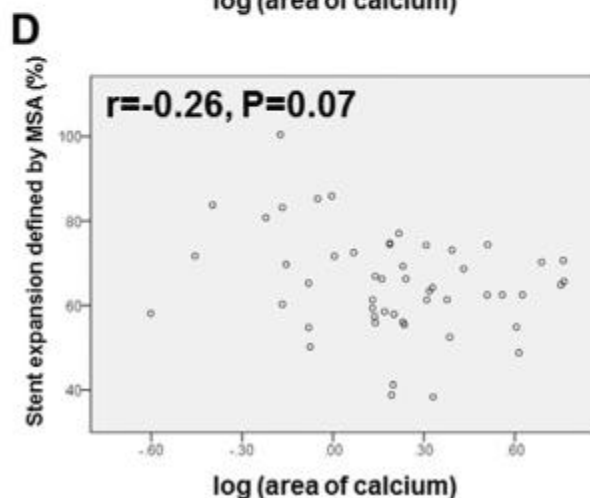
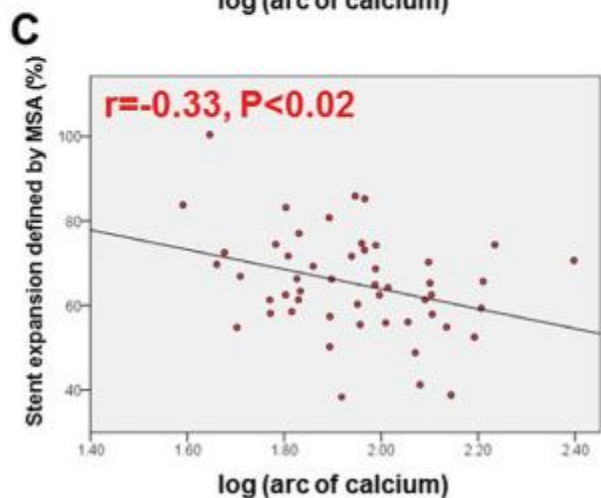
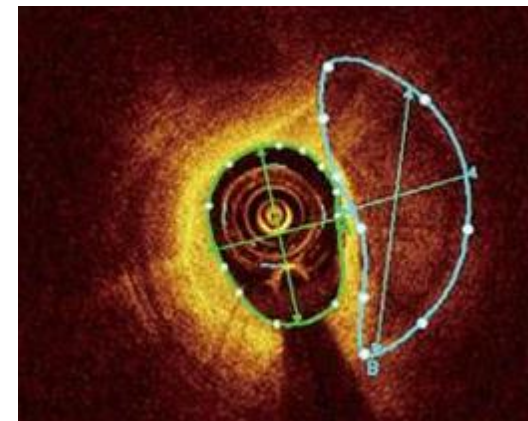
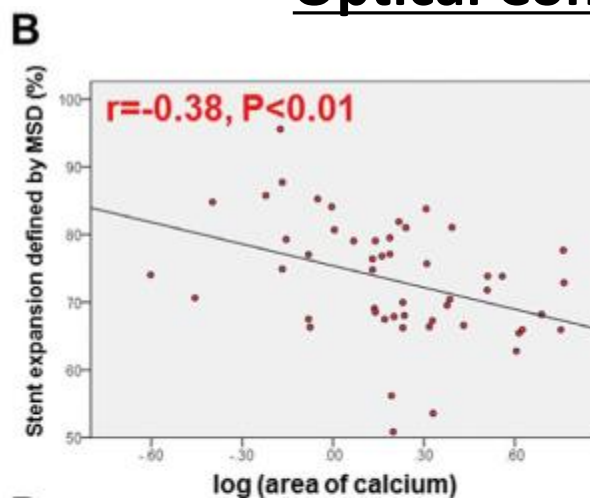
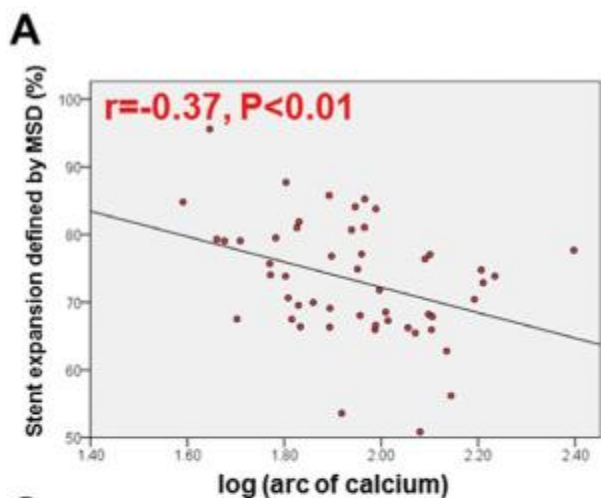


Superficial calcification could be quantified more accurately by using OCT rather than IVUS.

-> The area of calcification assessed by OCT might be related to stent expansion.

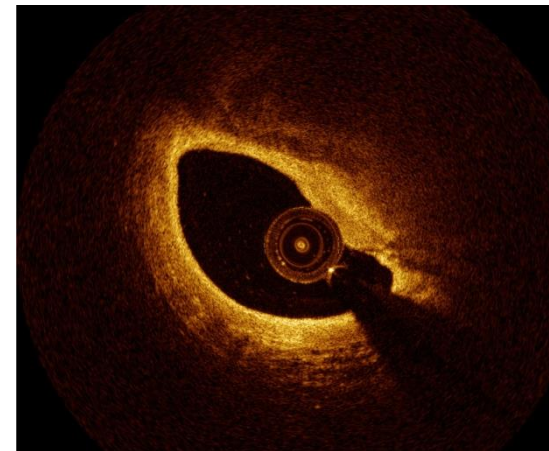
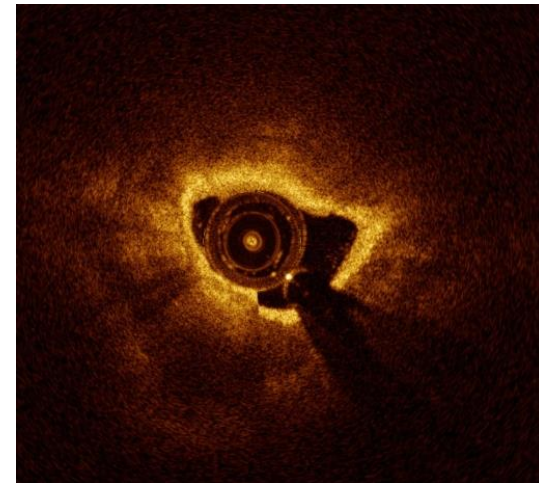
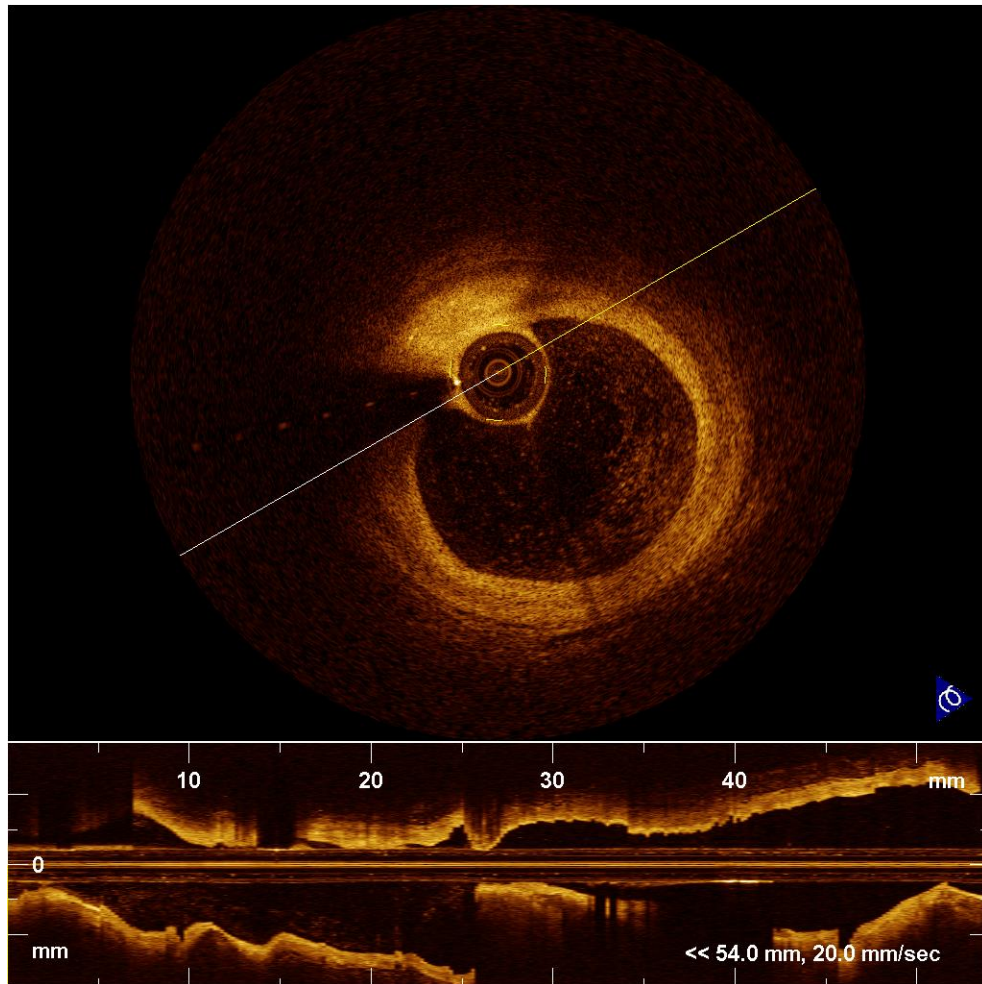
Impact of Target Lesion Coronary Calcification on Stent Expansion

Optical Coherence Tomography

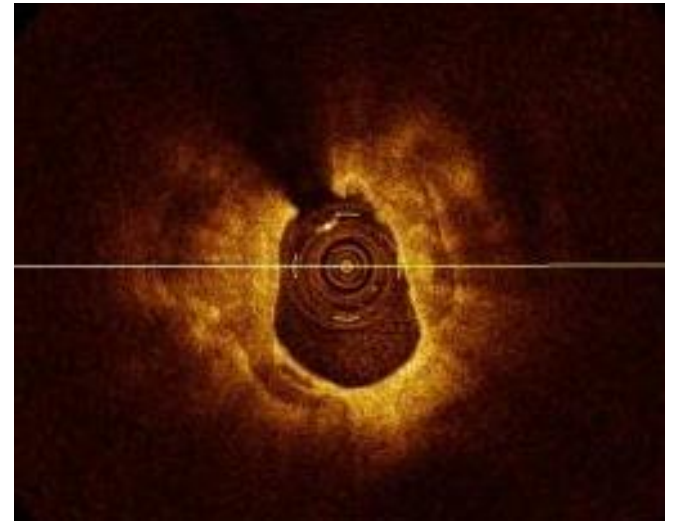
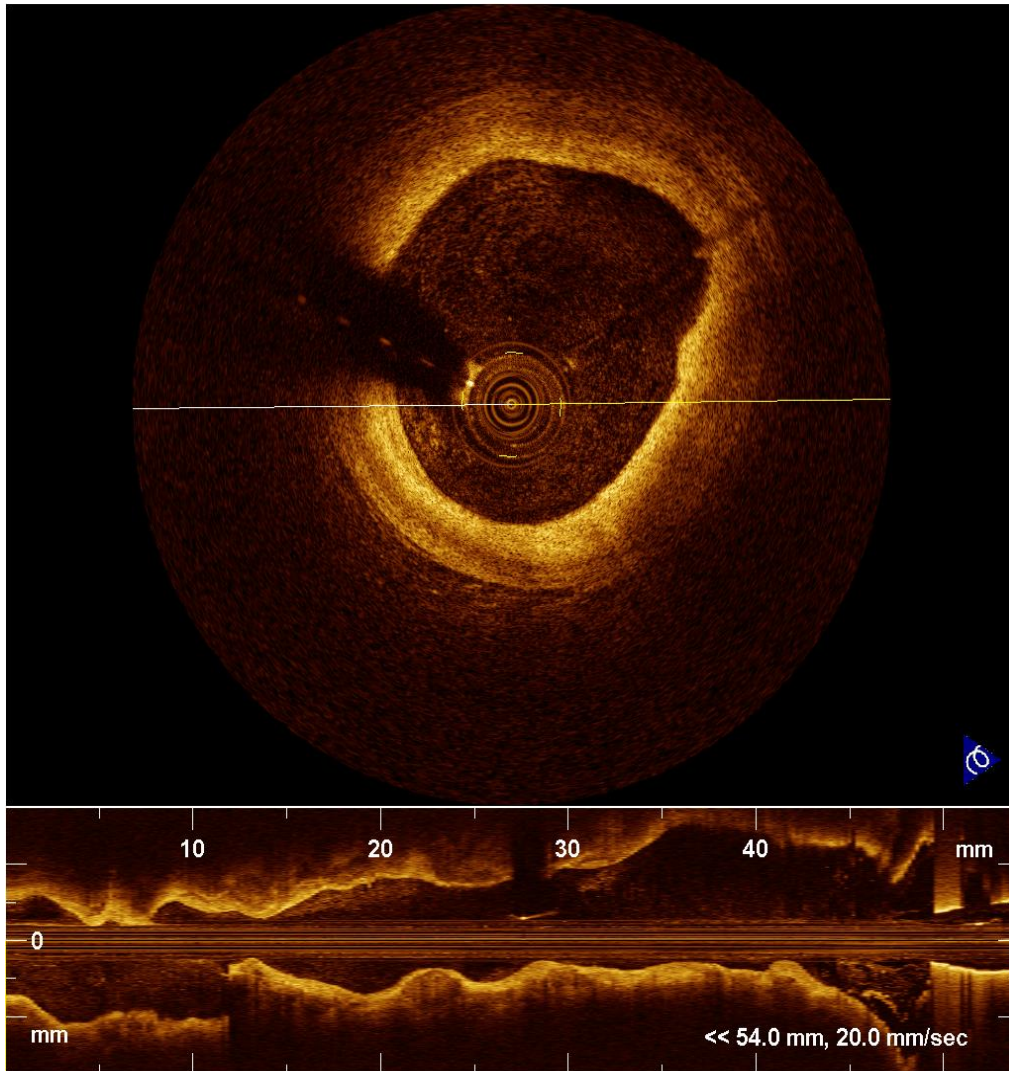


Kobayashi Y, et al. Cir J 2014;78:2209-14

2nd case - OCT finding Pre-Intervention



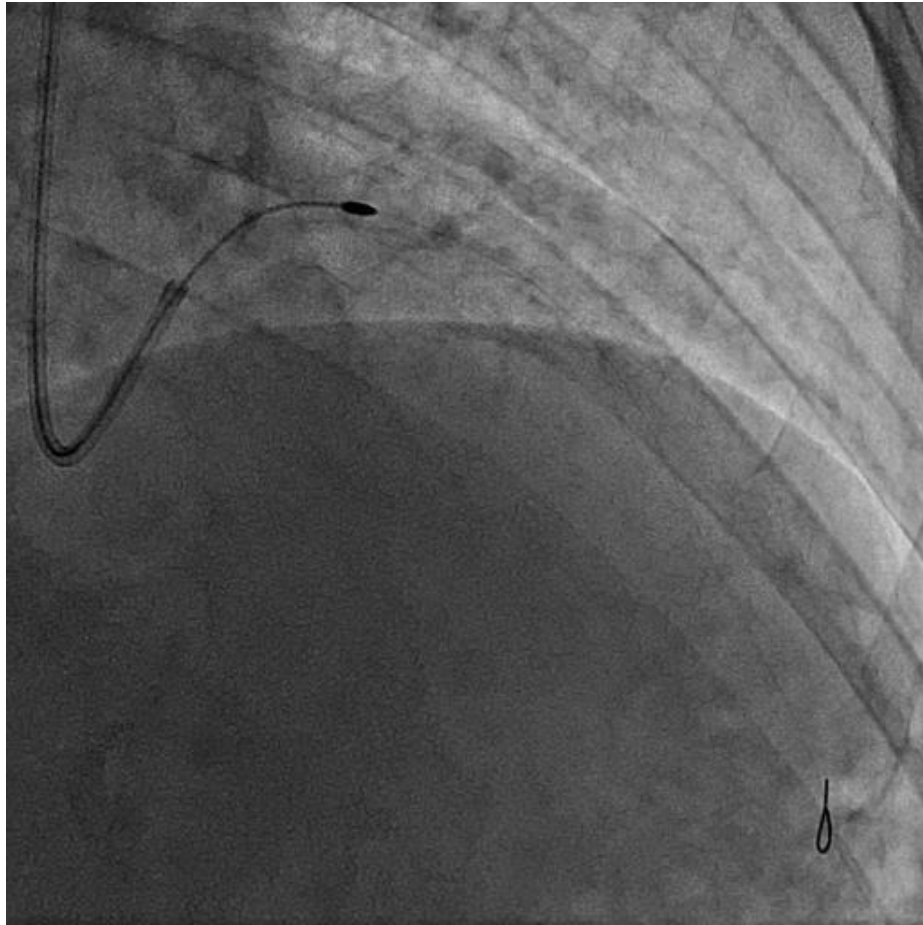
3rd Case - OCT finding Pre-Intervention



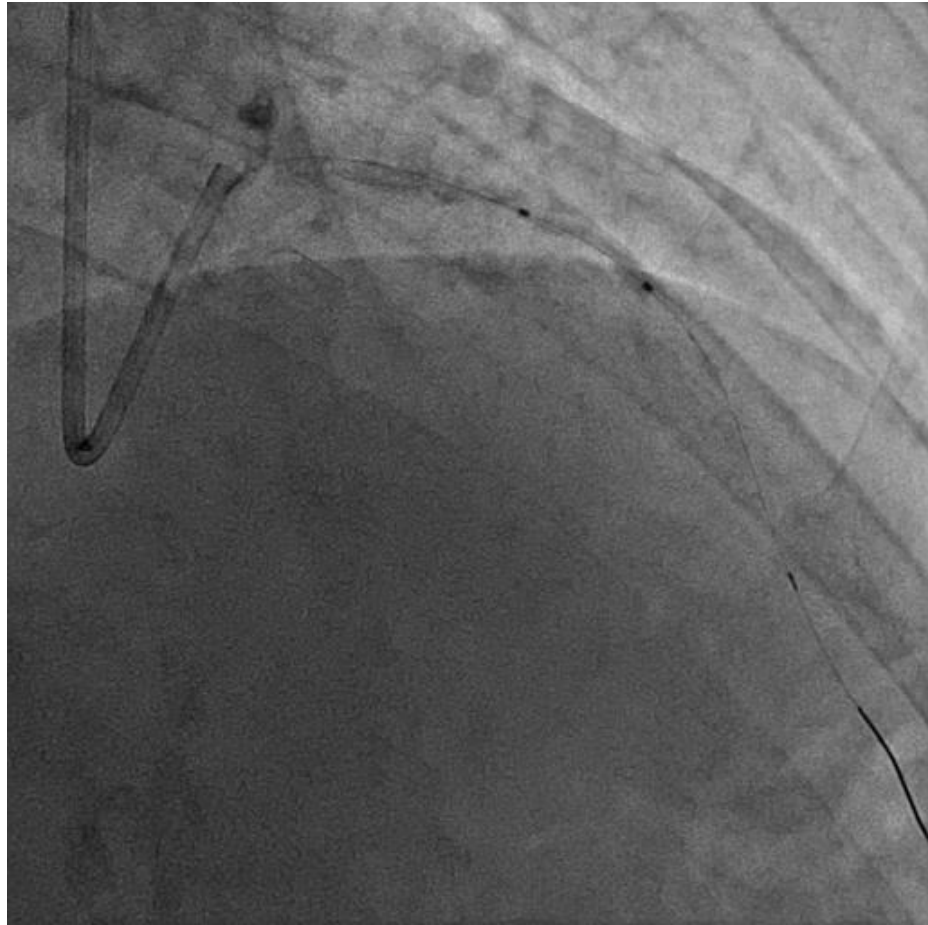
Can We Change the Strategy ?

- **Simple Balloon**
- **Cutting Balloon**
- **Rotational Atherectomy**

1st Case – Just Apply Rotablation

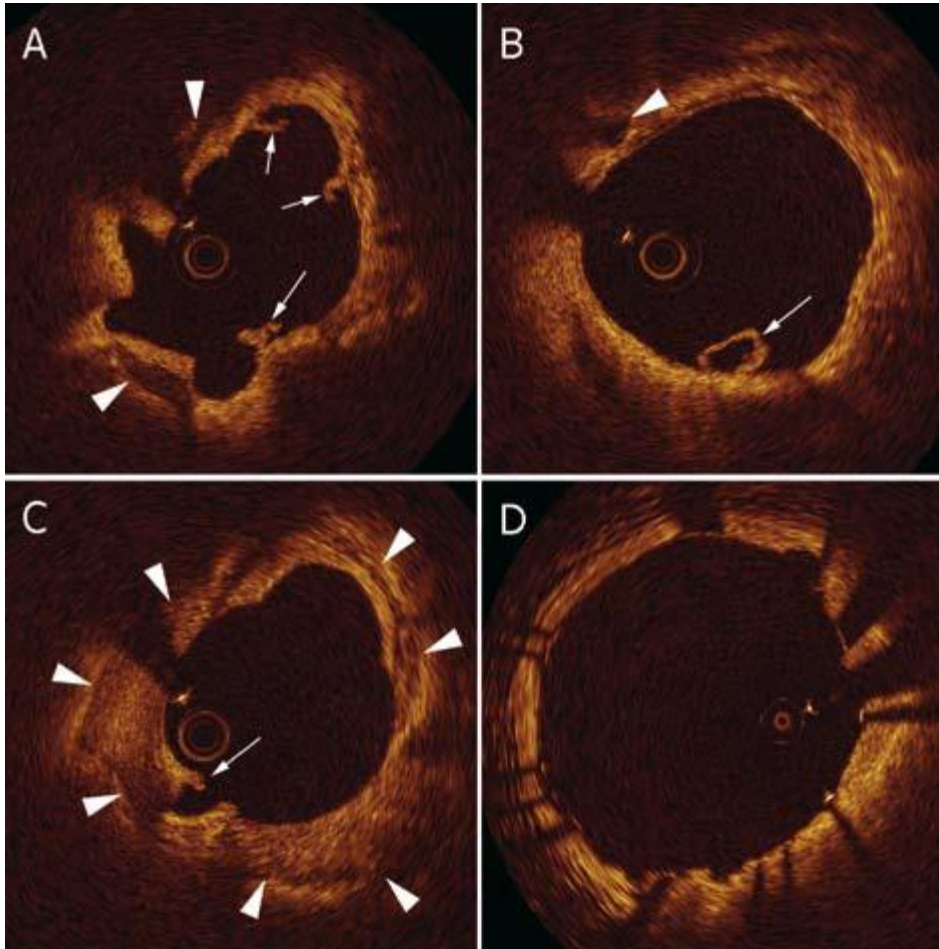


Rotablation burr 1.5



NC Balloon 3.0x15

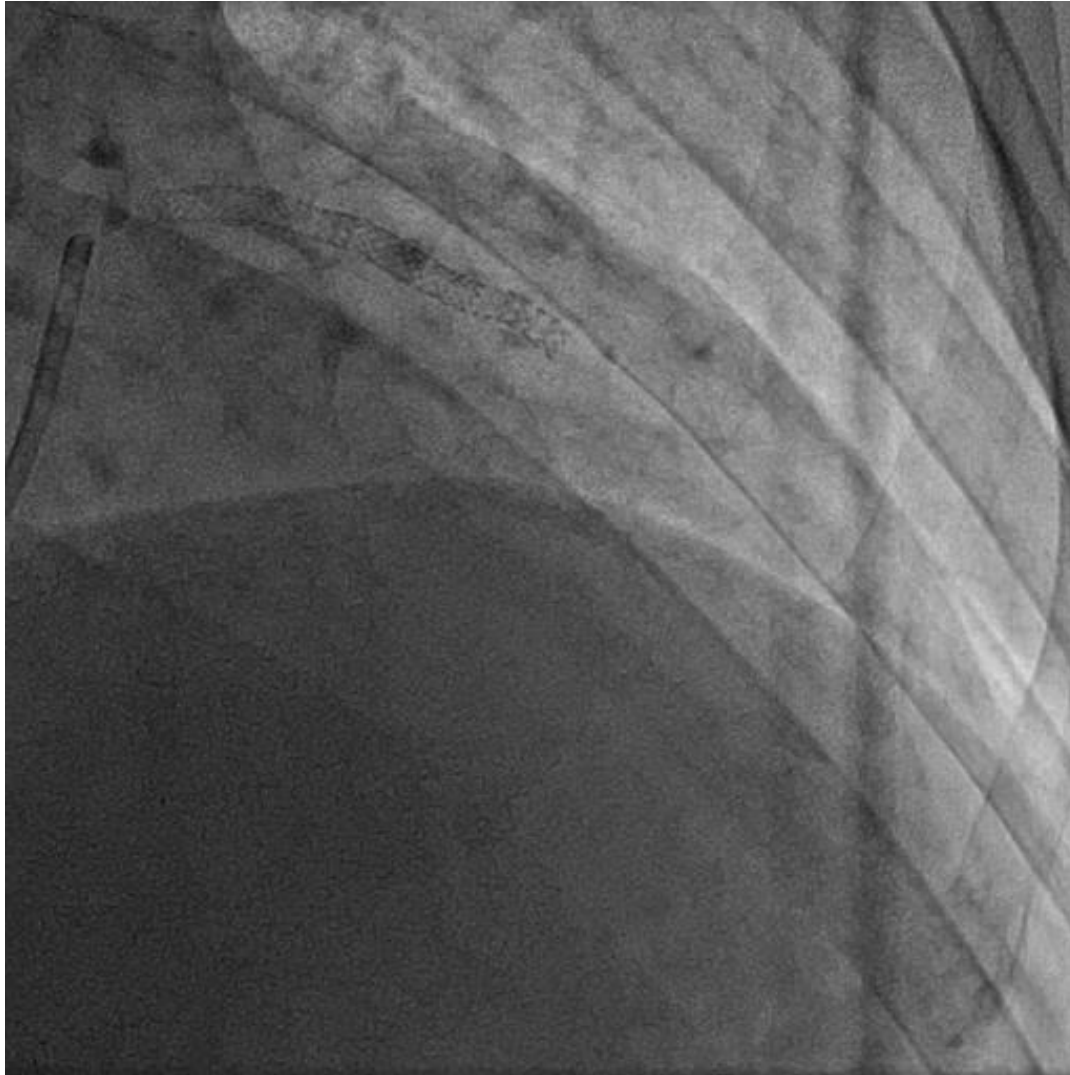
What is the Optimal Result after RA in OCT ?



The OCT can assess the effect of the rotational atherectomy in the calcified plaque:

a uniform arterial lumen
multiple microdissections
on the arterial wall.

1st Case - Final Angiography



**No further
Intravascular Imaging**

**Just angiography
-> Good results**

Promus element 3.5x12 mm

Rotablation in Calcified Lesion

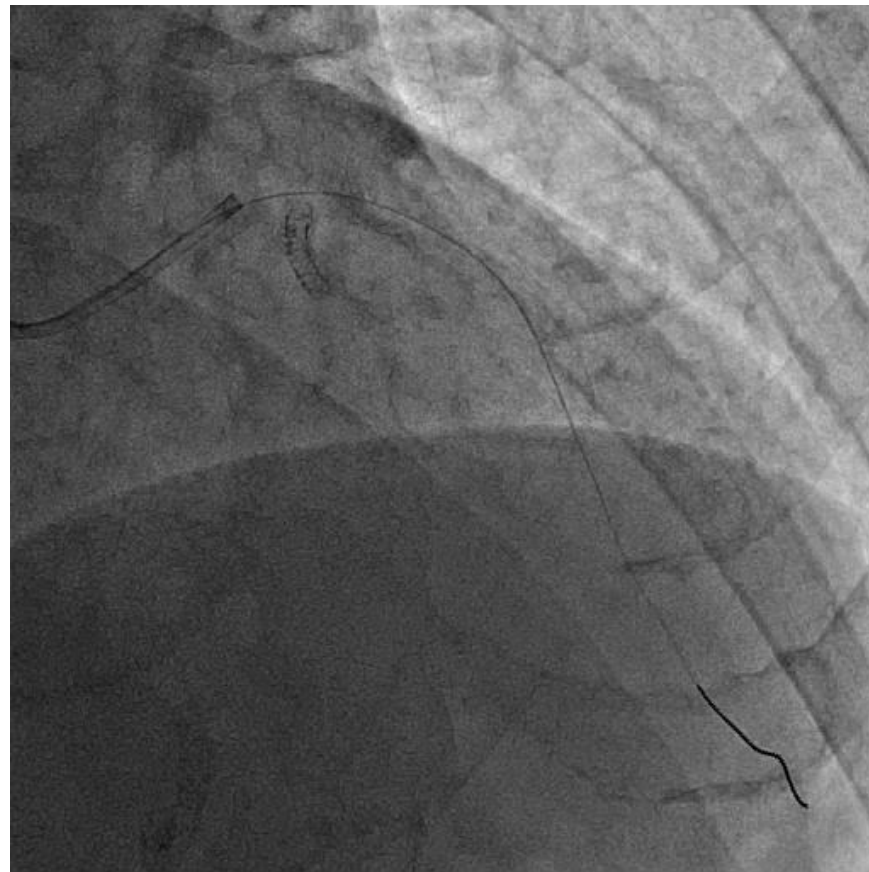
- Current PCI guidelines state that RA is a reasonable strategy in calcified lesions that are not crossable by a balloon catheter or adequately dilated before stent implantation (Class IIa, Level of Evidence: C).
- Lesion preparation with RA before PCI is currently performed in approximately 8% of cases with calcified lesions in the United States

Levine GN, et al. 2011 ACCF/AHA/SCAI guideline for percutaneous coronary intervention. J Am Coll Cardiol 2011;58:e44–122.

2nd Case - Balloon Angioplasty with NC balloon



2.5*15 NC Balloon



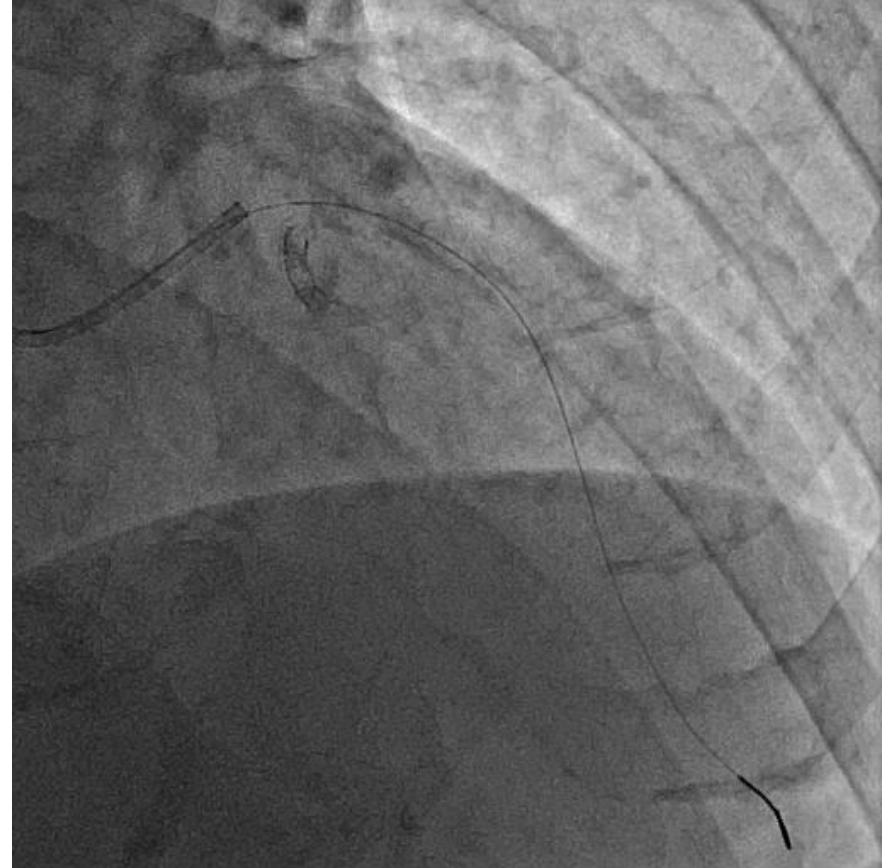
R/S > 70% !!!

2nd Case – Increase balloon size (NC 3.0 x 15 mm and Cutting Balloon)

Around 20 times

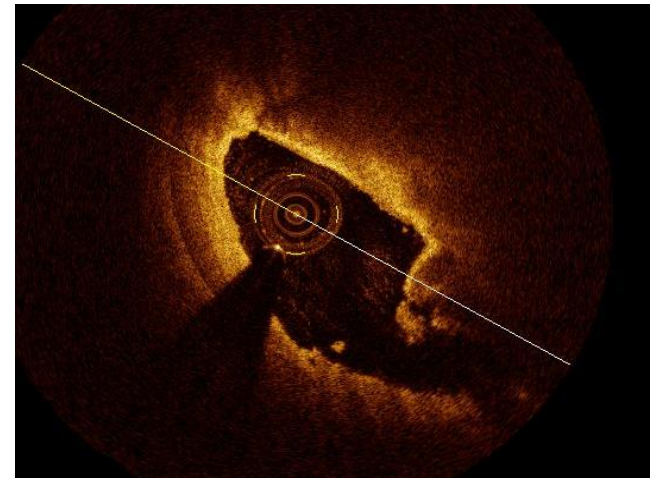
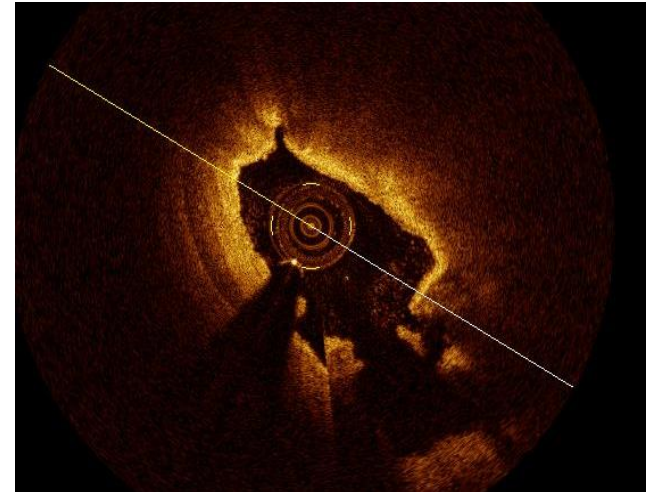
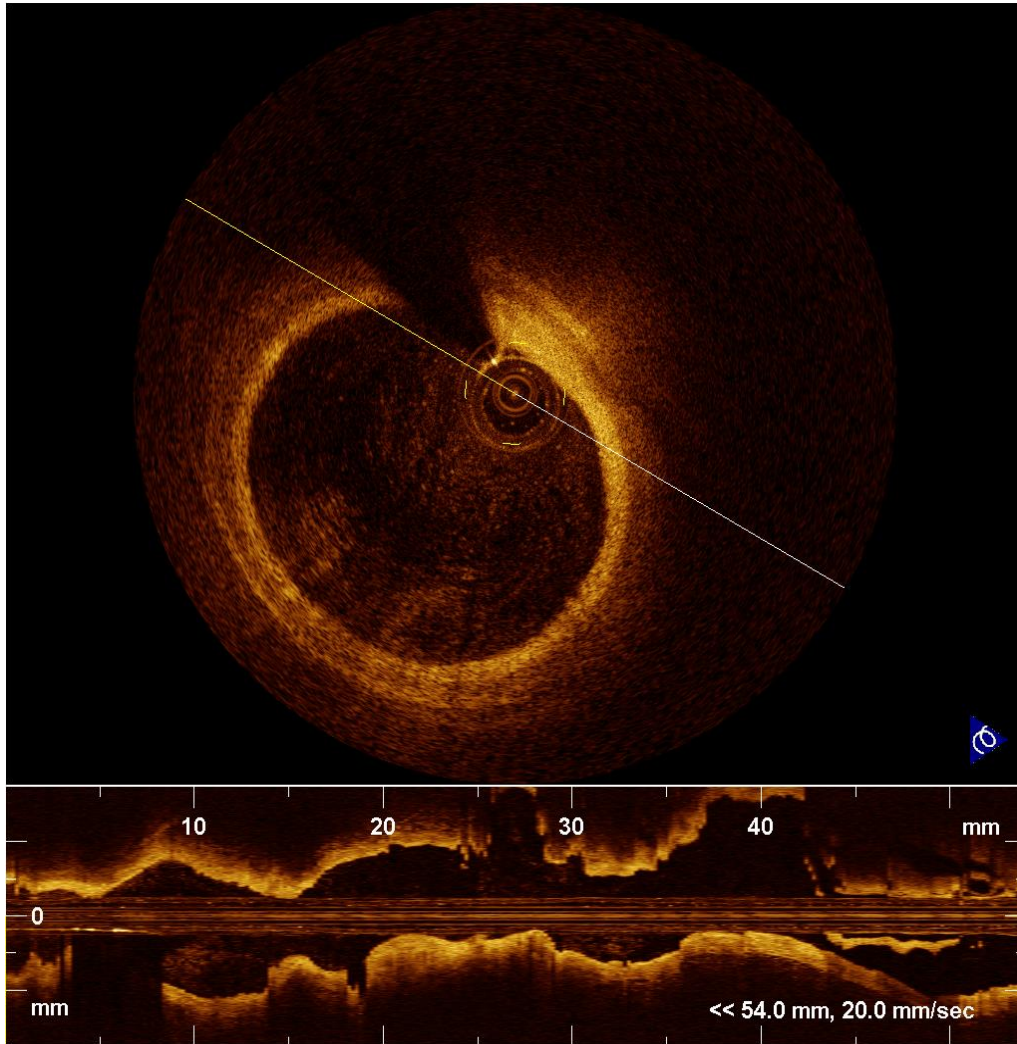


3.0*15 NC Balloon



But, R/S > 60% !!!

2nd Case- OCT - Post balloon



The Role of Cutting balloon or scoring balloon

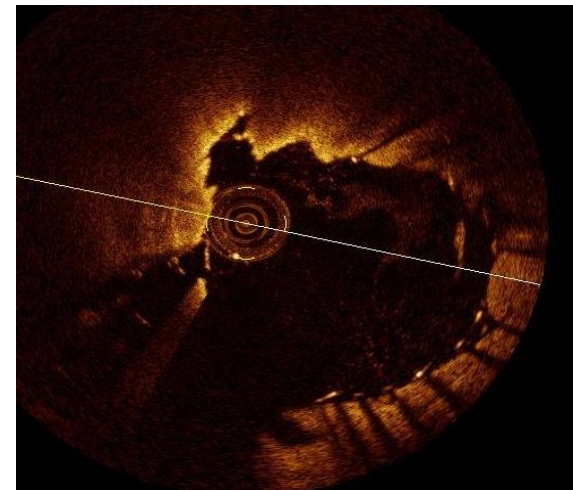
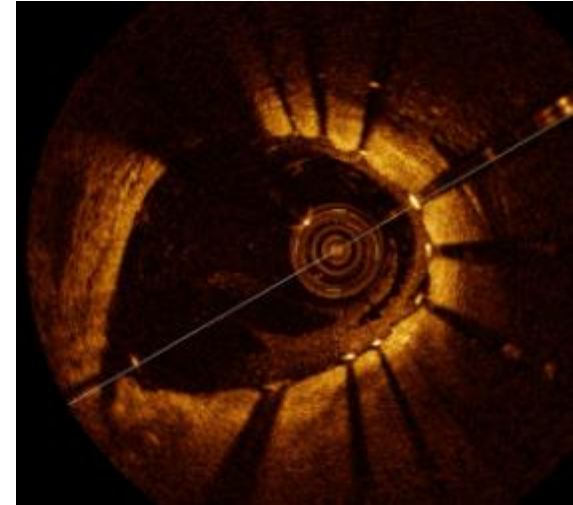
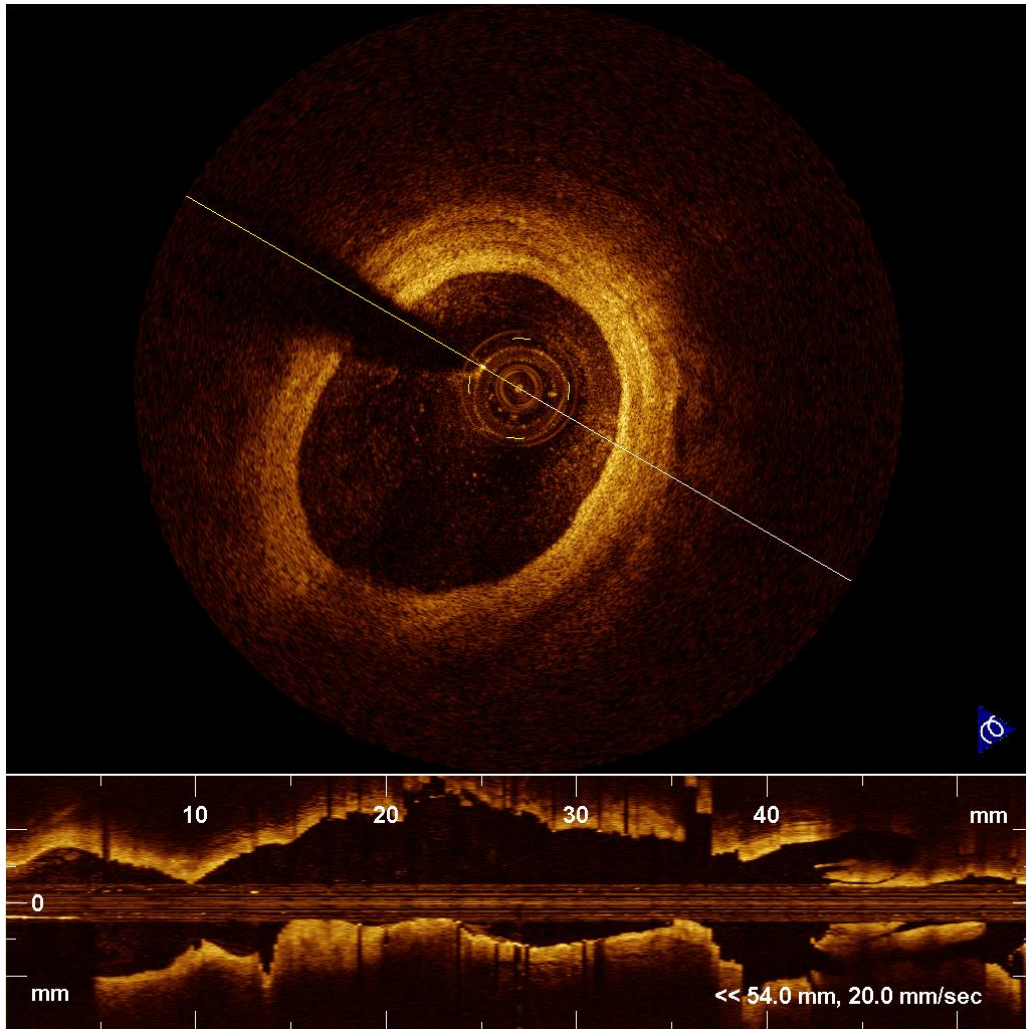
- **We expect** an improve vessel compliance by creating discrete incisions in the plaque, enabling greater lesion expansion and reducing recoil while preventing uncontrolled dissections.

2nd Case - Stent Implantation



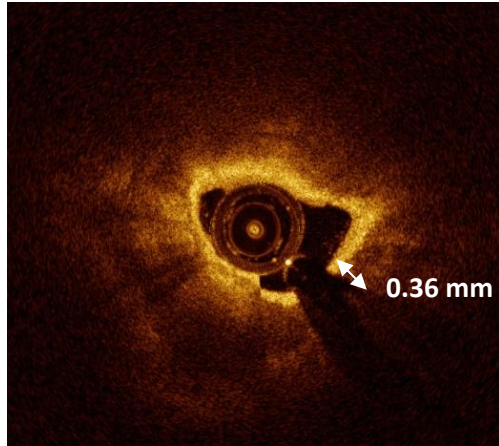
Xience Xpedition 3.5*15

2nd Case- OCT – post stenting



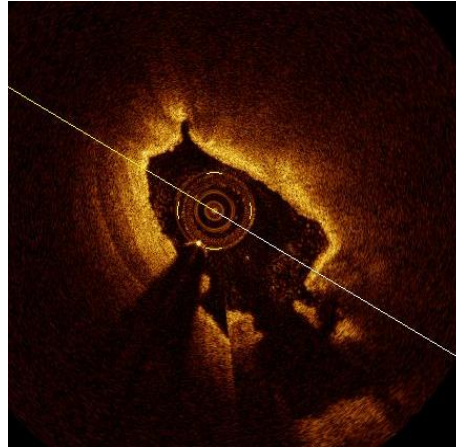
2nd Case

Pre



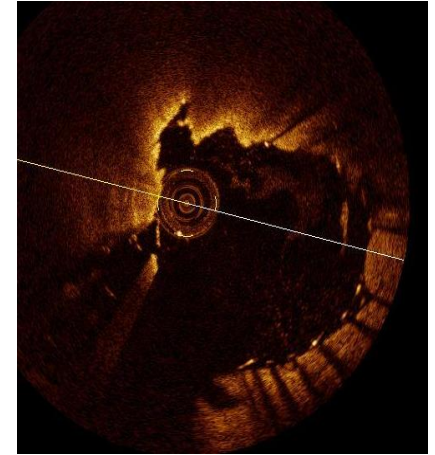
Lumen Area 1.18

Ballooning

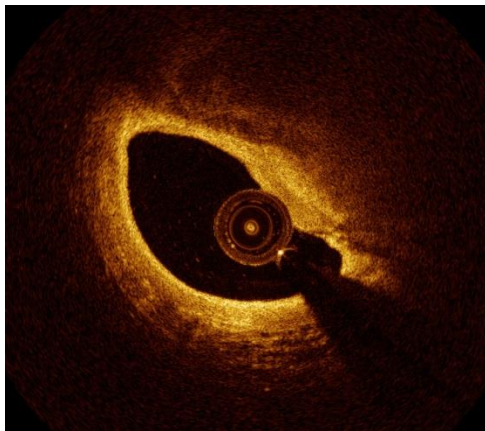


Lumen Area 4.36

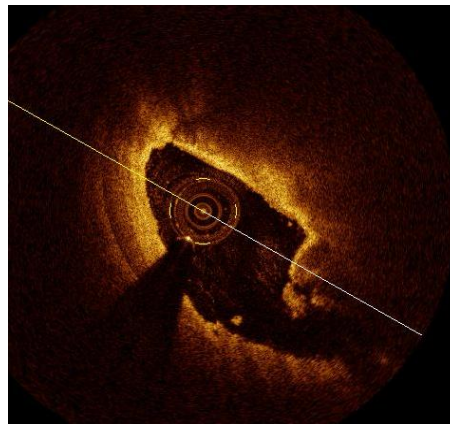
Stenting



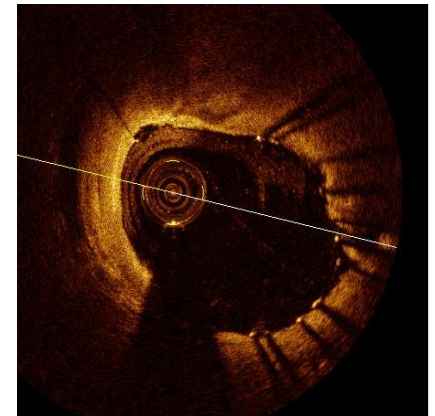
Stent Area 8.32



Lumen Area 3.53



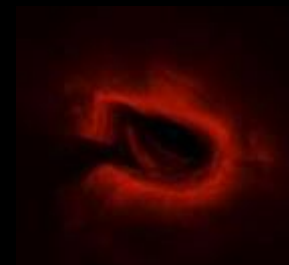
Lumen Area 4.3



Stent Area 8.04

3D OCT image

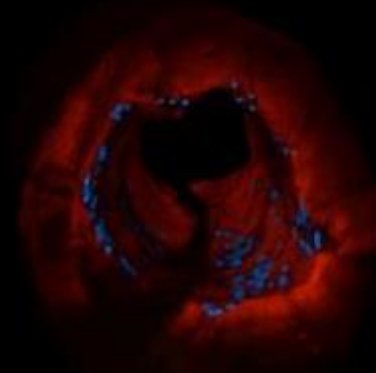
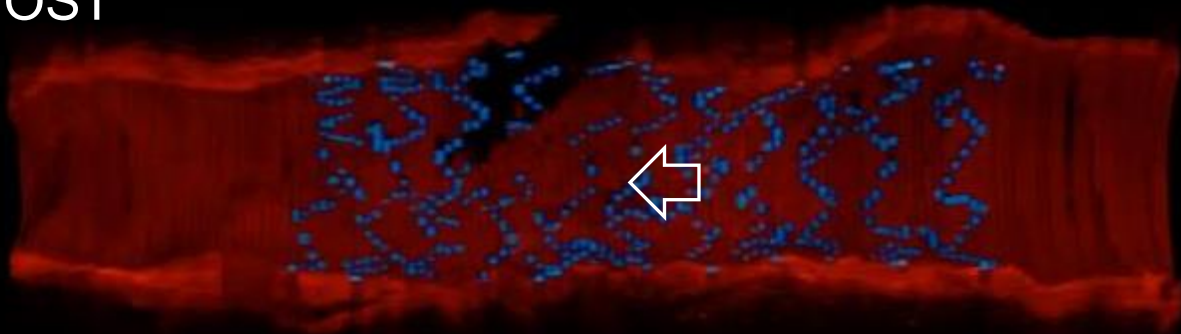
PRE



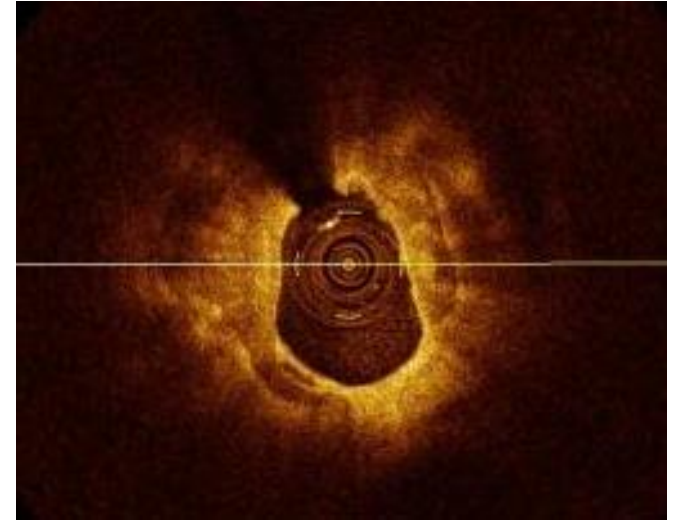
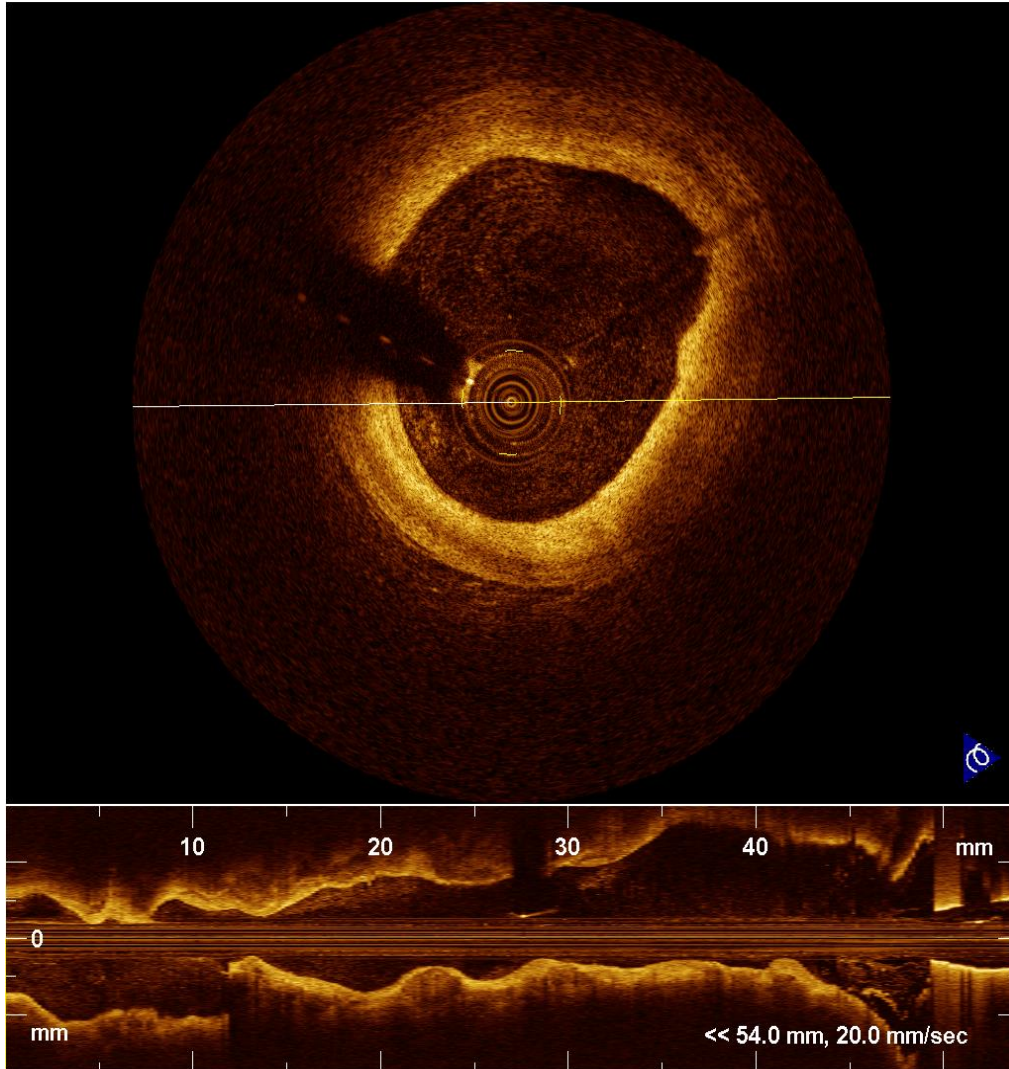
Balloon expansion



POST

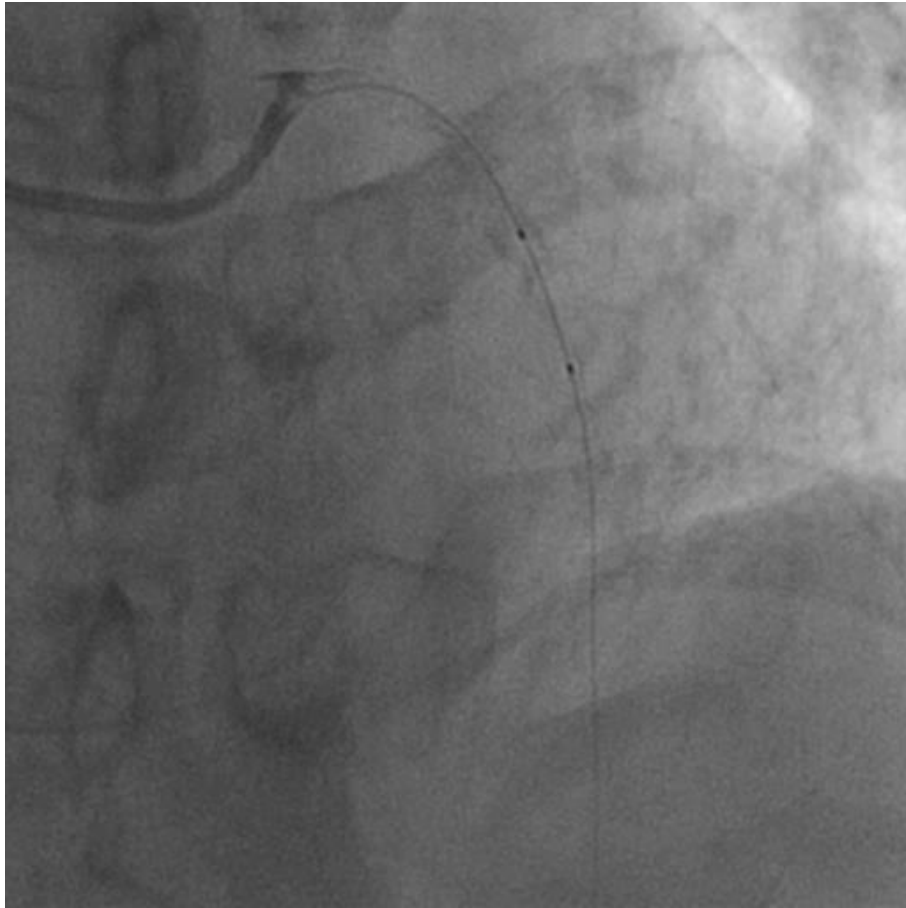


3rd Case- OCT finding Pre-Intervention

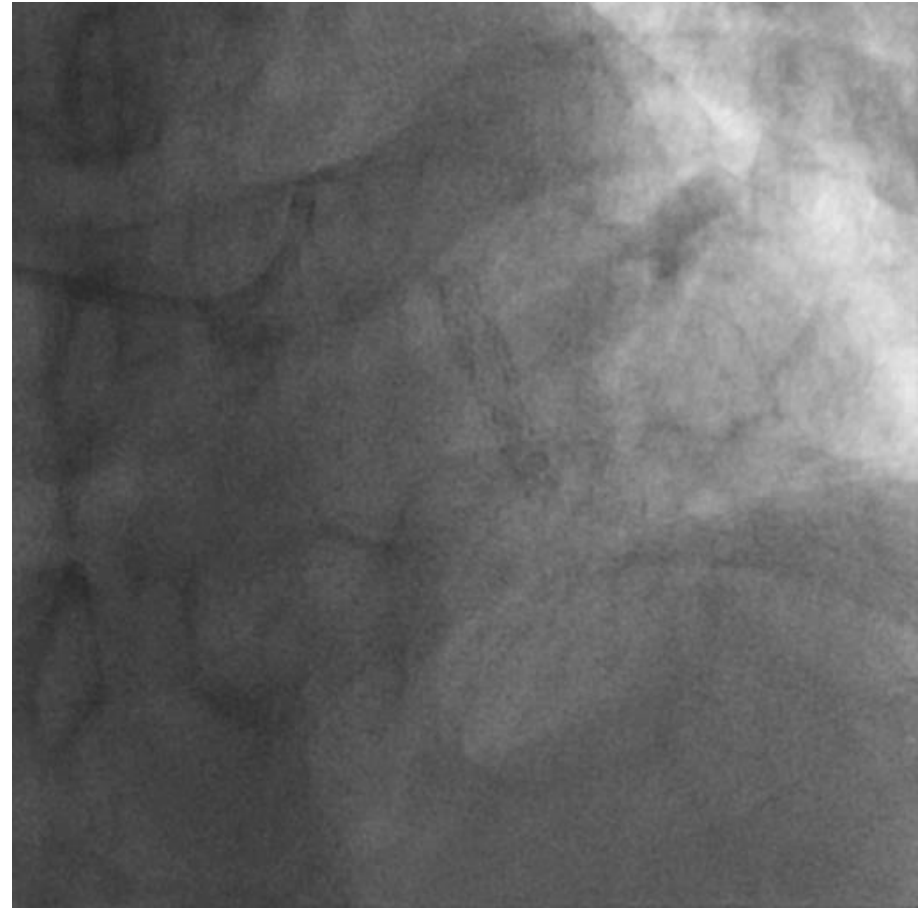


**Not encircling and
superficial thin
calcification**

3rd Case – Just Balloon angioplasty and stenting

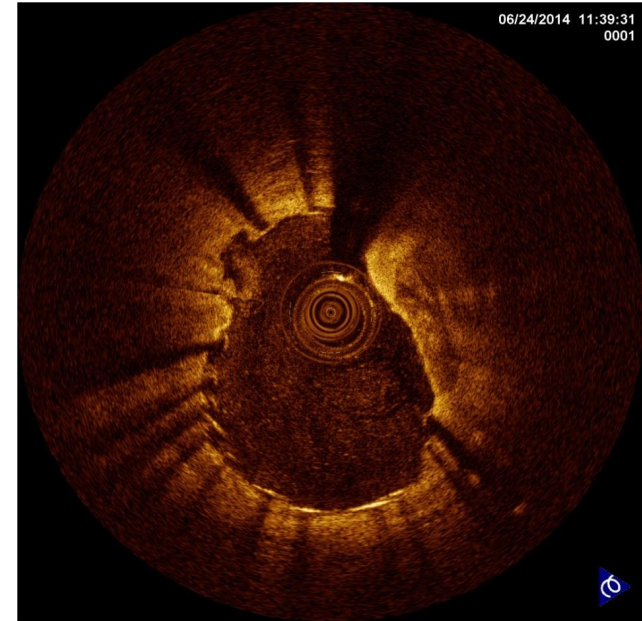
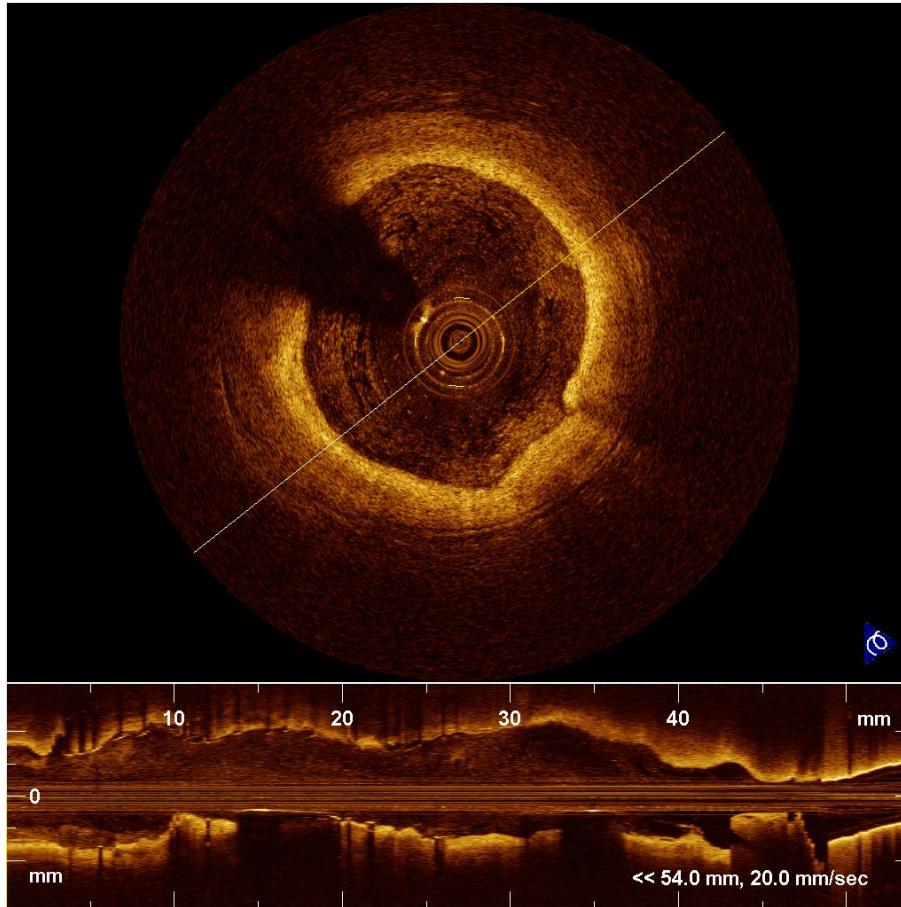


**2.0 * 15 and 3.0*15 NC
Balloon**



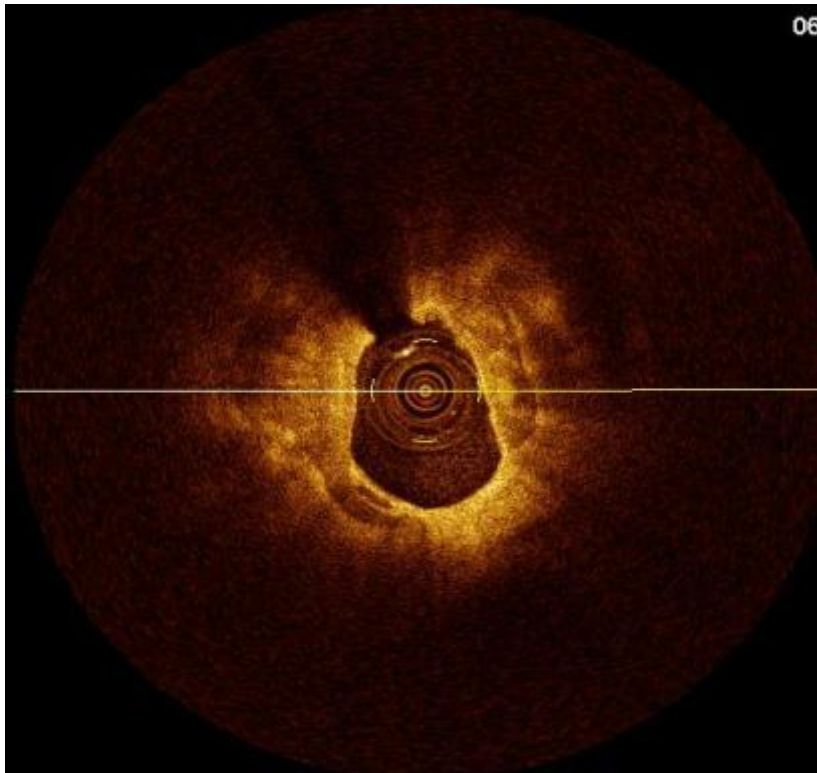
Biomatrix 3.5 x 24

3rd Case - OCT - Post Stenting



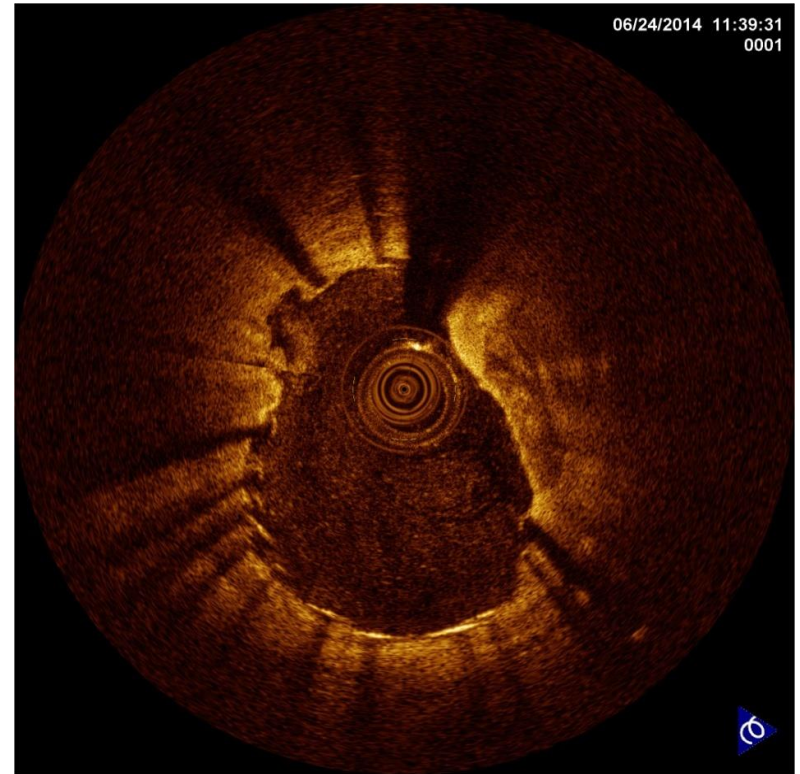
3rd Case

Pre



Lumen Area 1.64

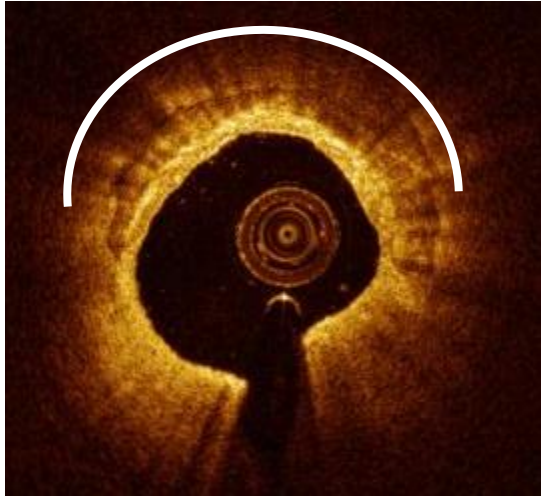
Post-Stent



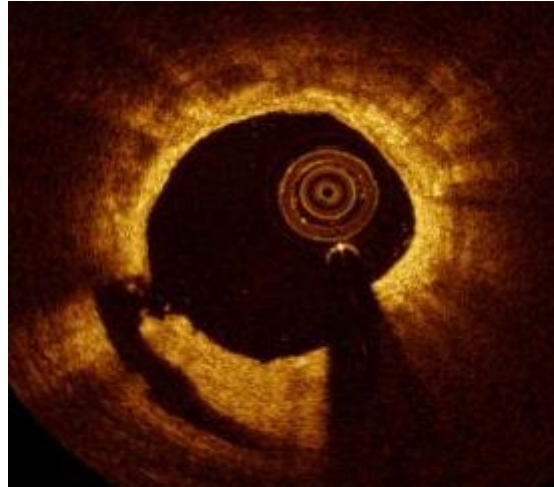
Stent Area 5.99

Possible Dissection Point

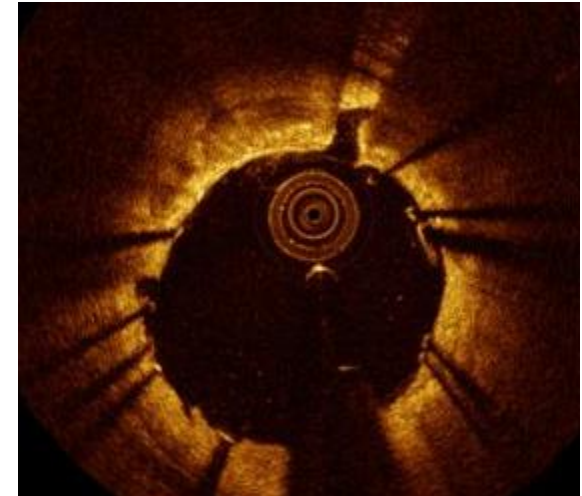
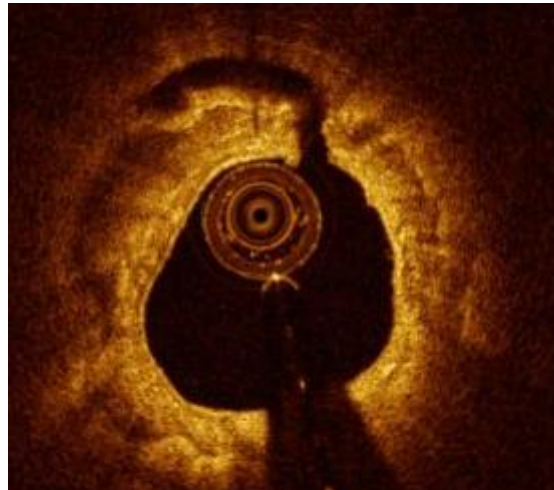
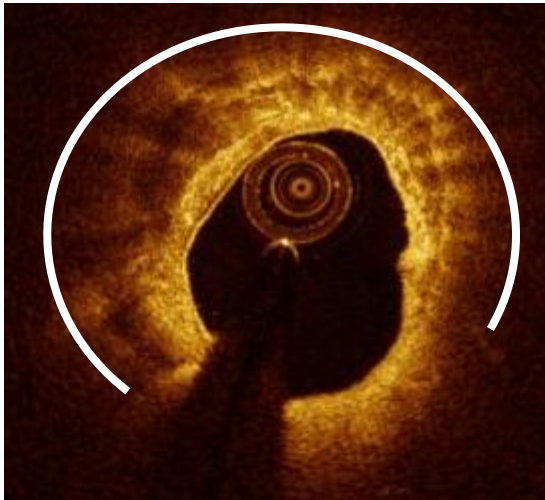
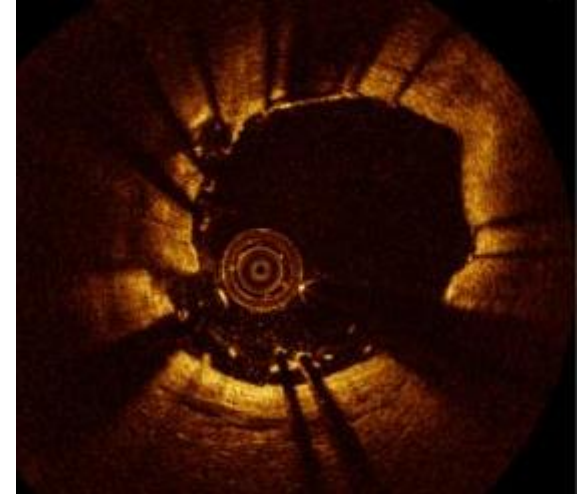
Pre



After Ballooning



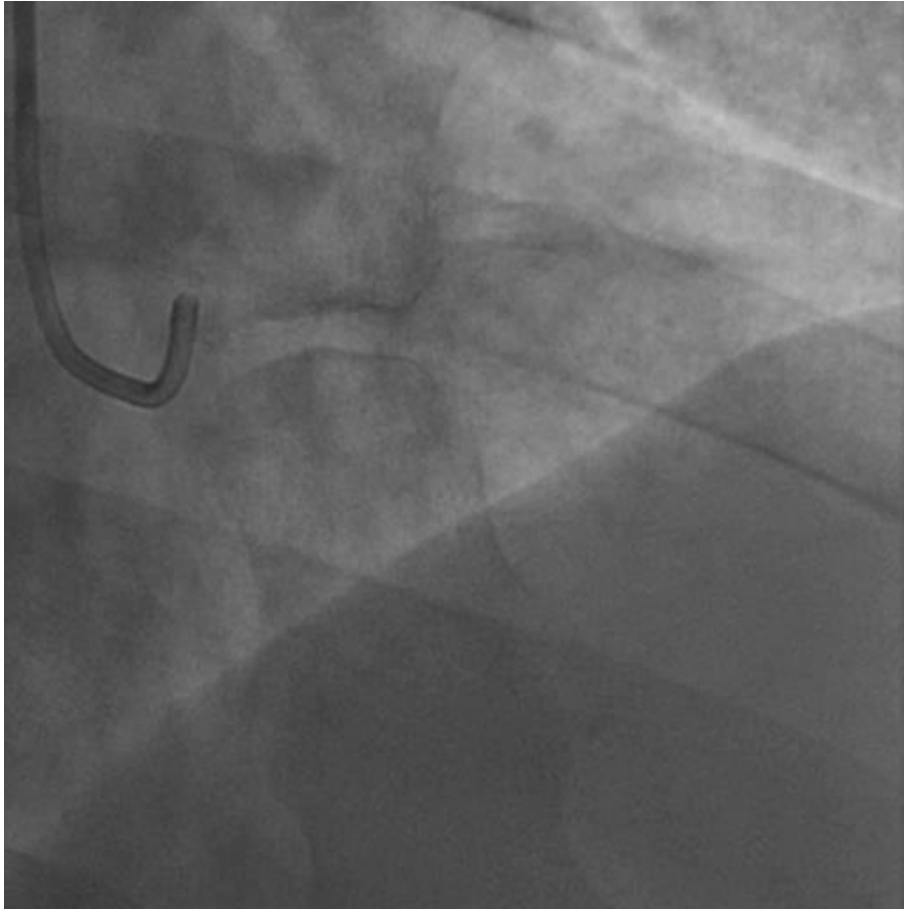
Stent



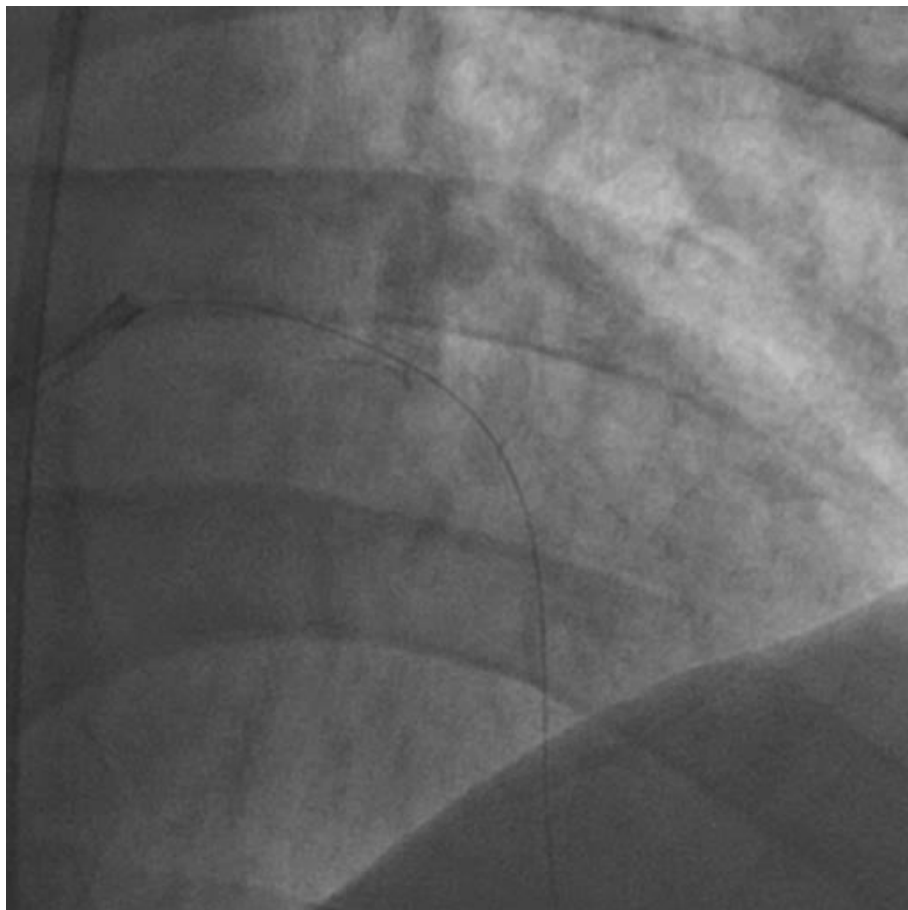
Calcium is the Possible Cause of Haziness

- **The presence and extent of calcium in coronary lesions is directly related to the appearance of questionable (“hazy”) images on conventional angiography, especially in eccentric lesions.**

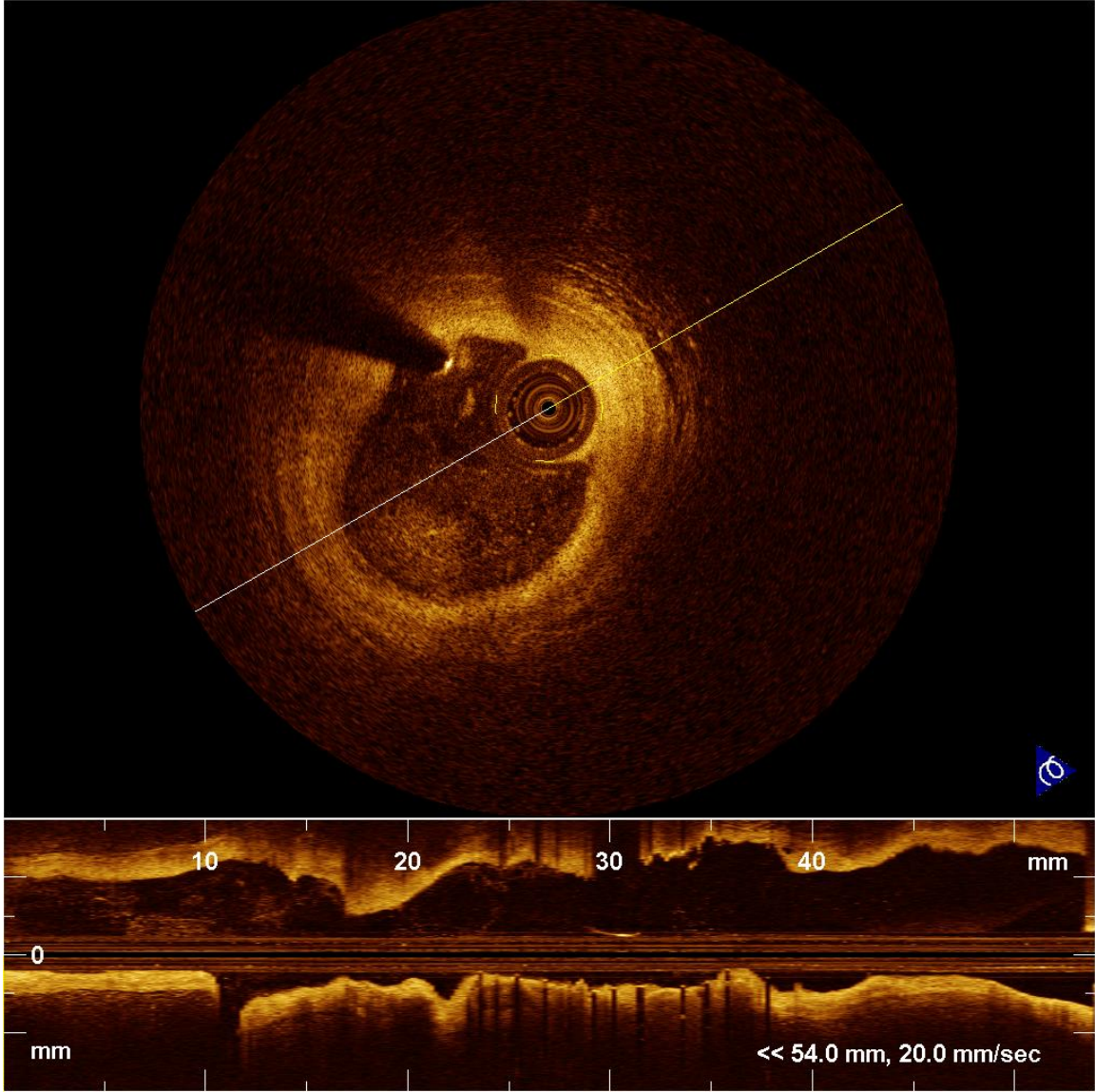
Initial Angiography



Osorio 2.75x15



OCT Evaluation



Take Home Message

- **RA is a reasonable strategy in calcified lesions that are not crossable by a balloon catheter and OCT can evaluate the result of RA.**
- **If OCT catheter is able to pass the lesion, OCT can provide a useful information to decide a strategy (Location, arch, depth and thickness of calcium).**
- **However, due to the method's low penetration, calcium plaques not exceeding 1.0–1.5 mm in thickness can be precisely assessed.**