Left main PCI
Simplfying the procedure

TCTAP 2023

Patrick Lim, Singapore

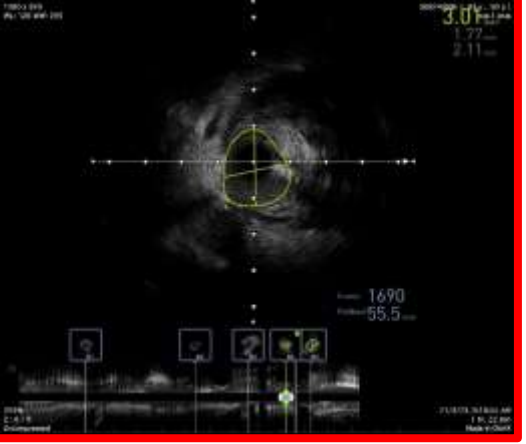
Disclosures

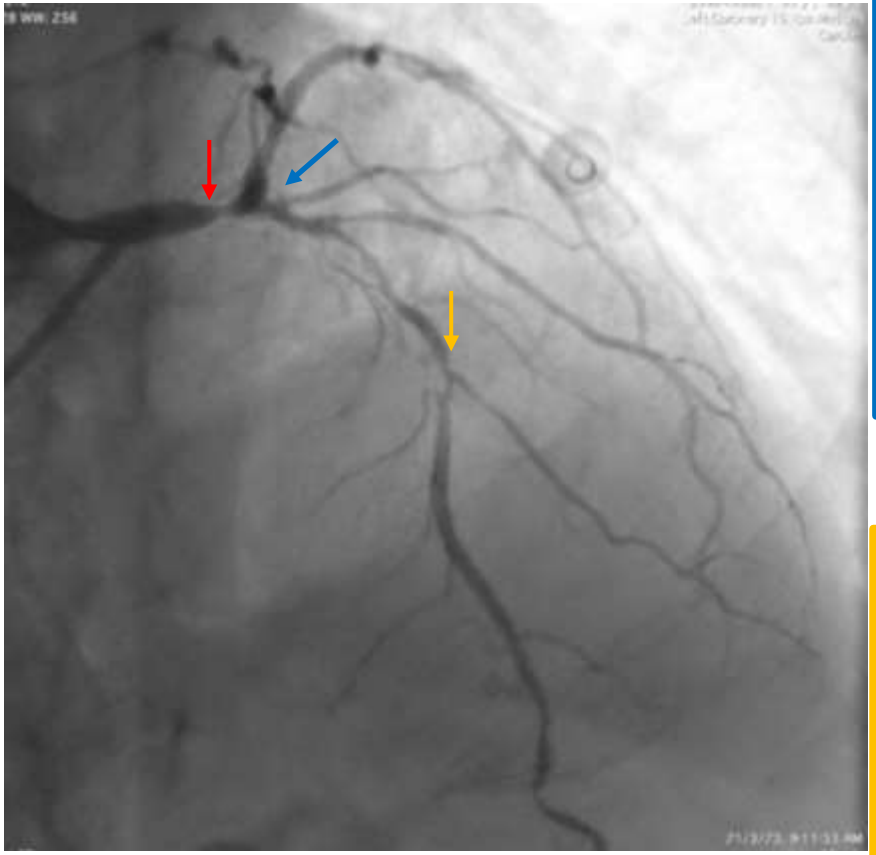
- None

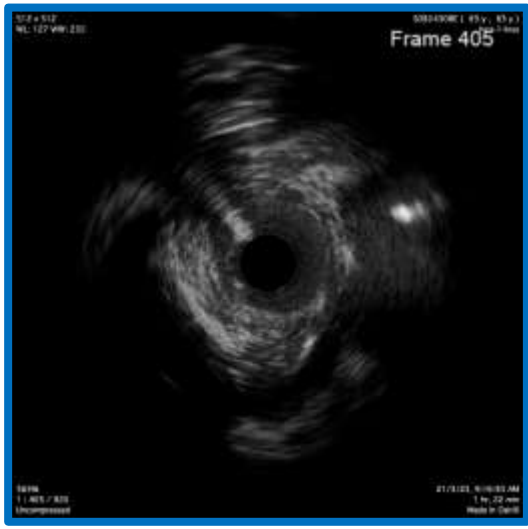
Case 1

- 83 male
- CCS III. Declined CABG
- PCI RCA.
- Planned staged PCI LMS/LAD/ Cx

Diagnostic images

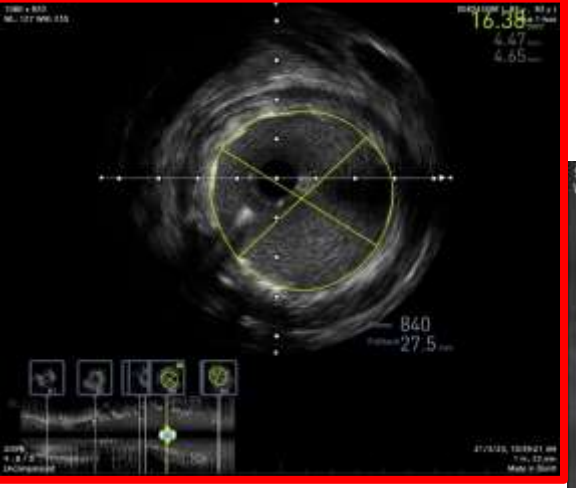


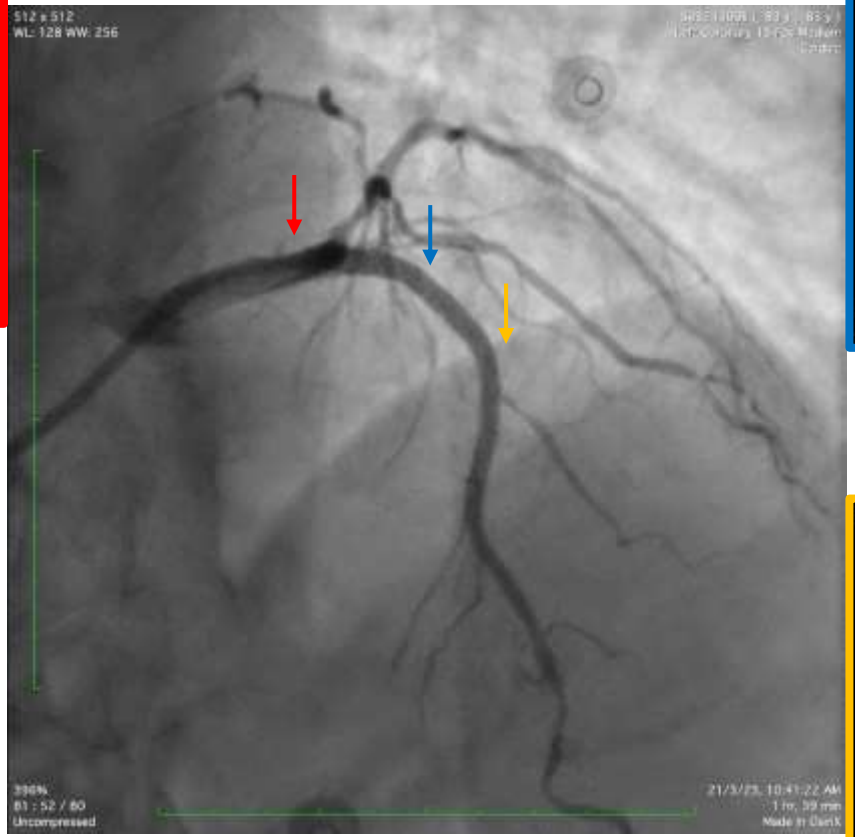


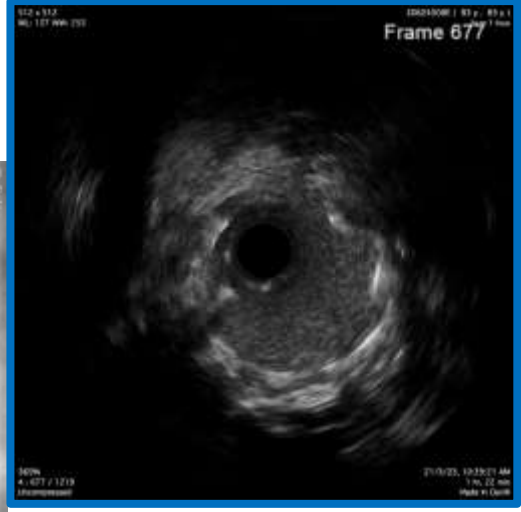


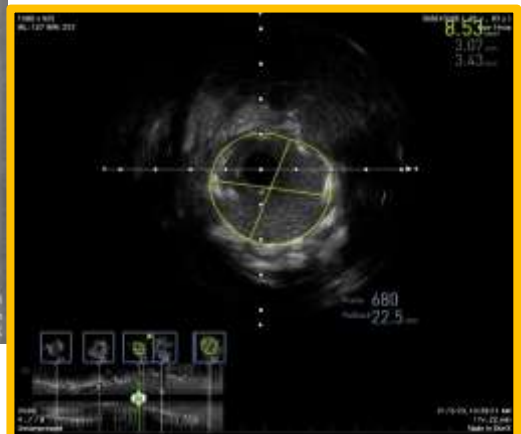
- dLM 3
- mLAD 2.2
- osCx 4
- Non calcified plaque

Post PCI







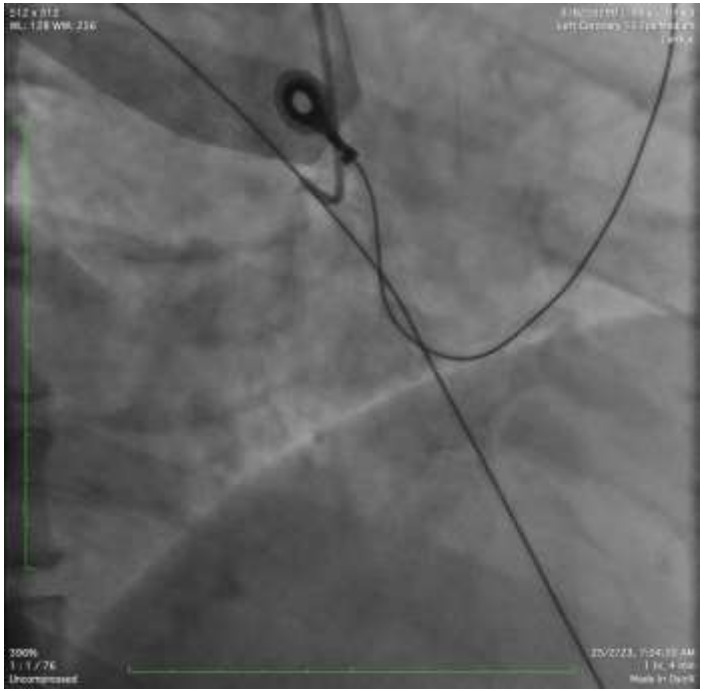


- LM 16.4
- mLAD 8.5

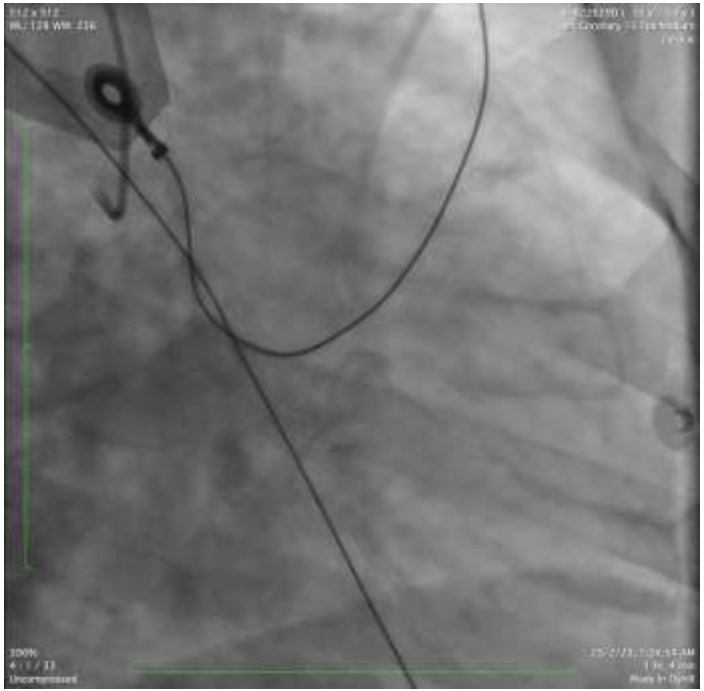
Case 2

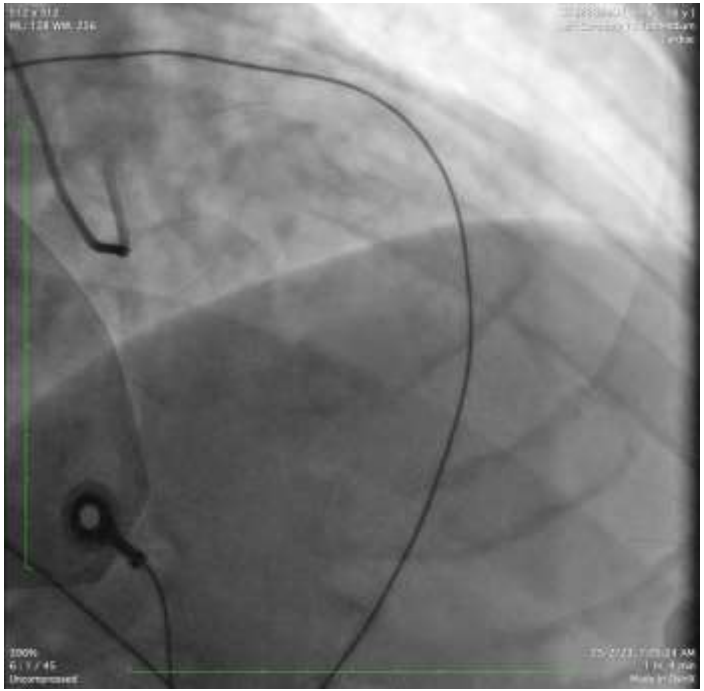
- 55 Male
- Anterior STEMI

Diagnostic

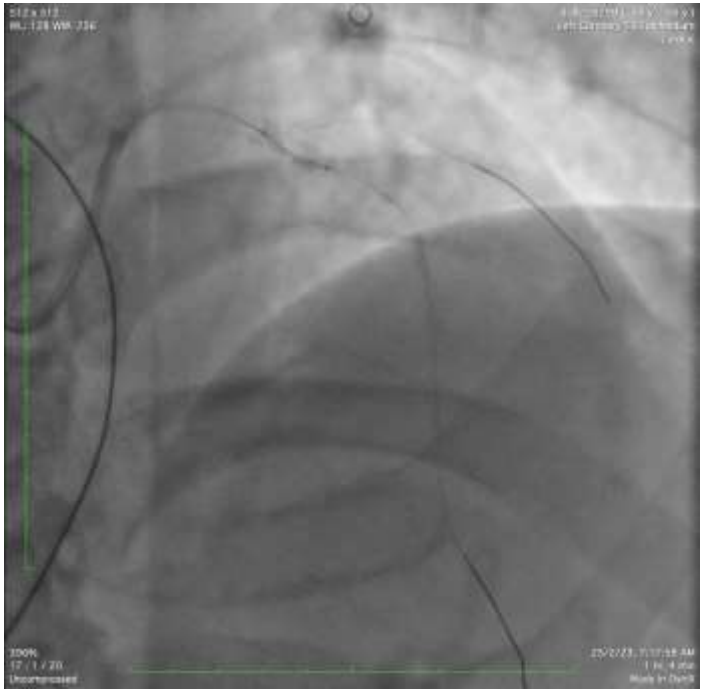


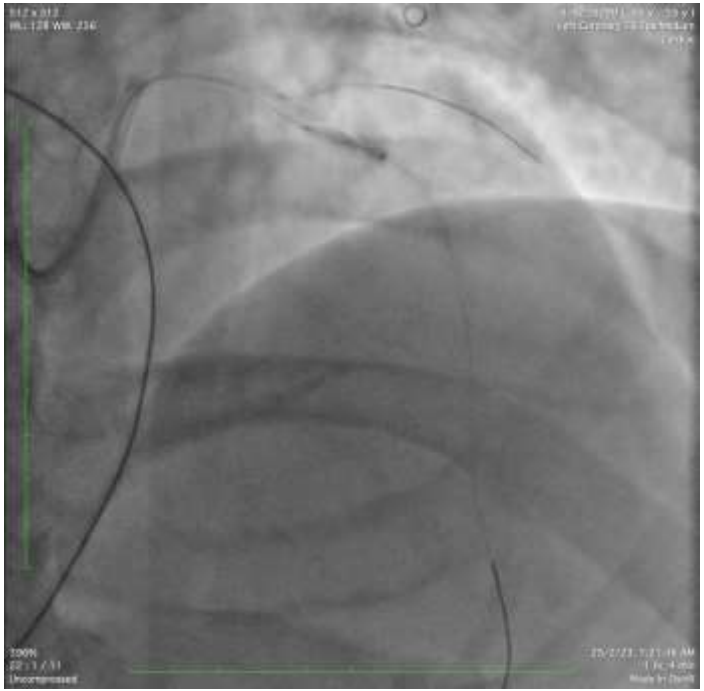
Diagnostic





POBA





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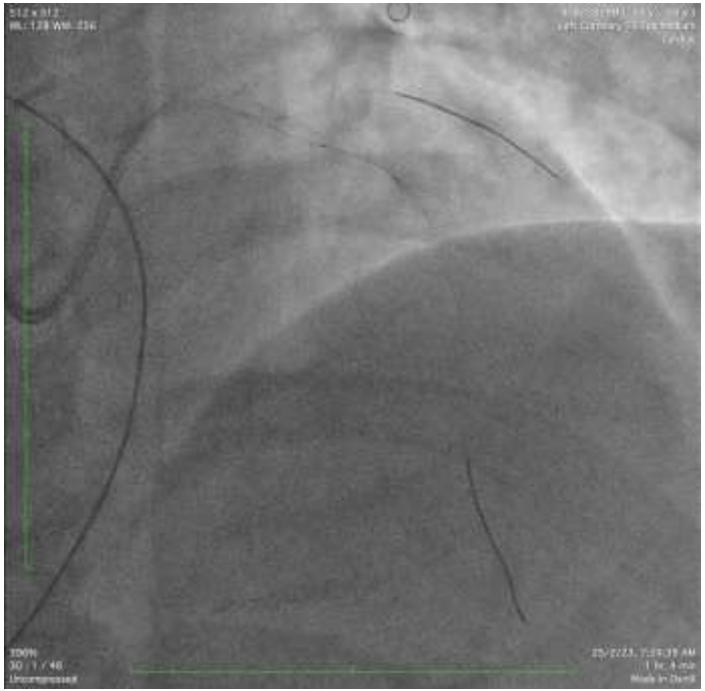
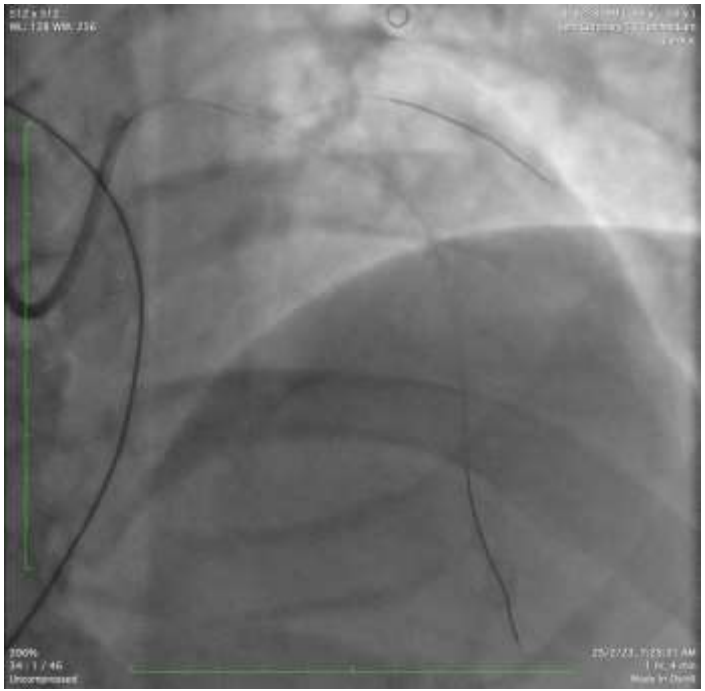
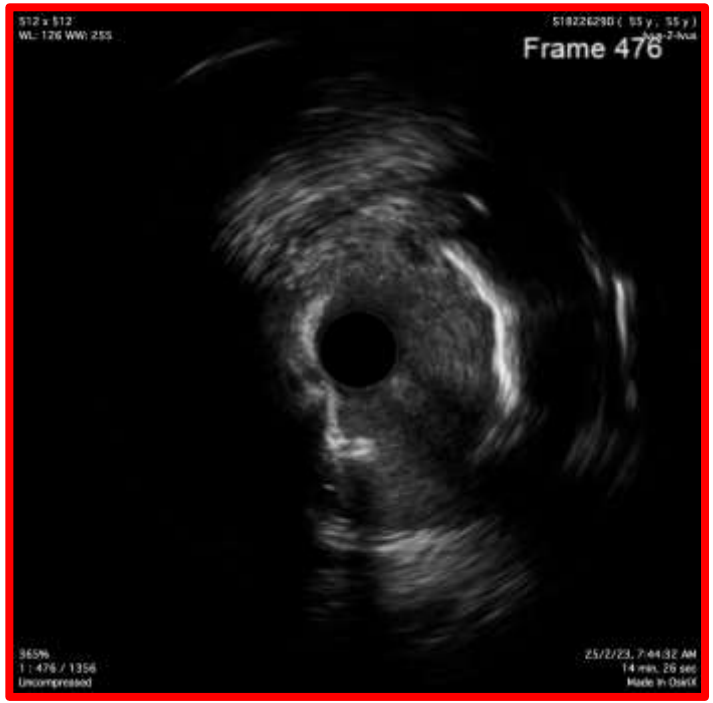




IVUS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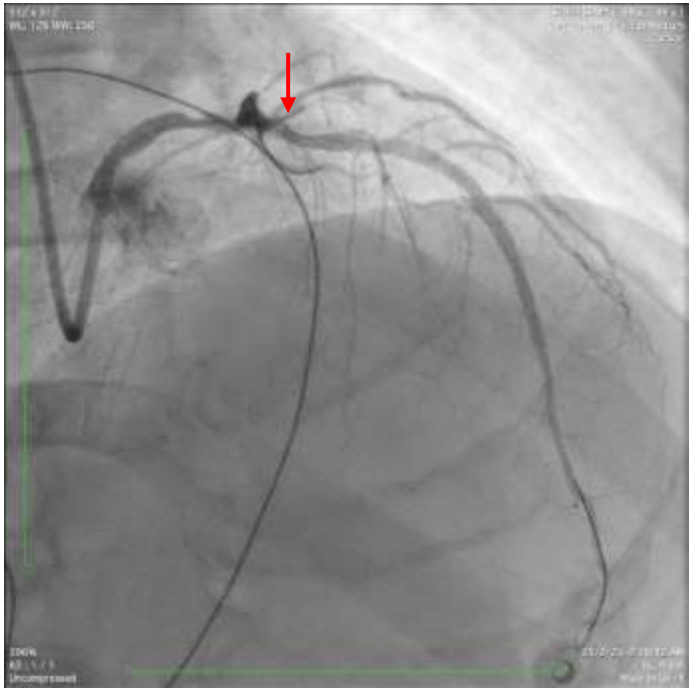
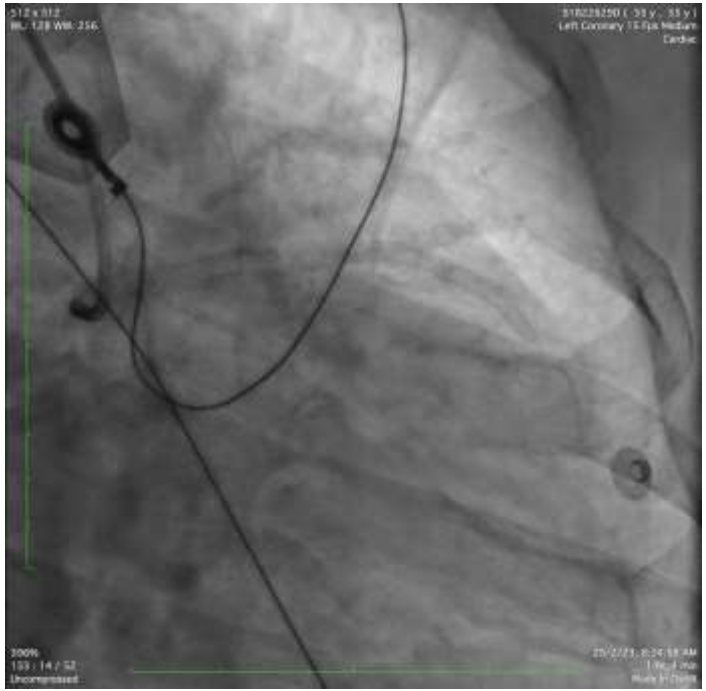
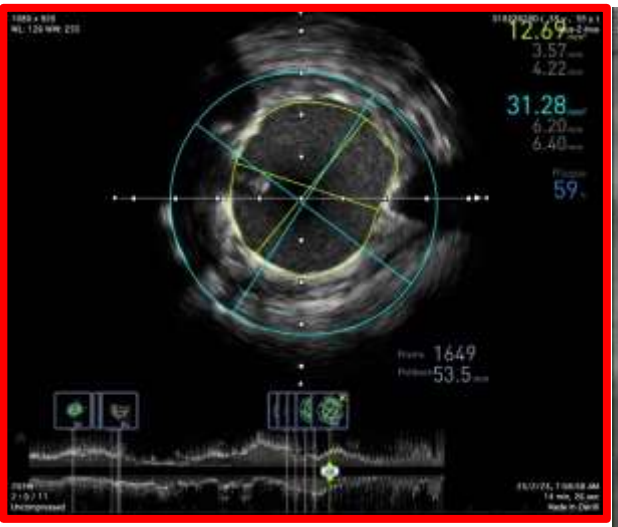
Frame 476
365%
1 : 476 / 1356
Uncompressed
25/2/23, 7:44:32 AM
14 mm, 26 sec

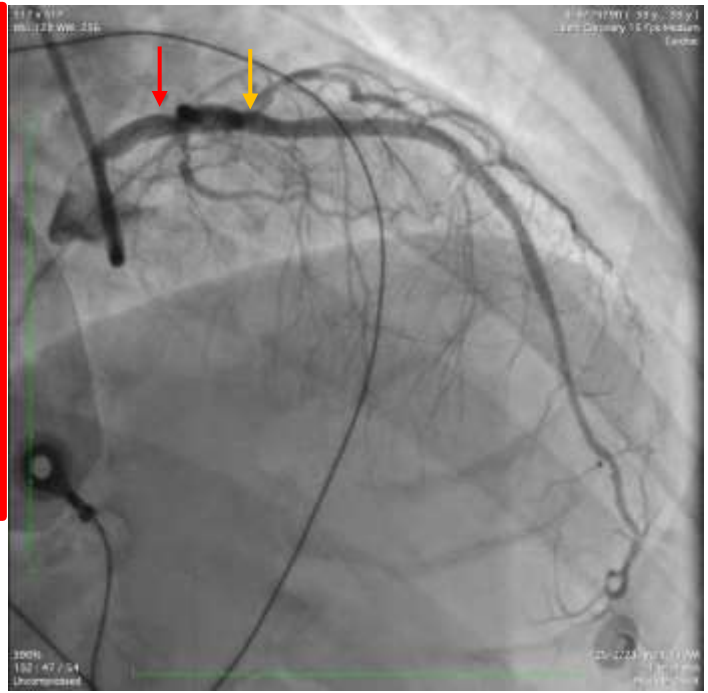


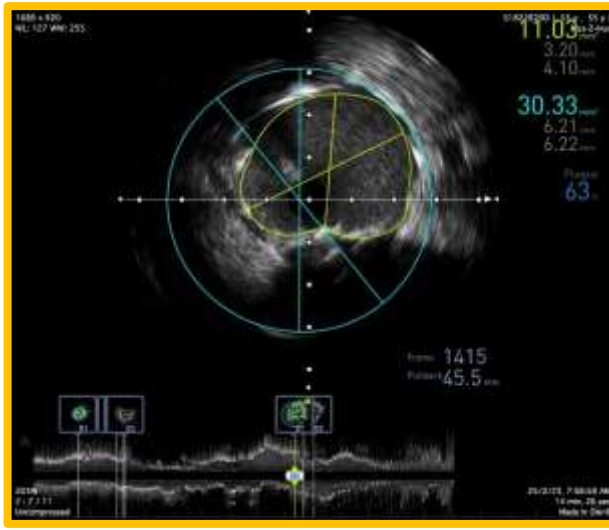
Post PCI



Post PCI





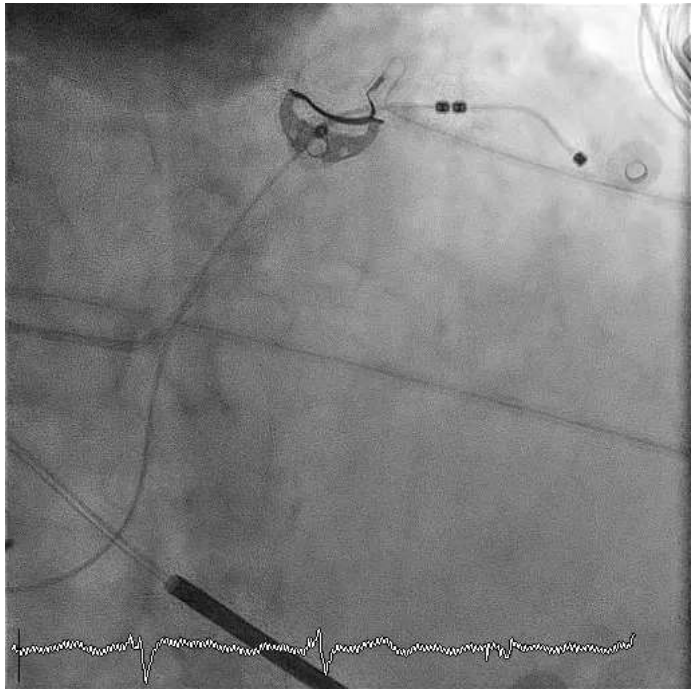


- LM 12.7
- oLAD 11

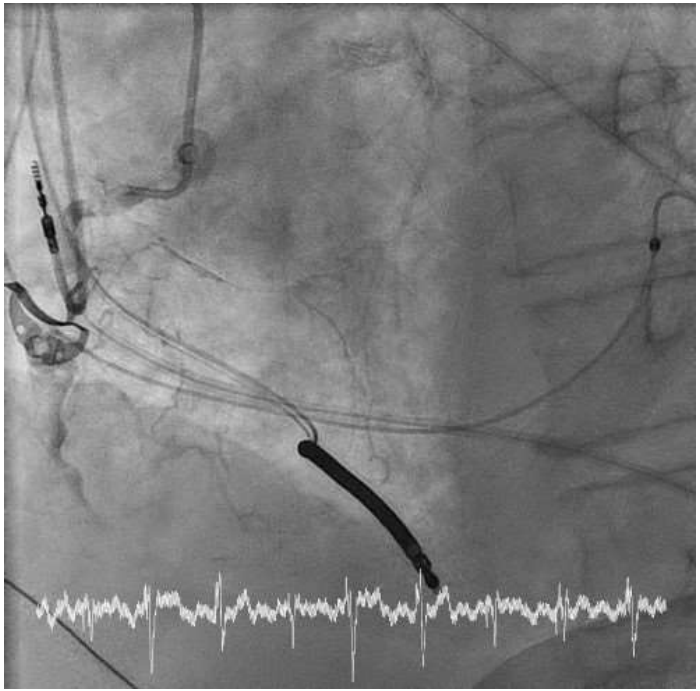
Case 3

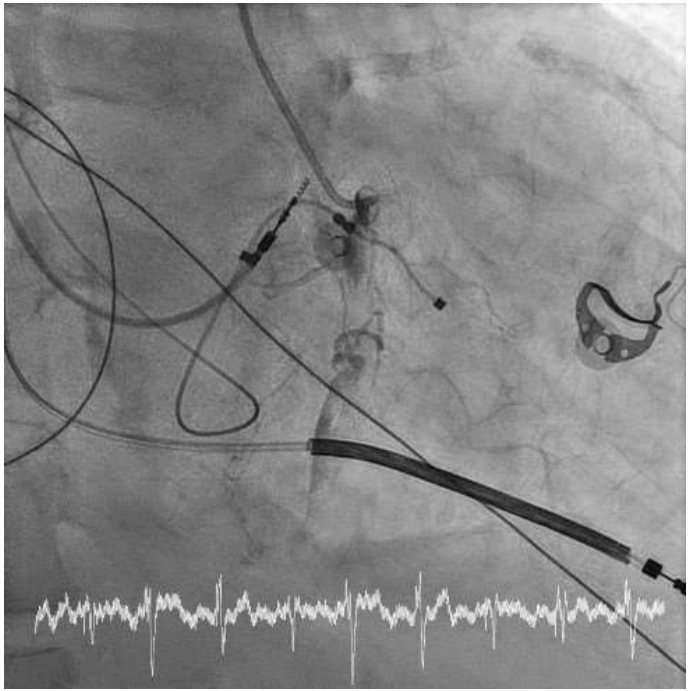
- 82 Male
- CRT D inserted 2017.
- Recurrent ventricular tachycardia despite 2 anti arrhythmics
- LVEF 30%-> 20%
- Robust and independent prior

Diagnostic

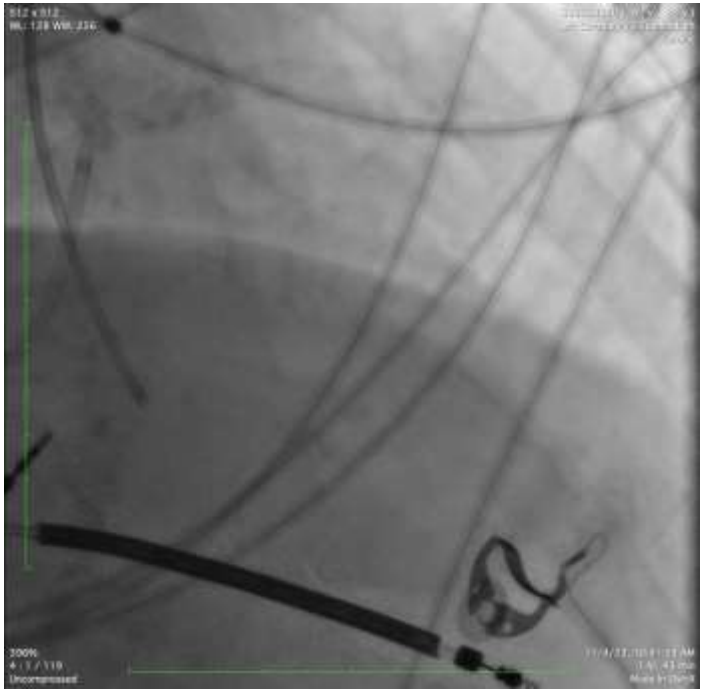


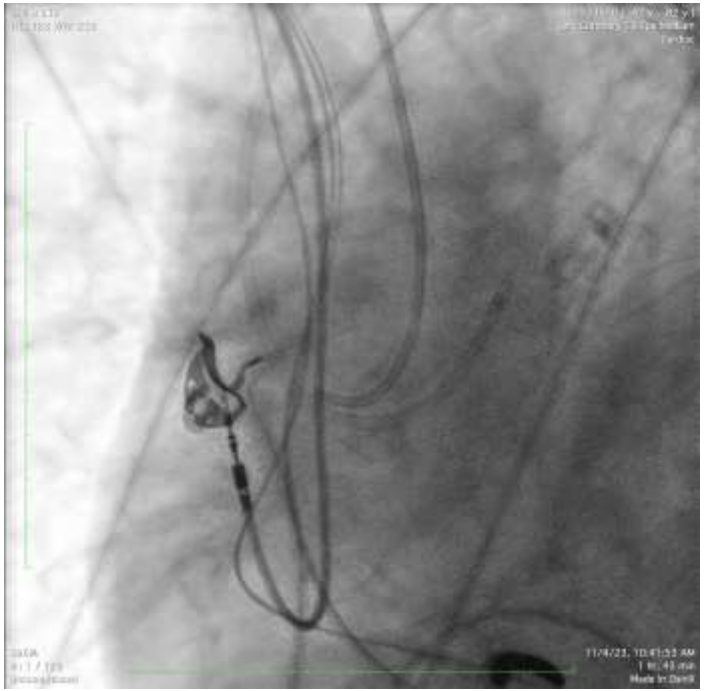
Diagnostic



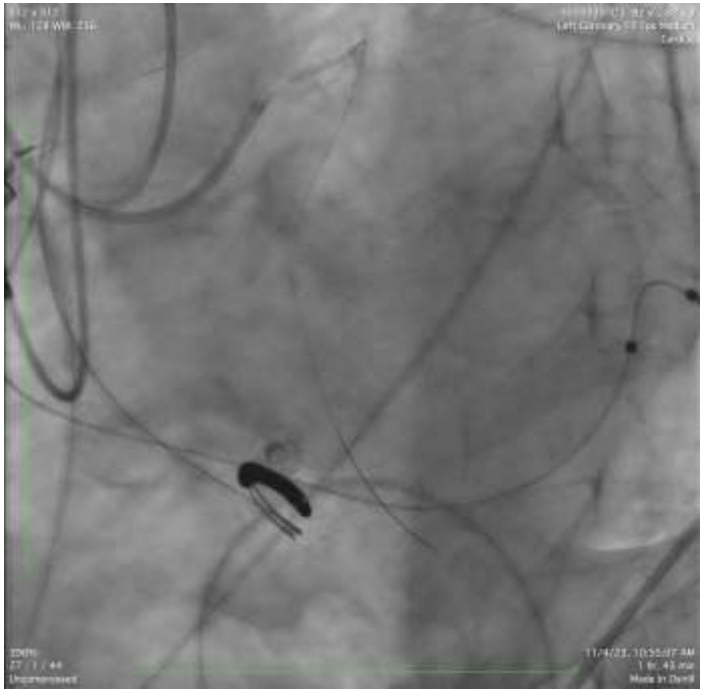


PCI

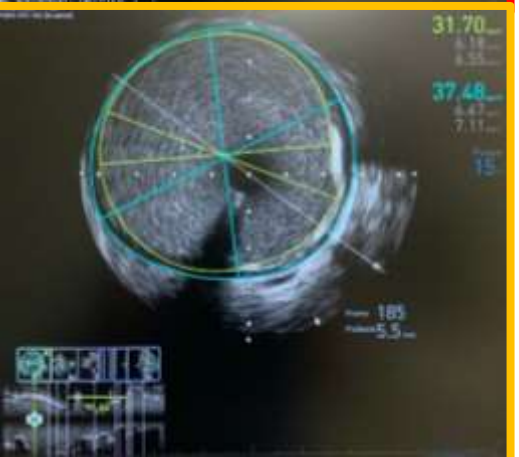


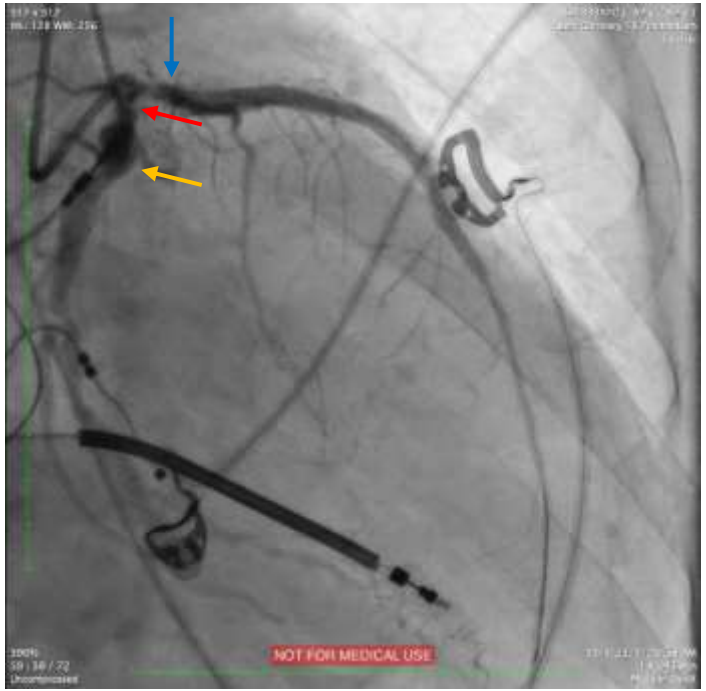


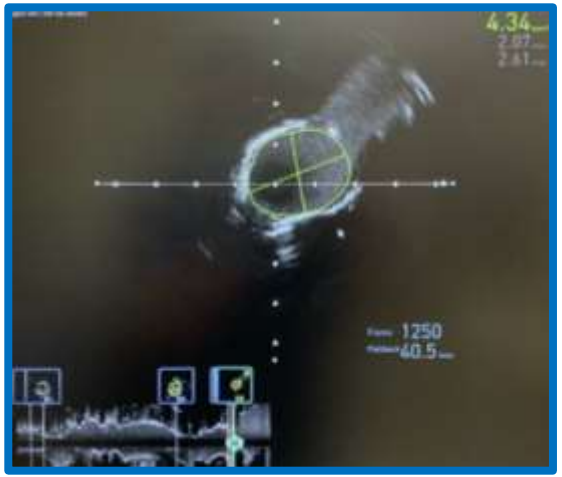
PCI- Post POBA



IVUS

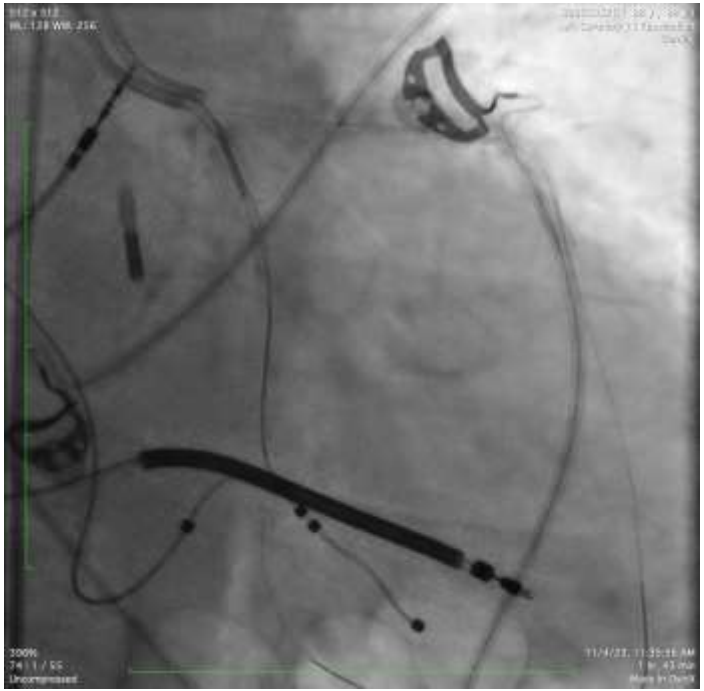


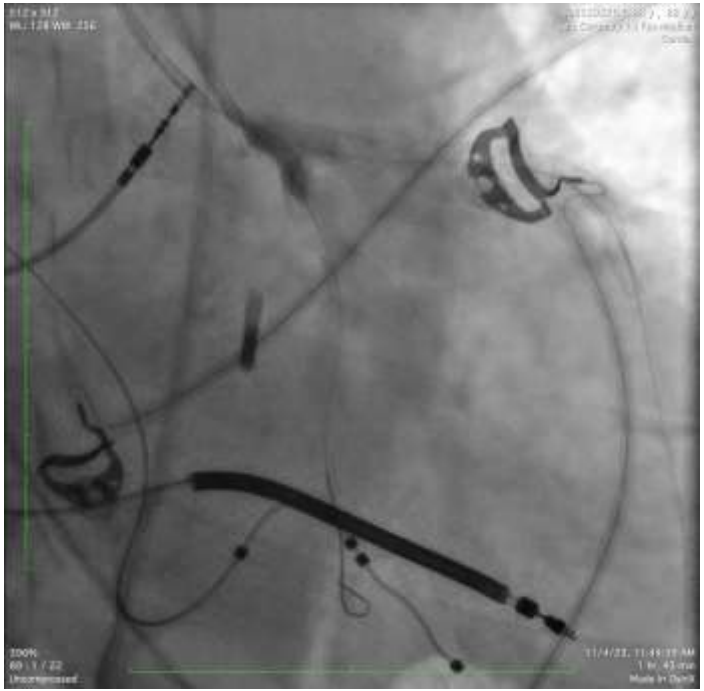




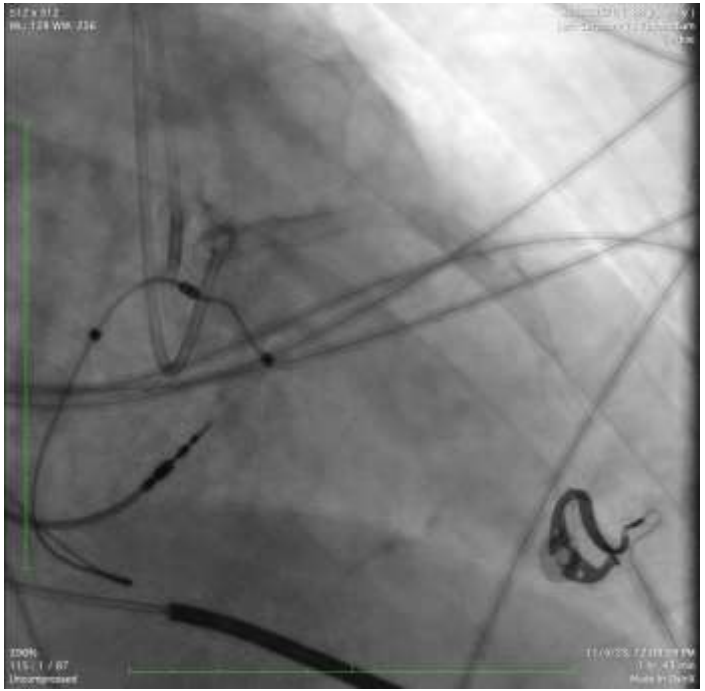
- Cx aneurysm 6.1mm X 6.5mm.
- oCx 3.16mm2
- oLAD 4.34mm2

PCI

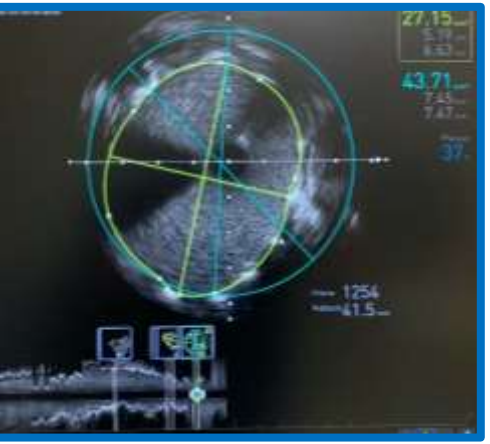


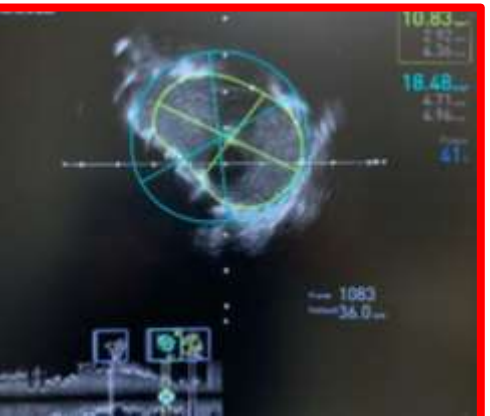


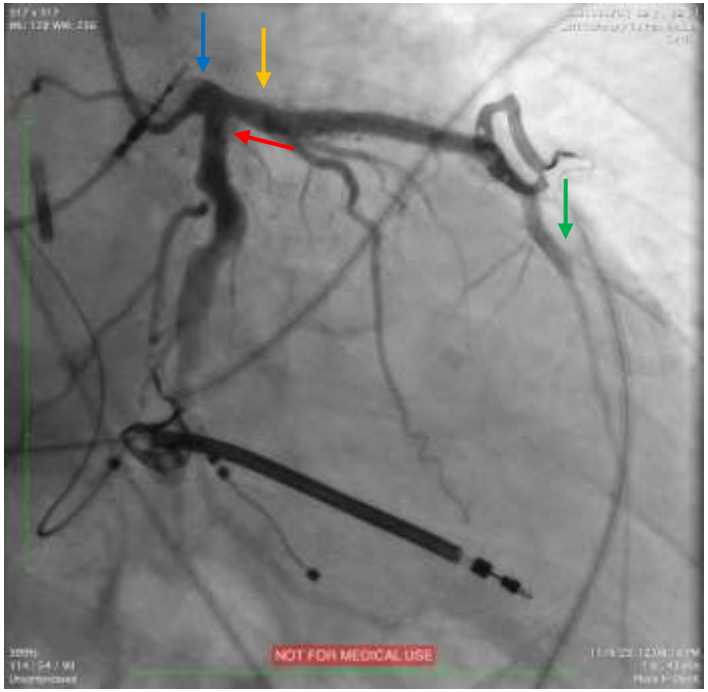
Final images



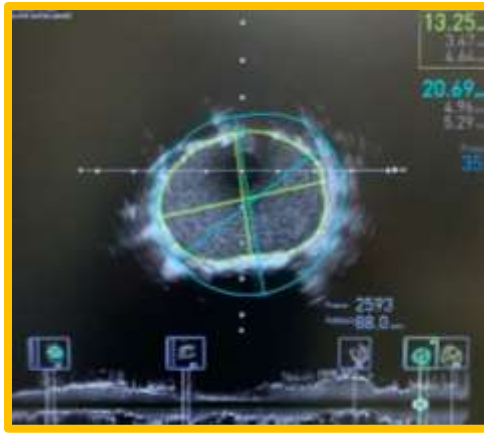
Post PCI

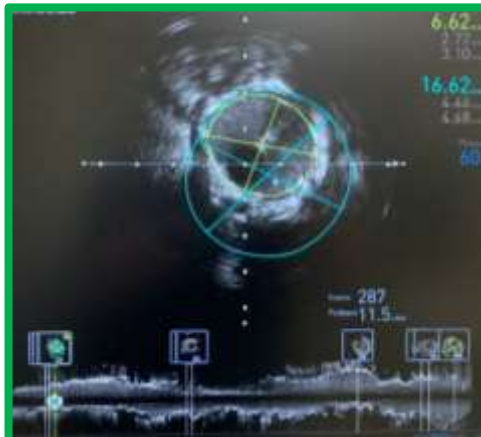






- LM 27.1
- mLAD 6.6, oLAD 13.3
- oCx 10.8





Left main PCI can be straightforward…

- As long as we have a consistent framework

Thinking about it…

1) Haemodynamics and anatomy? - MCS
2) Resolving angiographic ambiguities – Imaging
   - Plaque distribution/ characterization
   - Complex/Simple bifurcation
   - Stent sizing/length
3) Lesion preparation
4) Choice of stent platform with left main data
5) Optimised?

Haemodynamics and anatomy

Upfront MCS should be considered in patients:

- Sole surviving artery
- Severe LV impairment
- Shock

Resolve the ambiguity…

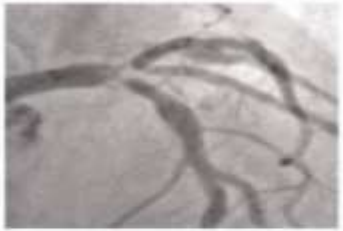
Take out the IVUS

- Define the plaque
- Define the bifurcation
- Have the end in mind (Stent size/ length/ strategy)

Defining complex: Beyond 1,1,1 and 0,1,1

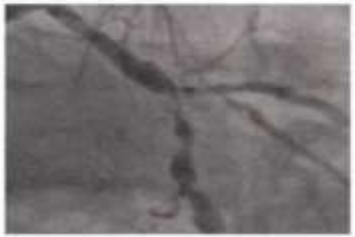
DEFINITION study: Complex bifurcation lesions

LMS lesion with SB ≥70% and ≥10mm



or

Non - LMS lesion with SB ≥90% and ≥10mm

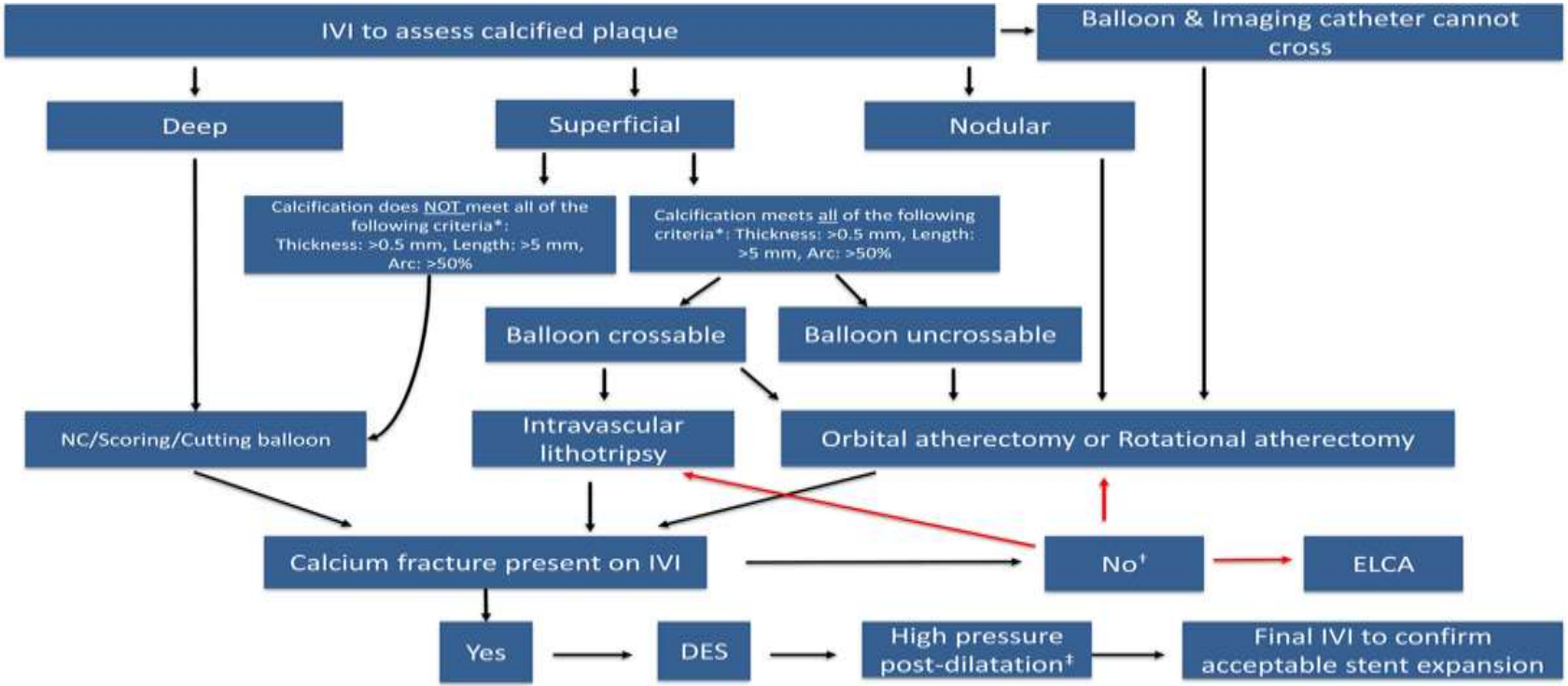


Any two of:

- ❑ Moderate to severe calcification
- ❑ Multiple lesions
- ❑ Active thrombus
- ❑ Bifurcation angle <45°
- ❑ MB reference diameter <2.5mm
- ❑ MB lesion >25mm length

The DEFINTION study: SL Chen, et al, Leon, M. JACC: Cardiovascular Interventions Volume 7, Issue 11, November 2014, Pages 1266-1276

Lesion prep



Evan Shlofmitz. Circulation: Cardiovascular Interventions. Intravascular Imaging-Guided Percutaneous Coronary Intervention, Volume: 13, Issue: 12, DOI: (10.1161/CIRCINTERVENTIONS.120.008686)

Choice of stent platform

Stent platform in CABG vs PCI LM trials

Table 1. Key randomized clinical trials comparing PCI versus CABG for LMCAD

	LEMANS[25,26]	Boudriot et al.[27]	SYNTAX-LM[28,29,30]	PRECOMBAT[31,33]	EXCEL[34,35]	NOBLE[36,37]
Enrollment time	2001–2004	2003–2009	2005–2007	2004–2009	2010–2014	2008–2015
PCI/CABG (patient number)	52/53	100/101	357/348	300/300	948/957	598/603
Available follow-up period (years)	10	1	5 (for MACCE); 10 (for mortality)	10	5	5
Diabetes (%)	18	36	25	32	29	15
Distal LMCA bifurcation disease (%)	58	72	61	64	81	81
Mean SYNTAX score	Not reported	23	30	25	21	22
Used stents	BMS and DES (35%)	DP-SES	DP-PES	DP-SES	DP-EES	BP-BES and DP-SES (7.7%)
IVUS guidance	Recommend	Infrequent	Infrequent	Recommended (91%)	Recommended (77%)	Recommended (72%)
FFR guidance	Not reported	Not reported	Infrequent	Not reported	Recommended (9.0%)	Recommended
LIMA use (%)	72	99	97	94	99	96
Off-pump CABG (%)	1.9	46	Not reported	64	29	16
Primary trial end point	LVEF change	Cardiac death, MI, or TVR	MACCE (death, MI, stroke, or RR)	Death, MI, stroke, or TVR	Death, MI, or stroke	Death, nonprocedural MI, stroke, or RR
Key findings	- A trend toward higher LVEF in the PCI group at 10 years.	- PCI was inferior to CABG at 1 year.	- PCI was noninferior to CABG up to 5 years in MACCE. - No difference in all-cause mortality at 10 years.	- PCI was noninferior to CABG at 1, 5, and 10 years. - No difference in al-cause mortality at 10 years.	- PCI was noninferior to CABG at 3 and 5 years. - All-cause mortality at 5 years was higher after PCI than after CABG.	- PCI was inferior to CABG at 5 years. - No difference in all-cause mortality at 5 years.

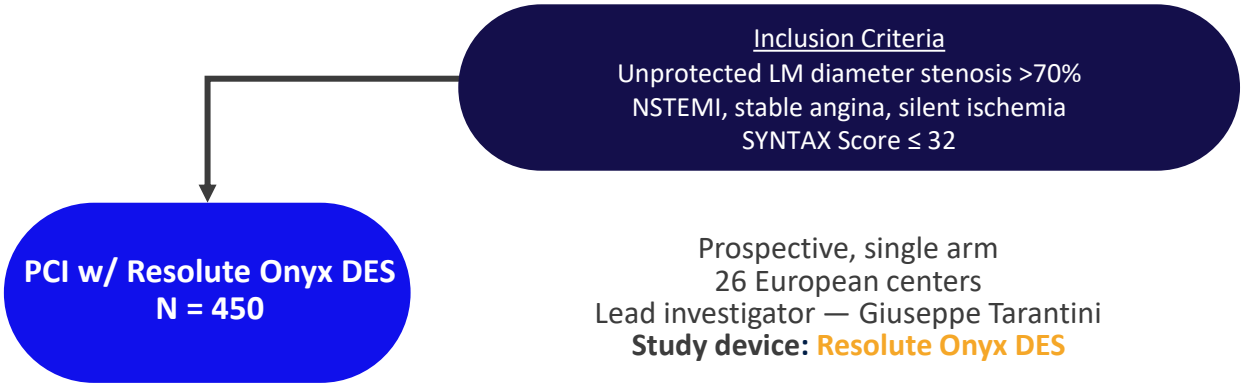
Park SW, et al. Korean Circ J. 2023 Mar;53(3):113-133

Stent platforms in (other) LM trials

Fine Registry	Ideal LM	DK Crush V	ROLEX	EBC Main
First generation vs newer generation	Synergy BP EES Xience DP EES	Provisional vs DK Crush	Provisional vs 2 stent (Culotte 53%, TAP 33%, DK Crush 5%)	Provisional vs 2 stent (Culotte 53%, TAP 33%, DK Crush 5%)
Endeavour Resolute, Xience V, Biomatrix, Nobori, Promus	Synergy BP EES Xience DP EES	Firebird 2 Endeavour Resolute Xience V	Resolute Onyx	Resolute Onyx
	DAPT 4 months in Synergy	7 30-day ST. 6 Provisional T and 1 DK Crush	80% provisional, 20% 2 stent	

The ROLEX study

Assessing the safety and efficacy of Resolute Onyx™ DES for the treatment of left main disease



Prospective, single arm
26 European centers
Lead investigator — Giuseppe Tarantini
Study device: Resolute Onyx DES

Primary endpoint:	Target lesion failure at 1-year (Composite of cardiac death, TVMI, ID-TLR)
Secondary endpoints:	All-cause death, stent thrombosis, peri-procedural MI, stroke

Source: Tarantini, G. et al. The ROLEX Study (Revascularization of LEft main with resolute onyX). Presented at PCR 2022. Investigator-initiated study funded by Medtronic.

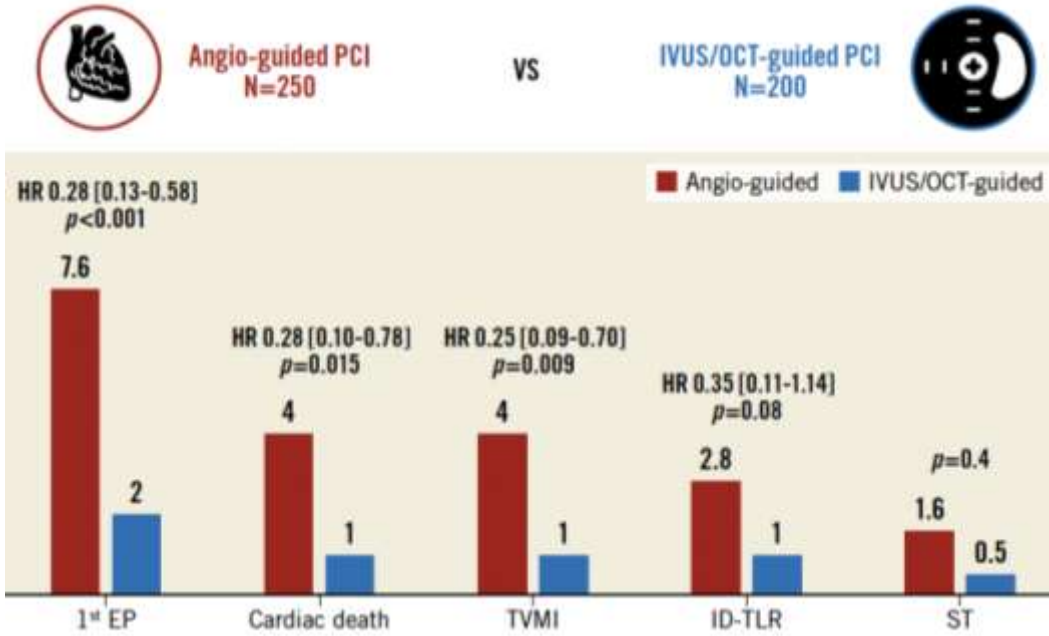
Procedural characteristics

% or mean ± SD	Resolute Onyx DES (N=450pts)
Intravascular imaging	45.1
IVUS	42.2
OCT	2.9
Rotational atherectomy	4.5
Rotational atherectomy	4.5
Initial treatment strategy	
Provisional	80.0
Two-stent strategy	20.0
Final treatment	
One-stent	75.8
Two-stent	24.2
T/TAP stenting	9.1
DK crush	8.5
Culotte	6.4

Source: Tarantini, G. et al. The ROLEX Study (Revascularization of LEft main with resolute onyX). Presented at PCR 2022. Investigator-initiated study funded by Medtronic.

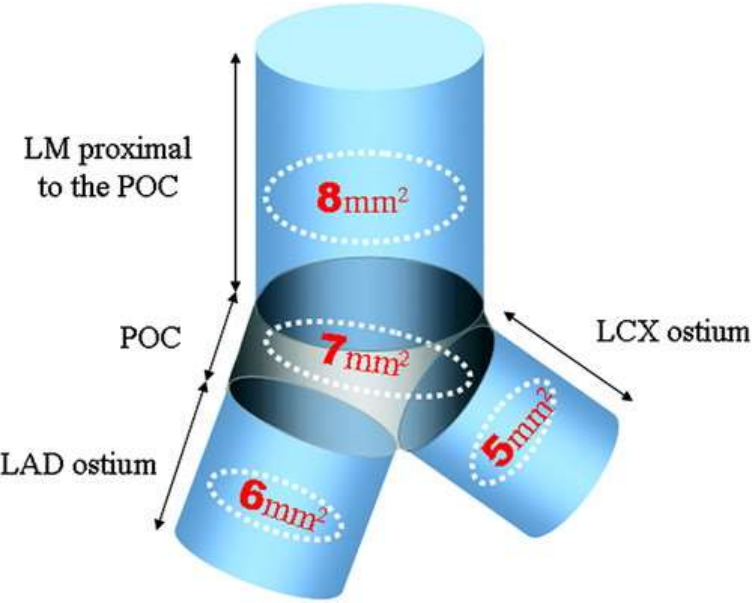
Outcomes

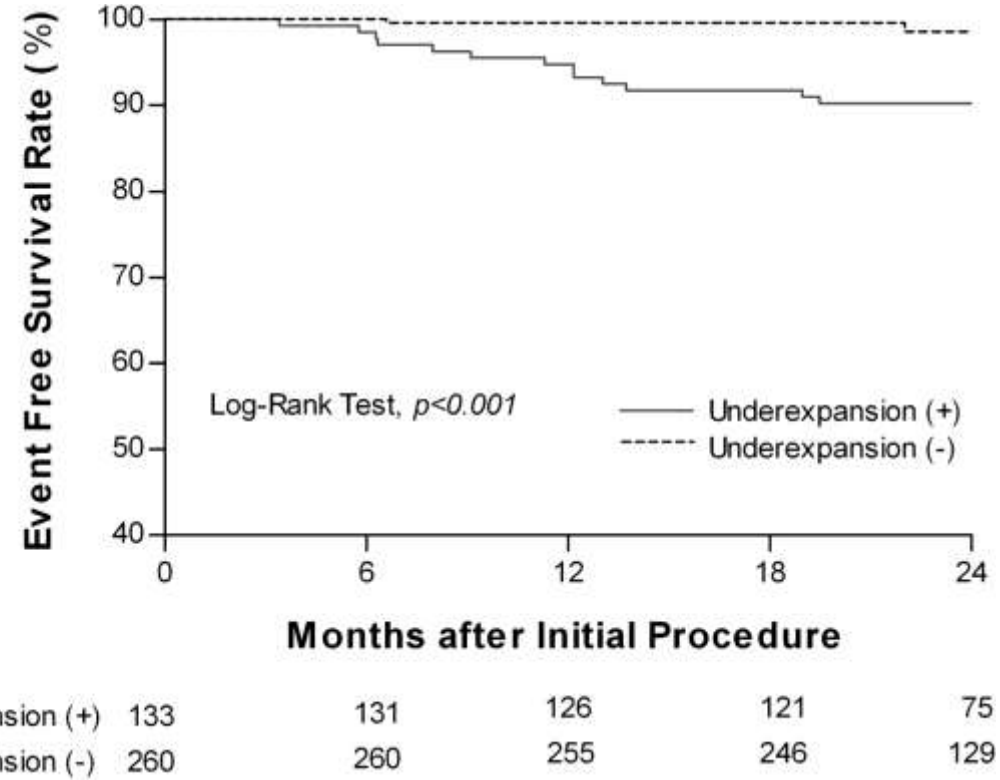
Outcome	N=450
Primary endpoint	
Target lesion failure	23 (5.1%)
Cardiac death	12 (2.7%)
TVMI	12 (2.7%)
ID-TLR	9 (2.0%)
Secondary endpoints	
All-cause death	28 (6.2%)
Periprocedural MI	17 (3.8%)
Stroke	5 (1.1%)
Stent thrombosis (definite/probable)	5 (1.1%)
Definite	3 (0.7%)
Probable	2 (0.4%)
Acute	1 (0.2%)
Subacute	2 (0.4%)
Late	2 (0.4%)
Bleeding	19 (4.2%)
BARC 2	3 (0.6%)
BARC 3A	11 (2.4%)
BARC 3B	4 (0.8%)
BARC 3C	1 (0.2%)



Source: Tarantini, G. et al. The ROLEX Study (Revascularization of LEft main with resolute onyX). Presented at PCR 2022. Investigator-initiated study funded by Medtronic.

Optimised?





Soo-Jin Kang. Circulation: Cardiovascular Interventions. Comprehensive Intravascular Ultrasound Assessment of Stent Area and Its Impact on Restenosis and Adverse Cardiac Events in 403 Patients With Unprotected Left Main Disease, Volume: 4, Issue: 6, Pages: 562-569, DOI: (10.1161/CIRCINTERVENTIONS.111.964643)

NOBLE IVUS Sub study

Table 2. Comparison of 5-year outcomes by LMS stent expansion tertile.

IVUS LMS MSA tertile (range)	Low 4.4-10.8 mm² n=74	Intermediate 10.9-13.3 mm² n=73	Upper 13.4-25.4 mm² n=77	*p*-value L vs I	*p*-value L vs H
MACCE	18 (24.3%)	19 (26.0%)	11 (14.3%)	0.92	0.10
All-cause mortality	2 (2.7%)	6 (8.2%)	6 (7.8%)	0.14	0.19
Cardiac death	0 (0%)	1 (1.3%)	4 (5.3%)	0.33	0.19
Non-procedural MI	4 (5.4%)	5 (6.9%)	3 (3.9%)	0.69	0.68
Definite stent thrombosis	1 (1.4%)	2 (2.7%)	1 (1.3%)	0.62	0.75
Stroke	2 (2.7%)	2 (2.7%)	3 (3.9%)	0.99	0.72
Repeat revascularisation	13 (17.6%)	10 (13.7%)	4 (5.2%)	0.47	0.02
LMS TLR	9 (12.2%)	4 (5.5%)	0 (0%)	0.15	0.002

L vs I: low tertile versus intermediate tertile; L vs H: low versus high tertile.

Ladwiniec A et al. IVUS to guide LM stem intervention: A NOBLE trial sub study. EuroIntervention 2020;16:201-209

EXCEL IVUS Sub study

3-year Outcome Stratified by Minimal Stent Area by IVUS

	Smallest tertile (n=172)	Intermediate tertile (n=169)	Largest tertile (n=163)	p-value Smallest vs Intermediate	p-value Smallest vs Largest
MSA range (mm^2)	4.4 - 8.7	8.8 - 10.9	11.0 - 17.8	-	-
3-year event rates					
Death/MI/stroke	19.4% (32)	16.1% (26)	9.6% (15)	0.45	0.01
Death	13.8% (22)	10.0% (16)	5.2% (8)	0.34	0.01
MI	10.5% (17)	8.2% (13)	3.7% (6)	0.49	0.02
Stroke	1.8% (3)	1.2% (2)	2.1% (3)	0.66	0.98
Definite/probable stent thrombosis	3.1% (5)	1.2% (2)	0.0% (0)	0.26	0.03
Left main revascularization	12.9% (19)	8.3% (13)	8.8% (14)	0.30	0.41

Akiko Maehara et al. *J Am Coll Cardiol* 2017; 69:963.

Perhaps it really is as simple as

1) Haemodynamics and anatomy? - MCS
2) Resolving angiographic ambiguities – Imaging
   - Plaque distribution/ characterization
   - Complex/Simple bifurcation
   - Stent sizing/length
3) Lesion preparation
4) Choice of stent platform with left main data
5) Optimised?