

# My challenging CTO-PCI

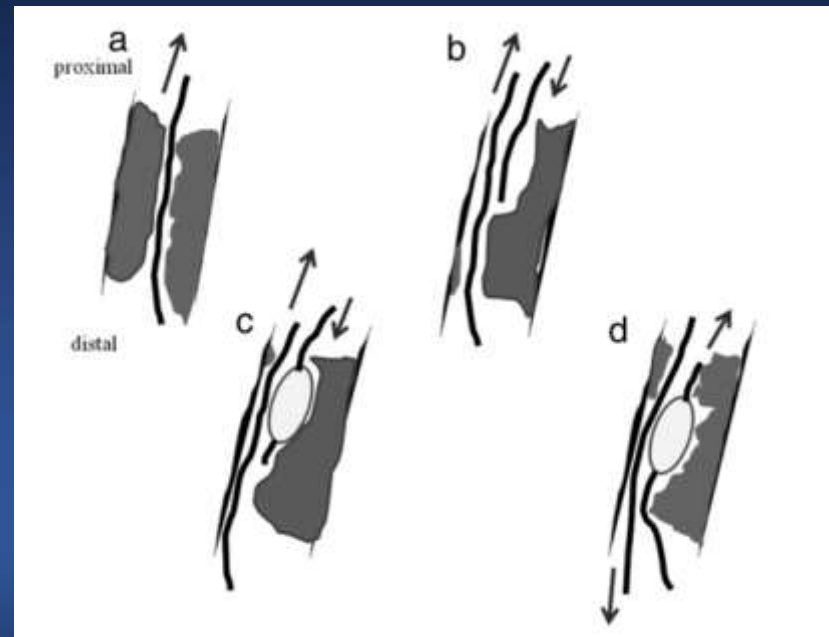
Seung-Whan Lee, MD, PhD

Asan Medical Center,  
University of Ulsan College of Medicine, Seoul, Korea

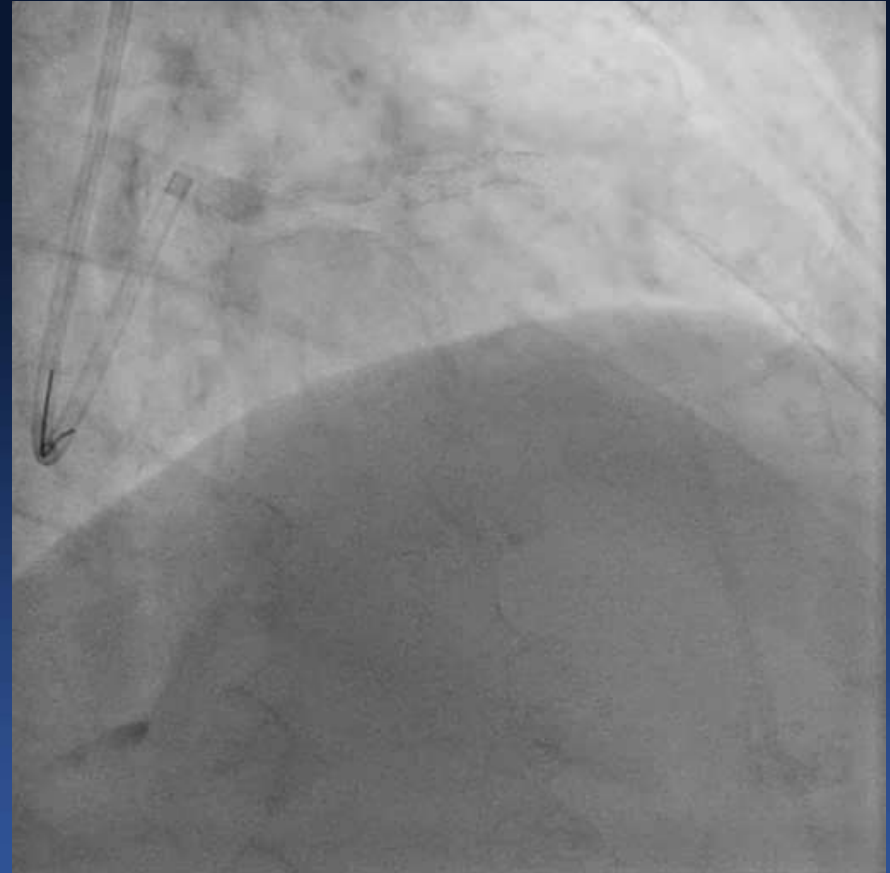
# Retrograde approach

- **Retrograde direct wire crossing:** in short lesion length (a)
- **Kissing wire technique :** bidirectional wiring (b)
- **Knuckle wire :** long, calcific, tortuous, unknown course
- **CART technique:** rarely used currently (d)
- **Reverse CART:** for bidirectional wire connection (c)

Conventional  
Contemporary  
Modified

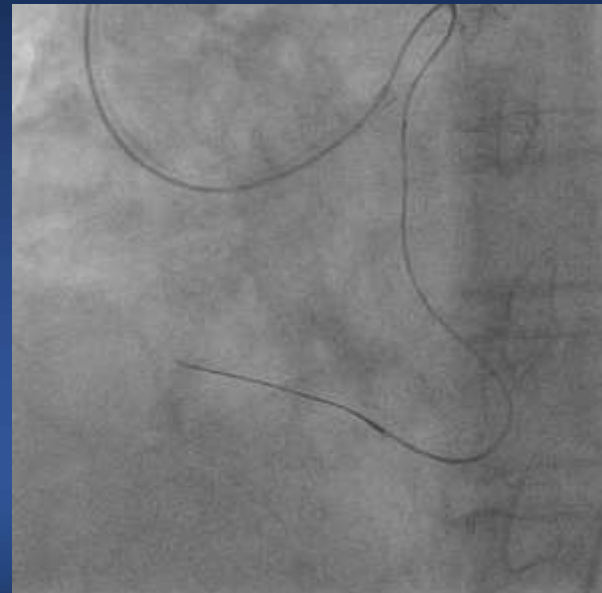
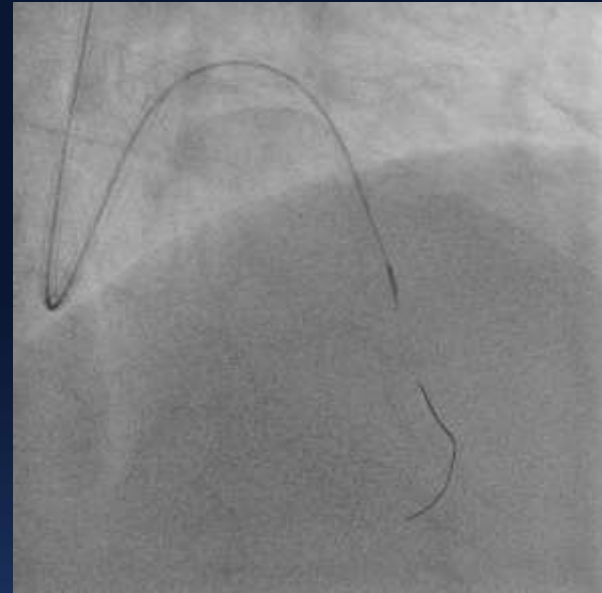
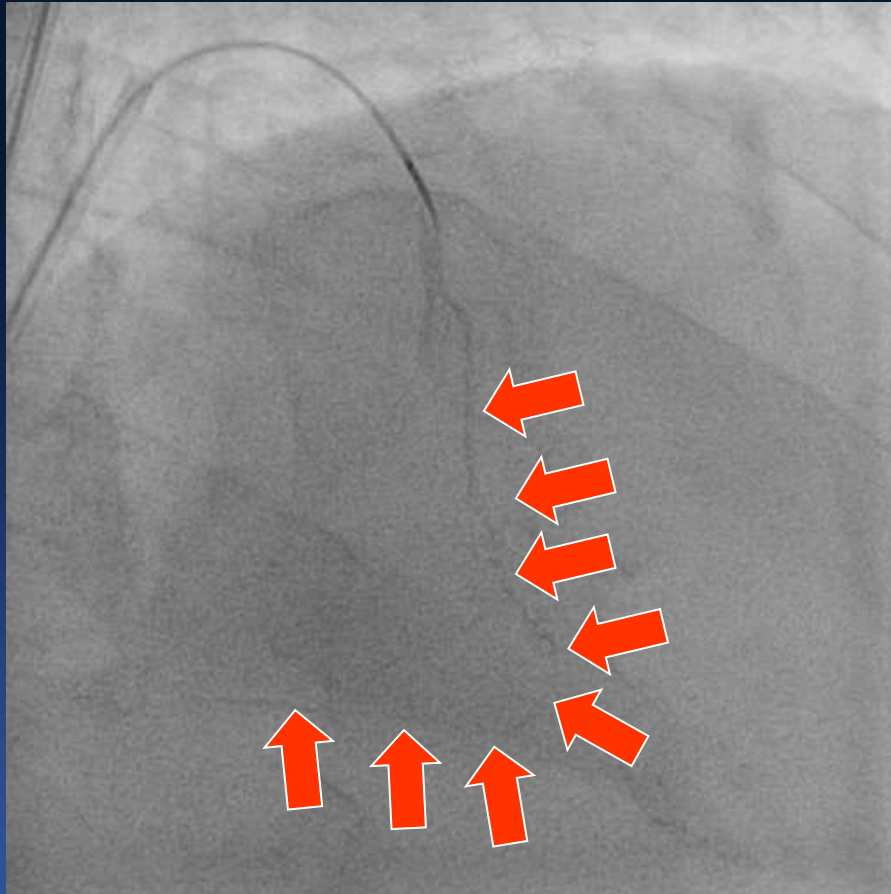


# 77/F, Long RCA CTO

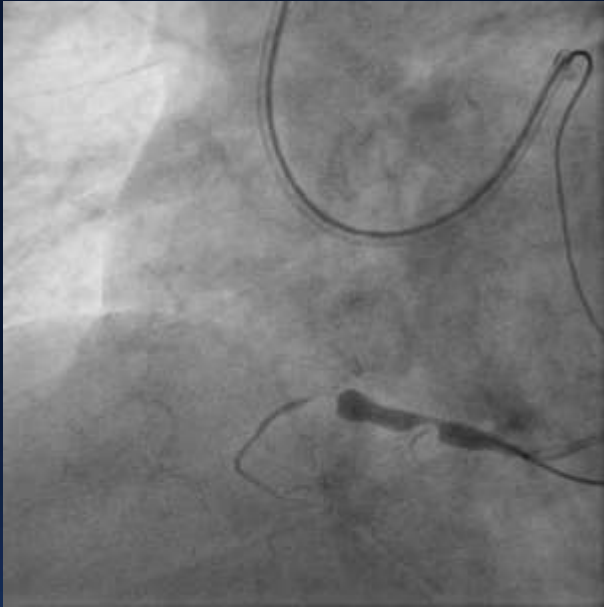


# Retrograde wire with sion wire

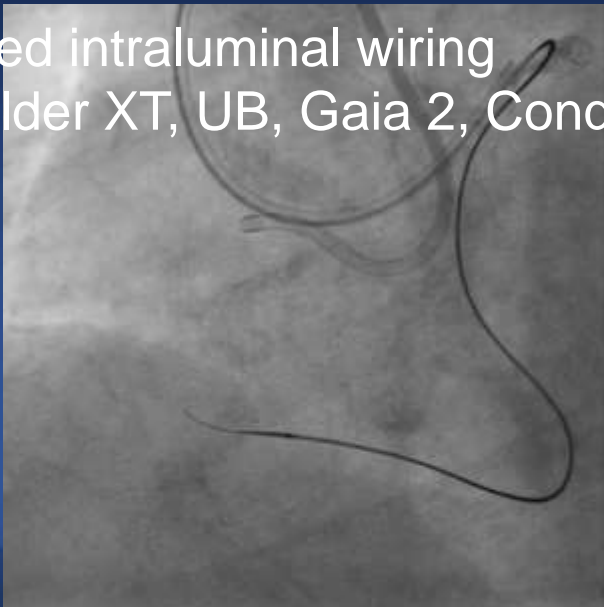
## Tip angiography



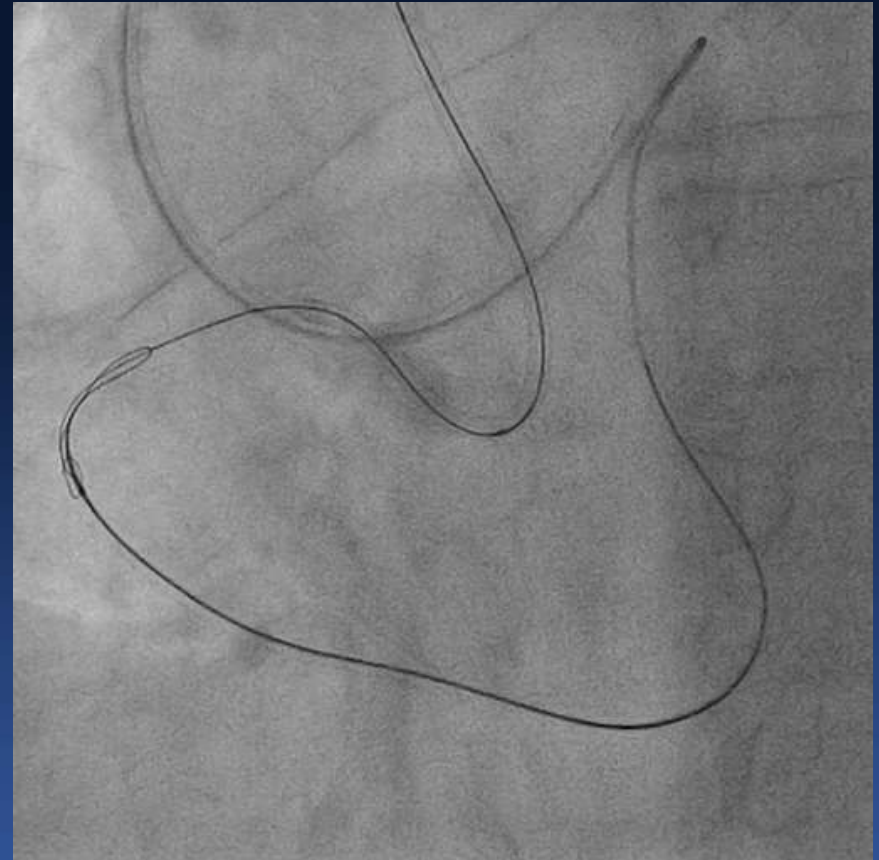
# Tip angiography



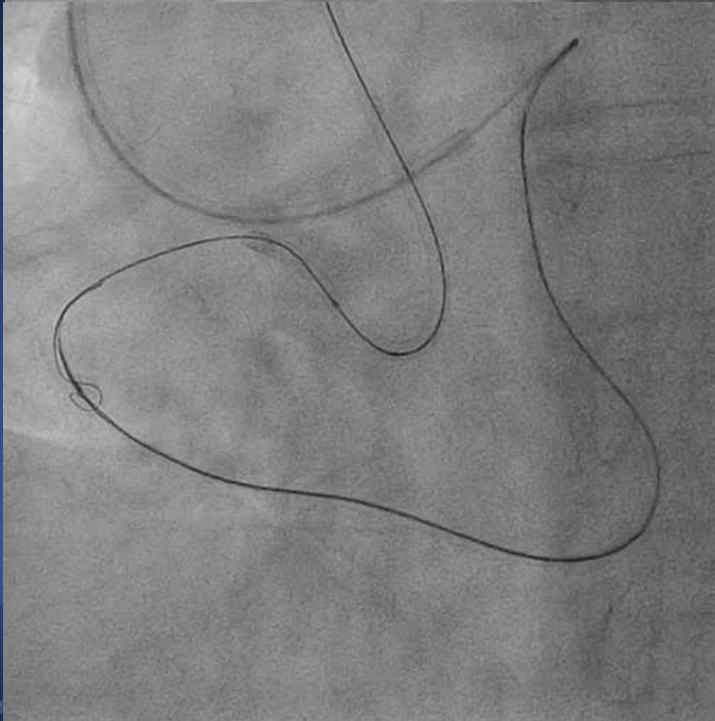
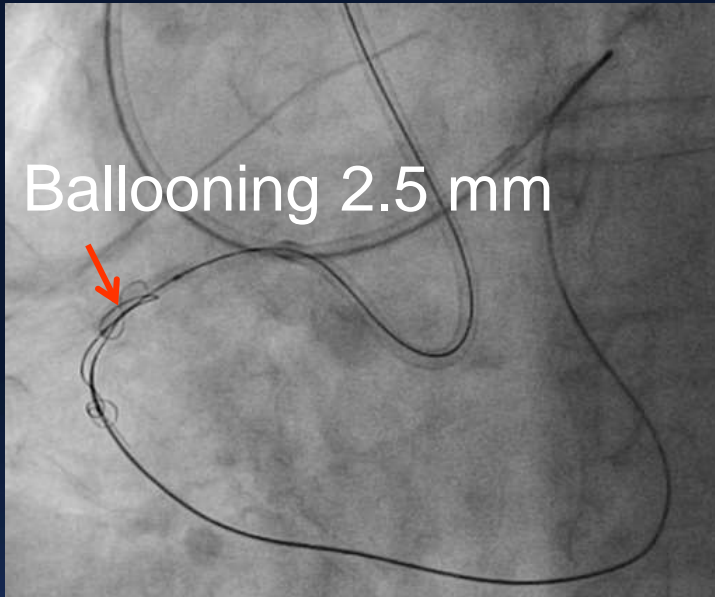
Failed intraluminal wiring  
(Fielder XT, UB, Gaia 2, Conquest)



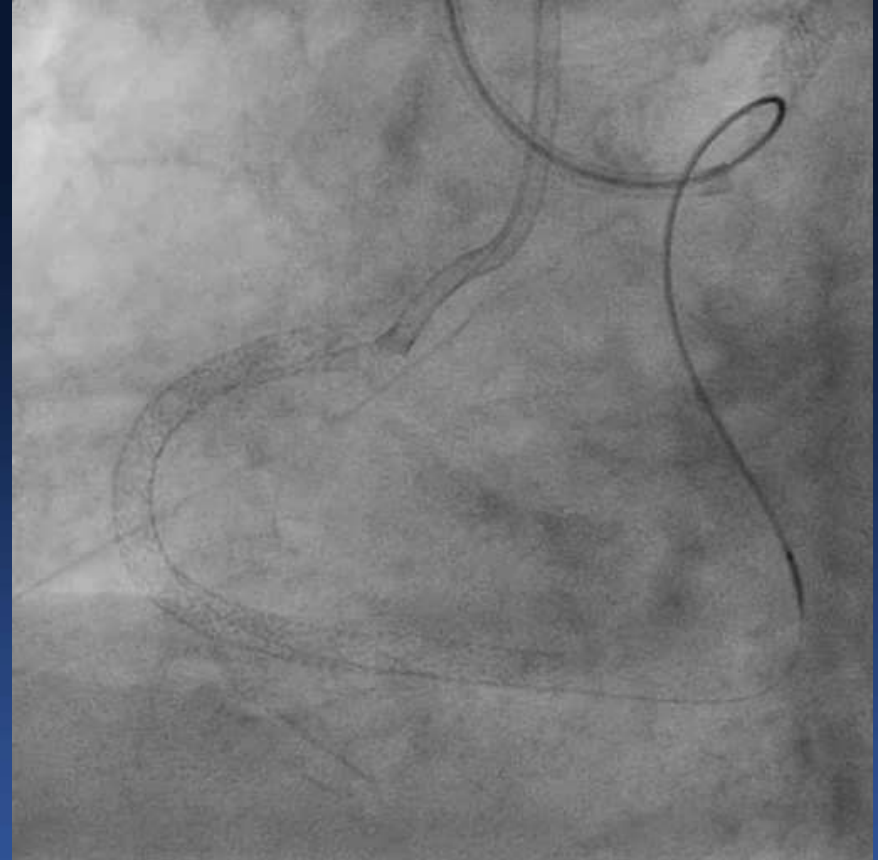
Knuckle wire with fielder XT



# Knuckle wiring with reverse CART



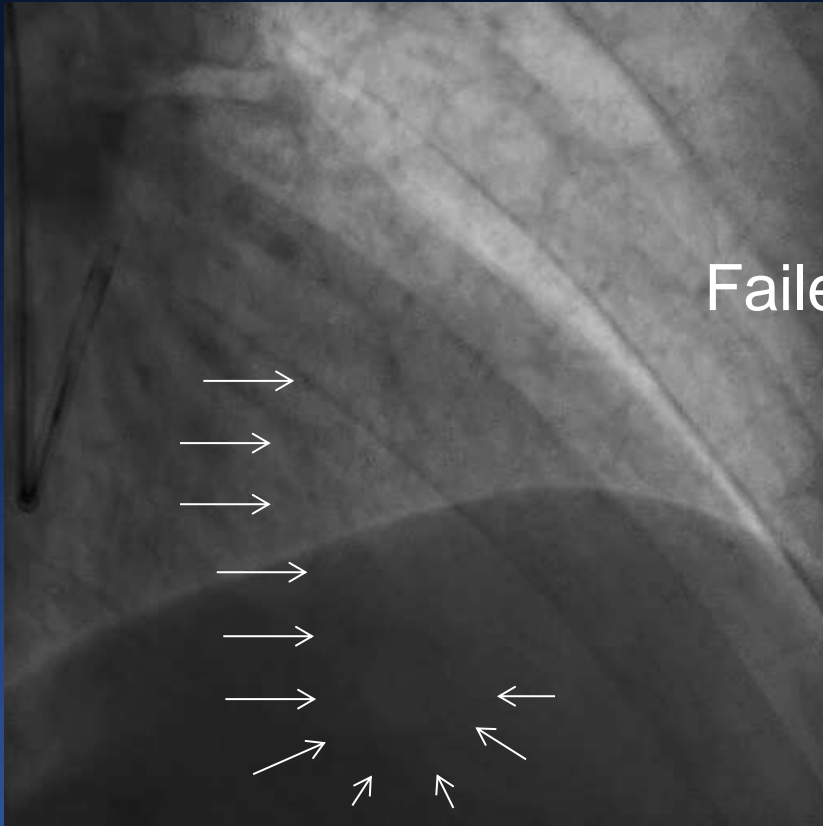
## Final angiography



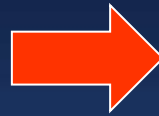


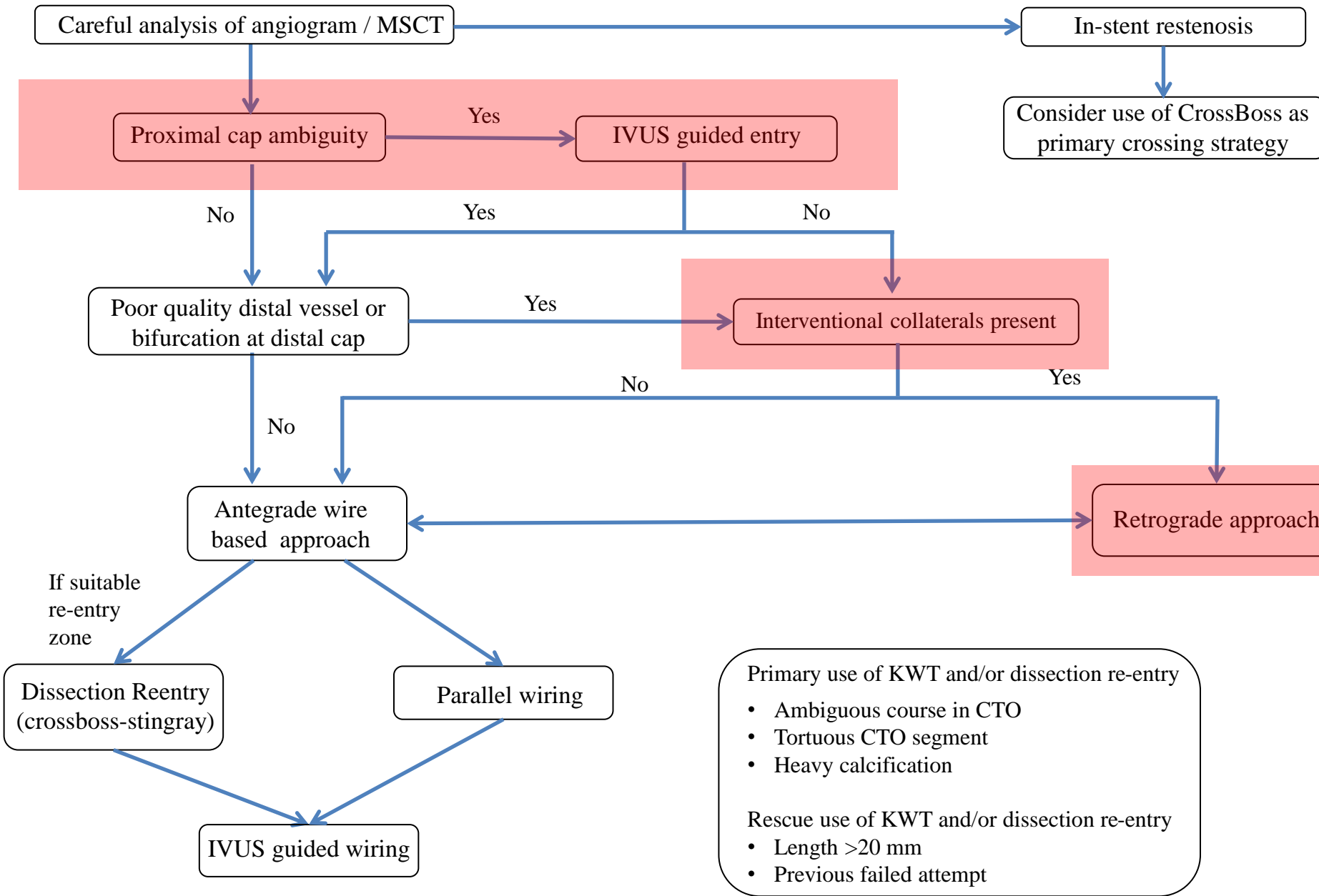
# 52/M, Failed LAD CTO

J CTO score 3



Failed 2Mo later

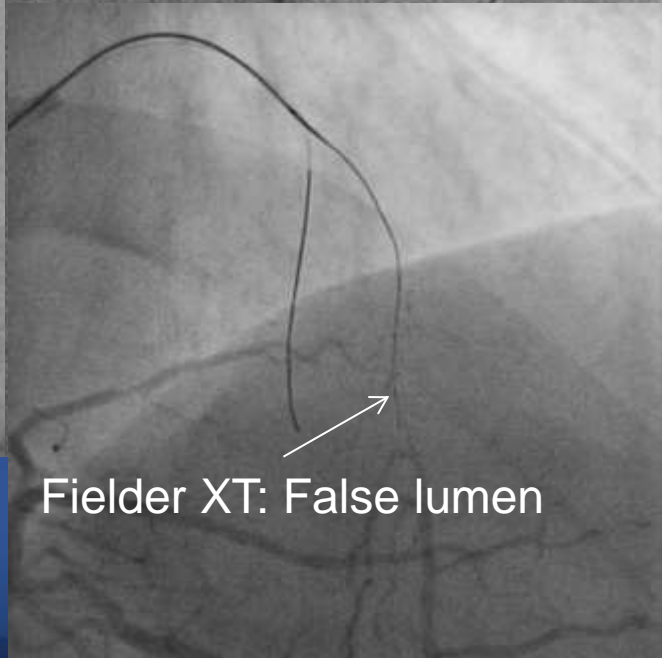
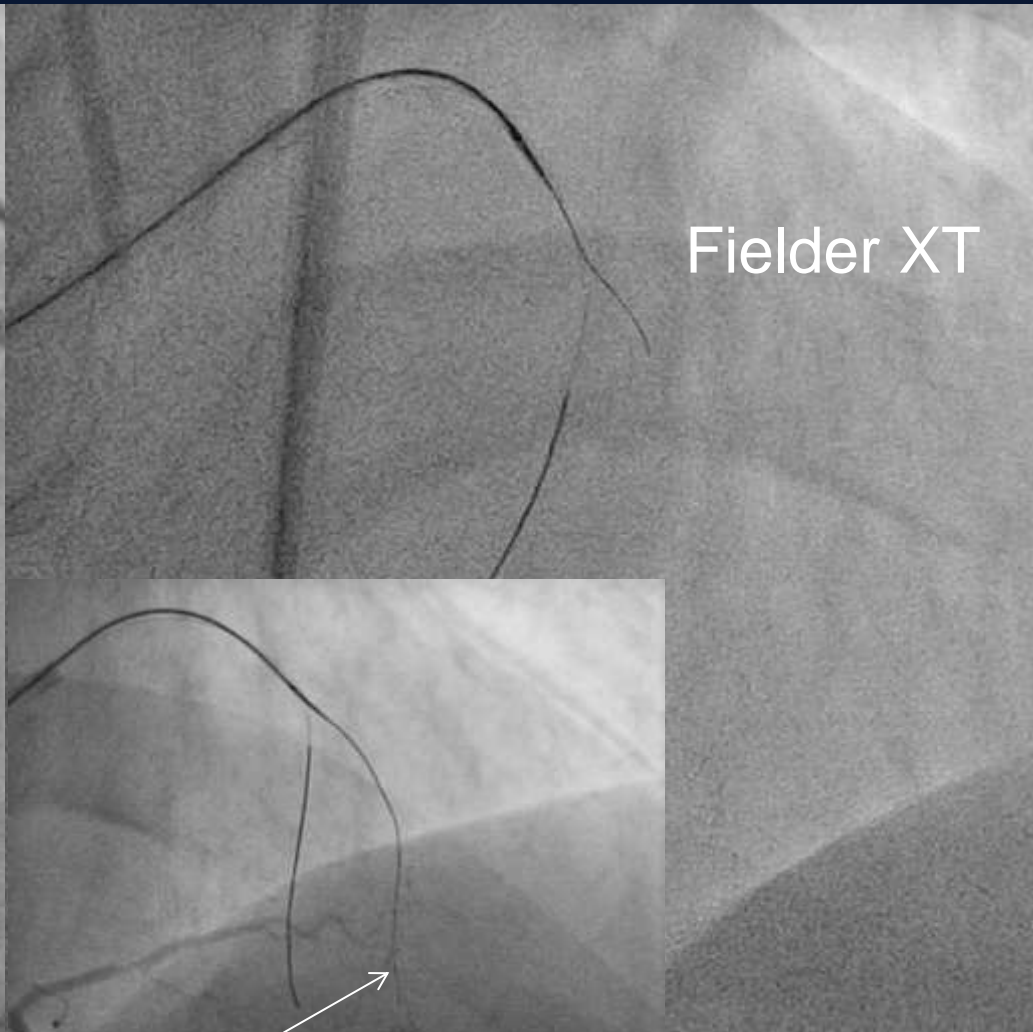
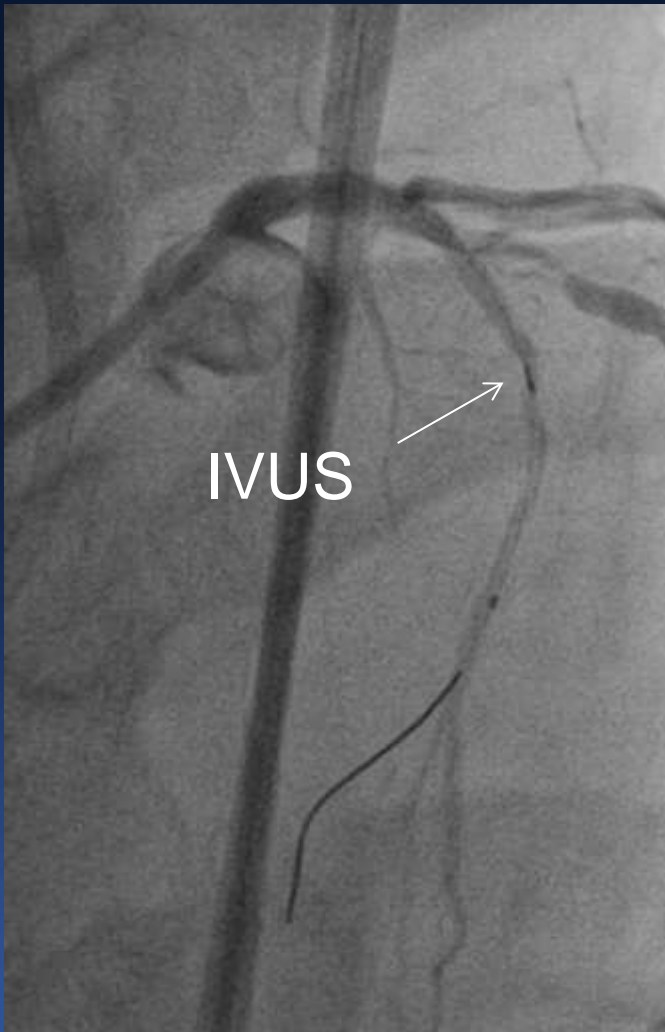




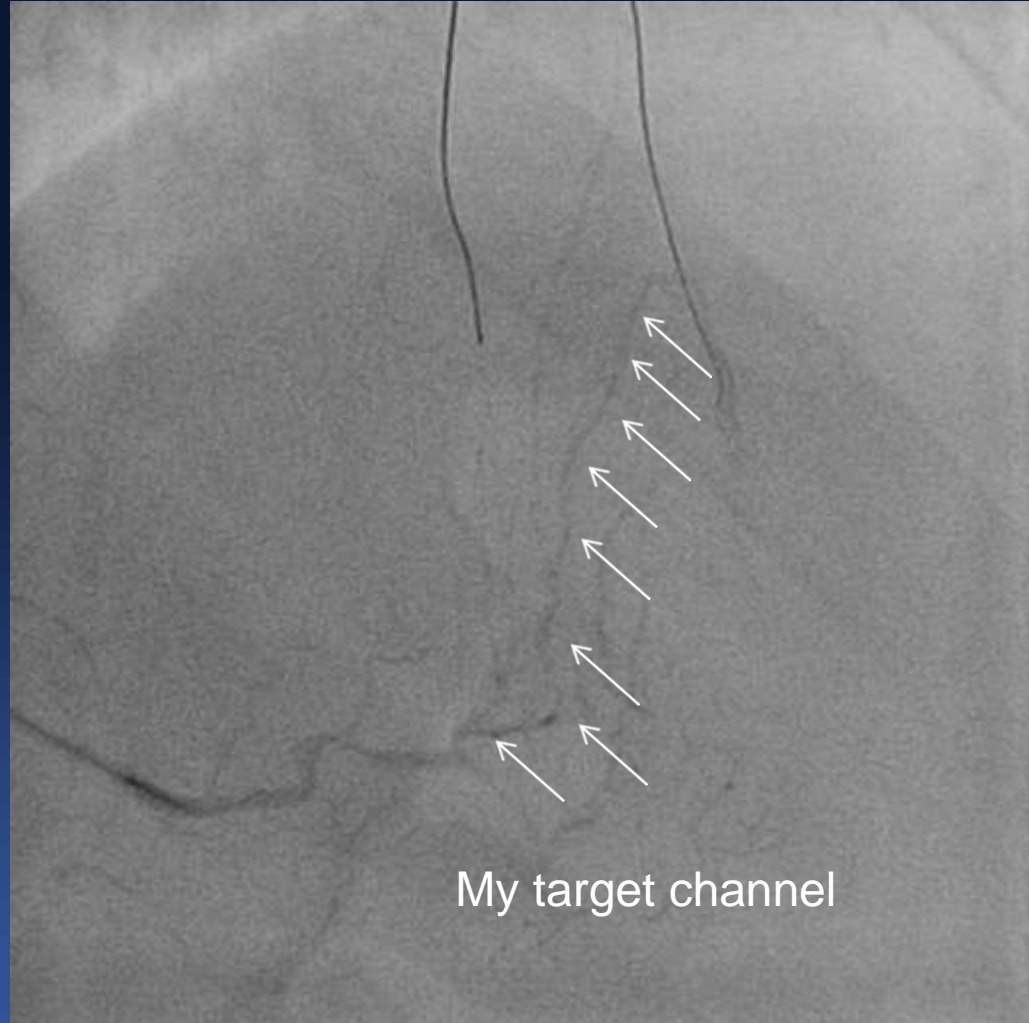
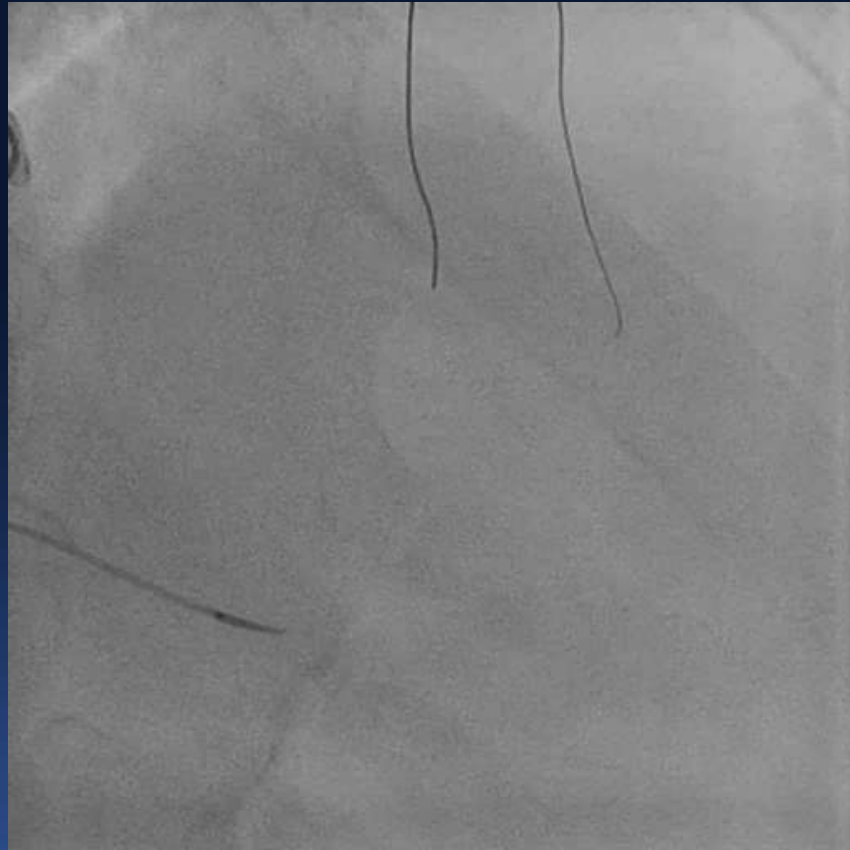
Consider stopping if >3 hours, 3.7 x eGFR ml contrast, Air Kerma > 5 Gy unless procedure well advanced



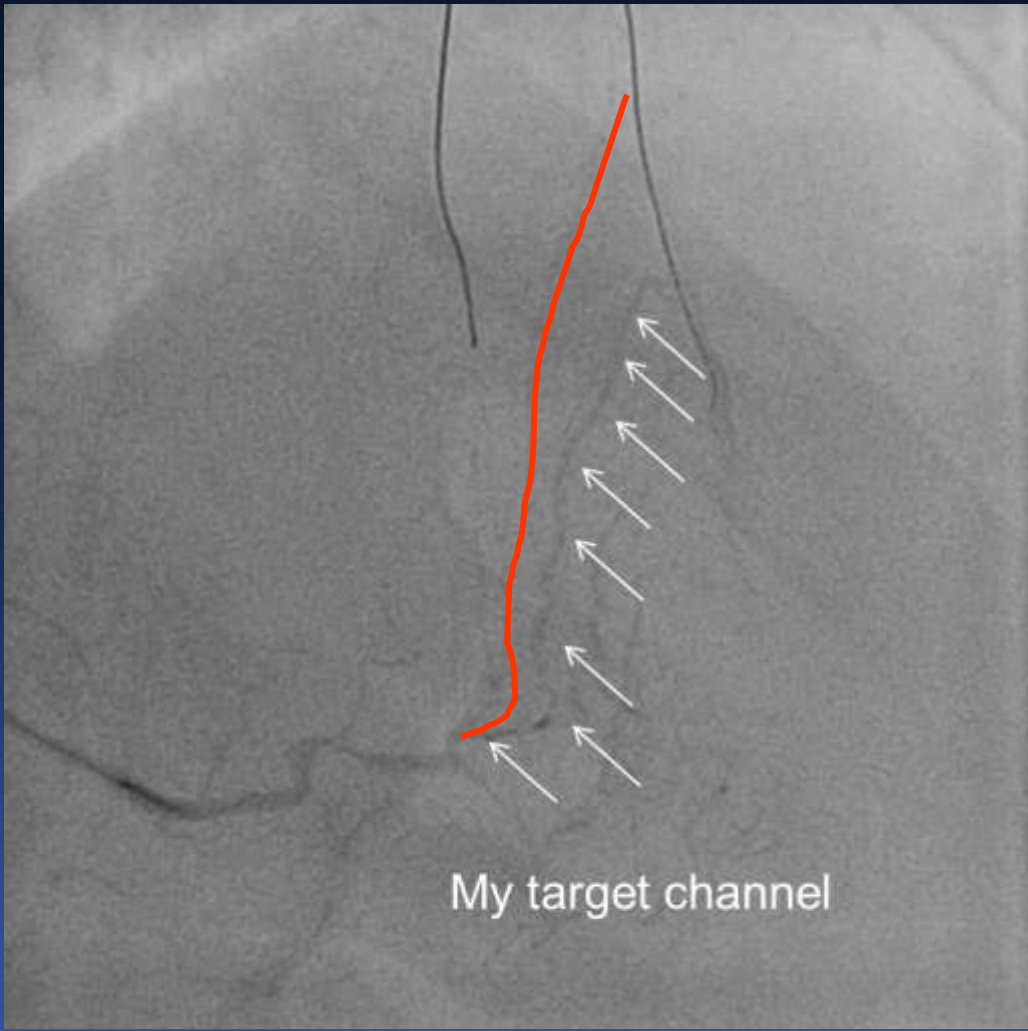
# IVUS use for proximal cap and antegrade wiring (fielder XT)



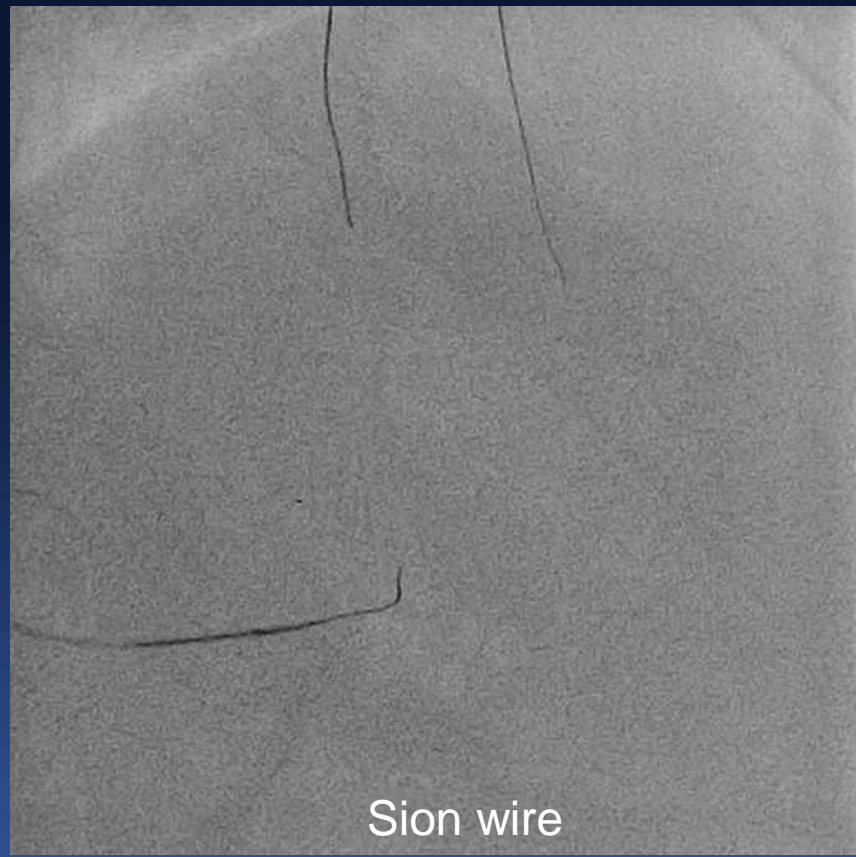
# Retrograde tip angiography for channel selection



My target channel



My target channel

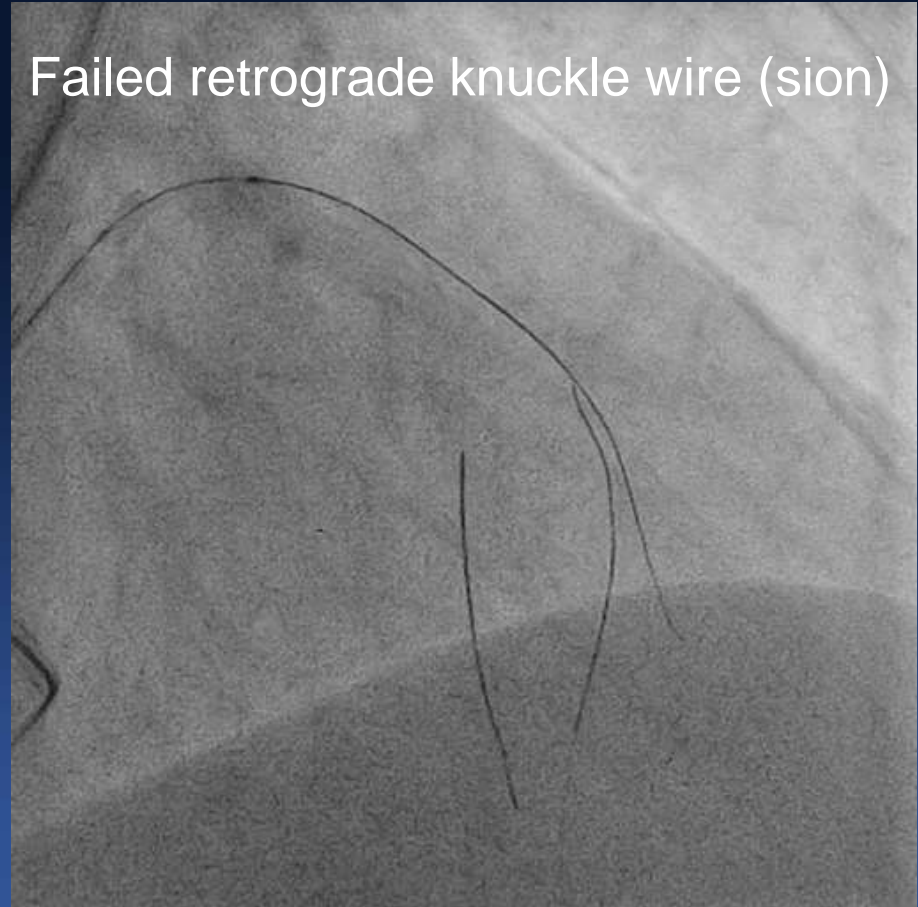
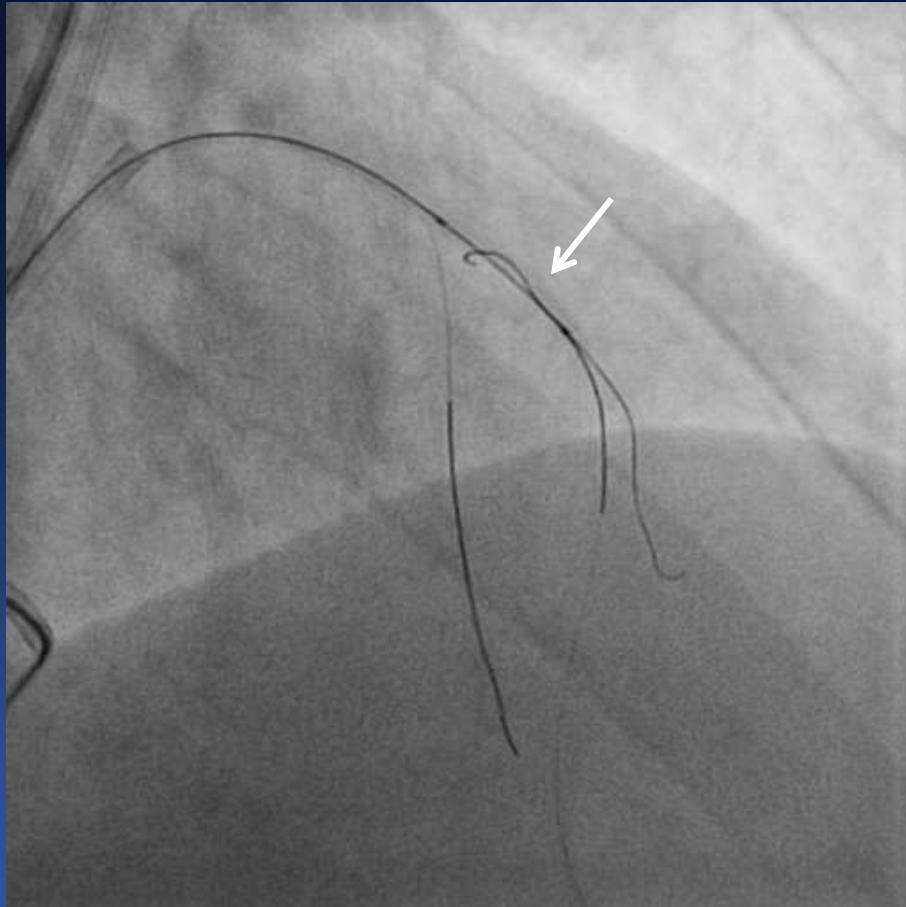


Sion wire

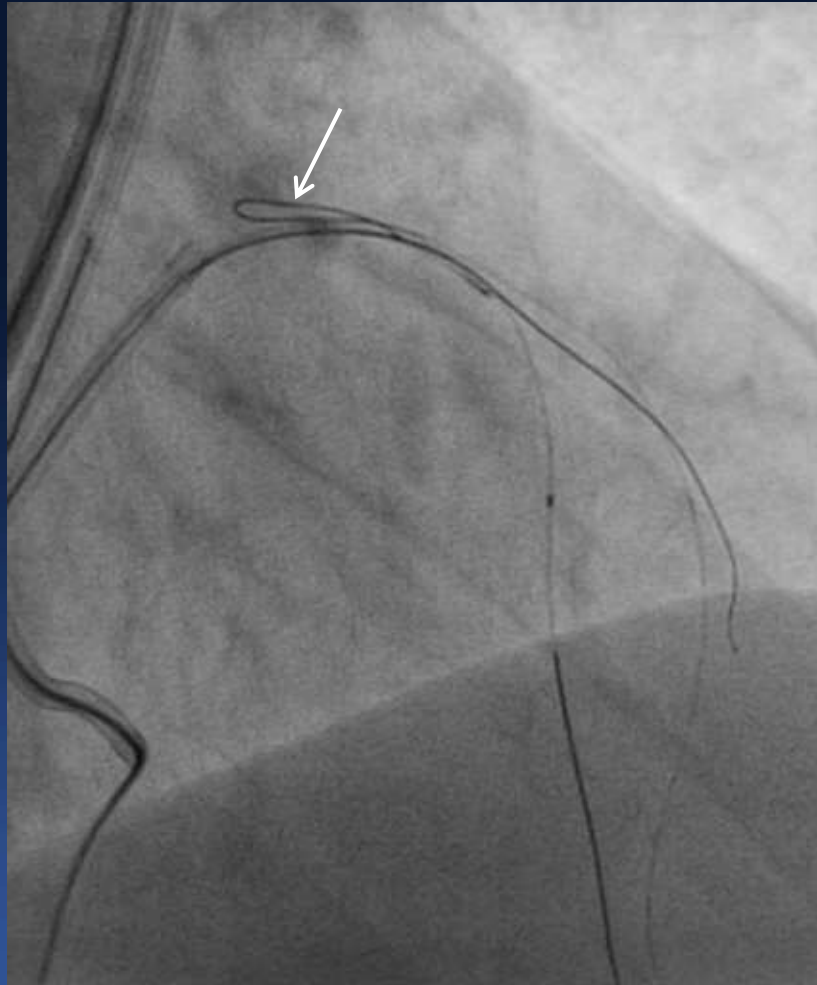


Corsair did not advance.

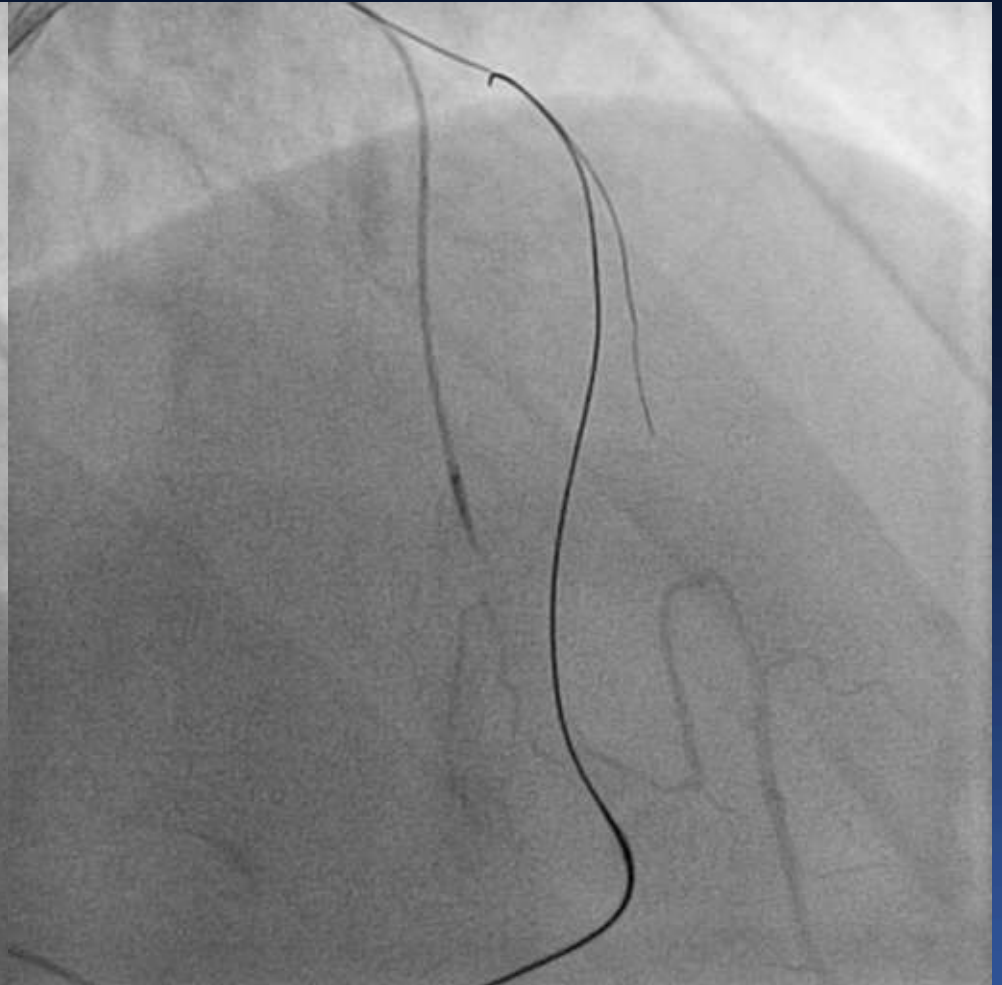
So antegrade balloon (2.5 mm) was done for reverse CART



Failed retrograde knuckle wire (sion)



Tip angiography

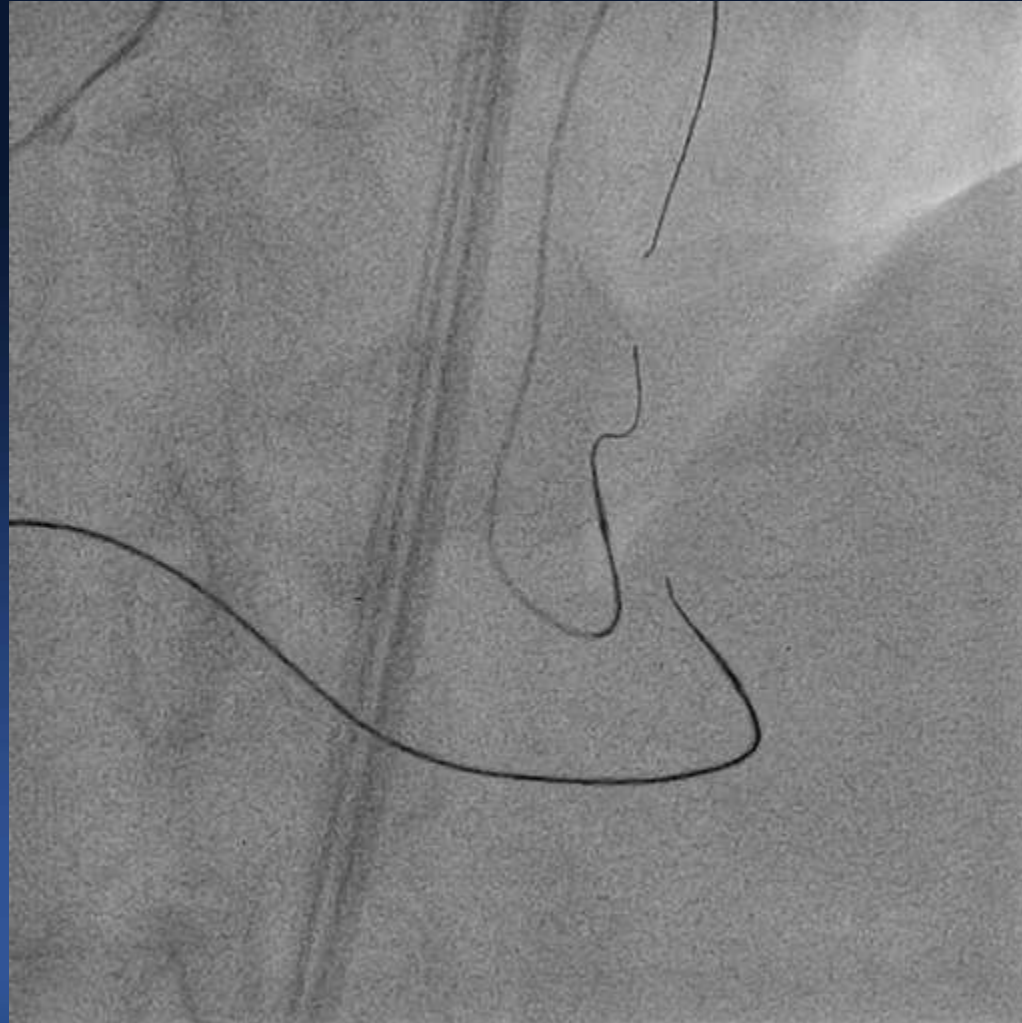


# Septal wiring with sion black wire

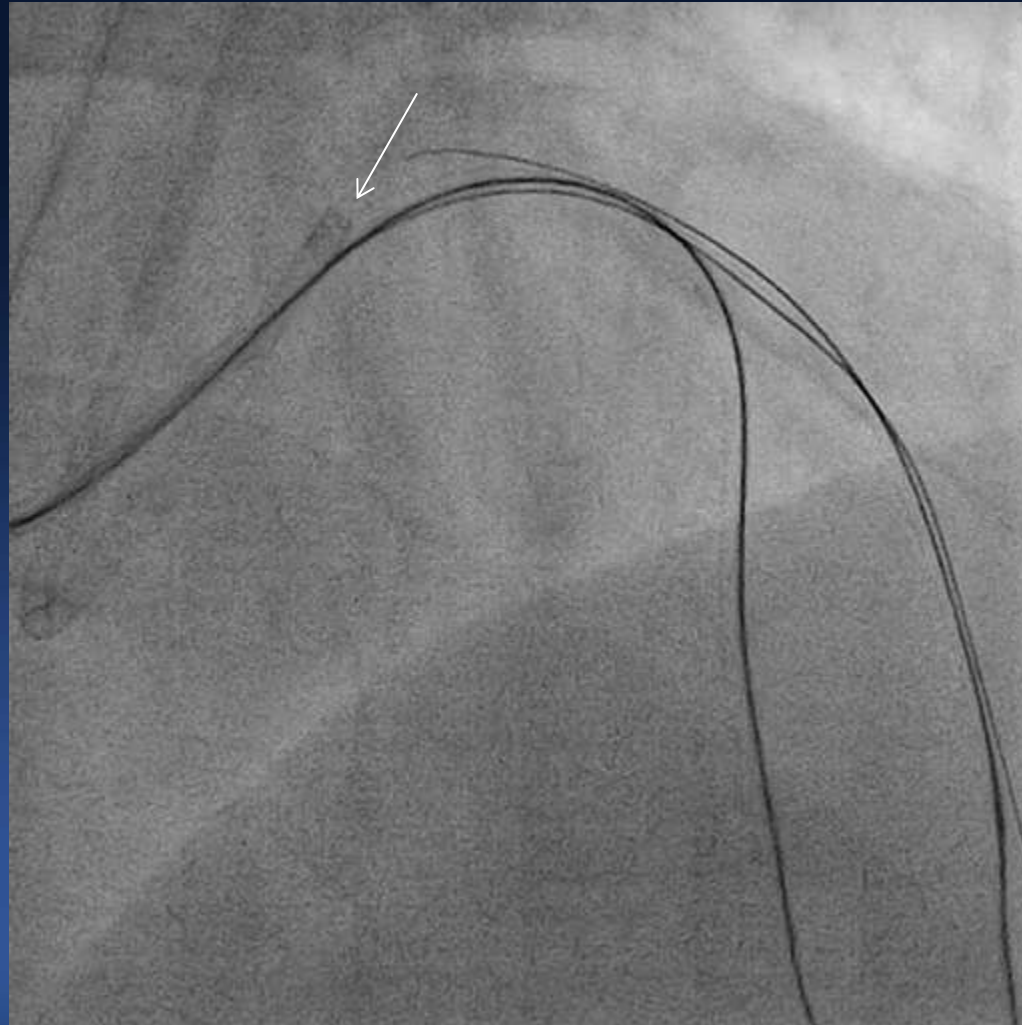




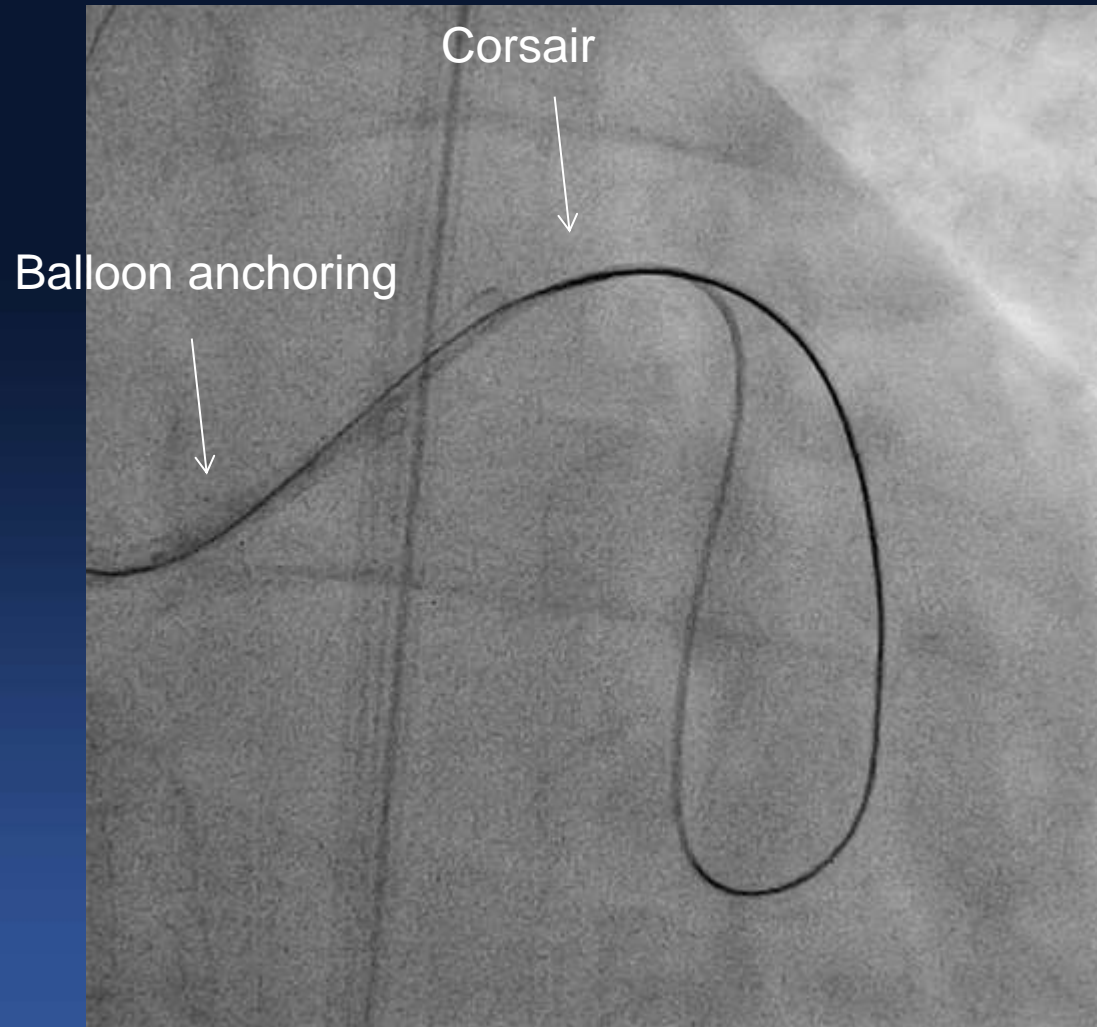
# Septal wiring with sion black wire



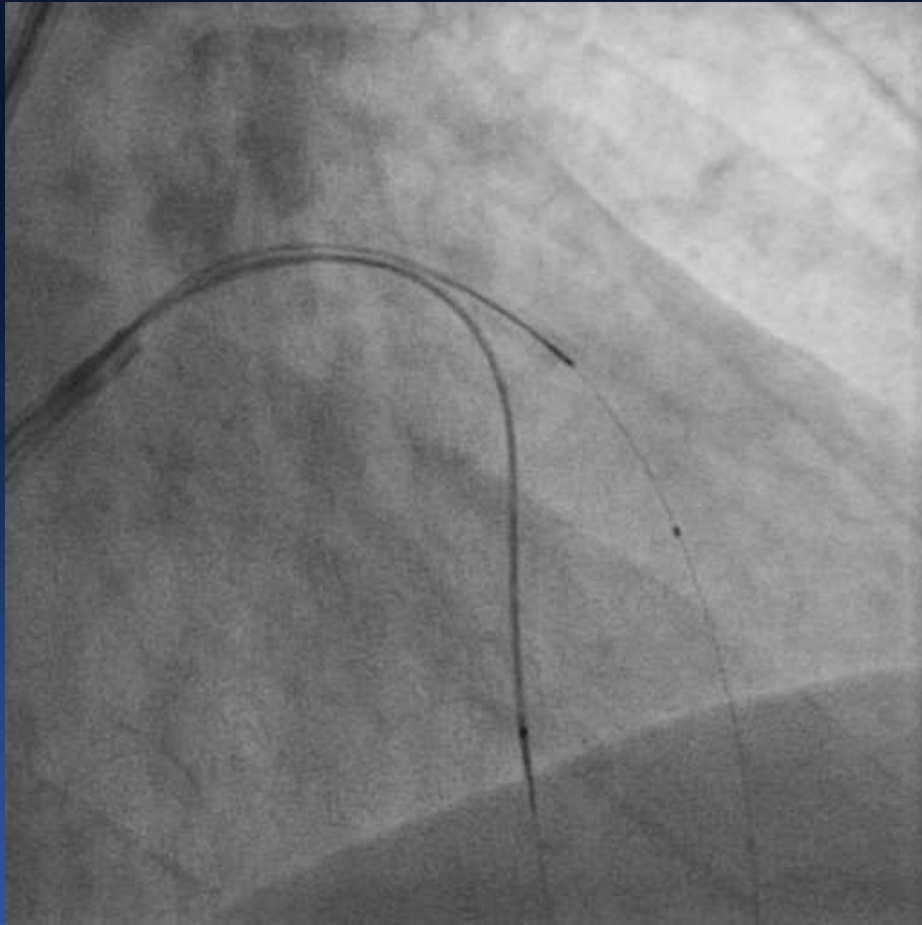
# Direct wiring with conquest pro into another LAD guiding



# Corsair advance with balloon anchoring



# IVUS exam

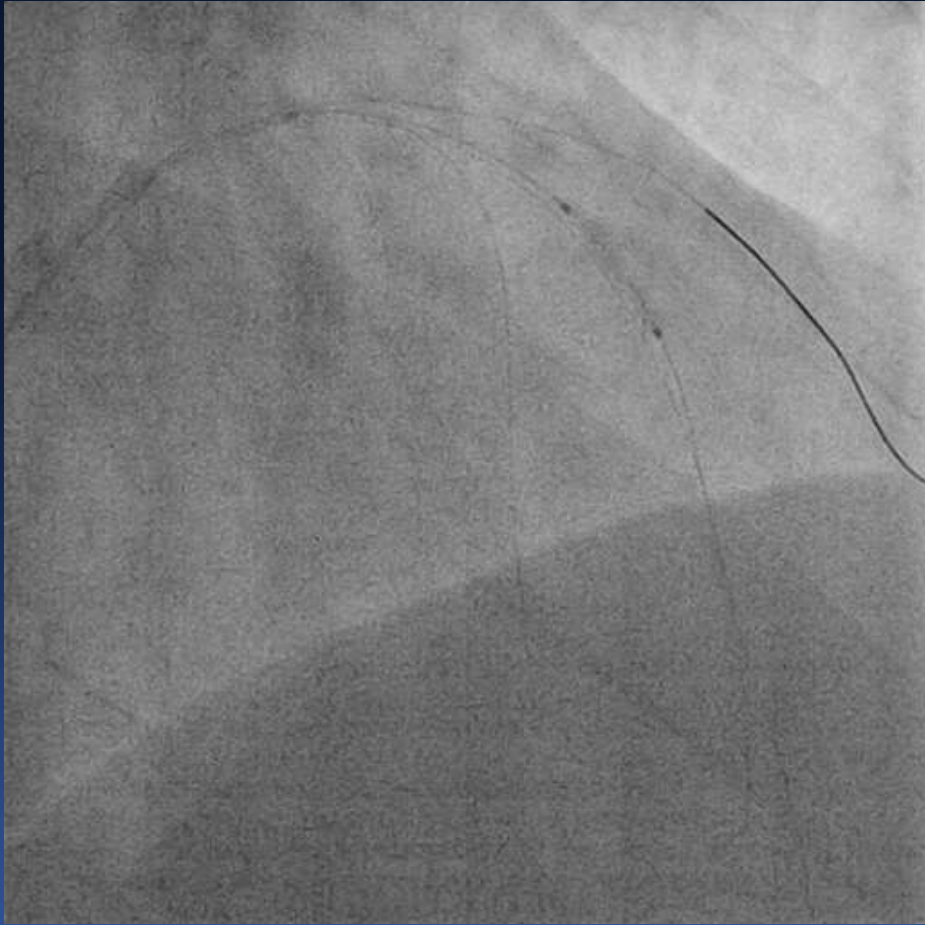


# Antegrade wiring with sion

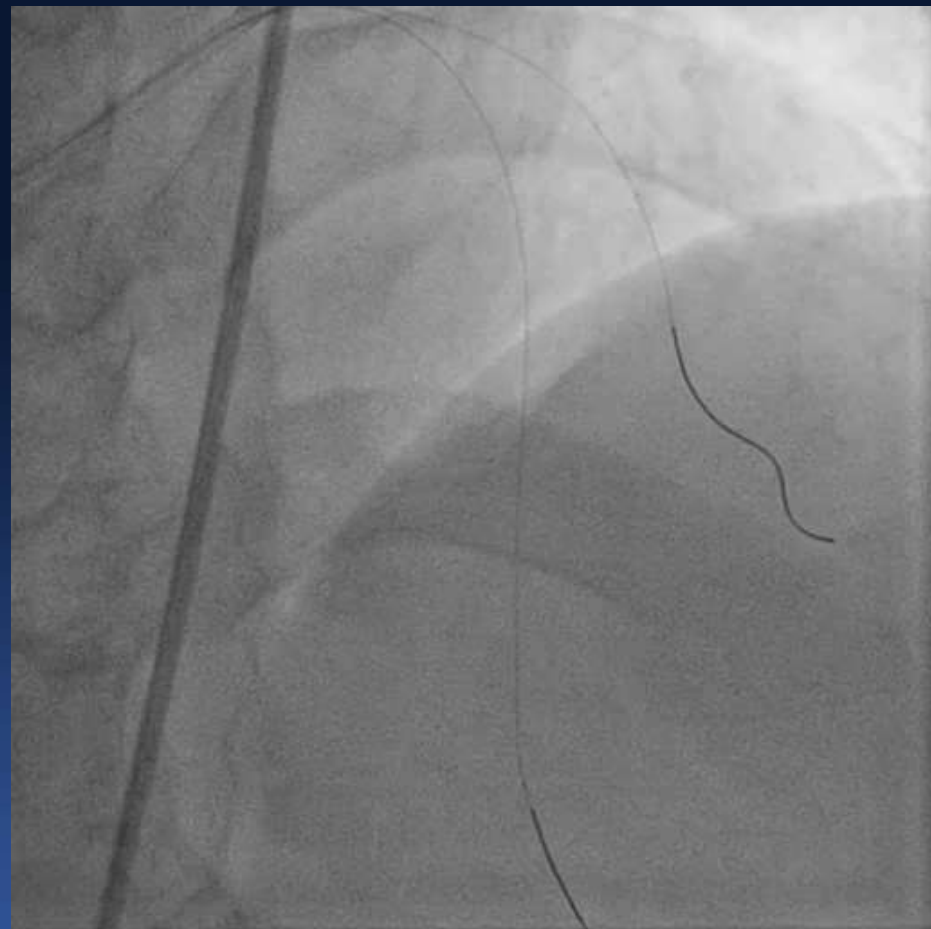




# Ballooning



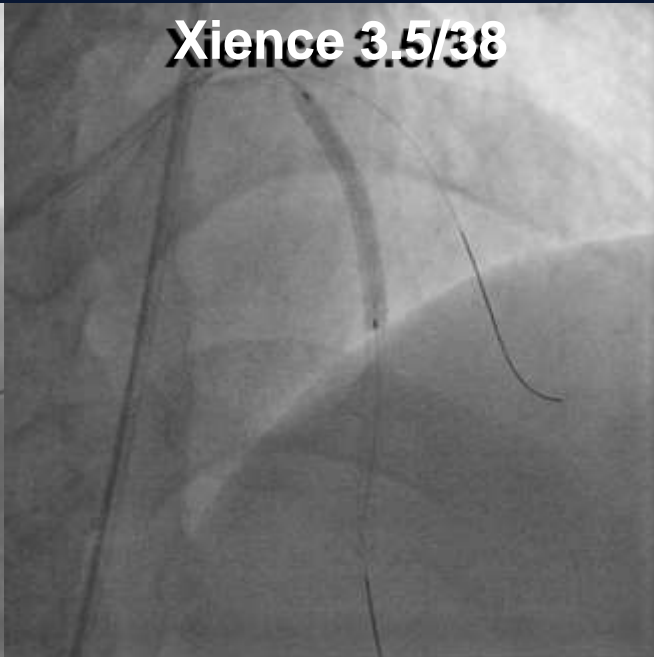
# Post-balloon



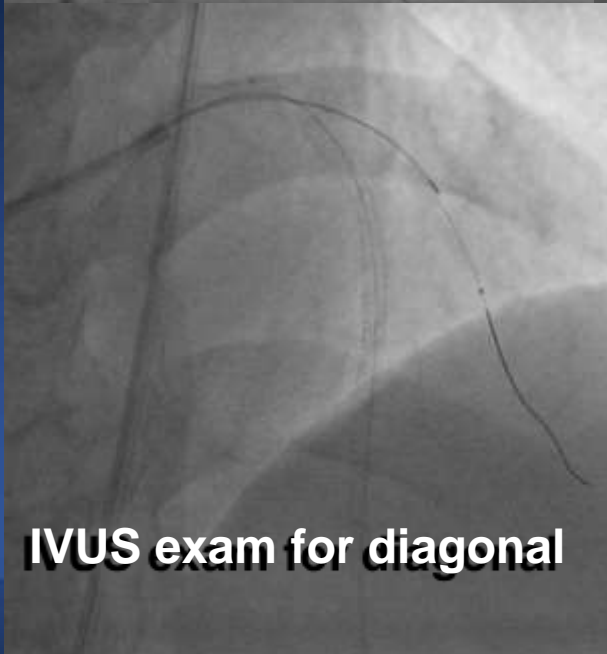
**Xiience 2.75/38**



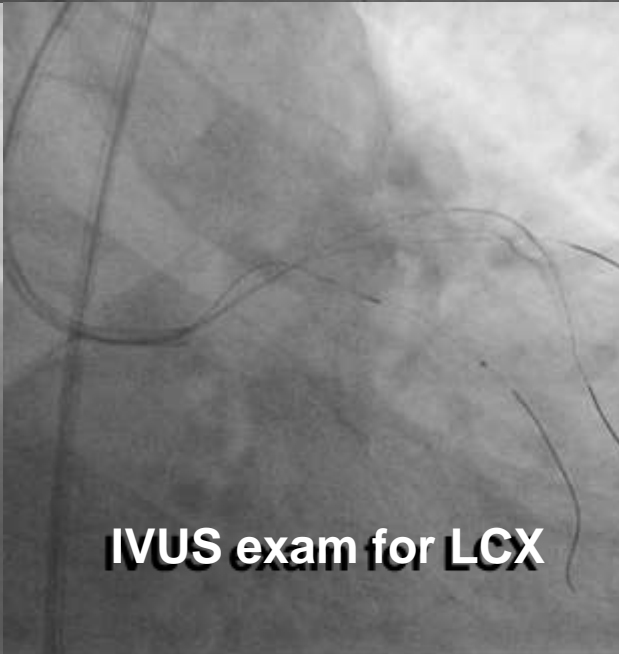
**Xiience 3.5/38**



**IVUS exam for diagonal**



**IVUS exam for LCX**

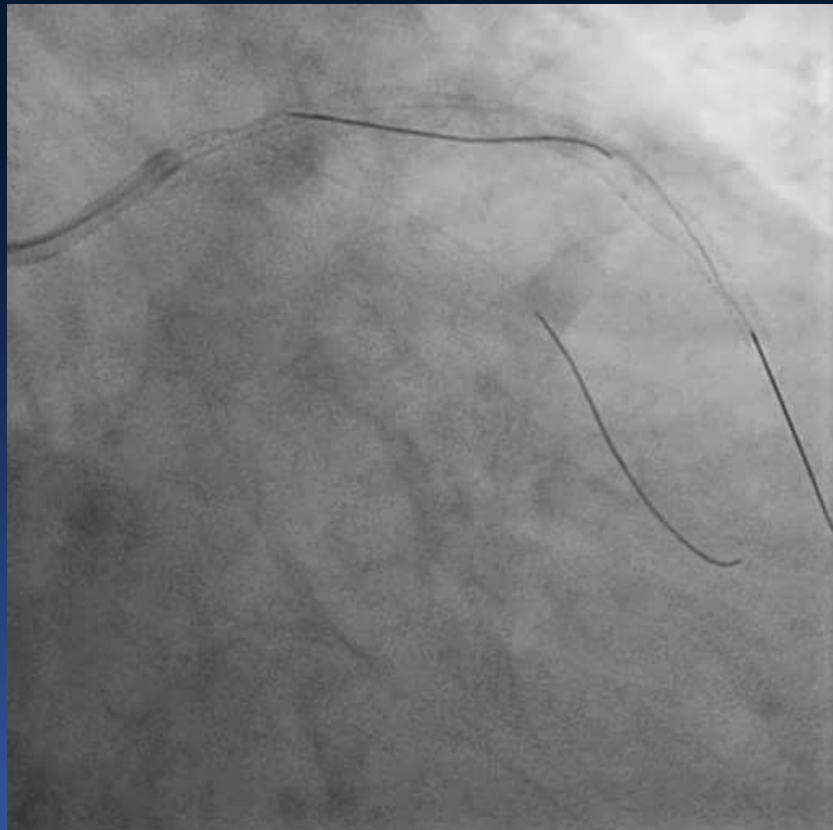


**Xiience 4.0/23**

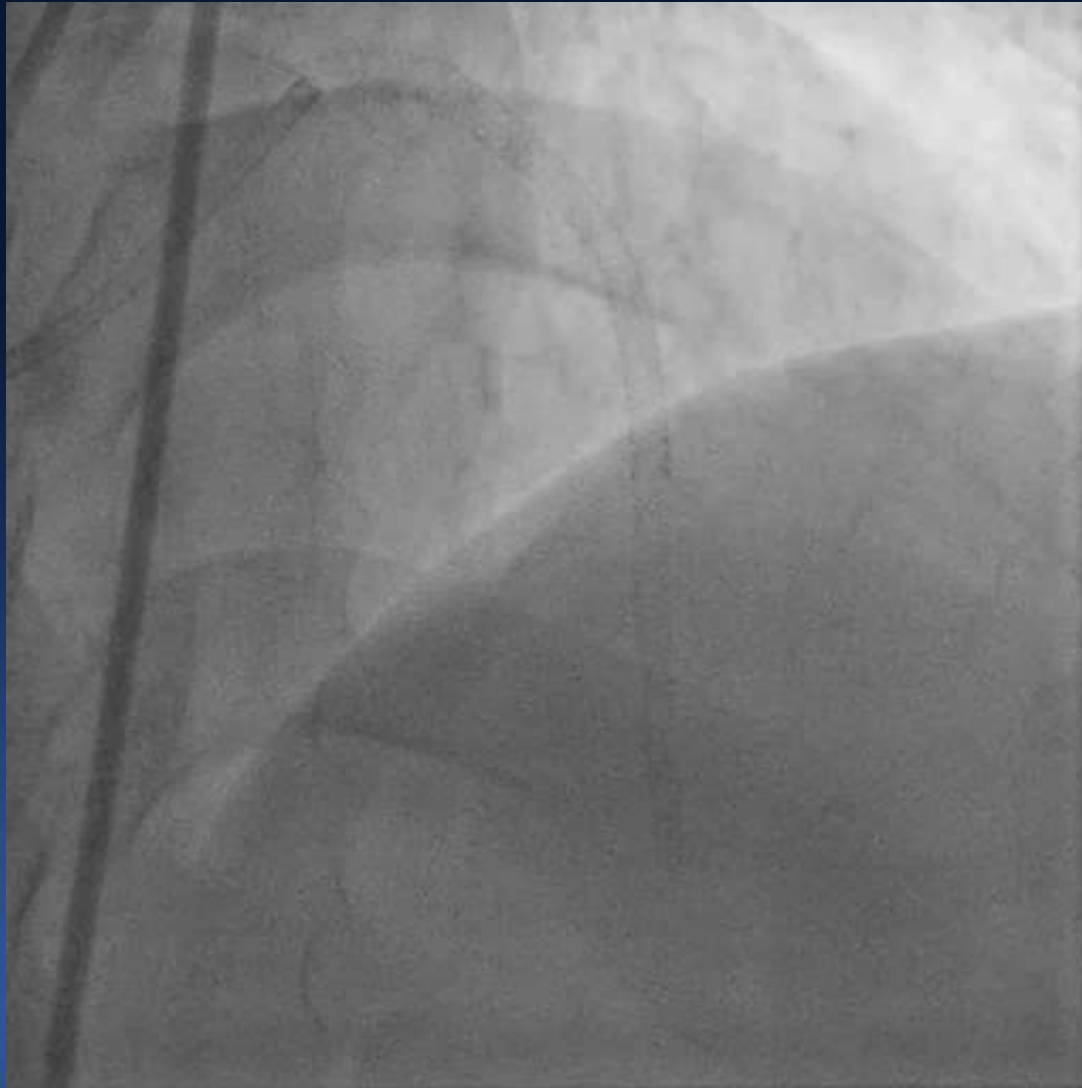




# Final angiography



# Final angiography



# Procedural summary

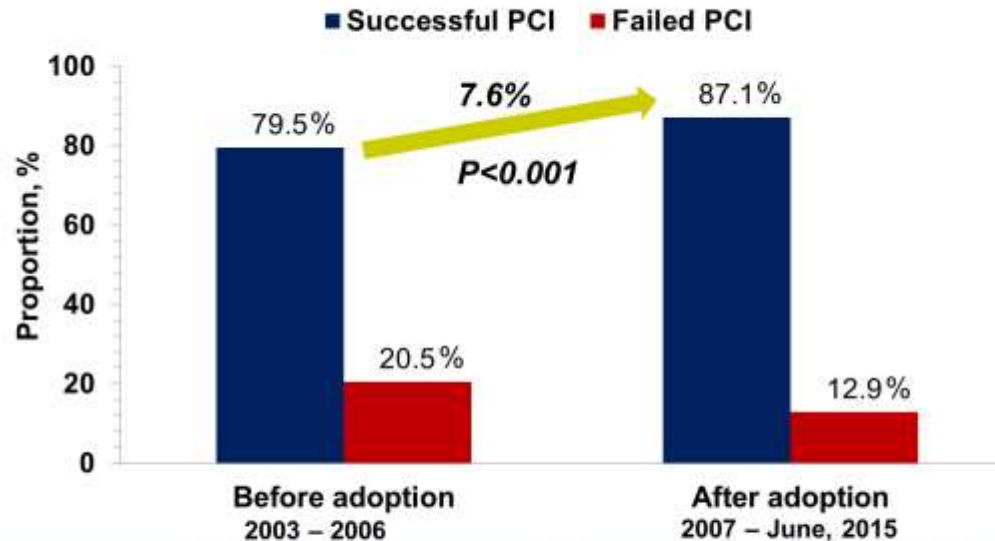
- Procedural time 3hr 40 min
- Fluoro time: 160 min
- Contrast media: 460 cc

# ASAN CTO registry: role of retrograde approach

## *The change of the technical success rate*

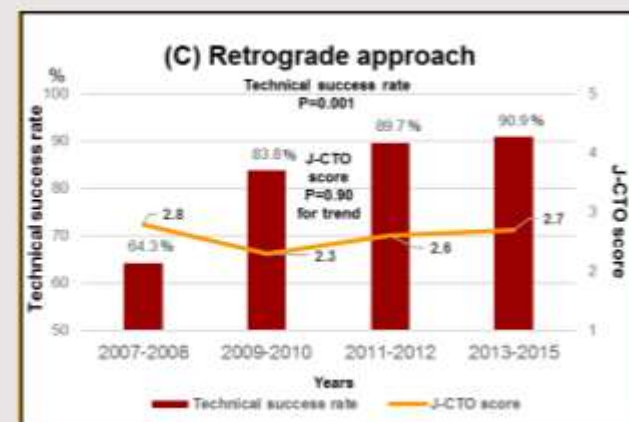
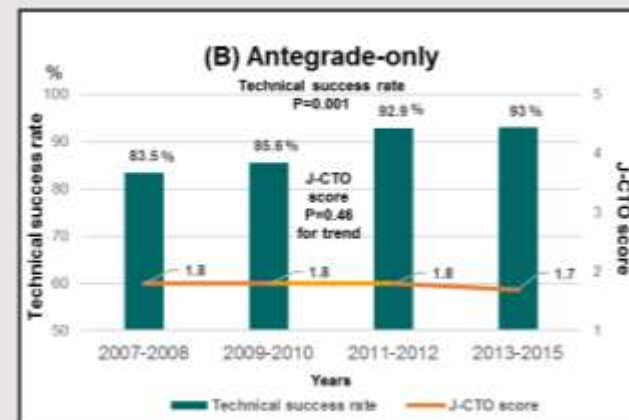
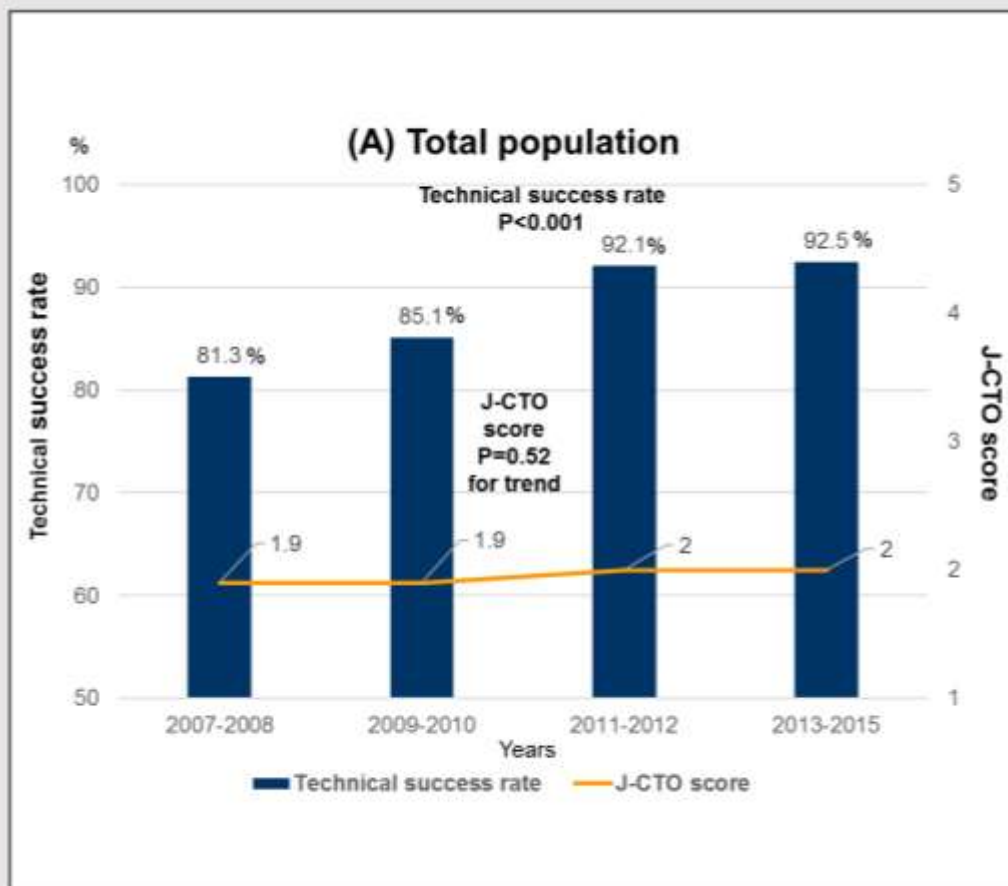
Total	Before adoption	After adoption
1,635 cases	484 cases	1,151 cases

Retrograde technique first adopted at January, 2007



J-CTO score	Before adoption	After adoption	p value
Overall	1.8 ± 1.2	2.0 ± 1.1	0.03
Successful PCI	1.7 ± 1.2	1.9 ± 1.0	0.01
Failed PCI	2.3 ± 1.1	2.4 ± 1.1	0.28

# Trends of J-CTO score and technical success rate



# Results

## *Procedural and In-hospital outcomes*

<b>Overall (1151 cases)</b>	<b>Retrograde approach (243 cases)</b>	<b>Antegrade-only (908 cases)</b>	<b>P value</b>
<b>Technical success</b>	204 (84.0%)	799 (88.0%)	0.09
<b>Procedural success</b>	197(81.2%)	784 (86.3%)	0.04
<b>In-hospital MACCE</b>	11 (4.5%)	37 (4.1%)	0.75
<b>Death</b>	0 (0.0%)	1 (0.1%)	1.00
<b>Periprocedural MI*</b>	9 (3.7%)	25 (2.8)	0.44
<b>Urgent repeat revascularization</b>	1 (0.4%)	10 (1.1%)	0.48
<b>Cardiac tamponade requiring intervention</b>	1 (0.4%)	1 (0.1%)	>0.99
<b>Stroke</b>	1 (0.4%)	1 (0.1%)	0.38

\*Postprocedural CK-MB elevation of  $\geq 10$  times the upper limit of normal.  
Abbreviation; MACCE, major adverse cardiac and cerebrovascular event; MI, myocardial infarction.



# Study Flow

## long-term outcomes

**PCI for CTO**  
From January, 2007 to June, 2015  
**N=1,151**

**Antegrade-only**  
**N=908**

**Retrograde-attempt**  
**N=243**

**Antegrade-only  
for Stenting**  
**N=714**  
**(702 patients)**

**Retrograde-attempt  
for Stenting**  
**N=202**  
**(202 patients)**

**109** technically-  
failed PCI  
**11** bare-metal stent  
**74** successful  
balloon angioplasty

**39** technically-  
failed PCI  
**2** successful  
balloon angioplasty

**Device-oriented outcomes**  
Median f/u duration (years): total 4.4 (IQR 2.3-6.2)

# Results

## Baseline characteristics

Overall (n=904)	Retrograde approach (N=202)	Antegrade-only (N=702)	P value
Age (year)	58.4 ± 9.9	60.7 ± 10.7	0.01
Men	188 (93.1%)	585 (82.0%)	< 0.001
Body mass index, (kg/m <sup>2</sup> )	25.5 ± 3.1	25.4 ± 3.1	0.46
Hypertension	119 (58.9%)	450 (63.1%)	0.32
Diabetes	58 (28.7%)	220 (30.9%)	0.62
Diabetes on insulin	11 (5.4%)	43 (6.0%)	0.89
Hyperlipidemia (%)	158 (78.2%)	497 (69.7%)	0.02
Current Smoker (%)	72 (35.6%)	174 (24.4%)	0.002
Congestive heart failure	27 (13.4%)	66 (9.3%)	0.12
History of myocardial infarction	31 (15.3%)	68 (9.5%)	0.03
Previous PCI	76 (37.6%)	168 (23.6%)	<0.001
Previous CABG	5 (2.5%)	24 (3.4%)	0.68
History of stroke	8 (4.0%)	56 (7.9%)	0.08
Peripheral artery disease	10 (5.0%)	22 (3.1%)	0.29
Renal dysfunction	1 (0.5%)	24 (3.4%)	0.05

# Results

## Angiographic characteristics

Overall (N=904)	Retrograde approach (N=202)	Antegrade-only (N=702)	P value
<b>Collateral grade, Rentrop scale</b>			<b>&lt;0.001</b>
0-1	15 (7.4%)	156 (21.5%)	
2	71 (35.1%)	244 (33.7%)	
3	116 (57.4%)	325 (44.8%)	
<b>J-CTO score</b>	<b>2.5 ± 1.0</b>	<b>1.8 ± 1.0</b>	<b>&lt;0.001</b>
<b>Entry shape, Blunt</b>	146 (72.6%)	422 (58.3%)	<b>&lt;0.001</b>
<b>Moderate/severe calcification</b>	104 (51.7%)	338 (46.7%)	0.20
<b>Bending &gt; 45°</b>	94 (46.8%)	252 (34.8%)	0.002
<b>Occlusion length ≥ 20 mm</b>	96 (47.8%)	183 (25.3%)	<b>&lt;0.001</b>
<b>Retry</b>	63 (31.2%)	74 (10.2%)	<b>&lt;0.001</b>

Abbreviation: CTO, chronic total occlusion.

# Results

## *Procedure characteristics*

Overall, (N=904)	Retrograde approach (N=202)	Antegrade-only (N=702)	P value
Total lesion length, mm	53.3 ± 21.2	37.3 ± 17.8	<0.001
Number of stents per lesion*	2.2 ± 0.8	1.7 ± 0.8	<0.001
Stent length per lesion*, mm	67.6 ± 25.4	49.7 ± 23.9	<0.001
Average stent diameter*†, mm	3.1 ± 0.3	3.2 ± 0.3	0.11
<b>Smallest stent diameter*, mm</b>	<b>2.9 ± 0.4</b>	<b>3.0 ± 0.4</b>	<b>&lt;0.001</b>
IVUS use	184 (91.1%)	667 (92.0%)	0.68
Non-target vessel intervention	66 (32.7%)	245 (33.8%)	0.77
Contrast media amount, ml	532.5 ± 244.3	389.9 ± 182.1	<0.001
Total fluoroscopy time, min	74.9 ± 42.6	33.8 ± 42.5	<0.001

\*Information associated with 916 target CTO vessels.

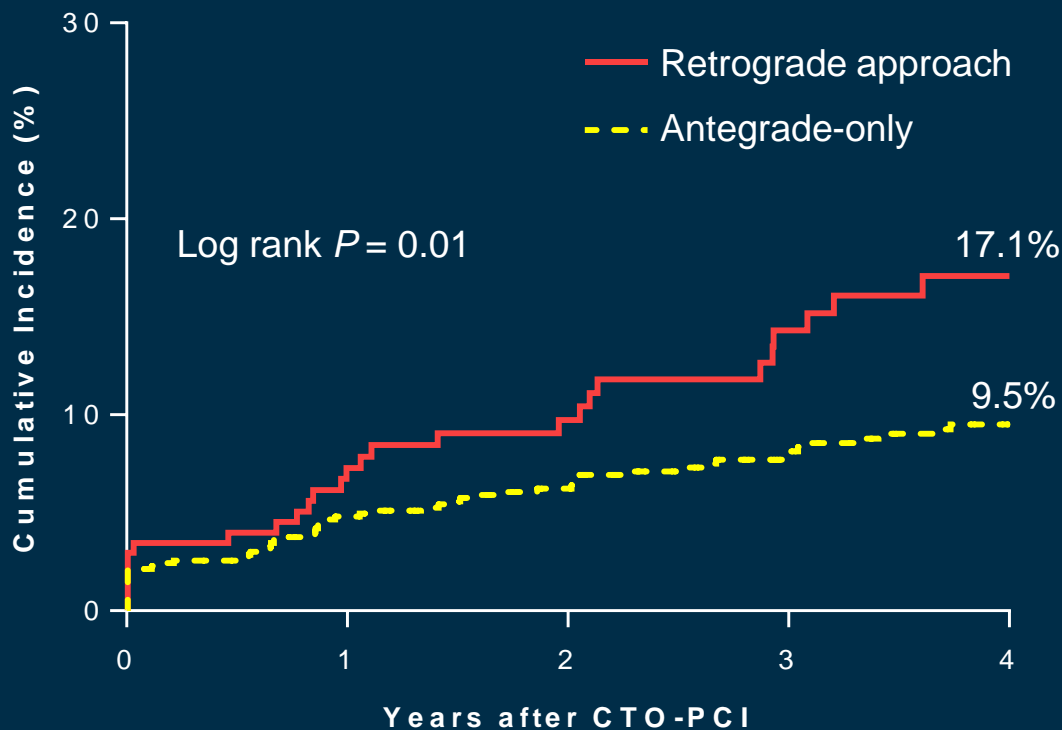
†Average stent diameter was calculated using individual stent diameter value weighted by stent length.

Abbreviation: BMS, bare-metal stent; CART, controlled antegrade and retrograde subintimal tracking; CTO, chronic total occlusion; DES, drug-eluting stent; IVUS, intravascular ultrasound.

# Results

## *Kaplan-Meier curves of end points*

### Target-vessel failure



#### ***No. of patients at risk***

Retrograde	202	165	135	99	75
Antegrade-only	702	627	548	432	356

# Results

## *Cox Proportional Hazards for TVF*

	Unadjusted Hazard ratio (95% CI)	P value	Adjusted Hazard ratio (95% CI)	P value
Age	1.01 (0.99-1.03)	0.48		
Diabetes Mellitus	0.85 (0.52-1.37)	0.50		
Renal dysfunction	3.23 (1.34-7.76)	0.009	3.33 (1.42-7.83)	0.006
Clinical presentation of ACS†	1.98 (1.24-3.14)	0.004	1.99 (1.26-3.14)	0.003
Left ventricular ejection fraction	0.99 (0.97-1.02)	0.81		
CTO located in the left anterior de scending artery	1.02 (0.65-1.58)	0.95		
J-CTO score	1.21 (0.98-1.49)	0.08	1.23 (1.00-1.51)	0.047
Stent number of the target vessel	1.16 (0.89-1.50)	0.27		
Smallest stent diameter of the target vessel	0.44 (0.22-0.86)	0.02	0.39 (0.21-0.74)	0.004

\*Renal dysfunction was defined as serum creatinine  $\geq$  2.0 mg/dL or dialysis. †Hazard ratios are for patients with clinical presentation of ACS, compared with those with stable angina. ACS = acute coronary syndrome; CTO = chronic total occlusion; NA = not applicable

# Summary

- Retrograde approach was observed to significantly contribute to the increased recanalization rates of more complex CTOs over time.
- The rates of in-hospital MACCE was low and long-term device oriented outcome after successful stenting via this technique was acceptable.
- Smaller final stent results associated with complex anatomy may be responsible for the future likelihood of TVF in this population.



**Thank you very much !**