

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

Antegrade approach

- Single wire technique
 - Parallel wire technique
 - Dissection reentry
- In conjunction with
IVUS-guided approach

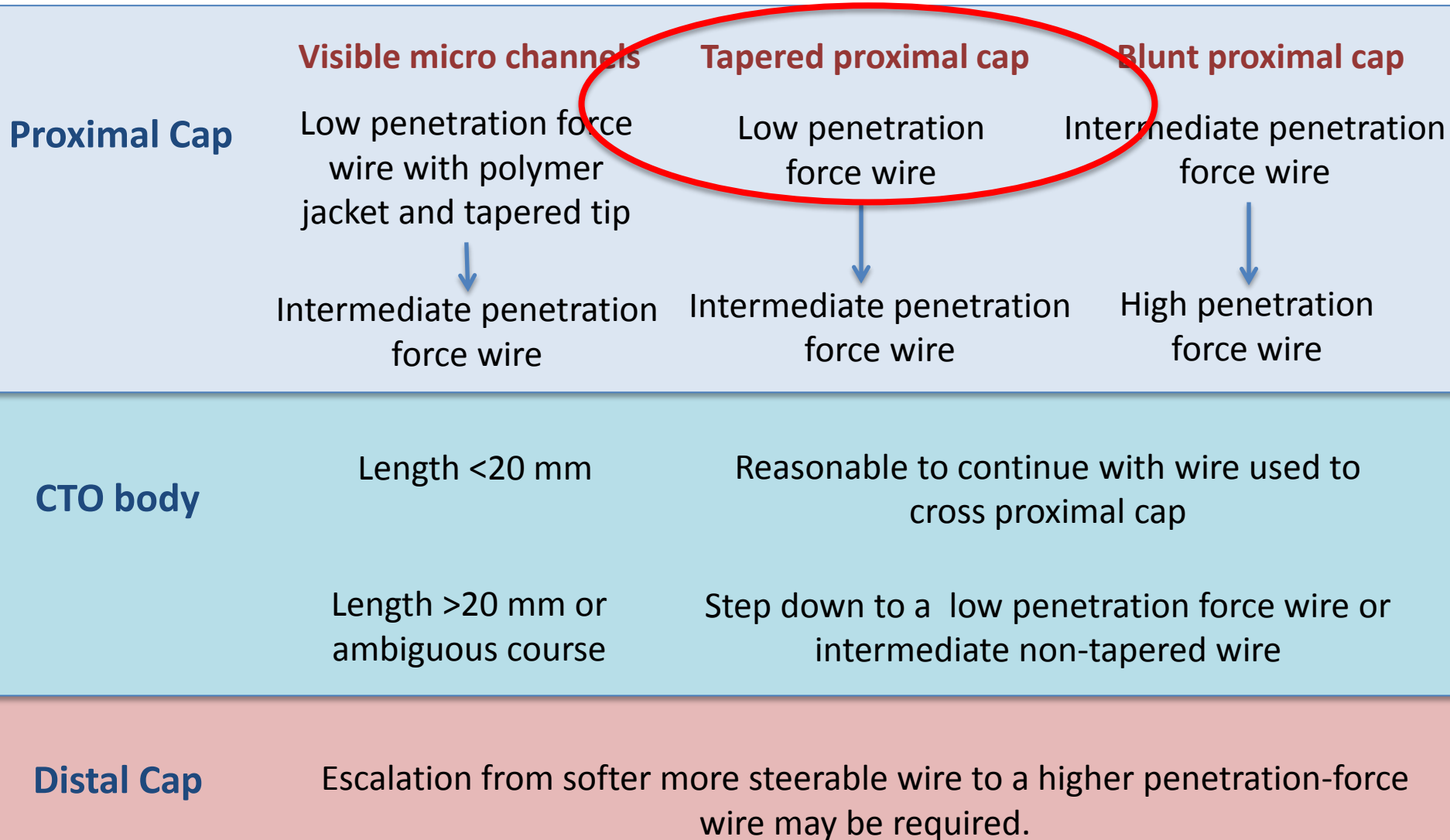
Antegrade wire based strategy



	Visible micro channels	Tapered proximal cap	Blunt proximal cap
Proximal Cap	Low penetration force wire with polymer jacket and tapered tip ↓ Intermediate penetration force wire	Low penetration force wire ↓ Intermediate penetration force wire	Intermediate penetration force wire ↓ High penetration force wire
CTO body	Length <20 mm Length >20 mm or ambiguous course	Reasonable to continue with wire used to cross proximal cap Step down to a low penetration force wire or intermediate non-tapered wire	
Distal Cap	Escalation from softer more steerable wire to a higher penetration-force wire may be required.		

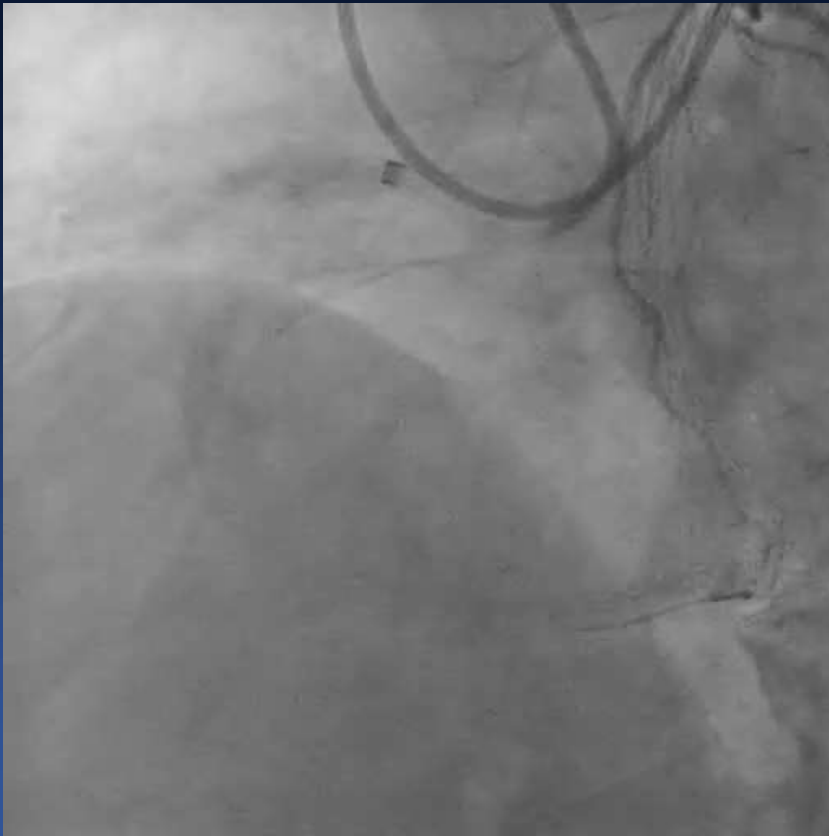
Single wire technique

Antegrade wire based strategy

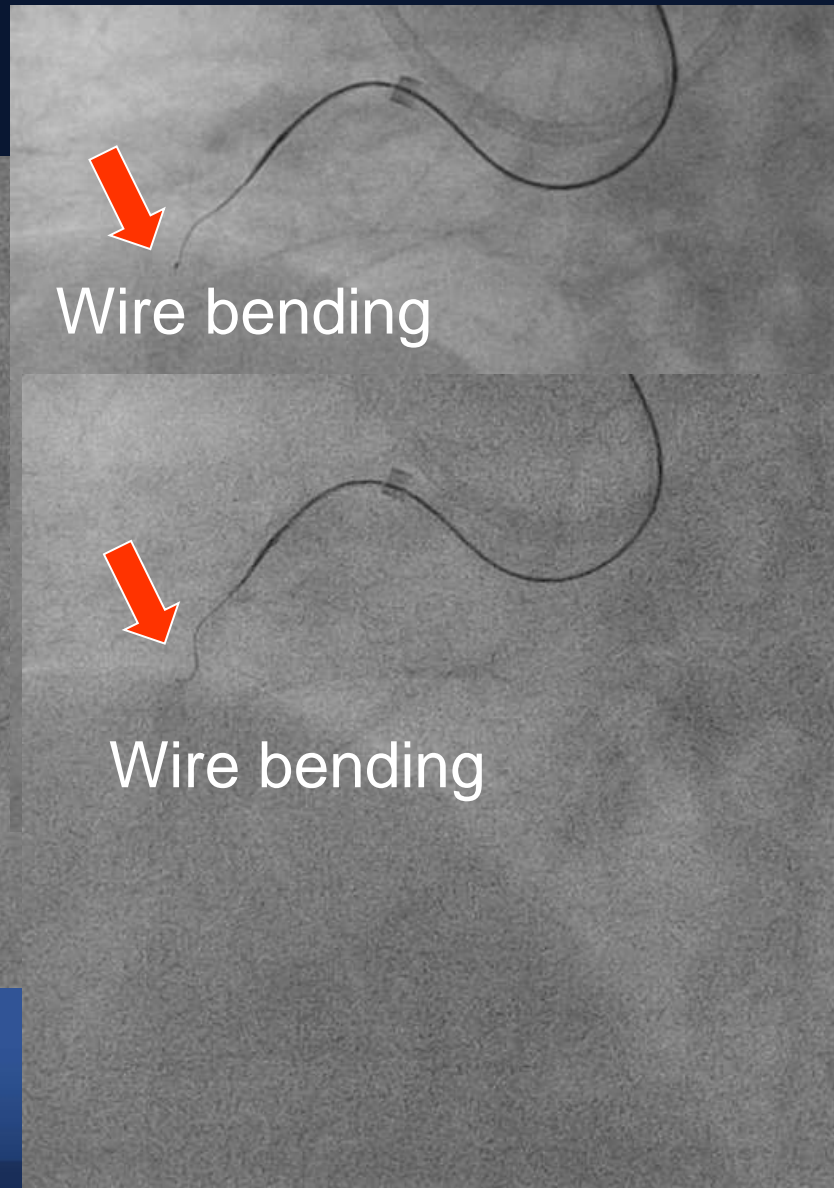
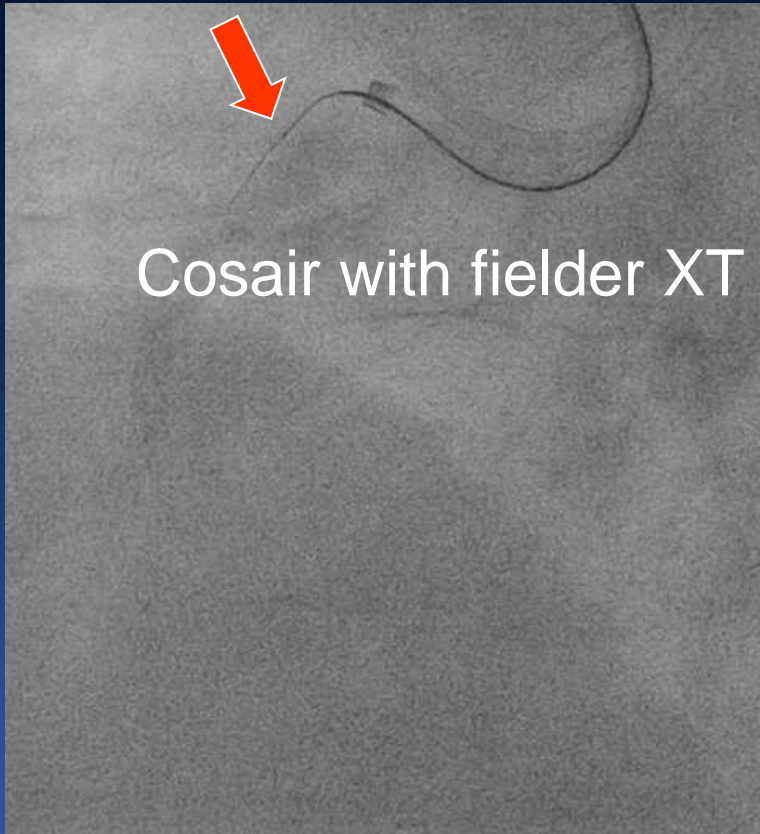


60/M, Long CTO with tapered cap

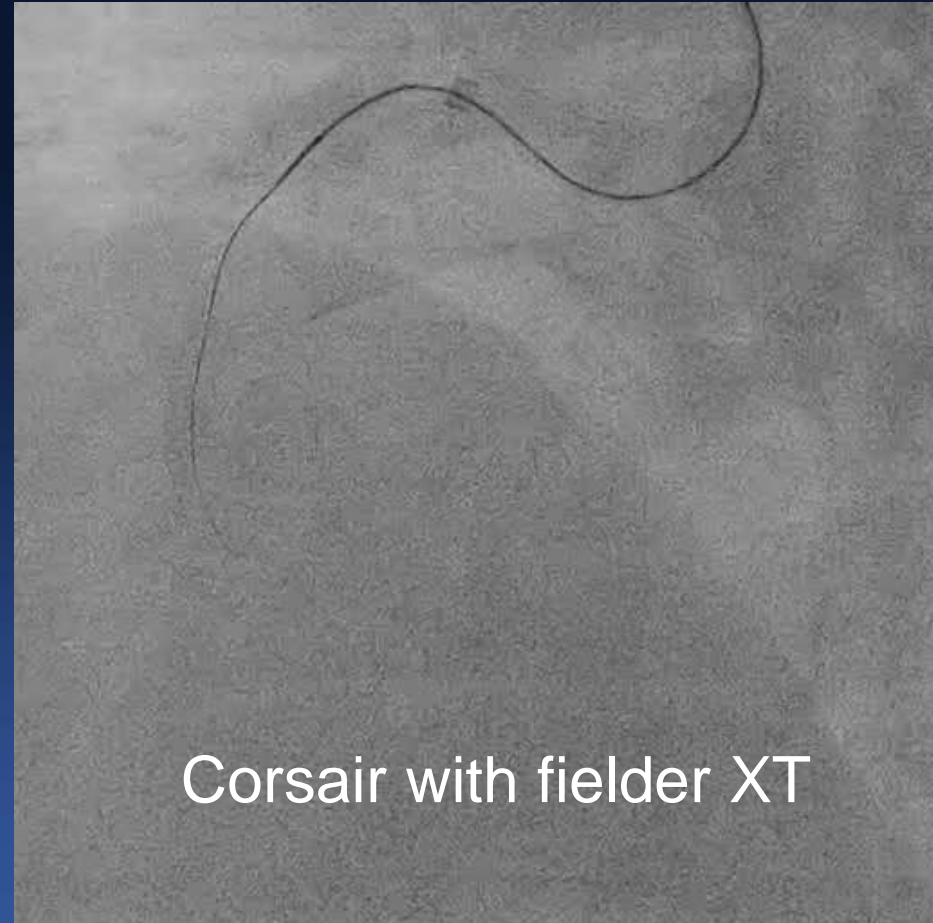
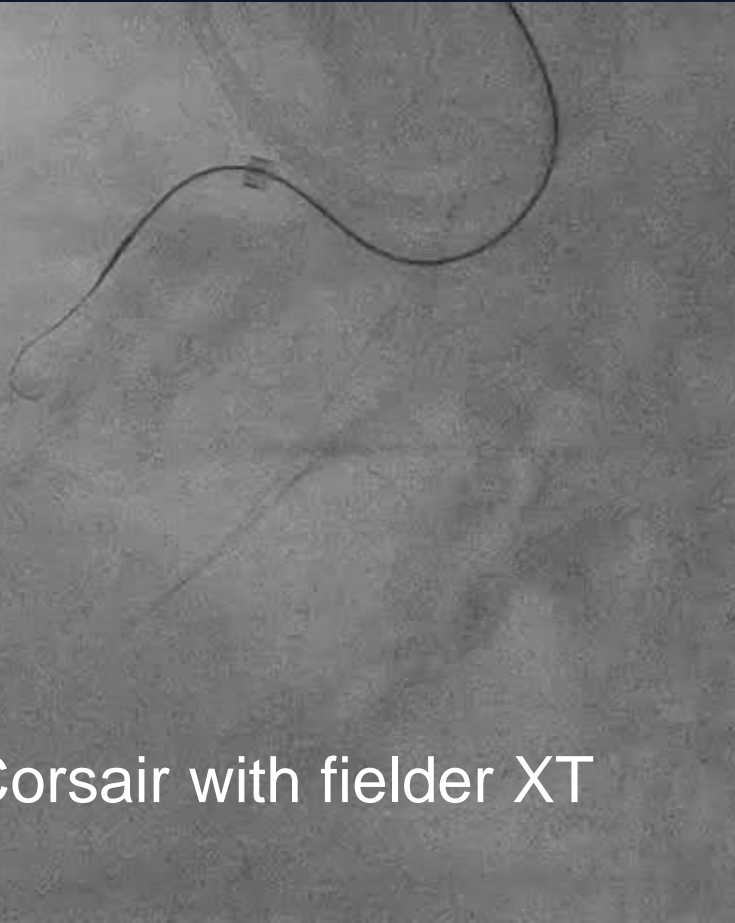
Poor distal target with good interventional collateral



Long CTO with tapered cap

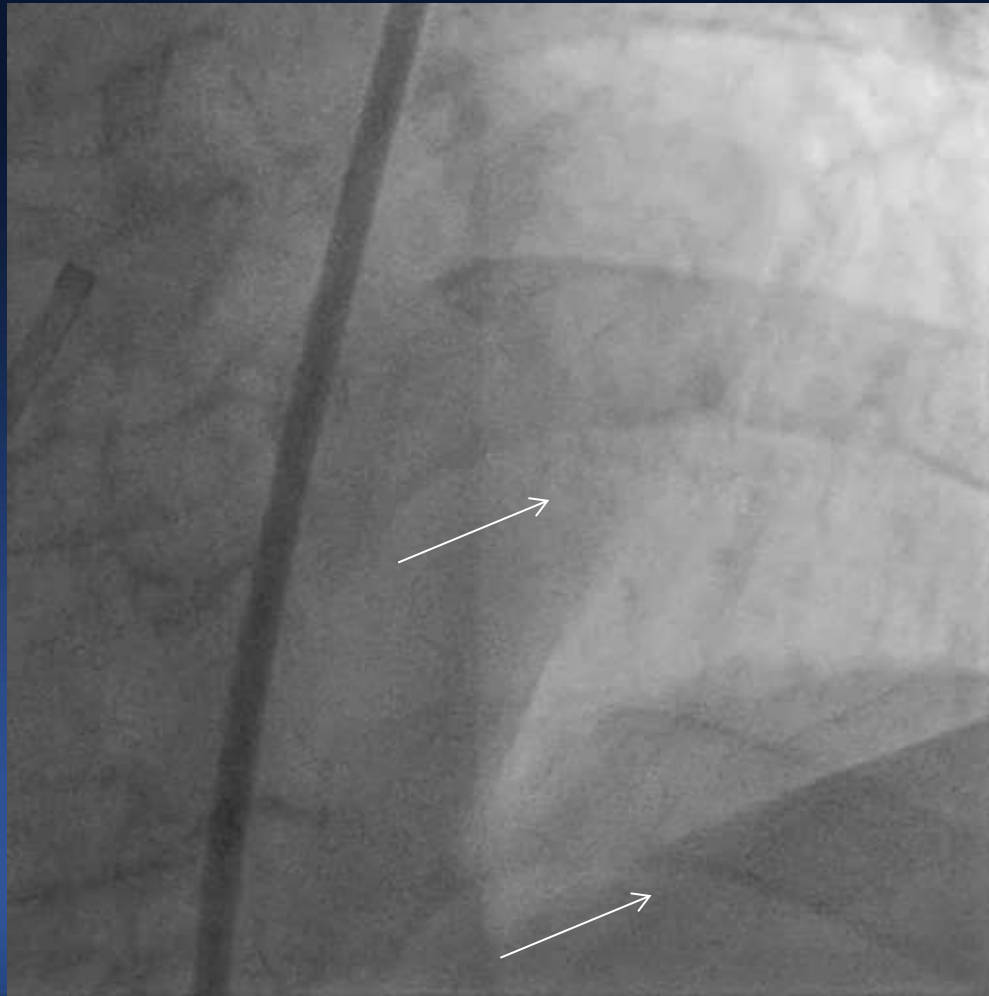


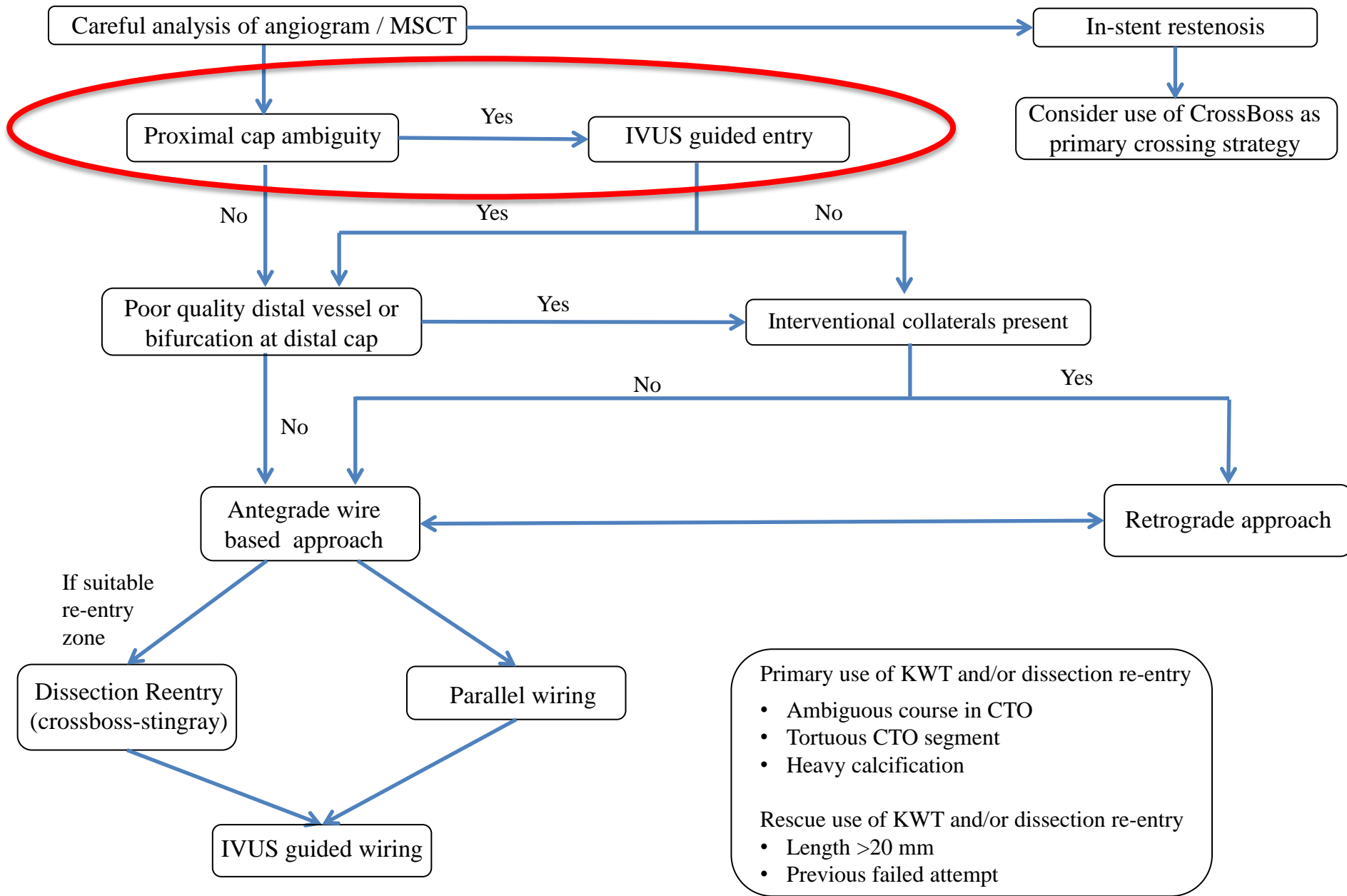
Long CTO with tapered cap



67/M Ambiguous stump

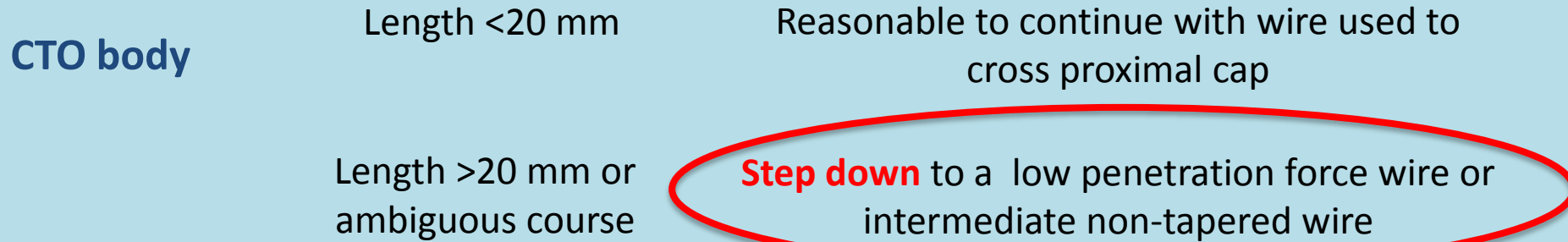
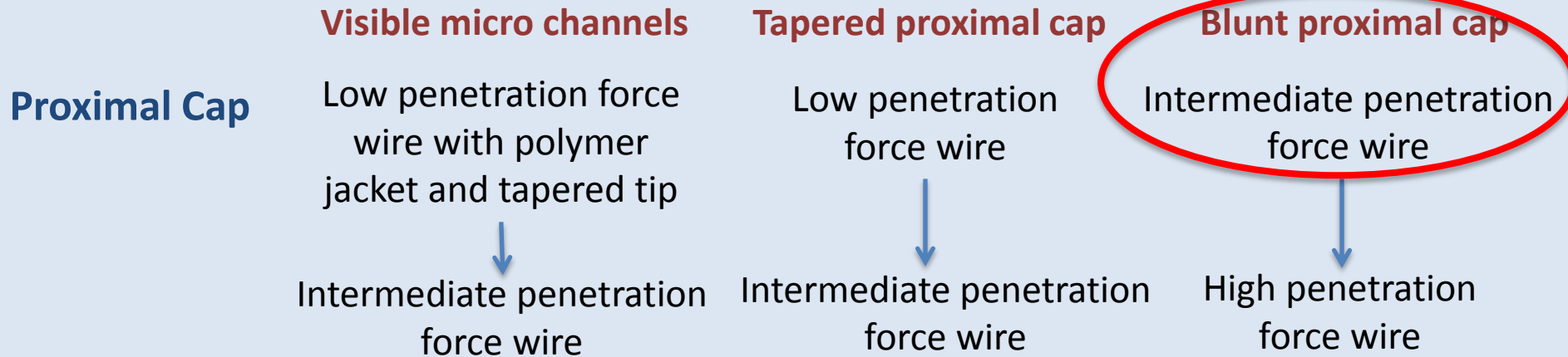
Poor distal target





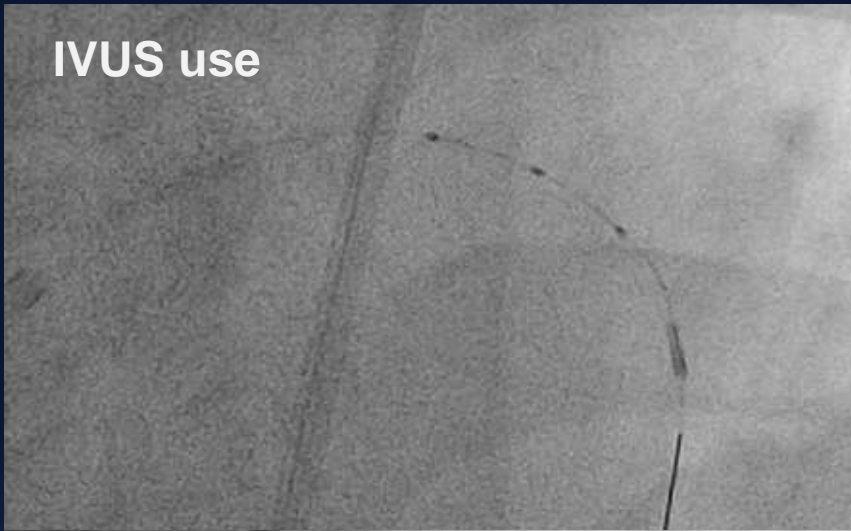
Consider stopping if >3 hours, 3.7 x eGFR ml contrast, Air Kerma > 5 Gy unless procedure well advanced

Antegrade wire based strategy

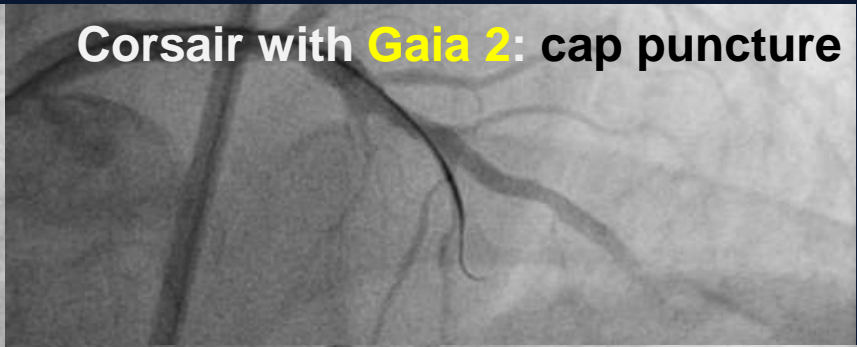


Distal Cap Escalation from softer more steerable wire **to a higher penetration-force** wire may be required.

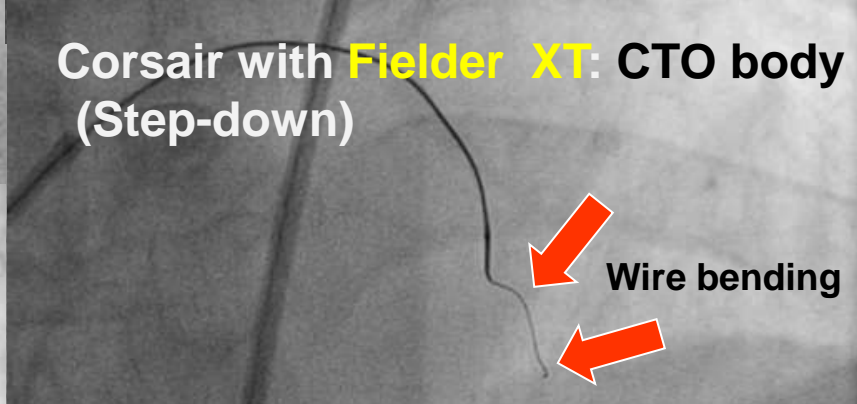
IVUS use



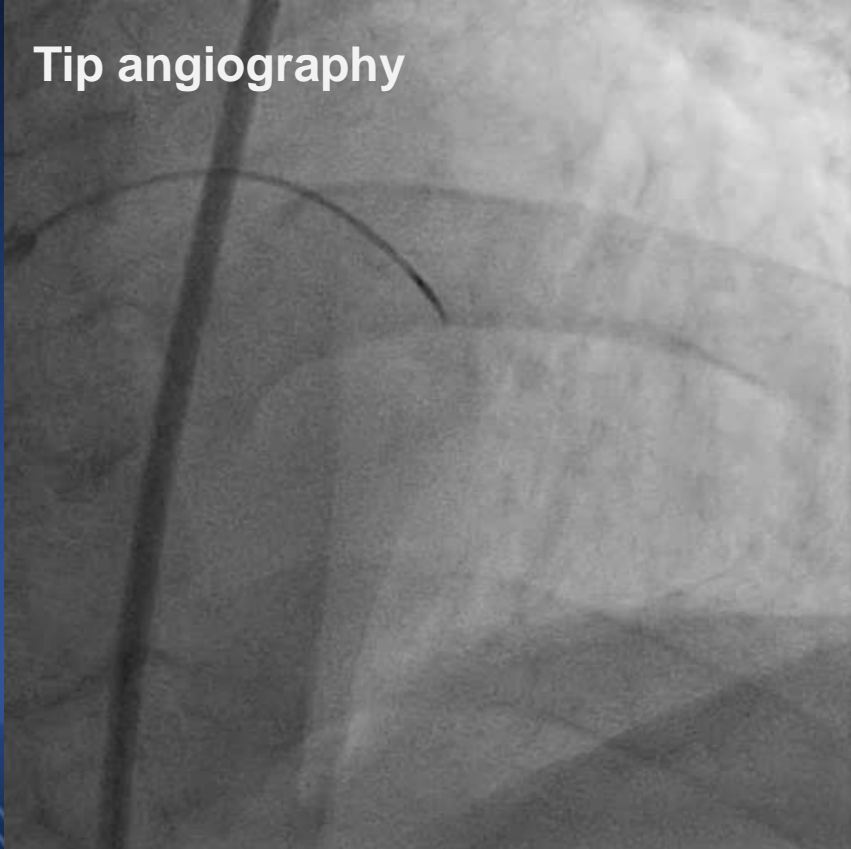
Corsair with **Gaia 2**: cap puncture



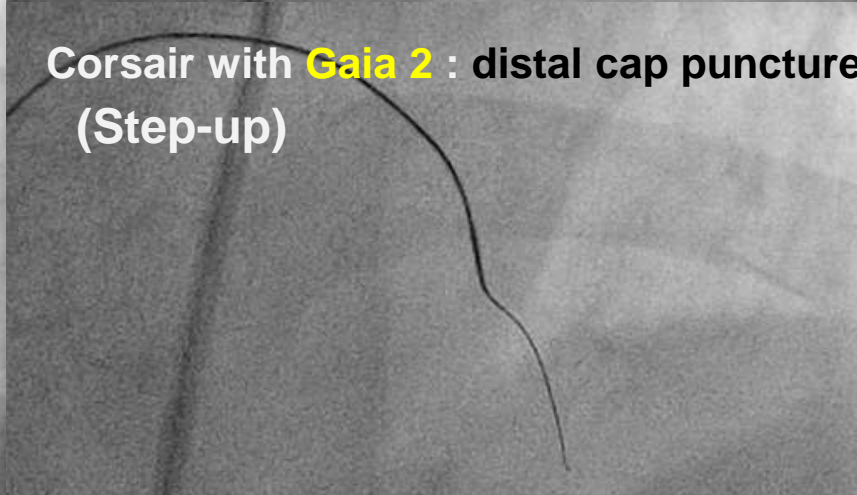
Corsair with **Fielder XT**: CTO body (Step-down)

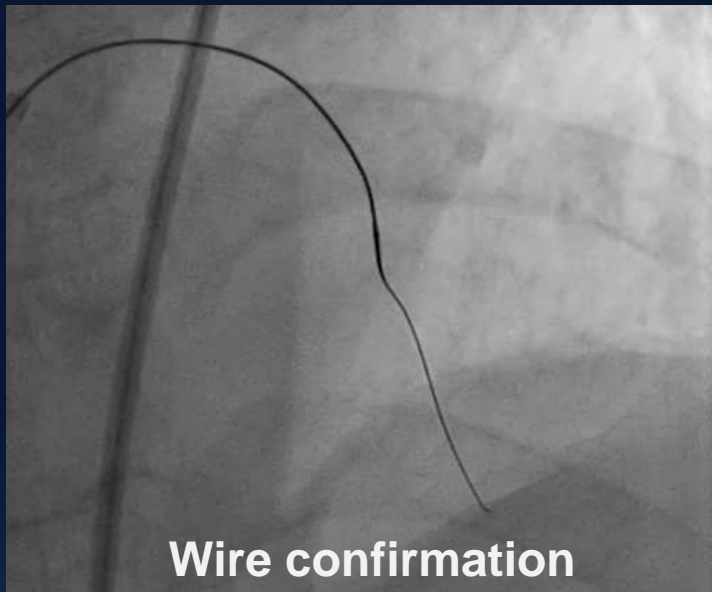


Tip angiography

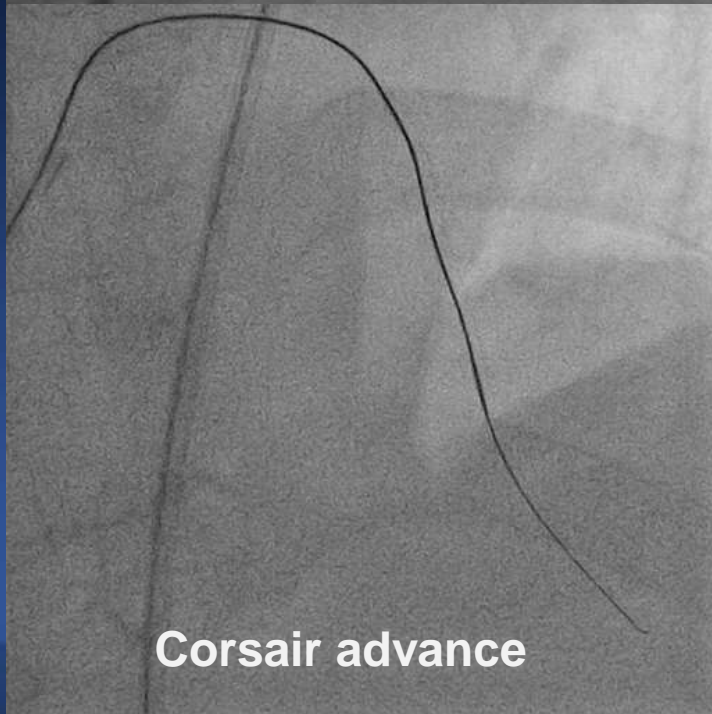


Corsair with **Gaia 2**: distal cap puncture (Step-up)

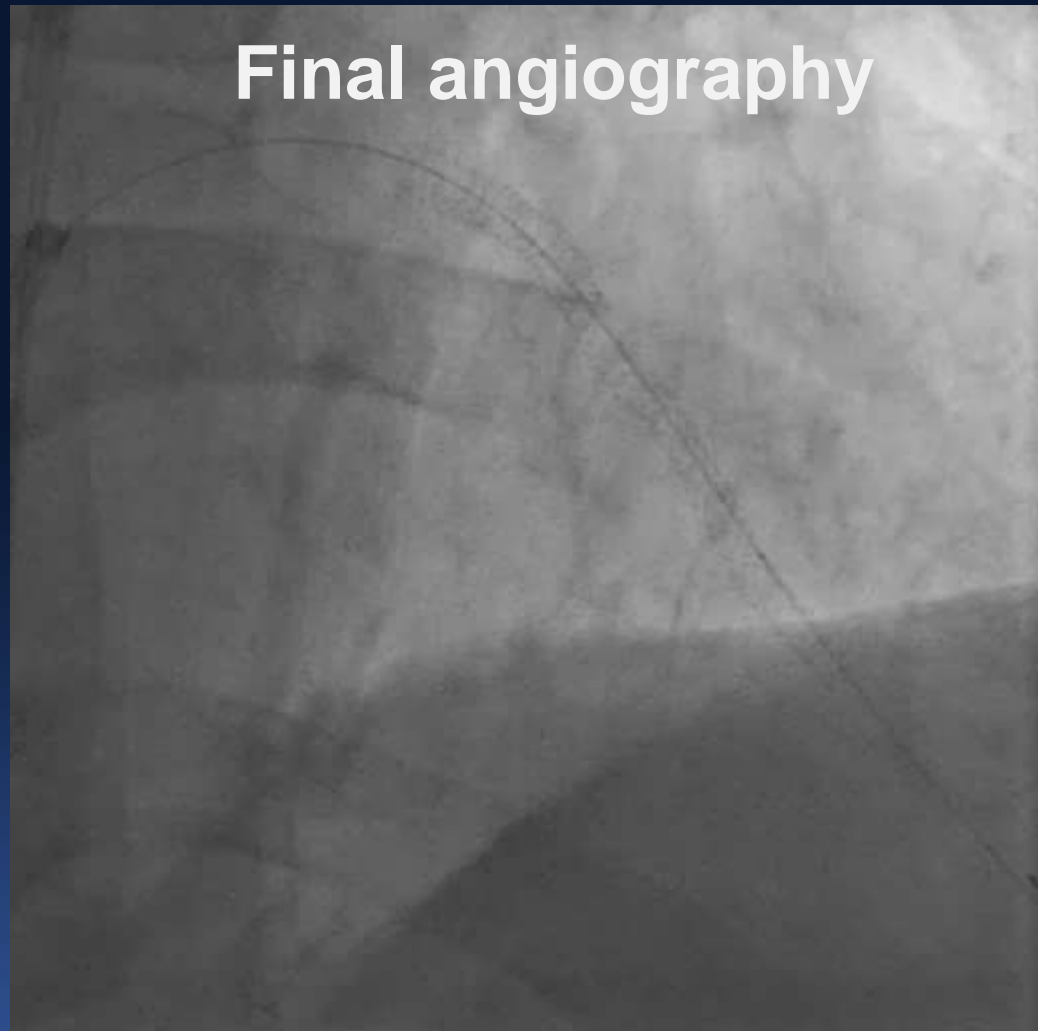




Wire confirmation

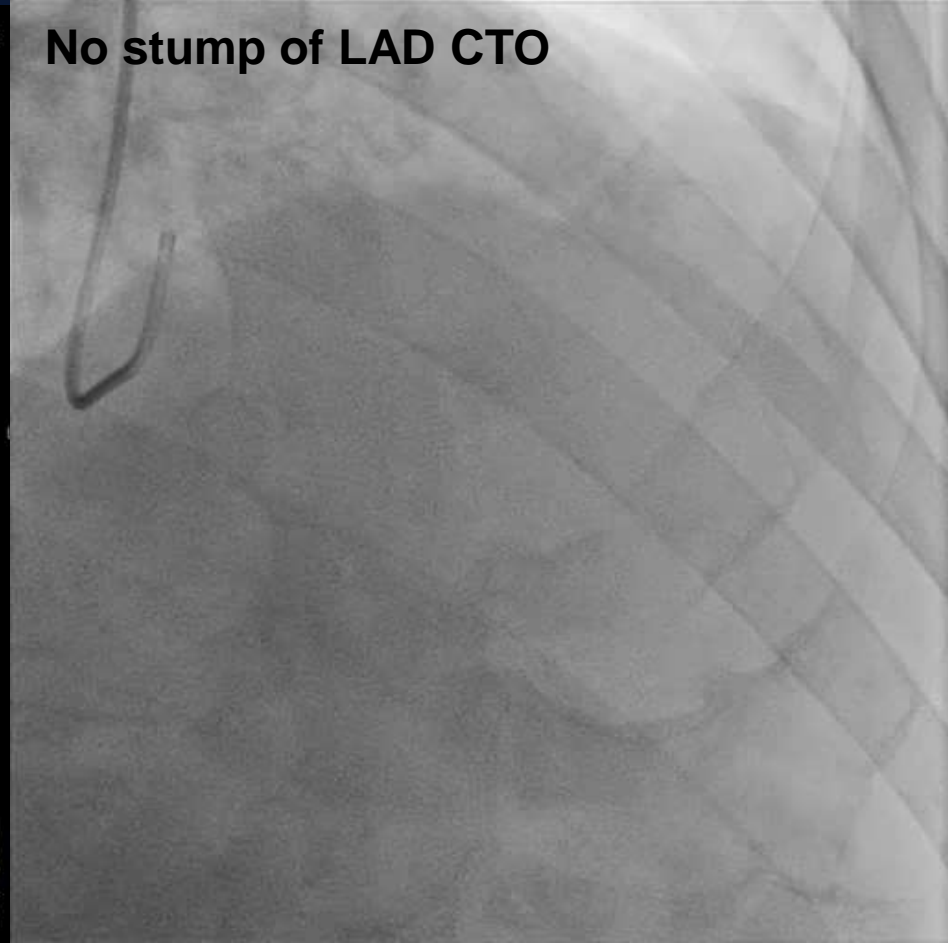
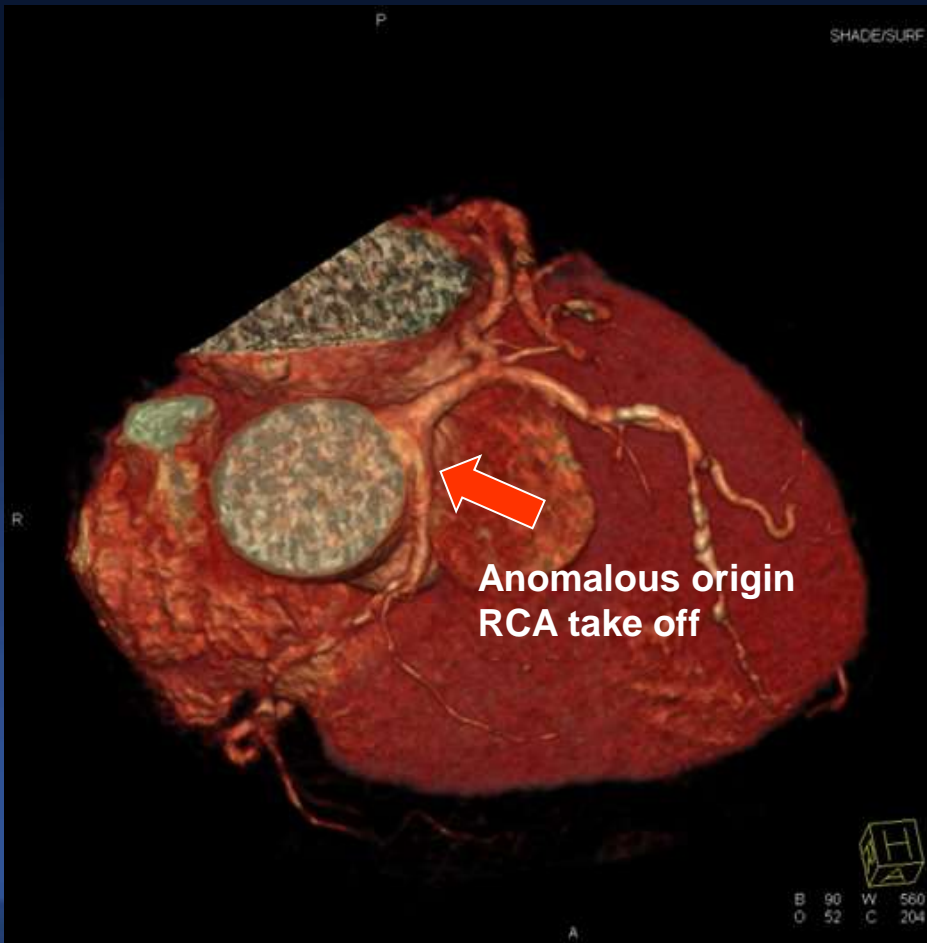


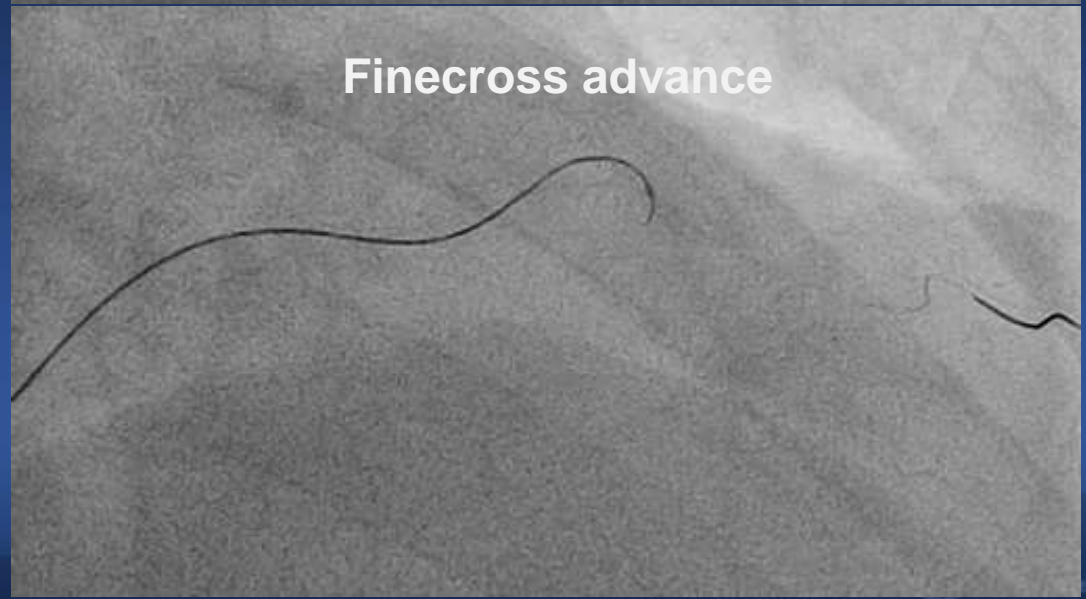
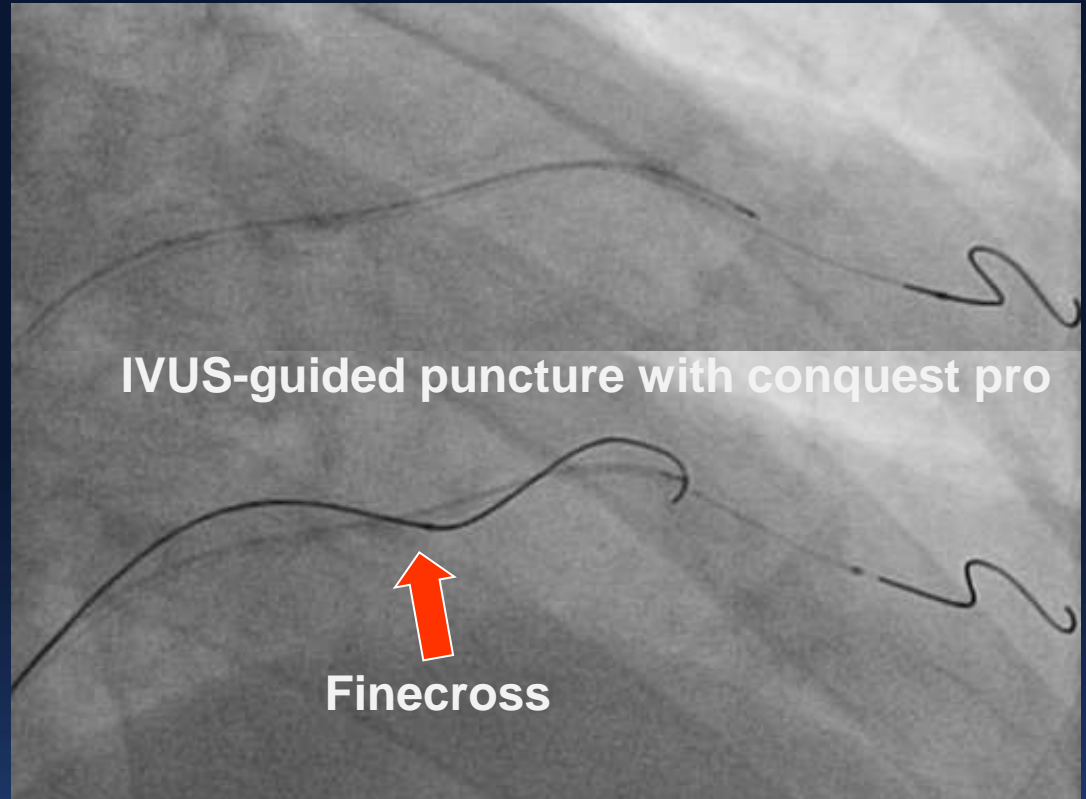
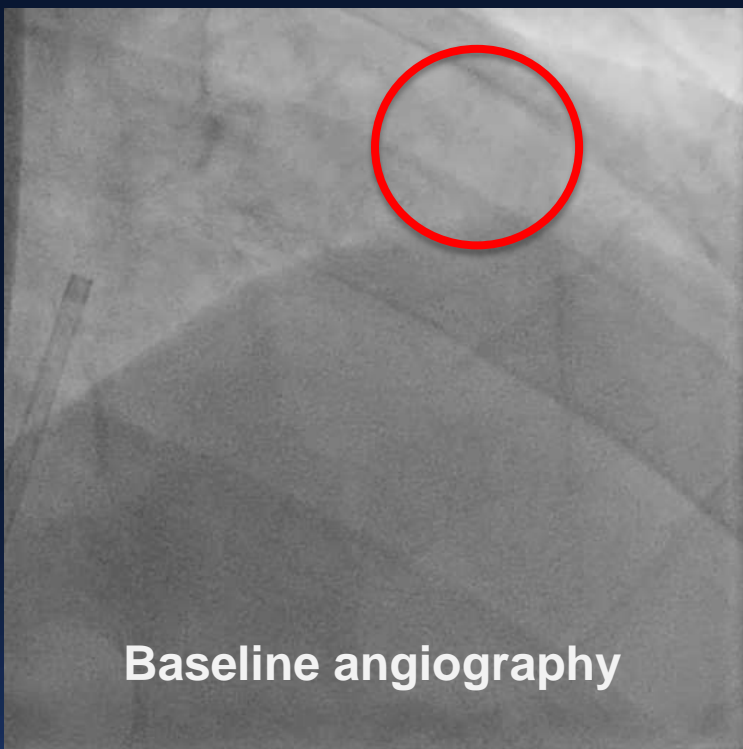
Corsair advance



Final angiography

LAD CTO with anomalous origin RCA CTO







Fielder XT (step down)

This fluoroscopic image shows a Fielder XT catheter with a step-down configuration. The catheter is positioned in a curved, step-like manner, likely to navigate a specific anatomical bend or lesion in the coronary artery.



Tip angiography

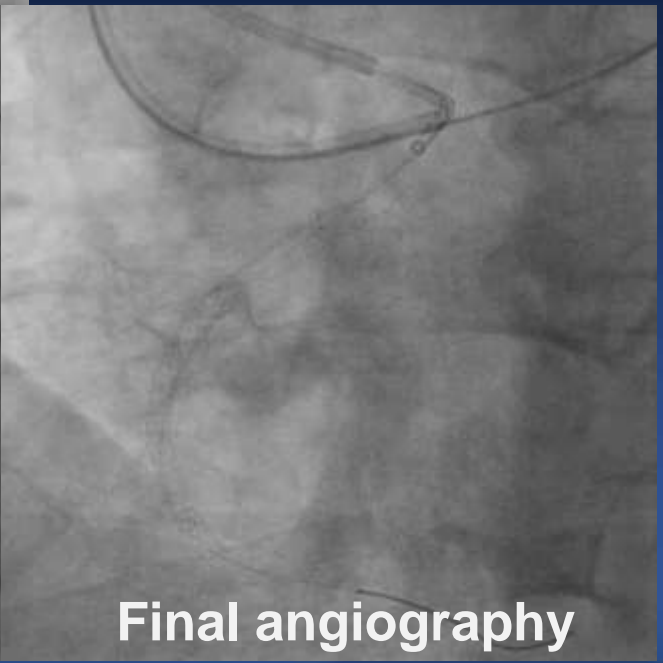
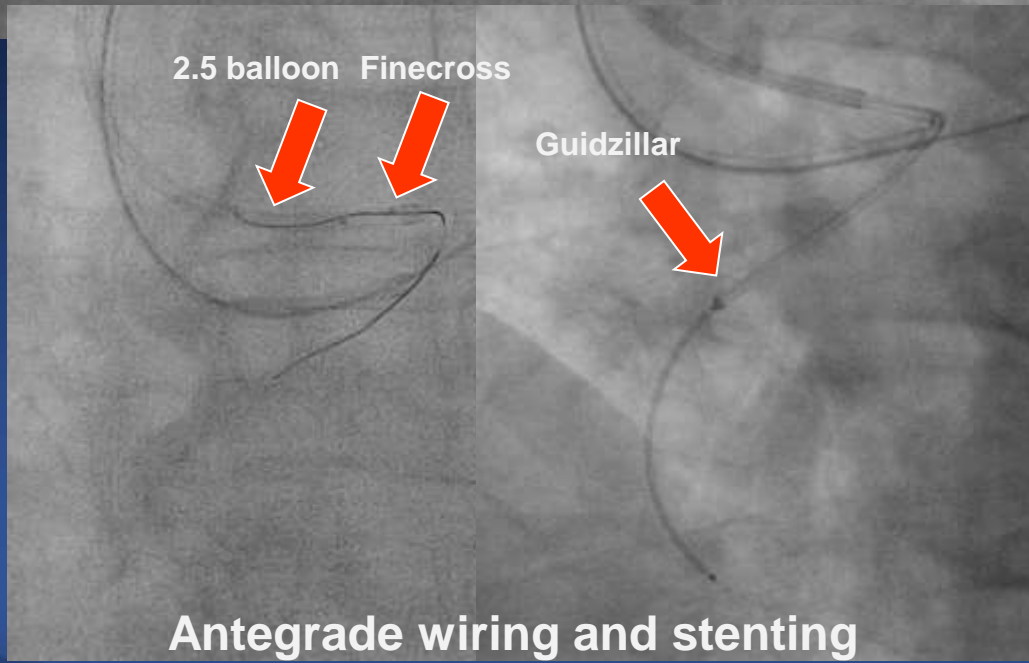
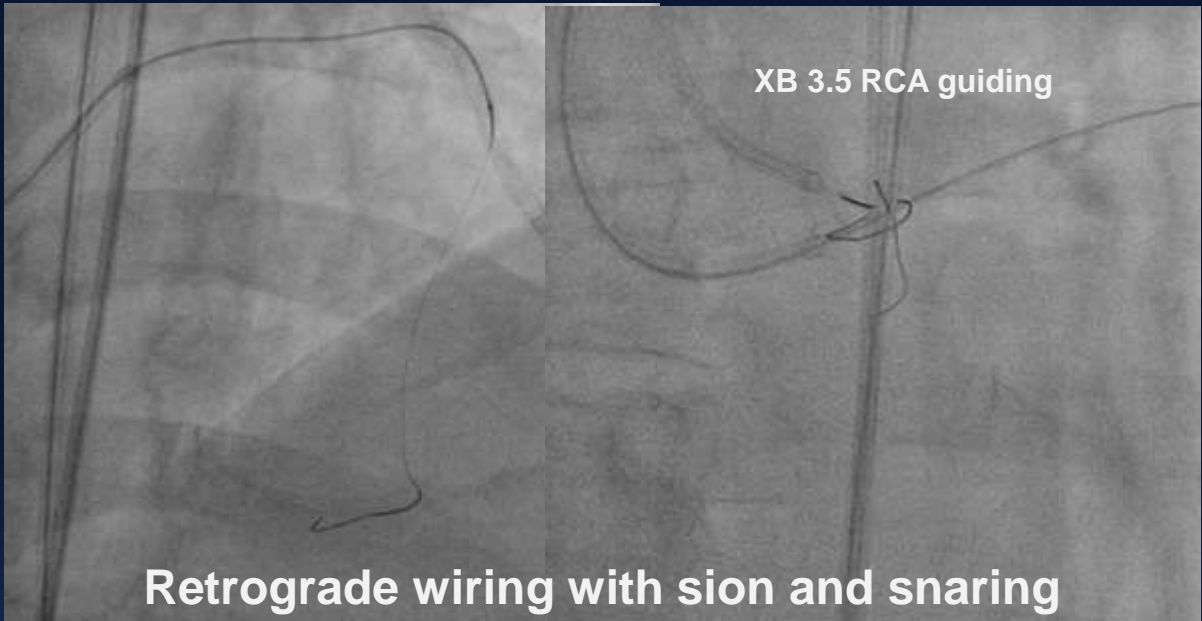
This image shows the tip of the catheter performing angiography. The catheter tip is positioned at the site of interest, and the resulting angiogram shows the vessel lumen.



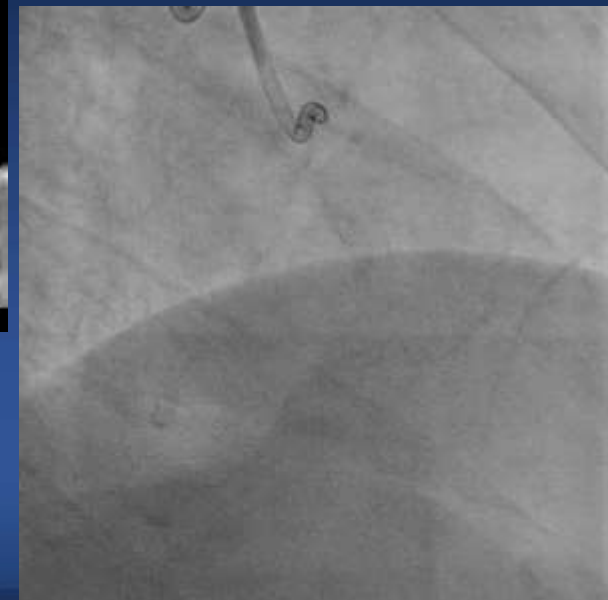
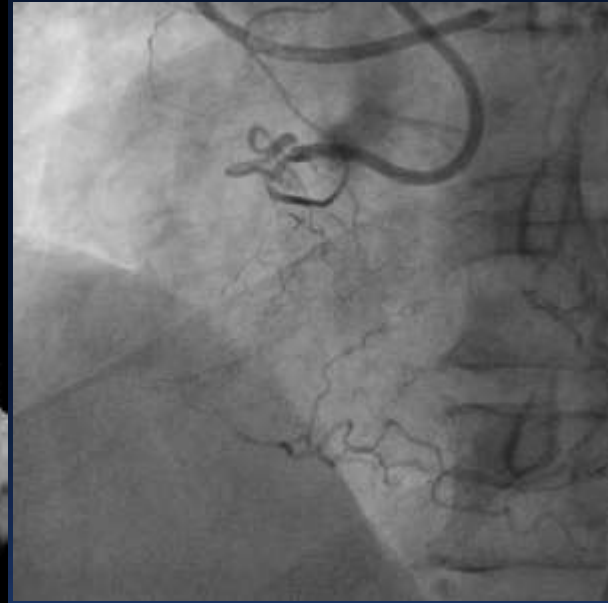
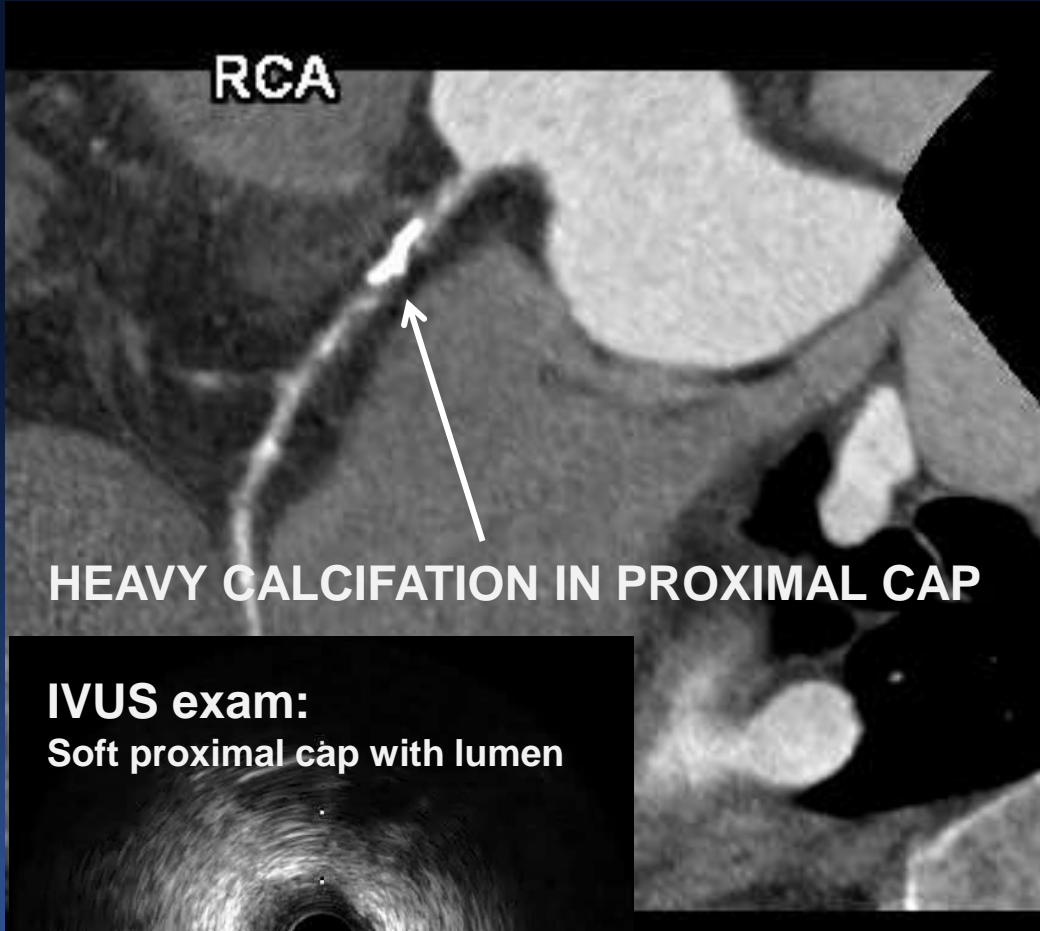
Final angiography

This image shows the final angiogram after the procedure. The catheter is still in place, and the final view of the vessel lumen is displayed.

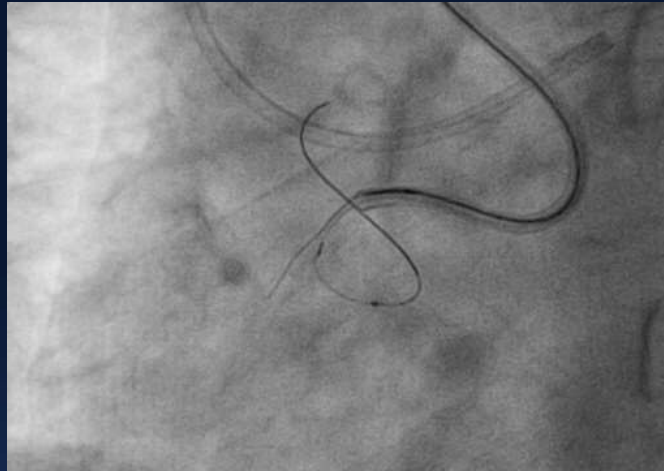
Distal true lumen wiring with fielder XT



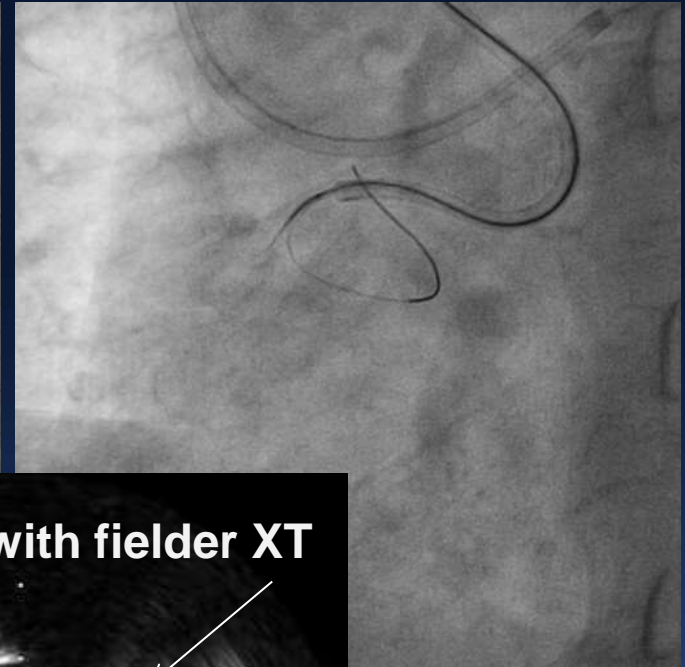
56/M, Long RCA CTO with no stump



IVUS-guided Fielder XT



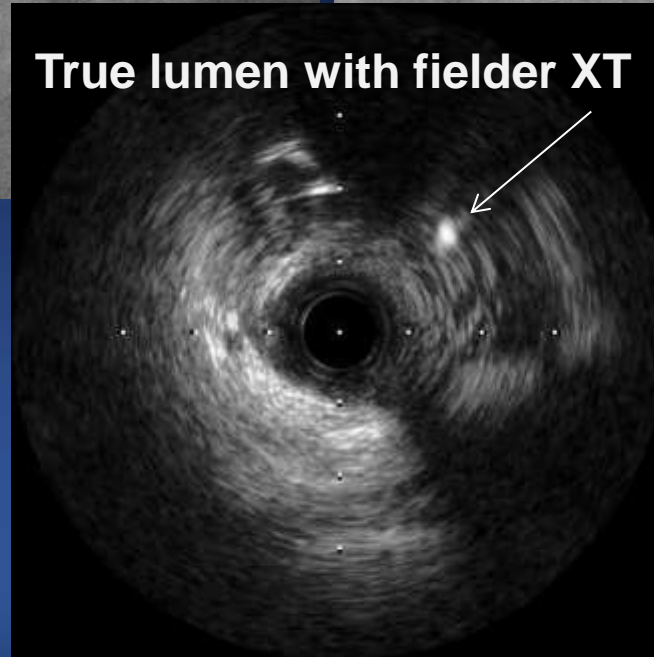
Corsair advance



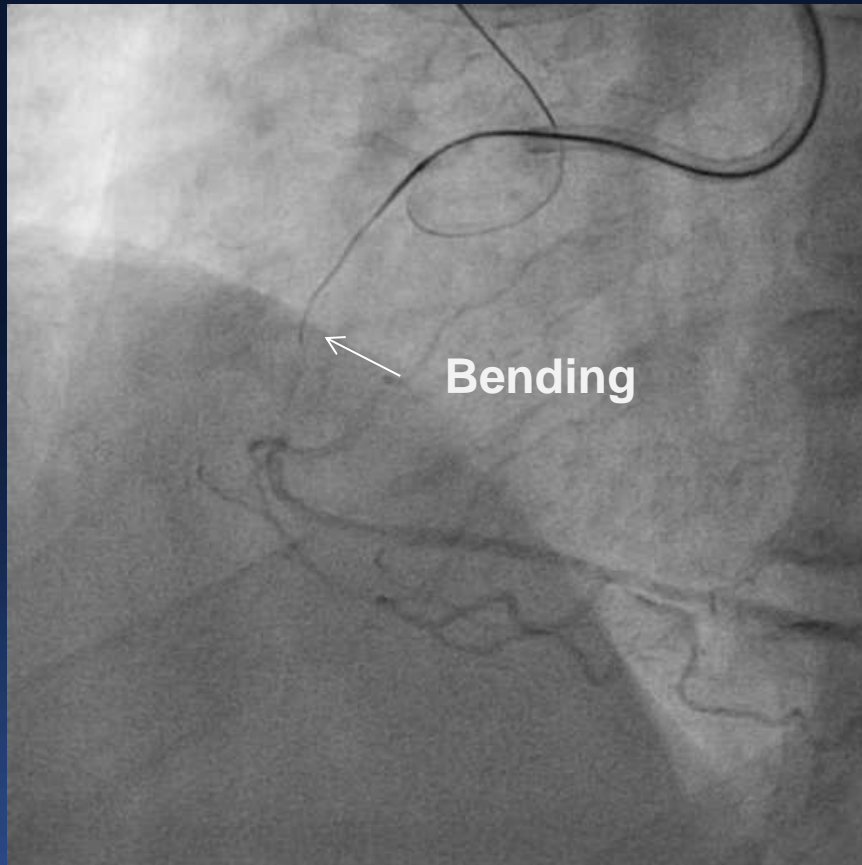
**IVUS exam:
Soft proximal cap with lumen**



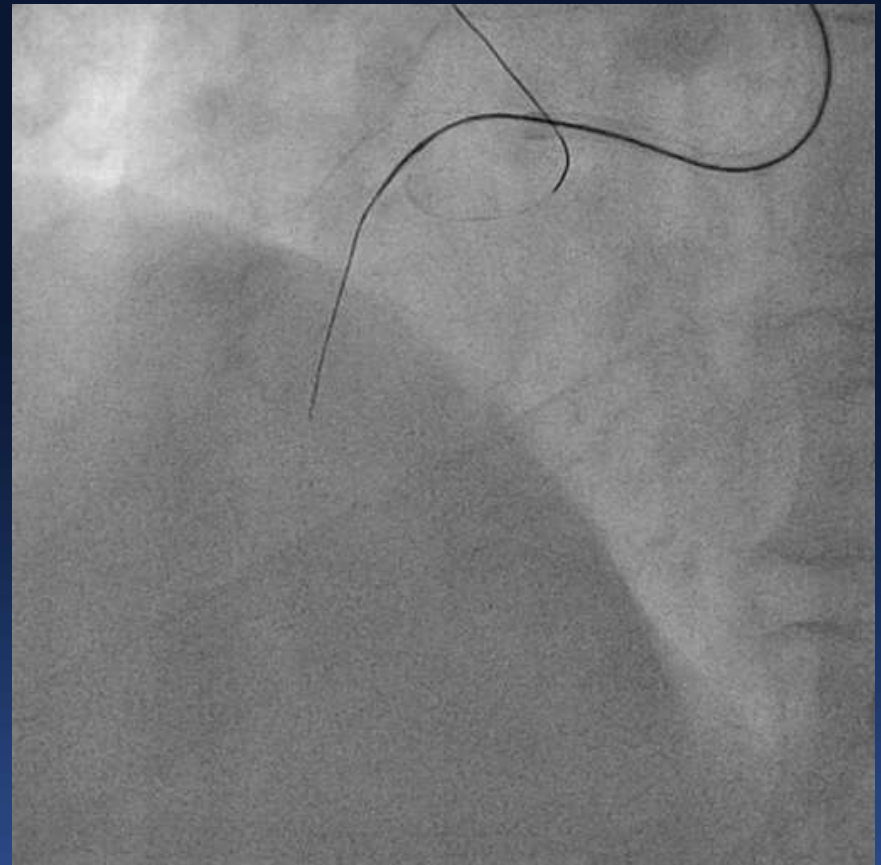
True lumen with fielder XT



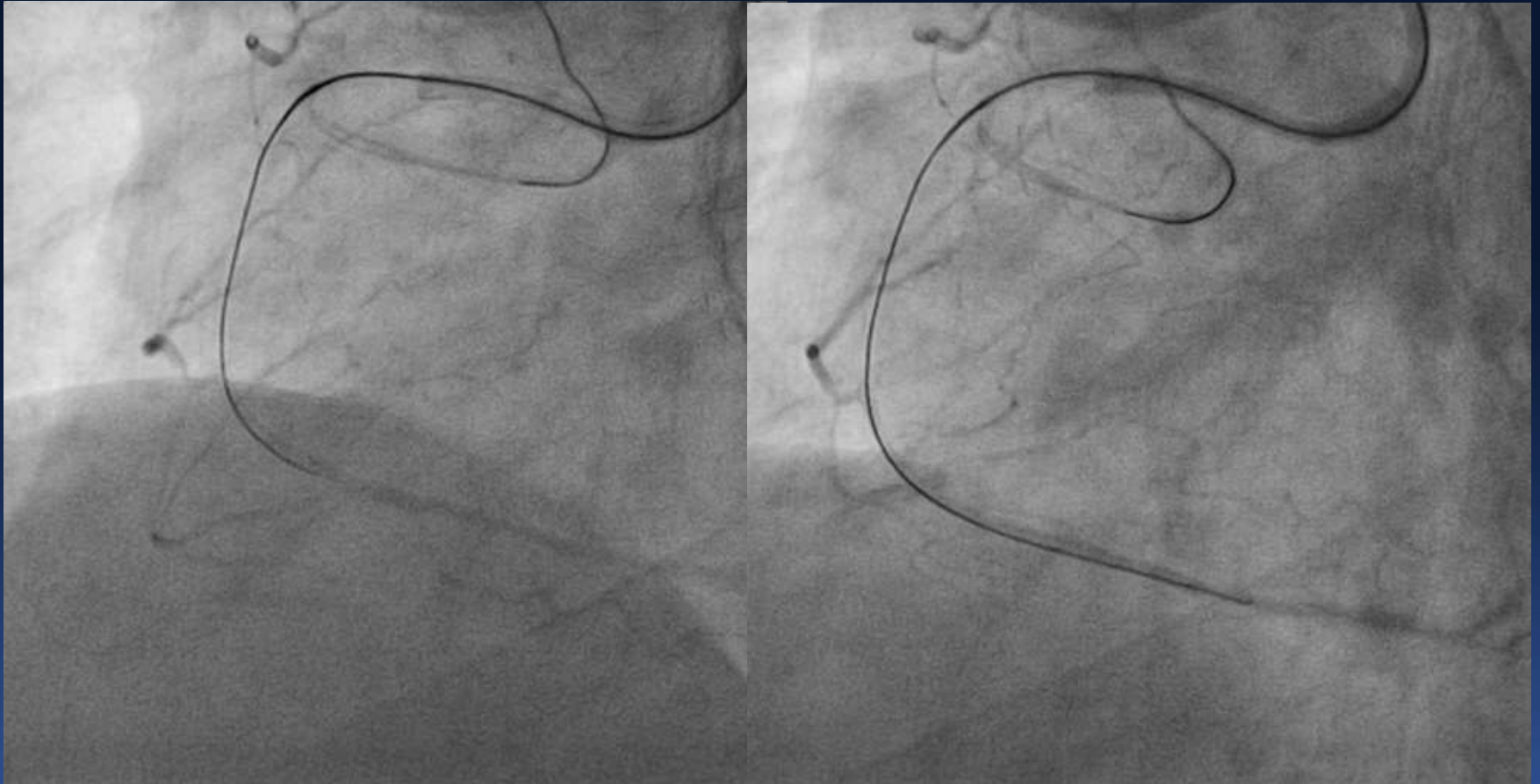
Fielder XT



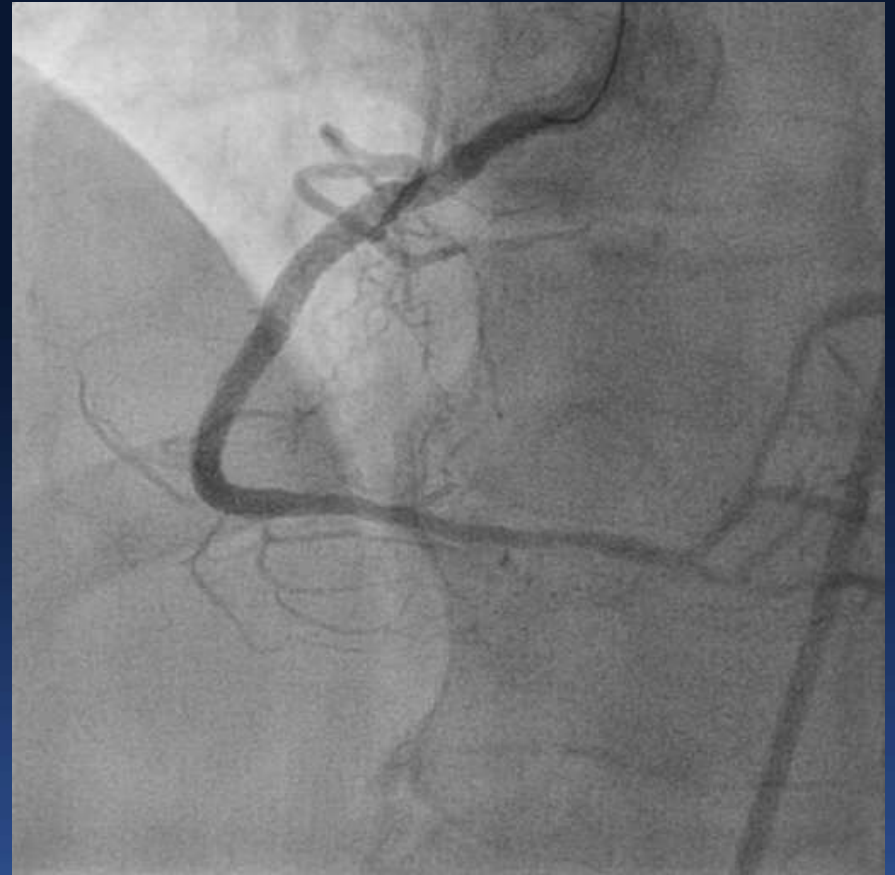
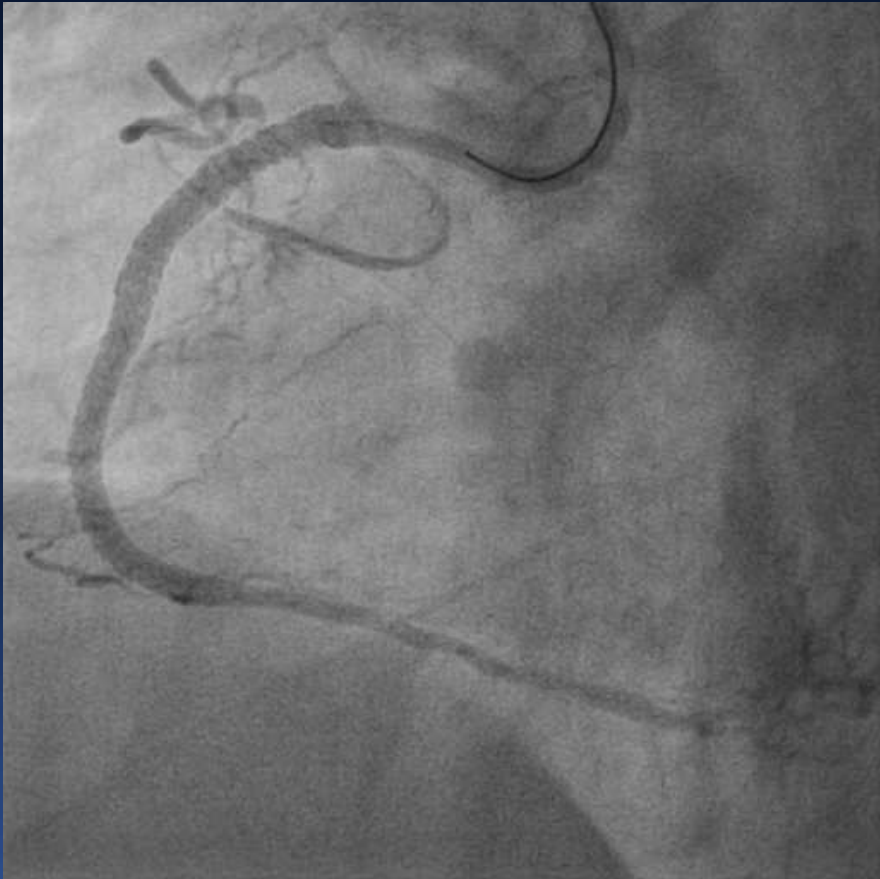
Gaia 2 (step-up escalation)



Gaia 2 : Advance into true lumen

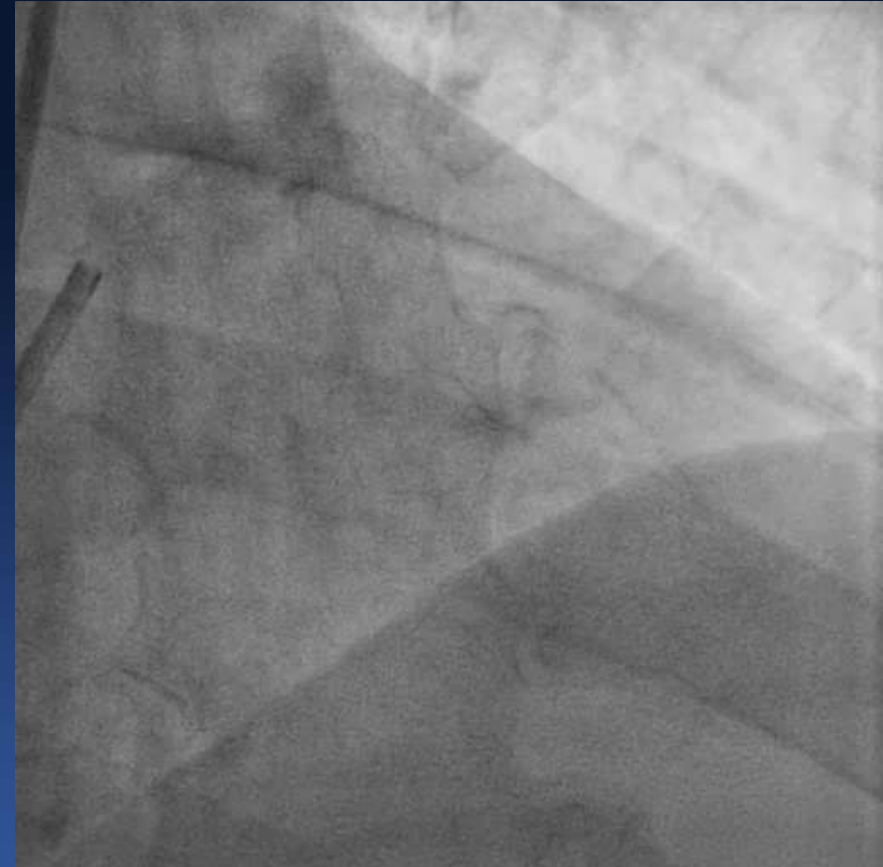
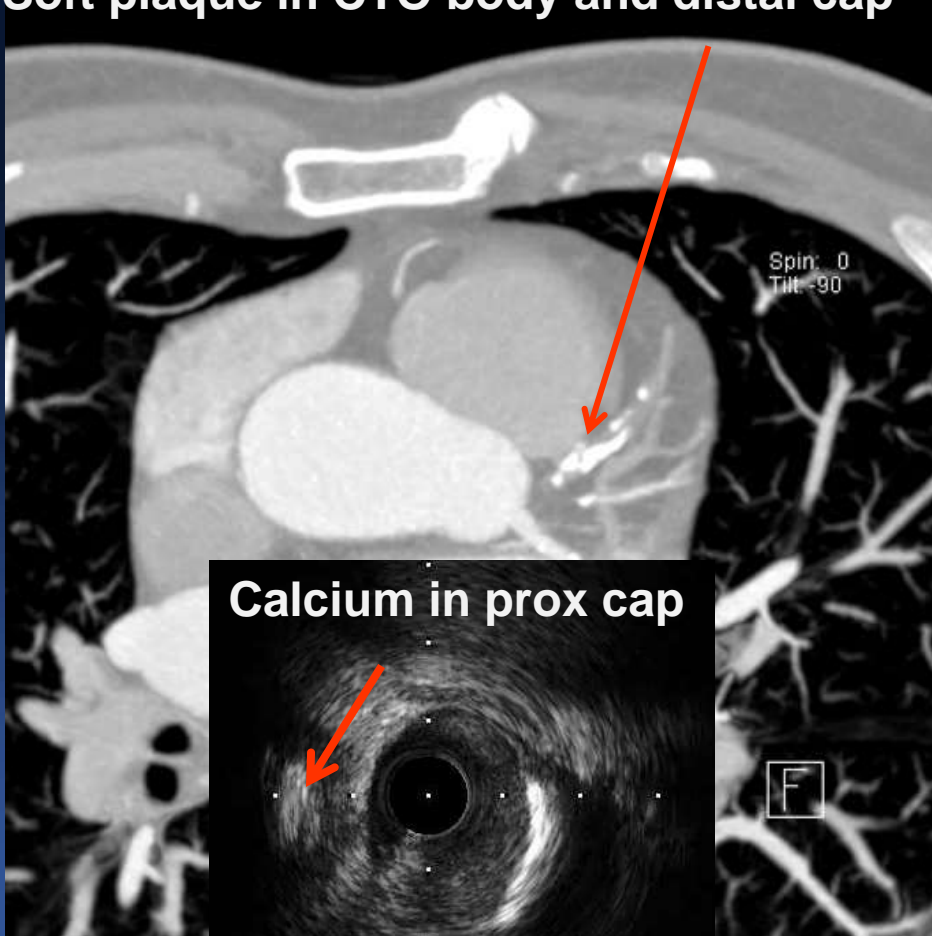


Final angiography

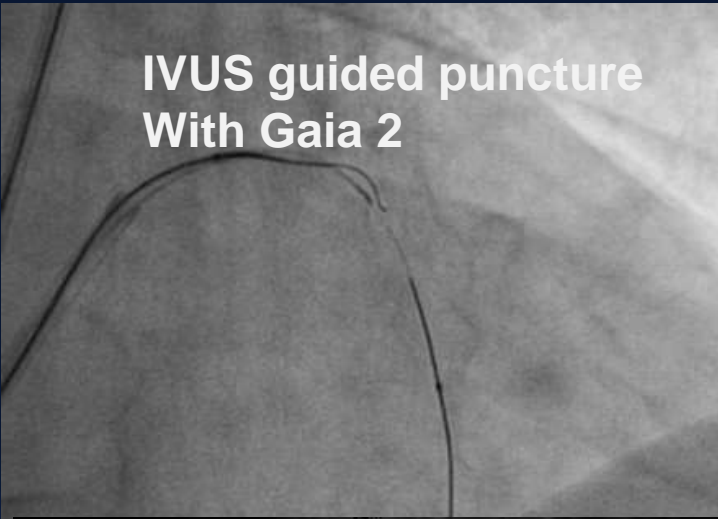


62/M, Prox LAD CTO with no stump

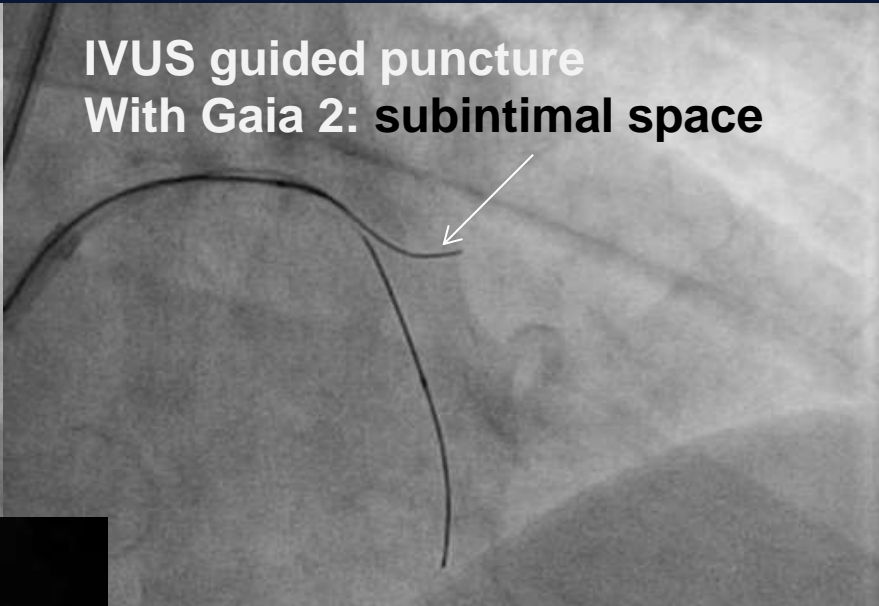
HEAVY CALCIFICATION IN PROXIMAL CAP
Soft plaque in CTO body and distal cap



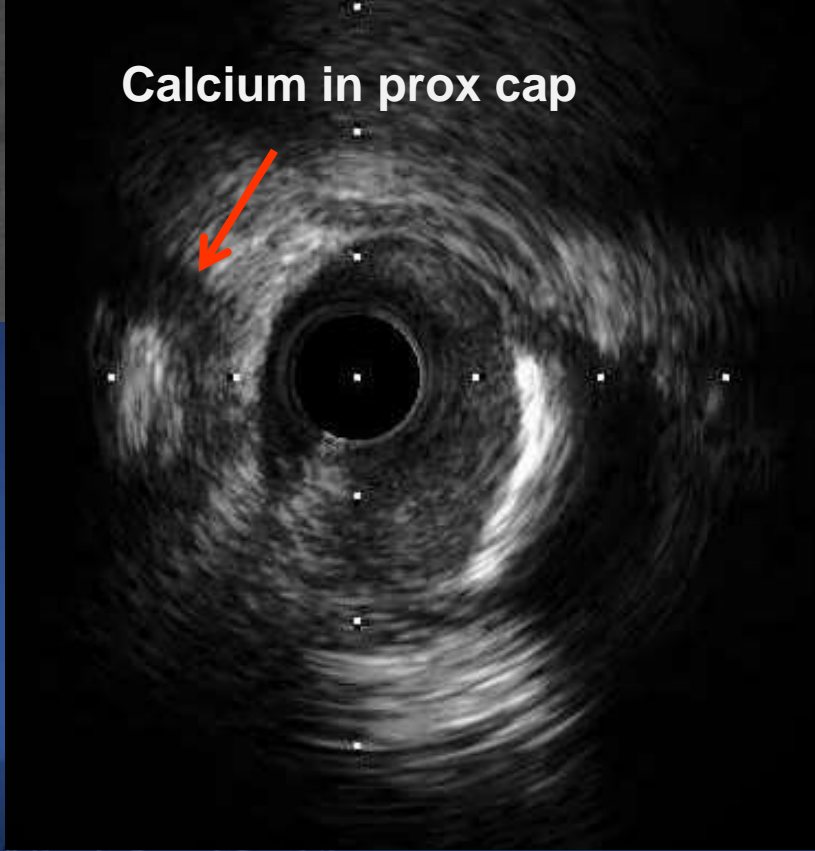
**IVUS guided puncture
With Gaia 2**



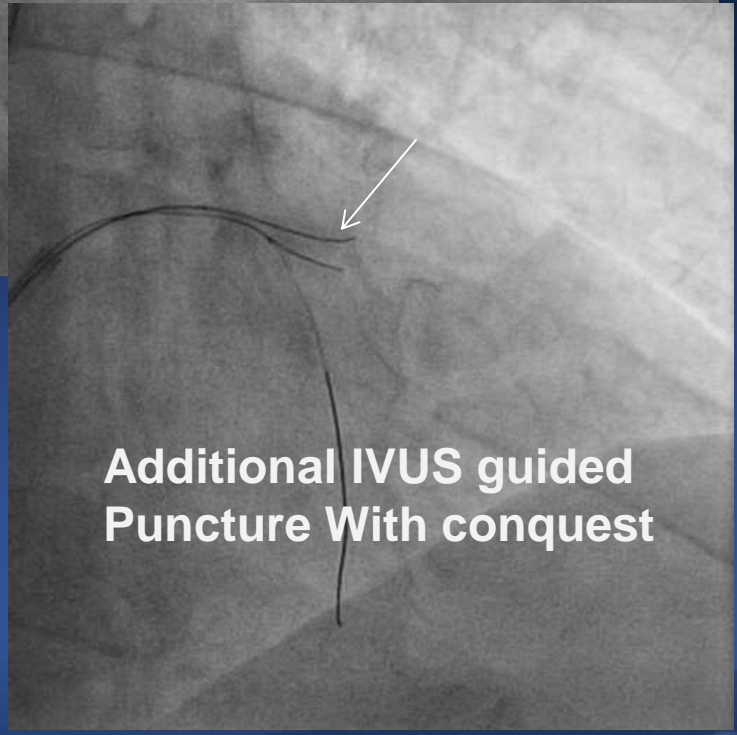
**IVUS guided puncture
With Gaia 2: subintimal space**



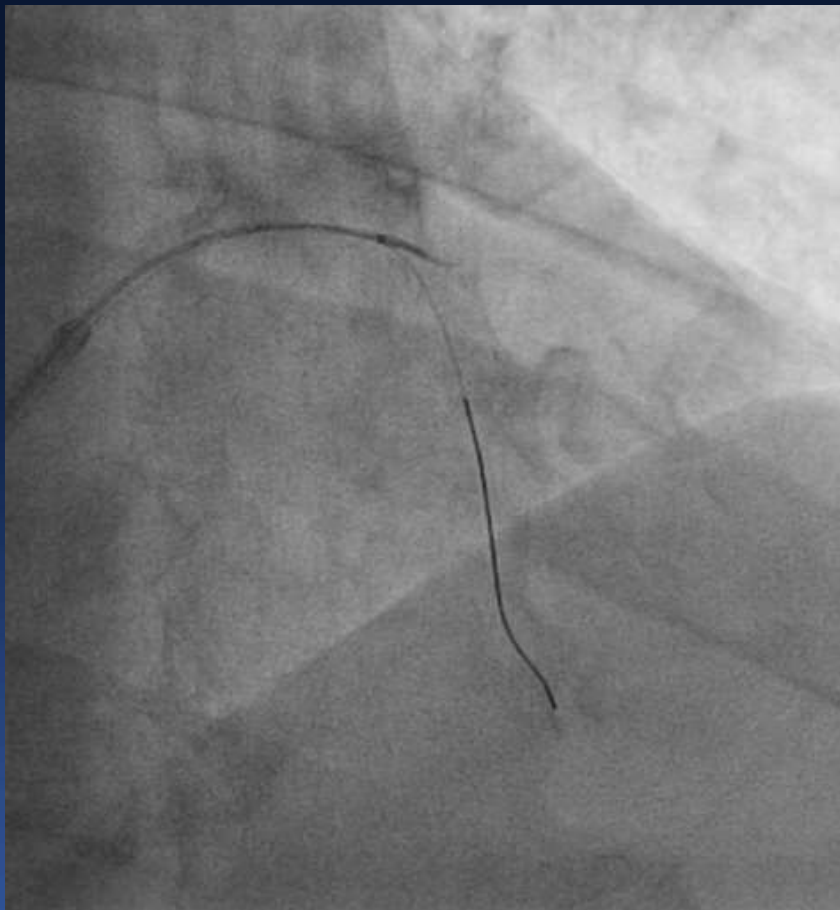
Calcium in prox cap



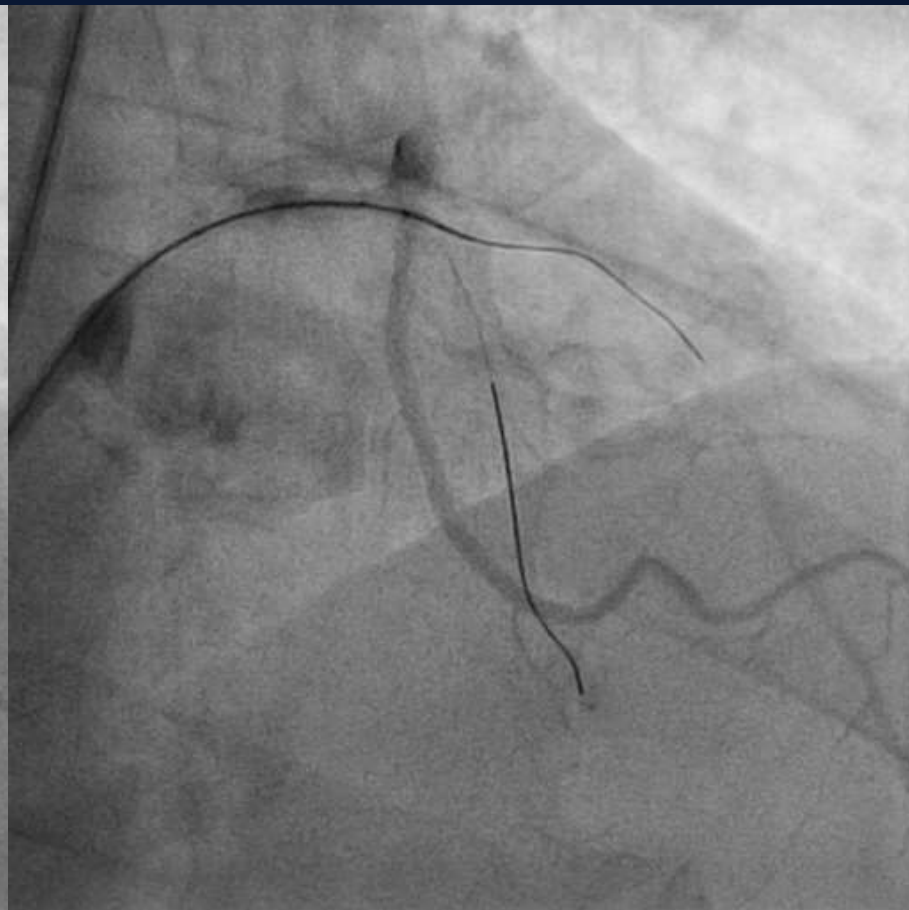
**Additional IVUS guided
Puncture With conquest**



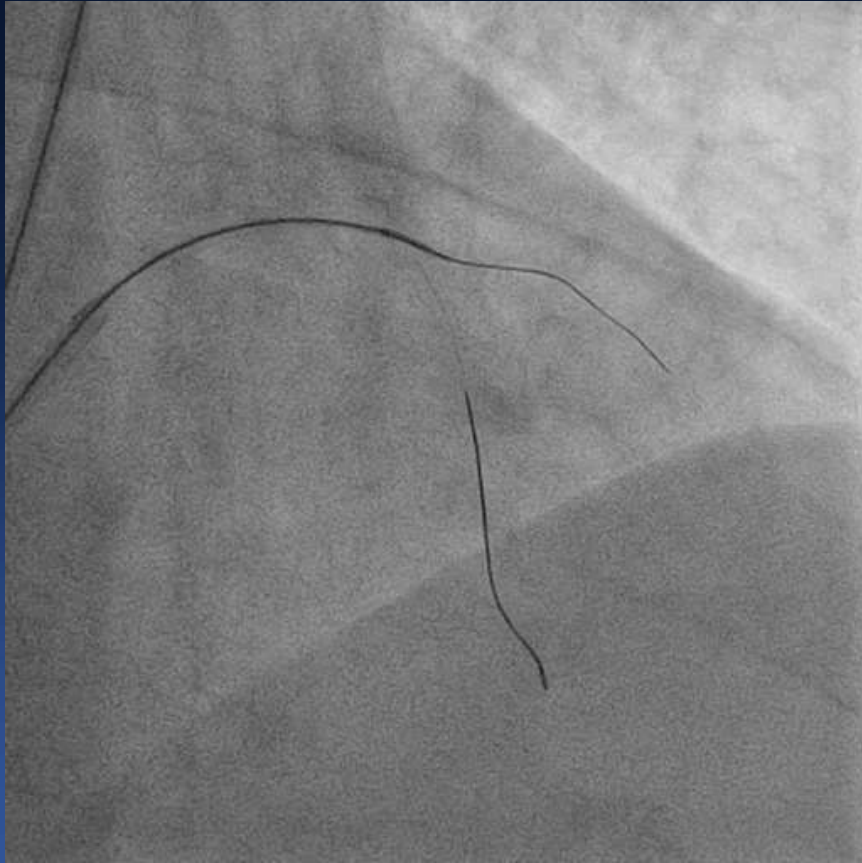
Corsair advance



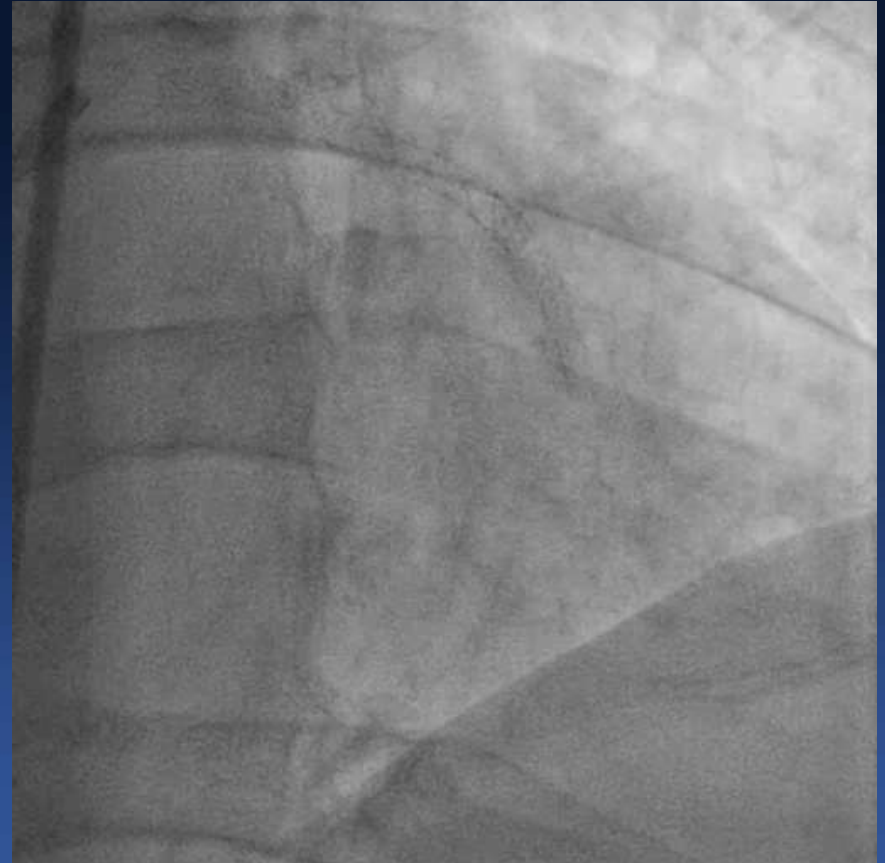
Fielder XT (step down escalation)



Fielder XT wiring

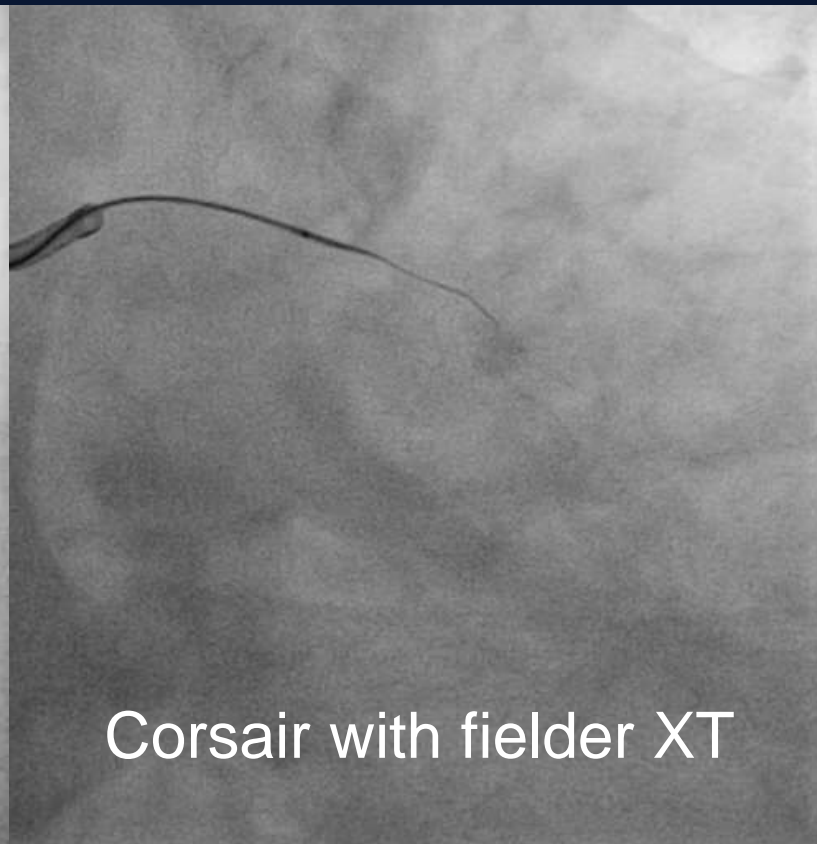


Final result

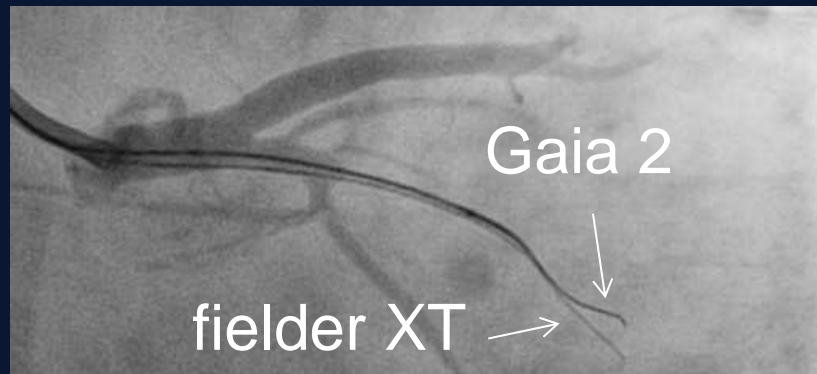
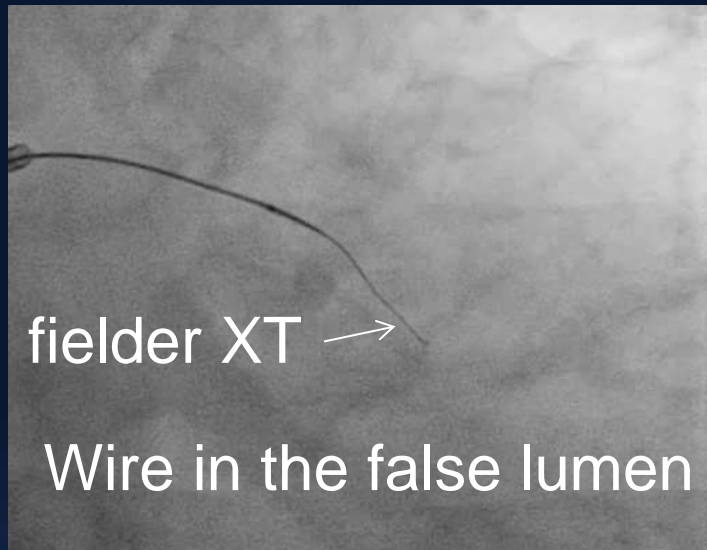


Parallel wire technique

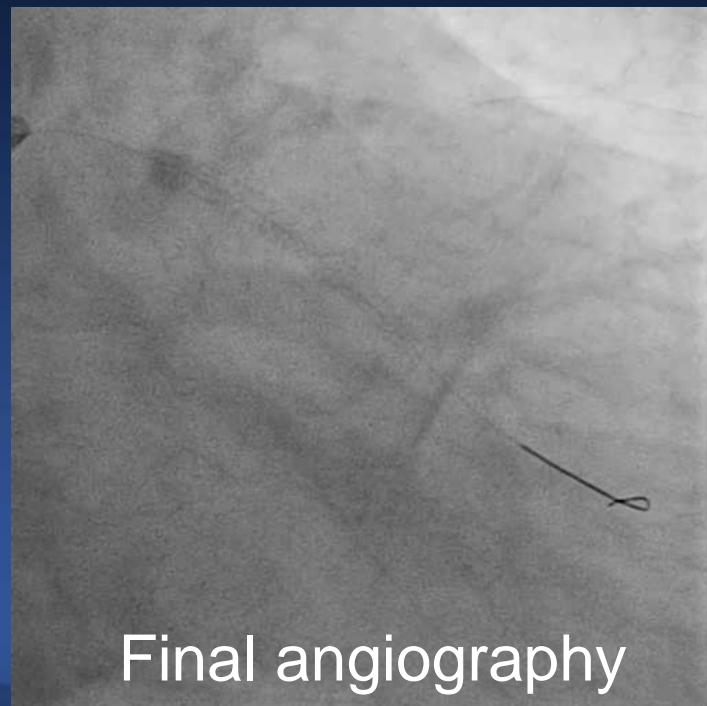
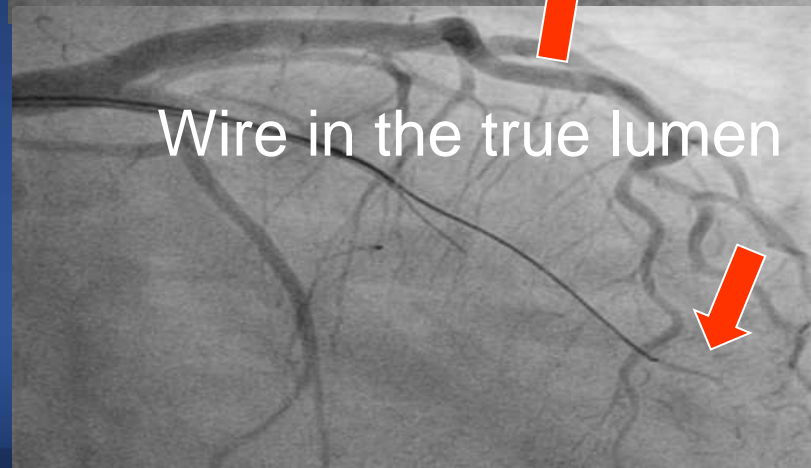
67/M, Failed OM CTO x 2 times



Corsair with fielder XT

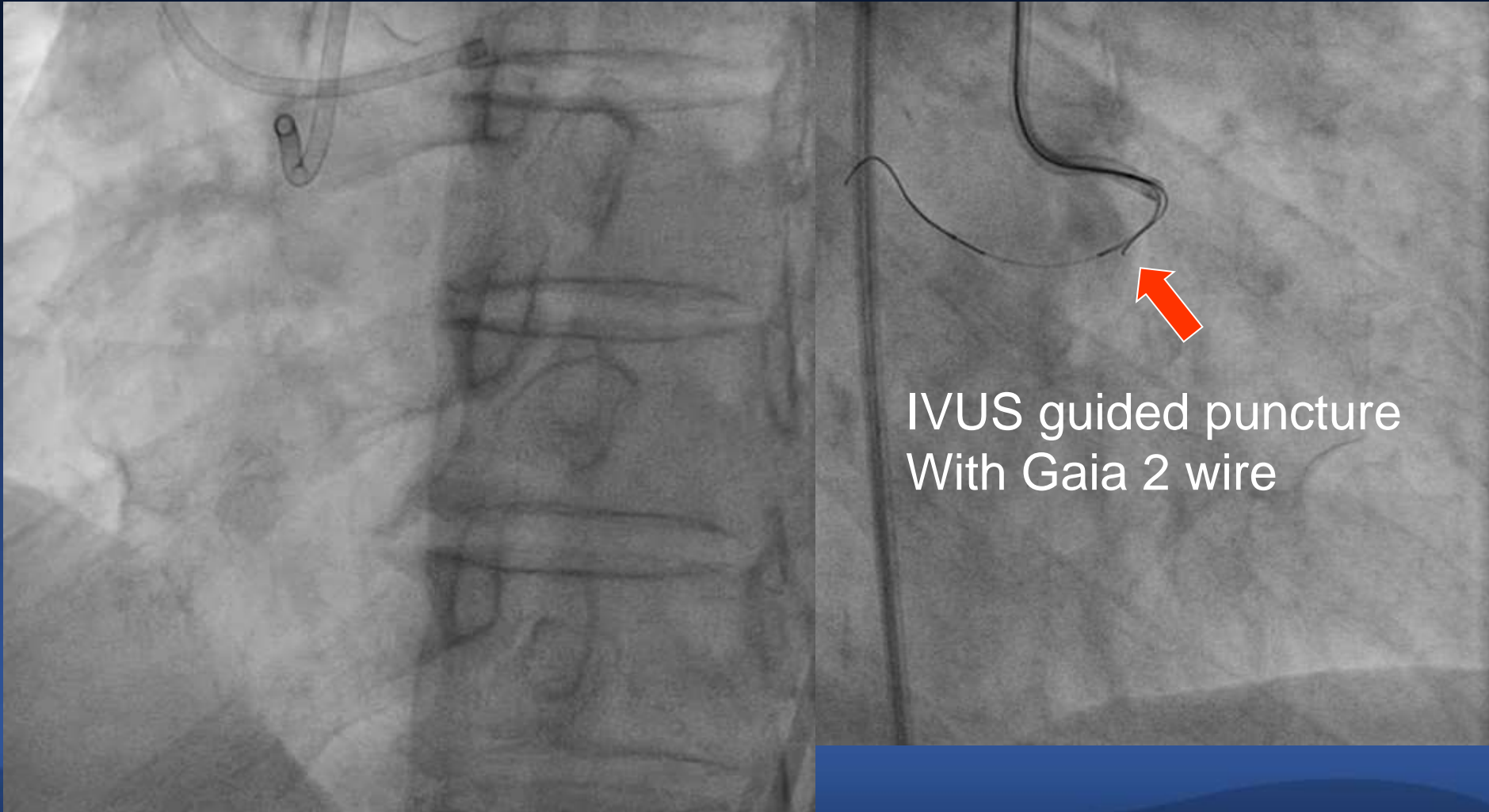


Parallel wire with Gaia 2



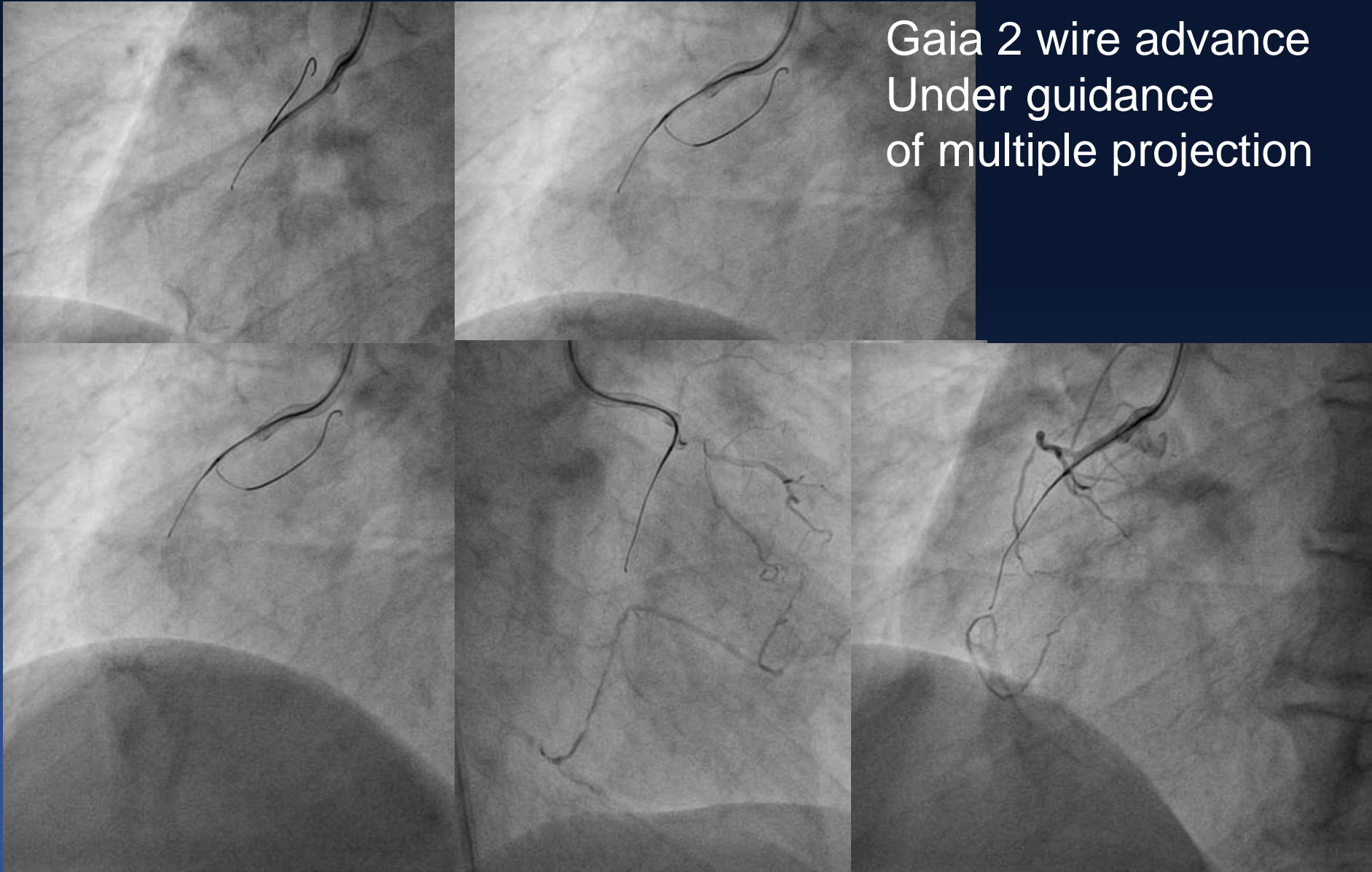
71/M, proximal RCA CTO

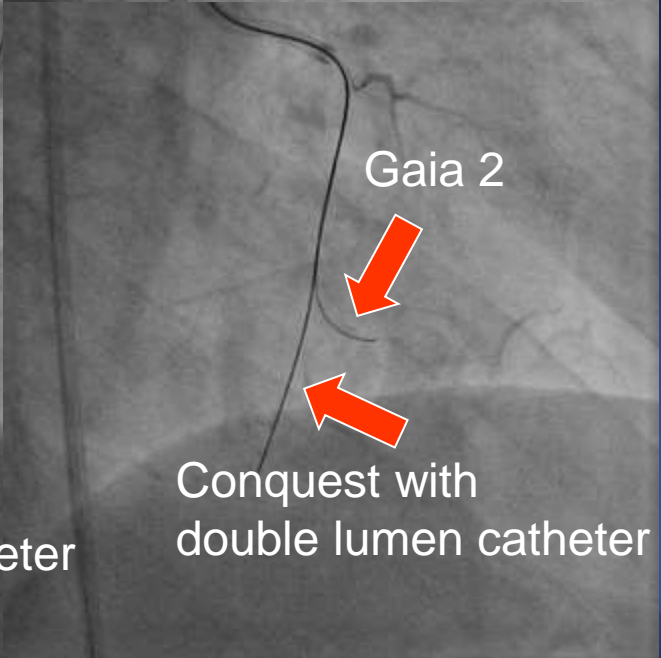
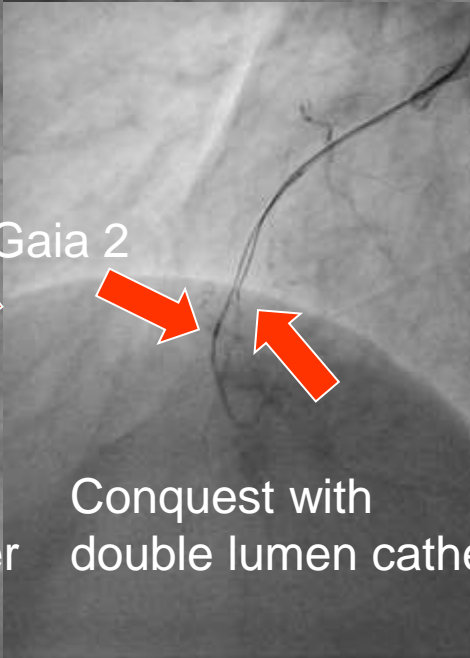
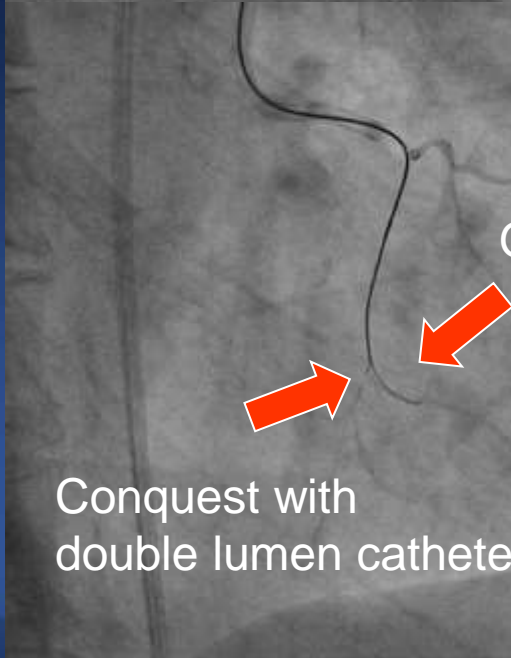
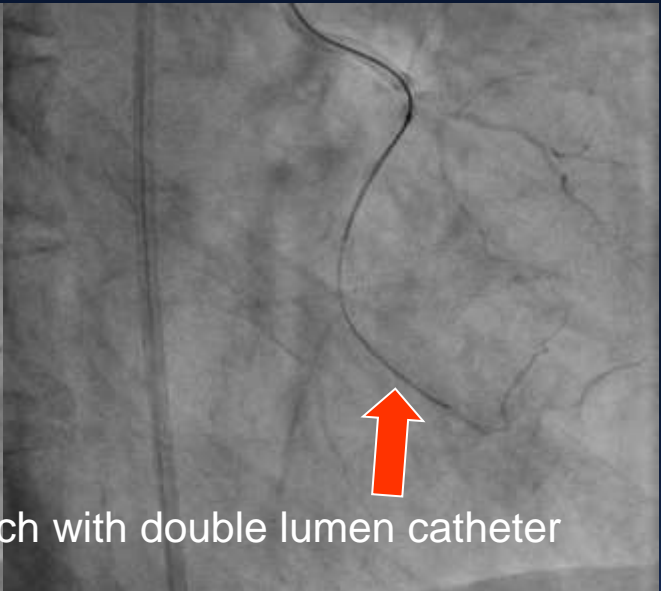
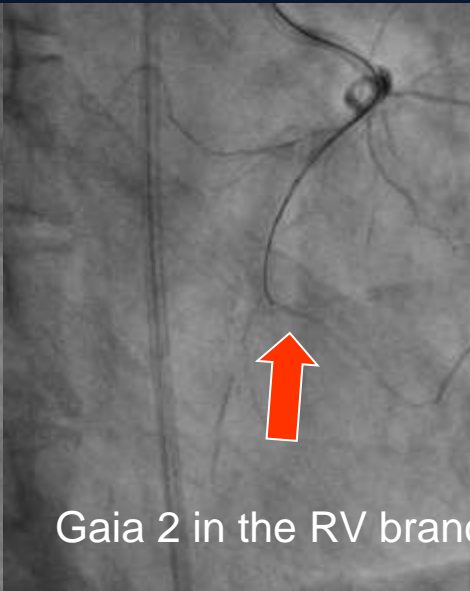
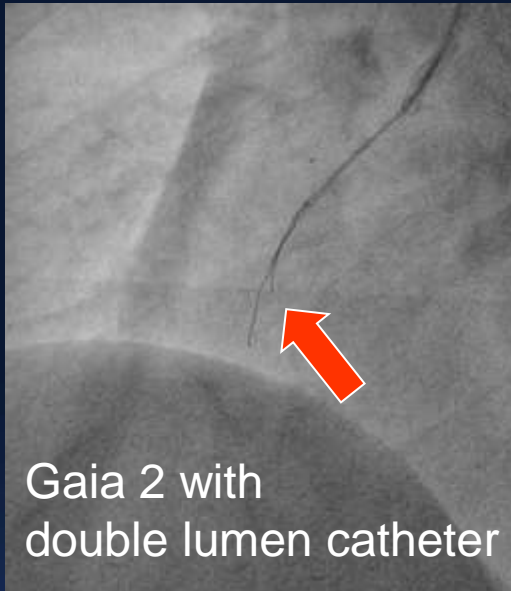
No proximal stump & Poor distal target



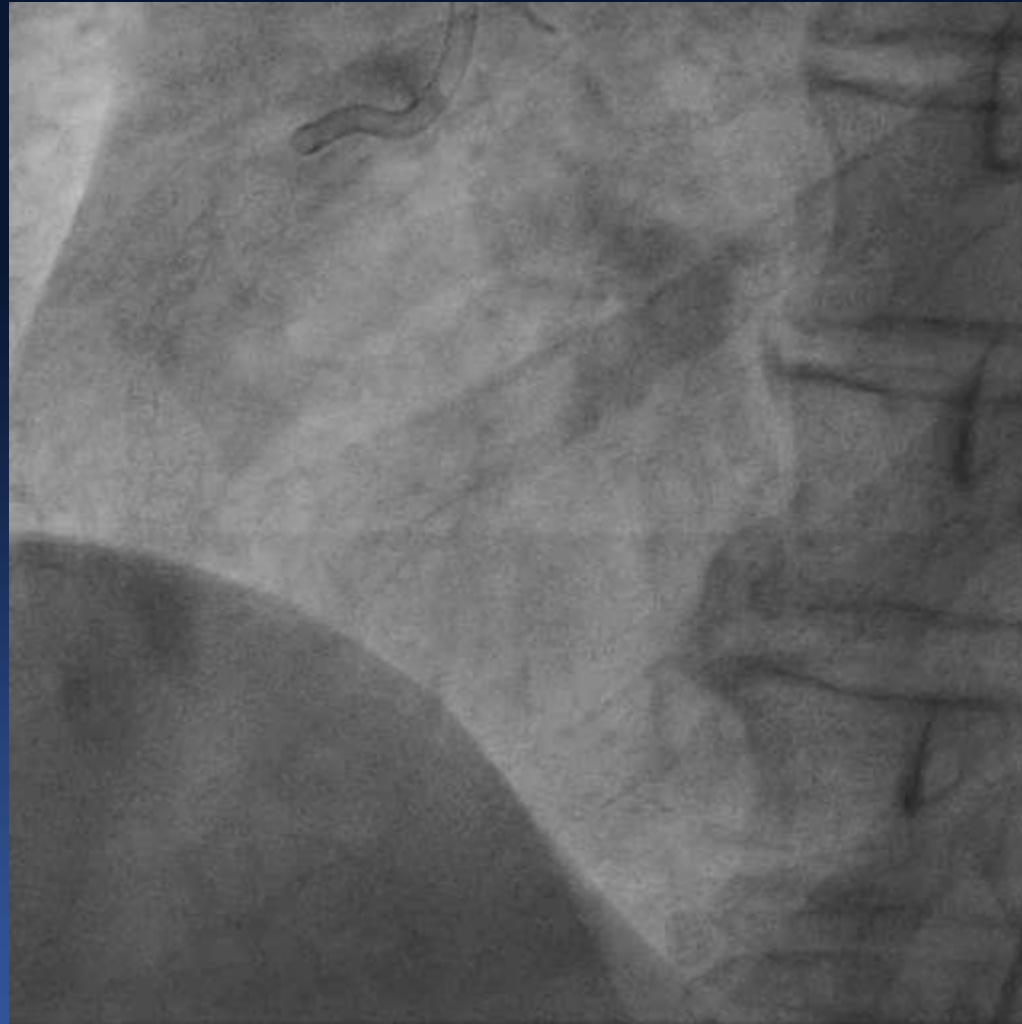
IVUS guided puncture
With Gaia 2 wire

Gaia 2 wire advance
Under guidance
of multiple projection





Final angiography



Antegrade wire escalation

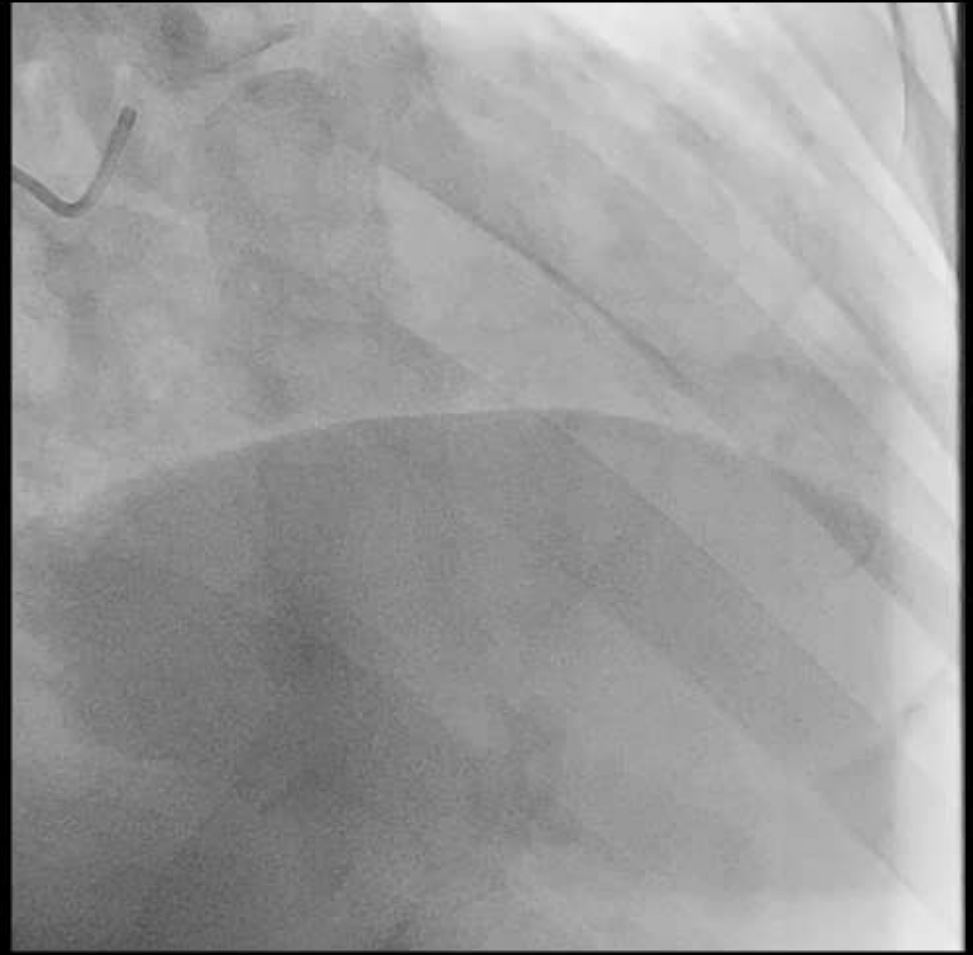
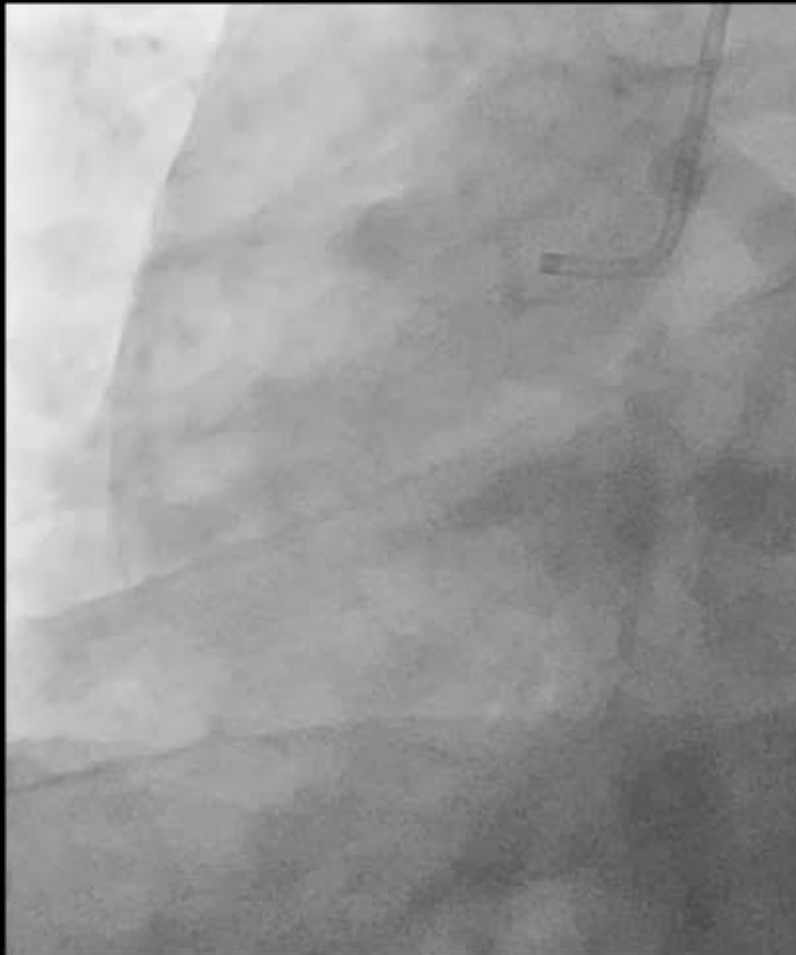
Up & down escalation

- Proximal cap: image guidance or morphology
- CTO body: image guidance or resistance
- Distal cap: image guidance or resistance

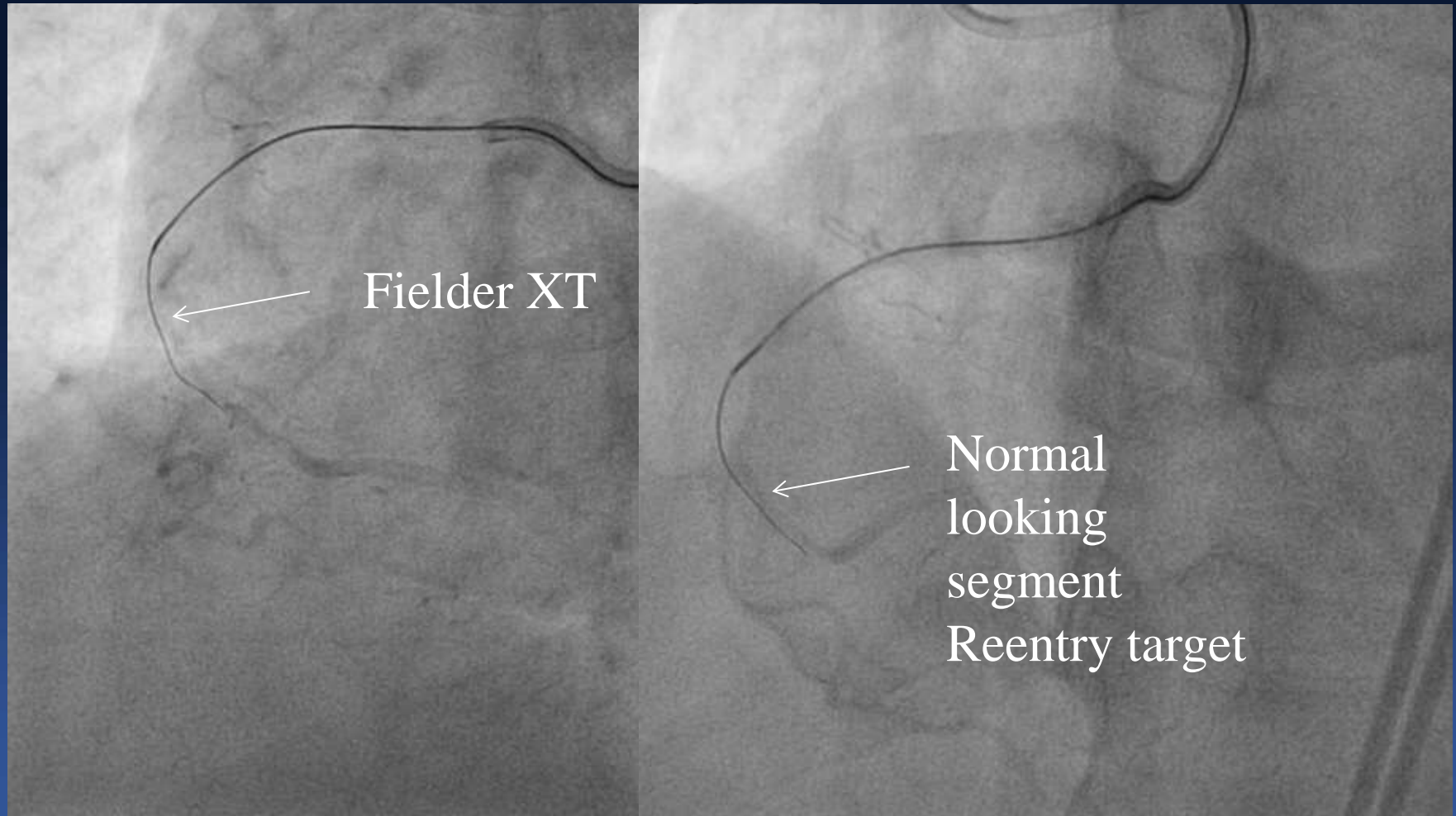
Dissection reentry

Baseline angiography

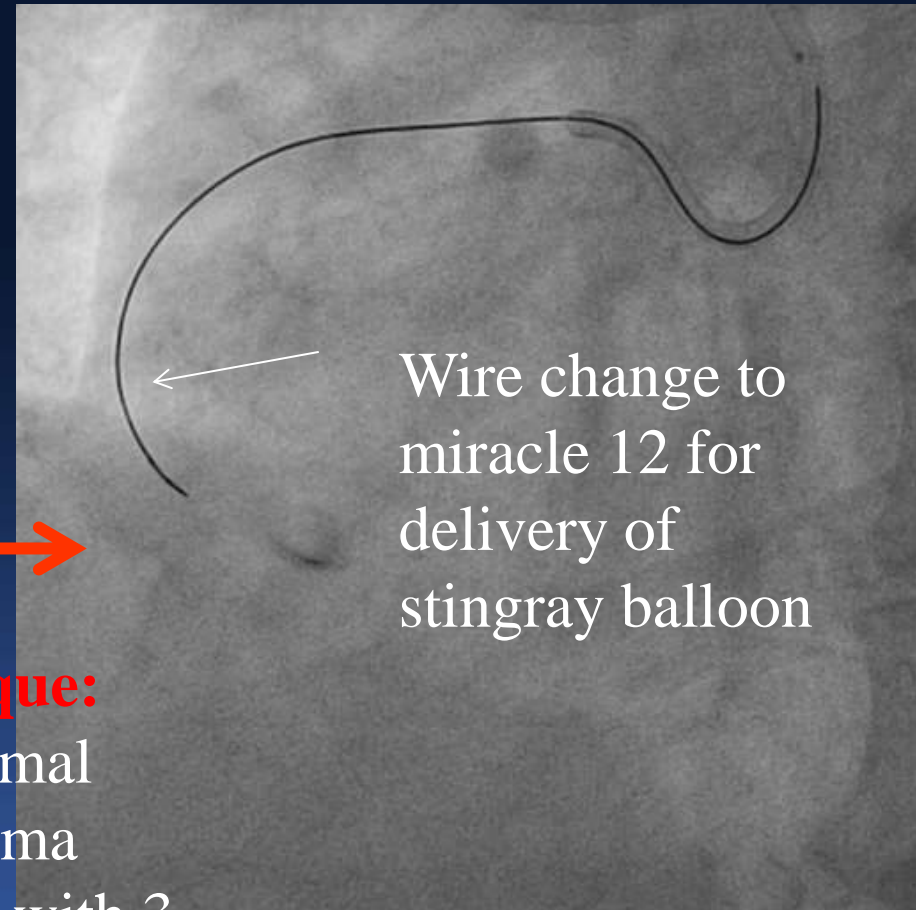
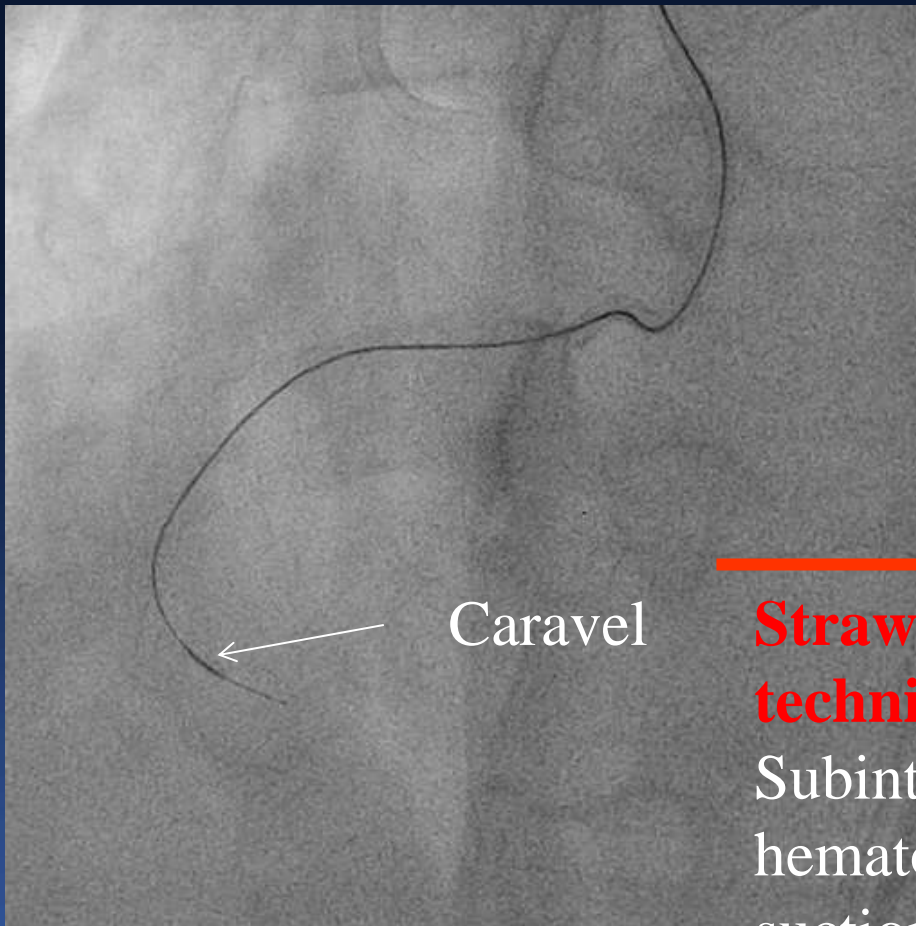
Good interventional collateral



Subintimal wiring with caravel



Microcatheter advance and wire exchange



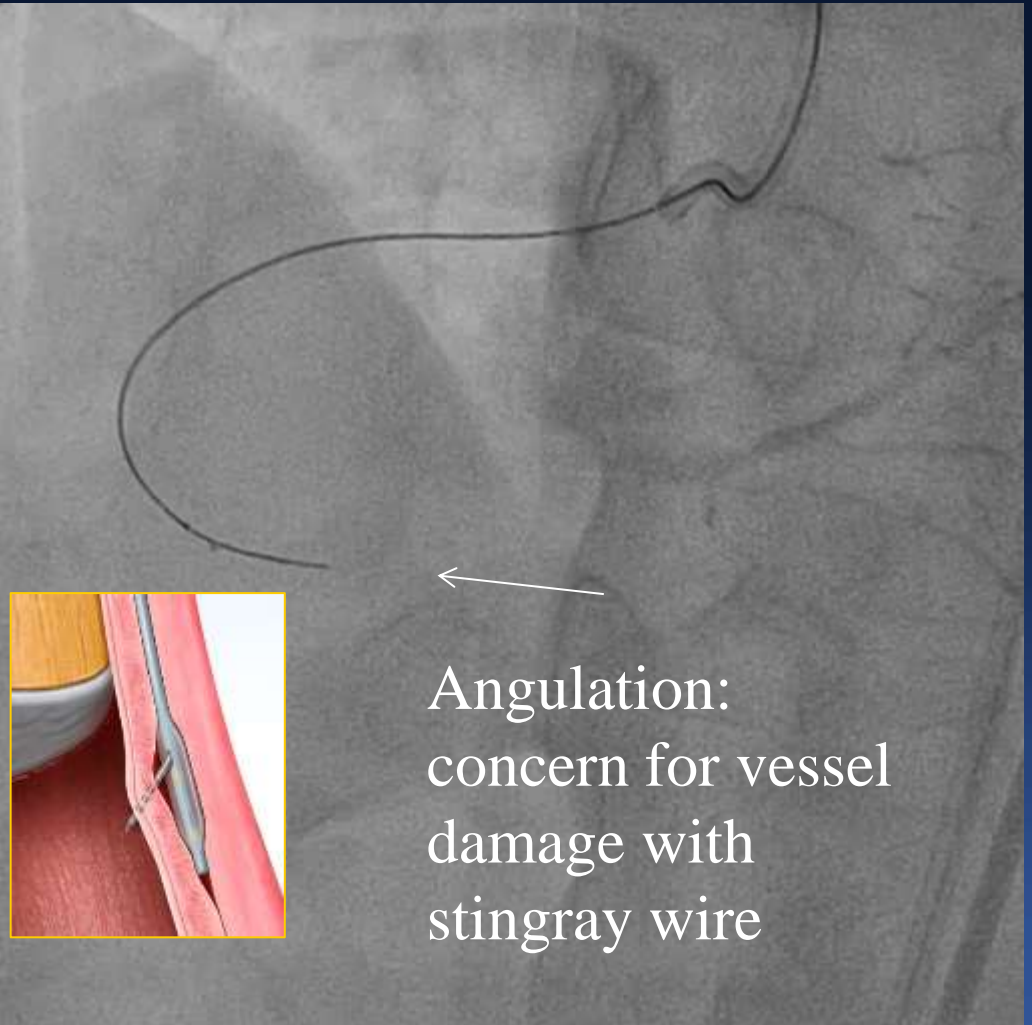
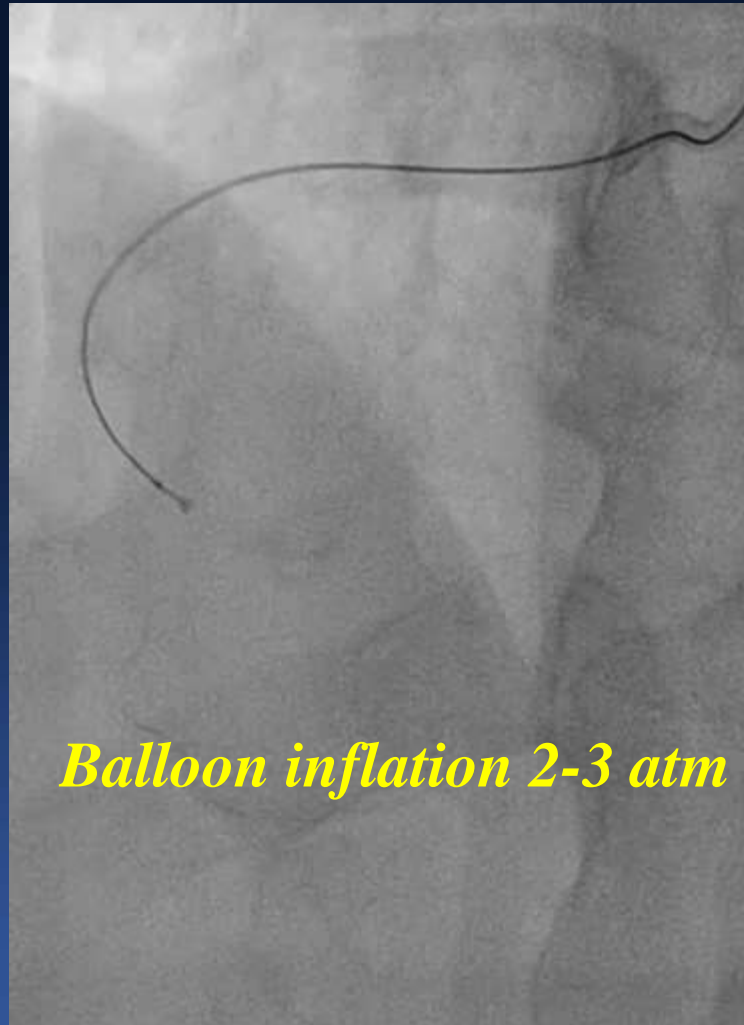
Straw technique:
Subintimal
hematoma
suction with 3
way system

Wire removal and straw technique balloon positioning by angiography

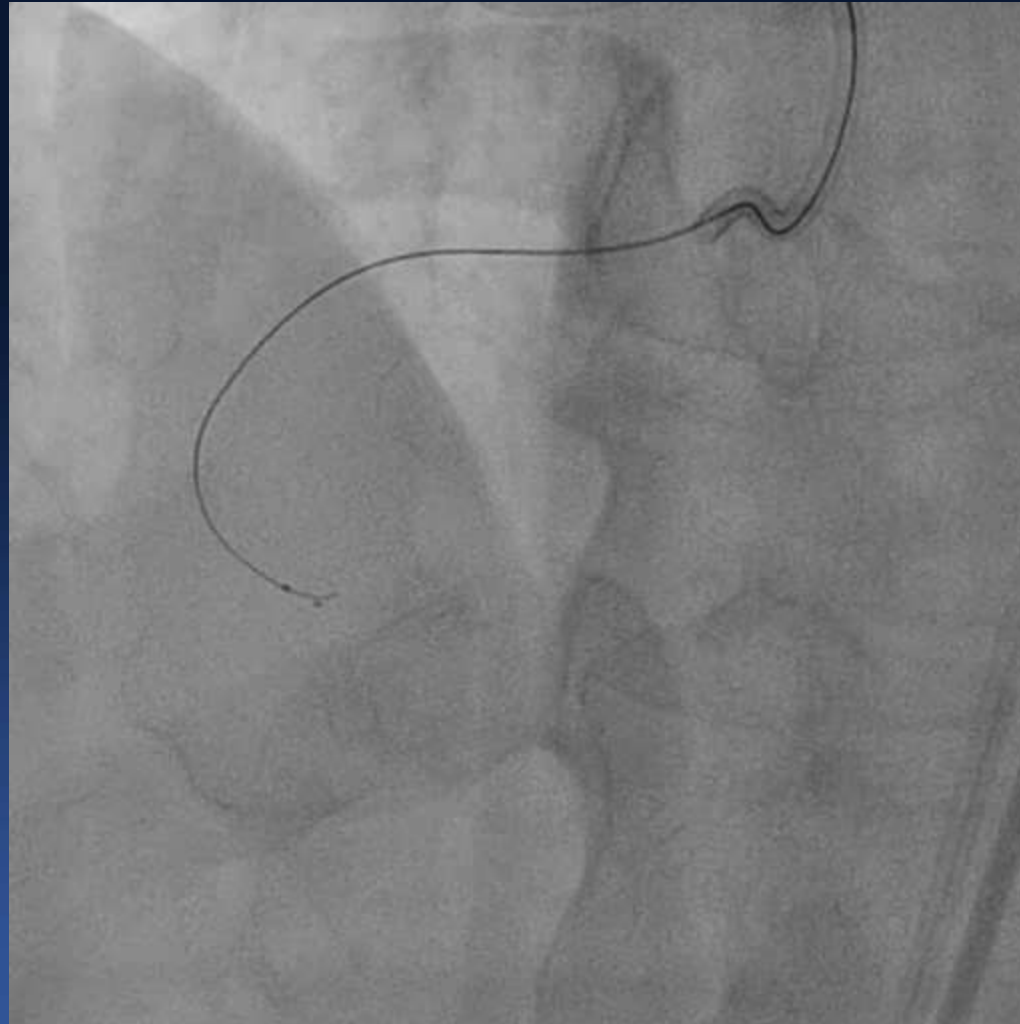
**Straw technique
again through
stingray balloon:**
Subintimal
hematoma suction
with 3 way system



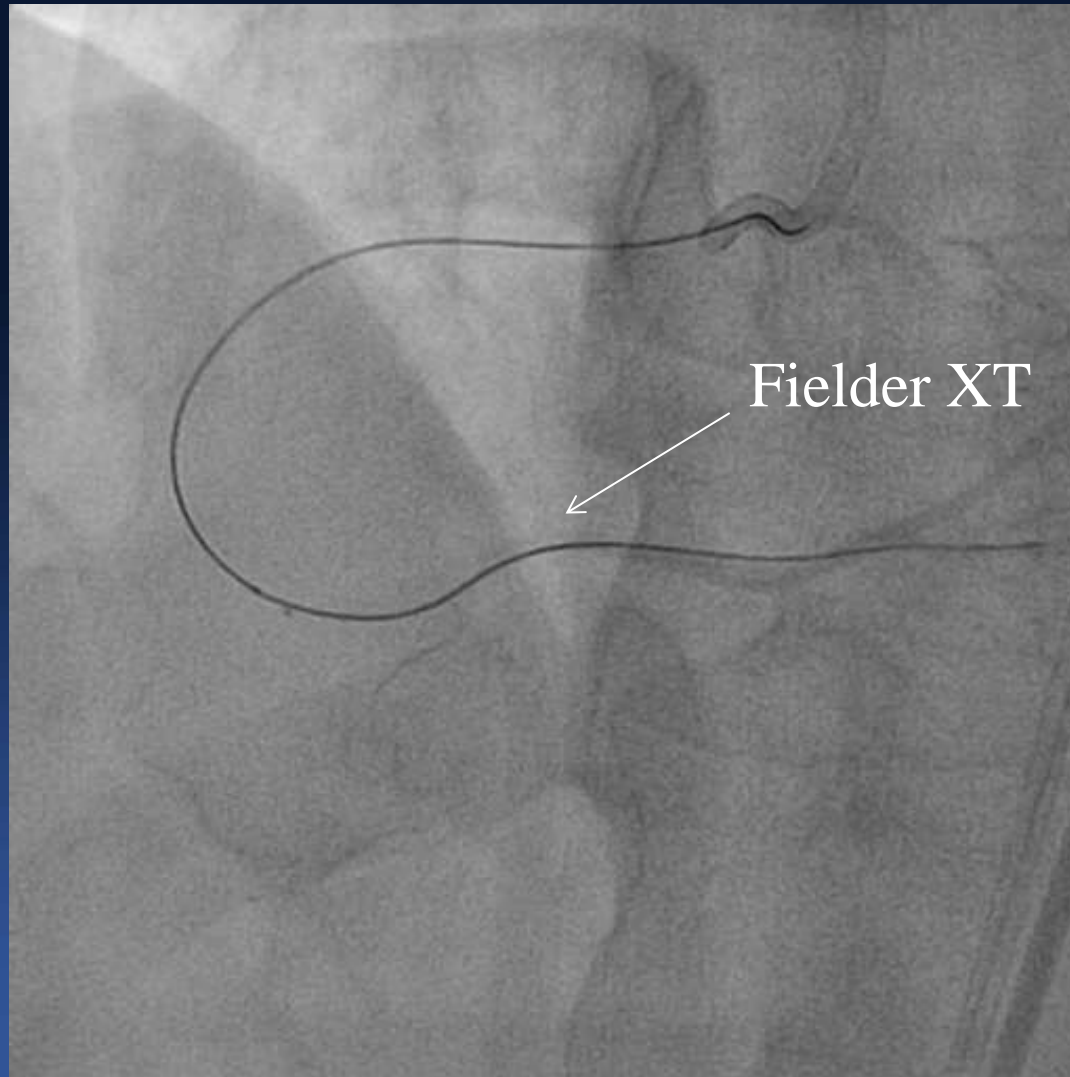
Reentry using Stingray wire



Stick and Swab using Fielder XT wire



Wire position confirmed

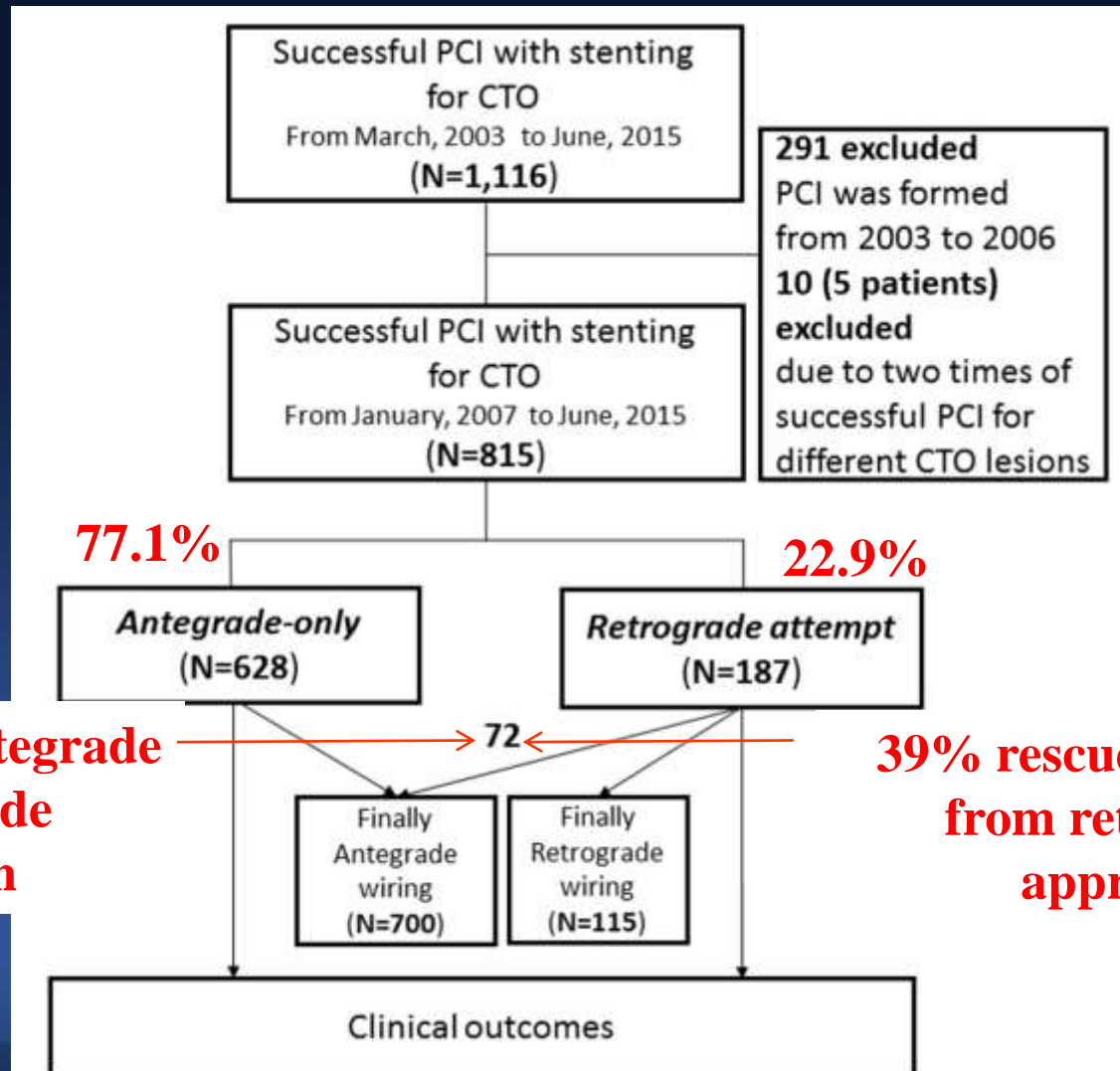


Final angiography



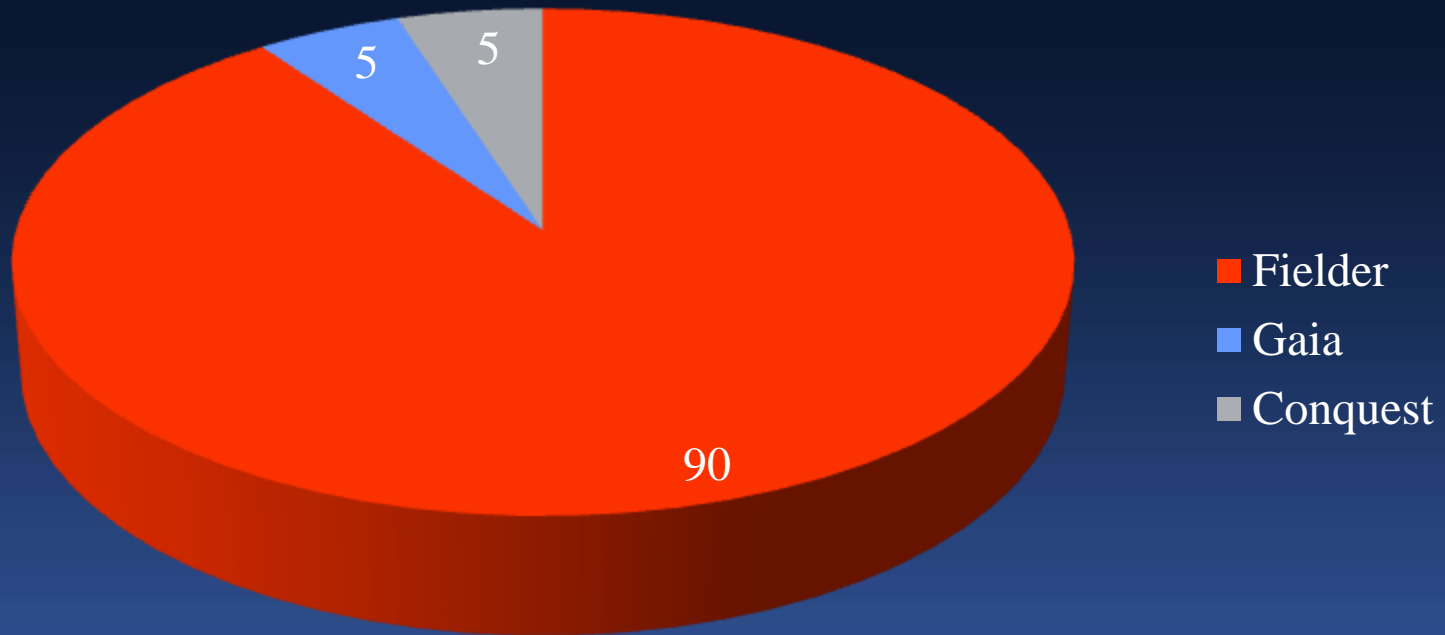
Antegrade vs. retrograde in Korea

Asan medical center registry



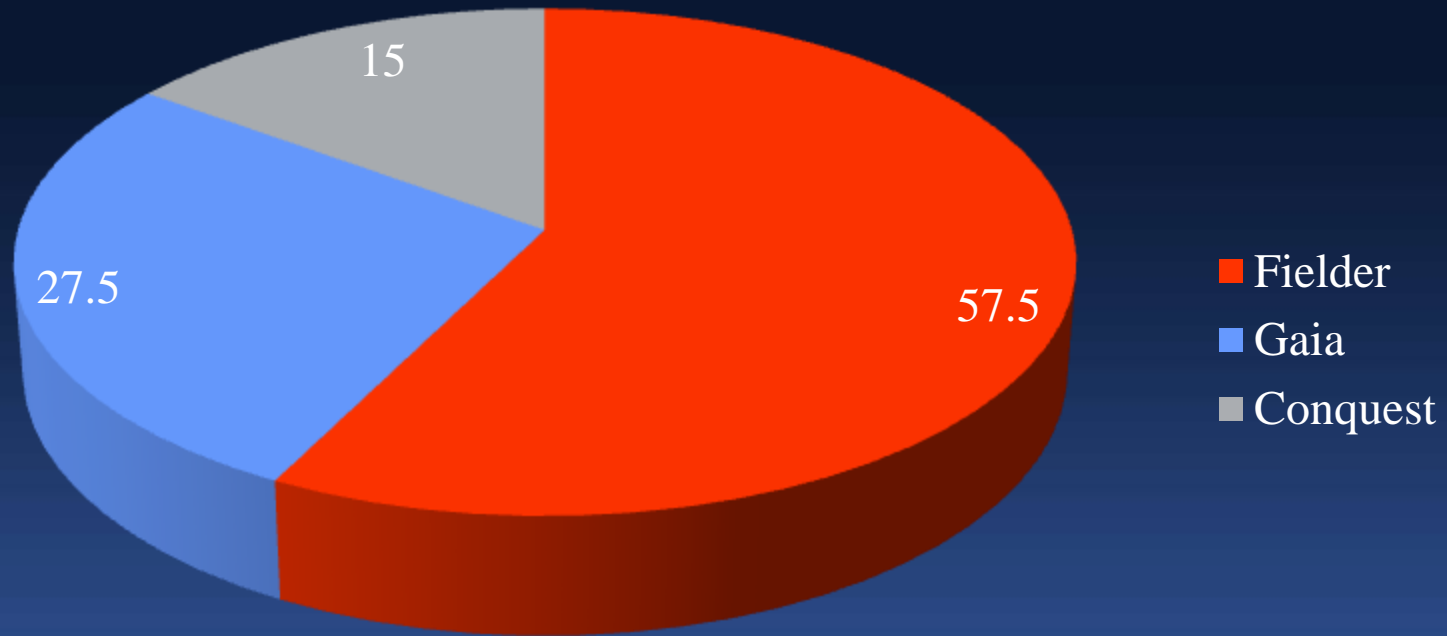
Initial wire for antegrade

Asan medical center registry



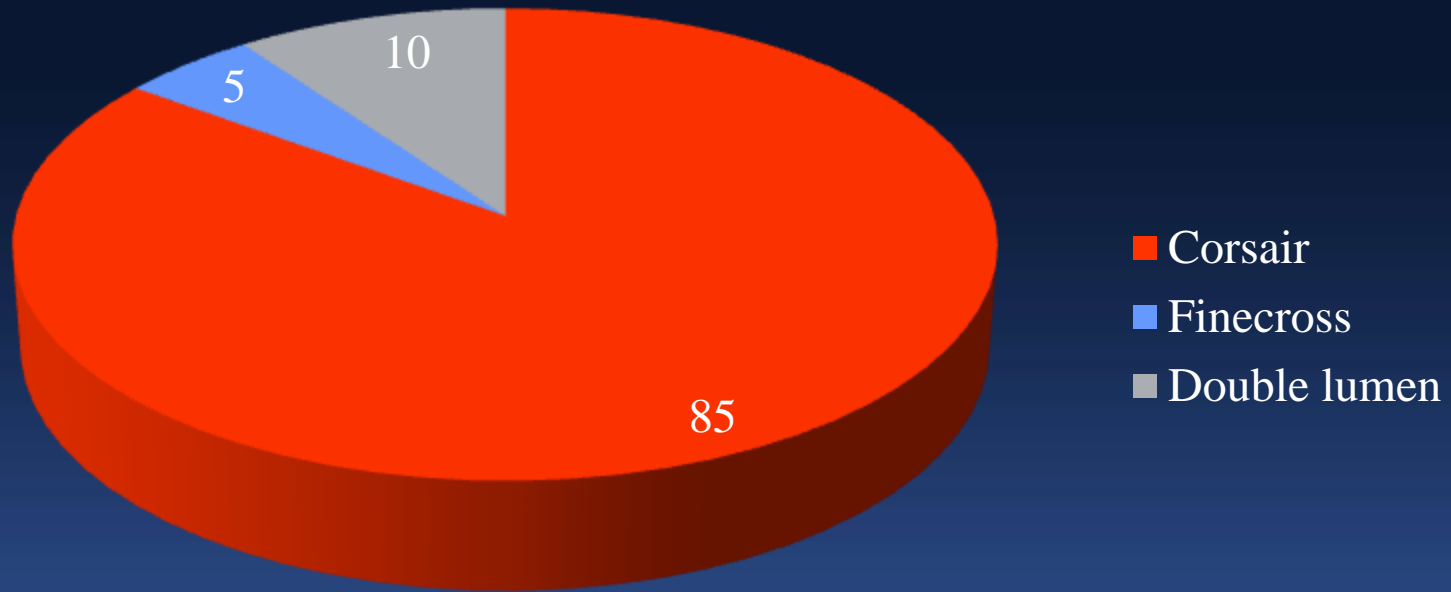
Final crossing wire for antegrade

Asan medical center registry



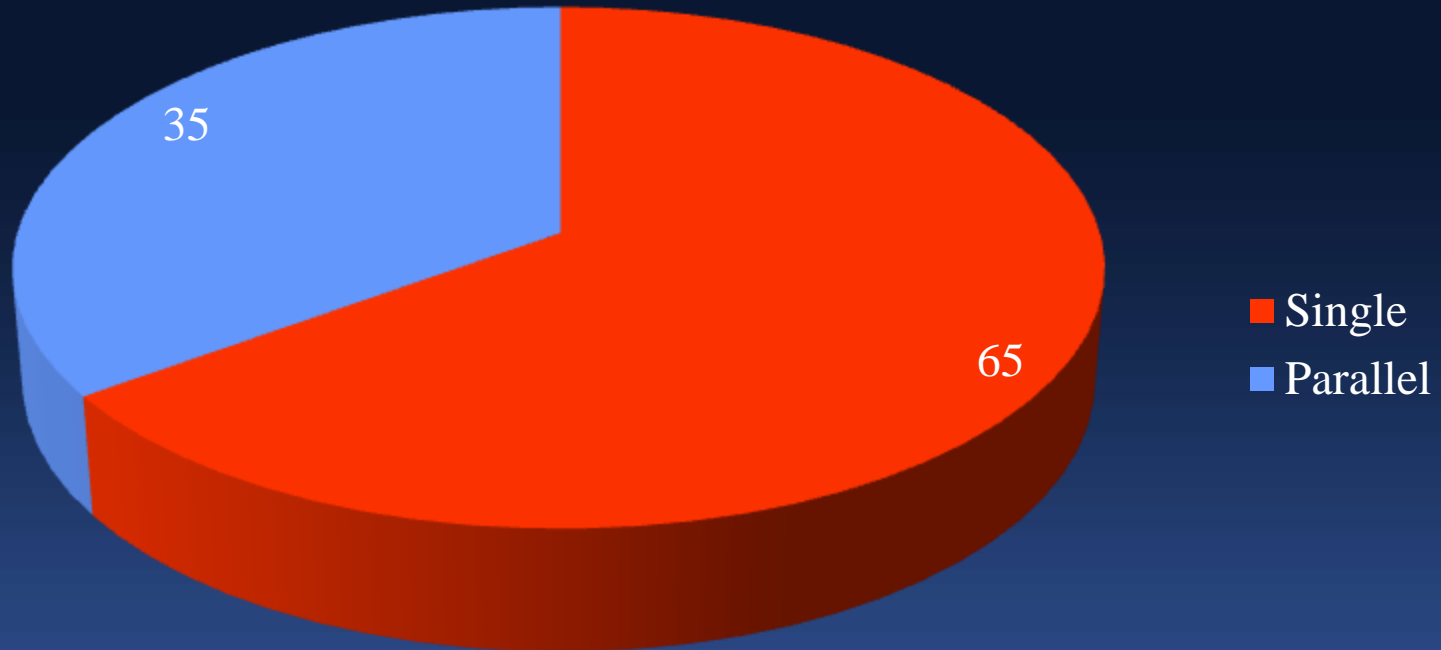
Microcatheter for antegrade

Asan medical center registry



Crossing technique for antegrade

Asan medical center registry



IVUS- guided wiring : 10%

Antegrade vs. retrograde in Korea

Asan medical center registry

Figure 2(A). Procedural success rate

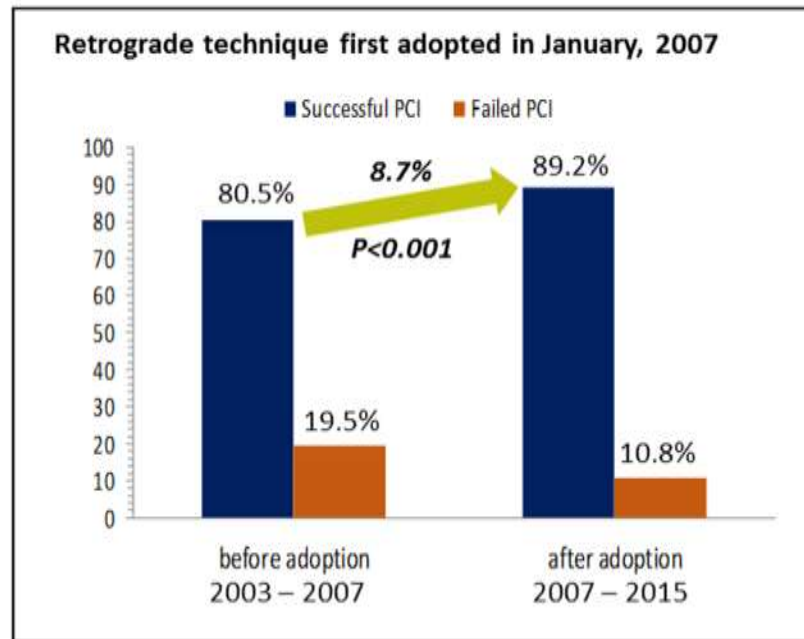
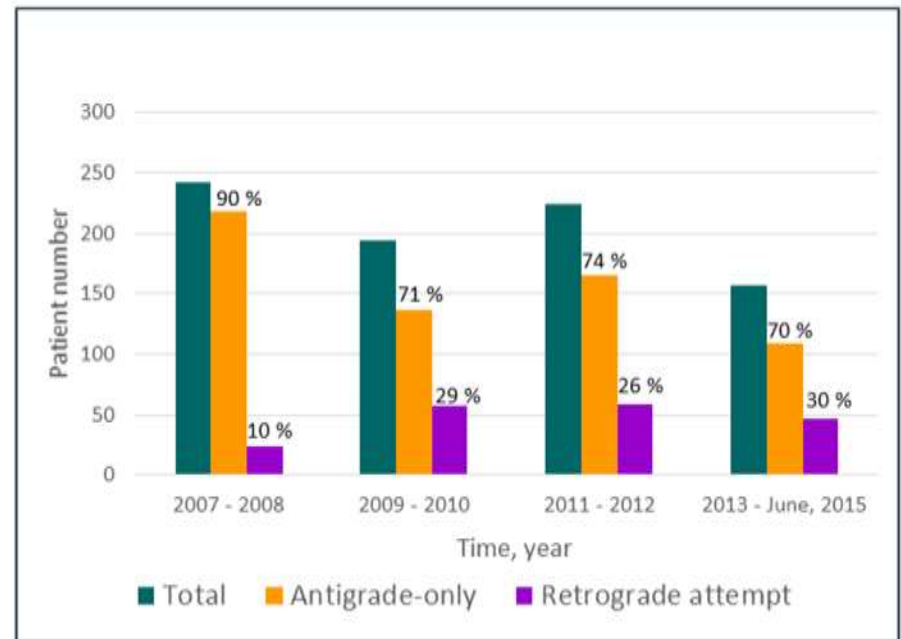
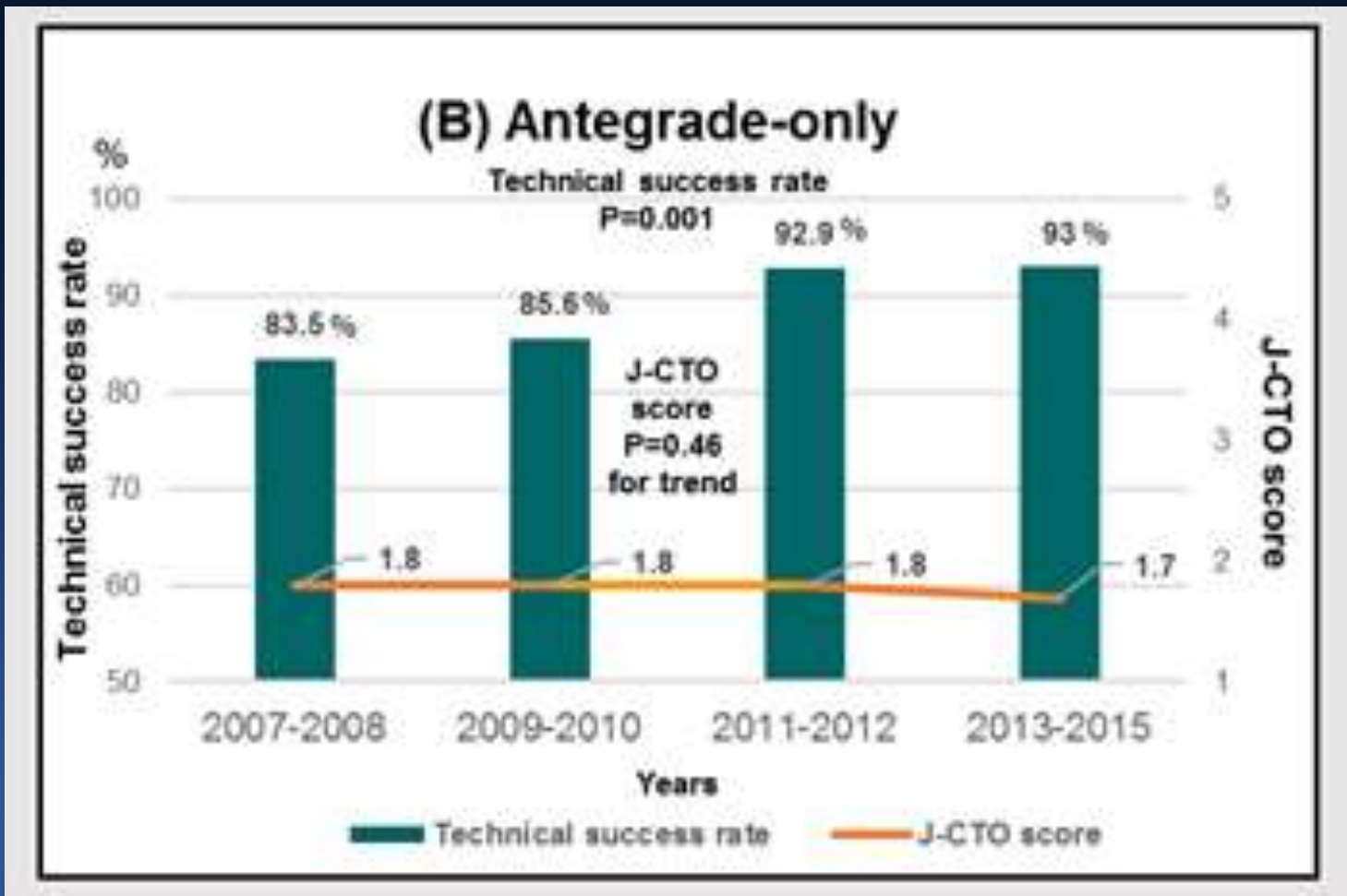


Figure 2(B). Procedure number over time



Antegrade approach

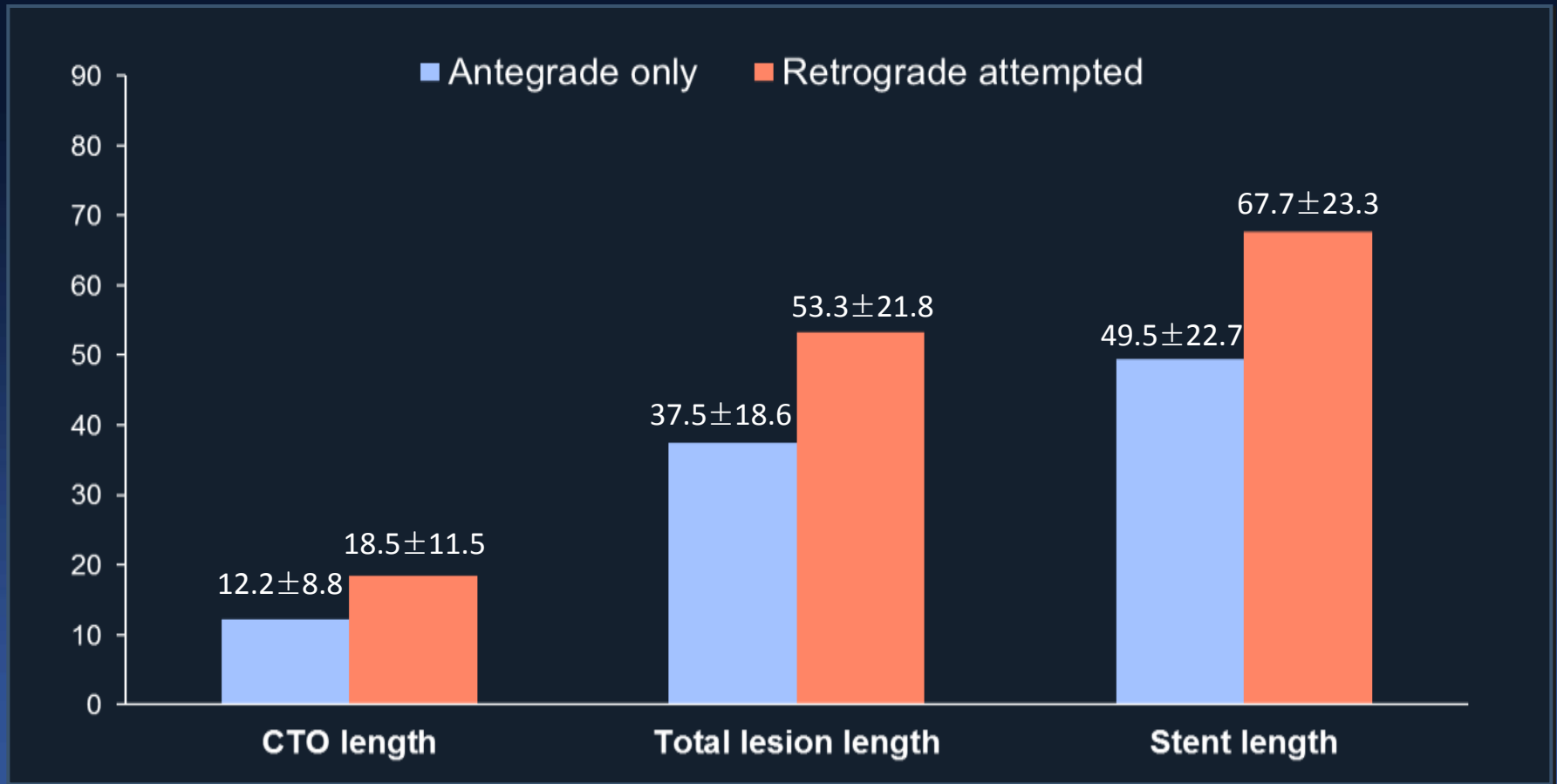
Trends of J-CTO score and technical success rate



Lesion and Procedural Characteristics

Successful CTO-PCI	Antegrade only (N=628)	Retrograde attempted (N=187)	P value
J CTO score	1.8±1.0	2.5±1.0	<0.001
Blunt proximal cap	382 (60.8)	135 (72.2)	0.01
Moderate/severe calcification	306 (48.7)	99 (52.9)	0.35
Bending > 45°	223 (35.5)	86 (46.0)	0.01
Occlusion length >20mm	123 (19.6)	85 (45.5)	<0.001
Retry lesion	71 (11.3)	85 (45.5)	<0.001
Number of stent per lesion	1.7±0.8	2.2±0.8	<0.001
Stent length, mm	48.7±22.6	66.9±22.9	<0.001
Average stent diameter, mm	3.2±0.3	3.2±0.3	0.512
IVUS use	578 (92.0)	171 (91.4)	0.913
Contrast media amount, ml	386.9±181.0	538.0±243.9	<0.001
Total fluoroscopy time, min	34.3±45.7	72.6±42.1	<0.001

Relationship between *CTO length, Total lesion length, and final stent length*



Successful CTO-PCI since 2007.6

Hazard Ratios of Clinical Outcomes

Medium Follow-up Time: 4.0 years

Outcome	Antegrade only (N=599)	Retrograde attempted (N=129)	HR (95% CI)	<i>P</i> value	IPTW adjusted HR (95% CI)	<i>P</i> value
Target lesion failure	34 (7.0)	14 (14.1)	2.27 (1.29–3.99)	0.005	2.55 (1.50–4.36)	<0.001
Target vessel failure	36 (7.4)	15 (15.1)	2.29 (1.32–3.96)	0.003	2.64 (1.57–4.42)	<0.001
Death	27 (5.5)	9 (9.5)	1.36 (0.65–2.83)	0.41	1.36 (0.66–2.84)	0.41
Death or MI	36 (7.2)	11 (11.8)	1.41 (0.74–2.66)	0.29	1.47 (0.79–2.74)	0.22
MACE	50 (10.8)	15 (20.0)	1.98 (1.23–3.19)	0.005	2.20 (1.39–3.48)	<0.001
TLR	18 (3.7)	8 (7.4)	2.94 (1.41–6.12)	0.004	2.59 (1.52–4.42)	<0.001
TVR	20 (4.1)	9 (8.5)	2.91 (1.44–5.86)	0.003	3.38 (1.75–6.52)	<0.001

4-year event rates are shown as Kaplan–Meier estimates (number and percentage of events).

Hazard ratios are for patients who underwent retrograde procedure compared with patients with antegrade only procedure.

Conclusions

- After adoption of retrograde approach, more challenging CTO lesions were tried to open, thereby use of antegrade approach decreased over times.
- Fielder wire, Gaia wire, and Corsair microcatheter are widely used for antegrade approach, such devices improved overall success rate in conjunction with retrograde approach.
- Proper use of antegrade single wire or parallel wire technique with or without IVUS guidance make procedure simple and improve success rate.

Conclusions

- **Antegrade approach usually was done in less complex lesion subset, which was translated into less complex procedural characteristics, shorter stent length, and good long-term outcomes compared to retrograde approach**
- **Therefore, antegrade approach is still main default strategy for less complex CTO and essential for success after failed retrograde approach**
- **If wire-based antegrade approach is failed, reentry device could be option instead of retrograde approach to reduce procedural time.**

Thank you for your attention