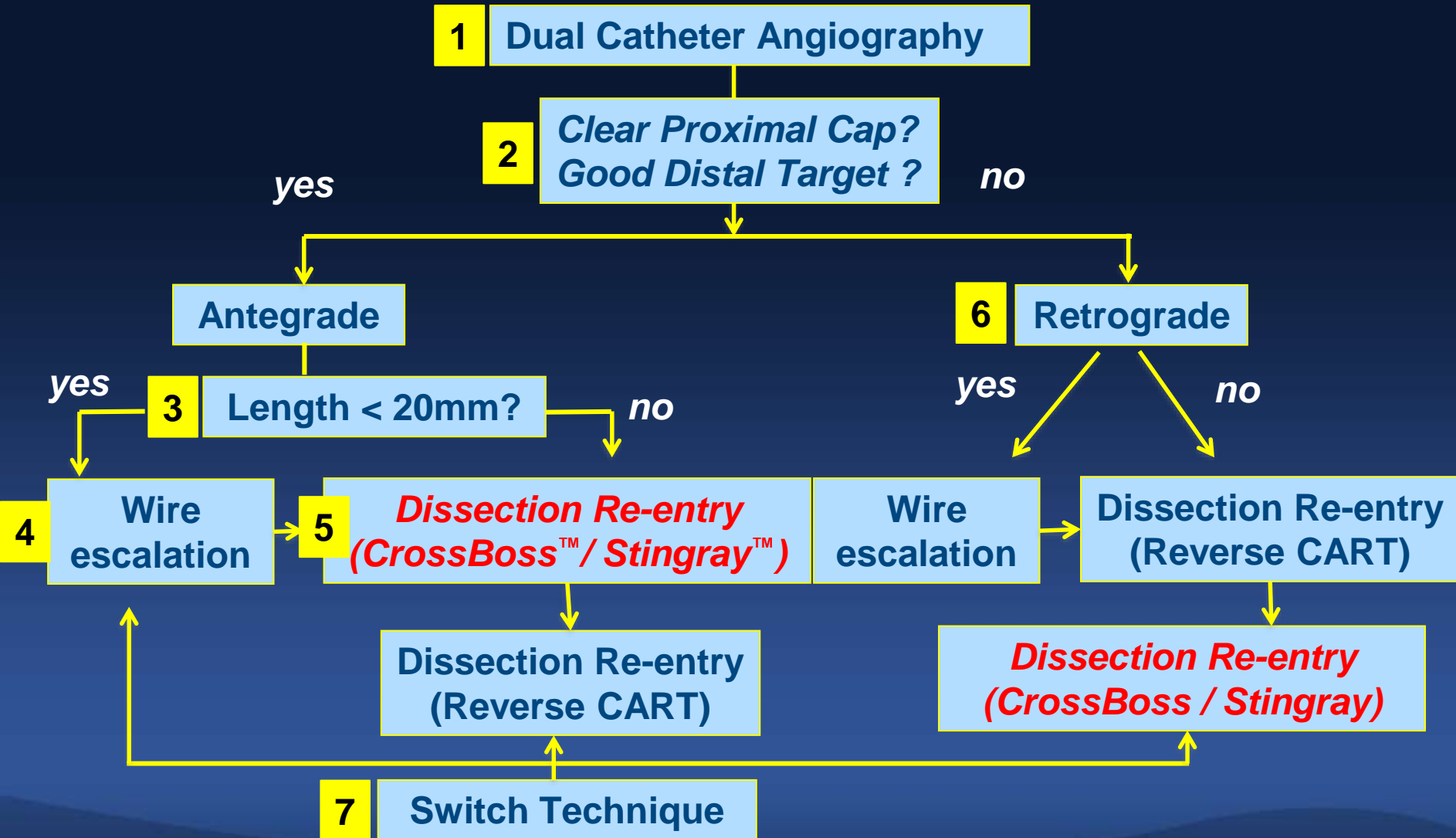


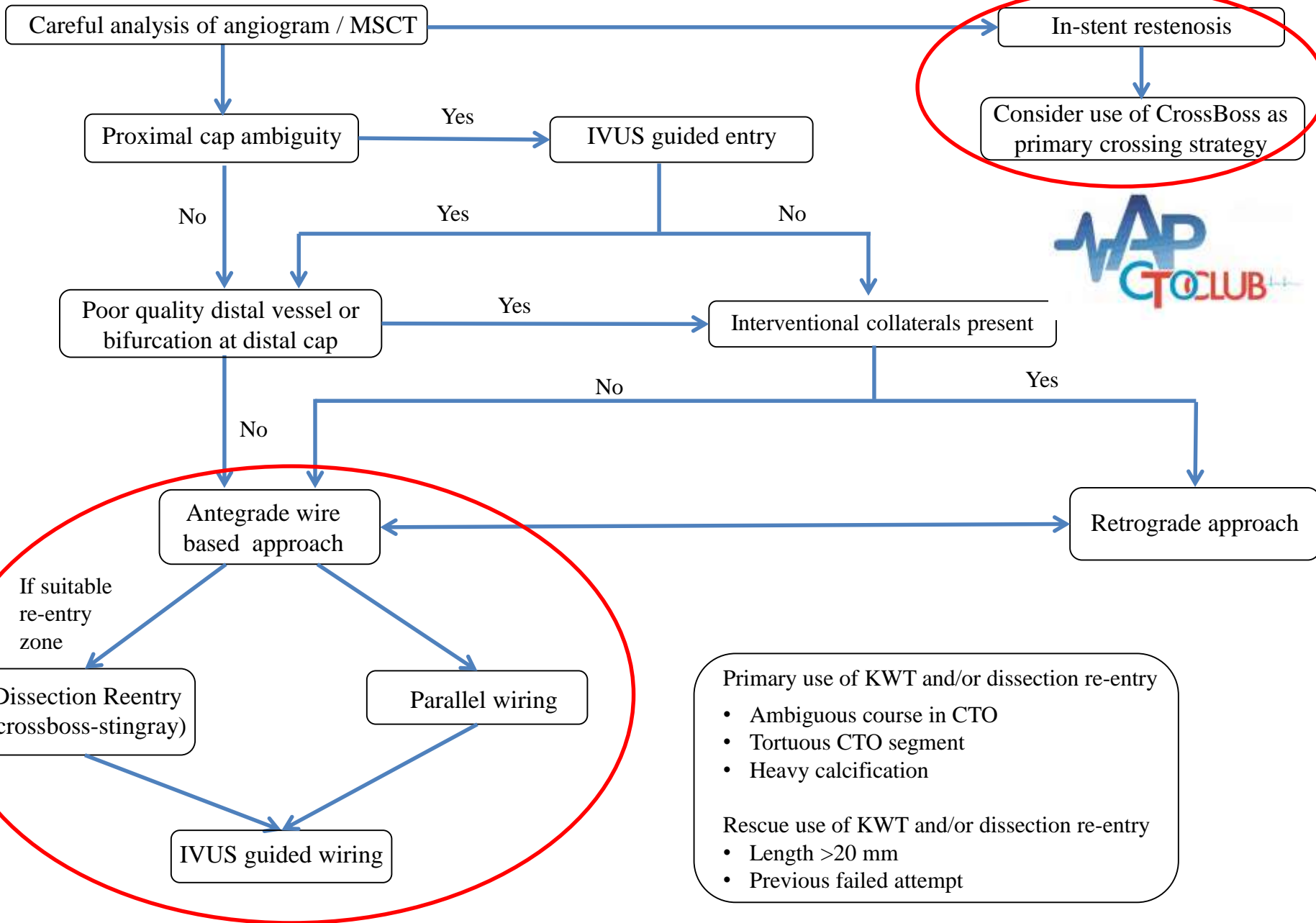
When and How to Change Your Plan A to Plan B

Seung-Whan Lee, MD, PhD

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

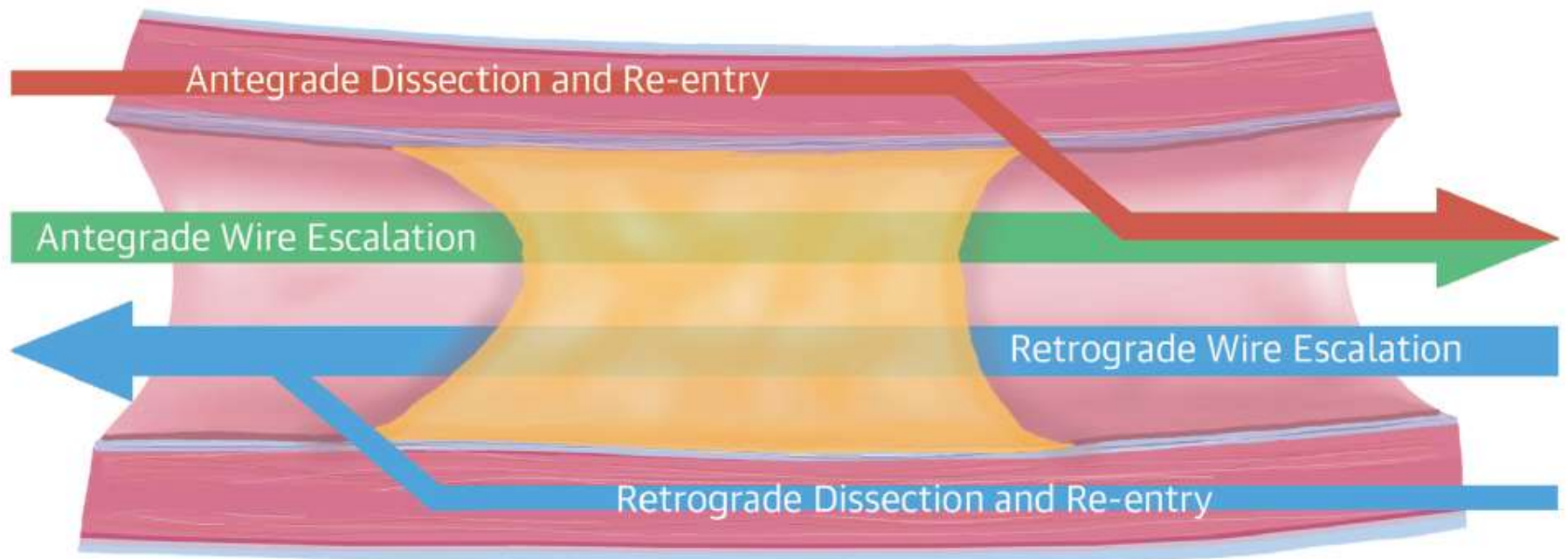
Hybrid Algorithm for CTO-PCI





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

Four strategies (routes) for CTO.



J Am Coll Cardiol 2016;68:1958–70

Selection of crossing strategy

**Antegrade crossing first !!!
even in retrograde crossing**

- Antegrade crossing is preferred over retrograde crossing as the initial crossing strategy, given higher risk for complications with the retrograde approach
- Need for antegrade lesion preparation even when the retrograde approach is eventually used.

Change of crossing strategy

When and How ?

If the initial or subsequent crossing strategy fails to achieve progress, flexibility is important for the success, safety, and efficiency of CTO PCI.

- **Guidewire level**

- Guidewire tip angulation (reshaping) or changing guidewire

- **Strategy level**

- Single wire to parallel wire crossing or dissection reentry

- Antegrade to retrograde crossing

- IVUS-guided wiring

Change of crossing strategy

When and How ?

- **Timing & selection of subsequent crossing strategies**

- Lesion characteristics.

- Challenges encountered.

- Local equipment availability and expertise.

Strategy options

Antegrade wire based approach

Single wire redirection

If suitable re-entry zone

**Dissection Reentry
(crossboss-stingray)**

Parallel wiring

Retrograde approach

IVUS guided wiring

Antegrade wire based strategy



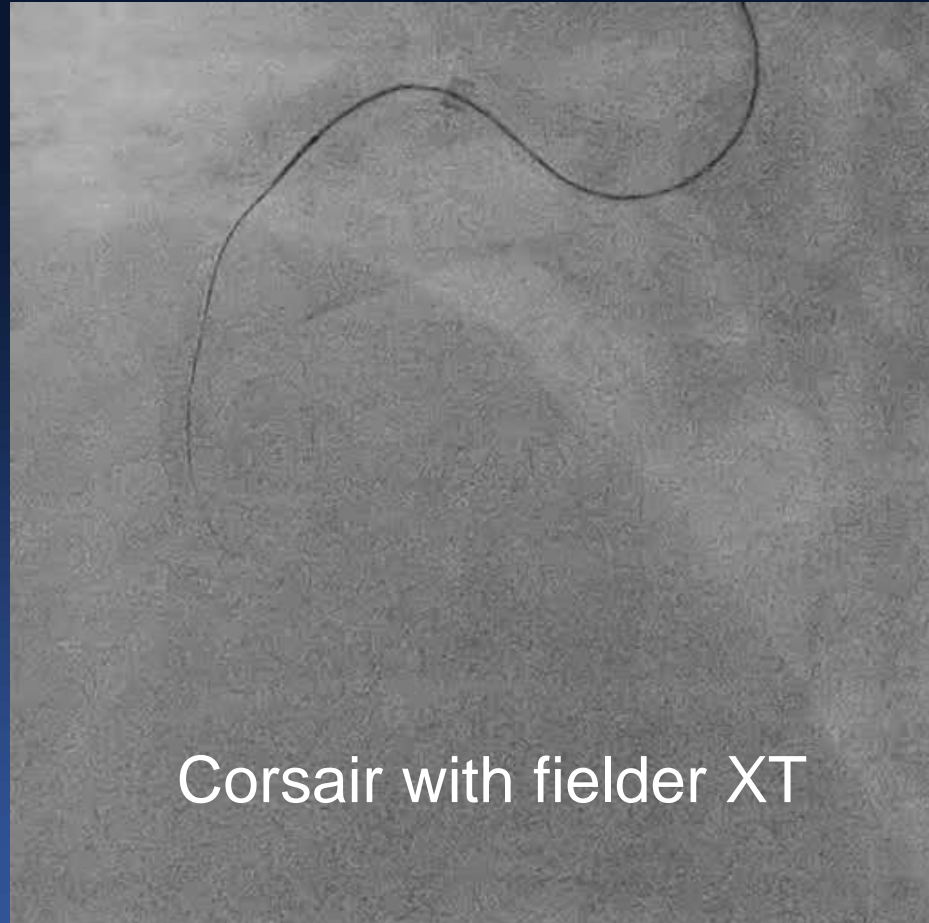
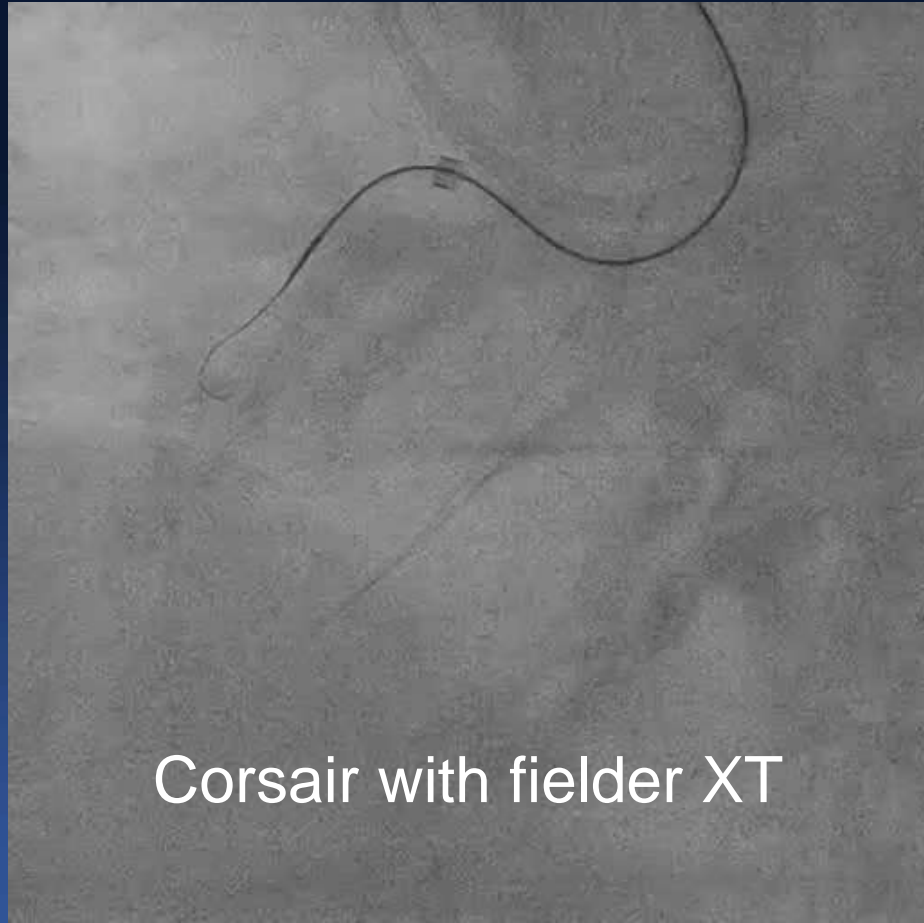
	Visible micro channels	Tapered proximal cap	Blunt proximal cap
Proximal Cap	Low penetration force wire with polymer jacket and tapered tip	Low penetration force wire	Intermediate penetration force wire
	↓	↓	↓
	Intermediate penetration force wire	Intermediate penetration force wire	High penetration force wire
CTO body	Length <20 mm	Reasonable to continue with wire used to cross proximal cap	
	Length >20 mm or ambiguous course	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.		

60/M, Long CTO with tapered cap

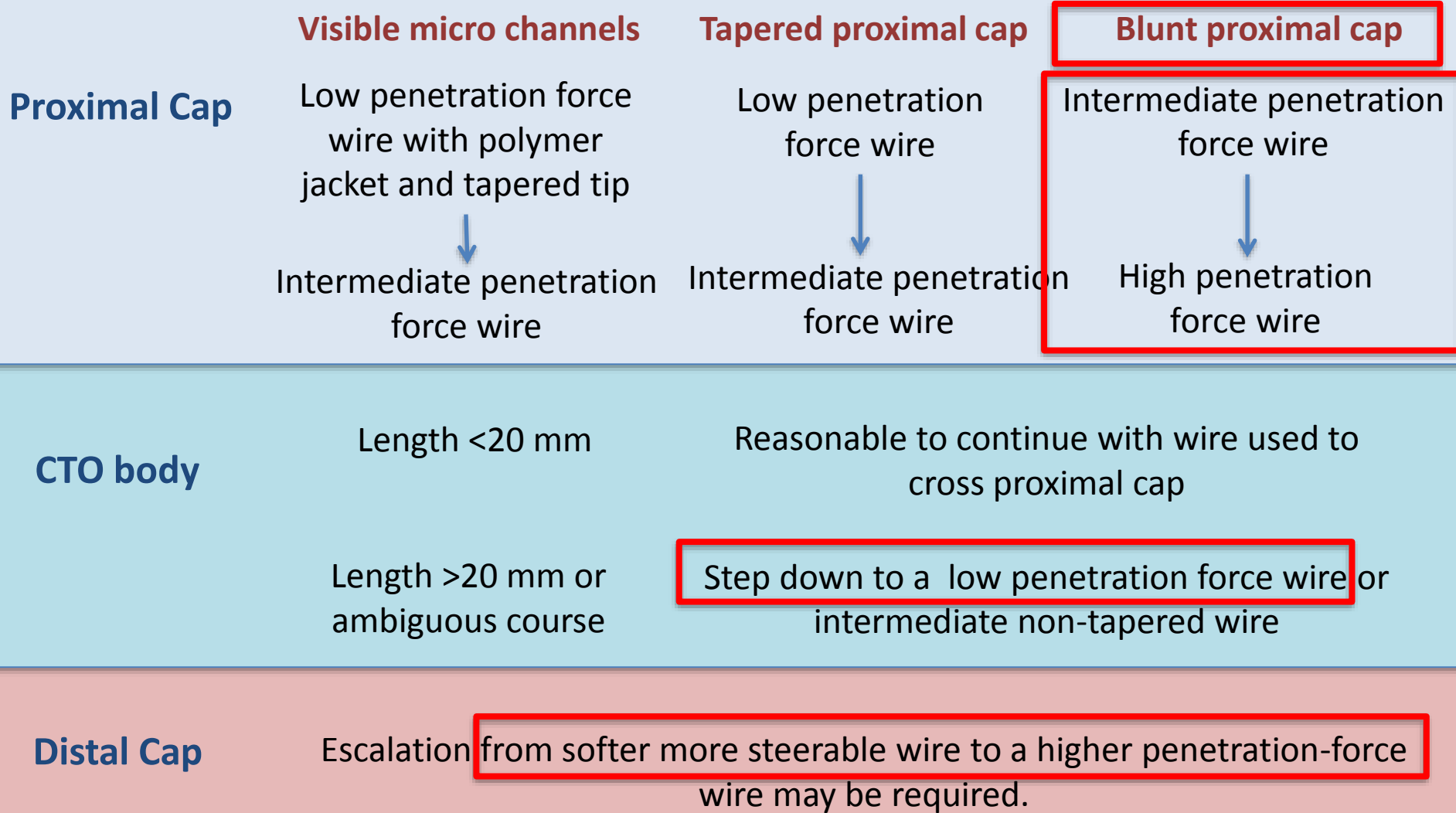
Poor distal target with good interventional collateral



Long CTO with tapered cap

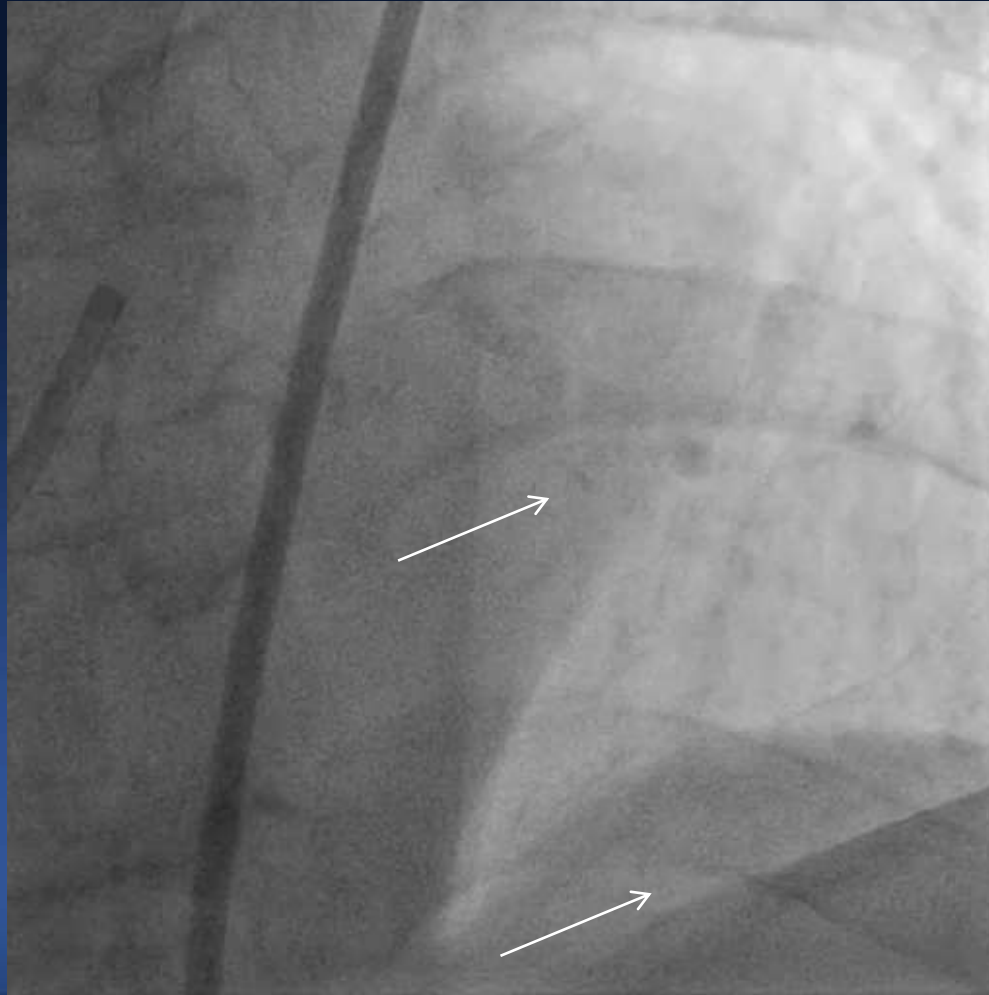


Antegrade wire based strategy

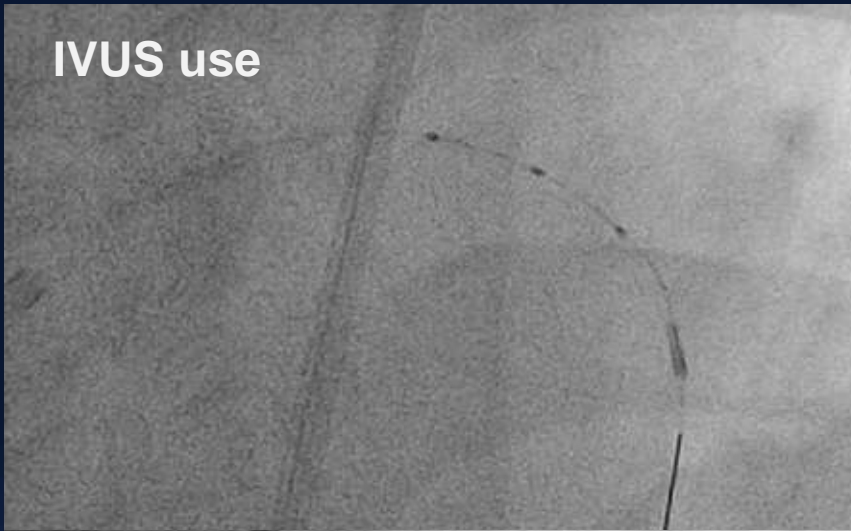


67/M Ambiguous stump

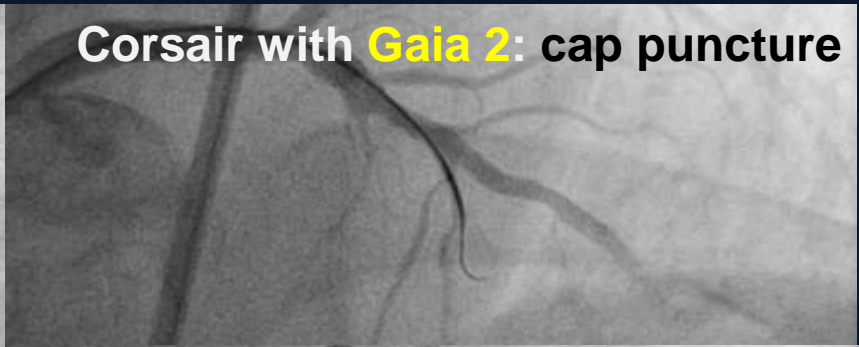
Poor distal target



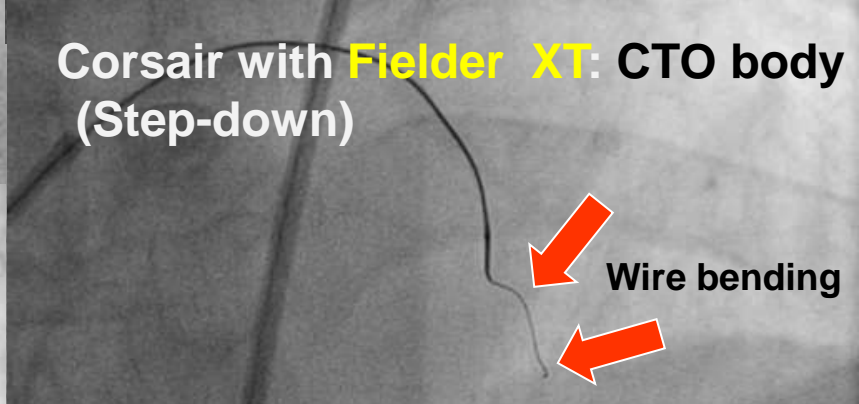
IVUS use



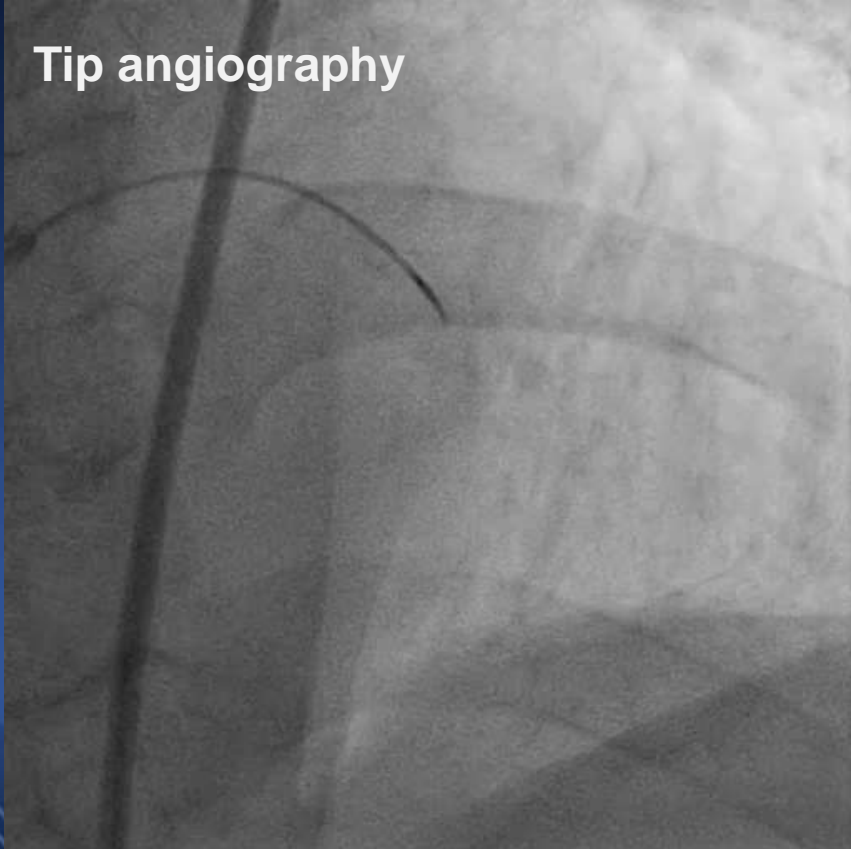
Corsair with **Gaia 2**: cap puncture



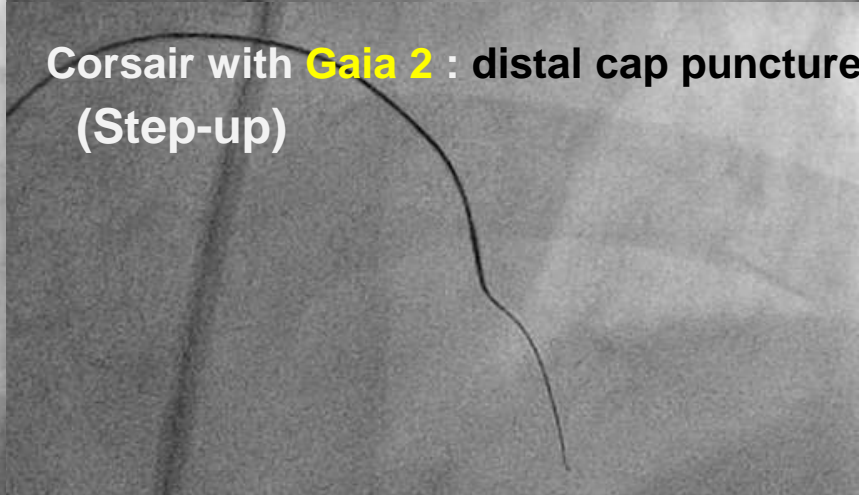
Corsair with **Fielder XT**: CTO body (Step-down)



Tip angiography



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



Strategy options

Antegrade wire based approach

Single wire redirection

If suitable re-entry zone

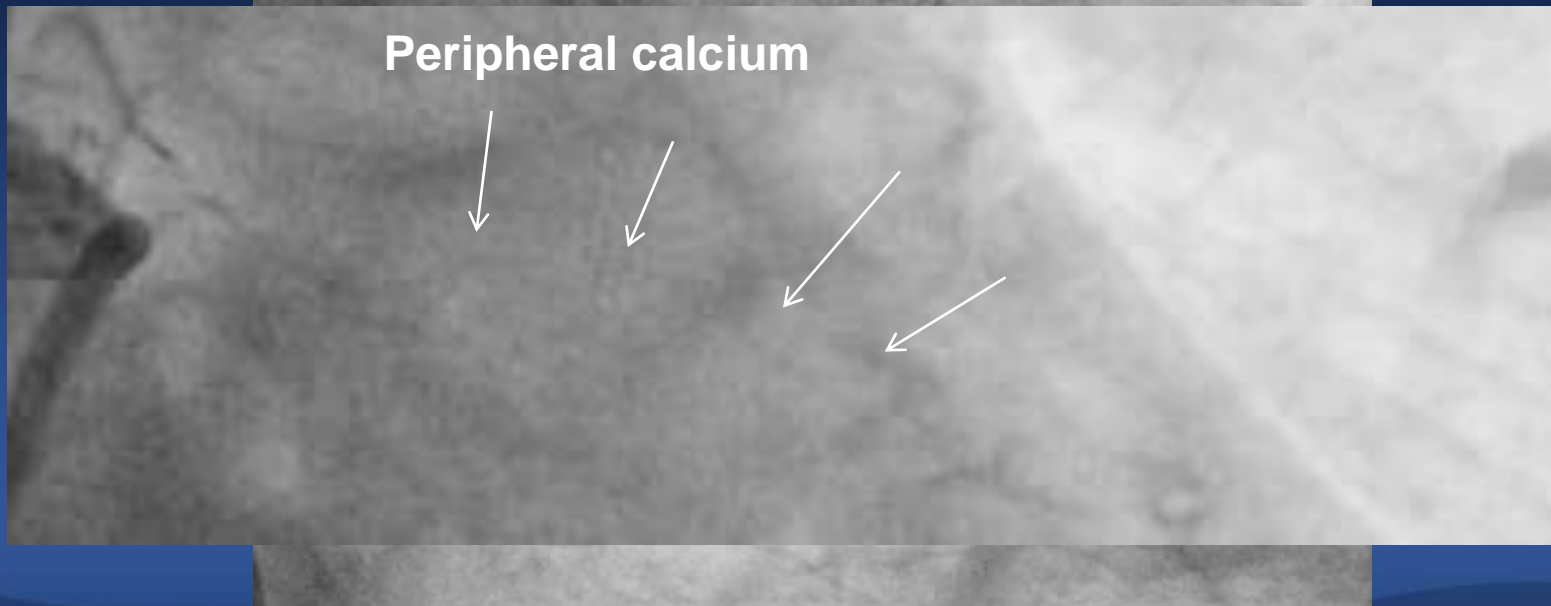
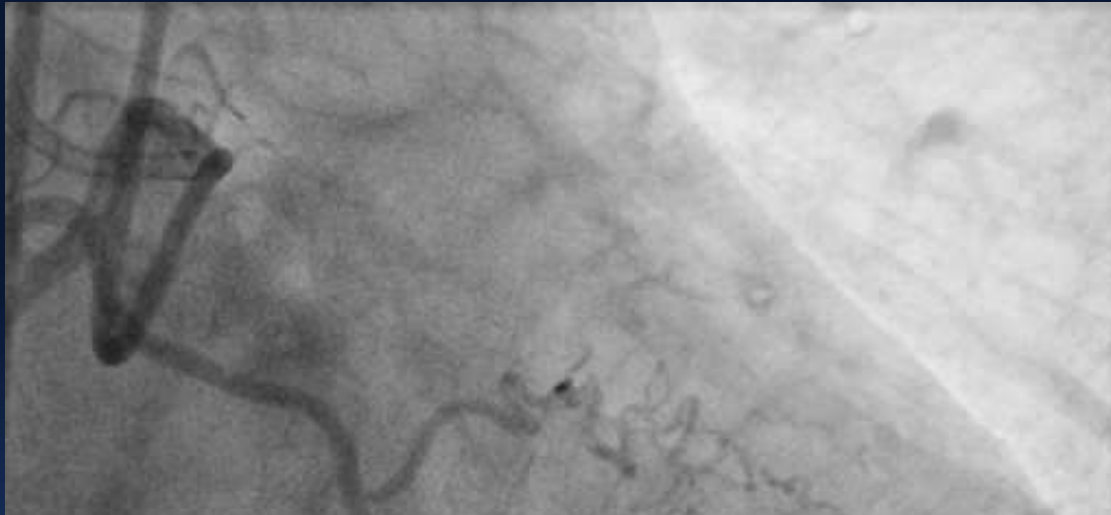
**Dissection Reentry
(crossboss-stingray)**

Parallel wiring

Retrograde approach

IVUS guided wiring

LAD os CTO



Wire going outside calcium line

***Fielder XT/Corsair**



Corsair advance

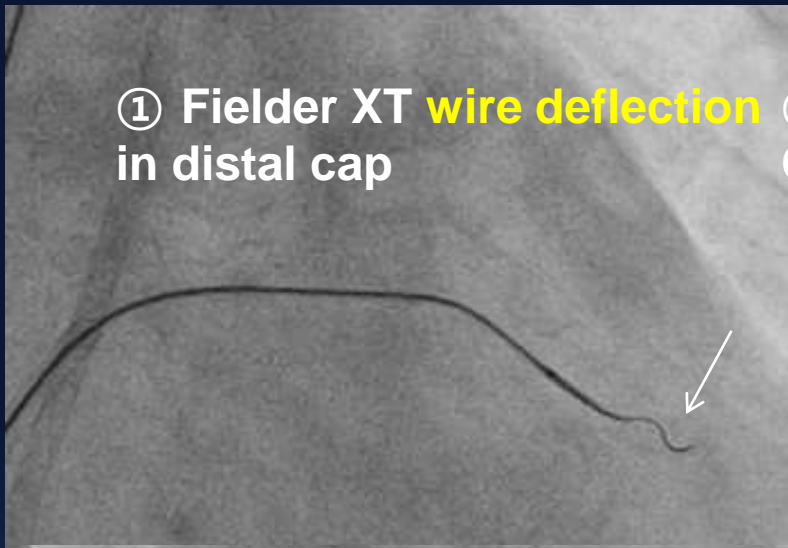
**Fielder XT reshaping
d/t flattened wire tip
during wiring**



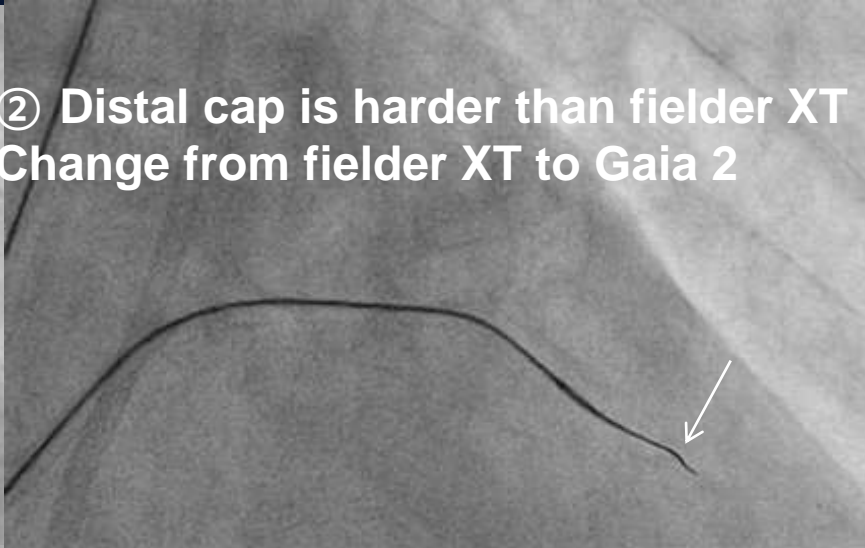
***Fielder XT advance
After tip reshaping**

Fielder XT advance

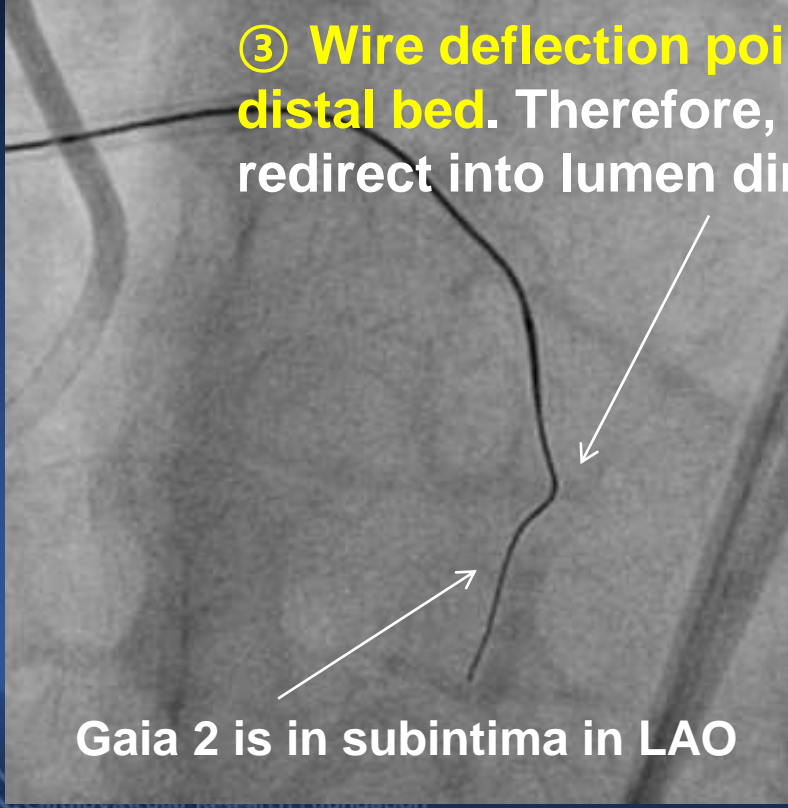
① Fielder XT **wire deflection** in distal cap



② Distal cap is harder than fielder XT
Change from fielder XT to Gaia 2

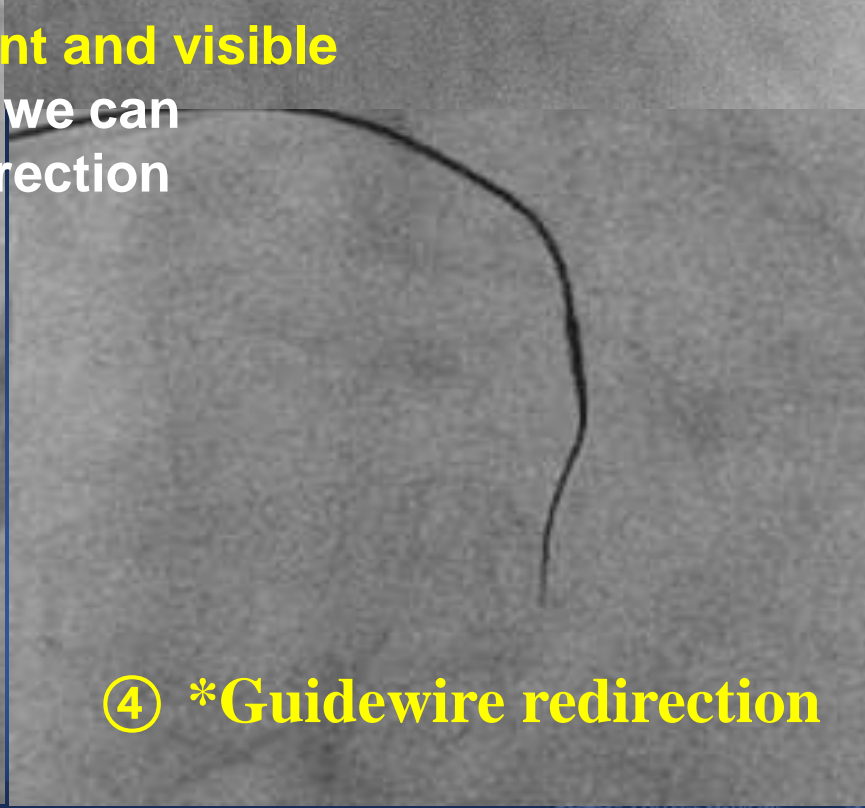


③ **Wire deflection point and visible distal bed.** Therefore, we can redirect into lumen direction



Gaia 2 is in subintima in LAO

④ ***Guidewire redirection**



Change of crossing strategy

Guidewire level

- If difficult to change wire direction: **wire reshaping**
- Wire bending or deflection: need **stiffer wire**
- Guidewire redirection:**
 - Identified deflection point into subintimal space
 - Short length between deflection point to distal cap

Strategy options

Antegrade wire based approach

Single wire redirection

If suitable re-entry zone

**Dissection Reentry
(crossboss-stingray)**

Parallel wiring

Retrograde approach

IVUS guided wiring

Strategy options

Antegrade wire based approach

Single wire redirection

If suitable re-entry zone

**Dissection Reentry
(crossboss-stingray)**

Parallel wiring

Retrograde approach

IVUS guided wiring

Change of crossing strategy

Strategy level?

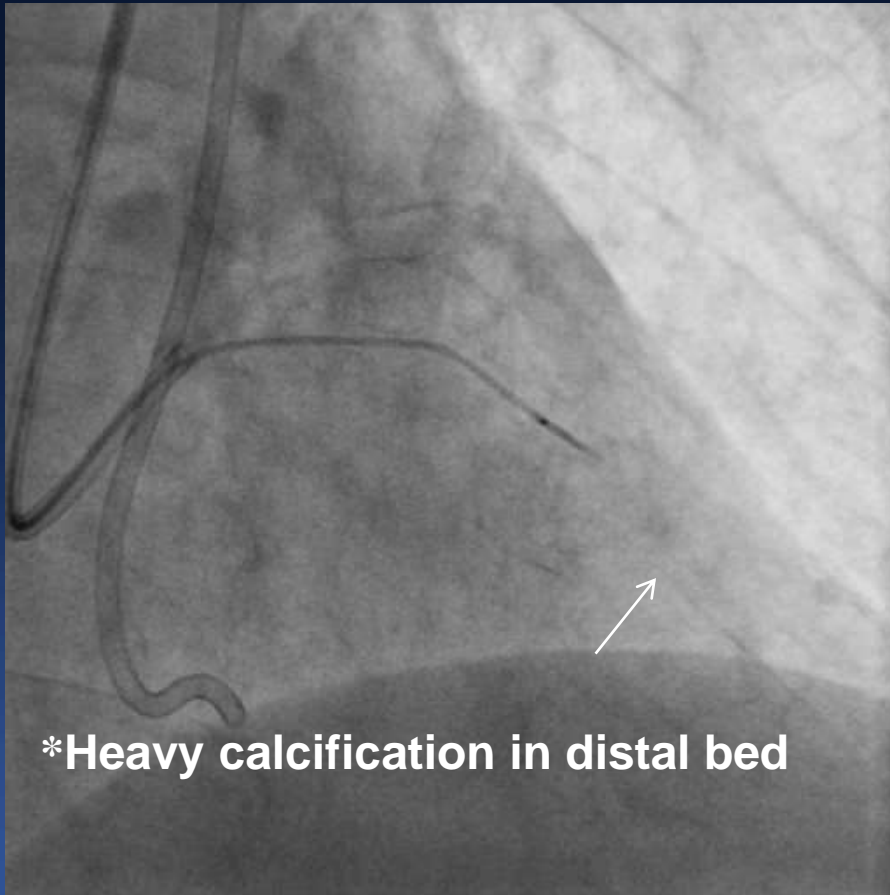
- **Feature favoring use of dissection reentry or stingray**
 - Ambiguous vessel course
 - Long, calcified, tortuous CTO lesion
 - If wire is in subintimal at the proximal cap
 - Good landing zone without major side branch and calcification
- **Feature favoring use of parallel wiring**
 - Identified deflection point into subintimal space
 - Heavy calcification and/or diffuse diseased distal bed
 - Important side branch near distal cap

Use of *parallel wiring* and *stingray* is not interchangeable

Feature favoring use of stingray



Feature favoring use of parallel wiring



Strategy options

Antegrade wire based approach

Single wire redirection

If suitable re-entry zone

**Dissection Reentry
(crossboss-stingray)**

Parallel wiring

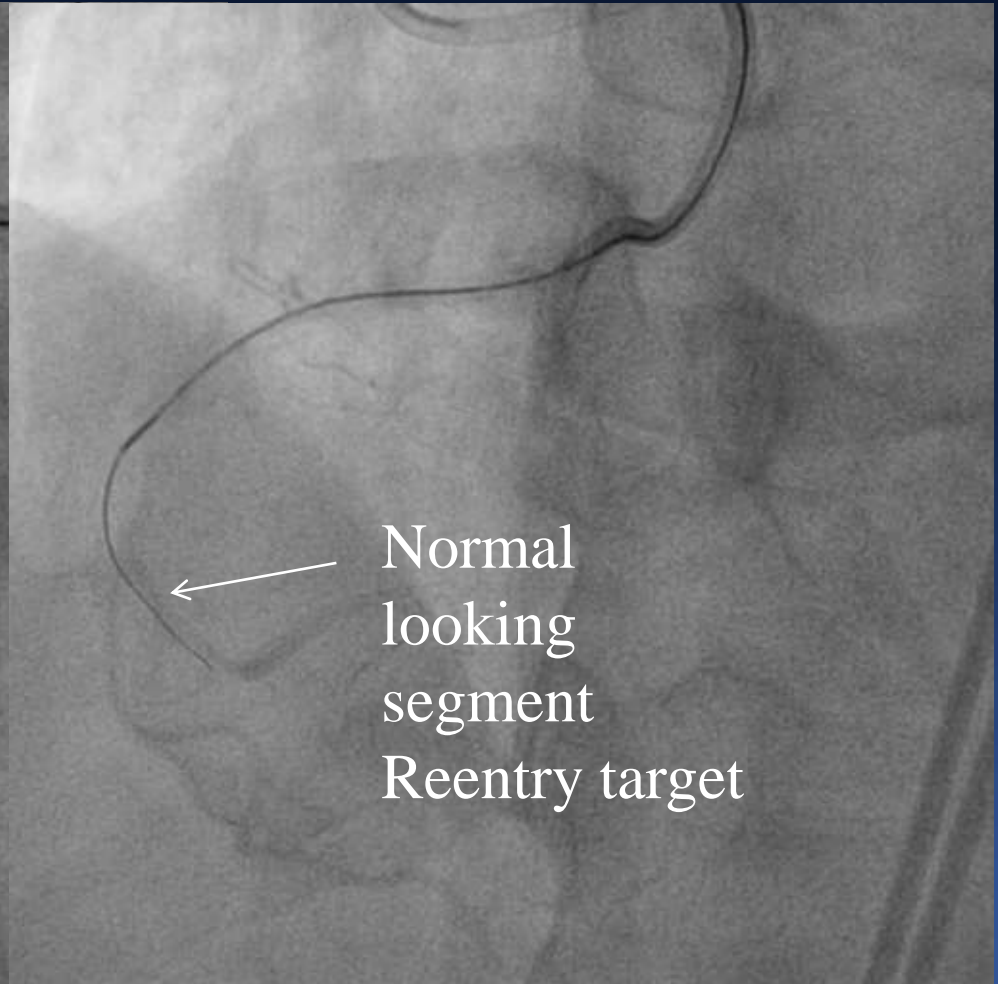
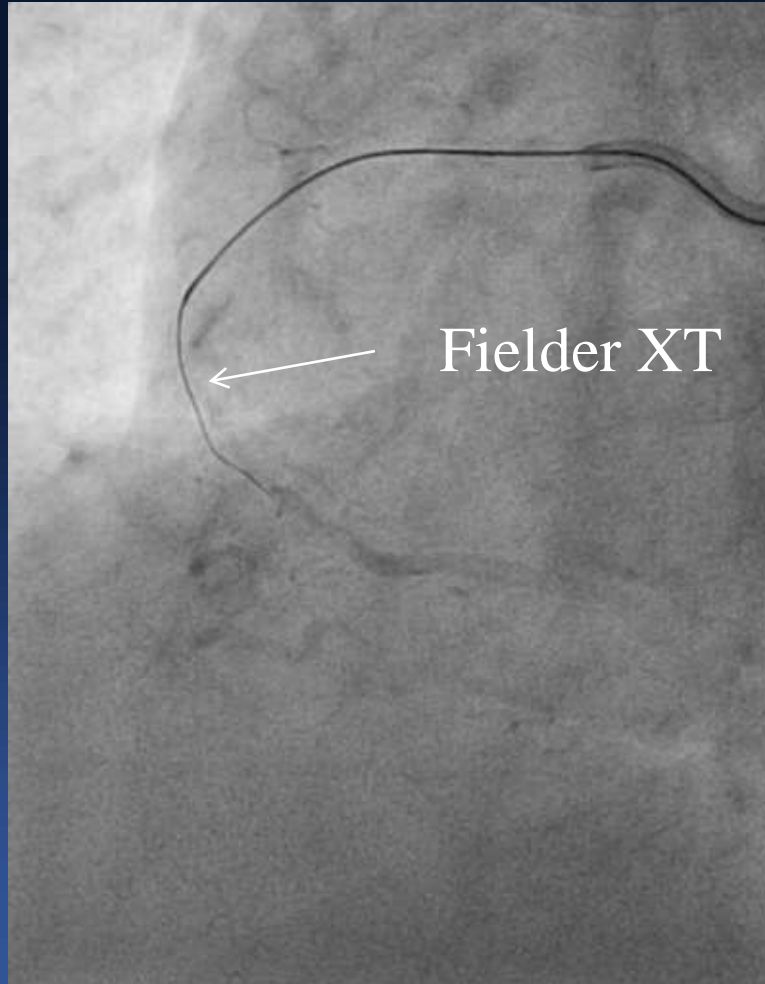
Retrograde approach

IVUS guided wiring

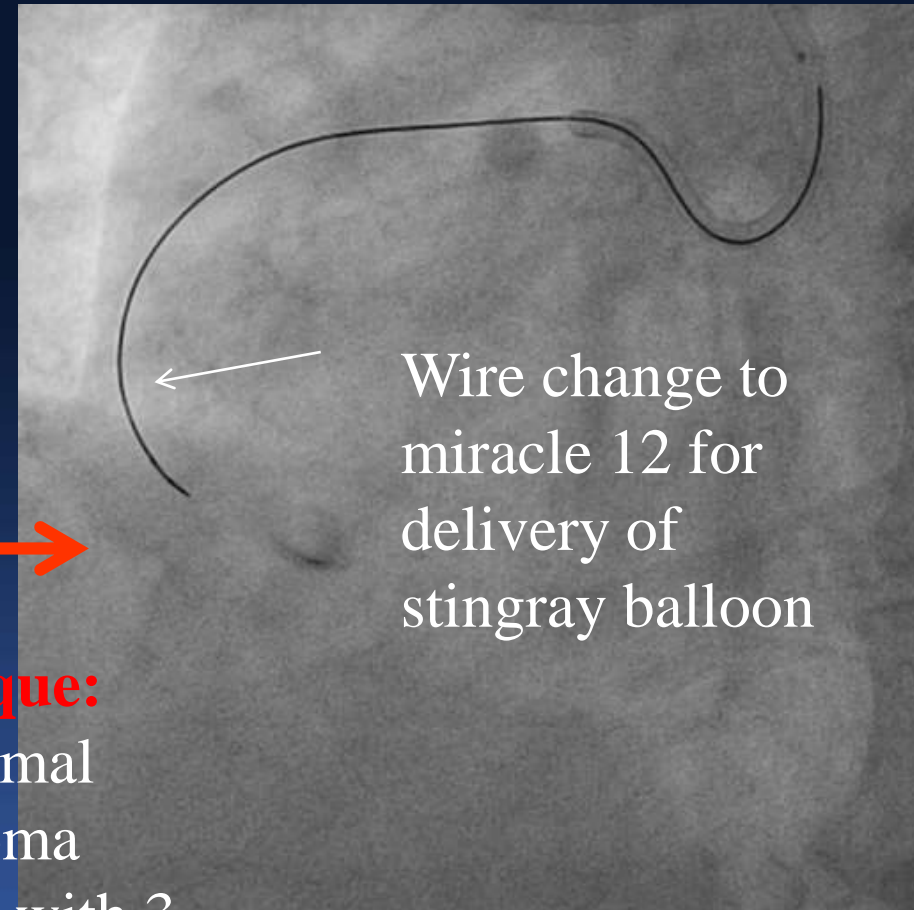
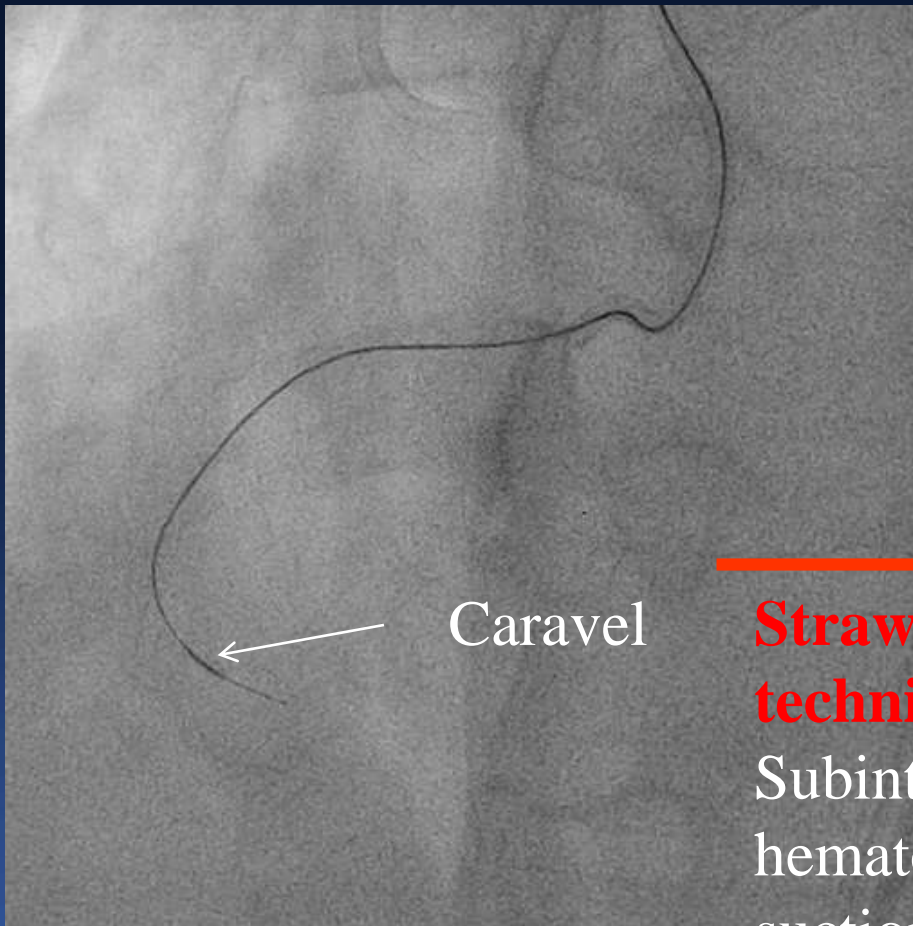
Feature favoring use of stingray



Subintimal wiring with caravel



Microcatheter advance and wire exchange



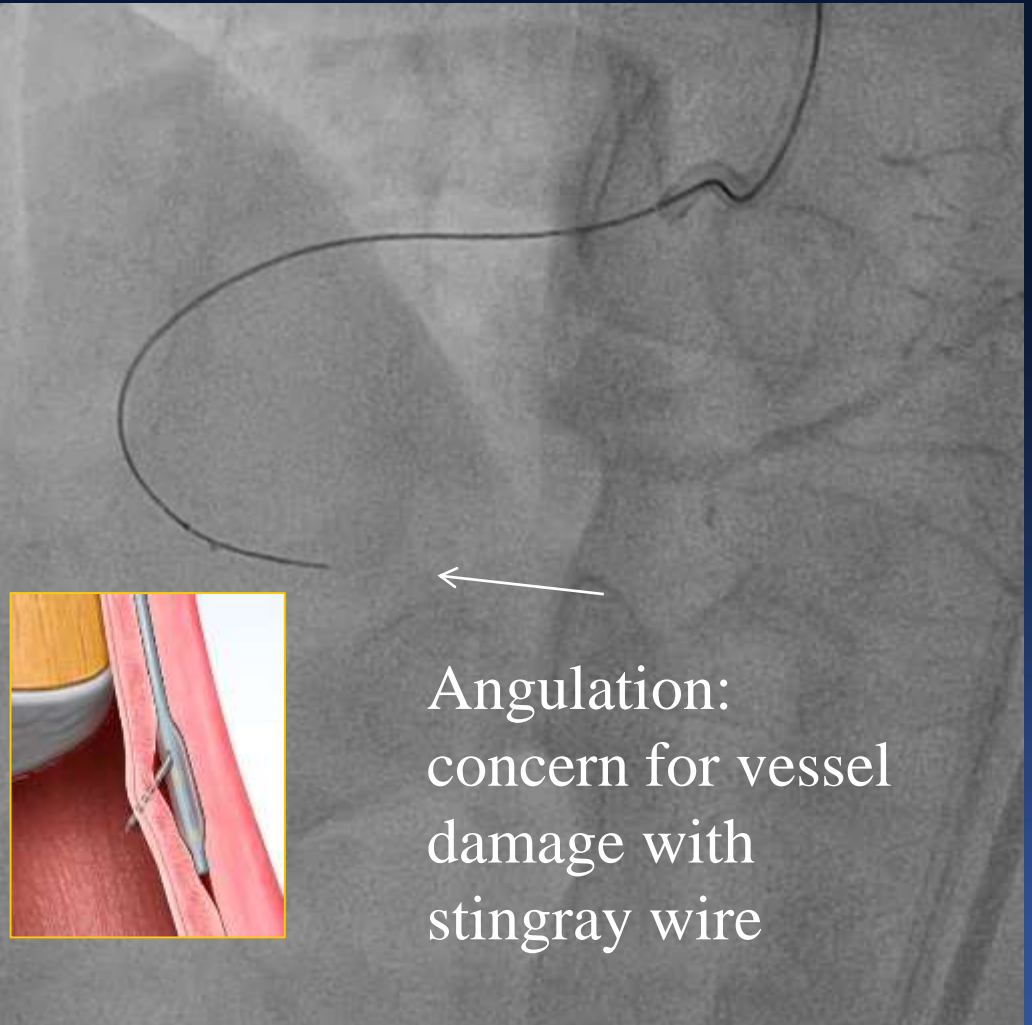
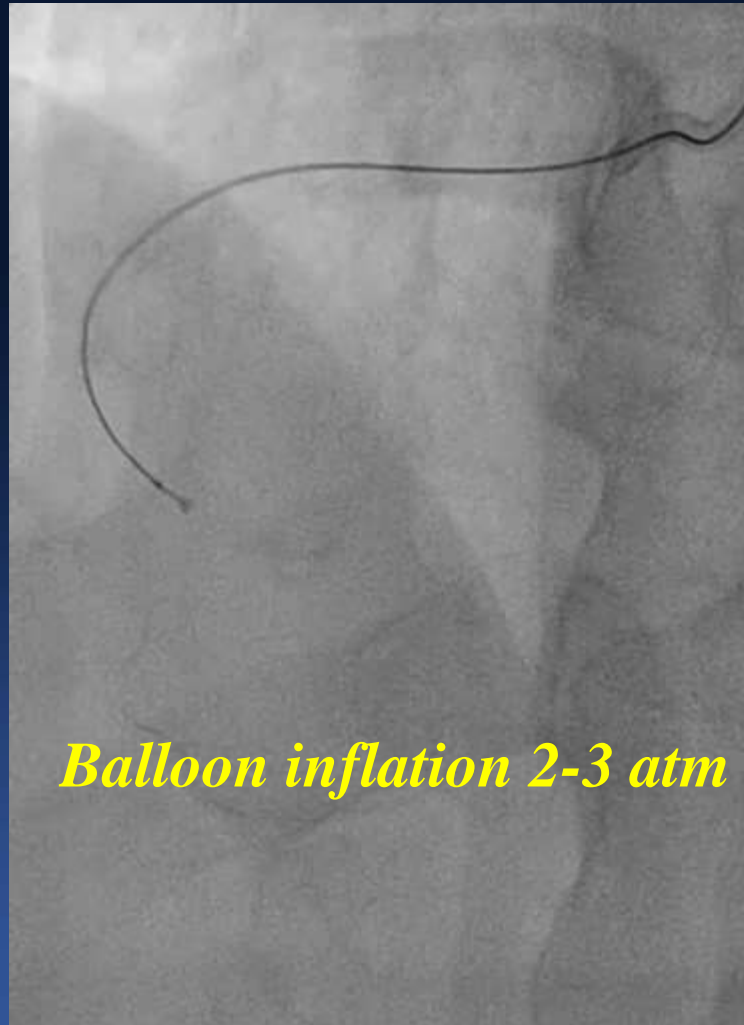
Straw technique:
Subintimal
hematoma
suction with 3
way system

Wire removal and straw technique balloon positioning by angiography

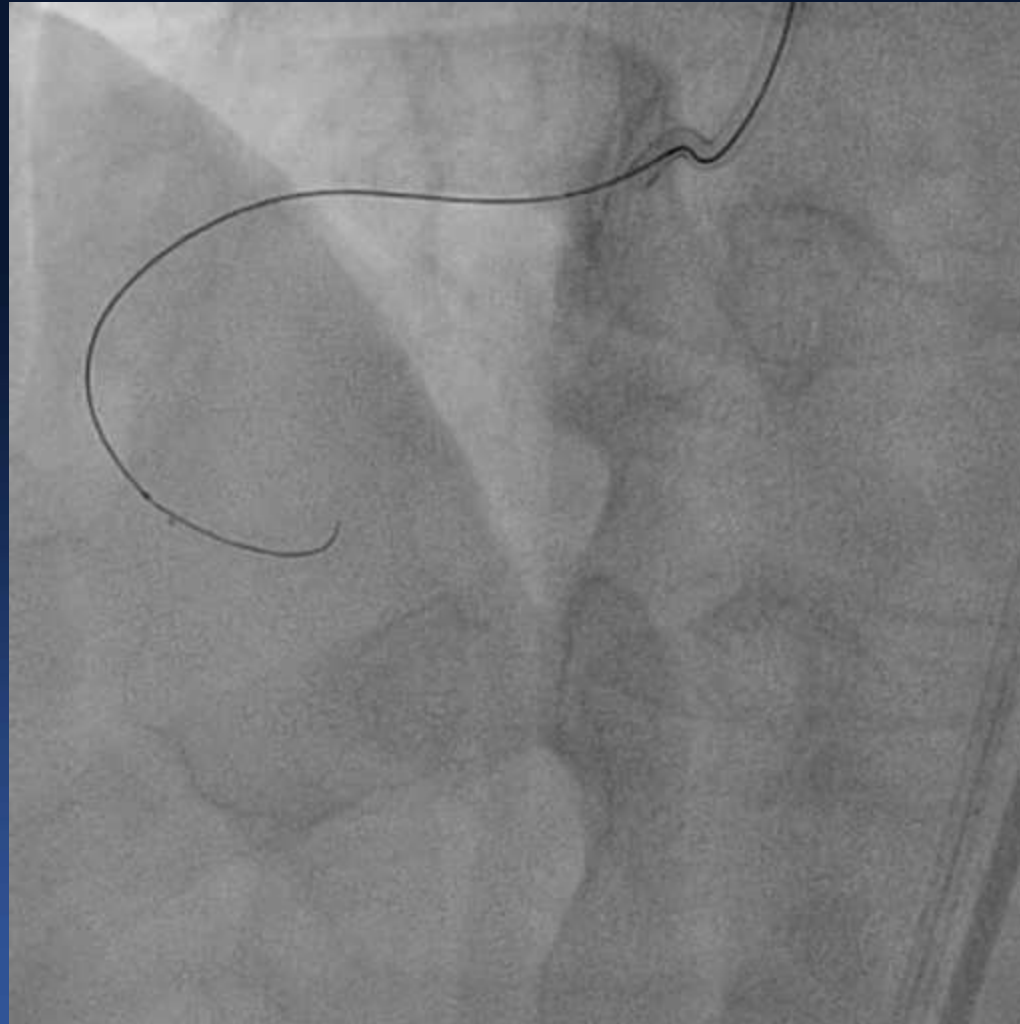
**Straw technique
again through
stingray balloon:**
Subintimal
hematoma suction
with 3 way system



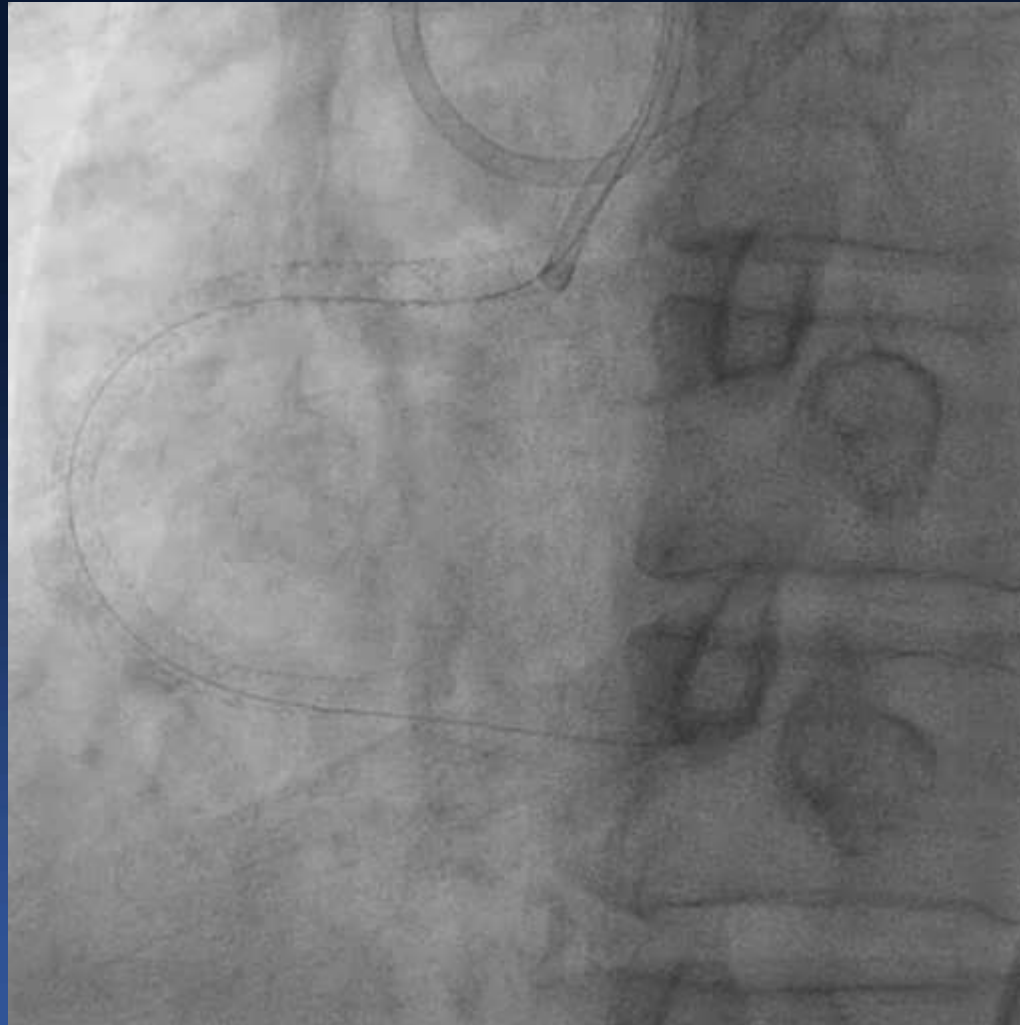
Reentry using Stingray wire



Stick and Swab using Fielder XT wire



Final angiography



Strategy options

Antegrade wire based approach

Single wire redirection

If suitable re-entry zone

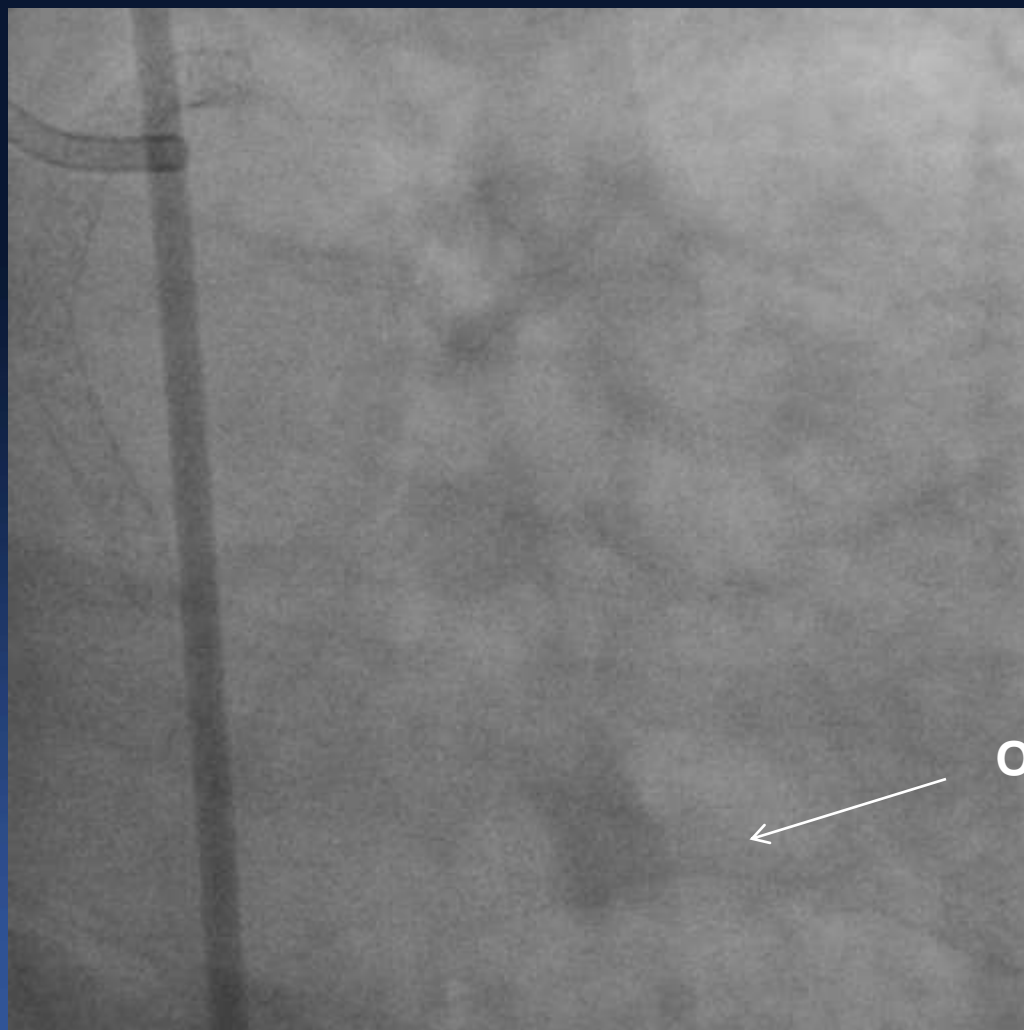
**Dissection Reentry
(crossboss-stingray)**

Parallel wiring

Retrograde approach

IVUS guided wiring

Feature favoring use of parallel wiring



OM branch near distal cap area

RAO caudal

RAO caudal



Possible deflection point



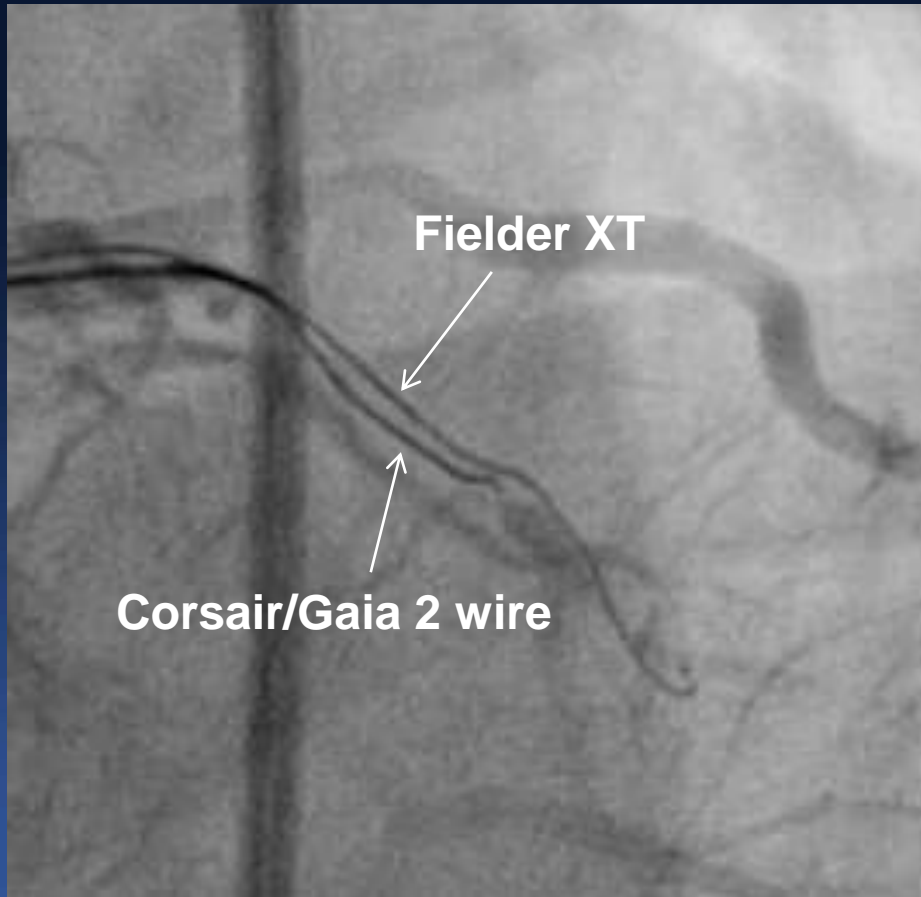
Corsair/fielder XT

Fielder XT in Subintimal space

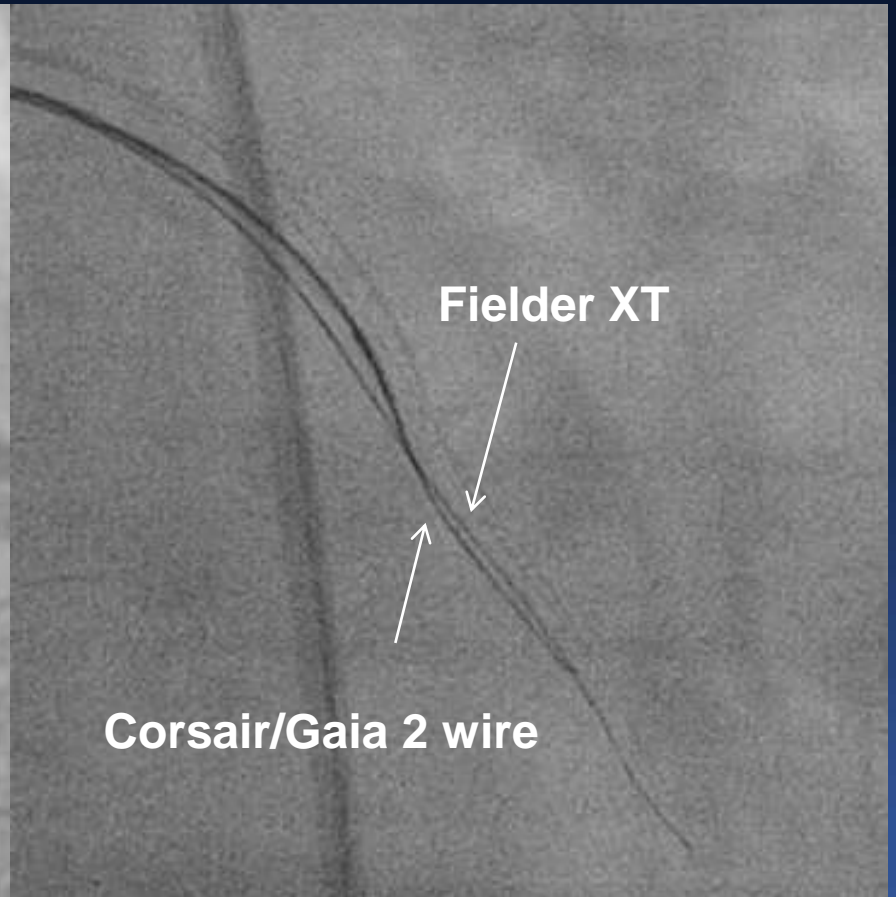


LAO cranial

LAO cranial

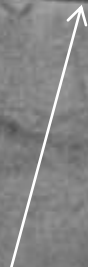


RAO caudal



LAO cranial

Fielder XT



Corsair/Gaia 2 wire

RAO caudal

Fielder XT



Corsair/Gaia 2 wire

Strategy options

Antegrade wire based approach

Single wire redirection

If suitable re-entry zone

**Dissection Reentry
(crossboss-stingray)**

Parallel wiring

Retrograde approach

IVUS guided wiring

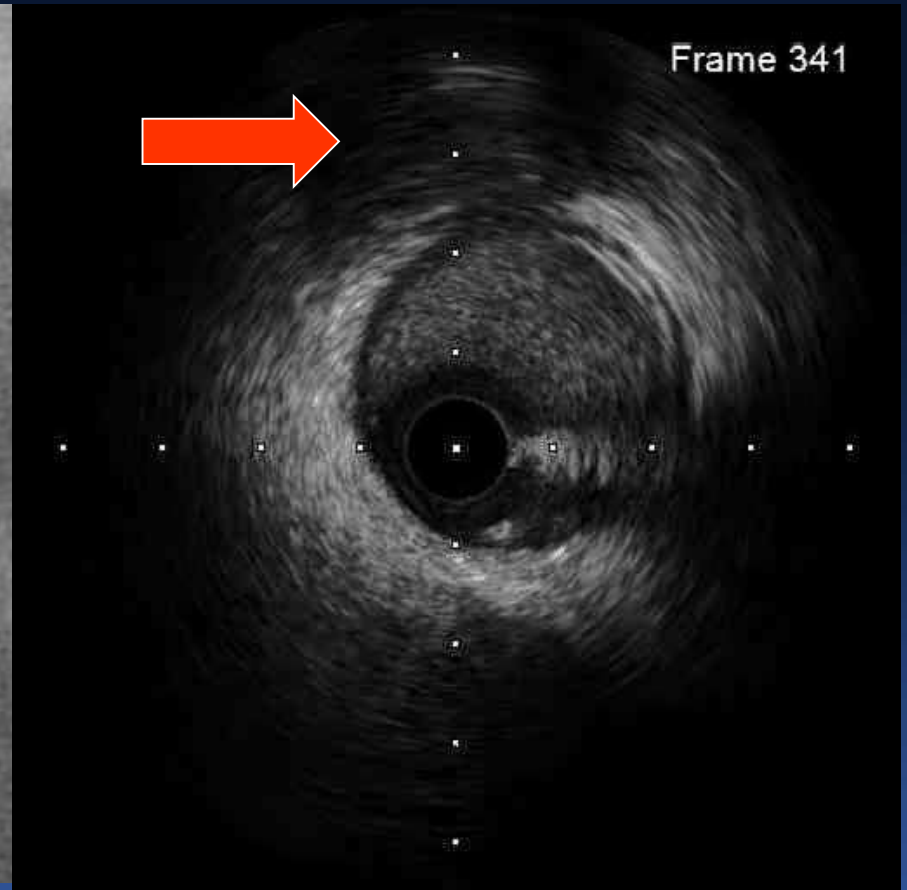
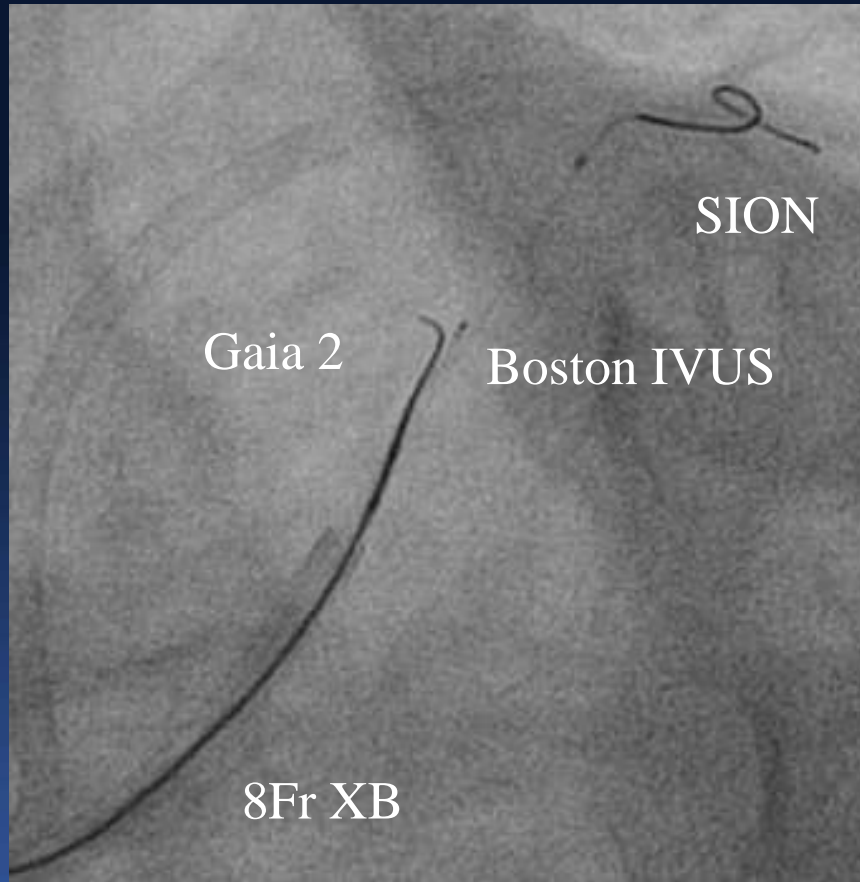
IVUS-guided wiring as a last resort

- When the Stingray system is failed or not available
- Both antegrade and retrograde strategies have failed.
- 1.5-mm balloon is advanced over the antegrade wire and inflated in the subintimal space to allow delivery of an IVUS catheter.
- Direct high penetration force wire (i.e., Conquest Pro), from subintimal space toward the true lumen.

Blunt stump LAD CTO with bridge collateral



IVUS-guided puncture with real time application



IVUS pull-back from Diagonal

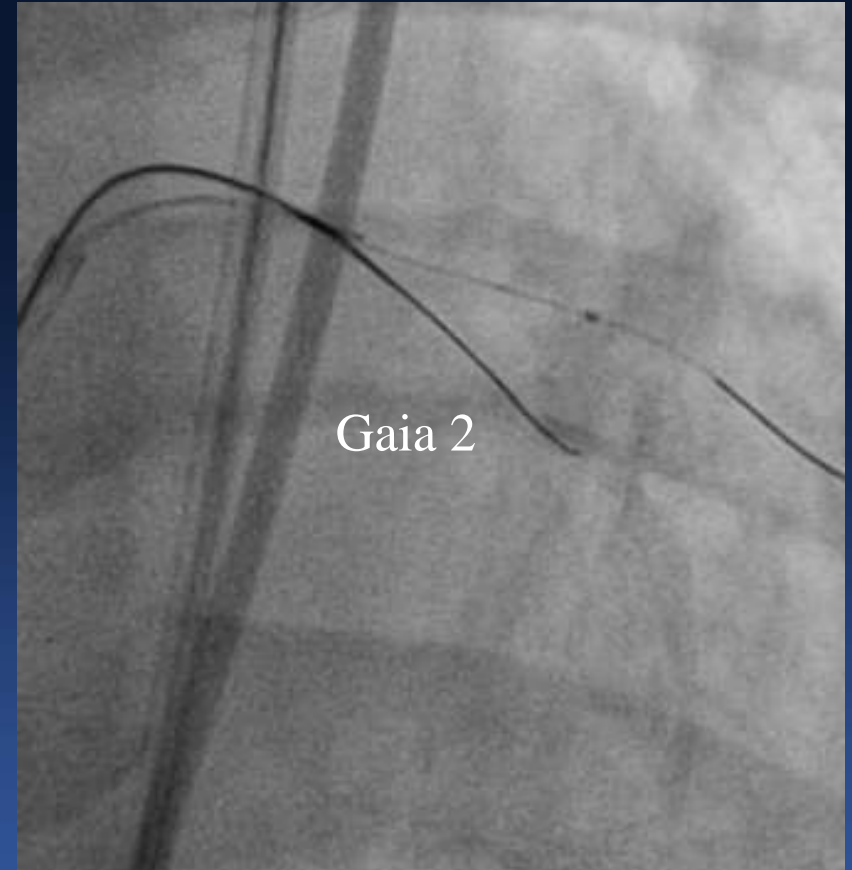
Proximal cap



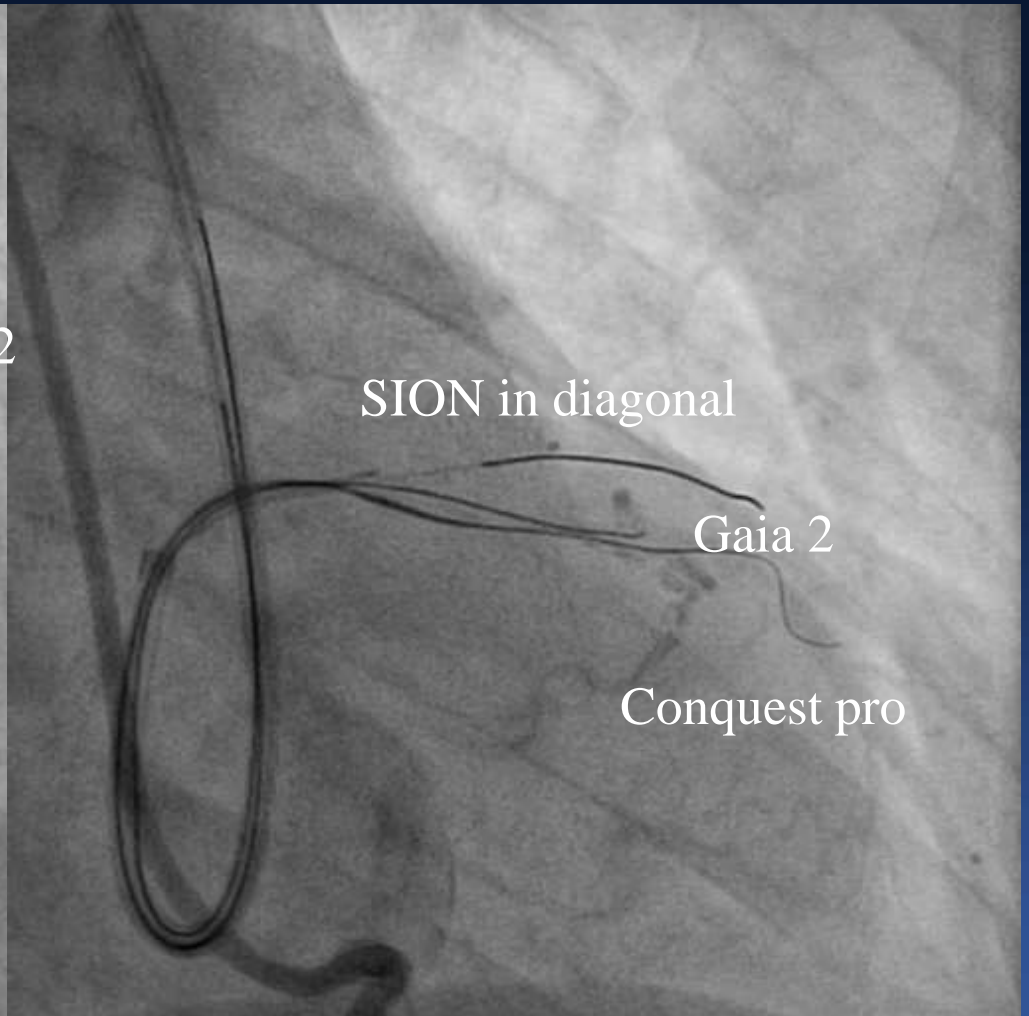
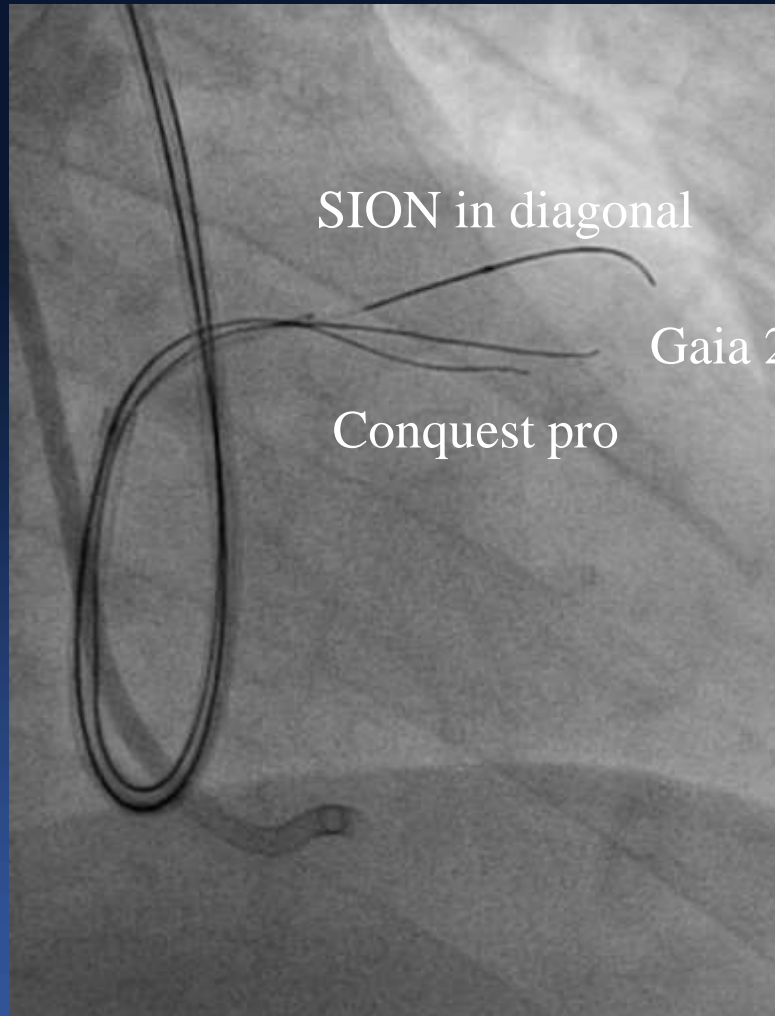
Gaia 2, A little bit lean to one-side



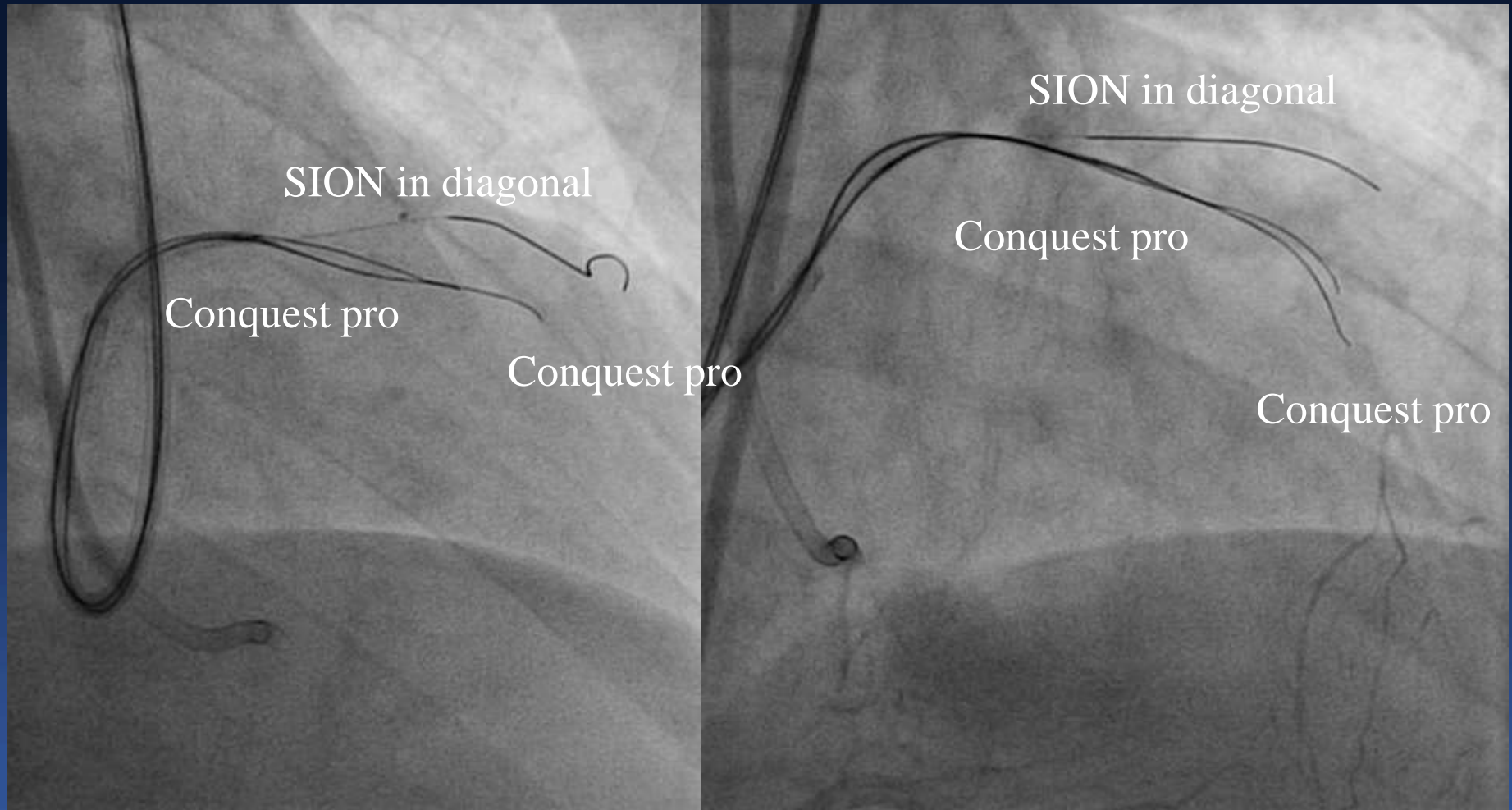
After proximal puncture, wire advanced to subintimal



Parallel wire technique



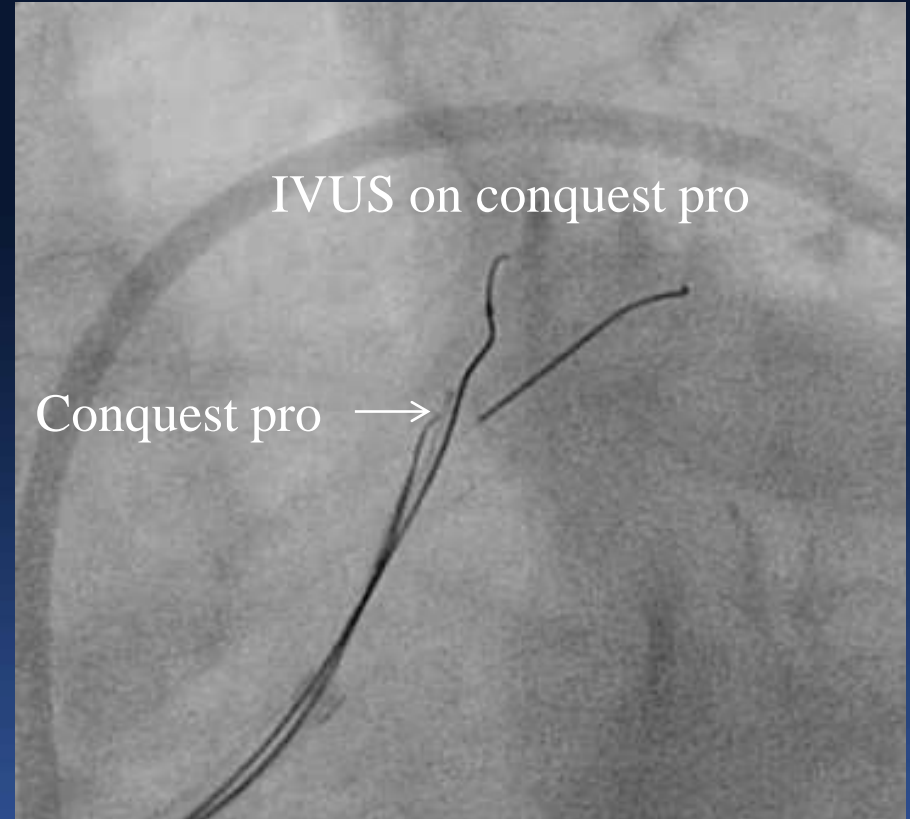
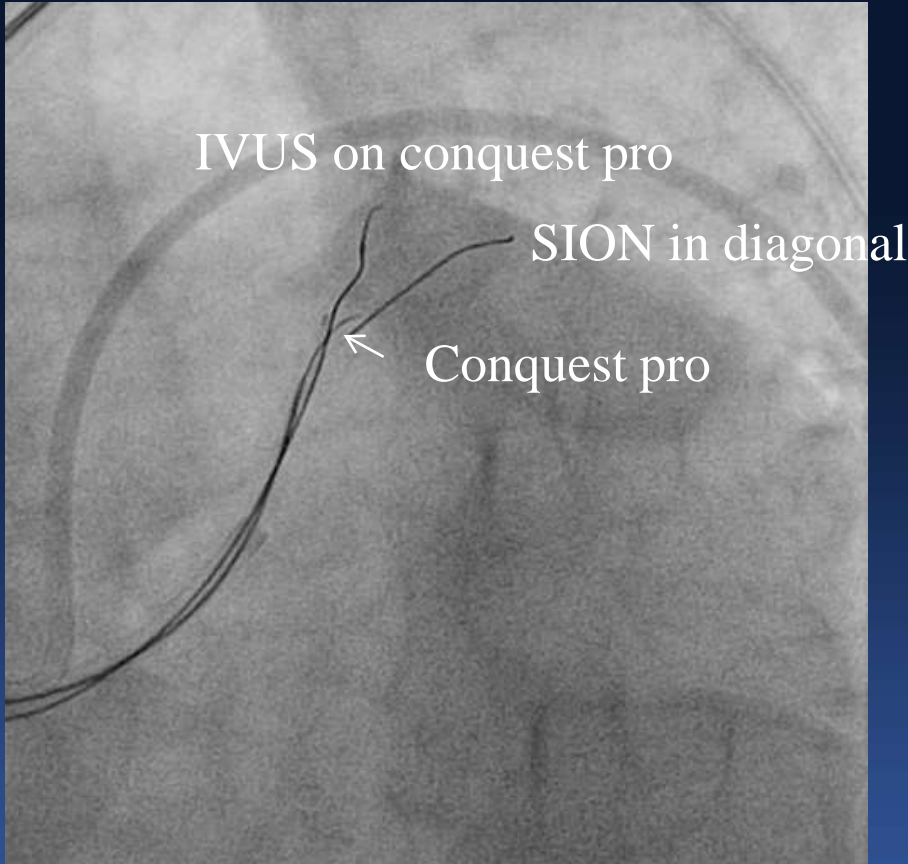
See-saw wire technique



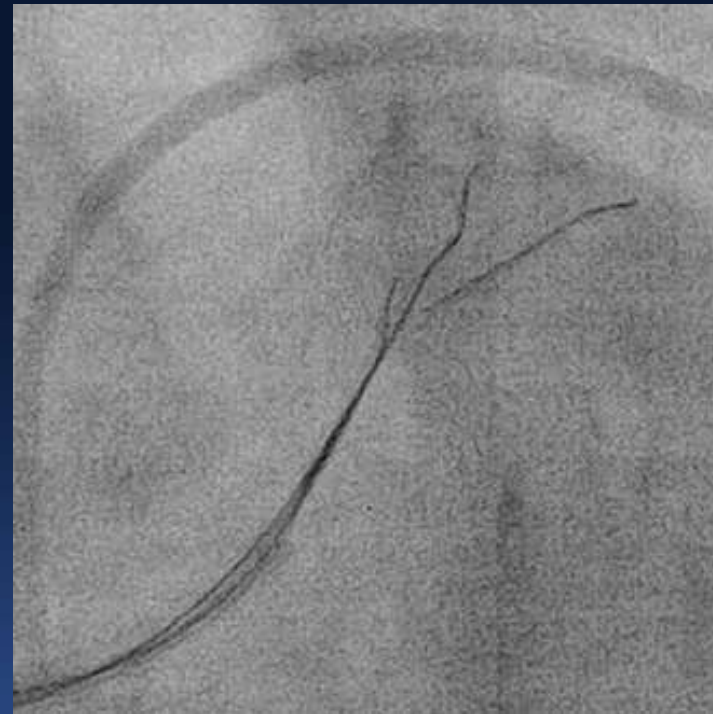
1.5 mm balloon for IVUS advance to CTO segment subintimal space



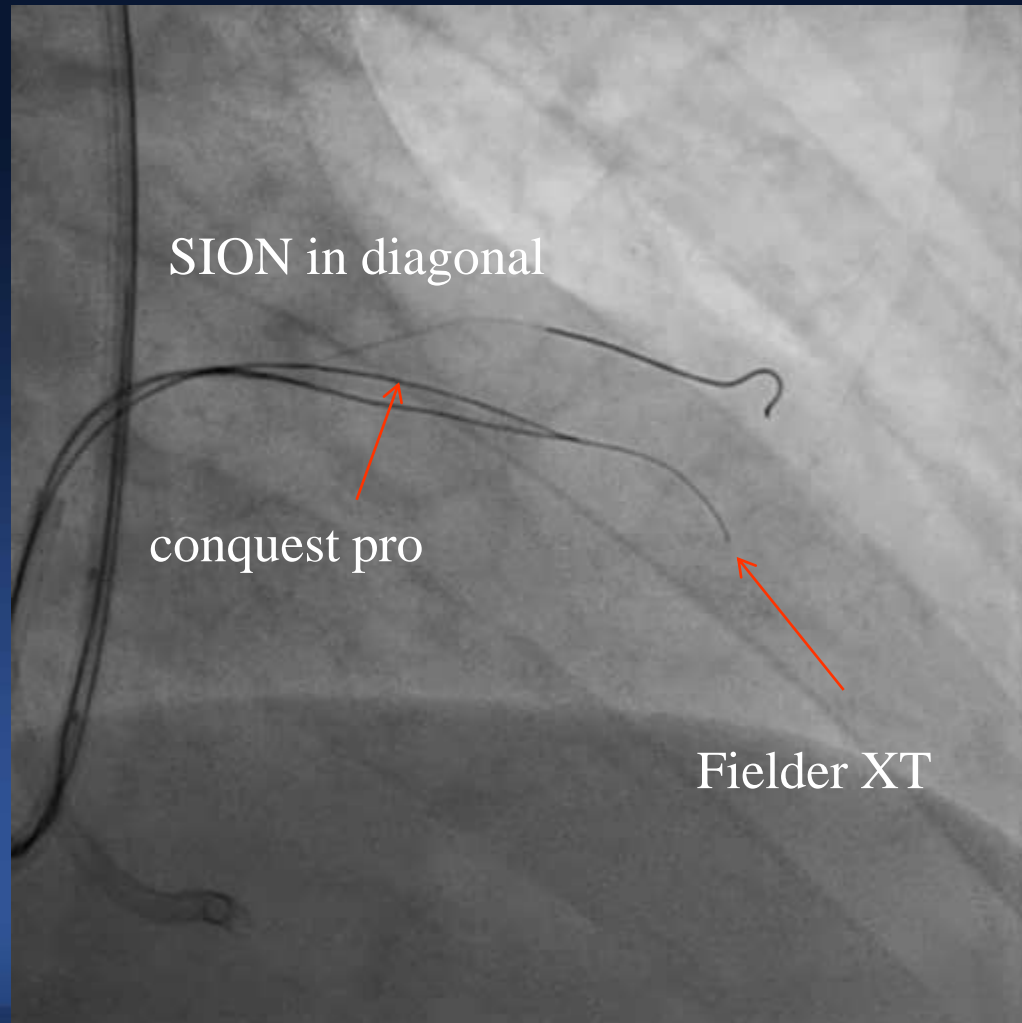
IVUS guided wiring



IVUS guided wiring

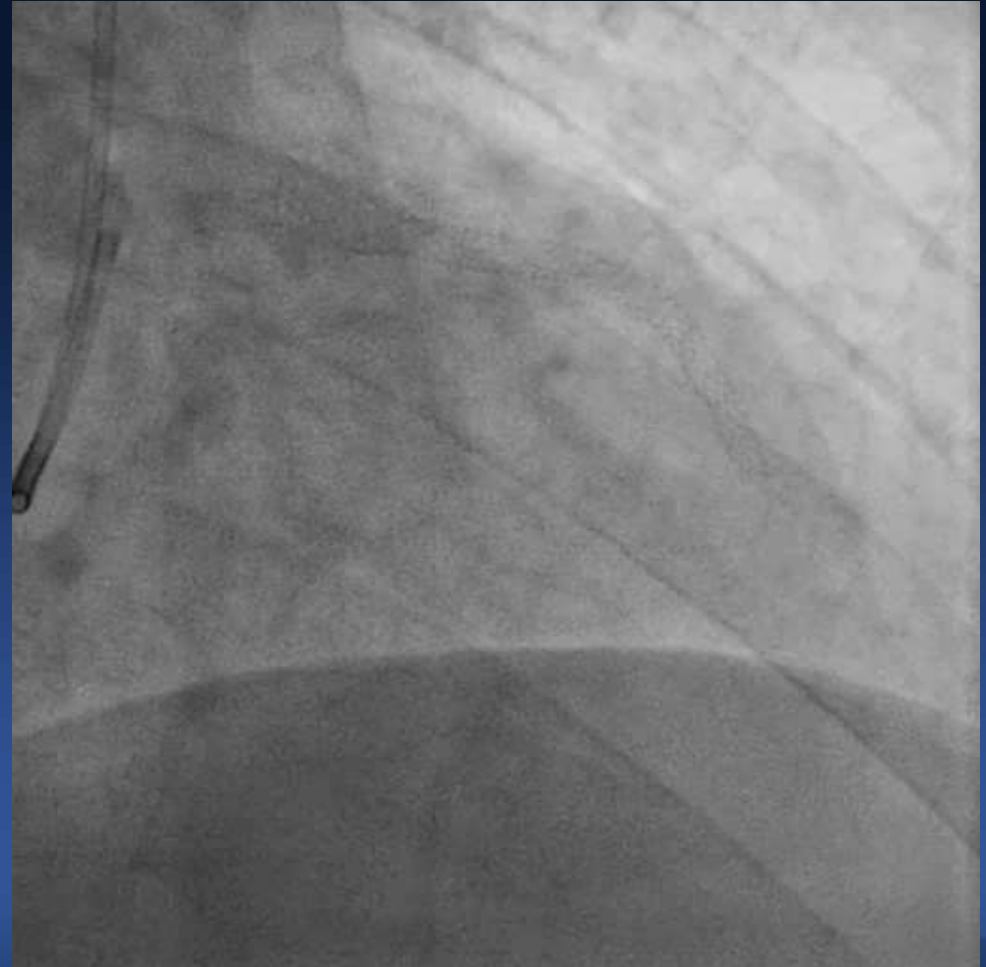
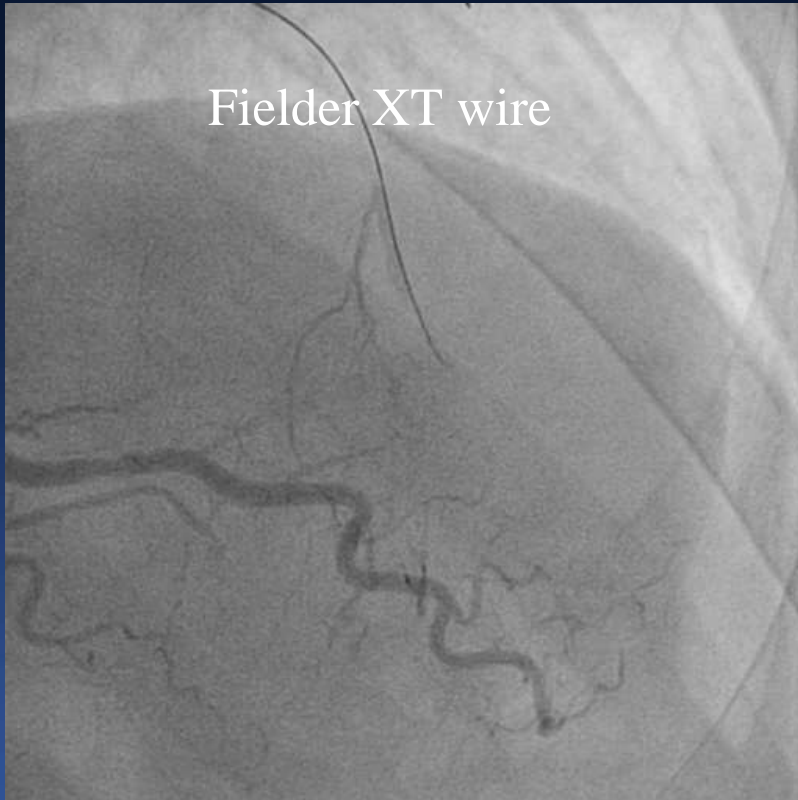


After corsair advance, wire down escalation from conquest to fielder XT



Wire in true lumen

FINAL ANGIOGRAPHY



Strategy options

Antegrade wire based approach

Single wire redirection

If suitable re-entry zone

**Dissection Reentry
(crossboss-stingray)**

Parallel wiring

IVUS guided wiring

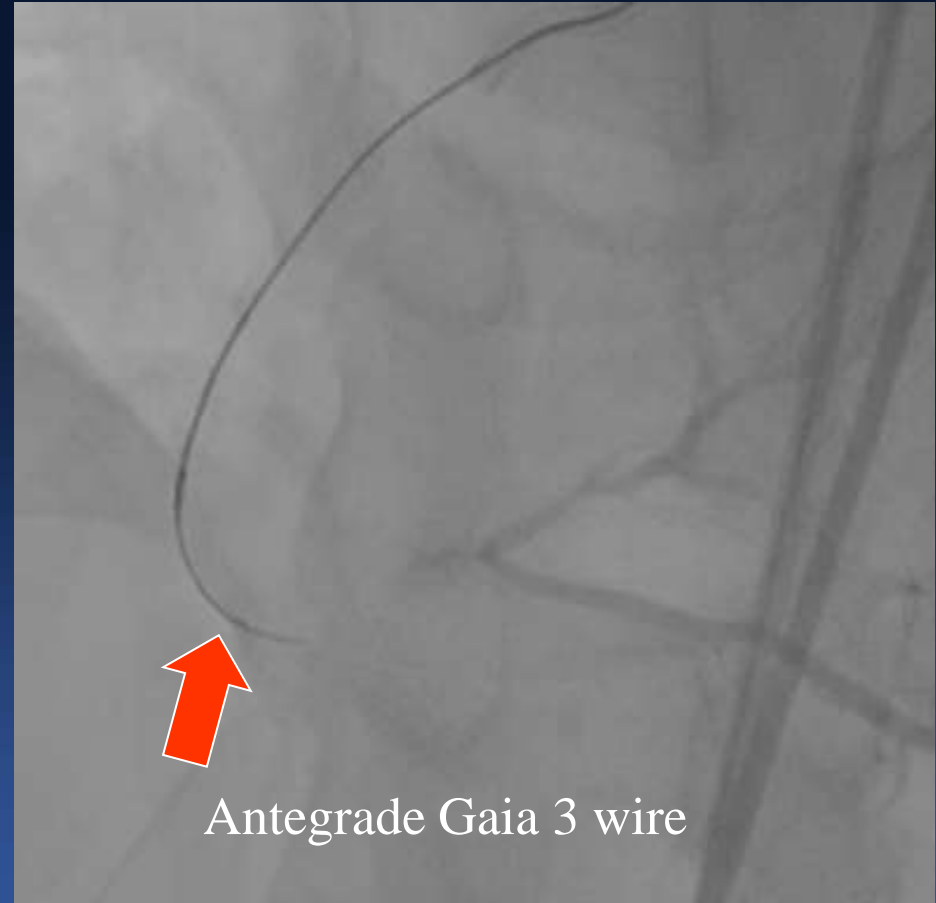
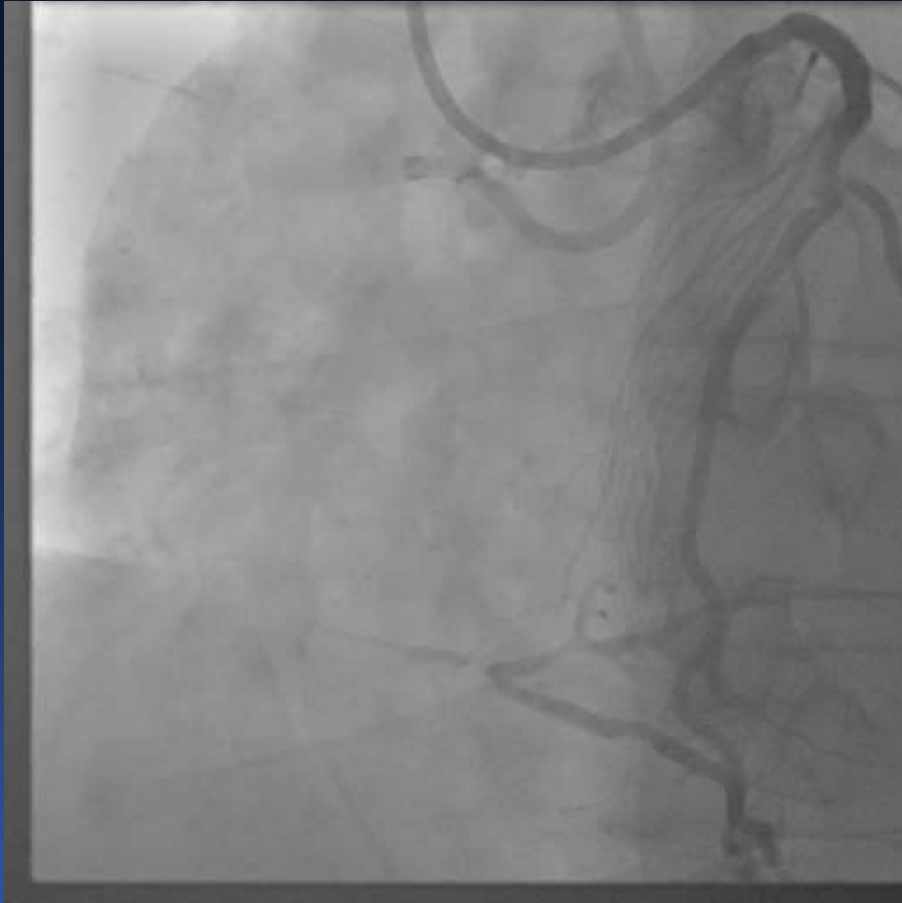
If interventional collateral

Retrograde approach

severe disease, calcification, or a bifurcation in the re-entry zone favors retrograde approach.

Indication for retrograde app

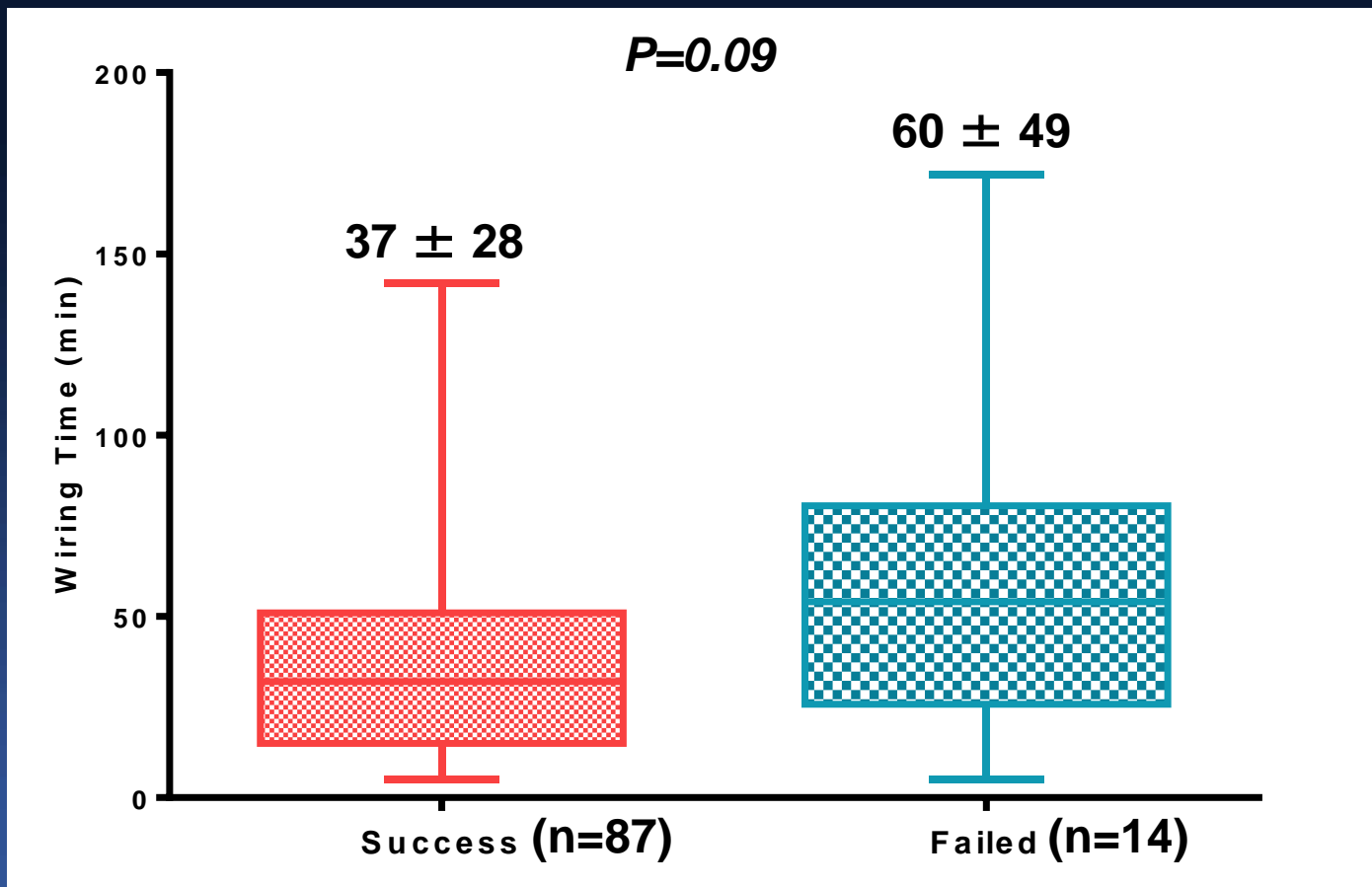
Unidentified antegrade wire deflection point



Antegrade Gaia 3 wire

Time to switch to retrograde

ASAN CTO registry



Conclusions

- Antegrade wire escalation is the preferred initial strategy in most cases, because of higher complications with the retrograde approach and preparation for retrograde approach
- Do not get “stuck in a failure mode” with antegrade wiring expending contrast, radiation, and time with little progress.
- Change of guidewire level (wire tip angulation or wire change, redirection) or strategy level (to parallel wire, stingray use, retrograde app, IVUS guided wiring) needs flexibility for eventual success.

Thank you for your attention