PCI for Chronic Total Occlusions

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CTO Strategies
Principles of Technique

- Contralateral angiography
- Multiple views
- Guiding catheter selection
- Wire/device selection
- Incremental stiffness (’drilling’) vs. ‘penetration’
- Parallel/Seesaw wiring, STAR
- IVUS
- Retrograde via collaterals, CART, Reverse CART

↑ Success vs.
↑Complications

CTO lesion assessment

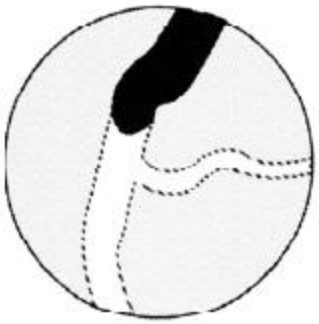
- Proximal and distal caps.
- Presence of micro channels.
- Calcification at entry and distal caps.
- Angulation and tortuosity.
- Side branch relationship.
- CTO length (>20 mm).
- Presence and quality of collaterals.
- Disease in donor and distal artery .
- Donor and CTO vessel anatomy for guide and guide wire selection.

Angiographic Lesion Morphology

Tapered Stump

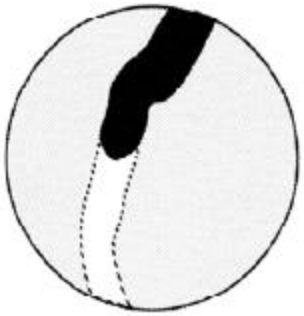
Functional occlusion

Stump absent



Total occlusion

Pre or Post-branch occlusion



Bridging collaterals absent

Occlusion at side-branch

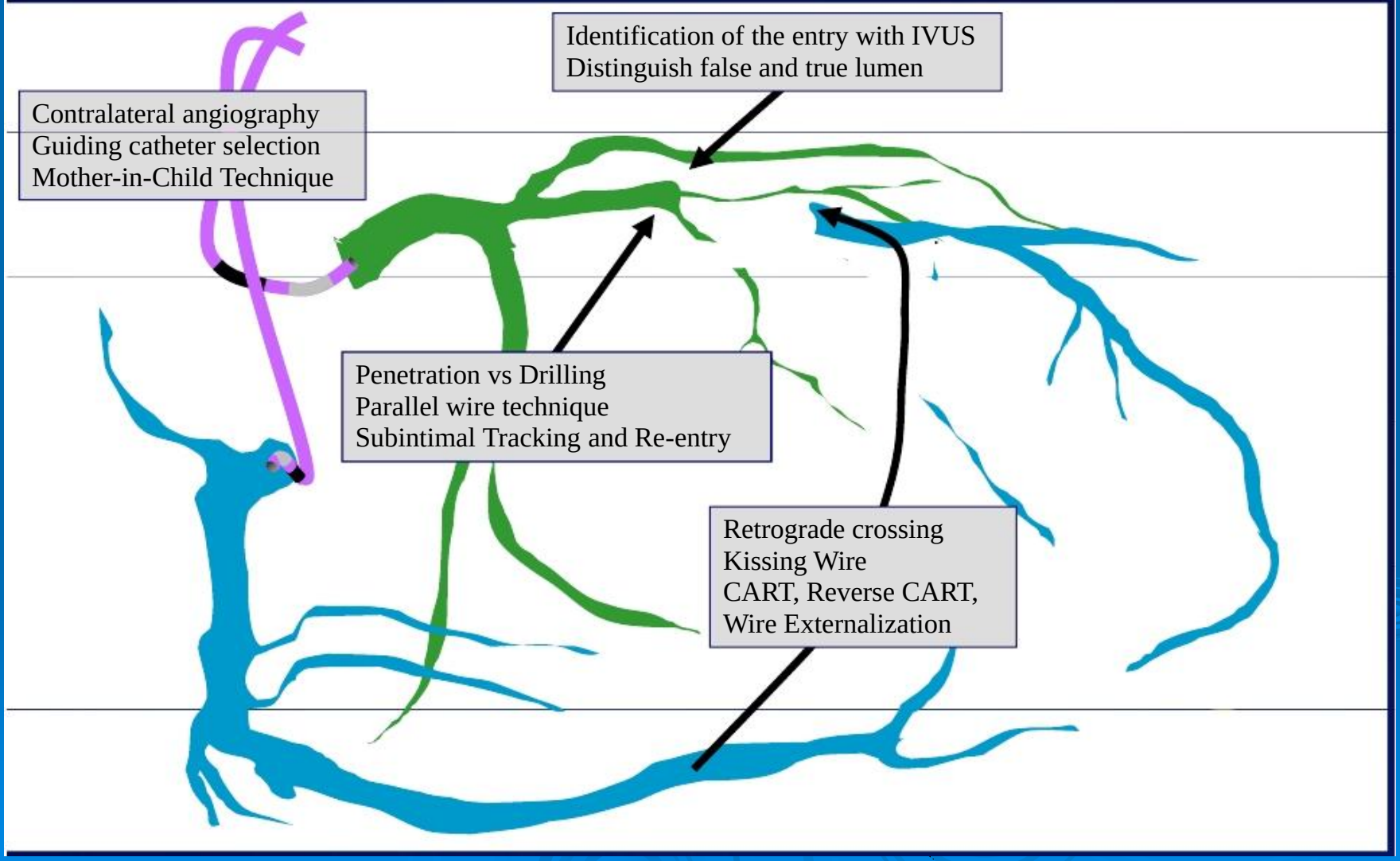
Bridging collaterals present

Favor Procedural Success

Does Not Favor Procedural Success

Principles of CTO Revascularization

Advanced Strategies and Technique



Basic Concepts of Antegrade CTO PCI

- **Antegrade Goal**
  - ***Move gear safely and quickly to distal cap to focus on true lumen entry or…***
  - ***Move gear beyond distal cap to focus on reentry***

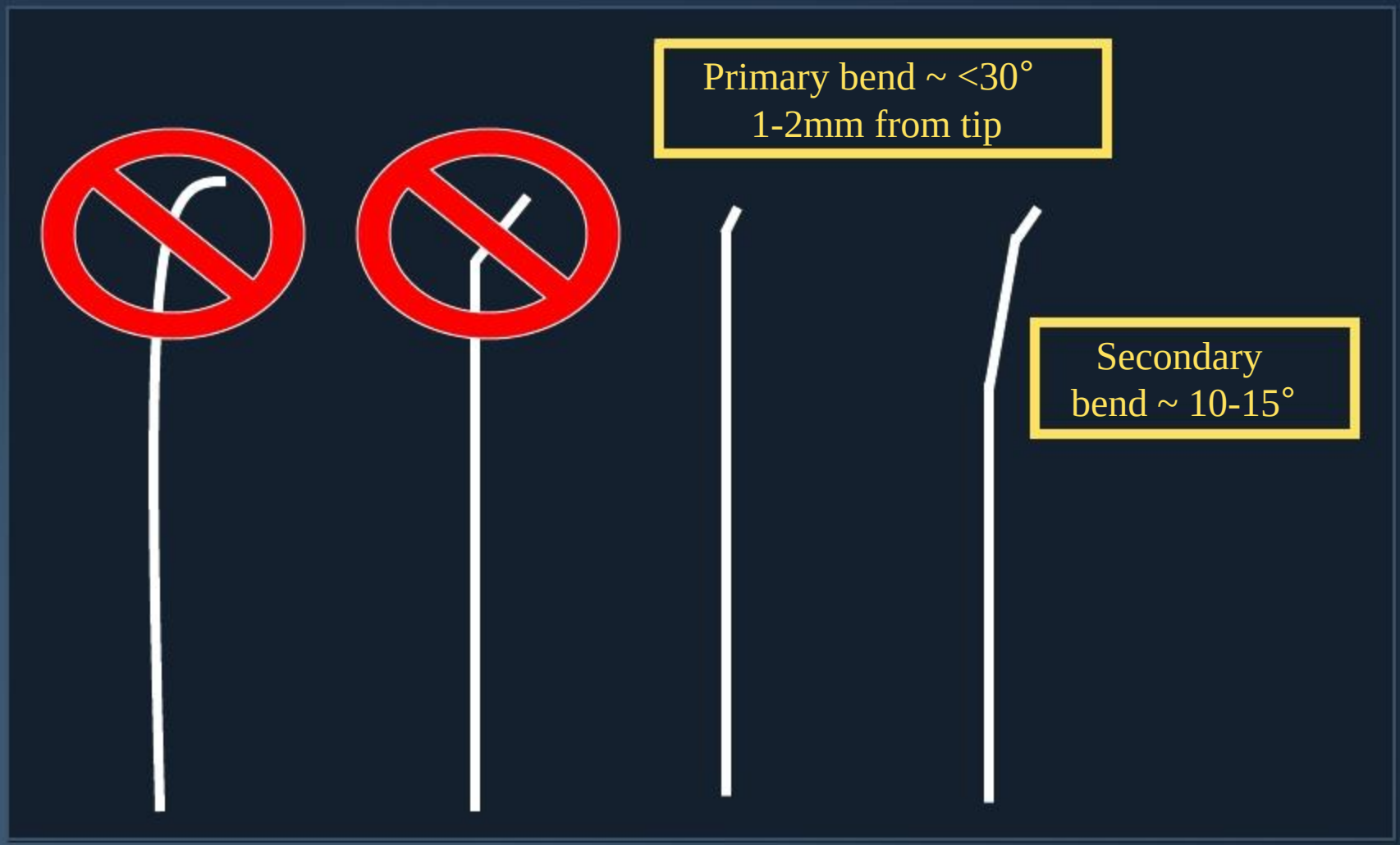
Which wire and when?

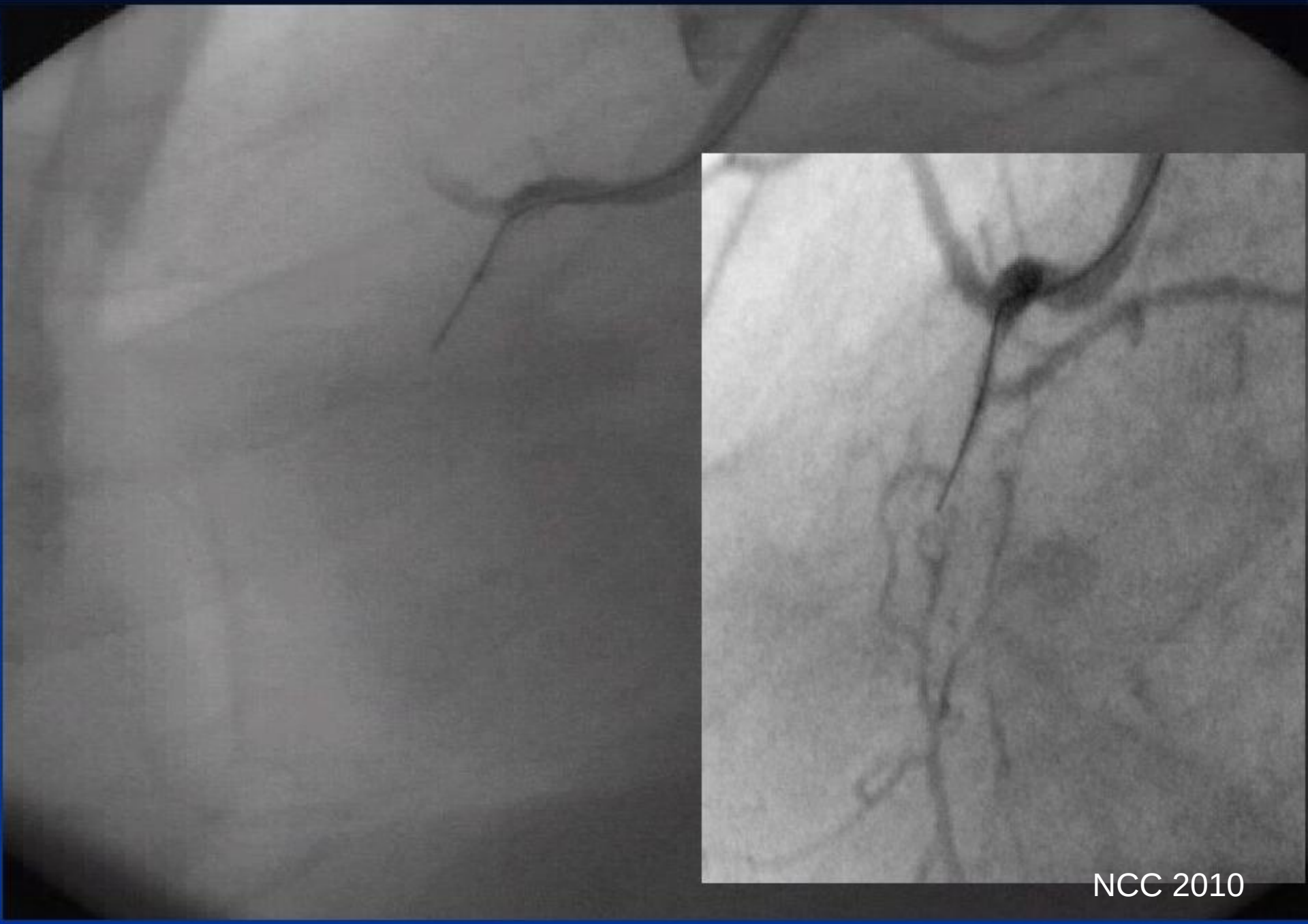
- Detailed study of cine angiogram- Micro-channels present in 30-50% cases

Micro-channels visible	Severe fibro calcific segment
Plastic jacket or hydrophilic wires **-Fielder XT, Fielder FC, & Fielder** **-Pilot 50** **-Terumo runthrough NS**	**Stiff extra support wires** **-Miracle series 3, 4.5, 6, 12 gm** **-Cross IT 100, 200, 300** **-Intermediate wires** **-Conquest pro, 8/12 gm**

Always start with the soft wires as micro-channels are sometimes not visible and quickly upgrade to stiffer wires in a step up strategy.

CTO Guidewires – Tip Shaping



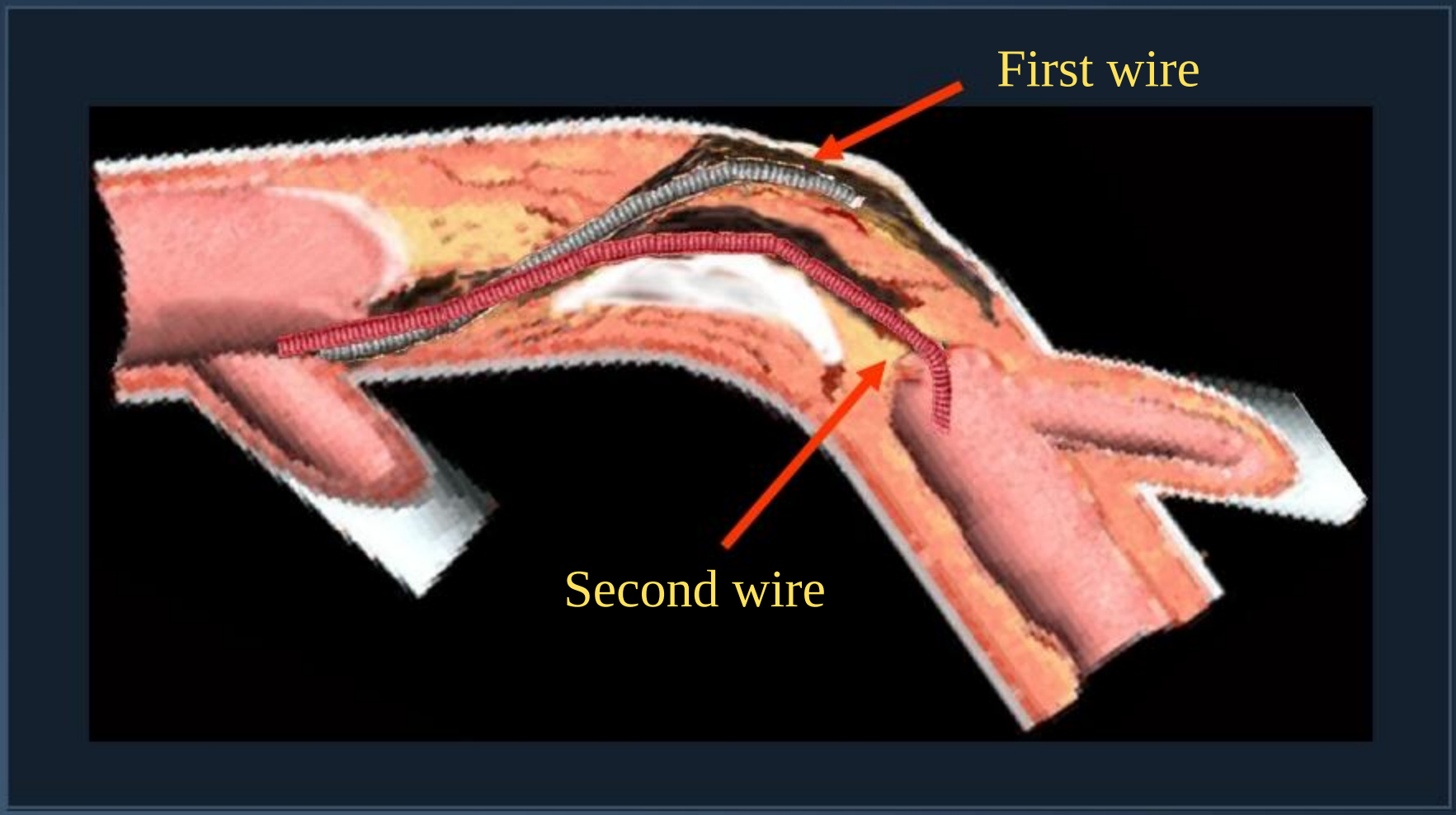

NCC 2010

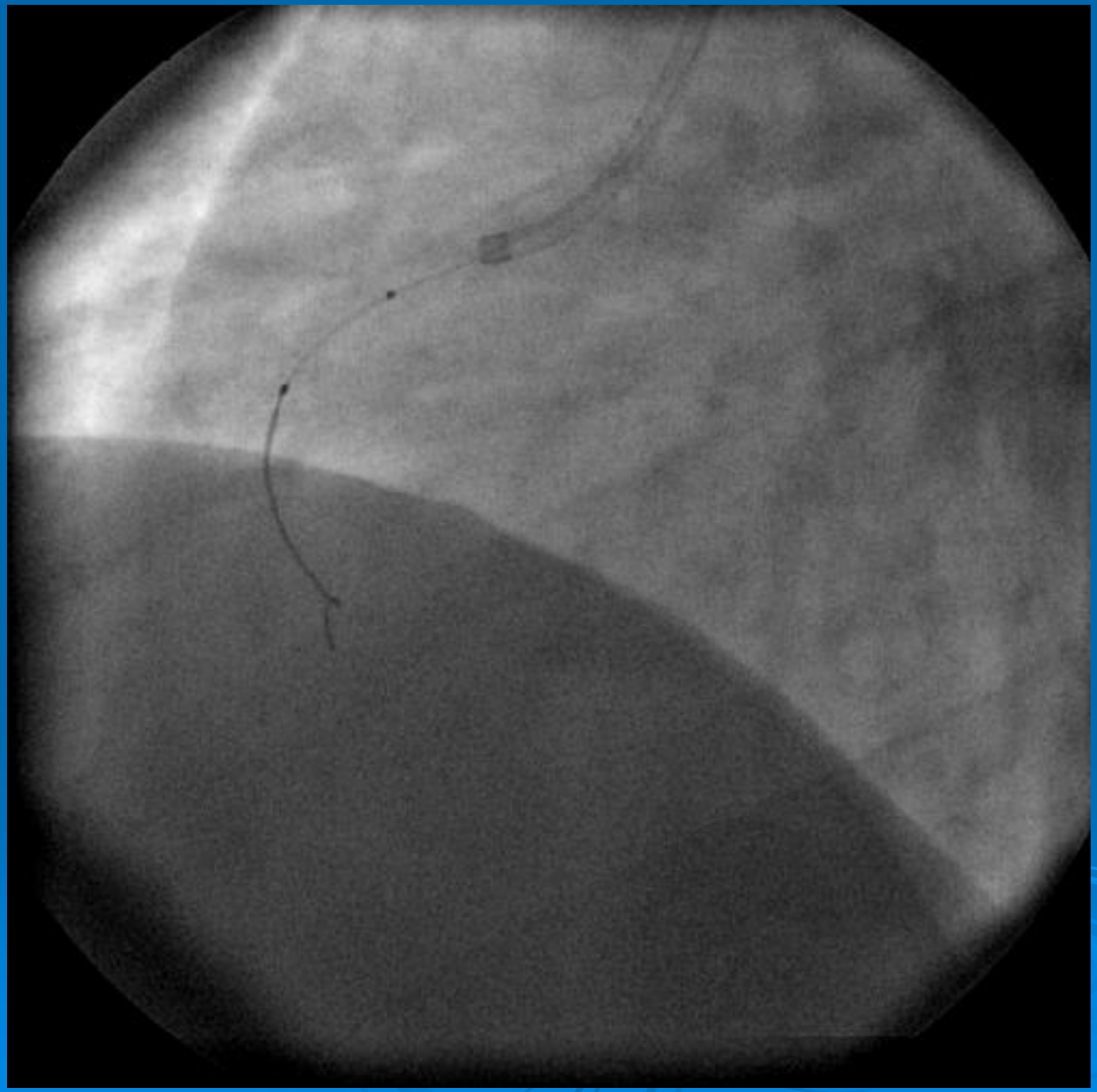
PCI for CTO
When you can't cross with wire

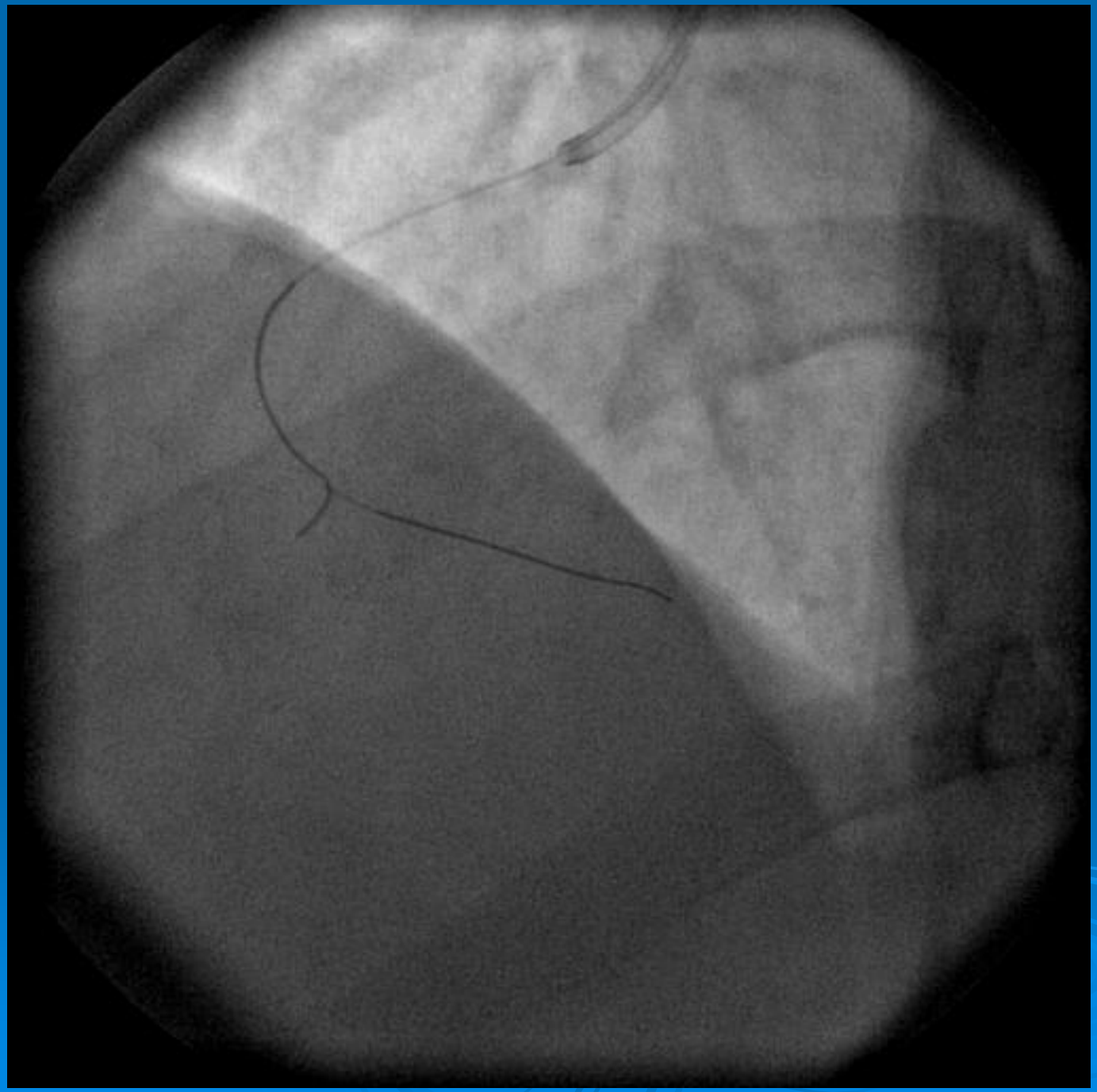
- Advance wire techniques.
- Advance support with guides, mother and child, anchor balloons, microcatheters.
- IVUS guidance.
- Switch to Retrograde approach.

Antegrade CTO Wiring

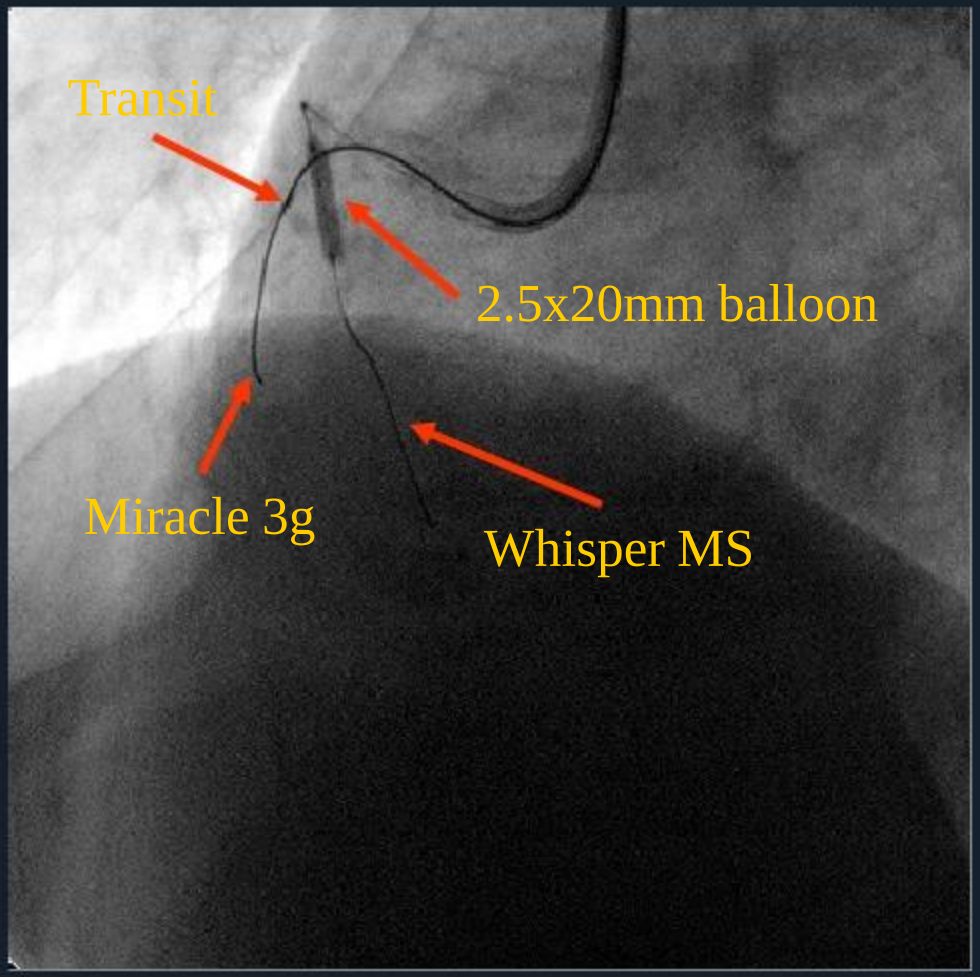
Parallel wire technique



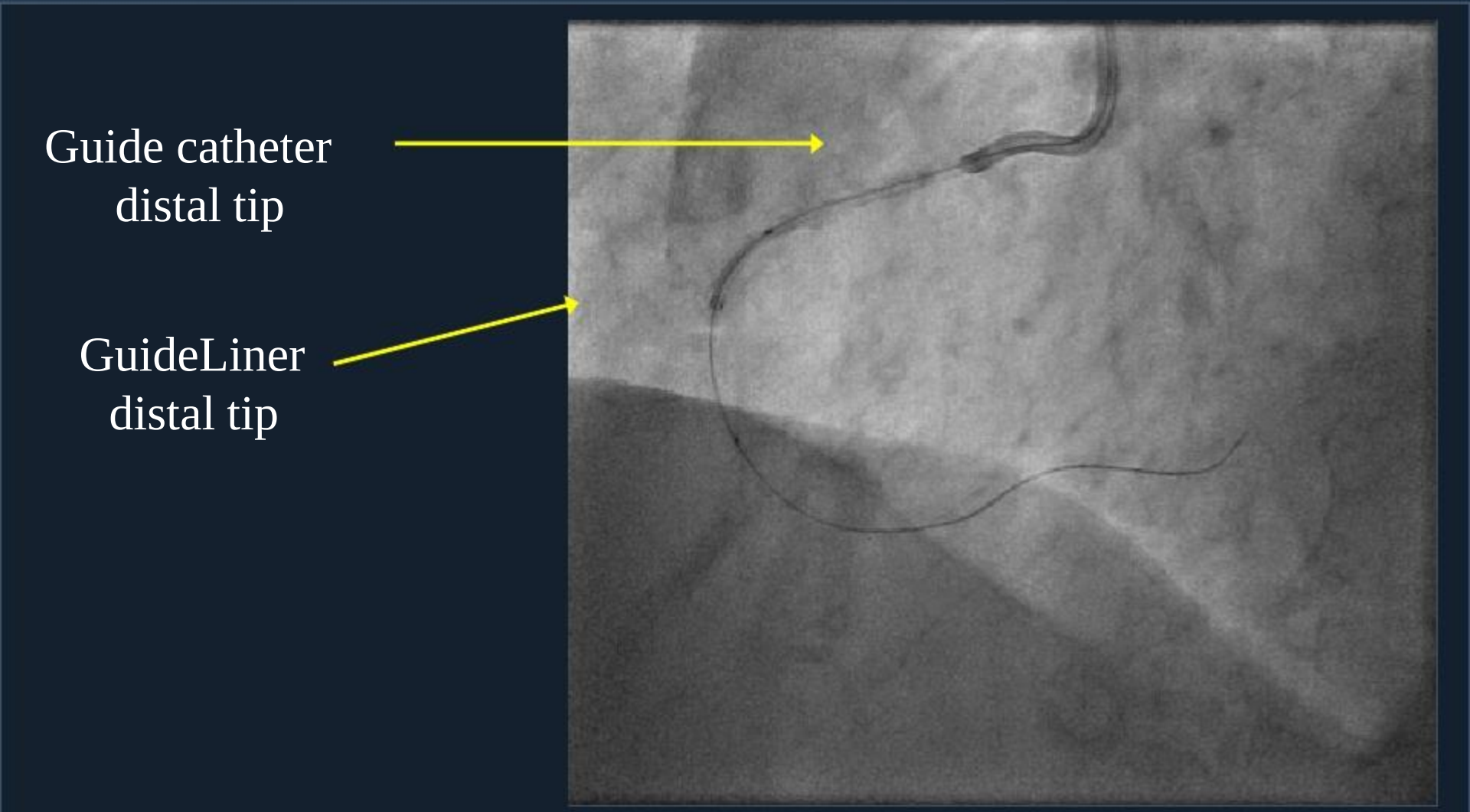




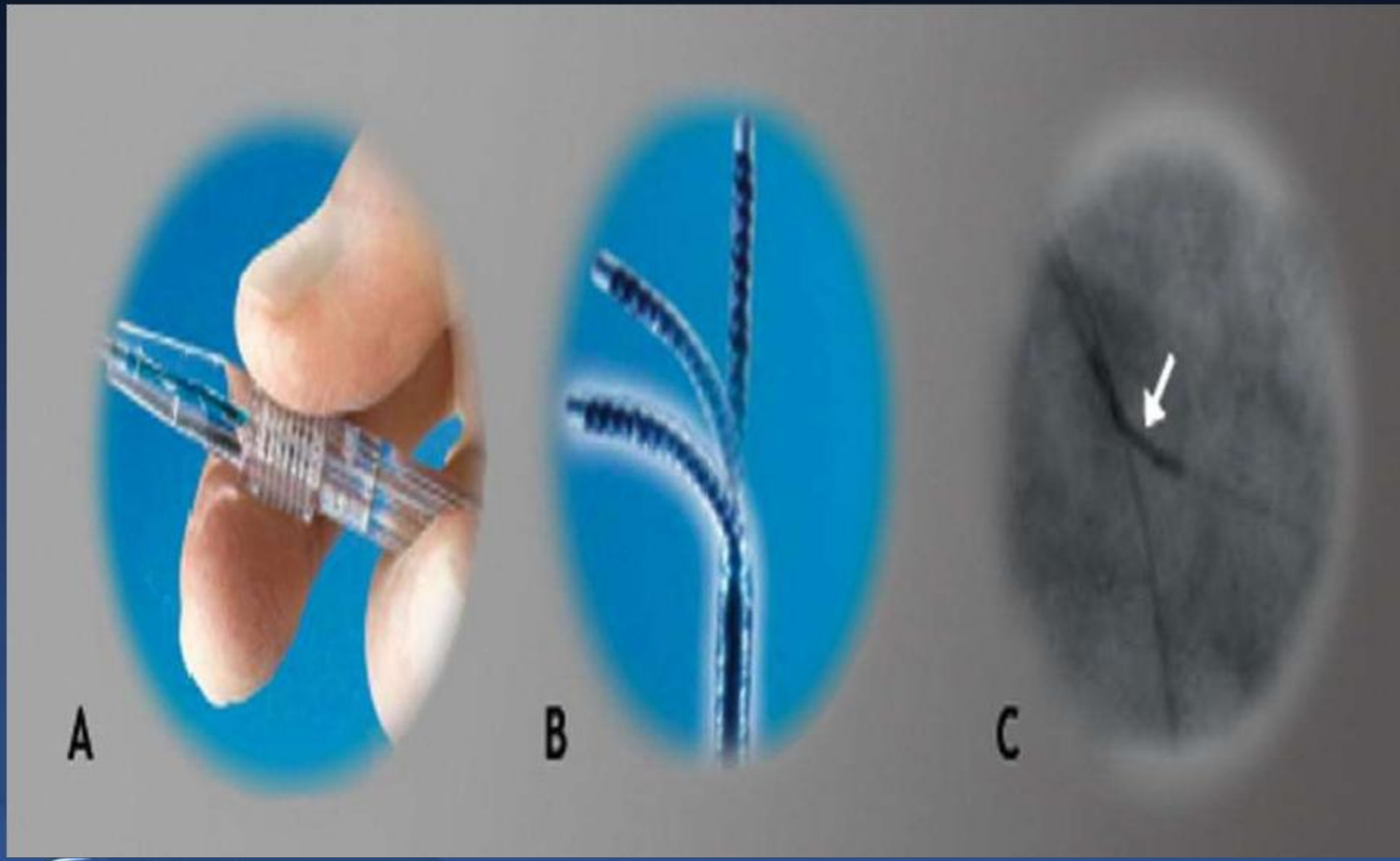
Anchor Technique



Mother Child Support with Guideliner



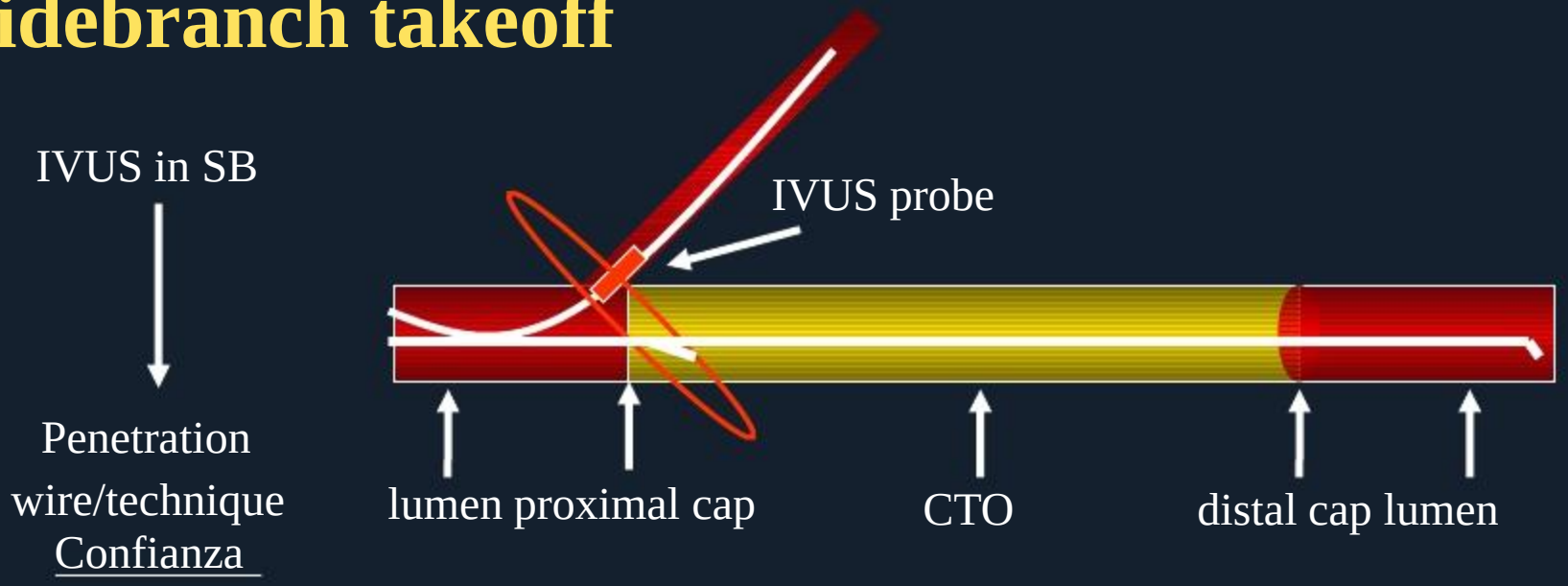
St. Jude Medical Venture Wire Control Catheter



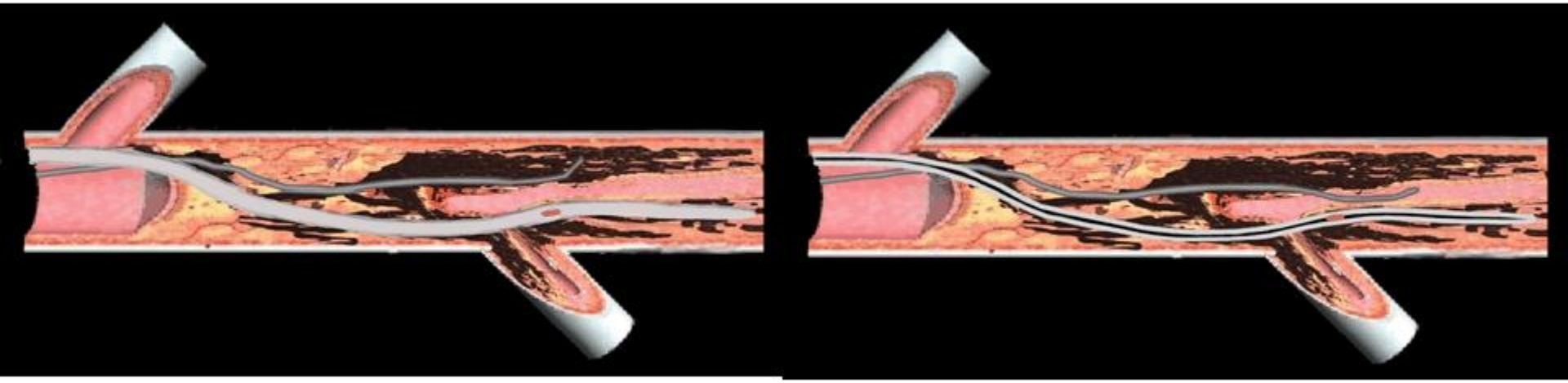
Antegrade CTO Wiring Techniques

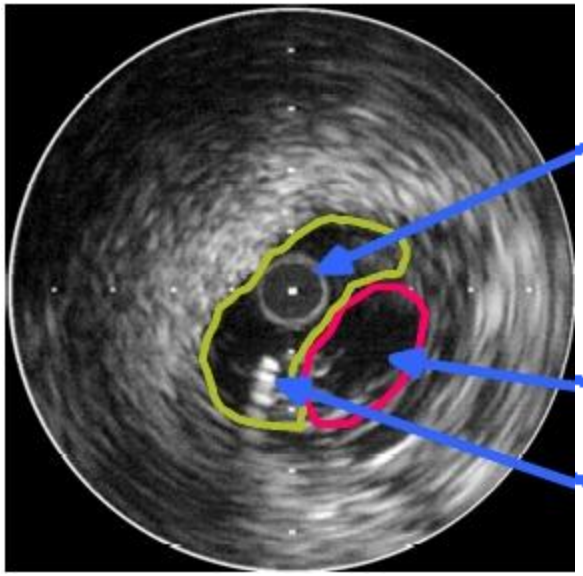
IVUS guidance

Blunt occlusion at sidebranch takeoff



Alternatively, PTCA balloon in SB to help direct wire into proximal cap ---"open sesame"

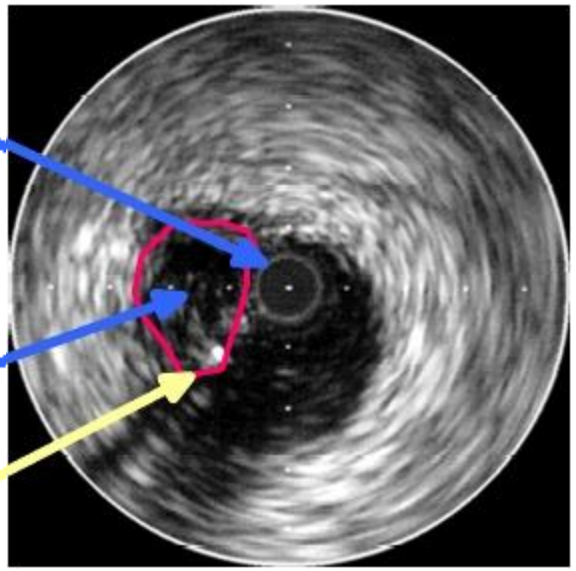




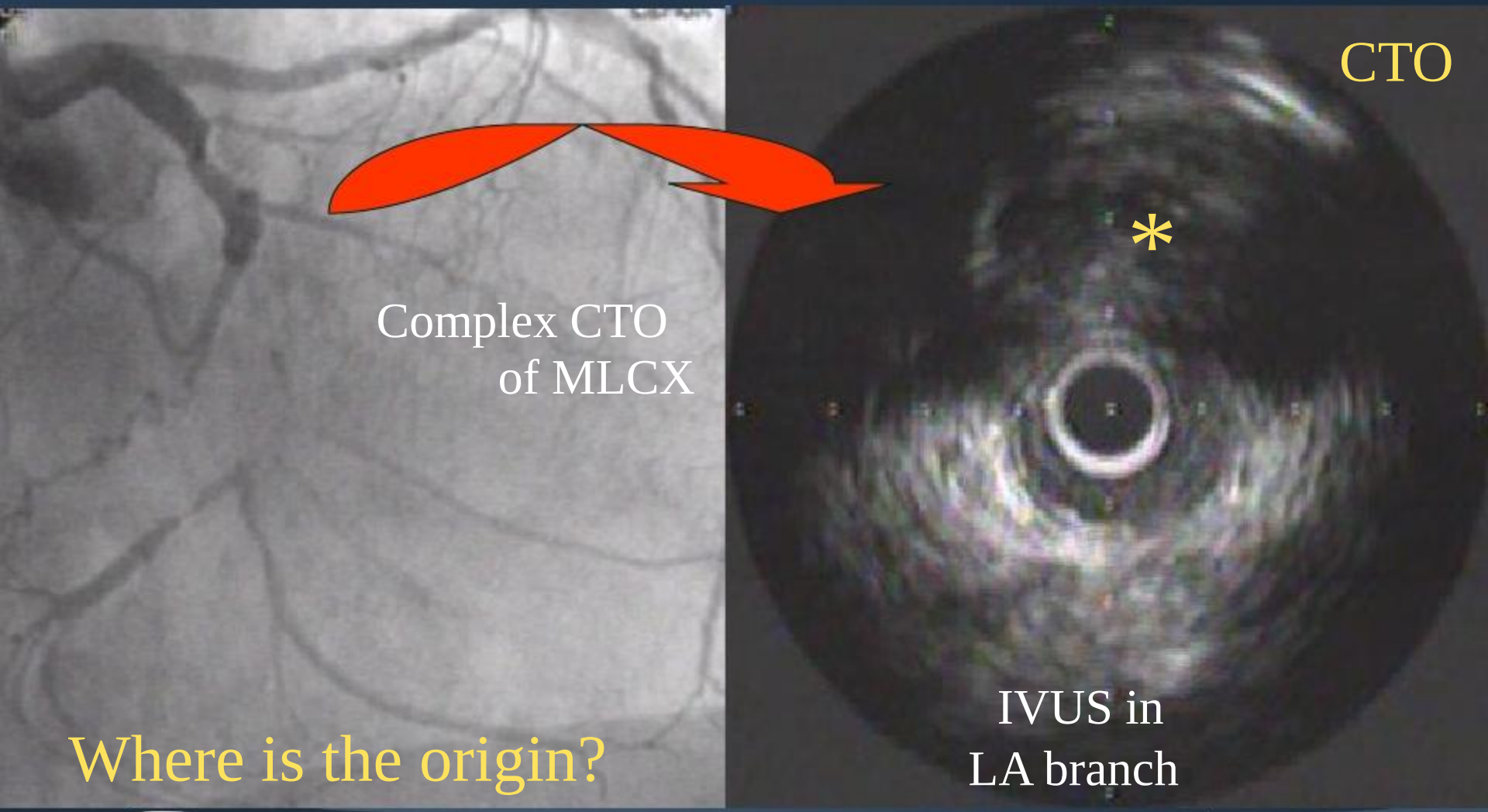
IVUS in
false lumen

True lumen

Guidewire



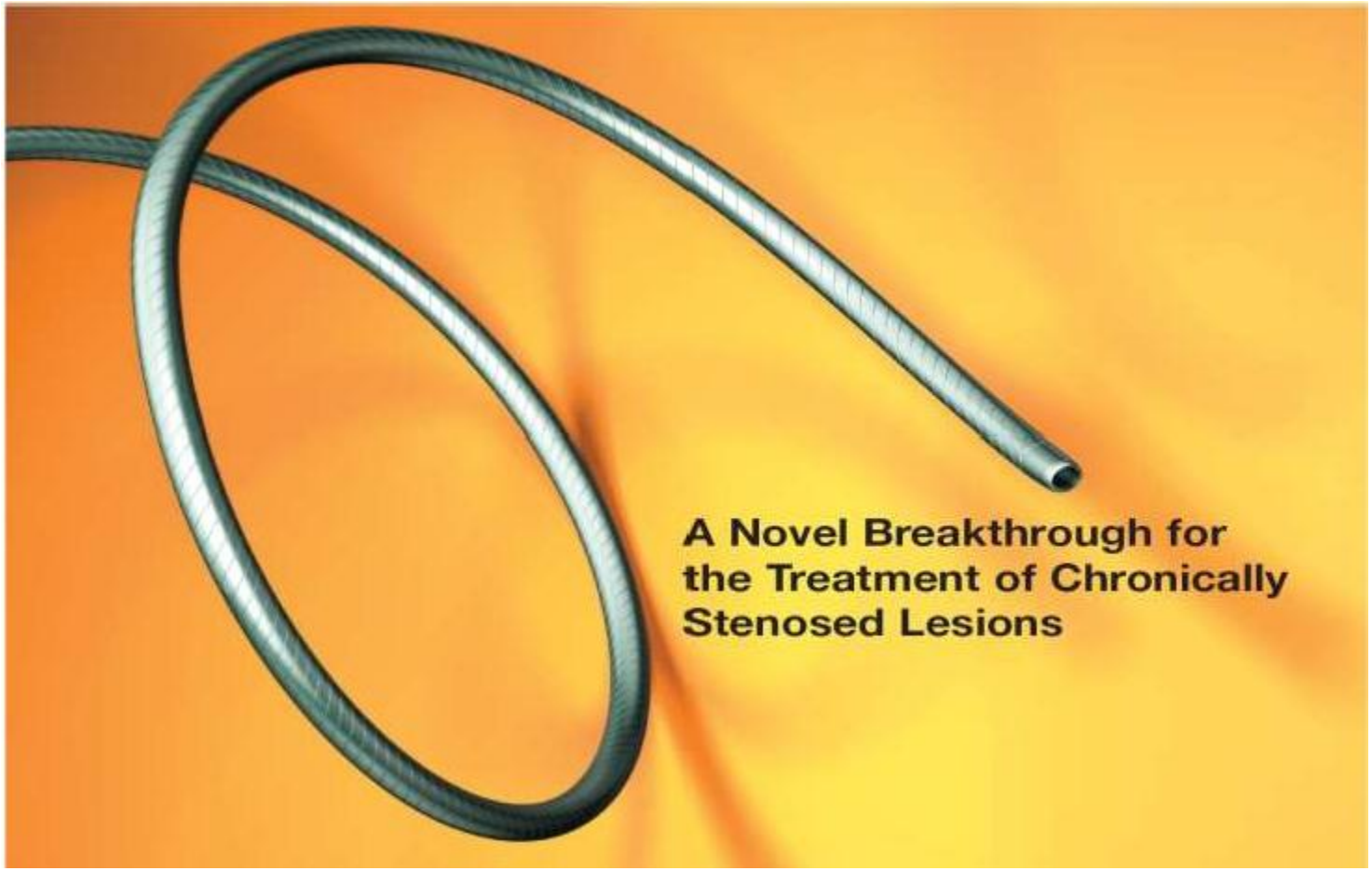
IVUS Guided Technique for Finding the CTO Entry Point



PCI for CTO
When you can't cross with balloon.

- Buddy wire, Low profile balloons.
- Guide support, anchor balloons.
- Crossing devices
  - Tornus catheter or Corsair/Fine cross
  - Laser.
  - Rotablator
- Switch to retrograde approach.

ASAHI TORNUS™

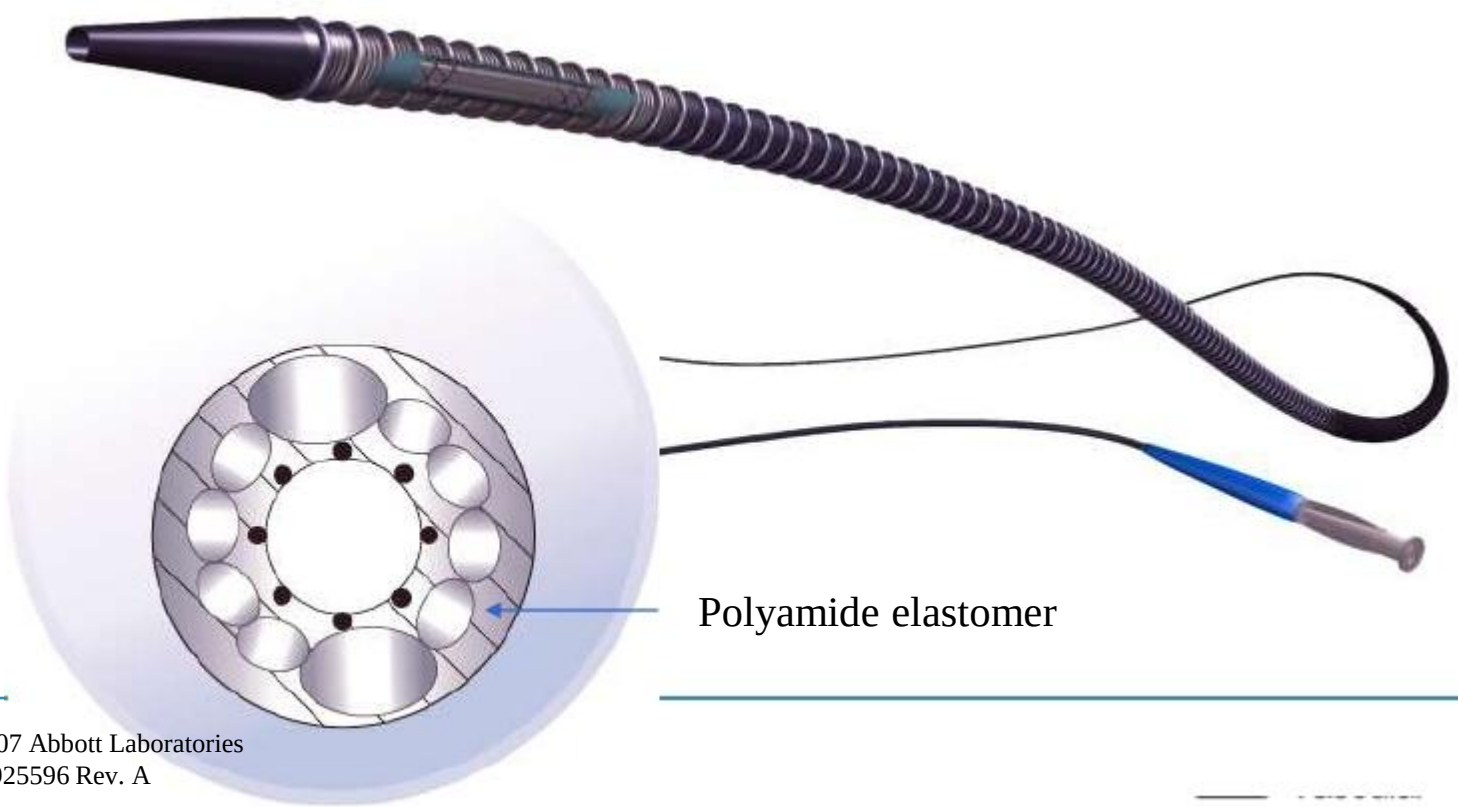


AP2925596 Rev. A

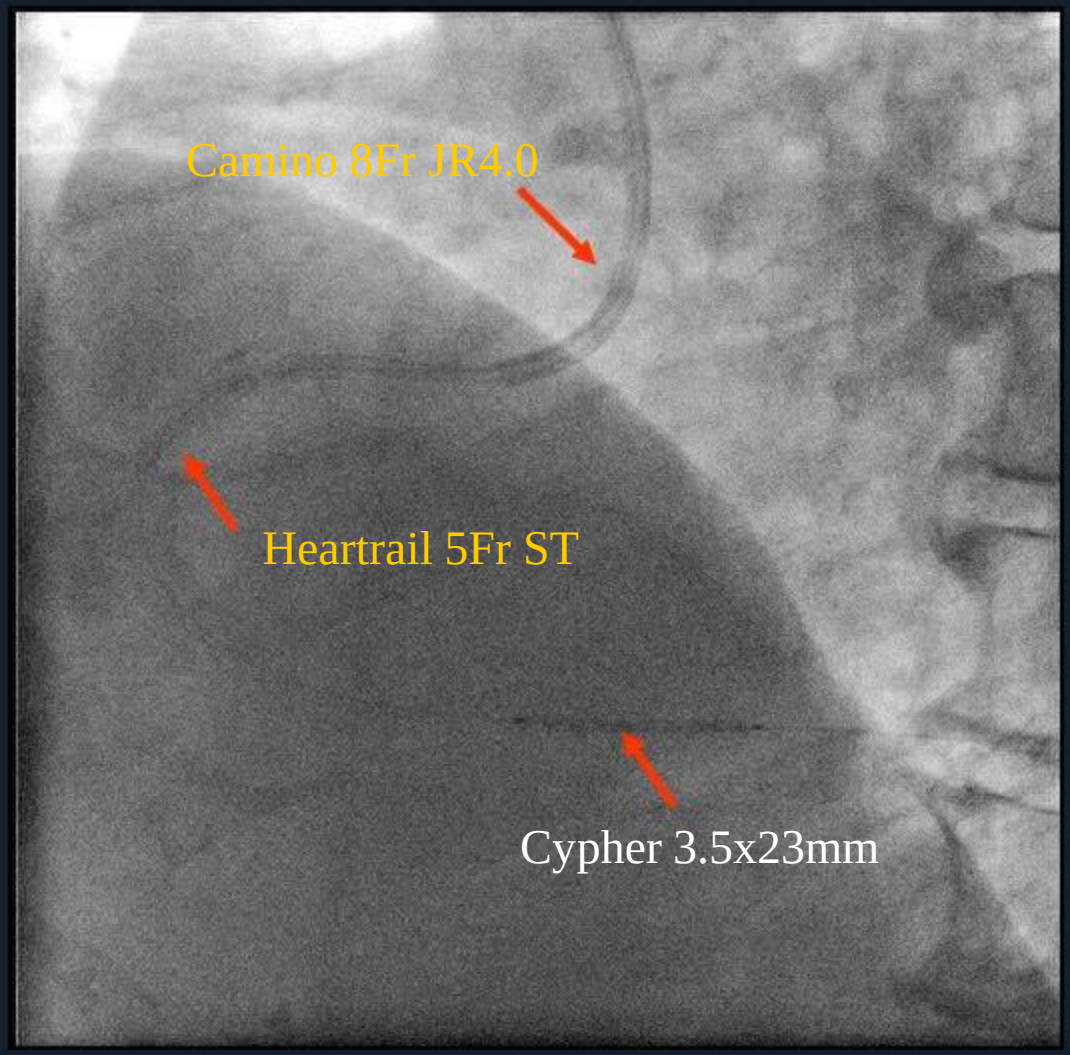
Asahi Corsair

For shaft rigidity

After the screw head structure, the grade and the thickness of the polyamide elastomer resin are gradually increased to provide optimal rigidity and pushability at the proximal shaft.



Mother-Child Catheter Technique



Basic Steps in retrograde technique

- Simultaneous bilateral angiograms.
- Identify collateral channels.
- Wiring and device tracking thru collateral channel.
- Reach the true lumen distal to CTO.
- Cross the CTO – Direct/CART/ Reverse CART.
- Retrograde wire in proximal segment.
- Externalise the guide wire / antegrade wire.
- Dilate and stent the CTO.

Suitable equipment

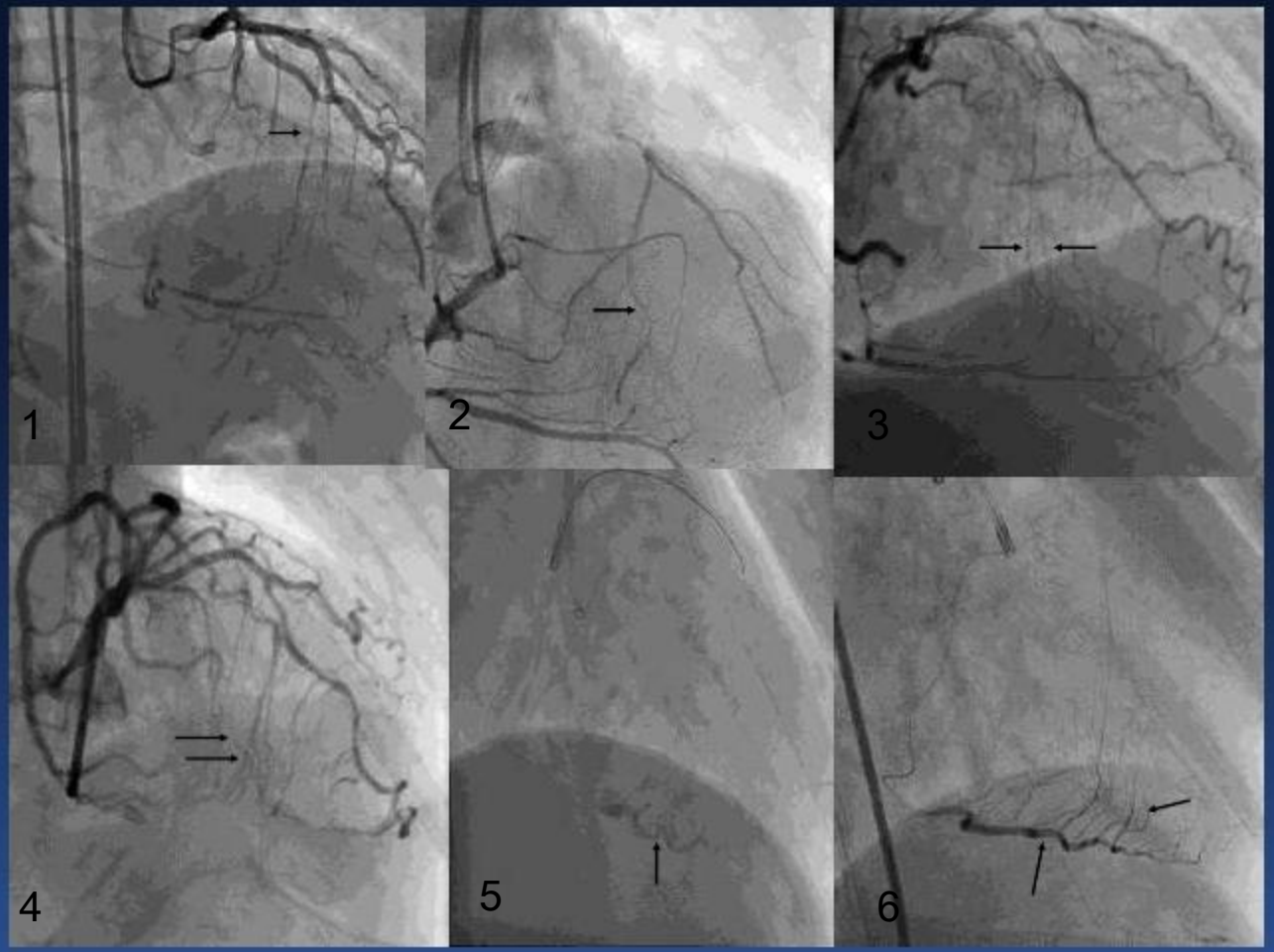
- Bi-femoral, Bi-radial or Radio-femoral approach.
- 7Fr/8Fr guides.
- Short (90 cms) guide for donor artery.
- Fielder FC, Fielder XT or stiffer wires.
- Corsair or Fine cross catheters.
- Appropriate anticoagulation (ACT>300). Check every 30 mins.

PCI for CTO
Collateral channels for retrograde approach

- Septal channels.
- Epicardial channels.

Patterns of Septal Collaterals

1. < 90 degree
2. >90 degree
3. Corkscrew
4. Corkscrew
5. Recepient vessel>90
6. >90 R Vessel



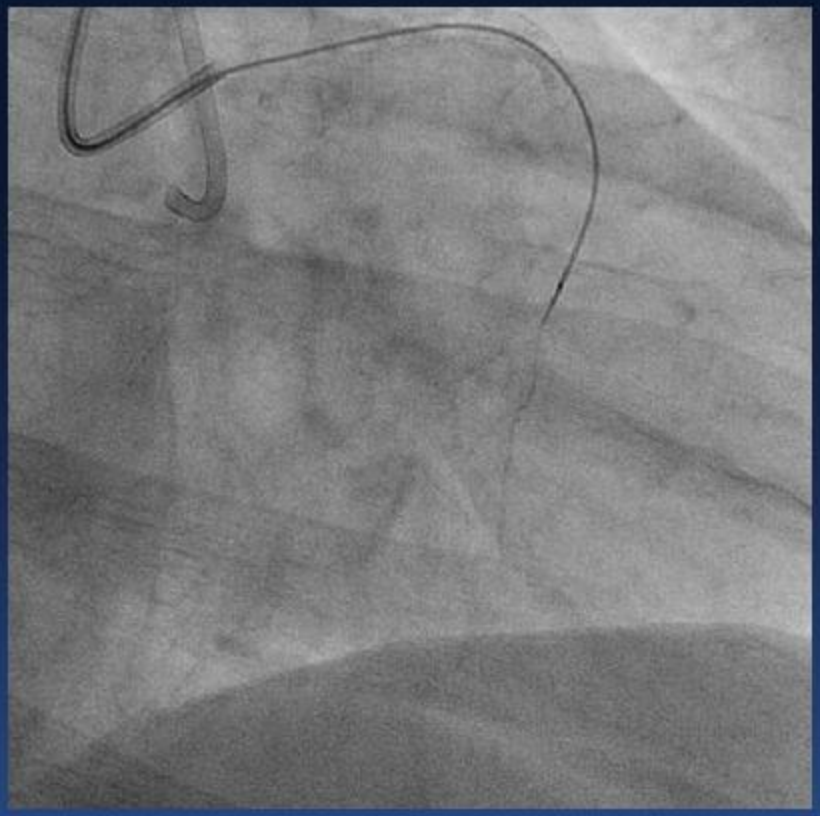
Patterns of Epicardial channel

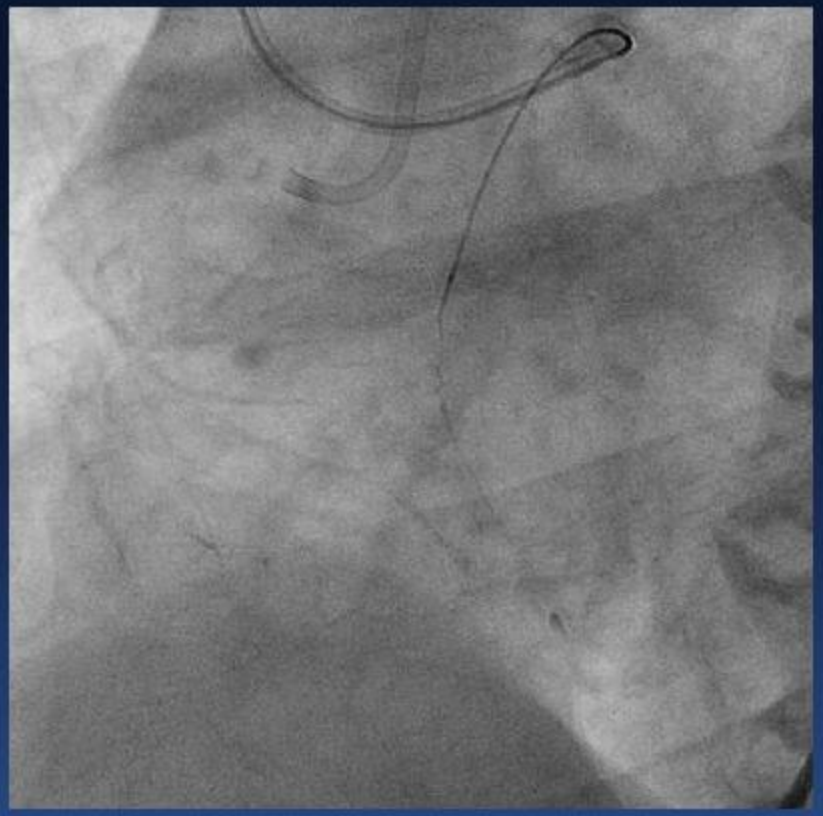
- **Usually very tortuous, Large, visible.**
- **Easier to cross with Corsair.**

PCI for CTO
Wire handling

- Slow rotation and advancement of wire.
- Stop if PVC.
- Wire migration into side branch.
- If in doubt, advance microcatheter and pull out the wire and inject 2 cc of dye.
- Immediate wash out of dye.
- Contrast hangs-- chose new channel.

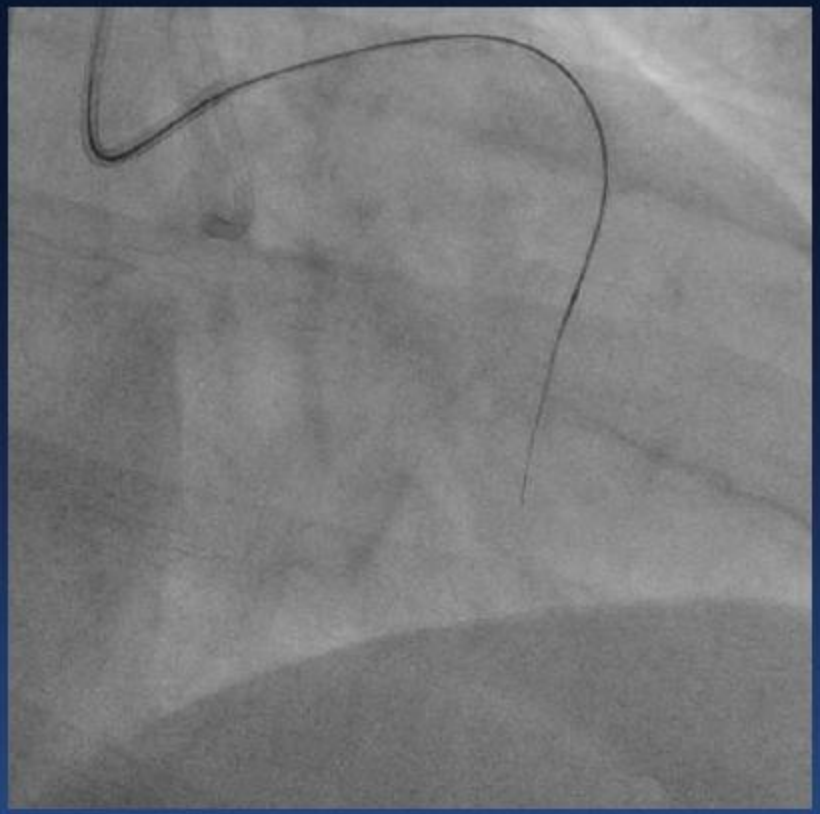
Collateral channel isolation

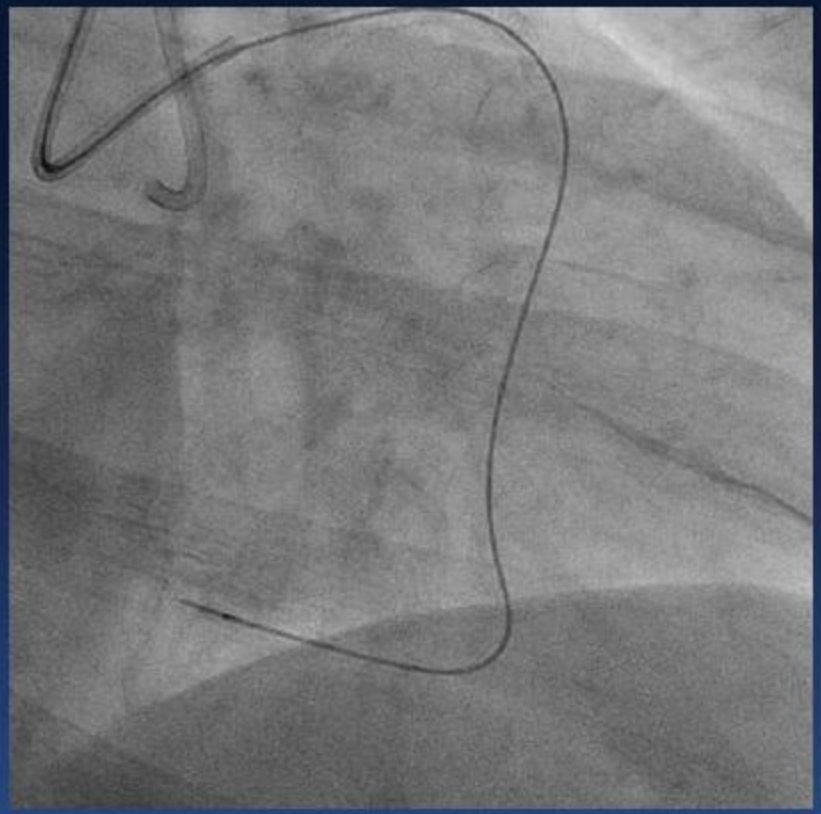




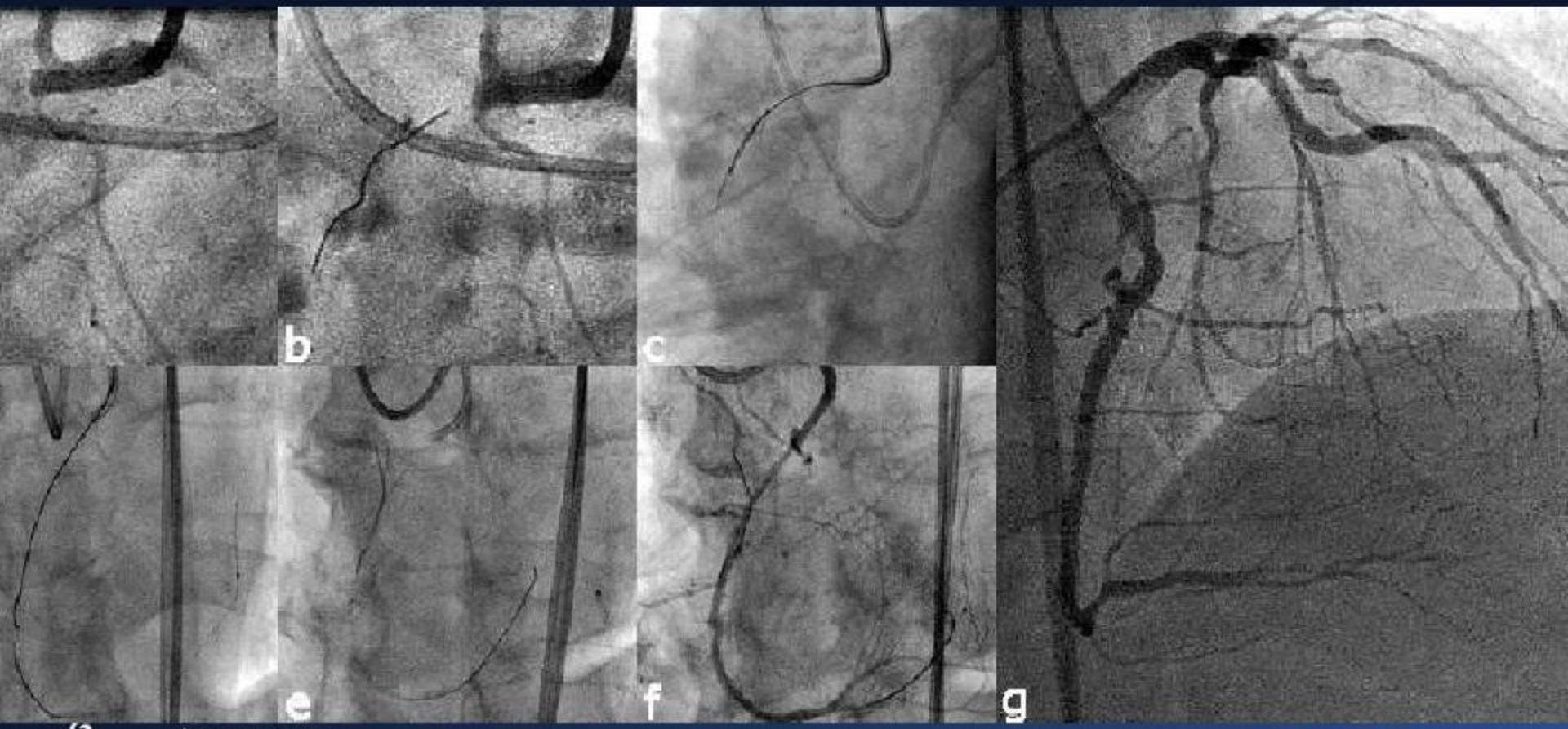
- Selective CC angiography to assess the course and morphology
- Wires: Fielder FC, Fielder XT with Corsair/ Finecross support

Wiring the collateral channel

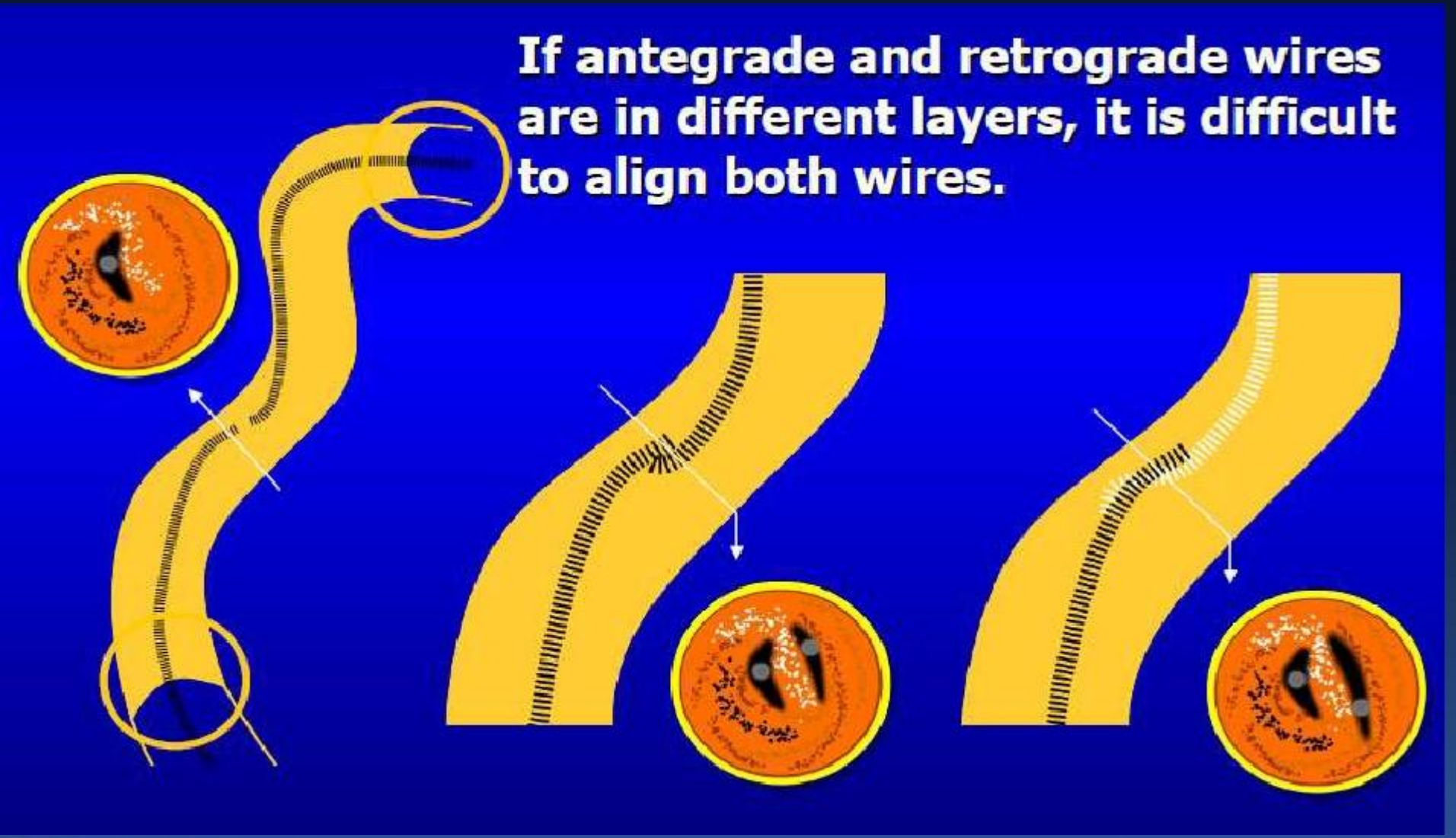




Kissing wire technique

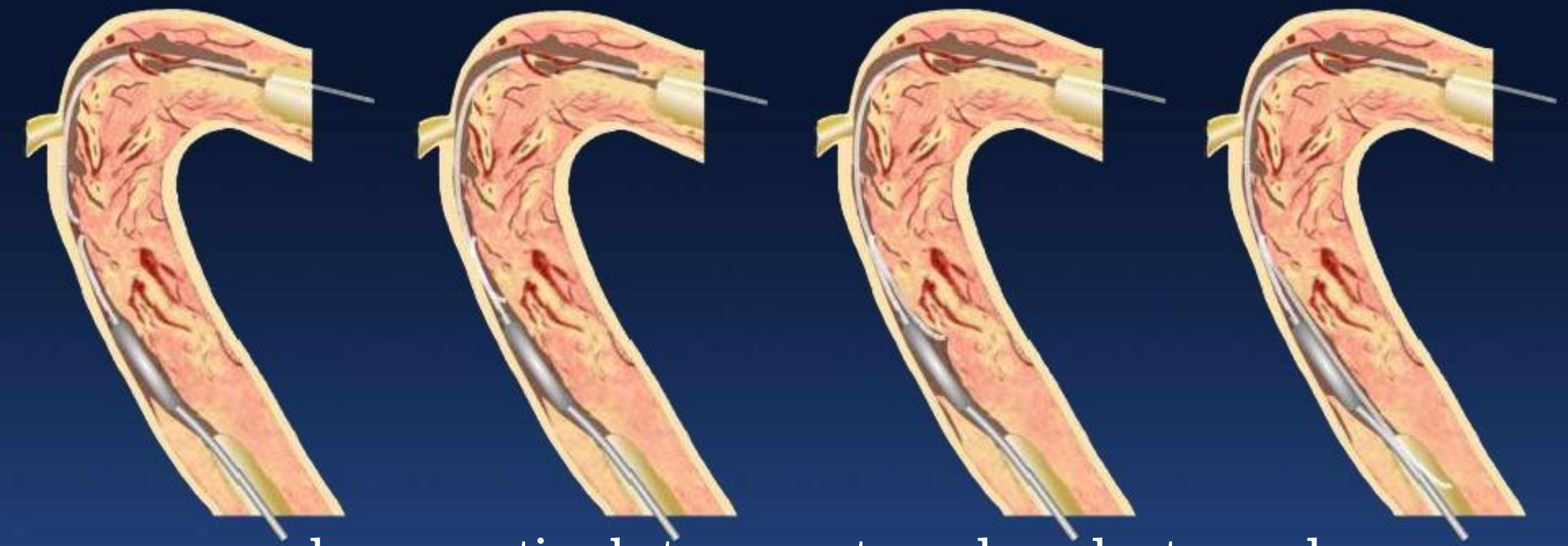


Limitation of Kissing wire



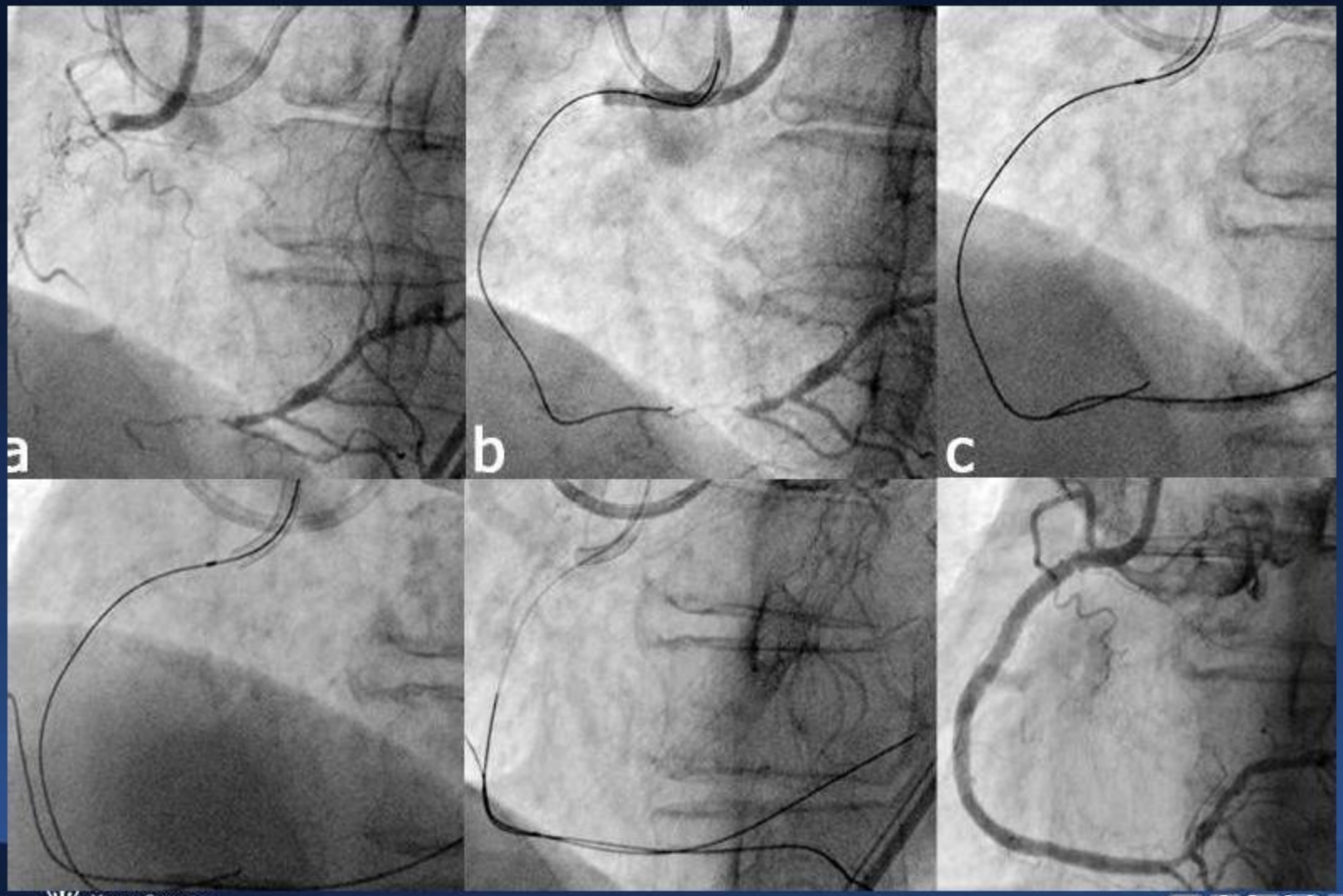
Concept of CART™ technique

(Controlled Antegrade and Retrograde subintimal Tracking)

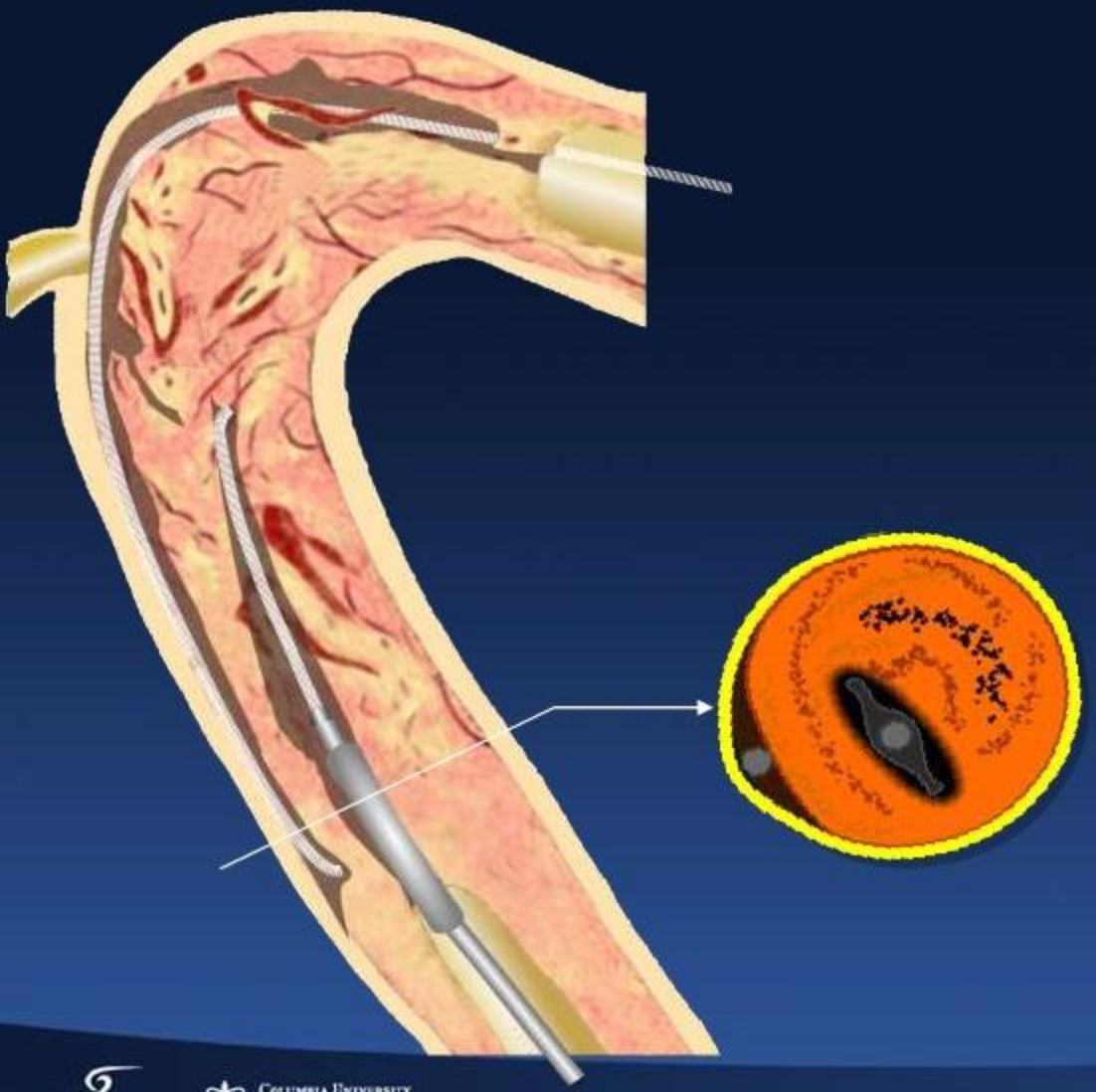


- **make connection between antegrade and retrograde subintimal space utilizing** behavior of subintimal dissection.
- **antegrade wire** automatically **gets into distal true lumen.**

CART Technique



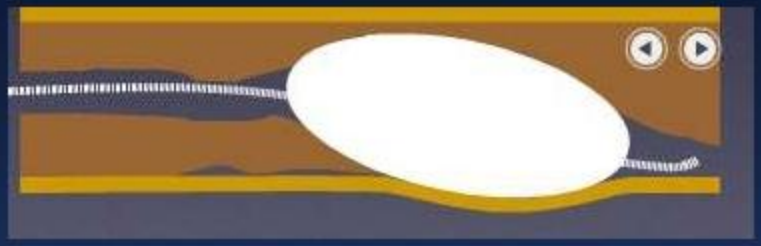
Limitations of CART



- Retrograde wire usually gets into plaque, not into subintima at proximal part of distal CTO end so that retrograde balloon is inflated at intra-plaque.
- If antegrade wire is advanced into subintima at the site of retrograde balloon dilation, it is difficult to direct the antegrade wire to the true distal lumen, similar to a difficult situation in the antegrade approach.
- Collateral dilatation is needed to pass balloon.

CONCEPT OF REVERSE CART

a



b

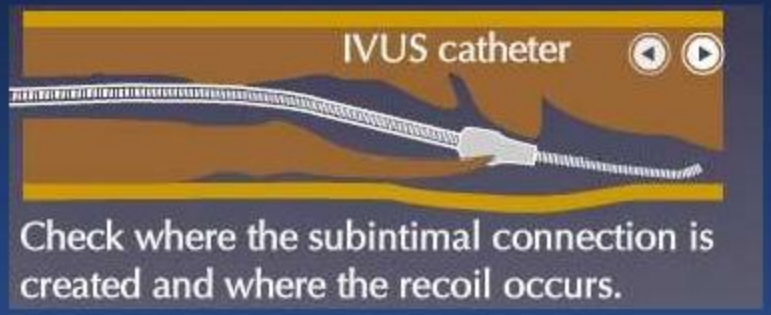
c

d

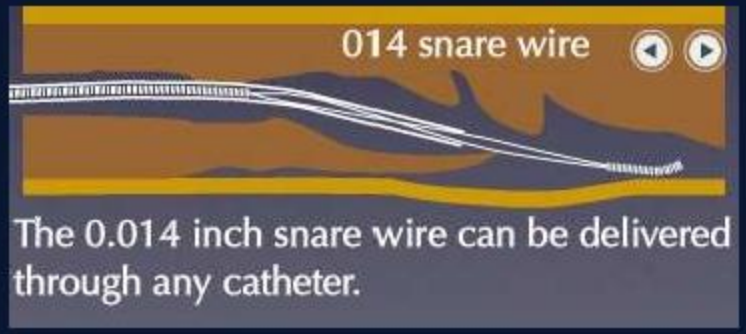
e

ROLE OF IVUS AND SNARE

a



b

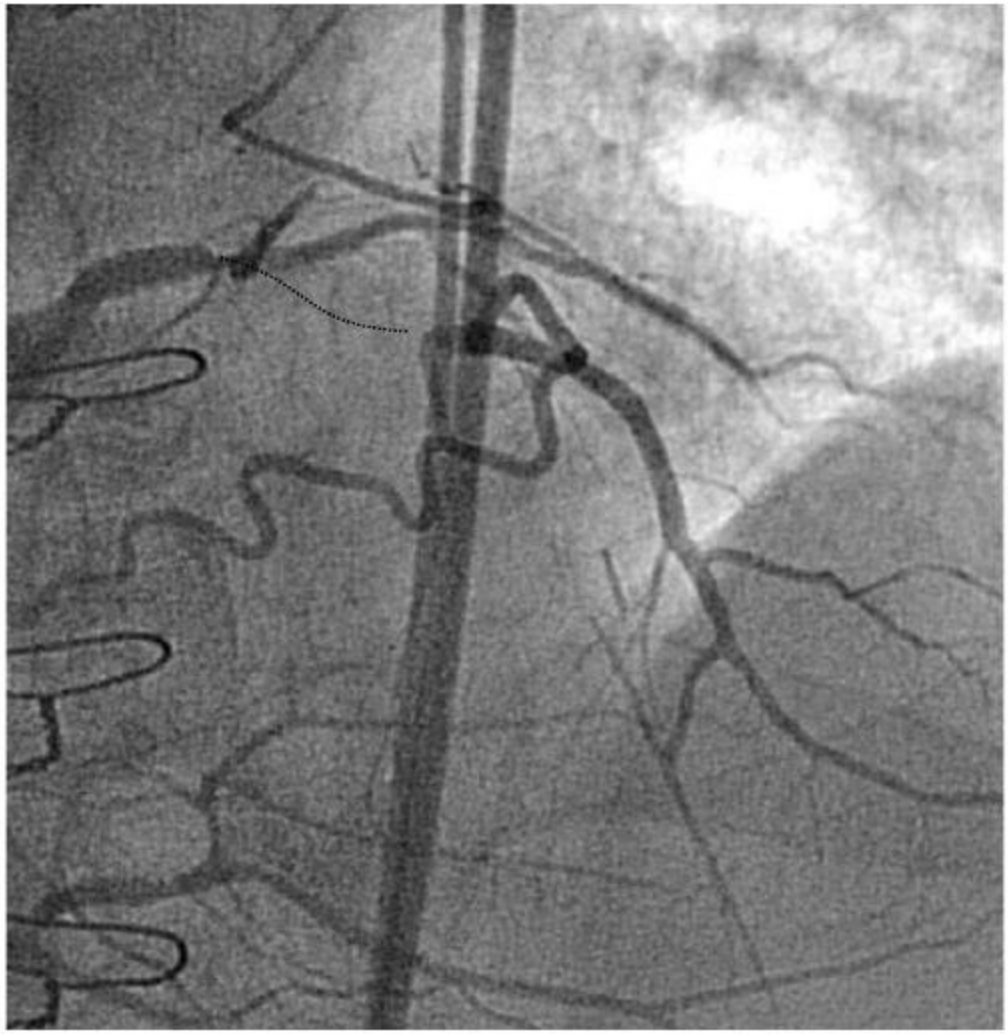


c

d

e

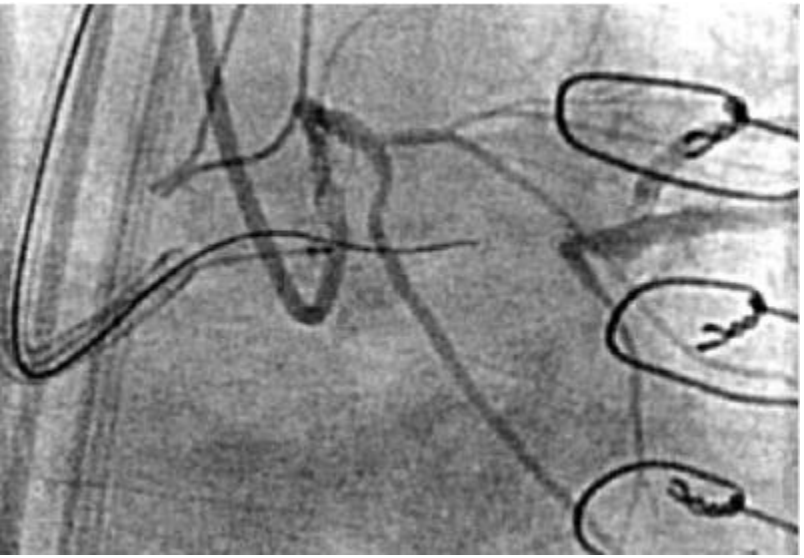
LAD - CTO

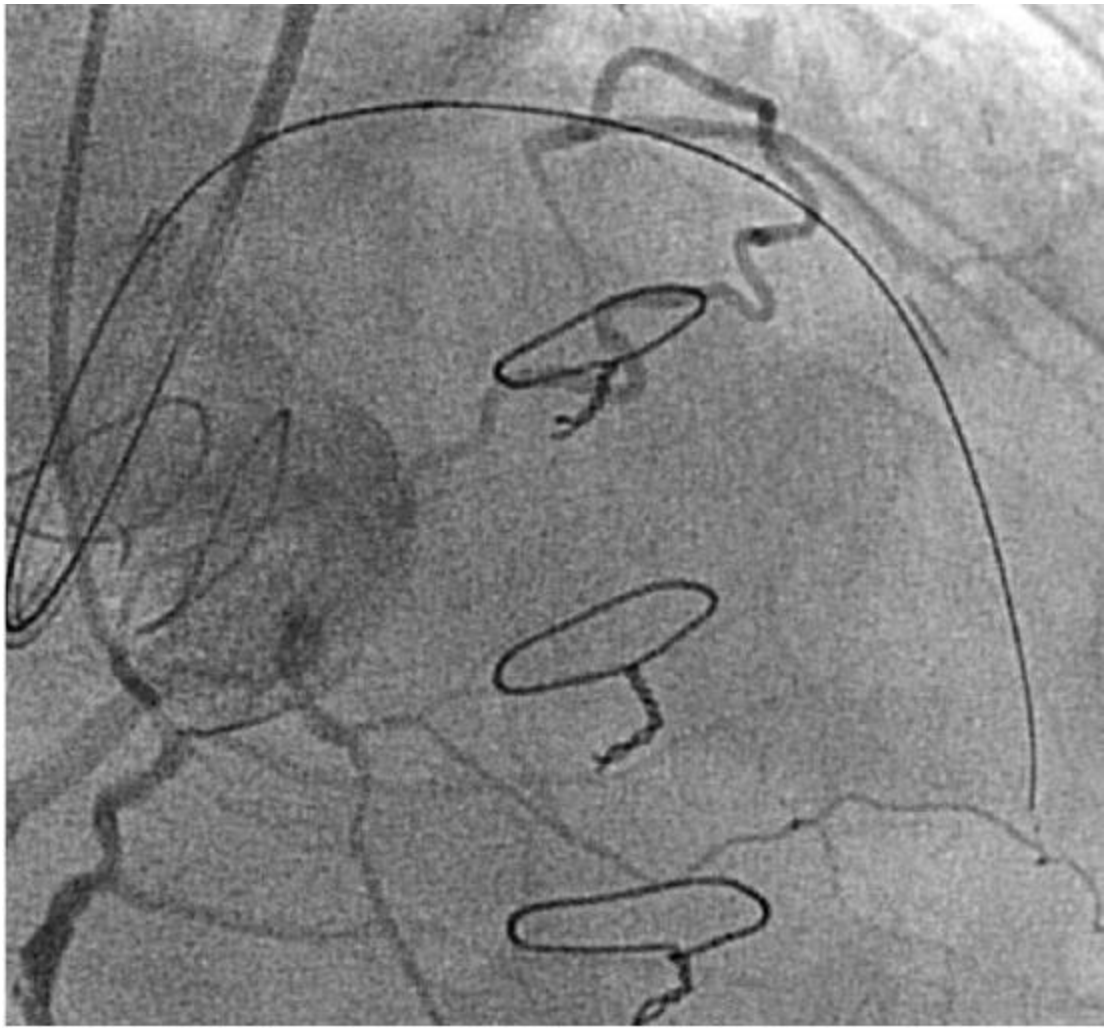


AP cranial

LAO cranial

Failed antegrade approach

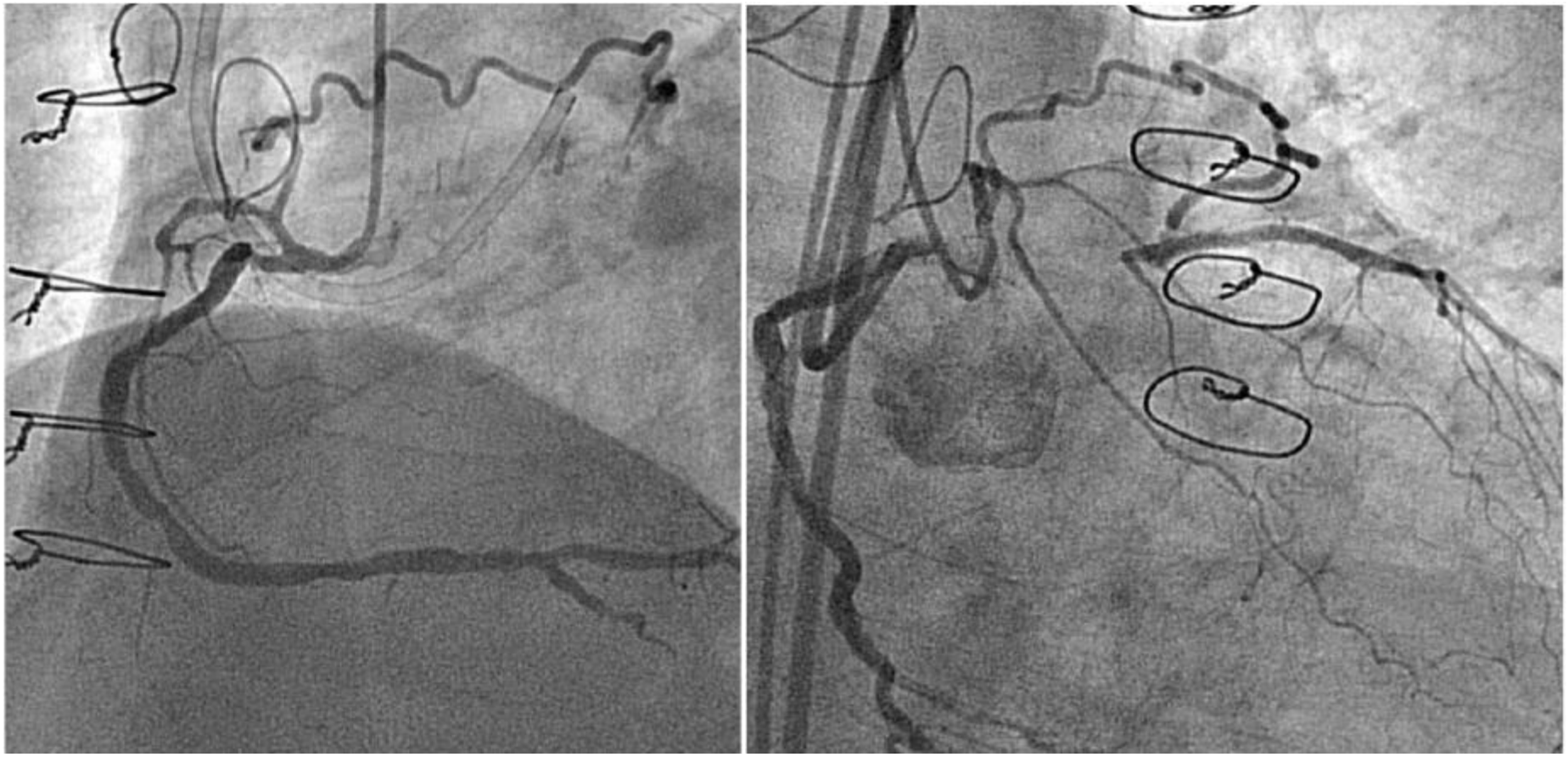




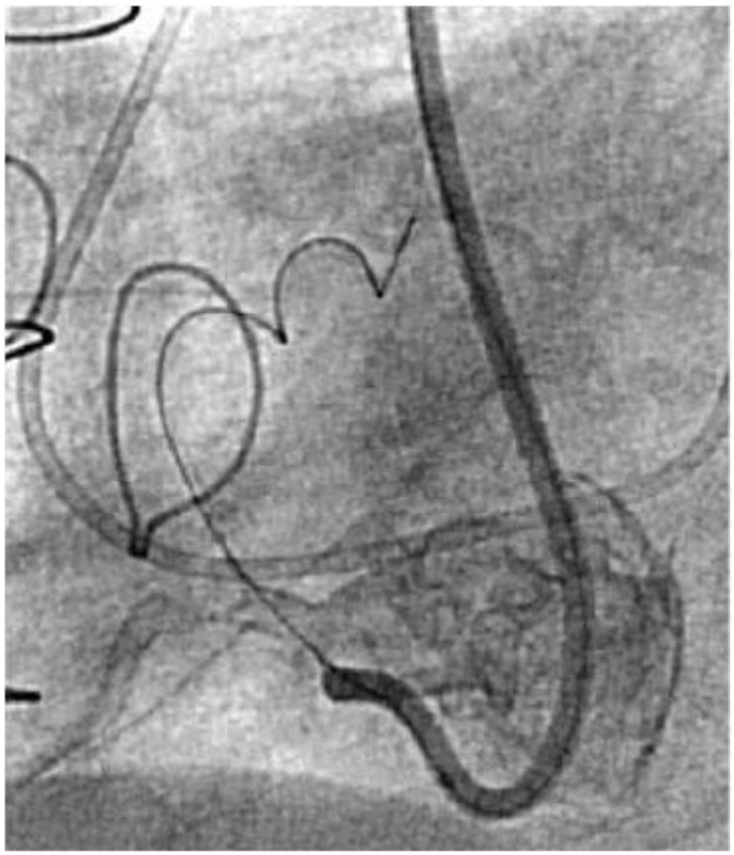
Conquest Pro
Tornus

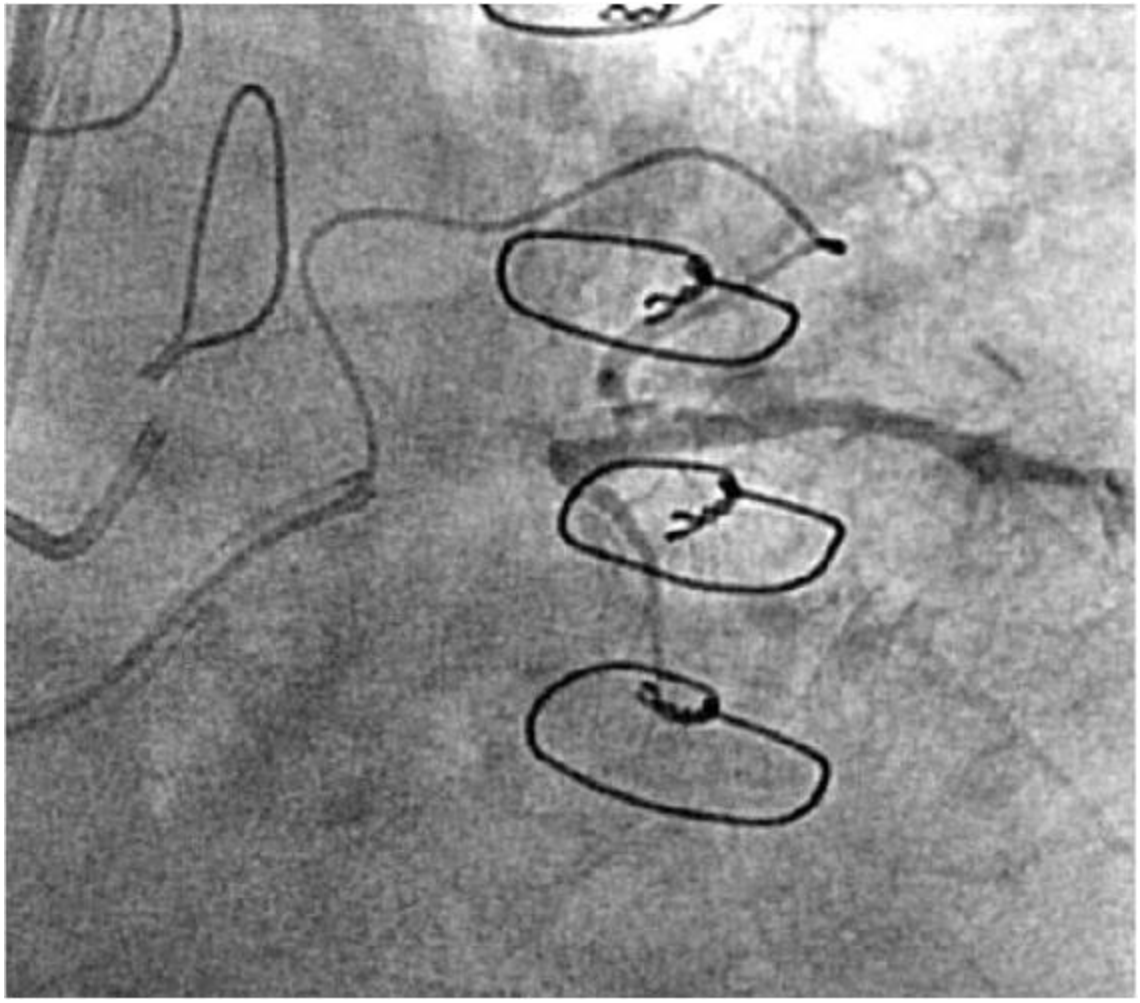
Conus to LAD

Short distance, large size but torturous and rigid



Conus to LAD

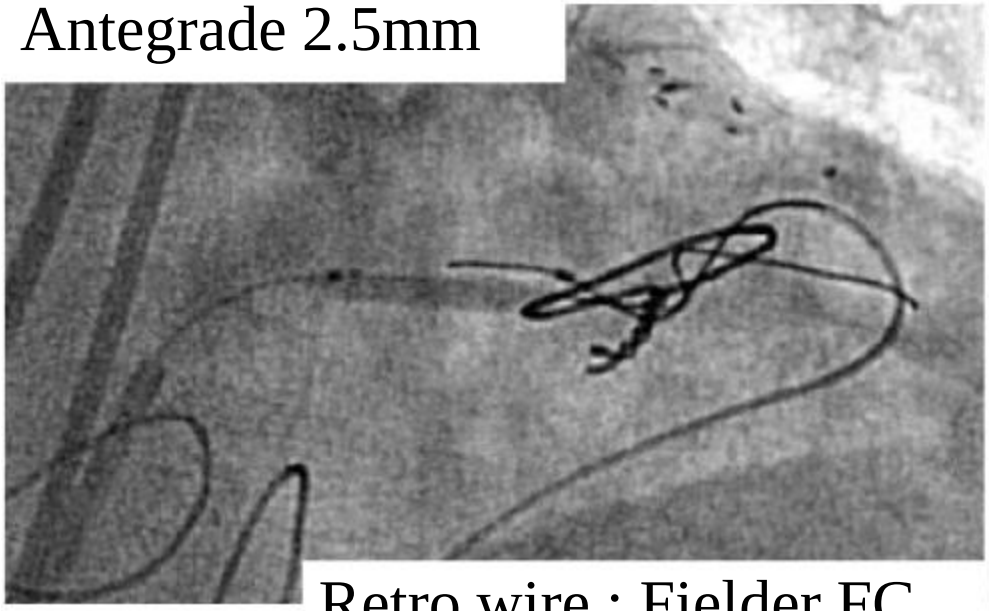




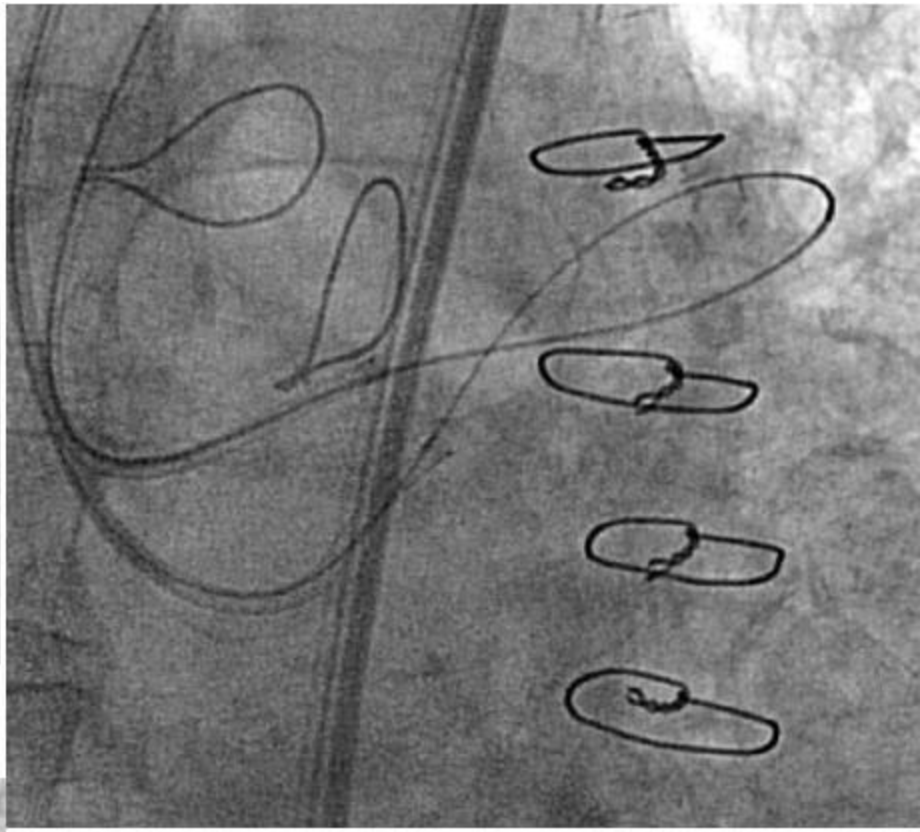
Choice floppy
Transit

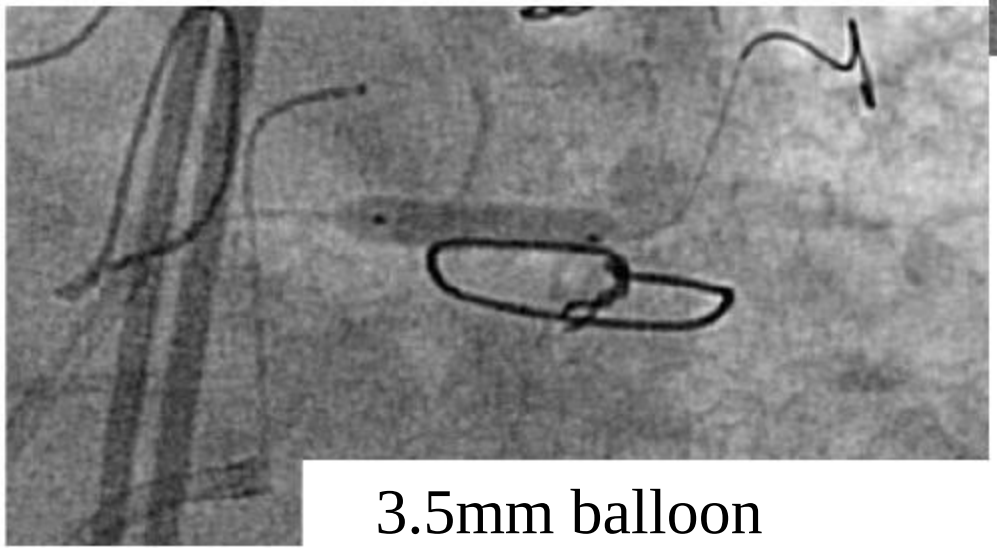
Reverse CART

Antegrade 2.5mm



Retro wire : Fielder FC



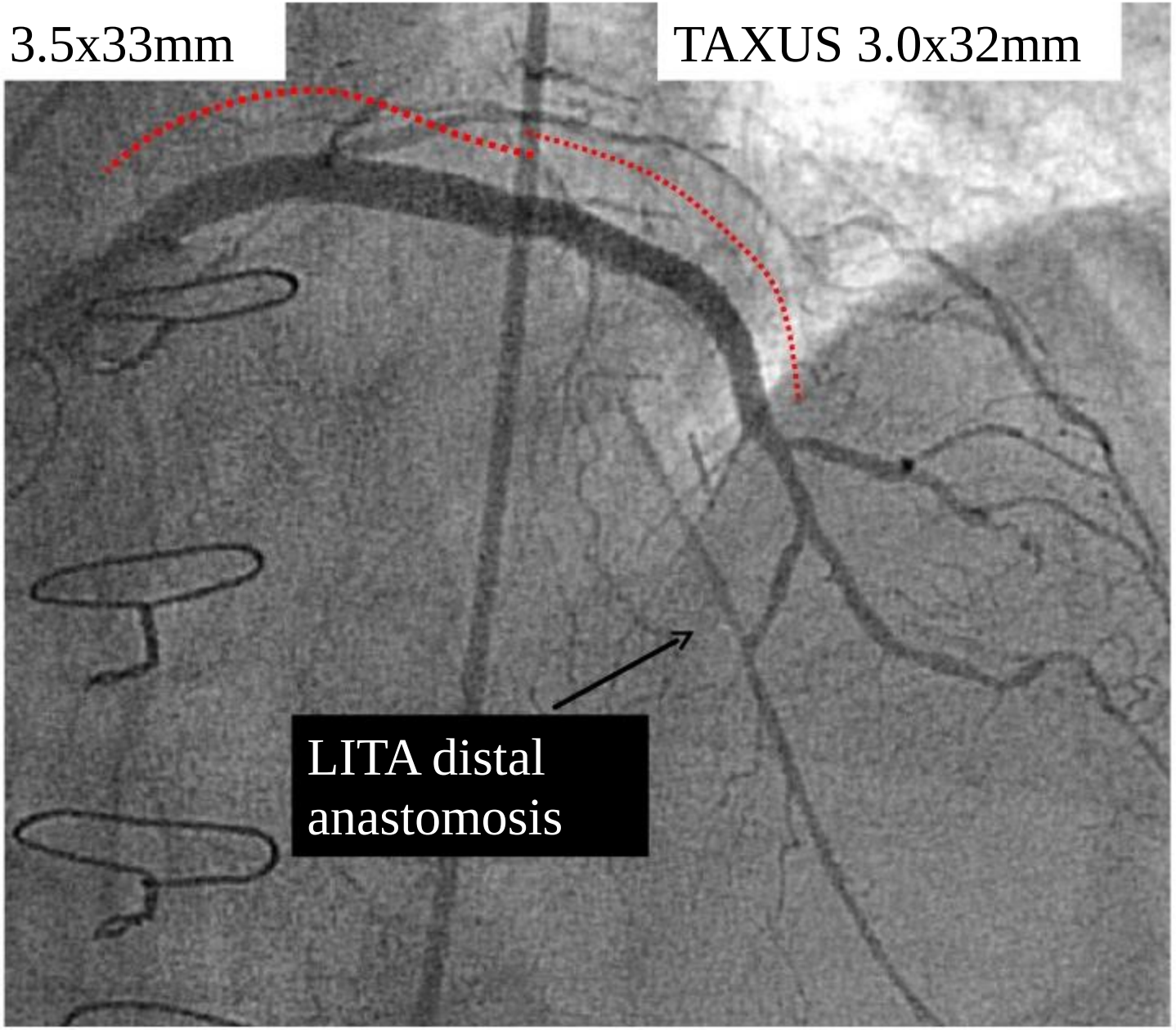


3.5mm balloon

Retrograde wire crossed to the guiding.
Wire direction was changed to antegrade with a Grandslam

Cypher 3.5x33mm

TAXUS 3.0x32mm



Distal LAD

PCI for CTO
Conclusion

- Evolving techniques leading better success rates (90%).
- Some getting standardised.
- Careful evaluation of angiograms.
- Familarity with a variety of catheters and wire.
- Switch approach early.
- Contrast and radiation dose.
- Patient comfort.

Progress with CTOs over the years

PCI for CTO
Retrograde approach

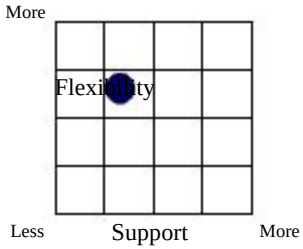
- Bilateral approach in majority of CTO”s.
- Antegrade wiring fails in 20-30%.
- Retrograde wiring fails in 5-10%.
- Remaining cases both wires are subintimal.
- Connect both spaces with CART/reverse CART with IVUS guidance.

Guidewire Selection

Fielder XT (X-treme)

Radiopacity 3cm
Coil 12 cm
Diameter 0.014inch
Tip Diameter 0.009inch

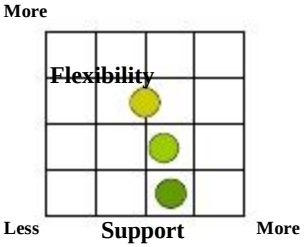
Hydrophilic coated guidewire with polymer sleeve
Tapered tip to 0.009
(Tip load . 8G)



Miracle 3/6/9
(Miraclebros 3/6/9)

Radiopacity 11cm
Coil 11 cm
Diameter 0.014inch

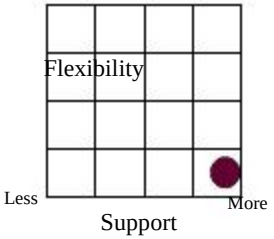
Non-tapered tip
(Tip load 6.0G)



Confianza Pro 12
(Conquest Pro 12)

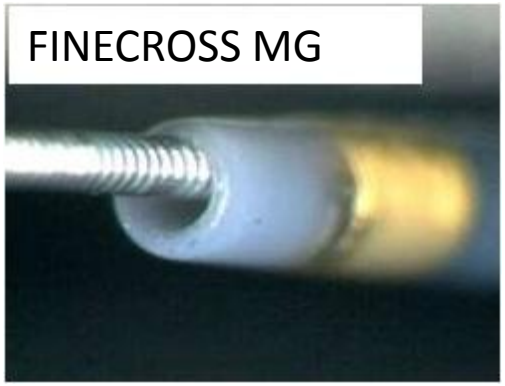
Radiopacity 20cm
Coil 20 cm
Diameter 0.014inch/
Tip Diameter 0.009inch

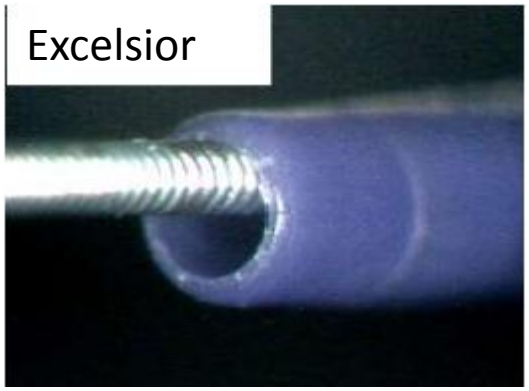
Tapered tip to 0.009
(Tip load 12.0G)

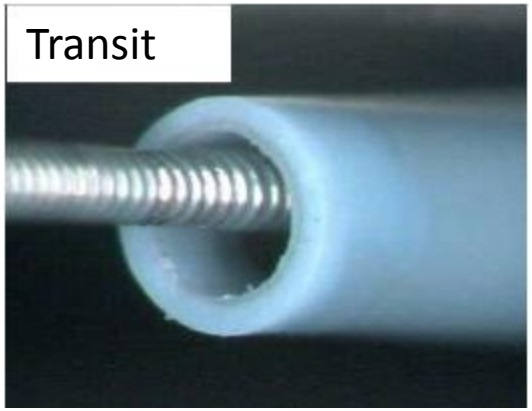


Micro Catheters

	Distal		Proximal	
	O.D.	I.D.	O.D	I.D
FineCross MG	1.8Fr (0.60mm)	0.018'' (0.45mm)	2.6Fr (0.87mm)	0.021'' (0.55mm)
Excelsior (BSC)	2.0Fr (0.67mm)	0.019'' (0.48mm)	2.6Fr (0.87mm)	0.019'' (0.48mm)
Transit (Cordis)	2.3Fr (0.76mm)	0.021'' (0.50mm)	2.8Fr (0.95mm)	0.021'' (0.50mm)



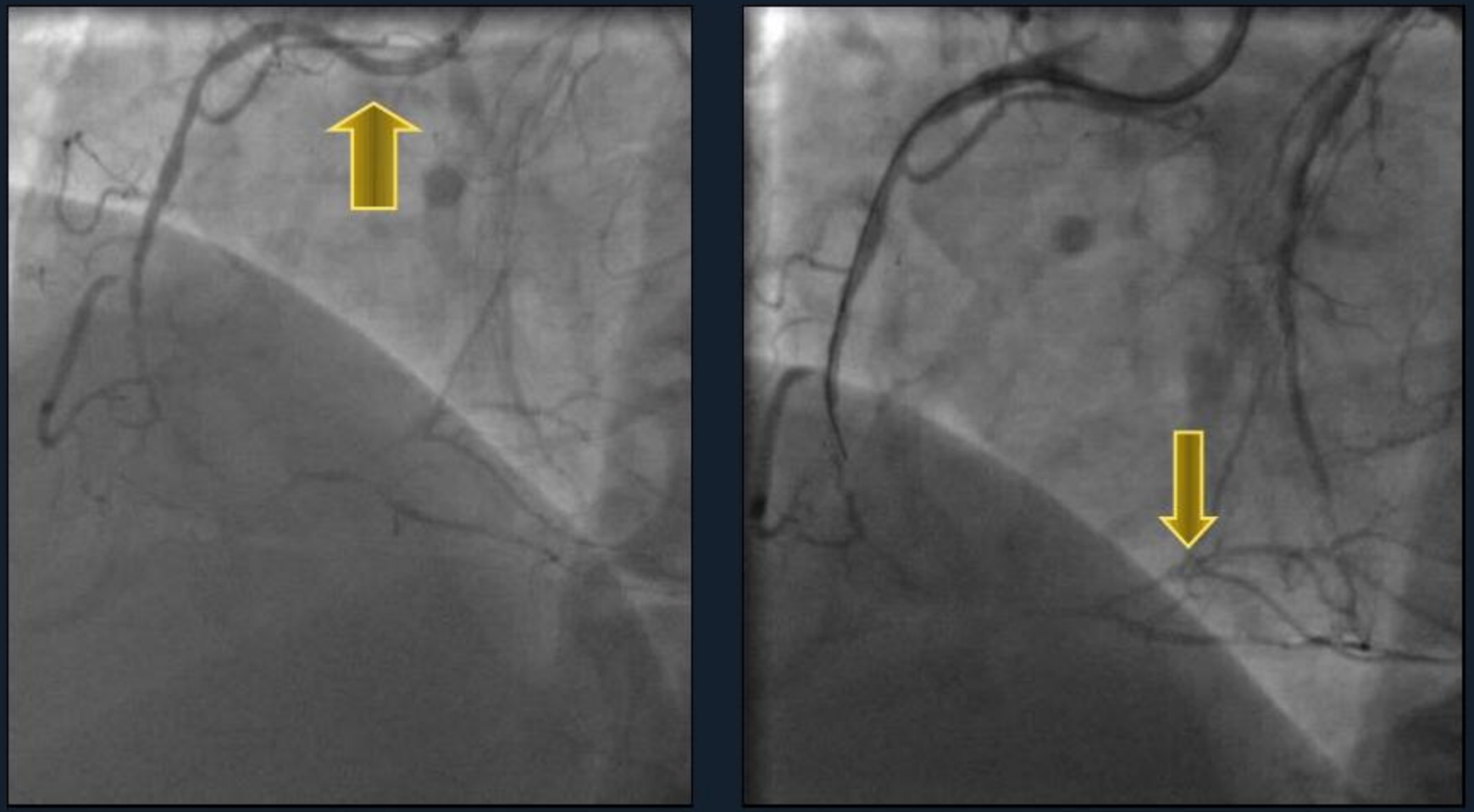




Other Specialized Microcatheters

- Venture
- Twin-pass

CTO: Key Starting Points



Excellent Guide Support and distal vessel visualization

Select Your Guiding Catheter Carefully

- Use: 7-8F for LCA, and 8F in RCA with optimal alignment
- Curve 1 size larger for CTO (e.g., Voda 4 EBU 4.5 – AL 0.75 for RCA…)
- Sideholes recommended for RCA – rarely necessary in LCA
- But .....care with proximal disease (RCA) sometimes an R4 with an anchor is safer

Twin-pass dual lumen catheter (Vascular Solutions)

-Separate RX and OTW lumens

-Maintain distal access with ability to introduce second wire (or contrast)

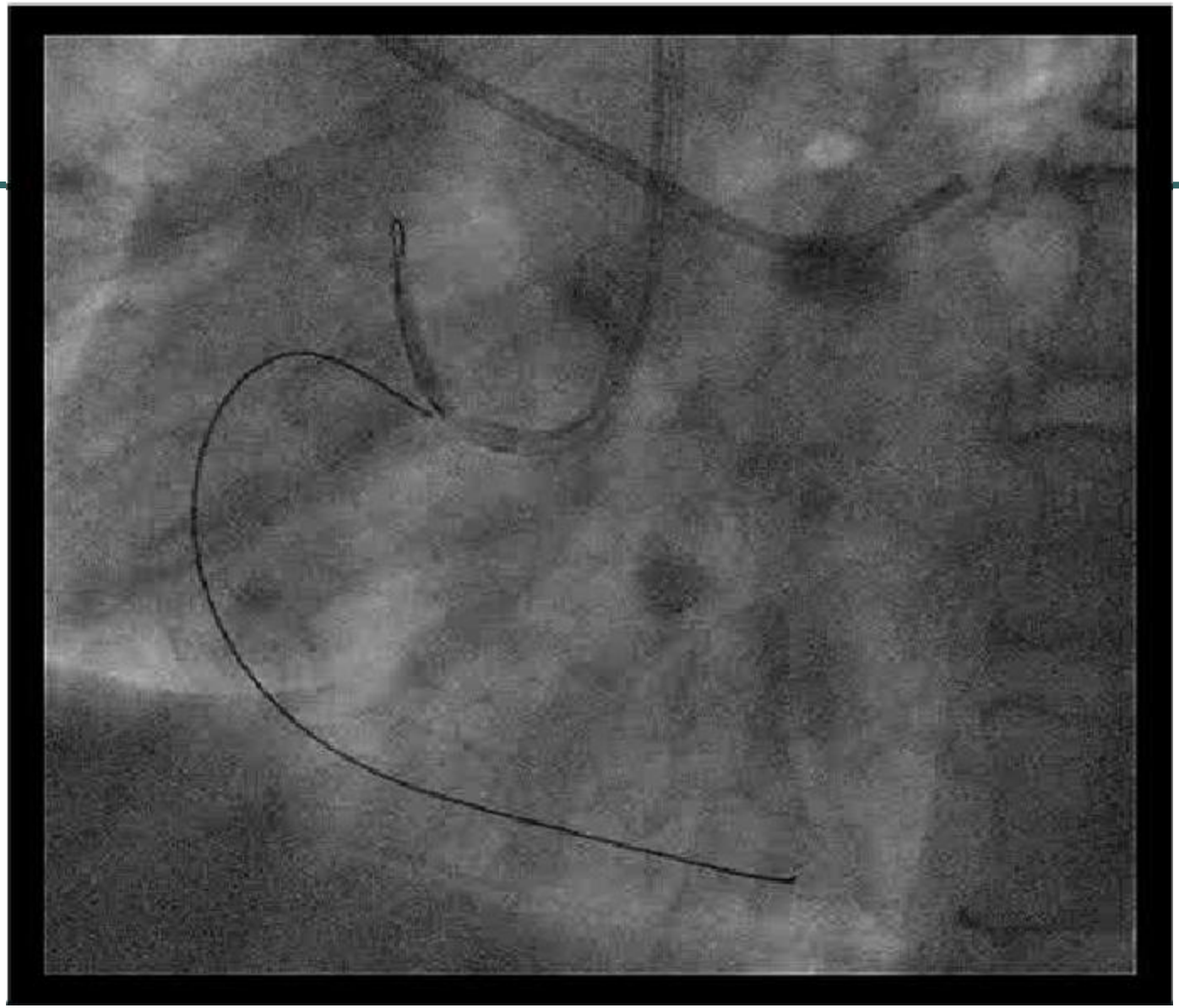
Simplified Concepts

- Support, Support, Support

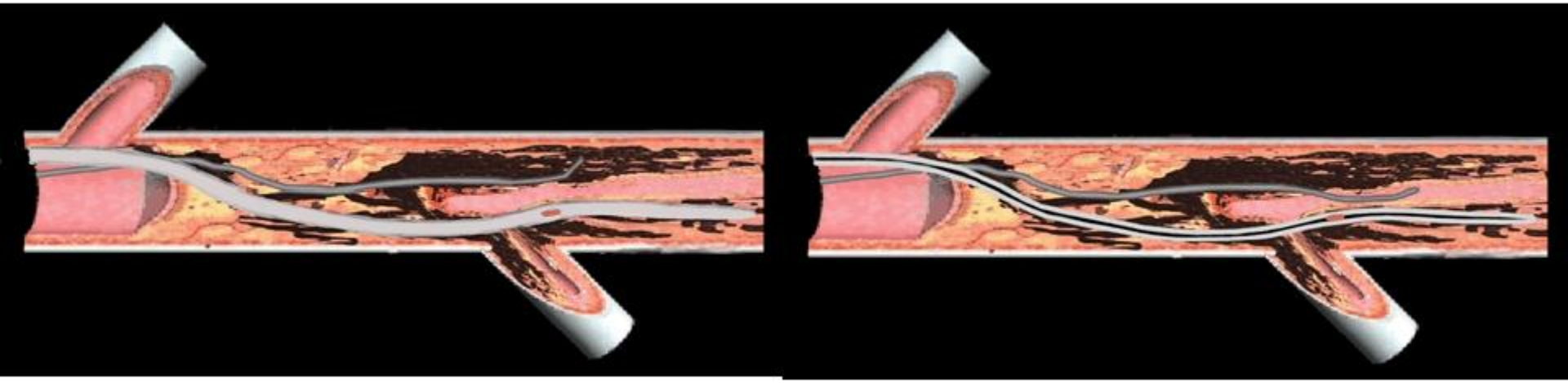
  -Guide Catheter

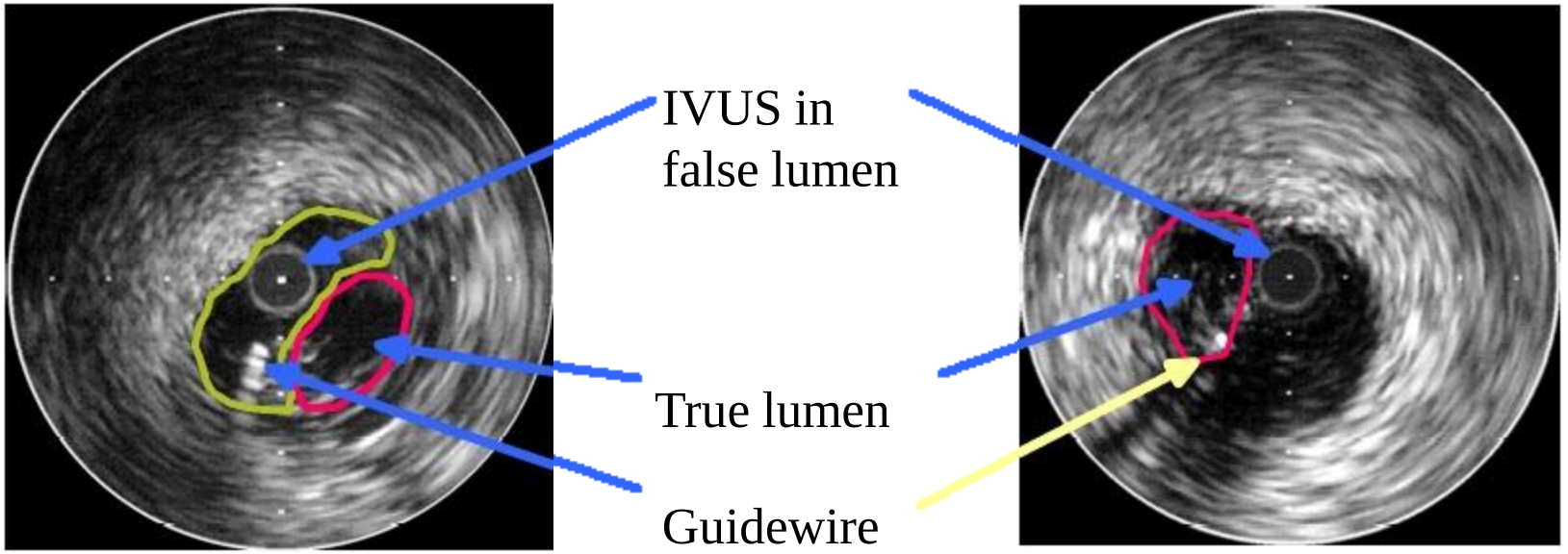
  -Support catheter: 1.5 mm OTW balloon, microcatheters (Transit, Finecross), Tornus, Corsair

  -Anchor techniques: Wire, balloon



IVUS guidance in CTO
Distinguish false lumen fron true lumen





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