

Retrograde CTO PCI: Reverse CART and its variation

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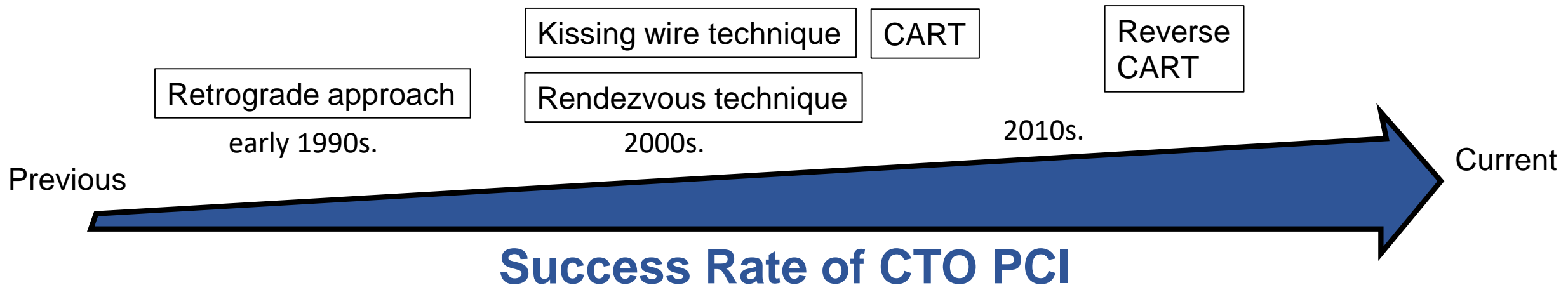
Background

- Bi-direction approach increase the success rate of CTO-PCI.

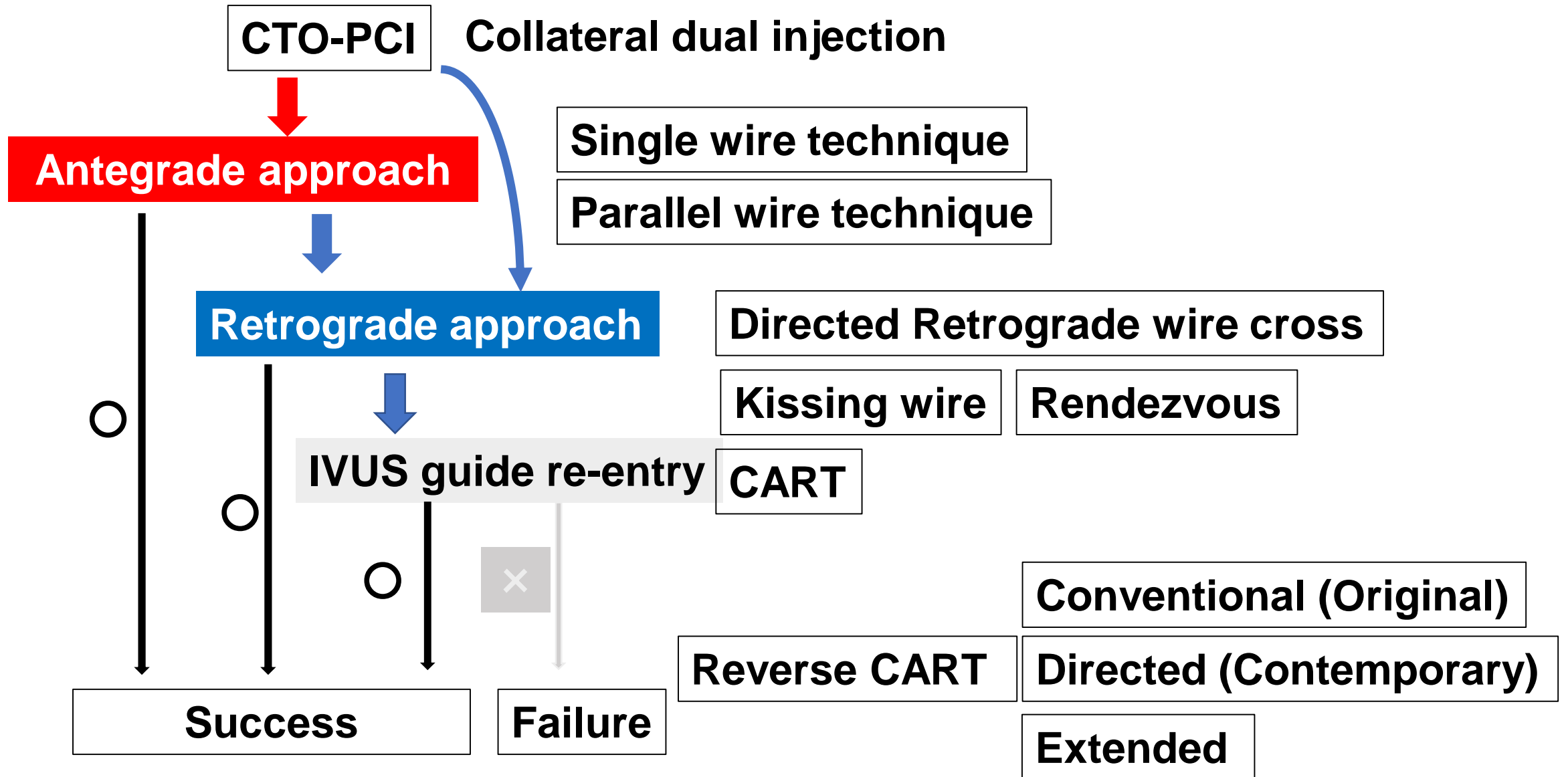


Current of Retrograde Approach







- CTO is one of the most challenging lesion subsets in PCI.
- During the past three decades, there has been significant progress in equipment and techniques, resulting in significant improvement in success rates of CTO PCI.
- One of the most important advances is the introduction and subsequent evolution of retrograde techniques.



Procedural Steps of Current CTO-PCI



Current of Retrograde Approach

Country/region	Europe			USA			Japan		
Year	2011	2015	2016	2012	2016	2017	2013	2013	2017
Study	Galassi et al ^{13,22}		Maeremans et al ²⁴	Karpaliotis et al ^{19,23}		Sapontis et al ²⁵	Tsuchikane et al ²¹	Yamane et al ²⁰	Suzuki et al ²⁶
Retrograde CTO PCI, n (%)	234 (12)	1,582 (16)	207 (17)	462 (34)	539 (41)	NA	801 (27)	378 (25)	1,206 (46)
Overall technical success in retrograde PCI, %	65	75	75	81	85	NA	85	84	84
Distribution of retrograde wire crossing strategies									
Reverse CART, %	–	16.0	67 	46	62	70 	55.2	42.1	62.4 
CART, %	31.8	13.9	3 	11.5	2.7	– 	6.4	12.0	0.7 
Retrograde wire crossing, %	37.2	31.2	28	NA	19	30	22.9	23.3	16.3
Kissing wire, %	22.3	22.0	NA	NA	3.3	–	15.5	22.6	17.7

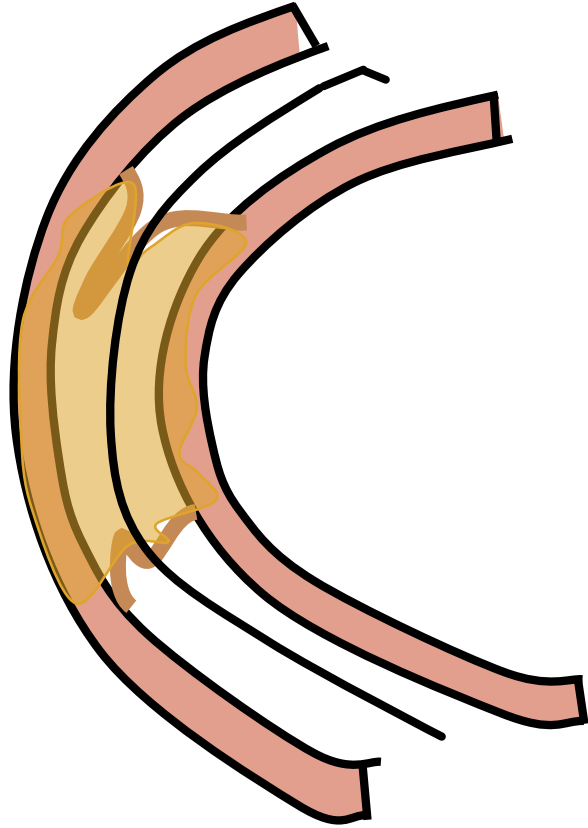
Terminology of Reverse CART

Prior term

Contemporary term

- **Original** reverse CART → "**Conventional**" reverse CART
- **Contemporary** reverse CART → "**Directed**" reverse CART
- **Modified** reverse CART → "**Extended**" reverse CART

Current Retrograde Approach



1. Retrograde wire and micro catheter access

Wire (SUOH 03, SION, others)

Micro catheter (Corsair, Caravel, Fine cross, others)

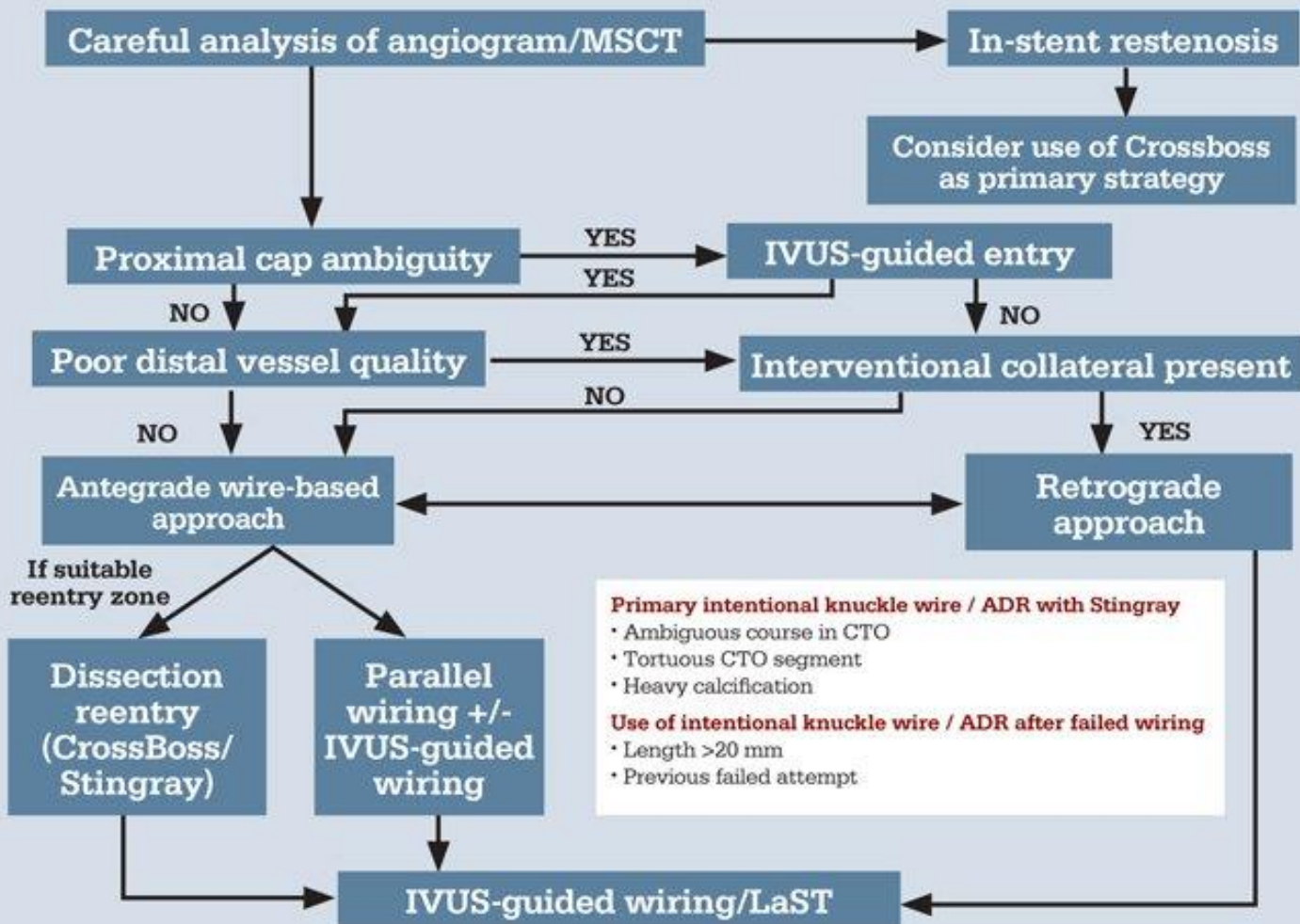
2. Retrograde wire with high torque into CTO body

Wire (GAIA series)

3. CTO length <15mm

→ **Direct retrograde wire crossing**

The Asia Pacific Algorithm for CTO Crossing

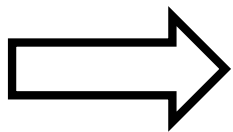


Consider stopping if >3 hr; 3.7x eGFR ml contrast; Air Kerma > 5Gy unless procedure well advanced

According to Algorithm

Procedural Issues

- Ambiguous course in CTO
- Tortuous CTO segment
- Heavy calcification
- The long CTO
- Primary knuckle wire

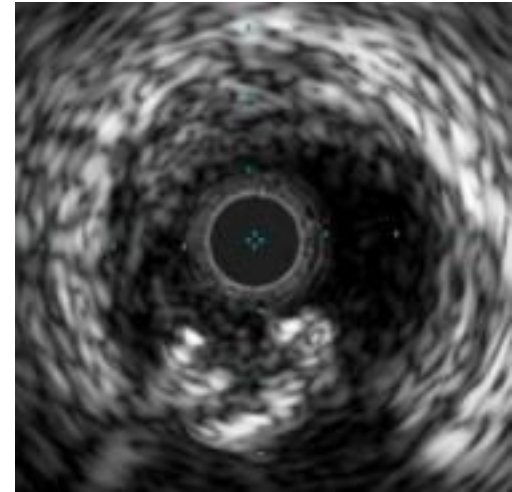
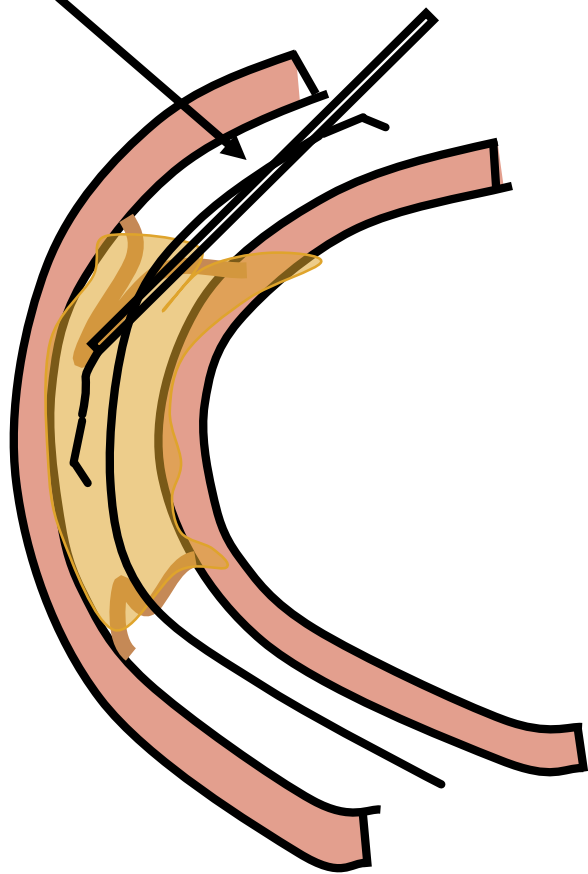


Recommend
“Directed” reverse CART
(IVUS is not mandatory)

Current Retrograde Approach

Next

→ IVUS guided wiring with penetration directable retrograde wire

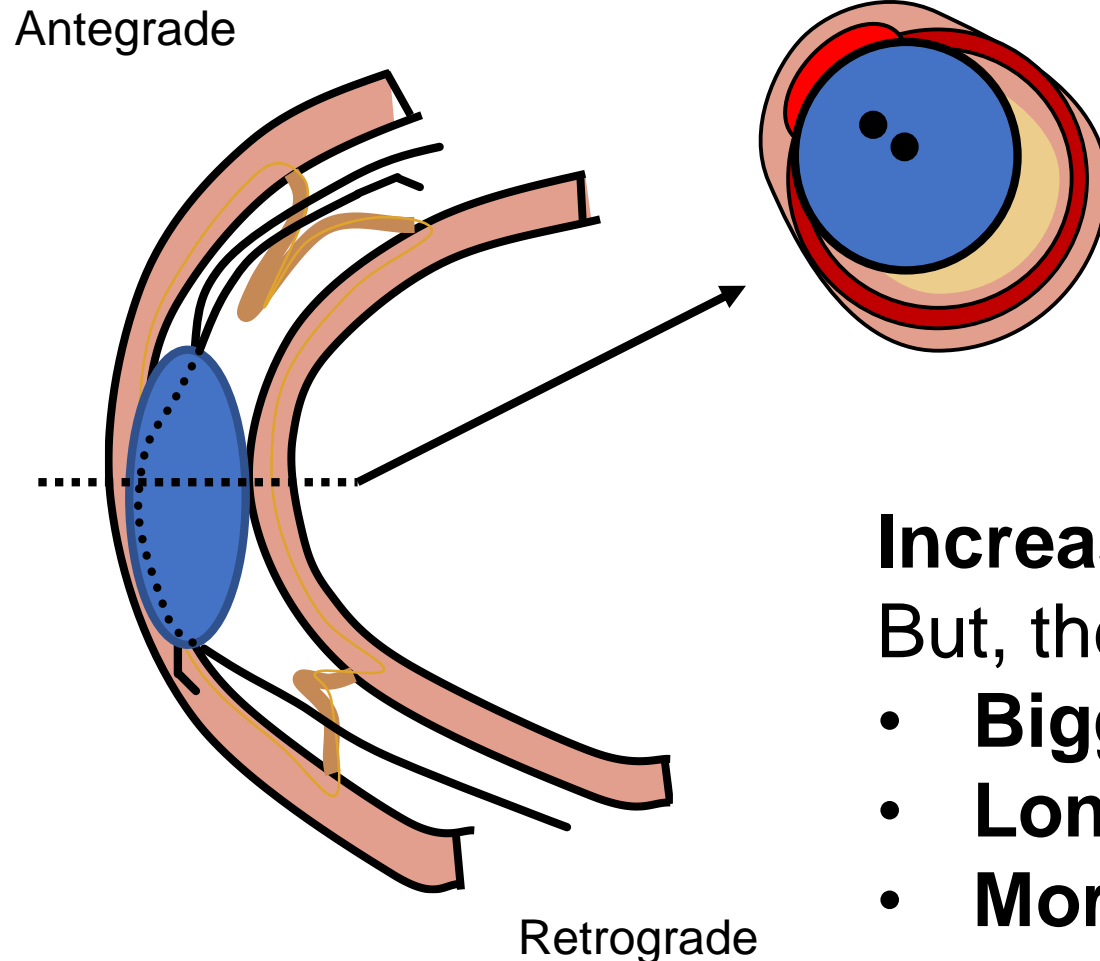


If **FAIL**,

IVUS guided reverse CART

Need to confirm both wire position

“Conventional” Reverse CART



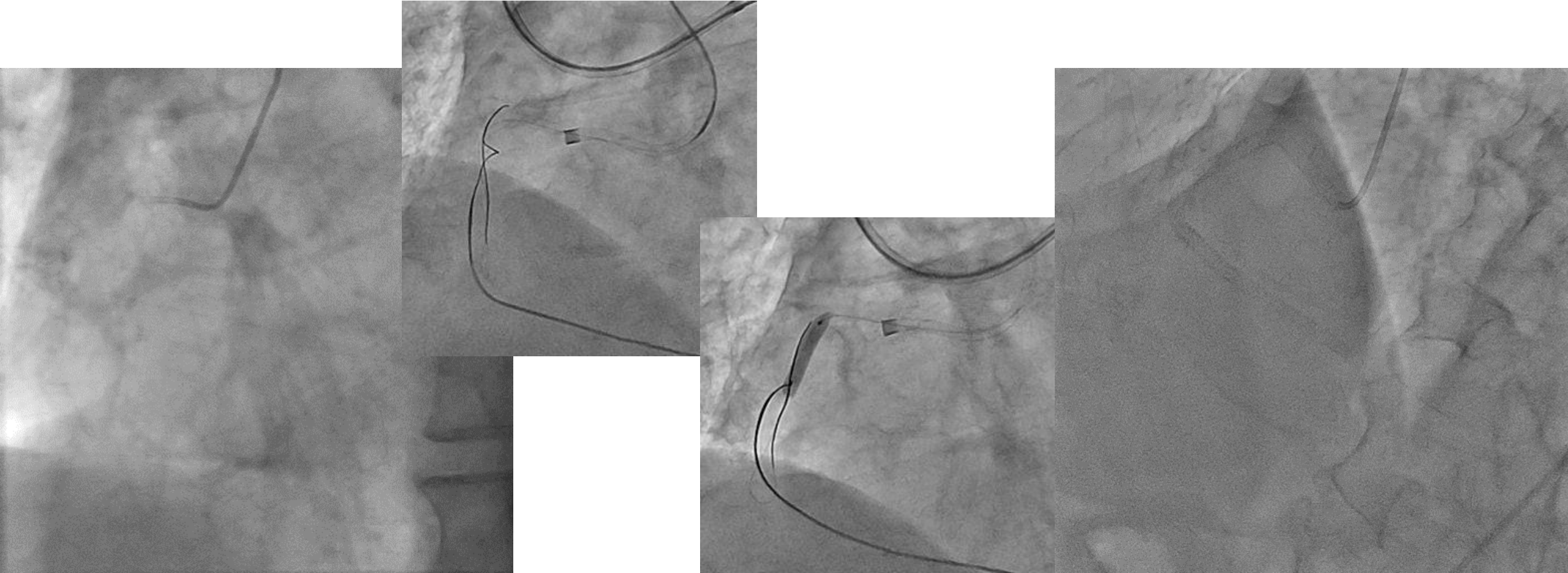
1. Antegrade preparation
2. Passing Retrograde wire through collateral
3. Advance Retrograde wire into CTO body

Increasing the success rate of CTO PCI

But, there are procedural Issue ...

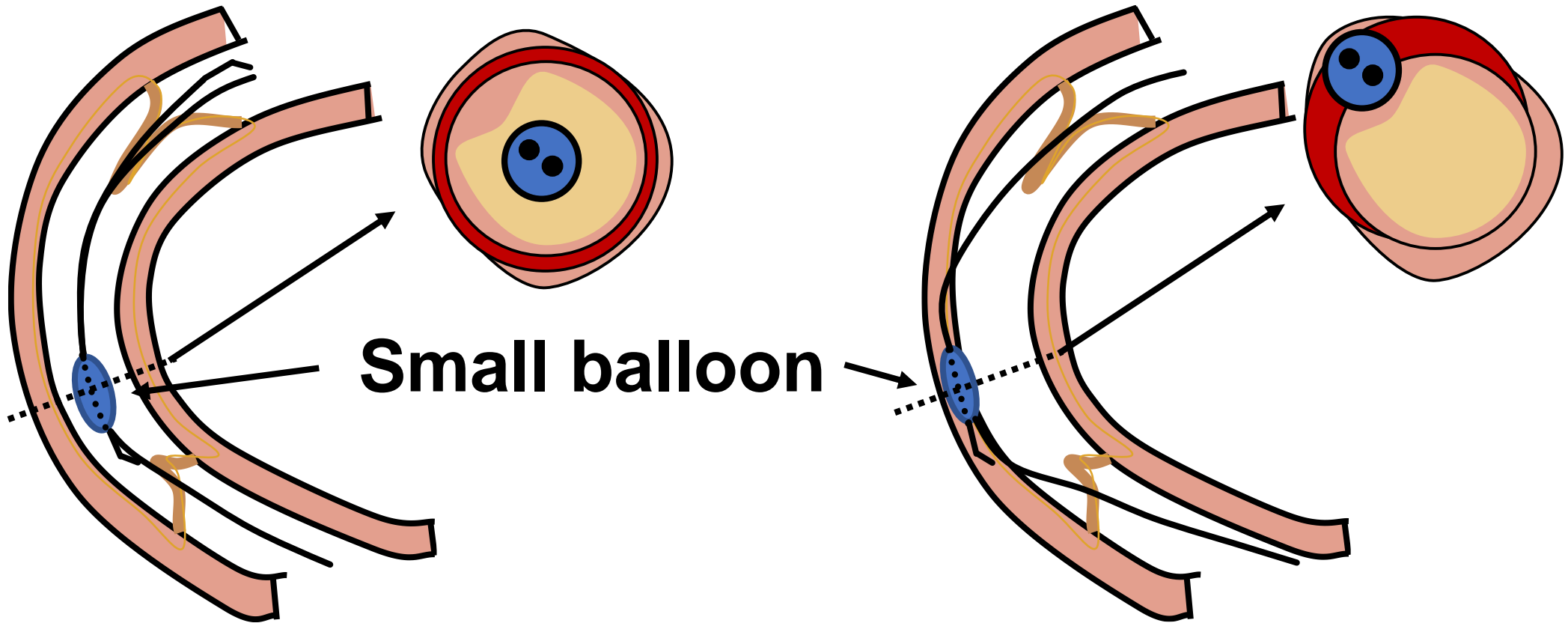
- **Bigger balloon**
- **Longer stent**
- **More vessel dissection**

“Conventional” reverse CART



Bidirectional knuckle wire, Detection of wire position by using IVUS, Balloon dilation decided size by IVUS

“Directed” reverse CART

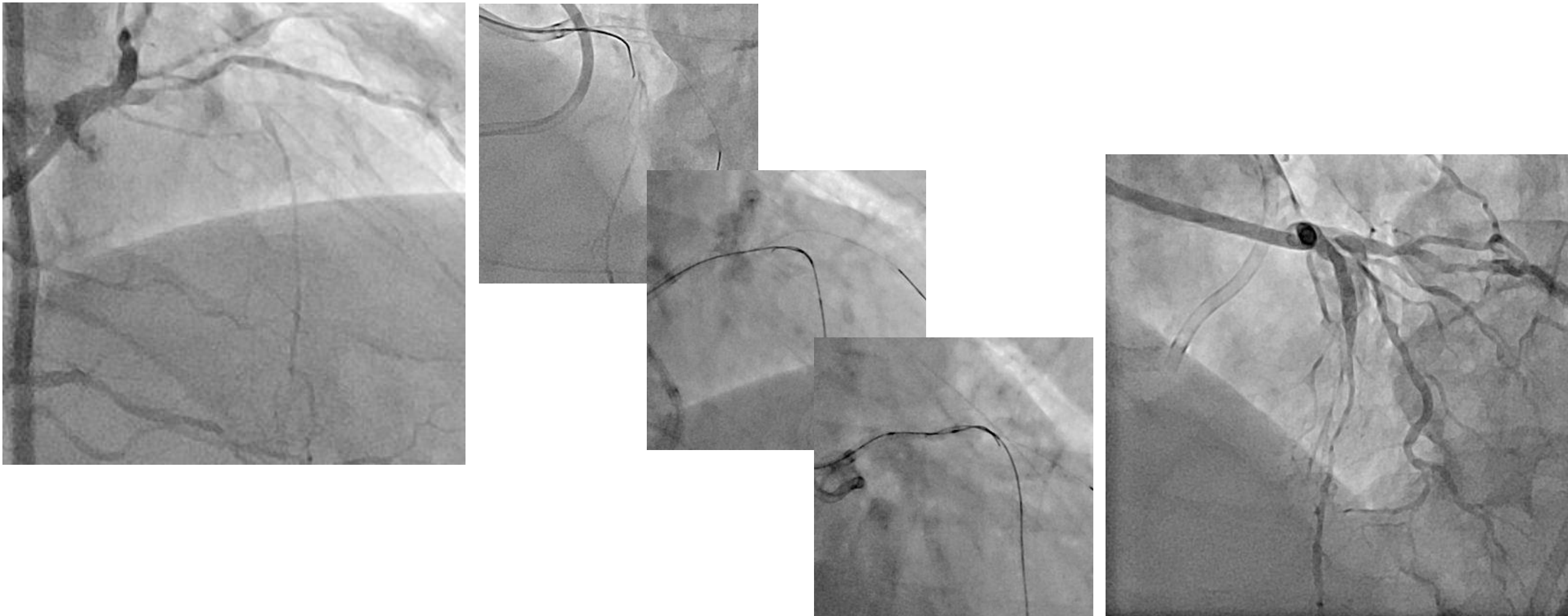


Small balloon

Connection within intimal space in the CTO body

Connection close to the subintimal space in the CTO body

“Directed” reverse CART

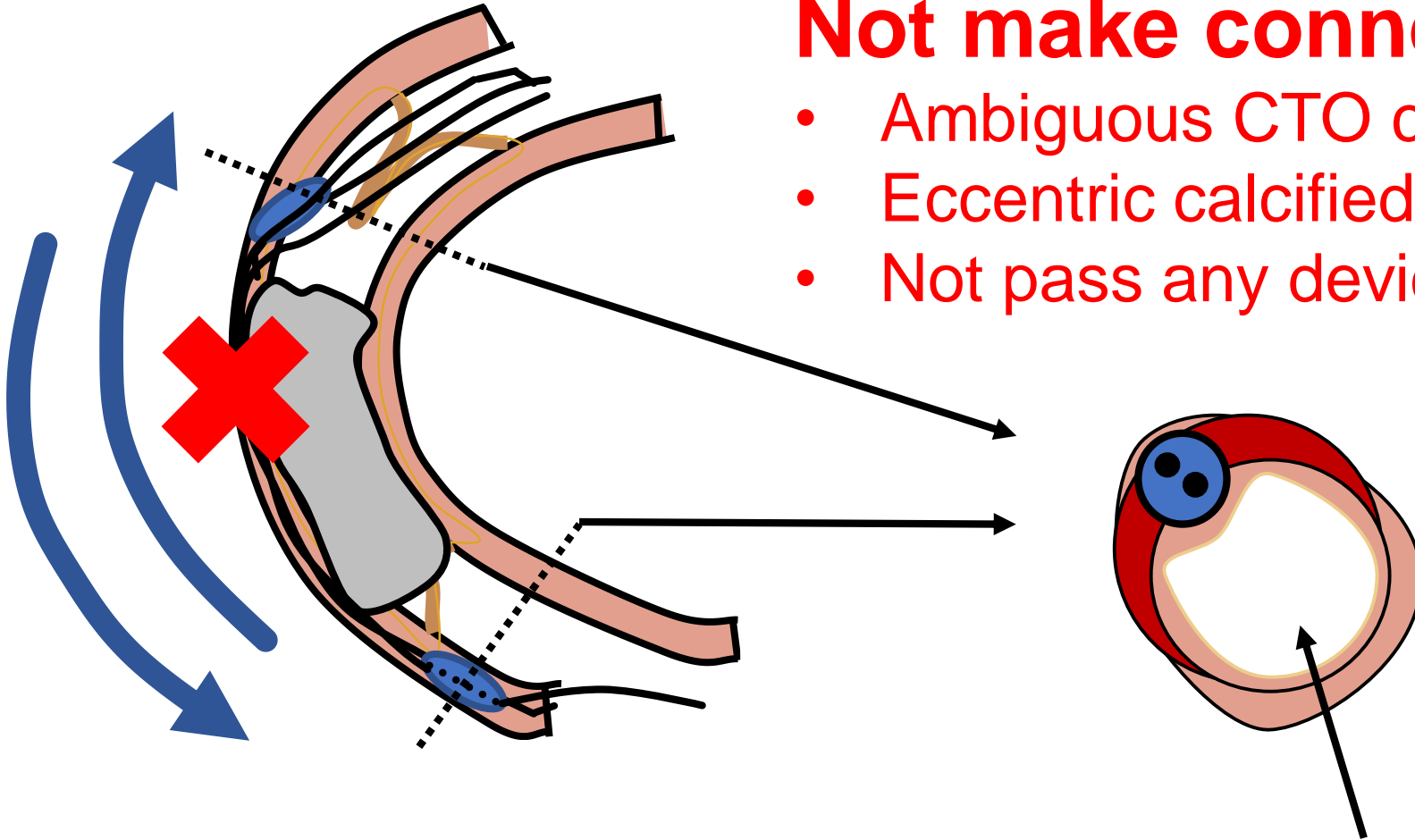


Antegrade wire: GAIA 2 ⇒ Miracle neo 3, Retrograde wire: UB 3 ⇒ GAIA 2
Balloon size 2.0mm

“Extended” reverse CART

Not make connection

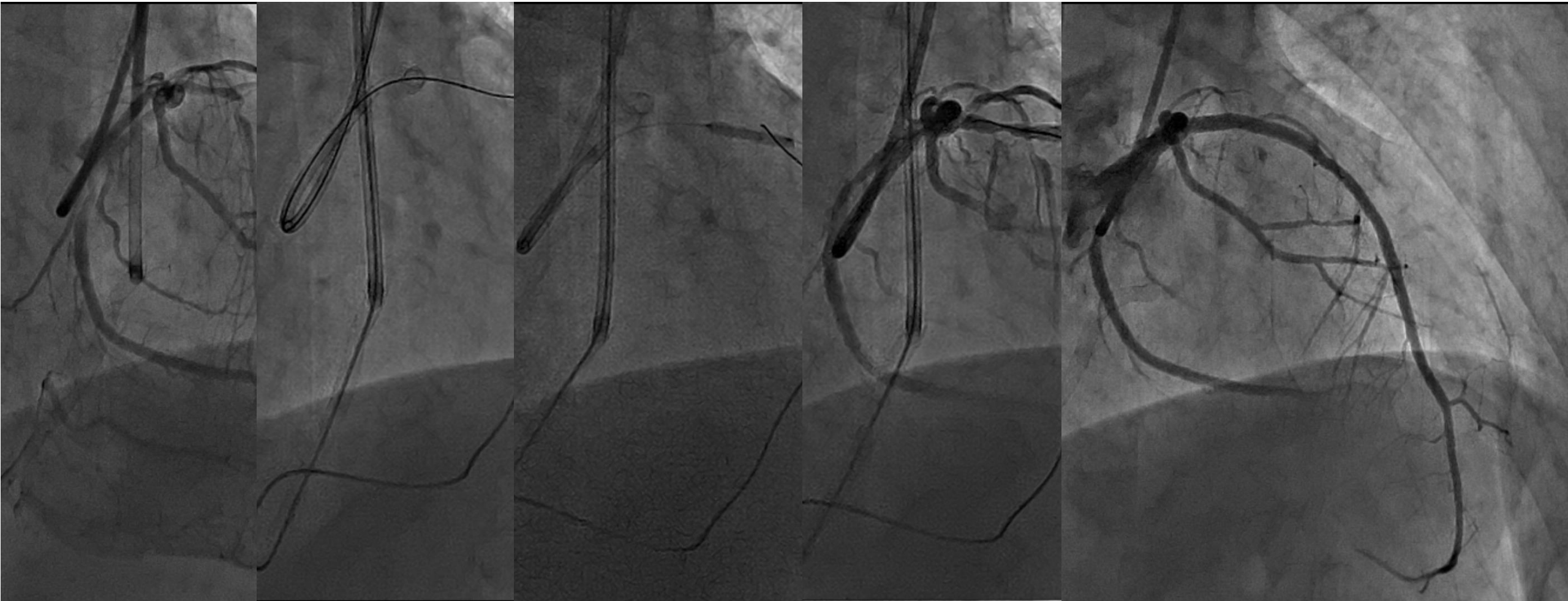
- Ambiguous CTO course
- Eccentric calcified plaque
- Not pass any device at proximal part



Connection at the Proximal or Distal true lumen

“Extended” Reverse CART

Antegrade wire: Conquest pro not advance

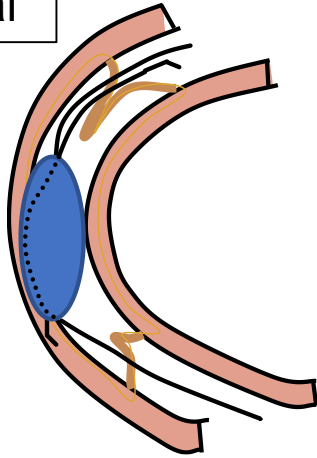


Retrograde wiring
Not pass any device at proximal part

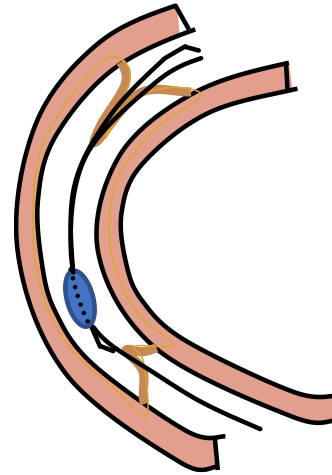
Made the connection at proximal part at the diagonal branch
performed “Extended” reverse CART

Comparison of the reverse CART

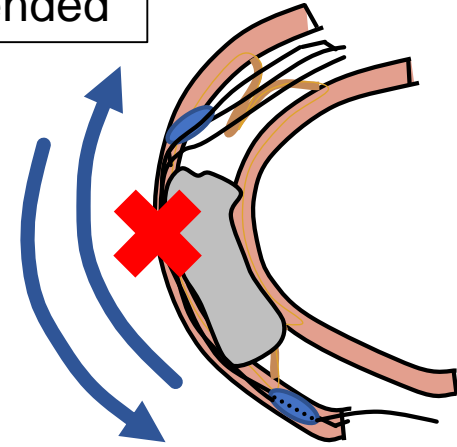
“Conventional”



“Directed”

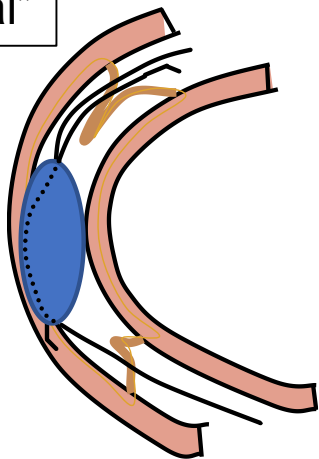


“Extended”

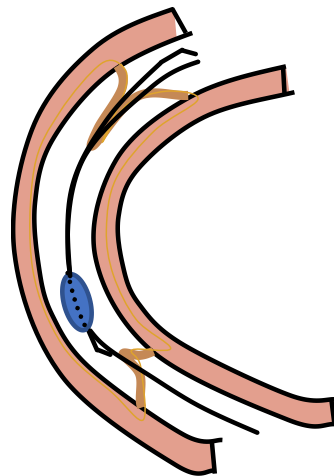


Extent of subintimal space	Within CTO	Within CTO	Beyond the CTO segment
Prior wiring	Both (A and R) OK	Antegrade is Better	Both (A and R) OK
Retrograde wiring	Usually low to intermediate penetration force wire. However, HIGH penetration force wire is required if the antegrade wire in the subintima and the retrograde wire is in the intima.	One choice, GAIA series with high torque	Proximal :anywire without high penetration wire Distal : HIGH penetration wire

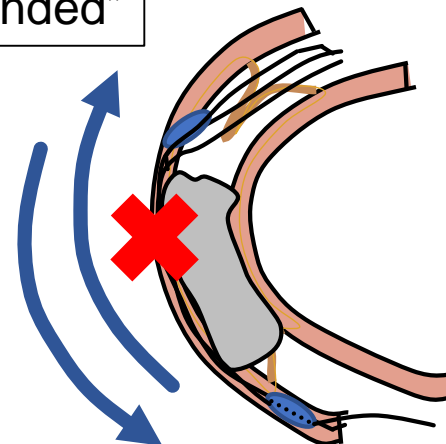
“Conventional”



“Directed”



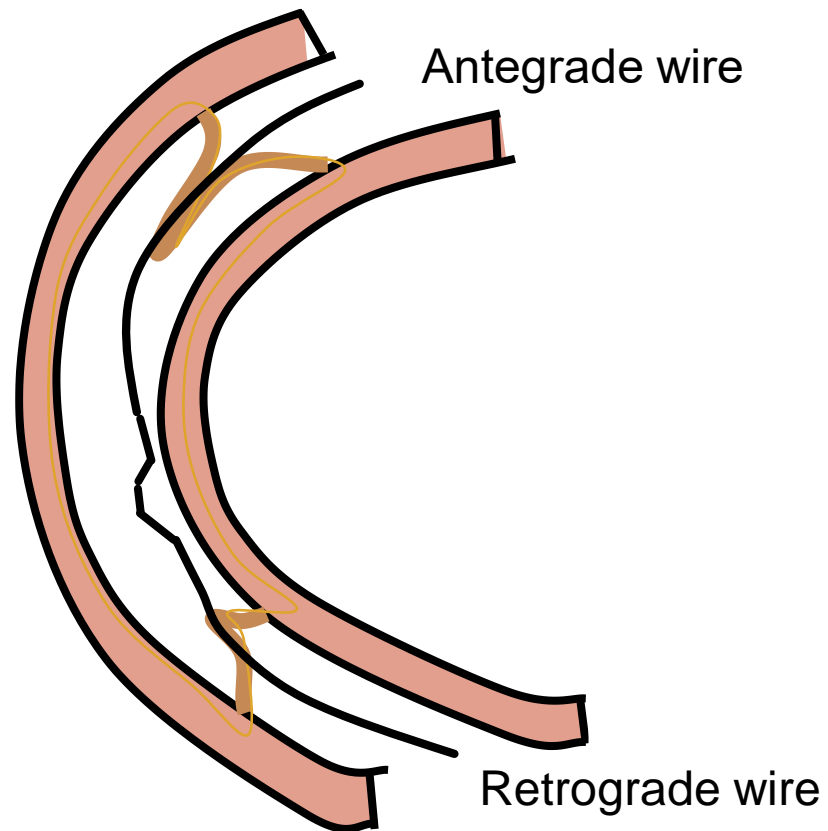
“Extended”



Knuckle wire technique	If necessary	Unsuitable	If necessary
Using Ba. size	Large	Small	Large
IVUS guided	Recommend Considered when there is difficulty in achieving reverse CART	Not routinely used due to the clear target	Recommend prevent from extension of the subintimal space
Suitable case	Bidirectional approach which NOT suitable directed reverse CART	CTO with clear proximal cap, without severe calcification, severe tortuosity	CTO with proximal or distal cap penetration is NOT possible due to ambiguity or calcification
Unsuitable case	Not limited	CTO with ambiguous proximal cap and vessel course, severe calcification and tortuous short length	

Another Retrograde technique

If retrograde MC was **fail** to pass the channel,
Antegrade KISSING wire technique



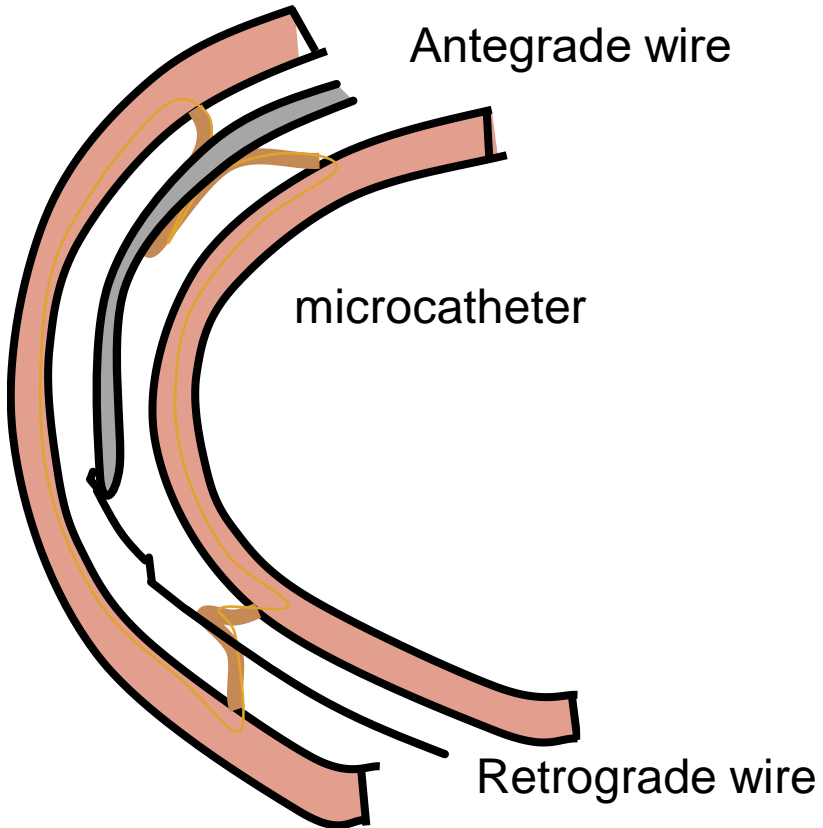
⇒ Antegrade wire can trace retrograde wire
→ Antegrade micro catheter or balloon will be able to advance through CTO lesion



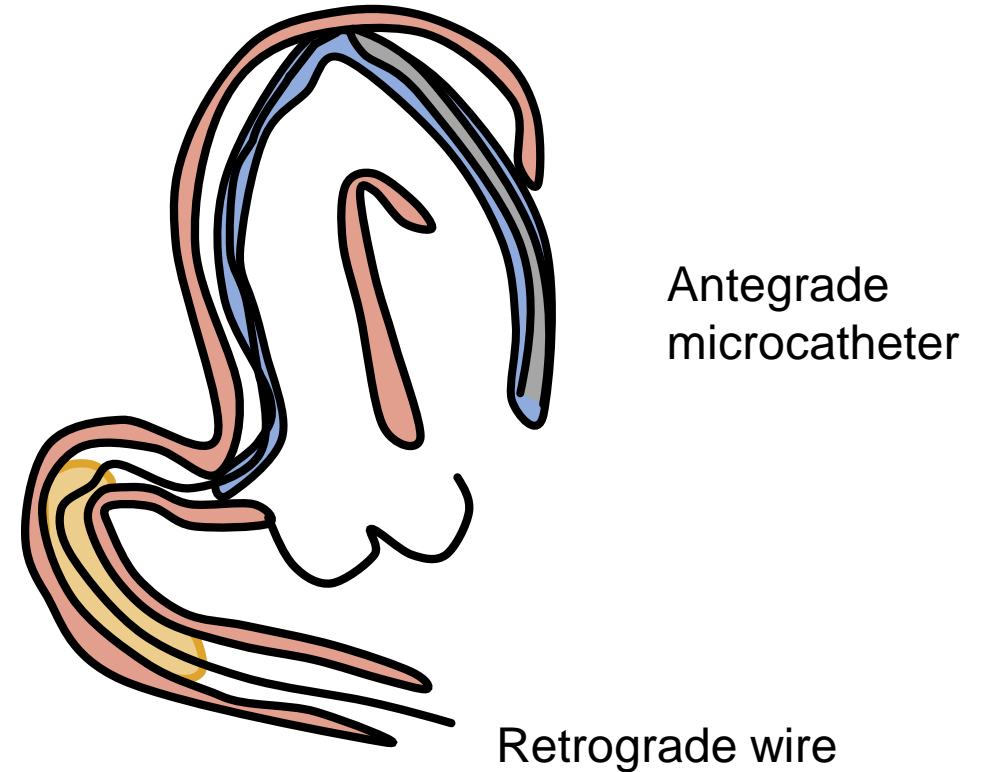
Another Retrograde technique

Rendezvous technique

In coronary



In guiding catheter



Messages

- The current reverse CART technique has evolved significantly over time with the introduction of new dedicated equipment and techniques.
- We should understand the underlying concepts and the procedural steps of each technique. This in turn will aid appropriate selection and application of these wire crossing techniques and also facilitate communication and teaching.
- Prospective validation of the usefulness of the classification and examination of the clinical impact of techniques are required.
- The innovation is required in contemporary intervention era.