

Bifurcation Treatment in the Setting of CTO-PCI: Special Considerations

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Disclosure

- I, Gerald S. Werner, MD, have received speaker fees from
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- Philips-Volcano
- Siemens
- Terumo

STATE-OF-THE-ART REVIEW

CTO and Bifurcation Lesions

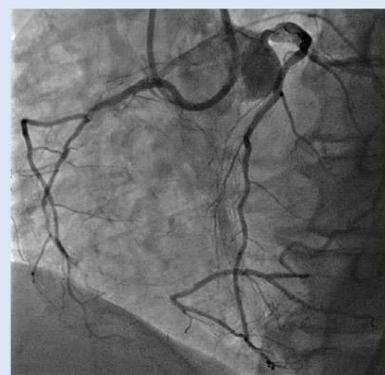
An Expert Consensus From the European Bifurcation Club and EuroCTO Club



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CENTRAL ILLUSTRATION CTO Lesions Associated With Bifurcations

A Bifurcations in up to 49% of CTO Cases



Proximal cap
35%

CTO body
27%

Distal cap
38%

B Dedicated Microcatheters

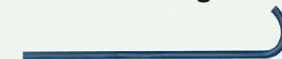
Dual Lumen Microcatheters:

- Allow to maintain wire position at main vessel, while accessing the side branch
- Facilitate side branch wiring

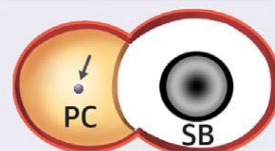


Angulated Microcatheters:

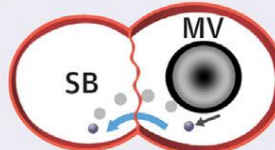
- Useful for side branch wiring in cases of unfavorable angulation of side branch origin



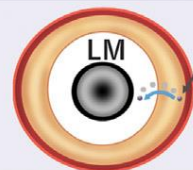
C IVUS



Resolves cap ambiguity in proximal bifurcation location



Guides side branch rewiring in case of subintimal tracking



Guides re-entry in retrograde approach of LAD/Cx ostial CTO

D Treatment

- General principles of bifurcation treatment apply to the setting of CTO-bifurcation
- Wiring the side branch required
- Provisional stenting in most of the cases
- Two-stent strategies when:
 - Difficult access to the side branch
 - Long diseased/dissected segment at the side branch

Bifurcation can be the central problem of a CTO

- The most frequent problems where a bifurcation is encountered within a CTO are:
 - Bifurcations at the entry into the CTO disguising the proximal cap of the occlusion
 - At the distal end of the occlusion, with the risk of losing one of the branches in case of subintimal entry into the cap
 - In the middle of a CTO we may have a number of relevant side branches

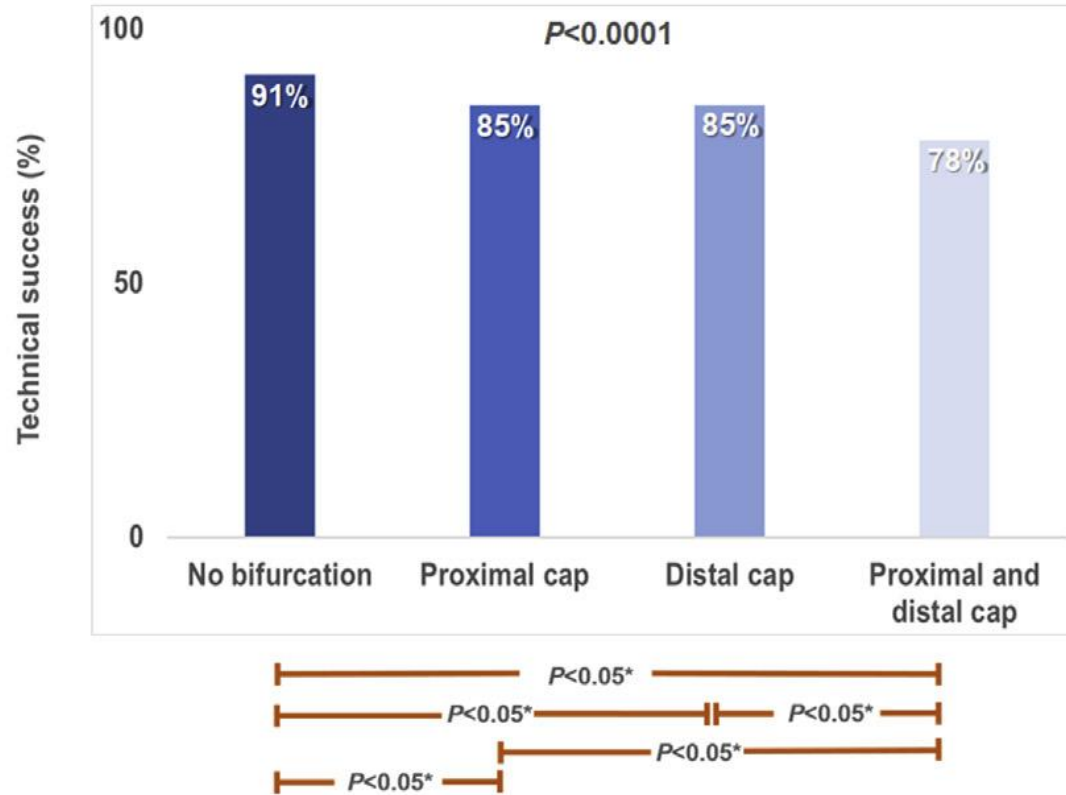
TABLE 1 Frequency of Bifurcation Lesions in CTO Series

First Author (Ref. #)	Year	CTOs, n	Bifurcations, n	Bifurcation CTO, %	Proximal Cap, %	CTO Body, %	Distal Cap, %
Chen et al ⁸	2012	659	254	38	53		47
Galassi et al ⁹	2015	922	244	26	12	43	45
Ojeda et al ¹⁰	2017	391	130	33	25	23	52
Ojeda et al ¹¹	2018	922	267 (238) ^a	28 (26) ^a	40	25	35
Baystrukov et al ¹²	2018	335	182 (146) ^a	54 (44) ^a	36	29	35
Adachi et al ¹³	2021	1,207	314 ^b	26	46	26	28
Nikolakopoulos et al ¹⁴	2022	4,584	3,027	67	32	14	21
Overall		9,020	4,418	49	35	27	38

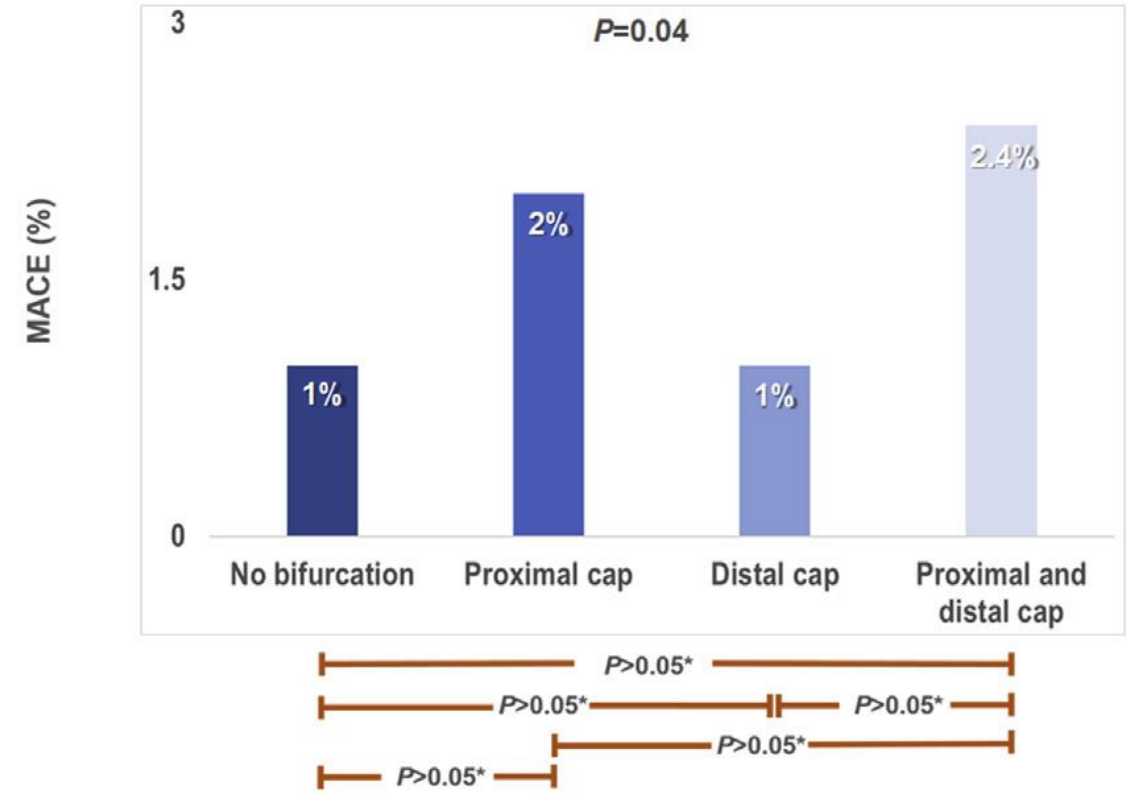


Progress-CTO data analysis 2012-2020

A.



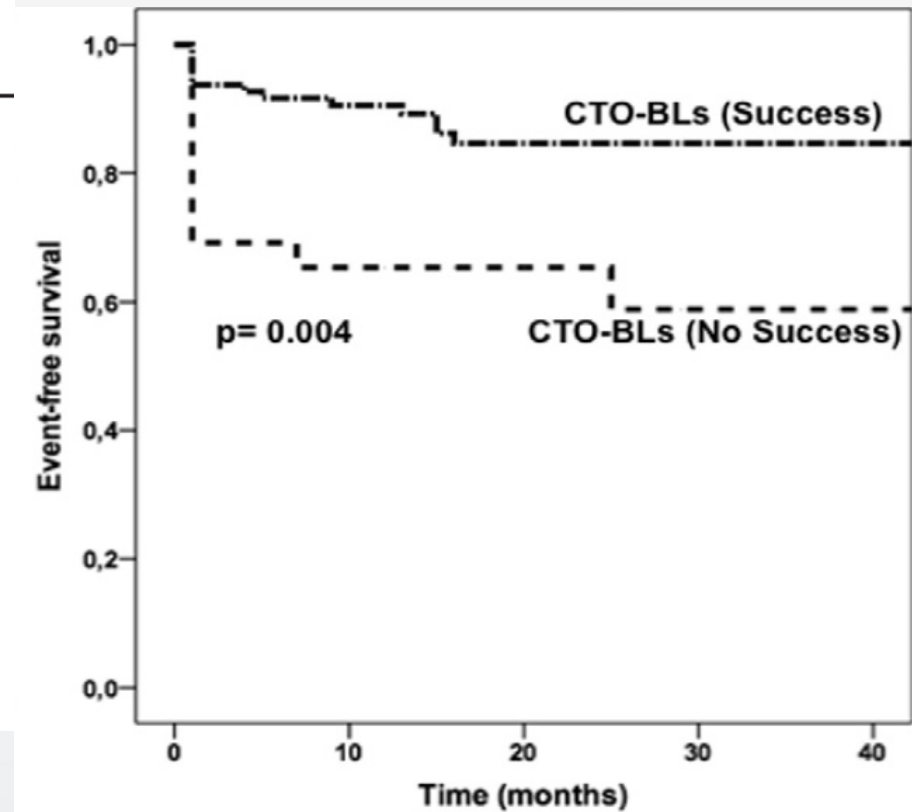
B.



Bifurcation lesions and CTOs

Immediate and clinical outcomes on follow-up

	CTO-BLs (n = 130)	Non CTO-BLs (n = 243)	p
In- hospital events			
Cardiac tamponade	1 (0.8%)	2 (0.8%)	ns
Cardiac death	0	1 (0.4)	ns
Periprocedural MI	13 (10%)	9 (3.7%)	<0.05
Contrast-induced acute kidney injury	3 (2.3%)	5 (2.1%)	ns
Stroke	0 (0%)	0 (0%)	ns
Follow-up events			
Major adverse cardiac events	10 (7.7%)	23 (9.5%)	ns
MI	0	1 (0.4%)	ns
TLR	7 (5.4%)	12 (4.9%)	ns
Cardiac deaths	3 (2.3%)	12 (4.9%)	ns
Probable stent thrombosis	1 (0.8)	1 (0.4%)	ns

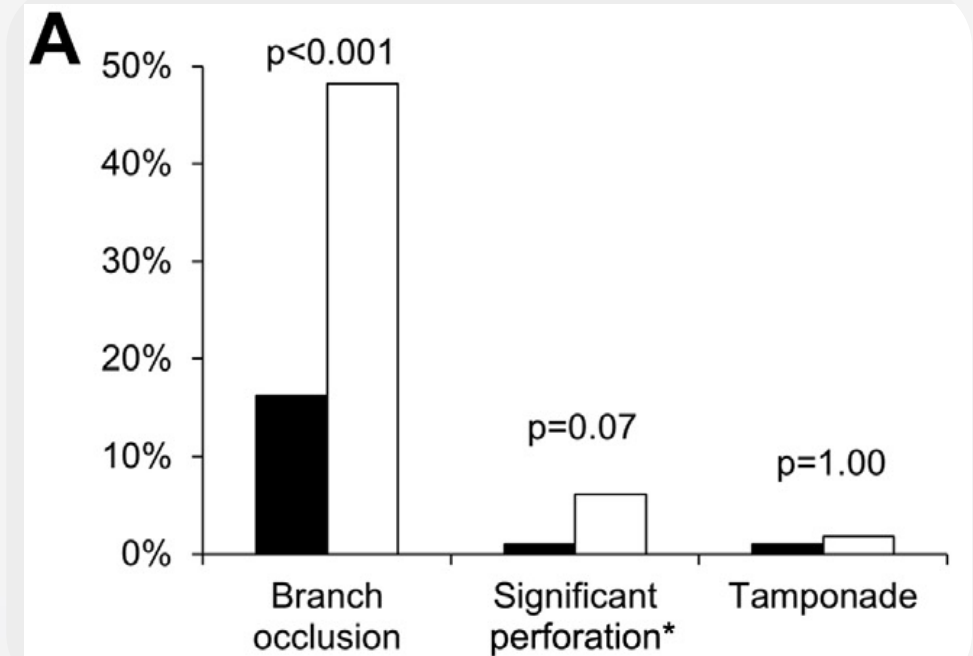
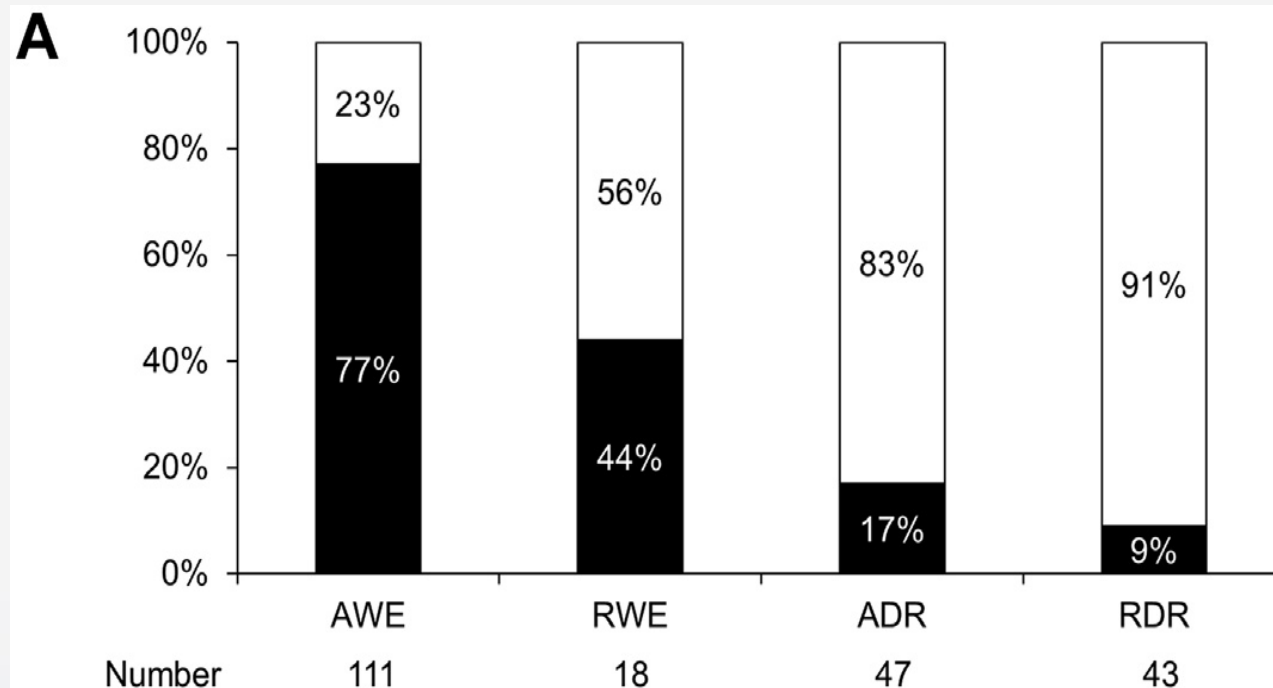


Bifurcation can be the central problem of a CTO

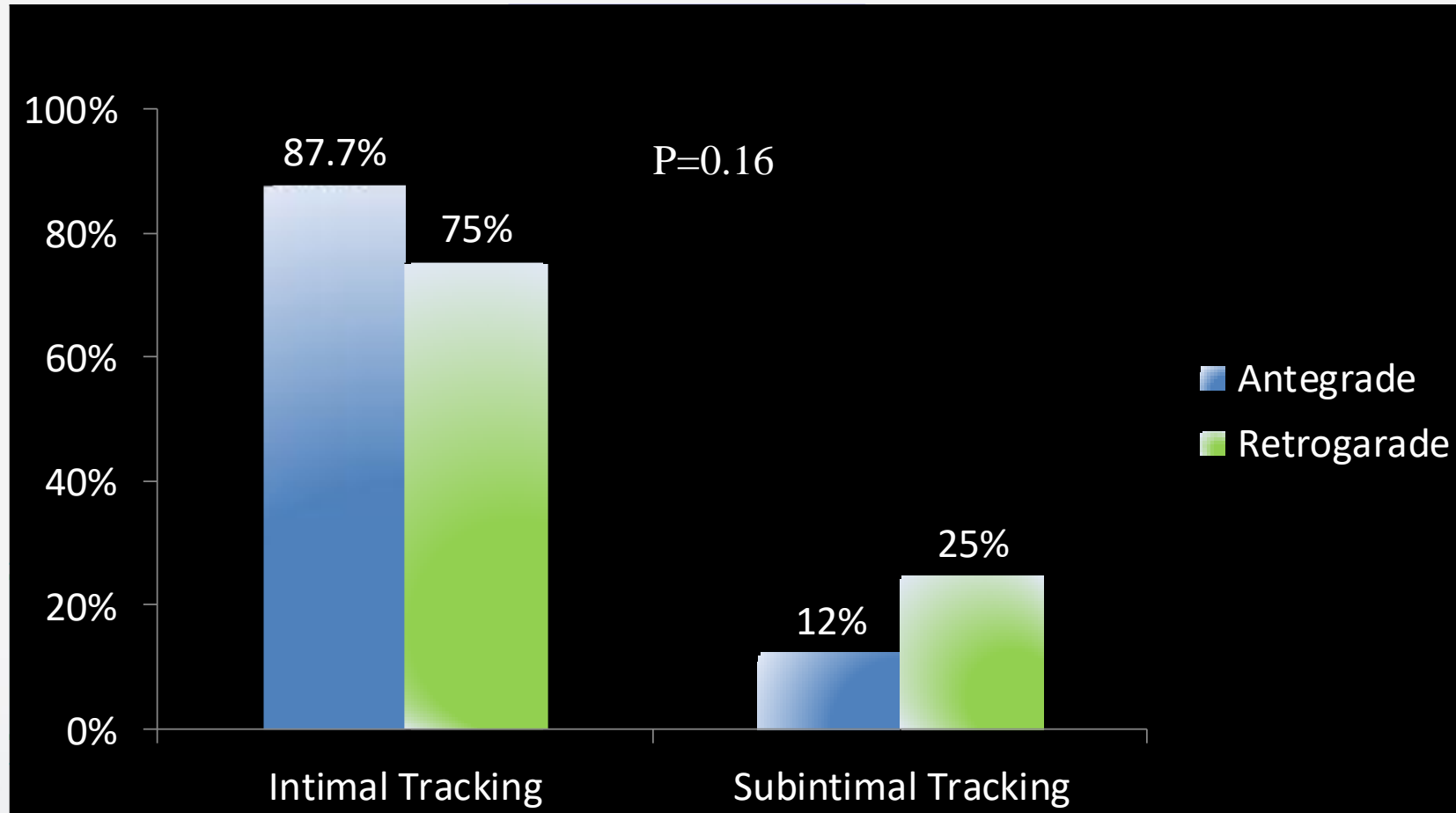
- You should have the goal to preserve major branches of arteries, otherwise your surgeon will tell you he could have done better
- Saving branches must be part of the initial plan

Side branch preservation is not possible with radical dissection techniques

FIGURE 4 Guidewire Tracking Pattern Compared With Angiography-Defined Successful Approach and Difficulty Grades



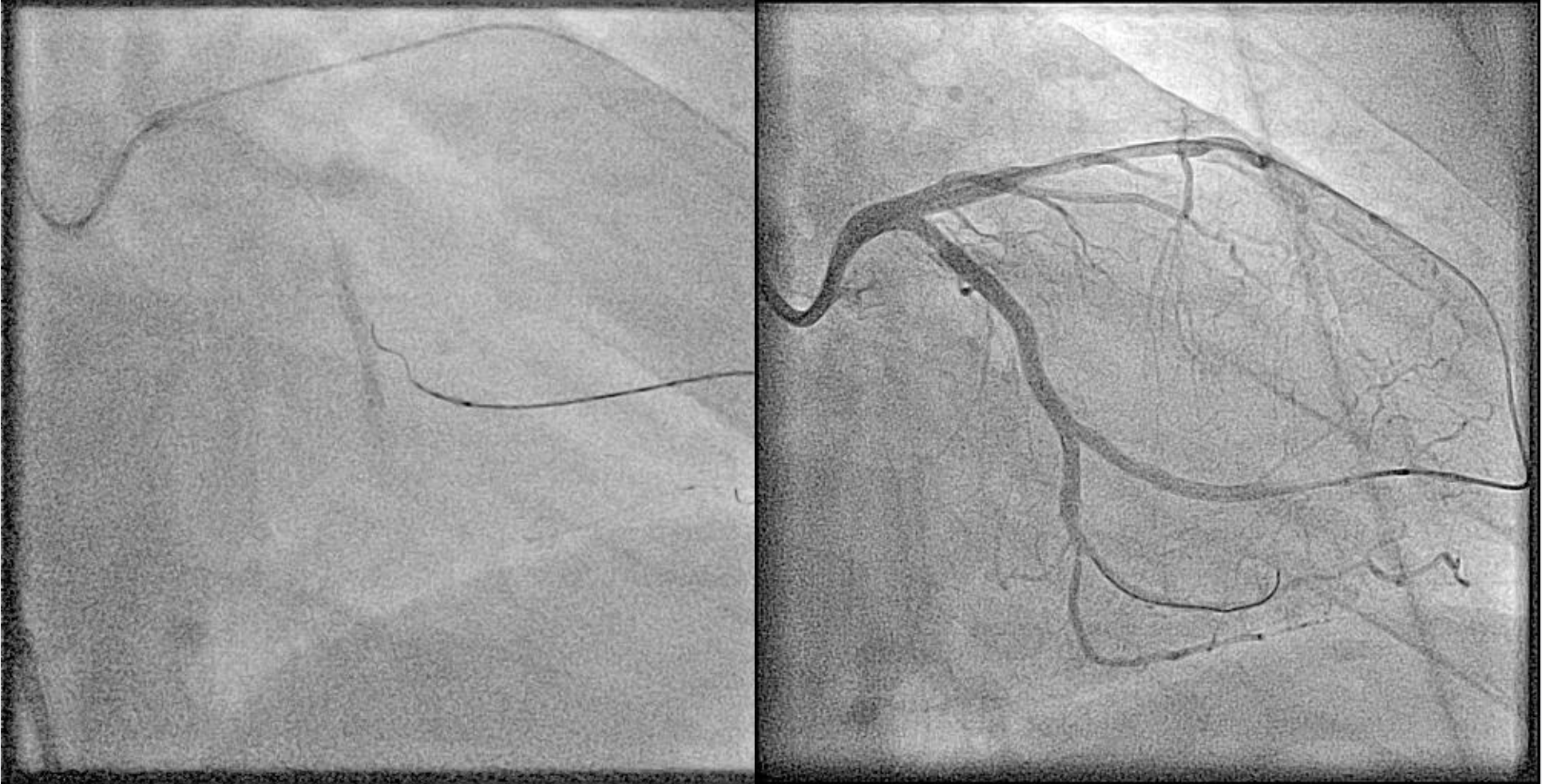
If you follow an anatomic preservation strategy, side branches may be rescued



LCX mid bifurcation



Combined antegrade and retrograde preserving the bifurcation



Bifurcation at the “end” of a CTO

- Besides the problem of the bifurcation itself, the specific problem to do a CTO with bifurcation is...
- that most times it comes at the end of an already lengthy procedure
- that the operator might already be exhausted
- that he thinks he can get away with a single stent technique (justified by the EBC rules)

Specific question in a retrograde approach: *Which is the primary vessel for the bifucation stenting ?*

- If both distal vessels are equally big, choose the one which is not directly supplied by a collateral, as you can always recover the side branch from the retrograde position
- Do not jail your RG3
- But do not give up the distal catheter position before you are satisfied with your bifurcation result

FIGURE 5 Different Mechanisms of Side Branch Compromise in Chronic Total Occlusions With Bifurcation Lesions

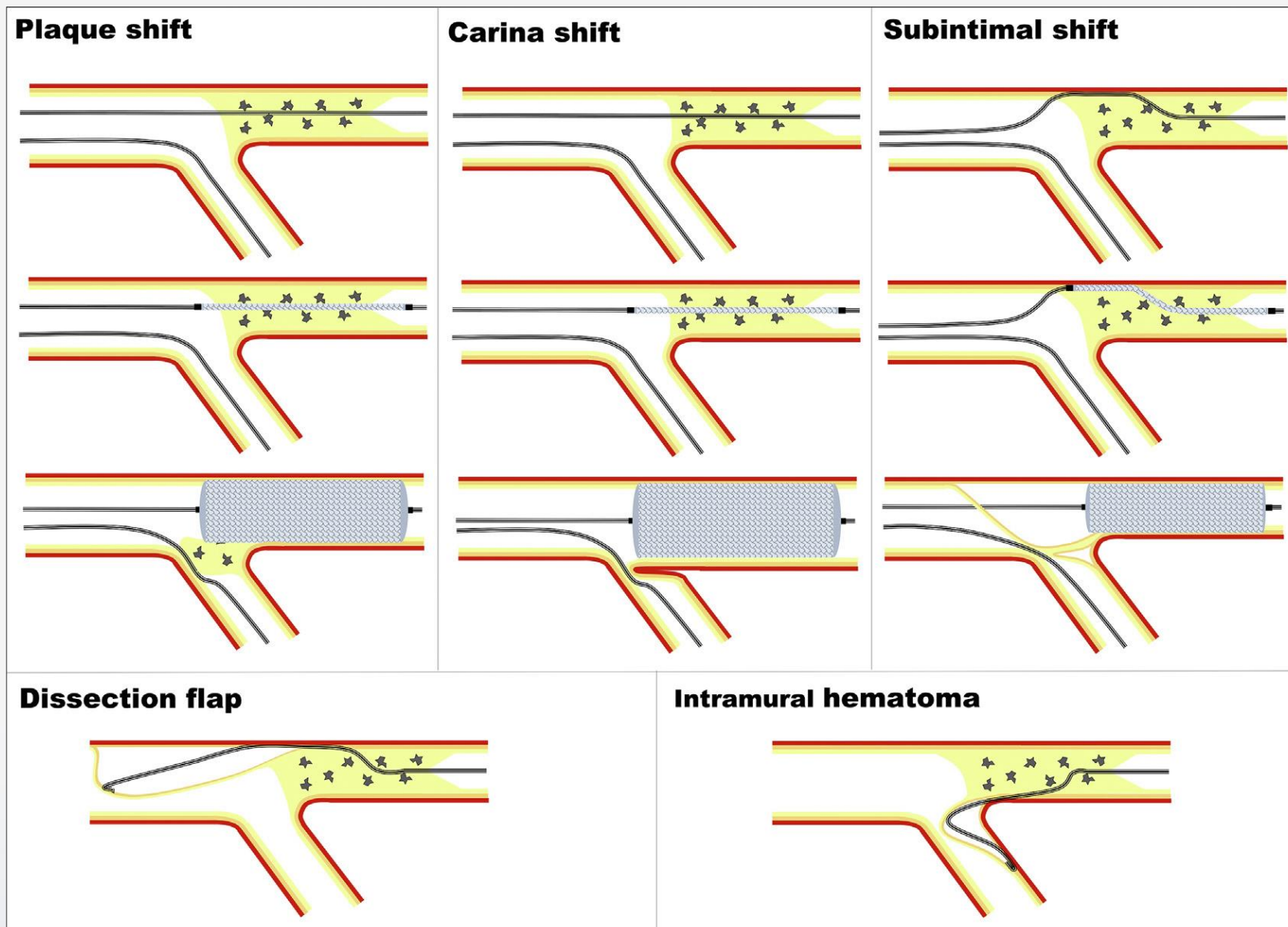
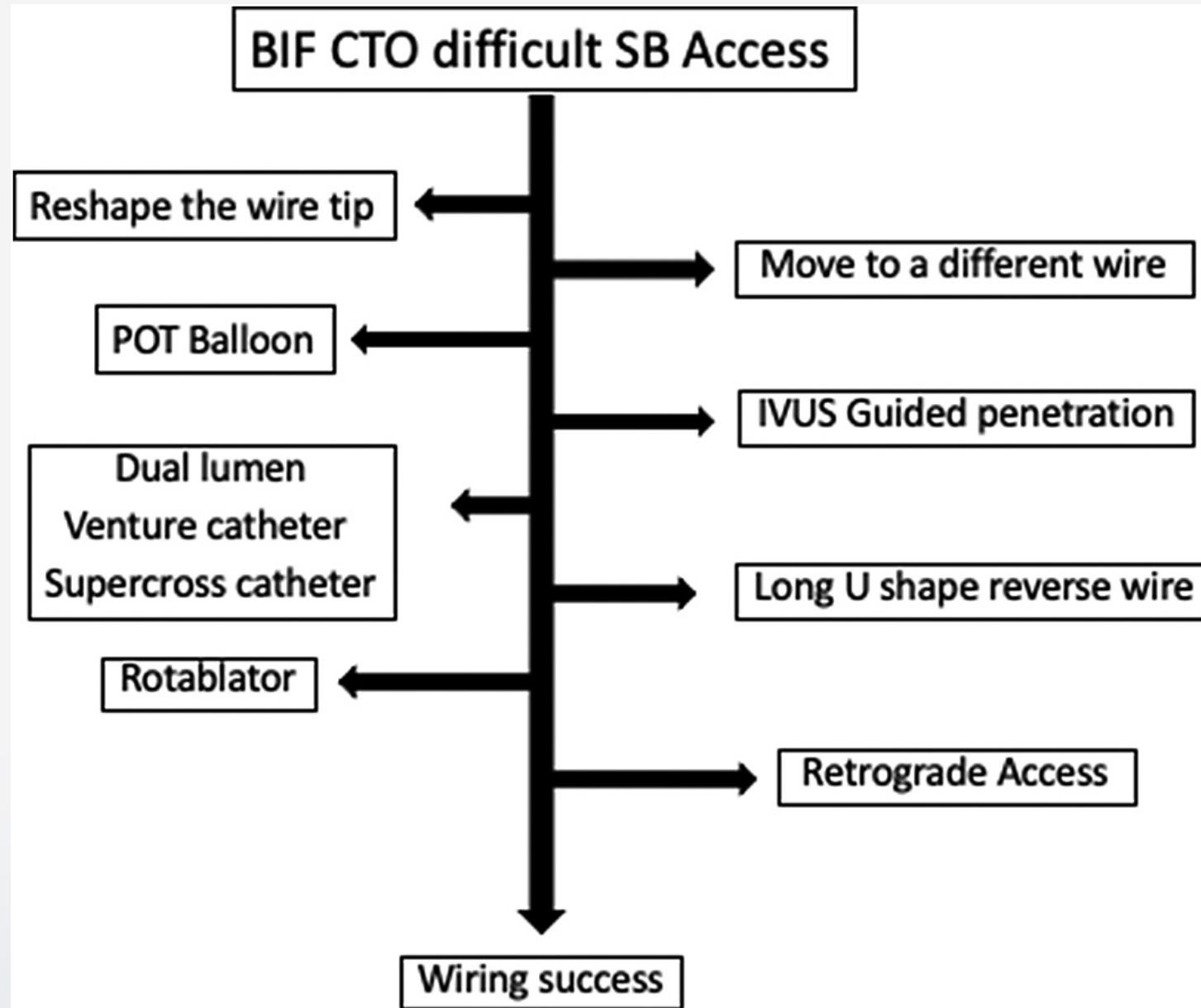


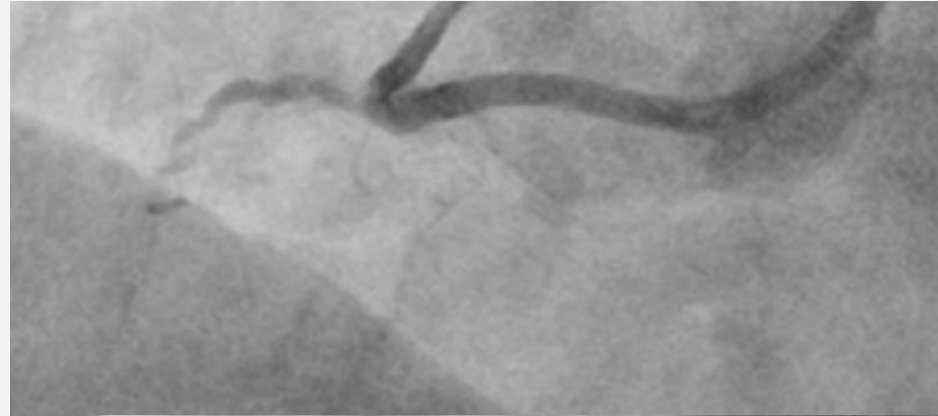
FIGURE 6 Main Wiring SB Approaches in CTO Lesions With Bifurcations



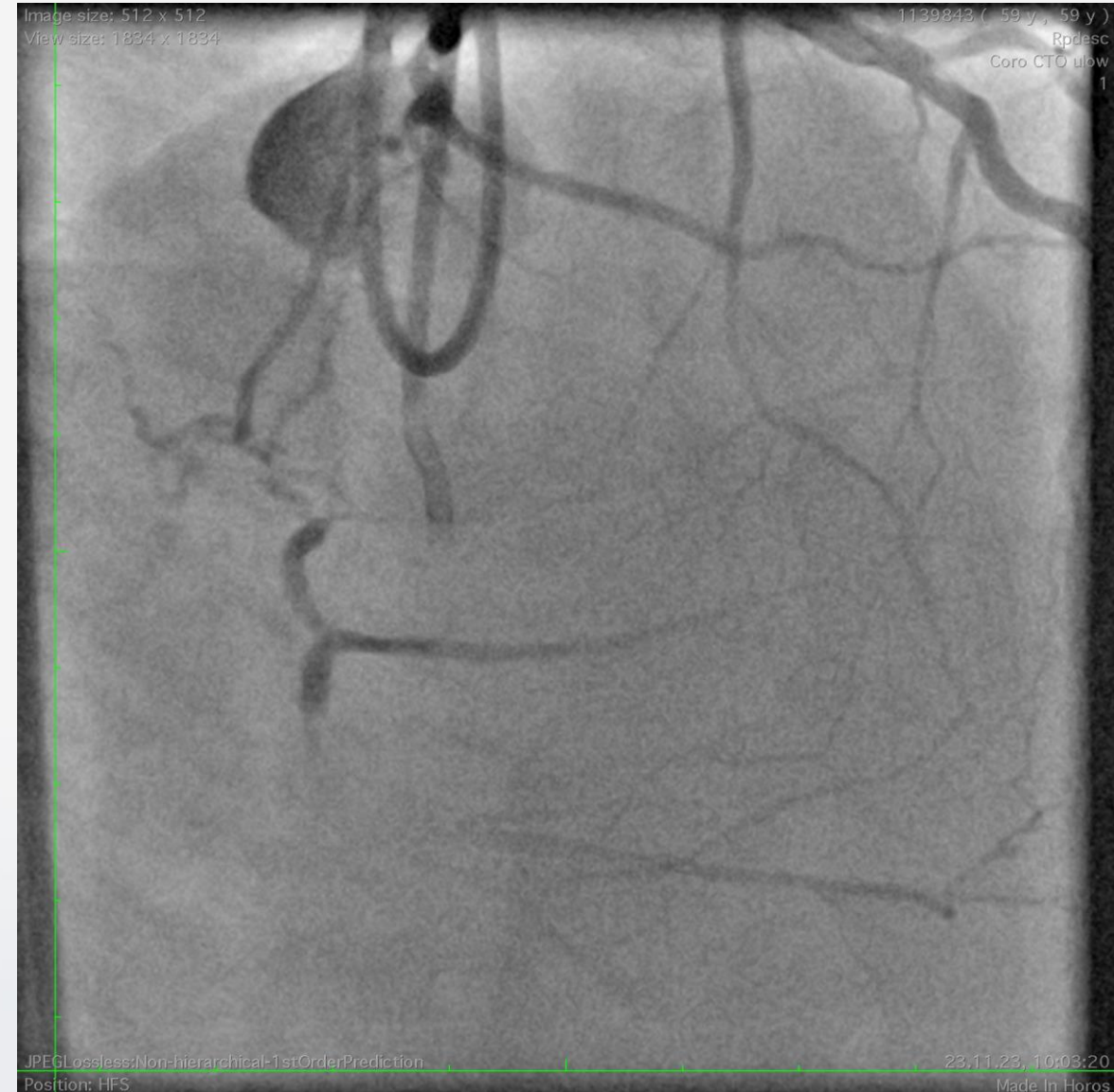
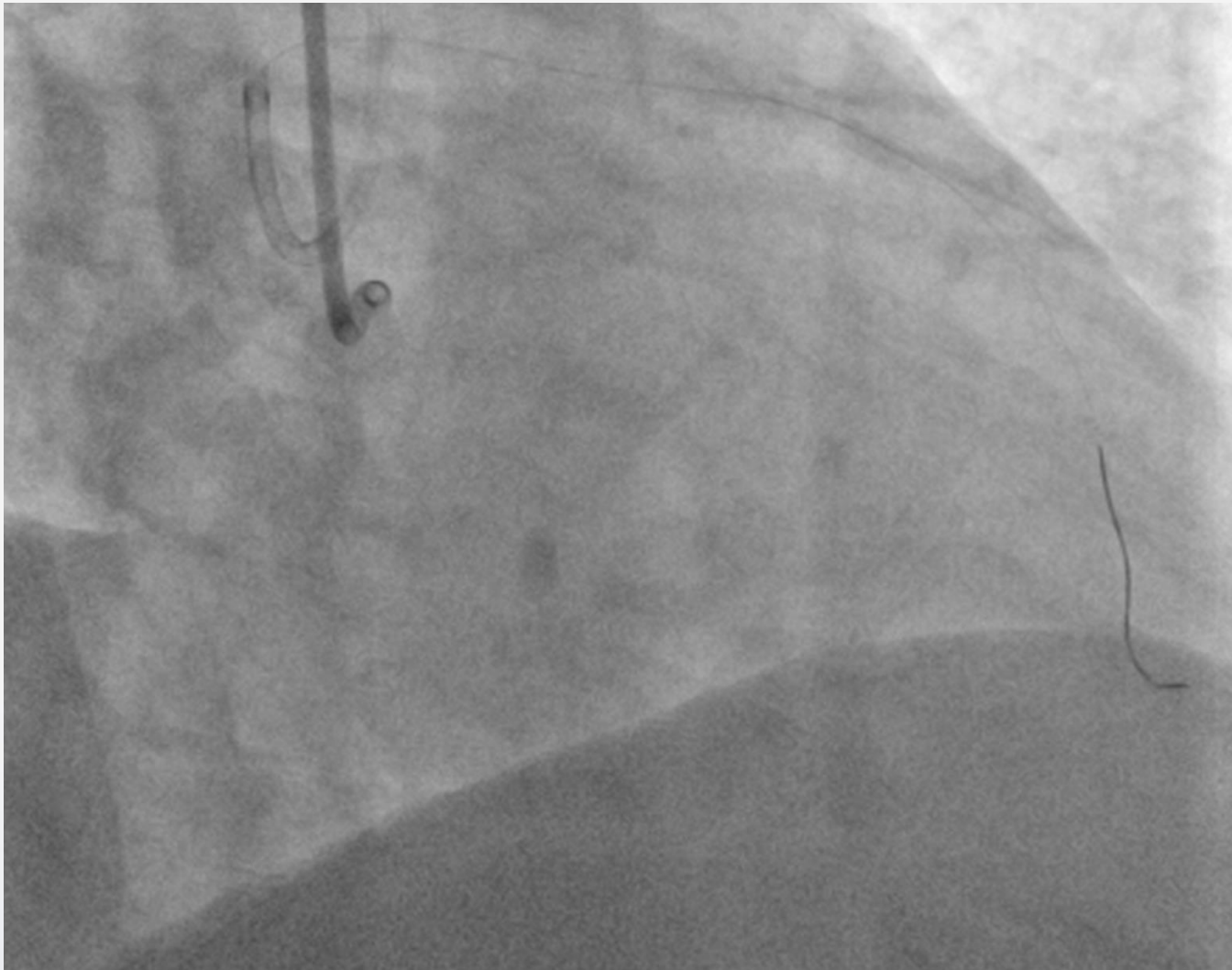
Long RCA CTO with diffuse distal bifurcation lesion at the crux

Strategic problems:

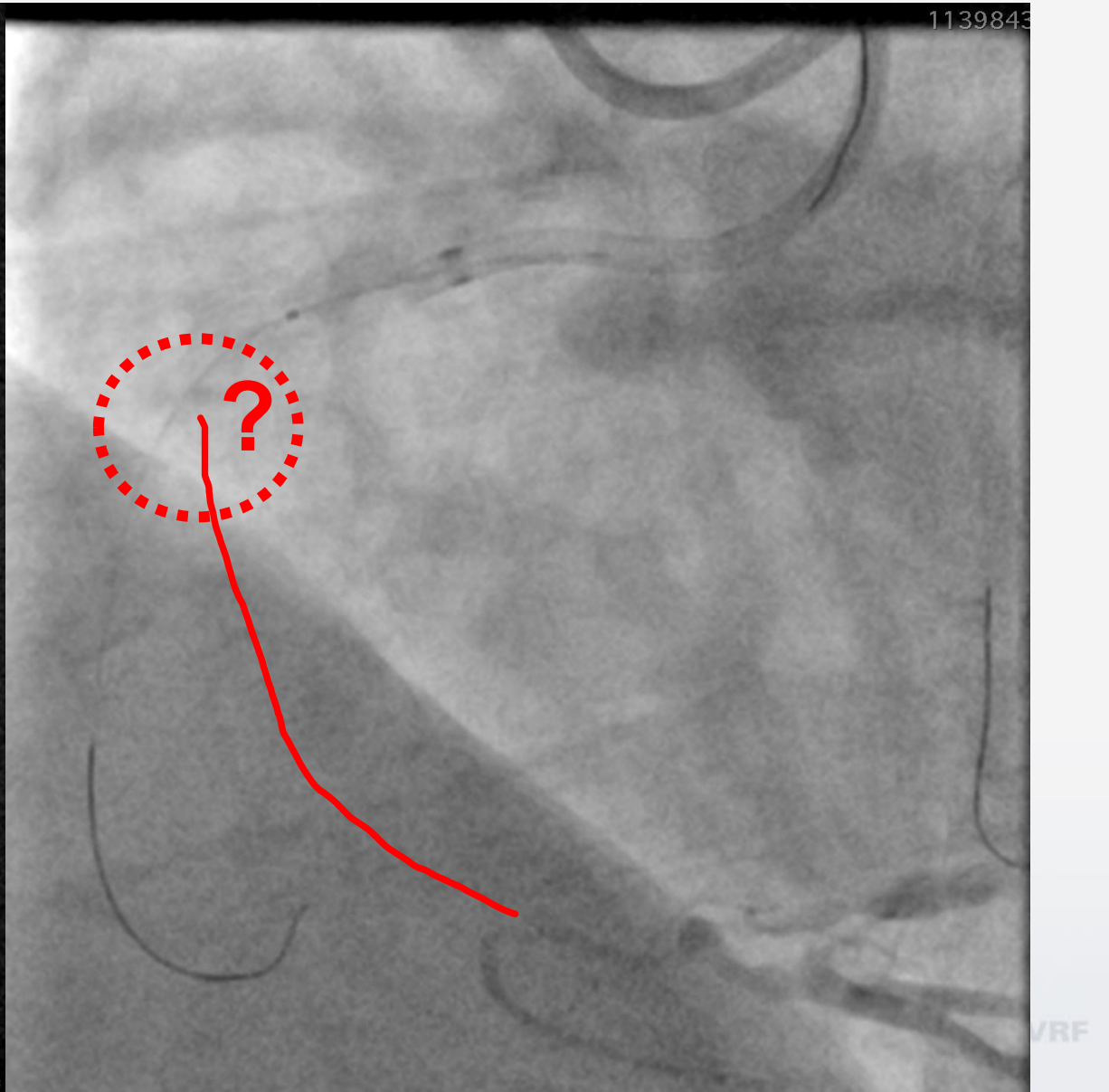
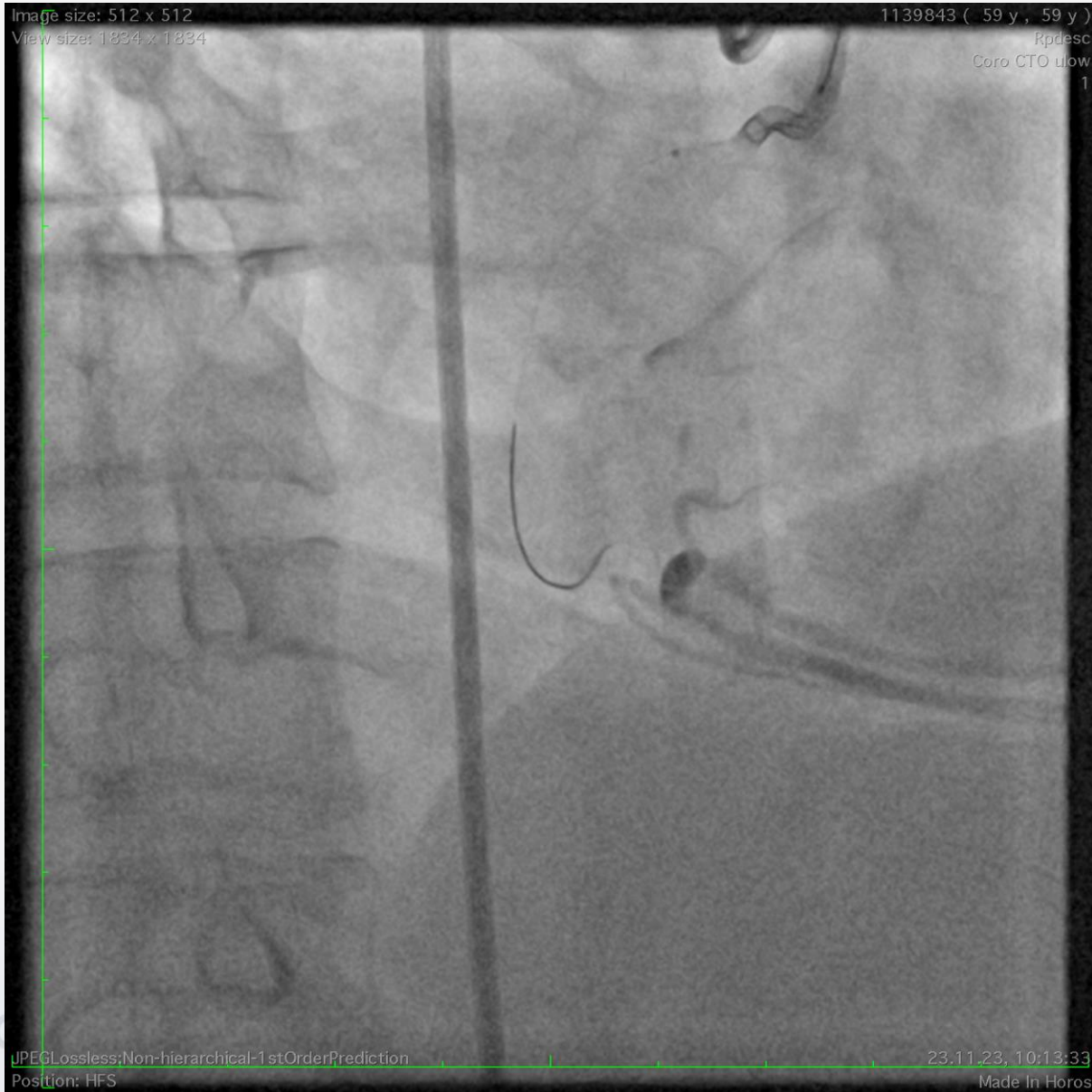
- Long pathway with no anatomic delineation by calcium, possible bend
- Distal cap ambiguous
- Medina 1,1,1 at the crux
- A RCA CTO is only successful if both PL and PD are preserved



Retrograde options: Atrial to PL; Septal to PD



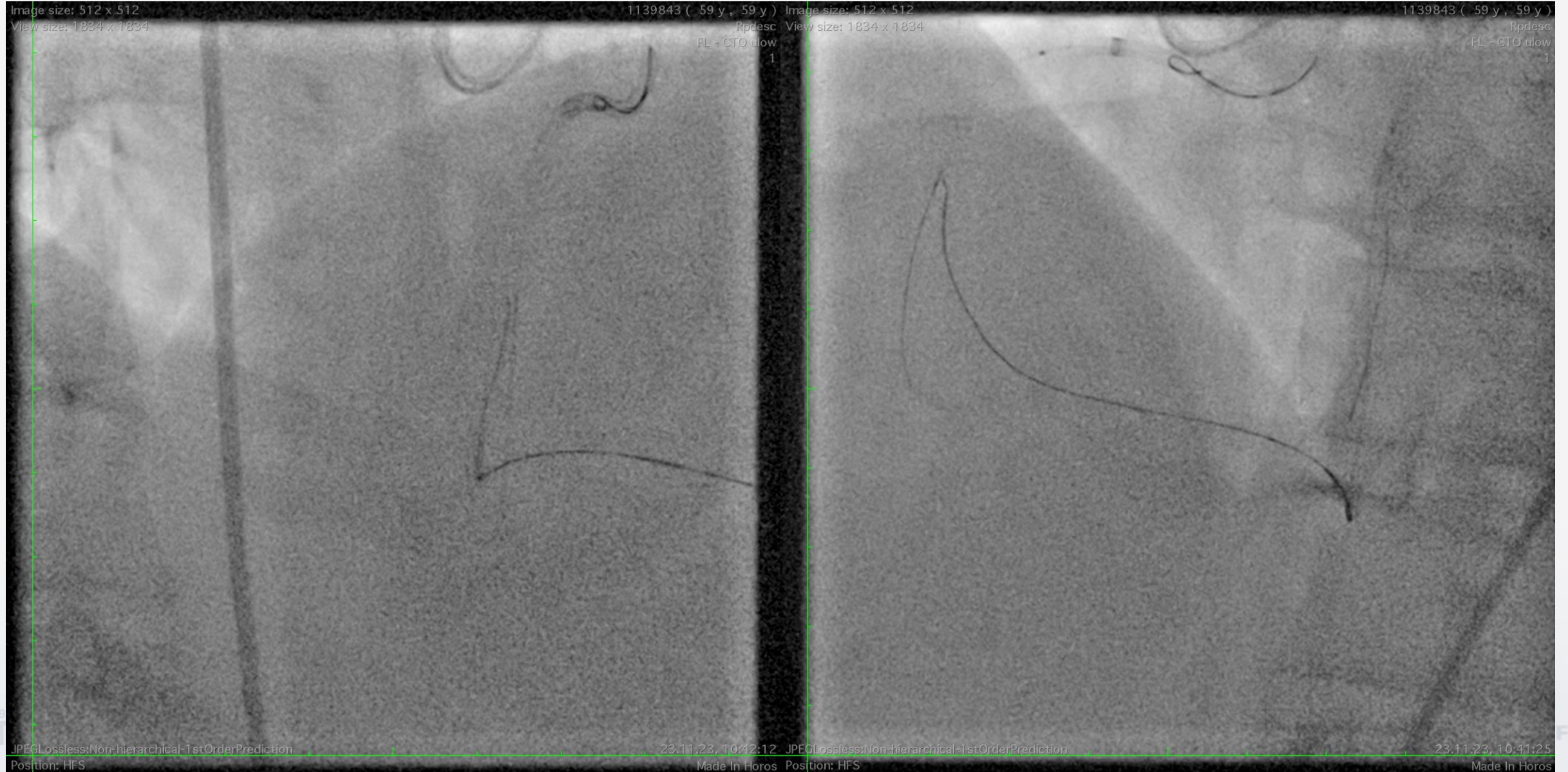
Gladius MG antegrade in a side branch, no idea of the correct direction



Getting to the distal cap from septal pathway



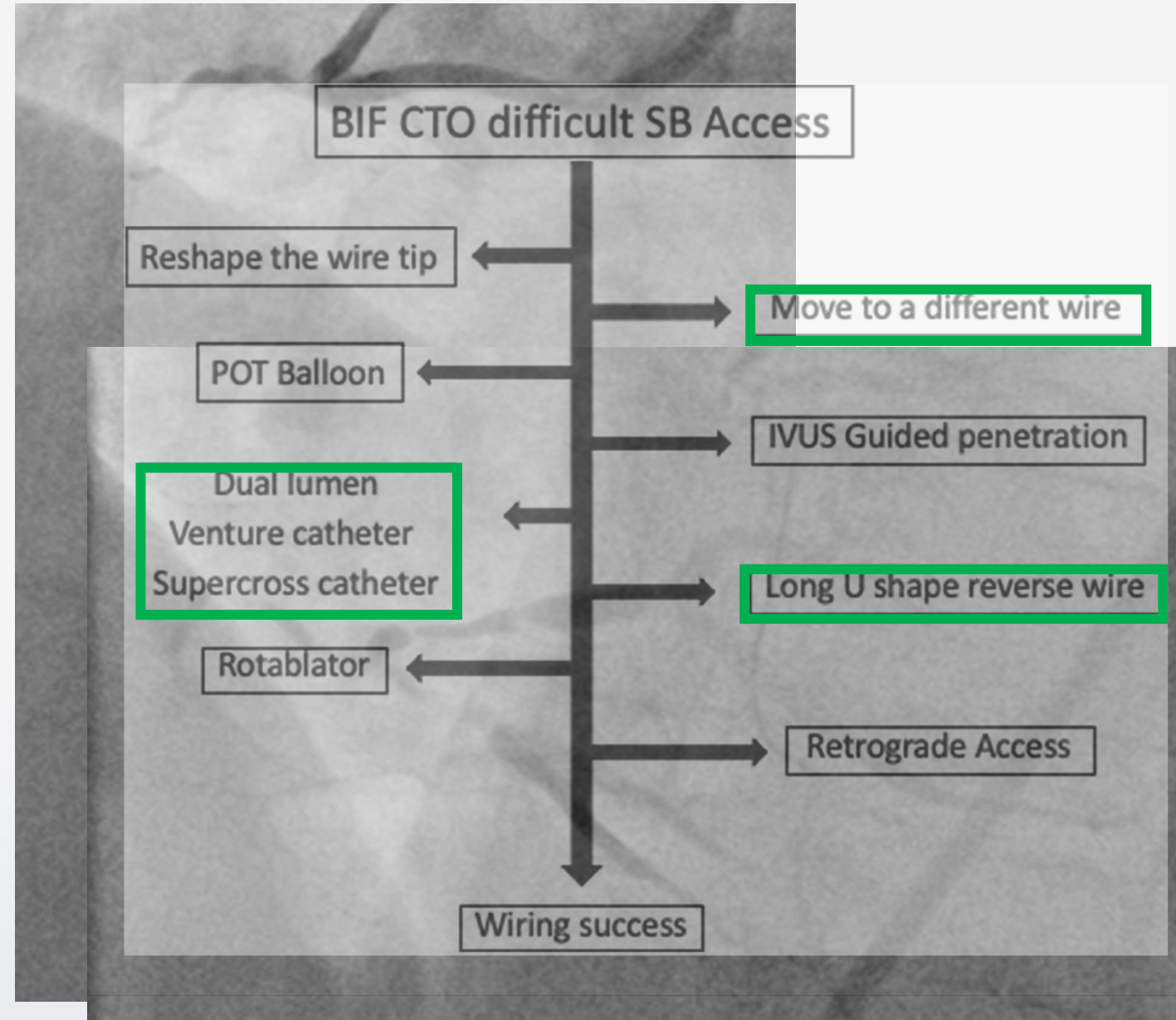
... passing with an Ultimate Bros 3



Long RCA CTO with diffuse distal bifurcation lesion at the crux

Strategic problems:

- Long pathway with no anatomic delineation by calcium, possible bend
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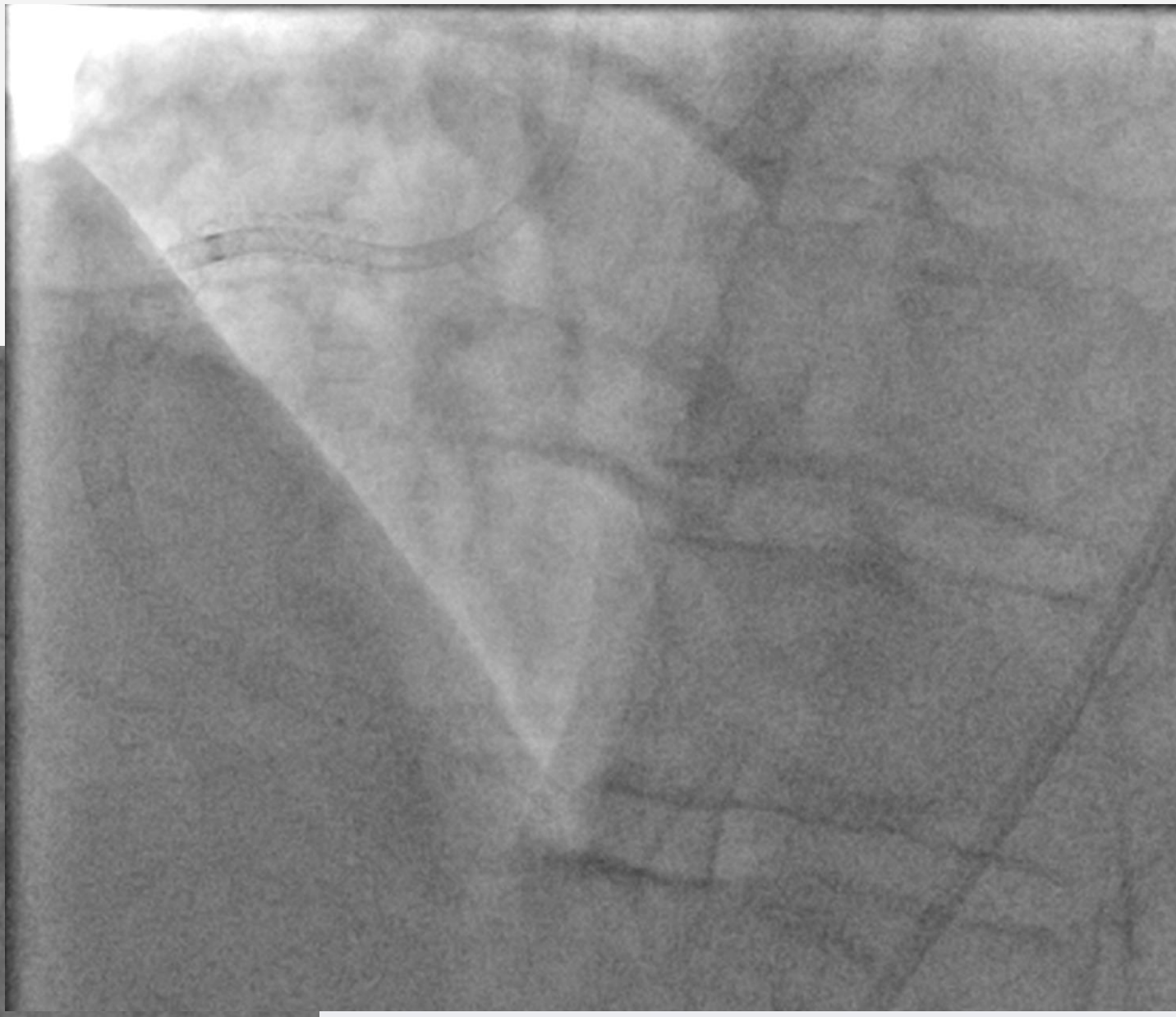
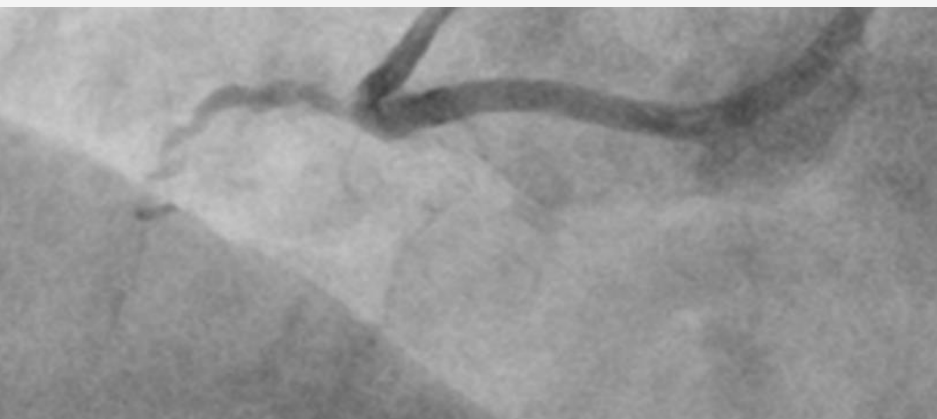
Long RCA CTO with diffuse distal bifurcation lesion at the crux

Solution:

- Stent proximal to the crux, then attempt to secure the PL with dual lumen catheter, fails
- Small diameter balloon across the crux, then reverse wiring with Sasuke and Fielder XTR: successful
- Do not give up the branches, therefore micro Crush for PL and main stent in the PD
- POT, rewiring and final kiss



...and then final result



Bifurcation: the crux of the crux in CTO PCI

- Bifurcations are a frequent problem during the course of revascularizing a CTO
- They must be dealt with like in non-occlusive lesions
- In some cases we need all the technique and technology of complex bifurcation treatment
- IVUS should be used to clarify the plaque load of a distal bifurcation in case of doubt
- Loosing major side branches is a Pyrrhus' victory and should be considered a failure