

CTO Revascularization in 2015

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Disclosure Statement of Financial Interest

**I, Jeffrey W. Moses, MD am a consultant
to BSC ,Abbott,Medtronic (minor)**

False Assumptions about Coronary Chronic Total Occlusions

- **The CTO is well collateralized and therefore there is minimal impact on quality of life and prognosis**
- **CTO is a closed vessel and therefore not at risk for/or during ACS/AMI**
- **CTO outcomes are more benign than non CTO coronary disease**

Current Perspectives on Coronary Chronic Total Occlusions

The Canadian Multicenter Chronic Total Occlusions Registry

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P. Diane Galbraith, BN, MSC,‡ Azriel B. Osherov, MD,* Sergey Yalonetsky, MD,*
Sharon Gannot, BS,† Michelle Samuel,* Max Weisbrod,* Daniel Bierstone,* John D. Sparkes, MSC,*
Graham A. Wright, PhD,* Bradley H. Strauss, MD, PhD*

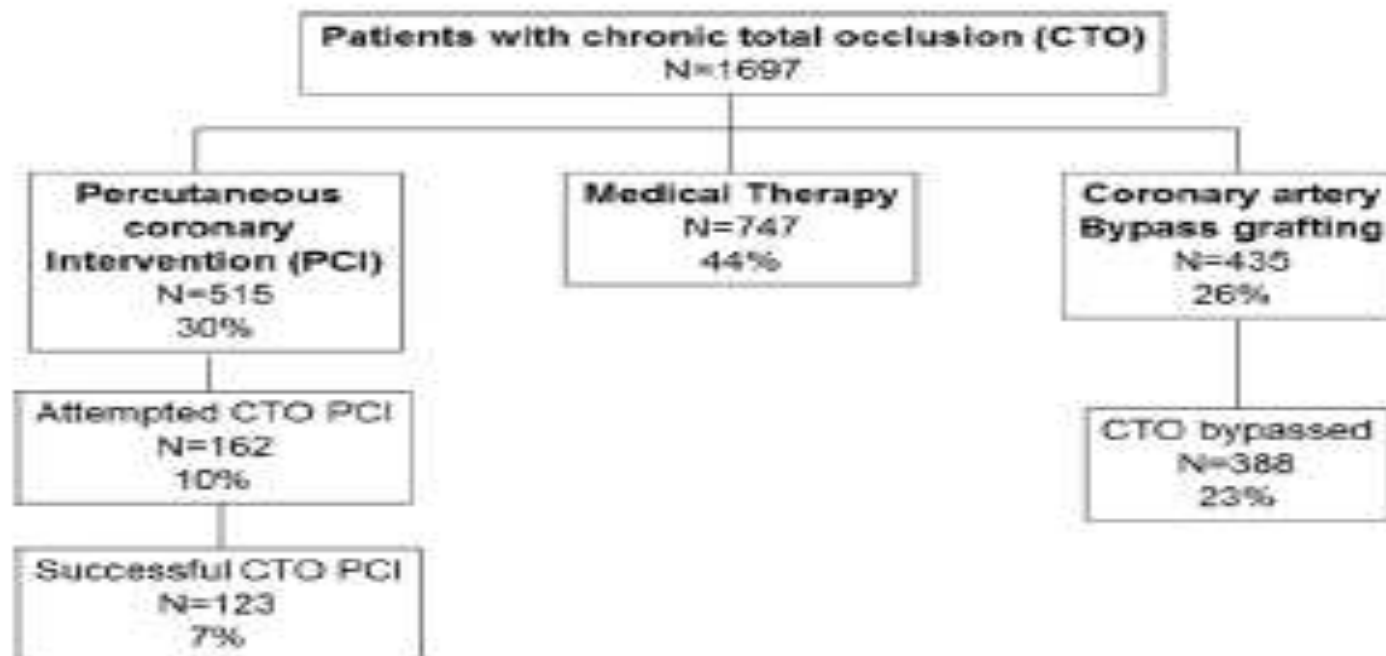


Figure 1 Management of CTO Registry Patients

Flow chart of chronic total occlusion (CTO) registry patients showing management up to 12 months after index angiography. PCI = percutaneous coronary intervention.

Conclusions

Chronic total occlusions are common in contemporary catheterization laboratory practice. Prospective studies are needed to ascertain the benefits of treatment strategies of these complex patients. (*J Am Coll Cardiol* 2012;59:991-7) © 2012 by the American College of Cardiology Foundation

National Attempt Rates ACC-NCDR

National Attempt Rate Over Time



[^] Jan 1 2004-Mar 31 2005

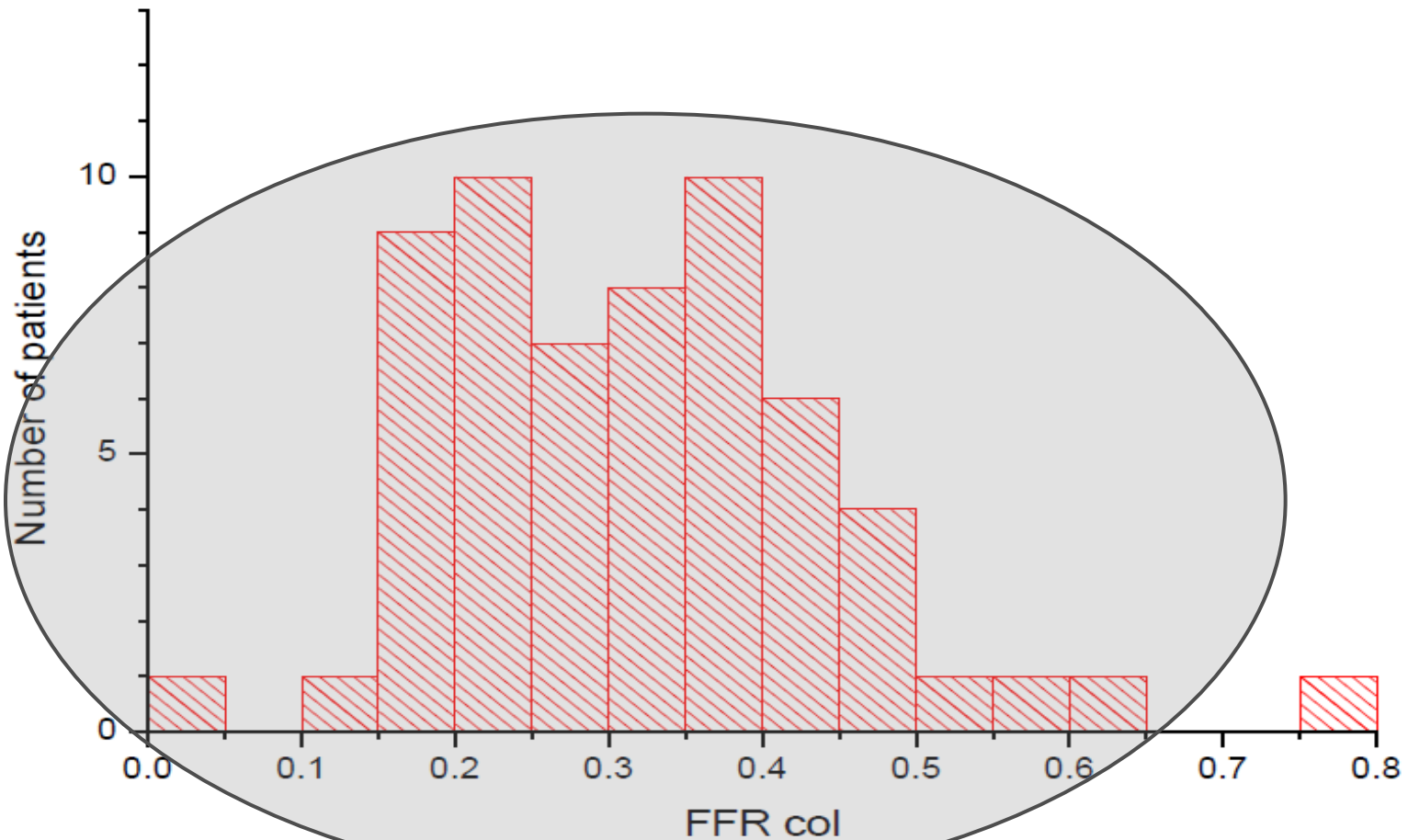
* Through Q3

Clinical Indications

Why Open a Chronically Occluded Coronary Artery?

- **Symptom control**
 - Angina
 - CHF
 - Fatigue
- **Improve LV function**
 - Regional
 - Global
- **Survival**
 - Improved tolerance of AMI
 - Complete revascularization
 - Ischemic Risk

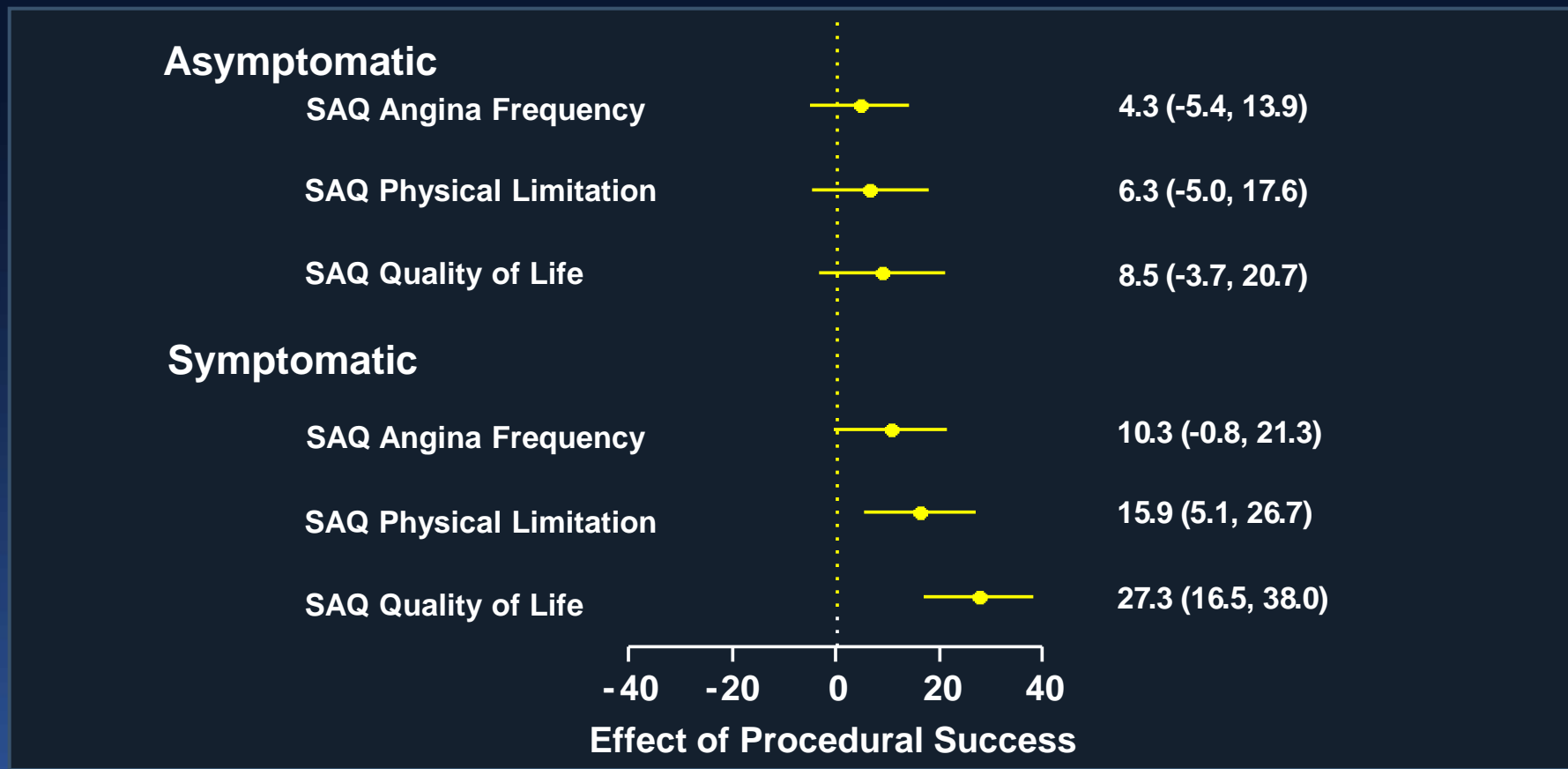
Collaterals are Usually not Sufficient to Substantially Reduce Ischemia in CTO



Modified from Werner GS et al, *European Heart Journal* 2006, courtesy Werner GS

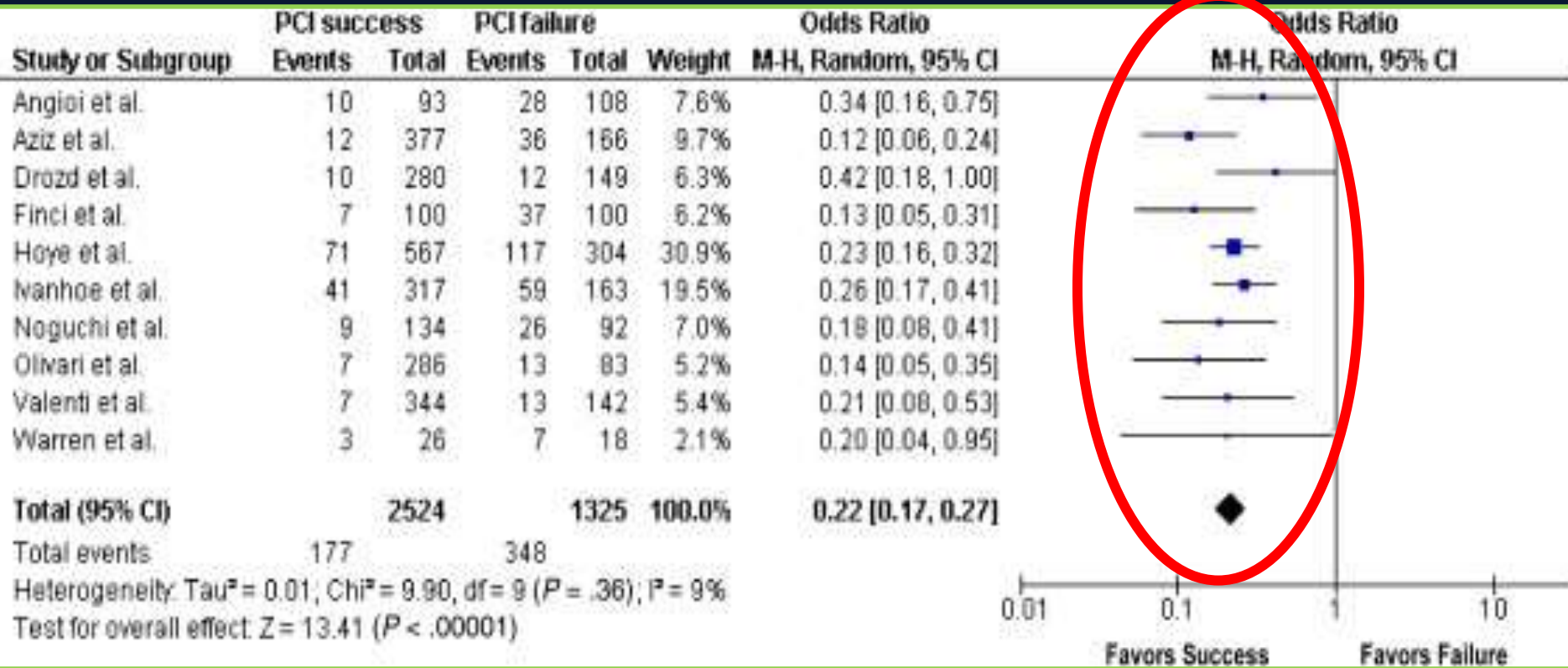
Evidence for Quality of Life Benefit

125 pts completed the Seattle Angina Questionnaire (SAQ) before and one month after PCI. 69 procedural success (55%), 56 failures (45%)



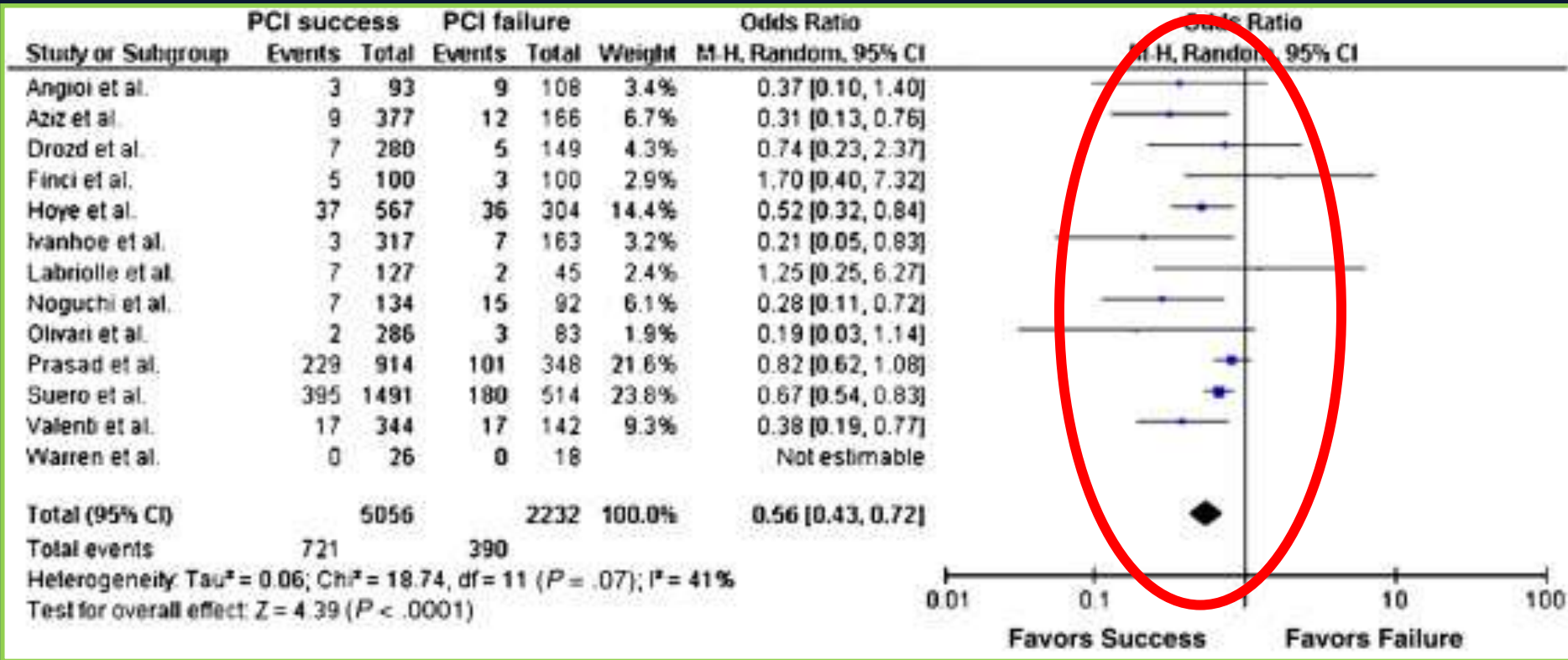
Impact of Successful CTO-PCI: Angina

Long-term angina benefit favors CTO-PCI success



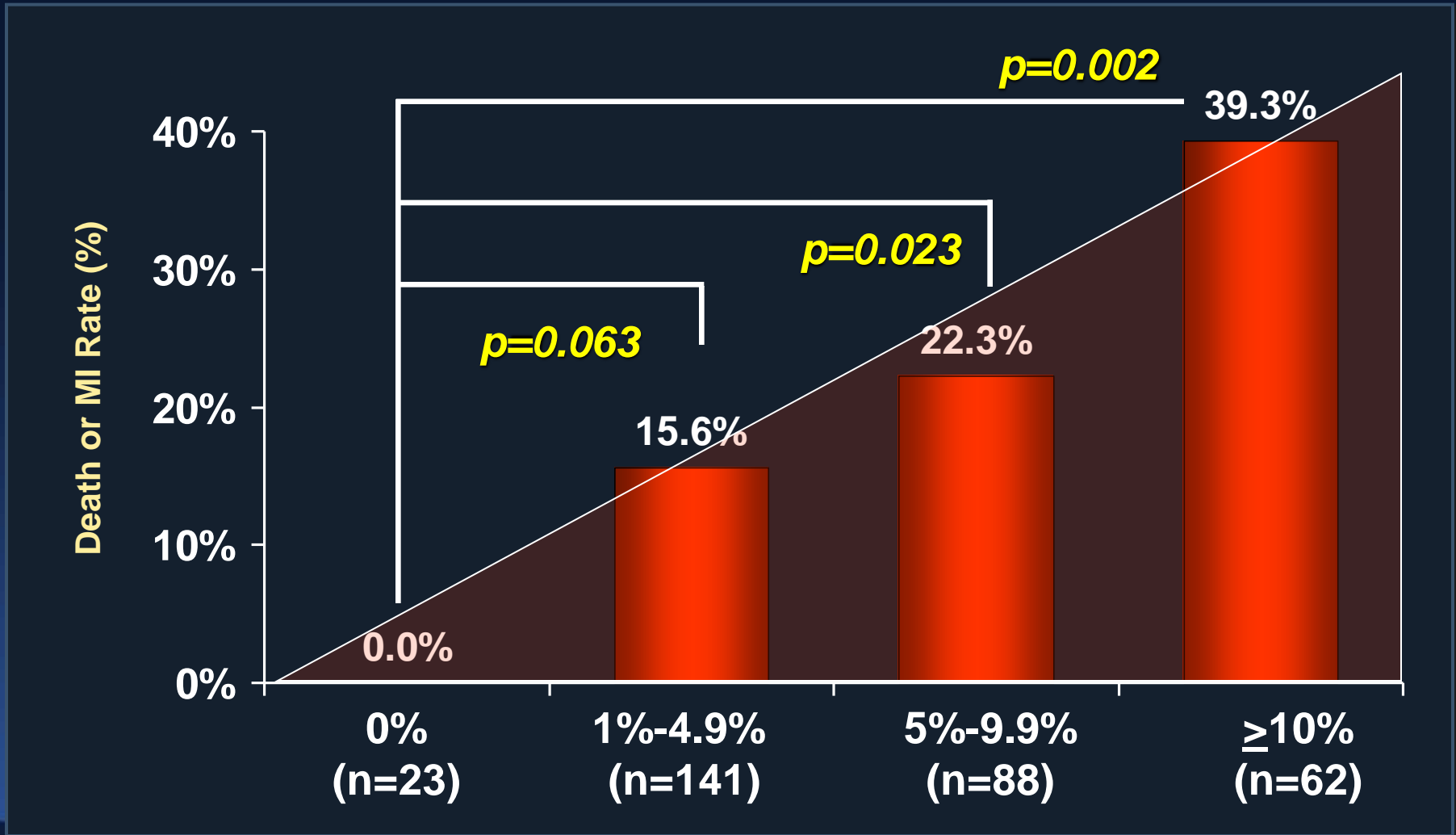
Impact of Successful CTO-PCI: Mortality

Long-term survival benefit favors CTO-PCI success



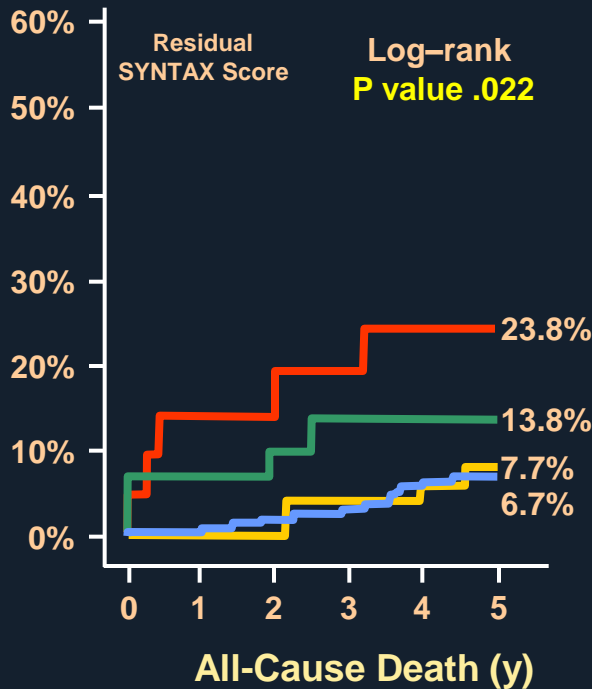
COURAGE

Rates of Death or MI by Residual Ischemia

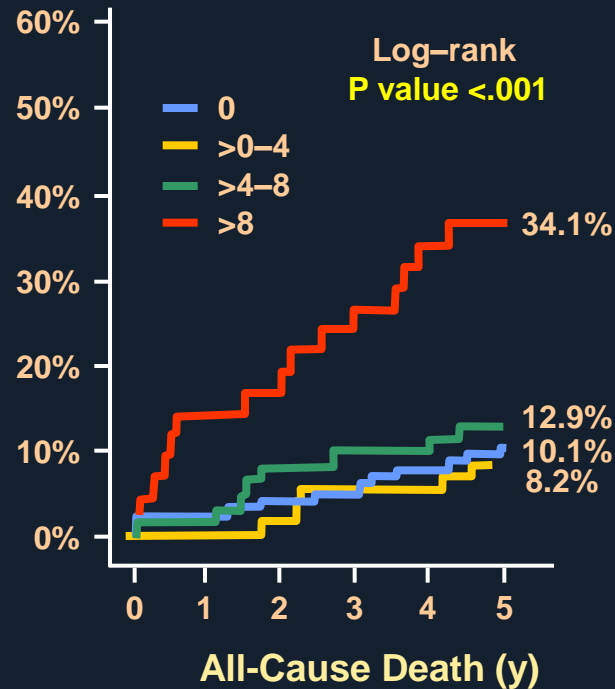


Residual SYNTAX Score in SYNTAX Trial

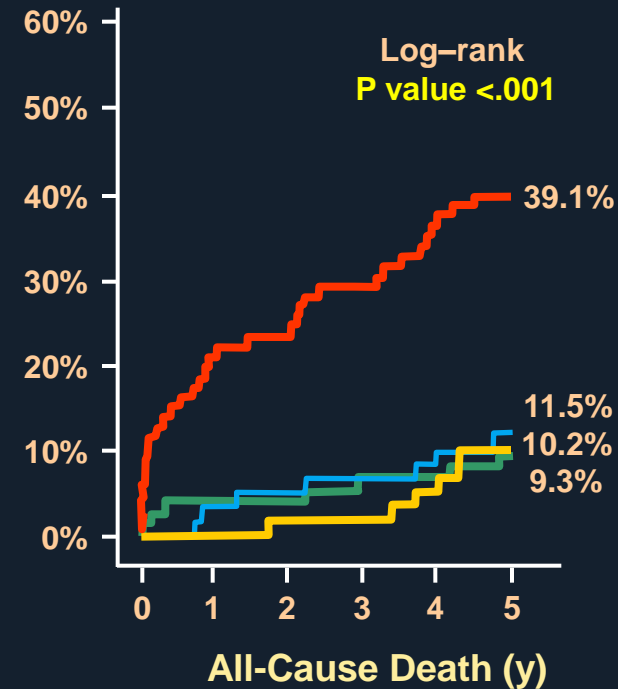
Low Baseline SYNTAX Score (0-22)



Intermediate Baseline SYNTAX Score (23-32)



High Baseline SYNTAX Score (≥33)

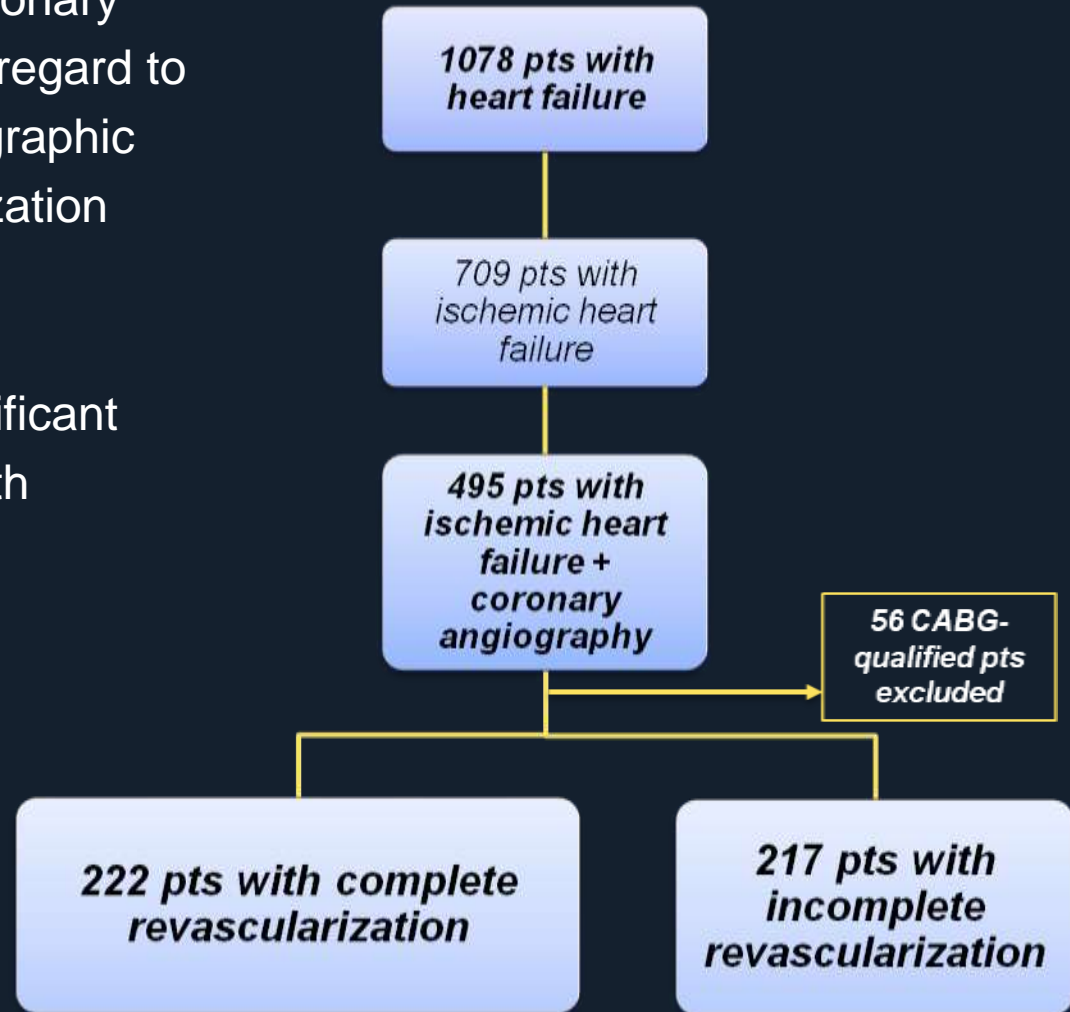


Farooq Circ 2013;128:141

Kereiakes et al, Rev Cardiovasc Med. 2014;15:24-30

Material and Methods

- Retrospective analysis of coronary angiography performed with regard to procedure details and angiographic completeness of revascularization
- Complete angiographic revascularization defined as:
 - No angiographically significant stenosis in all vessels with diameter of at least 2mm
 - Significant stenosis defined as: LM and proximal LAD $\geq 50\%$ MLD and $\geq 70\%$ in all other arteries

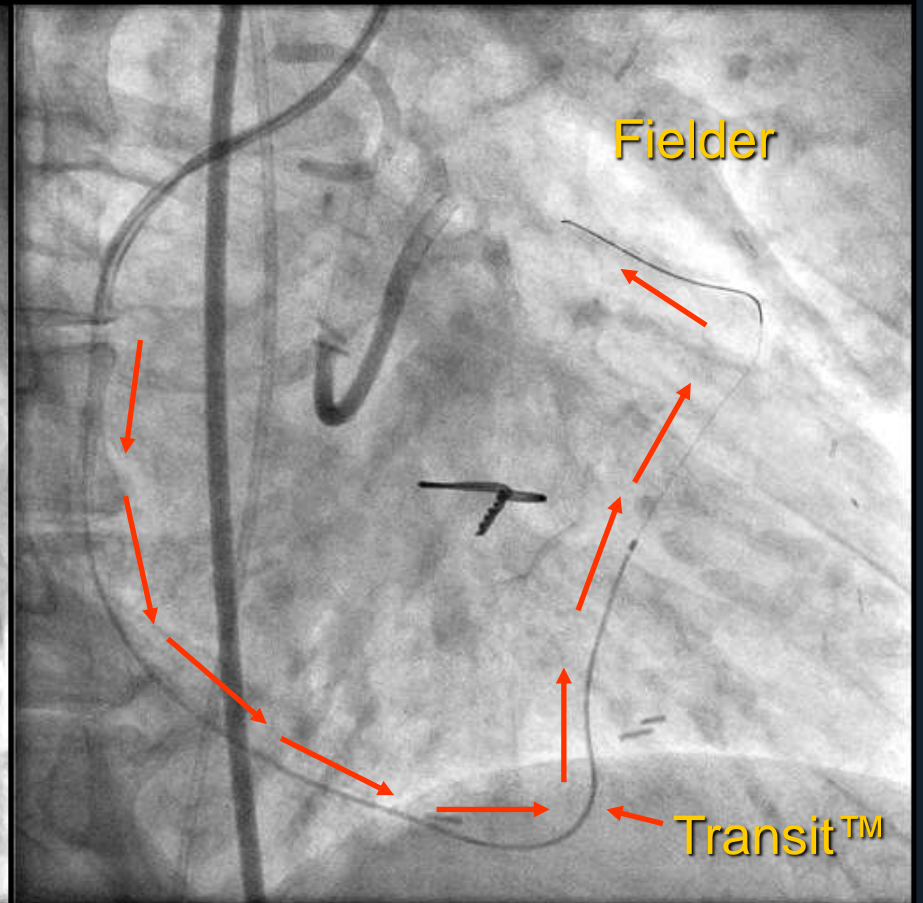
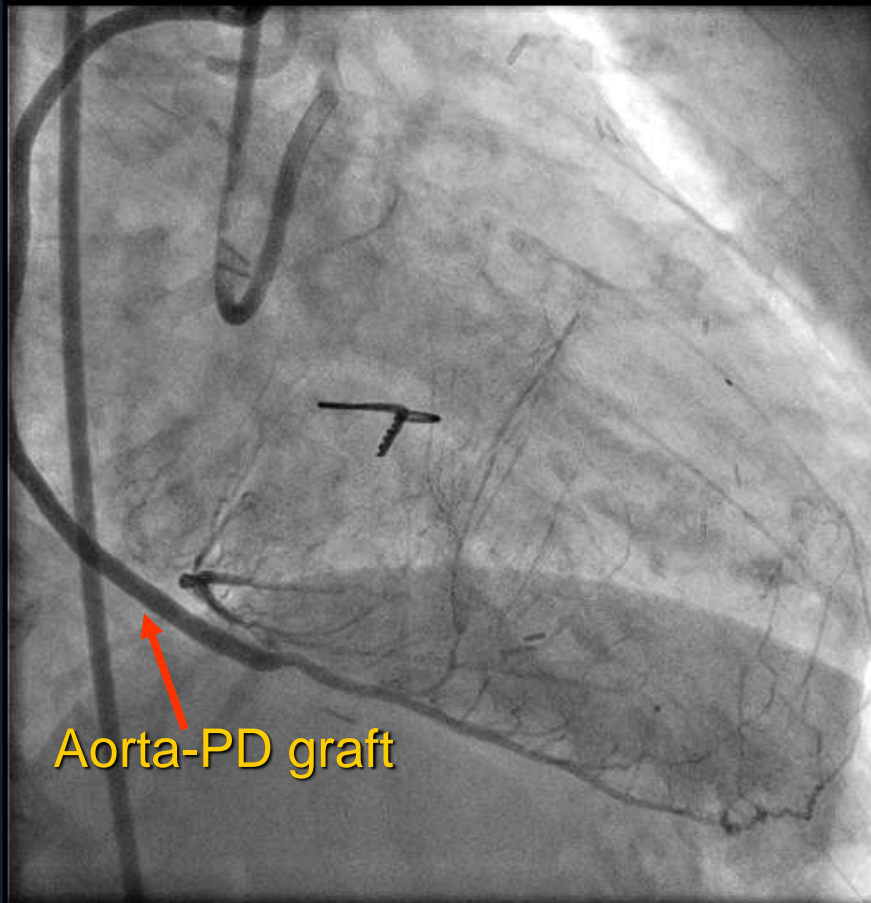


Results

12 Months

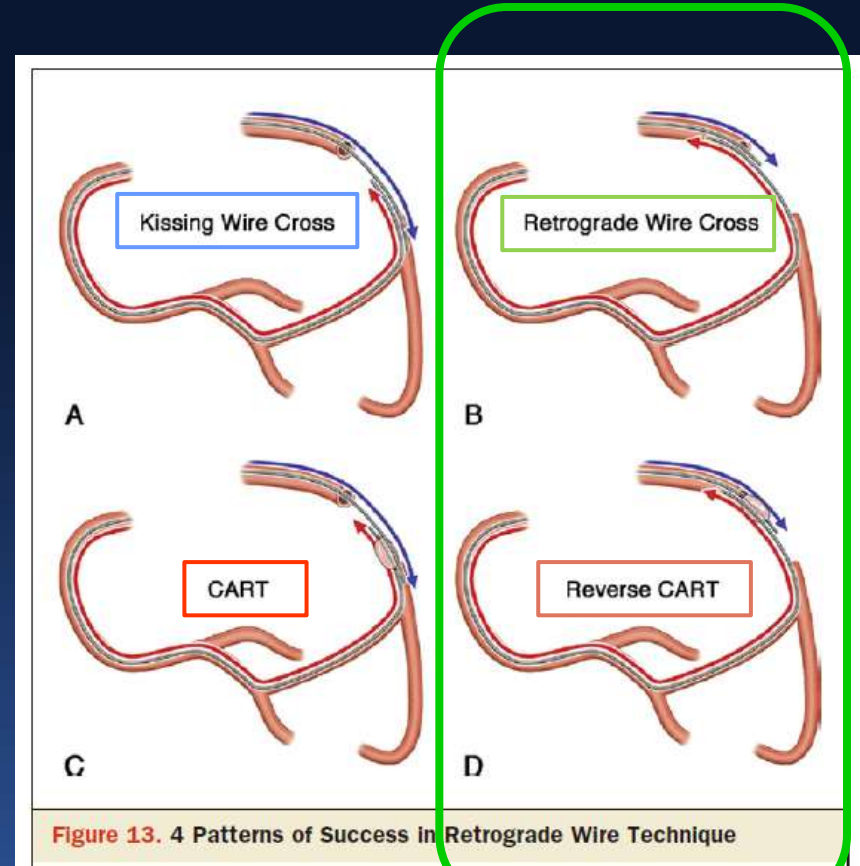
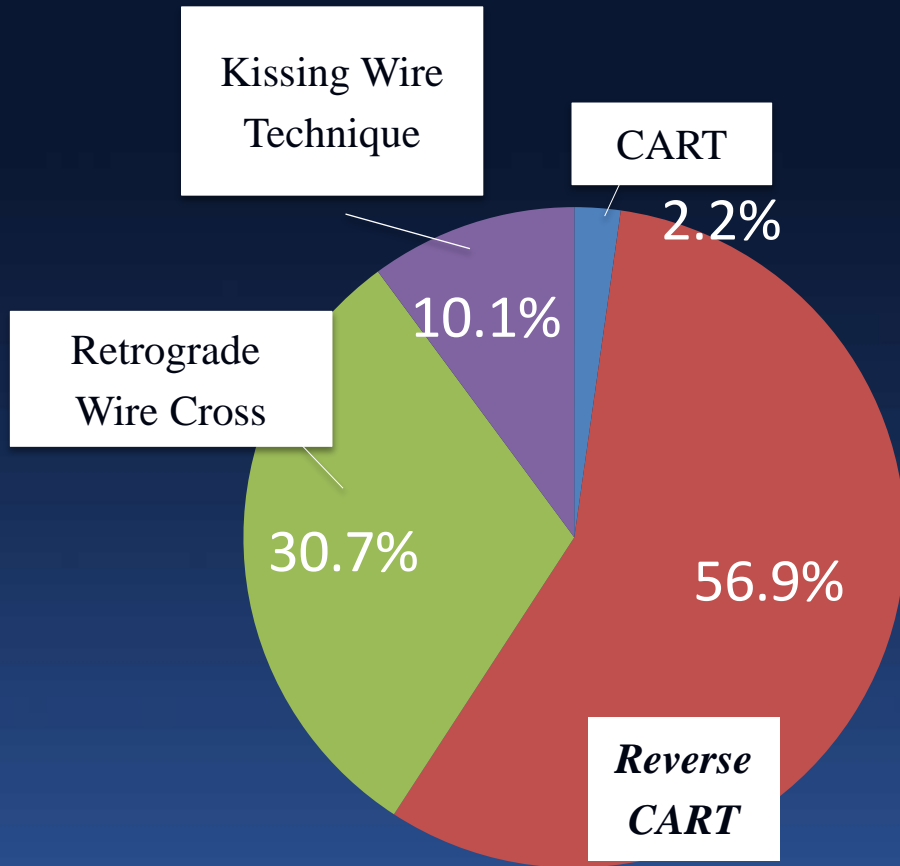
Variable (%)	Complete revasc (n=222)	Incomplete revasc (n=217)	<i>P</i> value
Myocardial infarction	2,3%	5,5%	0,125
All-cause mortality	10,4%	18,4%	0,01
Death or MI	11,7%	23,5%	0,002

Retrograde Approach



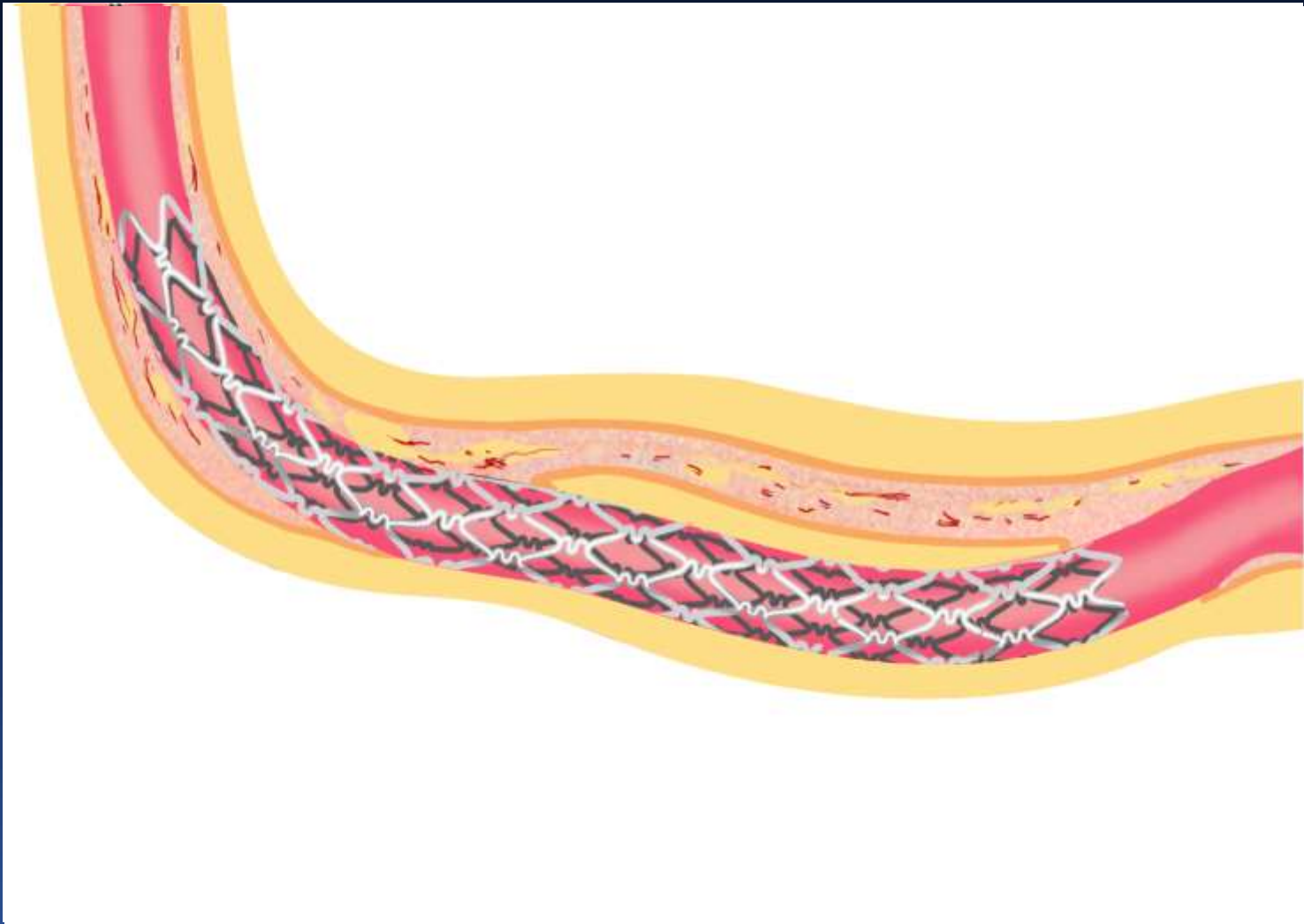
CTO Crossing

Successful strategy



~ 90%

Reverse CART



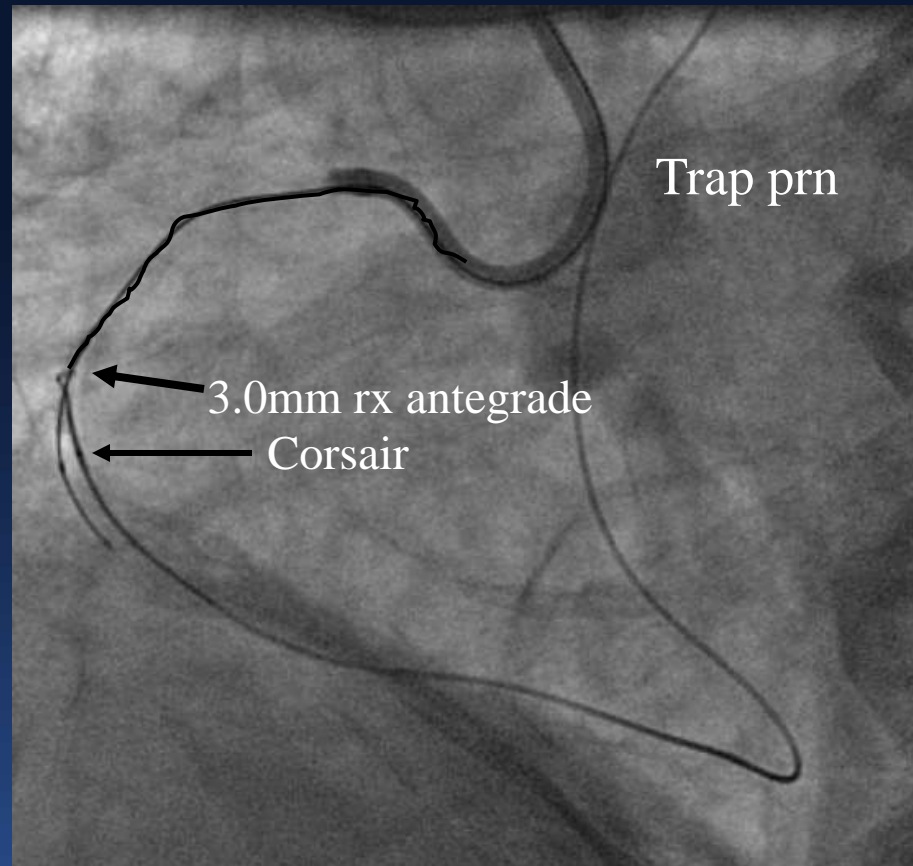
Reverse CART

Distal cap access

Lossy compression - not intended for diagnosis

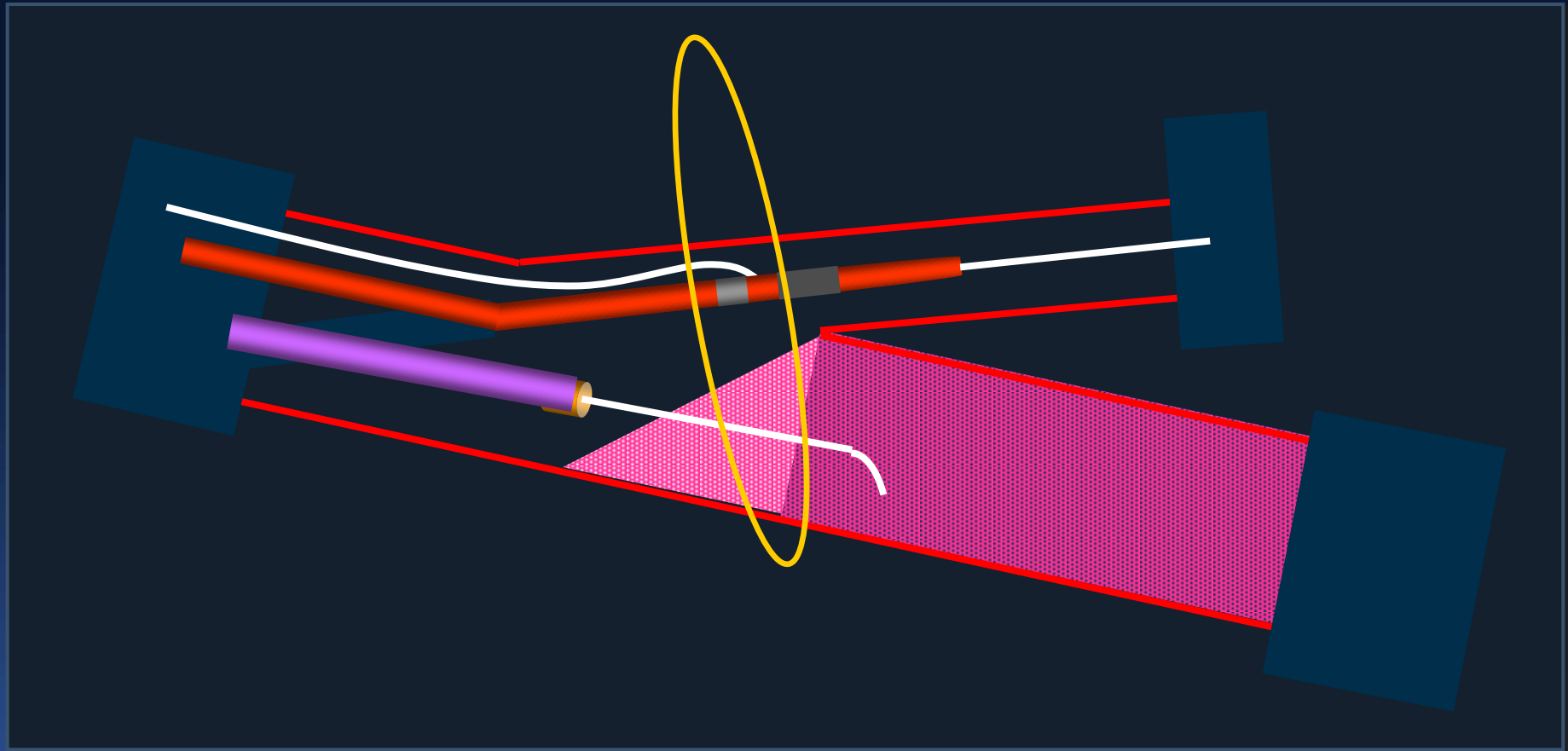


Reverse CART

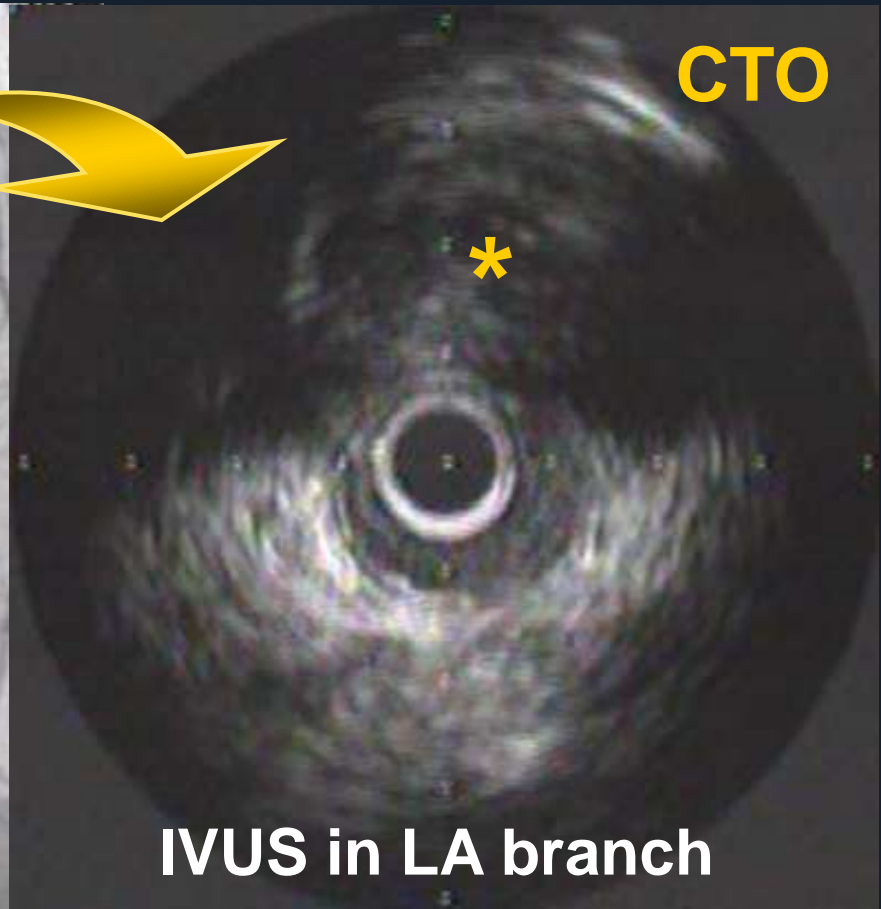
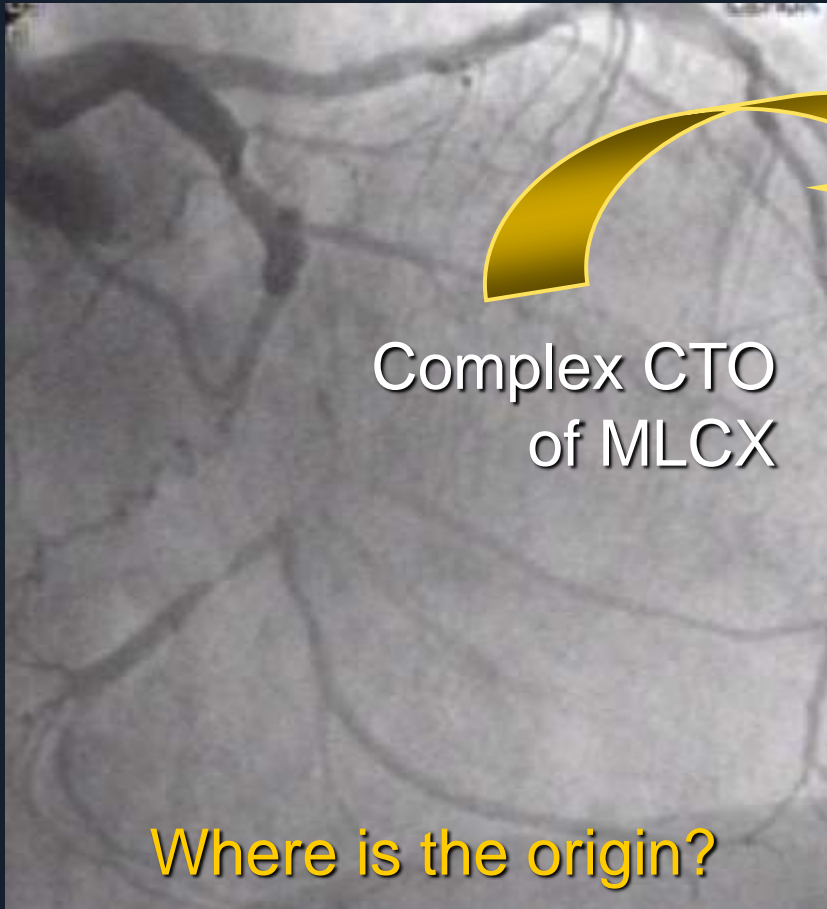


Advance corsair into antegrade guide
Exchange for viper wire

IVUS Guided Identification of the Entry



IVUS Guided Technique for Looking For the Entry



The Stingray™ CTO Re-Entry System

The StingRay™ System (Catheter and Guidewire) is designed to accurately target and re-enter the true lumen from a subintimal position.

Compatibility:
Coronary: 0.014" Wire

Unique self-orienting balloon has a flat shape for true lumen targeting

180° opposed and offset exit ports for selective guidewire re-entry

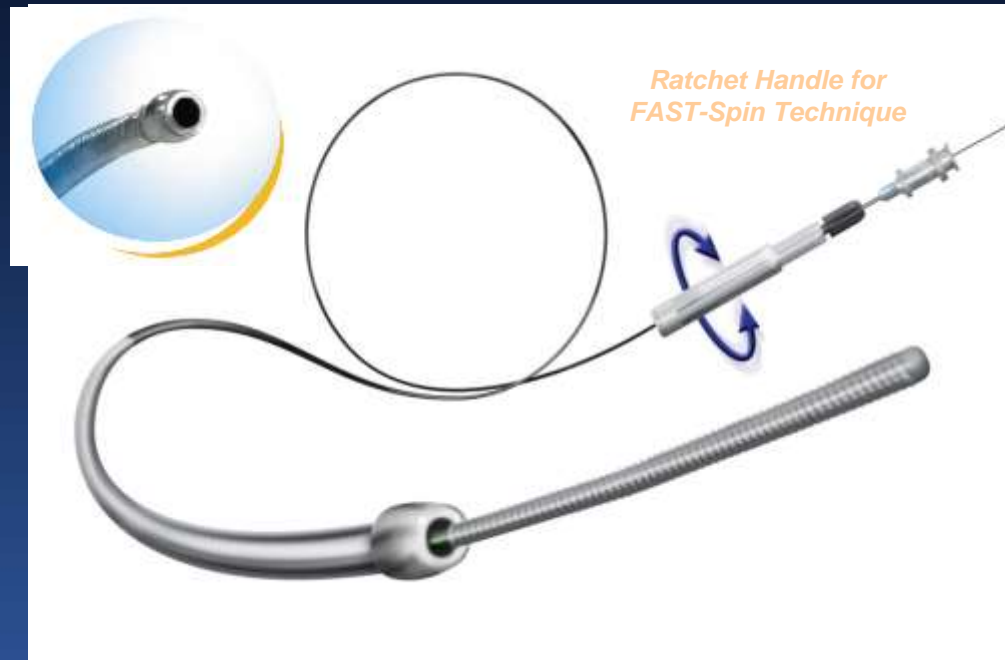
Re-entry probe at Stingray Guidewire tip



The CrossBoss™ CTO Crossing

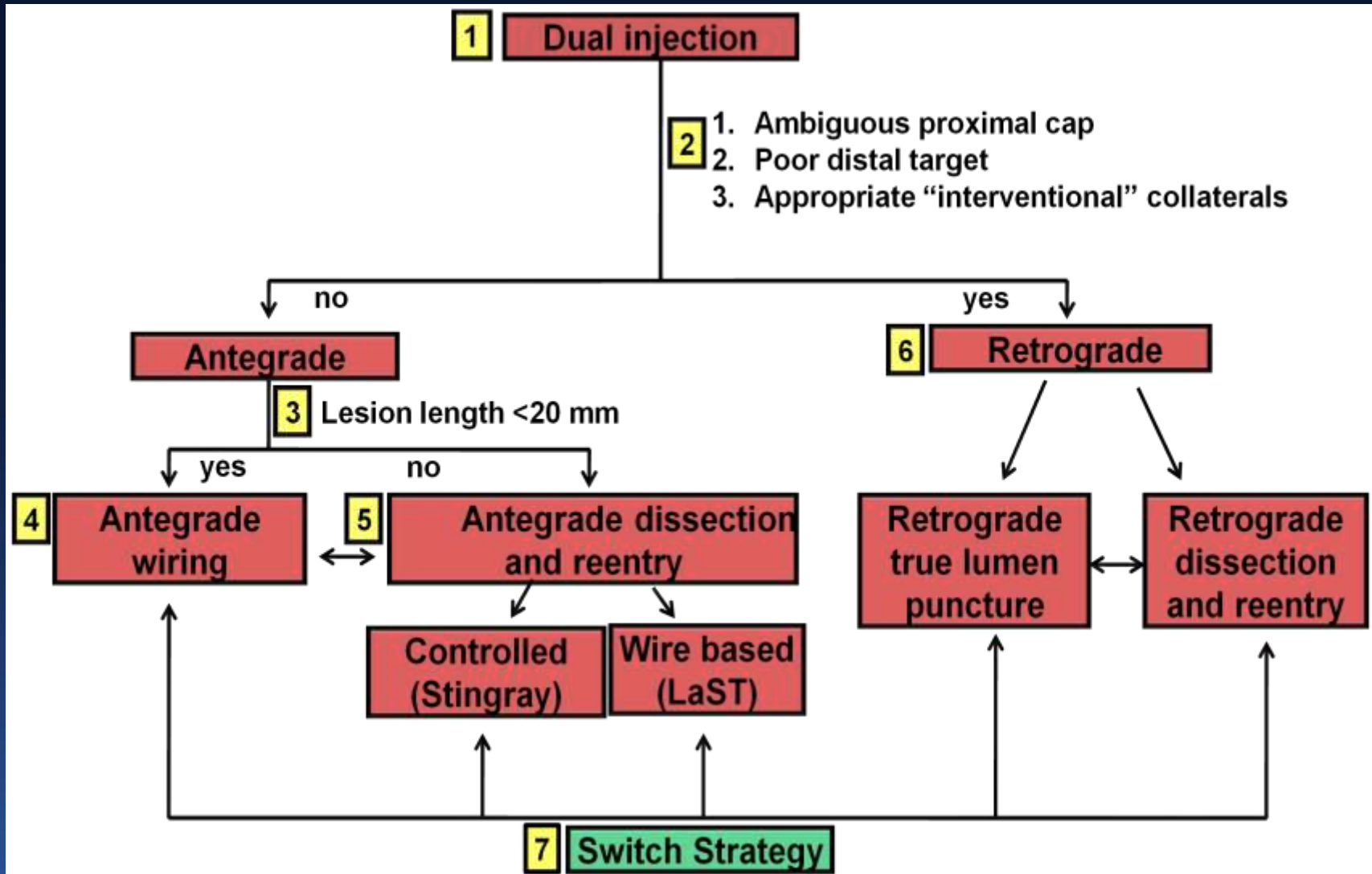
The CrossBoss™ catheter is a new stainless steel catheter designed to quickly and safely pass through the CTO to gain access to the distal true lumen or enter subintimal pathways. The catheter is advanced by using rapid bi-directional rotation.

- **Multi-wire coiled shaft**
- **Tracks via FAST Spin Technique**
 - **Highly torqueable coiled-wire shaft**
 - **FAST Spin reduces push required to cross CTO**
- **Atraumatic distal tip advanced across a CTO ahead of the guidewire**
- **OTW 0.014" guidewire compatible**



Atraumatic 1 mm
Distal Tip

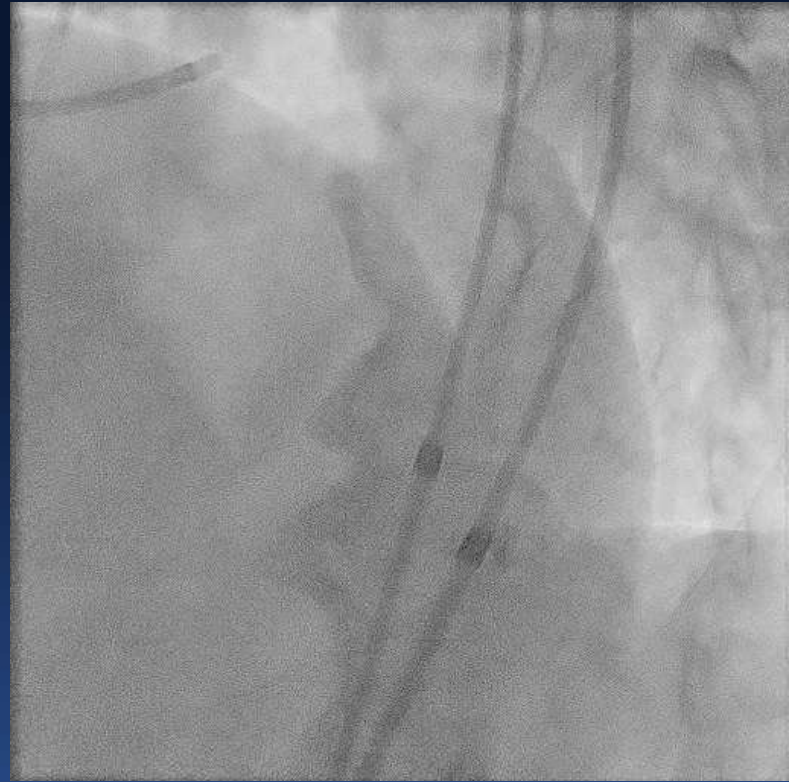
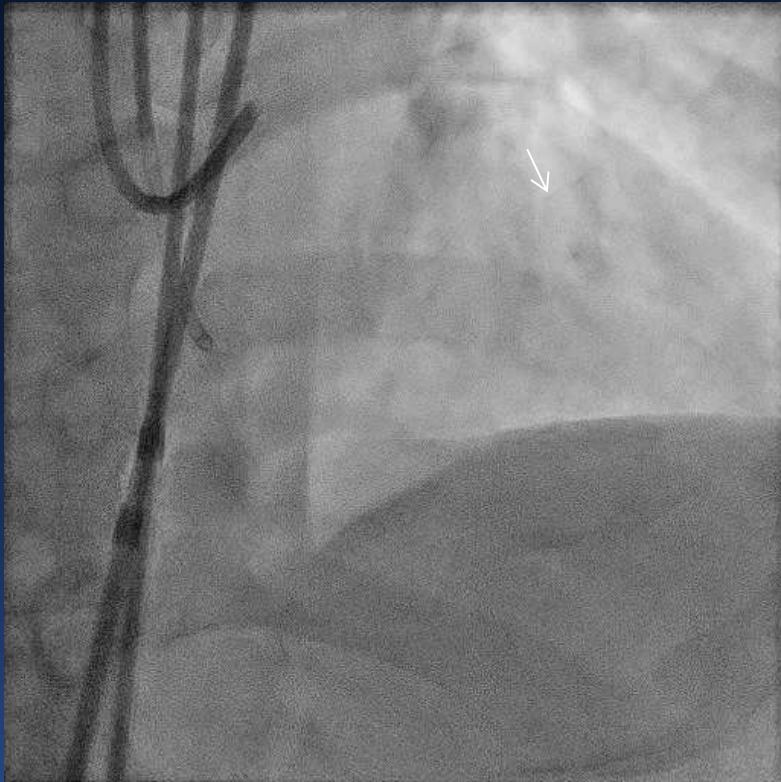
Hybrid Strategy Treatment Algorithm



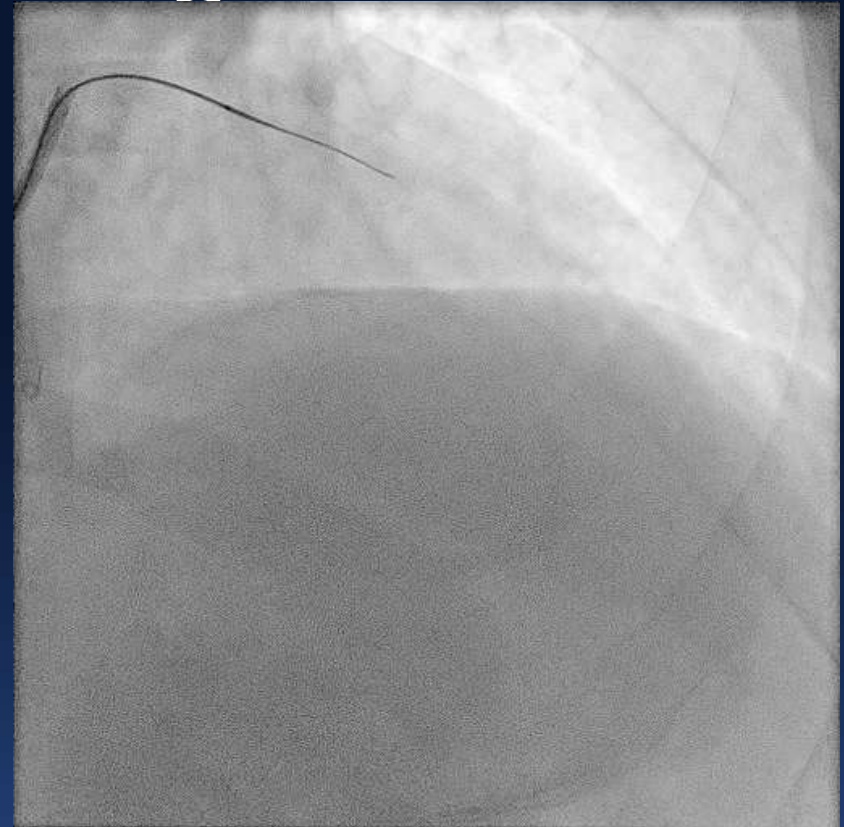
Antegrade Paradigm

- **48 year old man with hypertension, hyperlipidemia, known coronary artery disease**
 - **3 months prior to admission presented to outside hospital with acute chest pain, STEMI, and underwent thrombus aspiration and PCI to RCA**
 - **LAD CTO intervention attempted but abandoned due to vessel perforation**
 - **Continued to have exertional chest pain, so he was referred to Columbia for second opinion**

Dual Injection

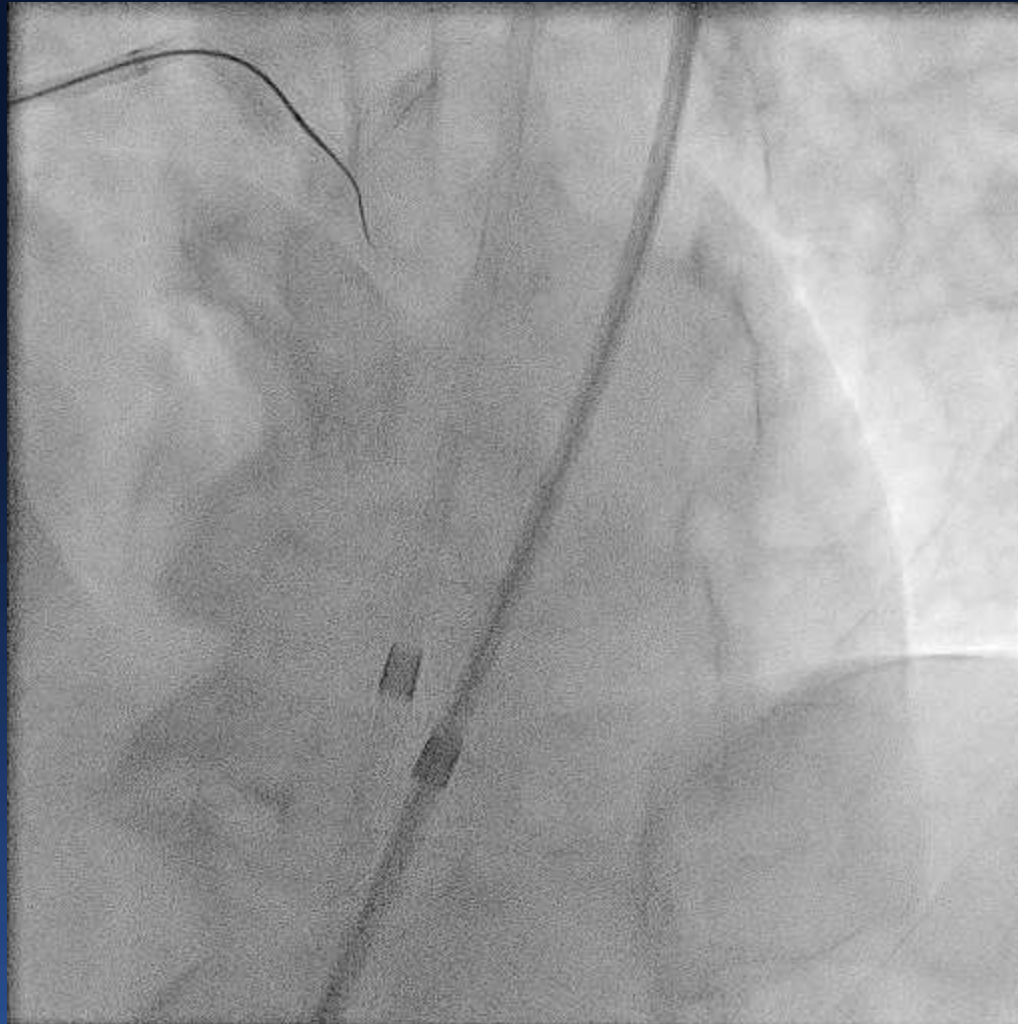


Antegrade – Crossing the lesion

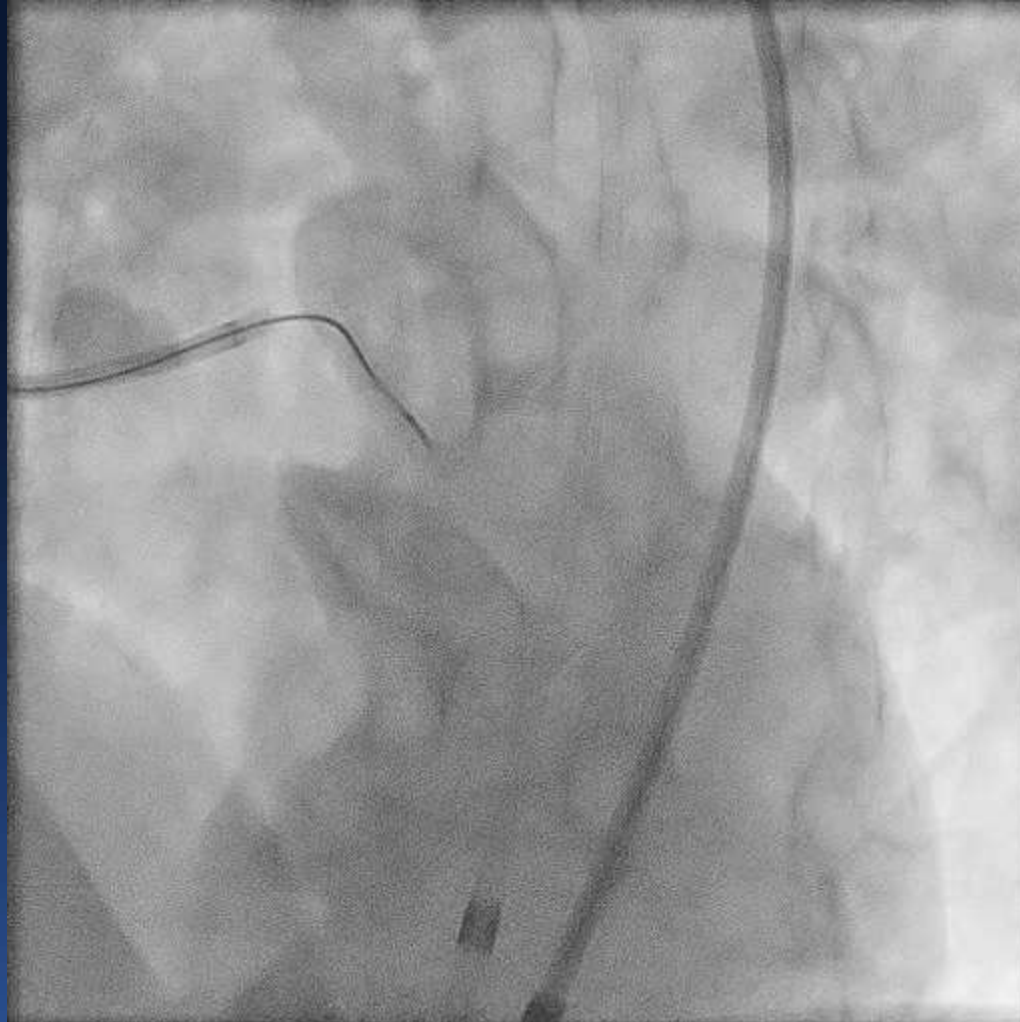


- Corsair
- Attempted wires: Asahi Gaia 1, 2, 3
- Confianza Pro 12 used to pierce
- Gaia 2 used to cross lesion

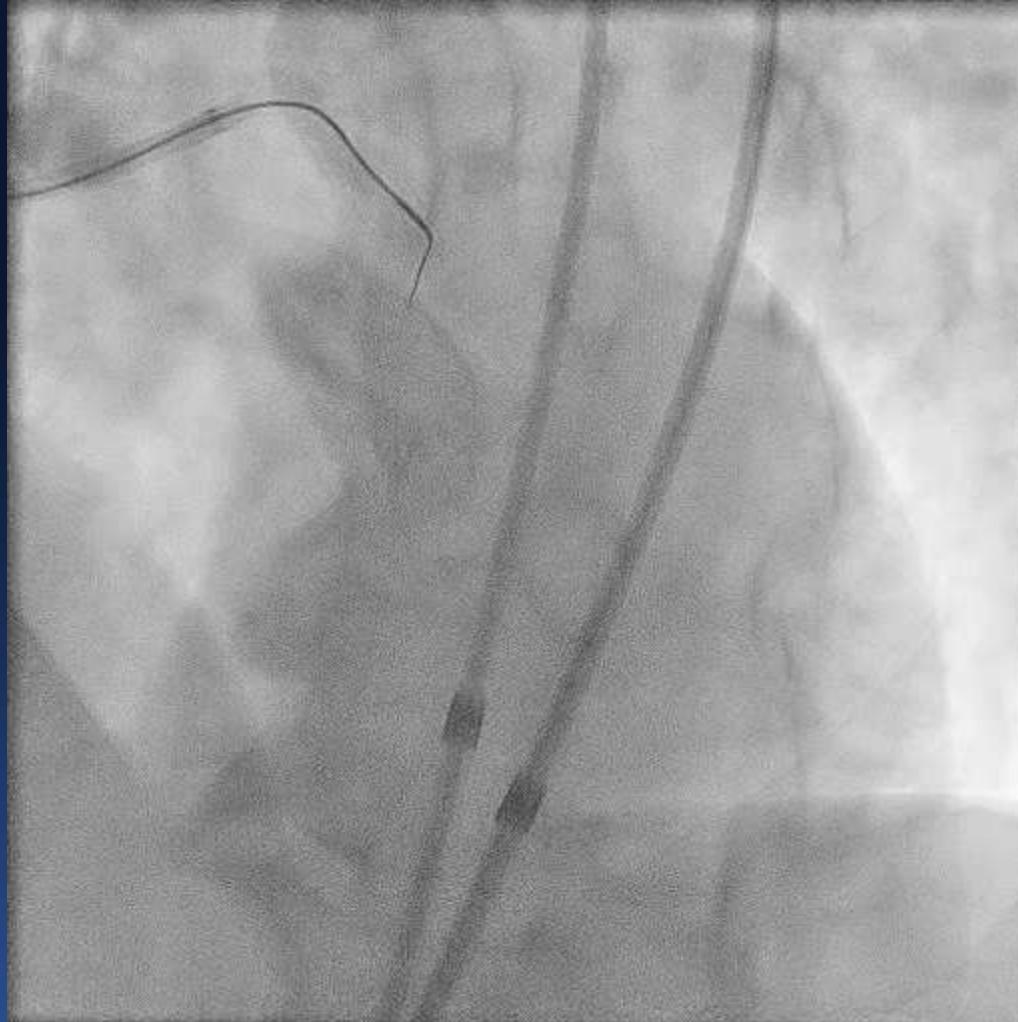
Confianza



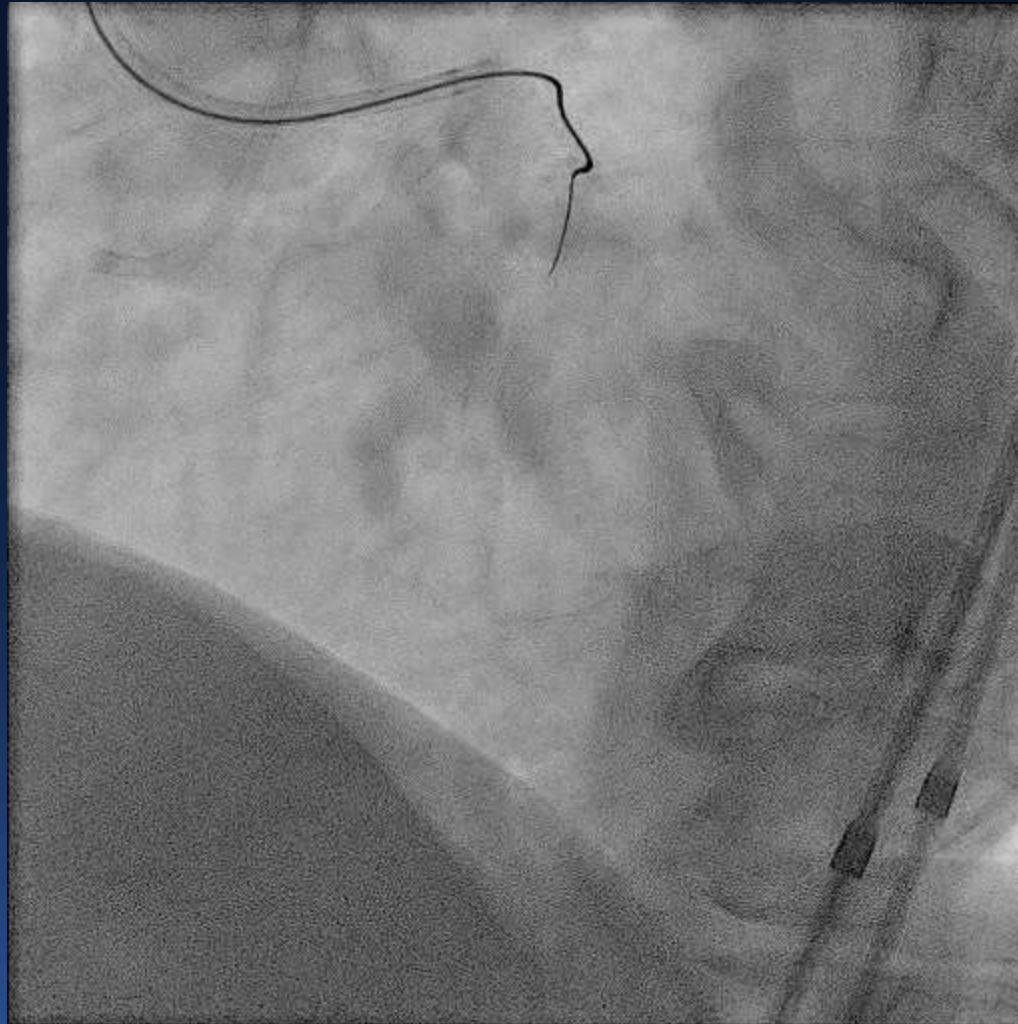
Corsair Tip In



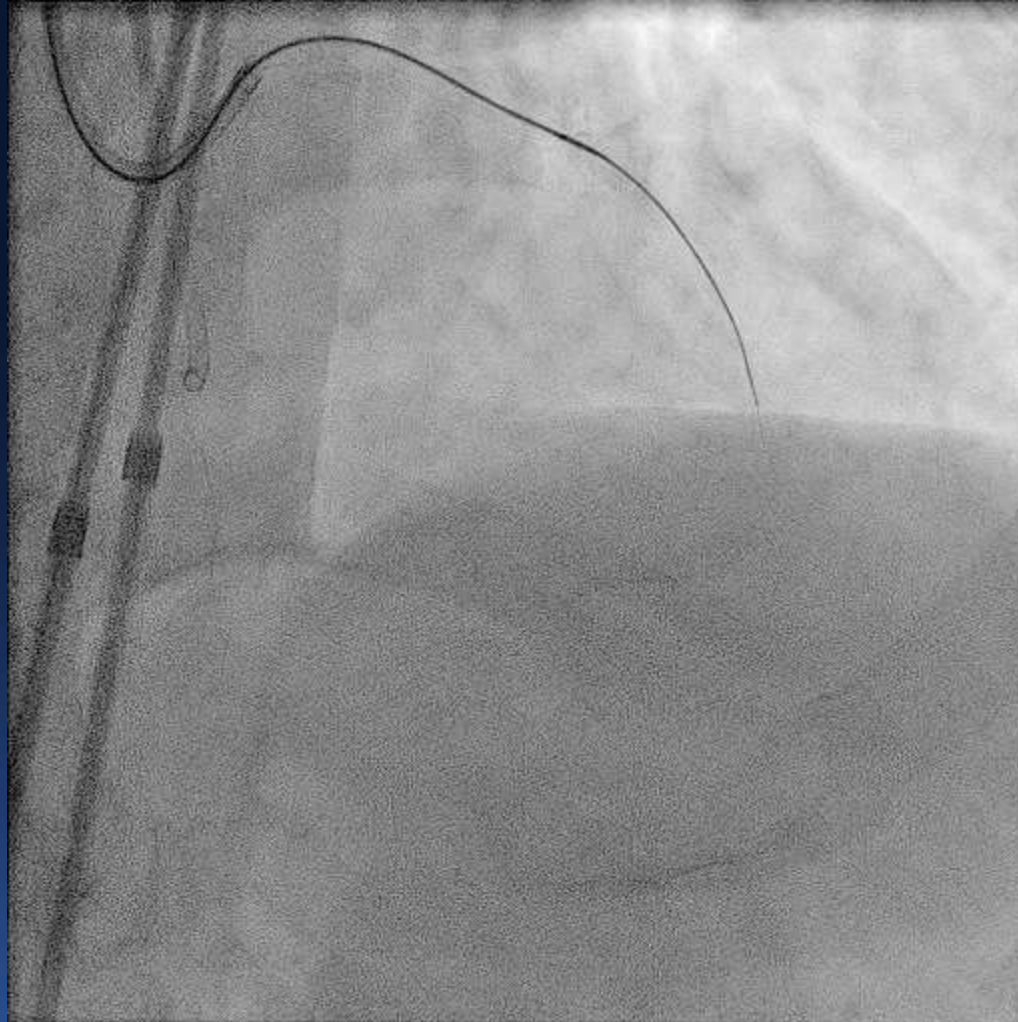
Gaia 2nd Advancing



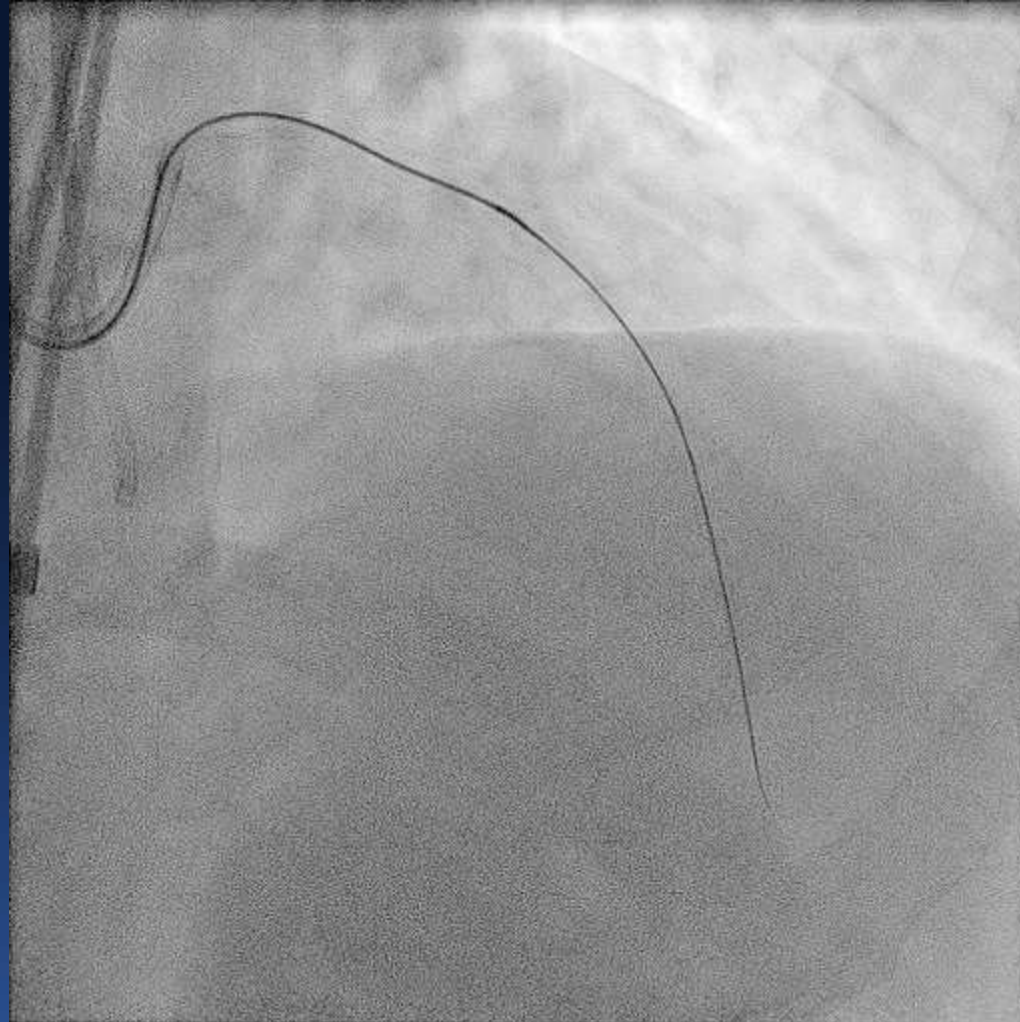
Aligning



Crossing

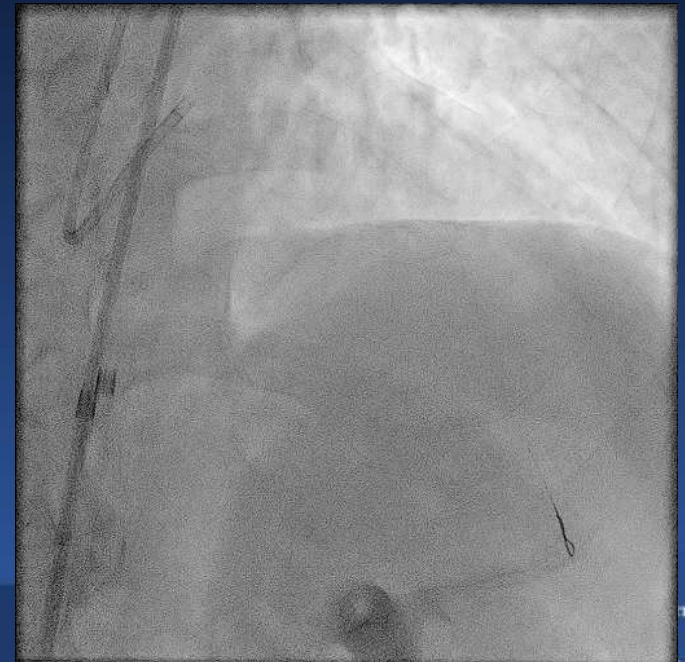


In Distal Vessel

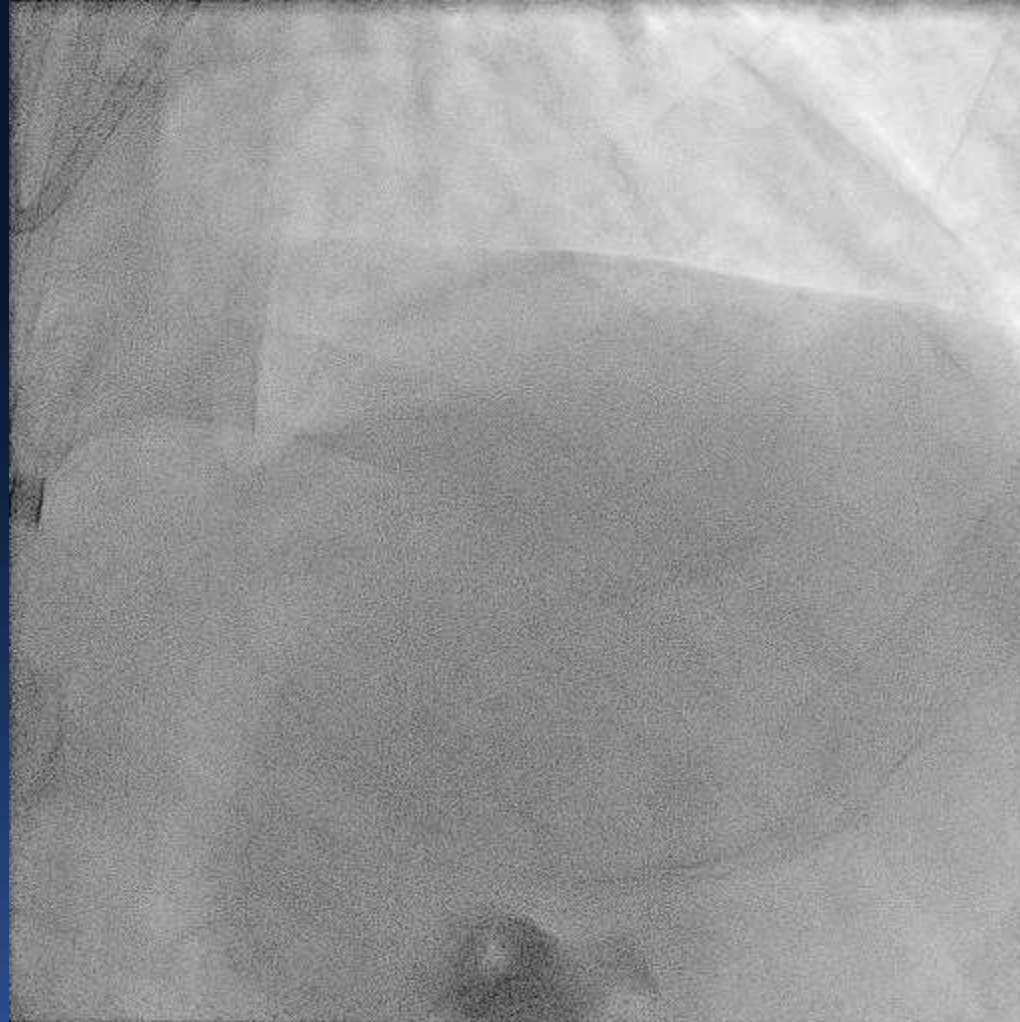


LAD lesion prep

- **Gaia exchanged for BMW wire**
- **Corsair removed with trapping balloon**
- **Mid-LAD dilated with NC 2.5 and 3.0 x 8mm balloons**



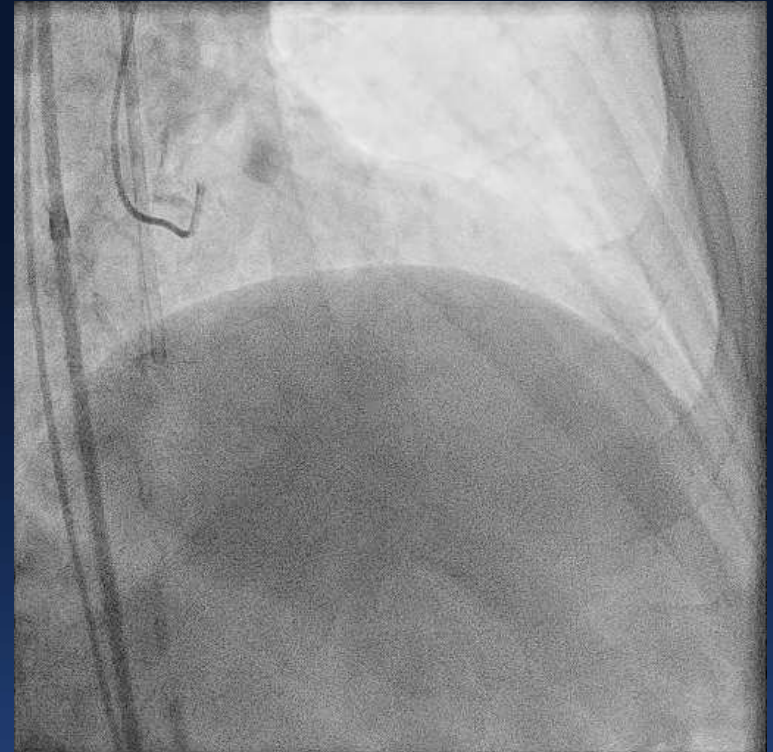
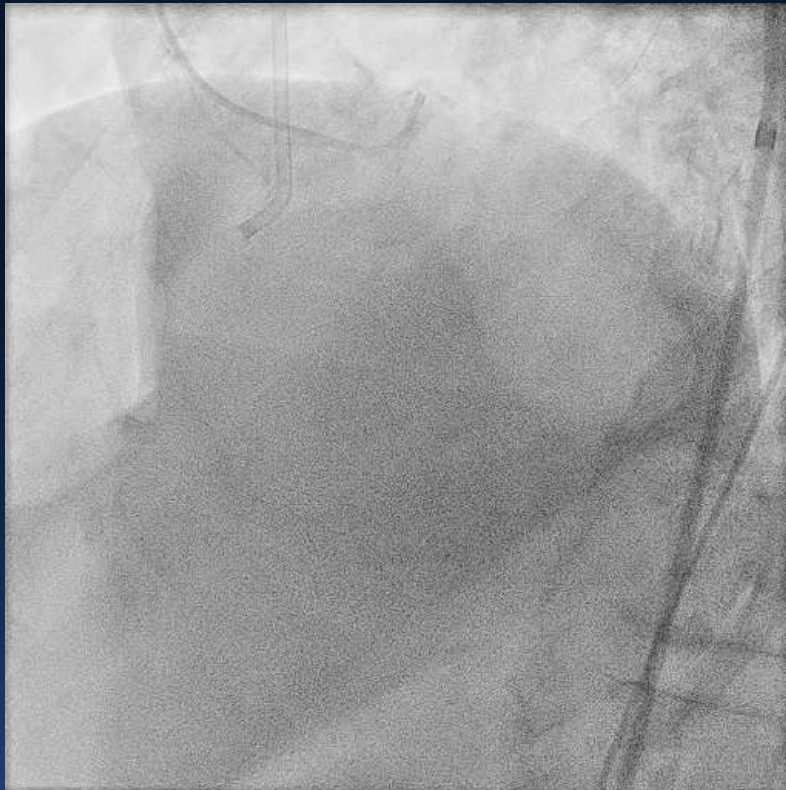
Final picture



Typical Retrograde Wire Sequence

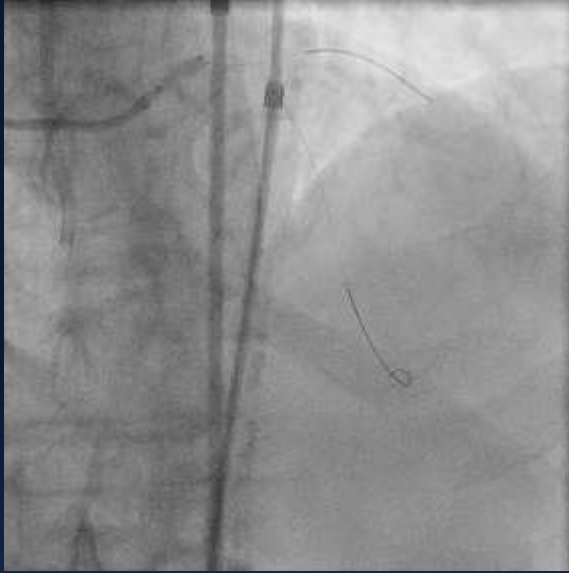
- **78 year old man with hypertension, prior tobacco use, prostate cancer, carotid stenosis and coronary artery disease**
 - **1987: Cardiac catheterization via brachial approach in with PTCA to unknown vessel complicated by endocarditis**
 - **2014: Presented with one month of worsening exertional chest pain to outside hospital**
 - **Echocardiogram: normal systolic function, no wall motion or valvular abnormalities**
 - **Coronary angiogram: complex multi-vessel disease including chronic total occlusion of the PDA for which he was transferred to Columbia-Presbyterian**

Initial dual injection



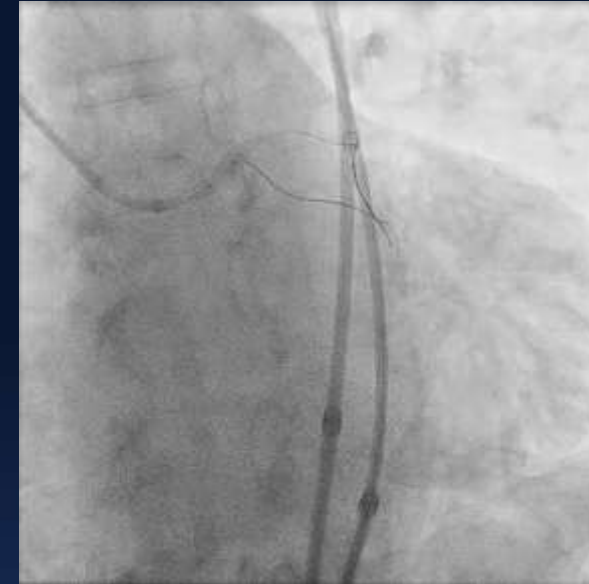
8F bright-tip sheaths
8F JR4
5F diagnostic JL4

Left coronary intervention



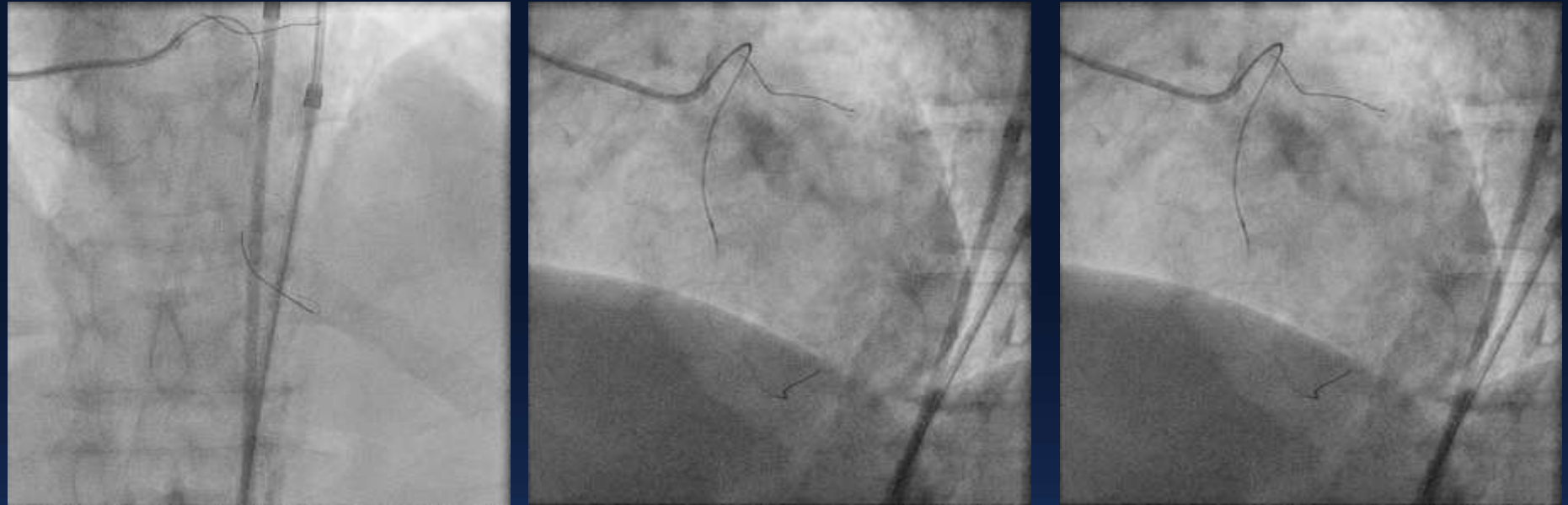
- **7F FL 4.0 Guide for antegrade left coronary intervention**
- **BMW, Prowater wires**
- **Angiosculpt 3 x 10mm in left main 18atm**
- **NC 3 x 12mm balloon in mid LAD**

Left coronary intervention



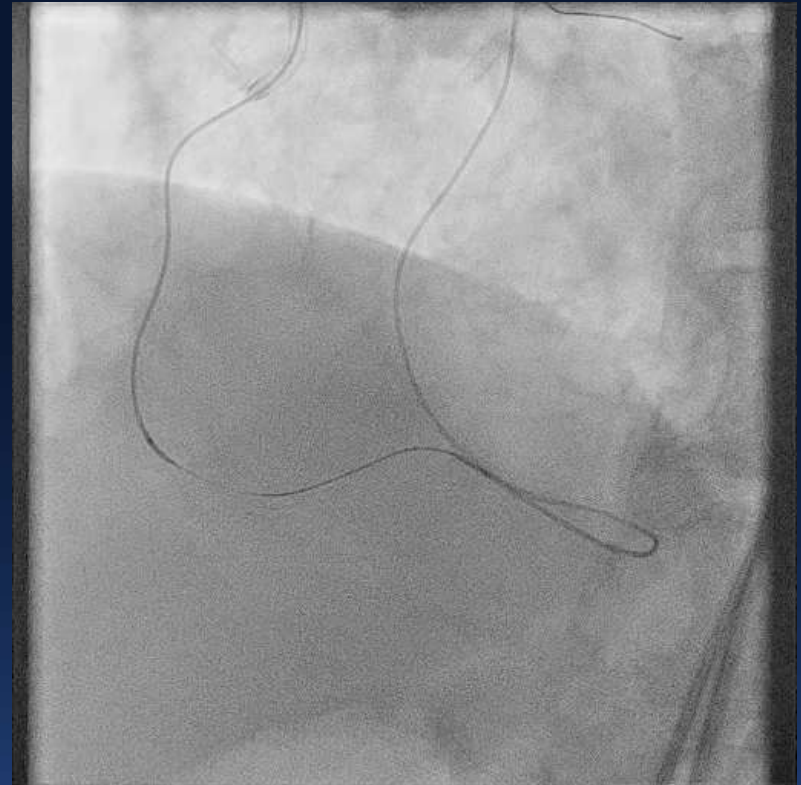
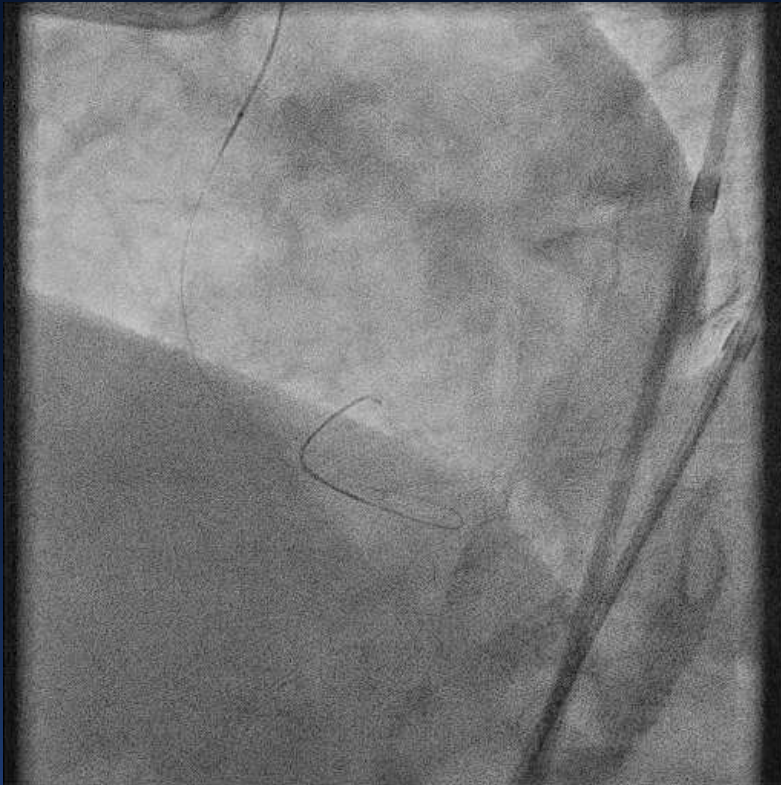
- Premier 3 x 12mm stent in LAD
- Premier 4 x 8mm stent in LM
- NC 4.5 x 8mm in LM stent post-dilation
- IVUS
- NC 4 x 8mm post-dilate

Retrograde RCA CTO Intervention



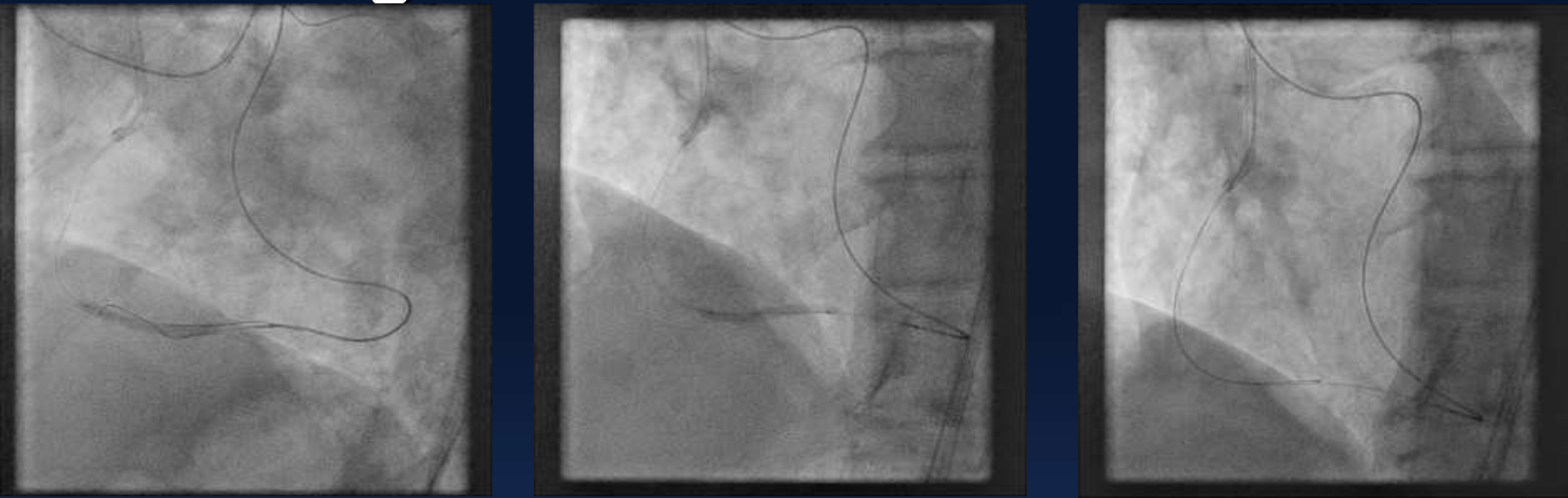
- 150cm Corsair
- Prowater used to access septal collaterals
- Sion wire for collateral surfing, successfully accessed RPDA

Setup for reverse CART



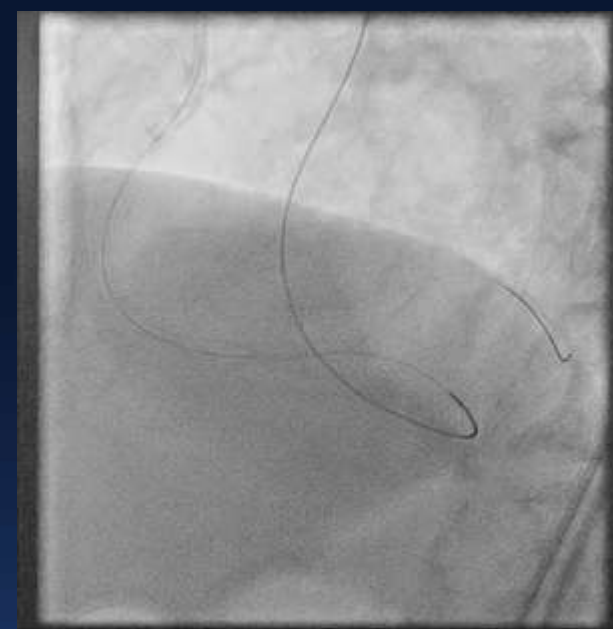
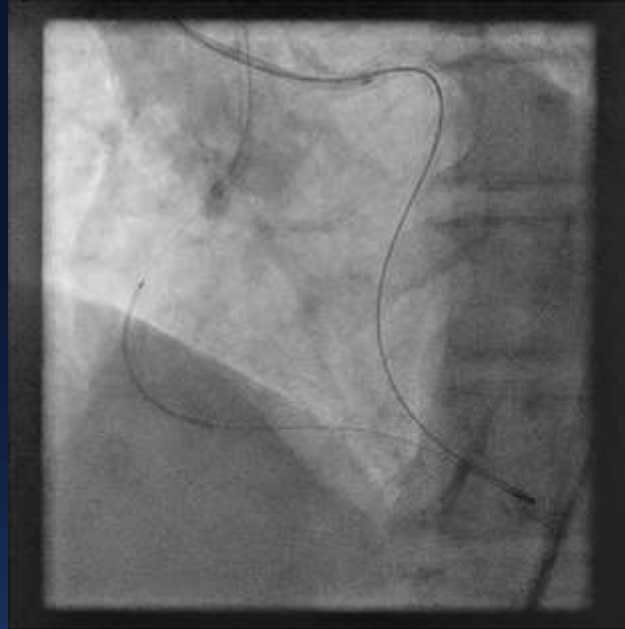
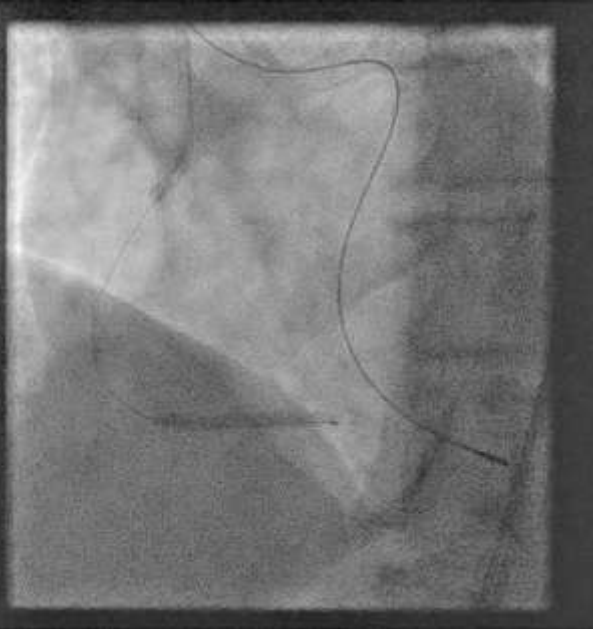
- **Miracle 6 in corsair antegrade**
- **Pilot 200 retrograde**

Retrograde RCA CTO Intervention



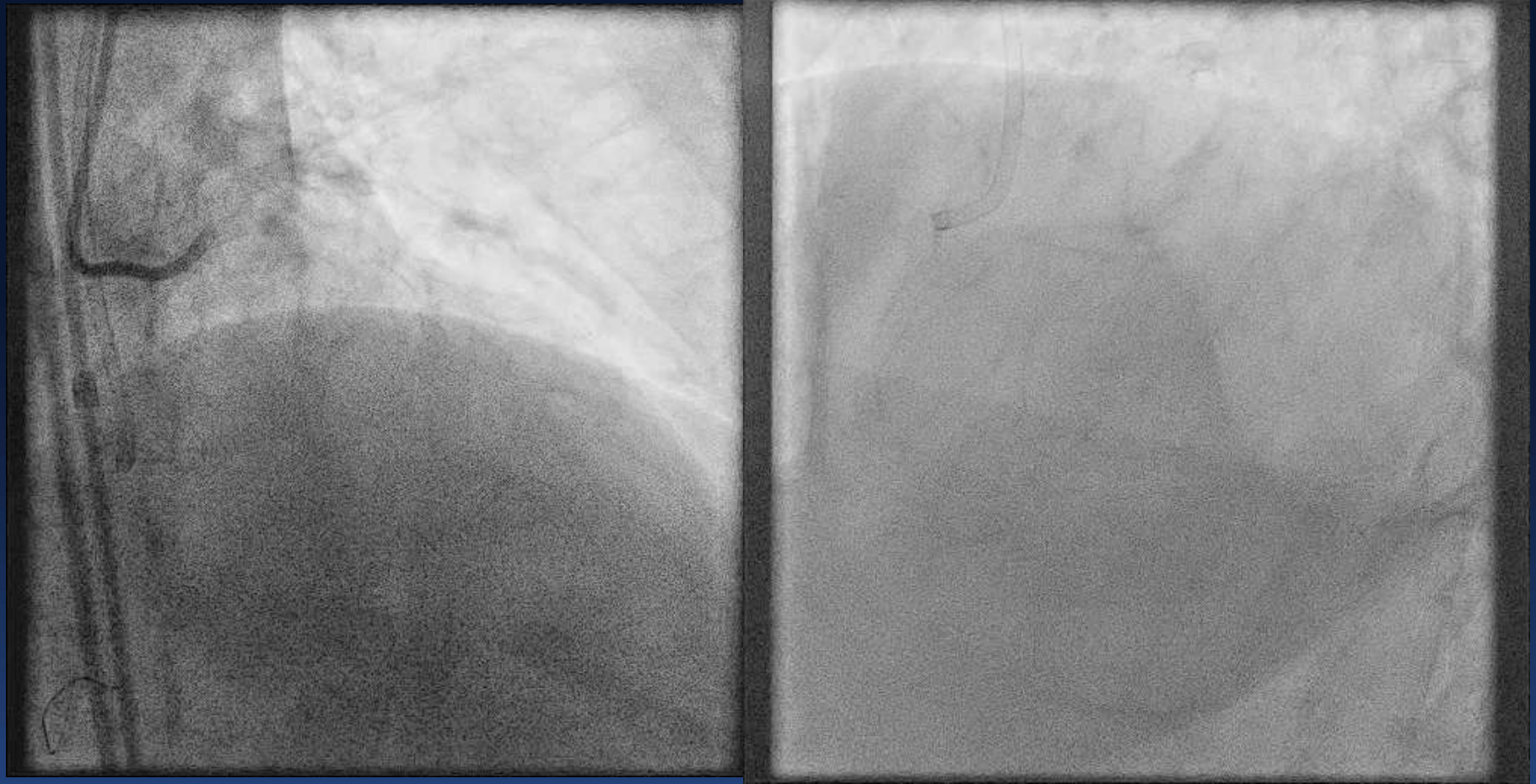
- 2.5 x 30 balloon in distal RCA
- 8F Guideliner entered with Confianza Pro 12 and exchanged for Viper wire

RCA stents



- Resolute 2.5 x 30mm stent in distal RCA
- Resolute 3 x 38mm stent in mid RCA
- Resolute 3.5 x 22mm stent in proximal RCA

Final pictures



Antegrade Dissection Reentry

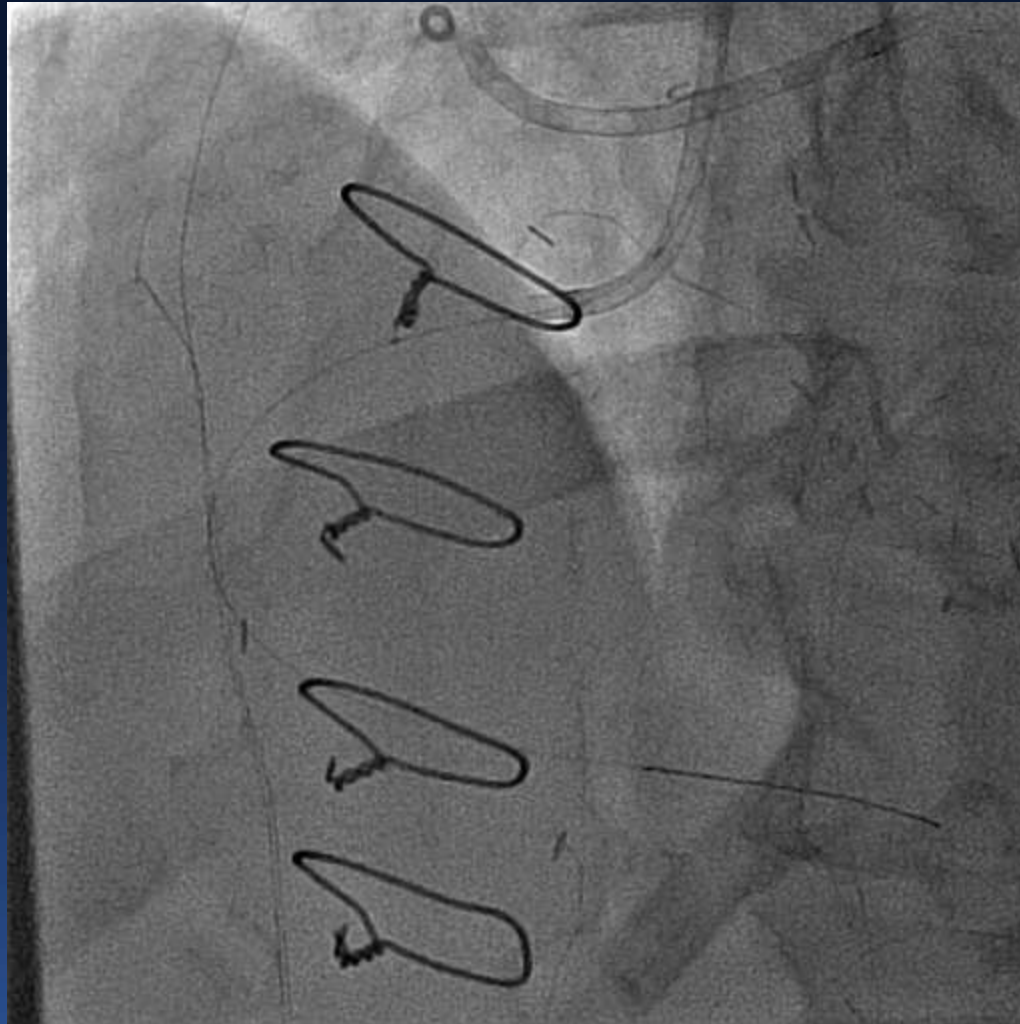


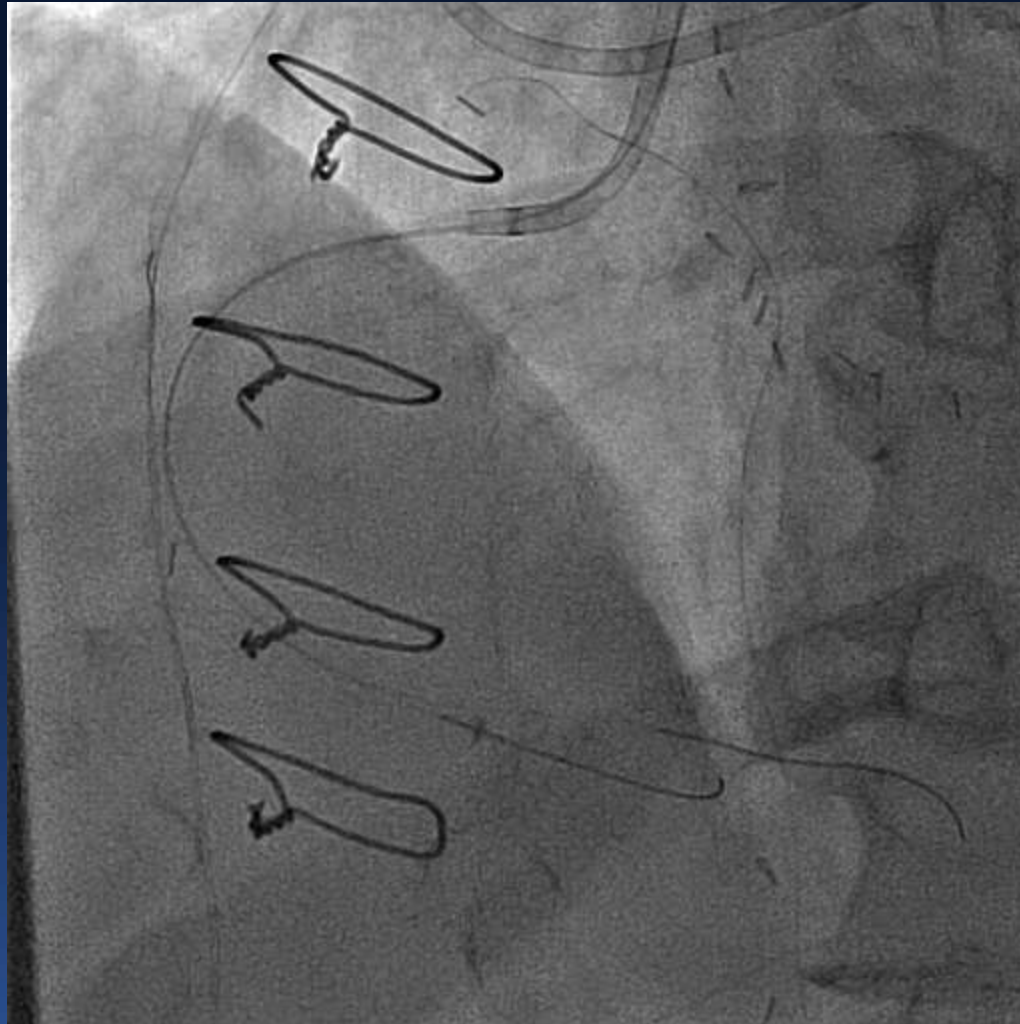


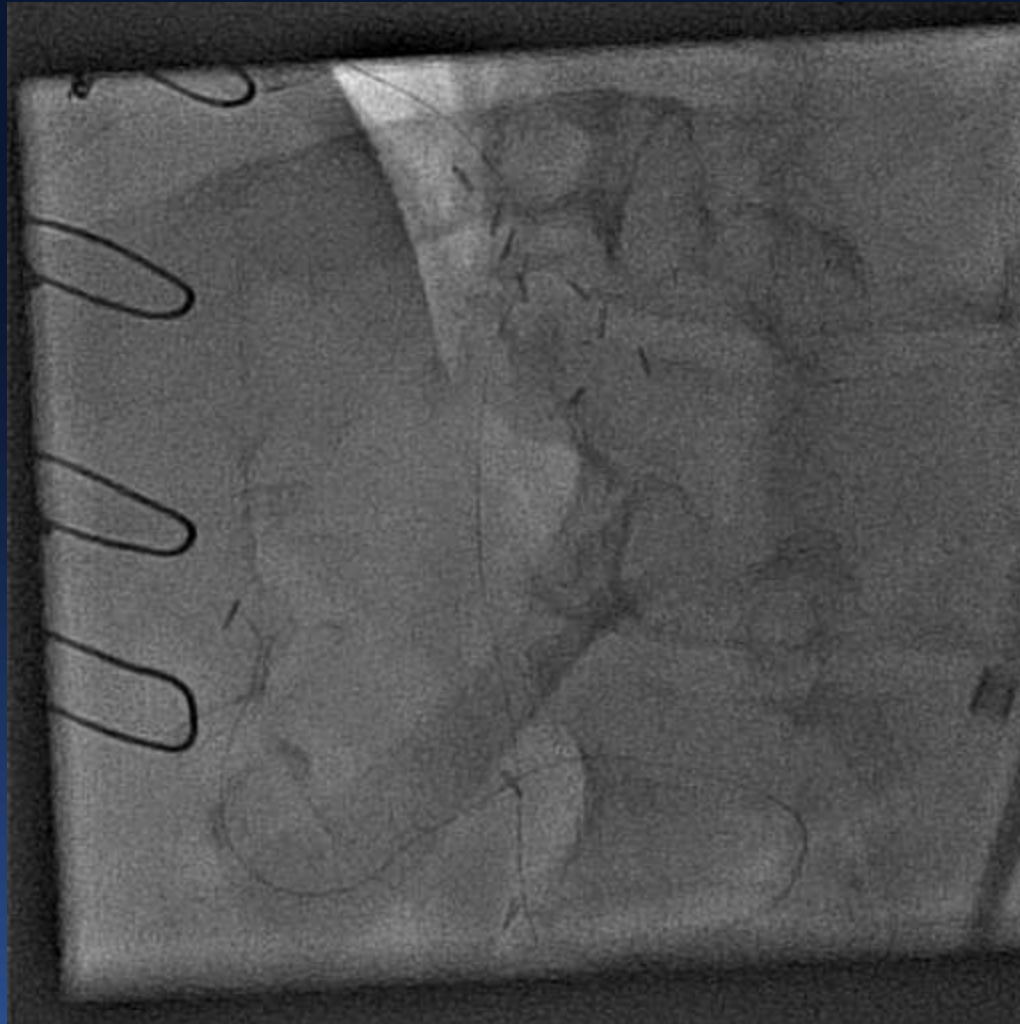












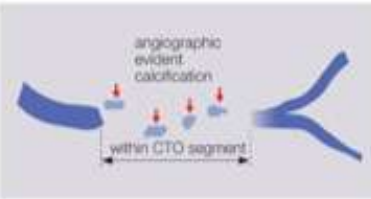
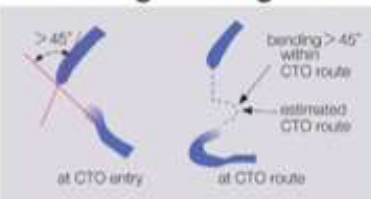
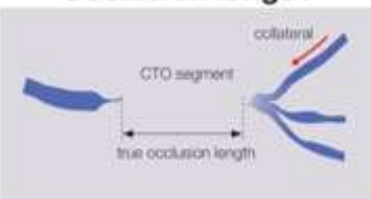


J-CTO Score Sheet

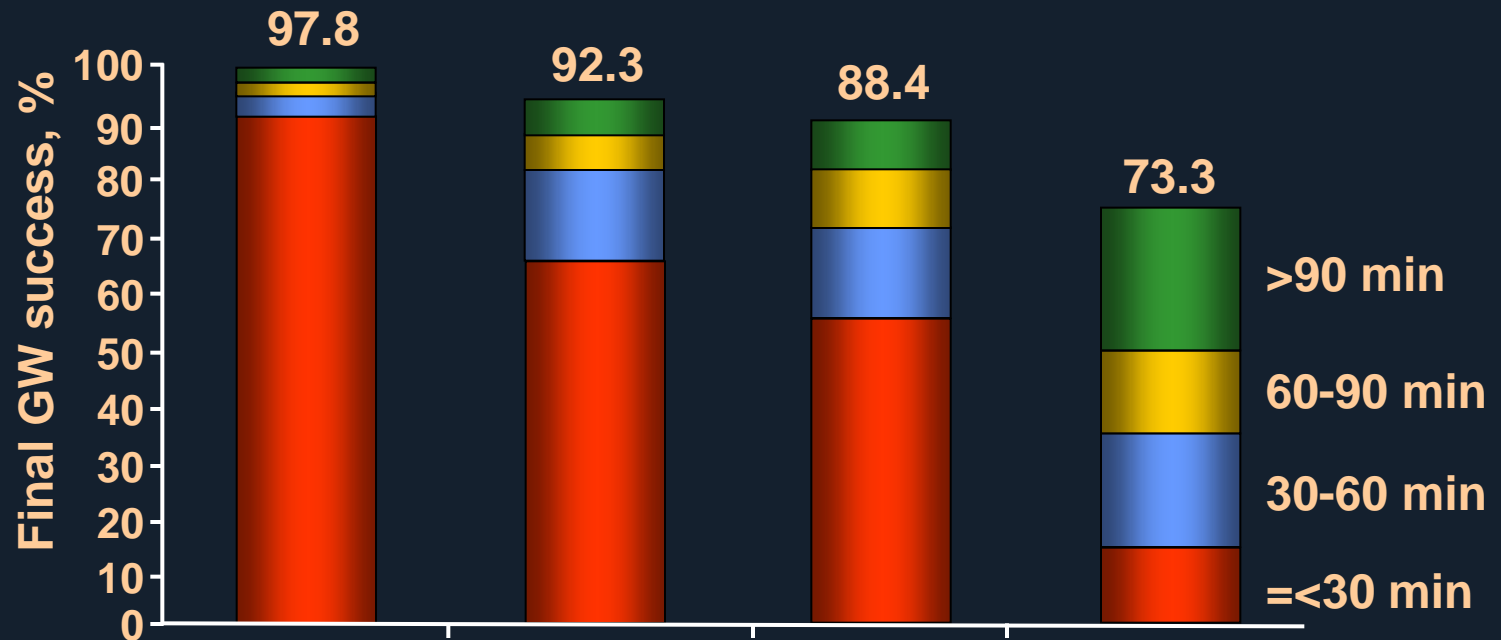
Category of difficulty (total point)

easy (0) Intermediate (1)

difficult (2) very difficult (≥ 3)

<p>Tapered</p> 	<p>Blunt</p>  <p>Entry with any tapered tip or dimple indicating direction of true lumen is categorized as "tapered".</p>	<p>Entry shape</p> <p><input type="checkbox"/> Tapered (0)</p> <p><input type="checkbox"/> Blunt (1)</p> <hr/> <p>point</p>	
<p>Calcification</p>  <p>Regardless of severity, 1 point is assigned if any evident calcification is detected within the CTO segment.</p>		<p>Calcification</p> <p><input type="checkbox"/> Absence (0)</p> <p><input type="checkbox"/> Presence (1)</p> <hr/> <p>point</p>	
<p>Bending > 45degrees</p> 		<p>One point is assigned if bending > 45 degrees is detected within the CTO segment. Any tortuosity separated from the CTO segment is excluded from this assessment.</p>	<p>Bending > 45°</p> <p><input type="checkbox"/> Absence (0)</p> <p><input type="checkbox"/> Presence (1)</p> <hr/> <p>point</p>
<p>Occlusion length</p> 		<p>Using good collateral images, try to measure "true" distance of occlusion, which tends to be shorter than the first impression.</p>	<p>Occl.Length</p> <p><input type="checkbox"/> < 20mm (0)</p> <p><input type="checkbox"/> ≥ 20mm (1)</p> <hr/> <p>point</p>
<p>Re-try lesion</p> <p>Is this Re-try (2nd attempt) lesion ? (previously attempted but failed)</p>		<p>Re-try lesion</p> <p><input type="checkbox"/> No (0)</p> <p><input type="checkbox"/> Yes (1)</p>	

Predicting Success: The J-CTO Score

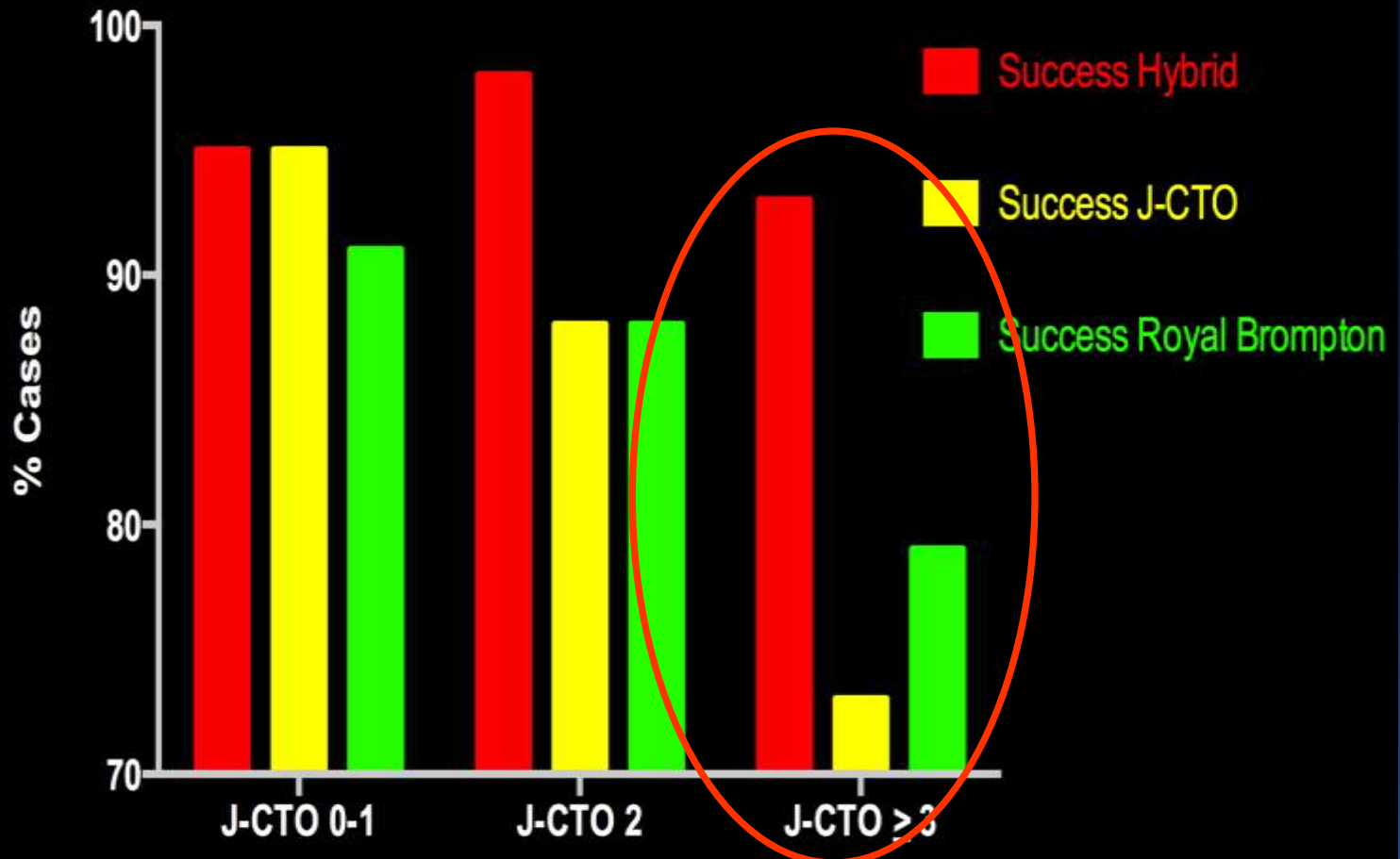


Risk groups: Easy Intermediate Difficult Very difficult

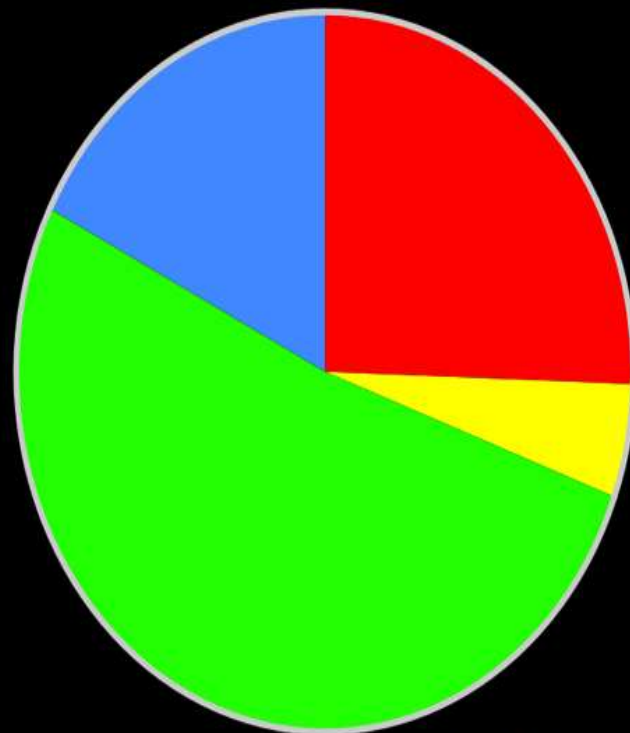
J-CTO Score: 0 1 2 ≥3

Patient number 494 91 130 138 135

Success by J-CTO score



Successful Hybrid Strategies



- 51% Antegrade DR
- 26% Antegrade Wiring
- 18% Retrograde DR
- 5% Retrograde Wiring

Total=137

Revascularization for CTO

Conclusions

- **CTOs negatively impact our patients quality of life as well as prognosis**
- **Patients with symptoms, multivessel CAD, and moderate to large CTO-mediated ischemic burden derive clinical benefit**
- **We under treat these patients**
- **Great opportunity exists to benefit public health by expanding CTO revascularization**