

ACADEMY JOURNAL



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Kambis
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MASTERING CTO INTERVENTIONS: HIGHLIGHTS OF THE 3rd ML CTO ACADEMY WORKSHOP

The ML CTO Academy is proud to announce the third edition of its acclaimed Workshop, a leading educational initiative for interventional cardiologists seeking to refine their expertise in the field of chronic total occlusion (CTO) treatment.

This new edition offers two complementary sessions - a fully immersive, hands-on experience in Nice and a combined theoretical and practical program in Paris - designed to advance procedural performance and foster excellence in CTO education through structured, progressive learning.

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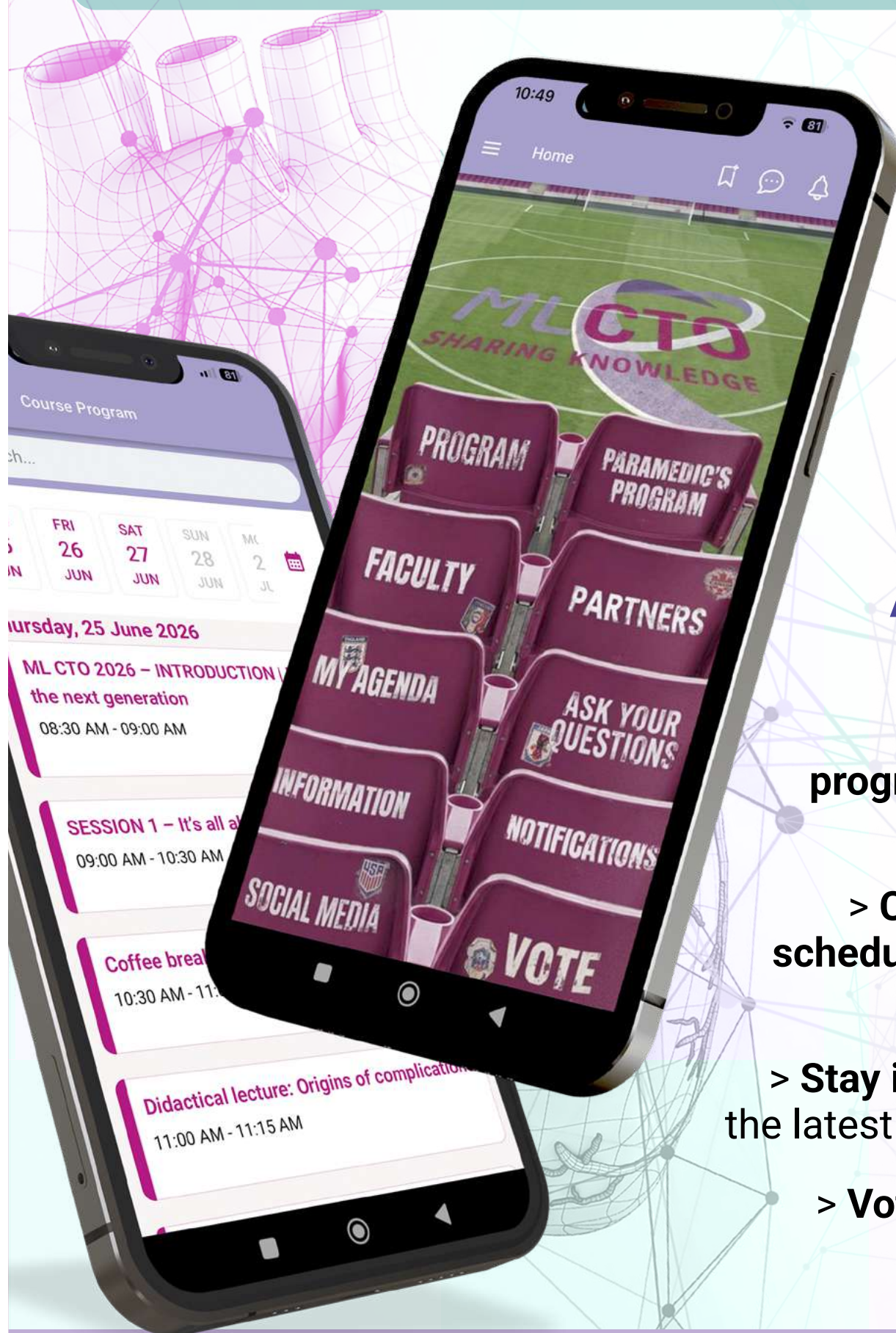
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#MLCTO2026!



AFTER INSTALLING THE APP, YOU CAN

- > **Access the event program**, list of attendees and speakers
- > **Create your own daily schedule** that will guide you through the day
- > **Stay informed** and receive the latest messages and news
- > **Vote and ask questions** during sessions

JOIN THE CONVERSATION #MLCTO2026



BRIDGING EXPERTISE, BREAKING BARRIERS

Dear Colleagues, Dear Friends,

Welcome to Nice and to the 11th edition of the Multi-Level CTO (ML CTO) Course.

It is an immense privilege to gather here once again for what has truly become a cornerstone event in the global interventional cardiology calendar. This year, our gathering holds a special resonance. As the world turns its eyes toward the football World Cup, celebrating the universal passion that unites nations across borders, we find a powerful parallel right here in our lecture halls and live cases.

This year, ML CTO is incredibly proud to welcome participants and faculty from **nearly 80 different nationalities**. Just like the world's greatest sporting event, our congress proves that while we may come from different corners of the globe, we are driven by the exact same dedication: mastering the complexities of chronic total occlusions to improve patient lives.

However, unlike a stadium, ML CTO is not about competition; it is about connection.

The Power of Sharing

From its very inception, the DNA of ML CTO has been defined by three core pillars:

- **Conviviality:** Creating an environment where every attendee, from fellow to expert, feels at home.
- **Interaction:** Moving away from passive listening toward dynamic, real-time debates during our world-class live cases.
- **Knowledge Sharing:** Stripping away egos to openly discuss complications, tips, tricks, and the evolving algorithms of Multi-Level CTO PCI.

We encourage you to speak up, ask questions, challenge the strategies presented, and actively engage with the faculty. The coffee breaks and social gatherings are just as vital as the scientific sessions - they are where international partnerships are forged and lifelong friendships are made.

One Global Team

In this World Cup year, let us celebrate our own global team. The diversity of our 80 represented nations is our greatest strength, bringing unique perspectives, varied experiences, and a shared enthusiasm to the field of interventional cardiology.

We thank you for traveling from near and far to contribute your expertise to this collective puzzle. We hope these few days inspire you, challenge you, and fill you with the warm energy that defines the ML CTO family.

Enjoy the 11th edition, enjoy Nice, and let's make this a memorable tournament of knowledge and camaraderie!

Warmest regards,

The ML CTO Co-Directors

Alexandre Avran, MD

Kambis Mashayekhi, MD

Stéphane Rinfret, MD



WHAT DEFINES ML CTO ACADEMY TODAY

Over the years, ML CTO Academy has evolved far beyond a single annual course. Today, it represents a sustainable educational ecosystem, shaped by experience, responsibility, and a clear commitment to clinical excellence. What defines the Academy now is not the pursuit of novelty, but the consistency of its vision: **high-quality education translated into daily practice and better patient outcomes.**



1 Structured teaching programs

ML CTO Academy relies on a clear and progressive educational framework, designed to mirror real-life clinical development in CTO intervention.

- Level-based teaching pathways (basic, intermediate, advanced).
- Educational continuity between courses, workshops, and Academy initiatives.
- Strong focus on strategy, indication, and procedural planning.

2 Hands-on training

Practical experience remains a cornerstone of ML CTO Academy education. Techniques are not simply transmitted; they are practiced, discussed, and refined.

- Dedicated hands-on workshops.
- Small-group formats favoring interaction and direct feedback.
- Simulation-based environments aligned with real CTO scenarios.



3 Scientific collaboration and research support

From its early stages, ML CTO Academy has actively supported collaborative research within the CTO community, addressing the structural challenges of clinical investigation in this field.

- Participation in registries and multicenter research initiatives.
- Support for ethical data collection in accordance with national regulations.
- Opportunities for members to contribute cases and clinical data for publications and presentations.
- A centralized scientific platform, acting as a CRO-type structure

5 Supporting the next generation: Grant & Fellowship programs

Education within ML CTO Academy extends beyond courses and workshops. Supporting young interventional cardiologists is a core commitment.

- ML CTO Academy Training Grant & Fellowship program.
- Clinical training opportunities in expert CTO centers.
- Direct mentoring within structured educational environments.

4 Shared clinical experience and mentorship

ML CTO Academy promotes an open culture of exchange, where experience is shared transparently and constructively.

- Direct interaction with experienced CTO operators.
- Open discussion of complex cases, successes, and complications.
- Strong mentorship culture based on accessibility, dialogue, and humility.



Today, **ML CTO Academy** brings together **more than 2,500 members worldwide**, forming an active, international community grounded in education, research, and clinical responsibility.

Together, these five pillars define what ML CTO Academy represents today: **a living educational and scientific ecosystem, built around a strong professional association dedicated to responsible CTO intervention.**



**BE PART OF THE
CONVERSATION.**

**BE PART OF THE
ML CTO ACADEMY.**



BECOME A MEMBER

REFLECTIONS ON THE CROSSING ALGORITHMS WORKSHOP:

Advancing Expertise in CTO Recanalization

Chronic total occlusion (CTO) recanalization remains one of the most challenging procedures in interventional cardiology. For young CTO operators, mastering crossing strategies is essential to improving procedural success and patient outcomes.

In 2025, the ML CTO Academy hosted the second edition of its *Crossing Algorithms Workshop*, bringing together a selected group of 25 participants for an intensive and highly practical learning experience.

Two Dates, Two Levels of Expertise

The program was structured across two sessions:

- **JUNE 25th, 2025 - Nice**
(Basic/Intermediate Level)
- **NOVEMBER 29th, 2025 - Paris**
(Advanced Level)

Each session was tailored to progressively develop technical skills, from foundational concepts to advanced decision-making in complex CTO cases.

A Focus on Crossing Algorithms

The workshop provided a structured, step-by-step approach to CTO recanalization, focusing on:

- Antegrade and retrograde crossing strategies.
- The latest advancements in wire escalation, parallel wiring, and dissection-reentry techniques
- Case-based discussions with experienced CTO operators, offering real-world insights and troubleshooting strategies
- A dedicated simulation corner, allowing hands-on practice through bench testing



An Interactive Learning Experience

With its small-group format, the workshop encouraged active participation and direct interaction with expert faculty. This immersive approach enabled participants to refine their technical skills, strengthen decision-making, and build confidence in tackling complex CTO procedures.

A Valuable Step in CTO Training

The *Crossing Algorithms Workshop* reaffirmed the ML CTO Academy's commitment to practical, high-quality education. By combining structured learning with hands-on experience, the program provided young CTO operators with the tools needed to advance their expertise and improve clinical outcomes.

Panel of experts



Alexandre
AVRAN
Valenciennes, France



Emmanouil
BRILAKIS
Minneapolis, USA



Stéphane
CARLIER
Mons, Belgium



Thomas
HOVASSE
Massy, France



Kambis
MASHAYEKHI
Lahr, Germany



Stéphane
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Georgia, USA



Claudiu
UNGUREANU
Brussels, Belgium



Mastering CTO Interventions:

HIGHLIGHTS OF THE 3rd ML CTO WORKSHOP

The ML CTO Academy is proud to present the third edition of its workshop, a leading educational initiative dedicated to advancing expertise in coronary chronic total occlusion (CTO) treatment.

Two Dates, Two Complementary Experiences

JUNE 24th, 2026 – NICE (France)

Hyatt Regency

100% Practical Session

NOVEMBER 21st, 2026 – PARIS (France)

INNSiDE by Meliá Charles de Gaulle Airport

Theoretical & Practical Session

Key features of the program:

- Immersive, hands-on training driven by expert faculty
- Access to a wide range of devices across several structured hands-on stations
- Exploration of different tools and strategies to enhance procedural performance
- Practical insights designed to improve outcomes in complex CTO cases

A Progressive Learning Experience

Coronary chronic total occlusion (CTO) treatment remains one of the most demanding areas in interventional cardiology, requiring a high level of technical expertise and clinical judgment.

Building on the success of previous editions, the 3rd Workshop of the ML CTO Academy continues its commitment to advancing expertise through a structured and progressive educational experience.

An Immersive First Session in Nice

The first session, held on June 24th in Nice, is designed as a fully hands-on, practice-driven experience. Developed in a shared-sponsorship format, it provides participants with unique exposure to multiple technologies and techniques in a highly interactive environment.

Participants refine their technical skills, compare approaches, and gain direct, practical experience essential for daily clinical practice.

A Comprehensive Second Session in Paris

The second session, scheduled for November in Paris, complements this practical foundation with a combined theoretical and hands-on approach.

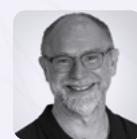
Building on the experience gained in Nice, participants will benefit from deeper clinical insights, structured discussions, and advanced case-based learning - ensuring a coherent and progressive educational pathway in CTO intervention.

A Commitment to Excellence in CTO Education

With a focused format and close interaction with expert faculty, the workshop offers a unique opportunity to strengthen expertise in CTO PCI.

The ML CTO Academy continues to support the development of the next generation of operators by bridging the gap between theory and real-world practice.

Faculty



Alexandre AVRAN
Valenciennes, France



Stéphane CARLIER
Mons, Belgium



Emrah ERDOĞAN
Istanbul, Turkey



Kambis MASHAYEKHI
Lahr, Germany



Stéphane RINFRET
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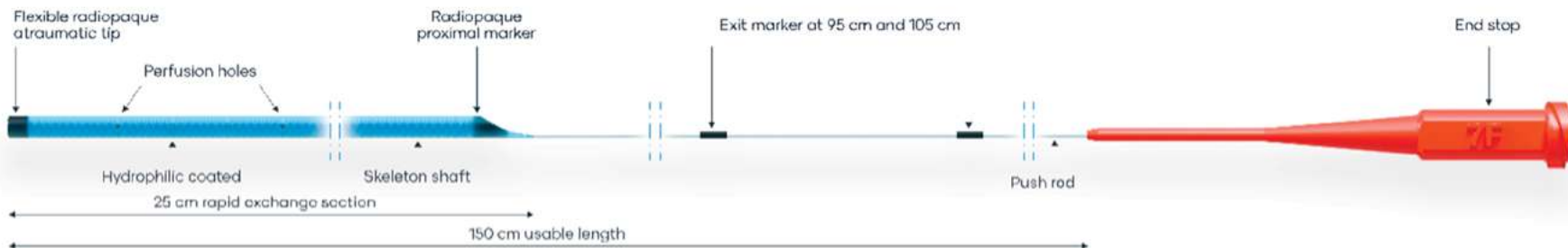
Ram VIJAYARAGHAVAN
Toronto, Canada



Register for the 2nd session in November!

FlowGuide 7F Case Report

Dr. Gregor Leibundgut, Head of Interventional Cardiology, University Hospital Basel, CH



Traditional guide extension catheters deliver support, but often at the expense of distal flow and tip visibility, increasing the risk of procedure induced ischemia and limiting precise stent placement. FlowGuide is designed for deep access while preserving distal perfusion, pressure and IVUS visibility. Scattered mid-shaft perfusion holes maintain consistent blood flow (12.5mL/min at 80mmHg), helping prevent pressure dampening.¹ (1. IMDS data on file).

PATIENT AND LESION DESCRIPTION:

Case led by Dr. Gregor Leibundgut - A symptomatic 77-year-old female patient was treated for left coronary artery disease (CAD) in the left anterior descending artery (LAD). The LAD demonstrated significant tortuosity, and therefore a 6F Guideliner was selected to improve guide support.



Figure 1: Angio overview of the left system demonstrating a tortuous LAD

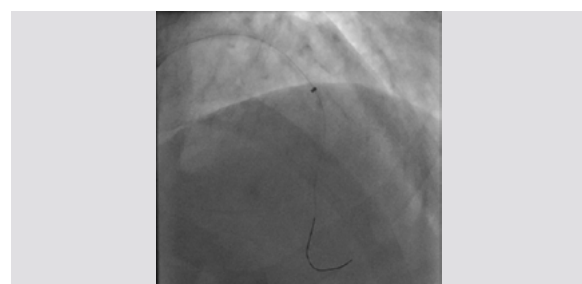


Figure 2: Angio Guideliner 6F being engaged in the LAD with significant pressure dampening.

PROCEDURE:

Upon engagement in the LAD significant pressure dampening was notified. To reduce pressure dampening the Guideliner 6F was removed and replaced for a 7F FlowGuide. The FlowGuide is designed and labeled to provide a perfusion flow with an FFR>0.6. This is enabled by 9 scattered very small perfusion holes starting at 1 cm (FlowGuide 7F design) from the distal tip and ending at 5.5 cm from the tip. The illustration below demonstrate continuous blood flow with the FlowGuide. Blood enters through the proximal perfusion holes and exits through the more distal holes and the distal tip.



Illustration 1: Visual Impression of FlowGuide 7F Perfusion Principle

The FlowGuide 7F was engaged in the LAD even in a more distal position than the Guideliner 6F. As can be derived from the above graph the Guideliner 6F induced problematic pressure dampening. When replaced with the FlowGuide 7F only minor dampening occurred enabling effective procedure continuation without procedural induced ischemia.

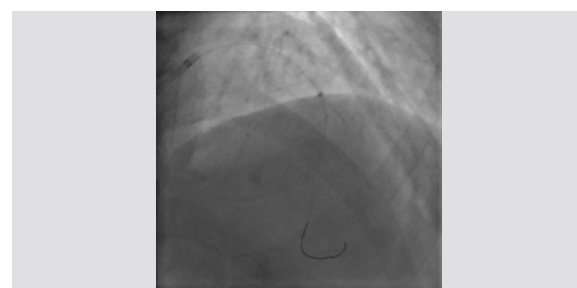


Figure 3: Angio FlowGuide 7F being engaged in the LAD with very limited pressure dampening.

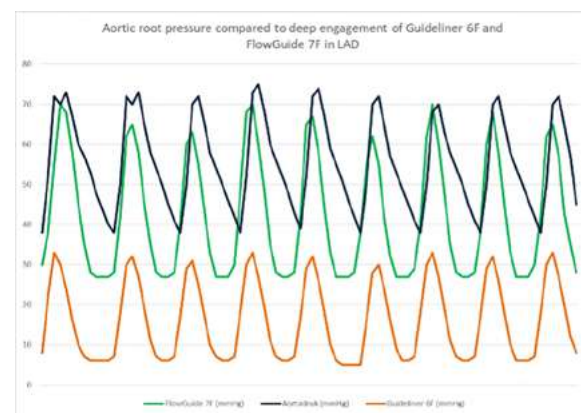


Figure 4: Pressure graph overlay of the aortic root pressure, LAD pressure curve with Guideliner 6F in the LAD and with the 7F FlowGuide engaged at a bit more distal position in the LAD

CONCLUSION:

To our knowledge, this is the first case report describing the use of the FlowGuide 7F and directly comparing it with a conventional 6F guide extension catheter without perfusion holes. This single case suggests that guide extension catheter-induced pressure dampening can be substantially reduced with the FlowGuide. Another important aspect highlighted by this case is that operators often select smaller guide extension catheters when deep intubation is required or when patients are sensitive to pressure dampening. With the FlowGuide, guide extension catheter selection may be driven primarily by procedural requirements rather than by patient-related limitations.

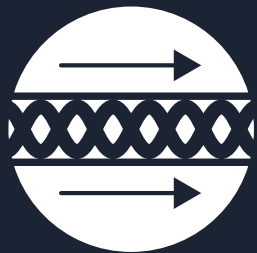
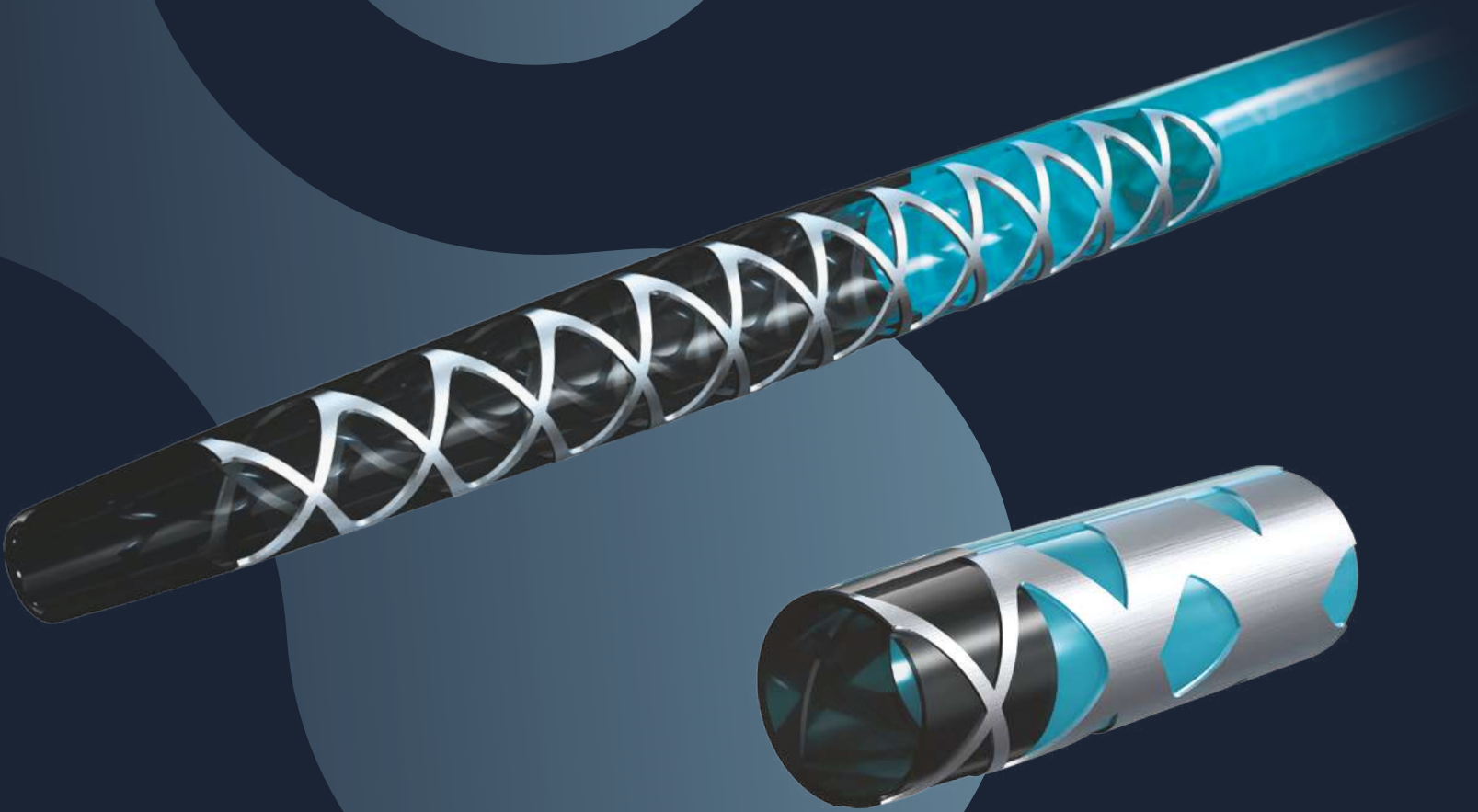


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SINGLE LUMEN OTW MICROCATHETER

IMDS

 **SKELETON
BACKBONE™**
TECHNOLOGY



SUPERIOR FORCE
TRANSMISSION



1:1 TORQUE
RESPONSE



REINFORCED
METAL TIP



Power Through Complexity with Precision and Control

11 Editions as Part of the ML CTO Annual Course

A CONVERSATION WITH DR. ARTHUR DARMON

Over the years, the ML CTO Annual Course has become a landmark meeting and a leading educational platform in interventional cardiology, bringing together a global community of experts and learners. As the course continues to grow, we take a moment to explore its impact through the perspective of those who have experienced it across multiple editions.

Among them is Dr. Arthur Darmon, an interventional cardiologist who has been part of eleven editions of the course and whose journey has evolved alongside it. Few participants have witnessed its transformation as closely, offering a unique perspective on both the course’s development and the broader evolution of CTO practice.

We sat down with Dr. Darmon to reflect on what first drew him to ML CTO, how the course has evolved throughout the years, and what continues to make it a unique and essential meeting within the field.

You have participated in many ML CTO Annual Course Editions. What initially motivated you to get involved, and what keeps you coming back each year?

What initially motivated me to attend the ML CTO Annual Course was very simple: I was at the beginning of my journey as an interventional cardiologist, and I already knew that CTO PCI was the field in which I wanted to invest deeply. I was looking for a course that was accessible, practical, and educational — a place where I could learn the fundamentals, understand contemporary strategies, become familiar with dedicated devices, and, importantly, learn how to anticipate and manage complications.

In many ways, the reasons that brought me there initially are exactly the reasons that keep me coming back every year. The ML CTO Annual Course has built a strong reputation because it is centered on live cases performed by international experts, with a very high educational value. What makes it particularly unique is that it speaks to everyone: from young operators who are discovering CTO PCI to experienced practitioners looking to refine their decision-making. The progressive complexity of the live cases throughout the course is also extremely valuable — as the meeting moves forward, the cases become more challenging, and the discussions naturally become deeper and more sophisticated.

But beyond the technical content, there is also a very special atmosphere. You really feel the energy of a community. It is a friendly, open, and welcoming environment during the social moments, but once the scientific sessions begin, it becomes highly demanding, intellectually honest, and never afraid of controversy or debate. That balance — collegiality, expertise, and critical discussion — is what makes the ML CTO Annual Course so valuable, and why I keep returning year after year.

How have you seen the course evolve over time, both in terms of content and participant profile?

I have mainly seen the course grow — not only in size, but also in reach and influence. Over the years, the number of participants has clearly increased, with colleagues coming from many different countries and practice environments. What is particularly striking is the growing presence of younger interventional cardiologists. In that sense, the course has played an important role in making CTO PCI more visible, more accessible, and

less intimidating for the new generation of operators.

In terms of content, the course has also become increasingly rich and diverse. Of course, CTO remains at the center, with a strong focus on lectures, live cases, clinical case discussions, and very practical tips and tricks that can be directly applied in daily cath-lab practice. This is one of the great strengths of the meeting: you always leave with something concrete that may change the way you approach a case the following week.

But what I also appreciate is that the program goes beyond purely technical teaching. Some sessions are more conceptual and inspiring, drawing unexpected parallels between CTO PCI and other fields — for example chess lessons from a master, or high-level sports training. These perspectives may seem unconventional at first, but they are extremely valuable because CTO PCI is not only about wires and devices. It is also about strategy, anticipation, resilience, teamwork, and the ability to adapt when the

“ **WHAT SETS ML CTO APART IS THE COMBINATION OF VERY HIGH SCIENTIFIC STANDARDS WITH A TRULY UNIQUE ATMOSPHERE.** ”

initial plan fails. In that regard, the course helps us broaden the way we think about our specialty.

From your perspective, what sets ML CTO apart from other programs in interventional cardiology, especially in CTOs?

What sets ML CTO apart is the combination of very high scientific standards with a truly unique atmosphere. The course brings together outstanding international CTO experts, but in an environment that remains relaxed, accessible, and genuinely friendly. That balance is not so common. You can have very advanced technical discussions, sometimes very direct and challenging, but always within a spirit of collegiality and shared learning.

Another major strength is the live-case format. Having more than ten live cases per edition gives the course a level of intensity and realism that is difficult to reproduce with lectures alone. CTO PCI is a discipline where decision-making

evolves minute by minute, and live cases allow participants to follow the entire process: the initial strategy, the moments of uncertainty, the changes in plan, the management of complications or near-complications, and the final result. This is where the real educational value lies.

And of course, the setting also contributes to the identity of the meeting. Being on the French Riviera, with its light and its atmosphere, creates a very special environment for networking and informal discussion. In the end, ML CTO is not only a scientific meeting; it is a place where the CTO community gathers, exchanges openly, challenges itself, and leaves with renewed motivation

What value does ML CTO offer to both beginner and experienced operators?

For beginners, ML CTO is a true immersion into everything the CTO world has to offer. It allows young operators to discover the main strategies, understand the role of dedicated devices, and, most importantly, follow the reasoning behind each procedural decision. CTO PCI can initially seem complex and intimidating, but the course helps break it down into structured concepts: how to analyze a CTO, how to build a “flight plan,” how to apply the different algorithms, and how to adapt when the case does not follow the expected route.

It is also an opportunity to learn practical tips and tricks that are rarely found in textbooks: what to do, when to do it, and just as importantly, what not to do. This is essential for building confidence while maintaining safety and humility — two key qualities in CTO PCI.

For experienced operators, the value is different but just as important. ML CTO is a place to share experience, discover emerging techniques, challenge one’s own habits, and sometimes rethink established practices.

The frank discussions around live cases are particularly valuable because they force us to reflect on our decision-making in

real time. It is also a great opportunity to expand one’s network and exchange with colleagues facing similar challenges in different healthcare systems.

Ultimately, whether you are a beginner or an experienced operator, CTO PCI remains a continuous learning process. Courses like ML CTO remind us that there is always a new strategy to understand, a new technique to refine, and a new lesson to bring back to the cath lab.

What do you think interventional cardiologists are looking for today when they attend courses like this?

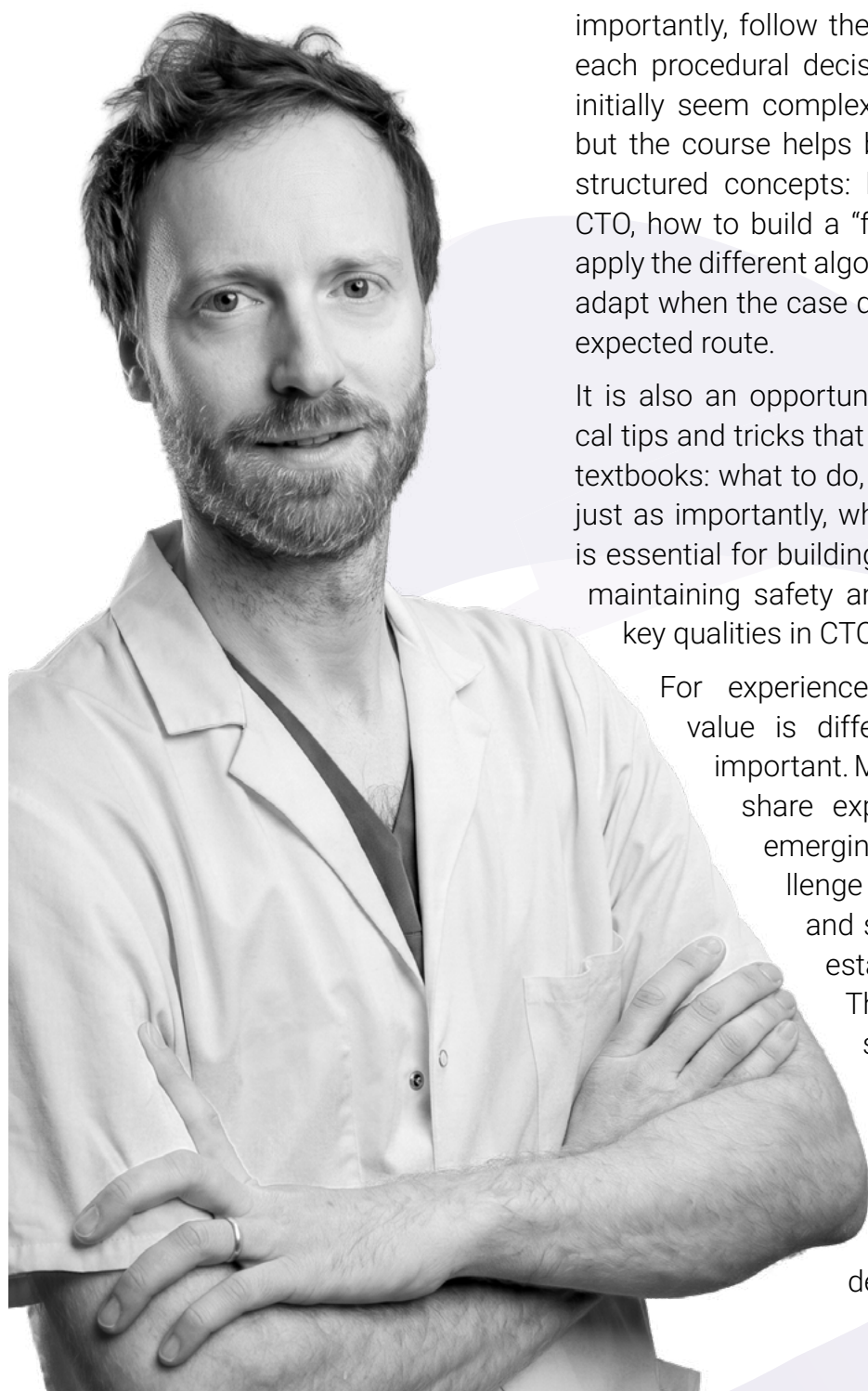
First, they want to consolidate what they already know — to make sure their daily practice is aligned with contemporary strategies, current devices, and the safest procedural standards. But they also come to acquire new techniques, refine their approach, and bring back practical tools that can immediately improve their work in the cath lab.

In CTO PCI specifically, one of the greatest values of a live-course format is the opportunity to observe how expert operators think in real time. Participants are not only looking at the final angiographic result; they want to understand how the case is analyzed, how the initial strategy is selected, why a device is chosen, when the operator decides to persist, and when it becomes necessary to switch strategy.

What is probably even more important is seeing how experts adapt when things do not go according to plan — because in CTO PCI, this happens frequently. The ability to remain calm, reassess the situation, manage uncertainty, and modify the strategy safely is one of the most valuable lessons such a course can provide. Ultimately, people come to gain knowledge, but they also come to gain confidence, perspective, and a more structured way of making decisions.

What key techniques or innovations highlighted in ML CTO do you believe are currently shaping interventional cardiology practice?

First, the use of structured algorithms has become central. CTO PCI is no longer based only on individual experience or improvisation; it is increasingly driven by systematic lesion analysis, strategy



11 Editions as Part of the ML CTO Annual Course

A CONVERSATION WITH DR. ARTHUR DARMON

selection, and timely switching between approaches.

Second, intravascular imaging – especially IVUS – has taken a predominant role. Today, it is almost exceptional to watch a live CTO case without imaging guidance. At every edition, we discover new ways in which IVUS can change the procedure: clarifying an ambiguous proximal cap, managing ostial lesions, guiding puncture, supporting tip-detection ADR, or helping analyze and manage complications.

Third, dissection and re-entry techniques have become increasingly refined, whether guidewire-based, device-assisted, or IVUS-guided. These approaches have expanded our procedural options and made complex CTO PCI more strategic, more reproducible, and, when properly used, safer.

Beyond technical skills, what defines a great CTO operator?

Beyond technical skills, I believe a great CTO operator is defined by a combination of humility, perseverance, and judgment. Humility is essential because CTO PCI constantly reminds us that even well-planned procedures may not go as expected. A good operator must be able to reassess, change strategy, ask for help, and know when to stop.

Perseverance is equally important. CTO PCI is a long and demanding journey, often requires patience, resilience, and the ability to stay focused despite frustration or failure. It also means accepting to step outside one's comfort zone, because progress in this field comes from continuous learning and controlled exposure to complexity.

Finally, a great CTO operator has a strong sense of responsibility: the willingness to take justified risks for patients when the expected benefit is meaningful, but never losing sight of safety. And beyond individual performance, I think transmission of knowledge is fundamental. The best operators are not only those who succeed in difficult cases, but those who help others understand how and why they succeed.

How do you envision training in interventional cardiology evolving over the next 10 years?

I think training in interventional cardiology will have to evolve in several directions over the next decade. First, in a challenging economic environment, we must do everything possible to preserve high-quality academic meetings such as ML CTO. These courses remain essential because they provide live education, expert discussion, networking, and exposure to real-world decision-making that cannot be fully replaced by online content.

At the same time, new technologies will probably transform the way we teach and learn. Virtual reality, augmented reality, and remote proctoring may allow experts to support operators without always having to travel physically to the cath lab. This could make advanced training more accessible, more scalable, and more efficient across different regions.

Finally, I strongly believe simulation-based training will become increasingly important. In complex PCI – and especially in CTO PCI – it will no longer be acceptable to perform a first epicardial collateral crossing, a first reverse CART, or a first complication-management scenario directly on a patient without prior simulation. Simulation can make training safer, more structured, and more reproducible. The future of interventional training will probably combine the best of both worlds: live expert education and hands-on simulation before real-life application.

What about Alexandre Avran, your mentor?

My relationship with Alexandre goes back to the time when I was at Bichat Hospital. I was immediately impressed by his level – honestly, a stratospheric level – at a time when CTO PCI was still in its early development in France. It was obvious to me that he was someone I could learn a lot from.

Of course, his technical skills are exceptional, but what defines him most is probably the way he performs complex PCI: with humility, calmness, and remarkable control. He has this rare ability to manage highly complex situations – including complications – with complete composure. This is extremely valuable to observe, because in CTO PCI, the emotional control of the operator is often as important as the technical move itself.

He is also an outstanding mentor and teacher. During proctoring sessions, he has a unique ability to give confidence to operators, to guide them without overwhelming them, and to transmit not only techniques but also a way of thinking. His experience is immense, yet he remains very open, curious, and always up to date with new devices and evolving strategies.

For me, Alexandre represents exactly what a mentor should be in interventional cardiology: highly skilled, humble, generous in sharing knowledge, and deeply committed to helping others progress.

And on a more personal note, he is also a great lover of fine wines, with an almost endless knowledge in that field as well – which gives us the opportunity to share something else beyond CTO PCI.

QUICK ROUND!

One word to describe ML CTO: Community

An essential value in CTO & Complex PCI: Transmission

A breakthrough that will shape the future: Simulation

One quick tip for fellows: Find a good mentor

A place where you disconnect: Home



Empowering Complex PCI

AnyreachC™ & AnyreachP™

PTCA Guidewire

**Safe Net Design
Core-to-tip**

Collateral Navigation

0.3g

Workhorse

0.6g / 1.0g

CTO Indicated

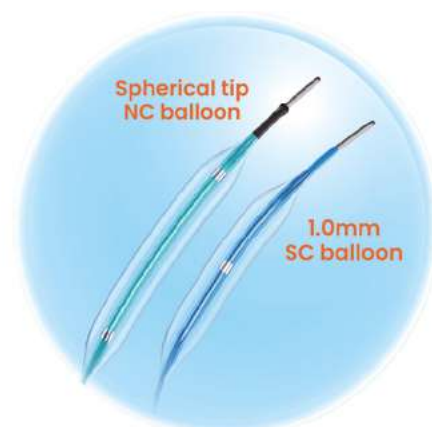
1.5g / 3.0g / 6.0g



Elong™
Microcatheter



Expressman™
Guiding extension catheter



CONQUEROR™
PTCA balloon catheter

Successful Recanalization of Complex CTO Lesions: Insights from Multiple Cases Managed with APT Solutions

By



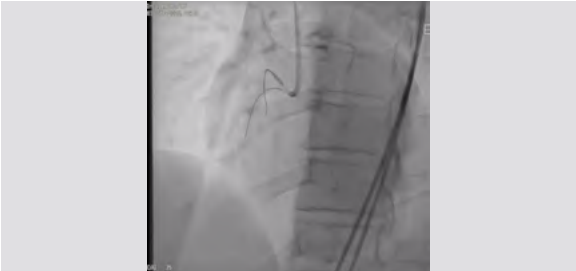
The following representative CTO cases were performed by Roberto Garbo, MD, Director of the Turin CTO & CHIP Live Course, and illustrate the application of APT CTO solutions across a range of challenging CTO scenarios.

CASE I: Successful Recanalization of Complex Double CTO in the RCA Using a Retrograde Approach and Rendezvous Technique

This is a complex double CTO involving both the proximal and distal RCA.



Antegrade puncture was performed with the Elong™ 2.6F and AnyreachP™ LanceR 3g.



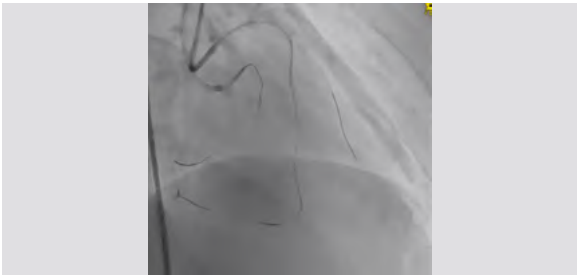
The wire entered the subintimal space of the distal RCA beyond the second distal lesion.



A retrograde approach was adopted with the Elong™ 2.6F and AnyreachP™ 0.3 to address the complex septal collateral. Successful crossing was achieved despite the difficult wiring.



The rotatable Elong™ 2.6F was advanced retrogradely with clockwise rotation to navigate the tortuosity. This video demonstrates the real-time crossing of the retrograde microcatheter. Significant force was required against the guiding catheter, necessitating firm stabilization with the left hand to maintain backup support. This technique is critical for traversing complex collateral channels. The Elong™ was successfully advanced through the collateral channel.



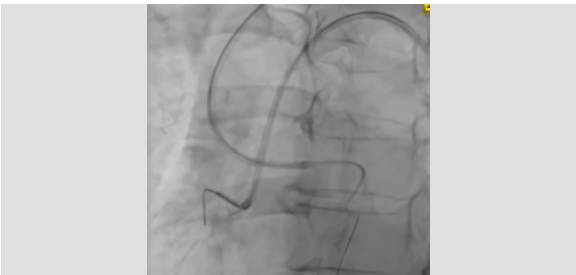
As previously noted, the combination of a polymer-jacketed wire and the Elong microcatheter is crucial for managing occlusions. Here, the AnyreachP™ LanceR 3g was utilized for retrograde crossing. The real-time crossing alongside fluoroscopy registration was displayed, demonstrating the mechanism in action. With the polymer-jacketed wire facilitating the crossing, the wire can now be seen successfully traversing the lesion.



Following confirmation, successful re-entry into the guiding catheter was achieved using the AnyreachP™ LanceR 3g. The re-entry was visualized, demonstrating precise re-entry.



The antegrade Elong™ was advanced via the guiding catheter to engage the retrograde AnyreachP™ LanceR. Following successful alignment, a rendezvous technique was performed in the PDA.



The rendezvous technique was utilized to enhance antegrade wire support during the conversion to an antegrade approach. Real-time imaging confirmed the antegrade wire advancing within the retrograde microcatheter, achieving excellent support.(page 8 2)



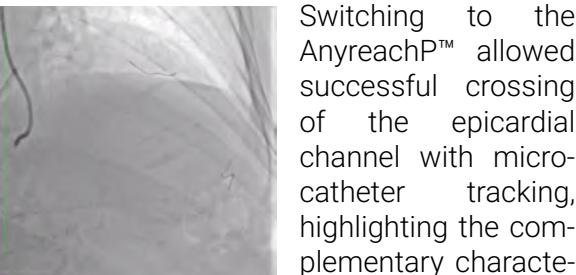
The final angiogram following multiple stentings and kissing balloon inflation of the posterolateral branch is shown. The final angiographic result was excellent.

CASE II Management of LAD CTO with Ambiguous Cap using Combined Wire Strategy

This LAD CTO presents with a complex epicardial connection.



Following a failed antegrade attempt with an ambiguous proximal cap, the AnyreachC™ 0.3 initially crossed the epicardial channel, but the Elong™ 1.7F microcatheter could not cross the distal segment.



0.3 and AnyreachP™ 0.3 in complex collateral crossing.

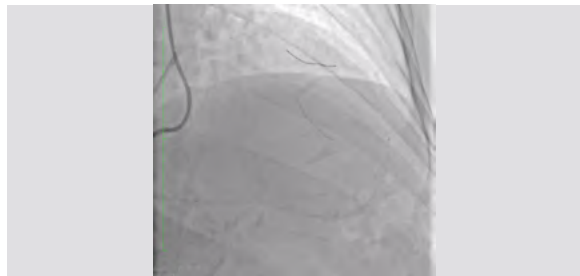
**AnyreachC
AnyreachP
Workhorse Wire**

Features

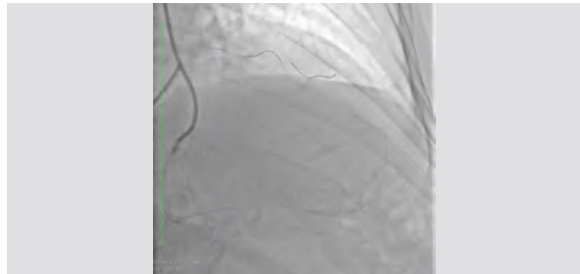
- Tip load 6.5g - Excellent collateral channel tracking
- Tip safe net & nitinol core - Superior Durability
- Case to tip - Superior Torque Transmission

Optimal for CTO

- Side branch protection
- Avoiding distal vessel injury and perforation
- Septal collateral channeling



The AnyreachP™ LanceR 3g successfully achieved retrograde crossing in a short time, allowing for successful externalization.



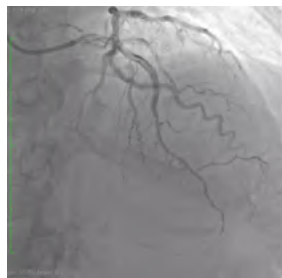
**AnyreachP™ LanceR
CTO Indicated Wire**

Features

- Sequential tip-load escalation strategy - 1.5g → 3g → 6g
- Hydrophilic polymer jacket - Lubricity and trackability
- Tip nitinol core - Durable curve retention / Excellent trackability

Optimal for CTO

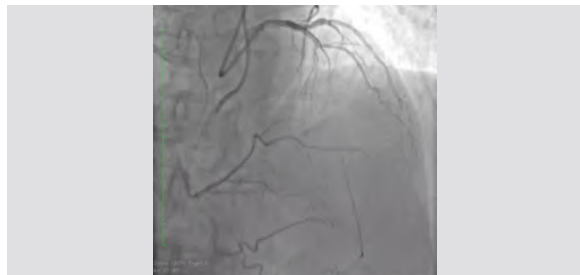
- Tapered proximal cap
- Blunt proximal cap
- Highly resistant proximal caps
- Ambiguous proximal cap
- Knuckle



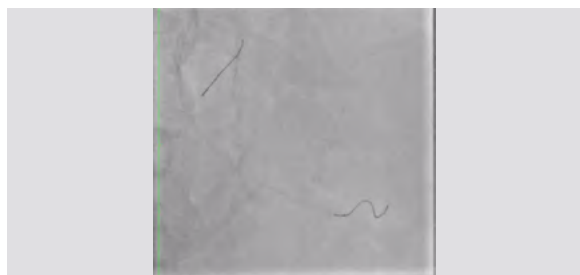
The final angiogram demonstrates an excellent stenting outcome.

CASE III: Navigation of Tortuous Epicardial Collaterals in LAD CTO with Bifurcation

Another challenging LAD CTO is presented, featuring an ambiguous proximal cap and a bifurcation with complex epicardial collateral.



The AnyreachC™ 0.3 was advanced through a highly tortuous and tiny epicardial connection, supported by the Elong™ 1.7F microcatheter.



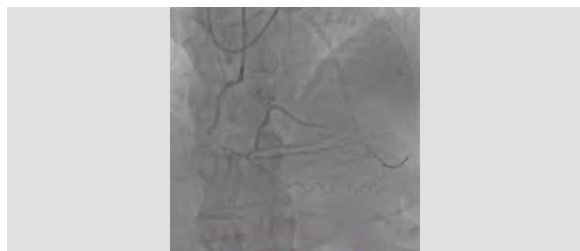
Subsequent advancement of the wire and microcatheter proceeds smoothly.



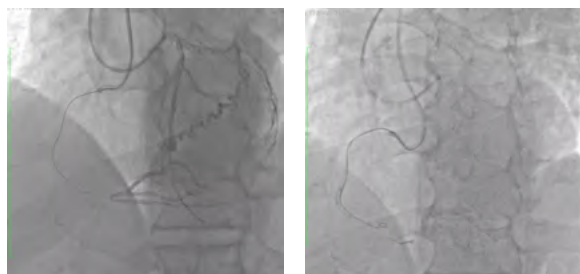
The final stenting result demonstrates a patent vessel and a preserved epicardial connection.

CASE IV: Retrograde Treatment of Complex RCA CTO with Super-Dominant Epicardial Connection

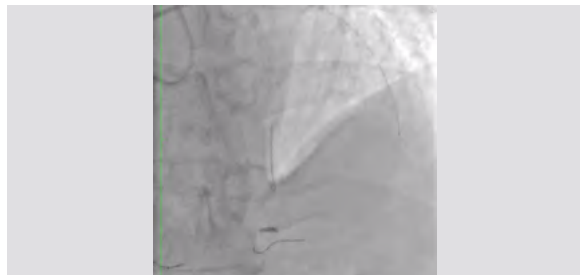
This case presents a complex RCA CTO featuring a super-dominant epicardial connection, with two distinct epicardial channels.



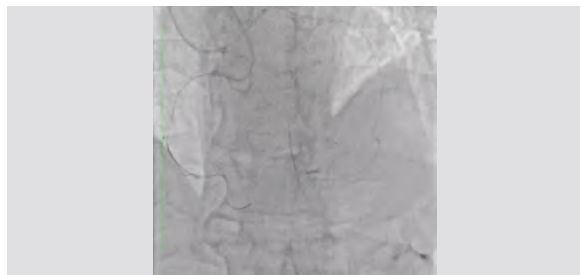
The procedure was initiated antegrade using an Elong™ 2.6F microcatheter, but due to the CTO wire deflecting into the subintimal space, the strategy was switched to a retrograde approach.



Following the failure to engage the large epicardial collateral, an alternative channel was successfully navigated using **AnyreachC™ 0.3**.



However, advancement of the Elong™ 1.7F microcatheter failed due to the tiny epicardial anatomy, necessitating a switch to the Elong™ 2.6F.



A switch to the Elong™ 2.6F was made to provide additional support, allowing the microcatheter to traverse the epicardial collateral via rapid rotation, while the Expressman guide extension was positioned in the mid RCA.



Reverse CART was successfully performed with Expressman, establishing a connection between the antegrade and retrograde channels.

**Expressman™
Guiding Extension**

Features

- Thinnest 1.0F for easy wire negotiation
- Elongated 35 cm RX sections - Avoid fracture & Facilitate device delivery

Optimal for CTO

- Initial cap puncture
- Uncrossable lesions
- Reducing hematoma in ADR
- Facilitate ADR device crossing
- Facilitate reverse CART
- Treatment of CTO in bifurcation

The final angiographic result is excellent, confirming that the epicardial vessel remained intact even after the Elong™ 2.6F crossed. While initial attempts with smaller 1.7F or 1.9F microcatheters are recommended, switching to an Elong™ 2.6F is a viable strategy for navigating small channels if initial advancement fails.

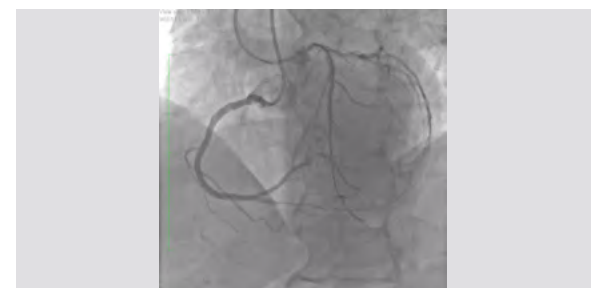
**Elong™
Microcatheter**
1.7F / 1.9F / 2.6F

Features

- Elong 1.7F pushable MC - Great crossability and trackability
- Elong 1.9F coiled MC - Better support than 1.7F, coil delivery
- Elong 2.6F coiled MC - Structural integrity after 50 rotations
- Elong 2.6F durable tip - Reduced tip damage in calcification
- PTFE inner layer - Avoid wire trapping & smooth wire exchange

Optimal for CTO

- 1.7F for collateral channel tracking
- 2.6F for torquable for hard lesion
- All suitable for S-shaped artery



These cases demonstrate the versatility of the APT CTO portfolio across a broad range of challenging CTO scenarios, including collateral channel tracking, retrograde crossing, reverse CART, and guide extension support.

The Anyreach guidewire family, Elong™ microcatheter series, and Expressman™ guide extension catheter provided complementary support throughout different procedural steps and strategies.



Complex patient with post-CABG diseases

USA

September 2027



PROGRAM

- ★ Live streaming procedures
- ★ Cath Lab staff dedicated program
- ★ Workshop & hands-on



MasterClass



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More information to come, stay connected!

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Coming soon, stay connected!



The ML CTO 2026 Journal Club

REVIEW OF CTO STUDIES



Message from the Co-Director

WELCOME TO MLCTO 2026!

While last year we singled out two articles suggesting improvements in clinical outcomes, including survival, after CTO PCI, this year's journal club covers two recent interesting publications on the impact of successful CTO PCI on quality of life (QOL). As you will assess, both the meta-analysis of EuroCTO and DECISION CTO trials QOL results and the outcomes of the sham-controlled ORBITA CTO confirm what we have all observed for years: patients feel better with an open artery!

Ironically, we might be the only specialty trying to show that aiming at renovating an anatomy close to what the patient had prior to being diseased is better than giving medication to compensate for this change in anatomy. Orthopedic surgeons never had to demonstrate with the same level of scientific robustness that a fully functional new hip or knee make their patients walk easier and without pain much better than with pain killers and anti-inflammatory agents. But, in a field driven by data, cardiology must always make the extra scientific steps, and it did beautifully again this time.

I asked Drs. Ybarra and Verreault-Julien again to provide a review of those 2 studies for our attendees.

Enjoy reading, please share your thoughts and enjoy the meeting!

Stéphane Rinfret
on behalf of the Co-Directors

Randomized, Placebo-Controlled Trial of Chronic Total Occlusion Percutaneous Coronary Intervention in Stable Angina

The ORBITA-CTO Trial

Sarosh Khan, MBBS, Uzma Sajjad, MBBS, Samer Fawaz, MD, Haroun Butt, MBCHB, Rupert Simpson, MBCHB, Abdalla Ibrahim, MBBS, Craig Robertson, BSC, Paul Kelly, MD, Shah R. Mohd-nazri, MD, Kare Tang, BM, Christopher M. Cook, PHD, Ozan M. Demir, PHD, Peter O'Kane, MD, James C. Spratt, MD, Emmanouil S. Brilakis, PHD, Grigoris V. Karamasis, MD, Matthew Shun-Shin, PHD, Rasha Al-Lamee, PHD, Thomas R. Keeble, MD, John R. Davies, PHD, the ORBITA-CTO Investigators

Journal of the American College of Cardiology 2026, in press

ABSTRACT

BACKGROUND.

Percutaneous coronary intervention for coronary chronic total occlusion (CTO PCI) is offered for symptom and quality of life improvement, despite the absence of blinded randomized evidence.

OBJECTIVES.

The aim of this study was to assess the efficacy of CTO PCI in the first randomized, placebo-controlled trial of CTO PCI.

METHODS.

ORBITA-CTO is a multicenter, randomized, blinded trial comparing CTO PCI with a placebo procedure. Patients had angina attributable to a single-vessel CTO, without bystander coronary disease. Angina symptoms were recorded daily using the ORBITA app. After dual-injection coronary angiography, patients were randomized to either CTO PCI or placebo. Blinding was maintained using auditory isolation and deep conscious sedation. Antianginal medications were stopped at randomization and reintroduced on a patient-initiated protocol. At the 6-month follow-up, assessments were repeated. The primary efficacy outcome was the angina symptom score, an ordinal scale combining the daily symptom burden assessed by the ORBITA app, antianginal use, and over-ride events. Secondary outcomes were symptom and quality of life questionnaires and blinding fidelity.

RESULTS.

Between October 19, 2021 and October 21, 2025, 50 patients were randomly assigned to CTO PCI (n = 25) or placebo (n = 25). One patient randomized to PCI was withdrawn during the procedure because of a complication. All 50 patients were included in the primary analysis. Compared with placebo, CTO PCI resulted in an immediate and sustained improvement in the angina symptom score (OR: 4.38; 95% credible interval [CrI]: 1.57-12.69; probability of benefit [Pr{Benefit}] = 0.996), arising from a clear reduction in the number of episodes of angina (OR: 4.38; 95% CrI: 1.5511.78; Pr[Benefit] = 0.997). This resulted in an additional 30.6 days free of angina (95% CrI: 11.1-50.7; Pr[Benefit] >0.999). Improvements were also observed with the Seattle Angina Questionnaire in angina frequency (+10.7; 95% CrI: 1.4-20.2; Pr[Benefit] = 0.988), physical limitation, quality of life, and summary score and Canadian Cardiovascular Society class. Blinding of patients, staff, and researchers was maintained.

CONCLUSIONS.

In patients with symptomatic single-vessel CTO, CTO PCI improves angina beyond placebo.

CENTRAL ILLUSTRATION: A Randomized, Placebo-Controlled Trial of Chronic Total Occlusion Percutaneous Coronary Intervention in Stable Angina—ORBITA-CTO

This is the first randomized, double-blind, placebo-controlled trial evaluating CTO PCI, addressing a major evidence gap in a field where procedural risks are higher and prior trials have been unblinded. It provides the first data isolating the treatment effect of CTO PCI from the substantial placebo response known to accompany revascularization procedures.

TRIAL DESIGN

- Investigator-initiated
- Multicenter
- Double-blind
- Randomized 1:1 to CTO PCI or placebo procedure
- Blinded 24-week follow-up

POPULATION

50 patients with

- symptomatic, single-vessel CTO (J-CTO ≤ 3)
- evidence of ischemia and viability
- no significant non-CTO coronary disease
- optimized anti-anginal therapy before randomization

64
median age

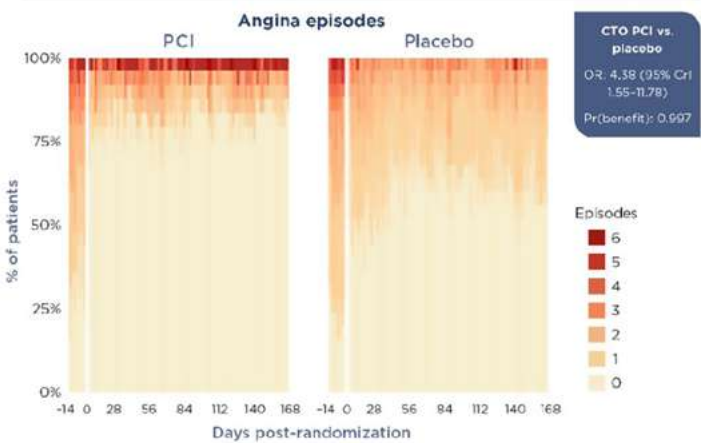
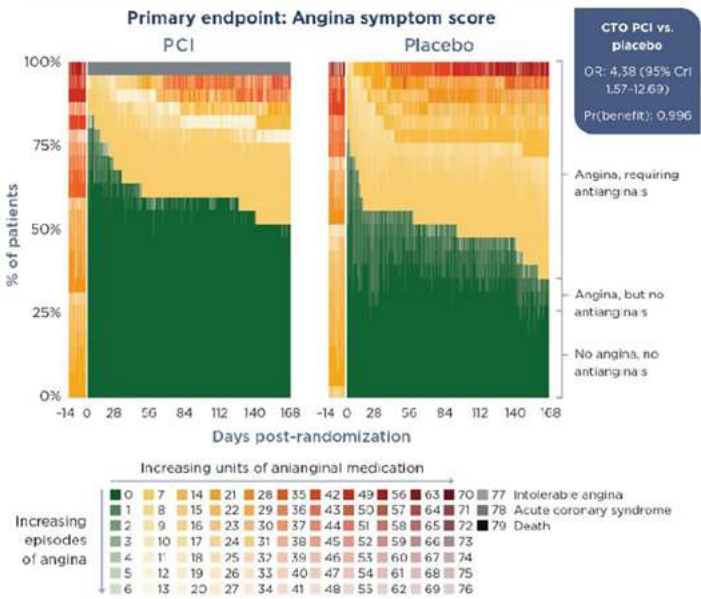
74%
men

94%
CCS class II-III
at baseline



In patients with symptomatic single-vessel chronic total occlusion (CTO), percutaneous coronary intervention (PCI) **produced a measurable reduction in angina burden** compared with a placebo procedure.

RESULTS



Over 6 months, patients undergoing CTO PCI experienced **~31 additional angina-free days** compared with placebo.



patients with single-vessel chronic coronary syndrome, but CTOs were explicitly excluded. Until now, there remained a knowledge gap in this subset of patients. The publication of ORBITA-CTO by Khan and colleagues in JACC now fills that gap, with results that the CTO community can welcome.

What the trial shows

ORBITA-CTO randomized 50 patients with symptomatic, single-vessel CTO subtending viable and ischemic myocardium to CTO PCI (n=25) or to a meticulously executed placebo procedure (n=25), with deep conscious sedation, auditory isolation, dual-injection coronary angiography in both arms, and blinded post-procedural care. Inclusion required a J-CTO score ≤ 3 , no significant bystander disease, and adjudication by a regional CTO and complex PCI multidisciplinary team. All antianginal medications were stopped at randomization and could only be reinitiated through a blinded, patient-driven protocol. Symptom burden was captured daily through the ORBITA app over six months.

The primary endpoint, an ordinal daily angina symptom score combining ORBITA-app angina episodes, antianginal medication units, and over-ride events, favored CTO PCI with an odds ratio of 4.38 (95% credible interval [CrI], 1.57–12.69; probability of benefit, 0.996). Patients allocated to PCI experienced 30.6 additional angina-free days over six months (95% CrI, 11.1–50.7; probability of benefit > 0.999). The Seattle Angina Questionnaire (SAQ) angina frequency domain improved by 10.7 points more in the PCI group (95% CrI, 1.4–20.2), the SAQ summary score by 13.7 points (95% CrI, 4.2–23.2), and the blinded physician-assessed Canadian Cardiovascular Society (CCS) class fell by 0.7 classes more in the PCI arm. Technical success was 96%. Blinding fidelity was, remarkably, essentially perfect: the Bang indices for patients, ward staff, and blinded research personnel were all close to zero.

Symptom and quality-of-life benefit

The magnitude of benefit warrants close attention. A 10.7-point improvement in SAQ angina frequency meets established criteria for a moderate-to-large clinical change; a 13.7-point gain in the SAQ summary score substantially exceeds the conventional 5-point minimum clinically important difference.

Thirty more days free of angina every 6 months is the kind of number patients understand, and the kind that should change a clinic conversation. The shift in physician-assessed CCS class, from a median of 2–3 to predominantly 0, was the clearest blinded illustration of the trial's clinical impact and is consistent with what high-volume operators have observed for years.

MY EDITORIAL COMMENT

**ORBITA-CTO:
A PLACEBO-CONTROLLED VERDICT**



**Louis Verreault-Julien,
MD, MPH, FRCPC,
DRCPS, FACC, FSCAI**

Montefiore Medical Center,
Albert Einstein College of
Medicine, Bronx, New York, USA

For nearly a decade, the most uncomfortable question in our field has been deceptively simple: when we open a chronic total occlusion (CTO) to relieve a patient's angina, are we doing what we believe we are doing, or are we performing a complex and expensive placebo? After ORBITA showed that the symptomatic benefit of non-CTO percutaneous coronary intervention (PCI) for stable angina was substantially smaller than open-label trials had suggested, doubt remained regarding the true effect of coronary revascularization on symptoms. ORBITA-2 then restored our confidence in modern PCI by demonstrating that, in the setting of antianginal washout, PCI was superior to a sham procedure in

How does this compare with the broader CTO evidence base? EuroCTO, the largest unblinded randomized trial to date (n=396), reported an 86.6% PCI success rate, mean SAQ angina frequency gains of approximately 6 points over optimal medical therapy, and consistent improvements across all SAQ domains. COMET-CTO and IMPACTOR-CTO, both smaller and open-label, reported numerically larger SAQ deltas of 20–25 points. DECISION-CTO, which suffered from high crossover and a primary endpoint that pooled hard and soft outcomes, did not detect a quality-of-life difference but had a 91% procedural success and was not designed to interrogate symptom efficacy with the granularity now possible. ORBITA-CTO sits broadly where one would expect on this continuum: numerically larger than EuroCTO (which was diluted by an 86.6% success rate and unblinded contamination), smaller than the open-label trials (where placebo and reporting bias inflate the effect), and on a scale that mirrors ORBITA-2 once one accounts for the markedly higher ischemic burden of CTO lesions.

Procedure matters

Perhaps the most clinically actionable lesson of this trial is not what was done to patients, but how it was done. A 96% technical success rate, dual-operator delivery in every case, dual arterial access in every case, intravascular ultrasound guidance in 92%. These numbers should be the standard and reflect what should be done and achieved in CTO PCI to obtain the same outcomes. Contemporary European registry data report intravascular imaging use of approximately 21% in everyday CTO practice, and the ISCHEMIA CTO sub-population achieved a recanalization rate of only 54%. The signal that emerges from ORBITA-CTO is therefore strongly tied to the procedural quality that produced it.

This supports the CTO community’s longstanding insistence that procedural excellence is the only path to clinical benefit. As we all know, CTO PCI does not work by intention-to-treat. The lone unsuccessful procedure in ORBITA-CTO was a patient who continued to average approximately six episodes of angina per day during follow-up, echoing the OPEN-CTO data that failed CTO PCI is meaningfully worse than successful CTO PCI for nearly every health-status domain. Previous studies also identified a residual CTO as a powerful predictor of persistent angina after PCI in chronic coronary syndromes, reinforcing that incomplete or unsuccessful revascularization is the worst-of-both-worlds outcome.

The implication for our programs is direct. If a center’s CTO success rate sits well below the 85–90% benchmark, the symptomatic benefit demonstrated in ORBITA-CTO cannot be assumed to translate to its patients. The path forward is to invest in CTO PCI programs so that procedural quality and outcomes reach the standard set by this trial.

Patient selection and generalizability

The funnel from 418 assessed patients to 50 randomized is the trial’s principal limitation. It is also its principal strength. Restriction to single-vessel CTOs of moderate complexity, with documented ischemia and viability in the territory and no competing significant disease, isolates the question the trial was designed to answer: does CTO PCI provide a symptomatic benefit beyond placebo when the lesion is plausibly responsible for the patient’s symptoms? We can now confidently answer yes.

What ORBITA-CTO does not directly tell us is how the benefit scales in the multivessel CTO patient, the post-CABG patient with a complex CTO, the J-CTO 4–5 retrograde cases, or the patient with reduced ejection fraction. However, the absence of evidence in these groups is not evidence of absence of benefit. The mechanistic case for symptomatic benefit is at least as strong in more diseased patients. The myocardium supplied by CTO vessels is persistently ischemic regardless of collateral grade, with mean pre-PCI fractional flow reserve values around 0.45, and the observational literature consistently links successful CTO revascularization to improved quality of life and, in long-term registry data, to lower mortality compared with medical therapy alone. ORBITA-CTO should therefore encourage us to offer CTO PCI to broader CTO populations if the operator is confident that ORBITA-CTO-like outcomes can be achieved.

Where this leaves us

ORBITA-CTO does not overturn anything. It confirms, with the most rigorous methodology available, what the community’s most experienced operators have observed thousands of times in practice: in the right patient, CTO PCI works. It also makes the conversation regarding expectations after CTO PCI easier.

The trial also makes the remaining questions more specific. Whether CTO PCI alters hard outcomes remains uncertain and would require larger-than-possible trials. Whether the symptom benefit extends in the same magnitude to multivessel CTO patients and to higher J-CTO complexity is plausible but unproven. Whether less expert centers can reproduce the procedural quality required to deliver this benefit is a question we, as a community, must answer for ourselves, lab by lab. None of these questions diminish what Khan and colleagues have given us. ORBITA-CTO is a landmark contribution. It tells our patients, and tells us, that when we open a chronic total occlusion in the right patient, symptomatic relief can and should be expected.

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Quality of Life After Percutaneous Coronary Intervention or Medical Therapy for Chronic Total Coronary Occlusions

EUROCTO and DECISION-CTO Meta-Analysis

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Journal of the American College of Cardiology 2026, in press

ABSTRACT

BACKGROUND.

The benefit of percutaneous coronary intervention (PCI) for chronic total coronary occlusions (CTOs) to improve clinical symptoms and quality of life (QoL) as compared with optimal medical therapy (OMT) is still under debate because of the scarcity of available randomized trials (RCTs).

OBJECTIVES.

We evaluated the effect of PCI vs OMT in patients with a CTO and no concomitant coronary lesions in a post-hoc pooled analysis of 2 RCTs.

METHODS.

A total of 518 patients with a single CTO and no other significant coronary lesion were extracted from 2 RCTs, EUROCTO and DECISION-CTO, which had compared PCI vs OMT. Randomization to PCI or OMT was 1:1 in DECISION and 2:1 in EUROCTO. The clinical status was assessed by the Seattle Angina Questionnaire (SAQ) at baseline and after 12 months, and clinical events were monitored for 3 years.

RESULTS,

PCI was successful in 92.2%. On an intention-to-treat analysis, PCI appeared to be superior to OMT for the change of angina frequency scores between baseline and follow-up (12.2 vs 8.6; P = 0.009), QoL (19.5 vs 11.3; P < 0.001), and the SAQ summary score (13.8 vs 8.5; P <

0.001). For physical limitation, the difference was just at the level of the Bonferroni correction for multiple tests (P = 0.01). There was a wide variability of changes in SAQ scores. For QoL, the major determinant for a significant improvement was a low baseline score and the assignment to PCI, whereas gender, diabetes, or lesion complexity had no influence. During a mean follow-up of 3.1 years, the clinical endpoints of cardiac death or nonfatal myocardial infarction were similar in both groups (OMT vs PCI: 2.7% vs 5.1%; P = 0.17). The rates of stroke or hospitalization for bleeding were similar, and only target lesion revascularizations were more frequent with OMT (18.8% vs 10.6%; P = 0.005).

CONCLUSIONS.

In this post-hoc analysis from 2 RCTs of patients with a single CTO and no significant concomitant lesion, PCI achieved better improvement in QoL, angina frequency, and the SAQ summary score than OMT with no signal of excess harm regarding clinical endpoints.

MY EDITORIAL COMMENT

FROM UNCERTAINTY TO CONVERGENCE: HAS THE QUALITY-OF-LIFE DEBATE IN CTO PCI FINALLY BEEN SETTLED?

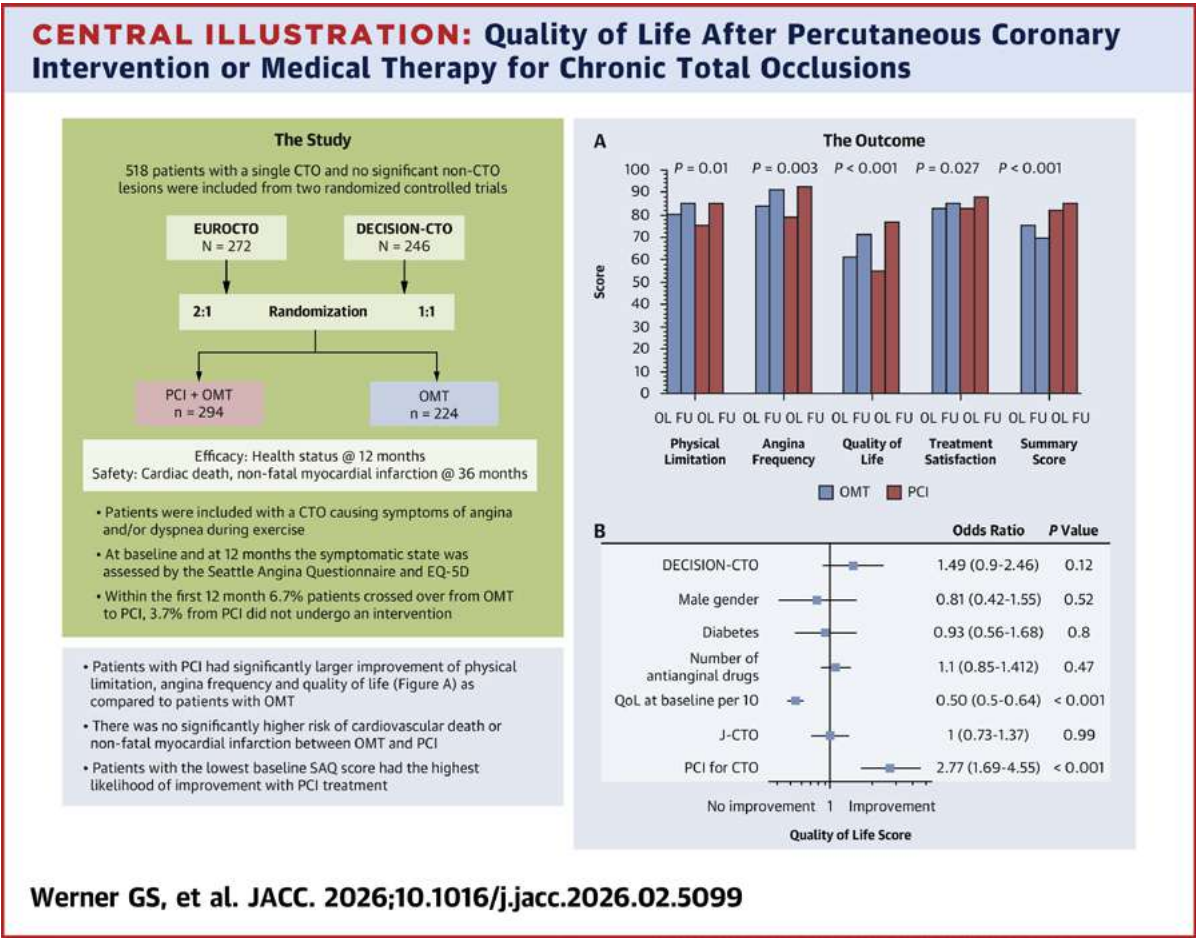


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Few questions in contemporary interventional cardiology have generated as much debate as the role of chronic total occlusion (CTO) percutaneous coronary intervention (PCI). While technical success rates have steadily improved over the last decade, uncertainty has persisted regarding whether CTO PCI delivers benefits beyond what can be achieved with optimal medical therapy alone. The absence of a demonstrated mortality advantage and the conflicting results of randomized trials have fueled ongoing skepticism regarding the value of this complex procedure.

In this context, the patient-level pooled analysis of EUROCTO and DECISION-CTO by Werner and colleagues adds meaningfully to the randomized record. Both trials compared PCI plus optimal medical therapy against medical therapy alone in patients with a symptomatic CTO, but each was compromised by non-CTO PCI, which was performed before randomization in EUROCTO and after in DECISION-CTO,



obscuring any treatment signal attributable to the CTO revascularization itself. To address this, the investigators identified the subgroup of patients with a single CTO and no other significant coronary lesion from both trials (272 from EUROCTO and 246 from DECISION-CTO). In total, 518 patients were included, of whom 294 were assigned to PCI and 224 to medical therapy, reflecting the 2:1 randomization ratio used in EUROCTO and 1:1 in DECISION-CTO. In-stent CTOs and patients with ejection fractions below 30% were excluded to harmonize entry criteria across studies. The study population was predominantly male (83%), with a mean age of 62.8 years, a mean J-CTO score of 1.81, and a left ventricular ejection fraction of 56.8%. The right coronary artery was the most common CTO vessel (52%), followed by the left anterior descending artery (40%) and left circumflex (8%). Health status was assessed with the Seattle Angina Questionnaire (SAQ) at baseline and 12 months, and clinical events were tracked over a mean follow-up of 3.1 years. PCI was successful in 92.2% of cases (88.7% on the first attempt, rising to 92.2% after a second attempt in 15 patients) with one-third of procedures requiring a retrograde approach.

On intention-to-treat analysis, patients assigned to PCI had significantly greater improvements in angina frequency ($\Delta 12.5$ vs. 8.2; $P=0.003$), quality of life ($\Delta 19.5$ vs. 11.3; $P<0.001$), and the SAQ summary score ($\Delta 14.2$ vs. 8.1; $P<0.001$) at 12 months. Changes in physical limitation came close to but did not cross the prespecified Bonferroni threshold ($\Delta 10.1$ vs. 5.6; $P=0.01$), which is not surprising given how mildly symptomatic this population was at baseline. Among individual patients, clinically meaningful improvements, defined as 8 or more points for physical limitation, 20 or more for angina frequency, and 16 or more for quality of life, were more frequent with PCI, with 66% of PCI-treated patients achieving a significant quality-of-life gain compared with 42% in the medical therapy arm ($P<0.001$). The EQ-5D visual analog scale also improved more with PCI ($\Delta 9.6$ vs. 6.4; $P=0.03$). No significant difference in cardiovascular death or myocardial infarction was observed over follow-up (5.1% vs. 2.7%; $P=0.17$), and major adverse cardiovascular and cerebrovascular event rates, though higher with medical therapy, were largely driven by ischemia-driven revascularization in that arm (14.7% vs. 5.4%; $P=0.001$) rather than hard endpoints. Notably, the strongest predictor of improvement was neither lesion complexity, nor diabetes, sex, or J-CTO score. It was the severity of symptoms at baseline. Patients who were most impaired before the procedure gained the most, which has direct consequences for how we should be selecting candidates for CTO PCI.

What the study did not show is equally important. Like previous randomized investigations, no reduction in cardiac death or myocardial

infarction was demonstrated. This should not be surprising. Neither EUROCTO nor DECISION-CTO was designed or powered to detect prognostic differences, and even after pooling, the number of clinical events remains modest. What the analysis does accomplish is to shift the CTO discussion away from a binary question about whether PCI prolongs life toward a more patient-centered one: does it improve how patients feel and function? For many patients with chronic coronary syndromes, that is the outcome that matters most.

The present findings resonate with prior observational evidence. Nearly a decade ago, we demonstrated significant improvements across all five SAQ domains following successful CTO PCI (physical limitation, angina frequency, treatment satisfaction, disease perception, and quality of life) at one year, in a contemporary hybrid CTO program. Critically, patients with complex CTOs, including those with J-CTO scores of 3 or greater, post-CABG anatomy, and those requiring dissection and re-entry techniques, derived benefits comparable to their less complex counterparts. The message then, as now, is that lesion complexity alone should not preclude referral, provided symptoms are present and the operator is equipped to handle the anatomy. At the time, critics correctly noted that observational data cannot fully account for selection bias and placebo effects.

That criticism has been directly addressed by ORBITA-CTO, the first sham-controlled randomized trial of CTO PCI, published concurrently this year. Investigators demonstrated that revascularization significantly reduced angina burden beyond placebo: patients treated with CTO PCI experienced fewer angina episodes, more angina-free days, and meaningful improvements across multiple quality-of-life measures. Blinding was successfully maintained throughout, strengthening confidence that the observed benefits reflect a true physiological effect rather than patient expectation.

The pooled EUROCTO/DECISION-CTO analysis and ORBITA-CTO offer complementary evidence from distinct methodological vantage points. One demonstrates consistency across the largest randomized CTO dataset available; the other confirms efficacy under rigorous placebo-controlled conditions. The convergence of these findings, spanning observational cohorts, open-label trials, patient-level meta-analysis, and a sham-controlled trial, is hard to set aside.

Caveats remain. The pooled analysis is a post hoc study derived from trials with different designs, enrolling predominantly mild-to-moderate symptom patients. ORBITA-CTO enrolled only 50 patients and excluded lesions with J-CTO scores above 3. Neither provides definitive evidence on hard clinical endpoints, and neither fully reflects the anatomic complexity encountered in contemporary

high-volume programs. However, requiring survival data before acknowledging a symptomatic benefit that is now consistent across multiple methodologies sets a standard we apply to no other class of procedure. Medicine routinely offers therapies that improve symptoms without extending life, such as hip or knee replacement— and few clinicians would argue that symptom relief is irrelevant simply because a mortality signal has not emerged.

The CTO field has spent years defending itself against the charge that symptomatic improvement after PCI may simply reflect placebo effects, selection bias, or operator enthusiasm. That position is harder to maintain in 2026. The more relevant question facing CTO operators is no longer whether symptom benefit exists, but how to identify those most likely to experience it. Future work should focus on refining patient selection, defining the role of physiology and imaging in predicting response, optimizing procedural success, and determining whether specific high-risk subgroups may also derive prognostic benefit.

For now, the message from Werner et al. is clear. In the absence of definitive survival data, quality of life remains the most robust evidence-based indication for CTO PCI. With the addition of ORBITA-CTO, that indication rests on stronger scientific foundations than it ever has before.

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