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CASE REPORT

Antegrade Wire-based Fenestration and Channel Tracking Technique: A Novel Step-Forward Antegrade Approach for Coronary Chronic Total Occlusion Recanalization

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ABSTRACT

Antegrade wiring is the preferred initial strategy for chronic total occlusion (CTO) percutaneous coronary intervention (PCI), yet success may be limited in complex lesions. To present antegrade wire-based fenestration and channel tracking (AWF-CT), a novel antegrade technique facilitating true lumen CTO crossing. AWF-CT uses controlled proximal cap fenestration with a penetration wire, followed by softwire tracking through intraplaque microchannels, enabling physiological true lumen-to-true lumen crossing. AWF-CT is a simple, vessel-preserving antegrade strategy that may enhance CTO PCI success without increasing procedural risk.

Keywords: Chronic total occlusion, antegrade wire escalation, antegrade fenestration and re-entry

INTRODUCTION

Percutaneous coronary intervention (PCI) for chronic total occlusion (CTO) remains one of the most challenging procedures in interventional cardiology. The development of standardized CTO crossing strategies, particularly antegrade wire escalation, has signficantly improved procedural success rates and safety profiles.[1] However, more advanced techniques, such as retrograde wiring and subintimal tracking with re-entry devices—although effective in complex cases—are associated with an increased incidence of major adverse cardiac events.

Antegrade wiring strategies, especially when intimal tracking is achieved, are associated with lower procedural risk and therefore remain the preferred first-line approach.[2] In this context, we introduce a novel wire-based antegrade technique—antegrade wire-based fenestration and channel tracking (AWF-CT)—aimed at facilitating safe and effective CTO recanalization through the exploitation of intraplaque microchannels.

AWF-CT represents a modifications of the conventional antegrade wire escalation strategy and incorporates microchannel-based intraplaque navigation to achieve CTO crossing.

The technique begins with the placement of a microcatheter at the proximal cap of the CTO. A high-penetration wire—such as Conquest Pro 12, Hornet 14, Gaia Next 3, or an equivalent device—is then employed to repeatedly puncture the proximal cap using short, controlled movements by approximately 1–2 mm. This step creates a "spongy" zone within the proximal CTO body and is not to acheive immediate lesion crossing. Rather, the objective is to fenestrate and mechanically loosen the lesion, potentially exposing or generating entry points into pre-existing or concealed microchannels within the plaque (see Figure 1).

Following this initial step, the operator transitions to a softer, polymer-coated, low-tip-load wire—such as Fielder XT-R, Sion Black, or Gladius MG. This wire is carefully manipulated with the intention of engaging a microchannel, thereby facilitating true lumen-to-true lumen crossing while minimizing the risk of significant subintimal disruption. Unlike techniques that rely on forceful dissection, this technique utilizes natural or mechanically facilitated microchannel pathways within the CTO body.

CASE REPORT

Below, we present a fluoroscopic case example illustrating the step-by-step application of the AWF-CT technique in a real patient. The procedure, including its potential risks and complications, was explained to the patient, and informed consent was obtained (see Figure 2).

The AWF-CT technique offers an alternative and potentially safer antegrade approach for CTO PCI. Although recent innovations, such as hybrid algorithms and device-assisted techniques have, have increased

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procedural success rates to over 90%, many of these strategies require high level of operator experience, expensive equipment, or are associated with elevated complication risk.

AWF-CT is founded on the growing recognition that many CTOs contain concealed or microstructural intraplaque channels that may serve as conduits for wire passage. The technique emphasizes simplicity, cost-effectiveness, and a controlled, physiologic approach, while avoiding disruption of vessel architecture. Importantly, AWF-CT does not exclude the use of other techniques; rather, it is designed to complement existing techniques.

DISSCUSION

This approach is most suitable for lesions with a blunt but non-ambiguous proximal cap, where direct visualization and targeting are possible. For less experienced operators, AWF-CT may serve as an accessible, entry-level technique before escalating to retrograde or device-assisted approaches. For more experienced operators, it provides an additional tool to increase technical success while minimizing procedural complications.

AWF-CT may also function as a bridge strategy. In cases where the technique is unsuccessful, operators may proceed with traditional antegrade dissection and re-entry or transtion to retrograde techniques without compromising prior procedural progress or patient safety.

The subintimal space dissection and re-entry–related (SSDR) fenestration technique and the antegrade wire fenestration–controlled technique differ fundamentally with respect to their underlying mechanistic objectives, degree of vessel manipulation, and level of control exerted over wire trajectory. In the SSDR technique, a microcatheter is advanced over an extraplaque wire to a position immediately proximal to either the antegrade or retrograde cap. The initial wire is subsequently exchanged for a stiff wire, which is manipulated using repetitive forward–backward motions combined with continuous rotational movements until a full 360° rotation is achieved. This maneuver enables variable advancement of the stiff wire, typically ranging from 10 to 40 mm—into the occlusion. Consequently, multiple fenestrations are generated between the extraplaque and intraplaque compartments, thereby creating potential re-entry pathways.[3] However, owing to the absence of a predefined endpoint, wire advancement may proceed unpredictably with either the intraplaque or extraplaque planes, often resulting in uncontrolled, multidirectional dissections.

By contrast, the AWF-CT technique is intentionally designed as a highly localized, precisely controlled intraplaque strategy. In this approach, microcatheter advancement is avoided. Instead, wire manipulation is strictly confined to the proximal segment of the proximal cap and limited to a depth of only a few millimeters. The primary objective is not longitudinal dissection but rather the creation of a localized "spongy-like" microarchitecture within the proximal cap. This targeted fenestration functions as a controlled entry gateway to pre-existing, concealed microchannels within the CTO body.

Through strict spatial limitation and the preservation of distal propagation, AWF-CT markedly reduces extraplaque disruption and preserves a predominantly intraplaque wire trajectory. Once this microfenestrated proximal cap has been established, CTO crossing with a low tip-load, hydrophilic wire becomes more achievable, guided along these microchannel pathways. In contrast to SSDR, where wire advancement may occur across multiple planes without directional control, AWF-CT is specifically intended to maintain continuous intraplaque progression, thereby reducing vessel trauma and unintended subintimal expansion.

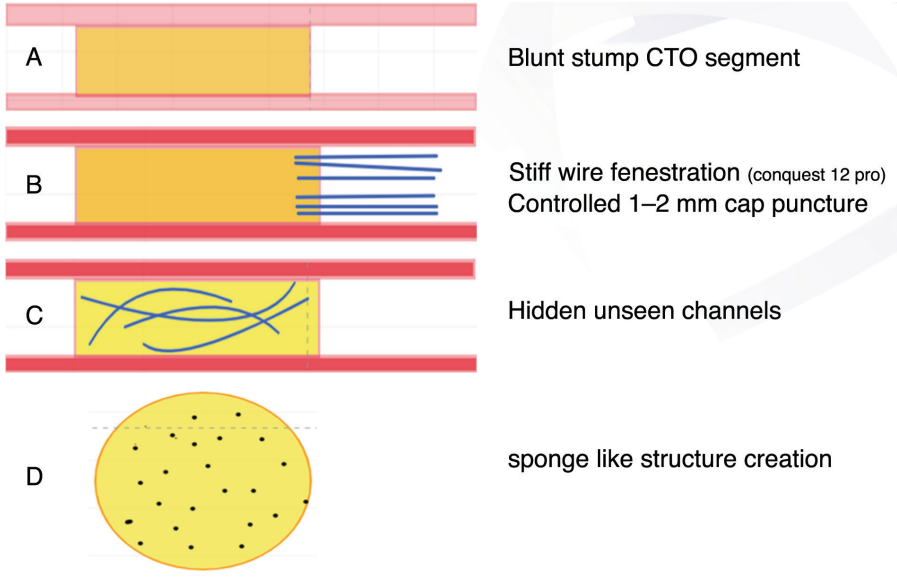

Figure 1. Overview of the antegrade wire-based fenestration and channel tracking technique. (A) Illustration of a chronic total occlusion (CTO) with a blunt proximal cap. (B) Controlled puncturing of the proximal cap using a penetration wire with 1–2-mm movements. (C) Depiction of hidden microchannels within the CTO body. (D) Frontal view demonstrating the proximal "spongy" zone created by fenestration

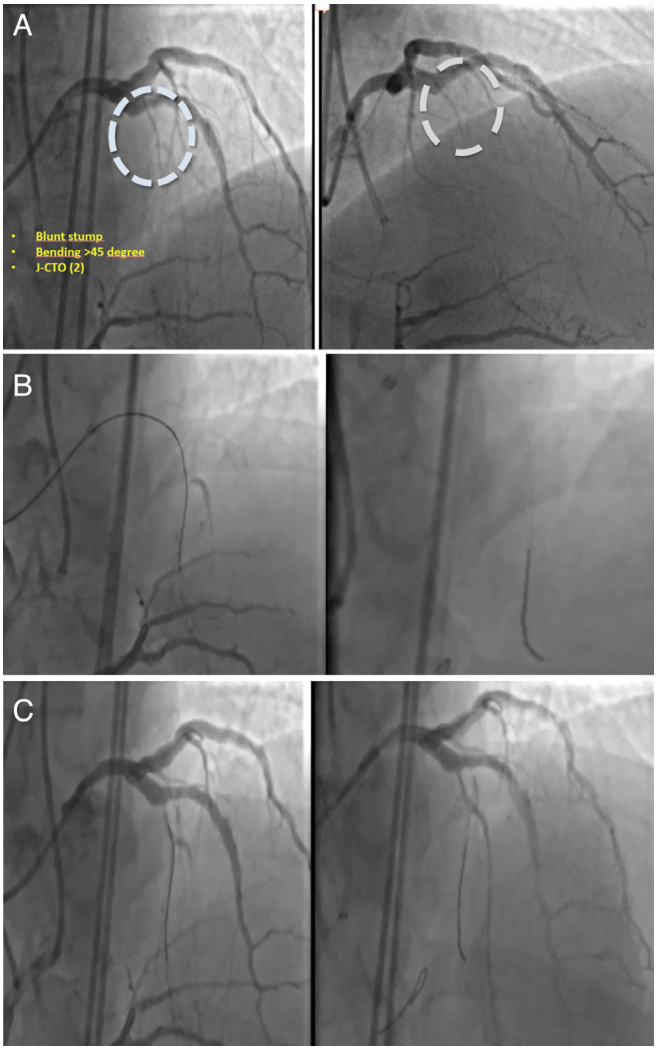

Figure 2. Antegrade wire-based fenestration and channel tracking in a left anterior descending (LAD) chronic total occlusion (CTO) case. (A) Pre-crossing view of a blunt LAD CTO segment. (B) Antegrade CTO crossing using a Fielder XT-R wire following multiple controlled punctures of the proximal cap with a conquest pro 12 wire. (C) Post-predilation view confirming true-to-true lumen crossing via intraplaque microchannels

CONCLUSION

The AWF-CT technique represents a novel, physiologically guided, and minimally disruptive strategy for antegrade CTO crossing. By exploiting the presence of hidden intraplaque microchannels, this approach may increase the probability of acheiving true lumen-to-lumen wiring without reliance on extensive dissection or advanced devices. Moreover, AWF-CT preserves key advantages, including simplicity, lower cost, and a favorable safety profile. Importantly, unsuccessful application of AWF-CT does not compromise the effectiveness of subsequent advanced CTO techniques. Accordingly, AWF-CT constitutes a promising addition to the antegrade CTO PCI toolbox, especially for operators seeking a safe, structured, and stepwise escalation strategy.

Informed Consent: The procedure, including its potential risks and complications, was explained to the patient, and informed consent was obtained.

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