# Retrograde Approach to Crossing CTOs in the Setting of CLI

An exotic and technically challenging approach that can save lives and limbs.

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Approximately 8 to 12 million Americans are currently affected by peripheral arterial disease (PAD).[1] Advanced age, diabetes, and renal insufficiency predispose patients to developing intra-arterial calcium and, subsequently, PAD.[2] An estimated 40% of these PAD patients have an intra-arterial chronic total occlusion (CTO) that may lead to critical limb ischemia (CLI).[3] CLI commonly involves multiple complex lesions or blockages that may impair or obstruct distal arterial perfusion and lead to limb amputation, morbidity, or even mortality without successful intervention.[4]

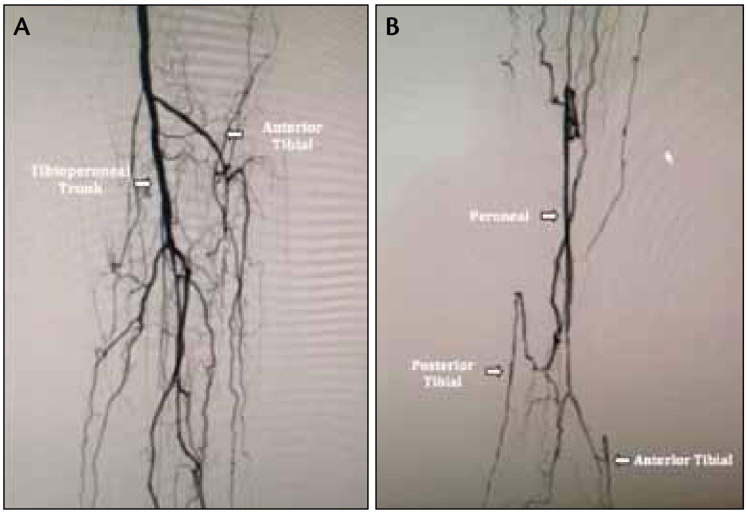


**Figure 1. Left lower extremity runoff results showing the proximally occluded anterior tibial artery (A), peroneal artery, and posterior tibial artery (B).**

Treatment options for patients with a CTO include percutaneous revascularization, surgical bypass, and as a last resort, limb amputation. High-risk patients, or patients with a failed bypass surgery, may not be good candidates for surgery. Under these circumstances, endovascular intervention is often the final option for limb salvage.

Endovascular interventions focusing on inflow (arterial vessels above the knee) have been well described. However, the importance of outflow (focusing on tibiopedal vessels below the knee) requires further investigation. Research on outflow procedures has shown that tibiopedal interventions not only increase the patency of inflow interventions but also increase limb salvage rates and decrease morbidity rates.[5,6] Efforts to further decrease amputation rates have spurred the advent of novel approaches to address CTOs of the tibial vessels. Interventionists may utilize different arterial access points to treat a blockage with an antegrade and/or retrograde approach. One such method utilizes tibiopedal access to open tibial arteries in a retrograde fashion and enables antegrade approaches to be successful.

The following case details a 58-year-old man with a history of a right below-knee amputation presenting with a nonhealing ulcer on the left fourth toe. This case highlights an uncommon (exotic) endovascular approach, utilizing peroneal artery access for crossing a CTO in a retrograde fashion to successfully treat the occlusion.

## CASE REPORT

A 58-year-old man with a history of hypertension, hyperlipidemia, and a right below-knee amputation was referred to our care because of a left lower extremity wound that was failing to heal and rest pain. A left lower extremity ankle-brachial index revealed a score of 0.69, indicating moderate-to-severe disease.

Considering the nonhealing ulcer, abdominal aortography and bilateral lower extremity runoff were performed (Figure 1). The left lower extremity displayed poor outflow: a proximally occluded anterior tibial artery that reconstituted at the level of the ankle by a peroneal collateral, a proximally occluded peroneal artery that reconstituted at the level of the mid-shin, and a proximally occluded left posterior tibial artery that reconstituted at the level of the ankle by a peroneal collateral.

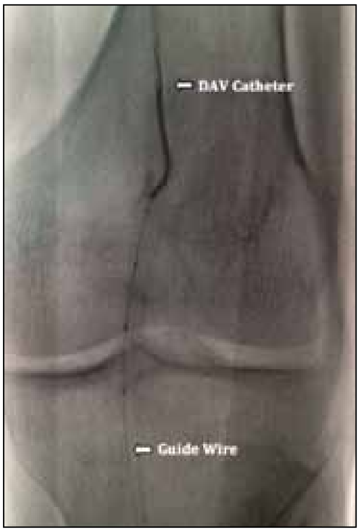


**Figure 2. Threading of the Cook CTO guidewire through the DAV catheter located in the popliteal artery after retrograde passage of the peroneal artery CTO. This flossing technique enabled contralateral femoral approaches for balloon angioplasty and stenting.**

Initially, an 18-g Cook CTO wire (Cook Medical, Bloomington, IN) with the support of a 0.014-inch CXC catheter (Cook Medical) was used in an attempt to cross the left peroneal CTO in an antegrade fashion, but the attempt was unsuccessful. Therefore, distal peroneal access was determined to be the next best access because the peroneal artery provided in-line flow to the foot, as well as collateralization of the anterior tibial and posterior tibial arteries. Angiographically, the peroneal artery was visualized in a left anterior oblique (approximately 30°) projection, coursing between the tibia and fibula. With angiographic guidance, a micropuncture needle was advanced perpendicular to the peroneal artery and parallel to the radiation beam. Once the interosseous membrane was engaged (friction on the needle), a right anterior oblique projection (approximately 30°) was utilized to visualize the distance from the needle to the artery. The needle was then advanced to the artery, and a 4-F Micropuncture Cook catheter (Cook Medical) was placed. Next, 400 units of nitroglycerin were delivered through the sheath to vasodilate the peroneal artery. An 18-g Cook CTO wire with the support of a 0.018-inch CXC catheter was used to traverse the peroneal artery CTO in a retrograde fashion. The wire was then inserted into a DAV catheter (Cook Medical) located in the popliteal artery and taken out the right common femoral artery (Figure 2). As such, the distal end of the 18-g Cook CTO wire was coming out the right common femoral artery access, and the proximal segment was coming out the peroneal artery in a "flossing" fashion. From a contralateral femoral approach, a 2.5- X 200-mm Cook 14LP balloon (Cook Medical) was advanced to the CTO and inflated to nominal pressure, taking the 100% stenosis to approximately 70% residual stenosis with disruption of the plaque. Three 2.5- X 38-mm Xience drug-eluting stents (Abbott Vascular, Santa Clara, CA), in addition to a 2.5- X 32-mm Xience drug-eluting stent, were placed from the proximal-to-mid peroneal artery, reducing the 70% stenosis to < 10% residual (Figure 3). The peroneal then reconstituted both the anterior and posterior tibial arteries, improving blood flow to the foot and specifically the wound.

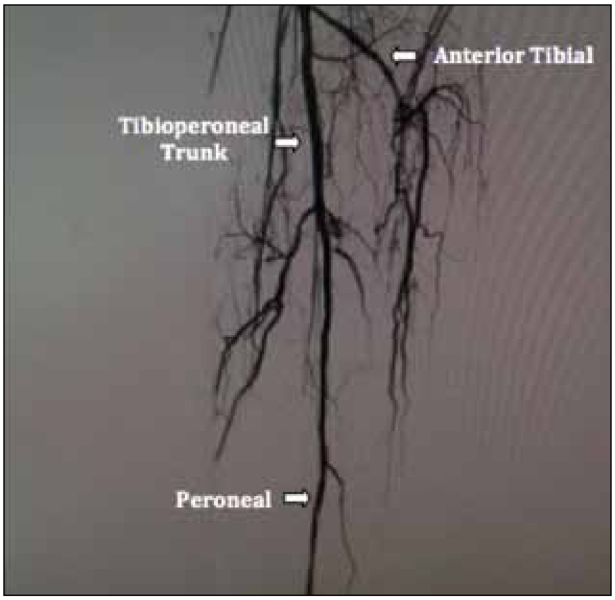


**Figure 3. Angiographic imaging results showing < 10% residual stenosis in the peroneal artery, which reconstituted the anterior and posterior tibial arteries, improving blood flow.**

## DISCUSSION

Approximately 25% of patients with CLI will die within the first year alone, and approximately 30% will require an amputation; of these amputees, 40% will die within 2 years.[7,8] The high risks of morbidity and mortality associated with amputation may be avoided through successful endovascular revascularization of diseased segments. Although endovascular revascularization can be difficult


**Figure 4. The operator must avoid the two veins on either side of the artery and can ensure proper needle placement with 2 to 3 mL of intravenous contrast.**

due to complex lesion location or configurations, every attempt must be made to salvage limbs before irreparable damage has occurred and amputation is required as a life-saving procedure. Interventionists must utilize their ingenuity and understanding of the peripheral vasculature in conjunction with available access points and endovascular techniques to achieve blood flow in tissues located distal to the impaired or occluded segments. Even in the presence of a failed antegrade approach, exotic accesses and retrograde approaches are capable of opening diseased vasculature and are beneficial in increasing blood flow and healing wounds.

In the present case, antegrade approaches of the left peroneal artery repeatedly failed to pass the 100% stenosis. Performing an "exotic access" (ie, via the distal peroneal artery) is technically challenging. Careful attention should be placed on splaying the tibia and fibula angiographically such that the peroneal artery courses between these two bones. In this left leg case, it was a left anterior oblique projection. The operator should then access the artery by advancing the needle perpendicular to the artery and parallel to the radiation beam. Understanding lower extremity vascular anatomy is essential. After coursing through the interosseous membrane, the angiographic projection should switch to a right anterior oblique position such that the distance from the needle to the artery can be visualized. Additionally, two veins course on either side of the artery. As such, if the needle does not course as previously described, it may engage the vein rather than the artery. If there is concern that the vein has been engaged, the operator should inject 2 to 3 mL of intravenous contrast to confirm placement (Figure 4). Once engaged in the artery, the operator should administer vigorous vasodilators (eg, nitroglycerin) and work quickly considering the complications of spasm and acute thrombosis when working in an approximate 2-mm vessel. Hemostasis after intervention is achieved by inflating a balloon sized 1:1 at low pressure for approximately 3 minutes inside the vessel covering the access site, as external pressure cannot be applied.

## CONCLUSION

In this case, the benefits of peroneal access outweighed the risk and resulted in reestablishing in-line flow to the ulcer. The patient experienced pain relief, increased limb mobility, and healing of his fourth toe ulceration. He is now capable of walking 2 miles and does not show significant claudication symptoms. In conclusion, this case is supporting evidence for tibial access and retrograde crossing of CTOs if attempts at antegrade crossing are unsuccessful. Further research or randomized studies are needed to quantitatively evaluate other factors related to procedural success and complication rates, but the presented case may provide confidence when using pedal access for peroneal revascularization. ■

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1. US Department of Health and Human Services. National Heart, Blood, and Lung Institute. Facts about peripheral arterial disease (P.A.D.). NIH Publication No. 06-5837. Accessed on August 5, 2012.
2. Floege J, Ketteler M. Vascular calcification in patients with end-stage renal disease. Nephrol Dial Transplant. 2004;19:59-66.
3. Al-Ameri H, Clavijo L, Mathews RV, et al. Devices to treat peripheral chronic total cclusions. J Interv Cardiol 2012;25:1-9.
4. Ohno T, Kaneda H, Nagai Y, et al. Regenerative medicine in critical limb ischemia—current and future directions. J Atheroscler Thromb. 2012;19:883-889.
5. Gallino A, Mahler F, Probst P, et al. Percutaneous transluminal angioplasty of the arteries of the lower limbs: a 5 year follow-up. Circulation. 1984;70:619-623.
6. Davies MG, Saad WE, Peden EK, et al. Impact of runoff on superficial femoral artery endoluminal interventions for rest pain and tissue loss. J Vasc Surg. 2008;48:619-626.
7. Norgren L, Hiatt WR, Dormandy JA, et al. Inter-society consensus for the management of peripheral arterial disease (TASC II). J Vasc Surg. 2007;45(suppl S):S5-67.
8. Fisher RK, Harris PL. Epidemiological and economic considerations in the critically ischemic limb. Critical Limb Ischemia. Armonk, NY: Futura Publishing Company, Inc.; 1999: 19-25.