

# Direct Tibial Artery Access:

## A New Approach to Challenging CTOs

When conventional femoral access did not permit antegrade guidewire traversal, successful retrograde guidewire traversal was achieved in four cases using direct tibial artery puncture.

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**A**s the technology for percutaneous endovascular management of symptomatic peripheral arterial disease (PAD) of the legs rapidly evolves, the need to cross long occlusions with guidewires has grown dramatically. Although direct traversal of these lesions is usually achievable using hydrophilic guidewires, various available re-entry systems, and laser catheters, many attempts fail because of inability to cross total occlusions with guidewires. In patients with occlusions of the superficial femoral (SFA) and popliteal arteries, a direct retrograde puncture of the popliteal artery often permits guidewire traversal. However, many patients have popliteal artery disease or infrapopliteal artery disease that would preclude such an approach. We report a four-case series of significantly challenging chronic total occlusions (CTOs) that were initially unsuccessfully approached through conventional femoral arterial access sites and were unapproachable through popliteal access sites; subsequently, successful revascularization was achieved by angioplasty, stenting, and plaque excision after

retrograde guidewire traversal was achieved via direct percutaneous access of the tibial arteries.

### CASE REPORT

#### Case 1

A 75-year-old man with hypertension, dyslipidemia, and noninsulin-dependent diabetes mellitus presented with recent critical limb ischemia (CLI). Seven months previously, the patient developed claudication because of severe femorotibial disease necessitating a femoral-posterior tibial venous bypass. However, 5 months later, the bypass graft was confirmed to be totally occluded despite two previous attempts at percutaneous transluminal angioplasty (PTA) of the graft. The patient's claudication was unsuccessfully managed medically for 2 months, culminating in an ischemic ulcer of the right hallux and subungual gangrene. The patient had no palpable popliteal or pedal pulses on the right side.



Figure 1. An .018-inch Glidewire (Terumo Medical Corporation, Somerset, NJ) is subintimal. Note the extensive infrapopliteal occlusive disease that would preclude popliteal artery access in this case.

#### Case 2

A 48-year-old man with a history of myocardial infarction, coronary

artery bypass grafting, percutaneous coronary intervention, right carotid endarterectomy, dyslipidemia, tobacco use, and a left femoropopliteal-posterior tibial Gore-Tex bypass graft (Gore & Associates, Flagstaff, AZ) 1 year previously presented with claudication and rest pain of the right leg. There were no palpable popliteal or pedal pulses on the right side.

## Case 3

Fourteen months later, the same patient from case 2 presented with a history of two-block left-calf claudication with confirmation of an occlusion in his previous left leg graft. There were no palpable pedal pulses on the left side.

## Case 4

A 62-year-old man with a history of chronic atrial fibrillation, hypertension, dyslipidemia, and coronary artery bypass grafting presented with left foot and calf claudication. The ankle-brachial index was 0.4, and angiography revealed a total occlusion at the SFA/popliteal artery junction with obliteration of the anterior tibial artery and reconstitution of the peroneal artery and posterior tibial artery.

## TECHNIQUE/PROCEDURE

Initially, revascularization of the SFA occlusions were planned to be performed antegrade via the contralateral common femoral artery (CFA). Access was obtained in the contralateral CFA using the modified Seldinger technique. A 45-cm, 7-F sheath was advanced over the aortic bifurcation into the ipsilateral CFA. Attempts at crossing the CTOs in the SFAs were unsuccessful in all the cases despite the application of various guidewires, support catheters, laser atherectomy, and the Frontrunner CTO Catheter (Cordis Corporation, a Johnson & Johnson company, Miami, FL) (Figure 1). All patients received therapeutic heparin anti-



Figure 2. Tibial vessels at the ankle demonstrate the patent anterior tibial artery at the ankle suitable for percutaneous access.

coagulation during the procedures.

In all of the cases, the retrograde approach via ipsilateral popliteal access was precluded by either diffuse popliteal artery disease, tibial disease, or unsuccessful puncture of the popliteal artery (Figure 1).

Because of failed antegrade wire traversal and the inability to access the popliteal arteries, the tibial arteries were accessed directly to permit retrograde guidewire traversal. Using road mapping techniques and micropuncture needles, arterial access was successful via the distal anterior tibial artery in two cases and via the distal posterior tibial artery in two cases (Figures 2 and 3).

After successful puncture of the tibial vessels at the level of the ankle, an .018-inch wire was inserted, and the inner dilator of a 4-F micropuncture sheath was inserted. Through this microdilator, the wire was exchanged for an .018-inch, 180-cm Gold tip Glidewire and the microdilator was exchanged for an .018-inch X 150-cm Quick-Cross Support Catheter (Spectranetics Corporation, Colorado Springs, CO). In cases in which this wire would not traverse the occlusions, the wire was exchanged for a

.014-inch X 300-cm Choice PT Guidewire (Boston Scientific Corporation, Natick, MA).

This combination of instruments allowed successful crossing of the total occlusions in the SFA, popliteal artery, and tibial occlusions in cases 1, 2, and 4. The wires were advanced retrograde through the occlusions into the ipsilateral CFA, just distal to the tip of the originally placed contralateral femoral sheath. Case 3 had a total occlusion in the SFA at a stent fracture site that prevented the wire from entering the true lumen of the SFA. The Frontrunner device would not cross, and laser atherectomy was not feasible.

In case 3, a Venture Wire



Figure 3. A micropuncture needle is inserted into the anterior tibial artery, and an .018-inch guidewire is advanced into the vessel.

Control Catheter (St. Jude Medical, Inc., St. Paul, MN) was advanced to the site of the stent fracture to provide support for the Choice PT wire. Although the wire was directed toward the stump of the stent lumen, the wire could not cross the lesion because of the plaque burden and stent fracture. The Choice PT wire was exchanged for an Asahi Confianza AG143090 Guidewire (Abbott Laboratories, Abbott Park, IL), which also would not cross. Keeping the Venture catheter in place, the Confianza wire was removed and readvanced with the stiff back end of the wire leading the course. With the Venture catheter's support, the stiff portion of the wire was negotiated into the stent lumen, through the stent fracture site, and into the lumen of the CFA.

In all cases, after the wire was successfully advanced to the CFA, it was exchanged through the catheter to a 300-cm, .014-inch exchange wire. The wire in the ipsilateral CFA was then exteriorized out the contralateral femoral sheath by snaring the wire (Figures 4 and 5) from the sheath. Typically, a 6-mm or 7-mm Microvena (Minneapolis, MN) snare was used. This allowed wire access from the contralateral CFA and the ipsilateral posterior tibial artery or anterior tibial artery. In general, once the wire is exteriorized, a .014-inch exchange catheter is then inserted over the wire from either direction, and then this exchange catheter is also exteriorized. This allows for removal of the exteriorized wire, which can now be re-inserted in the usual direction. This maneuver puts the wire in the usual orientation with the stiff side extending out the femoral sheath. The original antegrade revascularization plans via the contralateral CFA were then pursued over the exteriorized wire. During the intervention, there is an option to retract the wire com-



**Figure 4.** An 8-mm Microvena snare is advanced from the femoral sheath into the CFA to snare the wire advanced from the tibial puncture.

pletely into the tibial artery or to leave it extending out of the ankle puncture site. The former approach works well unless wire tension is required for some reason during the intervention, in which case leaving the wire exteriorized out the ankle provides added trackability of devices.

A combination of plaque excision with SilverHawk Peripheral Catheters (FoxHollow Technologies, Redwood City, CA), balloon angioplasty, and stenting was successfully performed in the SFA and popliteal arteries as originally planned. Once the wire is retracted into the tibial access site, brief manual compression of the access site is all that is required, even in patients with therapeutic levels of anticoagulation. We observed no ankle

## DISCUSSION

Although great strides have been made in the treatment of CTOs through the antegrade approach, the failure rates of these approaches are not negligible. In one series, treatment of SFA lesions via the antegrade approach failed in 17% of cases.<sup>1</sup> In another series, the technical success rate for SFA CTOs was only 67%.<sup>2</sup> When the popliteal artery is also involved, technical success rates may be lower, exemplified by a wide range of 26% to 91%.<sup>1-4</sup>

When antegrade guidewire traversal fails for SFA CTOs, the transpopliteal approach has proven to be adequate in many patients.<sup>1,2,5-18</sup> It is effective for treating flush SFA occlusions, lesions with large collaterals arising from the point of occlusion, SFA lesions with tandem CFA involvement, and SFA lesions in patients with acutely angled aortic bifurcations.<sup>1</sup> However, in



**Figure 5.** The snare is closed on the tibial wire allowing for exteriorization of the tibial wire out the contralateral sheath. With this exteriorized wire, the intervention can be completed in the usual fashion.

patients with significant plaque or occlusion in the popliteal artery near the knee, direct puncture of the popliteal artery is precluded.

Few previous reports have described distal tibial arterial access to perform angioplasty.<sup>19,21</sup> Botti et al demonstrated in a series of six patients with CLI the feasibility of performing retrograde PTA via tibial artery access.<sup>21</sup> Because the complexity of the disease in our patients necessitated the use of stents and the performance of plaque excision, direct retrograde PTA via the tibial arteries was not possible and insertion of the required 6-F or 7-F sheaths directly into these small tibial arteries was not feasible. In a subseries of 12 CLI patients, Spinosa et al applied the Subintimal Arterial Flossing with Antegrade-Retrograde Intervention (SAFARI) technique from tibial arterial access sites.<sup>20</sup> The SAFARI technique has been used to recanalize obstinate CTOs that fail conventional measures. This technique uses a retrograde ipsilateral approach from popliteal or tibial vessels to propagate a subintimal plane that can connect to the initially unsuccessfully recanalized antegrade subintimal plane; presumably, the initial antegrade subintimal dissection plane aids retrograde crossing either by creating a shorter lesion to traverse or by altering the lesion milieu to facilitate retrograde crossing. This added a nuanced wire and snare (if needed) approach that had not been previously described.

## CONCLUSION

Our modified-SAFARI technique expounds on the previously described tibial access approaches: we have shown reproducible technical success rates, we have demonstrated lesion crossing techniques solely through the retrograde passage of the wire without initial antegrade subintimal dissection, we have shown that a wire pull-through with a snare allows an interventionist to revert to a multitude of endovascular interventions and devices (balloons, stents, plaque excision devices) via the contralateral CFA—a technique with which many interventionists are comfortable. This approach also does not require the patient to be turned prone for popliteal puncture.

We propose that our revascularization protocol expands the armamentarium of techniques and technology that endovascular specialists can apply for the treatment of CTOs. We hope this will improve the technical success rate for the recanalization of CTOs and the coincident amelioration of CLI symptoms. ■

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