Access strategy for chronic total occlusions (CTOs) is crucial in obtaining procedural success. Some access sites may have a higher complication rate or be more technically difficult to obtain; therefore, the pros and cons of the approach must be weighed against the clinical situation to determine the balance between a successful procedure and avoidance of complications. The choice of access site depends on 3 important factors. The first is the clinical situation. Does the case involve a patient with claudication or critical limb ischemia (CLI)? The second factor is the anatomy. For example, is it a tortuous, calcified, or steep iliac bifurcation, which can hinder crossing efforts? What does the tibial runoff look like? What does the proximal cap look like? Is it a flush occlusion? What is the proximal and distal anatomy? We must also consider lesion traits. Is the lesion a 4 cm occlusion or a 400 cm occlusion? Is it a calcified lesion? Third, the operator’s comfort and experience in terms of antegrade and retrograde common femoral access, tibial access is an important consideration.

CTO STRATEGIES

CTOs can be crossed with a wire and catheter-based strategy, using an intimal or subintimal approach. Another approach is to use a CTO device and attempt to cross luminally. With either technique, the operator can usually reach the distal cap. Crossing the distal cap is an important point in the case. If the operator is unsuccessful at crossing the distal cap, a re-entry device can be utilized to cross, or alternatively the operator can obtain distal access and come retrograde using the same wire-based/crossing catheter strategy again.

In 2016, Walker et al demonstrated that tibiopedal access contributed to high success rates and very low adverse event rates (<3%). Chronic total occlusions can still prove difficult to cross despite utilizing antegrade and retrograde access and CTO devices. It is important to be adept at employing advanced crossing techniques such as CART and reverse-CART, double balloon or parallel balloon technique, or reentry-assisted fenestration techniques.

ACCESS IN 2018

In 2018, antegrade access is no longer limited to common femoral access. It can mean radial/brachial, common femoral artery, superficial femoral artery (SFA), tibial, and even pedal artery access.

Retrograde access can mean common femoral artery, superficial femoral artery, popliteal, tibiopedal, plantar, or digital access. These access sites are all possible because of ultrasound.

RETROGRADE ACCESS FIRST?

In cases in which the anatomy would suggest a higher likelihood of success using a retrograde approach, why not start there in the first place? If a wire-based or crossing-catheter–based retrograde approach fails to cross, the operator still has the option to either use a reentry device or switch to antegrade access and finish the procedure.

C-TOP CLASSIFICATION

Fadi Saab, MD, et al have classified proximal and distal cap anatomy into 4 different types with their C-TOP system and have investigated how it affects crossing technique and success. They found that type II–IV caps more often require retrograde access (Figure 1). You can see in type I that the shape of the cap facilitates antegrade access. In type II and type III, when the wire reaches...
the distal cap, the wire is more likely to go subintimal. In type IV, the geometry can be crossed more easily from a retrograde direction. In this study, the predictors of needing retrograde access (or a combination of retrograde and antegrade) were therefore type II-IV caps, severe calcification, and longer lesion length.

ACCESSING OCCLUDED ARTERIES

Gaining access to an occluded artery can be very helpful when there is a long occlusion with a distal reconstitution site that is difficult to approach. This is technically easier to perform in the SFA due to its size and ease of visualization under ultrasound and even using fluoroscopy at times when there is calcification or previously placed occluded stents. It can be done in the tibial vessels as well but is much more technically challenging.

CASE EXAMPLE

A 76-year-old woman who was an ex-smoker presented with multiple ulcers of the left forefoot. Her left ankle-brachial index was falsely normal at 1.12, and her toe-brachial index was falsely elevated at 0.18. She had an anomalous posterior tibial take-off that was occluded, and the anterior tibial was occluded, but the peroneal artery was open, with reconstitution into the lateral plantar artery in the foot. We used several techniques to try to stay luminal, but ultimately we were subintimal. You can see this at the level of the lateral plantar artery. You can also see the reconstitution and small portion of the lateral plantar artery, as well as some of the plantar arch and the most distal portion of the dorsalis pedis.

**Figure 2.** A 76-year-old woman presented with an anomalous posterior tibial take-off that was occluded as well as an occluded anterior tibial. The peroneal artery was patent, with reconstitution into the lateral plantar artery in the foot. We used several techniques to try to stay luminal, but ultimately we were subintimal. You can see this at the level of the lateral plantar artery. You can also see the reconstitution and small portion of the lateral plantar artery, as well as some of the plantar arch and the most distal portion of the dorsalis pedis.

Ultrasound was used to examine distal access sites. Left image: first, the lateral plantar artery was accessed but allowed for minimal to no pushability. Bottom right image: short-axis view of a deep perforating artery coming off the dorsalis pedis. Access was performed by coming down on top of the foot into the artery. Top right image: the distal anterior tibial of the dorsalis pedis artery; a nice delineation of the artery with flecks of calcification and the occluded lumen is visible.

**Figure 3.** Ultrasound was used to examine distal access sites. Left image: first, the lateral plantar artery was accessed but allowed for minimal to no pushability. Bottom right image: short-axis view of a deep perforating artery coming off the dorsalis pedis. Access was performed by coming down on top of the foot into the artery. Top right image: the distal anterior tibial of the dorsalis pedis artery; a nice delineation of the artery with flecks of calcification and the occluded lumen is visible.

as a little bit of the plantar arch and the most distal portion of the dorsalis pedis. Thus, we used ultrasound to examine distal access sites (**Figure 3**). First, we stuck the lateral plantar artery, as shown in the left image in **Figure 3**, but the distance from the access to occlusion was too short to be effective. The bottom right image in **Figure 3** shows the short-axis view of a deep perforating artery coming off the dorsalis pedis. We accessed this coming down on
top of the foot into the perforating artery and thought we were successful, but we had actually accessed the vein.

Instead of continuing to stick there, we stuck the occluded anterior tibial artery. The top right image in Figure 3 shows the distal anterior tibial of the dorsalis pedis artery. You can see a nice delineation of the artery borders with flecks of calcification and the occluded echolucent lumen in the center.

We maintained the wire loop while pushing through the occlusion and into the lateral plantar artery. (Figure 4) We were able to cross the occlusion at that point and treated the posterior tibial artery with orbital atherectomy and angioplasty. The patient did well for 6 months and healed completely but developed restenosis at the

Figure 4. A wire loop technique was used and maintained while crossing the occlusion in the lateral plantar artery.

Figure 5. Demonstration of a retrograde CTO technique that is very helpful for long occlusions with a distal reconstitution site that is difficult to approach. Anterior tibial access was achieved via an occluded anterior tibial vessel. A V18 wire and a CXI catheter were used to form a loop (left); the entire catheter will want to loop too, so the loop should be kept relatively small while pulling back (right).

Figure 6. A wire loop technique was used and maintained while crossing the occlusion in the occluded anterior tibial artery and advanced crossing technique using parallel balloons was employed to ultimately recanalize the AT.
level of the common plantar artery with rest pain. We brought her back and opened this vessel again. In addition, we opened the anterior tibial artery using the same technique of accessing the occluded vessel (Figures 5 and 6). We were able to restore 3-vessel runoff with an open pedal loop (Figure 7).

In another case that demonstrates retrograde access, a patient presented with toe necrosis that was thought to be possibly due to some distal embolization. He had declined angiography because of an aversion to groin access. Over the course of a year, he had multiple office visits but still adamantly refused groin access. He had finally auto-amputated and healed, but he returned with rest pain. He finally agreed to a procedure with no groin access.

Duplex ultrasonography showed occluded SFA stents with one-vessel anterior tibial runoff. We first accessed the anterior tibial, but the wire would not cross the occluded SFA stents and would not remain in the stent despite multiple attempts and even using an anchoring balloon technique (Figure 8). Therefore, we performed a direct SFA puncture within the body of the occluded stent more proximally and looped the wire to cross the proximal cap. Selective contrast injection confirmed that we were in the true lumen of the CFA. We next performed another SFA antegrade stick to cross the distal cap (Figure 9). At this point, we used the original anterior tibial access to recross both distal and proximal caps, which was easy to traverse now that a wire was already across the occlusions.
from the direct SFA approaches (Figure 10). We then inflated the balloon from the anterior tibial access, concurrently removing the access from the SFA. The final result is shown in Figure 11.

CONCLUSION

• CTOs are prevalent in patients with peripheral arterial disease.
• Being able to cross these lesions is important in determining a patient’s outcome.
• Access is a crucial element in achieving revascularization.

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Figure 10. I then used my original retrograde pedal access to cross the entire lesion. A balloon was then inserted via the pedal access to tamponade the SFA puncture.

Figure 11. Final result.