A thorough preoperative vascular evaluation should be performed before the initiation of any lower extremity surgical intervention, but particularly in situations of diabetic foot reconstruction with compromised blood flow. The intended emphasis of this brief report is to provide the foot and ankle surgeon with an appreciation for the clinical vascular anatomy of the transmetatarsal amputation through a handheld Doppler examination.

The lower extremity benefits from a redundant vascular supply through the terminal branches of the popliteal artery: the anterior tibial, posterior tibial, and peroneal arteries. Generally, the anterior and posterior tibial arteries are the dominant source arteries to the forefoot through the dorsal and plantar metatarsal arteries, respectively. An important anastomosis is found in the proximal aspect of the first intermetatarsal space as a terminal branch of the dorsalis pedis artery connects with the lateral plantar artery and, to a lesser extent, the medial plantar artery. This location represents a direct communication between the anterior and posterior tibial source arteries (Figure 1). If this connection is patent, then a patient is said to have an intact “vascular arch,” which can be appreciated with angiographic imaging (Figure 2). It should be noted that although there are other similar connections in the proximal and distal aspects of the other interspaces, the anastomosis in the proximal first interspace is the most significant.

The authors have found that the surgical preservation and specific characteristics of vascular flow through this anastomosis may be essential to the survival of a transmetatarsal amputation. It is often not enough to simply assess the patient for palpable or Dopplerable pulses, but to also have an understanding of the direction of the flow and the patency of the primary angiosome source arteries.

**Technique**

Flow through this vascular arch and to the dorsal and plantar flaps of a transmetatarsal amputation may proceed in 1 of 3 directions (Table 1). The first is with adequate flow from both the anterior and posterior tibial arteries. In this situation, there is antegrade flow through both the dorsalis pedis artery to the dorsal flap, and the posterior tibial artery to the plantar flap. If the anastomosis is disrupted during surgery, then both the dorsal and plantar flaps will still maintain an intact vascular supply through this dual-antegrade flow.

The second potential situation of flow through the vascular arch occurs with diminished or absent posterior tibial artery flow and dominant anterior tibial artery flow. In this situation, flow through the dorsalis pedis artery to the dorsal flap is antegrade, whereas flow through the posterior tibial artery to the plantar flap is retrograde. If the anastomosis is disrupted during surgery, then the dorsal flap is at risk for ischemia and failure (Figure 3).

The third potential situation of flow through the vascular arch occurs with diminished or absent anterior tibial artery flow and dominant posterior tibial artery flow. In this situation, flow through the posterior tibial artery to the plantar flap is antegrade, whereas...
flow through the dorsalis pedis artery to the dorsal flap is retrograde. If the anastomosis is disrupted during surgery, then the dorsal flap is at risk for ischemia and failure (Figure 4).

Each of these situations can be appreciated during the preoperative vascular examination with the use of a handheld audible Doppler. The Doppler is first used to identify the signal of the dorsalis pedis artery (Figure 5). Finger pressure is then used to compress the posterior tibial artery behind the medial malleolus. If the Doppler signal is maintained or augmented, then flow through the dorsalis pedis artery to the dorsal flap is antegrade. If the signal disappears or is significantly blunted, then retrograde flow should be suspected. Verification of retrograde flow through the dorsalis pedis artery should then be performed. The Doppler is again used to locate the dorsalis pedis artery on the dorsum of the foot, but now finger pressure is applied to the anterior tibial artery and lateral malleolar artery at the level of the ankle joint (Figure 6). Retrograde flow from the posterior tibial artery is confirmed if the signal is maintained.

A similar technique is then used in assessment of the posterior tibial artery. To begin, the Doppler is used to identify the signal of the posterior tibial artery (Figure 7). Finger pressure is then used to compress the dorsalis pedis artery on the dorsum of the foot. If the Doppler signal is maintained or augmented, then flow through the posterior tibial artery to the plantar flap is antegrade. If the signal disappears or is significantly blunted, then retrograde flow should be suspected. Verification of retrograde flow through the posterior tibial

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<th>Dorsal foot flow</th>
<th>Plantar foot flow</th>
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<td>Antegrade</td>
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<td>Both amputation flaps maintain antegrade flow if anastomosis is disrupted.</td>
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<td>Plantar flap is at risk for ischemia and failure if anastomosis is disrupted.</td>
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<td>Dorsal flap is at risk for ischemia and failure if anastomosis is disrupted.</td>
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artery should then be performed. The Doppler is now used to locate the lateral plantar artery, which is the dominant terminal branch of the posterior tibial artery supplying the plantar foot, while finger pressure compresses the posterior tibial artery at the porta pedis (Figure 8). Retrograde flow from the dorsum of the foot is confirmed if the signal is maintained.

**Discussion**

A thorough preoperative vascular evaluation should be performed before the initiation of any surgical intervention, but particularly in situations of diabetic foot reconstruction with compromised flow. Knowledge of specific vascular flow patterns should have an impact on the choice of procedure and incision planning. During the transmetatarsal amputation, particular care should be maintained to preserve the anastomosis in the proximal first interspace between the anterior and posterior tibial source arteries. One way to accomplish this during the procedure is to dissect the first metatarsal out in a medial direction, and the second through fifth metatarsals out in a lateral direction. This will minimize soft tissue destruction in the proximal first interspace and help to preserve the anastomosis. If a more proximal amputation (i.e., Lisfranc or Chopart) is required in which destruction of the anastomosis might occur, then the surgeon should confirm antegrade flow to both the dorsal and plantar flaps before proceeding. If only one of the arteries is open, then the...
Fig. 5. Antegrade flow through the anterior tibial artery. Antegrade flow to the dorsal transmetatarsal flap is determined by first locating the dorsalis pedis artery with the Doppler and then compressing the posterior tibial artery with finger pressure. If the Doppler signal is maintained, then flow through the dorsalis pedis artery to the dorsal flap is antegrade. If the signal disappears or is significantly blunted, then retrograde flow should be suspected.

Fig. 6. Retrograde flow through the anterior tibial artery. To verify retrograde flow to the dorsal transmetatarsal flap, the Doppler is used to locate the dorsalis pedis artery, while finger pressure compresses the anterior tibial artery and lateral malleolar artery at the level of the ankle joint. Retrograde flow from the plantar foot is confirmed if the signal is maintained.

Fig. 7. Antegrade flow through the posterior tibial artery. Antegrade flow through the posterior tibial artery is determined by first locating the posterior tibial artery with the Doppler and then compressing the dorsalis pedis artery with finger pressure. If the Doppler signal is maintained, then flow through the posterior tibial artery to the plantar flap is antegrade. If the signal disappears or is significantly blunted, then retrograde flow should be suspected.

Fig. 8. Retrograde flow through the posterior tibial artery. To verify retrograde flow through the posterior tibial artery, the Doppler is used to locate the lateral plantar artery, while finger pressure is used to compress the posterior tibial artery at the porta pedis. If the signal is maintained, then retrograde flow from the dorsum of the foot is confirmed.
anastomosis has to be preserved. Otherwise, the dorsal flap (no dorsalis pedis antegrade flow) or plantar flap (no plantar artery antegrade flow) is at risk of ischemia and the incision may not heal. If the anastomosis cannot be surgically spared, then a more proximal amputation (i.e., Syme or below knee) should be considered as part of the surgical plan.

References