Use of Fibula-Free Tissue Transfer With Preoperative 2-Vessel Runoff to the Lower Extremity

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**Objective:** To present our experience with fibula-free tissue transfer in patients with documented 2-vessel runoff to the lower extremity on preoperative angiography.

**Methods:** A case series of 16 patients with segmental mandibular defects reconstructed with a fibula-free flap by the senior author with 100% stenosis of the anterior or posterior tibial arteries were retrospectively reviewed for radiographic data and complications.

**Results:** All flaps performed were successful, and there were no donor site complications. Angiography documented flow of contrast to the foot by a patent anterior or posterior tibial artery in all patients. Occlusive arteriosclerotic disease was identified in the anterior tibial artery in 10 patients and in the posterior tibial artery in 6 patients.

**Conclusions:** Using our specific criteria, we experienced no complications with the use of a fibula-free flap in extremities with 100% obstructive vascular disease in the anterior or posterior tibial artery. Preoperative angiography is indicated to select appropriate candidates for fibula-free tissue transfer with 2-vessel lower extremity runoff to avoid potential donor site ischemic complications.

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Hidalgo was the first to describe the fibula-free flap for reconstruction of segmental mandibular continuity defects. This versatile flap provides up to 25 cm of bone stock that may be harvested with or without a cutaneous paddle. The fibula osseous flap allows reconstruction of near-total mandibular defects with bone that is able to resist normal masticatory forces and is able to support dental implants primarily or secondarily. Its vascular supply is derived from the peroneal artery and its two venae comitantes, which course along the length of the fibula between the tibialis posterior and flexor hallucis longus muscles. The peroneal artery branches off from the posterior tibial artery in the posterior leg 2 to 3 cm distal to the bifurcation of the popliteal artery into the anterior tibial artery and the posterior tibial artery. The peroneal artery typically ends in terminal branches above the ankle, and the tibial arteries continue distally to supply the foot.

The most devastating potential donor site complication of harvesting a fibula-free flap is catastrophic ischemia of the lower extremity. The anterior or posterior tibial arteries may be diseased in 10% to 20% of patients. Harvest of a peroneal artery supplying collateral circulation to the territory of a deficient tibial artery has the potential to cause foot ischemia. Numerous methods have been used for preoperatively evaluating a patient for a fibula-free flap reconstruction. Imaging allows assessment for leg selection and adequacy of perfusion of the leg. Angiography currently provides the most accurate detail of arterial anatomy and is considered the gold standard for vascular assessment, but it carries a small risk that a patient will develop thrombosis, hemorrhage, or embolism. Noninvasive alternatives for evaluating crural vascular anatomy include magnetic resonance (MR) angiography and color flow Doppler imaging.

The ideal method for preoperative radiographic assessment prior to creating a fibula-free flap is controversial. Even less clear are the imaging criteria that contraindicate the safe use of a fibula flap. Clearly, 3-vessel runoff to the foot is ideal, and single-vessel runoff is not usable. In this article, we will address our positive expe-
artery in 6 patients. All patients demonstrated a dominant vascular supply to the foot by the single remaining patent tibial artery, with a well-visualized collateral branch to the region supplied by the occluded tibial artery given off at the level of the ankle (Figures 1, 2, and 3). There were no complications from angiography. All fibula-free tissue transfers with 2-vessel runoff performed by the senior author were successful, and there were no donor site complications or evidence of gangrene, extremity loss, or total skin graft loss. There were 2 cases of subtotal skin graft take. The resulting wound closed subsequently with simple wound care.

The extent of preoperative radiographic assessment prior to performing a fibula-free flap is controversial. Several authors do not feel that routine preoperative imaging is indicated. They reserve angiography for evaluation of patients with abnormal distal pulses or history of lower extremity trauma. However, imaging detects congenital and acquired abnormalities in lower extremity vessels that may be missed on clinical examination. Patients undergoing a segmental mandibulectomy are often at high risk for peripheral vascular disease secondary to smoking and advanced age. Significant atherosclerotic disease may be detected that determines the site of fibula harvest or the need for alternative reconstructions. If congenital variations of the popliteal artery branches (diagnosed in 7.8% of femoral angiograms) are detected, the reconstructive plan may need to be revised. Congenital absence of the peroneal artery is rare (incidence, 0.1%). In addition, serious complications may result if the peroneal artery is the dominant vascular supply to the foot, which has been reported in 5% to 7% of the population. Candidates with peroneal arterial magna are at an especially high risk for ischemia with fibula-free flaps. This congenital anomaly occurs in 0.2% to 0.9% of the population. These patients have normal pulses and are without claudication despite having the peroneal artery as the sole arterial supply of the foot. Overall, imaging has been reported to alter the reconstructive plan of 21% to 25% of patients being evaluated for a fibula-free flap. Angiography is considered the procedure of choice by many surgeons for evaluating arterial anatomy. We consider this the preferred method of investigation. Digital subtraction arteriography provides accurate, detailed, functional anatomy of lower extremity vessels. Disadvantages include expense and the risk of rare complications such as hemorrhage, thrombosis, embolism, pseudoaneurysm, arteriovenous fistula, and contrast nephropathy or allergic reaction. Magnetic resonance angiography is a noninvasive alternative for preoperatively evaluating crural vessels. This study has a cost similar to that of conventional angiography and is capable of identifying vascular abnormalities. Overlay by venous channels may affect the accuracy of MR angiography results in certain individuals.

Color flow Doppler studies have been proposed as an inexpensive, accurate method of evaluating lower ex-
Extremity vasculature. Color flow Doppler has sensitivity for detecting 95% of occluded vessels and 87.5% of stenotic vessels. Patients with monophasic flow or no flow in any of the trifurcation vessels are considered to be at high risk for ischemic complications. Patients with biphasic flow require evaluation with MR angiography or angiography and patients with triphasic flow do not require any further evaluation.

Imaging criteria for exclusion of a fibula-free flap are not clearly delineated. Smith et al considered a stenosis of greater than 50% in 1 lower extremity artery as a basis to contraindicate a fibula-free flap. In contrast, Lutz et al performed fibula-free flap reconstruction, with no donor morbidity, in 3 patients with complete occlusion of a tibial artery on angiography. We have performed a relatively large number of reconstructions in patients with 2-vessel runoff. This may be related to the referral patterns to our center from multiple specialties for difficult head and neck reconstructions. A number of the patients in our study were referred from other centers and initially were considered to be unsuitable candidates for fibula harvest. Also, almost all of the 2-vessel angiograms revealed severe atherosclerotic occlusion of the remaining tibial vessel rather than congenital absence. Our practice is to routinely perform arteriography on patients who are being considered for a fibula-free flap procedure. We feel that this procedure provides the most detailed information about lower extremity vascular anatomy. In our patients with arteriosclerosis in 1 of the tibial vessels, angiography demonstrated collateral circulation to the region of the stenotic vessel. We believe that it is safe to harvest a fibula-free flap in a patient with 2-vessel runoff, provided that the patellar tendon vessel is the dominant arterial supply to the foot. In addition, there must be a well-defined vessel (that we term the crossover collateral) at the level of the ankle (distal to proposed peroneal artery harvest) from the remaining tibial vessel to the occluded tibioperoneal territory. We would consider other reconstructive options in patients whose peroneal artery was the dominant or sole artery to the foot or in whom the criteria mentioned herein were not met.

Despite the presence of arteriosclerosis in 1 of the tibial vessels, all of the fibula-free flap reconstructions were successful. The peroneal artery tends to be less severely affected by peripheral vascular disease compared with the tibial vessels, which may be related to the straighter course of the peroneal artery.
Despite the precautions described herein, as with any fibula-free tissue transfer, a small risk of donor site morbidity, including foot loss, remains. We feel that strict use of the criteria described in this article, with particular note made of the crossover collateral, should make 2-vessel extremity donor sites a safe option in experienced hands.

We feel that MR angiography may be used as a screen depending on surgeon preference. If 3-vessel runoff is noted, then no further imaging is required. If, however, 2-vessel runoff is noted, then an angiogram should be performed to establish with as much certainty as possible whether flap harvest will be safe.

In conclusion, a fibula-free flap can be safely performed in patients with 2-vessel runoff of the lower extremity. Angiography provides accurate detail of the arterial supply to the lower extremity. Patients can be considered for fibula reconstruction if the remaining patent tibial artery is the dominant arterial supply to the foot and provides collateral circulation to the region of the saphenous tibial artery with the identification of the crossover collateral. Absence of this vessel should preclude harvest.

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REFERENCES

10. Lutz BS, Wei FC, Ng SH, Chen IH, Chen SHT. Routine donor leg angiography before vascularized free fibula transfer is not necessary: a prospective study in 120 clinical cases. Plast Reconstr Surg. 1999;103:121-127.