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CASE REPORT
Reconstructive

FFF Utilizing an Arteriovenous Vascular Loop of Two Peroneal Venae Comitantes for a PAM

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Summary: Vascularized bone grafting is widely used for reconstruction of osseous defects of the forearm. Fibular free flap (FFF) is one option, which relies on harvesting the peroneal artery. This procedure is subject to lower extremity anatomic variants; therefore, some recommend preoperative angiography. However, high quality evidence for this approach and its cost-effectiveness are lacking and instead one can diligently assess the vascular anatomy intraoperatively. Here, we describe a case of a 73-year-old man who was found to have a peronea arteria magna intraoperatively during an FFF for a left radius reconstruction secondary to an infectious nonunion. We describe an approach to performing an FFF using an arteriovenous vascular loop through the fibula employing the two accompanying peroneal venae comitantes. The patient had no complications and was found to have appropriate healing of the upper extremity without lower extremity compromise at 3-month follow-up. This report illustrates an alternative to using an interpositional venous graft for peronea arteria magna found intraoperatively during FFFs. *(Plast Reconstr Surg Glob Open 2021;9:e3790; doi: 10.1097/GOX.0000000000003790; Published online 13 September 2021.)*

The vascularized fibular free flap (FFF), first described by Taylor et al in 1975, is a vascularized bone graft method that can be used for reconstruction of bony and soft tissue defects and limb salvage of the upper extremity.[1,2] The FFF relies on the peroneal artery (PA), which typically minimally contributes to the pedal circulation. However, a peronea arteria magna (PAM), which has a prevalence of 0.4%–5.3%, is an anatomical anomaly in which the PA serves as the dominant blood supply to the foot, which can lead to acute ischemia of the limb in patients undergoing an FFF.[3–6]

There is scant literature describing methods for handling a PAM intraoperatively during an FFF, with prior reports focusing on interpositional venous grafting or abortion of fibula harvesting with prior reports focusing on reversed venous bypass using the saphenous vein.[5,7] Herein, we present an alternative to venous grafting, a case of an FFF performed by creating an arteriovenous vascular (AV) loop through the fibula by employing the accompanying peroneal venae comitantes after a PAM was discovered intraoperatively.

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CASE REPORT

A 73-year-old man presented with pain, swelling, gross deformity, and drainage of the dorsal incision in the setting of chronic left wrist osteomyelitis for an unknown duration secondary to an infectious nonunion of the left distal radius. The patient had undergone an unknown distal radius surgery 9 years prior after fracturing it in a motor vehicle accident in his home country (Fig. 1).

The patient was indicated for a two-stage procedure. The patient underwent a 3.4 cm radial and ulnar resection with application of a tobramycin antibiotic cement spacer. The surgery was uncomplicated and a subsequent FFF was planned. A preoperative CT angiography was not performed as this is the standard of care of the senior author due to the low incidence of PAM, the lack of high-quality evidence supporting the need and cost-effectiveness of preoperative imaging, and because the patient had preoperative palpable posterior tibial pulses.[8,9]

The patient received general anesthesia and underwent an FFF procedure. During the FFF, visualization of the PA and posterior tibial artery was challenging. Thus, fibular osteotomies were performed, enabling identification of the peroneal vessels. The PA appeared

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Fig. 1. Left wrist x-ray of a 73-year-old man who presented with chronic osteomyelitis secondary to infectious nonunion. The patient sustained a distal radius fracture 9 years before presentation.

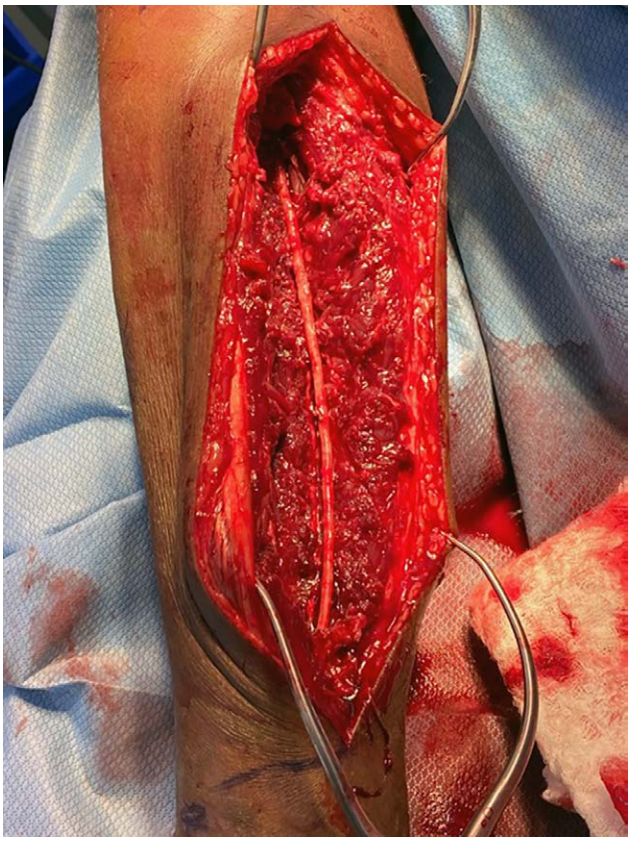

Fig. 2. Intraoperative picture of the left lower extremity after the fibular graft was removed with the accompanying peroneal venae comitantes demonstrating gross hyperplasia of the peroneal artery. On subsequent dissection and evaluation, the anterior tibial artery was found to be hypoplastic and the posterior tibial artery could not be identified.

to be grossly enlarged, which was concerning for the possibility of a PAM (Fig. 2). The anterior tibial vessels were examined and found to be hypoplastic and the posterior tibial artery could not be located. To test for a PAM, Acland clamps were placed on the proximal PA and the tourniquet was released; the foot became cold with poor turgor and no distal pulses were palpable. After removing the clamps, the foot became warm and well perfused, and pulses returned. Therefore, we were confident that the patient had a PAM, and we would be unable to harvest the PA without inducing foot ischemia.

After further dissection of the PAM, the fibular venae comitantes were divided proximally and distally, and the fibula (20-cm free flap) was removed (Fig. 3). A physical examination of the foot was performed to ensure that the foot remained perfused and that there were excellent vascular pulses. The fibula was shortened to 9 cm, resulting in a 11-cm pedicle. We then tested the ability of the two peroneal venae comitantes to function as an AV loop by irrigating through one of the venae comitantes, as there were concerns that valves may be present and inhibiting flow. Flow was observed through the medullary canal and second vein. Therefore, we decided to perform an artery to vein anastomosis and arterialize one of the venae comitantes.

The fibula was inserted into the left upper extremity and an arthrodesis using a dorsal spanning wrist plate was performed with previously harvested iliac crest bone graft. An artery to venous anastomosis was performed by sewing the deep branch of the radial artery to one of the peroneal vena comitans. Adequate flow was observed and there was a positive patency test with bleeding from the medullary canal and back bleeding through the second venae comitantes. The second vena comitans was then sewed to the cephalic vein. After closure, fluoroscopy confirmed appropriate in-setting of the fibula and hardware positioning. The patient was then placed into a volar splint for 6 weeks.

The patient was seen at 2-week, 6-week, and 3-month follow-ups and reported no complications. The patient was able to make a full composite fist and extend his fingers without difficulty. His left lower extremity was healed with minimal swelling, and he was able to ambulate without difficulty. At 3-month follow-up, three view X-rays of

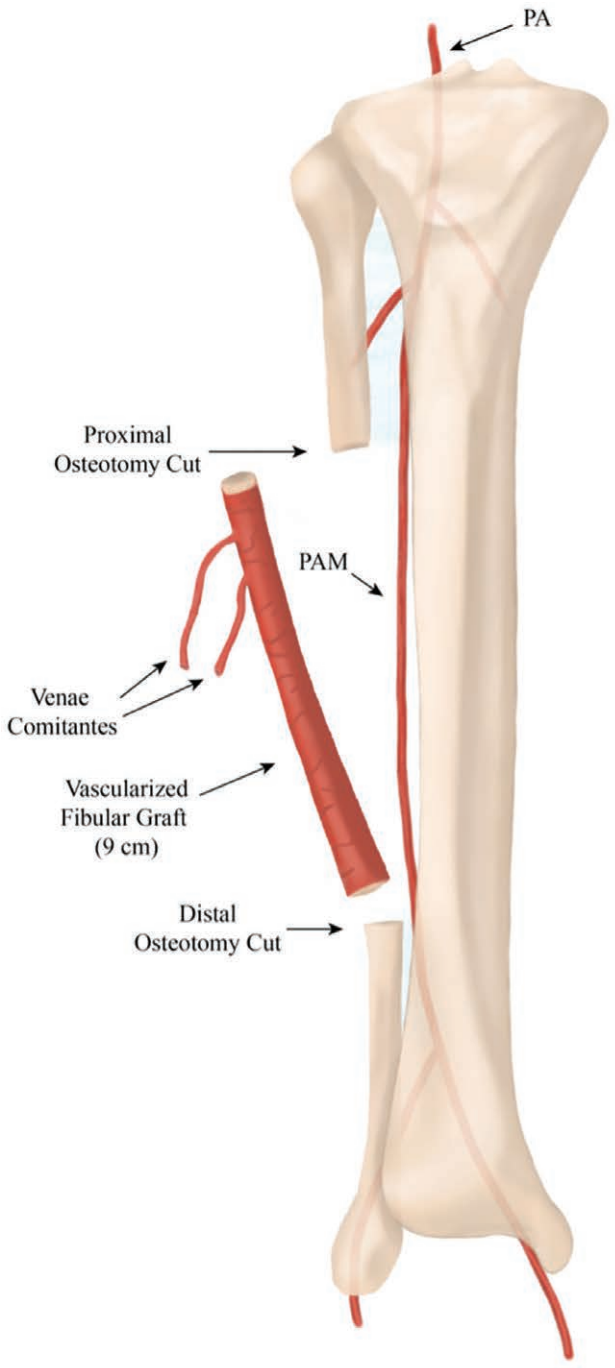

Fig. 3. Illustration of the 9 cm resected vascularized fibular graft with corresponding two peroneal venae comitantes in the setting of a PAM.

the left wrist demonstrated bridging callus of the fibular graft and appropriate hardware alignment (Fig. 4).

DISCUSSION

FFF is a reliable reconstructive option for large (>6 cm) osseous defects of the forearm and has demonstrated good clinical outcomes.[10,11] This procedure, however, can be

Fig. 4. L wrist x-ray of the patient 3 months postoperative after an FFF with an AV loop using two peroneal venae comitantes.

subject to anatomic vascular variations. Due to this concern and the discordance between angiography findings and physical examination, some surgeons advocate for preoperative imaging.[12] However, despite dominant PAs having a strong effect on surgical planning, the overall incidence of a PAM remains very low at 0.4%–5.3%.[5,13] Due to this low incidence, other surgeons argue that the there is no need for preoperative imaging and that it results in unnecessary costs and risks.[9] Historically, CT angiography has been the gold standard for preoperative evaluation. However, more recently some have recommended the use of magnetic resonance angiography as an alternative to decrease radiation exposure.[4] Other novel approaches have been cited in the literature: one case report detailed the use of preoperative balloon occlusion to assess distal limb ischemia in the setting of PAM.[14]

For surgeons who opt to use preoperative imaging, the knowledge of a PAM may alter the surgical plan. A systematic review reported that in 21 of the 28 cases of a dominant PA in FFF, surgeons altered their plan and did not to utilize the affected leg in 17 of 21 patients.[3] In these cases, other options include using the contralateral limb if the PAM is unilateral or using a flap of a different location, such as an MFC flap or other vascularized bone option for smaller lesions (<6 cm).

When preoperative imaging is not performed, close intraoperative assessment of the PA is imperative. Prior case reports have described intraoperative or postoperative foot ischemia due to a PAM after an FFF harvest. In these

descriptions, an interpositional saphenous venous graft was used after angiography confirmed the presence of a PAM.[5,7] We have concerns, however, of the risk of the failure rate of saphenous venous grafts without the presence of collaterals.[15] To our knowledge, there has been no prior description of creating an AV loop through the FFF using two peroneal venae comitantes for an FFF in the setting of a PAM. We believe that this approach is a safe and efficacious alternative to an interpositional saphenous graft, and it removes the need for intraoperative angiography and acquisition of a venous graft, while also reducing the risk of foot ischemia. Future clinical studies are needed to assess the outcomes after this surgical approach and compare its outcomes with those of traditional FFF, although this will be hindered by the relative rarity of PAM.

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