

Maximizing Solid Organ and Face Transplant Procurement Team Coordination: The Posterior Tibial Artery Flap as an Ideal Sentinel Flap

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Abstract

Face transplantation became a reality with the first case performed in 2005. Facial tissue allograft procurement is technically complex and time-intensive. Brain-dead deceased donors are frequently, if not always, multiorgan donors. Every effort should be made during face allograft recovery to minimize any risk to the recovery of lifesaving solid organs. Some programs require the procurement of a myofascial vascularized skin graft to function as a sentinel flap allowing frequent monitoring for rejection without negatively impacting the esthetics of the face graft. Up till now, the flap used has been the radial forearm flap. Procuring the radial forearm flap places the procuring team in close proximity to the head and torso, where the face recovery and the solid organ recovery teams would require unhindered access. Here, we present the posterior tibial artery flap as an alternative flap that would provide benefits to the coordination of the multiple teams working to procure organs from a deceased donor.

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Facial vascularized composite tissue allotransplantation (VCA) is an innovative procedure that is life-changing for patients who have exhausted traditional reconstructive operation options.¹ Monitoring for early signs of graft rejection is necessary to ensure recognition and appropriate treatment of rejection episodes. Sentinel flaps are used by some centers for remote-site rejection monitoring in facial VCA, thus minimizing biopsies of the facial allograft. Surveillance biopsies are performed on the sentinel flap, and the facial allograft is biopsied only if there are suspicious visible changes or when the histopathology of the sentinel allograft demonstrates a grade I, or higher, rejection according to the Banff criteria.² The only reported sentinel flaps used have been the radial forearm flap, which is most commonly inset into the groin.³ This is a reliable flap that provides well-vascularized and supple tissue. However, flap procurement presents logistical challenges because of the flap's location near

the face and solid organ procurement teams.^{3,4} This increases the added logistical challenges of procuring VCA allografts in the already challenging situation of multiorgan recovery. We present the first case using a posterior tibial artery flap as a sentinel flap for immune monitoring in facial VCA. This flap places the procuring surgeon away from the face and solid organ recovery teams, thus enabling concurrent unhindered procurement. This flap is thin, has a long pedicle, and is simple to procure.⁵ We present our experience with the use of the posterior tibial artery flap as a sentinel flap in facial reconstructive transplantation.

REPORT OF CASE

Our patient was a 32-year-old man with a history of a gunshot wound to the face. The donor was a 21-year-old man who was a deceased multiorgan donor with a beating heart. The posterior tibial artery sentinel flap

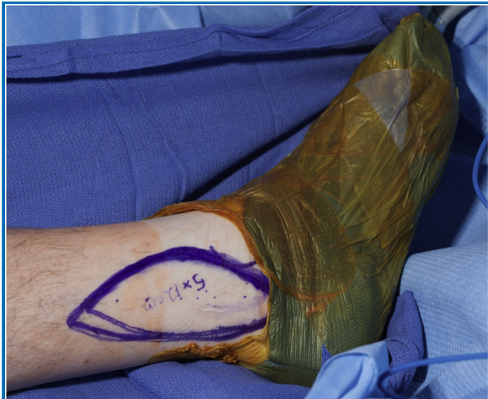


FIGURE 1. The flap was marked to cover the distal third of the posterior tibial artery, a location far from the solid organ procurement teams.



FIGURE 2. The sentinel flap was inset into an inconspicuous location at the left groin. The lateral femoral circumflex artery of the recipient was coapted to the posterior tibial artery of the flap. The flap has been crucial in providing a biopsy location for immune monitoring.

was procured and inset in the left groin concurrently with the facial VCA procedure.

Donor Procurement of the Posterior Tibial Artery Flap

Hand-held Doppler was used to confirm the presence of an intact posterior tibial artery. Subsequently, the flap was designed on the skin of the distal third of the leg centered over the posterior tibial artery (Figure 1). The distal transverse incision was made through the skin and subcutaneous tissue, identifying the posterior tibial neurovascular pedicle. The artery and vein were suture-ligated. The distal pedicle was temporarily secured to the distal skin paddle to prevent traction injury during flap dissection. The anterior incision was then made going down to a subfascial plane and dissecting posteriorly until the septum between the flexor digitorum longus and soleus was reached, and the posterior tibial artery and vein were seen. The posterior incision was made, and dissection proceeded in a subfascial plane from posterior to anterior until the same septum was located, indicating the position of the neurovascular pedicle. The flap was raised distal-to-proximal under the vessels and in a subfascial plane, taking care to ligate all peripheral arterial and venous branches. The pedicle was dissected proximally until the adequate length was achieved.

Because this flap is located far from the trunk and solid organ donor sites, this portion of the operation did not require any accommodation from the teams procuring the face or solid organs. Recovery of the posterior tibial artery flap required 2 hours of dissection time. The flap was perfused through the pedicle

TABLE. Sentinel Flap Procurement Sites and Recipient Inset Locations of the 5 Prior Sentinel Flaps That Have Been Used in Facial Vascularized Composite Allotransplantation

Reference, year	Donor flap procurement	Recipient inset location
Devauchelle et al, 2006 ⁴	Radial forearm flap	Left axillary vessels
Kueckelhaus et al, 2015 ³	Radial forearm flap	First-web space of right hand
Kueckelhaus et al, 2015 ³	Radial forearm flap	Dorsum of right hand
Kueckelhaus et al, 2015 ³	Radial forearm flap	Left axilla
Kueckelhaus et al, 2015 ³	Radial forearm flap	Inguinal region

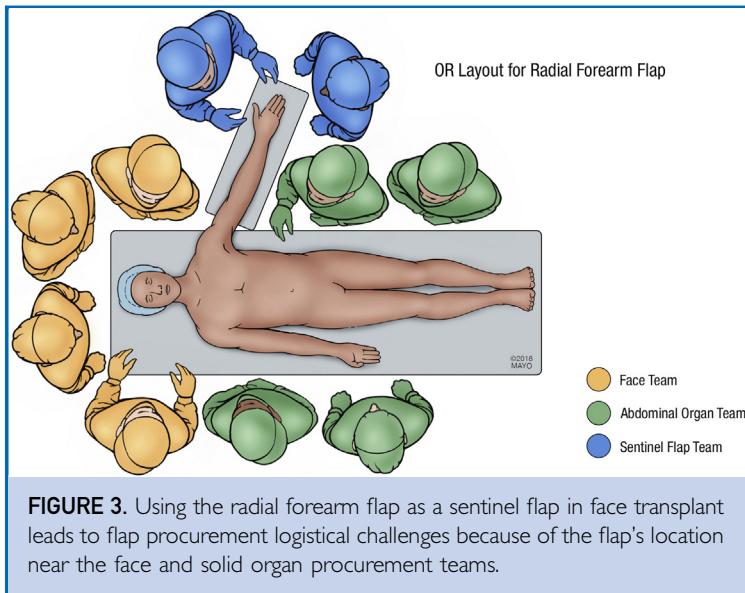


FIGURE 3. Using the radial forearm flap as a sentinel flap in face transplant leads to flap procurement logistical challenges because of the flap's location near the face and solid organ procurement teams.

until the aorta was cross-clamped by the solid organ recovery team, at which point the flap was procured. The posterior tibial artery and vein were ligated immediately before the cross-clamp of the aorta, and the flap was subsequently flushed with heparinized saline. The donor site was closed with sutures, and a gauze dressing was wrapped around the area for donor restoration.

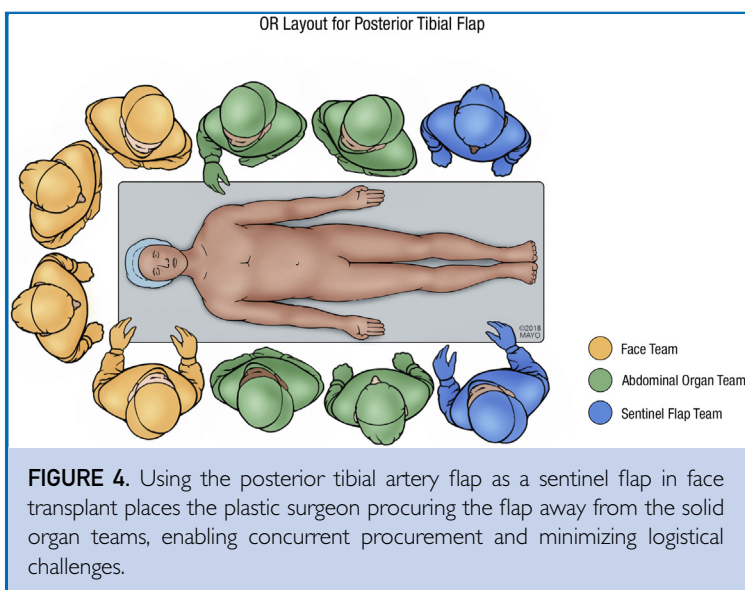


FIGURE 4. Using the posterior tibial artery flap as a sentinel flap in face transplant places the plastic surgeon procuring the flap away from the solid organ teams, enabling concurrent procurement and minimizing logistical challenges.

Flap Inset in the Groin of the Face Transplant Recipient

A curvilinear incision was marked 2 cm inferior to the inguinal ligament (Figure 2). An incision was made through the skin and subcutaneous tissue and medially through the fascia lata. The femoral artery and vein were identified and dissected. The medial and lateral circumflex femoral arteries and saphenous vein were dissected free. The posterior tibial artery flap was then transplanted to the recipient and inset into the groin defect. An end-to-end anastomosis was performed between the medial femoral circumflex artery and the posterior tibial artery. Flap perfusion and venous drainage were confirmed. The posterior tibial vein of the donor was anastomosed to the saphenous vein of the recipient using the Synovis venous anastomotic coupler (Synovis Micro Companies Alliance Inc.). Flap perfusion and color were excellent until 3 hours later, while the face transplant was being inset, there was a change in flap color, and Doppler signals were absent. On exploration, it was apparent that there was a clot at the arterial anastomosis, and the anastomosis was taken down. The lateral femoral circumflex artery was dissected free and coapted to the posterior tibial artery of the flap, which provided a better size match than the medial femoral circumflex artery. The flap was reperfused, and its color appeared pink. A drain was placed, and the flap inset was completed with layered closure.

Postoperatively, the flap healed well. Drain output remained high for 4 weeks and then quickly tapered off. High output was likely because of the extensive dissection around the femoral vessels to expose the lateral femoral circumflex artery as well as the medial femoral circumflex artery. The drain was removed at 3 months, and no further issues developed. The flap is doing well without any issues at 36-months of follow-up. Routine biopsies were performed on this transplanted tissue regularly (weekly until 2 months after operation, biweekly 2-4 months after operation, monthly 4-8 months after operation, and then annually).

DISCUSSION

Face transplantation fills an unmet clinical need for select patients who have exhausted conventional surgical options. As in solid organ

transplants, it is necessary to successfully prevent, recognize, and treat episodes of rejection. The sentinel flap is important in monitoring immune therapy regimens and rejection episodes in the acute posttransplant period as well as throughout long-term monitoring.

Facial VCA procurement has unique logistical challenges and requires immense coordination with the solid organ procurement teams.⁶ Procuring the sentinel flap is an added challenge, especially because it is ideal to procure before the aorta cross-clamp to minimize ischemia time and prevent thrombus formation. All prior sentinel flaps used for immune monitoring in face transplant recipients have used the radial forearm flap with various inset locations (Table).^{3,4} This flap places the surgeon in the midst of the solid organ procurement teams during recovery (Figure 3). Furthermore, a radial arterial line is often used in deceased multiorgan donors for accurate monitoring of hypotension, hindering access to the radial forearm flap. We present the use of the posterior tibial artery flap, which places the plastic surgeon away from the solid organ teams, enabling concurrent procurement and minimizing logistical challenges (Figure 4). We recommend that face transplant teams use this sentinel flap to enable a smoother procurement process and reduce any inconvenience to the solid organ recovery teams.

POTENTIAL COMPETING INTERESTS

The authors report no competing interests.

Abbreviations and Acronyms: VCA, vascularized composite tissue allotransplantation

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