

Percutaneous Double Bypass For Lower Extremity Revascularization of Non-Healing Chronic Ulcer



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Introduction

Atherosclerosis affecting the lower extremities frequently results in rest pain, non-healing ulcers and extensive soft tissue loss. Peripheral arterial disease affects 8-10 million people in the USA (3). It is characterized by atherosclerotic occlusions that can occur in any of the arteries of the lower extremity and limit blood flow to one or both lower extremities. For patients with non-healing ulcers, re-establishing flow to the area facilitates healing. The angiosome concept (AC) introduced in 1987 by Taylor and Palmer divided the body into three-dimensional vascular territories supplied by specific source arteries (4). According to the AC, the foot and ankle has six distinct angiosomes arising from the posterior tibial artery, anterior tibial artery, and peroneal artery. Revascularization based on the angiosome concept is highly debatable for various reasons but has been used successfully. Open bypass and endovascular bypass techniques have been the mainstay of revascularization. Endovascular bypass has several advantages over open, including decreased recovery time and wound infections. With modern advancements in endovascular medicine, the percutaneous transmural bypass system has become frontline therapy for long segment SFA disease. In our case, the patient had a previous endovascular bypass (popliteal to posterior tibial) but developed a non-healing ulcer with cellulitis in the anterior tibial angiosome requiring revisional revascularization.

Case Presentation

A 64-year-old male with an extensive medical history, including type 2 diabetes, hypertension, hyperlipidemia, factor V deficiency on Coumadin, deep vein thrombosis (DVT), pulmonary embolism (PE), atrial fibrillation, and coronary artery disease, presents with a non-healing wound at the left transmetatarsal amputation (TMA) stump. The patient has a known history of peripheral arterial disease (PAD) and has been managed by multiple vascular specialists. He underwent a left femoral to posterior tibial artery bypass in 2022 due to a necrotic wound at the left foot TMA stump, which failed to heal despite multiple rounds of antibiotics and debridement. An angiogram performed on July 10, 2024, revealed moderate to severe stenosis of the proximal left superficial femoral artery (SFA), a patent posterior tibial (PT) bypass conduit, and moderate to severe stenosis of the posterior tibial artery. The stenosis was treated successfully with atherectomy and angioplasty to improve flow through the PT artery. Despite this intervention, the patient continued to experience redness, swelling, and no signs of healing at the wound site. On October 23, 2024, an attempt was made to revascularize the native anterior tibial (AT) artery to improve perfusion to the anterior and medial stump. This attempt was unsuccessful due to the presence of a clip in the mid-popliteal artery, which impeded in-line flow to the anterior tibial angiosome. Following this, an endovascular bypass procedure was considered and, on October 28, 2024, a percutaneous transmural bypass was successfully performed to revise and restore blood flow to address the wound healing concern.

Procedure Technique

Under fluoroscopy, left groin access of the left CFA was performed in an antegrade fashion showing unobstructed flow from the SFA to the PT artery but with sluggish AT and peroneal artery outflow. In this case, due to native popliteal artery being clipped at the P2 segment for previous femoral to posterior tibial arterial bypass, a different approach was investigated. Wires were directed through the popliteal artery above the site of ligation. Retrograde pedal access of the left anterior tibial (AT) artery was obtained to allow access up to SFA and popliteal occlusion. The left popliteal vein was accessed and stripped of valves. The arterial re-entry catheter was entered into the popliteal vein creating A-V anastomosis. The AT vein was then accessed then followed by the AT artery. This resulted in successful revisional revascularization utilizing the popliteal and anterior tibial veins to restore blood flow to the anterior tibial artery angiosome while successfully bypassing the previous angioplasty site.



Figure 1: IntraOp Popliteal artery access

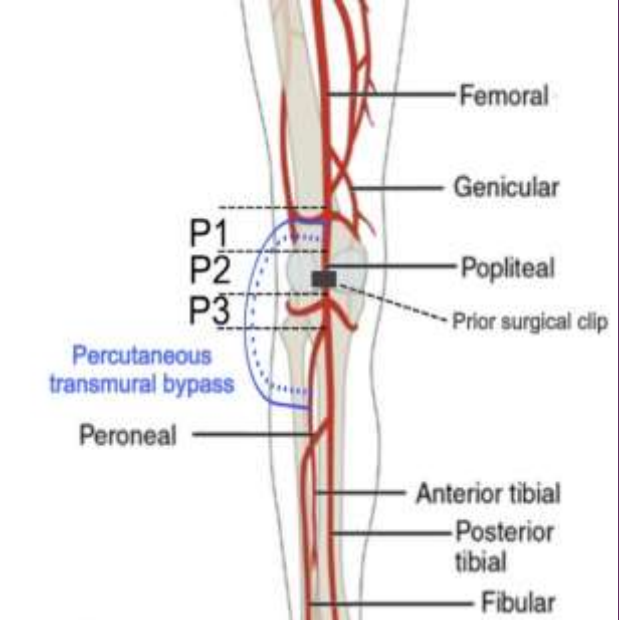


Figure 2: Schematic design of arterial component of percutaneous transmural bypass

Results/Follow Up



Figure 3: Wound pre percutaneous transmural bypass



Figure 4: 19 weeks post percutaneous transmural bypass

Analysis & Discussion

Time Point	Rutherford Class	Wound Measurement	Doppler of PT/ DP	Wound base
Before Revascularization	5	3.5 x 2.0 x 0.6 cm	PT -biphasic DP- Monophasic-turbulent	full thickness open TMA site red granulation tissue with slight bleeding
Time to Healing	19 weeks with regular local wound care post revascularization			

Immediately after revascularization, intraoperative Doppler demonstrated biphasic waveforms of PT and DP

Post op anticoagulant protocol: Continued warfarin for his Factor V deficiency & Plavix for stent indefinitely.

Continued on IV antibiotics post revascularization through Infectious Disease until resolution of cellulitis

Angiosome based revascularization using percutaneous transmural bypass can be an alternative for wound healing of chronic ulcers followed by conservative care.

Limitations include limited generalizability due to case report and all procedures were performed percutaneously by two experienced interventional radiologist so level of experience may play a role in the outcome and willingness to perform the procedure.

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