

# Retrograde superficial femoral artery recanalization through a deep femoral collateral: A transradial approach

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## ABSTRACT

A novel endovascular approach using retrograde access to an occluded superficial femoral artery via collaterals of the deep femoral artery is described. Owing to a prior aortobifemoral bypass, transradial access was used. (*J Vasc Surg Cases Innov Tech* 2023;9:1-4.)

**Keywords:** Superficial femoral artery; Angioplasty; Collateral access

## CASE REPORT

Written consent was obtained for the publication, reproduction, broadcast, and other use of photographs, recordings, and other audiovisual material. An 81-year-old woman presented with ischemic rest pain in her left lower extremity. Her history was significant for an end-to-side aortobifemoral (ABF) bypass graft and a subsequent intervention for a prior right limb occlusion and diabetes. After the prior intervention for a right limb occlusion, the patient was being followed with bilateral lower extremity arterial duplex examination. Her ankle-brachial index (ABI) was falsely elevated ( $>0.9$ ) as she has significant tibial calcification. The patient had a known left superficial femoral artery (SFA) occlusion and a high-grade stenosis of proximal profunda on the left side. She had initially refused left leg intervention until she started experiencing rest pain in her left leg. Access was obtained in the left radial artery followed by the placement of a 105-cm R2P 6F sheath (Terumo, Somerset, NJ). The distal tip of the sheath was positioned in the left limb of the ABF graft.

An initial diagnostic angiogram demonstrated an occluded left SFA with reconstitution of the above-knee popliteal artery with a single vessel tibial runoff. The length of the occlusion was 202 mm and extended from origin of the SFA to just above the popliteal artery. Attempts at antegrade cannulation of the occluded SFA were unsuccessful (Fig 1). The angiogram demonstrated a robust deep femoral artery reconnecting to the distal SFA via multiple collaterals (Fig 2). The main collateral supplying the SFA was then cannulated with a 0.014 angled guidewire

advantage track (Terumo) wire with a 0.014 quick cross (Philips, Cambridge, MA) catheter support (Fig 3). Once the distal SFA was reentered through this collateral, the wire was directed retrograde through the occluded SFA into the common femoral artery. A 2 mm  $\times$  150-mm nanocross elite (Medtronic, Minneapolis, MN) 0.014 balloon was then used to balloon the SFA over the retrograde wire access (Fig 4). Subsequently, an 0.014 buddy wire was passed through the radial sheath and the SFA was reengaged in the antegrade direction using the retrograde wire as a landmark. Once the antegrade wire was passed through the occlusion successfully, the retrograde wire was removed. This now allowed for antegrade access into the SFA. Distal embolic protection was not used because this occlusion seemed to be chronic and not a fresh thrombus.

The SFA was subsequently successfully treated with a balloon angioplasty using a 5  $\times$  200-mm nanocross elite 0.014 balloon (Medtronic) and two 5  $\times$  120 Protégé Everflex (Medtronic) self-expanding stents (Figs 5 and 6). A completion angiogram demonstrated brisk flow through the SFA with a single vessel tibial runoff to the foot (Fig 7). The radial access sheath was removed with a TR band access site control. The patient was discharged home after observation for 2 hours. Follow-up consisted of an arterial duplex, ABI in 1 month, and every 6 months subsequently. The patient has now completed her 12-month follow-up with a normal ABI (0.97), arterial duplex examination, and a palpable posterior tibial pulse. Because of the calcified tibial vessels, her ABIs as a standalone metric was not felt to be reliable. Her rest pain symptoms have resolved. She is currently maintained on aspirin 81 mg once a day and rivaroxaban 2.5 mg twice a day.

## DISCUSSION

Occlusion of the SFA in a patient with a prior ABF bypass has been known to decrease graft patency.<sup>1</sup> The patient in our case report had a prior occlusion of the right limb of the ABF graft, requiring an initial endovascular salvage and a subsequent femoral to below-knee popliteal bypass. SFA occlusion predicts a four-fold increased hazard of primary ABF graft failure.<sup>1</sup> Unfortunately, the presence of an ABF bypass graft increases the complexity of a standard contralateral retrograde

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Author conflict of interest: K.K. is a paid consultant to Bard, Abbott, Terumo, and Shockwave Medical.

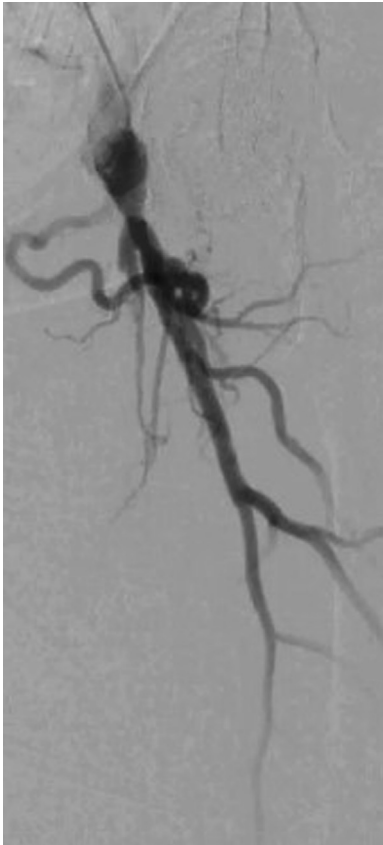
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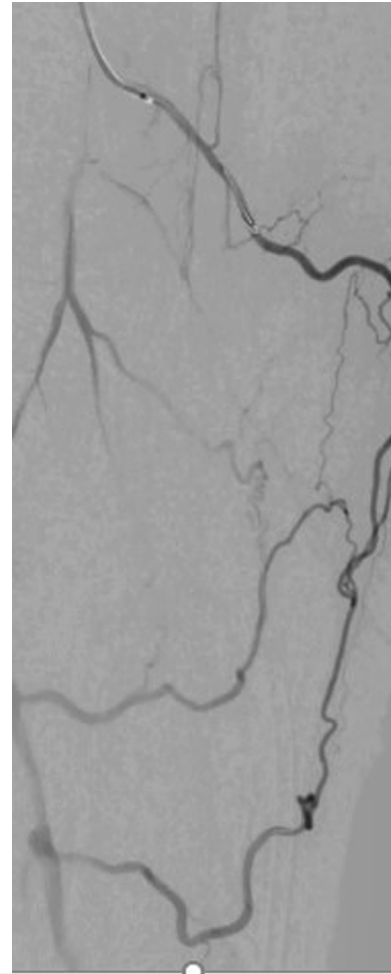
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**Fig 1.** Flush occlusion of the superficial femoral artery (SFA) extending for 202 mm in a patient with a prior aortobifemoral (ABF) bypass graft.

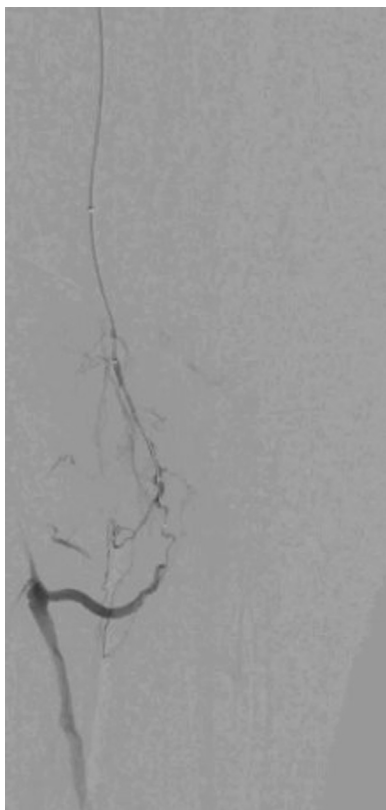


**Fig 2.** Deep femoral collateral reconstituting the distal superficial femoral artery (SFA).

femoral approach for endovascular procedures owing to a steep aortic angle. Alternate access sites include an ipsilateral antegrade femoral access. Owing to the patient's obese body habitus, we felt that this access site would not be ideal. Additionally, antegrade femoral access in patients with flush SFA occlusions do not typically allow adequate sheath access for ease of catheter manipulation. The author also avoids pedal or popliteal access in patients with single vessel tibial runoff, because it could potentially compromise the target for an open surgical bypass. Recently, radial access has been used with increasing frequency because patients can be immediately mobilized, resulting in greater patient satisfaction and lower complications compared with percutaneous brachial or femoral access. In a meta-analysis of randomized trials, when comparing the rates of major bleeding and major vascular complications, radial artery access was superior to femoral artery access, with a hazard ratio of 0.43.<sup>2</sup>

The use of the collateral circulation to cross a chronic total arterial occlusion successfully was described initially in the coronary arteries; despite their small diameter and

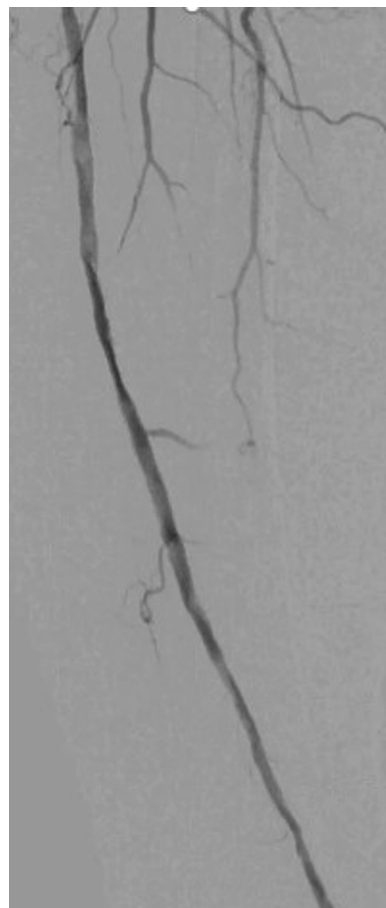
significant tortuosity, it was successful in approximately 70% of cases.<sup>3</sup> Similarly, the technique of crossing a long segment of occlusion of the tibial and external iliac arteries via collaterals has been described previously.<sup>4,5</sup> The presence of a suitable arterial anatomy that includes large, short, and relatively nontortuous collaterals make this technique more likely to succeed. The collateral circulation in patients with SFA occlusions are typically quite extensive and often of adequate diameter. The main challenge is usually the extent of tortuosity. However, the advantage compared with an ipsilateral retrograde approach via popliteal or tibial artery access is the ability to avoid a second puncture with the potential for damage to the target vessel that may be needed for an open bypass. Two different techniques can be used once the wire is able to traverse the occlusion. Some authors use a snare to withdraw the wire and use the through-and-through access for subsequent access to the occluded vessels. We prefer to use a low-profile



**Fig 3.** Cannulation of a collateral leading to the distal superficial femoral artery (SFA).



**Fig 4.** Retrograde wire access across occluded superficial femoral artery (SFA) from the deep femoral collateral. Arrows point to location of a low-profile 2-mm angioplasty balloon.



**Fig 5.** Completion angiogram of the superficial femoral artery (SFA) after angioplasty and stent insertion.

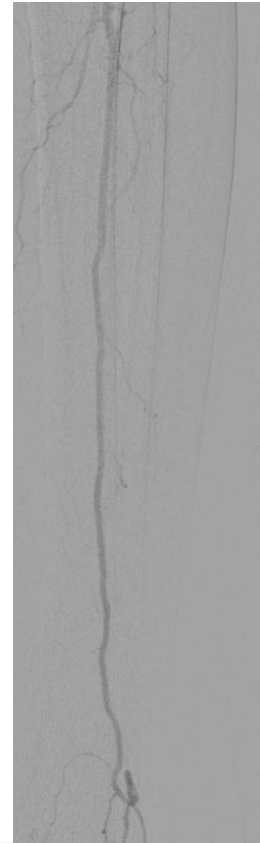
balloon to dilate the lesion. This technique allows for subsequent antegrade access with a buddy wire.

The author's preference is for an endovascular-first approach in most patients with critical limb ischemia. The decision to revascularize by an endovascular approach or open surgery may differ between centers, with regard to expertise, lesion location, available conduit, comorbidity, practice patterns, and cost. More recently, given the superior outcomes of open surgical bypass reported in the Best Endovascular vs. Best Surgical Therapy in Patients with Critical Limb Ischemia (BEST CLI) trial, this treatment option is presented to all patients who are ideal open surgical candidates.<sup>6</sup> Patient in case report had a greater saphenous vein diameter of <2 mm (1.7 mm) in multiple segments and would not have been an ideal candidate for open surgery.

The advantages of collateral approaches are that (1) the impenetrable portion of the long segment occlusions is typically the proximal cap with the distal portion being much softer, so crossing from the retrograde direction is often more feasible, (2) the distal collateral vessels usually reenter in a cranial angle, hence, the ability to direct



**Fig 6.** Proximal extent of the stented superficial femoral artery (SFA) with visualization of the left limb of the aortobifemoral (ABF) bypass graft.



**Fig 7.** Completion angiogram demonstrating the single vessel tibial runoff.

the wire retrograde is not difficult, (3) there is less radiation exposure to the operator especially if using the radial access, (4) it is safer in obese patients or those with an infected groin, and (5) it maintains the distal target vessel for a potential open surgical bypass. Disadvantages include that (1) the small diameter collaterals are prone to spasm and dissection, (2) success is highly dependent on the anatomy of the collateral vessels, and (3) the learning curve may be quite steep.

Collateral vessel spasm is addressed typically with the intra-arterial administration of nitroglycerine. If dissection of the collateral vessel is encountered during manipulation, the technique would need to be aborted and an alternate collateral, if available, will need to be accessed. If a collateral-assisted recanalization technique had failed in our patient, alternate options would include direct access into the occluded SFA for retrograde wire access or a femoral to above-knee popliteal bypass with a synthetic graft (the saphenous vein was <2 mm).

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