

# Tackling Popliteal Artery Lesions

Today's devices enable lesion-specific care tailored to each patient.

BY SUBHASH BANERJEE, MD; EMMANOUIL S. BRILAKIS, MD, PhD; AND TONY S. DAS, MD

**E**merging endovascular devices have expanded percutaneous treatment to popliteal artery lesions, traditionally treated via open surgical means. We present a case-based review of currently available percutaneous endovascular treatment options for popliteal artery lesions.

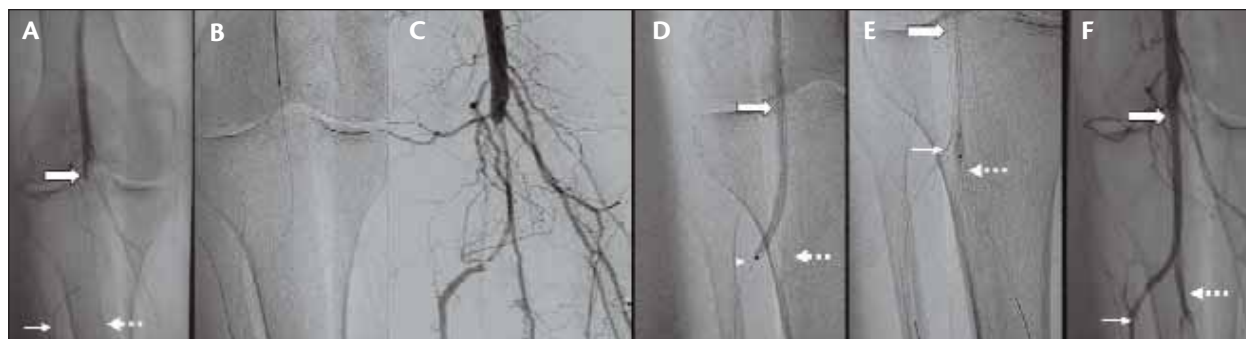
## CASE 1

A 50-year-old man with known coronary disease underwent a bilateral lower extremity angiography for left calf, lifestyle-limiting (Rutherford category 3) claudication symptoms. His ankle-brachial indices (ABIs) were 0.51 and 0.89 in the left and right lower extremities, respectively. Angiography revealed an occluded left popliteal artery and delayed filling of the left anterior tibial artery and

tibioperoneal trunk from bridging collaterals (Figure 1A). Selective access to the distal left superficial femoral artery (SFA) was obtained via the right common femoral artery using a 6-F Pinnacle Destination sheath (Terumo Medical Corporation, Somerset, NJ). The left popliteal artery occlusion was crossed with a Safe-Cross wire (Spectranetics Corporation, Colorado Springs, CO). After angiographically confirming distal true lumen access, the left popliteal and anterior tibial arteries were treated with a 1.4-mm Excimer Laser (Spectranetics Corporation) at 45 mJ/mm<sup>2</sup> fluency and a 25 pulse/second repetition rate (Figure 1B), yielding restoration of distal flow and a focal 50% residual lesion in the left popliteal artery (Figure 1C). Subsequent treatment with a 5-mm X 60-mm PolarCath cryoplasty balloon



Figure 1. A 50-year-old man with lifestyle-limiting claudication and left popliteal artery occlusion. The bold arrow indicates the site of popliteal artery stenosis before and after successful endovascular treatment.



**Figure 2.** A 79-year-old woman with a nonhealing ulcer and left popliteal artery occlusion involving the anterior tibial artery and tibioperoneal trunk. The bold arrow indicates the popliteal artery, the thin arrow indicates the anterior tibial artery, and the hatched arrow indicates the tibioperoneal trunk.

(Boston Scientific Corporation, Natick, MA) (Figure 1D) revealed an excellent angiographic result, with brisk three-vessel infrapopliteal runoff (Figure 1E).

## CASE 2

A 79-year-old woman with known coronary and peripheral vascular disease was referred for an evaluation and treatment of a nonhealing ulcer of the right heel (Rutherford category 5). Her ABIs were 0.25 and 0.8 in the right and left lower extremities, respectively. Angiography with distal runoff revealed a long-segment occlusion of the right popliteal artery involving the right anterior tibial artery and tibioperoneal trunk, filling late from bridging collaterals (Figure 2A). Selective access to the distal right SFA was obtained via the left common femoral artery using a 6-F Pinnacle Destination sheath. The right popliteal artery occlusion was crossed with a .014-inch Persuader 3 wire (Medtronic Vascular, Santa Rosa, CA). After confirming distal true lumen access, the right popliteal and anterior tibial arteries were treated with the 70- $\mu$ m, 1.75-mm Diamondback 360° orbital atherectomy system (Cardiovascular Systems Inc., St. Paul, MN) at low, medium, and high speed for 30 seconds each at 160 X 1,000 rpm (Figure 2B), achieving restoration of distal flow and revealing long segments of severely diseased right popliteal artery, anterior tibial artery, and tibioperoneal trunk (Figure 2C). After initial predilations, the right anterior tibial artery and tibioperoneal trunk segments were

stented with 3-mm X 24-mm and 3-mm X 18-mm bare-metal coronary stents, respectively. Finally, a self-expanding nitinol 4-mm X 60-mm stent was deployed in the right popliteal artery, overlapping the right anterior tibial artery stent and was postdilated with a 3-mm X 100-mm balloon (Figure 2D). The ostium of the right tibioperoneal trunk was also postdilated with a 3-mm X 9-mm balloon (Figure 2E). Final angiography revealed an excellent result of the right popliteal artery and a brisk three-vessel infrapopliteal runoff (Figure 2F).

## CASE 3

A 76-year-old woman with known hypertension and peripheral vascular disease was referred for lower extremity angiography for severe right calf claudication (Rutherford category 3). Her ABIs were 0.45 and 0.78 in the right and left lower extremities, respectively. Angiography with distal runoff revealed a focal area of severe stenosis in the right popliteal artery (Figure 3A). The right anterior tibial artery and tibioperoneal trunk had



**Figure 3.** A 76-year-old woman with severe right calf claudication and severe focal stenosis of the right popliteal artery. The bold arrow indicates the site of popliteal artery stenosis before and after successful endovascular treatment.

mild diffuse disease; however, distal runoff was sluggish. Selective access to the distal right SFA was obtained via the left common femoral artery using a 6-F Pinnacle Destination sheath. The right popliteal artery stenosis was crossed with a .014-inch Persuader 3 wire. After confirming distal true lumen access, the right popliteal artery lesion was treated with a 70- $\mu$ m, 2.25-mm Diamondback orbital atherectomy system at medium and high speeds for 45 seconds each at 160 X 1,000 rpm (Figure 3B) with an excellent angiographic result and restoration of brisk distal flow (Figure 3C).

All three patients were discharged the following day after an uneventful postprocedure course. Mean fluoroscopy time was 32.2 minutes; mean contrast volume was 266.6 mL. At 6-month follow-up, two patients (cases 1 and 3) reported significant improvement in walking distance and one (case 2) reported healing of her right heel ulcer.

## DISCUSSION

Traditionally considered a “no-stent zone,” the popliteal artery presents a unique set of challenges for an endovascular specialist. First and foremost, an operator should be aware of nonatherosclerotic narrowing of the popliteal artery via extrinsic compression. These challenges most commonly include popliteal artery entrapment syndrome, which results from an anomalous course of the popliteal artery in the popliteal fossa and/or an abnormal insertion of the medial head of gastrocnemius muscle or soft tissues of the knee joint.<sup>1</sup> These anatomic variants cause transient, partial, or complete occlusion of the popliteal artery during activity of the lower extremity. The clinical presentation is one of intermittent claudication in an otherwise young, athletic individual at low risk of atherosclerotic vascular disease. On examination, the symptoms can be elicited by forced plantar flexion and simultaneous palpation of distal lower extremity pulse. Definitive treatment of this condition is surgical. Other rare nonatherosclerotic lesions of the popliteal artery may arise from false aneurysms after total knee arthroplasty.<sup>2</sup> This condition may be treated endovascularly with a covered stent similar to the treatment of atherosclerotic popliteal artery aneurysms.<sup>3</sup>

Endovascular treatment of the popliteal artery and the accompanying infrapopliteal vessels is limited by elastic recoil, dissection, distal embolization, and high rates of intermediate and long-term restenosis. As in case 1, debulking with an excimer laser, capable of ablating or vaporizing plaque, has been advocated as a useful strategy to improve procedural success and long-term patency. The LACI pivotal multicenter trial (limb salvage following Laser-assisted Angioplasty for Critical limb Ischemia)

enrolled 145 critical limb ischemia patients and 155 limbs presenting with pain and early tissue loss ulcerations.<sup>4</sup> Of the 423 lesions treated, 15% were popliteal arteries, and 41% were infrapopliteal arteries. Only 38% in the popliteal and 16% in the infrapopliteal required subsequent stenting. A 93% 6-month limb salvage rate was reported during follow-up. Straight-line flow to the foot was achieved in 89% of patients, and only 16% required a secondary reintervention at 6 months, with 69% achieving improvement in Rutherford category.

The use of cryoplasty for the treatment of complex infrainguinal arterial disease is supported by the Below-The-Knee (BTK) CHILL study, which evaluated the role of cryoplasty in chronic limb ischemia due to infrapopliteal disease.<sup>5</sup> The study enrolled 100 patients. The study reported an acute technical success rate of 97.3% (primary endpoint) and a 93.4% rate of freedom from major amputation at 180 days. Mechanistically, the cold energy delivered through the vaporizing nitrous oxide during cryoplasty causes crystallization of the vessel wall interstitial fluid. This leads to formation of microfissures, enabling more uniform expansion of the vessel and the lesion at a significantly reduced risk of intimal dissections compared to traditional balloon angioplasty.

Another recent device, the Diamondback 360° orbital atherectomy system, uses the principle of centrifugal force. As crown rotation increases, centrifugal force presses the eccentrically mounted, diamond-coated crown against the stenotic lesion, removing a thin layer of plaque and creating a larger lumen with increasing crown orbit. The resulting particles are approximately 75% smaller than a red blood cell, which minimizes the risk of distal embolization. The device recently gained FDA approval based on the OASIS prospective, multicenter, IDE clinical study. The study reported that the device met or exceeded the objective performance criteria for both efficacy and safety. The 180-day target lesion revascularization rate was 0.9%.<sup>6</sup>

It is important to mention that limb salvage and primary patency rates of devices may vary significantly over time. Sung et al have recently reported primary patency rates of 38%, 10%, and 10% per treated limb at 3, 6, and 12 months, respectively, using infrainguinal excisional atherectomy in 19 patients using the SilverHawk device (ev3, Plymouth, MN).<sup>7</sup> The acceptable 74% limb salvage rate was maintained through secondary interventions. The assisted patency rates were 50%, 23%, and 10%.

## CONCLUSION

The cases presented in this review highlight the use of atheroablation, cryoplasty, and selective stent placement in the treatment of focal and long-segment atheroscle-

rotic disease of the popliteal artery and the involved infrapopliteal arteries. The indication for treatment, the primary clinical objective, and lesion complexity (lesion length, presence of calcification, tortuosity, and thrombus) need to be carefully assessed before considering endovascular intervention in this challenging anatomic location.

Although preliminary data supporting the use of these devices may be promising, the primary determinant of success will be the appropriate application of these niche technologies to specific patient and lesion subsets by an experienced operator. ■

*Subhash Banerjee, MD, is Acting Chief, Division of Cardiology, and Co-Director, Cardiac Catheterization Laboratory, at Dallas VA Medical Center; and Assistant Professor of Medicine at University of Texas Southwestern Medical Center in Dallas, Texas. He has disclosed that he holds no financial interest in any product or manufacturer mentioned herein. Dr. Banerjee may be reached at mdcare@aol.com.*

*Emmanouil S. Brilakis, MD, PhD, is Director, Cardiac Catheterization Laboratory, at Dallas VA Medical Center; and Assistant Professor of Medicine at University of Texas*

*Southwestern Medical Center in Dallas, Texas. He has disclosed that he holds no financial interest in any product or manufacturer mentioned herein.*

*Tony S. Das, MD, is Director, Peripheral Vascular Interventions at the Presbyterian Heart Institute in Dallas, Texas. He has disclosed that he receives grant/research funding from Boston Scientific Corporation and Cardiovascular Systems Inc. Dr. Das may be reached at tdas@civadallas.com.*

1. Gaines VD, Ramchandani P, Soulen RL. Popliteal entrapment syndrome. *Cardiovasc Intervent Radiol.* 1985;8:156-159.
2. Vaidyanath R, Blanshard KS. Case report: insertion of a covered stent for treatment of a popliteal artery pseudoaneurysm following total knee arthroplasty. *Br J Radiol.* 2003;76:195-198.
3. Kudelko PE, Alfaro-Franco C, Diethrich EB, et al. Successful endoluminal repair of a popliteal artery aneurysm using Wallgraft endoprosthesis. *J Endovasc Surg.* 1998;5:373-377.
4. Laird JR, Zeller T, Gray BH, et al; LACI Investigators. Limb salvage following laser-assisted angioplasty for critical limb ischemia: results of the LACI multicenter trial. *J Endovasc Ther.* 2006;13:1-11.
5. Das T, McNamara T, Gray B, et al. Cryoplasty therapy for limb salvage in patients with critical limb ischemia. *J Endovasc Ther.* 2007;14:753-762.
6. Niaz K, Safian R, Dulas D; OASIS Investigators. Orbital atherectomy for percutaneous treatment of below the knee vascular stenosis: results of the OASIS multicenter study. Abstract presented at: Transcatheter Cardiovascular Therapeutics Annual Meeting; October 22-24, 2007; Washington, DC.
7. Chung SW, Sharafuddin MJ, Chigurupati R, et al. Midterm patency following atherectomy for infrainguinal occlusive disease: a word of caution. *Ann Vasc Surg.* 2008;22:358-365.