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Case Report

Popliteoperoneal *In Situ* Bypass Using the Small Saphenous Vein Enables Revascularization With Low Trauma

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In patients with diabetes, a popliteocrural vein bypass frequently must be linked to the distal peroneal artery. To reduce trauma to the ischemically damaged tissue, we used a dorsal approach to the peroneal artery. With the patient prone, a incision parallel to the posterolateral margin of the Achilles tendon is made. After the deep crural fascia and flexor hallucis longus are split, access to the peroneal artery is easily obtained. The second segment of the popliteal artery is exposed in the popliteal cavity. The small saphenous vein is left *in situ* and anastomosed with the arteries after proximal and distal preparation and valvulotomy.

Key words: Peroneal artery – Dorsal access – *In situ* small saphenous vein bypass

Infragenual revascularization is an established method for limb conservation in chronically critical ischemia. Treatment of the ischemic diabetic foot syndrome, in particular, calls for distal reconstruction, because the arteriosclerotic occlusive disease mainly affects arteries of the lower leg.[1,2] Frequently, the peroneal artery is the only vessel that is not occluded and thus eligible for bypass. To reduce general and local complications affecting a leg with severe circulatory disturbance, the operation should be performed quickly and with minimal trauma. Both the medial and lateral accesses (with partial fibula resection) are traumatizing and technically complex. The posterior approach with the small saphenous vein was first described by Ouriel in 1994.[3] In 1997, Gelabert *et al*[4] described the *in situ* technique with the small saphenous vein. Here we present our experience for revascularization of the distal peroneal artery with a minimal access trauma.

Technical Procedure

The patient is in prone position, with the knees slightly flexed with the aid of a cushion roll below the

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knees. The incision is made parallel to the posterolateral margin of the Achilles tendon, with the small saphenous vein (SSV) being spared. The superficial crural fascia is cleaved, and the superficial fascial compartment of the flexor is separated from the deep compartment along the posterior crural intermuscular septum. After longitudinal cleaving of the deep crural fascia, the caudal edge of the flexor hallucis longus muscle is exposed. Once the muscle is partially detached from the medial edge of the fibula, the peroneal artery can be exposed. Subsequently, the SSV can be localized in the subcutaneous tissue of the medial border of the wound and dissected in the distal direction for a length that is sufficient to enable tension-free anastomosis.

The midportion of the popliteal artery is exposed between the heads of the gastrocnemius muscle. The tibial nerve should be carefully avoided. Then the SSV is dissected up to its junction with the popliteal vein. If a femoropopliteal vein exists, this should first be spared, in case it is needed to compensate for any length deficit toward the popliteal artery. After valvulotomy, distal end-to-side anastomosis of the SSV with the peroneal artery is performed. Finally, lateral branches of the SSV are identified and ligated. SSV not less than 3 mm in diameter is usable as bypass graft. Preoperative duplex scanning in standing position can be done to assess whether adequate vein is present.

Case Report

A diabetic 82-year-old man with rest pain in the right foot underwent angiography that showed obliteration of the popliteal artery 2 cm proximal to the articular space of the knee (Fig. 1). The only artery visible in the lower leg was the distal peroneal artery (Fig. 2). Using duplex sonography, the SSV appeared usable, although it had many varicose lateral branches. We recommended a popliteoperoneal bypass.

With the patient prone, the peroneal and popliteal arteries were exposed. Because of the many lateral branches, the skin and the crural fascia were incised over the full length of the SSV. All lateral branches were ligated without the vein fully liberated from its tissue bed. After anastomosis with the popliteal artery, the venous valves were destroyed with a valvulotome and finally, distal anastomosis with the peroneal artery was performed (Fig. 3). The bypass function and runoff were monitored by duplex sonography and intraoperative angiography after puncture of the popliteal artery (Fig. 4).

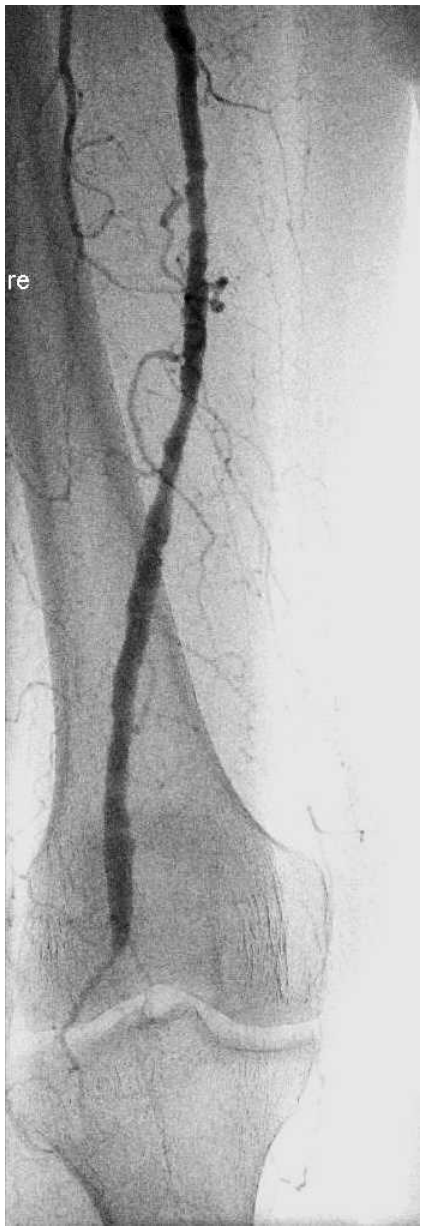

Fig. 1 Preoperative angiogram with obliteration of the supragenicular popliteal artery.

The patient was free from pain immediately after surgery. Because of no postoperative complications, the patient was discharged from hospital on postoperative day 7. The ankle brachial index increased from 0.4 (posterior tibial artery and dorsal artery of foot) preoperatively to 0.94 (posterior tibial artery) and 1.0 (dorsal artery of foot) postoperatively.

Fig. 2 Preoperative angiogram with the distal peroneal artery.

Discussion

The revascularization of crural arteries is an established method for conserving an extremity affected by chronically critical ischemia.[5,6] In patients with diabetes, angiography often reveals a popliteal or ''cross-sectional'' obstruction of the proximal crural arteries. Frequently the peroneal artery is the only vessel suitable for anastomosis. Although the peroneal artery disperses in the vascular network of the fibular ankle, the patency rates of fibular bypasses are comparable with those leading to the anterior or posterior tibial artery.[7–9] However, access to the peroneal artery is problematic. The common medial and lateral accesses are technically complex and traumatize the tissue. Debus *et al*[10] described an alternative with dorsolateral preparation in a semi-lateral decubitus position without partial fibular resection.

Prerequisites for the procedure, as described in the present study, are good afflux to the second popliteal segment, and a usable SSV. Insufficient afflux can be improved by preoperative or intraoperative endovascular ''service'' angioplasty.

With dorsal access to the popliteal artery and the distal peroneal artery, suggests performing an *in situ* bypass using the SSV. This reduces tissue trauma even further, as no vein is removed. The *in situ* technique offers better size-matching between vein and artery at the anastomoses, and improving hemodynamics.[11] The primary patency rates of our series were 87.5% at 12 months, 87.5% at 18 months, 75.0% at 24 months, and 62.5% at 36 months (Table 1). Other investigators reported that patency

Fig. 3 Distal anastomosis of the SSV with the peroneal artery (right leg). *In situ* bypass across the lateral edge of the soleus muscle.

rates are not worse than with distal origin bypasses with reversed vein grafts.[11,12]

The well-known downsides of *in situ* bypasses, such as exposed superficial location and kinking due to rerouting of the bypass from the subcutaneous course to greater depth, are insignificant at the proximal end in the popliteal cavity, but should be heeded at the distal end. This is because the SSV must be routed into depth across the lateral edge of the soleus muscle or the Achilles tendon (Fig. 3). Some protection of the bypass is afforded by the subfascial course of the SSV between the middle of the lower leg and the popliteal cavity.

Only in cases of numerous lateral branches of SSV, a continuous incision from the popliteal region to the outer ankle, as also described by Oderich and Panneton,[11] is necessary. According to Ouriel[3] dorsal access using the SSV is suitable for establishing bypasses to all three crural arteries. In case of bypasses to the proximal third of a crural artery, however, one must cleave the soleus muscle (*i.e.*, with considerable trauma). In our opinion, the tissue-sparing effect of the operation is best ensured if the site of the anastomosis with the peroneal or the posterior tibial artery is chosen far toward its distal end. An orthotopic bypass route from the popliteal artery to the distal peroneal artery would require dangerous tunneling in the depth of the crural musculature. This involves risking compression of the bypass by the tendinous arch of the soleus muscle.

Table 1 Primary patency rate in our series (N = 8 patients) of popliteoperoneal in situ small saphenous vein bypass

	12 months	18 months	24 months	36 months
Primary patency rate	87.5%	87.5%	75.0%	62.5%

In conclusion, for a popliteal-to-distal peroneal artery bypass, the combination of dorsal vessel access with an *in situ* bypass using the SSV is a minimally traumatic technique. The advantages described, including the unproblematic function control by palpation, outweigh the well-known disadvantages.

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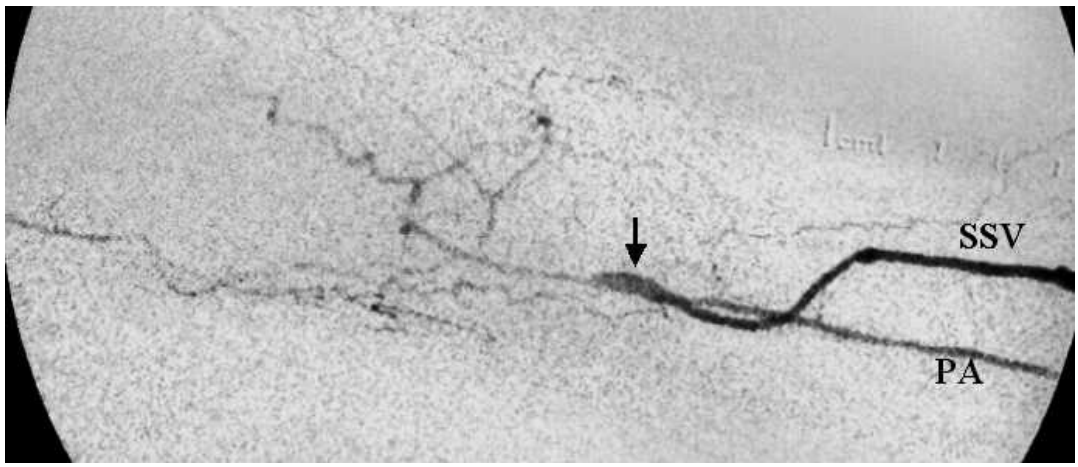

Fig. 4 Intraoperative angiography after anastomosis. Distal anastomosis (arrow) of the SSV with the peroneal artery (PA).

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