# Primary patency rate of native vessel revascularization after failed femoropopliteal bypass surgery

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**Introduction**
Treating patients with chronic limb-threating ischemia who have had failed femoropopliteal bypass represents a challenge, because these patients have TASC C or D lesions and may not be good candidates for surgical intervention. Endovascular intervention may offer a suitable solution.
**Patients and methods**
A retrospective case series of 34 patients presenting with chronic limb-threating ischemia and previously failed femoropopliteal bypass were subjected to native vessel revascularization through a contralateral approach with balloon dilatation and stenting on demand of the superficial femoral artery.
**Results**
Technical success was achieved in 91.18% of cases, stenting was done in 64.51% of cases, and the mean time for the procedure was 73.18±12.96 min. Ankle–brachial index significantly increased with clinical improvement. The patency rates at 3, 6, and 12 months were 80, 56.67, and 43.33%, respectively, whereas the limb-salvage rates at 3, 6, and 12 months were 96.67, 93.33, and 93.33%, respectively.
**Conclusion**
Native vessel revascularization is a feasible procedure that can be done safely with acceptable technical success and limb-salvage rate. It represents a good option for patients who are poor candidates for redo-surgery.

**Keywords:**
bypass failure, endovascular recanalization, native artery

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## Introduction

Open infrainguinal bypass surgery is preferred in patients having major tissue loss with life expectancy more than 2 years, low surgical risk, and acceptable vein conduit owing to the higher patency rate [1].

In the mean time, occluded arterial bypass graft represents a challenge, as it presents with an array of symptoms ranging from claudication to limb-threating ischemia. It carries an increased rate of morbidity and mortality [2,3]. The limb-salvage rate in 2 years is ~50% with failed bypass grafts [4,5].

The available options for management of graft failure are thrombectomy, thrombolysis, or redo-sugery, but they have low long-term patency and limb-salvage rates [6,7]. Redo-surgery is associated with high complication rate, as well the patients may not be suitable candidates for redo-bypass owing to unavailable suitable conduit, bad outflow vessel, and increased surgical risk [8].

Those bypass grafts were done mainly to TASC C and D [1], but nowadays, owing to the advancement in the endovascular techniques and equipment, the management of such patients is no longer limited to TASC II guidelines [9].

Endovascular intervention offers a feasible method to treat patients with failed infrainguinal bypass grafts with acceptable success rate [10,11].

In general, patients with repeated revascularizations have progressively worse outcome with each procedure [12,13].

## Patients and methods

Between January 2015 and December 2020, 34 patients presented with chronic lower limb ischemia (gangrene, ulcer, or rest pain) at Ain Shams University hospitals. This research was performed at the Department of General Surgery, Ain Shams University Hospitals. Ethical Committee approval and written, informed consent were obtained from all participants. They gave history of previous surgical intervention in the

form of a femoropopliteal bypass surgery either with reversed saphenous graft or a synthetic graft. At the time of presentation, this graft was occluded.

### Patient selection

In this retrospective case series, we included male or female patients 35–75 years old, presenting with signs of chronic limb-threating ischemia; they underwent femoropopliteal bypass surgery more than 1 year before presentation. We excluded patients presenting with acute lower limb ischemia, patients who underwent femoropopliteal bypass during the period of 1 year before presentation, patients presenting with intermittent claudication, and patients with severe tibial disease.

### Preintervention history taking and examination

All patients were subject to careful history taking, physical examination, and preoperative investigations, including computed tomography angiography. Superficial femoral artery lesions were classified according to TASC II classification [9].

### Procedure

Native vessel revascularization was attempted through a contralateral retrograde approach. Femoral artery was accessed using Seldinger technique with insertion of an 8-F sheath. Through this sheath, a curved 45-cm 6-F sheath was advanced over a 0.035 guidewire to the other side, angiography was done to identify the lesion, and the outflow vessel; negotiation of the lesion was done with a 0.035 guidewire with the support of a 5-F vertebral catheter.

If we failed to cross the lesion, we used a TrailBlazer support catheter (Medtronic) to aid in crossing the lesion. Percutaneous transluminal angioplasty balloons were used (5×200 mm or 5×300 mm) for femoral artery according to lesion length, (4×80 mm, 4×100 mm) for popliteal lesions. If stenting was required, a self-expandable stent was used according to the size and length required. Technical success was defined as restoration of the flow in the native vessel with no residual stenosis or a stenosis less than 30%.

### Postoperative follow-up

It was done at 1, 3, 6, and 12 months, which consisted of clinical examination and duplex ultrasound. During clinical examination, we assessed improvement or return of complaint, wound healing, and limb salvage.

## Results

We included 34 patients with failed femoropopliteal bypass surgery, and the demographic data of these patients are shown in Table 1.

**Table 1 Demographic data**

| | *n* (%) |
|---|---|
| Sex | |
| Male | 27 (79.4) |
| Female | 7 (20.6) |
| Age (mean±SD) | 61.26±6.0064 |
| Diabetes mellitus | |
| Yes | 30 (88.2) |
| No | 4 (11.8) |
| Hypertension | |
| Yes | 29 (85.3) |
| No | 5 (14.7) |
| Cardiac disease | |
| Yes | 22 (64.7) |
| No | 12 (35.3) |

**Table 2 Rutherford classification, angiographic findings, and ankle–brachial index (superficial femoral artery)**

| | *n* (%) |
|---|---|
| Rutherford class | |
| 4 | 12 (35.30) |
| 5 | 17 (50) |
| 6 | 5 (14.70) |
| ABI | |
| Mean±SD | 0.40±0.17 |
| Angiographic finding | |
| Class C | |
| Proximal SFA | 4 (11.76) |
| Class D | |
| SFA | 24 (70.59) |
| SFA+popliteal | 6 (17.65) |

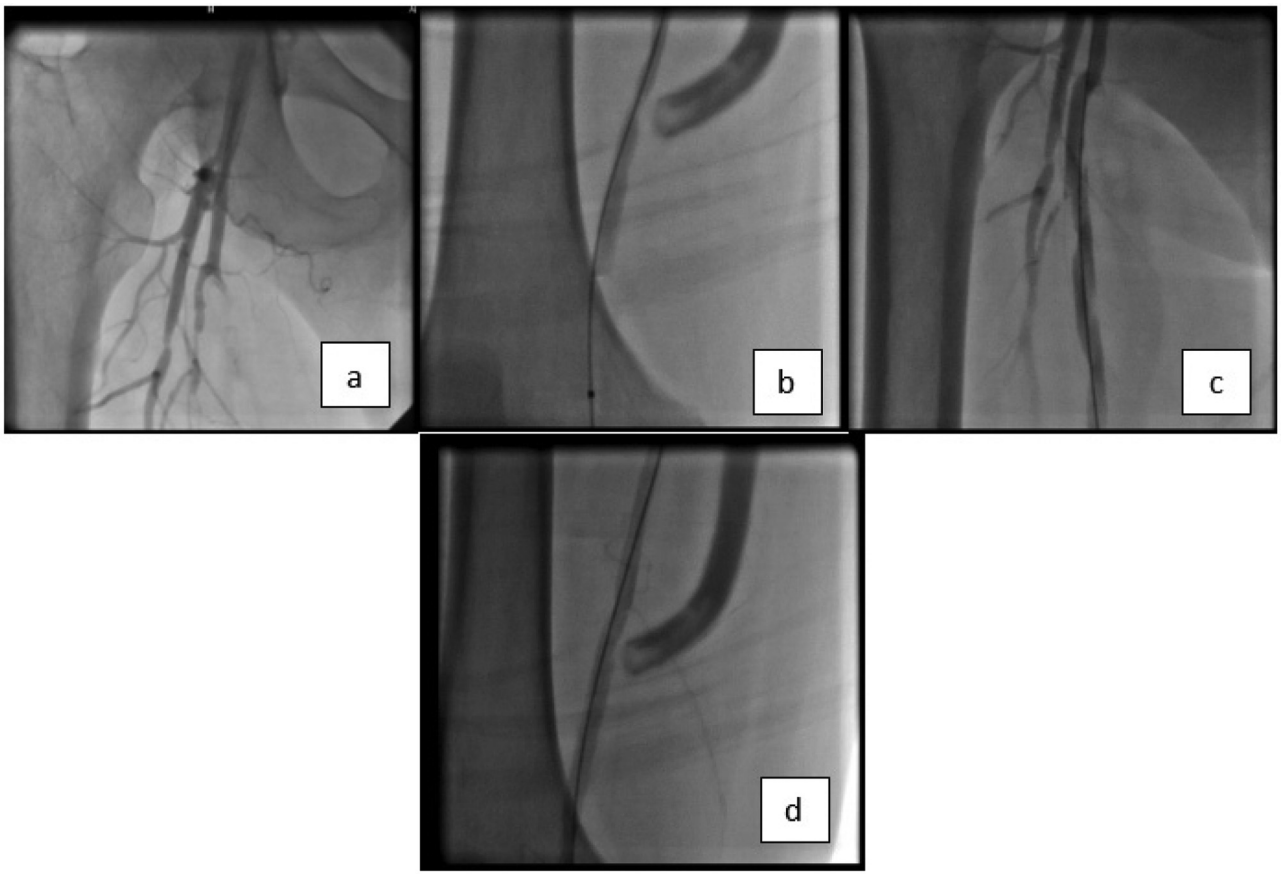
ABI, ankle–brachial index; SFA, superficial femoral artery.

These patients underwent femoropopliteal bypass more than 1 year before the presentation, starting from 18 months till 12 years, with a mean and SD of 59.65±28.99 months. They presented with critical limb-threating ischemia (Rutherford 4, 5, or 6). Preoperative computed tomography angiography was done to assess the access site and the extent of the lesion. Table 2 represents these data.

A total of 33 (97.06%) patients had a single previous bypass, whereas one (2.94%) patient had two previous bypasses (the first bypass was done with reversed saphenous graft, and the second one was done with an ePTFE synthetic graft). The previous bypass was done with reversed saphenous graft in 18 (52.94%) patients, and 16 (47.06%) patients had ePTFE synthetic graft (Fig. 1).

During the procedure, it was difficult to cross the lesion at the pervious anastomotic site, either at the outflow or inflow anastomosis. The procedure took 73.18 ±12.96 min.

**Figure 1**




(a) Totally occluded SFA, (b) balloon dilatation of the popliteal artery, (c) SFA regained patency, (d) popliteal artery regained patency. SFA, superficial femoral artery.

We failed to cross the lesion in two (5.88%) patients, and another patient (2.94%) had acute thrombosis during the procedure, and we added thrombolytic to restore luminal patency. So, we achieved technical success in 31 (91.18%) cases. Stenting was mandatory due to rapid recoil, residual stenosis, or flow-limiting dissection (Fig. 2); this was evident mainly at the anastomotic sites. Table 3 describes the stenting sites.

After the procedure, patients were maintained on double antiplatelet, together with follow-up of improvement of clinical symptoms. Patients with Rutherford class 6 were subjected to surgical debridement 2–3 days after revascularization.

Postprocedural ankle–brachial index (ABI) (mean±SD) was 0.96±0.11, and compared with the preprocedural ABI, it was significantly increased ($P \leq 0.0001$).

Figure 3 shows improvement of clinical symptoms according to Rutherford classification during follow-up at 1-month interval. Duplex ultrasound was done that showed patency of the revascularized vessel in all patients. Only one (3.2%) patient was subjected to below-knee amputation owing to severe foot infection.

During the follow-up period of 3 months, one patient died (70 years old, died from severe pneumonia; he was excluded from the study). Duplex scanning was done for all patients. Six (20%) patients had significant restenosis (>50%) or total occlusion of the superficial femoral artery. Four patients were managed conservatively, whereas the other two (6.67%) patients needed reintervention owing to recurrence of symptoms in the form of rest pain.

Follow-up at 6 months showed seven (23.33%) patients had significant restenosis (>50%) or total occlusion of the superficial femoral artery by duplex ultrasound. Five patients were managed conservatively (patients either did not complain or complained only of intermittent claudication), and two underwent a trial of revascularization; one of them presented with rest pain, and we succeeded in revascularization, and the other presented with forefoot gangrene and infection, where

**Figure 2**


A patient with occluded saphenous vein graft. (a) Totally occluded SFA, (b) distal outflow at second part popliteal artery, (c) recanalization of the SFA with recoil, (d) stenting of proximal SFA, (e) stenting of distal SFA. SFA, superficial femoral artery.

**Table 3 Stenting during revascularization of the native superficial femoral artery**

| | *n* (%) |
|---|---|
| Balloon dilatation only | 11 (35.49) |
| Stenting of proximal SFA | 16 (51.61) |
| Stenting of distal SFA | 2 (6.45) |
| Stenting of proximal and distal SFA | 2 (6.45) |

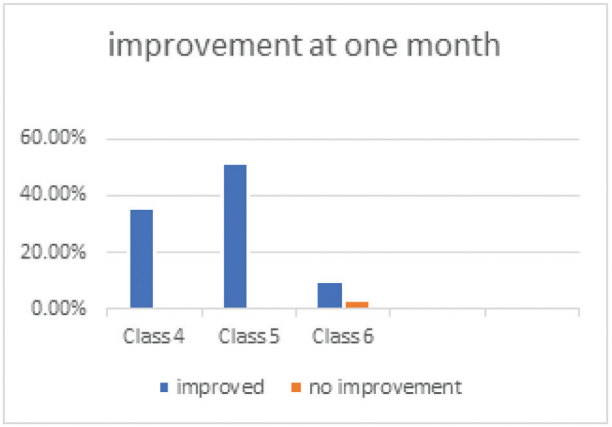
SFA, superficial femoral artery.

we were unable to achieve luminal patency and we ended up with above-knee amputation.

Follow-up at 12 months shows that four (13.33%) more patients showed significant restenosis (>50%) or total occlusion of the superficial femoral artery by duplex ultrasound. Three patients were managed conservatively; only one patient presented with rest pain, and revascularization was done and was successful.

Primary patency rates and limb-salvage rates are shown in Table 4, and a Kaplan–Meier curve shows these results (Fig. 4).

**Figure 3**




Improvement of clinical symptoms at 1 month.

## Discussion

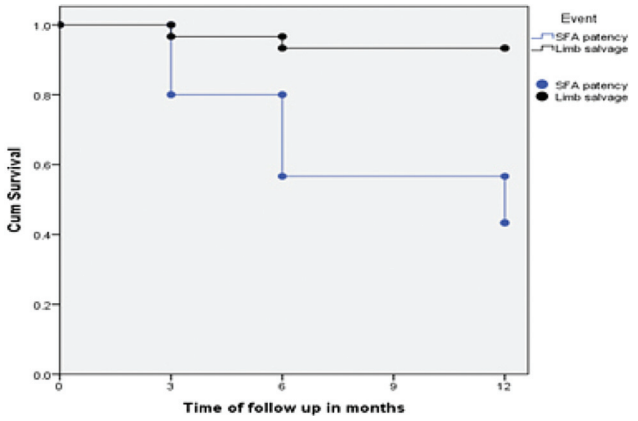
Occluded infrainguinal bypass represents a challenge in treating patients presenting with critical limb ischemia, either owing to no available option for further bypass or unsuitable patients' condition. In our study, we were

**Table 4 Patency rates at 3, 6, and 12 months**

| | Patent SFA during follow up | Percentage | Limb salvage | Percentage |
|---|---|---|---|---|
| 3 months | 24 | 80.00 | 29 | 96.67 |
| 6 months | 17 | 56.67 | 28 | 93.33 |
| 12 months | 13 | 43.33 | 28 | 93.33 |

SFA, superficial femoral artery.

**Figure 4**




A Kaplan–Meier curve showing the patency rate and the limb-salvage rate of more than 12 months.

able to achieve technical success in 91.18% of cases, and stenting was done in 64.51% of cases, which is considered to be higher than the average because of higher rates of recoil or flow-limiting dissections after ballooning, which may be attributed to intimal hyperplasia, especially at anastomotic sites, and the mean time for the procedure was 73.18±12.96 min. The stenting rate and the procedural timing were a little bit higher than the usual from our own experience.

In our study, we referred to stenting if there was rapid recoil, residual stenosis, or flow-limiting dissection. This conformed with the guidelines by Tsetis and Belli [14]. In other randomized studies, primary stenting is the standard practice to guard against restenosis and repeat procedures in mid-term follow-up period [15–17]. However, stenting appears to be controversial according to some meta-analyses [18,19].

In our study, stenting was done in 64.51% of cases, whereas in the study by Raskin *et al.* [20], stenting was done in 14 of 15 limbs.

The mean age of the previous bypass was 59.65±28.99 months in our study. Another study, comparing endovascular revascularization with bypass in management of failed femoropopliteal bypass, had a median age of 7 years (3–11 year) [21]. However, Simosa *et al.* [10] reported a median time of graft failure of 647 days.

We achieved technical success in 91.18% of cases, and limb-salvage rate at 12 months was 93.33%. In the retrospective analysis by Gandini *et al.* [22], technical success was achieved in 93.7%, and limb-salvage rate was 90% at 30 months.

Yin *et al.* [23] reported 92.9 and 91.6% for technical success and limb-salvage rate, respectively.

In the national series by Mehaffey *et al.* [24], they compared performing a bypass with saphenous vein, a bypass with an alternative conduit, and endovascular native vessel revascularization. They found that bypass using a saphenous vein graft have the lower rate of major adverse limb events, but endovascular intervention offers an acceptable choice to patients requiring an alternative conduit [24].

Reopening the native vessel by endovascular means offered clinical improvement as well as significant improvement in ABI. Moreover, there was improvement in the ABI shown with Yin *et al.* [23] (0.78±0.08 vs. 0.31±0.10, $P<0.01$). In the study by Wrigley *et al.* [25], on 19 limbs, there was an increase in ABI from 0.34 to 0.73.

Moreover, the study by Li *et al.* [26] observed significant increase in the ABI (0.3±0.1 before procedure to 0.7±0.1 after procedure; $P<0.01$).

In our study, the patency rates were 80, 56.67, and 43.33% for 3, 6, and 12 months, respectively. The primary patency rate by Wrigley *et al.* [25] was 87, 48, and 16%, for 3, 6, and 12 months, respectively. In another study, the primary patency was 52.2% [23]. As for Li and colleagues, they reported a patency rate of 54 and 51% at 12 and 36 months, respectively.

## Conclusion

Native vessel revascularization is a feasible procedure that can be done safely with acceptable technical success and limb-salvage rate. It represents a good option for patients who are poor candidates for redo-surgery.

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### Conflicts of interest

There are no conflicts of interest.

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