

## TECHNICAL NOTE

# A Novel Hybrid Viabahn-assisted Bypass Technique: Extra-arterial Flossing Wiring for Chronic Total Occlusion in Superficial Femoral Artery

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### WHAT THIS PAPER ADDS

Nowadays, endovascular techniques are used to treat most peripheral arterial occlusive disease. However, re-entry to the true lumen is not always feasible. This report introduces a novel technique that combines the endovascular approach and open surgery to ensure re-entry. The technique has never been established before. The result is promising. The technical successful rate is 100%. This may be a useful alternative treatment for extremely difficult cases.

**Introduction:** A hybrid Viabahn-assisted bypass (VAB) technique is introduced for revascularizing chronic total occlusion (CTO) in superficial femoral artery (SFA) when bypass surgery is difficult or endovascular intervention fails.

**Report:** This technique combines extra-arterial flossing wiring with antegrade-retrograde intervention via traditional open exposure of middle SFA and deploying a Viabahn from the proximal true lumen through the subintimal lumen and extra-arterial space, and back into distal true lumen to restore flow. It only needs a 3–5 cm incision to expose the mid-SFA without clamping or endarterectomy of the SFA.

**Discussion:** This hybrid procedure is an alternative technique to improve SFA revascularization in some difficult CTOs.

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## INTRODUCTION

Bypass surgery is the treatment of choice for a TASC II D lesion in the superficial femoral artery (SFA). However, a poor autologous vein, extensive arterial calcification, and multiple comorbidities may deny the patient such treatment.

Endovascular treatment has recently become an alternative. The most crucial step is to pass the guidewire across the lesion. Since an intraluminal technique is not always feasible, subintimal angioplasty (SIA) has been introduced. However, it still has a 13–24% failure rate for long SFA occlusion.<sup>1</sup> Spinosa et al.<sup>2</sup> introduced subintimal arterial

flossing with antegrade–retrograde intervention (SAFARI) technique. By combining an antegrade and retrograde approach, the success rate is around 90%.<sup>3</sup> Here, a hybrid Viabahn-assisted bypass (VAB) technique is described, which combines localized open surgery and the SAFARI technique for true lumen re-entry in difficult cases.

## SURGICAL TECHNIQUE

Antegrade access is built up first, from either the ipsilateral or the contralateral leg. An intraluminal approach is attempted first, followed by a subintimal approach. If antegrade approach fails, retrograde access can be established using the angiogram for reference. The distal SFA, the popliteal artery, the anterior tibial artery, or the posterior tibial artery can be used for the retrograde access. The peroneal artery is not recommended because of difficult access and hemostasis. The SAFARI technique may be tried, and the VAB technique is used only when the SAFARI technique fails.

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Local anesthesia is usually adequate, but if the patient cannot tolerate intravenous local anesthesia, general anesthesia may be required. With reference to the angiogram and fluoroscopy, a 3–5 cm incision is made just above distal end of the chronic total occlusion (CTO), where the guidewires overlap. The SFA is identified and a longitudinal or oblique arteriotomy is done. The SFA is not transected or clamped as arteriotomy is performed over the CTO region and the risk of bleeding is quite low. Both the antegrade guidewire and the retrograde guidewire are retrieved (Fig. 1A). A supporting catheter is introduced from the antegrade access, and the guidewire from the retrograde access is inserted into the antegrade catheter manually to establish a flossing guidewire (Fig. 1B, C). The retrograde wire is retrieved out from the antegrade access and then repositioned into the distal true lumen under the guidance of fluoroscopy. Pre-dilatation is performed from the antegrade access and the Viabahn is deployed across the incised area (Fig. 1D). Post-dilatation is carried out and restoration of blood flow is confirmed by angiography (Fig. 2). Hemostasis and wound closure are achieved in the conventional way. Post-operative CT angiography showed that the covered stent was outside the native SFA (Fig. 3).

## DISCUSSION

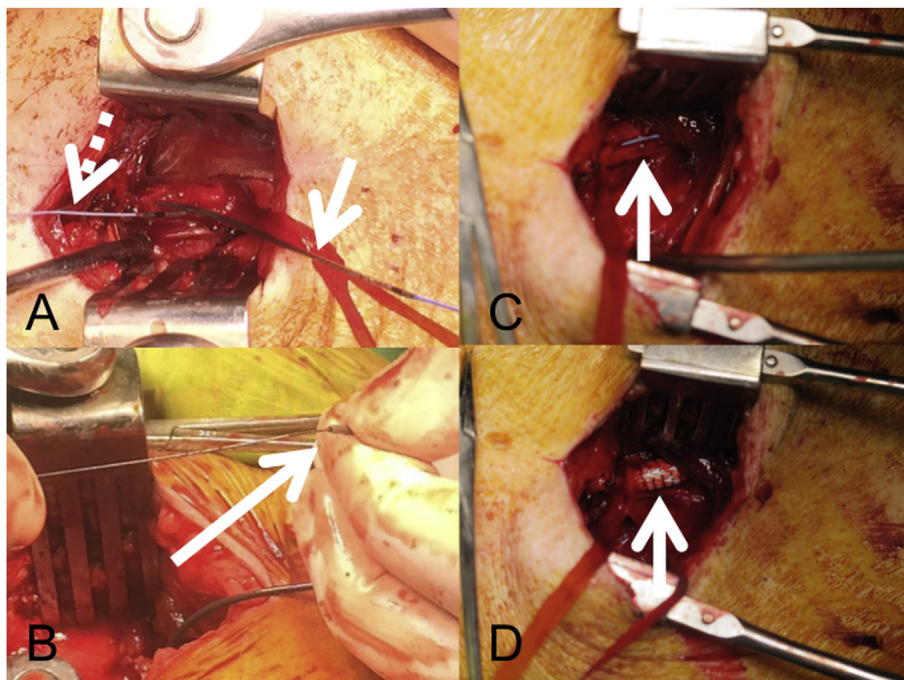
For endovascular treatment of SFA occlusion, the most common cause of failure is the inability to re-enter distal true lumen. It may produce arterial perforation,

arteriovenous fistulae, and disrupt vital collateral vessels, which may result in acute limb ischemia. The VAB technique increases the success rate and does not need a specialized device. Once the two guidewires have been retrieved from the incision, the theoretical successful rate is 100%.

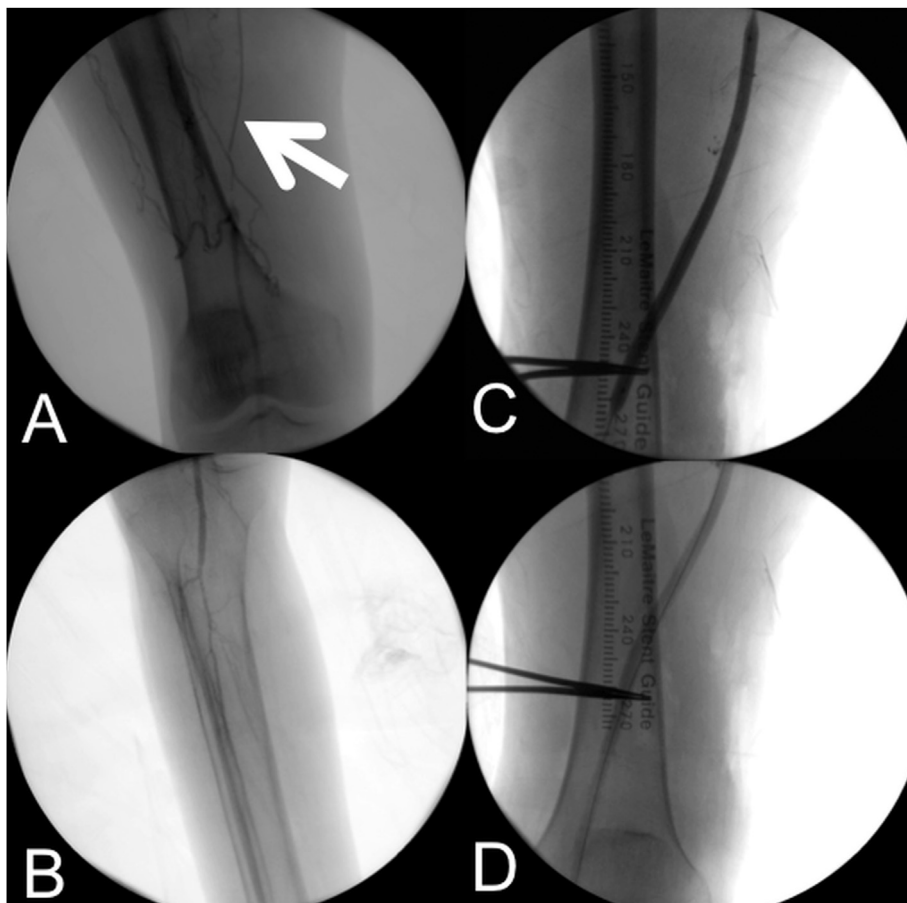
Some specialized devices have been developed for distal re-entry, but unfortunately the re-entry device is not available in every country. Also, they need to be positioned adjacent to the true lumen, which is not always possible, and the subintimal channel could be extended distally. This technique can be performed when the guidewires are stacked in a severe occluded lesion, and can avoid subintimal channel extension.

Some alternative endovascular approaches combining antegrade and retrograde accesses such as the SAFARI technique have been developed. In these techniques, the antegrade and retrograde guidewires need to be overlapped in the same plane of the subintimal space. Our VAB technique can be performed when the two guidewires do not meet at the same space. Through the incision, both guidewires can be retrieved easily, and the procedure can be completed even if the two guidewires are apart initially. This technique has already been performed in seven patients and the technical successful rate was 100%.

Several hybrid techniques have been described. Bonvini et al.<sup>4</sup> introduced the Viabahn Padova Sutureless (ViPS) technique to avoid distal anastomosis. Narayanan et al.<sup>5</sup> described primary suture anastomosis of the Viabahn



**Figure 1.** Viabahn-assisted bypass technique with open SAFARI and covered stent implantation. (A) After a small incision was made and an arteriotomy carried out, the guidewire and supporting catheter from the antegrade and retrograde access were all retrieved. The white arrow depicts the guidewire and supporting catheter retrogradely from distal artery, and the white dotted arrow depicts the guidewire and supporting catheter antegradely from proximal artery. (B) The white arrow shows the retrograde guidewire being inserted into the antegrade catheter manually. (C) The flossing stiff guidewire (white arrow) was established and it crosses the arteriotomy incision. (D) A covered stent (white arrow) was then deployed to cover the lesion, and should be positioned across the arteriotomy. SAFARI = subintimal arterial flossing antegrade and retrograde intervention.

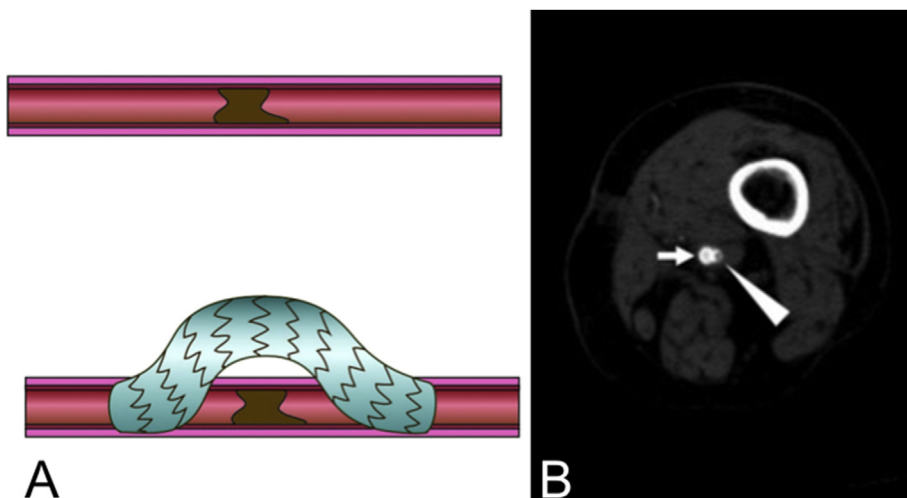


**Figure 2.** Angiography. (A) Pre-operative angiography showing a superficial femoral artery chronic total occlusion. The antegrade wiring (white arrow) could not pass through the lesion. (B) Pre-operative angiography showing acceptable distal runoff. (C) After the Viabahn-assisted bypass technique, post-balloon dilatation was performed. (D) Final angiography showing optimal revascularization.

endoprosthesis for a short proximal landing zone. These techniques do not provide the solution for difficult re-entry as the technique described here does.

There are some limitations of the VAB technique. An incision brings the risk of poor wound healing and wound infection, and the technique is not suitable for patients with

an active ulcer or infection over the planned incision area. The proximal and distal landing zone of the covered stent should be long enough ( $>3$  cm) to prevent the covered stent jumping out, and thus the technique is contraindicated for an inadequate landing zone, for covering important collaterals, and if the popliteal artery is across the



**Figure 3.** (A) Schematic diagram of Viabahn-assisted bypass. (B) A post-procedural CT scan revealed the stent graft (arrow) outside the native superficial femoral artery (arrowhead).

knee. Retrograde access may not be not feasible if the distal runoff is poor. This is, after all, a bailout technique when SAFARI fails and cannot be taken as a regular approach.

### CONCLUSION

True lumen re-entry is crucial for endovascular treatment of SFA CTO. The VAB technique can be used in extremely difficult cases. This technique is not a standard procedure but is a bailout technique after all attempts have failed. More experience and follow up are needed to confirm the adequacy and long-term result.

### CONFLICTS OF INTEREST

None.

### FUNDING

None.

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