

## TECHNICAL NOTE

## Surgical Technique for Deep Venous Reflux Suppression in Femoral Vein Duplication

P. Zamboni<sup>\*</sup>, S. Giancesini

Vascular Diseases Centre, Unit of Translational Surgery, University of Ferrara, Italy

**Background:** Deep venous surgery is a challenging field with limited indications. Femoral vein duplication (FVD) is a frequent anatomical variant (55% prevalence). The aim was to describe a simple technique for managing deep venous reflux in FVD, when just one of the two segments exhibits deep venous reflux.

**Methods:** The technique consists of closing the refluxing femoral branch with a titanium clip. In this way abolition of reflux along the duplicated vessel is achieved, together with the restoration of femoral vein drainage.

**Results:** The technique is feasible and associated with improvement in limb haemodynamics.

**Conclusions:** Thanks to the high prevalence of FVD, the proposed technique provides an opportunity to treat a larger number of cases affected by primary or post-thrombotic deep venous reflux.

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### INTRODUCTION

Contrary to general opinions, femoral vein (FV) duplication is a highly prevalent anatomical variant being present in up to 55% of cases.<sup>1,2</sup>

In primary and post-thrombotic reflux patterns the duplication feeds a closed circuit where an incompetent branch constitutes the leaking point, whereas the second one represents the antegrade draining route. For clarity, the anatomical and haemodynamic network is shown in Fig. 1C, where magnetic resonance venography imaging clearly shows the FV duplication, and Fig. 1A and B shows the associated flow patterns. In clinical practice echo colour Doppler (ECD) assessment permits deep venous reflux to be identified along the accessory femoral vein (AFV), with the leaking point at the vessel bifurcation with the FV (Fig. 2A). In this scenario surgical closure of the leaking point was proposed in order to test the feasibility of the technique, as well as to achieve abolition of deep venous reflux.

### SURGICAL TECHNIQUE

The technique was initially tested on five patients, aged  $59 \pm 4$  years: three males and two females. They all gave an informed consent. Surgery was indicated when a non-healing venous leg ulcer had been present more than 6

months (mean ulcer onset  $9 \pm 2$  months). Three patients had ulcerations from post thrombotic syndrome and were classified according to CEAP as C6EsAdPr, whereas two patients had skin lesion from a combination of superficial and deep primary reflux, and were graded in CEAP C6EpAs-dPr.

The patient lies supine with the leg flexed at the knee and in abduction (frog-legged), in order to facilitate access to the medial aspect of the thigh.

Under local anaesthesia and after accurate pre-operative echo guided mapping, a longitudinal incision was performed along the medial aspect of the upper thigh over the anterior border of the sartorius muscle and dissection between the sartorius and the medial edge of the vastus medialis was performed to expose the FV, AFV, and superficial femoral artery. The vessels were isolated and controlled, mobilising the superficial femoral artery in order to obtain better exposure of the femoral venous bifurcation. A titanium clip (large size) was applied flush on the confluence between the AFV and the FV (Fig. 3).

The dissection layers were closed by running 3-0 absorbable sutures, and the skin by a subcuticular 4-0 absorbable monofilament.

Neither antibiotics nor low molecular weight heparin (LMWH) prophylaxis are considered mandatory. In post-thrombotic cases, oral anticoagulants are continued after 1 week of LMWH.

### Post-operative outcomes

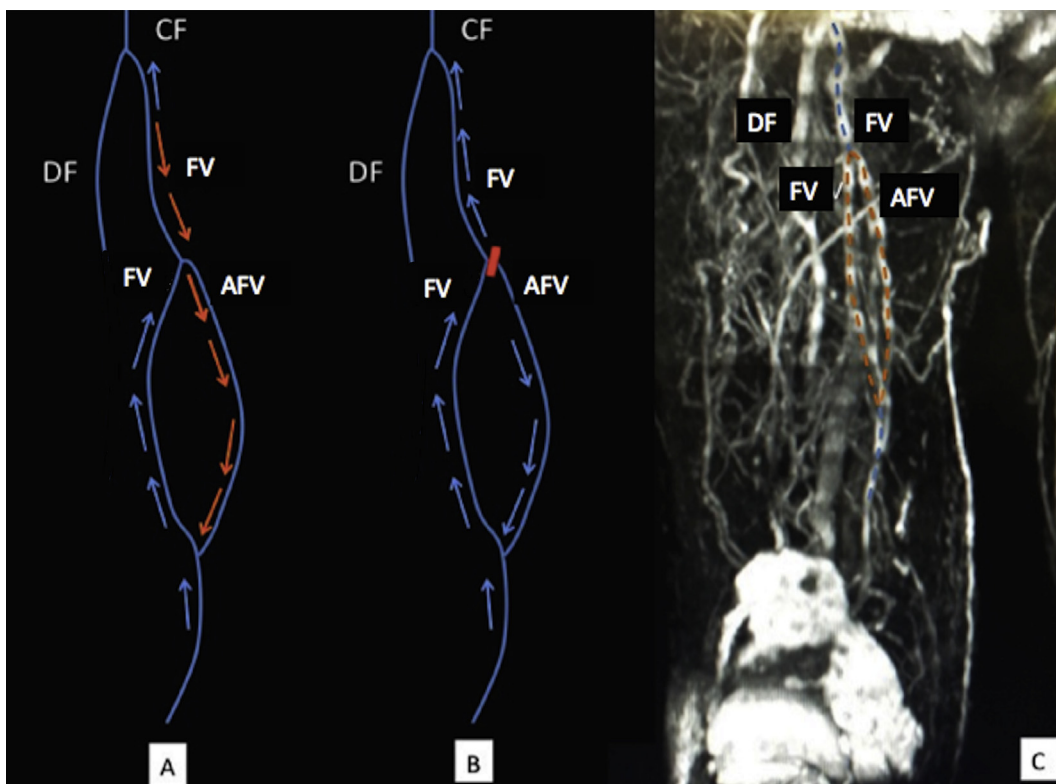
Immediately after the procedure, the ECD scan revealed resolution of the previous reflux in the entire iliac-femoral

<sup>\*</sup> Corresponding author. Via Aldo Moro 8, Cona, 44100 Ferrara, Italy.

E-mail address: [paolozamboni@icloud.com](mailto:paolozamboni@icloud.com) (P. Zamboni).

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**Figure 1.** (A) Reflux pattern involving the femoral vein (FV) and the accessory femoral vein (AFV) in a closed circuit. (B) Titanium clip application to close the leaking point at the confluence of the AFV and FV with consequent resolution of reflux above the leaking point. The AFV flow is directed downwards without blood coming from the areas above, and subsequently drains upwards through the competent FV. (C) Pre-operative magnetic resonance venography shows the duplication of the FV and the area of the closed circuit (orange dotted line). DF = deep femoral vein; CF = common femoral vein.

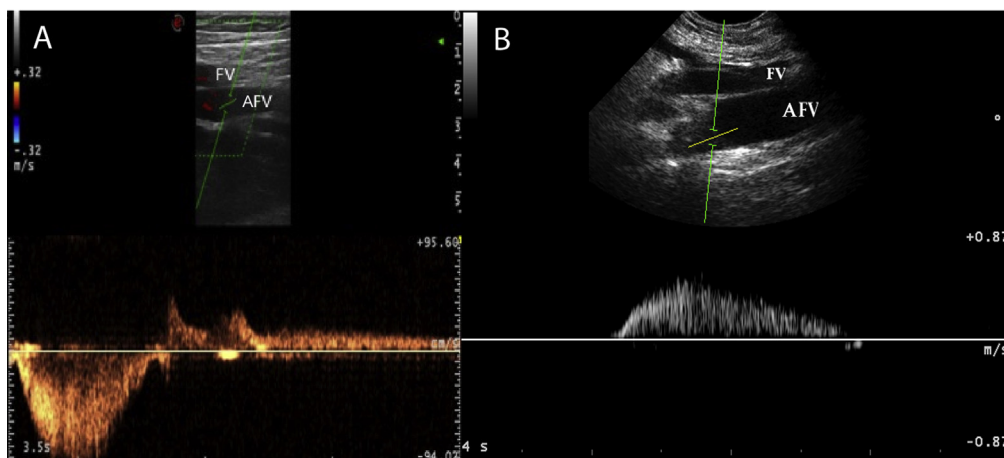
segment, as a consequence of the interruption of the incompetent hydrostatic column. Moreover, the ECD investigation of the AFV below the interruption demonstrated typical retrograde but not refluxing drainage towards the re-entry site and competent FV (Fig. 2B).

Air plethysmography (APG) was performed in three of the five cases, demonstrating an improvement in venous haemodynamics.

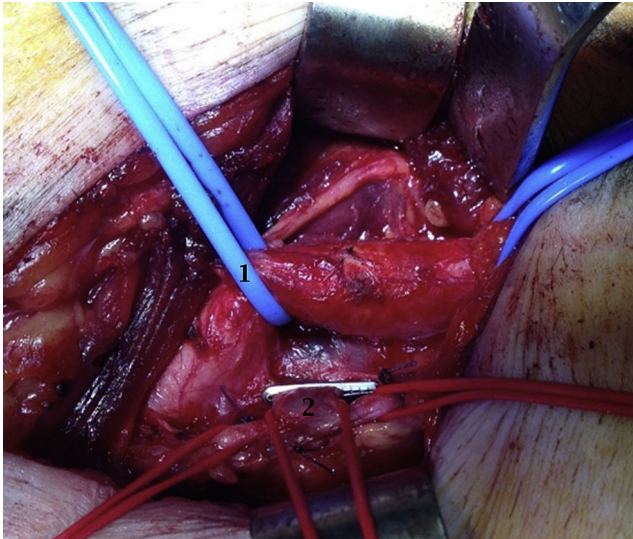
The treatment proposed here led to a significant improvement in venous refilling time, venous volume, and residual volume fraction. The ejection fraction remained unchanged.

Neither major nor minor complications were reported in any of the five cases.

At 1 year follow up, clinical evaluation together with an ECD assessment was performed in all five patients. The



**Figure 2.** (A) Deep venous reflux along the femoral vein (FV), with the leaking point at the vessel bifurcation. (B) A shorter mono-directional downward flow along the AFV (accessory femoral vein) is recorded post-operatively. The change with respect to the bi-directional, high velocity and longest reflux wave shown in A is very clear.



**Figure 3.** 1. Superficial femoral artery mobilized for better venous exposure. 2. Titanium clip applied at the confluence between the accessory femoral and femoral veins.

venous clinical severity score (VCSS) decreased from  $20.4 \pm 1.3$  to  $10.2 \pm 2.6$  ( $p < .0004$ ). Three cases had complete ulcer healing, whereas the other two reduced their size by more than 50%. ECD evaluation continued to demonstrate the reflux suppression.

## DISCUSSION

The frequent presence of duplicated deep venous segments creates the anatomical conditions for the abolition of reflux that originates from closed circuits.<sup>1,2</sup> About 45% of cases of deep venous thrombosis lead to reflux involving the femoro-popliteal segment.<sup>3,4</sup> Since the femoral segment is duplicated approximately half the time, it is potentially available for the selective treatment described here. The lower limb deep venous system constitutes one of the most fascinating but challenging topics in vascular surgery. Nowadays, therapeutic options such as valvuloplasty, transpositions and translocations are used in a limited number of cases and only in highly specialized centres.<sup>5–7</sup>

A simple technique has been presented whose feasibility and performance allow a potential widening of the indications for surgery, thanks to both the frequency of venous duplication and the feasibility of the operation.

As was demonstrated for haemodynamic restoration during superficial venous insufficiency, the abolition of the leaking point transforms a bi-directional high-energy reflux wave into a mono-directional downward draining flow.<sup>8–10</sup> In addition, as previously reported, the flush interruption of a closed refluxing circuit improves venous haemodynamics.<sup>8,9</sup> As demonstrated here by air plethysmography, analogous haemodynamic improvement also follows in the deep venous system.

An active muscle pump action is required to generate the post-operative retrograde draining flow. For this reason, the procedure is only suggested for patients with severe deep

reflux affecting ulcer healing, who are not bedridden, and who have previously failed with conservative measures.

## CONCLUSION

This surgical note paves the way for further clinical trials with an adequate study population. Confirmation of these data might broaden the scope of the vascular surgeon and, hopefully, improve the outcome of a disabling disease that is still not effectively treatable.

In perspective, it could offer the basis for future investigations to be addressed to identify innovative endovascular/percutaneous techniques based on the strategy proposed here.

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## CONFLICT OF INTEREST

None.

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