ORIGINAL ARTICLE

ENDOVENOUS TREATMENT OF SUPERFICIAL CHRONIC VENOUS DISEASE IN A STRICT AMBULATORY SETTING: A SINGLE-CENTER EXPERIENCE

Luís Loureiro*[1,2,3,4], Paulo Almeida[1,2,4]

[1] Angiology and Vascular Surgery, SAMS–SBN, Porto, Portugal
[2] Angiology and Vascular Surgery, ULS Santo António, Porto, Portugal
[3] ICBAS – School of Medicine and Biomedical Sciences, Universidade do Porto, Portugal
[4] Grupo de Estudos Vasculares, Porto, Portugal

* **Corresponding author:** luis.loureiro@sbn.pt

Abstract

Introduction: *Minimally invasive endovenous techniques have become central to the treatment of superficial chronic venous disease (CVD) of the lower limbs. Their ability to avoid general or locoregional anaesthesia allows treatment to be performed in an outpatient setting.*

Objective: *To evaluate clinical and duplex ultrasound outcomes of endovenous treatment of superficial CVD performed exclusively in a strict ambulatory setting.*

Methods: *A retrospective observational study was conducted, including patients treated for superficial CVD between January 2017 and March 2019. Treatments modalities included radiofrequency ablation, catheter-directed foam sclerotherapy, and ultrasound-guided foam sclerotherapy by direct puncture. Clinical status was assessed using the CEAP classification. Duplex ultrasound follow-up was performed according to the institutional follow-up protocol.*

Results: *Ninety-seven patients were included, with a mean age of 67 years and predominance of CEAP C2–C3 disease (86%). Axial reflux was treated by radiofrequency ablation in 78% of patients and catheter-directed foam sclerotherapy in 22%. At 12 months, 95% of treated saphenous segments were completely occluded, with a recanalization rate of 2.5%. CEAP reassessment at 12 months was available for 84 patients, of whom 87% were classified as CEAP C0–C1. All patients initially classified as CEAP C5 or C6 were lost to follow-up before the 12-month assessment. All procedures were performed on an outpatient basis, with same-day discharge.*

Conclusions: *Endovenous treatment of superficial chronic venous disease in a strict ambulatory setting was feasible and associated with high anatomical success at 12 months. Clinical follow-up findings were favorable among the assessed patients, but should be interpreted in light of the loss to follow-up among patients with more advanced baseline CEAP classes*

Keywords: *Chronic venous disease; Varicose veins; Endovenous treatment; Radiofrequency ablation; Foam sclerotherapy; Ambulatory surgery.*

INTRODUCTION

Chronic venous disease (CVD) of the lower limbs is a highly prevalent condition associated with significant morbidity, impaired quality of life, and substantial healthcare costs. The therapeutic goals in the management of superficial venous reflux include symptom relief, durable elimination of reflux, prevention of disease progression, and minimization of treatment-related morbidity. Over the last two decades, the treatment paradigm has progressively shifted from conventional surgery toward minimally invasive endovenous techniques.

Endovenous thermal ablation, particularly radiofrequency ablation (RFA) and endovenous laser ablation (EVLA), has demonstrated high occlusion rates, low complication rates, and faster recovery compared with high ligation and stripping, establishing these techniques as first-line therapy for axial saphenous reflux in current international guidelines[1–3]. In parallel, ultrasound-guided foam sclerotherapy (UGFS), including catheter-directed techniques, has emerged as a valuable alternative or adjunctive strategy,

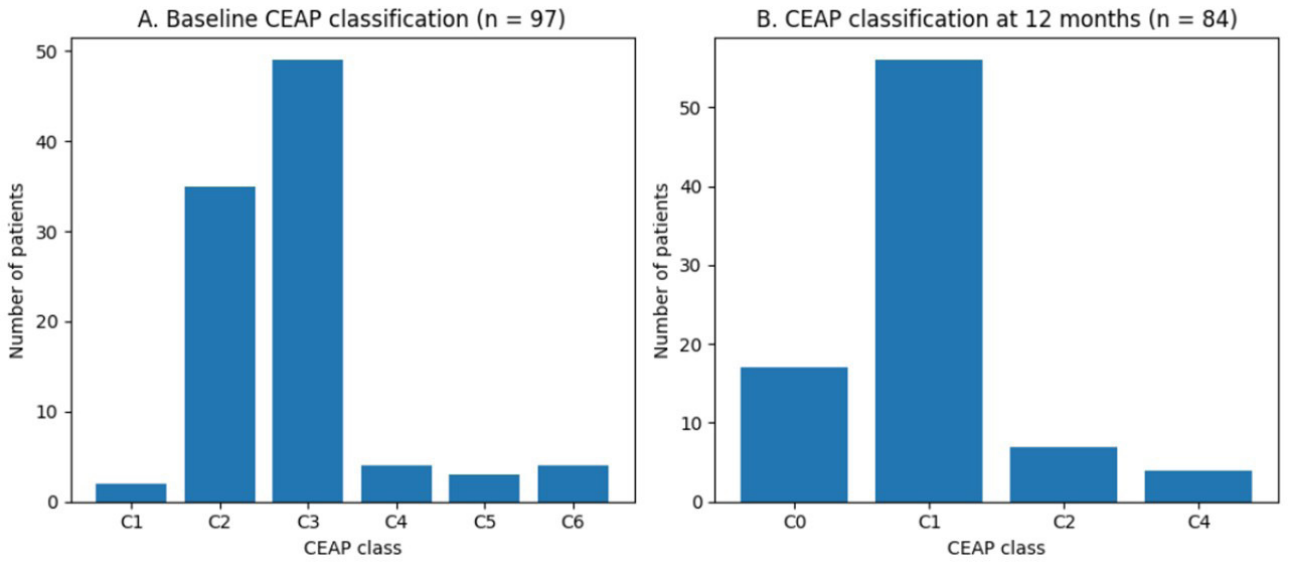

Figure 1 *CEAP clinical classification at baseline and at 12-month follow-up.*

particularly in selected anatomical scenarios or in patients unsuitable for thermal ablation [1,4–6].

A major advantage of these techniques is the ability to perform treatment without general or locoregional anesthesia, allowing procedures to be safely conducted in an outpatient or ambulatory setting. This model of care has been associated with reduced hospital resource utilization, shorter recovery times, and high patient satisfaction without compromising clinical or anatomical outcomes [7–9]. Consequently, ambulatory management of superficial CVD is increasingly regarded as the standard of care in experienced centers.

Despite robust evidence supporting the efficacy of endovenous therapies, real-world data describing comprehensive treatment strategies combining axial reflux correction with adjunctive treatment of tributaries or perforators performed entirely in a strict ambulatory setting remain limited. Furthermore, outcomes in patients treated outside standard device instructions for use—such as those with larger vein diameters or reduced vein-to-skin distance—remain underreported.

The present study reports a single-center experience in the treatment of superficial chronic venous disease of the lower limbs performed exclusively in a strict ambulatory setting using radiofrequency ablation, catheter-directed foam sclerotherapy, and ultrasound-guided foam sclerotherapy via direct puncture. Clinical and duplex ultrasound outcomes at 3, 6, and 12 months were analyzed, with particular emphasis on anatomical success, CEAP clinical class distribution, and the feasibility of this treatment model.

METHODS

Study Design and Population

A retrospective observational study was conducted including all patients with superficial chronic venous disease (CVD) of the lower limbs treated in a strict ambulatory setting between January 2017 and March 2019. All procedures were performed in a dedicated minor surgery operating room by vascular surgeons experienced in endovenous techniques.

The study population consisted of beneficiaries of a freely accessible healthcare subsystem, with treatment initiated at the patient's request. No inpatient admission was required for any procedure, and all treatments were performed on an outpatient basis with same-day discharge.

Inclusion and Exclusion Criteria

All adult patients undergoing treatment for superficial venous reflux of the lower limbs using endovenous techniques were eligible for inclusion. Treatment modalities included radiofrequency ablation (RFA), catheter-directed foam sclerotherapy (CDFS), and ultrasound-guided foam sclerotherapy (UGFS) via direct puncture.

Patients with deep venous obstruction, acute deep vein thrombosis, or incomplete procedural or follow-up data were excluded from the analysis.

Preoperative Assessment

All patients underwent a standardized preoperative assessment including clinical evaluation and duplex ultrasound examination. Disease severity was classified according to the Clinical–Etiological–Anatomical–Pathophysiological (CEAP)

classification. Symptoms including limb edema, heaviness, fatigue, and the presence of varicose veins were recorded.

Venous duplex ultrasound was used to identify reflux within the superficial venous system and to define the anatomical segments to be treated. Preoperative and follow-up duplex ultrasound examinations were performed by the same vascular surgeon according to the institutional assessment and follow-up protocol for superficial venous disease.

Definition of Venous Segments

Treated saphenous segments were classified as follows: great saphenous vein (GSV), when the saphenofemoral junction was patent; trunk of the great saphenous vein (TGSV), when the saphenofemoral junction had previously been ligated; small saphenous vein (SSV), when the saphenopopliteal junction was patent; and trunk of the small saphenous vein (TSSV), when the saphenopopliteal junction had previously been ligated.

TREATMENT TECHNIQUES

Radiofrequency Ablation

Endovenous thermal ablation of axial reflux was performed using the ClosureFast™ system (Medtronic, Minneapolis, MN, USA). Procedures were conducted according to the manufacturer's instructions for use in the majority of cases. Selected patients were treated outside standard indications, namely in cases with a vein diameter greater than 12 mm or a vein-to-skin distance less than 1 cm, based on clinical judgment. All RFA procedures were performed under ultrasound guidance, with perivenous tumescent anesthesia. No general or locoregional anesthesia was used.

Catheter-Directed Foam Sclerotherapy

Catheter-directed foam sclerotherapy was performed using a straight 5 Fr multiperforated catheter. Polidocanol foam at 2% was administered. Foam was prepared using the Tessari method, with a 3:1 ratio of ambient air to liquid sclerosant.

Ultrasound-Guided Foam Sclerotherapy by Direct Puncture

UGFS by direct puncture was used for the treatment of incompetent tributaries, truncal varices, reticular veins, or perforator veins. Polidocanol at 1% or 0.5% was selected based on the diameter of the treated veins. Adjunctive UGFS was performed in subsequent sessions following axial reflux treatment when clinically indicated.

Follow-up and Outcome Assessment

Clinical and duplex ultrasound assessments at 3-6 months and 12 months were the standard institutional follow-up protocol for patients undergoing endovenous treatment of superficial venous disease during the study period.

Anatomical outcomes were classified as total occlusion, partial occlusion, or recanalization. Clinical outcomes were assessed using the CEAP clinical classification at follow-up visits. Patients lost to follow-up were recorded, and available data were analyzed up to the last documented visit.

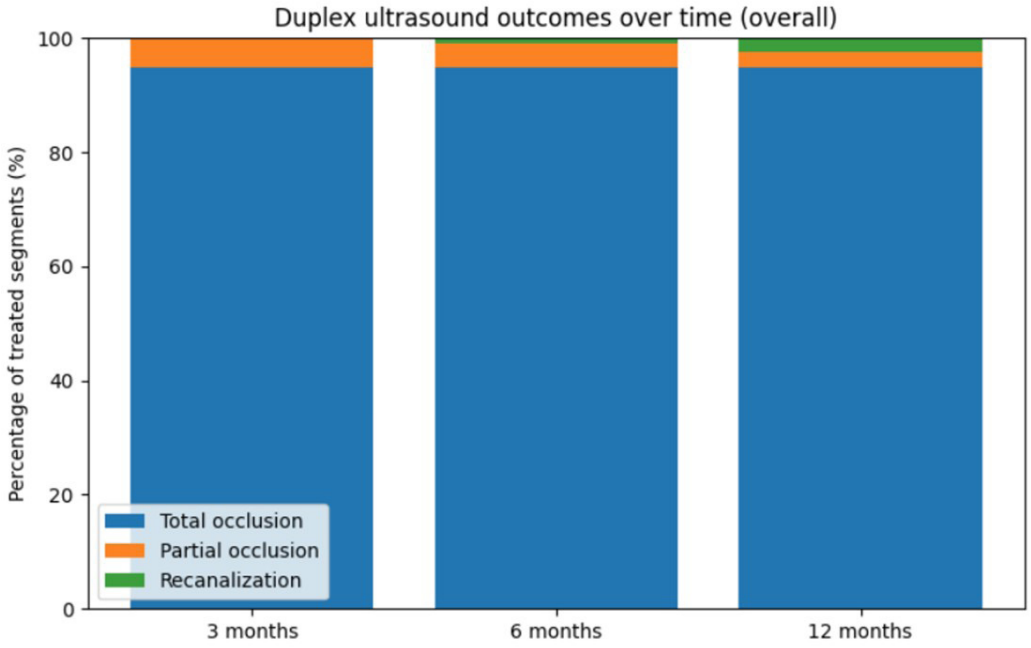

Figure 2 *Stacked bar chart of duplex ultrasound outcomes over time.*

Study Endpoints

The primary endpoint was anatomical success, defined as complete occlusion of the treated saphenous segment on duplex ultrasound at 12 months.

Secondary endpoints included partial occlusion and recanalization rates, CEAP clinical class distribution at follow-up, and the feasibility of performing all procedures in a strict ambulatory setting.

Statistical Analysis

Statistical analysis was performed using descriptive methods. Continuous variables were expressed as mean and range, while categorical variables were reported as absolute numbers and percentages.

Clinical variables were analyzed at the patient level, whereas anatomical outcomes were analyzed at the treated venous segment level, as some patients underwent treatment of multiple venous segments.

Overall anatomical outcomes on duplex ultrasound, including total occlusion, partial occlusion, and recanalization, were analyzed during follow-up and presented as proportions of all treated venous segments. Segment-specific subgroup analysis was available for radiofrequency-treated segments. However, consistent segment-specific follow-up data for catheter-directed foam sclerotherapy were not available in a sufficiently reliable manner to allow separate subgroup analysis.

No formal hypothesis testing or inferential statistical analysis was performed, given the study's retrospective and descriptive nature. Patients lost to follow-up were excluded from time-point-specific analyses, and results were analyzed using available-case analysis.

All data were anonymized prior to analysis.

Table 1 **Baseline demographic characteristics, comorbidities, previous venous surgery, and CEAP clinical classification of the study population**

Variable	n (%)
Sex	
Male	29 (29.9)
Female	68 (70.1)
Age (years)	
Mean (range)	67 (37-85)
Comorbidities	
Hypertension	46 (47.4)
Dyslipidemia	40 (41.2)
Smoking	6 (6.2)
Diabetes mellitus	8 (8.2)
Previous venous surgery	
None	58 (59.8)
One previous procedure	29 (29.9)
Two previous procedures	8 (8.2)
Three previous procedures	2 (2.1)
Baseline CEAP clinical class	
C1	2 (2.1)
C2	35 (36.1)
C3	49 (50.5)
C4	4(4.1)
C5	3 (3.1)
C6	4 (4.1)

RESULTS

Study Population and Baseline Characteristics

A total of 97 patients were treated in a strict ambulatory setting during the study period. The male-to-female ratio was 3:7, corresponding to 29 men and 68 women, with a mean age of 67 years (range 37–85). Hypertension and dyslipidemia were the most frequent comorbidities, present in 47% and 41% of patients, respectively. Smoking and diabetes mellitus were less common, occurring in 6% and 8% of patients, respectively.

Regarding prior venous interventions, 60% of patients had no history of venous surgery, while 30%, 8%, and 2% had undergone one, two, or three prior procedures, respectively. At baseline, clinical severity was predominantly CEAP C2–C3, accounting for 86% of the cohort. The most common presenting symptoms were edema (66%), calf fatigue or heaviness (60%), and truncal varicose veins (65%). Table 1 summarizes baseline demographic characteristics, comorbidities, prior venous surgery, and baseline CEAP clinical classification.

Procedural Strategy and Treated Segments

Axial reflux was treated using radiofrequency ablation (RFA) in 76 patients (78%) and catheter-directed foam sclerotherapy (CDFS) in 21 patients (22%).

A total of 142 saphenous segments were treated: 113 with RFA and 29 with CDFS. Following axial reflux correction, 29 patients (30%) underwent adjunctive ultrasound-guided foam sclerotherapy by direct puncture in subsequent sessions to treat residual truncal or tributary varices, reticular veins, or incompetent perforators. Table 2 summarizes treatment modalities and treated saphenous vein segments.

Follow-up Completeness

During the 12-month follow-up period, 13 patients (13%) were lost to follow-up. CEAP reassessment at 12 months was available for 84 patients. All patients initially classified as CEAP C5 (n=3) or C6 (n=4) were lost to follow-up and therefore not available for clinical reassessment at 12 months.

Duplex Ultrasound Outcomes

Overall, duplex ultrasound outcomes included all treated saphenous segments, regardless of treatment modality. Complete occlusion was observed in 95% of treated segments at the first follow-up assessment, with 5% showing partial occlusion. At the second follow-up assessment, 95% of segments remained completely occluded, 4% were

partially occluded, and 1% had recanalized. At 12 months, 95% of treated segments were completely occluded, 2.5% were partially occluded, and 2.5% were recanalized. Figure 2 illustrates duplex ultrasound outcomes over time.

Detailed segment-level anatomical outcomes were available for the RFA subgroup. Consistent segment-specific follow-up data for the CDFS subgroup were not available with sufficient reliability to permit separate subgroup analysis.

Clinical Outcomes

Among the 84 patients available for clinical assessment at 12 months, the CEAP clinical class distribution was as follows: C0, 20%; C1, 67%; C2, 8%; and C4, 4%. Overall, 87% of assessed patients were classified as CEAP C0–C1 at the final follow-up visit. Interpretation of these results should consider that all patients initially classified as CEAP C5 or C6 were lost to follow-up before the 12-month assessment. Figure 1 shows CEAP clinical classification at baseline and at 12 months.

Segment-Level Outcomes in the RFA Subgroup

Among patients treated with RFA for axial reflux, the treated venous segments included GSV, TGSV, SSV, and TSSV. At 12 months, GSV and TGSV showed 100% occlusion, while SSV showed 92% occlusion. TSSV-treated segments were not available for 12-month analysis due to loss to follow-up.

DISCUSSION

The present study demonstrates that treatment of superficial chronic venous disease (CVD) of the lower limbs can be performed in a strict ambulatory setting using endovenous techniques, with high anatomical success at 12 months. These findings support the feasibility of this model of care in appropriately selected patients and reflect real-world vascular practice in an outpatient environment.

Endovenous thermal ablation has become the first-line treatment for axial saphenous reflux, with reported occlusion rates consistently exceeding 90% in randomized trials and real-world series [1–3,10,12]. The overall 95% complete occlusion rate at 12 months observed in the present cohort is consistent with this evidence. Importantly, no relevant deterioration in anatomical outcomes was observed between early and 12-month follow-up, suggesting durable reflux control in the treated segments.

Catheter-directed foam sclerotherapy accounted for a significant proportion of axial reflux treatments in this series, reflecting its role as an alternative in selected anatomical scenarios or patient profiles. Current guidelines recognize ultrasound-guided foam sclerotherapy as an effective treatment option, particularly when thermal ablation is not feasible or contraindicated [1,5]. In this cohort, overall duplex ultrasound outcomes included all treated saphenous segments, including those treated with catheter-directed foam sclerotherapy. However, separate segment-specific analysis for the CDFS subgroup was not possible due to incomplete retrospective recording of subgroup-specific follow-up data, which should be considered when interpreting the anatomical results.

A notable finding of this study is the excellent performance of radiofrequency ablation in the great saphenous vein (GSV) and in previously ligated great saphenous trunks, with 100% occlusion at 12 months. Small saphenous vein (SSV) treatment showed a slightly lower occlusion rate, consistent with previously published data and likely reflecting anatomical variability and technical challenges inherent to this segment [11].

Among patients available for clinical follow-up, 87% were classified as CEAP C0–C1 at 12 months. This finding suggests a favorable clinical profile among patients who completed follow-up. However, interpretation of the final CEAP distribution should take into account that all patients initially classified as CEAP C5 or C6 were lost to follow-up before the 12-month assessment, which may have influenced the observed clinical distribution. Therefore, the 12-month CEAP data should be considered descriptive rather than a definitive measure of clinical improvement across the entire baseline cohort.

The strict ambulatory model adopted in this study deserves particular attention. All procedures were performed without general or locoregional anesthesia, with same-day discharge in all cases. This approach aligns with contemporary recommendations advocating outpatient management of CVD to reduce healthcare resource use, shorten recovery time, and improve patient experience [7,9]. The absence of hospital admission did not compromise anatomical outcomes, reinforcing the feasibility of this model in experienced hands.

The relatively advanced age of the cohort likely reflects the demographic profile of the institution's population rather than deliberate selection of elderly or comorbid patients for endovenous treatment. No institutional preselection favouring endovenous treatment in older or more comorbid patients was applied. All patients with suitable venous anatomy were

Table 2 **Treatment modalities and treated saphenous vein segments**

Variable	n%
Axial reflux treatment (patients)	
Radiofrequency ablation (RFA)	76 (78.4)
Catheter-directed foam sclerotherapy (CDFS)	21 (21.6)
Treated saphenous vein segments (total)	
Total number of segments	142 (100)
Segments treated by technique	
Radiofrequency ablation	113 (79.6)
Catheter-directed foam sclerotherapy	29 (20.4)
Adjunctive treatment	
Ultrasound-guided foam sclerotherapy by direct puncture*	29 (29.9)

*Performed in subsequent sessions after axial reflux treatment.

considered candidates for ambulatory endovenous treatment.

Another relevant aspect is the inclusion of selected patients treated outside standard device instructions for use, such as cases with larger vein diameters or reduced vein-to-skin distance. Although such cases were not analyzed separately, the overall outcomes suggest that careful patient selection and technical expertise may allow safe extension of indications. Nevertheless, these observations should be interpreted with caution, as the study was not designed to compare outcomes by anatomical characteristics or adherence to device instructions for use.

This study has limitations inherent to its retrospective and observational design. There was no control group, and no formal quality-of-life instruments were applied. A proportion of patients were lost to follow-up at 12 months, including all patients initially classified as CEAP C5 or C6, limiting interpretation of clinical outcomes. In addition, although overall anatomical outcomes included all treated saphenous segments, separate segment-specific analysis for the CDFS subgroup was not possible because subgroup-specific follow-up data were not fully recorded retrospectively. Finally, the study reports a single-center experience and may not be generalizable to all practice settings. Nevertheless, the standardized follow-up protocol, use of duplex ultrasound assessment, and strictly ambulatory setting strengthen the practical relevance of the findings.

CONCLUSION

Endovenous treatment of superficial chronic venous disease of the lower limbs can be performed in a strict ambulatory setting with high anatomical success at 12 months. Radiofrequency ablation and foam sclerotherapy, used as part of a comprehensive endovenous strategy, provided durable occlusion of treated saphenous segments in this single-center experience.

Among patients available for follow-up, the 12-month CEAP distribution was favorable; however, clinical interpretation should account for loss to follow-up, particularly among patients initially classified as CEAP C5 or C6. These results support the feasibility of ambulatory-based endovenous management of chronic venous disease in centres with appropriate expertise.

Funding

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Conflicts of Interest

The authors declare no conflicts of interest related to this work.

Ethical Approval

The study was conducted in accordance with the principles of the Declaration of Helsinki. Given its retrospective and observational nature, formal informed consent for study participation was waived. All patient data were anonymized prior to analysis.

Data Availability

All data supporting the findings of this study are included in the article.

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