



Original

A prospective comparative analysis of cyanoacrylate sealing and radiofrequency thermal ablation for the treatment of internal saphenous vein insufficiency: evaluation of clinical outcomes and quality of life

Análisis prospectivo comparativo entre el sellado con cianoacrilato y la termoablación con radiofrecuencia como tratamiento de la insuficiencia de vena safena interna: evaluación de resultados clínicos y de calidad de vida

Cristina Martínez Ingelmo, Marina Navarro Garre, Laura Romero Vázquez, Felipe Neri Arribas Aguilar, Manuel Rodríguez Piñero

Department of Angiology, Vascular and Endovascular Surgery. Hospital Universitario Puerta del Mar. Cádiz, Spain

Abstract

Introduction: minimally invasive endovenous techniques have progressively replaced conventional surgery in the treatment of great saphenous vein (GSV) incompetence.

Objective: to compare the efficacy and safety of cyanoacrylate closure (CAC) vs radiofrequency ablation (RFA) for GSV incompetence, with a focus on patient-reported quality of life.

Methods: prospective comparative study including 45 patients treated between June and October 2024: 30 with CAC (VenaSeal™) and 15 with RFA (ClosureFast™). Clinical, ultrasonographic, and quality-of-life variables (VEINES-QOL/Sym, EUROQOL-5D) were recorded at baseline and 3 months after intervention.

Results: both groups were comparable in age, BMI, and CEAP classification. No major complications or saphenous nerve injury were observed. Closure rates were high and similar between groups. Statistically significant improvements in common symptoms and quality of life were observed in both groups, with no significant differences between techniques.

Conclusions: Both CAC and RFA are safe and effective techniques, with comparable short-term clinical and quality-of-life outcomes. CAC appears to be a valid, less invasive alternative in selected patients.

Keywords:

Chronic venous insufficiency.
Cyanoacrylate.
Radiofrequency.
Quality of life.

Received: 09/01/2025 • Accepted: 12/11/2025

Conflicts of interest the authors declare no conflicts of interest.

Artificial intelligence: the authors declare that no artificial intelligence (AI) or AI-based tools were used in the preparation of this manuscript.

Martínez Ingelmo C, Navarro Garre M, Romero Vázquez L, Arribas Aguilar FN, Rodríguez Piñero M. A prospective comparative analysis of cyanoacrylate sealing and radiofrequency thermal ablation for the treatment of internal saphenous vein insufficiency: evaluation of clinical outcomes and quality of life. *Angiología* 2026;78(3):114-119

DOI: 10.20960/angiologia.00821

Correspondence:

Cristina Martínez Ingelmo. Department of Angiology, Vascular and Endovascular Surgery. Hospital Universitario Puerta del Mar. Avda. Ana de Viya, 21. 11009 Cádiz, Spain
e-mail: cristina.martinezilc@gmail.com

Resumen

Introducción: las técnicas endovenosas mínimamente invasivas han sustituido progresivamente a la cirugía convencional en el tratamiento de la insuficiencia de la vena safena interna (VSI).

Objetivo: comparar la eficacia y la seguridad del cianoacrilato (CAC) frente a la radiofrecuencia (RFA) en el tratamiento de la insuficiencia de VSI, con énfasis en la calidad de vida percibida por los pacientes.

Métodos: estudio prospectivo comparativo en 45 pacientes con insuficiencia venosa crónica tratados entre junio y octubre de 2024: 30 con CAC (VenaSeal™) y 15 con RFA (ClosureFast™). Se recogieron variables clínicas, ecográficas y de calidad de vida mediante los cuestionarios VEINES-QOL/Sym y EUROQOL-5D antes de la intervención y 3 meses después.

Resultados: ambos grupos fueron comparables en edad, IMC y clasificación CEAP. No se registraron complicaciones mayores ni casos de neuropatía safena. Las tasas de oclusión fueron elevadas y similares. Se objetivó una mejoría estadísticamente significativa en los síntomas más comunes y en la calidad de vida en ambos grupos, sin diferencias significativas entre técnicas.

Conclusiones: tanto CAC como RFA demostraron ser técnicas seguras y efectivas, con mejoras clínicas y de calidad de vida comparables a corto plazo. CAC se presenta como alternativa válida y menos invasiva en casos seleccionados.

Palabras clave:

Insuficiencia venosa crónica. Cianoacrilato. Radiofrecuencia. Calidad de vida.

INTRODUCTION AND OBJECTIVES

Chronic venous disorders (CVD) affect a large proportion of the general population, with an estimated prevalence of 83.6%, according to the multicenter epidemiological study by Rabe et al. (1). This entity encompasses a spectrum ranging from asymptomatic telangiectasias to active venous ulcerations (CEAP C0s-C6) and may produce symptoms from mild discomfort to significant disability.

Within this spectrum, chronic venous insufficiency (CVI) with significant reflux in the great saphenous vein (GSV) represents a clinically relevant condition. In the general adult population, the prevalence of clinically significant venous reflux is approximately 40%, with variations ranging from 7% to 60% depending on the series. In Spain specifically, GSV reflux has been detected in 32.8% of patients evaluated by Doppler ultrasound (2). This condition may lead to persistent symptoms such as heaviness, edema, and cramps, and is associated with a significant impairment in quality of life.

Traditionally, surgical treatment with saphenectomy has been the standard approach. However, over the past 2 decades, the development of endovenous techniques has transformed the therapeutic management of this condition. Among these, radiofrequency ablation (RFA) stands out, demonstrating high occlusion rates but requiring tumescent anesthesia, as well as cyanoacrylate closure (CAC), a non-thermal

and non-tumescent alternative that avoids multiple punctures and reduces postoperative discomfort.

Numerous randomized clinical trials have demonstrated the efficacy profile of both techniques, such as the VeClose trial, which established the non-inferiority of cyanoacrylate compared to radiofrequency in terms of occlusion rate and symptomatic improvement. However, direct evidence in real-world settings and with a focus on quality of life remains limited (3-7).

The aim of this study was to compare the safety and efficacy profile of cyanoacrylate closure vs radiofrequency ablation in patients with great saphenous vein insufficiency, evaluating both clinical outcomes and quality-of-life improvement measured using validated questionnaires (8-10).

MATERIALS AND METHODS

We conducted a prospective, observational, and comparative study at Hospital Universitario Puerta del Mar (Cádiz, Spain). A total of 45 patients diagnosed with GSV insufficiency between June 1st and October 30th, 2024 were included. Inclusion criteria were: adults > 18 years, clinical CEAP C2-C4, presence of GSV reflux documented by Doppler ultrasound, and signed informed consent. Patients with a history of deep vein thrombosis, arterial insufficiency, pregnancy, known allergy to adhesives, or prior interventions on the same venous axis were excluded.

A total of 30 patients were treated with cyanoacrylate (VenaSeal™, Medtronic), under local anesthesia and following a segmental manual compression protocol, without additional phlebectomy. Fifteen patients underwent radiofrequency treatment (ClosureFast™, Medtronic), under spinal anesthesia, tumescent infiltration, and with adjunctive phlebectomy according to clinical criteria. Both groups received antithrombotic prophylaxis during the first 7 postoperative days and standardized discharge recommendations.

Demographic (age, sex, and BMI), clinical (CEAP classification), and ultrasound data were collected, including proximal (saphenofemoral junction) and mid-thigh GSV diameter, ultrasound evaluation of GSV occlusion or recanalization at 3 months after intervention, persistence of truncal varices at 3 months, and postoperative complications during the first 90 days. Quality of life was assessed using the validated EUROQOL-5D (9) and VEINES-QOL/Sym (10) questionnaires, administered before treatment and 3 months after the procedure.

Statistical analysis was performed using IBM SPSS Statistics v27.0 software. Quantitative variables were expressed as mean $\pm$ SD, and qualitative variables as frequencies and percentages. Student's *t* test or Welch correction was used for comparison of means, and the chi-square test or Fisher's exact test for proportions. Statistical significance was defined as $p < 0.05$.

RESULTS

Both groups were comparable in age (CAC, 50.3 ± 9.2 years; RFA, 52.9 ± 8.9 years; $p = 0.369$) and BMI (CAC, 27.8 ± 3.6 kg/m²; RFA, 27.8 ± 4.5 kg/m²; $p = 1.000$). Overall, 66.6% of patients were women (RFA 10/15 vs CAC 20/30; $p = 1.000$). CEAP classification showed a comparable distribution between techniques (CAC, C2, 66.7 %; C3, 26.7 %; C4, 6.7 %; RFA, C2, 66.7 %; C3, 20.0 %; C4, 13.3 %), with no significant differences ($p = 0.711$).

Venous diameters showed slight differences without statistical significance: mean proximal diameter was 0.89 ± 0.35 cm in CAC vs 1.14 ± 0.43 cm in RFA ($p = 0.063$); mid-thigh diameter was 0.68 cm in CAC vs 0.73 ± 0.19 cm in RFA ($p = 0.504$) (Table I).

The 3-month GSV occlusion rate was high and comparable in both groups (93% in both groups, with 7 % of patients showing partial recanalization in both CAC and RFA). Persistence of truncal varices was higher in the CAC group, although the difference did not reach statistical significance ($p = 0.115$). In the cyanoacrylate group, 53 % of patients showed complete absence of truncal varices at 3 months postoperatively, 20 % showed significant reduction, and 27 % showed partial reduction.

No serious complications were recorded in any patient included in the study, and no cases of saphenous nerve neuropathy were observed in those

Table I. Baseline demographic, clinical, and ultrasound characteristics of the study population according to the technique used

Variable	Total (n = 45)	CAC (n = 30)	RFA (n = 15)	p
Age (years), mean $\pm$ SD	51.18 ± 9.07	50.3 ± 9.2	52.9 ± 8.9	0.369
Female sex, %	66.7 %	66.7 %	66.7 %	1.000
CEAP (%)	C2: 66.6 % C3: 24.4 % C4: 8.8 %	C2: 66.7 % C3: 26.7 % C4: 6.7 %	C2: 66.7 % C3: 20.0 % C4: 13.3 %	0.711
Proximal GSV diameter (cm)	0.96 ± 0.38	0.89 ± 0.35	1.14 ± 0.43	0.063
Mid-thigh GSV diameter (cm)	0.71 ± 0.19	0.69 ± 0.18	0.73 ± 0.19	0.504
Values are expressed as mean $\pm$ SD or percentage.				

treated with radiofrequency. The incidence of post-operative phlebitis was similar in both groups (13%). The safety profile was favorable for both treatments.

Regarding quality of life, the VEINES-QOL/Sym and EUROQOL-5D questionnaires showed statistically significant improvements with both techniques. In the CAC group, symptoms of heaviness, swelling, and fatigue were significantly reduced ($p < 0.01$). Similar improvements were observed in the RFA group, with no significant differences between groups ($p = 0.33$) (Figs. 1 and 2).

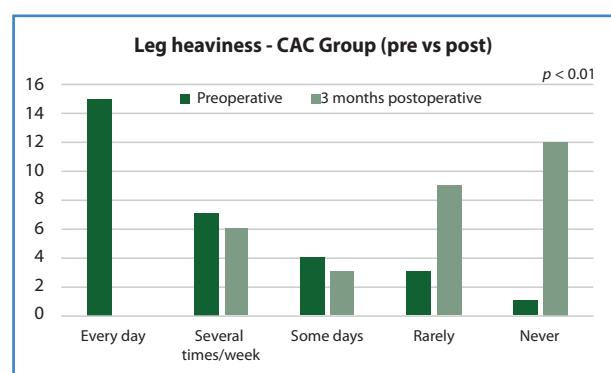


Figure 1. Comparison of leg heaviness (VEINES-QOL/Sym) before and after treatment with cyanoacrylate.

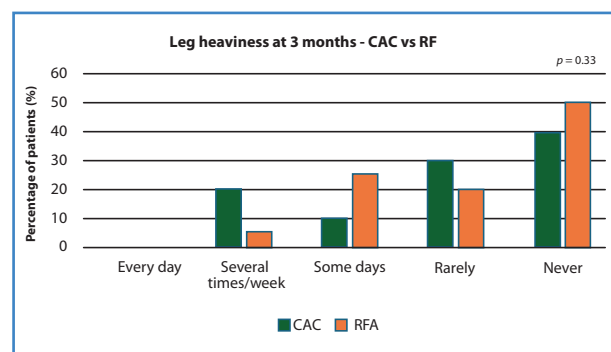


Figure 2. Comparison of heaviness reduction between CAC and RFA at 3 months.

Regarding the aesthetic component, the number of patients concerned about the appearance of their legs decreased significantly (Fig. 3): from 24 to 8 cases in the CAC group ($p = 0.006$) and from 13 to 5 in the RFA group ($p = 0.01$).

Similarly, the results of the EUROQOL-5D questionnaire demonstrated significant improvement in key dimensions such as "pain/discomfort" and "anxiety/depression," despite this being a generally non-dis-

abling condition. In the cyanoacrylate-treated group, cases of moderate or severe pain decreased from 24 to 8 (Fig. 4), whereas levels of moderate/severe anxiety or depression declined from 11 to 4. In turn, in the radiofrequency-treated group, anxiety/depression decreased from 9 cases to a single case.

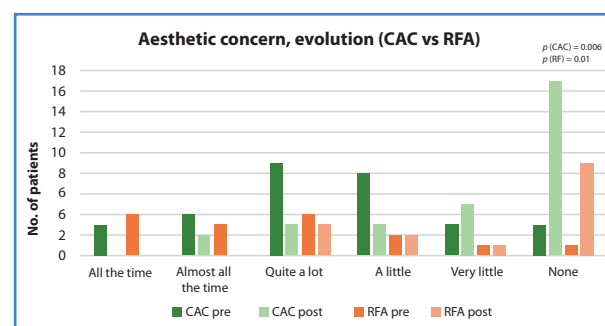


Figure 3. Progression of aesthetic concern related to the legs (before and after treatment with cyanoacrylate and RFA).

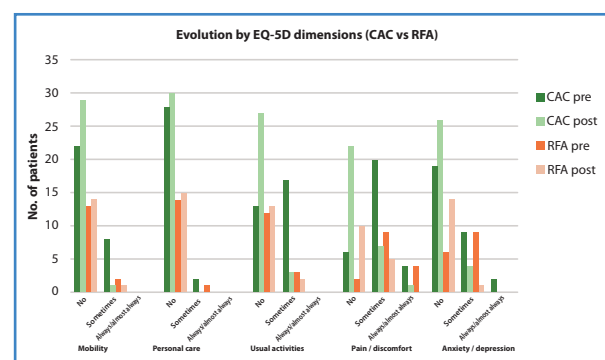


Figure 4. Distribution of EUROQOL-5D questionnaire dimensions before and after treatment with cyanoacrylate and RFA.

DISCUSSION

The results of this study reinforce the existing evidence regarding the safety and efficacy profile of endovenous techniques for the treatment of great saphenous vein insufficiency (5,6,12). Both cyanoacrylate and radiofrequency achieved high occlusion rates at 3 months, with a low incidence of short-term recanalization and no occurrence of major complications. These findings are consistent with those reported by Morrison et al. in the VeClose trial (3,4). In that study, the noninferiority of cyanoacrylate compared with radiofrequency was demonstrated at 36 months, with occlusion rates of 94.4 % and 91.9 %, respectively.

In our study, the group treated with cyanoacrylate showed a higher rate of persistent truncal varicosities at 3 months vs radiofrequency combined with adjunctive varicectomy; however, this difference did not reach statistical significance ($p = 0.115$). This finding may be influenced by patient selection, as the indication for radiofrequency with adjunctive varicectomy was more frequent in patients presenting with large varicose clusters, whereas CAC was more widely used in patients in whom additional procedures were intended to be avoided. Nevertheless, our clinical experience shows that even in patients with significant varicose clusters treated with CAC, their reduction was clinically relevant in more than 70% of cases, with complete resolution in some instances. This observation suggests that the use of CAC could be considered more broadly, even in the presence of extensive truncal varicosities, a hypothesis that should be confirmed through specifically designed comparative studies with longer follow-up.

Furthermore, the cyanoacrylate technique offers relevant advantages from the perspective of patient comfort by avoiding the use of locoregional and/or tumescent anesthesia, the latter being associated with multiple punctures, and by facilitating faster recovery. In the WAVES study (6,7) these advantages translated into a return to normal activities in an average of 2.4 days, without the need for postoperative compression and with satisfaction rates exceeding 95%.

These results are consistent with recent national publications. In a prospective study conducted in 176 patients, Jiménez and Quiroga demonstrated that radiofrequency achieves high occlusion rates and rapid recovery, with low associated morbidity (13). Likewise, the review by Arroyo et al. synthesizes the available evidence on endoablative techniques and concludes that thermal and nonthermal alternatives offer comparable efficacy profiles, supporting the equivalence observed between CAC and RFA in our cohort (14).

Additionally, significant improvements were observed in both groups across functional and emotional domains, including reductions in pain/discomfort and anxiety/depression. This reinforces the concept that therapeutic success in chronic venous insufficiency should be measured not only by venous occlusion but also by its impact on patient well-being.

These findings are consistent with the results of the VeClose trial (3) and the WAVES study (6,7), which also reported sustained improvements in quality of life following cyanoacrylate treatment.

Among the limitations of the study are the small sample size and the short-term follow-up. Furthermore, the nonrandomized design and consecutive inclusion of patients may introduce selection bias. Nevertheless, the study accurately reflects routine clinical practice and contributes local data to the international literature.

Future studies with larger sample sizes and longer follow-up will allow confirmation of these findings and exploration of differences in terms of cost-effectiveness, duration of benefit, and recurrence rates.

CONCLUSIONS

Both cyanoacrylate closure and radiofrequency thermal ablation proved to be safe and effective techniques for the treatment of great saphenous vein insufficiency. Both methods achieved high short-term occlusion rates, without relevant complications and with significant improvement in patients' quality of life. No statistically significant differences were observed between the two techniques in the analyzed parameters, suggesting therapeutic equivalence in appropriately selected clinical settings.

Further studies with larger sample sizes, long-term follow-up, and cost-benefit analyses are required to consolidate this evidence and guide clinical decision-making based on outcomes and patient preferences.

REFERENCES

1. Rabe E, Guex JJ, Puskas A, Scuderi A, Fernandez Quesada F. Epidemiology of chronic venous disorders in geographically diverse populations: results from the Vein Consult Program. *Phlebology* 2012;27(2):75-84.
2. Lozano F, JiménezCossío JA, Ulloa J; Grupo RELIEF. La insuficiencia venosa crónica en España. Estudio epidemiológico RELIEF. *Angiología* 2001;53(1):516.
3. Morrison N, Gibson K, McEnroe S, Goldman MP, King JT, Weiss RA, et al. Randomized trial comparing cyanoa-

- crylate embolization and radiofrequency ablation for incompetent great saphenous veins (VeClose). *J Vasc Surg Venous Lymph Disord* 2018;6(3):321-30. DOI: 10.1016/j.jvsv.2017.10.010
4. Morrison N, Kolluri R, Vásquez M, Madsen M, Jones A, Gibson K. Comparison of cyanoacrylate closure and radiofrequency ablation for the treatment of incompetent great saphenous veins: 36-month outcomes of the VeClose randomized controlled trial. *Phlebology* 2019;34(6):380-90. DOI: 10.1177/0268355518810259
5. Whing J, Nandhra S, Nesbitt C, Stansby G. Interventions for great saphenous vein incompetence. *Cochrane Database Syst Rev* 2021;8(8):CD005624. DOI: 10.1002/14651858.CD005624.pub4
6. Gibson K, Ferris B. Cyanoacrylate closure of incompetent great, small, and accessory saphenous veins without the use of postprocedure compression: Initial outcomes of a postmarket evaluation of the VenaSeal system (the WAVES study). *Vasc Endovasc Surg* 2017;51(3):141-7. DOI: 10.1177/1538574417691739.
7. Gibson K, Ferris B, The WAVES investigators. Real-world outcomes of cyanoacrylate closure for the treatment of incompetent great saphenous veins: 24-month results from the WAVES study. *Phlebology* 2021;36(2):123-31. DOI: 10.1177/0268355520932163
8. Launois R. Health-related quality-of-life scales specific for chronic venous disorders of the lower limbs. *J Vasc Surg Venous Lymphat Disord* 2015;3(2):219-27.e1-3. DOI: 10.1016/j.jvsv.2014.08.005
9. Herdman M, Gudex C, Lloyd A, Janssen M, Kind P, Parkin D, et al. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Quality of Life Research* 2011;20(10):1727-36.
10. Kahn SR, Lamping DL, Ducruet T, Arsenault L, Miron MJ, Roussin, et al. VEINES-QOL/Sym questionnaire was a reliable and valid disease-specific quality of life measure for deep venous thrombosis. *J Clin Epidemiol* 2006;59(10):1049-56.
11. Rial R, Garg M, Pooley N, Ducaju GM, Doth A, Joaquim I. A review of clinical efficacy, safety, and quality of life of ClosureFast™ radiofrequency ablation of saphenous vein insufficiency. *Int Angiol* 2025;44(1):14-23. DOI: 10.23736/S0392-9590.25.05284-8
12. Jiménez C, Quiroga F. Radiofrecuencia en el tratamiento de las varices de los miembros inferiores. Estudio prospectivo en 176 pacientes en Bogotá. *Angiología* 2017;69(2):89-97. DOI: 10.1016/j.angio.2016.10.004
13. Arroyo Bielsa A, Leiva Hernando L, Fletes Lacayo JC. Estado actual de las técnicas endoablativas en el tratamiento de la insuficiencia venosa superficial. *Angiología* 2017;69(2):103-10. DOI: 10.1016/j.angio.2016.06.003