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# Study on the Efficacy of Radiofrequency and Laser Ablation in the Treatment of Superficial Varicose Veins in the Lower Extremities

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**Abstract:** *Objective:* To evaluate the efficacy of endovenous radiofrequency ablation (RFA) and laser ablation (EVLA) in the treatment of superficial varicose veins of the lower extremities. *Methods:* Seventy-eight patients with superficial varicose veins treated at a hospital between April 2022 and May 2023 were selected and divided into a radiofrequency ablation group (RFA group; 39 cases) and a laser ablation group (EVLA group; 39 cases) based on the treatment method. Operation time, postoperative recovery duration, venous clinical severity score (VCSS) changes, complication rates, closure rates, and recurrence rates were compared between the groups at 1 month, 3 months, and 12 months postoperatively. The postoperative therapeutic outcomes were comprehensively evaluated. *Results:* No significant differences in age, gender, disease grade, or disease course were observed between the groups ($P > 0.05$). The superficial varicose vein closure rate was 100% in both groups at 1 and 3 months postoperatively. At 12 months, the closure rate was 94.87% in the RFA group and 97.43% in the EVLA group, with no statistically significant difference ($P > 0.05$). No significant differences were observed in VCSS changes or complication incidence between the groups ($P > 0.05$). *Conclusion:* Radiofrequency ablation and laser ablation demonstrate comparable efficacy and safety in the treatment of superficial varicose veins of the lower extremities.

**Keywords:** Radiofrequency ablation; Laser ablation; Superficial varicose veins; Closure rate; Complications

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## 1. Introduction

Varicose veins of the lower extremities represent a prevalent vascular condition that significantly impacts patients' quality of life. This condition can be categorized into primary and secondary varicose veins based on its etiology [1]. The primary cause is elevated venous pressure, resulting from superficial and deep venous reflux disorders due to congenital weakness of the superficial venous walls and structural abnormalities in venous valves.

According to the latest guidelines, treatment for lower extremity varicose veins is determined by the Clinical-

Etiology-Anatomy-Pathophysiology (CEAP) classification [2,3]. For patients classified as C0, who exhibit no symptoms or indications for surgical intervention, the primary goal is to improve their lifestyle and work habits. The use of compression stockings and oral medications effectively alleviates discomfort.

However, for patients presenting with discomfort, lower limb edema, pruritus, eczema, or severe cases of venous leg ulcers (CEAP C2-C6), which substantially affect their quality of life, surgical intervention is typically required.

In recent years, minimally invasive procedures such as radiofrequency ablation (RFA) and endovenous laser ablation (EVLA) have gained widespread application for the treatment of superficial varicose veins due to their minimal invasiveness and rapid recovery times [4,5]. RFA and EVLA offer effective solutions for managing reflux disorders by sealing the affected veins, thus restoring proper venous function [6-8].

This study aims to investigate and compare the efficacy and safety of RFA and EVLA in the treatment of superficial varicose veins, providing further insight into the advantages and limitations of these minimally invasive techniques.

## 2. Materials and methods

### 2.1. General information

A total of 78 patients with superficial varicose veins of the lower extremities and 46 patients with small saphenous varicose veins, treated at the hospital between April 2022 and May 2023, were included in the study. The 78 patients with superficial varicose veins were randomly divided into the RFA group ($n$ = 39) and the EVLA group ($n$ = 39). The RFA group included 17 males and 22 females, while the EVLA group included 16 males and 23 females.

Inclusion criteria: (1) Patients aged 20–75 years; (2) Availability of complete medical records; (3) Diagnosis of primary superficial varicose veins confirmed through clinical symptoms, signs, and imaging examinations; (4) Patients with normal consciousness who could cooperate during procedures and assessments, with no severe mental illness or contraindications; (5) CEAP classification grades C1–C4; (6) Patients who had signed informed consent.

Exclusion criteria: (1) Patients with severe diseases of vital organs; (2) Presence of iliac vein compression; (3) Post-thrombotic syndrome; (4) Severe allergic constitution; (5) Pregnant or lactating women; (6) Patients with contraindications for surgery; (7) Loss to follow-up.

No statistically significant differences were observed in general characteristics between the two groups ($P$ > 0.05), as shown in **Table 1**.

**Table 1.** Comparison of general characteristics of patients with superficial varicose veins of the lower extremities ($n$ = 39, mean ± SD)

| Indicators | RFA group | EVLA group | $t$ / $\chi^2$ | $P$ |
|---|---|---|---|---|
| Gender (male/female, cases) | 17/22 | 16/23 | 0.052 | 0.820 |
| Affected sides (left/right, cases) | 19/20 | 22/17 | 0.457 | 0.499 |
| C1–2 | 9 | 10 | 0.623 | 0.891 |
| C3 | 15 | 14 | | |
| C4a | 9 | 7 | | |
| C4b | 6 | 8 | | |
| Age (years) | 56.1 ± 8.9 | 56.3 ± 8.6 | 0.103 | 0.918 |
| Duration of disease (years) | 4.6 ± 2.1 | 4.7 ± 2.0 | 0.465 | 0.783 |

## 2.2. Treatment methods

### 2.2.1. Instruments

(1) RFA group: The ClosureRFG Radiofrequency Generator (Medtronic Inc.) and the ClosureFast catheter were used, along with an introduction sheath (Terumo Corporation, Japan).

(2) EVLA group: The Halo Diode Laser System (Micro-Energy Medical Technology Co., Ltd.) and Halo-R-0.40-2.5 and Halo-R-0.60-2.5 fibers were used.

### 2.2.2. Procedures

On the treatment day, venous positions in the affected leg were mapped using ultrasound. Mild intravenous sedation was administered using propofol or midazolam under anesthesiologist supervision. For great saphenous vein (GSV) treatment, ablation began 2 cm distal to the saphenofemoral junction (SFJ) and avoided the area below the knee. Small saphenous vein (SSV) ablation was initiated 2 cm distal to the saphenopopliteal junction. Patients were positioned at a 30-degree head-down tilt during ablation. Wet gauze was used to compress the skin around the laser fiber to minimize heat damage, and the lower limb was bandaged with elastic bandages.

A tumescent anesthetic solution was prepared by mixing 500 mL of Hartmann's solution with 20 mL of 2% lidocaine. Under intraoperative ultrasound guidance, perivenous infiltration ensured a minimum vein-skin distance of 10 mm.

RFA group: RFA was performed using a ClosureFast catheter with a 7F sheath. The GSV was punctured to establish vascular access, and ablation was performed with two cycles for the proximal segment and a single cycle for subsequent segments. Manual pressure was applied throughout the procedure.

EVLA group: EVLA was conducted using a vascular needle to establish access, and a laser fiber connected to a 1470 nm laser system was inserted into the vein via a vascular sheath. Treatment parameters adhered to the "Guidelines for the Diagnosis and Treatment of Common Venous Diseases (2022 edition)." For GSV, a 600 μm fiber was used, with laser power set at 6–8 W and LEED at 40–50 J/cm. For SSV, a 400 μm fiber was used, with laser power set at 4–5 W and LEED at 35–40 J/cm.

### 2.2.3. Postoperative management

Branch varices, reticular veins, and telangiectasia were treated with venectomy or sclerotherapy at the surgeon's discretion. Patients were encouraged to mobilize 4–8 hours postoperatively and were discharged the same day. Oral non-steroidal anti-inflammatory drugs were prescribed for three days, without thromboprophylaxis. Patients wore gradient compression stockings (20–30 mmHg) at thigh level during the day for two weeks. Numerical rating scale (NRS) scores were recorded at 6 hours, 1 day, 10 days, and 30 days postoperatively.

## 2.3. Observation indicators

(1) Telephone follow-ups were conducted one week after treatment to evaluate return-to-normal activity days. Short-term (baseline, 1 month, 3 months) and long-term (12 months) venous closure rates were compared between groups. Changes in venous clinical severity scores (VCSS) before and after treatment were analyzed.

(2) Complications, including deep vein thrombosis (DVT), heat-induced thrombosis (EHIT), surgical site ecchymosis, paresthesia, postoperative edema, burns, and superficial phlebitis, were assessed during the one-month follow-up.

## 2.4. Statistical analysis

Data analysis was conducted using statistical software. Measurement data were expressed as mean ± standard deviation (SD), with comparisons between groups performed using *t*-tests. Count data were expressed as rates (%), with group comparisons analyzed using $\chi^2$ tests. A value of $P < 0.05$ was considered statistically significant.

# 3. Results

## 3.1. Short-term and long-term postoperative closure rates

Immediately after the procedure (0 time), the vein closure rate was 100% in both groups. At 1 month, 3 months, and 12 months postoperatively, the closure rates decreased slightly in both groups. However, no statistically significant difference was observed between the two groups at any time point ($P > 0.05$) (**Table 2**).

**Table 2.** Comparison of surgical closure rates between the two groups for superficial varicose veins of the lower extremities [$n = 39$, $n$ (%)]

| Groups | At 0 time* | 1 month* | 3 months* | 12 months* |
|---|---|---|---|---|
| RFA group | 39 (100%) | 39 (100%) | 39 (100%) | 37 (94.87) |
| EVLA group | 39 (100%) | 39 (100%) | 39 (100%) | 38 (97.43%) |
| $\chi^2$ | | | | 0.010 |
| $P$ | | | | > 0.999 |

Note: * indicates the time immediately after surgery.

## 3.2. Days of postoperative return to activity

**Table 3** shows that the average recovery time for returning to normal activities was 2.92 ± 1.08 days in the RFA group and 2.82 ± 1.14 days in the EVLA group. The difference was not statistically significant (P > 0.05).

**Table 3.** Comparison of days of return to activity after surgery between the two groups ($n = 39$, mean ± SD)

| Groups | Cases | Days of return to activity after surgery |
|---|---|---|
| RFA group | 39 | 2.92 ± 1.08 |
| EVLA group | 39 | 2.82 ± 1.14 |
| $t$ | | 0.406 |
| $P$ | | 0.686 |

## 3.3. Venous clinical severity scores

Before surgery, there was no statistically significant difference in VCSS scores between the two groups ($t = 0.082$, $P > 0.05$). Postoperatively, both groups showed significantly improved VCSS scores at 1 month, 3 months, and 12 months compared to preoperative scores (RFA group, $t = 24.07$, $P < 0.0001$; EVLA group, $t = 24.73$, $P < 0.0001$). However, no significant difference in VCSS scores was observed between the groups at any postoperative time point ($P > 0.05$), as shown in **Table 4**.

**Table 4.** Comparison of VCSS scores for superficial varicose veins of the lower extremities in both groups ($n$ = 39, mean ± SD)

| Groups | Pre-operation | 1 month* | 3 months* | 12 months* | $t$ | $P$ |
|---|---|---|---|---|---|---|
| RFA group | 10.20 ± 4.18 | 1.59 ± 0.75 | 2.07 ± 0.90 | 4.02 ± 1.71 | 8.543 | < 0.001 |
| EVLA group | 10.48 ± 4.30 | 1.56 ± 0.72 | 2.02 ± 0.96 | 4.00 ± 1.61 | 8.820 | < 0.0001 |
| $t$ | 0.294 | 0.154 | 0.243 | 0.068 | | |
| $P$ | 0.767 | 0.878 | 0.808 | 0.946 | | |

Note: * indicates the time immediately after surgery.

## 3.4. Incidence of complications

No significant differences were found in the incidence of complications, including deep vein thrombosis (DVT), heat-induced thrombosis (EHIT), surgical site ecchymosis, postoperative paresthesia (numbness), postoperative edema, burns, or superficial phlebitis, between the two groups ($P > 0.05$), as shown in **Table 5**.

**Table 5.** Comparison of the incidence of surgical complications between the two groups [$n$ = 39, $n$ (%)]

| Groups | DVT | EHIT | Ecchymosis at the surgical site | Postoperative paresthesia (numbness) | Postoperative edema | Burns | Superficial phlebitis | Incidence of surgical complications |
|---|---|---|---|---|---|---|---|---|
| RFA group | 0 | 0 | 7 (17.95%) | 2 (5.12%) | 1 (2.86%) | 0 | 0 | 10 (25.64%) |
| EVLA group | 0 | 0 | 6 (15.38%) | 1 (2.56%) | 0 | 0 | 0 | 7 (17.95%) |
| $\chi^2$ | | | | | | | | 0.909 |
| $P$ | | | | | | | | 0.635 |

# 4. Discussion

The treatment of varicose veins has undergone significant advancements over the years. The increasing adoption of minimally invasive procedures such as EVLA, RFA, ultrasound-guided foam sclerotherapy, and cryopexy has resulted in excellent therapeutic outcomes [9-11]. Most patients undergoing these minimally invasive treatments report high levels of satisfaction with the results. Radiofrequency ablation utilizes radiofrequency energy to shrink the collagen in the venous wall and close the lumen, while laser ablation employs thermal energy from the laser to achieve the same outcome. Both RFA and EVLA are intraluminal procedures, eliminating the need for vein extraction, which shortens the operation time and reduces intraoperative blood loss. The efficacy of these techniques is influenced by factors such as precision in execution, appropriate energy settings, and adherence to standardized postoperative care protocols. The Society for Vascular Surgery and the American Venous Forum endorses thermal ablation techniques (EVLA or RFA) as safe and effective methods for treating incompetent saphenous veins [12].

In this study, both EVLA and RFA were utilized to treat superficial varicose veins of the lower extremities. The findings indicated that both methods produced satisfactory therapeutic outcomes, aligning with previous research [9-12]. No statistically significant differences were observed between the two groups regarding vein closure rate, symptom improvement, or complication rates. The closure rate was 100% in both groups immediately after surgery (time 0). Although the closure rate decreased slightly over time, there was no significant difference

between the two groups.

Similarly, the two groups exhibited comparable results in terms of the number of days required to resume normal activities after surgery and improvements in Venous Clinical Severity Scores (VCSS). Regarding safety, the incidence of adverse events was low and did not differ significantly between the two techniques, indicating comparable safety profiles during treatment.

Radiofrequency ablation achieves vein closure by constricting the collagen in the venous wall using radiofrequency energy, while EVLA utilizes laser-induced thermal energy for the same purpose. The effectiveness of both techniques appears to depend on factors such as precise operation, optimal energy settings, and standardized postoperative care.

## 5. Limitations

This study has several limitations. The relatively small sample size and limited follow-up duration may affect the accuracy and generalizability of the findings. Future research involving larger sample sizes, multi-center studies, and extended follow-up periods is necessary to comprehensively evaluate the efficacy and safety of these two laser devices.

## 6. Conclusions

In conclusion, both radiofrequency ablation and laser ablation are safe and effective treatment options for superficial varicose veins of the lower extremities. No statistically significant differences were observed between the two methods in terms of closure rates, postoperative recovery times, improvements in VCSS scores, or the incidence of adverse events. Clinicians may choose either procedure based on the specific clinical context and patient needs.

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## Disclosure statement

The author declares no conflict of interest.

## References

[1] Raetz J, Wilson M, Collins K, 2019, Varicose Veins: Diagnosis and Treatment. Am Fam Physician, 99(11): 682–688.

[2] Baccellieri D, Ardita V, Carta N, et al., 2020, Anterior Accessory Saphenous Vein Confluence Anatomy at the Sapheno-Femoral Junction as Risk Factor for Varicose Veins Recurrence After Great Saphenous Vein Radiofrequency Thermal Ablation. Int Angiol, 39(2): 105–111. https://doi.org/10.23736/S0392-9590.20.04271-6

[3] Westin GG, Cayne NS, Lee V, et al., 2020, Radiofrequency and Laser Vein Ablation for Patients Receiving Warfarin Anticoagulation is Safe, Effective, and Durable. J Vasc Surg Venous Lymphat Disord, 8(4): 610–616. https://doi.

org/10.1016/j.jvsv.2019.11.013

[4] Lurie F, Passman M, Meisner M, et al., 2020, The 2020 Update of the CEAP Classification System and Reporting Standards. J Vasc Surg Venous Lymphat Disord, 8(3): 342–352. https://doi.org/10.1016/j.jvsv.2019.12.075. Erratum in J Vasc Surg Venous Lymphat Disord, 9(1): 288. https://doi.org/10.1016/j.jvsv.2020.11.002

[5] Kumar P, Khan IA, Das A, et al., 2022, Chronic Venous Disease. Part 1: Pathophysiology and Clinical Features. Clin Exp Dermatol, 47(7): 1228–1239. https://doi.org/10.1111/ced.15143

[6] Chen T, Liu P, Zhang C, et al., 2024, Pathophysiology and Genetic Associations of Varicose Veins: A Narrative Review. Angiology, 2024: 33197241227598. https://doi.org/10.1177/00033197241227598

[7] Zan S, Contessa L, Varetto G, et al., 2007, Radiofrequency Minimally Invasive Endovascular Treatment of Lower Limbs Varicose Veins: Clinical Experience and Literature Review. Minerva Cardioangiol, 55(4): 443–458.

[8] Narula S, Sivakumar M, Nerantzakis G, et al., 2023, Comparative Analysis of Long-Term Efficacy, Safety, and Complications of Radiofrequency Ablation Versus Endovenous Laser Treatment of Varicose Veins. Journal of Vascular Surgery, 77(4): 44S. https://doi.org/10.1016/j.jvs.2023.01.125

[9] Mohammadi Tofigh A, Tahmasebi H, Zebarjadi J, 2020, Comparing the Success Rate and Side Effects of Endovenous Laser Ablation and Radiofrequency Ablation to Treat Varicose Veins in the Lower Limbs: A Randomized Clinical Trial. J Lasers Med Sci, 11(Suppl 1): S43–S48. https://doi.org/10.34172/jlms.2020.S7

[10] Paravastu SC, Horne M, Dodd PD, 2016, Endovenous Ablation Therapy (Laser or Radiofrequency) or Foam Sclerotherapy Versus Conventional Surgical Repair for Short Saphenous Varicose Veins. Cochrane Database Syst Rev, 11(11): CD010878. https://doi.org/10.1002/14651858.CD010878.pub2

[11] Van den Bos R, Arends L, Kockaert M, et al., 2009, Endovenous Therapies of Lower Extremity Varicosities: A Meta-Analysis. J Vasc Surg, 49(1): 230–239. https://doi.org/10.1016/j.jvs.2008.06.030

[12] Go SJ, Cho BS, Mun YS, et al., 2016, Study on the Long-Term Results of Endovenous Laser Ablation for Treating Varicose Veins. Int J Angiol, 25(2): 117–120. https://doi.org/10.1055/s-0035-1555749