Research Article

The multimodal treatment approaches to varicose veins: Preservation versus thermal ablation of the incompetent great saphenous vein

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Abstract

Objective: To compare the clinical efficacy of Ambulatory Selective Varices Ablation under Local Anesthesia (ASVAL) and Endovenous Laser Ablation (EVLA) with concomitant phlebectomy in patients with the incompetent Great Saphenous Vein (GSV).

Methods: This was a prospective observational cohort study in a single center. Seventy-six patients (59 females) with GSV incompetence and C2-C3 were included in the prospective consecutive case study. The diameter of GSV at the 15-cm below the SFJ level was the main criterion to identify two groups of patients. Thirty-three patients (25 females, mean age 37.03) with the GSV diameter ≤6 mm were treated with ASVAL. Forty-three patients (34 females, mean age 46.19) with the GSV diameter >6 mm were treated by EVLA with concomitant phlebectomy. Clinical and functional outcomes measured by Venous Clinical Severity Score (VCSS) and clinical recurrence-free rate according to the classification of recurrent varicose veins after treatment (PREVAIT) were analyzed in 2 years follow-up. The clinical recurrence-free rate was analyzed in 5 years follow-up.

Results: 2-year follow-up was detected a significant decrease in the postoperative VCSS in the ASVAL and the EVLA group (p<0.001). There was no statistically significant difference between both groups in VCSS in 2 years post-operation (p=0.681). Frequency of recurrence did not differ between ASVAL (18.8%) and EVLA (21.4%) groups 2 years after treatment (p=0.776) and the diameter of the GSV significantly decreased in the ASVAL group (5.48 vs 5.13, p=0.008). The 5-year follow-up was detected recurrences in 40.0% of patients ASVAL group and 45.6% EVLA group (p=0.668).

Conclusions: Both ASVAL and EVLA effectively improve the disease severity in the groups of patients, selected according to the GSV diameter (≤6 mm or >6 mm).

Introduction

In the last decade, endovenous methods of thermal ablation for treating varicose veins of lower extremities have been widely recognized, and the efficacy and safety of these methods have been demonstrated in large randomized trials [1-4]. However, the evidence suggests that neither endovenous thermal ablation, nor surgical removal of Great Saphenous Vein (GSV) guarantee long-term clinical efficacy: for both methods, there are no differences in the recurrence rates in 2- and 5-year periods [5-8]. In light of these observations, removal/ablation of the GSV trunks as a standard treatment for all patients with varicose veins is in question.

According to the concept of ascending or multifocal evolution of varicose veins, preservation of an inconsistent
Table 1: Inclusion/ exclusion criteria.

| Inclusion criteria                                      | Exclusion criteria                                    |
|--------------------------------------------------------|-------------------------------------------------------|
| Great saphenous vein (GSV) incompentence with reflux at least down to the knee level | Previous surgical groin exploration, except herniotomy |
| Primary symptomatic varicose veins, CEAP clinical class C2-C3 | The small saphenous vein, anterior or posterior accessory saphenous vein incompetence at the same limb |
| Physical status according to the American Society of Anesthesiologists (ASA) I-II | Deep venous thrombosis, thrombophilia associated with a high risk of deep venous thrombosis or postthrombotic syndrome |
| Reverse flow at least 0.5 seconds was considered pathological. Preoperative venous duplex mapping was done in the upright position [14]. |

Methods

This was a prospective observational cohort study (ClinicalTrials.gov ID: NCT04034329). Patients at a single center (University Hospital No. 10, Minsk, Belarus) were included onwards and all data were entered into a database. The study protocol was approved by the University ethics committee (No. 20140431) and all patients signed a written consent to participate in the study. Patients with GSV incompetence and C2–C3 were included in the prospective consecutive case study if they satisfied the selection criteria outlined in Table 1.

Full venous duplex ultrasonography was performed using B–K Medical REP ZV0071 colour–coded duplex scanner fitted with a 7.5–MHz linear probe. Cognizant of the negative consequences of standing and sitting for long periods of time (e.g. venous hypertension, venous reflux), we scheduled investigations for early morning, thus ensuring examination of the physiological status of the venous system in each patient. Ultrasound examinations of reflux at the Saphenofemoral Junction (SFJ) were performed using the Valsalva maneuver. Ultrasound examination of GSV reflux was performed by manually compressing the calf followed by sudden release.
taking into account the severity of the disease (as measured by VCSS) and the degree to which patients were affected by it; 2) to establish the 2 years and 5 years clinical recurrence-free rate according to the classification of recurrent varicose veins after treatment (PREVAIT) [16,17]. PREVAIT is defined as the presence of any new visible or palpable varicosities on the studied leg that had been noticed through the clinical examination. The criterion of a recurrent varicose vein was a visible or palpable varicosity with a diameter of more than 3 mm.

**Statistical analysis**

We used descriptive statistics to report baseline characteristics of the sample and pre-and postoperative scores. Dependent t-test and Wilcoxon signed-rank test were used to analyze changes in VCSS pre- and post-operation. Differences in frequencies of categorical variables between groups were analyzed using Fisher’s exact test. The multivariable regression model was used to establish the relationship between a dependent variable (recurrence rate) and independent variables (treatment method, category C, side, age. The level of statistical significance was set at an alpha level of 0.05. IBM SPSS 22 was used to conduct all statistical analyses.

**Results**

The sample in this study included 76 patients / 88 legs. However, to achieve higher homogeneity of the two groups, a leg with a more severe varicose disease was included in the study, hence the final sample included 76 patients/76 legs. The flowchart (Figure 1) shows the number of patients excluded from and included in the analysis.

Baseline patient characteristics are presented in Table 2.

**2 years follow-up. Evolution of signs and symptoms**

In the ASVAL group, VCSS before operation (Me=3.0, IQR 2.0-3.0) was higher than VCSS post-operation (Me=0.0, IQR 0.0-1.75), p< 0.001. Statistically significant decrease in the VCSS post-operation was also detected in the EVLA group: the mean VCSS pre-surgery (Me=5.0, IQR 3.0-6.0) was substantially higher than the mean VCSS post-operation (Me=0.0, IQR 0.0-1.0), p<0.001. There was no statistically significant difference between both groups in VCSS 2 years post-operation (p= 0.681) (Figure 2).

**2 years follow-up. Clinical recurrence according to PREVAIT**

Overall, frequency of clinical recurrence, irrespective of extent and source, did not differ between ASVAL (18.8%) and EVLA (21.4%) groups 2 years after treatment (p=0.776).

Table 3 summarizes the detailed PREVAIT data.

A small number of observations did not allow for comparisons of two groups by sections of PREVAIT. Phlebectomy was recommended for treatment of PREVAIT in 3

![Figure 1: Chart is showing the flow of patients through the prospective consecutive case study.](image-url)
ASVAL patients and 5 EVLA patients. Two patients in the ASVAL group required repeated surgery of extensive recurrence due to SFJ reflux. One EVLA patient underwent Anterior Accessory Saphenous Vein (AASV) surgery. All re-operations were for cosmetic indications.

2 years follow-up. Duplex reflux and GSV incompetence

Reflux was not significant in the GSV (reflux duration <0.5 seconds) after 2 years in 15 (46.9%) ASVAL patients. The diameter of the GSV, as measured at 15 cm below the SFJ level, significantly decreased in the ASVAL group (5.48 vs 5.13, p=0.008). There was no statistically significant association between refluxing GSV and observed recurrence in the ASVAL group (p=0.659). The results of the GSV examination 2 years after EVLA are presented in Table 4.

GELEV-score: Lev 0: no occlusion, refluxing vein, unchanged vein. Lev 1a: partial occlusion with proximal reflux. Lev 1b: partial occlusion without reflux. Lev 2a: complete occlusion with unchanged or larger diameter. Lev 2b: complete occlusion with diameter reduction >30%. Lev 3: complete occlusion with diameter reduction >50%. Lev 4: fibrotic cord, vein not visible. This scoring was introduced by GELEV (Groupe d’Évaluation des Lasers et de l’Échographie Vasculaire, part of the “ Société Française d’Angéiologie”) – information is in accordance to M.E. Vuylsteke, et al. [15].

Recurrences connected with GSV recanalization were detected only in 4 out of 9 patients of the EVLA group.

2 years follow-up. Complications

We observed postoperative thrombosis of the GSV in 1 patient in the ASVAL group. Endothermal Heat Induced Thrombosis (EHIT) was not observed in the EVLA group. A lymphocele developed on the phlebectomy side in 3 patients in the ASVAL group and 4 patients in the EVLA group. One puncture and additional compression were sufficient for rapid resolution.

Table 3: Clinical recurrences by PREVAIT classification and management.

| Group | ASVAL | EVLA |
|-------|-------|------|
| Overall PREVAIT, n (%) | 6 (18.8) | 9 (21.4) |
| Topographical sites of PREVAIT | | |
| Groin | 3 | 1 |
| Thigh | | |
| Popliteal fossa | 3 | 8 |
| Lower leg | | |
| Other | | |
| Source of recurrence | | |
| Pelvic or abdominal | 1 | |
| SFJ | 2 | 4 |
| Thigh perforator | 1 | |
| SPJ | | |
| Lower leg perforator | 2 | 5 |
| Nature of source | | |
| Same site | | |
| Persisting or recurrent reflux | 3 | 4 |
| Neovascularization | | |
| Uncertain | | |
| Different site | | |
| Persistent | | |
| New | 3 | 5 |
| Uncertain | | |
| Contribution from persistent incompetent GSV | | |
| Reflux not detectable (%GSV not detectable | 3 | 5 |
| Reflux above knee | 3 | 3 |
| Reflux below knee | | 1 |
| Management of PREVAIT | | |
| Wait and see | 1 | 2 |
| Sclerotherapy | | |
| Phlebectomy | 3 | 5 |
| SFJ and/or GSV or AASV redo treatmentb | 2 | 2 |
| SSV surgery | | |

ASVAL= Ambulatory Selective Varices Ablation Under Local Anaesthesia
EVLA= Endovenous Laser Ablation; GSV= Great Saphenous Vein; PREVAIT= Recurrent Varicosities After Treatment; SFJ= Saphenofemoral Junction; SPJ= Saphenopopliteal Junction; SSV= Small Saphenous Vein.

*We added the option Reflux not detectable for characteristics of ASVAL group.

Comprises EVLA in ASVAL group.

Table 2: Baseline patient characteristics.

| Characteristic | ASVAL group (n=33) | EVLA group (n=43) | p |
|----------------|-------------------|------------------|---|
| Age (M, SD)    | 37.03 (11.4)      | 46.19 (10.76)    | <.001 |
| Sex:           |                   |                  |    |
| Female (N, %)  | 25 (76)           | 34 (79)          | .731 |
| Male (N, %)    | 8 (24)            | 9 (21)           |    |
| The severity of the varicose disease (CEAP stage): | | |
| C2 stage       | 27 (82)           | 17 (40)          | <.001 |
| C3 stage       | 6 (18)            | 26 (60)          |    |
| Side:          |                   |                  |    |
| Right          | 22 (67)           | 17 (40)          | .019 |
| Left           | 11 (33)           | 26 (60)          |    |
| Diameter       | 5.5 (0.74)        | 7.53 (0.92)      | <.001 |
| VCSS (prior to the surgery), Me | 3.0 | 5.0 | <.001 |

Figure 2: VCCS 2 years post-operation.
Table 4: Two years follow up GSV occlusion rates in EVLA group.

| GELEV-score | n (%) |
|-------------|-------|
| Lev 0       | 0     |
| Lev 1a      | 4 (9.3%) |
| Lev 1b      | 5 (11.6%) |
| Lev 2a      | 0     |
| Lev 2b      | 1 (2.3%) |
| Lev 3       | 9 (20.9%) |
| Lev 4       | 23 (53.5%) |
| Not-controlled | 1 (2.3%) |
| Total       | 43    |

treatment of lymphocele. Transient paresthesia was detected in 2 patients of the ASVAL group and 3 patients of the EVLA group.

5 years follow-up

The 5-year follow-up also showed no significant differences in treatment outcomes in both groups. Recurrences were detected in 40.0% of patients ASVAL group and 45.6% EVLA group (p = 0.668). Repeated interventions were performed in 5 patients ASVAL group and 9 patients EVLA group (p = 0.933). The multivariate regression model was unable to establish a relationship between the dependent variable (recurrence rate) and independent variables, such as the treatment method used in the form EVLA or ASVAL (0.867), category C (0.785), side (0.953), age (0.073).

Discussion

This study supports the need to implement a cost-effective individualized approach for the treatment of varicose disease that is different from ones widely accepted worldwide (i.e. removal of the GSV). Based on the overall health status, the clinical manifestation of varicose veins, and the venous hemodynamics detected by DUS, this approach allows treatment alternatives for a specific patient. This paper is an attempt to correct the prevailing view on the destruction of the GSV as a component of the varicose veins treatment. As our findings showed, there should be a shift in the understanding of varicose disease treatment from “one size fits all” to an individualized approach.

We suggest using a less traumatic ASVAL technique, with saphenous vein preservation, in patients with a mild course of varicose disease and the GSV diameter ≤ 6 mm. Securing the GSV as a potential shunt is recommended by 2017 ESC Guidelines on the diagnosis and treatment of peripheral arterial diseases: “limit vein harvesting if lower extremity artery disease (class recommendation IIa)”[18].

In addition, preservation of the GSV and selective phlebectomy in the treatment of varices in nullipara patients may lead to a reduction in the severity of signs and symptoms in the case of varicose vein recurrence after pregnancy[19].

Reduction in diameter of the main saphenous vein after the selective removal of its incompetent side branches is illustrated in several investigations. In 1999 D. Creton revealed the diameter reduction of the proximal GSV after ablation of a distal incompetent tributary[20]. The same tendency was observed by N.S.Theivacumar, et al. and P.Pittaluga, et al.[21,22]. Nevertheless, the reflux and incompetence of the saphenous veins in some patients persisted even after the selective removal of the insolvent tributaries. This fact rises interest in terms of the possible relapses and VCSS in the long run.

In the present study, VCSS and the number of varicose vein recurrences did not differ significantly among the patients of the two groups, despite the fact that the ASVAL group maintained reflux in 43.1% of patients. The recurrence rate was slightly higher in our patients who had undergone ASVAL than in the trial by P.Pittaluga[23] (5.4%) and did not differ significantly from the I.Zolotukhin[24] results (13.5%). The amount of the relapses after EVLA in our study is equal to L.Rasmussen, et al. [5], who notes 26% of relapses in 2 years follow up. We have a slightly higher recurrence rate after EVLA than N.S.Theivacumar, et al.[25] (7%) and K. Rass, et al.[6] (16.2%).

However, the data presented by K. Rass[6] indicates recurrence in 32 out of 185 patients in the EVLA group revealed on a duplex scan, but 26 of them (81%) were clinically silent. There were partial GSV recanalizations observed in 24 patients (75%), but GSV surgery was performed only in 1 case.

A good clinical and cosmetic result, despite the recanalization of GSV, confirms the evidence that it is possible to keep an incompetent GSV without worsening the clinical outcome of varicose veins treatment in a selective group of patients. Similar data was given by N.S. Theivacumar, et al.[26], noting the absence of clinical manifestations during the recanalization of GSV even in the presence of reflux. GSV recanalization without clinical manifestations was demonstrated in a trial by J.T.Christenson[27]. This being said, the recurrence of varicose veins in our patients was minor, in many cases not noticed by the patient, and was not associated with a significant increase in mean VCSS. LEED that was used in the EVLA group was at par with other studies[25-28].

Two major limitations of the study include its study design (i.e. non-randomized nature) and small sample size (derived from a single center). Moreover, group allocation based on the GSV diameter does not take into account other characteristics of reflux and the state of the muscular pump of the calf. Nonetheless, we have not noted any reflux below the knee in patients with GSV>6. The results obtained in a prospective study of the GSV preservation concept in real clinical practice are encouraging. Further follow-up with an increased number of patients will probably provide more evidence on this topic.

Conclusion

Patients suffering from varicose disease with GSV incompetence have certain differences in severity and the course of the disease, therefore treatment should be individualized. We found similar good results using the following treatment
options: selective phlebectomy with GSV preservation for patients with diameter ≤ 6 mm and mild clinical course of the disease and/or with mostly cosmetic concerns; and GSV ablation with concomitant phlebectomy in more severe clinical cases and GSV diameter > 6 mm. Both ASVAL and EVELA effectively improve the disease severity in the groups of patients, selected according to the GSV diameter.

The results obtained in a prospective study of GSV preservation in real clinical practice are quite encouraging. Further large randomized trials will probably provide more evidence on this topic.

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**Guarantor:** II

**Contributorship:** II and KI researched literature and conceived the study. II, GK, JD, and NN were involved in protocol development, gaining ethical approval, patient recruitment, and data analysis. KI and II wrote the first draft of the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

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**References**

1. van den Bos RR, Arends L, Kockaert M, Neumann M, Nijsten T (2009) Endovenous therapies of lower extremity varicosities. a meta-analysis. J Vasc Surg 49: 230-239. [Link: https://bit.ly/3zi16xr]
2. Carroll C, Hummel S, Leaviss J, Ren S, Stevens JW, et al. (2013) Clinical effectiveness and cost-effectiveness of minimally invasive techniques to manage varicose veins: a systematic review and economic evaluation. Health Technol Assess 17: xvi, 1-141. [Link: https://bit.ly/34559u3]
3. Nesbitt C, Bedenis R, Bhattacharya V, Stansby G (2014) Endovenous ablation (radiofrequency and laser) and foam sclerotherapy versus conventional surgery for great saphenous vein varicosities. Cochrane Database Syst Rev 7: CD005624. [Link: https://bit.ly/3JBKryj]
4. 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: CD010878. [Link: https://bit.ly/3mpQyVzG]
5. Rasmussen LH, Bjoern L, Lawaetz M, Lawaetz B, Lemlings A, et al. (2010) Randomised clinical trial comparing endovenous laser ablation with stripping of the great saphenous vein: clinical outcome and recurrence after 2 years. Eur J Vasc Endovasc Surg 39: 630-635. [Link: https://bit.ly/3FPUU7L]
6. Rass K, Frings N, Glowacki P, Hamsch C, Gräber S, et al. (2012) Comparable effectiveness of endovenous laser ablation and high ligation with stripping of the great saphenous vein two-year results of a randomized clinical trial (RELACS Study). Arch Dermatol 148: 49-58. [Link: https://bit.ly/3EqfKcE]
7. Rasmussen L, Lawaetz M, Bjoern L, Lemlings A, Ekløf B (2013) Randomized clinical trial comparing endovenous laser ablation and stripping of the great saphenous vein with clinical and duplex outcome after 5 years. J Vasc Surg 58: 421-426. [Link: https://bit.ly/3qGnHTp]
8. Rass K, Frings N, Glowacki P, Gräber S, Tilgen W, et al. (2015) Same site recurrence is more frequent after endovenous laser ablation compared with high ligation and stripping of the great saphenous vein: 5-year results of a randomized clinical trial (RELACS Study). Eur J Vasc Endovasc Surg 50: 648-656. [Link: https://bit.ly/32mVpOu]
9. Głowacki J, Comerota AJ, Dalsing MC, Eklöf BG, Gillespie DL, et al. (2011) The care of patients with varicose veins and associated chronic venous diseases: Clinical practice guidelines of the Society for Vascular Surgery and the American Venous Forum. J Vasc Surg 53: 2S-48S. [Link: https://bit.ly/3eKyUy0N]
10. Nicolaides A, Kakkos S, Baekgaard N, Comerota A, de Maeseneer M, et al. (2018) Management of chronic venous disorders of the lower limbs. Guidelines According to Scientific Evidence. Part I. Int Angiol 37: 181-254. [Link: https://bit.ly/3StCkr2]
11. Wittens C, Davies AH, Baekgaard N, Broholm R, Cavezza A, et al. (2015) Editor’s Choice - Management of Chronic Venous Disease: Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg 49: 678-737. [Link: https://bit.ly/3epfPLl]
12. Rau J, Ward M, Jones T (2015) Quantifying saphenous reflux. J Vasc Surg Venous and Lym Dis 3: 8-17. [Link: https://bit.ly/32BWBS3]
13. Mendoza E, Blättler W, Amsler F (2006) Intra- and Inter-observer Reproducibility of the saphenofemoral junction and proximal thigh as parameters of venous disease class. Eur J Vasc Endovasc Surg 45: 288-299. [Link: https://bit.ly/330Ww29]
14. Cavezzi A, Labropoulos N, Partsh C, Ricci S, Caggiani A, Myers K, et al. (2006) Duplex ultrasound investigation of the veins in chronic venous disease of the lower limbs–UIP Consensus Document. Part II. Anatomy. Eur J Vasc Endovasc Surg 31: 289-299. [Link: https://bit.ly/3E0w1Cw]
15. Vuylstee ME, Thomis S, Mahieu P, Mordon S, Fournier I (2012) Endovenous laser ablation of the great saphenous vein using a bare fibre versus a tulip fibre: a randomised clinical trial. Eur J Vasc Endovasc Surg 44: 587-592. [Link: https://bit.ly/32izCzX]
16. Perrin M, Allaert FA (2006) Intra- and Inter-observer Reproducibility of the Recurrent Varicose Veins after Surgery (REVAS) Classification. Eur J Vasc Endovasc Surg 32: 326-332. [Link: https://bit.ly/32mukLM]
17. Eklöf B, Perrin MR, Delis KT, Rutherford RB, Głowacki J (2009) Updated terminology of chronic venous disorders: the VEIN-TERM transatlantic interdisciplinary consensus document. J Vasc Surg 49: 498-501. [Link: https://bit.ly/3qL4Ah]
18. Aboyans V, Ricco JB, Bartelink ML, Bjorck M, Brodmann M, et al. (2017) 2017 ESC Guidelines on the diagnosis and treatment of peripheral arterial diseases, in collaboration with the European Society for Vascular Surgery (ESVS). Eur Heart J 00: 1-60. [Link: https://bit.ly/3zYFpJ1]
19. Pittaluga P, Chevillet S (2013) Varicose vein recurrence after pregnancy: influence of the preservation of the saphenous vein in nullipara patients. In: Bastos, Francisco Reis. Anais do V Simpósio Internacional de Flebologia [Blucher Medical Proceedings 1: 81. [Link: https://bit.ly/33ot7euf]
20. Creton D (1999) Diameter reduction of the proximal long saphenous vein after ablation of a distal incompetent tributary. Dermatol Surg 25: 394-398. [Link: https://bit.ly/3sOmwmt]

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21. Theivacumar NS, Darwood RJ, Gough MJ (2009) Endovenous laser ablation (EVLA) of the anterior accessory great saphenous vein (AAGSV): abolition of sapheno-femoral reflux with preservation of the great saphenous vein. Eur J Vasc Endovasc Surg 37: 477-481. [Link](https://bit.ly/3FRLTpi)

22. Pittaluga P, Chastanet S, Locret T, Barbe R (2010) The effect of isolated phlebectomy on reflux and diameter of the great saphenous vein: a prospective study. Eur J Vasc Endovasc Surg 40: 122-128. [Link](https://bit.ly/3JDzCQ)

23. Pittaluga P, Chastanet S, Rea B, Barbe R (2009) Midterm results of the surgical treatment of varices by phlebectomy with conservation of a refluxing saphenous vein. J Vasc Surg 50: 107-118. [Link](https://bit.ly/3FPUtskt)

24. Zolotukhin IA, Seliverstov EI, Zakharova EA, Kirienko AI (2017) Short-term results of isolated phlebectomy with preservation of incompetent great saphenous vein (ASVAL procedure) in primary varicose veins disease. Phlebology 32: 601-607. [Link](https://bit.ly/3JE6css)

25. Theivacumar NS, Darwood R, Gough MJ (2009) Neovascularisation and recurrence 2 years after varicose vein treatment for sapheno-femoral and great saphenous vein reflux: a comparison of surgery and endovenous laser ablation. Eur J Vasc Endovasc Surg 38: 203-207. [Link](https://bit.ly/3eJx246)

26. Theivacumar NS, Dellagrammaticas D, Darwood RJ (2008) Fate of the great saphenous vein following endovenous laser ablation: does recanalisation mean recurrence? Eur J Vasc Endovasc Surg 36: 211-215. [Link](https://bit.ly/3ziAkoJ)

27. Christenson JT, Gueddi S, Gemayel G, Bounameux H (2010) Prospective randomized trial comparing endovenous laser ablation and surgery for treatment of primary great saphenous varicose veins with a 2-year follow-up. J Vasc Surg 52: 1234-1241. [Link](https://bit.ly/3eMCyCo)

28. Pronk P, Gauw SA, Mooij MC, Gaastra MT, Lawson JA, et al. (2010) Randomised controlled trial comparing sapheno-femoral ligation and stripping of the great saphenous vein with endovenous laser ablation (980 nm) using local tumescent anaesthesia: one year results. Eur J Vasc Endovasc Surg 40: 649-656. [Link](https://bit.ly/3ziOAOQ)

29. Ignatovich IN, Kondratenko GG, Novikova NM, Ignatovich EI (2020) Preservation or obliteration of Great Saphenous Vein in surgery for varicose veins of the lower extremities: long-term follow-up data of single-center study. Phlebologiya 14: 19-24.