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## Medical Policy



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**\*Current Policy Effective Date: 7/1/26**  
(See policy history boxes for previous effective dates)

### **Title: Treatment of Varicose Veins/Venous Insufficiency**

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#### **Description**

A variety of treatment modalities are available to treat varicose veins/venous insufficiency, including surgery, thermal ablation, sclerotherapy, mechanochemical ablation (MOCA), cyanoacrylate adhesive (CAC), and cryotherapy. However, not all treatments are considered medically necessary. The application of each modality is influenced by the severity of the symptoms, type of vein, source of venous reflux, and the use of other (prior or concurrent) treatment.

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#### **Medical Policy Statement**

Treatment of the great or small saphenous veins by surgery (ligation and stripping), endovenous thermal ablation (radiofrequency or laser), microfoam sclerotherapy or cyanoacrylate adhesive is **established** when criteria are met.

Treatment of accessory saphenous veins by surgery (ligation and stripping), endovenous radiofrequency or laser ablation, microfoam sclerotherapy or cyanoacrylate adhesive is **established** when criteria are met.

Treatment of symptomatic varicose tributaries is **established** when criteria is met.

Treatment of leg ulcers associated with chronic venous insufficiency by surgical ligation (including subfascial endoscopic perforator surgery) or endovenous radiofrequency or laser ablation of incompetent perforator veins is **established** when criteria is met.

Endovenous ablation of varicose veins by mechanochemical (ClariVein®) is **experimental/investigational**. There is insufficient evidence to determine that the technology results in an improvement in net health outcomes.

Endovenous cryoablation (e.g., VenaSeal) of any vein is **experimental/investigational**. There is insufficient evidence to determine that the technology results in an improvement in net health outcomes.

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## **Inclusionary and Exclusionary Guidelines**

### **Great or Small Saphenous Veins**

Treatment of the great or small saphenous veins by surgery (ligation and stripping), endovenous thermal ablation (radiofrequency or laser), microfoam sclerotherapy or cyanoacrylate adhesive criteria:

- There is demonstrated saphenous reflux and CEAP [Clinical, Etiology, Anatomy, Pathophysiology] class C2 or greater; **AND**
- There is documentation of 1 or more of the following indications:
  - Ulceration secondary to venous stasis; **OR**
  - Recurrent superficial thrombophlebitis; **OR**
  - Hemorrhage or recurrent bleeding episodes from a ruptured superficial varicosity; **OR**
  - Persistent pain, swelling, itching, burning, or other symptoms are associated with saphenous reflux, **AND** the symptoms significantly interfere with activities of daily living, **AND** conservative management including compression therapy for at least 3 months has not improved the symptoms.
    - Conservative management must include a trial of compression therapy garments, **OR**
    - Medical reason for compression therapy exemption is documented (e.g., existing chronic limb ischemia, severe musculoskeletal disability, morbid obesity, unusual leg anatomy)

### **Accessory Saphenous Veins**

Treatment of accessory saphenous veins by surgery (ligation and stripping), endovenous radiofrequency or laser ablation, microfoam sclerotherapy or cyanoacrylate adhesive criteria:

- Incompetence of the accessory saphenous vein is isolated, **AND**
- There is demonstrated accessory saphenous reflux; **AND**
- There is documentation of 1 or more of the following indications:
  - Ulceration secondary to venous stasis; **OR**
  - Recurrent superficial thrombophlebitis; **OR**
  - Hemorrhage or recurrent bleeding episodes from a ruptured superficial varicosity; **OR**
  - Persistent pain, swelling, itching, burning, or other symptoms are associated with saphenous reflux, **AND** the symptoms significantly interfere with activities of daily living, **AND** conservative management including compression therapy for at least 3 months has not improved the symptoms.
    - Conservative management must include a trial of compression therapy garments, **OR**

- Medical reason for compression therapy exemption is documented (e.g., existing chronic limb ischemia, severe musculoskeletal disability, morbid obesity, unusual leg anatomy)

Concurrent treatment of the accessory saphenous veins along with the great or small saphenous veins is established when criteria are met for each vein and there is documentation of anatomy showing that the accessory saphenous vein discharged directly into the common femoral vein.

**Note:** Radiofrequency or laser treatment of varicose veins will be covered for two treatments per lower extremity per individual per lifetime. Any additional claims should be submitted using and NOC code to facilitate evaluation for reimbursement. An unusual situation such as a demonstrated recanalized vessel, would be considered for reimbursement on an individual case by case basis.

### **Symptomatic Varicose Tributaries**

The following treatments are established in the treatment of symptomatic varicose tributaries\* of the saphenous veins (none of these techniques has been shown to be superior to another):

- Stab avulsion
- Hook phlebectomy
- Sclerotherapy
- Transilluminated powered phlebectomy.

\* when performed either at the same time or following prior treatment (surgical, radiofrequency, or laser)

### **Perforator Veins**

Surgical ligation (including subfascial endoscopic perforator surgery) or endovenous radiofrequency or laser ablation of incompetent perforator veins as a treatment of leg ulcers associated with chronic venous insufficiency criteria:

- There is demonstrated perforator reflux; **AND**
- The superficial saphenous veins (great, small, or accessory saphenous and symptomatic varicose tributaries) have been previously eliminated; **AND**
- Ulcers have not resolved following combined superficial vein treatment and compression therapy for at least 3 months; **AND**
- The venous insufficiency is not secondary to deep venous thromboembolism.

### **Telangiectasia**

Treatment of telangiectasia such as spider veins, angiomas, and hemangiomas is cosmetic and not covered.

### **Exclusions:**

Techniques for conditions not specifically listed above are **experimental/investigational**, including, but not limited to:

- Sclerotherapy techniques, other than microfoam sclerotherapy, of great, small, or accessory saphenous veins
- Sclerotherapy of perforator veins

- Sclerotherapy of isolated tributary veins without prior or concurrent treatment of saphenous veins
- Stab avulsion, hook phlebectomy, or transilluminated powered phlebectomy of perforator, great or small saphenous, or accessory saphenous veins
- Endovenous radiofrequency or laser ablation of tributary veins
- Mechanochemical ablation of any vein
- Endovenous cryoablation of any vein.
- Ligation or ablation of incompetent perforator veins performed concurrently with superficial venous surgery is not covered.

**Note:** The standard classification of venous disease is the CEAP (Clinical, Etiologic, Anatomic, Pathophysiologic) classification system. Table PG1 provides the Clinical portion of the CEAP.

**Table PG1. Clinical Portion of the CEAP Classification System**

| Class           | Definition                                               |
|-----------------|----------------------------------------------------------|
| C <sub>0</sub>  | No visible or palpable signs of venous disease           |
| C <sub>1</sub>  | Telangiectasies or reticular veins                       |
| C <sub>2</sub>  | Varicose veins                                           |
| C <sub>2r</sub> | Recurrent varicose veins                                 |
| C <sub>3</sub>  | Edema                                                    |
| C <sub>4</sub>  | Changes in skin and subcutaneous tissue secondary to CVD |
| C <sub>4a</sub> | Pigmentation and eczema                                  |
| C <sub>4b</sub> | Lipodermatosclerosis or atrophie blanche                 |
| C <sub>4c</sub> | Corona phlebectatica                                     |
| C <sub>5</sub>  | Healed                                                   |
| C <sub>6</sub>  | Active venous ulcer                                      |
| C <sub>6r</sub> | Recurrent active venous ulcer                            |
| S               | Symptomatic                                              |
| A               | Asymptomatic                                             |

Adapted from: [https://www.jvsvenous.org/article/S2213-333X\(20\)30063-9/pdf](https://www.jvsvenous.org/article/S2213-333X(20)30063-9/pdf)

CEAP: Clinical, Etiologic, Anatomic, Pathophysiologic classification system; CVD, chronic venous disease. Each clinical class subcharacterized by a subscript indicates the presence (symptomatic, s) or absence (asymptomatic, a) of symptoms attributable to venous disease.

## CPT/HCPCS Level II Codes

### Established codes:

|       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|
| 36465 | 36466 | 36470 | 36471 | 36475 | 36476 |
| 36478 | 36479 | 36482 | 36483 | 37700 | 37718 |
| 37722 | 37735 | 37760 | 37761 | 37765 | 37766 |
| 37780 | 37785 | 76942 | S2202 |       |       |

### **Other codes (investigational, not medically necessary, etc.):**

0524T      37799      36468      36473      36474

#### **Notes:**

- *Code(s) may not be covered by all contracts or certificates. Please consult customer or provider inquiry resources at BCBSM or BCN to verify coverage.*
  - *Individual policy criteria determine the coverage status of the CPT/HCPCS code(s) on this policy. Codes listed in this policy may have different coverage positions (such as established or experimental/investigational) in other medical policies.*
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## **Background**

### **Venous Reflux/Venous Insufficiency**

The venous system of the lower extremities consists of the superficial veins (this includes the great and small saphenous and accessory, or duplicate, veins that travel in parallel with the great and small saphenous veins), the deep system (popliteal and femoral veins), and perforator veins that cross through the fascia and connect the deep and superficial systems. One-way valves are present within all veins to direct the return of blood up the lower limb. Because the venous pressure in the deep system is generally greater than that of the superficial system, valve incompetence at any level may lead to backflow (venous reflux) with pooling of blood in superficial veins. Varicose veins with visible varicosities may be the only sign of venous reflux, although itching, heaviness, tension, and pain may also occur. Chronic venous insufficiency secondary to venous reflux can lead to thrombophlebitis, leg ulcerations, and hemorrhage. The CEAP classification of venous disease considers the clinical, etiologic, anatomic, and pathologic characteristics of venous insufficiency, ranging from class 0 (no visible sign of disease) to class 6 (active ulceration).

### **Treatment of Saphenous Veins and Tributaries**

Saphenous veins include the great and small saphenous and accessory saphenous veins that travel in parallel with the great or small saphenous veins. Tributaries are veins that empty into a larger vein. Treatment of venous reflux has traditionally included the following:

- Identification by preoperative Doppler ultrasonography of the valvular incompetence
- Control of the most proximal point of reflux, traditionally by suture ligation of the incompetent saphenofemoral or saphenopopliteal junction
- Removal of the superficial vein from circulation, e.g., by stripping of the great and/or small saphenous veins.
- Removal of varicose tributaries (at the time of the initial treatment or subsequently) by stab avulsion (phlebectomy) or injection sclerotherapy.

Minimally invasive alternatives to surgical ligation and stripping have been investigated. These include forms of sclerotherapy, cyanoacrylate adhesive, and thermal ablation using cryotherapy, high-frequency radio waves (200 to 300 kHz), or laser energy.

### **Thermal Ablation**

Radiofrequency ablation (RFA) is performed using a specially designed catheter inserted through a small incision in the distal medial thigh to within 1 to 2 cm of the saphenofemoral junction. The catheter is slowly withdrawn, closing the vein. Laser ablation is performed similarly. A laser fiber is introduced into the great saphenous vein under ultrasound

guidance. The laser is then activated and slowly removed, along the course of the saphenous vein. Cryoablation uses extreme cold. The objective of endovenous techniques is to injure the vessel, causing retraction and subsequent fibrotic occlusion of the vein. Technical developments since thermal ablation procedures were initially introduced include the use of perivenous tumescent anesthesia, which allows successful treatment of veins larger than 12 mm in diameter and helps to protect adjacent tissue from thermal damage during treatment of the small saphenous vein.

### **Sclerotherapy**

The objective of sclerotherapy is to destroy the endothelium of the target vessel by injecting an irritant solution (either a detergent, osmotic solution, or chemical irritant), ultimately occluding the vessel. Treatment success depends on accurate injection of the vessel, an adequate injectate volume and concentration of sclerosant, and compression. Historically, larger veins and very tortuous veins were not considered good candidates for sclerotherapy due to technical limitations. Technical improvements in sclerotherapy have included the routine use of Duplex ultrasound to target refluxing vessels, luminal compression of the vein with anesthetics, and a foam/sclerosant injectate in place of liquid sclerosant. Foam sclerosants are produced by forcibly mixing a gas (e.g., air or carbon dioxide) with a liquid sclerosant (e.g., polidocanol or sodium tetradecyl sulfate). Physician-compounded foam is produced at the time of treatment. A commercially available microfoam sclerosant with a proprietary gas mix is available and is proposed to provide a smaller and more consistent bubble size than what is produced with physician-compounded sclerosant foam.

### **Endovenous Mechanochemical Ablation**

Endovenous mechanochemical ablation uses both sclerotherapy and mechanical damage to the lumen. Following ultrasound imaging, a disposable catheter with a motor drive is inserted into the distal end of the target vein and advanced to the saphenofemoral junction. As the catheter is pulled back, a wire rotates at 3500 rpm within the lumen of the vein, abrading the lumen. At the same time, a liquid sclerosant (sodium tetradecyl sulfate) is infused near the rotating wire. It is proposed that mechanical ablation allows for better efficacy of the sclerosant, and results in less pain and risk of nerve injury without the need for the tumescent anesthesia used with endovenous thermal ablation techniques (RFA, endovenous laser ablation).

### **Cyanoacrylate Adhesive**

A cyanoacrylate adhesive is a clear, free-flowing liquid that polymerizes in the vessel via an anionic mechanism (i.e., polymerizes into a solid material on contact with body fluids or tissue). The adhesive is gradually injected along the length of the vein in conjunction with ultrasound and manual compression. The acute coaptation halts blood flow through the vein until the implanted adhesive becomes fibrotically encapsulated and establishes chronic occlusion of the treated vein. Cyanoacrylate glue has been used as a surgical adhesive and sealant for a variety of indications, including gastrointestinal bleeding, embolization of brain arteriovenous malformations, and surgical incisions or other skin wounds.

### **Transilluminated Powered Phlebectomy**

Transilluminated powered phlebectomy is an alternative to stab avulsion and hook phlebectomy. This procedure uses 2 instruments: an illuminator, which also provides irrigation, and a resector, which has an oscillating tip and suction pump. Following removal of the saphenous vein, the illuminator is introduced via a small incision in the skin and tumescence solution (anesthetic and epinephrine) is infiltrated along the course of varicosity.

The resector is then inserted under the skin from the opposite direction, and the oscillating tip is placed directly beneath the illuminated veins to fragment and loosen the veins from the supporting tissue. Irrigation from the illuminator is used to clear the vein fragments and blood through aspiration and additional drainage holes. The illuminator and resector tips may then be repositioned, thereby reducing the number of incisions needed when compared with stab avulsion or hook phlebectomy. It has been proposed that transilluminated powered phlebectomy might decrease surgical time, decrease complications such as bruising, and lead to a faster recovery than established procedures.

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## Summary of Evidence

### Saphenous Veins

For individuals who have varicose veins/venous insufficiency and saphenous vein reflux who receive endovenous thermal ablation (radiofrequency or laser), the evidence includes randomized controlled trials (RCTs) and systematic reviews of controlled trials. Relevant outcomes are symptoms, change in disease status, morbid events, quality of life, and treatment-related morbidity. There are a number of large RCTs and systematic reviews of RCTs assessing endovenous thermal ablation of the saphenous veins. Comparison with the standard of ligation and stripping at 2- to 5-year follow-up has supported the use of both endovenous laser ablation and radiofrequency ablation (RFA). Evidence has suggested that ligation and stripping lead to more neovascularization, while thermal ablation leads to more recanalization, resulting in similar clinical outcomes for endovenous thermal ablation and surgery. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have varicose veins/venous insufficiency and saphenous vein reflux who receive microfoam sclerotherapy, the evidence includes RCTs and systematic reviews. Relevant outcomes are symptoms, change in disease status, morbid events, quality of life, and treatment-related morbidity. In a Cochrane review, ultrasound-guided foam sclerotherapy was inferior to both ligation and stripping and endovenous laser ablation for technical success up to 5 years and beyond 5 years, but there was no significant difference between treatments for recurrence up to 3 years and at 5 years. For physician-compounded sclerotherapy, there is high variability in success rates and some reports of serious adverse events. By comparison, rates of occlusion with the microfoam sclerotherapy (polidocanol 1%) approved by the U.S. Food and Drug Administration (FDA) are similar to those reported for endovenous laser ablation or stripping. Results of a noninferiority trial of physician-compounded sclerotherapy have indicated that once occluded, recurrence rates at 2 years are similar to those of ligation and stripping. Together, this evidence indicates that the more consistent occlusion with the microfoam sclerotherapy preparation will lead to recurrence rates similar to ligation and stripping in the longer term. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have varicose veins/venous insufficiency and saphenous vein reflux who receive mechanochemical ablation (MOCA), the evidence includes 4 RCTs with 6 months to 2-year results that compared MOCA to thermal ablation, and 2 prospective cohorts with follow-up out to 8 years. Relevant outcomes are symptoms, change in disease status, morbid events, quality of life, and treatment-related morbidity. MOCA is a combination of liquid sclerotherapy

with mechanical abrasion. A potential advantage of this procedure compared with thermal ablation is that MOCA does not require tumescent anesthesia and may result in less pain during the procedure. Results to date have been mixed regarding a reduction in intraprocedural pain compared to thermal ablation procedures. Occlusion rates at 6 months to 2 years from RCTs indicate lower anatomic success rates compared to thermal ablation, but a difference in clinical outcomes at these early time points has not been observed. Experience with other endoluminal ablation procedures suggests that lower anatomic success in the short term is associated with recanalization and clinical recurrence between 2 to 5 years. The possibility of later clinical recurrence is supported by prospective cohort studies with up to 8-year follow-up following treatment with MOCA. However, there have been improvements in technique since the cohort studies began, and clinical progression is frequently observed with venous disease. Because of these limitations, longer follow-up of the more recently conducted RCTs is needed to establish the efficacy and durability of this procedure compared with the criterion standard of thermal ablation. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have varicose veins/venous insufficiency and saphenous vein reflux who receive cyanoacrylate adhesive (CAC), the evidence includes 2 RCTs and prospective cohort studies. Relevant outcomes are symptoms, change in disease status, morbid events, quality of life, and treatment-related morbidity. Evidence includes a multicenter noninferiority trial with follow-up through 36 months, 2 RCTs with follow-up through 24 months, and a prospective cohort with 30-month follow-up. The short-term efficacy of VenaSeal CAC has been shown to be noninferior to RFA at up to 36 months. At 24 and 36 months, the study had greater than 20% loss to follow-up, but loss to follow-up was similar in the 2 groups at the long-term follow-up and is not expected to influence the comparative results. Another RCT (N=248) comparing VenaSeal CAC with RFA found similar proportions of vein closures at 24 months with both treatments, with potentially shorter procedure duration with CAC vs RFA. A third RCT (N=525) with the same active CAC ingredient (N-butyl cyanoacrylate) that is currently available outside of the U.S. found no significant differences in vein closure between CAC and thermal ablation controls at 24-month follow-up. The CAC procedure and return to work were shorter and pain scores were lower compared to thermal ablation, although the subjective pain scores may have been influenced by differing expectations in this study. Prospective cohort studies report high closure rates at follow up to 30 months.

Overall, results indicate that outcomes from CAC are at least as good as thermal ablation techniques, the current standard of care. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have varicose veins/venous insufficiency and saphenous vein reflux who receive cryoablation, the evidence includes RCTs. Relevant outcomes are symptoms, change in disease status, morbid events, quality of life, and treatment-related morbidity. Results from a recent RCT of cryoablation have indicated that this therapy is inferior to conventional stripping. Studies showing a benefit on health outcomes are needed. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

### **Varicose Tributary Veins**

For individuals who have varicose tributary veins who receive ablation (stab avulsion, sclerotherapy, or phlebectomy) of tributary veins, the evidence includes RCTs and systematic reviews of RCTs. Relevant outcomes are symptoms, change in disease status, morbid events,

quality of life, and treatment-related morbidity. The literature has shown that sclerotherapy is effective for treating tributary veins following occlusion of the saphenofemoral or saphenopopliteal junction and saphenous veins. No studies have been identified comparing RFA or laser ablation of tributary veins with standard procedures (microphlebectomy and/or sclerotherapy). Transilluminated powered phlebectomy (TIPP) is effective at removing varicosities; outcomes are comparable to available alternatives such as stab avulsion and hook phlebectomy. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

### **Perforator Veins**

For individuals who have perforator vein reflux who receive ablation (e.g., subfascial endoscopic perforator surgery) of perforator veins, the evidence includes RCTs, systematic reviews of RCTs, and a retrospective study. Relevant outcomes are symptoms, change in disease status, morbid events, quality of life, and treatment-related morbidity. The literature has indicated that the routine ligation or ablation of incompetent perforator veins is not necessary for the treatment of varicose veins/venous insufficiency at the time of superficial vein procedures. However, when combined superficial vein procedures and compression therapy have failed to improve symptoms (i.e., ulcers), treatment of perforator vein reflux may be as beneficial as an alternative (e.g., deep vein valve replacement). Comparative studies are needed to determine the most effective method of ligating or ablating incompetent perforator veins. Subfascial endoscopic perforator surgery is possibly as effective as the Linton procedure with a reduction in adverse events. Endovenous ablation with specialized laser or radiofrequency probes has been shown to effectively ablate incompetent perforator veins with a potential decrease in morbidity compared with surgical interventions. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

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## **Rationale**

Evidence reviews assess the clinical evidence to determine whether the use of a technology improves the net health outcome. Broadly defined, health outcomes are length of life, quality of life, and ability to function including benefits and harms. Every clinical condition has specific outcomes that are important to individuals and to managing the course of that condition. Validated outcome measures are necessary to ascertain whether a condition improves or worsens; and whether the magnitude of that change is clinically significant. The net health outcome is a balance of benefits and harms. The following is a summary of the key literature to date.

### **Treatment of Saphenous Veins**

#### **Clinical Context and Therapy Purpose**

Treatment of venous reflux/venous insufficiency seeks to reduce abnormal pressure transmission from the deep to the superficial veins. Conservative medical treatment consists of elevation of the extremities, graded compression, and wound care when indicated. Conventional surgical treatment consists of identifying and correcting the site of reflux by ligation of the incompetent junction followed by stripping of the vein to redirect venous flow through veins with intact valves. While most venous reflux is secondary to incompetent valves

at the saphenofemoral or saphenopopliteal junctions, reflux may also occur at incompetent valves in the perforator veins or the deep venous system. The competence of any single valve is not static and may be pressure-dependent. For example, accessory saphenous veins may have independent saphenofemoral or saphenopopliteal junctions that become incompetent when the great or small saphenous veins are eliminated, and blood flow is diverted through the accessory veins.

The following section addresses the efficacy of the conventional treatments, specifically on the appropriate length of a trial of compression therapy and evaluation of recurrence rates for surgical treatment (i.e., ligation and stripping) compared with compression therapy.

### **Compression Therapy**

A Cochrane review by O'Meara et al (2009) evaluating compression for venous leg ulcers included 39 RCTs with 47 different comparisons.<sup>1</sup> This review was updated in 2012 and included 48 RCTs with 59 different comparisons.<sup>2</sup> Most RCTs were small. Measures of healing were the time to complete healing, the proportion of ulcers healed within the trial period (typically 12 weeks), the change in ulcer size, and the rate of change in ulcer size. Evidence from 8 trials indicated that venous ulcers healed more rapidly with compression than without. Findings suggested that multicomponent systems (bandages or stockings) were more effective than single-component compression. Also, multicomponent systems containing an elastic bandage appeared more effective than those composed mainly of inelastic constituents. Although these meta-analyses did not include time to healing, studies included in the review reported the mean time to ulcer healing was approximately 2 months, while the median time to healing in other reports was 3 to 5 months.

A Cochrane review by Knight Nee Shingler et al (2021) assessed compression stockings as an initial treatment for varicose veins in patients without venous ulceration.<sup>3</sup> This is the second update of a review first published in 2011. Thirteen studies involving 1021 participants with varicose veins without healed or active venous ulceration (CEAP [Clinical, Etiology, Anatomy, Pathophysiology] class C2 to C4) were selected. Compression ranged from 10 to 50 mmHg among studies. Studies could not be pooled for analysis due to heterogeneity in outcomes and method of assessment leading to a low or very low certainty of evidence. Using compression stockings compared to no treatment or placebo stockings led to subjective improvement in symptoms but this finding could be biased because the change in symptoms was not compared to the control arm in all studies. Studies that compared different compression stockings also found subjective improvement in symptoms from baseline to the end of the study, but the change in symptoms was not always compared between groups. The authors were unable to make conclusions about the optimal stocking pressure or length of stocking exposure from the included studies. Reviewers concluded that there was insufficient high-quality evidence to determine whether compression stockings were effective as the sole and initial treatment of varicose veins in patients without venous ulceration, or whether any type of stocking was superior to another type.

### **Ligation and Stripping**

Systematic literature reviews have indicated a similar healing rate of venous ulcers with superficial vein surgery and conservative compression treatments but a reduction in ulcer recurrence rate with surgery.<sup>4,5</sup> In general, recurrence rates after ligation and stripping are estimated at 20% in short-term follow-up. Jones et al (1996) reported on the results of a trial that randomized 100 patients with varicose veins to ligation alone or ligation plus stripping.<sup>6</sup> At

1 year, reflux was detected in 9% of patients, rising to 26% at 2 years. Rutgers and Kitslaar (1994) reported on the results of a trial that randomized 181 limbs to ligation and stripping or to ligation plus sclerotherapy.<sup>7</sup> At 2 years, Doppler ultrasound demonstrated reflux in approximately 10% of patients after ligation and stripping, increasing to 15% at 3 years.

### **Alternatives to Ligation and Stripping**

The purpose of endovenous thermal ablation (radiofrequency or laser), microfoam sclerotherapy, mechanochemical ablation (MOCA), cyanoacrylate adhesive (CAC), or cryoablation in patients who have varicose veins/venous insufficiency and saphenous vein reflux is to provide a treatment option that is an alternative to or an improvement on existing treatments.

## **Review of Evidence**

### **Treatment of Saphenous Veins: Endovenous Thermal Ablation (Laser or Radiofrequency)**

#### **Systematic Reviews**

Farah et al (2022) conducted a systematic review and meta-analysis that informed the 2022 mutiorganization guideline on management of varicose veins.<sup>8</sup> The review addressed 3 key questions related to treatment: whether there is a benefit of surgical stripping versus endovenous ablation, whether there is a benefit of thermal versus nonthermal ablation techniques, and whether ablation of incompetent perforator veins improves outcomes. Multiple outcomes of interest were assessed at various time points for each question. For the first key question, an analysis of 30 RCTs and 16 observational studies found few studies that reported the outcomes of interest at each time point (between 1 month and 5 years), but anatomic closure was better with surgical stripping compared to endovenous ablation techniques. Analysis for the second question included 16 RCTs and 11 observational studies, few of which included the outcomes of interest at the time points of interest. Overall, endovenous laser ablation resulted in higher rates of anatomical closure at 1 year and 5 years versus nonthermal ablation techniques.

A Cochrane review by Whing et al (2021) compared interventions for great saphenous vein incompetence.<sup>9</sup> The review included 24 RCTs (N=5135) and the duration of follow-up for included trials ranged from 5 weeks to 8 years. When comparing endovenous laser ablation to ligation and stripping, pooled data from 6 RCTs (n=1051) suggest that technical success may be better with endovenous laser ablation up to 5 years (odds ratio [OR], 2.31, 95% confidence interval [CI], 1.27 to 4.23; low-certainty evidence), but not at 5 years and beyond based on data from 5 RCTs (n=874). The risk of recurrence is similar between treatments within 3 years and at 5 years based on data from 7 RCTs each (n=1459 and n=1267, respectively). When comparing radiofrequency ablation (RFA) to ligation and stripping, data from 2 RCTs (n=318) suggest that there is no significant difference in the rate of technical success up to 5 years; data from 1 RCT (n=289) with duration over 5 years also suggest no significant difference between treatments. Based on data from 4 RCTs (n=546), there is no significant difference in the risk of recurrence up to 3 years; but based on 1 trial (n=289), a possible long-term benefit for RFA is observed (OR, 0.41, 95% CI, 0.22 to 0.75; low-certainty evidence). When comparing endovenous laser ablation with RFA, technical success is comparable up to 5 years and over 5 years. Based on data from 1 study (n=291), there is no significant difference in the

risk of recurrence between treatments at 3 years, but a benefit for RFA over endovenous laser ablation may be seen at 5 years (OR, 2.77, 95% CI, 1.52 to 5.06).

A Cochrane review by Paravastu et al (2016) compared endovenous laser ablation or RFA with surgical repair for small saphenous veins with reflux at the saphenopopliteal junction.<sup>10</sup> Three RCTs identified compared endovenous laser ablation with surgery. There was moderate-quality evidence that recanalization or persistence of reflux at 6 weeks occurred less frequently after endovenous laser ablation than after surgery (OR, 0.07, 95% CI, 0.02 to 0.22), and low-quality evidence that recurrence of reflux was lower after endovenous laser ablation at 1 year (OR, 0.24, 95% CI, 0.07 to 0.77).

## **Randomized Controlled Trials**

The largest RCT was reported by Brittenden et al (2014) and compared foam sclerotherapy, endovenous laser ablation, and surgical treatment in 798 patients.<sup>11</sup> The trial was funded by the U.K.'s National Institute for Health Research. Veins greater than 15 mm in diameter were excluded from the trial. At the 6-week follow-up visit, patients assigned to treatment with foam or laser had the option of treatment with foam for any residual varicosities. This optional treatment was performed in 38% of patients in the foam group and 31% of patients in the endovenous laser ablation group. Disease-specific quality of life was similar for the laser and surgery groups. The frequency of procedural complications was similar for the foam sclerotherapy (6%) and surgery (7%) groups but was lower for the laser group (1%).

The 2012 Randomized Study Comparing Endovenous Laser Ablation with Crossectomy and Stripping of the Great Saphenous Vein (RELACS) study randomized 400 patients to endovenous laser ablation performed by a surgeon at 1 site or to ligation and stripping performed by a different surgeon at a second location.<sup>12</sup> At 2-year follow-up, there were no significant differences between groups for clinically recurrent varicose veins, medical condition measured on the Homburg Varicose Vein Severity Score, or disease-related quality of life. Saphenofemoral reflux was detected by ultrasonography more frequently after endovenous laser treatment (17.8% vs. 1.3%). The follow-up rate at 5 years was 81%.<sup>13</sup> Same-site recurrences were more frequent in the endovenous laser ablation group (18% with endovenous laser ablation vs. 5% with surgery,  $p=.002$ ), but different-site recurrences were more frequent in the surgically treated group (50% with surgery vs. 31% with endovenous laser ablation,  $p=.002$ ). Overall, there was no significant difference in recurrence rates between groups. There were also no significant differences between groups in disease severity or quality of life at 5 years.

Christenson et al (2010) compared endovenous laser ablation with ligation and stripping in 200 limbs (100 in each group).<sup>14</sup> At 1-year follow-up, 98% of the limbs were reported to be free of symptoms. At 2-year follow-up, the endovenous laser ablation group had 2 veins completely reopened and 5 partially reopened, which was significantly greater than in the ligation and stripping group. In the 2013 Comparative Study of the Treatment of Insufficient Greater Saphenous Vein: Surgery vs Ultrasound Guided Sclerotherapy With Foam and Endovenous Laser Therapy (MAGNA) trial, 223 consecutive patients (240 legs) with great saphenous vein reflux were randomized to endovenous laser ablation, ligation and stripping, or foam sclerotherapy.<sup>15</sup> At 1-year follow-up, the anatomic success rates were similar for endovenous laser ablation (88.5%) and stripping (88.2%), which were both superior to foam sclerotherapy (72.2%). Ten percent of the stripping group showed neovascularization. At 5 years, health-

related quality of life and CEAP classification improved in all groups with no significant differences among them.<sup>16</sup> Grade I neovascularization was higher in the conventional surgery group (27% vs. 3%,  $p<.001$ ), while grade II neovascularization did not differ significantly between surgical (17%) and endovenous laser ablation (13%) groups.

Wallace et al (2018) published the 5-year outcomes of an RCT consisting of endovenous laser ablation compared with conventional surgery as treatments for symptomatic great saphenous varicose veins.<sup>17</sup> Data from 218 patients were available at the 5-year follow-up. The clinical recurrence rate was 34.4% for the surgery group and 20.9% for endovenous laser ablation ( $p=.010$ ). Patients' quality of life, assessed using EuroQol Five Dimensions (EQ-5D) and AVVQ, was significantly improved from baseline for both surgery (EQ-5D: 0.859 to 1.0,  $p=.002$ ; AVVQ: 13.69 to 4.59,  $p<.001$ ) and endovenous laser ablation (EQ-5D: 0.808 to 1.0,  $p=.002$ ; AVVQ: 12.73 to 3.35,  $p<.001$ ). Technical success assessed by duplex ultrasound examination was 85.4% for surgery and 93.2% for endovenous laser ablation ( $p=.074$ ).

Tables 1 and 2 provide a summary of key characteristics and results, respectively, of these RCTs. The primary limitation of all studies was a lack of blinding.

**Table 1. Summary of Key RCT Characteristics**

| Study; Trial                       | Countries | Sites | Dates                  | Participants                                        | Interventions                                                    |                            |
|------------------------------------|-----------|-------|------------------------|-----------------------------------------------------|------------------------------------------------------------------|----------------------------|
|                                    |           |       |                        |                                                     | Active                                                           | Comparator                 |
| Brittenden (2014) <sup>11</sup>    | UK        | 11    | 2008-2012              | Individuals with primary varicose veins             | Foam sclera-therapy (n=286) or endovenous laser ablation (n=210) | Surgical treatment (n=289) |
| Rass (2012) <sup>12</sup> ; RELACS | US        | 2     | 2004-2007              | Individuals with great saphenous vein insufficiency | Endovenous laser ablation (n=185)                                | Surgical treatment (n=161) |
| Wallace (2018) <sup>17</sup>       | UK        | 1     | 2004-2009 <sup>1</sup> | Individuals with great saphenous vein insufficiency | Endovenous laser ablation (n=108)                                | Surgical treatment (n=110) |

RCT: randomized controlled trial.

<sup>1</sup> Date of original intervention study

**Table 2. Summary of Key RCT Results**

| Study                            | AVVQ Score at Baseline; 6 Months | Frequency of Procedural Complications | Rate of Same-Site Recurrence | Clinically Recurrent Varicose Veins | AVVQ Score at Baseline; 5 years |
|----------------------------------|----------------------------------|---------------------------------------|------------------------------|-------------------------------------|---------------------------------|
| Brittenden (2014) <sup>11</sup>  |                                  |                                       |                              |                                     |                                 |
| Foam                             | 17.69.9; 9.17.9                  | 6%                                    |                              |                                     |                                 |
| Laser                            | 17.89.1; 7.98.4                  | 1%                                    |                              |                                     |                                 |
| Surgery                          | 18.29.1; 7.87.5                  | 7%                                    |                              |                                     |                                 |
| p-value                          |                                  | <.001                                 |                              |                                     |                                 |
| Rass (2012) <sup>12</sup> RELACS |                                  |                                       |                              |                                     |                                 |
| Laser                            |                                  |                                       | 18%                          | 16.2%                               |                                 |

|                              |  |  |      |       |             |
|------------------------------|--|--|------|-------|-------------|
| Surgery                      |  |  | 5%   | 23.1% |             |
| p-value                      |  |  | .002 | .15   |             |
| Wallace (2018) <sup>17</sup> |  |  |      |       |             |
| Laser                        |  |  |      | 20.9% | 13.69; 4.59 |
| Surgery                      |  |  |      | 34.3% | 12.73; 3.35 |
| p-value                      |  |  |      | .010  | <.001       |

AVVQ: Aberdeen Varicose Veins Questionnaire; RELACS: Randomized Study Comparing Endovenous Laser Ablation with Crossectomy and Stripping of the Great Saphenous Vein; RCT: randomized controlled trial.

The literature on the isolated treatment of the anterior accessory saphenous vein is relatively limited. A systematic review by Alozai et al (2021) identified 16 studies that evaluated treatment modalities for anterior accessory saphenous vein incompetence.<sup>18</sup> All included studies were of moderate to poor quality. The pooled anatomic success rates were 91.8% after endovenous laser ablation and RFA (n=11 studies), 93.6% after CAC (n=3 studies), and 79.8% after sclerotherapy (n=2 studies).

### **Subsection Summary: Endovenous Thermal Ablation (Laser or Radiofrequency)**

There are multiple large RCTs and systematic reviews of RCTs assessing endovenous ablation using radiofrequency or laser energy of the saphenous veins. Comparison with ligation and stripping at 2- to 5-year follow-up has indicated similar recurrence rates for the different treatments. Evidence has suggested that ligation and stripping may lead to neovascularization, while thermal ablation may lead to recanalization, resulting in similar outcomes for endovenous thermal ablation and surgery. Laser ablation and RFA have similar success rates.

## **Treatment of Saphenous Veins: Sclerotherapy**

### **Systematic Reviews**

A Cochrane review by Whing et al (2021) that compared interventions for great saphenous vein incompetence was introduced above.<sup>9</sup> Based on pooled data from 4 RCTs (n=954), ultrasound-guided foam sclerotherapy was inferior to ligation and stripping for technical success up to 5 years (OR, 0.32, 95% CI, 0.11 to 0.94; low-certainty evidence), and beyond 5 years based on 3 RCTs (n=525)(OR, 0.09, 95% CI, 0.03 to 0.30; moderate-certainty evidence). There was no significant difference between treatments for recurrence up to 3 years based on 3 RCTs (n=822) and beyond 5 years based on 3 RCTs (n=639). Similarly, technical success was improved with endovenous laser ablation over ultrasound-guided foam sclerotherapy up to 5 years based on data from 3 RCTs (n=588) (OR, 6.13, 95% CI, 0.98 to 38.27; low-certainty evidence), and beyond 5 years based on data from 3 RCTs (n=534) (OR, 6.47, 95% CI, 2.60 to 16.10; low-certainty evidence). There was no significant difference between endovenous laser ablation and ultrasound-guided foam sclerotherapy for recurrence up to 3 years based on data from 2 RCTs (n=443), and at 5 years based on data from 2 RCTs (n=418).

Hamann et al (2017) conducted a meta-analysis of RCTs reporting 5-year follow-up.<sup>19</sup> The meta-analysis (3 RCTs, 10 follow-up studies) included 611 legs treated with endovenous laser ablation, 549 treated with high ligation and stripping, 121 with sclerotherapy, and 114 with high ligation and endovenous laser ablation. Ultrasound-guided sclerotherapy had significantly

worse outcomes than the other 3 treatments, with anatomic success rates of 34% for sclerotherapy compared with 83% to 88% for the other 3 treatments ( $p < .001$ ).

## **Physician-Compounded Sclerotherapy**

### **Randomized Controlled Trials**

In the 2013 MAGNA trial (previously described), 223 consecutive patients (240 legs) with great saphenous vein reflux were randomized to endovenous laser ablation, ligation and stripping, or physician-compounded foam sclerotherapy (1 mL aethoxysclerol 3%: 3 cc air).<sup>15</sup> At 1-year follow-up, the anatomic success rate of foam sclerotherapy (72.2%) was inferior to both endovenous laser ablation (88.5%) and stripping (88.2%). Twenty-one patients in the sclerotherapy group had partial occlusion with reflux, though the clinical complaint was completely relieved. At 5-year follow-up, obliteration or absence of the great saphenous vein was observed in only 23% of patients treated with sclerotherapy compared with 85% of patients who underwent conventional surgery and 77% of patients who underwent endovenous laser ablation.<sup>15</sup> Thirty-two percent of legs treated initially with sclerotherapy required 1 or more reinterventions during follow-up compared with 10% in the conventional surgery and endovenous laser ablation groups. However, clinically relevant grade II neovascularization was higher in the conventional surgery (17%) and endovenous laser ablation (13%) groups than in the sclerotherapy group (4%). EQ-5D scores improved equally in all groups.

Vahaaho et al (2018) published a study looking at the 5-year follow-up of patients with symptomatic great saphenous vein insufficiency.<sup>20</sup> Between 2008 and 2010, 166 individuals were randomized to receive open surgery, endovenous laser ablation, or ultrasound-guided foam sclerotherapy. The great saphenous vein occlusion rate was 96% (95% CI, 91 to 100%) for open surgery, 89% (95% CI, 82 to 98%) for endovenous laser ablation, and 51% (95% CI, 38 to 64%) for ultrasound-guided foam sclerotherapy ( $p < .001$ ). For patients with no additional treatment during follow-up, occlusion rates for open surgery, endovenous laser ablation, and ultrasound-guided foam sclerotherapy were 96%, 89%, and 41%, respectively. The study was limited by a lack of blinding and by non-standardized foam application.

Hamel-Desnos et al (2023) conducted a randomized trial of endovenous laser ablation versus physician-compounded foam sclerotherapy (0.5 mL polidocanol at concentrations ranging from 1% to 3% depending on vessel diameter; 2 mL air) in 161 patients with isolated small saphenous vein incompetence.<sup>21</sup> Tributary vein treatments were not allowed for the first 6 months after the procedure. After the first 6 months, 33% of patients who received sclerotherapy and 19% of patients who received endovenous laser ablation received tributary treatment. The primary endpoint, absence of reflux in the treated segment at 3 years, was achieved in 86% of patients who received endovenous laser ablation versus 56% of patients who received sclerotherapy (risk ratio, 1.59; 95% CI, 1.26 to 2.01). Rates of partial and total failure were higher in the sclerotherapy group than the endovenous laser ablation group. Limitations include the pragmatic design that allowed clinicians to treat patients according to their normal practice except for the study intervention and a lack of blinding.

### **Non-randomized Comparative Studies**

A noninferiority trial by Shadid et al (2012) compared foam sclerotherapy with ligation and stripping in 430 patients.<sup>22</sup> The analysis was per protocol. Forty (17%) patients had repeat sclerotherapy. At 2 years, the probability of clinical recurrence was similar in both groups (11.3% sclerotherapy vs. 9.0% ligation and stripping), although reflux was significantly more

frequent in the sclerotherapy group (35% vs. 21%). Thrombophlebitis occurred in 7.4% of patients after sclerotherapy. Two serious adverse events in the sclerotherapy group (deep venous thrombosis, pulmonary emboli) occurred within 1 week of treatment. Lam et al (2018) reported 8-year follow-up with 53% of the patients in the original trial.<sup>23</sup> All measures of treatment success (e.g., symptomatic great saphenous vein reflux, saphenofemoral junction failure, and recurrent reflux in the great saphenous vein) were lower in the physician-compounded sclerotherapy group compared to the ligation and stripping group.

## **Microfoam Sclerotherapy**

### **Randomized Controlled Trials**

In 2013, polidocanol microfoam (Varithena®) was approved under a new drug application for the treatment of varicose veins. Efficacy data were derived from 2 randomized, blinded, multicenter studies.<sup>24</sup> One compared polidocanol at 0.5%, 1.0%, and 2.0% with endovenous placebo or a subtherapeutic dose of polidocanol foam. The primary endpoint was an improvement in symptoms at week 8, as measured by the Varicose Vein Symptoms Questionnaire. The improvement in symptoms was greater in the pooled polidocanol treatment group ( $p < .001$ ) and in each of the individual dose-concentration groups compared with vehicle alone. Secondary and tertiary endpoints (appearance, duplex ultrasound response, quality of life) were also significantly better for the polidocanol groups compared with controls. The second study, VANISH-2, was published by Todd et al (2014).<sup>25</sup> At the 8-week assessment, there was elimination of reflux and/or occlusion of the previously incompetent vein in 85.6% of the combined 0.5% and 1.0% groups, 59.6% of patients in the 0.125% group, and 1.8% of the placebo group. Analysis of data from both studies showed a dose-response from 0.5% to 2.0% for improvement in appearance and from 0.5% to 1.0% for Duplex responders. The polidocanol 1.0% dose was selected for the U.S. Food and Drug Administration (FDA) approval. Safety analysis found deep vein thrombosis detected by ultrasound in 2.8% of polidocanol-treated patients, with 1% of patients having proximal symptomatic thrombi; these patients were treated with anticoagulants. There was no sign of an increase in neurologic adverse events, and there were no adverse cardiac or cardiopulmonary effects following treatment with polidocanol injectable foam. Rates of occlusion with Varithena are similar to those reported for endovenous laser ablation or stripping. A randomized trial comparing endovenous laser ablation and stripping with this new preparation of foam sclerotherapy is needed to evaluate its comparative effectiveness. Evaluation out to 5 years is continuing.

Vasquez et al (2017) reported on a double-blind RCT that evaluated the addition of polidocanol microfoam to endovenous thermal ablation.<sup>26</sup> A total of 117 patients who were candidates for both endovenous thermal ablation and treatment of visible varicosities received endovenous thermal ablation plus placebo ( $n=38$ ) or polidocanol 0.5% ( $n=39$ ) or 1% ( $n=40$ ). At 8-week follow-up, physician-blinded vein appearance was significantly better with the combined polidocanol groups ( $p=.001$ ), but the improvement in patient ratings was not statistically significant. At 6-month follow-up, the percentages of patients who achieved a clinically meaningful change were significantly higher in both physician (70.9% vs. 42.1%,  $p=.001$ ) and patient (67% vs. 50%,  $p=.034$ ) ratings. The proportion of patients who received additional treatment for residual varicosities between week 8 and month 6 was modestly reduced (13.9% for the polidocanol vs. 23.7% for placebo,  $p=.037$ ).

Watanabe et al (2024) conducted a double-blinded trial RCT comparing transluminal injection of microfoam sclerosant plus endovenous laser ablation to endovenous laser ablation alone in

142 patients (160 legs) with small saphenous vein reflux.<sup>27</sup> At one year, the transluminal injection of microfoam sclerosant plus endovenous laser ablation reduced residual or recurrent reflux (4% vs. 16%;  $p=.027$ ) and secondary interventions (4% vs. 16%;  $p=.027$ ), without major complications. Improvements in venous clinical severity score were similar with both interventions.

### **Retrospective Studies**

Deak (2018) reported results from a retrospective review of 250 patients with symptomatic chronic venous insufficiency who were treated with polidocanol microfoam in a community practice.<sup>28</sup> Patients who had tortuous veins that were not accessible with a catheter or who had a history of a previous vein ablation procedure with scarring in the lumen were selected for treatment with the microfoam sclerosant. It was reported that some patients required additional treatments between 5 days and 2 years for the vein to close, but the publication did not report how many additional treatments were given. After all the treatments were completed, 94.4% of patients showed elimination of venous valvular reflux and symptom improvement. In addition to the lack of information on the number of treatments given, the time of patient follow-up was variable (from 1 month to 2 years), precluding any conclusions regarding the durability of the treatment.

### **Subsection Summary: Sclerotherapy**

In a Cochrane review, ultrasound-guided foam sclerotherapy was inferior to ligation and stripping and endovenous laser ablation for technical success up to 5 years and beyond 5 years, but there was no significant difference between treatments for recurrence up to 3 years and at 5 years. For physician-compounded sclerotherapy, there is high variability in success rates of the procedure and some reports of serious adverse events. Results of a noninferiority trial of physician-compounded sclerotherapy indicated that once occluded, recurrence rates at 2 years are similar to those of ligation and stripping. By comparison, rates of occlusion with the FDA-approved microfoam sclerotherapy (polidocanol 1%) are similar to those reported for endovenous laser ablation or stripping.

## **Treatment of Saphenous Veins: Mechanochemical Ablation**

### **Randomized Controlled Trials**

Four RCTs with over 100 patients each (range, 132 to 213) have been identified that compared MOCA to thermal ablation. Study characteristics and study results are presented in Tables 3 and 4. Study limitations are described in Tables 5 and 6.

Two publications (Bootun et al [2016], Lane et al [2017]) reported on early results from an RCT of 170 patients that compared ClariVein with RFA.<sup>29,30</sup> Maximum VAS pain scores (out of 100) during the procedure were significantly lower in the MOCA group (median, 15 mm) than in the RFA group (median, 34 mm;  $p=.003$ ). Average VAS pain scores during the procedure were also modestly lower in the MOCA group (median, 10 mm) than in the RFA group (median, 19.5 mm;  $p=.003$ ). Occlusion rates, clinical severity scores, disease-specific quality of life, and generic quality of life scores were similar between the groups at 1 and 6 months. Limitations of this study are described in Tables 5 and 6. Only 71% of patients were available for follow-up at 6 months, limiting the evaluation of closure rates at this time point.

Vahaaho et al (2019) reported an RCT that compared MOCA with endovenous thermal ablation (endovenous laser ablation or RFA).<sup>20</sup> Liquid sclerosant at a concentration of 1.5%

was used. Out of 132 patients enrolled, 7 patients were later excluded and 117 (88.6%) attended the 1-year follow-up evaluation. Occlusion of the great saphenous vein was observed in 45 of 55 (82%) of the MOCA group compared to 100% of the endovenous laser ablation and RFA groups ( $p=.002$ ). Another randomized trial (Lam et al [2016]) reported interim results of a dose-finding study, finding greater closure with the use of polidocanol 2% or 3% (liquid) than with polidocanol 1%.<sup>31</sup> Therefore, it is uncertain whether the concentration of sclerosant in the study by Vahaaho et al (2019) was optimal (Table 5).

Three percent polidocanol was tested in the Mechanochemical endovenous Ablation to RADiOfrequeNcy Ablation (MARADONA) non-inferiority trial reported by Holewijn et al (2019).<sup>32</sup> Although the study was powered for 400 participants, only 213 patients were randomized before reimbursement for the procedure was suspended. Pain scores in the 14 days after the procedure were slightly lower, but hyperpigmentation was higher. Anatomic failures were significantly greater in the MOCA group at 1 year and approached significance at 2 years; with the note that the study was underpowered for anatomic failures because of the early stoppage of the study. At 1 and 2 years, clinical and quality of life outcomes were similar in the 2 groups.

A fourth RCT reported by Mohamed et al (2020) is the ongoing Randomized Clinical Trial Comparing Endovenous Laser Ablation and Mechanochemical Ablation (ClariVein) in the Management of Superficial Venous Insufficiency (LAMA).<sup>33</sup> Patients ( $n=150$ ) were randomized to MOCA with 1.5% sodium tetradecyl sulfate or to endovenous laser ablation. Anatomic success (occlusion) rates were lower in the MOCA group (77%) compared to the endovenous laser ablation group (91%) with no significant difference between the 2 treatments in intraprocedural pain scores. In contrast to the difference in anatomical occlusion rates, clinical severity and quality of life scores were not significantly different between the groups at 1 year follow-up. Follow-up is continuing to evaluate the durability of the treatments.

**Table 3. Summary of Key RCT Characteristics**

| Study; Trial                                                      | Countries | Sites | Dates     | Participants                                                          | Interventions                                                                                     |                                                     |
|-------------------------------------------------------------------|-----------|-------|-----------|-----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------|
|                                                                   |           |       |           |                                                                       | Active                                                                                            | Comparator                                          |
| Booton et al (2016) <sup>29</sup> Lane et al (2017) <sup>30</sup> |           |       |           | 170 patients with varicose veins                                      | MOCA                                                                                              | RFA                                                 |
| Vahaaho et al (2019) <sup>20</sup>                                |           |       |           | 132 patients with varicose veins                                      | MOCA with 1.5% polidocanol                                                                        | Thermal ablation (endovenous laser ablation or RFA) |
| Holewijn et al (2019) (MARADONA) <sup>32</sup>                    | EU        | 4     | 2012-2015 | 213 patients with great saphenous vein incompetence and CEAP C2 to C5 | MOCA with 2 mL of 3% polidocanol for the first 10 to 15 cm and 1.5% polidocanol for the remainder | RFA                                                 |
| Mohamed et al (2020) <sup>33</sup> (LAMA)                         | UK        | 1     | 2015-2018 | 150 patients with symptomatic superficial                             | MOCA ( $n=75$ ) with 1.5% sodium tetradecyl sulfate                                               | Endovenous laser ablation ( $n=75$ )                |

|  |  |  |  |                                                 |  |  |
|--|--|--|--|-------------------------------------------------|--|--|
|  |  |  |  | venous<br>incompetence<br>CEAP grades 2<br>to 6 |  |  |
|--|--|--|--|-------------------------------------------------|--|--|

CEAP: clinical etiologic anatomic pathological; LAMA: A Randomised Clinical Trial Comparing Endovenous Laser Ablation and Mechanochemical Ablation (ClariVein) in the Management of Superficial Venous Insufficiency; MOCA: mechanochemical ablation; RCT: randomized controlled trial; RFA: radiofrequency ablation.

**Table 4. Summary of Key RCT Results**

| Study                                                    | Pain                                           | Post-procedure Occlusion Rate | Occlusion Rate at Follow-up | Clinical Severity        | Clinical Severity at Follow-up |           | Quality of Life   |
|----------------------------------------------------------|------------------------------------------------|-------------------------------|-----------------------------|--------------------------|--------------------------------|-----------|-------------------|
| Booton (2016) <sup>29</sup><br>Lane (2017) <sup>30</sup> | During Procedure - VAS                         |                               | 6 mo occlusion rates        |                          |                                |           |                   |
| N                                                        |                                                |                               | 71%                         |                          | 71%                            |           |                   |
| MOCA                                                     | 10 mm                                          |                               |                             |                          |                                |           |                   |
| RFA                                                      | 19.5 mm                                        |                               |                             |                          |                                |           |                   |
| p-value                                                  | .003                                           | NS                            | NS                          | NS                       | NS                             |           | NS                |
| Vahaaho (2019) <sup>20</sup>                             |                                                |                               | 1 yr                        |                          | 1 yr                           |           |                   |
| N                                                        |                                                |                               | 117 (88.6%)                 |                          | 117 (88.6%)                    |           |                   |
| MOCA                                                     |                                                |                               | 45 of 55 (82%)              |                          |                                |           |                   |
| Endovascular laser ablation or RFA                       |                                                |                               | 100%                        |                          |                                |           |                   |
| p-Value                                                  |                                                |                               | .002                        |                          |                                |           |                   |
| Holewijn et al (2019) <sup>32</sup> (MARADONA)           | For 14 days after the procedure median (range) | 30 day failure rate           | 1 yr recanalization rate    | 2 yr recanalization rate | 1 yr VCSS                      | 2 yr VCSS | AVVQ improved     |
| N                                                        |                                                |                               | 153 (72%)                   | 157 (73%)                | 153 (72%)                      | 157 (73%) |                   |
| MOCA                                                     | 0.2 (0.0 to 0.8)                               | 5 (4.9%)                      | 15 (16.5%)                  | 21 (20%)                 | 1.8                            | 1.0       | 88%               |
| RFA                                                      | 0.5 (0.2 to 1.3)                               | 1 (1%)                        | 5 (5.8%)                    | 12 (11.7%)               | 1.7                            | 1.0       | 89%               |
| p-Value                                                  | .01                                            | .10                           | .025                        | .066                     | .695                           | .882      | .90               |
| Mohamed et al (2020) <sup>33</sup> (LAMA)                | Median (IQR)                                   |                               | Occlusion at 1 yr           |                          | VCSS                           |           | AVVQ Median (IQR) |
| N                                                        |                                                |                               | 138 (92%)                   |                          |                                |           |                   |
| MOCA                                                     | 15 (9-29)                                      |                               | 53/69 (77%)                 |                          |                                |           | 2.0 (0.0 to 5.3)  |

|                             |           |  |             |  |    |                  |
|-----------------------------|-----------|--|-------------|--|----|------------------|
| Endovascular laser ablation | 22 (9–44) |  | 63/69 (91%) |  |    | 2.0 (0.0 to 4.8) |
| p-Value                     | .21       |  | .020        |  | NS | NS               |

AVVQ: Aberdeen varicose vein questionnaire; IQR: intraquartile range; LAMA: A Randomised Clinical Trial Comparing Endovenous Laser Ablation and Mechanochemical Ablation (ClariVein) in the Management of Superficial Venous Insufficiency; MARADONA: Mechanochemical endovenous Ablation to RADiOfrequeNcy Ablation; MOCA: mechanochemical ablation; NS: not significant; RCT: randomized controlled trial; RFA: radiofrequency ablation; VAS: visual analog scale.; VCSS: venous clinical severity score.

**Table 5. Study Relevance Limitations**

| Study                                                               | Population <sup>a</sup>                                                             | Intervention <sup>b</sup>                                                        | Comparator <sup>c</sup> | Outcomes <sup>d</sup>                           | Follow-Up <sup>e</sup>                                                   |
|---------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------|-------------------------------------------------|--------------------------------------------------------------------------|
| Bootun et al (2016) <sup>29</sup> ; Lane et al (2017) <sup>30</sup> |                                                                                     |                                                                                  |                         | 1.Primary outcome was pain during the procedure | 1. Outcomes only out to 6 mo, which is insufficient to assess durability |
| Vahaaho et al (2019) <sup>20</sup>                                  | 4. Strict inclusion criteria that may not be representative of intended use.        | 3. The concentration of sclerosant (1.5% polidocanol) may not have been optimal. |                         |                                                 | 1. Outcomes only out to 1 yr, which is insufficient to assess durability |
| Holewijn et al (2019) <sup>32</sup> (MARADONA)                      | 4. Patients with bilateral reflux were excluded due to dosing limits of polidocanol |                                                                                  |                         |                                                 |                                                                          |
| Mohamed et al (2020) <sup>33</sup> (LAMA)                           |                                                                                     |                                                                                  |                         |                                                 | 1. Outcomes out to 1 yr, follow-up is continuing                         |

LAMA: A Randomised Clinical Trial Comparing Endovenous Laser Ablation and Mechanochemical Ablation (ClariVein) in the Management of Superficial Venous Insufficiency; MARADONA: Mechanochemical endovenous Ablation to RADiOfrequeNcy Ablation.

The study limitations stated in this table are those notable in the current review; this is not a comprehensive gaps assessment.

<sup>a</sup>Population key: 1. Intended use population unclear; 2. Clinical context is unclear; 3. Study population is unclear; 4. Study population not representative of intended use.

<sup>b</sup>Intervention key: 1. Not clearly defined; 2. Version used unclear; 3. Delivery not similar intensity as comparator; 4. Not the intervention of interest.

<sup>c</sup>Comparator key: 1. Not clearly defined; 2. Not standard or optimal; 3. Delivery not similar intensity as intervention; 4. Not delivered effectively.

<sup>d</sup>Outcomes key: 1. Key health outcomes not addressed; 2. Physiologic measures, not validated surrogates; 3. No CONSORT reporting of harms; 4. Not establish and validated measurements; 5. Clinical significant difference not prespecified; 6. Clinical significant difference not supported.

<sup>e</sup>Follow-Up key: 1. Not sufficient duration for benefit; 2. Not sufficient duration for harms.

**Table 6. Study Design and Conduct Limitations**

| Study                                                             | Allocation <sup>a</sup> | Blinding <sup>b</sup>                                                 | Selective Reporting <sup>c</sup> | Data Completeness <sup>d</sup>                                                        | Power <sup>e</sup> | Statistical <sup>f</sup> |
|-------------------------------------------------------------------|-------------------------|-----------------------------------------------------------------------|----------------------------------|---------------------------------------------------------------------------------------|--------------------|--------------------------|
| Bootun et al (2016) <sup>29</sup> Lane et al (2017) <sup>30</sup> |                         | 1. Patients not blinded to treatment (assessors of duplex ultrasound) |                                  | 1. There was high loss to follow-up (76% follow-up at 1 mo and 71% follow-up at 6 mo) |                    |                          |

|                                                |  |                                                                          |  |  |                                                                              |                                                                    |
|------------------------------------------------|--|--------------------------------------------------------------------------|--|--|------------------------------------------------------------------------------|--------------------------------------------------------------------|
|                                                |  | were blinded)                                                            |  |  |                                                                              |                                                                    |
| Vahaaho et al (2019) <sup>20</sup>             |  | 1, 2, 3. Patients, surgeons, and assessors were not blinded to treatment |  |  |                                                                              |                                                                    |
| Holewijn et al (2019) <sup>32</sup> (MARADONA) |  | 1, 2, 3. Patients, surgeons, and assessors were not blinded to treatment |  |  | 3. Underpowered for anatomic success due to early termination of recruitment | 4. Results of noninferiority analysis were not reported            |
| Mohamed et al (2020) <sup>33</sup> (LAMA)      |  | 1, 2, 3. Patients, surgeons, and assessors were not blinded to treatment |  |  |                                                                              | 2. 14-day pain scores were not analyzed by repeated measures ANOVA |

ANOVA: analysis of variance; LAMA: A Randomised Clinical Trial Comparing Endovenous Laser Ablation and Mechanochemical Ablation (ClariVein) in the Management of Superficial Venous Insufficiency; MARADONA: Mechanochemical endovenous Ablation to RADiOfrequeNcy Ablation.

The study limitations stated in this table are those notable in the current review; this is not a comprehensive gaps assessment.

<sup>a</sup> Allocation key: 1. Participants not randomly allocated; 2. Allocation not concealed; 3. Allocation concealment unclear; 4. Inadequate control for selection bias.

<sup>b</sup> Blinding key: 1. Not blinded to treatment assignment; 2. Not blinded outcome assessment; 3. Outcome assessed by treating physician.

<sup>c</sup> Selective Reporting key: 1. Not registered; 2. Evidence of selective reporting; 3. Evidence of selective publication.

<sup>d</sup> Data Completeness key: 1. High loss to follow-up or missing data; 2. Inadequate handling of missing data; 3. High number of crossovers; 4. Inadequate handling of crossovers; 5. Inappropriate exclusions; 6. Not intent to treat analysis (per protocol for noninferiority trials).

<sup>e</sup> Power key: 1. Power calculations not reported; 2. Power not calculated for primary outcome; 3. Power not based on clinically important difference.

<sup>f</sup> Statistical key: 1. Intervention is not appropriate for outcome type: (a) continuous; (b) binary; (c) time to event; 2. Intervention is not appropriate for multiple observations per patient; 3. s and/or p values not reported; 4. Comparative treatment effects not calculated.

## Prospective Cohort Studies

Oud et al (2025) reported on a single-center, prospective cohort study evaluating the long-term effectiveness of MOCA using the ClariVein device for treating great saphenous vein incompetence.<sup>34</sup> The study had a mean follow-up of 8.4 years and was conducted as a continuation of a previous multicenter RCT, including 109 patients (115 treated limbs) who underwent treatment between 2012 and 2018. The primary outcome was anatomical success, defined as complete closure of the treated vein or a partially reopened segment measuring <10 centimeters. A secondary measure, called reflux-free anatomical success, required that any reopened segment did not show backward blood flow. Results are reported in Table 8. Approximately 7% of patients required repeat interventions due to treatment failure.

A prospective cohort study that had a 5-year follow-up was reported by Thierens et al (2019).<sup>35</sup> Study inclusion criteria are described in Table 7. Anatomic and clinical follow-ups were performed at 4 weeks, 6 months, and 1, 3, and 5 years after the procedure (Table 8).

With slightly less than half of the participants remaining in the study through 5 years, 79% had freedom from anatomic failure and clinical measures had worsened. Nearly 15% of the recanalizations occurred in the first year, which the authors considered to be due to technical issues when the procedure was initially introduced. For example, there had been an increase in the concentration of sclerosant over time. It should be noted, however, that the more recent MARADONA trial from the same group of investigators using 3% polidocanol (described above) also saw a rate of recanalization of 16.5% in the first year and 20% in the second year.<sup>32</sup> Without a control condition, it cannot be determined whether the loss of clinical improvement in this cohort study is due to recanalization or the usual progression of venous disease over time.

**Table 7. Summary of Prospective Cohort Study Characteristics**

| Study                                | Country     | Participants                                                                                                                                                    | Treatment Delivery                                       | Follow-Up  |
|--------------------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|------------|
| Oud et al (2025) <sup>34</sup>       | Netherlands | Great saphenous vein insufficiency determined by duplex ultrasound examination                                                                                  | MOCA with 2% polidocanol or 3% polidocanol as sclerosant | Mean, 8 yr |
| Thierens et al, (2019) <sup>35</sup> | Netherlands | C2 to C5 varicose veins, great saphenous vein diameter of 3 to 12 mm and primary great saphenous vein insufficiency determined by duplex ultrasound examination | MOCA with 2% polidocanol as sclerosant                   | 5 yr       |

MOCA: mechanochemical ablation.

**Table 8. Summary of Prospective Cohort Study Results**

| Outcome Measure                      | Baseline                   | <6 months             | 1 yr          | 3 yr          | 5 yr          | 8 Yr                 |
|--------------------------------------|----------------------------|-----------------------|---------------|---------------|---------------|----------------------|
| Oud et al (2025) <sup>34</sup>       | n=109 patients (115 limbs) |                       |               |               |               |                      |
| Anatomical success                   |                            | 88.5% (100/113 limbs) |               |               |               | 60.5% (69/114 limbs) |
| Reflux-free anatomical success       |                            | NR                    |               |               |               | 72.8% (83/114 limbs) |
| VCSS score                           | 5.3                        |                       |               |               |               | 4.1                  |
| DVAAQ                                | 13.5                       |                       |               |               |               | 10.5                 |
| Thierens et al, (2019) <sup>33</sup> | n=94                       |                       | 90            | 71            | 58            |                      |
| Freedom from anatomic failure (SE)   |                            |                       | 85.6% (0.033) | 80.1% (0.039) | 78.7% (0.041) |                      |
| AVVQ score                           | 8.9                        |                       | 2.3           | 5.6           | 6.3           |                      |

|                      |     |  |     |     |     |  |
|----------------------|-----|--|-----|-----|-----|--|
| VCSS score           | 4.0 |  | 1.0 | 1.0 | 2.0 |  |
| Clinical improvement |     |  | 80% | 74% | 65% |  |

AVVQ: Aberdeen varicose vein questionnaire; DVAAQ: Dutch version of the Aberdeen Varicose Vein Questionnaire; NR: not reported; SE: standard error; VCSS: venous clinical severity score.

### Subsection Summary: Mechanochemical Ablation

MOCA is a combination of liquid sclerotherapy and mechanical abrasion of the lumen. The evidence on MOCA includes 4 RCTs that compared MOCA to thermal ablation with 6 month to 2-year results, and 2 prospective cohorts with follow-up out to 8 years. Results to date have been mixed regarding a reduction in intraprocedural pain, which is a proposed benefit of MOCA compared to thermal ablation procedures. Occlusion rates at 6 months to 2 years in the RCTs indicate lower anatomic success rates compared to thermal ablation, but a difference in clinical outcomes at these early time points has not been observed. Experience with other endoluminal ablation procedures suggests that lower anatomic success in the short term is associated with recanalization and clinical recurrence between 2 to 5 years. The possibility of later clinical recurrence is supported by prospective cohort studies with up to 8-year follow-up following treatment with MOCA. However, there have been improvements in technique since the cohort studies began, and clinical progression is frequently observed with venous disease. Because of these limitations, longer follow-up of the more recently conducted RCTs is needed to establish the efficacy and durability of this procedure compared with the criterion standard of thermal ablation.

## Treatment of Saphenous Veins: Cyanoacrylate Adhesive

### Randomized Controlled Trials

The VenaSeal pivotal study (VeClose), a multicenter noninferiority trial with 222 patients, compared VenaSeal with RFA for the treatment of venous reflux.<sup>36,37</sup> The pivotal registration study for the VeClose study and follow-up through 36 months have been published. These reports are summarized in Tables 9 and 10. The primary endpoint (the proportion of patients with complete closure of the target great saphenous vein at 3 months measured by ultrasound) was noninferior to RFA, with a 99% closure rate for VenaSeal compared with 96% for RFA. The secondary endpoint (intraoperative pain) was similar for both groups (2.2 on a 10-point scale for VenaSeal vs. 2.4 for RFA,  $p=.11$ ). Ecchymosis at day 3 was significantly lower in the cyanoacrylate group; 67.6% of patients treated with cyanoacrylate had no ecchymosis compared with 48.2% of patients following RFA ( $p<.01$ ). Scores on the AVVQ and Venous Clinical Severity Score improved to a similar extent in both groups. The mean time to return to work in a prospective cohort of 50 patients reported by Gibson and Ferris (2017) was 0.2 days.<sup>38</sup>

For the CAC and RFA groups, the complete occlusion rates were 97.2% and 97.0%. Freedom from recanalization was also similar between the 2 groups ( $p=.08$ ).<sup>39</sup> Twenty-four month results were reported by Gibson et al (2018), which included 171 patients (87 from CAC and 84 from RFA).<sup>40</sup> Thirty-six month results were reported by Morrison et al (2019), with follow-up on 146 (66%) patients (72 from CAC and 74 from RFA).<sup>41</sup> Loss to follow-up was similar in the 2 groups. The complete closure rates for CAC and RFA were 94.4% and 91.9% ( $p=.005$  for non-inferiority), respectively. Recanalization-free survival through 36 months was not statistically different for the 2 groups. No significant device- or procedure-related adverse events were reported for either group.

VariClose CAC was compared with RFA and endovenous laser ablation by Eroglu and Yasim (2018) in an RCT with 525 patients (Table 9).<sup>42</sup> Periprocedural outcomes showed a shorter intervention time, less pain, and shorter return to work with CAC compared to endovenous thermal ablation (Table 10). There was no significant difference in occlusion rates between the 3 treatments at 6, 12, and 24-month follow-up.

Alhewy et al (2024) conducted an RCT at 2 centers in Egypt comparing VenaSeal CAC with RFA in 248 patients with venous reflux, with follow-up extending to 2 years postprocedure.<sup>43</sup> The primary outcome was complete closure of the target great saphenous vein at the 3-month visit, although results for this outcome were not reported by the authors. Authors reported that at the 1-month follow-up, all veins treated with CAC remained occluded, while 154 out of 158 (97%) veins treated with RFA remained occluded. At 24 months, 122 out of 128 (95%) veins treated with CAC and 146 out of 158 (93%) veins treated with RFA remained occluded. At month 24, there were 6 recanalizations in the CAC group and 12 in the RFA group, with recanalization-free survival in the CAC group found to be non-inferior to that of the RFA group (95.3% vs. 92.4%, respectively;  $p < .0001$  for 10% noninferiority). The CAC group experienced fewer complications, with only 2 cases of paresthesia and 18 cases of bruises reported, whereas the RFA group encountered 18 cases of bruises, 2 cases of skin burns, and 2 cases of access site hematoma. Periprocedural outcomes showed a potentially shorter intervention time with CAC vs RFA.

**Table 9. Summary of Key RCT Characteristics**

| Study; Trial                                                                                                               | Countries              | Sites | Dates                         | Participants                                                                                                                                                             | Interventions <sup>2</sup> |                                           |
|----------------------------------------------------------------------------------------------------------------------------|------------------------|-------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------------------------|
|                                                                                                                            |                        |       |                               |                                                                                                                                                                          | Active                     | Comparator                                |
| FDA SED (2015); <sup>36</sup> Morrison et al (2015, 2017, 2019) <sup>37,44,41</sup> ; Gibson et al (2018); [VeClose trial] | US                     | 10    | 2013-2014                     | Age $\geq 21$ and $\leq 70$ years with symptomatic <sup>1</sup> great saphenous vein reflux and CEAP C2-C4b great saphenous vein diameter while standing of 3 to 12 mm   | 108 VenaSeal CAC           | 114 RFA                                   |
| Eroglu and Yasim (2018) <sup>42</sup>                                                                                      | Asia                   | 1     | NR                            | 525 patients $\geq 18$ years with incompetence of the great saphenous vein ( $>5.5$ mm in diameter) or small saphenous vein ( $>4$ mm in diameter) and reflux $>0.5$ sec | 175 VariClose CAC          | 125 RFA and 125 endovenous laser ablation |
| Alhewy et al (2024) <sup>43</sup>                                                                                          | Egypt and Saudi Arabia | 2     | August 1, 2018 to May 1, 2022 | 248 patients $\geq 18$ years (286 limbs) with symptomatic moderate to severe varicosities, CEAP classifications of                                                       | 128 VenaSeal CAC           | 120 RFA                                   |

|  |  |  |  |                                                                            |  |  |
|--|--|--|--|----------------------------------------------------------------------------|--|--|
|  |  |  |  | C2-C5, and great saphenous vein incompetence with a reflux time of 0.5 sec |  |  |
|--|--|--|--|----------------------------------------------------------------------------|--|--|

CAC: cyanoacrylate ; CEAP: Clinical Etiology Anatomy Pathophysiology; FDA: Food and Drug Administration; NR: not reported; RCT: randomized controlled trial; RFA: radiofrequency ablation; SSED; Summary of Safety and Effectiveness Data;

<sup>1</sup>One or more of the following symptoms related to the target vein: aching, throbbing, heaviness, fatigue, pruritus, night cramps, restlessness, generalized pain or discomfort, swelling.

<sup>2</sup>Protocol mandated use of compression stockings for 7 days post-procedure

**Table 10. Periprocedural Outcomes**

| Eroglu and Yasim (2018) <sup>42</sup> | Duration of Procedure min (SD) | Average Periprocedural Pain <sup>1</sup> | 2 or More Analgesics Used Daily n (%) | 1 Day to Return to Work n (%) | 2 Days to Return to Work n (%) | 3 or More Days to Return to Work n (%) |
|---------------------------------------|--------------------------------|------------------------------------------|---------------------------------------|-------------------------------|--------------------------------|----------------------------------------|
| N                                     | 503                            | 503                                      | 456                                   | 456                           | 456                            | 456                                    |
| VariClose                             | 15.3 (2.6)                     | 1 (mild)                                 | 105 (62.5)                            | 161 (95.8)                    | 7 (4.2)                        | 0 (0)                                  |
| RFA                                   | 27.3 (7.7)                     | 2 (moderate)                             | 98 (65.8)                             | 75 (50.3)                     | 53 (35.6)                      | 21 (14.1)                              |
| Endovenous laser ablation             | 35.0 (5.2)                     | 2 (moderate)                             | 105 (75.5)                            | 105 (75.5)                    | 24 (17.3)                      | 10 (7.2)                               |
| p-Value                               | <.001                          |                                          | .1472                                 | <.0012                        |                                |                                        |
| Alhewy et al (2024) <sup>43</sup>     |                                |                                          |                                       |                               |                                |                                        |
| N                                     | 248                            |                                          |                                       |                               |                                |                                        |
| VenaSeal                              | range, 25 to 54                |                                          |                                       |                               |                                |                                        |
| RFA                                   | range, 40 to 70                |                                          |                                       |                               |                                |                                        |
| p-value                               | NR                             |                                          |                                       |                               |                                |                                        |

<sup>1</sup>Scale of 1 to 4; <sup>2</sup>overall p-Value, NR: not reported; RFA: radiofrequency ablation; SD: standard deviation.

**Table 11. Summary of Key RCT Results**

| Study                                                                                                                                   | Vein Closure <sup>1</sup> n (%) | Vein Closure 12 months n (%) | Vein Closure 24 months n (%) | Vein Closure 36 months n (%) or VCSS | Device Related Event n (%) |
|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------------------------------|------------------------------|--------------------------------------|----------------------------|
| FDA SSED (2015) <sup>36</sup> Morrison et al (2015, 2017, 2019); <sup>37,44,41</sup> Gibson et al (2018); <sup>38</sup> [VeClose trial] | <b>3 months</b>                 |                              |                              |                                      |                            |
| N                                                                                                                                       | 222                             | 189                          | 171                          | 146                                  | 222                        |
| VenaSeal                                                                                                                                | 107 (99.1%) <sup>2</sup>        | 92 (96.7%)                   | 82/86 (95.3%)                | 68/72 (94.4%)                        | 31 (27%)                   |
| RFA                                                                                                                                     | 109 (95.6%) <sup>2</sup>        | 91 (96.8%)                   | 79/84 (94.0%)                | 68/74 (91.9%)                        | 7 (6%)                     |
| Eroglu and Yasim (2018) <sup>40</sup>                                                                                                   | <b>6 months</b>                 |                              |                              | <b>VCSS at 24 months</b>             |                            |
| N                                                                                                                                       |                                 | 503                          | 456                          | 456                                  |                            |

|                                   |                         |               |       |       |  |
|-----------------------------------|-------------------------|---------------|-------|-------|--|
| VariClose                         | 98.1%                   | 94.1%         | 95.1% | 2.7   |  |
| RFA                               | 94.7%                   | 92.5%         | 94.2% | 3.7   |  |
| Endovenous laser ablation         | 92.6%                   | 90.9%         | 91.5% | 3.5   |  |
| p-Value                           | NS                      | NS            | NS    | <.001 |  |
| Alhewy et al (2024) <sup>43</sup> | Vein Closure at 1 month |               |       |       |  |
| N                                 | 248                     |               |       |       |  |
| VenaSeal                          | 128/128 (100%)          | 122/128 (95%) |       |       |  |
| RFA                               | 154/158 (97%)           | 146/158 (93%) |       |       |  |
| p-value                           | NR                      | NR            |       |       |  |

FDA: Food and Drug Administration; NS: not significant; RCT: randomized controlled trial; RFA: radiofrequency ablation; SSER: Summary of Safety and Effectiveness Data; VCSS: venous clinical severity score.

<sup>1</sup>Complete closure defined as Doppler ultrasound showing vein closure along entire treated vein segment with no discrete segments of patency exceeding 5 cm. Central laboratory confirmation.

<sup>2</sup> Used prespecified data imputation method (Last Observation Carried Forward).

Notable limitations of the studies are shown in Tables 12 and 13. The primary limitation of the pivotal study of VenaSeal is the loss to follow-up at 2 and 3 years, although loss to follow-up was similar in the 2 groups. The study by Eroglu and Yasim (2018) had an unequal loss to follow-up after patients were informed of the treatment allocation. Different expectations in the CAC group compared to the control groups may have influenced subjective outcomes. In addition, VariClose is not currently approved for marketing in the U.S.; both CAC products use N-butyl cyanoacrylate. The study conducted by Alhewy et al. (2024) presented descriptive results for vein closure outcomes without inclusion of p-values or other statistical outputs. Additionally, the study did not report the results of the prespecified primary outcome.

**Table 12. Study Relevance Limitations**

| Study                                                                                                                                   | Population <sup>a</sup> | Intervention <sup>b</sup>                                                   | Comparator <sup>c</sup> | Outcomes <sup>d</sup> | Follow-Up <sup>e</sup>                          |
|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------------------------------------------------------|-------------------------|-----------------------|-------------------------------------------------|
| Morrison (2015), <sup>37</sup> Morrison (2017), <sup>44</sup> Gibson (2018) <sup>40</sup> Morrison (2019) <sup>41</sup> [VeClose trial] |                         |                                                                             |                         |                       | 1. Follow-up scheduled to continue to 60 months |
| Eroglu and Yasim (2018) <sup>42</sup>                                                                                                   |                         | 2. This specific cyanoacrylate product is not currently available in the US |                         |                       |                                                 |
| Alhewy (2024) <sup>43</sup>                                                                                                             |                         |                                                                             |                         |                       |                                                 |

The evidence gaps stated in this table are those notable in the current review; this is not a comprehensive gaps assessment.

<sup>a</sup> Population key: 1. Intended use population unclear; 2. Clinical context is unclear; 3. Study population is unclear; 4. Study population not representative of intended use.

<sup>b</sup> Intervention key: 1. Not clearly defined; 2. Version used unclear; 3. Delivery not similar intensity as comparator; 4. Not the intervention of interest.

<sup>c</sup> Comparator key: 1. Not clearly defined; 2. Not standard or optimal; 3. Delivery not similar intensity as intervention; 4. Not delivered effectively.

<sup>d</sup> Outcomes key: 1. Key health outcomes not addressed; 2. Physiologic measures, not validated surrogates; 3. No CONSORT reporting of harms; 4. Not establish and validated measurements; 5. Clinical significant difference not prespecified; 6. Clinical significant difference not

supported.

<sup>e</sup> Follow-Up key: 1. Not sufficient duration for benefit; 2. Not sufficient duration for harms.

**Table 13. Study Design and Conduct Limitations**

| Study                                                                                                                                     | Allocation <sup>a</sup> | Blinding <sup>b</sup>                                                                     | Selective Reporting <sup>d</sup> | Data Completeness <sup>e</sup>                                                                                                                               | Power <sup>d</sup>                 | Statistical <sup>f</sup>                 |
|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------------------------------------------------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------------------|
| Morrison (2015) <sup>37</sup> , Morrison (2017) <sup>44</sup> , Gibson (2018) <sup>40</sup> Morrison (2019) <sup>41</sup> [VeClose trial] |                         | 1, 2, 3. The outcome was assessed by the treating physician and patients were not blinded |                                  | 1. >20% loss to follow-up                                                                                                                                    |                                    | 3. Variable reporting of CI and p values |
| Eroglu and Yasim (2018) <sup>42</sup>                                                                                                     |                         | 1, 2, 3. Patients were notified of the group assignment a day before the procedure        |                                  | 6. Not intent-to-treat analysis and unequal loss to follow-up. 21 patients did not receive the allocated intervention, 19 of whom were in the control groups |                                    |                                          |
| Alhewy et al (2024) <sup>43</sup>                                                                                                         |                         | 4. blinding not reported                                                                  |                                  |                                                                                                                                                              | 1. power calculations not reported | 3. CI and p values mostly not reported   |

CI: confidence interval.

The study limitations stated in this table are those notable in the current review; this is not a comprehensive gaps assessment.

<sup>a</sup> Allocation key: 1. Participants not randomly allocated; 2. Allocation not concealed; 3. Allocation concealment unclear; 4. Inadequate control for selection bias; 5. Other.

<sup>b</sup> Blinding key: 1. Participants or study staff not blinded; 2. Outcome assessors not blinded; 3. Outcome assessed by treating physician; 4. Other.

<sup>c</sup> Selective Reporting key: 1. Not registered; 2. Evidence of selective reporting; 3. Evidence of selective publication; 4. Other.

<sup>d</sup> Data Completeness key: 1. High loss to follow-up or missing data; 2. Inadequate handling of missing data; 3. High number of crossovers; 4. Inadequate handling of crossovers; 5. Inappropriate exclusions; 6. Not intent to treat analysis (per protocol for noninferiority trials); 7. Other.

<sup>e</sup> Power key: 1. Power calculations not reported; 2. Power not calculated for primary outcome; 3. Power not based on clinically important difference; 4. Other.

<sup>f</sup> Statistical key: 1. Analysis is not appropriate for outcome type: (a) continuous; (b) binary; (c) time to event; 2. Analysis is not appropriate for multiple observations per patient; 3. Confidence intervals and/or p values not reported; 4. Comparative treatment effects not calculated; 5. Other

## Prospective Cohort Studies

Eroglu et al (2017) reported closure rates of 94.1% at 30 months in a prospective cohort of 159 patients.<sup>45</sup> Thirty-three-month follow-up was reported by Zierau (2015) for 467 (58.7%) of 795 veins treated at 1 institution in Germany.<sup>46</sup> An inflammatory reddening of the skin was observed at 1 week posttreatment in 11.7% of cases. No permanent skin responses were observed. Of the 467 veins reexamined, the sealing rate was 97.7%. This series had a high loss to follow-up.

Imai et al (2025) conducted a multicenter, prospective registry study in Japan to evaluate the efficacy and safety of VenaSeal CAC for treating incompetent great and small saphenous veins.<sup>47</sup> The study included 125 patients, and results showed a 92.6% overall vein closure rate at 1 year, with significant improvement in venous clinical severity scores and quality-of-life measures, though no significant change in EuroQol scores. Postoperative complications were observed in 20 patients, including hypersensitivity-type phlebitis in 7 patients and superficial venous thrombosis in 5 patients.

### **Section Summary: Cyanoacrylate Adhesive**

Evidence assessing CAC for the treatment of varicose veins and venous insufficiency includes a multicenter noninferiority trial with follow-up through 36 months, 2 RCTs with follow-up through 24 months, and prospective cohorts with up to 30 months of follow-up. The short-term efficacy of VenaSeal CAC has been shown to be noninferior to RFA at up to 36 months of follow-up. At 24 and 36 months, the study had greater than 20% loss to follow-up, but loss to follow-up was similar in the 2 groups at the long-term follow-up and is not expected to influence comparative results. Another RCT (N=248) comparing VenaSeal CAC with RFA found similar proportions of vein closures at 24 months with both treatments (100% and 95%, respectively; p-value not reported), with potentially shorter procedure duration with CAC vs RFA (25 to 54 minutes and 40 to 70 minutes, respectively; p-value not reported). An RCT (N=525) with an active CAC ingredient (N-butyl cyanoacrylate) that is currently available outside of the U.S. found no significant differences in vein closure between CAC and thermal ablation controls at 24 months of follow-up. The CAC procedure and return to work were shorter and pain scores were lower compared to thermal ablation; the subjective pain scores may have been influenced by differing expectations in this study. Prospective cohort studies report high closure rates at follow up to 30 months. Overall, results indicate that outcomes from CAC are at least as good as thermal ablation techniques, the current standard of care.

### **Treatment of Saphenous Veins: Cryoablation**

#### **Randomized Controlled Trials**

Klem et al (2009) reported on a randomized trial that found endovenous cryoablation (n=249) to be inferior to conventional stripping (n=245) for treating patients with symptomatic varicose veins.<sup>39</sup> Forty-four percent of patients had residual great saphenous vein remaining with cryoablation while 15% had residual vein remaining with conventional stripping. AVVQ scores also showed better results for conventional stripping (score, 11.7) than cryoablation (score, 8.0). There were no differences between groups in 36-Item Short-Form Health Survey summary scores or neural damage (12% in both groups).

Disselhoff et al (2008, 2011) reported on 2- and 5-year outcomes from a randomized trial that compared cryoablation with endovenous laser ablation.<sup>48,49</sup> Included were 120 patients with symptomatic uncomplicated varicose veins (CEAP class C2) with saphenofemoral incompetence and great saphenous vein reflux. At 10 days after treatment, endovenous laser ablation provided better results than cryoablation with respect to pain scores over the first 10 days (2.9 vs. 4.4), resumption of normal activity (75% vs. 45%), and induration (15% vs. 52%), all respectively. At a 2-year follow-up, freedom from recurrent incompetence was observed in 77% of patients after endovenous laser ablation and in 66% of patients after cryoablation (p=NS). At 5 years, 36.7% of patients were lost to follow-up; freedom from incompetence and neovascularization were found in 62% of patients treated with endovenous laser ablation and in 51% of patients treated with cryoablation (p=NS). Neovascularization was more common after cryoablation, but incompetent tributaries were more common after endovenous laser ablation. There were no significant differences between groups in the Venous Clinical Severity Score or AVVQ scores at either the 2 or 5-month follow-up for endovenous laser ablation.

### **Subsection Summary: Cryoablation**

Two RCTs have suggested that cryotherapy is ineffective for treating varicose veins compared with available alternatives.

## **Tributary Varicosities**

### **Clinical Context and Therapy Purpose**

The purpose of ablation (stab avulsion, sclerotherapy, or phlebectomy) of tributary veins in patients who have varicose tributary veins is to provide a treatment option that is an alternative to or an improvement on existing therapies.

### **Review of Evidence**

#### **Sclerotherapy and Phlebectomy**

##### **Systematic Reviews**

Early studies established ligation and stripping as the criterion standard for treating saphenofemoral incompetence based on improved long-term recurrence rates, with sclerotherapy used primarily as an adjunct to treat varicose tributaries. A Cochrane review of 28 studies by de Avlia Oliveira et al (2021) concluded that there is low certainty evidence that sclerotherapy is effective and safe compared to placebo for treating cosmetic appearance, persistent symptoms, and quality of life concerns related to varicose veins.<sup>50</sup> Evidence was limited or lacking for comparisons of foam with liquid sclerotherapy or other substances, and between concentrations of foam. Sclerotherapy and phlebectomy are considered appropriate in the absence of reflux of the saphenous system (e.g., post- or adjunctive treatment to other procedures such as surgery).<sup>51</sup>

##### **Randomized Controlled Trials**

El-Sheikha et al (2014) reported on a small, randomized trial of concomitant or sequential (if needed) phlebectomy following endovenous laser ablation for varicose veins.<sup>52</sup> Quality of life and clinical severity scores were similar between the groups by 1 year, with 16 (67%) of 24 patients in the sequential phlebectomy group receiving a secondary intervention.

The bulk of the literature discussing the role of ultrasound guidance refers to sclerotherapy of the saphenous vein, as opposed to the varicose tributaries. For example, Yamaki et al (2012) reported on a prospective RCT that compared visual foam sclerotherapy plus ultrasound-guided foam sclerotherapy of the great saphenous vein with visual foam sclerotherapy for varicose tributary veins.<sup>53</sup> Fifty-one limbs in 48 patients were treated with ultrasound-guided foam sclerotherapy plus visual foam sclerotherapy of the varicose tributaries, and 52 limbs in 49 patients were treated with foam sclerotherapy alone. At 6-month follow-up, complete occlusion was found in 23 (45.1%) limbs treated with ultrasound plus visually guided foam sclerotherapy and in 22 (42.3%) limbs treated with visual sclerotherapy alone. Reflux was absent in 30 (58.8%) limbs treated with ultrasound plus visual guidance and in 37 (71.2%) treated with visual guidance alone ( $p=NS$ ). The authors noted that, for the treatment of tributary veins in clinical practice, most patients receive a direct injection of foam without ultrasound guidance.

A small proportion of patients may present with tributary varicosities in the absence of saphenous reflux. For example, as reported by Michaels et al (2006), of 1009 patients recruited for an RCT, 64 patients had minor varicose veins without reflux, 34 of whom agreed

to be randomized to sclerotherapy or conservative treatment.<sup>54</sup> At baseline, 92% had symptoms of heaviness, 69% had cosmetic concerns, 53% reported itching, and 30% reported relief of symptoms using compression hosiery. At 1-year follow-up, there was an improvement in clinician-assessment of the anatomic extent of varicose veins, with 85% of patients in the sclerotherapy group showing improvement compared with 29% of patients in the conservative therapy group. Symptoms of aching were milder or eliminated in 69% of the sclerotherapy group and 28% of the group treated with conservative therapy.

## **Transilluminated Powered Phlebectomy**

### **Systematic Reviews**

A meta-analysis by Luebke and Brunkwall (2008) included 5 studies that compared TIPP with conventional surgery.<sup>55</sup> Results showed a significant advantage of TIPP over the conventional treatment for the number of incisions, mean cosmetic score, and duration of the procedure. However, TIPP also increased the incidence of hematoma and resulted in worse mean pain scores.

### **Randomized Controlled Trials**

Included in the meta-analysis by Luebke and Brunkwall (2008) was an RCT by Chetter et al (2006) that compared TIPP (n=29) with a multiple stab incision procedure (n=33).<sup>56</sup> A single surgeon performed all but 2 of the procedures, and there was no difference in operating time. Patients treated with TIPP had an average of 5 incisions, compared with 20 for the multiple stab procedure. However, the blinded evaluation revealed that bruising or discoloration was higher for the TIPP group at 1 and 6 weeks post-surgery. At 6 weeks after surgery, patients in the TIPP group showed no reductions in pain (-2 points on the Burford Pain Scale), while patients in the multiple stab incision group had a significant reduction in pain scores compared with presurgical baseline (-20 points). Six weeks post-surgery, quality of life measures had improved in the multiple stab incision group but not in the TIPP group. Thus, although TIPP required fewer surgical incisions, in this single-center study, it was associated with longer recovery due to more extensive bruising, prolonged pain, and reduced early postoperative quality of life.

### **Section Summary: Tributary Varicosities**

The evidence on the use of stab avulsion, sclerotherapy, and phlebectomy includes RCTs and systematic reviews of RCTs. The literature has indicated that sclerotherapy is effective for the treatment of tributary veins following occlusion of the saphenofemoral or saphenopopliteal junction and saphenous veins. No studies have been identified comparing RFA or laser ablation of tributary veins with standard procedures (microphlebectomy and/or sclerotherapy). TIPP is effective at removing varicosities; outcomes are comparable with available alternatives such as stab avulsion and hook phlebectomy. However, there is limited evidence that TIPP is associated with more pain, bruising, discoloration, and a longer recovery, and the current literature does not show an advantage of TIPP over conventional treatment.

## **Perforator Reflux**

### **Clinical Context and Therapy Purpose**

Perforator veins cross through the fascia and connect the deep and superficial venous systems. Incompetent perforating veins were originally treated with an open surgical

procedure, called the Linton procedure, which involved a long medial calf incision to expose all posterior, medial, and paramedial perforators. While this procedure was associated with healing of ulcers, it was largely abandoned due to a high incidence of wound complications. The Linton procedure was subsequently modified by using a series of perpendicular skin flaps instead of a longitudinal skin flap to provide access to incompetent perforator veins in the lower part of the leg. The modified Linton procedure may occasionally be used to close incompetent perforator veins that cannot be reached by less invasive procedures.

## **Review of Evidence**

### **Systematic Reviews**

Giannopoulos et al (2022) performed a systematic review of percutaneous treatments for pathologic perforating veins.<sup>57</sup> Thirty-five studies met the inclusion criteria (5 double-arm studies and 28 single-arm studies). Endovenous laser ablation (with or without microphlebectomy and/or sclerotherapy) was successful within the first 2 weeks after the procedure in 95% of patients. Success rates for RFA (with or without microphlebectomy) were 91% (95% CI, 75% to 99%). Ultrasound-guided sclerotherapy had a success rate of 70% after multiple sessions (95% CI, 53% to 84%). After 12 months of follow-up, occlusion rates were 89%, 77%, and 83% in the 3 groups, respectively. Limitations of the review include heterogeneity of the interventions in the included studies, including adjuvant therapy that could be provided at the investigator's discretion.

Ho et al (2022) published a systematic review to compare interventions for incompetent perforator veins, including open ligation, SEPS, endovascular laser ablation, ultrasound-guided sclerotherapy, and RFA.<sup>58</sup> A total of 81 studies (N=7010) were identified, and the overall quality of evidence was low to intermediate. Results demonstrated that in the short term ( $\leq 1$  year), efficacy rates for wound healing were 99.9% for ultrasound-guided sclerotherapy, 72.2% for open ligation, and 96.0% for SEPS. For short-term freedom from wound recurrence, the pooled estimate for SEPS was 91.0%; wound recurrence rates were not reported for other interventions.

A systematic literature review by O'Donnell (2008) indicated there was a lack of evidence on the role of incompetent perforator vein surgery performed in conjunction with superficial saphenous vein surgery.<sup>5</sup> These conclusions were based on 4 RCTs published since 2000 that compared superficial vein surgery with conservative therapy for advanced chronic venous insufficiency (CEAP classes C5 to C6). The 4 trials included 2 level I (large subject population) and 2 level II (small subject population) studies. Two trials combined surgical treatment of the incompetent perforator veins with concurrent or prior treatment of the superficial saphenous veins; the other 2 treated the great saphenous vein alone. The 2 randomized studies (2004, 2007) in which the great saphenous vein alone was treated (including the ESCHAR trial) showed a significant reduction in ulcer recurrence compared with conservative therapy.<sup>59,60</sup>

Treatment of the great saphenous vein alone has been reported to improve perforator function. For example, Blomgren et al (2005) showed that reversal of perforator vein incompetence (28 [41%] of 68 previously incompetent perforators) was more common than new perforator vein incompetence (41 [22%] of 183 previously competent perforators) following superficial vein surgery.<sup>61</sup> O'Donnell (2008) discussed additional (lower quality) evidence to suggest deep venous valvular involvement rather than incompetent perforators in venous insufficiency.<sup>5</sup> Thus, although incompetence of perforator veins is frequently cited as an

important etiologic factor in the pathogenesis of venous ulcer, current evidence does not support the routine ligation or ablation of perforator veins.

### Subfascial Endoscopic Perforator Surgery

A Cochrane review by Lin et al (2019) evaluated the efficacy of SEPS for the treatment of venous ulcers.<sup>62</sup> The authors identified 4 RCTs, 2 compared SEPS plus compression with compression alone (n=208), 1 compared SEPS with the Linton procedure (n=39), and 1 compared SEPS plus saphenous vein surgery with saphenous vein surgery alone (n=75). Results are shown in Table 14. The authors concluded that:

- Compared with compression alone, there was low certainty evidence that SEPS may increase the rate of ulcer healing compared to compression alone, but it was uncertain whether SEPS reduced the rate of ulcer recurrence.
- Compared with the Linton procedure, it was uncertain whether there was a difference in ulcer healing, and very uncertain whether there was a difference in ulcer recurrence. Based on very low certainty evidence, the Linton procedure was possibly associated with more adverse events.
- Compared to saphenous vein surgery alone, it was uncertain whether there was a difference in ulcer healing or the risk of ulcer recurrence. It was uncertain whether SEPS led to an increase in adverse events (very low certainty due to imprecision and risk of reporting bias)

**Table 14. Meta-analysis Results**

| Comparator             | Ulcer Healing       | Ulcer Recurrence    | Adverse Events      |
|------------------------|---------------------|---------------------|---------------------|
| Compression alone N    | 196                 | 208                 |                     |
| Risk ratio (95% CI)    | 1.17 (1.03 to 1.33) | 0.85 (0.26 to 2.76) |                     |
| Linton Procedure N     | 39                  | 39                  | 39                  |
| Risk ratio (95% CI)    | 0.95 (0.83 to 1.09) | 0.47 (0.10 to 2.30) | 0.04 (0.00 to 0.60) |
| Saphenous Vein Surgery | 22                  | 75                  | 75                  |
| Risk ratio (95% CI)    | 0.96 (0.64 to 1.43) | 1.03 (0.15 to 6.91) | 2.05 (0.86 to 4.90) |

CI: confidence interval.

In a meta-analysis of subfascial endoscopic perforator surgery for chronic venous insufficiency, Luebke and Brunkwall (2009) concluded that "its use should not be employed routinely and could only be justified in patients with persistent ulceration thought to be of venous origin, and in whom any superficial reflux has already been ablated and postthrombotic changes excluded."<sup>63</sup> Reviewers also stated that the "introduction of less invasive techniques for perforator vein ablation, such as ultrasound-guided sclerotherapy or radiofrequency ablation, may diminish the role of subfascial endoscopic perforator surgery in the future."

### Retrospective Studies

Lawrence et al (2020) reported a multicenter retrospective review of 832 consecutive patients who met criteria and were treated for venous leg ulcers in the U.S.<sup>64</sup> Of the 832 patients, 187 were managed with compression alone (75% ulcer healing) and 528 received superficial vein treatment after failure of a mean of 23 months of compression. Of the 528, 344 also underwent ablation of an average of 1.8 perforator veins. Techniques included radiofrequency, laser, and sclerotherapy. The ulcer healing rate was 17% higher in patients treated for perforator reflux (68%) in comparison with superficial vein treatment alone (51%; hazard ratio, 1.619, 95% CI,

1.271 to 2.063), even though the ulcers were larger at baseline. Perforator vein treatment did not affect recurrence rates in ulcers that had healed. Larger ulcers were associated with reflux in more than 1 level, and deep vein stenting was performed in 95 patients, some in combination with superficial vein treatment and some in combination with both superficial and perforator vein treatment. The ulcer healing rate in patients who underwent all 3 procedures was 87% at 36 months with an ulcer recurrence of 26% at 24 months.

### **Section Summary: Perforator Reflux**

The literature has shown that the routine ligation and ablation of incompetent perforator veins is not necessary for treating varicose veins and venous insufficiency concurrent with superficial vein procedures. However, when combined superficial vein procedures and compression therapy have failed to improve symptoms (i.e., ulcers), treatment of perforator vein reflux may be as beneficial as any alternative (e.g., deep vein valve replacement). Comparative studies are needed to determine the most effective method of ligating and ablating incompetent perforator veins. There is some low quality evidence that SEPS is as effective as the Linton procedure with a reduction in adverse events. Endovenous ablation with specialized laser or RFA probes has been shown to effectively ablate incompetent perforator veins with a potential decrease in morbidity compared with surgical interventions.

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## **Supplemental Information**

### **Clinical Input From Physician Specialty Societies and Academic Medical Centers**

While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process, through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted.

In response to requests, input was received from 4 physician specialty societies while this policy was under review in 2015. There was no agreement on the need to treat varicose tributaries to improve functional outcomes in the absence of saphenous vein disease.

Input was also mixed on the use of mechanochemical ablation and cyanoacrylate adhesive.

### **Practice Guidelines and Position Statements**

Guidelines or position statements will be considered for inclusion in 'Supplemental Information' if they were issued by, or jointly by, a US professional society, an international society with US representation, or National Institute for Health and Care Excellence (NICE). Priority will be given to guidelines that are informed by a systematic review, include strength of evidence ratings, and include a description of management of conflict of interest.

### **American Venous Forum et al**

In 2020, in response to published reports of potentially inappropriate application of venous procedures, the American Venous Forum, Society for Vascular Surgery, American Vein and Lymphatic Society, and the Society of Interventional Radiology published appropriate use criteria for the treatment of chronic lower extremity venous disease.<sup>62</sup> Appropriate use criteria were developed using the RAND/UCLA method incorporating best available evidence and expert opinion.

Appropriate use criteria were determined for various scenarios (e.g., symptomatic, asymptomatic, CEAP [Clinical, Etiology, Anatomy and Pathophysiology] class, axial reflux, saphenofemoral junction reflux) for the following:

- Saphenous vein ablation
  - Great saphenous vein
  - Small saphenous vein
  - Accessory great saphenous vein
- Nontruncal varicose veins
- Diseased tributaries associated with saphenous ablation
- Perforator veins
- Iliac vein or inferior vena cava stenting as a first line treatment
- Duplex ultrasound
- Timing and reimbursement.

Treatment of saphenous veins for asymptomatic CEAP class 1 and 2, or symptomatic class 1, was considered to be rarely appropriate or never appropriate, and treatment of symptomatic CEAP class 2, 3, and 4 to 6 without reflux was rated as never appropriate. Based on the 2011 Guidelines from the Society for Vascular Surgery and American Venous Forum (see below), treatment of perforator veins for asymptomatic or symptomatic CEAP class 1 and 2 was considered to be rarely appropriate or never appropriate. Perforator vein treatment was rated as appropriate for CEAP classes 4 to 6, and may be appropriate for CEAP class 3. Except for a recommendation to use endovenous procedures for perforator vein ablation, techniques used to treat veins in these scenarios were not evaluated.

### **Society for Vascular Surgery and American Venous Forum**

The Society for Vascular Surgery and the American Venous Forum (2011) published joint clinical practice guidelines.<sup>66</sup>

The Society for Vascular Surgery, the American Vein and Lymphatic Society (AVLS), and the American Venous Forum published a joint clinical practice guideline in 2022 on management of lower extremity varicose veins.<sup>67</sup> The guideline will be published in sections; the first part (published in 2022) focuses on duplex scanning and treatment of superficial truncal reflux. Superficial truncal veins are defined as the great saphenous vein, small saphenous vein, anterior accessory great saphenous vein, and posterior accessory great saphenous vein. The second part of the guideline was published in 2023 and focuses on the management of varicose vein patients with compression, treatment with drugs and nutritional supplements, evaluation and treatment of varicose tributaries, superficial venous aneurysms, and management of complications of varicose veins and their treatment.<sup>68</sup>

### **American Vein and Lymphatic Society**

In 2015, the American Vein and Lymphatic Society (AVL, previously named the American College of Phlebology) published guidelines on the treatment of superficial vein disease.<sup>69</sup>

AVL gave a Grade 1 recommendation based on high quality evidence that compression is an effective method for the management of symptoms, but when patients have a correctable source of reflux, definitive treatment should be offered unless contraindicated. AVL recommends against a requirement for compression therapy when a definitive treatment is available. AVL gave a strong recommendation based on moderate quality evidence that endovenous thermal ablation is the preferred treatment for saphenous and accessory

saphenous vein incompetence, and gave a weak recommendation based on moderate quality evidence that mechanochemical ablation may also be used to treat venous reflux.

In 2017, AVL published guidelines on the treatment of refluxing accessory saphenous veins.<sup>40</sup> The College gave a Grade 1 recommendation based on level C evidence that patients with symptomatic incompetence of the accessory saphenous veins be treated with endovenous thermal ablation or sclerotherapy to reduce symptomatology. The guidelines noted that although accessory saphenous veins may drain into the great saphenous vein before it drains into the common femoral vein, they can also empty directly into the common femoral vein.

In 2025, AVLS published a position statement on mechanochemical chemically assisted ablation of varicose veins for venous insufficiency.<sup>70</sup> The following conclusion and recommendations were made: "Mechanical occlusion chemically assisted venous ablation is effective in alleviating symptoms and a safe treatment option for venous insufficiency. As a non-thermal ablation method, MOCA [mechanical occlusion chemically assisted ablation] obviates the need for tumescent anesthesia and thus results in less procedural discomfort and risk of thermal nerve or skin injury. It may be used in both the below knee distal GSV [great saphenous veins] as well as the SSV [small saphenous veins] with no risk of thermal injury to the adjacent nerves. However, it is associated with significantly lower rates of vessel closure and higher recanalization rates when followed for more than 1 year compared to both radiofrequency ablation and endovenous laser ablation." "It is an available option for those in whom thermal ablation is not suitable."

**National Institute for Health and Care Excellence**

In 2013, the National Institute for Health and Care Excellence (NICE) updated its guidance on ultrasound-guided foam sclerotherapy for varicose veins. NICE stated that:

- "1.1 Current evidence on the efficacy of ultrasound-guided foam sclerotherapy for varicose veins is adequate. The evidence on safety is adequate, and provided that patients are warned of the small but significant risks of foam embolization (see section 1.2), this procedure may be used with normal arrangements for clinical governance, consent and audit.
- 1.2 During the consent process, clinicians should inform patients that there are reports of temporary chest tightness, dry cough, headaches and visual disturbance, and rare but significant complications including myocardial infarction, seizures, transient ischaemic attacks and stroke."

In 2015, NICE published a technology assessment on the clinical effectiveness and cost-effectiveness of foam sclerotherapy, endovenous laser ablation, and surgery for varicose veins.<sup>71</sup>

In 2016, NICE revised its guidance on endovenous mechanochemical ablation, concluding that "Current evidence on the safety and efficacy of endovenous mechanochemical ablation for varicose veins appears adequate to support the use of this procedure...."

**Ongoing and Unpublished Clinical Trials**

Some currently unpublished trials that might influence this review are listed in Table 18.

**Table 18. Summary of Key Trials**

| NCT No.                  | Trial Name                                                                                                                                                                                                                              | Planned Enrollment | Completion Date |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------|
| <b>Ongoing</b>           |                                                                                                                                                                                                                                         |                    |                 |
| NCT04737941              | Finnish Venous Ulcer Study                                                                                                                                                                                                              | 248                | Mar 2026        |
| NCT03820947 <sup>a</sup> | Global, Post-Market, Prospective, Multi-Center, Randomized Controlled Trial of the VenaSeal™ Closure System vs. Surgical Stripping or Endothermal Ablation (ETA) for the Treatment of Early & Advanced Stage Superficial Venous Disease | 806                | Apr 2028        |
| <b>Unknown</b>           |                                                                                                                                                                                                                                         |                    |                 |
| NCT05633277              | Outcomes of Sclerotherapy of the Ulcer Bed Compared to a Combination of Ablation and Injections                                                                                                                                         | 30                 | Mar 2024        |
| <b>Unpublished</b>       |                                                                                                                                                                                                                                         |                    |                 |
| NTR4613 <sup>a</sup>     | Mechanochemical endovenous ablation versus radiofrequency ablation in the treatment of primary small saphenous vein insufficiency (MESSI trial)                                                                                         | 160                | Apr 2020        |

NCT: national clinical trial. NTR: Netherlands Trial Registry.

<sup>a</sup> Denotes industry-sponsored or cosponsored trial.

## Regulatory Status

In 2015, the VenaSeal™ Closure System (Sapheon, part of Medtronic) was approved by the U.S. Food and Drug Administration (FDA) through the premarket approval (P140018) process for the permanent closure of clinically significant venous reflux through endovascular embolization with coaptation. The VenaSeal Closure System seals the vein using a cyanoacrylate adhesive agent. FDA product code: PJQ.

In 2013, Varithena® (formerly Varisolve), a sclerosant microfoam made with a proprietary gas mix, was approved by the FDA under a new drug application (205-098) for the treatment of incompetent great saphenous veins, accessory saphenous veins, and visible varicosities of the great saphenous vein system above and below the knee.

The following devices were cleared for marketing by the FDA through the 510(k) process for endovenous treatment of superficial vein reflux:

In 1999, the VNUS Closure® System, a radiofrequency device, was cleared by the FDA through the 510(k) process for "endovascular coagulation of blood vessels in patients with superficial vein reflux." In 2005, the VNUS RFS® and RFSFlex® devices were cleared by the FDA for "use in vessel and tissue coagulation including treatment of incompetent (i.e., refluxing) perforator and tributary veins." In 2008, the modified VNUS ClosureFast® Intravascular Catheter was cleared by the FDA through the 510(k) process. FDA product code: GEI.

In 2002, the Diomed 810 nm surgical laser and EVLT® (endovenous laser therapy) procedure kit were cleared by the FDA through the 510(k) process ".....for use in the endovascular coagulation of the great saphenous vein of the thigh in patients with superficial vein reflux." FDA product code: GEX.

In 2005, a modified Erbe Erbokryo cryosurgical unit (Erbe USA) was approved by the FDA for marketing through the 510(k) process. A variety of clinical indications are listed, including cryostripping of varicose veins of the lower limbs. FDA product code: GEH.

In 2003, the Trivex system (InaVein), a device for transilluminated powered phlebectomy, was cleared by the FDA through the 510(k) process for "ambulatory phlebectomy procedures for the resection and ablation of varicose veins." FDA product code: DNQ.

In 2008, the ClariVein® Infusion Catheter (Merit Medical) was cleared by the FDA through the 510(k) process (K071468) for mechanochemical ablation. The FDA determined that this device was substantially equivalent to the Trellis Infusion System (K013635) and the Slip-Cath Infusion Catheter (K882796). The system includes an infusion catheter, motor drive, stopcock, and syringe, and is intended for the infusion of physician-specified agents in the peripheral vasculature. FDA product code: KRA

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## **Government Regulations**

### **National:**

No NCD for this service.

### **Local:**

LCD: L34536. Treatment of Varicose Veins of the Lower Extremities. For services performed on or after 08/28/2025

Historically, varicose veins have been treated by conservative measures such as exercise, periodic leg elevation, weight loss, compressive therapy, and avoidance of prolonged immobility. When conservative measures are unsuccessful, and symptoms persist, the next step has been sclerotherapy or surgical ligation with or without stripping. Sclerotherapy involves the injection of a sclerosing solution into the varicose vein(s).

More recently, endoluminal radiofrequency ablation (ERFA) and endoluminal laser ablation have been developed as alternatives to sclerotherapy and surgical intervention. These procedures are designed to damage the intimal wall of the vein resulting in fibrosis and subsequent ablation of the lumen of a segment of the vessel. Both procedures utilize specially designed catheters inserted through a small incision in the distal thigh and advanced, often under ultrasound guidance, nearly to the saphenofemoral junction. The catheter is then slowly withdrawn while controlled radiofrequency or laser energy is applied. This is followed by external compression of the treated segment.

Doppler ultrasound or duplex studies are often used to map the anatomy of the venous system prior to the procedure. There is adequate evidence that pre-procedural ultrasound is helpful, and Medicare will cover one ultrasound or duplex scan prior to the procedure to determine the extent and configuration of the varicosities when it is medically necessary.

Evidence and clinical experience support the use of ultrasound guidance during the procedure and show that the outcomes may be improved and complication rates may be minimized when ultrasound guidance is used. The CPT codes for radiofrequency and laser include the intra-

operative ultrasound service in the evaluation, and ultrasound may not be billed separately with these procedures.

A duplex ultrasound examination is considered medically necessary and will be allowed when performed within 1 week (preferably within 72 hours) of EFRA to check for any evidence of thrombus extension from the saphenofemoral junction into the deep system.

A. Indications for surgical treatment and sclerotherapy:

1. A 3-month trial of conservative therapy such as exercise, periodic leg elevation, weight loss, compressive therapy, and avoidance of prolonged immobility where appropriate, has failed, AND
2. The patient is symptomatic and has one, or more, of the following:
  - a. Pain, aching, cramping, burning, itching and/or swelling during activity or after prolonged standing severe enough to impair mobility
  - b. Recurrent episodes of superficial phlebitis
  - c. Non-healing skin ulceration
  - d. Bleeding from a varicosity
  - e. Stasis dermatitis
  - f. Refractory dependent edema
3. The treatment of spider veins/telangiectasis will be considered medically necessary only if there is associated hemorrhage.

B. Indications for ERFA or laser ablation:

In addition to the above (see A), the patient's anatomy and clinical condition are amenable to the proposed treatment including ALL of the following:

1. Absence of aneurysm in the target segment.
2. Maximum vein diameter of 20 mm for ERFA or 30 mm for laser ablation.
3. Absence of thrombosis or vein tortuosity, which would impair catheter advancement.
4. The absence of significant peripheral arterial diseases.

C. Limitations for ERFA and laser ablation:

1. ERFA and laser ablation are covered only for the treatment of symptomatic varicosities of the lesser or greater saphenous veins and their tributaries which have failed 3 months of conservative therapy.
2. Intra-operative ultrasound guidance is not separately payable with ERFA, laser ablation.
3. The treatment of asymptomatic varicose veins, or symptomatic varicose veins without a 3-month trial of conservative measures, by any technique, will be considered cosmetic and therefore not covered.
4. The treatment of spider veins or superficial telangiectasis by any technique is also considered cosmetic, and therefore not covered unless there is associated bleeding.
5. Coverage is only for devices specifically FDA-approved for these procedures.
6. One pre-operative Doppler ultrasound study or duplex scan will be covered.
7. Post –procedure Doppler ultrasound studies will be allowed if medically necessary.

The stab phlebectomy of the same vein performed on the same day as endovenous radiofrequency or laser ablation may be covered if the criteria for reasonable and necessary as described in this LCD are met.

If sclerotherapy is used with endovenous ablation, it may be covered if the criteria for reasonable and necessary as described in this LCD are met.

The treatment of asymptomatic veins with endoluminal ablation or sclerotherapy is not considered medically reasonable and necessary. If it is determined on review that the varicose veins were asymptomatic, the claim will be denied as a noncovered (cosmetic) procedure.

*(The above Medicare information is current as of the review date for this policy. However, the coverage issues and policies maintained by the Centers for Medicare & Medicare Services [CMS, formerly HCFA] are updated and/or revised periodically. Therefore, the most current CMS information may not be contained in this document. For the most current information, the reader should contact an official Medicare source.)*

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## Related Policies

- Endovenous Ablation For The Treatment of Varicose Veins (e.g., ClariVein®, VenaSeal™ Closure System) (Retired)
  - Echosclerotherapy for The Treatment of Varicose Veins (Retired)
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*The articles reviewed in this research include those obtained in an Internet based literature search for relevant medical references through February, 2026, the date the research was completed.*

### Joint BCBSM/BCN Medical Policy History

| Policy Effective Date | BCBSM Signature Date | BCN Signature Date | Comments                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------|----------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7/1/23                | 4/26/23              |                    | Joint policy established. Adopted BCBSA policy. Retired current BCBSM policies, and incorporated current BCBSM IMP. Vendor managed: N/A (ds)                                                                                                                                                                                                                                                                        |
| 7/1/24                | 4/16/24              |                    | Updated rationale section, added references 8, 21, 46 and 53. No change in policy status. Vendor managed: N/A (ds)                                                                                                                                                                                                                                                                                                  |
| 7/1/25                | 4/15/25              |                    | Routine maintenance (jf)<br>Vendor Managed: NA<br>No change in policy status<br>Patients removed and replaced with individuals<br>Added References: 41,63,64,65                                                                                                                                                                                                                                                     |
| 7/1/26                | 4/21/26              |                    | Routine maintenance (jf/fr)<br>Vendor Managed: NA<br>Added Ref: 27,34,47 and 70 <ul style="list-style-type: none"> <li>○ <b>Formatting changes made:</b></li> <li>○ Sections rearranged for better flow</li> <li>○ Added Description and Background separated</li> <li>○ MPS edited</li> <li>○ Notes edited in code section</li> <li>● Code update delete code 37500 due to low utilization eff 12/31/25</li> </ul> |

Next Review Date: 2<sup>nd</sup> Qtr., 2027

### Pre-Consolidation Medical Policy History

| Original Policy Date | Comments |
|----------------------|----------|
| BCN:                 | Revised: |
| BCBSM:               | Revised: |



**BLUE CARE NETWORK BENEFIT COVERAGE**  
**POLICY: TREATMENT OF VARICOSE VEINS/VENOUS INSUFFICIENCY**

**I. Coverage Determination:**

|                                                                                            |                                                             |
|--------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| <b>Commercial HMO<br/>(includes Self-Funded<br/>groups unless otherwise<br/>specified)</b> | Covered per policy                                          |
| <b>BCNA (Medicare<br/>Advantage)</b>                                                       | See government section                                      |
| <b>BCN65 (Medicare<br/>Complementary)</b>                                                  | Coinsurance covered if primary Medicare covers the service. |

**II. Administrative Guidelines:**

- The member's contract must be active at the time the service is rendered.
- Coverage is based on each member's certificate and is not guaranteed. Please consult the individual member's certificate for details. Additional information regarding coverage or benefits may also be obtained through customer or provider inquiry services at BCN.
- The service must be authorized by the member's PCP except for Self-Referral Option (SRO) members seeking Tier 2 coverage.
- Services must be performed by a BCN-contracted provider, if available, except for Self-Referral Option (SRO) members seeking Tier 2 coverage.
- Payment is based on BCN payment rules, individual certificate and certificate riders.
- Appropriate copayments will apply. Refer to certificate and applicable riders for detailed information.
- CPT - HCPCS codes are used for descriptive purposes only and are not a guarantee of coverage.