

American College of Radiology ACR Appropriateness Criteria®

Clinical Condition: Radiologic Management of Lower-Extremity Venous Insufficiency

Variant 1: Asymptomatic bilateral great saphenous venous insufficiency with visible varicose veins. Patient desires treatment for cosmesis.

Treatment/Procedure	Rating	Comments
Endoluminal laser therapy	8	
Endoluminal radiofrequency therapy	8	
Surgical vein stripping	4	Traditional treatment, but more invasive than endoluminal treatments, and scarring may be an issue.
Injection sclerotherapy	4	May be appropriate for specific patient populations. Typically used for smaller veins or telangiectasias. Adjunctive to GSV ablation if necessary. May cause hyperpigmentation changes which may be of cosmetic concern.
Compression stocking therapy only	2	Unlikely to provide cosmesis by itself.
No therapy	1	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Variant 2: Left small saphenous venous insufficiency resulting in intermittent pain and swelling without skin discoloration or ulceration.

Treatment/Procedure	Rating	Comments
Endoluminal radiofrequency therapy	8	
Compression stocking therapy only	7	Most conservative approach. Patients may find it difficult to live with, which may lead to noncompliance with therapy.
Endoluminal laser therapy	8	
Surgical vein stripping	5	
Injection sclerotherapy	4	May be appropriate for specific patient populations.
No therapy	2	Depends on symptomatology.
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Clinical Condition: Radiologic Management of Lower-Extremity Venous Insufficiency

Variant 3: Left great saphenous venous insufficiency with associated lower leg skin ulceration.

Treatment/Procedure	Rating	Comments
Endoluminal laser therapy	8	
Endoluminal radiofrequency therapy	8	
Surgical vein stripping	5	More invasive than endoluminal techniques. May be appropriate in certain clinical situations.
Injection sclerotherapy	4	May be appropriate for specific patient populations.
Compression stocking therapy only	1	Compression stockings alone would usually be inadequate.
No therapy	1	

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

Variant 4: Symptomatic bilateral great saphenous venous insufficiency and large visible varicose veins during pregnancy.

Treatment/Procedure	Rating	Comments
Compression stocking therapy only	9	Compression stocking therapy should be sole therapy during pregnancy. Patient can be reassessed following delivery.
No therapy	4	Depends on symptomatology.
Surgical vein stripping	2	Treat only if signs/symptoms persist after delivery.
Endoluminal laser therapy	2	Treat only if signs/symptoms persist after delivery.
Endoluminal radiofrequency therapy	2	Treat only if signs/symptoms persist after delivery.
Injection sclerotherapy	2	Treat only if signs/symptoms persist after delivery.

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

Clinical Condition: Radiologic Management of Lower-Extremity Venous Insufficiency

Variant 5: Chronic left femoral venous thrombosis with left great saphenous venous insufficiency and lower-extremity swelling.

Treatment/Procedure	Rating	Comments
Compression stocking therapy only	9	
Venous recanalization	6	May not be definitive therapy for superficial venous insufficiency. Few data to document success rates.
Anticoagulation	6	May not be definitive therapy for superficial venous insufficiency.
Surgical vein stripping	1	
Endoluminal laser therapy	1	
Endoluminal radiofrequency therapy	1	
Injection sclerotherapy	1	
No therapy	1	

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

Variant 6: Symptomatic bilateral great saphenous venous insufficiency with remote history of deep venous thrombosis with no residual thrombus present.

Treatment/Procedure	Rating	Comments
Compression stocking therapy only	8	
Endoluminal laser therapy	7	At increased risk for recurrent deep venous thrombosis.
Endoluminal radiofrequency therapy	7	At increased risk for recurrent deep venous thrombosis.
Surgical vein stripping	5	More invasive than endoluminal techniques. May be appropriate in certain clinical situations.
Injection sclerotherapy	4	May be appropriate for specific patient populations.
No therapy	2	Depends on symptomatology.

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

Variant 7: Right great saphenous venous insufficiency status post vein stripping 1 year ago with persistent lower-extremity swelling. Reflux is noted in the below-knee greater saphenous vein measuring up to 5 mm.

Treatment/Procedure	Rating	Comments
Compression stocking therapy only	5	
Endoluminal laser therapy	8	
Endoluminal radiofrequency therapy	8	
Repeat surgical vein stripping	4	
Injection sclerotherapy	4	
No therapy	2	

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

RADIOLOGIC MANAGEMENT OF LOWER-EXTREMITY VENOUS INSUFFICIENCY

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Summary of Literature Review

Introduction/Background

Lower-extremity venous insufficiency is a common medical condition [1,2]. Venous insufficiency typically results from primary valvular incompetence or less commonly from previous deep venous thrombosis (DVT) [3]. Venous insufficiency may result in varicose veins that may be of cosmetic concern or cause symptoms such as discomfort, extremity swelling, skin discoloration, skin induration, or ulceration [4,5]. Affected veins may thrombose or bleed.

Venous insufficiency most commonly results from reflux originating from the great saphenous vein (GSV). Other sources of venous insufficiency include superficial veins, such as the small saphenous vein (SSV), the anterior thigh circumflex vein, the posterior thigh circumflex vein, and the anterior accessory GSV.

Treatment of venous insufficiency is intended to alleviate symptoms and reduce the risk of complications. Conventional management of GSV reflux has been surgical removal of the saphenous vein from the level of the saphenofemoral junction to the level of the knee or ankle (stripping), along with ligation of the saphenous branches in the groin [6,7]. An alternative to ligation and stripping of the saphenous vein is endovenous ablation of the vein using laser energy, radiofrequency-generated thermal energy, or a chemical sclerosing agent. Treatment is aimed at relief of symptoms, prevention of progression of venous insufficiency, prevention of complications, and improvement in cosmesis.

History and Physical Examination

Venous disease of the legs can be categorized according to the severity, cause, site, and specific abnormality using the CEAP classification ([Table 1](#)) [8-10]. The elements of the CEAP classification are: Clinical severity (grade 0-6, asymptomatic, symptomatic), Etiology (congenital, primary, secondary), Anatomical distribution (superficial, deep, perforator veins), and Pathophysiological dysfunction (reflux, obstruction).

Noninvasive Evaluation

Noninvasive studies are used to confirm the presence of venous insufficiency, define the anatomical distribution of venous insufficiency, and identify the presence of venous anomalies and venous thrombosis [11]. Duplex ultrasonography (US) can be used for initial evaluation and evaluation of treatment adequacy [12-14]. Real-time US guidance is commonly used during endovenous treatment. Other diagnostic modalities that can be used to evaluate extremity veins include plethysmography, computed tomography (CT), magnetic resonance imaging (MRI), and conventional contrast venography [15-17].

Treatment Options

Compression Stockings

Graduated compression stockings are routinely used to control venous insufficiency symptoms [18,19]. They provide external support that can constrict dilated veins and restore competence to incompetent valves. Compression stockings are particularly helpful during pregnancy [20], and they are frequently used following venous ablation treatment [21].

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Surgery

GSV stripping with branch ligation had historically been the primary treatment option for venous insufficiency [22-24]. The GSV is ligated near the groin. Ligation alone can preserve the vein for subsequent harvesting in case of arterial bypass; however, ligation alone has proven unsatisfactory for preventing the occurrence of reflux, so it is often supplemented by vein stripping [25,26]. Saphenous vein stripping may additionally reverse the derangement in lymphatic flow associated with venous reflux [27], and it has been proven to be cost-effective while improving health-related quality of life [28]. However, surgery comes with the added risk of peroneal nerve injury [29].

Ambulatory phlebectomy is primarily used to treat surface varicose veins. It can be performed as an isolated procedure [30], or as an adjunct to endovenous ablation or stripping [31-35]. This procedure involves making tiny punctures or incisions through which the varicose veins are removed. Other surgical methods to treat venous insufficiency have been described, including subfascial endoscopic perforator surgery (SEPS) for treating venous ulcers, valvular surgery for treating reflux caused by incompetent valves of the deep veins [36-38], and conservative hemodynamic management of varicose veins (CHIVA) which preserves the greater saphenous vein by ligating the refluxing saphenous trunks and diverting blood flow to the competent deeper veins [39].

Injection Sclerotherapy

Injection sclerotherapy is a common treatment for telangiectasias and can be used to treat smaller varicose veins. The sclerotherapy solution can be in liquid form or can be injected as “foam” (mixed with a gas such as air) [40-42]. Sclerotherapy has not been shown to have long-term effectiveness for large veins, such as the GSV [43].

Endovenous Ablation

Endovenous ablation is a minimally invasive alternative to surgery [32,44-49]. It is a percutaneous procedure that can be used to treat the GSV, SSV, and other superficial veins. Endovenous ablation uses radiofrequency (RFA) or laser energy (EVLA) applied inside the vein to cause occlusion [41,50-61].

Small prospective trials comparing EVLA and RFA with conventional surgery in patients with GSV reflux have shown favorable results. Darwood et al [62] demonstrated that EVLA is comparable to surgery in abolishing reflux and improving disease-specific quality of life and that it allows earlier return to normal activity. Follow-up in this study was only at 3 months. Since then, there have been larger randomized control trials over a 1- to 2-year period demonstrating that endovenous ablation is as effective as surgery with similar occlusion rates [63-66]. Helmy et al [64] showed shorter hospital stays and lower overall complication rates with endovenous treatment. However, when compared to surgery, EVLA patients experienced more pain [65], and RFA was more expensive [64]. Rasmussen et al [66] demonstrated similar improvements in clinical severity scores and quality of life when comparing EVLA to surgery. Recent systematic literature reviews comparing the safety and efficacy of endovenous therapy and surgery involving saphenous ligation and stripping as treatments for varicose veins showed few differences in clinical effectiveness outcomes; however, consistent long-term follow-up was lacking [67,68]. A literature meta-analysis by van den Bos et al [69] suggested that EVLA and RFA are at least as effective as surgery in treating lower-extremity varicose veins. After 3 years, the estimated pooled success rates for treatment were 78% for surgical stripping, 77% for foam sclerotherapy, 84% for RFA, and 94% for laser therapy. In a prospective study by Subramona and Lees [70], RFA took longer than conventional surgery, but resulted in a significantly better early outcomes, where patients returned to their normal activities earlier, experienced less postprocedure pain, and reported higher overall satisfaction.

Adjunctive Treatments

Adjunctive treatments may be required to help eliminate venous insufficiency. Patients with venous insufficiency and associated venous occlusion or stenosis of the common iliac vein (eg, May-Thurner syndrome) may require venous recanalization with angioplasty and stenting to achieve a patent conduit for venous return [71-74]. Patients with pelvic venous insufficiency may require percutaneous embolization of the ovarian veins [75,76]. Patients with DVT are typically treated with anticoagulation to reduce the risk of thrombus propagation, embolization, and post-thrombotic syndrome [77]. Puggioni et al [78] suggested that endovenous ablation of the saphenous vein can be considered as a viable treatment alternative in patients with venous insufficiency and previous DVT.

Complications

All forms of lower-extremity venous insufficiency treatment are subject to recurrence [12,13,79-83]. Additional risks of vein ligation and stripping surgery include anesthetic risk, scarring, pain, bleeding, deep venous injury or thrombosis, nerve injury, and infection [7,84]. Complications of the endovenous ablation procedure include

bruising, swelling, transient numbness, and rarely DVT [48,50,85]. The DVT rates for RFA and EVLA are less compared to those published for saphenous vein stripping [86]. Among patients undergoing endovenous treatment, pain and bruising are less in RFA compared to EVLA [87].

Treatment for Recurrence

Recurrence following both primary varicose vein surgery and endovenous treatment has been described. Treatment options for recurrence include both surgery and endovenous therapy. Neither approach has been proven more effective. Conventional surgical treatment for varicose recurrence involves removing sources of reflux from the deep venous system to the superficial network. This is invariably a complex and aggressive approach. Pittaluga et al [88] compared conventional surgery to a more conservative surgical approach for recurrent greater saphenous vein reflux (which only focuses on the varicose reservoir) and found a reduction in postoperative complication rates with improvement in symptoms and lower costs. Van Groenendael et al [89] retrospectively compared surgical retreatment for recurrent small saphenous varicosities and EVLA. They reported that technical success and patient satisfaction in both groups were comparably high and that complications were minor. However, the incidence of sural nerve injury was more frequent in the surgically treated patients. Additional studies have demonstrated the effectiveness of EVLA for recurrence. Anchala et al [90] reported the effectiveness and safety of EVLA after recurrent symptoms following saphenous vein stripping and ligation, Nwaejike et al [91] prospectively followed patients who developed recurrent varicose veins and who were retreated with endovenous ablation. They concluded that EVLA is useful, technically feasible, and can be safely performed.

Summary

- Several treatment options are available for managing lower-extremity venous insufficiency.
- Long-term randomized prospective studies comparing endovenous obliteration of the saphenous vein with surgical ligation and stripping demonstrate that endovenous ablation is as effective as surgery and results in similar occlusion rates. Differences between the two procedures relate to complications, postprocedure pain, length of hospital stay, and costs.
- Recurrent varicose veins can be treated by either surgery or endovenous therapy. Neither approach has been proven superior to the other.

Supporting Documents

- [ACR Appropriateness Criteria® Overview](#)
- [Evidence Table](#)

References

1. Callam MJ. Epidemiology of varicose veins. *Br J Surg*. 1994;81(2):167-173.
2. Evans CJ, Fowkes FG, Ruckley CV, Lee AJ. Prevalence of varicose veins and chronic venous insufficiency in men and women in the general population: Edinburgh Vein Study. *J Epidemiol Community Health*. 1999;53(3):149-153.
3. Raffetto JD, Khalil RA. Mechanisms of varicose vein formation: valve dysfunction and wall dilation. *Phlebology*. 2008;23(2):85-98.
4. Davies AH, Steffen C, Cosgrove C, Wilkins DC. Varicose vein surgery: patient satisfaction. *J R Coll Surg Edinb*. 1995;40(5):298-299.
5. Labropoulos N, Delis K, Nicolaides AN, Leon M, Ramaswami G. The role of the distribution and anatomic extent of reflux in the development of signs and symptoms in chronic venous insufficiency. *J Vasc Surg*. 1996;23(3):504-510.
6. Dwerryhouse S, Davies B, Harradine K, Earnshaw JJ. Stripping the long saphenous vein reduces the rate of reoperation for recurrent varicose veins: five-year results of a randomized trial. *J Vasc Surg*. 1999;29(4):589-592.
7. Perkins JM. Standard varicose vein surgery. *Phlebology*. 2009;24 Suppl 1:34-41.
8. Eklof B. CEAP classification and implications for investigations. *Acta Chir Belg*. 2006;106(6):654-658.
9. Eklof B, Rutherford RB, Bergan JJ, et al. Revision of the CEAP classification for chronic venous disorders: consensus statement. *J Vasc Surg*. 2004;40(6):1248-1252.
10. Kistner RL, Eklof B, Masuda EM. Diagnosis of chronic venous disease of the lower extremities: the "CEAP" classification. *Mayo Clin Proc*. 1996;71(4):338-345.

11. Khilnani NM, Min RJ. Duplex ultrasound for superficial venous insufficiency. *Tech Vasc Interv Radiol*. 2003;6(3):111-115.
12. Geier B, Mumme A, Hummel T, Marpe B, Stucker M, Ascitutto G. Validity of duplex-ultrasound in identifying the cause of groin recurrence after varicose vein surgery. *J Vasc Surg*. 2009;49(4):968-972.
13. Hartmann K, Klode J, Pfister R, et al. Recurrent varicose veins: sonography-based re-examination of 210 patients 14 years after ligation and saphenous vein stripping. *Vasa*. 2006;35(1):21-26.
14. Myers K, Fris R, Jolley D. Treatment of varicose veins by endovenous laser therapy: assessment of results by ultrasound surveillance. *Med J Aust*. 2006;185(4):199-202.
15. Jung SC, Lee W, Chung JW, et al. Unusual causes of varicose veins in the lower extremities: CT venographic and Doppler US findings. *Radiographics*. 2009;29(2):525-536.
16. Min SK, Kim SY, Park YJ, et al. Role of three-dimensional computed tomography venography as a powerful navigator for varicose vein surgery. *J Vasc Surg*. 2010;51(4):893-899.
17. Park UJ, Yun WS, Lee KB, et al. Analysis of the postoperative hemodynamic changes in varicose vein surgery using air plethysmography. *J Vasc Surg*. 2010;51(3):634-638.
18. Motykie GD, Caprini JA, Arcelus JI, Reyna JJ, Overom E, Mokhtee D. Evaluation of therapeutic compression stockings in the treatment of chronic venous insufficiency. *Dermatol Surg*. 1999;25(2):116-120.
19. van Geest AJ, Franken CP, Neumann HA. Medical elastic compression stockings in the treatment of venous insufficiency. *Curr Probl Dermatol*. 2003;31:98-107.
20. Norgren L, Austrell C, Nilsson L. The effect of graduated elastic compression stockings on femoral blood flow velocity during late pregnancy. *Vasa*. 1995;24(3):282-285.
21. Biswas S, Clark A, Shields DA. Randomised clinical trial of the duration of compression therapy after varicose vein surgery. *Eur J Vasc Endovasc Surg*. 2007;33(5):631-637.
22. Hammarsten J, Pedersen P, Cederlund CG, Campanello M. Long saphenous vein saving surgery for varicose veins. A long-term follow-up. *Eur J Vasc Surg*. 1990;4(4):361-364.
23. Murli NL, Navin ID. Classical varicose vein surgery in a diverse ethnic community. *Med J Malaysia*. 2008;63(3):193-198.
24. Walsh JC, Bergan JJ, Beeman S, Comer TP. Femoral venous reflux abolished by greater saphenous vein stripping. *Ann Vasc Surg*. 1994;8(6):566-570.
25. McMullin GM, Coleridge Smith PD, Scurr JH. Objective assessment of high ligation without stripping the long saphenous vein. *Br J Surg*. 1991;78(9):1139-1142.
26. Rutgers PH, Kitslaar PJ. Randomized trial of stripping versus high ligation combined with sclerotherapy in the treatment of the incompetent greater saphenous vein. *Am J Surg*. 1994;168(4):311-315.
27. Suzuki M, Unno N, Yamamoto N, et al. Impaired lymphatic function recovered after great saphenous vein stripping in patients with varicose vein: venodynamic and lymphodynamic results. *J Vasc Surg*. 2009;50(5):1085-1091.
28. Eskelinen E, Rasanen P, Alback A, et al. Effectiveness of superficial venous surgery in terms of quality-adjusted life years and costs. *Scand J Surg*. 2009;98(4):229-233.
29. Herman J, Sekanina Z, Utikal P, Bachleda P, Duda M. Peroneal nerve injury during varicose veins surgery. *Int Angiol*. 2009;28(6):458-460.
30. Pittaluga P, Chastanet S, Locret T, Barbe R. The effect of isolated phlebectomy on reflux and diameter of the great saphenous vein: a prospective study. *Eur J Vasc Endovasc Surg*. 2010;40(1):122-128.
31. Carradice D, Mekako AI, Hatfield J, Chetter IC. Randomized clinical trial of concomitant or sequential phlebectomy after endovenous laser therapy for varicose veins. *Br J Surg*. 2009;96(4):369-375.
32. Ho P, Poon JT, Cho SY, et al. Day surgery varicose vein treatment using endovenous laser. *Hong Kong Med J*. 2009;15(1):39-43.
33. Jung IM, Min SI, Heo SC, Ahn YJ, Hwang KT, Chung JK. Combined endovenous laser treatment and ambulatory phlebectomy for the treatment of saphenous vein incompetence. *Phlebology*. 2008;23(4):172-177.
34. Kim HK, Kim HJ, Shim JH, Baek MJ, Sohn YS, Choi YH. Endovenous laser versus ambulatory phlebectomy of varicose tributaries in conjunction with endovenous laser treatment of the great or small saphenous vein. *Ann Vasc Surg*. 2009;23(2):207-211.
35. Mekako A, Hatfield J, Bryce J, et al. Combined endovenous laser therapy and ambulatory phlebectomy: refinement of a new technique. *Eur J Vasc Endovasc Surg*. 2006;32(6):725-729.
36. Jeanneret C, Fischer R, Chandler JG, Galeazzi RL, Jager KA. Great saphenous vein stripping with liberal use of subfascial endoscopic perforator vein surgery (SEPS). *Ann Vasc Surg*. 2003;17(5):539-549.

37. Kianifard B, Holdstock J, Allen C, Smith C, Price B, Whiteley MS. Randomized clinical trial of the effect of adding subfascial endoscopic perforator surgery to standard great saphenous vein stripping. *Br J Surg*. 2007;94(9):1075-1080.
38. Kumar A, Agarwal PN, Garg PK. Evaluation of subfascial endoscopic perforator vein surgery (SEPS) using harmonic scalpel in varicose veins: an observational study. *Int J Surg*. 2009;7(3):253-256.
39. Pares JO, Juan J, Tellez R, et al. Varicose vein surgery: stripping versus the CHIVA method: a randomized controlled trial. *Ann Surg*. 2010;251(4):624-631.
40. Gonzalez-Zeh R, Armisen R, Barahona S. Endovenous laser and echo-guided foam ablation in great saphenous vein reflux: one-year follow-up results. *J Vasc Surg*. 2008;48(4):940-946.
41. Luebke T, Brunkwall J. Systematic review and meta-analysis of endovenous radiofrequency obliteration, endovenous laser therapy, and foam sclerotherapy for primary varicosis. *J Cardiovasc Surg (Torino)*. 2008;49(2):213-233.
42. Figueiredo M, Araujo S, Barros N, Jr., Miranda F, Jr. Results of surgical treatment compared with ultrasound-guided foam sclerotherapy in patients with varicose veins: a prospective randomised study. *Eur J Vasc Endovasc Surg*. 2009;38(6):758-763.
43. Belcaro G, Nicolaidis AN, Ricci A, et al. Endovascular sclerotherapy, surgery, and surgery plus sclerotherapy in superficial venous incompetence: a randomized, 10-year follow-up trial--final results. *Angiology*. 2000;51(7):529-534.
44. Disselhoff BC, Buskens E, Kelder JC, der Kinderen DJ, Moll FL. Randomised comparison of costs and cost-effectiveness of cryostripping and endovenous laser ablation for varicose veins: 2-year results. *Eur J Vasc Endovasc Surg*. 2009;37(3):357-363.
45. Nwaejike N, Srodon PD, Kyriakides C. Endovenous laser ablation for short saphenous vein incompetence. *Ann Vasc Surg*. 2009;23(1):39-42.
46. Theivacumar NS, Darwood RJ, Dellegrammaticas D, Mavor AI, Gough MJ. The clinical significance of below-knee great saphenous vein reflux following endovenous laser ablation of above-knee great saphenous vein. *Phlebology*. 2009;24(1):17-20.
47. van den Bremer J, Joosten PP, Hamming JF, Moll FL. Implementation of endovenous laser ablation for varicose veins in a large community hospital: the first 400 procedures. *Eur J Vasc Endovasc Surg*. 2009;37(4):486-491.
48. Zafarghandi MR, Akhlaghpour S, Mohammadi H, Abbasi A. Endovenous laser ablation (EVLA) in patients with varicose great saphenous vein (GSV) and incompetent saphenofemoral junction (SFJ): an ambulatory single center experience. *Vasc Endovascular Surg*. 2009;43(2):178-184.
49. Ravi R, Trayler EA, Barrett DA, Diethrich EB. Endovenous thermal ablation of superficial venous insufficiency of the lower extremity: single-center experience with 3000 limbs treated in a 7-year period. *J Endovasc Ther*. 2009;16(4):500-505.
50. Almeida JI, Kaufman J, Gockeritz O, et al. Radiofrequency endovenous ClosureFAST versus laser ablation for the treatment of great saphenous reflux: a multicenter, single-blinded, randomized study (RECOVERY study). *J Vasc Interv Radiol*. 2009;20(6):752-759.
51. Golan JF, Glenn DM. Laser and radiofrequency endovenous ablation of venous reflux. *Perspect Vasc Surg Endovasc Ther*. 2008;20(1):75-79.
52. Luebke T, Gawenda M, Heckenkamp J, Brunkwall J. Meta-analysis of endovenous radiofrequency obliteration of the great saphenous vein in primary varicosis. *J Endovasc Ther*. 2008;15(2):213-223.
53. Pannier F, Rabe E. Endovenous laser therapy and radiofrequency ablation of saphenous varicose veins. *J Cardiovasc Surg (Torino)*. 2006;47(1):3-8.
54. Roth SM. Endovenous radiofrequency ablation of superficial and perforator veins. *Surg Clin North Am*. 2007;87(5):1267-1284, xii.
55. Desmyttere J, Grard C, Stalnikiewicz G, Wassmer B, Mordon S. Endovenous laser ablation (980 nm) of the small saphenous vein in a series of 147 limbs with a 3-year follow-up. *Eur J Vasc Endovasc Surg*. 2010;39(1):99-103.
56. Hingorani AP, Ascher E, Marks N, et al. Predictive factors of success following radio-frequency stylet (RFS) ablation of incompetent perforating veins (IPV). *J Vasc Surg*. 2009;50(4):844-848.
57. Hissink RJ, Bruins RM, Erkens R, Castellanos Nuijts ML, van den Berg M. Innovative treatments in chronic venous insufficiency: endovenous laser ablation of perforating veins: a prospective short-term analysis of 58 cases. *Eur J Vasc Endovasc Surg*. 2010;40(3):403-406.

58. Marsh P, Price BA, Holdstock JM, Whiteley MS. One-year outcomes of radiofrequency ablation of incompetent perforator veins using the radiofrequency stylet device. *Phlebology*. 2010;25(2):79-84.
59. Nwaejike N, Srodon PD, Kyriakides C. 5-years of endovenous laser ablation (EVLA) for the treatment of varicose veins--a prospective study. *Int J Surg*. 2009;7(4):347-349.
60. Trip-Hoving M, Verheul JC, van Sterkenburg SM, de Vries WR, Reijnen MM. Endovenous laser therapy of the small saphenous vein: patient satisfaction and short-term results. *Photomed Laser Surg*. 2009;27(4):655-658.
61. van den Bos RR, Wentel T, Neumann MH, Nijsten T. Treatment of incompetent perforating veins using the radiofrequency ablation stylet: a pilot study. *Phlebology*. 2009;24(5):208-212.
62. Darwood RJ, Theivacumar N, Dellagrammaticas D, Mavor AI, Gough MJ. Randomized clinical trial comparing endovenous laser ablation with surgery for the treatment of primary great saphenous varicose veins. *Br J Surg*. 2008;95(3):294-301.
63. Christenson JT, Gueddi S, Gemayel G, Bounameaux H. Prospective randomized trial comparing endovenous laser ablation and surgery for treatment of primary great saphenous varicose veins with a 2-year follow-up. *J Vasc Surg*. 2010;52(5):1234-1241.
64. Helmy ElKaffas K, ElKashef O, ElBaz W. Great saphenous vein radiofrequency ablation versus standard stripping in the management of primary varicose veins-a randomized clinical trial. *Angiology*. 2011;62(1):49-54.
65. Pronk P, Gauw SA, Mooij MC, et al. Randomised controlled trial comparing sapheno-femoral ligation and stripping of the great saphenous vein with endovenous laser ablation (980 nm) using local tumescent anaesthesia: one year results. *Eur J Vasc Endovasc Surg*. 2010;40(5):649-656.
66. Rasmussen LH, Bjoern L, Lawaetz M, Lawaetz B, Blemings A, Eklof B. Randomised clinical trial comparing endovenous laser ablation with stripping of the great saphenous vein: clinical outcome and recurrence after 2 years. *Eur J Vasc Endovasc Surg*. 2010;39(5):630-635.
67. Hoggan BL, Cameron AL, Maddern GJ. Systematic review of endovenous laser therapy versus surgery for the treatment of saphenous varicose veins. *Ann Vasc Surg*. 2009;23(2):277-287.
68. Murad MH, Coto-Yglesias F, Zumaeta-Garcia M, et al. A systematic review and meta-analysis of the treatments of varicose veins. *J Vasc Surg*. 2011;53(5 Suppl):49S-65S.
69. van den Bos R, Arends L, Kockaert M, Neumann M, Nijsten T. Endovenous therapies of lower extremity varicosities: a meta-analysis. *J Vasc Surg*. 2009;49(1):230-239.
70. Subramonia S, Lees T. Randomized clinical trial of radiofrequency ablation or conventional high ligation and stripping for great saphenous varicose veins. *Br J Surg*. 2010;97(3):328-336.
71. Binkert CA, Schoch E, Stuckmann G, et al. Treatment of pelvic venous spur (May-Thurner syndrome) with self-expanding metallic endoprostheses. *Cardiovasc Intervent Radiol*. 1998;21(1):22-26.
72. Heniford BT, Senler SO, Olsofka JM, Carrillo EH, Bergamini TM. May-Thurner syndrome: management by endovascular surgical techniques. *Ann Vasc Surg*. 1998;12(5):482-486.
73. O'Sullivan GJ, Semba CP, Bittner CA, et al. Endovascular management of iliac vein compression (May-Thurner) syndrome. *J Vasc Interv Radiol*. 2000;11(7):823-836.
74. Patel NH, Stookey KR, Ketcham DB, Cragg AH. Endovascular management of acute extensive iliofemoral deep venous thrombosis caused by May-Thurner syndrome. *J Vasc Interv Radiol*. 2000;11(10):1297-1302.
75. Kim HS, Malhotra AD, Rowe PC, Lee JM, Venbrux AC. Embolotherapy for pelvic congestion syndrome: long-term results. *J Vasc Interv Radiol*. 2006;17(2 Pt 1):289-297.
76. Kwon SH, Oh JH, Ko KR, Park HC, Huh JY. Transcatheter ovarian vein embolization using coils for the treatment of pelvic congestion syndrome. *Cardiovasc Intervent Radiol*. 2007;30(4):655-661.
77. Segal JB, Streiff MB, Hofmann LV, Thornton K, Bass EB. Management of venous thromboembolism: a systematic review for a practice guideline. *Ann Intern Med*. 2007;146(3):211-222.
78. Puggioni A, Marks N, Hingorani A, Shiferson A, Alhalbouni S, Ascher E. The safety of radiofrequency ablation of the great saphenous vein in patients with previous venous thrombosis. *J Vasc Surg*. 2009;49(5):1248-1255.
79. Blomgren L, Johansson G, Dahlberg-Akerman A, Thermaenius P, Bergqvist D. Changes in superficial and perforating vein reflux after varicose vein surgery. *J Vasc Surg*. 2005;42(2):315-320.
80. Fischer R, Linde N, Duff C, Jeanneret C, Chandler JG, Seeber P. Late recurrent saphenofemoral junction reflux after ligation and stripping of the greater saphenous vein. *J Vasc Surg*. 2001;34(2):236-240.

81. O'Hare JL, Vandenbroeck CP, Whitman B, Campbell B, Heather BP, Earnshaw JJ. A prospective evaluation of the outcome after small saphenous varicose vein surgery with one-year follow-up. *J Vasc Surg.* 2008;48(3):669-673; discussion 674.
82. Pittaluga P, Chastanet S, Guex JJ. Great saphenous vein stripping with preservation of sapheno-femoral confluence: hemodynamic and clinical results. *J Vasc Surg.* 2008;47(6):1300-1304; discussion 1304-1305.
83. Winterborn RJ, Foy C, Earnshaw JJ. Causes of varicose vein recurrence: late results of a randomized controlled trial of stripping the long saphenous vein. *J Vasc Surg.* 2004;40(4):634-639.
84. Rudstrom H, Bjorck M, Bergqvist D. Iatrogenic vascular injuries in varicose vein surgery: a systematic review. *World J Surg.* 2007;31(1):228-233.
85. Kontothanassis D, Di Mitri R, Ferrari Ruffino S, et al. Endovenous laser treatment of the small saphenous vein. *J Vasc Surg.* 2009;49(4):973-979 e971.
86. Marsh P, Price BA, Holdstock J, Harrison C, Whiteley MS. Deep vein thrombosis (DVT) after venous thermoablation techniques: rates of endovenous heat-induced thrombosis (EHIT) and classical DVT after radiofrequency and endovenous laser ablation in a single centre. *Eur J Vasc Endovasc Surg.* 2010;40(4):521-527.
87. Goode SD, Chowdhury A, Crockett M, et al. Laser and radiofrequency ablation study (LARA study): a randomised study comparing radiofrequency ablation and endovenous laser ablation (810 nm). *Eur J Vasc Endovasc Surg.* 2010;40(2):246-253.
88. Pittaluga P, Chastanet S, Locret T, Rousset O. Retrospective evaluation of the need of a redo surgery at the groin for the surgical treatment of varicose vein. *J Vasc Surg.* 2010;51(6):1442-1450.
89. van Groenendael L, Flinkenflogel L, van der Vliet JA, Roovers EA, van Sterkenburg SM, Reijnen MM. Conventional surgery and endovenous laser ablation of recurrent varicose veins of the small saphenous vein: a retrospective clinical comparison and assessment of patient satisfaction. *Phlebology.* 2010;25(3):151-157.
90. Anchala PR, Wickman C, Chen R, et al. Endovenous laser ablation as a treatment for postsurgical recurrent saphenous insufficiency. *Cardiovasc Intervent Radiol.* 2010;33(5):983-988.
91. Nwaejike N, Srodon PD, Kyriakides C. Endovenous laser ablation for the treatment of recurrent varicose vein disease--a single centre experience. *Int J Surg.* 2010;8(4):299-301.

The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

Table 1. Basic CEAP Classification of Chronic Venous Disease [9]

Clinical classification

C0: no visible or palpable signs of venous disease

C1: telangiectasies or reticular veins

C2: varicose veins

C3: edema

C4a: pigmentation or eczema

C4b: lipodermatosclerosis or atrophie blanche

C5: healed venous ulcer

C6: active venous ulcer

S: symptomatic, including ache, pain, tightness, skin irritation, heaviness, and muscle cramps, and other complaints attributable to venous dysfunction

A: asymptomatic

Etiologic classification

Ec: congenital

Ep: primary

Es: secondary (post-thrombotic)

En: no venous cause identified

Anatomic classification

As: superficial veins

Ap: perforator veins

Ad: deep veins

An: no venous location identified

Anatomic classification

Pr: reflux

Po: obstruction

Pr, o: reflux and obstruction

Pn: no venous pathophysiology identifiable