

Treating the Small Saphenous Vein

Anatomical considerations and techniques for treating the SSV and junctional tributaries.

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Small saphenous vein (SSV) reflux is an important and often overlooked cause of superficial venous insufficiency. It is present in about one-sixth of patients with superficial venous insufficiency, and its manifestations are often confused with reflux in the great saphenous vein (GSV).

The use of the previously common terms “short” and “lesser” saphenous vein have been discouraged, and an international consensus has promoted the term SSV as the most acceptable. The SSV begins on the lateral foot and passes lateral to the Achilles tendon to ascend the calf in its midline. Like the GSV, it is more accurately characterized as an “intrafascial vein” as it is present in the saphenous space, which is found superficial to the deep and deep to the superficial fascia.

ANATOMY

The classic anatomy is for the SSV to enter the popliteal fossa and then drain into the popliteal vein just above the level at which the two heads of the gastrocnemius diverge. It does so by joining the popliteal directly or after joining a gastrocnemius vein first. However, the cephalad termination of the SSV is variable, and dominant popliteal termination is present in 60% of cases at most. In approximately 15% of cases, the dominant portion of the SSV will terminate into a deep vein of the posterior thigh via a perforating vein. In

about 25% of cases, the SSV will extend more cephalad to the popliteal space. The cephalad or thigh extension travels in the same plane as the saphenous space deep to the superficial fascia but superficial to the muscular fascia. The thigh extensions of the SSV are variable and include termination into a vein, which communicates with the GSV (the cephalad extension in this case is known as the Giacomini vein) into a perforating vein in the posterior thigh and into the gluteal vein in descending order of frequency. Very rarely, the SSV may termi-



Figure 1. Prone access to the inferior border of the gastrocnemius muscle.

nate below the level of the popliteal fossa either into a perforating vein or into a gastrocnemius vein. Combinations of these patterns are common in most patients, with one pattern being the main form of drainage and or pathology in each case. We feel it appropriate to characterize the SSV as having a sapheno-popliteal junction (SPJ), a cephalad extension to a certain level, or both, in our reporting of the duplex evaluation of this vein.

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About one-third to one-half of the way down from the popliteal fossa to the ankle, near the inferior termination of the gastrocnemius muscles, the sural nerve enters the saphenous space and is adjacent to the SSV. These two structures become more intimately related further down the calf. The sural nerve provides sensory innervation to the posterolateral calf and lateral aspect of the foot.

PATTERNS OF REFLUX

Knowledge of the precise anatomy of an incompetent pathway is crucial to the success of its treatment. Since the clinical appearance of abnormalities with different patterns of venous disease overlap significantly, duplex ultrasound is critical to the accurate characterization of the pattern of venous insufficiency in each patient with CEAP 2-6 venous insufficiency.

SSV incompetence can occur because of reflux from the SPJ. Similar to the GSV, reflux in the SSV tends to be segmental, usually involving the one-third to one-half of the vein just below the SPJ. It is less common for SSV reflux to extend below the mid-calf region.

Isolated reflux of the SSV can occur without SPJ incompetence. This includes situations in which the reflux develops incompetent tributary inflow from the GSV or accessory GSV, or less commonly, reflux inflow from an incompetent perforator. An interesting observation is that varicose tributaries from an incompetent SSV can drain cephalad before

either draining into a competent GSV tributary, a re-entry perforator, or into varicose tributaries that then progress downward. SSV reflux-related skin changes classically occur on the lateral malleolar region.

Reflux in the cephalad extension of the SSV can occur secondary to pudendal vein reflux, thigh-perforating vein reflux, reflux that begins in the GSV (either incompetent tributary inflow or via the posterior circumflex vein of the thigh directly into the Giacomini vein), or from a gluteal vein reflux. This reflux may produce varicose veins in the posterior thigh, drain via re-entry perforating veins directly to the deep veins, or lead to SSV reflux and calf manifestations with or without additional SPJ incompetence.

TREATMENTS

The goal of small saphenous ablation techniques is the same as great saphenous ablation: permanent closure of the vein without complications. As mentioned previously, the course, anatomic landmarks, draining veins, branches, and surrounding nerves are unique and clearly different than the GSV. These unique aspects make thermal ablation of the SSV different as well.

In general, the patient position is prone. This allows easier imaging and access than the supine position. If the patient also requires treatment on the GSV, the SSV is examined in the supine position to evaluate access. This is aided by elevation of the foot on a pillow or foam block, with the leg rotated externally (frog-leg position). If obtainable in this position, SSV and GSV access is per-

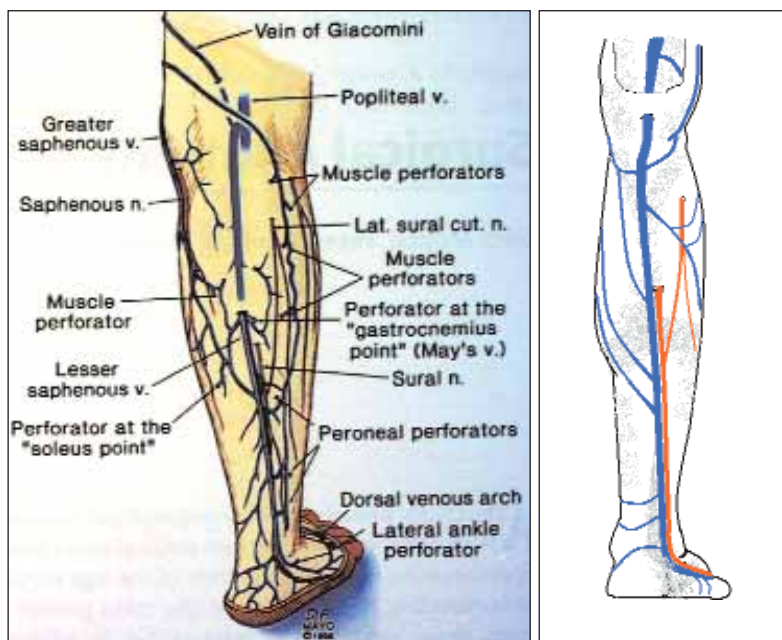


Figure 2. The SSV/sural nerve relationship.

formed. Access to both veins is obtained before treatment of either vein, as spasm can occur during treatment of the first vein. For solely SSV procedures, the prone position is preferred.

The level of access is to the lowest point of incompetence, but certainly not much below the inferior border of the gastrocnemius muscle (Figure 1). The diameter of an incompetent SSV is larger than that of a normal vein but smaller than an incompetent GSV. The average diameter of the SSV in the author's series of 50 limbs (SE) was 5.8 mm. The reason for minimizing treatment below the inferior border of the gastrocnemius muscle is to avoid injury to the sural nerve. The sural nerve runs adjacent to the SSV at this level and is more caudal, but tends to course more lateral and deeper than the SSV above this level (Figure 2).

Proximal (SPJ) positioning is also different. The structures to be avoided include the popliteal vein, the tibial nerve, and the peroneal nerve. The tibial nerve and peroneal nerve lie close to the popliteal artery and vein (Figure 3). If one searches carefully with ultrasound, the tibial nerve may be visualized lying on top of (more

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superficial) the popliteal vein. The authors begin thermal treatment just before the SSV dips down through the deep fascial sheath (Figure 4). This is usually at or just below the connection to the thigh extension of the SSV, if present. Much like the inferior epigastric vein, this landmark can be used to judge the starting point for GSV ablation. This distance is usually about 2.8 cm from the SPJ. If the reflux begins in the thigh extension of the SSV, the ablation is extended to include this segment. This can be accomplished with a single venous access; however, if the thigh extension connection from the SSV is angulated at the SPJ, a second venous access may be required to treat the thigh extension. It is important to limit the ablation to the intrafascial portion of the thigh extension because nerve or arterial injuries may occur with subfascial ablations. Also, avoid treating an incompetent sciatic vein, which could appear similar to the SSV to physicians unfamiliar with its course. It is distinguished from the SSV as an intrafascial vein that runs somewhat lateral to the SSV in the calf, then goes deeper at the lateral popliteal fossa as it enters the deep thigh compartment to follow the course of the sciatic nerve.

Tumescence infusion is similar to GSV treatment; one wants to surround the vein with a "sea of tumescence." The needle delivering the fluid should be as close to the SSV as possible so as to theoretically "push" the sural nerve away from the vein. To protect the overlying skin, a 1-cm distance of tumescence should be placed. The SSV is closer to the skin level than the GSV.

When applying energy, the same rules apply as the GSV. Somewhere between 70 and 100 joules/cm are required for durable occlusion. Some have advocated less energy (LEED or joules/cm) due to the smaller size and a more superficial location. The technique or amount of energy delivered is not altered. One author (NK) will deliver less energy if the ablation is extended into the region where the sural nerve is potentially vulnerable. No increase in complications has been noted with this protocol.

SUCCESS RATES AND COMPLICATIONS

Anatomical success with radiofrequency ablation and laser endovenous thermal ablation of the SSV has generally been reported between 85% to 100%. The follow

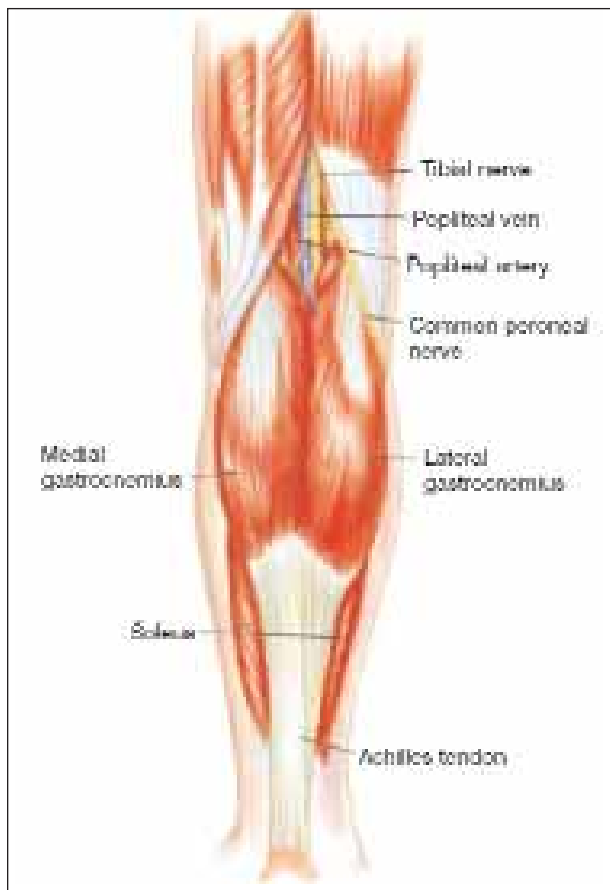


Figure 3. Popliteal fossa artery/vein/nerves.

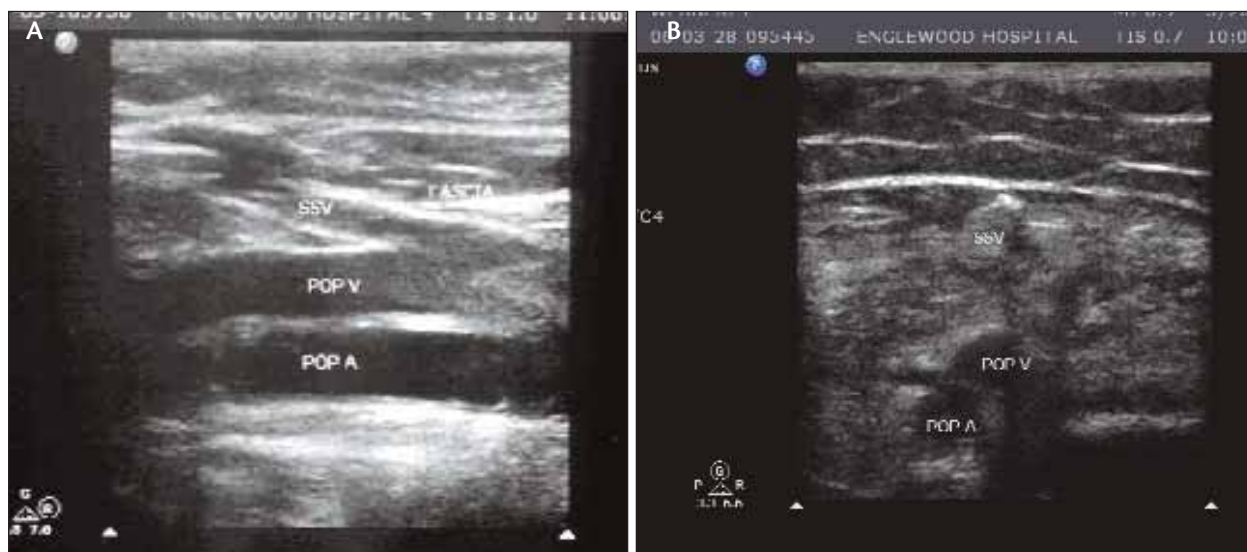


Figure 4. Longitudinal SPJ with the catheter at the fascial level (A). Transverse SPJ (B).

up for these evaluations has been relatively short, compared with evaluations for the GSV, varying from 1 to 36 months.

Clinical evaluations of laser ablation have been performed using laser energy of several wavelengths (810, 940, 980, 1320) that are produced by several manufacturers.

The incidence of junctional extension of thrombus after SSV ablation has been described to be low (0%–6%). In one study, the rate of popliteal extension of SSV thrombus at 2 to 4 days after endovenous thermal ablation was thought to be related to the anatomy of the SPJ. The incidence was 0% when no SPJ existed, 3% when a thigh extension existed, but it was 11% when no junctional vein could be identified.

The incidence of nerve injuries has been infrequent in the published series, but an insufficient amount of data exists to accurately quantify it.

CONCLUSIONS

The SSV has anatomical relationships that make evaluation and management decisions more complex when compared to the GSV. Treatment goals are similar: eliminate reflux from its highest possible point, and then eliminate the varicose outflow tracts to maximize clinical benefit and durability. Endovenous thermal ablation is the preferred technique in the US because it is efficient, highly successful, and very safe. Thermal ablation of the SSV is similar to GSV treatment with some minor modifications based on the anatomy. As always, anatomic relationships play a key role in avoiding injury. ■

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Recommended Reading:

1. Almeida JJ, Raines JK. Radiofrequency ablation and laser ablation in the treatment of varicose veins. *Ann Vasc Surg.* 2006;20:547-552.
2. Caggiati A. Fascial relationships of the short saphenous vein. *J Vasc Surg.* 2001;34:241-246.
3. Gibson KD, Ferris BL, Polissar N, et al. Endovenous laser treatment of the short saphenous vein: efficacy and complications. *J Vasc Surg.* 2007;45:795-801; discussion 801-803.
4. Labropoulos N, Giannoukas AD, Delis K, et al. The impact of isolated lesser saphenous vein system incompetence on clinical signs and symptoms of chronic venous disease. *J Vasc Surg.* 2000;32:954-60.
5. Min RJ, Khilnani NM, Golia P. Duplex ultrasound evaluation of lower extremity venous insufficiency. *J Vasc Interv Radiol.* 2003;14:1233-1241.
6. Merchant RF, Pichot O, for the Closure Study Group. Long-term outcomes of endovenous radiofrequency obliteration of saphenous reflux as a treatment of superficial venous insufficiency. *J Vasc Surg.* 2005;42:502-509.
7. Myers K, Fris R, Jolley D. Treatment of varicose veins by endovenous laser therapy: assessment of results by ultrasound surveillance. *Med J Austral.* 2006;185:199-202.
8. Proebstle TM, Gul D, Kargl A, et al. Endovenous laser treatment of the lesser saphenous vein with a 940-nm diode laser: early results. *Dermatol Surg.* 2003;29:357-361.
9. Ravi R, Rodriguez-Lopez JA, Trayler EA, et al. Endovenous ablation of incompetent saphenous veins: a large single-center experience. *J Endovasc Ther.* 2006;13:244-248.
10. Theivacumar NS, Beale RJ, Mavor AI, et al. Initial experience in endovenous laser ablation (EVLA) of varicose veins due to small saphenous vein reflux. *Eur J Vasc Endovasc Surg.* 2007;33:614-618.