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Great Saphenous Vein Diameters in Phlebological Practice in France: A Report of the DIAGRAVES Study by the French Society of Phlebology

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WHAT THIS PAPER ADDS

In routine phlebological practice, only a small minority of patients with venous symptoms and/or clinical signs of chronic venous disorders present with large diameter (>8 mm) incompetent great saphenous veins (GSVs). More than half of the incompetent GSVs are small (<6 mm). This knowledge should influence management strategies in daily practice, with a view to reducing the global cost of treating patients with chronic venous disorders.

Objective: The aim was to evaluate the distribution of the diameter of the great saphenous vein (GSV) at mid-thigh level and to investigate its association with clinical class, symptoms, and proximal extent of reflux.

Methods: Vascular physicians, members of the French Society of Phlebology, were invited to participate in a consecutive observational study in patients presenting with symptoms and/or signs of uni- or bilateral chronic venous disorders (CVDs) in previously untreated limbs (clinical class of the CEAP classification C0s — C6). Patients were included between January and March 2015. They completed a specially designed venous symptoms questionnaire. Duplex ultrasound of the included limbs was performed with the patient standing to detect reflux in the GSV and to measure the GSV inner diameter at mid-thigh.

Results: Between January and March 2015, 35 physicians examined 1245 patients (2450 limbs after excluding 40 limbs): 77% were female, mean age 52 ± 14; 69% of the patients had venous symptoms in one or both legs. The most frequent symptoms were feeling of heaviness, feeling of swelling and aching. Predominant CEAP clinical classes were C2 (38% of limbs) and C1 (35%). In case of GSV reflux (40% of limbs), the average diameter was 5.6 ± 2 mm and the distribution was 62% < 6 mm, 30% between 6 and 8 mm, and 8% > 8 mm. The study showed a clear association between clinical class and GSV diameter (the higher the clinical class, the larger the diameter; $p < .0001$), between venous symptoms and diameter (the larger the diameter, the higher the intensity of symptoms, $p < .0001$ for overall discomfort) and between proximal extent of reflux and diameter (the more proximal the extent of reflux, the larger the diameter, $p < .0001$).

Conclusion: The DIAGRAVES study demonstrated that in France for patients consulting with CVDs, more than half of the incompetent GSVs had a diameter < 6 mm, while large diameters were relatively infrequent. This should be kept in mind when considering management strategies in patients with CVDs.

Keywords: Great saphenous vein, Duplex ultrasound, Diameter, Reflux, Foam sclerotherapy
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INTRODUCTION

Chronic venous disorders (CVDs) caused by superficial venous pathology are a frequent reason for medical consultation. In France, between 20% and 35% of the general population suffers from varices in the lower limbs, that is 18—20 million individuals.[1] In 30—50% of these patients with CVDs (about 8 million people), the saphenous veins are involved, in particular the great saphenous vein (GSV).[1]

In Europe, the treatments for saphenous vein incompetence offered most frequently are endovenous thermal ablation (TA), endovenous non-thermal, non-tumescent ablation techniques (NTNTs) including ultrasound guided foam sclerotherapy (UGFS), and still to a considerable

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extent surgery, usually consisting of high ligation, stripping and phlebectomy.[2] In addition, single phlebectomies with preservation of the saphenous trunk are performed in certain cases, mainly in limbs with C2 — C3 disease.[2–4]

In France the technique of UGFS is widespread for treating patients with varicose veins and patients with CVDs in general, mainly based on a longstanding tradition of sclerotherapy. If used for the proper indications, UGFS may offer a cheap alternative to TA or surgery. Although clinical improvement and improvement of quality of life are quite similar after the different treatment techniques, the occlusion rate is less good after UGFS according to the results of several randomised clinical trials, comparing TA, surgery, and UGFS.[5–8] One of the key points for obtaining effective occlusion of the GSV by UGFS appears to be the diameter of the trunk.[6] Several studies confirmed that recanalisation was significantly more frequent if the pre-treatment diameter of the GSV was > 6 mm and therefore the advice is to use UGFS for smaller diameters.[7,9,10]

There are currently few data available on the distribution of GSV diameters in large cohorts of patients presenting with venous symptoms and clinical signs of CVDs. Therefore, the French Society of Phlebology (Société Française de Phlébologie, SFP) set up a large observational study to assess the distribution of GSV diameters in patients with CVDs and reflux presenting at phlebology clinics in France.

The primary aim of the study was to assess the distribution of GSV diameter and the presence or absence of GSV reflux in limbs of patients who were referred with CVDs. The secondary aim was to investigate a potential association between CEAP clinical classes and GSV diameter, between venous symptoms and diameter, and between proximal extent of reflux (from terminal valve, pre-terminal valve, or only segmental reflux) and diameter.

METHODS

A consecutive and multicentre observational study was conducted in France, the DIAGRAVES study (DIAmètres de GRAndes VEines Saphènes).

Investigators

During the annual meeting of the SFP in December 2014, about 200 vascular physicians experienced in clinical and duplex ultrasound assessment of patients with CVDs and members of the SFP were invited to become investigators for the DIAGRAVES study. Medical doctors were invited but vascular technologists were excluded. To obtain a representative sample, the target was to include at least 1000 patients during a three month period (January to March 2015). Each participating centre had to recruit a minimum of 20 consecutive patients. Standardised forms were used to register all study findings for each patient (Fig. S1).

Patients

Eligible patients were those presenting with venous symptoms and/or signs of unilateral or bilateral CVDs, classified C0s — C6 according to the CEAP classification. Exclusion criteria were previous bilateral treatment of the GSV, pregnancy, and deep venous abnormalities. Patients who had undergone previous unilateral treatment for CVDs were only included for one (contralateral) leg. Patients who were unable to stand and those not capable of understanding the questions and giving informed consent were also excluded.

All patients were asked to complete a questionnaire about the presence or absence of venous symptoms (Fig. 1) and underwent clinical examination to determine the clinical class of CVDs.

Right Lower Limb	Symptoms	Left Lower Limb
0 – 1 – 2 – 3 – 4	Overall discomfort	0 – 1 – 2 – 3 – 4
0 – 1 – 2 – 3 – 4	Pain	0 – 1 – 2 – 3 – 4
0 – 1 – 2 – 3 – 4	Heaviness	0 – 1 – 2 – 3 – 4
0 – 1 – 2 – 3 – 4	Swelling	0 – 1 – 2 – 3 – 4
0 – 1 – 2 – 3 – 4	Itching	0 – 1 – 2 – 3 – 4
0 – 1 – 2 – 3 – 4	Cramps during the night	0 – 1 – 2 – 3 – 4
0 – 1 – 2 – 3 – 4	Feeling of warmth or burning	0 – 1 – 2 – 3 – 4
0 – 1 – 2 – 3 – 4	Tingling	0 – 1 – 2 – 3 – 4
0 – 1 – 2 – 3 – 4	Throbbing	0 – 1 – 2 – 3 – 4
0 – 1 – 2 – 3 – 4	Restless legs	0 – 1 – 2 – 3 – 4
0 – 1 – 2 – 3 – 4	Complaints increasing with heat and/or improving with cold	0 – 1 – 2 – 3 – 4

Venous symptoms: 0: none / 1: mild / 2: moderate / 3: severe /4: extreme
Please circle the number corresponding to your answer

Figure 1. Symptoms questionnaire (to be completed by the patient).

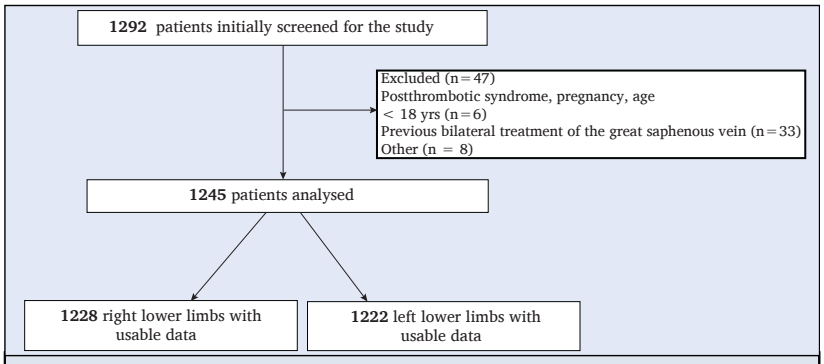

Figure 2. Study flow diagram.

Duplex ultrasound

All patients were investigated by one of the vascular physicians participating in the study. Duplex ultrasound was performed with the patient standing, using a linear transducer (7.5—14 MHz) in the vast majority of cases. The deep veins were also examined, mainly focusing on the popliteal, femoral, and common femoral veins (5 — 7.5 MHz). In case of any suspicion of history of deep venous problems the iliac veins and the deep veins below the knee were also investigated.

All superficial truncal and tributary veins were carefully scanned to detect *reflux,* using a Valsalva manoeuvre at the saphenofemoral junction (to distinguish between terminal and pre-terminal valve incompetence) and a compression/release manoeuvre for the remaining veins.[11,12] Reflux was defined as reversed flow lasting more than 0.5 seconds when using pulsed Doppler interrogation in longitudinal view.

Great saphenous vein reflux was registered at the terminal valve, at the pre-terminal valve, and in the trunk at the upper, middle, and lower third of the thigh. In the presence of a large medial tributary in the thigh, parallel to the GSV, with a competent and hypoplastic GSV in the lower part of the thigh, reflux was also registered in this vein.

The *diameter* of the GSV was measured at two places, three cm below the saphenofemoral junction and at mid-thigh. If there was a focal dilatation, measurement was performed just above or below it. For simplicity, only the mid-thigh measurements were considered for analysis in the present study.

According to requirements for this type of study in France in 2015, the study was submitted to and approved by the Commission Nationale de l'Informatique et des Libertés (CNIL) (French data protection body).

Statistics

Quantitative variables were described as means with standard deviations and qualitative variables by numbers and percentages. Multiple Comparisons were conducted according to the presence of a venous reflux and the GSV diameters. Comparisons of categorical values (like C-class, venous reflux or GSV diameter in class) were performed using the chi-square test or the Fisher exact test if required, and comparisons between a categorical value and a quantitative value (like GSV diameter) by variance analyses or Wilcoxon test (if not normally distributed). A study of the correlations between the quantitative values such as the intensity of the symptoms and the diameter of the GSV was performed using a Pearson coefficient test. The data were entered in Clinsight software and the analysis was performed using SAS software version 9.3. The threshold for statistical significance was set to $p < .05$ for all analyses.

RESULTS

During the study period 35 investigators selected a total of 1292 patients presenting with C0s — C6 disease, of whom 47 had to be excluded, so that a total of 1245 patients (2450 limbs) could be studied (Fig. 2). The mean age of the included population was 52 ± 14 years). The mean body mass index was 25.5 ± 5.3, and 77% of the patients were female. Sixty-nine per cent of the patients were symptomatic and the intensity of the symptoms indicated on the questionnaire form was 'mild' (Score 1) in most cases. Predominant symptoms were feeling of heaviness, feeling of swelling and aching (Table 1). The most frequent C classes of CEAP were C1 and C2 in respectively 35% and 38% of limbs (Fig. 3).

Primary aim

There were no significant differences in GSV diameters between the left and right lower limbs ($p = .45$ for all limbs, $p = .65$ for limbs with reflux, $p = .63$ for limbs without reflux). Globally, 60% of the limbs did not have reflux in the GSV, while the remaining 40% did. A detailed analysis of the mean GSV diameter at mid-thigh is presented in Fig. 4:

- Left lower limb: 4.5 ± 1.9 mm for all GSVs, 3.7 ± 1.4 mm for GSVs without reflux vs 5.6 ± 2.0 mm for GSVs with reflux ($p < .0001$).
- Right lower limb: 4.4 ± 1.9 mm for all GSVs, 3.6 ± 1.4 mm for GSVs without reflux vs 5.5 ± 2.0 mm for GSVs with reflux ($p < .0001$).
- Both lower limbs: 4.5 ± 1.9 mm for all GSVs, 3.7 ± 1.4 mm for GSVs without reflux vs 5.6 ± 2.0 mm for GSVs with reflux ($p < .0001$).

Fig. 5 shows that the vast majority (92%) of refluxing GSVs had a diameter < 8 mm, and 62% < 6 mm.

Table 1. Mean self-reported scores of venous symptoms (CEAP C0s-C6) in 1222 left lower limbs and 1228 right lower limbs, respectively.

Symptom	Left lower limb mean ± SD	Right lower limb mean ± SD
Overall discomfort	1.6 ± 1.1	1.6 ± 1.1
Pain	1.4 ± 1.2	1.3 ± 1.1
Heaviness	1.9 ± 1.1	1.9 ± 1.1
Swelling	1.6 ± 1.3	1.5 ± 1.3
Itching	0.7 ± 1.1	0.7 ± 1.1
Cramps during the night	1.1 ± 1.3	1.1 ± 1.3
Feeling of warmth or burning	0.9 ± 1.2	0.9 ± 1.2
Tingling	0.7 ± 1.0	0.7 ± 1.0
Throbbing	0.8 ± 1.1	0.8 ± 1.1
Restless legs	1.0 ± 1.3	1.0 ± 1.2
Complaints increasing with heat and/or improving with cold	1.8 ± 1.3	1.7 ± 1.4

The scores range from 0 = none; to 1 = mild; 2 = moderate; 3 = severe; 4 = extreme. SD = standard deviation; CEAP = comprehensive classification system for chronic venous disorders.

Secondary aim

GSV diameter was clearly associated with CEAP clinical class ($p < .0001$) and it was obvious that C4 to C6 corresponded with larger GSV diameters (Table 2 and Fig. 6): 70% of C4 and 90% of C5 and C6 had diameters > 6 mm, while only 10% of C0s and C1 and 40% of C2 were > 6 mm. Furthermore, the correlation between diameter and symptoms made it possible to demonstrate that venous symptoms, excluding night cramps, throbbing, and restless leg syndrome, were more frequent if the diameter was large. Although these correlations were weak, varying between 0.06 and 0.16, they were statistically significant (Table 3). The presence of reflux was associated with a higher symptom score than the absence of reflux ($p < .0001$ for overall discomfort and most symptoms at different levels of extent of reflux) (Table 4). If the pre-terminal and terminal valves were competent, the diameter of the GSV at mid-thigh was less than 6 mm in 80% of cases and more than 6 mm in 20% ($p < .0001$). The more proximal the extent of reflux the larger the diameter became ($p < .0001$).

DISCUSSION

The present study reports findings about GSV diameter measurement and its correlation with venous symptoms and clinical findings in the French population consulting a specialist for CVDs of all types with superficial venous pathology. The target of the DIAGRAVES study was not the general population as in the Edinburgh Vein Study or the Bonn Vein Study, but a selected sample of patients with CVDs.[13,14] Demographics, with a clear female predominance (77%) and an average age of 52 years, corresponded with the literature on patients with CVDs.[2] All clinical classes of the CEAP classification were represented, although the majority of limbs were classified C2, closely followed by C1. Telangiectasias are a frequent reason to consult a vascular specialist, in particular in countries where vein clinics are common.[15]

Diameters of GSVs vary considerably between limbs and are significantly larger in limbs with reflux than in those without, as was clearly demonstrated in the present study. This corresponds with previous reports.[16,17] There was no significant difference between measurements of the left and right lower limb, which suggests that compression of the left common iliac vein by the right common iliac artery (May—Thurner syndrome) does not play an important role in primary varicose veins.

A striking feature was that refluxing GSV diameters above 8 mm were relatively uncommon, and that the majority (62%) had diameters smaller than 6 mm. This may have direct consequences for phlebology practice in France. In view of the small diameter in more than half of the limbs with GSV reflux, UGFS may be a good treatment option for these small diameter GSVs (<6 mm), with very satisfactory

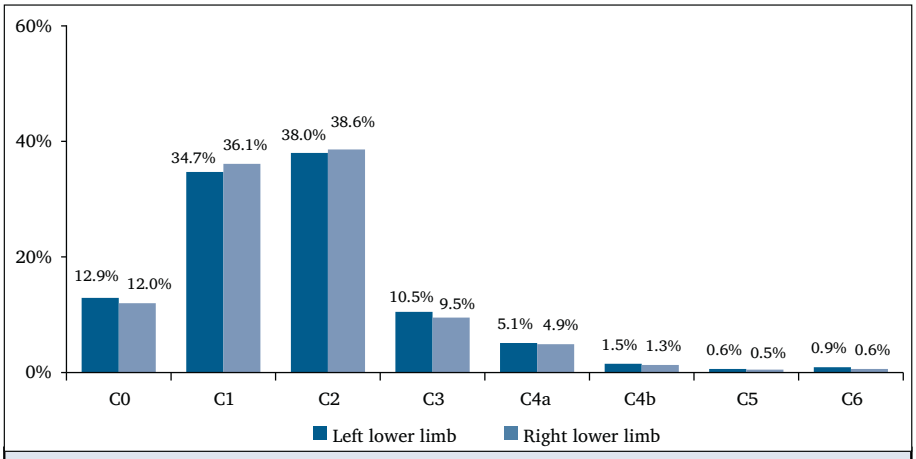

Figure 3. Distribution of C classes of the basic CEAP classification in 1222 left and 1228 right lower limbs. CEAP = comprehensive classification system for chronic venous disorders; C0 = no visible or palpable signs of venous disease; C1 = telangiectasies or reticular veins; C2 = varicose veins; C3 = edema; C4a = pigmentation or eczema; C4b = lipodermatosclerosis or atrophie blanche; C5 = healed venous ulcer; C6 = active venous ulcer.

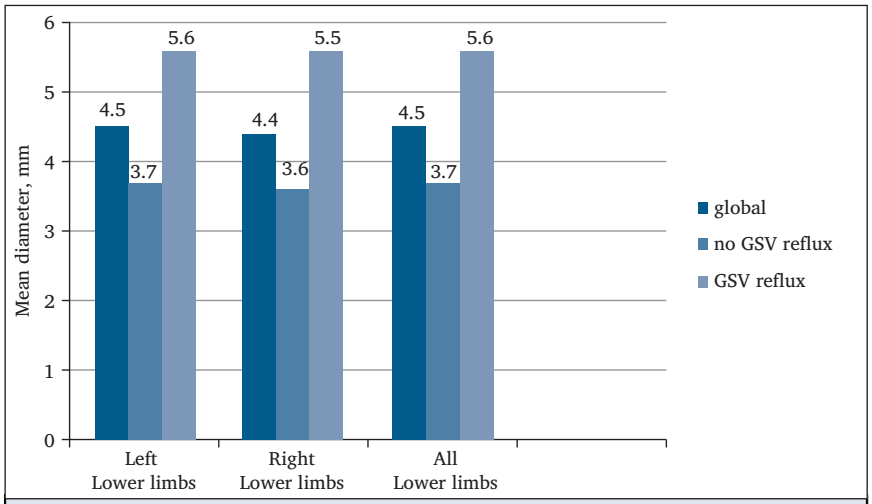

Figure 4. Great saphenous vein (GSV) mean diameters in 1222 left and 1228 right lower limbs and all limbs together, stratified by GSV reflux.

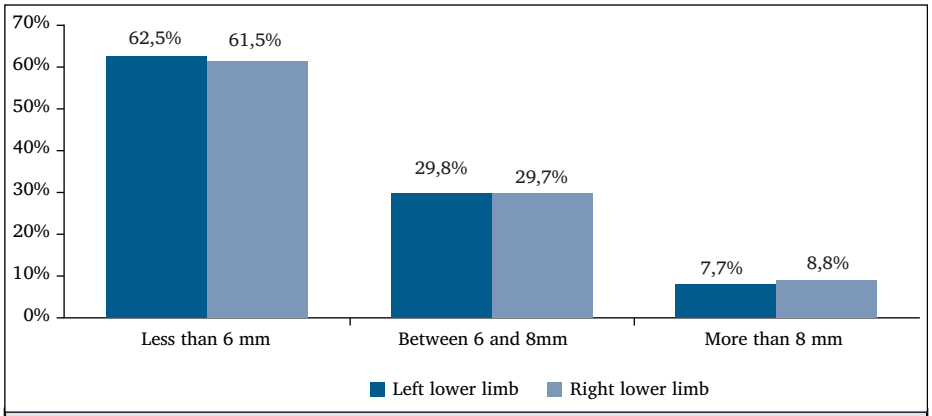

Figure 5. Distribution of incompetent great saphenous vein diameters in 392 left and 364 right lower limbs.

Table 2. GSV diameter according to clinical class (C) of CEAP in 1222 left and 1228 right lower limbs.

CEAP	Mean GSV diameter ± SD, mm		
	Left LL	Right LL	All LL
C0	4.6 ± 2.1	4.6 ± 1.4	4.6 ± 1.8
C1	4.6 ± 1.3	4.6 ± 1.4	4.6 ± 1.4
C2	5.9 ± 2.0	5.8 ± 2.0	5.9 ± 2.0
C3	6.4 ± 2.5	6.1 ± 1.8	6.3 ± 2.2
C4a	7.8 ± 3.0	7.5 ± 3.1	7.7 ± 3.0
C4b	7.4 ± 2.7	7.1 ± 2.6	7.2 ± 2.6
C5	8.0 ± 2.5	10.5 ± 3.7	9.1 ± 3.2
C6	8.3 ± 1.9	6.3 ± 2.5	7.5 ± 2.3
ANOVA (p)	< .0001	< .0001	< .0001

GSV = great saphenous vein; LL = lower limb; SD = standard deviation; ANOVA = analysis of variance; CEAP = comprehensive classification system for chronic venous disorders; 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.

obliteration rates to be expected, based on previous studies.[7,9,10,18,19] An alternative option could consist of performing phlebectomies only if varicose veins present connected with the refluxing GSV.[3,4] Both treatment strategies, UGFS and single phlebectomies, would be in agreement with a worldwide survey about management strategies in patients with varicose veins, in which 211 specialists indicated that diameter measurement was important and stated that saphenous diameter did influence their choice of treatment modality.[20] However, based on the answers of these specialists, the threshold for opting for a less invasive treatment, such as UGFS or single phlebectomies, was set at a diameter of 4 mm, and the same low threshold was used in a subsequent Delphi consensus investigation.[21] In a recently published document on behalf of the French National Council of Vascular Medicine focusing on "Choosing Wisely", UGFS has been recommended as a wise option for treatment of incompetence of small diameter trunks, offering patients at the same time high quality of care and safety.[22]

In clinical practice, diameter measurement may not only modify the treatment strategy and the result to be

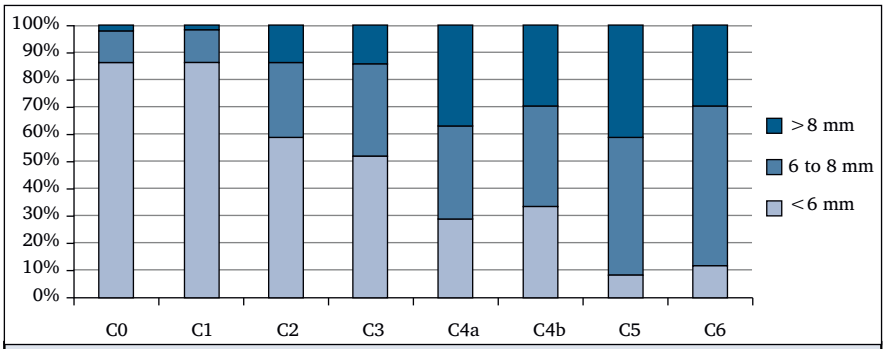

Figure 6. Great saphenous vein diameter distribution of all limbs according to the basic CEAP classification (highest C). This analysis covers 2269 lower limbs that can be evaluated for this criterion, including 1131 right lower limbs and 1138 left lower limbs; CEAP = comprehensive classification system for chronic venous disorders; 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.

expected, but it may also indirectly have a considerable impact on health economics. Owing to the differences in the cost of the various available techniques, global costs for treating patients with CVDs might be consistently reduced if a cheaper treatment option like UGFS replaced the more expensive TA and alternative NTNT (e.g., mechanochemical ablation, cyanoacrylate glue) whenever possible, based on the saphenous diameter as one of the important parameters. Therefore, in future revisions to the presently available guidelines on management of chronic venous disease,[2] it would be appropriate to differentiate between GSV diameters of different calibres, to fine tune the recommendations on treatment of a refluxing GSV (or another saphenous trunk). Obviously more evidence is needed, based on properly designed randomised controlled trials (RCTs), specifically addressing this issue. Sub-analysis of groups of limbs with different pre-treatment diameters should be added when comparing results of UGFS versus other techniques, as has been performed in the RCT by Shadid et al.[9] This would shed more light on the proper indications for UGFS and save costs for patients and society.

Table 3. Correlation between increasing great saphenous vein diameter and self-reported symptom scores including both, left and right lower limbs

Symptom	Number of observations	Pearson correlation coefficient	*P*-value
Overall discomfort	2,197	.12	<.001
Pain	2,208	.07	.001
Heaviness	2,208	.08	.001
Swelling	2,191	.09	<.001
Itching	2,182	.16	<.001
Cramps during night	2,191	.02	.29
Feeling of warmth or burning	2,210	.09	<.001
Tingling	2,211	0.09	<.001
Throbbing	2,179	.03	.17
Restless legs	2,206	.006	.76
Complaints increasing with heat and/or improving with cold	2,210	.06	.002

In the present study, diameters correlated well with the clinical class of the CEAP classification, which confirms previous findings.[16,17,21,23] The largest diameters are found in clinical class C4 to C6, whereas GSVs of limbs with a lower clinical class usually have a smaller diameter.

The study also demonstrated an association between most venous symptoms and large diameters as well as between symptoms and the presence of reflux. The latter has been documented previously.[24] However, a potential correlation between diameters and venous symptoms has not yet been reported. The authors of the recently published SYM Vein Consensus statement mentioned the correlation between venous symptoms and the C of the CEAP classification. Based on the fact that the C class correlates with saphenous diameters, it seems logical that patients experience more symptoms in a limb with large diameter refluxing veins. Nevertheless, it should be acknowledged that the pathophysiology of venous symptoms remains poorly understood, and additional research is warranted, as was stated in the SYM Vein document.[25] It would be interesting to further investigate the relationship between saphenous diameters and venous symptoms, in particular in C4 — C6 disease.

Finally, GSV diameter tends to be smaller in segmental GSV reflux without involvement of the pre-terminal or terminal valve, and larger in terminal valve incompetence.[16,26] Cappelli et al.[26] found a statistically significant correlation between a competent terminal valve and a GSV diameter < 5 mm.

To use saphenous vein diameter as a reliable parameter for evaluation and decision making, standardisation of diameter measurement is of the utmost importance. Diameter measurement uses B mode and transverse positioning of the transducer, with the patient in the standing position. This is generally agreed in guidelines and consensus documents.[2,11,12] Measurement of the diameter at mid-thigh, usually at about 15 cm from the saphenofemoral junction, in

Table 4. Comparison of self-reported mean venous symptom scores between patients with and patients without great saphenous vein reflux, including both left and right limbs and different degrees of reflux

All lower limb	Terminal valve reflux			Pre-terminal valve reflux			Trunk reflux		
	No	Yes	*P*-value	No	Yes	*P*-value	No	Yes	*P*-value
Overall discomfort	1.2 ± 1.1	1.5 ± 1.2	<.001	1.1 ± 1.1	1.5 ± 1.2	<.0001	1.1 ± 1.1	1.4 ± 1.2	<.001
Pain	1.0 ± 1.1	1.2 ± 1.2	<.001	0.9 ± 1.1	1.3 ± 1.2	<.0001	0.9 ± 1.1	1.2 ± 1.2	<.001
Heaviness	1.4 ± 1.2	1.7 ± 1.3	.001	1.4 ± 1.2	1.7 ± 1.2	<.0001	1.4 ± 1.2	1.6 ± 1.2	<.001
Swelling	1.2 ± 1.3	1.4 ± 1.3	.001	1.1 ± 1.3	1.5 ± 1.3	<.0001	1.1 ± 1.3	1.4 ± 1.3	<.001
Itching	0.5 ± 0.9	0.8 ± 1.3	<.001	0.5 ± 0.9	0.8 ± 1.2	<.0001	0.5 ± 1.0	0.7 ± 1.1	.001
Cramps during the night	0.9 ± 1.2	1.0 ± 1.2	.038	0.8 ± 1.2	1.0 ± 1.2	.0125	0.8 ± 1.2	0.9 ± 1.2	.054
Feeling of warmth or burning	0.7 ± 1.1	0.9 ± 1.2	.001	0.6 ± 1.0	0.9 ± 1.2	<.0001	0.6 ± 1.0	0.8 ± 1.2	<.001
Tingling	0.5 ± 0.9	0.7 ± 1.1	<.001	0.5 ± 0.9	0.7 ± 1.1	<.0001	0.5 ± 0.9	0.7 ± 1.0	<.001
Throbbing	0.5 ± 0.9	0.7 ± 1.0	.005	0.5 ± 0.9	0.7 ± 1.1	<.0001	0.5 ± 0.9	0.7 ± 1.0	<.001
Restless legs	0.8 ± 1.1	0.8 ± 1.2	.32	0.8 ± 1.1	0.9 ± 1.2	.0347	0.8 ± 1.1	0.8 ± 1.2	.18
Complaints increasing with heat and/or improving with cold	1.4 ± 1.4	1.6 ± 1.4	.002	1.3 ± 1.3	1.7 ± 1.4	<.0001	1.3 ± 1.3	1.6 ± 1.4	<.001

Scores range from 0 = none; to 1 = mild; 2 = moderate; 3 = severe; 4 = extreme, and are reported as mean ± standard deviation.

a straight part of the GSV, not at a focal dilatation, appears to be the most reproducible and has therefore also been used for the present study.[12,23,27,28] However, there may be still different ways of measuring the diameter at this standard location. The outer diameter of the vein can be measured (between the outer borders of the adventitia) or the inner diameter (i.e., the diameter of the lumen, between the inner borders of the intima). Although the UIP consensus document of 2011[12] recommended measuring the external diameter, in view of comparison pre- and post-operatively in an individual patient, it seems to be more applicable to use the inner diameter for screening and pre-operative assessment, which allows for comparison between patient cohorts in different studies. In a recent study about postural diameter change[28] the investigators also measured the inner diameter and the same strategy was used in the present study. Unfortunately, in several studies, diameter measurement has not been performed in a standardised way and often the methodology lacks clarity on details about how venous diameters were measured. In the three arm CLASS trial[29] conducted in the UK (comparing endovenous laser, surgery, and foam sclerotherapy), the "mean" diameter of the GSV was reported to be very large, respectively 9.1 mm, 8.7 mm, and 8.4 mm in the three cohorts. However, in this study measurement of the "widest" diameter was used, not the above-described standardised method. The lack of standardisation in measurement methods leads to inconsistencies when trying to compare the results of different studies on GSV treatment.

Limitations

First, in the present study the internal diameter of the GSV was measured, but the thickness of the vein wall has not been considered. According to recent investigations, thickening of the vein wall and phlebosclerosis may indicate more advanced disease,[30] hence this may warrant a more aggressive approach (TA, NTNT) to obtain a good result. This should be further studied in trials including measurement of vein wall thickness in addition to simple diameter measurement.[31]

Second, the correlations between diameter and symptoms, found in this study, should be interpreted with care. Even if statistical significance was reached, this may have been due to the large size of the cohort investigated.

Third, small saphenous vein or perforator incompetence was not an exclusion criterion. Even if superficial disease has frequently been associated with GSV incompetence, it should be acknowledged that according to the literature small saphenous vein reflux is responsible for 15% of all varicose disease.[32,33] Some of the included patients might indeed have suffered from other than GSV incompetence, and this may have played a role in their symptoms and in the CEAP clinical class.

Finally, in this study, information about wearing compression stockings or not was not collected, which may have influenced the symptoms and C class in these patients.

CONCLUSION

The DIAGRAVES study demonstrated that, in patients consulting for CVDs in France, more than half of the incompetent GSVs had a diameter < 6 mm, while only 8% had a large diameter of > 8 mm. This should be kept in mind when considering management strategies in patients with CVDs.

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CONFLICTS OF INTEREST

None.

APPENDIX A. SUPPLEMENTARY DATA

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejvs.2018.09.011.

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