View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Elsevier - Publisher Connector

A randomized trial of cryo stripping versus conventional stripping of the great saphenous vein

Taco M. A. L. Klem, MD,[a] J. Marco Schnater, MD, PhD,[b] P. Ronald Schütte, MD,[c] Wim Hop, MSc, PhD,[d] Arie C. van der Ham, MD, PhD,[a] and **Cornelis H. A. Wittens, MD, PhD,[e]** *Rotterdam, Amsterdam, and Dordrecht, The Netherlands*

Objective: **This multicenter randomized clinical trial compared cryo stripping of the great saphenous vein (GSV) with conventional stripping.**

Methods: **The study randomized 494 patients with symptomatic (CEAP) clinical severity class 2 to 4 to cryo stripping (n = 249) or conventional stripping (n = 245). The primary outcome was residual GSV 6 months after surgery measured by venous duplex ultrasound imaging. Secondary outcomes were quality of life, operation time, and postoperative neural damage. Duration of follow-up was 6 months. Quality of life was measured at 6 and 26 weeks postoperatively with the Aberdeen Varicose Vein Questionnaire (AVVQ) and Medical Outcomes Study Short-Form 36 (SF-36) Health Survey.**

Results: **The two groups were well matched at baseline. The percentage of patients with residual GSV at 6 months (primary outcome) was 44% (102 of 230) in the cryo group and 15% (33 of 215) in the conventional group (difference 29%; 95% confidence interval [CI], 21%-37%, $P < .001$). Median operation time was significantly shorter in the cryo group (30 minutes) compared with the conventional group (39 minutes). Neural damage was 12% in both groups, and thus not significantly different. Scores on the subdomains of the SF-36 showed no significant change between the groups. The AVVQ after conventional stripping was 8.0, which was a better result than the 11.7 result after cryo stripping (difference 2.6 points; 95% CI, 1.0-4.2; $P = .001$, repeated measurements analysis of variance with adjustment for baseline scores).**

Conclusions: **Cryo stripping accounts for numerous procedural failures and hence residual GSV in patients. The AVVQ showed small but significantly better results for patients after a conventional stripping. Cryo stripping has no benefits over conventional stripping. (J Vasc Surg 2009;49:403-9.)**

The high prevalence of venous disease of the leg accounts for enormous costs and loss of quality of life (QOL) worldwide.[1-4] Venous disease is caused by venous incompetence of the superficial venous system, with or without venous incompetence of the deep or perforator vein system, or both.[5-7] If we can reduce the number of patients with venous disease of the leg by improving the outcome of the current surgical therapy, it will reduce the costs and use of health care resources and improve QOL.

Surgical treatment of the great saphenous vein (GSV) is indicated when there is valve incompetence at the saphenofemoral junction (SFJ) and GSV. Although endovenous laser and radiofrequency thermoablation of the GSV are often used, the most commonly performed surgical treatment of the GSV in Europe is still conventional stripping. Cryo stripping of the GSV has been introduced in Europe as a faster and cosmetically better procedure compared with conventional stripping. Although there is insufficient evidence that cryo stripping can actually adequately strip the GSV, the technique is widespread throughout Europe.[8-16] The outcomes in patients with symptomatic venous disease of the leg and duplex ultrasound (DU)–proven venous incompetence of the SFJ and GSV treated by conventional or cryo stripping were assessed in a multicenter, randomized clinical trial.

From the Departments of Vascular Surgery of Sint Franciscus Hospital, Rotterdam,[a] Academic Medical Center, Amsterdam,[b] Albert Schweitzer Hospital, Dordrecht,[c] and VU Medical Center, Amsterdam,[e] and the Department of Epidemiology & Biostatistics, Erasmus Medical Center, Rotterdam.[d]

Competition of interest: none.

Presented at the Twentieth Annual Meeting of the American Venous Forum, Charleston, SC, Feb 20-23, 2008.

Reprint requests: T.M.A.L. Klem, MD, Sint Franciscus Hospital, Department of Vascular Surgery, Kleiweg 500, 3045 PM Rotterdam, The Netherlands (e-mail: t.klem@wxs.nl).

0741-5214/$36.00

Copyright © 2009 Published by Elsevier Inc. on behalf of The Society for Vascular Surgery.

doi:10.1016/j.jvs.2008.09.016

PATIENTS AND METHODS

This study was done accordance with the Consolidated Standards of Reporting Trials (CONSORT) statement.[17,18] The study protocol was approved by the local ethics committee for every participating hospital. This trial was funded with local funds from the participating hospitals. There was no involvement of any company.

The primary outcome was residual GSV 6 months after surgery. Secondary outcomes were QOL, operation time, and postoperative neural damage. Patients had to be aged ≥18 years to be part of the study, and written informed consent was obtained from all participants. Patients were eligible for the trial if they had duplex-proven venous incompetence of the SFJ and GSV and symptomatic venous disease of the leg in the CEAP clinical severity class of C2 to C4: C2, varicose veins, distinguished from reticular veins by a diameter of ≥3 mm; C3, edema; C4, changes in skin and

subcutaneous tissue secondary to chronic venous disease like pigmentation, eczema, lipodermatosclerosis or atrophie blanche.[19]

All patients had primary etiology and reflux pathophysiology concerning their venous disease. Regarding anatomy, patients could have an incompetent deep venous system or incompetent perforating veins, which would not exclude them from the trial.

Exclusion criteria were healed or active venous ulcer (C5 to 6), body mass index (BMI) >40 kg/m^2, recurrence of venous incompetence in the GSV, occlusion of the deep venous system, venous incompetence of the small saphenous vein, peripheral arterial disease as indicated by a nonpalpable pulse and an ABI <0.9, already being part of the study with the contralateral leg, and the inability to understand the Dutch language.

Patients were recruited from three district general hospitals. After confirmed diagnosis by venous DU imaging, patients were randomized to conventional stripping or cryo stripping. Patient and surgeon were not blinded to the treatment. All surgeons who participated in this trial had to have performed at least five cryo stripping procedures to avoid the learning curve effect.

Venous DU imaging. An expert vascular technician did all DU scanning of the venous system. We used an ATL 5000 scanner (Advanced Technology Laboratories, Bothell, Wash) with a 5- to 12-MHz linear array transducer. Venous incompetence of the GSV was defined when reflux times were >0.5 seconds in the full supine position. Venous incompetence of the perforating veins was defined when reflux times were >0.35 seconds in half-supine position.[20]

Conventional stripping. The procedure was performed with spinal or general anesthesia. A 3-cm groin incision in the femoral skin crease was made. The common femoral vein (CFV) was dissected 1 cm cranial and distal to the GSV. All SFJ tributaries were ligated and divided. The GSV was ligated and divided, flush on the CFV.

Conventional stripping was performed by passing a plastic stripper (Dormo-strip, TapMed, Schauenburg, Germany) through the GSV from proximal to distal, to 8 cm below the knee. A 1-cm skin incision parallel to Langer's lines was made over the tip of the plastic stripper. The end of the distal GSV was tied to the stripper, and a medium cone was attached to the plastic stripper. The distal incision was closed, and grade 2 stockings were applied. By pulling the stripper from distal to proximal, an antegrade stripping of the GSV was performed. The groin incision was closed with 4-0 subcutaneous suture (Vicryl, Ethilon, or Monocryl, Ethicon/Johnson & Johnson, Somerville, NJ).

Cryo stripping. This procedure started the same as the conventional stripping and was performed by passing a 3.5-mm diameter cryoprobe (Angiology Cryoprobe, Erbe, Germany) through the GSV from proximal to distal, to 8 cm below the knee. After freezing for 10 seconds at −85°C (expansion of liquid nitrous oxide in the cryoprobe), the tip of the probe freeze attaches to the GSV. Antegrade cryo stripping the GSV was performed by pulling back the probe. Grade 2 stockings were applied, and the groin incision was closed in the same fashion as in conventional stripping.

Postoperative protocol. The following data were entered in the patient case record form directly after the operation:

- Total operating time; as measured from skin incision to skin closure.
- Length of stripped GSV. The length of residual GSV was calculated by subtracting measured stripped GSV from measured length on the leg (from the proximal to distal wound).
- Grading of the operative procedure as "no problems during procedure" or "problems during procedure" with a written explanation of the problems.

If necessary, phlebectomy or sclerotherapy, or both, were performed a minimum of 2 to 3 months after surgery. Stab avulsions of varices were not performed during surgery. This policy has been in use in the participating hospitals for years because it was found that most patients with varicose veins did not need extra interventions 2 to 3 months after stripping the GSV. This was also confirmed by van Neer et al.[21]

All patients were given subdermal low-molecular-weight heparin injections (2500 U, Dalteparin, Pfizer) preoperatively and for 1 day postoperatively.

Patients had to wear the stockings continuously for the first 48 hours and 2 weeks postoperatively only in daytime. They were instructed to mobilize as soon as possible.

Only one leg at a time was operated on. This was normal policy in the participating hospitals. It is thought that this decreases morbidity and increases mobility. The second leg was treated, if needed, outside the scope of this trial after 6 months, which was the average time on the waiting list. So the included number of patients equals the number of legs in this study.

Follow-up. All patients were reviewed by an independent surgeon at the outpatient clinic at 2, 6, and 26 weeks after treatment. Wound problems were assessed. Neural damage was examined with cotton sticks on the treated leg and compared with the untreated leg. Neural damage was graded as "numb feeling" or "hyperesthesia" of the leg. Venous DU imaging was performed 26 weeks after surgical treatment. The result of the venous DU imaging was graded as a successful stripping or a nonsuccessful stripping.

A successful stripping procedure was defined as a DU-proven absent GSV without residual GSV. A nonsuccessful stripping procedure (primary outcome) was defined as residual GSV, subdivided in the following two categories:

1. Competent residual GSV was defined as DU-proven competence of a residual GSV.
2. Incompetent residual GSV was defined as DU-proven incompetence of a residual GSV.

Quality of life measurement. Quality of life was measured preoperatively and 6 and 26 weeks postoperatively

using the Aberdeen Varicose Vein Questionnaire (AVVQ) and the Medical Outcomes Study Short-Form 36 (SF-36) Health Survey. Garratt et al[22] designed the AVVQ in 1993 for measuring health-related QOL in patients with varicose veins. The AVVQ consists of 13 questions related to problems of venous disease such as pain and dysfunction, cosmesis, complications of venous disease, and extent of varicosity. The AVVQ results in a score from 0 to 100, with 0 representing the best score and 100 the worst. We used the validated Dutch AVVQ.

Generic health status in patients with venous disease of the leg can be measured with the SF-36 survey.[23] The 36 items result in eight domains after recoding related to physical and mental health and social functioning. The scores in the domains range from 0 (worst score) to 100 (best score), which is exact the opposite of the AVVQ score system.

Statistical analysis. Central randomization was performed using a computer-generated randomization list prepared by the trial statistician. Stratification was done according to center, venous incompetence of the deep venous system, and venous incompetence of the perforating vein system.

To exclude a difference (cryo stripping minus conventional stripping) of 10% or more regarding the percentage of patients with residual GSV at 6 months, we calculated ($\alpha = 0.05$, 80% power) that 260 patients were needed in each arm of this noninferiority study.

Percentages were compared using the χ^2 test or the Fisher exact test. Continuous data were compared using the Mann-Whitney test. Center effects for the primary end point were investigated using multiple logistic regression analysis. A repeated measurements analysis of variance (ANOVA; SAS proc mixed) was used to evaluate changes from baseline of the various domains and scores of the SF-36 and AVVQ with adjustment for baseline value. Patients were analyzed in their allocated group (intention to treat principle). A two-sided $P = .05$ was considered the limit of significance in all analyses.

RESULTS

The study randomized 536 patients: 268 to cryo stripping and 268 to conventional stripping. After randomization, 42 patients were excluded: 25 went to another hospital because of a shorter waiting list, 16 cancelled their operation for personal reasons, and one patient had a small transient ischemic attack, after which he cancelled his operation. This resulted in 249 patients in the cryo strip group and 245 patients in the conventional strip group (Fig).

Patient demographics are reported in Table I. There were 121 men (25%) and 373 women (75%), with a mean age of 55 (SD 14.1). Mean BMI was 25.4 (SD 4.2) kg/m^2. Comorbidity included hypertension, 25 patients; diabetes mellitus, 6; pulmonary disease, 17; cerebrovascular accident or transient ischemic attack, 5; and cardiac disease, 11. The full CEAP score for both groups is reported in Table II. As a result of stratification, both groups had similar numbers of patients with an incompetent deep venous system or incompetent perforating vein system.

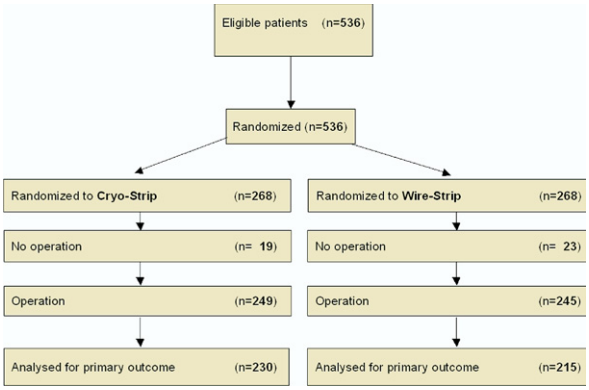

Fig. Flow diagram shows inclusion of trial patients.

Table I. Demographics of included patients in the cryo strip group compared with the conventional strip group

Variable	*Cryo*	*Conventional*
Patients, No.	249	245
Age, mean (SD), y	56 (14.3)	54 (14.0)
Male, No. (%)	52 (21)	70 (29)
Female, No. (%)	197 (79)	175 (71)
Body mass index, mean (SD) kg/m^2	25.1 (4.2)	25.8 (4.3)
Hypertension, No.	10	15
Diabetes mellitus, No.	3	3
Pulmonary disease, No.	9	8
CVA or TIA, No.	2	3
Cardiac disease, No.	5	6

CVA, Cerebrovascular accident; *TIA,* transient ischemic attack.

Nine patients underwent conventional stripping instead of cryo stripping because on six occasions no experienced surgeon was available to perform cryo stripping and on three occasions the cryo stripping device was being used in another operating room. One patient underwent cryo stripping instead of conventional stripping because of a miscommunication.

A total of 19 patients in the cryo strip group and 30 patients in the conventional strip group were lost to follow-up for the primary outcome. A total of 38 patients were contacted several times by mail and telephone but refused to visit the outpatient clinic. The other 11 patients had given a wrong address or telephone number and could not be traced. In the cryo strip group, 230 patients could be analyzed for primary outcome. In the conventional strip group, 215 patients could be analyzed for primary outcome.

The number of operations performed in the different hospitals was as follows: 374 in Sint Franciscus Hospital, 111 in Albert Schweitzer Hospital, and nine in Twee Steden Hospital.

Primary outcome. We found a significant difference of residual GSV between cryo stripping and conventional

Table II. Number of patients by treatment group according to the CEAP classification

	Conventional stripping, No.							
	E			*A*			*P*	
C	*Primary*	*Secondary*	*Congenital*	*Superficial*	*Deep*	*Perforating*	*Reflux*	*Obstruction*
2	208	0	0	208	51	66	208	0
3	18	0	0	18	10	15	18	0
4	19	0	0	19	15	17	19	0
	Cryostripping, No.							
2	211	0	0	211	51	65	211	0
3	18	0	0	18	11	17	18	0
4	20	0	0	20	17	18	20	0

stripping in this study. The percentage of patients with residual GSV at 6 months was 44% (102 of 230) in the cryo strip group and 15% (33 of 215) in the conventional strip group (difference 29%; 95% confidence interval [CI], 21%-37%, $P < .001$).

Competent residual GSV was found in 47 patients (20%) after cryo stripping and in 15 (7%) after conventional stripping. Incompetent residual GSV was found in 55 patients (24%) after cryo stripping and in 18 (8%) after conventional stripping. Multiple logistic regression analysis showed that this difference was not affected by center.

Secondary outcomes. Recurrence at the SFJ is a known phenomenon.[24] The stripping technique in this study had no influence on the incidence, because groin incision and dissection at the SFJ were identical in both techniques. There was no significant difference between the stripping techniques in recurrence at the SFJ: 42 patients (18%) after cryo stripping and 37 patients (17%) after conventional stripping.

Operation time was significantly different between cryo stripping and conventional stripping. Median operation time was 30 minutes (range, 10-120 min) in the cryo strip group and 39 minutes (range 15-100 min) in the conventional strip group ($P < .001$).

Significantly more problems during operation were encountered in the cryo strip group. Cryo stripping was problematic in 84 patients (34%), and conventional stripping was problematic in 28 patients (11%; $P < .001$). The most common problems were perforation of the GSV by the rigid cryoprobe and detachment of the GSV from the probe during stripping. Neural damage occurred in 31 patients (12%) after cryo stripping and in 30 patients (12%) after conventional stripping, which was not a statistically significant difference ($P = .787$).

Quality of life. The AVVQ and SF-36 questionnaires were returned by 419 patients (85%) preoperatively, 334 (67%) at 6 weeks postoperatively, and 265 (53%) at 26 weeks postoperatively.

The AVVQ change for baseline scores were compared for randomized treatments using repeated measurements ANOVA with adjustment for baseline scores (Table III). All changes from baseline scores within groups were significantly lower at both time intervals. At 26 weeks the adjusted baseline score difference between groups was 2.6 points in favor of conventional stripping (95% CI, 1.0-4.2; $P = .001$).

Table III. Aberdeen Varicose Vein Questionnaire score change by treatment group

	AVVQ score (standard error)		
Time	*Cryo*	*Conventional*	P[a]
Baseline	18.3 (0.57)	16.4 (0.59)	
6 weeks	13.5 (0.57)	12.5 (0.60)	
26 weeks	11.7 (0.60)	8.0 (0.65)	.001
P[b]	<.001	<.001	

AVVQ, Aberdeen Varicose Vein Questionnaire.
[a]Score at 26 weeks comparing AVVQ scores for cryo stripping with conventional stripping using repeated measurements analysis of variance with adjustment for baseline scores.
[b]Score at 26 weeks compared with score at baseline within group.

In the SF-36 (Table IV), significant changes of baseline score were found after cryo stripping and conventional stripping for the domains of physical functioning and bodily pain. Significant changes of baseline score were only found after cryo stripping for the domains of role limitations due to physical problems and vitality. The domains of general health, social functioning, role limitations due to emotional problems, and mental health did not significantly change from baseline scores in either group. For none of the domains did the mean changes differ between both groups. This applies to both the 6 weeks and 26 weeks results.

Complications. Seven patients presented with complications, of which five were in the cryo strip group:

- A small groin hemorrhage required operative exploration.
- A postoperative neurapraxia of the peroneal nerve developed, which healed after 4 months with no clinical complaints.
- A deep venous leg thrombosis developed in an operated leg, confirmed by venous DU imaging, 2 weeks after surgery. This patient was treated with warfarin for

Table IV. Medical Outcomes Study Short-Form 36 Health Survey score change by treatment group

Group[a]	*PF*	*RP*	*BP*	*GH*	*VT*	*SF*	*RE*	*MH*
Cryo								
Baseline	78.5	72.3	68.5	272.6	66.0	85.7	86.2	58.2
6 weeks	82.5	78.0	78.1	72.5	65.3	85.1	84.5	58.2
26 weeks	85.8	84.1	81.7	72.2	69.8	87.0	87.8	57.8
P[b]	<.001	<.001	<.001	.71	.01	.58	.80	.66
Conventional								
Baseline	80.9	79.7	73.3	74.7	69.3	88.2	87.1	59.9
6 weeks	83.7	79.8	78.6	72.9	67.8	88.2	88.0	58.6
26 weeks	84.5	83.2	82.2	72.3	69.1	89.2	89.4	58.1
P[b]	.02	0.19	<.001	.07	.96	.58	.47	.08

PF, Physical functioning; *RP,* role limit (physical problems); *BP,* bodily pain; *GH,* general health perception; *VT,* vitality; *SF,* social functioning; *RE,* role limit (emotional problems); *MH,* mental health.
[a]No significant differences were found between both groups at 6 and 26 weeks.
[b]Statistical significance was set at $P < .05$.

6 months, after which there were no clinical complaint, and DU imaging showed an open, although incompetent deep system.
- Persistent lymph leakage from the groin incision required operative exploration, after which there were no clinical complaints.
- In one patient the surgeon mistook the CFV for the GSV and had thus divided the CFV. An expert vascular surgeon anastomosed the CFV, and the GSV was not stripped. After receiving warfarin for 6 months, the patient had no clinical complaints and an open, although incompetent, deep venous system. One year later, cryo stripping of the GSV was performed.

Two complications occurred in the conventional strip group:

- A clamp on the GSV was pulled which caused a lesion of the CFV. The CFV was sutured using a patch.
- A small myocardial infarction occurred that required no invasive interventions. The patient was discharged from the cardiology ward after 2 days.

Secondary phlebectomy or sclerotherapy for nontruncal varicosities was performed in 108 patients (22%) after 2 to 3 months. There was an even distribution among the groups: cryo stripping, 52 patients (10.5%); conventional stripping, 56 patients (11.3%).

DISCUSSION

Primary outcome. When the primary outcome was examined, cryo stripping performed significantly worse than conventional stripping in terms of residual GSV. The participating surgeons graded the cryo stripping in 34% of the cases as a procedure with minor or major problems compared with 11% who had conventional stripping. Although every participating surgeon had performed at least five cryo strip operations to avoid the learning curve effect, it could be argued that this number was too small. There was an indication of a learning curve effect for one of the centers in the cryo strip group. For that center, the first 25 patients who had cryo strip procedures did somewhat worse than later patients ($P = .048$). However, comparing the percentages of residual disease at 6 months after disregarding the first 25 patients within each center and treatment group gave similar results as for the total group: 42% for cryo stripping vs 15% for conventional stripping ($P < .001$).

The cryo stripping technique is substantially different from a conventional technique. Instead of a flexible plastic stripper, a rigid metal probe has to be advanced in retrograde fashion through the GSV. Although the cryoprobe provides some tactile feedback to the surgeon, it is much less compared with a plastic stripper. When the probe cannot easily be pushed further through the GSV, it is difficult to differentiate between a competent valve and the wall of the GSV. This is probably the cause of many procedural failures during cryo stripping where perforation through the GSV had occurred.

Another problem was caused during the initial freezing of the distal GSV. Although the cryo probe has to be pulled vigorously to break the frozen GSV, too much force can detach the probe from the GSV, which results in a partially stripped GSV. It could be argued that retrograde cryo stripping could decrease the procedural problems, but the possible cosmetic advantage is then lost because of the need for a distal incision under the knee.

Schouten et al[16] also reported more residual GSV after cryo stripping, with a mean length of stripped GSV of 27 cm after cryo stripping compared with 40 cm after conventional stripping. This was because an alternative cryo strip technique was used in this study; the GSV was stripped from the groin to above the knee to avoid possible difficult guiding of the cryo probe past the knee. Although Stötter et al[25] also found residual GSV after cryo stripping (10%), the low number of patients (n = 20) randomized in the cryo stripping arm makes a conclusion of that study difficult. Menyhei et al[26] found major procedural problems in the cryo strip group in six of the 79 included patients (8%). These patients were further excluded from the trial. The primary outcome of that study was QOL; therefore, no venous DU follow-up was described.

Regarding recurrence at the SFJ, no significant difference between cryo stripping and conventional stripping was found. This was expected because the operation technique of groin exploration was the same in both groups. This recurrence rate is similar to that reported by de Maeseneer.[27]

Operation time. Median operation time was significantly shorter in the cryo strip group (30 minutes), which was expected because a distal incision at the knee is not needed. The outliers in the operation time range were caused by complications in both groups. It took 120 minutes in the cryo strip group and 100 minutes in the conventional group to repair the CFV. Stötter et al[25] reported a shorter mean operation time of 19 minutes, whereas Schouten et al[16] reported an operation time of 18 minutes. A possible reason for these faster operation times could be that all the cryo stripping procedures were performed by a standard team of two surgeons, as described by Schouten et al. A faster operation time makes it possible to treat more patients in a given time and shorten the long waiting lists that exist in the Netherlands for GSV stripping. Although this is a positive finding of the cryo strip technique, it is overshadowed by the high incidence of postoperative residual GSV.

Neural damage. No significant difference in postoperative neural damage between cryo stripping and conventional stripping were expected or found. The incidence of neural damage at 26 weeks was similar as that reported by Tennant et al[28] and Critchley et al.[29] Most patients had a hyperesthesia or numb feeling of the medial aspect of the upper or lower leg, which can be explained by a lesion or neurapraxia of the saphenous nerve. Because both techniques performed a short stripping of the GSV, no difference was expected.

Complications. Of the seven complications, two major complications were a direct result of the surgical stripping technique. In one patient in the cryo strip group with a BMI of 18 kg/m^2, a transection of the CFV was made, caused by a surgeon who misidentified the GSV. The misidentification occurred because the GSV was extremely superficial and had such a small diameter that it was mistaken for an accessory vein. When dissecting to the deep venous system, the CFV had the diameter of a regular GSV. This complication could have been prevented if the surgeon had anticipated a small diameter GSV in this thin patient and had tried to identify the SFJ.[30] In another patient in the conventional strip group, the CFV was torn when a clamp on the GSV was accidentally pulled. It is not certain if this complication could have been prevented. There is always a small complication risk during surgical procedures, and one can only try to decrease this risk by working meticulously. Accidental deep vein lesions during superficial vein surgery have been described before in the literature, but mostly as case reports.

Quality of life. Patients in both groups had significantly better AVVQ scores postoperatively. Patients in the conventional strip group scored significantly better than those in the cryo strip group. The AVVQ is a health-related QOL questionnaire that has been proven to measure small changes in QOL before and after treatment. The reason that conventional stripping scored better than cryo stripping could be the high incidence of residual GSV after cryo stripping.

Although the small change in AVVQ score (2.6) between both groups is numerically significant, one could argue if this has any clinical relevance on a total score of 100. A long-term follow-up study of all patients with venous DU imaging, AVVQ, and SF-36 is now being conducted to answer this question. Smith et al[2] also found minute AVVQ changes before (18.8) and after (14.1) surgical treatment. The AVVQ scores can significantly increase when patients with healed or active venous ulcers (C5 and C6) are included, because these AVVQ-related items account for much higher scores. Because this study excluded patients with clinical severity class C5 and C6, one can expect to have patients with lower preoperative AVVQ scores and hence smaller changes postoperatively.

Possibly two new health-related QOL questionnaires could be designed. One questionnaire needs to emphasize items specifically related to patients with clinical severity class 1 to 4. Most patients with venous disease would be appropriate for this questionnaire. The other questionnaire would need to emphasize items specifically for severity class 5 to 6, because pain and socially related items carry more weight in these patients. This would have the benefit that QOL scores in patients with C1 to 4 are not diminished by items related to C5 to C6, such as in the AVVQ.

No significant changes were found in the SF-36 results postoperatively in any of the eight domains between the cryo strip group and the conventional strip group. Studies have shown that a generic QOL questionnaire like the SF-36 poorly reflects the effects of chronic venous disease. This may well explain that no difference was found between the groups. There were significantly better scores postoperatively in the domains of physical functioning and bodily pain in both groups. These results were similar to those reported by Menyhei et al,[26] in which QOL was the primary end point It was to be expected that the domains of physical functioning and bodily pain would have better scores postoperatively because most patients have fewer problems from swollen legs, restless legs, heavy feeling, and pain in the legs after their operation.

The cryo strip group had significantly better scores postoperatively in the domains of vitality and role limitation because of physical problems (RP). There is no ready explanation for these higher scores except perhaps the lower baseline scores in the cryo strip group compared with the conventional strip group. Menyhei et al[26] found no significant difference for the RP domain but a significant change for the vitality domain, which was also unexplained.

In both AVVQ and SF-36 pain was found to be significantly less 26 weeks after stripping of the GSV, regardless of which strip was used. Future use of generic QOL questionnaires like the SF-36 for measuring the often-small changes in QOL after (surgical) therapy in patients with clinical severity class 1 to 4 should be dissuaded.

CONCLUSIONS

Cryo stripping with a rigid cryoprobe accounts for numerous procedural failures and hence residual GSV in patients. Health-related QOL measured by the AVVQ showed small but significantly better results for patients after conventional stripping. Cryo stripping has no benefits over conventional stripping.

AUTHOR CONTRIBUTIONS

Conception and design: TK, JS, PS, AH, CW
Analysis and interpretation: TK, WH, CW
Data collection: TK, JS
Writing the article: TK, JS, PS, WH, AH, CW
Critical revision of the article: TK, JS, PS, WH, AH, CW
Final approval of the article: TK, JS, PS, WH, AH, CW
Statistical analysis: TK, WH
Obtained funding: CW, AH, PS
Overall responsibility: CW

REFERENCES

1. Callam MJ. Epidemiology of varicose veins. Br J Surg 1994;81:167-73.
2. Smith JJ, Garratt AM, Guest M, Greenhalgh RM, Davies AH. Evaluating and improving health-related quality of life in patients with varicose veins. J Vasc Surg 1999;30:710-9.
3. Van den Oever R, Hepp B, Debbaut B, Simon I. Socio-economic impact of chronic venous insufficiency. An underestimated public health problem Int Angiol 1998;17:161-7.
4. Ruckley CV, Evans CJ, Allan PL, Lee AJ, Fowkes FG. Chronic venous insufficiency: clinical and duplex correlations. The Edinburgh Vein Study of venous disorders in the general population. J Vasc Surg 2002;36:520-5.
5. Bradbury A, Evans CJ, Allan P, Lee AJ, Ruckley CV, Fowkes FG. The relationship between lower limb symptoms and superficial and deep venous reflux on duplex ultrasonography: The Edinburgh Vein Study. J Vasc Surg 2000;32:921-31.
6. Delis KT, Husmann M, Kalodiki E, Wolfe JH, Nicolaides AN. In situ hemodynamics of perforating veins in chronic venous insufficiency. J Vasc Surg 2001;33:773-82.
7. Labropoulos N, Giannoukas AD, Delis K, Mansour MA, Kang SS, Nicolaides AN, et al. Where does venous reflux start? J Vasc Surg 1997;26:736-42.
8. Milleret R. My experience with cryosurgery of varicose veins [French]. Phlebologie 1989;42:573-7.
9. Milleret R. Cryosurgery of varicose veins [French]. Soins Chir 1992; 18-9.
10. Cheatle TR, Kayombo B, Perrin M. Cryostripping the long and short saphenous veins. Br J Surg 1993;80:1283.
11. Etienne G, Constantin JM, Hevia M. Cryo-stripping: an advance in the treatment of varicose veins. 3811 operated limbs [French]. Presse Med 1995;24:1017-20.
12. Etienne G, Constantin JM, Hevia M. Cryo-stripping: an alternative to perforate-invaginate stripping. Ann Vasc Surg 1997;11:325-8.
13. Constantin JM, Etienne G, Hévia M. Technique and results of cryostripping in the treatment of varicose veins of the lower limbs [French]. Ann Chir 1997;51:745-8.
14. Manner M, Koeth T, Geelhaar G, Stickel W. Cryotechnique in varicose vein surgery [German]. Chirurg 1999;70:79-84.
15. Cappendijk VC, Schutte PR, Tan KG. Cryostripping of the great saphenous vein [Dutch]. Scripta Phlebologica 1999:23-5.
16. Schouten R, Mollen RM, Kuijpers HC. A comparison between cryosurgery and conventional stripping in varicose vein surgery: perioperative features and complications. Ann Vasc Surg 2006;20:306-11.
17. Moher D, Schulz KF, Altman DG. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomised trials. Lancet 2001;357:1191-4.
18. Altman DG, Schulz KF, Moher D, Egger M, Davidoff F, Elbourne D, Gøtzsche PC, Lang T. The revised CONSORT statement for reporting randomized trials: explanation and elaboration. Ann Intern Med 2001; 134:663-94.
19. Eklöf B, Rutherford RB, Bergan JJ, Carpentier PH, Gloviczki P, Kistner RL, et al; American Venous Forum International Ad Hoc Committee for Revision of the CEAP Classification. Revision of the CEAP classification for chronic venous disorders: consensus statement. J Vasc Surg 2004;40:1248-52.
20. Labropoulos N, Tiongson J, Pryor L, Tassiopoulos AK, Kang SS, Ashraf Mansour M, et al. Baker WH. Definition of venous reflux in lower-extremity veins. J Vasc Surg 2003;38:793-8.
21. van Neer P, Kessels A, de Haan E, Estourgie R, Veraart J, Lijnen R, et al. Residual varicose veins below the knee after varicose vein surgery are not related to incompetent perforating veins. J Vasc Surg 2006;44: 1051-4.
22. Garratt AM, Macdonald LM, Ruta DA, Russell IT, Buckingham JK, Krukowski ZH. Towards measurement of outcome for patients with varicose veins. Qual Health Care 1993;2:5-10.
23. Aaronson NK, Muller M, Cohen PD, Essink-Bot ML, Fekkes M, Sanderman R, et al. Translation, validation, and norming of the Dutch language version of the SF-36 Health Survey in community and chronic disease populations. J Clin Epidemiol 1998;51:1055-68.
24. Glass GM. Neovascularization in recurrent sapheno-femoral incompetence of varicose veins: Surgical anatomy and morphology. Phlebology 1995;10:136-42.
25. Stötter L, Schaaf I, Bockelbrink A. Comparative outcomes of radiofrequency endoluminal ablation, invagination stripping, and cryostripping in the treatment of great saphenous vein insufficiency. Phlebology 2006;21:60-4.
26. Menyhei G, Gyevnár Z, Arató E, Kelemen O, Kollár L. Conventional stripping versus cryostripping: a prospective randomised trial to compare improvement in quality of life and complications. Eur J Vasc Endovasc Surg 2008;35:218-23.
27. de Maeseneer M. Neovascularization; an adverse response to proper groin dissection. In: Bergan JI, editor. The vein book. San Diego, CA: Elsevier Academic Press; 2007. p. 239-46.
28. Tennant WG, Ruckley CV. Medicolegal action following treatment for varicose veins. Br J Surg 1996;83:291-2.
29. Critchley G, Handa A, Maw A, Harvey A, Harvey MR, Corbett CR. Complications of varicose vein surgery. Ann R Coll Surg Engl 1997; 79:105-10.
30. Wakefield SE, Elewa AA. Improving exposure and safety at the saphenofemoral junction. Ann R Coll Surg Engl 1995;77:139-40.

Submitted Jul 5, 2008; accepted Sep 12, 2008.