

Crossectomy (flush ligation) of small saphenous vein

Die Krossektomie der V. saphena parva

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ABSTRACT

A correct crossectomy of the small saphenous vein, as stipulated by Hach and Mumme, is seldom carried out in literature. The two authors thoroughly describe the technical procedure

of a high, flush ligation of the saphenopopliteal junction (SPJ). The risks and problems of the surgery are described and illustrated.

A retrospective cohort study with the aim of conducting a flat small saphenous crossectomy yielded the following findings in 187 operated legs: small saphenous remainder stumps with clinically relevant recurrence in 2.1 %, small saphenous neovasculature with clinically relevant recurrence in 1.1 %, junction stump or neovasculature without clinically relevant recurrence in 1.6 % of cases. In summation, the total amount of actual recurrences was 4.8 %.

ZUSAMMENFASSUNG

Eine korrekte Parvakrossektomie, wie von Hach und Mumme gefordert, wird in der Literatur selten durchgeführt. Die beiden Autoren beschreiben ausführlich das technische Prozedere einer niveaugleichen Ligatur bei der V.-saphena-parva-Krosse. Risiken und Probleme bei der Operation werden beschrieben und ausführlich bebildert.

Eine retrospektive Kohortenstudie, mit dem Ziel durchgeführt, eine plane Parvakrossektomie vorzunehmen, ergab bei 187 operierten Beinen folgende Befunde: belassener Parvastumpf mit klinisch relevanter Rezidivvarikose in 2,1 %, Parva-neovaskulat mit klinisch relevanter Rezidivvarikose in 1,1 %, Krossenstumpf bzw. Neovaskulat ohne Rezidivvarikose in 1,6 % der Fälle. Die Gesamtzahl echter Rezidive lag in Summe bei 4,8 %.

Approximately 350 000 procedures are carried out on the epifascial venous system each year, of which some 10–19 % entail surgery of the saphenopopliteal junction (SPJ); the figure in our own patients is 15 %. We recently described these patients in detail in a review article published in the medical journal *Phlebologie* [28]. According to Hach [10], involvement of the small saphenous vein (SSV) compared with the great saphenous vein (GSV) is in a ratio of 1:6. Women are affected twice as frequently as men. The left leg is involved slightly more often [8] (► **Fig. 1**).

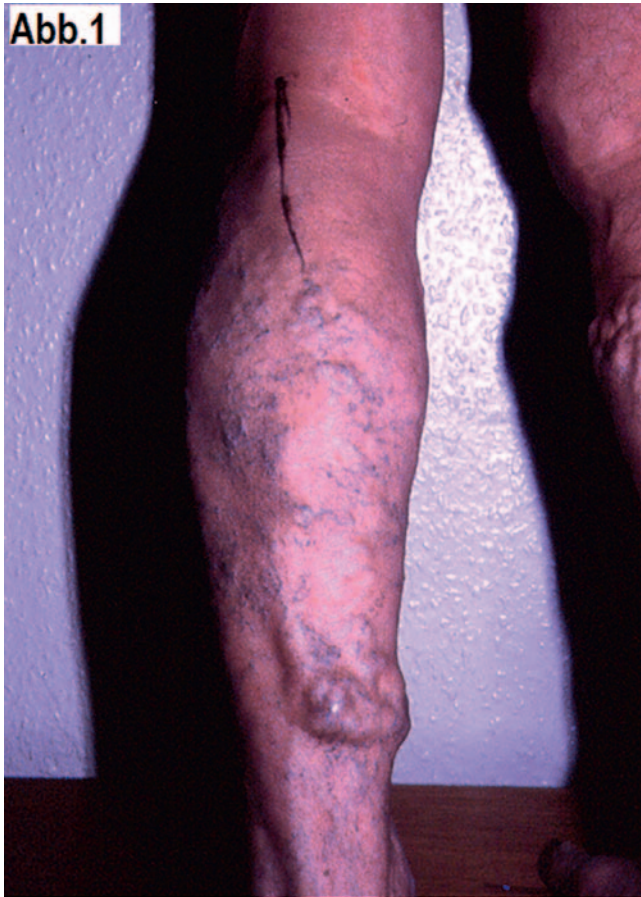
Open flush ligation of the small saphenous vein

High ligation of the great saphenous vein (GSV) as Hach stipulated in his definition of ‘crossectomy’ – “removal of the trunk vein flush with its opening into the deep vein and resection of the

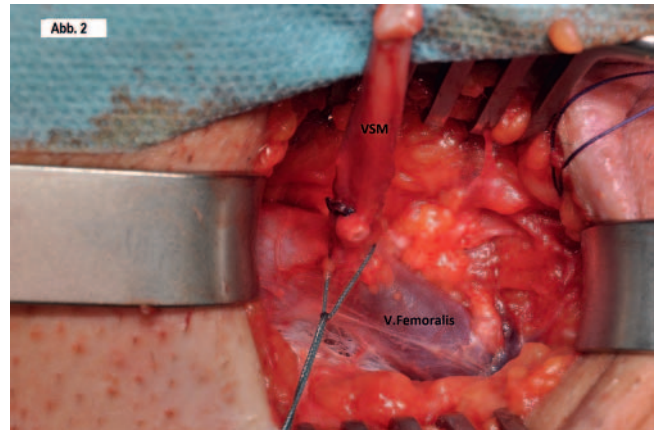
proximal segment after dissection of all small tributary veins opening around the saphenofemoral junction” – is always possible. There are no exceptions or anatomical reasons to prevent such a procedure. No matter how short it is, a stump left behind after high ligation is a technical error and often the cause of recurrent varicose veins. The German study on inguinal recurrence provided firm evidence for this [18].

In this way, Mumme et al. underpinned the old saying of G. Salzmann, a long-serving consultant under Prof. Hach, namely that recurrent varicose veins are not due to inherited venous incompetence but rather to the surgical skill that has not been acquired (► **Fig. 2, 3**).

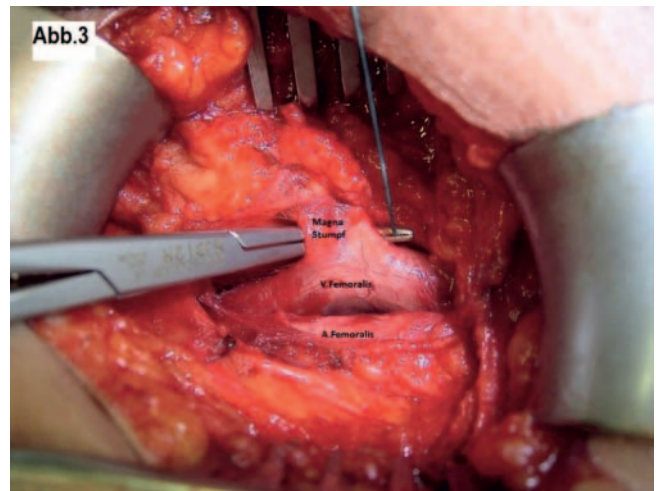
Despite this clear requirement, the basic principles of a proper flush ligation have not been observed in many cases, especially in the English-language literature, as we have repeatedly demon-



► **Fig. 1** Impressive robust trunk varicose vein of the small saphenous vein in the left leg. The subfascial course to the saphenopopliteal junction is indicated with a coloured marker.



► **Fig. 2** Correctly performed high ligation of the great saphenous vein (GSV). The ligature lies flush with the deep vein.



► **Fig. 3** Redo high ligation with residual GSV stump. Clear technical error during the first operation. No neovascularisation!

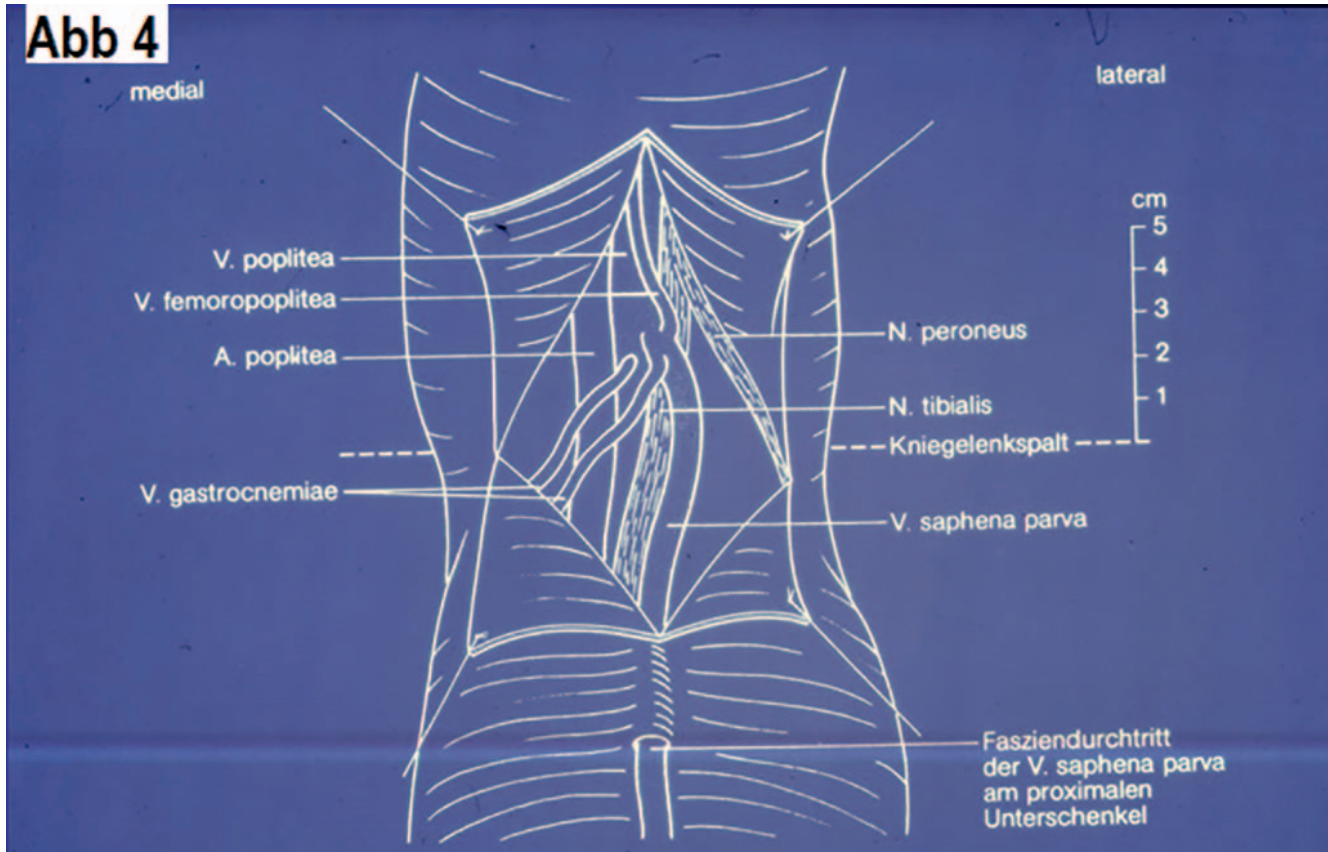
strated [11, 28, 29]. Unlike the procedure for high ligation of the great saphenous vein, there are no generally recognised guidelines for small saphenous varicose veins with respect to their treatment at the junction with the deep vein. Hach and Mumme [10] described flush ligation of the small saphenous vein as the amputation of the small saphenous vein directly at its opening into the popliteal vein, together with any necessary ligation of the muscle veins (► **Fig. 4, 5**).

In addition to the flush ligation of the small saphenous vein recommended by Hach and Mumme, current guidelines on the treatment of varicose veins [2] also include modified high ligation as close to the saphenopopliteal junction as possible. The reason for this option is that, according to the guidelines, a flush ligation is not always possible. This is a thoroughly worthwhile addition to the specifications of Hach and Mumme.

The guidelines recommend the use of non-absorbable sutures, as was found to be the case in a survey of varicose vein surgeons in Germany, Austria, and Switzerland twenty years ago [15]. The experts who drew up the guidelines considered the use of non-absorbable sutures to be the simplest and most cost-effective means of preventing recurrence after high ligation of both the great and the small saphenous veins [16, 23]. Hach and Mumme [10] also recommended a double ligature with non-absorbable

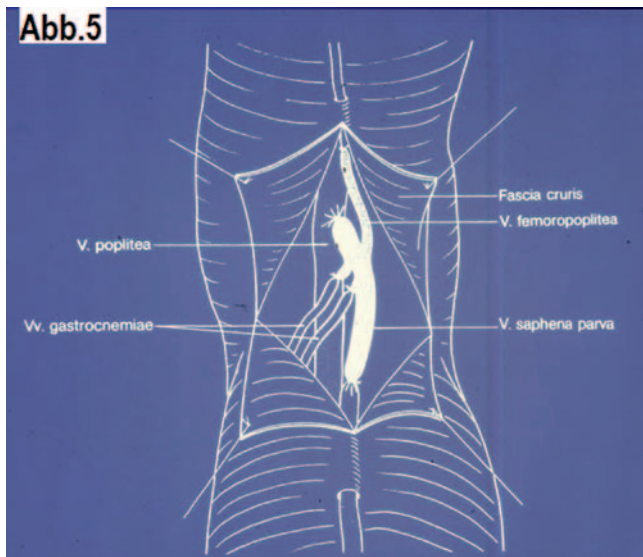
suture material for flush ligation of the small saphenous vein. The wide range of anatomical variation at the saphenopopliteal junction, with the small saphenous vein draining into the deep vein on the anterior or posterolateral aspect, is one reason why flush ligation of the small saphenous vein is not performed in all cases [13, 14, 33]. In a few exceptional cases, therefore, the current guidelines consider modified high ligation of the small saphenous vein close to the junction to be safer with fewer side effects. This applies both to anomalies of the saphenopopliteal junction and to the topographical features of the motor nerves in the popliteal fossa. Before risking injury to the deep vein or a motor nerve by forcing a flush ligation of the small saphenous vein, we consider a modified high ligation close to the junction to be more expedient and associated with fewer side effects. However, the rate of flush ligations increases proportionately to the surgeon's experience [28]. In a not-inconsiderable number of cases, flush ligation of the small saphenous vein is made more difficult by the muscle veins draining into the saphenopopliteal junction. In his reference work 'Phlebography of the leg and pelvic veins'

Abb 4



► Fig. 4 Diagram of the surgical site in the popliteal fossa.

Abb.5



► Fig. 5 Correctly performed flush ligation of the small saphenous vein, with ligation of the gastrocnemius veins draining at the saphenopopliteal junction.

[8] Hach states that the small saphenous vein and gastrocnemius veins drain into the popliteal vein in a common trunk in 32% of cases. Tying off the muscle veins by placing a ligature on the small

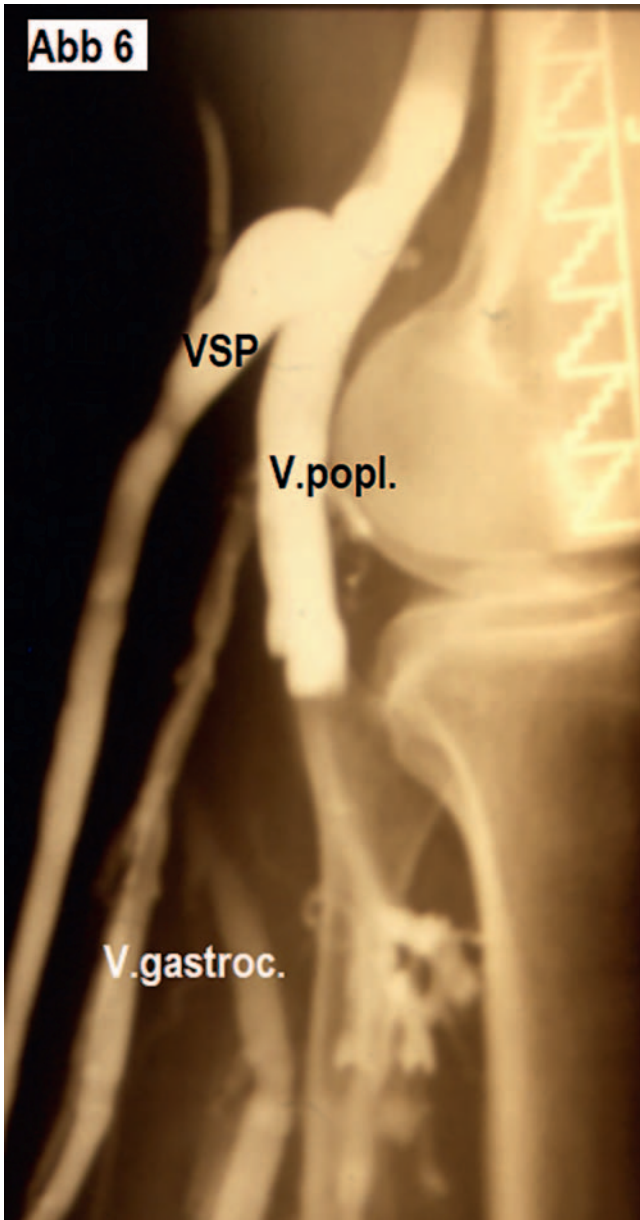
saphenous vein flush with the popliteal vein would block the blood flow from the gastrocnemius veins, even without ligating them directly. In a small cohort study of 55 patients, we observed the gastrocnemius veins draining directly at the saphenopopliteal junction in 38% of cases, analogous to the 32% reported by Hach [30].

Fourteen days after ligation of these muscle veins, we found thrombosis in only 6% of the gastrocnemius veins that has been tied off. Ectasia and the thin walls of the gastrocnemius veins are amongst the reasons why the proper flush ligation of the small saphenous vein is such a challenging surgical procedure that demands great experience on the part of the surgeon [10].

Problems that may arise in open flush ligation of the small saphenous vein are shown in ► Table 1.

Preoperative diagnostic investigation

Each surgical procedure on the small saphenous vein must be preceded by meticulous diagnostic imaging. In most cases today, this entails duplex ultrasound scanning, ascending venography with a Valsalva manoeuvre only seldom being required, and possibly being supplemented by varicography [8]. Hach performed his greatest service by demonstrating the different anatomical variants of the saphenopopliteal junction on venography, thus allowing the first surgical procedures targeted to the origin of the reflux (Hach's recirculation circuit) [9] (► Fig. 6–8).

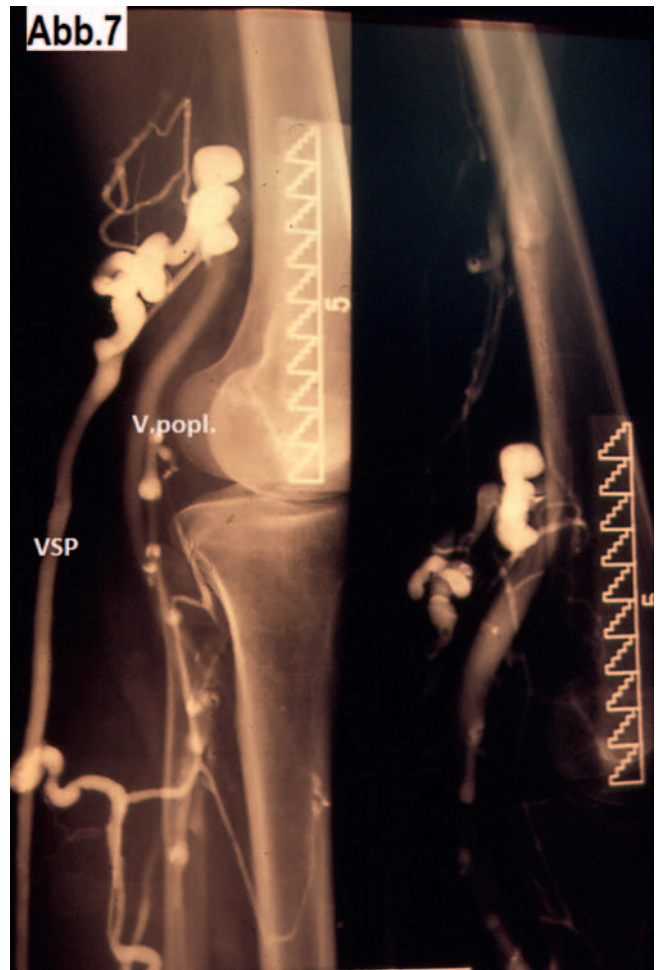


► **Fig. 6** Venogram showing the saphenopopliteal junction: classical situation at the opening. The gastrocnemius vein drains separately into the popliteal vein at a more distal location.

Duplex scans today do not give the topographical overview of the anatomy in the same way as the more clearly depicted images obtained by venography. However, it is indisputable that duplex ultrasound scanning has now replaced venography (► **Fig. 9**).

In his reference work 'Vein surgery', Hach gave precise descriptions and exact frequencies of the different levels at which the small saphenous vein drains into the deep venous system [10]. Our own investigations of the saphenopopliteal junction also using venography with a Valsalva manoeuvre showed that the small saphenous vein opens into the popliteal vein 2–5 cm above the radiological knee joint line in about 50% of cases [31]. In another approximately 30%, the opening lies 5–8 cm above the joint line. There are also anterior openings, posterolateral openings,

► Table 1 Problems in small saphenous vein surgery.
high opening
intersection of motor nerves running immediately across the saphenopopliteal junction
anterior opening
multiple openings of the SSV
reduced calibre of the lateral popliteal fossa perforator close to the junction
gastrocnemius veins draining at the saphenopopliteal junction
gastrocnemius incompetence with the clinical picture of short saphenous varicose veins



► **Fig. 7** Venogram showing the saphenopopliteal junction: atypical double opening.

junctional aneurysms, and sometimes gastrocnemius veins with ectatic changes draining at the saphenopopliteal junction (► **Table 2**).

The most common finding was an acute-angled saphenopopliteal junction situated about 3–4 cm above the knee joint line. But very tortuous anomalies at the junction with siphon- or double-



► **Fig. 8** Venogram showing the saphenopopliteal junction: completely atypical opening; the arrow indicates the opening of the small saphenous vein into the popliteal vein. The centimetre grid helps to guide the incision during surgery.

siphon-like openings of the small saphenous vein were also observed (► **Fig. 10**).

Preoperative duplex scans are carried out with the patient standing with a slightly bent knee. These investigations should be performed by the surgeons themselves. The precise level of the junction can easily be indicated by small pressure markings with a ballpoint pen. Both the course of the small saphenous vein and the level at which it opens into the popliteal vein can then be indicated on the leg with a coloured marker. In addition to duplex ultrasound scanning, we also perform preoperative peripheral venous pressure measurements (phlebodynamometry) (► **Fig. 11**).

Only when these functional diagnostics show that the venous haemodynamics return to normal once the pathological recirculation circuit described by Hach has been interrupted manually do we consider that there is an indication for active intervention. We do not consider duplex scanning alone to be a sufficient criterion for surgery!

► **Table 2** Anatomical variants of the saphenopopliteal junction seen on ascending venography with a Valsalva manoeuvre, according to Hach.

level of the saphenopopliteal junction (n = 127)		saphenopopliteal junction abnormalities (n = 140)	
below the knee joint line	n = 0 (0.0%)	ventral opening	n = 10 (7.1%)
up to 2 cm above	n = 7 (5.6%)	lateral opening	n = 22 (15.7%)
2–5 cm above	n = 66 (52.4%)	aneurysm	n = 20 (14.1%)
5–8 cm above	n = 42 (33.3%)		
8–11 cm above	n = 8 (6.3%)		
11–15 cm above	n = 1 (0.8%)		
15–20 cm above	n = 1 (0.8%)		
more than 20 cm above	n = 1 (0.8%)		
no information	n = 13 (9.3%)		

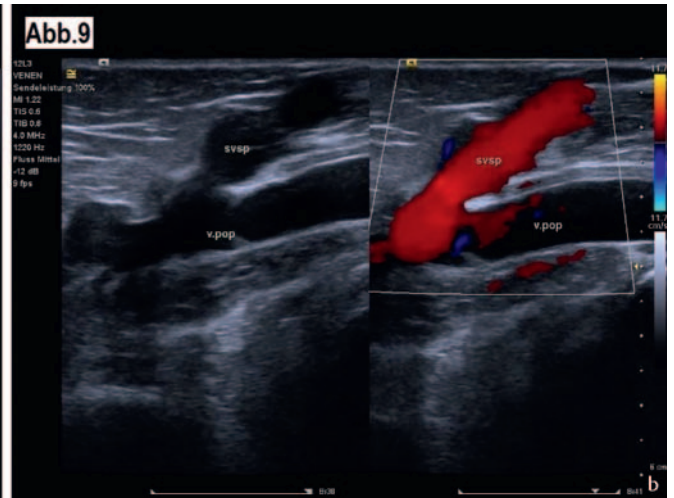
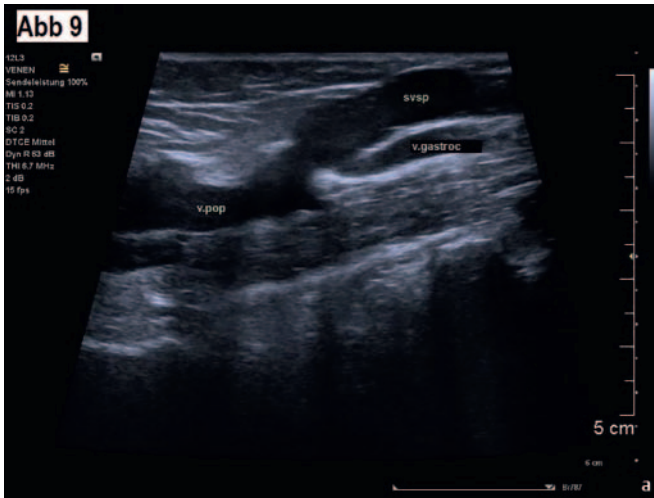
Surgical technique

The operation is to be carried out with the patient lying prone and with the knee bent at an angle of 30° [10, 28].

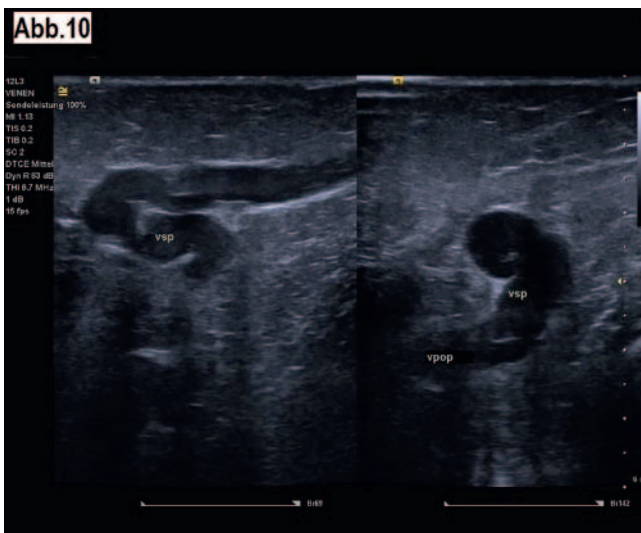
With combined procedures on the great and small saphenous vein territories, the patient's position has to be altered during the operation. It is more difficult to perform a flush ligation of the small saphenous vein correctly when the patient is in a lateral or supine position with the leg elevated, and there is a higher associated risk of injury to adjacent structures; these positions should therefore be avoided!

The results of the retrospective small saphenous vein study cited below refer solely to surgery performed with the patient in the prone position. We have recently described the precise details of the surgical technique [28]. The transverse incision in the popliteal fossa must be sufficiently large, depending on the local anatomy, the presence of junctional anomalies, the level of the saphenopopliteal junction in relation to the knee joint, and how thick the leg is. Obtaining a good surgical view takes priority over leaving a small scar! If the incision is too small it diminishes the overview, increases the surgical risk, and is associated with a higher risk of recurrence [10].

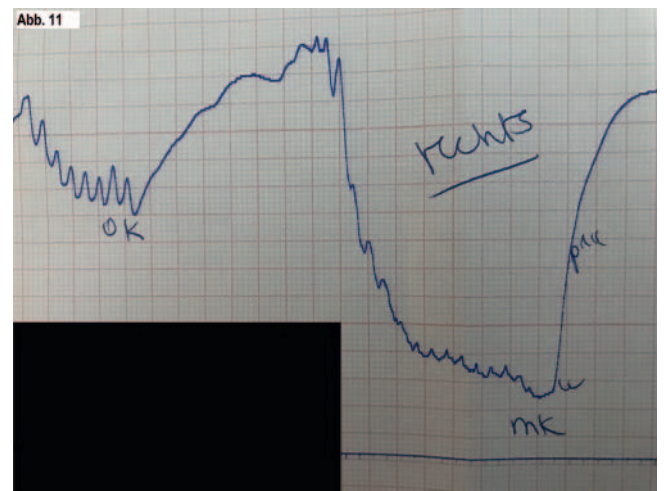
Open flush ligation of the small saphenous vein requires a dry surgical field. Injuries to the blood vessels must be avoided. Saphenopopliteal surgery requires a delicate touch. Self-retaining retractors should not be used because of the risk of injury to nerves and thin-walled veins (gastrocnemius veins, ectatic saphenopopliteal junction). We have found that four hands are needed (2 × Roux retractors and 2 × Langenbeck retractors), which means that we need a team of two scrub nurses or one scrub nurse and a surgical assistant. Injury to the motor nerves must always be considered a possibility with a flush ligation of the small saphenous vein, and particularly with redo surgery for recurrence [28]. We therefore look specifically for the tibial nerve, free up a long seg-



► **Fig. 9** Duplex ultrasound scan of the saphenopopliteal junction: gastrocnemius vein draining into the small saphenous vein.



► **Fig. 10** Ultrasound scan of a small saphenous vein with syphon-like opening.



► **Fig. 11** The pressure curve returns to normal after compression of the proximal small saphenous vein (mk = with compression; ok = without compression).

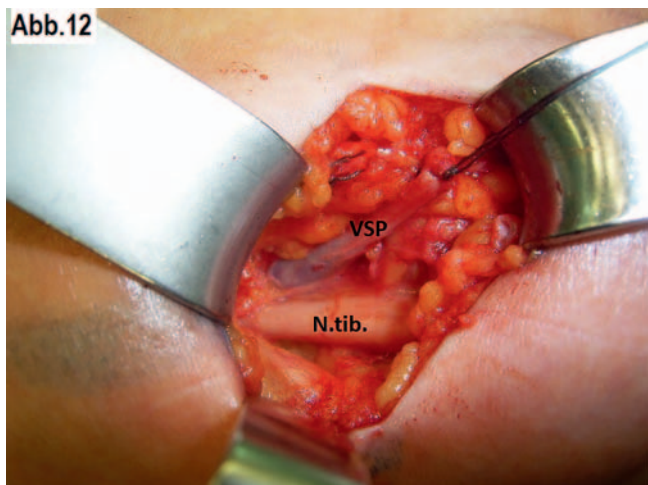
ment and displace it carefully to the side with a Langenbeck retractor or, better still, with a wide silicone loop (vessel loop), as far as necessary for us to be able to tie the ligature flush with the popliteal vein.

We adhere closely to the surgical maxim ‘what I can see, I don’t damage’. The robust tibial nerve lies in the middle of the surgical field, often directly on the roof of the popliteal vein. It lies medially to the small saphenous vein in 54% of cases, and laterally in 51% of cases [17]. The peroneal nerve only has to be identified when the small saphenous vein terminates very laterally in the popliteal vein but then also has to be freed very carefully over a long segment. The peroneal nerve is a ‘sensitive plant’ which takes any pulling or pushing amiss. You can look at it but must not grasp it with forceps. The peroneal nerve has to be very carefully, cautiously, and gently dissected out and equally carefully displaced to the side. The saphenopopliteal junction sometimes lies directly

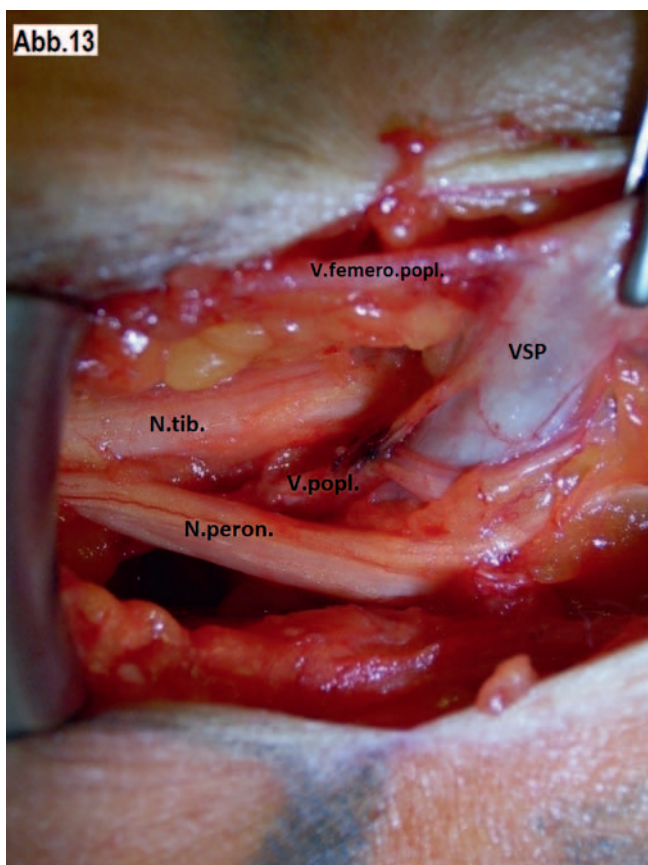
beneath the y-shaped fork where the sciatic nerve divides into the peroneal nerve and the tibial nerve (► **Fig. 12–14**).

In these cases, the three nerves have to be identified and a long segment meticulously exposed. Without pulling or tension, the small saphenous vein can then be displaced medially or laterally below the nerve, depending on the anatomical situation. The vein is moved until the saphenopopliteal junction can be identified conclusively and dissected out carefully to allow ligation of the small saphenous vein flush with the deep vein (► **Fig. 15**).

Any pressure or pulling on either of the two nerves, especially the peroneal nerve, should be avoided. The gentlest approach is to displace the nerves with a wide silicone loop, but sometimes a narrow Langenbeck retractor has to be used. The tibial nerve is ‘robust’. In approximately 6000 flush ligations of the small saphenous vein, we have never seen an injury or pressure-induced damage of the tibial nerve. Nevertheless, there were three instances of transient pressure-induced damage to the peroneal nerve in our

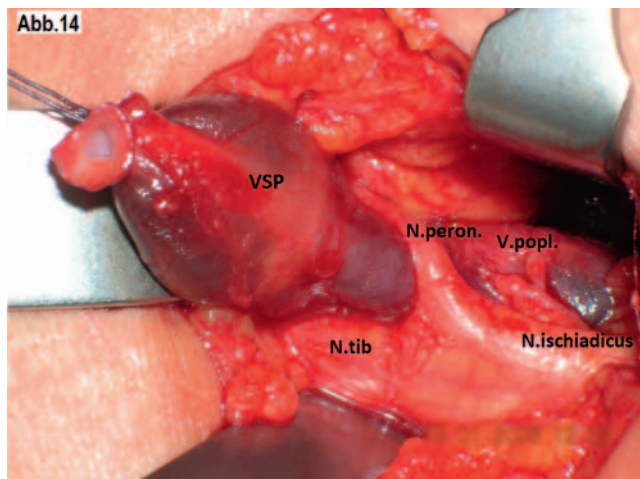


► **Fig. 12** Surgical site in the popliteal fossa; proximity of the tibial nerve (N. tib.) to the small saphenous vein (VSP).

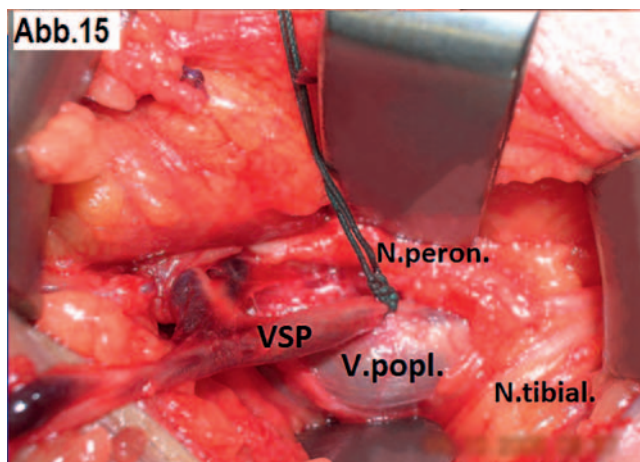


► **Fig. 13** Surgical field showing the small saphenous vein, saphenopopliteal junction, and motor nerves (VSP = small saphenous vein, N. tib = tibial nerve, N. peron = peroneal nerve, V. popl. = popliteal vein).

patient population. Function was restored completely in all three cases, although it took nearly a year until the foot drop finally disappeared in a very muscular scuba diver.



► **Fig. 14** Surgical field showing the small saphenous vein, saphenopopliteal junction, and motor nerves (VSP = small saphenous vein, N. tib = tibial nerve, N. peron = peroneal nerve, V. popl. = popliteal vein).



► **Fig. 15** Correct flush ligation of the small saphenous vein (VSP = small saphenous vein, N. tib = tibial nerve, N. peron = peroneal nerve, V. popl. = popliteal vein).

In his standard work 'Vein surgery' [10], Hach referred to the patient population of a 1983 study [12], in which Helmig also saw three cases of transient peroneal lesions in 1094 open flush ligations of the small saphenous vein.

The indications for redo surgery must be carefully considered, particularly in the popliteal fossa following incomplete high ligation leaving short or very short stumps, or in the case of technically demanding operations for neoangiogenesis after previous first-time surgery. Possible improvements in the venous haemodynamics, as shown by preoperative phlebodynamometry, have to be weighed up carefully against the surgical risks. In individual cases, it may be better not to re-operate and instead use foam sclerotherapy as the treatment of choice for the patient. Demonstrable mild saphenopopliteal junction reflux in the popliteal fossa should not automatically induce the surgeon to carry out a revision! Ligation of the small saphenous vein is one of the most

demanding procedures in vein surgery. There is an inherent risk of major complications, as well as vascular and motor nerve injuries.

Correctly determining the indication for revision surgery therefore has absolute priority. In accordance with Hach's recommendations [9], popliteal stump ligation is the only redo surgery for saphenopopliteal recurrence that we perform (► Fig. 16).

Redo surgery is always carried out in an inpatient setting. Despite or perhaps even because of our own great experience, we consider that it is not acceptable for this procedure to be carried out on an ambulatory basis, even if our colleagues from the medical service of the health insurance companies (MDK) sometimes think otherwise. Surgeons who are experienced in small saphenous vein surgery are rare, and they are even more rarely to be found in the MDK.

Besides the strict determination of the indication, redo surgery at the saphenopopliteal junction requires an experienced surgeon, two assistants (or two scrub nurses) and a specific set of surgical instruments, including small vascular clamps, a Baby-Satinsky clamp, etc. However, the use of these instruments should be avoided whenever possible. Projectile venous bleeding that immediately obscures the view can be dealt with less traumatically by gentle finger pressure or with surgical cotton buds held above and below the source of bleeding, then placing interrupted 5–0 or 6–0 vascular sutures. A strong jerky approach as for arterial surgery is contraindicated.

Nevertheless, when pressure is being applied by a finger or cotton bud above and below the bleeding source, the space in the popliteal fossa available for suturing may be very limited. It is therefore difficult to perform a vascular suture. In these circumstances, we have found the following procedure to be of value:

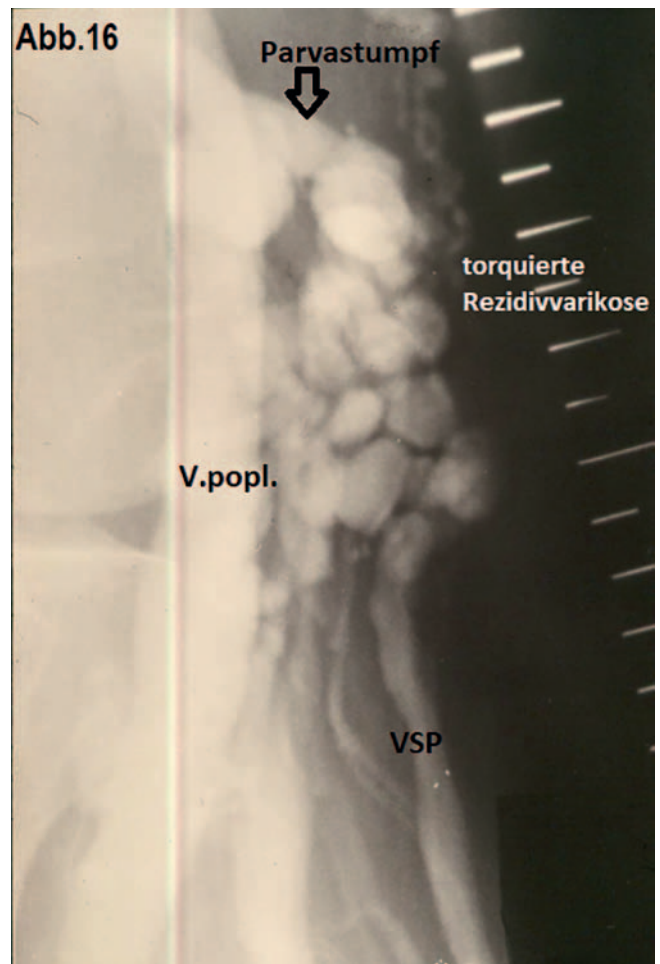
Bleeding is stilled by applying several layers of scrunched-up compresses and then a Löfqvist cuff, which is rolled on as far as the mid-thigh and then fixed in place with metal brakes (► Fig. 17).

Even though minimal bleeding remains in the popliteal fossa, there is a clearer view and the vascular suture is much easier to perform. On no account must there be any suture cerclage, blind clamping or bulk ligation! In emergency situations during flush ligation or redo surgery of the small saphenous vein, the basic principles of Pschyrembel and especially of Hach [10] must be remembered, namely to keep calm and radiate calm, so that the subsequent surgical steps required can be considered quietly, planned properly, and then carried out without a rush.

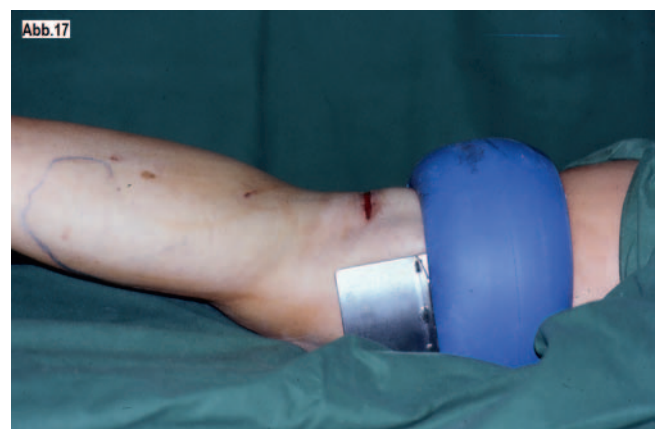
Cohort study on flush ligation of the small saphenous vein

Our cohort study included 153 patients. Of the 187 surgically treated legs, 138 (74%) were in women and 49 (26%) in men. The study examined and included all patients who routinely attended the Saarlouis Vein Centre in 2016 and had undergone flush ligation of the small saphenous vein at the Centre during the previous years.

The aim of the study was to determine the duplex ultrasound findings in the treated popliteal fossa. The optimal result was the absence of a small saphenous vein stump, neovascularisation, or



► Fig. 16 Venography with Valsalva manoeuvre after Hach. Recurrent small saphenous varicose veins with a short small saphenous vein stump.



► Fig. 17 Löfqvist cuff with metal brake, after R. Fischer.

any other pathological findings at the saphenopopliteal junction. Pathological findings were divided into the following groups:

1. Small saphenous vein stump, clinically relevant
2. Neovascularisation, clinically relevant

3. Small saphenous vein stump or neovascularisation, not clinically relevant
4. Recurrent varicose veins in the treated popliteal fossa, but with new openings, clinically relevant

Results

In the follow-up of the 187 treated legs, the operation had been carried out 1 to 5 years previously in 84 cases, 6 to 10 years previously in 82 cases, and 11 to 19 years previously in 21 cases.

We found a small saphenous vein stump with clinically relevant recurrent varicose veins in 4 patients (2.1%); the length of the stump ranged from 3 mm to 10 mm. Neovascularisation with clinically relevant recurrent varicose veins was present in two patients (1.1%). Duplex ultrasound scans showed a stump or neovascularisation without clinical evidence of recurrent varicose veins in three patients (1.6%). We also found completely new sites of incompetence in the popliteal fossa, clearly distant from the first treated site, in six patients (3.2%). These last findings were not counted as recurrences. Between the first and second intervention, the level of the opening into the deep vein differed completely by 3–5 cm. The reason for this may be that the first operation dealt with the small saphenous vein, while the redo surgery concerned a lateral perforator in the popliteal fossa, or vice versa. These are, however, rare isolated cases.

The rate of true saphenopopliteal junction recurrences, with or without clinical signs was 4.8% (► **Table 3**).

Discussion

The research presented here in no way meets the criteria for a proper scientific study. The 187 legs followed-up over a period going back 19 years came from about 3800 operations on the small saphenous vein, while figures for the 166 legs going back 10 years were taken from about 2000 operations. The exact follow-up rate in relation to the number of operations carried out is therefore very small, and considerably less than 10%. The data do, however, give an idea of the activities being carried out in the setting of a practising phlebologist.

After an average of 4 years' follow-up, the findings of the two cohort studies were as follows [31]: in the older study conducted in 1995 we found the recurrence rate at the saphenopopliteal junction to be 10%, with evidence of a small saphenous vein stump in 14%. The second study carried out 12 years later showed pathological findings at the junction in 3%, with a residual stump in 7% [31]. Due to increasing surgical experience, the saphenopopliteal junction recurrences decreased because the incidence of a residual stump had halved.

Results of small saphenous vein surgery published in the literature are unsatisfactory (► **Table 4**). Nevertheless, it must be remembered that the available studies do not use a standardised surgery technique and their definitions of recurrence are very different [32]. The high rates of small saphenous vein stumps are evidence that the saphenopopliteal ligation was not performed properly. All possible variations are represented, from a simple subfascial ligation [5, 6] to a true flush saphenopopliteal ligation

► **Table 3** Duplex ultrasound scanning evidence of recurrence after small saphenous vein surgery.

recurrence	number (187)	percentage (%)	
clinically relevant with stump	4	2.1 %	3–4.1–5.9–10.1 (stump length in mm)
clinically relevant with neovascularisation	2	1.1 %	
clinically not relevant with stump/neovascularisation	3	1.6 %	Σ 4.8 %
clinically relevant with new opening	6	3.2 %	
total	15	8 %	
true recurrences	9	8 %–3.2 % = 4.8 %	

► **Table 4** Overview of the literature. Recurrence rate after small saphenous vein surgery.

high ligation and stripping of the small saphenous vein				
year	author	n	follow-up	recurrence
1996	Tong	70		61 %
1999	Hanzlick	41	5 years	
2001	Vin	77	9.2 years	68 %
2003	Pukacki	42	4.9 years	78 %
2007	Allegra	132	5 years	30 %
1995	Stenger	140	3.75 years	10 %
2007	Stenger	137	4.5 years	3 %
2006	Hartmann	25	14 years	12 %
2012	Samuel	50	1 year	0 %

[27, 31, 34]. Allegra et al. [1], with a saphenopopliteal junction recurrence rate of 30% after five years, gives no details at all of the surgical technique. The high recurrence rate, however, suggests that the flush ligation was not performed correctly, even though the authors talk of 'stripping of the small saphenous vein from the saphenopopliteal junction to the lateral malleolus'. This once again shows the discrepancy between rhetoric and reality with respect to the proper flush ligation of the small saphenous vein. This discrepancy was also reflected in the work by Winterborn et al. 2004 [35]. Rebecca Winterborn, a co-worker of the renowned British vein surgeon Jonathan Earnshaw, asked 379 vascular surgeons in Great Britain and Ireland about their routine practice for open flush ligation of the small saphenous vein. 11.5% of those questioned declined to operate on small saphenous varicose veins at all, because of the risk of nerve injury. Only about 50% carried

out preoperative duplex ultrasound scans. 20 % did not operate with the patient lying prone. 13 % still performed a direct subfascial ligation in the same way as Feuerstein had done 40 years before [5]. 76 % placed the ligature around the small saphenous vein somewhat more deeply, but where? Precise details of the ligature's position were lacking. Only 10 % of surgeons performed open flush ligation of the small saphenous vein in line with the recommendations made by Hach and Mumme, after properly exposing the saphenopopliteal junction. O'Hare et al. [21], from the Winterborn and Earnshaw research group, reported a retrospective multicentre study in the United Kingdom, in which saphenopopliteal junction disconnection and stripping were compared with saphenopopliteal junction disconnection alone. One year later, duplex ultrasound showed recurrence in 13 % of the SPJ disconnection/stripping group and in 32 % of those who had undergone SPJ disconnection alone. As in the publication by Allegra et al., these authors talked of 'saphenopopliteal junction ligation' [1]. It makes us wonder, however, as Winterborn et al. stated that only 10 % of British surgeons actually expose the popliteal vein. Once again, we have reasonable doubts about the accuracy of use of the terms 'flush ligation', 'high ligation' and 'saphenopopliteal ligation' in the same way as for procedures at the saphenofemoral junction [11, 28, 29].

Other authors, such as O'Donnell et al. [20], are more critical of saphenopopliteal ligation. They are of the opinion that the risk of postoperative complications increases with the extent of dissection around the saphenopopliteal junction. Rashid et al. [24] provided evidence that, despite preoperative duplex imaging, the saphenopopliteal junction was not exposed during 22 % of operations and a flush ligation was not achieved in 59 %. Even in the three randomised controlled trials so far available, in which ligation and stripping of the small saphenous vein was compared with endoluminal treatment methods, flush ligation of the small saphenous vein was obviously not performed [3, 19, 26]. We have recently published details of these RCTs [28]. In summary, we can say that the principles of a proper flush ligation of the small saphenous vein, as described by Hach and Mumme in their handbook and as they appear in the current guidelines of the German Society of Phlebology, have not been respected – especially in the literature of English-speaking countries. Nor is surgery performed according to these criteria in those parts of the world. On the other hand, the data we have presented above can at least be considered evidence that the observance of Hach's recommendations on saphenopopliteal ligation leads to a low recurrence rate which more or less corresponds to that of high ligation of the great saphenous vein [22, 23, 25]

This article was written to honour the occasion of Professor Wolfgang Hach's 90th birthday. It was he who developed German phlebology from pragmatic practice-oriented therapy to a scientifically based medical specialty.

Conflict of Interest

The authors declare that they have no conflict of interest.

References

- [1] Allegra C, Antignani PL, Caralizza A. Recurrent Varicose Veins Following Surgical Treatment: Our Experience with Five Years Follow-up. *Eur J Vasc Endovasc Surg* 2007; 33: 751–756
- [2] Pannier F, Noppeney T, Alm J et al. AWFOM Online Studie S2k-Leitlinie 037-018, Diagnostik und Therapie der Varikose (aktueller Stand 03/2019).
- [3] Brittenden J, Cotton SC, Elders A et al. Clinical effectiveness and cost-effectiveness of foam sclerotherapy, endovenous laser ablation and surgery for varicose vein: results from the Comparison of Laser Surgery and foam Sclerotherapy (CLASS) randomised controlled trial. *Health Technol Assess* 2015; 19: 142–342
- [4] Gauw SA, Lawson JA, Van Vlijmen-Van Keulen CJ et al. Five-year follow-up of a randomized, controlled trial comparing saphenofemoral ligation and stripping of the great saphenous vein with endovenous laser ablation (980 nm) using local tumescent anesthesia. *J Vasc Surg* 2016; 63 (2): 420–428. doi:10.1016/j.jvs.2015.08.084
- [5] Feuerstein W. Zur Behandlung der Vena saphena parva Varizen. *Phlebol* 1993; 22: 230–235
- [6] Fischer R, Vogel P. Resultate der Strippingoperation bei der vena saphena parva. *VASA* 1987; 16: 349–351
- [7] Hach W. Spezielle Diagnostik der primären Varikose. Untersuchungen des extrafaszialen Venensystems unter normalen und pathologischen Bedingungen mit der aufsteigenden Präphlebographie. Gräffelfing: Demeter; 1979
- [8] Hach W, Hach-Wunderle V. Phlebographie der Bein und Beckenvenen. Schnetztor: Verlag GmbH Konstanz; 1985
- [9] Hach W, Hach-Wunderle V. Die Rezirkulationskreise der primären Varikose; Springer Verlag; 1994
- [10] Hach W, Mumme A et al. Venenchirurgie. 3. Auflage Stuttgart: Schattauer; 2012
- [11] Hartmann K, Stenger D, Rafi-Stenger L. Endochirurgie versus offene Chirurgie der Varikose. *Hautarzt* 2017; 68: 603–613
- [12] Helmig L. Häufigkeit von Frühkomplikationen bei 13024 Krampfaderoperationen. *Phlebol u Proctol* 1983; 12: 184–195
- [13] Hoare MC, Royle JP. Doppler ultrasound detection of saphenofemoral and saphenopopliteal incompetence an operative venography to ensure precise saphenopopliteal ligation. *Aust N Z J Surg* 1984; 54: 49–52
- [14] Hobbs JT. Preoperative venography to ensure accurate saphenopopliteal vein ligation. *Br Med J* 1980; 280: 1578–1579
- [15] Kluess H, Rabe E, Mulkens P. Welche Bedeutung hat das Nahtmaterial in der Varizenchirurgie? (Ergebnisse einer Umfrage zu 19000 Stammveneneingriffen). *Vasomed* 1998; 10 (Suppl): 24
- [16] Kluess H, Drosner M, Hanauske U et al. Strategie zur Vermeidung von Rezidivkrossenvarikosen der V. saphena magna: Erste Ergebnisse nach konsequenter Verwendung eines nicht resorbierbaren Ligaturfadens. *Phlebologie* 2003; 32: A22
- [17] Lang J, Wachsmuth W. Bein und Statik. *Praktische Anatomie Bd. I Teil 4*. Berlin, Heidelberg, New York: Springer; 1972: 54-66; 73-91; 226-30
- [18] Mumme A, Hummel T, Burger P et al. High Ligation of the Saphenofemoral Junction Is Necessary! Results of the German Groin Recurrence Study. *Phlebologie* 2009; 38, no. 3: 99–102
- [19] Nandhra S, Elsheika J, Carradice D et al. A randomized clinical trial of endovenous laser ablation versus conventional surgery for small saphenous varicose veins. *Journal of Vascular Surgery* 2015; 61: 741–746
- [20] O'Donnell TFO Jr, lafrati MD. The small saphenous vein and other „neglected“ veins of the popliteal fossa: a review. *Phlebologie* 2007; 22: 148–155

- [21] O'Hare JL, Vandenbroeck CP, Whitman B et al. A prospective evaluation of the outcome after small saphenous varicose vein surgery with one-year follow-up. *Journal of Vascular Surgery* 2008; 48: 669–673
- [22] Papastopoulou G, Altenkämpfer H, Bernheim C et al. Die LaVaCro-Studie: Langzeitergebnisse der Varizenoperation mit Crossektomie und Stripping der V. saphena magna. *Phlebologie* 2013; 42 (5): 253–260
- [23] Rafi-Stenger L. Retrospektive Langzeitstudie zur Inzidenz der Neovaskularisations-/Rezidivrate nach Vena saphena magna Crossektomie mittels Ultraschallmonitoring. (Abstract). *VASA* 2016; 45 (Suppl. 93): 1–105
- [24] Rashid HL, Ajeel A, Tyrell MR. Persistent popliteal fossa reflux following saphenopopliteal disconnection. *British Journal of Surgery* 2002; 89: 748–751
- [25] Rasmussen L, Lawaetz M, Bjoern L et al. Randomized clinical trial comparing endovenous laser ablation and stripping of the great saphenous vein with clinical and duplex outcome after 5 years. *J Vas Surg* 2013; 58 (2): 421–426. doi:10.1016/j.jvs.2012.12.048
- [26] Roopram AD, Lind MY, Van Brussel JP et al. Endovenous laser ablation versus conventional surgery in the treatment of small saphenous vein incompetence. *J Vasc Surg: Venous Lym Dis* 2013; 1: 357–363
- [27] Samuel N, Caradice D, Wallace T et al. Saphenopopliteal ligation and stripping of small saphenous vein: does extended stripping provide better results? *Phlebologie* 2012; 27: 390–397 *Venous Lym Dis* 20113; 1: 357–363
- [28] Stenger D, Hartmann M. Die Chirurgie der V. saphena parva – endoluminal oder operativ. *Phlebologie* 2019; 48: 23–31
- [29] Stenger D, Hartmann M. Crossektomie und Strippingoperation. *Hautarzt* 2012; 63: 616–621
- [30] Stenger D, Rafi L, Hauch T et al. Chirurgie der Vena saphena parva-Varikose – Antworten bisher ungeklärter Fragen. *Phlebologie* 2011; 5: A 22
- [31] Stenger D, Janthur E, Rafi L. Stripping-Operation heute. *Vasomed* 2011; 23: 6–13
- [32] Tellings SS, Ceulen RPM, Sommer A. Surgery and endovenous techniques of the treatment of small saphenous varicose veins: a review of the literature. *Phlebologie* 2011; 26: 179–184
- [33] Thomas LM, Chan O. Anatomical variations of the short saphenous vein: A phlebographic study. *Vasa* 1988; 17: 51–55
- [34] Whiteley MS, Lewis G, Holdstock JM et al. Minimally invasive technique for ligation and stripping of the small saphenous vein guided by intraoperative duplex ultrasound. *Surgeon* 2006; 4: 372–377
- [35] Winterborn RJ, Campbell WB, Heather BP et al. The Management of Short Saphenous Varicose Veins: A Survey of the Members of the Vascular Surgical Society of Great Britain and Ireland. *Eur J Vasc Endovasc Surg* 2004; 28: 400–403