Endovascular Obliteration of the Greater Saphenous Vein: 
The Closure Procedure

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Abstract: The Closure procedure is an endovascular method to obliterate the greater saphenous vein as an alternative to surgical ligation and stripping. It is based upon the effect that controlled heat exerts upon the collagen in the vein wall, resulting in shrinkage of the wall and its lumen. The development of the technique and its early applications are reviewed. Technical details of the procedure are described as they have evolved in the Straub Clinic experience. Key points in technique relate to use of positioning of the table to facilitate different stages in the procedure, the use of tumescent infiltration in the subcutaneous tissue to provide a ‘dry’ vein, careful monitoring with the duplex scan during the procedure, and utilization of guidewires to assist in catheter placement are discussed.

Two series of cases are presented to examine the results obtained to date with this treatment and to highlight both the advantages and the areas of potential concern for the future. The infrequent (1%) but real complication of DVT in the femoral vein is placed in perspective and recommendations are made to minimize this problem. The potential for future recurrences due to thigh branch persistence exists but has not materialized in the first two years of experience. Other perceived complications of Closure, such as neuritis and thermal injury to the skin, have not materialized as serious problems.

The advantages of this endovascular procedure have been rapid recovery and minimal pain, with early return to normal activity and to work. It is a highly desirable method to patients who are attracted by the minimally invasive, non-surgical nature of the procedure, and the absence of surgical scarring in the post-operative recovery.

Key words: Endovascular obliteration, Greater saphenous vein

The Closure procedure is an endovascular alternative to conventional ligation and stripping for definitive treatment of the greater saphenous vein. The endovascular treatment consists of carefully controlled heat (85°) applied to the endothelium of the vein in order to shrink the lumen of the vein via contraction of the collagen fibrils in the wall. The heat is delivered through a sheathed catheter passed from the calf to the sapheno-femoral junction under ultrasound (duplex scan) guidance. The wall shrinkage leaves a small central lumen of 1-2mm that quickly develops a thrombus plug, resulting in total occlusion of the vein throughout the treated length.

This technique evolved from an initial effort to produce
competence in the refluxing greater saphenous valve by shrinking the collagen in the wall of the vein at the base of the valve. This began in 1996 in the laboratory of the Vnus company where shrinkage of the collagen was shown to occur. Although this was not a reliable method of producing a competent valve the early studies did demonstrate the feasibility of shrinking the vein wall to a small diameter (1-2mm) from which terminal thrombosis of the lumen produced complete occlusion of the vein in the goat model. In the human, early trials were done by shrinking the saphenous vein to the point of closure followed by removal of the vein for histologic study. These studies showed injury to the endothelium and the subendothelial layer without gross necrosis of the vein wall. Human trials were begun in European centers in 1998, followed by FDA approval in the United States in 1999 and further trials on both continents. Ongoing series are being followed both in Europe and the United States to observe the effect of the procedure after follow-up of 2 years, and now just beginning to see the three-year results. Overall, the Vnus company reports that over 10,000 procedures have been performed with this technique by mid-2002. A randomized prospective study on a defined population of 80 patients followed for 4 months has been completed and is under preparation for publication.

The effect of the Closure treatment can be divided into the immediate, or early effect, and the late effect up to 12-24 months. The early effect is based upon treatment of the vein at average temperature of 85°C. The vein is treated from a proximal point 1-2cm distal to the exact sapheno-femoral junction to a distal site at the level of the knee or the upper calf, with a measured withdrawal rate of 2-3cm/minute. This results in apparent shrinkage of the vein wall that resembles (by duplex scan observation) the experimental shrinkage of 65% or more of the vein lumen. It has been found that the remaining lumen of 1-2mm becomes clotted while the patient is still under treatment in most cases. The patient should be scanned on the day following the procedure or within 72 hours to confirm the closure and to rule out thrombosis extending into the common femoral vein. Such thrombosis has been seen in about 1% of cases in our experience and is always diagnosable on the first scan at 24 hours post-operative. If present, it is managed by thrombectomy or anticoagulation.

The late effects of the Closure treatment have been thoroughly studied by serial scans for up to two years, and in some centers in Europe extending to 3 years. In the Straub Clinic experience, scans initially were performed at 24 hours, one week, one month, three months, 6 months, and one year. This experience involved over 170 cases and was continued for over one year; it showed that an initially satisfactory scan at 24 hours remained satisfactory, and that further scans added very little information. The treated saphenous vein remains at its immediate post-treatment size for 3-6 months, and then begins to show progressive shrinkage until it totally disappears as an ultrasound-definable structure. At 12 months, over 85% of the veins are no longer seen, and during the second year most of the remaining veins become invisible. This finding has been mentioned repeatedly in other series in the literature. It appears that the veins shrink to a scar that becomes indistinguishable from the background tissue, and this is interpreted as a sign of permanent eradication of the vein as a functioning structure.

The Closure technique was used in about 50% of candidates for stripping in our early experience, but now it is used in 80-90%. The ideal candidate has a straight course of the saphenous vein in the thigh, an internal diameter of 3-10mm in the greater saphenous vein (GSV), and a normal amount of subcutaneous fat to provide a depth of 1.0 mm between the skin and the GSV. Candidates who are less than ideal but still readily treated are those with a tortuous GSV, with aneurysms of the GSV up to 1.5 cm in diameter, with axial internal GSV diameters of less than 1.2 cm, or with an absence of subcutaneous fat in the thigh as seen in the highly conditioned athlete or the asthenic individual. Many of these cases were initially considered to have a contra-indication to Closure, but with experience and improvements in the technique it has been found they can be reliably treated. Cases still considered to have contra-indications to Closure are post-thrombotic saphenous veins, those with aneurysms at or adjacent to the sapheno-femoral junction, and those with huge saphenous veins where the internal diameter is greater than 1.2 cm along the length of the vein (mega-veins).
Technical Aspects of Closure

The Closure procedure is performed with equipment designed and manufactured by the Vnus company*. There is a bipolar RF generator (Fig. 1) which provides real-time read-out of the elapsed treatment time, the temperature at the electrode-endothelial interface, the impedance expressed in ohms, and the power expressed in watts. There is a test button to check the condition of the catheter. This generator is attached to the Closure catheter by a cable. The Closure catheters (Fig. 1) come in two sizes, 6 Fr. and 8 Fr., and in various lengths up to 100 cm with graded markings on the catheter to determine the length of the catheter within the vein. The size of the catheter is determined by the internal diameter of the vein. It is the diameter reached with maximal extension of the treatment electrodes on the catheter that limits the size of vein that can be treated because the electrodes must be in apposition to the endothelium of the vein wall in order to have an effective shrinking of the vein.

The procedure can be done under local, regional, or general anesthesia in an ordinary operating room or a well-equipped out-patient office setting. Closure is performed on the greater saphenous vein of the thigh and upper calf because the vein is of adequate size to accommodate the catheter and of adequate depth to avoid skin burn or other thermal effects on the skin.

Access to the vein refers to the technique of introduc-

   * The Closure System (VNUS Medical Technologies Inc., Sunnyvale, Ca. into the GSV in the calf. This is easily accomplished by a mini-incision that allows the GSV to be brought to the surface for cannulation. With practice, this can be reliably done by percutaneous puncture of the vein utilizing duplex scan guidance and avoiding the small skin incision. It is helpful to have the patient in the reverse Trendelenburg position to dilate the vein during access and to facilitate passage of the catheter or its guide-wire up to the sapheno-femoral junction.

   Once the vein is accessed, either a guidewire or the catheter itself is passed proximally under duplex guidance into the common femoral vein (CFV) while the patient remains in reverse Trendelenburg. All of the Closure catheters have a central lumen for through-the-catheter cannulation over a guidewire. Personal preference will dictate the frequency of use of the guidewire. Some of the pitfalls to the successful passage of the catheter up to the sapheno-femoral junction are due to the presence of aneurysms in the degenerated saphenous vein causing the catheter to hang up and possibly perforate the thin aneurysm wall, excessive tortuosity of the vein causing similar problems, large perforator branches which allow the catheter to pass into the deep veins of the thigh, and retained elements of deformed valves allowing the catheter to become caught in the endovenous structures. It is a dictum of successful cannulation that the catheter never be forced when inside the vein. If a problem occurs during passage it can almost always be overcome with careful manipulation aided by changing the position of the leg, visualizing the hang-up with the duplex scan, or using a guidewire to pass the problem site. Because the occurrence of one of these problems can delay or frustrate the entire procedure, one may choose to use a guidewire from the outset because it is less traumatic than passing the catheter itself.

   After the catheter has been passed to the common femoral vein the patient is placed in the Trendelenburg position because this decreases the luminal size of the vein. In order to achieve a ‘dry vein’ status which means that flow within the vein is stopped, infiltration of the tissues (tumescent infiltration) above the vein with a dilute (0.1-0.2%) lidocaine
solution containing epinephrine (1:100,000) is performed under duplex guidance. This is a very important part of good technique for several reasons. This infiltration is used to provide a ‘heat sink’ of 1.0-2.0 cm. between the skin and the vein to avoid thermal injury to the skin and to eliminate flow within the vein. The solution is placed in the subcutaneous tissue between the skin and the vein and as it is placed the vein is monitored with duplex scanning to observe the shrinkage of the vein and the skin-vein distance. As the infiltration proceeds, flow inside the vein can be seen to cease by ultrasound monitoring. Under duplex scan visualization, the vein can be observed to shrink in size as the tumescent infiltration proceeds. It appears that the infiltration causes a change in the tissue pressure around the vein which results in redistribution of the flow into alternate channels away from the saphenous itself.

Placement of the catheter at the upper end of the saphenous vein for the start of treatment should be carefully done. It is recommended that the catheter’s electrodes be situated within the GSV about 1.0-2.0 cm. distal to the actual sapheno-femoral junction. This is usually just below the entrance of the highest branch of the GSV, typically the superficial epigastric vein. This branch is permitted to remain patent and flowing into the sapheno-femoral junction. The importance of this is to avoid thermal injury to the CFV itself to limit the chance of an early post-operative DVT within the femoral vein and to prevent the potential late development of CFV stenosis.

The actual treatment is begun at this proximal site and conducted by a slow pullback technique of 2.0-3.0 cm. per minute.\textbf{(Fig. 2)} The purpose is to treat the vein with a sufficient exposure to a temperature of 85°C +/- 2°C. This temperature and exposure time is based upon initial results in the experimental laboratory and has been found reliable in producing obliteration of the vein.

Treatment is carried down to the knee crease or into the upper calf, depending upon the local distribution of the veins in the individual case. The catheter is withdrawn from the sheath followed by removal of the sheath and finger pressure to obtain hemostasis. In the Straub technique, 2.0 ml.
of 5% sodium morrhuate or other sclerosant is injected into
the distal end of the saphenous vein to obliterate local
branches just before removing the sheath from the vein.

For emphasis, the key points in this technique are sev-
eral:

1. Adjust the position of the table from reverse Trend-
delenburg to dilate the vein during access maneuvers, to
full Trendelenburg during treatment to aid constric-
tion of the vein and provide a ‘dry vein’.

2. Careful placement of tumescent infiltration under ultrasound control to achieve shrinkage of the vein
and to eliminate flow in the lumen, as well as to provide
an effective heat sink.

3. Check with the duplex scan to be sure there is a ‘dry
vein’ during treatment to maximize the electrode
effect upon the intima. The ‘dry vein’ is achieved
by the combination of a sharp Trendelenburg posi-
tion with the pressure of the tumescent infiltration
around the vein, and the use of a dilute solution of epinephrine in the tumescent mixture.

4. Utilize the through-the-lumen guidewire to ensure
minimal wall injury and to facilitate access to the S-
F junction.

5. Monitor with the duplex scan throughout the treat-
ment to ensure an accurate procedure.

Anesthesia for the procedure can be local, regional, or
general. Since this is an out-patient procedure local and re-
gional (femoral nerve block) anesthetics give the best results
during the first 24 post-operative hours because there is less
nausea and G.I. upset. Patients with Closure are frequently
very active the day after surgery and this early return to full
activity is facilitated by a lighter anesthetic. General anes-
thesia is often helpful for bilateral cases because they tend to
be longer cases and more difficult for the patient to tolerate.

Clinical and duplex scan follow-up during the first 24-
72 hours is necessary to check the adequacy of closure of the
GSV and to be certain there are no thrombi in the common
femoral vein. There is an incidence of 0.5-1.0% of post-
operative DVT in the common femoral vein2-4) which should
be found early and treated aggressively to prevent thrombo-
embolic sequelae from this procedure. Treatment with hep-
arin or with thrombectomy is recommended to preserve the
integrity of the femoral vein. After an initial normal scan,
there is practically no tendency for thrombosis in the femo-
ral vein. An early clinical follow-up is useful to explain to
the patient that full activity can begin immediately and to
evaluate the patient’s response to the procedure. In our ex-
perience most of the patients do not require more than one or
two pain pills throughout the post-operative experience, and
many use no pain pills at all. The majority of post-operative
complaints involve nausea after the anesthetic drugs rather
than pain after the procedure.

A bandage over the treated saphenous vein is not needed
and is actually cumbersome. Full activity may include re-
turn to work including standing, sitting, mild lifting, and even
manual labor. Subsequent follow-up can be at the discretion of the surgeon. We formerly followed scans at one week,
one month, 6 months and one year, and yearly thereafter.
The changes between the first P. O. scan and the one year
scan involve progressive shrinkage of the saphenous vein until
it actually becomes invisible to the ultrasound scan. About
90% of saphenous veins have disappeared to sonographic
examination at one year post-operative.

Based upon these observations, our present recommen-
dation is to see the patient 24 hours post-operative for a clini-
cal examination and a post-operative scan, at one month for
a clinical visit only, and at one year for another scan and a
clinical visit to follow the disappearance of the GSV, and
yearly thereafter. In cases where the saphenous vein is still
identifiable at 12 months, an 18 month scan is recommended
to learn more about the natural history of the long term fol-
low-up.

In comparing the Closure procedure against conven-
tional ligation and stripping, the similarity is that the saphe-
nous vein is eliminated from the circulation in both proce-
dures. In Closure, the vein is retained in the body where it
heals to become a scar that is sonographically invisible to
ultrasound as an identifiable structure distinct from the back-
ground subcutaneous tissues; in stripping, the vein is removed
from the body. In both procedures the branches are obliter-
ated with the sole exception (in Closure) of the highest branch
(es) at the sapheno-femoral junction, namely the superficial
epigastric branch in most cases. Branches that are still patent post-operatively can be checked for competence in the post-operative scan by local augmentation or Valsalva testing. During the first two years there have been no recognized untoward sequelae from persistence of these branches, but the true test may require longer follow-ups of 5-10 years.

The great attraction of Closure is that there are no surgical wounds to heal, little or no need for pressure dressings post-operatively instead of a pressure dressing or constricting garment for one week or longer, and minimal to complete absence of post-operative pain in the great majority of cases. These latter advantages of Closure are very attractive to patients and lead to a significantly earlier return to normal activities and return to work. Since saphenous vein surgery is elective and is done for improved quality-of-life rather than for limb or life-threatening indications, these advantages of Closure assume greater significance than might be seen in more severe clinical situations.

**Case Series Reported in the Literature**

A multicenter series with 2 year follow-up that was reported in June 2002 concentrated on the results in patients who were determined by post-operative duplex scan study to have complete occlusion of the saphenous vein, near complete occlusion (< 5cm open), and less than near-complete occlusion (> 5cm open) which were termed recanalization. The patients had non-aneurysmal saphenous veins less than 12mm in diameter pre-operatively. 75% of cases were CEAP class 2 or less and 17% were CEAP class 4-6 pre-operatively. All cases were followed 24 months for a total of 286, 223, 232, and 142 limbs at 1 week, 6 months, 12 months, and 2 years. The study was designed as a prospective registry of cases.

At 24 months 85% of cases were completely closed, 3.5% were near-complete, and 11.5% showed some degree of recanalization. 90% of limbs at 24 months were free of saphenous reflux. Paresthesia was present in 5.6% of limbs at 24 months, varicose veins were identifiable in about 10% of cases at 24 months, and patient satisfaction was achieved in 94% at 2 years.

The analysis showed that the results of the complete occlusion and of the near-complete-occlusion groups are similar at 2 years, while those of the less than near-complete, or recanalized group were significantly worse. Thermal injuries to the skin were seen in the first half of the series (6/143 limbs) and were eliminated in the second half (0/143 limbs) by improvements of technique (tumescent infiltration) achieved in the learning curve of performing the procedure. Post-operative deep vein thrombosis was found in 3/286 limbs (1%) with one pulmonary embolus, and all were treated successfully by anticoagulation.

Since these results with Closure were found to be comparable to results reported for vein ligation and stripping by Jones and Rutgers, this report concludes that Closure is an acceptable alternative to vein stripping up to 2 years after surgery.

The experience with Closure at Straub Clinic comprises 300 total operated limbs performed over a period of 24 months with follow-up for one year or longer in 170 cases. (Table) The indications for surgery were less restrictive than in the above-described multicenter study because tortuous veins and aneurysmal veins were not excluded, nor were

<table>
<thead>
<tr>
<th>Complications:</th>
<th>Total cases: 300</th>
</tr>
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<tbody>
<tr>
<td>successful:</td>
<td>97 %</td>
</tr>
<tr>
<td>(Convert to strip:</td>
<td>3 %</td>
</tr>
<tr>
<td>F. U. &gt; 1 yr.:</td>
<td>160</td>
</tr>
<tr>
<td>Adjunctive proc:</td>
<td>95 %</td>
</tr>
<tr>
<td>Phlebectomy:</td>
<td>78 %</td>
</tr>
<tr>
<td>Perforator:</td>
<td>70 %</td>
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<tr>
<td>DVT: 2 (CFV)</td>
<td>0.7 %</td>
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<tr>
<td>Skin burn: (1)</td>
<td>0.3 %</td>
</tr>
<tr>
<td>Skin discoloration:</td>
<td>&lt; 10 %</td>
</tr>
<tr>
<td>Recur reflux: (3)</td>
<td>1 %</td>
</tr>
<tr>
<td>Access problems:</td>
<td>15 %</td>
</tr>
<tr>
<td>Miscellaneous:</td>
<td>1 %</td>
</tr>
<tr>
<td>Mortality:</td>
<td>None</td>
</tr>
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**Table Straub Closure Series**
veins with focal areas of internal diameter greater than 12 mm excluded. Adjunctive procedures of phlebectomy or perforator interruption were performed in 95% of this series. A liberal policy of conversion of the procedure to open ligation and stripping was followed to ensure that a proper operation was performed in each limb, and the total of conversions was 3% over the 170 cases. As the learning curve of performing the procedure progressed, significantly fewer conversions to stripping procedures were needed. The other 97% of cases achieved successful initial closure as determined on the operating table by duplex scan criteria. The complications in this experience (Table) were limited to one skin burn in the second case, recurrent reflux in 3 cases on post-operative duplex study, DVT in 2/300 limbs, miscellaneous minor problems in 1%, and no mortality. The DVTs both occurred in the common femoral vein (CFV), were found at the first 24 hour post-operative scan, and were managed by thrombectomy with no subsequent sequelae and no clinical pulmonary emboli. There have been no subsequent thromboses after 24 hours in this series of cases that were all followed with serial post-operative scans. The greatest problems in the learning curve were those of access (15%) including entering the saphenous vein in the calf and passing the catheter successfully to the sapheno-femoral junction.

The observed results in the Straub Clinic series confirm minimal to absent pain, early return to activity within 12-48 hours in most cases, and early return to work depending mainly upon the individual’s desire to return to work than upon any medical necessity to defer the return. The choice of Closure is extremely popular with patients both pre and post-operatively. Many individuals harbor a fear of the stripping procedure which may not be truly warranted but is nevertheless real, while most approach the Closure technique as acceptable for the magnitude of the problem they experience. When warned that long-term knowledge of the ultimate comparative effects of Closure vs. stripping is still not known, most reply that this is not a deciding factor for them.

The statistical results of Closure that have been reported are important in establishing Closure as an alternative to Stripping, but they do not tell the entire story. These statistics reflect the learning curve of a new procedure. Analysis of the series show that once a satisfactory technical result has been produced with closure of the vein to a point <5 cm from the sapheno-femoral junction, subsequent recurrence of reflux is infrequent. In the multicenter study3 'recanalization' was found in 1.7% at one week and in 11.3% at 24 months. In the Straub follow-up4, this occurrence was seen in 3% at 12 months. Since 90% of the veins become sonographically invisible at about 12 months, further deterioration of the saphenous vein result is unlikely to occur in later follow-up since there is no longer a vein present to develop reflux. Any future reflux will occur in veins other than the saphenous.

Learning Curve of Closure

There is a definite learning curve for each team to develop high competence with Closure because this is an endovascular procedure rather than a surgical one, and there are peculiar problems attached to successfully accessing and treating the saphenous veins. As the procedure has matured over the past 3 years new developments include the modification of the catheter to provide a through-the-lumen guidewire capability, routine use of ultrasound-guided tumescent infiltration to deepen and shrink the vein and to provide a ‘dry’ vein, and the importance of excellent ultrasound monitoring for each of the several steps of the procedure5). It appears to require 10-20 cases for most of the teams to develop their technique. Much help is afforded by the policy of the Vnus company to have representatives present for the initial cases as an aid to familiarization with the equipment and its usage.

Commentary on Specific Concerns about Closure

A list of concerns about Closure would include these five items:

1. Occurrence of DVT in the common femoral vein (~1%)
2. Potential recanalization of the GSV (similar to sclerotherapy)
3. Potential for recurrent reflux due to persistent proximal GSV branch(es)
4. Paresthesias and post-operative neuritis
5. Persistence of duplicated saphenous veins
The problem of the occasional case of DVT in the CFV at present is a risk of the procedure that has to be accepted by the patient and the physician. The incidence appears to be about 1% of the cases. It has always been found on the first scan after the procedure and has not developed as a later complication. Once found, it should be treated either by anticoagulation or thrombectomy. To this author's knowledge, there has been one pulmonary embolus reported to the Vnus company, and one case of iliofemoral venous thrombosis (successfully treated with lytic therapy) has been described indirectly (personal discussion with R. Merchant). Nevertheless, this potential for a proximal thrombosis exists and requires ongoing study by those who perform the procedure. Vein stripping also carries a risk of DVT and even pulmonary embolism with a probable incidence of less than 1%.

Extensive recanalization of the 'closed' saphenous vein is an unusual event. It has been found in only 1/300 cases in the Straub Clinic series, and in less than 5% in all of the reported series. Focal sites of recanalization are also unusual and tend to occur in the most proximal part of the GSV. The multicenter study addresses this point directly and indicates that patency and even reflux in the proximal 5 cm of the GSV is well tolerated, but more extensive reflux leads to unsatisfactory results. A high incidence of reflux was reported in the early series of Manfrini et al who suggested that a rapid pull-back time was a likely cause of later recurrence of segmental patency and reflux in the GSV.

The fate of the persistently patent highest branch (superficial epigastric, etc.) vein has been benign for the first two years of follow-up. Whether this will result in later recurrence out of proportion to GSV ligation and stripping results remains to be seen in the later (5-10 year) follow-ups. Proper evaluation of this point will need to have concomitant study of ligation and stripping cases because the incidence may be as high or higher in these patients. Possible causes of recurrent varices after vein stripping reported in the literature include persistence of these branches, a point addressed in an earlier publication on Closure. One cogent difference may be that dissection of the groin can lead to neovascularization with flow into these branches by reason of the presence of the surgical scar, a factor that is not present in the endovascular Closure cases.

The role of duplications and other peripheral branches after Closure would seem to be no different after Closure than after stripping since the orifice of these vessels is removed from the GSV in both cases.

Neuritis as a complication seems to be equivalent following Closure and stripping. The potential irritation of the nerve by the heat of the probe in the Closure procedure is offset by the absence of a ligature around the nerve, or actual cutting of the nerve, that can occur in stripping.

Advantages and Disadvantages of Closure

The actual advantages of Closure lie in the absence of scars and bruising, the minimal to absent pain, and the rapid recovery to activity and to work. Patients clearly relate to the minimal invasive nature of this procedure compared to stripping, and seem to find the magnitude of the Closure procedure more in keeping with the magnitude of the problem caused by varicose veins. These advantages need be weighed against the 1% incidence of DVT in the CFV, the theoretic potential for higher ultimate recurrence due to persistence of proximal branches in Closure, and the higher cost of Closure due to the cost of the disposable catheter and the need for intra-operative duplex monitoring.

Conclusions

Closure is an endovascular procedure that has undergone rigorous testing in the 3 years of its existence. A recent count showed 6 peer-reviewed papers published prior to 2002 and 2 more accepted for publication in 2002, and abstracts published or presented in 16 different programs. In addition, a randomized study of Closure vs. stripping and ligation (the EVOLVeS study) has been completed in 80 patients and is presently under preparation for publication. A smaller randomized study (28 patients) from Finland was recently published.

With follow-up now reported up to two years, Closure provides an alternative method of eradicating the greater saphenous vein with results that are at least comparable to stripping at two years, and with high patient desirability.

Due to the lessons learned in the early experience with
Closure, 70-90% of candidates for vein stripping can be effectively treated with Closure. The contra-indications to Closure at this time are the presence of post-thrombotic changes in the GSV which prevents access, a hugely dilated ‘mega-vein’ size of the GSV (> 12 mm in its axial length), and dilation of the proximal GSV over 10mm, especially with aneurysm formation near the sapheno-femoral junction.

The late follow-up of Closure cases shows that over 90% of the GSVs have become sonographically invisible at 12 months, indicating that the treatment of the GSV itself will be permanent.

References


