The role of superficial venous operations for leg ulceration

Venous ulceration is a common clinical problem with high recurrence rates. The role of operative treatment to correct superficial reflux in venous ulceration remains unclear. This review reports current evidence for superficial surgical procedures in the treatment of venous ulceration.

Chronic venous insufficiency is the most common cause of leg ulcers. This type of ulceration affects approximately 0.5% of the population over 40 years. As age increases the incidence becomes greater still. The prevalence of ulceration is higher in women who make up 69% of patients with ulcers (Cornwall et al, 1986). Venous hypertension may be caused by a congenital or acquired deficiency in the vein wall or valve system. In deep venous reflux, deep vein thrombosis and destruction of the valves is often a cause.

Venous hypertension and stasis leads to a local inflammatory response, endothelial activation, fibrin deposition and extravasation of cells. These changes lead to haemosiderin deposition, lipodermatosclerosis, skin breakdown and ulceration. Ulceration often follows a long and protracted course, with healing of the ulcer occurring in the majority of patients but many go on to suffer recurrent ulceration with pain and immobility for a number of years. Treatment requires a multidisciplinary approach including hospital and district nursing, general practitioner and surgical care. Managing venous leg ulcers involves treating the cause, optimizing local wound care, and addressing patient-centred concerns.

Although many patients are unfit for or refuse operation, many have venous reflux that may be amenable to surgical correction, but there is debate about which groups benefit. Superficial venous surgical operations may be undertaken to ligate the saphenofemoral or saphenopopliteal junction, strip the long saphenous vein, avulse large tributaries or serially avulse the short saphenous vein. In addition, perforator branches may be dealt with surgically. Perforator branches have been tackled in many ways over the history of the disease. Currently a minimally invasive technique, subfascial endoscopic perforator surgery (SEPS), is the least invasive way to deal with venous perforators definitively.

This review discusses the evidence for superficial venous procedures to aid the treatment of chronic venous ulceration, to improve healing and to reduce rates of recurrence.

Healing and recurrence with compression bandaging

Traditionally venous ulceration has been treated with compression bandaging, most commonly the Charing Cross four-layer compression bandage. Research from this institution demonstrates a 74% healing rate within 12 weeks if the bandaging is applied in a controlled fashion (Blair et al, 1988). In the four-layer technique a wool bandage is applied. This is followed by the application of a crepe bandage. Next to this an elastic extensible compression bandage, in a figure of eight, is applied followed by a cohesive bandage. The layers are applied from the base of the toes to the knee, and extra padding can be used around ulcerated areas to increase pressure at these areas. Using this technique the bandaging provides a pressure of 35–40 mmHg.

The results of compression bandaging from institutions other than Charing Cross are also adequate, achieving full healing in 55–96% of patients at varied time periods from 16 weeks to 5 years (Mayberry et al, 1991; Thomson et al, 1996; Nelzen et al, 1997; Scriven et al, 1998a; Marston et al, 1999; Barwell et al, 2000; Partsch et al, 2001).

Other methods of compression also seem efficacious. Short stretch bandaging is a technique that uses a single compression bandage that is a minimally extensible bandage, usually made of cotton, with few elastic fibres, which forms a semirigid dressing. Healing rates are similar for four-layer compression bandaging and short stretch bandaging when compared in randomized controlled trials (Scriven et al, 1998b; Partsch et al, 2001). In both of these studies ulcer size seems to be the main factor that determines healing rates.

Continued compression seems beneficial for large and slow healing ulcers. In one study the healing rates increased from 40% at 12 weeks to 80% at 2 years (Thompson et al, 1996). However, once healing has occurred there is a high ulceration recurrence rate. This is reported to be between 29 and 32% at 5 years in patients who continue to wear surgical support stockings (Mayberry et al, 1991; Nelzen et al, 1997). As the years pass the number of recurrences seem to rise. In one study the recurrence rate in patients with venous ulceration treated with compression alone rose steadily from 28%

Mr C Bicknell *is Specialist Registrar, North West Thames and* **Professor NJW Cheshire** *is Professor of Vascular Surgery, Regional Vascular Unit, St Mary's Hospital, London W2 1NY*

Correspondence to: Mr C Bicknell

at 1 year to 44% at 3 years (Barwell et al, 2000). This high recurrence rate presumably reflects the fact that after the ulcer has healed, full compression bandaging is no longer necessary but the venous hypertension continues. Although patients are commonly advised to wear class II compression stockings the compliance is poor.

The presumed role of superficial venous surgery

Superficial venous reflux seems to be intimately related to the presence of ulceration. According to a meta-analysis study (Tassiopoulos et al, 2000), which included 13 studies and 1249 limbs, superficial reflux can be detected in approximately 90% of patients with ulceration secondary to venous disease. Reflux is confined to the superficial system in 45% of these patients and is combined superficial and deep venous reflux in a further 43%. Only 12% of patients therefore have deep venous reflux alone. Deep vein obstruction, usually following thrombosis, is a rare cause of ulceration.

Haemodynamic studies, in patients with combined deep and superficial venous reflux on preoperative colour duplex ultrasonography, show that operation on the long saphenous and short saphenous system and treatment of incompetent perforating veins significantly improves venous outflow from the leg. The result is improved overall haemodynamic flow measured by various parameters such as air plethysmography. The mean venous filling index decreases from 12–2.7 ml/sec after surgery. Calf pump function is also better, the mean ejection fraction increases from 43–59% and the mean residual volume fraction decreases from 56–33%. Deep venous reflux, studied using duplex, is abolished by operation in some limbs. These findings are associated with a significant decrease in symptom scores (Padberg et al, 1996).

Given that the healing rates with compression bandaging are varied, recurrence rates are high and the venous haemodynamics of the leg can be significantly improved in a large proportion of patients with ulceration, there seems to be a good case for undertaking superficial venous operative treatment of patients with leg ulceration.

The compliance of patients with compression bandaging and support stockings is also a factor that cannot be ignored. There is a significant non-compliance with surgical support stockings which confers a significant decrease in healing rates (Mayberry et al, 1991). Recurrence rates are also much higher in those who do not comply with stocking application after the ulcer has healed (Blair et al, 1988). This implies that patients treated with compression alone out of the context of a well-structured treatment trial may have worsened healing and recurrence rates.

Ulcer healing and recurrence after superficial surgery

The results of operation for venous ulceration vary according to the disease picture, most significantly according to the pattern of venous incompetence. In series of patients with superficial and perforator incompetence alone healing rates vary from 57–100% over time periods from 12 weeks to 3 years (Darke and Penfold, 1992; Scriven et al, 1998b; Bello et al, 1999; Al-Mulhim et al, 2003). The recurrence rates are quoted as 14%, 20% and 10–26% after 1, 2 and 3 years (Scriven et al, 1998b; Barwell et al, 2000). In series of patients with mixed patterns of superficial alone or superficial and deep venous reflux the healing rates vary from 44–84% (Sottiurai, 1991; Dunn et al, 1995; McDaniel et al, 2002; Adam et al, 2003), with recurrence rates of 18% at a median of 3 years (Dunn et al, 1995). Comparisons between operative and non-operative treatment of venous ulceration in patients with varying patterns of disease have been made (McDaniel et al, 2002). The recurrence rate at 1 year was 6% in the operative group compared with 34% in the non-operative group, but most patients in the operative group had superficial venous reflux only and therefore it would be unwise to compare these groups.

Superficial venous operations on limbs with mixed superficial vein and segmental deep venous reflux has been shown to produce healing in 77% of limbs at 12 months (Adam et al, 2003). This was partially attributed to resolution of deep segmental reflux in approximately 50% of limbs after operation, confirmed using duplex ultrasound. The authors suggest that there is an extended role for superficial venous operations to help healing rates of ulcers by correcting this segmental deep venous reflux.

Considering these retrospective series it seems that the healing of ulcers is not clearly improved using a operative approach. However, recurrence rates look to be improved in those receiving surgery at an early stage. This evidence should be interpreted cautiously as there is well known bias in single centre series reports, studies are difficult to compare and follow-up periods differ. One paper has compared operative management and compression for isolated superficial venous incompetence to conservative treatment alone and shown significant decreases in recurrence rates at 1, 2 and 3 years in those receiving an operation (Barwell et al, 2000). At 3 years the recurrence rate was significantly different between groups: 26% (in those receiving operation) compared to 44% (treated with compression bandaging). This study was retrospective, however, and must suffer from patient selection bias.

Randomized controlled studies on this subject are sparse. The Gloucester Vascular Group has undertaken a large randomized study on this subject, the ESCHAR trial (Barwell et al, 2004). Five hundred patients were randomized to compression therapy alone or compression and superficial venous surgical operation. This well-conducted study has shown no difference in healing rates over a 24-week period, but has shown a statistically significant benefit in recurrence rates for those with isolated superficial venous reflux that receive operation. At 1 year the recurrence rate was 23% in the compression alone group and 11% in the operative group. For those with superficial venous reflux and segmental deep system reflux the recurrence rates were again much improved in the operative group, but this was not statistically significant. This was a much smaller group and the data were analysed on an intention to treat basis (meaning that a significant number of patients in the surgery group did not receive the operation) that may explain the confusing picture.

Data from the USABLE (Ulcer Surgery as Adjuvant to compression Bandaging Evaluation) trial has been presented at the Vascular Surgical Society. This multicentre trial was established to evaluate the effect of venous operations in ulcer disease but suffered huge recruitment problems. Out of 759 patients assessed only 75 patients were randomized into the trial. This trial highlights the fact that many patients presenting with venous ulceration are not suitable for operation.

The lack of improvement in ulcer healing rates with the addition of surgery presumably reflects the fact that ulceration requires optimum conditions for healing, with reduction of oedema and abolition of venous hypertension and stasis which is achieved effectively by correct lower limb compression techniques. Recurrence occurs after operation to correct the underlying defect less commonly in patients with superficial venous reflux alone. It is assumed that this finding occurs because the primary cause has been effectively abolished. Where there is deep venous reflux in conjunction with superficial reflux, a major cause of venous hypertension and stasis remains and hence no difference is seen between operative and non-operative groups in terms of recurrence.

Subfascial perforator surgery and subfascial endoscopic perforator surgery

Around 1940–50 operation for incompetent perforating veins was popularized by Linton and Dodd. Subfascial vein ligation involved long incisions through damaged skin, often causing wound infection, delayed healing and skin necrosis. SEPS is a relatively new technique that involves examination of the subfascial plane of the leg using an endoscope, direct identification of perforating branches in the calf and ligation. It is effective in identification and ablation of medial calf perforating branches (Pierik et al, 1997). It is commonly used in the treatment of medial ulcers that are primarily the result of perforator incompetence (Whiteley et al, 1998), allowing direct ligation of perforating branches in a minimally invasive fashion. Reports of early healing rates (58–89% at 6–9 weeks) and recurrence (11% at 1 year) show this technique to be safe and feasible (Baron et al, 2001; Lee et al, 2001). Long-term results are perhaps even more encouraging. When combined with long saphenous or short saphenous vein surgery this technique has been shown to produce healing rates of up to 91% within 2 years and a low recurrence rate of 0–8% at up to 4 years (Pierik et al, 1997; Bianchi et al, 2003) and 13% at 5 years (Iafrati et al, 2002).

The North American Subfascial Endoscopic Perforator Surgery registry (NASEPS) has provided further information into the results of this procedure, with healing rates of 88% at 1 year and a 16% recurrence rate at 1 year and 28% at 2 years (Gloviczki et al, 1999). Approximately two thirds of these patients with a varied pattern of reflux had superficial venous operations. A review of the literature in 2000 combined the results of 428 patients with active ulcers who underwent SEPS. Seventy-nine per cent of the active ulcers healed on average in 2.3 months, with a range of 21 days to 5.4 months, recurrent ulcers were identified in 2.8%. However, the authors admit that many of the studies included have short follow-up periods and this may bias the calculated rate of recurrence in this review (Olivencia, 2000).

In all of these studies the patterns of reflux are varied, as is the number of patients receiving superficial venous procedures. Consequently studies are difficult to compare with each other and conventional operation. This technique boasts excellent healing and recurrence rates for the treatment of ulceration when these retrospective patient series are studied; however, there is no level 1 evidence to compare an additional advantage of SEPS and superficial operation to superficial procedures alone. When SEPS has been compared to an open approach to perforator ligation (Linton procedure), the long-term recurrence rates appear to be similar but the wound infection rate is far higher and hospital stay longer after open procedures (Pierik et al, 1997; Sybrandy et al, 2001).

Although some report good results using this procedure for the treatment of ulceration, others are more sceptical. Once reflux in the superficial venous system is treated, there is often a reversal of perforator incompetence in up to 74% of cases (Al-Mulhim et al, 2003), which casts doubt on whether perforator procedures are needed. In addition, studies examining healing and recurrence rates for patients with venous ulceration and isolated superficial venous incompetence who underwent superficial venous operations alone have adequate success without the need for perforator surgery (Bello et al, 1999). In contrast, one randomized study has compared patients who underwent high saphenous ligation, vein stripping and SEPS and patients who underwent ligation and stripping alone (Kianifard et al, 2003). In both groups incompetent perforator veins were seen infrequently after surgery. However, after 6 months incompetent perforator veins were seen significantly more often than those that underwent SEPS in addition to conventional operations. The case for and against SEPS in treatment of venous ulceration needs further evaluation.

Conclusions

Superficial venous reflux is a common haemodynamic picture in patients with venous ulceration. Treatment of this abnormality appears to improve significantly the venous haemodynamics of the limb. Given this one would expect superficial venous procedures to alter significantly the healing and recurrence rates of chronic venous ulceration. Study of the available literature suggests that ulcer healing rates are unchanged, but there may be a benefit in

the prevention of recurrence in those with superficial venous reflux without deep system incompetence. The effect of venous operation in those with superficial and deep venous reflux is still under debate. On the face of it SEPS appears to be an innovative advance in the treatment of incompetent perforators of the lower limb, however, doubts have been raised as to whether this procedure is necessary if combined with treatment of the long or short saphenous veins. Studies need to be performed to assess the effectiveness of SEPS in relation to conservative treatment and standard operative techniques.

Over the last few years, endovenous procedures for abolition of the superficial veins in the lower limb have been developed such as foam sclerotherapy and laser treatment. The evidence of their role in treating ulcers of the leg and preventing recurrence of ulcers is sparse. If these methods are as effective as conventional operations in treating varicose veins their role in treatment of ulceration may be important, as they may be performed under local anaesthetic. Elderly patients with significant comorbidity may benefit greatly from these techniques. BJHM

Conflict of interest: none.

Adam DJ, Bello M, Hartshorne T, London NJ (2003) Role of superficial venous surgery in patients with combined superficial and segmental deep venous reflux. *Eur J Vasc Endovasc Surg* **25**(5): 469–72

Al-Mulhim AS, El-Hoseiny H, Al-Mulhim FM et al (2003) Surgical correction of main stem reflux in the superficial venous system: does it improve the blood flow of incompetent perforating veins? *World J Surg* **27**(7): 793–6

Baron HC, Saber AA, Wayne M (2001) Endoscopic subfascial surgery for incompetent perforator veins in patients with active venous ulceration. *Surg Endosc* **15**(1): 38–40

Barwell JR, Taylor M, Deacon J et al (2000) Surgical correction of isolated superficial venous reflux reduces long-term recurrence rate in chronic venous leg ulcers. *Eur J Vasc Endovasc Surg* **20**(4): 363–8

Barwell JR, Davies CE, Deacon J et al (2004) Comparison of surgery and compression with compression alone in chronic venous ulceration (ESCHAR study): randomised controlled trial. *Lancet* **363**(9424): 1854–9

Bello M, Scriven M, Hartshorne T, Bell PR, Naylor AR, London NJ (1999) Role of superficial venous surgery in the treatment of venous ulceration. *Br J Surg* **86**(6): 755–9

Bianchi C, Ballard JL, Abou-Zamzam AM, Teruya TH (2003) Subfascial endoscopic perforator vein surgery combined with saphenous vein ablation: results and critical analysis. *J Vasc Surg* **38**(1): 67–71

Blair SD, Wright DD, Backhouse CM, Riddle E, McCollum CN (1988) Sustained compression and healing of chronic venous ulcers. *BMJ* **297**(6657): 1159–61

Cornwall JV, Dore CJ, Lewis JD (1986) Leg ulcers: epidemiology and aetiology. *Br J Surg* **73**(9): 693–6

Darke SG, Penfold C (1992) Venous ulceration and saphenous ligation. *Eur J Vasc Surg* **6**(1): 4–9

Dunn JM, Cosford EJ, Kernick VF, Campbell WB (1995) Surgical treatment for venous ulcers: is it worthwhile? *Ann R Coll Surg Engl* **77**(6): 421–4

Gloviczki P, Bergan JJ, Rhodes JM, Canton LG, Harmsen S, Ilstrup DM (1999) Mid-term results of endoscopic perforator vein interruption for chronic venous insufficiency: lessons learned from the North American subfascial endoscopic perforator surgery registry. The North American Study Group. *J Vasc Surg* **29**(3): 489–502

Iafrati MD, Pare GJ, O'Donnell TF, Estes J (2002) Is the nihilistic approach to surgical reduction of superficial and perforator vein incompetence for venous ulcer justified? *J Vasc Surg* **36**(6): 1167–74

Kianifard BAC, Holdstock J, Whiteley MS (2003) Perforator veins do not remain closed following long saphenous vein stripping - preliminary results of a prospective randomised clinical trial. *Br J Surg* **90**(4): 491–509

Lee DW, Chan AC, Lam YH et al (2001) Early clinical outcomes after subfascial endoscopic perforator surgery (SEPS) and saphenous vein surgery in chronic venous insufficiency. *Surg Endosc* **15**(7): 737–40

Marston WA, Carlin RE, Passman MA, Farber MA, Keagy BA (1999) Healing rates and cost efficacy of outpatient compression treatment for leg ulcers associated with venous insufficiency. *J Vasc Surg* **30**(3): 491–8

Mayberry JC, Moneta GL, Taylor LM Jr, Porter JM (1991) Fifteen-year results of ambulatory compression therapy for chronic venous ulcers. *Surgery* **109**(5): 575–81

McDaniel HB, Marston WA, Farber MA et al (2002) Recurrence of chronic venous ulcers on the basis of clinical, etiologic, anatomic, and pathophysiologic criteria and air plethysmography. *J Vasc Surg* **35**(4): 723–8

Nelzen O, Bergqvist D, Lindhagen A (1997) Long-term prognosis for patients with chronic leg ulcers: a prospective cohort study. *Eur J Vasc Endovasc Surg* **13**(5): 500–8

Olivencia JA (2000) Subfascial endoscopic ligation of perforator veins (SEPS) in the treatment of venous ulcers. *Int Surg* **85**(3): 266–9

Padberg FT Jr, Pappas PJ, Araki CT, Back TL, Hobson RW 2nd (1996) Hemodynamic and clinical improvement after superficial vein ablation in primary combined venous insufficiency with ulceration. *J Vasc Surg* **24**(5): 711–18

Partsch H, Damstra RJ, Tazelaar DJ et al (2001) Multicentre, randomised controlled trial of four-layer bandaging versus short-stretch bandaging in the treatment of venous leg ulcers. *Vasa* **30**(2): 108–13

Pierik EG, van Urk H, Hop WC, Wittens CH (1997) Endoscopic versus open subfascial division of incompetent perforating veins in the treatment of venous leg ulceration: a randomized trial. *J Vasc Surg* **26**(6): 1049–54

Scriven JM, Hartshorne T, Thrush AJ, Bell PR, Naylor AR, London NJ (1998a) Role of saphenous vein surgery in the treatment of venous ulceration. *Br J Surg* **85**(6): 781–4

Scriven JM, Taylor LE, Wood AJ, Bell PR, Naylor AR, London NJ (1998b) A prospective randomised trial of four-layer versus short stretch compression bandages for the treatment of venous leg ulcers. *Ann R Coll Surg Engl* **80**(3): 215–20

Sottiurai VS (1991) Surgical correction of recurrent venous ulcer. *J Cardiovasc Surg (Torino)* **32**(1): 104–9

Sybrandy JE, van Gent WB, Pierik EG, Wittens CH (2001) Endoscopic versus open subfascial division of incompetent perforating veins in the treatment of venous leg ulceration: long-term follow-up. *J Vasc Surg* **33**(5): 1028–32

Tassiopoulos AK, Golts E, Oh DS, Labropoulos N (2000) Current concepts in chronic venous ulceration. *Eur J Vasc Endovasc Surg* **20**(3): 227–32

Thomson B, Hooper P, Powell R, Warin AP (1996) Four-layer bandaging and healing rates of venous leg ulcers. *J Wound Care* **5**(5): 213–16

Whiteley MS, Smith JJ, Galland RB (1998) Subfascial endoscopic perforator vein surgery (SEPS): current practice among British surgeons. *Ann R Coll Surg Engl* **80**(2): 104–7

KEY POINTS

- Venous operations for the treatment of ulceration are a contentious issue.
- Evidence suggests there is no advantage in operative treatment over compression bandaging for healing ulceration.
- There may be a benefit in treating superficial venous reflux with operation to reduce ulcer recurrence rates.
- There is no evidence to suggest operation is of benefit in treating ulcers secondary to deep venous reflux disease.
- Subfascial endoscopic perforator surgery may be a useful adjunct to standard operative treatment but the jury is still out.