



## Endoscopic Treatment of Chronic Venous Insufficiency by Interrupting Below Knee Perforating Veins: A Prospective Study

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### INTRODUCTION

Chronic venous insufficiency (CVI) is a long-term disabling problem. The prevalence of venous ulceration due to chronic venous insufficiency has been estimated to be approximately 0.1 to 0.3%.<sup>1</sup> In addition for each patient with frank ulceration, there are up to 30 patients with lipodermatosclerosis.<sup>2</sup> Perforating veins which connect deep and superficial venous systems are thought to play an important role in the pathogenesis of these ulcers. The management of ulceration associated with chronic venous insufficiency remains difficult and associated with high failure rates. Cutaneous venous hypertension which occurs as a consequence of primary valvular incompetence is up to 60% of patients<sup>3</sup>. Although superficial stripping, deep venous valve repair and valve transfer all have their advocates, the mainstay of therapy has remained mechanical compression. External elastic stockings, worn by compliant patients, contributes to ulcer healing in 85% of cases.<sup>4,5</sup> However compliance is difficult to obtain in the elderly and infirm, due to difficulty in applying the stockings as well as poor compliance in hot climates. Most importantly, ulcer recurrence remains an unsolved problem. Even in the best series using non-operative

management, ulcer recurrence at a mean follow-up of 30 months was 33% and all ulcers recurred in non-compliant patients.<sup>5</sup>

Division of incompetent perforating veins of the calf to treat patients with venous ulcers was first recommended by Robert Linton in 1938.<sup>6</sup> His procedure included a long skin incision made on the medial aspect of the leg to access perforating veins that connect the superficial with the deep venous system. The original Linton operation due to wound complications, associated with the long skin incision made in compromised skin, were frequent and hospitalization was prolonged.<sup>7</sup>

Therefore Modified Linton's techniques were developed in subsequent years. These included the use of short longitudinal or transverse skin incisions to lessen the risk of wound complications by ligating perforators above or under the fascia.<sup>4-11</sup> While wound complications were fewer, these operations lacked adequate visual control and undoubtedly missed important incompetent perforating veins.

So Endoscopic techniques have clear advantages because they improve visual control of perforator interruption, decrease wound complications and shorten hospital stay. Therefore, there is clearly a

role for a procedure which can promote ulcer healing and minimize recurrence.

Subfascial endoscopic perforator surgery (SEPS) may represent such a procedure, which was first introduced in Europe in the mid-1980s by Hauer<sup>6</sup> and Fischer.<sup>7</sup>

### **Patients and Methods**

The present study was conducted on 50 patients admitted in one year for treatment of chronic venous insufficiency at King George's Medical University, Lucknow, India. Patient having healed or active ulcer was included in this study. Patients having deep venous thrombosis, secondary varicose vein, previous leg surgery were excluded. 40 patients had active venous ulceration (average size was 4.7x3.5 cm) and 10 had healed ulceration on medial aspect of the lower leg due to chronic venous insufficiency. All patients underwent examination of their venous status by physical examination and duplex ultrasound scan before surgery, at 6 weeks and 6 months after surgery.

SEPS was performed in patients having incompetent below knee perforators by conventional laparoscopic instruments. Concomitant incompetency of saphenofemoral junction (SFJ) was treated by flush ligation and limited stripping of the Great saphenous vein (GSV) from groin to just below knee.

A third generation intravenous antibiotic was administered in all patients at the time of the operation. Demography of patients are described in table no 1. All patients were followed for one year.

### **Preoperative evaluation**

Preoperative evaluation is performed by duplex scanning of the superficial, deep and perforator venous systems to diagnose both valvular incompetence and obstruction. Colour doppler ultrasonography guided perforator sites were marked by skin marker.

### **Operative Techniques for SEPS**

#### **Position**

Patient was placed in Trendelenberg's position. Knee of that site (diseased side) was flexed and slightly elevated by placement of a pillow. Surgeon stands on same side of leg. Camera man stands opposite side. SEPS was done by conventional laparoscopic instruments through two ports.

#### **First Port**

A transverse incision was carried four to six cm posteromedial to tibial tuberosity through the subcutaneous tissue. The deep fascia was incised and calf muscle visualized. Subfascial space was created by blunt gauze dissection or by balloon inflation (Finger gloves were tied on tip of endoscopic suction cannula and inflated in subfascial space by normal saline) The laparoscopic port (10 mm or 5mm) was then inserted beneath the fascia and carbon dioxide was insufflated (15-18 mm Hg). Usually this port was used for working channel.

#### **Second Port**

A second transverse incision was made 6 cm posteroinferior from the first one, and the second 10 mm laparoscopic port was inserted under visual control or guided by first port. This port was used for zero degree telescope.

#### **Subfascial Dissection and perforators interruption**

Under videoscopic control, all connective tissue bridging between muscles and fascia was dissected with Maryland forceps and endoscopic scissors. Perforating veins bridging in the Subfascial space visualised easily, isolated and coagulated by ultrasonic scalpel / bipolar diathermy or clipped and divided. Complete visualization of all perforating veins down upto the medial malleolus, posteriorly to the midline of leg & anteriorly to the tibial edge was performed. Finally the instruments and all ports were removed.

The wound was sutured with 2/0 absorbable sutures for the subcutaneous tissues and 3/0 non absorbable sutures for the skin.

After completing SEPS if patient has incompetent SFJ ,Flush ligation and stripping of GSV at level of first port was done concurrently .First port incision site was used for stripping of GSV. In 44 patients stripping of GSV was done after completing SEPS. In 06 patient only SEPS was done. Elastic crepe bandage was applied from foot to thigh in all patients.

### Post operative Management

Once the effect of anesthetic wear off , the patients were encouraged to ambulate and are discharged few days after surgery. In Post operative instruction, stress on the need for active ambulation, elevation of operated limb and maintenance of elastic bandage advised. Enoxaprin sodium (40mg/0.4ml) was administered subcutaneously in all for 3 days. Patients were seen for removal of skin sutures in the outpatients department.

### RESULTS

SEPS Was performed in 50 patients. In a follow-up period of 12 months, the venous ulceration of all patients healed in five months. The recurrence rate (after one year) was 02% (2 patients) .10% (05 patients) developed wound infection managed conservatively. None of patients developed DVT or CO2 embolisation. In 2 patients (4 %) having lipodermatosclerosis perforators at malleolus needed separate short incision, as was difficult to create subfascial space. Average duration for SEPS was 45 minutes. Average number of perforators interrupted was 4 per leg. 02 % patients developed neuralgia on medial aspect of leg and on dorsum of foot,all improved after 6 weeks. In one patient clip came out after one month through port site sinus. Hypertrophic scar was found in one patient at trocar site. No death or serious complication occurred in any patient.

### DISCUSSION

Linton proposed that those patients with perforator incompetence could be treated by directly dividing the offending perforators<sup>9</sup>. Unfortunately, in order to achieve this goal, a long incision through the medial skin from knee to the medial malleolus was necessary. Perforators could then be identified below the fascia and divided. On average, 85% of patients enjoyed ulcer-free recurrence in the long term. However, wound-related complications such as infection, flap necrosis, and delayed healing occurred in 17% of patients and caused the procedure to fall into disfavor<sup>9-11</sup>. Although several modifications of the Linton procedure have been developed to minimize wound morbidity such as the posterior stocking seam incision<sup>13</sup> and parallel oblique incisions<sup>14</sup> it was not until the development of minimally invasive procedures, which permitted small remote incisions to be created, that the procedure began to be re-evaluated

Hauer<sup>6</sup> in Germany used a mechanical system for endoscopic subfascial surgery and, to date, has the greatest experience. O'Donnell, in the United States, employed saline infusion (due to concerns of CO<sub>2</sub> embolization) in the subfascial space to create an adequate optical space. More recently, Gloviczki, in the United States, employed CO<sub>2</sub> insufflation.<sup>15</sup> Renewed enthusiasm was heralded due to the increasing technical ease, associated with CO<sub>2</sub> insufflation<sup>16</sup>

The Society for Vascular Surgery (SVS) and the American Venous Forum (AVF) have developed clinical practice guidelines for the care of patients with varicose veins of the lower limbs and pelvis. He recommend against selective treatment of perforating vein incompetence in patients with simple varicose veins (CEAP class C(2); GRADE 1B), but we suggest treatment of pathologic perforating veins (outward flow duration  $\geq$ 500 ms, vein diameter  $\geq$ 3.5 mm) located underneath healed or active ulcers (CEAP class C(5)-C(6); GRADE 2B)<sup>17</sup>.

However, SEPS has not been widely adopted because of the technical difficulty and

burdensome apparatus involved in its performance. In Japan, the two-port system utilizing screw-type ports (EndoTIP®, Karl Storz, Tuttlingen, Germany) was introduced by Haruta in the beginning of the 21st century, which made the performance of SEPS simpler and easier.<sup>18-19</sup>

Results of the Mayo Clinic experience, which included 57 consecutive SEPS procedures, were reported.<sup>8-14</sup> Some 22 patients had active and 20 had healed ulcerations. A total of 20 limbs had post-thrombotic syndrome and 37 had primary valvular incompetence without any evidence of previous deep vein thrombosis. Concomitant ablation of saphenous reflux was performed in 41 limbs. The number of perforating veins divided averaged  $4.9 \pm 0.2$  (range: 1–11) per limb. Minor wound complications occurred in 5% and one patient with known inferior vena cava occlusion had recurrent deep venous thrombosis within 30 days.

Clinical scores were calculated based on the recommendations of the Committee of Reporting Standards of the Joint Vascular Societies,<sup>20</sup> and significant improvement was found with scores decreasing from  $6.42 \pm 0.41$  preoperatively to  $2.70 \pm 0.32$  after surgery ( $p = 0.0001$ ). Calculating outcome with the scoring system of Porter et al,<sup>17</sup> clinical outcome averaged  $2.11 \pm 0.12$  (range -1 to 3; the scale is from -3 to 3). Within a median of 36 days after surgery all the ulcers present at operation on 22 limbs healed (mean:  $99 \pm 37$  days, range: 11–670 days). However, eight limbs had poor ulcer healing (40 days) and one ulcer healed only by 670 days after surgery. No ulcers recurred in patients with primary valvular incompetence, and all five ulcer recurrences occurred in patients with post-thrombotic syndrome. Therefore, post-thrombotic limbs had a 42% ulcer recurrence rate compared with 0% (0/30) in limbs with primary valvular incompetence ( $p = 0.001$ ).

In a Meta analysis of 3 study (two RCT and one retrospective comparative study) by Luebke T, Brunkwall J between SEPS and Linton groups, there was a significant lower rate of wound

infections for SEPS (odds ratio [OR] 0.06 [95% confidence interval (CI) 0.02 to 0.25]) and a significantly reduced hospital stay for SEPS (OR - 8.96 [95% CI -11.62 to -6.30]). In addition, SEPS was associated with a significant reduced rate of recurrent ulcers (mean follow-up 21 months) (OR 0.15 [95% CI 0.04-0.62]). There was no significant difference between the groups in the following dimensions: rate of hospital re-admission (OR 0.21 [95% CI 0.03-1.31]), death at six months (OR 3.00 [95% CI 0.11-78.27]), ulcer healing rate at four months (OR 0.44 [95% CI 0.09-2.12]), and the rate of deep vein thrombosis (DVT) (OR 0.35 [95% CI 0.01-8.85])<sup>21</sup>. Most venous ulcers treated with SEPS with ablation of superficial venous reflux heal rapidly and remain healed during medium-term follow-up<sup>22</sup>.

In other meta analysis by Tenbrook JA Jr et al of 20 studies, 1 randomized trial and 19 case series, involving 1140 treated limbs. CEAP classification was secondary cause (E(S)) in 36%, deep venous involvement (A(D)) in 56%, and obstructive (P(O)) in 12%. Overall, after surgical treatment including SEPS, with or without concomitant superficial venous ablation, ulcers in 88% of limbs healed. Ulcers recurred in 13%, at mean time of 21 months<sup>23</sup>. Risk factors for nonhealing and recurrence included postoperative incompetent perforator veins, pathophysiologic obstruction, secondary cause, and ulcer diameter greater than 2 cm. Complications and their overall rates after surgical treatment including SEPS were wound infection (6%), hematoma (9%), neuralgia (7%), and deep venous thrombosis (1%).<sup>24-25</sup> In one RCT, SEPS is found as an adjunct to standard varicose vein surgery reduces the number of incompetent perforating veins at 1 year but has no effect on quality of life or varicose vein recurrence at 1 year<sup>26</sup>. In long term follow up, three and five year recurrence rates were 8% and 18% respectively among survivors. In a multivariate Cox regression analysis previous vein surgery was the only factor significantly associated with recurrent ulceration ( $p = .004$ )<sup>26</sup>. SEPS combined with superficial venous surgery

leads to healing with a low recurrence rate in patients with open and healed venous ulcers<sup>24-28</sup>

**Table 1-Demography of 50 Patients**

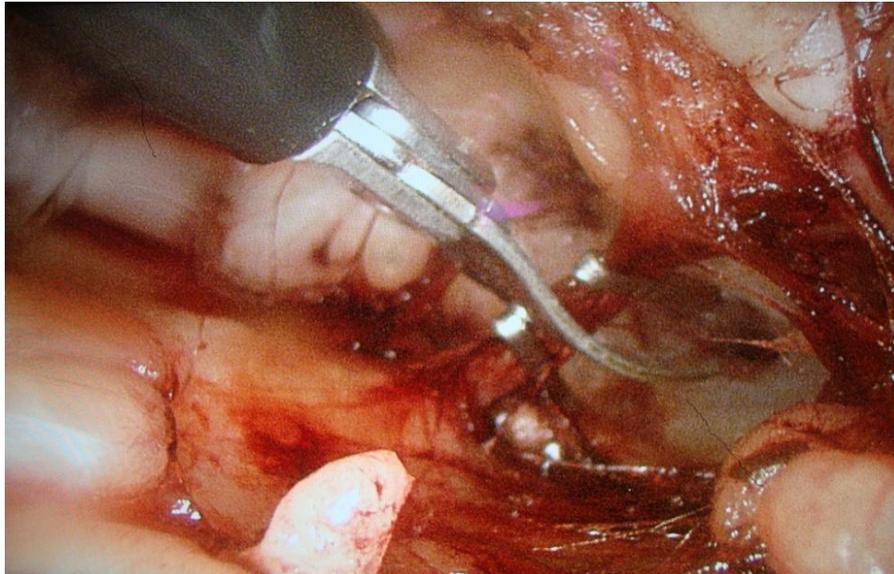
Average age of patients	48± 4 year
No of Female patients	28
No of Male patients	22
No of patients having incompetent perforators below knee	50
No of patients having SFJ incompetency with incompetent perforators below knee	44
No of patients having SFJ competent and below knee competent perforators .	06
No of patients having healed ulcer(C5)	10
No of patients having open ulcer(C6)	40

**Table 2 Results of SEPS (n=50)**

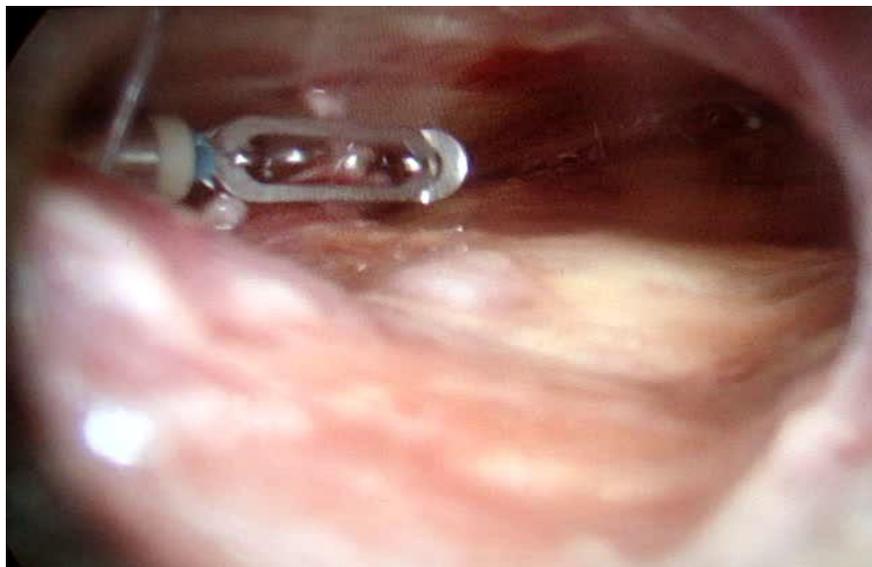
1	Duration of ulcer healing	5 months
2	Infected seroma (calf abscess)	2%
3	Port sites infection	10%
4	Recurrence (after one year)	01%
5	Neuralgia (temporary)	2%
6	Hypertrophic scar	2%
7	DVT	Nil
8	Gas embolism	Nil
9	Rejection of clip(after one month) through port site sinus	2 %



**Figure 1: Both ports**



**Figure 2:** Clipping and cutting perforating vein



**Figure 3:** interruption of perforator by bipolar cautery



**Figure 4 :** Endoscopic view of perforator

**CONCLUSION**

SEPS is feasible, safe effective and superior to conventional open ligation of perforating veins. It has been found that SEPS is a promising technique for treatment of incompetent perforators. Favorable ulcer healing rate and improvement in clinical symptoms suggests that SEPS plays a considerable role in correcting the underlying pathology in chronic venous insufficiency caused by below knee perforating veins.

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