Original Research

MINIMALLY INVASIVE VERSUS OPEN SUBFASCIAL PERFORATOR LIGATION IN GREAT SAPHENOUS VEIN VARICOSE DISEASE: A CLINICAL OUTCOME ANALYSIS OF SEPS AND OSPL

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ABSTRACT

Background: Chronic venous insufficiency (CVI), which mostly affects the lower extremities, causes varicose veins. Venous flow, symptoms, and prevention of venous ulcers and deep vein thrombosis are the goals of varicose vein treatment. CVI management requires interventions targeting incompetent veins, especially perforator veins that connect superficial and deep venous networks.[1] Subfascial endoscopic perforator surgery (SEPS) is a less invasive alternative to open subfascial perforator ligation (OSPL), which involves larger incisions, wound problems, and a longer recovery time.[2] SEPS and OSPL are compared in patients with GSV varicose veins with perforator incompetence to demonstrate their benefits and promote evidence-based surgical technique selection.
Material and Methods: Institutionally-based interventional two-arm trial compares SEPS and OSPL in the management of great saphenous vein varicosities, conducted in the Department of General Surgery, SVRRGGH, S.V. Medical College, Tirupati, over one year following scientific and ethics committee approval, with a sample size of 60. The study includes patients aged 18–65 years undergoing surgery for varicose veins with involvement of the great saphenous vein, and excludes pregnant or lactating women, morbidly obese patients, those with poorly controlled comorbidities, prior surgery for varicosities on the same leg, and patients deemed unfit for anaesthesia.
Results: Sixty patients were randomized equally to SEPS (n=30) and OSPL (n=30) groups. Baseline characteristics, including age, gender, physical activity, BMI, smoking, alcohol use, CEAP class, and Doppler findings, were comparable between groups (all $p > 0.05$). Mean operative time was significantly longer in the SEPS group than in the OSPL (82.4 ± 15.2 vs 60.1 ± 12.8 minutes, $p < 0.001$), and early postoperative pain was higher in the SEPS group on day 1 and day 3 ($p = 0.032$ and $p = 0.045$, respectively), but similar by day 7.
Conclusion: SEPS and OSPL cure GSV varicosities with perforator incompetence safely and effectively, with similar clinical, complication, and long-term outcomes. SEPS features smaller incisions, less tissue dissection, and better cosmetic results but takes longer and causes greater early postoperative pain. Patients who value aesthetics and minimally invasive surgery may consider it. With its reduced surgical time and easier methodology, OSPL is a viable alternative when finances or endoscopic experience are restricted. Choose between the two operations based on patient preference, clinical profile, and surgeon expertise.

Keywords: Subfascial Endoscopic Perforator Surgery, Open Subfascial Perforator Ligation, Chronic Venous Insufficiency, Great Saphenous Vein Varicose Disease.

INTRODUCTION

Chronic venous insufficiency (CVI) is a prevalent disorder that leads to the development of varicose veins, primarily in the lower extremities.

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The management of varicose veins seeks to re-establish normal venous circulation, mitigate symptoms, and avert complications such as venous ulcers and deep vein thrombosis. Interventions aimed at incompetent veins, especially perforator veins linking the superficial and deep venous systems, are essential in the management of chronic venous insufficiency (CVI).[1] Open subfascial perforator ligation (OSPL) is a conventional treatment linked to extensive incisions, wound complications, and extended recovery times, thereby

stimulating interest in minimally invasive alternatives like subfascial endoscopic perforator surgery (SEPS), which presents a promising solution.[2,3] This is a minimally invasive procedure that use endoscopic visualisation to ligate incompetent perforator veins via small incisions, hence minimising the necessity for extensive surgical wounds. The surgeon can reach the perforator veins with greater precision using an endoscope, thereby reducing tissue stress and enhancing recovery times. SEPS is linked to a reduction in postoperative sequelae, including wound infections and haematomas, as well as a decreased recovery duration in comparison to OSPL. This technique has demonstrated a reduction in postoperative pain and improved aesthetic outcomes, resulting in more patient satisfaction.[3-6] Rosen M et al. have yielded inconsistent findings in their evaluation of the efficacy of SEPS and OSPL.[7] Mills JL et al. assert that SEPS yields superior short-term outcomes, including accelerated healing of venous ulcers and improved quality of life.[8] Nonetheless, alternative studies indicate that OSPL remains a viable option in certain situations, particularly in cases of extensive venous disease or when endoscopic instruments are unavailable. Numerous studies indicate that SEPS reduces the risk of complications; yet, the long-term recurrence rates of varicose veins are comparable for both techniques.[7-10]

Despite the advantages of SEPS, there is ongoing debate over its superiority compared to OSPL in terms of long-term clinical outcomes, such as recurrence rates and the durability of symptom relief. This study evaluates the clinical results of SEPS and OSPL in patients with GSV varicose veins and perforator incompetence to identify their respective benefits and substantiate evidence-based procedural selection in standard surgical practice. Aim: To assess the feasibility and safety of subfascial endoscopic perforator surgery (SEPS) in the management of great saphenous vein (GSV) varicosities and to compare its clinical and functional outcomes with those of open subfascial perforator ligation (OSPL). Objectives: 1. To compare the operating time and number of perforator veins ligated in patients undergoing subfascial endoscopic perforator surgery (SEPS) and open subfascial perforator ligation (OSPL). 2. To evaluate early postoperative outcomes, including pain intensity, duration of hospital stays in SEPS and OSPL. 3. To assess overall treatment effectiveness SEPS versus OSPL, based on post operative complications and post operative recovery to resume normal activities.

MATERIALS AND METHODS

Study Design and Setting- This was an institution-based, interventional, two-arm comparative trial conducted in the Department of General Surgery at Sri Venkateswara Ramnarain Ruia Government General Hospital (SVRRGGH), S.V. Medical College, Tirupati, Andhra Pradesh, India. The study was carried out over a period of one year after obtaining approval from the Institutional Scientific Committee and the Institutional Ethics Committee.

Study Population- The study population comprised patients admitted for surgical management of lower-limb varicose veins in the Department of General Surgery at SVRRGGH during the study period. Eligible patients were those with clinically and Doppler-confirmed great saphenous vein (GSV) varicosities associated with incompetent perforator veins.

Inclusion Criteria were- Age 18–65 years. Presence of varicosities involving the GSV with documented perforator incompetence on venous Doppler.

Exclusion Criteria were- Pregnant or lactating women. Morbid obesity. Poorly controlled medical comorbidities (e.g., uncontrolled diabetes, hypertension, or significant cardiovascular disease). Previous surgery for varicose veins on the same limb. Patients are deemed unfit for anaesthesia based on pre-anaesthetic evaluation.

Sample Size- The sample size was calculated using the formula. $N = 2(Z_{\alpha/2} + Z_{\beta})^2 P(100 - P)/(P_1 - P_2)^2$, where $Z_{\alpha/2} = 1.96$ (5% level of significance), $Z_{\beta} = 0.84$ (80% power), $P_1 = 16\%$[1] (proportion of participants requiring OSPL from a previous study), and $P_2 = 1\%$. The pooled prevalence P was taken as $(P_1 + P_2)/2 = 8.5\%$, yielding a required total sample size of 60 patients, with 30 patients allocated to each arm.

Allocation of Study Groups- Patients fulfilling eligibility criteria were enrolled consecutively and allocated into two groups: SEPS group: patients undergoing subfascial endoscopic perforator surgery. OSPL group: patients undergoing open subfascial perforator ligation. Both procedures were performed by experienced surgeons following standard departmental protocols.

Preoperative Evaluation- All patients underwent a thorough history and physical exam, including symptom assessment, CEAP grading, and localised limb evaluations. Complete blood count, renal and hepatic function tests, coagulation profile, blood glucose, and comorbidity assessment were performed. All patients had lower leg duplex venous Doppler to detect saphenofemoral or saphenopopliteal reflux, perforator incompetence, and deep vein thrombosis.

Surgical Procedures-

SEPS (Subfascial Endoscopic Perforator Surgery) - In the SEPS group, patients were operated under general anaesthesia in the supine position with the hip and knee flexed to expose the

medial aspect of the leg. A 10-mm port was introduced through a small incision on the medial calf, and carbon dioxide insufflation (25–30 mmHg) was used to create the subfascial working space. A 10-mm 30° endoscope was inserted, and a second working port was placed inferoposteromedially to the first. Incompetent perforator veins were identified endoscopically, clipped, and divided using endoscopic instruments. After completing perforator ligation, the ports were removed, the fascia closed where required, and skin incisions were sutured.[11-13]

OSPL (Open Subfascial Perforator Ligation) - In the OSPL group, under general anaesthesia, an incision was made over the clinically and Doppler-marked site of the incompetent perforator on the medial aspect of the leg. Dissection was carried through the subcutaneous tissue to the deep fascia, which was incised to expose the perforator vein. The perforator was isolated, ligated with 2-0 absorbable suture, and divided. The fascia was closed with absorbable sutures, and the skin with subcuticular closure. An elastic compression bandage was applied postoperatively.[11,14]

Postoperative Care and Follow-Up- Postoperative management in both groups included limb elevation, compression bandaging, and analgesia as required. Pain was assessed using the Visual Analogue Scale (VAS) on postoperative days 1, 3, and 7. Wounds were inspected for signs of infection, hematoma, or other complications at regular intervals and during follow-up visits. Patients were encouraged to mobilize early to reduce venous stasis and the risk of deep vein thrombosis.

Follow-up was scheduled on day 3, day 7, and at 3 months post-surgery. At the 3-month visit, all patients underwent repeat venous Doppler to detect residual or recurrent incompetent perforators and to assess for venous reflux. Time to resume normal daily activities was recorded based on the patient's report.

Statistical Analysis- Data were entered and analysed using SPSS V.26 statistical software. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Between-group comparisons of continuous variables were performed using the Student's t-test for normally distributed data and the Mann–Whitney U test for non-parametric data. Categorical variables were compared using the chi-square test. A p-value < 0.05 was considered statistically significant, and 95% confidence intervals were calculated where appropriate.

RESULTS

The SEPS and OSPL groups had similar age-wise patient distributions. The 21–30, 31–40, 41–50, 51–60, and >60 year groups had similar SEPS and OSPL proportions, and the overall totals were mostly middle-aged. The mean ages of the SEPS and OSPL groups were similar (45.2 ± 8.3 years and 46.1 ± 7.9 years, respectively) with no significant difference (p = 0.563). The observed age ranges (21-62 vs 24-67 years) overlapped significantly. Both treatment arms had a modest male predominance. Men made up 60% of the SEPS group and 53.3% of the OSPL group (56.7%), while women made up 40% and 46.7%, respectively. No statistically significant gender difference between groups (p = 0.641), indicating that sex was well balanced and unlikely to affect surgical outcomes.

Table 1: Showing Comparison of Operative Parameters and Hospital Stay between SEPS and OSPL Groups

Parameter	SEPS Group (n = 30)	OSPL Group (n = 30)	P-Value
Operative time (minutes), mean ± SD	82.4 ± 15.2	60.1 ± 12.8	<0.001
Perforators ligated (per patient), mean ± SD	5.2 ± 1.3	4.8 ± 1.2	0.278
Duration of hospital stay (days), mean ± SD	2.5 ± 0.7	2.1 ± 0.5	0.289

The SEPS arm had a significantly longer mean operational time (82.4 ± 15.2 minutes) compared to the OSPL arm (60.1 ± 12.8 minutes) (p < 0.001). The SEPS group had an average of 5.2 ± 1.3 perforators ligated per patient, while the OSPL group had 4.8 ± 1.2, a difference that did not reach statistical significance (p = 0.278). SEPS needed longer operational time without treating more perforators.

With few statistically significant differences in early postoperative phase, SEPS and OSPL had similar clinical courses. The SEPS group had a somewhat longer mean hospital stay (2.5 ± 0.7 days) than the OSPL group (2.1 ± 0.5 days), although the difference was not significant (p = 0.289) in (Table 1)

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Table 2: Postoperative Pain Scores (VAS) in SEPS and OSPL Groups

Time point	SEPS Group (n = 30)	OSPL Group (n = 30)	P-Value
VAS Day 1	7.3 ± 1.2	6.1 ± 1.4	0.032
VAS Day 3	5.1 ± 1.0	4.2 ± 1.1	0.045

VAS Day 7	2.4 ± 0.9	2.1 ± 0.8	0.313

Postoperative pain scores were considerably greater for SEPS patients on day 1 (7.3 ± 1.2 vs 6.1 ± 1.4, p = 0.032) and day 3 (5.1 ± 1.0 vs 4.2 ± 1.1, p = 0.045), but by day 7 pain levels were comparable (2.4 ± 0.9 vs 2.1 ± 0.8, p = 0.313). Postoperative wound infection (3.3% vs 10%, p = 0.375) and haematoma (6.7% vs 13.3%, p = 0.304) were numerically reduced in the SEPS group but not statistically significant. One DVT occurrence occurred in the OSPL group (3.3%), while none occurred in SEPS (p = 0.533). Both methods had equal short-term efficacy (3.3% in SEPS vs 6.7% in OSPL, p = 0.665) for varicose vein recurrence in (Table 2).

Table 3: Immediate and Long-Term Complications in SEPS and OSPL Groups

Complication	SEPS Group (n = 30)	OSPL Group (n = 30)	P-Value
Immediate complications			
Wound infection, n (%)	1 (3.3%)	3 (10%)	0.375
Hematoma, n (%)	2 (6.7%)	4 (13.3%)	0.304
Deep vein thrombosis (DVT), n (%)	0 (0%)	1 (3.3%)	0.533
Recurrence (early), n (%)	1 (3.3%)	2 (6.7%)	0.665
Long-term complications			
Wound dehiscence, n (%)	0 (0%)	1 (3.3%)	0.533
Recurrence of varicose veins, n (%)	1 (3.3%)	2 (6.7%)	0.665
Chronic pain, n (%)	2 (6.7%)	1 (3.3%)	0.665
Hyperpigmentation at incision site, n (%)	4 (13.3%)	3 (10%)	0.739

For immediate post-operative sequelae, wound infection occurred in 1 patient (3.3%) in the SEPS group and 3 patients (10%) in the OSPL group, with no significant difference (p = 0.375). Haematoma occurred in 2 SEPS patients (6.7%) and 4 OSPL patients (13.3%) (p = 0.304). The OSPL group had 1 patient (3.3%) with deep vein thrombosis, while the SEPS group had none (p = 0.533). Varicose veins recurred early in 1 patient (3.3%) in the SEPS group and 2 patients (6.7%) in the OSPL group, without a significant difference (p = 0.665). Long-term consequences included wound dehiscence in one OSPL patient (3.3%) and none in SEPS patients (p = 0.533). Varicose vein recurrence at follow-up was modest in both groups, with only 1 patient (3.3%) in the SEPS group and 2 patients (6.7%) in the OSPL group (p = 0.665). Two SEPS patients (6.7%) and one OSPL patient (3.3%) had chronic discomfort (p = 0.665). 4 patients (13.3%) in the SEPS group and 3 patients (10%) in the OSPL group showed hyperpigmentation at the incision site (p = 0.739), showing no significant increase in long-term adverse effects.

Table 4: Time to Resume Normal Activities in SEPS and OSPL Groups

Duration To Resume Normal Activities	SEPS Group (n = 30)	OSPL Group (n = 30)	P-Value
<10 days	2 (6.6%)	4 (13.3%)	0.061
10–15 days	10 (33.3%)	15 (50%)	0.081
15–20 days	15 (50%)	10 (33.3%)	0.118
>20 days	3 (10%)	1 (3.3%)	0.080

Return to normal activities followed a similar pattern in both groups, with no statistically significant difference in overall recovery time. A small proportion of patients in each arm resumed normal activities within 10 days (6.6% SEPS vs 13.3% OSPL), while most recovered between 10 and 20 days: 33.3% vs 50% within 10–15 days and 50% vs 33.3% within 15–20 days for SEPS and OSPL, respectively. Only a few patients required more than 20 days (10% SEPS vs 3.3% OSPL), and the mean time to resume normal activities (16.4 ± 2.1 days for SEPS vs 14.5 ± 3.3 days for OSPL; p = 0.157) did not differ significantly, indicating broadly comparable functional recovery between the two techniques.

DISCUSSION

This study aimed to compare the clinical and functional outcomes of subfascial endoscopic perforator surgery (SEPS) and open subfascial perforator ligation (OSPL) in the management of great saphenous vein (GSV) varicosities with perforator incompetence.

The present study observed that the mean age of participants in the SEPS group was 45.2 ± 8.3 years, and in the OSPL group, it was 46.1 ± 7.9 years.

These age distributions are consistent with findings from several studies. For example, Berteloot et al.[15] reported a mean age of 44.5 ± 7.8 years in patients undergoing either SEPS or OSPL, emphasizing that GSV varicosities primarily affect middle-aged individuals, with the highest prevalence between 40 and 60 years. Similarly, Frankel et al.[16] also found that the mean age of patients undergoing venous surgery was 45 years, aligning with our sample. This consistency highlights that the findings in our study are in line with the established demographic profile of varicose vein patients. In terms of gender distribution, the SEPS group had 18 male participants (60%) and 12 females (40%), while the OSPL group had 16 males (53.3%) and 14 females (46.7%). The male preponderance, observed in both groups, mirrors that reported by Eklöf et al.,[17] who noted that 58% of their study population with varicose veins was male. However, other studies such as Harrison et al.[18] found a higher proportion of female patients in varicose vein surgeries due to pregnancy-related venous insufficiency. The gender distribution in our study was not significantly different between groups ($p = 0.641$), suggesting that both groups were comparable in terms of gender.

One of the most notable findings from our study was the difference in operative time between the two groups. The mean operative time for SEPS (82.4 ± 15.2 minutes) was significantly longer than for OSPL (60.1 ± 12.8 minutes) ($p < 0.001$). This finding aligns with Frullini et al.,[19] who reported an average operative time of 80 minutes for SEPS and 55 minutes for OSPL. The longer operative time in SEPS is often attributed to the need for endoscopic visualization and CO_2 insufflation, which, while more time-consuming, results in smaller incisions and less tissue dissection Berteloot et al.,[15] The number of perforators ligated was not significantly different between the two groups (5.2 ± 1.3 vs 4.8 ± 1.2), which aligns with the study by Wang et al.,[20] who found similar perforator ligation rates for SEPS and OSPL. This suggests that both techniques are equally effective in managing perforator incompetence, with the difference in operative time being primarily due to the technical demands of SEPS rather than a difference in the extent of surgery.

Regarding post-operative pain, SEPS patients reported higher pain scores on Day 1 (7.3 ± 1.2) and Day 3 (5.1 ± 1.0) when compared to OSPL patients (6.1 ± 1.4 and 4.2 ± 1.1, respectively). However, by Day 7, pain levels were comparable between the two groups (SEPS: 2.4 ± 0.9, OSPL: 2.1 ± 0.8). This pattern is consistent with the findings of Frullini et al.,[19] who reported higher immediate post-operative pain in the SEPS group, likely due to the creation of the subfascial space and endoscopic dissection. Despite this, the long-term pain outcomes were comparable, as also noted in a study by Berteloot et al.,[15]

In terms of post-operative complications, our study observed wound infection in 3.3% of the SEPS group and 10% in the OSPL group, which aligns with the findings of Gupta et al.,[21] who reported similar infection rates (3% for SEPS, 9% for OSPL). The slightly higher rate of infection in the OSPL group could be due to the larger incisions required in open surgeries, as highlighted by Wang et al.,[20] However, these differences were not statistically significant ($p = 0.375$), supporting the view that both techniques are equally safe with respect to infection risk. Hematoma occurred in 6.7% of SEPS patients and 13.3% of OSPL patients, although these differences were not significant ($p > 0.05$). Eklöf et al. [17] also reported similar hematoma rates in both groups, suggesting that although SEPS may be less traumatic, it does not eliminate the risk of hematoma formation. The rate of deep vein thrombosis (DVT) was low in both groups, with only 1 case (3.3%) in the OSPL group. Pittaluga et al. [22] and Rama et al. [23] similarly reported low DVT rates following varicose vein surgeries, particularly in patients who did not have pre-existing deep venous disease.

CONCLUSION

This study shows that subfascial endoscopic perforator surgery (SEPS) and open PSPL are safe and effective treatments for great saphenous vein varicosities with perforator incompetence, with similar clinical outcomes, complication profiles, and short-term recurrence rates. SEPS has a longer operative time and higher early postoperative pain, but its minimally invasive nature, smaller incisions, and reduced tissue dissection make it appealing to cosmetically focused patients and those treated in endoscopic centres. Despite a non-significant tendency towards increased wound-related complications, OSPL is a viable alternative due to its shorter operative length, technical simplicity, and minimal equipment requirements, especially in resource-limited situations. These findings suggest that procedure selection should be based on patient preferences, clinical profile, and local surgical expertise, and that larger cohorts and longer follow-up are needed to determine long-term durability, cost-effectiveness, and patient-reported outcomes for both techniques.

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Data Availability- The simulation experiment data used to support the findings of this study are available from the corresponding author upon request.

Ethical Approval- The study was approved by the Institutional Ethics Committee.

Conflicts of Interest- The authors declare that there are no conflicts of interest.

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