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Research Article

Comparative Study of Outcomes Following Invagination Stripping Versus Conventional Stripping in Patients with Lower Limb Varicose Veins at a Tertiary Care Hospital in South India

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ABSTRACT

Background: Varicose veins are a common manifestation of chronic venous insufficiency, often requiring surgical intervention for symptomatic relief and prevention of complications. Conventional stripping of the great saphenous vein (GSV) remains widely practiced but is associated with postoperative pain, bruising, and hematoma. Invagination stripping has been proposed as a less traumatic alternative with potential benefits in patient recovery.

Methods: This prospective cohort study was conducted in the Department of General Surgery, over a period of 18 months. Sixty patients with unilateral symptomatic lower limb varicose veins and documented GSV insufficiency on Doppler ultrasonography were enrolled and randomized into two groups: Group A underwent invagination stripping and Group B underwent conventional stripping. Operative parameters, including time taken and length of vein stripped, and postoperative outcomes such as pain, bruising, hematoma, and hospital stay, were recorded. Statistical analysis was performed using the Chi-square test, with a p value < 0.05 considered significant.

Results: There was no statistically significant difference between the two groups in operative time, length of vein stripped, postoperative bruising, hematoma formation, or hospital stay. However, postoperative pain scores were significantly lower in the invagination stripping group compared to the conventional stripping group ($p = .01$).

Conclusion: Both invagination and conventional stripping are effective techniques in the management of lower limb varicose veins. Invagination stripping, however, offers the added advantage of reduced postoperative pain, making it a preferable option in suitable patients.

Keywords: *Varicose veins, Great saphenous vein, Invagination stripping, Conventional stripping, Postoperative outcomes.*

INTRODUCTION

Varicose veins of the lower limbs are a common manifestation of chronic venous insufficiency and represent a significant public health concern.[1] They are not only associated with cosmetic disfigurement but also contribute to pain, swelling, heaviness, skin changes, ulceration, and impairment of quality of life.[2] The underlying pathophysiology is related to valvular incompetence of the superficial venous system, particularly the great saphenous vein, leading to venous reflux and chronic venous hypertension.[3-5]

Surgical stripping of the great saphenous vein has long been considered the standard treatment for varicose veins.[6] Conventional stripping, which involves high ligation at the saphenofemoral junction and mechanical removal of the vein,

has demonstrated effectiveness in relieving symptoms and preventing progression of disease.[7] However, the procedure is often associated with drawbacks such as increased intraoperative blood loss, longer incisions, postoperative hematoma, bruising, pain, and a relatively prolonged recovery period. [8-9]

In response to these limitations, modifications of the stripping technique have been developed. Invagination stripping is one such technique, in which the vein is inverted and removed through its lumen.[10] This approach reduces tissue trauma by minimizing collateral damage during extraction. Theoretical advantages of this method include reduced intraoperative bleeding, smaller incision size, lower risk of nerve injury, less postoperative discomfort, and faster recovery, making it an attractive alternative to conventional stripping. [11-12]

Although both conventional and invagination stripping aim to achieve the same therapeutic objective, the relative merits and demerits of each technique require careful evaluation. Comparative assessment of operative parameters such as duration of surgery and length of vein removed, alongside postoperative outcomes like pain, bruising, hematoma formation, and duration of hospital stay, provides important insights into the efficacy and safety of these procedures. [13-16]

Despite the availability of multiple techniques for the management of varicose veins, there remains no universal consensus on the superiority of one method over another. Differences in patient demographics, institutional practices, and healthcare settings further complicate direct comparisons. In the context of tertiary care hospitals in India, where surgical stripping continues to be widely practiced, there is a need for locally relevant evidence to guide clinical decision-making.

The present study was undertaken to compare outcomes of invagination stripping and conventional stripping in patients with lower limb varicose veins. Specific focus was placed on operative parameters, including time taken and length of vein stripped, as well as postoperative outcomes such as pain, bruising, hematoma formation, and length of hospital stay. By systematically assessing these outcomes, the study seeks to provide meaningful evidence that may aid in optimizing surgical management of varicose veins in similar clinical settings.

Aims and Objectives

The aim of this study was to compare the operative parameters, postoperative outcomes, and recovery profile of patients undergoing varicose vein surgery by invagination stripping versus conventional stripping.

Objectives

- To evaluate and compare the intraoperative parameters, including operative time and length of vein stripped, between invagination stripping and conventional stripping techniques.
- To assess postoperative outcomes in terms of pain, bruising, hematoma formation, and duration of hospital stay, and to determine whether there is a statistically significant difference between the two surgical methods.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective cohort study conducted in the Department of General Surgery at tertiary care hospital in Tamil Nadu. The study was carried out over a period of 18 months.

Study Population

The study included patients with unilateral symptomatic lower limb varicose veins who were admitted to the Department of General Surgery during the study period. A total of 60 patients who satisfied the eligibility criteria and provided written informed consent were enrolled.

Inclusion and Exclusion Criteria

Patients between 20 and 65 years of age with unilateral symptomatic lower limb varicose veins were considered eligible if they demonstrated great saphenous vein (GSV) insufficiency on Doppler ultrasound and had a competent deep venous system. Only patients who consented to participate in the study were included.

Exclusion criteria comprised patients with ipsilateral recurrent varicose veins after stripping, varicose ulcers, short saphenous vein (SSV) insufficiency, previous GSV thrombophlebitis, or those with systemic comorbidities such as

malignancy, renal insufficiency, uncontrolled diabetes mellitus, and those on immunosuppressive therapy. Patients with deep vein thrombosis, Klippel-Trenaunay syndrome, or those who were pregnant or nursing were also excluded.

Sample Size and Sampling Technique

A total of 60 patients were included in the study, with 30 patients each allocated to the two groups. Group A underwent invagination stripping, while Group B underwent conventional stripping. Patients were enrolled consecutively based on their admission and eligibility, until the sample size was achieved.

Study Procedure

All eligible patients underwent baseline evaluation, including detailed history, physical examination, and routine laboratory investigations. Venous Doppler ultrasonography of the lower limb was performed in all cases to confirm GSV insufficiency. Preoperative radiographic studies and other necessary investigations were obtained as required.

Surgical intervention was performed under standard operative protocols. Patients in Group A underwent invagination stripping of the GSV, whereas those in Group B underwent conventional stripping. Perioperative care included administration of analgesics, anti-inflammatory medications, and blood products if necessary. Postoperatively, patients were followed at intervals of two weeks up to one month. Outcomes assessed included operative parameters (time taken for stripping and length of vein stripped), postoperative pain, area of bruising, hematoma formation, and duration of hospital stay. Complications were recorded during follow-up.

Statistical Analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 25. Quantitative variables were expressed as mean and standard deviation, while qualitative variables were expressed as numbers and percentages. The association between categorical variables and outcomes was assessed using the Chi-square test. Association between continuous variables were measured using independent t test. A p value < 0.05 was considered statistically significant.

Ethical Considerations

Approval for the study was obtained from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment. Confidentiality of patient data was maintained throughout the study. There were no conflicts of interest, and no external financial support was received for this study.

RESULTS

Table 1. Baseline Demographic Characteristics of Study Participants

Characteristic	Group A (Invagination Stripping) n, %	Group B (Conventional Stripping) n, %	Total	*p* value
Male	16 (53.3)	17 (56.7)	33	0.79
Female	14 (46.7)	13 (43.3)	27	
Total	30	30	60	

A total of 60 patients with lower limb varicose veins were included in the study, with 30 participants allocated to each group. In Group A (invagination stripping), 16 patients (53.3%) were male and 14 (46.7%) were female, whereas in Group B (conventional stripping), 17 patients (56.7%) were male and 13 (43.3%) were female. Overall, the study population comprised 33 males (55.0%) and 27 females (45.0%). There was no statistically significant difference in the gender distribution between the two groups ($p = 0.79$), indicating that the groups were comparable in terms of baseline demographic characteristics.

Table 2. Operative Parameters: Time Taken and Length of Vein Stripped

Operative Parameter	Group A (Invagination Stripping) n, %	Group B (Conventional Stripping) n, %	Total	*p* value
Time taken < 40 min	18 (60.0)	21 (70.0)	39	0.41
Time taken ≥ 40 min	12 (40.0)	9 (30.0)	21	

Vein length < 30 cm	16 (53.3)	19 (63.3)	35	0.43
Vein length ≥ 30 cm	14 (46.7)	11 (36.7)	25	

The comparison of operative parameters between the two groups is presented in Table 2. In Group A (invagination stripping), 18 patients (60.0%) had a procedure duration of less than 40 minutes compared to 21 patients (70.0%) in Group B (conventional stripping), while 12 (40.0%) and 9 (30.0%) patients in Groups A and B, respectively, had operative times of 40 minutes or longer. Similarly, the length of vein stripped was less than 30 cm in 16 patients (53.3%) in Group A and in 19 patients (63.3%) in Group B, whereas 14 (46.7%) and 11 (36.7%) patients, respectively, had veins stripped of 30 cm or more. The differences in operative time ($p = 0.41$) and vein length ($p = 0.43$) between the two groups were not statistically significant, indicating comparable intraoperative performance of both techniques.

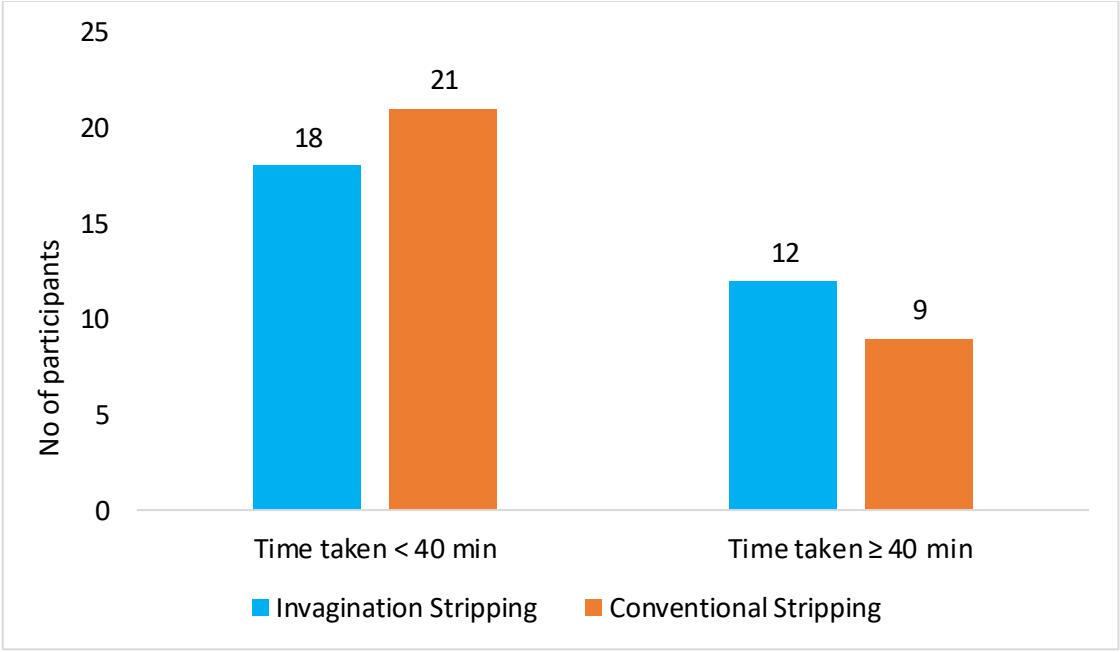


Chart 1. Time taken among the groups

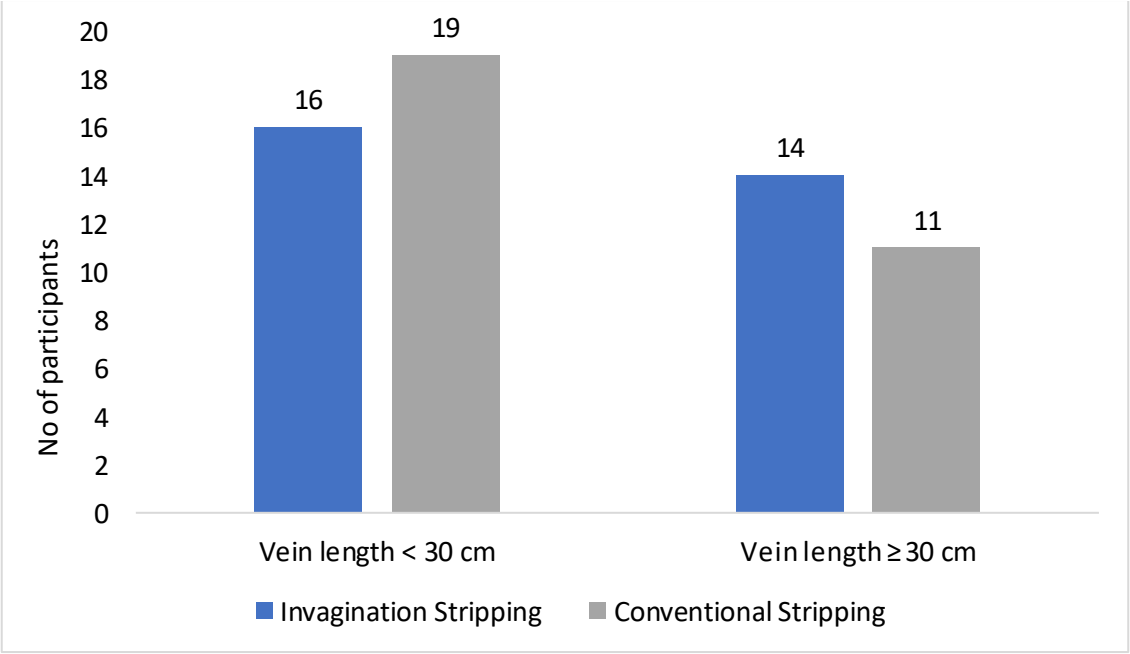


Chart 2. Vein length among the groups

Table 3. Postoperative Pain Assessment

Pain Category	Group A (Invagination Stripping) n, %	Group B (Conventional Stripping) n, %	Total	*p* value
VAS ≥ 3.5	3 (10.0)	11 (36.7)	14	**0.01***
VAS < 3.5	27 (90.0)	19 (63.3)	46	

*-statistically significant

Postoperative pain assessment using the Visual Analogue Scale (VAS) is shown in Table 3. In Group A (invagination stripping), only 3 patients (10.0%) reported significant pain (VAS ≥ 3.5), compared to 11 patients (36.7%) in Group B (conventional stripping). Conversely, 27 patients (90.0%) in Group A and 19 patients (63.3%) in Group B reported VAS scores below 3.5. The difference in pain scores between the two groups was statistically significant ($p = 0.01$), indicating that patients undergoing invagination stripping experienced less postoperative pain compared to those who underwent conventional stripping.

Chart 3. Vein length among the groups

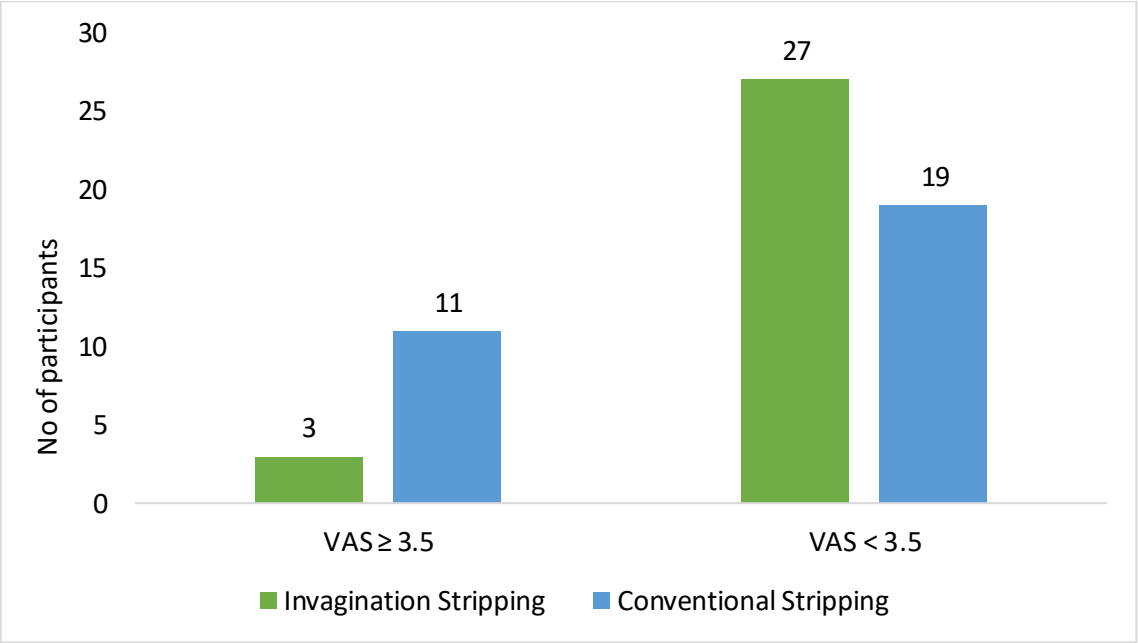


Table 4. Postoperative Morbidity: Bruising and Hematoma Formation

Morbidity Outcome	Group A (Invagination Stripping) n, %	Group B (Conventional Stripping) n, %	Total	*p* value
Postoperative bruising, n (%)	3 (10.0)	6 (20.0)	9 (15.0)	0.27
No bruising, n (%)	27 (90.0)	24 (80.0)	51 (85.0)	
Postoperative hematoma, n (%)	2 (6.7)	4 (13.3)	6 (10.0)	0.38
No hematoma, n (%)	28 (93.3)	26 (86.7)	54 (90.0)	

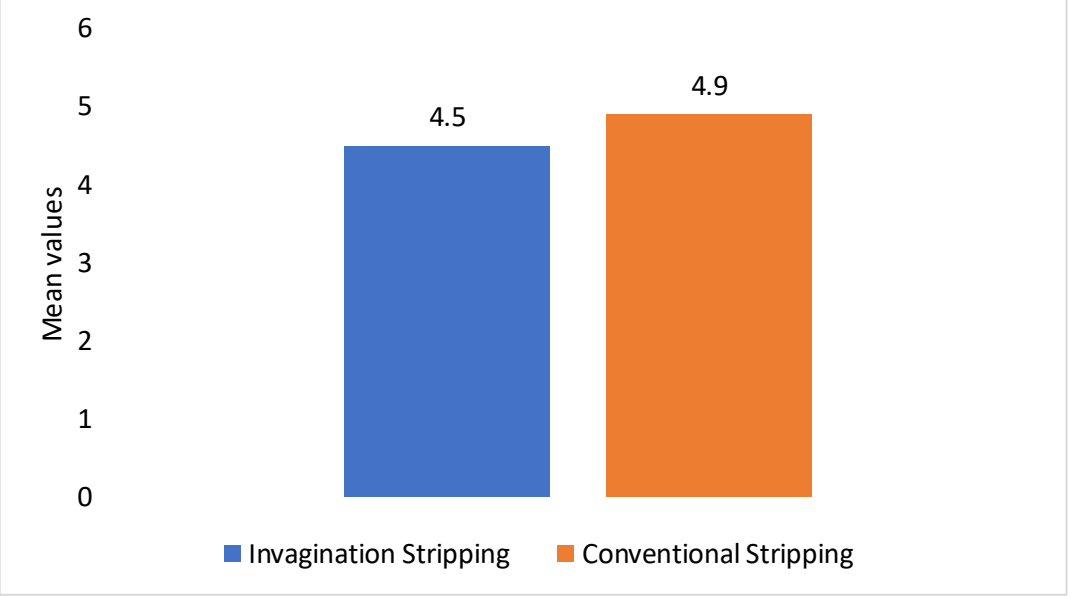
Postoperative morbidity in terms of bruising and hematoma formation is summarized in Table 4. In Group A (invagination stripping), 3 patients (10.0%) developed postoperative bruising compared to 6 patients (20.0%) in Group B (conventional stripping). Similarly, postoperative hematoma was observed in 2 patients (6.7%) in Group A and 4 patients (13.3%) in Group B. The majority of patients in both groups did not develop bruising (90.0% in Group A vs. 80.0% in Group B) or hematoma (93.3% vs. 86.7%). The differences in the occurrence of postoperative bruising ($p = 0.27$) and hematoma ($p = 0.38$) between the two groups were not statistically significant.

Table 5. Hospital Stay and Recovery Profile

Variable	Group A (Invagination Stripping) Mean ± SD	Group B (Conventional Stripping) Mean ± SD	*p* value
Mean hospital stay (days)	4.5 ± 0.89	4.9 ± 1.09	0.12

The mean duration of postoperative hospital stay is presented in Table 5. Patients in Group A (invagination stripping) had a mean hospital stay of 4.5 ± 0.89 days, while those in Group B (conventional stripping) had a mean stay of 4.9 ± 1.09 days. Although the invagination stripping group demonstrated a slightly shorter hospital stay, the difference was not statistically significant ($p = 0.12$).

Chart 4. Mean hospital stay among the groups



DISCUSSION

In the present study, operative parameters, including the time taken to strip the vein and the length of the vein stripped, showed no statistically significant difference between invagination and conventional stripping. This aligns with Shetty et al., who reported similar operative efficiency across both techniques [1]. Scheltinga et al. likewise observed comparable operative times, although conventional stripping was associated with greater incision length and blood loss [3]. Patel et al. noted that while stripping produced more tissue stress, it did not significantly alter the efficiency of vein removal [4]. Similarly, Kumar et al. demonstrated that operative time was not substantially influenced by the choice of stripping or non-stripping procedures [5]. These findings suggest that both methods are equally effective in terms of procedural execution.

A key finding in the current study was the significantly lower postoperative pain observed in the invagination stripping group. This result is consistent with Shetty et al., who also documented reduced pain scores following invagination compared to conventional stripping [1]. Scheltinga et al. highlighted that invagination stripping was associated with fewer nerve injuries and improved pain outcomes over the long term [3]. Piekarska et al. further reinforced the advantages of minimally invasive and tissue-sparing techniques in lowering postoperative discomfort [6]. Parés et al. demonstrated similar improvements in pain outcomes with alternative techniques like CHIVA, which minimize tissue trauma compared to conventional stripping [7]. Collectively, these findings support the concept that techniques reducing tissue disruption are associated with better postoperative pain control.

In the present study, postoperative bruising and hematoma formation were less frequent in the invagination group, though not statistically significant. Shetty et al. reported lower intraoperative blood loss and reduced postoperative bruising with invagination stripping [1]. Patel et al. observed higher hematoma and bruising rates in patients who underwent stripping compared to those managed with ligation alone [4]. Kumar et al. similarly demonstrated increased hematoma formation in

the stripping group compared to non-stripping procedures [5]. Scheltinga et al. found significantly lower blood loss and less tissue trauma in invagination stripping patients [3]. These findings suggest that although differences may not always achieve statistical significance, invagination stripping demonstrates a consistent clinical trend toward reduced morbidity. In the current study, the mean hospital stay was slightly shorter in the invagination group compared to the conventional group, although the difference did not reach statistical significance. Hussain et al. reported shorter hospitalization and improved recovery profiles for patients who underwent GSV stripping compared to non-stripping procedures [2]. Shetty et al. documented faster return to activity among patients treated with invagination stripping [1]. In contrast, Patel et al. and Kumar et al. did not observe significant differences in hospital stay, although both noted that patients undergoing stripping had greater postoperative discomfort [4,5]. Taken together, these results imply that while invagination stripping may provide marginal improvements in recovery, institutional factors and patient-related variables may also influence hospital stay.

Overall, the present study demonstrates that both techniques are comparable in terms of operative parameters, morbidity, and recovery, with the exception of postoperative pain, which was significantly lower in the invagination group. This finding is consistent with existing literature highlighting the benefits of invagination stripping in reducing soft tissue trauma, thereby minimizing patient discomfort [1,3,6,7]. At the same time, results from other comparative studies emphasize that conventional stripping remains an effective and reliable option, albeit with slightly higher morbidity rates [4,5]. Thus, the choice of technique may ultimately depend on surgeon preference, patient profile, and institutional resources, with invagination stripping offering modest but clinically meaningful advantages.

The implications of these findings are particularly relevant in resource-constrained healthcare settings, where open surgical stripping remains the most widely practiced intervention. By demonstrating reduced postoperative pain and a trend toward lower morbidity, invagination stripping can be considered a feasible and patient-friendly modification of conventional stripping. However, the lack of significant differences in other outcomes suggests that both procedures are safe and effective. Larger multicenter trials with extended follow-up are needed to confirm these findings and evaluate long-term recurrence rates. Until such evidence becomes available, invagination stripping may be regarded as a suitable alternative that balances efficacy with improved patient comfort.

Limitations

The study was limited by short follow-up period of one month, which may not adequately capture long-term outcomes or recurrence. Additionally, the single-center design may restrict the generalizability of the findings to broader populations.

CONCLUSION AND RECOMMENDATIONS

The present study demonstrated that invagination stripping and conventional stripping are comparable in terms of operative parameters, postoperative morbidity, and hospital stay. However, patients who underwent invagination stripping experienced significantly less postoperative pain, highlighting its advantage as a less traumatic technique. Both procedures remain safe and effective for the management of lower limb varicose veins, with invagination stripping offering modest but clinically meaningful benefits in patient comfort and recovery.

Invagination stripping can be considered a preferable alternative to conventional stripping in surgical management of varicose veins, particularly in patients where minimizing postoperative pain is a priority. Surgeons should adopt this technique where feasible, while also individualizing surgical choice based on patient profile, comorbidities, and institutional resources. Further large-scale, multicenter studies with longer follow-up are recommended to validate these findings and to assess long-term outcomes such as recurrence and quality of life.

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