RESEARCH PAPER

Effect of Surgery on Venous Severity Scoring System in Varicose Veins: A Prospective Longitudinal Study

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ABSTRACT

Background: Chronic venous disease is a major healthcare issue, which requires validated tools to evaluate the severity of disease and response to treatment. The CEAP (Clinical-Etiology-Anatomy-Pathophysiology) classification system is widely utilized; however, this system has limitations in performing serial assessments of disease progression. Due to the limitations of the CEAP classification, the Venous Severity Score (VSS) has been developed.

Objective: The purpose of the current study was to evaluate the presenting symptoms, to evaluate the CEAP grading and VSS at the time of admission, and to compare the VSS with the CEAP classification in evaluating the postoperative outcome of surgery for varicose veins.

Methods: The study included 30 patients (42 limbs) who had surgical treatment for primary varicose veins with the Trendelenburg procedure and stripping of the GSV with perforator ligation. The patients were evaluated preoperatively, 6 weeks postoperatively, and 6 months postoperatively with regards to the CEAP classification, CEAP clinical score, venous clinical severity score (VCSS), and the venous disability score (VDS).

Results: The study population was predominantly male (70%) with an age range of 41-60 years (63.3%). Preoperatively, 66.6% of limbs were classified as CEAP classes C4-C6. The mean preoperative scores were as follows: CEAP class 4.31, CEAP score 8.57, VCSS 12.83, and VDS 1.07. Significant reductions were observed at the 6-month follow-up: CEAP score decreased by 88.9% (mean=0.95), and both VCSS and VDS by 92.9% (mean=0.90) and 100% (mean=0.0), respectively. Pain and edema resolved completely in all patients by 6 months postoperatively, and 13 patients had healed active ulcers by that time. CEAP classification did not change following surgery in any of the C4-C6 patients, even though the clinical condition improved.

Conclusion: The VCSS demonstrated superior sensitivity in assessing postoperative outcomes compared to the CEAP classification alone. The VCSS should be used together with the CEAP classification to provide a comprehensive, evaluative, and longitudinal assessment of the severity of venous disease and surgical outcomes, and therefore is a more appropriate instrument for serial assessments than the CEAP classification.

Keywords: Varicose veins, CEAP classification, Venous Clinical Severity Score, Venous Disability Score, surgical outcomes, chronic venous disease

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INTRODUCTION

Chronic venous disease (CVD) affects the veins of our bodies and can be thought of as an ongoing decline of the function and shape of the veins. The long-term change that occurs is complete loss of the ability of our venous valves to close properly to allow blood to flow towards the heart only. Therefore, when someone has CVD, their veins have a constant supply of blood that moves down, resulting in constant high blood pressure in their veins when they are upright (the way we stand and walk). This high pressure in the veins can be seen as varicosities - veins that have become enlarged, wiggly, and thickened (1, 2).

The understanding of how sick you are when diagnosed with CVD has led to the need for an accurate, validated tool for measuring and reporting health status (3). To report on your CVD, there must be an evaluation tool to report how sick you are or how much of a burden the illness is causing you. Additionally, the tool used to measure your health or sick condition must provide a way to compare your sick condition with other people and to monitor you over time (4).

The Clinical-Etiology-Anatomy-Pathophysiology (CEAP) classification system was created to help standardize how to evaluate CVD and has become the most popular tool for clinicians and researchers to use

to evaluate their patient's CVD and treatment out comes (5). The CEAP classification is a very complete (all inclusive) method to evaluate how the veins of a person are sick, how they became ill, where they are sick, and what or how the veins of that person are working within or out of their body. The CEAP classification also provides a method to classify your CVD based on the natural history of CVD and to separate your CVD into different categories (6).

Even though almost everyone uses CEAP or has used CEAP to evaluate a person's health, there are limitations to using this tool to evaluate overall wellness or how well a person will heal after surgery for CVD (7). The Venous Severity Scoring System was created by a committee of the American Venous Forum to develop a system that would improve the evaluation of the severity of the disease (8). The Venous Severity Scoring System consists of two foundational elements: the Venous Disability Score (VDS) and the Venous Clinical Severity Score (VCSS).

The VCSS was developed to add a third type of information to the CEAP classification. The VCSS provides better distinction among the very sick with CVD and who are at different stages of illness than CEAP would provide, and the VCSS provides a way to follow the sick person with the serious form of CVD (CEAP Clinical classes 4 and 6) (1, 9). By providing a way to score numerically many clinical factors associated with CVD, the VCSS allows for the comparison of clinical severity changes after a medical or surgical procedure for CVD and provides the ability to fill the gap created by the limitation of the CEAP classification system for measuring CVD (10).

This study is attempting to determine whether to use the VCSS or the CEAP classification system when determining the postoperative outcome of surgical procedures for patients with primary varicose veins. To accomplish this, we utilized the prospective longitudinal type of research to determine which measurement system will allow us to identify how improved the patients are after surgical intervention related to the patient's CVD.

Primary Objectives

1. To comprehensively document and analyze the presenting symptoms of patients with primary varicose veins at the time of admission.
2. To systematically classify patients according to the CEAP grading system and calculate baseline Venous Severity Scoring parameters at admission.
3. To compare the performance characteristics of the Venous Severity Scoring system versus the CEAP classification system in assessing postoperative outcomes following surgical intervention.

Secondary Objectives

1. To evaluate the temporal evolution of clinical parameters over a 6-month follow-up period following varicose vein surgery.
2. To determine the sensitivity of different assessment tools in detecting clinically meaningful changes following surgical treatment.
3. To establish the relative utility of quantitative versus qualitative assessment methods in the longitudinal evaluation of patients with chronic venous disease.

METHODOLOGY

Study Design and Setting

This investigation was conducted as a prospective longitudinal clinical study at the Department of General Surgery, Chettinad Hospital and Research Institute, Chennai, India. The study design incorporated systematic preoperative assessment and structured postoperative follow-up at predetermined intervals to facilitate comprehensive evaluation of treatment outcomes.

Study Duration and Sample

The study was conducted over a 12-month period from March 2025 to Feb2026. A total of 30 patients presenting with primary varicose veins were enrolled, representing 42 affected limbs, as several patients exhibited bilateral disease.

Inclusion Criteria

Patients were eligible for study enrollment if they met the following criteria:

1. Age 18 years or above, encompassing both male and female patients
2. Diagnosis of primary varicose veins with documented saphenofemoral junction incompetence
3. Presence of incompetent perforator veins on clinical or imaging assessment
4. Willingness to undergo surgical intervention and comply with follow-up protocols
5. Presence or absence of complications related to chronic venous disease
6. Provision of written informed consent for study participation

Exclusion Criteria

The following criteria precluded study enrollment:

1. Age below 18 years
2. Secondary varicose veins resulting from deep venous pathology or other underlying conditions
3. Pregnancy at the time of assessment or anticipated during the study period
4. Concurrent lymphatic disease that might confound assessment of venous outcomes
5. Arterial insufficiency of the lower extremities
6. Refusal or inability to provide informed consent
7. Significant medical comorbidities precluding surgical intervention

Classification Systems and Scoring Instruments

CEAP Classification

The CEAP classification system was applied according to established international standards, incorporating four dimensions:

Clinical Classification (C):

- C0: No visible or palpable signs of venous disease
- C1: Telangiectasias or reticular veins
- C2: Varicose veins
- C2r: Recurrent varicose veins
- C3: Edema
- C4: Changes in skin and subcutaneous tissue secondary to chronic venous disease
    - C4a: Pigmentation or eczema
    - C4b: Lipodermatosclerosis or atrophie blanche
    - C4c: Corona phlebectatica
- C5: Healed venous ulcer
- C6: Active venous ulcer
- C6r: Recurrent active ulcer

Etiologic Classification (E):

- Ep: Primary
- Es: Secondary
- Esi: Secondary intravenous
- Ese: Secondary extra venous
- Ec: Congenital
- En: No cause identified

Anatomic Classification (A):

- As: Superficial veins
- Ap: Perforator veins
- Ad: Deep veins
- An: Venous location not identified

Pathophysiologic Classification (P):

- Pr: Reflux
- Po: Obstruction
- Pr,o: Reflux and obstruction
- Pn: No pathophysiology identified

CEAP Clinical Score

The CEAP clinical score provided quantitative assessment of eight clinical attributes:

1. Pain (0-2 points)
2. Edema (0-2 points)
3. Venous claudication (0-2 points)
4. Pigmentation (0-2 points)
5. Lipodermatosclerosis (0-2 points)
6. Ulcer diameter (0-2 points)
7. Ulcer duration (0-2 points)
8. Ulcer recurrence (0-2 points)

Each attribute was scored based on severity, with higher scores indicating greater disease burden.

Venous Clinical Severity Score (VCSS)

The VCSS assessed ten clinical parameters, each rated on a 4-point scale (0-3):

1. Pain or other discomfort
2. Varicose veins
3. Venous edema
4. Skin pigmentation
5. Inflammation
6. Induration
7. Active ulcer number
8. Active ulcer duration
9. Active ulcer size
10. Compression therapy use

Detailed descriptors for each severity level were applied consistently across all assessments.

Venous Disability Score (VDS)

The VDS evaluated functional impairment on a 4-point scale:

- 0: Asymptomatic
- 1: Symptomatic but able to work without support
- 2: Able to work 8 hours with supporting device
- 3: Unable to work even with supporting device

Surgical Intervention

All patients underwent standardized surgical treatment consisting of:

1. High ligation and division of the saphenofemoral junction (Trendelenburg procedure)
2. Stripping of the great saphenous vein from groin to knee
3. Identification and ligation of incompetent perforating veins
4. Excision of prominent varicose vein clusters as indicated

Surgical procedures were performed under appropriate anesthesia by experienced vascular surgeons following institutional protocols.

Follow-up Protocol

Patients were evaluated at three time points:

1. **Preoperative assessment:** Comprehensive baseline evaluation including complete history, physical examination, and scoring using all classification systems
2. **6-week postoperative assessment:** First follow-up evaluation with repeat scoring
3. **6-month postoperative assessment:** Final follow-up with comprehensive reassessment

At each follow-up visit, all scoring systems were systematically applied, and clinical photographs were obtained for documentation purposes.

Data Collection and Management

Data were collected on standardized case record forms and included:

1. Demographic information
2. Clinical presentation and symptoms
3. Preoperative scoring system results
4. Surgical details
5. Postoperative assessment findings
6. Complications if any

Statistical Analysis

All collected data were entered into Microsoft Excel spreadsheets and subsequently analyzed using SPSS version 22.0 statistical software. The following statistical methods were employed:

1. **Descriptive statistics:** Mean, standard deviation, and percentages were calculated for continuous and categorical variables
2. **Comparative analysis:** Paired comparisons between preoperative and postoperative scores were performed
3. **Correlation analysis:** Relationships between different scoring systems were evaluated
4. **Significance testing:** A p-value of less than 0.05 was considered statistically significant

Percentage reduction in scores was calculated using the formula: Percentage reduction = [(Preoperative score - Postoperative score) / Preoperative score] × 100

Ethical Considerations

The study protocol received approval from the institutional ethics committee. All patients provided written informed consent after receiving detailed information about the study objectives, procedures, potential risks, and benefits. Patient confidentiality was maintained throughout the study, and all data were anonymized for analysis purposes.

RESULTS

The study population demonstrated a characteristic age distribution pattern consistent with the epidemiology of chronic venous disease. Among the 30 enrolled patients, the majority (n=19, 63.3%) fell within the 41-60 years age bracket, representing the peak incidence age group. Six patients (20%) were in the 20-40 years category, while five patients (16.7%) were above 60 years of age. This distribution reflects the progressive nature of chronic venous disease and its increasing prevalence with advancing age.

The study cohort showed a marked male predominance, with 21 patients (70%) being male and 9 patients (30%) being female. This male-to-female ratio of approximately 2.3:1 is consistent with several regional studies, though it differs from Western populations where varicose veins demonstrate female preponderance. This demographic pattern may reflect occupational factors, healthcare-seeking behavior, or population-specific risk factors prevalent in the study region.

Clinical manifestations seen within the population showed a wide variety of chronic venous disease signs (e.g., seen as a wide variety of signs associated with chronic venous insufficiency/blood flow/edema):

- All 42 limbs had varicose veins (enter inclusion criteria)
- Approximately half of limbs had pain; pain of all severity levels was included (21 limbs)
- 50% of limbs had pigmentation; pigmentation was a result of hemosiderin
- Lipodermatosclerosis was present in 21 limbs (50% of included limbs, or at least some advanced lesions and skin and subcutaneous tissues)
- Edema was found in 10 limbs (23.8% of included limbs, with most found around ankles and lower legs)
- Active ulcers were found in 14 limbs (33.3% of included limbs, as other extreme form)
- No healed ulcers had been seen at any previous exam

There are many advanced manifestations of chronic venous disease (i.e., pigmentation, lipodermatosclerosis, and ulcers (active)) in this group of patients, so it is clear that patients did not seek medical care until much later in the disease process.

The distribution of preoperative CEAP Clinical Classification was as follows:

- Most limbs (28) presented as Class C6 (active ulcer)
- There were (3) Class C5 (healed ulcer) limbs
- There were (11) Class C4 (skin and subcutaneous changes) limbs

- There were (10) Class C3 (edema) limbs
- There were (4) Class C2 (varicose vein) limbs
- There were (0) Class C1 limbs

Of the total number of limbs (28 limbs (66.6%) were advanced (C4-C6) limbs, which is indicative of the significant severity of the venous disease seen in this study group and the need for well-established tools for determining outcome(s) for patients who have advanced venous disease.The means of CEAP clinical preoperative scores were as follows:

- <7: 33.3% or 14 limbs had mild to moderate disease.
- 8–10: 54.8% or 23 limbs had moderate to severe disease.
- >11: 11.9% or 4 limbs had the highest degree of severity.

The mean of CEAP preoperative score was an 8.57 (not reported SD), with the majority of patients in the moderate to severe range.

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The distribution of VCSS preoperative scores was as follows:

- 0–5: No limbs (0%) had mild disease.
- 6–10: 5 limbs (16.7%).
- 11–15: 16 limbs (53.3%) -- greatest number of limbs.
- >15: 9 limbs (30%) had severe disease.

The mean of VCSS preoperative score was 12.83, which was much higher than the CEAP preoperative, demonstrating the comprehensiveness of VCSS assessment and that VCSS captures multiple domains of disease severity.

The functional assessment yielded the following data:

- VDS 0, 33.3% or 14 limbs had no symptoms.
- VDS 1, 26.2% or 11 limbs had symptoms that did not require help to do work.
- VDS 2, 40.5% or 17 limbs needed assistance to perform work.
- VDS 3, no patient had symptoms that caused them not to be able to work.

The mean of VDS preoperative score was 1.07, which reflects moderate functional impairment for this population of study participants. The absence of any VDS 3 patients is likely due to the selection bias, -- as such severely limited patients were probably not eligible for elective surgery.Statistical analysis indicated a strong positive correlation ($p<0.01$) between the various preoperative assessment tools:

- CEAP clinical class positively correlates to CEAP score, VCSS, and VDS
- Higher CEAP scores positively correlated with higher VCSS values
- Higher VCSS disease severity positively correlated with greater VDS functional impairment

These positive correlations across the various assessment tools demonstrate that all four sets of assessment tools assess disease severity consistently and support the complementary use of several different assessment tools.

The following improvements were noted at 6 weeks post-operatively:

- Pain – 11 patients either had no pain or had significant reductions in pain. One patient, however, continued to have mild pain.
- Edema – All (n = 10 limbs) limbs with edema at the time of surgery are now completely edematous.
- Active Ulcers – Partial healing of active ulcers present immediately after surgery, but no active ulcers had healed completely by 6 weeks.
- Pigmentation and lipodermatosclerosis - No significant changes in pigmentation or lipodermatosclerosis were observed at 6 weeks.

The CEAP clinical class distribution at 6 weeks demonstrated:

- CEAP class distribution with pre-operative classes C4-C6 was still within the C4-C6 range (28 limbs, 66.6%).
- Mean CEAP class = 3.57 (compared to mean pre-operative CEAP class = 4.31).

The relative stability of CEAP clinical class ownership despite the demonstrated clinical improvements illustrates a significant limitation of the CEAP classification system's ability to detect postoperative changes.

The CEAP clinical score showed a 57.9% decline from pre-operative (mean = 8.57) to 6-week post-operative (mean = 3.60) clinical assessments, which demonstrate improvement in pain, edema and other parameters, as indexed by the CEAP clinical score.The VCSS indicated a mean value of 5.19 as opposed to 12.83 prior to surgery with a percentage decrease in the score of 59.5%. It was also noted that improvement in the VCSS was consistent with the improvement seen in the

CEAP score; however, the VCSS provided a more detailed assessment of individual clinical characteristics. Evidence of improved functional ability was demonstrated, as noted by:

- the mean value of 0.67 as compared to 1.07 pre-operatively,
- with a percentage decrease of 37.3%.

Additionally, the modest decrease in VDS at six weeks prompted the need for longer follow-up to address issues relating to full return of functional ability.

The percent decrease in both the VCSS and the VDS demonstrates that six months did elapse without any changes to those preoperatively documented; and further improvements were noted in the following:

- pain: 100% of patients had complete resolution of pain (21 limbs with pain pre-operatively),
- edema: 100% of limbs with edema were completely resolved at six weeks,
- active ulcers: 13 of 14 limbs (92.9% of the limbs) with active ulcers were completely healed,
- varicose veins: 100% of limbs had significant improvement with prominent varicosities disappearing, and
- pigmentation and lipodermatosclerosis: persisted with significant changes, therefore indicating the presence of irreversible skin changes.

Additionally, the CEAP clinical class distribution at six months in patients with Classes C4–C6 preoperatively remained the same at C4–C6 (66.6% of limbs total). The mean CEAP class was found to be 2.98 (as opposed to 4.31 preoperatively).

The persistence of the class types preoperatively supports the indication of no change in both the VCSS and CEAP classification of venous insufficiency in patients with irreversible skin changes.

As indicated by both the CEAP and VCSS scores, the substantial drop in score of 0.95 (vs 8.57) represents an 88.9% reduction in the score; therefore, supporting the conclusion that there has been successful treatment (resolution) of the reversible component of venous disease.The VCSS provided excellent sensitivity in terms of detecting changes in clinical outcomes as shown by:

• Mean Score: 0.90 (vs. Preoperative: 12.83)
• % Reduction in Score: 92.9%

The percentage reduction of the VCSS was slightly higher than CEAP indicating that the VCSS demonstrates a more significant ability to discriminate clinical improvements.

Complete functional recovery was seen.

• Mean Score: 0.00 (vs. Preoperative: 1.07)
• % Reduction in Score: 100%

All patients attained asymptomatic status with complete work capacity without the need for assistive devices.

When comparing % reductions for 6-month assessment:

1. VDS: 100% reduction (most sensitive for functional outcomes)
2. VCSS: 92.9% reduction
3. CEAP score: 88.9% reduction
4. CEAP class: minimal change (least sensitive)

4.9.2 Correlation of Follow-Up Scores

There were strong correlations in each post-operative assessment at both 6 weeks and 6 months between:

• CEAP and VCSS (both were reduced in parallel)
• VCSS and VDS (the better the clinical outcome the better the functional outcome)
• There was a weak correlation between the CEAP class and other outcome measures, particularly in patients with advanced disease

When examining the temporal pattern of care, there were:

1. Early Post-operative Period (0-6 weeks):

• Patients experienced a rapid reduction in pain and swelling
• CEAP and VCSS scores were reduced moderately at 57-60%
• There was a limited functional recovery (37% VDS reduction) at 6 weeks

2. Late Post-operative Period (6 weeks-6 months):

• Patients had complete resolution of pain and swelling
• The majority of patients had healing of ulcers.
• Their scores were almost normalized.
• Patients had a complete recovery of function at 6 months.

This finding demonstrates two distinct phases of clinical response wherein patients experience relief from symptoms rapidly, but there is significantly extended time required to achieve full clinical and functional recovery.

All reductions noted in CEAP, VCSS, and VDS at both follow-up assessments were statistically significant ($p < 0.05$), and thus, improvements cannot be attributed to chance. VCSS detects clinically meaningful changes at a greater magnitude than CEAP does at both time points; thus confirming the greater sensitivity of VCSS to quantify clinical outcomes.

DISCUSSION

The findings of this prospective longitudinal study demonstrate the relative effectiveness of various methods for assessing venous disease and subsequent

surgical outcomes for patients with primary varicose veins. There were some key findings from this study that have substantial implications for clinical practice and research techniques.

While the clinical classification or CEAP classification system provides a good basis for initial classification of disease, there are significant limitations when it comes to using CEAP for the classification of serial assessment following surgery (1,5); i.e., the patients in the most advanced preoperative disease stages (C4-C6) will continue to be classified into that same CEAP category following surgery even though they experienced a significant reduction in clinical symptoms. The continued persistence of classification category is primarily related to irreversible skin changes (e.g., pigmentation, lipodermatosclerosis) that will continue to classify the patient into previous advanced categories regardless of whether or not their reversible complaints (pain, edema, ulceration) have improved or resolved (7,11).

On the other hand, there are significant advantages for the VCSS (Venous Clinical Severity Score) in identifying clinically important postoperative changes (1,9). For example, at the 6-month postoperative visit, the clinically significant change in the patient's VCSS was 92.9% compared to 88.9% for the CEAP clinical score from the baseline. The advantage of using VCSS is because of the more comprehensive assessment of multiple clinical parameters and the use of continuous scoring of the VCSS instead of categorical classifications of the CEAP (10,12).

In addition, the Venous Disability Score (VDS) provided accurate measures of functional improvements, and all patients had fully normalized (i.e., all 100% reduction) with 6 months of post-operative surgery (8). This result illustrates the extent to which successful varicose vein surgery can positively impact patients' quality of life and work capacity, rather than only considering anatomical and/or clinical measures when evaluating the surgical procedure (3,13).The demographic characteristics of the study population are worth reviewing compared to previously reported studies. The male predominance(70%) is not consistent with many western studies, which report a female predominance in varicose vein disease (2,14). The predominance of men may be seen in studies out of India or Asia and could be attributed to many factors, including credentials of the subjects, the amount of standing time within occupations dominated by males in the area, variations between populations based on genetic predisposition, the amount of time available to seek assistance for health-related issues, and possibly systematic bias in referral to surgical management (15,16).

The peak age range(41-60 years) is representative of the natural history of chronic venous disease(5,6); there is a continued likelihood that chronic venous disease manifests after many years of cumulative venous valvular failure and increased venous pressure. The small number of age groups(20%) within the younger age span, 20 years old, would further suggest that progression of the disease would also be evident for those 20 years old.

The presence of a high level of disease at presentation is also worth noting. Two-thirds of the limbs were presented with C4-C6(CEPA) and a third presented with active ulcers. This suggests presentation was delayed; this could be due to neglect of symptoms following extensive time, distance, and/or a possibility of conservative attempts having continued to progress and later requiring more definitive surgical treatment (14,17). This reinforces the need for early diagnosis and treatment of chronic venous disease.

The strength of the CEAP classification system is that it provides a comprehensive description of the disease based on a number of components, including clinical, aetiological, anatomical, pathophysiological components of the disease. The strengths of the system also include the commonality of the terminology used, allowing different health care providers to communicate in a standard manner, and providing an opportunity to assist with the diagnosis and disease stratification (5,6).Many limitations were recognized with respect to the existing classification system such as low sensitivity in measuring postoperative changes in patients with advanced disease (7), the inability to distinguish an improvement within the same classification, a static classification system where classifications are not able to be longitudinally assessed, and the classifications were based upon irreversible changes even if the reversible manifestations resolved (11).
The fact that all of the patients with a preoperative classification of C4 to C6 remained in these classifications after clinically significant improvement

was a fundamental limitation of the classification system for assessing improvement following treatment (1, 18). For example, if a patient had an active, painful 6 cm venous ulcer and achieved complete healing of the ulcer with total resolution of pain, he would still be classified as C5 (the ulcer has healed) rather than having his classification reduced to a lower classification as the clinical condition improved to the extent that he will now no longer have pain or ulceration, and therefore, the lack of downgrading in classification type does not reflect the significant clinical improvement.

Outcome assessment was improved using the CEAP clinical score vs the CEAP classification score. Clinical improvement was paralleled by a very large reduction of 88.9% at 6 months when comparing CEAP clinical scores and the CEAP classification score. In addition, the CEAP clinical score had advantages over the CEAP classification score in that the CEAP clinical score provided a quantitative measure which could be used to calculate the percentage of improvement, could assess multiple clinical parameters, and had moderate sensitivity to treatment effectiveness.

Still, the CEAP clinical score had limitations compared to the VCSS in that the VCSS utilized more clinical parameters than the CEAP clinical and CEAP classification score systems (the VCSS assessed 10 parameters vs 4 and 4 respectively for the CEAP classification and clinical scores), had less detailed scoring granularity for each clinical parameter than the VCSS, and generated a slightly lower percentage of reduction compared to the VCSS, indicating slightly less sensitivity to detecting improvement.

The VCSS was the most sensitive tool for measuring outcomes following surgery, with a reduction of 92.9% recorded at the 6-month postoperative assessment (1, 9).The benefits of this assessment are numerous, such as the inclusion of multiple clinical parameters (10) and the four-point grading scale for each clinical parameter providing a comprehensive assessment of the parameter, the ability to discriminate between subtle changes in advanced disease categories, and the ability to quantify changes for statistical analysis and comparison (12).

In addition to detecting subtle improvements associated with pain intensity, extent of edema, and degree of inflammation that would not be discernible using the CEAP classification (9), the VCSS's separate determination of compression therapy use adds a dimension of patient compliance and ongoing treatment needs.

The VDS also allows for a unique perspective regarding functional outcomes with complete normalization at 6 months (8). This tool provides focused assessments of work capacity and quality of life resulting from compression therapy, an easy-to-use four-point scale, and is a patient-centered measure of outcomes that complements clinical assessments (3).

The time course of VDS improvements that showed modest reductions after 6 weeks (37.3% reduction) and complete normalization at 6 months suggests that while symptoms may dissipate quickly, it may take longer for total restoration of functional capacity to occur (20). Therefore, this information may be helpful in counseling patients about their expected timeframes to return to work and resume activities of daily living.

The biphasic pattern of improvement should be reviewed in detail. The first phase (0-6 weeks) demonstrated rapid improvement in pain and edema with a moderate decline in both CEAP and VCSS scores (approximately 58%-60% reduction), limited functional recovery as shown by a VDS reduction of only 37%, and ulcer healing without total resolution in most patients.The follow-up phase (spanning six weeks to six months) showed that all participants had an end to their pain, there was an ongoing reduction in swelling, 92.9% of those with ulcers before surgery had their ulcer healed, those undergoing treatment experienced a near-complete return to normal of both the CEAP and VCSS scores, and 100% of patients experienced a return to full function as shown from the VDS score.

The clinical implications of this timing of the clinical improvements above occur in three ways. First, this shows the need for at least six months of time after surgery before evaluation of the benefits of treatment from the time of surgery. Second, this indicates that patient education must provide adequate information regarding length of time required to achieve the final result because while they are likely to have symptom improvement soon after the procedure, it will take a considerable amount of time until they have completed the entire healing process and recover to full function. Third, it demonstrates the sequential nature of benefit from surgery, whereby improvement occurs on a continuous basis for several months following surgery and not necessarily immediately upon postoperative evaluation.

The impact of the findings of this study impact the clinical efficacy or quality of care provided to patients

that underwent the procedures described (saphenofemoral junction ligation and great saphenous vein stripping and perforator ligation) because of the fact that there was 100% of all patients experiencing complete relief of pain, 92.9% of those with ulcers being healed, and 100% of patients returning to full function promoted by the positive behavioral change demonstrated on the VDS; thus, the findings in the study validate the use of the surgical protocol described as an effective method for treating patients with varicose veins (3,13). Additionally, the documented quality of life improvements through the total return to normal from VDS results demonstrate that a well-defined surgical intervention for a properly selected patient will lead to a dramatic improvement in quality of life after surgery and provide significant benefits (3,13).

From the perspective of research methodology, the findings of this study support the continued use of the VCSS for future clinical trial studies evaluating the effects of varicose veins on multiple health care issues (1,10). The enhanced sensitivity of VCSS in comparison to CEAP classification allows for detection of smaller differences in treatment responses between patients with varicose veins and requires a smaller sample size to detect clinically meaningful differences (9,12).From the viewpoint of economics and health care, the overall normalization/vds that occurred indicates a substantial potential to create economic benefits through restored work capacity and reduced disability (22). The evidence from durability of results at 6 months indicates an ongoing continuum of benefit; however, additional long-term follow-up would help determine recurrence rates.

The findings from this study also confirm and extend other studies to examine tools for assessing venous disease. The Meissner et al. landmark study validating the VCSS demonstrated a good correlation between the VCSS and CEAP classification while also possessing an increased sensitivity for serial assessment (1). Our study confirmed and continues these findings in the surgical population.

Studies seeking to assess postoperative outcome through the CEAP Classification have also documented their inability to assess outcomes longitudinally (7,11). Additionally, investigators have reported that patients who have had clinical improvement (18) will often remain in advanced CEAP Classifications despite clinical improvement, confirming observations made in our study (18). As documented by others, the development of a revised CEAP Classification system and complementary scoring tools continues to attempt to address these limitations (6,23).

In our study, the healing rate of 92.9% at 6 months post-surgical treatment is consistent with previously published literature related to surgical treatment of ulcers (21,24). Studies report a wide range of ulcer healing rates based on ulcer characteristics and technique, with global approaches, on average, providing better outcomes than limited approaches (25).

This study is designed with several methodological strengths. These strengths include a prospective design that minimizes recall bias by allowing for systematic data collection from the time of injury to the time of assessment; a standardized surgical intervention to ensure that all patients received the same treatment; a comprehensive assessment of patients utilizing multiple validated scoring systems; a structured and systematic follow-up protocol with pre-established dates for patient assessment; and an adequate sample size to ensure there are clinically and statistically significant differences.There is a range of limitations to be aware of regarding this study. Firstly, the relatively short duration of 6 months of follow-up did not give an opportunity to ascertain long-term recurrence rates or durability of functional improvement. Longer follow-up between 2-5 years would be beneficial to evaluate long-term results of sustained benefit and identify the patterns of recurrence that may occur with this intervention.

Secondly, the study lacks a control group, making it impossible to definitively attribute improvement to the surgical intervention versus the natural history of the disease or a placebo effect. However, the consistent magnitude of improvement seen across all metrics strongly suggests that there is a true treatment effect.

Thirdly, since this is a single-center study, the generalizability of the results may be limited. The type of patients cared for by the institution and the expertise within the institution can affect outcomes and therefore multi-center studies would enhance the external validity of these findings.

Fourthly, selection bias may be an issue because patients with the highest degree of disability (VDS 3), or with significant medical co-morbidities, may have

been excluded from the surgical intervention, which may yield an inflated success rate.

Fifthly, the study did not use any quality of life instruments such as the Aberdeen Varicose Vein Questionnaire/ SF-36 which would give another patient-centered outcome measure to complement the clinical and functional assessments evaluated in this study.

Based on these findings, there are several clinical implications for the practice. For routine clinical evaluation, the use of the VCSS in addition to CEAP classification for complete clinical evaluation of patients with chronic venous disease (1,9), would provide more comprehensive data regarding the patient. Although CEAP classification provides good diagnostic measures, VCSS will provide more useful information to monitor treatment success (10,12).The VCSS (Venous Clinical Severity Score) should be the primary endpoint in clinical trials and quality improvement initiatives for outcome measurement due to its greater sensitivity and quantitative nature than other measures (9,19). The VDS (Venous Disability Score) is an important measure of how well a patient is functioning, and will provide additional functional data to supplement the clinical assessment of the patient (8,13).

Counseling for patients should explain how long it typically takes to see improvement and how the expected rate of improvement is more gradual over several months than immediately after surgery. Also, patients should be made aware of the time required for complete healing, and that they will need to follow the instructions regarding postoperative care in order to attain full function (20,26).

Our results support the need to perform more aggressive surgical procedures on patients selected appropriately, based on their ability to tolerate the procedure, who have advanced venous disease (14,21). The dramatic improvements observed in all outcome measures including complete functional recovery support the need for surgical intervention in this patient population, even in elderly patients with advanced venous disease, if they are medically acceptable candidates for surgery (24,25).

Future research should answer several important additional questions. Long-term outcome assessment through the use of 5 and 10 year follow-up will provide insight into the durability of the benefit from surgery and the recurrence rate of the condition for these patients (21,27). Additionally, comparative research assessing different surgical approaches to treat patients by utilizing VCSS as the primary variable to study different surgical techniques (endovenous thermal ablation vs traditional surgery, location and number of perforators to ligate) will assist in identifying the best treatment modalities for patients (23,28).

Cost-effectiveness analysis incorporating VCSS outcomes, quality of life measures, and utilization of health care resources will provide information necessary for health policy decision making (22). Furthermore, additional research identifying prognostic factors through multivariable analysis to describe all the patient and disease characteristics that would predict an appropriate VCSS response would allow better patient selection and counseling (19,26).

Furthermore, future studies will provide valuable information that could be utilized to develop appropriate patient selection criteria as well as determining appropriate timing for when to initiate treatment for patients, through comparative effectiveness research (surgical treatment vs conservative management and early vs late surgical intervention) with VCSS as the primary outcome measure (24,25).

Minimally clinically important differences established for VCSS would allow for better understanding of changes in scores and will enhance sample size calculations for future studies (9,12).

Patient-reported outcomes and correlation analysis will provide important validation of VCSS score changes by examining the relationship between VCSS score changes and corresponding changes in patient-reported quality of life measures (3,13).

CONCLUSION

This prospective longitudinal study provides robust evidence supporting the superior utility of the Venous Clinical Severity Score compared to traditional CEAP classification for assessing surgical outcomes in patients with primary varicose veins. While the CEAP classification system serves valuable functions in disease categorization and communication, its static nature and classification based on irreversible changes limit its applicability for serial assessment of treatment response.

The key conclusions of this investigation include:

1. **VCSS demonstrates superior sensitivity:** The 92.9% reduction in VCSS at 6 months postoperatively exceeded the 88.9% reduction in CEAP clinical score and substantially surpassed the minimal changes observed in

CEAP classification, establishing VCSS as a more responsive outcome measure.

2. **Comprehensive assessment provides optimal evaluation:** The combination of CEAP classification (for initial diagnosis and disease categorization), VCSS (for quantitative severity assessment and serial monitoring), and VDS (for functional outcome measurement) provides the most comprehensive evaluation framework for patients with chronic venous disease.
3. **Surgical intervention achieves excellent outcomes:** The comprehensive surgical approach employed in this study (saphenofemoral junction ligation, great saphenous vein stripping, and perforator ligation) resulted in dramatic improvements across all outcome measures, including complete pain relief, 92.9% ulcer healing rate, and 100% functional recovery.
4. **Recovery follows a biphasic pattern:** Initial rapid symptomatic improvement during the first 6 weeks is followed by continued consolidation and healing over subsequent months, with maximum benefit achieved at 6 months. This temporal pattern should inform patient counseling and follow-up protocols.
5. **Irreversible changes persist despite clinical improvement:** The persistence of pigmentation and lipodermatosclerosis despite resolution of other symptoms explains why CEAP class changes minimally even with dramatic clinical improvement, highlighting a fundamental limitation of classification-based outcome assessment.

The practical implications of these findings are substantial. For clinical practice, VCSS should be incorporated as a routine outcome measure when evaluating patients undergoing treatment for varicose veins. For research applications, VCSS represents the preferred primary endpoint for clinical trials, offering superior discriminatory ability and quantitative measurement. For patient care, the excellent outcomes demonstrated across all metrics support surgical intervention for appropriately selected patients, even those with advanced disease.

Future research should focus on long-term follow-up to assess durability of outcomes, comparative effectiveness studies examining different treatment modalities using VCSS as the primary endpoint, and health economic analyses incorporating comprehensive outcome assessments to inform resource allocation decisions.

In summary, this study demonstrates that the Venous Clinical Severity Score, when used adjunctively with CEAP classification and Venous Disability Score, provides a comprehensive, evaluative, and longitudinal assessment framework that is superior to CEAP classification alone for assessing surgical outcomes in varicose vein disease. The quantitative, multidimensional nature of VCSS makes it particularly well-suited for serial assessment, enabling clinicians and researchers to accurately capture the magnitude of treatment benefit and guide clinical decision-making.

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TABLES AND FIGURES

Table 1: Demographic Characteristics of Study Population (N=30)

Characteristic	Number (n)	Percentage (%)
Age Distribution		
20-40 years	6	20.0
41-60 years	19	63.3
>60 years	5	16.7
Sex Distribution		
Male	21	70.0
Female	9	30.0
Total Limbs Affected	42	-

Table 2: Preoperative Clinical Manifestations (N=42 limbs)

Clinical Feature	Number of Limbs	Percentage (%)
Varicose veins	42	100.0
Pain	21	50.0
Pigmentation	21	50.0
Lipodermatosclerosis	21	50.0
Edema	10	23.8
Active ulcer	14	33.3
Healed ulcer	0	0.0

Table 3: Preoperative CEAP Classification Distribution (N=42 limbs)

CEAP Class	Number of Limbs	Percentage (%)
C6	28	66.7
C5	3	7.1
C4	11	26.2
C3	10	23.8
C2	4	9.5
C1	0	0.0

Table 4: Comparison of Preoperative Scoring Systems

Scoring System	Mean Score	Standard Deviation	Range

CEAP Class	4.31	-	C2-C6
CEAP Score	8.57	-	3-14
VCSS	12.83	-	6-20
VDS	1.07	-	0-2

Table 5: Temporal Evolution of Outcomes

Parameter	Preoperative	6 Weeks	6 Months	% Reduction (6M)
CEAP Class (mean)	4.31	3.57	2.98	-
CEAP Score (mean)	8.57	3.60	0.95	88.9%
VCSS (mean)	12.83	5.19	0.90	92.9%
VDS (mean)	1.07	0.67	0.00	100.0%

Table 6: Resolution of Clinical Features at Follow-up

Clinical Feature	Baseline (n)	6 Weeks Resolution	6 Months Resolution
Pain	21	Partial (11/21)	Complete (21/21, 100%)
Edema	10	Complete (10/10, 100%)	Complete (10/10, 100%)
Active ulcer	14	None (0/14)	13/14 (92.9%)
Pigmentation	21	None (0/21)	None (0/21)
Lipodermatosclerosis	21	None (0/21)	None (0/21)

Table 7: Comparative Sensitivity of Assessment Tools

Assessment Tool	6-Week % Reduction	6-Month % Reduction	Ranking (Sensitivity)
VDS	37.3%	100.0%	1 (Highest)
VCSS	59.5%	92.9%	2
CEAP Score	57.9%	88.9%	3
CEAP Class	Minimal	Minimal	4 (Lowest)

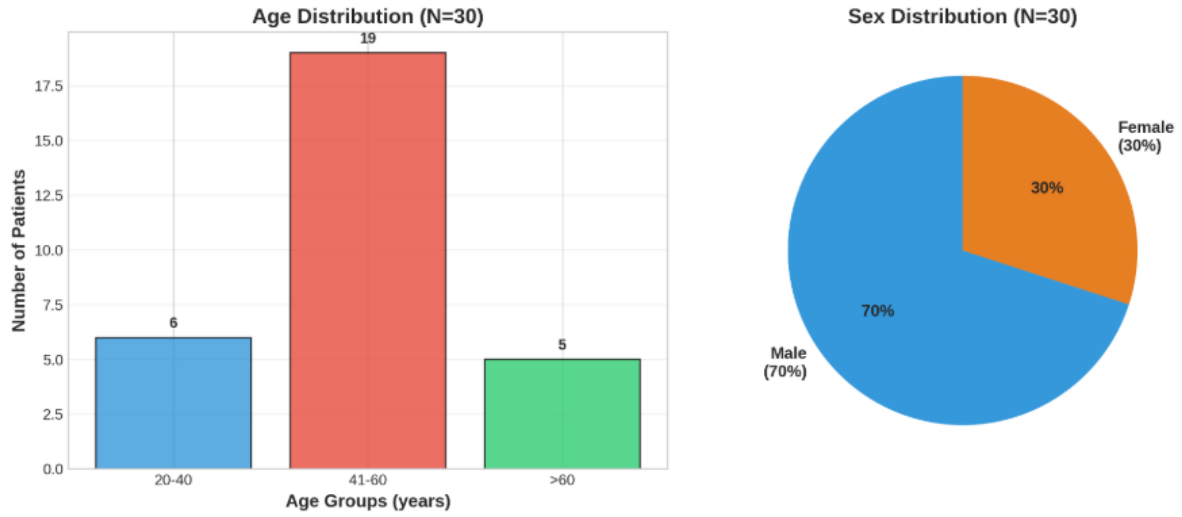

Figure 1. Patient Demographics
(A) Age distribution showing peak incidence in the 41-60 years age group (63.3%, n=19). **(B)** Sex distribution demonstrating male predominance (70%, n=21) in the study cohort. N=30 patients.

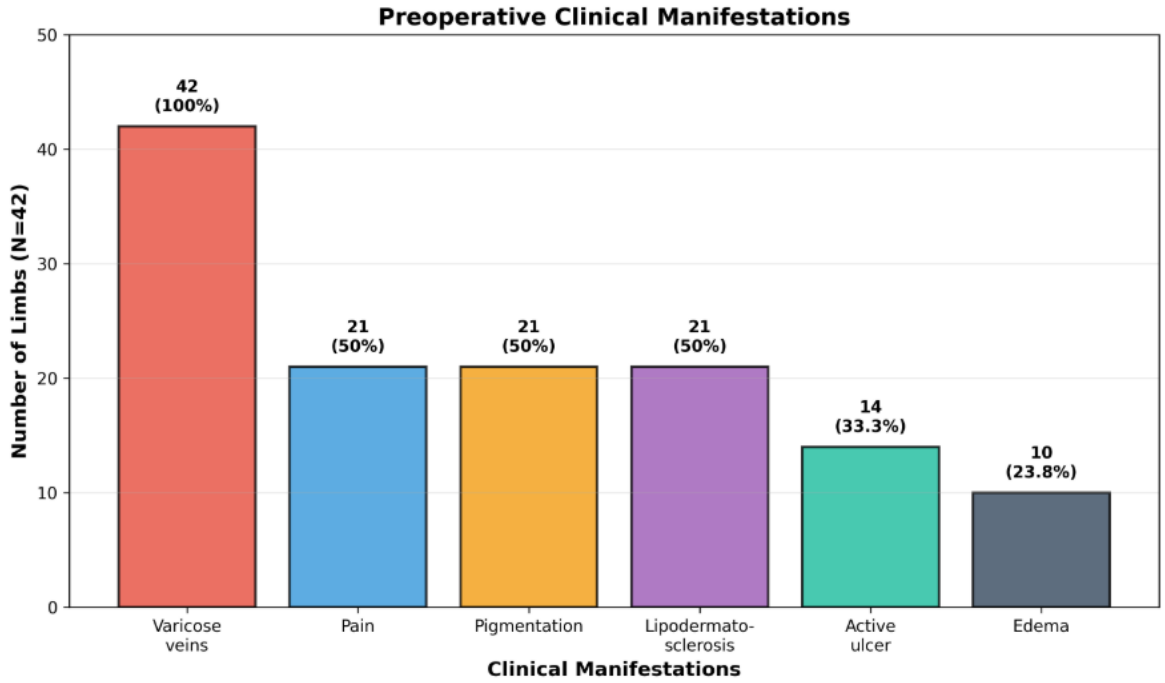

Figure 2. Preoperative Clinical Manifestations
Distribution of clinical features at baseline assessment. All 42 limbs presented with varicose veins (100%). Pain, pigmentation, and lipodermatosclerosis were each present in 21 limbs (50%). Active ulceration was observed in 14 limbs (33.3%), while edema was documented in 10 limbs (23.8%). N=42 limbs.

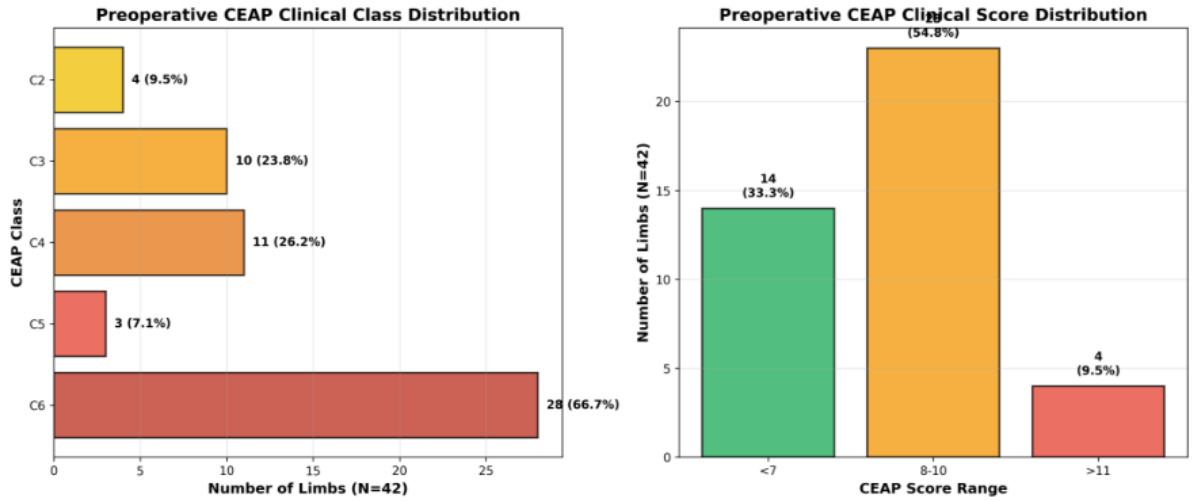

Figure 3. Preoperative CEAP Classification

(A) Distribution of CEAP clinical classes showing predominance of advanced disease (C4-C6) in 28 limbs (66.6%). Class C6 (active ulcer) was most common with 28 limbs (66.7%). **(B)** Distribution of CEAP clinical scores demonstrating that the majority of limbs (54.8%, n=23) scored between 8-10, indicating moderate to severe disease. N=42 limbs.

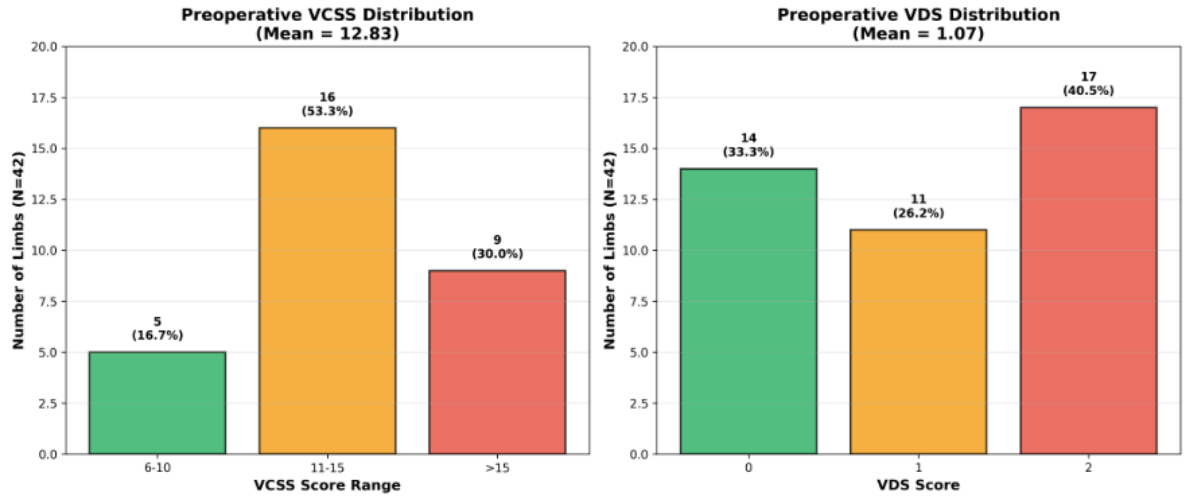

Figure 4. Preoperative Severity Scores

(A) Venous Clinical Severity Score (VCSS) distribution showing most patients (53.3%, n=16) scored between 11-15, with a mean of 12.83. No patients presented with scores below 6. **(B)** Venous Disability Score (VDS) distribution demonstrating that 40.5% of limbs (n=17) scored 2 (able to work with supporting device), reflecting significant functional impairment. Mean VDS was 1.07. N=30 patients for VCSS; N=42 limbs for VDS.

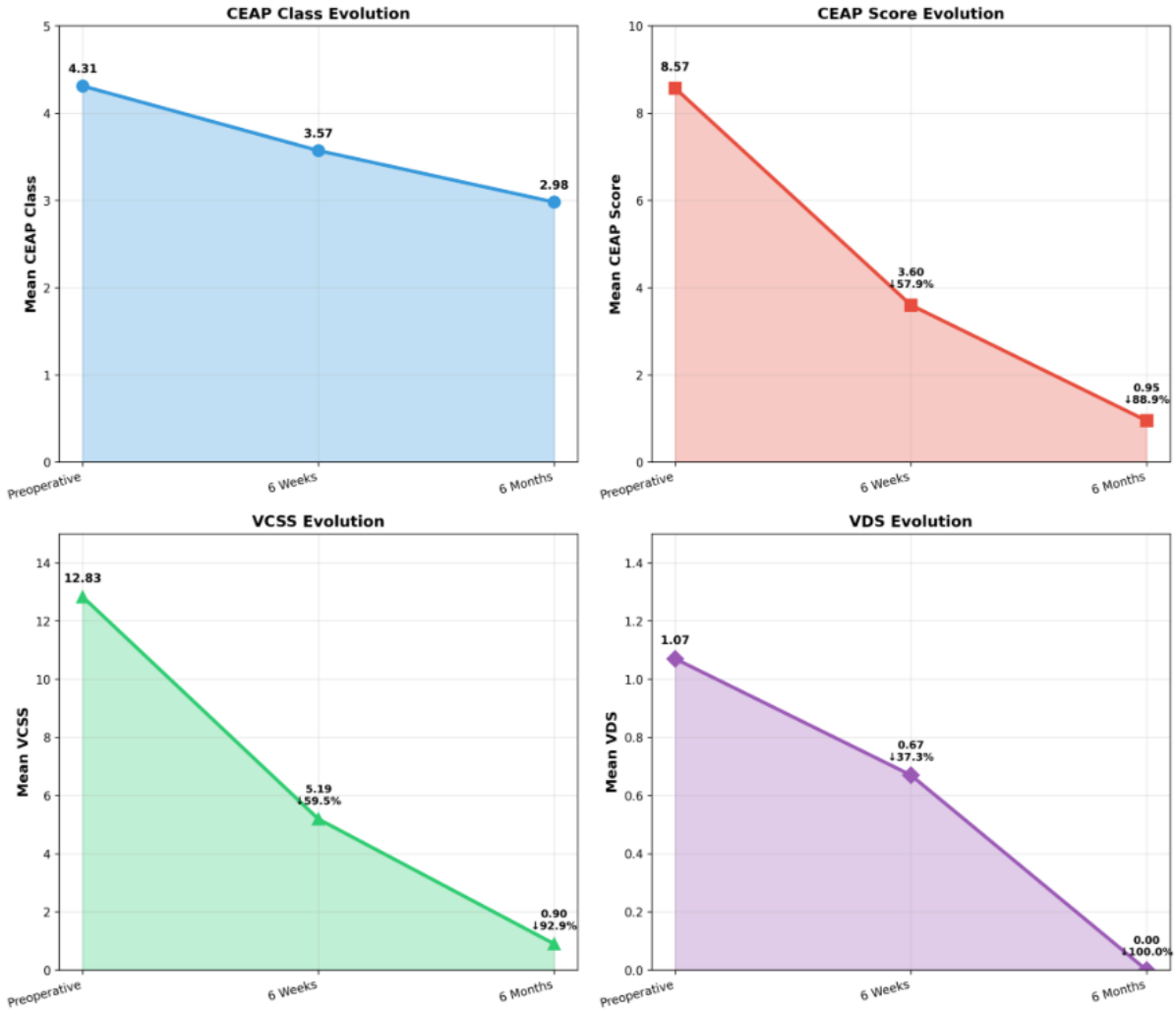

Figure 5. Temporal Evolution of Assessment Scores Following Surgical Intervention

Serial changes in all four assessment tools over 6-month follow-up period. **(A)** CEAP class showed gradual reduction from 4.31 to 2.98 but remained elevated due to irreversible skin changes. **(B)** CEAP score demonstrated 57.9% reduction at 6 weeks and 88.9% reduction at 6 months. **(C)** VCSS showed similar pattern with 59.5% reduction at 6 weeks and 92.9% reduction at 6 months, demonstrating slightly superior sensitivity. **(D)** VDS showed modest early improvement (37.3% at 6 weeks) followed by complete normalization (100% reduction) at 6 months. Percentage reductions calculated from baseline values. N=42 limbs.

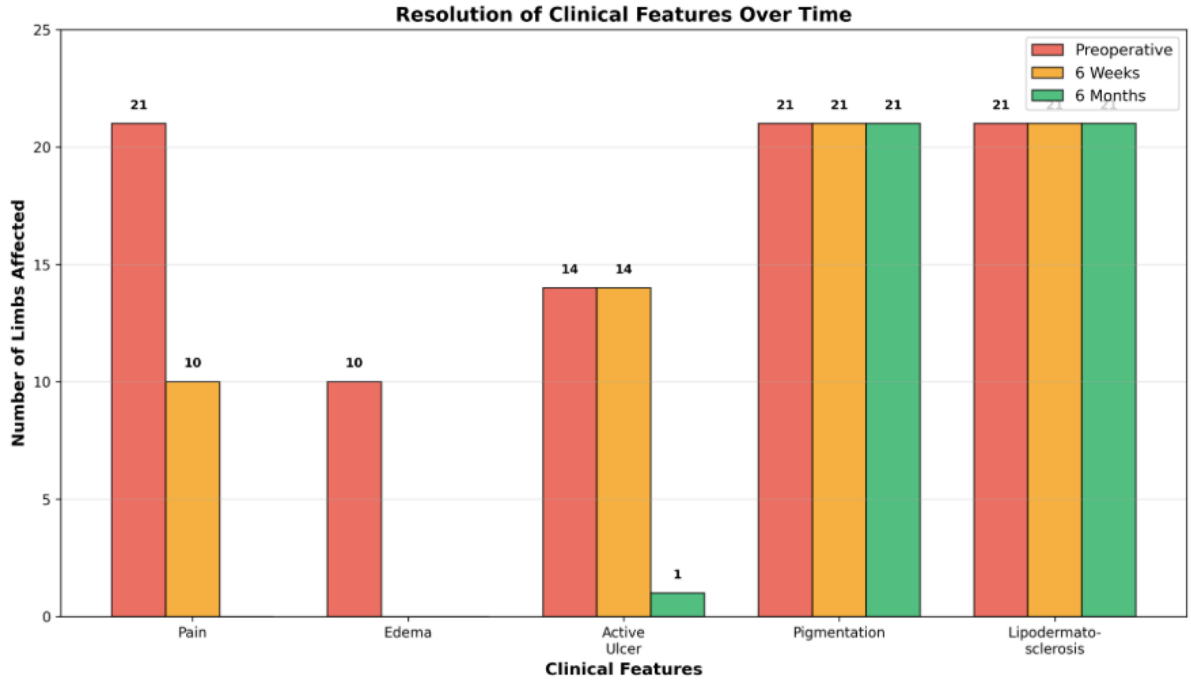

Figure 6. Resolution of Clinical Features Over Time

Temporal pattern of symptom resolution following surgery. Complete resolution of edema was achieved by 6 weeks in all affected limbs. Pain resolved completely by 6 months in all 21 limbs with baseline pain. Active ulcers healed in 13 of 14 limbs (92.9%) by 6 months. Pigmentation and lipodermatosclerosis remained unchanged, representing irreversible tissue changes. N=42 limbs.

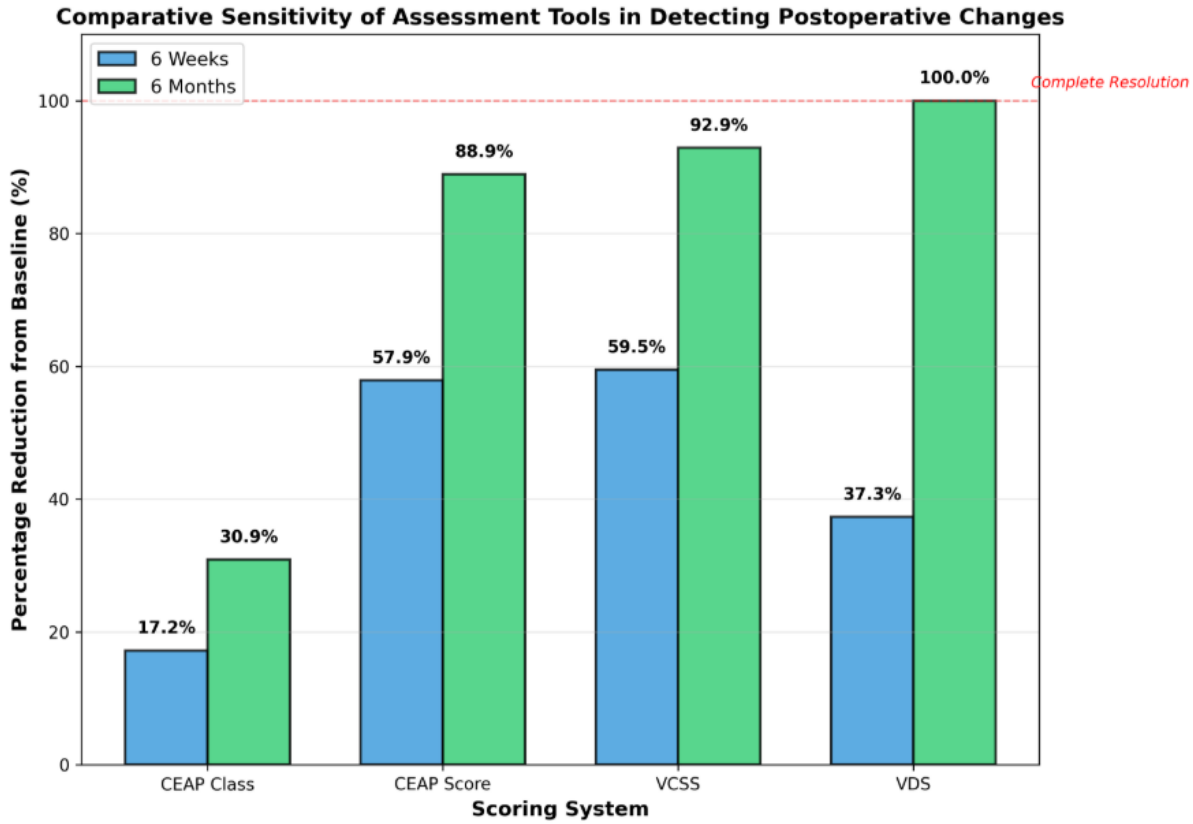

Figure 7. Comparative Sensitivity of Assessment Tools in Detecting Postoperative Changes

Percentage reduction from baseline at 6 weeks (blue) and 6 months (green) for each scoring system. VDS demonstrated greatest sensitivity with 100% reduction at 6 months, followed by VCSS (92.9%), CEAP score (88.9%), and CEAP class (30.9%). The superior performance of quantitative scoring systems (VCSS, VDS) compared to categorical classification (CEAP class) demonstrates their utility for longitudinal outcome assessment. Dashed red line indicates complete resolution. N=42 limbs.