Efficacy of a WeChat-Based Follow-Up Approach in Patients Undergoing Minimally Invasive Treatment for Lower Extremity Varicose Veins

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AIM: This study aims to explore the effectiveness of the WeChat-based digital follow-up approach in patients undergoing minimally invasive surgery for lower extremity varicose veins by evaluating postoperative follow-up compliance, incidence of complications, and patient satisfaction with doctor-patient communication to provide evidence-based improved postoperative follow-up approaches.
METHODS: This retrospective study enrolled 128 patients who underwent minimally invasive surgery for lower extremity varicose veins between January 2022 and June 2023. According to the postoperative follow-up strategy used, patients were divided into an observation group (n = 66) that received WeChat-based digital follow-up, and a control group (n = 62) that underwent traditional outpatient visits combined with telephone-based follow-up. Patients were followed for 6 months, and postoperative follow-up data were recorded. Adherence with scheduled follow-up, improvements in postoperative symptoms, incidence rate of complications, and patient satisfaction with doctor-patient communication were systematically compared between the two groups.
RESULTS: The observation group had significantly higher follow-up compliance rate (96.97%), greater postoperative symptom improvements both after 3- and 6-month follow-up (95.45% and 98.48%), doctor-patient communication satisfaction (96.97%), and a lower overall incidence of complications (4.55%) compared to the control group (83.87%, 82.26%, 88.71%, 83.87% and 16.13% respectively); similarly, the recurrence rate was significantly lower in the observation group (3.03%) compared with the control group (12.90%) (all $p < 0.05$).
CONCLUSIONS: For patients undergoing minimally invasive surgery for lower limb varicose veins, WeChat-based digital follow-up strategies are associated with higher follow-up compliance, earlier detection of postoperative complications, and higher patient overall satisfaction with doctor-patient communication.

Keywords: postoperative complications; lower extremity varicose veins; minimally invasive surgery; follow-up compliance; doctor-patient communication; telemedicine

Introduction

Lower extremity varicose veins are among the common vascular diseases worldwide, affecting a significant proportion of the population, particularly younger people, and compromising patients' lower limb function and significantly reducing quality of life [1–3]. Epidemiological estimates from China show that the prevalence of lower extremity varicose veins is approximately 8.89%, with a clear age-related increase in onset, and has been reported to reach 55.7% among those aged 55–64 years [4–6]. Minimally invasive surgeries, including laser ablation and radiofrequency ablation of the great saphenous vein, have become widely preferred treatment options due to advantages like minimal surgery-associated trauma, faster postoperative recovery, and favorable clinical outcomes [7–9].

Standardized postoperative follow-up plays a crucial role in ensuring treatment efficacy, reducing recurrence, and preventing potential complications like subcutaneous congestion or deep vein thrombosis [10,11]. However, traditional follow-up approaches that rely on outpatient visits combined with telephone communication present several practical concerns. Patients' compliance with scheduled follow-up is often limited by several associated factors, such as work commitments, time constraints, travel distance and geography, resulting in high rates of missed appointments and incomplete clinical monitoring. Moreover, telephone-based follow-up provides limited clinical information, making it challenging to accurately assess limb recovery progress, potentially delaying complication interventions and failing to meet the demands of precise follow-up management [12].

With the widespread adoption of mobile internet technologies, social media platforms such as WeChat have been increasingly used in healthcare delivery systems. These

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platforms provide real-time communication, efficient information dissemination, and versatile content delivery, and have gradually permeated clinical medical services, offering a new path for innovative postoperative follow-up models [13,14]. Currently, WeChat-based managements have been used in several areas, including chronic disease management and postoperative rehabilitation guidance [15–17]. However, a study specifically investigating the application of social media-supported follow-up in patients receiving minimally invasive intervention for lower extremity varicose veins remains limited and fragmented [18].

Therefore, this retrospective study aims to explore the clinical application of a WeChat-based follow-up model in patients who underwent minimally invasive intervention for lower extremity varicose veins. By addressing challenges associated with conventional follow-up strategies, this study seeks to offer evidence that may inform the development of more efficient, tailored, and clinically responsive postoperative management frameworks, while also contributing clinical research data to the growing body of literature on digital health-guided postoperative care.

Methods

Baseline Characteristics of the Study Participants

This retrospective study enrolled 128 patients who underwent minimally invasive surgery for lower extremity varicose veins at Affiliated Hospital of Xuzhou Medical University between January 2022 and June 2023. This study was approved by the Medical Ethics Committee of Affiliated Hospital of Xuzhou Medical University (XYFY2024-KL272-02). All patients were screened according to predetermined inclusion-exclusion criteria to ensure the reliability and consistency of the study cohort.

Inclusion criteria for patient selection were as follows: (1) patients diagnosed with lower extremity varicose veins following the "Diagnosis and Treatment Guidelines for Chronic Venous Diseases of the Lower Limbs (2022 edition)" [4] and confirmed by color Doppler ultrasound; (2) those undergoing their first minimally invasive surgery for lower extremity varicose veins, including laser ablation of the great saphenous vein, radiofrequency ablation, or injection of sclerosing agents; (3) patients capable of basic smartphone operation and able to use social media platforms like WeChat independently; (4) individuals with normal cognitive status, clear consciousness, sufficient communication ability; and (5) availability of complete follow-up data with a low risk of loss to follow-up.

Exclusion criteria included, (1) individuals with severe dysfunction of important organs such as the heart, liver, or kidneys; (2) those with concurrent lower extremity deep vein thrombosis, venous inflammation, skin ulcer infections, or other related diseases; (3) patients with psychiatric disorders or cognitive impairments that could hinder follow-up participation; (4) those residing in remote locations with unstable contact information and a high likelihood of follow-up discontinuation; and (5) individuals who refuse to participant in follow up through WeChat or unable to comply with the study protocol.

Patients were divided into an observation group (n = 66) and a control group (n = 62) based on the postoperative follow-up strategy used. The observation group received follow-up through the WeChat-based social media model, whereas the control group received traditional outpatient visits combined with telephone follow-up. All patients were admitted and treated during the same time period. In routine clinical practice at Affiliated Hospital of Xuzhou Medical University, both the WeChat-based model and traditional outpatient visits combined with telephone follow-up were commonly used. Baseline demographic and clinical characteristics indicated no statistically significant differences between the two groups, suggesting good comparability ($p > 0.05$). Baseline characteristics of the study participants are shown in Table 1.

Intervention Procedures

All patients underwent a standardized preoperative clinical assessment, minimally invasive surgical treatment, and basic postoperative rehabilitation guidance. Postoperatively, patients received routine symptomatic management, including anticoagulation therapy, measures to reduce swelling, and analgesic intervention when needed. Before discharge, the nursing staff provided structured education on postoperative precautions, essential aspects of home-based rehabilitation training, and scheduled follow-up time points. Fixed follow-up visits were arranged for 1 month, 3 months, and 6 months postoperatively through outpatient clinic visits. During the follow-up period, they were instructed to seek medical attention promptly if they observed worsening limb swelling, significant pain, skin damage, or any other abnormal symptoms indicative of complications.

Control Group

Patients in the control group received follow-up through a traditional management strategy combining outpatient visits with telephone-based follow-up. Patients were informed in advance about the timing and procedures of the outpatient visits and in-person evaluation. During revisits, color Doppler ultrasound was conducted to assess vein patency in the treated limb. Physical and clinical examinations were performed to evaluate the functional recovery of the lower limbs, and rehabilitation plans were adjusted according to individual recovery progress. Follow-up telephone calls were conducted by a dedicated responsible nursing staff according to a standardized schedule at 1 week, 2 weeks, 1 month, 3 months, and 6 months after surgery. During each call, nursing staff evaluated postoperative symptoms, adherence to suggested home-based rehabilitation training, and any issues related to recovery. They were also reminded about scheduled clinic revisits, and all follow-up

Table 1. Baseline characteristics of study participants.

General information	Observation group (n = 66)	Control group (n = 62)	χ^2/t value	*p*-value
Gender			0.047	0.828
Male	30 (45.45)	27 (43.55)		
Female	36 (54.55)	35 (56.45)		
Age (years)	53.23 ± 8.18	52.91 ± 7.93	0.224	0.823
Age stratification			0.070	0.791
Young/Middle-aged (≤60 years)	43 (65.15)	39 (62.90)		
Elderly (>60 years)	23 (34.85)	23 (37.10)		
Education level			0.058	0.809
Junior high school and below	28 (42.42)	25 (40.32)		
High school and above	38 (57.58)	37 (59.68)		
Occupation			0.019	0.889
Sedentary Occupation	37 (56.06)	34 (54.84)		
Non-Sedentary Occupation	29 (43.94)	28 (45.16)		
Surgical procedure			0.025	0.987
Great saphenous vein laser ablation	39 (59.09)	36 (58.06)		
Radiofrequency ablation	17 (25.76)	16 (25.81)		
Sclerosing agent injection	10 (15.15)	10 (16.13)		

information was recorded systematically. If a patient could not be reached via phone calls, repeat calls were attempted after a 24-hour interval. Patients who could not be reached after three consecutive attempts and for whom no other means of contact were available were considered lost to follow-up.

Observation Group

Patients in the observation group underwent a WeChat-based social follow-up. This follow-up approach included a three-tier framework consisting of "common group management + precise intervention with subgroup labels + one-on-one precise connections". Before discharge, specialized medical staff assessed baseline patient information and invited patients and their families to join a WeChat follow-up group. Each group was supervised by one attending vascular surgeon and two specialized nurses responsible for providing health education, answering queries, and ensuring consistent delivery of follow-up information. The nursing staff established a one-on-one WeChat contact with each patient to facilitate personalized communication. These follow-up strategies were tailored according to patient age, education level, occupation and communication preferences. The specific implementations were as follows:

(1) *Stratified group structure and subgroup labeling*: Based on age, education level, and occupation, patients were divided into four core groups, including "Young/Middle-aged High Education Group", "Young/Middle-aged Low Education Group", "Elderly Non-Sedentary Group", and "Elderly Sedentary Group". Within the Young/Middle-aged High/Low Education Groups, further subgroup distinctions were made as "[Sedentary Occupation]" or "[Non-Sedentary Occupation]" to fine-tune intervention strategies and avoid redundancy within groups.

(2) *Precision follow-up reminders*: Reminder methods were tailored to patient characteristics. The Young/Middle-aged High Education Group received combined reminders through group announcements and one-on-one messages, with an additional exclusive reminder provided during workday lunch breaks for the [Sedentary Occupation] subgroup. The Young/Middle-aged Low Education Group received voice reminders in addition to combined reminders, with the [Sedentary Occupation] subgroup also receiving lunch break reminders. The Elderly Group received voice reminders, and, when necessary, family members were involved to improve adherence.

(3) *Real-time efficient communication*: Real-time communication was adopted to enhance accessibility and responsiveness. The Young/Middle-aged High Education Group supported text/voice/picture/video consultations with medical staff responding within 12 hours. The Young/Middle-aged Low Education Group prioritized voice and simplified text/image communications with responses within 24 hours, providing one-on-one video guidance for complex issues. The Elderly Group was encouraged to involve family members in audio/video consultations when needed, with a dedicated response within 24 hours. Male patients received rapid alerts about complications, simplifying communication processes, while female patients received additional guidance on rehabilitation details and psychological support. All [Sedentary Occupation] subgroups had access to an emergency consultation green channel, with responses prioritized within 3 hours during working hours.

(4) *Personalized rehabilitation guidance*: Rehabilitation guidance was provided according to individual patient demands. The Young/Middle-aged High Education Group [Non-Sedentary Occupation] subgroup received in-depth rehabilitation materials through text, pictures, and videos,

while the [Sedentary Occupation] subgroup received 3-minute work break exercises, compression stocking maintenance guides, and occupational vein protection tips. The Young/Middle-aged Low Education Group [Non-Sedentary Occupation] subgroup received short videos and core recovery points in ≤50 characters, while the [Sedentary Occupation] subgroup received animated rehabilitation exercises and occupational protection advice. The Elderly Group received ≤1-minute short videos with voice explanations and one-on-one video guidance to correct rehabilitation movements.

(5) *Information collection and remote monitoring*: The Young/Middle-aged High Education Group was encouraged to upload pictures of the affected limb and provide self-reported data for review by medical staff. The Young/Middle-aged Low Education Group utilized a multiple-choice recovery status survey, with the [Non-Sedentary Occupation] subgroup able to have family assistance in uploading limb photos. Patients in the Elderly Group were assisted by family members in submitting pictures and basic health-related data, with medical staff actively engaged in one-on-one inquiries once a week. Male patients uniformly followed a simplified data reporting process, focusing on multiple-choice/one-click feedback.

(6) *Targeted health education*: Monthly online health educational sessions were conducted to enhance patient understanding of postoperative management. The Young/Middle-aged High Education Group focused on evidence-based medicine and the latest advances in diagnosis and treatment. The Young/Middle-aged Low Education Group used comics/short videos for basic recovery and complication identification, while the Elderly Group focused on early identification of complications and home emergency handling, with dialect explanations as needed. All [Sedentary Occupation] subgroups held biweekly occupational vein injury prevention and control-themed health education sessions, with the content shared in group chats and one-on-one chat windows.

Both groups of patients completed a full 6-month follow-up, and all follow-up data were systematically recorded. Stratified follow-up indicators in the observation group were statistically analyzed to identify factors influencing postoperative outcomes.

Special emphasis was given to patient privacy and data protection throughout the stratified WeChat-based follow-up. Patient information was de-identified and desensitized, and an encrypted data storage approach was used to prevent information leakage and unauthorized access. During implementation, regular security evaluations were conducted to identify potential risks. At the same time, privacy protection training was provided for medical staff participating in the follow-up to strengthen their confidentiality and data protection procedures. Through these measures, no patient information leakage incidents occurred during the follow-up period, and patient satisfaction with privacy protection reached over 95%. This effectively safeguards patients' rights and interests, allowing them to receive secure and reliable follow-up services.

Evaluation Metric and Outcome Indicators

The following outcome measures were assessed in this study.

(1) *Follow-up compliance*: Patients' compliance with scheduled follow-up was quantitatively assessed by calculating the proportion of completed follow-up appointments. Complete compliance was defined as participation in ≥90% of scheduled follow-ups (both outpatient visits and online or telephone calls). Partial compliance was categorized as participation in 50–89% of follow-ups, whereas participation in less than 50% follow-up contacts or refusal to continue was classified as non-compliance. The overall compliance rate was calculated as follows: Compliance rate = (complete compliance case count + partial compliance case count) / total number of participants × 100%.

(2) *Postoperative clinical efficacy*: Symptom improvement was assessed at 1, 3, and 6 months postoperatively using a standardized questionnaire that included items on limb swelling, pain, heaviness, and skin-related abnormalities. Each symptom was rated on a 5-point Likert scale (0 = no relief, 4 = complete relief). Complete symptom relief was defined as a score of 3 or 4 for all observed symptoms, partial relief as a score of 1 or 2 for at least one symptom, and no relief as a score of 0 for all symptoms. Assessments were conducted by trained medical staff blinded to the patient's group assignment. The symptom improvement was determined as follows: Symptom relief rate = (complete relief case count + partial relief case count) / total number of participants × 100%.

(3) *Postoperative complications*: Postoperative complications, occurring within 6 months, were documented for both groups, including subcutaneous hematoma, deep vein thrombosis of the lower limb, sensory abnormalities of the skin, and incision infection. The overall complication rate was calculated.

Criteria for complication assessment were as follows: ① Subcutaneous hematoma, defined as subcutaneous hemorrhage with a diameter >10 mm, resulting from vascular leakage and accumulation in subcutaneous tissues. Clinically, the patient may experience localized swelling or fluctuation sensation accompanied by ecchymosis, purpura, or tenderness. The lesion does not fade with pressure. Superficial B-mode ultrasound and other imaging examinations were used to assess the size and location of the subcutaneous hematoma. Laboratory examinations, such as blood routine and coagulation function tests, were used to exclude bleeding diseases or coagulation dysfunction. ② Deep vein thrombosis (DVT) patients often present with unilateral limb swelling, pain, increased skin temperature, skin redness or discoloration, with symptoms usually worsening by standing or walking and partially relieved by

Table 2. Comparison of follow-up compliance between groups [n (%)].

Group	n	Complete compliance	Partial compliance	Non-compliance	Compliance rate
Observation group	66	54 (81.82)	10 (15.15)	2 (3.03)	64 (96.97)
Control group	62	37 (59.68)	15 (24.19)	10 (16.13)	52 (83.87)
χ^2 value					6.456
p-value					0.011

limb elevation. Physical examination may show Homer's sign, indicated by calf pain when flexing the dorsum of the foot, accompanied by tenderness along the venous pathway. Doppler ultrasound is used to identify intravascular thrombus and the absence of normal blood flow. Contrast venography, a diagnostic gold standard, is usually used to detect venous filling defects or truncation. CT or MRI venography may be used in complex cases or suspected pelvic or abdominal thrombosis. ③ Skin sensory abnormalities are manifested as numbness, tingling, burning sensations, sensory loss, or hypersensitivity. Physically, spontaneous abnormal sensations such as numbness or tingling may spread along the nerve distribution area. In auxiliary examinations, nerve conduction tests can be used to assess nerve function. Imaging examinations such as MRI may help in excluding other causes, such as cervical spondylosis or diabetic peripheral neuropathy. Final identification requires a comprehensive assessment of the medical history and symptom presentation. ④ Incision infection is usually characterized by localized redness, swelling, heat, and pain around the incision site. Deeper incisions may present with tenderness, induration, or fluctuation sensation, and may sometimes show incision dehiscence or separation, exudate or pus, typically yellow or green in color and have a foul odor. Systemic manifestations may include fever, chills, and fatigue, indicating extensive infection spread. Laboratory examinations may show increased white blood cell count and elevated inflammatory markers, such as C-reactive protein and procalcitonin. Etiological or histopathological examination of incision tissue may be conducted to identify causative organisms and confirm the diagnosis.

(4) *Patient satisfaction with doctor-patient communication*: Satisfaction level was assessed using the hospital-developed "Patient Satisfaction Scale for Doctor-Patient Communication", which includes three dimensions: nursing attitude, effectiveness of intervention, and overall medical experience. The scale consists of 15 items rated on a 5-point Likert scale, with a total score of 75 points. Scores of $\geq$60 indicated very satisfied, 45–59 indicated satisfied, and $<$45 indicated dissatisfied. The satisfaction rate was calculated as follows: Satisfaction rate = (the number of very satisfied individuals + the number of satisfied individuals) / total cases $\times$ 100%.

(5) *Diagnostic criteria for recurrence of lower limb varicose veins*: Recurrence was defined as the reappearance of tortuous and dilated venous masses at the original surgical site or in a newly affected area, which worsen after prolonged standing. Patients may experience lower limb soreness, heaviness, skin hyperpigmentation, or eczema-like skin changes. In severe cases, venous ulcers may develop. Ultrasound examination was used to assess venous valve regurgitation and hemodynamic abnormalities. A reflux duration of $>$0.5 s was used as the criterion for diagnosing venous valvular insufficiency. Recurrence was confirmed when imaging findings revealed deep vein or communicating branch vein dysfunction with factors such as inconsistent use of compression stockings or long-term occupational standing after surgery considered as potential contributing factors.

Statistical Methods

Statistical analysis was conducted using SPSS (version 26.0, International Business Machines Corporation). Continuous variables were first examined for normality using the Shapiro-Wilk test. Normally distributed variables were represented as mean $\pm$ standard deviation, and an independent sample *t*-test was used for intergroup comparison. Non-normally distributed variables were analyzed using the Mann-Whitney U test. Count data or categorical variables were expressed as frequencies and percentages [n (%)], and comparisons between groups were conducted using the chi-square test. If necessary, Fisher's exact probability method was used. All statistical tests were two-sided, and a *p*-value $<$ 0.05 was considered statistically significant.

Results

Comparison of Follow-Up Compliance Between the Two Groups of Patients

The follow-up compliance rate in the observation group was 96.97%, significantly higher than the 83.87% in the control group. The difference between the groups was statistically significant ($p < 0.05$, Table 2).

Comparison of Postoperative Symptom Relief Rates at Different Time Points Between the Two Groups of Patients

One-month postoperative assessment, the rate of symptom improvement did not differ substantially between the two groups ($p > 0.05$). However, at 3- and 6-month follow-up, patients in the observation group exhibited significantly higher symptom relief rates compared with the control group ($p < 0.05$, Table 3).

Table 3. Comparison of postoperative symptom relief rates at different time points between the two groups of patients [n (%)].

Group	n	1 month postoperatively	3 months postoperatively	6 months postoperatively
Observation group	66	57 (86.36)	63 (95.45)	65 (98.48)
Control group	62	51 (82.26)	51 (82.26)	55 (88.71)
χ^2 value		0.409	5.715	5.213
p-value		0.523	0.017	0.022

Table 4. Comparison of postoperative follow-up results between two groups of patients [n (%)].

Group	n	Subcutaneous hematoma	Deep vein thrombosis	Skin sensation abnormality	Incision infection	Total incidence rate [n (%)]	Recurrence rate [n (%)]
Observation group	66	2 (3.03)	0 (0.00)	1 (1.52)	0 (0.00)	3 (4.55)	2 (3.03)
Control group	62	5 (8.06)	2 (3.23)	2 (3.23)	1 (1.61)	10 (16.13)	8 (12.90)
χ^2 value						4.701	4.327
p-value						0.030	0.038

Table 5. Comparison of patient-doctor communication satisfaction between the two groups of patients [n (%)].

Group	n	Very satisfied	Satisfied	Dissatisfied	Total satisfaction rate [n (%)]
Observation group	66	47 (71.21)	17 (25.76)	2 (3.03)	64 (96.97)
Control group	62	22 (35.48)	30 (48.39)	10 (16.13)	52 (83.87)
χ^2 value					6.456
p-value					0.011

Comparison of Postoperative Follow-Up Outcomes Between the Two Groups

The overall incidence of postoperative complications was 4.55% in the observation group, which was significantly lower than the 16.13% in the control group. Similarly, the recurrence rate was significantly lower in the observation group (3.03%) compared with the control group (12.90%) ($p < 0.05$, Table 4).

Comparison of Patient Satisfaction With Doctor-Patient Communication Between the Two Groups of Patients

Patient satisfaction with doctor-patient communication was significantly higher in the observation group (96.97%) than in the control group (83.87%) ($p < 0.05$, Table 5).

Discussion

Recovery of vascular integrity and functional improvement of the affected limb after minimally invasive surgery for lower limb varicose veins typically requires approximately 6–12 months. In addition, some complications may manifest insidiously and remain clinically mild in the early stages. Without timely intervention, they can lead to disease recurrence and even trigger more serious adverse events such as deep vein thrombosis. Therefore, standardized and efficient postoperative follow-up is crucial in supporting recovery and maintaining long-term clinical benefit [19–22]. Traditional follow-up models have significant practical challenges. Participation in outpatient visits is often limited by factors such as work schedules, individual lifestyle, and travel distance, resulting in low compliance and interrupting continuity of management. Telephone-based follow-up offers only limited clinical information, making it challenging to objectively assess recovery progress, which may potentially delay intervention for complications. Furthermore, delayed communication between medical staff and patients may affect patient confidence and overall healthcare experience. As a result, there is increasing interest in developing innovative follow-up models that combine efficiency with personalized care to enhance the quality of postoperative management for patients undergoing minimally invasive surgery of lower limb varicose veins.

Digital communication and social media platforms provide a feasible approach to optimizing postoperative follow-up because they enable real-time interaction, diverse information dissemination, and easy access to clinical guidance. In the present study, retrospective analysis demonstrated that patients managed through a WeChat-based social media follow-up approach, stratified according to age, education level, gender, and occupation, exhibited significantly higher compliance with scheduled follow-up and greater postoperative symptom improvement at 3 and 6 months compared with those receiving conventional follow-up care. The incidence of complications was lower, and patient satisfaction with medical communication was significantly improved in the observation group. These findings are consistent with previous studies suggesting a close association of this care model with the improvement in postoperative recovery indicators [23–25].

The improved outcomes observed with this strategy may be explained by several factors. First, structured follow-up reminders through digital platforms may reduce missed

follow-ups, while online communication decreases the time and economic costs associated with physical visits, thereby enhancing compliance. Second, various forms of communication, such as text, images, and videos, allow healthcare providers to assess limb recovery remotely, facilitating early detection of even mild complications and clinical changes and enabling prompt intervention. Third, the removal of temporal and distance constraints supports continuity of doctor-patient communication, providing real-time answers to patient queries, personalized rehabilitation guidance, and enhancing patient awareness of disease and promoting compliance through education, thus optimizing communication experience. Additionally, this study introduced subgroups labeled as [Sedentary Occupation]/[Non-Sedentary Occupation] within the core group of middle-aged individuals with high/low education levels. This adjustment of intervention strategies achieved precise coverage across the entire population, avoiding the increase in healthcare management costs associated with grouping across all dimensions. It also addressed the lack of precision in interventions for individual groups, ensuring that follow-up strategies align more closely with the actual needs of different subgroup populations. Furthermore, this approach may have contributed to the improved follow-up effectiveness observed in the digital follow-up group.

We acknowledge several limitations that should be considered when interpreting these results. This study included patients treated with three surgical methods (laser ablation, radiofrequency ablation, and sclerosing agent injection), which may have introduced variability in recovery patterns and follow-up compliance. The sample size calculation was exclusively reported, and the relatively small sample size may limit statistical power. Some outcome measures, such as follow-up compliance and symptom improvement, incorporated subjective elements that may affect the reproducibility of results and introduce potential measurement bias. Finally, the study was performed in a single center, which may restrict the generalizability of the findings, and the short follow-up period of 6 months may not enable assessment of long-term outcomes. Moreover, no quantitative assessment was performed regarding the workload efficiency of healthcare providers or the cost-effectiveness associated with the WeChat-based follow-up approach. Future research should consider a multicenter design with large sample sizes and long-term follow-up periods to further evaluate the long-term clinical efficacy and economic feasibility of this care model more comprehensively. Concurrently, evaluation of healthcare resource utilization, such as clinician working hours and patient-related medical expenses, would provide further insights into the practical application of digital follow-up strategies. This study assumed that all patients had access to smartphones and internet connectivity and therefore, did not include special populations with limited access to smart devices or digital technologies, which may raise concerns regarding equity in digital follow-up. Although patient-related data were protected during WeChat-based online follow-up, further research is warranted to assess data security and privacy frameworks in greater detail.

Conclusions

For patients undergoing minimally invasive surgery of lower limb varicose veins, follow-up based on social media platforms such as WeChat demonstrates potential benefits in enhancing compliance with follow-up schedules, facilitating early detection and management of complications, supporting postoperative outcomes, and improving patient satisfaction with doctor-patient communication. While this care model showed promising results, further multicenter studies are needed to validate the generalizability and effectiveness of this approach across different clinical settings. In conducting digital follow-ups, careful attention should be paid to patient privacy protection and confidentiality to ensure the safe handling of medical information.

Availability of Data and Materials

The data analyzed are available from the corresponding author upon reasonable request.

Author Contributions

YW designed the research study. ZZ performed the research and analyzed the data. YW wrote the manuscript. Both authors have been involved in revising the manuscript critically for important intellectual content. Both authors gave final approval of the version to be published. Both authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

Ethics Approval and Consent to Participate

This study is in accordance with the Declaration of Helsinki. The study was approved by the Medical Ethics Committee of Affiliated Hospital of Xuzhou Medical University (XYFY2024-KL272-02). The study adhered to the principle of informed consent throughout the experiment, with information about the study provided to patients or their families, and written consent was obtained.

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Conflict of Interest

The authors declare no conflict of interest.

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