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Original Article

Healing Delay in Venous Leg Ulcer Post Endovenous Laser Ablation: A Single Center Study

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Abstract

Venous leg ulcer (VLU) is the most advanced manifestation of chronic venous insufficiency and remains a major cause of morbidity, prolonged disability, and healthcare burden worldwide. Although endovenous laser ablation (EVLA) improves ulcer healing by correcting superficial venous reflux, delayed healing remains common in a subset of patients. This study aimed to evaluate factors associated with delayed healing of VLUs following EVLA. This retrospective cohort study was conducted at the Department of Vascular Surgery, Ibrahim Cardiac Hospital and Research Institute, Dhaka, Bangladesh, from January 2020 to December 2024. A total of 256 adult patients with duplex-confirmed venous leg ulcers who underwent EVLA with or without adjunctive foam sclerotherapy were included using consecutive sampling. Delayed healing was defined as failure of complete epithelialization or a <50% reduction in ulcer area within 12 weeks after intervention. Demographic, socio-economic, clinical, mobility-related, and venous variables were analyzed. Univariate and multivariate logistic regression analyses were performed to identify predictors of delayed healing. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. The mean age of the participants was 48.16±11.69 years, and 65.6% were male. Hypertension (56.3%), atrial fibrillation (33.6%), diabetes mellitus (32.8%), and coronary artery disease (23.8%) were common comorbidities. Most patients belonged to lower and middle socio-economic groups and demonstrated limited mobility and delayed healthcare-seeking behavior. Significant predictors of delayed healing in univariate analysis included small saphenous vein reflux (OR 2.15; p=0.012), persistent superficial reflux after ablation (OR 5.72; p<0.001), recanalization (OR 5.80; p<0.001), previous deep vein thrombosis (OR 2.21; p=0.015), and wheelchair dependence (OR 2.06; p=0.035). In multivariate logistic regression analysis, persistent superficial reflux after ablation remained the strongest independent predictor of delayed healing (adjusted OR 5.28; p<0.001), while wheelchair dependence also remained significant (adjusted OR 2.10; p=0.027). Other demographic and systemic comorbidities were not statistically significant. Persistent superficial reflux, recanalization, previous DVT, SSV reflux, and impaired mobility are major contributors to delayed healing after EVLA. Early detection of residual reflux, optimized post-procedural surveillance, rehabilitation, and improved socio-economic support may improve healing outcomes and reduce chronic ulcer burden.

Keywords: *Venous leg ulcer; endovenous laser ablation; delayed healing; venous reflux; deep vein thrombosis; chronic venous insufficiency.*

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INTRODUCTION

Venous leg ulcer (VLU) is the most severe clinical manifestation of chronic venous insufficiency and accounts for approximately 70–80% of lower limb ulcers worldwide. VLUs are associated with substantial morbidity, prolonged treatment duration, recurrent infection, impaired mobility, reduced quality of life, and increased healthcare expenditure.[1] Delayed healing and ulcer recurrence remain major therapeutic challenges despite advances in venous interventions and wound care strategies.[3–5]

In low- and middle-income countries such as Bangladesh, delayed referral, poor socioeconomic conditions,

inadequate compliance with compression therapy, and limited access to vascular care may further influence healing outcomes and resource utilization.[1]

The pathophysiology of VLU is multifactorial and involves sustained venous hypertension caused by superficial, perforator, or deep venous reflux. Persistent venous hypertension leads to microcirculatory dysfunction, tissue hypoxia, inflammation, and eventual skin breakdown.[5] Several clinical and wound-related factors have been identified as predictors of delayed healing, including prolonged ulcer duration, recurrent ulcers, deep vein thrombosis (DVT), impaired mobility, infection, large ulcer size, persistent venous reflux, and associated comorbidities such as diabetes mellitus and cardiovascular disease.[3–5,9,10]

Compression therapy remains the cornerstone of VLU management and has demonstrated significant benefit in improving venous return and ulcer healing.[12,18] However, compression therapy alone is often insufficient in patients with underlying superficial venous incompetence. Surgical and endovenous interventions targeting refluxing veins have therefore emerged as important adjunctive therapies. The ESCHAR (Effect of Surgery and Compression on Healing and Recurrence) trial demonstrated that surgery combined with compression therapy significantly reduced ulcer recurrence compared with compression alone.[8] Similarly, the EVRA trial showed that early endovenous ablation accelerated ulcer healing and improved ulcer-free time in patients with venous ulceration.[6] Contemporary European Society for Vascular Surgery (ESVS) guidelines also recommend early correction of superficial venous reflux in appropriately selected patients with VLUs.[13]

EVLA has become a widely accepted minimally invasive treatment modality for superficial venous insufficiency due to its high occlusion rates, shorter recovery time, and favorable clinical outcomes.[16] Nevertheless, a proportion of patients continue to experience delayed ulcer healing despite technically successful ablation. Persistent superficial reflux, perforator incompetence, recanalization, reduced mobility, and previous DVT have been implicated as possible contributors to poor healing outcomes after endovenous intervention.[7,14,15,17]

This study aimed to evaluate factors associated with delayed healing in patients with venous leg ulcers following endovenous laser ablation at a tertiary vascular center in Bangladesh. The findings may help identify high-risk patients, optimize postoperative surveillance, and improve individualized management strategies for venous ulcer care.

MATERIALS AND METHODS

Study design and setting: This was a retrospective cohort study conducted among 256 patients with venous leg ulcers in the Department of Vascular Surgery at Ibrahim Cardiac Hospital & Research Institute, Dhaka, Bangladesh, between January 2020 and December 2024.

Study population and sampling: All consecutive adult patients (≥18 years) diagnosed with venous leg ulcers (VLUs) and treated with endovenous interventions at the study center during the study period were considered eligible. A non-probability consecutive sampling technique was used to minimize selection bias.

Inclusion criteria: 1) Patients with clinically and duplex ultrasonography (DUS)-confirmed venous leg ulcers, 2) Patients undergoing endovenous treatment (endovenous laser ablation and/or radiofrequency ablation with or without foam sclerotherapy), and 3) Availability of baseline and follow-up clinical and ultrasonographic data.

Exclusion criteria: 1) Significant peripheral arterial disease (ankle–brachial index <0.8), 2) Non-venous ulcers (e.g., arterial, diabetic, malignant, or vasculitic ulcers), 3) Ulcer size <1 cm^2 or >100 cm^2, 4) Ulcer duration >5 years, and 5) Incomplete clinical records or loss to follow-up within 3 months.

Diagnostic assessment: All patients underwent duplex ultrasonography performed by an experienced vascular physician to confirm venous etiology. Superficial venous reflux was defined as retrograde flow lasting >0.5 seconds. The evaluation included the great saphenous vein (GSV), small saphenous vein (SSV), perforator veins, and assessment of deep venous patency and reflux.

Intervention protocol: Endovenous treatment was performed using endothermal ablation techniques (endovenous laser ablation or radiofrequency ablation) with or without adjunctive foam sclerotherapy, depending on venous anatomy and reflux patterns. Procedures were conducted under ultrasound guidance with tumescent local anesthesia. Post-procedure, all patients received standardized compression therapy and wound care. Patients were followed at 4-6 week intervals. Clinical assessment and repeat duplex ultrasonography were performed during follow-up visits.

The primary outcome was delayed ulcer healing, defined a priori as <50% reduction in ulcer area or failure to achieve

complete epithelialization within 12 weeks after the initial endovenous intervention. Ulcer size was measured using a standardized planimetric assessment.

Variables and data collection: Data were extracted from hospital records, including- 1) Demographic characteristics (age, sex), 2) Clinical variables (ulcer duration, recurrence, mobility status), 3) Comorbidities (hypertension, diabetes mellitus, atrial fibrillation, coronary artery disease, cardiac insufficiency), 4) Risk factors (smoking, history of deep vein thrombosis, erysipelas), and 5) Venous characteristics (GSV/SSV reflux, perforator incompetence, persistent reflux after ablation, recanalization). Records with missing key outcome data were excluded. For variables with minor missing values (<5%), complete-case analysis was performed. No imputation was applied due to the retrospective nature of the study.

Statistical analysis: Data were analyzed using Statistical Package for Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Univariate logistic regression analysis was performed to identify factors associated with delayed healing. Variables with $p<0.20$ in univariate analysis and clinically relevant variables were included in a multivariate logistic regression model to identify independent predictors. Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs). A p-value <0.05 was considered statistically significant. Multivariate logistic regression was used to adjust for potential confounders, including age, sex, ulcer duration, and major comorbidities. Collinearity between variables was assessed before model inclusion.

Ethical considerations: Ethical approval was obtained from the Institutional Review Board (IRB) of Ibrahim Cardiac Hospital & Research Institute (Approval No.: [to be added]). As this was a retrospective study using anonymized data, the requirement for informed consent was waived. Written informed consent was obtained from all participants prior to enrollment.

RESULTS

A total of 256 patients with venous leg ulcers were included.

Table I shows the demographic profile of the study population, which indicates that the mean age was 48.16 ± 11.69 years. The major age group was 46-60 years (53.5%), followed by 31-45 years (23.8%), >60 years 14.1%), and 18-30 years (8.6%). Male patients comprised 168 cases (65.6%), and the male-to-female ratio was about 2:1.

Table I: Demographic characteristics of the study population (n=256)

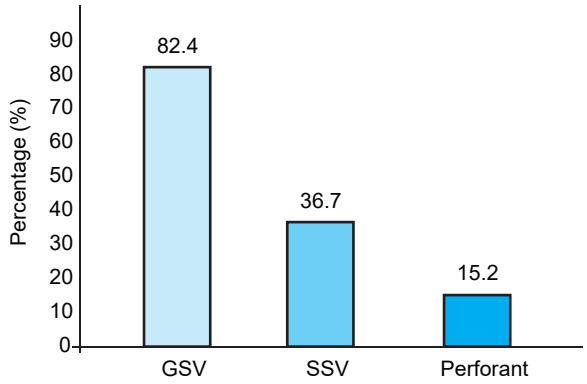
Characteristics	Frequency	Percentage (%)
Age in years		
18-30	22	8.6
31-45	61	23.8
46-60	137	53.5
>60	36	14.1
Mean±SD	48.16±11.69	
Sex		
Male	168	65.6
Female	88	34.4

Table II presents the clinical characteristics and comorbidities of the study population; hypertension was present in 144 patients (56.3%), atrial fibrillation in 86 (33.6%), diabetes mellitus in 84 (32.8%), coronary artery disease in 61 (23.8%), and cardiac insufficiency in 57 (22.3%). Other recorded factors included a history of erysipelas in 44 patients (17.2%), previous ulcer in 39 (15.2%), smoking in 38 (14.8%), a history of deep vein thrombosis in 31 (12.1%), and dementia in 19 (7.4%) (Table 2).

Table II: Clinical characteristics and comorbidities of the study population (n=256)

Comorbidity	Frequency	Percentage
Hypertension	144	56.3
Atrial fibrillation	86	33.6
Coronary artery disease	61	23.8
Diabetes mellitus	84	32.8
Cardiac insufficiency	57	22.3
Alzheimer's/other form of dementia	19	7.4
Smoking	38	14.8
Previous ulcer	39	15.2
History of erysipelas	44	17.2
History of deep vein thrombosis	31	12.1

Figure 1 focuses on the main reflux sources of the study population; the most frequent reflux source was the great saphenous vein (82.4%), followed by small saphenous vein reflux (36.7%) and perforator reflux (15.2%).



GSV = great saphenous vein; SSV = small saphenous vein

Figure 1: Main reflux sources of the study subject (n=256)

Figure 2 highlights the ulcer duration of the study population. Ulcer duration was <365 days in 73.8%, >365 days in 9.4%, and not documented in 16.8%.

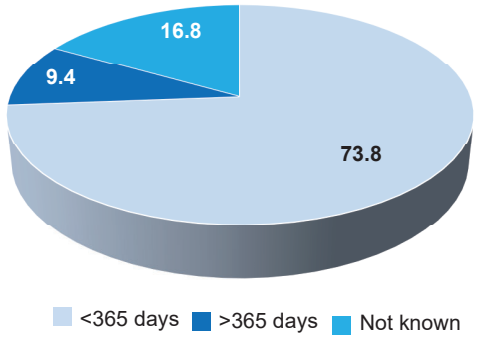


Figure 2: Ulcer duration of the study population (n=256)

Table III contains the mobility status of the study population; mobility was normal in 172 patients (67.2%), assisted with a cane or rollator in 73 (28.5%), and wheelchair-bound in 11 (4.3%).

Table III: Mobility status of the study population (n=256)

Mobility status	Frequency	Percentage (%)
Normal	172	67.2
Walking with support (cane, rollator)	73	28.5
Non-ambulatory patient (wheelchair-bound)	11	4.3

Table IV demonstrate that, in univariate logistic regression, delayed healing was significantly associated with small saphenous vein reflux (OR 2.15; p=0.012), persistent superficial vein reflux after ablation (OR 5.72; p<0.001), recanalization in treated segments (OR 5.80; p<0.001), history of deep vein thrombosis (OR 2.21; p=0.015), and wheelchair status (OR 2.06; p=0.035). Age >50 years, sex, recurrent ulcer, GSV reflux, ulcer duration >365 days, smoking, hypertension, atrial fibrillation, coronary artery disease, diabetes mellitus, cardiac insufficiency, dementia, erysipelas, and walking with support were not statistically significant.

Table IV: Univariate logistic regression analysis of factors associated with delayed healing

Variable	OR	95% CI	p- value
Age >50 years	1.18	0.68–2.04	0.55
Male sex	1.12	0.65–1.93	0.68
Recurrent ulcer	1.29	0.72–2.31	0.39
GSV reflux	0.88	0.48–1.61	0.67
SSV reflux	2.15	1.18–3.90	0.012
PSVR after ablation	5.72	3.10–10.55	<0.001
Recanalization in treated segments	5.80	3.05–10.90	<0.001
Ulcer duration >1 year	1.36	0.80–2.32	0.25
Smoking	1.33	0.74–2.40	0.33
Hypertension	1.22	0.70–2.12	0.47
Atrial fibrillation	1.08	0.62–1.88	0.78
Coronary artery disease	1.14	0.64–2.04	0.66
Diabetes mellitus	1.21	0.70–2.08	0.49
Cardiac insufficiency	1.28	0.71–2.29	0.41
History of DVT	2.21	1.16–4.20	0.015
Dementia	1.05	0.46–2.40	0.91
Erysipelas	1.19	0.63–2.25	0.59
Walking with support	1.31	0.72–2.38	0.37
Wheelchair-bound	2.06	1.05–4.05	0.035

GSV = great saphenous vein; SSV = small saphenous vein; PSVR = Persistent superficial vein reflux; DVT = deep vein thrombosis; OR = odds ratio; CI = confidence interval; p<0.05 was considered statistically significant.

Table V shows that, in multivariable logistic regression, persistent superficial vein reflux after ablation remained associated with delayed healing (OR 5.28; p<0.001).

Wheelchair-bound status was also associated with delayed healing (OR 2.10; p=0.027). Small saphenous vein reflux, recanalization in treated segments, and history of deep vein thrombosis were not statistically significant after adjustment.

Table V: Multivariate logistic regression analysis of independent predictors of delayed healing

Variable	Adjusted OR	95% CI	p-value
SSV reflux	1.78	0.94–3.38	0.076
PSVR after ablation	5.28	2.73–10.20	<0.001
Recanalization	1.41	0.89–2.23	0.14
History of DVT	1.52	0.78–2.96	0.21
Wheelchair-bound	2.10	1.16–4.34	0.027

SSV = small saphenous vein; Persistent superficial vein reflux (PSVR); OR = odds ratio; CI = confidence interval; DVT = deep vein thrombosis; p<0.05 was considered statistically significant.

Delayed healing was significantly associated with SSV reflux, persistent superficial reflux after ablation, recanalization, history of DVT, and wheelchair status in univariate analysis. After multivariate adjustment, persistent reflux after ablation (OR 5.28, p <0.001) and wheelchair status (OR 2.10, p = 0.027) remained independent predictors. Other demographic and systemic comorbidities were not statistically significant.

DISCUSSION

The present study evaluated factors associated with delayed healing of VLUs following EVLA in a tertiary vascular center in Bangladesh. The study demonstrated that persistent superficial reflux after ablation, recanalization, SSV reflux, previous DVT, and severe mobility limitation were significantly associated with delayed ulcer healing. In addition, several demographic, clinical, and socio-economic characteristics showed important relationships with ulcer chronicity and healing outcomes.

The mean age of the study population was 48.16±11.69 years, with the majority of patients belonging to the 46–60 years age group (53.5%). Similar demographic patterns have been reported in previous vascular studies where chronic venous disease was more prevalent among middle-aged and older adults.[7,9] Male predominance was observed (65.6%). Similar age distributions have been reported in previous venous ulcer studies, where chronic venous insufficiency and venous ulceration were more common among middle-aged and elderly individuals because of prolonged venous hypertension, valvular incompetence, reduced mobility, and vascular comorbidities.[2,5,8] The predominance of males in the present study differs from some Western studies reporting higher female prevalence, possibly reflecting occupational standing exposure, delayed healthcare seeking, and gender-related healthcare access differences in the local population.[11,14]

Hypertension was the most common comorbidity (56.3%), followed by atrial fibrillation (33.6%), diabetes mellitus (32.8%), coronary artery disease (23.8%), and cardiac insufficiency (22.3%). These findings indicate the substantial burden of cardiovascular disease among patients with VLUs. Similar associations have been documented in previous studies where systemic vascular disease impaired tissue perfusion and delayed wound healing.[4,12] Diabetes mellitus particularly contributes to endothelial dysfunction, chronic inflammation, microvascular compromise, and increased susceptibility to infection, all of which adversely affect ulcer healing.[10,13]

Socio-economic variables also appeared to influence healing patterns. Chronic venous insufficiency among economically active individuals may also contribute to productivity loss and increased healthcare burden.[1] Financial limitations, occupational standing, inadequate wound care resources, and restricted access to specialized vascular services may contribute to delayed presentation and chronic ulceration in developing countries. Similar socio-economic barriers have been reported in previous literature from resource-limited settings.[14,15] These findings emphasize the need for patient education, affordable compression therapy, community wound care support, and early vascular referral.

The present study identified SSV reflux as an important predictor of delayed healing in univariate analysis (OR 2.15; p=0.012). Patients with SSV reflux had more than twice the risk of delayed healing compared with patients without SSV reflux. Persistent venous hypertension due to untreated or residual reflux may impair venous return and sustain inflammatory changes within the ulcer bed. Previous studies similarly demonstrated that residual superficial venous reflux contributes to prolonged healing and recurrence.[6,11]

Persistent superficial reflux after ablation showed the strongest association with delayed healing in both univariate and multivariate analyses. In multivariate logistic regression, persistent reflux remained an independent predictor of delayed healing (adjusted OR 5.28; p<0.001). This finding indicates that patients with persistent reflux were more than five times more likely to experience delayed ulcer healing. Persistent reflux may result from incomplete ablation, untreated tributaries, perforator incompetence, or progression of venous disease. Similar findings were reported in the EVRA trial and other

venous intervention studies demonstrating that effective elimination of reflux significantly improves healing outcomes and reduces recurrence.[7-9] These findings highlight the importance of meticulous duplex-guided procedural planning and post-procedure surveillance.

Recanalization after EVLA was another important factor associated with delayed healing in univariate analysis (OR 5.80; p<0.001). Although recanalization lost statistical significance in multivariate analysis, it remained clinically important. Previous studies also demonstrated that incomplete occlusion and recanalization reduce long-term procedural success and increase ulcer recurrence.[9,12] Goldschmidt et al. noted that nonhealing ulcers may persist despite apparent superficial reflux correction due to residual venous hypertension, neovascularization, or incomplete venous occlusion.[15] Similarly, Sinabulya et al. observed that long-term ulcer healing outcomes after EVLA were closely related to sustained vein closure and absence of recurrent reflux.[16]

History of DVT was significantly associated with delayed healing in univariate analysis (OR 2.21; p=0.015). Similar findings have been reported by studies evaluating post-thrombotic syndrome and chronic venous disease.[5,13] Previous thrombotic events may result in deep venous obstruction, valvular destruction, and post-thrombotic syndrome, all of which contribute to persistent venous hypertension and impaired healing.[9,10] The present findings align with prior studies demonstrating poorer healing rates among patients with previous DVT and mixed venous pathology.[5,14]

Mobility status also demonstrated a significant influence on healing outcomes. Wheelchair-bound patients had a significantly increased risk of delayed healing in multivariate analysis (adjusted OR 2.10; p=0.027). Impaired calf muscle pump function, reduced venous return, prolonged dependency, and pressure-related tissue compromise likely contribute to poor healing among immobile patients. Similar observations have been documented in previous venous ulcer studies.[4,10] Meagher et al. demonstrated that structured walking improves venous hemodynamics and supports ulcer healing.[11]

Comorbid conditions such as hypertension, diabetes mellitus, atrial fibrillation, and coronary artery disease were common in the study cohort. Although these variables were not independently associated with delayed healing in multivariate analysis, their high prevalence suggests an important systemic disease burden among patients with VLUs. Similar observations were reported by Parker et al. and Milic et al., who emphasized that wound-related and venous hemodynamic factors often exert a stronger influence on healing than isolated systemic comorbidities.[5,10]

Compression therapy remains a fundamental component of VLU treatment even after endovenous intervention.[12,18] In the current study, all patients received postoperative compression therapy; however, socioeconomic barriers and compliance variability may have influenced outcomes. Delayed referral and chronic, untreated disease further contribute to increased resource utilization and poorer prognosis, as emphasized by Kiguchi et al.[1]

The present study findings are broadly consistent with major randomized trials evaluating venous interventions. The EVRA trial demonstrated that early endovenous ablation accelerated ulcer healing and improved ulcer-free survival compared with deferred intervention.[6] Likewise, the ESCHAR study showed reduced recurrence with surgical correction of superficial reflux combined with compression therapy.[8] Current ESVS guidelines also recommend early intervention in patients with superficial venous incompetence to improve healing outcomes and reduce recurrence risk.[13] The present study extends these observations by identifying post-procedural factors associated with delayed healing within a Bangladeshi tertiary care setting.

Although hypertension, diabetes mellitus, smoking, atrial fibrillation, coronary artery disease, and recurrent ulcers were not statistically significant independent predictors in the final multivariate model, they remain clinically important contributors to chronic venous disease and impaired wound healing. Their lack of statistical significance may be related to limited sample size, overlapping risk interactions, or confounding effects.

LIMITATIONS OF THE STUDY

It was a retrospective single-center study, which may limit generalizability and introduce selection bias. The sample size was relatively small. Some socio-economic variables, such as educational status, monthly income, treatment adherence, and nutritional status, could not be fully evaluated. Long-term recurrence rates and quality-of-life outcomes were not assessed. Residual confounding may have persisted despite multivariate adjustment.

CONCLUSIONS

Delayed healing after endovenous laser ablation for venous leg ulcers is strongly associated with persistent superficial reflux, recanalization, previous deep vein thrombosis, small saphenous vein reflux, and severe mobility limitation. Persistent reflux after ablation emerged as the most significant independent predictor of delayed healing. Cardiovascular comorbidities and socio-economic barriers may further contribute to poor healing outcomes and delayed recovery. Careful patient selection, meticulous

duplex-guided intervention, routine post-procedure surveillance, optimization of mobility, and early identification of residual reflux are essential to improve ulcer healing outcomes. Larger prospective multicenter studies with longer follow-up are recommended.

REFERENCES

1. Kiguchi MM, Reynolds KB, Biagetti GM, Knoles-Barnett K, Naz I, Alfawaz A, et al. Delayed referral of venous ulcers increases resource usage. J Vasc Surg Venous Lymphat Disord. 2022; 10(1):87–93.
2. Harlander-Ocke M, Lawrence P, Jimenez JC, Rigberg D, DeRubertis B, Gelabert H. Combined treatment with compression therapy and ablation of incompetent superficial and perforating veins reduces ulcer recurrence in patients with CEAP 5 venous disease. J Vasc Surg. 2012;55(2):446–50.
3. Parker CN, Finlayson KJ, Edwards HE. Predicting the likelihood of delayed venous leg ulcer healing and recurrence: development and reliability testing of risk assessment tools. Ostomy Wound Manage. 2017; 63(10):16–33.
4. Weller CD, Bouguettaya A, Team V, Flegg J, Kasza J, Jayathilake C. Associations between patient-, treatment-, or wound-level factors and venous leg ulcer healing: wound characteristics are the key factors in determining healing outcomes. Wound Repair Regen. 2020;28(2):211–8.
5. Parker CN, Finlayson KJ, Shuter P, Edwards HE. Risk factors for delayed healing in venous leg ulcers: a review of the literature. Int J Clin Pract. 2015; 69(9):967–77.
6. Gohel MS, Heatley F, Liu X, Bradbury A, Bulbulia R, Cullum N, et al. A randomized trial of early endovenous ablation in venous ulceration. N Engl J Med. 2018;378(22):2105–14.
7. Pihlaja T, Vanttinen LM, Ohtonen P, Pokela M. Factors associated with delayed venous ulcer healing after endovenous intervention for superficial venous insufficiency. J Vasc Surg Venous Lymphat Disord. 2022;10(6):1238–44.
8. Barwell JR, Davies CE, Deacon J, Harvey K, Minor J, Sassano A, et al. Comparison of surgery and compression with compression alone in chronic venous ulceration (ESCHAR study): a randomised controlled trial. Lancet. 2004;363(9424):1854–9.
9. Gohel MS, Taylor M, Earnshaw JJ, Heather BP, Poskitt KR, Whyman MR. Risk factors for delayed healing and recurrence of chronic venous leg ulcers: an analysis of 1324 legs. Eur J Vasc Endovasc Surg. 2005;29(1):74–7.
10. Milic DJ, Zivic SS, Bogdanovic DC, Karanovic ND, Golubovic ZV. Risk factors related to failure of venous leg ulcers to heal with compression treatment. J Vasc Surg. 2009;49(5):1242–7.
11. Meagher H, Ryan D, Clarke-Moloney M, O'Laighin G, Grace PA. An experimental study of prescribed walking in the management of venous leg ulcers. J Wound Care. 2012;21(9):421–8.
12. O'Meara S, Tierney J, Cullum N, Bland JM, Franks PJ, Mole T, et al. Four-layer bandage compared with short-stretch bandage for venous leg ulcers: systematic review and meta-analysis of randomised controlled trials. BMJ. 2009;338:b1344.
13. de Maeseneer MG, Kakkos SK, Aherne T, Baekgaard N, Black S, Blomgren L, et al. Editor's choice—European Society for Vascular Surgery (ESVS) 2022 clinical practice guidelines on the management of chronic venous disease of the lower limbs. Eur J Vasc Endovasc Surg. 2022;63(2): 184–267.
14. Melikian R, O'Donnell TF, Suarez L, Iafrati MD. Risk factors associated with the venous leg ulcer that fails to heal after 1 year of treatment. J Vasc Surg Venous Lymphat Disord. 2019;7(1):98–105.
15. Goldschmidt E, Schafer K, Lurie F. A systematic review on the treatment of nonhealing venous ulcers following successful elimination of superficial venous reflux. J Vasc Surg Venous Lymphat Disord. 2021 ;9(4):1071–6.e1.
16. Sinabulya H, Ostmyren R, Blomgren L. Mid-term outcomes of endovenous laser ablation in patients with active and healed venous ulcers: a follow-up study. Eur J Vasc Endovasc Surg. 2017;53(5):710–6.
17. Lawrence PF, Alktaifi A, Rigberg D, DeRubertis B, Gelabert H, Jimenez JC. Endovenous ablation of incompetent perforating veins is an effective treatment for recalcitrant venous ulcers. J Vasc Surg. 2011;54(3):737–42.
18. O'Meara S, Cullum N, Nelson EA, Dumville JC. Compression for venous leg ulcers. Cochrane Database Syst Rev. 2012;(11):CD000265.