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EFFICACY OF ENDOVENOUS LASER ABLATION IN THE TREATMENT OF VENOUS TROPHIC ULCERS

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Summary.

Venous trophic ulcers represent a severe complication of chronic venous insufficiency, characterised by a protracted clinical course, frequent recurrences, and substantial impairment of patients' quality of life.

Study Objective. *To evaluate the clinical efficacy of endovenous laser ablation in the combined treatment of trophic ulcers of venous aetiology.*

Materials and Methods. *The study enrolled 60 patients with venous trophic ulcers, allocated to a study group (endovenous laser ablation combined with conservative therapy) and a control group (conservative therapy alone). The primary outcomes assessed were ulcer healing time, pain intensity dynamics (Visual Analogue Scale), recurrence rate, and quality-of-life indices (VEINES-QOL). The study was conducted in accordance with the ethical principles governing biomedical research involving human subjects, as set forth in the Declaration of Helsinki (1964-2013), the ICH GCP guidelines (1996), and EEC Directive No. 609 (24 November 1986). Statistical analysis was carried out using SPSS 25.0. The study was conducted under the planned research programmes of the relevant departments of Bukhara State Medical Institute named after Abu Ali ibn Sino and Samarkand State Medical University.*

Results. *The mean ulcer healing time in the study group was 5.2 ± 1.3 weeks, compared with 8.7 ± 2.1 weeks in the control group ($p < 0.001$). The recurrence rate over 6 months was 6.7% and 26.7%, respectively ($p = 0.03$). A statistically significant reduction in pain intensity and improvement in quality of life were recorded in the study group. The findings confirm the high efficacy of endovenous laser ablation in the combined treatment of trophic ulcers of venous aetiology. Elimination of pathological venous reflux – the principal pathogenetic driver of trophic ulcer development – by means of endovenous laser ablation normalises venous haemodynamics, thereby establishing conditions favourable for tissue regeneration and restoration of skin integrity. Adjunctive local wound therapy and compression treatment further enhance clinical outcomes and patients' quality of life. Endovenous laser ablation markedly accelerates ulcer healing, reduces pain intensity, and lowers recurrence rates relative to conventional conservative approaches.*

Conclusions. *Endovenous laser ablation constitutes a highly effective component of combined treatment for venous trophic ulcers, accelerating wound healing and reducing recurrence rates.*

Keywords: *Endovenous Laser Ablation; Trophic Ulcers; Chronic Venous Insufficiency; Venous Reflux; Compression Therapy.*

Introduction

Chronic venous insufficiency (CVI) is a prevalent condition characterised by impaired venous circulation in the lower extremities [1-3]. Among its most severe and socially significant complications are trophic ulcers, which develop as a consequence of prolonged venous stasis and result in destruction of the skin and underlying tissues. Trophic ulcers follow a protracted clinical course, resist healing, recur frequently, and substantially impair patients' quality of life [4, 5].

Conventional treatment modalities – encompassing local wound therapy, compression treatment, and general measures – frequently prove insufficient, as they do not address pathological venous reflux, the primary pathogenetic mechanism. Persistent impairment of venous outflow consequently leads to disease progression and associated complications [6-8].

Endovenous laser ablation (EVLA) – a minimally invasive technique that occludes affected varicose veins intraluminally by means of laser energy – has gained widespread adoption in the practice of vascular surgeons and phlebologists. By effectively eliminating pathological reflux, EVLA normalises venous haemodynamics and promotes trophic ulcer healing [9, 10].

Relative to conventional phlebectomy, EVLA offers several advantages: high clinical efficacy, minimal tissue trauma, no requirement for general anaesthesia, a short rehabilitation period, and a low recurrence rate [11]. Its application in patients with trophic ulcers has expanded considerably in recent years, warranting a more rigorous analysis of outcomes and a systematic comparison with traditional therapeutic approaches [12, 13].

Despite the accumulated clinical experience, key questions regarding the optimal indications for EVLA, the timeline of ulcer healing following the procedure, and the criteria for efficacy assessment remain unresolved [14, 15]. The present study aimed at a comprehensive evaluation of EVLA efficacy in patients with trophic ulcers of venous origin, encompassing both immediate and long-term clinical outcomes [16, 17].

The incorporation of EVLA into the combined treatment of patients with trophic ulcers of venous

aetiology reduces healing time, lowers recurrence rates, and improves clinical outcomes. Beyond the ablative procedure itself, the combined approach encompasses contemporary local wound therapy, compression treatment, and pharmacological support [18].

Study Objective. To evaluate the clinical efficacy of endovenous laser ablation in the combined treatment of venous trophic ulcers.

Materials and Methods

A total of 60 patients with trophic ulcers of venous aetiology, receiving outpatient treatment at the Bukhara branch of the Republican Scientific Centre for Emergency Medical Care and the Varikoz OFF – Bukhara Laser Centre clinic of contemporary laser phlebology between 2023 and 2025, were examined and treated. The study was conducted in accordance with the ethical principles governing biomedical research involving human subjects, as set forth in the Declaration of Helsinki (1964-2013), the ICH GCP guidelines (1996), and EEC Directive No. 609 (24 November 1986). All participants were informed of the study objectives, organisation, and methods, and provided written voluntary informed consent to participate in a fully anonymised study. Patients were allocated to two groups of 30 participants each:

1. *Study group (n = 30):* received combined treatment comprising endovenous laser ablation (EVLA) together with conventional modalities (local wound therapy, compression treatment, and pharmacological support).
2. *Control group (n = 30):* received standard conservative treatment, including local ulcer care, compression therapy, and venoactive pharmacotherapy, without EVLA.
3. *Inclusion Criteria:*

- Confirmed chronic venous insufficiency with pathological venous reflux established by duplex ultrasonography.
- Trophic ulcer of the lower extremity with a surface area not exceeding 10 cm².
- Patient age between 40 and 75 years.
- Absence of severe comorbidities affecting wound healing (including uncontrolled diabetes mellitus, connective tissue disorders, and severe lower-extremity ischaemia).

4. *Exclusion Criteria:*

- Trophic ulcers of non-venous aetiology (arterial or diabetic).
- Active inflammatory processes or acute infections.
- Coagulation disorders or other contraindications to laser therapy.

EVLA Technique:

Endovenous laser ablation was carried out using the LAKHTA-MILON diode laser (Russia) at a wavelength of 1470 nm (Figure 1). The procedure was carried out on an outpatient or day-case basis under ultrasound guidance and sterile conditions. Following venous access via a small puncture, a laser fibre was introduced into the venous lumen; laser energy was then applied to induce coagulation and subsequent occlusion of the treated vein.

Figure 1. The LAKHTA-MILON laser system for phlebological procedures.

Local Wound Therapy. Local treatment comprised wound debridement, application of antiseptic and antibacterial agents, and use of advanced dressings incorporating hydrogels and sorbents to promote optimal healing conditions. Dressing changes were carried out daily or on alternate days according to wound status.

Compression Therapy. Compression constituted a mandatory component of treatment, with Class II compression applied by means of elastic bandages or medical compression hosiery. Compression therapy was initiated following resolution of acute inflammatory signs and assessment of individual patient tolerability.

Efficacy Assessment. Treatment outcomes were evaluated by dynamic monitoring of ulcer epithelialisation rate, wound surface area measurement by planimetry, and surveillance for recurrence over a 6-month follow-up period. Patient-reported outcomes were additionally recorded, encompassing pain intensity rated on the Visual Analogue Scale and quality of life assessed by the VEINES-QOL/Sym questionnaire.

Statistical Analysis. Data were analysed using the SPSS 25.0 statistical software package, with means and standard deviations calculated for all continuous variables. Between-group comparisons were carried out by Student's independent-samples t-test, with statistical significance set at $p < 0.05$.

Table 1

Baseline clinical and demographic characteristics of patients in the study and control groups.

Characteristic	Study group (EVLA) (n=30)	Control group (conservative therapy) (n=30)	p-value
Mean age, years	58.4 ± 8.7	57.9 ± 9.1	0.78
Male sex, n (%)	18 (60%)	17 (56.7%)	0.79
Mean ulcer surface area, cm²	6.3 ± 2.1	6.5 ± 2.3	0.68
Ulcer duration, months	7.2 ± 3.4	7.5 ± 3.7	0.71
Venous reflux, n (%)	30 (100%)	30 (100%)	-
Comorbidities: – Arterial hypertension, n (%)	12 (40%)	13 (43.3%)	0.79
– Diabetes mellitus, n (%)	5 (16.7%)	4 (13.3%)	0.71

Results

Clinical parameters and ulcer healing dynamics were analysed in both patient groups – those receiving combined treatment incorporating EVLA and those managed conservatively without laser intervention.

The mean ulcer healing time in the study group was 5.2 ± 1.3 weeks, a statistically significant reduction relative to the control group, where healing time reached 8.7 ± 2.1 weeks ($p < 0.001$). Complete epithelialisation by week 12 was observed in 83.3% of study group patients, compared with 53.3% in the control group ($p = 0.02$).

The 6-month recurrence rate following treatment completion was markedly lower in the study group at 6.7%, compared with 26.7% in the control group ($p = 0.03$), indicating a sustained beneficial effect of EVLA incorporation into combined therapy.

Study group patients additionally reported substantial reduction in pain intensity. Mean pain scores on the Visual Analogue Scale were comparable between the groups at baseline – 6.8 ± 1.2 and 6.9 ± 1.1 points, respectively ($p = 0.85$). At treatment completion, pain intensity decreased to 2.1 ± 0.9 in the study group, whereas pain remained considerably more pronounced in the control group at 4.5 ± 1.3 ($p < 0.001$).

Quality-of-life assessment by the VEINES-QOL questionnaire revealed substantial improvement in study group patients, with a mean score increment of +15.4 ± 4.2, compared with a less pronounced gain of +7.8 ± 3.7 in the control group ($p < 0.001$). These findings reflect the clinical efficacy of treatment alongside an improvement in patients' general wellbeing and functional capacity.

Local wound therapy and compression treatment, applied in both groups, supported favourable wound healing conditions; however, their efficacy was considerably augmented when combined with EVLA.

The totality of the findings thus confirms the high efficacy of EVLA in the combined treatment of trophic ulcers of venous aetiology, manifested as accelerated healing, reduced pain intensity, lower recurrence rates, and improved quality of life (Figure 1, Figure 2).

Figure 2. Clinical presentation of a venous trophic ulcer prior to EVLA.

Figure 3. Clinical presentation of a venous trophic ulcer following EVLA.

Table 2

Comparative clinical outcomes of trophic ulcer treatment in the study and control groups.

Outcome measure	Study group (EVLA) (n=30)	Control group (conservative therapy) (n=30)	p-value
Mean ulcer healing time, weeks	5.2 ± 1.3	8.7 ± 2.1	< 0.001
Complete epithelialisation by week 12, %	83.3%	53.3%	0.02
Recurrence rate at 6 months, %	6.7%	26.7%	0.03
Pain intensity (VAS) at baseline	6.8 ± 1.2	6.9 ± 1.1	0.85
Pain intensity (VAS) at treatment completion	2.1 ± 0.9	4.5 ± 1.3	< 0.001
Quality-of-life improvement (VEINES-QOL), points	+15.4 ± 4.2	+7.8 ± 3.7	< 0.001

Trophic ulcers of venous aetiology remain among the most challenging problems in vascular surgery and phlebology. The available treatment modalities have not eliminated the problem of protracted healing and frequent recurrences, which continue to limit the efficacy of conventional approaches and necessitate the development of more effective therapeutic strategies [19, 20].

The findings of this study confirm the high efficacy of EVLA as a key component of combined treatment for trophic ulcers of venous origin. By eliminating the principal pathogenetic mechanism – pathological venous reflux – EVLA substantially normalises venous outflow and establishes favourable conditions for ulcer healing [21, 22].

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Conservative treatment limited to local wound therapy and compression alone achieves neither the epithelialisation rates nor the recurrence reduction attainable with EVLA. These findings are corroborated by published international and domestic evidence demonstrating the clinical efficacy of laser ablation in the management of varicose vein disease and complications arising from chronic venous insufficiency [23].

Reduced pain intensity and improved quality of life recorded in the study group attest to the broad positive impact of EVLA on patients' overall condition – an effect of particular clinical relevance given that chronic ulcers are associated with pronounced discomfort and substantial restriction of daily activity [24, 25].

Favourable treatment outcomes are contingent upon rigorous patient selection and precise procedural execution. Thorough duplex ultrasonographic assessment of the venous system prior to the intervention, meticulous ultrasound-guided EVLA, and comprehensive post-procedural therapy are essential determinants of a positive clinical outcome.

The present findings are subject to certain limitations, namely the modest sample size and restricted follow-up period. Studies enrolling larger patient cohorts over extended observation periods will enable a more rigorous evaluation of the long-term efficacy and safety of the technique.

Integration of EVLA into treatment protocols for trophic ulcers of venous aetiology represents a meaningful advance in the management of this complex condition, contributing to reduced treatment costs and improved patient quality of life.

Conclusion

This study confirms the high efficacy of EVLA in the combined treatment of trophic ulcers of venous aetiology. EVLA markedly accelerates ulcer healing, reduces pain intensity, and lowers recurrence rates relative to conventional conservative therapy.

Elimination of pathological venous reflux – the principal pathogenetic driver of trophic ulcer development – by means of EVLA normalises venous haemodynamics, thereby establishing conditions favourable for tissue regeneration and restoration of skin integrity. Adjunctive local wound therapy and compression treatment further enhance clinical outcomes and patients' quality of life.

The findings substantiate that incorporation of endovenous laser ablation into the practice of vascular surgery and phlebology constitutes a promising avenue for optimising the management of patients with chronic venous insufficiency and its trophic ulcer complications.

A comprehensive assessment of the long-term outcomes and safety of this technique will require studies with larger patient cohorts and extended follow-up periods. The available evidence nonetheless supports the recommendation of EVLA as an important component of combined treatment for trophic ulcers of venous aetiology, directed at improving clinical outcomes and enhancing patients' quality of life.

Future Research Directions. Multicentre studies enrolling larger patient cohorts over extended observation periods are warranted to evaluate the long-term outcomes of EVLA and to develop standardised treatment protocols for venous trophic ulcers.

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All authors have reviewed the final version of the manuscript and consent to its publication.

Conflict of Interest. The authors declare no conflict of interest.

Use of Artificial Intelligence. Artificial intelligence tools were employed during the preparation of this manuscript for linguistic processing, English language refinement, and text structuring. Their use was confined to language clarification and had no bearing on the scientific design of the study, data collection, statistical analysis, interpretation of results, or study conclusions. All scientific content and ultimate responsibility for the manuscript remain with the authors.

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ЕФЕКТИВНІСТЬ ЕНДОВЕНОЗНОЇ ЛАЗЕРНОЇ ОБЛІТЕРАЦІЇ ПРИ ЛІКУВАННІ ТРОФІЧНИХ ВИРАЗОК ВЕНОЗНОГО ПОХОДЖЕННЯ

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Резюме.

Трофічні виразки венозного походження є важким ускладненням хронічної венозної недостатності та характеризуються тривалим перебігом, частими рецидивами та зниженням якості життя пацієнтів.

Ціль дослідження. Оцінити клінічну ефективність ендовенозної лазерної облітерації у комплексному лікуванні трофічних виразок венозної етіології.

Матеріали та методи. До дослідження включено 60 пацієнтів із венозними трофічними виразками, поділені на основну (ендовенозна лазерна облітерація + консервативна терапія) та контрольну групи (консервативне лікування). Оцінювалися терміни

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загоєння виразок, динаміка больового синдрому, частота рецидивів та показники якості життя (VEINES-QOL). Дослідження проводилося відповідно до основних положень «Правил етичних принципів проведення наукових медичних досліджень за участю людини», затверджених Гельсінською декларацією (1964-2013), стандартами ICH GCP (1996) та Директивою ЄЕС № 609 (від 24.11.1986). Статистичний аналіз виконаний у SPSS 25.0. Дослідження проводилося у рамках планових науково-дослідних робіт профільних кафедр Бухарського державного медичного інституту імені Абу Алі ібн Сіно та Самаркандського державного медичного університету.

Результати. Середній термін загоєння виразок в основній групі становив 5,2±1,3 тижні проти 8,7±2,1 тижня у контрольній ($p<0,001$). Частота рецидивів за 6 місяців – 6,7% та 26,7% відповідно ($p = 0,03$). В основній групі зазначено достовірне зниження болю та покращення якості життя. У результаті проведеного дослідження підтверджено високу ефективність ендовенозної лазерної облітерації у складі комплексного лікування трофічних виразок венозної етіології. Усунення патологічного венозного рефлюксу, що є ключовим патогенетичним фактором розвитку трофічних виразок, за допомогою ендовенозної лазерної облітерації забезпечує нормалізацію венозного кровотоку, що створює оптимальні умови для регенерації тканин та відновлення шкірного покриву. Крім того, комплексний підхід до лікування, що включає місцеву терапію та компресійне лікування, додатково підвищує клінічну ефективність та якість життя пацієнтів. Застосування ендовенозної лазерної облітерації сприяє значному прискоренню процесів загоєння виразок, зниженню інтенсивності больового синдрому та зменшенню частоти рецидивів у порівнянні з традиційними консервативними методами терапії.

Висновки. Ендовенозна лазерна облітерація є високоефективним компонентом комплексного лікування венозних трофічних виразок, забезпечуючи прискорене загоєння та зниження частоти рецидивів.

Ключові слова: ендовенозна лазерна облітерація; трофічні виразки; хронічна венозна недостатність; венозний рефлюкс; компресійна терапія.

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