

# Treatment of Venous Ulcer of the Lower Leg by Endovenous Laser Ablation

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## ABSTRACT

Venous ulcer is the most advanced stage of chronic venous insufficiency (CVI). Its prevalence is estimated to be between 1% and 3%. Recent articles have suggested that leg ulcers with reflux in superficial veins can be treated by endovenous laser ablation (EVLA). Endovenous laser ablation of the great and/or short saphenous vein has already become the treatment of choice for varicose vein and can also be applied for superficial veins and perforators. In this study, a new approach for treating patients with venous ulcer of the lower leg has been evaluated combining foam sclerosation (TRIS) and endovenous laser ablation (EVLA) of refluxing saphenous and perforating veins. 45 patients with venous ulcer of the lower leg were treated in our clinic, combining TRIS and EVLA of perforating and truncal veins using 1064 nm Nd:YAG laser.

**Key words:** chronic venous insufficiency, venous ulcer, endovenous laser, perforating veins.

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## I. INTRODUCTION

Venous ulcer is the most advanced stage of chronic venous insufficiency (CVI). Active venous ulcers affect 0.3% of the adult population in developed countries. The prevalence of active and healed ulcers is around 1% but it rises to approximately 3% in the elderly population. Half of the ulcers heal within 4 to 6 months, 20% remain open after two years and 8% of the ulcers are present even after five years [1, 2].

The cause of venous ulcer of the lower leg is increased pressure in the veins due to failed valves and inefficient pumping of blood out of the lower leg while walking. This increased pressure in the venous system is transferred to the venous side of the microcirculation via the superficial and perforating veins. This causes disorder at the level of the microcirculation, which ultimately leads to tissue

hypoxia. This has the effect of changing the tissue, and in end stage of the disease, tissue destruction [1, 3].

Conservative therapy of venous ulcers and the prevention of new ulcers includes control of edema and venous hypertension by adequate compression therapy, wound cleaning or surgical debridement and systemic antibiotic therapy [4]. Studies with compression bandaging have demonstrated successful healing of venous leg ulcers, but recurrence rates have been high [5, 6].

Surgical therapy, in addition to non-invasive therapy, is focused on eliminating venous reflux in superficial veins and perforating veins [7]. Surgical techniques or minimally invasive perforator therapy (SEPS) [8] used as adjuncts in the treatment of venous ulcers have reduced the ulcer recurrence rate, but have not been shown to improve the rate of healing even in compliant patients. Recently a new method - terminal interruption of the reflux source (TIRS), has been proposed, allowing achievement of rapid healing in patients undergoing this procedure [9].

In the case of leg ulcers with reflux in superficial veins (estimated to be 85% of all ulcers), a surgical intervention with eradication of the superficial reflux is frequently indicated [10]. These veins can also be treated by endovenous ablation by either radiofrequency or laser [11–14]. Due to higher patient satisfaction and shorter recovery time, endovenous laser ablation (EVLA) of the great and/or short saphenous vein has already become the treatment of choice for varicose veins. The principle mechanism of EVLA therapy is ablation and photocoagulation of the vein interior by laser-induced thermal effects. EVLA therapy can also be applied for superficial veins and perforators of suitable length and diameter [13, 14].

At the Avelana d.o.o. clinic for vascular surgery, a new approach for treating patients with venous ulcer of the lower leg has been developed. This approach combines foam sclerosation (TRIS) and endovenous laser ablation (EVLA) of refluxing saphenous and perforating veins to offer quick and effective healing of ulcers.

## II. MATERIALS AND METHODS

Patients with venous ulcer of the lower leg underwent the following set of diagnostic procedures: measurement of perfusion pressures (ABPI), ultrasound investigation of superficial and deep veins of the lower leg, photo plethysmography and air plethysmography. The purpose of this investigation was to diagnose patients with predominantly superficial reflux and subsequent reflux of perforating veins. Patients with nonthrombotic obstruction at the iliac level and patients with posttrombotic syndrome were sent to magnetic resonance venography or CT venography. If the suspicion was confirmed, we focused on the endovascular treatment with stenting.

Patients with predominantly superficial reflux were treated immediately. During the first appointment, we reduced distal superficial reflux in the area of the ulcer (TIRS) [9, 15]. This was done by ultrasound guided sclerotherapy of the superficial veins around the ulcer with 2% Aethoxysklerol foam.

The patient was then scheduled for endovenous laser ablation (EVLA), which was carried out within a period of between two weeks to two months after the TIRS.

Depending on the site of reflux, the EVLA with 1064 nm Nd:YAG laser (XP-2 Focus, Fotona, Slovenia) was targeted at truncal veins and/or insufficient perforating veins of the lower leg. This was performed in patients with unhealed venous ulcers two weeks to two months after sclerotherapy. In the first step, perforating veins were treated with Nd:YAG laser with an average of 845.5 J (750 J - 1100 J) of energy per perforator. During the same session we continued with EVLA of the truncal vein GSV, SSV, AASV as described previously [14]. In both steps ultrasound guidance was used for improvement in the accuracy of the EVLA treatment.

After the procedure, the patients wore thigh high-compression class 2 stockings for 24 hours, day and night, and later during the day for four weeks. After that period we encouraged the wearing of calf high-compression class 2 stockings. For better healing the ulcer was regularly re-banded.

## III. RESULTS

Lower leg venous ulcer is the final stage of advanced chronic venous failure. Recent developments in imaging of the venous system by using color duplex ultrasound allows precise venous mapping and precise identification of sources of reflux extending beyond the GSV to the small saphenous

vein, the anterior saphenous accessory vein as well as the wide variety of perforator veins. With the development of ultrasound diagnostics, it became clear that the underlying cause is the reflux in superficial veins and that incompetent perforating veins are the result of superficial reflux in more than 90% of cases [16]. Despite different treatment options, venous ulcers are slow to heal and are prone to recur [17].

In the period from 2007 to 2011, 45 patients with venous ulcer of the lower leg were treated in our clinic combining (TRIS) and endovenous laser ablation (EVLA) of perforating and truncal veins. In our study, foam sclerostation with Aethoxysklerol foam (TRIS) was used during the first appointment to reduce superficial reflux in the area of the ulcer. In 22 patients (48.8%) the venous ulcers were healed at two weeks to two months follow up prior to EVLA. All patients (22 patients with healed and 23 patients with persisting ulcers after the foam sclerostation) were treated with 1064 nm Nd:YAG laser using the previously described protocol of endovenous laser ablation (EVLA) [14]. The procedure was performed in two steps: first, the perforating vein was treated by laser ablation, followed by EVLA of the truncal vein. After the procedure, the active ulcers of 21 patients out of 23 patients (91.3%) were healed within 6 weeks of the treatment (Figure 1). By removal of superficial reflux and reflux in the perforating veins, the improvement of microcirculation was achieved, which subsequently restored the recovery potential of the tissue [20].



Fig. 1: Venous ulcer before treatment and 1 month after treatment. Almost complete healing of the ulcer is observed.

In two patients who had ulcers with very fibrosed bottoms resulting in reduced mobility of the ankle and which persisted for 9 and 15 years, an additional

operation was needed to excise the ulcer together with the crural fascia and cover the defect with a split skin free transplantation. In both patients, healing of the ulcers was achieved (Figure 2).



Figure 2: Venous ulcer healed after 15 years: Before EVLA procedure (top), immediately after (bottom left) and 1 year after the treatment (bottom right).

#### IV. DISCUSSION

The terminal interruption of the reflux (TIRS) method [9] is achieved by ultrasound-guided foam sclerotherapy with Aethoxysklerol. One can treat the veins draining the ulcer at the first examination. The TIRS technique differs from classic foam sclerotherapy in that the most distal area of reflux is treated first, which allows temporary relief of venous hypertension in the area of the ulcer [9]. An instantaneous effect is the relief of pain, which happens the following night.

Foam sclerosation was repeated several times prior to surgery. In 22 patients (48.8%) the ulcers healed

prior to surgery. Nevertheless laser ablation of the refluxing stem and perforating veins was performed on all patients with ulcers. EVLA is already established as the standard method for treating saphenous vein reflux, and several studies have also demonstrated that EVLA of the perforator veins is safe and effective, but only a few reports have been published in patients with lower leg venous ulcers. Proebstle et al. were the first authors who described the safety and feasibility of EVLA treatment of perforating veins on a series of 67 patients, predominantly with early clinical stage ulcers [21]. Recently, a study of Ryan Abdul-Haqq et al. demonstrated that a significantly larger proportion of patients with venous stasis ulcers caused by saphenous vein and perforator vein reflux healed with combined EVLA of the saphenous and perforator veins compared to saphenous vein or perforating vein EVLA alone [19].

Studies have shown that by removing superficial reflux and incompetent perforators, rapid healing of ulcers can be achieved [18, 19]. Additionally, some studies have also demonstrated a lower recurrence of ulcers [18].

We believe that non-healing of ulcers of years-long duration is due to elevated subfascial pressure from high fibrinogen of subcutaneous tissue and fascia. Therefore, it is necessary to reduce the subfascial compartment pressure of the lower leg [10].

#### V. CONCLUSIONS

In this study of 45 individuals suffering from years of chronic non-healing venous stasis ulcers, 22 of 45 (44.8%) were healed using ultrasound-guided endovenous foam sclerotherapy of distal incompetent varices associated with ulcers. Healing occurred within two weeks to two months. The remaining 23 unhealed chronic ulcers were treated with endovenous laser ablation (EVLA) of associated perforating and truncal incompetent veins. 21 of these 23 (91.3%) individuals experienced healing of their chronic ulcer. The remaining two active ulcer patients were treated with full-thickness excision of the ulcer and underlying fascia with split-thickness skin grafting, with resolution. With the development of the new method of endovascular ablation of the perforating veins, the treatment of peripheral venous stasis ulcers has become less invasive with more rapid healing, and the need for more invasive procedures with prolonged healing can be avoided in the majority of cases.

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