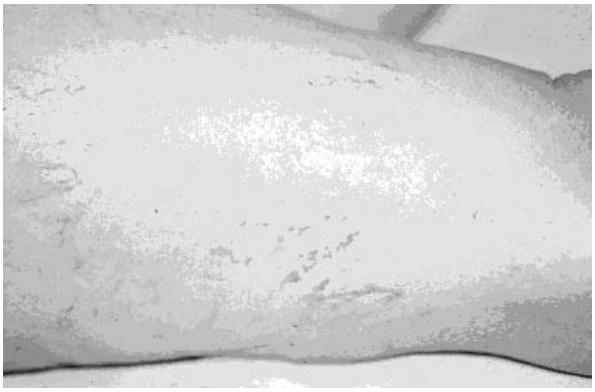
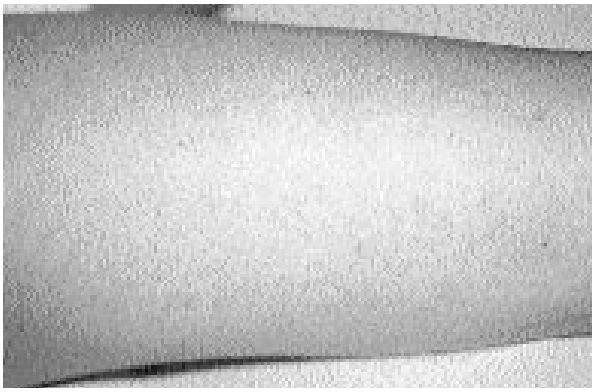
PhotoDerm® Application Notes
Volume 1, Number 6

Effective Treatment of Deep and Large Vessels with VascuLight™



Female with reticular leg veins and telangiectasias on the thigh before treatment.



Follow-up after 6 months.

Photos courtesy of D. Wilder, MD, Augsburg, Germany

Introduction

Millions of women suffer from cosmetically disfiguring leg veins and the symptomatic conditions that are associated with deep underlying reticular veins.

Currently there are several treatment options available to rid patients of unsightly leg veins, however, each method is inherent with limitations. Non-invasive methods that use intense light, such as laser treatments, have been effective for the treatment of superficial leg telangiectasias, but not deeper vessels. PhotoDerm®, an intense pulsed light source with a broad wavelength spectrum, has proven effective for a wider range of leg telangiectasias and leg veins (with depths of 0.1-2 mm). Sclerotherapy is an invasive method that involves injecting a sclerosing agent into the blood vessel in order to induce thrombosis and subsequent fibrosis. The success of sclerotherapy depends on the skill of the physician and requires an exact pin-point technique. Furthermore, many women are repelled by the notion of multiple needle injections.

VascuLight™, an extension of the versatile PhotoDerm® technology, integrates the full spectrum intense pulsed light of PhotoDerm® with high energy fluence (up to 150 J/cm^2) near infrared pulsed laser energy. Therefore, the device is effective for treating deeper (up to 5 mm) and larger (up to 3.5 mm) blood vessels. VascuLight™ is a unique system that enables the physician to treat a full range of leg telangiectasias and leg veins (particularly reticular leg veins) without the precision required for sclerotherapy. It offers the patient a non-invasive treatment method with minimal risk of adverse effects.

VascuLight™ operates on the principle of selective photothermolysis. Light is selectively absorbed by the blood in the target vessel and converted into heat energy, thus raising the blood temperature to higher than the point of coagulation and inducing the eventual destruction of the vessel wall with minimal effect on the surrounding tissue. To achieve selective photothermolysis of reticular veins, three basic elements need to be addressed:

- Wavelength for deep penetration and selective coagulation without damage to the skin
- Timing for optimized thermal control
- Fluence for efficacy

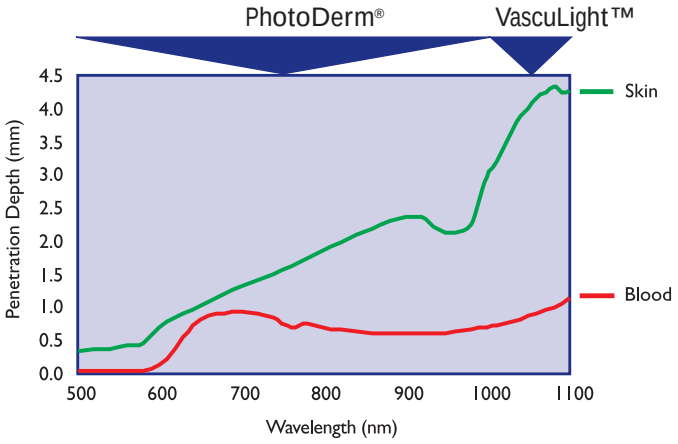


Figure 1: Penetration depths of light in skin and in blood as a function of wavelength.

How it works

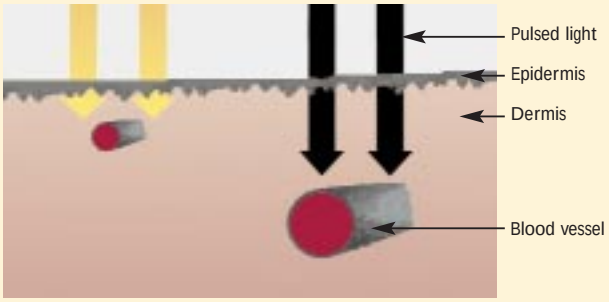


Figure 2: The pulsed light penetrates the skin to heat the target tissue. Wavelength is adjusted to the vessel depth & size: near IR for deep & large—visible for smaller vessels.

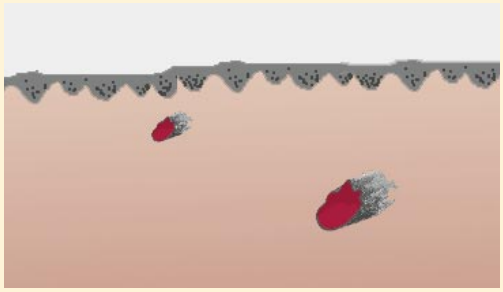


Figure 3: Target tissue after treatment in process of resolving.

Wavelength

By shifting to the longer near infrared wavelength spectrum (where light penetration depth in tissue reaches its maximum), physicians are able to non-invasively eradicate larger and deeper vessels than ever before. In addition, blood absorption is high enough for selective photothermolysis, but is still relatively low, which allows the treatment of large vessels (light penetrates deep into the blood). Also of importance is that, in this wavelength range, melanin, the pigment found in the skin, has negligible influence on absorption. This enables both dark and light skin individuals to be treated successfully, while preventing damage to the epidermis.

Figure 1 shows the penetration depths of light in skin and blood as a function of wavelength. It can be seen that the use of longer wavelengths obtains better penetration into the skin. Shorter wavelengths are optimal for the treatment of smaller and shallower vessels. Considering that most patients have a combination of vessel sizes, it is necessary to have a device that can treat both shallow and deep vessels.

Timing

Timing refers to the duration of the pulse, the number of pulses and the delay between the pulses. Varying these parameters can have a significant impact on the efficacy of the treatment as relatively long pulses and multiple pulses are needed to treat larger and deeper vessels.

The VascuLight™ system incorporates Multiple Synchronized Pulsing™ in which the operator can choose the pulse duration and the number of pulses applied to differentially heat and cool vessels of various depths and sizes. Single, double or triple pulses with durations from 1-14 msec are available. These parameters allow the physician to select a pulse duration that is short in comparison to the thermal cooling time of the vessel being treated and long in comparison to the thermal cooling time of the epidermis and small vessels that do not need treatment. In addition, larger vessels that require the use of higher energies to reach coagulation temperatures can be treated with longer pulses. This ensures that small blood vessels and the epidermis will

Simulation of Light Treatment Effects

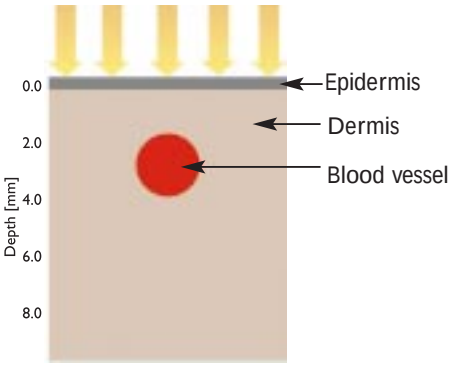


Figure 4: 2.0mm diameter and 2.0mm depth reticular vessel before treatment.

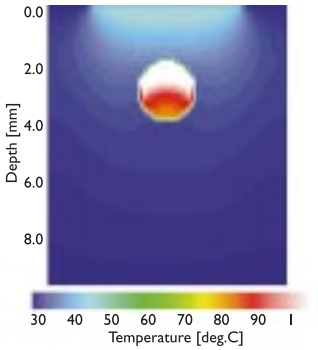


Figure 5: After treatment, the area surrounding the vessel is between 37-40°C (no thermal damage). Vessel is heated to a temperature sufficient for coagulation.

cool down sufficiently during the pulse to avoid damage, yet the treated vessel will not cool significantly.

Fluence

Sufficient energy is needed to heat the entire cross section of the vessel to a high enough temperature to cause coagulation. The use of high energy fluences can be problematic due to the adverse effects to the epidermis. Because light absorption by melanin in the epidermis is negligible with long wavelengths, the very high fluences (up to 150 J/cm²) that are necessary for successful thermal damage to the target vessel can be employed without harm to the skin. VascuLight™ can be effectively operated at an energy fluence range from 40-150 J/cm².

Clinical Results

Table 1 summarizes the clinical results of a multi-center study (RA Weiss, MD, Assistant Professor at John Hopkins U. School of Medicine, Baltimore, MD, USA & A. Vanzelbaum, MD, CARE Institute, Tel Aviv, Israel) of treatment (1-3) of 46 reticular veins in 9 patients. The depths and diameters of the veins were measured using a 7.5 MHz ultrasound transducer. Evaluation of the results were visual and performed by assessing the vessels while pressing on the skin with the ultrasound transducer. If the vessel was alive and open, then it could be compressed, thus resulting in a change of its form in the ultrasound image, whereas, a closed thrombosed vessel was not compressible. In some cases, the vessels had shrunk following the treatment, in addition to the thrombosis which had developed.

Depth (mm) \ Diameter (mm)	0.2-1	1-2	2-3	3-4
0.3-1	(1) 100% closed	(1) 100% closed	—	—
1-2	—	(18) 100% closed	(4) 100% closed	—
2-3	—	(10) 100% closed	(1) 100% closed	(1) No effect
3-4	—	(3) 100% closed (1) 50% closed (SFJ insufficiency)	(2) 100% closed	—
4-5	—	(1) 100% closed	(2) 100% closed	(1) 50% shrink

Table 1: Clinical results of treatment (1-3) of 46 reticular veins in 9 patients. The fluence levels employed were 110-150 J/cm². The average follow-up time was 3 weeks. Number in parentheses ( ) indicates number of vessels treated.

A vessel was defined as 100% closed when the vessel could not be compressed at all, whereas, a 50% closed vessel was compressible to 50% of its original diameter. In contrast, shrunk vessels had not closed, but had reduced in diameter following the treatment.

The overall treatment success rate was 93% (43 of the 46 vessels were closed after the treatment). Eighty percent of the vessels that were completely closed required only a single treatment with VascuLight™. Adverse effects were minimal. There were no cases of skin burns, edema or hypo or hyperpigmentation reported.

These results indicate that VascuLight™ is highly effective in treating vessels with diameters up to 3 mm and depths as great as 5 mm. In addition, it is interesting to note that there was a reduction in the size of the vessels with diameters as large as 4 mm and depths up to 5 mm. Prior to the introduction of the VascuLight™ device, there was no other system in the market that could penetrate to sufficient depths to reach deeper vessels and be utilized at high enough energy levels to selectively damage larger vessels without causing thermal damage to surrounding tissue.

Conclusions

Effective non-invasive treatment of deep and large reticular leg veins requires a pulsed optical source that uses a longer wavelength spectrum (1-1.1 µm) with high energy fluence and longer bursts of pulses.

VascuLight™ is an accessory for the successful PhotoDerm® device that has proven to be effective for the treatment of a wide range of vascular lesions. VascuLight™ provides the operator with the optimal parameters for the treatment of a full range of vessel sizes and depths, even including reticular veins.

References

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