

A stylized illustration of a human leg, primarily in shades of orange and red, set against a white background. A prominent, thick red vein runs diagonally from the top left towards the bottom left. A horizontal blue bar with a white 'Selected Paper' label is positioned across the middle of the leg. The title text is located in the upper right quadrant.

Endovenous Laser Ablation of Varicose Veins 10 years after: Past, Present & Future

Selected Paper

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Effectiveness of the ELVeS 1470nm
diode laser for leg ulcers treatment

Effectiveness of the EVLA 1470nm diode laser for leg ulcers ablation

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Since their inception in 1960, lasers have proved their effectiveness in various medical applications including ENT, vascular surgery, general surgery, dermatology, neurosurgery, etc. The laser use is reported to have beneficial effects on wound healing by stimulating the immune system, increasing various cytokines and leukocyte population, arresting bacterial growth, increasing the amount of total collagen and skin circulation and by accelerating the regeneration processes (1-7). In this study we used the new diode laser (Ceralas ELVeS 1470nm/15Watt) at the wavelength of 1470 nm in order to evaluate the effectiveness on foot and leg ulcers healing.

Materials

The diode laser Ceralas 1470nm (gallium arsenide semiconductor) was used for leg ulcer treatment. A low energy laser fluence was delivered on the ulcers through a 7 mm spot aiming to produce a photobiostimulation effect to reduce inflammation, enhance microvascular activity in order facilitate new tissue growth and accelerate the wound healing process.

Patient selection

In the course of this study and from February 2009, until November 2009 we enrolled 20 patients, 10 males and 10 females, ages 38-87 years old, with one up to five ulcers/case, counting a total number of 36 ulcers. In the study included all forms of ulcers: venous, arterial-diabetic, neurotrophic and meta-traumatic and even patients with very deep ulcers, with tendon and small bones of the toes exposed. In addition, two of them had undergone plastic operation and unsuccessful "graft" covering of the ulcer. The size of ulcers was varying from 1 cm² up to 132 cm². From the total number of ulcers included (36), 9 were venous (superficial incompetence and metathrombotic syndrome), 8 were arterial (5 diabetic), 16 were neurotrophic and 3 traumatic. 23 ulcers were categorized as chronic (>6 weeks) and 13 as acute (<6 weeks).

Laser ablation

Laser ablation took once every 7-10 days. Before the laser session, all the ulcers were cleaned with normal saline or sterile water for injection and debrided from any necrotic tissues (especially at the first session). The ulcer area was measured before the start of every therapeutic session and images were taken before the start of every laser session.

The laser was set to 60 m sec. pulse duration, applying through a 7 mm spot an average fluence (energy) of 60 J/cm² on the wounds. The laser treatment was well tolerated and the energy fluence applied was varying (50-70 J/cm²). For the niche treatment of the entire ulcerous area, a "tailor's" technique was used with point to point laser appliance, irradiating also an area of 1-2 cm out of the edges of the ulcers. After treatment, a hyaluronic acid jel (Jalplast) was used.

Analysis

For results evaluation we examined a) the progress and the level of the ulcer healing (closure) and b) the time/sessions required for the healing, and c) side effects.

Results

In conclusion, 77,7% of the venous ulcers, 62,5% of the neurotrophic ulcers, 87,5% of the arterial ulcers and 100% of the traumatic ulcers were completely closed. The average period until healing was 5,02 weeks (3-32 weeks). In detail, for venous ulcers it was 3,7 weeks (3-20 weeks), for neurotrophic ulcers it was 4,6 weeks (3-8 weeks), for arterial ulcers it was 7,7 weeks (3-32 weeks) and for traumatic ulcers it was 3,3 weeks (3-4 weeks). Of the 27 healed ulcers, 15 were chronic and 12 acute, which means that 65,2% of the chronic and 100% of the acute ulcers were completely healed.



Table 1: Results analysis for ulcers healing

Form of Ulcers	Number of Ulcers	Ulcers completely healed	Average Heal Period (Weeks)	Non Healed Ulcers
VENOUS	9	7 (77,7%)	3,7 (3-20)	2 (22,3%)
NEUROTROPHIC	16	10 (62,5%)	4,6 (3-8)	6 (37,5%)
ARTERIAL	8	7 (87,5%)	7,7 (3-32)	1 (12,5%)
TRAUMATIC	3	3 (100%)	3,3 (3-4)	- (-%)
TOTAL	36	27 (75%)	5,02	9 (25%)

Of the 9 ulcers that were not healed completely up to the end of the study we had analytically:

Table 2: Summary analysis and healing progress of the 9 non healed ulcers

Duration of ulcer	Type of ulcer	Size of Ulcer (cm²)	Treatment time (weeks) progress of healing
10 years	venous	132 cm²	33 weeks/91% smaller
3 years	arterial	5,3 cm²	13 weeks/59% smaller
4 months	neurotrophic	23,4 cm²	3 weeks/32% smaller
4 months	neurotrophic	4,4 cm²	3 weeks/45% smaller
4 months	neurotrophic	25,5 cm²	3 weeks/30% smaller
3,5 months	neurotrophic	13,6 cm²	2 weeks/24% smaller
2 years	venous	78,12 cm²	3 weeks/76,5% smaller
8 months	neurotrophic	16,06 cm²	3 weeks/31,8% smaller
8 months	neurotrophic	5,76 cm²	3 weeks/29,7% smaller

Table 3: Summary analysis of the 27 headled ulcers

Duration of ulcer (pro-treatment)	Type of ulcer	Size of Ulcer (cm²)	Time to Healing (weeks)
4 years	VENOUS failed "graft" covering	52 cm²	20 weeks
4 weeks	VENOUS	2,4 cm²	3 weeks
4 weeks	VENOUS	4,6 cm²	4 weeks
6 weeks	VENOUS	5,7 cm²	3 weeks
4 weeks	VENOUS	5,2 cm²	3 weeks
5 weeks	ARTERIAL (with bone exposure)	4,9 cm²	32 weeks
4 weeks	VENOUS	4,5 cm²	3 weeks
5 weeks	NEUROTROPHIC	2 cm²	4 weeks
4 weeks	NEUROTROPHIC	1,7 cm²	3 weeks
3 weeks	ARTERIAL	1,8 cm²	3 weeks
2 weeks	ARTERIAL	2,5 cm²	3 weeks

4 weeks	ARTERIAL	2 cm²	3 weeks
8 weeks	ARTERIAL	9 cm²	5 weeks
12 weeks	NEUTROPHIC	1 cm²	2 weeks
10 weeks	NEUTROPHIC	2 cm²	2 weeks
2 years	VENOUS	3,8 cm²	4 weeks
2 weeks	TRAUMATIC	5,5 cm²	4 weeks
10 weeks	TRAUMATIC	4,5 cm²	3 weeks
9 weeks	TRAUMATIC	3,5 cm²	3 weeks
2 weeks	ARTERIAL	14,2 cm²	3 weeks
2,5 weeks	ARTERIAL	12,5 cm²	3 weeks
16 weeks	NEUTROPHIC	3,3 cm²	4 weeks
18 weeks	NEUTROPHIC	2,5 cm²	4 weeks
5 weeks	NEUTROPHIC	10,7 cm²	4 weeks
4 weeks	NEUTROPHIC	4,4 cm²	3 weeks
9 weeks	NEUTROPHIC	9,5 cm²	8 weeks
10 weeks	NEUTROPHIC	5,06 cm²	8 weeks

Discussion

The results of the study are very promising as the 75% of all the ulcers included in the study have completely healed. The closure rate was higher for acute ulcers than for the chronic ulcers. A part from the progressive closure of ulcers, the ulcer related pain was significantly relieved after the first or second laser session, especially in arterial ulcers. No side effects were reported by the laser irradiation and the laser fluence at 50 Joules/cm was well tolerated by the patients.

Conclusion

The diode laser 1470nm as a source of photobiostimulation with a fluence of 60J/cm showed beneficial effect on wound healing by reducing inflammation, improving vascular activity and accelerating tissue growth and repair. The diode laser 1470nm seems to be an effective, non-invasive, simple, painless and pain-relieving treatment with no reported side effects for the ulcer wound healing.

References

1. Kawalec J., Hetherington V., Pfennigwerth T., Dockery D., Dolce M.: Effect of a diode laser on wound healing by using diabetic and nondiabetic mice. *The Journal of foot and ankle surgery* 2004, vol. 43, no4, pp. 214-220.
2. Nemeth A. J. (1993). Lasers and wound healing *Dermatology clinics* 11(4):783-9.
3. Potinen P. J. (1992) Biological effects of LLLT. In P. J. Potinen, ed. *LLLT as a medical treatment modality*. Art Upro, Tampere, Finland, 99-101.
4. Schindl A., Heinzeg G., Schindl H., Pernastorfer Schon H., Schindl L. (2002). Systemic effects of low-intensity laser irradiation on skin microcirculation in patients with diabetic microangiopathy. *Microvascular research*.
5. Schindl A., Schindl M., Pernerstorfer Schon H., Kersch K., Knobler R., Schindl L. (1999). Diabetic neuropathic foot ulcer: successful treatment by low-intensity laser therapy *Dermatology* 198(3) 314-6.
6. Ribeiro M. S., Silva D. F., Maldonado E. P., De Rossi W. (2002) Effects of 1047nm neodymium laser radiation on skin wound healing. *Journal of clinical laser medicine and surgery* 20(1):37-40.
7. Loevschal A. L., Avenholt-Bindsler (1994). Effect of low level diode laser irradiation of human oval mucosa fibroblasts invitro. *Lasers in surgery and medicine* 14(4).