

## **EFFECTIVENESS OF THE ELVeS 1470nm DIODE LASER FOR LEG ULCERS TREATMENT**

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Since their inception in 1960, lasers have proved their effectivity 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 7mm spot aiming to produce a photobiostimulation effect to reduce inflammation, enhance microvascular activity in order facilitate new tissue growth and accelerate the would 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 cm<sup>2</sup> up to 132 cm<sup>2</sup>.

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 Treatments**

The laser treatments were taking place 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 60msec pulse duration, applying through a 7mm spot an average fluence (energy) of 60 J/cm<sup>2</sup> on the wounds. The laser treatment was well tolerated and the energy fluence applied was varying (50-70 J/cm<sup>2</sup>).

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 1-2cm out of the edges of the ulcers. After the 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 and 100% of the traumatic were completely closed.

The average period until healing was 5,02 weeks (3-32 weeks). In detail, for venous ulcers was 3,7 weeks (3-20 weeks), for neurotrophic ulcers was 4,6 weeks (3-8 weeks), for arterial was 7,7 weeks(3-32 weeks) and for traumatic 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)	- (-%)
<b>TOTAL</b>	<b>36</b>	<b>27 (75%)</b>	<b>5,02</b>	<b>9 (25%)</b>

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

## 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.

Apart from the progressive closure of ulcers, the ulcer related pain was significantly relieved after the first or second laser session, especially at 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 laser Ceralas ELVeS 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 laser Ceralas ELVeS 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

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**Table 3: Summary analysis of the 27 headled ulcers**

Duration of ulcer (pro-treatment)	Type of ulcer	Size of ulcer (cm <sup>2</sup> )	Time to Healing (weeks)
4 years	VENOUS failed "graft" covering	52 cm <sup>2</sup>	20 weeks
4 weeks	VENOUS	2,4 cm <sup>2</sup>	3 weeks
4 weeks	VENOUS	4,6 cm <sup>2</sup>	4 weeks
6 weeks	VENOUS	5,7 cm <sup>2</sup>	3 weeks
4 weeks	VENOUS	5,2 cm <sup>2</sup>	3 weeks
5 weeks	ARTERIAL (with bone exposure)	4,9 cm <sup>2</sup>	32 weeks
4 weeks	VENOUS	4,5 cm <sup>2</sup>	3 weeks
5 weeks	NEUTROPHIC	2 cm <sup>2</sup>	4 weeks
4 weeks	NEUTROPHIC	1,7 cm <sup>2</sup>	3 weeks
3 weeks	ARTERIAL	1,8 cm <sup>2</sup>	3 weeks
2 weeks	ARTERIAL	2,5 cm <sup>2</sup>	3 weeks
4 weeks	ARTERIAL	2 cm <sup>2</sup>	3 weeks
8 weeks	ARTERIAL	9 cm <sup>2</sup>	5 weeks
12 weeks	NEUTROPHIC	1 cm <sup>2</sup>	2 weeks
10 weeks	NEUTROPHIC	2 cm <sup>2</sup>	2 weeks
2 years	VENOUS	3,8 cm <sup>2</sup>	4 weeks
2 weeks	TRAUMATIC	5,5 cm <sup>2</sup>	4 weeks
10 weeks	TRAUMATIC	4,5 cm <sup>2</sup>	3 weeks
9 weeks	TRAUMATIC	3,5 cm <sup>2</sup>	3 weeks
2 weeks	ARTERIAL	14,2 cm <sup>2</sup>	3 weeks
2,5 weeks	ARTERIAL	12,5 cm <sup>2</sup>	3 weeks
16 weeks	NEUTROPHIC	3,3 cm <sup>2</sup>	4 weeks
18 weeks	NEUTROPHIC	2,5 cm <sup>2</sup>	4 weeks
5 weeks	NEUTROPHIC	10,7 cm <sup>2</sup>	4 weeks
4 weeks	NEUTROPHIC	4,4 cm <sup>2</sup>	3 weeks
9 weeks	NEUTROPHIC	9,5 cm <sup>2</sup>	8 weeks
10 weeks	NEUTROPHIC	5,06 cm <sup>2</sup>	8 weeks