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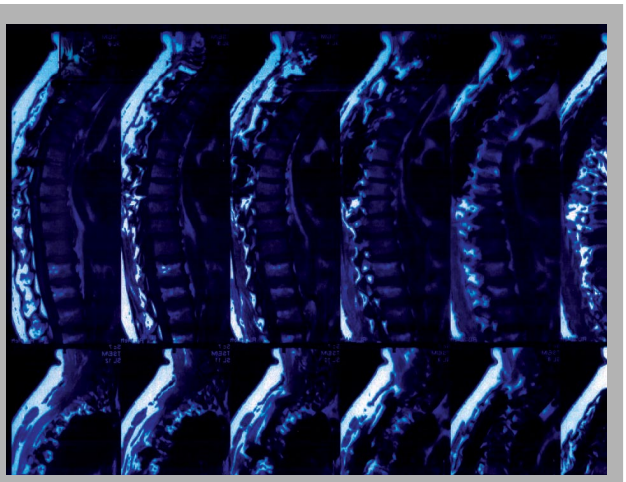
Abstract: Since many years some effects of non surgical laser and light on biological tissue have been demonstrated, *in vitro* and *in vivo*. This review is based on the results obtained by me and my colleagues/follower in Italy. Aim of our study is to verify the anti-inflammatory and regenerative effects of non surgical laser and light therapy on patients with chronic diseases not good treatable with traditional therapies, as diabetes, and central nervous system injuries. In addition, many clinical data have emerged from double-blind trials on laser treatment of rheumatic diseases and in sports medicine. So, we would like to do a review on the state of the art of non surgical laser treatment in medicine, included aesthetic laser and light therapy field. We discuss the indications and limitations of aesthetic laser medicine, as concluded from the data analysis of the published literature and from over thirty years of personal experiences.



NMR of the first patient. After laser therapy. March 2005

Non surgical laser and light in the treatment of chronic diseases: a review based on personal experiences

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Key words: laser biomodulation; dosimetry; spinal cord injuries; brain injuries; diabetes; chakra; coherence domain; quantum medicine; anti-inflammatory effect

1. Background and objectives

The beneficial effect of light on biological tissues has been known since the days of Hippocrates and even earlier. Approximately 5000 years before Christ it was known that all living matter produces and exchanges different types of energy with the surrounding environment. Many different names were given to these phenomena, starting with "prana" for all, including luminous, energies; "chakra" to identify the areas where energy exchange with the outside is greatest, and finally "aura" for the energy layers around and immediately interconnected with matter. J. White, a North American scientist has studied approximately 100 different ancient civilizations and found one hundred different words used to identify the above concepts [1]. Up to a few years ago, the science that studies the human body as if it were a machine that produces and exchanges energy with the outside was called energetic medicine [2], and today it is known as quantum medicine [3], prana or "cosmic energy", and the chakras are related to the "coherence domains".

It has been found that the non-corpuscular electromagnetic radiation produced by the human body is distributed to the areas, in which it is called aura, and each aura has got its corresponding wavelength and apparatus. This is the place where endogenous energy is immediately exchanged with the outside exogenous energy. It has also been seen that there is an interval of approximately twenty days between positive and negative changes in the energetic aura

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•	Modulation of tissue repair [5,6,30] Therapy of skin ulcers, wound healing, hypertrophyc scars, keloids, rejuvenation
•	Anti-inflammatory effects [4,8,11] Therapy of fibromyositic rheumatisms, sport injuries, other
•	Pain control [21,33,36] Therapy of neuralgias
•	Increasing venous – lymphatic drainage [9,40] Therapy of oedemas, haematomas

Table 1 NSLT – non surgical laser therapy. Clinical practical uses

•	Modulation of metabolisms [9,20]
•	Modulation of immunological system [45–47]
•	Modulation of nerve cell functions [14,15,21,22,24,48]
•	Modulation of stem cells [23,50]
•	Modulation of light energy exchanges [2,4,46,47]

Table 2 NSLT – non surgical laser therapy. Clinical experimental uses

and body matter, as organs and apparatus, which it corresponds, and that lasers selectively influence the auras. Since the human body comprises 15% matter and 85% water, it is possible that the energy must first get through the water, and be modulated by it before it can be totally absorbed by the matter. Some of light's biomodulating effects were already known and partially measured in the 1950s, that is even before the laser was invented. V.M. Inyushin et al. [4] spoke of "bioplasm" to describe the energies that surround the human body and must always be in dynamic equilibrium with it in order to avoid organic diseases. According to [4], light influences and restores the bioplasm's integrity. This global approach to human body's study justifies some evidence based medicine's data and enlarges enormously our knowledge. Of course, in medicine and biology, the experimentation must follow three fundamental criteria:

- Helsinki Declaration rules and E.C. Guidelines;
- Virchow's approach: "At first we study the Facts, then the causes of Facts";
- W.H.O. approach: We must study and verify each substance, energy, tool, which modifies a physiological process of the human body.

From an exclusively material and Newtonian standpoint, around 1966 E. Mester et al. [5,6] pointed out, for the first time, that a red light laser stimulates hair re-growth in the coats of rats and halves the healing time of experimental ulcers. Many experiments have been done since then

Lamp	**Laser**
Not exact dosage of radiation on the tissue	Exact dosage of radiation
More wavelength available contemporaneously	One wavelength available each time
Very large area treatable in less time	Not large area treatable contemporaneously
More filters avoiding melanin damage	Selective damage
Not only physician operator, in Italy and many countries	Only physician operator, in Italy and many countries

Table 3 Lamp *versus* laser differences

and proved incontrovertibly that visible and close to infrared wavelength lasers influence the healing time of skin wounds and ulcers, stimulating or inhibiting the process according to the radiation dosage and method [7–10]. Ten years ago, at the University of Bethesda (Maryland, USA) it was shown that at specific doses some lasers increase cultured fibroblast activity by 98% [11]. Many, strictly dose-dependent effects have been demonstrated in nearly all normal and pathological biological processes: from cell maturation to reproduction, from inflammation to edema, from neural irritation to pain inhibition, and also through increased endogenous endorphin production (Table 1).

The importance of dosage in all these cases was immediately realized to be fundamental because the same type of laser may have opposite effects on the same biological process and on the same tissues if the irradiation's dose is modified. A good bibliographic critical review on this topic had written by J. Tunér and L. Hode [12]. Many other uses of non surgical laser were studied following this concept (Table 2).

In terms of dosage, in order to obtain the desired effects we must consider a whole series of physical parameters (wavelength, emission, fluence, energy density, repetition pulse frequency, spot size, irradiation time/spot), biological factors (type of tissue, biological health), and clinical factors (irradiated point, number and rhythm of sessions, irradiation procedure) [7–10]. Therefore, it is evident that if the effects of light are contingent on small quantities of radiation and how they are administered, it follows that we must use lasers, which allow us to administer precise and selective doses to the tissues. This is what is done in soft tissues regeneration such healing of cutaneous wounds and ulcers, in the treatment of osteomuscular-tendinous inflammations and traumas and neuralgias [11–15].

If, however, we need greater amounts of energy beyond a given minimum threshold and a wide range of doses before we can reach the tissue damage, we must also use intense pulsed lights instead of the coherent type used in

Patient's inclusion criteria	
•	Type 1 – 2 human diabetes in compensative phase
•	Both sex and middle/old age
•	Weight normal or high
•	Diabetes started more than one year ago
•	10 + 10 voluntaries, unpaid, with consensus signed
Patient's exclusion criteria	
•	Diabetes 1–2 with unstable glycaemic control
•	History of hypo-hyperglycaemic coma
•	History of cardiovascular not treatable complication
•	History of malignancy
•	Previous participation in a clinical trial for hypoglycaemic drug effects control
Patient's suspension criteria	
•	Patients with diabetes complication starting after laser treatment
•	Patients who don't follow the protocol prescribed and the diet (very frequent!)
•	Patients with adverse effects to laser irradiation (local burns, allergic reaction)
•	Patients who present some exclusion criteria that appear after the inclusion in the treatment protocol

Table 4 Phase 2 of experimentation

non-ablative skin rejuvenation and in the treatment of hypertrophic scars, stretch marks and keloids [16, 17].

In recent years there has been intensive research in the field of non-ablative skin rejuvenation. This comes as a response to the desire for a simple method of treating rhytids caused by aging or ultraviolet (UV) exposure and acne scars. In numerous studies intense visible light pulsed (IPL) systems are used. The mechanism of action was supposed to be a selective heat induced denaturalization of dermal collagen that leads to subsequent reactive synthesis.

Today, lasers are used successfully together with pulsed light in cosmetic medicine to treat skin-ageing, dystrophic skin and to reabsorb small wrinkles [16]. Difference between laser and intense pulsed lamp are shown in Table 3. They are also used .in the treatment of some chronic pathology such as skin ulcers and skeletal-muscular-tendon inflammations as well as the treatment of any inflamed tissue as long as it can be reached by the beam. At cellular level, L. Longo et al. [18] have shown that lasers act on the several components of the cell in a selective mode and according to the wavelength, affecting the mechanism that produces water on the part of the mitochondria, which in turn triggers adenosine triphosphate (ATP) production and hence immediately available energy. This stimulates cell function of all types of cells. It seem that if the cell is damaged, the natural defense mechanism makes the mitochondria produce oxygenated water as opposed to "normal" water so that the cell cytoplasm is "cleaned" and can resume its normal function. If the damage is severe and irreversible, the cell produces activated "singlet" oxygen, a cytocide, which coagulates the cytoplasm preventing oncogenic and teratogenic transformations from taking place. All these mechanisms are influenced by luminous radiation in a strictly dose-dependent manner [18].

Another important factor concerns the current terminology. Most lasers were named after the medium generating the laser energy: CO_2, argon, dye, etc. Well known developments can make one medium to generate more than one laser with different wavelengths: argon, for instance, can generate a group of lasers with a wavelength from 488 nm to 560 nm and the dye lasers can produce blue, green, yellow and red color light [9].

2. Material and methods

Following this scientific rationale, we treated a chronic systemic metabolic disease such as diabetes and difficult chronic tissue lesions such as spinal and brain injuries (BI). In both cases we irradiated both the sites of the lesions and the coherence domains of the injured apparatus.

2.1. Laser therapy of diabetes

The effects of light on glucose metabolism are not yet clear. We do know, however, that sailors with Type 1 and Type 2 diabetes reduce the dosage of insulin and antidiabetic drugs when at high sea. For over twenty years evidenced-based medicine has shown that lasers have positive glucose-normalizing effects on Type 1 and Type 2 diabetes [19]. In the world, there are at least three different types of antidiabetic treatments based on light and other energy sources. These data led us to experiment the effects of a system based on lasers and electromagnetic fields on patients with Type 1 and Type 2 diabetes following the guidelines of the Declaration of Helsinki as recently reiterated by the European Union. Our first aim was to determine whether or not lasers have an effect on sugar metabolism in diabetic patients. In this case the electromagnetic fields serve to create a "bioresonance", that is it increases intercellular vibrations in order that light can better penetrate the intercellular spaces while maintaining its coherence.

The patients were selected on the basis of inclusion-exclusion criteria and treatment interruption criteria (Table 4); the patients were properly informed about the experimental nature of the study, the potential benefits and risks connected with it and they gave their informed consent prior to the start of laser treatment [20]. It is interesting to note that the Florence Ethics Committee did not

•	Wavelength	810 nm
•	Power density in average	50 mW/cm^2
•	Time/spot in average	5 min
•	Emission in average	50 Hz PW
•	Fluence maximum	1 J/cm^2
•	Spot size	1 cm^2
•	Irradiated points (zones) abdomen. chakras	
•	No. & rhythm of sessions variable (see text)	

Table 5 Dosage parameters (average)

•	40 y.o. male
•	Subtotal spinal fracture in 2000 year, T4 level
•	Total paralysis sensory and motor under T4 level – ASIA A
•	Non perception of the body under T4
•	Presence of spontaneous muscle contractions

Table 6a February 2004, first patient with SCI treated in Italy

•	Stand up 4–8 hours for day, assisted by tutor
•	Regular motor and sensory activity of the abdomen and dorsal regions
•	Regular sexual activity
•	Anal sphincter normalized
•	Walking movements – ASIA D

Table 6b January 2007, after 14 cycles, 85 sessions in total

approve this trial on the grounds that it was not ethical to probably interrupt established treatments such as insulin and oral anti-diabetic drugs. However, it did approve an experimental protocol involving a molecule proposed as an oral antidiabetic, which, if effective, would not have changed anything in the treatment regimen for diabetes. This molecule proved ineffective: it took two years and eighteen million Euros of Italian public funds to reach this conclusion. Blood sugar was measured before, immediately after and 10 minutes after the treatment. Then, the patient took his/her scheduled daily measurements as prior to the treatment, and one extra reading at the same time of day that the treatment was completed.

These measurements were continued for at least one month after concluding the treatment, and then we recommended taking at least two daily measurements on an empty stomach in the morning and evening, even more than one month after completing the treatment. The patients were always treated at the same time of day.

The irradiation zones were different, depending by the type of diabetes: chakras 2, 3, 4, for Type 1, region of liver,-pancreas and spleen, and chakra 4, for Type 2. Treatment intervals varied from 12 hours to seven days until blood sugar levels normalized. Insulin and oral hypoglycemic drugs were gradually reduced as blood sugar levels decreased under laser irradiation. The patients were irradiated on an average of once or twice a day for 7 to 15 days, then once a week for 4 to 8 weeks and then once a month in the event that the blood sugar level started to rise and glycated hemoglobin did not decrease significantly after three months from the start of treatment.

Patient's inclusion criteria	
•	Both sex, young – middle age
•	SCI occurred one year ago and more
•	NMR: Total and subtotal lesion of SC
•	ASIA A
•	No therapy advised
•	Stop drugs , progressively
•	Rehabilitation fitness continues
Patient's exclusion criteria	
•	Previous surgical intervention contranature
•	Patients following further experimental trials
•	Drugs not prescribed by us
•	Patient stops rehabilitation fitness
Patient's suspension criteria	
•	No results after the end of one treatment cycle
•	Patients who don't follow the protocol prescribed
•	Patients with adverse effects to laser irradiation (local burns, allergic reaction)
•	Patients who present some exclusion criteria that appear after the inclusion in our trial

Table 7 Criteria of patient's selection

We used a prototype laser device made by General Project S.r.l. from Florence. This system comprises an 810 nm laser diode that is coupled with a low frequency magnet and a series of photodiodes (Table 5). Energy doses could vary during the course of treatment on the basis of the results obtained from time to time in each patient.

2.2. Laser therapy of spinal cord injuries (SCI)

Regarding the effects of lasers on the central nervous system (CNS), several authors [21–25] have demonstrated that at given doses some lasers regenerate experimentally injured neuron cell cultures and cause them to multiply. This scientific evidence prompted us to verify the effects *in vivo*.

First patient with SCI was treated in the year 2004 (Table 6a and Table 6b); then we selected young to adult patients of both sexes who had suffered traumatic spinal cord lesions. These patients were selected on the basis of rigid inclusion-exclusion and suspension criteria and strict standards were applied for treatment interruption (Table 7).

•	Diode laser	808 nm 30 W
•	Spot-size	5 cm^2
•	Fluence	12 J/cm^2
•	Energy density	720 J in total
•	PW 3	until 1000 Hz
•	Target	Column
•	Three sessions for day	
•	First cycle	15 sessions

Table 8a NSLT Anti-inflammatory anti-oedema

•	CO_2 laser	10600 nm 15 W CW
•	Spot size	10 cm^2
•	Time exposure	20 s/spot
•	Emission	SPW
•	SPW	999 Hz
•	Distance source/tissue	20 cm
•	Target	Column
•	Three sessions for day	
•	First cycle	15 sessions

Table 8b NSLT for muscle relaxation

•	Diode laser	808 nm 30 W
•	Spot-size	5.0 cm and 2.5 cm
•	Fluence	12 J/cm^2 and 4 J/cm^2
•	Energy density	variable
•	Target	Column, trigger points of the nerves, chakras
•	Three sessions a day	
•	Cycle	5 sessions
•	Pranotherapy	

Table 9 NSLT. Further monthly cycles. Regenerative?

In detail, ASIA is the acronym of American Spinal Injuries Association, which classifies the SCI in 5 classes, depending by the degree of sensory and motor lost of function, sphincters included.

The lasers were used on the lesion for anti-inflammatory and anti-edema purposes (Table 8a and Table 8b) and on the coherence domains corresponding to the CNS.

We used on the lesions an 808 nm laser, 30 W PW, pulses of 250 ms, pause of 5 ms, 3 Hz, spot size 5 cm^2, fluence 12 J/cm^2, energy density in total 720 J/cm^2, for anti-inflammatory goal, and a 10600 nm, 15 W continuous wave (CW) laser, spot size 10 cm^2, time exposure 20 s for spot, as a skeletal muscle anti-spasm, not only on the lesion, but also along the nerves in the paralyzed area. First cycle of treatment is 15 sessions, average 3 sessions for day, with minimum interval of two hours between the sessions.

•	Total right motor haemiplegia
•	Partial right sensory haemiparesis
•	Right facial paralysis
•	Dislepsias
•	Disphonias
•	EEG: total absence of normal activity on left haemisphere, maximum on temporo-parietal region
•	Low comprehension and expression
•	Loss of memory
•	Oedema right arm, hand, leg, foot

Table 10a Brain lesion, January 2008

•	Improvement $>$ 50% right motor haemiparesis
•	Improvement $>$ 90% right sensory haemiparesis
•	Recovery right facial paralysis
•	No dislepsias
•	Impoverishing 50% disphonias
•	EEG: presence of initial activity on left haemisphere
•	Improvement of comprehension and expression
•	Normal memory
•	Oedema right arm, hand
•	Disappearance oedema right leg, foot
•	Return of sexual libido

Table 10b Brain lesion, October 2008

Further monthly cycles were done, with different dosage (Table 9). This procedure could add anti-inflammatory effects with regenerative effects on nervous cells and/or on nerve functions, mediated by energetic system of the body.

The first difficulty is classifying this type of patient because there are not two patients with identical lesions, identical symptoms or identical responses to the treatments. For this reason, the statistical criteria that are widely used to classify these patients are very relative and dangerous because there is the risk of not treating patients who are statistically considered irrecoverable, according to existing diagnostic protocols, and of overtreating patients who do not respond to the therapy. Furthermore, all of our patients came to us with written opinions from orthopedists, physiatrists, neurologists and neurosurgeons that defined the lesions as complete and incurable and advised against any type of treatment and/or physiotherapy! Although it is true that for the foregoing reasons we cannot

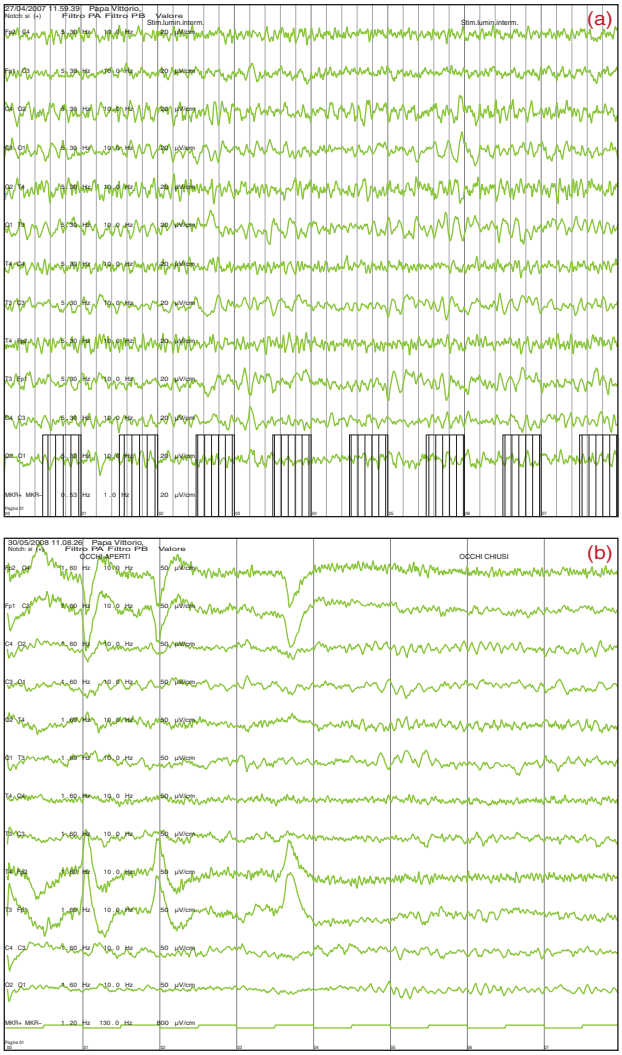

Figure 1 (online color at www.lphys.org) EEG control. (a) – before treatment, (b) – after 4 cycles of treatment

raise false hopes by talking about definite improvements, it is just as true that for the same reasons we cannot exclude the possibility of some spontaneous and/or induced improvement by basing our opinions only on statistical criteria.

2.3. *Laser therapy of brain injuries (BI)*

We treated only a 48 year old male, who was totally hemiplegic due to a traumatic cerebral hemorrhage he had suffered 20 years earlier that partially destroyed the left brain's hemisphere; the electroencephalography (EEG) was flat on the left side of Table 10a and Table 10b.

This patient was treated with 15 applications, at two hours' intervals, once a month starting in January 2008.

•	Complete paralysis of voluntary muscles in all parts of the body except for those that control eye movement (only left eye for this patient, male, 35 y.o.)
•	It resulted from traumatic brain injury suffered in year 2005

Table 11a Locked-in. Treated in July 2008

•	Control both eyes
•	Facial paralysis quite disappeared
•	Voluntary movements of mouth
•	Total sensory function of the body: tactile, thermal, pressurized, postural
•	Voluntary movements of arms and hands
•	Persistence of results until today

Table 11b Locked-in syndrome. Results in September 2008

The areas treated with laser associated with magnetic fields corresponded to the cerebral coherence domains; the hemiplegic areas were also treated with the anti-inflammatory and anti-spastic lasers. After the fourth treatment cycle, the EEG showed the beginning of functional recovery of the left hemisphere with responses to various types of stimuli (Fig. 1).

There was marked improvement in the interrupted sensory and motor functions, as well as intellectual functions as he was again able to read, to understand complex speeches and he recovered his memory. Muscular tone of the lower limb returned to normal activity although there is still a slowness in response to voluntary stimuli, the upper limb is still poorly responsive. The facial hemiplegia totally regressed after the first treatment cycle, and the motorial situation continues to improve with each treatment.

Other interesting experience: in July 2008 we treated a 35 year old patient with locked-in syndrome following an automobile accident that occurred five years before (Table 11a and Table 11b).

This patient was totally paralyzed and could only move the left eyelid, and that is how he communicated. Since this involved only the coherence domains, the patient was treated with twenty applications, the facial paralysis was eliminated, body temperature regulation and sensitivity were restored, he could move both eyelids and jaw; after a cycle of motor physiotherapy he is now able to move his arms voluntarily and flex the right leg 30°.

Therefore, we began using lasers for the treatment of degenerative diseases of the CNS such as multiple sclerosis and all its variations, including. ALS is amyotrophic lateral sclerosis [26]. The results up to now have been encouraging, but we would prefer to have a few years of follow-up before reporting on them.

•	Wavelength	511 nm and 577 nm
•	Emission	Wave pulse
•	Fluence	3 – 10 J/cm^2
•	Repeat-pulse	QCW * Hz
•	Pulse duration	20 – 70 ms
•	Spot caliber	1.5 mm
•	Irradiated points	Lesions zones
•	Procedure of irradiation	Fixed point
•	No. and spacing of sessions	1 – 5 a month

*) QCW – quasi-continuous wave

Table 12 TCuBr laser dosage for stretch-mark's treatment

2.4. Aesthetic laser therapy

In a study we involved patients with wrinkles, rhytids and acne scars. Our goals were: a) improving of clinical symptoms; b) suggesting a mechanism based on light induced reactive oxygen species (ROS) formation [18].

30 women of middle-old age with wrinkles and rhytides and 30 women of young-middle age with acne scars were treated in this work. We used a lamp with a broad band of visible light, 590 – 1200 nm, surface dose 25 – 30 J/cm^2 for wrinkles and rhytids and 390 – 510 nm, 30 – 35 J/cm^2 for acne scars. Spot-size was 15×25 mm^2. We repeated the irradiation 6 times in average with intervals of twenty days between the sessions. For ROS detection we irradiated collagen and fibroblasts in-vitro with a broad band of visible light, 400 – 800 nm, 4 – 8 J/cm^2, and used the spin trapping coupled with electron paramagnetic resonance (EPR) spectroscopy. As results, visible light had a good effect on rejuvenation of skin with wrinkles and acnes scars in the majority of the patients. Irradiated collagen or fibroblasts in-vitro, resulted in hydroxyl and superoxide anion radicals formation. We propose, as a new concept, that visible light 25 – 35 J/cm^2, produces high amounts of ROS, which destroy old collagen fibers encouraging the formation of new ones. On the other hand at inner depths of the skin, where the light intensity is much weaker, low amounts of ROS are formed, which are well known to stimulate fibroblast proliferation. The aesthetic results were excellent. Regarding the striae distensae or stretch-marks [17], already in the year 1974 argon laser was used and produced fairly good results. Currently there are three kinds of lasers suggested for the treatment of stretch-marks: 585 nm flash-lamp-pumped pulsed dye laser [17, 27], Nd:YAG with 1320 nm [28], and CO_2 laser ultra pulse wave (UPW) and super pulse wave (SPW) [28, 29]. The last one can be combined with detergent and nourishing chemicals mixed in a compound called "laser-peel" [30,31]. We selected in 1998-99 fifteen, early middle-aged women of phototype II-III (Fitzpatrick classification scale), with stretch marks on the breasts, abdomen, dorso-lumbar region, and at the base of the lower limbs. The patients interrupted any other treatment two months before the laser procedure and they were in good health. They underwent treatment with a copper bromide laser at 577 nm at tissue doses of 4 J/cm^2 on the breasts, and 8 J/cm^2 in the other regions. They were treated with 1 to 5 sessions, one month apart, using 1.5 mm spot diameter, with irradiation of the edges surrounding the lesion. Overlapping of 1/3 between the spots was included. Off-time between the pulses was from 120 ms until 150 ms.

The 577 nm laser was chosen because of its greater versatility as compared with the 585 nm pulsed dye laser. In fact, with the 577 nm laser it is possible to vary more parameters including the duration of the pauses between laser pulses, and adapt them to the individual case. In addition, 577 nm is the maximum absorption peak of hemoglobin. The effects of the 577 nm laser have also been studied *in vitro* [32].

The dosage parameters applied in each irradiation are summarized in Table 12.

Before irradiation, the target zone was cooled with a desensitizing cooling spray of *Aloe Vera* + *Asialene* + *Echinacea*. A similar combination without *Echinacea*, but with propylhydroxilic acid, in gel form, was applied for a week after the session. No other substances were administered before, during or after the treatment. Anti-inflammatory and anti-erythema spray and cream were applied only for protective purposes, during and immediately posttreatment.

Histological and histochemical evaluation was performed on 3 mm diameter punchbiopsies, including at the margin of the striae and in tissue around the lesion.

The results were evaluated on the basis of the planimetry of the lesions measured before and one month after each treatment and the morphological appearance of the lesions – using photographs, with specific reference to the depth, width and color of the striae. The patients were evaluated after 1, 2, 3, 4 months and at 1 and 2 years. The intense pulse light has been proposed too for this inaesthetism, with good results [9, 31]. Non ablative lasers yellow, green, red, near infrared, and intense pulse light with range of wavelength similar than lasers used for the treatment of superficial wrinkles and rhytides [16].

This procedure called laser and light rejuvenation is applied in the treatment of photoaging of face, neck, décolleté, hands, and legs (experimentally), stretch-marks; hypertrophic scars, acnis scars, and active psoriasis; redness of the face, called here "couperose"; skin atrophy/dystrophy; pigmented lesions dark, blue, black; hypopigmented lesions, as white scars and vitiligo; follicolitis; poikiloderma of Civatte; hair removal The new intense lamps have larger spot, possibility of irradiation with more wavelengths contemporaneously; Before the irradiation best lamps don't require application of gel or other substance on the skin, as in recent past. The use is easy and safe, the pulses are robotized but the emission is not complicated and maintained for long time of exposure. As

Characteristics	Diode	CO_2
Wavelength, nm	904	10600
Emission	SPW	SPW
Duration of spiked pulse, ms	200	250
Peak power, W	54	200
Duty cycle, %	0.1	30
Repetition pulse frequency, Hz	1 – 3000	1 – 999
Spot, cm^2	1	5 – 10
Beam divergency/expansion	$12°V \times 7°H$	3 mrad
Distance source/tissue	contact	20 cm

Table 13 Lasers used

side effect, some old and complicated lamps can emit irregular train of pulses for prolonged use, with burns for the patients. The use of the gel is another potential danger of bad irradiation, reflection of the light, loss of power with final result in burns for the patient. Curiously these lamps are retired in USA but distributed in Europe and rest of the world!

Usually we irradiate the target area with one, two, or three pulses for spot. We can choice in advance different range of wavelength, from 280 until 1200 nm. The majority of the light is lost for diffusion in the air, because this source is incoherent, but a quote of light penetrates on the skin with different absorption in the cells. The different absorption in the cells depends on different wavelength of the photons. We know for instance that the near infrared light is absorbed by the cell wall, the red by the mitochondrion, the UV by the nucleus, etc. We know also that different colors absorb selectively their complementary wavelengths. All these things give a photochemical reaction with formation of more oxygen peroxide in the mitochondria, then ROS for the reaction of the oxygen peroxide in and out the cells. Less amount of ROS clean the cells and the tissues and increase their activity. High amount of ROS are toxic, kill the cells (for instance old fibroblasts) stimulating the micro-drainage of the damaged old tissue and the apposition of new tissue. This mechanism of action is valid for all the effects of the light on the human body. Prof. Rachel Lubart (Bar-Ilan University, Israel) and mine proposed it some years ago [18].

The rejuvenation procedure reduces much the need of resurfacing with the advantage of avoid the discomfort and the dangers of the post-surgical intervention course. Anesthesia is never required. It is necessary to clean and refresh the skin with cool water. At first we put protective lens at the patient and ourselves, then put the tool on the skin and do a gentle pressure to deliver the flash. This pressure is necessary to open a safety control of the lamp. The safety control blocks the emission if lamp is not in direct contact with the skin. We irradiate until three times on the same target, consecutively. The lamp gets also the possibility to repeat the irradiation automatically. The involuntary irradiation's overlapping is impossible with this technique. The patient has the same sensation of a flash emitted by a camera near the skin. This technique increases light's absorption on the skin, limiting the dispersion. The emission's control is total in each moment and the safety is maximum. The sessions are repeated with interval of 2 – 3 weeks for the rejuvenation technique in general; one week for the psoriasis and vitiligo, 3 – 4 days for the acne active; 3 weeks for stretch-marks and scars and couperose. The total number of the sessions starts from 3 – 4 until 15 – 20.

2.5. Traumatic sport injuries and rheumatic diseases

Non surgical laser therapy (NSLT) has been applied in sport traumatology since many years [8, 33–35]. J. Walker has been the first scientist, which had the idea to use laser therapy as analgesic and antinflammatory treatment, in occidental world [36]. The mechanisms of action of laser therapy in these pathologies are still discussed. The positive results in the majority of cases are a fact. Many types of lasers have been used: helium-neon, galium aluminium arsenide with various wavelengths, Nd:YAG, carbon dioxide [8, 37, 38]. Often the authors call this therapy as low level laser therapy (LLLT) [37–40]. The use of Nd:YAG and CO_2 laser, with high power, but focalized on large spot, don't allows calling LLLT. On the other hand it is incorrect the division of different types of laser therapy, based only on the power of the irradiation, with the definition of LLLT, mid level laser therapy (MLLT), high level laser therapy (HLLT), and high intensity laser therapy (HILT). Fundamental importance has the procedure of the irradiation and the summary of the laser physics parameters [8–10]. It is better to say NSLT and surgical laser therapy (SLT) [10].

In details, the authors treated with CO_2 and diode laser therapy 904 nm the acute phlogosis post-trauma of muscle-skeletal system, and their chronic complications, as calcium metaplasias, pseudocystis, and fibromyositis. Regarding the acute pathologies, the patient were treated having the objective of reducing time of recovery, so all the patients seemed to be treated with laser therapy.

Regarding the patients with chronic complications, they were selected following a common protocol, and treated with laser therapy in simple blind. The dosage wasn't standard, but the dose of irradiation was adjusted following the changes of the clinical signs and echographic features [12, 13, 41]. In Table 13 the lasers used are shown, in Table 14 the starting dosage is summarized.

2.5.1. Laser therapy of induratio penis plastica

Since 1984 until 2000 year we have been treating 101 patients who are in middle-aged and advanced in years with a NSLT treatment [42–44].

Pathology	mm/spot	Number of spots for session	Number of sessions, 1/day	Energy density, J/spot
Sc. Hum. Periarthritis	1 – 3	4 (1 – 7) *	12	12 – 36 (0 – 1.8)
Ankle	1 – 5	5	15	12 – 48 (0 – 2.5)
Cervical	1 – 3	2 4 (2 – 14) *	15	12 – 36 (0 – 1.8)
Toracic	1 – 3	24 (2 – 14) *	10	12 – 36 (0 – 1.8)
Lumbar	3 – 7	24 (2 – 8) *	20	12 – 80 (0.64 – 2)
Sacro-coccygeal	3 – 7	24 (2 – 8) *	15	idem
La Peyronie	1 (10)	4	15	12 – 48 (0 – 2.5)
Dupuytren	1 (10)	4	15	12 – 48 (0 – 2.5)
Epicondylitis	1 – 3	4	1 – l5	12 – 24 (0 – 1.2)
Knee	1 – 3	5 – 7	1 – 15	12 – 36 (0 – 1.8)
Pubis	3 – 5	2 – 4	1 – l2	12 – 48 (0 – 2.5)
Achilles tendon	1 – 3	2 – 4	15	12 – 36 (0.5 – 1.8)

*) CO_2 laser is used at 100 W of peak power, 1000 (half time of irradiation) and 10 Hz in SPW, spot of 5 cm^2. Diode laser 904 nm is used always at 54 W of peak power, spot of 5 $cm^2$and 3000 Hz, in SPW. Where there are parentheses, the figures in parentheses refer to diode lasers; figures without parentheses refer CO_2 laser. Where there are not parentheses, figures refer lasers, diode and CO_2.

Table 14 Laser irradiation dose for each pathology

The patients were divided into several groups in relation of the type of induratio. Before the treatment the patients have undergone an erectile test, which resulted positive.

The dosage for spot varied from patient to patient and it was included in a range of 4 and 20 J/cm^2. We have used pulsed diode laser, before 904 nm for first, and then 810 nm with a frequency of 3000 Hz and with irradiation on fix points, on ten patients, not included in this study.

The ray's diameter varied from 1 to 6 cm, depending by the size of the lesion. Diode laser irradiation was followed by irradiation with CO_2 laser, with parameters listed in Table 15.

The specific dosage for each patient had been settled taking into account the clinical aspect of the lesion under the treatment. With a low-power diode laser only by a mild change of color of the area we thought to have reached a maximum dosage, while with high power diode laser and with laser CO_2 the patient himself suggests when the application should be finished, since he feels a sensation of local heath, which at first it could be relieving but at last it ended to be fastidious and this is the point to stop the action. Then we calculated the average of the dosage for spot irradiated for each patient.

The length of each application varies with the power of lasers available. Much stronger are the lasers, much shorter will be the applications' time required to reach the therapeutic dosage of joule. When we use scanner procedure, we regulate the scanner to a speed of 1 cm/s and the dosage must be estimated taking into account this further variable parameter. Always make an echography of the penis before the treatment and after twenty days (Fig. 2). The combined substances should be suspended.

Parameters	CO_2	Diodes	
Wavelength, nm	10600	904	810
Emission	PW	PW	PW
Spot size, cm	3 – 10	3 – 5	3 – 5
Flux of radiation, J/cm^2	4 – 8	8 – 20	8 – 20
Repetition pulse frequency, Hz	100	3000	3000
Irradiated points (zones)	Lesion and adjacent tissue		
Procedure of irradiation	Scanner	Fixed point	
Number and rhythm of session	15 – once a day		

Table 15 Induratio penis plastica dosage

2.5.2. Endovenous non surgical laser therapy (NSLT)

To summarize, laser is excellent local anti-inflammatory and it is useful wherever there is an inflammation that can be irradiated. According to some Russian authors, lasers could also be effective against bacteria, viruses and parasites by stimulating immune defenses and specifically the lymphocytes [45–47]. But these statements must be verified through adequate testing, which has not been done up to now. Those same authors also propose intravenous laser treatment, in which an optical fiber laser, put in a venous cannula needle, is inserted in a brachial vein to irradiate all the blood in the body. It has been seen that this method increases both the number of lymphocytes and their activity and affects all blood chemistry parameters.

3. Results and conclusions

3.1. Diabetes

Our data shows that laser therapy have a positive role in the treatment of diabetes Type 1 and Type 2. Although

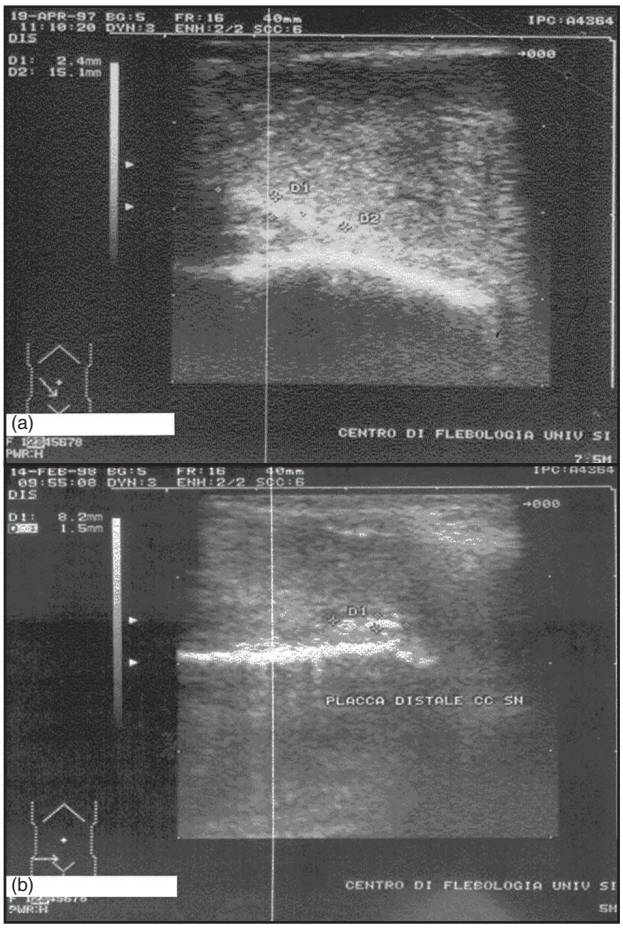

Figure 2 (online color at www.lphys.org) (a) – echographic findings before diode 810 nm laser treatment, (b) – echographic findings after diode 810 nm laser treatment

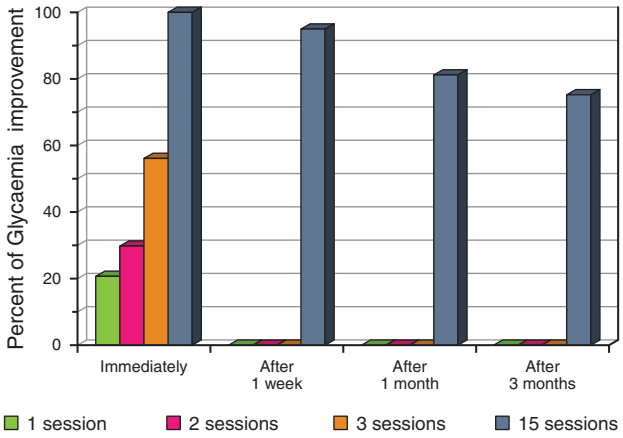

Figure 3 (online color at www.lphys.org) Results on Type 1 diabetes

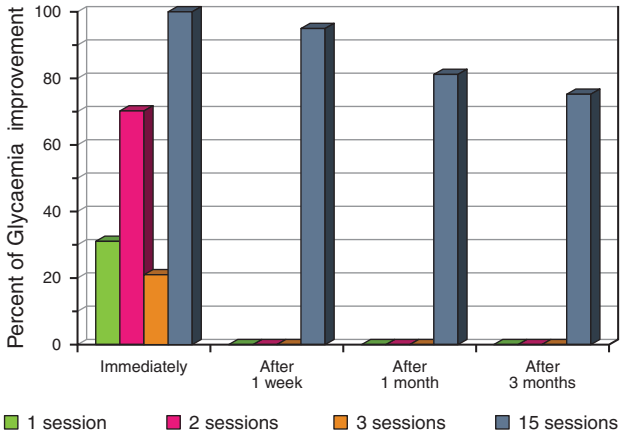

Figure 4 (online color at www.lphys.org) Results on Type 2 diabetes

the follow-up is still short, it is positive both in Type 1 and Type 2 diabetes. There were no episodes of biological hypoglycemic effects such as hypoglycemic crises due to an excessive drop in blood sugar on fasting or induced by the laser. There were two instances of post-treatment hypoglycemia in Type 2 diabetic patients, but they were asymptomatic.

There was one case of transitory hyperglycemia in a patient who had not fasted for four hours prior to treatment, and it resolved spontaneously during the course of the day.

Lasers can cause localized first and initial second degree burns, and there was one case of post-treatment erythema, which cleared up spontaneously. Allergic (idiosyncratic) reactions to light may trigger an urticarioid syndrome with itching and erythema. This did not occur in any of our patients; however, all these adverse reactions are easily treated with topical antihistamines.

From the ethical standpoint we can say that:

1. Evidence-based medicine tells us that non surgical laser treatment has hypoglycemic effects on patients with Type 1 and Type 2 diabetes. This requires other rigorous scientific studies to consolidate its validity;
2. The exact laser radiation dose needed to produce a hypoglycemic effect is still unknown and is probably not univocal as it may vary not only from patient to patient, but also on the same patient during the course of treatment. Therefore, we will have to use a range of doses that definitely will not have negative effects on the irradiated tissues, as demonstrated in the literature;
3. Preliminary experiments have shown that glucose lowering laser irradiation accelerates gastric emptying. This could raise blood sugar levels if the patient has not fasted for at least 4 hours prior to treatment. Therefore, it is absolutely essentially that the patients do not eat for at least four hours before the treatment;

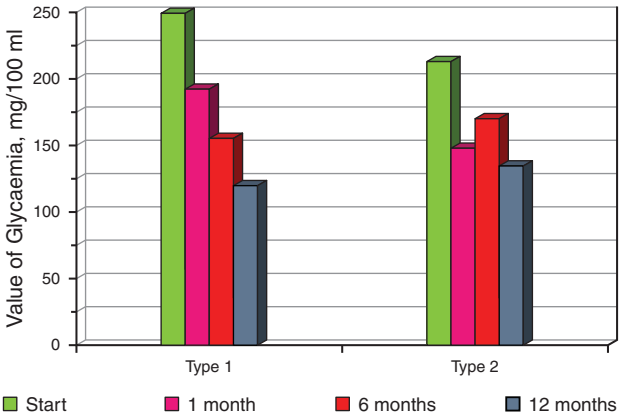

Figure 5 (online color at www.lphys.org) Follow up – 1 year

•	After 3 month	< 30% in both types
•	Six months	< 50% Type 1
		< 35% Type 2
•	One year	< 80% Type 1
		< 60% Type 2

Table 16 Follow-up of glycated hemoglobin

4. The adverse reactions from laser irradiation may be local burns. Fortunately, the doses used for glucose lowering treatments are very far from the toxic dose level;
5. There are no other known negative systemic effects caused by the laser beams used in these cases.

From our findings we can state that nonsurgical laser treatment associated with pulsed magnetic fields can normalize glucose metabolism in patients with Type 1 and Type 2 diabetes without causing adverse reactions and/or complications (Fig. 3 and Fig. 4).

Insulin replacement therapy and oral antidiabetic drugs can therefore be gradually suspended to the point of no longer being needed. The duration of the normal blood sugar state after the conclusion of laser treatment has not been clearly and uniformly determined (Table 16 and Fig. 5). It seems that a near infrared photodiode held in contact with the skin during the digestion of the main meals, at individually doses adjusted for each patient, accelerates glucose metabolism, preventing hyperglycemia secondary to food intake, and that this helps maintain the results achieved.

As to the mechanism of action, at this time we can only present hypotheses that will need to be verified over time:

- anti-inflammatory effects;
- stimulation of beta cells;
- stimulation of cromaphine cells;
- stimulation of microcirculation;
- cleaning of cell walls;

Figure 6 (online color at www.lphys.org) NMR of the first patient. Before laser therapy. December 2003

- hypolipemic effects;
- increased " bioplasm" metabolism;
- other associated effects.

We must also investigate the potential effects of light and lasers on other – protein and lipid – metabolisms as well as on all of the human body's neuroendocrine functions. And then, we shall go on to phase three of the clinical trial as soon as we find an institution to finance the project.

Further study must establish best dosage for this application and must increase the duration of the results. Regarding latter, evidence based medicine say that the irradiation of 4th coherence domain with simple photodiodes, dosed as non surgical lasers, could avoid secondary hyperglicaemia post-prandium. But this clinic impression must be verified scientifically, it is an experiment in another experiment.

3.2. Traumatic central nervous system (CNS) injuries

In traumatic diseases of the CNS positive results will presumably always be permanent. However, in degenerative

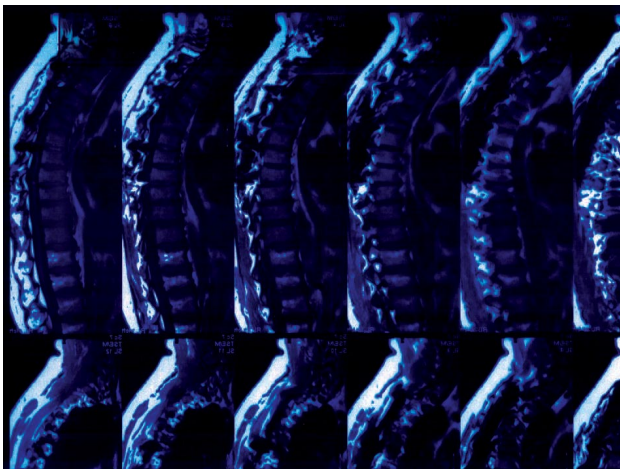

Figure 7 (online color at www.lphys.org) NMR of the first patient. After laser therapy. March 2005

Further treated patients with SCI First cycle of 20 sessions, then 8 cycles, each of 5 sessions for month, in average			
		Patients	Improvement
•	SCI lumbar level	15	40%
•	SCI dorsal level	9	50%
•	SCI cervical level C4-7	13	50%
•	SCI cervical level C2-3	6	20%
Further treated patients with other CNS diseases Only 1 cycle of 15 sessions			
		Patients	Improvement
•	Progressive leucodistrophy	2	Recovery
•	Cobalt neuropathy	2	Recovery
•	Facial paresis	20	Recovery
•	SPE syndrome	2	Recovery
•	Multiple sclerosis	7	30%

Table 17 Further treated patients with CNS lesions

diseases it is highly unlikely that the results of laser therapy will last forever, since the cause – which is often unknown – remains; therefore, the patients will have to undergo periodic treatments.

3.2.1. Laser therapy of spinal cord injuries (SCI)

The results obtained on the patients who underwent laser therapy were evaluated by physiatrists other than the operator, and in most cases they did not know that the patients had had laser treatments. For the sensory motor clinical examination we used the standard classifications, such as ASIA and the Asworth scale modified. Before and after treatment all the patients underwent vertebral column nuclear magnetic resonance (NMR) examinations and some also had electromyography (EMG) and evoked somatosensory potentials (ESSP) (Fig. 6 and Fig. 7).

For ethical reasons, treatment cycles were interrupted if there was no objective improvement after each treatment, and this occurred only in three cases: two quadriplegics and one paraplegic.

In patients with spinal lesions at different levels (Table 17), there was always a recovery in heat and tactile sensitivity as well as pain and proprioreceptivity below the lesion, albeit to different standard classifications, such as ASIA and the Asworth scale modified. Before and after treatment all the patients underwent vertebral column NMR examinations and some also had EMG and ESSP (Fig. 1 and Fig. 2). For ethical reasons, treatment cycles were interrupted if there was no objective improvement after each treatment, and this occurred only in three cases: two quadriplegics and one paraplegic. In patients with spinal lesions at different levels (Table 17), there was always a recovery in heat and tactile sensitivity as well as pain and proprioreceptivity below the lesion, albeit to different extents and at different times, but it was always permanent and never transient.

Normal body heat regulation was always recovered when interrupted by the lesion, as were normal anal sphincter control and sexual activity in both sexes including erectile, ejaculatory and sensory functions. Bladder control was restored in the women, but never in the men in whom there was increased diuresis and urine loss during treatment, which may be due to a redistribution of bladder tone. Muscle relaxant drug treatments that affected bladder tone were gradually interrupted in all patients because they were not necessary. Gradually, there was muscular relaxation in spastic paralyses and a reduction and disappearance of spastic contractures, which were slowly replaced by normal spontaneous contractions, hyperreflexia, and also fasciculation, in the patents who were restored to almost normal motility. Appropriate physiotherapy was recommended for voluntary motor functions. The physiotherapists noted that the patients undergoing laser therapy have better reactions and strength when doing their exercises and better muscle tone, which never develops into spasms. These results were transient at the outset during the early treatment cycles, lasting for about one month and then became permanent. This may be due to an accumulation of radiation or the possibility that the patients are better able to do their motor exercises.

Regarding the laser's mechanism of action, it is probable that the anti-inflammatory and anti-edema effects at the lesson level immediately decompress the nerve tissues, which are then better able to transmit stimuli. In cases of physical interruption there may be two mechanisms-effects: the lesion may be reduced by new, functional neurons formed by laser stimulation rather than glial neurons; or natural anastomoses may be formed between the supralesion central nervous tissues and the peripheral radicular

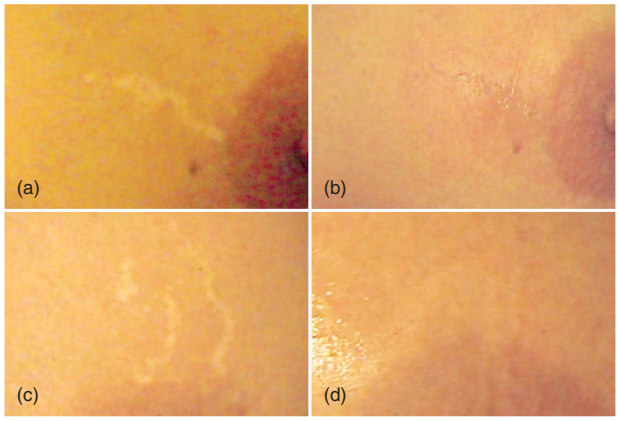

Figure 8 (online color at www.lphys.org) Breast strias. (a) – before, (b) – 20 days after four treatments, (c) – before, (d) – 20 days after four treatments

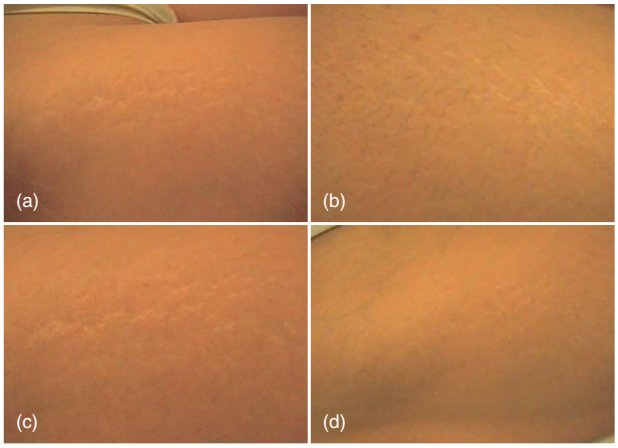

Figure 9 (online color at www.lphys.org) Leg strias. (a) – before, (b) – after one laser treatment, (c) – after two laser treatments, (d) – after four laser treatments

and/or skin nerves leading to the creation of bypasses that transmit the stimuli to a level above the lesion [48].

In fact, in some cases we noted dissociation between the NMR and the symptomatic-functional picture in the sense that the healed lesions under the NMR did not present the same functional healing, whereas the lesions that were still visible on the NMR were accompanied by a nearly total functional recovery, including walking with tibial braces. The patient with the NMR that showed recovery reacquired sensory and smooth muscle function, but not the voluntary muscles because she refused to do motor physiotherapy.

3.3. Skin ulcers and aesthetic medicine

Regarding laser treatment of stretch-marks, results were divided in three groups: excellent, with total disappearance of the stretch-marks; good, with reduction from 50% until 99% of the strias area; less, with reduction less than 50%; poor, without changes. Copper bromide laser (577 nm) treatment of cutaneous striae has proven effective in this trial. Too often in the past this cosmetic defect seems to have been remedied with causal and non-causal treatments but the results were always disappointing in relation to the optimistic forecasts. For this reason, we examined our patients again after one and two year prior to submitting these definitive results. Fortunately the results obtained remained the same after one and two years. At the same time, we hope that our positive clinical impressions will be confirmed by broader, multi-center studies. The impossibility of obtaining histological and histo-chemical confirmation data limits the value of our data. On the other hand, *in vivo* radio-immuno assays to measure procaollagen type III (PIIINP) values carried out by some authors in the study of collagen neogenesis, confirmed this effect of yellow laser light. The photographic evidence from this study also confirms it (Fig. 8 and Fig. 9).

One thing, however, is certain: the 577 nm copper bromide laser can greatly improve scarring especially in the remodeling and reepithelialization phases and this is already an encouragement for the pursuit of striae reduction in further trials.

Making rejuvenation procedure, usually first results appear after 3–4 treatments. We seem on the treatment of scars and stretch-marks that the collagen matrix metallic proteinase increase until 80% of its activity within 20 days after each pulse lamp irradiation, while the transforming growth factor (TGF) decrease only within 20 days after 3–4 irradiation [9]. When clinical features: improved partially or totally, or relapsed, the retreatment may be necessary. Recovery time and rare side effects depend on each specific patients and each specific lesion. Fortunately pulse lamp treatment is not a surgical procedure, so we don't have discomfortable post-treatment period.

Immediately after the irradiation the patient can have redness for some minute, and then he can continue his normal life, social activity included. The patient will see some positive change on this skin each twenty days after each treatment, each two days in psoriasis, acnis and other active lesions.

The patient can have sun exposure with protection after two days after the treatment. Rare side effects are burns as erythema and blisters, these recoveries spontaneously refreshing the skin lesions within some day. *Discromias* as hypopigmented and hyperpigmented lesions can occur exceptionally; this recovery spontaneously within some week, but we can accelerate the recovery using the lamp with opposite effect: UV for the hypo-pigmented lesions, 590 and 640 for the hyper-pigmented.

Comparing pulse lamp skin rejuvenation with laser skin resurfacing and other surgical laser and radiofre-

		Groups (and %) of results (number of cases)			
Pathologies periarthyrins		1st	2nd	3rd	4th
Scapulo-humeral (90)	nr	12	12	16	50
	%	13.3	13.3	17.8	55.6
Ankle (20)	nr	4	2	4	10
	%	20.0	10.0	20.0	50.0
Fibromyositis	nr	2	1	10	51
Cervical (64)	%	3.1	1.6	15.6	79.7
Thoracic (6)	nr	0	0	3	3
	%	0	0	50.0	50.0
Lumbar (81)	nr	5	2	11	63
	%	6.2	2.5	13.6	77.0
Sacro-coccygeal (5)	nr	0	0	3	3
	%	0	0	50.0	50.0
Epicondylitis (19)	nr	2	2	4	11
	%	10.5	10.5	21.1	57.9
Tendinitis	nr	3	5	17	63
of knee (88)	%	3.4	5.7	19.3	71.6
Pubis	nr	0	0	5	11
tenoperiostitis (16)	%	0	0	31.3	68.8
Tendinitis of Achilles	nr	1	1	6	21
tendon (29)	%	3.4	3.4	20.7	72.4

Table 18 Treated patients and results

quency procedures, there is the same difference than the day and the night! Pulse lamp treatment is not invasive and not traumatic and offer maximum safe. It doesn't require continuous use of topic or general drugs, avoiding the side effects of them.

On the other hand, non surgical laser treatment is better than pulse lamp treatment when we need to know the exact dose of irradiation on the tissue and we need light of one wavelength only. This is right when we would like to stimulate the wound healing, where we need a range of 2 – 8 J maximum and wavelength visible or near infrared. In opposite we inhibit the would healing, rather than stimulate that, because the laser and light effect is strictly dose-depending [8]. In other terms, each treatment has specific indication and requires a corrected procedure. This approach gives always the best results the absorption power of the skin increase enormously immediately after the irradiation with laser and light rejuvenation procedure, perhaps caused by active hyperemia. So, specific topical substances can be used, as hialuronic acid, vitamins, and others. In the next future, perhaps light and laser rejuvenation could be used on the legs, preventing of scar and keloids in high risk regions, preventing of hypertrophic scars after each surgical cut of the skin, and in different fields of energetic medicine. To conclude, the use of lasers and light on biological tissues is already yielding very positive results in various diseases, which are very difficult to treat. There are fascinating developments and applications in store for this energy source if it applied according to the criteria

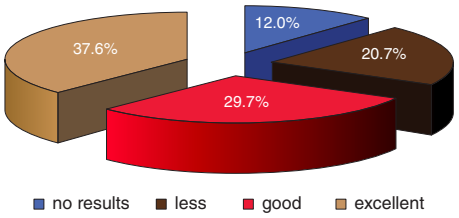

Figure 10 (online color at www.lphys.org) Results of induratio penis plastica. Patients treated 111 in total, 10 not classified because in pre-experimental phase, 1 stopped the treatment for occurrence of side effect

of energetic or, if you prefer, quantum medicine. Lasers and light too occupy an important place in the modern aesthetic medicine and their use is destined to grow exponentially. There are some factors that limit the use of lasers such as the high costs, the need of continuous training for new technologies, the quick depreciation of the machine, the poor technical assistance, the lack of specialization in laser bio-technology and the big confusion at mass media level. The over scrupulous doctor, as well as the well educated patient, are inclined to distrust the last miraculous instrument seen on the television or on other media forum, sponsored by our colleague who are unknown in scientific field but have experience in the field. This distrust in the technology that is very sound if used in the right way.

3.4. Traumatic sport injuries and rheumatic diseases

Efficacy of laser therapy in neck pain management is universally known [49], as in many other pathologies, demonstrated by a series of data analyzed critically with double-blind controls and meta-analysis. Regarding the effects of laser therapy in this field, much control must be done with each different pathology, but already now we have many positive indications.

Table 18 shows some results. The evaluation of the results in four groups was based on clinical and radiological features: presence/absence of inflammation signs and echographic/radiographic signs. In details, no results were Group 1, improvement of clinical signs Group 2, clinical and laboratory features, Group 3, recovery, Group 4. Each sign were measured with the usual methods of evaluation, and observed statistically.

The sport men can continue their job after the end of laser therapy. The return to agonistic sport was possible soon (two days after the end of the cycle of application).

3.4.1. Induratio penis plastica

The results have been recapitulated in the chart (Fig. 10). One patient interrupted the therapy from a little side effect,

a blister post irradiation, recovered spontaneously after 1 week. In the reckoning of the results we should consider the following parameters: presence/absence of recurvatio, measurement of patch/node under echographic check-up, presence/absence of pain and/or phlogosis.

The patients were divided in four groups following the results obtained: no results (no group), improvement of one parameter above described (less group), improvement of two parameters (good group) and improvement of all parameters with disappearance of the clinical and echographic findings (excellent group).

Patients have been heeded for 1 year after the cycle of applications. The echographies have been made at first after one month, then every six months and 1 per year.

Evaluating the results we must remember that about 5–15% of induratio penis plastica has a spontaneous remission. Echographic findings confirmed the positive results of the clinical features (Fig. 9).

No substantial differences have been observed between the groups treated with different kinds of lasers and the percentage of positive results in each group, so we show in Fig. 5 the summary of the results obtained on all patients, independent by the kind of laser used.

It has been observed that the forms of induratio with circular patches or with the major horizontal axis are the less treatable forms. As for the cause is regarded, we can say that post-traumatic forms have much better prognosis than those who are degenerative.

The age of the patient and the period of the manifestation of the patch don't seem to influence significantly on the achievable results. In most cases we can obtain the stability of the results, as shown by one year of the follow-up. The relapses had an incidence of 15.5% after one year. These relapses have been treated with another cycle of applications; the same treatment has been used for those patients, which showed results below the 50% of improvement. But these patients with relapses or partial results, treated again with other cycles of laser applications, were not included again two times in Fig. 10.

3.4.2. Laser treatment of stem cells

Laser treatment of stem cells *in vitro* was proposed by us about ten years ago. After 5 years of experiments with 18 different types of laser and many different procedures and dosage of irradiation, on stem cells of various proveniences, best range of dosage and best procedure were established and patented [50].

So today it is possible to use laser light as a replacement for mitogenic factors on progenitor cells, because laser light increases the proliferation, migration, differentiation, maintenance and survival of progenitor cells in vitro. These methods could be particularly useful in the cellular regeneration and replacement in a tissue injury, such as CNS or PNS injury, and in transplantation of organs, tissues and cells.

4. Conclusion

On diabetes treatment the results obtained were always positive. The follow up was variable depending of the type of the diabetes and the behavior of the patient after the treatment. Our problem was the maintenance of the normoglycaemic level. On central nervous system injuries, after first cycle all the patients had different degree of improvement sensory, motor and voluntary command and important improvement of the EEG, magnetic resonance imaging (MRI), and EMG features. Further improvement added after each cycle. Many diseases treated improved after NSLT. NSLT was very useful in these patients with diabetes and CNS chronic injuries. Number of sessions and time of improvement are variable for each patient and years of treatment could be required. Laser often allows the treatment of diseases not good treatable with other therapies.

These conclusions are valid when the doctor is well trained in lasers, has a suitable laser machine for each clinical entity and that he/she can use them only after an accurate diagnosis has been made. A specialization in any field of medicine does not give the necessary knowledge to use lasers, as the laser technology is in continuous evolution. A specialization and training in this field by all the users of lasers would help the scientific progress enormously. Einstein said that imagination is more important than knowledge, but I would like to add that it must be supported by knowledge, and in order to acquire that knowledge we must have the humility of learning will and the curiosity of experimenting.

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