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Laser Florence 2013

GUIDELINES ON LASER MEDICINE WORLD

DERMATOLOGY/PLASTIC SURGERY, NEUROLOGY, DENTISTRY

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Foreword

Today there is the need of guidelines on the use of laser in different sectors of medicine and surgery.

Many people speak about this problem, but few of them really do anything about it. Obviously It is difficult put together experts of different disciplines who only have in common the use of the same technology.

The International Academy of Laser Medicine and Surgery and the World Health Academy are looking to develop these guidelines and propose their use, starting from three sectors where the laser is widely used: Dermatology, Neurological Rehabilitation and Dentistry.

The annual Congress Laser Florence will be based on these three topics.

The World Health Academy, based in Switzerland, agreed totally with the proposals of Laser Florence 2013. Thus, this very important Institution offered its precious support, of knowledge and organization. The WHA will focus on the development of laser-related science and practice in Europe, Asia, Australia, New Zealand and America, beyond Arab Countries.

Scholarships are introduced in order to sponsor the participation of the most brilliant laser medicine expert under 40 y.o. from the five continents.

The leading international experts should compare their knowledge with the goal of establishing common rules and procedures for their respective specialties, from which sets of guidelines can evolve.

As always, one session will be dedicated to young researchers, in which the latest advances will be presented. The International Academy and the WHA ensures the high quality of the lectures and posters presented.

With the backing of the WFSLMS – the World Federation of Societies for Laser Medicine and Surgery, the IALMS is presenting an International Masters Course on Laser Medicine and Surgery, with a duration of 1 year.

Laser Florence will represent an annual adjournment for the International Medical Laser Specialists.

The Organisers of Laser Florence have one aim in particular: to establish an outstanding interaction between the delegates in a unique location and an unforgettable atmosphere where friendship, intelligence and scientific know-how are blended.

Several awards are available for the presenters of the best papers and posters and the recipients will be invited to participate in the next conference of Laser Florence. Finally, some grants will be assigned by the IALMS and other Institutions.

We hope to meet you in Laser Florence this year!

Best regards,

Leonardo Longo, *I.A.L.M.S. President*
Torello Lotti, *W.H.A. President*

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Clinical Applications of Laser Therapy Based on Translational Preclinical Dental Research

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Summary

Translational research is a process which leads from evidence based studies to sustainable solutions for public health by linking basic research with clinical investigation providing changes in clinical practice. The aim of this work is showing findings of basic studies and the development of applications of phototherapies for a patient driven environment. Our results are indicative that Laser phototherapy is an effective clinical tretament.

Introduction

A real situation is the discontinuity of the knowledge produced basic sciences and how it comes to the quality of life of our patients. In this sense, according to Venters[1], translational research refers to the application of knowledge generated by basic science into medical practice. To do so, it is mandatory that we have first to accept that a discovery in basic science should not be the end of a research project, but a beginning, since this knowledge can be translated into health benefits.

Discussion

Over the past 20 years our team has been investigating the effects of the use of laser technology on many medical and dental fields. Interesting data was obtained on the mechanisms of wound healing on both healthy and systemically compromised animal models[2]. These findings provided new insights on treating soft-tissue lesions using laser. We were able to demonstrate that the use of light effectively improves the repair of bone defects[3], the synergy between bone and biomaterials[4,5], the repair of fractures[6,7] and the osteointegration of dental implants[8]. We also carried out clinical trials on the use of Laser phototherapy on the treatment of oral and maxillofacial diseases[9]. Another exciting result of basic studies from our group is the development of protocols to kill microorganisms. Preclinical studies have been carried out to clinically use Antimicrobial Photochemotherapy to kill bacteria, fungi and protozoans[10]. From the data collected over more than 20 years, we were able to translate important data from the bench side to the dental chair improving the effectiveness of new clinical approaches and the quality of life of our patients.

Conclusion

Our results are indicative that the use of laser light improves tissue healing and repair; reduces pain and edema; improves the integration of biomaterials; reduces implant loading time; improves both quality and timing of fracture repair, and associated to photosensitizers kills efficiently many microorganisms and parasites.

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Use of scanner handpiece Er:YAG laser in orthodontics and conservative dentistry

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Summary

Laser technology has assumed an increasingly important role in modern dentistry and, recently in orthodontics and conservative as well. Er:YAG (λ=2940 nm), being able to treat both hard and soft tissues, is the wavelength of choice. The main advantages are related to the ability to reduce treatment duration, to control pain and to minimize discomfort, and to decrease the probability of relapse. The aim of this work is to describe the utilization of Er:YAG coupled with Scanner handpiece, to improve orthodontic and conservative treatments.

Different applications were described, to condition enamel for bracket bonding and to prepare filling cavities by using the principles of "minimally invasive dentistry".

All the reported cases showed, according to the literature, that the use of Er:YAG laser for orthodontic and conservative treatments offers several advantages when compared with conventional methods, giving a stronger adhesion of the composite resin Use of Scanner handpiece it also allows to get a greater precision with time reduction.

Er:YAG laser may be used, coupled with Scanner handpiece, during orthodontic therapy and also in conservative dentistry, with many advantages and no side effects, although professional training is necessary in order to understand the principles of the techniques as well as the parameters and safety procedures for the devices.

Introduction

The notion of utilizing laser technology in conservative dentistry was proposed in 1990 by Hibst and Keller, who introduced the possibility of using an Er:YAG laser as alternative to conventional instruments such as the turbine and micro-motor [1, 2]. Widespread interest in employing this new technology stems from a number of significant advantages, as described in several scientific studies. Thanks to the affinity of the Er:YAG laser wavelength to water and hydroxyapatite, laser technology allows for efficient ablation of hard dental tissues without the risk of micro- and macro-fractures, as have been observed with the use of conventional rotating instruments [3-5]. The dentin surface treated by laser appears clean, without a smear-layer, and with the tubules open and clear [6].

Thermal elevation in the pulp, recorded during Er:YAG laser irradiation, is lower than that recorded by using a turbine and micro-motor with the same conditions of air/water spray [7, 8]. This wavelength also has an antimicrobial decontamination effect on the treated tissue, which destroys both aerobic and anaerobic bacteria [9]. The most interesting aspects of this new technology are related to the goals of modern conservative dentistry: i.e. minimally invasive treatments and adhesive dentistry. Er:YAG lasers can reach spot dimensions smaller than 1 mm, which enables a selective ablation of the affected dentin while preserving the surrounding sound tissue to produce highly efficient restorations [10]. Several in vitro studies have demonstrated that the preparation of enamel and dentine by Er:YAG laser, followed by orthophosphoric acid-etching, enhances the effectiveness in terms of reduced microleakage and increased bond strength [11].

To understand the role that a scanner can perform in dental treatments, it is useful to take a comparative look at the field of aesthetic medicine. The Er:YAG laser has been used for many years in the field of dermatology, where it is employed for the vaporization of lesions such condyloma, naevi, warts, mollusca contagiosa, as well as for the treatment of cheloid scars and wrinkles with so-called laser "resurfacing"[12]. For many years, scanners have proven highly effective in dermatological treatments, enabling high-precision surface treatments without overlapping or under-coverage of the laser treatment area.

The aim of our study, which began several years ago, has been to evaluate the possibility of transferring the same type of scanner technology that is widely utilized in dermatology to the dental field. The first "in vitro" tests were performed on extracted teeth by using a scanner and a dermatological Er:YAG laser. Due to fact that this particular dermatological device operates without water, it was necessary to modify it by adding a double external pipeline in order to deliver an air/water spray at the point of the laser's impact on the tooth.

The results of this first sequence of tests were very promising and convinced the manufacturer Fotona to invest in a major research and development effort to construct a scanner handpiece of reduced size, able to be employed intra-orally.

Once developed, the new dental-optimized scanner was given another series of "in vitro" tests, and after the safety of its utilization was demonstrated via K-thermocouple records, optical microscope and SEM observation, it was subsequently applied to "in vivo" tests on human subjects.

Material and methods

The laser appliance used was a LightWalker device, which is the latest generation of dental lasers from the manufacturer Fotona.

The scanner handpiece is very similar to the usual non-contact Er:YAG laser handpiece. The scanning mechanism is integrated inside an ergonomic box that lies on the operator's hand connected by an electrical cable delivering the digital information from the laser device to the scanning mirrors. Its application is very easy and practically the same as with the usual non-contact handpiece; the only difference is that it covers a bigger area than the standard handpiece. However, it is very useful because it can cover a larger area, or by pressing the button on the screen, it can be used as a classical one-spot laser handpiece. The scanner handpiece can thus be used for all kinds of treatments just by switching from the scanner modality to classic handpiece modality, without swapping handpieces.

The following settings are available for the scanner handpiece on the touch screen:

-scanning area shape (circular, rectangular, hexagonal),

-size of the scanning area (width and length of the rectangle, diameter in the case of the circle and hexagon),

-number of scan passages (a function of the requested ablation depth),

-delay between consecutive scans (duration of the pause between scans).

Moreover, all parameters available with the classic handpiece (energy, frequency, mode, spray) are also used with the scanner handpiece.

By reducing one of the sides of the rectangular shape, it is possible to obtain a linear cut without moving the handpiece, for instance to cut the root apex during endodontic surgery or to perform an incision in soft tissues surgery.

In this preliminary study, some clinical applications are shown below which illustrate the advantages of this new Er:YAG laser technology.

Results

CASE 1: Enamel laser conditioning for orthodontic bracket bonding.

The employment of an Er:YAG laser to prepare the enamel for improving the strength of adhesion of composite resins has been proposed by several authors in conservative dentistry as well as for bracket bonding in orthodontics (13).

Several studies, based both on traction and microleackage tests, have shown that the best values were obtained with samples irradiated by an Er:YAG beam before acid etching (14). Additionally, an "in vitro" study on extracted human teeth demonstrated that preparation by Er:YAG laser alone also gives a stronger adhesion than orthophosphoric acid alone (15). Moreover, other authors have underscored these results when using lasers to prepare enamel surfaces to make them more resistant to decay (16). This is possible due to the modification of hydroxyapatite crystals, which is very important in the prevention of decalcification zones around brackets, particularly in patients with scanty oral hygiene (17).

Another advantage of laser utilization is the ability to prepare a very small surface area of enamel, exactly of the same dimension of the bracket. We initially proposed a technique based on the use of a plastic template with rectangular windows designed to limit the irradiated area. Now, by using the scanner handpiece, the procedure is faster, easier and more precise.

The case described presents a 14-year-old female receiving orthodontic fixed treatment of the upper arch. (Fig. 1-2-3)

The parameters used were determined by SEM observation in order to give the best enamel conditioning coupled with the minimal ablation:

95 mJ, 8 Hz, MSP mode, 4/6 air/water spray.

The dimension of the ablation area was 2.5x3 mm and the number of passes was 15, once for each tooth.

CASE 2: Treatment of "amelogenesis imperfecta" spots on permanent incisors.

Fig. 1

Fig. 2

Fig. 3

The term “amelogenesis imperfecta” is defined as a diverse group of hereditary disorders that primarily affects the quantity, structure, and composition of enamel [18]. In the hypomature type, the affected teeth exhibit mottled, opaque white-brown or yellowish discolored enamel, which is softer than normal. The hypocalcified type shows pigmented, softened, and easily detachablenamel, while in the hypoplastic type, the enamel is well mineralized but the amount is reduced (19).

In our daily practice, we have worked with several young patients exhibiting zones of discoloration in their frontal teeth and who needed treatment to improve the aesthetics of their smile. Due to the impossibility of treating these cases with classical bleaching techniques, it was necessary to ablate the affected zones and to fill the cavities produced with composite resins. We have already described the use of the Er:YAG laser in this type of case as a good example of “minimally invasive dentistry” (20) but the use of the scanner improves the precision of the ablation even further by programming the extent and depth of the zone in advance.

The case presented concerns an 18-year-old male who had enamel lesions in the right upper lateral incisor and canine.

The treatment was performed without anaesthetic, with a total laser irradiation time of 186 sec.

For this case we used the following parameters:

250 mJ, 10 Hz, MSP mode, 4/6 air/water spray.

The ablation area was a 3.5 mm diameter circle and the number of passes was 15. (Fig. 4-5-6)

Fig. 4

Fig.54

Fig. 6

Conclusion

Laser technology was introduced in dentistry by Goldman in 1967 (21). Since that time, a great effort has been made by clinicians, researchers and companies to improve the results of clinical treatments. The introduction of Er:YAG in 1990 enabled the option to also treat hard tissues, and this technology was further improved through greater control of pulse duration (VSP – variable square pulse technology – a proprietary technology of Fotona d.d.).

The recent introduction of a scanner handpiece enabled a higher precision of irradiation and depth of ablation as well as reduced treatment time, allowing laser technology to more fully realize the vision of "minimally invasive" conservative dentistry.

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Stimulation of growth factors secretion by low intensity laser and LED

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Abstract

The effectiveness of phototherapy with low intensity laser therapy on wound healing has been proven in several studies. As the low intensity laser, light emitting diodes (LED), when used in the same parameters, can promote similar biologic effects. In the repair process, the release of growth factors such as IGF-I and TGF-beta, is a critical part. The aim of this study was to verify infrared laser, red laser and LED effects on growth factors production by human gingival fibroblasts *in vitro*. For this study human gingival fibroblasts were obtained from primary cultures. Human gingival fibroblasts were grown in a 96-well plate and irradiated punctually and in contact with red laser (660nm – 40mW), infrared laser (780nm – 40mW) and red LED (660nm – 40mW) with 3 and 5 J/cm² of energy density. The experimental groups were divided as follows: C+ - positive control (DMEM + 10% FBS), C- – Negative control (DMEM + 1% FBS), RL3 – Red laser 3J/cm², RL5 – Red laser 5J/cm², IRL3– Infrared laser 3J/cm², IRL5 – Infrared laser 5J/cm², LED3 – Light emitting diode 3J/cm², LED5 – Light emitting diode 5J/cm². Insuline growth factor (IGF-I) and transforming growth factor beta (TGF-beta) quantification was done by immunoenzymatic test (ELISA) at the conditioned medium. The absorbance was read in a spectrophotometer with a 450 nm filter. Data were compared by Kruskal-Wallis' test complemented by Tukey's test ($p<0.05$). The IGF-I production was significantly higher in infrared groups (3 and 5J/cm²) than negative control ($p<0.05$). All groups but negative control showed no significant differences from positive control ($p>0.05$). There was a significant higher production of IGF-I at infrared laser groups with 3 and 5J/cm² compared to LED 3J/cm² ($p<0.05$). There was no detection of TGF-beta. It can be concluded that red laser and LED neither stimulated nor inhibited growth factors production. Infrared laser (3 and 5 J/cm²) stimulated growth factors release only in malnourished cells and didn't enhance its production in cells grown under ideal nutritional conditions.

Keywords: Laser Therapy, Low-Level; Lasers, Semiconductor; Fibroblasts; Enzyme-Linked Immunosorbent Assay; Intercellular Signaling Peptides and Proteins

1 Introduction

The acceleration of wound healing by phototherapy with low intensity laser has been proved to be effective since the first reports by Mester [1], [2]. This therapy comprises the use of laser power outputs between 0.005 and 0.5 W, doses higher than 50 mW/cm² and energy densities of 1–4 J/cm² [3]. Although some studies fail to show this properties [4], [5] others have shown positive influence of laser on key events of wound healing as cell proliferation [6], cell differentiation [7] secretion of growth factors [8] protein synthesis [9] and vasodilatation [10].

Most recently some studies proved that treatment with light emitting diodes (LED) used at the same parameters as lasers promote similar biologic effects [11], [12]. LEDs differ from lasers because they have a non-coherent light and emit radiation in a narrow bandwidth. So far, the narrow bandwidth and monochromaticity were found optimal in treatment [3]. LEDs seem to be a promising alternative of treatment because of its low cost, reduced size and easy handling. There are a few reports in literature about LED effects on growth factors. One study has shown that genes for fibroblast growth factor 7 and 12, TGF-beta and thrombospondin 1 (TSP-1) are upregulated by LED irradiation [13].

Release of growth factors is a critical part of the repair process. The IGF-I is involved in differentiation, proliferation, morphogenesis, growth, apoptosis, control of metabolic function and carcinogenesis [14]. After injury IGF-I synthesis is necessary for normal tissue repair. Also, IGF-I is important on periodontal regeneration by stimulating formation of mesenchymal tissues including soft tissue collagen, bone, and cementum proliferation of periodontal ligament fibroblasts, cementoblasts and osteoblasts [15]. During wound healing TGF-beta1 is released from platelets and induces proinflammatory citokynes, matrix synthesis from fibroblasts, proliferation of keratinocytes [16], [17].

There is no report in literature comparing the stimulus of LED and laser on secretion of growth factors. So, the aim of this study was to verify infrared laser, red laser and LED effects on growth factors production by human gingival fibroblasts *in vitro*.

2 Material and methods

This research was approved by Ethical Committee in Human Research of Hospital for Rehabilitation of Craniofacial Anomalies (HRAC) (58/ 2012 SVAPEPE-CEP).

Human gingival fibroblasts were obtained by primary culture. The gingival tissue was obtained from patients who needed ressective periodontal surgeries as gingivoplasty or distal wedge procedure. The exclusion criteria were: presence of systemic conditions that contraindicated the surgical procedure as uncontrolled diabetes and coagulation problems, use of drugs that alter the gingival tissue and smoke habit. Immediately after removal, the tissue was transported to the laboratory in a transport medium consisted of Dulbecco Modified Essential Medium (DMEM) complemented by 20% bovine fetal serum (FBS), 2% antibiotic-antimycotic solution. The tissue was dissected in small pieces in petri dishes with PBS and 2% of antibiotic-antimycotic solution. The primary culture was obtained by a mechanic-enzymatic process with warm trypsin. When the fibroblasts reached the subculture stage they were cultured until the 5^{th} passage to be used in the experiment.

For the experiment, $5x10^3$ cells were plated in sextuplicate in a 96-well plate. The experimental groups were divided as follows:

C+ - positive control (DMEM + 10% FBS)
C - - Negative control (DMEM + 1% FBS)
RL3 – Red laser 3J/cm²
RL5 – Red laser 5J/cm²
IRL3 – Infrared laser 3J/cm²
IRL5 – Infrared laser 5J/cm²
LED3 – Light emitting diode 3J/cm²
LED5 - Light emitting diode 5J/cm²

At the first day of experiment cells were grown in 10% FBS DMEM with and 1% of antibiotic-antimycotic solution (Penicillin 10.000UI, streptomycin 0,050g/L – Amphotericin 0.5%). After 24 hours the medium was substituted by 1% FBS DMEM to induce a quiescence state in order to synchronize the cell cycle [8] for another 24h. In the next day the medium was substituted for regular medium (DMEM FBS 10%) in all groups except for negative control (C-) group which received 1% FBS DMEM. The irradiation was performed in all experimental groups.

For laser groups the plate was irradiated from the bottom with diode lasers (MMOptics Ltd., São Carlos, SP, Brazil). The parameters used for red laser were 660nm (indium–gallium–aluminum phosphide- InGaAlP), 40mW±6.24, 3 and 5 J/cm², 3 and 5 seconds. The infrared laser was used with 780nm (gallium–aluminum–arsenium- GaAlAs), 40±6.24 mW, 3 and 5 J/cm², 3 and 5 seconds. The spot area was 0.042 cm² and the punctual irradiation mode was used. The power density for both wavelengths was 1 W/cm^2. According to a previous paper there is a loss of 12% of power when laser passes through polystyrene plates, so the power was adjusted to compensate the loss [18]. The optical output power of the light sources was checked before the experiments with the use of a power meter (FieldMax II , Coherent - Santa Clara, California USA). One separate plate for each laser and controls was used to avoid cross irradiation. The LED irradiation was done by a LED-based device (Biotable – USP, São Carlos, Brazil) [19]. The plates were in contact with the table. The LED was applied with 630± 10nm, 60mW/cm², 3 and 5 J/cm^2 (50 and 83s).

After 24 hours of irradiation or substitution of the medium on control groups the conditioned medium was collected and centrifuged at 13,000 g for 5 min to remove cellular debris. The supernatants were assayed in duplicate by a quantitative sandwich enzyme immunoassay technique. The human IGF-I and TGF-beta1 enzyme-linked immunosorbent assay (ELISA) kits, both from R & D Systems Inc., MN, USA, were used in accordance with the manufacturer's instructions. The absorbance was read in a spectrophotometer with a 450 nm filter.

The statistical analysis was done by Kruskal-Wallis test complemented by Tukey at a significance level of 5% ($p<0.05$).

3 Results

The results are presented in fig.1. The IGF-I production was significantly higher in infrared groups (3 and 5J/cm²) than negative control ($p>0.05$). All groups but negative control showed no significant differences from positive control ($p>0.05$). There was a significant higher production of IGF-I at infrared laser groups with 3 and 5J/cm² compared to LED 3J/cm² ($p<0.05$). There was no detection of TGF-beta.

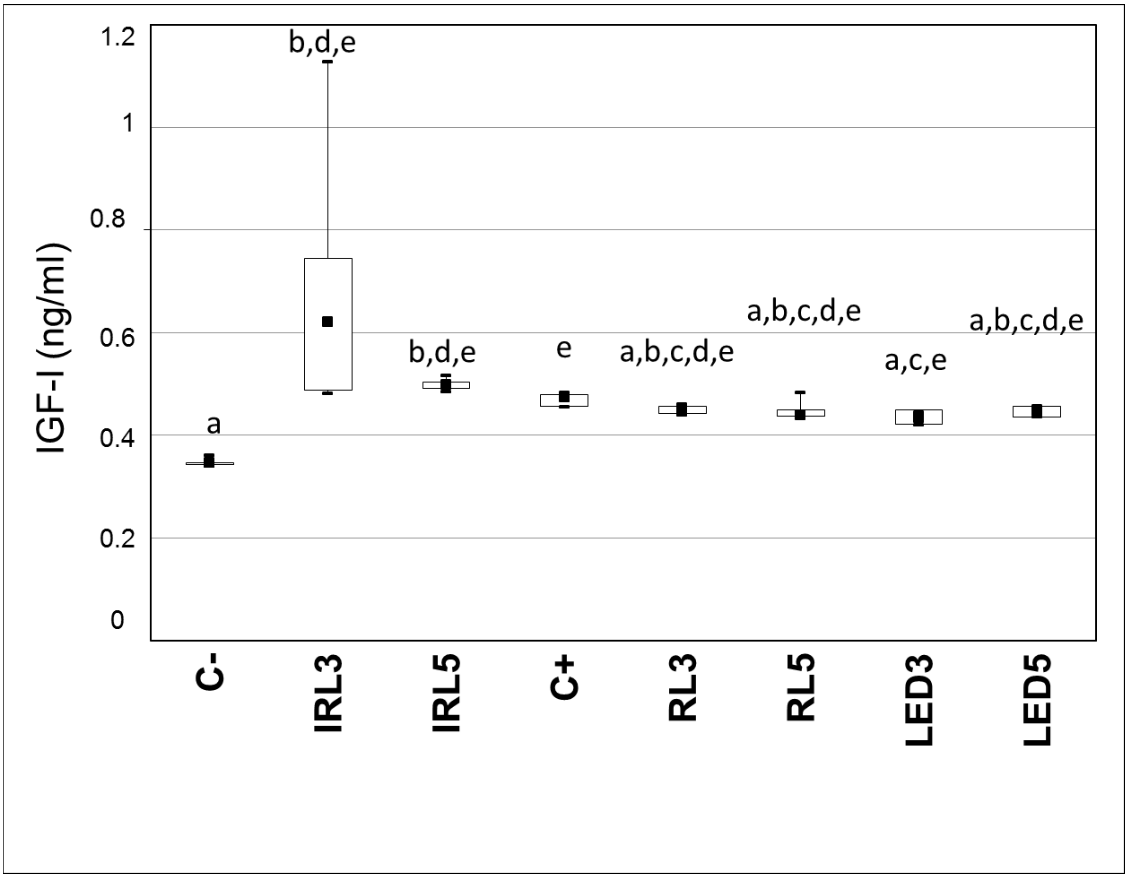

Fig. 1 – Secretion of IGF-I by human gingival fibroblasts under different light stimulus. Different letters = p<0.05.

4 Discussion

This research demonstrated that infrared laser (3 and 5 J/cm²) is capable of stimulating gingival fibroblasts to produce IGF-I when the cells are under nutritional deprivation (1% FBS). Almeida-Lopes et al. found that gingival fibroblasts cultured in nutritional deficit condition (5% FBS), when irradiated, presented similar or higher growth rate than cells grown in ideal culture condition [20]. This starvation is necessary to simulate a clinical condition where tissues under surgical stress or affected by pathologies, respond better to laser stimulus [21]. The same holds true in relation to growth factors secretion. In the present study the production of IGF-I increased to the same level as the production by cells cultured under optimal nutritional conditions (10% FBS). Another research evidenced an increase in growth factor production after infrared irradiation with the same parameters (3 and 5J/cm²) and after starvation or quiescence with 1% FBS [8]. But the increase was significantly higher than positive control, i.e. cells cultured under optimal nutritional conditions.

In relation to LED and red laser, the production was similar to control groups (positive and negative) suggesting that these treatments neither stimulated nor inhibited IGF-I production. In an animal model study, a 670-nm LED applied daily with 4 J/cm^2 for 14 days upregulated tissue regenerating genes [13]. This study was performed in diabetic mice, a systemic condition that responds better to laser stimulus. They found a positive stimulus of LED for fibroblast growth factor 7 and 12 genes after 2 days of irradiation [13]. These positive results, nevertheless, cannot be compared to the present data because the methodologies are distinct. There is always some discussion about how lasers and LEDs act on wound healing. The most accepted theory is that the infrared light is absorbed by some photoreceptors that trigger a cascade of reactions in a cell. Some studies showed that LED effectively energizes the cells by stimulating their cytochrome oxidase triggering a cascade of cellular and molecular events [22].

There was no detection of TGF-beta in the present study. One study showed an upregulation of the TGF-beta1 gene after 14 days of irradiation with a 670-nm LED (Whelan 2003). Other cell culture studies detected TGF-beta secretion in the medium [23]. In the study by Szymanska et al. (2013) the Infrared laser (830 nm) caused a decrease in TGF-beta secretion by endothelial cells while red laser (635nm) did not influence its secretion [23]. The research by Morandini et al. (2001) demonstrated that human gingival fibroblasts produce low concentrations as ± 20pg/ml TGF-beta without stimulus of *P. gingivalis* lipopolysaccharides [24]. In our ELISA assay, the detection of TGF-beta started in a concentration of ±80 pg/ml.

Moreover, we may suggest that the lack of detection of TGF-beta in our study may be due to the functions of this growth factor. TGF-beta is an important signal in stopping immune and inflammatory responses and has potent effects on wound healing [25]. Furthermore, TGF- beta is credited for promoting wound fibroblasts to differentiation at sites of inflammation and repair [26]. In our study, the tissue was collected from teeth previously scaled and planned without active gingival inflammation. Although it was not the objective of our study to check any differences in cleft palate patients, our cells were obtained from these patients. The literature shows that TGF-beta family is essential for the process of secondary palate formation, and TGF-beta expression is low in cleft palate only individuals [27]. Thus, we may suggest that the absence of detection of TGF-beta in our study could be due to this condition.

5 Conclusion

Red laser and LED neither stimulated nor inhibited growth factors production. Infrared laser (3 and 5 J/cm²) stimulated growth factors release only in malnourished cells and didn’t enhance its production in cells grown under ideal nutritional conditions.

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A Comparison of Non Contact Measurement Methods for the Assessment of Vital Signs: Laser Doppler Vibrometry vs Image-Based Techniques

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Abstract

Background: Non contact assessment of vital signs such as the respiration (RR) and cardiac rates (HR) is an important research issue. Recently Laser Doppler Vibrometry (LDVi) has been proposed to measure RR and HR; image-based methods also have been proved to be able to measure such quantities without contact.

Purpose: The aim of this paper is to present 3 non-contact measurement methods (LDVi, image-based technique) for the assessment of HR and RR and to discuss pros and cons of these techniques.

Material and Methods: HR and RR values were measured using LDVi (55 subjects) and image-based technique (18 subjects). Data collected were compared with reference instruments (ECG and spirometry) simultaneously used.

Results: HR and RR values measured with the 3 methods are all well correlated with the reference instruments ($P > 0.90$). Reported uncertainties for HR and RR are respectively: 6% and 3% for LDVi, 6% and 14% for CCD camera.

Discussion and Conclusion: All the analysed measurement methods (LDVi and imaging method) are able to correctly measure HR and RR. The LDVi method is more suited for HR and RR measurement when the chest surface is directly accessible while the image-based method (CCD camera) allows to measure from the face.

Keywords: Laser Doppler Vibrometry, Image-based method.

Introduction

In clinical routine, vital signs are typically monitored on recovered patients, using contact measurement methods. Electrocardiography (ECG) is operated to study the electrical activity of the heart, together with other information, it can provide heart rate (HR) measurements through the use of adhesive patches electrodes (2 up to 12). The reference method to monitor respiration activity is spirometry (SP). It is the gold standard method allowing the assessment of the respiration rate (RR), of volumes and flow through the airways during all the respiratory tasks, required to the patient. In most of the cases ECG and SP are unconfortable and not suited for long monitoring.

Heart and respiratory rates are essential parameters in hospital environment, but they are also the main quantities to be measured at home for monitoring purposes. In such domestic environment, the non-contact monitoring represents a challenge. The laser-based approaches were already used both for therapy and vital signs monitoring [1] [2]. In the first field, Low level Laser therapy (LLLT) has primarily been shown useful in the short-term treatment of acute pain caused by rheumatoid arthritis, tendinopathy and possibly chronic joint disorders [3]. Considering monitoring of physiological parameters, Laser Doppler Vibrometry (LDVi) was proposed [4] by some authors of the present work as a valuable no-contact technique able to provide information about cardiac and respiratory contributions [5,6] in hospitalized preterm infants, measuring velocity of one moving point on the neonate chest [5]. Also image-based techniques have been developed for HR and RR measurements [7,8].

The aim of the present work is to describe two non-contact measurement methods (LDVi, CCD-image) for the measurement of heart and respiratory rates and to compare the different approaches.

Material and methods

2.1. Measurement procedures and experimental set-up.

First part of the experimental set-up aims to show and validate the ability to assess cardiac and respiratory activities in supine position with LDVi [4]. The test set up was composed by a Laser Doppler vibrometer (LDVi), the spirometer and the electrocardiograph as gold standard methods respectively for RR and HR, a data acquisition unit (DAQ) and a personal computer (Fig. 1, top). All the technical features of the employed instrumentation will be reported at the end of this paragraph. In the study 55 subjects (29 M, 26 F) were involved, with the following characteristics (mean ± SD) : weight of 67,3 ± 12,5 kg, height of 1,74 ± 0,09 m, age of 25 ± 3 years. Each test had the duration of 60 s. A second part of the experimental set-up was aimed to operate HR and RR measurements using an image-based technique. The method was based on the processing of video sequences in order to capture variations of the pixel intensities caused by the normal cardiac activity [7,8]. The experimental bench was constituted by a digital CCD camera, the ECG and a respiratory belt (RB) for RR monitoring as reference techniques for HR and RR, a DAQ and a personal computer (Fig. 1). The new method was applied on 18 subjects (6 M, 12 F), seated in front of the CCD camera for 60 s, at a distance of 50 cm. Subject characteristics were (mean ± SD): weight of 63,7 ± 14,0 kg, height of 1,70 ± 0,07 m, age of 23 ± 3 years. Subjects were tested in normal environmental situation, with natural light. In the final part of the study the simultaneous assessment of Laser Doppler Vibrometry and the image-based method was carried out to monitor vital signs. This phase of the study was realized using the set-up showed in Fig. 1, formed by a digital camera and LDV as systems under investigation, the electrocardiograph, a data acquisition unit and a laptop, but without using the reference instruments [5,9]. Five subjects (4 M, 1 F) were tested for this part of the study, with the following characteristics (mean ± SD): weight of 72,4 ± 23,2 kg, height of 1,75 ± 0,08 m, age of 24 ± 2 years.

Devices and components used in the tests are described in the following.

The digital portable vibrometer Polytec PDV-100 measures surface vibrational rate, without contact. Main features are: frequency range from 0 to 22 kHz, measurement distance from 0.2 m to 3 m, laser He-Ne visible red light, single point, output low-pass filter : 2kHz, out-of-plane performance, anti-alias filter 500 Hz. LDVi is able to provide information on the velocity of one moving point of the subject; in particular the beam has been focalized and pointed on the skin perpendicular to the surface, in proximity of intercostal gaps [5] for the declared purposes, in each kind of test performed. Regarding LDV, his performance could be improved using some cosmetics like body-cream, in fact the beam reflection would be better. The digital camera is a Microsoft LifeCam Studio (Microsoft®, RGB with 3 channels) provided by USB connection. It can register a video with high resolution until 1929 x 1080 pixels, and a sampling frequency up to 30 fps (frame per second). For the tests working parameters are set as follows : frame rate of 30 fps, resolution of 640 x 480 pixels. Videos can be acquired using a customized software implemented in LabView environment. The ECG allows to acquire electrical cardiac activity using electrodes directly applied on human skin in different not equipotential areas. In particular for subsequent processing it will be considered only the II-lead ECG signal. Skin has been cleaned with alcohol before red dot application. The spirometer (MLA 140, ADInstruments) is the gold standard for respiration activity assessment. It measures the airflow throughout the lungs, allowing to estimate respiratory rate. RB used to evaluate thoracic circumference variation during the test in the second set-up, is a MLT1132 Respiratory Belt Transducer. ECG, LDV, SP and RB can be connected with data acquisition unit PowerLab 4/25T (ADInstruments), to acquire all the signals with a sampling frequency of 1 kHz, through Chart 5 software. It has been set a standard filtering (bandpass: 0.05 – 150 Hz) for ECG trace. The DAQ and the digital camera are interfaced to a laptop PC. The test start and stop for video and signals acquisition, where necessary, were synchronized with a software trigger.

2.2. Signal and image processing

All the signals and the images were processed in MATLAB® environment with purpose-written algorithms. Gold standard systems used in this work allow to study cardiac and respiratory activity and to compare them with those obtained by optical and image-based methods. ECG trace was processed using Pan Tompkins algorithm [10]. Signal acquired by the spirometer was detrended. Both the signals were submitted to a peak detection procedure, to obtain reference values for HR and RR. Laser Doppler Vibrometry allows to acquire the velocity of displacement of one point on the chest. The signal was processed in order to extract respiratory and heart rate. An example of LDVi signal, acquired for 60 s, is reported in Fig. 1 (bottom).

Signal processing is based on Discrete Wavelet Transform (DWT) consisting in signal decomposition into a set of basic functions, that are wavelets [11] [12]. After decomposition the signal must be reconstructed considering only interesting components. Two mother wavelets were chosen to extract cardiac and respiratory rates: “rbio 2.2” and “db8” respectively [9]. An example of wavelet decomposition could be seen in Fig. 2, for HR and RR calculations, respectively.

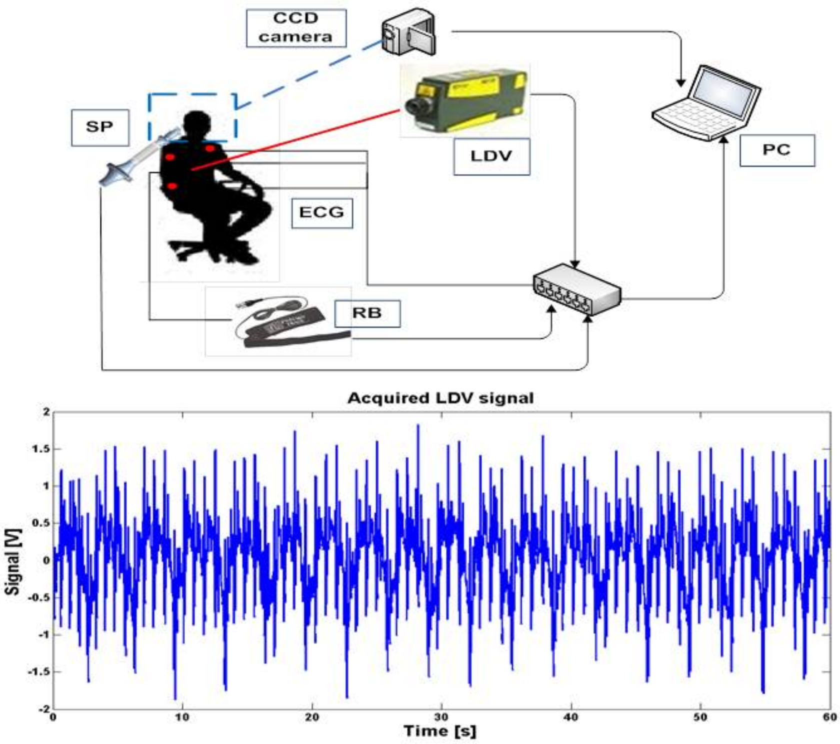

Fig. 1- Experimental set-up (top). LDV signal: Low frequency variation are related to respiration, while high frequency variation to the cardiac activity (bottom)

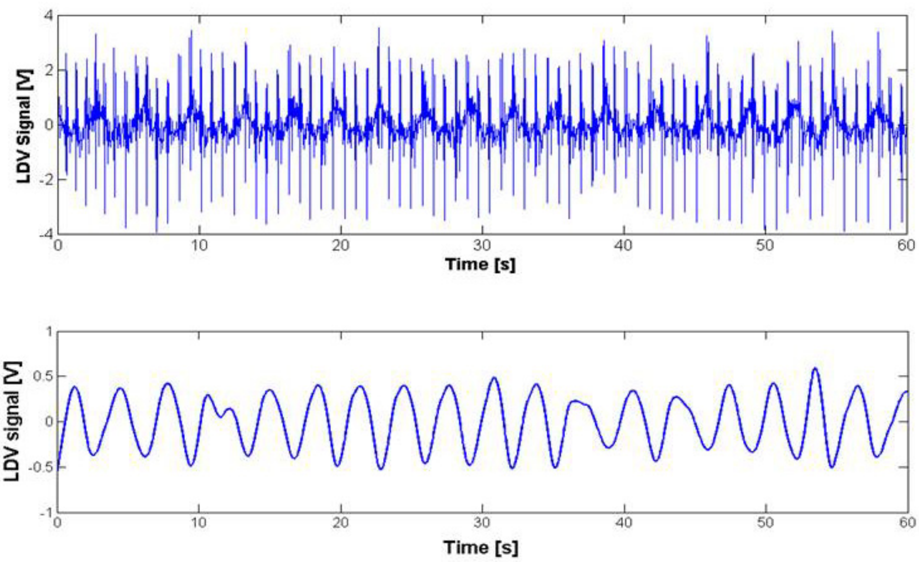

Fig. 2 – LDV signal after DWT : cardiac contribution (top) and respiratory contribution (bottom)

In the first case (Fig.2, top), a peak detection procedure was implemented on the signal provided by LDV in order to find the events corresponding to ventricular systole. Mean heart period were measured evaluating time distances between the peaks and computing the average value. Wavelet analysis was also used;

the Daubechies family was performed in order to study respiration from LDV signal, that was then derived to find slope variations in order to extract respiration periods. The averaged period was then calculated; an example is reported in Fig. 2, bottom. For what concern the image processing, a frame by frame selection of the region of interest (ROI) for subsequent analysis was operated; an automatic face detection algorithm [13] was adopted and optimized. The bounding box already found was then reduced in its width of 50% (see Fig. 3, left). For each frame all the three color channels (red, green and blue) were considered separately and the average value of all the pixel on a single matrix was evaluated. The three traces, obtained in this way, were submitted to the smoothness prior method [8,14], and normalized (Fig. 3, right). In the following, the Independent Component Analysis (ICA) was performed, using JADE algorithm by Cardoso [15], in order to retrieve sources, in a random way, from the original traces. The aim is to search a signal that could represent the pixel color variation due to volumetric changes of blood vessels during cardiac activity.

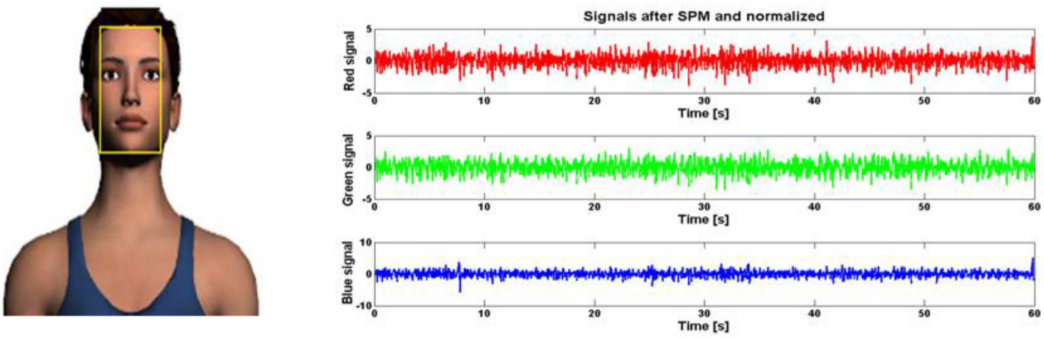

Fig. 3 - Left: Region of Interest (ROI); Right: Signals after smoothness prior method and normalization

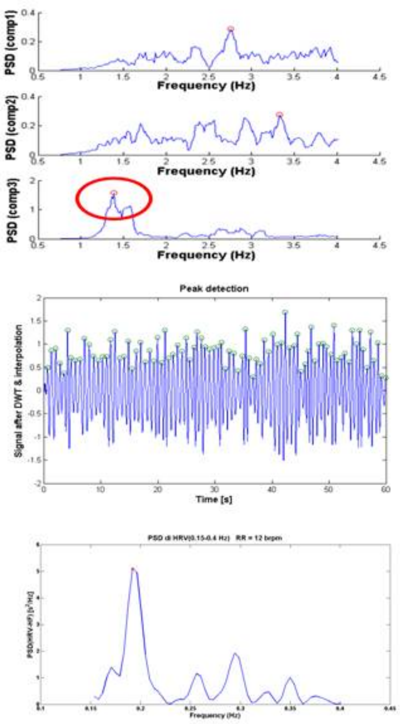

Fig. 4 – Power Spectrum Densities of three sources (top); HR calculation: Peak detection (middle); Power Spectrum Density of the tachogram: High Frequencies (0.15 – 0.4 Hz) (bottom)

For this purpose Power Spectral Density (PSD) [16] was computed for the three sources (fig.4, top) and between them the signal with the highest peak in PSD was chosen to be used for further analysis. A 'db8' mother wavelet was chosen [4], after trying many families. Interpolation was done to achieve a frequency of 256 Hz, necessary to conduct heart rate variability analysis. Signal peak detection (Fig. 4, middle) was performed in order to extract heart period and calculate heart rate (bpm). After that it is possible to obtain a graph like tachogram that shows heart periods over the time. PSD of the tachogram was evaluated using Lomb periodogram [17], and only the range between 0,15 and 0,4 Hz was considered, that corresponds to High Frequencies (HF) [18], see Fig.4, bottom. The frequency value in correspondence to the maximum peak was considered, converting in breaths per minute, to find respiratory rate.

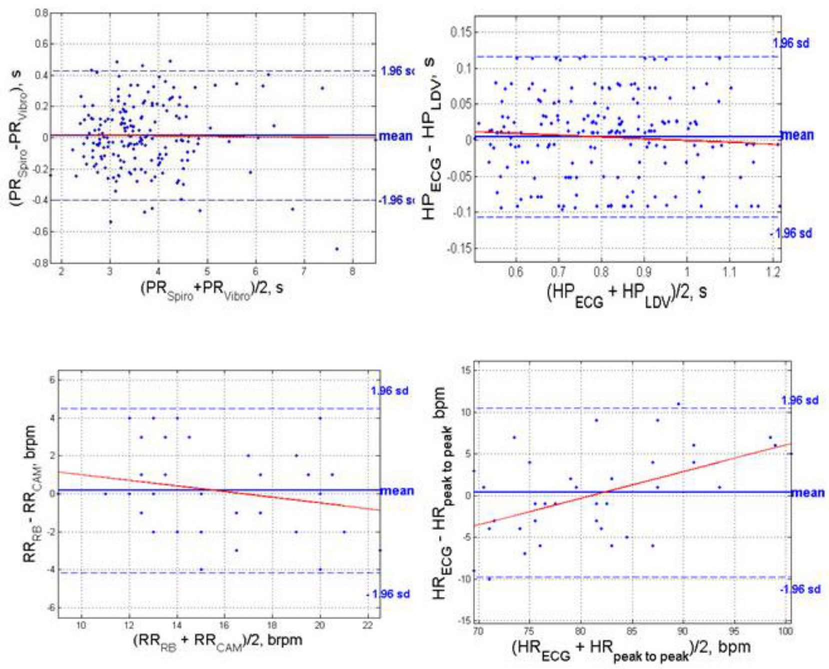

Fig. 5 – Bland- Altman test for LDVi : respiratory periods (top, left), heart periods(right)
Fig. 11 – Bland- Altman test for image-based method: RR (left) and HR (right)

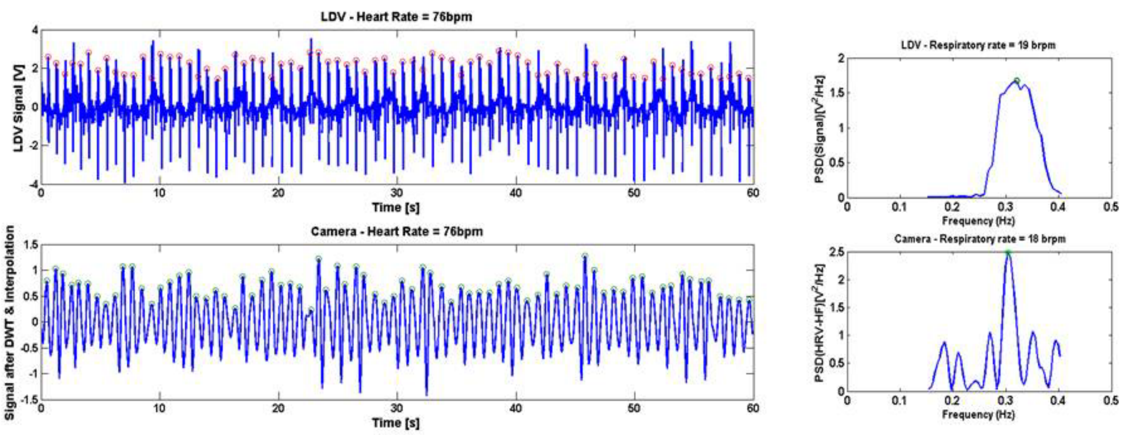

Fig. 6 – Cardiac activity monitoring (top); respiration monitoring (bottom)

Results

Considering the first two steps of the study (HR and RR rates measurements), experimental results were compared with the parameters acquired using gold standard methods (ECG, spirometer, respiratory belt). Heart and respiratory rate values are well correlated for both the new methods (P > 0.90). The good correlation is showed in the Bland-Altman graphs reported in Fig. 10 and 11 [19] [20] respectively for LDVi and camera. Estimated uncertainty values [21] are 3% for LDVi, 14% for image-based method for RR measurements, while it is of 6% for both the methods for RR

In the last part of the present work Laser Doppler Vibrometry and image-based method were used together in order to compare respectively their potentiality to monitor these vital signs. In particular all the tests (N=5) were conducted in sitting position. In Fig. 6, top signals provided by the two innovative systems can be seen for cardiac activity monitoring, while in Fig. 6, bottom respiration rate is assessed.

In Tab. 1 and Tab. 2 a comparison between the two techniques is reported for the case of 5 subjects, with the residuals (RES_CAM and RES_LDV) for RR and HR respectively. They show that, respect to the LDVi measurements (LDV), the digital camera (CAM) provides better conditions for heart rate for the sitting position.

Tab. 1. Comparison between methods for the RR.

Subject	LDV (brpm)	CAM (brpm)	RES (%)
1	19	18	5
2	13	15	15
3	19	20	5
4	15	13	13
5	18	15	16
Mean	17	16	11

Tab. 2. Comparison between methods for the HR.

Subject	ECG (bpm)	CAM (bpm)	LDV (bpm)	RES_LDV (%)	RES_CAM (%)
1	76	76	74	3	-
2	90	90	87	3	-
3	81	75	77	5	7
4	72	71	70	3	1
5	80	78	74	7	3
Mean	80	78	76	4	2

Discussion

A compelling and actual challenge is to perform no contact techniques in order to assess patient health condition. The absence of contact is really important for cardiac activity monitoring in critical conditions, and it could be very useful to assess cardiac activity as well as respiration without the need of patient collaboration, required by spirometry.

Two methods were proposed and both of them are suitable for vital signs measurement with good correlation with gold standard systems. LDVi used in supine position is more precise than the image-based methods, especially for RR measurement. Tests with LDV and camera were conducted in sitting position due to illumination needed for the second method. Camera results to be better for heart rate measurement.

Laser Doppler vibrometer has high precision and allows the hospital monitoring especially in case of burns, skin diseases or non-collaborative patients. Camera is an extremely low cost system and can be used in home monitoring applications. On the other hand LDV is too expensive and provides a single point measurement, camera is sensible to illumination and health condition, for all the systems we have problems with movement and possible covering of the region of interest, due to the fact that we have to look at the subject in order to avoid invasivity.

Future steps will be to validate LDV in sitting position, searching the optimal point to focalized the laser beam. Another important feature is to make image based system more robust respect to the movement and environment situation.

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Assessment of apple optical properties using the spatially resolved spectroscopy laser method

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Abstract

Determining the optical properties of a biological tissue is crucial for the application of light in the diagnosis and therapy fields, but also to classify the fruits and vegetables by their degree of ripeness. In the present work, the measurements were performed to determine the optical properties which include the absorption coefficient and reduced scattering coefficient (μ'_s and μ_a respectively) in different areas of apple fruit to find the perfect area where measurement must be done on a curved surface, taking into account the anisotropy of the parenchyma cells of a radial section and mildewed areas in the apple. Three varieties of apples were studied (Golden Delicious, Royal Gala and the Queen of Pippin) and the optical properties were measured at the wavelength λ= 633 nm using the method of spatial resolution in a steady state. Findings show that optical properties differ depending on where the measurement of the optical properties was performed and on the variety of apples. It's found that the measurement must be done on the part of most planar to converge on the exact value of the optical properties. The spatial resolution technique provides an effective way to measure the optical properties of biological tissues, and is also useful for the assessment of quality attributes of the fruit.

Keywords: spectroscopy space resolved, optical properties, reflectance measurements, apple fruit.

1 Introduction

Understanding the interaction of light with turbid biological tissue is an important issue in many areas although it was mainly developed for medical purpose in diagnosis and laser therapy. Recent papers [1] based on the same theories showed that the transfer of laser technology is very useful for quality evaluation of food products such as fruit and vegetables. Thus, there has been increased interest recently in optical characterization of agricultural and food products for nondestructive quality evaluation. In the recent years different spectroscopic techniques have been used to optically categorize the effect of absorption from scattering in the investigated fruit samples [2]. Therefore, the absorption and scattering coefficients expressed as the optical parameters, μ_a and μ'_s, conveys some information about the fruit pulp. The optical properties of turbid biological materials like fruits and vegetables are described by the absorption coefficient μ_a and the reduced scattering coefficient μ'_s which is related to μ_s by the equation: $\mu'_s = \mu_s (1\text{-}g)$, where g is the anisotropic factor that measures the asymmetry of the single scatter pattern. Using μ'_s avoids the need of knowing or measuring the g parameter when dealing with diffusion theory model. The light scattering is primarily due to physical characteristics, whereas light absorption is related to the chemical constituents**.** Several spectroscopic techniques have been developed to nondestructive evaluation on the quality of fruits and vegetables. Among them, time resolved spectroscopy [3], frequency domain resolved spectroscopy [4] and spatial resolved spectroscopy [5], are used in the measurement of absorption and scattering properties in order to determine the chemical constituents and quality attributes of agricultural products. In this study, the optical properties of apples are assessed from the space-resolved spectroscopy method. Then, it's shown that the variations of the absorption and reduced scattering coefficients values are both related to the curving fruit surface. The optical properties of apples are determined at 633 nm.

2 Materials and methods

2.1. Diffusion model

Light propagation in biological materials is governed by the light transport equation, also known as the Boltzmann equation [6]. For most biological materials where scattering is dominant ($\mu'_s \gg \mu_a$), diffusion approximation is valid [7]. For a homogeneous semi-infinite turbid medium illuminated by an infinitely small continuous wave point light source, the diffuse reflectance $R(\rho)$ at its surface can be expressed as the sum of isotropic fluence rate and the flux, and it is a function of the source detector distance ρ and the two optical parameters μ_a and μ'_s, which are given below:

$$R(\rho) = \frac{1}{4\pi\mu'_t}\left[\left(\mu_{eff} + \frac{1}{r_1}\right)\frac{e^{-\mu_{eff} r_1}}{r_1^2} + \left(\frac{4}{3}A + 1\right)\left(\mu_{eff} + \frac{1}{r_2}\right)\frac{e^{-\mu_{eff} r_2}}{r_2^2}\right] \quad (1)$$

In which $\mu'_t = \mu'_s + \mu_a$ is the total optical transport coefficient, $\mu_{eff} = \sqrt{3\mu_a(\mu_a + \mu'_s)}$ is the effective attenuation coefficient and r_1 and r_2 are given by the following two equations: $r_1 = \sqrt{\left(\frac{1}{\mu'_t}\right)^2 + \rho^2}$, $r_2 = \sqrt{\left(\frac{\frac{4}{3}A + 1}{\mu'_t}\right)^2 + \rho^2}$. The diffusion model in Eq. (1) is the theoretical basis of this research. It is used to fit the normalized profiles using a trust-region [8], a nonlinear least squares curve fitting algorithm which allows to estimate μ_a and μ'_s from the spatially resolved reflectance profiles.

2.2. Apple samples

Eighteen fruits of each apple variety « Golden Delicious, Royal Gala and the Queen of Pippin » were used in the experiment. The experiments were carried out on full apple and slice of one centimeter Fig.1 (a), (b), (c). The slices were made horizontally and vertically. As shown, vertical slices are cut following the calyx-stalk axis, whereas horizontal are perpendicular to this axis. On a full apple, measurements were made on three areas: top, middle and bottom. Thus, values of absorption and reduced scattering coefficient reported in following sections for full apple were average. Regarding sliced apples, measures were made on an optimized area in order to avoid the edge effects.

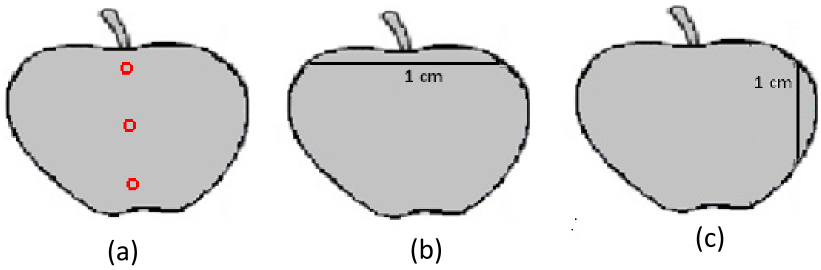

Figure 1: Measurement areas: (a) Full apple (b) Horizontal slices (c) Vertical slices

2.3. Laser setup

The experimental setup used for spatially resolved spectroscopy measurements is shown in Figure 2(a). A He-Ne laser emits at the wavelength λ= 633 nm is used as a light excitation source irradiating perpendicularly the apple's surface. The reflectance curve is shown in Figure2 (b). First, accuracy and limitations of the measurement system were tested and calibrated by means of the well-known-optical properties solid phantom.

For this purpose, this latter was illuminated by the He-Ne laser. The profile of the fluence rate was then obtained through optical fibers. Thus, this experimental profile was fitted using Farrell's solution Eq. (1). This was achieved using Trust-region algorithm. We started measuring the backscattered light fluence rate profiles of apples. For this purpose, we proceeded in the same way as for the solid phantom.

3 Results and discussion

The results are too numerous to be discussed in this paper. Thus, we will focus on the main one. In the calibration stage, the Trust-region method is used to fit the experimental data of optical reflectance by Farrell's function (Eq. (1)) gives to very robust results. This is affirmed by the values of the statistics parameters obtained. Adjusted R^2 and R^2 values were 0.9997, the *SSE* value was 2.2950×10^{-8} and the *RMSE* value was $3.09231\times10^{-6.}$

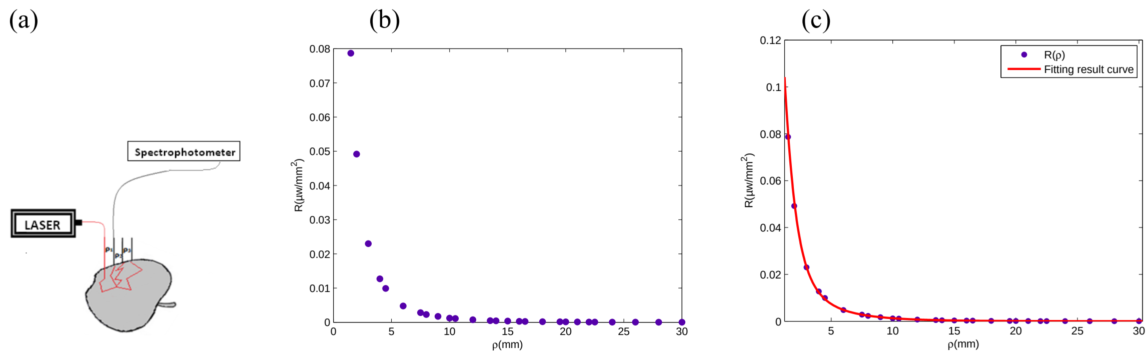

Figure 2: (a) Measurement chain schema of spectroscopy space resolved; (b) Profile of backscattering light (reflectance) emerging from a turbid biological material; (c). Fitting curve of reflectance

The quality of the fitting is confirmed by the optical properties obtained (μ_a=0.38 cm^{-1} and μ'_s=10.715cm^{-1}) which are very closed to those given by the supplier (μ_a=0.3 cm^{-1} and μ'_s=11cm^{-1}). Once the calibration is performed, we were able to measure the optical properties of apples.

Table.1 absorption and reduce scattering coefficients (μ_a and μ'_s respectively) of apples measured horizontally and vertically.

Apple	μ_a (cm^{-1})	μ'_s (cm^{-1})	μ_a (cm^{-1})	μ'_s (cm^{-1})
	Horizontally		Vertically	
Full Royal Gala	0.736 ±11%	8.102 ±17%	0.674 ±11%	7.151±17%
Slice 1cm	0.676±5%	6.102±9%	0.153±5%	3.973±9%
Full Golden Delicious	0.870 ±11%	7.095 ±17%	0.831 ±11%	9.684 ±17%
Slice 1cm	0.121±8%	6.515±8%	0.244±6%	5.225±8%
Full Queen of Pippin	0.981 ±11%	14.370 ±17%	0.986 ±11%	14.321 ±17%
Slice 1cm	0.193±9%	8.316±8%	0.719±6%	10.656±9%

Tab. 1 gives the absorption and reduce scattering coefficients (μa, μ's) of apple samples obtained by fitting the reflectance curve**.** As mentioned previously, to make slices, fruits were cut along with the calyx-stalk axis or perpendicular to it. This led to two kinds of measurements. Below, we will refer to them as vertical or horizontal measurements. The results for the optical properties related to slices, both horizontal and vertical measurements are summed up in Table.1. In the same table, are also reported those obtained with the whole fruit.

For all samples, the absorption coefficient μ_a ranged from 0.153cm^{-1} to 0.986cm^{-1}.and μ'_s, from 3.973cm^{-1} to 14.321cm^{-1}. These ranges are consistent with those reported in the literature [9-10]. In general, for both parameters μ_a.and μ'_s, values obtained when the measurements were performed on the whole fruit were greater than those with slices. This might be due to many facts. First, the measurements were based on Farell's model (point source, semi-finite flat surface). Slices surfaces are flat whereas the whole fruit surface is curved. We can assume that using Farrell procedure, optical properties are overestimated for curved surface [11]. In addition, the whole fruit is compound with fruit flesh surrounded by skin. Yet, this latter has been pointed out as multiple scattering due to the cell walls structure and the phenolic compounds [12]. For slices, regarding vertical measurements, values obtained are very convergent (*Tab. 1*). This convergence is due to the homogenety of the parenchyma which is the part of the fruit where the measurements were performed. We can noticed that values are less homogeneous for horizontal measurements. This is mainly due to the heterogenity of these slices. In such case, the photon may be scattered by parenchyma, stalk, the endocarp and or pips.

4 Conclusions

This research has demonstrated that the spatially resolved spectroscopy laser based on the diffusion approximation model gives good and rapid measurements of both the absorption coefficient and the reduced scattering coefficient of biological turbid medium tissue as well as apples. To show that the shape of the surface influences the values of the optical properties, measurements are made on different areas which are flat and/or curved surfaces to show that the shape of the surface influences significantly the measurement response therefore absorption and diffusion values are overestimated. Waiting for developing a correction factor of surface, it is recommended to performed measurements on an over planer surfaces. Another perspective is to use MRI to better understand the structure of apple [13] that means to revels the map of the scatters and the porosity that govern the optical properties.

Acknowledgments

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Carbon dioxide laser in the treatment of genital warts

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Summary

Genital warts are one of the most common and highly infectious Sexually Transmitted Diseases. The authors report their clinical experience in the treatment of genital warts with carbon dioxide laser, a safe and effective therapy.

Introduction

Genital warts, also known as condyloma acuminate, are one of the most common Sexually Transmitted Diseases, affecting the general population. In USA, more than 500.000 new cases of genital warts are diagnosed each year, expecially in adolescent and young adult (15-49 years old)[1]. Genital warts are caused by Human Papilloma Virus (HPV) infection and are spread by skin to skin contact. HPV is a group of noneveloped, doble-stranded deoxyribonucleic acid viruses, belonging to the family Papovaviridae. They infect epithelia of the skin or mucosa. The viruses are classified in three categories (low, intermediate and high risk), based on the likelihood of inducing intraepithelial dysplasias[2]. Anogenital warts are typically caused by HPV-6 or 11, which are considered low-risk subtypes. Moreover, some patients have an infection by HPV-16 or 18 that are the major cause of cervical cancer and more rarely of other genital cancers. Lesions can appear as flat lesion or papillomatous plaques. They could be singular, multiple or they can coalesce. Usually they are localized on the vulva, perineum, perineal area, cervix, penis, anus, scrotum and urethra. Warts are often asymptomatic but can cause pain, burning, irritation or bleeding. They can be physically and psychologically distressing for patients. The diagnosis of condyloma acuminate is made by clinical history and examination of the patients. Occasionally, a biopsy is performed to confirm the diagnosis and rule out the malignancy. In each case, the acetic acid test is fundamental for an early diagnosis of genital warts and for their follow-up after treatment. It consists in the application of 5% acetic acid to help visualize lesions, because it produces the "acetowhite" change, characteristic for genital warts. Fortunately a number of different treatments are now avaible. The conventional treatments for genital warts include chemical treatments (eg. trichloracetic acid, podophyllin, interferon, green tea extract) and ablative ones (eg. electrosurgery, cryotherapy, curettage, surgical excision, laser therapy, photodynamic therapy)[3]. The authors report their clinical experience in treating genital warts with carbon dioxide laser.

Materials and methods

Between January 2010 and January 2012, 289 patients with genital warts (185 male, 104 female) have been treated with CO2 laser. Patients were excluded if they had concomitant local infection or if they were pregnant. Usually, patients had multiple lesions. Lesions were localized on the anus (45male, 22 female), inguinal area (38 men, 24 women), penis (156 patients), scrotum (40 pt), vulva-vagina (100) pt). The appearance of the lesions varied from flat lesion or papillomatous plaques, to cauliflower-like condylomas. The diameter of the lesions ranged between 2 mm and 55 mm. 44 patients, before laser therapy, had been unsucessfully treated with other modalities (26 imiquimod cream, 5 podophyllotoxin, 13 cryotherapy). In each case, before laser therapy, we have obtained a written informed consent from patients. After decontamination of the lesions' area, we performed local anesthesia, with mepivacaine injection. Because the toxicity of the evaporated tissue, we adopted misure of safeness (eg. mask, smoke extractor). Genital warts have been evaporated using CO2 laser (wavelength 10600) in continuous or pulsed mode. Operative parameters (fluency, power, pulse duration) have being changed in base of the clinical features of lesions. After lesion removal, we have prescribed a topical or systemic antibiotic therapy to avoid secondary infection. Lesions were evaluated after 2 weeks and 3 months later.

Fig. 1-2: man[redacted] *with multiple genital warts before and after laser therapy.*

Results

At the first control, we didn't observe any new lesions in all patients. At the second control, 14 patients showed a recurrence of genital warts, that we treated with a new laser session. A history of burning sensation was reported by 4 patients. 24 patients reported itching sensation. Scarring was observed in 18 patients.

Conclusions

Carbon dioxide laser therapy could be considered a safe and effective treatment for genital warts[4]. In our experience, all lesions showed clearance after a single treatment. Only 14 patients showed a recurrence of the lesions 3 months later the treatment. Side effects were practically absent. The laser lesions showed rapid re-epithelisation; the aesthetic and functional results were excellent.

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Laser therapy in burns

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Summary

The treatment of burns physiologically proceeds through a succession of well-defined tissue repair processes. Initially, the body reacts to the trauma and demarcates the scalded skin, then follows the autolytic removal of the eschar with subsequent tissue repair. We are witnessing the constant succession of stages in each of which we can make use of pharmacological and instrumental aids to limit the damage from burns. We have identified the potential use of laser therapy in the experiences gained in the treatment of burns in the Burns Unit in Pisa. We evaluated the benefits of laser therapy in burns, expecially in the debridement of eschars and in the treatment of scars.

Introduction

In partial thickness and full-thickness burns we observe an area of central necrosis and, around it, an area of circulatory stasis that is separated from the living tissue surrounding by an area of inflammatory reaction that is produced to contain and repair the wound from burns.

The necrotic tissue is without circulation and is rapidly colonized by exogenous bacteria. Which are no longer contained by the skin barrier (physical integrity, pH, immune defences, etc.), and by bacteria of endogenous origin (intestine and upper airways). Sepsis of the burn occurs within a few hours of the event and represents a dangerous septic focus for the health of the burned patient because the sepsis can spread in the surrounding tissues and, therefore, in the whole organism. The risk of a generalized sepsis is directly proportional to the severity of the burns (1).

Sepsis is a constant phase in the course of the burn disease and represents the most frequent cause of death.

The body reacts to the necrosis with an inflammatory reaction surrounding the area of stasis and the area of stasis plays an important role in the destiny of the burn because it can follow two paths:

a. It's involved by ischemia and sepsis of the eschar with aggravation of the necrosis which extends on the surface and in depth (progression from one degree to another),

b. It resumes its functionality and delimits effectively the septic necrosis and together with the surrounding reactive tissue promotes the healing of the burn.

The eschar removal, therefore, is an important strategic moment in the healing of the burns and affects the prognosis of the burned patients (2, 3).

The removal of the eschar may be spontaneous or assisted with proteolytic enzymes, biological methods (Maggots larvae) and instrumental tools.

The surgical debridement can be performed on admission (immediate), from the third to the fourteenth day (early) or fourteen days later (late) by superficial or deep excision. The debridement is performed in the progressive removal of the eschar until the surgeon reaches the viable tissue (subcutaneous or fascia) that is characterized by the occurrence of bleeding (4, 5, 6).

The instrumental method of the necrosis include dermatome (by air, electric or air compressed dermatome), dermabrasion and laser debridement (7, 8).

We refer to the experience gained with the laser debridement in the treatment of burns in the Department of Dermatology of the University of Pisa.

In our work we have used a carbon dioxide laser (CO^2 laser) that allows to cut, coagulate and evaporate tissues. The thermal effects of CO^2 laser allows us to promote the coagulation (cauterization) and the vaporization of tissue for incising or excising o the laser may be used as a laser scalpel and as a tool that helps the coagulation.

The goal with laser debridement consists of excising non-viable tissue (partial or total ablation of the eschar), to leave in situ as much viable perilesional tissue as possible, reduce bleeding by heat energy (mild coagulation) and to promote a stimulation over the granulation tissue and epithelial healing.

Materials and Methods

In the treatment of burns, the laser can operate with no interruption during the delivery of its energy (continuous wave emission) or with interruption of the energy delivery (fractional or pulsed therapy).

In continuous light emission, the laser acts as a scalpel when it is in focus and to coagulate when it works out of focus. We work in local or general anesthesia with a range of power from five to twenty watts with a low power suction to clear away the smoke.

At the beginning, we incise a rim of tissue surrounding the burned area and we dissect a flab of burned tissue with an excision underlying tissue clinically viable (subcutaneous or fascia level). Generally we have an automatic hemostasis from heat coagulation (small vessels) but, when we need, from direct laser beam (bleeding of larger vessels). Seldom it may be necessary to clamp and tie the vessels.

For the burns debridement we used the CO^2 laser also in pulsed and fractional wave laser emission with a technique of photo micro debridement. The method: we make small holes in the necrotic tissue that reach the underlying tissue necrosis to promote the lysis of the eschar and stimulate a more rapid healing by viable tissue surrounding.

Before making the holes with the CO^2 laser, we calculate the depth to be reached to employ the right power to be used. To know these data we perform an ultrasound evaluation of the depth of the necrotic tissue or the border into near viable tissue. Then we adjust the laser power to start a course of ablative pulsed or fractional laser therapy. The power is such as to remove the eschar partially (a hole of the beam) and release heat in the sub layer tissue surrounding the necrosis to limit bleeding and stimulate its reactivity. After the laser therapy we make a dressing with topical silver sulfadiazine ointments alternating with proteolytic ointments to facilitate the detachment of the eschar (1). We change the dressing twice a day. With this method we mean to perform an effective debridement, a biofilm disruption and a stimulation of the secretion of growth factors.

Fig. 1. Laser debridement performed with continuous wave emission.

Fig. 2. Photo micro debridement and spontaneous healing.

Results

The CO^2 photo micro debridement was useful in partial-thickness and full thickness burns of minor size (< 1-2% TBS) where we observed: little bleeding, fast debridement, stimulation of spontaneous healing (partial-thickness burns) and low production of hypertrophic scars (Fig. 1).

The CO^2 laser debridement performed by continuous wave emission was useful in full-thickness burns and in burns of greater extension because it reduced the bleeding produced by eschar's removal and permitted a successful engrafment of skin autografts (Fig. 2)..

Conclusions

The Co^2 Laser therapy is another effective device for the excision of the necrotic tissue in burns treatment.

We can use continuous and pulsed laser emission beam.

Laser beam reduces bleeding against the surgical excision and stimulates the spontaneous healing in partial thickness burns.

Autografts applied to the skin treated with laser had a good engraftment.

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The efficacy of diode laser 820 nm in the treatment of Acne vulgaris

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Abstract

Objectives: To evaluate the efficacy of Omega Xp® laser in the treatment of Acne vulgaris in Sudanese patients**. Methodology**: This is a prospective clinical descriptive, interventional study. The study was conducted from January-march 2011and included ten patients (eight females and two males). Patients were classified as mild, moderate and severe acne. The laser system used was low level laser therapy Omega XP. All patients received the same laser parameters, using the contact method, twice weekly for four weeks. Photographs were taken weekly to observe the pattern of response. **Results:** There was significant response in the pustular lesions on the face which dried up within24-48 hours after the session without any residual skin changes. This duration of recovery of the lesions is considered shorter than any other modalities used recently in the treatment of pustular lesions. **Conclusions:** the use of low level laser therapy in the treatment of acne vulgaris is promising. Further studies with more patients and extended periods of time are recommended.

Introduction

Acne vulgaris is a chronic disease of the pilosebaceous follicle and is the most common disease of skin, affecting up to 80% of individuals at some time in their life. Current treatments for acne include topical and systemic antimicrobials, and topical and oral retinoids. These are successful in some, but not all, patients. All acne treatments have potential adverse effects, some of which may be severe, and generally need to be used for long times which may be associated with poor patient compliance. (1)

Low level laser Therapy (LLLT) has been defined (Ohshiro and Calderhead, 1988) as treatment with a dose rate that causes no immediate detectable temperature rise in the treated tissue and no macroscopically visible change in tissue structure. There are several mechanisms which underly therapeutic effects with LLLT such as increased ATP production, increased serotonin and endorphins and increased anti-inflammatory effects through reduced prostaglandin synthesis. (2) (3)

This study considers the role of laser therapy in the management of acne vulgaris in clinical practice**,** as recent technologic advancements have provided viable treatment options to achieve clinical outcomes that were previously only attainable in patients with lighter skin tones. Current literature regarding the use of lasers in darker skin types is limited. The present study brings into focus the response of pigmented skin acne patients to low level laser therapy.

Methodology

This is a prospective clinical descriptive, interventional study. Performed in the laser clinic, institute of laser Sudan University of Science and Technology, Khartoum Sudan. The objective is to evaluate the efficacy of diode laser (820 nm) in the treatment of Acne vulgaris in Sudanese patients. The study was conducted from January to march 2011. The study was performed on 10 patients clinically diagnosed as cases of acne vulgaris. The patients were divided clinically as having mild, moderate, and severe acne according to the acne lesion counting.1 case was considered as mild, 5 cases as moderate and 4 as severe acne. They were selected from different dermatology clinics in Khartoum state. They were over 18 years of age, able to give informed consent and have the desire for removal of lesions. Those who were less than 18 years or with history of photo sensitivities or unable to give informed consent were excluded. Data was collected by means of a questionnaire. The laser system used in this study was diode laser 820 nm. After considering the safety measures, the single probe was applied first over each individual lesion with a wavelength of 820 nm; energy density of 32 J/cm^2; frequency of 20 Hz; and pulse duration 20 seconds. Secondly the cluster probe was applied, with an energy density of 9.6 J/cm2; frequency of 20 Hz; pulse duration of 2 minutes. This was applied on cheeks, forehead, nose and chin. The total exposure time was calculated from the records on the display screen. Photographs were taken weekly to observe the results of treatment.

Results

All patients had the same number of sessions, except the two male patients who had six sessions. Clinical results were analyzed after 4 weeks. Generally the treatment was well tolerated by all patients, with no adverse effects, neither short- term nor long – term complications up to date.

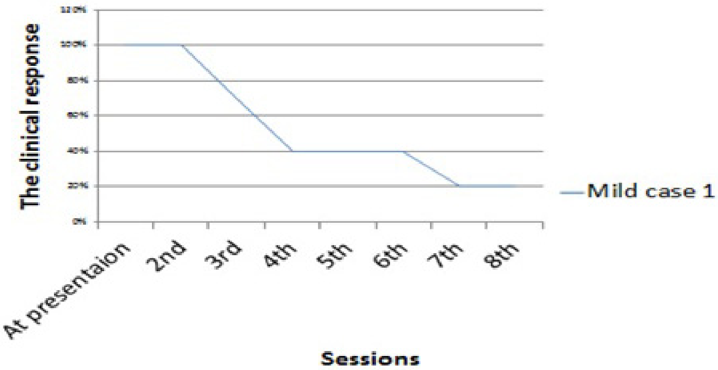
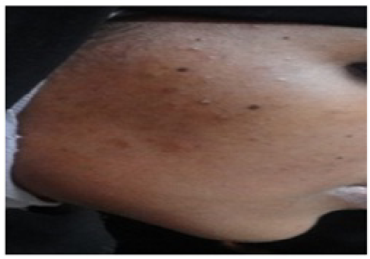


FIG -1: The Clinical response of acne vulgaris in the m ild case during the treatment among the study groups.

FIG2, A: ABEFORE TREATMENT

FIG2, B: AFTER TREATMENT



Discussion

This study depends on acne lesion counting for dividing the patients to mild, moderate and severe acne. Although lesion counts alone may be inaccurate due to the presence of other factors associated with the pleiomorphic nature of acne, but it has been considered as a primary criteria for measuring treatment outcome. In this application, the specificity of counting is valuable, as acne treatments may have a greater effect on certain lesion types. The clinical response measures in this study were change in skin oiliness or seborrhea, lesion counts, and change in acne severity. [4] There are two main mechanisms that laser treatment may help acne: By destroying Propionibacterium acnes; by exhibiting the phototoxic effect of heme metabolism of Propionibacterium acnes, or by inducing oxygen in the bacteria killing them, and by destroying the sebaceous glands / entire pilosebaceous unit. [5]

One female case presented with mild disease at age of 40 years mainly in a form of comedones, no significant clinical response was observed after the 1st and the 2nd sessions, and then a dramatic response was obsereved when the total lesion counts fell by 60% on the 4th session. On the 7th and 8th sessions 80 % of the disease disappeared "*Fig.1, 2*". Comparing the clinical response between the different skin lesions of acne the main effect was on pustular lesions with a less marked effect on comedones.

Regarding the moderate group, 40% of cases were not compliant with the total number of sessions, as they were satisfied with the clinical response achieved after the six sessions with marked reduction of sebum production and reduction of inflammatory lesions count "*Fig. 3,4*". 40% of cases showed a dramatic recurrence observed at the 5th session. This could be related to the premenstrual flare, and by the end of our study just 20% of their disease disappeared. 20% of cases showed signs of good response to the treatment. "*Fig. 3*"

The majority of the severe cases showed a dramatic response to the treatment and by the 8th week about 80 % of the disease disappeared "*fig.5*". 25% of cases in the severe group, had atrophic scars from the healed acne lesions, and they presented with numerous pustules. fortunately after laser treatment the lesions healed without scarring. 25% of this group had prominent erythema (was on prolonged use of topical steroids for acne treatment), which was increasing after sun exposure. Also this patient was highly satisfied with the reduction of the erythema and the rest of the inflammatory lesions "*fig.6*".Our findings do not compare with a study done in 2004 by Orringer (2004), 40 patients (24 Males, 16 Females), with a mean age of 20·7, with clinically evident facial acne; 585 nm pulsed dye laser in a split-face trial, single treatment and two treatment (2 weeks apart) groups, assessed at 2, 4, 6, 8, 10 and 12 weeks after final treatment by change in inflammatory lesion count and change in Leeds acne severity score. Reduction in mean papule count was 39% on the treatment side vs. 25% on the control side; reduction for pustules was 0 on the treatment side vs. 31% on the control side. There was no significant difference between the treatment and control groups for either outcome measure. (6) The most striking outcome was the response of the pustular lesions, which dried up within 24-48 hours after the sessions, without any residual skin changes especially hyper pigmentation.

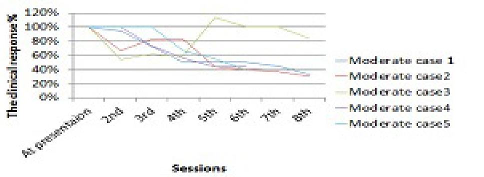


FIG3: The clinical response of acne vulgaris in the moderate cases during the treatment among the study groups.

FIG4, B: AFTER TREATMENT

FIG4, A: BEORE TREATMENT

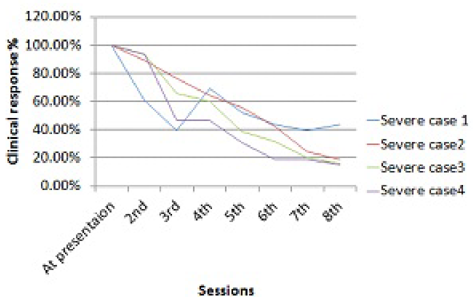


FIG5: The clinical response of acne vulgaris in the severe cases during the treatment among the study groups.

FIG6, A: BEFORE TREATMENT

FIG6, B: AFTER TREATMENT

Conclusions

This study showed that laser therapy is a promising alternative that would allow the simultaneous treatment of both active acne and associated scarring. Thus, laser therapy can be used as an alternative or as an adjuvant treatment for acne and can negate the need for oral treatment and its associated toxicity. Further studies are needed, to determine the ideal wavelengths, durations of treatment, dose and location of treatment, which are important in ensuring a substantial margin of safety while still producing satisfactory results.

Although our preliminary results seem to indicate persistence and evidence of skin improvement, the limited number of patients, short duration and with a relatively short follow-up period does not allow definitive conclusions. Long-term follow-up of this study population will be necessary to determine the final effects of this treatment.

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Rosacea: experience with the long –pulsed 1064 nm Nd:YAG laser

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Summary

Rosacea is a chronic inflammatory skin disease, which affects the blood vessel and the pilo-sebaceous units of the face and neck. Typically, rosacea is manifested as erythematous flushing, telangiectasias, papules and pustules affecting the central third of the face. More rarely, the skin disease can occur in other body areas. Patients affected by a long-standing disease present also a dominant sebaceous hyperplasia. The diagnosis is mainly clinical. Treatment should address the clinical pattern, the staging and severity of skin lesions. Nd:YAG laser is an effective treatments for telangiectasia, which are foundamental in the pathogenesis of rosacea.

Introduction

Rosacea is a chronic inflammatory skin disease, which affect the blood vessel and the pilo-sebaceous units of the face and neck. It's one of the most common skin disorders in adults, especially in fair-skinned populations. The reported prevalence in the countries of northern Europe (light skinned, red haired people and Celtic skin type) is up to 10%, in the south 2%[1]. Usually, rosacea starts in the third or fourth decade of life and it's more commonly described in women. Instead its high prevalence, the exact cause of rosacea remains unknown. Several factors have been implicated in its pathogenesis, some based on the evidence of scientific investigation, others on anecdotal observation. The most-cited pathogenetic theories about rosacea center on inherent abnormalities in cutaneous vascular homeostasis, which result in structural vascular change and permanent dilatation of superficial vessel[2]. Maybe, this leads to alterations of the connective tissues and, subsequently, of the lymphatic system. Rosacea presents with different symptoms and signs, which may occur together or independently. Based on patterns of physical findings, rosacea could be classified into 4 broad subtypes[3]: the erythematotelangiectatic rosacea (ETR), which is characterized by telangiectasias, flushing and persistent erythema of the face; the papulopustular one (PPR), characterized by papules and pustules on a background of edema and persistent central face erythema; the phymatous rosacea, characterized by an overgrowth of sebaceous glands and by fibrosis; and the ocular rosacea which presents the typical skin lesions associated to an ocular involvement. In each case, the diagnosis is mainly clinical. Treatment should address the clinical pattern, the staging and severity of skin lesions. The authors report their personal experience in treating facial telangiectasias with long-pulsed Nd:YAG laser[4].

Materials and methods

A retrospective review identified 148 patients (55 male and 83 female) with ETR, who underwent to vascular laser therapy at our hospital from 2009 to 2012. Patients were aged 37-71 years old (mean age 54 years old) and they had Fitzpatrick skin type I to III. Patient selection should be done after detailed counseling with respect to the course of lesions, different treatment options, possible results, cost, need for multiple treatments, and possible postoperative complications. Excluding criteria were: cardiovascular diseases, haematological disorders, current use of drugs which increase the blood flow; active local infection, UV exposure, intake of photo-sensitizer, unstable vitiligo, psoriasis, and keloidal tendencies. Telangiectasias have been treated using Nd:YAG laser (wavelength: 1064 nm) long pulsed (pulse duration 10-40ms), with a spot size ranging from 1.5 to 3.5 mm at the level of the handpiece. Lower fluences were used for shallower vessels, higher fluences for deeper vessels (28-70 J/cm²). Immediately after lasing, each vessel was examined with a dermoscope after pressure was applied. If blood refilled the vessel an additional pulse or two was delivered to this vessel. A cryogen cooling system has been used during each treatment. After laser therapy, we have prescrived a topical lenitive cream and a sun-protection. Patients were evaluated at intervals of 3-5 weeks and received one or two additional treatments if necessary. During each visit of control, we have evaluated the clinical and dermatoscopic apperance of the skin lesions, grading lesions on a percentage scale on the base of their response to laser therapy (Poor/absent response to treatment= less than 25% of telangectasias has been resolved; Partial response= 25–75% of ecstatic vessels has been treated; Excellent response= 76–100% of telangectasias has been disappeared). Moreover, we have investigated possible side effects due to laser treatment, and how patients' Life Quality Index (personal embarrassment, emotional distress, social isolation) could be changed with therapy.

Fig. 1: woman with ETR before and after a session of laser therapy.

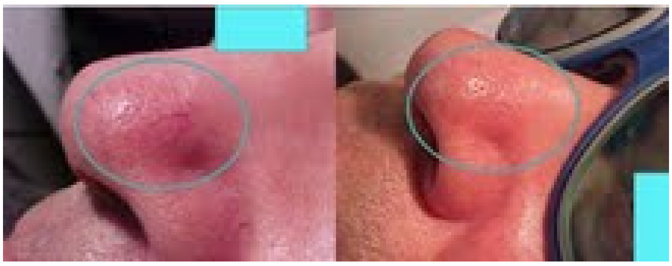

Fig. 2: fine teleagiectasias of ala nasi before and after laser treatment.

Results

After the first laser session more than 60 patients showed a marked improved of their skin lesions; about 80 patients had a partial response and 8 patients a poor response. In these patients we performed a second treatment, obtaining an excellent result in most of them. A third laser session was necessary only in ten cases. In general, the treatment was well-tolerate by patients, except for 4 women which didn't want to continue the therapy because of pain. A history of transient inflammation, of different severity, has been reported by about all patients. We never observed problem of urticarial reaction, focal thrombosis or bulla formation. Only one patient showed a more severe reaction, characterized by erosion and crusting. 3 patients showed a mild local pigment changes.

Conclusions

Long pulsed Nd:YAG laser therapy has been shown to be effective in the treatment of facial telangiectasias, related to rosacea[5]. Patients showed not only a decrease in erythema and telangiectasias grading scores, but also a reduction in flushing by the destruction of the excessive cutaneous vasculature. Excepting for 4 patients, the treatment was well-tolerate, with minimal discomfort. In our experience, all lesions showed clearance with 1 or 2 treatments, and only in a poor percentage of patients we need an additional laser session. Nd:YAG laser has been also useful for the treatment of stubborn telangeictasias on face (alae nasae and tip). The aesthetical results were excellent and the side effects rare. Patients were really satisfied by the clinical result obtained, and they showed an improved of their Life Quality Index. The technique is speed and it doesn't require any patient's preparations. After laser treatment, we have prescrived to patients a short-term topical lenitive cream and a sun-protection.

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Actinic keratoses and CO2 laser ablation

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Summary

Actinic keratoses (AK) are intra-epidermal neoplasm consisting of proliferations of cytologically abnormal keratinocytes that develop in response to prolonged exposure to UV radiation. It's a common skin disease, which clinical significance is related to the risk of malignant trasformation to squamous cell carcinoma. Early diagnosis and treatment of actinic keratoses is recommended to prevent malignant diseases. The authors of the article report their clinical experience in treating actinic keratoses with carbon dioxide laser, a safe and effective therapy.

Introduction

Actinic Keratosis (AK) is a cutaneous neoplasm, which consists of the proliferation of cytologically abnormal epidermal keratinocytes in response to prolonged exposure to UV.

AK is the initial lesion in a disease continuum that may progress to SCC and identify a group of people affected by a long-term sun damage, who are at high risk of developing NMSC and melanoma.

AK is one of the most common skin diseases and represents the second diagnoses made by dermatologists of United States. Although the high prevalence of the disease, its real worldwide incidence is difficult to estimate, given that it varies depending on the population evaluated. In US, 60% of adults, who have high risk feature, will develop at least 1 AK[1]. In general, Actinic Keratosis is more commonly described in the areas closer to the Equator line and high altitude, especially in adult-old men with fairy skin type. The major risk factors are the individual susceptibility and a history of chronic sun exposition. UV radiations play an important role in the initiation and promotion of epithelial neoplasm, by the induction of mutations in cellular DNA and of an immunosuppression which prevent tumor rejection.

More than 80% of AKs are localized in sun-exposed skin areas, on a background of photodamaged skin, characterized by solar elastosis, pigmentation abnormalities, ephelides, lentigos, telangiectasias, wrinkles, starry scars and/or yellow coloration. Usually, patients have multiple lesions, which can also confluence as a rash. Also the apparently normal skin, which surrounds the lesion, would already have genetic changes associated with carcinogenesis ("cancerization field"). Clinically, AK vary in size (mm – cm), form and number. Often, they are asymptomatic although some patients report itching, burning or a splinter-like sensation in the affected skin area. Commonly, AK presents as 2-6 mm erythematous flat, rough, gritty or scaly papules or plaques ("erythematous actinic keratosis"). Typically, it's easier to feel than to see.

The diagnosis is based on patient history and skin examination. The biopsy is recommended for atypical lesions (eg. large, ulcerated or bleeding lesion) and in case of recurrence or persistence following standard treatment. The histological examination of the lesion shows atypical keratinocytes within the deeper portion of epidermis (loss of polarity, nuclear pleomorphism, disordered maturation, increased number of mitotic features), and chronic inflammatory infiltrate. The nearest skin areas are characterized by features of sun-damage, like solar elastosis of the dermis and superficial parakeratosis.

Actinic keratoses could persist, regress or evolve to SCC. The risk of progression to SCC is unknow (0.025%-16% per years[2]). Conversely, it has been estimated that more than 60% of SCC arise from AKs. The major risk factors are: lenght of time an AK has been present, numbers of AKs, AKs type (hypertrophic), UV exposure, individual characteristics (eg. Immunosuppression). Because of their risk of malignant transformation, an early diagnosis and treatment are recommended to clear actinically damaged skin[3]. Fortunately, numerous effective therapies (medical or procedural) are now available for the treatment of Aks[4]. The authors report their clinical experience in treating AKs with CO2 laser, a safe and effective therapy[5].

Materials and methods

A retrospective review identified 600 patients (316 male, 284 female) with AK treated with CO2 laser vaporization at our hospital from 2006 to 2011. Patients were aged 38-87 years old (mean age 64 years old) and they had Fitzpatrick skin type I to III. Patients had one or more lesions localized on sun exposed areas, typically on a background of photo-damaged skin. Excluding criteria were active local infection, ultraviolet exposure, intake of isotretinoin or other photo-sensitizer, and keloidal tendencies. Before laser treatments, we obtained an informed consent by each patient. After decontamination of the lesions' area with Amukine 0.05% solution, we performed local anesthesia, with mepivacaine injection. AKs have been evaporated using CO2 laser. Operative parameters (fluency, power, pulse duration) have being changed in base of the clinical features of lesions. In case of lesions at risk, we used to perform a punch biopsy before laser treatment. After lesion removal, we have prescribed a topical cicatrizing-antibiotic therapy and a sun-protection. Lesions were evaluated after 3 months, 6 months, and 1 year.

Fig. 1: Woman with AK localized on the nose, on a background of important sun damaged skin. The same patient immediately after laser treatment and after 3 months.

Fig. 2: Man with AK on the nose before and one year after laser treatment.

Results

During each visit of control, we have evaluated the clinical and dermatoscopic apperance of the patients. Moreover, we have investigated possible side effects due to laser treatment. A history of transient inflammation, of different severity, has been reported by about all patients.

We never observed problem of healing or local infection. 43 patients showed a mild local pigment changes. Also aesthetical results were good; a more evident but not so important scarring has been described only in 20 patients.

Conclusions

CO2 laser has been shown to be effective in the treatment of AKs, also for lesions of big size or which are localized in particular skin areas (such as scalp) where the classical surgical technique risk to be too invasive and difficult to perform. In our experience, all lesions showed clearance after a single treatment and didn't show any sign of recurrences. The technique is speed and it doesn't require any patient's preparations. Because, it's quite painful procedure, we only performed a local anesthesia. After laser treatment, we have prescribed to patients a short-term local antibiotic-cicatrizing therapy and sun-protection. CO2 laser is a safe therapy, which can provide good aesthetical result, with minimal side effects.

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The tennis player's shoulder

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Abstract

For a professional tennis player, the shoulder, specifically the sovraspinatus tendon, is one of the most stressed parts of the body. This happens because of strong athletic action itself in addition to movements like for instance "the service". Athletes sometimes develope what is called the "tennis elbow", a pathology that involves the epicondilus. It's due to wrong technical movements but also can affect the very active athlete worn out. Therefore over 100 professional tennis player, mostly at very high levels, have been studied, focusing on the sovraspinatus tendon. Since 1990 lesions have been trated with the new HPLT method, conceived by Prof. Parra and Eng. Algeri. Results compared to the traditional surgical solution prove that concernes the sovraspinatus tendon lesions, the new HPLT technic is far more effective.

Keywords: High power laser defocused, tennis player, sovraspinatus tendon.
PACS: 42.62

High power laser therapy

Since 1988, Prof. Parra together withEng. Algeri, and Eng. Aloisini, have been treating pathologies related to sport activities especially tendinopaties. The mechanism of the laser is based on defocusing the beam. (Fig.1).

FIGURE 1. *Neodymium-yag defocused, 1988. First technic of Prof. Parra*

Research contunued. Prof. Parra and Eng. Algeri, conceived 3 wave lenghts separated at the beginning, that mixed togheter after, with simultaneous emissions. This new laser was called FP3 system.

FIGURE 2. *FP3 prototipe (1997)*

FIGURE 3. *FP3 prototipe (1997)*

A study on players affected by degeneration of the sovraspinatus tendon

Starting from 1998 up to 2013 a study focused on 118 professional tennis player, affected by degeneration of the sovraspinatus tendon over streassed. In order to avoid the traditional surgery procedure, the players were trated with HPLT. At first with Nd Yag defocused, then with FP3 system and finally with Doctor Laser.

The average age of the players was 25; 58 of them were treated with 60/90 micro sessions. In every micro session the emission of the laser was continued with a maximum total rate of 100-150 Joules/cm2.

Results were positive on 115 of them, only 3 were negative.

All of them had been evaluated before and after the treatment by a scan echography and MRI.

On what concerned their follow up 80 % were checked after 6 months, 20 % within 6 months.

Doctor laser

"Doctor Laser" is the new portable device that can be carried around during tournaments. (Fig. 5) Its characteristics are to work on:

- High Power
- Elevated penetration
- Manageability
- Transportability
- Reduced maintenance costs
- Rechargeable

FIGURE 4. *Doctor Laser, 2010*

Principle of multi-frequency laser or of maximum biostimulating probability

Each photochemical reaction requires anexact amount of energyfor the two compounds to react in order to produce one or the other.

E=hv, where h is Planck's constant

It also provides a formula for the statistical distribution of the energy of these quantities. Using SI units, energy is measured in joules, frequency is measured in hertz, andPlanck's constant is measured in joule/seconds.

The laser radiation id characterized by “carrying” photons with only one level of energy according to Planck's law, hence we have two cases in order to have the desired photochemical reaction:

CASE 1: The required energy is a multiple of the photon energy associated with the radiation . Maximum statistical probability to have a reaction with the smallest energy amount.

CASE 2: The required energy is not a multiple of the photon energy associated with the radiation and therefore requires the involvement of photons that are generated through the processes of excitation and decay that occur in site. This condition reduces the statistical probability and requires the bringing into play of high energies.

Conversely, if the tissue is simultaneously exposed to laser radiation of different wavelenght belonging to the therapeutic window we will have a simultaneous flow of photons with different energy. Thus, the value of energy required can be easily obtained as the sum of the combination of photons having different energies.

The greatest biostimulating chance for the tissue is obtained thanks to simultaneous action of more laser radiations.

Effects of the multi frequency laser fp3

The testing of the triple-wavelenghts laser began in 1996.

This new source allowed to program, test and verify the results obtainable from a single high biostimulating three-wavelenght radiant emission with minimum absorption and therefore limited dermal heating.

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Low Level Laser Therapy in Rheumatology

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short title: *LLLT in Rheumatology*
key words: *low level laser therapy, rheumatology, rheumatoid arthritis, osteoarthritis,*
abbreviations: *CTS, carpal tunnel syndrome; DMARD, disease modifying anti-rheumatic drug; LLLT, low level laser therapy; NSAID, non-steroidal anti-inflammatory drug; OA, osteoarthritis; RA, rheumatoid artritis*

Introduction

Pain is the common symptom of rheumatic diseases. Beside drug therapy physical therapy including low level laser therapy (LLLT) is a useful addition for pain control. Some studies describe an antianalgesic effect of LLLT after surgery but strong evidence is missing (*Aras MH 2010*). The lack of evidence and results' reproducability may be caused by differences in study design, missing methods to evaluate objectively pain and differences in lasers and laser energies (*Tuner J and Hode L 2010*).

In musculoskeletal disorders drug therapy including non-steroidal anti-inflammatory drugs (NSAIDs), corticosteroids and disease modifying anti-rheumatic drugs (DMARDs) including biologicals are the basis for pharmacological treatment. Nevertheless pain often remains and needs additional therapeutic assistance. Among different kinds of physical therapy LLLT is common to try satisfying pain control. The usefulness of LLLT as therapeutic intervention for pain control in rheumatic diseases was aimed to be evaluated focusing on the years 2010 to 2013.

Materials und Methods

Literature search in PubMed focusing on the years 2010 up to 2013 was done to look for useful applications and randomised controlled trials with LLLT in painful musculoskeletal disorders.

Results

Carpal tunnel syndrome (CTS) is a painful numbness of hands whose only established disease modifying treatment is surgery with cutting the transverse carpal ligament. Conservative treatments are usually less effective. In a placebo controlled double blind and randomly assigned study on 60 patients divided into three groups (two groups with active laser with different energies, one placebo group) only sensory nerve velocity showed improvement in both active laser groups but not in the placebo group, all other variables (pain intensity, grip strength, symptom severity score, functional status score and ultrasonography measurements) revealed significant improvements in all groups (Tascioglu F et al. 2012). The authors conclude that LLLT is not more effective than placebo in CTS.

The analgesic effect of LLLT was most often evaluated in patients with osteoarthritis (OA). In 2000 the first Cochrane review on Low level laser therapy for the treatment of OA was published (*Brosseau L et al 2000*) and updated in the following years. The latest review in 2007 (*Brosseau L. et al. 2007*) was withdrawn as some recent studies were missing and some errors made in the extraction of data. Nevertheless this latest and withdrawn review of eight clinical trials, five of the trials favored laser therapy over placebo for at least one outcome (pain, pain during movement, improved knee range of motion, disease activity, and temporomandibular joint pain) and three other trials did not report benefit associated with laser therapy. Though the review was withdrawn by Cochrane there is a clear statement that replacing Cochrane's calculations with those suggested by the authors would not affect the conclusions of the review (http://mrw.interscience.wiley.com/cochrane/clsysrev/articles/CD002046/frame.html).

In a systematic review of rehabilitative interventions on pain, function and physical impairments in people with hand OA (figure 1) also LLLT was included. With a high level of evidence (1b) LLLT was found to be effective at improving range of motion in patients with hand OA (*Ye L et al. 2011*).

Figure 1: Advanced osteoarthritis of finger joints (female, 58 years of age; picture: M. Herold)

Among conservative treatment of knee OA LLLT is moderately supported in the literature as an indicated management strategy (*Adams et al 2013*).

Rheumatoid arthritis (RA) is the most common chronic inflammatory rheumatic disease. Untreated RA results in irreversible and painful joint destruction with substantial loss of function and mobility (figure 2). Opinion about efficacy of LLLT in rheumatoid arthritis is controversially discussed. In a double-blind controlled trial the effectiveness of LLLT on pain reduction and improvement in function of hands was assessed in patients with RA. An aluminium gallium arsenide laser was used at a wavelength of 785 nm, dose of 3 J/cm^2 and a mean power of 70 mW. LLLT proved to be safe in patients with RA without any side effects. In most tested variables a statistically significant improvement was seen in the verum as well as in the control group. Authors conclude that LLLT as used in this study did not result in any effectiveness for patients with RA (*Meireless SM et al 2010*). One reason for the missing effect may be a too low energy used in the study (*Tuner J and Hode L 2010*).

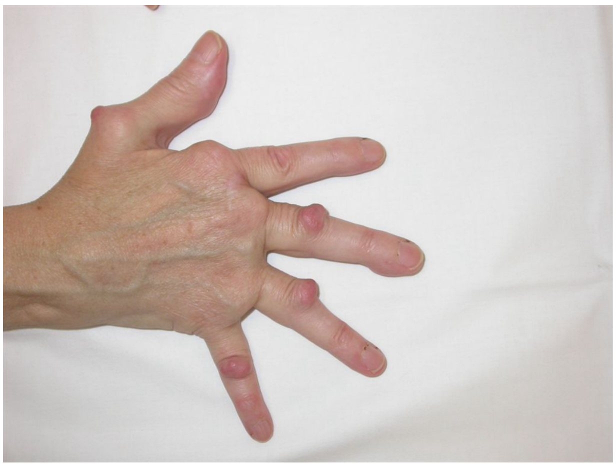

Figure 2: Advanced rheumatoid arthritis with disturbed MTP joints, typical ulnar deviation on fingers 2 to 5 and rheumatoid nodules on fingers 1, 3, 4 and 5 (female, 47 years of age; picture: M. Herold)

Investigations with LLLT in animals as well as in humans show positive effects of LLLT for treatment of several kinds of joint inflammation. In a histological study the anti-inflammatory effect of LLT in different stages of arthritis was evaluated in animals with collagen-induced arthritis which is similar to human RA. In early as well as in late RA progression stages statistically significant improved influx of mononuclear inflammatory cells, exudate protein, medullary haemorrhage, hyperemia, necrosis, distribution of fibrocartilage, chondroblasts and osteoblasts. Authors conclude that LLLT is able to modulate inflammatory response both in early as well as in late progression of RA (*Alves ACA et al. 2013*).

Evaluation of LLLT in an experimental model of septic arthritis resulted with no effect in reduction of nociception, which was assessed with a von Frey digital analgesimeter, but revealed a slight recovery in the articular cartilage and synovia (*Araujo BF et al. 2013*).

The protective effect of LLLT could be shown in an experimental acute zymosan-induced arthritis (*Carlos FP et al 2013*). Laser treatment significantly inhibited leucocytes influx, the release of pro-inflammatory cytokines and the activity of metalloproteinases suggesting less degradation of collagen tissue. It was concluded that LLLT provides protective effects of degradation of joint cartilage network.

In case of acute or chronic back pain LLLT was not effective (Ay S et al. 2010). Comparing LLLT to placebo treatment revealed no differences on pain severity or functional capacity. Whereas in inflammatory back pain (sacroiliac pain) LLLT was effective in pain reduction and increase of mobility (*Ohkuin I et al 2011*).

The effectiveness of LLLT on pain in musculosceletal syndroms is unclear (*Thornton L et al 2013*).

Discussion

LLLT is an additional option in non-pharmacological treatment of pain in rheumatic disorders. LLLT has short term effects on pain, is helpful in OA, has antiinflammatory effects, decreases symptoms in RA and reduces pain in sacroiliitis. But recommendations for best energy ranges are still missing.

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Laser And Physical Therapy Applied To Traumatic Central Nervous System Injuries: Update

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Introduction

Traumatic Central Nervous System Injuries (TCNSI) are not diseases but lesions that concern an ever growing number of people who have lost their independence and are unable to work. These persons need help to recover at least some of their functional abilities. Causes include traffic accidents, diving in shallow water, occupational accidents, war, falls, gunshots, stab wounds and natural disasters (earthquakes). Social aspect is highlighted by WHO in its definition of health , which is "not the absence of disease or infirmity but a state of complete physical, psychological and social wellbeing." Right indications are given in the International Classification of Functioning, Disability and Health, established by WHO in the year 2001. There is significant correlation of trauma epidemiology with the economic conditions of a community [1]. In USA, more than 10% of residents suffered from non fatal injuries in 2002. Trauma was the leading cause among those aged 1-4 years. In Germany, 40% of the injured were aged between 20 and 39 years in 2002 (greatest incidence between 20-24 years).

The beneficial effects of light on biological tissues have been known since Hippocrates time [2,3,4].

Around 1966, Mester et al. [5] were the first to point out 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 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. [6,7,8,9,10]. In 1998, researchers of Bethesda University (Maryland) demonstrated that, at specific doses, some lasers could 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. 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 dose is modified. A good bibliographic critical review on this topic has been written by Tuner and Hode [12]. Many other uses of non-surgical laser were studied following this concept, as the modulation of metabolisms, immunological system, nerve cells functions, progenitor cells, light energy exchanges [10,12,13,17,20].

In terms of dosage, in order to obtain the desired effects, it is necessary to 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) [7,8,9,10,13,18].

Therefore it is evident that, if the effects of light are dependent on small quantities of radiation and on how they are administered, it follows that we must use lasers which allow us to administer precise and selective doses to tissue. This is what is done in soft tissues regeneration, such as healing of skin wounds and ulcers, in the treatment of bone-muscle-tendon inflammations and traumas and neuralgias [11,12,13,14,15,16,18].

Regarding cellular level, Lubart et al. [17] demonstrated that lasers act on several components of the cell in a selective mode and according to the wavelength, affecting the mechanisms that produces water on mitochondria. This in turn triggers ATP production and immediately available energy, which stimulates cell function. It seems that, if the cell is damaged, the natural defense mechanism makes the mitochondria produce oxygenated water as opposed to “normal” water, so that cell cytoplasm is “cleaned” and can resume its normal function. If the damage is severe and irreversible, cell produces activated “singlet” oxygen, a cytocide substance which coagulates cytoplasm, preventing oncogenic and teratogenic transformations from taking place. All these mechanisms are influenced by luminous radiation in a strictly dose-dependent manner.

TCNSI represents a social problem today, interesting 5% of human population of economical developed countries. It is understandable that scientists, researchers, clinicians, health economists and planners are concerned with TCNSI and try their best to control it through more effective, easier and cheaper methods.

Regarding the effects of lasers on central nervous system, several authors (18,19,20,21,22,23,24,25,26) have demonstrated in vitro that, at given doses, some lasers regenerate injured neuron cell cultures and cause them to multiply. This scientific evidence prompted us to verify the effects in vivo.

Materials and methods

Following this scientific background, since year 2004 we treated chronic systemic tissue lesions such as spinal and brain traumatic injuries, in patients of both genders, aged 16 – 60 years old.

The whole project followed the rule of good clinical practice, established by European Community and published in the Italian "Gazzetta Ufficiale" (supplement N°191, 18/8/1997) N°39, 18/6/2001 and by the Helsinki Declaration.

Patients were selected on basis of inclusion-exclusion criteria and treatment interruption criteria (Fig 1). They were properly informed about the nature of the study, potential benefits and risks connected with it and were asked to give their informed consent prior to the start of laser treatment.

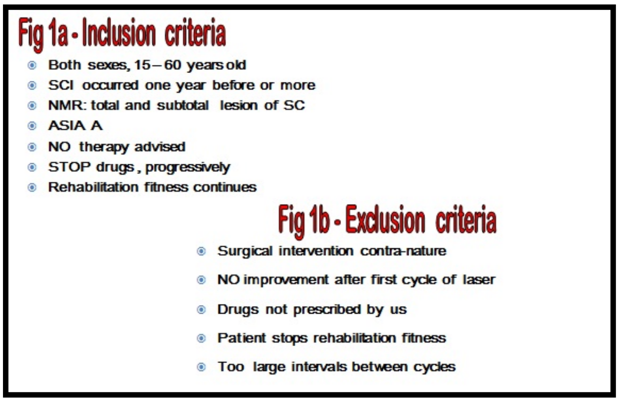


Fig. 1: inclusion and exclusion criteria

Patients admitted to the study were treated in our consulting room. Their documentation and treatment schedule were defined. Before treatment patients were informed about the steps that were followed. They were then submitted to the prescribed treatment according to the established protocol. Operator were attentive to any possible adverse immediate reaction. After treatment the operator checked health condition of the patients and keep them under observation for two hours after which they were released. Their comments were noted and the next appointment was fixed.

Both sides of the lesions and related domains of the injured apparatus were irradiated.

Laser treatment was done in consulting rooms, where instruments and drugs needed for the treatment of adverse radiation effects were placed. Each patient was treated in the same place for all the duration of the treatment.

Before starting treatment, patients undergo a check-up, with control of haemato-chemical parameters of blood and urines and function of principal organs, such as heart, liver, kidney, brain, lung, eye, endocrine system.

A qualified person controlled the efficiency of lasers and determined when laser was active. The same person was responsible for the application of safety rules following the standards of the American National Standard Institute (ANSI).

A third person evaluated rehabilitation results, measured with the same devices and the same criteria for each patient. An epidemiologist evaluated results and their statistical significance, comparing data obtained for the trials.

Energy doses may vary during the course of treatment on the basis of results obtained from time to time in each patient for each lesion. Duration of each session was 30 minutes in average.

No sensation was felt during diode laser irradiation, except a slight feeling of wind or heat.

The sample of the population obtained during period examined was significant for sex and age. All treatment groups were balanced with respect to baseline demographics and previous therapies.

All statistics data were calculated with the use of EpiInfo (statistical analysis software).

Effects of laser irradiation is strictly dose-dependent, a rule that applies to all non-surgical laser.

Laser dosages planned for treatment were below the dosage necessary to cause local burns.

Patients was kept under surveillance in order to avoid potential adverse reactions.

Laser could cause minor local burns (first degree), easily treatable with appropriate medication (antiseptic and laser wound healing stimulation). Allergic reaction to laser could be orticaria syndrome, itching and erythema. All these effects are easily treatable with topic medication (antistaminic drugs).

Follow up was done each month until one year, then every six months.

We enrolled 216 patients of both genders and aged 14-60 years, with traumatic spinal cord and brain injuries, occurred since at least one year before laser treatment.

Our preliminary experience started in 2004.

Standardization of these patients is difficult because each patient is totally different in terms of lesion, loss of sensitivity and degree of inflammation/degeneration.

Since trauma, all patients treated had total or subtotal sensory and motor paralysis under lesion level, clinically classified with ASIA (American Spinal Injuries Association) impairment scale, ASCII scale, EEG (electroencephalogram), NMR (Nuclear Magnetic Resonance), EMG (Electromyography), EPSS (Evoked Somato-Sensory Potentials), ESSP (Evoked Somato-Sensory Potentials) and neuro-physiological tests on spinal cord and brain lesions.

ASIA impairment scale classifies spinal cord injuries in 5 categories, depending on the degree of sensory and motor loss of function, sphincters included.

Further evaluations were done using ISCOS datasets. (www.iscos.org.uk/page.php?content=20 accessed 19 February 2012).

A diode laser 808 nm was used, with fluence 4-12 Joule/cm^2 in average, with a first cycle of 20 sessions, 4 per day. We repeated half cycle per month, for approximately 12 months. We do not know precisely how many cycles do these patients need and what is the end point of their improvement. These aspects will be object of further studies.

Laser which were used on lesions for anti-inflammatory and anti-edema purposes, were an 808 nm laser (Eufoton), 30 W PW, 3 Hz, spot size 5cm, fluence 720 J/cm^2 in total, 12 J/cm^2 for anti-inflammatory goal (Tab. 1); a 10600 nm, 15 W CW laser (General Project), spot size 10 cm, time exposure 20 sec for spot, as a skeletal muscle anti-spasm, not only on the lesion, but also along the nerves in the paralyzed area ; from December 2012, Nd-YAG laser 1064 nm (Aerolase Light-pode Neo), 5 W PW, 1 Hz, pulse duration 0,35 millisec, spot-size 6 mm, fluence 35 J/cm^2 for passage.

Tab 1 - Laser used

	Treatment of Inflammation and Edema	Support of Nerve Regeneration	Muscle Tone	Anti-Inflammatory Muscle Tone
Laser	2 diode 808 nm wavelength	4 diode 808 nm wavelength	CO_2 10,600 nm wavelength	Nd-YAG 1064 nm wavelength
Output power	10 W	10 W	15 W	5 W
Spot size	5 cm	5 cm	10 cm	6 mm
Fluence	12 J/cm^2	4 J/cm2	36 J/cm^2	35 J/cm^2/passage
Total Energy	720 J	240 J		
Wave Form	1000 HZ	10 HZ	Continuous Wave	1 HZ
Tissue Target	Spinal Column	Nerve Trigger points Coherence Domains	Spinal Column area of the lesion	Area of Lesion and adjacent tissue
Sessions per day	4	4	4	3 passages
Sessions per First Cycle	20	20	20	20

Tab 1: parameters of used lasers

First cycle of treatment was composed of 20 sessions, 4 sessions per day, each session of 30 minutes, with minimum interval of two hours between the sessions.

It was possible to computerize laser emissions, and to use more than one laser simultaneously, saving time and discomfort for the patient.

Further monthly cycles were done, with different dosage (Fig. 2). This procedure could add anti-inflammatory with regenerative effects on nervous cells and/or on nerve functions.

All patients came to us with written opinions from orthopedists, physiatrists, neurologists and neurosurgeons, who defined lesions as complete and incurable and advised against any type of treatment and/or physiotherapy.

In fact we continued monthly laser therapy only if we noticed some positive and objective results after the first cycle of treatment. Other causes of interruption of treatments are shown in Fig. 3. Results obtained on patients who underwent laser therapy were evaluated by physiatrists other than the operator, and after first cycle they didn't known if the patients has had laser treatments.

Concerning sensory-motor clinical examination we used standard classifications, such as ASCII, ASIA, Asworth Scales and Franklin modified.

Before and after treatment all patients undergone NMR examination and some also had EMG and ESSP.

Fig 2 - Further monthly cycles

- 4 Diode laser 808 nm, same previous dosage
- CO_2 laser 10600 nm, same previous dosage
- Nd-YAG 1064 nm, same previous dosage
- Energy density variable
- Target Column, trigger points, coherence domains
- Four sessions a day
- Cycle of 8 sessions

Fig. 2: parameters of laser used in further monthly cycles

FIG 3 - INTERRUPTION OF LASER TREATMENT
49 Patients on 209 treated in total

- No Results after 1st cycle — 4 patients
- Less And Slow Results — 18 patients
- Uncorrect Rithme of the Cycles — 15 patients
- Expensive therapy — 9
- Temporary results — 3 patients

Fig. 3: causes of interruption of treatment

Results and discussion

Results are shown in Fig. 4 and Graph. 1.

In patients with spinal lesions at different levels, there was always a recovery in heat and tactile sensitivity as well as pain- and proprio-receptivity below the lesion, although in different extents and at different times, but it was always permanent and never transient.

Normal body thermic regulation was always recovered, if interrupted by the lesion, as normal anal sphincter control and sexual activity in both sexes, including erectile, sensory and ejaculatory functions. Bladder control was restored in women, but never in 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 and regulatory of bladder tone were gradually interrupted in all patients because they became 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, hyper-reflexia, and also fasciculation, in patients whom were restored to almost normal motility.

In any case, all the necessary effective measures were available and ready in case of any possible minor local burn or micro-vessel dilatation.

Appropriate physiotherapy is recommended for voluntary motor functions. Physiotherapists noted that patients undergoing laser therapy have better reactions and strength when doing their exercises and better muscle tone, which never develops into spasms. These results are transient at the outset during the early treatment cycles, lasting for about one month and then become permanent. This is may be dued to an accumulation of radiation or the possibility that patients are better able to do motor exercises or both.

Results were monitored as usual, by Neurologists and Physical Therapists.

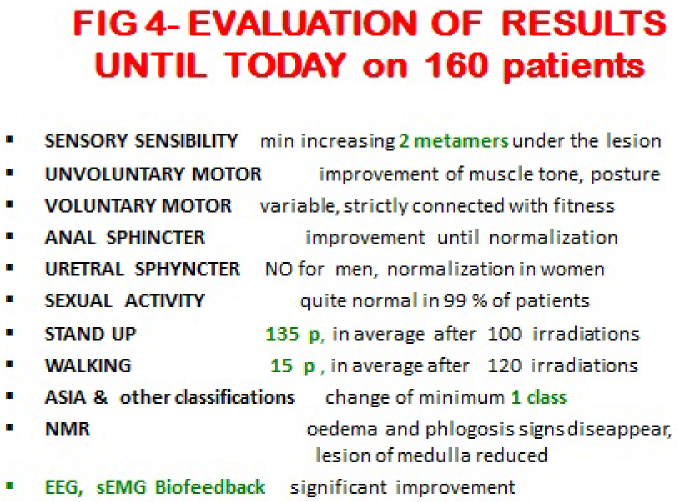
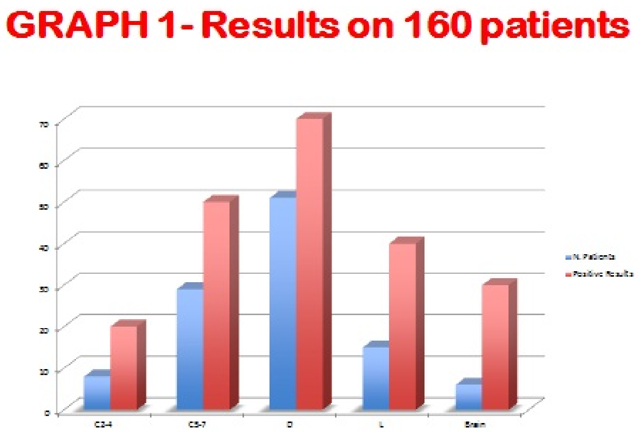


Fig. 4: evaluation of result on 160 patients treated until today



Graph. 1: results on 160 patients

Conclusions

Results obtained demonstrated that lesions still untreatable or inadequately treatable could be improved or totally recovered. The worldwide impact of the study is enormous.

Medical low-density laser stimulation for nervous tissue regeneration has received international and national attention and has been widely applied in the last thirty years. The present research is only a continuation of a long line of experimentation in this field.

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Increased ATP levels in cardiac and sperm cells immediately after broad band visible light illumination

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Abstract

Background: Studies on illuminated cells report immediate ATP increase after illumination with 808nm diode laser.

Purpose: To determine ATP levels in cardiac and sperm cells immediately after **broadband** visible light illumination.

Materials and Methods: Cardiac and sperm cells in glucose free or enriched medium were illuminated with 160 mW/cm^2 white light and ATP was measured 1 and 3min following irradiation. Luciferase reagent from an ATP Bioluminescence Assay Kit was used for determining the ATP concentrations.

Results: ATP levels in cardiac and sperm cells immediately after illumination with white light were found to be slightly higher than control levels. Glucose abolished ATP increase in sperm cells.

Discussion and Conclusions: The small but significant increase in ATP in two different cell types immediately after illumination is consistent with the hypothesis that visible light increases the rate of mitochondrial electron transport.

As sperm cells produce ATP from glucose by glycolysis, in a process unaffected by mitochondrial cytochromes, the finding that sperm cells do not respond to light *in glucose-enriched medium* supports the assumption that the effect of light on ATP levels is mediated by the mitochondrial cytochromes.

Key words: ATP, Broadband visible light, Cardiac cells, Sperm cells

Introduction

Adenosine triphosphate (ATP) is a highly important molecule in biology, which stores energy in the bonds connecting its three phosphate groups. Hydrolysis of these bonds releases considerable energy due to the electrostatic repulsion between the negative charges of the phosphate groups, and increased resonance and hydration in the end products. [1] Enzymes routinely couple ATP hydrolysis to energetically unfavorable reactions in order to create a net favorable reaction.

Most ATP synthesis occurs as a result of oxidative phosphorylation in the mitochondria. Electrons obtained from oxidation of fuel (such as glucose and fat) are transported along a series of enzyme complexes in the mitochondrial membrane, before reducing molecular oxygen to water. This electron transport is coupled to pumping of protons across the membrane, creating a chemical and electric charge gradient. ATP synthase couples return of the protons across the membrane to phosphorylation of adenosine diphosphate (ADP) to create ATP.

The significance of oxidative phosphorylation to photobiomodulation is that not only is it an important process providing most of the cell's energy, but that all the enzymes in electron transport absorb visible light (400-800nm). It is possible that absorption of a photon provides an electron with the energy to overcome an energy barrier at some point. However, such a mechanism would facilitate the transport of only one electron per photon. If excitation alters a protein in some way that allows an increased flux of electrons, a single photon could have a long-lasting effect on transport of many electrons.

If light absorbed by an electron transport enzyme directly increases the rate of electron transport, the effect, if any, would be expected to be an immediate increase in ATP synthesis. Experimental results do not provide a clear picture whether this is the case.

Studies on illuminated cells often report ATP increases well after illumination. Wong-Riley *et al.,* [2] observed an increase in ATP levels days after, but did not observe a change immediately after illumination. Other reports of ATP increases also refer not to immediate effects, but to long-term increases, [3-4] or delayed increases. [5] Some groups have shown illumination limiting the rate of a decrease in ATP levels. [6-7] This ATP increase however, may simply reflect the preservation of cell viability, particularly when no change is observed shortly after illumination, [6-7] and does not really suggest a direct effect on electron transport. On the other hand, Hilf *et al.,* [8] observed a large increase (up to 80%) in ATP during continuous illumination of tumor cells. Recently Lapchak *et al.,* [9] measured an increased cortical ATP content in irradiated rabbits following embolic strokes, Oron et al., [10] and Hamblin *et al.,* [11] reported an increased ATP content in irradiated Neuronal Cells in Culture.

In the present study, we demonstrate broadband visible light induced ATP formation in both sperm and cardiac cells. We chose cardiac cells since low energy photo-irradiation has been found to improve heart preservation for transplantation, [7] and to reduce formation of scar tissue following myocardial infarction in dogs. [12] Regarding sperm cells, previous studies of our group revealed that broadband visible light can enhance the fertilizing capability of sperms and their motility, [13-14] which might be mediated by ATP synthesis.

Materials and Methods

Sperm cells

Sperm cells were obtained from fresh ram semen supplied by the animal facilities at Bar-Ilan University. The semen was diluted 1:1 in Ringer glucose phosphate buffer (RGP), centrifuged twice at 400 g for 15 min and suspended in RGP. For some experiments, the cells were centrifuged again and resuspended in another buffer solution.

Cardiac cells

Cardiac cells were prepared from the hearts of 1-3 day old rats, which were washed three times in phosphate-buffered saline (PBS), minced to small fragments and then agitated in a solution of the proteolytic enzyme RDB (Biological Institute, Ness-Ziona, Israel). Dulbeccos's modified Eagle's medium (DMEM), supplemented with inactivated 10% horse serum and 0.5% chick embryo extract, was added to supernatant suspensions containing dissociated cells. The mixture was centrifuged at 300 g for 5 min. The supernatant phase was discarded, and the cells were resuspended in the same medium. The suspension of the cells was diluted to10^6 cells/mL, and placed in culture dishes coated with gelatin/collagen. 10 mL of the suspension was placed in 100 mm dishes, and 1.5 mL in 35 mm dishes. The cultures were incubated in a humidified atmosphere of 5% CO_2, 95% air at 37 °C. Confluent monolayers exhibiting spontaneous contractions developed in culture within 2 days. The cells were experimented on after being grown for 4-7 days in culture.

Suspensions of cardiac cells were prepared by rinsing the cells three times with PBS shortly before an experiment, and scraping them off the culture dishes into a PBS solution. For some experiments, the cells were scraped off into a solution of PBS with 2 mM glucose.

ATP assay

For sperm cells, 100 µL of cell suspension was illuminated for 1 or 3 min or placed in the dark for a corresponding length of time as a control. The sample was then immediately transferred to 900 µL Tris/EDTA buffer that was pre-heated to 100^{o}C. After 2 min at 100^{o}C, samples were kept in ice, and then centrifuged for 1 min at 13,000 g. 50 µL of supernatant was mixed in wells of a 96-well dish with 50 µL of luciferase reagent from an ATP Bioluminescence Assay Kit, and the resulting luminescence was read by an ELISA spectrometer. ATP in cardiac cells was measured in the same way, except that 50 µL of cell suspension was illuminated and added to 450 µL of pre-heated Tris/EDTA buffer.

The results of each experiment were normalized relative to the average control value for that experiment, which was defined as 100%. The results of several experiments were pooled. Statistical significance was calculated by a 1-tailed 2-sample Student's t-test.

Light source

A homemade broadband (400-800nm) halogen lamp with appropriate filters was used in this work. The emission spectrum of the light device is presented in Fig. 1.

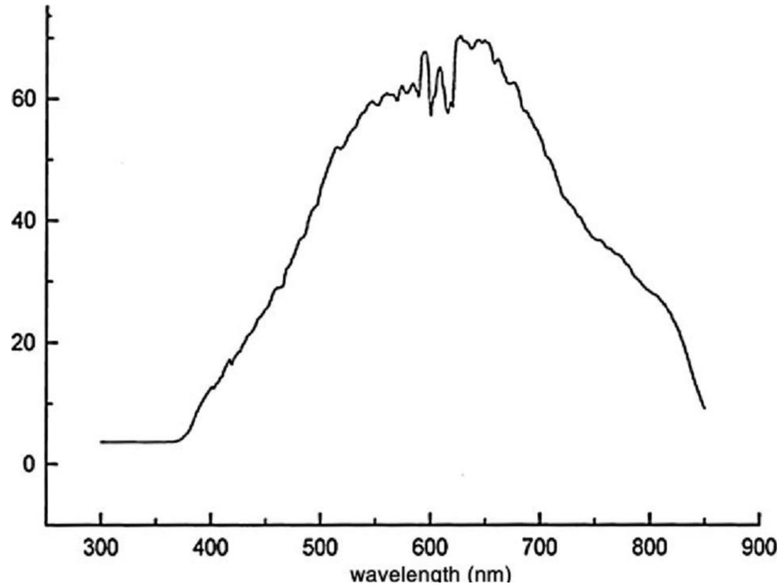

Figure1*: Emission spectrum of the lamp, intensity expressed in arbitrary units.*

Results and Discussion

3.1 Cardiac cells

ATP in cardiac cells after 1 min of 160 mW/cm^2 white light

ATP levels in cardiac cells immediately after 1 min illumination with 160 mW/cm^2 white light were found to be higher than control levels (fig.2). The ATP concentration in illuminated samples was 8.6% higher than the concentration in the control. The data were collected from 44 illuminated samples and 48 control samples, providing a highly significant P = 0.0048.

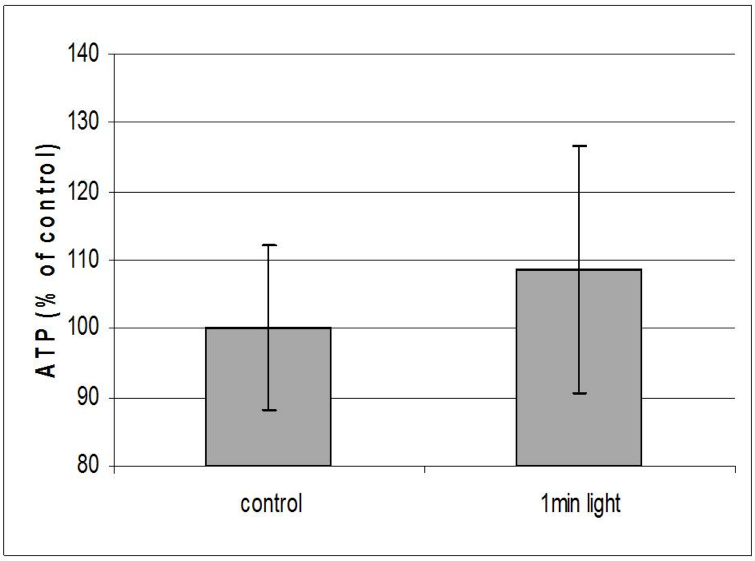

Figure 2: ATP in cardiac cells immediately after 1 min 160 mW/cm^2 white light. *ATP in illuminated cells was 108.6±18.0 % versus 100±12.0% in control. P=0.0048 (For control, n=48, for 1 min light, n=44)*

ATP after 1 and 3 min of 160 mW/cm^2 white light

ATP levels immediately after 1 or 3 min illumination were compared (fig.3). Only data from experiments measuring both illumination times are shown. Included are the data from 11 control samples, 9 samples illuminated for 1 min, and 7 samples illuminated for 3 min. For both illumination times, ATP rose significantly (P<0.05).

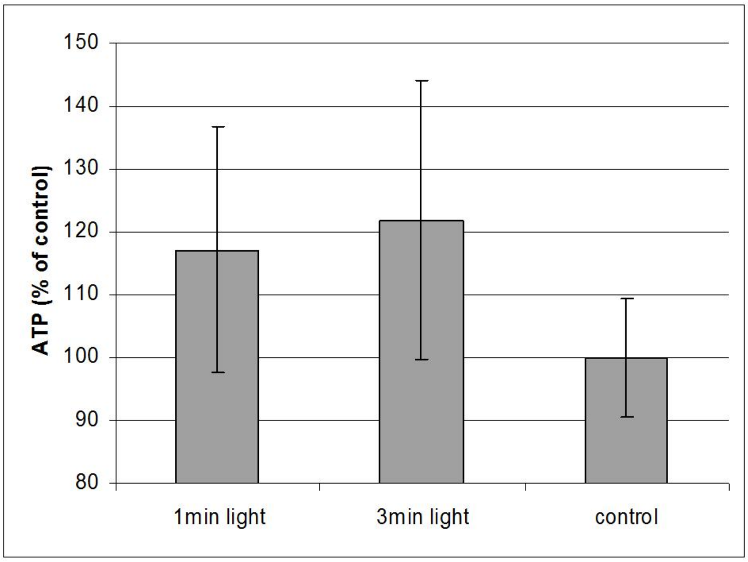

Figure 3: ATP in cardiac cells immediately after 160 mW/cm^2 white light. *ATP was 117.2±19.6% after 1 min light and 121.9±22.2% after 3 min light, versus 100±9.4% in control. P=0.017 for 1 min, P=0.020 for 3 min (For control, n=11; for 1 min light, n=9; for 3 min light, n=7)*

3.2 Sperm cells

ATP in sperm cells in glucose-free medium following 160 mW/cm^2 white light

Sperm cells were rinsed three times in PBS to remove glucose from the solution and suspended in PBS at a concentration of 10^8 cells/mL. The cells were then illuminated for 1 min and 3 min, and the ATP levels immediately afterwards were measured (fig.4). After 1 min illumination, ATP concentrations rose by 8.7% over control concentrations. This increase was statistically significant (P=0.0089). After 3 min, ATP concentrations were lower than control concentrations, but this decrease was not statistically significant.

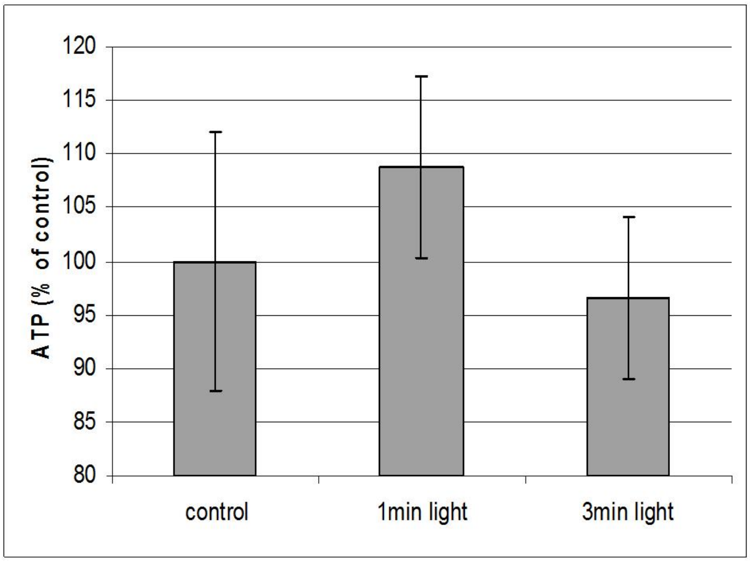

Figure 4: ATP in sperm cells immediately after 160 mW/cm^2 white light in glucose-free PBS. *ATP was 108.7±8.5% after 1 min light and 96.5±7.6% after 3 min light, versus 100±12.0% in control. P=0.0089 for 1 min light (For control, n=18, for 1 min light, n=18, for 3 min light, n=14)*

ATP in sperm cells in glucose-enriched medium following 160 mW/cm^2 white light

Sperm cells were rinsed three times in PBS and suspended in PBS with 5 mM glucose at a concentration of10^8 cells/mL. The cells were then illuminating for 1 or 3 min, and the ATP levels immediately afterwards were measured. Illumination had no statistically significant effect on ATP concentrations immediately following illumination (fig.5).

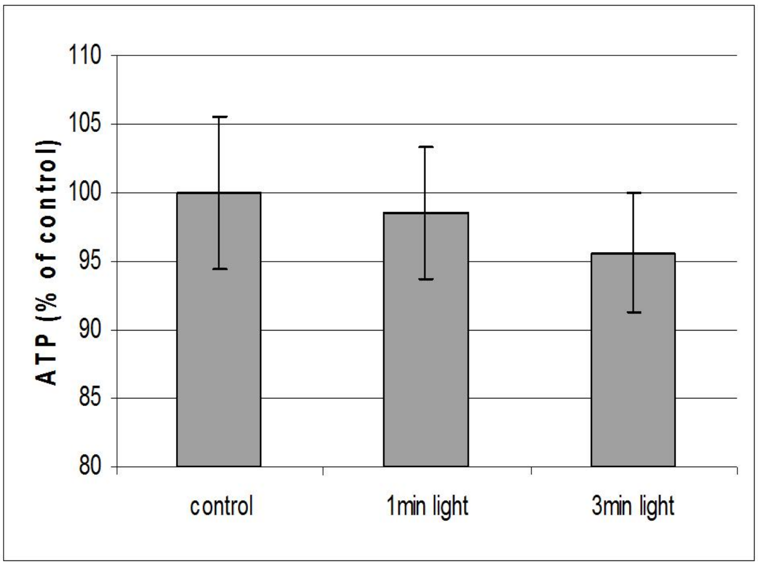

Figure 5: ATP in sperm cells immediately after 160 mW/cm^2 white light in PBS + 5 mM glucose. *ATP was 98.5±4.8% after 1 min light and 95.6±4.4% after 3 min light, versus 100±5.6% in control. Differences are not statistically significant. (For control, n=9, for 1 min light, n=7, for 3 min light, n=7)*

3.3 Discussion

The small but significant increase in ATP in two different cell types immediately after illumination is consistent with the hypothesis that visible light increases the rate of mitochondrial electron transport. These results support those of previously published reports. [8, 15] However, to our knowledge, only Hilf *et al.,* [8] have reported increased ATP immediately following illumination but in tumor cells. If visible light raises ATP synthesis by directly affecting mitochondrial cytochromes, the increase in ATP would be expected to be immediate.

The small degree of the ATP increase may be explained by the fact that ATP must be synthesized from ADP. Because the cellular concentration of ADP is normally much smaller than that of ATP, ATP concentrations can increase only slightly. [16-17] In fact, the results of Hilf *et al.,* [8] that show large increases in ATP indicate that the cellular ATP levels are abnormally low, perhaps because they used tumor cells. However, a small increase in ATP may entail a large change in ADP concentrations and the ATP/ADP ratio, which may have a significant effect on some enzyme systems, such as calcium signaling. [18-19]

The finding that sperm cells respond to light in the absence of glucose, but not in its presence provides an explanation of the problem posed by Corral-Baques *et al.* . [20] They noted that sperm cells produce ATP by glycolysis, not in the mitochondria, therefore visible light can not affect ATP levels by being absorbed by mitochondrial cytochromes. The present results suggest that visible light increases ATP levels *only* when sperm cells can not produce ATP by glycolysis. In the absence of glucose, sperm cells must oxidatively metabolize their own lipids in order to produce ATP, and this oxidative metabolism involves the mitochondrial cytochromes.

Summary

The immediate increase in ATP levels in both cardiac and sperm cells supports the hypothesis that photobiomodulation is a result of increased mitochondrial electron transport. In addition, glucose abolishes this increase in sperm cells, suggesting that light does not affect the cells' ATP levels when ATP is synthesized by a non-mitochondrial pathway (i.e. glycolysis).

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Lasers for Treatment of Scars

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Abstract

More than 70 million surgical procedures are performed annually in the US with the majority involving a skin incision. Almost all individuals in their lifetime will have one or more surgical procedures resulting in scars. Patients and surgeons alike are motivated to influence the scarring process and ultimately improve scar cosmesis. Several treatment modalities have been utilized to either alter the scarring process or improve the appearance of well-established scars. Most interventions achieve modest results at best leaving much to be desired in current scar treatment options. To this end, lasers have been utilized with great success in several types of scars, including hypertrophic, keloidal, and burn scars, among others.

Lasers have also been widely and successfully used in the treatment of vascular lesions such as port-wine stains, hemangiomas, and telangiectasias among others.

This section will discuss the use of several different laser and light systems, both ablative and non-ablative for the treatment of scars and vascular lesions. Specifically, an in-depth discussion of the use of the pulsed-dye laser (PDL) for surgical scar prevention will be included. Moreover, a special focus on the principles of fractional photothermolysis as they apply to scar remodeling and future scar therapies will be addressed. The types of lasers in treating vascular lesions and their individual indications will also be discussed.

Keywords: lasers, scars, keloids, pulsed dye laser

Introduction

More than 70 million surgical procedures are performed annually in the US with the majority involving a skin incision [1]. Almost all individuals in their lifetime will have one or moresurgical procedures resulting in scars. Patients and surgeons alike are motivated to influence the scarring process. Current treatments for scars include surgery/grafting, dermabrasion, cryotherapy, pressure therapy, intralesional corticosteroids, interferon, imiquimod, intralesional 5-fluorouracil, along with lasers.

The lasers studied in the treatment of scars include the CO_2, argon, Nd:YAG, non-ablative, pulsed dye, and fractional lasers.

The pulsed dye laser (PDL) has emerged as a successful alternative to excision in patients with hypertrophic burn scars [2]. Multiple studies have shown its ability to decrease scar erythema and thickness while significantly decreasing pruritus and improving the cosmetic appearance of the scar. The PDL should become an integral part of the management of burn scarring and will significantly decrease the need for excisional surgery.

The PDL laser has been reported to be efficacious for treatment of hypertrophic scars and keloids [3-5]. In one study, ten keloidal or hypertrophic median sternotomy scars were chosen, and three segments of each scar were randomly treated with 585 nm PDL (450 µsec), 5 mm spot size, fluence of 3, 5, and 7 J/cm², for six sessions at 4 week intervals [6]. The study reported evident improvement (in height, erythema, pliability) of scars after PDL treatment. There was no significant difference in outcome with variations in fluence, but a trend for better results with lower fluence was seen. The study suggested multiple sessions for greater response. In an uncontrolled study, McGraw et al. also showed the benefit of early PDL use on surgical scars [7].

One study treated 12 postoperative linear scars with PDL [8]; scars were randomly divided into two equal parts: either PDL 585 nm treatment site (10mm spot size and 3.5 Joules) or control (no treatment). Three treatments, at monthly intervals, were done starting on suture removal day. Final scar analysis by a blinded examiner revealed a significant difference between treated and untreated sites. Treated halves scored better in all scar parameters in the Vancouver Scar Scale (VSS) and in cosmetic appearance.

585nm vs. 595nm PDL

Nouri et al. conducted a study to compare the efficacy of 585 nm vs. 595 nm PDL in the treatment of surgical scars starting on suture removal day [9]. Nineteen scars from 14 patients (skin types I-IV), males and females (age range between 18-85 years) with postoperative linear scars greater than 3 cm were enrolled in the study. The scar was divided into 3 equal parts. The middle section was always designated the control (no treatment). The outer sections were randomized into either PDL 585 nm or 595 nm treatment site (10mm spot size and 3.5 J/cm²).

Scars were later evaluated by a blinded examiner using the VSS for pigmentation, vascularity, pliability and height. Scars were also blindly examined for cosmetic appearance using a cosmetic visual analog scale; a blinded observer and the patient evaluated the cosmetic appearance of all three sections of the scar with a scale of 0-10.

One month after the last treatment, final scar analysis revealed a significant difference between treated and untreated sites favoring the treated sites. The 585nm and 595nm treated sections demonstrated an overall average improvement of the VSS of 67% and 55%, respectively, compared to 32% for the control site. There was a statistically significant difference between 585 nm treated sites vs. control but there was no significant difference between the 585 and 595nm treated sites ($p>0.05$). This study demonstrated that the PDL is safe and effective in improving the quality and cosmetic appearance of surgical scars in skin types I-IV starting on the day of suture removal. Moreover, both 585 and 595 nm resulted in scar improvement, but there was a trend towards 585 nm.

Comparison of Pulse Durations with 585nm PDL

Nouri et al. conducted a follow-up study to compare different pulse durations when using the 585nm PDL in the treatment of surgical scars starting on suture removal day [10].

Twenty scars from 17 patients (skin types I-IV), males and females (age range between 18-85 years), with postoperative linear scars greater than 2.1 cm were enrolled in the study. The scar was divided into 3 equal parts. The three sections were randomly assigned to either treatment or control sites. The three section were randomly assigned to receive either short-pulse (450 µsec) PDL 585nm 7mm spot size and 4.0 J/cm², long-pulse (1.5 msec) PDL 585 nm 7mm spot size and 4.0 J/cm², or no treatment (control).

One month after the last treatment, final scar analysis revealed a significant difference between treated and untreated sites favoring the treated sites. The short-pulse and long-pulse 585nm PDL treated sections demonstrated an overall average improvement of the VSS of 92% and 89% respectively, compared to 67% for the control site. There was a statistically significant difference between short and long-pulse PDL treated sites vs. control, but there was no significant difference between the short-pulse and long-pulse PDL treated sites ($p>0.05$). The study showed that both short- and long-pulse 585nm PDL resulted in scar improvement, with no difference in outcome between the two pulse durations.

Fractional Photothermolysis (FP)

Fractional lasers, which operate by producing ablated vertical columns within the epidermis known as Microscopic Treatment Zones. Fractional lasers have many indications including facial and nonfacial photodamage, atrophic acne scars, hypopigmented scars, and dyspigmentation.

Non-ablative FP

Alster et al. treated mild to moderate atrophic facial scars in fifty- three patients (skin phototypes I-V) with monthly treatment with non-ablative 1550 nm erbium-doped fiber laser (Fraxel, Reliant Technologies Inc., San Diego, CA) [11]. Clinical response at each treatment visit and at six months after final treatment was evaluated. Clinical improvement averaged 51% to 75% in nearly 90% of patients after three monthly laser treatments. Mean improvement scores increased proportionately with each successive laser session. This study demonstrated that fractional skin resurfacing is safe and effective for atrophic scars.

In a prospective clinical study, Pham et al. treated 13 adults (skin types I-III and facial surgical scars with a postoperative duration longer than 6 months) with 1550-nm nonablative laser once every 4 weeks for a total of 4 treatments [12]. Preliminary data suggest improved aesthetic results, demonstrating the potential use of fractional photothermolysis as a scar revision technique. Future studies with a longer follow-up period could elucidate the role of fractional photothermolysis in more permanent scar improvements.

Fractional resurfacing is also a potentially effective modality for the treatment of hypopigmented scarring on the face. Glaich et al treated 7 patients with hypopigmented scars on the face with 2-4 successive treatments at 4-week intervals with 1550nm Fraxel SR laser (7-20mJ and total density of 1000-2500MTZs/cm^2) [13]. Digital photographs were taken before each treatment and 4 weeks after the last treatment. Independent physician assessments were performed revealing 51-75% improvement in hypopigmentation in 6 out of 7 patients. Clinical improvements were noticed in overall texture of the skin. Patients' degree of satisfaction paralleled physician assessment of improvement.

FP may be effective in treating strtiae distensae as well, especially in patients with white striae. Bak et al. treated 22 women with striae distensae with 2 sessions each of FP at a pulse energy of 30mJ, a density level of 6, and eight passes at intervals of 4 weeks [14]. Assessment was made by means of pre- and post-treatment clinical photographs and skin biopsy. 6 of 22 patients (27%) showed good to excellent clinical improvement, while another 16 showed various degrees of improvement. Most lesions with excellent results were white in color and of long duration. Skin biopsy revealed that average epidermal and dermal thickness were greater than at baseline. Immunoreactivity of procollagen-1 increased after treatment. No significant adverse effects were noted.

Ablative vs. Non-ablative FP

Kim et al. conducted a split-face study for evaluating the effectiveness and safety of concomitant use of Ablative Fractional Resurfacing (AFR) laser and Non-ablative Resurfacing (NAR) Laser for treatment of acne scars [15]. They treated a series of 20 patients (skin phototypes-IV-V) with mild to moderate acne scars. Patients were randomly divided into two groups that received three successive monthly treatments. Patients were treated and evaluated using clinical assessment and digital photography at 4 week intervals for a total of 3 treatments and 3 months after completion of final treatment. Although the use of AFR laser with high energy resulted in an improvement in acne scars, the combination of AFR and NAR laser yielded the best results with fewer complications.

Leet et al. treated thirty non-hypertrophic (surgical, post-herpetic, post-traumatic) facial scars in 24 Asian patients (skin phototypes III-IV) with ablative lasers (pulsed CO_2 and Er:YAG) followed by fractional (1550nm) laser and non-ablative (1450nm) laser alternatively every 2-3weeks [16]. Thirty-one pairs of pre- and post-treatment photographs were evaluated independently by three dermatologists and two plastic surgeons on a scale of 0-100% improvement. Evaluators rated an average improvement of 86.8%. 10 out of 31 pairs of photographs were rated 100%. With appropriate combinations of different lasers, complete or near-complete resolution can be expected in many types of scars.

Non-ablative Fractional Laser vs. PDL

Tierney et al. reported a randomized blinded split-scar study involving fifteen scars (scar age minimum of 2 months) in 12 patients [17]. Patients were treated on half of the scar with a 1,550-nm NAFL and on the contralateral half with the 595 nm PDL. After a series of four treatments at 2-week intervals, greater improvements were noted in the portion of surgical scars treated with NAFL. These data support the use of NAFL as a highly effective treatment modality for surgical scars, with greater improvement in scar appearance than with PDL.

Ablative Fractional Laser vs. PDL

Nacer compared the efficacy of a CO_2 fractional ablative laser with a V-beam PDL in 11 patients with surgical scars [18]. All patients were a minimum of 2 months status-post surgery at the time of treatment. Split lesion study design with a non-treating physician evaluator using the Vancouver scar scale. After 4 treatments at 1 month intervals no significant difference in scar improvement was noted between the two lasers.

Ablative Fractional Laser for Scars

Van Drooge et al. conducted a randomized, controlled, split lesion, single-blinded study using the ablative fractional CO_2 laser for various types of scars (hypertrophic and atrophic secondary to surgery, acne, burns, or miscellaneous) [19]. 21 total patients completed 3 treatments at 8-week intervals (scar age ≥ 1 year). The Physician Global Assessment (PhGA) at 6 months follow-up revealed: 25-50% improvement in 6/21 (24%) and > 50% improvement in 1/21 (4%) patients.

Adverse events included ulcer formation (n=3), persistent erythema (n = 14), and hyperpigmentation (n=8). This trial could not confirm the efficacy of the fractional ablative CO_2 laser, but the authors believe that different scars may respond differently to treatment and therefore further studies are warranted.

Fractional Laser Assisted Drug Delivery

Waibel et al. treated 20 patients with corticosteroids OR 5-fluorouracil immediately after fractional ablative CO_2 laser treatment [20]. Energy settings were constant for each of 3 treatment sessions delivered at 1 month intervals. Primary endpoints were caliper measurement of the scar and photographic improvement assessed by independent evaluators at 3 months follow-up. Average decrease in scar height of 0.415mm and average decrease in scar length of 0.455mm was reported. While both corticosteroids and laser-assisted 5-FU delivery resulted in improvement of hypertrophic and keloid scars, no statistical difference was discovered between the the two groups; however, the laser/5-FU group reported fewer adverse effects.

Conclusions

FP is being used in both ablative and non-ablative fashion. It has been used for treatment of atrophic acnes scars, hypertrophic scars, hypopimented scars, burn/traumatic scars, surgical scars, and striae distensae with varying success. Studies are underway to demonstrate the use of FP for improvement of surgical scars.

Lasers can be used for treatment of scars. The most common lasers that have been used for this purpose have included PDL and fractional lasers, both ablative and non-ablative. The combination of medications along with fractional lasers for improvement of scars has also been reported. Further studies are warranted to corroborate these results and further uses.

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IALMS NEWSLETTER - December 2013

Report on Laser Florence 2013

A. Baruchin, MD, PhD, Rapporteur, Askelon University, Israel

Laser Florence 2013 meeting was characterized by the presence of many young medical students, doctors, researchers and various healthcare professionals. Laser Florence, once again brought together international group of delegates despite difficult economic and financial times in Europe and elsewhere, to discuss pertinent and topical issues surrounding the laser world in a two-day conference in Florence during 9th-10th November 2013.

The exceptional meeting offered a rare opportunity to intermingle the scientific world of laser technology, delegates from 40 countries who delivered more than 100 Lectures .The meeting offered a rare opportunity to have a glimpse into some interesting but little-discussed aspects of laser medicine related to Eastern & Western thoughts.

The project was made possible thanks to the generous support of the World Health academy. More than 150 attendants came from 36 countries including least developed countries.

The traditional Italian hospitality and kindness coupled with 27 years experience of the Laser Florence meetings, helped to create the proper atmosphere for scientific discussions, to renewal of old friendship and establishing new ones.

Less emphasis was given to commercial and advertisement by laser manufacturers due to legal restrictions and for conflict of interests reasons

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The main themes of the meeting were as follows:

1. Laser Therapy of stem cells
2. Laser Therapy of traumatic and degenerative spinal cord injuries, including paraplegia, tetraplegia, brain injuries.
3. Laser Therapy of female infertility.
4. Laser surgery of arterial and vein
5. Aesthetic & Dermatologic laser medicine and surgery.
6. Laser Dentistry: state of the art
7. Photodynamic diagnosis and therapy

Juanita Andres from Bethesda University (USA) reviewed the pathway and evolution of laser treatment of stem cells in severe cases of spinal cord injuries , starting with the Leonardo Longo's proposed experimental protocol in 2000, through laboratory experiments in 2005 and final results in 216 SCI patients. After 10 years of research the results are: 16 walking patients, 135 patients are standing upright and have various degrees of movements with aid ,the rest of the patients regained several activities below injury level e.g. anal sphincter function, sexual activity. Sensibility and muscle response to stimuli. Nowadays, the EMG Biofeedback devices offer a technologically advanced yet cost effective range of EMG display and data capture systems offering both full portability and real time display and analysis options.

Klaus Fritz (Germany) and George Sorin Tiplica (Rumania) have demonstrated the beneficial effects of Cryoneuroablation (also known as cryoanalgesia or Cryoneurolysis) as treatment with Long-lasting solution for dynamic facial lines e.g. : eye bags, sagging skin, wrinkles and nasolabial folds. The authors claim that the results last for about 4 months with no nerve damages.

Some promising results using new laser devices & technology have been communicated as well: the new 355 nm laser for treatment of vitiligo psoriasis ,alopecia areata & scleroderma , Angelo Massimilliano D'Erme & Torello Lotti (Italy), Rosacea ,E.Moroz (Ukraine)

The detailed program of the meeting is shown below:

(The awarded lectures and posters are highlighted in yellow)

LASER FLORENCE 2013 - PROGRAM AT-A-GLANCE

LASER DENTISTRY

Room A – November 9th, 2013

Chairpersons: C. Fornaini, J-P Rocca, S. Svanberg

9:00	**LASER SPECTROSCOPY APPLIED TO MEDICINE, FOOD SAFETY, AND ECOLOGY**	**Sune Svanberg** Department of Physics, Lund University, Lund - Sweden
9:15	**CLINICAL APPLICATIONS OF LASER THERAPY BASED ON TRANSLATIONAL PRECLINICAL DENTAL RESEARCH**	**A. L. B. Pinheiro , L. G. P. Soares** Center of Biophotonics, School of Dentistry, Federal University of Bahia, Salvador, BA, Brazil
9:30	**MULTIWAVELENGHT DIODE LASER : PRELIMINARY CLINICAL OBSERVATIONS**	**Rocca JP, Fornaini C.** UFR Odontologie. Univ. Nice Sophia Antipolis
9 :45	**OZONE VS TECHNICAL STANDARD IN THE TREATMENT OF NECROTIC ROOT CANAL STUDY IN VIVO**	**Raphael Sanchez-Chacón JR,** Unidad de Especialidades Odontológicas, Mexican Army Mexico D.F.
10 :00	**THE CHOICE OF THE PROPER WAVELENGHT IN THE SOFT TISSUES ORAL SURGERY: "IN VITRO" AND "IN VIVO" STUDY.**	**E. Merigo** Ambulatorio di Patologia e Chirurgia Orale Laser Dental School - EMDOLA (European Master Degree in Oral Laser Applications) - Università degli Studi di Parma, Italy
10 :15	**USE OF SCANNER HANDPIECE ER:YAG LASER IN ORTHODONTICS AND CONSERVATIVE DENTISTRY**	**Fornaini C** Dental School, University of Parma

10 :30	COFFEE-BREAK	
Chairpersons: A.L.B. Pinheiro, M. Rashkova, K. Svanberg		
10 :45	LLLT EFFICACY EVALUATION IN SWELLING AND PAIN CONTROL AFTER THE EXTRACTION OF LOWER IMPACTED THIRD MOLARS: "IN VIVO" STUDY	**Margalit Meirav, Ricotti E, Merigo E, Fornaini C, Meleti M, Manfredi M, Vescovi P** European Master Degree on Oral Laser Application (EMDOLA) - University of Parma – Italy
11 :00	LASER IN OTOLARYNGOLOGY 35 YEARS OF EXPERIENCE AND FUTURE POSSIBILITIES OF THE RESEARCH AND ON THE FIELD	**G. Bastianelli, MD, L. Longo[1], MD, C. Cavicchi, MD, A. Alweis, Ph, D. Bellomo, PhD** Centro Oncologico Fiorentino Villa Ragionieri, Firenze [1]Institute Laser Medicine, Firenze
11 :30	SINERGY LIGHT/COLOR IN THE PHOTODYNAMIC THERAPY: "IN VITRO" STUDY	**Parisi A, Pedicchio F, Merigo E, Fornaini C, Conti S, Ciociola T, Lagori G, Meleti M, Manfredi M, Vescovi P** European Master Degree on Oral Laser Application (EMDOLA) – University of Parma -Italy
11 :45	ROLE OF THE LASER IN THE SPECIAL CARE DENTISTRY: A CLINICAL OVERVIEW	**Oppici A, Fornaini C, Fontana M, Merigo E and Clini F** Odontostomatology Unit "Special Cares and Special Projects" "Guglielmo da Saliceto" Hospital – Piacenza (Italy)
12 :00	LASER VS. QUANTIC MOLECULAR RESONANCE SURGERY OF ORAL LEUKOPLAKIA: HISTOMORPHOMETRICAL COMPARED ANALYSIS OF SURGICAL MARGINS	**Barbieri C, Monteiro L, Meleti M, Merigo E, Manfredi M, Fornaini C, Vescovi P** Institute: University of Parma – European Master Degree on Oral Laser Applications
12 :15	A SELECTIVE ER-YAG LASER EXCAVATION CONTROLLED BY FLUORESCENCE- IN VIVO STUDY	**Zhegova Galia[1], Rashkova Maya[2] , Mitova Nadia[3]** [1]Assistant professor, Medical University of Sofia, Faculty of Dental Medicine, Dept of Pediatric Dentistry; [2]PhD Professor, Medical University of Sofia, Faculty of Dental Medicine, Dept of Pediatric Dentistry; [3]Assistant professor; Medical University of Sofia, Faculty of Dental Medicine, Department of Pediatric Dentistry
12 :45	APPLICATIONS OF LASER SPECTROSCOPY TO MEET CHALLENGES IN MEDICINE	**Katarina Svanberg, MD, PhD** Dept of Oncology, Lund University Hospital, Lund, Sweden
13 :30	LIGHT - LUNCH	

BASIC SCIENCE AND LASER PHYSICS

Room B – November 9th , 2013

Chairpersons: A. Goren, M. Pascu, J. Vaitkus

9:00	OVERVIEW ON THE INTERACTION BETWEEN MEDICINES EXPOSED TO LASER RADIATION AND MATERIALS OF MEDICAL INTEREST	**M.L. Pascu[1,2], Agota Simon[1,2], Victoria Dutsch[3], Tatiana Alexandru[1,2], V. Nastasa[1], M. Boni[1,2], Andra Dinache[1,2], Ruxandra Angela Pirvulescu[4]** [1]National Inst. for Laser, Plasma and Radiation Physics, Bucharest [2] Physics Faculty, University of Bucharest, Romania [3] Faculty for Engineering Technology, Univ. of Twente, Enschede, NL [4]Faculty of Medicine, University of Medicine and Pharmacy "Carol Davila", Bucharest, Romania
9:15	LASER METHODS IN GENERATING ANTI-INFECTIVE EFFECTS OF NON-ANTIBIOTICS	**M.L. Pascu[1,2], I.R. Andrei[1], Adriana Smarandache[1], Andra Dinache[1,2], Tatiana Alexandru[1,2], M. Boni[1,2], Angela Staicu[1], Ruxandra Angela Pirvulescu[3]** [1]National Inst. for Laser, Plasma and Radiation Physics, Bucharest, Romania [2] Physics Faculty, University of Bucharest, Romania [3]Faculty of Med., Univ. of Med. Pharmacy "Carol Davila", Bucharest, Romania
9:30	THE INFLUENCE OF LASER ON THE MECHANICAL PROPERTIES	**M. Kucharova[1], V. Navratil[2], L. Navratil[2], P. Klemera[1], S. Doubal[1], Y. Efremova[1]** [1]Charles University in Prague, Faculty of Pharmacy in Hradec Kralove, Czech Republic [2]Czech Technical University in Prague, Faculty of Biomedical Engineering in

		Kladno, Czech Republic
9:45	HIGH TECH BIODEGRADABLE NANOVECTORS IMPROVE DELIVERY OF SELECTED ANTIOXIDANTS TO TARGET CELLS	**Jacopo Lotti*, Victoria Barygina, Silvia Misuraca, Francesco Lotti** & Torello Lotti** *Dept. of Nuclear , Sub-Nuclear and Radiation Physics. University of Rome "G.Marconi" , Rome - Italy **Dept. of Clinical Physiopathology , University of Florence , Florence - Italy Dermatology Chair , University of Rome "G. Marconi"
10:00	NON CONTACT ASSESSMENT OF VITAL SIGNS: LDV vs IMAGE-BASED	**L. Scalise, N. Bernacchia, P. Marchionni, I. Ercoli, E.P. Tomasini** DIISM - Univ. Politecnica delle Marche, Ancona, Italy AWARD AND GRANT OFFERED BY THE LIONS CLUB FIRENZE STIBBERT
10:15	LASER SURGERY IN G.I. TRACT	**S. Rau** Chennai University, India
10:30	FLUORESCENCE DIAGNOSTICS *IN VIVO* AND *IN VITRO* COMPARISON ON CERVIX UTERI	**A.Vaitkuviene[1], K.Svanberg[2]** [1]Vilnius University, Lithuania [2]Dept of Oncology, Lund University Hospital, Lund, Sweden
10:45	LASER SAFETY: KEYS TO COMPLIANCE	**Penny J. Smalley RN, CMLSO** Technology Concepts International, Chicago, Illinois, USA
11:00	ASSESSMENT OF APPLE OPTICAL PROPERTIES USING THE SPATIALLY RESOLVED SPECTROSCOPY LASER METHOD	**M.L. Askoura [1,2*], V. Piron [1,2], E. Madieta[a] and J-P. L'Huillier[2]** [1]Groupe ESA, Angers, France [2]ENSAM Arts et Métiers ParisTech
11:15	COFFEE BREAK	

November 9th, 2013
ROOM A *13:00 -14.00* - *TALK POSTER SESSION*
Chairpersons: J. Hercogova, T. Lotti, M. Postiglione, A. Tataru, A. Vaitkuviene

1	BURNING MOUTH SYNDROME BEFORE AND AFTER TREATMENT WITH LOW LEVEL LASER THERAPY	**Pezelj-Ribarić Sonja, Peršić Romana, Muhvić Urek Miranda, Glažar Irena, Brekalo Pr** Braće Branchetta , Rijeka - HR
2	INFLUENCE OF MEDIUM CONDITIONED BY ROOTS TREATED WITH LASER	**C. Andreotti Damante,P S B H Karam, R C Oliveira, S L A Greghi, M L R Rezende, AC** Bauru School of Dentistry - University of São Paulo
3	MODIFICATION OF RADIATION DAMAGE TO BIOLOGICAL OBJECTS BY LASING	**K.S. Voskanyan, G.V. Mitsyn, V.N. Gaevsky, S.V. Shvidky** *Joint Institute for Nuclear Research, Dubna, Russia*
4	RAMAN AND CARS MICROSCOPY FOR BIOMEDICAL APPLICATIONS	**Grigory Arzumanyan, V. Vartic, K. Voskanyan** Joiliot-Curie, 6 – Dubna 141980, Russia
5	THE EFFICACY OF LOW LEVEL LASER THERAPY IN KNEE OSTEORTHRITIS	**Abdullah Al Rashoud, PhSt, R.J. Abboud, W. Wang, C. Wigderowitz -** Department of Orthopaedic and Trauma Surgery, College of Medicine, Dundee - UK
6	LASER ASSISTED LIPOLYSIS - A NEW TREATMENT IN AXILLARY HYPERHIDROSIS	**A.Tataru, A.Avram**
7	A COMPARATIVE STUDY ON EFFICACY OF 308NM-EXCIMER LASER VS. TACROLIMUS IN THE TREATMENT OF PROGRESSIVE VITILIGO ON FACE OR NECK	**Yan Wu, Li Qiu, Hong-Duo Chen, Xing-Hua Gao** Department of Dermatology, No.1 Hospital of China Medical University, Shenyang, China SCHOLARSHIP
8	EVALUATION OF THE EFFECT OF SUBLATIVE FRACTIONATED RADIOFREQUENCY (E-MATRIX , SYNERON) IN COMBINATION WITH ELOS-TECHNOLOGY(SRA) ON THE IMPROVEMENT OF STRIAE	**Avierina Vladliena[1], Elena Moroz[3]** [1]Feofania Clinic, Kiev, Ukraine [3]Oxford Medical, Ukraine SCHOLARSHIP

9	CARBON DIOXIDE LASER IN THE TREATMENT OF GENITAL WARTS	S. Gianfaldoni[1], R. Gianfaldoni[1], T. Lotti[2] [1]Dept of Dermatology, University of Pisa, Italy [2]Professor and chair of Dermatology University of Rome G. Marconi
10	EFFECTS ON PERMANENT HAIR REMOVAL WITH LASERS	Koçinaj A[1], Fida M[2], Ferizi M[1], Koraçi A[2] [1]University of Prishtina, Prishtina, Kosovo [2]University of Tirana, Tirana, Albania
11	DIFFERENT TREATMENT APPROACHES WITH ERBIUM LASER	Koçinaj A1, Fida M2, Koraçi A2 1University of Prishtina, Prishtina, Kosovo 2University of Tirana, Tirana, Albania
12	LASER IN MELASMA	Amin Amer, Mohamed Amer Dermatology and Venereology,zagazig University Cairo - Egypt
13	EFFICACY OF TOPICAL 35% TRI-CHLOROACETIC ACID IN THE TREATEMENT OF POST-ACNIS SCARS	Feroza Fatima Abbasi Shaheed Hospital, Karachi, Pakistan
14	FRACTIONAL CO2 LASER VERSUS COMBINED FRACTIONAL CO2 LASER AND ND:YAG LASER IN TREATMENT OF STRIAE DISTENSAE : A CLINICAL AND HISTOPATHOLOGICAL STUDY	Eman Shaarawy, MD , Dalia M. Abdel Halim, MD, Yosra Abdel Galeil Abdel Halim Department of Dermatology, Cairo University, Egypt.
15	EFFICACY AND SAFETY OF TOPICAL BETA BLOCKERS(0.5% TIMOLOL MALEATE EYE DROPS) IN THE TREATMENT OF INFANTILE HAEMANGIOMAS	Tissera MKD[1], Senevirathne JKK[2], Jayamanne BDW[3], Munasinghe R[4] [1]Senior Registrar ,Dermatology LRH ,Colombo 9 ,Sri Lanka [2] Professor in Dermatology LRH ,Colombo 9,Sri Lanka [3] PG Trainee –MSc. In Biomedical Informatics, Post Graduate Institute of Medicine,Sri Lanka [4] Medical Officer - Dermatology LRH ,Colombo 9,Sri Lanka
16	PULSE DYE LASER IN THE TREATMENT OF VERRUCAE VULGARIS	Panagioti Despina MD Kostakis Panagiotis MD, Drekolia Eugenia MD Greece
17	STIMULATION OF GROWTH FACTORS SECRETION BY LOW INTENSITY LASER AND LED	P S B H Karam, P O Cunha, R Ferreira, A C P Sant'Ana, M L R de Rezende, S L A Greghi, R C Oliveira, C A Damante. Bauru School of Dentistry, Univ. of São Paulo, Brasil
18	EFFECTS OF POLARIZATION ON LIOB FOR SKIN REJUVENATION	Valentina Bonito, Babu Varghese, Simona Turco, Rieko Verhagen Philips Research Care&Health, High Tech Campus, The strip, Eindhoven – The Netherlands
19	EFFECTIVENESS OF THE DEVELOPED METHODS OF PREPARATION FOR THE COURSE OF TREATMENT OF EXCESS BODY FAT BY LOW-LEVEL LASER-ASSISTED LIPOSUCTION	Mariya Serheyeva, M.D. Ukrainian Medical Systems, Kiev, Ukraine
20	ROSACEA TREATMENT USING THE NEW-GENERATION, 595 NM, LONG PULSE-DURATION PULSED-DYE LASER VBEAM PERFECTA (CANDELA CORP. USA)	E. Moroz (Ukraine) Oxford Medical, Ukraine SCHOLARSHIP, AWARD AND GRANT OFFERED BY DOLCE AQUA

LASER DERMATOLOGY - 1

Room A – November 9th, 2013

Chairpersons: P. Cunha, J. Hercogova, K. Khatri, T. Lotti

14:30	LASER TO TREAT NAIL FUNGUS – EFFECTIVE OR JUST A NEW HYPE?	**Klaus Fritz[1,3], Wojciech Francuzik[2], George Sorin Tiplica[3]** [1]Haut und Laserzentrum Landau [2]University Poznan dept. Dermatology [3]University Clinics Carol Davila Bukarest
14:45	NOVEL CLASS OF PRO-DRUGS IN DERMATOLOGY: MIMICRY OF NARROWBAND PHOTOTHERAPY WITH NATURAL SUNLIGHT	**Andy Goren, MD** University of Rome ("G.Marconi"), Italy
15:00	LASER THERAPY IN BURNS	**R. Gianfaldoni** Dept of Dermatology, University of Pisa, Italy
15:15	LASER HAIR REMOVAL: WHAT'S NEW	**Khalil A. Khatri, MD** Skin & Laser Surgery Center of New England New England institute of Laser Research, Boston, MA
15:30	LASER PLA TREATMENT USING HYDROGEL BANDAGE	**Keti Zeka ,E.Tchokogue,V.Corradini,M.A.Continenenza, F.Vegliò, L.Pajewski** Università degli Studi Dell'Aquila, Italy
15:45	FOCUSED COLD THERAPY FOR DYNAMIC FACIAL LINES	**[1,2]Klaus Fritz, [2]George Sorin Tiplica** [1]Haut und Laserzentrum Landau, Germany [2]University Carol Davila Bukarest, Rumania
16:00	TOPICAL APPLICATIONS OF PRP POST LASER RESURFACING	**Alessio Redaelli, Pietro Limardo** (Milan, Italia), (Lodi Italia)
16:15	LASER SKIN RESURFACING: ARE WE THERE YET	**Khalil A. Khatri, MD** Skin & Laser Surgery Center of New England New England institute of Laser Research, Boston, MA
16:30	COFFEE BREAK	

LASER DERMATOLOGY - 2

Room A – November 9th , 2013

Chairpersons: K. Fritz, K. Nouri, C. Spartera

16:45	VASCULAR MALFORMATIONS TREATMENT BY MEANS OF COMBINED PRP AND ND. YAG LASER 1064 NM METHOD	**I. Kapchucenko (Ukraine)**
17:00	PRIMARY AND SECONDARY HYPERHIDROSIS TREATED WITH BTXA	**Alessio Redaelli, MD, Pietro Limardo, MD** Milan, Italy; Lodi, Italy
17:15	UVA1 LASER (ALBA 355®) FOR ALOPECIA AREATA	**Angelo Massimiliano D'Erme[1], Torello Lotti [2]** [1]Division of Dermatology, Dept.of Surgery and Translational Medicine, University of Florence, Italy [2]Full Professor and Chair of Dermatology, University of Rome G.Marconi, Rome, Italy
17:30	LASERS FOR SCARS	**Keyvan Nouri, MD** University of Miami Dept of Dermatology and Cutaneous Surgery, Miami, USA
17:45	LASER AND LIGHT TREATMENT OF HYPERTROPHIC SCARS and KELOIDS	**L. Longo, MD, F. Giubilo, MD, C. Romanelli, MD, D. Longo, PTSt** *Institute Laser Medicine – Florence, Italy*
18:00	THE EFFICACY OF LOW LEVEL LASER	**Sulafa Abdalla Mohammed**

	THERAPY (810 NM) IN THE TREATMENT OF ACNE VULGARIS	Khartoum, Sudan SCHOLARSHIP
18:15	DIODE LASER VS. INTENSE PULSED LIGHT FOR HAIR REMOVAL: A RANDOMIZED CONTROLLED TRIAL	E Angelovska[1], S Nikolovska[1], K Damevska[1], A Kokaleska-Petrushevska[2] [1]University Clinic of Dermatology, Skopje, Macedonia [2]PHO Dr. Anchevski, Skopje, Macedonia SCHOLARSHIP AND GRANT OFFERED BY EVILASER
18:30	COMBINED LASER - SURGICAL TREATMENTS IN POST-ACNE SCARS	Alexandru Tataru [1] , Adrian Avram[2] [1] Univ. Med. Pharm. Cluj – Napoca, Dept.Dermatology [2]Q – Clinic, Aesthetic surgery, Cluj – Napoca
18:45	LASER LIPOLYSIS AND SKIN TIGHTENING	M. Trelles, MD Instituto medico Vilafortuny, Cambrils, Spain
19:00	355NM UVA1 LASER - A NEW TREATMENT OPTION FOR INFLAMMATORY SKIN DISEASES	Thomas Dirschka, MD, PhD Dermatology Dept, University of Witten-Herdecke, Germany
19:15	Open Ceremony with Welcome Cocktail and leading lecture of Prof J. Anders, University of Bethesda (USA), on TRANSLATING RESEARCH FROM THE LABORATORY BENCH TO THE BED SIDE: THE ROLE OF INTERNATIONAL CONFERENCES	

LASER DERMATOLOGY - 3

Room A – November 10th , *2013*

Chairpersons: A.Baruchin, R. Gianfaldoni, K. Konnikov, K. Russe

9:00	PLANTAR WARTS (*VERRUCAE* PLANTARIS) TREATED BY CO2 LASER: Single-center Experience with 1724 cases gained during 12 years.	Ohad Baruchin MD[1,2] & Abraham M.Baruchin MD[1] [1] *Laser Unit, Barzilai University Medical Center, Ashkelon, Israel* [2] *Department of Ob/Gyn, Assaf Harofeh University Medical Center, Zerifin.Israel*
9:15	ROSACEA: EXPERIENCE WITH THE LONG –PULSED 1064 NM ND:YAG LASER	S. Gianfaldoni[1], R. Gianfaldoni[1], T. Lotti[2] [1]Dept of Dermatology, University of Pisa, Italy [2]Professor and chair of Dermatology Univ. of Rome G. Marconi
9:30	ACTINIC KERATOSES AND CO2 LASER ABLATION	S. Gianfaldoni[1], R. Gianfaldoni[1], T. Lotti[2] [1]Dept of Dermatology, University of Pisa, Italy [2]Professor and chair of Dermatology University of Rome G. Marconi
9:45	UVA1 LIGHT VS UVA1 LASER EMISSION: NEW DATA AND HYPOTHESES	Angelo Massimiliano D'Erme[1] , Torello Lotti [2] [1]Division of Dermatology, Dept.of Surgery and Translational Medicine, University of Florence, Italy [2]Full Professor and Chair of Dermatology, University of Rome G.Marconi, Rome, Italy
10:00	UVA1 LASER (ALBA 355®) FOR LOCALIZED SCLERODERMA	Angelo Massimiliano D'Erme[1] , Torello Lotti [2] [1]Division of Dermatology, Dept.of Surgery and Translational Medicine, University of Florence, Italy [2]Full Prof and Chair of Dermatology, Univ. of Rome "G.Marconi", Italy
10:15	A NEW CONCEPT OF FACIAL REJUVENATION: MINIMALLY INVASIVE 1440nm LASER TISSUE TIGHTENING IN COMBINATION WITH AUTOLOGOUS FAT GRAFTING	Katharina Russe-Wilflingseder, Elisabeth Russe Plastische Chirurgie und Laserzentrum Innsbruck, Austria
10:30	NEW PATIENT ENGAGEMENT TOOLS FOR PRE-CLINICAL R&D AND MEDICAL PRACTICE	Yan Valle VR Foundation, Inc., 1, Penn plaza, suite 6205 New York, USA
10:45	COFFEE BREAK	

LASER DERMATOLOGY - 4 ROOM A – NOVEMBER 10th , 2013 Chairpersons: D. Parshad, J. Sigova, A. Turkevych, M. Trelles		
11:00	ABLATIVE LASER THERAPY GUIDED BY OPTICAL COHERENCE TOMOGRAPHY	**Jagdeo Jared** UC Davis, Brooklin 11230 – NY, USA SCHOLARSHIP
11:15	TREATMENT OF MACULAR AMYLOIDOSIS WITH FRACTIONAL CO_2 LASER ALONE OR IN COMBINATION WITH TOPICAL STEROID OR VITAMIN C: SINGLE BLINDED CONTROLLED STUDY	**Rehab Aly Hegazy** Lecturer of Dermatology, Faculty of Medicine, Cairo University
11.30	FRACTIONAL CO_2 LASER IS AN EFFECTIVE THERAPEUTIC MODALITY FOR XANTHELASMA PALPEBRARUM	**S. Esmat, MD, A. El- Ramly, MD, D. Abdel Halim, MD, H. Gawdat, MD, H. Taha** MBBCH,Dept of Dermatology, Faculty of Medicine, Cairo University. Cairo, Egypt.
11:45	SCAR TISSUE TREATMENT WITH RF AND ULTRASOUND	**M. Trelles, MD** Instituto medico Vilafortuny, Cambrils, Spain
12:00	ENDOVENOUS LASER TREATMENT: STATE OF THE ART	**C Spartera, MD** Director, Vascular Surgery, Dept, L'Aquila University
12.15	THE MOST EFFECTIVE TREATMENT FOR MELASMA: RADMANESH'S METHOD	**Mohammad Radmanesh[1] and Nooshin Bagherani [2]** [1]Associate Professor of Dermatology, Department of Dermatology, Ahvaz Jundishapur Univ. of Medical Sciences, Ahvaz, Iran [2]Dermatologist, Dr. Nooshin Bagheran's Office, Taha Physician Building, Khoramshahr, Iran
12.30	MELASMA: ADVANCES IN TREATMENT USING Q-SWITCHED ND-YAG AND/OR IPL	**P. Cunha, MD** Latin America Chair for Advances in Laser and High Technology, Sao Paulo, Brazil
12.45	Meet the Chairpersons **A.Baruchin, P. Cunha, K. Fritz, R. Gianfaldoni, A. Goren A. Greco, J. Hercogova, K. Khatri, N. Konnikov, T. Lotti, U. Montaguti, K. Nouri, D. Parshad, K. Russe, C. Spartera, J. Sigova, A. Tataru, M. Trelles, A. Turkevych, A. Vaitkuviene, Y. Valle**	
13.00	LIGHT LUNCH	

LASER NEUROLOGY REHABILITATION
Room A – November 10th , 2013
Chairpersons: **J. Anders, GD Baxter, A. Lauto, P.F. Parra**

14 :45	GUIDELINES FOR NON SURGICAL LASER THERAPY	**GD. Baxter, PhD** Dean, School of Physiotherapy, Univ.of Otago, Dunedin, New Zealand
15 :00	MEDIAN NERVE ANASTOMOSES USING CHITOSAN ADHESIVE FILMS	**Matthew J. Barton[1], John W. Morley[1], Marcus A. Stoodley[2], Sumaiya Shaikh[1], David A. Mahns[1] and Antonio Lauto[1].** [1]School of Medicine, Univ.of Western Sydney, [2]The Australian School of Advanced Medicine, Macquarie Univ, 2 Technology Place, Macquarie University, Sydney. Australia.
15 :15	GREEN LASER PROMOTES PROLIFERATION OF NEURAL PROGENITOR CELL	**Yumi Fukuzaki, Haruna Sugawara,Banri Yamanoha,Hideki Kawal,Shinichi Kogure** Dept of Bioinformatics, Faculty of Engin, Soka Univ. – Japan **AWARD AND KAPLAN'S BOOK SIGNED**
15 :30	HIGH FLUENCE LOW-POWER LASER EFFECT IN GAMMA-IRRADIATED MICE	**Yulia Efremova[1], Vaclav Navratil,[1] Zuzana Sinkorova[2], Leos Navratil[1]** [1]Czech Tech. Univ.,Faculty of Biomedical Engineer., Kladno [2]University of Defence, Faculty of Military Health Sciences, Hradec Kralove, Czech Republic
15 :45	LASER BIOMODULATION OF NORMAL AND NEOPLASTIC CELLS	**Farouk A.H. Al-Watban, MSc, PhD** President , World Academy for Laser Applications (WALA) Riyadh, Saudi Arabia
16 :00	sEMG-BIOFEEDBACK FOR THE EVALUATION OF LASER THERAPY ON TRAUMATIC CENTRAL NERVOUS SYSTEM INJURIES	**J. Lotti, PhD*, D. Longo, PTSt, C. Romanelli, MD, L. Longo, MD** **University of Rome "Guglielmo Marconi", Dept. of Nuclear, Subnuclear and Radiation Physics - Institute Laser Medicine - Florence, Italy*
16 :15	COFFEE-BREAK	

Chairpersons: F. Al-Watban, M. Herold, L. Longo, L. Navratil

16 :30	THE TENNIS PLAYER'S SHOULDER" THE CONSERVATIVE TREATMENT WITH LASER	**Parra Pier Francesco, MD** Visiting Professor in Phisical Science at Pisa University, Italy
16 :45	LLLT IN RHEUMATOLOGY	**M. Herold** Innsbruck University, Austria
17 :00	NON SURGICAL LASER THERAPY 1064 NM *(Aerolase)* FOR THE TREATMENT OF THE INDURATIO PENIS PLASTICA	**L. Longo, MD, F. Giubilo, MD, C. Romagnoli, MD, D. Longo, PTSt** Institute Laser Medicine – Florence, Italy
17 :15	INCREASED ATP LEVELS IN CARDIAC AND SPERM CELLS IMMEDIATELY AFTER BROADBAND VISIBLE LIGHT ILLUMINATION	**R. Lubart, A. Shainberg and M. Eichler** Physics and Life Sciences Departments, Bar-Ilan University, Israel
17 :30	QUANTITATIVE ANALYSIS OF TRANSCRANIAL AND INTRAPARENCHIMAL LIGHT PENETRATION IN HUMAN CADEVER BRAIN TISSUE	**J. Anders[1], C.E. Tedford[1], S. Delapp[2]** [1]USUHS Bethesda, USA [2]Photothera Inc, Carlsbad,

17 :45	LASER AND PHYSICAL THERAPY APPLIED TO TRAUMATIC CENTRAL NERVOUS SYSTEM INJURIES: UPDATE	L. Longo, MD, F. Giubilo, MD, C. Romanelli, MD, D. Longo, PTSt Institute Laser Medicine – Florence, Italy
18 :00	Meet the Chairpersons F. Al-Watban, J. Anders, GD Baxter, M. Herold, A. Lauto, L. Longo, L. Navratil, P.F. Parra	
18.15	PATIENT'S SESSION	
21.00 - GALA DINNER WITH MUSIC AND SHOW, AWARD ASSIGNATION AND CLOSING CEREMONY at Palazzo Borghese, Via Ghibellina, 110 - Firenze		

NETWORKS GENERATED BY PREVIOUS LASER FLORENCE CONFERENCES

1997: Pulse light for vascular lesions, advantages and limits. Endovascular laser therapy for various veins. Indication and contraindications for Laser resurfacing procedures.

1998: mechanism of action, ant inflammatory and anti-edema effects of Laser. Advantages and limits for laser in dentistry. Types of laser recommended for treatment of telangiectases and reticular veins.

1999: Prostatectomy laser. Non surgical endovenous laser modulating the immune system. Advantages and limits of Laser and IPL as hair removal techniques.

2000: PDD and PDT for the treatment of gastrointestinal and urological cancers. Laser therapy for wound healing and skin ulcers. , stretch marks,scars, keloids. Laser and IPL in skin rejuvenation.

2001: Laser treatment for diabetes type 1 and 2 (live demonstration on patients during the congress, probably, for the first time in the world). Advantages and limits of pulsed light in aesthetic medicine and surgery. What kind of laser should be in rheumatology and sport traumas? Role of European Community and World Health Organization in these issues.

2002: Laser Treatment of disk Hernias. Laser and light treatment for Psoriasis and Vitiligo.

2003: Laser therapy for nervous cells regeneration, in vitro and experimental. Complications of laser and light therapy and their treatment. Selection of affordable instrumentation. Advantages and limits of laser in ophthalmology. Position of FDA and other International Institution on non surgical laser.

2004: laser therapy of spinal cord injuries in clinical practice; first diabetic patients treated with laser in Italy, following Helsinki declaration rules; news on mechanisms of ant inflammatory and regenerative effects of lasers on the human tissues; prostatectomy laser in day surgery; advantages and limits of endoluminal laser surgery of varicose veins ; laser coupled with radio frequency scalpel for skin lesion treatment. Laser treatment of progenitor cells.

2005: Cesarean incision with laser. Photodyalisis laser for chronic degenerative conditions. Follow-up of laser therapy for diabetes. Laser therapy of traumatic spinal cord injuries. Action mechanism of laser beam on nervous tissue.

2006: Photopletismography multi laser in vascular diseases. News substances for PDT of lung cancer. Ant inflammatory and regenerative mechanisms of laser treatment of experimental myocardial infarct. News on Laser therapy in sport traumatology Radio protective effects of non surgical laser.

2007: Laser in stem cells therapy: preclinical phase. Laser therapy for traumatic and degenerative spinal cord injuries with live patients presentation. Follow-up of laser therapy in diabetes type 1 e 2. Laser therapy for female infertility. Laser vascular and aesthetic surgery. State-of-the art on laser dentistry and PDD/PDT.

2008: Laser in brain traumatic injuries; Laser for male infertility. Laser and energetic medicine; laser and progenitor cells.

2009: Guidelines for the use of non surgical lasers. Laser Diagnosis. Laser therapy for infertility. Laser and stem cells

2010: Follow up of results on central nervous system traumatic injuries. Laser for peripheral nerve reconstruction. Laser for prevenction of central nervous system post-traumatic damages. Laser diagnosis of early cancer of lung, uterus, breast, urinary bladder, prosthate. Laser and photodynamic therapy of prosthate cancer and lung cancer. Laser therapy of the menopause. Light for improving the follow-up of laser therapy of diabetes. Laser and stem cells for treatment of myocardial lesions.

2011: mechanisms of laser effects in quantum medicine; new procedures of percutaneous laser disc decompression of inter-vertebral disks. antimicrobial photodynamic therapy in chronic osteomyelitis. Multispectral visualization of glial brain tumors containing ppix in diffuse and laser-induced fluorescent light. Follow-up of laser treatment of spinal cord traumatic injuries.

2012: new treatment of non ablative laser for hypertrophic scars and keloids; new lasers in sport medicine; lasers for differentiation of stem cells; laser doppler myography; laser surgery of pancreas

IALMS ACTIVITY 2013

IALMS – WHA COOPERATION

The World Health Academy [**www.worldhealthacademy.org**] chares its mission and organization with the IALMS. This fact is a milestone for the increasing of both Academies. Laser Florence 2013 was first joint congress of the IALMS and WHA.

Supported by the WHA, Scholarship were introduced in order to sponsor the participation of the most brilliant laser medicine expert under 40 y.o. from the five continents.

VILNIUS INTERNATIONAL CONGRESS 2013

This year Vilnius was the Capital of Laser Medicine, because the World Federation Societies for Laser Medicine and Surgery had there her four yearly congress, jointed with the bi-yearly congress of the IPTA and of the ISLSM.

The IALMS supported that congress.

Full details on this appointment are available on the web.site http://www.ipta2013.com/

ATTENTION !!

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It is my intention to subscribe the membership of the IALMS for the year……………………………..
Please indicate your choice(s) by ticking the appropriate box(es)

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Fellow: after five years of membership, or after *three* presentations at different Academy Congresses a Academy Journal. Fellowship is by application to the Executive Committee	100
Ordinary: all the other members. Members are expected to pay the admission fees prevailing at the time o	200
Scientific Societies and Associations : these pay one USD for each of their member, and each Soc members can have one representative in the Executive Committee upon application.	1 for member
Manufacturers: they can have a member in the Executive Committee; They can use the logo of the Aca subject to the approval of the Executive Committee.	500

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Payment may be made ***(In Euro Dollars)*** *as follows:*

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