INDEX

PART ONE: KEY CONCEPTS ON LASER THERAPY

INDEX

PART TWO: HOW TO MAKE PBM MORE EFFICENT?

PART THREE : APPLICATION FIELDS

PART FOUR : TREATMENT EXAMPLES

INDEX

PART FIVE: MECTRONIC LASER THERAPY DEVICES

PART ONE: KEY CONCEPTS ON LASER THERAPY

PROLIFE

I. What is **laser**?

Light

Amplification by the

Stimulated

Emission of

Radiation

Laser therapy is a medical treatment that uses laser light to stimulate a process called photobiomodulation (PBM)

I. What is **laser**?

PHYSICAL CHARACTERISTICS

Laser is an artificial electromagnetic radiation similar to the sun light, but laser light has some special features (monocromaticity, coherence, directionality) that allows to use it in some different applications.

I. What is **laser**?

LASER POINTERS

I. What is **laser**?

LASER METERS

I. What is **laser**?

SPEED CAMERAS

I. What is **laser**?

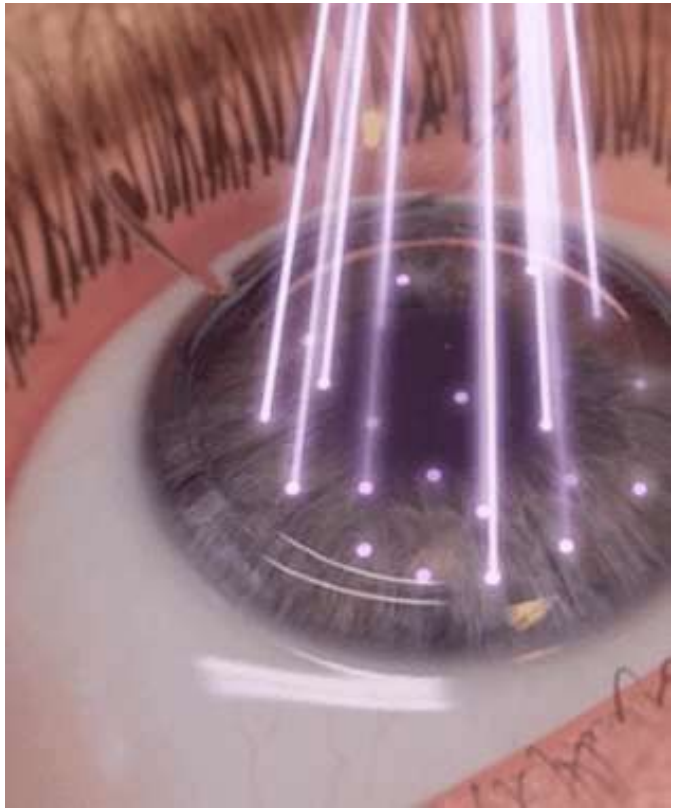
METAL LASER CUTTERS

I. What is **laser**?

LASER MARKING AND ENGRAVING

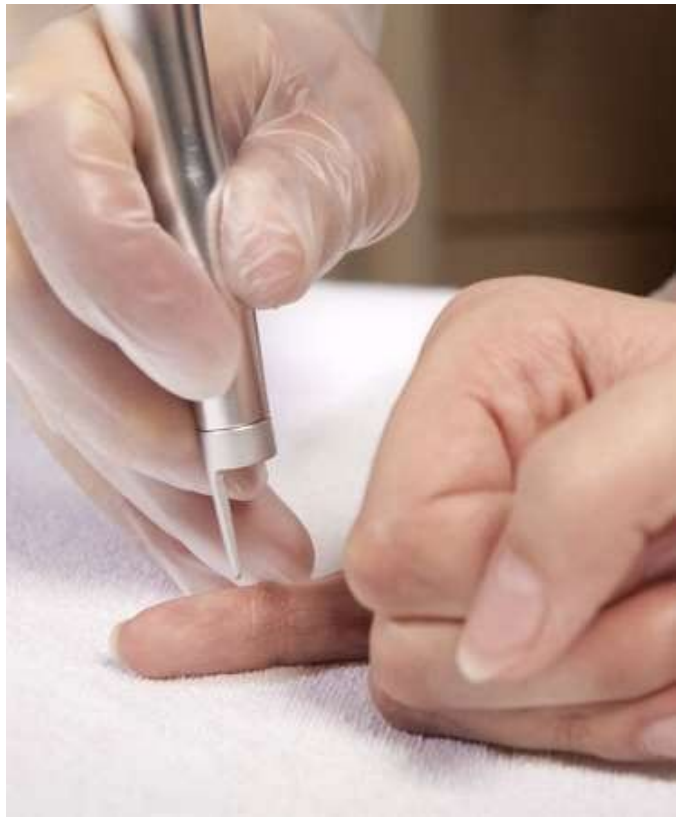
I. What is **laser**?

OPHTHALMOLOGY



I. What is **laser**?

SURGERY



I. What is **laser**?

DERMATOLOGY

I. What is **laser**?

DENTAL

I. What is **laser**?

REHABILITATION

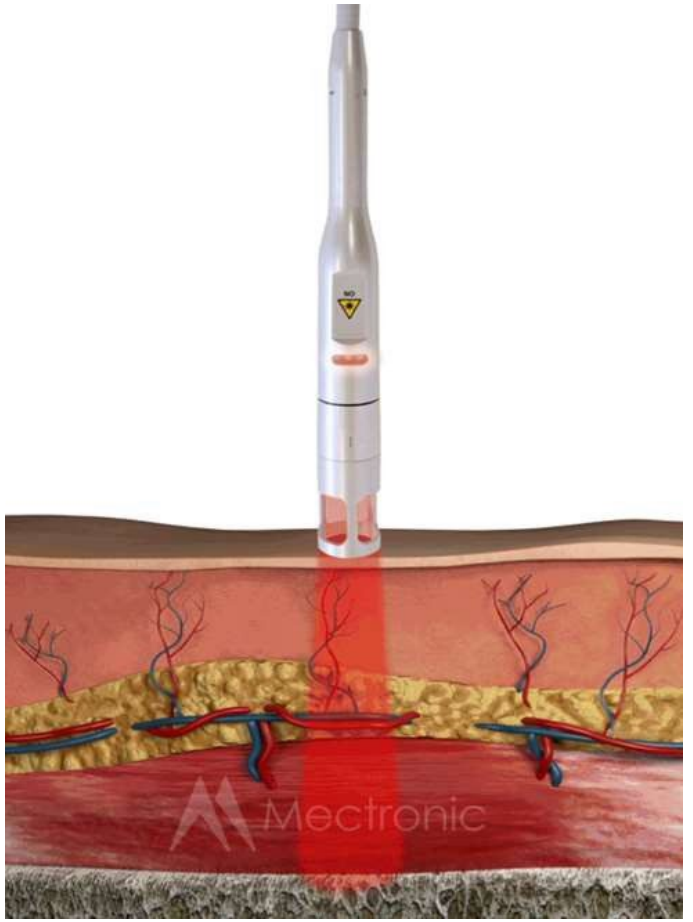
I. What is **laser**?

Over 40 years of research and thousands of scientific researches have demonstrated the efficacy of laser light. Laser therapy is the physical therapy with **the most scientific publications**.

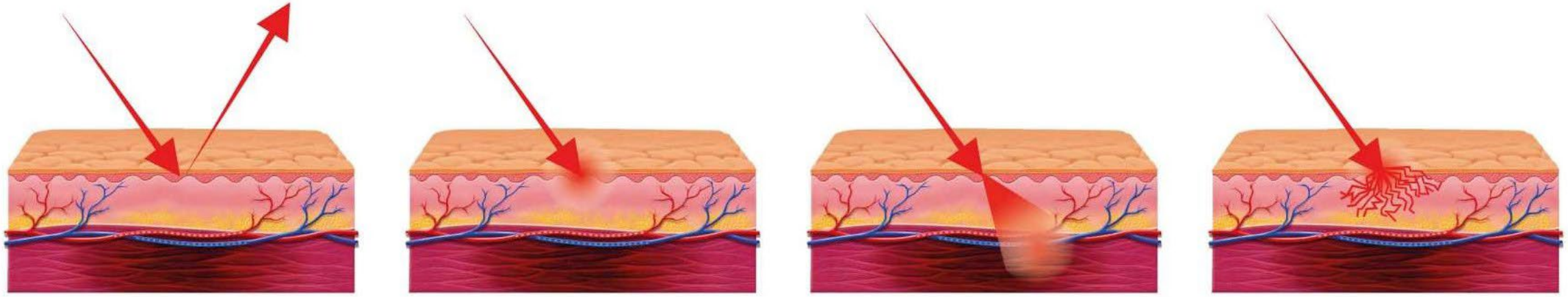
THERAPIES	SCIENTIFIC RESEARCH
LASER THERAPY	→ 91.225 ←
ULTRASOUND THERAPY	67.636
TENS	24.183
MICROWAVE THERAPY	7.377
SHOCKWAVE THERAPY	6.329
MAGNETOTHERAPY	4.245
TECAR	97

II. Laser therapy: **Interaction with the biological tissues**

What happens when laser light interacts with **biological tissues**?



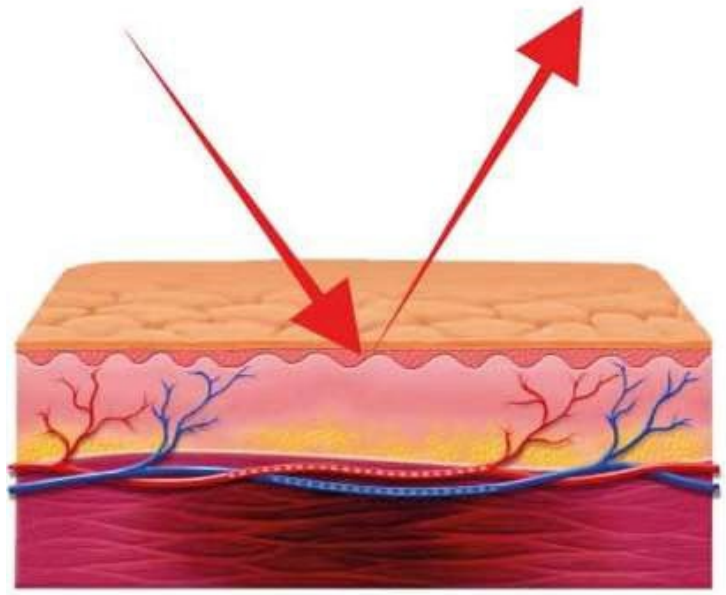
II. Laser therapy: **Interaction with the biological tissues**



Reflection | Absorption | Transmission | Scattering

II. Laser therapy: **Interaction with the biological tissues**

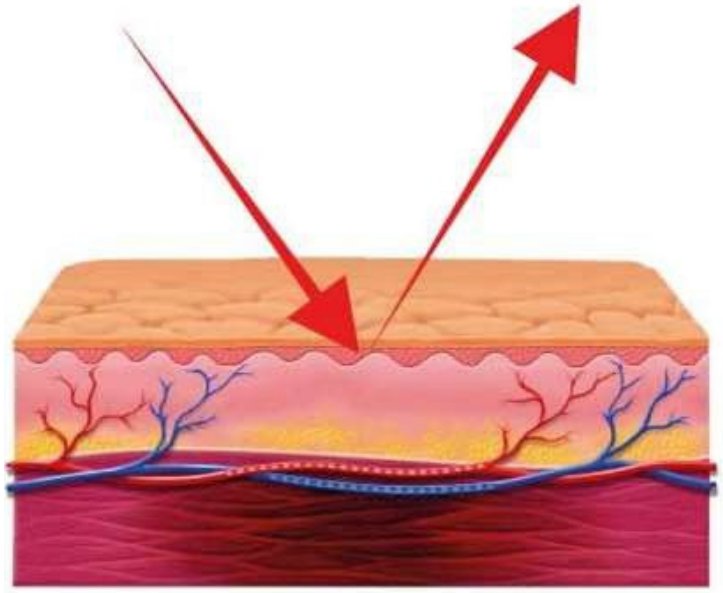
A percentage of the laser light that hits the biological tissues is reflected. Phototypes I and II reflect laser light more than phototypes V or VI.



II. Laser therapy: **Interaction with the biological tissues**

The percentage of reflected laser light must be reduced!

HOW?



II. Laser therapy: **Interaction with the biological tissues**

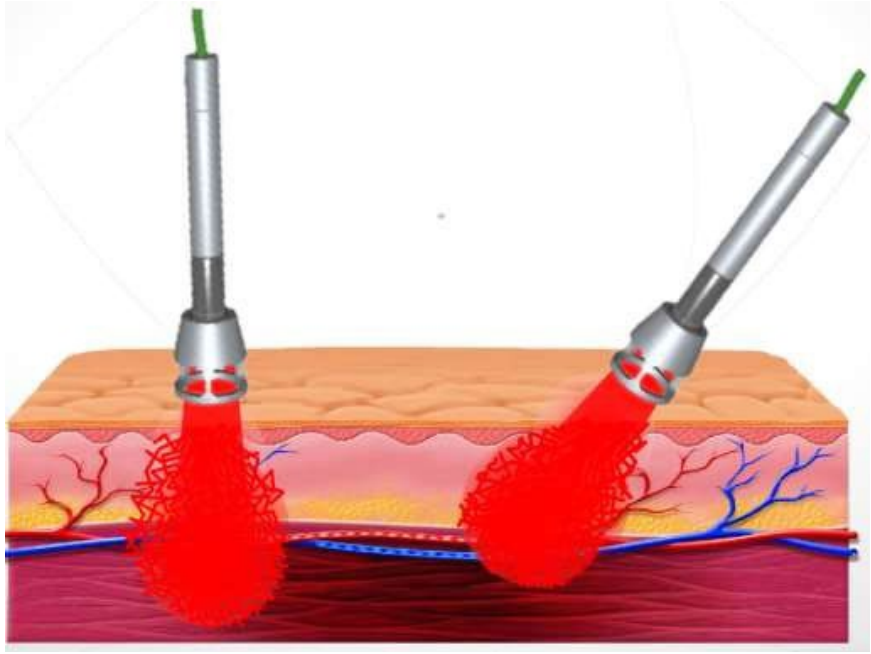
The percentage of reflected laser light must be reduced!

HOW?

- CLEANING THE PATIENT'S SKIN BEFORE TREATMENT
- PERFORMING THE TREATMENT ORTHOGONALLY TO THE TREATED TISSUE

II. Laser therapy: **Interaction with the biological tissues**

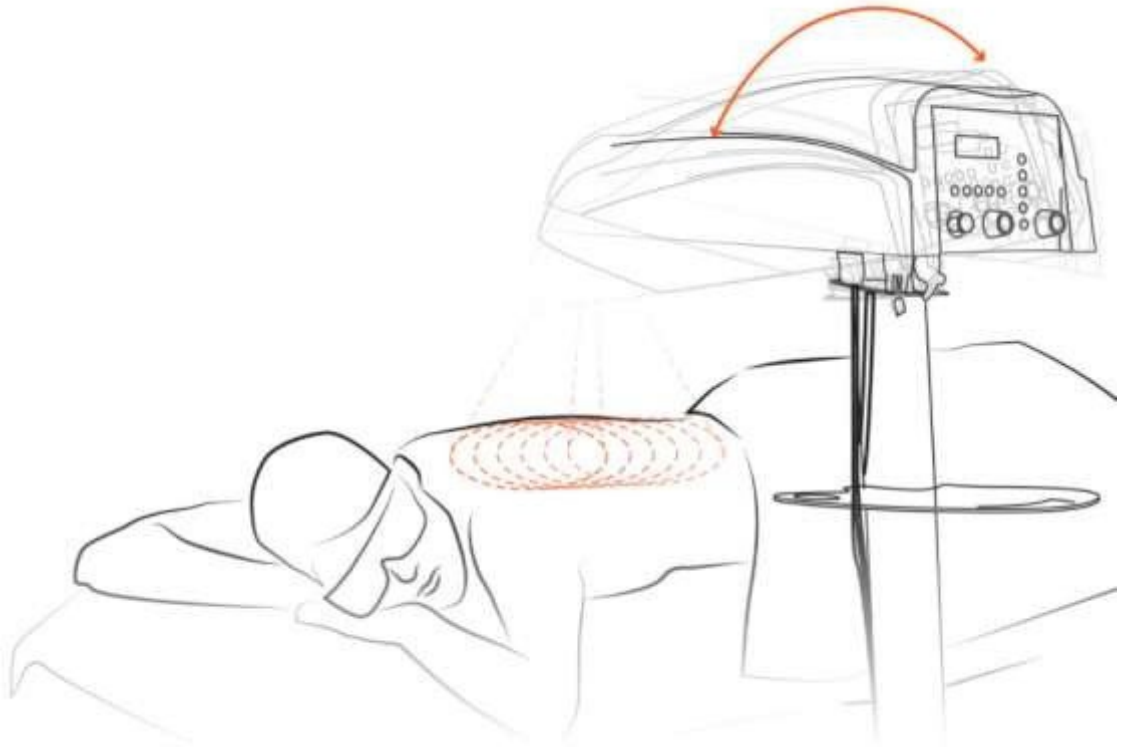
THE IMPORTANCE OF ORTHOGONALITY



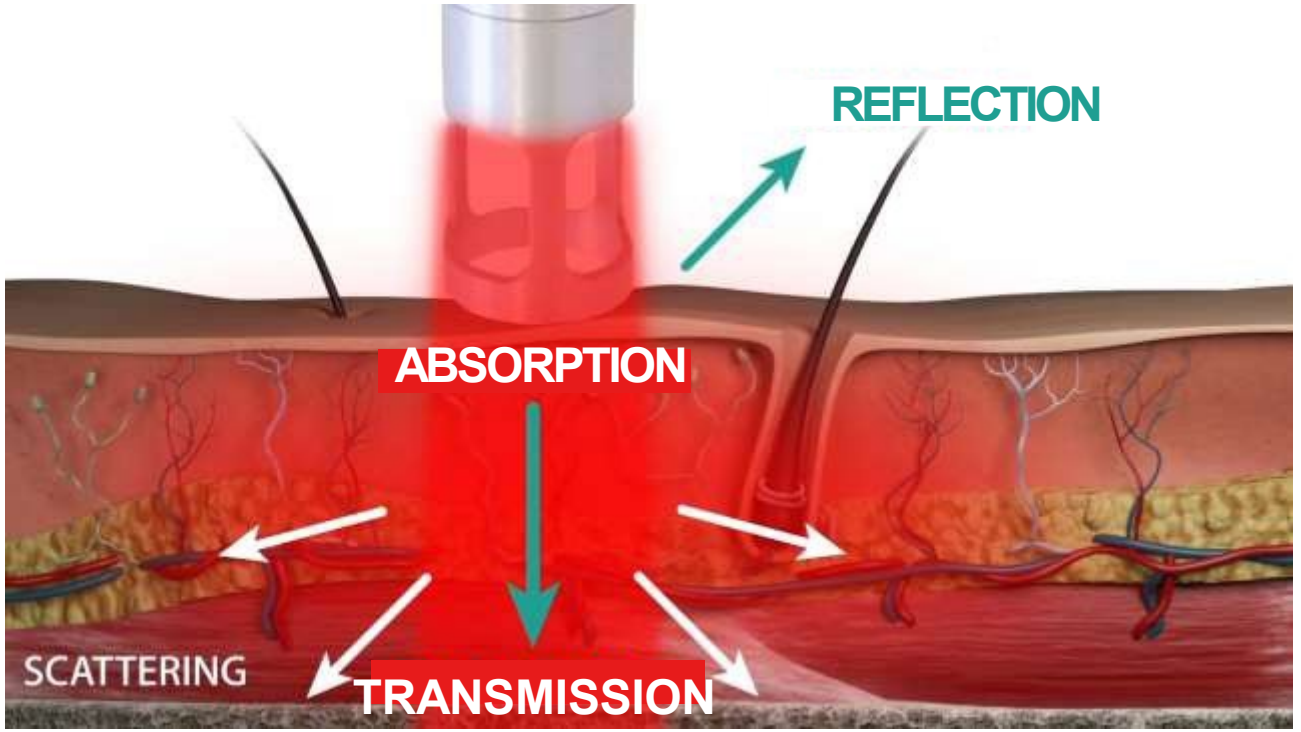
II. Laser therapy: **Interaction with the biological tissues**

THE IMPORTANCE OF ORTHOGONALITY

The **scanning laser** allows to treat very large areas, but it is almost always **non-orthogonal** and the percentage of reflected laser light is higher.



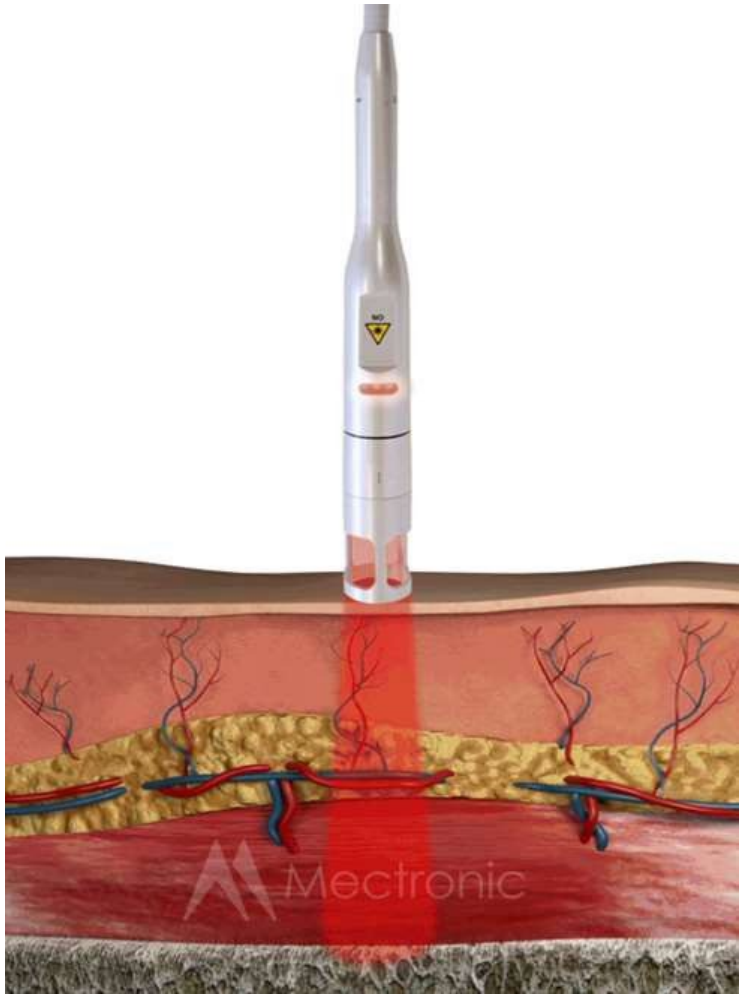
II. Laser therapy: **Interaction with the biological tissues**



OUR FOCUS IS THE ABSORPTION COEFFICIENT THAT DETERMINES THE TRANSMISSION

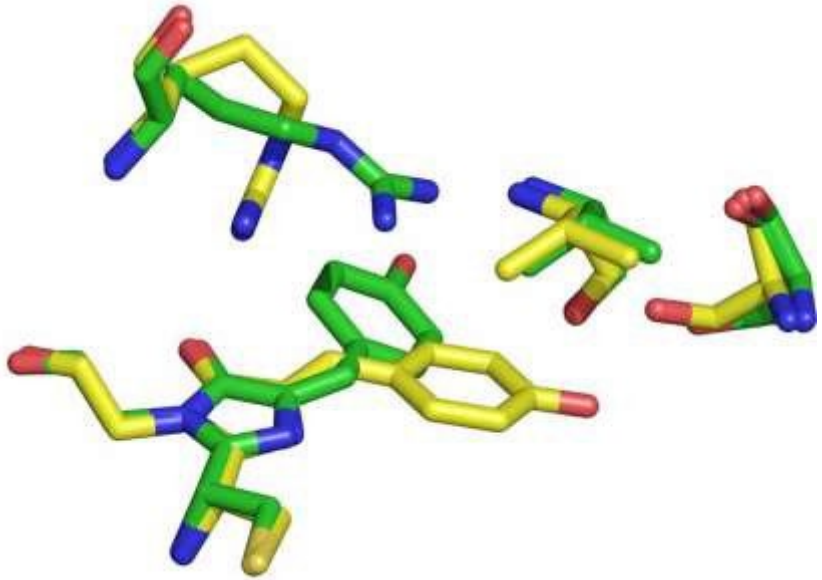
II. Laser therapy: **Interaction with the biological tissues**

The laser light must interact with **the chromophores** in the human tissues, therefore the laser light that brings photon energy must be able to penetrate those tissues.



II. Laser therapy: **Interaction with the biological tissues**

The term **chromophore** defines a group of atoms capable of giving color to a substance.



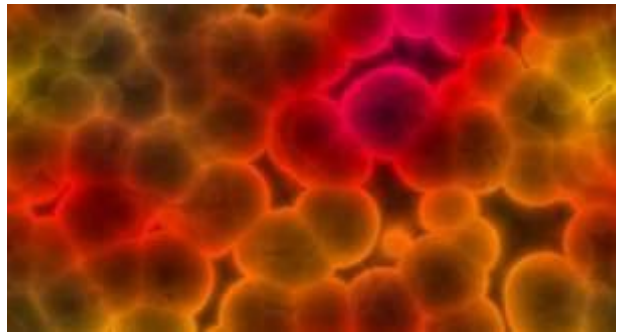
II. Laser therapy: **Interaction with the biological tissues**

The laser light must penetrate inside the biological tissues. To do that, the laser wavelength must be not overly absorbed by the chromophores:

Melanin

Water

Hemoglobin



Hemoglobin oxide

III. Laser therapy: **The therapeutic window**

The laser light suitable for therapeutic activities/purposes must belong to the therapeutic window.

The therapeutic window is well defined in the scientific article:

"Mechanisms of low-level light therapy" (2006)

Proc. of SPIE Vol. 6140 614001-1

M. HAMBLIN, T. DEMIDOVA

III. Laser therapy: **The therapeutic window**

The therapeutic window is a range of wavelengths of laser light that can be used for therapeutic purposes.

"Mechanisms of low level light therapy" (2006)

Proc. of SPIE Vol. 6140 614001-1

M. HAMBLIN, T. DEMIDOVA

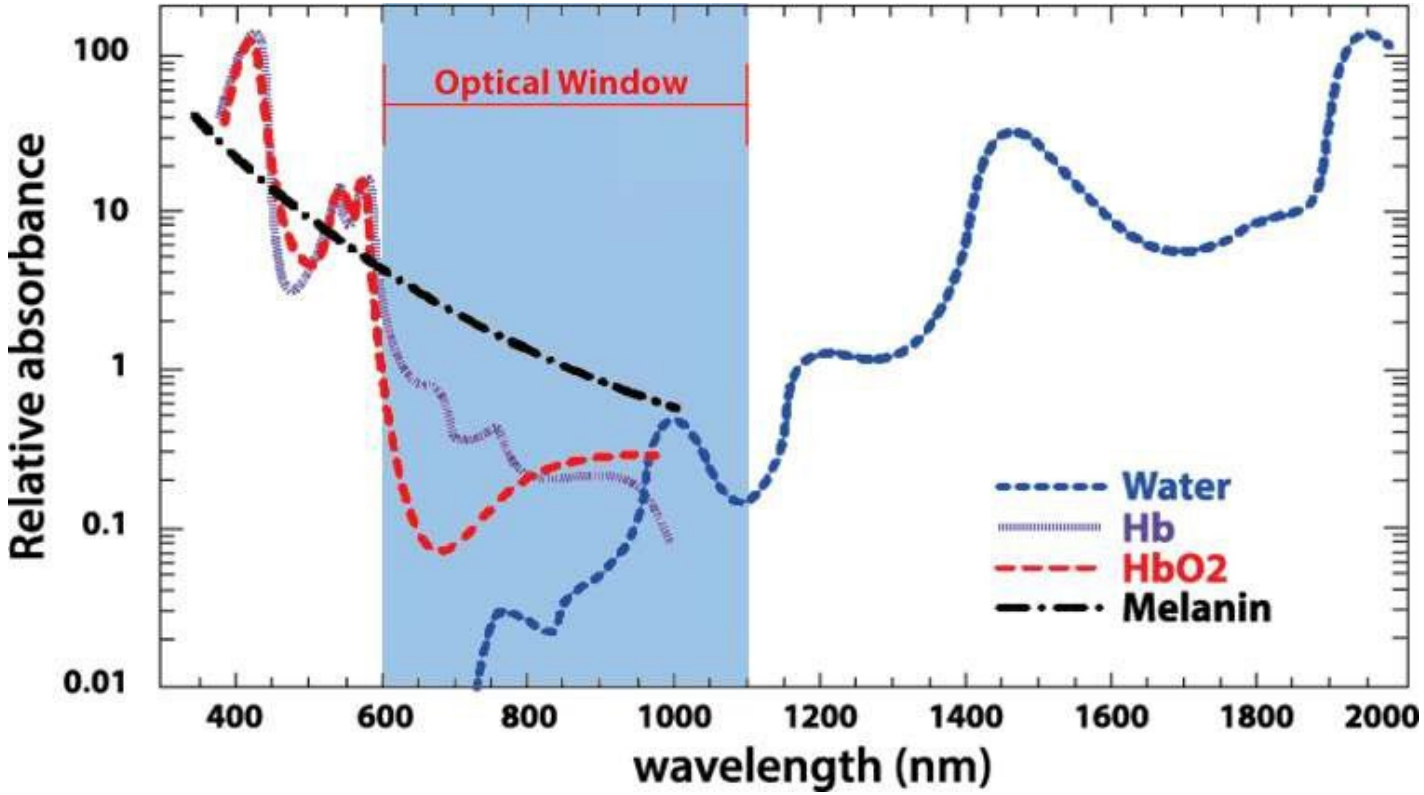
III. Laser therapy: **The therapeutic window**

"Mechanisms of low-level light therapy" (2006)

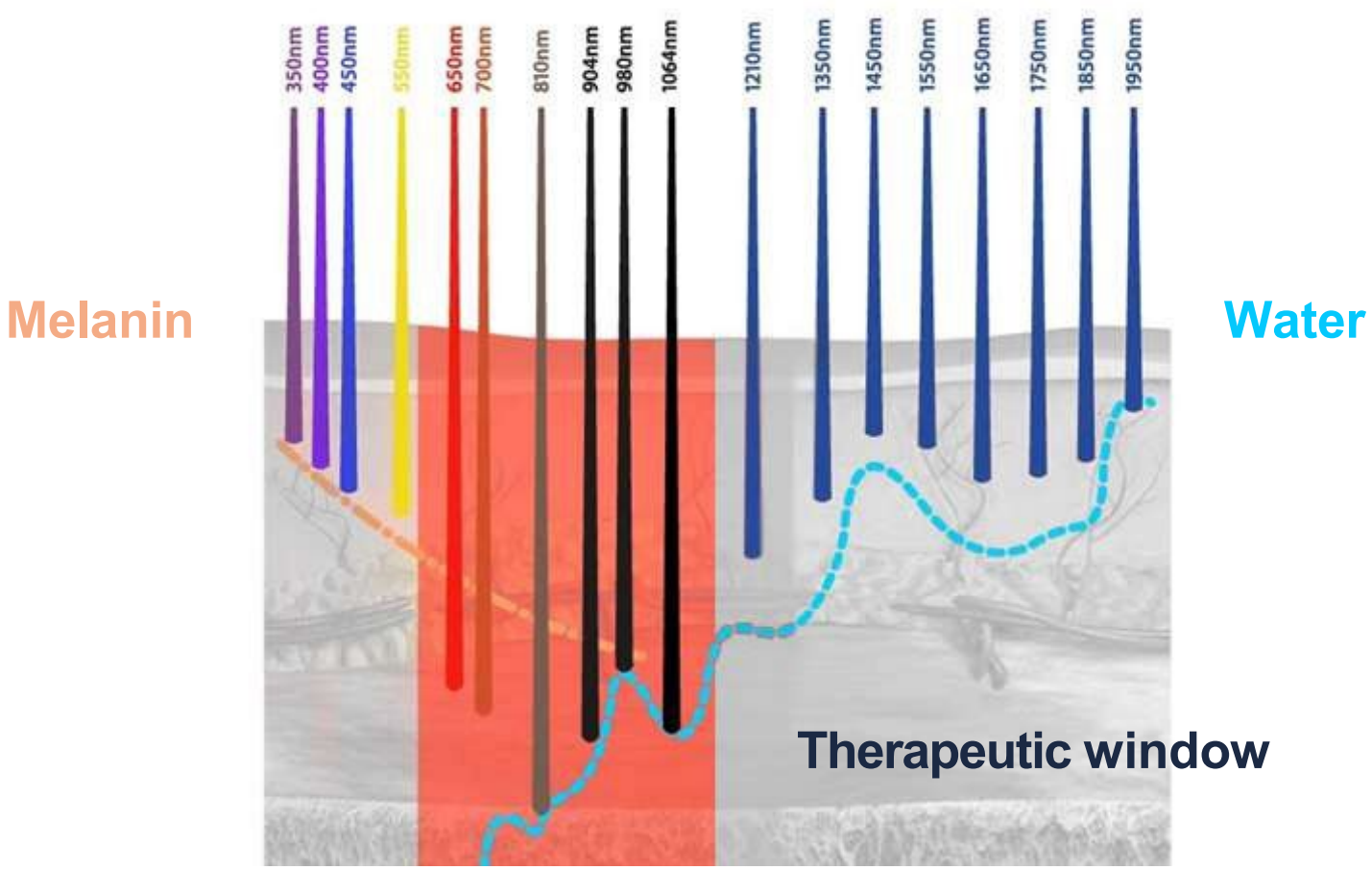
Proc. of SPIE Vol. 6140 614001-1

M. HAMBLIN, T. DEMIDOVA

Therapeutic window
600nm - 1100nm



III. Laser therapy: **The therapeutic window**



IV. Laser therapy: **The importance of average power**

The ability of a laser to penetrate inside biological tissues depends **solely on the wavelength**, but the number of photons and energy inside the tissues is proportional to the **average power applied**: **the greater the average power**, **the greater the energy carried in depth**.

IV. Laser therapy: **The importance of average power**

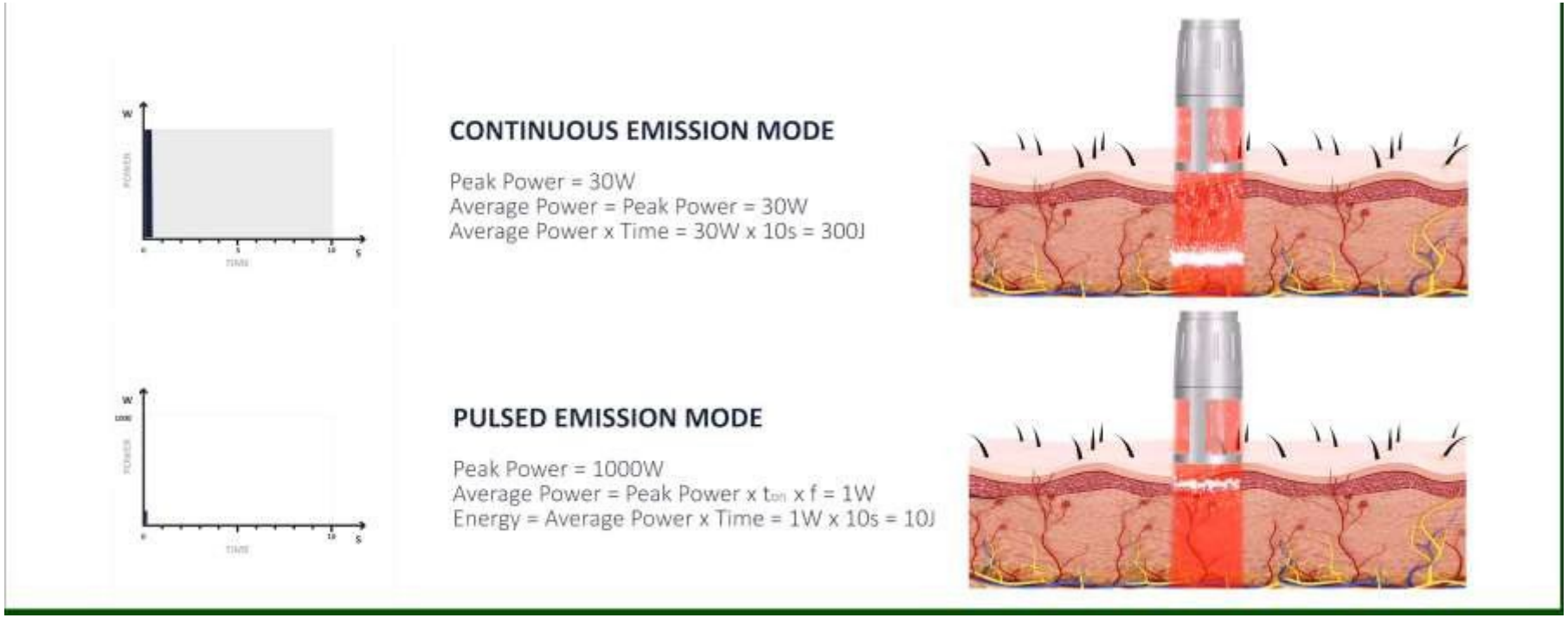
The ability of a laser to penetrate into biological tissues depends **solely on the wavelength**

High
Average power

High
Energy in depth

High
Depth of action

IV. Laser therapy: **The importance of average power**



The higher the average power, the greater the depth of action of the laser beam

IV. Laser therapy: **The importance of average power**

The ability of a laser to penetrate into biological tissues depends **solely on the wavelength**

High
Average power

High
Energy in depth

High
Depth of action

The peak power does not increase the ability of the laser light to penetrate inside biological tissues!

IV. Laser therapy: **The importance of average power**

Comparison of Light Penetration of Continuous Wave 810 nm and Superpulsed 904 nm Wavelength Light in Anesthetized Rats. Anders JJ[1], Wu X[1] - 2016 Sep;34(9):418-24. doi: 10.1089/pho.2016.4137. Epub 2016 Aug 8.

OBJECTIVE:
The purpose of this study was to investigate light transmission of continuous wave (CW) 810 nm wavelength light and 904 nm wavelength superpulsed light through skin and gastrocnemius muscle and skin only using an anesthetized Sprague-Dawley rat model.

RESULTS: The percentages of light transmission (fluence rate) through muscle and skin were

7.42% (810 nm wavelength)
4.01% (904 nm wavelength)

and through skin were

24.63% (810 nm wavelength)
19.94% (904 nm wavelength)

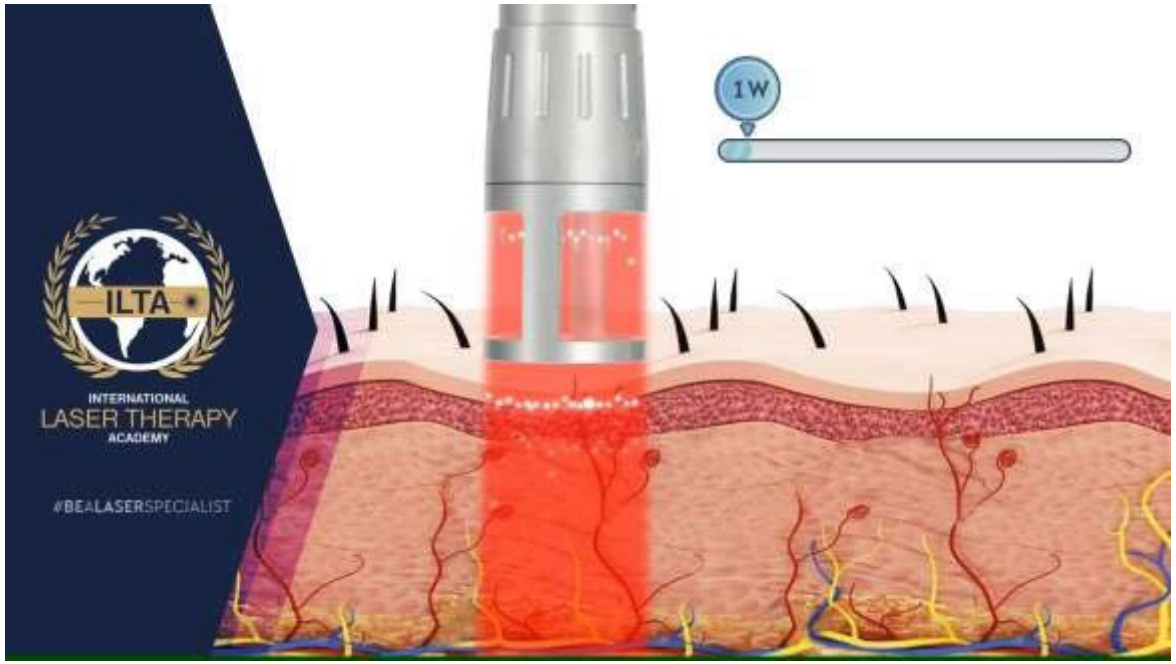
These data prove that transmission of CW 810 nm wavelength light through muscle and skin and skin alone is greater than transmission of superpulsed 904 nm wavelength light.

IV. Laser therapy: **The importance of average power**

High
Average power

High
Energy in depth

High
Depth of action



Mectronic

V. Laser therapy: **Photobiomodulation**

Laser therapy is a medical treatment that uses laser light to stimulate a process called **photobiomodulation (PBM)**

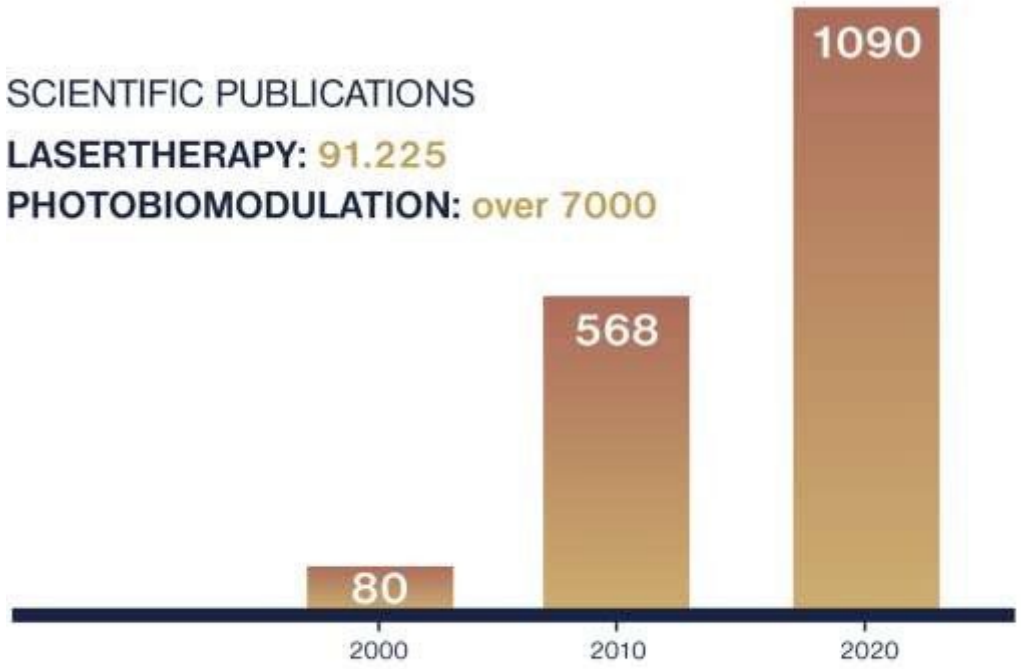
V. Laser therapy: **Photobiomodulation**

Photobiomodulation is defined as a form of light therapy that uses visible and near infrared laser sources.

It is a non-thermal or moderately thermal process that involves endogenous chromophores that cause photophysical and photochemical events at various biological scales. This process results in therapeutic outcomes not only aimed at reducing pain and inflammation, but also at promoting immunomodulation, wound healing and tissue regeneration.

V. Laser therapy: **Photobiomodulation**

There are over 90.000 scientific publications dedicated to laser therapy and over 7.000 dedicated to Photobiomodulation. In recent years, **Photobiomodulation is increasingly the subject of study and attention**, with an exponential increase in scientific publications produced annually. In fact, in the last 20 years we have gone from 80 researches published in 2000 to 1090 in 2020.



Photobiomodulation, scientific publications by year.
Data According to PubMed

VI. Laser therapy: **The effects of therapeutic laser light**

The effects of therapeutic laser light on the tissue are three:

- **Photochemical**
- **Photothermal**
- **Photomechanical**

PHOTOCHEMICAL EFFECT

PROLIFE

VI. Laser therapy: **The effects of therapeutic laser light**

PHOTOCHEMICAL EFFECT: LIGHT IS AT THE BASE OF LIFE

The light is essential for the wellness of living beings.

PLANTS

ANIMALS

HUMANS

VI. Laser therapy: **The effects of therapeutic laser light**

PHOTOCHEMICAL EFFECT: THE LIGHT EFFECT ON PLANTS

The bright energy is absorbed by a photoreceptor that triggers a fundamental chemical reaction for the wellness and the growth of the plants.

VI. Laser therapy: **The effects of therapeutic laser light**

PHOTOCHEMICAL EFFECT: THE LIGHT EFFECT ON PLANTS

Energy absorbed by the chlorophyll (photoreceptor)

$6CO_2 + 6H_2O + \text{Solar power} \rightarrow C_6H_{12}O_6 + 6O_2$

Glucose + Oxygen

Essential sugar for
the wellness of plants

VI. Laser therapy: **The effects of therapeutic laser light**

PHOTOCHEMICAL EFFECT: THE LIGHT EFFECT ON PLANTS

Chlorophylline

photosynthesis

VI. Laser therapy: **The effects of therapeutic laser light**

PHOTOCHEMICAL EFFECT: THE LIGHT EFFECT ON HUMANS

There is a similar reaction in human beings.

The laser energy interacts with the human body to obtain a healthy and therapeutic effect.

Theal THERAPY

VI. Laser therapy: **The effects of therapeutic laser light**

PHOTOCHEMICAL EFFECT: THE LIGHT EFFECT ON HUMANS

First law of photochemistry:

“Light must be absorbed before photochemistry can occur”

VI. Laser therapy: **The effects of therapeutic laser light**

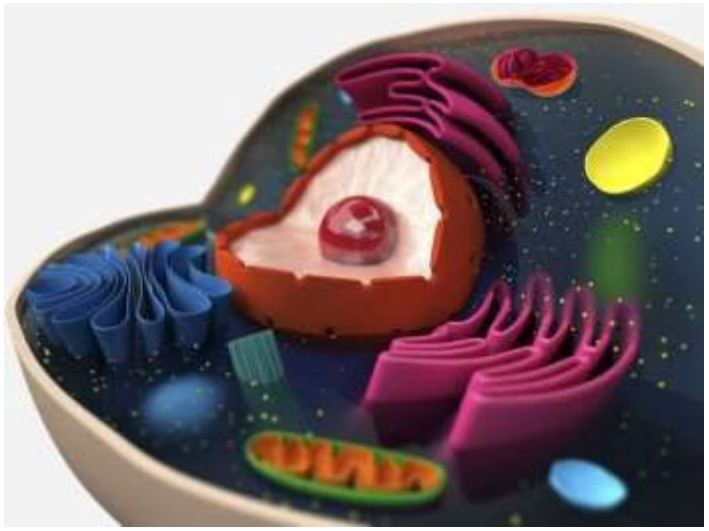
PHOTOCHEMICAL EFFECT: THE LIGHT EFFECT ON HUMANS

The photobiomodulation, at the base of metabolic activities, is triggered by the **selective and naturally thermal laser light absorption**, which provides three fundamental effects: **tissue regeneration**, **inflammatory action modulation** and **analgesic effect**.

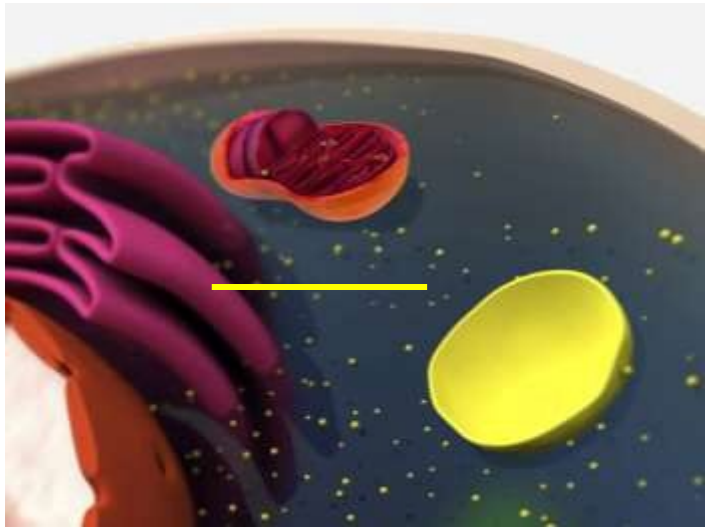
VI. Laser therapy: **The effects of therapeutic laser light**

PHOTOCHEMICAL EFFECT:

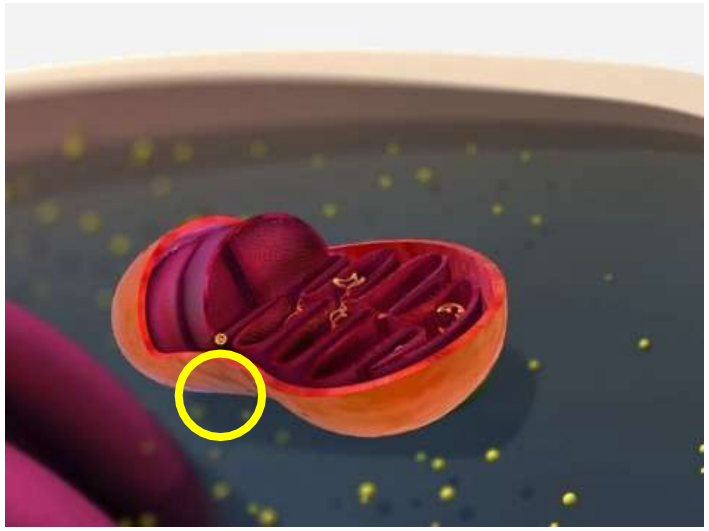
The main photo acceptor that absorbs the bright energy to trigger photobiomodulation is the **Cytochrome C Oxidase** present in a cellular organelle: the mitochondrion.



CELL

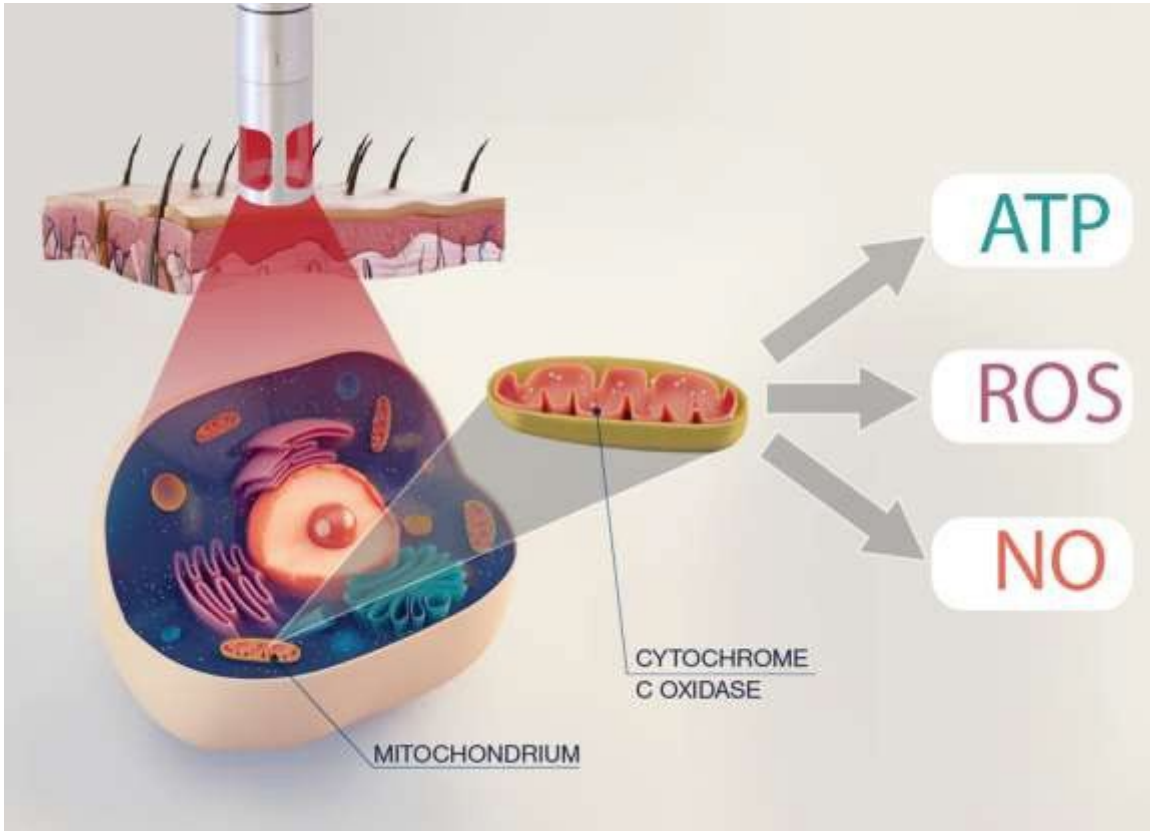


MITOCHONDRION



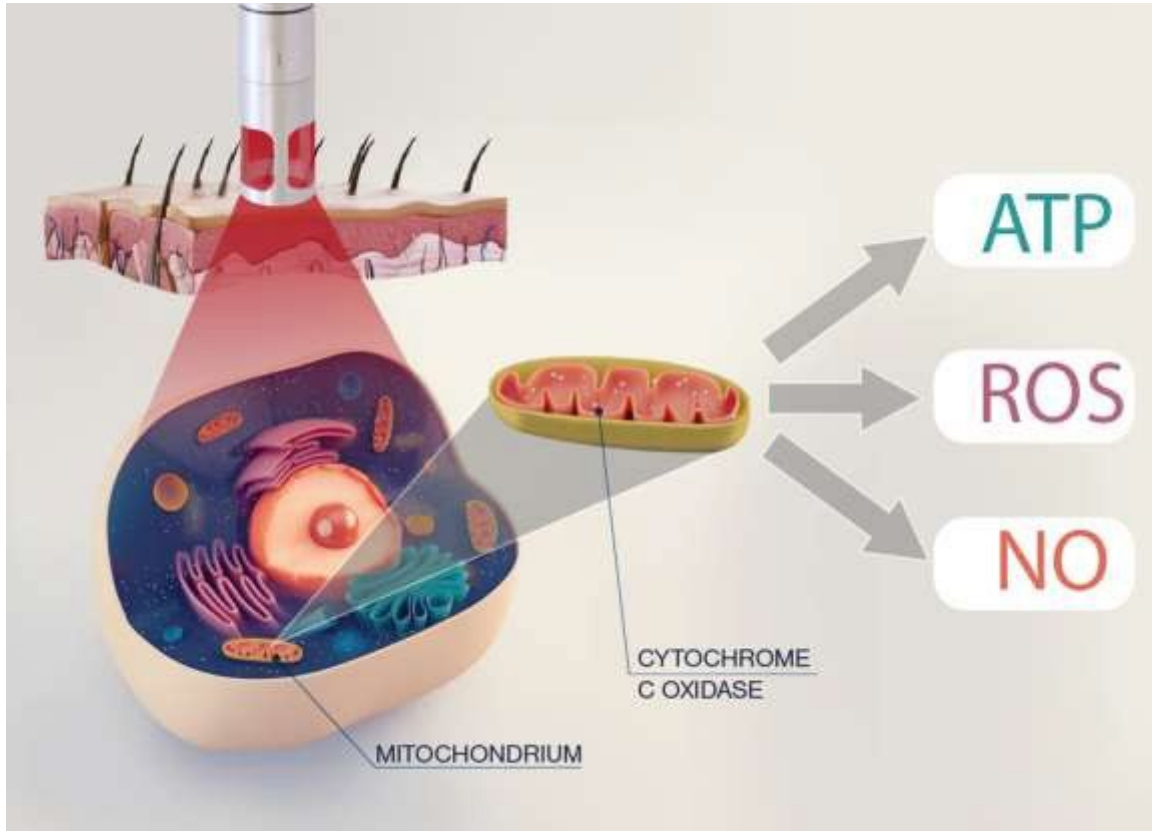
CYTOCHROME

VI. Laser therapy: **The effects of therapeutic laser light**



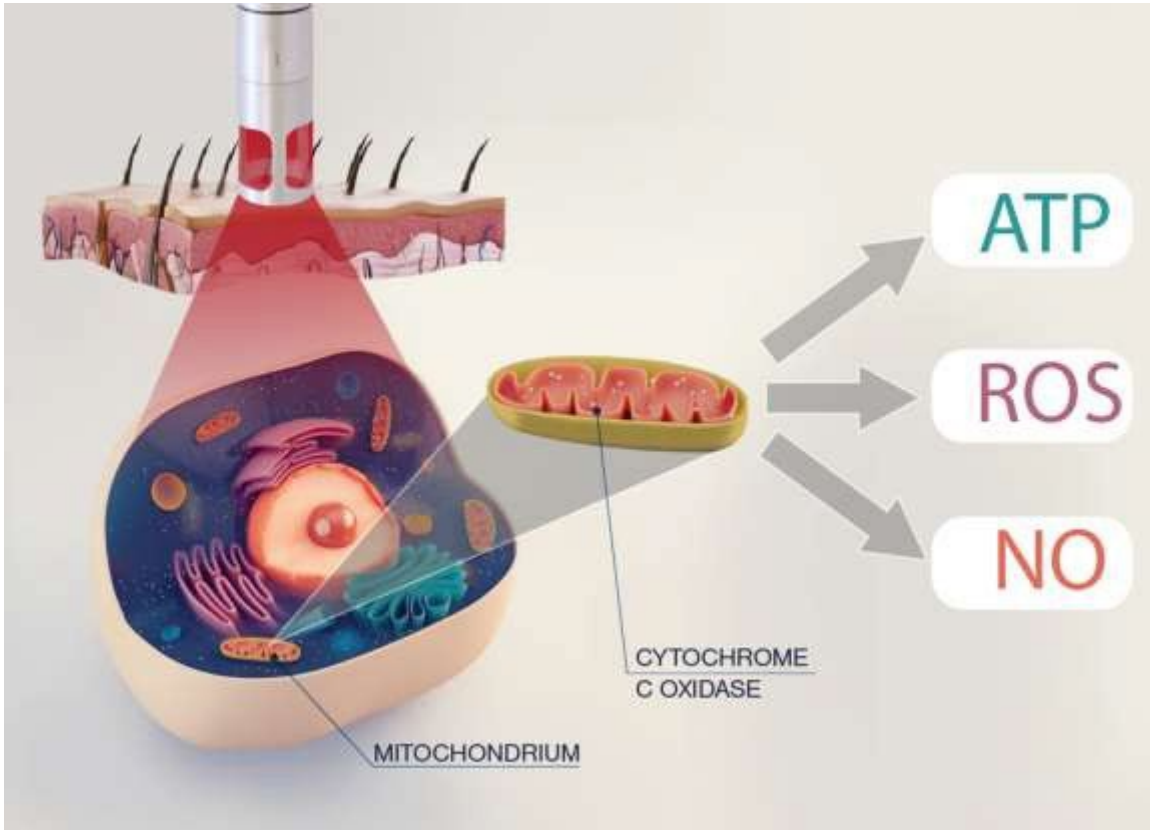
When laser light is absorbed by cytochrome c it stimulates the electron transport chain to increase the production of adenosine triphosphate (ATP) within the mitochondria. Adenosine triphosphate (ATP) is the molecule that facilitates the transfer of energy within the cell.

VI. Laser therapy: **The effects of therapeutic laser light**



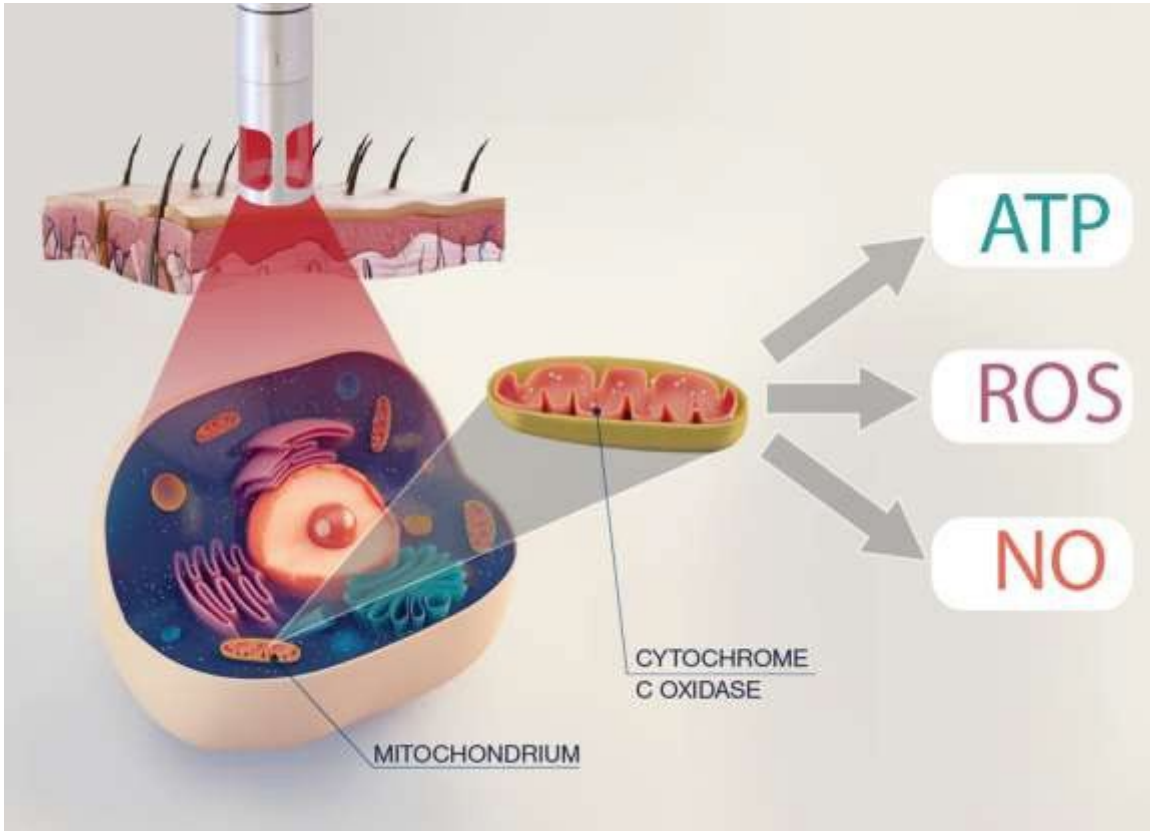
When the tissue is damaged, ATP production in the cell is impaired, which slows down the cell's metabolism as a protective mechanism. Photobiomodulation (PBM) helps restore the oxidative process which helps restore normal cell function.

VI. Laser therapy: **The effects of therapeutic laser light**



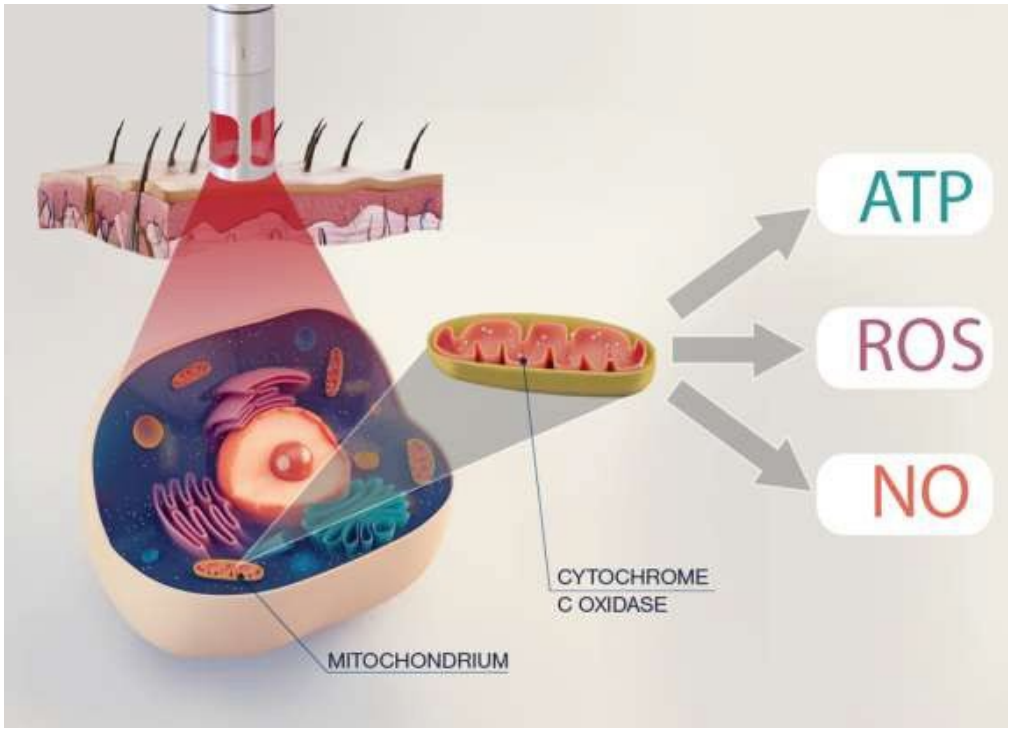
Laser stimulation also produces nitric oxide (NO). Nitric oxide (NO) is a powerful vasodilator and an important cell signaling molecule involved in many physiological processes. The release of nitric oxide (NO) increases circulation, decreases inflammation and improves the transport of oxygen and immune cells throughout the tissue.

VI. Laser therapy: **The effects of therapeutic laser light**



Laser stimulation also produces reactive oxygen species (ROS). Reactive oxygen species (ROS) have been shown to influence many important physiological signaling pathways, including the inflammatory response. Furthermore, the production of these signaling molecules has been shown to induce the **production of growth factors**, **increase cell proliferation and mobility** and **promote extracellular matrix deposition**.

VI. Laser therapy: **The effects of therapeutic laser light**



In concert, the production of these signaling molecules has been shown to:

Accelerate tissue regeneration

Modulate the inflammatory response

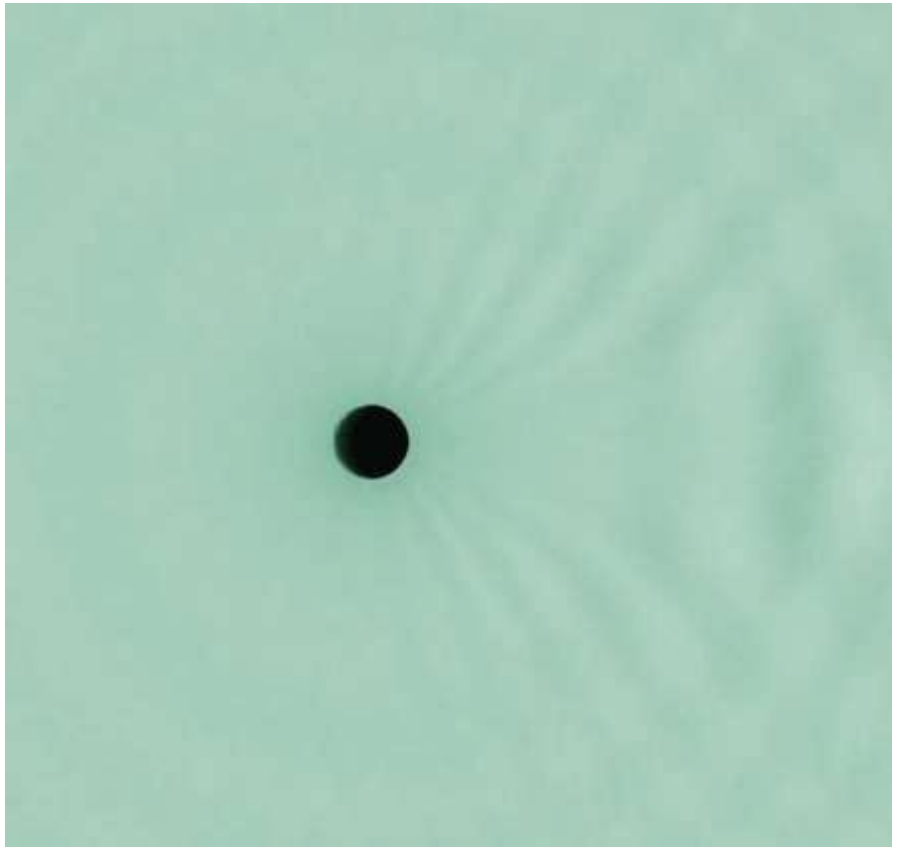
Reduce the pain sensation

PHOTOMECHANICAL EFFECT

PROLIFE

VI. Laser therapy: **The effects of therapeutic laser light**

Laser light interacts with the tissue transforming the light energy in an acoustic / mechanical impulse.



VI. Laser therapy: **The effects of therapeutic laser light**

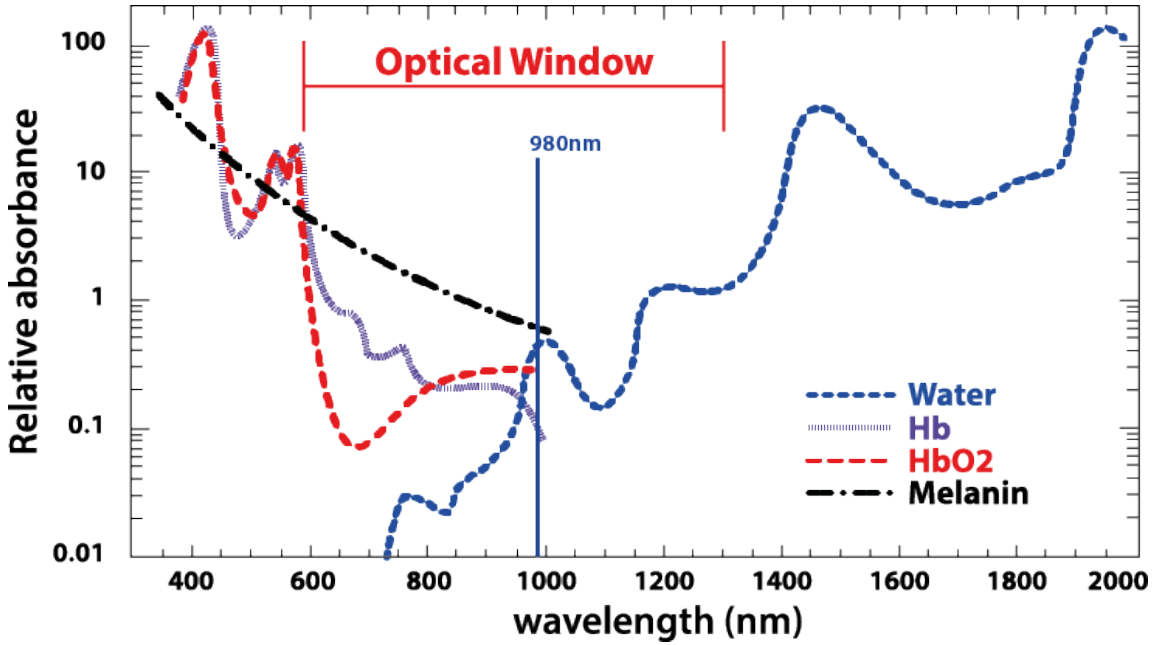
Interaction with mechanoreceptors → Analgesic effect

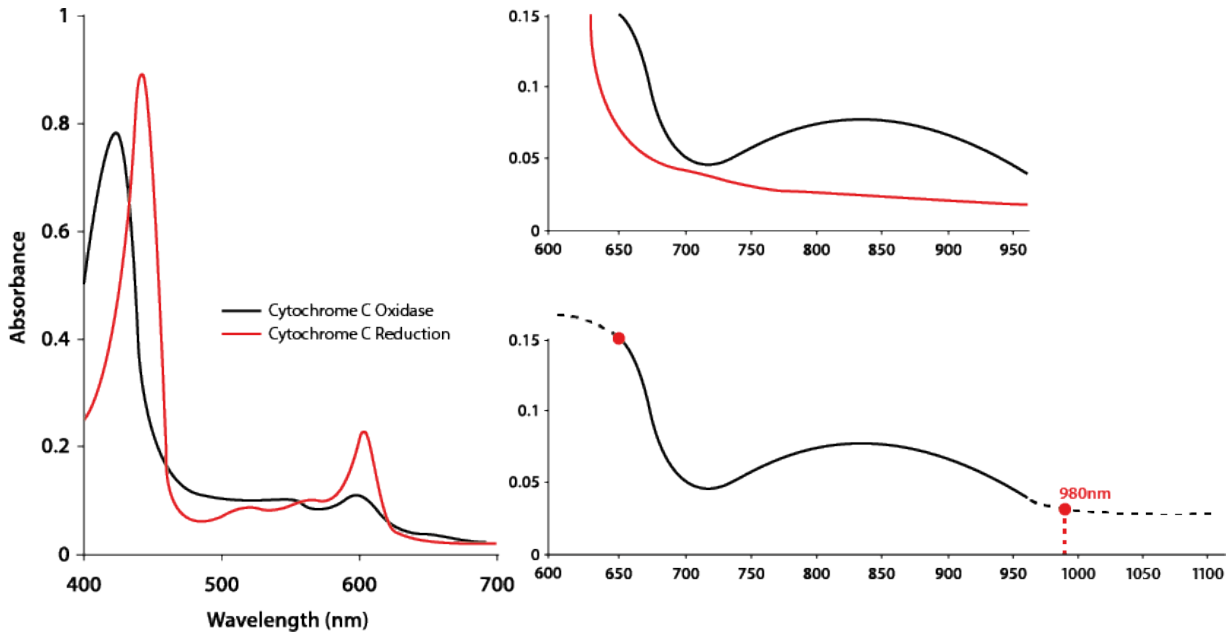
Mechanical stress of tissues → Supports tissue regeneration

Anti-inflammatory action

VI. Laser therapy: **The effects of therapeutic laser light**

980 nm: Mainly absorbed by water, it allows to optimize the action on thermoreceptors and mechanoreceptors.

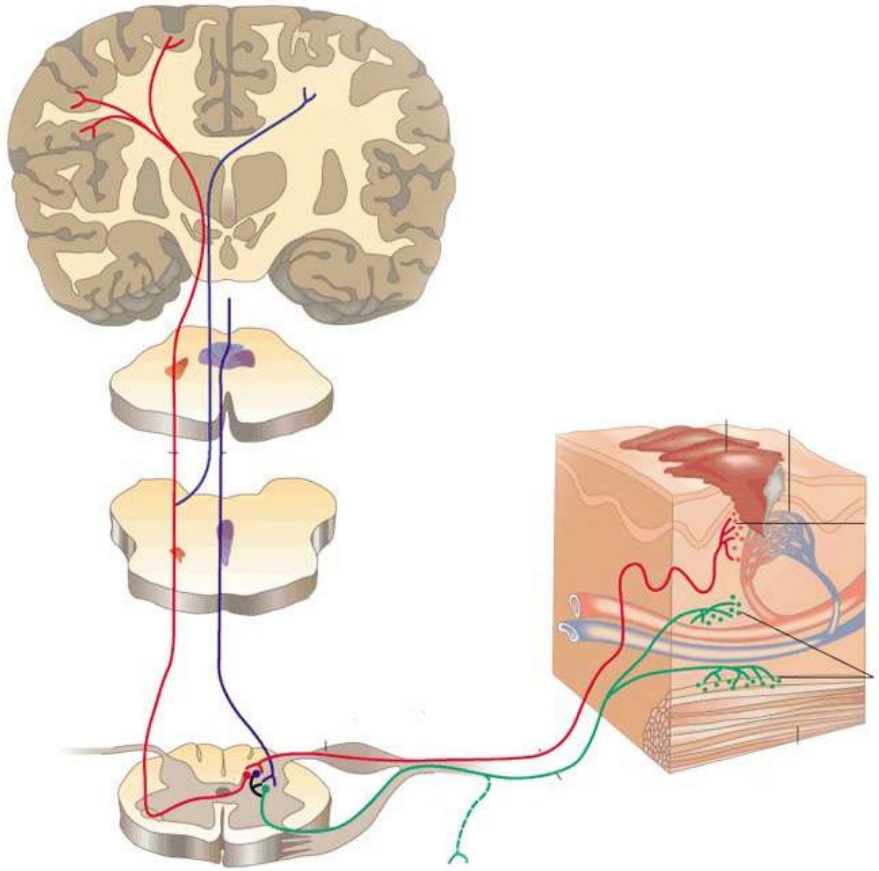




VI. Laser therapy: **The effects of therapeutic laser light**

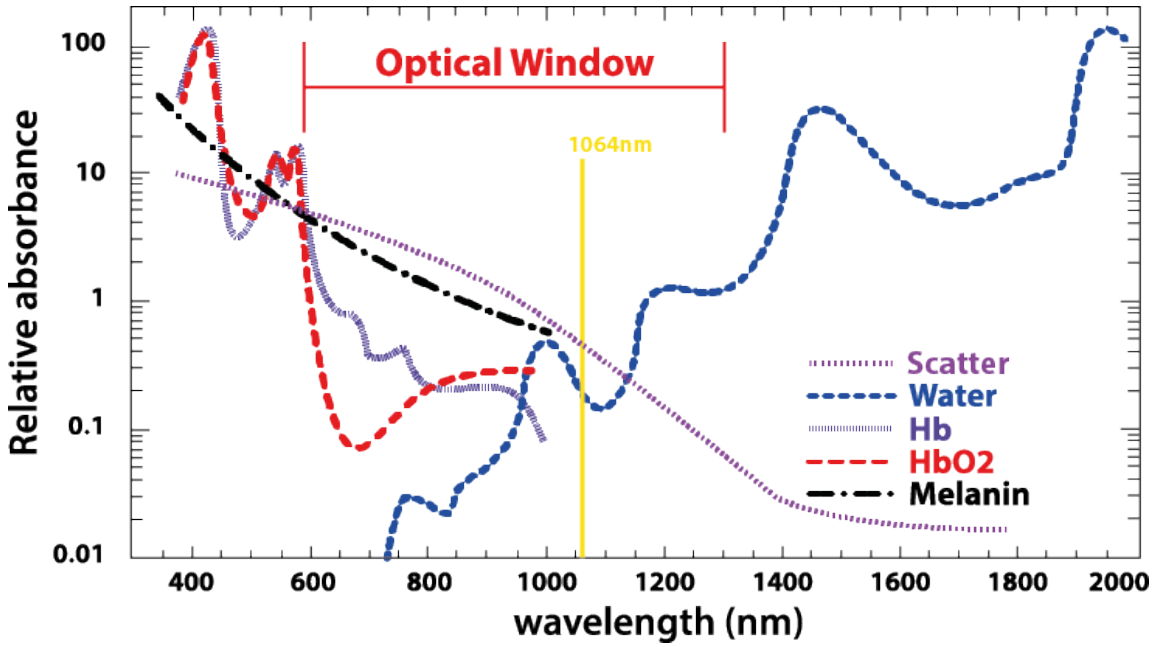
980 nm

When combined with the E²C mode, ensure the right interaction with the peripheral nervous system, activating the Gate Control mechanism for a quick analgesic effect.

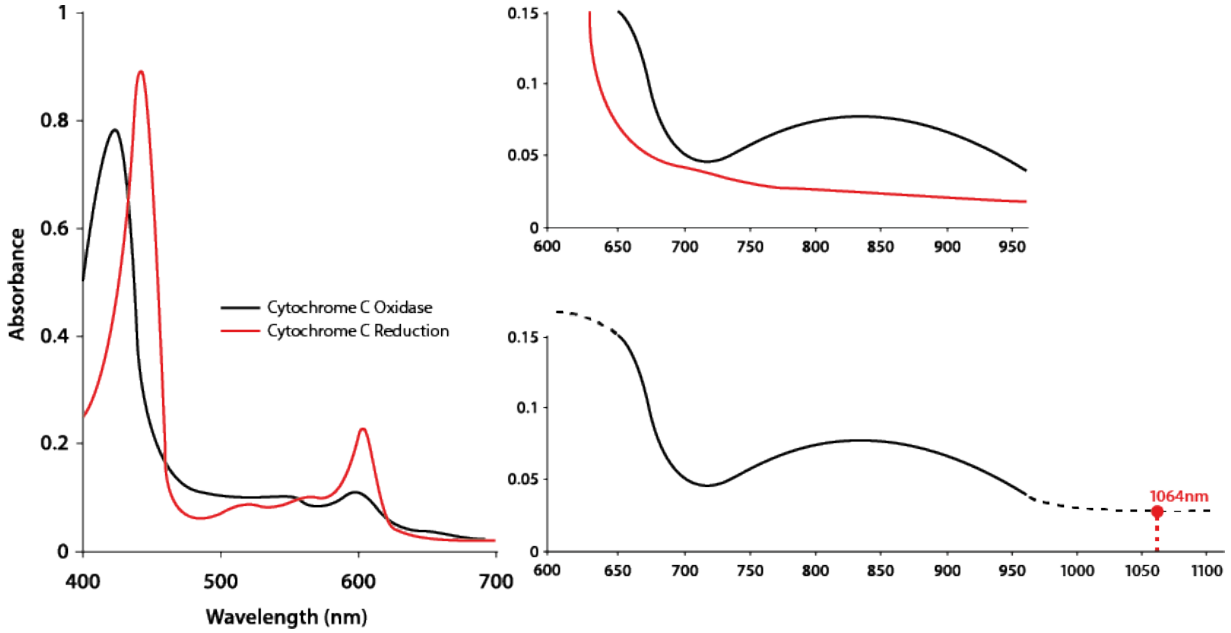


VI. Laser therapy: **The effects of therapeutic laser light**

1064 nm: Its high directionality allows to convey the correct dose of energy directly to the noxa.



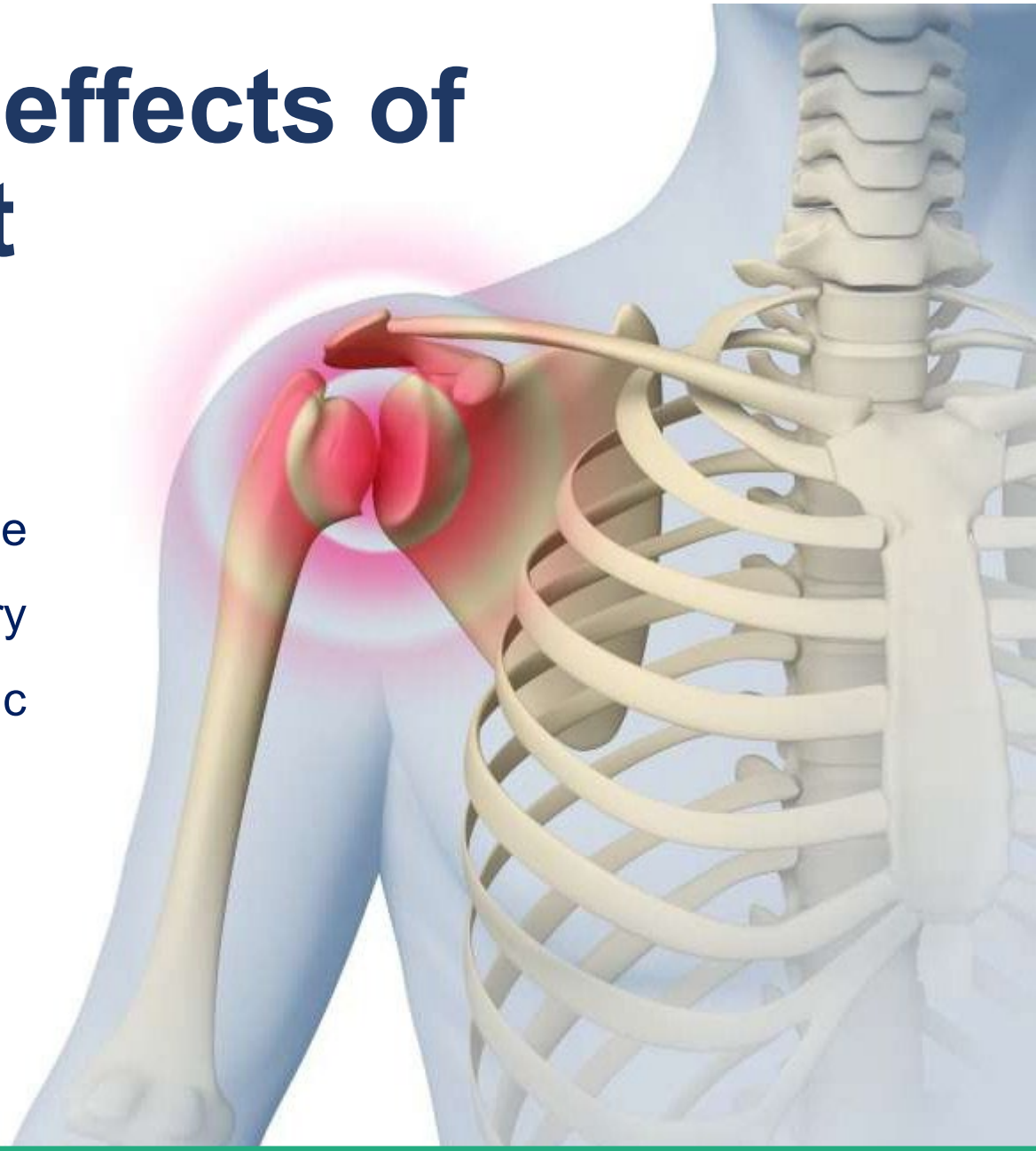
"Mechanisms of low level light therapy" (2006)
Proc. of SPIE Vol. 6140 614001-1 - M. HAMBLIN, T. DEMIDOVA



"Re-evaluation of the near infrared spectra of mitochondrial cytochrome c oxidase: Implications for non invasive in vivo monitoring of tissues"
(2014) BBA Bioenergetics - G.MASON, P. NICHOLLS, E. COOPER

Mectronic

VI. Laser therapy: **The effects of therapeutic laser light**



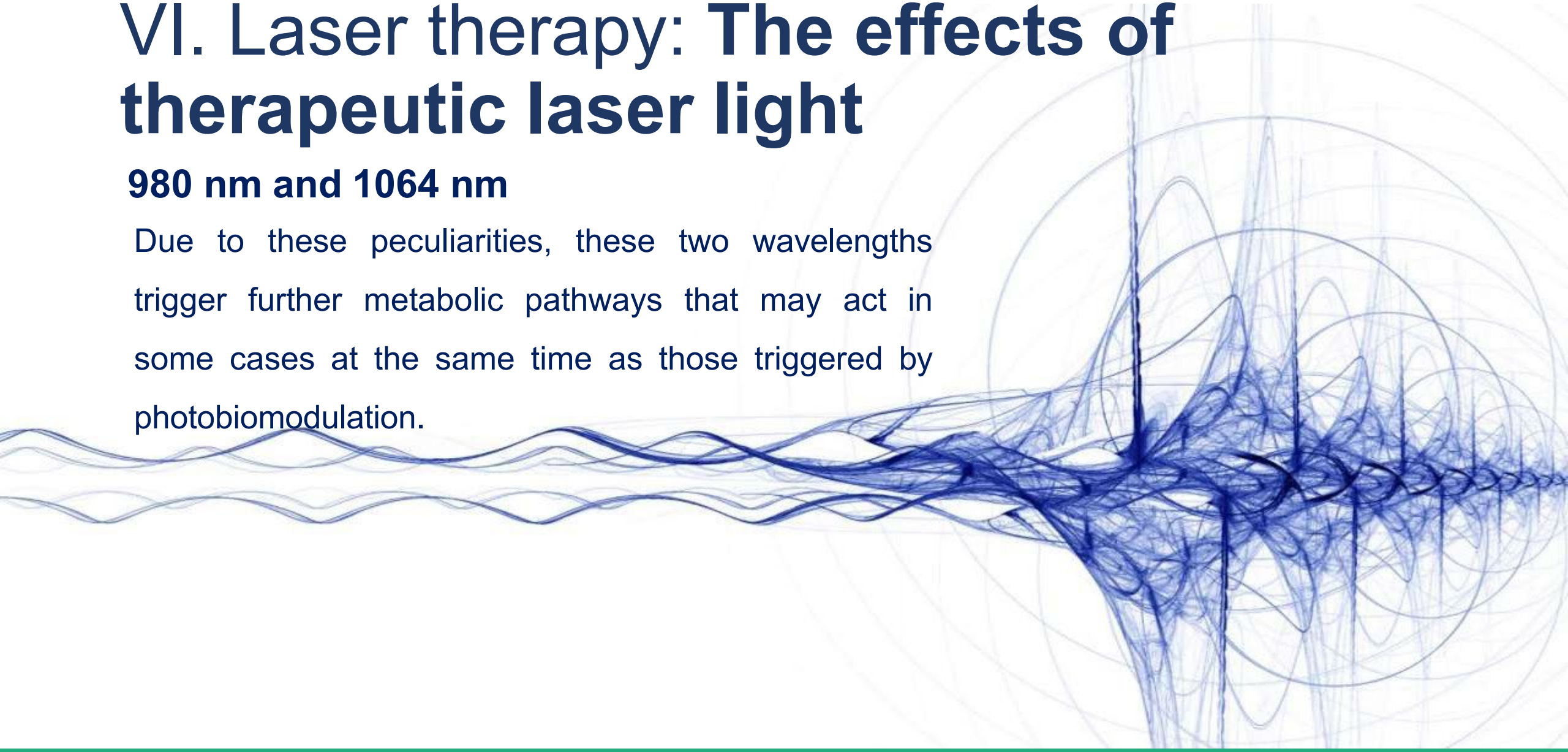
1064 nm

The result is a perfect synergy that harmonizes the rapid analgesic effect with a control of inflammatory processes and the deep activation of vital metabolic processes for all cellular activities.

VI. Laser therapy: **The effects of therapeutic laser light**

980 nm and 1064 nm

Due to these peculiarities, these two wavelengths trigger further metabolic pathways that may act in some cases at the same time as those triggered by photobiomodulation.

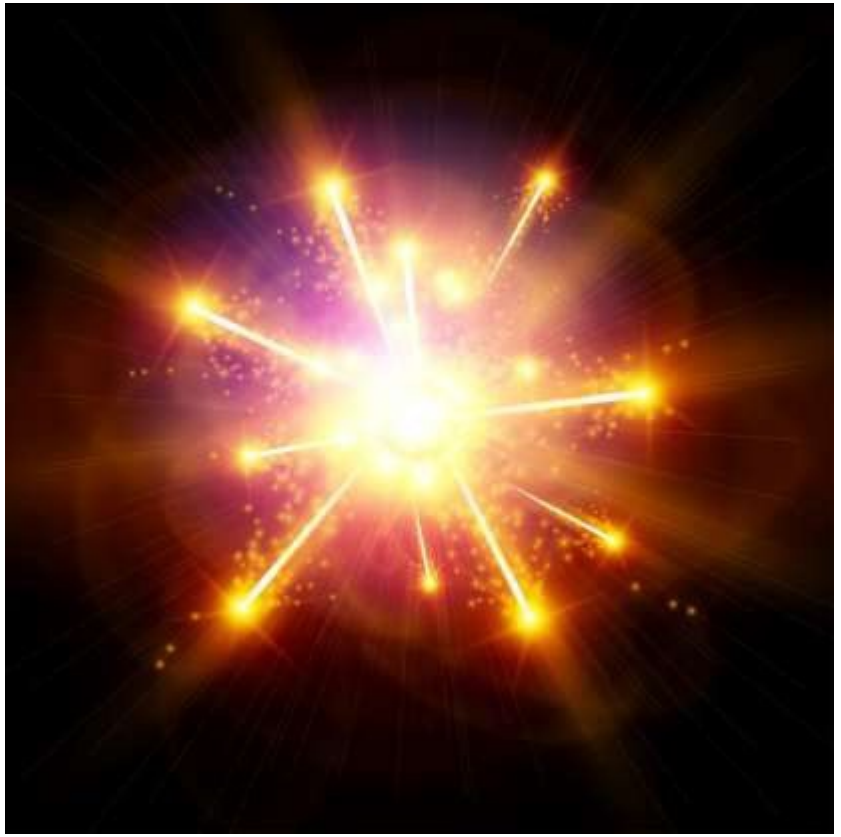


VI. Laser therapy: **The effects of therapeutic laser light**

PHOTOTHERMAL EFFECT

PROLIFE

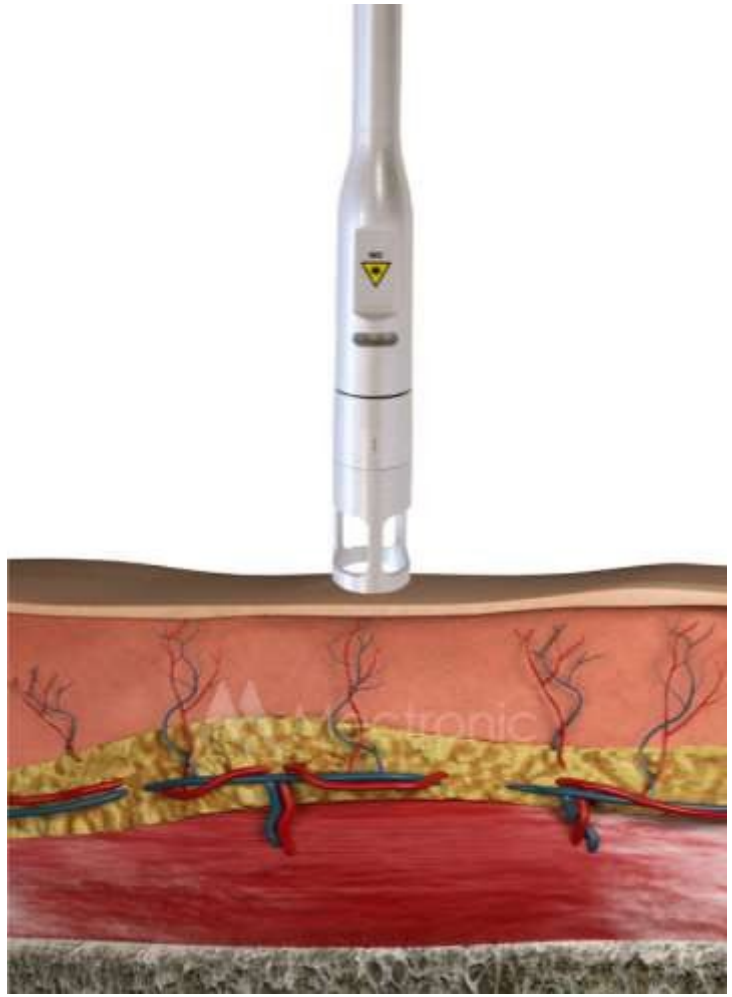
VI. Laser therapy: **The effects of therapeutic laser light**



The laser light interacts with the tissue transforming the light energy in heat.

VI. Laser therapy: **The effects of therapeutic laser light**

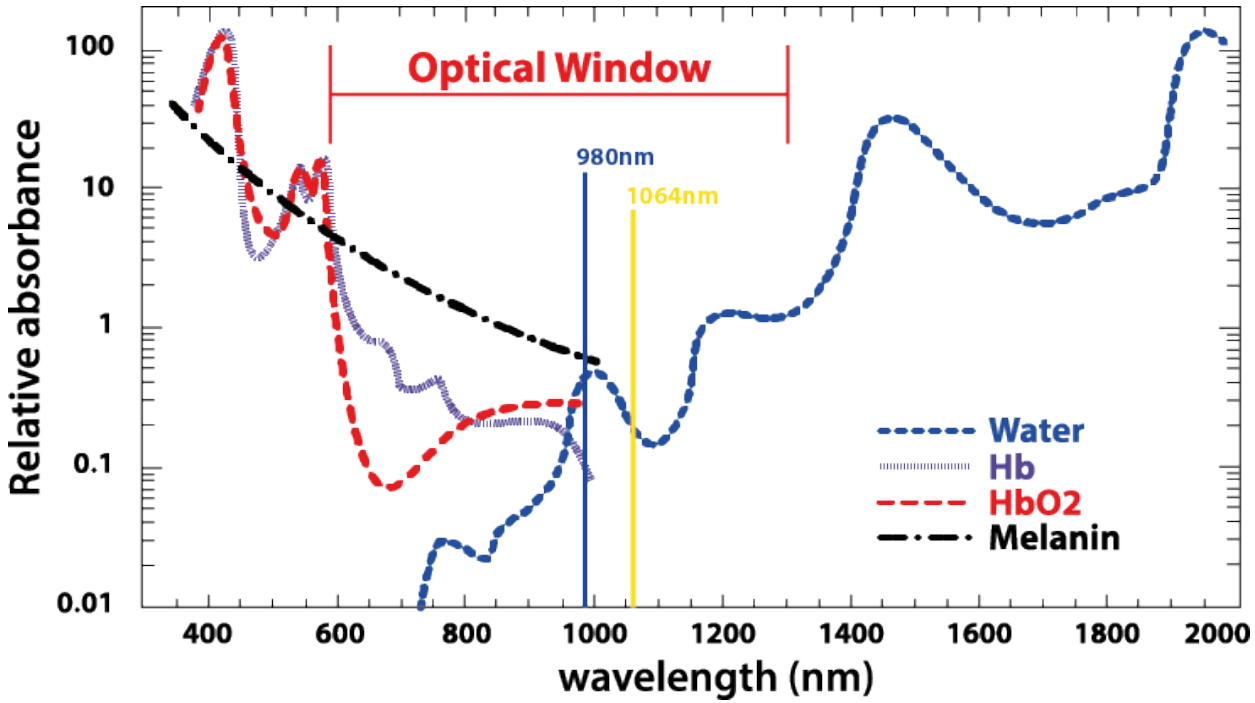
The thermal gradient created increases the blood flow at the local level.



VI. Laser therapy: **The effects of therapeutic laser light**

All the wavelengths of the therapeutic window applied with a sufficiently high-power density allow to obtain a photothermal effect.

Among these the 980nm, having a peak of absorption on the water, at the same power can create a greater thermal gradient.

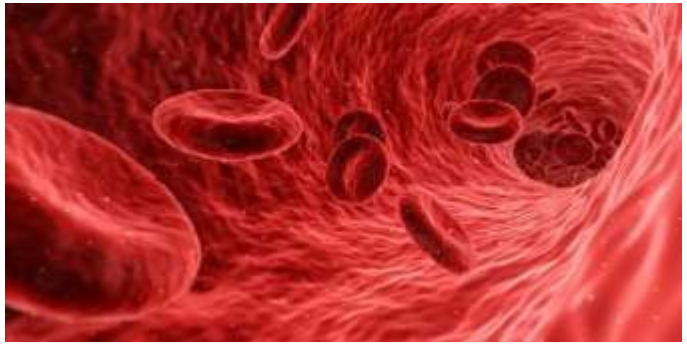


"Mechanisms of low-level light therapy" (2006)
Proc. of SPIE Vol. 6140 614001-1 - M. HAMBLIN, T. DEMIDOVA

VI. Laser therapy: **The effects of therapeutic laser light**

Effects associated with the photothermal action:

Decontracting

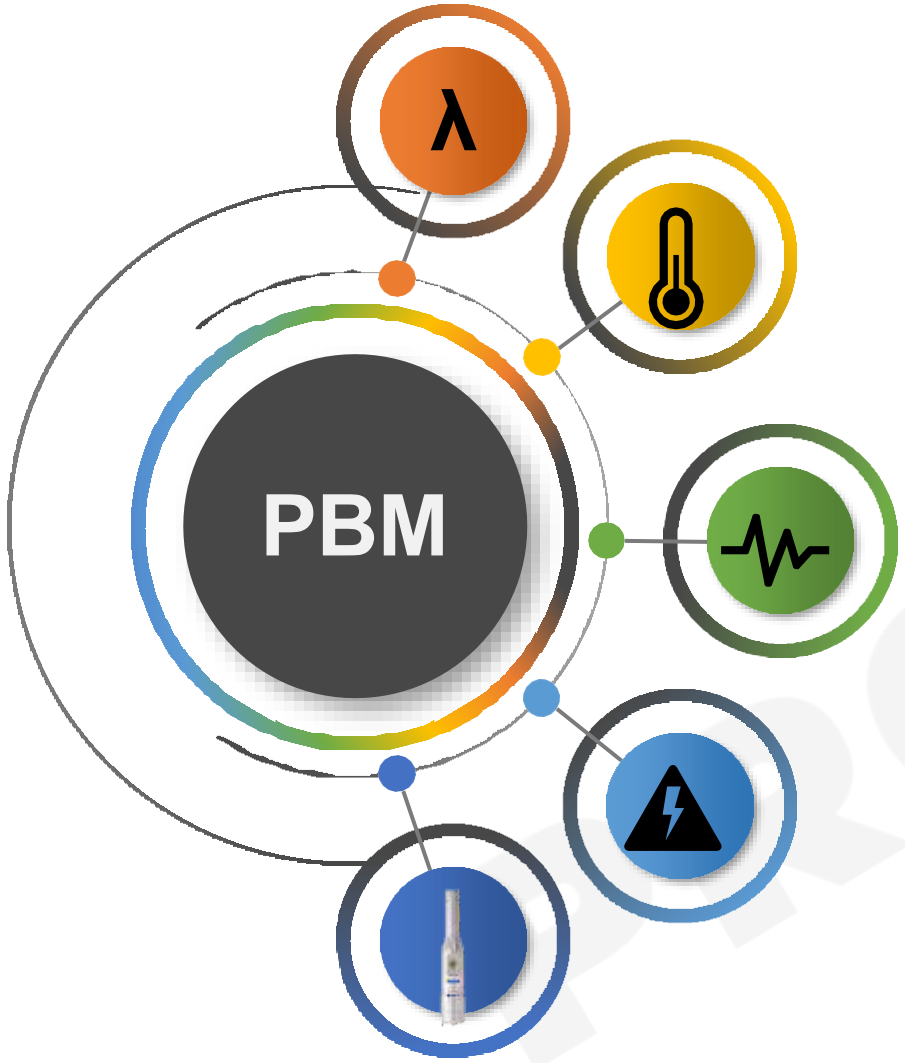


Anti-edema

Muscle relaxant

PART TWO:
HOW TO MAKE PBM MORE EFFICENT?

PROFILE



- Wavelengths
- Thermal control
- Emission mode
- High Average Power
- Correct transfer method

PROLIFE

I. PBM: **Which wavelengths can make it more efficient?**

Does the **Cytochrome C Oxidase** absorb all the wavelengths of the therapeutic window in the same way?

NO!

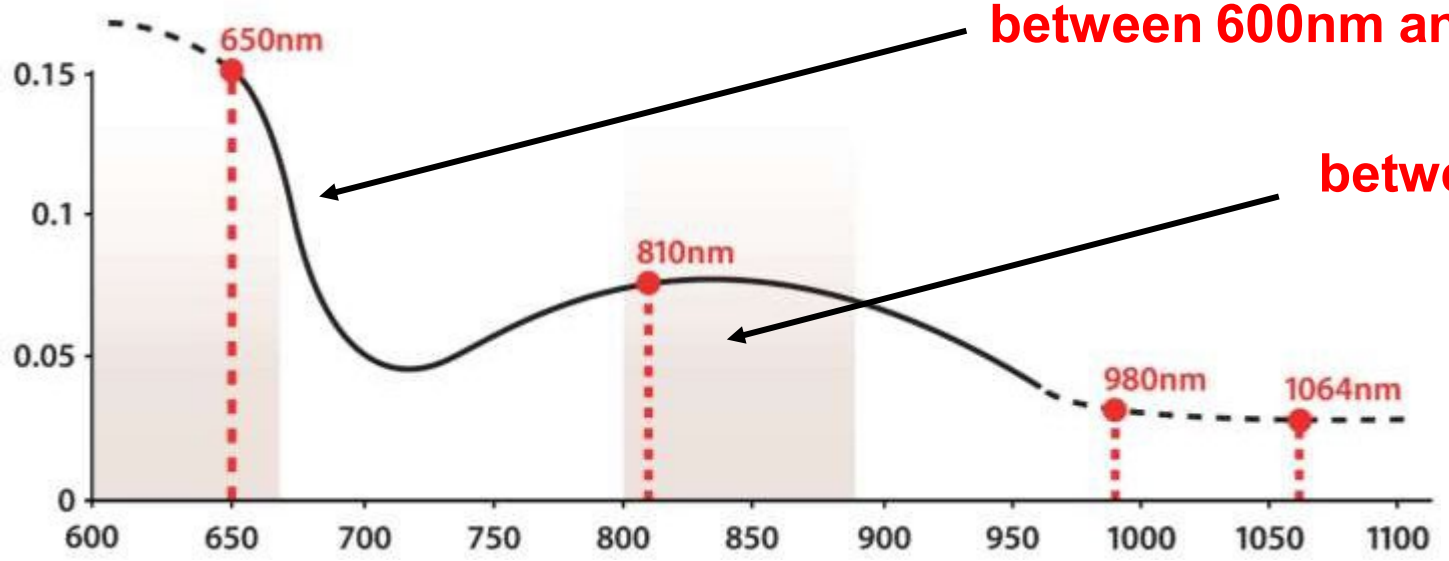
I. PBM: **Which wavelengths can make it more efficient?**

"Multiple Roles of Cytochrome c Oxidase in Mammalian Cells Under Action of Red and IR-A Radiation» (2010) IUBMB LIFE - **T. I. KARU**

There are numerous studies that explain **Photobiomodulation**. **Tina Karu** is one of the most important expert and reseacher of the phenomenon of light absorption on **Cytochrome C Oxidase**.

I. PBM: **Which wavelengths can make it more efficient?**

Several studies show how **Cytochrome C Oxidase** mainly absorbs laser light:



between 600nm and 670 nm

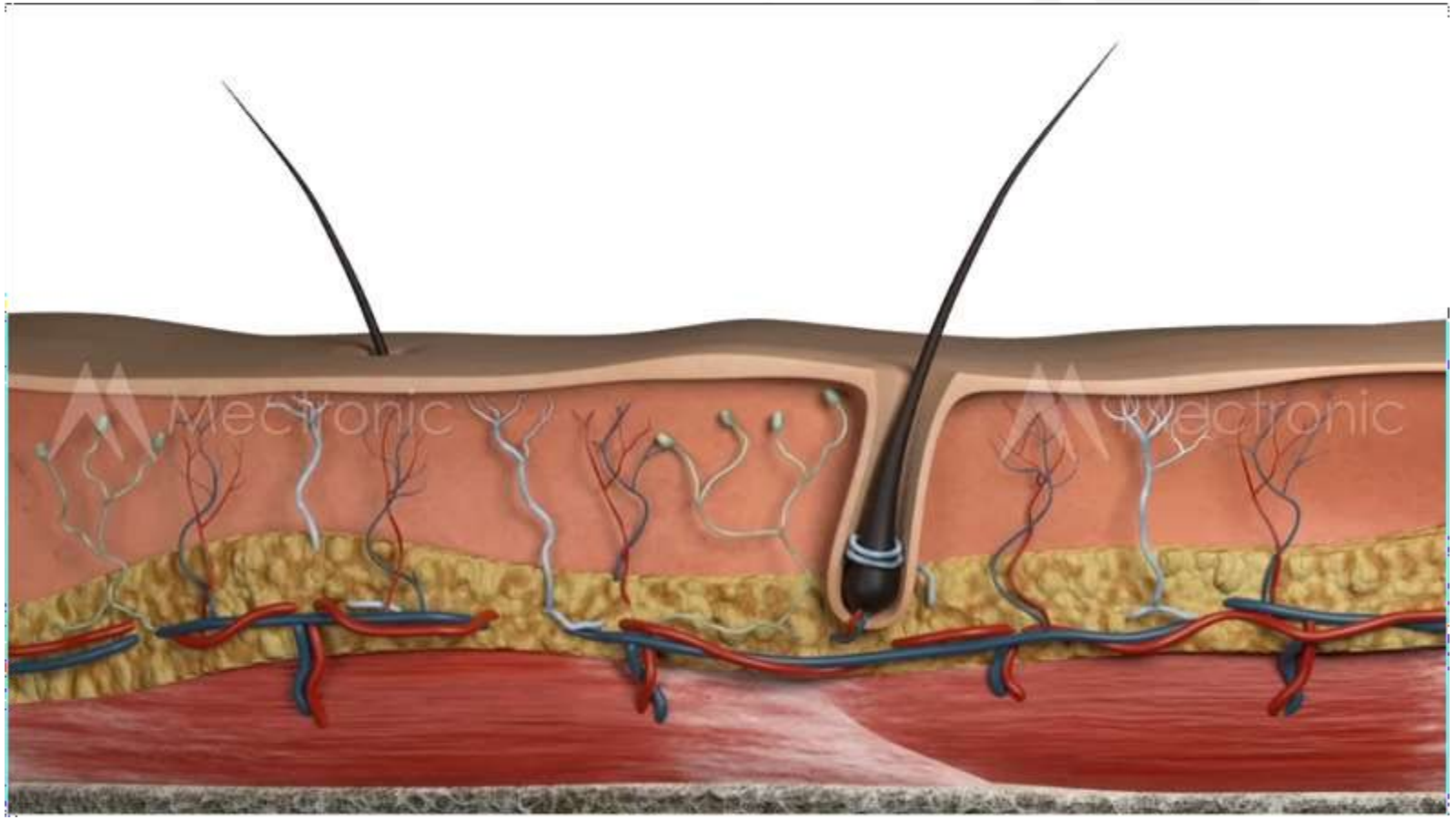
between 780nm and 880nm

"Re-evaluation of the near infrared spectra of mitochondrial cytochrome c oxidase: Implications for non invasive in vivo monitoring of tissues"
BBA Bioenergetics - (2014) G.MASON, P. NICHOLLS, E. COOPER

I. PBM: **Which wavelengths can make it more efficient?**

Numerous scientific articles have shown how the wavelengths in the range **600 nm - 670 nm** and in the range **780 nm - 880 nm** are more absorbed by the main **photoacceptor** of laser therapy (Cytochrome C Oxidase) and therefore make it possible to make **photobiomodulation** (PBM) more efficient.

I. PBM: **Which wavelengths can make it more efficient?**



I. PBM: **Which wavelengths can make it more efficient?**

Other wavelengths within the therapeutic window (for example 980 nm and 1064 nm), although less absorbed by the Cytochrome C oxidase, are useful because they guarantee excellent interaction with thermo- and mechanoreceptors.

- **980 nm: the most absorbed by water within the therapeutic window**
- **1064 nm: less scattering and more directional**

II. PBM: **Which emission mode can make it more efficient?**

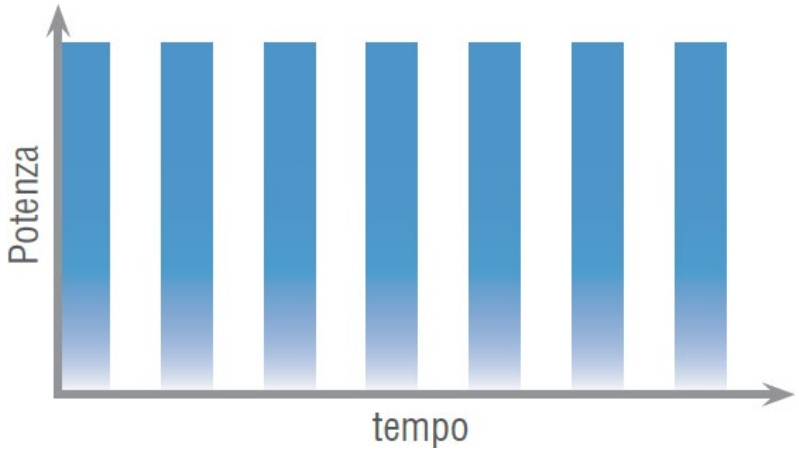
It has been demonstrated that the optimal laser emission to trigger photobiomodulation must be **continuous or pulsed with a pulse duration of at least a few milliseconds (10^{-3} seconds)**, as stated by Hamblin, in 2010 in the article “Effect of Pulsing in Low-Level Light Therapy”.

II. PBM: **Which emission mode can make it more efficient?**

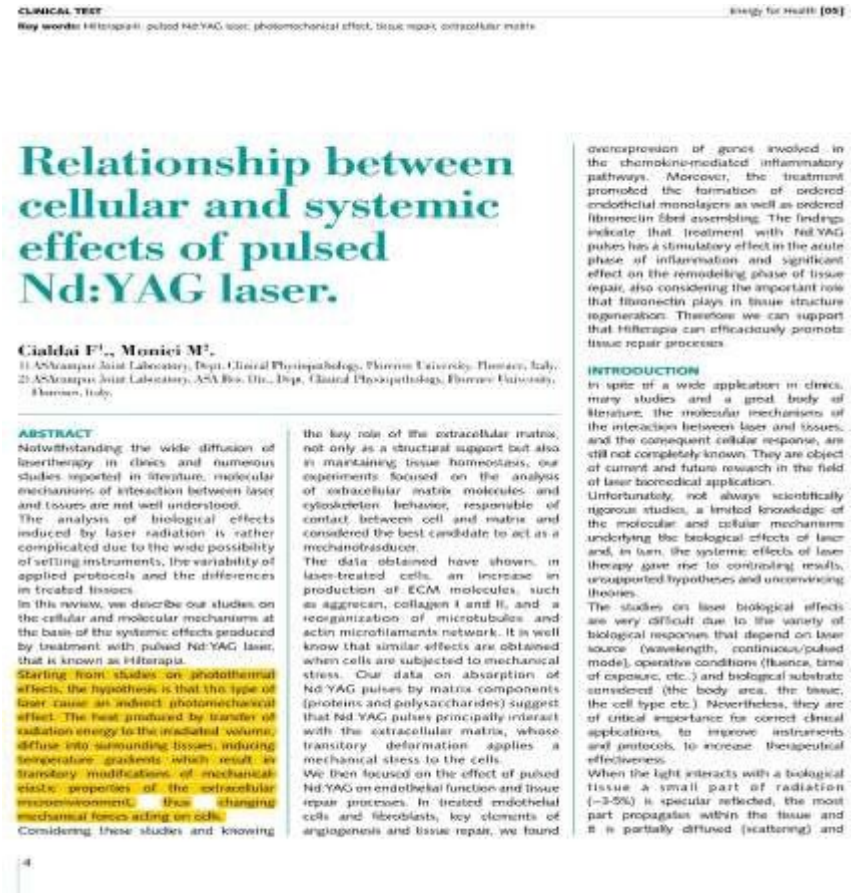
ATTENTION !!!

SUPERPULSED LASER: pulse duration microseconds (s 10^{-6}) nanoseconds (s 10^{-9})

Pulse duration



II. PBM: **Which emission mode can make it more efficient?**



CLINICAL TEST

Key words: Hiterapia®, pulsed Nd:YAG laser, photomechanical effect, tissue repair, extracellular matrix

Relationship between cellular and systemic effects of pulsed Nd:YAG laser.

Cialdai F[1]., Monici M[2].

1) ASTRAMPO Joint Laboratory, Dept. Clinical Physiopathology, Florence University, Florence, Italy.
2) ASTRAMPO Joint Laboratory, ASA Bio. Uic., Dept. Clinical Physiopathology, Florence University, Florence, Italy.

ABSTRACT

Notwithstanding the wide diffusion of laserotherapy in clinics and numerous studies reported in literature, molecular mechanisms of interaction between laser and tissues are not well understood.

The analysis of biological effects induced by laser radiation is rather complicated due to the wide possibility of setting instruments, the variability of applied protocols and the differences in treated tissues.

In this review, we describe our studies on the cellular and molecular mechanisms at the basis of the systemic effects produced by treatment with pulsed Nd:YAG laser, that is known as Hiterapia.

Starting from studies on photothermal effects, the hypothesis is that this type of laser cause an indirect photomechanical effect. The heat produced by transfer of radiation energy to the irradiated volume, diffuse into surrounding tissues, inducing temperature gradients which result in transitory modifications of mechanical-elastic properties of the extracellular microenvironment, thus changing mechanical forces acting on cells.

Considering these studies and knowing the key role of the extracellular matrix, not only as a structural support but also in maintaining tissue homeostasis, our experiments focused on the analysis of extracellular matrix molecules and cytoskeleton behavior, responsible of contact between cell and matrix and considered the best candidate to act as a mechanotrasducer.

The data obtained have shown, in laser-treated cells, an increase in production of ECM molecules, such as aggrecan, collagen I and II, and a reorganization of microtubules and actin microfilaments network. It is well know that similar effects are obtained when cells are subjected to mechanical stress. Our data on absorption of Nd:YAG pulses by matrix components (proteins and polysaccharides) suggest that Nd:YAG pulses principally interact with the extracellular matrix, whose transitory deformation applies a mechanical stress to the cells.

We then focused on the effect of pulsed Nd:YAG on endothelial function and tissue repair processes. In treated endothelial cells and fibroblasts, key elements of angiogenesis and tissue repair, we found overexpression of genes involved in the chemokine-mediated inflammatory pathways. Moreover, the treatment promoted the formation of ordered endothelial monolayers as well as ordered fibronectin fibril assembling. The findings indicate that treatment with Nd:YAG pulses has a stimulatory effect in the acute phase of inflammation and significant effect on the remodeling phase of tissue repair, also considering the important role that fibronectin plays in tissue structure regeneration. Therefore we can support that Hiterapia can efficaciously promote tissue repair processes.

INTRODUCTION

In spite of a wide application in clinics, many studies and a good body of literature, the molecular mechanisms of the interaction between laser and tissues, and the consequent cellular response, are still not completely known. They are object of current and future research in the field of laser biomedical application.

Unfortunately, not always scientifically rigorous studies, a limited knowledge of the molecular and cellular mechanisms underlying the biological effects of laser and, in turn, the systemic effects of laser therapy gave rise to controversy results, unsupported hypotheses and unconvincing theories.

The studies on laser biological effects are very difficult due to the variety of biological responses that depend on laser source (wavelength, continuous/pulsed mode), operative conditions (fluence, time of exposure, etc..) and biological substrate considered (the body area, the tissue, the cell type etc.). Nevertheless, they are of critical importance for correct clinical applications, to improve instruments and protocols, to increase therapeutical effectiveness.

When the light interacts with a biological tissue a small part of radiation (~3-5%) is specular reflected, the most part propagates within the tissue and it is partially diffused (scattering) and

4

"Relationship between cellular and systemic effects of pulsed Nd:YAG laser."
CIALDAI F., MONICI M.

Starting from studies on photothermal effects, the hypothesis is that this type of laser cause an indirect photomechanical effect. The heat produced by transfer of radiation energy to the irradiated volume, diffuse into surrounding tissues, inducing temperature gradients which result in transitory modifications of mechanical-elastic properties of the extracellular microenvironment, thus changing mechanical forces acting on cells.

Mectronic

II. PBM: **Which emission mode can make it more efficient?**

CLINICAL TEST

Key words: Photomechanical stress, pulsed Nd:YAG laser, connective tissue, extracellular matrix, Hilterapia®

Effects of pulsed Nd: YAG laser at molecular and cellular level. A study on the basis of Hilterapia®.

Monici M.[1], Cialdai F.[1], Fusi F.[1], Romano G.[2], Pratesi R.[3]

"Effects of pulsed Nd: YAG laser at molecular and cellular level. A study on the basis of Hilterapia."

MONICI M., CIALDAI F., FUSI F., ROMANO G., PRATESI R.

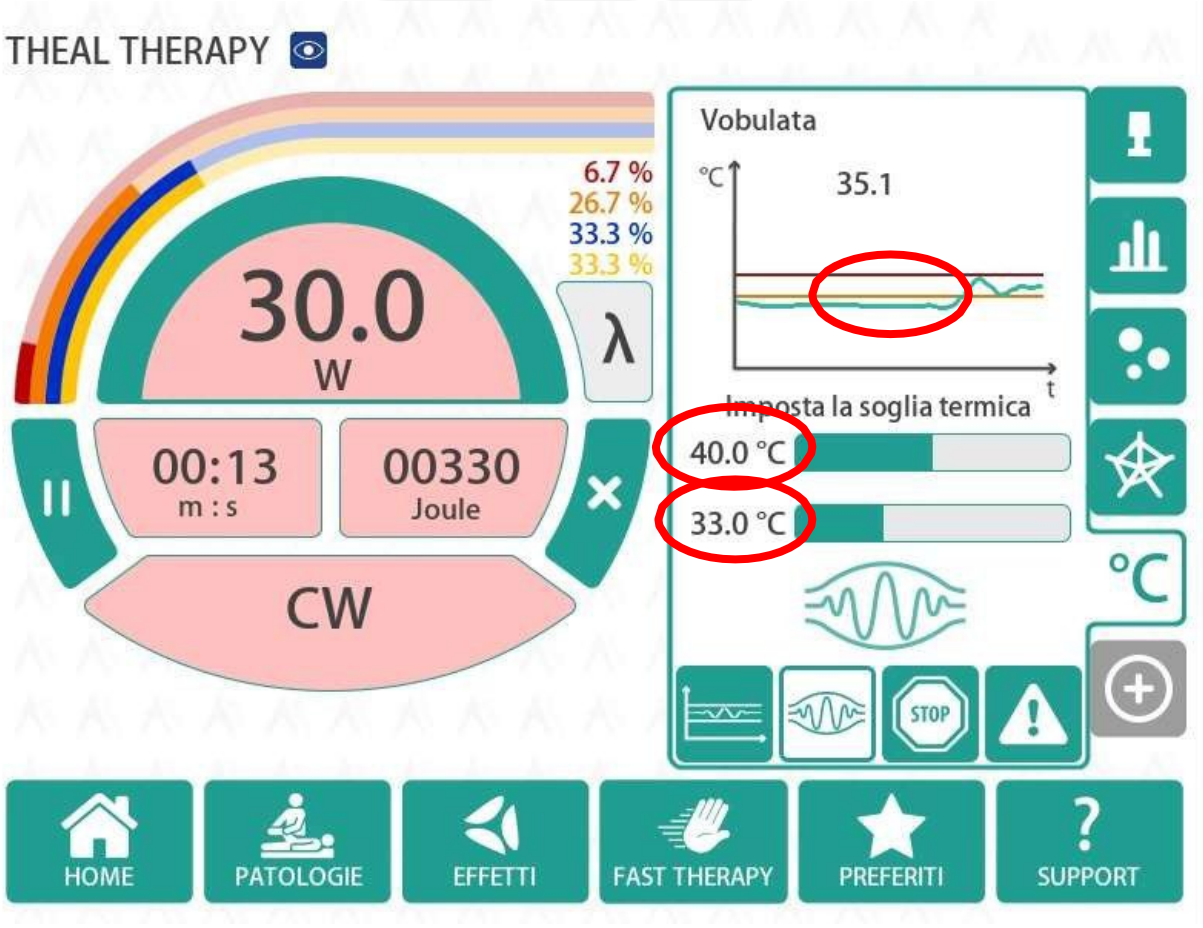
Owing to the lack of chromophores efficiently absorbing Nd:YAG radiation (wavelength 1064 nm) in cells and tissues, we hypothesized that, rather than photochemical processes, aspecific mechanisms probably due to combined photothermal and photomechanical interactions could be responsible for the above mentioned effects of pulsed Nd:YAG laser.

In conclusion, our results demonstrate that the effects of Nd:YAG pulses on culture cells are very similar to those induced by mechanical stress, thus supporting our

III. PBM: **Is a temperature control system necessary?**

Photobiomodulation is a **non-thermal** or **moderately thermal** process. It is essential to monitor the temperature of biological tissues during laser therapy and modulate the laser therapy according to the thermal response of biological tissues (**Vobulate Thermal Control**).

III. PBM: **Is a temperature control system necessary?**



III. PBM: **Is a temperature control system necessary?**

III. PBM: **Is a temperature control system necessary?**

- Treatment of pathologies in the acute phase
- Control of the excessive vascularization of the transition tissues to limit the effects of exacerbation or avoid possible blood effusions in case of micro lesions
- Treatment of neuropathies
- Greater safety in the treatment of dark skin types and tattoos

IV. PBM: **The correct dose**

PHOTOMEDICINE AND LASER SURGERY

Mary Ann Liebert, Inc. publishers

Journals | Search | Alerts

Photomed Laser Surg. 2013 May; 31(5): 189–191.
doi: 10.1089/pho.2013.3510
PMCID: PMC3643261
PMID: 23600376

Is It Time to Consider Photobiomodulation As a Drug Equivalent?

Tiina Karu, PhD, DrSci

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This article has been cited by other articles in PMC.

The question of whether photobiomodulation should be used as a drug equivalent arose in my mind after listening to presentations at the recent conference of the World Association for Laser Therapy (WALT)-2012 (Gold Cost City, Australia), and later at home when searching MEDLINE® for the years 2009–2012. Photobiomodulation (earlier terms: low level laser therapy, LLLT, laser biostimulation) has been used in clinical practice for >40 years by now, and its action mechanisms on cellular and molecular levels have been studied for >30 years. Enthusiastic medical specialists successfully used photobiomodulation in treating healing-resistant wounds and ulcers (e.g., chronic diabetic ulcers), in pain management, and in spinal cord and nervous system injuries when other methods had had limited success.[1] However, photobiomodulation is still not a part of mainstream medicine. The goal of the present Editorial is to highlight some important recent developments in clinical applications and in studies of cellular and molecular mechanisms behind the clinical findings.

Is it Time to Consider Photobiomodulation As a Drug Equivalent?

Photomedicine and Laser Surgery (2013)

T.Karu

Mectronic

IV. PBM: **The correct dose**

The **dose** is the determined quantity of a substance, in relation to an effect to be achieved directly or through the presence of other substances in reciprocal quantitative relationship.

In the rehabilitation field, we mean **the amount of energy needed to induce cellular metabolic activity.**

The energy dose can be insufficient, effective or toxic.

IV. PBM: **The correct dose**

In order to precisely define the calculation of the therapeutic dose we must consider the following physical quantities:

1) Average Power (W)

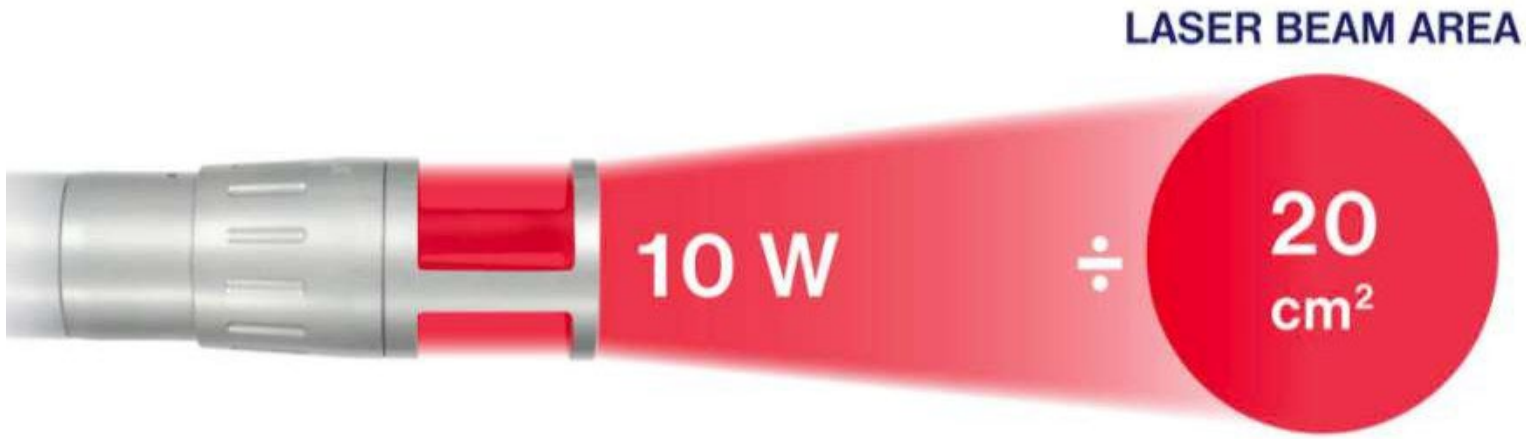
2) Laser Beam Area (cm^2)

(Average Power / Laser Beam Area) = POWER DENSITY (W/ cm^2)

IV. PBM: **The correct dose**

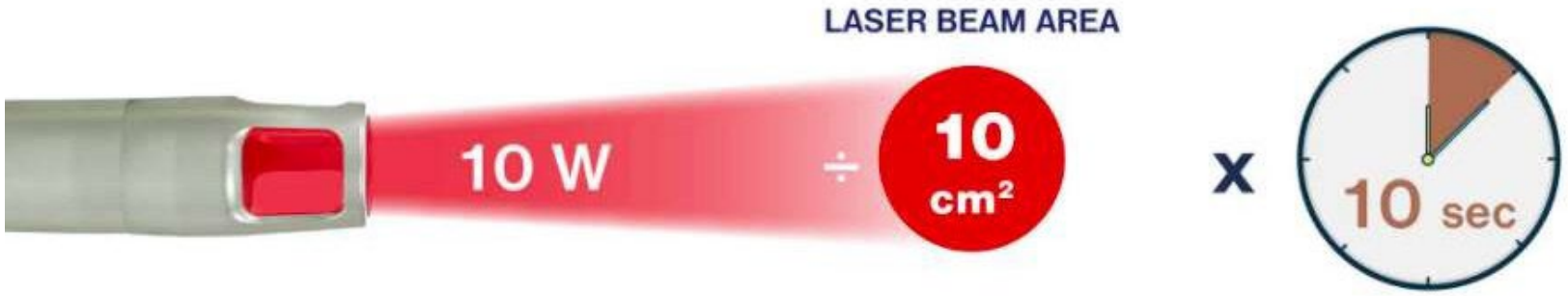
$$\text{POWER DENSITY (IRRADIANCE)} = \frac{\text{AVERAGE POWER (W)}}{\text{LASER BEAM AREA (cm}^2\text{)}} = \frac{10\ \text{W}}{10\ \text{cm}^2} = 1\ \text{W/cm}^2$$

IV. PBM: **The correct dose**



$$\text{POWER DENSITY (IRRADIANCE)} = \frac{\text{AVERAGE POWER (W)}}{\text{LASER BEAM AREA (cm}^2\text{)}} = \frac{10\ \text{W}}{20\ \text{cm}^2} = 0.5\ \text{W/cm}^2$$

IV. PBM: **The correct dose**



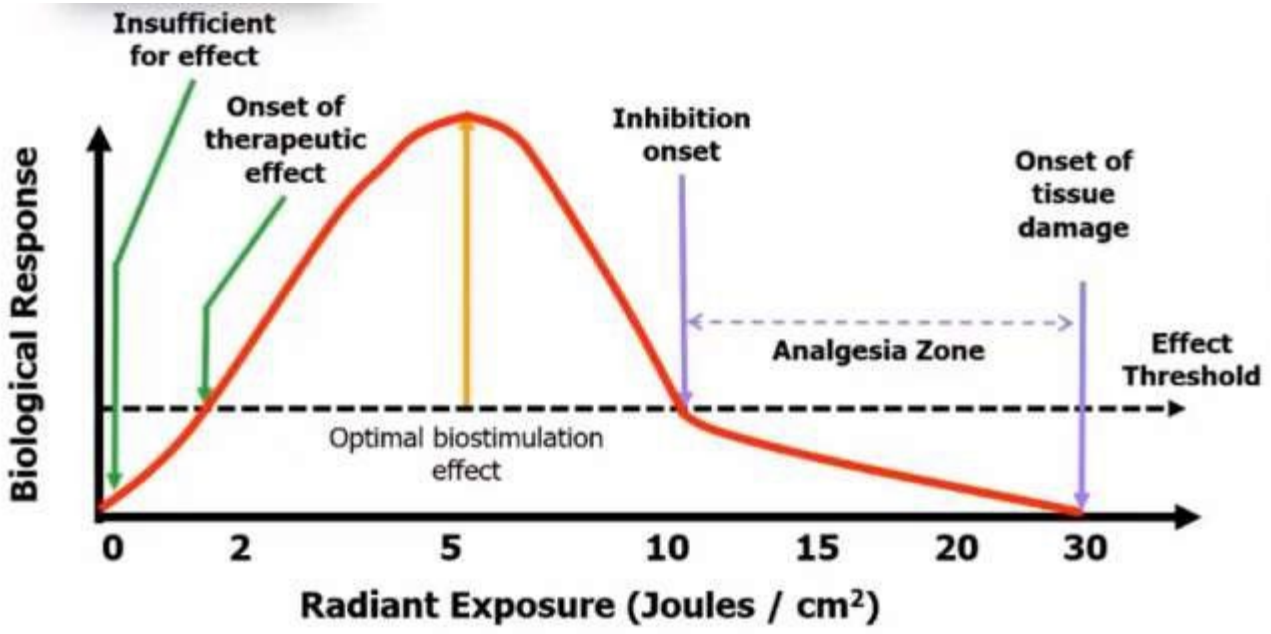
DOSE = POWER DENSITY X EXPOSURE TIME

$$\frac{\text{AVERAGE POWER (W)}}{\text{LASER BEAM AREA (cm}^2\text{)}} \times \text{EXPOSURE TIME (sec)} = \frac{\text{J}}{\text{sec x cm}^2} \times \text{sec} = \frac{\text{J}}{\text{cm}^2} = 10\ \frac{\text{J}}{\text{cm}^2}$$

APPLIED ENERGY = DOSE X AREA = $\frac{\text{J}}{\text{cm}^2} \times \text{cm}^2 = 100\ \text{J}$

Mectronic

IV. PBM: **The correct dose**



Photobiomodulation delivery parameters: an evidenced based approach

Photobiomodulation, photomedicine and Laser Surgery (2021)

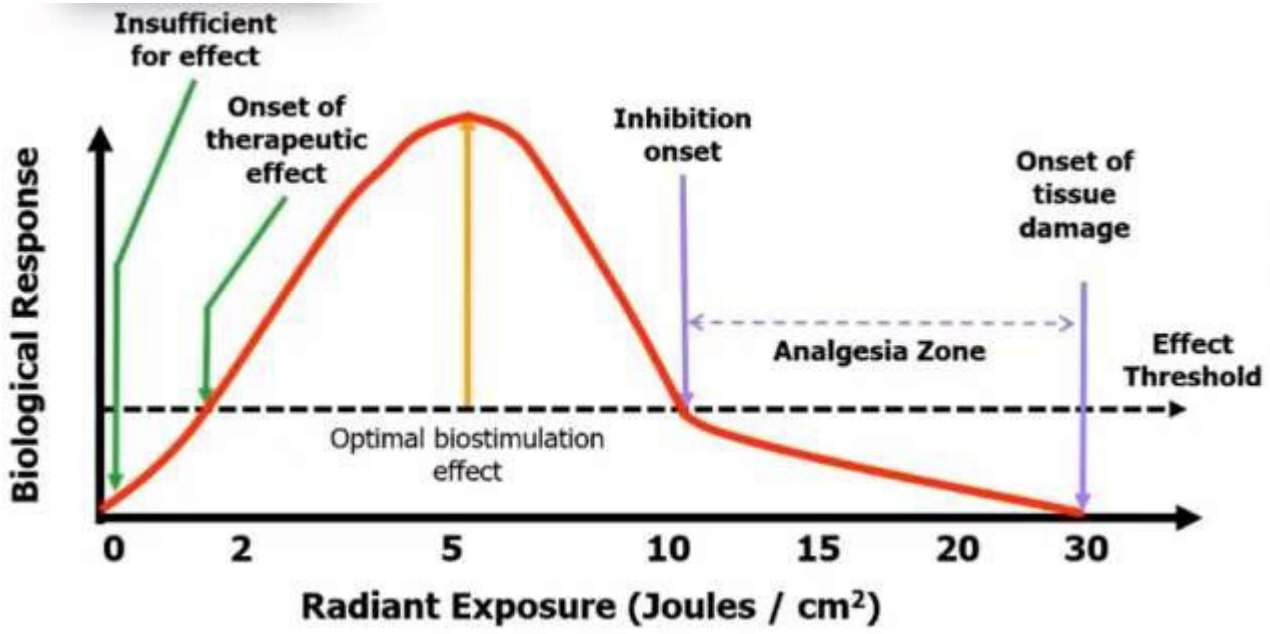
M.Grootveld, M. Cronshaw and S. Parker

Feeling the Heat: Evolutionary and Microbial Basis for the Analgesic Mechanisms of Photobiomodulation Therapy

Photobiomodulation, photomedicine and Laser Surgery (2019)

M. Cronshaw, S. Parker and P. Arany

IV. PBM: **The correct dose**



HEALING

Superficial targets: 2 – 10 J/cm2 [best 5 J/cm2]

Deeper structures (to 1cm): 20 – 100 J/cm2 [best 50 J/cm2]

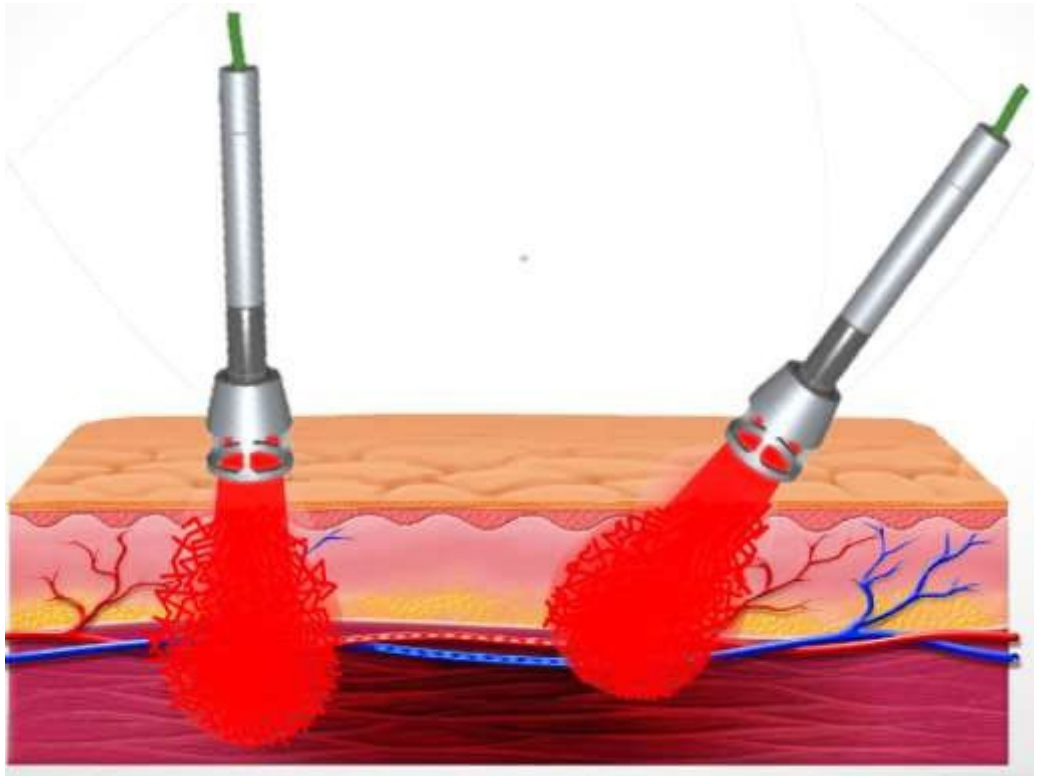
ANALGESIA AND ANTI-INFLAMATORY

Superficial targets: 10 – 30 J/cm2

Deeper structures (to 1cm): 100 – 300 J/cm2

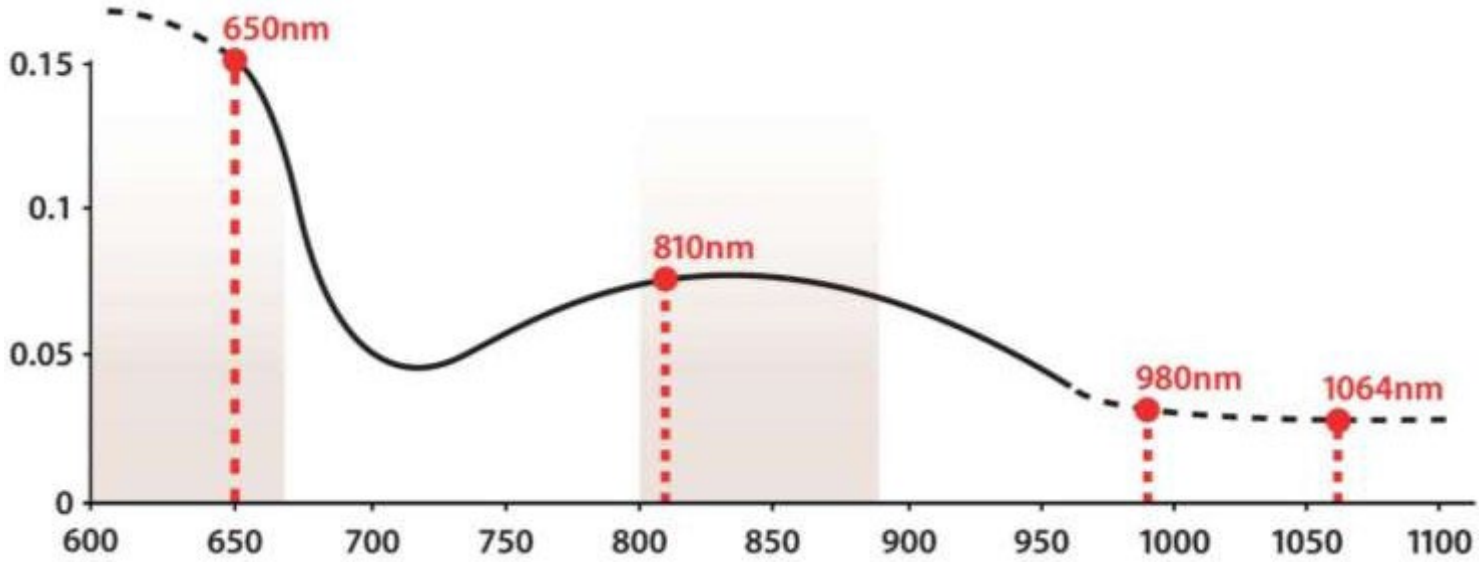
V. Summary: **How to make PBM more efficient?**

1. **CORRECT TRANSFER METHOD** (Orthogonality)



V. Summary: **How to make PBM more efficient?**

2. **WAVELENGTHS** in the range **600 nm - 670 nm** and **780 nm - 880 nm**



V. Summary: **How to make PBM more efficient?**

2. **WAVELENGTHS** in the range **600 nm - 670 nm** and **780 nm - 880 nm**

Wavelengths in the range **900 nm - 1100 nm** have an excellent interaction with thermo and mechanoreceptors.

- **4 WAVELENGTHS: 650 nm + 810 nm + 980 nm + 1064 nm**
- **Possibility to activate and deactivate the wavelengths**
- **Ability to create custom mixes**

V. Summary: **How to make PBM more efficient?**

3. **<u>Emission mode</u>**: **Continuous** or **pulsed emission** with a pulse duration of at least a few milliseconds (s 10^{-3})

ATTENTION !!!
SUPERPULSED LASER: pulse duration microseconds (s 10^{-6}) nanoseconds (s 10^{-9})

V. Summary: **How to make PBM more efficient?**

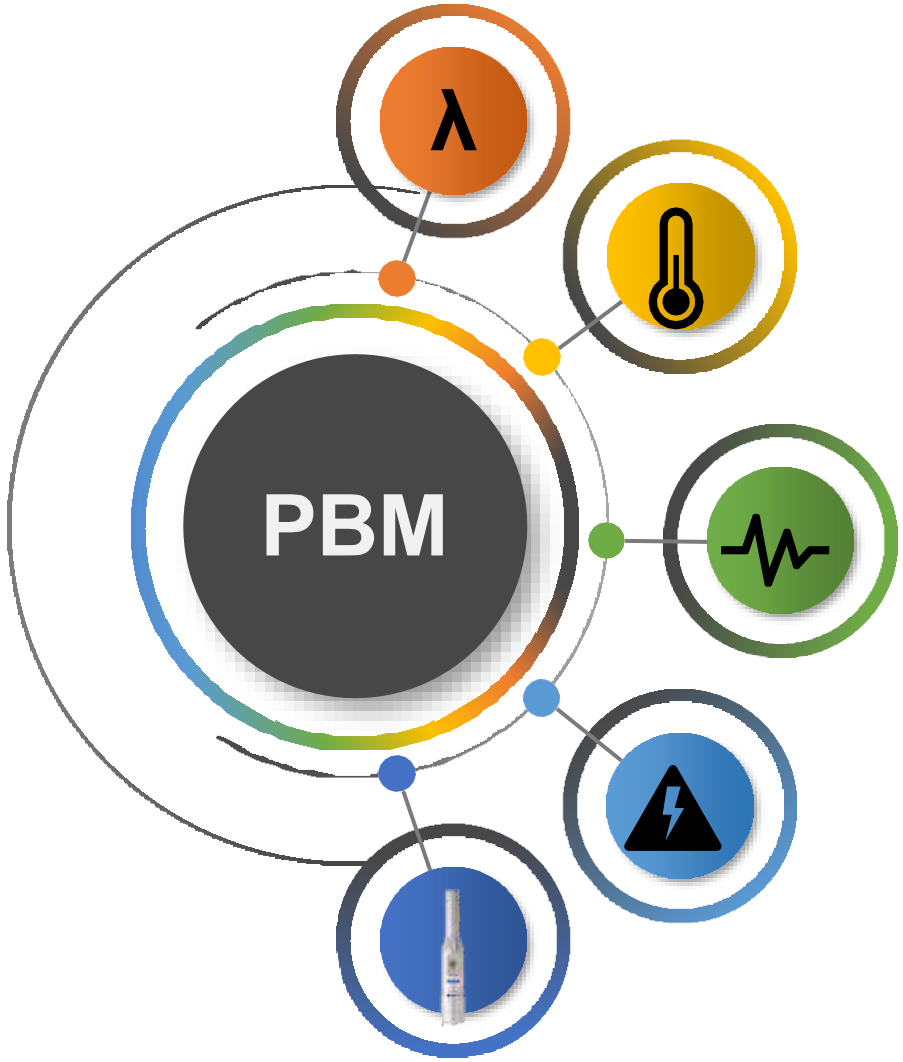
4. **THERMAL CONTROL**: it is not sufficient a thermal control, but it is necessary a precise and powerful thermal control. **Photobiomodulation** is a **non-thermal** or **moderately thermal** process. It is essential to monitor the temperature of biological tissues during laser therapy and modulate the laser therapy according to the thermal response of biological tissues (**Vobulate Thermal Control**).

V. Summary: **How to make PBM more efficient?**

5. HIGH AVERAGE POWER

High Average power → **High Energy in depth** → **High Depth of action**

High Average Power to bring the right dose to the biological tissue



Wavelengths

Wavelengths in the range
600 nm - 670 nm and
780 nm - 880 nm

Emission mode

Continuous or **pulsed emission** with a pulse duration of at least a few milliseconds

Correct transfer method

Reduce energy losses to always transfer the **correct dose** (orthogonal treatment)

Thermal control

Vobulate thermal control

High Average Power

PART THREE :
APPLICATION FIELDS

PROLIFE

DENTAL

- Herpes labialis
- Angular cheilitis
- Dental hygiene
- Ulcers
- Leukoplakia
- Mouth therapy
- ATM
- Conservative therapy
- Bactericide action

DENTAL

- Herpes labialis
- Angular cheilitis
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PODIATRY

- Onychomycosis
- Plantar warts
- Diabetic ulcers
- Vascular malleolus ulcers
- Foot pathologies

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- Onychomycosis
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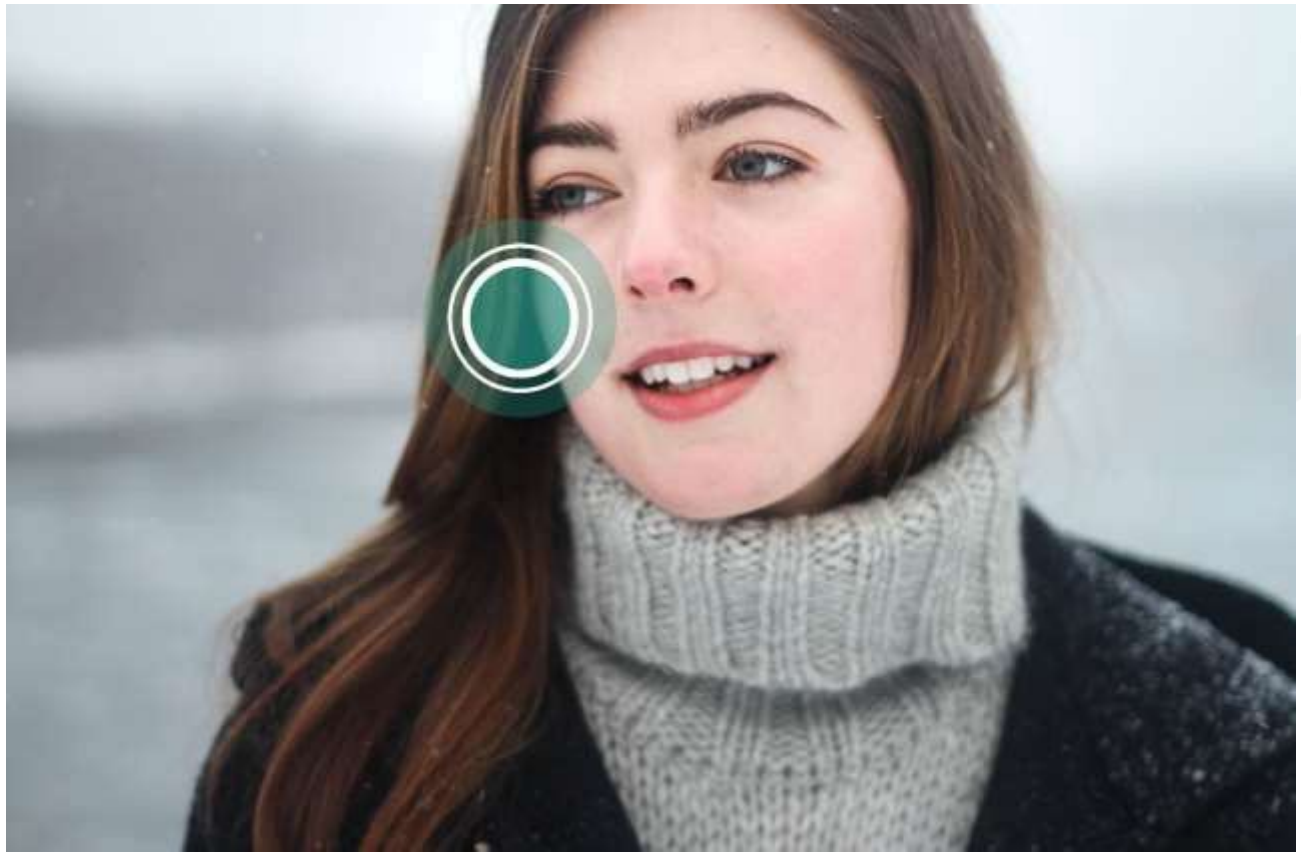
NEUROLOGICAL



DERMATOLOGY

SPORT

- Pain therapy
- Traumatology
- Accident prevention
- Accelerating physical recovery
- Fast elimination of edemas
- Physiological accelerator
- Muscular lesions
- Acute pathologies
- Tendinopathy

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- Muscular lesions
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REHABILITATION

- Pain therapy
- Acute and chronic pathologies
- Increased mobility
- Lymphatic drainage
- Traumatology
- Rheumatology
- Tissue repair and regeneration

REHABILITATION

- Pain therapy
- Acute and chronic pathologies
- Increased mobility
- Lymphatic drainage
- Traumatology
- Rheumatology
- Tissue repair and regeneration

DISC PATHOLOGIES

DISC PATHOLOGIES

WOUNDS

- Wounds
- Diabetic ulcers
- Vascular ulcers
- Decubitus ulcers and lesions

WOUNDS

- Wounds
- Diabetic ulcers
- Vascular ulcers
- Decubitus ulcers and lesions

WELLNESS

ACUTE TRAUMA

ACUTE TRAUMA

PART FOUR: TREATMENTS EXAMPLES

PROLIFE

Treatment examples

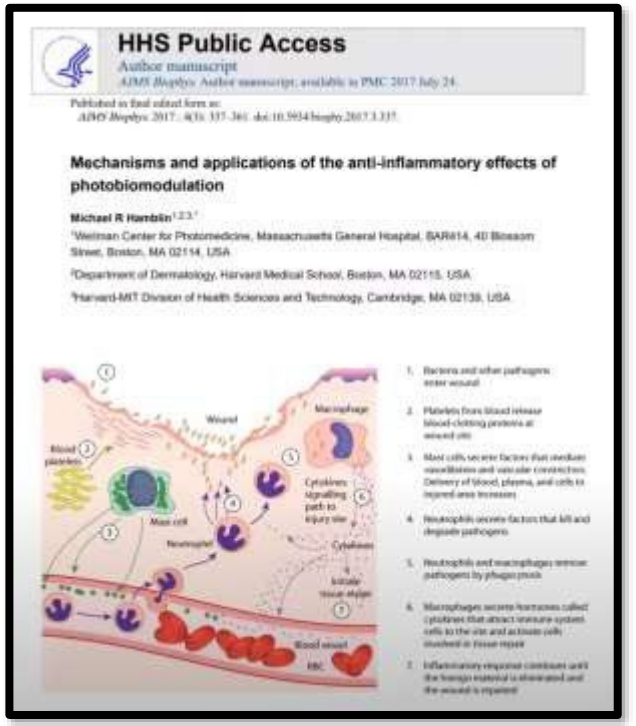
- INFLAMMATIONS
- NERVE REPAIR
- ŒDEMAS
- MUSCLE INJURIES
- TENDON INJURIES
- PAIN MANAGEMENT
- ACTIVE AND LATENT TRIGGER POINTS
- SPINE PATHOLOGIES

I. Inflammations

-PBM activates microcirculation

-PBM promotes the reduction of inflammation

-PBM breaks the cycle of chronic inflammation



Strengths of Mectronic Medicale lasers

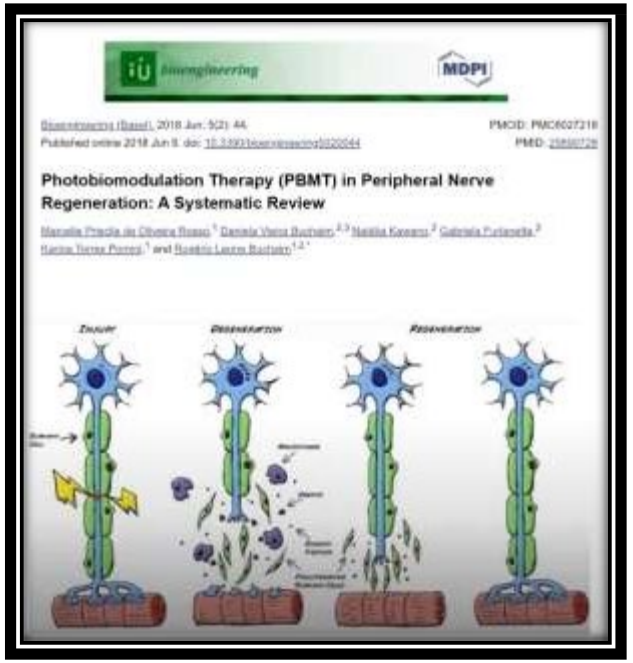
1. The best range of wavelengths, emission modes and power to maximise PBM
2. Temperature control system to treat acute inflammation and avoid pain return (THEAL and CHELT)
3. Different applicators to adapt the therapy to the treatment area and to transfer the correct dose in orthogonal mode. In addition to the wide range of powers, it is possible to deliver the right dose at different depths depending on the depth of the pathology.

II. Nerve repair

Injuries such as cuts, diabetes, sprains, carpal tunnel syndrome

- PBM not only treats the symptoms, but repairs the nerves.

- Improves nerve function and reduces inflammation- PBM can avoid surgery or improve results after surgery.



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II. Nerve repair

Treatment of carpal tunnel with THEAL Therapy

III. Oedema

- PBM promotes vasodilation and activates microcirculation by increasing NO production (also without heat)

- PBM reduces pain and oedema after injuries and surgeries.

Use of low-level laser therapy to reduce postoperative pain, edema, and trismus following third molar surgery: A systematic review and meta-analysis

Francisca Jennifer Duarte de Oliveira [1], Giuliana Moura Luz Cordeiro Brasil [2], Gabriella Peixoto Araújo Soares [2], Daniel Felipe Fernandes Paiva [2], Francisco de Assis de Souza Júnior [3]

Affiliations + expand

PMID: 34217567 DOI: 10.1016/j.joms.2021.06.006

Abstract

This Systematic Review and Meta-analysis was conducted with the following PICOS question: patients undergoing third molar surgery (P) can benefit from low-intensity laser therapy (I) as compared to other postoperative management (C) to reduce pain, edema, and trismus (O), evaluated in previous randomized clinical trials (S). Databases used were PubMed, SCOPUS, Web of Science, and Biblioteca Virtual em Saúde, screening for studies published between 2015 and 2020. The meta-analysis was based on the standardized mean difference (SMD), under a 95% confidence interval (CI). 246 studies were initially included, and after the screening of data, 10 studies were selected for the final sample. The qualitative analysis resulted in favorable results for pain and edema management in most studies, whereas trismus remained controversial. Meta-analysis resulted in (SMD, -0.53; 95% CI, -0.82,-0.24), (SMD, -0.60; 95% CI, -0.81,-0.39), and (SMD, -0.62; 95% CI, -2.63, 1.39) for pain, edema, and trismus, respectively, indicating statistical success on pain and edema reduction, but not for trismus. LLLT can act on reducing postoperative pain and edema following third molar surgery, whereas, trismus remains not significantly changed.

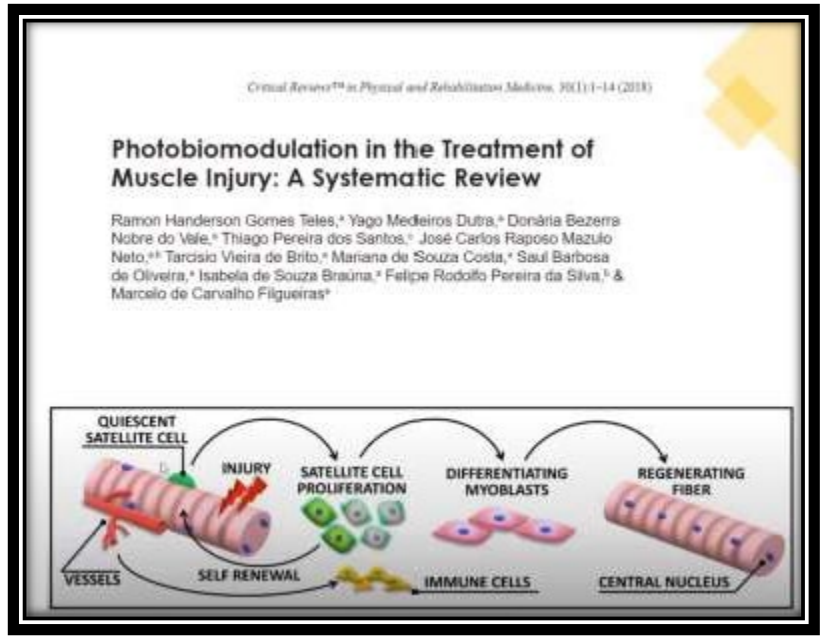
Strengths of Mectronic Medicale lasers

1. Best wavelengths, emission modes and power
2. Temperature control system to act on the anti-edema effect in the acute phase (THEAL e CHELT)
3. Different applicators to adapt the therapy to the treatment area and to transfer the correct dose in orthogonal mode.
4. Wide range of power: it is possible to use the right dose at different depths depending on the pathology
5. Pre-defined protocols

III. Oedema

IV. Muscular injuries

- Common muscle injuries, especially in sports
- Typical pain on contraction, stretching and direct pressure
- Post-surgical muscle trauma
- PBM reduces inflammation
- PBM reduces muscle fatigue
- PBM reduces scarring
- PBM enables stronger repair and reduces the possibility of relapse



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IV. Muscular injuries

IV. Muscular injuries

V. Tendon injuries

- Effective for tendonitis and also for tendonosis
- Tendonitis: acute and highly inflamed
- Tendinosis: a degenerative and chronic condition
- PBM improves inflammation and collagen (type 1) by stimulating cells
- PBM allows scar tissue to shrink, repair itself more firmly and be less susceptible to injury


The efficacy of low-level laser therapy for shoulder tendinopathy: a systematic review and meta-analysis of randomized controlled trials

Abstract

Strengths of Mectronic Medicale lasers

1. The best wavelengths, emission modes and power
2. Temperature control system to treat acute inflammation (tendonitis) and chronic inflammation (tendinosis) (THEAL and CHELT)
3. Different applicators to adapt the therapy to the treatment area and to transfer the correct dose in orthogonal mode.
4. Wide power range to deliver the right dose at different depths depending on the pathology.
5. Predefined protocols

Achilles tendon treatment with THEAL Therapy

VI. Pain Management

- PBM activates microcirculation
- PBM promotes reduction of inflammation
- Photomechanical effect of PBM for peripheral pain information

Effectiveness of High Intensity Laser Therapy for Reduction of Pain in Knee Osteoarthritis

Anna Angelova [1], Elena M Ilieva [1]

Affiliations + expand

PMID: 28096711 PMCID: PMC5206453 DOI: 10.1155/2016/9163618

Free PMC article

Abstract

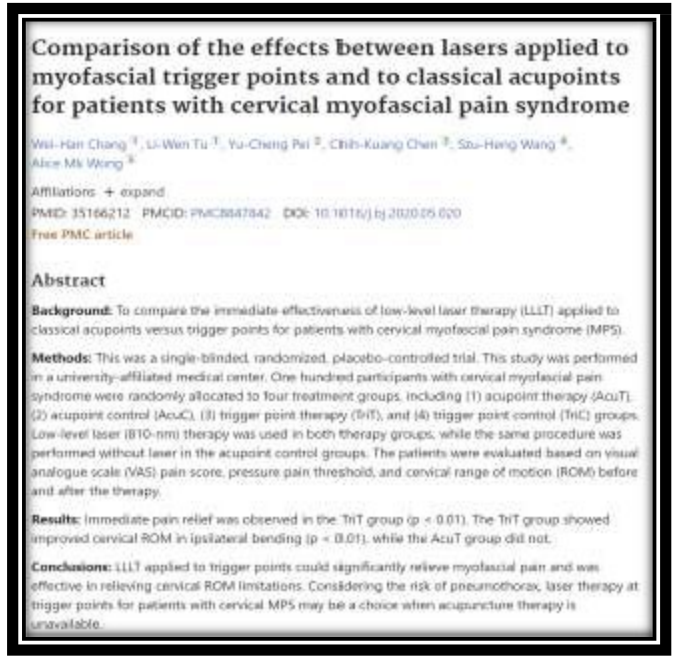
Introduction. Osteoarthritis is the most common type of arthritis. It is the main cause of chronic musculoskeletal pain and disability among the elderly population. *Aim.* This is a pilot, randomized clinical study about the effect of high intensity laser therapy in patients with osteoarthritis of the knee (OA of the knee). *Material and Method.* 72 patients (aged between 39 and 83 years) with (clinically and radiographically proved) OA of the knee were included in the study. They were randomized in two groups: therapeutic (test) one ($n = 37$, 65,11 ± 1,40 (mean ± SD) years old; patients were treated with HILT) and control group ($n = 35$, 64,71 ± 1,98; patients receive sham laser). Both groups had seven sessions of treatment. VAS and dolorimetry were used for assessment of pain before and after the therapy. Pedobarometric analysis (static and dynamic) was used to assess comparatively the contact surface area and maximum pressure under the heel. *Results.* Pain levels measured by VAS and dolorimetry decreased significantly in the therapeutic group after seven days of treatment ($p < 0.001$). *Conclusion.* The results after seven days of treatment show more intensive and cumulative effect after the application of high intensity laser therapy in comparison to sham laser. This is the reason why HILT can be a method of choice in the treatment of gonarthrosis.

Strengths of Mectronic Medicale lasers

1. The best wavelengths, emission modes and power
2. Temperature control system to activate the analgesic effect through heatless photomechanical laser effect (THEAL and CHELT)
3. Patented E2C stochastic emission mode for variable photomechanical effect to obtain pain information (analgesic effect)
4. Different applicators to adapt the therapy to the treatment area and deliver the correct dose in orthogonal mode
5. Pre-defined protocols

VII. Active and latent Trigger Points

- PBM activates microcirculation
- PBM promotes reduction of inflammation
- Photomechanical effect of PBM for peripheral pain information



Comparison of the effects between lasers applied to myofascial trigger points and to classical acupoints for patients with cervical myofascial pain syndrome

Wei-Han Chang [1], Li-Wen Tu [1], Yu-Cheng Pei [2], Chih-Kuang Chen [3], Szu-Heng Wang [4], Alice Mk Wong [5]

Affiliations + expand

PMID: 35166212 PMCID: PMC8847842 DOI: 10.1016/j.bj.2020.05.020

Free PMC article

Abstract

Background: To compare the immediate effectiveness of low-level laser therapy (LLLT) applied to classical acupoints versus trigger points for patients with cervical myofascial pain syndrome (MPS).

Methods: This was a single-blinded, randomized, placebo-controlled trial. This study was performed in a university-affiliated medical center. One hundred participants with cervical myofascial pain syndrome were randomly allocated to four treatment groups, including (1) acupoint therapy (AcuT), (2) acupoint control (AcuC), (3) trigger point therapy (TrPT), and (4) trigger point control (TrPC) groups. Low-level laser (810-nm) therapy was used in both therapy groups, while the same procedure was performed without laser in the acupoint control groups. The patients were evaluated based on visual analogue scale (VAS) pain score, pressure pain threshold, and cervical range of motion (ROM) before and after the therapy.

Results: Immediate pain relief was observed in the TrPT group ($p < 0.01$). The TrPT group showed improved cervical ROM in ipsilateral bending ($p < 0.01$), while the AcuT group did not.

Conclusions: LLLT applied to trigger points could significantly relieve myofascial pain and was effective in relieving cervical ROM limitations. Considering the risk of pneumothorax, laser therapy at trigger points for patients with cervical MPS may be a choice when acupuncture therapy is unavailable.

Strengths of Mectronic Medicale lasers

1. The best wavelengths, emission modes and power
2. Temperature control system to activate the analgesic effect through heatless photomechanical laser effect (THEAL and CHELT)
3. Patented E2C stochastic emission mode for variable photomechanical effect to obtain pain information (analgesic effect)
4. Different applicators to adapt the therapy to the treatment area and deliver the correct dose in orthogonal mode
5. Pre-defined protocols

VII. Active and latent Trigger Points

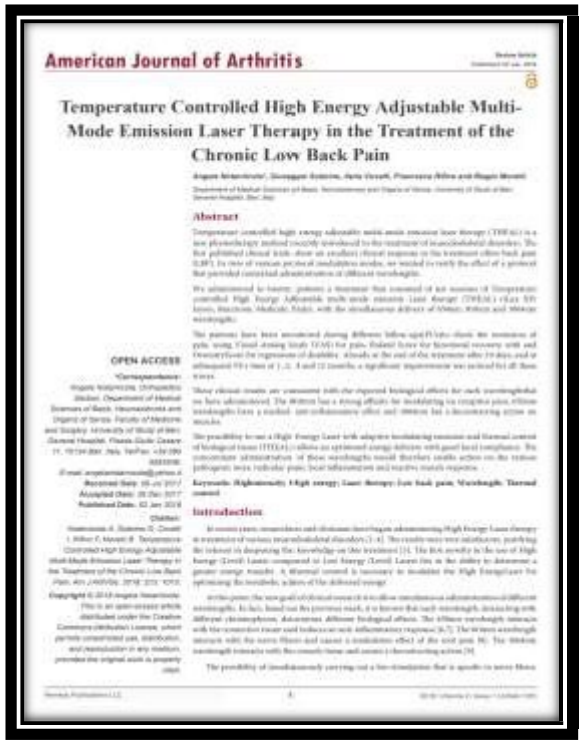
Treatment of an active Trigger Point with THEAL Therapy

VII. Active and latent Trigger Points

Treatment of an active Trigger Point with THEAL Therapy

VIII. Spine pathologies

- Lumbago, lumbosciatica, cervico-brachialgia, stenosis, herniated disc, etc...
- PBM activates the microcirculation
- PBM promotes the modulation of inflammation
- PBM reduces compression and stenosis of the spinal canal


American Journal of Arthritis

Temperature Controlled High Energy Adjustable Multi-Mode Emission Laser Therapy in the Treatment of the Chronic Low Back Pain

Strengths of Mectronic Medicale lasers

1. The best range of wavelengths, emission modes and power
2. Temperature control system to treat acute nerve inflammation with a special collimated applicator (THEAL e CHELT)
3. Patented E2C stochastic emission mode for variable photomechanical effect to obtain pain information (analgesic effect)
4. Different applicators to adapt the therapy to the treatment area and deliver the correct dose in orthogonal mode
5. Pre-defined protocols

Treatment of low back pain with THEAL Therapy

VIII. Spine pathologies

18 ans, F, good health
Competitive gymnast,
9 training sessions per week
Low back pain with hyposthenia and dysesthesia of the left posteromedial thigh
L4-L5 disc herniation with 50% residual vertebral canal.

VIII. Spine pathologies

2 treatments per week for 5 weeks with Theal Therapy

6 months later

Reduction of the effect of compression and stenosis of the spinal canal
Stability of the clinical picture of a fully active athlete

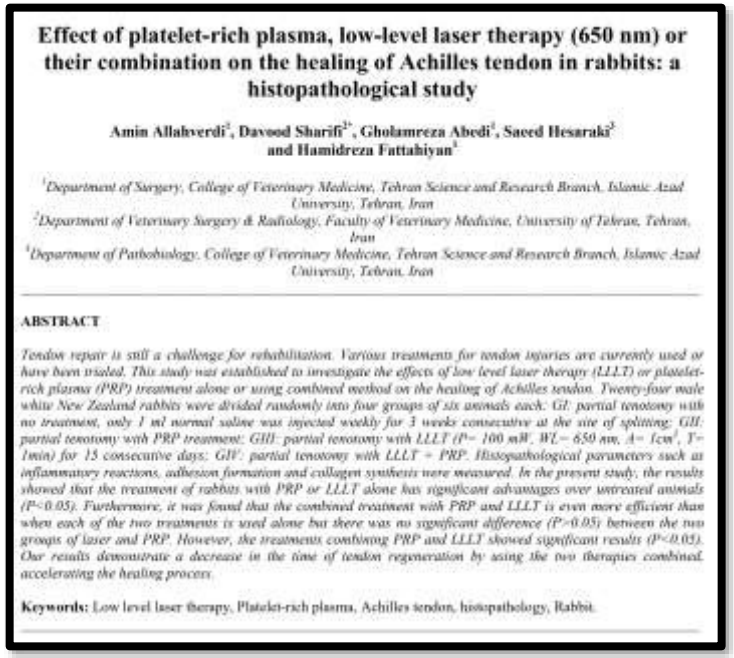
Mectronic

Treatment examples – regenerative medicine

- PRP
- WOUNDS

I. PRP

- PRP is a type of regenerative medicine.
- New tissue formation and healing
- PRP combined with PBM accelerates the healing process.
- PBM with red laser light is the best combination with PRP.



Effect of platelet-rich plasma, low-level laser therapy (650 nm) or their combination on the healing of Achilles tendon in rabbits: a histopathological study

Amin Allahverdi[1], Davood Sharifi[2*], Gholamreza Abedi[1], Saeed Hesaraki[3] and Hamidreza Fattahiyan[3]

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[2]Department of Veterinary Surgery & Radiology, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran
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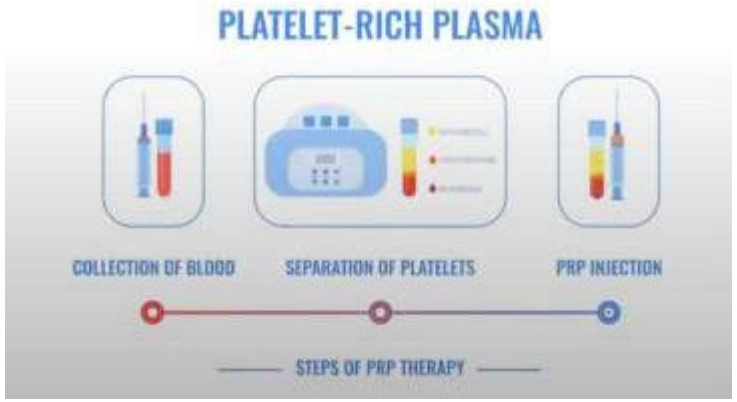
ABSTRACT

Tendon repair is still a challenge for rehabilitation. Various treatments for tendon injuries are currently used or have been trialed. This study was established to investigate the effects of low level laser therapy (LLLT) or platelet-rich plasma (PRP) treatment alone or using combined method on the healing of Achilles tendon. Twenty-four male white New Zealand rabbits were divided randomly into four groups of six animals each: GI: partial tenotomy with no treatment, only 1 ml normal saline was injected weekly for 3 weeks consecutive at the site of splitting; GII: partial tenotomy with PRP treatment; GIII: partial tenotomy with LLLT (P= 100 mW, WL= 650 nm, A= 1cm², T= 1min) for 15 consecutive days; GIV: partial tenotomy with LLLT + PRP. Histopathological parameters such as inflammatory reactions, adhesion formation and collagen synthesis were measured. In the present study, the results showed that the treatment of rabbits with PRP or LLLT alone has significant advantages over untreated animals (P<0.05). Furthermore, it was found that the combined treatment with PRP and LLLT is even more efficient than when each of the two treatments is used alone but there was no significant difference (P>0.05) between the two groups of laser and PRP. However, the treatments combining PRP and LLLT showed significant results (P<0.05). Our results demonstrate a decrease in the time of tendon regeneration by using the two therapies combined, accelerating the healing process.

Keywords: Low level laser therapy, Platelet-rich plasma, Achilles tendon, histopathology, Rabbit.

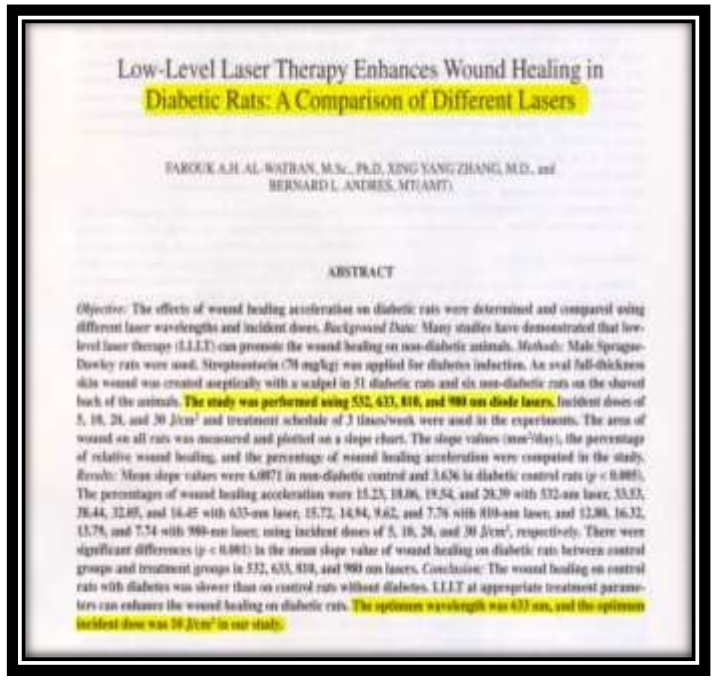
Strengths of Mectronic Medicale lasers

1. Best wavelength range, emission modes and power to maximise PBM
2. High power range at 650 nm, from 10 mW to 2000 mW
3. Different applicators to adapt the therapy to the treatment area and to transfer the correct dose in orthogonal mode (Collimated or Aurix)



I. PRP

- PBM activates the microcirculation
- PBM with the 650nm wavelength acts directly on collagen
- PBM increases ATP production and accelerates the healing process
- PBM with high-powered red laser light is best for treating wounds



Low-Level Laser Therapy Enhances Wound Healing in Diabetic Rats: A Comparison of Different Lasers

FAROUK A.H. AL-WATBAN, M.Sc., Ph.D, XING YANG ZHANG, M.D., and BERNARD L. ANDRES, MT(ASMT)

ABSTRACT

Objective: The effects of wound healing acceleration on diabetic rats were determined and compared using different laser wavelengths and incident doses. *Background Data:* Many studies have demonstrated that low-level laser therapy (LLLT) can promote the wound healing on non-diabetic animals. *Methods:* Male Sprague-Dawley rats were used. Streptozotocin (70 mg/kg) was applied for diabetes induction. An oval full-thickness skin wound was created aseptically with a scalpel in 51 diabetic rats and six non-diabetic rats on the shaved back of the animals. **The study was performed using 532, 633, 810, and 980 nm diode lasers.** Incident doses of 5, 10, 20, and 30 J/cm² and treatment schedule of 3 times/week were used in the experiments. The area of wound on all rats was measured and plotted on a slope chart. The slope values (mm²/day), the percentage of relative wound healing, and the percentage of wound healing acceleration were computed in the study. *Results:* Mean slope values were 6.0871 in non-diabetic control and 3.636 in diabetic control rats ($p < 0.005$). The percentages of wound healing acceleration were 15.23, 18.06, 19.54, and 20.39 with 532-nm laser, 55.53, 38.44, 32.05, and 16.45 with 633-nm laser, 15.72, 14.94, 9.62, and 7.76 with 810-nm laser, and 12.80, 16.32, 13.78, and 7.74 with 980-nm laser, using incident doses of 5, 10, 20, and 30 J/cm², respectively. There were significant differences ($p < 0.001$) in the mean slope value of wound healing on diabetic rats between control groups and treatment groups in 532, 633, 810, and 980 nm lasers. *Conclusion:* The wound healing on control rats with diabetes was slower than on control rats without diabetes. LLLT at appropriate treatment parameters can enhance the wound healing on diabetic rats. **The optimum wavelength was 633 nm, and the optimum incident dose was 10 J/cm² in our study.**

Strengths of Mectronic Medicale lasers

1. The best range of wavelengths, emission modes and power
2. 2W 650nm with Theal and Chelt and up to 4W with iLux Plus
3. Temperature control system for better treatment efficiency and to activate the PBM in the best possible way (THEAL and CHELT)
4. Different applicators to adapt the therapy to the treatment area and to transfer the correct dose in orthogonal mode (e.g. ScanX system).
5. Predefined protocol

II. Wounds

Treatment of wounds with Theal Therapy

II. Wounds

Wound care: results after 15 treatments with Theal Therapy

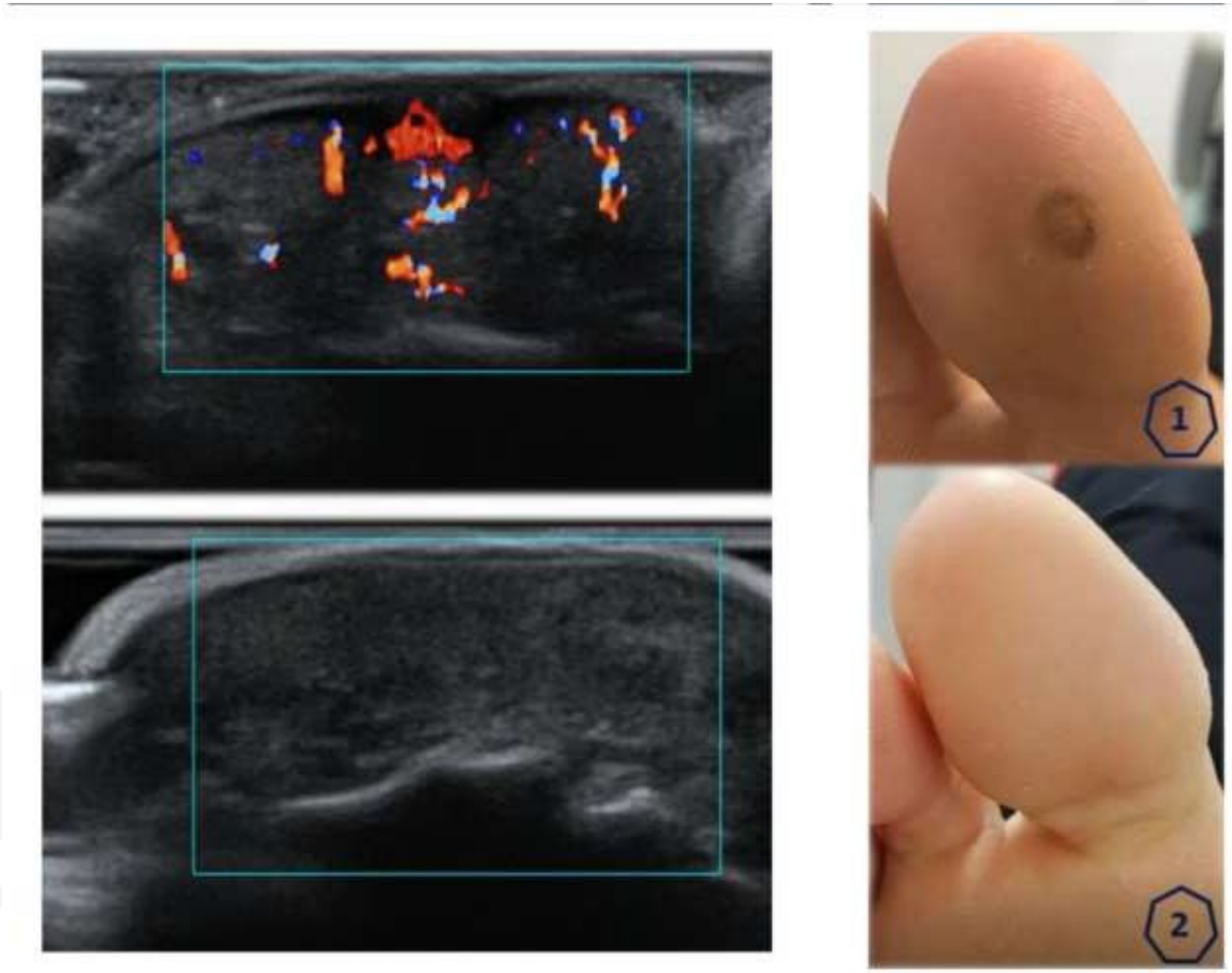
Treatment examples – Podiatry

- WARTS
- ONYCHOMICOSIS
- FOOT PATHOLOGIES
- NAIL REGENERATION

I. Onychomycosis

BEFORE TREATMENT 1 MONTH AFTER 2 MONTHS AFTER

II. Warts



III. Nail regeneration

IV. Nail regeneration

Treatment examples – Wellness

SKIN REJUVENATION

I. Skin rejuvenation

- Anti-ageing, wrinkles and firmness
- PBM activates microcirculation
- PBM increases the production of collagen and elastin by photobiomodulation of the fibroblasts.
- The red laser light acts directly on the collagen.
- Non-invasive treatment. The epidermal layer is not damaged. This reduces the side effects of the treatment.

PHOTOMEDICINE AND LASER SURGERY

A Controlled Trial to Determine the Efficacy of Red and Near-Infrared Light Treatment in Patient Satisfaction, Reduction of Fine Lines, Wrinkles, Skin Roughness, and Intradermal Collagen Density Increase

Abstract

Objective: The purpose of this study was to investigate the safety and efficacy of two novel light sources for large area and full body application, providing polychromatic, non-thermal photobiomodulation (PBM) for improving skin feeling and appearance. **Background data:** For non-thermal photorejuvenation, laser and LED light sources have been demonstrated to be safe and effective. However, lasers and LEDs may offer as one disadvantages because of dot-shaped (punctiform) emission characteristics and their narrow spectral bandwidths. Because the action spectra for tissue regeneration and repair consist of more than one wavelength, we investigated if it is favorable to apply a polychromatic spectrum covering a broader spectral region for skin rejuvenation and repair. **Materials and methods:** A total of 136 volunteers participated in this prospective, randomized, and controlled study. Of these volunteers, 113 subjects randomly assigned into four treatment groups were treated twice a week with either 611–650 or 570–850 nm polychromatic light (normalized to ~9 J/cm² in the range of 611–650 nm) and were compared with controls (n=23). Irradiances and treatment durations varied in all treatment groups. The data collected at baseline and after 30 sessions included blinded evaluations of clinical photography, ultrasonographic collagen density measurements, computerized digital profilometry, and an assessment of patient satisfaction. **Results:** The treated subjects experienced significantly improved skin complexion and skin feeling, profilometrically assessed skin roughness, and ultrasonographically measured collagen density. The blinded clinical evaluation of photographs confirmed significant improvement in the intervention groups compared with the control. **Conclusions:** Broadband polychromatic PBM showed no advantage over the red-light-only spectrum. However, both novel light sources that have not been previously used for PBM have demonstrated efficacy and safety for skin rejuvenation and intradermal collagen increase when compared with controls.

Strengths of Mectronic Medicale lasers

1. The best range of wavelengths, emission modes and power to maximise PBM.
2. 2W from 650nm with Theal and Chelt and up to 4W with iLux Plus
3. Temperature control system for improved treatment compliance and to activate PBM (Theal and Chelt only)
4. Different applicators to adapt the therapy to the treatment area and to transfer the correct dose in orthogonal mode.

I. Skin rejuvenation

Treatment of wrinkles with Theal therapy

Treatment examples - otorhinolaryngology

TINNITUS

I. Tinnitus

- PBM activates the microcirculation.
- PBM promotes the modulation of inflammation
- PBM increases ATP production and accelerates the healing process.
- PBM reduces dizziness and lightheadedness

Clinical Study

Low-Level Laser Therapy in Patients with Complaints of Tinnitus: A Clinical Study

Strengths of Mectronic Medicale lasers

1. Improved wavelengths, emission modes and power to maximise PBM
2. Temperature control system to treat acute inflammation with a special collimated applicator (THEAL and CHELT)
3. High power range at 650 nm from 10 mW to 2000 Mw
4. Different applicators to adapt the therapy to the treatment area and to transfer the correct dose in orthogonal mode. For example, a micro-spherical applicator.

Treatment of tinnitus with Theal Therapy

Contraindications

The laser sources used emit in the visible and near infrared (NIR) spectrum.

There are two contraindications:

- Eye damage
- Thermal damage to the tissues exposed to the therapy, paying particular attention to the continuous emission and the phototype of the patient.

The first case is solved by the use of glasses, while the second is solved by the operator's ability to assess the thermal sensitivity and the correct phototype of the subject.

Avoid use in :

- **Patients with suspected or confirmed cancer**
- **Pregnant women**
- **Photosensitive areas**
- **Infected areas**
- **Epilepsy**
- **Areas of bleeding**
- **Treatment in the sympathetic, vagal or cardiac areas in cardiac patients.**

PART FIVE:
MECTRONIC LASER THERAPY DEVICES

PROLIFE

I. Laser line 2023

MHEL

THEAL

CHELT

Laser line 2023

SMART

iLux SMART

Mectronic

Laser line 2023

PLUS	iLux PLUS
SMART	iLux SMART

Laser line 2023

XP	iLux XP	Ixyon XP
PLUS	iLux PLUS	
SMART	iLux SMART	

Laser line 2023

TOP	Ixyon XP	CHELT
XP	iLux XP	Ixyon XP
PLUS	iLux PLUS	
SMART	iLux SMART	

II. MHEL Therapy

MHEL THERAPY

PROLIFE

Available models

iLUX SMART

iLUX PLUS

Available models

iLUX SMART

Available models

iLUX SMART

iLux SMART 810nm

7 W

iLux SMART 980nm

10 W

iLux SMART 1064nm

10 W • 15 W

iLux SMART 650nm

500 mW • 1 W

Available models

iLUX PLUS

Available models

iLUX PLUS

iLux PLUS 810+980nm

10 W • 15 W • 20 W • 30 W

iLux PLUS 1064nm

10 W • 15 W • 20 W • 30 W

iLux PLUS 810+1064nm

10 W • 15 W • 20 W • 30 W

iLux PLUS 650nm

2 W • 3 W • 4 W

Available models

	ILUX SMART	ILUX PLUS
AVERAGE POWER	7W – 15W	10W – 30W
PEAK POWER	Peak power : 20% more than the average power (for iLux 10W the peak power is 12W)	20W - 60W
NUMBER OF WAVELENGTHS	1	1 or 2
WAVELENGTH TYPE	• 650nm • 810nm • 980nm • 1064nm	• 650nm • 1064nm • 810nm + 980nm • 810nm + 1064nm

Available models

	ILUX SMART	ILUX PLUS
EMISSION MODE	10 EMISSION MODES • CW • E²C • AntInf • PULS1 • PULS2 • PULS3 • SINGLE PULSE • BURST • DIMMER • HPM	13 EMISSION MODES • CW • E²C • AntInf • PULS1 • PULS2 • PULS3 • SINGLE PULSE • BURST • DIMMER • HPM • THP • PBM • CUSTOM MODE
CUSTOM MODE	-	(WAVE EDITOR)

Available models

	ILUX SMART	ILUX PLUS
EFFECTS MODE	✔	✔
PATHOLOGICAL LIBRARY	60 protocols	150 protocols
CUSTOMIZED PROTOCOLS	✘	✔
INCLUDED APPLICATORS	1	2
OPTIONAL APPLICATORS	2	4
SCANX SYSTEM	✔	✔
SCREEN DIMENSIONS	7"	10,1"
FINGER SWITCH	✘	✔
FEEDBACK LED	✘	✔ during treatment

Available models

	ILUX SMART	ILUX PLUS
DIMENSIONS	295x265x147 mm	Without trolley: 295x265x150 Mm With trolley: 516x516x1017 Mm
TROLLEY	Not included	Included
WEIGHT	Without trolley : 3,5 Kg	Without trolley: 5 Kg With trolley: 24 Kg

The strengths of MHEL Therapy

Compact, lightweight and portable

Affordable price for a device with excellent performance

ScanX mode

Up to 30W power

More than 150 protocols

Handpiece with finger switch

13 emission modes

Mectronic

III. THEAL Therapy

PROLIFE

THEAL THERAPY

Available models

ILUX XP

IXYON XP

Available models

Available models

ILUX XP

iLux XP 16 W

- **650 nm** - 2 W
- **810 nm** - 7 W
- **1064 nm** - 7 W

iLux XP 30 W

- **650 nm** - 2 W
- **810 nm** - 8 W
- **980 nm** - 10 W
- **1064 nm** - 10 W

Available models

IXYON XP

Available models

IXYON XP

Available models

	ILUX XP 16W	ILUX XP 30W	IXYON XP 50W
AVERAGE POWER	16W	30W	50W
PEAK POWER	30W	50W	100W
MAXIMUM FLUENCE	30000 mJ/cm2	30000 mJ/cm2	50000 mJ/cm2
PULSE FREQUENCY	Up to 1000 Hz	Up to 1000 Hz	Up to 1000 Hz
PULSE ENERGY	Up to 30000 mJ	Up to 30000 mJ	Up to 50000 mJ
TIME GAP BETWEEN PULSES	1 – 1000 ms	1 – 1000 ms	1 – 1000 ms

Available models

	ILUX XP 16W	ILUX XP 30W	IXYON XP 50W
WAVELENGTHS NUMBER	3	4	6
WAVELENGTHS	650 + 810 + 1064 nm	650 + 810 + 980 + 1064 nm	650 + 780 + 810 + 905 + 980 + 1064 nm
MIX OF WAVELENGTHS	✔	✔	✔
LAMBDA WAVE CREATOR	X	X	✔
CALIBRATION SYSTEM	✔	✔	✔
THERMAL CONTROL	✔	✔	✔
VOBULATED THERMAL CONTROL	✔	✔	✔

Available models

	ILUX XP 16W	ILUX XP 30W	IXYON XP 50W
FINGER SWITCH	✔	✔	✔
EMISSION MODES	10	10	17
FEEDBACK LED	✔	✔	✔
NUMBER OF APPLICATORS	12	12	12
ZOOM APPLICATOR WITH THERMAL CONTROL	✔	✔	✔

Available models

	ILUX XP 16W	ILUX XP 30W	IXYON XP 50W
SPHERIC APPLICATOR	✔	✔	✔
AUTOMATIC MODE	✔	✔	✔
THERMAL CONTROL AUTOMATIC MODE	✔	✔	✔
NUMBER OF PROTOCOLS	More than 150	More than150	More than 150
CUSTOM PROTOCOLS	✔	✔	✔
SCREEN DIMENSIONS	8”	8”	10,1”
POWER SUPPLY	100÷240V 50÷60Hz	100÷240V 50÷60Hz	100÷240V 50÷60Hz

Available models

	ILUX XP 16W	ILUX XP 30W	IXYON XP 50W
ABSORBTION	160 VA	160 VA	160 VA
DIMENSIONS	30 x 25 x 102 cm	30 x 25 x 102 cm	30 x 25 x 102 cm
WEIGHT	5 kg without trolley, 20 kg with trolley	5 kg without trolley, 20 kg with trolley	5 kg without trolley, 20 kg with trolley

The strengths of THEAL Therapy

- Power from 10mW to 50w
- Up to 6 different wavelengths
- Patented wavelength mixing system
- Up to 17 emission modes
- Wave Creator
- 12 different applicators

- Extensive interactive pathology library (over 150 protocols)
- Patented vobulated thermal control
- Time, Joule and Trigger Point
- Automatic working mode with thermal control (ScanX)
- Calibration system

Mectronic

	iLux Smart	iLux Plus	iLux XP	Ixyon XP	CHELT
Wounds	★ ★ (810 nm models) ★ ★ ★ (650 nm models)	★ ★ (810nm models) ★ ★ ★ ★ (650 nm models)	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Podiatry	★ ★	★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Pain management	★ ★ ★	★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Acute pain	★ ★ ★	★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Chronic pain	★ ★ ★	★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Nerve inflammation, radiculopathy, neuropathy	★	★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★

PROLIFE

	iLux Smart	iLux Plus	iLux XP	Ixyon XP	CHELT
Muscular injuries	★ ★ ★	★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Tendon injuries	★ ★ ★	★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Oedemas	★ ★	★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★
Active Trigger Points	★ ★ ★	★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Latent Trigger Points	★ ★ ★	★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★	★ ★ ★ ★ ★
Fascia	★	★ ★	★ ★ ★ ★	★ ★ ★ ★	★ ★ ★ ★
Contractures	★ ★	★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Active and passive rehabilitation	★	★ ★	★ ★ ★	★ ★ ★	★ ★ ★
Physio-aesthetics			★ ★ ★	★ ★ ★	★ ★ ★ ★ ★

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