

# How Does Light Therapy Work?

## Is all light therapy the same?

By Dr. Graham, III

These are complex questions with literally thousands of research papers documenting the answers. There are many known functions, many additional theories and still much to discover about this amazing and powerful therapy. Due to the complexity of these questions much confusion surrounds Light Therapy. This white paper will attempt to resolve much of this confusion.

To understand **Light Therapy** you must first understand that what everyone calls light therapy today is not light therapy at all. Light Therapy originated when man discovered that when people were deprived of the full spectrum of energy given off by the sun they developed significant health issues. And that by exposing the patient to full spectrum sun light the health issues resolved on their own. Today what we commonly call light therapy is almost the opposite of the true original light therapy. The light sources we use are not full spectrum nor are they natural. We use a very specific wavelength of light, derived from electronic sources that have very specific properties that allow us to manipulate very specific functions or reactions in the body. So from here on out we will call this light, Low Level Laser Therapy or (LLLT).

The second thing you must understand is that there are many different forms of LLLT. In fact some forms are not even laser but non coherent forms of light derived from Light Emitting Diodes or LEDs. However you also must remember that all semiconductor lasers generate their light from diodes making them technically an LED laser. The simplest way to understand this is that even though all modern electronic lasers are LEDs, not all LEDs are lasers. So from here on out we will only be talking about true semiconductor laser diodes, not just any form of LEDs.

The final thing you must understand is that laser therapy is not just laser therapy. When I read the current research or articles based and referenced on current research they all talk as if all (light therapy) or LLLT has the same therapeutic action on the human body. And the only major difference between the different lasers is the penetration and time of therapy. This concept is so far from the truth, no wonder there is so much confusion. In reality every different wavelength of energy and every different power density of energy has different therapeutic effects on the body. And many are not really therapeutic effects but physiologic reactions depending on the wavelength and power density being used.

The last basic concept before we begin this article is what is our therapy goal in LLLT? And what is the difference between true LLLT and Natural Energy Medicine. LLLT is the foundational component of Natural Energy Medicine because true LLLT is used to deliver or enhance the other forms of informational medicine that make up a full Natural Energy Medicine therapy system. And the goal of Natural Energy Medicine is to deliver and or manage the body's information. This includes all information from the programs and information that we were born with like the shape of your nose and how the immune system is supposed to function to memories and emotions and how they are tied together

to every piece of information our body gathers from our 5 senses. When the body is functioning properly it knows how to fix itself. And when it knows how, it does, and does it so much better than we can do it. These other forms of therapy include frequency biomodulation, homeopathy, nutrition, essential oils, reflexology, chiropractic, massage / body work, and so on. We will describe Natural Energy Medicine and how it differs from LLLT in a separate article.

This article is dedicated to the different common forms of LLLT. We will attempt to describe the properties, functions and differences of these forms of therapy.

As we discuss LLLT, many terms and their abbreviations will be utilized. Another aspect of LLLT that adds to the confusion is terminology itself or I should say the lack of definitions of the terms used in LLLT. We have dictionaries so we can communicate with precision. And without proper definitions of words communication becomes very confusing. Unfortunately many specialists in the field of LLLT have never heard of this concept so we broke out the dictionaries and placed the true definitions to the terms used to the right side in gray.

**Light** therapy is a very broad term and can include everything from standing in the sun, to using full spectrum lighting, but it should not be used to describe today's LLLT. For this article we will try to make it clear as to what form of energy we are discussing at all times.

There are several different properties that determine the effect of light on living tissue. These are the **wavelength** of the light used, the power density or mW of power, the light source that is used (Laser – LED), and if that light source is continuous wave or pulsed (turned on and off) and if it is pulsed, at what frequency.

Surgical lasers are not considered therapeutic because they are not designed to heal tissue but to burn and cut tissue during surgical procedures.

**Ultraviolet** light devices are also not designed to be therapeutic. They are promoted to kill bacteria. It is often used for acne therapy to kill bacteria that causes acne and you can even purchase a tooth brush holder that utilizes ultraviolet radiation to sanitize your tooth brush.

There are two basic concepts currently utilized for therapeutic light instruments. The first is higher power infrared light devices and the second is low power visible red lasers that are pulsed. We will discuss each of these in detail.

**Light:** Light is a small spectrum of electromagnetic energy with wavelengths between 380nm and 760nm in length. This spectrum of energy is visible to the naked eye.

**Wavelength:** The property that differentiates different spectrums of energy within the electromagnetic spectrum of energy is wavelength. Each photon contains energy and just as energy of the ocean comes to shore in waves of high and low energy, the same is true of photons. Only with photons, the energy is measured by the number of waves the photon carries. These waves are measured in two ways; the **frequency** of the energy which is the number of waves that will pass a given point in one second, or **wavelength**, the distance between one wave and the next.

**Ultraviolet:** Ultraviolet is electromagnetic energy with a wavelength shorter than 380nm. It is not truly light because it is not visible to the eye but it is still commonly called light therapy. Ultraviolet rays are damaging to all organic material. It is the ultraviolet (UV) protection that we look for in sunscreens and sun glasses to prevent us from being burned by the sun. The only therapeutic effects of

## Infrared light therapy devices:

**Infrared** lamps, LEDs and LASERS are intended to emit energy in the infrared spectrum to provide topical and deep heating for the purpose of elevating tissue temperature. This heating is promoted to relieve pain, increase joint mobility and relax muscles. The mechanism of action for infrared lasers and light units is thermal and mechanical, and healing comes about as a byproduct of the stimulation, not as a direct mechanism of the therapy.

If the infrared therapy contains infrared lasers they are not **collimated** (with the exception of surgical lasers) because collimation will cause heat to focus on a small area and burning may occur.

Many devices will only use **LEDs** or **SLDs** as their light source because the properties of the laser light are not required for thermal actions of these units.

The **infrared** light devices are effective at killing pain but not correcting the causes of pain. Pain relief is so consistent and predictable that it is obviously a **pharmacological dose** of therapy. As described in the glossary, this means that the patient's body has little to do with the response. The therapy is mechanically and/or thermally killing the pain. This is usually accomplished by thermally ablating the fine sensory nerve endings to stop the sensation of pain. When used properly, this damage is not permanent and the nervous system heals in two or three weeks. This factor is also why the therapy requires another dose at or about the two to three week timeframe to keep the pain away. This is certainly safer, more effective, and lower in cost than using narcotics and other pain killing drugs, but the operator needs to understand that they have not corrected the cause of the pain; they have only stopped the pain. When utilized on athletes, **caution** must be advised or the athlete - without having the pain sensation - may push an injured area to the point of severely injuring themselves.

There is a suggested mechanism of healing with infrared therapy, which states that the stimulation of the infrared wavelengths stresses the local tissue and stimulates the body to mobilize resources to that area of the body to increase the healing of that tissue. This is quite sound and emphasizes the fact that infrared is more of an irritant than a healing stimulation to the body

UV waves are that of the production of Vitamin D. However this takes minimal exposure of very specific wavelengths of the UV spectrum. UV burns tissue with energy but produces no heat in the process.

**Infrared:** Wavelengths above 760 *nm* have fewer waves per second than red and termed infrared wavelengths. They carry or transfer heat from one object to another. They have been utilized for thermal applications for many years in the medical field as infrared lamps.

**Collimation:** A property of light commonly associated with lasers and accomplished with focusing lenses where all the photons are traveling in the same direction.

**LED:** Light Emitting Diode: There are thousands of different types of diodes that can emit light ranging in power density and bandwidths of wavelength. All semiconductor lasers produce light from a diode, however, LED's are NOT Lasers. LEDs do not produce coherent or polarized light.

**SLD:** Super Luminescent Diode; is a specific type of LED that has a higher emission of energy than typical LEDs. All other aspects are the same as LEDs.

**Pharmacological Dose:** A pharmacological dose of any therapy is the dose necessary to produce and maintain a desired effect. The goal is to have a drug or therapy to stay above or at the threshold level for effective therapeutic action but below the toxic level.

Therefore;

- A **pharmacological dose** always contains risk and **WILL DO HARM**.
- A **pharmacological dose** seldom improves health on its own merit.
- A **pharmacological dose** will generally be predictable and consistent for

but **can** stimulate the healing process.

There are biomodulation effects to different wavelengths of the infrared spectrum, unfortunately they **stimulate the growth** and health of specific **pathogens** not human cells. There is also evidence that different wavelengths of the infrared spectrum **may** in fact **inhibit the growth and healing of human tissue**.

Other therapeutic effects of infrared lasers appear to be present but are not understood or defined. Further research may discover other mechanisms of action that are not understood today.

**Infrared** devices can be recognized by the following characteristics:

1. In the product description the wavelength of the light will be in the infrared range, greater than **760nm**, usually in the **800nm** and **900nm** wavelengths.
2. In the product description the total power output will be 100mW or higher. It can be much higher even up to 100,000 mW. The greater **power density** is needed to produce the heat required to create the desired thermal effect on the tissue.
3. If the unit contains **laser** diodes the unit will be classified as a Class IIIb or Class IV laser.
4. They require that the wand that contains the lasers be in direct contact with the skin. This is confusing since the FDA states that you should avoid direct exposure to the radiation from Class IIIb and Class IV lasers.
5. Eye protection is mandatory for both operator and patient.
6. The proper treatment will be based on the **Irradiation dose** or the Joules of energy delivered. This is an equation of the amount of optical energy or heat that is delivered to the area of tissue.
7. They will advertise greater **penetration** of energy into the body. However, penetration is related to physical and thermal actions, not healing actions.

symptomatic response because it is measuring a response to a concentration, exposure, etc. mostly independent of the body – overriding the normal physiology of the patient.

**Nanometer (nm):** One nanometer is one billionth of a meter.  $10^{-9}$  meters or .000000001 meter = 1 *nm*. It is the unit of measurement that is commonly used to measure the wavelength of energy commonly used in light therapy.

**Power Density (mW):** Power density is synonymous with the Watts of power produced by the light source.  $P = mW$

**LASER:** *Light Amplification by Stimulated Emission of Radiation*; refers to the specific qualities and methods by which lasers produce light. Originally theorized and defined by Albert Einstein in 1917, it was not produced until the 1950s. Laser light is *Coherent, has a Monochromatic wavelength, is Collimated, and Polarized*. These four characteristics differentiate Laser's from LED & SLD light sources.

**Irradiation Dose ( $J/cm^2$ ):** Irradiation dose is defined by the product of the power density (mW); exposure time divided by area irradiated and is reported as Joules of energy per square centimeter ( $J/cm^2$ ).

**ID ( $J/cm^2$ ) = P (mW) X T (sec) / A ( $cm^2/sec$ )**

**Penetration:** Propagation of light though tissue is regulated by three properties, Reflection, Penetration, and Absorption. Penetration refers to the distance an energy wave travels into the tissue before it is absorbed and dissipated as heat or molecular vibration. Penetration is a physical and thermal phenomenon, not a therapeutic phenomenon.

8. Infrared devices frequently claim that the higher the mW, the faster the therapy. **Example:** If it takes 10 minutes to produce 'x' amount of Joules of energy at 100 mW, then you could perform the same therapy in 1 minute if you had a unit that produced 1,000mW of energy. If this example were accurate, it would also mean that if you needed to bake a cake for 30 minutes at 300 degrees, if you had a better oven you could bake the same cake for 3 minutes at 3,000 degrees and have the same outcome. Obviously, even though the math is the same the results will be different in people and cakes. So just because someone wrote it and it sounds logical at the time does not mean that it is.
9. Infrared energy is not visible so most units will contain a visible red laser for the purpose of aiming and knowing when the laser is turned on. These are not considered part of the therapy.
10. The infrared units will have a pulse duration setting. This setting is not for the pulse frequency but for the **duty cycle** of the light. By varying the duty cycles you can change the amount of energy delivered during the treatment.

**Low Level visible red Laser Therapy devices:  
(BioLight PTL Series of Professional therapy lasers)**

Unlike the infrared devices that are only concerned about delivering the correct amount of heat to the correct depth in the tissue, true LLLT devices are very complex in their actions because they are designed to **stimulate the physiology** of the body through a mechanism called **biomodulation** or **photobiomodulation**. These principles of light or energy medicine originated in the quantum physics of Einstein himself. He first introduced the concept of the LASER "**Light Amplification by Stimulated Emission Radiation**". He also stated that every living cell emits radiation called the "**photon emission of living cells**", or what we commonly refer to as the aura. Albert Einstein, in 1917, proposed all living and nonliving matter represented dynamic electromagnetic fields, which exist in an electromagnetic environment – the universe! It took nearly 60 years for fellow physicists to begin to comprehend Einstein's holistic worldview of quantum mechanics, and the relationship between

**Duty Cycle:** Duty cycle relates to the amount of time the light source is active, usually from 10% to 100%. If the setting was a 10% duty cycle then out of every second the light source would be on 1/10 of a second and be off 9/10 of a second. This cycle can be at various pulse intervals depending on the manufacture.

**Biomodulation:** Biomodulation is the process of changing the natural biochemical response of a cell or tissue within the normal range of its function, stimulating the cell's innate metabolic capacity to respond to a stimulus. A cell can heal itself by this basis.

**Photobiomodulation:** When biomodulation occurs from a photon transferring its energy to a chromophore it is referred to as photobiomodulation.

**Chromophores:** Chromophore

matter, energy and health.

## There are two primary components required for true LLLT units:

### 1. Wavelength = 635nm

Biological light receptors in living tissue, termed **chromophores**, have peak activation at wavelengths between 600nm and 720nm. The most effective wavelengths to activate these chromophores are from 630nm to 635nm depending on the type of laser being used. This is because even though different chromophores have peak activation somewhere between 600nm and 720nm, each chromophore can still be activated within a wider wavelength spectrum. 635nm falls within the wavelength spectrum of all biological chromophores in mammals (man and animals). So where many companies talk about different wavelengths activating specific chromophores also referred to as light receptors to perform a specific function, remember that they will not perform that function significantly better than a wavelength of 635nm. This means there is no need to utilize multiple colors of lasers to activate the different chromophores in the body. One wavelength – 635nm – has the potential to activate every biological photo-sensitive receptor in the body. For this reason, **BioLight Technologies** has selected only 635nm lasers for its therapy systems.

### 2. Power Density = <5 mW

When we discuss power density the first thing we must cover is the names. Low Level Laser Therapy (LLLT), Low Intensity Laser Therapy (LILT) and Cold Laser Therapy (CLT).

We will start with Cold Laser Therapy. Remember that all laser light contains energy, and all energy will be dissipated as heat. So there is no such thing as a Cold Laser because no laser will cool the body.

Low Level and Low Intensity originally had a very specific definition. It was defined that any laser that could be applied to the body and the temperature of the tissue being treated would never raise more than 1 degree centigrade was a Low Level Laser. Which meant that Low Level Laser Therapy was a therapy that never raised the treated tissue temperature more than 1

literally means, “Color lover” (**L. chromo** = color; **L. Phore** = to seek out, to have an affinity for, to love). Chromophores are generally pigmented molecules that accept **photons** within living tissue. When the chromophore accepts a photon, it causes a **biochemical** change within an atom, molecule, cell or tissue. If this change increases cellular function, it is said to have activated the tissue. If this change decrease cellular function it is said to have inhibited the tissue. Biomodulation occurs in both cases.

degree. This therapy could only be applied to class IIIa lasers as they were the only lasers that qualified under this definition. This term became very popular as it indicated a very safe therapy system. As the rise in infrared lasers became popular they adopted the also popular term Low Level Laser. I can only assume that it was to give an otherwise potentially dangerous therapy system a safe sounding name. Of course they had to discard the definition of Low Level to do this. Today the term Low Level Laser means virtually nothing as it has no definition. Any therapy laser can be called Low Level, Low Intensity or even Cold Laser therapy. All class IIIb and even some class IV lasers are now called LLLT. So when I refer to **TRUE** LLLT I am referring to the actual original definition of the words.

The power density or mW of power of the light source is very important. As identified earlier, the power density of the infrared radiation needs to be high to quickly produce the heat required for the symptomatic relief. However, in the low-level therapeutic lasers, heat is the enemy. **Heating tissue is not conducive to healing.** In LLLT the object is to deliver all the therapeutic energy without raising the temperature of the tissue. Chromophores are very sensitive to the power density. For example, the easiest way to understand the action of the chromophore is to think about your vision. The cones on the retina of the eye contain three different chromophores. Each is sensitive to different wavelengths of light, allowing us to see in colors. But it is not just the wavelength; it is also the power density of the light. If it is too dark, you cannot see because the power density is too low to activate the chromophore. However, if the light is too bright, it over stimulates the chromophore into a sedated state and you still can't see. The chromophore has to be stimulated not only by the right wavelength but also with the correct power density. This is one more reason why a fully collimated laser light source is needed for LLLT. To get the correct penetration of the outer skin with very low power density, you must use a fully collimated laser light source.

### **The mechanism of action for Low Level 635nm laser light:**

Due to the low power density and the properties of the wavelength used, the true low level therapy lasers are only capable of delivering a **physiological dose** of therapy (with no heat). Some may consider this limited because it is dependent on the ability of the patient to

**Physiological Dose of therapy:** A Physiological Dose of any therapy is designed to stimulate production of, or provide to the body what it needs to normalize and heal itself through biomodulation. The symptomatic response to a physiological dose of therapy is dependent of the capacity of the patient's body to respond to the therapy. The physiological dose of any treatment has specific advantages.

- A **physiological dose**

respond to care which creates less consistent and less significantly predictable outcomes. However, when you consider that this therapy actually gives the body a **greater ability to respond** you can see that it has significantly expanded the limits of what can be accomplished.

One of the most important aspects of a **physiological dose** of therapy is that it is **safe**. It is safe no matter what the condition or pathology is, no matter what medications the patient is on, no matter what the patient may be allergic to, **no matter what, a true LLLT unit will**

**“...DO NO HARM!”**

One of the most profound physiological effects of low level therapeutic lasers is the effect of **Neuroplasticity**. Neuroplasticity represents the brain's ability to reorganize itself by forming new neural connections throughout life. Neuroplasticity provides a way for nerve cells (neurons) in the brain to respond and compensate for injury and disease and adjust neuronal activity in response to a new situation or to changes in the environment.

Reorganizing the brain occurs by the mechanism of “axonal sprouting” where damaged axons grow new nerve endings to reconnect neurons whose links were injured or severed. Undamaged axons can also contribute new nerve endings and connect with other undamaged nerve cells, forming new neural pathways to accomplish a needed function. In order for neurons to reconnect or form new connections, the neurons need active stimulation. **LLLT provides one of the most powerful stimulants for Neuroplasticity known today** and it provides that stimulation in a safe, therapeutically correct, organized manner.

Neuroplasticity represents unlimited potential to retrain the brain after injury. However, neuroplasticity can also contribute to impairment. For example, deaf individuals may suffer from continual ringing in the ears (tinnitus), which results from faulty rewiring of the brain cells starved for sound. For beneficial neural connections to form, neurons must be stimulated correctly.

**Neuroplasticity represents a new rapidly evolving approach to healing.** *Given any trauma, realizing all traumas involve the central nervous system recognizing the trauma (consciously or subconsciously), quick response with active neuronal stimulation, could*

represents the body's own response to a stimulus (e. g., adrenaline in response to a “fight or flight” challenge) and is generally safe and will **DO NO HARM**.

- A **physiological dose** generally improves the patient's health.
- A **physiological dose** will always be less predictable and consistent than a pharmacological dose for symptomatic response because it depends upon an interaction with the individual patient's entire body system.

**Neuroplasticity:** Neuroplasticity represents the brain's ability to reorganize itself by forming new neural connections throughout life.

**Dose:** The term **dose** is an estimate of a **therapy**, traditionally a drug, which produces a desired therapeutic action without harmful side effects. The **therapeutic dose** (safe and effective) range is defined by clinical evaluation of the response of a sufficient number of patients, generally 50 percent who improve without toxicity.

Drugs are evaluated at doses to which 20%, 70% or any percentage to which a subject responds.

It is customary to calculate:

**Median Effective Doses** or ED<sub>50</sub>, the dose that gives rise to a response in 50 % of the subject

**Median Toxic Dose** or TD<sub>50</sub> is the dose that manifests toxic side effects in 50 % of the subjects

**Median Lethal Dose** or LD<sub>50</sub> is the dose that gives rise to the death of 50% of the subjects

*theoretically maintain, repair, retain most CNS functions (learning, memory, speech, emotional distress, movement, balance etc.).* In simpler terms, theoretically the proper immediate use of LLLT therapy post trauma, especially brain trauma, could eliminate much of the neurological disabilities common in head trauma today.

Even the simplest memory stimulates complex neural networks at several different sites in the brain. The content (what happened) and meaning (how it felt) of an event are laid down in separate parts of the brain. The goal of neuroplastic therapy is to connect these sites to resolve the damaged, disjointed, dysfunctional nervous systems.

**“...The effect of LLLT on the brain is not magic, it’s malleable”**

There are three specific and unique methods the 635nm wavelength lasers of the **PTL** modulates tissues:

1. Within the cell, the signal is transduced and amplified by a photon acceptor (chromophore). When a chromophore first absorbs light, *electronically excited states* are stimulated, primary molecular processes are initiated which lead to measurable biological effects. These photobiological effects are mediated through a secondary biochemical reaction, photosignal transduction cascade, or intracellular signaling which amplifies the biological response.

2. The *ionizing* effects of LLLT allow photon acceptors to accept an electron. This turns on the oxidation-reduction cycle of the stimulated chromophores such as Cytochrome oxidase, hemoglobin, melanin, and serotonin. Changing the redox state of the chromophore changes the biological activity of that chromophore e.g., hemoglobin changes its oxygen carrying capacity. This has the potential to triple the oxygen carrying capacity of blood instantly.

3. When photon energy *breaks a chemical bond*, changes occur in the allosteric proteins in cell membranes (cell, mitochondrial, nuclear) and monovalent and divalent fluxes activate cell metabolism and intracellular enzymes directly. Direct activation of cell membranes alters ion fluxes, particularly calcium, across that membrane. Changes in intracellular calcium alter the concentrations of cyclic nucleotides, causing an increase in DNA, RNA, and protein synthesis, which stimulate mitosis and cellular

In general, a therapy (traditionally a drug) is considered safe when the harmful LDR region of the side effects is much greater than the therapeutic dose range, expressed as: **Therapeutic Index: TI = TD 50/ED50** Medical Principles of Pharmacology, 1990

**Biological Amplification:** When photobiomodulation occurs, the photon activates a chromophore, amino acid, nucleic acid, or molecule. Activation of a single

proliferation.

When any of the above occurs, the initial biological reaction rapidly catalyzes thousands of other chemicals similar to the calcium regulated, 2<sup>nd</sup> messenger cAMP cascade. This **biological amplification** process produces systemic effects – which means that as you are treating a wound on the left hand, the wound on your right hand and the injury to your liver and kidney are also being treated equally as well. So while the infrared manufacturers brag about a 2 inch penetration of their energy, true therapeutic lasers are profoundly more advanced, producing systemic therapeutic results.

These three actions produce four separate and distinct functions that are clearly understood in the body.

1. **Growth factor production** occurs within cells and tissue in response to increased ATP and protein synthesis. This initiates mitosis and cell proliferation by changing the cell, mitochondrial, or nuclear membranes permeability to monovalent (Na<sup>+</sup>, K<sup>+</sup>) and divalent (Ca<sup>++</sup>, Mg<sup>++</sup>) ions (Karu 1987, 1998, 2002).

2. **Pain relief** results from suppression of the nociceptor response mediated by increased serotonin and endorphin release (Sumano et al., 1987a, 1987b).

3. **Immune-modulation and mitigation of the inflammatory response** occur because the mononuclear phagocytic cells, mast cells, and leukocytes are stabilized preventing the release of harmful inflammatory mediators (Amano 1994). In addition, vasodilatation and increased microcirculation allows a rapid return to homeostasis and promotes first intention healing (Sumano 1987a, 1987b; Fiszerman and Rozenbom 1995).

4. **Direct trigger point stimulation** allows direct release of endorphins and other endogenous pain mediators such as serotonin, VIP, substance P, prostaglandins, etc. (Kaada, B and Eielson O, 1983, Kaada, Olsen and Eielson, 1985).

#### **The common effects of 635nm light:**

For those research scientists that read this paper the above section is very clear, however, for the rest of us, the common effects are easier to understand.

The above mechanisms of action produce three basic functions in the body. It provides **pain relief**. It reduces or **manages inflammation** around injuries thereby

enzyme molecule rapidly catalyzes thousands of other chemical reactions amplifying the signal to the cell. This is similar to the, calcium regulated, 2<sup>nd</sup> messenger cAMP cascade. **Biological amplification** explains how systemic, cellular, and clinical effects can occur almost instantaneously after exposure to light therapies.

**Effects of 630-, 660-, 810-, and 905-nm laser irradiation delivering radiant exposure of 1-50 J/cm<sup>2</sup> on three species of bacteria in vitro.**

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Results:

**The 905-nm wavelength** light had a negative effect on *S. aureus* bacteria with an increased growth of 27% following irradiation at 50

controlling pain, swelling, redness, and heat. Finally it **stimulates the growth** of new cells to improve healing time. One other factor that is not covered in this paper but has been well researched is that 635 nm laser light also **inhibits** the growth of almost all known infection causing **bacteria**.

The BioLight PTL unit goes even further by presenting substance specific frequencies to the body allowing the body to reorganize and no longer view normal healthy substances as something that is a problem for the body.

**Therefore 635nm light will control the pain and swelling related to acute and chronic pain such as:**

- Shoulder pain
- Carpal tunnel
- Back pain
- Tennis elbow
- Arthritic pain
- Fibromyalgia
- Dental pain
- Headaches
- Stomach pain

Controlling pain also reduces the need for pain medications.

**Because LLLT reduces pain, manages inflammation, reduces bacteria related to infection, and stimulates new human cell growth, it is ideal for Wound Management therapy including:**

- Skin ulcers
- Diabetic ulcers
- Wounds, deep and superficial
- Fractures
- Bruises, deep and superficial
- Open wounds
- Burns, all types and levels
- Skin abrasions
- Pre and Postoperative wound and surgical care

**Based on the above, Low-Level Laser Therapy should also support a number of other conditions including:**

- Osteochondriosis
- Scoliosis
- Intervertebral disk
- Post-traumatic pain
- Radiculitis
- Arthritis
- Arthrosis
- Contractures
- Calcaneal spurs
- Myositis.
- Sunburn
- Tendonitis
- Tennis/golfer elbow
- Carpal tunnel syndrome
- Migraines
- Tinnitus
- Ankle strain/sprain
- Common colds
- Muscle cramps
- Over exertion
- Allergies
- Brain Injury
- reorganization of collagen to reduce scar tissue

### The properties of LASER Light:

There are different properties of light. And the properties of laser light are the most unique. The first and most important property of Laser Light is that it is **coherent**. This means that the peaks and troughs of the photons are all in phase with each other. Laser Light is also naturally **polarized**. Laser Light is also

J/cm<sup>2</sup>.

**The 810-nm wavelength** light increased the growth of E. coli by 30% following irradiation of 20 J/cm<sup>2</sup>

**A wavelength of 630 nm appeared to be most commonly associated with bacterial inhibition.** The findings of this study might be useful as a basis for selecting LLLT for infected wounds. J Clin Laser Med Surg. 2000 Oct;18(5):235-40.

**Coherent:** The peaks and troughs of the photons are all in phase with each other.

**Polarized:** All the photons are in the same plane.

**Monochromatic:** One color or wavelength.

**Reflection:** Propagation of light though tissue is regulated by three

**monochromatic** meaning that it is one color or wavelength, however they now make lasers of multiple wavelengths even full spectrum light. Finally lasers are collimated meaning that the energy is focused into a fine beam that can travel great distances and remain a fine point. This is why they call laser pointers LASER pointers, as no other form of light can perform this action. The introduction of lasers is what changed “Light Therapy” into LLLT and the Natural Energy Medicine health care system that we have today. So why are these properties important?

Most light that we are exposed to is **reflected** off our bodies. This is a natural *in vivo* protection mechanism. If we absorbed all photon energy that struck our skin, we would explode in a few minutes of standing in the sun. So the first requirement is understanding how to achieve the proper penetration through the skin. This includes all the skin layers – not only our outer skin but the skin of the cell, the skin of the nucleus of the cell, the skin of the mitochondria and so on. All tissues have optical windows and guards to let only specific forms of light penetrate and activate the chromophores and other light sensitive properties of the tissue. This requires the properties that **only LASER light** possesses. Collimated light is essential for penetrating the outer surface of the skin. Coherent light and polarized light is required to pass through the optical windows of different tissue cells. The correct wavelength is imperative to activate all the light receptors (chromophores) in the body.

Many assertions have been made claiming that LEDs – which do not have coherent, polarized, or collimated properties – work as well as LASER light does. If one reviews the scientific papers, one quickly will find that these studies were performed on tissue cells *in vitro*, or in a test tissue sample. When the test is run on living animals and people, *in vivo*, LED light is not nearly as effective as the LASER light source due to the above mentioned properties of the LASER.

**True Low Level Therapeutic Lasers (LLLТ)** can be recognized by the following properties:

1. In the product description the wavelength of the light will be in the visible red range, 630nm (for HeNe tube lasers) and 635nm (for semiconductor laser diodes).

properties, **Reflection**, Penetration, Absorption. When energy waves strike the skin of any tissue, they will either pass through or reflect off the tissue. The energy’s ability to pass through a surface tissue is dependent on the collimation, coherency, wavelength and polarization of the light. Reflected energy has no therapeutic effect to the internal tissue.

**LASER:** *Light Amplification by Stimulated Emission of Radiation*; refers to the specific qualities and methods by which lasers produce light. Laser light is *Coherent* (having all waves in phase), *Monochromatic* (having a very narrow band of wavelength), *Collimated* (all photons traveling in the same direction), and *Polarized* (all waves are in the same plane). These four characteristic differentiate Laser’s form LED & SLD, light sources.

### Properties of The **BioLight PTL Therapy Systems**

Multiple **635nm** wavelength semiconductor laser diodes of visible red light.

Less than **5mW** each laser.

Each laser is a Class IIIa, fully collimated laser.

Designed to be held a comfortable distance from the wound.

Works equally well through natural fiber clothing.

Eye protection is not required by the FDA.

Each different therapy protocol is based on specific unique

2. In the product description the total power output will be less than 5mW per laser.
3. It will always have fully collimated true lasers and the unit will be classified as a class IIIa laser.
4. The housing that contains the lasers can be held at a comfortable distance from the wound or tissue being treated.
5. The therapy can be administered through natural fiber clothes so that the patient seldom has to be gowned.
6. Eye protection is not necessary for the patient or the doctor; although directing any LLLT unit directly into the eyes too long can be dangerous.
7. The proper treatment procedure will be based on the frequencies utilized and the Joules of energy are never mentioned.
8. Photobiomodulation and biological amplification is promoted, the word "penetration" will never be found. (Penetration as explained before is not important for healing purposes- Photobiomodulation is the key factor )
9. Low power and no heat will be promoted; High power of **any** kind should not be seen.
10. 635nm energy is visible so you always know if the unit is on and where it is pointed.
11. The laser will have pulsed frequency settings and the precision and range will be documented.

### The **PTL II, PTL Home & PTL Home Pro**

The PTL II Professional, PTL Home & PTL Home Pro therapy systems by Biolight Technologies possesses all the properties of a true Low Level Therapeutic Laser. It is also designed to be the most user friendly LLLT unit on the market with easy to use controls, lightweight(7oz), one hand operation, fully portable and the most precise and highest range of frequency therapy in any LLLT unit on the market. Go to <http://biolighttechnologies.com/> to learn more.

frequencies, the light source and power density never changes.

The **PTL series** is low power and not designed for penetration but for maximum systemic physiological actions through **biological amplification** producing no significant rise in tissue temperature.

Generating precise frequencies up through 12,000,000Hz – others cannot compare to this.

Plus the PTL II is so unique and highly effective because it also uses thousands of substance specific frequencies piggy backed on the Hz frequency to present these to the body to allow it reorganize and appropriately respond to substances it once responded inappropriately to.

Thousands of preprogrammed frequencies organized into therapy programs for instant use.

#### Contact Info:

**770-302-6900 press 3**

<http://biolighttechnologies.com/>