OVERVIEW OF LIGHT THERAPY RESEARCH AND LITERATURE

Overview of Research and Literature

Light therapy has been shown in over 40 years of independent research worldwide to deliver powerful therapeutic benefits to living tissues and organisms. Both visible red and infrared light have been shown to effect at least 24 different positive changes at a cellular level. Light radiation must be absorbed to produce a biological response. All biological systems have a unique absorption spectrum which determines which wavelengths of radiation will be absorbed to produce a given therapeutic effect. The visible red and infrared portions of the spectrum have been shown to be highly absorbent and produce unique therapeutic effects in living tissues.

What Does Infrared Therapy Actually Do?

Light therapy has been shown to Increase vascularity (circulation) by increasing the formation of new capillaries, which are additional blood vessels that replace damaged ones. New capillaries speed up the healing process by supplying additional oxygen and nutrients needed for healing.

Stimulate the production of collagen. Collagen is the most common protein found in the body. Collagen is the essential protein used to repair and replace damaged tissue. It is the substance that holds cells together with a high degree of elasticity. Increasing collagen production will decrease scar tissue at the injured site.
Stimulate the release of adenosine triphosphate (ATP). ATP is the major carrier of energy to all cells. Increases in ATP allow cells to readily accept nutrients and expel waste products faster by increasing the energy level in the cell. All food turns into ATP before it is utilized by the cells. ATP provides the chemical energy that drives the chemical reaction of the cell.

Increase lymphatic system activity. Edema, which is the swelling or natural splinting process of the body, has two basic components. The first is a liquid part which can be evacuated by the blood system and the second is comprised of the proteins which have to be evacuated by the lymphatic system. Research has shown that the lymph vessel diameter and the flow of the lymph system can be doubled with the use of light therapy. The venous diameter and the arterial diameters can also be increased. This means that both parts of edema (liquid and protein) can be evacuated at a much faster rate to relieve swelling.

Increase RNA and DNA synthesis. This helps damaged cells to be replaced more promptly. Reduce the excitability of nerve tissue. The photons of light energy enter the body as negative ions. This requires the body to send positive ions, calcium among others, to flow to the area being treated. These ions assist in regulating the nerves, thereby relieving pain.

Stimulate fibroblastic activity which aids in the repair process. Fibroblasts are present in connective tissue and are capable of forming collagen fibers.
Increase phagocytosis, which is the process of scavenging for and ingesting dead or degenerated cells by the phagocyte cells. This is an important part of the infection control process. The healing process depends upon the Destruction of infection and cellular clean up.

Induce a thermal like effect in the tissue. The light raises the temperature of the cells although there is no heat produced from the diodes themselves.

Stimulate tissue granulation and connective tissue projections, which are part of the healing process of wounds, ulcers or inflamed tissue. Stimulate acetylcholine release. Acetylcholine causes cardiac inhibition, vasodilation, gastrointestinal peristalsis and other parasympathetic effects.

The Following Definitions Are Commonly Used with Light Therapeutic devices

1) Visible Light: light that is within the visible spectrum, 400nm(violet) to 700nm(red)
2) Infrared Light: light in the invisible spectrum below red, from 700nm to 2,000nm
3) Frequency: number of cycles per second measured in Hz.
4) Coherency: wavelengths of light traveling in phase with one another
5) Monochromatically: light that is of one color, or one wavelength
6) Collimation: light focused in a beam, maintaining a constant diameter regardless its distance from the object or surface directed toward
7) Nanometer (nm): a unit of measure of wavelength of light (one billionth of a meter)
8) Nanosecond: one billionth of a second
9) Joule (J): unit used to measure the energy delivered
10) Watts (w) and milliwatts (mw, 1/ 1000th of a watt): units used to measure the power capability
11) Peak power: output: the maximum output of power, measured in milliwatts and watts
12) Average power: amount of power actually delivered in a given period of time
13) Duty cycle: the amount of time the light is actually on during a given period of time

Depth of Penetration

Depth of penetration is defined as the depth at which 60% of the light is absorbed by the tissue, while 40% of the light will continue to be absorbed in a manner that is less fully understood. Treating Trigger points with Light can have a dramatic effect on remote and internal areas of the body through the stimulation of nerves, acupuncture and trigger points that perform a function not unlike transmission cables. The diverse tissue and cell types in the body all have their own unique light absorption characteristics; that is, they will only absorb light at specific wavelengths and not at others. For example, skin layers, because of their high blood and water content, absorb red light very readily, while calcium and phosphorus absorb light of a different wavelength. Although both red and infrared wavelengths penetrate to different depths and affect tissues differently, their therapeutic effects are similar. Visible red light, at a wavelength of 660 nanometers (nm - 1 nanometer is equal to one billionth of a meter), penetrates tissue to a depth of about 8-10 mm. It is very beneficial in treating problems close to the surface such as wounds, cuts, scars, trigger and acupuncture points and is particularly effective in treating infections. Infrared light (904nm) penetrates to a depth of about 30-40 mm which makes it more effective in the treatment of joints, deep muscle, etc.

What is the Difference between LED's and LASERS?

Dr. Kendric C. Smith at the Department of Radiation Oncology, Stanford University School

of Medicine, concludes in an article entitled The Photobiological Effect of Low Level Laser Radiation Therapy (Laser Therapy, Vol. 3, No. 1, Jan - Mar 1991) that "1) Lasers are just convenient machines that produce radiation. 2) It is the radiation that produces the photobiological and/or photophysical effects and therapeutic gains, not the machines. 3) Radiation must be absorbed to produce a chemical or physical change, which results in a biological response."

LED's and LASERS both produce electromagnetic radiation at specific wavelengths. Several studies establish that it is the light itself at specific wavelengths, which is therapeutic in nature and not the machine producing it. For example, In the majority of lasers on the market, the energy output varies with the frequency setting: the lower the frequency, the lower the output. Even in the case of lasers that have a peak output of 10 watts, the average output at the highest frequencies is of the order of about 10 milliwatts because of the very short duty cycle. At the lower frequencies, however, the average output plummets into the range of microwatts (1 microwatt = 1000th of 1 milliwatt).

LEDs are neither coherent nor collimated and they generate a broader band of wavelengths than do the single-wavelength laser. Non-collimation and the wide-angle diffusion of the LED confer upon it a greater ease of application, since light emissions are thereby able to penetrate a broader surface area. Moreover, the multiplicity of wavelengths in the LED, contrary to the single-wavelength laser, may enable it to affect a broader range of tissue types and produce a wider range of photochemical reactions in the tissue.

The LED dispersesment over a greater surface area results in a faster treatment time for a given area than laser. LEDs are safer, more cost effective, provide a gentle but effective delivery of light and a greater energy output per unit of surface area in a given time duration. They are offered in combinations of visible red light at 660nm and infrared light at from 830nm to 930nm, with 880nm as their average.

Light Emitting Diodes (LEDs) are a form of light therapy that is a relatively recent development of the laser industry. LEDs are similar to lasers inasmuch as they have the same healing effects but differ in the way the light energy is delivered. A significant difference between lasers and LEDs is the power output. The peak power output of LEDs is measured in milliwatts, while that of lasers is measured in watts. However, this difference when considered alone is misleading, since the most critical factor that determines the amount of energy delivered is the duty cycle of the device.
LED devices usually have a 50% duty cycle. That is, the LED pulse is "on" for 0.5 seconds and "off" for 0.5 seconds versus the 2 ten-millionths of a second burst from laser at 1 cycle per second (1 hz.). Moreover, LED is "on" 50% of the time and "off" 50% of the time regardless of what frequency setting (pulses per second) is used.

LEDs do not deliver enough concentrated energy to damage the tissue, but they do deliver enough energy to stimulate a response from the body to heal itself. With a low peak power output but high duty cycle, the LEDs provide a much gentler delivery of the same healing wavelengths of light as does the laser but at a substantially greater energy output. For this reason, LEDs do not have the same risk of accidental eye damage that lasers do.

Hot and Cold Lasers
Lasers are of two principal types, "hot" and "cold", and they are distinguished by the amount of peak power they deliver. "Hot" lasers deliver power up to thousands of watts. They are used in surgery because they can make an incision that is very clean with little or no bleeding and because the laser cauterizes the incision as it cuts. They are also used in surgery that requires the removal of unhealthy tissue without damaging the healthy tissue that surrounds it. . "Cold" lasers produce a lower average power of 100 milliwatts or less. This is the type of laser that is used for therapeutic purposes and it is typically, although not always, pulsed. The light is actually on for only a fraction of a second because it is pulsed rapidly during the time frame. Pulsation results in an average power output that is very low compared to the maximum or peak output. Hence, most therapeutic lasers produce a high peak but low average power output. Therapeutic laser light is generally either visible (red, in most cases) or invisible (infrared). However, most therapeutic lasers operate at 904 nm, which is an infrared light.

Side Effects
At this time, research has shown no side effects from this form of therapy. Occasionally, one may experience an increase in pain or discomfort for a short period of time after treating chronic conditions. This occurs as the body reestablishes new equilibrium points following treatment. It is a phenomenon that may occur as part of the normal process of recovery.

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