

TERMINOLOGY AND DEFINITIONS IN THE FIELD OF PHOTON THERAPY

- **Photon therapy/light therapy/Phototherapy**
The term used that includes laser and LED based light therapy devices. This includes all devices that deliver appropriate doses of light in the range of 600–1000 nm
- Terms used to describe laser therapy: Low level laser therapy (LLLT), low energy laser therapy (LELT), low-intensity laser activated biostimulation (LILAB), low-power laser irradiation (LPLI), low power laser therapy (LPLT), etc.
- LED light therapy
Light emitting Diode light therapy

Other terminologies:

- **Wavelength:** Radiation emitted by the sun, light bulbs, etc., is called electromagnetic radiation. These energy packets, called photons, can be seen as wave particles or wave packets. This wave has a defined wavelength and a frequency assigned to it.
The wavelength of the photon causes the bio-stimulus in the cell. Each mitochondria (the cell's battery), has receptors that can absorb certain specific wavelengths. (Much like the reception of satellite TV, you must tune to the correct wavelength)
The wavelength is measured in nano meters (nm)
The receptors inside the mitochondria (that causes the bio-stimulus) is sensitive towards wavelengths in the range of 600-1000nm.
- **Power output of the probe:** (instrument that emits the light)
This refers to the amount of energy the probe emits, and is measured in milli Wats (mW) or Watts (W).

The higher the output power of the probe, the less time is taken to administer a given dose. There is however a limit as to what will be a beneficial output power. Above this limit, the dose will have an inhibitory effect, which means that no destruction of cells will take place, but it will only operate slower. Photon therapy devices have usually output powers of 1mW –1W.

- **Coherent beam:**

Coherent generally means order. Just like soldiers march in order. Waves of coherent light stays in phase in long trains of waves.

- **Polarization:**

Light of laser and LED based devices are usually non-polarized. It is generally accepted that non-polarized light has a superior effect, as to polarized light.

- **Continuous and pulsed light:**

Light can be generated as a continuous or pulsed beam. A pulsed beam is an interrupted beam. This means it is switched on and off, either electrically or mechanically, and usually has a duty cycle of 50%. A pulsed beam's output power will be thus half of a continuous beam. This is called the average output power of the probe (the highest output-peak-, divided by the lowest output).

- **Power density:**

Power density is the other way of expressing "light intensity" or "light concentration", and is usually measured in W/cm^2 . Spreading the light over a wide area, will give a lower power density.

- **Energy density:**

Energy density is the same as dose. The difference between power density and energy density is the time to administer the energy.

- **Pulse frequency:**

Frequency is measured in Hertz (Hz). The light beam can be pulsed with different frequencies. Some frequencies are considered by acupuncturist on empirical grounds, to be particular beneficial towards certain conditions.

- **Collimation:**

This term refers to a parallel beam. Light emitted from a laser beam, is not always collimated or parallel. If a lens is placed in front of the beam, the light parallelism can be increased. This is called collimation. With such a beam, one can irradiate from a distance, and can still achieve a high power density. Light emitted from a laser device are more collimated than a LED based device.

- **Dose and dose ranges:**

The dose is the amount of energy administered to a surface area of tissue. The area is measured in cm^2 . Energy is measured in Joule (J). The dose is thus measured in J/cm^2 .

The dose is calculated as follow: : $t = \frac{D \times A}{P} \times (1+d)$ sec

Where: t= time, D= dose P= output power of the probe in Watts, A= area to be treated, and d=depth to be treated.

Dose ranges are the dosage that will have a bio-stimuli effect in tissue. Effective dosages are in the range of $0,01-10\text{J}/\text{cm}^2$. Dosages that are too low, will have no or a weak effect. Dosages that are too high will have an inhibiting effect.

- **Penetration, penetration depth and greatest active depth:**

Penetration refers how deep the light penetrates into tissue. Photons are absorbed as it penetrates. This means that less and less photons are available to travel deeper into the tissue. The output power and wavelength also influences penetration. This applies only to the direct effect on the cells, and not the systemic effect that photon therapy has (immune, pain, and other enzyme stimulation).

Depth of penetration shall mean then the depth into tissue, where the last photon is absorbed.

Penetration depth means that distance from the skin surface where 60% of the original dose given, are still present in the tissues. The other 40% still travels deeper.

Greatest active depth means that tissue depth, where the last effective photon is measured that will still have a bio-stimulus effect.

- **In Vitro and In Vivo studies:**

In Vitro means the study of naked cells. This implies that cells are isolated and radiated outside the body.

In Vivo means that the effect of light radiation is studied inside the body, where all the systems (immune, enzymes, hormonal, etc.) are working as a unit.

The dilemma of science is the application of In vitro studies in the practical treatment of living beings. It is at utmost importance that studies are done in both this fields. Cells do not operate alone inside the body, but as part of a system. Thus interpretation of these In Vitro studies must be made with caution. As in the case of Cancer and bacterial organisms; In vitro studies photon therapy stimulates both, but in In Vivo studies it is directly the opposite: Small cancer growths vanish, and bacteria are being delt with, both via the immune response.