Dynamic Chiropractic

LASERS & TENS

Pulsing in Laser Therapy, Part 2: Possible Physiological Effects

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An article published in *Lasers in Surgery and Medicine*[8] examined the effect of pulsing in low-level light therapy. The authors performed a review of peer-reviewed literature published between 1970 and 2010, including several that compared continuous wave and pulsed light in both animal and human treatments. They concluded, "There is some evidence that pulsed light does have effects that are different from those of continuous wave light."[7]

The review article describes advantages of pulsed light over continuous wave, including less tissue heating due to the "thermal relaxation period" between pulses. One quoted study compared continuous wave to pulsed light administered to pig craniums, and found that "pulsed light administered for 120 seconds produced no neurological or tissue damage, whereas an equal power density delivered by CW caused marked neurological deficits." It went on to say, "Higher peak powers that can be safely used by pulsing light can overcome tissue heating problems and improve the ability of the laser to penetrate deep tissues, achieving greater treatment depths."

The majority of pulsed devices used in laser therapy have frequencies in the 2 to 10,000Hz range, correlating to pulse duration of a few milliseconds. Therefore, if there is a benefit to using pulsed light, it could be explained by a fundamental frequency that exists in living organisms, or by some biological process that has a time scale of a few milliseconds.

It is known that mammalian brains exhibit waves of different frequencies, so there may be some yet-undiscovered natural frequency for other organs or body systems. There is also evidence that ion channels are involved in the subcellular effects of laser therapy. Voltage-activated ion channels comprise the nerve impulse, and the time scale for the opening and closing of the ion channels is on the order of a few milliseconds.[9]

Suggested Pulse Frequencies for VariousIndications

Indication	Frequency Range
Pain, neuralgia	1-100Hz
General stimulation	700-2,500Hz
Oedema, swelling	1,000Hz
Inflammations	5,000Hz
Infections	10,000Hz

Source: TheLaser Therapy Handbook

Another mechanism explored in the review article is the photodissociation of nitric oxide from a protein binding site; for example, that of cytochrome C oxidase. Pulsed light may produce more disassociation events than does CW light, and thus be more effective.

In studies comparing pulsed to CW, pulsed was found to be more effective for wound healing, pain and ischemic stroke *in vivo*, and at promoting bone stimulation *in vitro*. In one study on pain attenuation in white male mice, CW was compared to pulsed at 10, 600 and 8,000Hz. Both modes of delivery reduced pain behaviors compared to controls, but pulsed at 10 and 8,000 Hz was most effective.

Other studies have examined various pulse repetition rates, but the research in this area is preliminary. In their laser therapy textbook, Tuner and Hode write, "Although the literature in this field has not yet made clear which frequencies are particularly suited to which treatments, the many users of laser therapy have still produced a large body of empirical material."[9] They publish the following chart with suggested pulse frequencies for various indications.

Pulsed light is thought to penetrate more deeply than CW, due to a mitigating effect on melanin filters in the skin.[9] This is especially important when treating darker-skinned patients. High-power CW can rapidly heat surface tissues, presenting a potential safety risk. As discussed, pulsed modes allow for thermal relaxation and can deliver therapeutic dosages deep without excessive heating of surface tissues.

Final Thoughts

Therapeutic lasers emit light in continuous wave, modulated, superpulsed and intense-superpulsed modes. CW is considered the gold standard and has been successfully used to treat many conditions. Pulsed and modulated lasers seem to evoke different physiological responses from tissues, and allow for thermal relaxation of treated tissues.

Therapeutic laser technology and clinical applications are on the "front" of the wave. The use of pulsed and modulated frequencies versus CW to more specifically address certain conditions has a significant body of evidence, and more research will enhance the effectiveness of laser therapy treatments in the years to come.

References

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This is a continuing series by Dr. Harrington discussing lasertherapy from a physics perspective. To access previous articles, searchDynamicChiropractic.com (enter "Harrington" or "Physics forChiropractors" as search terms).

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