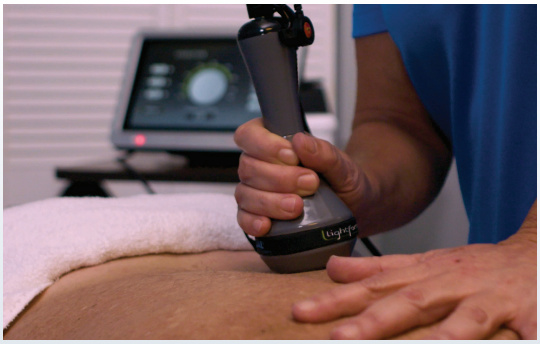
Understanding LED and Laser Therapy

There is currently a lot of discussion in rehab circles surrounding the efficacy and therapeutic potential of light-based modalities. From professional sports teams to private practices, these technologies are starting to be used on a daily basis to treat injured tissue. Light-based therapy used to treat pain and inflammation can be delivered by both lasers and LEDs, and consumers often want to know the operational and therapeutic differences between them.

Both laser and LED therapies rely on being able to deliver an adequate amount of energy to the target tissue in order to precipitate a photochemical process known as photobiomodulation (PBM). Some processes that are impacted include, but are not limited to, the alleviation of pain or inflammation, immunomodulation, and promotion of wound healing and tissue regeneration."[i]



Both sources of light share the same mechanism of action and are both commonly generated using diode technology. When used and studied in therapeutic applications, both lasers and LEDs are often built to emit similar wavelengths, and have been shown to have pain and inflammatory reduction properties.[ii] Significant differences between the two do exist, however; including the power generated, the specificity of wavelength, and the physical characteristics of the beam generated from the diode.

Two unique qualities that differentiate laser light from other light sources is that it is both monochromatic and coherent. Monochromatic light has a single wavelength and is ideal for stimulating chromophores in biological tissue. Coherent light is characterized by light wave sources that have a fixed relationship. Specifically, the waveform, frequency, and phase difference of the light are constant. These characteristics are unique to laser light and are important components when treating deeper tissue. Most light sources, including LED, are noncoherent which increases scatter and reflection as it interacts with tissue, making them much less effective when treating at depth.

LEDs usually emit light in a small band of wavelengths (~20 nm wide) but cannot emit a single specified wavelength (~1 nm wide). This bandwidth impacts their ability to dial in the wavelength to optimally target desired tissues. Additionally, LEDs produce neither a collimated nor coherent beam which is less ideal when treating deeper tissues. Lastly, LEDs operate at significantly lower power (wattage) than most lasers, which impacts their ability to reach deeper tissues.

When trying to target deeper tissues, wavelength is a critical variable that can play a significant role in the light's ability to penetrate tissue. But it is not the only determining factor. Power is a second variable that also plays a large role in determining both proper use and consistency of outcomes for light-based therapies.[iii] Lasers are generally capable of producing much higher powers than LEDs, which significantly impacts their ability to reach deeper tissues.

For superficial uses, such wound healing[iv], therapeutic effects can be achieved with a minimal amount of energy applied to the surface, for which LEDs are well suited. For deeper or more wide-spread conditions, such as fibromyalgiav or chronic low back pain[vi], a greater amount of energy must be delivered for a sufficient therapeutic effect to be achieved.

Knowing what types of injuries will be treated with your light-based modality will impact which device will be most beneficial to the practice. LEDs often get a lot of initial attention because they are much cheaper than laser technology. Lasers used to treat deep tissue (that offer a wider range of power), however, give providers the most flexibility in terms of treatment capabilities as they can be used to treat both superficial and deep conditions.

References available online

Author: Mark Callanen, PT, DPT, OCS