Just the Facts

Common phototherapy misconceptions can lead clinicians astray.

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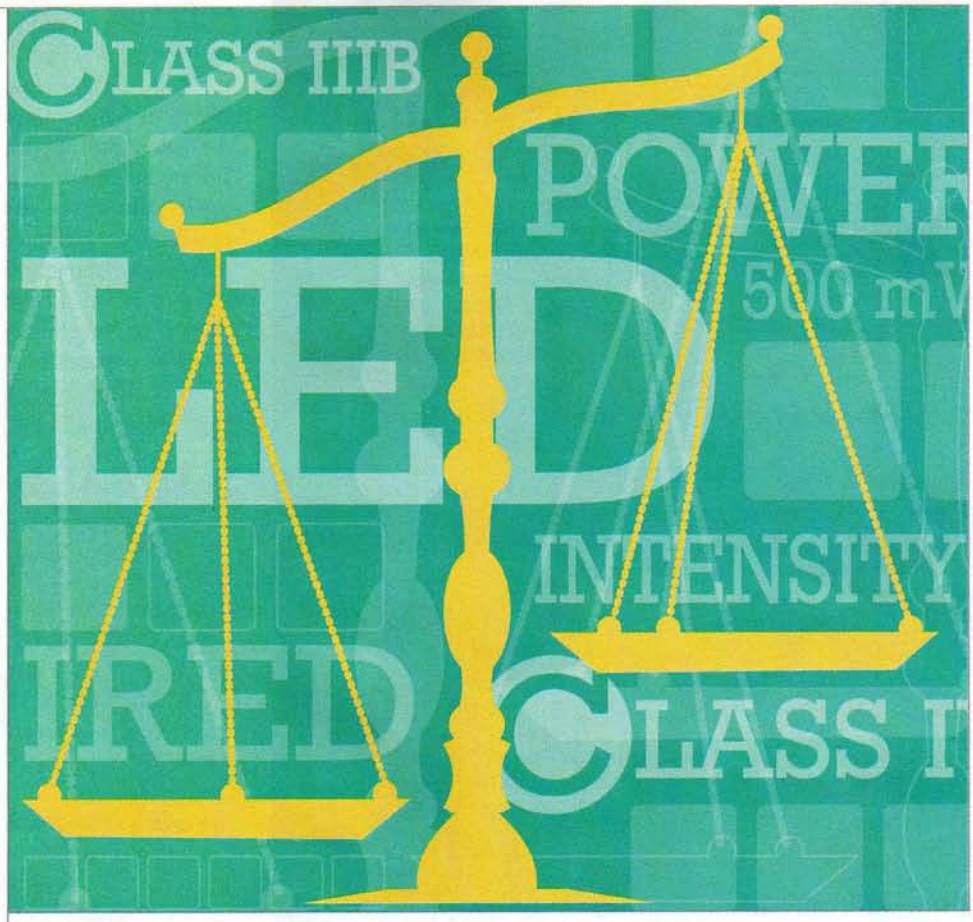

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As phototherapy gains popularity as a treatment modality, the misconceptions and confusion surrounding the use of light as a physical agent continue to prosper.

Before the confusion goes any further, it's time to clear up the inaccuracies and present the facts. What are the five most common myths and misconceptions about using light and lasers?

1. Light is light. So why do I need a laser?

This is a false assumption. If this were the case, then you wouldn't need any phototherapy devices, laser or not. Many sources of light can produce effects within cells. However, the majority of positive phototherapy research has been conducted using lasers, not LEDs. This can be attributed to the fact that LED and monochromatic infrared (IRED) technology are relative newcomers to phototherapy.

Manufacturers who only produce IRED or LED devices continue making the claim that non-coherent light sources produce equal, if not better, results than lasers. This hasn't been scientifically documented to be the case. Typically, light and infrared emitting diodes can be produced at a fraction of the cost of their laser counterparts.

NASA has conducted some research using monochromatic LEDs that has shown positive effects on various types of wound healing. But these studies don't support the use of IRED emitting diodes for pain relief.

2. All lasers under 500mW are outdated. Is this the case?

Lasers under 500mW are not outdated. Most positive studies have used low-powered lasers. There are no controlled studies validating the use of higher powered continuous wave lasers in human biostimulation. Clinicians need to demand studies that clearly state that positive results were due to lasers with high-powered diodes.

Many of today's laser diodes offer a power range between 5 mW and 500 mW, which is the upper limit of class 3b. There has been a trend to increase power beyond this limit. Powers in excess of several watts are considered class IV lasers. These class IV devices have power ranges from 500mw to a staggering 7,500 mW, making it a high-power laser that's potentially dangerous. The FDA has issued warnings with these devices about their safety and use.

The primary effects of phototherapy are based on photochemical changes, not the result of thermal tissue changes.[1] However, light generation creates heat as a byproduct. This can continually build up heat within target tissues, which can cut, vaporize and coagulate. This principle is the basis for laser surgical tools. Lasers at low levels, like ultrasound, can stimulate, while at higher levels they become destructive.[2]

For example, a laser beam mean output power (MOP) of 200 mW focused on an area of 1 cm^2 (power density 0.2 W/cm^2) for 10 minutes can produce first-degree burns. One class IV laser has a power of 7.5 watts and a 0.8 cm spot size. Based on the equation power density = power/area, the resulting power density is equal to 9.375 W/cm^2.

This is far above the recommended dosage and safety limit. Low-level laser devices usually have MOP values in the range of 5 to 400 mW and power densities of 1 to 100 mW/cm^2. It's not possible to induce skin lesions with low-level laser therapy if these power densities and the recommended irradiation doses are applied.[3]

3. Optimal wavelength is 635 nanometers.

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Optimal wavelength is 785 nanometers. Optimal wavelength is 830 nanometers. What is the optimal wavelength?

All of these wavelengths are therapeutic. What's important is the range of wavelengths necessary for the process of photobiostimulation. The "therapeutic window" contains all the wavelengths between 633nm (visible red) and 905nm (infrared) that elicit biological responses. The light's wavelength or color determines the overall depth of penetration the beam can attain. Wavelength is also determined by the medium from which it's generated.

Red and near-red wavelengths (a lower therapeutic window of 633 to 780 nm) don't penetrate as deep and are more readily absorbed by melanin. Therefore, an increase in power does nothing to improve depth of penetration. Red phototherapy devices have an array of dermatological applications, such as wound care and acne treatments. Infrared photons from 780 nm to 905 nm (upper therapeutic window) are less likely to be absorbed in the skin and blood. These wavelengths penetrate deeper and are best suited for greater tissue stimulation and musculoskeletal injuries.

Keep in mind that light from semiconductors is generally monochromatic. Since only a single wavelength is produced, wavelength selection depends on the specific depth of the target.

So it's critically important to choose a wavelength that can produce photons that readily absorb into desired tissue. It's evident why wavelength is the most crucial factor when purchasing a light therapy device.

4: The depth of penetration of an infrared laser is 5cm. How deep can it go?

Depth of penetration isn't clearly definable. Even among experts, there's a great deal of debate regarding the value of absolute and greatest active depths for light therapy devices. However, the idea of target depth must be taken into account if you plan to treat anything below superficial layers.

The Arndt Shultz Principle states that no reaction can occur unless a sufficient amount of energy has been absorbed in the target. What is this amount and how many photons are needed? This is a question scientists can't answer.

We know that a small dose at a target may not be adequate enough to produce a stimulus, so we increase the dose. As light travels further into the body, it becomes weaker. As a result, it may not be able to stimulate deeper structures to react.

Getting light to superficial structures is relatively simple. Both lasers and non-coherent light sources are capable of providing photons to theses targets. It's only when deeper structures are stimulated that you need to consider wavelength selection, adequate power and the type of power delivery system.

The greatest active depth can be affected by the wavelength of the light, the mean output of power, the technical design of the emitter, treatment technique, tissue type and pigmentation. Also, the vehicle of how the power is delivered is important.

Super-pulsed lasers, with their intense bursts of energy at durations of a millionth of a second and longer wavelengths, reach greater depths than continuous wave lasers of similar mean power outputs.

In *The Laser Therapy Handbook*, the authors illustrate the impact of super pulsing versus a continuous laser on depth of penetration and treatment time.[4] For example, consider that laser A is a continuous wave laser at 50 mW, and it takes 40 minutes of continuous use to reach 5 cm depth. Laser B produces a super-pulsed beam with a mean output of power of 50 mW. By contrast, it only takes 4 minutes of treatment time to reach the same 5 cm depth.

5: Phototherapy devices can treat an array of injuries and illnesses, from diabetic neuropathy to wounds. What does the FDA say?

The largest pitfall in phototherapy is differentiating the science from the hype. Claims of effectiveness without studies, the disingenuous use of research and abstracts overstating indications for use is too commonplace in this new field.

So how should clinicians protect themselves? Before acquiring a device, obtain the FDA 510K summary. This market clearance summary lists the indications and uses for laser devices. Though many units are cleared for the same conditions, several laser devices are specific in nature. For example, devices with infrared lamp clearance (ILC) have indications that read like this:

- temporary increase in local blood circulation
- temporary relief of minor muscle and joint aches, pains and stiffness
- relaxation of muscles
- for muscle spasms
- minor pain and stiffness associated with arthritis.

However, a handful of devices have been filed under a second classification. This category is considered non-heating. These devices have specific clearances and should only be used for FDA-cleared treatment applications. Some examples are adjunctive use for temporary relief of hand pain associated with carpal tunnel syndrome, pain associated with the neck and shoulders, and knee pain associated with chiropractic care.

With so much information floating around, it's possible to be misled. It's always better to have the facts. ■

For a list of references, go to www.advanceweb.com/rehab and click on the references toolbar.