

## **A Higher Power**

### **Therapeutic laser units feature drastically stronger intensity levels.**

By Robert L. Wertz, DC

Laser therapy has come a long way in the last decade.

Over the past 10 years, therapeutic laser devices have become equipped with higher power density and dosage capabilities. The first therapeutic laser in the United States, cleared by the FDA in 2002, had a power output of just 5 milliwatts (mW).<sup>1</sup> Today, several models of FDA-cleared therapeutic laser units have arrived on the market, and power has reached as high as 7,500 mW, an increase in power of 150,000 percent.<sup>2</sup>

One of the main reasons for this radical increase is therapeutic outcomes. While questions still surround the effectiveness of laser therapy, several controlled clinical studies have demonstrated that the most common reason for poor clinical outcomes is related to low power or dosage.<sup>3</sup> Suboptimal effects have heralded the need for higher output levels, which led to the implementation of higher wavelengths with deeper tissue penetration.<sup>4</sup>

But with more potent devices come new concerns. There's now an even greater level of misunderstanding among practitioners regarding the type of therapeutic laser that can provide the deepest penetration, and thus the highest amount of stimulation for conditions routinely seen in practice. Given the parallels of X-ray and infrared (laser) physics—both of which are continuums of energy within the electromagnetic spectrum—it's no surprise that many practitioners are confused.

## **Reviewing Laser Action**

The three most important parameters of laser therapy are power, wavelength and power density. These parameters have the most influence on clinical outcomes, and they're discussed most frequently in the literature. Before examining the clinical importance of power, it's important to review laser light's effect on cellular structures.

Cells and tissues that are ischemic and poorly perfused as a result of inflammation, edema and injury have been shown to have a significantly higher response to laser therapy irradiation than normal healthy structures.<sup>5</sup> Photoreceptors at the molecular level, when triggered, activate a number of biological reactions, such as DNA and RNA synthesis, increased cAMP levels, protein and collagen synthesis, and cellular proliferation. The result is rapid regeneration, normalization and healing of damaged cellular tissue. Thus, light

is a trigger for the rearrangement of cellular metabolism.<sup>6</sup>

The range of laser energy absorption (Joules) by the skin and subcutaneous tissue is 50 percent to 90 percent.<sup>7</sup> In addition, the amount of laser energy the body absorbs increases as the wavelength decreases. Therefore, higher wavelengths are preferable for deeper stimulation, and for stimulating the physiological processes necessary for pain reduction, inflammatory decline and accelerated tissue healing.

If the wavelength has a low penetration factor, increasing the dose won't have any effect.<sup>1</sup> The laws of laser physics have demonstrated that the higher the wavelength, the deeper the penetration. Sufficient penetration is required to stimulate deep musculoskeletal, vascular, lymphatic and neurological structures.

Given the in-depth nature of X-ray physics and utilization as they're taught in most school curricula, you can draw several parallels to increase the understanding of laser physics. The milliamp setting governs the quantity of X-ray photons produced in a given period of time. This is also referred to as the dose. Therapeutic lasers deliver their doses by the amount of photons emitted secondary to the milliwatt setting over a period of time. The higher the setting in both instances, the higher the dose.

X-ray penetration is governed by the kVp setting. In laser therapy, penetration is dictated by the wavelength, which is measured in nanometers (nm).<sup>7</sup> Both kVp and wavelength are affected by tissue density.

### **Putting Lasers Into Clinical Practice**

In translating these findings to the clinic, it's important to note that the most common musculoskeletal conditions that send patients to a health care provider are neck pain and low back pain. Substantial published research has identified that the most common generators of pain lie deep in the cervical and lumbar regions.

In the neck, the zygapophyseal joints are implicated most frequently in acute (traumatic) and chronic neck pain conditions.<sup>8-11</sup> In the low back, the outer layer of the annulus fibrosis and posterior longitudinal ligament have been reported by several authors to be the most common tissue of pain origin.<sup>12-13</sup>

Given the depth of these documented structures, which lie below multiple layers of muscle and fascia, a therapeutic laser device must be able to penetrate these areas and provide enough power to stimulate the photoreceptors and trigger positive physiological events.

Low-level lasers have a range of 1 mW to 500 mW, which don't appear powerful enough for these applications. Recent literature reviews have

concluded that there's a lack of adequate evidence supporting the effectiveness of using low-level laser therapy to treat musculoskeletal disorders, arthritis and pain.<sup>14-25</sup> Also, reviews have concluded that low-energy laser therapy is ineffective treating carpal tunnel syndrome.<sup>26,27</sup> As a result, high-power lasers are becoming the tools of choice to reach deeper structures.

However, with higher output levels comes the question of overstimulation. Some proponents of low-level laser devices express concern about higher power levels and increased treatment times, citing that they may inhibit healing. Despite these concerns, reports of therapeutic laser devices having an inhibitory effect on cells have only occurred on thin tissue cultures in vitro, and lack validation in human studies. One exception to this is the inhibition and suppression of depolarization of C-fibers, which result in pain reduction.<sup>28-33</sup>

As the interest level surrounding laser therapy continues to grow in physical medicine and rehabilitation, some high-power laser manufacturers are including outcome assessment tools, such as an algometer to measure changes in tissue sensitivity, and patient questionnaires to quantitatively assess patient improvement in areas such as pain, function and quality of life. Other assessment instruments can measure back-specific functions, generic health status, work disability and patient satisfaction.<sup>34</sup> For therapeutic lasers to take hold in clinical practices, technology must be exposed to the scrutiny of scientific rigor and objective quantified outcomes measures.

Given that the primary reasons for poor clinical outcomes are low power and poor penetration, health care providers using laser therapy must examine the current evidence, heed the pioneers in the field and recognize that a higher power may hold the answer for patients in pain.

For a list of references, go to [www.advancweb.com/REHAB](http://www.advancweb.com/REHAB), and click on the references tool bar.

*Robert L. Wertz, DC, is licensed by the Florida Board of Chiropractic Medicine and is an independent regulatory and business consultant for several medical device, pharmaceutical and biotechnology companies. He can be reached at [thespinedoc@hotmail.com](mailto:thespinedoc@hotmail.com)*

## **Pointing Lasers to the Future**

The Swedish Laser Medical Society, one of the world's leading authorities on lasers, has spoken out about the significance of intensity levels when examining the effect of laser therapy on painful and inflammatory conditions. For the society, power holds the key.

"I can see two alternatives for myself," says Jan Tuner, MD, president of the society. "To speak up and start a conflict within the laser community or to keep quiet and let U.S. practitioners pay a lot of money for very low-powered lasers, leaving us with dissatisfied customers and discredit from those who are supposed to use laser therapy in medicine."

Dr. Tuner and physicist Lars Hode—founder of the society—feel that high-powered lasers have brightened the future of this promising modality. "For the moment, we must rely on our own clinical experience," they write in *Laser Therapy Clinical Practice and Scientific Background*. "That experience, however, is so encouraging that it cannot be ignored, even with lack of scientific support. It would appear that high-powered therapeutic lasers will be able to further expand the scope of laser therapy."

*Robert L. Wertz, DC*