Lasers: More Variables Than Power

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Many veterinarians are acquiring lasers to lower patient pain and speed healing. In response, various companies have been introducing and promoting their units at CE conferences.

How Much Power Do I Need?
The laser classification system defines the amount of power emitted; class IIIa emits 1 to 5 mW, class IIIb 5 to 500 mW, and class IV above 500 mW (0.5 W). Laser therapy doses are usually described in total joules or joules per cm² (joules/cm²). Although which class may be more effective is controversial, the efficacy of gross and cellular effects of class III laser therapy has been documented (Table).¹ Research on class IV lasers is ongoing. Current thought is that physiologic effects are seen with both high- and low-power settings.²³

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Effect</th>
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<tbody>
<tr>
<td>Cellular</td>
<td>Enhanced adenosine triphosphate (ATP) production&lt;br&gt;Increased cell membrane pump function&lt;br&gt;Increased cell respiration</td>
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<tr>
<td>Gross</td>
<td>Analgesia&lt;br&gt;Antiinflammatory&lt;br&gt;Antiedema&lt;br&gt;Circulation improvement&lt;br&gt;Enhanced wound healing&lt;br&gt;Enhanced healing of tendons and ligaments with superior tensile strength&lt;br&gt;Nerve cell damage repair&lt;br&gt;Slow or reversed tissue degeneration</td>
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¹Table: Proven Effects of Class III Lasers

MORE
What Wavelengths Should I Use?
Different wavelengths have similar but slightly different effects on tissue; shorter wavelengths equal shallow penetration and longer wavelengths equal deeper penetration. Penetration is important when considering target tissue. For instance, for skin lesion treatment, shallow penetration is the goal, and a 600- to 700-nm wavelength may result in superior healing. A series of studies compared the use of 532-, 633-, 810-, 980-, and 10,600-nm lasers in diabetic rats with wounds and burns; 633 nm laser therapy was the superior wavelength for skin healing. In another study, rats treated with a 685-nm laser had the best healing pattern at the skin surface, but rats treated with an 830-nm laser had a higher degree of organization and maturation of collagen fibers below skin.

Penetration is determined by how much light the tissue absorbs. Wavelengths with high absorption potential need to use more total joules of light energy to reach the same therapeutic dose at deeper tissue levels. Wavelengths with higher penetration and less absorbance in superficial tissue can use significantly lower doses of light energy and yield a similar effect. Depending on the tissue treated, wavelengths in the 904- to 905-nm wavelength range have the deepest penetration and may be more beneficial in treating pain. Wavelengths in the 600- to 700-nm wavelength range are absorbed significantly by water, hemoglobin, and melanin. This change in penetration is also observed in dark-skinned animals (ie, melanin absorption of the energy), especially in wavelengths of 800- to 860-nm. Doses need to be adjusted to prevent tissue overheating.

Low doses of light energy (1–2 joules/cm²) are used for treating skin. Wavelengths with a high water absorption rate require higher doses to achieve the same penetration and effect of a low-water absorption rate wavelength (970–980 nm). These wavelengths create more heat, which may be beneficial if it does not exceed a therapeutic level. The deeper the wavelength penetrates, the fewer total joules are needed to appreciate an effect on deeper tissue. Lasers with a 904- to 905-nm wavelength have the deepest penetration when wavelength alone is evaluated. The World Association of Laser Therapists (laser.nu) has recommended using about half as many joules when treating with a laser in the 904- to 905-nm range versus 780- to 860-nm range.

Many practitioners purchase a laser to add to their modalities for controlling both acute and chronic pain. A metaanalysis found that the best wavelength to treat chronic joint disorder pain was 904 to 905 nm. In recent literature, the physiologic effects of how lasers actually block pain were evaluated. It was found that when using an 830-nm wavelength at 8 joules/cm², the laser energy was absorbed by the mitochondrial membrane causing a decrease in the mitochondrial membrane potential. This prohibited adenosine triphosphate from exiting the mitochondria, thus inhibiting cell propagation of an electric potential and effectively creating an axonal nerve block.

The author uses 1 joule/cm² when treating the tissue of a wound where there is no melanin to absorb light energy and 2 joules/cm² over skin around a wound or over an incision or infection. The author uses 3 to 6 joules/cm² when treating an arthritic joint with 904- to 905-nm (the highest penetration) and 808-nm (best for treating inflammation) wavelengths; 6 joules/cm² is used for significant pain, and 3 to 4 joules/cm² is used thereafter to stimulate healing.

This dog received oral laser therapy to lower its pain and residual inflammation after tooth extraction.Immediately after treatment, the gums were less red and inflamed and the dog seemed to be in less pain, as evidenced by a change in breathing and a more relaxed body.
Power Comparisons

The discussion on lasers would not be complete without looking at power comparisons. One study, evaluated changes in blood flow in human bicep muscles, comparing a sham, 1-, 3-, and 6-W laser. Improvement was found in blood flow of patients treated with the 3-W laser but not in patients treated with sham, 1-W, or 6-W. Wavelength was not noted. Another study compared 40-, 60-, 80- and 100-mW lasers on calcaneal tendon repair in Wistar rats and found that 60-, 80-, and 100-mW lasers increased type III collagen formation. The 100-mW laser caused the most significant increase in type III collagen, but the most significant increase in type I collagen formation was at 80 mW. These studies illustrated how different power amounts can affect the benefits of laser therapy. More research is needed to determine optimal variables for specific conditions.

Most therapeutic lasers on the market today have a power range of 250 mW to 15 W, with a few in the 1- to 5-mW range (ie, class IIIa lasers). The lowest powered lasers are usually sold with the purpose of stimulating acupuncture points to create a healing effect; additional research is required to prove or disprove these anecdotal claims.

Hip laser therapy was instituted to diminish pain in a dog with osteoarthritis. Achieving full effect of laser therapy to reduce pain usually takes 15–30 minutes after each session, and effects are cumulative. Many patients receive more relief after each treatment until they reach a plateau.

See Aids & Resources, back page, for references & suggested reading.