One look at the x-rays of my Border Collie’s phalanges make many people cringe and say “Ouch!” Those visible boney growths on his toes have been confirmed by biopsy as osteoarthritis. This disease is present in both of his front paws and his pain is evident after too much exercise. My friends with arthritis describe their pain as often being excruciating and so when Duncan shows pain, I can only imagine what he must be feeling. At 1½, Duncan – a.k.a. “Dutaro” – can still snag a ball like the San Francisco Giant’s second baseman and never wants the game to end. In an effort to keep him as pain-free as possible, and thus active, healthy and happy, I incorporated laser therapy into his treatment program. Playing ball is in his blood; by adding the effects of laser therapy, he’s able to stay off the disabled list.

The idea of laser (light) as a therapeutic method has been around for thousands of years – the Egyptians were known to use solar therapy. After observing that ultraviolet light killed bacteria, Niels Ryberg Finsen began employing UV rays to treat diseases in England in the 1890s, receiving the Nobel Prize in Physiology/Medicine in 1903.

In 1917 Albert Einstein theorized about the process of lasers through stimulated emissions of light; the term “laser” was first used in a scientific paper in 1959 (as an acronym for “light amplification by stimulated emission of radiation”). The first working lasers were developed in the early 1960s and laser therapy entered into its modern form in 1967 when Hungarian physician Endre Mester, considered the pioneer of laser medicine and credited as the discoverer of the positive biological effects of low-power laser, began his early science experiments. While applying lasers to the backs of mice whose fur had been shaved to see if laser irradiation caused cancer, Mester noticed that the shaved fur grew back faster on the treated group (who, by the way, did not get cancer) than on the untreated group. With other experiments he found that lasers could stimulate wound healing.

Laser therapy is akin to photosynthesis in plants in that the light delivered by the laser converts to energy that the body can use. It is not heat therapy, and therapeutic lasers are different than those lasers used for ablation, cutting, and thermally coagulating tissue.

A laser is an amplifier of light, emitted in the form of photons (discrete packets of electromagnetic energy). The absorption and penetration levels of each these photons is determined by its wavelength (light energy exhibits wave-like behavior as it travels through space.
and is measured in wavelengths, categorized by color and visibility). When the photons, in the form of light, come into contact with biological tissue, part of it is absorbed, part is reflected or scattered, and part is further transmitted.

The primary effects of laser therapy start with those photons that are absorbed, inducing activity at the molecular, cellular, and tissue levels. Damaged or compromised cells and tissues have been shown to have a significantly higher response to laser therapy than normal healthy structures.

**BIOSTIMULATORY EFFECTS**

Laser therapy does three things: increases healing, decreases inflammation, and decreases pain. One way laser therapy accomplishes these objectives is by generating an increase in localized blood flow, which normalizes and heals damaged cells. In the body, blood transports oxygen and nutrients to cells and carries waste products away; laser therapy increases this process, resulting in more oxygen being delivered to cells to be converted into cellular energy.

Perhaps the most essential action of laser therapy is the photochemical stimulation caused by the administration of infrared light in the 800-1000 nanometers (nm) range, which interacts with cytochrome C, located in the mitochondria (the cellular power plants) of cells, catalyzing several reactions. This interaction results in the formation of adenosine triphosphate (ATP), a coenzyme that stores and transports energy for various metabolic processes; nitric oxide (NO), a cellular signaling molecule involved in many physiological and pathological processes; and reactive oxygen species (ROS), chemically reactive molecules involved in cell signaling and homeostasis.

Protein synthesis can follow, triggering further effects such as increased oxygenation, increased cell generation and migration and regulation of the levels of growth factors, cytokines (molecules of protein, peptides, and glycoproteins that provide communication between cells) and inflammatory mediators, all of which stimulate cellular metabolism and the healing response.

Other effects have been documented, particularly as they relate to decreasing pain: increased endorphin and serotonin production, normalization of nerve cell action potentials, blocking of nerve cells and decreased bradykinin (peptides that cause blood vessels to dilate) production. Angiogenesis (the process of forming new blood vessels) and neurogenesis (the process of generating neurons) are also confirmed effects. Simply put, laser therapy means more energy is available for cells to conduct their processes.

**LASER DEVICES**

Laser therapy, especially as part of physical therapy, has been used in many parts of the world including Canada, Australia, Europe, and some Asian countries for many years. It wasn’t until 2002 that the FDA cleared the first therapeutic laser, with a power output of 5 milliwatts (mW), for use in the United States. Today, lasers can range up to 15,000 mW (15 watts) in power. Because lasers are regulated by the FDA, they must be classified according to their power output level and the potential to cause eye injury.

Most therapeutic lasers used in clinical practice fall into one of two classifications: Class 3B lasers, which can have a power output level anywhere from 5 to 500 mW; or Class 4, which is any laser with a power level of 500 mW or more. Class 3B lasers can be hazardous to the eyes if directly exposed and are sometimes referred to as “cold” lasers because they generate no significant thermal effect. Class 4 lasers can cause permanent eye damage from direct, diffuse, or indirect beam viewing (thus great care must be taken to control the light beam path); these lasers have the
potential to increase the temperature of tissues and cause burning, though this is extremely rare.

Practitioners of laser therapy tend to align themselves with either one or the other class of lasers. One is not necessarily better than the other; it’s really a matter of preference. Each have their advantages and disadvantages, but both can produce positive results.

Laser machines also come standard with one or multiple sets of predetermined wavelengths. The wavelength of the laser light determines the distance that the light penetrates through tissue. The laws of laser physics have demonstrated that the higher the wavelength, the deeper the penetration. The wavelengths of light used for laser therapy fall into an optical window of near-infrared wavelengths measuring in the range of 600-1070 nm.

Wavelengths within the 600 nm range do not directly penetrate more than 0.5 to 2 centimeters (cm), or indirectly up to 5 cm. Wavelengths in the mid 700 to low 1000 nm range penetrate deeper, directly affecting tissues up to 5 cm and indirectly up to 10 cm. Wavelengths in the 600-700 nm range can only be used for treating skin and subcutaneous tissue and wavelengths of 780-980 nm are preferable for the deeper stimulation required of the musculoskeletal, vascular, lymphatic, and neurological structures to initiate the physiological processes necessary for pain/inflammation reduction and accelerated tissue healing.

Laser devices can be operated in either continuous wave or pulsed mode, depending on whether the power output is essentially continuous over time or whether it takes the form of incremental emissions of light. There are also super pulsed lasers in which a high-powered high-dose beam of light is administered in timed bursts interspersed with large pauses. Research has not shown pulsing of any type to be more beneficial than continuous wave.

**DOSAGE**

Another primary component to the practice of laser therapy is the length of time the laser is administered. This, combined with power and wavelength, is referred to as the dosage. The World Association of Laser Therapy (WALT) provides a list of recommended treatment dosages for a variety of conditions in humans; because these are derived from clinical trials and studies on animals with similar pathologies, the recommendations for use of lasers in veterinary settings are based on these guidelines. The amount and strength of light used depends on the pathology being treated and in particular how deep the light is thought to need to penetrate into the tissue. Correct dosage is vital to the success of laser therapy.

**LASER THERAPY IN VETERINARY PRACTICE**

Laser therapy has been used as a modality in veterinary practices for decades, but only recently has it has gained mainstream acceptance and become readily
available, largely because the technology and science have evolved to the point to make its use scientifically valid and repeatable.

The interest in its potential has also resulted in an upsurge in the availability of training and education; today, veterinary conferences have full sections on laser therapy and schools of veterinary medicine offer courses as part of their curriculum. It is used to treat a wide spectrum of conditions in companion animals, ranging from skin issues to chronic pain to acute injury. A response to laser therapy is usually seen within one to three sessions.

Jeffrey Smith, DVM, is the owner of Middletown Animal Hospital in Middletown, California, a past president of the California Veterinary Medical Association, and a representative for Companion Therapy Laser® (a division of LiteCure, LLC). Dr. Smith reports that 98 percent of cases should show remarkable improvement by the third treatment. If some response to laser therapy has not been seen by this point, the case is re-evaluated to make sure the correct diagnosis has been made and that the correct location is being treated with the correct dose.

With chronic conditions, the patient may receive up to 12 treatments before a plateau is reached; the treatment then shifts to a maintenance phase – typically once per month. Chronic conditions, such as arthritis, chronic dermatitis, back injuries, inflammatory bowel disease, chronic cystitis, inherently require ongoing treatment. Dr. Smith points out, for example, that with arthritis, the boney pathology that can be seen on x-rays won’t be changed, but instead laser therapy will affect the soft tissue inflammation and chronic maladaptive pain associated with the condition.

To determine the efficacy of therapeutic laser treatment, Dr. Smith refers to the growing body of clinical studies that validate and quantify the effects. He notes that the understanding of laser science has advanced tremendously within the last five years and the technology has likewise followed. According to Dr. Smith, “Clinical experience and case studies are undeniable, especially for those difficult, chronic cases that traditional remedies have failed to treat adequately.”

Integrative practitioner Dale Olm, DVM, of Southampton Pet Hospital in Benicia, California, finds additional support for the efficacy of laser therapy through the resolution of clinical symptoms and by the owner’s perception of their pet’s condition. Dr. Olm’s clinic often combines laser therapy with both conventional medical treatment and acupuncture and chiropractic modalities, finding that they work synergistically to produce effective results.

When one of his patients presented with a severe yeast ear infection, Dr. Olm expected that the dog would require weeks of conventional treatment. After one laser therapy session and one week of conventional medical therapy, the condition was fully resolved. In yet other cases, it can be used as the sole treatment
when other treatments are impractical or not tolerated by the patient.

Dr. Olm likens the administration of laser therapy to an art form. Similar to acupuncture, the experience, knowledge, and skill of the practitioner affects the outcome of the treatment. While there is no specific training required for an individual to use a therapeutic laser (note that Class 3B and Class 4 lasers are FDA-approved devices that require administration by a veterinarian or under the supervision of a veterinarian), Dr. Olm feels that it should only be administered by a licensed medical practitioner who can evaluate the medical condition, understand the pathology involved, and can evaluate response to therapy.

Sandy Gregory, RVT, echoes this observation. Gregory works as an exercise physiologist and animal rehabilitation therapist, at Scout’s House, an animal rehabilitation center in Menlo Park, California. She believes...
that training should be required to use the equipment and views it as similar to “prescribing and administering a medication” that should be done only by an individual with the appropriate expertise.

Gregory points out that determining dosage can be a complex charting process given the multitude of parameters that need to be considered: power density, wavelength, and pulse structure of unit; anatomical location; whether the problem is acute or chronic; type, condition, and depth of the tissue to be treated; pigmentation of the skin (dark pigmentation can be burned); frequency and length of treatment; and treatment technique.

Laser manufacturers provide dosage guides for using their particular devices and many units have presets that can be selected, but a good practitioner will understand the evaluating factors that go into each patient’s dosage determination. Knowing the parameters gives the practitioner insight on how to specifically treat a condition, especially as each laser manufacturer has its own approach to dosing. Understanding the nuances of treatment can mean the difference between effectiveness and ineffectiveness.

**PAIN MANAGEMENT**

Laser therapy is becoming a huge component of pain management and rehabilitation. Gregory, who has been administering therapeutic laser therapy for over eight years to pets and wildlife (including elephant seals at the The Marine Mammal Center), finds it to be one of the most rewarding modalities that she uses because the results can be visible, sometimes even immediately, and the effects can provide great improvement in quality of life.

The biomechanisms of laser therapy can reduce pain in several ways. One study cites the anti-inflammatory effects of laser therapy as being similar to those of pharmacological agents for treating pain. This safe non-drug option is a welcome alternative to prescription medications that have the potential for serious adverse effects, especially when taken long-term.

Laser therapy can also control pain by reducing oxidative stress, increasing the release of endorphins, improving blood vessel formation, and promoting collagen synthesis and skeletal repair.

A randomized controlled trial showed that lasers were able to suppress the activity of nociceptors (sensory receptors that send signals that cause the perception of pain) thereby reducing nerve firing and pain signaling and, as a result, providing relief of acute and chronic pain. In humans, laser therapy has been shown to decrease neck pain immediately, with the
positive effects lasting up to three months after the end of a treatment series; it is thought that this same benefit occurs in animals.

**Scientific Support**
The multitude of clinical trials, high-quality peer-reviewed research, systematic reviews, and analyses supporting the effectiveness of lasers in many applications in both human and veterinary medicine are countering the criticisms of the therapeutic laser treatment. Since it is now scientifically demonstrated that light has biological effects, studies have shifted to investigating how energy from lasers functions at the cellular and organism levels. Determination of optimal parameters for application to different pathologies is also being explored.

**Contraindications and Precautions**

- The eyes are never treated due to the potential for retinal damage.

- Laser therapy should not be used over reproductive organs and caution for use is recommended during pregnancy, even when the target tissue is not in the reproductive region.

- Laser therapy should not be used in cases where cancer is suspected or confirmed because it can theoretically stimulate the cancerous cell activity and growth of that cancer. In end stage cases, it has been used as palliative care.

- Laser therapy should not be used on growth plates as the effect is not documented at this time.

- Laser therapy is not safe to use in patients with hemorrhagic disorders or with actively bleeding tissues because lasers can cause vasodilation and it is uncertain whether they have an adverse effect on coagulation. Lasers can however be used to promote resolution of hematomas once bleeding has ceased.

- Caution should be taken in cases of undiagnosed pain combined with a history of cancer within last five years.

- Caution should be taken in patients with photosensitivity disorders.

- Caution should be taken when using Class 4 lasers in animals with dark fur and skin due to the potential of a thermal reaction from a greater absorption of light.

- If the wavelength light is not sufficient or the irradiation time is too short, there is the potential for no response.

- Wait at least seven days after a cortisone injection before having laser therapy administered. Research has suggested that because both the laser and the steroid suppress prostaglandin E-2, it results in a zero net gain.

- Protective goggles, specific to the wavelength of light in use, should be worn during administration.

- The laser device should be activated only when the probe tip or array surface is applied to the tissue surface.
Despite the evidence, the use of therapeutic lasers is still sometimes considered controversial. One of the reasons for this is probably because the biomechanics of the effects are not yet fully understood. The large number of interconnected parameters involved in laser therapy application makes it essentially impossible to conduct a comprehensive study of the effect of varying all the individual parameters one by one.

Evidential support in veterinary clinical settings is growing; current clinical trials include studies on peripheral nerve injury, nervous system pain, muscle cell response, post-TPLO pain relief, and cell proliferation. Colorado State University is conducting a randomized, controlled clinical trial on the effectiveness of laser therapy in rattlesnake bite treatment for dogs. This study is investigating the possibility that laser therapy may decrease the length of stays in the clinic as well as lower the impact of snake venom in the dog’s body. Because laser therapy increases the cellular repair process and the metabolism within cells, it is theorized that it can reduce the pain and swelling from bites and help affected tissue heal more quickly.

Therapeutic laser treatment on dogs with intervertebral disk disease was the focus of a recent study at the University of Florida. This controlled study showed that dogs who received laser therapy after spinal cord injury and surgery had no medical complications, walked sooner, and were discharged earlier than dogs who did not receive laser therapy. The results were so impressive that laser therapy has been incorporated as part of the treatment protocol for every dog at the study center presenting with the condition.

The potential of laser therapy is nowhere close to being reached. New therapeutic strategies are being developed from studies on the variables of parameters. Exciting avenues are being explored including the possibility of using laser therapy as a viable treatment for serious neurological conditions such as traumatic brain injury, stroke and spinal cord injury, as well as for degenerative brain disorders. This is pretty impressive for a modality Dr. Smith describes as “a drug-free, surgery-free, non-invasive therapy with no known negative side effects – the worst result is that it could fail to do its job.”

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