

WHAT YOU SHOULD KNOW BEFORE YOU BUY A THERAPEUTIC LASER

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Hold onto your sunglasses! You've seen them in the exhibit hall at the conferences, you've heard about them in the lectures, you're seeing them advertised in magazines, and maybe your colleagues are extolling their virtues as well. You might be living under a rock if you don't yet know that therapeutic lasers are really taking a foothold in veterinary medicine! Why? Because they work! However, to be an informed buyer, you should know some of the facts and basic science behind this technology; so that you can ask the tough questions of the sales reps, before you open up your wallet!

How does LASER work?

The word LASER stands for light amplification by stimulated emission of radiation. Low level laser therapy (LLLT) is relatively new to the United States (FDA approval was granted in 2002), but it has been used for many years in other countries such as Canada, Australia, Europe and some parts of Asia. Randomized controlled trials (RCT), systematic literature reviews, and meta-analyses are now being conducted and are able to prove the effectiveness of laser, successful dosage recommendations, and optimal machine specifications.

Lasers reduce pain. One review paper cited the anti-inflammatory effects of laser to be similar to pharmacological agents (eg. celecoxib, meloxicam, diclofenac, and dexamethasone), and that pain is additionally controlled due to a reduction in oxidative stress, improved angiogenesis and augmentation of collagen synthesis and skeletal repair. A RCT showed that laser was able to inhibit transmission at the neuromuscular junction, which reduced nerve firing and pain signalling. Pain reduction can be long lasting. A meta-analysis of laser use in neck pain (human) determined that laser therapy could improve

neck pain and that the positive effects were immediate and could last for up to three months after the end of a treatment series.

Lasers have been shown to improve tendinopathy lesions. Research validates that injured soft tissues experience an increase in collagen synthesis, improved metabolism of tenocytes or myocytes, increased fibroblastic activity, neovascularisation, improved tensile strength, and an acceleration of the healing process and organization of collagen bundles when exposed to laser light. LLLT is also widely utilized and found to be effective in treating chronic joint disorders. It is able to enhance biosynthesis of cartilage, stimulate microcirculation, and reduce inflammation in the synovium and synovial fluid. Bone healing is another indication for LLLT. Improvement is seen osteoblastic proliferation, bone neoformation, bone stiffness, collagen deposition, amount of well organized trabeculae, and creation of a smaller, stronger callus. Wounds also benefit from exposure to laser light and cause diminution of wound size and reduced healing time. Lastly, lasers also provide impressive results in remediation of peripheral nerve injuries and even spinal cord lesions.

What are the dangers?

There are certainly contraindications for laser use that all practitioners should know. A recent publication in a Canadian physiotherapy journal thoroughly reviewed contraindications and precautions for laser therapy. Laser therapy should not be used over the eyes, or reproductive organs, or in regions known or suspected of malignancy. It is not safe to use in regions with circulatory compromise or in actively bleeding tissues in patients with hemorrhagic disorders. Experienced practitioners may also elect to treat with caution (e.g. using lower intensities, or closer monitoring), on recently irradiated tissues, patients with photosensitivity disorders, persons with infections with a compromised immune function, active epiphyses, or over the anterior neck or carotid sinus.

Phototherapy 101

Laser light is a collimating and consequently does not diverge. It possesses coherence and monochromaticity – meaning that when produced, it maintains a single wavelength. Body tissue (as per human and animal studies) tends to absorb and utilize wavelengths within the 600 – 1000nm range. Laser machines will usually come with one or sometimes more predetermined wavelengths. Wavelength determines the depth of penetration. Wavelengths within the 600nm range do not directly penetrate more than 0.5cm – 2cm, and indirectly up to 5cm via the dissipation of energy. Wavelengths that range from the mid 700nm to low 900nm range penetrate the deepest. Directly affecting tissues up to 5cm, and indirectly impacting up to 10cm.

Therapeutic laser machines come in a huge range of powers. Anything from 5mW to 10 Watts! The most common therapy lasers either fit into the power range of 5mW to 500mW (termed class 3b) or over 500mW (termed class 4a). Power has absolutely nothing to do with depth of penetration, or targeting of specific tissues, or anything other than speed of delivery. More powerful laser machines are able to deliver laser energy faster. Period.

Light energy is measured in joules. $1 \text{ Joule} = 1 \text{ Watt} \times 1 \text{ second}$. Thus if you have a 500mW machine, it can deliver 1 Joule of energy in 2 seconds of time. A 1 Watt machine will deliver 1 joule of energy in 1 second, and a 10 Watt machine will deliver that same energy in $1/10^{\text{th}}$ of a second. That's fast, and while fast might be good if you want to deliver a large number of joules or treat a large area, it also means that when you utilize higher powered machines, your laser technique must be different in order to prevent superficial tissue damage. Class 3b lasers are utilized in direct contact with the skin, and many manufacturers and laser therapy textbooks even recommend pressing the laser probe firmly against/into the skin in order to improve penetration depth. High powered class 4a lasers however, cannot be held motionless against the skin due to the potential for cutaneous thermal damage with these units. Accurate dosage calculation is not possible with the high powered class 4a units. Even with

direct contact, there is a substantial amount of laser light that is reflected and refracted by the skin and subcutaneous tissues. With the sweeping technique that is utilized with high powered class 4a lasers, there is a tremendous amount reflection of the light. Thus, there is no way of knowing exactly how much energy is actually reaching the target tissues. Manufacturers and clinicians will argue that they see benefits with their high powered class 4a lasers. That is not in dispute. Light energy has the potential to heal. However, high powered class 4a lasers cannot and have not been validated in research because of this dosage delivery dilemma. For this reason, there are companies that have produce 750mW and 1 Watt class 4a lasers that can be placed directly on the skin. Thus improving upon speed but maintaining the ability to calculate joules.

Lastly, is to understand how pulsing the light (frequency or hertz) comes into practice. It has been proposed that low frequencies (10 – 100Hz) have more of an impact on pain, whereas higher frequencies (2500 – 5000Hz) are supposed to impact inflammation. However, the use of different frequencies is contentious and not generally supported by the available literature. At least for now, there is no discernable correlation between any particular switching frequency and any specific clinical outcome. Beyond these controversies, it makes dosage calculation difficult as well, as pulsing the light breaks up the laser beam and impacts the overall joules of energy delivered. Clinically, if a patient seems to react to the laser light (e.g. animals with dark hair and people with dark skin may experience a thermal reaction due to greater absorption of the light), any pulsation frequency can be selected in order to diminish the energy delivered and reduce the superficial heating properties.

Conclusion

Lasers can be a great tool in clinical veterinary practice, but practitioners need to better understand the modality when they set out to purchase a laser machine. Beyond the purchase, knowing how to use a LLLT machine most effectively, selecting the most appropriate dosages for different conditions, and

comprehending when and where to apply it anatomically are of utmost importance. Rehab training is currently the only avenue to acquire the skills and knowledge to utilize laser therapy with all of these points in mind and from a non-biased perspective. Buyer beware, buyer be informed!