Laser Therapy May Work on TL IVDD
By Narda G. Robinson, DO, DVM, MS, FAAMA

Laser therapy, the latest modality to enter the marketplace, is taking the veterinary profession by storm.

But veterinary practitioners need to find out how laser helps and which units work before plunging tens of thousands of dollars into underpowered or dubious devices that pale in comparison to similarly priced laser powerhouses.

Facts come from research, and laser therapy currently lacks evidential support in veterinary clinical settings. This calls into question specifics about optimal laser dose and ideal wavelengths. Until studies take place on species treated within our facilities, veterinarians are once again left relying on tissue culture, rodent and human studies.

One application where laser therapy may shine is in patients recovering from thoracolumbar intervertebral disk disease. TL IVDD is the most common spinal cord dysfunction in dogs. Dachshunds outnumber other breeds for the disease by a significant margin; one study showed that dachshunds account for nearly 72 percent of cases.

Compressive spinal cord injury (SCI) causes both primary and secondary tissue damage. The secondary injury phase occurs one to two days after injury and leads to biochemically mediated neuronal death and spinal cord inflammation. Medical intervention yields the best clinical outcomes when treatments address both the primary traumatic and secondary biochemical neuronal injury.

Slow or disappointing recoveries lead to euthanasia in certain circumstances. The degree of improvement in SCI is measured by proprioception, voluntary motor movement, micturition control and deep pain perception. Fuller, quicker neurologic recoveries dissuade clients from opting for euthanasia.

Incomplete recovery means managing an incontinent, paraplegic animal for months to years. If an adjunctive, safe, therapeutic modality afforded an effective means of promoting less painful and faster functional recoveries after surgery for TL IVDD, it could not only decrease morbidity but also reduce mortality.

Conventional Treatments

Methylprednisolone sodium succinate administration had become commonplace for acute compressive SCI, although the human field no longer recognizes MPSS as the standard of care. Research revealed increased costs, longer hospital stays and adverse effects from its use.

Human clinical trials pointed to worsened long-term neurological outcomes in patients who received their first dose of MPSS over eight hours after initial injury. A study published in 2001 confirmed that giving MPSS to dachshunds with surgically treated IVDD linked MPSS with increased post-operative complications (melena, diarrhea, emesis, hematemesis and anorexia) and more costly medical care.

Surgical decompression of the spinal cord is instead considered the treatment of choice for dogs with TL IVDD. With surgery, however, come pain and tissue trauma. Surgery precipitates a complex humoral and neuronal response in the cord and surrounding tissue.

Multimodal analgesia is required to adequately manage the pain arising from dermal, myofascial, osseous, articular and neural origins. Multimodal analgesia also allows clinicians to reduce drug dosages and consequently their side effects. Novel, nonpharmacologic methods such as laser therapy and electroacupuncture open up additional avenues of pain relief as they diversify analgesic mechanisms of action.

Integrative Treatments

Electroacupuncture combined with conventional approaches for IVDD shortened the time needed to recover deep pain perception and ambulation compared to standard of care alone in dogs with TL IVDD, based on a study published in 2007 in the Journal of the American Veterinary Medical Association. Acupuncture stimulates neuronal regeneration, possibly through stem cell mobilization, differentiation and other avenues.

Though some practitioners claim that steroids negate the benefits of acupuncture, a 2003 study from Korea demonstrated the opposite; i.e., that the combination produced synergistic effects for pain relief, inflammation control and edema resolution.

Laser therapy, like acupuncture, offers the advantages of pain control, neuronal regeneration and tissue healing. While acupuncture incites its somatic afferent stimulation by mechanical means (i.e., a needle enters the tissue to engage collagen fibers and nerve endings), LLLT provokes alterations in cellular physiology and neural activity through photonic means.

Photoacceptor enzymes within the mitochondria such as cytochrome c oxidase absorb the laser light, influencing electron transfer, mitochondrial respiration and ATP synthesis. Cytochrome c oxidase activity in neuronal cells upregulates and can initiate a mitochondrial signaling cascade that fosters cellular proliferation and cytoprotection at the cellular level.

Specific Effects Of LLLT for IVDD

Pain control: Low-level laser irradiation alleviates acute and chronic pain at least in part by causing a reversible blockade of fast axonal flow and mitochondria transport along nociceptive axons. This leads to a decrease in mitochondrial membrane potential, reduced ATP availability and blocked conduction within the A-delta and C nociceptive fibers.

LLLT induces mRNA expression of the opioid precursor molecules proopiomelanocortin and corticotrophin releasing factor within inflammatory tissue, promoting increased levels of beta-endorphin at the site of damage. Long-term effects of laser therapy involve neuromodulation of ascending and descending pain-associated pathways within the brain and spinal cord.

Functional neurologic recovery: Studies in dogs suggest that LLLT improves neurologic function after IVDD. Nine to 12 weeks after experimental TL spinal cord transection and sciatic nerve autograft insertion, dogs who received LLLT were walking; those without LLLT remained paralyzed. Histologic
analysis of the dogs’ spinal cords in the LLLT group revealed new axons and blood vessels migrating into the graft as well as absence of prominent scar tissue, changes that were inapparent in control animals. Laser therapy mitigates neurotrauma through four mechanisms:

- Prevention of degeneration of motor neurons.
- Higher metabolism within nerve cells.
- Proliferation of astrocytes and oligodendrocytes, promoting myelinization of nerves.
- Increased axonal regeneration.

Even patients with long-term peripheral nerve injury have experienced significant functional restoration after laser therapy was applied to the damaged site(s). Regaining ambulation requires muscle preservation as well as neural tissue healing; laser biostimulation safely preserves the physiologic status of denervated muscle tissue while nerve regeneration is taking place.

Wound healing: LLLT stimulates fibroblast proliferation, collagen production, growth factor release and microvascularization of injured tissue. It activates local immune cells (macrophages and lymphocytes) and alters the expression of genes involved in wound healing and possibly analgesia. Laser fosters resolution of inflammation by modulating inducible nitric oxide synthase (iNOS) expression, reducing edema and speeding normalization of tissue architecture.

The Unmet Need

Though scientific evidence points to the value of laser therapy for individuals suffering from SCI, there are, unfortunately, few well-designed studies evaluating LLLT for dogs.

In order to evaluate whether LLLT would help dachshunds recover more quickly and less painfully after surgical decompression of TL IVDD, veterinarians working in Colorado State University’s Center for Comparative and Integrative Pain Medicine (including the author, the center’s director) are planning a study designed to compare the outcomes of dogs receiving conventional care with and without LLLT.

We hypothesize that by adding laser therapy, we will provide better analgesia, improve incisional healing and speed recovery of neurologic function over dogs not treated with LLLT. If an additive, safe, therapeutic modality such as LLLT affords an effective means of promoting quicker, less painful and faster functional recoveries following surgery for TL IVDD, it might not only decrease morbidity but also reduce mortality in the much-afflicted dachshund population as well as other breeds.

Narda Robinson, DO, DVM, MS, Dipl. ABMA, FAAMA, oversees complementary veterinary education at Colorado State University.

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FOOTNOTES:


