GET WELL SOON
There are many methods of rehabilitation for canines. The injury and desired outcome will help you decide which method will work best for your patient.

INTEGRATIVE MEDICINE

Rehabilitation Modalities for Pain Management and Healing

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Physical rehabilitation is an emerging area of veterinary medicine. Multiple training programs offer certification in canine rehabilitation, board certification with the American College of Veterinary Sports Medicine and Rehabilitation, and credentialing with the Academy of Physical Rehabilitation Veterinary Technicians. Rehabilitation modalities can be particularly useful as part of a multimodal pain management program. Rehabilitative methods can improve patient comfort and quality of life, especially in cases where pharmaceutical pain relievers are contraindicated. This article reviews some of the more common modalities that can be used to help reduce pain, enhance tissue healing, and improve patient function, as well as highlights associated evidence of efficacy (**TABLE 1**).

Which modality to choose depends largely on specific patient needs and the condition being treated. Although modalities can sometimes be used simultaneously, the synergistic or countereffects they may have on each other remain unknown. For this reason, you should consider the main goal of therapy and choose the most appropriate modality for addressing that goal.

TABLE 1 Summary of Clinical Evidence of Efficacy of Rehabilitation Modalities for Treating Various Conditions in Dogs, 2012-2019

EFFECT	LASER	PEMF	ECSW
Improved ambulation after hemilaminectomy	+/–		
Reduction of pain/pain medication administration	+	++	
Improved pelvic limb function after TPLO	+/–		
Alleviation of patellar desmitis			+
Improved wound healing	––	+	
Improved bone healing	–		+
Reduced lameness in dogs with osteoarthritis	+		+
Reduced lameness in dogs with shoulder tendinopathies			++

+ indicates number of studies with results supporting efficacy; – indicates number of studies with results showing lack of efficacy.
ECSW=extracorporeal shockwave; PEMF=pulsed electromagnetic field; TPLO=tibial plateau–leveling osteotomy.

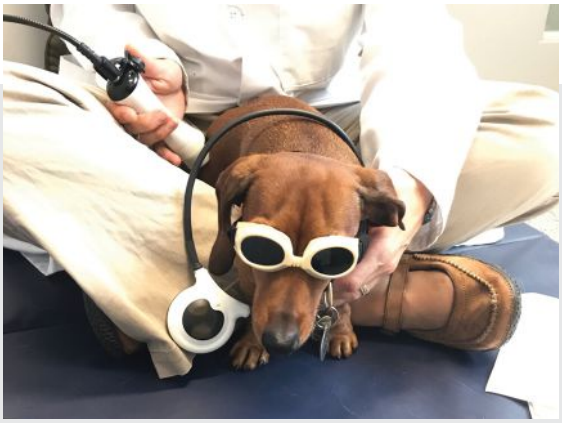

FIGURE 1. Class 4 laser and targeted pulsed electromagnetic field therapy being administered to a canine athlete with myofascial trigger points. This particular laser is ideal for providing massage and heat therapy simultaneously with the laser. Combined heat, laser, and massage can help relieve tense muscles.

LASER THERAPY/ PHOTOBIOMODULATION

Perhaps the most commonly used rehabilitative modality is laser therapy, which stands for light amplification by stimulated emission of radiation (**FIGURE 1**). This modality has more recently been called photobiomodulation, primarily because therapeutic lasers modulate biological cellular activity as opposed to other nontherapeutic lasers (e.g., grocery store scanners or laser pointers) that do not have a biological effect.

One proposed mode of action for therapeutic laser is stimulation of the respiratory chain in the mitochondria. The respiratory chain is a complex of genes that provide instructions for proteins involved in oxidative phosphorylation. As light enters the cell, it is absorbed by cytochrome c oxidase (the next-to-last step in the mitochondrial respiratory chain process) leading to increased production of adenosine triphosphate. Cells also release low levels of ROS (reactive oxygen species), resulting in endogenous anti-oxidant production by the cell and release of nitrous oxide, which leads to vasodilation and increased perfusion.

Lasers are classified according to risk for eye injury. The higher the class of laser, the greater the risk for eye injury and thermal damage to eyes and/or other tissue. Class 4 lasers are defined as those with power output of 500 mW and above. In general, therapeutic lasers with potential for photobiomodulation are Class 3 and above and require protective eyewear. Lower-class lasers can have photobiomodulation potential when tissues are exposed for a longer time at specific wavelengths. In general, lower wavelengths are more effective for superficial tissues (~600 nm) and higher wavelengths, for deeper tissues (up to 3 to 5 cm, or 800 to 900 nm).

Several recently published studies evaluated the efficacy of using photobiomodulation in veterinary medicine.[1-10] The results can be difficult to interpret because of the large number of different products on the market and variations in protocols and outcome measures. Thus, we should be cautious when making conclusions. Some authors question whether photobiomodulation can help improve recovery after hemilaminectomy in dogs. Draper et al. found that dogs receiving a low-level Class 3B laser (810-nm wavelength for 1 minute daily for 5 days) regained the ability to ambulate significantly faster than untreated dogs (3.5 vs 14 days).[1] In contrast, using the same laser and protocol, Bennaim et al. found no difference in outcome between laser and placebo groups.[2] In another prospective study evaluating wound healing, Kurach et al. found no apparent beneficial effects for dogs with experimentally induced incisions and subsequent exposure to a Class 2 laser (635-nm wavelength laser for 5 minutes for a total dose of approximately 1 J/cm^2).[3] When Kennedy et al. evaluated this same laser in a prospective study, they found no beneficial effects on pain, radiographic healing, or pelvic limb function in dogs who received this Class 2 laser before and 10 times after tibial plateau-leveling osteotomy (TPLO) for the first 96 hours at 2.5 J/cm^2 and then weekly at home for 4 weeks (at 1.5 J/cm^2).[4] However, those studies may have failed to demonstrate lack of efficacy because they used a lower class of laser. Usually, rehabilitation practitioners use Class 3B lasers and above. A small study demonstrated improved scores in incisional scars in 4 dogs who received postoperative

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photobiomodulation daily for 7 days at 8 J/cm^2 with a Class 3B laser compared with 5 dogs who did not receive photobiomodulation.[10]

Another study that evaluated the effects of laser on dogs after TPLO found improved pelvic limb function (determined by measuring peak vertical force with a pressure mat system).[5] Those dogs received a single Class 4 laser dose with dual 800- and 970-nm wavelengths, at 6 W for a unified dose of 3.5 J/cm^2 over a 100-cm^2 area.[5] In another recent prospective blinded study, dogs with naturally occurring elbow osteoarthritis demonstrated reduced lameness, pain scores, and nonsteroidal anti-inflammatory drug dosages compared with placebo-treated dogs.[6] The treated dogs received photobiomodulation therapy with a Class 4 laser twice weekly for 3 weeks and then weekly for 3 weeks at a dose of 10 to 20 J/cm^2 per joint.[6]

As previously stated, use of wide-ranging doses and various laser devices make it difficult to base conclusions on these limited data. Larger prospective, randomized, controlled clinical trials are needed before any conclusions about the therapeutic benefits of laser use in companion animals can be reached.

In human medicine, data are also not conclusive. A systematic review of the treatment of plantar fasciitis in people showed reduced pain and improved function; however, laser doses varied widely among studies, making it difficult to determine best treatment parameters.[7] Another recent systematic review and meta-analysis of photobiomodulation effects on bone healing in humans showed improvement in pain and function; however, the level of evidence is considered low to very low, and no effect on radiographic healing of the fracture line was found.[8] Similarly, results of a systematic review of low-level laser on pressure ulcers in humans were conflicting and not conclusive.[9]

PULSED ELECTROMAGNETIC FIELD THERAPY

Another rehabilitation modality that has recently gained popularity and become widely available to rehabilitation and general practitioners is pulsed electromagnetic field (PEMF) therapy (**FIGURE 1**). This technology has been available for over a century; however, it became more popularized in the 1980s when the Food and Drug Administration approved low-powered PEMF devices as bone growth stimulators. Since then, the technology has been further developed and targeted. There are many devices on the market, including PEMF beds and devices that provide more targeted therapy, such as a loop device. Of note, the particular signal of the device affects its therapeutic potential. Variations exist in pulse width, pulse frequency, size and geometry of the antenna, and duration of the signal. The targeted shortwave forms (27 mHz, 2-ms pulse width, 2-Hz pulse frequency) are thought to be more effective. Practitioners are advised to ask PEMF manufacturers what specific signal is used by their product and what evidence they have to support their dosage recommendations. In general, acute conditions should be treated 3 to 4 times daily for 5 to 10 days until pain resolves. Chronic conditions can be treated once or twice daily or even less frequently, depending on response. The postulated mode of action for the signal emitted by the loop device is upregulation of the voltage-dependent binding of calcium to calmodulin. This binding enhances release of constitutive nitrous oxide synthase, leading to vasodilation and an anti-inflammatory cascade.

The most notable benefits of PEMF include pain relief, increased wound healing, and reduced soft tissue pain and edema (**TABLE 1**). Two recent randomized and controlled clinical trials demonstrated benefits of PEMF use on recovery of dogs after hemilaminectomy.[11,12] In particular, Alvarez et al. demonstrated reduced client administration of opioid medications during the initial 7-day postoperative period for dogs who received PEMF therapy compared with those who received placebo.[11] In addition, 6-week postoperative wound scores were better for treated than control dogs.[11]

With regard to potential side effects, PEMF is perhaps one of the most benign of the rehabilitation modalities. However, its use is contraindicated for patients with pacemakers or arrhythmias and those with active hemorrhage.

EXTRACORPOREAL SHOCKWAVE THERAPY

Shockwave therapy was first introduced as a method for breaking up urinary calculi (lithotripsy). Since then, the technology has advanced and is widely used in human and veterinary medicine for treatment of nonunion or delayed union fractures, wound healing, tendinopathies, arthritis, and other conditions. Among rehabilitation modalities in the veterinary field, the level of evidence for efficacy is perhaps highest for extracorporeal shockwave (ECSW) therapy (**TABLE 1**). The mode of action is emission of acoustic waves at high velocity and pressure. A large amount of energy is deposited in the tissues, creating cavitation bubbles that subsequently collapse and lead to increased cellular permeability and expression of cytokines and growth factors. Because the pressure waves of ECSW are emitted at lower frequency than those of therapeutic ultrasonography, they cause no thermal effect. The analgesic effects most likely result from nociceptor stimulation and endorphin release.

A variety of ECSW devices, with varying effectiveness, are available. In particular, devices can vary by depth of penetration and focal area. Therefore, devices should be chosen according to the condition being treated and available evidence to support that use. Focal superficial signal devices may be more effective for treating myofascial trigger points, whereas electrohydraulic devices with higher energy and deeper penetration may be more appropriate for treating nonunion fractures, osteoarthritis, or other deeper tissue disorders. Several prospective studies that used higher energy and deeper signal devices demonstrated efficacy for treating patellar desmitis after TPLO,[13] acceleration of bone healing,[14] and osteoarthritis[15]; retrospective studies demonstrated efficacy for treating shoulder tendinopathies (**FIGURE 2**).[16,17] Contraindications include use on patients with immune-mediated joint disease, septic arthritis, neoplasia, diskospondylitis, unstable fractures, and neurologic deficits.

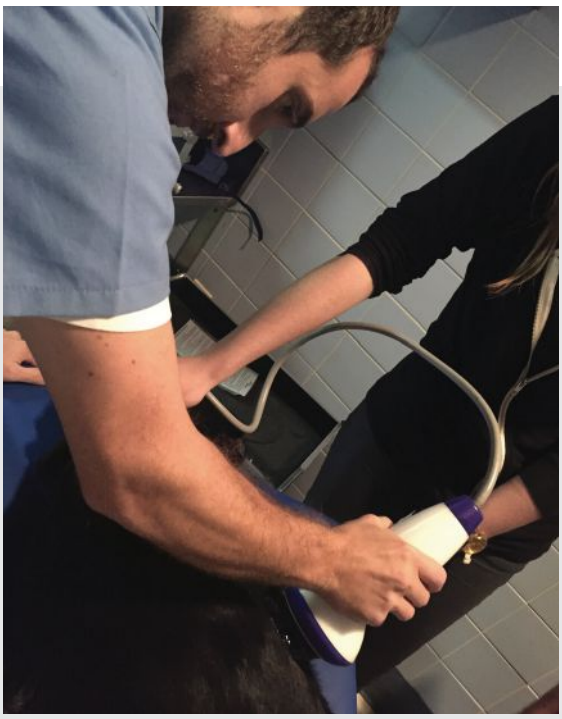

FIGURE 2. High-energy extracorporeal shockwave therapy being administered to a dog with chronic supraspinatus and biceps tendinopathy.

TAKE-HOME POINTS

- Rehabilitation modalities are used to help reduce pain and enhance tissue healing.
- Choice of rehabilitation modality should be based on the patient's needs, the condition being treated, and level of evidence.
  - **Laser:** Prospective clinical trials in veterinary medicine are reported for hemilaminectomy, TPLO, and elbow osteoarthritis. Results are not conclusive enough to use for clinical decision making.
  - **PEMF:** Most notable published veterinary benefits include pain relief, increased wound healing, and improved recovery after hemilaminectomy.
  - **ECSW:** Sufficient evidence in dogs exists to warrant use for nonunion or delayed union fractures, tendinopathies, and arthritis.
- Overall, rehabilitation modalities can be part of a multimodal pain management program and can improve patient comfort and function in a noninvasive manner. TVP

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