

## **Move It or Lose It: Basics of physical rehabilitation**

Jessica Bunch, DVM, CCRT, CVA  
Resident- Sports Medicine and Rehabilitation  
Washington State University

### **Introduction**

Physical rehabilitation is the diagnosis and management of patients with painful or functionally limiting conditions, particularly those with injury or illness related to the neurologic and musculoskeletal systems. The goals of rehabilitation are to improve function and quality of movement, reduce pain, increase the speed and success of post-operative recovery, increase strength and endurance, and improve quality of life. The terminology “physical therapy” is protected in most states and limited to use by physical therapists in the human field. Therefore, it is more appropriate as veterinarians to utilize the terms physical rehabilitation. Advanced training can be pursued by veterinarians, veterinary technicians, physical therapists, and physical therapy assistants in canine and/or equine physical rehabilitation. Legalities of who can practice rehabilitation on animals and whether direct or indirect supervision is needed, will vary per state based on their practice act (if defined). There are a number of programs that provide AAASB-RACE approved content in the United States.

Physical rehabilitation encompasses a wide array of therapeutic options with multi-modal management techniques. These include, but are not limited to, manual therapies, modalities, hydrotherapy, therapeutic exercise, pharmaceutical use, nutraceuticals/supplements, regenerative medicine, nutritional counseling, assistive devices, and environmental modification recommendations. Conditions that can benefit from physical rehabilitation are post-operative orthopedic and neurologic cases, medical management of orthopedic and neurologic conditions, soft tissue injuries, non-surgical neurologic conditions, osteoarthritis, obesity, conditioning/physical fitness, and performance.

### **Manual Therapies**

Soft tissue mobilization (massage), stretching, passive range of motion, traction, joint mobilizations, joint manipulations, and myofascial trigger point therapy are all considered manual therapies. The primary goals of manual therapies are to decrease pain, improve or maintain range of motion, promote blood flow, and improve and/or maintain tissue flexibility. Several of these techniques are simple and easy to learn and can be taught to clients, such as simple massage techniques, passive range of motion, stretching and some traction. Other techniques including mobilizations, manipulations and myofascial therapies are more advanced and should be reserved for a trained professional.

### **Massage**

Mechanical benefits of massage include the following: 1) Relieve tense muscles through relaxation, decreased pain, and increased mobility 2) Improve the circulation and lymphatic flow 3) Specialized massage for scar tissue mobilization, trigger points, and myofascial tissue release. Other benefits of massage are reduction of tension, relaxes patient, reduces stress, release of endorphins, and improves the human-animal bond. Contraindications/precautions of massage are shock (lowers blood pressure), fever, acute inflammation (use gentle techniques or massage away from the inflamed area), skin pathology, and infectious disease.

## **Range of Motion and Stretching**

Passive range of motion (PROM) is the motion of a joint that is performed without muscle contraction within the available ROM. It is an external force performed by the therapist or owner. Active range of motion (AROM) is the motion of a joint that may be achieved by active muscle contraction. The pet is doing this and is our end goal or used if the pet is not able to be restrained for PROM. Passive range of motion can decrease pain, improve rate of recovery, prevents joint and soft tissue contracture, maintain mobility between soft tissue layers, enhance blood and lymphatic flow, improves synovial fluid production and diffusion, and can slow muscle atrophy but does not prevent it.

Ideal techniques for PROM begin with having the patient in a relaxed, comfortable position, often in lateral recumbency. Performing gentle massage for a few minutes before may help relax the patient. Try to be gentle and not create pain, however in some cases, especially immediately post-op, patients may need to be muzzled to perform passive range of motion. When teaching owners, remind them to perform the movements within the comfort level of the patient. If the patient does not tolerate PROM and it is deemed very critical for successful outcome after surgery or injury, consider boarding the patient, using appropriate pain management and even mild sedation if needed. Support the bones proximal and distal to joint and avoid varus and valgus stresses. Often we isolate each joint individually, but some joints affect ROM in other joints (ex: to fully flex the tarsus you must flex the stifle) and some patients respond better to one fluid motion of the entire limb. Proceed in a smooth, slow and steady, and monitor for response. General recommendations are 10-20 (+/-) repetitions 2-4 times daily for routine problems. The primary precaution/contraindication for PROM would be if the motion would further the injury, cause instability, or disruption of the healing of tissues during the acute stage of healing.

Stretching is the general term that is used to indicate maneuvers to elongate tissues, to increase flexibility of normal and abnormal tissues and help increase joint motion. A stretch is performed opposite the action of the target muscle. If the muscle crosses multiple joints, then multiple actions will be necessary for a complete stretch. Stretching is often performed at the end of PROM by holding for 10-30 seconds then repeat. Stretching is generally more effective if heat is applied prior to stretching or performing the stretch after exercise. Precautions/contraindications for stretching would be similar to those of passive range of motion.

## **Therapeutic Modalities**

Therapeutic modalities are tools used to augment healing, decrease pain, and help restore function faster for our patients. There are numerous modalities and the evidence supporting the use of these modalities is highly variable in veterinary medicine as well as in the human literature. Several modalities with at least some evidence supporting their use include thermotherapy, photobiomodulation (laser), electrical stimulation (TENS and NMES), and therapeutic ultrasound. Pulsed electromagnetic field therapy (PEMF) and extracorporeal shockwave therapy will be discussed in the next session.

## **Thermotherapy**

Thermotherapy is the use of superficial heat and cold as a therapeutic modality for the treatment of disease or trauma. Estimated depth of penetration is approximately 1 to 3 cm (possibly up to 4cm for cryotherapy). These modalities can be easily utilized in the clinic and taught to owners for at home use.

Cryotherapy is used primarily for during the acute phase of tissue injury and healing. This is typically the first 72 hours post-surgery or injury however can be used longer if needed. It may also be considered for acute on chronic condition such as an arthritis patient that was a weekend warrior with its owner. Physiological effects of cryotherapy include vasoconstriction, analgesia, reduce edema, reduce inflammation, and reduce muscle spasms. Use of cryotherapy may assist in facilitating pain free exercise/PROM and even possibly permit a decrease in pain medications. There are several application methods including reusable commercial ice packs, homemade ice packs (Water/alcohol (3:1) slush packs), and cold compression units. Only a thin towel to no barrier is needed between ice pack and skin. Cryotherapy is applied for 10-20 minutes as often as q 2-4 hours (although more practically q 4-8 hours) during the first 24-48 hours then can be reduced to q 8-12 hrs. It is recommended to check the skin every 5-10 minutes for redness or blanching. Precautions and contraindications for use of cryotherapy are over areas of previous frostbit, areas of nerve impairment, over areas of open wounds or superficial nerves, areas of decreased to absent sensation, patients with hypertension (may increase blood pressure), and very young or very old patients. Do decreases risks application times can be altered from 5-10 minutes on to 5-10 minutes off.

Superficial heat is generally started after the acute inflammatory period. The effects are opposite cryotherapy except for relieving pain and muscle spasms. The primary physiological effects are vasodilation, increase soft tissue extensibility, pain relief, and relaxation of muscle spasm. It can also be beneficial to apply prior to stretching and exercises to improve range of motion. Treatment times range from 10-20 minutes 3-4 times daily. Methods of application may include hot packs (reusable, canvas or fabric covered, filled with beans, rice, corn, or bentonite), heat wraps, and circulating warm water blankets. Heating pads and heat lamps should be used with extreme caution as they present higher risks for burns. Greater than 45° C (113° F) is painful and can cause irreversible damage. Check the skin frequently, use towels in between hot pack and patient if concerned and stop if patient acts painful. Precautions with superficial heat include pregnancy, obesity, impaired circulation, poor thermal regulation, cardiac insufficiency, young and old patients. Contraindications for use are bleeding, acute inflammation (exception abscesses, bite wounds, etc), malignancy, thrombophlebitis, and fever.

### **Photobiomodulation (laser)**

Photobiomodulation is the application of light pathology to promote tissue regeneration, reduce inflammation, and decrease pain. Classification of laser is correlated to the wattage and range from Class I-IV. Most therapeutic lasers are Class III or Class IV lasers. Class IIIb lasers are 5mw to 500mw and Class IV lasers are any laser over 500mw (including surgical and industrial lasers) and have the potential to create heat. Depth of penetration for lasers is most likely about 3-5 cm of direct penetration depending on the wavelength.

Photons are absorbed by molecules called chromophores that transform light energy into other forms of energy. Cytochrome C oxidase (CcOx) is the key chromophore involved in photobiomodulation. When tissues are stressed or ischemic, mitochondria produce nitric oxide which binds to CcOx. This displaces oxygen causing a decrease in ATP production and increased oxidative stress. Laser light is absorbed by CcOx causing the following: 1) Accelerates the electron transport chain and results in increased production of ATP. 2) Dissociation of nitric oxide from CcOx which increases metabolic turnover, increases vasodilation, increases angiogenesis, and modulation of the inflammatory response. 3) Creation of a small amount of reactive oxygen species which may stimulate endogenous antioxidant production, progenitor cell differentiation, and stimulate cellular growth. Other effects that are less

understood: increase endorphins, decreased interleukins, decreased TNF, inhibit COX2 (cyclooxygenase), increased neurogenesis, increased cyclic AMP, increased NFkB (nuclear factor kappa B). These effects translate to decreased inflammation and edema, improved blood flow, decreased pain, and improved healing.

Contraindications and precautions of photobiomodulation are neoplasia, active bleeding, open growth plates, eyes, reproductive organs/pregnancy, and possibly photosensitization medications (such as tetracycline and some anti-fungals). The optimal optical wavelength is 600nm-1200nm with typically lower wavelengths being more effective for superficial tissues and skin penetration and higher wavelengths for deeper tissue. Ideal wavelengths for each tissue are still to be determined and more studies are needed. Doses highly range depending on condition, wavelength and your particular laser. Can start with the manufacturer settings and adjust if needed. This clinician uses 2-4 J/cm<sup>2</sup> for superficial conditions and wounds, 4-6 J/cm<sup>2</sup> for acute inflammation, and 6-10 J/cm<sup>2</sup> for chronic conditions. Treatment intervals also vary based on condition and chronicity and can vary from daily to as needed. Typically for acute conditions start with daily to every other day until improvement. For chronic conditions 2-3 times weekly for 4 weeks then taper to effect.

### **Electrical Stimulation (TENS and NMES)**

Electrical stimulation, also called E-stim, consists of neuromuscular electrical stimulation (NMES) and transcutaneous electrical stimulation (TENS). Small handheld units can be purchased for in-clinic or at home use that perform either function or both. NMES elicits a muscle contraction via electrical impulses. Impulses mimic the action potential that comes from the central nervous system, causing the muscles to contract. This is used to help prevent atrophy and retrain muscles. It probably does not build muscle, just maintains muscle/slowly disuse atrophy. It is also utilized in human sports medicine for strength training.

Transcutaneous electrical nerve stimulation (TENS) is used more commonly, and its primary use is for pain. Conventional TENS is low intensity/high frequency and selectively activates large diameter non-noxious afferents to elicit segmental analgesia (Gate Theory). Acupuncture-like TENS is high intensity/low frequency and activates small diameter motor afferents to elicit extrasegmental analgesia. This is used over acupuncture points and trigger points and the effects are mediated by neurotransmitters (opioids, serotonin, norepinephrine, etc).

Contraindications and precautions for electrical stimulation are over the heart in patients with a pacemaker, patients with seizure disorders, over areas of reduced sensation/infection/neoplasia, over the trunk of patients that are pregnant, osteomyelitis or immature bone/growth plates, and deep vein thrombosis/thrombophlebitis. Technical difficulties encountered with e-stim are the need to shave and use ultrasound gel, pad placement and maintaining them in place, and patient tolerance.

### **Therapeutic Ultrasound**

Therapeutic ultrasound utilizes sound waves to produce mechanical energy that is translated into tissue heating. The frequencies used in therapy are typically between 1.0 and 3.0 MHz (1 MHz = 1 million cycles per second). Deep tissue heating can be achieved up to 5 cm of depth. Beneficial effects include, improved blood flow, increase tissue flexibility, decrease pain, and improve healing. Additionally there are non-thermal effects called microstreaming and cavitation. These are believed to affect the cellular membrane permeability and improve cellular respiration and normalize cellular function.

The most common uses for therapeutic ultrasound include muscle spasms, contractures, increase soft tissue flexibility, fibrosis, and tendinopathies. Precautions and contraindications include direct use over implants, neoplasia, open growth plates, nerves (hemilaminectomy), pregnant abdomen, over a pacemaker, and over the eyes.

### **Hydrotherapy**

Hydrotherapy consists of using water as a therapeutic aid and typically is referring to the use of an underwater treadmill or swimming. Both underwater treadmill and swimming can be beneficial for condition, osteoarthritis, weight loss, some neurologic conditions, conservative and post-op management of many conditions. When to being hydrotherapy and which form is appropriate to utilize is highly depending on the condition, the patient, the conditions (swimming in a therapy pool versus a lake) and the therapist/surgeon's experience and preference. Swimming is more work and requires more energy, strength and stamina. It is also less controlled; therefore it may not be appropriate for some patients right away and client education and communication is key on advising how and when their pet can swim. Underwater treadmill therapy is more controlled and can often begin sooner but requires a trained therapist and proper facilities. Goals of hydrotherapy are to improve strength, muscular and cardiorespiratory endurance, improve/maintain range of motion, minimize/decrease pain, improve proprioception, reduces edema, and helps simulate mental well-being through reducing boredom especially during surgical recovery.

Hydrotherapy properties include buoyancy, hydrostatic pressure, viscosity/resistance, and surface tension. Buoyance allows for reduction of weight on distal joints. When water is at the level of the greater trochanter, it has been shown that a dog only is bearing 38% of its own weight, 85% at the level of the femoral condyles, and 91% at the lateral malleoli. Hydrostatic pressure applies constant pressure to the joints which can aid with swelling and edematous tissues. This pressure may also decrease pain by stimulating sensory receptors that decrease nociceptor hypersensitivity. The viscosity of the water is significantly greater than air. This provides resistance to strengthen muscles and improve cardiovascular fitness. It also provides increased sensory awareness, may assist in stabilizing unstable joint, and may give some some weaker and neurologic animals increased confidence to ambulate. Lastly, surface tension refers to the concept that resistance to movement is slightly greater at the surface of the water due to more cohesion at the surface. This can be used to our advantage when we want to work a particular muscle group/region more. However, considerations need to be made for weak patients as they will perform better with movements below surface versus breaking the water surface which requires more effort.

There are a few precautions and contraindications to consider with wanting to utilize hydrotherapy. These are skin infections, post-op incisions, diarrhea, cardiac and respiratory dysfunction, and patient tolerance/disposition.

### **Therapeutic Exercise**

Therapeutic exercises can be the key to a successful rehabilitation program. Some exercises may be advanced and better suited with a trained therapist in clinic, but many are designed to be accomplished at home. Client and patient compliance are key to successful therapeutic exercise utilization. What exercises to prescribe, when to start exercise, and when to advance these exercises depends on each case, each individual patient/owner, and the condition/surgery being treated. For some weaker, senior patients, simply getting up and going for a walk may be their primary exercise

versus an elite agility athlete who is practicing balancing two legs on a peanut. Therapeutic exercises can encompass functional and proprioceptive exercise, core, strengthening, conditioning, and even sports specific. Goals for post-operative and post-injury therapeutic exercises may include controlled weight bearing to facilitate healing, decrease compensatory issues, reduce/slow muscle atrophy, active range of motion, faster return to function, and exercise the mind as well during recovery. For neurologic conditions and osteoarthritis, we are hoping to maintain (or build) muscling, maintain/build strength, improve proprioception, possible weight loss (if needed), improve pain/function, and maintain/improve range of motion.

Some examples of exercises that can be considered for hindlimb strengthening include up-hill walking, stairs, backward walking, sidestepping, loving on the stairs, and sit to stand (on flat ground and with front feet elevated). For forelimb strengthening, down-hill walking, digging, high fives/shake, sit to down, push-ups. Core and proprioceptive exercise considerations include weight shifting (on steady and unsteady surfaces), balance work, cavalettis, 3 legged and 2 legged stands, weaves, figure 8's, and crawling. Generally, pick 2-3 exercises for owners to do daily. If it is soon post-op or a down patient, then exercises may need to be done several times daily. Remember, when to start exercises and which exercises to choose depends on surgery, condition, & patient.

## **References**

Millis, Daryl and David Levine. *Canine Rehabilitation and Physical Therapy 2<sup>nd</sup> edition*. 2013. Saunders

Zink, Chris and Janet Van Dyke. *Canine Sports Medicine and Rehabilitation 2<sup>nd</sup> edition*. 2018. Wiley-Blackwell