Practical Rehabilitation and Physical Therapy for the General Equine Practitioner

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KEYWORDS

• Equine • Rehabilitation • Sports medicine • Physical therapy

KEY POINTS

- Physical treatment and rehabilitation play major roles in recovery and maintenance of the equine athlete, and many therapeutic measures are accessible by the veterinarian in general practice.
- The basis for any treatment regimen is an accurate diagnosis with measurable outcome parameters.
- The general practitioner may readily use treatments from the electrophysical modality group and make recommendations for appropriate rehabilitation exercise.
- Consulting with specialist veterinarians trained in equine rehabilitation therapy or physical therapists trained in equine therapy is necessary for making appropriate treatment decisions.

Physical treatment and rehabilitation of horses is a major contributor to a successful outcome of surgical or medical therapy. It may also be the primary therapy when a horse is competing under *Federation Equestre Internationale* or other competition regulations that prohibit the use of medications.

Application of these techniques requires knowledge of indications, methods of treatment, and end points. For the general equine practitioner, rehabilitation therapy should be collaboration with a veterinarian or physical therapist trained in equine techniques. A veterinary technician trained and certified in an equine rehabilitation therapy program is also a useful resource.

The basis for any treatment regimen is an accurate diagnosis. Using lameness as an example, the practitioner must clearly identify the specific anatomic location, tissue injury, and other ancillary factors that are contributing to the gait abnormality. High-quality imaging is necessary to make the diagnosis and is used to monitor the response to treatment. For example, characteristics of the injured tissue, such as

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cross-sectional area, fiber pattern, and echogenicity, should be recorded for ultrasonographic evaluations. Other measurements may be made at the injury site and recorded for future use during rehabilitation. Examples include circumference of a swollen injury site, range of motion/degrees of flexion measured with a goniometer, and response to deep palpation over an injury site (subjective assessment or objective measurement using algometry). A complete diagnosis may require referral to an equine imaging center that has computed tomography, magnetic resonance, or scintigraphy imaging capabilities.

This article reviews common therapeutic modalities accessible to the equine practitioner.

THERMAL THERAPY

One of the most accessible and time-tested methods of physical treatment is thermal therapy (Table 1). Heat or cold may be administered to horses using many modalities and can range from simply applying water from a hose to cooling tissues with compression using therapeutic boots.

Cold Therapy

The major physiologic benefits of cold therapy are reduced local circulation, tissue swelling, and pain sensation.[1,2] These benefits are most effective early in the period following injury or surgery. The primary effect of local cold application is to constrict blood vessels and reduce tissue temperature. Reduced blood flow will reduce edema, hemorrhage, and extravasation of inflammatory cells. Cold reduces tissue metabolism and may inhibit the effect of inflammatory mediators and slow enzyme systems. Cyclical rebound vasodilatation is another response to cold therapy. After a minimum of 15 minutes of cold therapy that results in tissue temperatures from 10°C to 15°C, cycles of vasoconstriction and vasodilatation occur. Vasodilatation associated with cold therapy may help further resolve tissue edema. Analgesia is a significant effect of cold therapy.

Cold therapy is indicated in acute musculoskeletal injuries and following surgical procedures to reduce edema, slow the inflammatory response, and reduce pain. It is particularly effective during the first 24 to 48 hours after injury or surgery. Cold immersion of the distal limbs is also effective in reducing severity of laminitis by

Table 1
Thermal therapy indications, methods, and physiologic responses

Therapy Type	Indications	Methods of Application	Responses to Treatment
Cold	• Acute injury (first 24–48 h) • Pain reduction	• Ice water immersion • Ice surface application • Cold packs	• Restricts blood flow • Reduces metabolism • Reduces activity of inflammatory enzymes • Reduces pain
Heat	• Chronic injury (after 72 h) • Enhance tissue stretching • Enhance healing response	• Warm water from hose • Hot packs • Leg sweat • Therapeutic ultrasound	• Increases blood flow • Increases metabolism • Increases activity of tissue enzymes • Relaxes muscle spasm • Reduces pain • Increased tissue extensibility

decreasing the activity of laminar matrix metalloproteinases and causing laminar vasoconstriction when applied during the developmental phase.[3]

Cold may be applied by ice water immersion, application of ice packs or cold packs, cold water from a hose, and ice water–charged circulating bandages or boots. The most beneficial therapeutic effects of cold occur at tissue temperatures between 15°C and 19°C (59°F to 66°F).[1] Average time of cold application is 20 to 30 minutes. Treatments are best repeated every 2 to 4 hours during the first 48 to 72 hours of injury or surgery if the goal is to reduce tissue inflammation. Direct contact of ice water with the skin is the most effective method of cold therapy. Buckets or turbulator boots may be used depending on the treatment site. If immersion therapy is used immediately following surgery, the wound must be protected with a water impervious barrier.

To prevent or treat laminitis, continuous cold therapy is applied to the distal limbs using plastic bags filled with ice, ice water immersion, or commercial cold therapy boots. A simple method to effectively cool the distal limb using a bag-within-a bag that contains an ice water slurry has been reported.[4] Empty 5-L fluid bags are placed on the distal limb and secured with ice between the bags (**Fig. 1**). This technique effectively reduces tissue temperatures for a prolonged period of time. Ice water immersion of the equine digit for 30 minutes resulted in significant decreases in laminar temperatures.[4] Comparison of laminar and venous temperatures was made between ice water immersion in vinyl boots, ice water slurry in plastic bags, and application of malleable cold packs. Ice water immersion and the ice water slurry in bags were comparable in reducing measured temperatures, whereas cold packs did not substantially reduce temperatures.[4] The successful cooling of blood and laminae in a hoof at risk for laminitis reduces the likelihood of clinical laminitis signs of inflammation, pain, and distal phalanx displacement.[3] Cooling of a hoof that has clinical signs of laminitis will reduce the degree of inflammation and pain present.

Fig. 1. Application of 2 fluid administration bags, with ice water slurry between them, is an effective method to cool the distal limb.

Boots that connect to a cold source and circulate fluid through them are also very effective at chilling tissue (Fig. 2). Systems are available with a variety of boot configurations for different portions of the limb, making effective cold therapy logistically very simple (Game Ready, Concord, CA, USA). Some of the systems also provide compression and may be used for cold or heat therapy.

Cold therapy may also be applied by running a cold water hose on the target site. This method is very practical, but is not as effective at reducing tissue temperatures as ice water immersion.[5] The physical pressure from a hose with a spray nozzle is helpful in resolving edema and in debriding wounds.

Heat Therapy

The major physiologic benefits of heat therapy are increased local circulation, muscle relaxation (and therefore, reduction of muscle spasms and associated pain), and increased tissue extensibility.[1,2] Increased local blood flow mobilizes tissue metabolites, increases tissue oxygenation, and increases the metabolic rate of cells and enzyme systems. Metabolic rate increases 2 to 3 times for a tissue temperature increase of 10°C.[1] These responses to heat therapy are especially beneficial for wound

Fig. 2. Compression therapy boots with circulating cold or hot water are useful for treatment of cellulitis, lymphangitis, and other inflammatory conditions of the limb (Game Ready, Concord, CA).

healing. Increased blood flow and vascular permeability may promote resorption of edema, which is a common reason for heat application in horses. Heat application also decreases pain. Soft tissues may be stretched more effectively when they are warm. Heat decreases tissue viscosity and increases tissue elasticity. Low-load, prolonged stretching of tissues heated from 40°C to 45°C (104°F to 113°F) results in increased extensibility of tendons, joint capsules, and muscles.[1,2]

Heat is best applied after acute inflammation has subsided. It is useful for reducing muscle spasms and pain because of musculoskeletal injuries. Heat therapy can be used to increase joint and tendon mobility, particularly when heat is applied before active stretching. Heat may benefit recovery of localized soft tissue injuries by accelerating the healing response.

Superficial heat is most commonly applied using hot packs and hydrotherapy. These modalities provide heat penetration to approximately 1 cm deep to the skin. The most profound physiologic effects of heat occur when tissue temperatures are raised to 40°C to 45°C (104°F to 113°F).[1,2] Tissue temperatures greater than 45°C may result in pain and tissue damage. For deeper tissues, such as tendon or muscle, 15 to 30 minutes is required to elevate tissue temperature to the therapeutic range. When using heat sources warmer than 45°C, the source must be wrapped in several layers of moist towels before application. Heat from these sources is usually applied for 20 to 30 minutes. Warm water is probably the most accessible method of heat therapy. Methods of application include the use of a hose, wet towels, water immersion in a bucket, turbulator boot, and circulating treatment system. A rule of thumb is that water as hot as your hand can comfortably stand has a temperature of 38°C to 41°C (101°F to 105°F). However, tissue heated by water at this temperature may only reach the lowest tissue therapeutic range. Therefore, the target temperature should be above this level, but as mentioned earlier, horses will commonly experience discomfort with water 45°C and warmer.

Heat may be used to relax tight muscles in the back before exercise. Simply using a thick fleece blanket or exercise rug can be used to relax muscle spasm and prepare the back for stretching exercises or riding (**Fig. 3**).

Fig. 3. A fleece exercise blanket may be used to warm the back before and during exercise to relieve muscle spasm.

The use of magnetic blankets has been another treatment method used to treat muscle stiffness and soreness by increasing local blood flow. However, a study of a static magnetic field blanket on back muscle blood flow, skin temperature, mechanical nociceptive threshold, or behavior in normal horses failed to find any changes following a 60-minute treatment.[6]

THERAPEUTIC ULTRASOUND

Therapeutic ultrasound may be used to stimulate healing, for pain relief, for reduction of tissue edema, and for reduction of fibrous scar.[7,8] The sound waves of therapeutic ultrasound result in micromassage of tissues and acoustic streaming of fluids and ions.[7] These effects result in compression and expansion of tissues and tissue fluids that may improve tissue healing. Heating of muscle has been identified in the dog and human, but not in the horse.[2,9–11] Horse tendons are effectively heated with ultrasound.[11]

Treatment is commonly performed once or twice daily for 10 to 14 days. The hair must be clipped, and coupling gel must be used to provide good contact between the transducer and the skin. In horses, standard therapeutic ultrasound treatment is usually conducted with a 1-MHz transducer for deepest penetration (2.5–5 cm depth) and 3-mHz (1–2.5 cm depth) for superficial penetration. Energy levels administered are 1 to 2 W/cm^2, with a continuous wave for 10 minutes.[12,13] The transducer should be slowly moved throughout the treatment area. Pulsed wave may be used over a bony prominence to reduce discomfort. The ability to manipulate the transducer and adjustment of treatment output for specific circumstances makes traditional therapeutic ultrasound the most versatile means for applying this modality (**Fig. 4**).

Low-intensity ultrasound may be applied for 2 to 3 hours of treatment for acute injuries and 4 to 6 hours once daily for chronic injuries. The device does not have adjustable settings with output set at 2.75 MHz at 0.85 W/cm^2. For accessible anatomic locations, the device is placed on the limb for the appropriate treatment time (UltrOZ; ZetrOZ LLC, Trumbull, CT, USA) (**Fig. 5**).

Fig. 4. Traditional therapeutic ultrasound allows for manipulation of the transducer over a variety of anatomic sites and for adjustment of treatment output, yet requires a trained individual to administer treatment.

Fig. 5. Low-level therapeutic ultrasound with preset wavelength and power output is used to administer therapy over several hours. The transducer (*black disc within blue holder*) is attached to an elastic sleeve that is secured over the treatment site.

EXTRACORPOREAL SHOCK WAVE THERAPY

Extracorporeal shock wave therapy (ESWT) is an effective treatment for soft tissue and bone injuries that is readily accessible to most veterinarians. Indications include tendinitis, desmitis, osteoarthritis, and deep muscle pain.

The primary biological effects of ESWT include reduced levels of inflammatory mediators, increased levels of angiogenic cytokines resulting in vessel proliferation, increased levels of growth factors that result in tissue healing, increased numbers of osteoblasts, and recruitment of mesenchymal stem cells.[14,15] Pain relief has also been identified following shockwave treatment.[16]

Tissue compression and shear loads occur as the shock wave passes tissue interfaces, resulting in stimulation of bone and soft tissue healing.[17] ESWT treatment of arthritis of equine distal tarsal joints (bone spavin) resulted in improvement of lameness grade in 59 of 74 horses treated.[18] Chronic suspensory desmitis was successfully treated in 24 of 30 horses after 3 ESWT treatments.[19] ESWT is indicated for treatment of insertional desmopathy (such as at the origin or insertion of the suspensory ligament), dorsal cortical stress fractures, incomplete fractures of the proximal sesamoid bone, arthritis, and navicular disease and has also been used for treatment of tendonitis.

Treatment Protocols

For optimal outcomes, it is critical to have a specific diagnosis, accurate imaging that on follow-up will help determine treatment progress, and an appropriate rehabilitation exercise plan. Air blocks the sound energy of the ESWT device, similar to how poor transducer contact blocks transmission of sound energy during a diagnostic

ultrasound examination. When treating heel pain through the frog, the site must be trimmed and placed in a wet bandage overnight. This wet bandage softens the frog and provides better penetration of the sound energy. For treatment of limbs and back, the treatment site is clipped and wiped clean of dust and dander. For certain anatomic regions, steps must be taken to allow optimal exposure of the target tissue to the energy impulse (Fig. 6). The horse is sedated in most circumstances.

Impulses

Small lesions, such as a collateral ligament of the distal interphalangeal joint, require 1000 impulses per treatment site. The most common suspensory desmitis lesions are administered 2000 impulses per treatment. Large areas of the back may require a total of 3000 impulses for each treatment.

Energy levels

- Soft tissue injuries less than 4 cm deep to the skin: 0.2 to 0.35 mJ/mm^2.[20]
- Soft tissue and bone in the heel region: 0.35 to 0.45 mJ/mm^2.[21] These levels are higher than the previous example because the penetration of energy is not as efficient.
- Backs disorders: 0.4 to 0.5 mJ/mm^2.[22] Higher levels are indicated because the deep muscle mass overlying the target tissues will absorb energy.
- Bucked shins and incomplete fractures: 0.35 to 0.55 mJ/mm^2.[23]
- Osteoarthritis: 0.15 to 0.3 mJ/mm^2.[24]
- Wounds: 0.1 to 0.15 mJ/mm^2.[25]

Focus depth

The focus point for ESWT should be the average depth of the lesion from the skin. Some ESWT devices use gel standoffs to focus the energy depth, and other devices use hand pieces with different focus depths.

Fig. 6. The horse must be positioned with the fetlock flexed and the tendons displaced axially or abaxially for optimal energy exposure of the proximal suspensory ligament during extracorporeal shockwave therapy.

Aftercare and treatment intervals

The horse rests from exercise for 2 days following treatment. The horse then returns to the recommended rehabilitation exercise protocol. ESWT treatment is conducted at 2- to 3-week intervals for 3 sessions. The horse undergoes a full recheck examination 2 weeks following the third ESWT. At that examination, the decision is made to continue further ESWTs, to stop treatment, or to change treatment modalities.

LASER THERAPY

Indications for low-level laser therapy include wound therapy, treatment of soft tissue injuries, osteoarthritis, and local pain relief. The biological effects of laser include anti-inflammatory effects such as reduced IL-1 levels, reduction of pain sensation through reduced nerve depolarization and release of endorphins, and enhanced ATP production. The dose of energy required for treatment depends on the nature of the injury, depth of the tissue, and desired effect (stimulation of tissues for healing or anti-inflammatory and pain relief effects).[26]

There are a wide variety of laser devices available to the veterinarian. Wavelength and laser energy output are important considerations when choosing a device. Laser wavelengths for wound treatment should be in the 650-nm range, whereas treatment of deeper tissues requires wavelengths from 805 to 980 nm.[26] Lasers are available with energy outputs less than 500 mW and up to 15 W. Higher energy outputs reduce treatment time, but may cause undesired tissue effects if used incorrectly. Recommended laser dosage for soft tissue injuries is 4 to 12 J/cm^2.

A recent study by Haussler[27] found that laser combined with chiropractic therapy resulted in more pain relief for equine back pain than laser or chiropractic alone.

MANIPULATIVE THERAPY

Manipulative therapies such as stretching are methods of treatment that may be applied by the veterinarian and horse owner without the need for special equipment. Stretching is useful as a training aid to increase core strength; to maintain or increase neck, back, or limb joint range of motion; and for improving a horse's general flexibility. Specific issues that benefit from stretching exercise include neck or back pain, sacroiliac pain, and back muscle discomfort secondary to lameness.[7,28]

Range-of-motion exercises for the neck and back include so-called carrot stretches, whereby the horse is encouraged to bend the neck and trunk while reaching for a food reward. Use of such exercises has been shown to increase the cross-sectional area of the multifidus muscles that are primary stabilizers of the spine.[29]

The equine core muscles may be strengthened with work in side reins or long lines or using commercially available systems such as the Pessoa Training System (Dover Saddlery, Littleton, MA, USA) or Equiband (Equicore Concepts, East Lansing, MI, USA) training aids. The Pessoa system uses ropes and pulleys to adjust the horse's frame and neck position. A study reported that use of the Pessoa improved horse posture and stimulated core muscle activation.[30] The Equiband uses elastic bands around the trunk and hindlimbs to provide stimulation that engages the core muscle groups (**Fig. 7**).

Ground poles and cavaletti help activate a horse's full range of limb motion by strengthening the abdominal, back, and limb flexor musculature. This addition is very helpful to the rehabilitation exercise protocol because a horse returns to work and starts to develop strength. Comparisons of limb kinematics were made with poles set on the ground, at 11 cm and 20 cm above the ground. Hoof position was raised, and limb joint flexion was increased as ground poles were placed higher off the

Fig. 7. This apparatus uses elastic bands around the trunk and hindlimbs to provide stimulation that engages the core muscle groups. The device may be used during in-hand work or while under saddle.

ground. The greatest amount of flexion and hoof raise was identified with poles placed 20 cm above the ground surface.[31] For strengthening during rehabilitation exercise or during early training, poles are initially placed on the ground at regular intervals (**Fig. 8**). The horse is walked or trotted over the poles. The height of the poles is increased as the horse develops strength and neuromuscular control. Ground poles set randomly may be used to improve proprioception and core balance (**Fig. 9**).[32]

EXERCISE

Exercise protocols are established during rehabilitation from injury or during return to work following a prolonged lay-up period. Controlled exercise is slowly increased depending on the level of conditioning or the injury status of the horse based on sequential ultrasound and lameness examinations. For most soft tissue injuries, hand walking should begin very soon after injury to encourage optimal fiber alignment and prevent restrictive adhesions. Exercise is started at the walk for 5 to 10 minutes once or twice daily (depending on lesion severity). Ultrasound and lameness evaluations should be repeated every 8 to 10 weeks, and exercise levels may be increased as parameters improve. According to Gillis,[33] controlled exercise alone resulted in successful outcomes for 67% to 71% of horses with soft tissue injuries. Pasture turnout resulted in successful outcomes in 25% to 51% of horses. An example of an exercise protocol applied for most soft tissue injuries is shown in **Table 2**.

All exercise must be adjusted for the level of soundness. If there is increased lameness, swelling is noted at the injury site, or if ultrasound parameters deteriorate, the

Fig. 8. Evenly spaced ground poles may be used to increase joint flexion and to re-establish eye-to-limb coordination.

exercise level must be decreased. Work at the trot should only begin after a solid 10 to 15 minutes hand walking for warm-up and should occur in short 1- to 1.5-minute segments.

Controlled exercise and exercise that minimizes concussion may be used during the rehabilitation period after injury or surgery. Exercise protocols have been established for rehabilitation of tendon and ligament injuries.[33] Gradually increasing the time and intensity level of exercise is beneficial for healing of soft tissues and bone because both tissues become stronger with use than with rest, particularly in growing horses.[34–36] Commonly, the horse is maintained in stall confinement with controlled exercise via hand walking, via ponying, or by use of a mechanical exerciser. Harness race horses may readily enter a controlled exercise program by designating the number of jogging miles at a given pace for each exercise session.

Ultimately, horses must work under the same conditions they will encounter in competition; this means that riding or driving with a gradual increase in duration and intensity of exercise will be needed. The key to retraining a horse is to realize that cardiovascular fitness declines significantly after 4 to 6 weeks of rest[37] and that

Fig. 9. Randomly placed poles are used to improve core balance and proprioception.

Table 2
Rehabilitation exercise protocol for equine soft tissue injuries

Weeks After Injury	Exercise	Confinement
0–4	5–10 min 2–3 times daily	Stall
5–8	10–15 min 3 times daily	Stall or small paddock
9–12	Increase time at the walk 5 min per week. Continue 3 times daily By 12 wk, good progress is walking 30–35 min each session	Stall or small paddock
13–16	If sound and continued improvement in lesion parameters: ride at the walk 20–25 min daily, hand walk 30 min daily	Stall or small paddock
17–20	Ride at the walk 30 min, add 3–5 min trot. On week 18, add 3–5 min additional trot per week	Stall or small paddock
21 to recovery	Ride at the walk 30 min, ride at the trot 15 min per session, add 3 min canter. On week 22–24, add 3–5 min canter per session	Small paddock

Adapted from Gillis CL. Rehabilitation of tendon and ligament injuries. Proc Am Assoc Equine Pract 1997;43:306–9.

bone strength decreases significantly within 12 weeks of rest.[38] Retraining will result in noticeable improvement of cardiac measurements within 6 weeks,[39] increased bone mineral density within 16 weeks,[40] and tendon dimensions within 16 weeks.[34] The studies on bone and tendon do not identify the earliest time that significant strength returns to these tissues so as to allow training or competition without reinjury. The author assumes that 3 to 4 months is the minimum time required to re-establish musculoskeletal tissue strength following a period of complete rest.

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