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Equine Rehabilitation Therapy for Joint Disease

Mimi Porter, MS, ATC[a,b]

[a]Equine Therapy, 4350 Harrodsburg Road, Lexington, KY 40513, USA
[b]equinehealthcare.com, Lexington, KY 40513, USA

The principles of human athletic training and physical rehabilitation therapy can be applied to the horse, providing a reduction in discomfort and dysfunction associated with the various forms of joint disease. Conditions like osteoarthritis, rheumatoid arthritis, capsulitis, bursitis, tendonitis, and tenosynovitis have been studied in human medicine to determine the therapeutic effects of various physical agents. Physical agents, such as ice, heat, electricity, sound, light, magnetic fields, compression, and movement, can be used by the rehabilitation therapist to attempt to control pain, reduce swelling, and restore optimal movement and function in the affected joint. The equine therapist's attention is focused not only on the affected joint but on the body as a whole. Management of secondary or compensatory problems plays an important role in equine therapy regimens.

The equine therapist relies on information acquired from the attending veterinarian, the horse trainer, the rider, the groom, and the owner to obtain the history of the joint disease problem. Through palpation, observation of posture and movement, and range-of-motion (ROM) testing, the equine therapist gains information to use in planning a treatment program geared to the individual horse's needs. Equine therapists are trained to palpate the musculoskeletal structures to assess tissue temperature, mobility, and tension. The horse receives the greatest benefit from rehabilitative therapies when the equine therapist is in consultation with the veterinarian concerning his or her evaluation and diagnosis of the problem.

Early signs of joint disease are subtle and are often confused with behavioral problems or overlooked as "normal" postexercise stiffness. Usually, this is the result of repeated trauma associated with the impact shock when the horse's foot hits the ground. Three physiologic systems work together to absorb and disperse the impact shock of hoof-to-ground contact.

E-mail address: mporter@equinehealthcare.com

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The hoof, the joints, and the musculature all have roles in protecting the body structures from vibrational fatigue. The hoof provides the first line of defense against ground impact shock. Maximum energy dissipation depends on proper hoof preparation and shoeing. The ungula cartilage and the digital cushion provide the basis for energy dissipation via a hemodynamic flow hypothesis [1]. The joints become the next line of defense, with resiliency of the articular cartilage and viscosity of the synovial fluid being called on to absorb vibrational forces as they travel from the ground up through the limbs. When joint pain and inflammation set in, the horse begins to find protection in the musculature; therefore, the equine therapist must be a keen observer in assessing secondary problems in addition to the primary problem of joint disease. Increased muscle tension and muscle splinting are natural guarding mechanisms that are activated by pain in the joints and feet. This nonfunctional muscle activity reduces the horse's athleticism and depletes its energy. Disuse muscle atrophy is a consequence of joint and foot pain, further depleting the horse's performance. A team approach consisting of the trainer, the veterinarian, the farrier, the equine therapist, and any others involved in the horse management team can intervene in this downward spiral and help the horse to regain its athletic potential.

Cold therapy and compression

Cold therapy is indicated for physical problems that are associated with pain, heat, and swelling and is therefore an important conservative management practice for horses with joint disease. Cold therapy can come in many forms, such as tubs of ice slush or frozen bandages as well as ice massage. Ice massage is a simple yet effective means of pain relief via the application of ice directly to the tissues in a massaging motion until the local area is chilled. In the case of joint disease, this provides pain relief to the periarticular tissues and may reduce or eliminate the need for anti-inflammatory drugs. The application of ice to the skin stimulates mechanoreceptive afferent neurons that activate interneurons in the dorsal horn of the spinal cord. The interneurons release the neurotransmitter enkephalin, which binds with receptor sites on the primary afferents and on interneurons of the nociceptor (pain-transmitting) system. Enkephalin binding depresses the release of substance P and hyperpolarizes the interneurons, thus inhibiting the transmission of pain signals [2].

Application of some form of cold therapy in 30-minute doses several times during the 24 hours that follow an exercise bout can provide significant reduction in the signs of inflammation. In fact, after acute trauma, cold therapy is effective for up to 72 hours. Joint effusion or periarticular edema often follows athletic effort when joint disease is present. Edema retards the repair process and causes pain and loss of limb function. Skilled application of a compression wrap should follow the application of cold therapy. The combination of cold therapy and compression works synergistically to reduce edema and provide analgesic effects. The amount of remaining joint effusion can then be examined further, if required, to determine if additional injury has occurred to the joint. There are commercial devices used in human sports medicine that provide simultaneous cold therapy and compression and are making their way to the equine marketplace, which should make this combination of therapies easier to apply.

Passive range-of-motion exercise

Joints maintain their normal ROM by being moved. Joint disease discourages movement and encourages muscle guarding and soft tissue splinting. This leads to the potential for thickened fascia and connective tissue and disuse muscle atrophy. Passive ROM exercise is a specialized hands-on technique of joint and soft tissue mobilization used to reduce stiffness and encourage joint movement. Passive exercise means that the equine therapist is guiding the horse's limb through movement exercises without the horse actively using the muscles of that limb. Joint ROM exercise is performed one joint at a time in a slow and gentle manner. It is performed by lifting the horse's leg and stabilizing above and below the joint of interest while taking it through its full ROM. Usually, the joint is repeatedly guided through its normal physiologic range in sets of 10 repetitions.

This form of exercise is designed to restore length to soft tissues that have shortened and lost elasticity. Passive ROM exercise can also be used to maintain normal joint motion and prevent soft tissue contracture that can result from reduced weight bearing on the painful limb. When carrying out ROM exercises, it is important to avoid forceful movements. Gentle mobilization is sufficient. Damage to the joint structures can occur if too much force is applied.

Hydrotherapy

Hydrotherapy includes swimming for active exercise and the use of an underwater treadmill for active-assisted exercise. Movement is an important part of the rehabilitation process for the horse; however, in the early stages of recovery from joint disease, full weight-bearing exercise may put the horse at risk of reinjury. After a prolonged period of stall confinement, hand walking can be a dangerous experience for the horse or for the handler. Swimming or the use of an underwater treadmill provides a safe form of exercise with many advantages. Buoyancy aids recovery by encouraging limb movement without the need for full weight bearing. Hydrotherapy exercise uses buoyancy and the water's warmth and turbulence to reduce pain and edema, spasm, and discomfort while providing a medium for controlled exercise. The pressure exerted by the water and the mechanical and thermal stimuli improve circulation and reduce pain sensitivity.

Veterinary surgeons have come to recognize the benefits of nonconcussive exercise for healing tissues within the joint. After surgical removal of osteochondral fragmentation as well as after complete healing of skin incisions in racehorses, recovery time can be shortened while the horse maintains cardiopulmonary fitness by swimming or exercising on an underwater treadmill as a part of the daily routine. Underwater treadmill systems are preferred by some horsemen over swimming because the horse exercises with the same movements and muscles that it would use on land. Buoyancy from the water creates a low-impact walking workout, and resistance from the water creates increased muscular work. Equine exercise pools often have a gentle current to provide increased resistance to movement, causing the muscles to work harder than they would with dry land rehabilitation exercise, such as hand walking.

Underwater treadmill exercise can be customized through variable water depths and treadmill speeds. The quantity of water in the treadmill is raised or lowered to accommodate horses of different sizes and to vary the amount of weight bearing desired. Underwater treadmills designed for use with horses have speeds from 1 to 15 mph. A horse trots at approximately 14 mph; however, because of the water resistance, walking speeds are usually all that is needed. The referring veterinarian should re-evaluate the horse before exercise intensity or duration is increased. The water supply for the underwater treadmill must be filtered, chemically treated, and kept at around 62°C. Horses can overheat during strenuous exercise in water that is too warm. Exercise bouts must be closely monitored by an experienced handler and can be individually tailored to each horse's needs and abilities. The horse must be given plenty of time to accept this form of exercise. Mild sedation is also recommended for the first three sessions in the underwater treadmill. Horses are naturally claustrophobic; therefore, every precautionary step should be taken as a necessary part of risk reduction with this exercise device. If this device is operated by a skilled horseman who has experience using the underwater treadmill, it can be a safe and effective tool.

Unlike a horse that is confined to a stall, a horse that has the opportunity to use an underwater treadmill or to swim may rest better in the stall and be less likely to reinjure itself or develop stable vices. Rehabilitation with hydrotherapy should be followed by graduated accommodation to concussive forces before race training resumes to allow for reconditioning of the bone and joints to weight-bearing forces that occur with race training. When normal weight-bearing forces have been reduced for more than 30 days in the horse, some degree of osteoporosis occurs and can lead to stress fractures of the long bones if the horse returns to race training too quickly [3]. This is especially important in horses that have experienced underwater treadmill training, because the muscle is reconditioned before the skeleton.

Electrical stimulation

Electrical stimulation has the potential to benefit the horse that has joint disease by providing pain relief and improving muscle strength through the control of disuse atrophy. Therapeutic electrical stimulation goes by many names (eg, transcutaneous electrical nerve stimulation, neuromuscular electrical stimulation); however, in all cases, it involves the passage of low-voltage electrical current to skin surface electrodes. Therapeutic electrical current provides pain relief through the stimulation of large myelinated afferent neurons that override nociceptive transmission in the dorsal horn of the spinal cord. Pain relief is also achieved through stimulation of endogenous opiates, such as endorphins. Through these two mechanisms, electrical stimulation is able to provide immediate and long-lasting relief from pain associated with joint disease. Skin surface electrodes can be placed on the joint as well as on associated acupuncture points to achieve immediate and long-term pain control.

Electrical stimulation has scientific support for use in treating symptoms of osteoarthritis as well as rheumatoid arthritis in human beings. Under experimental conditions, electrical stimulation significantly reduced the intra-articular pressure and reduced the inflammatory reaction in synovial tissue [4]. A related study showed that electrical stimulation improved the load-carrying capacity of affected joints and reduced pain [5]. Placing skin surface electrodes on muscle motor points causes rhythmic muscle contraction and relaxation. After knee ligament surgery, human patients who received electrical stimulation were seen to have significantly improved muscle function and to have less atrophy than those doing exercise alone. Electrically stimulated muscle has higher levels of oxidative enzymes, which help muscles to function [6]. In the future, we could see electrical stimulators that are injected into the muscle through a 12-gauge hypodermic needle. Studies are already underway looking at the safety and effectiveness of radiofrequency microstimulator devices (BIONs; Alfred Mann Foundation, Santa Clarita, California) in strengthening atrophic muscles associated with stroke and chronic osteoarthritis of the knee. No adverse effects have been reported to date, and patients generally liked the stimulation and elected to continue stimulation after the prescribed study period [7]. Electrical stimulation has a relaxing effect on horses. Electrode placement, parameter selection, and treatment intensity and duration can positively as well as negatively affect the treatment outcome, requiring the operator to be knowledgeable in the use and effects of the unit.

Laser therapy

Laser therapy is the use of a pure light source of a single wavelength to stimulate reactions within cells. The light is in the far-red to near-infrared spectral range (≥ 750 nm). Laser therapy is used primarily for pain reduction and to improve the quality of repair in soft tissue wounds. The mechanism of action has been ascribed to the activation of mitochondrial respiratory chain components, resulting in a cascade of signaling events that promote cellular proliferation [8]. Because pain is a clinical sign of joint disease, Ozdemir and colleagues [9] sought to evaluate the analgesic efficacy and functional changes resulting from laser therapy in cases of cervical osteoarthritis in human patients. Pain and pain-related physical findings, such as increased paravertebral muscle spasm and range of neck motion, were observed to improve significantly in the laser-treated group. In addition, in a review of chronic joint disorders that included 565 human patients, pain scores were compared before and after therapeutic laser treatment to the knee and temporomandibular and vertebral joints, and it was found that laser therapy reduced pain and improved joint function [10].

The effects of laser therapy on pain and disability from degenerative osteoarthritis in elderly human patients were reported by Stelian and coworkers [11]. Fifty patients with degenerative osteoarthritis of both knees were treated with red and infrared laser therapy in a double-blind study. The treatment group showed significant pain relief and functional improvement compared with the control group. The treated group also had longer intertreatment intervals of reduced pain. Trelles and colleagues [12] studied the effects of the infrared diode laser on osteoarthritis of the human knee joint. An 830-nm, infrared, continuous-wave, gallium aluminum arsenide diode laser with output power of 60 mW was used on 40 patients. Four points around the patella were irradiated for 60 seconds each for two sessions per week for 8 weeks. Pain score and joint mobility assessments were made before and after the treatment regimen. Eighty-two percent of the patients in this study reported significant pain relief and increased joint mobility.

Because of the short duration of treatment, laser therapy offers a time-efficient, nonpharmacologic, anti-inflammatory treatment. The effectiveness of laser therapy depends on the proper selection of wavelength, power output, duration of treatment, and frequency of treatment for the type and duration of condition present. The equine therapist must have a complete working knowledge of these parameters. One precaution with laser therapy should be noted. The laser beam must not be shown directly into the eye because it can damage the retina. The beam of an infrared laser is invisible; thus, extra precaution should be taken.

Therapeutic ultrasound

Therapeutic ultrasound is often used by human rehabilitation specialists as an adjunct therapy for the symptomatic treatment of arthritis. The mechanical energy produced is proinflammatory, enhancing the inflammatory response so that the tissues can reach the proliferative or healing stage much earlier. Outcome measures in studies on the effects of therapeutic ultrasound include pain score, grip strength, measurement of joint circumference, ROM, and level of activity.

In ultrasound therapy, electrical energy is converted into high-frequency sound waves by means of piezoelectric material in the sound head. Ultrasound acts as a deep tissue heating agent and can produce changes in tissues as deep as 1 to 5 cm, without excessive heating of superficial tissues. This therapy can be used in treating joint mobility limitations, with the goal of increasing connective tissue temperature before stretching or ROM exercises are performed. Experience has shown that heating deep tissue immediately before or during stretching results in a greater effect on tissue length and less risk of injury than stretching alone. The highly collagenous joint capsule is often responsible for limiting joint motion. Ultrasound energy is readily absorbed by collagenous tissue, increasing its elastic property. The use of ultrasound at 1 MHz in the continuous mode is ideal for reaching deep tissues surrounding joints to increase soft tissue elasticity to accommodate stretching exercises. A study by Draper and Ricard [13] determined that the "stretching window" after ultrasound treatment is approximately 3 minutes if the tissue temperature is raised 5°C.

Therapeutic ultrasound can be used for targeted drug delivery in a process called phonophoresis. An increase in cell membrane permeability causes the medication to be absorbed more readily than it would be with topical application alone. In the author's observation, a topical anti-inflammatory substance (eg, 1% diclofenac sodium) can be placed on the skin with ultrasound transmission gel over it. Proper selection of ultrasound frequency determines the depth of penetration of the sound energy and medication transport. Therapeutic ultrasound units offer frequencies of 1 MHz for treating tissues at depths of 5 cm and 3 MHz for treating more superficial tissues. Pulse rates interrupt the sound wave train at rates of 50%, 80%, or 90% to negate heating effects. When heating is desired, the continuous mode is used. The sound head should be kept moving in a slow and steady motion to avoid the formation of hot spots in subcutaneous tissue. Precautions in the use of therapeutic ultrasound include avoiding bony prominences, surgical pins, and acute injuries.

Gene transfer

Gene transfer is a form of therapy that might eventually provide a mechanism for regenerating cartilage but is still in its infancy. Recent research has shown that ultrasound delivered at therapeutic levels can assist in the gene transfer process. Therapeutic ultrasound creates transient permeability of cell membranes, allowing foreign molecules to enter the cell. Ultrasound has been found to increase the effectiveness of gene transfer under in vitro and in vivo conditions. It is fascinating to think that the ultrasound treatment levels commonly used today (frequency of 1 MHz, power intensity of 2 W/cm^2, and treatment duration of 1 minute) greatly increase transfer of DNA into cells [14,15].

Stem cell therapy

The use of stem cells to repair tissue has become nearly commonplace today. The veterinary use of stem cells shows great promise as an efficient natural stimulant to the healing process in animals. Through maturation and differentiation, stem cells are capable of transforming into many of the cell types found in tissues throughout the body. The stem cell process uses the horse's own healing cells to stimulate repair. Currently, this application is used for tendon, ligament, and fracture repair, but stem cells are being tested for their application in the treatment of joint diseases. Based on the research that has accompanied the development of gene transfer, therapeutic ultrasound could be used to decrease cell membrane resistance, enhancing messenger molecule efficiency, as the stem cells accommodate to their new environment. In the author's experience, following stem cell therapy with therapeutic ultrasound results in rapid resolution of clinical signs of trauma after the procedure, allowing the repair phase to proceed optimally.

Summary

Physical agents, such as massage, hydrotherapy, natural light, cold, and heat, have been used through the millennia by human beings to relieve pain and restore movement. Advances in technology have now brought us the ability to harness other forms of natural energy, including electricity, sound, and specific wavelengths of light, to use therapeutically. These physical agents have few contraindications and provide effective conservative treatment. Experience with physical agents reminds us that the body has undeniable power to heal itself when inhibiting factors are controlled. Pain is one such inhibiting factor. When pain causes a young horse to bear a reduced amount of weight on one limb persistently, that horse runs the risk of developing a flexural deformity in that limb and disuse atrophy in the associated muscles. To date, no curative treatment for joint disease is clinically available. The primary goals of joint disease therapy are to relieve pain and inflammation and to maintain or improve functional status. The various physical approaches described here can reduce the symptoms of pain and swelling that accompany joint disease and help to control damage in the joint. Additionally, improving muscle function and comfort enables the horse to use its body in a balanced manner, reducing compensatory injuries.

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