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Abstract

Regardless of the veterinary patient species, specific rehabilitation goals (e.g., decrease pain, improve flexibility, increase strength, restore maximal neuromotor control) are believed to result in recoveries with less convalescence and morbidity. Physical rehabilitation can be considered in 3 general phases: pain mitigation, mobilization and strengthening, and athletic preparation with sport-specific/physical goals. The rehabilitative phases are not thought to be completely separate and distinct but rather to occur on a continuum according to the patient-specific diagnosis, clinical progression (or lack thereof), and rehabilitative goal. Physical therapy strategies that improve balance, strength, flexibility, and neuromotor control offer the clinician a unique way to maximize patient outcomes. One of several crucial elements to successfully managing professional rehabilitation cases is transparent communication with the client and trainer to direct their expectations, convey case progression, and set realistic timelines.



PHYSICAL REHABILITATION

Current Equine Rehabilitation and Physical Therapies

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Sports medicine and rehabilitation is quickly becoming one of the most progressive and exciting sectors within veterinary practice. While the human athletic world has embraced the vital role of physical therapy and rehabilitation in the longevity of successful careers, the veterinary sports medicine community has been slower to identify the rehabilitative approaches that are most beneficial for patients with specific diagnoses.

Barriers to progress include lack of universal recommendations regarding the timing, frequency, and specific indications for modalities in conjunction with widely varied therapeutic approaches. Whether human or veterinary, the specific rehabilitation goals of decreasing pain,

improving flexibility, increasing strength, and restoring maximal neuromotor control are believed to result in less convalescence and morbidity during recovery. Appropriate incorporation of any modality or therapeutic exercise into a successful rehabilitation program relies on an accurate diagnosis. The most effective rehabilitation protocols start with regular, longitudinal patient assessments and are followed by appropriate adaptation of protocols with both injury-specific and whole-body considerations.

This article reviews the physical modalities and therapeutic exercises commonly used for rehabilitation of orthopedic injuries of equine patients. More information regarding

Take-Home Points

- The most effective rehabilitation programs use regular, longitudinal patient assessments followed by appropriate protocol adaptations, with injury-specific and whole-body considerations.
- Appropriate incorporation of any modality or therapeutic exercise into a successful rehabilitation program relies on an accurate diagnosis.
- Physical therapy strategies that seek to improve balance, strength, flexibility, and neuromotor control offer the clinician a unique way to maximize patient outcomes.
- The best patient outcomes and overall returns to function are achieved by veterinarian prescription and oversight of custom rehabilitative programs that consider the basic principles of physical therapy (in lieu of just modalities).

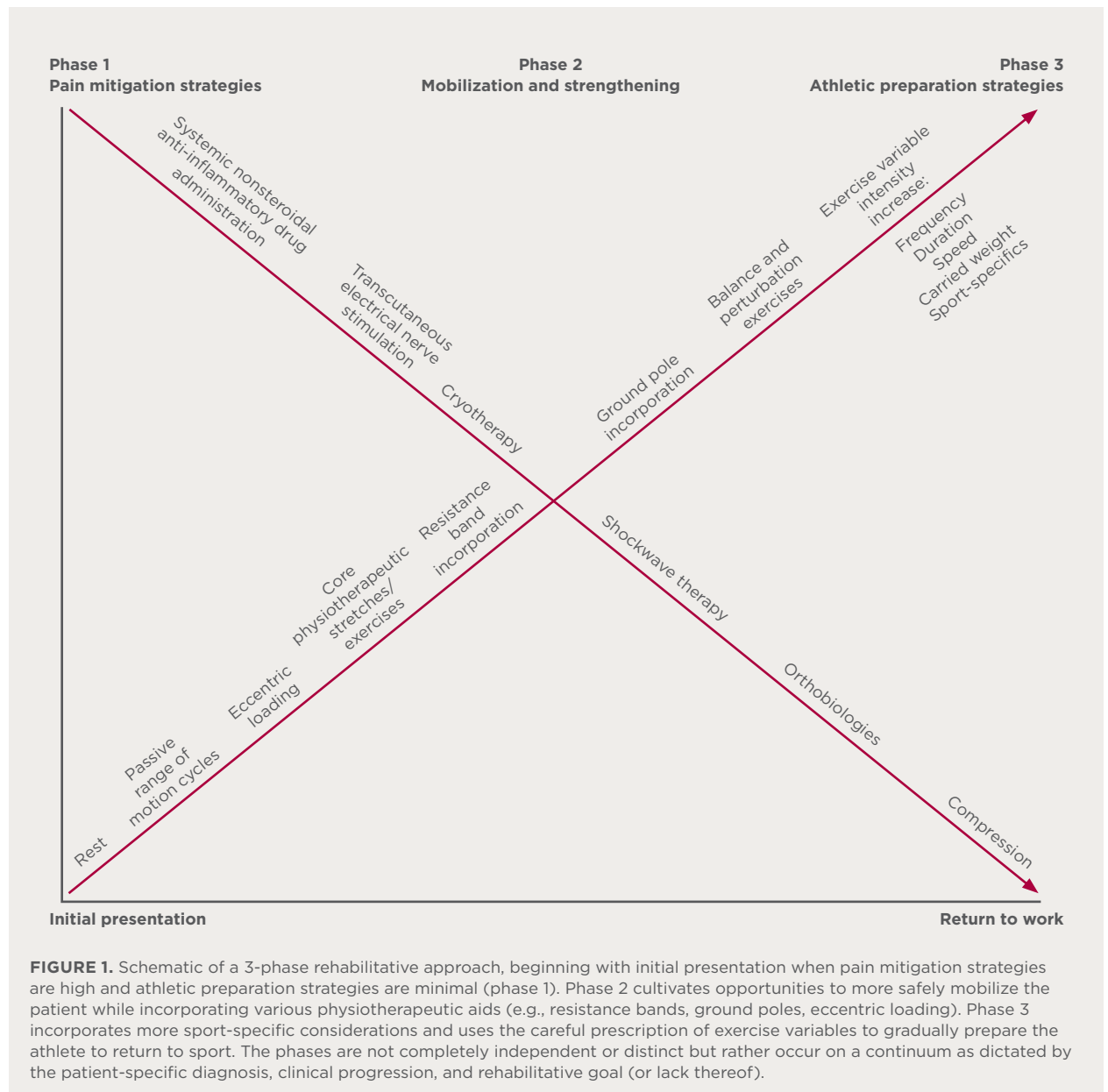


rehabilitative modalities for all species is available.¹⁻³ Significant advances within the rehabilitation field can be expected with further research.

GENERAL REHABILITATION PLAN CONSIDERATIONS

In the author's experience, physical rehabilitation can be considered in 3 general phases: pain mitigation, mobilization and strengthening, and athletic preparation with sport-specific/physical goal considerations (**FIGURE 1**). However, the rehabilitation

phases are not thought to be completely separate and distinct from one another but rather are often prescribed on a continuum according to patient-specific diagnosis, dictated by clinical progression (or lack thereof), and the rehabilitative goal. For example, some patients may require only elements of phase 1 rehabilitation and others may progress directly to phase 2. Serial, longitudinal clinical assessments followed by modification of protocols that include both injury-specific and whole-body considerations help optimize case progression and clarify client expectations. As the field of veterinary rehabilitation





continues to evolve, efforts should be directed at prescribing patient-specific rather than generalized protocols. In the author's experience, veterinary prescription and oversight of custom rehabilitative programs that consider the basic principles of physical therapy (in lieu of just modalities) realize the best patient outcomes and return to function.

Rehabilitation Phase 1: Pain Mitigation

The first phase encompasses the more delicate physiotherapeutic techniques (e.g., icing, compression, transcutaneous electrical nerve stimulation, heat, massage, limited amounts of controlled exercise). Goals for this phase of rehabilitation are to reduce swelling (when indicated), break the pain cycle/wind-up, and facilitate function so that the second phase of rehabilitation can be pursued more comfortably.

Rehabilitation Phase 2: Mobilization and Strengthening

The second phase cultivates the opportunity to more safely mobilize the patient while incorporating various physiotherapeutic aids such as resistance bands, ground poles at various configurations, blood flow restriction training (i.e., applying a specialized tourniquet to temporarily reduce blood flow to an exercising limb by using specific levels of occlusion)⁴ and aquatic therapy.

As the field of veterinary rehabilitation continues to evolve, efforts should be directed at prescribing patient-specific rather than generalized protocols.

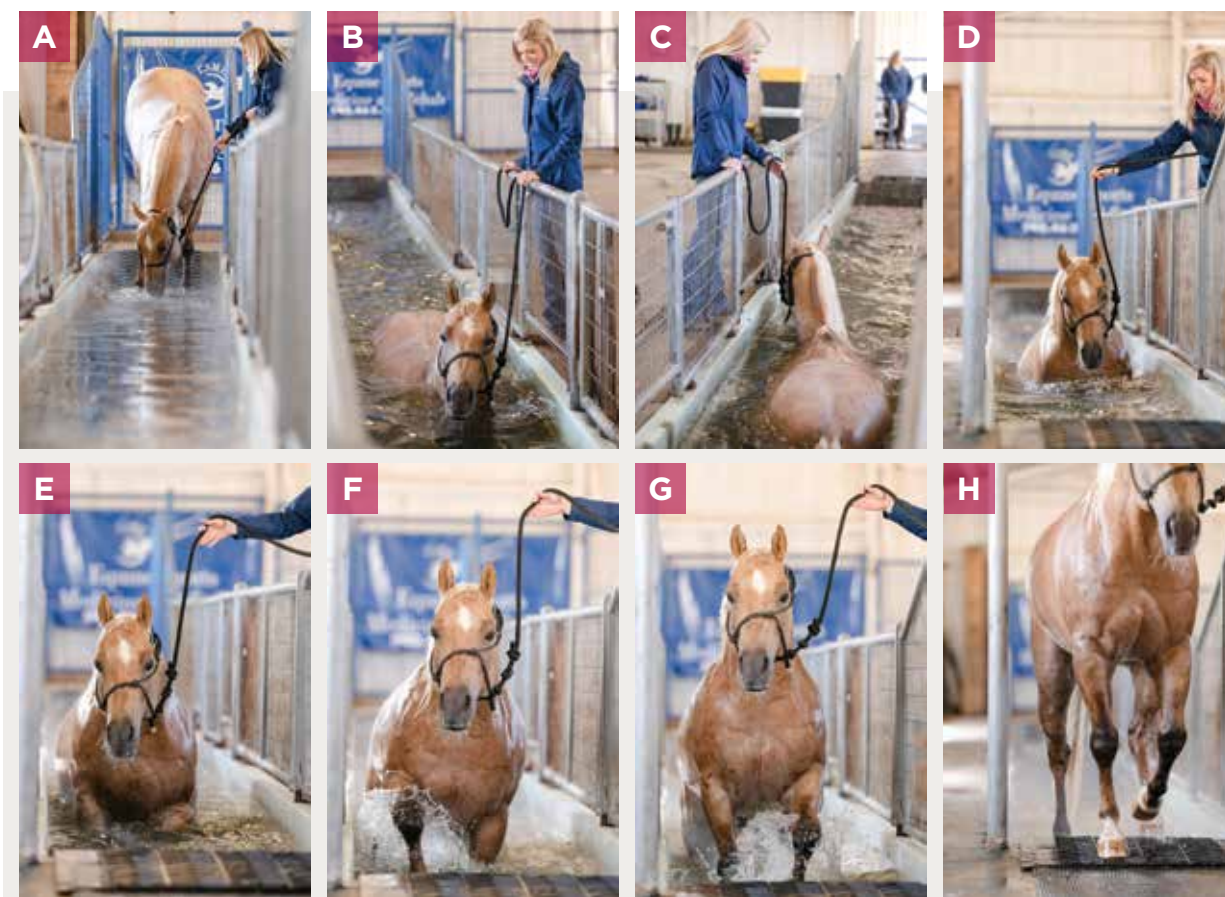


FIGURE 2. Underwater treadmill therapy during all phases of the session including entry (A), walk phase (B-D), and ramp exit (E-H) in a linear, in-ground, high-water depth system (HydroHorse, horsetreadmills.com). Before therapy on this particular treadmill is prescribed, the patient's ability to safely navigate damp incline and decline surfaces must be carefully considered.



Incorporating such exercise modifiers enables the clinician to target rehabilitative goals (e.g., improving active range of motion, targeting muscle strength through physiotherapeutic exercises, introducing controlled eccentric loading, stimulating neuromotor control). Some patients may require only elements of phase 1, and others may progress directly to phase 2.

Rehabilitation Phase 3: Athletic Preparation

The third and final phase of rehabilitation builds on phase 2 but begins to incorporate sport-specific/physical demands that the patient will encounter after full return to sport. During phase 3, exercise variables such as session length, frequency, speed, carried weight, and overall intensity should be gradually introduced while pain mitigation efforts remain minimal. Sport-specific knowledge and awareness of athletic demands are integral to building a targeted and appropriate phase 3 approach.

Progression through the phases will vary on a case-by-case basis; patients that are more difficult to manage often lag beyond expectations in phases 1 or 2.

Vigilance and regular recheck evaluations through all phases of rehabilitation remain imperative for identifying setbacks and incorporating increases or decreases in rehabilitative workload (i.e., pivots) when necessary. Progression through the phases will vary on a case-by-case basis; patients that are more difficult to manage often lag beyond expectations in phases 1 or 2. In addition, failure to respond to phase 3 rehabilitation indicates lack of suitability for certain sport intensities. One of several crucial elements for successfully managing professional rehabilitation cases is transparent communication with the client and trainer to manage expectations, convey case progression, and set realistic time lines.

AQUATIC THERAPY

In the rehabilitation setting, the proposed benefits of

aquatic exercise include buoyancy, viscosity, and resistance that promote global improvements in muscular timing, strength, and neuromotor control.⁵ Several options for the equine athlete are above-ground underwater treadmills, in-ground underwater treadmills (**FIGURE 2**), and swimming pools (circular or straight).³

Investigations into the benefits of aquatic therapy for the equine patient have thus far reported subsequent physiologic responses,⁶⁻⁸ biomechanical effects,⁹ and a role in mitigating carpal osteoarthritis.⁵ Alterations in limb kinematics secondary to varying water depths provide the clinician a way to target or spare flexion/extension joint angles, depending on the specific rehabilitation goals for the patient.¹⁰ Recently, walking slowly on a water treadmill (0.8 m/sec) was shown to reduce forelimb protraction/retraction range of motion and increase hind limb protraction/retraction range of motion compared with walking on a dry treadmill at normal speed (1.6 m/sec).¹¹ On the basis of those findings, the researchers concluded that during water treadmill exercise, forelimb protraction was decreased while hind limb retraction was increased, a finding that could be used to design rehabilitation programs.⁸

Two studies examined back and pelvic kinematics during aquatic therapy at varying water depths.^{12,13} When axial rotation, lateral bending, and pelvic flexion were evaluated in a population of riding horses, significantly increased rotation and flexion of the back as well as pelvic flexion were noted at higher water depths.¹² Similarly, increased cranial thoracic extension and thoracolumbar flexion were appreciated in 14 horses walking in high water depths compared with lower depths.¹³ Given the resultant spinal and pelvic biomechanical effects of aquatic exercise at varying water depths, the rehabilitation clinician must be mindful that some horses may not tolerate high water levels if pathologic change within the thoracolumbar region results in altered and potentially painful pelvic range of motion. Similar considerations should be given to horses with spinous impingement in the cranial thoracic region as high water depths may exacerbate inappropriate spinal extension.¹²

Other researchers compared fiber properties and metabolic responses of the superficial digital flexor and gluteal muscles to high-speed exercise in horses trained on conventional and underwater treadmills.¹⁴ Eight weeks of conventional or underwater treadmill training resulted in only minor changes in type 1 muscle fiber sizes with no effect on muscle metabolic or heart rate



responses to standardized exercise tests, leading the researchers to conclude that training at progressing speeds is warranted after rehabilitation involving underwater treadmill training.¹⁴ Similarly, recent investigation of the intensity of water treadmill exercise as a function of water depth and treadmill speed indicated that varying water depth and speed affects the workload associated with water treadmill exercise; however, the conditions investigated were all associated with low-intensity exercise.¹⁵ The researchers noted that exercise intensity was affected more by water depth than by speed.¹⁵ With persistent and exciting interest with regard to various forms of aquatic exercise, further insight into prescription can be expected.

PHYSICAL THERAPY EXERCISES

In human physical therapy programs, physiotherapeutic exercises aimed at stimulating motor control, flexibility, and stability are regularly used to help improve function to what it was before injury. Specifically, the use of such exercises has been shown to reduce pain and likelihood of reinjury.¹⁶⁻¹⁸ With regard to equine patients, several core strengthening exercises and their role in activating deep epaxial musculature to subsequently improve postural motor control and alter thoracolumbar kinematics have been investigated.¹⁹⁻²¹ Both baited (e.g., carrot stretches) and passive exercises offer opportunities to facilitate stretching during dynamic phases and strengthening during static phases of the exercise. Instituting dynamic mobilization

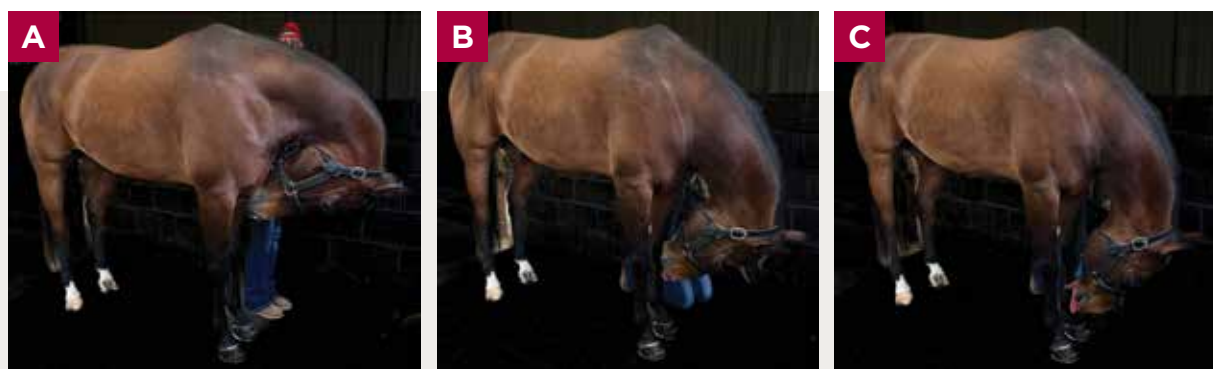


FIGURE 3. Ventral cervical flexion exercises performed at 3 levels: **(A)** chest, **(B)** carpi, and **(C)** front fetlocks. Corresponding anatomic regions targeted with each exercise for each level are based on research performed by Clayton et al, which found the largest angular changes to occur within the cranial and caudal cervical regions ($<10^\circ$ change within the middle cervical spine).²⁰ Incorporation of these exercises must align with the rehabilitative goals of improving cervical range of motion, augmenting core stability, and stretching the thoracolumbar region.

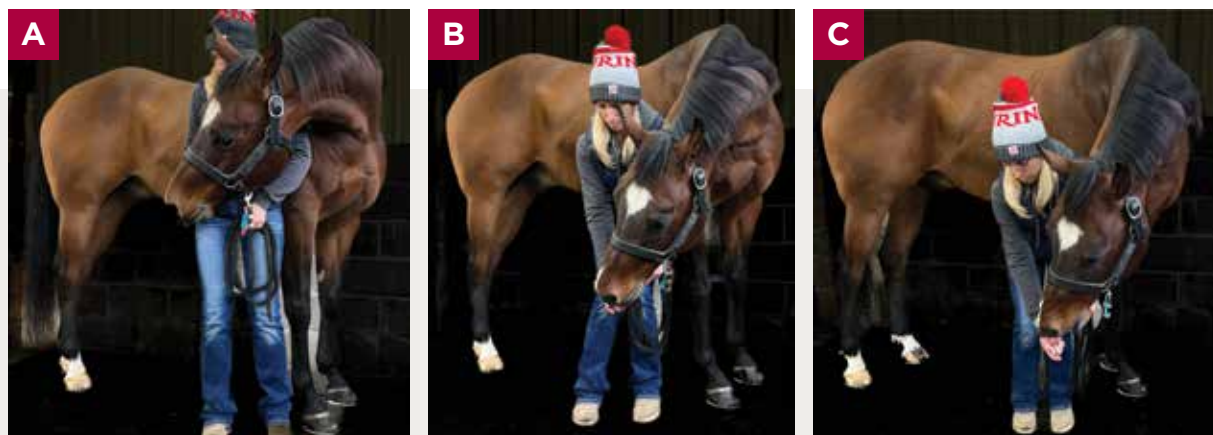


FIGURE 4. Lateral cervical bending exercises performed at 3 levels: **(A)** stifle, **(B)** hock, and **(C)** hind fetlocks. Corresponding anatomic regions targeted with each exercise for each level are based on research performed by Clayton et al, which evaluated lateral cervical bending at the levels of girth, hip, or tarsus and for which activation through the multifidus and longus colli muscles was noted.²⁰ The researchers also noted that the further horses were bending caudally, the more the caudal cervical and thoracolumbar regions were activated. Incorporation of these exercises must align with the rehabilitative goals of improving cervical range of motion, augmenting core stability, and increasing lateral spinal motion.



exercises over a 3-month period has been shown to increase the size and symmetry of the multifidus muscle as assessed through longitudinal ultrasonographic evaluation.¹⁹ Stretches offer means through which various regions of the spine and pelvis may be targeted (**FIGURES 3 AND 4**), although blanket recommendations regarding prescription are not advised. The following exercises are aimed at stimulating proprioceptive and neuromotor control.

Proprioception, Balance, and Strength Training

A central focus of human physical therapy programs is strengthening and improving proprioception and balance control after injury; although standardized investigations have yet to focus on equine applications, there are several mechanisms through which neuromotor control can be recruited. Specific physical therapy aids (e.g., ground poles, tactile stimulators,

surface changes) offer clinicians a way to passively engage neuromotor control during activities of daily rehabilitation or training. Ground poles arranged at various distances, heights, and configurations can encourage increased lateral thoracolumbar excursion. Hill work and incorporating backing exercises into hill work can also be used to simultaneously improve muscular strength and challenge proprioceptive acuity.

Perturbation Training

Perturbation (unconscious reaction to a sudden, unexpected outside force or movement) postural stability training has not yet been studied in horses, but it is well accepted that postural stability is integral to maintaining equine balance, protecting the spinal column, and allowing more accurate reactions to destabilizing forces.²¹ Improving postural stability in horses with neurologic conditions, therefore, represents a key rehabilitative target for improving static and



FIGURE 5. Balance pad use in horses referred for professional rehabilitation. **(A)** Bilateral forelimb application with the patient standing on medium density (purple) balance pads (Sure Foot Equine, surefootequine.com). **(B)** Bilateral forelimb application with the patient standing on soft pads (blue) and bilateral hind limb firm pad (green) application while performing ventral cervical flexion to the level of the fetlock to further challenge balance acuity. **(C)** Bilateral hind limb application with the patient standing on firm density (green) balance pads.



dynamic function. Practitioners can use a variety of physical therapy aids for rehabilitative management of the neurologically impaired horse, including recently developed foam pad systems (**FIGURE 5**). The pads are commercially available in varying levels of firmness for forelimb, hind limb, or multilimb use. The goal of using these pads as part of a neurologic rehabilitation program is to challenge and/or exacerbate postural weakness to stimulate and ultimately improve neuromuscular function. As recently described, depending on the severity of neurologic dysfunction, the author typically begins by placing firm pads under the forelimb on a smooth, nonslick surface to ensure safety for the horse and handler.²⁰ After the horse has acclimated physically and behaviorally to firm forelimb pads, softer pads are gradually incorporated and eventually used for the hind limb and/or all 4 limbs. Pads should be strategically used, with the clinician being mindful of concurrent orthopedic injuries so as not to exacerbate existing injuries through soft pad use.

After balance pad use is mastered in standard fashion (on a flat, nonslick surface), the clinician can then begin to incorporate further challenges to the neurologic system by introducing manual perturbation or combining pad application with core exercises (**FIGURE 5B**). Manual perturbation exercises also represent an avenue through which the clinician can

stimulate neuromuscular feedback in the neurologically impaired horse. Obvious safety considerations must be thoroughly evaluated, but if the horse is deemed physically stable enough, perturbation challenges can be introduced by lifting a forelimb or hind limb and gently applying steady pressure for 3 to 5 seconds toward the weight-bearing limb, followed by gradual pressure release and subsequent balance recuperation (**FIGURE 6**). Surface changes and/or incline/decline work can also be introduced as the horse progresses through a rehabilitative program, and a variety of proprioceptive stimulation tools (e.g., ground poles, tactile stimulators, resistance bands) can eventually be incorporated.

Manual perturbation exercises also represent an avenue through which the clinician can stimulate neuromuscular feedback in the neurologically impaired horse.

Resistance Aids

The use of various training aids within the equine rehabilitation setting has been of recent interest,

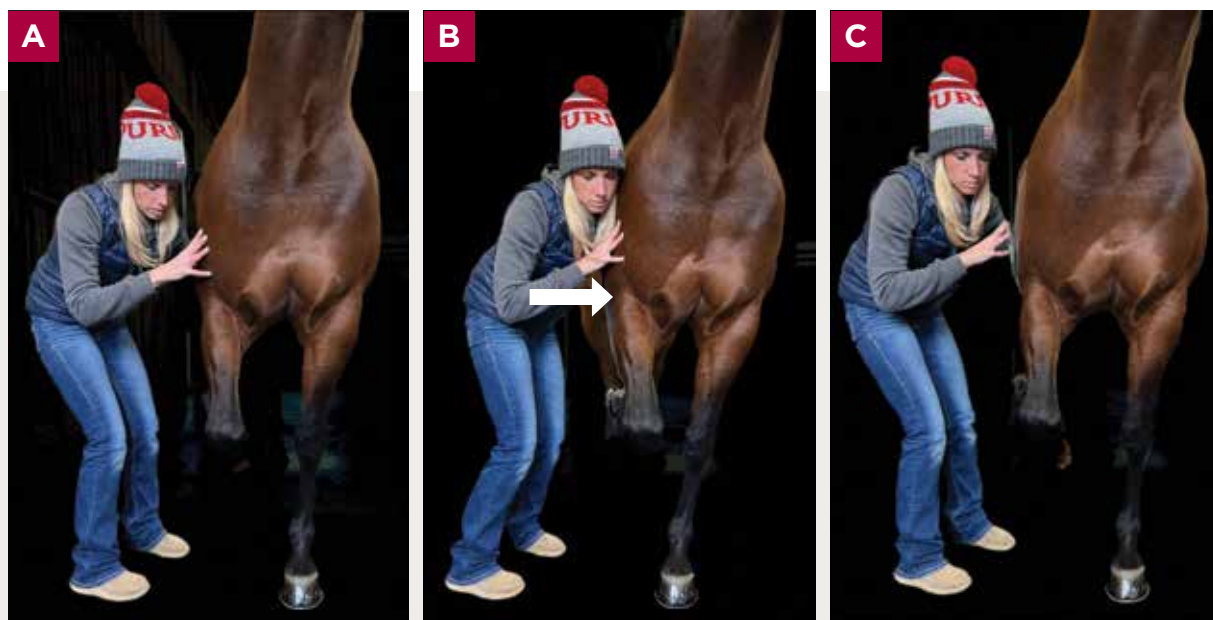


FIGURE 6. Manual forelimb perturbation. (A) Before pressure application, (B) during pressure application for 3–5 seconds (white arrow), and (C) gradual pressure release during balance recuperation. Such exercises represent an avenue through which the clinician can dynamically stimulate neuromuscular feedback in the neurologically impaired horse.

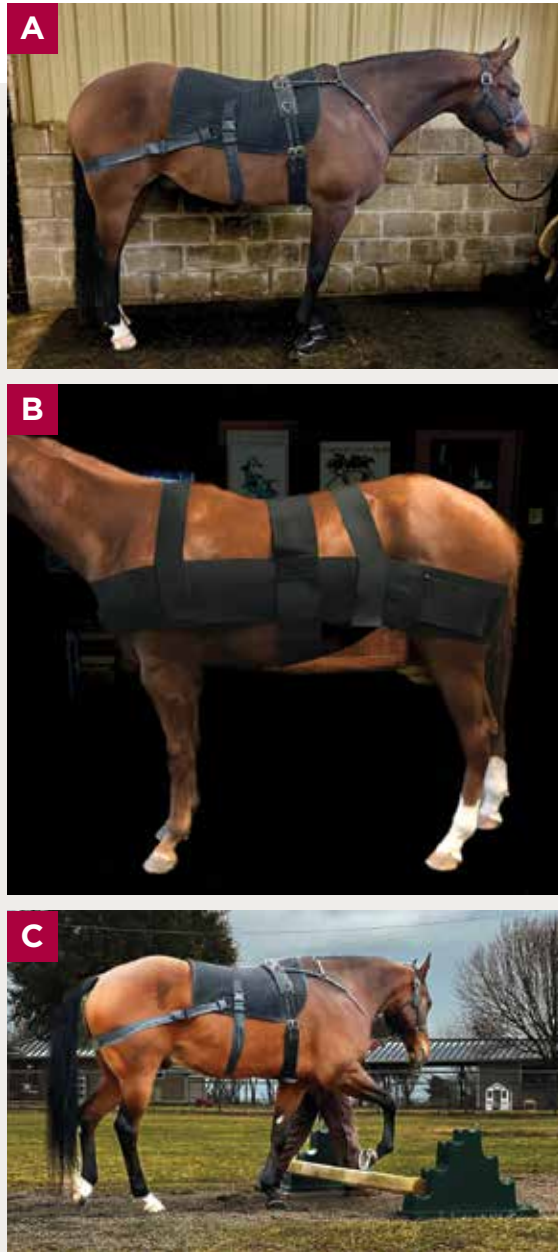


FIGURE 7. Incorporation of various forms of resistance band systems that are commercially available, including (A) hind end (EquiCore Concepts, equicoreconcepts.com) and (B) bellyband (Eagle ProSix full body wrap, eagleprosix.com) systems. For multimodal exercise, resistance band work can be combined with (C) ground pole exercises or other various forms of exercise.

including elastic resistance bands and Pessoa lines (pessoausa.com).²²⁻²⁴ In human physical therapy programs, resistance band training is successfully used to improve core strength and stability.²⁵⁻²⁷ Commonly referred to as therabands (**FIGURE 7**), the 2-piece equine resistance band system is thought to stimulate core abdominal muscles (abdominal band) and engage

hind limb muscles (hindquarter band). Recent investigation of resistance band use on horses at a trot determined that it reduced mediolateral and rotational movement throughout the thoracolumbar region.²³ Additional studies investigating more long-term use and potential mechanistic pathways will help refine resistance band use in the rehabilitation setting.

Also pertinent to rehabilitation of the back and pelvic regions is the use of training lines. Pessoa training aids have been shown to increase lumbosacral angles and thoracolumbar dorsoventral excursion when used in horses being lunged at a jog.²⁴

SUMMARY

Although additional studies are needed to establish specific recommendations regarding use, initial biomechanic effects for targeted rehabilitation are encouraging. However, rehabilitation of orthopedic injuries for all veterinary species remains a clinical challenge. Vigilance and regular recheck evaluations through all phases of rehabilitation remain imperative for identifying setbacks and incorporating pivots when necessary. Progression through rehabilitative phases will vary on a case-by-case basis; cases that are more difficult to manage often lag behind expectations in phases 1 or 2. Failure to respond to phase 3 rehabilitative approaches may indicate lack of suitability for certain sport intensities. Transparent communication with the client and trainer to convey expectations, case progression, and timelines remains an integral part of successfully managing professional rehabilitation cases. **TVP**

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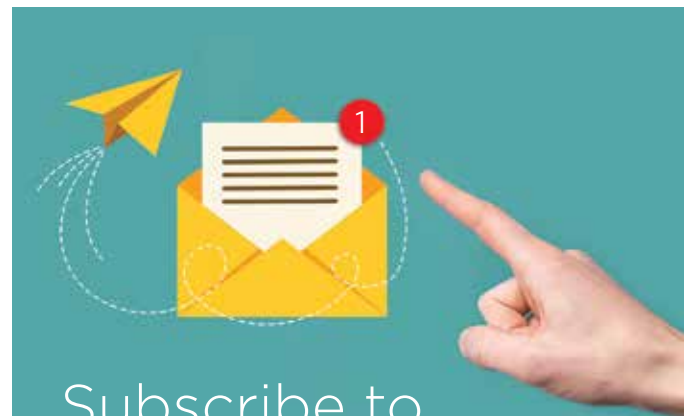
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