



Original Research

Gymnastic Training and Dynamic Mobilization Exercises Improve Stride Quality and Increase Epaxial Muscle Size in Therapy Horses



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ABSTRACT

The objective was to evaluate the efficacy of gymnastic training (GYM) and dynamic mobilization exercises (DMEs) on stride length (SL) and epaxial muscle size in therapy horses. Nine cross-bred hippotherapy horses that performed three, 25-minute therapeutic riding sessions per week throughout the study period were randomly assigned to three experimental groups: a control group in which the horses were sedentary with no additional physical activity; a group that performed DMEs; and a group that performed both DMEs and additional GYM including pelvic tilting, backing, turning in small circles, and walking over a raised rail to strengthen the abdominal and pelvic stabilizer muscles. The exercises were performed 3 days per week for 3 months, with evaluations at the start and end of the study. Stride quality was assessed by measuring SL and tracking distance (TD). Epaxial muscle size was monitored by ultrasonographic measurement of m. longissimus dorsi (LD) thickness and m. multifidi (MM) cross-sectional area. Paired *t* tests were used to compare within groups across time, and between groups were detected using analysis of variance with Tukey post hoc test. When walking at 1.3 m/s, SL and TD at walk increased significantly ($P < .05$) in horses subjected to GYM. Thickness of LD did not change in any group, but cross-sectional area of MM increased significantly by 3.55 cm² (DME) and 3.78 cm² (GYM). It was concluded that GYM training improved stride quality and DME-stimulated MM hypertrophy which has been shown to improve intervertebral joint stability in other species.

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1. Introduction

Hippotherapy uses horses as instruments for practitioners to treat individuals who have disabilities or special needs. These riders are often poorly balanced, poorly coordinated, and overweight [1], all of which increase the

stress on the therapy horses. It is not surprising, therefore, that therapy horses are susceptible to work-related injuries which may involve muscular pain [1,2]. It is speculated that these equine injuries may be similar to the muscular pain experienced by human laborers, who, due to overloading or repetitive movements combined with a lack of alternative types of exercise, become susceptible to obesity, back pain, and articular mobility problems [3]. Lumbar pain interferes with the horse's stride quality [4] which has been shown to deteriorate when the riders present special characteristics,

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such as pelvic misalignment and excessive body weight [1]. We hypothesize that poor stride quality could be improved if the horses performed additional exercises specifically designed to recruit and strengthen the core stabilizing and locomotor musculature while moving the joints through a wide range of motion.

One of the benefits of therapeutic riding is that the three-dimensional (3D) movements of the rider's pelvis show similar trajectories and displacement amplitudes when riding a horse at walk to those of an able-bodied person walking overground [5], which stimulates patients to activate their core musculature and stabilize their trunk in the same way as they would if they were walking. The horse's stride quality contributes to the value of the therapeutic experience so it is important for therapy horses to move freely and without restriction of their range of motion [6]. Thus, the therapy horse should have a full range of 3D movement in order for the patient to receive a quality treatment that accelerates the therapeutic and rehabilitative process. According to Dvorakova et al [7], the combined action of the horse's ventral (hypaxial) and dorsal (epaxial) musculature influences their 3D movement patterns, so specific exercises should be performed by therapy horses with the objective of strengthening the abdominal, sublumbar, and epaxial muscles. The pelvic stabilizer muscles, which maintain correct alignment of the sacroiliac, hip and stifle joints, are necessary for transmission of locomotor forces generated by the hind limb to the horse's trunk [8].

It is well known in people that gymnastic training (GYM) involving muscular stretching and/or strengthening exercises contributes to the prevention of occupational diseases and enhances rehabilitation from injuries [9]. Muscular stretching performed before athletic activity reduces the risk of muscular strain although muscular strength and power may be impaired [10]. Strength training not only improves muscular force and power, it also protects against injury by activating and strengthening the deep stabilizing musculature [9]. In horses, most conditioning studies have focused on cardiovascular fitness in specific sports and relatively little scientific information is available describing the effects of stretching or strength training exercises. Dynamic mobilization exercises (DMEs) involve voluntary movements of the horse's cervical and thoracolumbar intervertebral joints through a wide range of motion with the primary objectives of activating and strengthening the muscles that move and stabilize the intervertebral joints [8]. The kinematic effects of these exercises have been described [11,12], and their value for increasing the cross-sectional area of the equine spinal deep stabilizing m. multifidi (MM) has been reported [13,14]. These exercises may also recruit and strengthen the abdominal and pelvic stability muscles although the latter effects have not been evaluated.

Exercises that are thought to play a role in strengthening the abdominal and sublumbar muscles include caudal tilting of the pelvis, stepping backward, and turning in small circles around a barrel [15]. It has been suggested that the pelvic-stabilizing muscles, which include the gluteal muscles, m. biceps femoris, and other hamstring muscles, can be strengthened by stepping over obstacles at walk [15,16].

The objective of this study was to evaluate the effects of DMEs and GYM in therapy horses. The experimental hypotheses are that the regular performance of DMEs will be associated with epaxial muscle hypertrophy and the regular performance of GYM exercises will improve stride quality.

2. Materials and Methods

This study was approved by the Ethical Committee for the Use of Animals, of the Animal Husbandry Course, São Paulo State University, Dracena Campus, Brazil, under protocol number 36/2012, in accordance with the ethical principles of animal experimentation.

2.1. Experimental Design

The study was conducted in the Association of Parents and Friends of Exceptional Children Hippotherapy Center located in the town of Dracena, São Paulo. The inclusion criteria for horses were that they showed no overt lameness or signs of musculoskeletal lesions during clinical examination, they had been used in hippotherapy sessions for at least 3 years, and they were in regular work. This selection resulted in the inclusion of nine cross-breed therapy horses, with mean age of 16 ± 3.4 years and mean body weight of 450 ± 20.96 kg. The horses were randomly assigned to three groups: sedentary (SED), DMEs, and DMEs plus GYM.

The duration of the experiment was 3 months, during which time the horses continued to be used in hippotherapy sessions three times per week on alternate days with each session being approximately 25 minutes in duration. In addition, the horses performed the designated exercises three times per week under the supervision of a trained professional, who guided the horses using a halter. The SED group did not perform any additional type of physical activity. The DME group performed a series of baited stretches that have been shown to activate and strengthen MM which is a deep spinal-stabilizing muscle [13]. Specifically, the DME exercise routine consisted of three cervical flexion exercises (chin to chest, chin between carpi, and chin to fore fetlocks), a cervical extension exercise and three lateral cervical bending exercises performed to the right and left sides (chin to shoulder, chin to flank, and chin to hind fetlock). Each of the 10 mobilization exercises was repeated five times per exercise session using treats to entice the horses to the desired positions which were then maintained for 5 seconds. Horses were deemed to have performed each exercise successfully when they achieved the position described by Stubbs et al [13] and maintained that position for 5 seconds. The GYM group performed DMEs as described for the DME group together with exercises to recruit and strengthen the abdominal muscles and the pelvic-stabilizing muscles. These exercises were pelvic tilting, backing up, walking around tight turns, and stepping over obstacles at walk. Pelvic tilting was performed at the halt by applying pressure to a point located between m. biceps femoris and m. semitendinosus [8]. Horses were required to hold the pelvic tilt for 5 seconds with five repetitions per session. Backing up was

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