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Hippotherapy as a Tool for Improving Motor Skills, Postural Stability, and Self Confidence in Cerebral Palsy and Multiple Sclerosis

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Abstract

Hippotherapy utilizes the three dimensional movement of the horse to improve balance, strength, coordination, and postural symmetry in those with cerebral palsy, multiple sclerosis, or related neuromuscular disorders. The forward, side-to-side, and rotational movement of the horse provides the rider with different sensory cues to help improve gait. While this therapy is a passive exercise for the patient, the individual must engage the core muscles to sit upright along with making small corrections due to the constant movement of the horse to help with postural stability and strengthening. Ultimately, understanding how affected brain areas lead to symptoms in those with CP and MS, innovative therapies can be utilized such as hippotherapy to help improve balance, strength, coordination, and postural symmetry along with aspects of self confidence.

Introduction

Neuromuscular disorders are important to investigate and identify causes that lead to disability and to provide appropriate treatments for those affected. Two important neuromuscular disorders to consider are cerebral palsy (CP) and multiple sclerosis (MS). Incidence research suggests that CP affects every two children in 1,000 births and is the most likely cause of movement disorders in children [1]. Typically, CP is caused by abnormal development during the pre-natal period affecting movement, muscle tone, or posture [2]. Neurological alterations to the periventricular white matter tracts can cause changes in the physiological function of muscles, resulting in weakened force production, lower walking velocity, spasticity, and limited gross motor function in those with CP [2,3,4,5,6]. Other physiological factors related to CP hindering efficient walking include a velocity-dependent increased in resistance to muscle stretch, hypoextensibility, and impaired muscle recruitment and activation [7]. To improve force production, walking velocity, and gross motor function in those with CP, much focus is emphasized on strength training procedures [2,3,4,5,6].

MS is another neuromuscular disorder affecting more than 350,000 people in the United States where degradation of the myelin sheath via immune dysfunction causes difficulty coordinating muscle movement [8]. It is thought that T cells, involved in the autoimmune pathology, respond against the myelin antigens leading to neurodegenerative events [9,10]. Brain areas affected include ventricles of the cerebellum, brain stem, basal ganglia, and spinal cord. All of these are key areas essential for communication between muscles and the brain in order to have coordinated and planned movements. While remyelination does occur, oligodendrocytes cannot completely reform the myelin sheath, leading to a progressive manifestation of the disease [10,11,12]. Neurological signs include changes in sensation (tingling/numbness), muscle weakness or spasms, difficulty with coordination, gait, and balance, and/or problems with speech. Treatment for MS often involves controlling for symptoms and preventing disability to improve daily living. Physical, speech, and occupational therapy can be combined with medication to improve muscle

tone and coordination but do not eliminate symptoms fully. Gait training can be valuable to those with MS to reduce fatigue during walking and improve activities of daily living [13].

Recently, alternative approaches seek to maintain the enthusiasm of the patient during therapy while providing a multisensory experience to improve not only physical symptoms, but also aspects of self-control and self-confidence. Maintaining enthusiasm is especially important for children to obtain positive results [14,15]. One such technique is hippotherapy, which utilizes the three dimensional movement of the horse to improve balance, strength, coordination, and postural symmetry in those with CP, MS, or related neuromuscular disorders. The forward, side-to-side, and rotational movement of the horse provides the rider with visual, vestibular, and somatosensory cues to help improve gait. While this therapy is a passive exercise for the patient, the individual must engage the core muscles to sit upright along with making small corrections due to the constant movement of the horse [14,15]. Ultimately, by understanding how affected brain areas lead to symptoms in those with CP and MS, innovative therapies can be utilized such as hippotherapy to help improve balance, strength, coordination, and postural symmetry along with aspects of self-confidence.

Hippotherapy Versus Adaptive Riding

It is important to study the effectiveness of equine-assisted therapy because of the positive environment that the horse plays with the patient. Empirical research substantiates the effect of hippotherapy by measuring a functional outcome using tools such as the GMFM (Gross Motor Functional Measure) and PEDI (Pediatric Evaluation of Disability Inventory) to give evidence for the value of hippotherapy as a treatment option [14]. Two classes of equine-assisted therapy include adaptive riding and hippotherapy. Adaptive riding helps riders become as independent as possible while learning how to control and ride a horse. As patients often work in a group setting, communication and social skills can also be improved. Physical strength, muscle tone, balance, mobility, and hand-eye coordination are some of the visibly enhanced skills. The more subtle improvements are fortified self-esteem, self-control, and self-confidence.

Hippotherapy is individualized to the rider in a one-on-one therapy session focusing on improving aspects of daily living rather than learning how to ride a horse. Speech, occupational, or physical therapists can utilize the horse to help patients achieve goals. It is thought that the rhythmic pattern of the horse's gait mimics the movement of the pelvis during human gait. Hippotherapy is a useful form of therapy because the child learns to anticipate movement as the horse walks in a repetitive, rhythmic pattern. The rider can produce compensatory mechanisms to counteract the movement of the horse such that his or her center of gravity will remain fairly neutral. Improvements are often exhibited in range of motion, tone, posture, balance, and coordination [7,14,22]. Given an adequate period of time, the central nervous system can reorganize to affect sensory, muscular, vestibular, and visual systems and eventually lead to efficient and fluid movement patterns in daily activities [7,14].

The Advance of Hippotherapy with Cerebral Palsy

Those with CP typically lack control of trunk muscles, thus it is essential for therapy programs to develop both reactive and anticipatory postural stability [14]. To determine if symptoms can be improved using hippotherapy in those with CP, researchers have performed experiments measuring energy expenditure, gait, motor function, postural control, and trunk stability. Motor skills, such as stretching, mobilization of core muscle groups, orientation in space, and tactile reactions, can be learned while on the horse so that when off the horse, patients can activate muscles for enhancement of a functional task. An early study by McGibbon et al (1988) presented that hippotherapy can improve gait (stride length, velocity, and cadence), energy expenditure during walking, and motor function in those with CP. McGibbon et al (1988) suggest that hippotherapy is important for reducing energy expenditure by improving pelvic rotation, lateral displacement, and anterior tilt for correct center of mass positioning. Importantly, decreased energy expenditure and more efficient walking may give a child greater self-confidence to walk longer and more often. Enhanced gait is supported as the horse provides continual postural challenges in the upright position so that the child has to constantly practice postural control and stabilization.

Further evidence for the effectiveness of hippotherapy includes a study performed by Sterba et al (2003). After 18 weeks of therapy for seventeen patients, the GMFM total score increased by 7.6% while aspects of walking, running, and jumping improved by 8.5%. Importantly, these results remained elevated at 1.8% six weeks after treatment. Sterba et al (2003) concluded that the movement of the horse enhanced the movement of the rider's pelvis such that the rider exhibited a more functional gait. Furthermore, stimulation of the trunk muscles due to the forward and backward rocking motion caused an autonomic reaction in the rider to improve trunk stability and anterior/posterior tilt of the pelvis. However, in the non-ambulatory riders (5 of 17) there was no change in aspects of walking, running, and jumping or other GMFM outcomes. Due to the small subject pool, further studies should be completed to determine if hippotherapy can benefit children with more severe disability [16].

To determine if hippotherapy is a viable option for those with CP, two important studies concluded that hippotherapy may lead to nonspecific functional changes in a short period of time for those with CP similar to other treatment options [14]. In Casady et al (2004) study, there was between 1.0% and 10% change in the total GMFM scores during the 10 weeks of hippotherapy. In comparison, intensive physical therapy for eight months yielded a 4.2 to 6.2% change, Botox treatment caused a 2.3% to 5.1% change after three months of injection, and four months of treadmill training lead to a 5.0 to 14% change [14]. Shurtleff et al (2009) later evaluated if hippotherapy has lasting effects on head/trunk stability as well as upper extremity reaching ability in children with spastic diplegia CP beyond the treatment period. They observed significant changes with head/trunk stability as well as improved reaching efficiency after 12 weeks of treatment [15]. Moreover, these changes were maintained following treatment.

Based on the observations of Shurtleff et al (2009) subjects receiving hippotherapy treatment had a reduction in translation movement of the upper trunk and head, important for visual and vestibular function and stability. Importantly, the rhythmic pattern of the horse allows children with CP to learn to control movement of the trunk and head. Control of the trunk and head most likely contributed to the improved gross motor movement of upper extremities. Future research can help identify the

relationship between head and trunk stability with motor control of upper extremities. If such a relationship exists, vestibular and visual systems should also be improved with head and trunk stability [15]. Understanding the relationship between head/trunk stability with the sensory systems can allow therapists to develop treatments specifically geared to the needs of the patient. Critical to the Schurtleff et al (2009) study is the maintenance of results following treatment, indicating that improvement to trunk stability and upper extremities stretching is not limited to the treatment period. After hippotherapy treatment, children can continue to develop skills with their new confidence and participate in daily activities more frequently.

The Advance of Hippotherapy with Multiple Sclerosis

Like CP, those affected by MS exhibit dysfunctions of visual, somatosensory, and vestibular systems, and thus experience balance and postural instability. Patients with MS often report decreased range of motion, weakness of trunk and lower extremity, spasticity, and fatigue [17]. Poor postural control is often reported in people with MS where the primary mechanisms underlying changes include a slowed somatosenory conduction pathway and failure of central integration pathways [18]. Impairments can include an increased sway, delayed response to disturbances, and a limited ability to deviate from a stable stance. These impairments are likely reasons for increased falls and reduced gait speed in those with MS. Therefore, for functional improvement and to help with activities of daily living, it is essential to improve balance, gait, and falls in people with MS [17].

Hippotherapy can aid in limiting the progression of MS. Treatments have progressed to focus on a goal-oriented approach to help with balance problems and strengthen muscles in individuals with MS. This type of treatment is beneficial because impairments can be improved while allowing for functional recovery in every day life. Hippotherapy provides such a goal-oriented treatment for those with MS. Similar to treatment for CP, the movement of the horse allows for rotation in the pelvis and trunk for gait enhancement and postural stability [17,18]. The three dimensional movement through space provides visual and vestibular cues to help patients develop balance and equilibrium reactions. The therapist can control the speed, direction, and abrupt halts/starts to aid in teaching the patients to stay upright on a surface that moves three dimensionally.

Previous studies, the earliest by Mackay-Lyons et al (1988), examined the effects of hippotherapy on postural sway, gait, and changes in the MS Minimal Record of Disability (MRD) and the Symptom Checklist-90-Revised (SCL-90-R) [19]. Their results showed no significant improvements in the MRD and postural sway assessments, although the subjects reported feeling more functional, whereas the SCL-90-R scale showed improvement during walking. The next researchers to examine the effect of hippotherapy on different physical functions, such as balance, spasticity, strength, coordination, and activities of daily living, demonstrated improvement in ten of the eleven subjects with MS [20]. While hippotherapy affected subjects differently, the most consistent improvement observed among all subjects was in balance [20].

While there is potential for hippotherapy to be beneficial for those with MS, it is unclear how effective hippotherapy is for improving balance and postural stability [21]. Silkwood-Sherer (2007) hypothesized that hippotherapy would allow MS subjects to

improve balance while those not receiving treatment would display no change. Hippotherapy treatment was completed for nine subjects with MS for a 14-week period. Assessment with the BBS and POMA was conducted at 0, 7, and 14 weeks. Silkwood-Sherer (2007) observed statistically significant difference in scores for the BBS and POMA for the intervention group (and not the comparison group), with the biggest difference found between weeks 7 and 14 [21]. Furthermore, there was a statistically significant difference found in week 14 between the two subject groups for the BBS (and not for the POMA). Given these results, hippotherapy shows improvement of balance for those with MS. It will be important to compare techniques normally applied to treatment of MS with hippotherapy for improving postural stability [21].

Conclusion

As provided by the current studies evaluating the effect of hippotherapy on CP and MS, this innovative treatment shows initial validity as a method for improving symptoms related to postural control, balance, and gross motor skills. The movement of the horse effectively mimics the gait of a human; thus, treatment can benefit those affected by postural instability and a dysfunctional gait [18]. As the horse pushes off with the hind leg, the pelvis in concordance with the same side will drop leading to a lateral pelvic tilt in the rider. As the horse continues to step forward, it must laterally flex its spine while providing pelvic rotation for the rider. Upon striking the ground with the hind leg, the horse shifts its center of gravity. The riders must adjust their own center of gravity as they experience a lateral pelvic displacement. Changing the tempo or direction of the horse can enhance these properties and the degree of pelvic challenge. The rider must learn techniques to balance on the horse and hopefully these movement patterns translate to every day life [18].

To further verify hippotherapy as a treatment option, large randomized and controlled trials should be completed with specific protocols to target individualized aspects of the disorders [15]. Homogenous studies including age and severity of the disorder will help generate precise results. For example, a study could evaluate how hippotherapy affects individuals with more severe forms of CP or MS, such as quadriplegic CP or those with severe MS. Other studies could also answer questions about how long treatment is needed to observe functional improvement. Most cases observe patients for 8-10 weeks; however, it would be useful to note changes if the experiment were conducted for a longer period of time. This information would clarify if the effects of hippotherapy reach a plateau after a certain time period or if motor function continually improves. Also important would be to assess if functional outcomes remain after completion of treatment and if longer treatment periods are more successful at maintaining motor skills and postural stability.

Importantly, hippotherapy addresses aspects of motor, visual, tactile, and vestibular systems. Cognitive, communication skills, peer interaction skills, and self-confidence can also improve with the aid of hippotherapy treatment [14,15,18]. Not all therapy techniques can combine all these aspects into one treatment while maintaining the interest of the patient. However, there are certain limitations to hippotherapy that might restrict who can benefit. The rider must be able to sit on the horse. An individual with excessive lower extremity spasticity might not have the ability to sit astride the horse [18]. Thus, it is reasonable to combine different therapy techniques that would a)

allow the patient for some functional improvements in areas of postural stability, reduced spasticity, and motor skills, and then b) use hippotherapy for further treatment to enhance functional improvement and maintain the interest of the patient. Likewise, the tone of muscle in the trunk as well as head stability is important to assess before hippotherapy treatment. The benefits of hippotherapy to produce autonomic postural adjustments are lost when other people are supporting the rider astride the horse [18]. Other factors that would limit a patient from riding the horse include a weight limit, fear of horses/heights, or allergy to the horse dandruff.

After performing studies evaluating the physical effects of hippotherapy, further research can inquire about the outcomes of occupational or speech therapy in conjunction with the horse [14]. If symptoms of CP and MS are improved, then it will also be valuable to examine how hippotherapy affects other neuromuscular disorders such as stroke and traumatic brain injuries.

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