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Gait Training in Children with Cerebral Palsy: Review Article

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Abstract

Objective: The aim of this article is to provide an overview of Cerebral Palsy and to review the most recent advances in clinical and therapeutic gait interventions. In 1860, cerebral palsy, then termed as "cerebral paralysis," was identified by English surgeon William Little. Hypoxia at birth has been suggested as a probable cause of the condition. Cerebral palsy is a frequent cause of disability in children, as it encompasses a range of non-progressive postural and motor dysfunction syndromes. The disease is caused by numerous injuries to diverse regions of the developing neurological system, which explains why clinical findings are so varied **[1]**.

Key Words: *Gait training in children – Cerebral palsy.*

Introduction

CEREBRAL palsy (CP) is a non-progressive injury to the developing brain that results in postural and movement problems. Worldwide, 2 to 2.5 out of every 1000 live births are affected with cerebral palsy. Premature newborns are more likely than full-term babies to become infected **[2]**.

Causes of cerebral palsy:

The etiology is multi factorial and varied. Congenital, genetic, inflammatory, viral, anoxic, traumatic, and metabolic factors all have a role. Prenatal damage accounts for 75-80% of the cases, with major birth trauma or asphyxia accounting for less than 10% of the cases **[3]**.

With modern diagnostic techniques, specific etiologic factor in CP can be identified in no more than 50-75% of all cases. It was reported that 42% rate in CP is of unknown etiology. 36% related to prematurity and 16% to perinatal asphyxia **[4]**.

Intrauterine infections, placental problems, and multiple births are among prenatal risk factors. Infectious diseases, cerebral bleeding, hypoglycemia, and substantial birth asphyxia are among perinatal risk factors. Toxic, infectious meningitis or encephalitis are an examples of postnatal causes **[5]**.

The lesion generated by a brain injury has an effect on the structure and function of the brain. There are several kinds of this lesion, with periventricular leukomalacia (PVL) being the most common. PVL causes weakness, disruption, and the lack of the corticospinal tract (CST) in CP children **[6]**.

Types of cerebral palsy:

Monoplegia, hemiplegia, diaplegia, and triplegia are the topographic classifications for cerebral palsy. In most studies, diaplegia is the result from (30%-40%), hemiplegia from (20%-30%), and quadriplegia from (20%-30%). (10 percent-15 percent). Quadriplegia spastic CP is the most severe form of CP, with spasticity, stiffness affecting both arms and legs and Voluntary movements are limited. Diaplegia spastic CP is a condition in which spasticity occurs largely in the legs. A scissor gait can be caused by tightness in the legs. Hemiplegia spastic CP is the third kind, which affects only one side of the body's arm and leg **[7]**.

Dyskinetic CP, which affects 10-15 percent of children with CP and is characterized by uncontrolled, delayed, and writhing motions, is another form. Drooling and grimacing have been noticed on occasion. Poor coordination and balance issues are noted in ataxic CP, which is present in around 5% of cases. This subtype also has issues with locomotion and fine motor skills **[8]**.

Clinical picture of cerebral palsy:

Spasticity, involuntary movements, unsteady gait, and balance issues are all part of the CP clinical picture, as are neuromuscular dysfunctions

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such as loss of selective motor control and muscle tone disturbance, resulting in an imbalance between agonist and antagonist muscles, coordination problems, sensory alterations, and weakness. It has been suggested that spastic CP dominates the majority of cases, with prevalence rates of approximately 70-77% [8].

The motor disorders of cerebral palsy are often but not always accompanied by disturbances of sensation, cognition, communication, perception, and/or behavior, and/or a seizure disorder [9].

Postural control is a necessary component of a child's motor development. While he is standing still (static balance), when he is moving (dynamic balance), when he is starting a movement, or when he is about to stop a movement [10].

Vision, vestibular, and proprioceptive inputs, central nervous system instructions, and neuromuscular responses, notably muscle strength and reaction time, all play a role in postural regulation [11].

Postural control problems are a key stumbling block to motor development in children with cerebral palsy (CP) [12]. The performance of static and dynamic tasks, such as sitting, standing, and walking, is limited in these children due to postural instability [13].

Assessment of gait:

There are many methods to evaluate gait such as the Pro-Reflex motion analysis system which consists of an 8-meter-long wooden walkway, a three-dimensional infrared camera system with six cameras evenly spaced on both sides of the walkway, and a personal computer with Q-Trace software installed to analyze the motion pattern [14], Three-dimensional gait analysis has the ability to detect pathological alterations in ambulation and can give valuable information about children's gait patterns, assisting clinicians in making the best treatment options , Open circuit indirect calorimeter system which monitors the children's energy consumption with a mask and an open circuit indirect calorimeter device. It is completed with a five-minute walk at the treadmill's running pace at its own walking speeds [15], the Six minute walking test is used to measure changes in the patients' walking ability. The distance travelled by the patient in six minutes was measured in meters [16].

Physical therapy management of children with CP:

The goals of management in children with CP:

It focuses on reducing the impact of impairments and maximizing gross motor performance to prevent disability. Promoting and maintaining musculoskeletal integrity, preventing contractures, increasing range of motion, enhancing function and strengthening the limbs and back, preventing deformities, improving posture and mobility, and improving balance walking ability, and ADL in children with CP are all part of achieving these objectives [17].

Occupational treatment, medicines to manage seizures, surgery to correct anatomical issues, behavioral therapy, speech therapy, communication aids when needed, and collaboration with special educators to improve the school experience are all available for children with CP [18].

Management of gait in children with CP:

To walk normally, the head, upper limb, and trunk should be moving forward through rhythmical and alternative movement of both sides. To maintain gait, increasing the repetitive performance of a step at the same time is important to restore the symmetry of the body [19].

Sideways, forward, and backward walking between parallel bars in front of a large mirror, as well as walking training with a stepper, are all key aspects for balance training. Obstacles such as rolls and wedges are placed across the walking track during gait training in an open manner. Also, walking exercises on various surfaces such as a soft mat, sponge, carpet or hard surface is used [20].

In clinical settings, lateral walking training (LWT) is currently being used by some therapists; however, there are no published data documenting the effectiveness of LWT in patients with cerebral palsy. Lateral walking training is used by orthopedic surgeons and sports therapists for many purposes including its use as a strengthening exercise for the side of the hip and knee muscles, especially the adductors and abductors [21].

Indeed, LWT appears to cultivate greater muscle activity in proportion to effort than forward walking training (FWT) and backward walking training (BWT) suggesting a greater level of energy expenditure. However, while observational studies of FWT and BWT have been performed, no studies have yet examined the effects of LWT training on gait variability [22].

In the absence of biofeedback, individuals often experience difficulties in following the prescribed weight bearing regime. This results in limited therapy compliance in full weight bearing, partial

weight bearing and touch-down weight bearing **[23]**.

Methods for improving gait include neurodevelopment treatment, task-oriented training, virtual reality training, use of treadmill, and Nordic walking training **[24]**.

Treadmill training:

Treadmill training is thought to enhance postural control by allowing for numerous repeats of the stages of the gait cycle in a rhythmic manner, resulting in increased agonist-antagonist muscle harmony and static and dynamic balance. In order to maximize and gait speed, gait training on a treadmill has been utilized in the treatment of children with CP **[25]**.

Treadmill training is thought to help with postural control by allowing for numerous repeats of the phases of the gait cycle in a rhythmic manner, resulting in better control between agonist and antagonist muscles and enhanced functional and cardiorespiratory fitness. CP children have an inverted order of distal and proximal activation, as well as muscle synergies, which impairs responses to disequilibrium **[26]**.

At the lumbar level, treadmill training stimulates central pattern generators (CPGs) in the spinal cord **[27]**. CPGs are brain activations that can create motor patterns and lead to rhythmic, automatic strides, allowing biomechanical components involved in gait, postural control, and balance to be trained **[28]**. The stimulation of gait by treadmill training relies heavily on the activation of these CPGs and automatic reciprocation mechanisms **[29]**.

Types of treadmill training according to Aras et al., (2019):

1- Partial body weight supported treadmill exercises (PBWSTE).

2- Robotic assisted treadmill exercises (RATE).

3-Anti-gravity treadmill exercises (ATE).

Conclusions:

Cerebral palsy is a persistent motor disease that has eluded all attempts to avoid it. The etiology is usually unclear, and preterm is the most prevalent risk factor. Multiple issues and possible disabilities affect children with CP, including mental retardation, epilepsy, eating difficulties, visual, and hearing impairments. The first examination should include a screening for these conditions. Treatment strategy that includes a variety of treatments is ideal for children with CP. This necessitates the delivery of a variety of family-centered services. The management is seeking to promote the children's and families' quality of life. Physicians may organize a complicated care system to the maximum advantage of each child in collaboration with the child, family, and members of a multidisciplinary team. Gait training for children with cerebral palsy who want to improve their balance and postural responses.

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مراجعة منهجية عن تأثير تدريب المشى على الأطفال المصابين بالشلل الدماغى

الهدف من البحث: الهدف من هذه المراجعة المنهجية تقيم فعالية دراسات التدريب على المشى فى حالات الشلل الدماغى.

أسلوب البحث: استخدام الدراسات التى تضمنت تجارب عملية للتدريب على جهاز المشى مع الدعم الجزئى لوزن الجسم فى حالات الشلل الدماغى للأطفال بمراكز المعلو مات:

Pub med , Ovid , Cochrane, Pedro and Google

وتمت مراجعة العناوين والملخصات لاختيار المقالات المتعلقة بالموضوع.

نتائج البحث: تضمنت هذه الدراسة حيث أظهرت النتائج تحسن واضح فى تبكير سن المشى وكذلك تحسن فى أنماط حركة المشى.

توصيات البحث:

١- تطبيق التدريب على المشى باعتباره جزءاً مهماً ينفذ فى وقت مبكر من برنامج العلاج الطبيعى للأطفال المصابين بالشلل الدماغى.

٢- استخدام الممارسة المبنية على البراهين كطريقة لتعلم عملية صنع القرار فى الممارسة العملية فى مجال العلاج الطبيعى للأطفال.

٣- ينبغى أن يكون لاخصائى العلاج الطبيعى للأطفال موقفاً إيجابياً نحو الممارسة التى تستند إلى الادلة والحرص على تعلم وتحسين المهارات اللازمة لتنفيذها.

٤- مزيد من البحوث حول مدى سلامة استخدام التدريب على السير المتحرك لفترات أطول بالنسبة لأولئك العرضون لتشوه المفاصل تكون منهجية ويتم تقييمها بعناية.

٥- ينبغى أن تراعى التجارب العشوائية المحكومة تطبق التدريب ومقيم النتائج قدر الإمكان فى المستقبل.