

Benefits of Early Mobility with an Emphasis on Gait Training

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Ambulation is defined as the ability to walk from place to place, with or without an assistive device. Locomotion is the ability to move from one place to the next. In human development, independent mobility begins with the locomotion of crawling, and progresses to upright ambulation. During typical development, crawling begins at approximately 9 months, and walking begins between 12-18 months of age. When walking begins, a typical infant develops a much stronger engagement with their environment. When an infant becomes upright, they are on the same plane as the rest of the world around them; it allows them better interaction with people and objects in their environment.¹

Benefits of Independent Mobility

The human body is designed to be upright. Our bones, muscles, organs, and nervous system function optimally when upright, either walking or standing. Prior to ambulation, the hip joint is in an anteverted position, and normal hip alignment occurs through the development of gait in the first year of life. The change in the angle and rotation of the femoral head during development occurs with active movement into hip extension and external rotation, as well as through weight bearing. When standing, the changes in hip position better seat the femoral head in the hip joint, resulting in a more stable hip structure.^{2,3}

Weight bearing and gait also provide the needed environment to develop better foot and knee alignment. Being upright and standing prevents contractures and improves range of motion over being seated in a flexed position. Standing has a positive impact on decreasing

the effects of spasticity. This can improve overall alignment and decrease pain.⁴

A lack of weight bearing causes bone mineral density loss, which can result in osteoporosis and risk of fractures. Static loading of the bones is less effective in bone development than dynamic loading. Dynamic weight bearing is a loading and unloading of the skeleton that typically occurs during weight shifting in gait or stand. It is important for weight-bearing activities to be routine and regular, in order to maintain and continue bone growth and development.^{3,4}

When standing, the pelvis moves into increased anterior tilt, and the spine extends. This provides more space throughout the trunk cavity, allowing the internal organs to function better. When upright there is an increase in respiratory volume, improved gastric and bladder emptying, decreased constipation, and improved circulation.⁴

When a person is upright, there is a natural increase in awareness. Being upright stimulates the reticular activating system in the brainstem, and allows more alert and engaged interactions. The reticular activating system is affected by many types of stimuli, especially the vestibular and proprioceptive changes that occur during standing and walking. This increased arousal is greatly beneficial for learning and development throughout childhood.

The benefits of self-locomotion are monumental in a child's psychological, social, and cognitive development. The self-initiated motor experience helps develop central nervous system maturation, foster a new level of self awareness, decrease patterns of attachment to



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caregivers, and increase interactions. This can allow the child to develop a sense of competence and initiative, and give him a new capacity to cope with environmental stresses.

Studies have shown that infants and toddlers who seek out stimulation in their environment at an early age, demonstrate greater cognitive, academic, and neurophysiological performance later in life.³ This may be because young children who can explore and interact within their environment and with others in it, will continue to develop an environment for themselves that will be stimulating, varied, and challenging. Motor interactions allow children to learn about their world, becoming initiators and active participants in life. They learn about their own power and ability to make things happen.

Independent mobility for infants offers a variety of visual benefits. Mobile infants are more aware of events in the distance, because they develop the ability to sense peripheral visual information. Infants who have been moving independently for longer than one month demonstrate an increased fear or wariness of heights.⁵

Development of object-permanence-concepts is a cognitive benefit for mobile infants. To move independently toward a goal, the infant must encounter hidden obstacles. They also develop object lateralization, in which they can locate an object after being turned around, because a mobile infant is better able to identify subtle landmarks in the environment. Mobile infants are also able to visually look toward an object pointed to by someone communicating to them.⁶

When a typically developing infant starts to move through their environment by crawling and walking, parents are happy to see their child move, and are amazed by how their child learned the motor aspects of walking and moving. But so much more is learned when moving through space: the child learns to avoid obstacles, how their environment is mapped out, and how to react when that environment changes. They learn how to use their own power to get what they want, and how to engage others. This learning through movement is difficult to teach. An infant self-learns through a cycle of independent movement, exploration and discovery.

Socio-emotional changes in infants with independent mobility include an increase in a negative response or frustration when a desired object is blocked. When an infant begins to move independently, parents usually begin to expect more of the child, and tend to use more verbal directives. Since a mobile child tends to act more autonomously, the parent begins to make greater demands on the child, which in turn encourages the child to develop further independence.

Implications of Immobility

From birth, an infant is working hard, practicing and developing motor control in preparation to becoming upright and learning to walk. In typical development, this complex task takes just over 12 months. In children with neuromotor dysfunction, development is limited by compensatory movement patterns, decreased stability, increased muscle tone, tightness, and weakness. Children with cerebral palsy often present with increased tone and spasticity, decreased postural and sometimes head control, range of motion limitations, or orthopedic deformities. These impairments may limit typical stepping patterns, the ability to sustain standing without support, and overall endurance and strength to walk without assistance. Children with Down syndrome often present with significant hypotonia, ligamentous laxity, and decreased strength and postural control. Additionally, they often are delayed in learning to walk, and early gait training activities have been proven to reduce this delay.⁷ Children with spina bifida have paralysis (total or partial) below the site of their lesion and rely heavily on their trunk and upper extremities for gait training, often using specialized orthotics.

Young children who have restricted mobility due to neuromuscular disorders often develop a more apathetic behavior with decreased curiosity, initiative, and motivation: the onset of a more passive, dependent lifestyle pattern may begin at their inability to walk by around 12 months of age. It is then valuable to facilitate dynamic weight bearing and walking in children with disabilities as young as 9-12 months of age.

Research has also demonstrated a direct relationship between the level of physical activity in an infant or toddler's life to the achievement of motor milestones. Fostering a greater physical activity level early in life may help prevent chronic diseases and obesity later in life. Infants with Down syndrome who were held by a parent over a treadmill for gait training walked sooner than their peers who did not practice this task.⁷ A study also found that infants with Down syndrome who participated in physical activity through treadmill training appeared better placed on their developmental pathway to becoming more active individuals.⁸ Physical activity may delay the onset of secondary impairments such as obesity, cardiovascular disease and diabetes. When infants with Down syndrome participate in early gait training, they walk sooner and appear to follow through with a more active lifestyle; this increased engagement and activity within their environment may also progress cognitive development.

Children with cerebral palsy who performed 12 weeks of body-weight-supported treadmill gait training showed improvements in standing and walking domains.⁹ Children with spina bifida with thoracic and lumbar level lesions who were trained with early walking had less fractures and pressure sores, greater independence, and better transfer skills as they got older.¹⁰

Given the value of mobility to a child's overall development, encouraging an option of independent mobility is extremely important. Early gait training using the support of a gait trainer works towards the goals of ambulation, standing, weight bearing, improved trunk and head control, increased overall strength, and increased range of motion. Progress in the gait trainer can include increased tolerance to upright weight bearing, increased distance walked, less assistance with walking, or less support needed while walking. The long-term goal is more independent standing and walking.

Studies have proven the physical benefits of early mobility through the use of body-weight-supported gait training over a treadmill. The harness and treadmill system has many benefits, with the overall goal of progressing to on-land

ambulation. The cognitive and social benefits of independent, self-initiated locomotion are added when a child can move themselves over ground throughout their environment and engage with those in it.

Early Gait Training: Therapeutic Models

Within the physical therapy domain, early mobility using a gait trainer can be supported through several rationales. In a standard therapy practice, use of a gait trainer is beneficial because it offers standing and weight bearing opportunities, as well as trunk, head, and lower extremity strengthening. The supportive gait trainer allows the clinician to initiate earlier walking with more involved clients or those requiring more support.

When considering the neurodevelopmental treatment approach (NDT) and the use of a gait trainer early in development, some therapists may argue a hierarchical model should be followed, and the child should focus on developing floor skills, such as creeping, first. But NDT is a living concept and focuses on problem solving: how to best manage a patient as a whole, with the knowledge of typical and atypical development, biomechanics, movement science, and motor learning.² Therefore, a more current NDT treatment philosophy is a 'systems-perspective' that considers the whole child and their functional outcomes. Early use of a gait trainer may be a part of the environment that allows the therapist to best facilitate a child's functional gains. A gait trainer allows increased optimal biomechanical alignment in standing, weight bearing through the lower extremities, and dynamic weight bearing with stepping or weight shifting.

When considering a dynamic systems theory approach, motor learning occurs through movements that include: repetition, a functional context, environmental interaction, goal direction, practice and feedback. With over-ground gait training, one is using practice and repetition by performing the stepping task over and over. This may occur best in an environment in which the child wants to interact, is goal-oriented, and motivated to move. Through supported walking in a gait trainer, a child

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practices a functional task and receives continual feedback on successes from their intrinsic ability to move through space and achieve their goals, and from parent response. There can be transfer of learning, and progression to using less supports or assistance, gaining more independent movement through their environment.

Assistive Technology Options

Assistive devices enable a child to perform a functional task. A walker is an assistive device in which a child supports themselves with their arms for added balance and control while walking. A gait trainer provides greater support for a child who cannot hold onto a walker or stand without support. Gait trainers may give trunk support, as well as more options for arm and leg support.¹¹ Gait trainers are often larger and more stable than walkers. Partial weight-bearing gait trainers are devices that suspend a portion of the person's body weight to facilitate a more normal gait pattern. Many of the partial weight bearing devices are designed for use over a treadmill.

When choosing a walker or a gait trainer, it is important to try several models to determine which is best for the child. There are many options of gait trainers, depending on a child's needs and prognosis. First, consider the amount of support a child needs: do they need trunk support or a head rest; what kind of pelvic support is required? Next, consider how the child will hold onto the device, and in what position: do they need forearm supports? Does the upper body need to angle forward to better facilitate stepping? Leg positioning and tone should be considered as well: is there scissoring or contractures?

Examples of options when using a gait trainer for specific problems or impairments:

- For a child who has increased adductor tone and tends to scissor, ankle prompts or straps that help decrease scissoring may be useful. It is also important to consider what is going on at trunk level, and offer enough support there.
- For a child with decreased head control, consider a gait trainer with a head support. Forearm prompts and trunk support may provide proximal control that can foster head lifting.
- For a child with little strength and endurance, a gait trainer with a seat or saddle can allow brief periods of sitting and rest.
- Some children tend to pull into a strong flexor pattern when using forearm support or a handhold, causing poor posturing and control. These children may benefit from only using a trunk support and saddle.

Treatment Strategies and Equipment Selection

Suggestions for treatment strategies when using gait trainers:

- A gait trainer with a saddle or seat support can be used as a dynamic stander: a child can shift his weight forward and back, and in and out of a standing position.
- Begin by supporting the child's weaker segments, and progress by removing prompts or supports. Weight bearing through forearm supports can help a child gain upper trunk and head control. Overall supports and positioning should provide for optimal biomechanical alignment.
- Make sure the child is bearing enough weight through their feet. The feet should be on the ground and accepting 50 percent or more of the child's weight.
- When facilitating the lower extremities, it helps to get down low and move the child's feet or legs. Look to obtain hip extension in standing and stepping, and the greatest amount of weight bearing with terminal knee extension in midstance. A quick stretch to the hip flexors may help stimulate swing-through.
- As a child's control improves, start removing prompt supports, possibly transforming the gait trainer into a walker-like device.

- Implementing a forward-lean of the child in the gait trainer may help to stimulate a stepping reflex and provide a quicker stretch to the hip flexors. But the goal is to progress to upright walking.
- The specific configuration of the gait trainer may provide the child better access to their environment. For example, a young girl uses her Rifton Pacer in the reverse configuration with only the Chest Prompt when she wants to access the play kitchen or computer. In this way she can reach the items, engage and interact.

Guidelines for Using a Gait Trainer

A gait trainer is a piece of medical equipment and should be handled and considered carefully and with caution. The child should be medically cleared to be upright, bear weight, and use a gait trainer. A therapist should prescribe and instruct the family in the use of the child's gait trainer. Families and therapists should always monitor a young child for changes in status during gait training (i.e. discomfort, breathing difficulties, or seizures, and overall activity tolerance). It should also be emphasized that no matter how advantageous a gait trainer is for an infant or toddler, it remains a treatment option. The use of a gait trainer is one piece of an entire treatment regimen for a child that could include developing floor mobility, transitional skills and improved overall trunk and head control.

Generally, a therapist should help set up the gait trainer and fit it to the child, instructing the parents in how to put the child in the gait trainer and how to best facilitate stepping or standing. It is often beneficial to have a parent practice these techniques with the therapist. Some simple positioning advice is to avoid areas of excessive pressure (for example, no hanging by the armpits) and to always consider optimal alignment, limiting excessive lower extremity flexion.

Parents should also realize that although a gait trainer is very beneficial for their child, it is important for infants and toddlers to be encouraged to play on the floor. This is simply part

of their natural environment and can provide opportunity for activation of muscle groups that are important for motor skills development. And when offering an infant or toddler a new-found mobility through a gait trainer, the child must always be supervised for safety by an adult. Homes and areas where the gait trainer is used should be childproofed as is done for typical infants (i.e. stairs and other household dangers).

The gait trainer provides an environment by which an infant may gain strength and ambulation skills, but this physical activity must be combined with engaging the child in their typical environment. Do not fatigue the child or use the gait trainer as an extended positioning device. The ideal training occurs within the child's natural environment and activities, so have the child walk in the gait trainer when he would typically walk: from his room to the kitchen for a meal, or to play a game with a sibling. The strength and stamina developed through these opportunities may enhance core muscle activation that can carry over into other developmental motor skills such as transitional movements and floor play.

Conclusion

The importance of mobility in early childhood is self-initiated exploration. When considering independent mobility, the best option is truly many options. Depending on the environment, a child may explore more independently with different degrees of assistance. For example, in his room he may explore best by combat crawling to objects on the ground. Throughout the rest of the house or classroom, he may interact better with objects and people while in his gait trainer. In school or outdoors he might interact best while seated in a power wheelchair, because he can cover more distance with less difficulty. For yet another child, a gait trainer may be the only means that makes any independent mobility possible.

The use of a gait trainer is a key addition to a young child's mobility options. A child who accomplishes independent gait mobility has a changed perspective of the world. In many cases, the world's perception of them changes as well.

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Mobility learned in one context, such as in the home, will transfer to other environs, promoting a dynamic interaction with their world.

Early gait training can help a child progress through the typical developmental stages of exploratory movement to locomotion to ambulation. The physical benefits of strength gains, joint range of motion, neuromotor development, and respiratory or cardiovascular benefit, are yet to be fully explored and hold promise for the child's motor and health development. Enabling an infant or toddler to move while upright is not only important for their physical advancements: the cognitive, social, and emotional benefits are vital for overall development as well. Early mobility through the appropriate use of a gait trainer can be very advantageous, allowing for gains on many levels.

Benefits of Early Gait Training

- Promotes joint and bone development
- Prevents contractures and increases motion
- Improves lung function
- Better bowel and bladder function
- Better circulation
- Decreased constipation
- Decreased spasticity
- Lower risk of pressure sores
- Improved cognition growth with environmental exploration
- Improved visual awareness
- Improved socio-emotional and psychological aspects
- Promotes a more active lifestyle

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