

Physical Therapy

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Muscle tone and Hypotonia

All of the muscles in our bodies have a resting muscle tone. Muscle tone is a muscle's potential ability to respond or counter an outside force, a stretch, or a change in direction of the muscle. Muscle tone is involuntary and directly related to a child's inherent neural wiring in which the brain perceives the positions of the muscles. With an intact neuromuscular system, the muscles can adjust to immediate postural or limb changes and maintain a child's posture or arm and leg position upright against gravity.

Appropriate muscle tone enables a child to respond quickly to an outside force either through balance responses/righting reactions or protective reactions. It also allows a child's muscles to quickly relax once the perceived change is gone. A child with hypotonia has muscles that are slow to initiate a contraction against an outside force, and also cannot sustain a muscle contraction as long. In other words, the muscles "relax" quicker despite that the outside force may still be present. Muscle strength is different in that it increases with voluntary repetitions of movement (e.g. 10 repetitions of biceps curls). Muscle tone improves with a more comprehensive treatment approach directed to increase the "alert state" of the muscles themselves.

Hypotonia or low muscle tone can be based in the muscles themselves or within the central nervous system. If the low muscle tone is derived from the muscles (e.g. muscular dystrophy), then there is a dysfunction within the muscles. The receptors within the muscles are not getting the proper signal to the brain to alert the child's system of changes in position. If the hypotonia is based within the central nervous system, complex feedback loops of sensory processing and motor output are implicated. There are often sensory processing deficits (vestibular, proprioceptive and tactile) that are not alerting the brain of changes in body position. Also, the child may have a praxis or motor planning deficit in which the child's body cannot formulate the proper motor response.

A child with hypotonia may have mild and benign developmental delays or could potentially have a serious muscular, genetic or neurological illness. Regardless of the cause, these children are at risk for developing poor balance and coordination, permanent orthopedic abnormalities, learning disabilities, and language delays. The most appropriate treatment for a child with hypotonia is immediate early intervention and therapy.

An infant with hypotonia may have poor head control and resist propping on their tummies when awake. Babies will often seem to “slip out of your hands” and have trouble “stiffening” their bodies when you carry them. When lying on their backs, babies with hypotonia will often rest with their arms and legs extended outward and sometimes resist bearing weight on their feet when held upright on your legs. Younger children with hypotonia may tend to lean excessively forward when they are sitting up. Older toddlers and children will tend to “W-sit” to reduce the challenge to their postural muscles.

Children with low muscle tone may have difficulty learning to roll, sit, crawl and walk independently. Because these gross motor skills are the building blocks for later higher level gross and fine motor skills, it is recommended that children receive therapy to facilitate appropriate motor development. Muscle tone improves with a comprehensive treatment approach to improve postural control and address issues within the nervous system that help the brain perceive where the body is in space. Therapy often focuses on improving the delayed postural responses and protective reactions that are typical in children with hypotonia. Therapy will also focus on improving sensory processing in order to improve body awareness, balance and motor planning. Because low muscle tone is also associated with laxity or looseness in a child’s ligaments, therapy also aims to improve overall muscle strength to increase the support around the joints in the arms and legs. If you have any further questions about hypotonia, please do not hesitate to contact us for a consultation or physical therapy screening to determine whether your child will benefit from therapy.

Torticollis: Implications for Physical Therapy

Torticollis is a condition in which a baby’s neck muscles are tight, weak, or a combination of both. Babies with torticollis often have poor head control and delayed gross motor skills. The primary treatment for babies with torticollis is a comprehensive program designed by a skilled pediatric physical therapist. Physical therapy treatment is essential in order to avoid surgical intervention, and/or several long-term effects that torticollis will have if untreated (see below). The word torticollis means “wryneck” in Latin. An infant or baby with torticollis will typically tilt their head/neck one way, and look the opposite direction.

There are two very different types of torticollis: congenital muscular torticollis (CMT) and acquired torticollis. CMT is caused directly by a tightness and weakness of the neck muscles. The tightness is likely a result of damage to the muscles in utero, or at some point during the delivery process. The sternocleidomastoid muscle is typically the primary muscle injured. When the muscle(s) heals, it also shortens – just like a scar that heals and tightens the skin in and around the scar. CMT is typically noticed when the infant is 2-3 weeks old - when the healing process of the damaged muscle(s) is complete. A small percentage of babies (8-10%) with CMT also have developmental dysplasia of the hip.

Acquired torticollis is characterized by the same neck posture, however, the neck tightness and weakness are secondary to something else. Potential causes of acquired torticollis include: an ocular muscle impairment, a bony abnormality of the neck or spine, poor head control or muscle imbalance from a neurological impairment, or neck posturing to decrease esophageal pain and inflammation caused by gastroesophageal reflux disorder. The onset of neck position varies depending on the primary cause.

A Total Approach offers a unique physical therapy evaluation and individualized treatment program for an infant or baby with torticollis. The evaluation includes the assessment of neck flexibility and strength; comprehensive assessment of arm, leg and trunk flexibility and strength; and the assessment of gross motor skill development. Without proper evaluation and early intervention, an infant or baby with torticollis is at risk for developing permanent long-term effects.

Babies with torticollis have limited neck range of motion that, unless treated appropriately will result in a permanent loss of flexibility. Additionally, where there is tightness in muscles, there is always weakness. The weak neck muscles result in poor head control, and difficulty assuming upright and/or prone (belly) positions that are integral in the development of gross and fine motor skills. Babies may also develop a significant muscle strength imbalance that can cause an arm preference, or a preference for attending to one side of the body more than the other. A muscle strength imbalance will have immediate implications for a baby's development of proper reaching, rolling, sitting, crawling and walking skills. A muscle strength imbalance can have later implications that impact higher-level balance and bilateral coordination skills. Babies with torticollis could also develop a permanent flattening of the head on one side and/or asymmetrical facial features.

A skilled pediatric physical therapist will assist the family in carrying out appropriate flexibility and strengthening exercises. Treatment often includes myofascial release techniques in the neck and shoulder area, and/or transverse friction massage to the injured muscle itself in conjunction with proper stretches. Strengthening exercises for infants and babies include the facilitation of appropriate head control, arm strength, and gross motor skill facilitation. Physical therapy will also focus on positioning the baby for play, including techniques for increasing tummy time, and positions to prevent flattening of the head.

At times a baby's primary physician will recommend a consultation with additional medical specialists, including pediatric orthopedists, orthopedic surgeons, ophthalmologists, neurologists, gastrointestinal physicians, and/or orthotists. Please consult your doctor or physical therapist with any further questions.

Toe Walking: Implications for Therapy

Toe walking is commonly observed in all children up to 2 years of age as they learn to navigate, explore and manage their environment in a dynamic upright position. When toe walking is either observed consistently or beyond the age of 2-3 years, it could implicate a neurological illness, a muscular illness, a congenital heel cord contracture (tightness) or a sensory processing deficit.

Children who walk on their toes either have existing muscle tightness or develop tightness/contractures in their ankle muscles. This tightness could lead to serious injury. Toe walking changes the position of each joint in the legs (ankles, knees, hips) and could also lead to additional orthopedic deformity. In order to perform motor skills appropriately, children require a balance of the muscles that flex and extend their bodies. This provides them with a stable base of support for movement. Children who toe walk often develop an imbalance in their flexion and extension muscles and therefore may have poor motor control, balance and coordination. This can also potentially impact further higher level motor skill development. It is essential to determine the underlying cause(s) for toe walking in order to implement the appropriate treatment.

Three of the less common, but clearly understood causes of pediatric toe walking are congenital heel cord tightness, central nervous system damage or paralytic muscle disease. In the first case, the toe walking is caused by inherently tight ankle muscles. In the second case, toe walking is caused by spastic gastrocnemius and soleus (heel cord) muscles in a child's calf that result from an injury to the brain or the part of the spinal cord that contains fibers from the motor cortex in the brain. Infants and young children with an injury to the central nervous system by either a lack of oxygen or bleeding in the brain are diagnosed with cerebral palsy. Depending on the extent and nature of the injury, these children will end up with spasticity in their antigravity muscles, including the muscles that plantar flex the foot (point the toes downward). This results in a toe walking gait.

Children with Duchene's muscular dystrophy also have the tendency to walk on their toes. This results from the pattern of muscle fibrosis that occurs in the children's lower extremities. As their muscles become fibrotic, there develops an imbalance of muscle strength at the knee and ankle. The children lose strength in their quadriceps femoris muscles which makes it harder for them to keep their knees straight. When they stand on their toes, it makes it easier to do so. Also, the strength of the muscles around the ankles becomes disproportionate, and as a result the relatively stronger plantar flexors cause the children to go up on their toes.

Finally, the majority of children who walk on their toes are said to have what is termed in the medical community as "habitual" toe walking, or idiopathic (def. having no known cause) toe walking. This term does not implicate a disease or dysfunction underlying the atypical gait. There are a small number of children who habitually walk on their toes and have no other significant deficits. These children will often develop a typical heel-toe gait with verbal instruction and reminding to walk with their feet flat.

However, habitual toe walking is often related to a vestibular-visual dysfunction. Children with sensory processing disorders and autism are often observed walking on their toes.

Toe has been qualitatively linked to a vestibular deficit alone in some children. In this situation, a rigorous vestibular program alone can help a child walk with a typical heel-toe gait. The vestibular mechanism in the inner ear receives information from sensory receptors in different parts of the body to gain an accurate picture of the child's position in space. It receives information from the eyes, neck and shoulders, fingertips and palms, jaw muscles, the front part of the tongue, and the soles of the feet. Children with poor vestibular processing are often observed running their hands along the walls, chairs, etc. in an effort to increase the information being sent to the vestibular system. In a similar effort, these children will also toe walk. Theoretically, this increases the child's ability to perceive where they are in space.

A number of medical professionals attribute toe walking to possibly either a vestibular dysfunction or a visual-vestibular dysfunction. There is a great deal of qualitative research in which children have undergone prism work with a developmental optometrist and subsequently stopped toe walking. It has been shown that children can have an anterior visual shift in midline in which the child perceives the center of their body to be more forward in space than it actually is. From that standpoint, it can be theorized that a child may perceive that the floor is sloping downward and so the child will walk on their toes to "keep from falling forward." Additionally, a study entitled "When is Vestibular Information Important during Walking?" in *The Journal of Neurophysiology* (April 2004) was able to conclude that changes were noted in foot placement during typical heel-toe gait when vestibular stimulation was administered. The study states that (appropriate) walking is clearly dependent on visual, vestibular and somatosensory (light and deep touch) information together.

It is essential that a child receive a thorough neuromuscular examination to assess a potential underlying cause. This will enable a child to receive appropriate treatment for their atypical gait, and ensure that the child does not have additional impairments (habitual toe walking has also been linked to language delays often not picked up until later in the child's development). Depending on the cause, appropriate treatment may include physical therapy, occupational therapy, and possible intervention by a pediatric orthopedist and/or orthotist. Therapy will address muscle tightness, weakness, muscle imbalances, the need for orthotic intervention, and deficits in sensory processing, balance and coordination. If you have any further questions, or would like to arrange an evaluation, please contact us.