Early Onset Toe-Walking in Toddlers: A Cause for Concern?

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Clinical Presentation

Dr Billiaux

A child was born to non-consanguineous, healthy parents. Pregnancy and delivery were uneventful. At 17 months, he was seen by the pediatric emergency department because of mild cranial trauma, and clinical examination disclosed a small parietal hematoma. Neurologic examination was normal, except for a bilateral equinus foot position at rest (Figure) and toe-walking (Video 1; available at www.jpeds.com). Passive ankle dorsiflexion was limited to less than 10 degrees and was painful. His gait had a toe-to-toe pattern, and he was unable to rock back into a flat-foot position when cued. The rest of the physical examination results were normal, including normal strength and normal psychomotor development. His parents said he had a flat-foot position at the beginning stage of walking independently (15 months) and then progressively shifted to tip-toe. The family history was negative for toe-walking.

Dr Morin

The range of normal gait patterns in the 1- to 3-year-old child is broad. Initial gait may be toe-to-toe or flat-foot to flat-foot, and it is typically wide-based. Persistence of toe walking after the age of 2 years and asymmetrical patterns should be further investigated.1

Dr Billiaux

Clinical examination at 25 months showed a persistent tip-toe gait (Video 2; available at www.jpeds.com) with triceps contractures. Standard blood test results and creatine kinase levels were normal. Electromyelography testing showed no myopathic potentials or early recruitment. Nerve conduction velocities were normal. Brain and spinal cord magnetic resonance imaging results were normal.

Clinical Discussion

Dr Auvin

Toe walking has multiple causes, ranging from idiopathic to profound neuromuscular disease (Table). A common cause of toe walking is muscle spasticity. Spasticity results from damage of the corticospinal tract at any level from the motor cortex to the spinal motor neuron. The most common cause of spasticity is cerebral palsy, which frequently is due to perinatal brain injury. It can also be caused by cerebral vascular accidents later in infancy. The mechanism for toe walking is spastic contracture of the heel cord. Muscles that are more spastic grow less than muscles that are less spastic. If the gastrocnemius and soleus (the triceps surae) are excessively spastic, a fixed equinus develops.

Other neuromuscular diseases should be ruled out such as muscular dystrophy (eg, Duchenne) and congenital myopathies.2 Toe walking in muscle disease is caused by the replacement of muscle by fibrous tissue as the muscle deteriorates. All muscles are involved, but plantar flexors remain stronger than dorsiflexors, favoring the development of equinus and toe-walking. Correct diagnosis in many patients with neuromuscular disease is delayed because of the failure of practitioners to recognize the importance of the early gait abnormality. Although most parents want to know if there is something wrong with their child as soon as possible, the time between initial parental concern and final diagnosis is 2 to 5 years.3

In rare cases, toe-walking results from peripheral neuropathies (hereditary sensorimotor neuropathies) or focal dystonia.4 A toe-walking pattern may be also observed in children with autism. In a recent study, 19% of children diagnosed as suffering from autism spectrum disorders exhibited toe-walking for a minimum of 6 months.5 All of them walked on their toes only intermittently, and reduced ankle mobility was relatively rare. Interestingly, most of the parents perceived the toe-walking of their children as being a behavioral, rather than a physical disability. The most benign condition is idiopathic toe walking (ITW).6 ITW first appears in a toddler as walking begins: many children start out on their toes and most give up this pattern.

Dr Mercier

To help distinguish among these entities, asking about tip-toe onset might be of help. Early-onset tip-toe walking occurs within 3 months of the initial onset of ambulation. The 2 most common causes are spastic diplegic cerebral palsy and ITW. The latter is always bilateral, usually symmetrical and intermittent. Late-onset tip-toe gait is virtually always due to some neuromuscular disease. The most valuable diagnostic procedure is physical examination. For a patient with suspected idiopathic toe walking, the examination should be directed to rule out all other causes. To rule out nonidiopathic...
Assessing the extension of the knee with the hip extended and then flexed separates primary knee pathology from hamstring contracture. Assessing ankle dorsiflexion with the knee flexed and then extended separates the effects of the soleus muscle from the gastrocnemius. Inability to passively dorsiflex more than 10 degrees is abnormal and will interfere with gait. The foot examination may reveal cavus deformity or claw toes, suggesting a neurologic cause. Abnormal results of neurologic examination of the deep tendon, abdominal, plantar, and stretch reflexes may also orient diagnosis toward a central or peripheral nervous system disorder. Physical examination should include foot performance during walking, sitting, standing, and squatting to differentiate static and dynamic performances. Walking performance should be evaluated in various conditions, such as walking straight, walking sideways, and walking with and without assistance to monitor balance development. A more detailed evaluation of gait may include a full 3-dimensional gait analysis or a simple observational assessment. In general, under the age of 3 years, a video recording and spatial-temporal parameters are obtained. This examination can be complemented by dynamic electromyography. Although instrumented gait analysis alone does not permit the diagnosis of the cause of toe-walking, it provides precious information about stability, symmetry, and muscular activity. A pattern of toe-to-toe gait that is variable, which can be modified under demand and shows symmetry, good balance, and phasic muscular activity, is probably idiopathic rather than of neurologic origin. The difference between dynamic and fixed muscular contractures can be determined by physical examination and is important to indicate appropriate treatment. Clinical follow-up of these patients is crucial to detect any neurodevelopmental anomaly.

Dr Pernet
This child had a normal neurologic examination result, with the exception of severe limitations in ankle dorsiflexion and bilateral, symmetric toe-walking. A presumptive diagnosis of ITW was made. Conservative treatment was proposed between the ages of 17 months and 25 months. It consisted of stretching exercises of the plantar flexors and night splinting. We did not notice any improvement in his gait at 25 months. Serial casting was then proposed to correct triceps surae contractures.

Figure. Patient’s bilateral equinus foot A, at rest and at the ages of B, 17 and C, 25 months.

Table. Main etiologies of toe-walking in children

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<th><strong>Neuromuscular disorders</strong></th>
<th><strong>Central Nervous system</strong></th>
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<td>Cerebral palsy (perinatal injury, brain malformation, vascular accident)</td>
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<td>Spinal cord abnormalities (congenital, traumatic, acquired)</td>
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<td>Dystonia (usually asymmetrical)</td>
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<td>Peripheral Nervous system</td>
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<td>Peripheral neuropathy (HMSNs)</td>
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<th><strong>Paralytic Muscle disease</strong></th>
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<td>Congenital myopathy</td>
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<th><strong>Behavioral disorders</strong></th>
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| **Idiopathic** |
Dr Titomanlio

Conservative treatment of ITW usually includes observation, stretching, casting, and orthotics. The patient should be regularly monitored: if progressive heel-cord dynamic contractures are detected or do not resolve by the age of 2 to 3 years, stretching of the triceps should be considered. Serial casting has proven to be effective in gaining length of the triceps surae muscle. The child was placed in below-the-knee fiberglass walking casts. Casts were combined with knee immobilizers of night to maintain gastrocnemius stretching. Casts were changed weekly to progressively increase the range of ankle dorsiflexion. At age 3, fixed ankle contractures were persistent, and muscular stretching was painful. Amantadine was tried, considering the possibility of a dystonic toe-walking, but it had no influence on child’s gait. A local botulinum toxin type A injection was also performed, without any significant improvement on toe-walking pattern. We therefore considered operative lengthening of the gastrocnemius by aponeurotomy. After this procedure, the patient was unable to walk on his toes and run flat-footed. The gastrocnemius and the soleus regained strength slowly over the subsequent months. At the last follow-up, this 4-year-old child walked and ran normally.

Discussion

Dr Titomanlio

ITW is often a diagnosis of exclusion, bearing in mind that it can be observed in association with delays in acquisition of motor or language milestones, thus representing a soft sign of a more global neurodevelopmental condition. Close follow-up of patients with ITW is indeed mandatory.

Most children diagnosed with probable ITW do not require complementary tests except serum creatine kinase. Spinal magnetic resonance imaging can detect a tethered cord or syringomyelia, which can be difficult to diagnose in toddlers by neurologic examination alone. The choice of investigations should therefore be tailored to each child. Electromyography may be performed if a family history or clinical symptoms (absence of reflexes) are suggestive of hereditary sensorimotor neuropathies.

With respect to the efficacy of treatments for ITW, improvement has been reported with exercises, serial casting, and surgery, but comparisons across studies are difficult because of differences in evaluation criteria. Clinical prognosis of children with ITW is still unclear. In a long-term follow-up study of 14 children with ITW, only 3 previous toe walkers still exhibited toe-walking after several years. In a larger series of patients toe-walking persisted at follow-up. In more detail, gait was normal in 6%, improved in 45%, and unchanged in 49% of patients from the observation group, whereas in the surgical group (Achilles tendon lengthening) 22% walked normally, 50% had improved, 26% were unchanged, and 2% had deteriorated. Other studies have also found a better outcome after surgery for lengthening of the Achilles tendon. A conservative treatment might be proposed for all children with ITW until the age of 2 to 3 years. Surgical treatment by Achilles tendon lengthening or gastrocnemius recession by aponeurotomy should be considered for cases with a severe fixed contracture of the triceps surae. Patients with ITW who have spontaneously discontinued toe walking or who, after treatment, remain down on their heels for more than 1 year can be considered as cured.

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