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Idiopathic Toe Walking

İdiopatik Parmak Ucunda Yürüme

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ABSTRACT Toe walking is defined as the absence or inadequacy of heel contact at the first contact of the foot and during walking. Although toe walking can also be seen in neurological and neuromuscular diseases such as cerebral palsy, muscular dystrophy and autism, there is often no pathology to cause. Other diseases that may cause this condition should be excluded for the diagnosis of idiopathic toe walking (ITW). ITW had seemed in about one in 20 children. In children walking on the toes, balance disorders, frequent falls, pain, fatigue are observed and ankle sprain may occur. A careful history, physical examination, and in some cases, diagnostic tests can help classify the type of toe walking and determine the most appropriate treatment. Studies showing long-term follow-up results are limited. Many treatment methods such as follow-up, physical therapy, stretching, casting, orthoses, botulinum toxin injections and surgery have been used.

Keywords: Toe walking; cerebral palsy; idiopathic

ÖZET Parmak ucunda yürüme, ayağın ilk temasında ve yürüme sırasında topuk temasının olmaması veya yetersizliği olarak tanımlanır. Parmak ucunda yürüme, serebral palsi, kas distrofisi ve otizm gibi nörolojik ve nöromusküler hastalıklarda da görülebilmesine rağmen genellikle neden olacak bir patoloji yoktur. İdiopatik parmak ucu yürümesi [idiopathic toe walking (ITW)] tanısı için bu duruma neden olabilecek diğer hastalıklar dışlanmalıdır. ITW, yaklaşık 20 çocuktan 1'inde görünmektedir. Parmak ucunda yürüyen çocuklarda denge bozuklukları, sık düşme, ağrı, yorgunluk ve ayak bileği burkulması meydana gelebilir. Dikkatli bir öykü, fizik muayene ve bazı durumlarda tanısal testler, parmak ucu yürüme tipini sınıflandırmaya ve en uygun tedaviyi belirlemeye yardımcı olabilir. Uzun dönemli takip sonuçlarını gösteren çalışmalar sınırlıdır. Tedavide takip, fizik tedavi, germe, alçılama, ortez, botulinum toksin enjeksiyonları ve cerrahi gibi birçok yöntem kullanılmıştır.

Anahtar Kelimeler: Parmak ucunda yürüme; serebral palsi; idiopatik

Children learn how to walk in several stages. Children who are newly learning how to walk, initially walk by clinging to furniture. Over time, they begin the walking process consisting of three different stages. They make a heel hit first, then a middle foot contact and a toe contact. During this development, some children walk on their toes. Moreover toe walking is not a stage in the development of walking of all children. In fact, toe walking in motor development for healthy children is defined as a normal variant up to 18 months, 2.5 or even 7 years old by some authors.[1-3] Toe walking is defined as the absence or inadequacy of heel contact at the first contact of the foot and during walking.[3] Although toe walking can also be seen in neurological and neuromuscular diseases such as cerebral palsy, muscular dystrophy and autism, there is often no pathology to cause. All causes that may cause toe walking are shown in Table 1.

Idiopathic toe walking (ITW) was first described in 1967 as a congenital short tendocalcanous. Today, it is defined as ITW or habitual toe walking.[4] Other diseases that may cause this condition should be excluded for the diagnosis of ITW. ITW is frequently

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TABLE 1: Causes of toe walking.[2,8]

Neurologic/neuromuscular	Other
Cerebral palsy	Idiopathic
Muscular dystrophy	Congenital or posttraumatic limb-length discrepancy
Autism spectrum disorder	Clubfoot
Charcot-Marie-Tooth disease	Tendon or joint contracture
Spinal cord or brain injury	Ankylosing spondylitis
Tethered cord syndrome	Unilateral hip dislocation
Spina bifida	Plantar foot injuries
Schizophrenia	Global developmental delay
Transient dystonic reaction	Venous malformation of the posterior calf muscle

seen in pediatrics, neurology, orthopedics and physical medicine and rehabilitation clinics. In some cases, it is only a cosmetic concern, while in others, foot and ankle pain can cause psychological stress for children and families due to the increase in energy consumption when compensatory walking disorder occurs. In a small cross-sectional study, ITW had seemed in about one in 20 children.[3] While the frequency of ITW occurrence in normally developing children in the 5.5 age group is 2%, in another study the incidence is 41% in children with neurological or developmental retardation.[5] Spontaneous regression occurs in nearly 70% of these cases within six months from the start of the ITW.[6] Approximately 30% of patients have a family history. It is more common in boys than girls. In a study, 43% of familial ITW cases were seen in boys, while this rate was found as 13% in girls.[6] ITW can often be a habit, so they can achieve a heel strike when patients are asked or reminded to walk properly. With ITW, there may be differences in management functions, social skills, learning and memory, motor control, sensory development and delay in speech/language functions according to children with normal walking function.[2] Children with ITW usually walk at the normal walking age. ITW is noticeable when families compare their children with their peers when children start walking. Children with ITW stand by maintaining full base contact and a heel strike occurs in 15-92%. Also, while these children voluntarily perform heel strikes, non-idiopathic ones cannot perform heel strikes. In patients with neuromuscular disease, such as cerebral palsy, toe walking is seen initially or later, while ITW is observed when children first learn to walk. In a cohort study, 12% of the patients with ITW spontaneously recovered at the age of 3 years, while in other cases, spontaneous improvement was not detected.[7]

In children walking on the toes, balance disorders, frequent falls, pain, fatigue are observed and ankle sprain may occur. Step lenght decreases and while energy consumption increases due to increased cadence, they make a less effective walk. Muscle cramps may occur due to overuse of the musculus gastrosoleus. Over time, the pressure on the metatarsal heads leads to pain, callus, stress fractures and difficulty in wearing shoes.[2] A careful history, physical examination, and in some cases, diagnostic tests can help classify the type of toe walking and determine the most appropriate treatment.

HISTORY

The family's anxieties, the child's pain, impaired function, and whether there is a social or cosmetic problem should be questioned. The child's birth story, the development stages of motor and cognitive functions should be noted. In order to differentiate the idiopathic or neuromuscular causes, the child's first time to walk and toe walking time, past medical, surgical, and especially detailed family history should be taken. Improvement over time, prior treatments and effects should be questioned.[2]

EXAMINATION

If possible, the examination should start with the assessment of the gait when children enters the examination room for the first time. Because when children

are told to walk and observe, they can try to correct their walking, and misjudgment can be made. First of all, they should be asked to walk naturally and then make a heel strike. This examination should be done with shoes and bare feet when walking from the front, back and side. From the beginning of the stance phase, heel stroke should be observed and the degree of equinus should be estimated. The dorsiflexion angles of the ankle should be evaluated in the swing phase. During walking, hip and knee joint movements should be examined. If toe walking is unilateral, it should be evaluated for neuromuscular disease such as hemiplegia or hip dislocation. Observing the movements of the upper limb during walking or running, gives important information in terms of cerebral palsy.[2,8] It is necessary to check whether there is heel contact with the floor during standing. While standing, leg length should be examined by evaluating the pelvic symmetry. If asymmetry is detected in the pelvis, it should be evaluated whether the asymmetry has improved by placing an elevation under the short leg. Muscle atrophies, clubfood are generally seen in cerebral palsy and spinal cord injuries, and calf hypertrophy in muscular dystrophies. Muscle atrophies, clubfood are generally seen in cerebral palsy and spinal cord injuries, while calf hypertrophy is seen in muscular dystrophies.[2,8] In supine position, hip, knee, ankle and subtalar joint range of motion should be evaluated. With the Silverskiold test, it should be distinguished whether the limitation originates only from gastrocnemius or both gastrocnemius and soleus. Normal dorsiflexion angle is 25 degrees in women and 23 degrees in men between the ages of 2-4. As age increases, the angle decreases and becomes 14 degrees in young girls and 13 degrees in boys.[2] In the prone position, internal and external rotation of the hip, presence of femoral anteversion, tibial torsion are evaluated. Although rotational deformities are mostly seen in neuromuscular diseases such as cerebral palsy, external tibial torsion can also be seen on toe walking. Ligament laxity, skin thickening and edema, shoe deformities should be evaluated.

A complete neurological examination should be performed, consisting of special tests such as sensation, muscle strength, deep tendon reflexes, pathological reflexes and govers test.

Laboratory stuedies and radiological evaluations can be used to differentiate idiopathic and pathological toe walking. If muscular dystrophy or myopathy is considered, the patient may undergo a simple blood test, such as creatine kinase, and a muscle biopsy. Foot-ankle radiography can only be useful in rigid equinus deformity. Gait analysis or electromyography can only be used in cases where ITW and pathological fingertip walking are indifferentiable. Brain and spinal cord magnetic resonance imaging may be ordered if there are abnormal neurological examination findings.

TREATMENT

Studies showing long-term follow-up results are limited. Many treatment methods such as follow-up, physical therapy, stretching, casting, orthoses, botulinum toxin injections and surgery have been used. It has been observed that verbal cueing is not very useful. With verbal cueings, children do only a few steps of the heel strike and then walk again at their toe. In recent studies, it is seen that in 45% of children with ITW who are not actively treated, toe walking can be permanent.[9] In the physical therapy program, stretching exercises for the ankle plantar flexors, strengthening exercises for the tibialis anterior and other lower extremity and trunk muscles are applied. In addition, taping, biofeedback, neuromuscular electrical stimulation, manual therapy, ankle joint mobilization, orthotic interventions, walking training, treadmill training, motor sensory training, night splinting, shoe modifications, serial casting and home exercises are also performed.[10,11] In physical therapy, stretching exercises are started to prevent the achilles contracture caused by ITW. Orthosis and night splints are used to support the achilles tendon insufficient plantar flexion during stretching and walking. The use of Hinged Ankle foot orthoses (AFOs) is recommended for children who continue to walk on the toe despite having sufficient passive ankle dorsiflexion range to support heel strike and normal first, second and third rockers.[10] A study comparing an articulated ankle-foot orthosis with a rigid carbon fiber foot plate attached to the foot orthosis in children with ITW with walking control suggests that sequential orthosis therapy may be beneficial. Initial treatment may

involve a less restrictive orthosis such as a foot orthosis. If this fails within a given time frame, the patient may require a more restrictive form of treatment such as AFO.[12] In children with severe dorsiflexion contracture, stretching to the gastrosoleus muscle group is achieved with under-knee cast.[8] Short leg cast can be used for 4-6 weeks for maximum dorsiflexion. With the casting, we provide the child to perform a heel strike, while we provide continuous stretching on the achilles tendon. The plaster should be re-applied according to the dorsiflexion angle change with an interval of 1-2 weeks. However, there is no need for cast exchange in children without a achilles contracture. After casting, the treatment program includes passive stretching, dorsiflexor strengthening exercises, and active exercises of the plantar flexors. Dorsiflexion-supported AFOs are sometimes used to achieve heel-to-toe gait patterns.[10,13] Also, it is aimed to increase the ankle dorsiflexion angle with the combination of botulinim toxin and casting made to the gastrocnemius-soleus muscle group.[8] An increase in the ankle dorsiflexion angles was found in studies that included orthotic, casting and stretching exercises after botulinum toxin injection.[10,14,15] In a study in which auditory biofeedback was used with a pressure sensitive heel switch, improvement in ankle dorsiflexion angle and gait after treatment was reported.[10] In a study in which the effect of whole body vibration on heel strike, spatial and temporal gait parameters and ankle range of motion in children with ITW was determined, an increase in heel contact and ankle range of motion was observed.[16]

Surgical lengthening of the gastroc-soleus-Achilles can be performed for children with contractures in the Achilles tendon. After surgery, it is followed with a postoperative cast in a dorsiflexed position for 4-6 weeks. In a systematic rewiev that examined 10 studies comparing surgical treatment and orthoses, after 5 years of follow-up, it was stated that the sustainable effectiveness of surgery is only 1 year more than orthoses.[13]

In children under 5 years old with ankle dorsiflexion at normal angles, following with observation is recommended. They generally gain normal walking patterns at these ages. However, treatment algorithm should be followed in children over 5 years old. If the dorsiflexion angle is greater than 10 degrees, it can be continued with observation, or casting can be done at a maximum dorsiflexion during 6 weeks. The cast angle should be changed with an interval of 1 week until sufficient dorsiflexion angle is obtained. Casting may generally be insufficient in children older than 7 years. Surgical lengthening may be considered in cases where the cast is inadequate, there is severe mobility limitation or cannot be brought to the neutral dorsiflexion angle. Physical therapy and rehabilitation should be done after casting or surgery. AFO can be considered for children who have become a habit of toe walking despite the dorsiflexion angle is normal.[2]

CONCLUSION

Fingertip walking can be caused by a pathological cause, but it is mostly idiopathic. Toe walking reasons should be determined with a careful history, clinical examination and necessary diagnostic tests. Treatment options should be planned according to patient age and ankle dorsiflexion restriction. Non-rigid limitations should be treated with physical therapy, stretching exercises, orthoses, casting and botulinum toxin injections. Surgical methods should be preferred in the treatment of rigid dorsiflexion limitations. Although there are adequate studies on treatment options in the literature, long-term follow-up studies are needed.

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