

# Therapy of Idiopathic Toe Walking by Pyramid Insoles



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## Introduction

Idiopathic toe walking in children is a frequently occurring gait pattern (1). Studies examining possible causes have remained uncertain, but surveys show that disturbances of the muscular tone, vestibular and sensory dysfunctions, general developmental retardations, and familial accumulations may have an effect to toe walking (4, 7, and 9).

The cumulative incidence of idiopathic toe walking is up to 15%, some children who toe walk reach their climax around the age of 2 (2). The spontaneous remission is quite high, but toe walking often persists beyond pre-school age. The major drawback of a persisting toe walking gait pattern is in the possibly resulting secondary diseases and complications of the skeletal apparatus. Through a hyperlordosis of the lumbar spine, improper biomechanical stress in the trunk region may occur. This, in turn, may result in damages of the spinal column and hip flexion contractures. Feet are particularly endangered as deformations of the feet or irreversible shortening of the Achilles tendon is possible (5, 6, and 9).

Therefore, a specific therapy should be administered to patients whose toe walking has been persisting for more than a year. Physiotherapeutic treatments are highly valued among therapists (particularly the so-called 'Bobath-therapy'

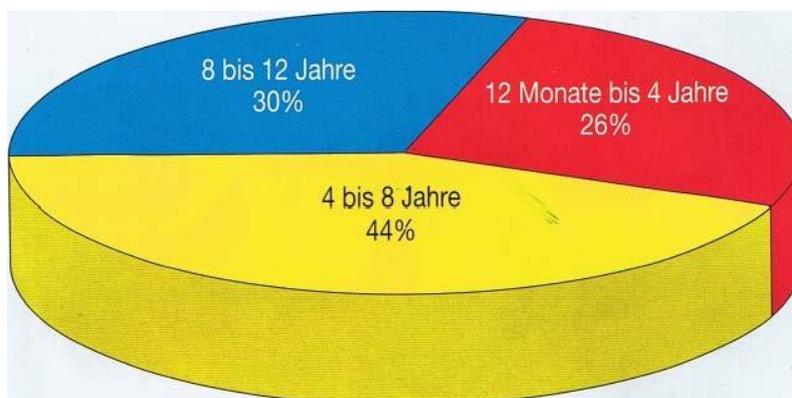


Fig. 1: Distribution of age of 215 children with idiopathic toe walking patterns, all of whom were in medical consultation in the Physiotherapeutic Center in Hamburg in the period between 2003 and 2004.

Blue = 8 – 12 years  
Red = 12 month to 4 years  
Yellow = 4 to 8 years

and 'sensory integration'), but they are quite often bound to fail due to their extraordinary administrative expense. Serial castings and Botox-injections are assumedly successful options, but often come with great mental and physical stress for the young patient (3).

Conventional treatments using insoles primarily affect the area around the heel only. Since toe walkers exert pressure to the forefoot only and because the supporting elements of conventional insoles are usually put slightly behind this region, the patient's foot would never touch the insole, simply because pressure is exerted somewhere else.

Pyramid insoles are therefore thought to provide an option

that affects primarily the forefoot.

In the following, build and function of pyramid insoles are introduced as are preliminary clinical data.

## Build and Structure of Pyramid Insoles

Pyramid insoles were developed in 2001. By now, these insoles have been used exclusively with toe walking infants (8). Pyramid insoles are designed to bear weight in the forefoot area. They resemble a pyramid, which is fixed right beneath the 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> metatarsal bone. Additionally, supporting elements that are meant to provide a supporting structure for the calcaneus and the position of the lower end of the foot are worked into the insoles. The supporting

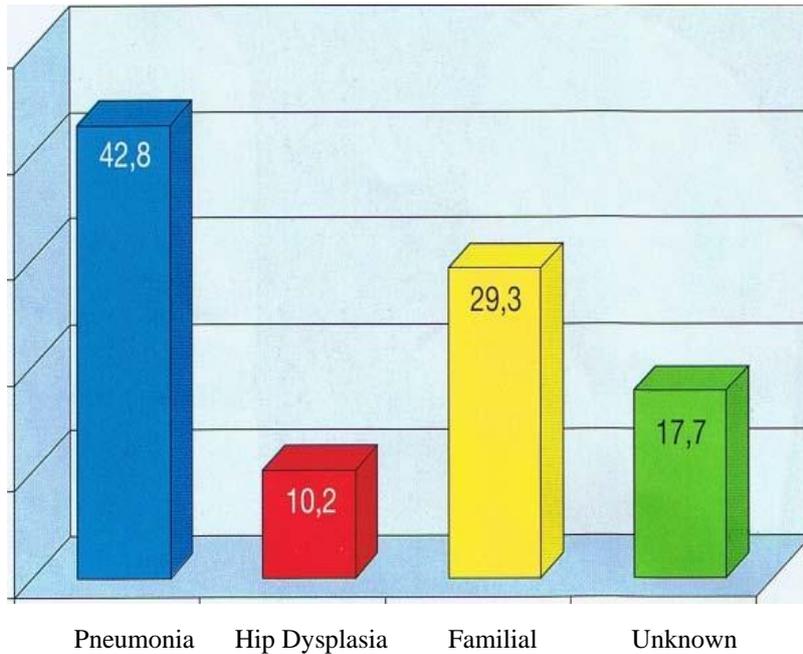


Fig. 2: Associated previous illnesses and familial accumulation of idiopathic toe walking. Study comprising 215 infants of the Physiotherapeutic Center of Hamburg in the years of 2003 and 2004.

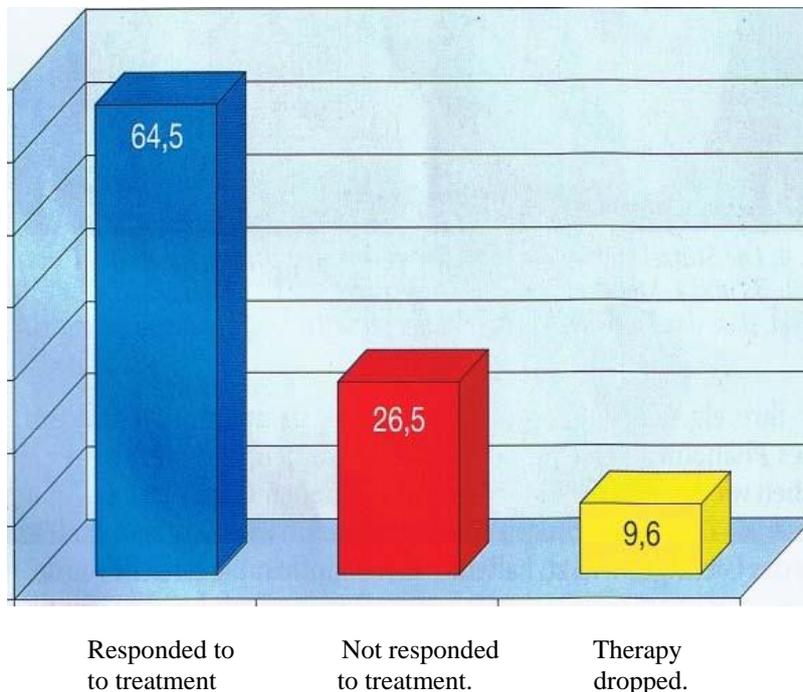


Fig. 3: Therapeutic outcome of the treatment of toe walkers with pyramid insoles. Study comprising 215 infants of the Physiotherapeutic Center of Hamburg in the years of 2003 and 2004.

elements provided for keeping the forefoot in its exact position are designed in accordance with the bones and joints, thus accounting for the different heights. They are made of soft and dermatologically tested material that would be keeping its shape even after prolonged use.

Usually, the focal point of balance centers on the middle part of the foot (with people with common gait patterns). Toe walkers, however, walk on their forefoot, preventing the middle foot from touching the ground. Because of that, the point of balance is shifted towards the forefoot. This requires a compensation of the pressure that results from the body weight and manifests itself in a flexion of the hip and an extension of the trunk.

Through the different position of the supporting elements, pyramid insoles exert the pressure to the forefoot, in order discourage the patient to toe walk. On the one hand, the pressure applied is displeasing, on the other, toe walking or a toe-walking-posture would now require more effort on the side of the muscles. The children are therefore forced to put their heels down. Thus, through the different heights of the supporting elements of the insole, the foot is forced into a normal position. To keep the balance while walking with the insoles, the patient is required to extent his pelvis and shift the balance point towards the middle part of the foot. Through this, an often coinciding hyperlordosis can successfully be avoided.

### Goals and Methods

In order to examine the effectiveness of a therapy with pyramid insoles, a prospective observational study of children with idiopathic toe walking gait patterns has been developed.

The diagnosis of 'idiopathic toe walking' was done anamnestic, clinic, and followed the method of exclusion, thus excluding the differential diagnosis of neurogenic toe walking of the groups 'spastic-dystonic,' 'flabby-paretic,' and myogenic pes equinus.

The following anamnestic factors have been recorded for toe walkers: pneumonia prior to the acquisition of walking, hip dysplasias and the incidence of toe walking gait patterns in members of the family.

All of the children have been treated with pyramid insoles; and in most cases, toe walking could be brought to an end.

## Results

In 2004 and 2003 about 215 children with idiopathic toe walking patterns of those visiting the Physiotherapeutic Center of Pomarino in Hamburg were included in the study. The age of the children ranged from 12 months to 12 years. 26% of these children were 12 months to 4 years, and 44% counted 4 to 8 years, while 30% of all children filled the 8 to 12 years slot (Fig. 1). 42.8% of all toe walkers examined have gone through pneumonia before they learned walking; 10.2% suffered from a hip dysplasia, and 26.8% had close relatives (parents, siblings) who were persistently toe walking in early childhood as well. In some cases, toe walking had been handed down up to three generations (Fig. 2).

All of the 215 children with idiopathic toe walking have initially been administered pyramid insoles. Toe walking gait patterns disappeared completely in 64.4% of these children, 9% dropped out of the study, and 26.5% did not show

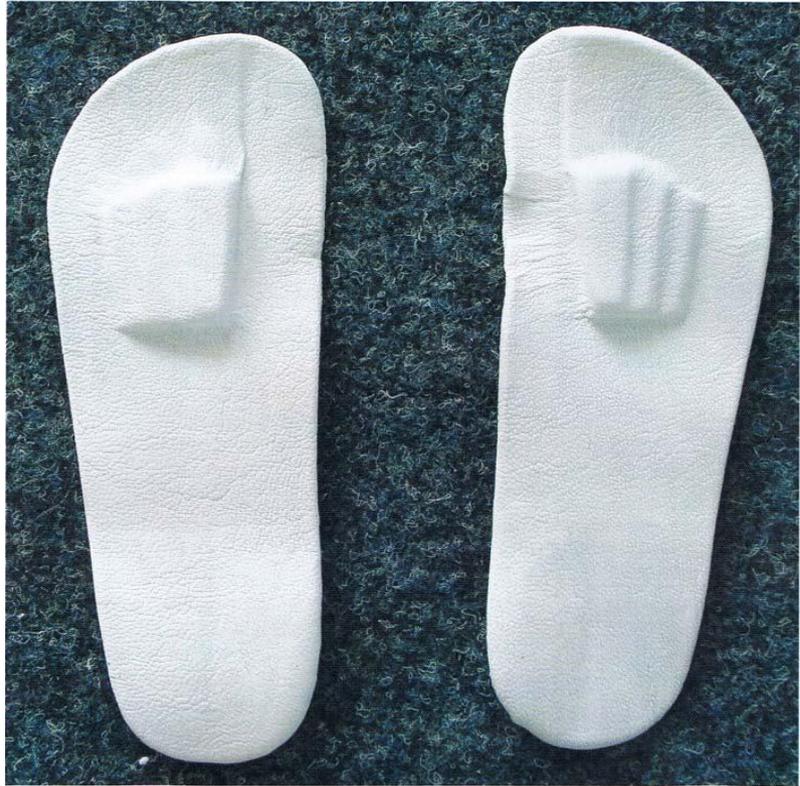


Fig. 4: The insoles resemble a pyramid, which is fixed right beneath the 2nd, 3<sup>rd</sup>, and 4<sup>th</sup> metatarsal bone. The pressure that the insoles exert onto the forefoot brings about a conditioning of the foot, making it nearly impossible for the children to walk on their toes and put the heels down instead.



Fig. 5: Patient with idiopathic toe walking gait patterns. Idiopathic toe walking is often associated with a hyperlordosis and can lead to a secondary shortening of the tendon calcaneus.

any effects. 38.5 of the latter (10.2% of all of the children participating) had been injected with Botox into the calf (Fig.3). There have been differences in age regarding the effectiveness of pyramid insoles.

In children of 12 months to 4 years, the application of pyramid insoles had an immediate effect: none of them has continued toe walking. Interestingly, a discontinuance of wearing pyramid insoles brought the children back to toe walking patterns. After a period of six weeks of wearing the insoles, toe walking without insoles has become significantly less frequently. A disruption of the wearing of pyramid insoles after 28 weeks has nearly cured toe walking children.

Children aged 4 to 8 years react similarly to wearing pyramid insoles as their younger fellows. However, compared to them, the average time of rehabilitation in children of this age has doubled. After four weeks of therapy with pyramid insoles, children displayed problems to keep their balance. They tended to stumble upon their own feet; a phenomenon that disappeared after four weeks as children had acquired the knowledge necessary to keep their bodily balance.

Similar to their younger peers, the 8 to 12 year old exhibited positive results as well. But different to other cohorts, the time they needed to abandon toe walking after the discontinuation of wearing insoles, was 1.5 years. Because of the long duration of wearing pyramid insoles, these children become weaned from the habit of wearing them by slowly tapering their application.

Those infants who had been administered a Botox therapy after the primary failure of the treatment with pyramid insoles, developed a plantargrade gait

pattern. The period of time they needed to obtain normal gait patterns after the treatment with Botox equaled the time of group that responded immediately well the pyramid insoles therapy.

## Discussion

The first data produced by studies examining the results of the treatment of idiopathic toe walking with pyramid insoles show great promise for achieving sustained success.

Two-thirds of the children participating in the study developed a complete plantargrade gait pattern after an average time of a half a year of wearing pyramid insoles. There is however no data available concerning the spontaneous remission rate of idiopathic toe walking. First studies looking at the prevalence of toe walking suggest that a yearly spontaneous remission of 15 to 20% is likely, so that the difference between those who have been worked with clinically and those who have not is significant.

Older children indicated similar results after the treatment, but it took them more time than their younger peers needed to achieve plantargrade gait patterns. This might be due to the fact that secondary diseases, such as the shortening of Achilles tendon, have already been more pronouncedly present. Moreover, the further developed brain in older children causes complex motoric processes to be more fixed and therefore harder to condition. A promising alternative therapy is the treatment with Botox. In Germany the injection of botulinum toxin into the calf muscles of children is approbated in cases of spastic club foot diseases. Experiences

made with treating hemi- or tetra spastic disorders in children suggest that the risk of adverse effects is very low if the therapy is properly done. The accumulation of toe walkers within generations of a single family leads to the assumption the generic predispositions may play a causal role in the development of toe walking gait patterns. At least a certain part of the patients examined indicated an autosomal/dominant inheritance.

Interestingly, the anamnesis of toe walkers coincides with a coincidental accumulation of pulmonal infects. Resulting pulling effects via the diaphragm and psoas musculature lead to secondary static and muscular shifts in the hip area, thus encouraging toe walking. The association with hip dysplasias may be accounted for in a similar way.

Obviously, in order to avoid secondary diseases, such as deformations of the foot or the spinal column, idiopathic toe walking needs to be treated properly and in every stage of life. Pyramid insoles, as a primarily applicable therapy, is an effective option that not only helps make the treatment easier, but also saves costs that could be spend elsewhere.

## Literature

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