

# New Therapy Concepts - Idiopathic Toe Walking



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## Summary

Idiopathic toe walking is a frequently indicated variant of the infant's walking pattern. Persisting toe walking may damage children's posture and may result in deformity of the feet. In such cases an intensified therapy is necessary.

The success of conventional physiotherapy and commonly used insoles is often limited. The physiotherapeutic concept of Bobath and the sensory integration method stimulate the perceptive faculty of the children.

A medical alternative provides the injection of botulinum toxin in the calves. The outcome can be optimized through simultaneous application of plaster therapy.

Pyramidal insoles affect primarily the front part of the plantar region. The pressure put on the forefoot makes it hard for the patient to walk or stand on his toes. Consequently, the child is forced to touch down the heel while walking.

In the course of their bodily and mental development, up to 15% of all children will toe-walk for a period of at least three months (Fig. 2). This so-called 'idiopathic' toe-walking is a gait deviation that is mostly limited to toddlers. Persisting toe walking may however result in damages of posture and gait. The occurring short tendo calcaneus (tendo Achilles) is irreversible.

Moreover, secondary tilting of the pelvis may lead to long-term damages of the spinal column (Fig. 1), and distinctive deformities of area around the foot (Fig. 5, 7, 10).

## Zusammenfassung

Idiopathischer Zehenspitzenengang ist eine häufig anzutreffende Variante des kindlichen Gangbildes. Persistiert der Zehengang über einen längeren Zeitraum, besteht die Gefahr von Haltungsschäden und Fußdeformitäten. In diesen Fällen ist eine intensive Therapie erforderlich.

Der Erfolg klassischer Physiotherapie und konventioneller Einlagen ist häufig begrenzt. Physiotherapie nach Bobath und sensorische Integration fördern insbesondere die Körperwahrnehmung des Kindes.

Eine medikamentöse Therapieoption bietet die Injektion von Botulinumtoxin in die Waden. Das Ergebnis kann durch zusätzliches Anlegen eines Gipses optimiert werden. Pyramideneinlagen richten ihre Wirkung auf den Vorfuß. Der Druck auf den Vorfuß schafft eine Konditionierung, wodurch das Kind nicht mehr auf den Zehenspitzen gehen oder stehen kann und somit gezwungen ist, mit der Ferse aufzutreten.

Persisting toe walking requires therefore an adequate and intensified therapy. In the following, besides the already known therapies, new approaches of preventive and curative healing methods are to be introduced.

## Physiotherapy

Conventional physiotherapy is commonly applied to toe walking children in order to improve the feet's dorsal flexion and avoid a contraction of the tendo Achilles.

During gait training, patients learn how to reach a normal walking pattern through the putting down of the heels and the rolling off of the feet.

Indeed, most diagnoses overlook the fact that toe walking affects not only the feet, but also the entire static build of the infant's body. Many cases of toe walking are associated with a hyperlordosis in the lumbar portion of the spine, leading to a contracture of the hip bend. Physiotherapeutic treatments should therefore also consider a stretching of the spinal column as well as the hip.

Special forms of physiotherapy are the Bobath-therapy and sensory integration.

The therapy according to Bobath aims to regulate the tonus and to harmonize the movements bridging different bodily positions, such as sitting, standing, etc. (6). Here, toe walking toddlers and infants are not simply perceived as completed human beings; rather they are regarded as developing (concerning motor skills) patients. Spatial arrangements in private and public buildings and other areas frequented by children are increasingly designed to cater to the smaller customers and they, in turn, fell less inclined to toe-walk. Sensory integration supports the perceptive faculty of infants, whose toe walking habits some experts link to the disruption of this very perception (1). This therapy addresses particularly the sensory organs. Through the use of sensory materials such as crème, razor foam, or climbing wall, and in an playful way, the conscious perception of the feet is stimulated. By means of different mats, the feeling for keeping the balance is trained and the total weight is meant to shift gradually to the feet. These measures are intended to re-establish a new sense of inner and outer balance.

## Botulinum Toxin and Physical Exercises

The injection of botulinum toxin, or Botox, leads to the agony of the calves, making the infant's standing on their toes quite difficult. This effect will reach its climax about three weeks after the initial injection (3). In the three-month period, during which Botox affects the infant's toe walking, a several-days-per-week schedule is set up to help the child train normal gait and posture. This procedure is aimed at accomplishing walking habits normal to most people. First experiences show very good results so far, and side effects are very unlikely if applied properly. A control group study is however lacking at the moment.

## Serial Casting of the Lower Extremities

Through serial casting, which usually takes about two to six weeks, a 90 degree angle of the ankle joint can possibly be reached. During this period, the infant is prevented from taking up a pes equinus (toe walking) position (4, 11).

Serial casting can also be combined with Botox injections, because immediately after the administration of Botox, a cast may be applied so as to intensify the impact of the toxin. Alternatively, the cast is put on three weeks after the initial injection of Botox, which would avoid pressure marks.

## Conventional Insoles

Conventional insoles, such as cork and Nancy-Hilton orthoses, are practically useless with toe walking children, because the supporting elements of conventional insoles are adjusted in the hindfoot area. 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. This is indicated by the marks left by the wearing-off-patterns of these insoles.

## Pyramid Insoles

Pyramid insoles have been developed by David Pomarino in 2001. By now, these insoles have been used exclusively with toe walking infants. Pyramid insoles are designed to bear weight in the forefoot area. They resemble a pyramid (Fig. 3), which is fixed right beneath the 2nd, 3<sup>rd</sup>, and 4<sup>th</sup> metatarsal bone. This is all made to cure toe walking (8).

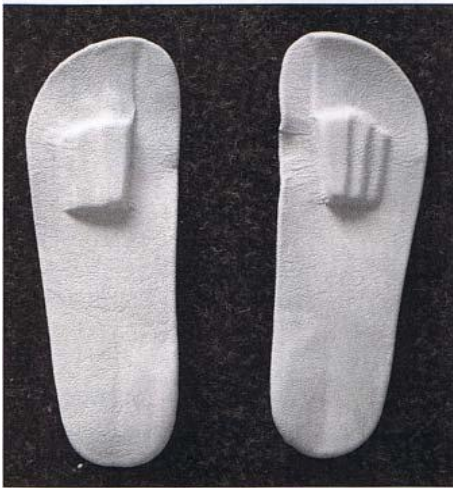
The pressure that the insole exerts onto the forefoot brings about a conditioning of the foot, making it nearly impossible for the children to walk on their toes and put the heels down instead. Thus, through the different heights of the supporting elements of the insole, the foot is forced into a normal position. Moreover, the application of pyramid insoles reduces the risk of a hyperlordosis.



*Fig. 1. Many cases of toe walking are associated with a hyperlordosis in the lumbar portion of the spine, leading to a contracture of the hip bend.*



*Fig. 2. 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.*



**Fig. 3.** The supporting elements of pyramid insoles resemble a pyramid, which is fixed right beneath the 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> metatarsal bone. This is meant bring about a shift of pressure away from the forefoot towards the heel.

## Conclusion

Conventional physiotherapy and commonly used insoles is not suitable to toe walking. Bobath physiotherapy and sensory integration are particularly of advantage in simultaneously occurring retardations of development. A medical alternative is offered with the intramuscular injection of Botox. This method could further be enhanced by the simultaneous application of serial casting. Disadvantages are their invasiveness and relatively high efforts.

Pyramid insoles made for the forefoot are the perfect alternative. Mental and physical stress for both parents and children can be maintained at an acceptably low level. The conditioning, caused by the insole, provides the sustainability necessary to overcome toe walking.

What exact therapy is finally selected, remains with the individuality of the patient. Age of the children, a possible shortening of the tendo calcaneus (tendo Achilles), and the acceptance of the specific form of therapy will all play their part in the selection of the treatment.

## Literature

1. Ayres AJ. Bausteine der kindlichen Entwicklung. Hamburg: Springer Verlag 2002.
2. Bernhard MK, Töpfer M, Merckenschlager A. Zehenspitzenengang – an was ist zu denken...? Kinder- und Jugendmedizin 2005; 2: 73–6.
3. Bhidayasiri R, Truong DD. Expanding use of botulinum toxin. J Neurol Sci 2005; online publiziert 28. Juni 2005.
4. Brouwer B, Davidson LK, Olney SJ. Serial casting in idiopathic toe-walking and children with spastic cerebral palsy. J Pediatr Orthop 2000; 22: 221–5.
5. Fragniere B, Garoflid N, Dutoit M. My child walks on his tiptoes. Rev med Suisse Romande 2000; 120: 811–4.
6. Hüter-Becker A, Schewe H, Heipertz W et al. Lehrbuch der Physiotherapie Band 12, Pädiatrie, Neuropädiatrie. Stuttgart: Thieme Verlag 1999.
7. Korinthenberg R. Differenzialdiagnose des Zehenspitzengangs. Neuropäd 2002; 3: 98–102.
8. Pomarino D. Sensomotorik: Pyramideneinlagen nach Pomarino. Orthopädie-Technik 2003; 11: 810-3.
9. Pomarino D. Der Fuß, Fundament des Körpers; Teil V – Der idiopathische Zehenspitzenengang. Physiotherapie med 2004; 4: 23–30.
10. Sala DA, Shulman LH, Kennedy RF et al. Idiopathic toe-walking: a review. Dev Med Child Neurol 1999; 41: 846-8.
11. Schumpelick V, Bleese NM, Mommsen U. Chirurgie, 4. Aufl. Stuttgart: Ferdinand Euke Verlag 1999.