

Idiopathic Toe Walking

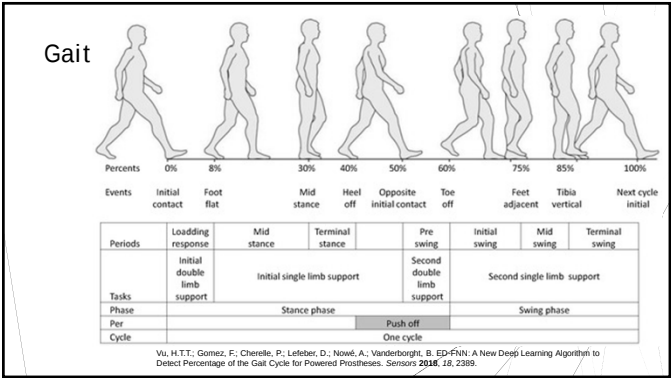
Jennifer Rosen, PT, DPT, CKTP
Board Certified Clinical Specialist in Pediatrics

Presenter

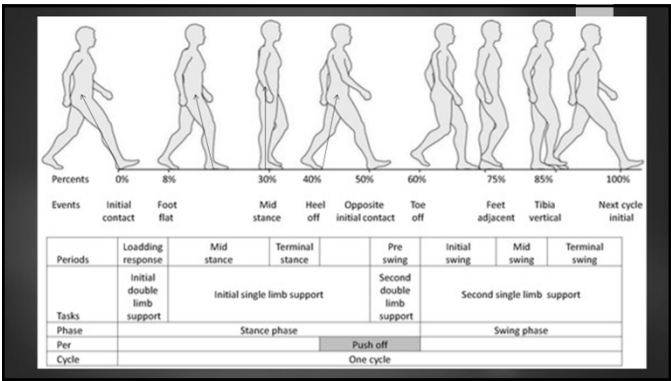
- ▶ Treats children birth to 21 years old with developmental disabilities for close to 20 years
- ▶ Teaches therapists how to use the LiteGait, a partial weight-bearing device to improve gait and function, through Mobility Research
- ▶ Completed transitional DPT program through Rocky Mountain University of Health Professions - Capstone: **Scoping Review and Recommendations for Physical Therapy Assessment and Treatment of Idiopathic Toe Walking**
- ▶ Teaches as an adjunct professor at Daemen College and University at Buffalo in both of their physical therapy departments

Objectives

- ▶ 1. Participants will learn what idiopathic toe walking is as compared with other types of toe walking
- ▶ 2. Participants will be able to assess for idiopathic toe walking and who might need to be consulted.
- ▶ 3. Participants will learn what the literature suggests needs to be covered in the initial evaluation.
- ▶ 4. Participants will learn about impairments noted in the literature.
- ▶ 5. Participants will learn what treatment techniques are suggested in the literature.
- ▶ 6. Participants will learn where future research is needed and how to get involved in the research.
- ▶ 7. Participants will be able to take the knowledge and use it in their daily practice.







What does the abnormal ground reaction forces cause?

Abnormal foot position potentially causing pain and decreased motor skills along with decreased endurance in the long run.

Pendulum aspects of gait

Past: Active gait

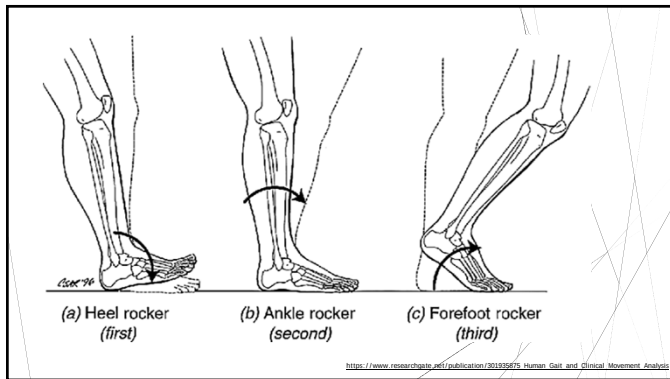
Present: Passive movement

Passive pendulum at hip (swing) and at ankle (stance)

Kuo AD, Donelan JM. Dynamic principles of gait and their clinical implications. *Phys Ther.* 2010;90: 157-174.

Definition

- HR32(Fanchiang et al 2015)
 - HR32- normal third rocker occurs between heel raise (32% of gait cycle) and toe off (60% of the gait cycle)
 - Early third rocker is when heel raise is before 32% of the gait cycle which is considered toe walking



Definition

Walking on toes without a cause

Related Diagnoses

- Cerebral palsy
- Autism
- Muscular Dystrophy
- Sensory processing disorder

Evaluation

- ▶ History
 - ▶ Neurological-
 - ▶ Birth weight
 - ▶ Prematurity
 - ▶ Cerebral Palsy
 - ▶ Muscular Dystrophy
 - ▶ Genetics ⁽⁶⁶⁾
 - ▶ Family History
 - ▶ Parents or sibling toe walk
 - ▶ Muscular Dystrophy
- ▶ Other diagnoses
 - ▶ Developmental Delay in other areas
 - ▶ Autism Spectrum Disorder
 - ▶ Sensory Processing Disorder
 - ▶ Developmental Milestones ^(17,18)
 - ▶ Balance and Posture
 - ▶ Vestibular

8-11, Williams et al

Assessment Tools

Toe Walking Tool - Dr. Cylie Williams, BAppSc(Pod), MHLthSc(Hlth Prom &ED), PhD

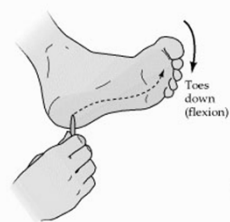
Assessment Criteria for Toe Walking - Liesa Persaud PT, DPT, PCS, CKTP

Evaluation Continued

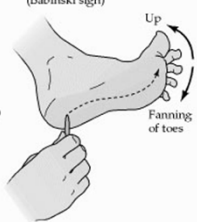
- ▶ Range of Motion Ankle
 - ▶ Other joints in body
 - ▶ Clonus when assessing hamstring or ankle ROM
- ▶ Bony malformations of foot⁽⁷¹⁾
- ▶ Reflexes
 - ▶ Babinski
 - ▶ Patellar Reflex

(2, 9, 16, 18-21, 59, 60)

(A) Normal plantar response

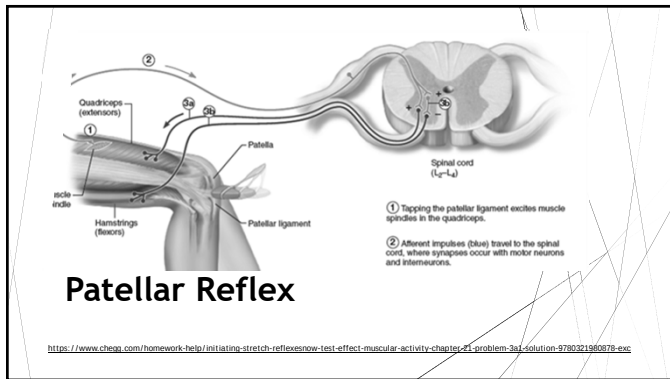


(B) Extensor plantar response (Babinski sign)



Babinski

<http://www.medicinestack.com/2011/07/plantar-reflex-babinski-sign.html>



Evaluation Gait

When begin walking?	
When begin toe walking? (17,18)	
Injury?	
Toe walk on one foot?	
Gowers sign when getting up off floor?	
Can they walk with heels on the floor?	

Evaluation Gait

- ▶ Gait assessment
 - ▶ Gait Lab Assessment (56)
 - ▶ Gait Assessment Tool (a video motion analysis system like GAITRite or Vicon motion analysis system)
 - ▶ Assess HR32
 - ▶ New Clinical Gait Assessment Scale (57)
 - ▶ Algorithms (6, 32, 33)
 - ▶ New-Lifestyles NL-1000 accelerometer (33, 34)
 - ▶ 50-foot walk test (33, 34)

Gait in Idiopathic Toe Walking

Stride length (22,23)

Knee kinematics (22-25, 58)

gastrocnemius and soleus (23,25, 27, 28)

vastail muscles, gluteal muscles, biceps femoris muscle and hamstring muscle (23,25, 27, 28)

Treatment

► Range of motion (36-38)

► Gait

► Treadmill training (39)

► Auditory feedback (40, 69, 70)

► Motor Control activities (41, 42)

► Whole body vibration (15, 29, 43, 44)

► Reinforcement(67)

► Sensory

► Vestibular (45)

► Other sensory (15, 37, 47)

Treatment

►Nothing (12,16)

►Surgery (51,52)

►Botox and Serial Casting (51)

►Orthotics (67)

Orthotics

- ▶ AFO, FO, Shoe insert (Herrin)
- ▶ Pyramidal Insoles (Pomarino)(66)
<https://www.youtube.com/watch?v=-9J76E5vbEJU>
- ▶ Carbon fiber inserts
- ▶ Solid Ankle AFOs
- ▶ Heel Wedges (65)

Relation to Current Practice



Algorithm for Assessment and Treatment

Videos

<https://www.youtube.com/watch?v=vdek7zhANfw>

<http://www.southfloridasportsmedicine.com/toe-walker.html>





Treatment Ideas

References

- ▶ 1.Fanchiang HD, Geil M, Wu J, Chen YP, Wang YT. The Effects of Vibration on the Gait Pattern and Vibration Perception Threshold of Children With Idiopathic Toe Walking. *Journal of child neurology*. 2015;30(8):1010-1016.
- ▶ 2. Abu-Faraj ZO, Harris GF, Smith PA, Hassani S. Human Gait and Clinical Movement Analysis. In: *Wiley Encyclopedia of Electrical and Electronics Engineering*. Second Edition, John Wiley & Sons, Inc., New York, USA, pp. 1-34, December 15, 2015.

1. Engstrom P, Tofret K. The precise and coarse course of idiopathic toe-walking in 5-year-old children. *J Pediatr*. 1998;134(10):279-284.
2. Engstrom P, Tofret K. Idiopathic toe-walking: prevalence and natural history from birth to ten years of age. *J Bone Joint Surg Br*. 2010;100B(1):60-67.
3. Williams CM, Parniani H, Bakker RP, et al. Interventions for idiopathic toe-walking. *Cochrane Database Syst Rev*. 2010;(3):1.
4. Williams CM, Parniani H, Bakker RP, et al. Interventions for idiopathic toe-walking: a systematic review. *Foot Ankle Int*. 2010;31(10):951-1018.
5. Suda SA, Stuckey M, Kennedy BP, et al. Idiopathic toe-walking: a review. *Dev Med Child Neurol*. 1998;41(2):86-94.
6. Williams CM, Tofret K, Parniani H. The toe walking tool: a novel method for assessing idiopathic toe walking children. *Foot*. 2010;30(4):505-508.
7. Haynes RB, Wintchey PR, Vavrin M, et al. A walking device: neurologist perspective after referral from pediatric orthopedic surgeons. *J Pediatr Orthop*. 2010;30(1):10-14.
8. Baker J, Mahalingam S, Parniani H, et al. A comparison of the birth characteristics of idiopathic toe-walkers and those who walked due to medical reasons. *J Pediatr*. 2011;159(2):290-293.
9. Shuman H, Suda SA, De Luca C, et al. Developmental milestones of toe-walking children. *J Pediatr*. 1997;132(4):543-546.
10. Acland RD, Williams CM, Parniani H. Toe walking: a marker for language delay in the developmentally delayed child. *J Child Neurol*. 1989;20(4):247-249.
11. Rubenstein T, Scher D, Osherson E. Toe walking: causes, epidemiology, assessment, and treatment. *Curr Opin Pediatr*. 2010;22(1):40-46.
12. Heron K, Gell R. Gait in the treatment of idiopathic toe walking: a randomized controlled trial. *Prosthet Orthot Int*. 2009;43(2):137-143.
13. Mahalingam S, Murphy AT, Banerji B, et al. Full length foot orthoses have an immediate treatment effect and monthly gait of children with idiopathic toe walking. *Gait Posture*. 2010;27(2):227-233.
14. Romeros E, Ramirez Llanusa M, et al. Literature review of idiopathic toe walking, etiology, prevalence, classification, and treatment. *Foot Ankle*. 2010;31(10):919-924.

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19. Michelland J, Murray AT, Rawicki B, et al. Full-length foot orthoses have an immediate treatment effect and modify gait of children with idiopathic toe walking. *Gait Posture*. 2017;53:105-112.
20. Pomarino D, Ramello L, et al. Literature review of idiopathic toe walking: etiology, prevalence, classification, and treatment. *Footwear*. 2017;10(4):337-342.
21. Radtke K, Karch H, Goede F, et al. Outcomes of noninvasively treated idiopathic toe walkers. *Foot Ankle Spec*. 2019;12(1):54-61.
22. Montgomery P. Gagey J. Sensory dysfunction in children who toe walk. *Phys Ther*. 2016;96(10):1189-1204.
23. Williams T, Gagey J. Sensory dysfunction and gaiting in sensory processing disorder. 2nd edition. *Footwear*. 2005.
24. Williams T, Gagey J, Curtis M. Idiopathic toe walking and sensory processing disorder: is there a link? *J Orthop Sports Phys Ther*. 2009;39(10):404-424.
25. Liddle TL. *Why Motor Skills Matter*. Virginia Beach: Koehnerbooks; 2013.
26. Pearsall T. The sensory side of pediatric toe walking. In: *Medbridge*. 2018.
27. Davies K, Black H, Ward J, Heintz L. Long-term gait outcomes following conservative treatment of idiopathic toe walking. *Gait Posture*. 2018;62:214-219.
28. Scopa A, Domestico S, Molteni S, Galletti-Grassi W, et al. Effect of a noninvasive treatment program on the gait pattern of children with idiopathic toe walking. *Footwear*. 2016;9(4):259-264.
29. La Sala C, Sabatello L, Lorenzetti C, et al. Conservative treatment of idiopathic toe walking. *Gait Posture*. 2016;43(Part 2):193-192.
30. Clark E, Seewer R, Yousaf A, McInch JW. Effects of motor control intervention for children with idiopathic toe walking: a case series. *Podiatr Med Clin*. 2019;64:427-438.

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38. Saito M, Waki M, Saito SA, Hayashi N, Saito RM. Therapeutic non-invasive results at internal rotation. *Journal of pediatric orthopaedics*. 2006;24(2):69-80.
39. Pagnier J, Dugas M, Lemerle C, Lissac C, Mithieux J. Treatment outcomes of adult foot/ankle trauma in a dedicated trauma unit: historical non-invasive. *European journal of physical and rehabilitation medicine*. 2010;44(1):1-6.
40. Pagnier J, Lissac M. Treatment of non-invasive non-invasive with non-invasive and physical therapy. *Applied Sciences in Physical Rehabilitation*. 1983;2(3):32-5.
41. Chouk S, Swenson JE, Yeung A. The Effect of three types of manual manipulation for children with oligosacral non-invasive: a case series. *Indian journal physical therapy (the official publication of the Indian Physiotherapy Association)*. 2009;43(1):67-70.
42. Lacroix J, Wilkerson-Dunn N, Hulse L, Saito M, et al. Translational research on the use of non-invasive therapy. *The Journal of pediatric orthopaedics*. 2004;24(1):100B-107.
43. Wilkerson-Dunn N, Saito M, Saito M, Saito M, Saito M. Within-day Vibratory Resonance in Short-Term Improvement in the Gait of Children with Oligosacral Non-Invasive. *Journal of orthopaedic research*. 2004;22(1):153-158.
44. Mithieux J, Pagnier J. Sensory adaptation in children on the neck. *Physical Therapy*. 1983;63(1):139-140.
45. Wilkerson-Dunn N, Saito M. Oligosacral non-invasive and sensory proprioceptive training in a child. *Journal of Pediatric Orthopaedics & Sports Physical Therapy*. 2006;36(3):423-424.
46. Gentry M, Behler C. Oligosacral non-invasive treatment for Oligosacral Non-Invasive. *Journal of Pediatric Orthopaedics*. 1986;6(2):187-189.
47. Papadimitriou M, Brown R. Spontaneous osteogenesis: analysis of isolated non-invasive. *Journal of pediatric orthopaedics*. 1986;6(2):273-278.
48. Chouk S, Saito M, Saito M. Vibratory non-invasive gait adaptation: electromyographical and biomechanical analysis. *European Journal of Physical Therapy*. 2002;4(2):153-161.
49. Nelson J, Kerrigan JC. Long term gait and initiation from non-invasive. *Journal of Biomechanics*. 2000;33(2):393-401.
50. Wilkerson-Dunn N, Saito M, Saito M, Saito M. Oligosacral non-invasive and sensory proprioceptive training in a child. *Journal of pediatric orthopaedics*. 2006;26(2):362-366.
51. Saito M, Saito M, Saito M, Saito M, Saito M. Translational research on the use of non-invasive therapy. *The Journal of pediatric orthopaedics*. 2004;24(1):100B-107.
52. Mithieux J, Pagnier J, Dugas M, Lemerle C, Lissac C, Mithieux J. Treatment of non-invasive non-invasive with non-invasive and physical therapy. *Applied Sciences in Physical Rehabilitation*. 1983;2(3):32-5.

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- 65. Sidman K, Silva R. Impact of using heel wedges to reduce idiopathic toe walking in a child with autism. *Am J orthop journal of occupational therapy*. 2018;72(4_supplement_1):7211520321. doi:10.5014/ajot.2018.7251-P06038
- 66. Radtke K, Karch N, Goede F, et al. Outcomes of noninvasively treated idiopathic toe walkers. *Foot & ankle specialist*. 2019;12(1):54-61. doi:10.1177/1938840018766609
- 67. Hirt ESJ, Lockenour FM, Allen JL. Decreasing toe walking with differential reinforcement of other behavior , verbal rules, and feedback. *Education and treatment of children*. 2019;42(2):185-199.
- 68. Bartolotta J, Tsao E, Bouchard M. A Retrospective Analysis of Nonoperative Treatment Techniques for Ido pathy The Walkers in Children: Outcomes and Predictors of Success [published online ahead of print. 2020 N ov 17]. *PM R*. 2020;10.1002/pmj.12520. doi:10.1002/pmj.12520
- 69. Pollitt M, Soang R, Grant-Bettler M, Aminian A. Customized wearable sensor based insoles for gait re-training in idiopathic toe walkers. *Biomedical sciences instrumentation*. 2019;55(2):192-198.
- 70. Kenis VM, Khussainov NO. The use of shoe type "sneakers" in children with idiopathic transient toe walkin g. *Lo-batskiy neurological journal*. 2020;16(1):21-23. doi:10.17816/2686-8997-2020-14-217-223
- 71. Sinclair MR, Lind AE, Knowlton JQ. The effect of persistent toe walking on the skeletal development of the pediatric foot and ankle. *Journal of pediatric orthopaedics B*. 2018;27(1):77-81. doi:10.1097/BBB.0000000000000461