Approach to Toe walking

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Disclosures

• I have no relevant disclosures.

• I have no conflict of interests.
Outline

• Definition.

• History and Exam.

• Cases.

• Approach.

• Management.
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Definition

- It refers to the lack of heel strike during the stance phase of gait cycle.
- It is a common variation of normal gait development in children.
- Typical heel–toe pattern develops by 24–36 months of age.
- Persistent toe walking past 2–3 years of age typically warrants further evaluation.

<table>
<thead>
<tr>
<th>Motion</th>
<th>Normal</th>
<th>Functional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankle Plantar Flexion</td>
<td>45°</td>
<td>20°</td>
</tr>
<tr>
<td>Ankle Dorsiflexion</td>
<td>20-25°</td>
<td>10°</td>
</tr>
<tr>
<td>Foot Inversion</td>
<td>35°</td>
<td>10°</td>
</tr>
<tr>
<td>Foot Eversion</td>
<td>25°</td>
<td>10°</td>
</tr>
</tbody>
</table>
Outline

• Definition.

• **History and Exam.**
  • Cases.
  • Approach.
  • Management.
History and Exam

- **History:**
  - Chief complaint: onset, progression.
  - Associated symptoms, review of systems.
  - Perinatal history.
  - Developmental history.
  - Past Medical history.
  - Family history.

- **Physical Exam:**
  - Developmental milestones.
  - General exam.
  - Musculoskeletal exam.
  - Neurological exam.
  - Gait.
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Case 1: A 4-year-old girl, with toe walking.

- She started walking around 1 year of age, and noted to have intermittent toe walking since.
- No associated symptoms reported.
- **Perinatal history:** unremarkable.
- **Developmental history:** no delays. No concern for cognitive or behavioral issues.
- **Past medical history:** unremarkable.
- **Family history:** is unremarkable.
- **Physical exam:**
  - General, musculoskeletal, and neurological exam show no abnormalities.
  - **Gait:** able to stand with flat feet without difficulty (plantigrade). Initially walks with alternating heel strike then starts to have symmetrical tiptoe walking.
Idiopathic toe walking
Toe walking: etiology

1) Idiopathic toe walking
Case 2:
A 5-year old girl with persistent toe walking.

- **Perinatal history:** born prematurely at 28 weeks’ gestation.
- **Developmental history:** delayed. Started walking at 24 months, and has had persistent toe walking. Her ankles are tight, worse in the morning, and gets better with stretching.
- **Past medical history:** otherwise unremarkable.
- **Family history:** unremarkable.
- **Physical exam:**
  - **General:** unremarkable.
  - **Musculoskeletal:** tight Achilles with no contractures.
  - **Neurological:** hypertonia, hyper reflexia, and some weakness in bilateral LE.
  - **Gait exam:** ambulates consistently on her tiptoes, unable to achieve flat foot stance. Exaggerated knee flexion, hip flexion, adduction, and internal rotation.
Diplegic Cerebral Palsy
1) Idiopathic TW.

2) Cerebral palsy (CP).
Case 3: A 5-year-old boy presents with frequent toe walking.

- **Perinatal history:** uneventful.
- **Developmental history:** walked around 14 months. Intermittent toe walking noted early on. Has some speech delay. Described as an aloof child that hates change in routine.
- **Past medical history:** unremarkable.
- **Family history:** unremarkable.
- **Physical exam:**
  - **General:** is unremarkable.
  - Noted to have poor eye contact, and repetitive stereotyped hand movements.
  - **Musculoskeletal:** passive dorsiflexion to 10 at both ankles.
  - **Neurological:** slightly decreased tone throughout, otherwise normal.
  - **Gait:** intermittently ambulate on his toes.
Autism Spectrum Disorder

ASD
1) Idiopathic TW.

2) Cerebral palsy (CP).

3) Neuropsychiatric disorders (ASD, ADHD, etc).
Case 4: 7 year old girl with progressive toe walking.

- **Perinatal history:** uneventful
- **Developmental history:** achieved milestones on time, walked around the age of 1 year.
  - 3 years ago, she started to have toe walking. It is less obvious in the morning, and would get worse towards the afternoon. She started PT, with stretches, braces, and casting, but her condition progressively got worse.
  - No associated bowel or bladder issues.
- **Past medical history** unremarkable. **Family history** non contributory.
- Physical exam:
  - General exam shows no abnormalities.
  - Musculoskeletal exam shows tight Achilles, right worse than left, with apparent leg length discrepancy.
  - Neurological exam shows normal tone except increased at the ankles, +3 DTR in the LE. Toes down going.
- Gait: see video.
Dopa Responsive Dystonia

DRD
1) Idiopathic TW.
2) Cerebral palsy (CP).
3) Neuropsychiatric disorders (ASD, ADHD, etc).
4) **Dopa Responsive Dystonia (DRD)**.
Case 5:
A 6-year-old boy with progressive toe walking

- **Perinatal history**: uneventful.

- **Developmental history**: achieved milestones on time, walked at 10 months.

- Started tiptoe walking about a year ago, and that has been getting worse over time. Gait usually worse in the morning. No bowel or bladder symptoms.

- **Past medical history** unremarkable.

- **Family history**: his mother was noted to have spasticity at a young age, and that gradually but slowly got worse.

- **Physical Exam**:
  - **General**: unremarkable.
  - **Musculoskeletal**: tight Achilles. No joint deformity, no sacral dimple.
  - **Neurological**: Tone is increased in the LE. DTR +3 and +4, with few beats of clonus. Toes upgoing bilaterally.
  - **Gait**: spastic with toe walking, unable to put feet flat on the floor. No dystonia. No ataxia.
Hereditary Spastic Paraparesis

HSP
**Toe walking: etiology**

1) Idiopathic TW.
2) Cerebral palsy (CP).
3) Neuropsychiatric disorders (ASD, ADHD, etc).
4) Dopa Responsive Dystonia (DRD).

5) **Hereditary Spastic Paraparesis (HSP).**
Case 6: 9-year-old boy with abnormal gait

- **Perinatal history:** unknown (adopted at 9 months).

- **Developmental history:** no delays.

- At the age of 2, noted to fall a lot, and also had some toe walking.

- He started getting PT. He also had surgery on his feet at the age of 5 years due to deformity of his toes.

- He recently had worsening of the tightness of his ankle and had to start wearing the brace.

- **Past medical history:** unknown before 9 months.

- **Family history:** unknown.

- **Physical exam:**
  - General exam: no dysmorphic feature.
  - Musculoskeletal exam: high arched feet, with deformed toes. Tight Achilles, decreased ROM at both ankles.
  - Neurological exam: tone is slightly decreased throughout with lax joints. Sensation is intact. DTR are +2 in the UE, absent in the LE. Toes mute.
  - Gait: intermittent toe walking when he walks fast.
Charcot Marie Tooth
(CMT)
(HMSN)
1) Idiopathic TW.
2) Cerebral palsy (CP).
3) Neuropsychiatric disorders (ASD, ADHD, etc).
4) Dopa Responsive Dystonia (DRD).
5) Hereditary Spastic Paraparesis (HSP).

6) Charcot Marie Tooth (CMT) (HMSN).
Toe walking: etiology

1) Idiopathic TW.

2) Cerebral palsy (CP).

3) Neuropsychiatric disorders (ASD, ADHD, etc).

4) Dopa Responsive Dystonia (DRD).

5) Hereditary Spastic Paraparesis (HSP).

6) Charcot Marie Tooth (CMT) (HMSN).

7) Deschene Muscular Dystrophy (DMD).

8) Glycogen Storage Disease (GSD) such as McArdle.

9) Tethered cord, spinal cord tumors, infarcts, etc.

10) M.skeletal: short achilles, contracture, leg length discrepancy, hip dislocation.
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History and Exam

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  - Gait.
Approach to toe walking

- **History:**
  - Age of walking vs age at onset of toe walking.
  - Specific questions: is it persistent or intermittent? Variation throughout the day? Progression over time?.
  - Pregnancy history (bleeding, infection, etc).
  - Birth history (prematurity, HIE, IVH, etc).
  - Past Medical history (TBI, meningitis, etc).
  - Developmental history (developmental delay, intellectual disability, autism, etc).
  - Family history (toe walking, myopathy, neuropathy, cardiac disease).

- **Exam:**
  - Developmental milestones, behavior.
  - General exam: Dysmorphic features, neuro cutaneous stigma.
  - Musculoskeletal: cutaneous spinal dysraphism, joint deformity, leg length discrepancy. Range of motion, contractures.
  - Neurological exam: muscle bulk (atrophy, hypertrophy, distribution), tone (increased, decreased), strength, sensation, reflexes.
Work up

• Blood work:
  • CK

• Special tests:
  • NCS/EMG
  • Muscle or nerve biopsy.

• Genetic
  • CMA
  • Genetic panels for Dystonia, CMT, HSP, etc.

• Imaging:
  • Brain MRI +/- spine MRI.
  • X-ray rarely indicated.
• 174 patients referred from the Orthopedic clinic between 2010-2015.
  • 62% were found to have a neurological etiology for TW.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Count [n (%)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebral palsy</td>
<td>40 (37.0)</td>
</tr>
<tr>
<td>Peripheral neuropathy</td>
<td>18 (16.7)</td>
</tr>
<tr>
<td>Autism spectrum disorder</td>
<td>17 (15.7)</td>
</tr>
<tr>
<td>Hereditary spastic paraparesis</td>
<td>15 (13.9)</td>
</tr>
<tr>
<td>Attention deficit hyperactivity disorder</td>
<td>9 (8.3)</td>
</tr>
<tr>
<td>Syndromic</td>
<td>6 (5.6)</td>
</tr>
<tr>
<td>Spinal cord disorder</td>
<td>3 (2.8)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>108 (100)</strong></td>
</tr>
</tbody>
</table>

• 71% unilateral toe walkers and 32% of bilateral but asymmetric toe walkers were diagnosed with CP (P<0.001).

• 145 had brain MRI, 26% diagnosed CP. Of the 125 (72%) with spinal imaging, 3 had spinal pathology to account for TW.
Red Flags

- Onset of TW after a period of normal walking.
- Unilateral or asymmetrical TW.
- Abnormal neurological exam (Increased or decreased tone, increased or decreased reflexes, muscle weakness).
- Developmental regression, incontinence, back pain.
- ?positive family history.
- ?contractures.
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Management of toe walking.

• Persistent toe walking may be just a cosmetic issue, or may be associated with pain, stress, and gait dysfunction.

• Despite variable pathophysiology, the treatment is similar.

• Indications for intervention and specific type of treatment depend on age, underlying cause, and the severity.

• Treatment options include:
  • Physical therapy.
  • Orthoses.
  • Botulinum toxin.
  • Surgical intervention

• Special considerations for autism, DMD, and treatable causes such as DRD and tethered cord.
Summary

• Toe-walking may be idiopathic, or may be associated with developmental, myopathic, neuropathic, or orthopedic disorders.

• The majority of disorders causing toe-walking can be ruled out through the history and physical examination.

• Management aims at maintaining range of motion, and is case-based.
References:

- Olga, Brown et al. Toe Walking: When Do We Need to Worry?


