Idiopathic Toe Walking Evidence Updates

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Disclosures

Speakers declare no conflicts of interest and have nothing to disclose.

CMS 2017 ITW Objectives

Attendees will:
2. Demonstrate understanding of evidence published in the last 5 years related to PT management of children with ITW.
3. Understand outcomes obtained via CCHMC review of electronic medical records after CPG implementation.
4. Apply ITW current evidence and recommendations to case studies.

What is Idiopathic Toe Walking (ITW)?

A diagnostic term used to describe the condition in which children ambulate with a bilateral toe-toe pattern without any known reason or pathology.

Definition of Idiopathic Toe Walking

• Diagnosis of exclusion
• Other diagnoses associated with toe walking include:
  • Cerebral Palsy
  • Autism Spectrum Disorders (ASD)
  • Tethered Cord Syndrome,
  • Charcot Marie Tooth (CMT)
  • Duchenne or Becker Muscular Dystrophy (DMD or BMD)
  • Spinal Muscular Atrophy (SMA)
  • Talipes Equinovarus (Clubfoot)
• Also referred to as habitual toe walking, toe walking and congenital short tendo calcaneus

Evidenced Based Practice

Definition
• “Open and thoughtful clinical decision making”
• Integration of best available evidence, clinical judgment and patient and family preferences and values

Jewell, 2010
Review of ITW Clinical Practice Guidelines (Published 2011)

ITW Inclusion/Exclusion Review

Inclusion Criteria:
- Ages 2-21
- Onset of TW within six months of walking onset
- Bilateral toe walking
- May include ADHD, sensory processing disorder or other neuropsychiatric diagnoses

Exclusion Criteria:
- Unilateral toe walking
- Sudden onset toe walking
- Autism
- Medical diagnosis that may cause TW (CNS, PNS, orthopedic, neuromuscular, tethered cord)

2011 Clinical Practice Guideline

Includes recommendations for:
- When to refer to PT for toe walking (TW)
- Evidenced-based components of PT examination
- Screenings for sensory processing dysfunction and language delays
- Referrals to specialists to r/o other conditions that cause TW
- Baseline measures for episode of care
- Measures to document at each treatment session
- Frequency and duration for PT episode of care
- Expected outcomes of PT intervention

Screening/Differential Diagnosis

- Sudden onset of toe walking or unilateral toe walking: Refer to Neurologist or Orthopedist
- Signs/symptoms of Autism Spectrum Disorder: Refer to Developmental Pediatrician
- Signs/symptoms of neuro or neuromuscular disorder or myopathy: Refer to neurologist or PM&R
- Congenital orthopedic condition: Refer to Orthopedist

Summary of Treatment Strategies

ITW Treatment strategy recommendations based on ankle dorsiflexion passive range of motion with knee extended (DF PROM KE) restrictions at time of initial assessment:
- DF PROM KE ≤ 0 degrees
- DF PROM KE 0 - 5 degrees
- DF PROM KE 5 - 10 degrees
- DF PROM KE ≥ 10 degrees

Treatment Recommendations: DF PROM KE ≤ 0 degrees

<table>
<thead>
<tr>
<th>Treatment Emphasis</th>
<th>Goal</th>
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</thead>
<tbody>
<tr>
<td>Serial Casting up to 6 weeks</td>
<td>DF PROM KE to ≥ 10 degrees</td>
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Additional Considerations:
- If DF PROM KE ≤ 0 following serial casting, consider referral to PM&R for Botox
### Treatment Recommendations: DF PROM KE 0 - 5 degrees

<table>
<thead>
<tr>
<th>Treatment Emphasis</th>
<th>Prolonged stretch through night splinting, establish home program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>↑ DF PROM KE to ≥ 10 degrees</td>
</tr>
<tr>
<td>Treatment Strategies</td>
<td>Prolonged stretching with night splinting, manual therapy, joint mobilizations, standing balance, HEP</td>
</tr>
<tr>
<td>Additional Considerations</td>
<td>If ankle DF PROM KE is ≤ 0 to 5 degrees after 4 to 6 months consider serial casting with/without Botox</td>
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### Treatment Recommendations: DF PROM KE 5 - 10 degrees

<table>
<thead>
<tr>
<th>Treatment Emphasis</th>
<th>Night splinting progressing towards daytime articulated AFOs as tolerated</th>
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<tbody>
<tr>
<td>Goals</td>
<td>↑ DF PROM KE to ≥ 10 degrees</td>
</tr>
<tr>
<td></td>
<td>↑ Spontaneous heel-toe gait pattern and presence of 2nd rocker during stance phase</td>
</tr>
<tr>
<td></td>
<td>↑ Balance skills</td>
</tr>
<tr>
<td>Treatment Strategies</td>
<td>Stretching, strengthening, manual therapy, joint mabs, gait/treadmill training, balance training, augmented auditory feedback, orthotics, including night splint and HEP</td>
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### Treatment Recommendations: DF PROM KE ≥ 10 degrees

<table>
<thead>
<tr>
<th>Treatment Emphasis</th>
<th>Articulated AFOs for daytime use</th>
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<tbody>
<tr>
<td>Goals</td>
<td>Maintain/increase ankle DF PROM KE</td>
</tr>
<tr>
<td></td>
<td>↑ Heel-toe walking to ≥ 75%</td>
</tr>
<tr>
<td></td>
<td>↑ OGS score improvement</td>
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<tr>
<td>Treatment Strategies</td>
<td>Articulated AFOs, possible night splinting, stretching, strengthening, manual therapy, joint mabs, gait/treadmill training, auditory feedback, balance training, HEP</td>
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<tr>
<td>Additional Considerations</td>
<td>Foot orthotic may be needed to maintain foot integrity, Consider functional use/quality of movement during gross motor skills</td>
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### ITW Intervention Priorities

- Obtain 10 degrees ankle DF PROM KE (stretching, night splints, serial casting)
- Strengthening core and lower extremities, postural training, locomotor training, balance training, articulated AFOs during the day
- Wean from daytime articulated AFOs, transition to HEP

### Frequency of PT Intervention

PT intervention frequency may be **increased** due to:
- Difficulty with HEP or PT treatment
- Decreased progress towards goals

PT intervention frequency may be **decreased** due to:
- Accelerated progress towards goals independence with HEP
- Non-compliance with PT recommendations

### Plateaus in Progress

At any point, if the child with ITW is not progressing towards goals, in spite of compliance with HEP and PT treatment/recommendations, recommend referral to PM&R.

- Botox injections provided by PM&R may increase ankle DF PROM gains and heel-toe ambulation during spontaneous gait when other conservative measures have not.
Discharge from PT

It is recommended that a child be discharged from PT when the following physical therapy goals have been met:

• Ankle DF PROM KE ≥ 10 degrees
• Heel-toe walking ≥ 75% or more of the time during spontaneous gait
• Independence with HEP
• Age-appropriate balance and gross motor skills

Discharge from PT

It is recommended that parents be instructed that plateaus in ankle passive or active range of motion and/or return of toe walking may occur due to:

• Growth spurt
• Anxiety
• Fatigue/illness
• Lack of follow through at home

If no improvements are seen after resuming home exercise program for 4 weeks, physical therapy reassessment may be indicated.

Current PT Practice: Survey Results

Survey Monkey
DD therapists at PCH and CCHMC (34 responses)

Results:

<table>
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<tr>
<th>Confidence in using CPG</th>
<th>70 % Very confident</th>
<th>18 % Somewhat Confident</th>
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<tbody>
<tr>
<td>Ease of implementing CPG</td>
<td>53 % Very Easy</td>
<td>35 % Somewhat Easy</td>
</tr>
<tr>
<td>Frequency of adherence to CPG</td>
<td>29 % Always</td>
<td>67 % Very Often</td>
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Reported Barriers to Implementation

CCHMC and PCH PTs reported the following barriers to implementation of the CPG and adherence to recommendations:

• Sensory or behavioral concerns of child that limit tolerance for recommended treatment
• Scheduling availability for PT services
• Confusion about treatment interventions
• Confusion about frequency/duration recommendations
• Confusion about inclusion/exclusion criteria
• Patient/family preferences and adherence to treatment recommendations

Requests for additional information or training

CCHMC and PCH PTs requested the following additional information or training:

• Treatment strategies for ITW, especially for children with suspected or diagnosed SPD
• Information about current orthotic intervention recommendations
• Assessment measures and outcome measures
• When, why, and how to refer for serial casting
• Long-term consequences of toe walking
• Strategies for maximize patient/family education, adherence and "buy in"

Literature Review 2016

> 40 new articles reviewed related to:

• Etiology/population characteristics
• Examination
  • Sensory impairments
  • Gait analysis
  • Range of motion measurement
  • Postural assessment
  • Quality of life
• Interventions and plan of care
• Review articles
**Evidence Updates:**
**ITW Etiology and Population Characteristics**

- **Birth History**
  1. Baber, 2016
  2. 95 children with ITW, mean age 5.8 +/- 2.9 years
  3. Compared to children who do not toe walk (TW), children with ITW found to have greater rates of:
     - Prematurity
     - Admission to special care nursery or NICU
     - Lower birth weight
  4. **Conclusion:** ITW gait associated with greater incidence of complications during and after birth compared to children who do not TW.

- **Genetic Predisposition**
  1. Two articles assessed family history of TW:
     - Pomarino 2016 (836 children with ITW)
       - 42% of children with TW had positive family disposition
       - Children with positive family disposition more “severely affected” than non TW children on unique measures.
     - Engstrom 2012 (51 children with ITW)
       - 61% of children had 1+ relatives with history of TW
       - In 47% first-degree relative had history of TW

- **SPD in ITW – Review and Theory**
  1. Williams et al, (2010) performed literature review regarding relationship between ITW and SPD
  2. Results:
     - Primarily anecdotal references, conference abstracts and case reports (low level evidence)
     - 3 articles identified possible link between toe walking and SPD, however all were low-quality, none demonstrated causal relationship of ITW

- **Sensory Assessment Measures**
  1. Multiple sensory assessment measures reported in ITW literature:
     - Short Sensory Profile (SSP) (Ganley 2016)
     - Sensory Profile (SP) (Williams 2014)
     - Sensory Integration and Praxis Test (SIPT) (Williams 2014)
     - Mean Vibration Threshold of 1st MTP joint (MVT) (Fanchiang 2015, Ganley 2016)

- **Sensory Processing in ITW**
  1. Performance of children with ITW on Sensorimotor Measures:
     - Short Sensory Profile (SSP)
       - 73 % of toe walkers (TW) “Probable difference” or “Definite difference” vs. 7 % of non TW
       - Did not exclude children with Autism (Ganley 2016)
     - Sensory Profile (SP)
       - Children with ITW scored “Probable Difference” in two quadrants: Sensory Seeking and Low Registration (Williams 2014)
3. Sensory Integration and Praxis Test (SIPT)
   Children with ITW demonstrated significant differences in Standing Walking Balance subtest (Williams 2014)

4. Bruininks-Oseretsky Test of Motor Proficiency (BOT-II)
   ITW group "below average" on Bilateral Coordination, Balance, and Upper-Limb Coordination
   By 8 years old, ITW group scored "average" on all but Upper-Limb Coordination (Williams 2014)

Sensory Processing in ITW

Mean Vibration Threshold (MVT)
- Significantly higher in TW group (not just ITW) compared with controls at the MCP and MTP joints = hyposensitive (Gamley 2016)
- Significantly lower in TW group compared with controls at 1st MTP joint = hypersensitive (Williams 2012, Williams 2014)

Walking surface may influence gait pattern in children with ITW (Fanchiang 2016)
- Improved heel strike when ambulating barefoot on pea gravel vs carpet or tile

Sensory Processing

Bottom Line:
- Sensory impairments may exist in some children with ITW, however specific impairments may differ by child.
- Causal relationship between SPD and ITW has not been demonstrated.
  ➢ Continue to recommend screening of ALL children with ITW for sensory processing impairments. Refer to OT if concerns regarding sensory processing.

Neuropsychiatric Symptoms & ITW

Engstrom, 2012
- Purpose: cross-sectional study to assess the incidence of neuropsychiatric symptoms in children with ITW compared to children without ITW
- Sample: 51 children (4 - 14 years) with ITW
- Outcome Measure: Five to Fifteen (FTF): parent questionnaire developed to screen for neuropsychiatric symptoms in children 5 to 15 years of age.

Neuropsychiatric Symptoms

- Children with ITW scoring above the 90th percentile on the Five to Fifteen questionnaire (indicating difficulties):
  - Motor skills 39.0%
  - Executive function 17.6%
  - Perception 25.5%
  - Memory 23.5%
  - Language 23.5%
  - Learning 25.9%
  - Social skills 25.5%
  - Emotional/behavioral problems 21.6%

  Conclusion: Children with ITW as a group displayed more neuropsychiatric problems than a normative group of age matched children.

Evidence Update
Natural History of ITW
Natural History

Engstrom, 2012

- **Purpose:** To determine incidence of toe walking in 5 year old children in Sweden
- **Sample:** 1436 with TW (not all ITW)
- **Results:**
  - 50% of children at 5.5 years of age with history of TW no longer walked on toes per parent report
  - Only 1/3 of “active” TW had significantly decreased ankle DF PROM

Study Limitations:

- Children who were “inactive” TW were not evaluated
- Examiner not blinded to subjects
- Authors included children who TW with Autism in study population
- Retrospective study with possibility for recall bias by caregivers

Natural History

**Bottom Line:**

- No change in practice recommendation for PT referral if child is ≥ 2 years of age and TW > 25% of the time
- At present, cannot predict who will “resolve” TW
- Earlier onset of PT may lead to improved outcomes and decreased PT visits or episodes of care to resolve TW

ITW Examination

- Gait Analysis
- Ankle ROM Measurement
- Foot/Ankle Postural Assessment
- Quality of Life

Typical Gait Pattern > 8 years

http://www.southfloridasportsmedicine.com/gait-disturbance.html

Characteristics of Gait in ITW

- PF in stance and/or swing phase of gait
- Lack of 1st and 2nd ankle rockers
- Decreased 3rd rocker
- Premature heel-rise
- Excessive midfoot pronation, hindfoot eversion and/or out-toeing during stance
- Knee hyperextension during stance
- Increased anterior pelvic tilt, increased hip flexion and lumbar lordosis throughout gait cycle
Gait Analysis - MAL

Motion Analysis Lab (MAL) = gold standard

Benefits
- Allows for quantitative and qualitative assessment of multiple joints and multi-segment analyses
- Allows for classification of ITW based on Alvarez (2007) and calculation of HR32 (Fanchiang 2016)

Limitations:
- Feasibility
- Availability, time, costs
- May not be represent walking pattern outside of MAL

HR 32: What is it?
- 3rd ankle rocker occurs between heel rise (HR) @ 32% of gait cycle and toe off @ 60% of gait cycle.
- Early 3rd rocker = HR occurs earlier than 32% of gait cycle.
- Increase in heel marker height before 32% of the gait cycle is indication of early HR or toe-contact pattern.
- The greater the heel marker height at 32% of the gait cycle, the earlier heel rise event occurrence.
- HR32 = difference between the heel marker in static stand and at 32% of gait cycle.


Toe Walking Severity Scale

Benefits:
- Easy to score

Limitations:
- Validity has not established.
- Correlation with other clinical measures unknown (ankle DF PROM)
- Correlation between clinical observation and parent report unknown

Beilman 2016

Observational Gait Assessments

Benefits:
- More readily available, timely and cost-efficient for clinical use than MAL
- Reliability with video

Limitations:
- No observational assessments validated for children with ITW
- Significant variability noted in validity and reliability studies
- Limited psychometrics on MCID and MDD
- Unknown correlations with ankle DF PROM, gross motor skills, posture, patient/family satisfaction

Observational Gait Assessments

• Edinburgh Visual Gait Analysis (EVAS)
• Observation Gait Analysis (OGA)
• Physician Rating Scale (PRS)
• Observational Gait Scale
• Visual Gait Assessment Scale
• Salford Gait Tool

(Bella 2012, Moissenet 2015)
The Foot Posture Index (FPI-6)

• FPI-6 is a diagnostic clinical tool aimed at quantifying the degree to which a foot is pronated, supinated or in a neutral position.
• Derived from 140 articles which identified 36 distinct clinical measures.
• Evaluates six clinical criteria.
• Has been found to be more valid than many static weight bearing and non-weight bearing goniometric measures.

The Foot Posture Index (FPI-6)

Gijon-Nogueron 2016

Purpose: Determine FPI reference values in childhood, taking into account age and gender
Sample: 1,762 Children (863 boys, 899 girls)
Results:
Normative FPI value for the pediatric population:
Age 6 years = 4 (FPI points) children of both genders
Age 11 years = 3 FPI points
Pathologically pronated foot = 85th percentile
Pathologically supinated foot = 4th percentile

Weight Bearing Lunge Test

1. Patient stands against wall with about 10 cm between feet and wall.
2. One foot back a foot’s distance behind the other.
3. Bend the front knee until it touches the wall (keeping the heel on the ground).
4. If knee can not touch wall without heel coming off ground, move foot closer to wall then repeat.
5. If knee can touch wall without heel coming off ground, move foot further away from wall then repeat.

Sacral Angle Measurement

Pomarino 2016

• Lumbar lordosis angle is increased in patients with habitual toe walking.
• Goniometer is placed at the point of the greatest convexity at the lumbar spine with the child in upright and neutral zero position. Lumbar lordosis angle measured and rounded up to the nearest 5 degree interval.
Quality of Life

Williams 2015
Using PedsQL 4.0, compared with non TW peers, children with ITW ...

• Parents of children with ITW reported significantly lower values on Total, Psychosocial, and Emotional subscales.
• Children with ITW self-reported significantly lower values on Physical, Psychosocial, and School subscales.
• Adults with ITW (past or current) reported calf pain and increased calluses and corns on balls of feet.

Conclusion: Children with ITW may have decreased quality of life compared to non ITW peers.

Oxford Ankle Foot Questionnaire

• Measures subjective well-being for patients 5-16 years affected by foot and ankle conditions using issues that are important to children.
• 15 item questionnaire includes physical, school and play, and emotional.
• Additional question asking if their foot or ankle stopped them from wearing any shoes they wanted to wear.
• Validity and reliability established, is responsive and longitudinally valid.

ITW Interventions

• Observation
• Sensory Interventions
• Orthotic Interventions
• Botox and Serial Casting
• Surgery

Intervention: Observation

• Toe walking is considered (by some, anecdotally) to be a normal phase of typically developing gait, but this has not been documented in gait development literature.
• Engstrom (2013) reported more than half of the children in their study spontaneously ceased toe walking by age 5 ½.
• Bishop (2016) recommended children younger than 2 without a contracture should be monitored as gait may improve after 2-3 years old.

➢ Bottom line: Intervention to address ankle DF PROM, strength, gait, posture and balance strategies to prevent secondary complications are recommended for children with ITW.

Sensory-Based Interventions

Theory:
• Children with ITW have altered vibration sensitivity compared with controls (Williams 2016, Ganley 2016)
• Whole Body Vibration (WBV) has been used to improve postural sway, and ambulation in adults with neurological impairment

Findings in ITW:
Fanchiang 2015
• Did not significantly change gait kinematics in children with ITW or non TW (30 Hz x 60 seconds)
Williams 2016
• Children with ITW had immediate increase in heel strike after WBV, not sustained 20 minutes post WBV
• Increase in stride length and velocity were sustained 20 minutes post WBV
• Improved weight bearing lunge test (improved ankle DF ROM) after WBV, not sustained at 20 min following WBV
Sensory-Based Interventions

**Bottom Line:**
- Additional research is needed to investigate the use of WBV in ITW with regards to efficacy, dosing parameters, and patient/family satisfaction
- Paucity of research assessing use of sensory integration strategies in the treatment of ITW
- Team is collaborating with OT to identify most appropriate sensory screening tools
  ➢ Continue to recommend referral to OT if sensory processing difficulties are suspected

Orthotic Interventions

**Pyramid Insoles**

Pomarino, 2016

**Three-Step Pyramid Insole Treatment:**
1. Patient wears pyramid-shaped insoles every day for 6-8 weeks, may also receive physical therapy.
2. Patient wears night splints if less than 0 degrees of ankle dorsiflexion.
3. At follow up BTX-A will be recommended if the insole and night splint haven't resulted in improved gait pattern or patient continues to demonstrate decreased ankle PROM.

**Orthotic Interventions: CFOs vs AFOs**

Herrin & Geil 2015

**Purpose:**
- RCT to examine effects of AFO versus carbon foot orthotic (CFO) on TW over 6 weeks on children with ITW, ages 2-8

**Outcome Measures:**
- 3-D gait analysis
- L-test of Functional Mobility
- Parent satisfaction survey

**Orthotic Interventions: SMO with plantarflexion stop**

Kevin Matthews, Orthotist
Advanced Orthotic Designs
San Antonio

Provides medial/lateral ankle stability, can correct over pronation and provides tactile cue to decrease toe walking. Anecdotal evidence only.

Sure Steps has a similar product: Toe walking modification to SMO.

**Orthotic Interventions: Pyramid Insoles**

(Pomarino 2016)
Orthotic Interventions

Williams 2014
Case series with different orthotic approaches

Case 1:
- Treatment included arch filler in the footwear to provide sensation of full foot contact in the shoe.
- Decreased TW at 3 and 6 months when shod with arch filler.
- F/U at 6 month intervals and noted positive effect of arch-filler and decrease in TW when barefoot.
- At 3 year f/u, minimal TW in/out of shoes.
- Proposed that TW due to sensory issues and encouraged close monitoring of ankle DF PROM.

Williams 2014 cont.
Case 2:
- Initially treated with serial casting, but had allergic reaction.
- Provided with night splints and HEP consisting of eccentric heel raises on incline board with minimal results.
- Botox-A injection with change in casting material for weight bearing cast for 7 days. Then full-length carbon custom orthotics with rear foot control and HEP of heel-raise stretching on incline board.
- 3 years after initial presentation, no TW with shoes without orthotics. Minimal TW noted at home by parents.
- Gait observation noted early heel rise at mid-stance which may indicate residual equinus though reduction in overall TW.

Orthotic Interventions

Bottom Line
- Additional research is needed regarding most appropriate orthotic intervention for children with ITW.
- Orthotic choice may be dependent on sensory concerns and/or presence of joint hypermobility in addition to ankle DF PROM.
- Clinical judgement and use of appropriate outcome measure are important.
- Family and patient values, ankle DF PROM and foot posture all play a role in orthotic recommendations.
  - Articulated AFO has been used in a number of studies as part of successful ITW treatment plan, remains primary recommendation for most children with ITW when more than 10 degrees ankle DF KE has been achieved.

ITW Interventions: Botox
Engstrom 2013
- No difference in gains made in ankle DF PROM, ankle DF strength, gait variables or cessation of TW with Botox + casting versus serial casting alone.

Beilman 2016
- No significant difference between groups for ankle DF ROM or function.
- Children s/p Botox injections achieved results quicker.
- No significant difference between groups for cessation of TW per PT observation or parent report.
- Greatest improvements in gait by 12 months, plateauing after.
- 38 adverse effects (87% mild to mod) noted in 30 Botox treatments.

ITW Interventions: Botox

Beilman 2016
Purpose
RCT to evaluate if conservative treatment with Botox is more effective than conservative treatment alone.

Intervention
Control group (n=14): shoes with firm heel cup and straps, night splints, home stretching program and weekly PT x 12 months.
Treatment group (n=16): same as the control group with Botox injections in 6 month intervals.

Results:
Both groups improved significantly over the 24 month study period.
Between group differences not significant.

Bottom line:
- Recommend serial casting without Botox injections for children with ITW with ankle DF PROM limitations (equal to or less than 0 degrees of ankle DF PROM KE).
- Consider referral for Botox injections if sufficient PROM gains not made with casting alone or if TW does not resolve with conservative management.
ITW Interventions: Serial Casting

Engstrom 2013
- Bilateral below-knee walking casts worn for 4 weeks followed by stretching after cast removal.
- Gait characteristics improved for initial contact, ankle dorsiflexion in stance and swing phase.
- Improvements in kinetics regarding power at the ankle.

Bishop 2016
- Recommend serial casting if no response to conservative management.

➢ Bottom line: No change in recommendation for serial casting for children presenting with ≤ 0 degrees of ankle dorsiflexion with knee extended.

ITW Interventions: Surgical Management

McMulkin 2016
- Assessed long term kinematic and kinetic outcomes for gastrocnemius/soleus contractures.
- Children with ITW treated surgically for triceps surae contractures showed significant improvements in key kinematic and kinetic gait analysis variables at 1 year post-operative that were maintained at 5 years post-operative.
- Overall, subjects were satisfied with outcomes of the surgery, unrestricted in activities, and reported minimal pain.

ITW Interventions: Surgical Management

Oetgen 2012
- Recommended neurodevelopmental disorders be ruled out.
- Treatment should be based on age of patient and physical findings.
- Children with fixed equinus contracture should undergo surgical lengthening of the triceps surae muscle-tendon complex.

➢ Bottom line: We continue to recommend referral to Orthopedics for children with less than 10 degrees of ankle DF PROM KE despite conservative treatment.

➢ PT evaluation and treatment and orthotic management is recommended following surgery.

Interventions: Review of articles

Dietz 2012
- Retrospective study with questionnaires sent to 98 with 14 returned to determine effectiveness of treatment.

Recommendations:
- ITW should be considered a cosmetic deformity and treated only if gait concerns the family.
- Non surgical treatment can be used in surgery-averse families even though its effectiveness is uncertain.
- Surgical treatment is a reasonable choice for families desiring rapid resolution of the toe walking.

Interventions: Review of articles

Ruzbarsky 2016 cont.
- For children that fail casting or have severely limited ankle DF PROM and cannot achieve DF to neutral, surgical lengthening can be considered. A short course of physical therapy after casting or surgery is reasonable to recover strength.
- In children who achieve good DF, but the ‘habit’ of toe walking persists, an AFO may be considered.
- Patients who TW and are diagnosed on the Autism spectrum may benefit from similar interventions, but limited progress or tolerance to treatments may be observed.
Interventions: Review of articles

Oetgen 2012

- Recommend observation in children younger than 2 years as TW may spontaneously resolve
- PT for stretching, bracing, and night splinting may be beneficial
- Success with nonsurgical management of ITW varies.
- Important to rule out underlying neurodevelopmental disorders and refer appropriately.

- Physicians should provide treatment options and involve the parents in treatment planning.

Chart Reviews - Process

- Inclusion Criteria:
  - Charts of patients placed on the ITW CPG by therapists in EMR between 3/2011 and 10/2016
  - Charts of patients between ages 2-17 years at time of initial evaluation
- 685 patient records identified
- Detailed chart reviews completed for subset of patients

Retrospective Chart Review

Analyses Performed

- Descriptive Statistics
- Comparative Statistics
  - Gender
  - Age at time of referral
  - Duration of episode of care
  - Initial and final ankle DF PROM with KE
  - Initial and final parent report of % of time spent heel toe walking
- Correlational Analyses
- Regression Analyses

Retrospective Chart Review - Results

Case Study

Take Home Messages - ITW

- Cause of ITW is still unknown.
- Theories on cause of ITW include: sensory, neurological, genetic.
- Population of children with ITW may not be homogenous in terms of impairments or cause.
Take Home Messages - ITW

Additional research needed in the following areas:
- Prognostic factors for ITW resolution
- Optimal timing, frequency and types of interventions for improved outcomes
- Development of diagnosis-specific outcome measures for gait, balance, and gross motor skills
- Optimal patient/family educational materials to improve adherence to PT recommendations and outcomes

Future research should accept uniform minimum ankle DF needed for heel-toe gait pattern to improve comparison of results.

Take Home Messages - CPG

- CPGs can improve standardization of care and contribute to optimal patient outcomes and value of therapy services.
- Development of computerized documentation to facilitate workflow and clinical decision making at point of care, database development, and therapist education regarding CPGs is needed to improve clinical care and outcomes for this population.

References
