

# IDIOPATHIC TOE WALKING IN CHILDREN

Chris Wallace, MHS, CPO, FAAOP

Dawn Davis, CO, CPed, COTA

# OBJECTIVES

- Participants will be able to define idiopathic toe walking (ITW) and discuss the prevalence among children today.
- Participants will be able to discuss the evaluation process and common historical treatment options for ITW.
- Participants will understand outcome measures and goals that can be employed to evaluate successful treatment for ITW.
- Participants will be able to discuss orthotic interventions as well as observations from orthotists on possible orthotic treatment options.



## WHAT IS ITW?

- ITW is a habitual persistence of failing to achieve heel contact in a child with no known neurological or orthopedic conditions at a time when physiological heel to toe gait pattern should be exhibited.
- Generally considered to be after age 2 and at least 6 months after independent walking is initiated.



# DISCUSSION

- Referrals for “idiopathic” toe walking are fairly common
- Treatment protocols vary widely and guidelines for treatment are limited
- We cannot touch on every treatment option today but will focus on the most common.
- To treat or not to treat?? The answer may well depend on the clinical presentation and be subject to the treating clinician’s observations vs empirical evidence
- Current theories regarding ITW include increasing sensory stimulation to increase support tone in lower limbs during gait and/or clinically undetectable neural impairments. <sup>(3)</sup>
- Some argue that the determinate of a correct ITW diagnosis is if the child can achieve normal gait by choice. <sup>(3)</sup>

## RESEARCH OF ITW

- Very few even medium-term follow up studies (<6 mos)
- Most studies are retrospective which creates challenges when trying to compare them since inclusion criteria is different.
- No standard treatment protocols
- Different determinates of success.
- Inconsistency in outcomes
- Small sample sizes
- Inconsistent ages included in many studies
- Only 1 study assigned random treatment to different groups. Two other studies (non-random, retrospective) incorporated non-treatment groups at all.

## CHARACTERISTICS OF ITW

- As stated in the definition the hallmark characteristics of ITW are a failure to achieve initial heel contact particularly in a child who otherwise should.
- Typically observed in children aged 2-7 years who have been toe walking for at least 6 months.
- Toe walking occurs at least 50% of the time.
- ITW is always bilateral and symmetrical.<sup>(2)</sup>
- Evidence of familial incidence up to 32%.<sup>(2) (11)</sup>
- No evidence of progressive muscular weakness.
- Most have at least some limited dorsiflexion.<sup>(11)</sup>



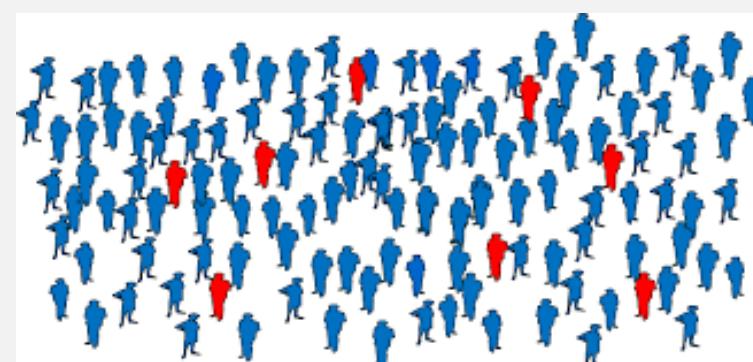
# CHARACTERISTICS OF ITW

- During gait assessment children with ITW were found to have premature onset of gastrocnemius activity during terminal swing phase along with abnormal timing of tibialis anterior activity and overlapping of these muscle groups. (11)
- One finding noticed that a group of children with ITW had EMG findings more closely resembling a group with CP than with a control group. (11)
- There are some studies that suggest ITW may be a marker for other developmental problems



## ITW PREVALENCE AND HISTORY

- While the evidence is mixed, prevalence of ITW is reported to be around 5% in children over 2 years of age with some reports as high as 7%.<sup>(7)</sup>
- Typically slightly greater prevalence in males
- Some report spontaneous remission of 50-70% within 6 months of onset.
- ITW is a diagnosis of exclusion



# WHY TREAT ITW?

- A better way to ask this may be to say “What are the potential long-term effects of ITW if left untreated?”
- Untreated ITW may lead to limited mobility in the ankle (loss of dorsiflexion), backache and knee pain.<sup>(5)</sup>
- Anecdotal and documented evidence also exist of increased lumbar lordosis with spondylolysis and osteochondritis dessicans of the talus and/or femoral condyles in long-term follow ups.<sup>(2)</sup>
- Persistent equinus positioning may result in contractures and permanent shortening of the gastrocnemius/soleus muscle complex.<sup>(2)</sup>
- ITW puts children at a greater risk of falls and requires greater effort than normal gait.<sup>(3)</sup>
- Some studies suggest that non-surgical treatment of ITW is of minimal value and should be avoided if toe walking does not trouble the patient or parents.<sup>(14)</sup> This is in comparison to studies that suggest postponing treatment may be harmful as well.<sup>(4)</sup>

TO TREAT OR NOT TO TREAT  
THAT IS THE QUESTION

# EVALUATION OF ITW

- Because ITW is a diagnosis of exclusion a thorough evaluation of the patient ruling out other neurological and/or orthopedic issues is necessary.
- History taking:
  - How old was the child when they reached milestones?
  - What age did they begin toe-walking?
  - Is the toe-walking bilateral?
  - Any family history of neurological or muscle disorders?
  - What % of time is spent toe walking?
  - If asked, can the child walk flat-footed?



# EVALUATION OF ITW

- Physical exam
  - Begins with observing gait
  - Check for LLD
  - Assess ROM at hips, knees and ankles
  - Evaluate for contractures/tightness particularly at gastroc/soleous
  - MMT, reflexes, sensation?
  - Some studies suggest ROM limitations may be congenital but a lack of longitudinal studies from birth makes it impossible to draw this conclusion definitively



## GOAL SETTING FOR TREATMENT

- Increasing or maintaining peak ankle ROM
- “normalization” of gait (Observational)
- Parental Satisfaction?



## TREATMENT OPTIONS

- **Lovell and Winter's Pediatric Orthopaedics, Sixth edition:**

*“The treatment of ITW [idiopathic toe walking] begins with instructions given to the parents regarding the importance of a long-term commitment to assisting the child with both **heel cord stretching and dorsiflexion strengthening exercises...** If toe walking persists, serial heel cord dorsiflexion casts should be considered... After casting, articulated AFOs with plantarflexion stops are used fulltime... If the use of serial stretching casts does not realize a satisfactory clinical improvement in the tendency to toe-walk, then heel cord lengthening procedures will be necessary to effect a change in gait. Persistent toe-walking secondary to a heel cord contracture can potentiate both forefoot splay and disproportionately wide forefoot compared to the heel. Standard footwear may not accommodate the wide forefoot and narrow heel. External tibial torsion frequently develops to compensate for the lack of foot flat contact. This external tibial torsion deformity becomes more obvious once the heel cord has been lengthened. It may be severe enough to warrant corrective osteotomy.”* <sup>(14)</sup>

## TREATMENT OPTIONS

- **Cincinnati Children's Hospital Medical Center:**
  - Developed an Evidence-Based Care Guideline for Management of Idiopathic Toe Walking
    - They recommended a sequence of PT, casts, AFOs and TAL for failures. <sup>(14)</sup>
    - Treatment largely determined by passive dorsiflexion measurements and percentage of time spent toe-walking.

## TREATMENT OPTIONS

- **Journal of Family Practice (2006):**
  - “What is the appropriate evaluation and treatment of children who are toe walkers?”
  - Conclusion was: “There is no convincing evidence that any treatment is necessary for toe-walking.”<sup>(14)</sup>

## TREATMENT OPTIONS

- Options for treatment of ITW may include one or more of the following:
  - No treatment (observation only)
  - Physical therapy
  - Custom insoles and/or footwear
  - Serial Casting
  - AFOs, SMOs or other orthoses
  - Botulinum Toxin type A
  - Surgical lengthening of the Achilles tendon



## TREATMENT OPTIONS

- **Observation only / watchful waiting**
  - May be appropriate when:
    - Younger child
    - Toe walking for short-term
    - No congenital shortening or tightness of Achilles tendon



## ENGSTROM & TEDROFF, 2018<sup>7</sup>

- Large study from Sweden of 1,401 healthy 5.5 year olds
- 5% ITW rate in group
- Followed from age 5.5 to age 10 (no conservative interventions)
- 63 children were or had been toe walkers
- 37 (59%) spontaneously resolved by age 5.5
- 50 (79%) spontaneously resolved by age 8
- No resultant contractures of triceps surae
- Remaining children were either treated surgically or regrouped

# TREATMENT WITH THERAPY

- **Physical Therapy**

- Focus on passive stretching
- Dorsiflexor strengthening exercises
- Active plantarflexor exercises
- May include the use of a night splint to hold positional gains



## TREATMENT WITH THERAPY

- Studies indicate success rates of 44-70%<sup>(14)</sup>
- Often the first course of treatment and combined with other interventions
- Appears to be most successful in younger children (2-4 yrs) with a strong family support system who continue treatment through 2-4 growth cycles.
- Therapists are particularly key in diagnosis, evaluation and goal setting. Establishing baseline and follow up measurements for determining success of intervention.

## TREATMENT WITH CUSTOM INSOLES

- Custom insoles / footwear:
  - Designs typically include some type of metatarsal build up (pyramidal) and a rigid or semi-rigid carbon plate on the plantar surface to resist plantarflexion.
  - Easier to don/doff than AFOs and compliance and wear times are generally higher.<sup>(5)</sup>



## RESULTS/INDICATIONS FOR CUSTOM INSOLES

- One of the main challenges with all orthotic interventions is the lack of conclusive evidence in duration of time an orthosis may need to be employed to maximize positive outcomes.
- Insoles may be effective in very compliant patients who respond well to verbal cueing. May serve as a kinesthetic reminder
- Foot orthoses have shown to be far less effective than AFOs at normalizing gait both observationally and in gait lab findings. (3)
- Parental observation tends to be remarkably similar between orthotic interventions.... Questionable reliability of this outcome type

# TREATMENT OPTIONS

- Serial Casting:
  - Below-knee walking casts set in plantigrade.
  - Cast changes ~ every 2 weeks
  - Assessment of peak passive dorsiflexion during cast change intervals
  - Range of casts are generally 6-10 weeks (once reduced resistance to passive ankle dorsiflexion is achieved)<sup>(12)</sup>



## SERIAL CASTING RESULTS

- Studies report improvement in most cases immediately following casting with gait improvement in ~60% of cases.<sup>(12)</sup>
- Long-term normalization of gait is rarely achieved but parental satisfaction remains high overall.

## TREATMENT AFO/SMO

- AFOs/SMOs or similar bracing:
  - Designs may include articulated with 90 degree stops. These often incorporate a flexible inner liner
  - Free dorsiflexion range facilitates movement, stretching and exercise
  - Should be worn at all times except when sleeping or playing sports
  - Alternative designs such as SMOs with high posterior trim-lines are an alternative especially if the child can achieve foot flat on command



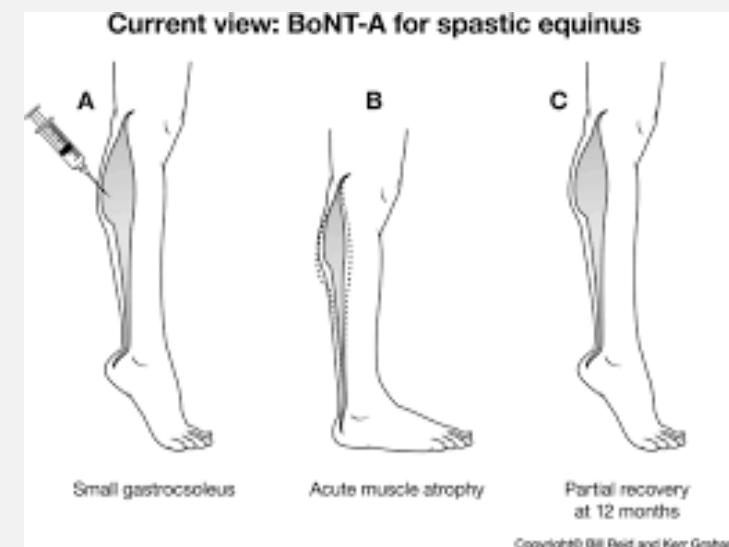
## AFO/SMO RESULTS

- Lack of studies to report on long-term outcomes as a stand alone intervention with only a few small studies indicating 71% showing resolution.<sup>(15)</sup>
- Observed gait while “in brace” is biomechanically well corrected. <sup>(3)</sup>
- Overall compliance tends to be good as long as family support is relatively intact and is reinforced by the team.
- Most effective when combined with PT and other modalities



# TREATMENT WITH BOTOX

- Botulinum Toxin type A
  - Generally incorporated in conjunction with PT stretching program
  - ~6 units/kg bodyweight administered (400 unit max) administered 1x only.<sup>(8)</sup>
  - 4 injection sites in each calf (2 in proximal 1/3 lateral and medial gastrocnemius bellies and 2 distally in gastrocnemius-soleus complex)
  - Injections administered with EMG amplifier guidance
  - Given home stretching program 5x/wk and walk on heels 50x/day
  - No orthotic treatment

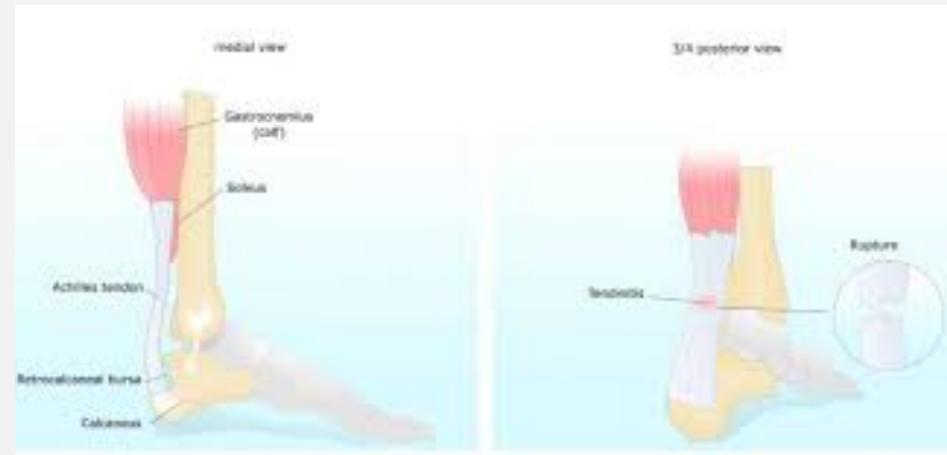


## BOTOX RESULTS

- Initial analysis of kinematic and kinetic data along with PT evaluation at 3 weeks, and 3,6,12 month post.
- In a study with 11 children only 3 completely ceased toe-walking.<sup>(8)</sup>
- Four children decreased toe-walking by ~25%.
- There was some overall improvement in kinematic and kinetic gait analysis but results were inconclusive that BTX administered only 1x was an effective treatment option.

# TREATMENT SURGICAL LENGTHENING

- Surgical lengthening of heel cord
  - Typically reserved for patients that do not respond satisfactorily to conservative treatment options and/or have a presence of plantarflexion contractures
  - Generally performed in children >5 years of age.
  - Appears to have the highest percentage of positive outcomes<sup>(11)</sup>



## SURGICAL LENGTHENING RESULTS

- Study results vary from 70 to close to 100% of children having resolved ITW following surgery.<sup>(14)</sup>
- Some children continued to “occasionally” toe walk but that number was reported to be between 11-25%<sup>(14)</sup>
- Parental satisfaction is very high although gait is not always normalized and weakness may still be evident 1 year after surgery.

## CURRENT TREATMENT OPTIONS AT MRC

- Custom fabricated dorsi-assist AFO
  - Generally includes a flexible inner boot and plantar stop.
  - May also include figure of 8 strap
  - 2-part SMO/AFO
    - High posterior trim-line with posterior plantarflexion limiting strap
    - Custom SMO with high posterior trimlines



## CASE STUDY

- LJ is a 5yo referred with dx of ITW 1/12/2021
- Diagnosed with significant abnormalities of gait and mobility
- Positive for bilateral ankle contracture (-10 active dorsiflexion ROM; passive ROM to zero)
- Adopted by G-parents in 2019
- Overall good physical condition

## CASE STUDY

- Physical exam / gait analysis
  - L/R knee remain in extension throughout most of gait cycle
  - L/R ankles remain in PF with L>R angle
  - Initial contact occurred at the forefoot ~100% of the time
  - L/R Lack of tibial progression
  - L/R knee extension in early stance phase
  - L/R inadequate dorsiflexion
  - No previous orthotic intervention

## CASE STUDY

- Pt is attending PT and OT in school 1x/week
- MMT and ROM at knees were WFL
- Goals:
  - To allow for controlled progression through set and limited range of motion.
  - To prevent development/worsening of joint contractures

# CASE STUDY

- Orthotic recommendation
  - Bilateral AFOs with molded inner boot
  - Articulated (tamarack joints) with 90 degree plantarflexion stop (elite)
  - Knee control strategy: Created a knee flexion moment at loading response
  - Ankle control strategy: Create a heel to toe gait pattern
  - Foot control strategy: Frontal and Sagital
    - Footplate: Full-length with addition of foot strut to stiffen footplate
    - Shoes: Rocker bottom shoe to assist with transition to toe off

## CASE STUDY

- Delivery of AFOs on 2/24/2021
- Gait evaluation with AFOs
  - Initial contact at forefoot reduced to ~40% bilaterally
  - Ankle – tibia is starting to progress over midline
  - Knee- Flexion in early stance

Goals: \*Allow for controlled progression of heel to toe gait ~ 60% of time

\*Prevent development/progression of joint contractures 100% of time pt is in AFOs

## CASE STUDY

- TX plan at delivery
  - To continue PT and OT and follow wear schedule with AFOs. Return to clinic for FU in 2 weeks

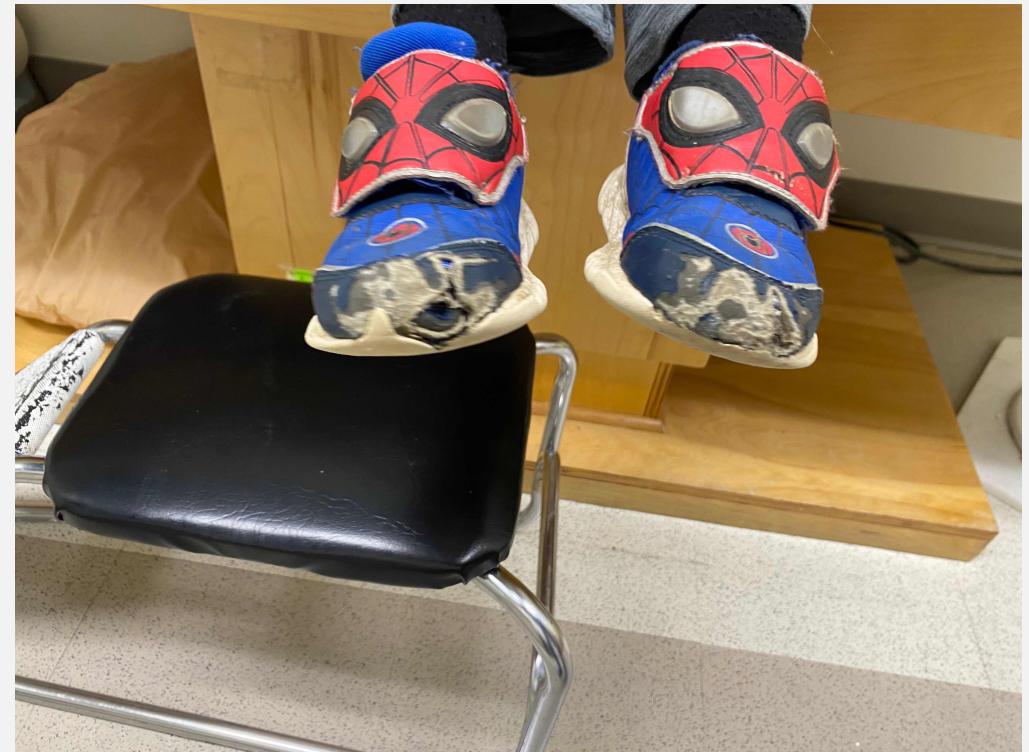
## CASE STUDY

- 4/28/2021
  - FU in clinic- Patient is ambulating with heel to toe gait ~95% time. Caregiver very pleased with results of AFOs. No problems indicated. Skin check was clear. Patient D/C back to MD for follow up.
- 5/26/2022
  - 1-year follow up. Patient seen in clinic for adjustments to AFOs. AFOs are now 2" too short. Adjustments made and requested order for new AFOs



# CASE STUDY

- 6/16/2022

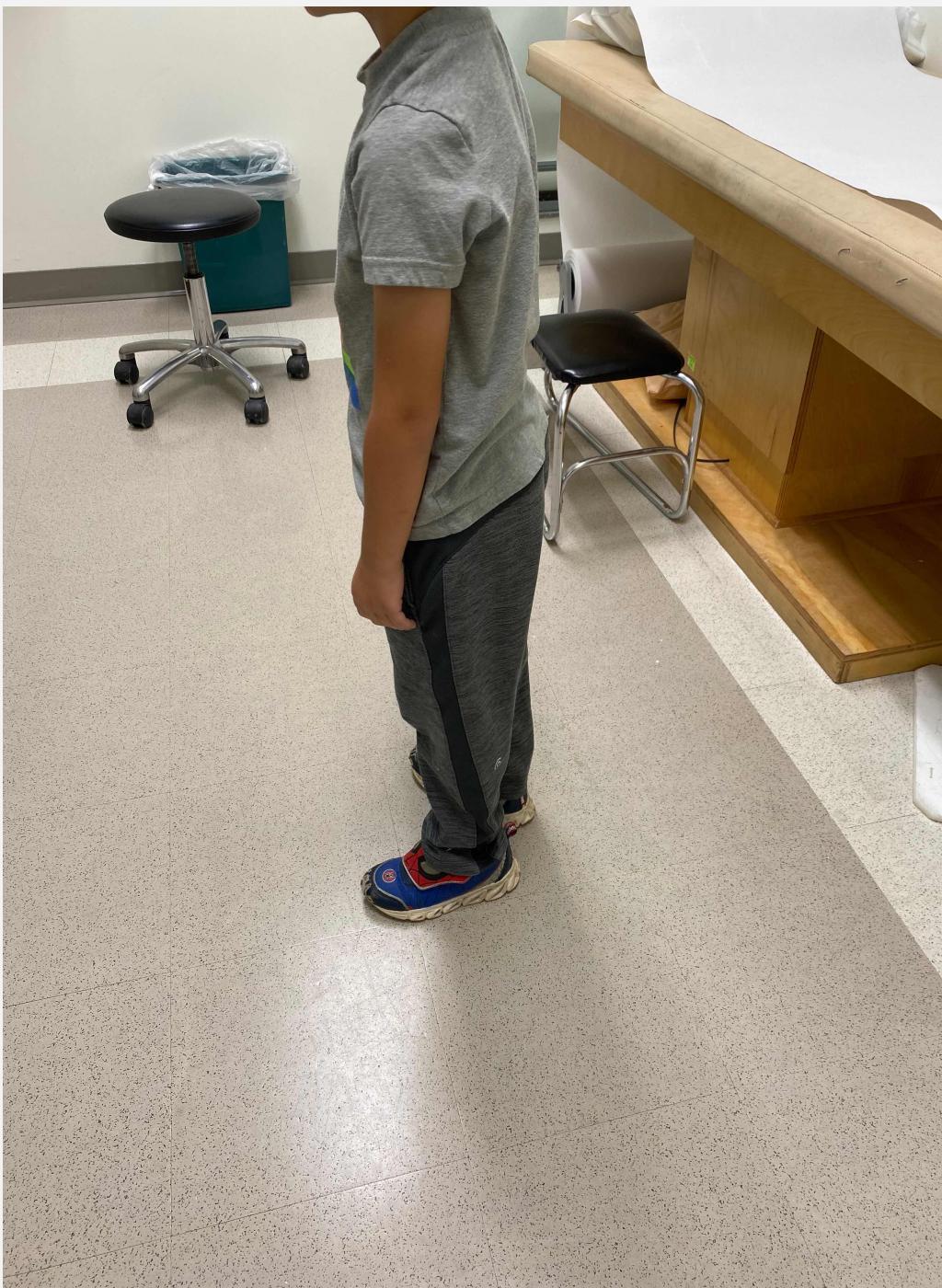


## CASE STUDY

- 6/16/2022
  - Patient still contacts forefoot for initial contact 100% of time w/o braces. However, angle is reduced to 5-10 degrees.
  - Still a lack of tibial progression w/o braces
  - Still noting extension in early stance
  - Inadequate dorsiflexion during swing phase.
  - Pt. still attending PT/OT in school 1x/week

## CASE STUDY

- 6/16/2022
  - ROM – Now able to achieve active ROM at ankle to 0.
  - Knees – bilateral MMT and ROM WFL
  - Goals: Continue previous goals
- Assessment: Patient now able to get bilateral heels onto the floor without anterior trunk lean. Patient highly active. Now has Dx of ADHAD.



## CASE STUDY

- New Orthotic Rx:
  - Bilateral AFOs with molded inner boot.
  - Articulated with 90 degree stop
  - No strut added to foot plate
- Treatment Plan:
  - Continue with PT/OT and return for delivery on 8/1/2022

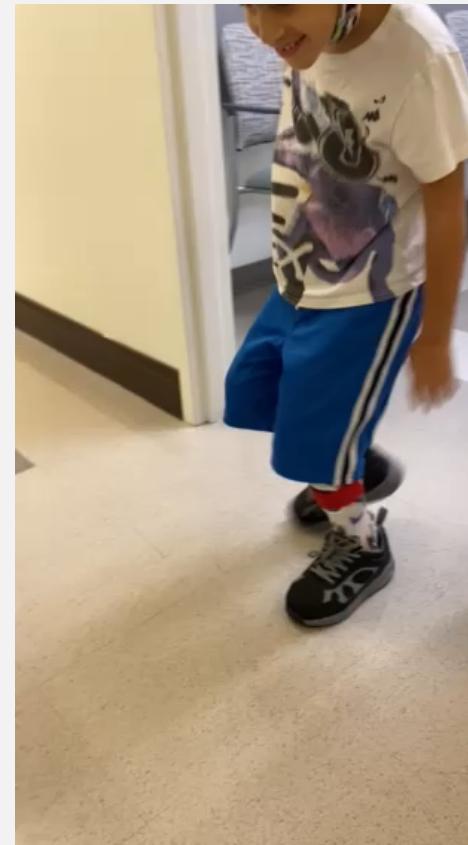
## CASE STUDY

- 8/1/2022 – Delivery of new AFOs
  - Assessment at delivery:
    - Bilateral heel contact 100% of time
    - Tibia progressing over midline
    - Knee flexion in early stance
  - Treatment Plan:
    - Continue with PT/OT and wear schedule for AFOs. FU in 2-3 weeks.

## CASE STUDY

- Final follow up 8/22/2022
  - Seen in clinic for follow up. Minor modifications to AFOs to relieve pressure on malleolus.
  - Patient continues to achieve initial heel contact 100% of time.
  - Tibial progression is consistent
  - Patient D/C back to MD for follow up.

## CASE STUDY



# QUESTIONS?

Chris Wallace, MHS, CPO, FAAOP

[cwallace@mmrcrehab.org](mailto:cwallace@mmrcrehab.org)

Dawn Davis, CO, CPed, COTA

[ddavis@mmrcrehab.org](mailto:ddavis@mmrcrehab.org)

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