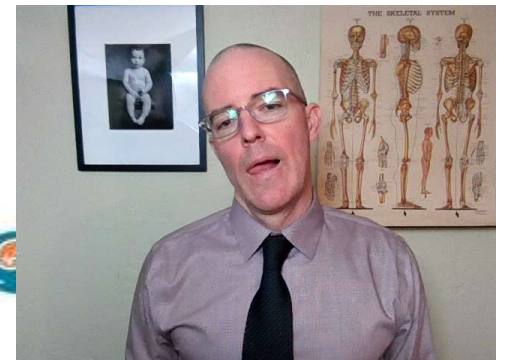


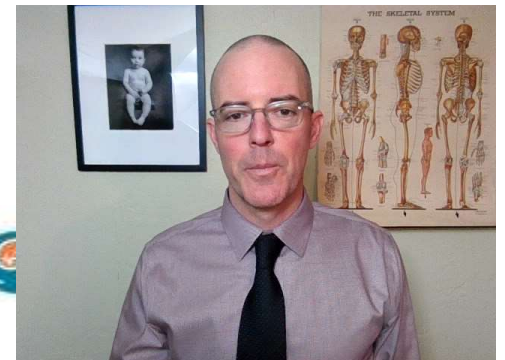
Toeing, Bowing And Flatfeet In Children: Kids come in all shapes and sizes

Patrick Parenzin PA-C



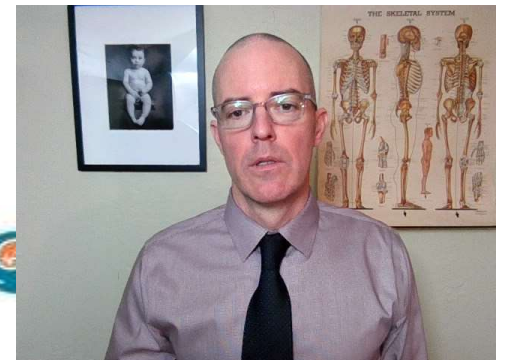
Disclosures

I have no relevant financial or nonfinancial relationships to disclose.



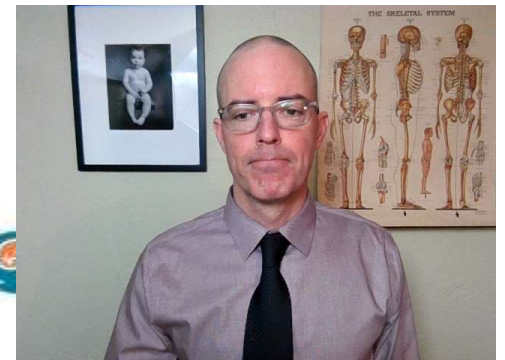
Pre-test

1. What is the most common cause of intoeing in children?
 - a) Femoral Anteversion
 - b) Internal Tibial Torsion
 - c) Blounts
 - d) Metatarsus Adductus



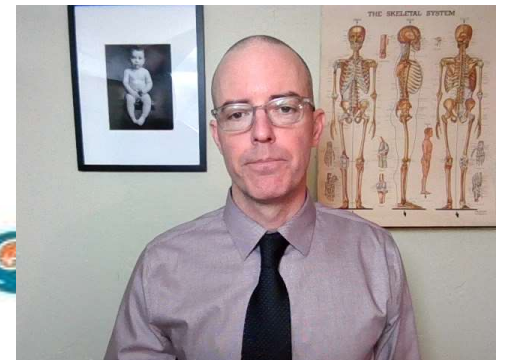
Pre-test

2. What is the best way to evaluate intoeing or outtoeing?
- a) Rotational Profile
 - b) MRI lower extremity
 - c) Xray
 - d) Hip exam



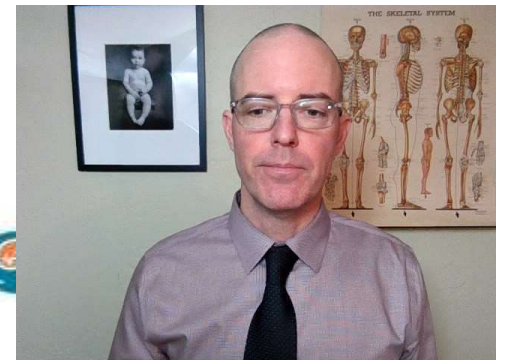
Pre-test

3. What causes “W” sitting and does it cause osteoarthritis?
- a) Developmental Hip Dysplasia, Yes
 - b) Tibial Torsion, No
 - c) Femoral Anteversion, No
 - d) SCFE, Yes



Pre-test cont.

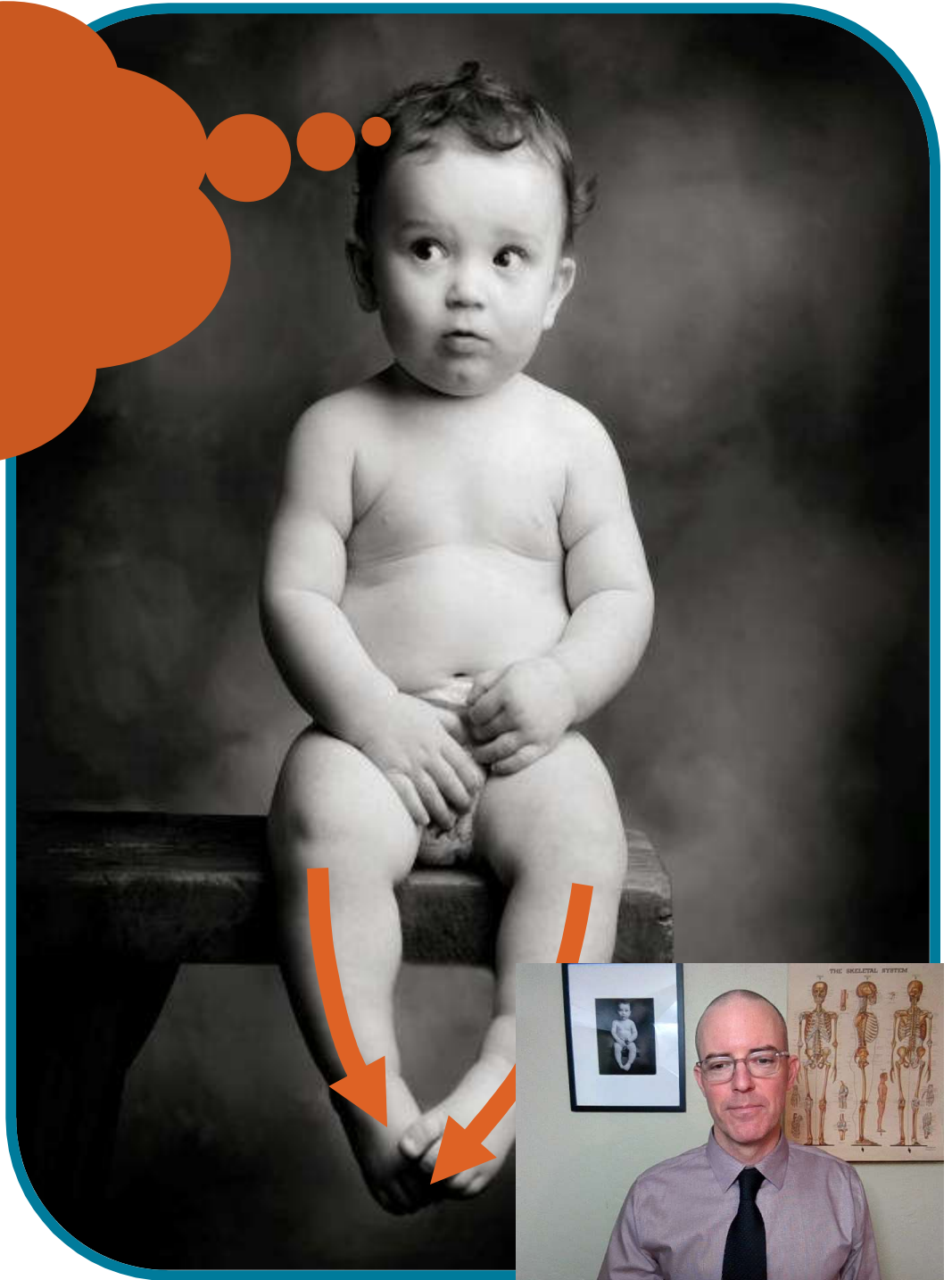
4. What treatment is required for a flexible flat foot?
- a) AFO
 - b) Soft inserts
 - c) Custom inserts
 - d) No treatment necessary



Am I pathologic?

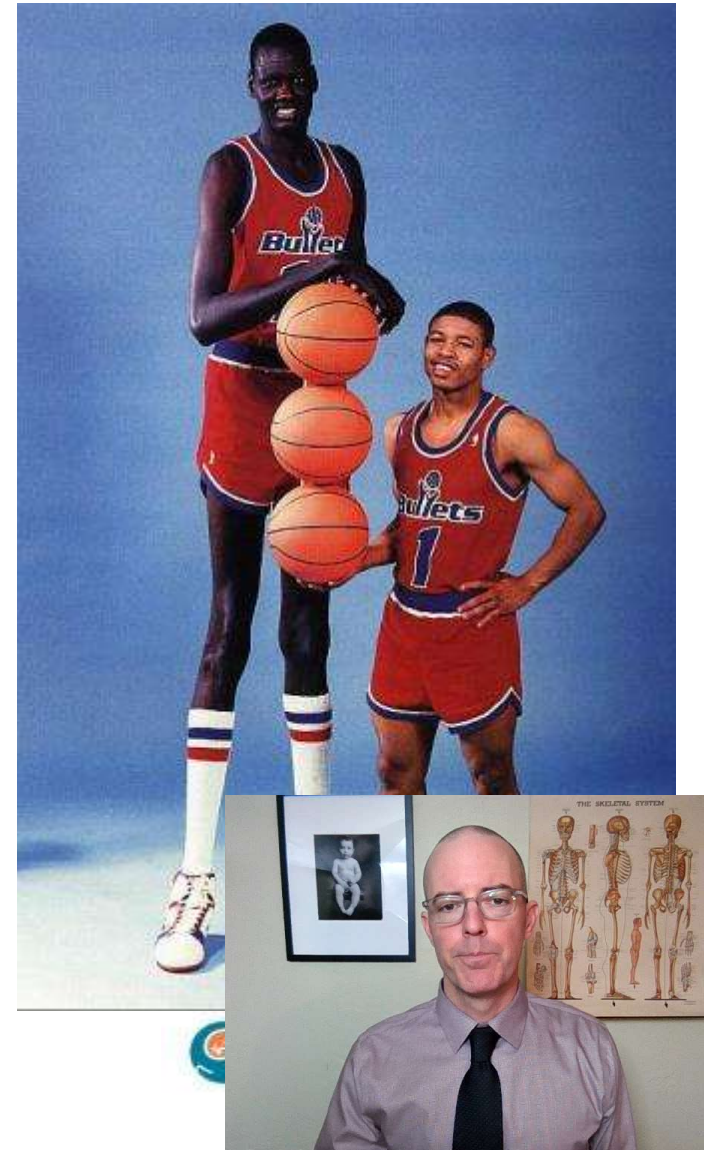
Variations

2. Assessment of lower extremity alignment
3. Distinguish physiologic variants vs. pathologic lower limb deformities



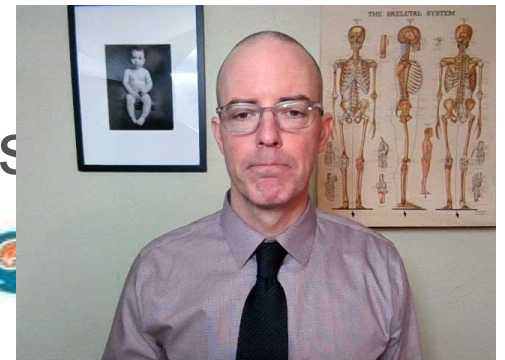
Toeing and Bowing Terminology

- **Normal = WIDE range**
 - Height
 - Normal = Functional
 - Normal changes with growth
- **Version = normal twist of the bone**
- **Torsion = twist of the bone beyond two standard deviations**
 - (Torsion is NOT a bad word!)



Multiple Causes (and Rule Outs) of Toeing and Bowing

- Physiologic/structural:
 - from hip, leg, foot or toe
- Other structural-Tibia Vara, DDH, Clubfoot
- Neuromuscular disease - muscle imbalance, spasticity, cerebral palsy
- Metabolic bone disease - rickets
- Skeletal dysplasia
- Post-traumatic/post-infectious, SCFE, s



Assessment = Localize the Deformity

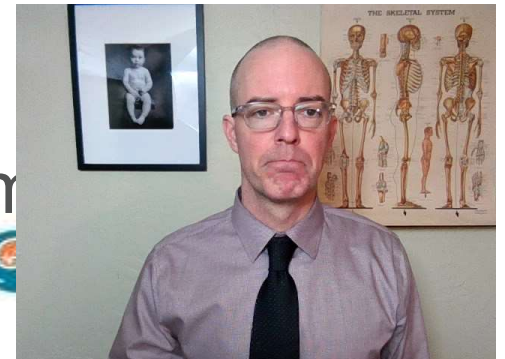
Common Concerns

In-toeing

- Out-toeing
- Bowed legs
- Knock-knees
- Flat feet

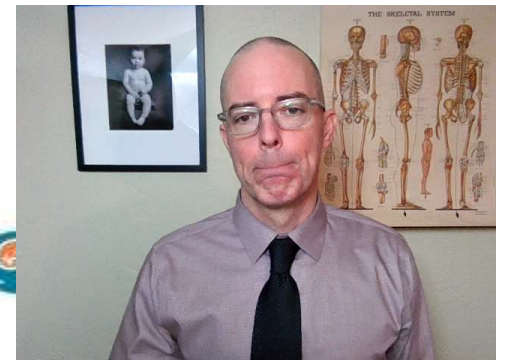
Where's the Source?

- Hip joint
- Thigh (femur)
- Knee joint
- Leg (tibia)
- Ankle joint
- Foot (tarsals/metatarsals)



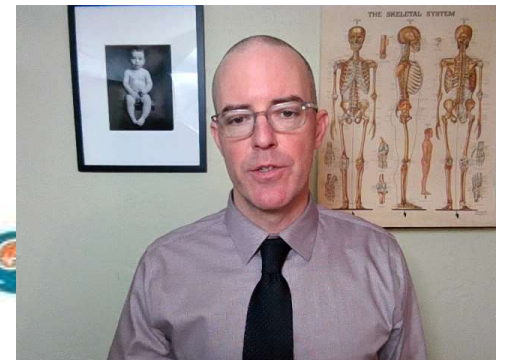
In-toeing

Assume a normal healthy toddler or child (age 1-7)



Step 1: History

- **Who is concerned?**
 - **What's the concern?**
 - **When does it manifest?**
 - **Duration?**
 - **Improving or Worsening?**
- Developmental Delay?**
- Precipitating event?**
- Family History?**
- Painful?**



Step 2: Assessment = Rotational Profile

Gait



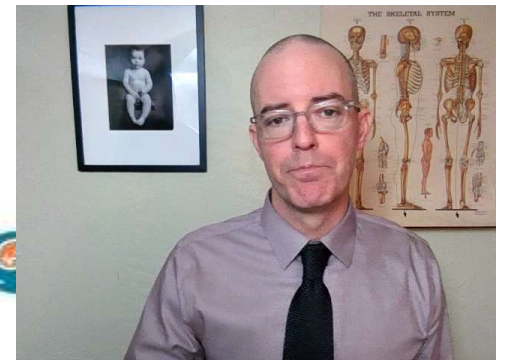
Foot Exam



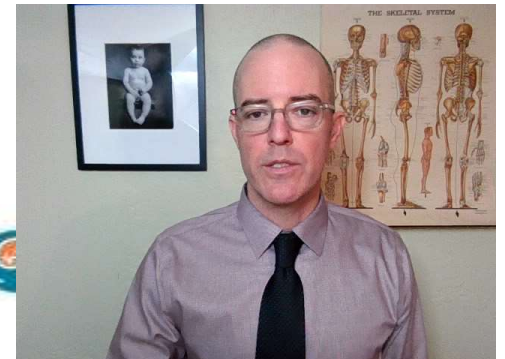
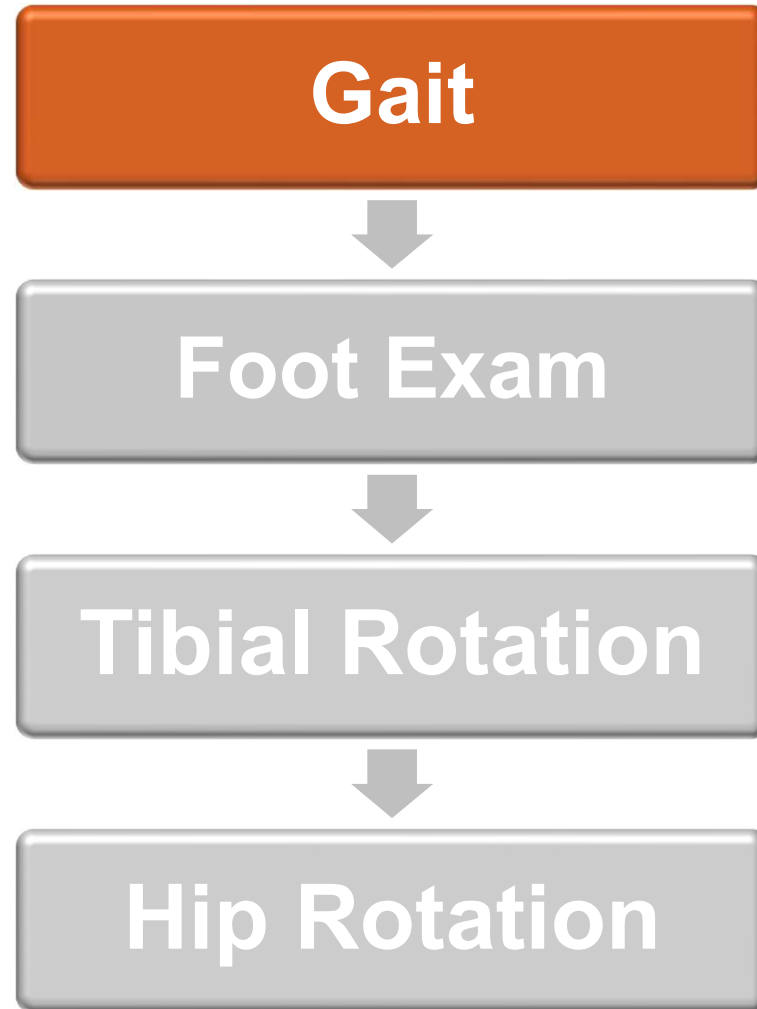
Tibial Rotation



Hip Rotation



Rotational Profile: Watch them walk



Gait

1. Foot Progression Angle:

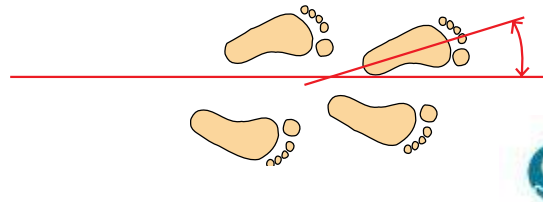
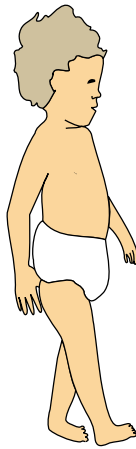
- Negative = In-toeing
- Positive = Out-toeing

2. Limp?

3. Asymmetry?

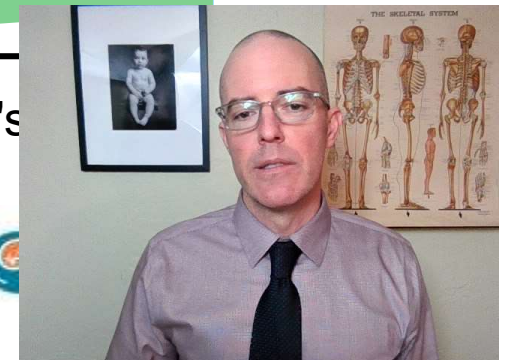
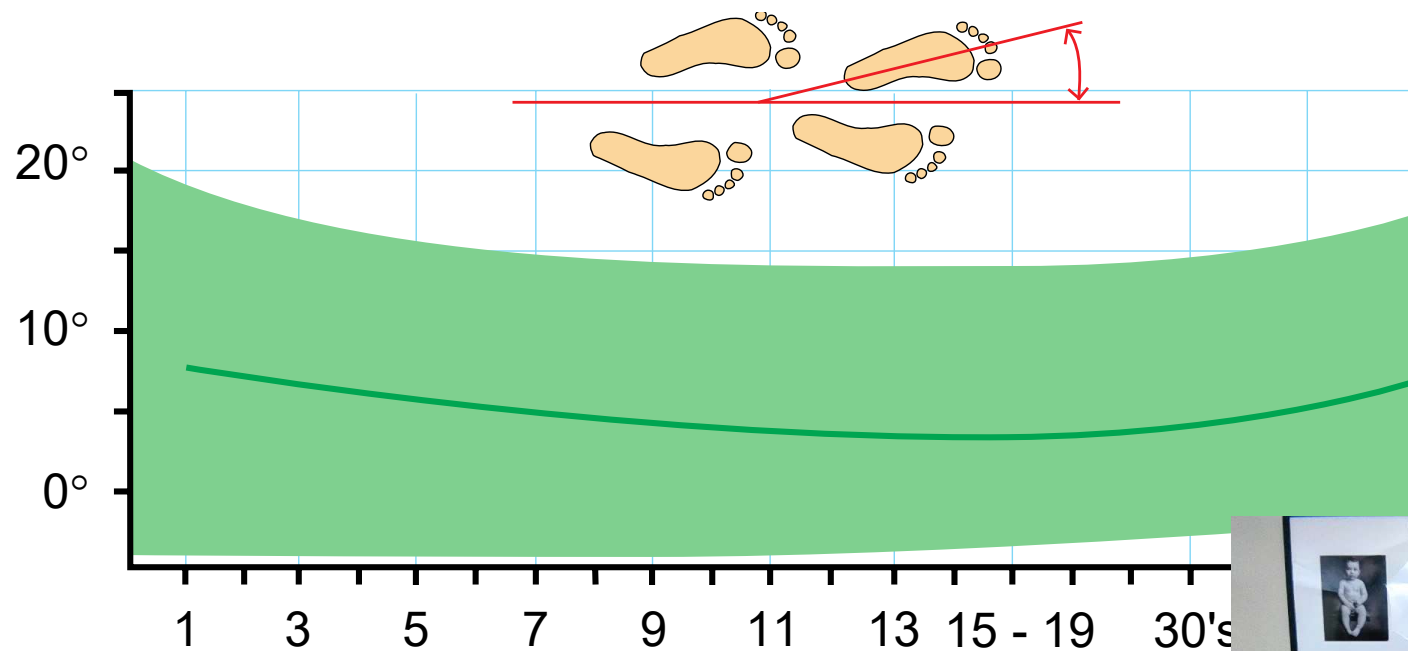
4. Toe-walking?

5. Run?

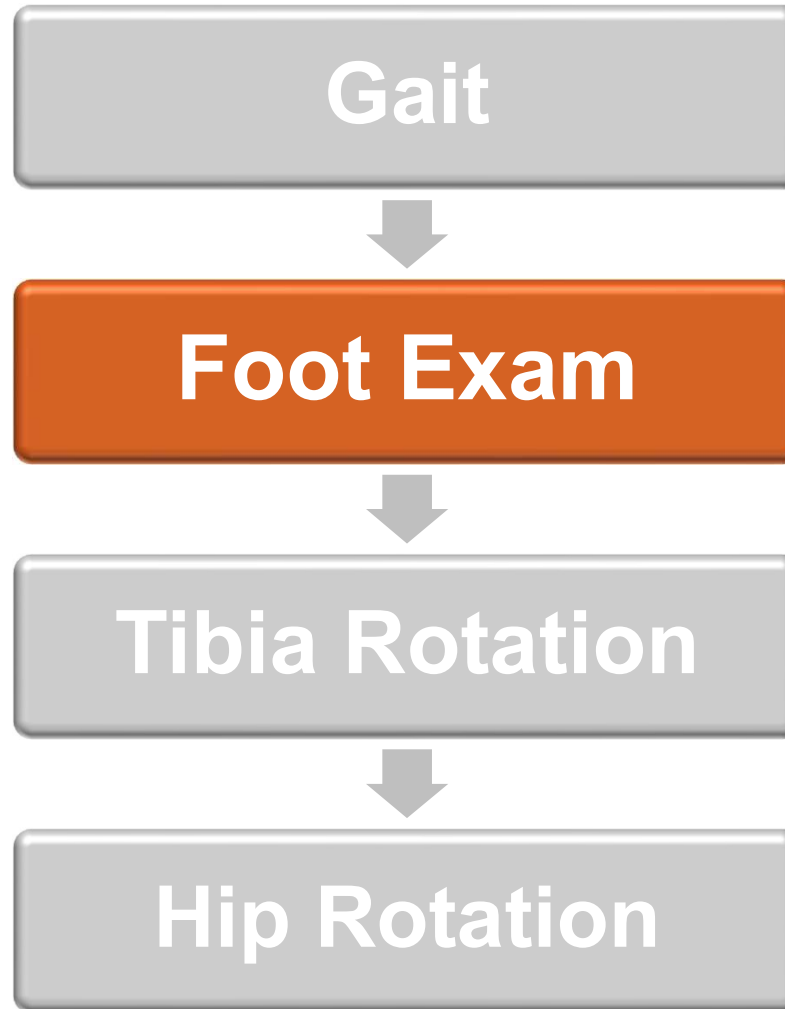


Foot Progression Angle cont.

Wide Range of Normal!



Rotational Profile: Foot Exam

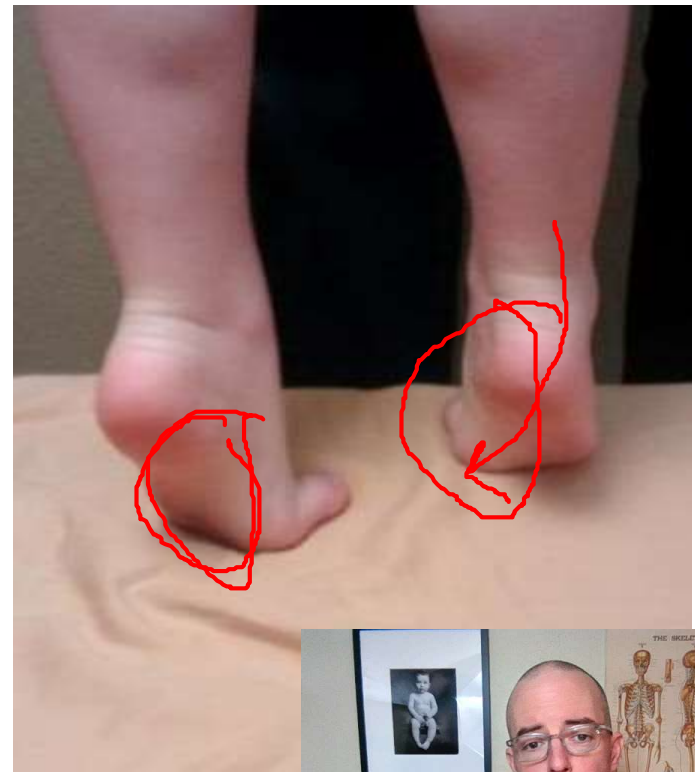


Foot Exam: Standing...

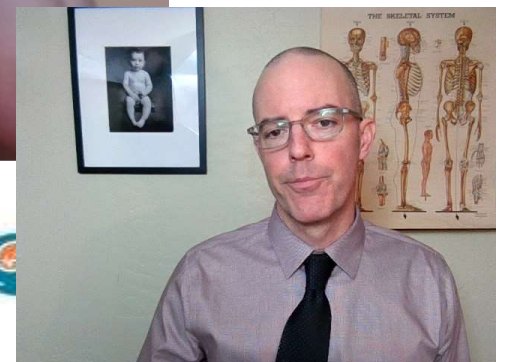
Standing



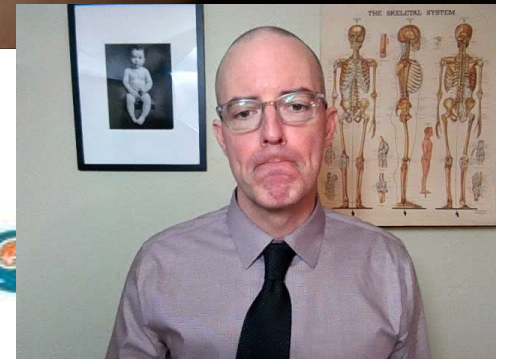
Up on toes



Foot Exam: Non-weight-bearing

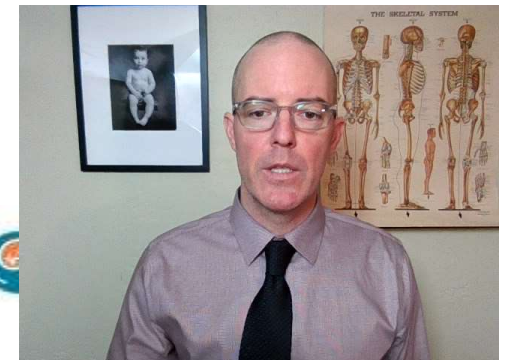
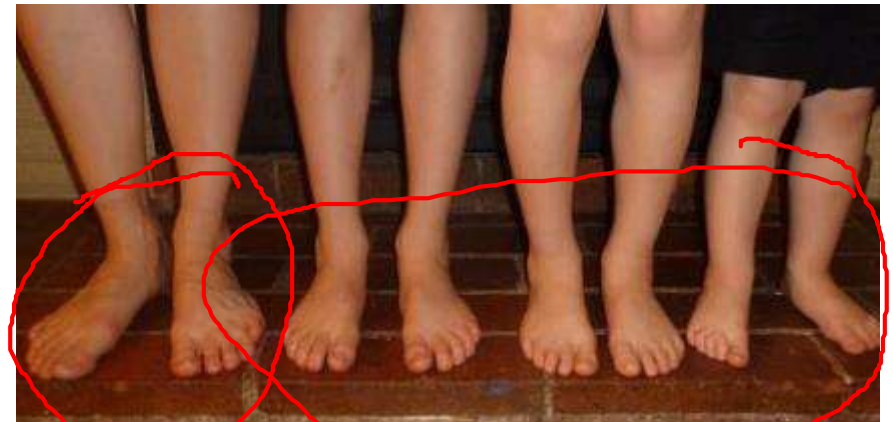


Foot Exam: Flexible?

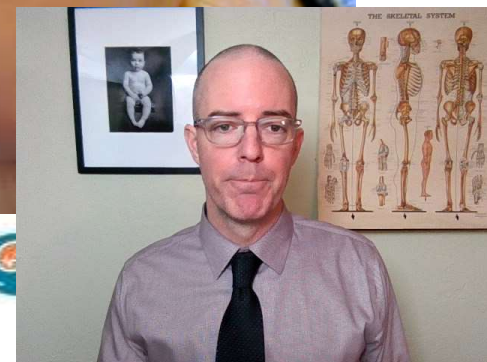


Flat Feet (Pes Planus)

- Arch when non-weight bearing
- Arch accentuated on toes
- 25-50% of population
- Orthotics DO NOT change arch shape!
- Arch develop's around 6 years
- NO treatment if asymptomatic
- **Tight Heel Cord can = pain**

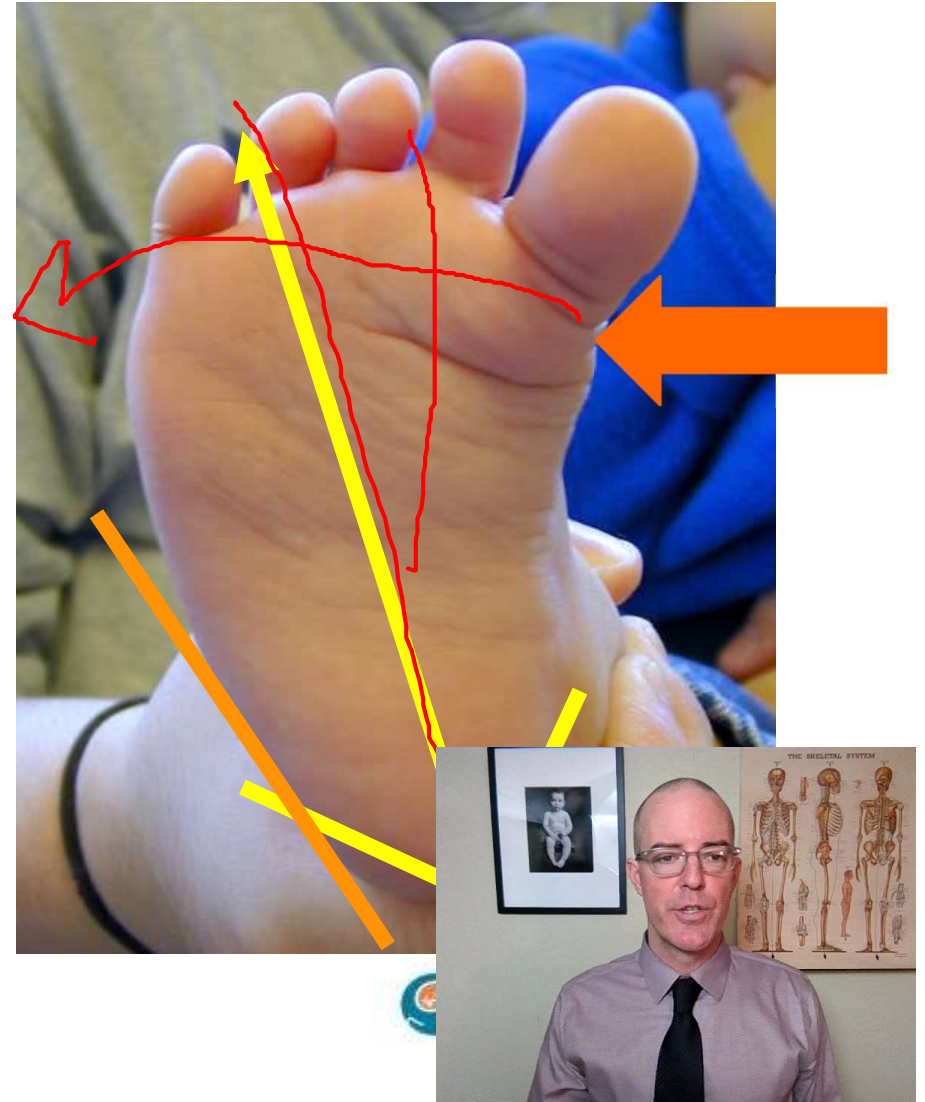


Foot Exam



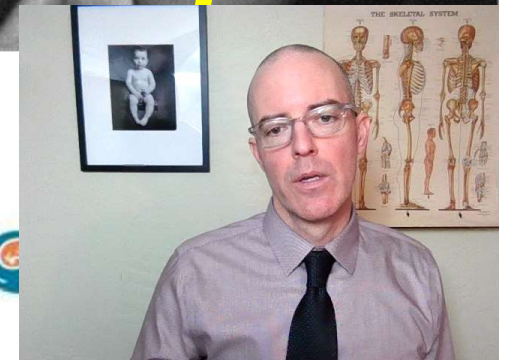
Foot Exam cont.

- Shape of the Foot
- **Lateral Foot Line**
 - Pressure over medial forefoot to test flexibility
- **Heel Bisector Line**
 - Normal = 2nd and 3rd toes
- Should be flexible



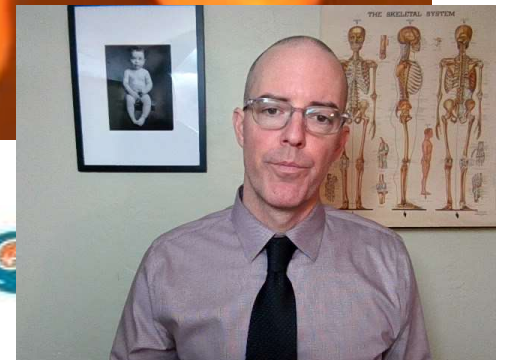
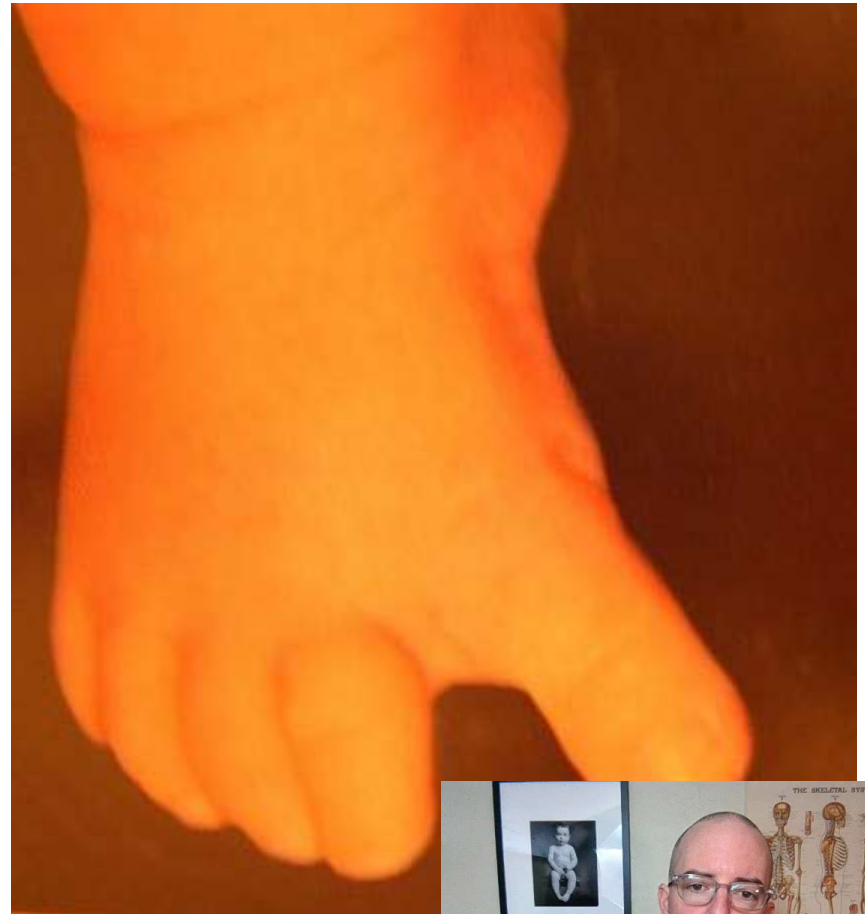
Metatarsus Adductus

- Most are flexible
- Most tend to improve by 12m
- 5-10% stiff & require casting
 - serial cast 10-12m, or as early as 6m if rigid
- Association with DDH?

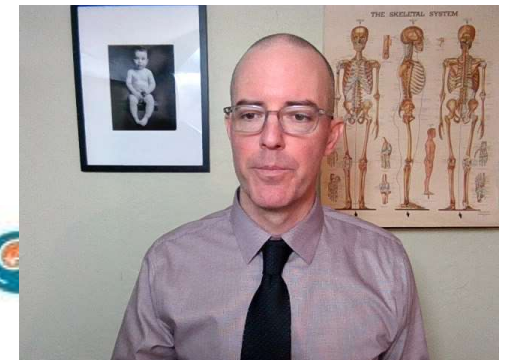
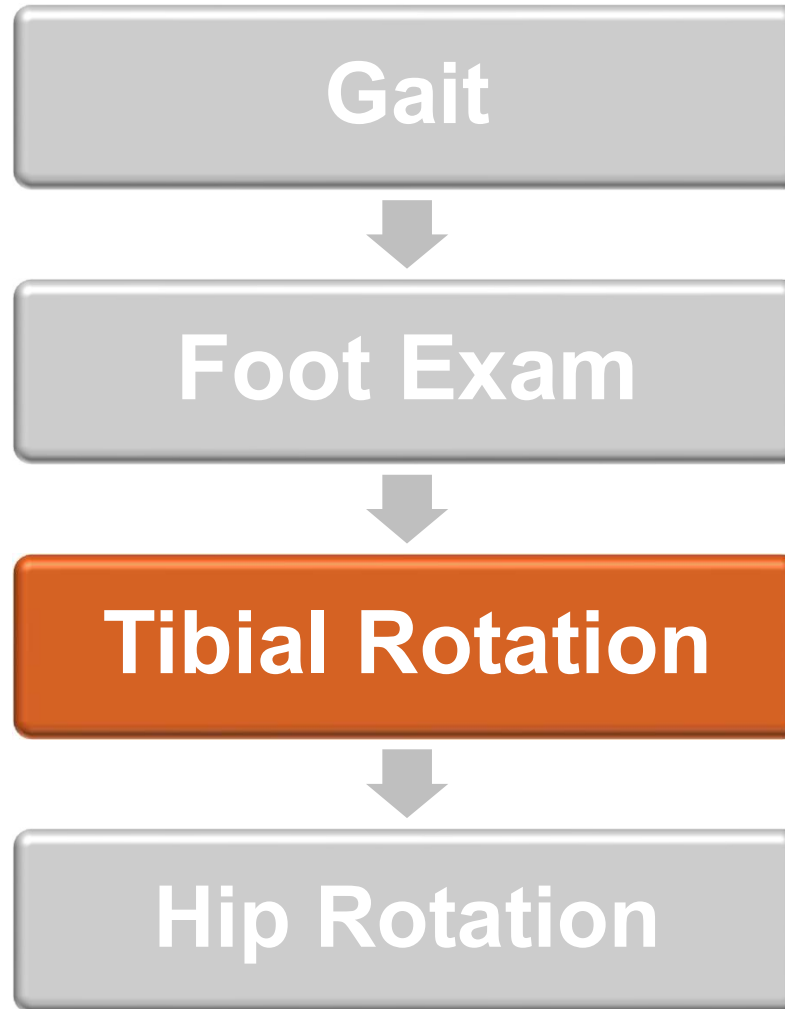


Wandering Toe

- Resolves completely without intervention
- This is dynamic deformity and there is no adduction of the toe when patient is sitting
- Reassurance is the best course

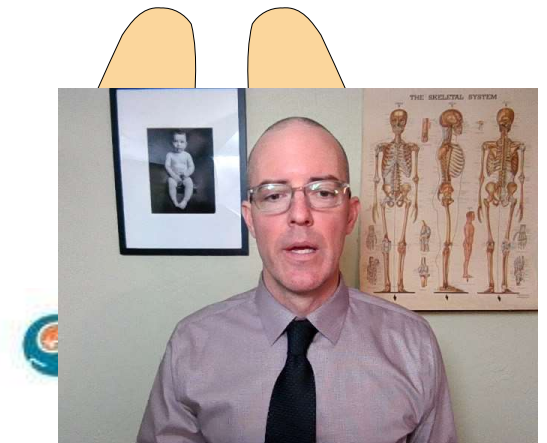
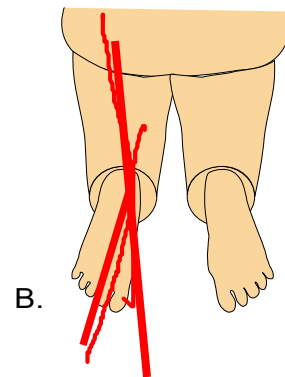


Rotational Profile: Rotation of Tibia

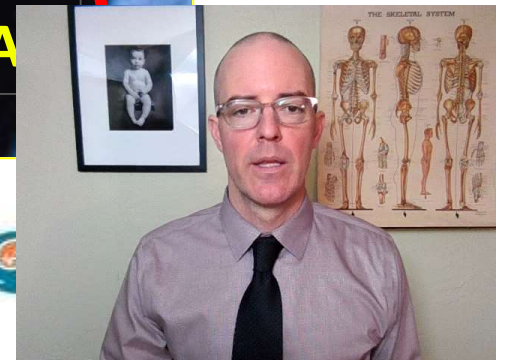
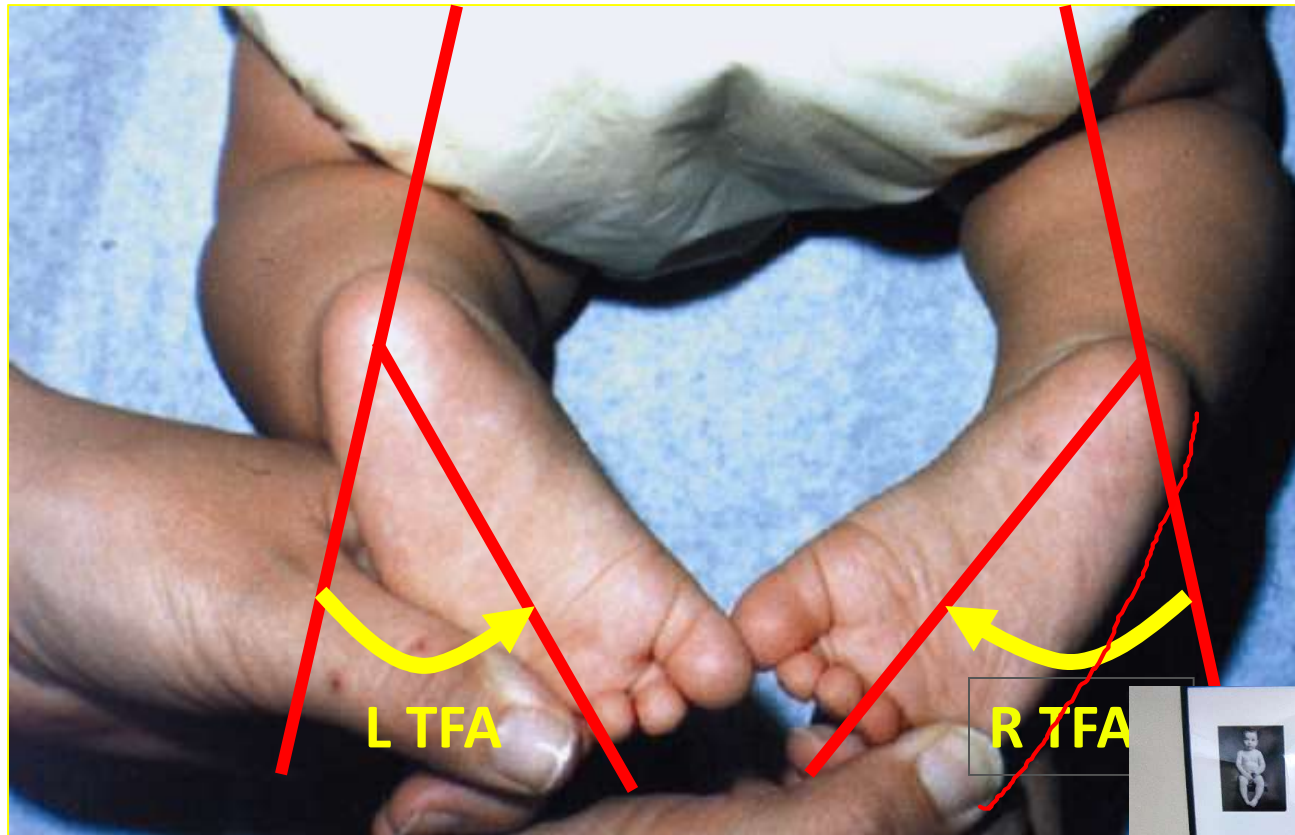


Tibial Rotation: Prone

- **Thigh-foot angle**

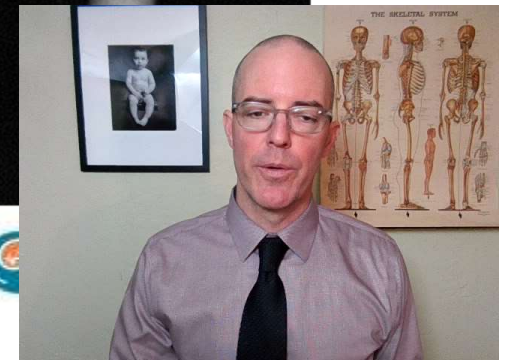


Tibial Rotation

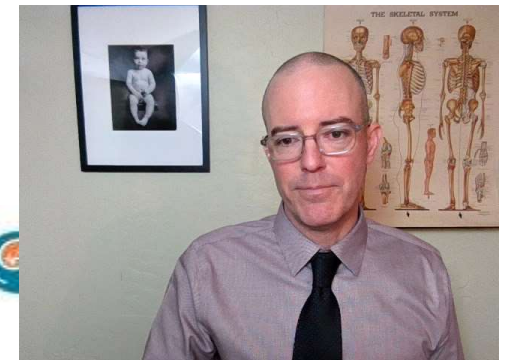
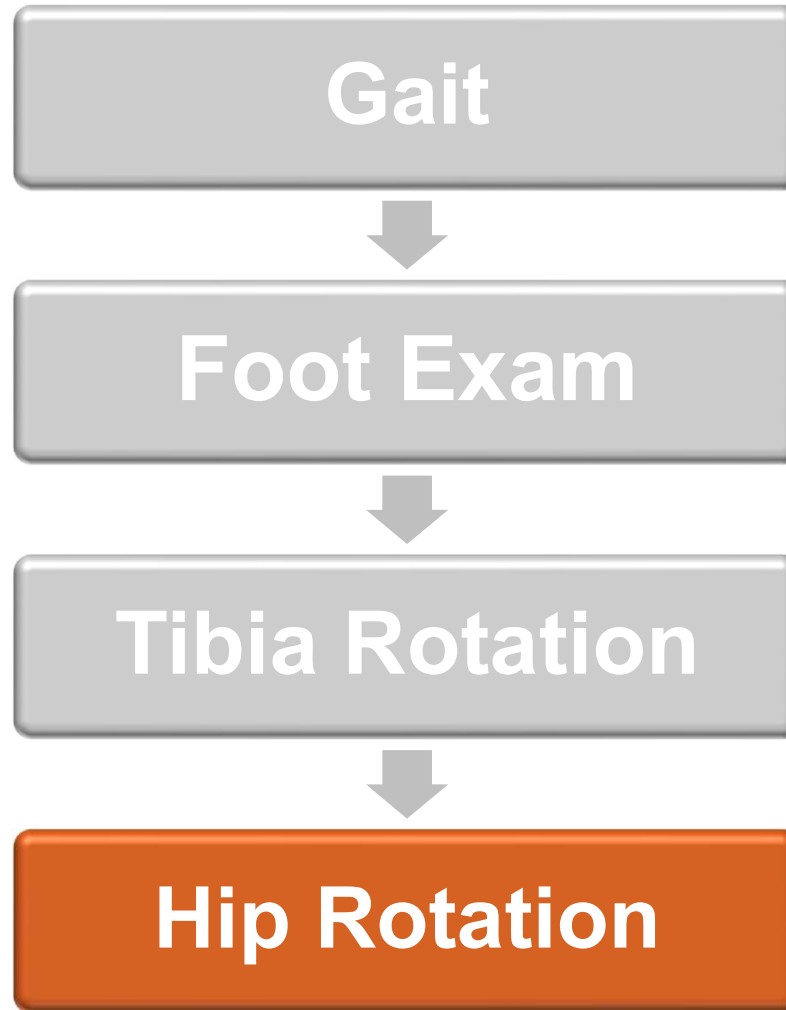


Internal Tibial Torsion

- Most common cause of intoeing
- Can be one sided
 - $L > R$
- Common in 1-3 yo
- Spontaneously resolves in 1-2 yrs
- No resolution?
 - Future Sprinter?¹

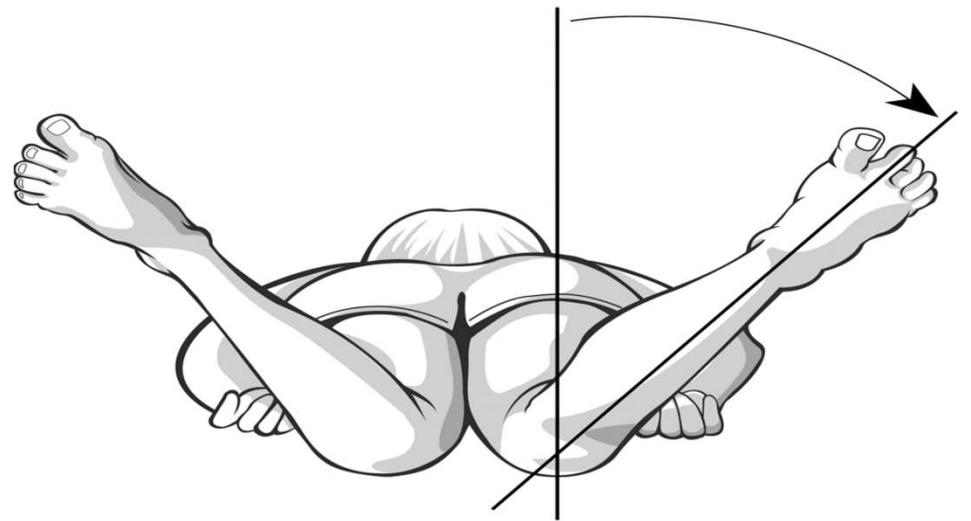


Rotational Profile: Rotation of Hip/Femur



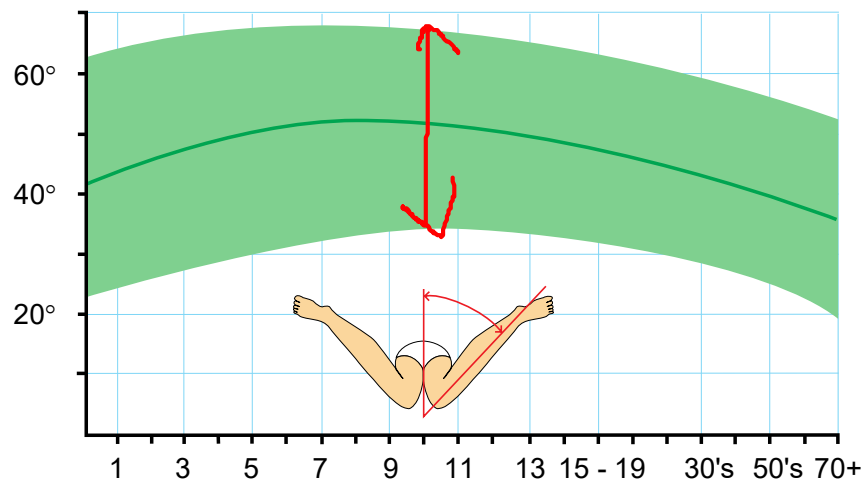
Hip/Femoral Rotation

- **Easiest done Prone**
 - Internal/Medial Rotation
 - External/Lateral Rotation
- **Symmetric?**
 - Asymmetry=Further Investigation
- **Painless?**

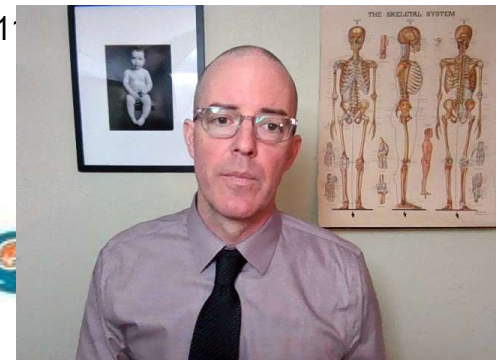
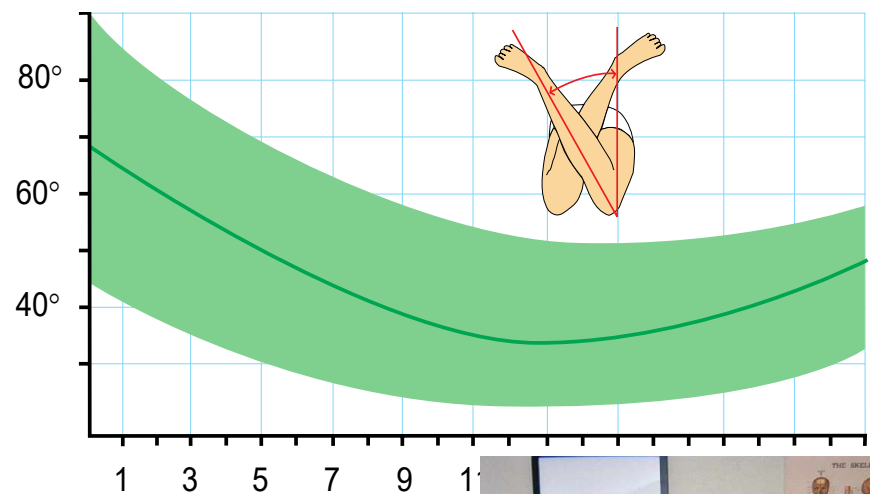


Hip/Femoral Rotation cont.

Internal Rotation

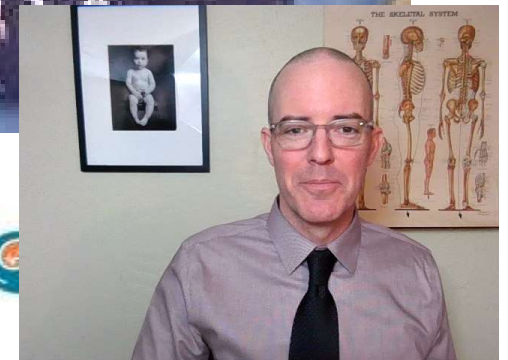


External Rotation



Femoral Torsion

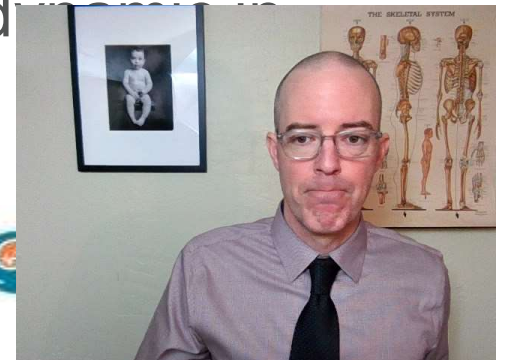
- More common in girls 2-5
- “Kissing patellae”
- “Egg-beater” run
- Sits in the “W” position
- Severe if $> 90^\circ$
- Usually improves with growth - but it can persist
- No association with hip osteoarthritis
- also called femoral anteversion, femoral antetorsion, internal femoral version, medial femoral version, medial femoral torsion



In-toeing Summary

YOU can determine the source:

- Curved foot = metatarsus adductus
- Medially rotated thigh foot angle = tibial torsion
- Excessive medial rotation of hips = femoral torsion
- Searching or wandering great toe produces dynamic in-toeing



In-toeing Summary cont.

Growth = lateral rotation of both femur and tibia

- Femoral torsion improves over time
- Medial tibial torsion improves over time
- Flexible metatarsus adductus resolves by age 4
- Wandering toe is self limited and pretty much always resolves



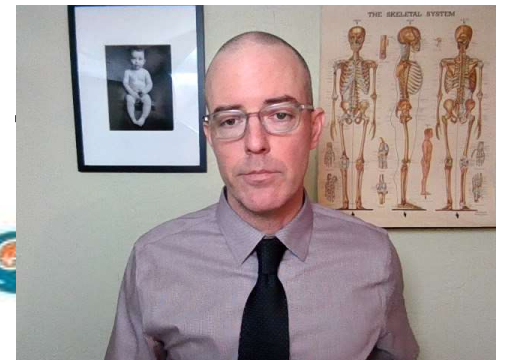
Case

Chief Complaint:

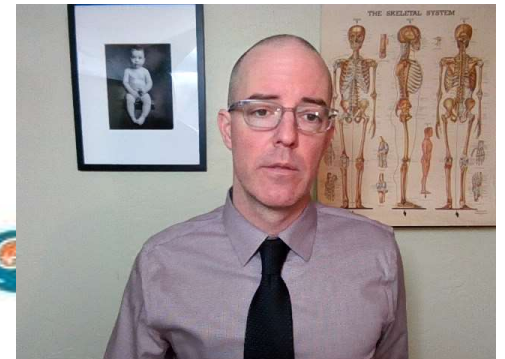
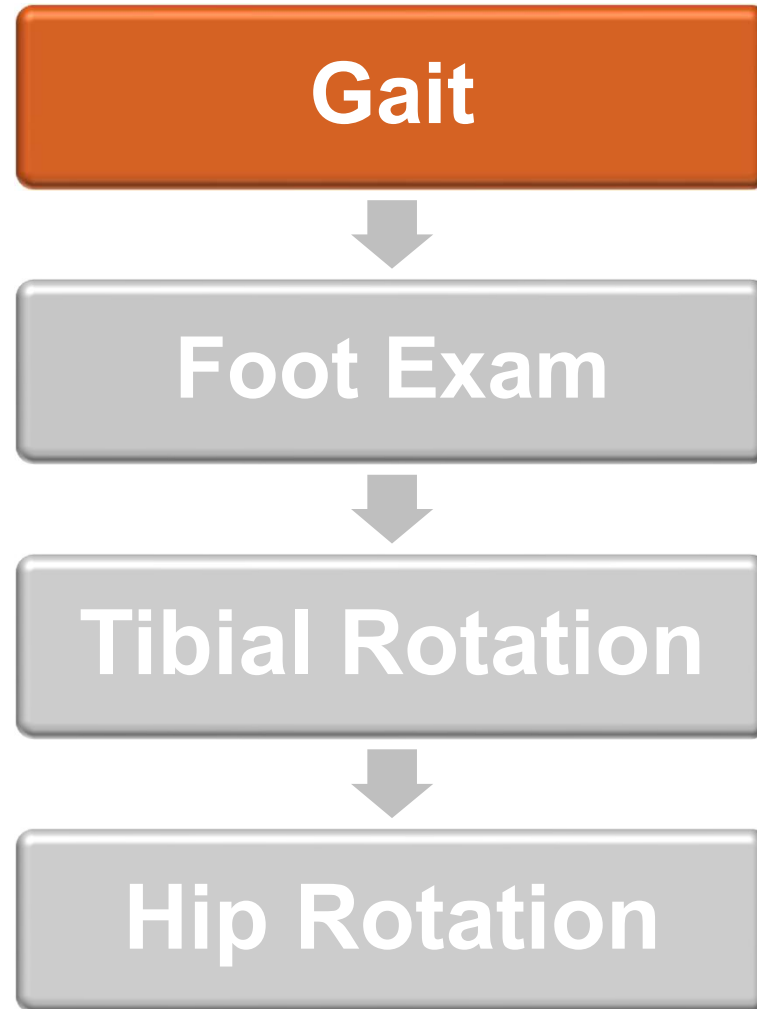
- Flat Feet
- In-toeing

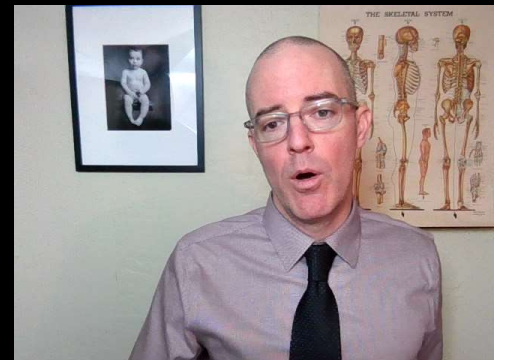
HPI: 4 yo girl. Healthy, active, loves soccer.

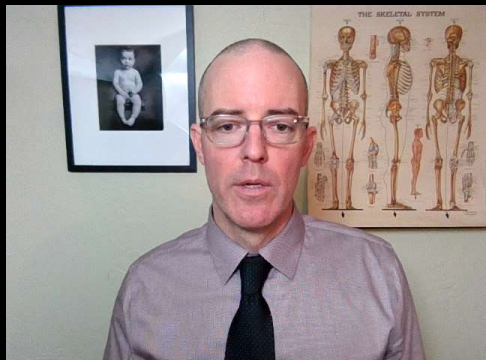
- 1. Parents would like to get new inserts for her intoeing and flat feet as they were told the series of custom inserts she has worn since 2yo would correct both.**
- 2. Sits in a “W” which parents have been also “bad” and they must cue to stop.**



Rotational Profile







Rotational Profile

Gait



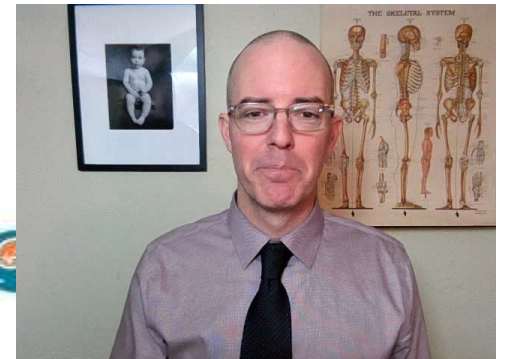
Foot Exam



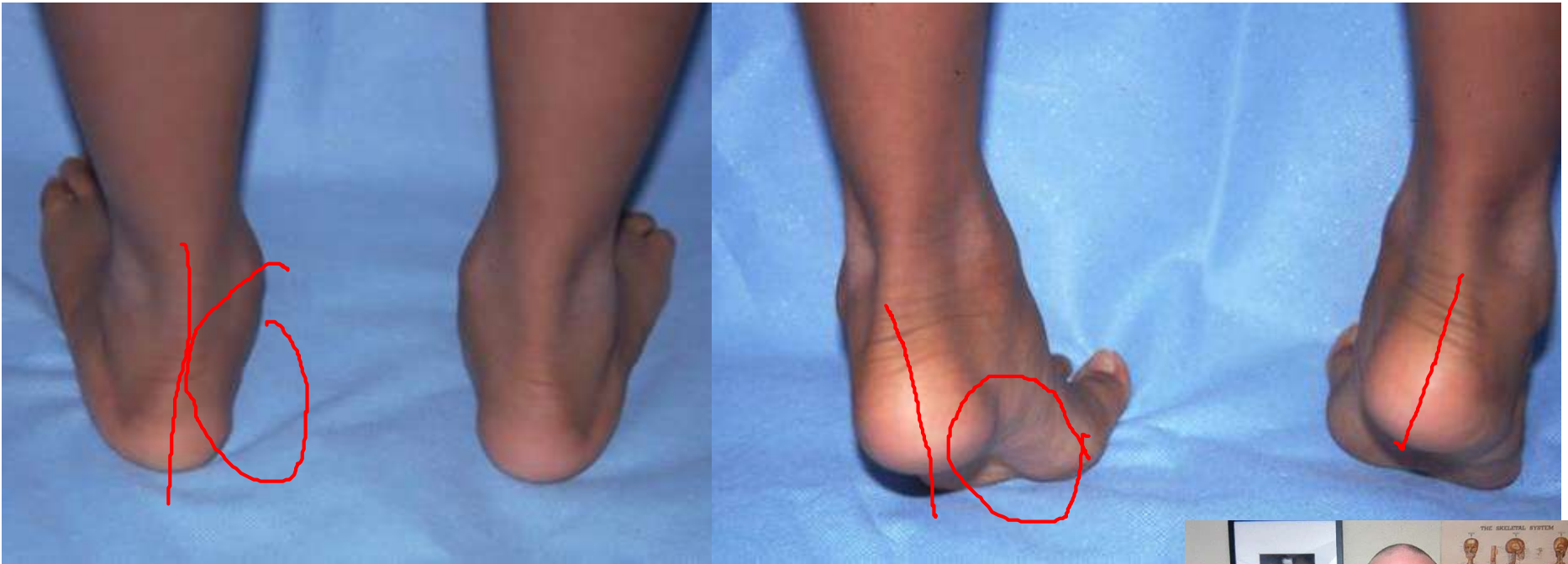
Tibia Rotation



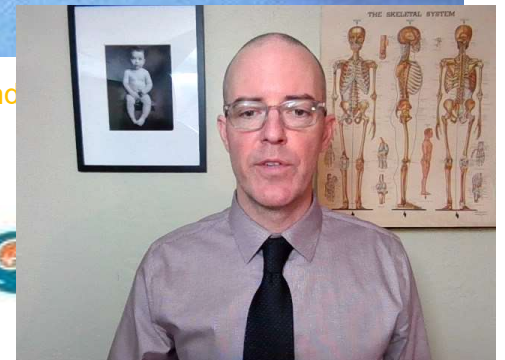
Hip Rotation



Case cont.

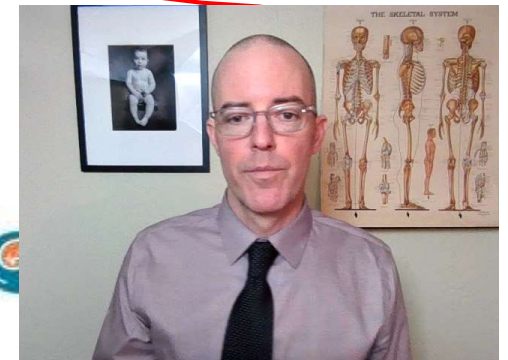
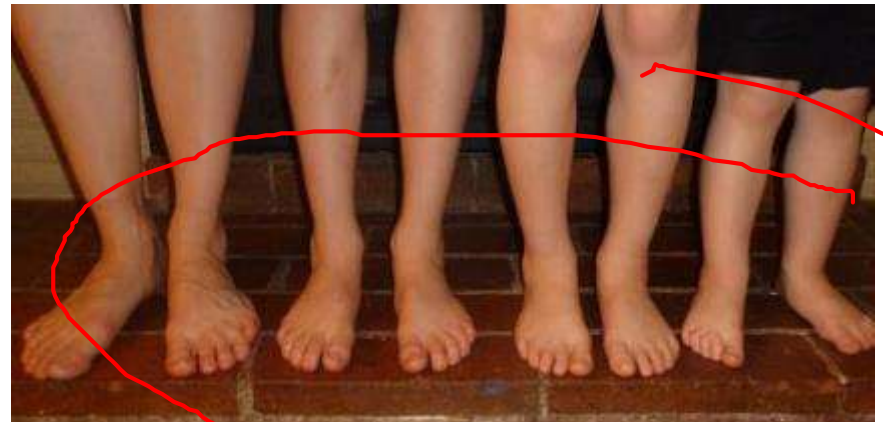


<http://www.seattlechildrens.org/medical-conditions/bone-joint-muscle-cond>



Flat Feet (Pes Planus)

- Arch when non-weight bearing
- Arch accentuated on toes
- 25-50% of population
- Arch develop's around 6 years
- Othotics DO NOT change foot shape
- NO treatment if asymptomatic
- Tight Heel Cord can = pain



Rotational Profile

Gait



Foot Exam

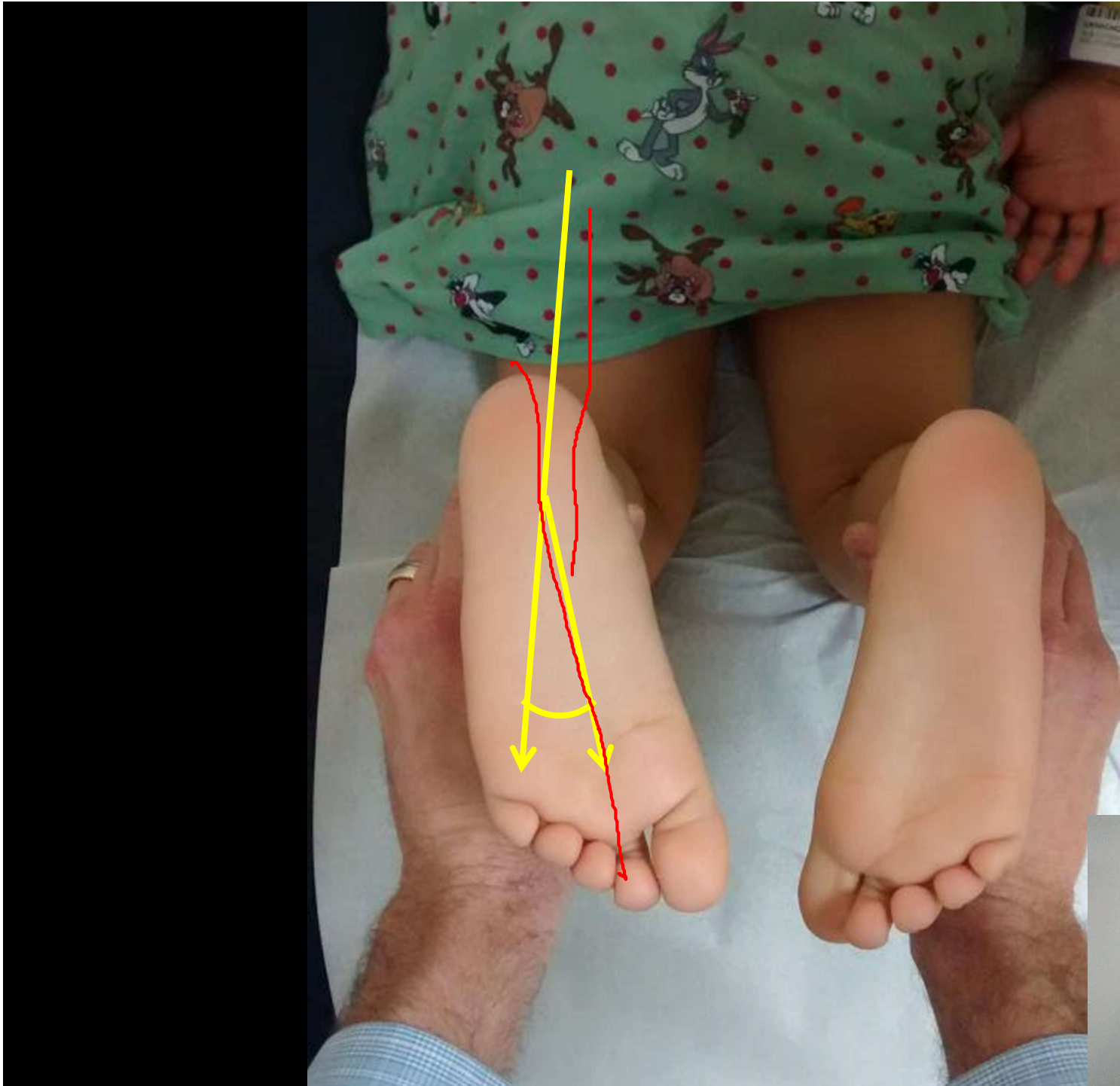


Tibia Rotation



Hip Rotation





Internal Tibial Torsion

**Most common cause of
intoeing**

Can be one sided

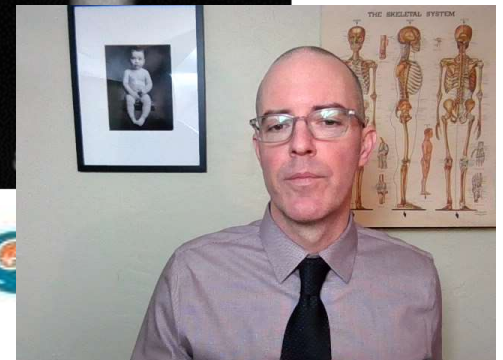
- $L > R$

Common in 1-3 yo

**Spontaneously
resolves in 1-2 yrs**

No resolution?

- Future Sprinter?¹



Rotational Profile

Gait



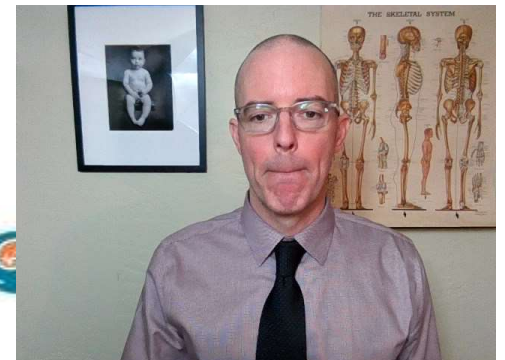
Foot Exam

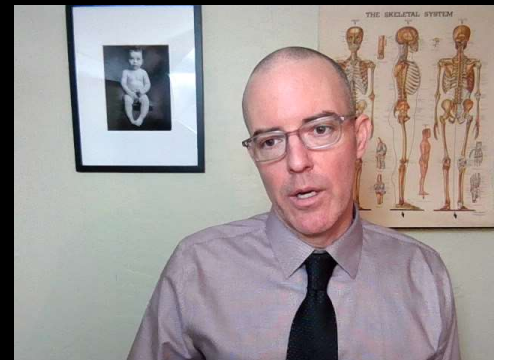


Tibia Rotation



Hip Rotation





Femoral Torsion

More common in girls 2-5

Sits in the “W” position

“Kissing patellae”

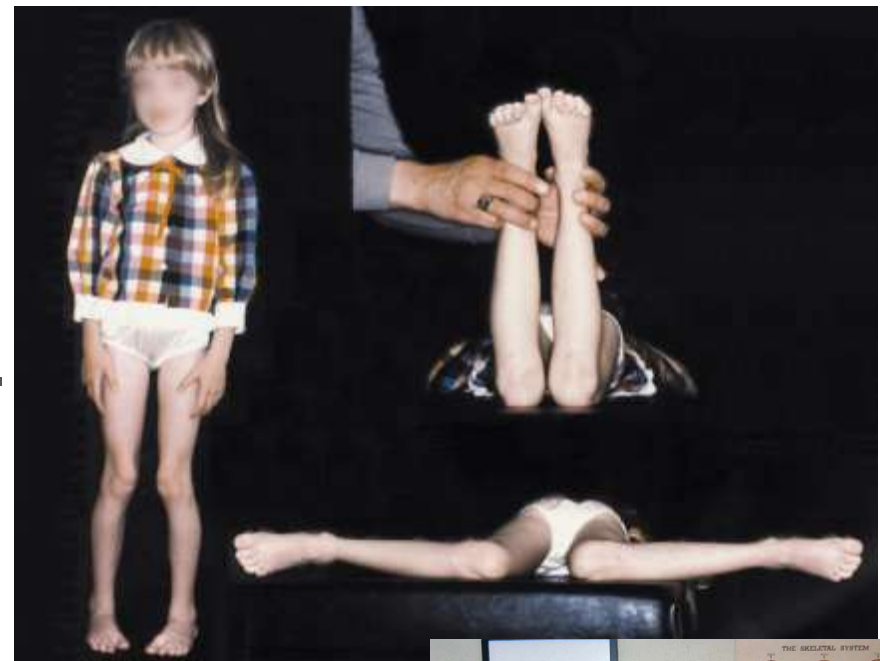
“Egg-beater” run

Severe if $> 90^\circ$

Usually improves with growth -
but it can persist

No association with hip
osteoarthritis

- AKA: femoral anteversion, femoral antetorsion, internal femoral version, medial femoral version, medial femoral torsion



Case cont...

HPI:

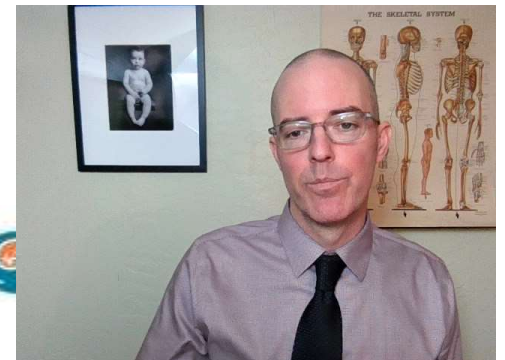
4 yo girl. Healthy, active, loves soccer.

Chief Complaint:

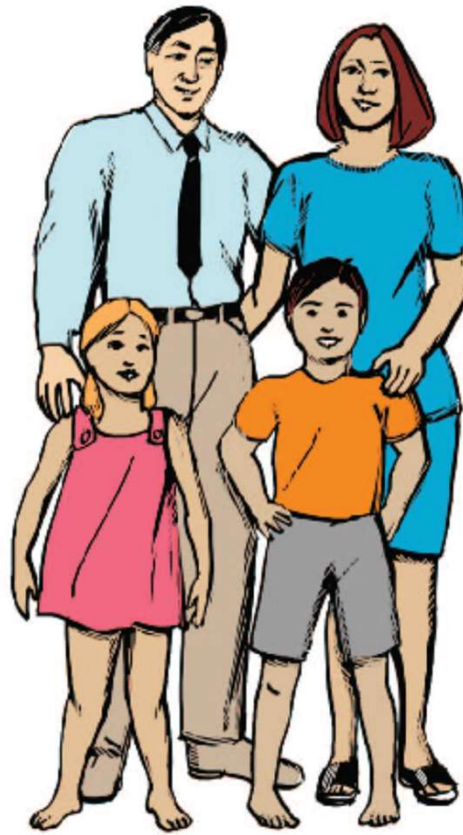
1. Parents would like to get new inserts for her intoeing and flat feet as they were told the series of custom inserts she has worn since 2yo would correct both.
2. Sits in a “W” which parents have been told was also “bad” and they must cue to stop.

Assessment:

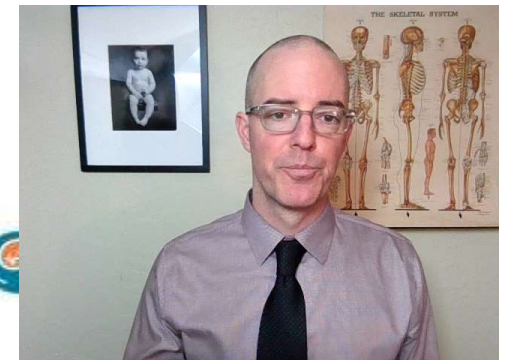
1. Intoeing due to Physiologic Internal Tibial Torsion and Internal Femoral Torsion (AKA Femoral Anteversion, etc.)
2. Asymptomatic, flexible flat feet.
3. NORMAL!



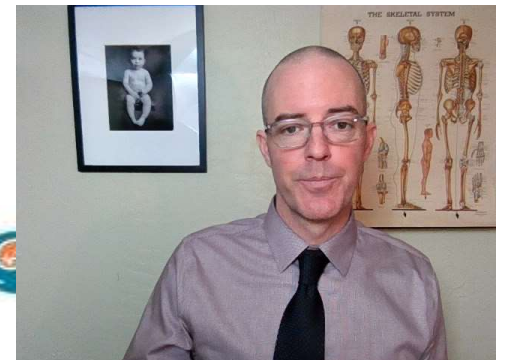
What Parents Should Know About Flatfeet, Intoeing, Bent Legs and Shoes for Children



Lynn T. Staheli, MD

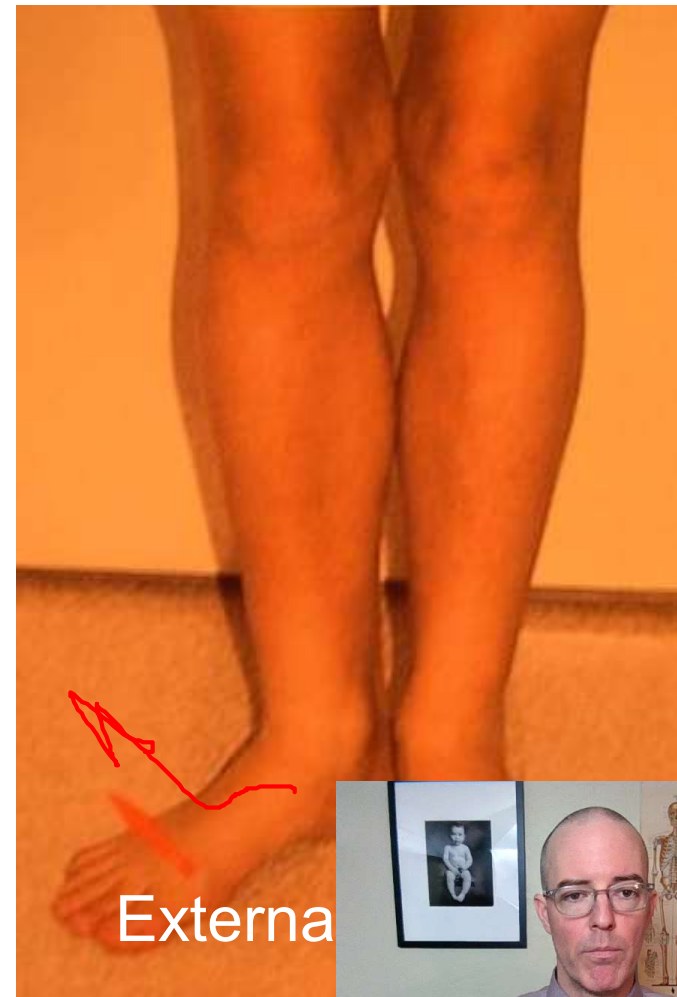


Out-toeing



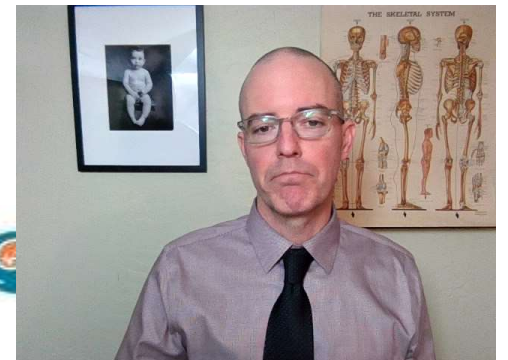
Out-toeing

- Complete the rotational profile to localize the site of the external rotation
- Asymmetric hip rotation always requires further evaluation
- External tibial version can be an isolated finding
- Most adults have symmetric mild out-toeing



Angular Deformities

Genu Varum and Genu Valgum

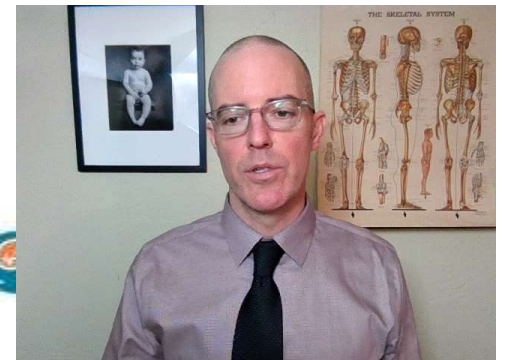
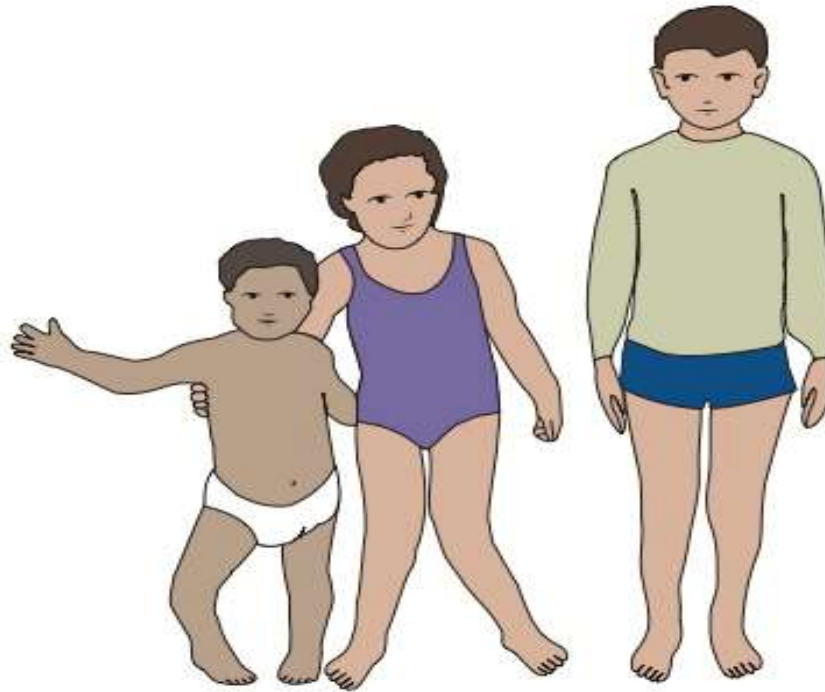


Bowlegs and Knock-Knees

Infants =
bowlegs

3-4yo = knock-
knees

7-10yo = adult
profile



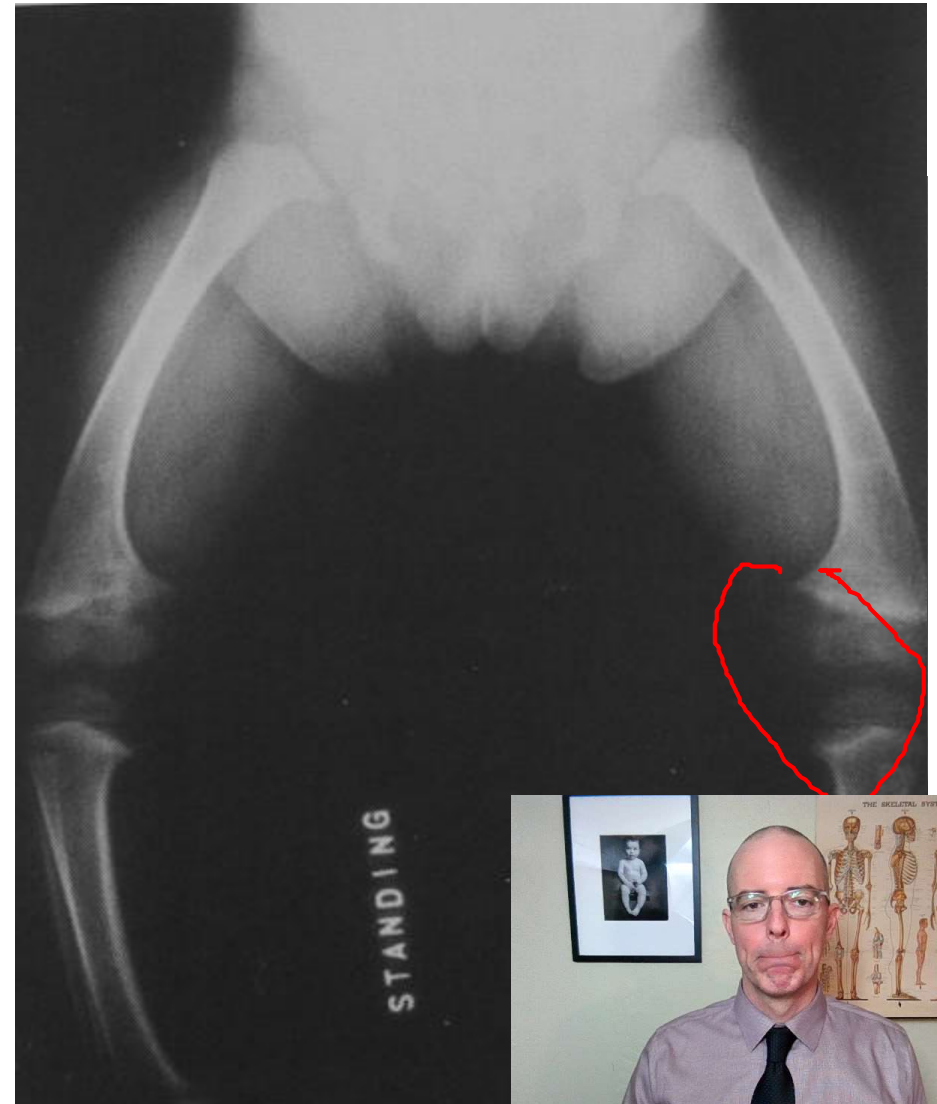
Bowlegs/Genu Varum

- Tibial bowing
 - 1st year
 - Originates from the middle and distal tibia.
 - The knee joint and proximal tibia are normal
 - Resolves with time.
- From the knee
 - 2nd year
 - Serial exams
 - Trans-condylar distance
 - > 2yrs or > 7cm = xray/referral



Pathologic Bowing

- Blount's Disease
 - (Tibia Vara)
- Vit-D deficient/resistant rickets
- Trauma or infection
- Skeletal dysplasias
- Neurofibromatosis



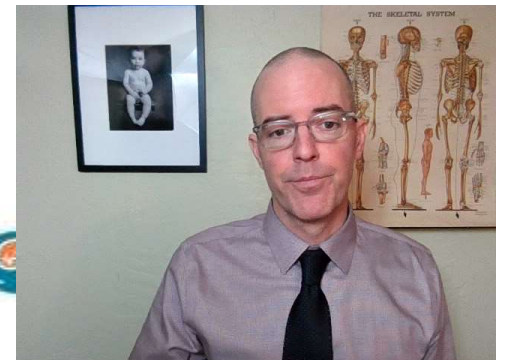
Case: 12 yo with “bowed legs”

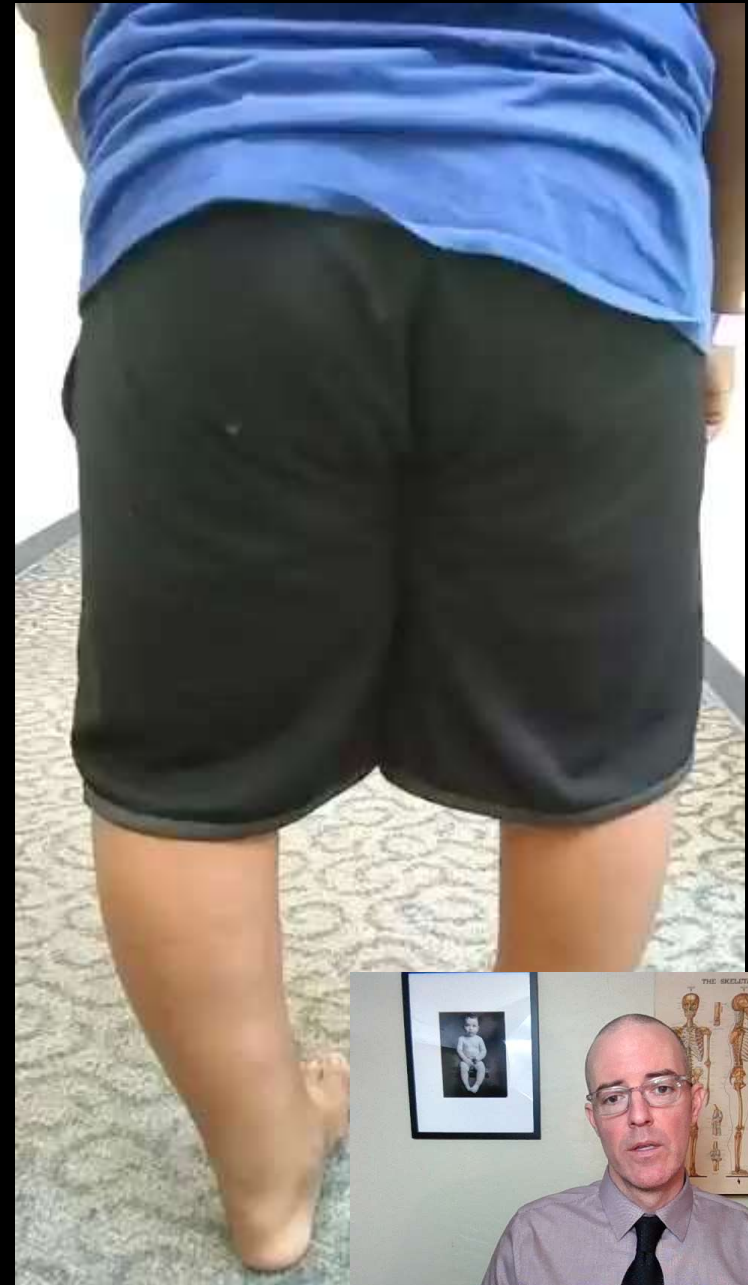
Chief Complaint:

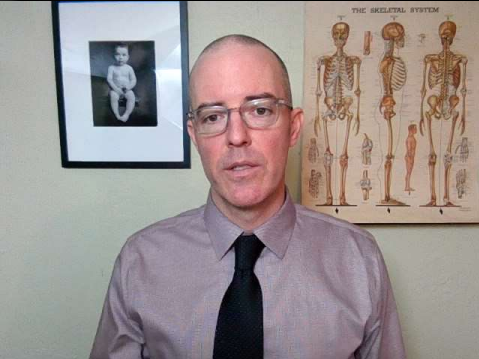
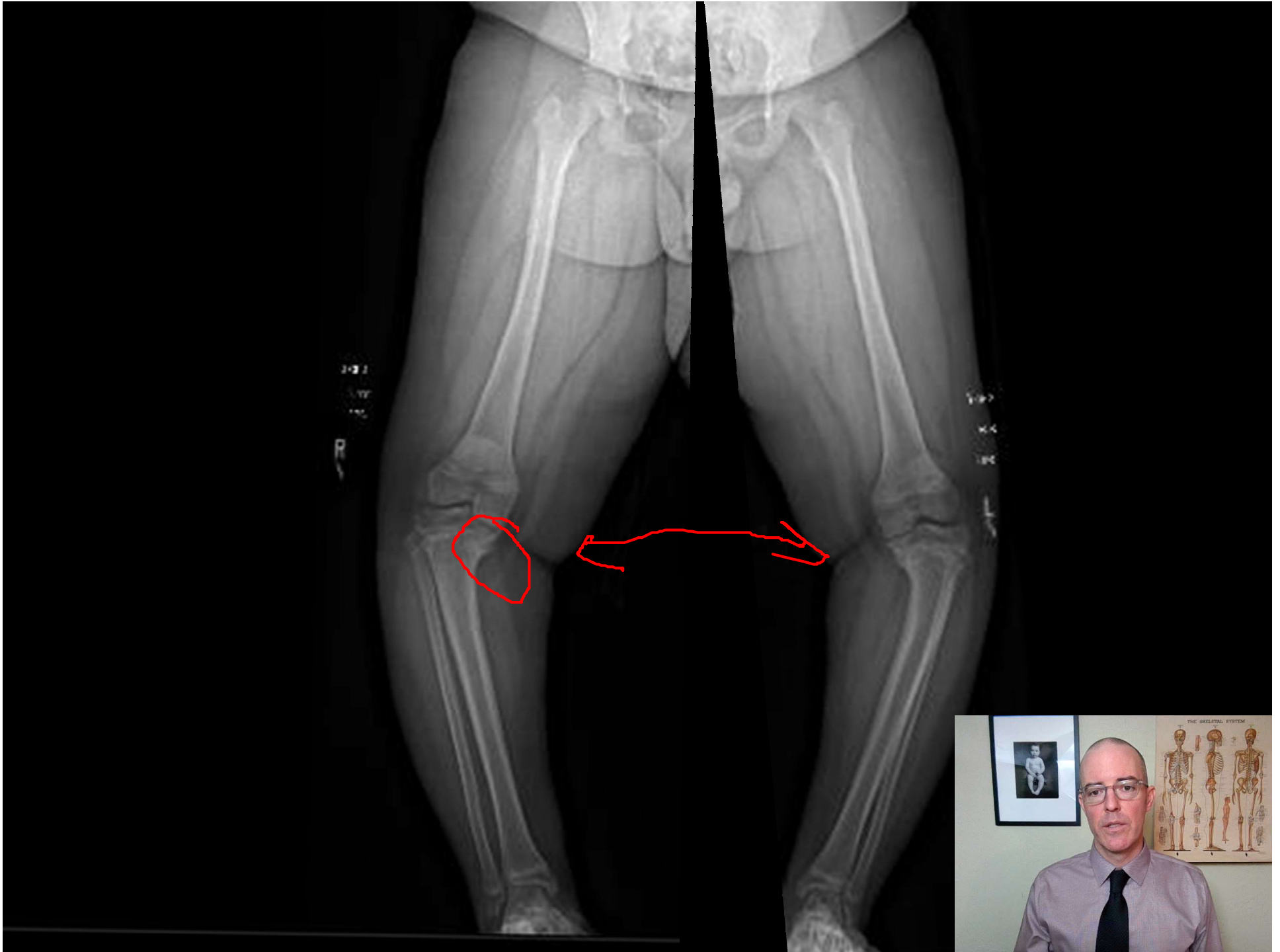
- Knee pain
- Bowed legs

HPI:

- 12yo boy. Has “always had bowed legs.” Increasing pain x 2 years with walking.







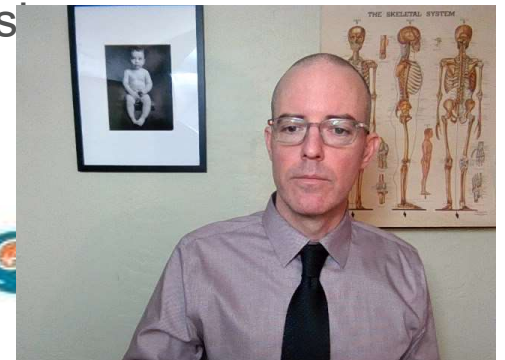
Knock Knees/Genu Valgum

- Reaches maximum at 3-4 yo
- Trans-malleolar Distance $> 8-10\text{cm}$ = referral
 - Always measure with knees directly anterior



Pathologic Genu Valgum

- ***Is the child healthy, normal height and weight, normal activity and development?***
- Rickets - later onset such as with renal osteodystrophy, (because the disease is active when knock knees are the norm)
- Valgus Deformity after Tibial Fracture
- Skeletal dysplasias
 - Diastrophic dysplasia
 - Morquio's syndrome
 - Ellis-van Creveld or chondroectodermal dysplasia
 - Spondyloepiphyseal and multiple epiphyseal dysplasia



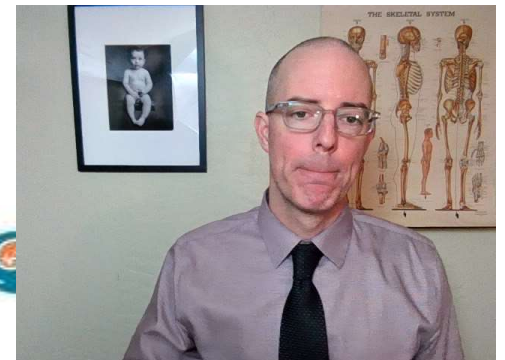
Case: 3yo with “Knock Knee’s”

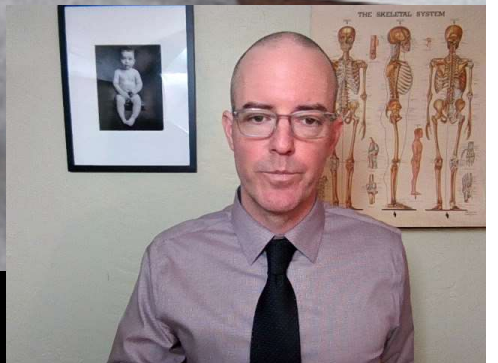
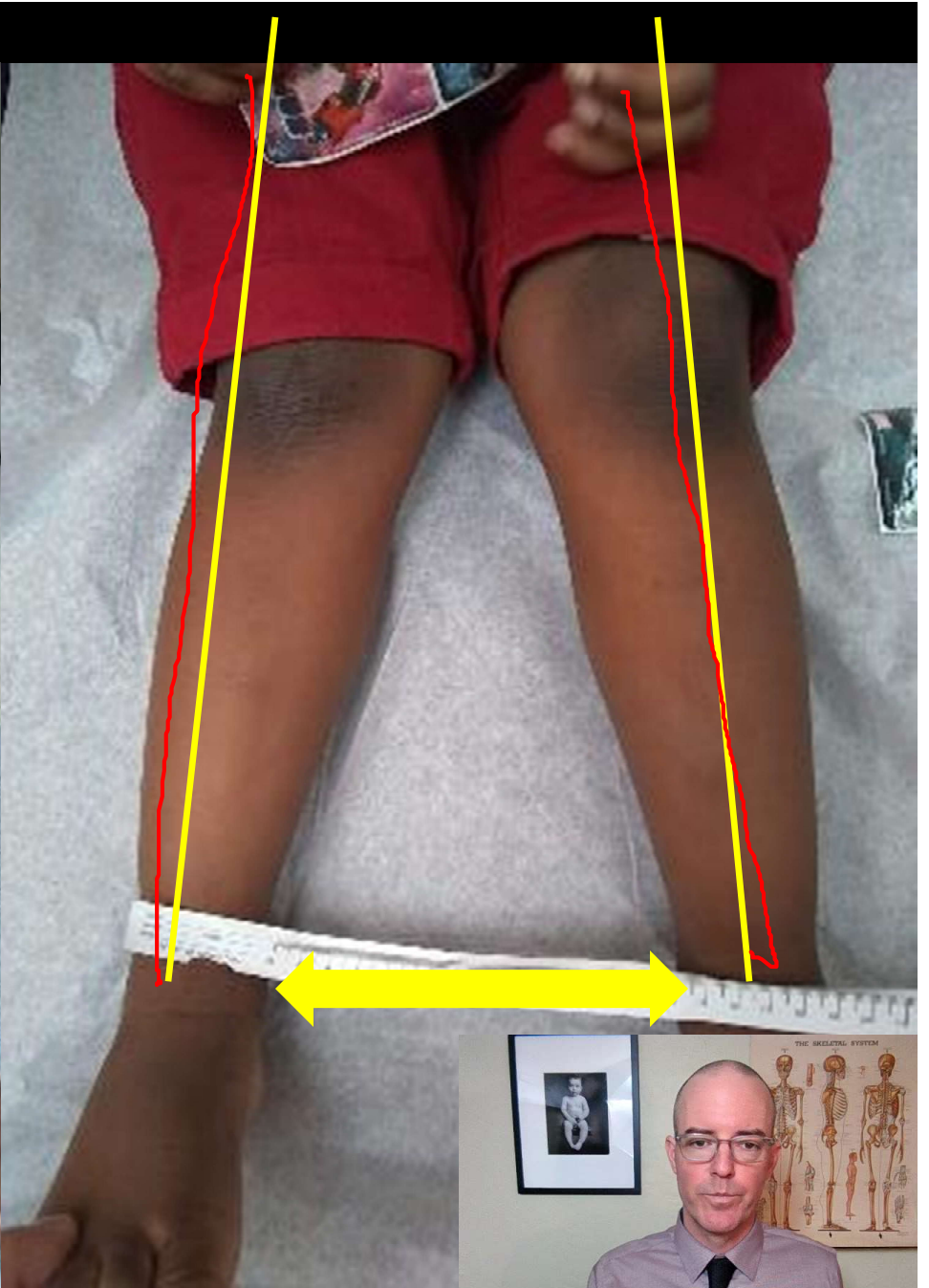
Chief Complaint:

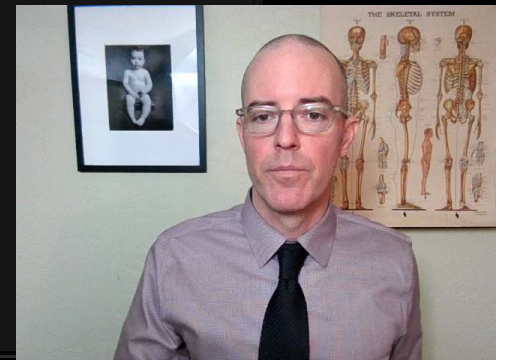
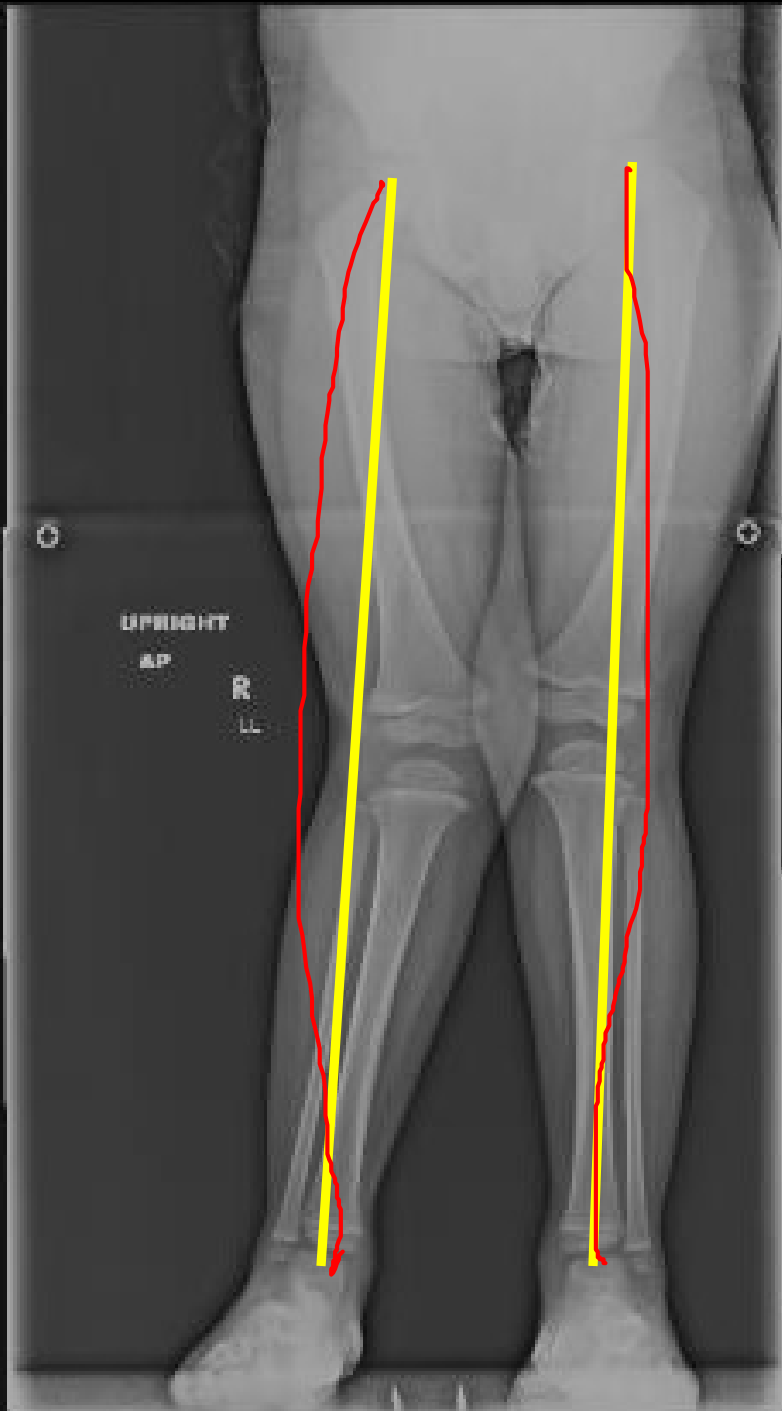
- “Knock knee’s”

HPI:

- 3yo boy, recently emigrated from Congo.
- Runs, plays, no pain or limitation.
- 40th Percentile for height.
- Possible Right leg injury at 2yo.

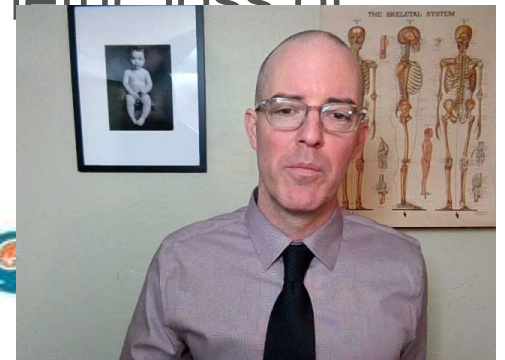






Summary

- The vast majority of rotational deformities are *variations of normal*, are benign, and resolve with time.
- Use history and exam to R/O the pathologic causes
 - Normal growth and development and no pain or limp with activity
- With a healthy young child use the rotational profile to help diagnose the location of the deformity. (Try not to get bogged down in numbers).
- Evaluate asymmetric hip rotation esp. asymmetric loss of internal rotation



Who might benefit from a referral?

- Parent/Guardian needs more reassurance
- Over 7 yrs with persistent in-toeing or out-toeing
- Stiff metatarsus adductus: Consider referral at 6 months of age
- Any asymmetry of hip rotation
- Bowing
 - below the 5th percentile for height
 - over 2-3 yrs of age with true genu valgum



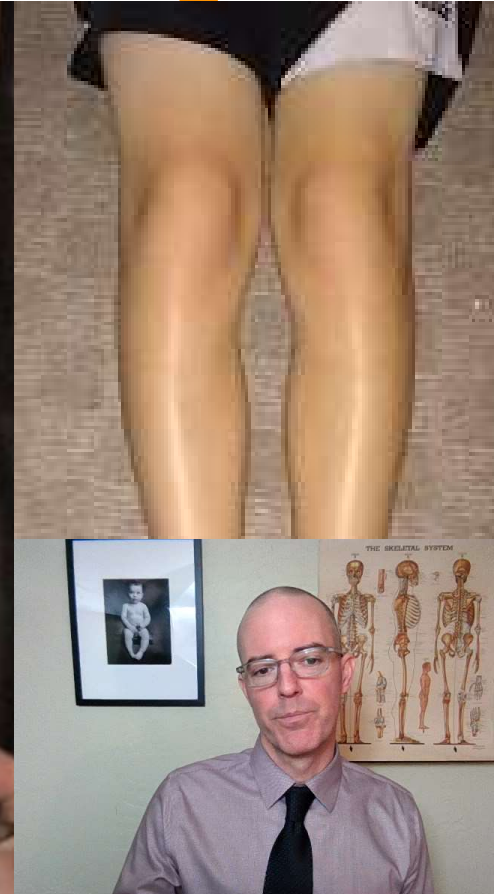
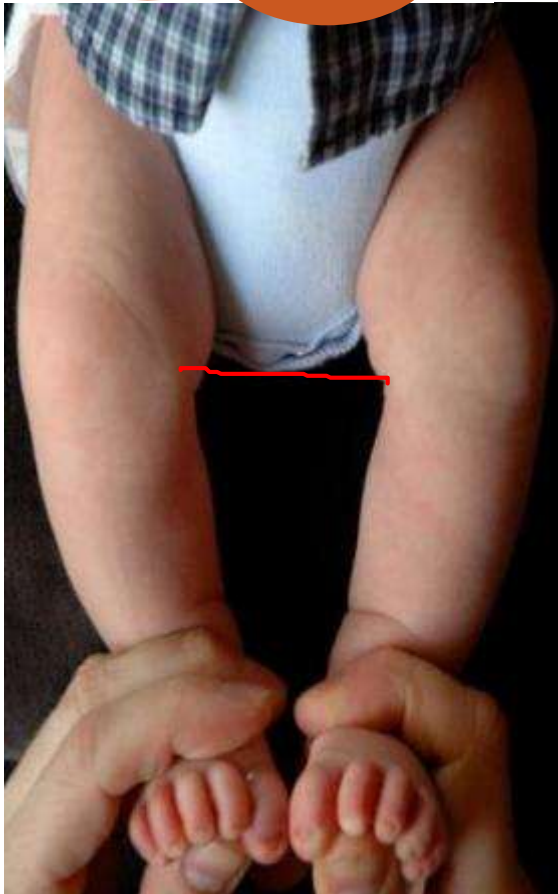
...and the answer to your question young man...

Am I
pathologic?

1 year

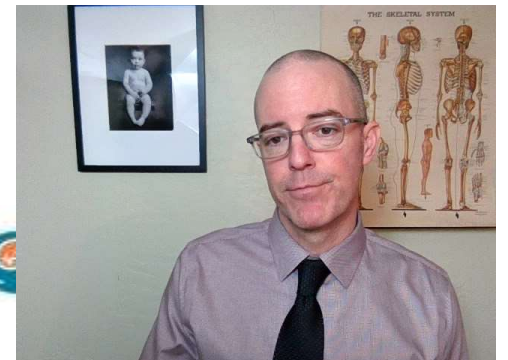
3 years

10 years



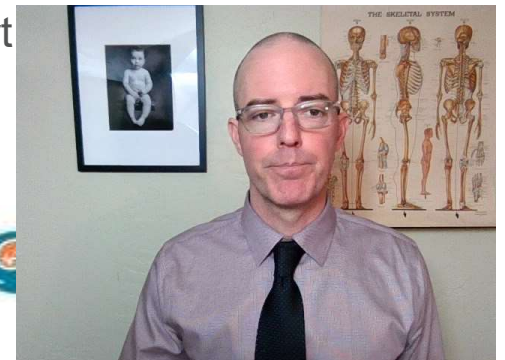
Thank you.

- Dr. Staheli
- Dr. Thomas Jinguji
- Dr. Greg Schmale



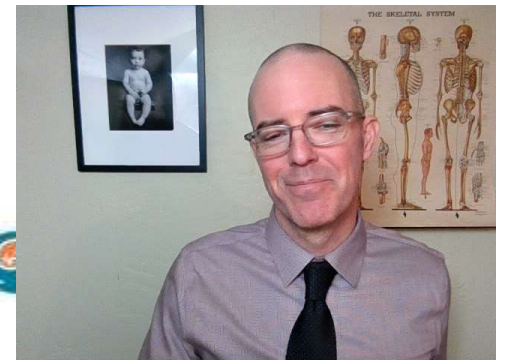
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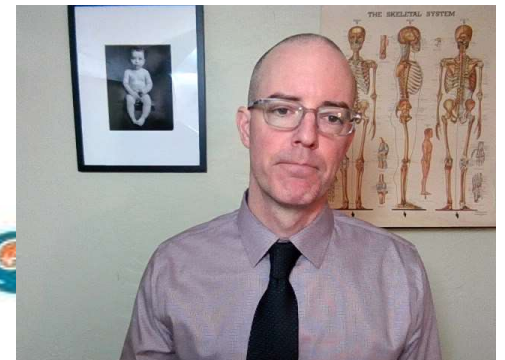
Post-test

1. What is the most common cause of intoeing in children?
 - a) Femoral Anteversion
 - b) Internal Tibial Torsion
 - c) Blounts
 - d) Metatarsus Adductus



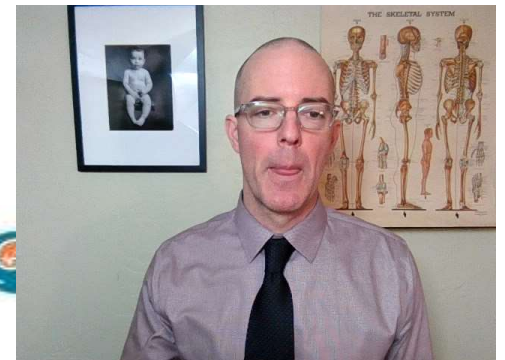
Post-test

2. What is the best way to evaluate intoeing or outtoeing?
- a) Rotational Profile
 - b) MRI lower extremity
 - c) Xray
 - d) Hip exam



Post-test cont.

3. What causes “W” sitting and does it cause osteoarthritis?
- a) Developmental Hip Dysplasia, Yes
 - b) Tibial Torsion, No
 - c) Femoral Anteversion, No
 - d) SCFE, Yes



4. What treatment is required for a flexible flat foot?
- a) AFO
 - b) Soft inserts
 - c) Custom inserts
 - d) No treatment necessary as these are completely normal.

