Intoeing

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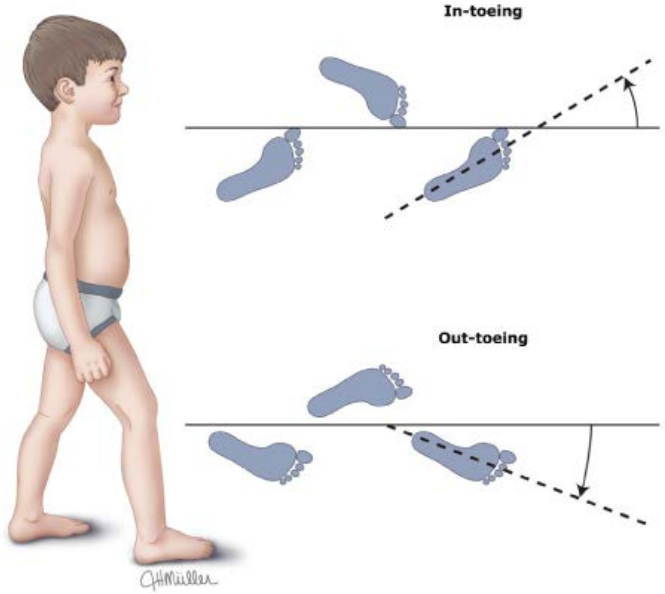
Introduction

- Intoeing is defined as the rotational variation of the lower extremity where the feet or toes point toward the midline during gait
- One of the most common anatomic musculoskeletal variations encountered by pediatric primary care providers
- Accentuated between six months and five years (when children are developing their walking and coordination skills)
- Most will improve spontaneously

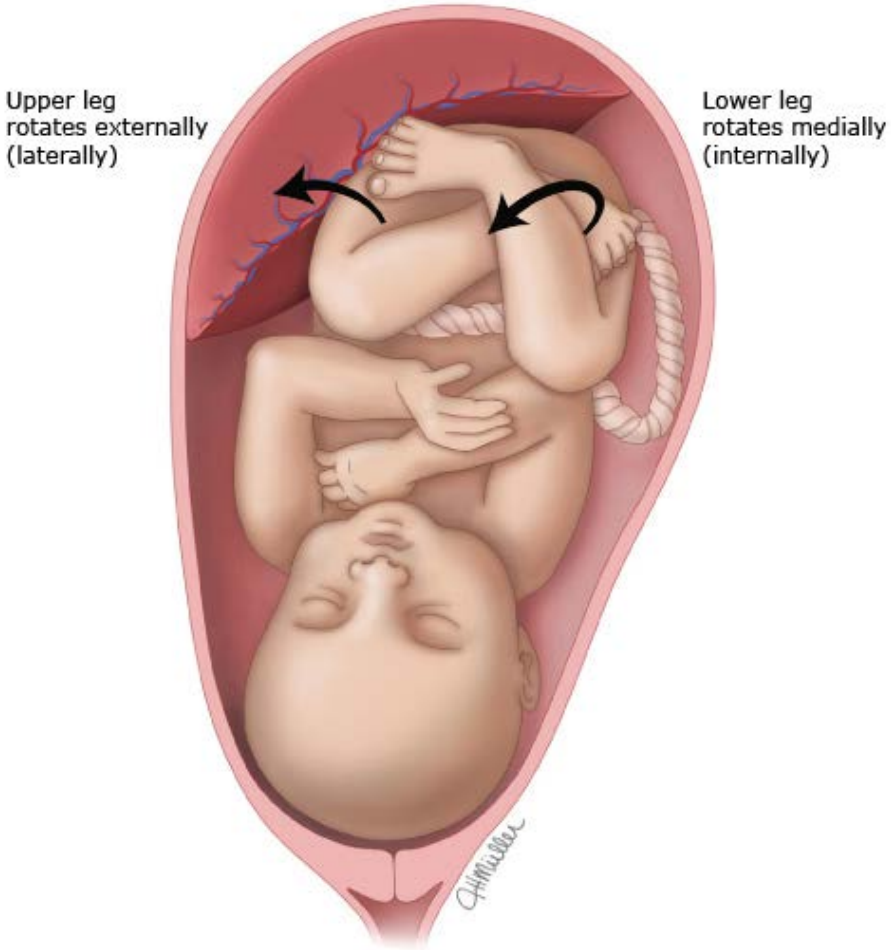


Determine the location of the problem to establish the diagnosis

femur

tibia

foot


Upper leg
rotates externally
(laterally)
Lower leg
rotates medially
(internally)

Common Causes for Intoeing

Metatarsus adductus

Internal tibial torsion

Increased femoral anteversion

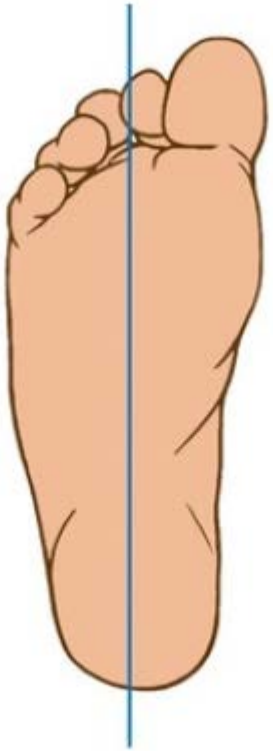
Metatarsus Adductus

Metatarsus Adductus

- Age group: <1 year
- Estimated to occur in up to 3% of term newborns, more frequent in girls than boys, and appears to run in families
- Often bilateral, and when unilateral, it occurs more often on the left than on the right (for unknown reasons)
- Can be associated with other conditions related to uterine malposition (such as hip dysplasia), but not all studies support this association

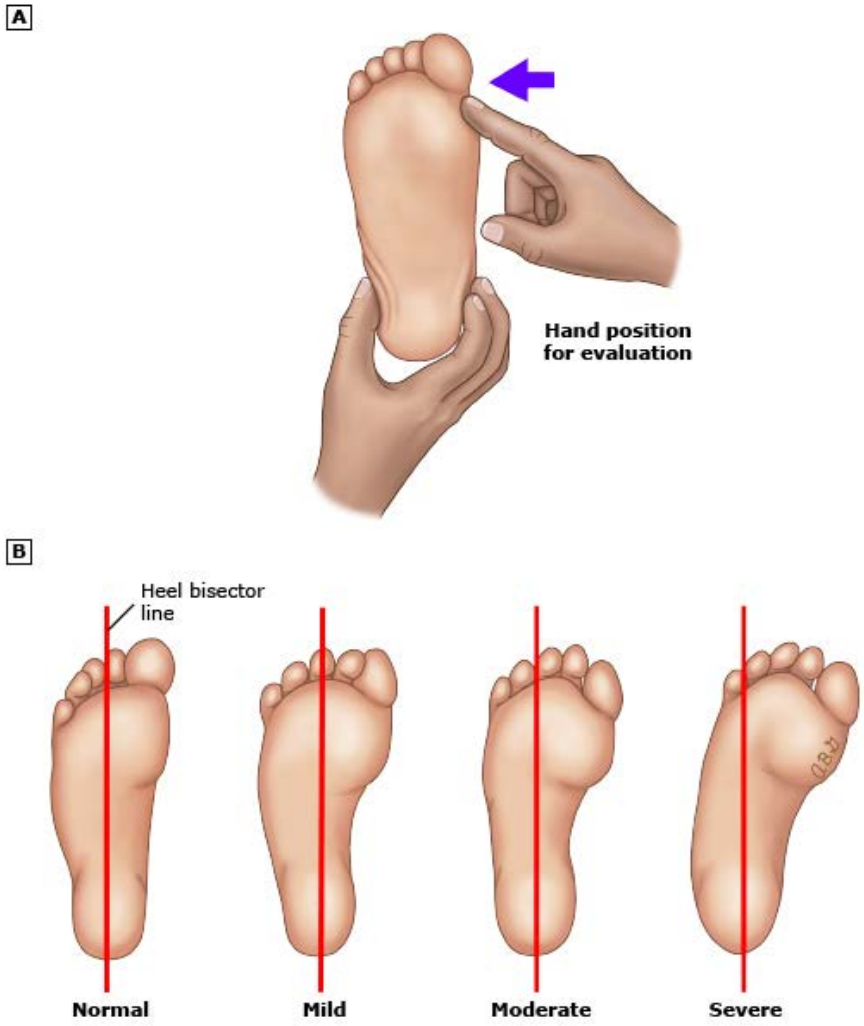
Metatarsus Adductus

- Adduction and inward position of the forefoot
- Characterized by angulation at the midfoot, with the metatarsals pointing toward the midline relative to the hindfoot
- Lateral border of the foot is convex, and the base of the 5th metatarsal appears prominent
- Use of the **heel bisector line** can be helpful to differentiate degree
    - Usually this line should cross lateral of the 2nd toe (in the web space between the 2nd and 3rd toe)
    - In metatarsus adductus, this line crosses medially



NORMAL

FIG. 695.7 **Schematic demonstration of heel bisector line.**


A
Hand position
for evaluation
B
Heel bisector
line
Normal
Mild
Moderate
Severe

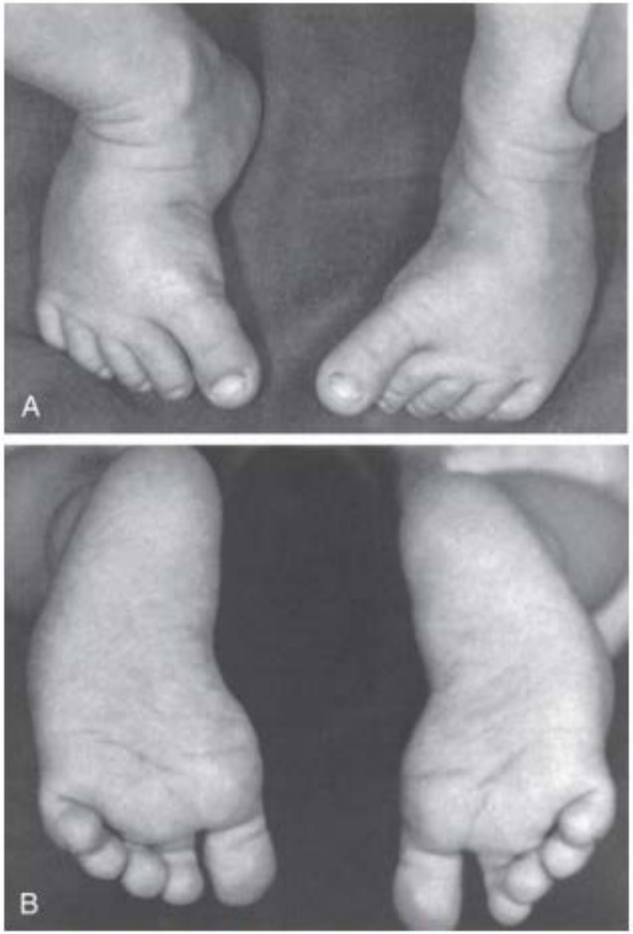


FIG. 694.1 **Bilateral mild metatarsus adductus. A, Dorsal view showing medial deviation of all the metatarsals. B, Plantar view showing the "bean-shaped" foot. This type of foot is easily corrected with serial casting. (From Ricco AI, Richards BS, Herring JA: Disorders of the foot. In Herring JA, editor: *Tachdjian's pediatric orthopaedics* , ed 5, Philadelphia, 2014, Elsevier, Fig. 23-19.)**

Metatarsus Adductus

- Differentiate from club foot by:
  - Absence of ankle equines (plantar flexion)
  - Absence of hind foot varus (inward position of the heel)
- Most infants will improve without interference
  - If flexible (forefoot can be passively abducted past the midline), will spontaneously resolve by 1 year
  - If semiflexible (forefoot can be passively abducted only to the midline), can observe for 6 months
    - Can consider passive stretching, but ? efficacy
- If the condition persists beyond 6 months of age and/or deformity is rigid, orthopedic referral may be indicated for either serial casting or bracing
  - Serial casting has best results if initiated before 8 months of age
  - Surgery is rarely indicated and very controversial

Internal Tibial Torsion

Internal Tibial Torsion

- Age group: 1-3 or 4 years
- The most common cause of intoeing
- Characterized by internal (medial) rotation of the shaft of the tibia and most commonly noticed when the child begins to walk
- Affects boys and girls equally and does not occur in premature infants
    - External tibial torsion more likely in premature infants
- Often bilateral (60% of the time), and when unilateral, it occurs more often on the left than on the right (for unknown reasons)
- Can be associated with metatarsus adductus and may accentuate the appearance of physiologic tibia vara and bow legs

Internal Tibial Torsion

- Hips and knees are found to be normally aligned, with patellas facing anteriorly, but lower legs and feet are rotated inward
- When standing or walking, the foot points inward (an inward foot progression angle)
- When lying prone, the thigh-foot angle is internal
- Typically resolves by age 5
  - There is wide variation of tibial rotation
  - As the child grows, the tibia spontaneously rotates laterally

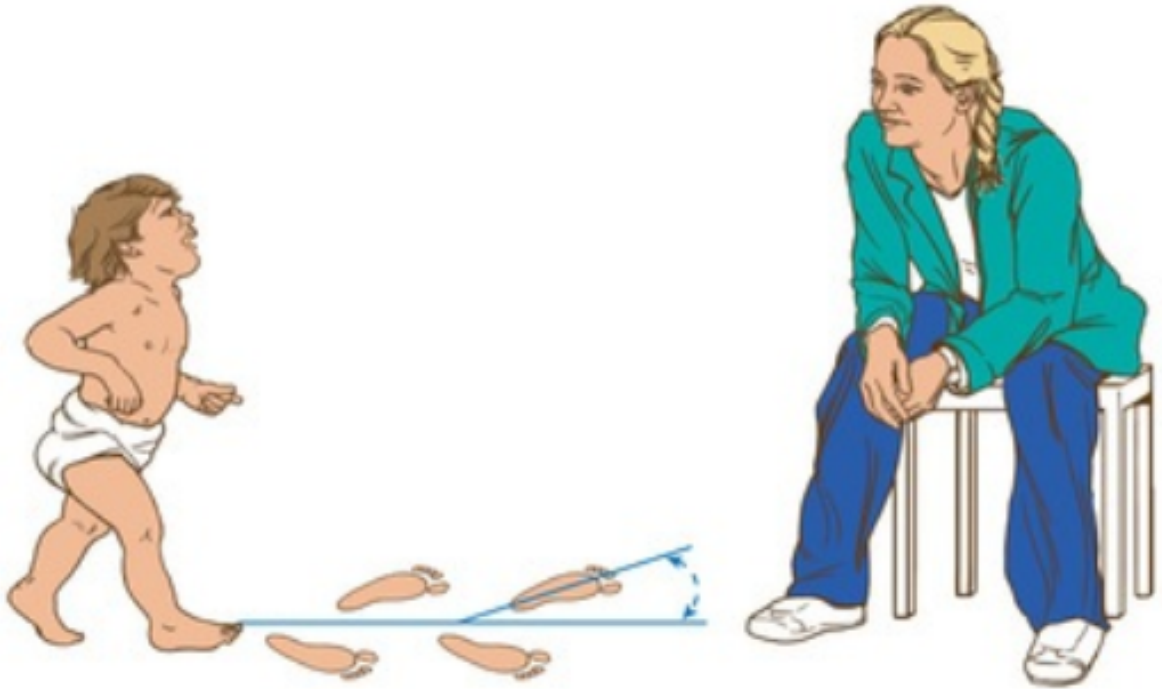
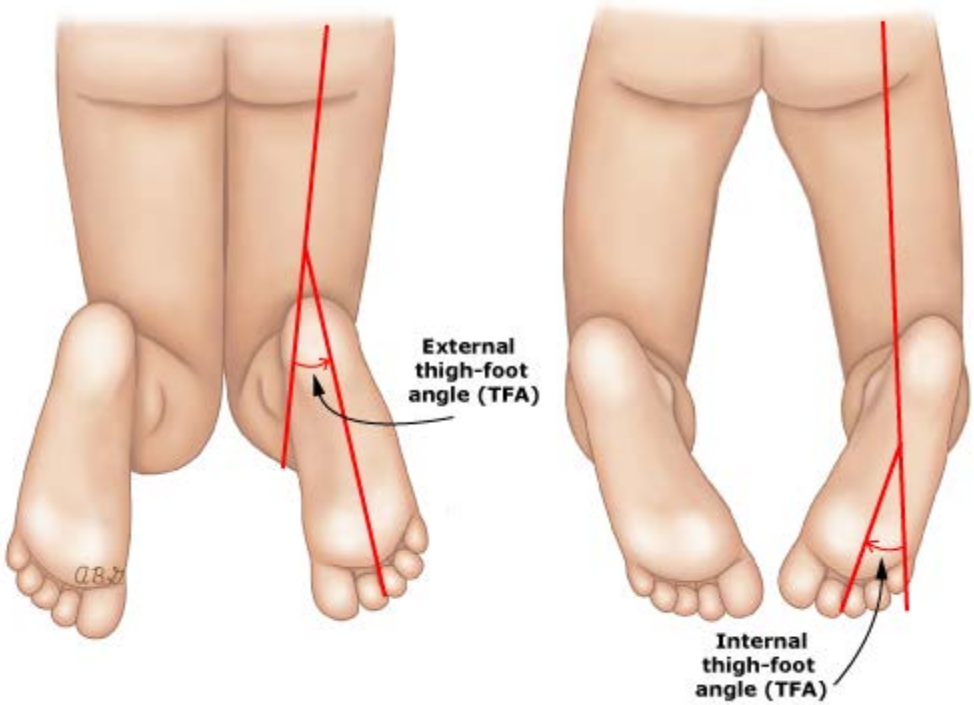


FIG. 695.3 **Foot progression angle. The long axis of the foot is compared with the direction in which the child is walking. If the long axis of the foot is directed outward, the angle is positive. If the foot is directed inward, the angle is negative and indicates in-toeing. (From Thompson GH: Gait disturbances. In Kliegman RM, editor: *Practical strategies in pediatric diagnosis and therapy* , Philadelphia, 2004, WB Saunders.)**


External
thigh-foot
angle (TFA)
Internal
thigh-foot
angle (TFA)

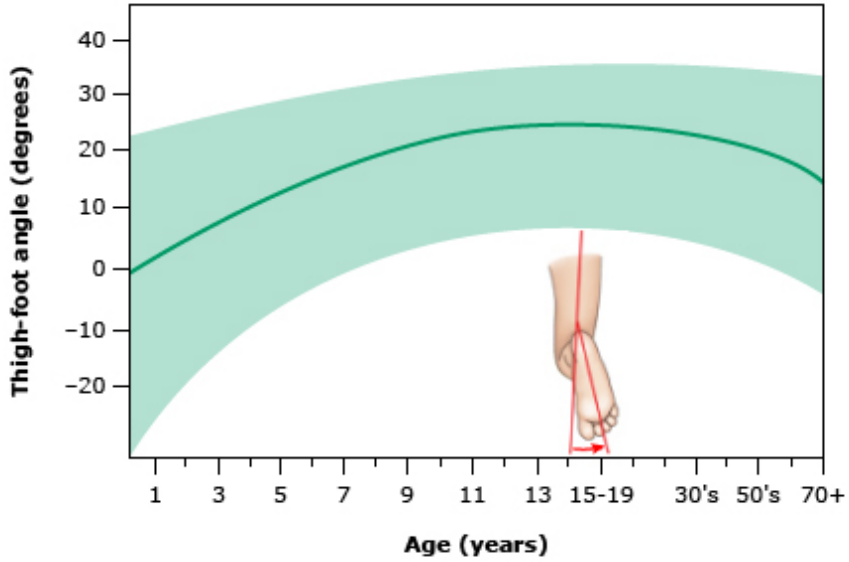

Thigh-foot angle (degrees)
40
30
20
10
0
−10
−20
1
3
5
7
9
11
13
15-19
30's
50's
70+
Age (years)

FIG. 695.5 Measurement of transmalleolar angle (TMA). (From Guler O, Isyar M, Karataş D, et al: Investigating the relationship between internal tibial torsion and medial collateral ligament injury in patients undergoing knee arthroscopy due to tears in the posterior one third of the medial meniscus. The Knee 23(4):655-658, 2016. Fig 2.)

FIG. 695.6 **Thigh-foot angle.**

Figure 22.99 Internal tibial torsion. **A,** On weight bearing, the hip, thigh, and knee are normally oriented and the patella faces anteriorly, but the lower leg and foot turn inward. The deformity results in prominent intoeing on walking, which may cause the child to trip frequently. **B,** In this view of the child while sitting, it is easy to appreciate that the lateral malleolus is positioned anteriorly to the medial malleolus. This shifts the ankle mortise and foot to a medially oriented position.

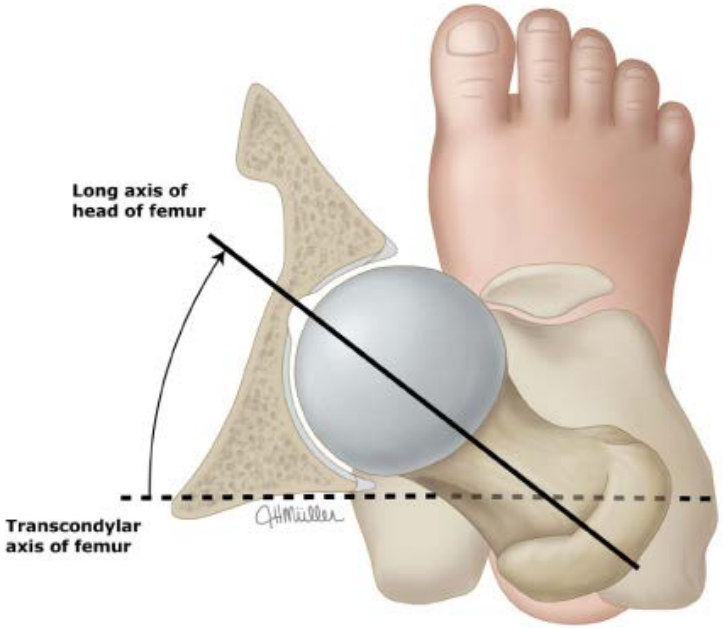
Internal Tibial Torsion

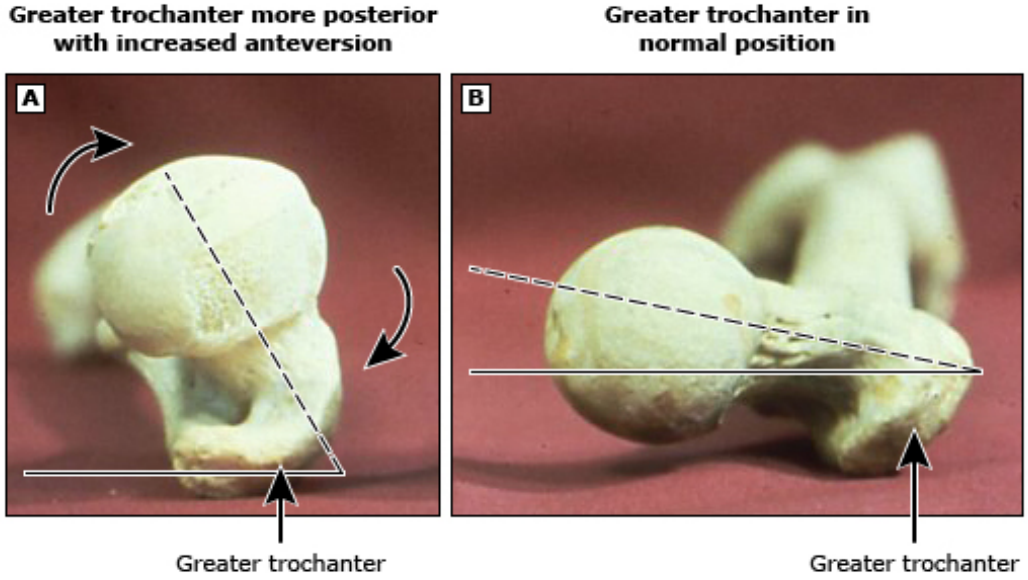
- Generally corrects spontaneously by the age of 5
- Even if persists, has few long-term sequelae
- The use of special shoes, orthotics, or braces is not recommended
- Surgical treatment is very rarely indicated
  - Only reserved for patients with severe intoeing
  - Patients meeting this criterion who are older than eight years with an internal thigh-foot angle greater than 15 degrees may be considered for distal tibial derotational osteotomy
- The correct answer on any board exam: parental reassurance

Internal Femoral Torsion

Increased Femoral Anteversion

- Age group: 3 years or older
- Femoral version: angular difference between the axis of the femoral neck and the transcondylar axis of the femur
- Femoral anteversion: increased internal rotation and decreased external rotation at the hip
- Thought to be due to intrauterine molding and genetic inheritance
- Twice as common in females as in males
- May increase until five to six years of age and then gradually decreases
- Increased femoral anteversion **does not cause pain**


Long axis of
head of femur
Transcondylar
axis of femur


Greater trochanter more posterior
with increased anteversion
Greater trochanter in
normal position
A
B
Greater trochanter
Greater trochanter

Increased Femoral Anteversion

- Tends to be symmetric
- When standing, the patellae face medially
- When walking, both the toes and the patellae point towards the midline
- Increased internal rotation and decreased external rotation of both hips
    - On exam, hip internal rotation > hip external rotation
- Preference for sitting in the "W" position
    - Uncomfortable sitting cross-legged until lateral rotation of the hip improves

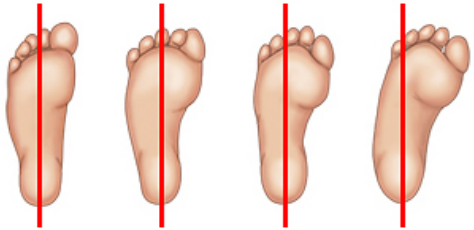
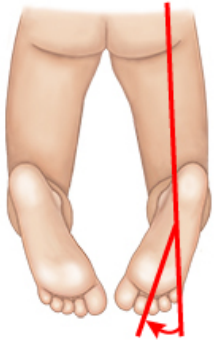
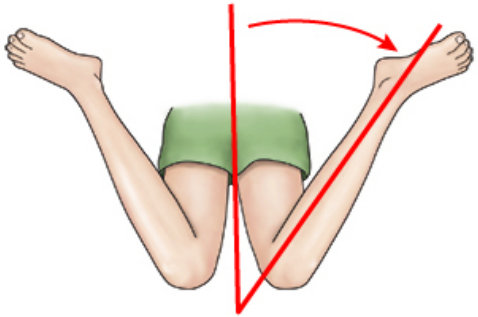
Increased Femoral Anteversion

- Generally no treatment is required and usually resolves spontaneously around the age of 8 (UpToDate says 11)
- Bracing and orthotics do not change the natural history of the condition
- Keeping kids away from “W” sitting position also does not help with natural history
- If persists or does not improve by age 11, then refer to orthopedic surgery
    - Femoral derotational osteotomy only effective treatment, but high complication rate so generally is not recommended
- When combined with external tibial torsion, patients with increased femoral anteversion may be more likely to develop anterior knee pain from so-called "miserable malalignment"

Uncommon Pathologic Causes

Uncommon Pathologic Causes

- Cerebral palsy
  - Spasticity may result in over-pull of the internal rotators of the hip or the adductors and inverters of the foot, which may cause an **asymmetric**, unilateral intoeing gait
- Developmental dysplasia or dislocation of the hip
  - Look for limitation of hip abduction, leg-length discrepancy, or persistent increased femoral anteversion
- Clubfoot
  - Medial deviation of the forefoot is combined with excessive supination (the sole of the foot faces inward), cavus (high midfoot arch), and ankle plantar flexion (equinus)
- Skewfoot (rare)
  - Medial deviation of the forefoot is combined with lateral translation of the midfoot and valgus position of the hindfoot
  - head of the talus may be visible and palpable medially.
  - Consider this with unilateral metatarsus adductus

	Metatarsus adductus	Internal tibial torsion	Increased femoral anteversion
Description	Medial deviation of the forefoot on the hindfoot	Internal (medial) rotation of the tibia relative to the transcondylar axis of the femur	Increased angle between the axis of the femoral neck and the transcondylar axis of the femur
Most common age group	Birth to 1 year	1 to 3 or 4 years	>3 years
Foot progression angle	Internal	Internal	Internal
Patellar progression angle	Neutral/external	Neutral/external	Internal
Evaluation	Heel bisector line* falls lateral to second toe 	Thigh-foot angle¶ is internal (negative) 	Internal (medial) hip rotation symmetrically increased for age△ 
Laterality	Usually bilateral; may be unilateral with L>R	Usually bilateral; may be unilateral with L>R	Bilateral; other conditions should be considered if unilateral
Other clinical features	May be associated with other conditions associated with intrauterine restraint (eg, torticollis) Normal range of motion at ankle and subtalar joint	Medial malleolus level with or posterior to lateral malleolus when seated with thigh directly in front of hip joint and the knee pointed straight ahead	Sits in "W" position Runs with "egg-beater" or "wind-mill" pattern◇ More common in girls Tends to run in families
Natural history	Resolves by age 1 year	Resolves by age 5 years	Resolves by age 11 years

References

- Kliegman RM, St Geme JW, Blum NJ, Shah SS, Tasker RC, Wilson KM. *Nelson Textbook of Pediatrics*. Elsevier Health Sciences. 2020, 21st ed.
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- Zitelli BJ, McIntire SC, Nowalk AJ. *Zitelli and Davis' Atlas of Pediatric Physical Diagnosis*. Elsevier Health Sciences. 2018, 7th ed.