In Toeing and Out Toeing in Children

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Abstract

Intoed and out-toed gait in children can occur due to foot deformities or torsional alignment of the femur and/or tibia. In most cases, these deformities are physiological and resolve with age. Physical examination consists of assessment of rotational profile of the lower limb which includes foot progression angle, torsional alignment of the femur and tibia, and foot shape. Few cases may be due to underlying pathological conditions which need to be identified and treated.

Keywords: in-toeing, out- toeing, torsional profile

Introduction

In-toed and out-toed gait are one of the most common causes of referral to a paediatrician or a paediatric orthopaedic specialist. In most of the cases, these gait patterns are normal anatomic variants. However, a thorough history and careful clinical examination are necessary to rule out pathological causes.

History

Evaluation of a child with in-toed or out-toed gait commences by obtaining a thorough history. The questions that need to be asked include:

1. When was the abnormality first noticed and who noticed it first?.
2. Pregnancy and birth history to rule out intrauterine mal-positioning (breech presentation, twin pregnancy).
3. The position of feet at birth/ shape of legs/ any problem with hips/ spine.
4. Developmental history: Delayed milestones/ hypotonia/ spasticity.
5. Upper limb function: To rule out hemiparesis and unilateral in-toed gait.
6. Course of deformity till presentation: Resolution/ worsening.
7. The nature of disability the deformity is causing to the child while walking/ playing (repeated falls).

Clinical Examination

Clinical examination of a child with in-toed or out-toed gait consists of assessment of rotational profile of the lower limb as described by Lynn Staheli. [1] This consists of:

Foot Progression Angle (FPA)

The FPAfoot progression angle (FPA) is the angle of made by the long axis of the foot with the line of progression of body (Fig. 1).

An in-toed gait is denoted by –-ve FPA, whereas out-toed gait is denoted by +ve FPA. FPA has a wide normal range (–-5 to +20).

Once a child is determined to be walking with an in-toed or out-toed gait, the next step is localizing the lower limb segment which is causing the FPA deviation.

Foot

The foot is assessed by observing the sole from it's plantar aspect. Metatarsus adductus leads to in-toeing whereas flatfoot leads to out-toeing.

Metatarsus adductusadducts is usually a postural deformity and may be associated with intra-uterine overcrowding (twin pregnancy, oligohydramnios, etc.). The natural history is one of spontaneous resolution (Fig. 2).

Flexible flatfoot is very common in the toddler age group and is considered a physiological variation. The incidence of flexible flatfoot decreases with age (Fig. 3).

Tibia

Torsion of the tibia implies lateral rotation of the distal tibio-fibular axis with reference to the proximal tibio-fibular axis. External torsion will lead to out-toeing whereas internal torsion will lead to intoeing. Torsional abnormalities can be assessed by performing following clinical tests:

- Assessment of patella position with reference to the foot axis:

If the foot axis is rotated inwards or

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Submitted Date: 15 Aug 2022, Review Date: 22 Sep 2022, Accepted Date: 18 Nov 2022 & Published Date: 10 Dec 2022

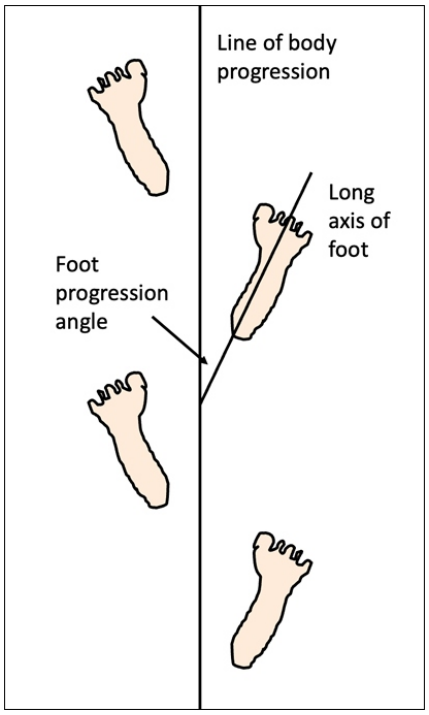

Figure 1: Foot progression angle.

outwards with reference to the position of patella, it implies that there is a torsional deformity distal to the knee joint. In the absence of a foot deformity, it can be assumed the source of deformity is torsion in the tibia (Fig. 5).

• Thigh-foot angle:

Figure 4: Foot axis orientation with reference to the patella position is a measure of tibia torsion.

Figure 2: Metatarsus adductus.

The thigh foot angle is a measure of tibial torsion. It is assessed by examining the child in prone position with knees flexed to 90°. The thigh foot angle is the angle formed by the long axis of the foot with the thigh axis (Fig. 5). In the presence of foot deformity, the orientation of the transmalleolar axis with reference to the thigh axis is measured.

• Transcondylar-transmalleolar axis angle (TC-TM angle):

Figure 5: Thigh foot angle.

Figure 3: Flexible flatfoot with out-toeing.

The TC-TM angle is measured by palpating the proximal tibial condyles with one hand, and the medial-lateral malleoli with the other hand, and assessing the rotation between the two planes (Fig. 6).

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Femur

Femoral anteversion which implies lateral rotation of the proximal femur

Figure 6: Transcondylar-transmalleolar axis angle.

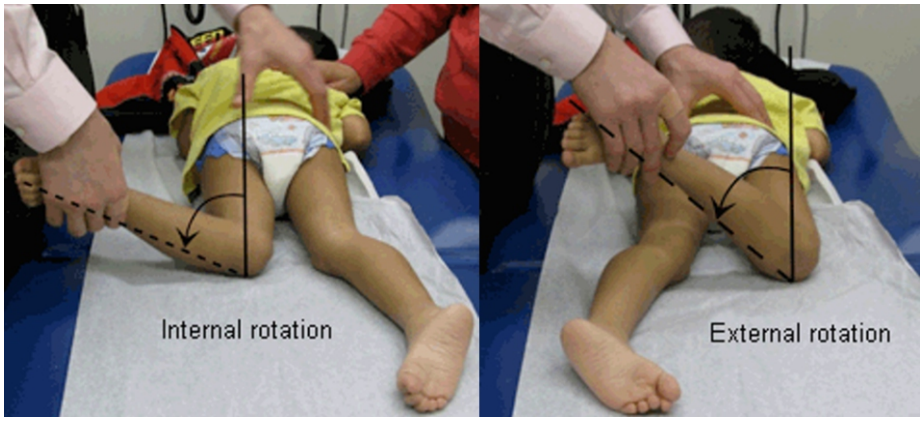

Figure 7: Hip rotations, (a) Internal rotation. (b) External rotation.

Figure 8: Trochanter prominence angle test.

neck axis with reference to the distal femur transcondylar axis will lead to intoeing. On the other hand, femoral retroversion will lead to out-toeing. Following clinical tests help to assess femoral version:

• Patella position with reference to foot axis:

In the presence of an intoed or out-toed gait, if patella points in the same direction as the foot, it implies a femoral version etiology. Thus, an inward facing patella in an intoeing child indicates femoral anteversion, whereas an outwards facing patella in an out-toeing child indicates femoral retroversion.

• Hip internal/ external rotation (EER):

With the child lying in prone position the knees are flexed to 90° degrees. The degree of internal and EERexternal rotation of hip is determined by stabilizing the pelvis on the bed. When the leg moves away from the body (i.e., towards the table) its termed as internal rotation (EIR) and the other way as EERexternal rotation (EER) (Fig. 7 a and b).

The normal range of hip IR is 60 to –70° degrees. In femoral anteversion, the hip IR is more than 70° degrees. There is a concomitant decrease in hip ER to less than <25° degrees.

• Trochanter Prominence Angle Test:

With the child in supine position, the hip is internally/ externally rotated while palpating the lateral aspect of greater trochanter (GT). The position of patella at which the GT is most prominently palpable is noted and its angle with the vertical is measured. This angle corresponds to the version of the femoral neck (Fig. 8).

• W sitting:

Children with femoral anteversion prefer to sit in W position as the range of hip internal rotation is greater than

Figure 9: W-sitting.

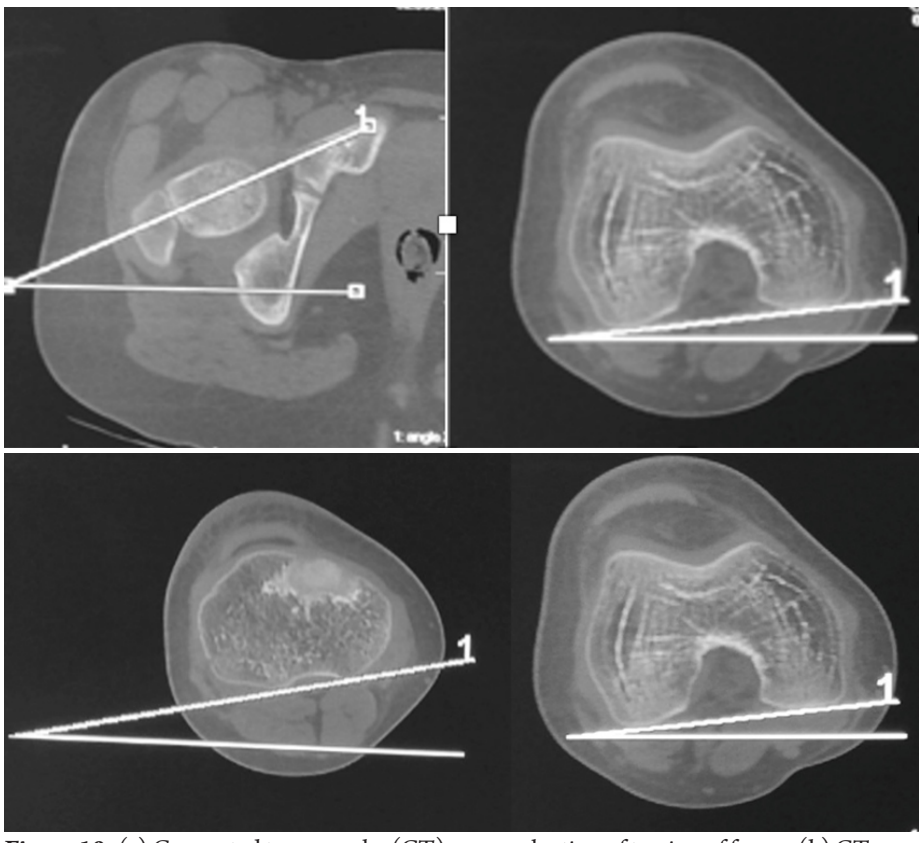

Figure 10: (a) Computed tomography (CT) scan evaluation of torsion of femur. (b) CT scan evaluation of torsion of tibia.

Table 1: Physiological causes of intoeing/out-toeing

Deformity	Gait	Age
Physiologic external rotation contracture of hip	Out-toeing	0–2 years
Metatarsus adducts	In-toeing	0–3 years
Flexible flatfeet	Out-toeing	1–6 years
Excess femur anteversion	In-toeing	2–8 years
Internal tibial torsion	In-toeing	2–6 years

EERexternal rotation (Fig. 9).

Radiological Evaluation

Assessment of the lower limb rotational profile can be made fairly reliably clinically;, however, radiological evaluation may be performed for documentation. Plain radiographs are of no value for assessment of femoral/ tibial torsion. Estimation of femur torsion on CT scan can be done by obtaining transverse cuts of proximal and distal ends of the femur and calculating the orientation of the distal femur transcondylar axis with reference to the proximal femur neck axis (Fig. 10a). Similarly for tibia, rotational angulation of distal tibia transmalleolar axis with respect to proximal tibia transcondylar axis is calculated (Fig. 10b).

Physiologic Causes of Intoeing and Out-toeing in Childhood

Torsional profile of the femur and tibia is not constant but keeps changing during the growing years. The femoral anteversion angle at birth is high (average 40° degrees). This angle gradually decreases with age and reaches the adult value of 10 to –15° degrees anteversion in adolescence. Also Furthermore at birth, the tibia is internally rotated (average –-5 °degrees, range –-30 to +20). The tibia rotates externally with age reaches the adult value of average 10° degrees external torsion by the age of 8 years.

Though Although intoeing and out-toeing are very common during childhood, in most of the cases it is due to deformities which spontaneously resolve, do n't not need intervention, and hence are considered physiological. The physiological causes of intoed/ out-toed gait are summarized in Table 1.

In-toeing/ out-toeing due to the above-mentioned causes warrant intervention, only if they persist into adolescence and are severe enough to lead to frequent falls or functional impairments.

Pathological Causes of Intoeing/ Out-toeing

Though Although majority cases of intoeing/ out-toeing are physiological, it is important to identify gait deviations associated with underlying pathology. Rotational gait deviations can occur in:

- Cerebral Palsy: Children with cerebral palsy often walk with in-toed gait. In younger children, cause of intoeing is medial hamstrings spasticity which causes internal rotation of the hip joint. In older children, persistence of high degrees of femoral anteversion contributes to intoeing. There may be additional tibial torsion deformities with external tibial torsion being commoner. It is important to correct femoral and tibial torsion in children with cerebral palsy since they lead to "lever arm disorders" and gait inefficiency. [2]
- Spinal dysraphism / Meningomyelocele. [3]
- Slipped Capital Femoral Epiphysis: Out-toeing gait is often the first presenting complaint in adolescents with Slipped Capital Femoral Epiphysis. It occurs due to posterior slippage of the proximal femur epiphysis.
- Torsional malalignment syndrome: Combination of excess femoral anteversion with tibial external torsion is called torsional malalignment syndrome and if left untreated can lead to anterior knee pain and patella-femoral degenerative joint disease.

Surgical Treatment of Torsional Deformities

As mentioned earlier, majority cases of intoed/ out-toed gait are physiological and intervention is indicated only if functionally significant grades of deformity persist beyond adolescence. There is growing body of evidence that correction of abnormal persistent femoral or tibial torsion has an important role in the management of patella instability and patella-femoral joint symptoms [4]. Surgical correction of torsional deformity consists of derotation osteotomy of the involved bone. In femur as well as tibia, both proximal and distal metaphyseal derotation osteotomies have been described. However, most authors prefer to avoid osteotomies around the knee (distal femur and proximal tibia), since these may interfere with the functioning of the quadriceps mechanism. Osteotomies may be fixed with plate-screws, interlocking nails, or external fixators.

Conclusion

Majority cases of intoed or out-toed gait in children are physiological. However, careful clinical evaluation is needed to identify the level of deformity and to rule out pathological causes which may need intervention.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL; **Source of Support:** NIL

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Conflict of Interest: NIL
Source of Support: NIL

How to Cite this Article

Bhide P, Vaidya SV. In Toeing and Out Toeing in Children. Journal of Clinical Orthopaedics Jul-Dec 2022;7(2):22-26.