Problems in Family Practice

In-Toeing and Out-Toeing in Children

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Torsional problems are common in children but rare in adults. Most resolve spontaneously; however, some require treatment. The primary care physician should be able to determine the cause of the deformity. A general screening examination is performed to rule out hip dysplasia and other skeletal defects, estimate in-toeing or out-toeing, determine hip rotation as a measure of femoral torsion, and observe the shape of the foot. These observations determine the torsional profile.

The site and severity of the deformity can be ascertained from the information on the torsional profile. The common problems encountered in clinical practice include metatarsus adductus, out-toeing in early infancy, medial tibial torsion, and medial femoral torsion.

The persisting or severe forms of these torsional deformities are probably genetically determined. Shoe modifications are useless; bracing is ineffective. Surgical rotational osteotomies are effective, but risky, and indicated only for severe, persisting deformities.

In-toeing and out-toeing are common during infancy and early childhood. Most of these variations resolve spontaneously, but a few persist into childhood and even fewer persist into adult life. The causes of these rotational problems can easily be determined on physical examination. This determination is necessary because each type is unique and requires a different management plan.

Rotational problems are best managed by the primary care physician; only rarely is referral to an orthopedist necessary. This article outlines the steps for diagnosis and proposes a rational management plan.

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Clinical Features and Evaluation

In-toeing is the most common complaint. The parents are worried that the child may have a problem that, if left uncorrected, will produce a disability in later life. Their fears are often aggravated by grandparents' warnings and shoe salespersons' dire predictions.

The examination of the infant or child is made in three steps. First, a screening examination is made to rule out other problems. This is the most important examination. Children with mild cerebral palsy or congenital hip dislocation may present

with in-toeing. For example, congenital hip dislocation is about ten times more common in infants with metatarsus adductus than in the general population. Limited ankle dorsiflexion is often present in patients with cerebral palsy, and there is limited hip abduction in children with congenital hip dislocation.

Second, the severity of the in-toeing or out-toeing is determined by watching as the child walks. Observe each foot independently, and estimate the number of degrees the foot turns in or out. The number of degrees is called the "foot-progression angle." If the child toes in, the number of degrees is preceded by a minus sign. The normal range for children and adults is from 0° to +20°. Mild in-toeing usually measures about −5°; moderate, −10°; and severe, −15° to −20°.

Third, the cause of the problem is identified by examining the child in the prone position. Medial and lateral rotation of the hip are estimated to assess the contribution from the hip and femur. The "thigh-foot angle" is next observed. This measures the leg and hind foot segment of the limb. Finally, the bottom of the foot is inspected. Normally the lateral border of the foot is straight; a convexity is evidence of metatarsus adductus.

The values in degrees for each of these observations are summarized in the "torsional profile." This information identifies the cause of the problem and allows an appropriate management plan to be established.

The causes of in-toeing and out-toeing are often complex. In many instances two levels, or even all three, are involved. It is common to see an infant with both medial tibial torsion and metatarsus adductus. Medial femoral torsion in the older child is often associated with a lateral rotation of the tibia. With this combination the child walks with the feet pointing forward, but with the knees medially rotated. The torsional profile of such a child is shown below:

	Right	Left
Foot progression angle	10°	10°
Medial rotation	80°	80°
Lateral rotation	10°	10°
Thigh-foot angle	30°	30°
Metatarsus adductus	—	—

These deformities are compensatory, resulting in a normal foot progression angle.

The child with unilateral in-toeing will show a mild medial femoral torsion on both sides and mild tibial torsion on the in-toeing side. The torsional profile of this child is:

	Right	Left
Foot progression angle	5°	−5°
Lateral rotation	20°	20°
Thigh-foot angle	10°	−5°
Metatarsus adductus	—	—

These deformities are individually mild but are additive on the left side, producing a noticeable in-toeing. A single-level mild deformity may go unnoticed, but if the deformity is present at two levels, it becomes obvious. The net effect is a summation of the different levels, which can be either compensatory or additive in effect.

Common Clinical Patterns

Metatarsus Adductus

This congenital deformity is usually secondary to intrauterine position (Figure 1) and is often associated with medial tibial torsion as reflected by the following torsional profile:

	Right	Left
Foot progression angle	5°	−10°
Medial rotation	70°	70°
Lateral rotation	30°	30°
Thigh-foot angle	10°	−15°
Metatarsus adductus	—	++

Since this is a positional deformity, the natural history is one of spontaneous resolution in most cases. Without treatment, about 85 percent will resolve in the first year or two.

Treatment is indicated for the unusual case that is rigid or fails to resolve during the first six to nine months. For these more resistant forms, the most effective treatment is corrective plaster casting. A long cast covering the entire leg corrects the deformities most rapidly. To test for rigidity, stabilize the hind foot with one hand and passively abduct the forefoot with the other hand. If the foot is not easily straightened, the metatarsus adductus is rigid, and the child should be referred to an orthopedist.

Figure 1. Metatarsus adductus showing the characteristic convexity of the lateral border of the foot

Casting can be effective until the child is 3 to 4 years old. Cast correction, however, becomes more difficult with advancing age, so it is best to proceed with treatment as soon as it appears that the foot falls into the resistant category.

Stretching exercises of the foot are frequently prescribed but their effectiveness is doubtful. If done gently, they are probably not harmful.

Surgical correction of simple metatarsus adductus is practically never justified. Metatarsus adductus is rarely seen in the adult, suggesting that even the more rigid forms eventually resolve. Furthermore, it is not associated with any demonstrated disability. Cast correction can be justified for cosmetic reasons, but operative intervention is difficult to defend.

Out-toeing in Early Infancy

Out-toeing is often noticed when the impatient parent stands the infant hoping that this will encourage early walking (Figure 2). One or both feet turn out. This alarms the family and prompts a visit to the physician. The torsional profile shows more lateral than medial hip rotation:

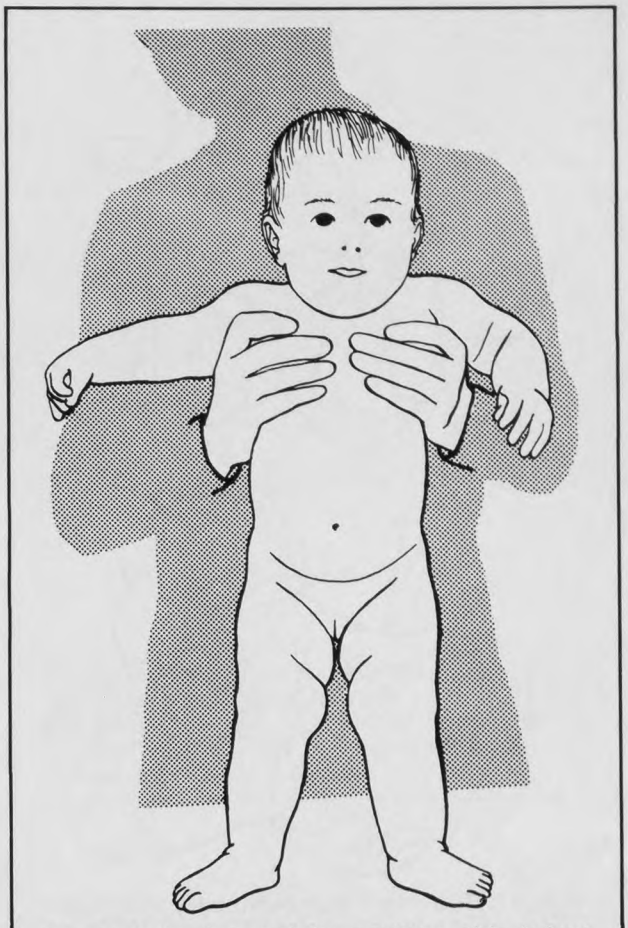

Figure 2. In the upright position, this infant shows a normal pattern of lateral rotation of the limb that is due to intrauterine position

	Right	Left
Foot progression angle	30°	30°
Medial rotation	10°	10°
Lateral rotation	80°	80°
Thigh-foot angle	10°	10°
Metatarsus adductus	—	—

Examination reveals normal legs and feet (Figure 3).

Such is the normal pattern seen during early infancy, which is due to a lateral rotation contracture of the hips secondary to intrauterine position. No treatment is necessary and resolution occurs progressively during the first two to three years.

An interesting variation of this pattern occurs unilaterally; most commonly the right foot turns out. The torsional profile demonstrates the normal lateral hip rotational pattern but with medial tibial torsion and metatarsus adductus on the left side.

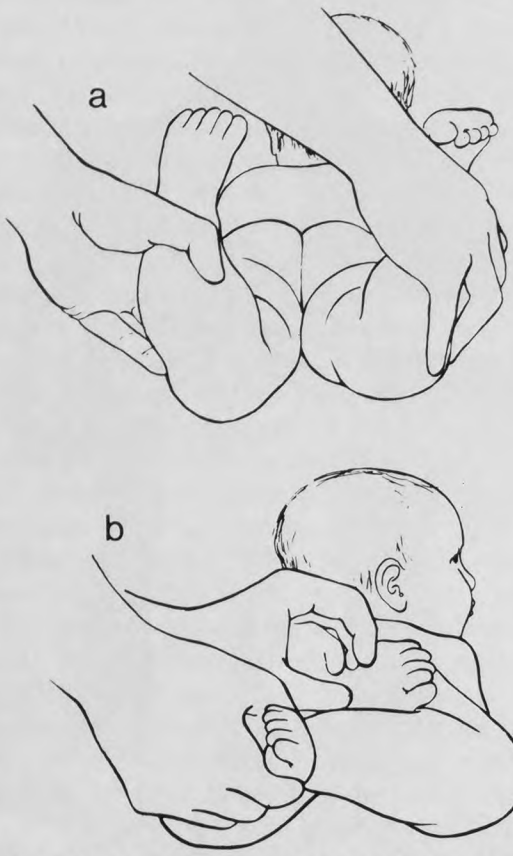

Figure 3. The infant with out-toeing shows limited medial (a) and extensive lateral (b) hip rotation. This normal asymmetry is the residual of intrauterine position

Figure 4. This child shows the typical appearance of medial tibial torsion, worse on the left side. The patellae are facing directly forward

The family, looking for asymmetry, attributes the problem to the wrong side.

Internal Tibial Torsion

Internal tibial torsion is most commonly seen during the second year when the child begins to walk (Figure 4). In-toeing is often asymmetrical and is usually more pronounced on the left. The torsional profile is shown below:

	Right	Left
Foot progression angle	−5°	−10°
Medial rotation	50°	50°
Lateral rotation	60°	60°
Thigh-foot angle	−15°	−20°
Metatarsus adductus	—	—

A normal hip rotation is demonstrated, but there is a negative thigh-foot angle (Figure 5).

During infancy there is a wide range of normal of the torsional profile. Up to −30° to −40° is probably normal for the thigh-foot axis at this age. The tibia rotates laterally with growth. Tibial torsion is common in infancy, and rarely persists into childhood or adult life. It is likely that the persisting problems are secondary to an intrinsic cause rather than simply intrauterine positioning.

Whether or not to treat tibial torsion is controversial. The trends have been toward "observational" management. Unfortunately, the effectiveness of treating tibial torsion has not been documented. If treatment is considered appropri-

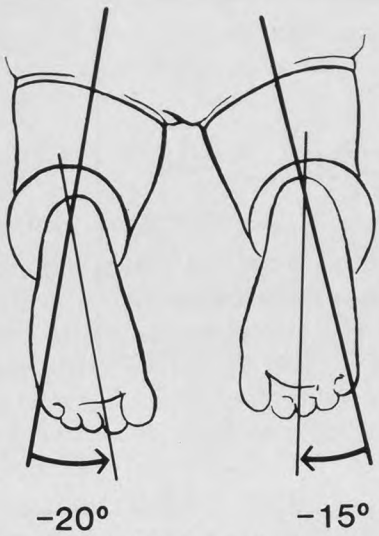

Figure 5. The thigh-foot angle showing medial rotation of both tibiae, worse on the left. In assessing this angle, the examiner must sight directly down over the tibia. The foot must be allowed to assume a comfortable resting position

Figure 6. The typical reverse tailor position of the child with medial femoral torsion. This is the effect, not the cause, of the torsional deformity. The child is encouraged, but not forced, to avoid this posture

ate, it should be limited to intervention only at night and nap time.

The objective of treatment is to rotate the feet laterally. This can be accomplished by a variety of means. The simplest method is to attach the heels together. This can be done by sewing the heels of the sleepers together or tying the heels of the shoes together through holes drilled in the heels.

Commercial splints accomplish the same thing. The most inexpensive type is the Fillauer splint, which is simply a bar 6 to 8 inches long with clamps at each end. High-top shoes with stiff soles are attached to the bar. The feet are rotated about 45° in the opposite direction of the deformity. They are turned out about 10° for a normal limb.

A recent normal-value study at Children's Orthopedic Hospital (unpublished data) shows that there is such a wide range of normal tibial rotation that any treatment is questionable. If treatment is given, it should be provided only between ages 12 and 36 months by a means that is inexpensive and does not interfere with the child's normal development. Prescribing use during daytime is not appropriate.

Tibial torsion is sometimes seen during childhood and may be severe enough to cause a disability. If the child toes in, tripping is the common problem. Out-toeing children often catch their foot against objects when walking through narrow areas. In addition, both forms may present cosmetic problems.

The correction of torsional deformity is possible only by tibial rotational osteotomy. This procedure is one of the most risky operations in orthopedics. It may cause a compartment syndrome with residual weakness. The indications for correction of tibial torsion are, therefore, very limited. It should not be undertaken unless the child has been followed for several years to determine that the deformity is permanent and that it is producing a persisting and serious disability.

Medial Femoral Torsion

This condition is sometimes referred to as "anteversion," or "cross-eyed patella," usually becoming apparent by the age of 3 to 4 years.[1] In-toeing is symmetrical and the child sits in the reverse tailor position (Figure 6). The natural his-

Figure 7. The child with medial femoral torsion shows excessive medial hip rotation

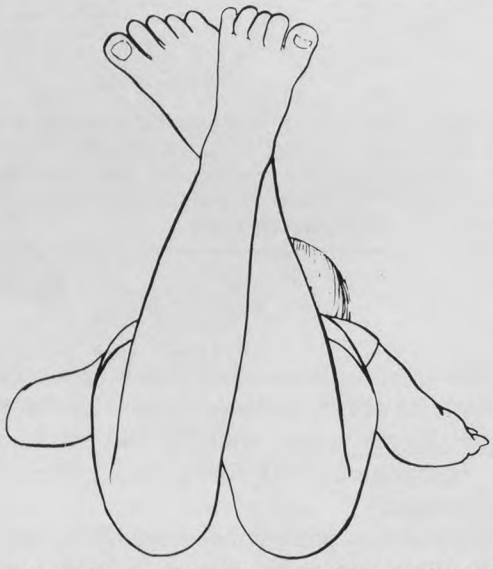

Figure 8. The child with medial femoral torsion shows limited lateral hip rotation

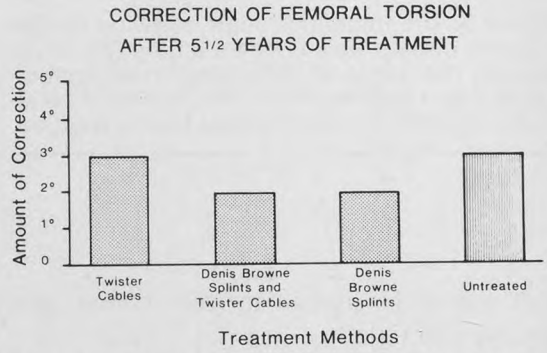

Figure 9. This graph from a study at the duPont Institute shows the ineffectiveness of bracing in management of medial femoral torsion after 5.5 years of treatment. The torsion was measured radiographically before and after treatment. No difference between the treated and untreated patient was observed. (With permission of the publisher, from Fabry et al[2])

tory of femoral torsion is one of increasing severity until the age of 5 or 6, followed by a gradual decline with advancing age. On physical examination, medial rotation of the hip is greater than 70° and lateral rotation is less than 20° (Figures 7 and 8). Associated tibial torsion, if medial, will accentuate the in-toeing, or if lateral, will normalize the foot progression angle.

The management of femoral torsion is observation and reassurance. The ineffectiveness of braces, such as twister cables, has been demonstrated (Figure 9).[2] The only effective means of correction is by femoral rotational osteotomy. The procedure is rarely indicated, since most children improve spontaneously. Furthermore, this procedure has been shown to carry about a 15 percent incidence of complications.[3]

The operation is indicated only in severe cases that clearly persist. If the child is followed for several years, and if by 10 years of age is still showing a significant disability with about 90° of medial and no lateral rotation, then rotational osteotomy may be considered.

Except in rare instances, this condition is usu-

ally managed by establishing the diagnosis, giving the family information and reassurance, and providing continued observation.

Inappropriate Treatment

Shoe modifications are often prescribed for practically everything, including in-toeing and out-toeing.[4] In a careful scientific study, shoe wedges were found to be ineffective (Figure 10).[5] They waste family resources and embarrass the child. In a number of instances, children who had congenital hip dislocation were treated with corrective shoes; a focus on diagnosis rather than treatment would have made a tremendous difference to these unfortunate children. Orthotics are even more expensive than modified shoes and, likewise, have no place in the management of these children.

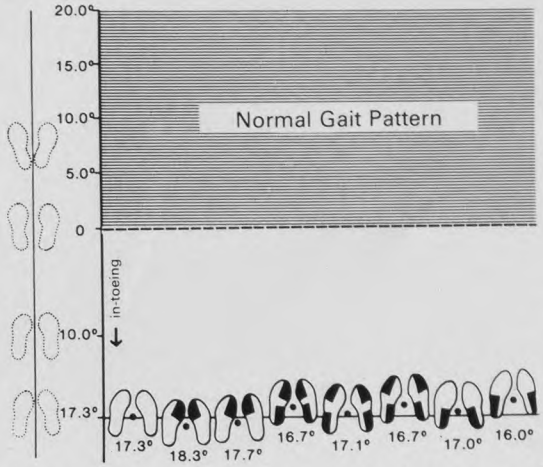

Figure 10. This drawing summarizes a study performed at Children's Orthopedic Hospital showing that shoe wedges do not change in-toeing. The degree of in-toeing is shown on the left with the normal range shaded. Ten in-toeing children showed a mean foot progression angle of −17° with normal shoes (unshaded shoe shape). Various wedges (shown in solid tones) produced no change in the foot progression angle

When to Refer

In a few situations referral to an orthopedist is appropriate. If the family seems unconvinced about the appropriateness of observational management, some help might be needed. It is useful to inform the orthopedist of the reason for the consultation so that he can support the original recommendation. Without this information the consultant may feel obligated to do something, such as ordering a brace or modified shoe, even if it is against his better judgment.

Appropriate referrals also occur when there is some question about the diagnosis, for infants with persisting metatarsus adductus requiring casting, and for the unusually severe, persisting tibial or femoral torsion that produces a disability and may be considered for surgical correction.

Prognosis

Torsional deformities are not major problems. The emphasis should be on diagnosis, ruling out more serious problems. Persisting torsional problems are occasionally seen in adult life, possibly aggravating chondromalacia patella[6,7] or producing a malalignment troubling the marathon runner.[8,9] Unfortunately, these variations of the normal are akin to other physical characteristics such as height, body build, and hair color. Correction can be obtained only by surgery, but the risks and costs of such treatment exceed the disability.

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