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# Assessment of Foot Deformities in the Infant



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The majority of foot deformities occur in otherwise healthy infants. However most generalized neurologic disorders (spina bifida, spinal dysraphism, cerebral palsy, arthrogryposis) may be associated with foot deformities. Therefore, the first component of the examination of a child with a foot deformity is a general neuromuscular assessment.

In-toeing and out-toeing gait are frequently perceived by parents as being due to foot problems. Lower extremity rotational alignment must be assessed, therefore, before deciding the foot is the primary problem.

Femoral rotation is evaluated with the patient lying on his/her stomach and measuring hip internal and external rotation. If there is a substantial excess of internal rotation, femoral anteversion is present. If the excess is in external rotation, femoral retroversion is present.

Tibial torsion is evaluated clinically with the patient supine. The patella is held between the index and thumb and the leg is rotated so the patella points toward the ceiling. If the foot lies naturally inward, internal tibial torsion is present. If the foot lies naturally outward, then external tibial torsion is seen.

Foot deformities in infancy can be divided into two broad categories, depending on whether the forefoot is adducted, or neutral to abducted. Metatarsus varus and club foot deformities are in the forefoot adducted category. In the forefoot neutral or abducted category, postural calcaneovalgus is far more common than the relatively rare conditions of vertical talus and posteromedial tibial bowing.

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# Foot Deformities *in the* Infant

## Metatarsus Adductus

**Definition** — The forefoot is in adduction at the tarsometatarsal joints. The hindfoot may be valgus or in neutral.

**Incidence** — It affects approximately one in 1,000 live births. The deformity is seen equally in males and females. It is bilateral in about 56% of cases.

**Etiology** — This deformity is thought to be related to intrauterine positioning, although there can be some component of muscle imbalance.

The deformity is frequently evident at birth, although milder forms may not be noticed until several months later.

**Clinical features** — The main features are an adducted and supinated forefoot of varying severity, with a normal or valgus hindfoot. The lateral border of the foot is convex and the medial border is concave. There may be an associated medial midfoot crease. There is an increased interval between the first and second toes, with the great toe held in slight varus. Dorsiflexion of the foot and ankle is normal. Internal tibial torsion is almost always present.

This condition can be associated with congenital muscular torticollis, as well as with congenital hip dysplasia in up to 10% of cases. In a walking child with uncorrected metatarsus varus, a toe-in gait is noted. The interval between the great toe and the second toe is more marked and is often referred to as “hitchhiking” of the great toe.

The foot may be classified into five groups, according to severity based on the relationship of the line bisecting the calcaneus and the forefoot:

- Normal: Heel-bisecting line between toes 2 and 3.
- Valgus: Heel-bisecting line between toes 1 and 2.
- Mild: Heel-bisecting line bisects third toe.
- Moderate: Heel-bisecting line between toes 3 and 4.
- Severe: Heel-bisecting line between toes 4 and 5.



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### **Radiographic findings** —

Radiographs are not used routinely in the assessment of this deformity in infancy. The anteroposterior radiograph, however, will show the adductus of the forefoot at the metatarsophalangeal joints with a normal talocalcaneal angle. The lateral radiograph shows a normal talocalcaneal angle.

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**Treatment** — The flexible foot of an infant that can be corrected easily beyond neutral can be treated by a trial of parental stretching daily with each diaper change. If there is residual deformity remaining at two to four months of age, serial casting is warranted to complete the correction. Casts can be made of plaster or fiberglass and are changed every two to four weeks, depending on the child's rate of growth. The casting is continued until the forefoot is flexible — usually four to eight weeks. Reverse last shoes are then often used to maintain the correction for three to six months after casting. The associated internal tibial torsion corrects itself spontaneously during the childhood years. Treatment started early (before four months of age) does not interfere with the onset of crawling or walking. Surgical treatment is reserved for uncorrected metatarsus varus in a child over the age of four years.

## Club foot

**Definition** — A club foot, or *talipes equinovarus*, is a complex deformity involving all the bones of the foot wherein the hindfoot is fixed in varus, and the midfoot and forefoot are in varus and supination. True club foot is not a flexible deformity and cannot be manipulated to full correction at birth. The deformity is evident at birth.

**Incidence** — Club foot occurs in one in 1,000 live births. The sex ratio is approximately two males to one female. The incidence of the same deformity among first-degree relatives is 20 to 30 times higher than the normal incidence. The inheritance pattern is considered multifactorial. Idiopathic club foot is most often unilateral. In bilateral cases, a neurological etiology should be carefully sought after.

**Etiology** — Many theories have been proposed, but the etiology remains an enigma. In idiopathic club foot, there appears to be a primary developmental deformity of the hindfoot in the first trimester. Neurogenic and fibromuscular causes explain the deformities seen in spina bifida and arthrogyrosis.

**Clinical features** — The deformity may present in mild or severe forms. In the milder, more common type — which accounts for 70% to 75% of cases — the typical deformities are more supple. In the severe form, the foot is extremely stiff and the difference in foot and lower leg size is more dramatic.

**Radiographic findings** — At birth, the primary ossification centres of the talus, calcaneus, and sometimes the cuboid are already present. Both anteroposterior and lateral radiographs are performed in a simulated weight-bearing position to

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measure the talocalcaneal angles. On the lateral view, lines drawn through the long axis of the talus and the inferior margin of the calcaneus should subtend an angle of 35 degrees or greater in the normal foot. On the anteroposterior view, similar lines drawn through the long axes of the talus and the calcaneus normally form an angle of between 20 to 35 degrees. In a club foot, both sets of lines are usually parallel.

**Treatment** — The treatment of a true club foot begins as soon as possible after birth with serial casting. The goal of casting is to stretch the medial soft tissues by gradually correcting the forefoot and midfoot, followed by the hindfoot. These casts extend from the foot to above the knee. Definitive treatment is surgical and will be performed between the ages of four and eight months, according to surgeon preference and experience. The surgical treatment involves a release of all tight structures in the midfoot, dissection of the navicular from the medial malleolus, lengthening of the tibialis posterior, flexor hallucis and digitorum, and a release of all tight posterior structures with Achilles tendon lengthening. A metal K-wire is usually used to maintain reduction of the navicular. Post-surgery, the foot is put in a cast for two to three months and corrective footwear will frequently be prescribed. While the final result will yield a plantigrade, functional foot, the foot and leg will not be normal in a true club foot. The affected foot is always smaller, sometimes by as much as two to three shoe sizes, and the lower leg muscles will always be atrophied. Frequently, there is also a leg length discrepancy of 1 cm to 2 cm with the affected side being shorter. Finally, some degree of ankle and subtalar joint stiffness will be present permanently.



Reverse last shoes can be used to maintain post-casting correction. They can also be used to treat a flexible metatarsus varus without casting.

## Postural Calcaneovalgus

The calcaneovalgus foot is a relatively common flexible deformity in the newborn consisting of dorsiflexion of the forefoot and hindfoot. The dorsum of the foot may touch the anterior surface of the tibia. There is no subluxation of any joints.

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**Incidence** — This occurs in one in 1,000 live births.

**Treatment** — The critical feature of this deformity is that it is flexible and gradually correctable. The milder deformity may be treated simply by parental stretching of the foot, daily, during each diaper change. In the severe form, serial casting may be required to complete the stretching.

## Posteromedial Bowing of the Tibia

Congenital posterior bowing of the tibia takes place at the junction of the distal and middle thirds of the tibia. The bow is primarily posterior, but there may be a medial component. The foot is in a calcaneus position with the dorsal surface often touching the anterior tibia. The anterior muscles of the foot and ankle are tight and shortened resulting in limited passive plantar flexion.

**Treatment** — Passive stretching is required to stretch the tight anterior structures. The natural history is progressive straightening of the tibia, with a normal appearance by the age of four years. Osteotomy is not indicated. There can be a degree of linear growth inhibition, but it rarely reaches a significant degree requiring correction.

## Congenital Vertical Talus

Congenital vertical talus or “rocker bottom” foot may occur as an isolated entity, but it is most frequently associated with other congenital anomalies, especially arthrogryposis and spina bifida. The etiology is unknown. It is more common in males and is frequently bilateral.

**Clinical features** — The condition is apparent in the newborn. The plantar aspect of the foot is convex, giving it the characteristic “rocker-bottom” appearance. The head of the talus is palpable medially. The hindfoot is in valgus and the equinus and the forefoot are abducted and dorsiflexed at the midtarsal joint. The foot is extremely rigid and uncorrectable.

**Radiographic findings** — The talus is almost vertical and is often parallel with the long axis of the tibia. The talocalcaneal angle is markedly increased in the anteroposterior view.

**Treatment** — Cast stretching begins at birth. Generally, a reduction of the head of the talus is not possible and surgical reconstruction is required. **Dx**

### Suggested Readings

1. Morrissy RT, Weinstein SL: Lovell and Winter Pediatric Orthopedics, fourth edition. Lippincott-Raven 1996, pp. 1077-1136.
2. Sponseller PD, Stevens HM: Handbook of Pediatric Orthopedics. Little Brown and Company 1996.
3. Staheli LT: Fundamentals of Pediatric Orthopedics. Raven Press 1992, pp. 5.10-5.22.
4. Tachdjian MO: Pediatric Orthopedics, second edition. WB Saunders 1990, pp. 2405-3001.