The foot is our body-ground interface, and is heavily endowed with sensory receptors that deliver necessary information for the acquisition and maintenance of postural control. The foot does not operate in isolation, but rather, is a complex system, anatomically linked in a biomechanical chain that connects the foot to the torso, and typically enduring full body weight in motion ~5,000 times per day, or nearly 2 million times per year, per foot, for 70 years. Changes in foot position alter leg and hip position, pelvic tilting, spinal alignment, and the orientation of body weight onto the foot segments.

There appears to be a gap in the training of physicians to whom parents bring their children with excessive foot pronation. The “party line” seems to be “Don’t worry - (s)he’ll outgrow it.” Without adequate training in foot and ankle development, biomechanics, and pathomechanics that would provide specific, age-related criteria for making this judgment, the children with feet that will not improve over time are dismissed, and they will load their pronated feet 2 million times per foot per year in pathomechanical alignment that communicates up the leg to the torso.

The expectation that the child will outgrow excessive foot pronation has been challenged by researchers. The incidence of flexible flat foot, ranging from mild to severe, was reported to be 16% of a population of 97,279 Israeli military recruits (as opposed to, say, secretaries or book editors). Because of the relationship between functioning foot alignment and that of the lower limb joints, problems of anterior knee pain, low back pain, and foot pain commonly occur in the presence of chronic foot pronation of moderate to severe degree. In another 1-year study in the US, musculoskeletal disorders were found to account for 67% of medical discharges from the Air Force, with patello-femoral syndrome, pes planus (flexible flat foot), and low back pain occurring most frequently.

The “asymptomatic” child with excessive pronation might perform well in sports, but could become symptomatic when he reaches adulthood. In 2010, an analysis of the National Health Interview Survey (Podiatry Supplement) from 1990 was undertaken to determine associations of various demographic factors and other foot and ankle pathologies with self-reported flatfoot deformity. The study revealed “significant associations of flatfoot with bunions, hammertoe, calluses, arthritis, and poor health. Treatment and prevention of flatfoot may have an effect on an individual’s overall health and occurrence of other foot and ankle pathologies.” In Denmark, a cross-sectional postal survey of a randomly selected sample of adult inhabitants ages 18-80 years yielded 1672 responses. Prevalence of foot pain was 36.4% with a total of 55.9% reporting pain in the foot, leg or back lasting more than 1 day within the previous month. Foot pain lasting more than 1 month was experienced by 16.2% and 11.9% had pain lasting more than 1 year. The prevalence of self-reported pes planus or pes cavus was 17.9%. There was a significant association between foot pain and pain elsewhere in the leg and low back. Self-reported foot deformity was significantly associated with foot pain. Guler et al (2009) found that of 115 women with knee osteoarthritis, 59 had bilateral pes planus, hallux valgus (>21°), or both. The authors concluded that foot pain is highly prevalent and associated with foot deformity and leg and low back pain, and suggested that more attention be focused on foot pain and foot deformity at the time that clinical complaints of leg and low back pain are addressed.

The development of the feet and of foot function is closely related to ligament status, movement skills, and habits of weight distribution on the feet – whether body weight is usually shared by the whole foot, or loaded too heavily on the inner forefoot. We all need to remain upright, so our muscles activate on the side opposite a weight displacement – all day long if needed.

Unless the problem is so serious that orthopedic surgery might be needed, I advise that parents with concerns consult a pediatric podiatrist or an experienced pediatric physical therapist for evaluation of foot alignment and function in the context of general postural alignment and control, and gross motor function. Most experienced pediatric physical therapists will refer to a physician if warranted.

Identifying Healthy Pediatric Feet - Guidelines for Clinicians

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The following lists comprise some of the features that identify healthy, growing feet.

**Age 1 year in standing position:**
- Body weight is carried on the whole foot – with toes flexing as needed to maintain balance.
- The knee axes are aligned in a little more lateral rotation than the hips and feet.
- The knees are a little further apart than the feet.
- The lateral column of the foot is load-bearing – in full contact with the floor.
- The shape of the foot is rectangular – medial and lateral borders are straight.
- The toes are straight and align parallel with the metatarsals.
- The foot placement angle is out-toed $\pm 10^\circ$.

**Healthy Feet**

**Ages 2 to 3 years:**
- Body weight is carried on the whole foot with occasional toe flexion used for balance.
- The lateral column of each foot is load-bearing – in full contact with the floor.
- Wet footprints show that the medial longitudinal arch is forming. Weight is lifting off the medial arch area in girls earlier than boys.
- The shape of the foot is rectangular at 2, and widening at the forefoot at age 3 years.
- The medial and lateral borders are straight.
- The heels, seen from the back, are slightly more tilted at this time because the legs changed from varum tilt (a little bowed) to valgum tilt (a little knock-kneed) before the foot muscles and ligaments finished developing. A guideline for optimum relaxed calcaneal stance angle ($7$ minus the child’s age) was proposed by Valmassy$^6$, i.e. heels might be everted $4$ to $5^\circ$ at these ages. The main criterion is that body weight is carried on the full foot with frequent shifts to heel and lateral surfaces, rather than mainly on the inner forefoot.
- The toes align parallel with each other and with the metatarsal shafts.
- In gait, the base of support is narrow, with foot placement and progression angles at $\pm 6^\circ$.

**Age 4 years:**
- The standing body weight is carried on the heels > metatarsal (met) heads by a ratio approaching $2:1$.$^7$
- The medial longitudinal arch is increasing in height.
- The foot shape is more triangular than rectangular.
- The medial and lateral borders of the feet are straight with toes parallel to each other and to met shafts.
- The heel tilt is reducing ($\pm 3^\circ$ is barely detectable without precise measurement tools and technique).

**Signs of Excessive Pronation – Different Feet Collapse in Different Ways**

- Low arches; lateral border angled; toes not parallel; hindfeet collapsed.
- Heels too tilted; lateral column unweighted; toes --> laterally. Leg rotated inward, midfoot falls inward.
- Hindfoot/midfoot fell to center. Grasping toes show weight is forward.
