



ORTHOTICS & ORTHOPEADICS

## Every Foot Tells a Story ,Äi But Are You Listening?

Kevin M. Wong, DC | DIGITAL EXCLUSIVE

The human body is an evolutionary and biomechanical marvel. We are organisms made up of 650-plus muscles, 360 joints and 206 bones. All of these components work together in a symphony so we can move and perform a multitude of tasks.

When our bodies are working well, we never notice them and we hardly pay them any mind. It's when body processes or movements become imbalanced, unsupported or deficient that we start to see breakdowns in the fluidity of the system. We see stress manifest itself in aberrant joint mechanics, tight muscles and pain. Nowhere is this more evident than in the foundation of our human house: the feet.

### Underappreciated Anatomy

The feet are one of the most important and most ignored body parts we humans have. Aside from dressing them up in trendy shoes, trimming / painting the toenails and making sure they get cleaned in the shower, the feet are not thought of that often. But when we look at the anatomy, 25 percent of the body's bones are in the feet!



We also understand that each foot has three functional arches (not just one) on the plantar surface. The arches of the feet do not finish forming until around the age of 7.<sup>1</sup> It is far more common for a person to have some degree of arch collapse rather than living their life with all three arches intact.

### An Unpleasant Reality

From what I see in my practice, about 10 percent of people maintain healthy, proper arch support throughout adulthood. What is even more interesting is the fact that a majority of the world's population have collapsed, flattened or excessively pronated arches to some degree, and this will be true for almost 100 percent of the offices that scan every patient. How many patients would benefit if you knew they had overpronation?

After age 7, genetics, shoe types, activity levels and weight-bearing activities are some of the factors that allow a foot to begin overpronating. The order in which the arches typically collapse under our feet is 1) lateral longitudinal, 2) transverse (MT) and then finally, 3) medial longitudinal. In essence, the foot flattens from outward to inward.

For most human beings, flattening of the arches happens so gradually and slowly that many people have no clue it is happening until it is pointed out. A segment of the population experiences injury to the foot, ankle, knee or hip that alters their biomechanical movement patterns, creates stress in the aforementioned joints and ultimately accelerates the arch collapse in one or both feet. We do see examples of this in clinical practice (e.g., sprained ankle).

### Dead Giveaways for Flat Feet

There are some morphological or visual findings we can see in people with feet that are excessively pronated. Here is a list of "Dead Giveaways for Flat Feet":

- *Bunions on metatarsal heads one and/or five:* When the transverse arch flattens, the ball of the foot gets wider. This causes MT one and five to rub against the roof or sides of the shoes. The stress created by this mechanical rubbing causes the body to respond by laying down calcium. Continued stress on the MT heads leads to more calcium being deposited and bunions growing larger with time.
- *Hallux valgus:* As the transverse and medial arches collapse, the foot continues to flatten toward the ground. This, coupled with the bunion on MT one, creates a valgus force on the big toe, which can range from mild to severe. It is often observed that the larger the bunion, the worse the hallux valgus.
- *Hammer toes:* As the transverse arch flattens, the toes pop up. Combined with the medial and longitudinal arches also falling, and the foot gets longer. In essence, the poor toes are raised up and then jammed into the roof or end of the shoe, causing further hammering. In cases of chronically flat feet, the toes become arthritic in a hammered position.
- *Callouses under the MT arch and/or under metatarsals 1, 5:* As the transverse arch falls, the metatarsal heads start to rub on the bottom of the shoes or the ground. A hard callous forms to protect. The bigger and harder the callous, the longer the excessive pronation has been present.
- *Corns on the tops of the toes:* With the collapse of the metatarsal arch, the toes will raise or pop up. The tops of the toes can rub on the roof of the shoes, causing corns.

### Common Consequences

By and large, a majority of the patients who have excessively pronated feet will not be aware of the process until months or years go by. Aside from common conditions that involve the knee, hip and the back, issues emanating from the feet are easy to spot once you know so many people's feet are overpronating. Here are a few of the most common ones:

*Plantar Fasciitis* is the most common foot ailment seen in a medical office. At its very heart, plantar fasciitis is absolutely a collapsed arch issue, but patients are never taught this from the classic foot doctor.

The plantar fascia is a thick ligament that begins at the calcaneal tubercle on the heel and extends forward to the five metatarsals. This ligament is the main stabilizer of the three foot arches. Once the ligament loses elasticity, starts to elongate and go through elastic deformation, the arches will fall. The only question is at what age and how fast.

*Achilles Tendonitis* occurs as the foot reaches the point of arch collapse and overpronation at which the Achilles tendon begins to bow inward. As the foot gets flatter, the Achilles tendon bows inward more and more. At some point, the stress on the Achilles tendon creates irritation and inflammation and it is then followed by pain.

You might remember that a bowing Achilles tendon is one of the five key indicators of foot pronation. Achilles tendonitis is a progression of that indicator.

*Neuromas* are formed due to the collapse of the transverse or metatarsal arch. The interdigital nerves run between the metatarsals and phalanges. As the metatarsal arch falls, the bones cramp together more, trapping the nerves between them. What starts out as a neuritis can continue getting larger until a benign tumor is formed. This tumor feels like a rock under the forefoot. People can have a neuroma between any of the toes, but a Morton's neuroma is between toes three and four.

Clinical Intervention: The Orthotic

So what can a patient do to not only deal with the pain of these three common foot conditions, but also save their collapsed arches? Well, since the arches are formed by the plantar fascia and the bone-to-bone ligaments (e.g., the spring ligament), they can't be brought back. There are muscles in the foot, but they serve to move the bones and do not come into a support role for the three arches until 400 pounds of pressure is put on the foot.

A clinically effective method of supporting the arches and preventing them from falling further is to introduce a custom-molded, three-arch, flexible orthotic for the patient's footwear. Often these types of orthotics are made by images from a weight-bearing 3D laser scanner or foam casts. Once these orthotics are placed under the feet, the overpronation is corrected and the three arches are supported properly - specifically according to the patient's individual needs.

With the feet and arches supported well, the pressure from the ground forces is reduced and the stress on the ankles, knees, hips and spine are greatly reduced. Properly made orthotics will reduce the seriousness and progression of the dead giveaways for flat feet. Orthotics will also help reduce the symptoms of plantar fasciitis, Achilles tendonitis and neuromas. Everyone's foot tells a story; are you listening?

### *Reference*

1. Hollander K, et al. Growing-up (habitually) barefoot influences the development of foot and arch morphology in children and adolescents. *Sci Rep*, 2017;7:8079.

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