



Pronation - The key to malalignment?

by Trevor Pryor - Podiatrist

The link between pronation of the foot and pathology of the foot, leg and pelvis is now a well accepted concept. It follows that control of pronation by the use of orthoses is an important component in the overall management of these conditions. An understanding of the underlying mechanisms allows the practitioner to evaluate the role of pronation in the condition they are managing. This article is an overview and the reader is advised to refer to current literature for greater depth.

The term pronation is used to describe motion at the subtalar joint resulting in eversion, abduction and dorsiflexion of the foot. Whilst a few degrees of pronation is required for normal foot function, pronation becomes potentially pathological when it is either excessive or occurs for too long during the stance phase of gait.

At heel strike, the rearfoot is slightly inverted with subtalar joint pronation occurring with foot loading. This pronation is quoted as 'unlocking' the midtarsal joint allowing the foot to become a mobile adapter to accommodate the walking surface. As body weight is transferred over the foot and the leg begins to externally rotate the subtalar joint begins to resupinate. This motion will take the foot through its neutral position at mid-stance until the subtalar joint is supinated, with the first ray plantarflexed. At toe off. This supination 'locks' the midtarsal joint and makes the foot a rigid lever for propulsion.

One explanation of the concept of 'unlocking' the foot has been described by Root, Orien and Weed. Although the exact mechanism is still unknown. The midtarsal joint comprises the talo-navicular joint (longitudinal axis) and the calcaneo-cuboid joint (oblique axis). When the subtalar joint is in neutral these two axes are relatively divergent. However as the subtalar joint pronates, these two axes become parallel. This allows a greater degree of motion and subsequent mobility. Thus excessive and prolonged pronation will cause increased motion and potentially render the foot mobile instead of rigid at toe-off.

However, it is not the foot alone that is effected by abnormal foot function. The subtalar joint converts pronation and supination of the foot into internal and external rotation of the leg respectively.

This excessive and prolonged pronation of the foot can cause excessive and increased internal rotation of the leg. It is therefore possible to have a situation

whereby pronation of the foot through midstance causes internal rotation of the leg whilst, at the same time, the forward progression and swing of the non-weightbearing leg causes external rotation of the leg.

This motion can place stress on the osseous and soft tissue structures of the leg, pelvis and spine. The Tibialis posterior muscle fires eccentrically during gait to slow subtalar joint pronation. Thus excessive motion can cause overuse. Similarly, increased leg (in particular tibial) rotation will place the Iliotibial band under tension and predispose to pathology either at the knee or hip. Maltracking of the patella as a result of pronation has been well documented and may be one factor requiring control in the management of anterior knee pain.

This increased internal rotation should also be considered in pelvic and spinal pain. Increased rotation places iliopsoas, piriformis and gluteus maximus under stress and can increase SI compression. This, in conjunction with a lack of shock absorption, can result in fatigue symptoms.

If the pronation, and thus the rotation, is increased on one side then all the symptoms of a limb length discrepancy can result (including pelvic tilt, SI rotation, scoliosis etc.) and is termed a functional leg length discrepancy. It is therefore essential to assess the relative levels of the anterior and superior iliac spines in both the relaxed stance position (compensated position) and the neutral stance position (uncompensated position). It is important to remember that, whilst the foot position may cause a more proximal imbalance, the same is true in reverse (i.e. muscle imbalance/inflexibility, SI rotation, osseous rotation etc.).

It is therefore important to ascertain the underlying cause to rectify the problem. However, even if the cause is located more proximally, orthoses are still warranted if they can help to restore alignment whilst the underlying problem is being rehabilitated. The improved postural position may restore dynamic equilibrium, thus speeding recovery. An attempt has been made to indicate how abnormal pronation can predispose to foot, leg and pelvic pathologies. Many pathologies are due to more than one aetiological factor re-inforcing the need for a multi-disciplinary approach. The more factors understood, and therefore assessed and managed, the greater the chances of successful treatment.

