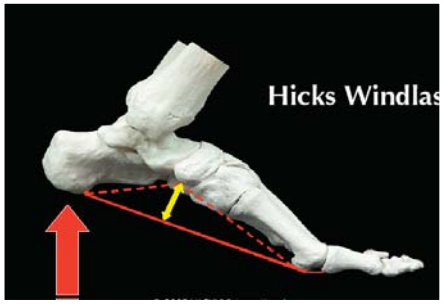
Functional Hallux Limitus (Fhl)

By Howard J. Dananberg, DPM

Functional hallux limitus is a highly prevalent foot condition that is often overlooked in clinical examination, as pain and symptoms are often not associated with the 1st MTP joint, but rather occur in remote sites due to compensations during the gait cycle. Having a clinical suspicion that Fhl is present can lead to improved outcomes.[1]

The 1st MTP joint represents the primary pivotal site about which the majority of extension of the lower limb occurs.[2] The base of the proximal phalanx is also the insertion point for the medial slip of the plantar fascia, the largest of all the fascia bands.[3] As normal MTP joint extension occurs during the 2nd half of single support phase, the fascia wraps around the enlarged circumference of the 1st metatarsal head complex (including sesamoids), providing a powerful winch like effect that supinates the entire foot even when maximally loaded. This was referred to as the Windlass Effect and was described by JH Hicks in the Journal of Anatomy over 50 years ago. [4] Hicks referred to this supinatory effect as "irresistible" once it began. In other words, the foot mechanism he described was capable of auto-support PROVIDED that the 1st MTP joint dorsiflexed in a timely fashion. [5]



Considering that the entire body is advancing past this single joint, the ability to raise the heel during single support phase while simultaneously self supporting against the developing forces for forward motion is essential for normal function. The ability to raise the heel during the single support phase also permits stepping forward greater than the length of one's limbs. This represents a tremendous evolutionary advantage for the development of bi-pedal, erect gait. [6] All told, the normal and timely function of this joint is critical for efficient gait.

Understanding how Fhl affects gait is dependent on the following. The description above suggests how a simple mechanical linkage can create a self supportive structure that simultaneously permits forward motion above it. Could it be possible that numerous pathologies that develop within the body be related to a failure of this mechanism? If self support fails, and sagittal plane compensation were to be forced to occur, what would one expect to see? If self support fails, and visible pronation develops, does simply "supporting" the foot structures only treat the effect, rather than addressing the cause? The answer to these questions is the basis of this article.

Managing Fhl

For the 1st MTP joint to dorsiflex, the 1st metatarsal head must be free to plantarflex during the 2nd half of single support phase. [7] Having the freedom to accomplish this is the goal of clinical treatment. The Vasyli-Dananberg device is specifically designed to prevent the formation of Fhl by creating an environment in which 1st metatarsal plantarflexion becomes the path of least resistance. As different feet function differently, the Vaysli-Dananberg appliance is designed to be customized based on individual needs. There are two removable plugs on the inferior surface of the device. This is designed to customize fit so that the area cut out is directly under the metatarsal head. The more proximal of the two plugs is intended for cases where 1st ray plantarflexion is markedly compromised, and maximum plantarflexion is required. This is usually in the more pronated, pes planus foot type. Enlargement of the 1st ray cutout by removal of the 2nd plug is also useful in cases of structural hallux limitus, as planflexion in these cases is often very restricted, and the more available space for motion…the better. The advantage of this device is also in cases where Fhl is a unilateral finding. In such instances, the plug on the unaffected side can be left in place, and the plug on the affected side removed. In addition, if Shl exists on one side, removal of two plugs can be performed, while on the less pathologic, removal of one may be sufficient. Asymmetry is the hallmark in pedal examination of chronic postural complaints, so having two devices with a somewhat different Rx is very appropriate.

Compensations for Fhl

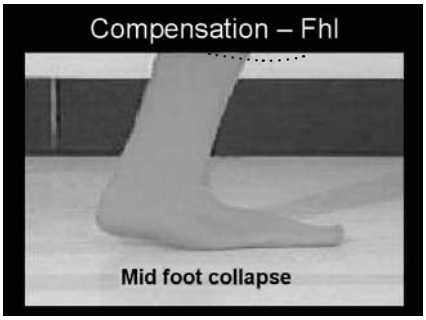
Watching someone walk while wearing swim fins can give the 1st clue to the compensatory mechanics associated with Fhl. Since they are unable to step over the fin portion, they step straight upwards, and without any propulsion. They simply advance by the length of their limbs, and not by a sufficient mechanical stride. [8] There are 4 basic types of compensation and are as follows:

1. Delayed heel lift
2. Absence of heel lift during single support phase
3. Inversion compensation
4. Abduction compensation

1. Delayed heel lift

For efficient gait to occur, the heel must lift from the ground PRIOR to the opposite side contacting the ground. This period of the step is known as active propulsive phase. The closer to opposite heel contact heel lift occurs, the less propulsive the stride. Since heel lift is a direct function of the ability of the 1st MTP joint to dorsiflex, failure to dorsiflex the MTP joint can have a "retrograde" affect and delay the timing of heel lift. The longer heel lift delays, the less time the Windlass Effect has to establish foot stability. Since the body is PULLED over the weight bearing limb by the free swinging limb, failure to create a supportive, and sagittaly mobile structure creates the need to dissipate the forces present for forward motion.

Midfoot collapse can be directly associated with the failure of MTP joint hinge as this unstable foot "reforms" into a near rocker shape as the body never stops advancing despite the foot's inability to efficiently create this motion.



2. Absence of heel lift during single support phase

This form of compensation is a progressive variation of delayed heel lift. Most common in the geriatric population, but certainly not exclusive to them, it represents the end result of a long term compensatory process. Whenever heel lift fails to occur during single support phase, gait becomes progressively slower. Balance, however, is dependent on maintaining a "resonant pace". Therefore, walking too slowly and becoming unsteady

is not dissimilar to trying to ride a bicycle too slowly. It is obviously unsteady. In humans, the same problem occurs. In geriatrics, this effect can lead to pronounced instability. The real difficulty arises as the normal human reaction to instability is to increase the double to single support ratio. However, since forward motion cannot occur while two feet are on the ground, the greater the amount of double support, the slower the gait. It becomes a near self-fulfilling prophecy. The slower one walks, the more unsteady one gets. Intervening within this process can provide marked improvements in steadiness. Careful evaluations of sagittal plane restriction along with differences in leg length discrepancy are essential for positive outcome.

3. Inversion compensation

One of the most intriguing Fhl compensations involves the ability to invert the foot to avoid the 1st MTP joint. Previously described as the Locke Manoeuvre in reference to a painful 1st MTP joint, avoidance manoeuvring via inversion is clearly not a new phenomena.[9] What is a fairly new thought, however, is that Fhl is not commonly painful in and of itself. Instead, the process of avoidance can cause lateral foot symptoms as the inversion tactic become repetitive and stressful to other these foot structures. In spite of this, patients seem to persist with this "solution" and maintain this inverted posture until adequate treatment is provided.

One of the best clues that this is occurring is to exam a subjects shoes. Particularly if they stand barefoot with a pronated foot posture, lateral wear of the mid to forefoot portion of the shoe is a strong indicator that inversion compensation in occurring. Should the prior treatment involve any type of rear or forefoot posting, then this inverted posture will be perpetuated, and the symptoms along with it.

4. Abducted compensation

The classic pronated foot type shows abducted stance positioning. Again, if the forward pathway to motion is blocked, the foot will find some alternative direction for progression. This is often dictated by anatomical alignment, and may relate to either hip or lower leg positioning. While treating the Fhl component may effectively reduce some of the abduction, resolving all of it may simply not be possible. That said, any reduction in the total amount of abduction often offers great relief to conditions involving the medial knee or hip, and can be used effectively as an adjunctive form of care.

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ARTICLE #2

Howard Dananberg, renowned worldwide for development of the concepts of Functional Hallux Limitus and the relationship of gait style to Chronic Lower Back Pain…