The calcaneus: Is it your achilles heel?!

Functional anatomy of foot

The calcaneus is both a commonly overlooked and rarely treated area of the body in massage and bodywork settings, but one that can have far reaching implications when it comes to athletic performance, injury prevention and pain management. This article will look into the local and global implications that faulty foot biomechanics, and in particular lack of calcaneus eversion movement, has upon functional capabilities of the foot and the stirrup support system (SSS).

The foot and ankle region is a hugely complex area of the body. The foot is comprised of 26 bones accounting for 33 joints. There are 20 muscles involved in movement of the foot. The ankle and foot move in a tri-planar fashion. The complex movement of the foot and ankle is a fully integrated motion involving multiple joints and muscles, both locally and globally.[1]

The foot is the first area of contact during the gait cycle. A fully functional foot and ankle will move through a tri-planar motion in order to dissipate ground reaction forces.[2]

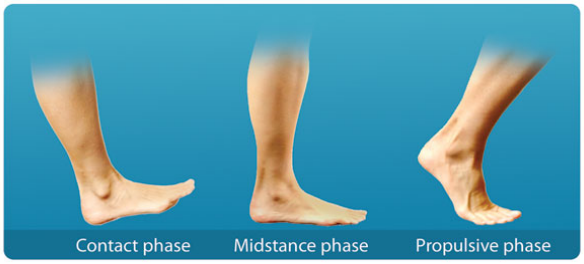


Figure 1

At foot strike, the calcaneus moves into eversion in tail leading to internal tibia rotation and dorsi flexion of the talocrural joint. As the gait cycle moves to the phases of stance and toe off, the mechanics change. The calcaneus inverts, the tibia externally rotates and the talocrural joint moves into plantar flexion. These complex motions are extremely important in reducing musculoskeletal stress in the foot and ankle.

You will read later how faulty biomechanics of one joint can disrupt an entire chain of movements.[1]

Figure 2 shows three very common foot positions; note how the location of the calcaneus changes with the foot posture. Pronation tends to move the calcaneus into an everted position and supination into inversion.

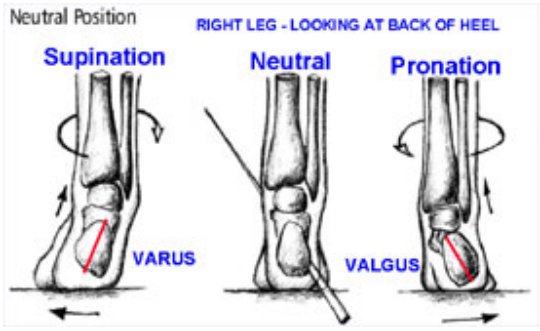


Figure 2

Determining faulty movement of the subtalar joint

Immobility of the subtalar joint can manifest pain and dysfunction in many different ways. But firstly it is important to determine if we are dealing with a flexibility or mobility issue, as illustrated in Figure 3. There many ways to establish this, but the easiest way is to utilize the classic soleus stretch position.[3]

If a deep stretch is felt in the achilles and soleus complex, we have a flexibility issue. If pinching and discomfort is felt in the anterior retinaculum and or around the medial malleolus, we are dealing with an impingment and/or mobility issue.[1]

In this picture a ruler was used; 8-12 cm is deemed to be a normal range of motion.[8] The final measurement is taken when the knee cannot reach the wall whilst the heal can no longer stay in contact with the floor.

Figure 3

We also need to determine the amount of calcaneal inversion, and more importantly, eversion. Calcaneal inversion is normally 20 degrees compared with 10 degrees of eversion. Therefore eversion is an extremely important motion of which we have only a little.[3]

Figure 4a

Testing calcaneal inversion range of motion

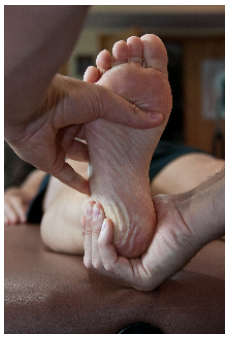


Figure 4b

Testing calcaneal eversion

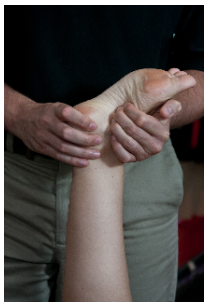
If you detect calcaneal restrictions whilst applying the technique described above, this maneuver can be used to increase the range of motion of the joint.

It is important to remember that achilles pain, plantar fasciitis, forefoot discomfort, recurring inversion ankle sprains and peroneal tendinopathy in can all be attributed to poor calcaneal eversion range of motion.[2]

Dysfunction of STJ and local problems

Adequate calcaneal eversion renders the midtarsal joint complex more mobile. This allows the foot to flatten in order to absorb stresses and load musculature, which in turn enables a proper gait pattern.[12]

Limited calcaneal eversion minimizes the gravitational consequences of foot pronation in the gait cycle. When assessing the range of motion of the subtalar joint, calcaneal eversion must be examined due to the potential domino effects upon other structures of the foot:

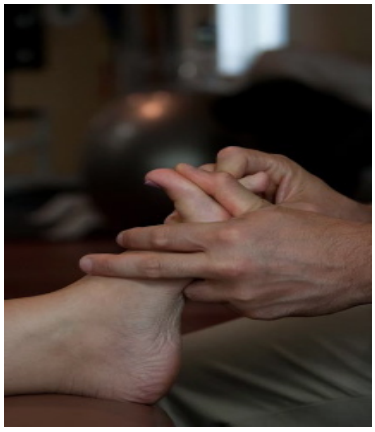


- MTJ may stiffen which can perpetuate a further loss of calcaneal movement. As demonstrated in Figure 5, palpate the navicualar to assess degree of movement and spring.

Figure 5: navicular spring test

- Anterior/posterior glide of the talocrural joint is commonly reduced when dealing with subtalar joint movement dysfunction, leading to loss of ankle dorsi flexion. Limited dorsi flexion can lead to whole myriad of problems, proximally and distally. Approximately 10-15 degrees of dorsi flexion is required for optimal gait.

Figure 6: anterior glide of talocrural joint



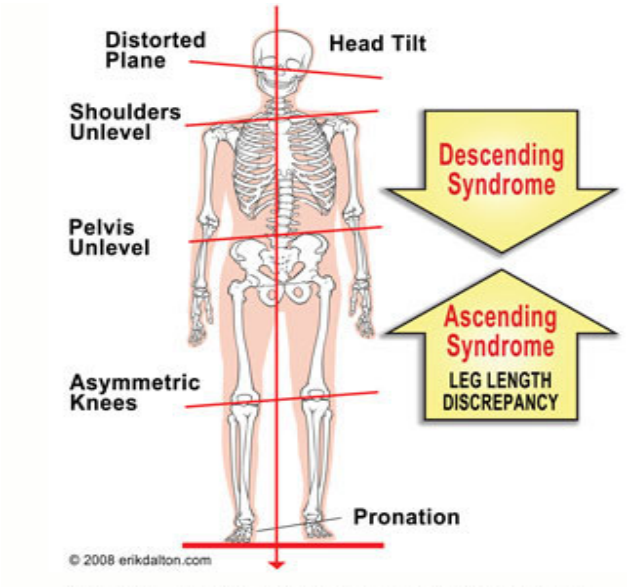
- Limited extension of the great toe due to altered mid foot biomechanics. Normal range is 45-60 degrees (see Figure 7).

Figure 7: Hallux extension

Lateral ankle ligamentous structures may be compromised due to faulty calcaneal positioning. This can cause weakness and instability of the lateral ligamentous complex. Prolonged faulty calcaneus alignment can cause creep of these structures.[1]

Dysfunction of STJ and global issues

The link between distal problems and faulty foot biomechanics is a huge topic of debate in many allied health care arenas, including massage therapy.



When the calcaneus subluxes into inversion this can cause an ascending pattern, i.e. the issue may be the foot causing a pelvic or low back problem and not necessarily a pelvic dysfunction causing the foot problem. As discussed previously, many proximal problems are caused which can lead to distal problems such quadriceps dominance. This particular problem is attributed to reduced dorsi flexion which overloads the rectus femoris during many activities of daily living.

Quadriceps dominance is of major concern due to the postural and functional implications, such as excessive anterior pelvic tilt, inhibition of gluteal and hamstring musculature and over use of external rotators.[4]

Figure 8

It is widely accepted that the feet conform to what happens superiorly. For example, excessive anterior pelvic tilt can lead to pronation of the feet, and posterior hip rotation can lead to supination. Erik Dalton refers to this as a descending syndrome.

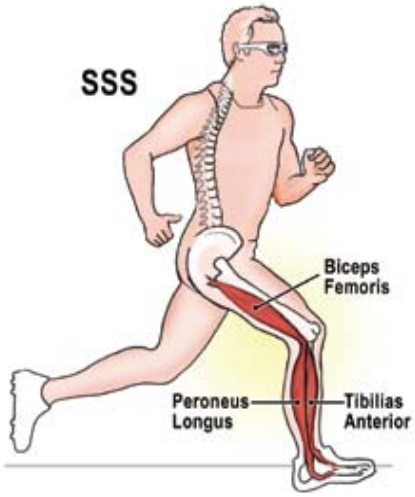
Interestingly, these problems can ALL lead to further reduction in available calcaneal eversion range of motion, therefore creating a vicious cycle of dysfunction (Figure 10).

Note the excessive anterior pelvic tilt and femoral external rotation which results in the calcaneus moving towards an everted resting position.

Reduced calcaneal eversion will inhibit normal movement of the bones in the feet, which will lead to reduced loading of the leg, hip and core musculature. [4]

Figure 10

In particular, the Stirrup Spring system (Figure 11) can be greatly affected due to the insertion points of the two distal muscles that comprise this system. The peroneus longus inserts on the first cuneiform and first metatarsal and the tibilias anterior to the medial cuneiform and the first metatarsal.



Without adequate movement of the foot bones, the stretch shortening cycle can be disrupted causing the Stirrup Spring System sling system to be negatively affected.

The global system and muscular sling synergy are of paramount importance in providing movement and gross stability to the lumbo-pelvic complex and the extremities.[6]

Muscular contractions produce forces that transmit beyond the origin and insertion of the active tissues. This notion explains why the global system is of such importance, since muscular slings are a fully integrated myofascial network with no origin or insertion. [7]

Figure 11

Treatment and mobilizations

Once limited calcaneal eversion has been determined, we need to establish the cascade effects upon dorsi flexion, mid tarsal joint motion glide of talocrural joint and hallux extension, and globally examine hip extension and rotation, paying particular attention to internal rotation.

Figure 12 shows the therapist moving the ankle joint in dorsi flexion, whilst simultaneously moving the calcaneus into inverted and everted positions in order to create movement of the subtalar joint.

Figure 12

Figure 13

The heel lock technique allows the therapist to move the ankle and calcaneus while simultaneously stimulating the lower part of the stirrup spring system.

Another great way to work the anterior and lateral lower leg muscles is in the prone position (see Figure 14).

Figure 14

This position allows the therapist to move the ankle in many different directions whilst applying various amounts of pressure on the anterior and lateral tissues of the lower leg

Hip rotation, or lack of it, can affect gait patterns and predispose us to low back pain through a plethora of mechanisms. If you discover rotational imbalances, these must be corrected in order to allow ideal foot motion. [9]

The therapist is putting the short external rotators on a stretch whilst simultaneously apply ischemic pressure adjacent to the greater trochnator in order to achieve to golgi tendon organ release of the shortened tissues.

Figure 15a

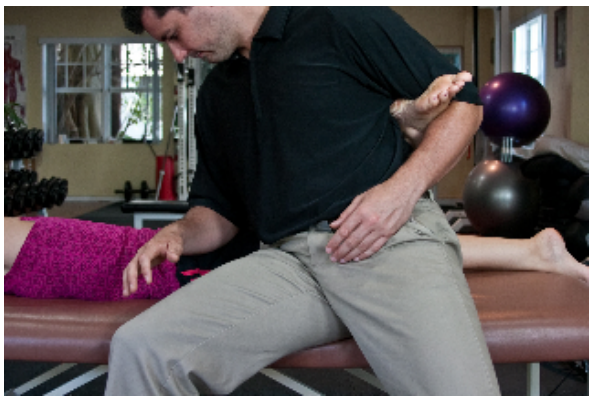


Figure 15a

Another superb way to achieve a great release of these structures is an Erik Dalton classic.

As demonstrated in Figure 15a, this technique allows the therapist to move the hip into extension; generally hip extension and internal rotation tightness occur in unison. So this technique allows the therapist work on both restrictions simultaneously.

Summary

When dealing with musculoskeletal issues, a holistic approach is of upmost importance. Many knee, hip and low back pains can be cause by and exaggerated by faulty mechanics of the foot and in particular limited range of motion of the calcaneus. The kinetic chain link theory states the lower extremity functions as a unit and alterations can affect biomechanics and musculature recruitment patterns anywhere within the musculoskeletal system. Many cases of low back pain are attributed to reduced hip mobility and altered muscle firing patterns and inhibition of the proximal hip musculature, namely the bicep femoris and gluteus maximus.[10]

This problem can be directly related to the mechanics of the foot and ankle. The SSS relies on movement and proprioceptive stimulus of muscles, joint capsules and bones of the foot to stimulate key muscles of gait and those muscles that are prone to inhibition when low back pain is present.[5]

When a client presents with foot issues and ongoing hamstring anterior knee pain and low back problems, assess the motion of the calcaneus and you will find severe limitations on a very high proportion.

I quote a sentence from a superb article by David Tiberio: “The internal power sources that drive the body are the hips and trunk, the core of the body. There are many ways to activate that power source but probably the most important for upright function in our gravitational environment is eversion of the calcaneous”.

About the author

Danny is a graduate Sports Therapist from England. He now lives and works in Miami Florida, where he continues to attend many manual therapy seminars. Danny is an Advanced Myoskeletal therapist and avid student of Erik Dalton’s teachings

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Photographs courtesy of Matt Roy

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