

## FOOT LECTURE DIALOGUE between Zoe and Frey

Zoe:

according to Kapanji (the most used biomechanics book in medicine) and Kingston's "understanding joints" there appears there is a three part system in the foot which reminds me of the three spinal centres in that they propose counter rotation as a means of weight distribution. The three blocks would hinge around the talocrural joint, the transverse tarsal joint and the tarsometatarsal joints. the function of which is to facilitate maximal adaptability in foot flat phase of walk and maximal rigidity in toe off for optimal muscle leverage. These aren't things i remember talking about specifically in AS classes but my memory might be misleading me.

According to these texts the three counter motions that facilitate mobility followed by rigidity are: the "supination twist" at the transverse tarsal joint: S shaped joint between hind foot (talus and calcaneus) and mid foot (cuboid and navicular) in which the bones of the mid and hind foot counter rotate so that in calcaneal eversion (sole of calcaneus moves laterally, body of calcaneus is moving medially) the midfoot bones are counter rotating laterally. Conversely in calcaneal inversion the mid foot counter rotates medially, further lifting the arch and in order that the whole foot doesn't completely laterally rotate.

these counter rotations make sense to me in the scheme of counter rotation throughout the body as a means of weight and momentum balancing/undulation.

questions have been brought up for me by the fact that the texts mentioned above describe tibial rotation differently than i have understood in the AS: they couple medial tibial rotation with calcaneal eversion and lateral tibial rotation with inversion. they also state pronation as a vital phase in the foot flat stage of walking so that the arch can be adaptable to uneven surface when it is mobile, which relates to the medial passage of weight in the AS proposed cure of momentum through the foot. supination puts the foot in the close packed position which it states is ideal for toe off when the foot needs to be rigid to serve as a lever on which the muscles can work to propel the body forward.

these arguments do make sense to me in that in heel strike the foot is supinating as it follows the fall from the calcaneus towards the 5th metatarsal and the tibia and femur are externally rotating to continue this pathway. as the 1st metatarsal moves towards the floor the foot must be performing an element of pronation, allowing adaptability to ground surface, concurrent with an element of internal rotation by the tibia and femur which according to this idea stay in fixed relationship of rotation once the initial unlocking has taken place. (We have not yet covered the knee so I don't know how they're gonna explain away the asymmetrical tibial plateaus, I'll let you know) for toe off the foot returns to

supination/lateral tibial rotation completing the S shaped curve of momentum illustrated in the AS book. (but strangely not by the almost upside down L shaped curve illustrated in these texts despite describing the process above as the gait trajectory)

An additional movement that seems obvious but i have never heard articulated is the action of the "rays of the foot". this is the opposition/counter flexion/extension of the medial and lateral metatarsals of the foot: this is to further offer adaptability of the foot to ground surface: pronation is coupled with medial metatarsal extension and lateral side flexion (this is seen as the lateral arch of the foot raising when the foot is pronated) and the reverse when the foot supinates. further increasing surface contact and balance of sides and increasing medial arch height and close packing in supination. I'm not sure this level of detail in the internal counter movements of the foot in foot flat was something I had previously considered

Something that I feel is missing from the discussion above is the metacentre which does seem like a pivotal idea in the weight distribution aspect of the foot. Mostly individual bones are considered the key stones of different arches eg talus keystone of medial arch.

Sorry this is so long! It's hard to summarise in brief and I feel it's good to share the harvest of my osteopathic education

Be great to hear your thoughts.

FREY:

Thank you Zoe,

It is true that the AS does not describe all of these subtle movements. I made a choice to focus on aspects that I felt were more immediately understandable for a general audience. I often talk about evers/invers - sup/pron in class, but do not describe the minute rotations that make these movements possible.

Considering the Meta-center allows us to cultivate a feel for a mid-way area, a suspended negotiation zone, not a single, fixed and immutable point. As is the case with so many of the ideas we are working with, the MC cannot be considered dogmatically, but as a suggested starting point towards an individualized awareness of one's own unique anatomy, and the most appropriate decision for the context.

This is how I personally understand the tibial interactions. The tibia drives eversion/inversion, pronation and supination in the foot, in other words it works medially and laterally through the subtalar joint and from there out through the rest of the joints of the meta tarsal. The navicular joint is tri axial, making it a center of articular subtleties.

The eversion/tibial internal rotation - inversion/tibial external rotation is only really visible if the knee is punktum fixum and the foot is open chain.

In other words, if you follow the hip axis flexion in a weighted, closed chain situation on your foot, the movement of the femur communicates to the foot as some inversion, while the internal rotation of the tibia, although associated with eversion in the open chain situation, in this case allows the medial arch to stay within neutral values, permitting adaptability of the arch to ground shock forces, and permitting the weight to pass across the meta-central area.

As the knee and ankle flex, the distal tibial surface slides up the dome of the talus, which is higher on its lateral anterior edge. The difference in the height of the talus' articular surface, coupled with the lateral motion of the knee, which is slaved to the hip axis flexion, causes some inversion as well, driving the lateral foot down at heel strike and through mid-stance. The subtalar joint, once again driving by the internal tibial counter rotation, contradicts this inversion as well, making sure the arch doesn't get lifted so high that the foot topples laterally.

In toe-off, the reverse motions happen: The tibia-calcaneus extend, pushing the medial side down (eversion) and lifting the lateral side, the external tibial rotation contradicts this, acting through the subtalar to pull the tarsals laterally into inversion, holding the action of the tibia accountable to the MC.

Perhaps this is another way of saying the same thing?

Frey

Zoe:

I think that is a much better way of (if I have understood your detailed description correctly) saying the same thing Frey. I strive to be as articulate as you!

It sounds like you are fully aware of all the aspects of foot mechanics that I wrote about. I think from the classes I have taken with you I did not understand that the internal rotation of the tibia is not coupled with the whole journey of the foot but

with the specific moment of mid stance associated with the pronatory phase and that the rest of the time it is coupled with the femur in external rotation.  
would you say this is accurate now?

FREY:

I think so Zoe... we will have to start sending videos soon...

I think I would say that no one of these movements is allowed to go too far, the structure is set up with opposing articular values, so that each suggested direction is in dialogue with its opposite. In any case I think its more useful to see the motions of the tibia in context with spinal motions, here I am just talking myself through a step. Eversion/pronation and inversion/supination phases are not completed in the sense that the end range of the articular facets is hopefully never reached. We can say that we are everting in the inversion phase, or vice versa, supinating in the pronation phase, or vice versa. These are all subset motions of the reception/propulsion phases, which are also never completed, that is if we are talking about neutral rom, optimal walking... I have to assume!

The counter-rotations of the connected sections of the body compensate each others direction, preventing excessive motion, but also taking advantage of the motion itself to store energy in twisting tensional fibers. This is what we call a kinetic chain, for example: upper body clockwise va rot, lower body counterclockwise, receptive thigh clockwise, lower leg counterclockwise, lateral foot clockwise, medial foot counterclockwise. In propulsion, these rotations reverse, everything unwinding like springs, opportunistically using translational momentum to propel us.

The closed chain leg, linked from hip to medial tarsal bones through the biceps femoris etc, is slaved to the hip axis arc, which attempts to minimize pronation and eversion as it swings the knee laterally. The job of the knee and subtalar, is to mediate this attempted directional imperative.

I am off to Moscow, but I will see if I cant make some visual support for our dialogue

Frey