A Re-Sergence of Interest in Spinal Mechanics

By Matt Wallden
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It was in 1988, with the publishing of the now-classic text "The Spinal Engine" that Serge Gracovetsky showed osteopaths the evidence for what they had reasoned and instinctively knew to be true:

Optimal mechanical function of the spine is necessary for optimal mechanical function of the limbs.

For some time it was good common sense that any restriction in the kinetic chain would result in dysfunction or strain elsewhere in that chain. Finally, with Gracovetsky's complex analysis of the spine, the evidence was indisputable that spinal manipulation in its various forms was a valid and indispensable method for enhancing peripheral mechanics. Not only this, but through mathematical modelling Gracovetsky had actually proven that the legs do *not* move the body, they were *not* the motor behind the movement, but it was the spine that generated locomotion – *the spinal engine*.

Since 1988, far more research has been generated to support the work of Gracovetsky; not least the masses of research from the Australian group headed by Caroline Richardson and Gwendolen Jull (amongst others) under the umbrella on core stability. A vast majority of manual therapy research over the past decade has proven that the deep muscles of the spine, abdominal wall and pelvic floor (known as the *inner unit* or *local stability system*) work in conjunction to stabilise the lumbar spine in a functional situation.

This inner unit of muscles works in advance of the more superficial multi-joint muscles, which more concerned with mobiliser function. However, that does not mean that the outer-unit, superficial muscles do not have a stabilising role.

Convincingly, the outcome of hundreds of studies was the same; demonstrating conclusively that the inner unit, or local stability system muscles contract somewhere between 30 and 120 milliseconds in advance of outer unit, or global stability muscles – irrespective of whether the movement pattern was intentional (planned) or whether it was through perturbation (unexpected).

The relevance of this new information to osteopaths and other manual therapists is that not only arthrokinematically, but also myographically, the spine and its local musculature are the driving force behind human movement.

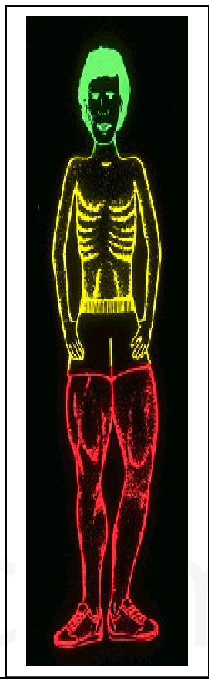
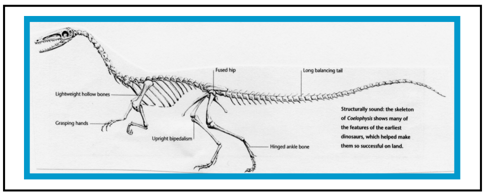


Figure 1: Gracovetsky's sprinter… if the legs truly drove the trunk

In reality, the truth is that the spine and its local musculature is the driving force behind *any* vertebrate's movement – from fish, to lizards, to mammals, to us, but it was not always this way. Gracovetsky demonstrates that if the classical way of looking at the legs as locomotive apparatus (in the gait analysis community) was correct then anyone who used their legs to locomote would look like his depiction of a sprinter in figure 1.



It seems that dinosaurs opted for this method of moving which followed the 2nd law of thermodynamics in a leg-based locomotion system. Additionally, they used a different subsystem to allow bipedal locomotion: a passive subsystem in the form of a counterbalancing tail

to raise the forelimbs from the ground. Homo-sapiens have used an active subsystem – predominantly the gluteals - to raise their forelimbs from the ground.
The attachment of the gluteals and hamstrings into the thoracolumbar fascia has been shown to be prime movers in our ability to become bipedal. However, as well as picking the forelimbs from the ground, this system is intimately involved in gait.

One of the flaws with any type of gait is, the loss of kinetic energy into the ground at every heel-strike. Particularly with the leg-driven gait adopted by the dinosaurs, the energy loss into the ground was dramatic. How human gait differs is in the rotary motion through the core and the potential energy that is subsequently stored in the collagen structures, such as the annulus of the disc and the Thoracolumbar fascia. This indicates the need to continuously adjust the lower limb during gait to ensure that the recovery pulse from ground reaction force travels back up through the lower limb into the spine and is dispersed primarily into the upper extremities. The leg therefore should not be viewed as a simple interface with the ground, but as a sophisticated mechanical filter.

The question posed by Gracovetsky is why homo sapiens need such a sensitive control system? According to the hierarchy of survival reflexes described by Chek (2003), and clear to see in vertebrate body design is the fact that the head is the control centre, housing the special senses. These special senses are far more than just vision, hearing, taste and smell; they are inextricably intertwined with vestibular function, with righting and tilting reflexes, with maintenance of the optic, otic and occlusal planes.

Simple demonstrations highlight the importance of these reflexes for survival of the organism and how and why these reflexes are so deeply engrained in the vertebrate nervous system.

Demonstration 1:
The importance of force dispersion on vision: With the flat palm of your hand, tap your head repeatedly over the parietal bone. Attempt to focus your eyes.

Teaching point: The inability to get a clear visual image to your cortex is an example of the need to stabilise the head during motion. If the kinetic forces travelling back up through the tissues from the ground reaction force during walking or running made it to the head, the vision would be compromised and hunting / escaping would be seriously jeopardised.

Demonstration 2:
The importance of occlusion: Start by swallowing, this puts your tongue in the physiological rest position and the teeth should be in a natural occlusion pattern; this is your start point. With a partner, or using a weight, perform resisted shoulder abduction to 90 degrees (arm straight). Get a sense for the strength / fatigue of your abductor group.

Rest of a few seconds to recover, then deliberately mal-occlude your teeth (eg pushing lower jaw as far to the right as you can actively). Perform the same resisted abduction. Get a sense for the strength / fatigue of your abductor group. Which feels stronger?

Teaching point: Maloccluding the teeth creates sheer in the temporomandibular joint. Seeing as good function of the TMJ is one of the most important factors in survival, the body will inhibit any muscles that can put force (and increased sheer) through that joint. How does the deltoid relate to the TMJ? The deltoid works in a force couple with the trapezius past 60 degrees of abduction. The trapezius, being a posterior rotator of the cranium (extensor) is antagonistic to the mandibular elevators (such as medial pterygoid, temporalis and masseter) and the supra-/infra-hyoid group. Therefore, in order to generate force through the trapezius, the mandibular elevators and supra-/infra-hyoid group need to co-contract to prevent cranial extension (remember the body is wired to keep the eyes on the “optic plane” – the horizon). This would jeopardise the integrity of the already sheared TMJ structures – therefore you cannot lift near the same weight you could with proper occlusion.

If that second demonstration does not seem to work for you, it would be wise to consider seeing a TMJ specialist, as you may well find that a lack of discrepancy in trapezius strength is due to the fact that your teeth are maloccluded in the first place!

So Gracovetsky's work shows that not only does the spine drive the legs forward, but that the legs and spine act as a dampening system to prevent vibration to the control centre and to store potential energy in their collagen structures to maximise efficiency of gait.

If, like me, this is the kind of information that fascinates you and brings clinical practice to life, you have a one-off chance to see Serge Gracovetsky for an evening presentation this December 16th in London. This is his first and only appearance in the UK since the 1980's. Having spoken at over 140 international conferences, contributed to more than 35 peer-reviewed articles and 6 textbooks, any attendees will get more than their money's worth. With a wicked sense of humour, an interactive question-answer session after his talk, and a clinical applications presentation as a bonus, this promises to be an exciting and fulfilling evening.

For those of you outside of London, why not take the opportunity to do some Kensington Christmas shopping and then settle down to hear one of the world's true authorities on the biomechanics of gait, its interaction with the spine and how this relates to clinical practice. We look forward to seeing you there.

Contact Lesley Lewis, Conference Organiser, on 01372 374530 or drop an email to bookings@chekclinic.com to find out more.

Tuesday 16th December, Royal Geographical Society, Kensington, London

Program:

7:00 **Serge Gracovetsky**
Evolution of vertebrate spine – from fish to Homo sapiens. How it functions and how it fails.

8:00 **Matthew Wallden**
Movement, stability and the 4th dimension: Clinical applications

8:30 **Refreshments break**

9:00 **Interactive Q-A session**