Interview with Serge Gracovetsky, Ph.D.

By Certified Advanced Rolfers™ Kevin McCoy and Kevin Frank

Editor's Note: Serge Gracovetsky will be a keynote speaker at the 2008 Rolf Institute® Annual Meeting, The Art and Science of Fascia. His presentation, From Fish to Man: the Story of the Human Spine will be held on August 1, 2008. He is the author of The Spinal Engine and was awarded "Best Paper Presentation" at the 2007 Fascia Research Congress.

KM and KF: Thank you for taking the time to speak with us. Your work has clearly shifted current thinking about the nature of the human spine and musculoskeletal function, which has impacted our work in the field of structural integration. We would like to use this interview to give Rolfers and other structural integrators who are not already familiar with your work a taste of your contributions.

First, your background is in computer science and yet you wrote a book about the evolution of movement and functional anatomy that has revolutionized research in biomechanics. How did your book The Spinal Engine come about? What made that investigation interesting to you?

SG: Actually my background is nuclear physics. Physics is the application of mathematics to natural sciences. During my university years I had a painful back problem. The physicians I consulted generated evasive and quite different answers. I concluded that they did not know what I had and decided to do something about it.

KM and KF: It seems like you were interested in modeling the problem and you investigated the different models already in use, and then when those were found lacking, you started to create your own. In The Spinal Engine you showed how the fish body action is, in the human spine, converted into contralateral movement in walking. In a follow-up article you describe how the feet and legs recycle the kinetic energy of walking back in to the spine so that contralateral gait is amplified and supported. This has led to interesting applications in our work. For example, some Rolfing instructors have started to refer to the three pathways by which energy is recycled from the feet and legs back into the spine as "Gracovetsky's chains." These three "lines of transmission" are used as a template to help assess preferences in coordinative strategy while a client walks. This assessment is then used to devise perceptual interventions that awaken fuller expression in one or more of the three pathways of kinetic energy.

Your spinal engine model also shows how the transversus abdominus effects lateral pull in the lumbar fascia, which stiffens that fascia. This stabilizes the spine for loading, in response to action of the psoas, and helps (in conjunction with the multifidus) to hold the spine erect. For some structural integrators, a strategy for restoring spinal stability – such as for rehabilitation from back injury – is to restore the ability of the transversus abdominus and multifidus to activate early. In other words, our job in structural integration can be viewed as work to establish better motor control in terms of the timing of core muscles. Carolyn Richardson and Diane Lee have advocated working in a similar way.

It seems your spinal engine model pioneered this viewpoint, which now seems revolutionary. Was this something you were hoping for in your work?

SG: No. I looked at the problem from the point of view of a physicist. I was interested in constructing an animal that would walk efficiently on two feet. The spinal engine was a logical consequence of that premise. It was only after that work was published that vigorous unsolicited criticism began to rain in on me and made me look more closely for clinical applications such as spinoscopy to see if these theoretical ideas had any real use.

I always thought that it was not for me to make that discovery. Many other people at that time were far more conversant with the spine and they should have logically made the discovery. Perhaps the fact that I was trained outside the influence of classical biomechanics allowed me total freedom in considering my options. In retrospect, I had nothing to defend, and I looked at the problem without passion or prejudice.

KM and KF: What are your thoughts on how / why human beings get low back pain? What do you see as opportunities for people to improve spinal health?

SG: It is estimated that 90% of low back pain has a mechanical component. It can be shown that there are two main types of injury: once due to excessive compression on the spine, and one due to excessive torsion. A compression injury is essentially a fracture of the end plate (Smorld's node). The cancellous bone of the end plate heals rapidly, and in a few weeks the patient is essentially fine. In contrast, a torsion injury is a collagenous injury where the multiple layers of the annulus fibrosus get damaged and delineated thereby opening a channel for the nuclear material to escape in the foramen or the canal. Collagenous injuries are notorious for taking a long time for healing, and even then the scar material replacing the damaged collagen does not have the same mechanical characteristics

of the original collagen. Indeed, it takes six weeks to recover 50% of the original strength and six months to reach 80%. This long process exposes the patient to the risk of re-injury. Hence one never really heals from a torsional injury, which is a prime candidate for chronicity.

The problem is that both compression and torsional injuries have similar symptomatology. It is therefore difficult to separate the two, and close to 90% of the time the diagnosis is an unhelpful "nonspecific low back pain." Since the course of each type of injury is different, they cannot be lumped in one category. Hence the frustration in having some patients recovering in a month or so while others do not do so well and even become chronic. Spinal health means above all a good understanding of the function of the spine and its limits.

KM and KF: What are your thoughts about other contributions to low back pain such as muscle spasm, ligamentous strain, and issues related to facet joints? What about motor programming or the role of consciousness (e.g., feeling state, awareness, or attitude) as a contributing factor? You created "spinoscope" technology for pinpointing spinal movement for patients as they move; does this assist in the diagnosis of spinal injury, or in assessing how to treat spinal injury?

SG: A diagnosis for low back pain is unknown in 90% of the cases. And there is no reliable correlation between pain, anatomy and function. So to assess the condition of the patient you should measure separately pain, anatomy and function. Spinoscopy was developed to assess function independently of pain or anatomy. For instance, the patient may report pain, but have a perfectly normal spine from a functional point of view.

KM and KF: Your work draws on evolution for explaining our human predicament. What would you say is the difference between primates and human beings in terms of musculoskeletal health?

SG: Primates are quadruped. Humans are biped. The use of the spine is different.

KM and KF: Yes, humans are the only true biped. What changes in the movement of the spine when we compare quadrupeds and bipeds? You stated in your presentation at the Fascial Congress in the fall of 2007 that human bipedal structure is inherently unstable, and that is an evolutionary advantage because proper motor control becomes more vital. Is the implication that we humans had better understand how to evoke healthy coordination if we wish to avoid musculoskeletal problems?

SG: Humans are not the only true biped. Many birds, including the now-defunct dodo, are perfectly functional on two feet. A lot of dinosaurs used that mode of locomotion for a much longer time than we have on this planet. So the jury is still out on us. You cannot separate the control system from the system itself. A deconditioned patient probably has a control system adapted to his lousy physical status. Healthy coordination is a consequence of maintaining the musculoskeletal system in top shape. This is elementary system integration.

KM and KF: Do you have any thoughts on the force closure / form closure debate regarding the sacroiliac (SI) joint? What have you learned about the evolution of the human SI joint and its vulnerabilities?

SG: The form / force closure debate is centered upon the hypothesis that the SI join is flat, and therefore the SI join on its own will dislocate unless forced to remain closed. That is incorrect. Cursory investigation of the SI joint has demonstrated (since 1957) the warped surfaces of the joint and the very strong collagenous structures that keep it as a unit. There is no need for a force closure / form closure argument to close an already closed joint. Besides, it is not unreasonable to consider the SI joint to be a particular form of a costovertebral join in which the vertebrae are fused (sacrum) and the ribs are also fused (pelvis). This representation unifies the spine function as a single machine extending from C1 to the acetabulum. The SI join is fairly strong, and it takes quite a bit of abuse to bring it down.

KM and KF: Given your description of the SI joint as inherently very stable, why is that so many people have discomfort there? With the functioning you describe, is it still possible that proprioceptors send distress to the brain even if there is a tiny amount of misalignment? Or is it a matter of muscular distress that we interpret to be subluxation of the SI joint?

SG: I do not know where the pain comes from, and I do not see how we can assess "tiny misalignment" of the SI joint in vivo and relate that to pain.

KM and KF: What aspects of biomechanical or fascial research look interesting to you, going forward? What is the role of fascia in healthy functioning, and what does the role of fascia tell us about effective rehabilitation?

SG: The energy storage properties of the collagenous fascia are unclear to me. The fascia is essential to explain function of the spine, and damage to the fascia will definitely prevent full rehabilitation.

KM and KF: What are the implications of fascia storing energy? It seems that you have pointed to fascia as a means by which energy is transferred, but why should we want to know about energy storage? Certified Rolfers™ like to think that they assist with improvement in the quality or differentiation of the fascial planes, so we are curious what you consider to be damage to the fascia and how that would impede rehabilitation. What do you think can be done to assist rehabilitation of the fascia?

SG: Storage and release of energy is inherently related to the efficiency of the gait process. An appreciation as to how this is done would help to understand the process and quantify the disability that results from a loss of collagenous tissue. Damage to the fascia forces tasks to be carried out by surrounding muscles at a cost of increased stress on the spine.

I do not know how damaged fascia could be rehabilitated. We know that the scar tissue that replaces damaged collagen has a different mechanical property, and therefore the efficiency of the original system is compromised for good. Hence, the only thing rehabilitation can do is to stop the patient from degrading any further, and help him recover the best possible residual function given the amount of scar tissue that has replaced the good collagen.

KM and KF: We are not sure how familiar you are with the Rolfing / structural integration as a profession, but we are interested in what our work looks like to you and how it fits into your understanding of human function.

SG: There is little doubt that the body functions as a unit driven by many factors, including emotional factors. The problem that Rolfers encounter in their relation with traditional medicine is rooted in the near impossibility of assessing the factors Rolfers add to standard biomechanics in the design of rehabilitation techniques. For instance,

we know that there is some correlation between reported low back pain and work satisfaction. But how do you measure unhappiness in relation to an increase in perceived pain, and how do you measure the improvement in happiness following a Rolfing® treatment?

The concept of structural integration is probably correct but suffers from the inability to quantify the very elements that are to be modified to enhance the overall balance of the individual. And it is precisely this inability to measure objectively the impact of Rolfing in a controlled environment that opens up Rolfing to criticism. The way to go is to test every hypothesis that forms the basis of Rolfing, one at a time, using the time-honored techniques of blind studies with control groups. This is, in my opinion, the price to pay if Rolfing is to gain acceptance in mainstream medicine.

KM and KF: Our colleague Hubert Godard has begun to work with researchers who use motion capture to determine the timing and activation of movement within the body, pre- and post-intervention. It is also a feedback strategy that helps people learn to change their motor control. Some of us believe that it will be through evaluating pre-movement (i.e., preparation to move, which is an aspect of motor control) that structural integrators will ultimately prove the value of our work in a rigorous manner. In other words, our claim to change structure may be better validated through capturing changes in coordination than by trying to study changes in the physical structure, which appears somewhat elusive so far. Comments?

SG: I will need to see the data published in a peer-reviewed journal such as Spine before I can offer any relevant comment. This being said, I have measured pre-movement in lifting and the changes in coordination associated with certain types of injury. That was the basis of the design of an automated diagnostic system, and its performance against [assessment by] real spine specialists was published in Spine almost ten years ago. This will be the subject of a breakout session in Boulder in August.

KM and KF: That's at the Rolf Institute's® annual meeting, August 1-3, 2008, where you will also be the keynote speaker. Can you give our membership a little taste of what your presentations will be about?

SG: On Friday evening, I will be presenting on how the function of our spine came about. My approach follows the argument of energy efficiency, in which each step of the evolutionary sequence from our fish ancestors represents an improvement in the ability of the animal to survive. Then in a breakout session on Saturday, I will be showing that the diagnosis of low back pain is strongly dependant on reported pain. The clinician cannot statistically override what the patient wants him to know; consequently, it is the patient who dictates the outcome of the clinical examination in the majority of the cases. That does not bode well for inserting nonmeasurable elements into the definition of the wellbeing of a patient.

KM and KF: Thank you very much.

SG: See you in August.