The Relationship of Contralateral Gait and the Tonic Function Model of Structural Integration: Working with Coordinative Structure

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This article outlines the usefulness of thinking about contralateral gait in doing structural integration. Tonic function theory posits four structures to be considered in the context of structural integration. One of these structures is referred to as coordinative structure. A person’s gait is an example of a coordinative structure. Integrating coordinative exercises into the flow of structural integration can help the client in finding contralateral gait in the aftermath of a session. Contralateral gait is often a confusing topic for bodyworkers and movement teachers. Improved definitions, taking time to find specific perceptions and embodiment of the movement, may help clarify this topic.

Contralateral movement of the spine primarily, and of the limbs secondarily, seems to be “hard-wired” into human coordination. Put another way, the human body is designed to walk and run so that the lower trunk and pelvis rotate and the upper trunk and shoulders counter-rotate. The feet and head are uncoupled from this torsion and counter-torsion so we can run and walk with our feet and head pointed forward. This is function that Dr. Rolf might have termed “normal.”

What is the usefulness of this observation to body therapists and movement educators? Why do we look for contralateral movement and how does thinking about contralateral movement help us design interventions that improve the function of a client? Since contralateral movement is a product of (1) human anatomy, (2) reflexive chains of coordination and (3) the context of walking upright in a gravitational field, on solid ground, we can think of this pattern as our ally. We don’t have to teach the body to do it. It is inherently present, if at times inhibited by fixations of tissue or perception.

When fixations of tissue or perception are released, contralateral movement may emerge, suddenly and without having to work at it. With a shift toward contralateral gait comes the potential for increased flow. Flow here is defined as economy of movement—an optimum orchestration of motor unit recruitment. Put another way, we would like to observe a quality of lengthening and fluidity in movement, and a resiliency to changes and surprises of circumstance.

INTEGRATING COORDINATIVE WORK ON THE TABLE

Helping a client to release tissue and perception fixations may be sufficient to allow contralateral gait. However, it is also useful to stimulate contralateral coordination by using movements embedded in walking or running during standard table work. Specifically, one can have a client push with different parts of the foot against a fixed vertical plane (such as a wall) while releasing fixations of tissue. Pushing the foot on a wall can be coupled with specific movements of lumbar and cervical spine. Working with a pushing foot dovetails well with teaching a client to simultaneously perceive the space around them. Also, the client can additionally use his/her upper girdle and link the hand function to foot function (see Figure 1). Thus is the client engaged broadly, and in a manner that will serve him/her in standing and walking.

THE VALUE OF SENSE IMPRESSION TO COMPETENT STABILIZATION

Coordinative work may need to start with teaching clients to attend to sensations in the hands and feet, to allow the impression of contact to register before pushing. Taking time to allow the impression to freshly register sensations in the extremities is a necessary pre-movement that can facilitate activation of core stabilizing muscles, the transversus abdominis and multifidus. Noticing sensations interrupts the client moving from learned body image—the conscious or unconscious beliefs and mapping of the body. We are teaching the client to “unlearn” body image rather than “learn” a new movement per se. Using impression to “inhibit the inhibition” of learned behaviors is a part of structural integration as expressed in the theory of tonic function.

Actions involving the extremities require a stabilized axis to transfer force. Competent stabilization occurs as the client learns to sustain sensory impression. The relevance of extremity-provoked stabilization to gait is the following: Gracovetsky observed in his spinal engine model that the transversus abdominis and multifidus work together to support the transfer of energy through the lumbar region—energy from the legs to the spine and energy from the spine to the legs. Counter-rotation in the spine diminishes if this response is weak or missing. The lumbar/abdominal part of
the trunk must be stable enough to bounce the kinetic energy from the legs into the upper body, but at the same time free enough to allow contralateral flow. When the extremities recover a vibrant contact with ground and space, the trunk will be appropriately stabilized.

By contrast, body image-controlled stabilization will also stabilize the trunk, but may do so at the expense of lost flow and compression of the spine. If we think, “I must stabilize myself and tighten my stabilizers,” phasic muscles, such as the rectus abdominis, will contract. This is likely to become an impediment to the emergence of contralateral gait.

LINKS BETWEEN CONTRALATERAL GAIT AND MOVEMENT GOALS OF STRUCTURAL INTEGRATION

The philosophy of structural integration includes the idea of conservation of energy in achieving economy of function. Gracovetsky's theory is helpful in identifying some of the coordinative mechanisms that can be improved in the process of doing structural integration. His work validates and explains some of the stated goals of structural integration. Examples of the link between Gracovetsky's ideas and those of structural integration can be illustrated with some movement goals drawn from structural integration.

Attempting to describe movement is, of course, inherently suspect. If we choose a particular detail to look at and speak about, we are artificially separating a whole body event into parts. Worse, we may unfortunately teach our clients to “improve” their movement by learning to “do” the movements consciously. That having been said, we do discuss movement in terms of parts in order to do analysis. Optimally, we might want to shift back and forth between details and the larger overall dynamic, both in our discussions of theory and in our work with clients.

Some movement “hallmarks” have been used for many years to evaluate movement in the context of structural integration. “Toe hinge” is an example. Toe hinge is the moment in contralateral gait when a sequence of heel to toe contact culminates in an acceleration of push-off that supplies the energy for spinal (and hip) extension and rotation. Toe hinge is part of the foot's exercise for maintaining functional arches and balancing intra-tarsal relationships. Structural integration practitioners work to release fixations of tissue and coordination to make it possible for better hinging of the toes in walking. Using a wall adds to the practitioner’s menu of choices. Howard Dannenberg is an important author on the relation of toe hinge to gait. (Dannenberg's discussion of what he calls “hallux limitus,” is about the relationship of proper hip extension to function of toe hinge and the proper coordination of hamstrings and other aspects of gait.)

During table work, toe push on a foot plate or wall can be combined with actions involving extension of the spine, use of the eyes, and reaching over the head with the arm (see Figures 2 and 3). Supine, the client can work at releasing fixations on the front surface of the body. In side-lying, the movement can have greater range and stronger dynamic. The use of wall pushing accelerates the learning process and prepares the client for what will happen when he/she stands up and moves in gravity.

Another hallmark of integrated function is what has been referred to as psoas/rhomboid balance. Psoas/rhomboid balance is a familiar phrase to structural integrators. Dr. Rolf used this phrase in her writing, yet the author observes less than universal agreement as to its interpretation. When we take this phrase apart we observe that the psoas relates the spine to the femur just as the rhomboids (and hence the serratus) relate the spine to the scapula/humerus. The psoas creates a connection for the lower limb, and the rhomboids/serratus make the connection for the upper limb. In the contralateral spinal engine model, we start to see that rotation and counter-rotation of the trunk is a coordination that happens as a whole or not at all. We cannot have a competent natural impulse of the psoas unless the femur adequately extends and this will not happen unless the opposite shoulder is adequately forward. In this moment of gait, the rhomboids on the right are fully stretched at the same time as the psoas on the left is about to fire. Godard has suggested, in fact, that the rhomboids' elongation engages the lower trapezius and latissimus dorsi and, by so doing, helps the lumbar spine rotate posteriorly on the opposite side, precipitating a stretch reflex from proximal lengthening of the psoas.

To help imagine the mechanics, think of the spine as the axis of a pulley and the chain of musculature from the arm and shoulder down and across the back as a belt. The belt pulls on the pulley and rotates it forward.

Figure 2. Client is pushing with toes against wall and working on extending hip, spine, and gaze, while reaching with the hand over his head.

Figure 3. Client is pressing the toes and reaching with hand and eyes. Reaching above head with gaze of eyes are helping to extend the head/neck.
on the side with the shoulder forward, while at the same time bringing the opposite side of the pulley back. Thus, the opposite side of the lumbar spine is brought posterior. As this posteriorly-rotating side of the lumbar spine comes back, it elongates the psoas at its upper attachments and this in turn gives the psoas a stretch reflex to initiate firing. Thus, psoas/rhomboiD balance is a way of referring to upper and lower girdle relationships during contralateral gait.

Movement exercise that dovetails with this view of psoas/rhomboiD balance includes working with reach of the hand on all fours to trigger the opposite knee to flex forward. You may wish to try this if it is not familiar to you. On hands and knees travel across the floor to let your body tune into the movement that we typically see children do prior to walking upright. Then reach out with your hand, enticed by something you wish to grasp or move toward. If you extend far enough, you may be surprised to feel a reflexive impulse of the opposite hip that brings the knee forward.

Adequate knee extension during walking is another hallmark of structural integration. If the knee is inadequately extended during the heel strike and toe push-off phases of the walk, ligaments and muscles aren’t fully stretched and the spinal movement will not be fully energized. Addition-ally, hamstring length is affected by the degree of knee extension in the walk, and the triggering of reflexes depends on adequate extension of the hamstring muscles. Working prone, the client can be asked to dorsiflex the foot and bring the toes in dorsiflexion so that they press on the table. The client reaches his/her heel to extend the knee. Knee extension is thus derived from a sense of support of the trunk and a vector of reach in the heel. Many aspects of tissue fixation can be addressed using this kind of heel reach. Table work of this sort can enhance knee extension when the client stands up and walks.

**COMBINING COORDINATIVE REFLEXES WITH TISSUE WORK FOR HAMSTRING RELEASE**

During the stance phase of gait, a sufficient commitment of the standing foot to contact the ground allows the hamstrings of the opposite leg to release. Additionally, the trunk stabilizers (here represented by the often-referred-to transversus abdominis and multifidus) will support the upper body during this movement only if the foot is contacting the ground with sufficient weight-orientation. One way of using this principle in table work is illustrated in Figure 4. The client reaches with the heel of the raised leg while competently pressing with the opposite foot on the wall. The pressed foot assists the practitioner by engaging reflexive release of the hamstrings undergoing fascial release.

During structural integration work that addresses fixations in the adductor compartment, pressing the foot against a wall can be combined with stabilized movement of the lumbar spine (Figure 5). The client can also use hand pressure against the table surface to stimulate optimum stabilization. Here, we wish to see a stabilized trunk without shortening due to dominant use of the rectus abdominis, iliacus, pectoralis major, etc., what could be termed the “rectus chain.” Use of the transversus abdominis and multifidus as primary stabilizers leaves the hip and spine free to extend as necessary and preserves the capacity of the front surface of the body to lengthen.

**Sacroiliac Function**

Adequate hip extension during gait is an important part of integrated function. Many consequences follow from the quality of hip extension. One physiological consequence of inadequate hip extension is sacroiliac joint dysfunction.

Sacroiliac stabilization by rotator and hip extension muscles will not occur if the overall contralateral pattern is inhibited. The completion of extension in the spine and lower limbs, as we walk, is linked to com-

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**Figure 4.** Client is pressing with left foot and reaching toward ceiling with right heel. Practitioner is pacing hamstring tissue work so as to allow release of right hip by active pressing of left foot. Wall provides support for practitioner’s left shoulder and trunk.

**Figure 5.** Practitioner is engaged with tissue in client’s left adductor compartment, and also giving client tactile feedback about movement of lumbar spine. Client is pressing wall with left foot and table with right hand. Client is learning to link sensory impression, and pressing of extremities with movement and stabilization of spine.
NEW FUNCTIONAL APPROACHES

potent "force closure" of the sacroiliac joint. Force closure and form closure are terms that help differentiate the necessity of proper alignment of joint surfaces—the shape of the joint (form)—from the correct reflexive compression of joints (force) that results from use of the appropriate muscles around the joint. Sacroiliac joint subluxation is subject to recurrence despite manual therapies to release it, so long as gait coordination is not restored. Muscles that close the SI joint are stimulated to fire, as there is sufficient extension of the spine and hip.

Table work can incorporate hip extension that initiates with toe push off. One is asking the client to find extension of the hip and spine by pressing toes against the wall. The work is done slowly until the client feels that the extension is happening naturally and dependably. After the client comes to standing and then walking, the practitioner and client can both observe an improvement in toe hinge and extension of the spine and hip, often with little or no verbal cueing to help elicit it.

STANDING EXERCISES FOR IMPROVING STABILIZER RECRUITMENT—AIDS TO BACK HEALTH

Standing work can incorporate the same combination of movements, but in gravity and with the use of an elastic therapy band attached to a stationary object. This demands that the client contact the ground with the standing foot, extend the hip, knee, ankle, spine, and arm, simultaneously building a strong orientation to space (Figure 6). Intrinsic core stabilizers fire from an appropriate orientation to ground and space as the challenged limbs call for stabilization of the trunk. Done without regard to orientation, one can observe extrinsic stabilizers firing such as the rectus abdominis, sternocleidomastoid, iliacus, and so on. A torsion version emphasizing use of the upper girdle is illustrated in Figure 7.

As details of muscles and movements are presented, it's worth remembering that competency in a particular movement comes via a dynamic, that contralateral gait is a system event. In other words, if we think about which muscle is supposed to contract, that will likely lead to an interruption of natural contralateral gait and a reinforcement of movement relying on body image. Conversely, learning to see contralateral gait and being able to define it in an agreed-upon way may be a pathway to movement that is natural to bipedal function.

DEFINING THE TERM "CONTRALATERAL GAIT"

The terms "contralateral walk" or "contralateral creep" (a term some have used for referring to the stage at which a child learns to locomote on hands and knees) often confuse bodyworkers. It is useful to more fully define the term contralateral.

Contralateral literally means opposing sides, but sides of what? Looking at walking, one may observe whether the right arm swings forward while the right leg is in extension. Or one might observe that the right arm and the left leg are both out in front of the body at the same time. However, looking at the movement pattern of the trunk...
while walking or creeping (crawling on hands and knees) reveals something different. The trunk is defined here as head, spine, rib cage and pelvis. What do the segments of the trunk do in walking or creeping?

In order to see trunk movement, it helps to experience a differentiated perception of one’s own spinal movements. It is as if the body can better perceive another’s body pattern if it’s able to imitate what it is looking at. To assist in perceiving spinal movement, it can help to put that movement in context.

**EVOlution of Human Spinal Movement Capacity**

To show the relevance of the various spinal patterns, some ideas from the story of biological evolution are pertinent. The most primitive axial creatures propel themselves by laterally bending their axes and swinging side to side through some fluid environment. Fish illustrate this strategy. Creatures that emerged from the ocean had to adapt to gravity, and sagittal flexion came into being as the spine found up and down movement in relation to the gravity field.

Sagittal flexion led to axes that could bend forward and backward. With the advent of sagittal flexion, creatures had to acquire axial torsion to assist newly acquired limbs in clearing obstacles. Spinal torsion served the continuing story of land-dwelling creatures, and some that returned to the ocean (whales and their cousins). One of the elements that separates hominids from apes is a locomotive strategy based on the trunk rotating and counter-rotation itself. Hominids are the first and only creatures with the anatomy that serves counter-rotation of the trunk in upright locomotion. When apes run they revert to the method of quadrupeds (sagittal flexion of the spine—what is sometimes referred to as homologous movement).

The shape of the human spine, with its lumbar and cervical lordoses, is specifically suited to counter-rotation of upper and lower trunk. It is only because of these lordotic spinal shapes (together with their opposing kyphotic curves—thorax and sacrum) that humans can walk and run differently from other mammals.

Lateral flexion, or fish movement, is what is often referred to as homolateral movement. Sagittal flexion (think of the first lizard arching up and down on land) is often referred to as homologous movement. Rotation and counter-rotation of the trunk is referred to as contralateral movement, although, as previously mentioned, contralateral can sometimes describe limb pattern during walk (or creep). The problem of looking at limbs is that although limbs may be congruent with the pattern in the trunk, they can also disguise a trunk pattern that is different. The trunk is the engine that drives the limbs. As bodyworkers, therefore, we want to think about the trunk movement pattern as the core of the pattern and not try to re-pattern the limbs.

Gracovetsky’s spinal engine theory offers a physics-based model by which the laterally bending spine causes spinal rotation, which in turn powers the lower limb in walking. Gracovetsky’s more recent work demonstrates the manner by which the legs recover the energy received from the spine and recycle it back into spinal rotation. This theory revisits the need for adequate core stabilization from the transversus abdominis and multifidus and has stimulated interest in the application of this work to back pain. Also, Gracovetsky’s theory points out that the upper girdle must be strong enough to assist in the conservation of angular momentum necessary for counter-rotation. Another way to put this is to say that the upper girdle must be properly coordinated for the overall system to operate in contralateral flow. Secondary patterns in the shoulder girdle can stymie our attempts to stimulate flow in contralateral gait. Pushing and reaching against an object during table work and in standing is one way to address this issue.

Moving in the lateral flexion, sagittal flexion, and rotation and counter-rotation dimensions are ways to more precisely feel these movements in one’s body. Feeling them clearly in oneself helps better distinguish which movements are present in one’s clients. Rotation/counter-rotation is typically the most difficult to “do”, although one can certainly concoct the mechanics through practice. However, evoking contralateral movement from stimulated perception allows this natural human movement pattern to emerge, with a quality of flow. The entry points to contralateral movement are a central aspect of Tonic Function theory and engender effective strategies for structural integration. Godard makes the assertion that merely assisting the client to find two directions in the spine will typically produce an improvement of contralateral function. The author has observed this as well, and encourages the reader to test this assertion out in his/her practice.

**Contralateral Gait as Part of a Language of Movement**

Structural integration’s purpose is assisting clients to function with improved flow and economy. Determining economical and better flowing function can be an intuitive process, certainly. However, for structural integrators to speak about improved function requires asking what improved function looks like and agreeing on language that describes it. Contralateral gait, a uniquely human accomplishment, is a template for describing integrated function. To use this template meaningfully requires embodying the anatomy and the variety of movement that constitutes it. Additionally, practitioners of structural integration are in a position to use this template to make table work more efficient and to bridge the gap between table work and standing/walking. Underlying shifts in coordination will be improvements of orientation and sensory perception.

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