A Historical Perspective and Rationale Behind the *Hruska Alternating Reciprocal Rotation Test*

Webinar
January 26, 2024

by Ron Hruska, MPA, PT

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This test is used as a thoracic-pelvis abdominal dynamic stabilization measurement, with each grade reflecting muscle position, strength, kinesthetic awareness, and neuromuscular ability to move ones self forward through anti-phasic interlimb movement.

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It is a good test, or activity, to consider when questions arise regarding upright thoracic-pelvis integration secondary to extremity phasic activity and sensory processing of associated supportive sense.

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Alternation of spinal rotation through the use of contralateral hip flexors with concomitant unilateral hip extensors requires appropriate abdominal integration and appropriate timing of upper extremity reciprocal flexion and extension.

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This webinar will highlight the following considerations as related to this test:

- *Postural Pivotal Points*
- *Obturator Foramen Regulation of Foramen Magnum Location*
- *Level Three and Level Five Recommendations*
- *Long Seated Tensegrity and Tension*
- *Long Seated, Long Floor Implications on the Ontogenetic Development of Upright Body Memory*
- *Pressure Offloading and Arm Reaching*
- *Midbrain Limb Control During Reaching Movement*
- *Suggestions for Individuals Who Cannot Long Sit*

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HUMAN POSTURAL PIVOTAL POINTS

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The pivotal points of our upright body are the ischial tuberosities and the calcaneus tuberosities. They provide pivotal sensorial information, for the vestibular and visual system synaptic network, during orientation of the lateral position of our center of mass.

This network and associated cortical map allow us to alternate our bodies for advancement of each side of our body and acceptance of gravity of each side of our ground, independently of the other side.

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Our primary cortical areas of our brain (motor, sensory, and visual) derive hemi-pelvis, hemi-thorax and hemi-cranial function from interconnected communication between the heels, ischial seats and hetero distal middle fingers.

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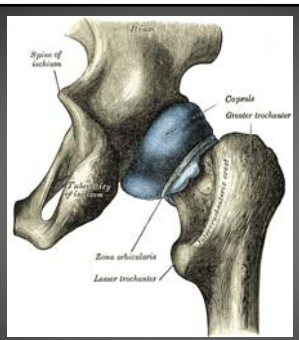

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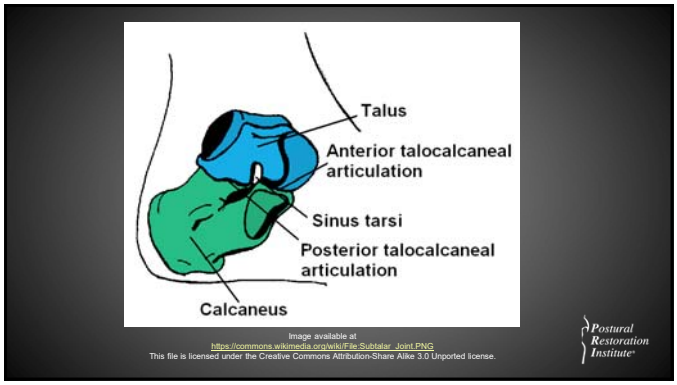

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All three have an axial component that they are responsible for.

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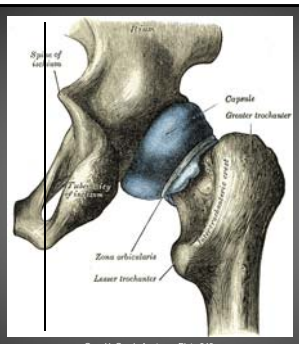

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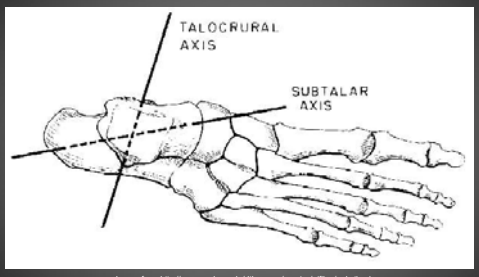

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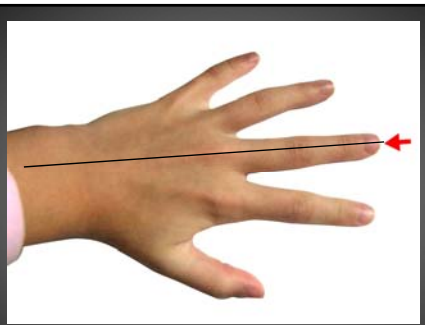

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Our primary axial cortical function is developed by rotational use, reflexive use and associated cortical and subcortical synaptic frequency.

Our center of mass or our postural placement, is organized around thresholds of synchronized brain waves and patterned synaptic networks of neurotransmission frequencies that activate and assimilate cortical change, challenge or designed shapes of synchronized maps of behavior.

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Our brain discriminates different frequencies of electrical waves through synaptic plasticity that allows neurotransmission of connections to change with experience and memory.

This synchronized mapping is built around oscillation and pendular forces and frequencies, that are designed around acceptable, aligned upright positional state of control and physiologic respiration, as the body shifts from side to side.

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Mechanical pivotal function really starts with pelvis inclination on the acetabulum, pelvic floor respiration, and internal rotation of the ilium on the sacrum in the anterior inlet.

Since the pelvis moves on and over two femoral heads, that also move on and over two calcaneus bones, the need to keep the one end of the leg rotating opposite to the direction of the other end, is dependent on the cortical recognition of both the movement itself, and the lateral direction the body is simultaneously moving in to.

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For example, if the distal leg is moving inwardly (internal rotation), the proximal leg would need to move outwardly, as the center of mass shifts over to the right.

Hopefully, the distal leg on the other side would be moving outwardly (external rotation), and the proximal leg would be moving inwardly as the center of mass remains over to the right.

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Upright Ski Shift Squat

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Lateral movement of the trunk is an essential requirement for a balanced sacral base that supports the spine.

Axial rotation around the subtalar axis, and the middle phalanx of the hand, predicts and precedes this lateral mass of shift; with the change in direction of the trunk and abdomen, mechanically occurring through the lower extremities.

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The pivotal points below the obturator foramen, the ischial tuberosities and calcaneal tuberosities, provide the body, that owns these sites, the freedom to move or rotate around a dynamic bone-point of surface contact with the world that is responsible for structural foundational behavioral support.

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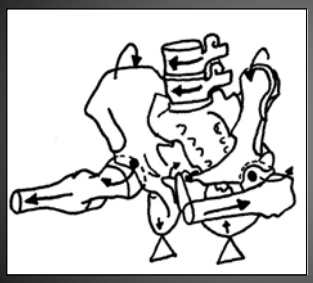

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Without the seat or ground surface sense, we would re-route brain synaptic electrical flow to engage plantar flexors, back extensors and in general, the autonomic nervous system to adapt to gravitational demands.

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A number of soft tissue structures attach to the ischial tuberosity.

For example, the sacrotuberous ligament, some gluteal muscles (inferior gemellus, quadratus femoris), adductor magnus and the posterior thigh muscles (biceps femoris, semitendinosus, semimembranosus) all attach here.

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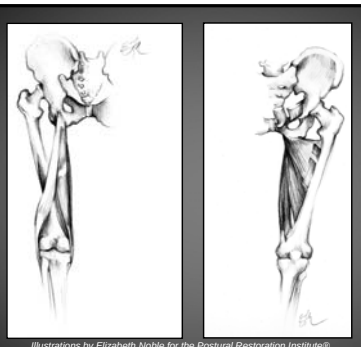

Illustrations by Elizabeth Noble for the Postural Restoration Institute®.

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These muscles pull on the ischial tuberosity and posteriorly rotate the bones that are responsible for pushing the anterior, spine upward, thus decreasing the demands on the muscle that attaches to the anterior femur and the lower spine that is used for forward declination of the lowest spinal segment to stay centered on the forwardly tipped sacrum.

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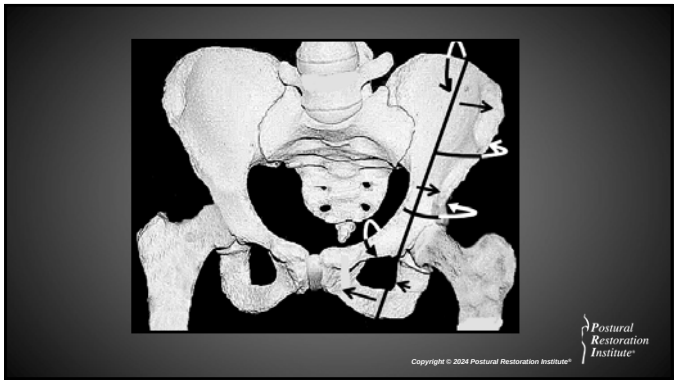
However, when the obturator foramens are positioned by end range of femoral flexion (90 degrees), as one would see in someone sitting in a long-seated position, the forward rotation, anterior tipping, and external rotation, so often seen at the left ilium in the anterior inlet, should be reduced.



In this same position, the accompanying internal rotation of the sacrum on the ilium, so often seen in the left posterior outlet, should also concomitantly be reduced.

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OBTURATOR FORAMEN REGULATION OF FORAMEN MAGNUM LOCATION

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Most of us are right-hand dominant, and it is likely that most people therefore, continue to perform the majority of activities with their right hands.

Consequently, many of us are more skilled at manipulating the right-side environment and reaching in rightward space, and therefore demonstrate comparatively less skill reaching leftward, or to the nondominant side.

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The extent to which reach distance reflects dynamic balance varies with the strategy used.

(Liao CF, Lin SI. Effects of different movement strategies on forward reach distance. Gait & Posture. July 2008;28(1):16-23.)

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Most strategic patterns used to maintain upright balance when reaching with one or both hands and arms include the use of the calcaneus muscle and ischial tuberosity muscle to center the foramen magnum (brainstem) between two points of floor or ground up sense of support.

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The Long Seated *Hruska Alternating Reciprocal Rotation Test* enables one to place, position and rest the foramen magnum in a centered state of stability, that is close to the ground for upper extremity regulation of forward locomotor movement, without the demand placed on the lower extremity for 'lift'.

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It allows human bipedal gait, a characteristic four limb pattern with anti-phase arm swing in the same frequency as the lower limb oscillations.

(Weersink JB, et al. EEG time-frequency analysis provides arguments for arm swing support in human gait control. Gait & Posture. May 2019;70:71-78.)

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Such arm swing has been suggested to contribute to stabilization, energetic efficiency and recruiting neuronal support, for maintaining the cyclic motor pattern necessary for brain stem and foramen magnum reciprocal lateralized centering.

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Controlled side to side movement of the FM can usually be preserved and re-established in the long seated position.

In this position, the obturator foramens (OFs) are placed in positions that complement each other and bilateral sense of the ground.

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The obturator externus (OE) muscle is positioned to provide the greatest control of centric FM function.

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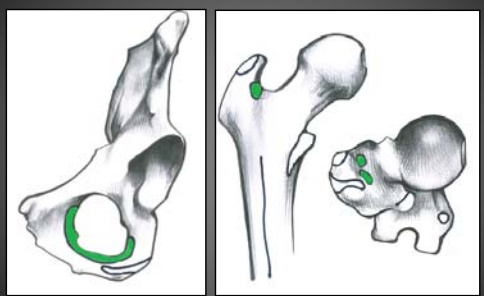

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The OE contributes to adduction of the flexed hip, while the obturator internus (OI) plays a role in abduction of the flexed hip.

It has been well established that the OI is a postural muscle that holds the femoral head in the acetabulum.

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The OI muscle, in this long seated position, helps provide the abduction control of the femur in the acetabulum during leg lifting and reaching.

It is the OE muscle on the other side that provides the pivotal guidance for the acetabulum on the femur during hip adduction.

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However, the obturator muscles, both OI and OE muscle, work synergistically with surrounding muscle to provide hip mobility, as the neck and head, or the FM, is centered between the two, converging ischial tuberosities.

Their primary function is external rotation of the hip and femur, for both FM 'hole' control and OF 'hole' control.

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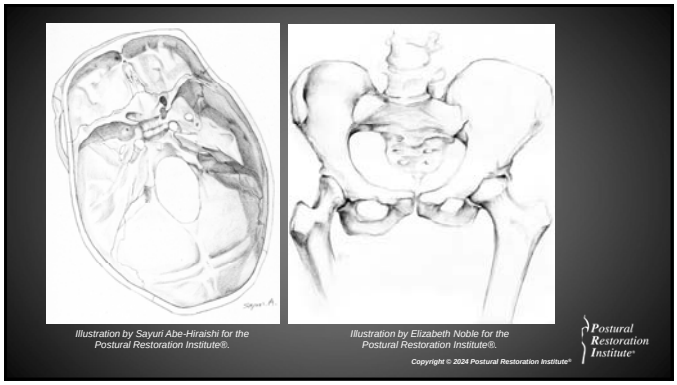

Illustration by Sayuri Abe-Hiraishi for the Postural Restoration Institute®.

Illustration by Elizabeth Noble for the Postural Restoration Institute®.

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LEVEL THREE / LEVEL FIVE RECOMMENDATIONS

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LEVEL → 3

Ability to rotate your trunk to the right by reaching with your left arm toward your right foot, while maintaining contact with the floor through your left "sit" bone.

Inability possibly reflects poor integration of left obturator, iliococcygeus, and hamstrings (pelvic outlet) with left IO/TA's and iliacus (pelvic inlet).

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The ability to perform level three of this test requires one to rotate their trunk to the right by reaching with the left arm toward the right foot, while maintain contact with the floor through the left sit bone.

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This requires and reflects the ability to integrate the left obturators, iliococcygeus and hamstring (pelvic outlet) to interact with the left IO/TAs and iliacus (pelvic inlet).

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Level Three Supportive Recommendations:

Long Seated Alternating Crossovers *(Long Seated Integration #6)*

Long Seated Supported Resisted Single Arm Pull Back with Left Ischiocondylar Adductor *(Long Seated Integration #3)*

Long Seated Supported Press Down with Abdominals *(Long Seated Integration #5)*

Long Seated Press Down *(Long Seated Integration #9)*

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LEVEL → 5

Ability to advance your right leg forward as your left arm swings toward the right toes. You should continue to maintain contact with the floor through your left "sit" bone during this step.

Inability possibly reflects poor integration of right rectus femoris, sartorius, gluteus maximus, piriformis and coccygeus with left IO/TA's, iliacus, IC adductor, gluteus medius, and hamstrings.

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The ability to perform level five of this test of this test requires one to advance their right leg forward as the left arm swings toward the right toes, while maintaining contact with the floor through the left sit bone.

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This requires and reflects the ability to integrate the right rectus femoris, sartorius, gluteus maximus, piriformis and coccygeus with the left IO/TA's, iliacus, ischiocondylar adductor, gluteus medius, and hamstrings.

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Level Five Supportive Recommendations:

Long Seated Supported Press Down with Right Iliacus and Psoas
(Long Seated Integration #4)

Paraspinal Release with Left Hamstrings
(Long Seated Integration #7)

Long Seated Supported Press Down with Abdominals
(Long Seated Integration #8)

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LONG SEATED TENSEGRITY AND TENSION

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Our positional sense of our location between the two sides of our body, is not better appreciated by our sensory and motor cortex, than it is through crawling on hands and knees or moving forward in the long seated position.

Both the pisiform and patella sesamoids in an all four position, and the ischial and calcaneus tuberosities in a long seated position, provide controlled centering of the sternum and sacrum.

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All Four Right AIC Pelvic Floor Respiratory Crawl
(All Four Integration #14)

4. At the end of inhalation, your right hand and right knee should be close to each other as your trunk remains sidebent to the left.
5. Begin to exhale through your nose as you move your right hand forward and your left knee forward as you continue to move and orient your body to your left or the counterclockwise direction.
6. At the end of exhalation, pause 4 to 5 seconds and repeat sequence 4 more times.

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The all four position allows equalization of body mass through the flexed hips and flexed shoulders to sequence sensory motor skills used for upper extremity 'reach in all fours, for shift sense'. *(Human Evolution course)*

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The long seated position allows equalization of body mass through the flexed hips and flexed shoulders to sequence sensory motor skills used for lower extremity reach in a hemi-long seated positional state for sense of 'alternation reciprocation'. (*Walking backwards downstairs - Human Evolution course*)

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The Postural Restoration Institute® offers many techniques that incorporate referencing of the ischial and calcaneal tuberosity for sensory motor awareness of their left tuberosities, and for right sided advancement on and through a pivotal point of reference referred to as the left ischial tuberosity and left calcaneal tuberosity.

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These tuberosities, especially on the left side of our body, allow the safe and appropriate integration of concomitant activity of the hip flexors and the contralateral abdominals.

Upper trunk and cervical independence from the lower body, depends on these two tuberosity sites and this abdominal sequencing with their contralateral hip flexor, alternating function.

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"*The long seated techniques, especially with vibrational bands, on that modified unit of tensegrity, is such a great teaching tool - making us so aware of how to respectively stop and start our shifts with heels and toes.*"

– Jen Smart DPT, PRC

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Egocentric Equalizing Recommendations:

Long Seated Supported Resisted Pull Backs
(Long Seated Right Lower Trapezius and Right Tricep #1)

Long Seated Supported Resisted Pull Backs with Bilateral HG ER
(Long Seated Right Lower Trapezius and Right Tricep #2)

Long Seated Supported Resisted Alternating Pull Backs
(Long Seated Right Lower Trapezius and Right Tricep #3)

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Egocentric Equalizing Recommendations:

Long Seated Supported Resisted Single Arm Pull Back with Left Ischiocondylar Adductor
(Long Seated Integration #3)

Decline Retro Walking
(Standing Integration #115)

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Our body is a structural system of isolated components that operate under compression through continuous tension, and arranged in such a way that the compressed members (legs and arms) do not touch each other, while the pre-stressed 'tensioned' hamstrings, lower trapezius and triceps delineate and equalize the system spatially.

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This tensional integrity, or tensegrity, of the ‘floating” thoracic – abdominal structure requires cortical and thalamic sense of clavicular-sternal and ilium-sacrum compression.

The orientation of sacral promontory and sternal manubrial location is provided by points of reference that are easily synchronized when in an ‘all four’ or ‘long seated’ position.

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Many dissociation syndromes can be related to this mal-tensegrity. Dissociation may represent a functional dysconnectivity. This research article reports that the high dissociators had a significantly lower left hemisphere excitability than right hemispheric excitability.

The neural basis of dissociation may involve a cortical asymmetry with a left hemispheric superiority or, alternatively, a lack of right hemispheric integration.

(Spitzer C, et al. Dissociation, hemispheric asymmetry, and dysfunction of hemispheric interaction: A transcranial magnetic stimulation approach. J Neuropsychiatry Clin Neurosci. 2004;16:2.)

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Right cortical hemispheric integration with left cortical hemispheric sensory motor activity reduces “disruption in the usually integrated functions of consciousness, memory, identity, and perception of the environment.”

(American Psychiatric Association. (1994). Diagnostic and statistical manual of mental disorders (4th ed.). American Psychiatric Publishing, Inc.)

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The long-seated position offers a more stable, controlled experience of hemi-spatial and hemi-cortical multisensory integration, for non-dominate lateralized awareness of perception, proprioception, interoception and vestibular input. Our body memory is built off and around this multisensory integration.

(Riva G. The neuroscience of body memory: From the self through the space to the others. Cortex. 2018 Jul;104:241-260.)

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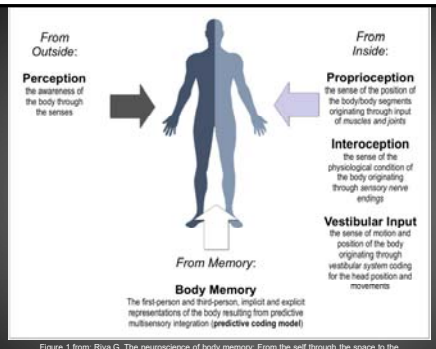

Figure 1 from: Riva G. The neuroscience of body memory: From the self through the space to the others. Cortex. 2018 Jul;104:241-260.)
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LONG SEATED, LONG FLOOR IMPLICATIONS ON THE ONTOGENETIC DEVELOPMENT OF UPRIGHT BODY MEMORY

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The stages and transitions that a human experiences and processes, from the early conception of heel sense and its relationship to the ischial seats, and the growing guidance provided by the sesamoid bones (patella and pisiform) for upright balanced standing and forward locomotor movement, is referred to as human ontogeny.

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Ontogenetic processes are involved in growth and development from the moment we sit up. The analysis of the development of childhood body representation is important for understanding the role body memory plays in different cognitive functions. Body use and processes of functional representations develop slowly and in a fragmented manner, reaching maturity at the age of 10 to 11.

(Cowie D, et al. The development of multisensory body representation and awareness continues to 10 years of age: Evidence from the rubber hand illusion. J of Experimental Child Psychology. 2016;142:230-238.)

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Anytime after this maturity age of 11, the long-seated position could be implemented to re-direct and re-establish cortical and midbrain frequencies for better sense of appropriate location of ‘self’ and body center of mass.

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It's really all about our sense of center of mass (posture) and thresholds of synchronized (patterned) cortical and midbrain thresholds of network frequency activity, that is assimilated to change, challenge or design shape.

These thresholds, built off of these tuberosity functions, are associated with synchronized three-dimensional effort to remain in acceptable positional control, for both physical alternation and physiological respiration.

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The brain may learn to discriminate between different frequencies (especially gamma oscillation) because of a process called synaptic plasticity, that allows connections between neurons to change with experience provided by the calcaneal and ischial tuberosities.

(Jirakittayakorn N, et al. Brain responses to 40-Hz binaural beat and effects on emotion and memory. International J of Psychophysiology. 2017 Oct;120:96-107.)

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Individuals have an innate superiority or habitual propensity for processing information with one or the other cerebral hemisphere, more or less independent of situation demands.

This is referred to as 'hemisphericity'.

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Regardless if one truly is operating in a more analytical, logical, sequential manner through use of the left hemisphere, or operating in a more wholistic, intuitive, simultaneous manner, the calcaneal and ischial tuberosities, when used operatively for forward locomotor alternating movement, should help provide the sense to balance hemisphericity.

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PRESSURE OFFLOADING AND ARM REACHING

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The Hruska Alternating Reciprocal Rotation Test and PRI Long Seated non-manual techniques are, and have always been, designed around pressure management as related to forward and lateral positioning necessary for cortical mapping and synchronized synapse of kinesthetic behavior.

I have learned a great deal from individuals whom have non-traumatic spinal cord issues, traumatic spinal cord issues and partial spinal cord injuries.

I have put programs together for those who have developed and were developing ischial pressure ulcers secondary to other contributing dysfunction and disease.

Both of these categories of people with SCI and non-SCI, have contributed to my deep sense and appreciation for pressure relief and for contralateral sense of load and lift.

To appreciate true trunk location and function during forward advancement of our body, ischial pressure offloading needs to send signals to our motor cortex and midbrain relay centers for reciprocal inhibition that is provided by our central pattern generators (CPGs) of our thoracic and lumbar spine, where they are located.

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Reaching forward with an upper extremity as the contralateral lower extremity reaches forward, accentuates this behavior and empowers the shift of body mass through trunk rotary feed forward direction.

In other words, our pressures inside of us, under us and around us are controlled and managed by our thoracic-abdominal rotation abilities and limitations.

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Our thoracic rotation function, or lack of, is designed, patterned and positioned by the accompaniment of hetero arm and leg reach.

Furthermore, our hypothalamus and baroreceptors receive information from sites of our body that are designed to help us sense our anti-gravity body position upon early forward advancement of ones self.

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The baroreceptors are located just below the midbrain and thus are at an advantageous position to monitor and safeguard blood pressure and flow to the brain and intracranial system.

(Petersen LG, Ogoh S. Gravity, intracranial pressure, and cerebral autoregulation. Physiological Reports. 2019;7(6):e14039.)

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Our sense of gravitational induced pressure exists “especially at two locations: The buttocks (below) the ischial tuberosities and the foot (below the heel). Pressure ulcers develop at sites where relief provided through alternation of contact is reduced.

(Luboz V, et al. Biomechanical modeling to prevent soft tissues pressure ulcers. J Biomech. 2014 Jul;47(10):2331-6.)

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To relieve pressure at the ischial tuberosity region, or to sense load on the opposite ischial site, one has to move the upper thorax forward on the side ‘sense of load’ is desired. This forward movement of the thorax is enhanced through arm and scapula ipsilateral forward reach.

We pivot and position ourselves around our ischial tuberosities and posterior calcaneal tuberosities, for cortical reference of “load” and “unload”.

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The SCI research and associated science, provides a plethora of statistical-significant corollaries on this topic. One research article in particular, addressed the relationship between arm reaching, trunk function and strength, and off loading of ischial tuberosities.

(Gabison S, et al. Trunk function and ischial pressure offloading in individuals with spinal cord injury. J Spinal Cord Med. 2017 Nov;40(6):723-732.)

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Participants in this study who were able to engage in the multidirectional reach test were defined as “Reachers”, whereas individuals who were unable to engage in the multidirectional reach test were defined as “Non-Reachers”.

Trunk strength was significantly higher in Reachers compared with Non-Reachers. ($P < 0.05$).

(Gabison S, et al. Trunk function and ischial pressure offloading in individuals with spinal cord injury. J Spinal Cord Med. 2017 Nov;40(6):723-732.)

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Offloading times over the left and right ischial tuberosities were lower in Non-Reachers when compared with Reachers.

However, the results were statistically significant only for the right ischial tuberosity.

(Gabison S, et al. Trunk function and ischial pressure offloading in individuals with spinal cord injury. J Spinal Cord Med. 2017 Nov;40(6):723-732.)

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(A good reflection of the biased mass distribution to the right in humans, and how arm swing and reach disrupts the patterned ischial load on the right ischial seat in sitting.)

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Gabison also found that there exists a "significant difference" between walkers and wheelchair users for strength measures. But not for "multidirectional reach distance". Left and right sided reaches increased in wheelchair users only.

(Gabison S, et al. Trunk strength and function using the multidirectional reach distance in individuals with non-traumatic spinal cord injury. J Spinal Cord Med. 2014 Sep;37(5):537-547.)

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Significant associations between changes in hip strength, trunk strength, and reach distance were found between the two activities.

(Reciprocal forward and backward arm reaching, performed in a sagittal plane, while sitting on a wheelchair significantly influenced strength parameters of the hip and trunk strength and range of movement of the arms.)

(Gabison S, et al. Trunk strength and function using the multidirectional reach distance in individuals with non-traumatic spinal cord injury. J Spinal Cord Med. 2014 Sep;37(5):537-547.)

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MIDBRAIN LIMB CONTROL DURING REACHING MOVEMENTS

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The structure in the rostral midbrain that is involved in movement and motor control and interlimb coordinated reaching, is the red nucleus.

It connects with the cerebellum, cerebral cortex and the spinal cord. It participates in maintenance of muscle tone.

(Waitzman DM, Oliver DL. In: Encyclopedia of the Human Brain, 2002.)

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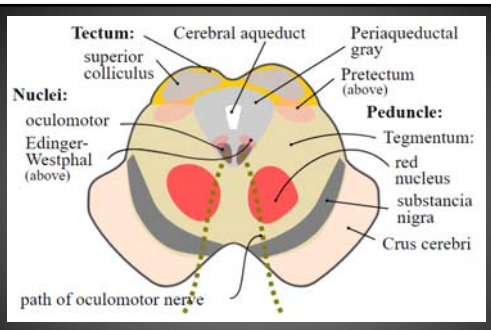

Image available at https://en.wikipedia.org/wiki/Red_nucleus#/media/File:Cn3nucleus-en.svg
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The red nucleus and substantial nigra are subcortical centers of the extrapyramidal motor system. The majority of its axons do not project to the spinal cord but, via its parvocellular part, relay information from the motor cortex to the cerebellum through the inferior olivary complex (rubrospinal tract), an important relay center in the medulla.

(Walter BL, Shaikh AG. In: Encyclopedia of the Neurological Sciences, 2nd Ed., 2014.)

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It plays a primary role in the motor control of the upper arm and shoulder. Crawling of babies is controlled by the red nucleus, as is arm swing in typical walking.

(Lesions of the red nucleus usually result in contralateral tremor, ataxia, choreiform movement, resting Parkinson-like tremors, oculopalatal myoclonus or pendular vertical oscillations of the eyes and palate.)

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This possibly explains why reaching with arms and legs, in anti-phases of motor coordination, in a long seated position, is often clinically seen in patients who want to calm and regulate muscle tone.

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Its participation in speech production, pain processing, sensory discrimination and completing complex tasks has been demonstrated by functional magnetic resonance imagery (fMRI) studies conducted over the past 20 years.

These functionalities have therefore attributed the red nucleus with execution of learned behavior.

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SUGGESTIONS FOR INDIVIDUALS WHO CANNOT LONG SIT

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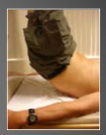
All Four Belly Lift Walk
(All Four Integration #5)



Dorsal Thoracic Inhibition
(Supine Paravertebral Inhibition #2)

Long Sitting
(Long Seated Integration #1)

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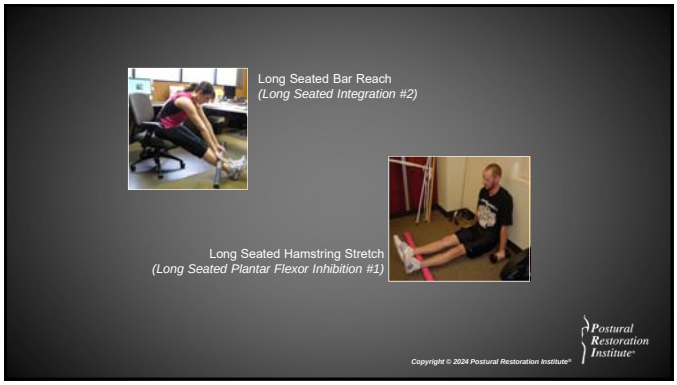
Long Seated Bar Reach
(Long Seated Integration #2)
Long Seated Hamstring Stretch
(Long Seated Plantar Flexor Inhibition #1)
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Thank you for joining us and for your genuine interest in these functional tests, that were created by Ron Hruska.
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