Axial Elongation & Core Control

Anatomy & Physiology

**Skeletal**  
Kyphosis-Lordosis, Sway Back, Flat Back

**Cervical Spine**  
Atlas, Axis, C3-C7

**Thoracic Spine**  
- see breathing principle

**Lumbar Spine**  
Facet (superior and inferior), Spinous Process, Transverse Process, Body, Disc

**Annulus** - Outer shell provides strength and stability to disc

**Nucleus Pulpus** - Jelly-like center, provides distribution of forces between vertebrae

**Pelvis**  
Sacrum, Coccyx, Iliac Crest, Pubic Symphysis, Ischial Tuberosities, ASIS, PSIS

**Muscular**

**Cervical Musculature - Short lever neck flexors** - Rectus Capitus Anterior and Lateralis, Longus Capitus; **Long lever Flexors** -Longus Capitus; Long lever Flexors - Sternocleidomastoid, Scalenes

**Suboccipital Muscles** - Rectus Capitus Posterior, Oblique Capitus Superior and Inferior

**Trunk Musculature** Rectus Abdominus, External & Internal Obliques, Transverse Abdominus, Erector Spinae, Latissimus Dorsi, Quadratus Lumborum, Mutifidus, Rotators, Psoas (Stabilizer)

**Pelvic Floor Musculature** - Cocygeus, Illiococygeus, Pubococygeus, Pubo-Analis

**Inert Structures** Rectus Sheath - Thoracolumbar Fascia, Ligaments of the spine and pelvis
**Biomechanics & Kinesiology**

**The Intervertebral Disc**
Function as a shock absorber. Axial Elongations places vertebrae in optimal position, minimizing destructive forces to the disc.
Weight-bearing increases compressive forces on disc
Compression/decompression necessary for disc health
Effect on spine flexion - Compresses anterior portion of disc, pushing nucleus posteriorly
Effect on spine extension - Compresses posterior portion of disc, pushing nucleus anteriorly

**Force Couples**
Diaphragm, Transverse Abdominus, Pelvic Floor, Multifidus
*Often referred to as:* Inner Unit (Andry Vleeming), Hydraulic Amplifier, Cylinder of Support (Paul Hodges), not quite the same as Pilates (powerhouse)

**Muscular Slings (Andry Vleeming)**
These larger muscle groups & their fascial connections move trunk & limbs creating everyday functional movements. As internal or external load is increased, so increases demand for core control.
These musculo-fascial systems play crucial role in movement as well providing stability & protection for inner, stabilizing muscles & joints

1. **AOS (Anterior Oblique System)** - External Obliques, Contralateral internal Oblique, Contralateral Adductors
   The AOS significantly contributes to force closure of pubic symphysis & sacroiliac joint.
   In some cases, the fibers of muscles cross the pubic symphysis & blend w/ fibers of the other muscle.

2. **POS (Posterior Oblique System)** - Latissimus dorsi, Thoracolumbar fascia, contralateral gluteus maximus
   The POS significantly contributes to force closure of the sacroiliac joint, and is a significant contributor to load transference through the pelvic girdle during rotational activities and during gait.
   The fibers of these two muscles are directly in line with each other, and perpendicular to the sacroiliac joint, giving external support.

3. **DLS (Deep Longitudinal System)** - Erector spinae, sacrotuberous ligament (& multifidus), biceps femoris, peroneus longus, anterior tibialis
   The DLS is affected whenever foot is on the ground. The DLS uses thoracolumbar fascia & erector spinae system to transmit kinetic energy above the pelvis, while using the biceps femoris to communicate between pelvis & lower extremities

4. **LS (Lateral System)** - Gluteus medius & minimus, contralateral adductors, contralateral quadratus lumborum
   These muscles provide essential frontal plane stability. Although these muscles are not directly involved in force closure of the SIJ, they are significant for the function of the pelvic girdle during standing and walking

**Neutral Spine** - Position of spine where every joint is in optimal position to allow for equal distribution of force through entire structure.
Stability: The appropriate amount of stiffness for the anticipated load. A healthy spine requires there to be a balance between stability & mobility, facilitated by neural control of those structures.

**Panjabi’s Model for Stability (1992)**

**Inert Structures** - Bone, Ligament, Fascia, Disc

**Contractile Structures** - Muscles

**Motor Control** - Neuromuscular system Feedback & Feedforward mechanisms
Motor Control

The Neutral Zone The Neutral Zone is defined by Panjabi as "a measure of spinal laxity in the vicinity of the neutral position". Abnormal increase in size of neutral zone leads to pain by producing strain on surrounding supportive passive tissues. Muscular factors are essential components of maintaining neutral zone w/in normal limits, thus providing stability for intervertebral joint. The multifidus is most important muscular factor in increasing stability of the motion segment, providing greater than 2/3 of the stiffness increase in L4-5 segments.

Normal Organization Proper Axial Elongation and Core Control give us greatest strategic potential for successful movement.

Axial Elongations Provides an optimal environment for segmental movement of spine preventing compressive & shear forces that my cause spine pathology.

Core Control Inner Unit muscles engaged "As much as necessary, as little as possible" pertains to stiffness & load Muscular slings engaged if dictated by the movement.

Normal Organization

Multifidus Proprioception plays an important role in spine stability. Lumbar tissues provide important proprioceptive feedback. Deep intersegmental muscles of spine have up to 6X more muscle spindle fiber than their superficial counterparts. (Bogduk & Twomey, 1991)

Transverse Abdominus Contributes to increased intra-abdominal pressure (IAP) In healthy people, TA works at sub-maximal levels during low-level activity In healthy people, TA fires in anticipation of movement.

Pelvic Floor The PF muscles are synergistic with the TA.

Faulty Organization

Where do these over-recruitment strategies come from?

The appropriate amount of Stiffness for the anticipated load

Neurological excitation Over-recruitment (guarding) of the global muscles; Over anticipation of load (often strategic for fear-avoidance)

Neurological inhibition Pain inhibition of intrinsic muscles Reciprocal inhibition caused by over-recruitment of antagonist.

Excessive stiffness vs. excessive movement "Movement takes the path of least resistance" (Shirley Sahrmann) Increased degree of movement at most flexible segment.

Hodges & Richardson, Spine 1996 Subjects: 15 controls & 15 LBP patients Method: EMG of rapid shoulder flexion, abduction and extension

Results: TA first muscle activity and not influenced by movement direction Conclusion: Delayed TA indicates a deficit of motor control in trunk muscles of LBP.

Other possible causes for faulty organization

Genetic predisposition Scoliosis, leg length discrepancy, other skeletal anomalies

Habitual patterns Work postures, sport postures, repetitive activities

Compensatory patterns Normal motor control strategies Pathological motor control strategies Fear-avoidance motor control strategies

Acquisition of new or correct movement By facilitating awareness of optimal alignment we can decrease stresses to compromised structures of body. Improved postural awareness in both static & dynamic postures.
Bio-Energetics
Kundalini Axial Elongation opens the pathway of Kundalini energy and allows it to flow. Kundalini energy is considered the thread between man and God. The energy flows from the root, (between the rectum and genitals) upwards exiting the top of the head. En route, the energy enlivens and passes through all the chakras (energetic centers).
Hara The activity of pelvic musculature during axial elongation stimulates the Hara, the source of life energy. Stimulation of the Hara supports well being on all levels and helps prevent premature depletion reflected in symptoms such as incontinence and prolapse of pelvic organs.

Practical Application of Axial Elongation: Improved postural alignment improved efficiency of movement decreased risk of injury

Core Control Neutral or "optimal"spine The appropriate amount of stiffness for the anticipated load.

Cueing for Successful Movement
Verbal Draw pelvic floor up toward posterior-superior part of your head
Move in the longest possible arc
Draw ischiums toward each other w/ inside muscles (no change in glut's,hamstrings, or adductors).
Draw navel in and up toward back of the waist
Lengthen through posterior/superior aspect of the head
Move your gaze until it is horizontal with floor if in vertical orientation or with the wall if in a horizontal orientation

Tactile
Ischium, Crown of the head, Guiding the scapulae down the back, Stroking from the lower abdominal mm. up toward the lower ribs, Hands drawing the sub occipital region superiorly/axially

Imagery
Imagine or feel area at base of pelvis moving up along front of spine out through top of head
Imagine a string of pearls being pulled upwardly from the pelvic floor up through top of head

In Pelvic Neutral: Tighten the abdominal muscles as if to tighten the skin on the head of drum w/out distorting the frame of the drum

In Flexion: Zip up from pubic bone to navel as if zipping up a pair of pants; Pretend that there is a ball of energy hollowing and lengthening the abdominal mm while flexing the spine: Concentrically and Eccentrically

In Extension: Take sternum up toward ceiling while funneling lower rib cage down toward pelvis

In Lateral Flexion
Make the longest possible C-curve from hip to top of head
Inhale into lung closest to ceiling as if reaching that lung to the ceiling
While bending sideways, imagine that your ribs are like a fan being opened toward the ceiling

Mat: Dead Bugs, Femur Arc and Quadruped