INTRODUCTION FOR AXIAL TRI-PLANAR MECHANICS

During this course we are going to discuss how the body manages loads through the axial frame, how muscles organize for core strength through the thoraco-abdominal and lumbo-pelvic femoral complexes, and how to identify the position of various body segments in movement. In order to do this effectively we need to understand movement terminology and will discuss families of muscles related to their planes of control.

Movement terminology is based upon the spatial orientation of three planes:

1. Sagittal plane – passes through and divides the body into two halves.
   - Movement in this plane includes forward and backward movements - flexion, extension, hyperextension, dorsiflexion, plantarflexion, protraction, retraction.
2. Frontal – passes through the body dividing it into front to back portions.
   - Movement in this plane includes deviations side to side and sideward movements – abduction/upward rotation, adduction/downward rotation, lateral flexion.
   - Movement in the frontal plane also includes elevation and depression, as vertical movements will happen in the frontal plane
3. Transverse plane – passes through and divides into top and bottom portions.
   - Movements include horizontal and rotational motions – medial/internal/inward rotation, lateral/external/outward rotation, left rotation, right rotation, horizontal abduction, and horizontal adduction.

Movement occurs around an imaginary axis that passes through a joint. Spatial organization is always happening in three planes and where the three planes intersect is how the center of mass (COM) and gravity line affect where the axis of motion will be and where load or forces will be applied.

- We can change our COM by manipulating how our body organizes in one plane, two planes, or all three.
- Changing and orienting our COM influences position and postural organization three dimensionally.
- We can change our COM by inducing new inputs and organizing loads and muscles differently, including giving clients new cues or new reference centers to help change their spatial orientation.

An athletic body in balance requires good tri-planar management of position, good use of the ground, and good spatial orientation. When you create training programs, you want to make sure you are strategically arranging loads to facilitate adaptation for an athletic body in balance. In order to do so, you need to be aware of how to effectively evaluate 3 planes of motion, as well as how to pick, choose, and arrange exercises to support balanced development.
An athletic body in balance also requires an understanding of asymmetrical form and function. PRI provides you with a framework to understanding how human asymmetry affects functional performance which verifies great value in injury management and prevention.

- Training symmetrical sagittal plane exercise on an axial frame that cannot achieve a zone to symmetrically breath, rest or rotate will create erroneous and dysynchronous patterns of adaptation which includes excessive muscle tension
  - The excessive muscle tension is neurological tension created from neuromotor instabilities and compensatory hyperactivity in the accessory muscles of respiration and at the appendicular flexors and axial extensors.

The limited functional patterns we can identify through PRI tests are created by poor tri-planar management of position, poor use of the ground, and poor spatial orientation. Limited functional patterns around the axial frame add stress, strain, and poor loading patterns leading to impingement or instability patterns.

Alignment of various body segments is related to the task, environment, and the body segment’s relationship to gravity. Inadequate position of body segments will cause function to be limited because soft tissue and osseous restrictions preventing one from using muscles and joints in their normal range.

- Regardless if good position is respected, our brains and bodies find a way to get the job done and will create adaptation and/or compensation to take over for these limitations. This adaptation often requires neuromotor encoding and hyperactivity of muscles that are placed in improper positions which may exceed normal physiological length, or are in positions that make them a mover or counter-mover in planes and directions that are not observed when one is in a neutral or more symmetrical state of rest.

When you get good at identifying position, it will become easier to recognize when there is a loss of tri-planar balance when watching your clients move. Loss of triplanar movement may look like:

- Inability to squat with heels flat on floor
- Inability to forward bend to touch toes with knees straight
- Inability to do get a passive SLR near 90°
- Inability to internally rotate arm up back or internally rotate humerus
- Asymmetrical weight bearing/shifting while lifting in symmetrical movement patterns
- Extending or bending one knee or one elbow earlier in symmetrical movement patterns
- Asymmetry noted in movements or stability when comparing two halves of the body

Training programs can include exercises within all three planes of motion and they can be applied in a systematic way which the neuromuscular system – including the brain, muscles, and joints - can best handle and organize for optimal mobility, control and stability. In order to understand tri-planar management of position/posture we have to understand how muscles influence position multidimensional. For teaching purposes we are going to break muscles into groups, PRI muscle families, and discuss how they can organize various body segments and biomechanical relationships in space.