I. Some Anatomy and Terminology

A. Local system/inner unit: muscles are deep, lie close to the vertebrae and are capable of increasing spinal segmental stiffness

1. Transversus abdominis
   a. anticipatory muscle for stabilization of the low back
   b. anticipatory recruitment is absent or delayed in patients with low back pain

2. Deep lumbar multifidus
   a. anticipatory for stabilization of the lumbar region
      - recruited prior to initiation of any movement of upper extremity when the timing of the load is predictable
      - superficial and lateral fibers shown to be direction dependent

3. Pelvic floor (Diane Lee)
   a. comprised muscle groups including
      - the levator ani (puborectalis, pubococcygeus and iliococcygeus)
      - the ischiococcygeus
   b. pelvic floor can be facilitated by co-activating the abdominals and visa versa

4. Diaphragm
   a. traditionally considered to be a respiratory muscle
   b. EMG activity occurred simultaneously with the transversus abdominis
   c. amplitude of diaphragm EMG was higher in inspiration than expiration
   d. TrA was active throughout the respiratory cycle but amplitude of TrA EMG was higher during expiration.

B. Global system/outer unit

1. Larger, torque producing muscles
   a. superficial
   b. important for controlling spinal orientation and balancing external loads

2. Four slings of muscle systems which stabilize the pelvis regionally

3. Posterior oblique sling
   a. latissimus dorsi
   b. contralateral gluteus maximus
      - through the thoracodorsal fascia

4. Anterior oblique sling
   a. external oblique
   b. anterior abdominal fascia
   c. contralateral internal oblique
   d. contralateral adductors
5. Longitudinal sling
   a. peroneals
   b. biceps femoris
   c. sacrotuberous ligament
   d. deep lamina of the thoracodorsal fascia
   e. erector spinae

6. Lateral sling
   a. primary stabilizers for the hip joint
      - gluteus medius/minimus
      - tensor fascia latae
      - lateral stabilizers of the thoracopelvic region.

C. Lumbo-pelvic-hip region neutral zone of motion (Panjabi)
   1. Three systems
      • Passive system (osteoarticular/ligamentous)
      • Active system (myofascia)
      • Control system (neural)
   2. Stability (effective load transfer) is achieved when the passive, active and control systems work together
   3. Ability to effectively transfer load through the pelvis is dynamic and depends on:
      a. optimal function of the bones, joints and ligaments
      b. optimal function of the muscles and fascia
      c. appropriate neural function (motor control, emotional state)

Core stability is the ability of the lumbopelvic hip complex to prevent buckling and to return to equilibrium after perturbation. Although static elements (bone and soft tissue) contribute to some degree, core stability is predominantly maintained by the dynamic function of muscular elements.

When the central nervous system can predict the timing of the load, the local system is anticipatory when functioning optimally. In other words, these muscles should work at low levels at all times and increase their action before any further loading or motion occurs.

D. Segmental stabilization training: to protect and support the spinal segments from re-injury
   1. Re-establish and enhance muscle control to compensate for loss of segmental stiffness caused by injury or degenerative change
   2. Use therapeutic exercise program aimed at reversing the loss in the motor control of the local muscle system and to restore the normal synergy between the local and global systems
   3. Initial and pivotal focus is on retraining the co-contraction of the transversus abdominis and lumbar multifidi - muscles are activated cognitively, and as independently as possible from global muscles
   4. Once motor control of the local system is restored then training is aimed on the integration of the local and global systems
   5. Move from associative to automatic stages
      Associative: “get the idea” and then groove motor pattern with thousands of repetitions
      Automatic: decrease facilitation/feedback as client demonstrates success -move from non-functional tasks to functional/integrated ones with additional load and speed
E. McGill’s bracing
1. Strive for symmetry in endurance of core stabilizers
   a. flexors: sit in hip flexion and neutral spine. Keep 90 degrees
      at the hip and knees, with feet secured. Sit with trunk at 60
      degrees from the floor.
   b. lateral: side bridge
   c. extensors: lie prone on table with ASIS at end of table.
      Secure legs and hold with neutral spine and arms crossed in front.

II. Questions for Personal Training
A. How do I know when to cue more
B. What about rotation
   1. Mostly from thoracic
C. Mobility and stability through the chain
D. Determine the limitation to core function
   1. Is it the deep core stabilizers
   2. Is it core stability relative to other variables
      a. core stability relative to hip mobility
      b. core stability relative to hip stability
      c. core stability relative to shoulder mobility
      d. core stability relative to shoulder stability

Conclusions and Summary
A. The core is wired to fire before/with movement
B. Respect the weak link
C. What is the risk vs. benefit of the exercise

References
13. Marshall, P., Murphy, B. The validity and reliability of surface EMG to assess the neuromuscular response of the abdominal muscles to rapid limb movement.
17. Ng, J., et al. Electromyographic amplitude and frequency changes in the iliocostalis lumborum and multifidus muscles during a trunk holding test. Physical Therapy, 77 (9).

Prepared by:
Annette Lang
Annette@annttelang.com