

# GO FIT for a functional spine!!!

**Anastasia Beneka**

Professor of Physical Rehabilitation

*School of Physical Education and Sports Science*

*Democritus University of Thrace, Komotini, Greece*

# Muscle Category

- **Agonists**
  - Muscles that act as prime movers (gluteus maximus)
- **Antagonists**
  - Muscles that act in direct opposition to prime movers (psoas)
- **Synergists**
  - Muscles that assist prime movers during functional movement patterns (semimembranosus)
- **Stabilizers**
  - Muscles that support or stabilize the body while the prime movers and the synergists perform the movement patterns (transverse abdominis)



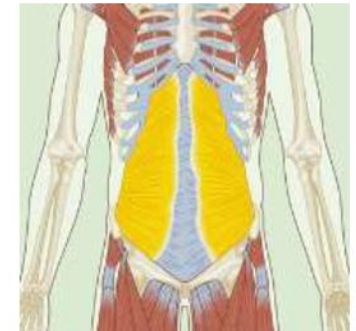
Gluteus  
maximus



Psoas

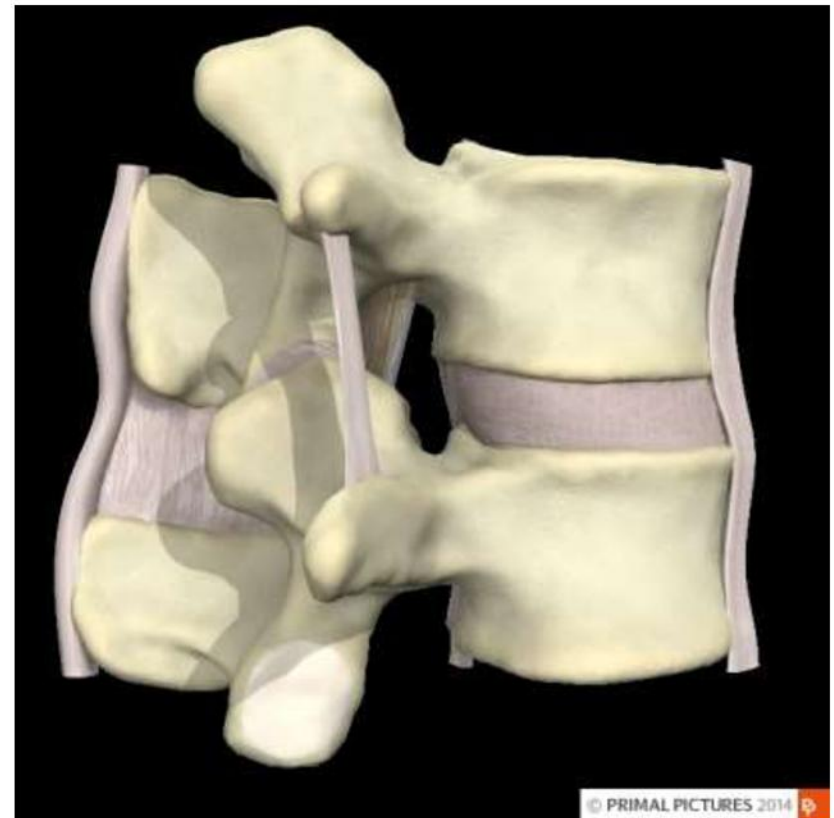


Semimembranosus

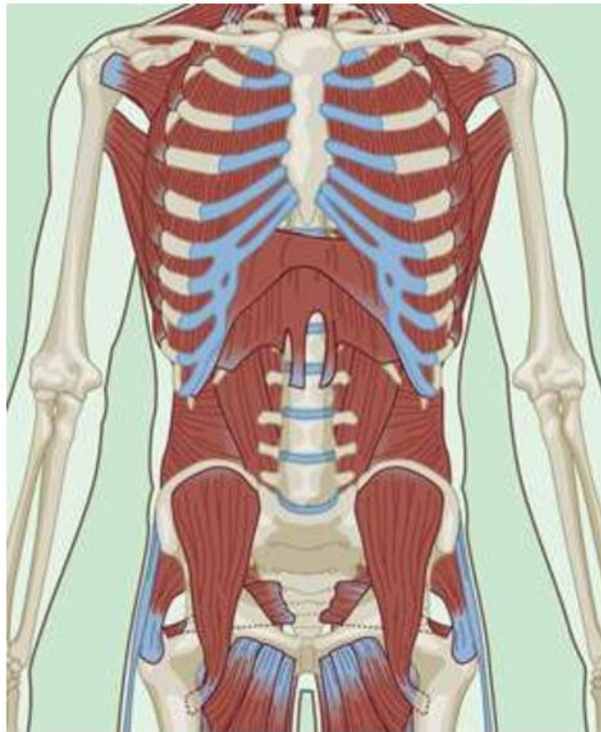


Transverse  
abdominis

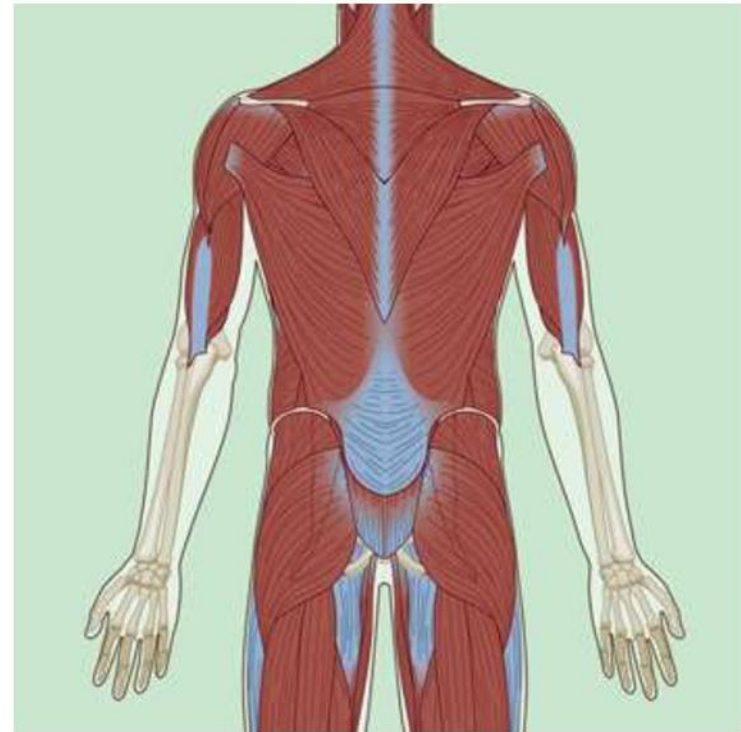
- 2 distinct and interdependent muscular systems that enable our bodies to maintain proper stabilization and ensure efficient distribution of forces for the production of movement:
  - ▣ Muscles located more centrally to the spine provide intersegmental stability
  - ▣ The more lateral muscles support the spine as a whole



# Current Concepts in Functional Movement



Local musculature system



Global musculature system

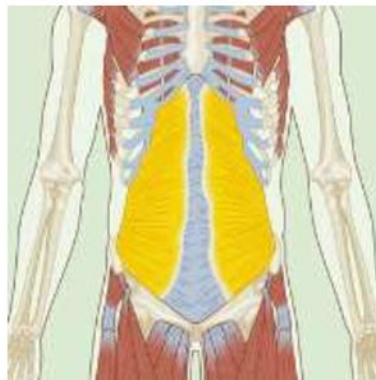


# Local Musculature System (Stabilization System)

- The local musculature system consists of muscles that are predominantly involved in joint support or stabilization, they are not movement specific, rather they provide stability to allow movement of a joint.



Rotator cuff



Transverse  
abdominus



Multifidus

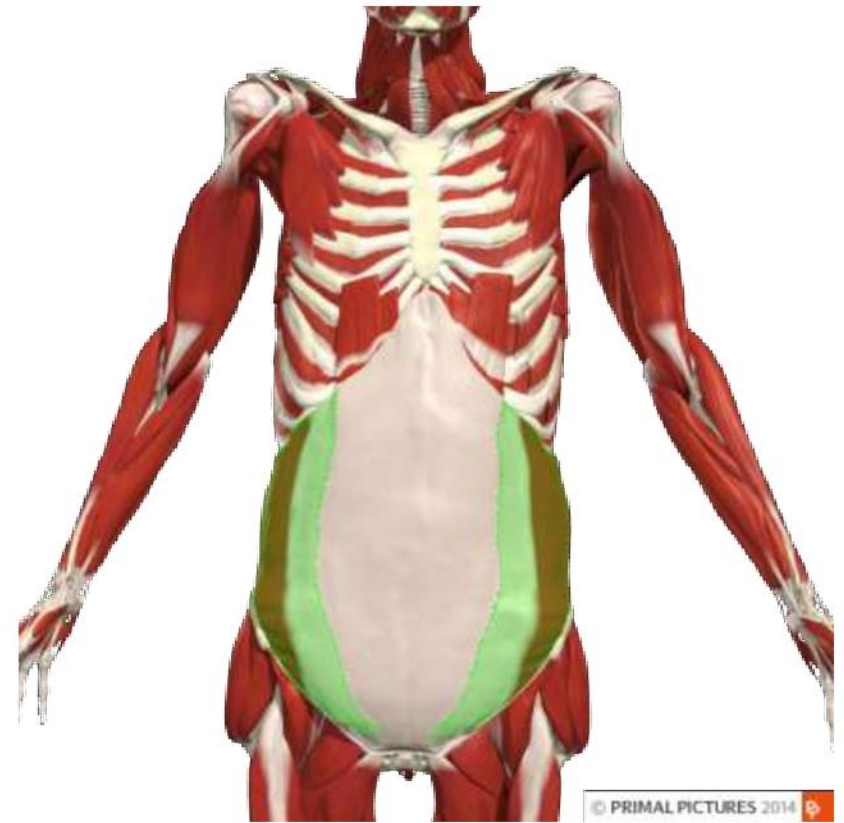


Diaphragm

# Core stabilizers: Transversus abdominis



# Core stabilizers: Multifidus – Internal Oblique

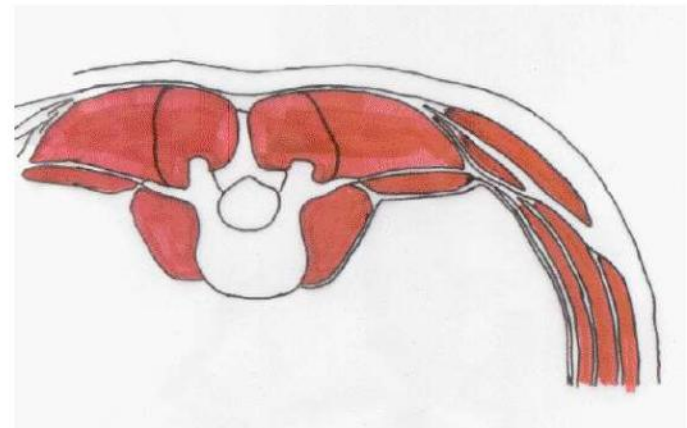
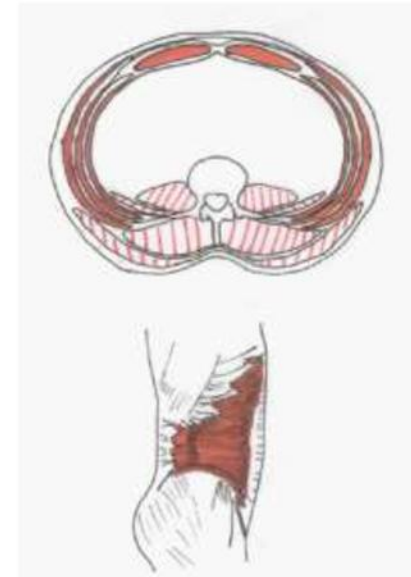




# Local/segmental Stability Muscles

## Function

- Increase muscle stiffness to control segmental translation
- No or minimal length change in function movements
- Anticipatory recruitment prior to functional loading provides protective stiffness
- Activity is continuous and independent of the direction of movement



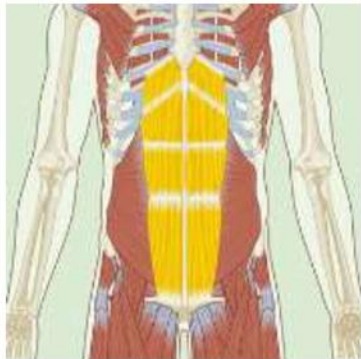
Democritus University of Thessaloniki (Gomerford & Mottram 2001)

School of Physical Education and

Sports



# Global Muscular Systems (Movement Systems) responsible for movement



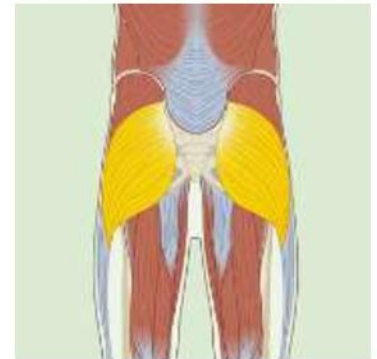
Rectus abdominis



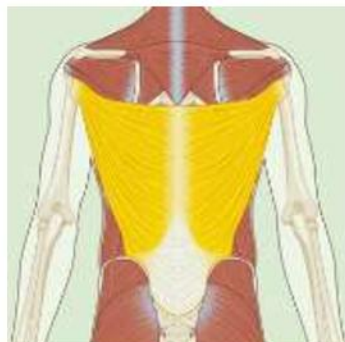
External oblique



Erector spinae



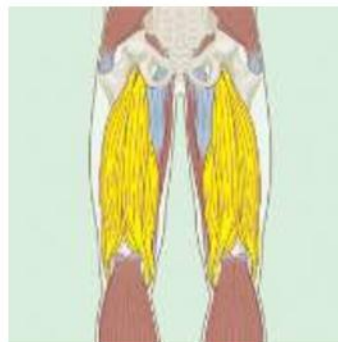
Gluteus maximus



Latissimus dorsi



Adductors



Hamstrings



Quadriceps



Gastrocnemius

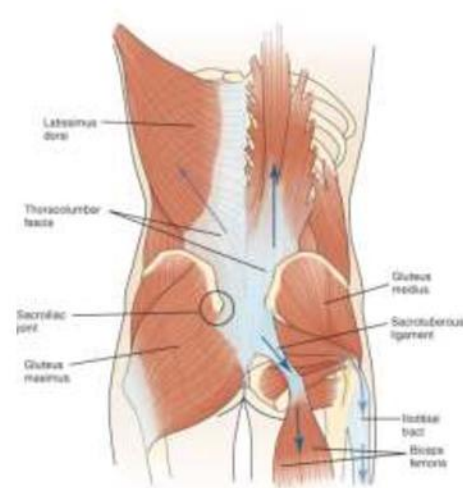
# Subsystems



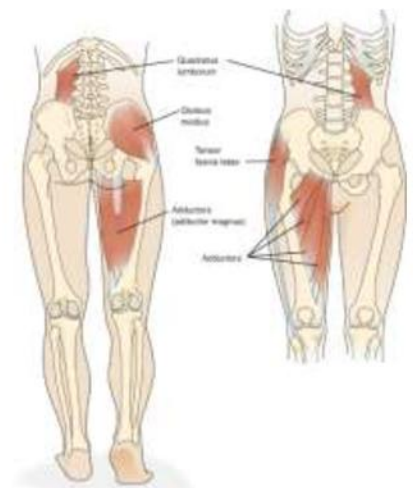
Deep longitudinal subsystem



Posterior oblique subsystem



Anterior oblique subsystem



Lateral subsystem

# Deep Longitudinal Subsystem

- Deep longitudinal subsystem
  - ▣ Erector spinae
  - ▣ Thoracolumbar fascia
  - ▣ Sacrotuberous ligament
  - ▣ Biceps femoris
- Provides force transmission longitudinally from the ground to the trunk and back down
- The dominant role of the deep longitudinal system is to control ground reaction forces during gait motions.



© Photodisc/Thinkstock



# Posterior Oblique Subsystem (Slide 1 of 2)

- ❑ Posterior oblique subsystem
  - ▣ Gluteus maximus
  - ▣ Latissimus dorsi
  - ▣ Thoracolumbar fascia
- ❑ The muscle fiber arrangements of the posterior oblique subsystem run perpendicular to the sacroiliac joint and provides transverse plane stabilization to the SI joint.



© Photodisc





## Posterior Oblique Subsystem (Slide 2 of 2)

- ❑ Dysfunction of any structure in the posterior oblique subsystem can lead to sacroiliac joint instability and low-back pain.
- ❑ The weakening of the gluteus maximus and/or latissimus dorsi can lead to increased tension in the hamstring and therefore cause reoccurring hamstring strains.

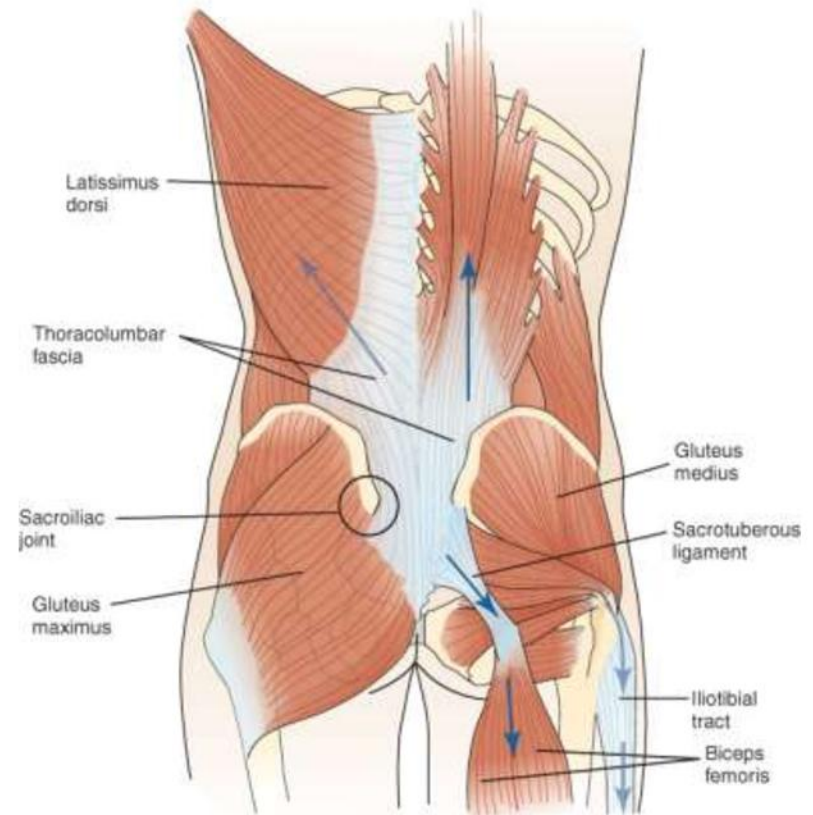


© Sebastian Kaulitzki/Shutterstock, Inc.



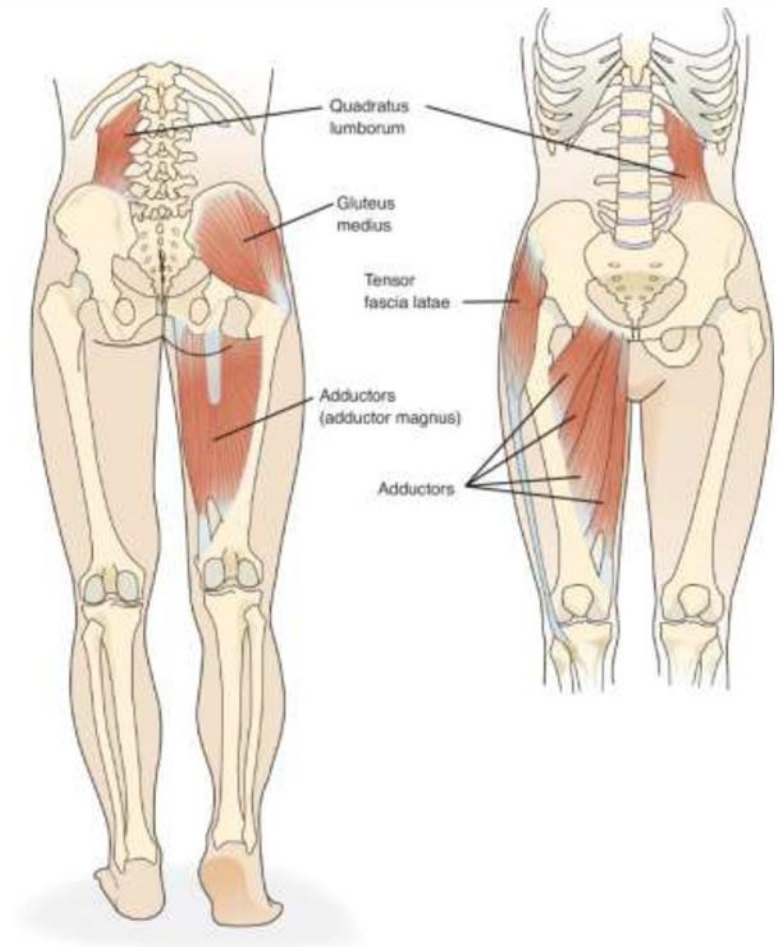
# Anterior Oblique Subsystem

- Anterior oblique subsystem
  - ▣ Internal oblique
  - ▣ External oblique
  - ▣ Adductor complex
  - ▣ External rotators
- Functions in a transverse plane orientation, mostly in the anterior portion of the body
- The obliques, in concert with the adductor complex, not only produce rotational and flexion movements, but are instrumental in stabilizing the lumbo-pelvic-hip complex.



# Lateral Subsystem

- Lateral subsystem
  - ▣ Gluteus medius
  - ▣ Tensor fascia latae
  - ▣ Adductor complex
  - ▣ Contralateral quadratus lumborum
- Implicated in frontal plane stability and is responsible for pelvo-femoral stability during single-leg functional movements such as in gait, lunges, or stair climbing



# Global muscles





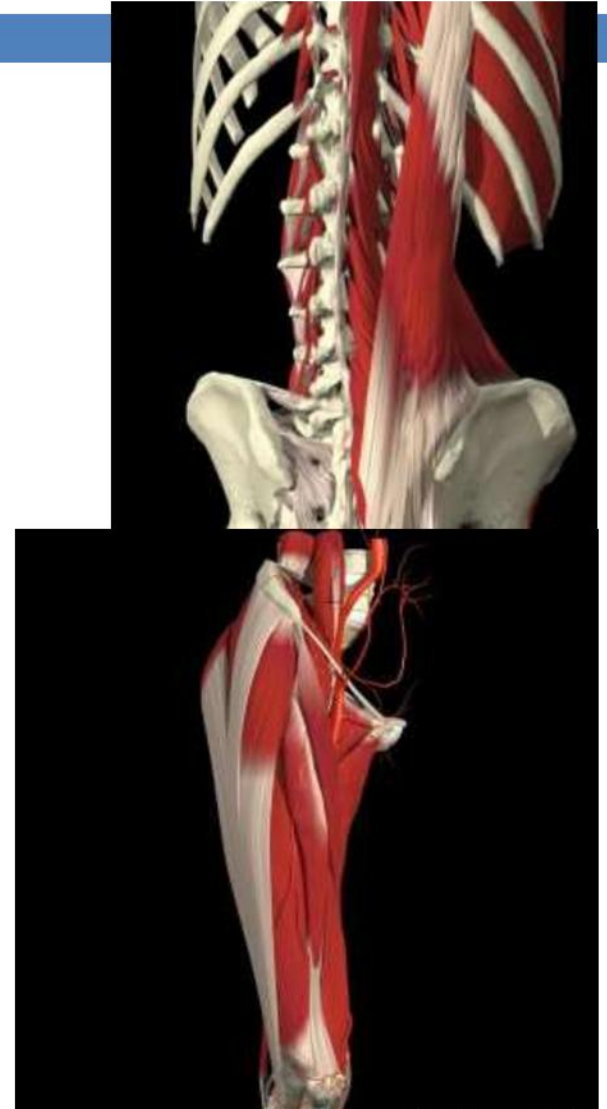
# Global Mobility Muscles

## Function

- Generates force to produce range of movement
- Concentric acceleration of movement (sagittal plane: power)
- High load shock absorption
- Activity is especially phasic (on:off pattern) and is direction dependent

*Comerford & Mottram 2001)*

Democritus University of Thrace, School of Physical Education and Sports

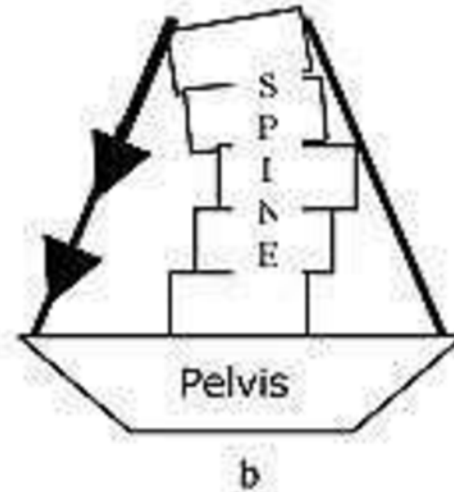
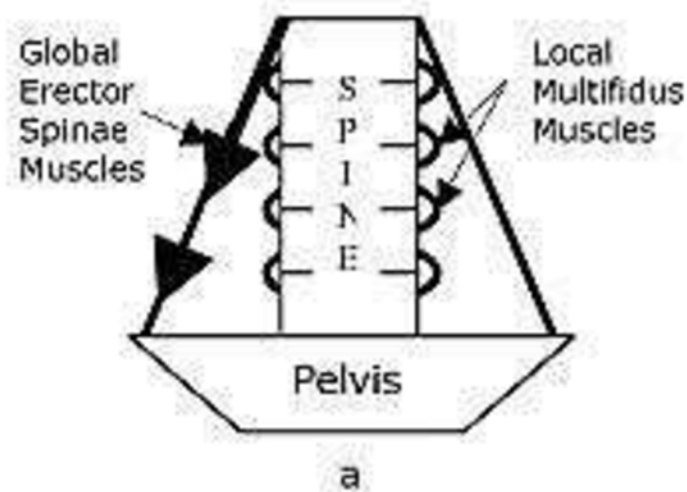


# Local stability segmental control

- The segmental stability of the spine is dependent on recruitment of the deep local stability muscles
- The spine will fail if local activity is insufficient even if the global muscles work strongly

*(Cholewicki & McGill 1996, Crisco & Panjabi 1991,  
Hoffer & Andreasson 1981)*

# For the spine the problem is...



- ❖ Coordinated action of local(segmental) and global stabilizers is needed
- ❖ If local(segmental) stabilizers don't initiate contraction the spine will be de-stabilized by global stabilizers and mobilisers

# Local Muscle System Dysfunction

There are changes in motor recruitment  
resulting in a loss of segmental control

Local inhibition



# Dysfunction in Local Stability System

- Motor control deficit associated with delayed timing or recruitment deficiency

*(Hodges & Richardson 1996)*

- Reacts to pain & pathology with inhibition

*(Stokes & Young 1984, Hides et al. 1994)*

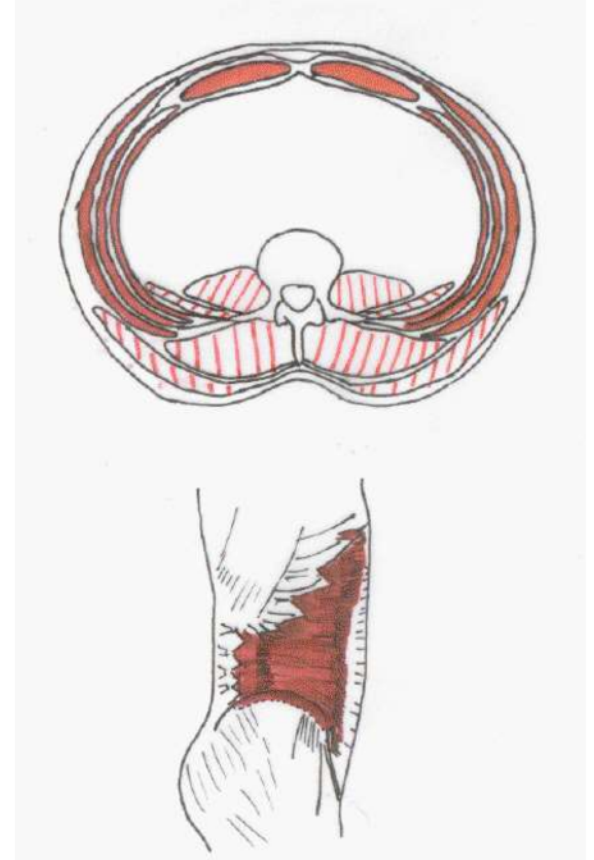
- Decrease in muscle stiffness and poor segmental control
- Loss of control of joint neutral position

# Transversus Abdominis

- Activates prior to movement of the limbs or trunk to increase stiffness and stability of the spine
- Its activity is independent of the direction of trunk movement or limb load

*(Cresswell 1992, 1994)*

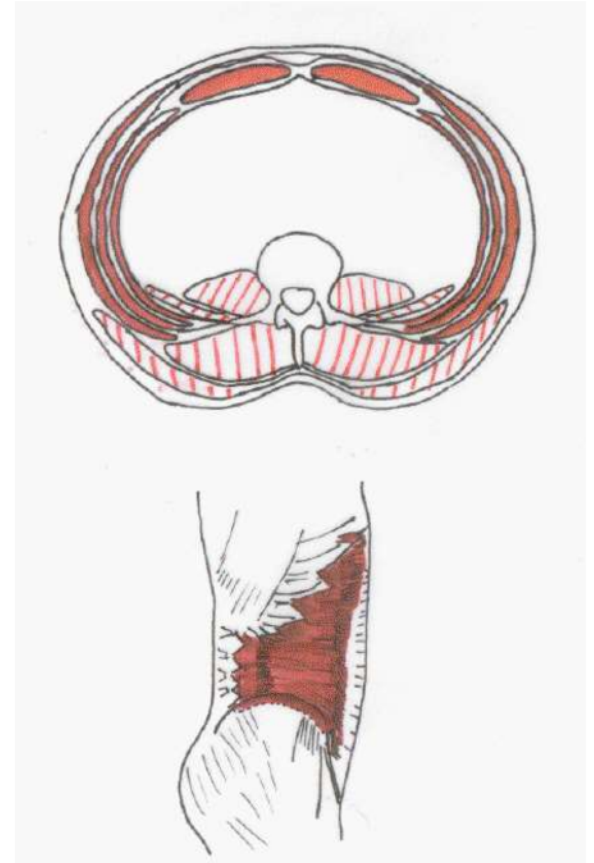
*(Hodges and Richardson 1995, 1996)*



# Transversus Abdominis

- A motor control deficit is present in subjects with low back pain
- Activation of transversus is significantly delayed
- The timing delay is independent of the type or nature of pathology

*(Hodges & Richardson 1995, 1996)*

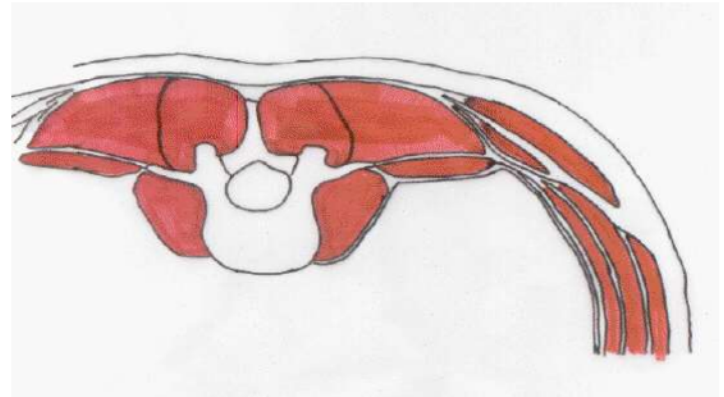


# Lumbar Multifidus

- Asymmetry of cross sectional area of multifidus in back pain subjects

*(Stokes et al. 1992)*

*(Hides et al. 1994, 1995)*



Dysfunction does not correct automatically when pain resolves & specific training can correct dysfunction and recurrence

*( Richardson et al. 1998, Hides et al. 1995, 1996)*



# Dysfunction in Global mobility System

- Myofascial shortening which limits physiological and / or accessory motion
- Overactive low load or low threshold recruitment
- Reacts to pain and pathology with spasm

# Myofascial functions...



# Dysfunction: What comes 1<sup>st</sup> ?

- Global dysfunction can precede and contribute to the development of pain & pathology
- Pain & pathology are not a necessary consequence of global dysfunction
- Local dysfunction does not precede the development of pain and pathology but rather is due to pain & pathology
- Pain & pathology do not have to be present (may be related to distant history)

# 'Motor Control' Stability versus 'Core' Stability

- **Motor control stability**
  - = low threshold recruitment of local and global stability muscle system
    - Well supported by the research literature
- **Core stability**
  - = high threshold recruitment of proximal trunk & girdle muscles

# Multifidus Muscle Recovery Is Not Automatic After Acute First Episode LBP

- Hides, Richardson, Jull. SPINE 1996:21
- Control (n=19) medical management/ activity
- Specific ex. (n=20) + med manage/ activity
- Multifidus ex. 2x/wk x 4 weeks
- Ultrasound image: smaller multifidus on painful side in all at start *(St Anna Hospital Herne Germany)*



# Results

- Multifidus CSA at most affected vertebral level painful side difference corrected in ex group but not in controls at 4 and 10 weeks.
- $P < 0.0001$  at both times
- Pain and Disability scores same in groups (pain and disability resolved at 4 wks in 90%)

# Long Term Effects of Stabilizing Exercises for First-Episode LBP

- Hides, Jull, Richardson. SPINE 2001:26
- Control(n=19) medical management/ activity
- Specific Ex(n=20) +med manage/ activity
- Multifidus ex. 2x/wk for 4 weeks

# Results

- 1 year recurrence: control=84%,  
ex.=30%
- $P < 0.001$
- 3 year recurrence: control=75%,  
~~ex.=30%~~ (3 controls lost at 3 year)

1



**A systematic review on economic evaluations investigated the cost-effectiveness of conservative treatments for non-specific neck pain and they found that therapeutic exercise was the most cost-effective therapy for non-specific neck pain patients.**

**Sometimes You Need To ...**



**Change Your Point of View**