

Development of THEWS protocol

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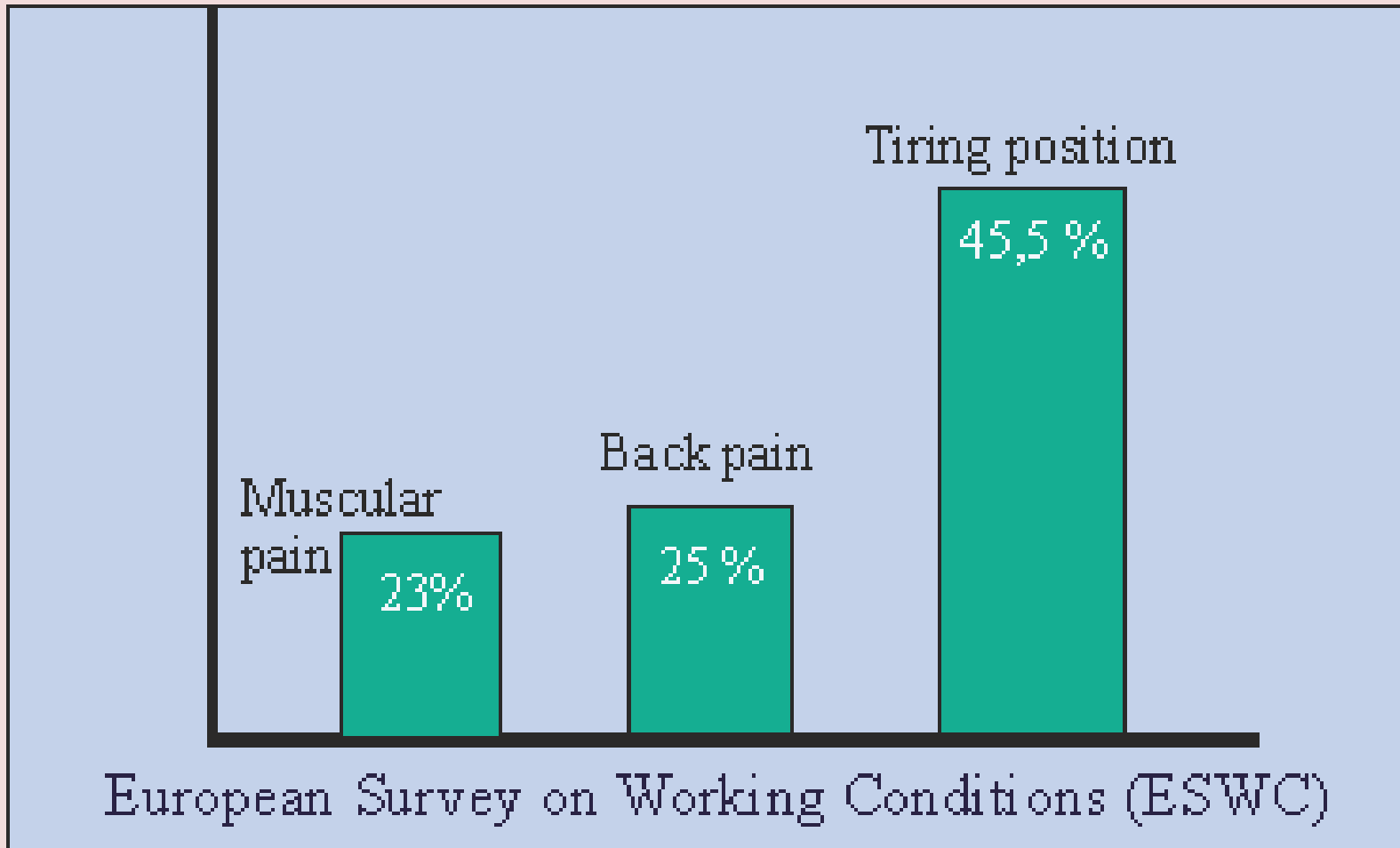
Paraskevi Malliou, *Professor DUTH*

Musculoskeletal disorders (MSDs) such as **neck/back pain** or upper limb disorders remain the most common occupational diseases in the European Union and workers in all sectors and occupations are affected.





They are also an increasing problem and one of the most important causes of long-term sickness absence.

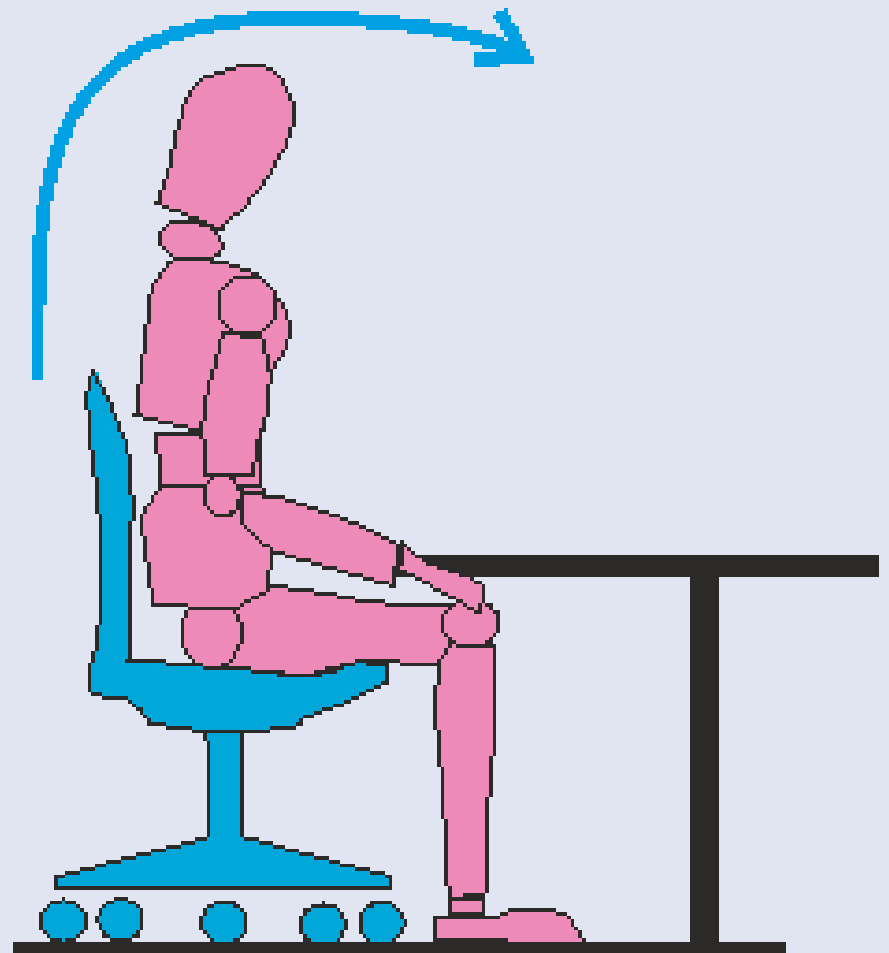
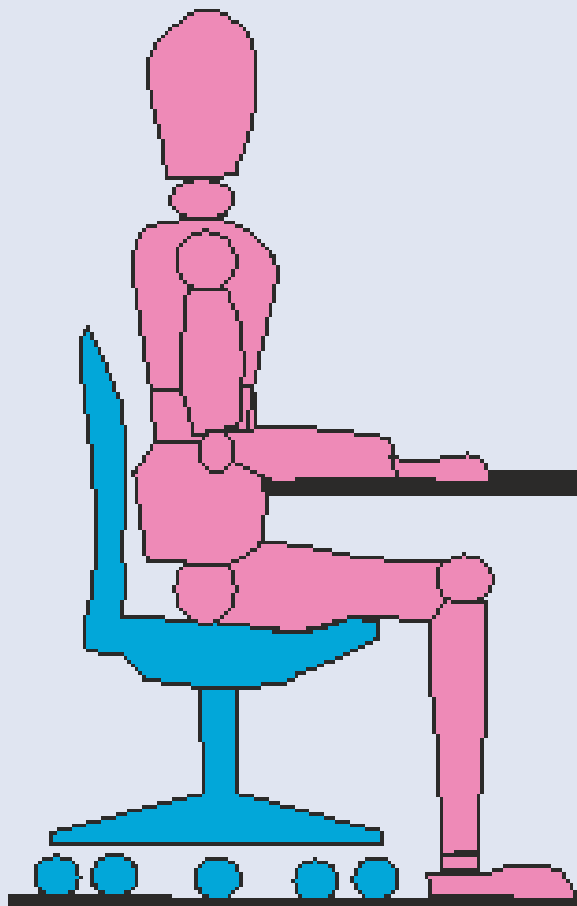


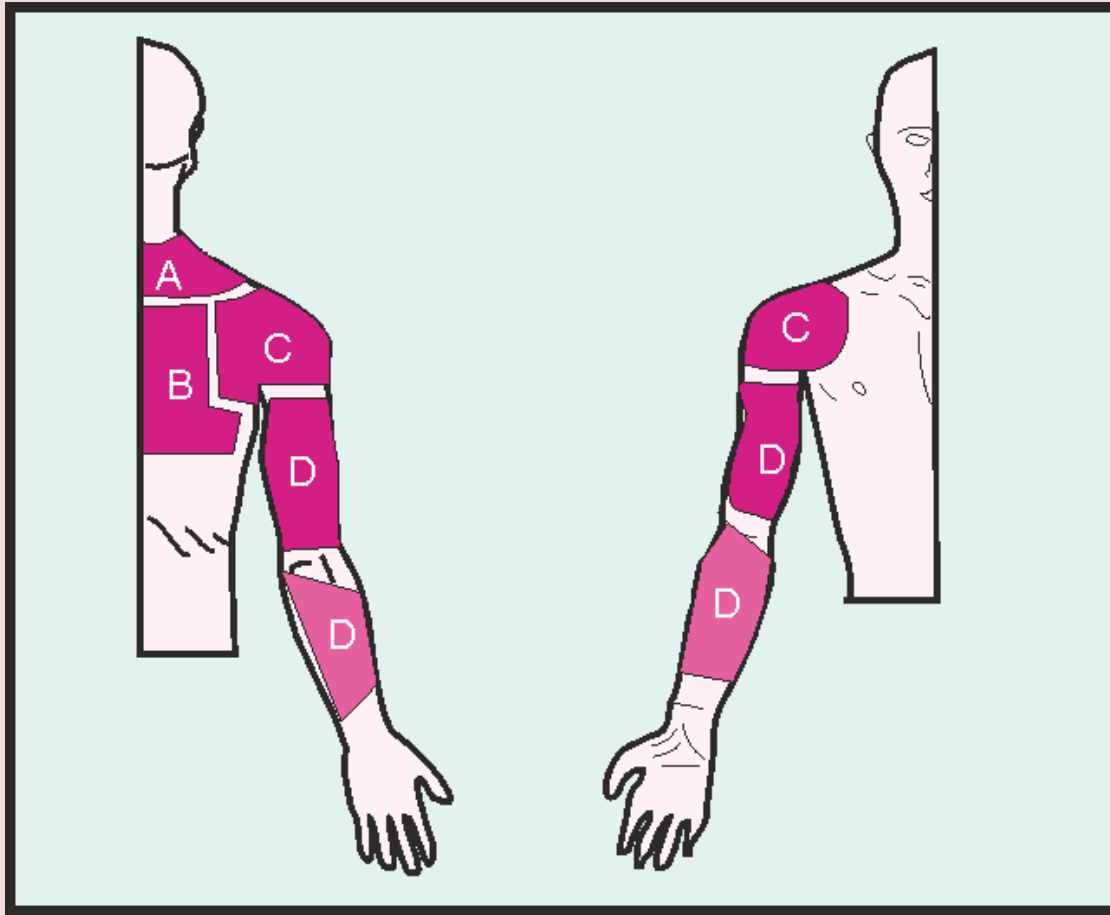
According to the latest figures of the European Survey on Working Conditions (ESWC), **24.7%** of the European workers complain of **backache**, **22.8%** of **muscular pains**, and **45.5%** report working in painful or tiring positions.

While sitting, office workers, tend to lean forward or to slouch down in the chair. This partial immobilization can cause low back pain or **neck pain** because static posture increases stress on the back, neck, shoulders, arms and legs.

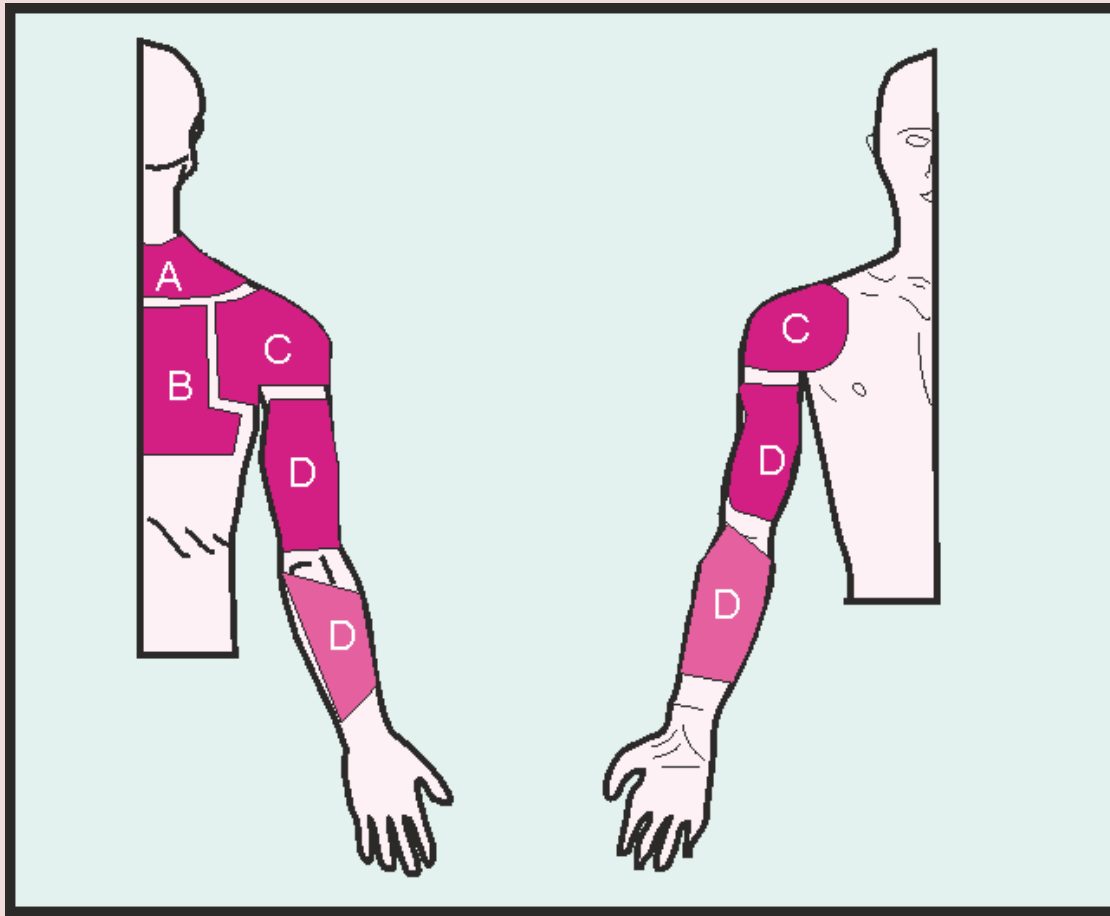
In particular, sitting can add large amounts of pressure to the back muscles, spinal discs and ligaments (Beneka et al, 2014).







Over time, incorrect sitting posture can damage spinal structures and contribute to or worsen back and neck pain (Bernard BP, 1997). **Chronic or recurrent neck pain** can be severely devastating and can also be accompanied by upper back pain, shoulder and scapula pain and headaches.



These symptoms, along with tight neck muscles and stiff joints can make even the simplest daily activity painful for the office worker. Therefore, strength and conditioning professionals, athletic trainers, and physical therapists often come across ongoing or recurrent complaints of neck pain.



While the etiology of **MUSCULOSKELETAL PAIN** symptoms is multi-factorial, there is a general consensus about the beneficial effect of **THERAPEUTIC EXERCISE!!**

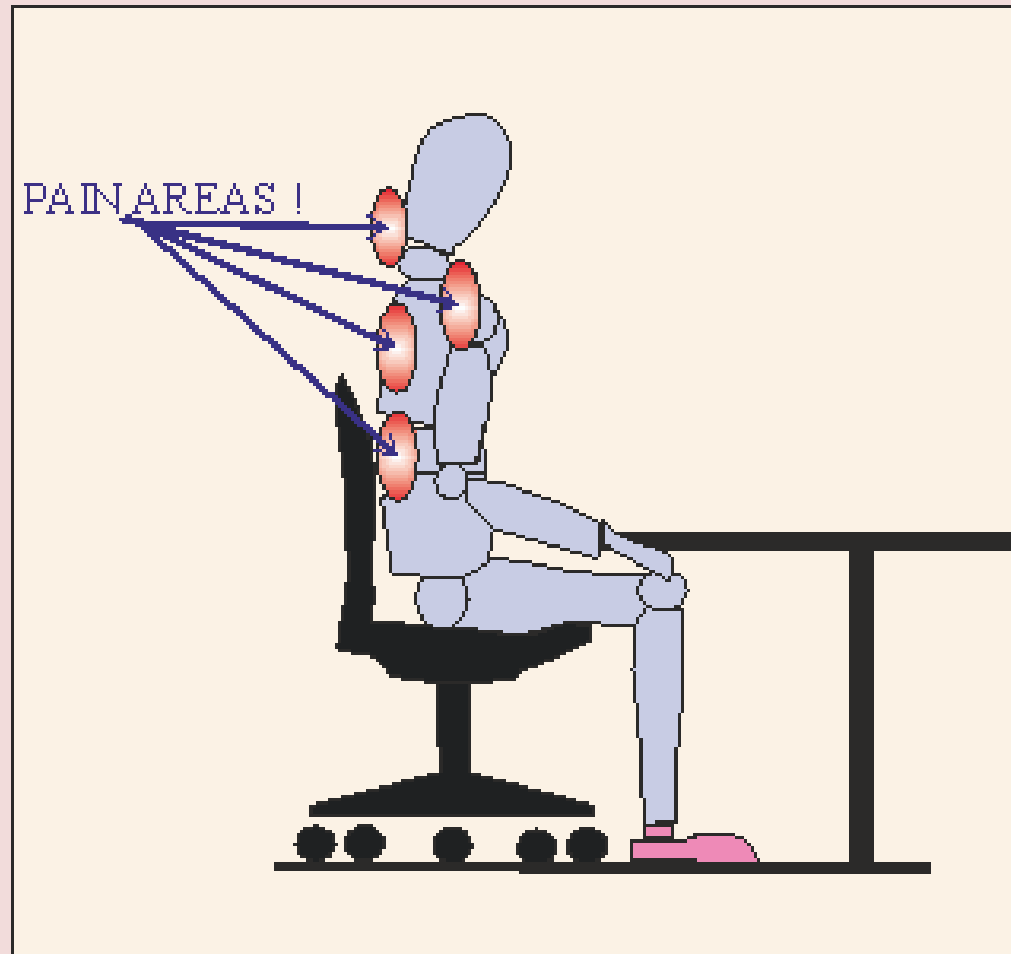
Pain !

- Acute pain
- Chronic pain (> 3 months).



Bad Posture Pain Etiology

- Ligaments, facets, muscle etc neurosis.
- Poor muscle physical condition level.
- Mechanical stresses in anatomical structures.
- Inflammation on stressed anatomical structures.



Every one has to “pay attention” to its
body pain signal !



Pain occurrence = a problem is coming

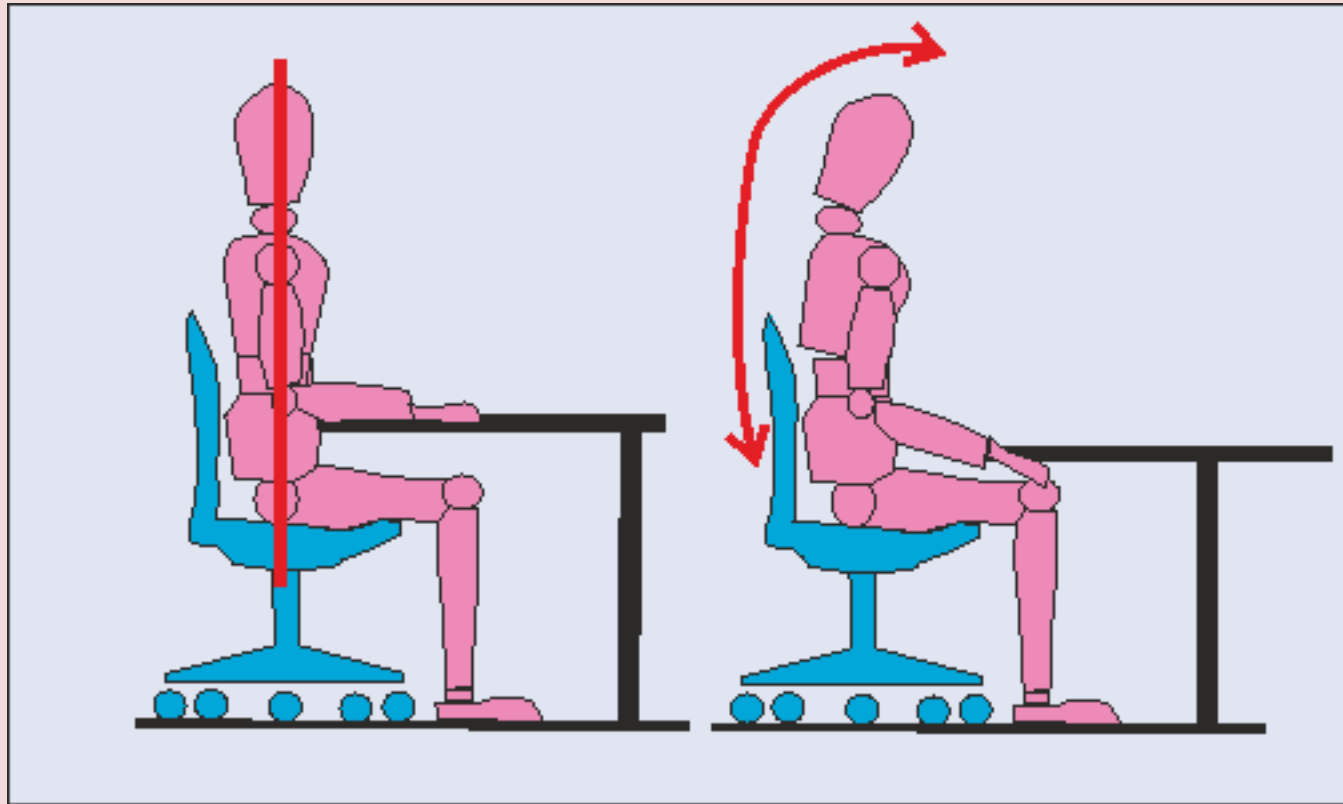


Caution!

- Although a neck pain is located in neck area and upper torso, the applied therapeutic exercise program has to focus on total spinal column function!

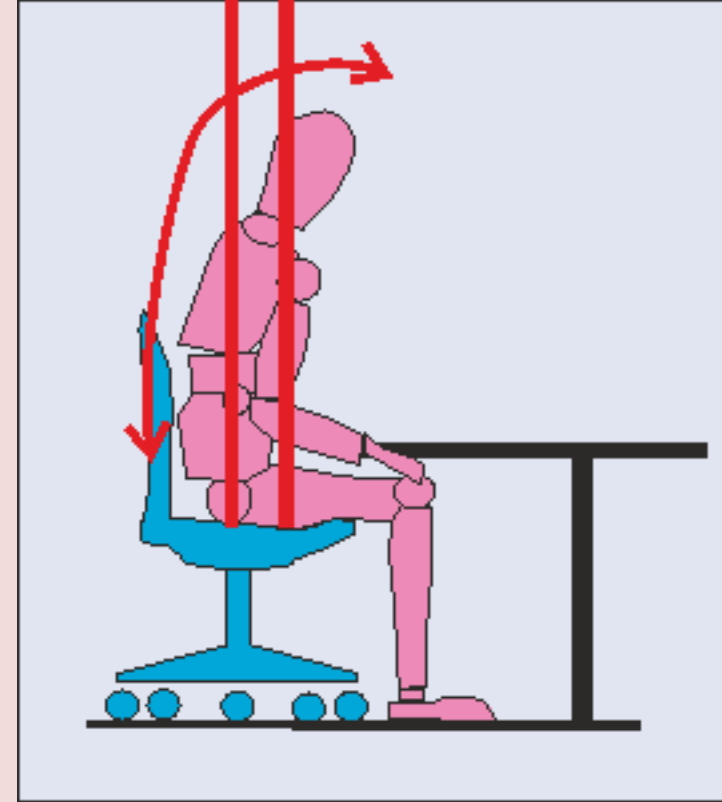
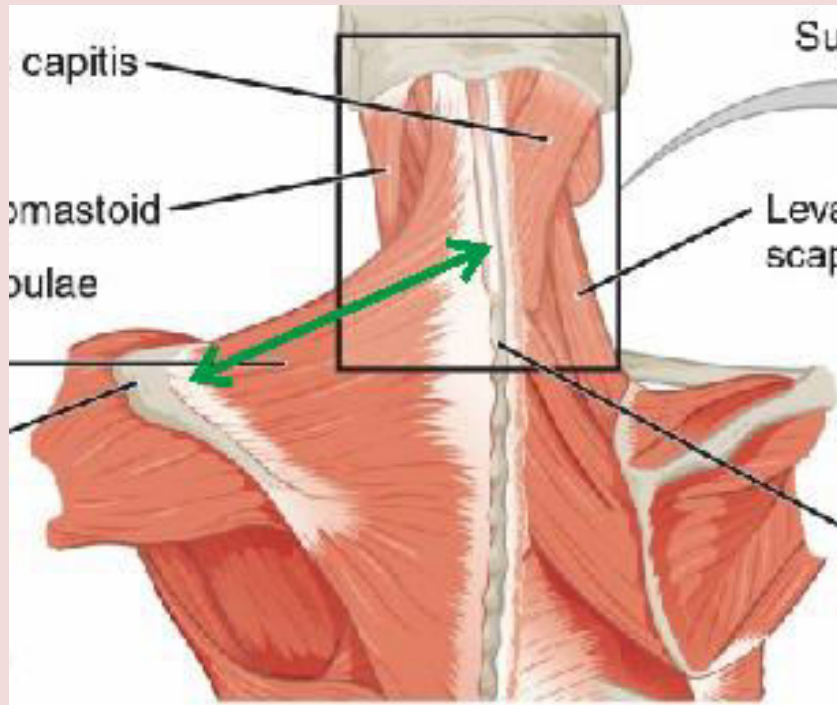


Muscle function and dynamic spine stabilization



Neck and torso muscles activate eccentrically during upright position (like wire rope). When the body moves away from the gravity center, these muscles control it while are activated against gravity

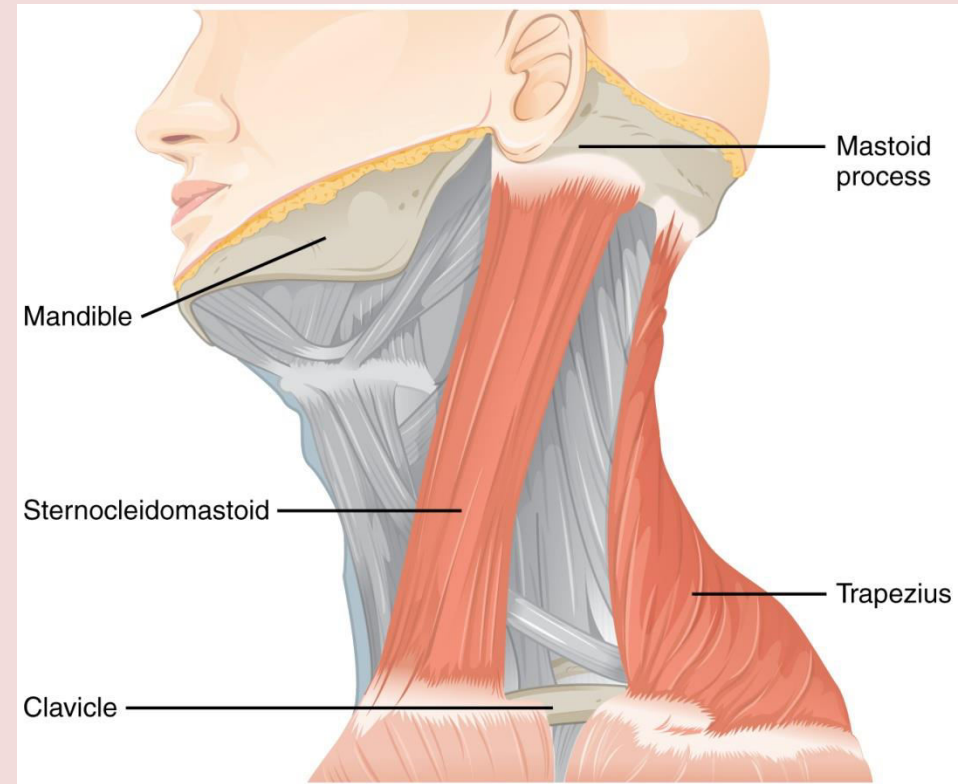
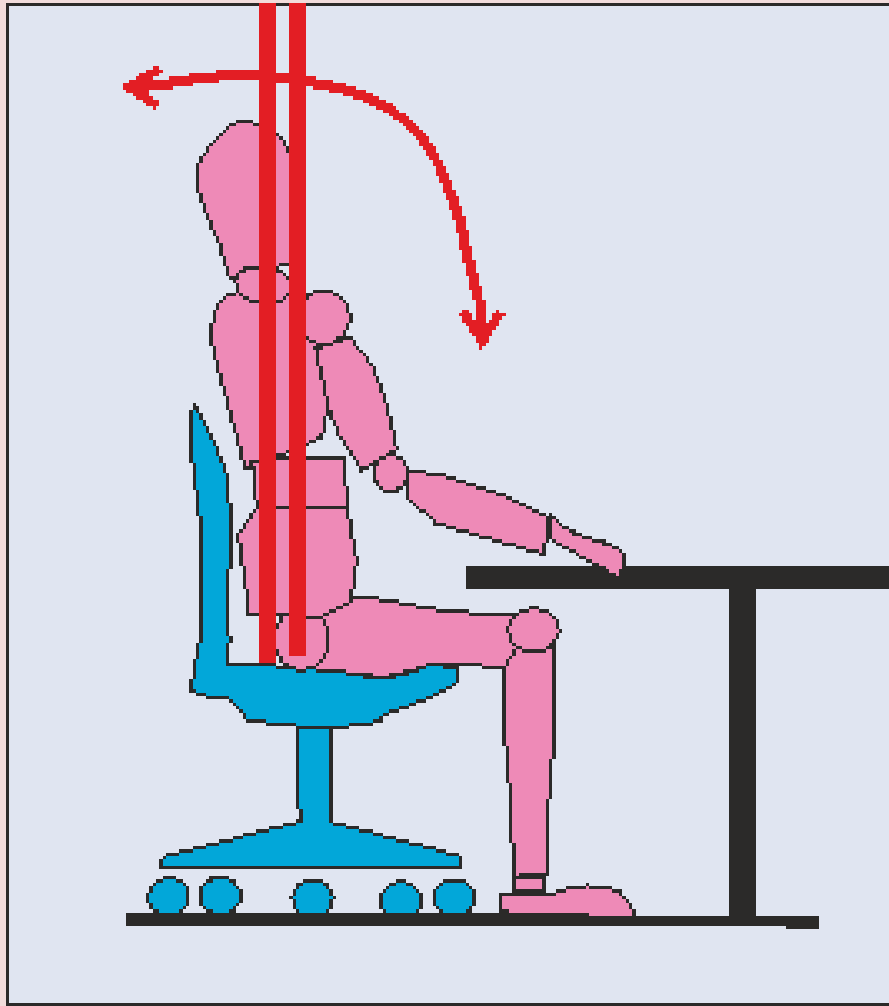
(Lehmkuhl και Smith, 1983, Kisner και Colby, 1996).



- Gravity line lines forward therefore the back extensors muscle group controls the upper body which include the neck extensors (upper trapezoid muscle, erector spinal group etc).

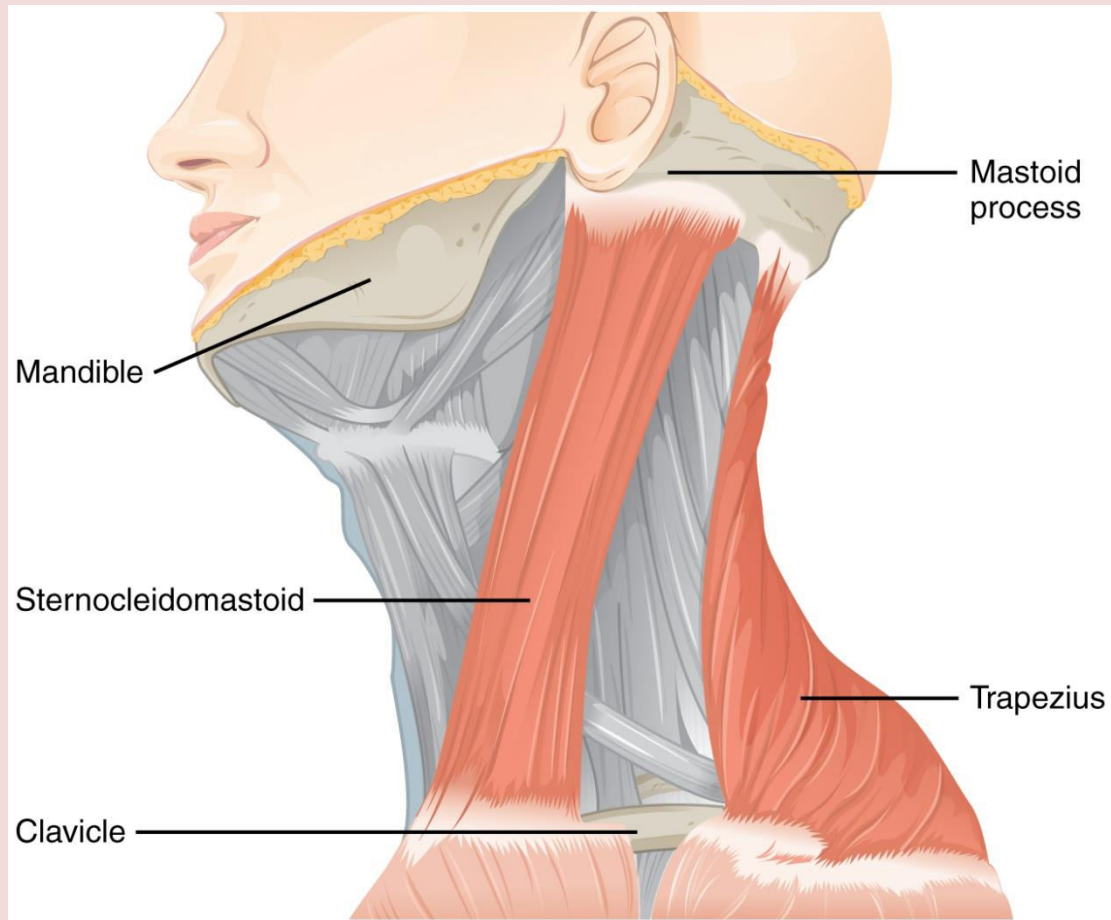
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On the other hand when the gravity line lines backward the back flexor muscle group controls the upper body which include abdominals, sternocleidomastoid etc).



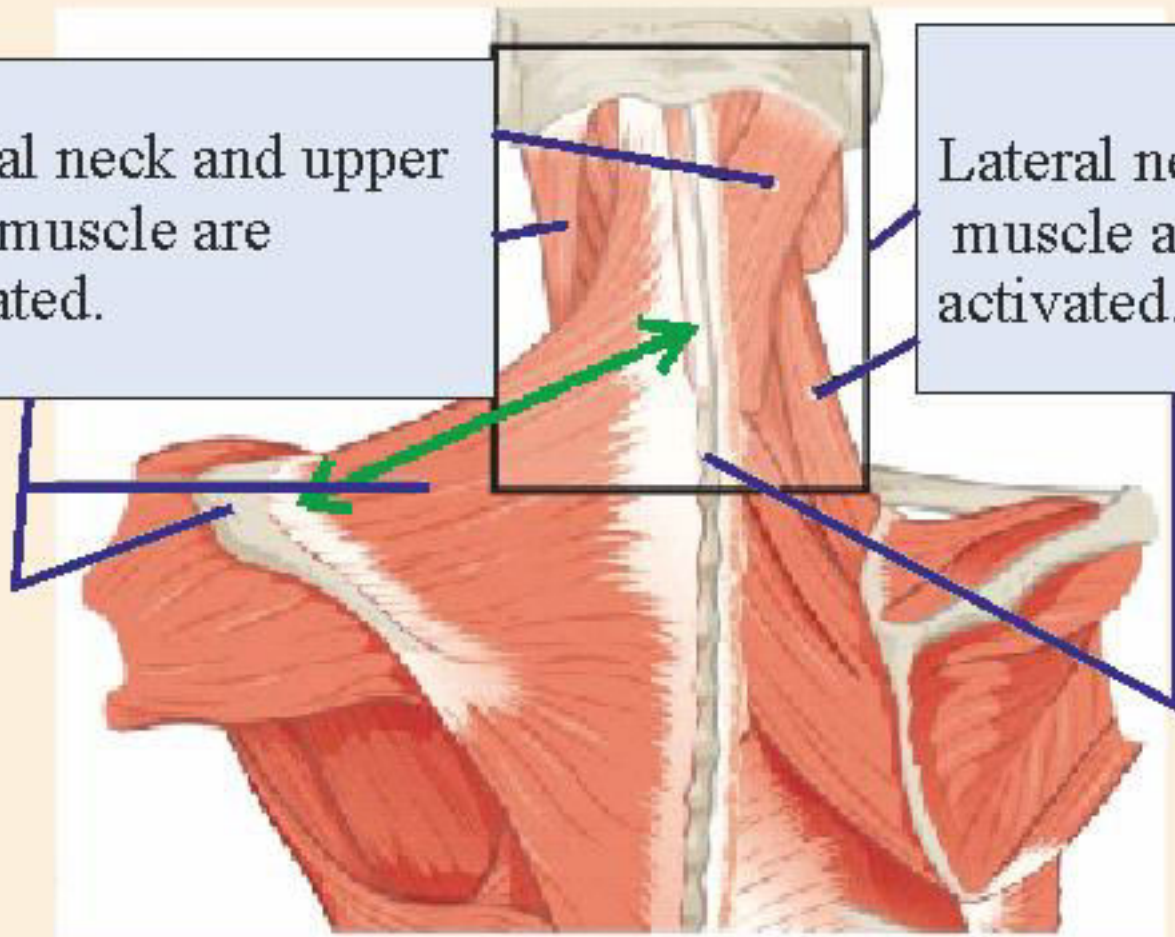


- When the gravity line moves laterally the opposite lateral torso muscles are activated.



Lateral neck and upper back muscle are activated.

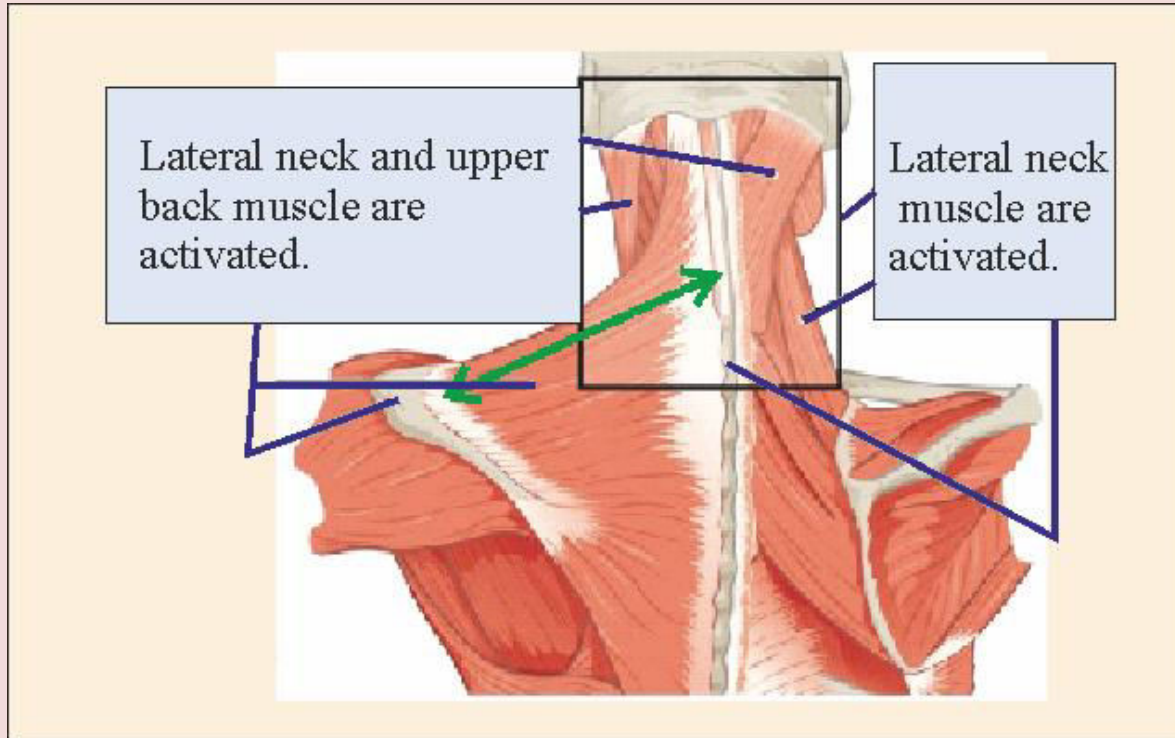
Lateral neck muscle are activated.



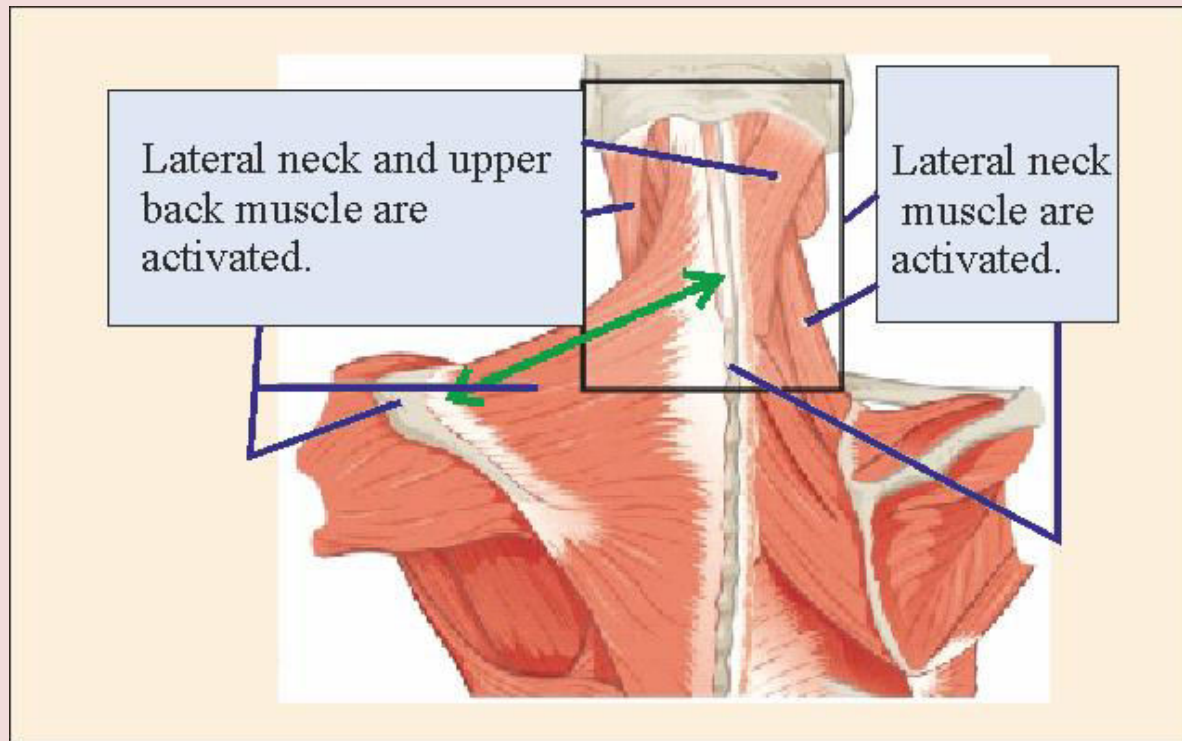
All these wrong postures leading to :

- Muscle imbalances
- Muscle tightness and muscle pain
- Other tissue hyper mobility
- Muscle pain !

1st problem



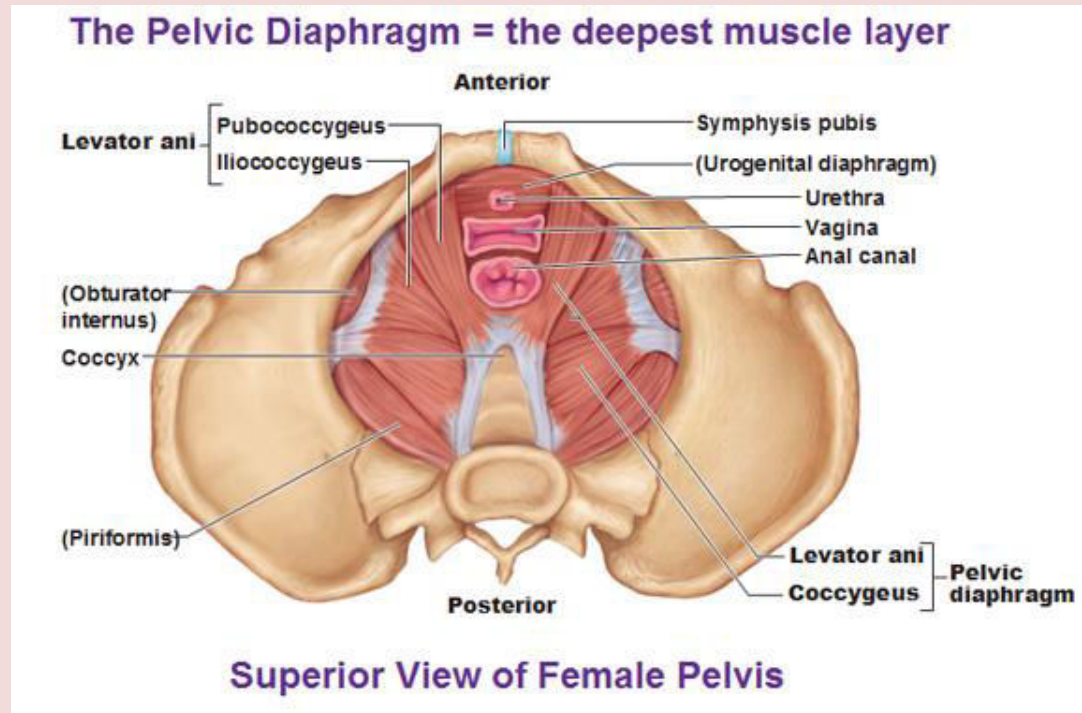
- Muscle atrophy with low muscle tone
(*Kendall, McCreary & Provance, 1993*)



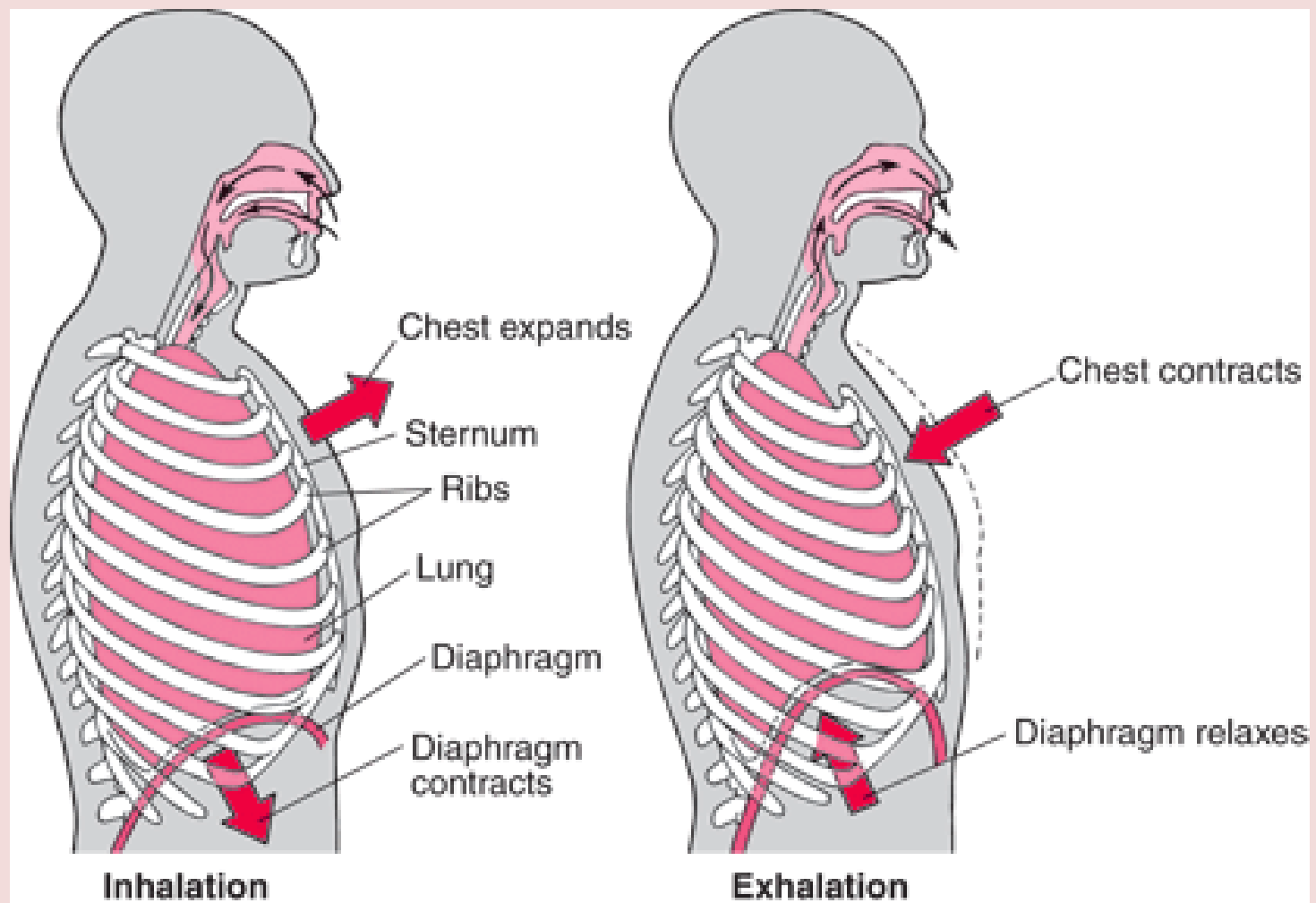
- Tight muscles : these muscle are strong in concentric position and weak in eccentric position.

(Gossman, Sahrmann & Rose, 1982)

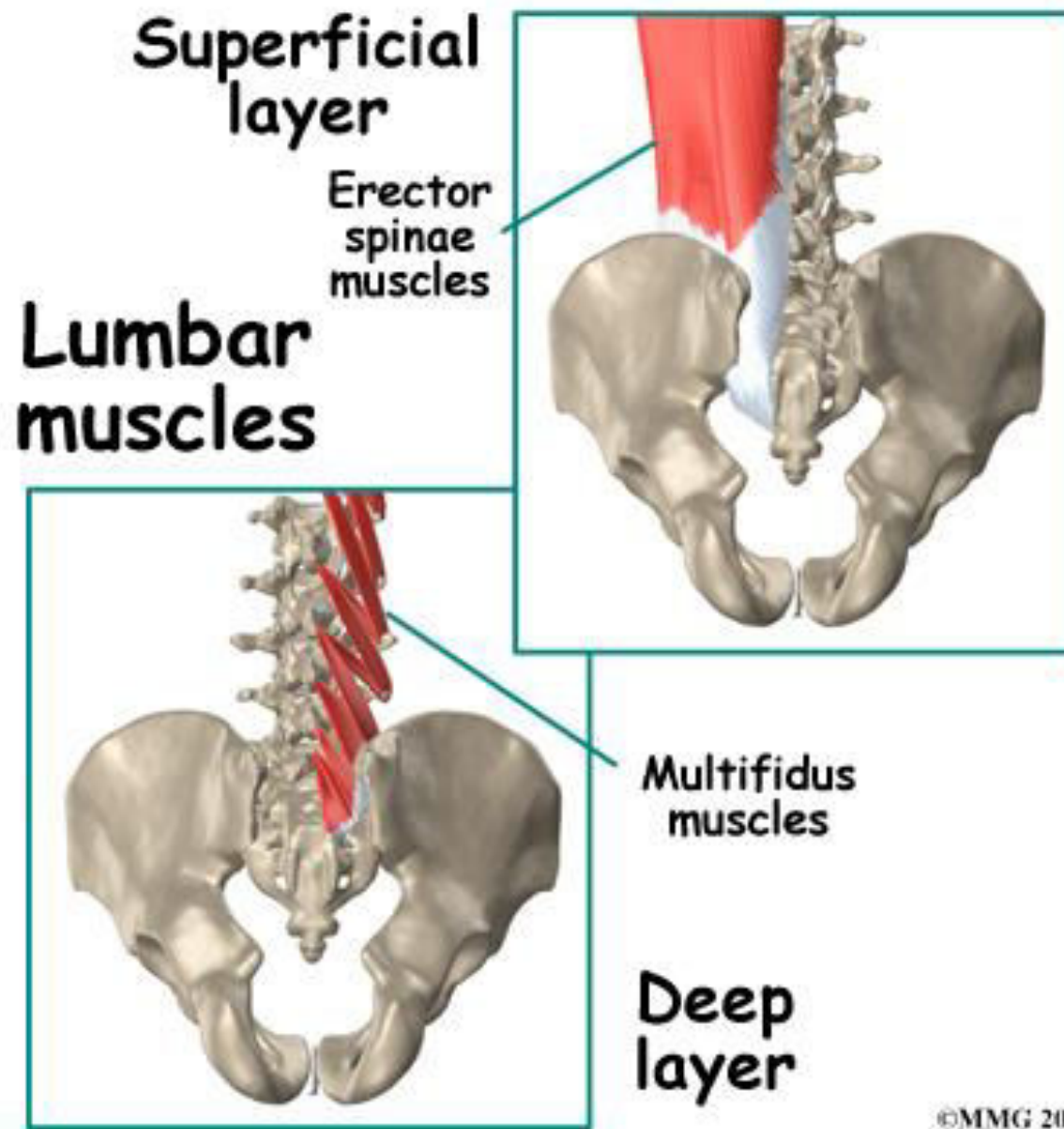
Spine control :



The deep torso muscles group (transversus abdominis, lumbar multifidus, pelvic floor muscles, lumbar square, diaphragm) controls the spine when participates in any type of activity.
(Bogduk, 2006)



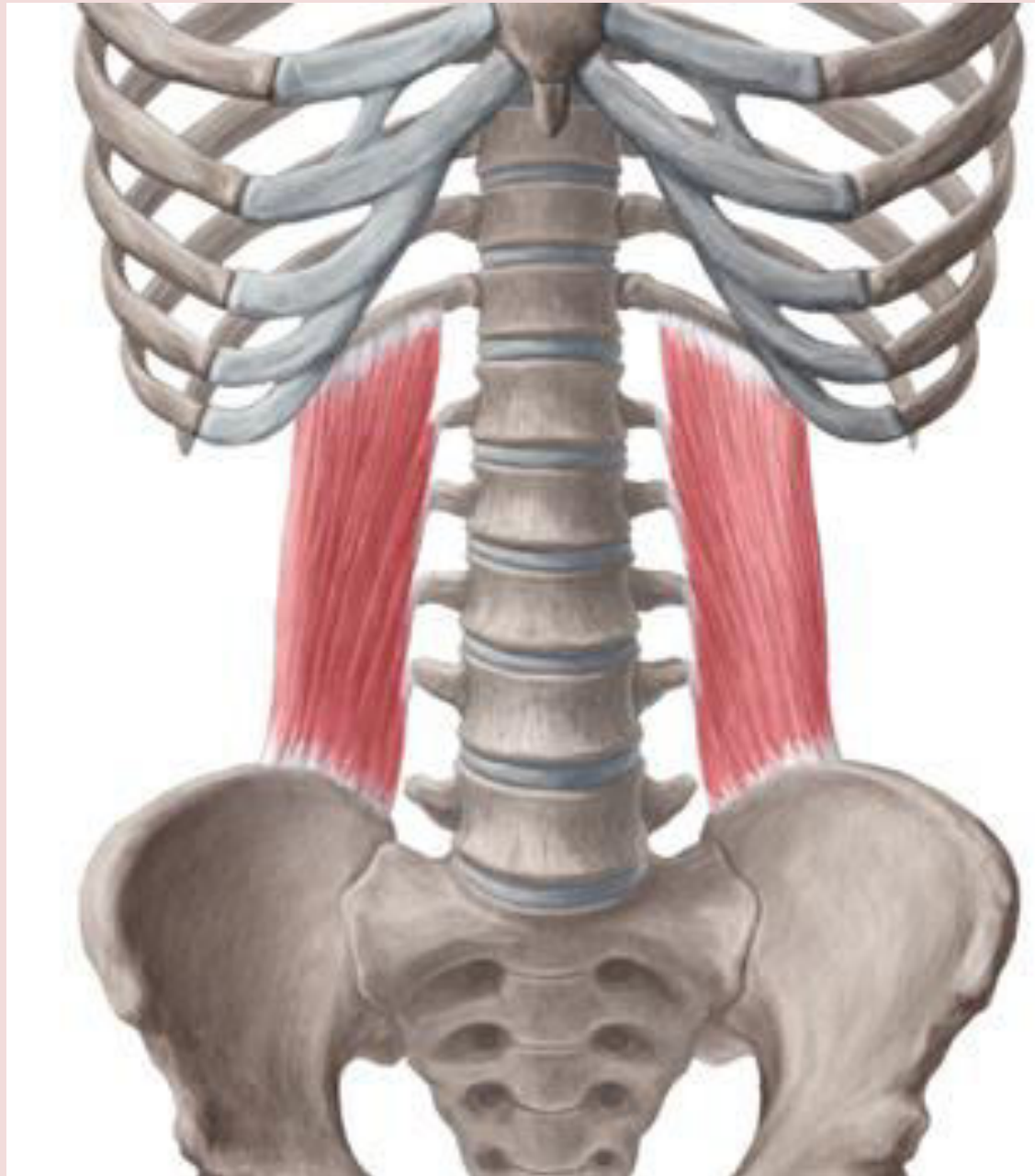
Diaphragm



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Lumbar multifidus

Transversus abdominis



Spine control :



On contrary, the insufficient activation of the deep torso muscles group leads to unstable and without control action producing bad posture, muscle and back and neck pain (Bogduk, 2006)



Two torso muscle groups !

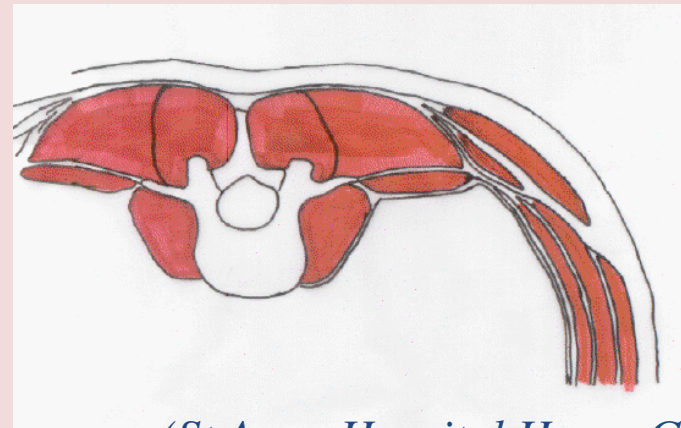
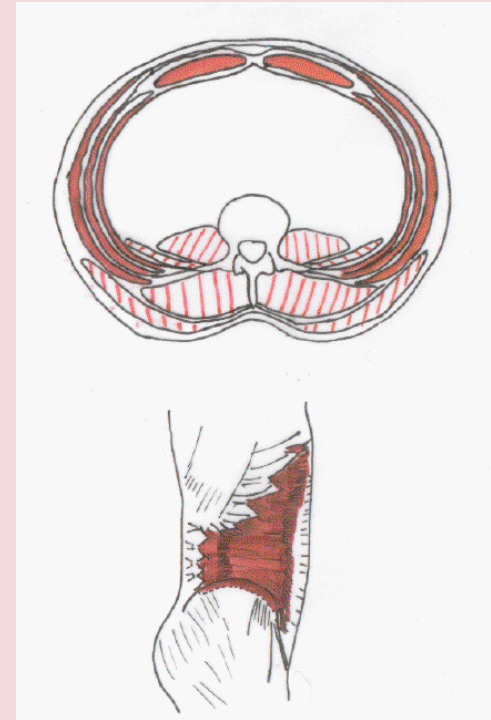
- Segmental Muscle or Local Stability Muscles
- Kinetic muscles or Global Mobility Muscles

Local Stability Muscles

Function

- ↑ 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

Comerford & Mottram 2001)

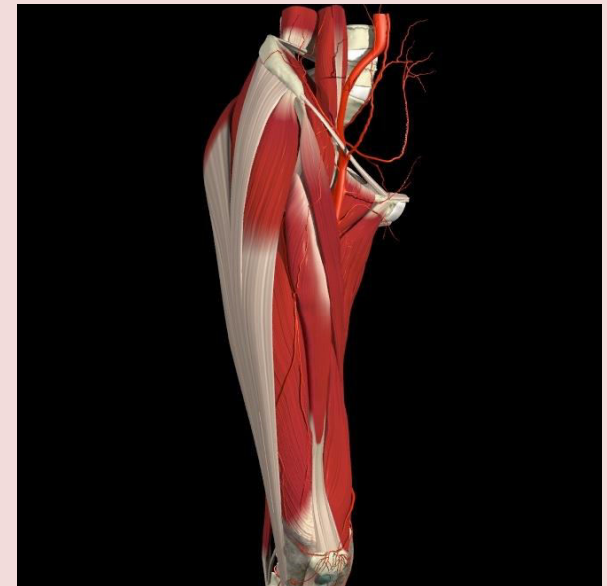
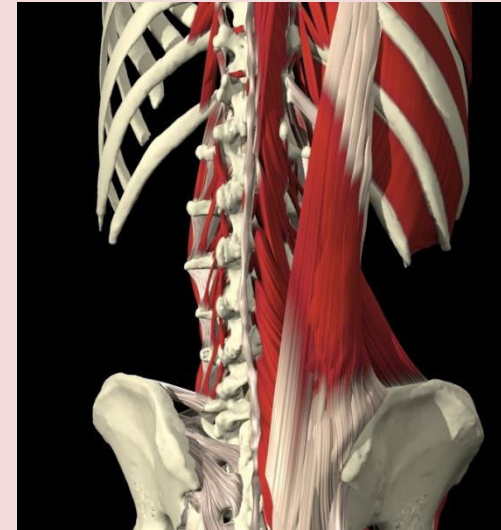


(St Anna Hospital Herne Germany)

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)

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
- 1 –3 % MVC ↑ muscle stiffness significantly increases stability
- 25% MVC = optimal stiffness & stability

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

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)

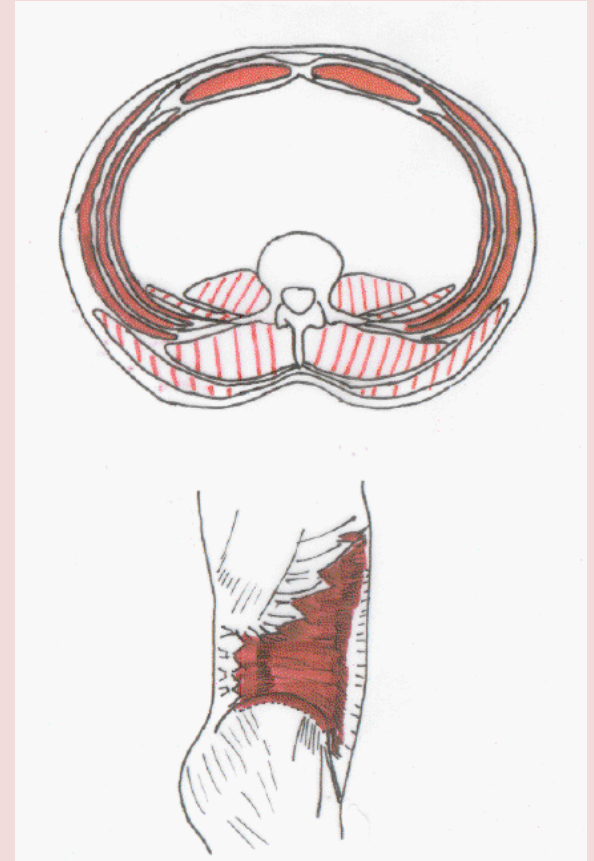
- Decrease in muscle stiffness and poor segmental control
- Loss of control of joint neutral position

Transversus Abdominis

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

(Cresswell 1992, 1994)

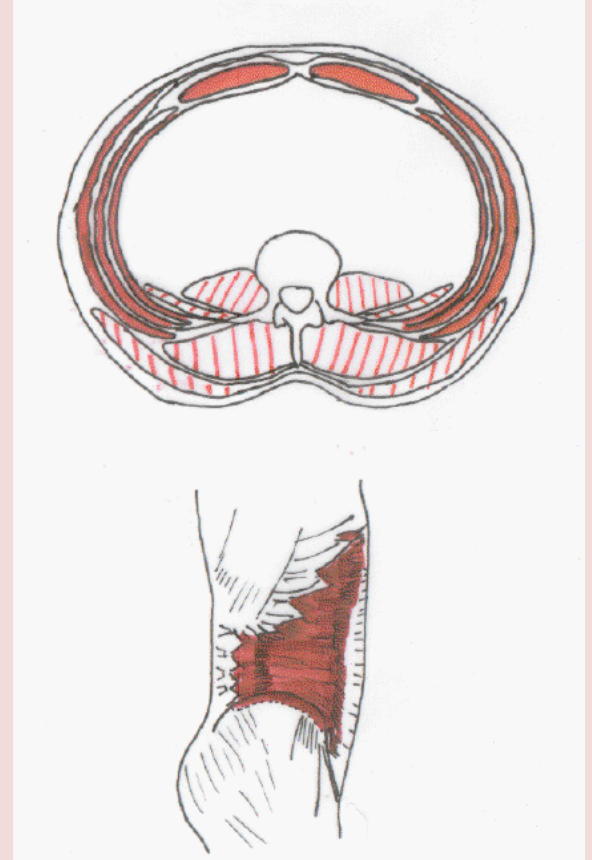
(Hodges and Richardson 1995, 1996)



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)

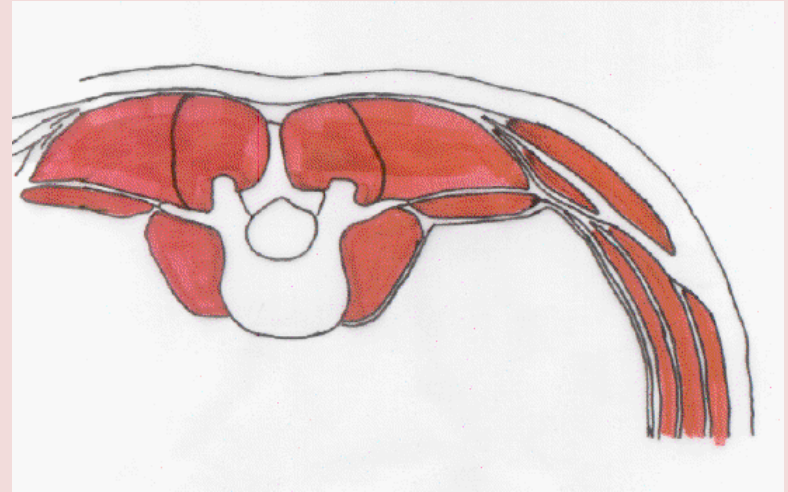


Lumbar Multifidus

- 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

DYSFUNCTION:

What comes 1st ?

- 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

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.=35%
- $P < 0.01$ (3 controls lost at 3 year)

Therapeutic Exercise for Spinal Segmental Stabilization in LBP

Scientific Basis and Clinical Approach

Richardson, Jull, Hodges, and Hides

Churchill Livingstone 1999

Cervical muscle dysfunction

- RCPMaj & RCPMin show atrophy and fatty degeneration in chronic neck pain

(Hallgren et al 1994, McPartland et al 1997)

- Anterior neck muscles show slow → fast fiber transformation in chronic neck pain

(Uhlig et al 1995)

- Noxious meningeal stimulation ↑ neck and jaw EMG activity

(Hu et al 1995)

Deep cervical flexor dysfunction

- Pressure biofeedback: incremental lordosis flattening pressure during active upper cervical flexion
- EMG: activity in anterior neck mobiliser muscles
 - » (Jull 1994)



Deep cervical flexor dysfunction

Control

- Can control greater range of 2mm Hg increments (up to 28 from baseline of 20) than WAD
- Less superficial muscle activity

WAD

- Can only control low increments (from baseline of 20 up to 23)
- Less consistent duration of hold
- More superficial muscle activity

Deep cervical flexor dysfunction

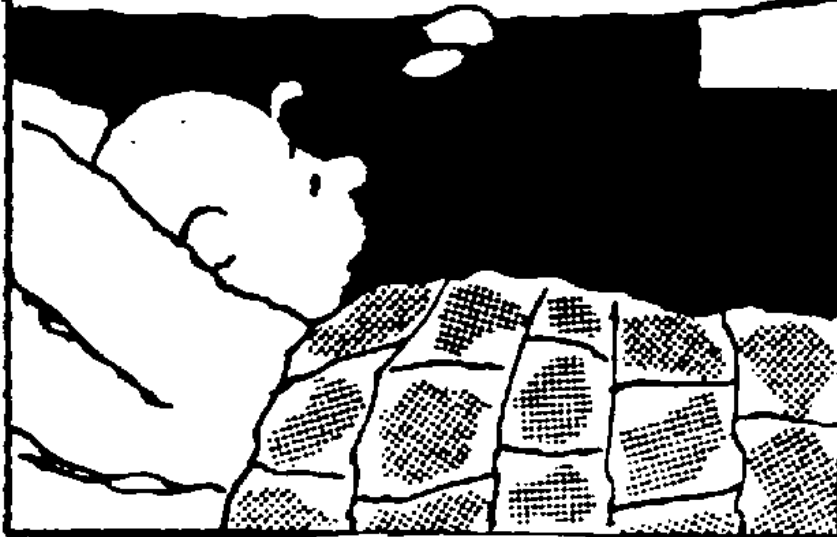
Identified in different pathological situations

- Whiplash Associated Disorder (*Jull 2000*)
- Post-concussional headache (*Treleaven et al 1994*)
- Cervical headache (*Watson & Trott 1993, Jull et al 1999*)
- Mechanical neck pain
(*Silverman et al 1991, White & Sahrman 1994, Jull 1998*)

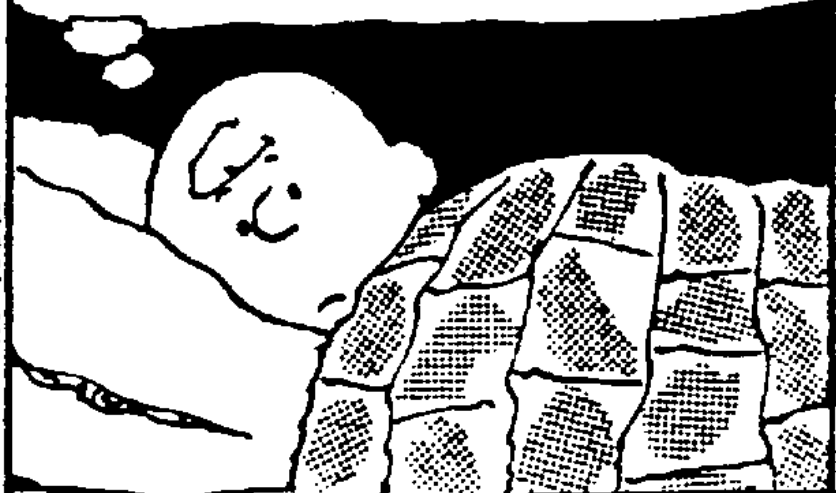
The meaning of Life ?

PEANUTS

SOMETIMES I LIE AWAKE AT NIGHT, AND I ASK QUESTIONS..



IS THERE ANY ONE THING A PERSON CAN DO TO MAKE HIS LIFE SUCCESSFUL?



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The control of stability dysfunction !



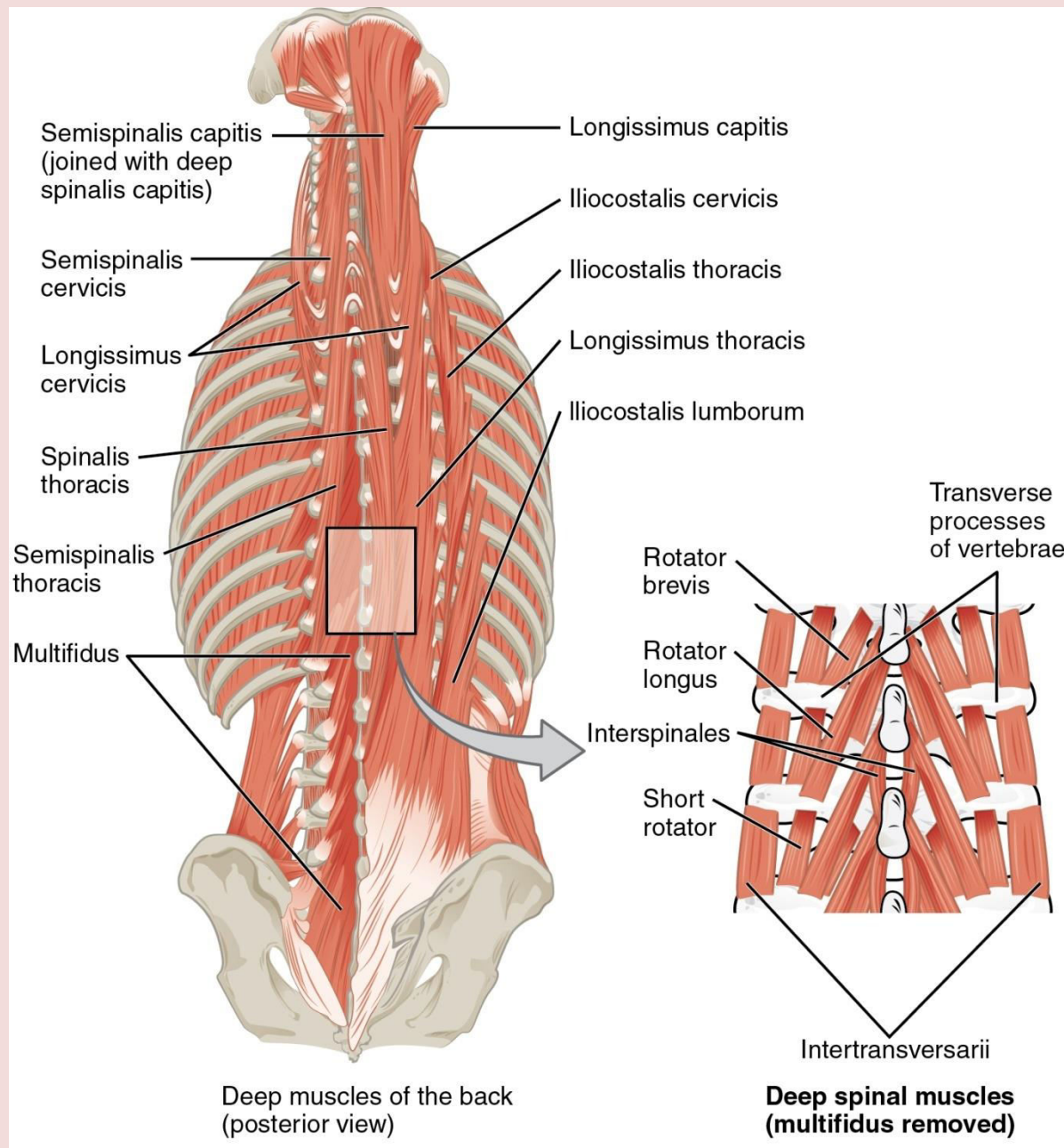
Segmental Muscles

Interspinalis

Action: extension of the vertebrae segments

Intertransversi

Action: laterally flexes each respective pair of vertebrae (also eccentric muscle contraction provides stability)



Splenius Muscles:

Splenius capitis

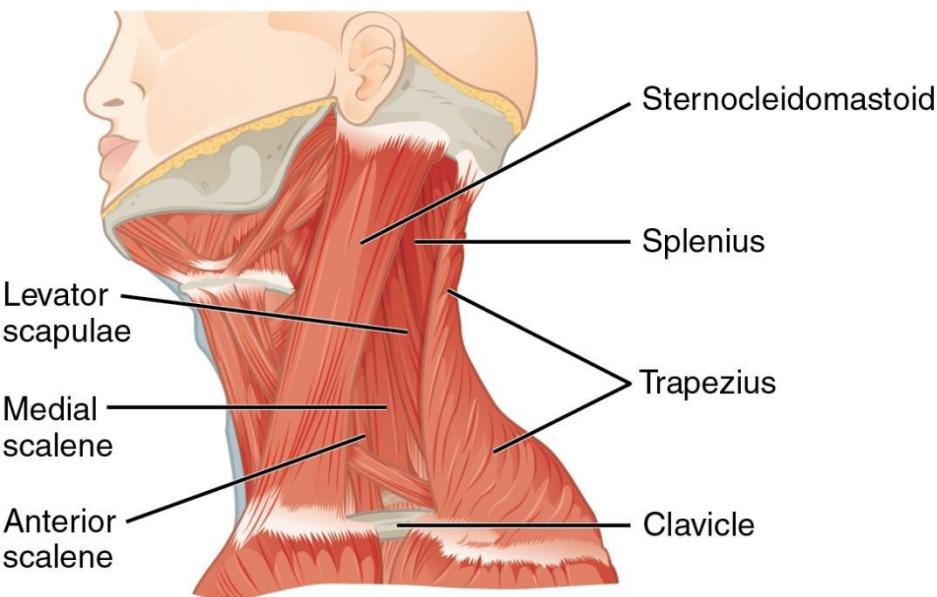
Action: bilateral contraction: extend head & neck

unilateral contraction: rotate and laterally bend head & neck to the contracted (same) side

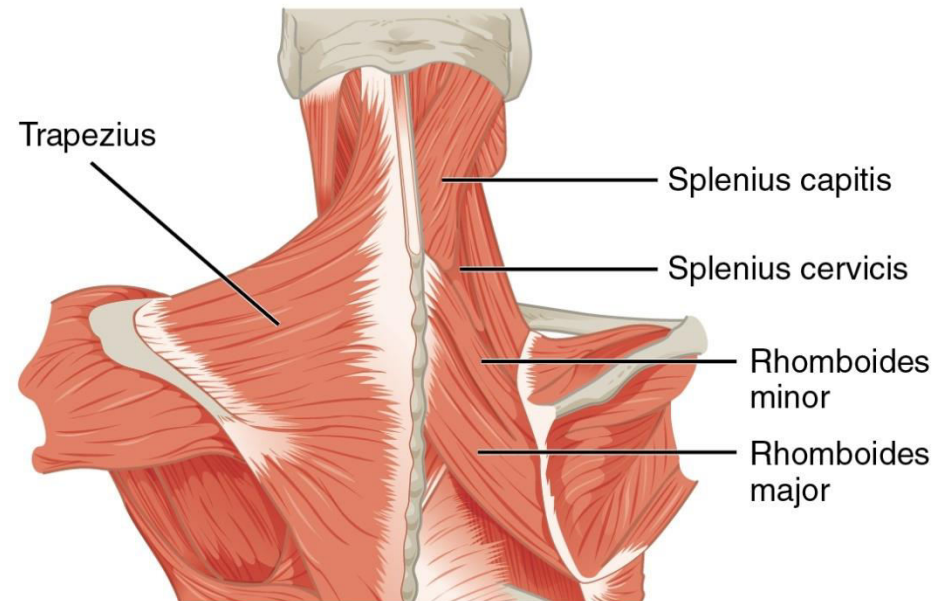
Splenius cervicis

Action: bilateral contraction: extend head & neck

unilateral contraction: rotate and laterally bend head & neck to the contracted (same) side



Muscles of the neck (left lateral view)



Superficial (left side) and deep (right side) muscles of the neck and upper back (posterior view)

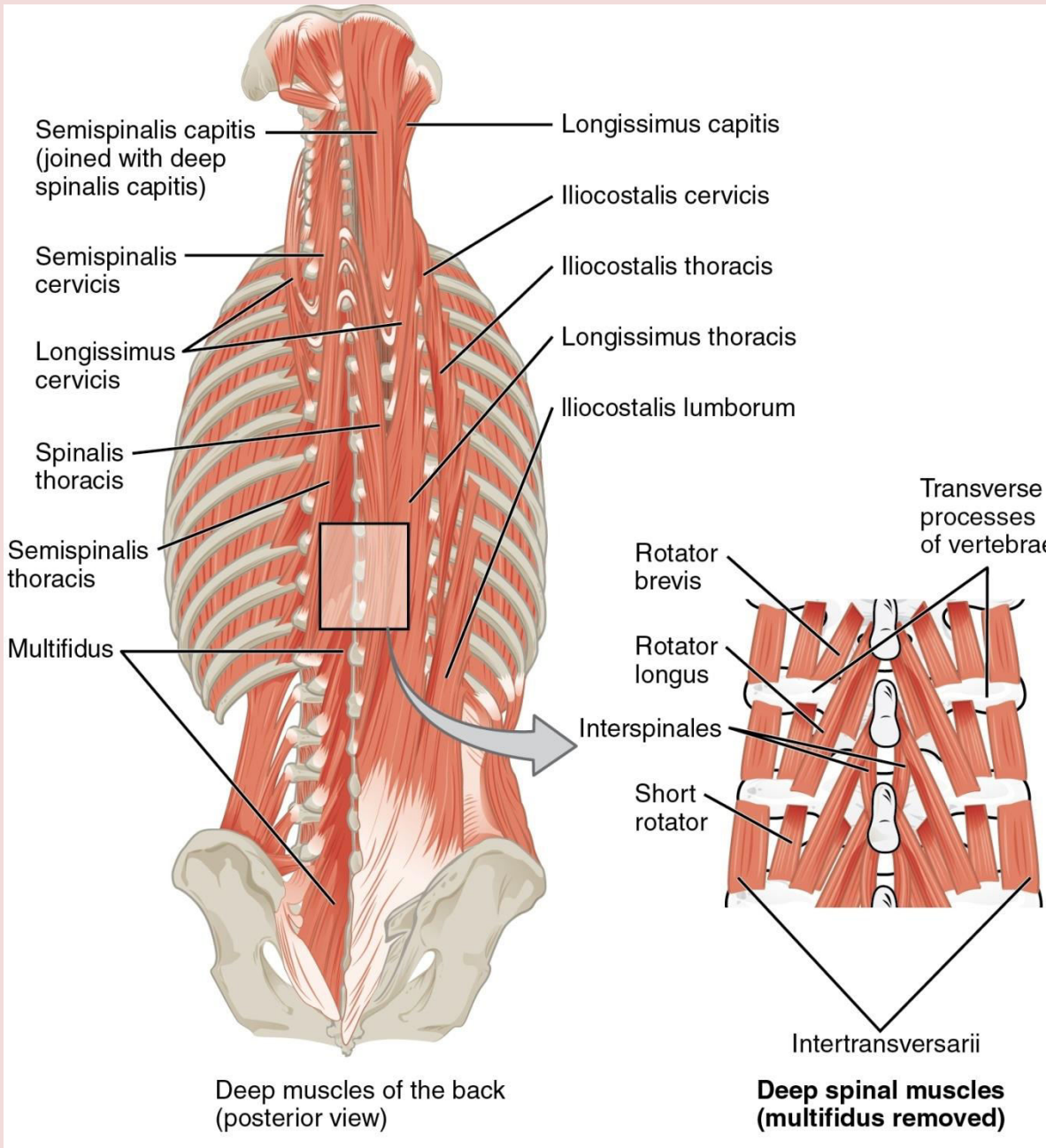
Erector Spinae Muscles

Iliocostalis lumborum

Action: (same for all erector spinae) bilateral:
extension of vertebral column
maintenance of erect posture
(pneumonic = / Like Standing)
stabilization of vertebral column
during flexion, acting in contrast to abdominal muscles and the action of gravity
unilateral:
lateral bend to same side
rotation to same side
opposite muscles contract eccentrically for stabilization

Iliocostalis thoracis

Iliocostalis cervicis



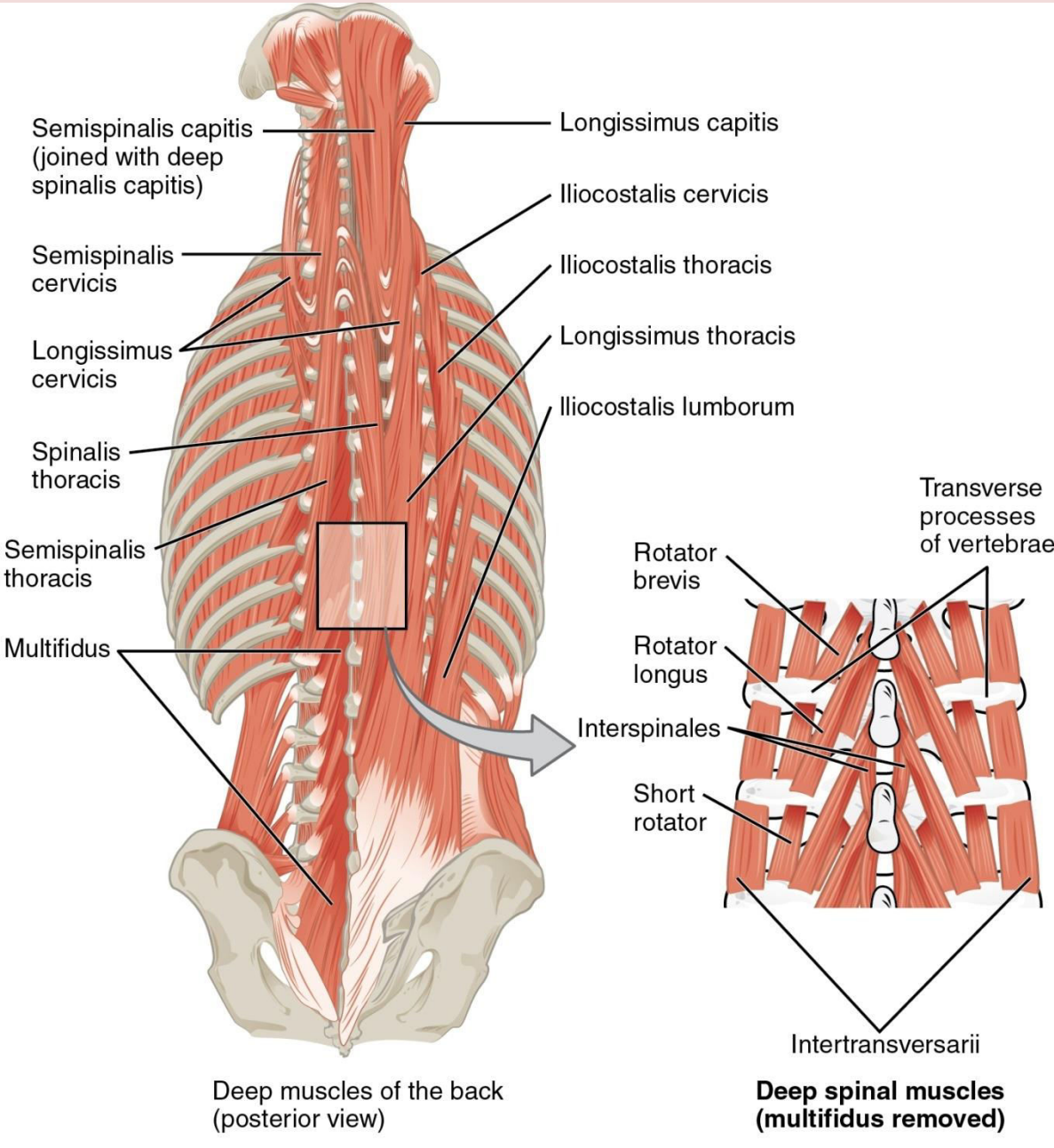
Erector Spinae Muscles

Longissimus thoracis

Action: (same for all erector spinae) bilateral:
extension of vertebral column
maintenance of erect posture
(pneumonic = / Like Standing)
stabilization of vertebral column
during flexion, acting in contrast
to abdominal muscles and the
action of gravity
unilateral:
lateral bend to same side
rotation to same side
opposite muscles contract
eccentrically for stabilization

Longissimus cervicis

Longissimus capitis



Erector Spinae Muscles

Spinalis thoracis

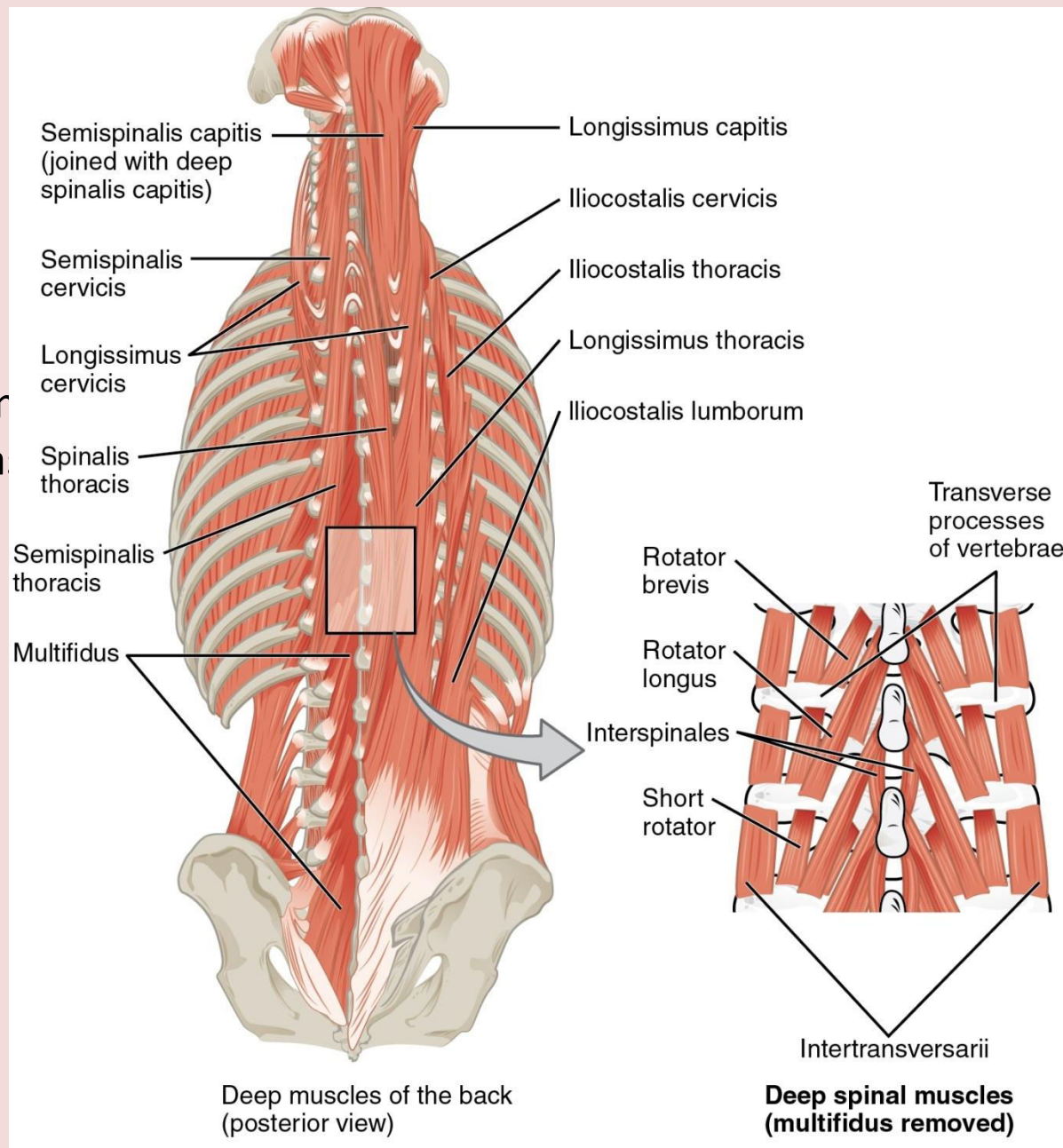
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extension of vertebral column
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unilateral:

lateral bend to same side
rotation to same side
opposite muscles contract eccentrically for stabilization

Spinalis cervicis

Spinalis capitis



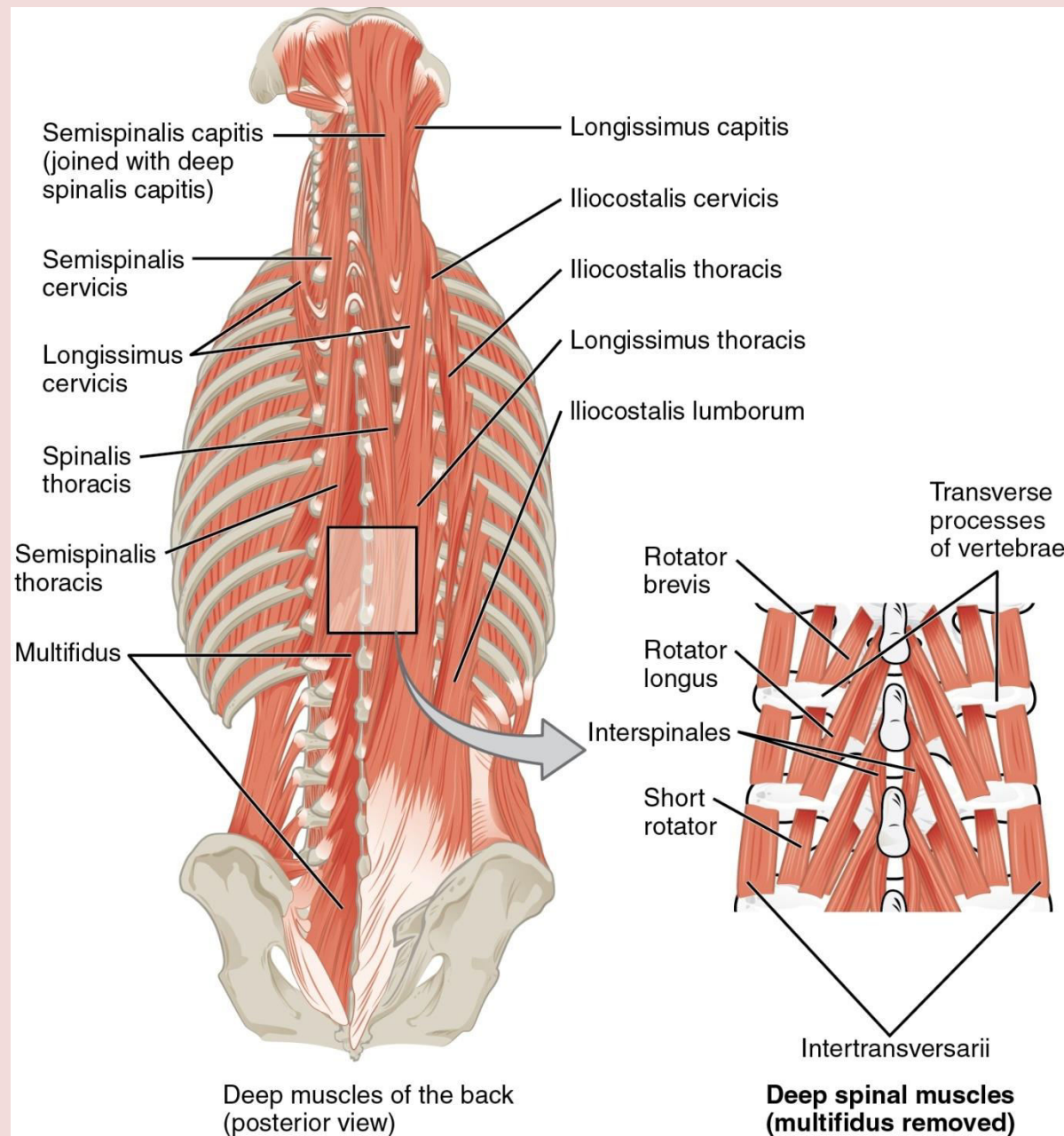
Transversospinal Muscles

Semispinalis thoracis

Action: bilaterally
extends vertebral
column, especially head
and neck
controls lateral flexion
to side opposite
contraction (eccentric
for stability)
maintains head posture

Semispinalis cervicis
same

Semispinalis capitus
same



Transversospinal Muscles

Multifidus

Action: bilaterally extends vertebral column
controls lateral flexion to side opposite contraction
(eccentric for stability)
unilaterally rotate vertebral bodies (column) to opposite side

