



Chapter 12

The Trunk and Spinal Column

Manual of Structural Kinesiology
R.T. Floyd, EdD, ATC, CSCS

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12-1

The Trunk and Spinal Column

- **Vertebral column – complex**
 - 24 intricate & complex articulating vertebrae
 - 31 pairs of spinal nerves
 - most complex part of body other than CNS
- **Abdominal muscles**
 - some sections linked by fascia & tendinous bands
 - do not attach from bone to bone
- **Many small intrinsic muscles act on head, vertebral column, & thorax**
 - assist in spinal stabilization or respiration
 - too deep to palpate

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Bones

- **24 articulating & 9 fused vertebrae**
 - 7 cervical (neck) vertebrae
 - 12 thoracic (chest) vertebrae
 - 5 lumbar (lower back) vertebrae
 - 5 sacrum (posterior pelvic girdle) vertebrae
 - 4 coccyx (tail bone) vertebrae
- **First 2 cervical vertebrae – shapes allow for extensive rotary movements of head to side, as well as forward & backward movement**



From Seeley RR, et al:
Anatomy & physiology, ed 3,
St. Louis, 1995, Mosby.

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12-3

Bones

- **3 normal curves within spine**
 - Thoracic spine curves anteriorly
 - Cervical & lumbar spine curve posteriorly
 - Spinal curves enable it to absorb blows & shocks
- **Vertebrae increase in size from cervical to lumbar region due to lower back having to support more weight**

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Bones

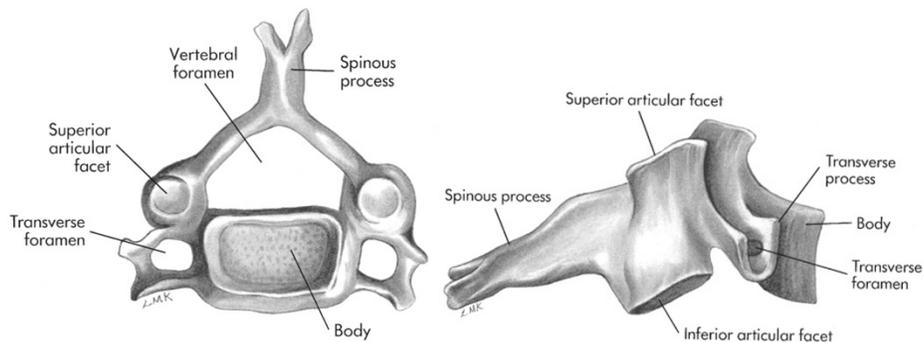
- First 2 cervical vertebrae – atlas & axis
- Vertebrae C2 through L5 – similar architecture
 - body – anterior bony block
 - central vertebral foramen for spinal cord
 - transverse process projecting out laterally
 - spinous process projecting posteriorly

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Bones

- Cervical vertebrae



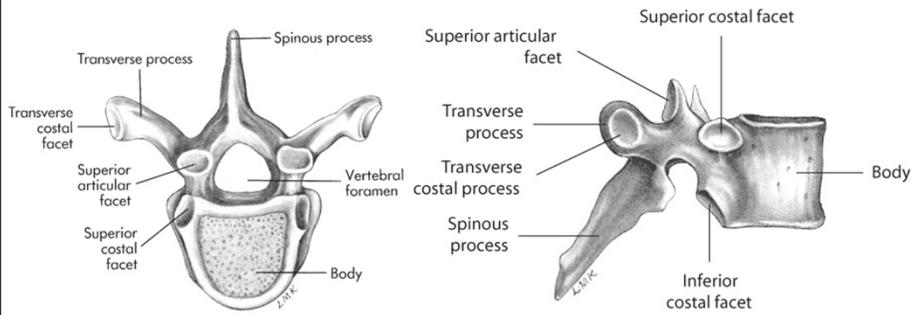
From Anthony CP, Kolthoff NJ: *Textbook of anatomy and physiology*, ed 9, St. Louis, 1975, Mosby.

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Bones

• Thoracic vertebrae



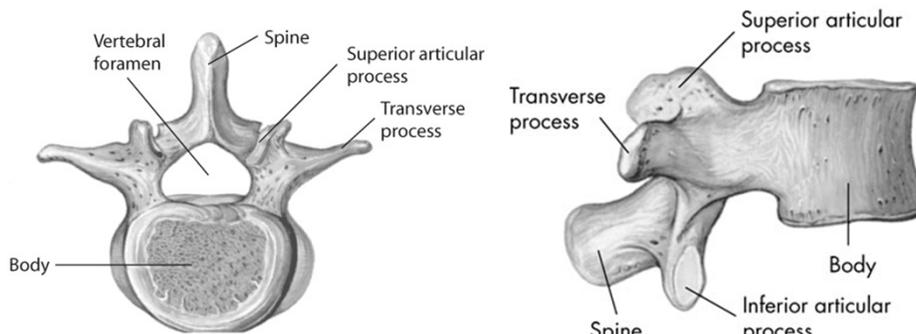
From Anthony CP, Kolthoff NJ: *Textbook of anatomy and physiology*, ed 9, St. Louis, 1975, Mosby.

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Bones

• Lumbar vertebrae



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Bones

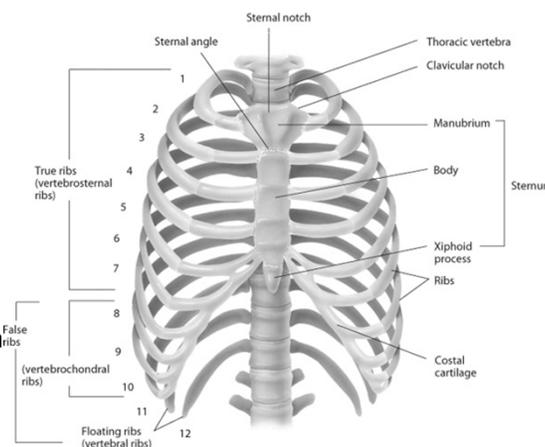
- Lordosis – increased posterior concavity of lumbar & cervical curves
- Kyphosis – increased anterior concavity of thoracic curve
- Lumbar kyphosis – reduction of normal lordotic curve, resulting in a flat-back appearance
- Scoliosis – lateral curvatures or sideward deviations of spine

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Bones

- 12 pairs of ribs
 - 7 pairs of true ribs attach directly to sternum
 - 5 pairs of false ribs
 - 3 pairs attach indirectly to sternum
 - 2 pairs of floating ribs – ends are free



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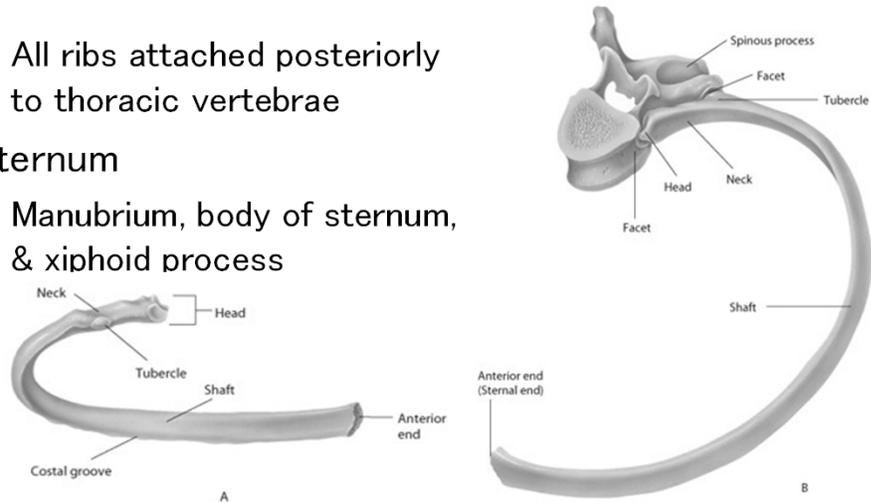
12-10

Bones

- All ribs attached posteriorly to thoracic vertebrae

- **Sternum**

- Manubrium, body of sternum, & xiphoid process



From Shier D, Butler J, Lewis R: *Hole's human anatomy & physiology*, ed 9, New York, 2002, McGraw-Hill.
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Bones

- **Key bony landmarks**
 - muscles of neck
 - mastoid process
 - transverse processes of cervical spine
 - spinous processes of cervical spine
 - spinous processes of upper 4 thoracic vertebrae
 - manubrium of sternum
 - medial clavicle

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Bones

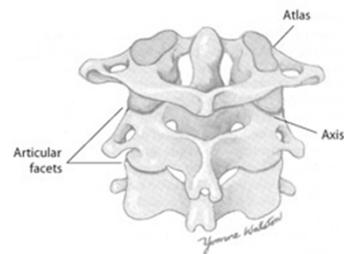
- Key bony landmarks
 - posterior muscles of spine
 - spinous processes of thoracic spine
 - transverse processes of thoracic spine
 - posterior ribs
 - anterior trunk muscles
 - borders of lower 8 ribs
 - costal cartilages of ribs
 - iliac crest
 - pubic crest

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Joints

- Atlantooccipital joint
 - first joint
 - formed by occipital condyles of skull sitting on articular fossa of the 1st vertebra
 - allows flexion & extension
- Atlantoaxial joint
 - Atlas (C1) sits on axis (C2)
 - Most cervical rotation occurs here
 - Trochoid or pivot-type joint
 - Most mobile joint of any two vertebrae



From Lindsay DT: *functional human anatomy*, St Louis, 1996, Mosby.

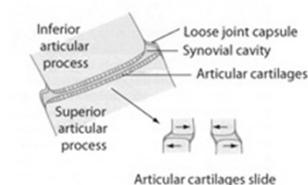
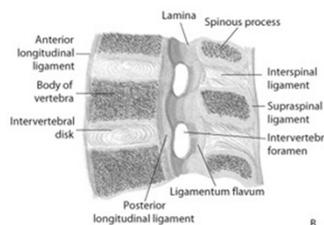
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Joints

- Minimal movement between any 2 vertebrae (except atlantoaxial joint)

- Cumulative effect of combined movement from several vertebrae allows for substantial movements
- Vertebral articulations classified as arthrodial
- Gliding-type joints due to limited gliding movements
- Gliding movement between superior & inferior articular processes of facets joints



From Lindsay DT: *functional human anatomy*, St Louis, 1996, Mosby.

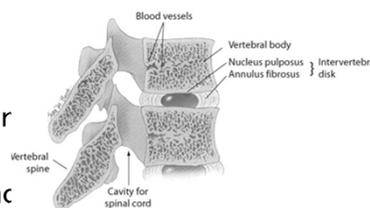
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Joints

- Intervertebral disks

- between & adhering to articular cartilage of vertebral bodies
- annulus fibrosus – outer rim of der fibrocartilage
- nucleus pulposus – central gelatinic pulpy substance
- compressed elastic material allows compression in all directions along with torsion
- become less resilient with age, injury, or improper use, resulting in a weakened annulus fibrosus



From Thibodeau GA, Paton KT: *Anatomy & physiology*, ed 9, St. Louis, 1993, Mosby; Seeley RR, Stephens TD, Tate P: *Anatomy & physiology*, ed 7, New York, 2006, McGraw-Hill.

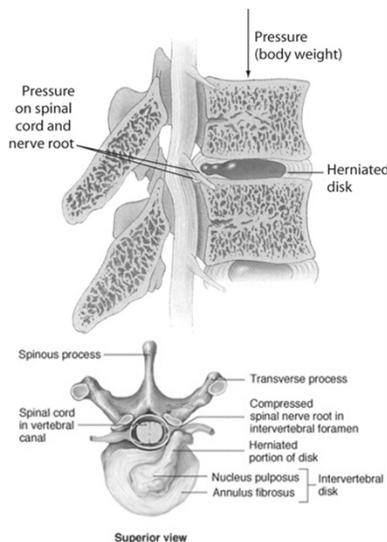
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Joints

– Intervertebral disks

- herniated nucleus pulposus (herniated or “slipped” disk) – nucleus protruding through annulus resulting from substantial weakening combined with compression
 - protrusion puts pressure on spinal nerve root, causing radiating pain, tingling, numbness, and/or weakness in lower extremity



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Joints

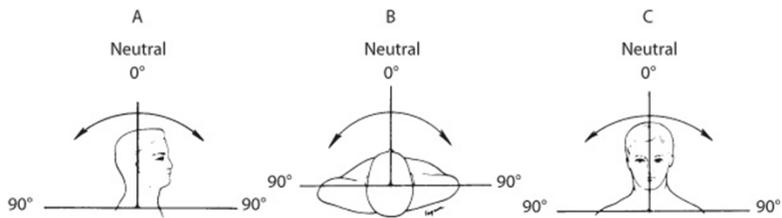
- Most movement occurs in cervical & lumbar
- Some slight thoracic movement
- Movements of head
 - Movement between cranium & 1st cervical and within other cervical vertebrae
 - Referred as cervical movements
- Trunk movements
 - Lumbar motion terminology describes combined motion in thoracic & lumbar

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Joints

- Cervical region
 - Flexes 45 degrees
 - Extends 45 degrees
 - Laterally flexes 45 degrees
 - Rotate approximately 60 degrees

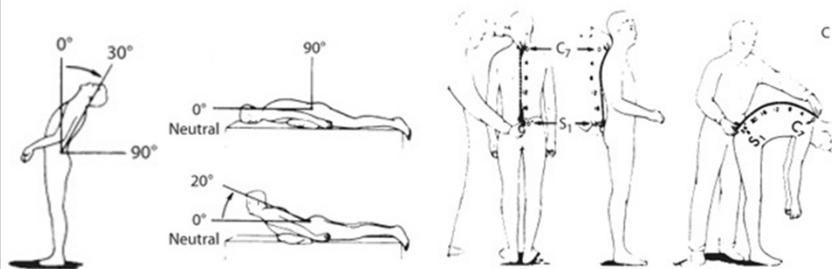


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Joints

- Lumbar spine including trunk movement
 - Flexes approximately 80 degrees
 - Extends 20 to 30 degrees

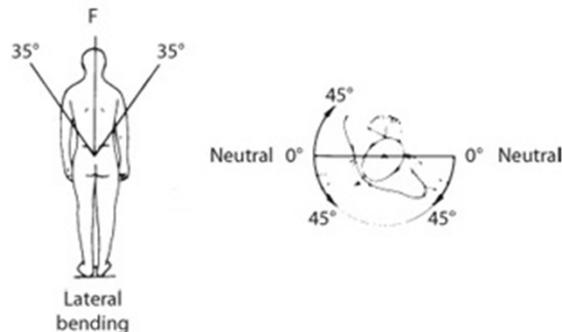


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Joints

- Lumbar spine including trunk movement
 - Lumbar lateral flexion to 35 degrees
 - Rotation approximately 45 degrees



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Movements

- Spinal movements are often preceded by the name given to the region of movement
- Ex. flexion of trunk at lumbar spine is known as lumbar flexion, & extension of neck is cervical extension
- Pelvic girdle rotates as a unit due to movement occurring in hip & lumbar spine

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Movements

- Spinal flexion
 - anterior movement of spine; in cervical region the head moves toward chest; in lumbar region the thorax moves toward pelvis



Cervical flexion
A



Lumbar flexion
E

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Movements

- Spinal extension
 - return from flexion or posterior movement of spine; in cervical spine, head moves away from the chest & thorax moves away from pelvis



Cervical extension
(hyperextension)
B



Lumbar extension
(hyperextension)
F

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Movements

- **Lateral flexion (left or right)**
 - sometimes referred to as side bending; head moves laterally toward the shoulder & thorax moves laterally toward pelvis
- **Reduction**
 - return movement from lateral flexion to neutral



Cervical lateral flexion to the right
C



Lumbar lateral flexion to the right
G

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Movements

- **Spinal rotation (left or right)**
 - rotary movement of spine in horizontal plane; chin rotates from neutral toward shoulder & thorax rotates to one side



Cervical rotation to the right
D



Lumbar rotation to the right
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Trunk & Spinal Column Muscles

- A few large muscles & many small muscles
- Erector spinae (sacrospinalis)
 - largest muscle
 - extends on each side of spinal column from pelvic region to cranium
 - divided into 3 muscles
 - Spinalis, longissimus, & iliocostalis
 - From medial to lateral side, has attachments in lumbar, thoracic, & cervical regions
 - Actually made up of 9 muscles
- Sternocleidomastoid & splenius muscles
 - large muscles involved in cervical & head movements

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Trunk & Spinal Column Muscles

- Large abdominal muscles – lumbar movements
 - Rectus abdominis, external oblique abdominal, internal oblique abdominal, & quadratus lumborum
- Numerous small muscles
 - Many originate on one vertebra & insert on next vertebra
 - Important in functioning of spine
- Grouped according to location & function

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Trunk & Spinal Column Muscles

- Some muscles have multiple segments
 - one segment of a muscle may be located & perform movement in one region while another segment of same muscle may be located in another region to perform movements in that region
- Many muscles of trunk & spinal column function in moving spine & aiding respiration
 - All thoracic muscles are primarily involved in respiration

Trunk & Spinal Column Muscles

- Abdominal wall muscles do not go from bone to bone but attach into an aponeurosis (fascia) around rectus abdominis area
 - external oblique abdominal, internal oblique abdominal, & transversus abdominis

Trunk & Spinal Column Muscles

- Muscles that move the head
 - Anterior
 - Rectus capitis anterior
 - Longus capitis
 - Posterior
 - Longissimus capitis
 - Obliquus capitis superior
 - Obliquus capitis inferior
 - Rectus capitis posterior – major & minor
 - Trapezius, superior fibers
 - Splenius capitis
 - Semispinalis capitis

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Trunk & Spinal Column Muscles

- Muscles that move the head
 - Lateral
 - Rectus capitis lateralis
 - Sternocleidomastoid
- Muscles of the vertebral column
 - Superficial
 - Erector spinae (sacrospinalis)
 - Spinalis – cervicis, thoracis
 - Longissimus – capitis, cervicis, thoracis
 - Iliocostalis – cervicis, thoracis, lumborum
 - Splenius cervicis

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Trunk & Spinal Column Muscles

- Muscles of the vertebral column
 - Deep
 - Longus colli – superior oblique, inferior oblique, vertical
 - Interspinales – entire spinal column
 - Intertransversales – entire spinal column
 - Multifidus – entire spinal column
 - Psoas minor
 - Rotatores – entire spinal column
 - Semispinalis – cervicis, thoracis

Trunk & Spinal Column Muscles

- Muscles of the thorax
 - Diaphragm
 - Intercostalis – external, internal
 - Levator costarum
 - Subcostales
 - Scalenus – anterior, medius, posterior
 - Serratus posterior – superior, inferior
 - Transversus thoracis

Trunk & Spinal Column Muscles

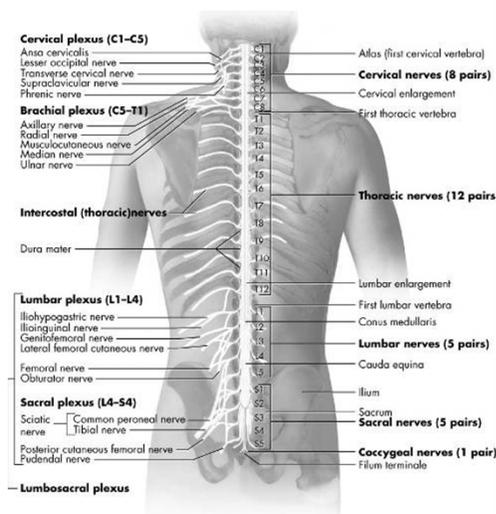
- Muscles of the abdominal wall
 - Rectus abdominis
 - External oblique abdominal (obliquus externus abdominis)
 - Internal oblique abdominal (obliquus internus abdominis)
 - Transverse abdominis (transversus abdominis)
 - Quadratus lumborum

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Nerves

- Cranial nerve 11 and C2 & C3 spinal nerves
 - Sternocleidomastoid muscles
- C4 through C8 posterior lateral branches
 - Splenius muscles
- Posterior branches of the spinal nerves
 - Entire erector spinae group



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Nerves

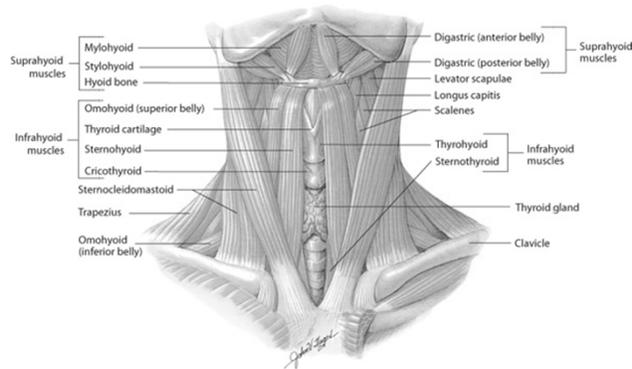
- Intercostal nerves of T7 through T12
 - Rectus abdominis
- Intercostal nerves (T8–T12), iliohypogastric nerve (T12, L1), & ilioinguinal nerve (L1)
 - Internal & external oblique abdominal muscles
 - Same for transverse abdominis except innervation begins with T-7 intercostal nerve
- Branches from T12 & L1
 - Quadratus lumborum

Muscles that Move the Head

- All originate on cervical vertebrae & insert on occipital bone of skull (capitis name)
 - 3 anterior vertebral muscles – longus capitis, rectus capitis anterior, & rectus capitis lateralis
 - All are flexors of head & upper cervical spine
 - Rectus capitis lateralis
 - laterally flexes head
 - assists rectus capitis anterior in stabilizing atlantooccipital joint

Muscles that Move the Head

- All originate on cervical vertebrae & insert on occipital bone of skull (capitis name)



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Muscles that Move the Head

– Posterior muscles

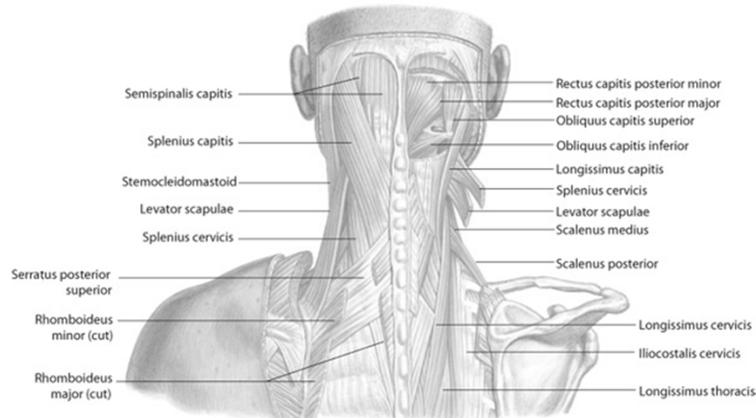
- Rectus capitis posterior major & minor, obliquus capitis superior & inferior, and semispinalis capitis
- All are extensors of head except obliquus capitis inferior which rotates atlas
- Obliquus capitis superior assists rectus capitis lateralis in lateral flexion of head
- Rectus capitis posterior major rotates head to ipsilateral side
- Semispinalis capitis rotates head to contralateral side
- Upper Trapezius extend head & rotate its to ipsilateral side

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Muscles that Move the Head

– Posterior muscles



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Muscles that Move the Head

- **Splenius capitis & sternocleidomastoid**
 - Much larger & more powerful in moving head & cervical spine
- **Remaining cervical spine muscles are grouped with muscles of vertebral column**

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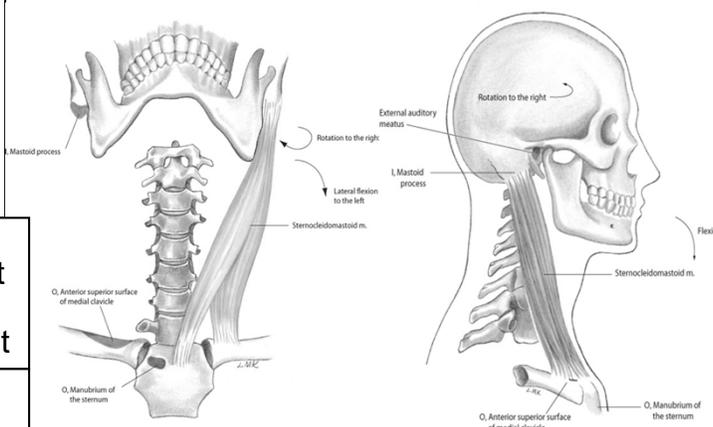
12-42

Sternocleidomastoid Muscles

Both sides:
extension of
head at
atlantooccipital
joint & flexion
of neck

Right side:
rotation to left
& lateral
flexion to right

Left side:
rotation to
right & lateral
flexion to left



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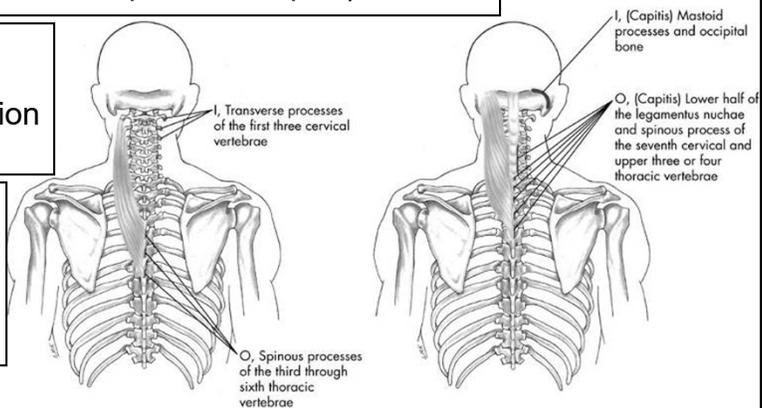
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Splenius Muscles (cervicis, capitis)

Both sides: extension of head (splenius capitis)
& neck (splenius capitis and capitis)

Right side:
rotation &
lateral flexion
to right

Left side:
rotation &
lateral flexion
to left



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Muscles of the Vertebral Column

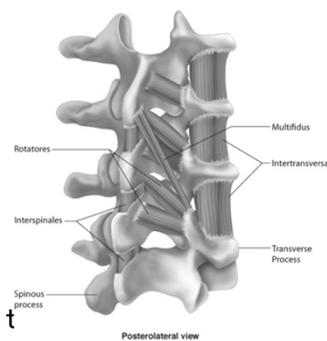
- **Cervical area**
 - Longus colli muscles
 - located anteriorly
 - flex cervical & upper thoracic vertebrae
- **Posterior**
 - Erector spinae group, transversospinalis group, interspinal–intertransverse group, & splenius
 - All run vertically parallel to spinal column
 - Location enables them to extend spine and assist in rotation & lateral flexion

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Muscles of the Vertebral Column

- **Posterior**
 - Interspinal–intertransverse group
 - lie deep to rotatores
 - laterally flex & extend
 - do not rotate vertebrae
 - Interspinales
 - » extensors
 - » connect from spinous process of one vertebra to spinous process of adjacent vertebra



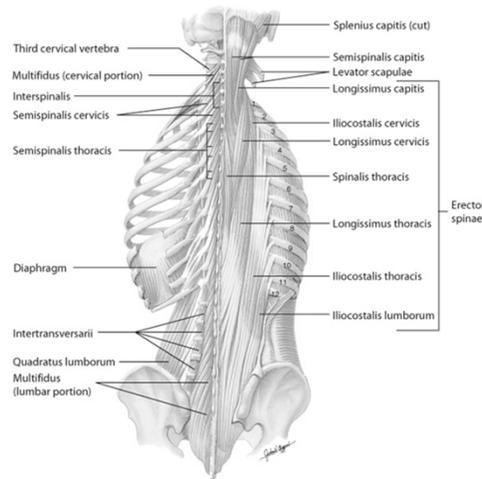
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Muscles of the Vertebral Column

- **Posterior**
 - **Interspinal-
intertransverse group**
 - **Intertransversarii
muscles**
 - » flex vertebral
column laterally
 - » connect to
transverse
processes of
adjacent
vertebrae



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Posterior Muscles of the Thorax

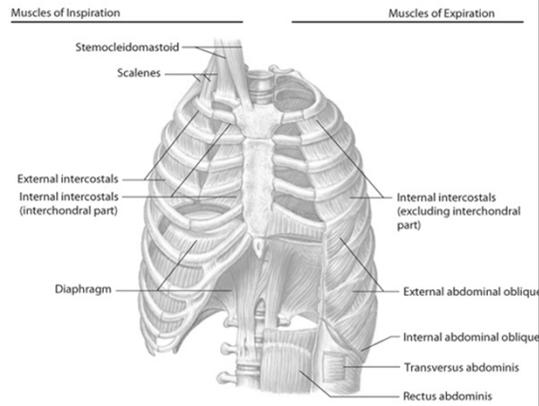
- **Involved almost entirely in respiration**
 - **Diaphragm**
 - Responsible for breathing during quiet rest
 - As it contracts & flattens, thoracic volume is increased & air is inspired to equalize the pressure
 - When larger amounts of air are needed, as in exercise, other thoracic muscle have a more significant role in inspiration

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Posterior Muscles of the Thorax

- Scalene muscles elevate first 2 ribs to increase thoracic volume
- External intercostals further expand the chest
- Levator costarum & serratus posterior – inspiration
- Internal intercostals, transversus thoracis, & subcostales contract to force expiration



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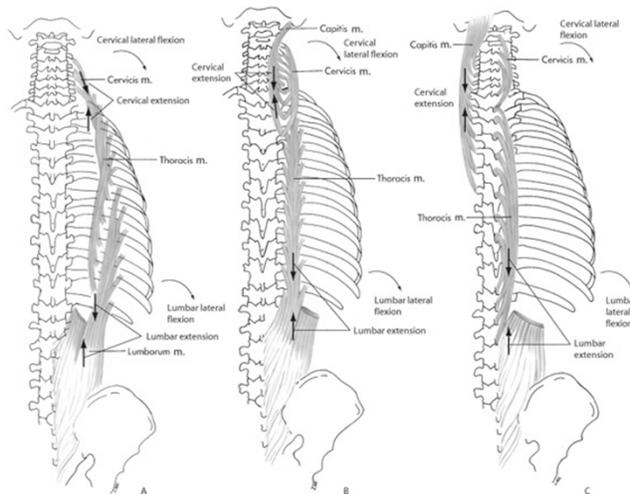
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Erector Spinae Muscles (sacrospinalis)

- *Iliocostalis* (lateral layer)
- *Longissimus* (middle layer)
- *Spinalis* (medial layer)

Extension, lateral flexion, & ipsilateral rotation of spine & head

Anterior pelvic rotation



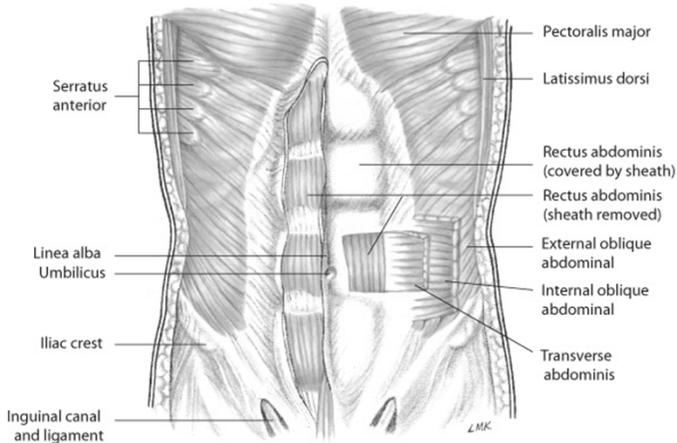
Lateral pelvic rotation to contralateral side

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Muscles of the Abdominal Wall

- Rectus abdominis
- External oblique abdominal
- Internal oblique abdominal
- Transverse abdominis

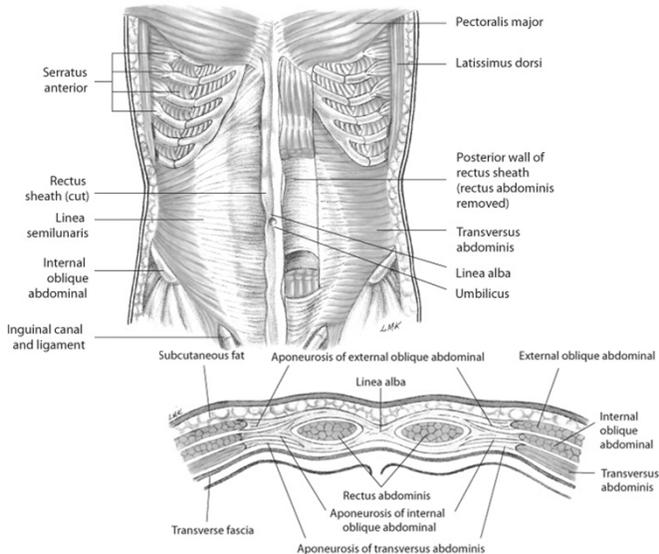


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Muscles of the Abdominal Wall

- Rectus abdominis
- External oblique abdominal
- Internal oblique abdominal
- Transverse abdominis



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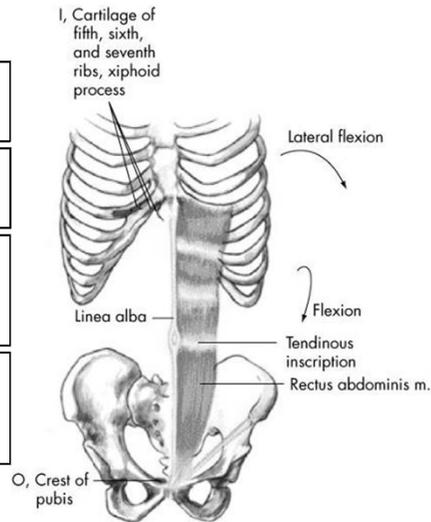
Rectus Abdominis Muscle

Both sides:
lumbar flexion

Posterior pelvic
rotation

Right side: weak
lateral flexion
to right

Left side: weak
lateral flexion
to left



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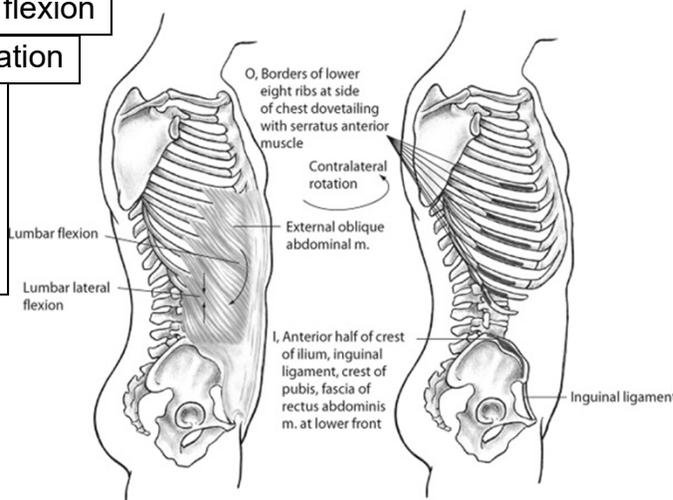
External Oblique Abdominal Muscle

Both sides: lumbar flexion

Posterior pelvic rotation

Right side: lumbar lateral flexion to right, rotation to left, & lateral pelvic rotation to left

Left side: lumbar lateral flexion to left, rotation to right, & lateral pelvic rotation to right



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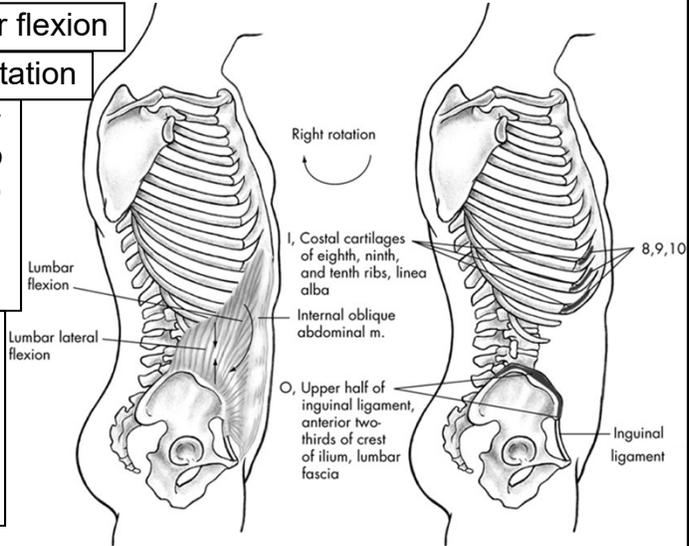
Internal Oblique Abdominal Muscle

Both sides: lumbar flexion

Posterior pelvic rotation

Right side: lumbar lateral flexion to right, rotation to right, & lateral pelvic rotation to left

Left side: lumbar lateral flexion to left, rotation to left, & lateral pelvic rotation to right

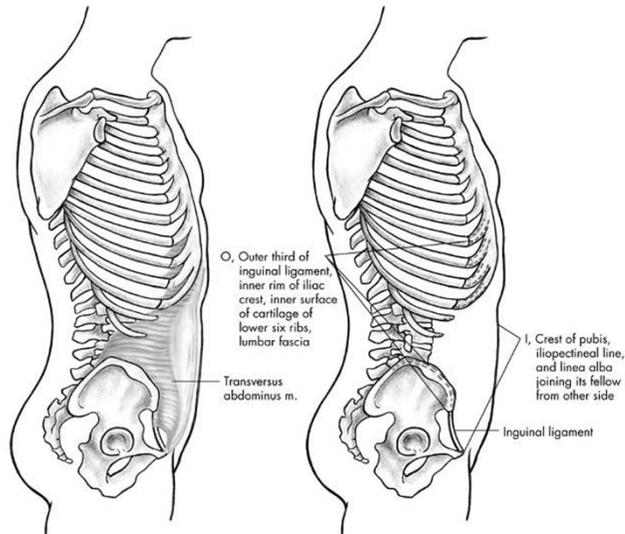


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Transversus Abdominis Muscle

Forced expiration by pulling the abdominal wall inward

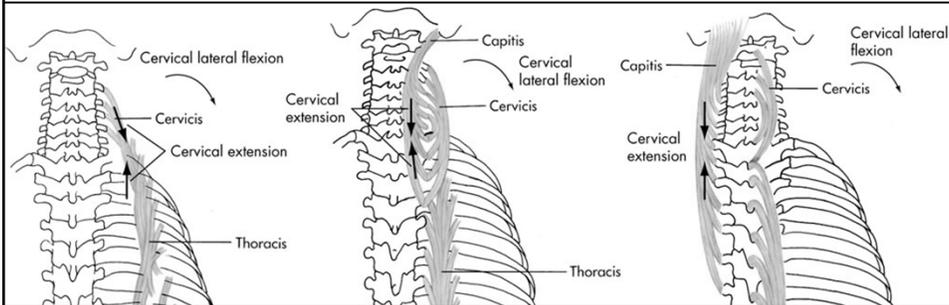


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Cervical Extension

- Agonists
 - Erector Spinae

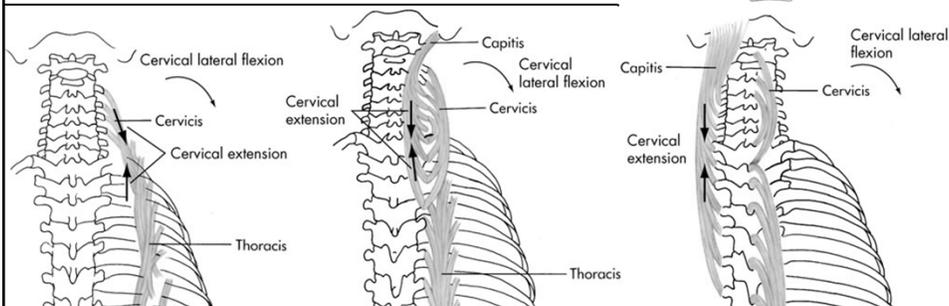
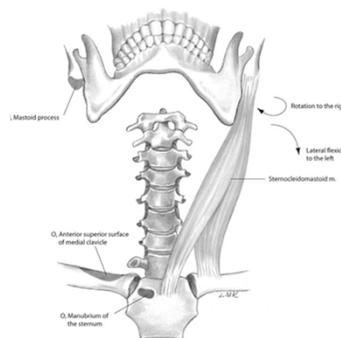


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Cervical Lateral Flexion

- Agonists
 - Sternocleidomastoid
 - Erector Spinae

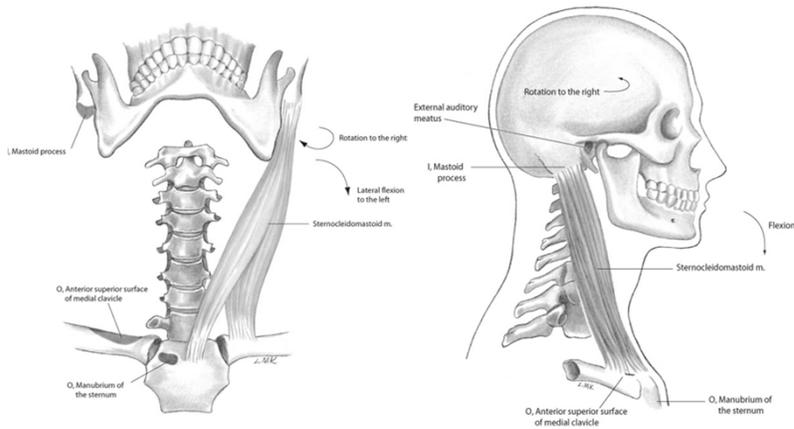


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Cervical Rotation

- Agonists
 - Sternocleidomastoid

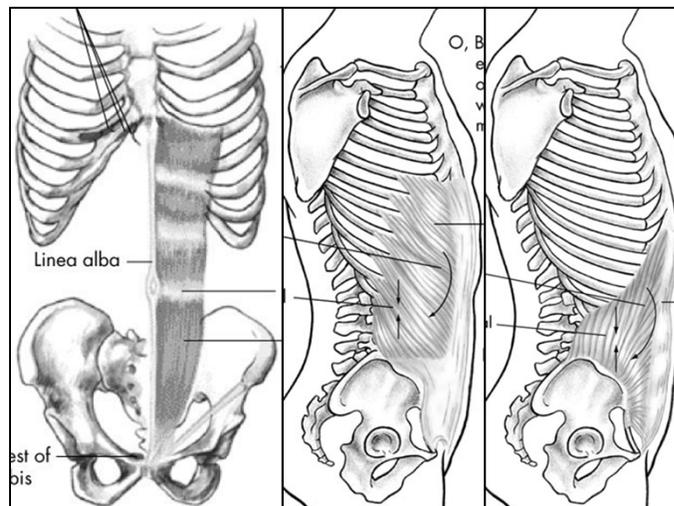


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Lumbar Flexion

- Agonists
 - Rectus abdominis
 - External oblique abdominal
 - Internal oblique abdominal

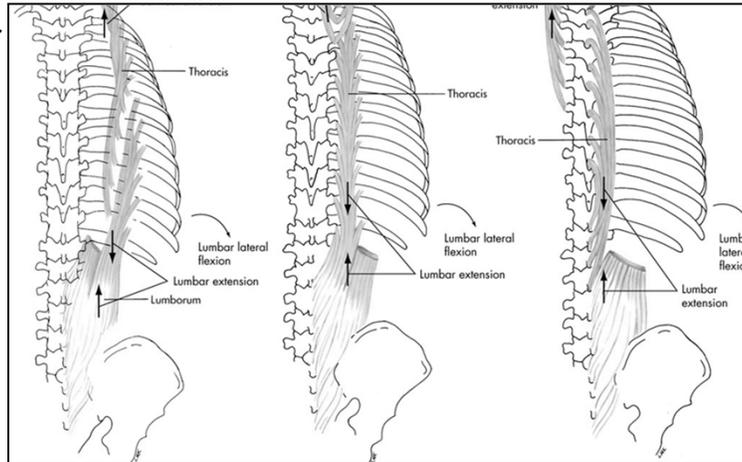


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Lumbar Extension

- Agonists
 - Erector spinae

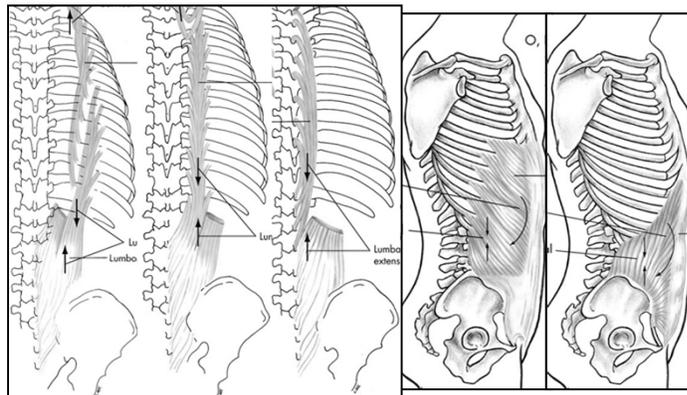


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Lumbar Lateral Flexion

- Agonists
 - Erector spinae
 - External oblique abdominal
 - Internal oblique abdominal

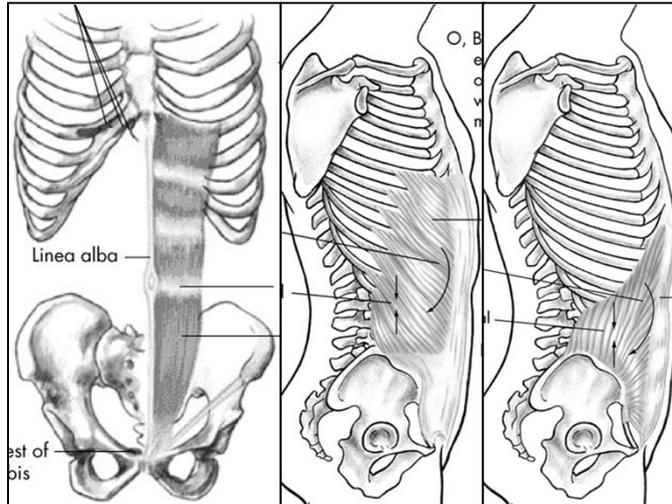


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Lumbar Rotation

- Agonists
 - Rectus abdominis
 - External oblique abdominal
 - Internal oblique abdominal



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Web Sites

Radiologic Anatomy Browser

<http://radlinux1.usuf1.usuhs.mil/rad/iong>

- This site has numerous radiological views of the musculoskeletal system.

Loyola University Medical Center: Structure of the Human Body

www.meddean.luc.edu/lumen/meded/grossanatomy/index.htm

- An excellent site with many slides, dissections, tutorials, etc. for the study of human anatomy

University of Arkansas Medical School Gross Anatomy for Medical Students

<http://anatomy.uams.edu/anatomyhtml/gross.html>

- Dissections, anatomy tables, atlas images, links, etc.

Wheless' Textbook of Orthopaedics

www.whelessonline.com/

- This site has an extensive index of links to the fractures, joints, muscles, nerves, trauma, medications, medical topics, lab tests, and links to orthopedic journals and other orthopedic and medical news.

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Web Sites

Premiere Medical Search Engine

www.medsite.com

- This site allows the reader to enter any medical condition and it will search the net to find relevant articles.

Virtual Hospital

www.vh.org

- Numerous slides, patient information, etc.

Core Stability

www.brianmac.demon.co.uk/corestab.htm

- The muscles of the trunk, training techniques, and exercises

Become Healthy Now.com: The Spine

www.becomehealthynow.com/category/bodyspine

- Anatomy and function of spine

Web Sites

Spine Universe

www.spineuniverse.com

- Information on the spine for educating the public about technologies, services, treatments and research available on spinal disorders

Stabilization Sensibility

www.calainc.org/Handouts/Participant_handouts/05_04%20Stabilization.pdf

- A discussion on muscles of the Abdomen

Hospital for Joint Disease Spine Center

<http://www.med.nyu.edu/hjd/hjdspine/musclesandligaments.htm>

- Muscles and Ligaments of the Spine