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

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

• Cervical vertebrae

• 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

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

- Thoracic vertebrae

- Lumbar vertebrae

- 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

- 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

- All ribs attached posteriorly to thoracic vertebrae
- Sternum
  - Manubrium, body of sternum, & xiphoid process

- 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
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

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

- 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 facet joints

- Intervertebral disks
  - between & adhering to articular cartilage of vertebral bodies
  - annulus fibrosus - outer rim of dense fibrocartilage
  - nucleus pulposus - central gelatinous, 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

- 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

- 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
Joints

• Cervical region
  – Flexes 45 degrees
  – Extends 45 degrees
  – Laterally flexes 45 degrees
  – Rotate approximately 60 degrees

Joints

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

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

Movements

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

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

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

Trunk & Spinal Column Muscles

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

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

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
- 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

- Muscles of the vertebral column
  - Superficial
    - Erector spinae (sacrospinalis)
      - Spinalis - cervicis, thoracis
      - Longissimus - capitis, cervicis, thoracis
      - Iliocostalis - cervicis, thoracis, lumborum
    - Splenius cervicis

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

- 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

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
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

- 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
  - Obligus capitis superior assists rectus capitis laterals 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

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
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

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

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 & assist in rotation & lateral flexion

Muscles of the Vertebral Column

- Posterior
  - Interspinal-intertransverse group
    - Inte deep to rotators
    - Laterally flex & extend
    - Do not rotate vertebrae
    - Interspinales
      - Extensors
        - Connect from spinous process of one vertebra to spinous process of adjacent vertebra

Muscles of the Vertebral Column

- Posterior
  - Interspinal-intertransverse group
    - Intertransversarii muscles
      - Flex vertebral column laterally
      - Connect to transverse processes of adjacent vertebrae

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
**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

**Erector Spinae Muscles (sacrospinalis)**

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

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

Anterior pelvic rotation

**Muscles of the Abdominal Wall**

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

**Rectus Abdominis Muscle**

<table>
<thead>
<tr>
<th>Both sides:</th>
<th>Lumbar flexion</th>
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<tbody>
<tr>
<td>Posterior rotation</td>
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<tr>
<td>Right side: weak lateral flexion to right</td>
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<tr>
<td>Left side: weak lateral flexion to left</td>
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</tbody>
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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 |
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

Transversus Abdominis Muscle

Forced expiration by pulling the abdominal wall inward

Quadratus Lumborum Muscle

Lateral flexion to ipsilateral side
Stabilizes pelvis & lumbar spine

Extension of lumbar spine
Anterior pelvic rotation

Lateral pelvic rotation to contralateral side

Cervical Flexion

• Agonists
  – Sternocleidomastoid

Cervical Extension

• Agonists
  – Erector Spinae

Cervical Lateral Flexion

• Agonists
  – Sternocleidomastoid
  – Erector Spinae
Cervical Rotation

- **Agonists**
  - Sternocleidomastoid

Lumbar Flexion

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

Lumbar Extension

- **Agonists**
  - Erector spinae

Lumbar Lateral Flexion

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

Lumbar Rotation

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

Web Sites

- **Radiologic Anatomy Browser**
  - 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](http://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**
  - Dissections, anatomy tables, atlas images, links, etc.

- **Wheeless’ Textbook of Orthopaedics**
  - [www.wheelessonline.com/](http://www.wheelessonline.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.
### 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

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### 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/hjds/hipspine/musclesandligaments.htm  
- Muscles and Ligaments of the Spine