The Vertebral Column
Clarification of Terms

The **Spine, Spinal Column, and Vertebral Column** are synonymous terms referring to the bony components housing the spinal cord.

- **Spinal Cord** = made of nervous tissue
- **Facet** = a small, smooth, flat surface on a bone
- **Facet Joint** = the articulation between the superior articular process of the vertebra below with the inferior articular process of the vertebra above

Lippert, p211-212
Osteology

- Occipital Bone
- Temporal Bone
- Vertebrae
- Intervertebral Disk
- Atlas
- Axis
- C7
Osteology...cont

- **Occipital Bone:**

![Diagram of Occipital Bone](image1.png)

- **External Occipital Protuberance**
- **External Occipital Crest**
- **Foramen Magnum**
- **Condylar Foramen**
- **Jugular Process**
- **Base of Occipital Bone**

![Diagram of Occipital Bone: Inf. View](image2.png)

- **Squama Part**
- **Occipital plane**
- **Ext occipital protuberance**
- **Highest nuchal line**
- **Ext occipital crest**
- **Sup.nuchal line**
- **Inf nuchal line**
- **Nuchal plane**
- **Mastoid border**
- **Condylar Part**
- **Condylar canal**
- **Jugular notch**
- **Hypoglossal canal**
- **Base of Occipital condyle**
- **Basilar Part**
- **Pharyngeal tuberc.**
Osteology...cont

Temporal Bone:
Osteology continued

Parts of a Vertebra

Body
Neural Arch
Vertebral Foramen
Pedicle
Lamina
Transverse Process
Articular Process
Spinous Process
Typical Cervical Vertebrae

Superior View

- Bifid spinous process
- Vertebral foramen
- Inferior articular process
- Pedicle
- Transverse foramen
- Superior articular process (facet)
- Lamina
- Body
Vertebrae:
Intervertebral Disks:

- 23 disks located between vertebrae, starting between C2 and C3
- Function = absorb and transmit shock and maintain flexibility of the vertebral column
- Disks make up approx 25% of the total length of the vertebral column

Lippert, p214-215
Intervertebral Disks...cont:

- **Annulus Fibrosus**: outer portion of the disk consisting of several fibrocartilagenous rings that contain the nucleus pulposus

- **Nucleus Pulposus**: pulpy, gelatinous substance with high water content in the center of the disk

Lippert, p215
Atlas: Caudal aspect

- Anterior tubercle
- Superior articulating facet
- Transverse foramen
- Transverse process
- Vertebral foramen
- Posterior arch
- Posterior tubercle

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Axis: 2nd Cervical Vertebra

Posterior Aspect

- posterior articular surface
- body of axis
- vertebral foramen
- odontoid process
- superior articulating surface
- transverse process
- arch of axis
- spinous process (bifid)
Osteology...cont

C7:
Examples of Vertebrae

- **Atlas**
- **Axis**
- **Cervical**
- **Thoracic**
- **Lumbar**
Joint Structure

- **Atlanto-Occipital Joint** = articulation between condyles of occiput with atlas (C1)
  - Strong union that supports the weight of the head
- **Atlantoaxial Joint** = articulation between atlas (C1) and axis (C2)

Lippert, p217
Articulations between C2 through S1 = all basically the same

Strong, weight bearing articulations occur anteriorly between the vertebral bodies

Posteriorly, there are 2 articulations (one on each side) called facet joints (formed by the articular processes of adjacent vertebrae)

Each facet joint = synovial joint with synovial membrane and capsular ligament

The direction the facets face largely determine the type and amount of motion possible at that part of the vertebral column
Joint Movement

- **Atlanto-Occipital Joint**
  - Flexion and extension, no rotation

- **Atlantoaxial Joint**
  - Rotation and some lateral flexion (aka sidebending)

- **Cervical Spine**
  - Flexion, extension, rotation, sidebending
  - Retraction = combined head flexion on C1 and C2-C7 extension
  - Protraction = combined head extension C1 and C2-C7 flexion

- **Thoracic Spine**
  - Facets in frontal plane
  - Mostly rotation and lateral flexion
  - Attachment of ribs contributes to lack of flexion and extension

- **Lumbar Spine**
  - Facets in sagittal plane
  - Most flexion and extension of vertebral column occurs in lumbar spine

Lippert, p219
Supporting Structures

Anterior longitudinal ligament
Attaches the bodies of the vertebrae on the anterior surface
Prevents excessive hyper extension
Thin superiorly and thick inferiorly to fuse the sacrum
Found in the thoracic and lumbar regions deep to the aorta

Lippert, 218
Posterior longitudinal ligament

Attaches to the bodies of the vertebrae on the posterior surfaces inside the vertebral foramen

Prevents excessive flexion

Thick superiorly to help support the skull and thin inferiorly

Contributes to instability and increased disk injury in the lumbar region.

Lippert, 218
Supporting Structures...cont

Supraspinal ligament
  Extends from the 7th cervical vertebra distally to the sacrum posteriorly along the tips of the spinous processes

Interspinous ligament
  Attaches successive spinous processes

Nuchal ligament
  Interspinous ligament in the cervical spine

Lippert, 218
Supporting Structures...cont

Ligamentum Flavum
Connects adjacent laminae on the anterior surface

Lippert, 218
Muscles of the neck and trunk are numerous and can be divided into anterior and posterior muscles.

The quadratus lumborum is the only exception (located laterally)

Anterior muscles ________________ the spine

Posterior muscles ________________ the spine
Cervical

Anterior

Superficial
- Sternocleidomastoid (SCM)
- Scalenes

Deep
- Longus colli and capitis
- Rectus capitis anterior and lateralis

Posterior

Superficial
- Splenius capitis and cervicis
- Erector spinae

Deep
- Suboccipital muscles (rectus capitis posterior major and minor, obliquus capitis superior and inferior)
Cervical

Anterior

Superficial

Sternocleidomasteoid (SCM)

Scalenes
<table>
<thead>
<tr>
<th><strong>Sternocleidomastoid</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
</tr>
</tbody>
</table>
| **Sternal head:** superior aspect of the manubrium of the sternum  
**Clavicular head:** medial 1/3 of the clavicle |
| **Insertion**           |
| Mastoid process of the temporal bone |
| **Innervation**         |
| Spinal accessory n. (cranial n. XI) |
| **Action**              |
| **Bilateral:** Flexion of the head & neck  
**Unilateral:** Contralateral rotation of the head and neck |

Lippert, p219-220
### Scalenes

| **Origin**          | Ant. Scalene: transverse processes of C3-C7  
|                    | Middle Scalene: transverse processes of C2-C7  
|                    | Posterior Scalene: transverse processes of C5-C7  |
| **Insertion**       | Ant. Scalene: 1\(^{st}\) rib  
|                    | Middle Scalene: 1\(^{st}\) rib  
|                    | Posterior Scalene: external surface of the 2\(^{nd}\) rib  |
| **Innervation**     | Ventral rami (C3-C7)  |
| **Action**          | Bilateral: flexion of the neck, assist with inspiration by elevating ribs 1&2  
|                    | Unilateral: lateral flexion  |

Lippert, p220
Myology…cont

Cervical

Anterior

Deep

- Longus colli = flexes neck
- Longus capitis = flexes head
- Rectus capitis anterior = flexes head
- Rectus capitis lateralis = laterally bends head

Lippert, p221
Posterior Neck

Superficial
- Splenius capitis & cervicis = bilaterally = extends head and neck, unilaterally = rotates and laterally bends the face to same side
- Erector spinae = extensors which bring the head back from a flexed position

Deep
- Suboccipital muscles (rectus capitis posterior major* and minor, obliquus capitis superior and inferior *) = extend the head and * also lateral bend and rotate to the same side
Neck: Posterior: Superficial: Splenius capitis and cervicis
Myology…cont

- **Neck:**
- **Posterior:**
- **Deep:**
- **Suboccipital Muscles**
Trunk

Anterior

Superficial to Deep:
- Rectus Abdominis
- External Oblique
- Internal Oblique
- Transverse Abdominis

Posterior

Superficial
- Erector spinae

Deep
- Transverse spinal muscles
Trunk

Anterior

Superficial to Deep:
- Rectus Abdominis
- External Oblique
- Internal Oblique
- Transverse Abdominis
<table>
<thead>
<tr>
<th><strong>Rectus Abdominis</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
</tr>
<tr>
<td><strong>Action</strong></td>
</tr>
<tr>
<td><strong>“tidbits”</strong></td>
</tr>
</tbody>
</table>

Lippert, p223
<table>
<thead>
<tr>
<th><strong>External Oblique</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
<td>Lateral side of ribs 4-12</td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
<td>Iliac crest and linea alba</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Intercostal nerves (T8-T12)</td>
</tr>
</tbody>
</table>
| **Action**          | **Bilateral:** Flexion of the trunk, posterior pelvic tilt, increased intra-abdominal and intra-thoracic pressure  
                      **Unilateral:** Rotation of the trunk to the contralateral side, lateral flexion of the trunk |

Lippert, p223
## Internal Oblique

<table>
<thead>
<tr>
<th><strong>Origin</strong></th>
<th>Iliac crest, inguinal ligament &amp; thoracolumbar fascia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insertion</strong></td>
<td>Ribs 9-12, linea alba</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Intercostal n. (T8-T12)</td>
</tr>
</tbody>
</table>
| **Action** | **Bilateral:** flexion of the trunk, posterior pelvic tilt, increases intra-abdominal and intra-thoracic pressure  
**Unilateral:** lateral flexion of the trunk, rotation of the trunk to the ipsilateral side |

Lippert, p223
## Transverse Abdominis

<table>
<thead>
<tr>
<th>Origin</th>
<th>Iliac crest, thoracolumbar fascia cartlages of ribs 6-12, &amp; inguinal ligament</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>Linea alba</td>
</tr>
<tr>
<td>Innervation</td>
<td>Intercostal n. (T7-T12)</td>
</tr>
<tr>
<td>Action</td>
<td>Increases intra-abdominal pressure, increases tension in thoracolumbar fascia</td>
</tr>
</tbody>
</table>

Lippert, p224
Myology...cont

- **Trunk: Posterior: Superficial: Erector Spinae**
  - 3 muscles make up the erector spinae
  - Medially = *spinalis*
    - Attaches spinous process to spinous process
    - Action = extension
  - Intermediate = *longissimus*
    - Attaches transverse process to transverse process
    - Action = extension and lateral bending
  - Laterally = *iliocostalis*
    - Attaches transverse process to rib or rib to rib
    - Action = extension and lateral bending

Lippert, p224
Trunk: Posterior: Deep: Transverse Spinal Muscle Group

- 3 muscles make up the Transverse Spinal Group
- They attach from transverse to spinous process
- Action = extension and rotation to the opposite side
  - Most superficial = *semispinalis* (tend to span ≥ 5 vertabrae)
  - Intermediate = *multifidus* (tend to span 2-4 vertebrae)
  - Deepest = *rotatores* (span 1 vertebrae)
- (All run the entire vertebral column in layers)

Myology...cont

Lippert, p225-226
Myology…cont

- **Trunk: Posterior: Deep: Transverse Spinal Muscle Group**
References