

# Anatomy & Physiology II

Trunk

# Bones and Landmarks of the Spine

- Vertebral column
  - 24 vertebrae
  - Sacrum - consists of 5 vertebrae that fuse into one bone
    - Median sacral crest
    - Sacral hiatus
    - 4 sacral foramina
  - Coccyx – 3-5 fused vertebrae
- Landmarks
  - Vertebral Body
  - Vertebral Arch
  - Articular Process
  - Facet Joints

# Vertebral Anatomy

- Vertebra contain
  - A Vertebral Body
  - A Vertebral Arch
- The vertebrae are held together by ligaments
  - Includes the:
    - Supraspinous ligament
    - Interspinous ligament
    - Ligamentum flavum
    - Posterior longitudinal ligament
    - Anterior longitudinal ligament

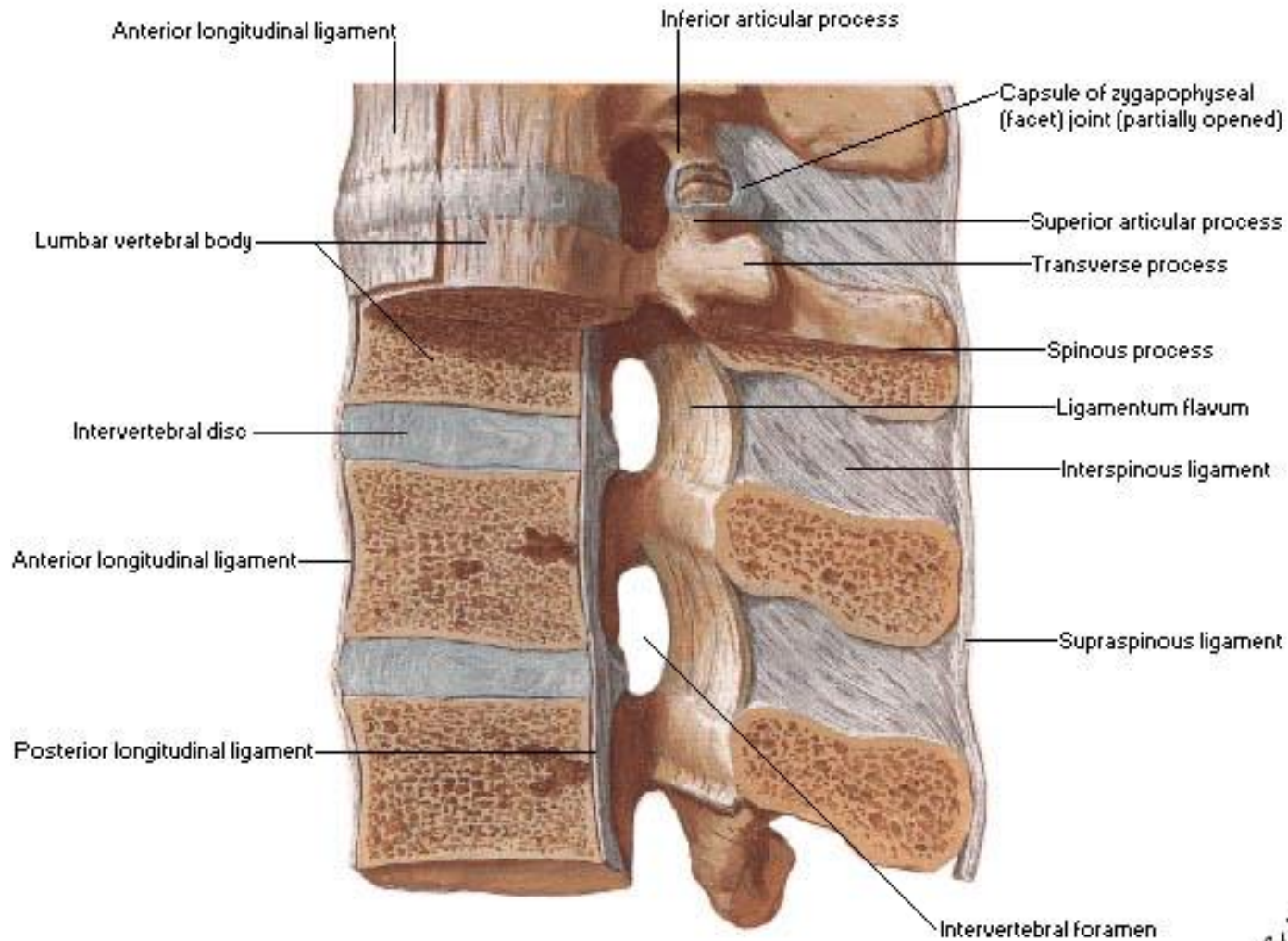
Thoracic Vertebrae [T6]

Superior View



# Vertebral Ligaments of Lumbar Region

## Left Lateral View - Partially Sectioned



# Vertebral Anatomy

- A Vertebral Body
  - Separated by intervertebral discs

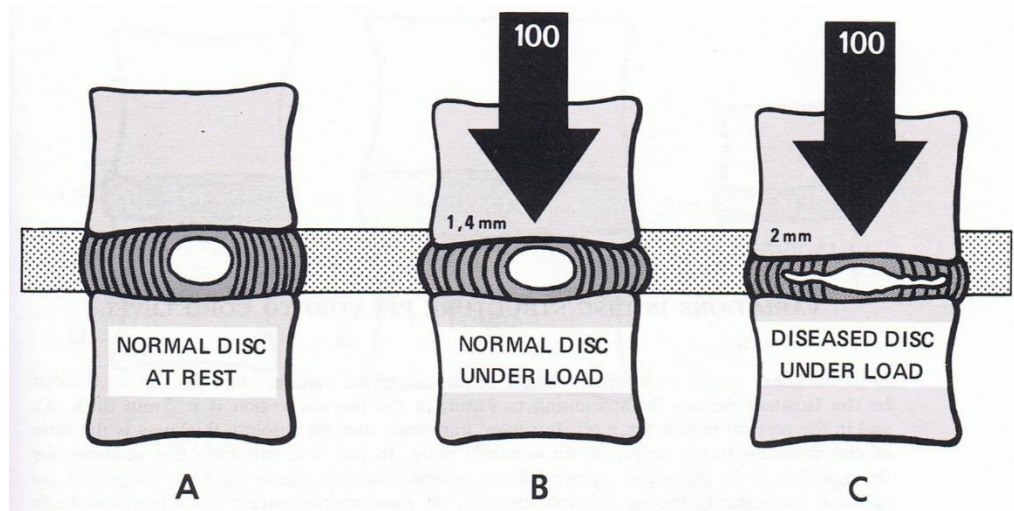
**Thoracic Vertebrae [T6]**

Superior View



# Intervertebral Disc

- Normal and Degenerative Disc
  - The Intervertebral disc consists of the outer fibrous annulus fibrosis and the gel-like inner nucleus pulposus
  - The intervertebral disc degenerates as a normal part of aging, though this can be accelerated by trauma, infection, smoking and other problems which damage the disc.
  - The nucleus pulposus is unable to keep properly hydrated and the disc starts to lose its ability to push the adjacent vertebral bodies apart.
  - Changes also occur in the annulus fibrosus. The fibroelastic fibers begin to break down, allowing small tears to occur. The exposed collagen fibers stimulate the growth of richly innervated granulation tissue which can lead to discogenic pain



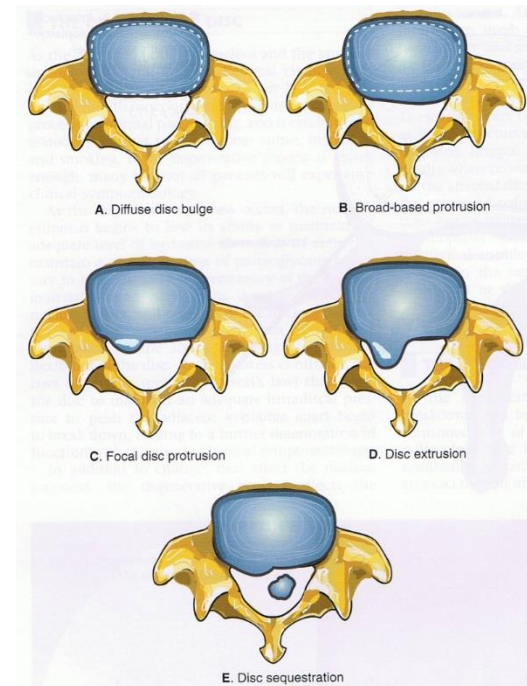
# Nomenclature and Classification of Disc Pathology

- Much confusion surrounds the nomenclature of disc pathology. Much of the nomenclature predates CT scans and MRI. Also, many clinicians look to impingement of intervertebral discs on neural structures to be the sole source of pain, ignoring facet joint pathology and pain due to disc pathology as a source of pain
- The most common classifications are listed in following slides:



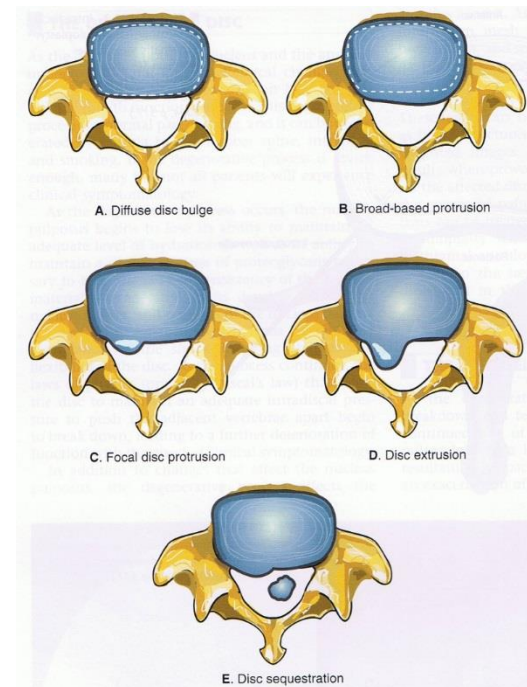
# Nomenclature and Classification of Disc Pathology

- Annular fissure/tear vs. disc herniation
  - Annular tear describes a separation between annular fibers, avulsion of fibers from their vertebral body insertions, or breaks through fibers that extend radially, transversely, or concentrically, involving one or many layers of the annular lamellae.



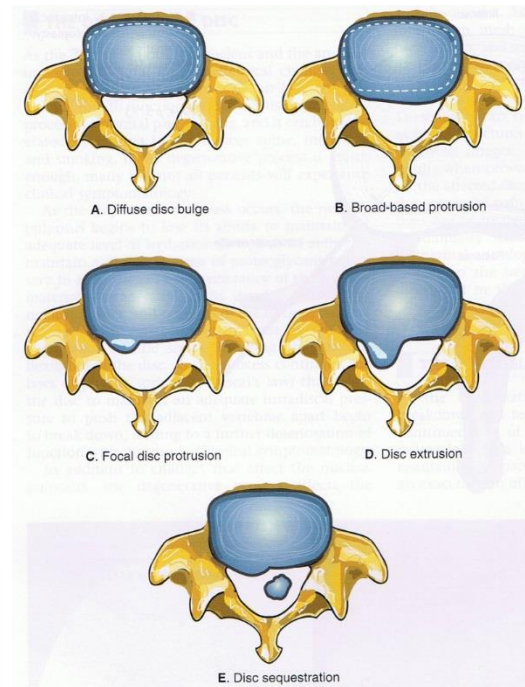
# Nomenclature and Classification of Disc Pathology

- Annular fissure/tear vs. disc herniation
  - Herniation describes a localized displacement of disc material beyond the limits of the intervertebral disc space.
  - Disc herniations may be contained (covered by annular fibrosus) or uncontained.
  - Herniations can be localized or generalized (greater than 50% [180 degrees] of periphery of disc).
  - Localized herniations can be classified as focal (less than 25% of disc circumference) or broad-based (between 25%-50% of disc circumference).



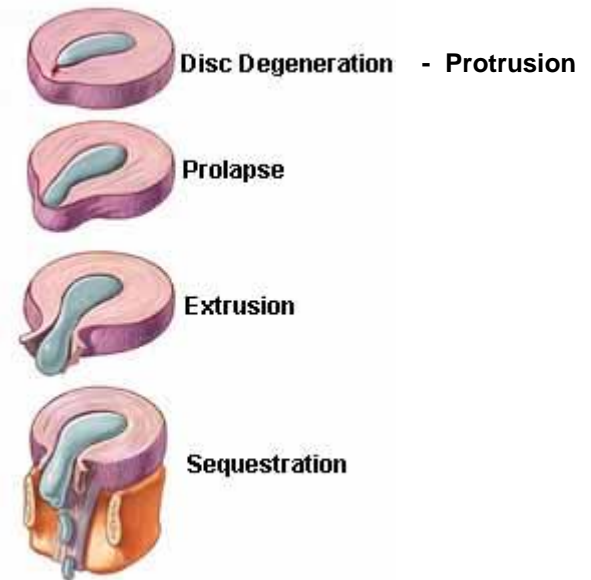
# Nomenclature and Classification of Disc Pathology

- Sometimes bulging refers to the presence of disc material beyond the boundaries of the vertebral bodies with a diameter from 180-360 degrees the circumference of the disk



# Nomenclature and Classification of Disc Pathology

- Herniations may have the following morphology and are often indicated as below on MRI reports:
  - Protrusion
  - Prolapse
  - Extrusion
  - Sequestration



# Pain from Disc Pathology and Dermatomal Distribution

- Pain can be discogenic, radicular or both. Radiculopathy symptomology is dependent on the vertebral level and follows dermatomal distribution. In general:
  - Cervical - Pain in the neck, shoulders, and arms
  - Thoracic - Pain radiating into the chest
  - Lumbar - Pain extending into the buttocks, thighs, legs

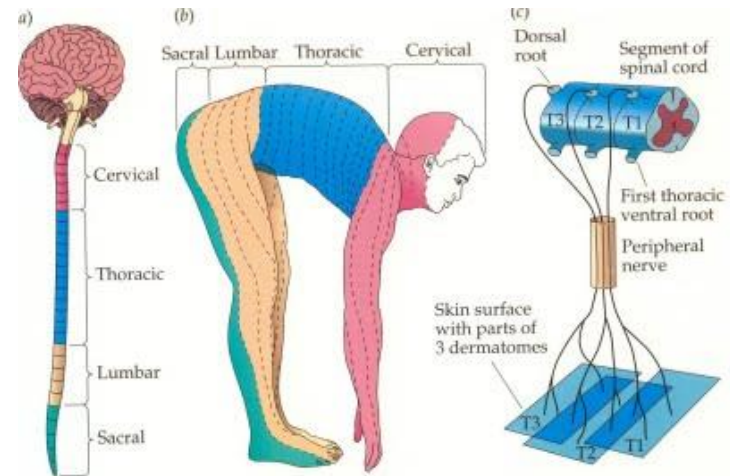
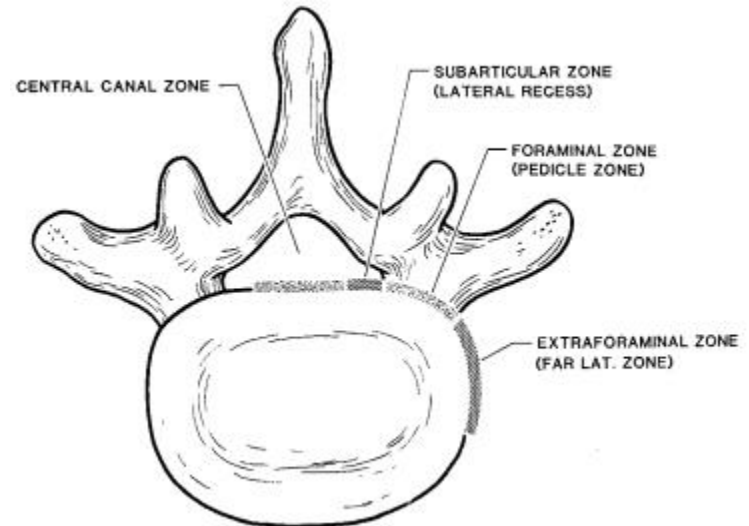


Figure 8.15 Dermatomes

# Axial Zones of Herniations

- Axial location of a herniated disc is indicated by zones. Zones predict symptomology due to which portion of the anatomy is affected:
- Central Canal Zone
- Lateral Recess or Paramedial Zone
- Subarticular or Intraforaminal Zone
- Extraforaminal or Lateral Zone



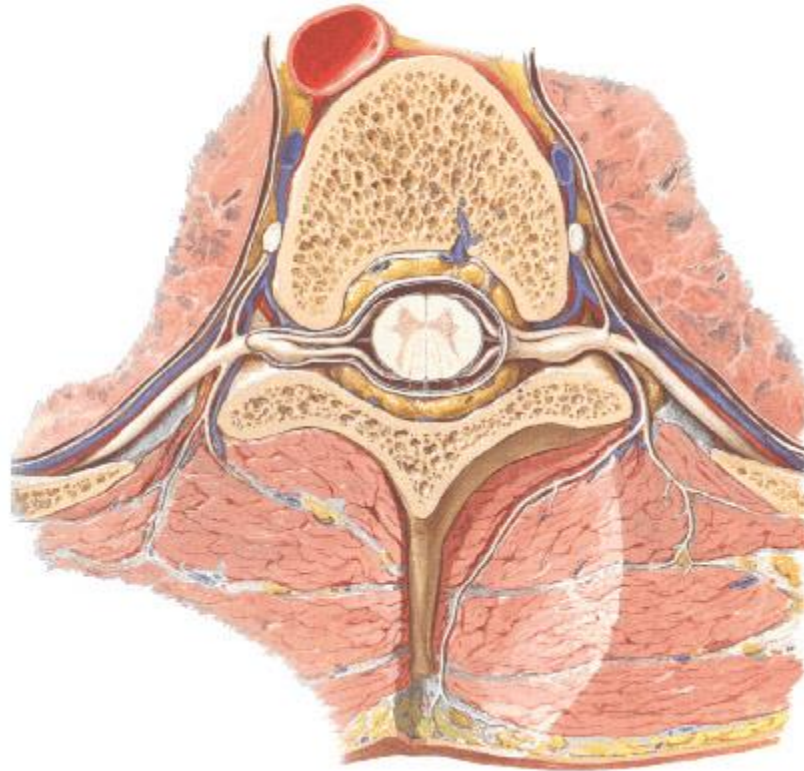
# Vertebral Canal

## Vertebral Ligaments of Lumbar Region

Left Lateral View - Partially Sectioned



**Spinal Nerve Origin**  
Section through Thoracic Vertebra



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DOM



# Vertebral Anatomy

- Vertebra also contains a vertebral arch
  - Consists of
    - Pedicles – ‘walls’
    - Laminae – ‘roof’
  - Together these form the Vertebral foramen. Vertebral foramina of all the vertebrae create the vertebral canal which houses and protects the spinal cord
  - The spinal nerves exit from the intervertebral foramen between the pedicles of two vertebrae
- Spinous process
  - Process that projects posterior
- Transverse processes
  - Processes that project lateral
- Articular processes
  - Each process has a smooth, concave surface called an articular facet (also called zygapophyseal joints)
  - These articulate with superior and inferior vertebrae (and for thoracic vertebrae with the ribs)

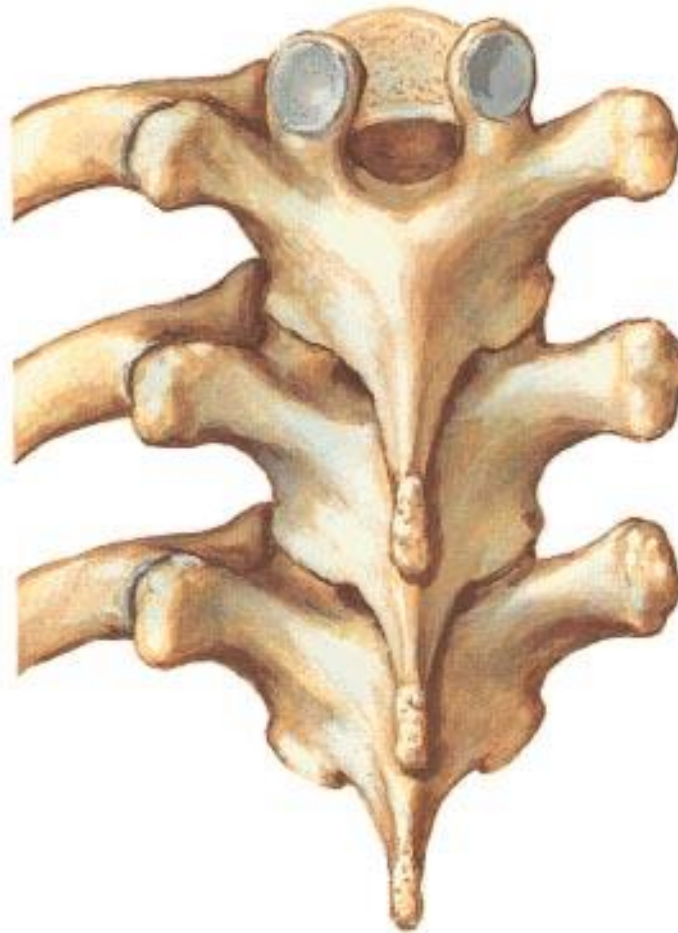
**Thoracic Vertebrae [T6]**

Superior View



# Thoracic Vertebrae [T7-9] - Assembled

## Posterior View



# Sacrum

- Sacral canal
  - Begins between the articular process of L5 and sacrum
- Median sacral crest
  - Ridge formed by the fused spinous processes of sacral vertebrae
- Sacral cornua and sacral hiatus
  - Sacral cornua are formed from the laminae of the fifth sacral vertebrae which fail to contact one another
  - These ridges form the margins of the sacral hiatus which is the opening of the inferior end of the sacral canal
- Sacral foramina
  - 4 pairs which open on either side of the median sacral crest

# Sacrum

## Sacrum and Coccyx

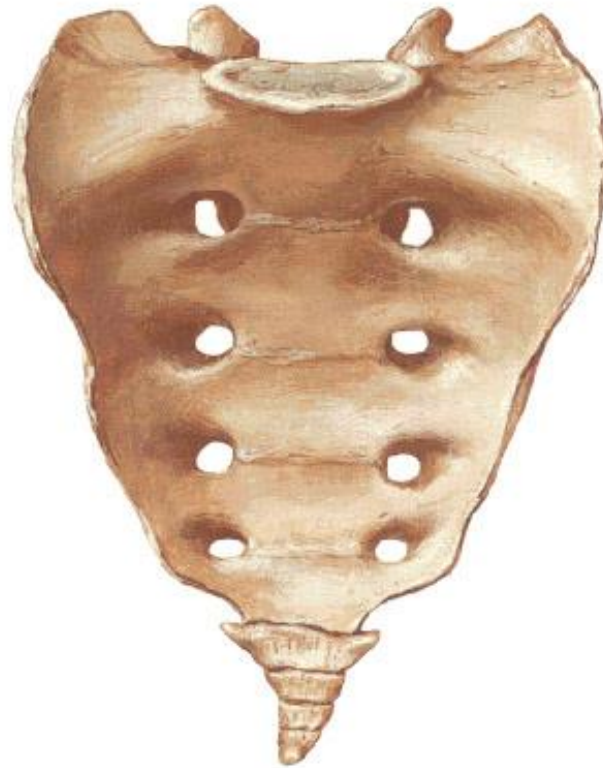
Dorsal Surface



# Sacrum

## Sacrum and Coccyx

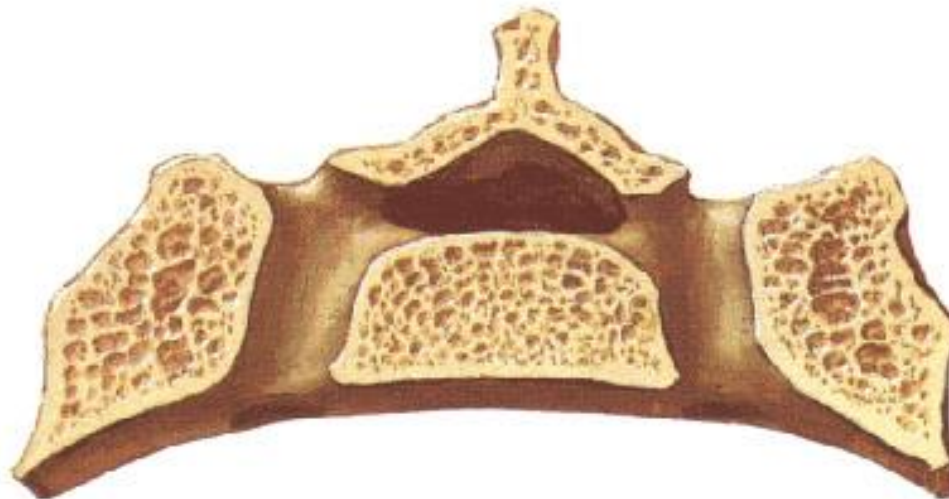
Pelvic Surface



# Sacrum

## Sacrum

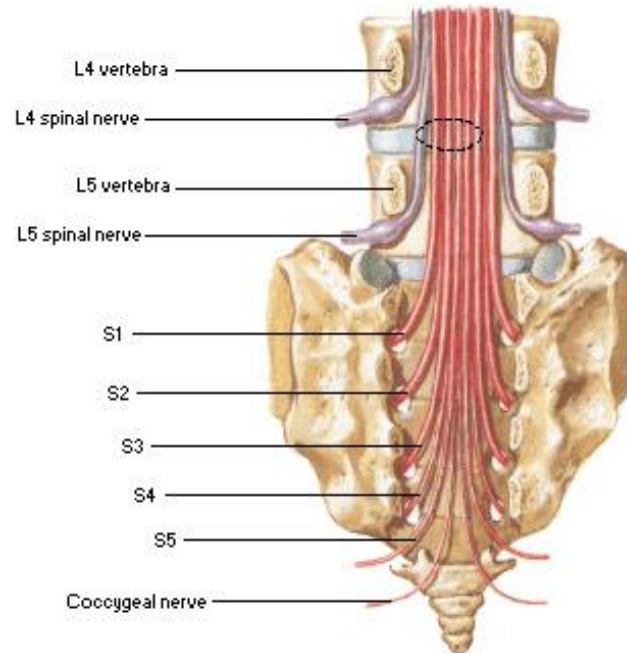
Coronal Section through S1 Foramina



# Sacral Foramina and Sacral Nerves

## Relation of Spinal Nerve Roots to Vertebrae

### Medial Protrusion



Medial protrusion at disc level L4 - 5 rarely affects L4 spinal nerve but may affect L5 spinal nerve and sometimes S1-S4 spinal nerves

# Bones and Landmarks of the Thoracic Cage

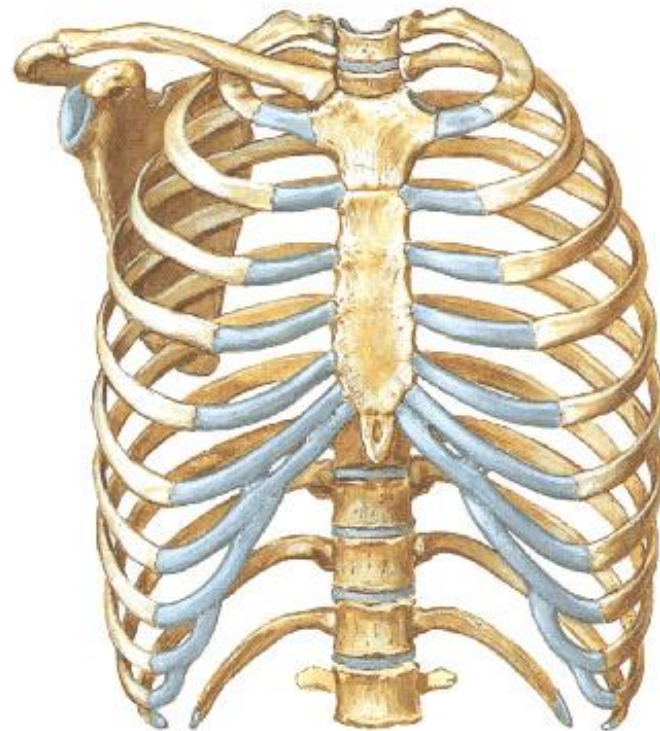
- Thoracic cage
  - Sternum
    - Sternal notch
    - Manubrium
    - Sternal angle (Angle of Louis)
    - Body
    - Xiphoid process
- 12 pairs of ribs
  - Head, neck and angle
  - Named according to number, most superior is rib 1 and most inferior is rib 12
  - Ribs 1-7 are considered true ribs (*vertebrosternal ribs*)
    - Connected posterior to the first 7 thoracic vertebrae and are connected anterior (via costal cartilage) to the sternum
  - Ribs 8-12 (*vertebrocostal ribs*) are considered false ribs
    - Do not attach directly to the sternum
    - Costal cartilage of ribs 8-10 fuse and merge with the costal cartilage of rib 7
  - Ribs 11 and 12 (*vertebral ribs*) are called floating ribs
    - Have no connection to sternum



# Ribcage Anterior

**Bony Framework of Thorax**

Anterior View



# Ribcage Posterior

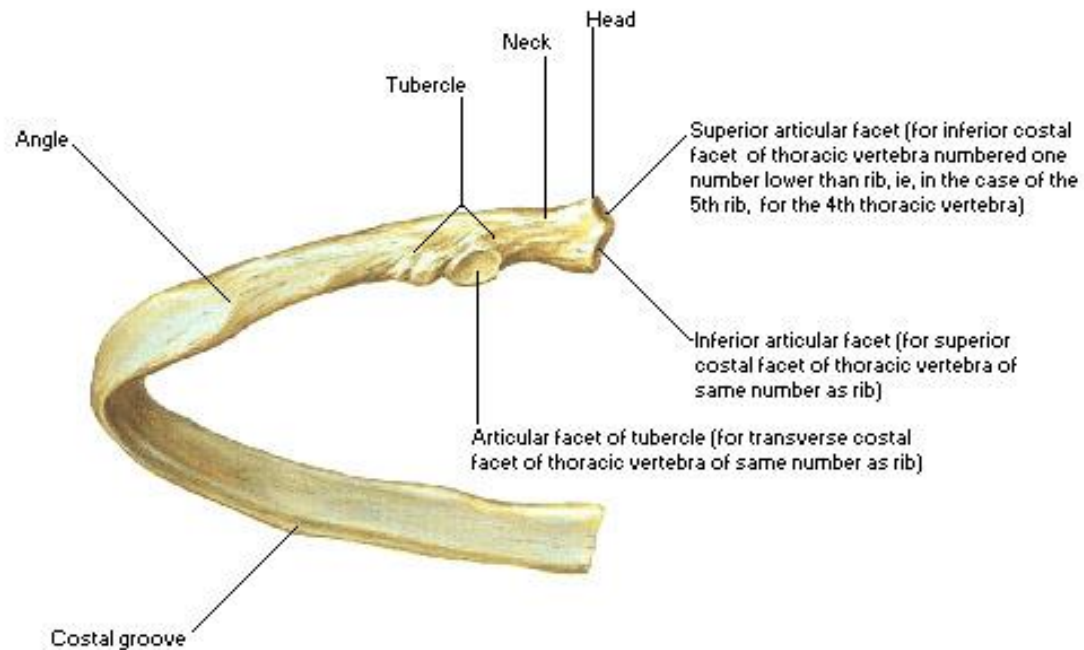
**Bony Framework of Thorax**

Posterior View



# Rib

## Middle Rib Posterior View



## Costovertebral Joints

Left Lateral View



## Costovertebral Joints

Right Posterolateral View



# Muscles of the Trunk

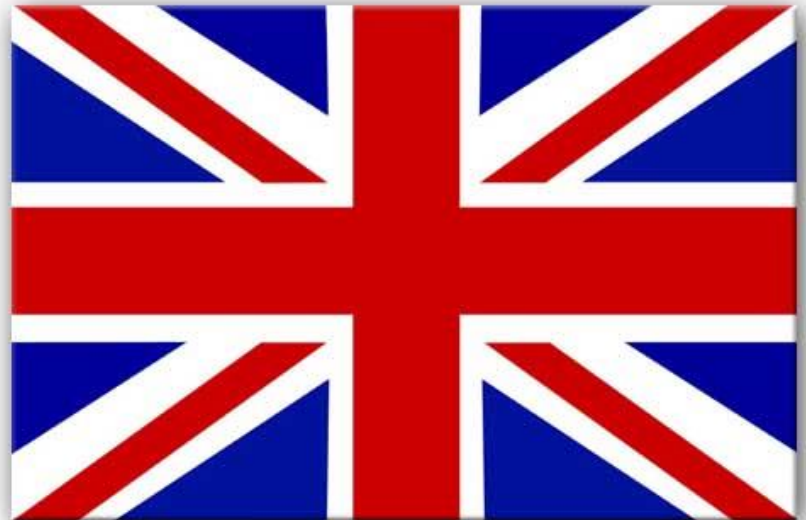
# Abdominal Muscles

## Anterior Thoracic Wall



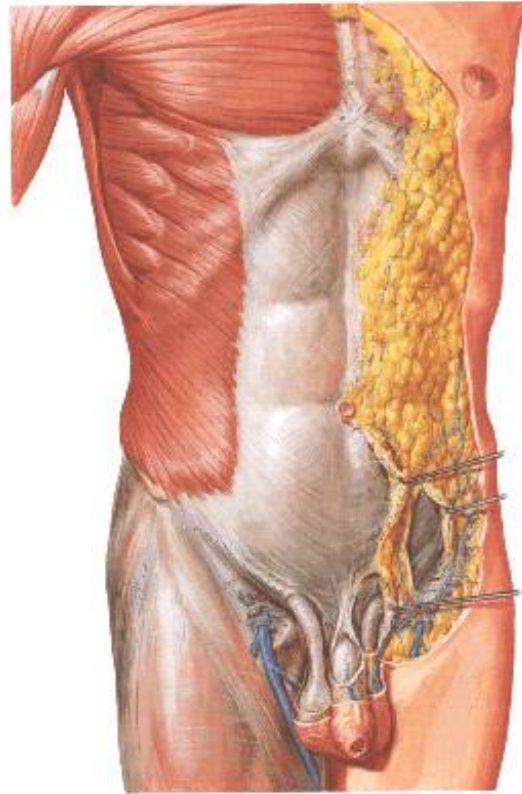
# Abdominal Muscles

- Rectus Abdominus – Fibers run vertical
- External Obliques – Fibers run at an angle from superior posterior to inferior anterior
- Internal Obliques – Fibers run at an angle from inferior posterior to superior anterior
- Transverse Abdominus – Fibers run horizontal
- Like the Union Jack



# Rectus Abdominus External Obliques

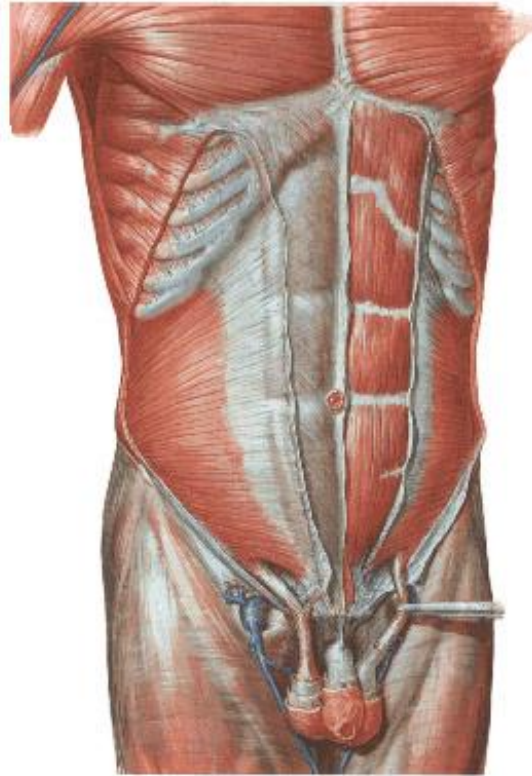
**Anterior Abdominal Wall**  
Superficial Dissection





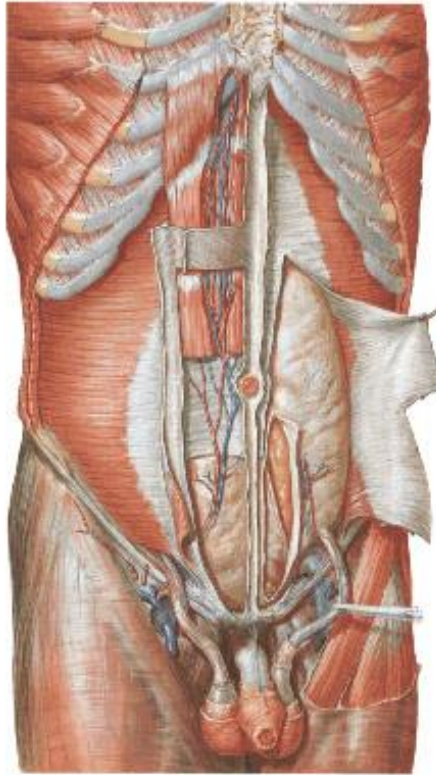
# Internal Obliques

**Anterior Abdominal Wall**  
Intermediate Dissection



# Transverse Abdominus

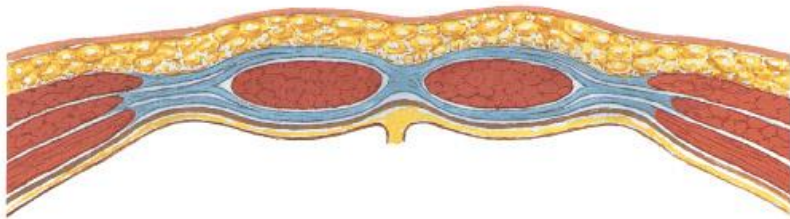
**Anterior Abdominal Wall**  
Deep Dissection



# Fascia of the Abdominals

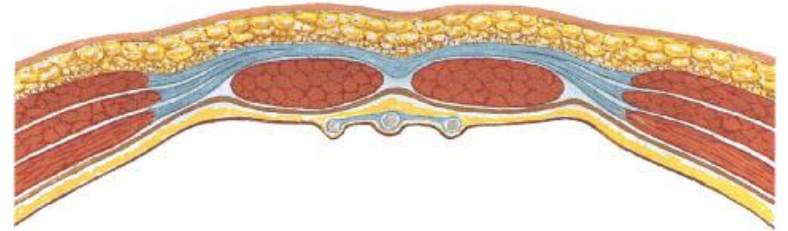
## Rectus Sheath

Cross Section Above Arcuate Line



## Rectus Sheath

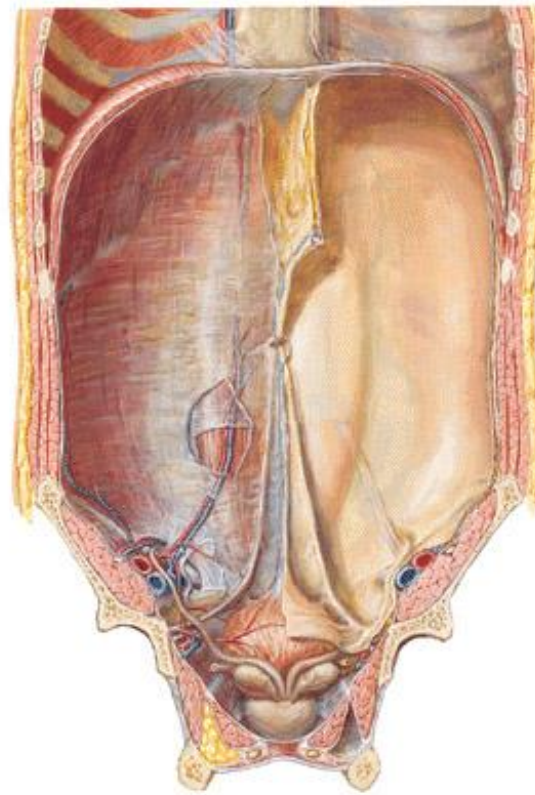
Cross Section Below Arcuate Line



# Posterior Abdominal Wall

**Anterior Abdominal Wall**

Internal View



# Muscles of the Back

## Superficial Layer

- Erector Spinae
  - Spinalis
    - Most medial
    - Slips of muscle from spinous process to spinous process
  - Longissimus
    - Middle
    - Longest, has uppermost attachment on mastoid process
    - Runs mostly from transverse process to transverse process with some slips of muscles attaching to ribs
  - Iliocostalis
    - Most lateral
    - Runs from ilium to ribs, where there are no ribs has attachments on transverse processes

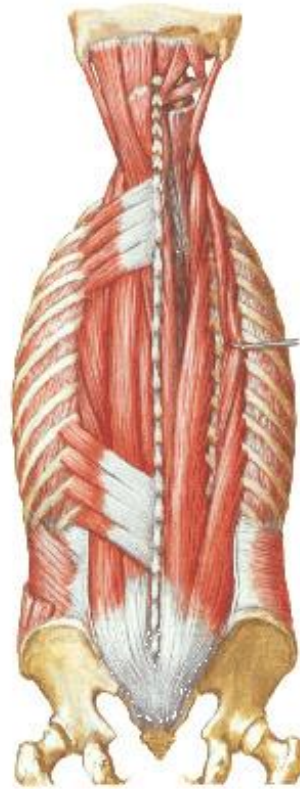
# Muscles of the Back

## Muscles of Back Superficial Layers



# Muscles of the Back

## Muscles of Back Intermediate Layers



# Muscle of the Back

## Deep Layer

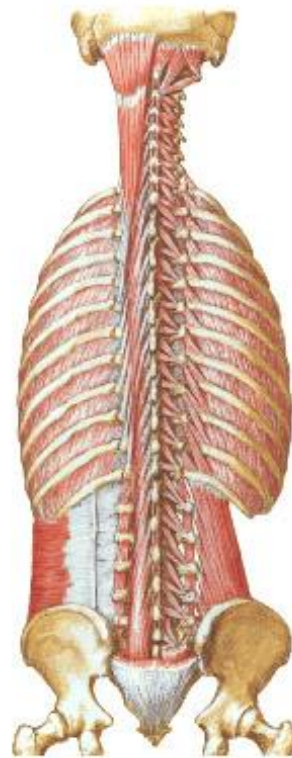
- Transversospinalis
  - Consists of the following:
    - Rotatores – TP to SP, spans 1-2 vertebra
    - Multifidi – TP to SP, spans 2-4 vertebra
    - Semispinalis – TP to SP, spans 4-6 vertebra
    - Interspinales and Intertransversarii



# Muscles of the Back

## Muscles of Back

Deep Layers



# More Information on Pathology

# Spondylosis or Degenerative Joint/Disc Disease

- Spondylosis (or DDD) is a chronic and usually progressive degeneration of the facet joints and/or intervertebral discs



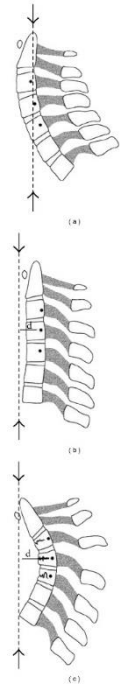
# Spondylosis or Degenerative Joint/Disc Disease

- Spondylosis is accompanied with
  - Calcific changes around the periphery of the joint
  - Wearing down of hyaline cartilage
  - Thickening of facet joint capsule
  - Dehydration of nucleus pulposus
  - Narrowing of intervertebral space
  - Muscle shortening of the deep paraspinal muscles
  - Facet joint approximation



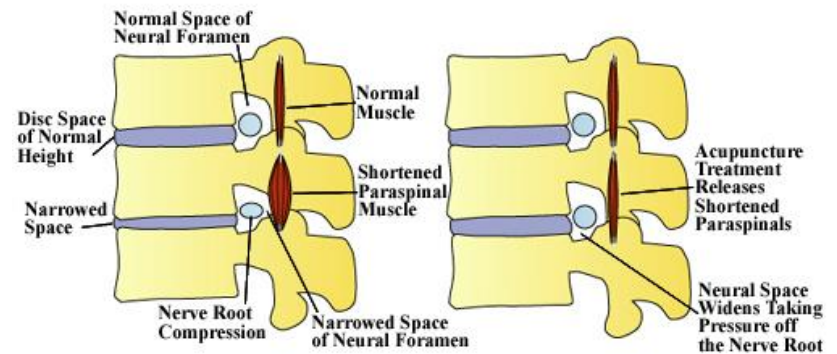
# Spondylosis or Degenerative Joint/Disc Disease

- Spondylosis often starts in the third decade of life and results in hypomobility of the vertebral disc
- Movement is necessary to bring nourishment to the discs and joints of the spine, so reduced mobility further speeds degeneration
- Hypermobility can also be a factor, as this can increase wear and tear



# Spondylosis or Degenerative Joint/Disc Disease

- Neurological complications can also be seen due to reduced space in the intervertebral foramen which affects the nerve root
- Patients might complain of numbness and tingling of a sensitivity awareness in the upper extremities
- Pain and paresthesia will usually be present along the nerve pathway (dermatome)
- Diagnosis is made by orthopedic evaluation, radiological and electromyographical examinations



# Spondylosis or Degenerative Joint/Disc Disease

- The spinal levels affected will often show signs of Qi edema and cold. Qi edema is the result of Qi and Blood stagnation interfering with the fluid pathways within the channels and collaterals. This obstruction at the spine impedes the local circulation of wei qi and yang qi resulting in localized cold stagnation.
- The patient will often experience traveling, migrating or radiating sensations which are assessed as excess in nature
- Palpation to the affected channel will highlight points of obstruction which will be described as a deep ache or sharp pain. These painful ashi points are often at the motor points of the muscle
- These points will limit the flow of Qi and Blood in the channel resulting in signs of deficiency (weakness, paresthesia, numbness and tingling)

# Spondylosis or Degenerative Joint/Disc Disease

- Symptoms manifest along the dermatomes of the upper extremities
- Radicular Pain usually affects the Yang channels and is assessed with nerve tension tests
- Non-radicular paresthesia is often due to peripheral nerve entrapments. Special tests are used to assess
- *Notes: Non-radicular paresthesia includes such conditions as carpal tunnel syndrome, pronator teres syndrome, thoracic outlet syndrome, trigger point referrals, etc.*



# Dermatomes of the Arm

- C5 – Lateral upper arm
- C6 – Thumb and lateral forearm
- C7 – Middle finger and posterior lateral forearm
- C8 – Little finger, ulnar border and distal medial forearm
- T1 – Medial side of forearm and upper arm

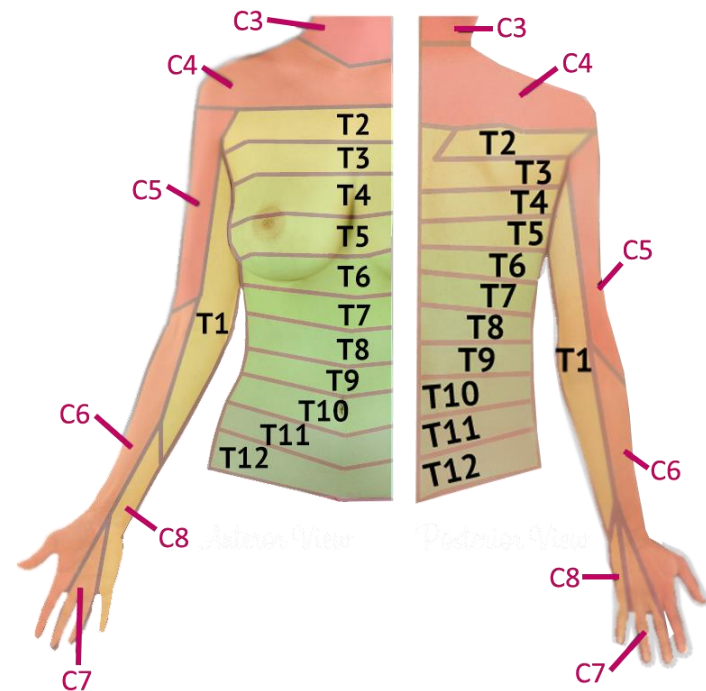
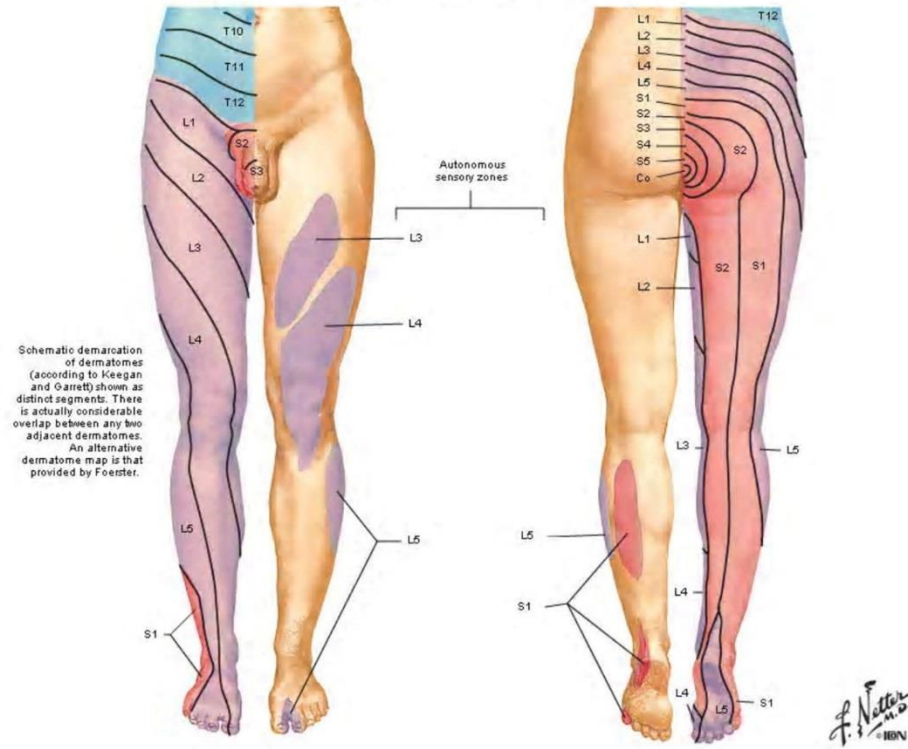


Plate 525A

### Dermatomes of Lower Limb Anterior and Posterior Views



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DOM

# Dermatome Of Legs

- L4

- Medial buttock
- Lateral thigh
- Medial leg
- Dorsum of foot
- Big toe

## L5

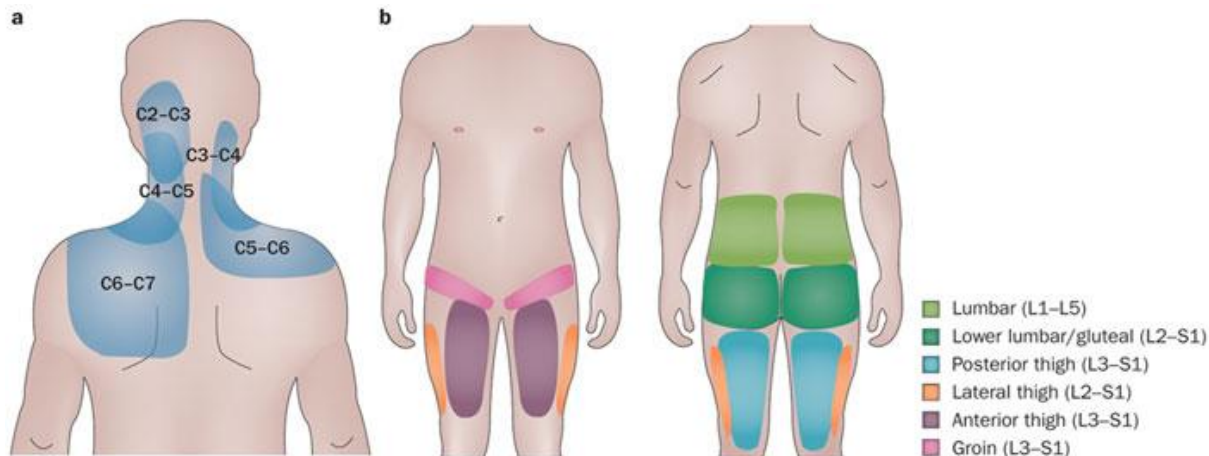
- Buttock
- Posterior and lateral thigh (GB channel of thigh, ST channel of leg)
- Dorsum of foot
- First, second, and third toes

- S1

- Buttock
- Posterior thigh
- Posterior leg

# Facet Syndrome

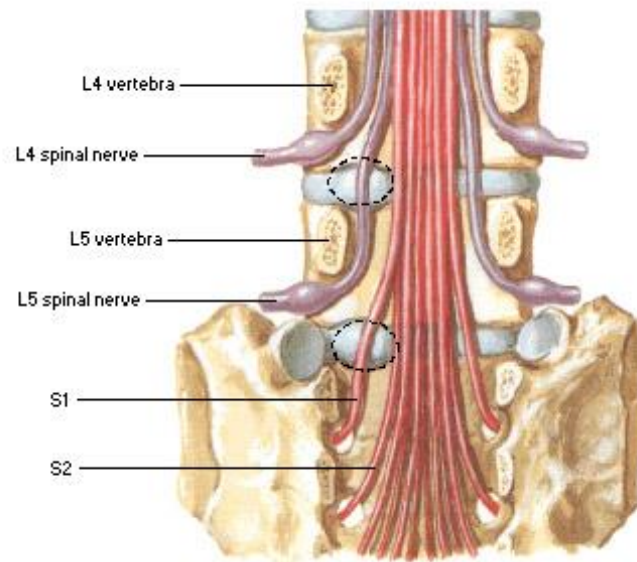
- Spondylosis which leads to a more pronounced deterioration of the facet joints and pain referral patterns from this deterioration is referred to as facet syndrome
- 55% of cases occurs in the cervical spine and 31% in the lumbar



# Relationship of Disc Pathology to Spinal Nerves

## Relation of Spinal Nerve Roots to Vertebrae

### Lateral Protrusion

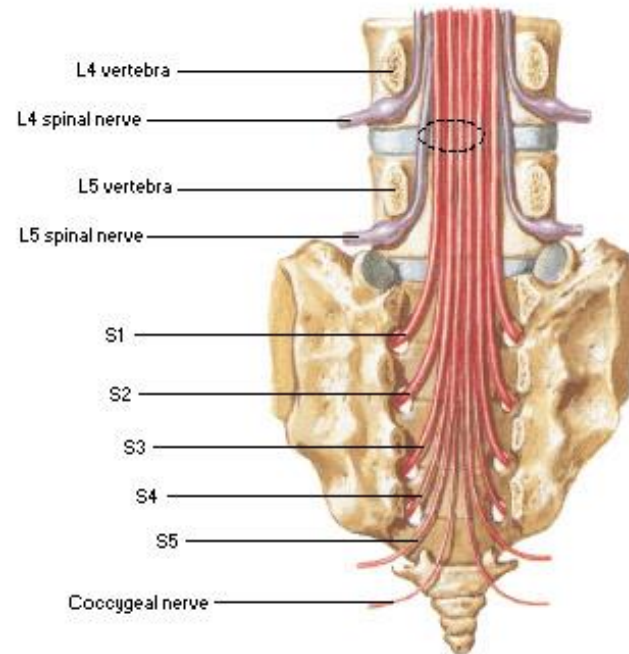


Lumbar disc protrusion does not usually affect nerve exiting above disc. Lateral protrusion at disc level L4- 5 affects L5 spinal nerve, not L4 spinal nerve. Protrusion at disc level L5- S1 affects S1 spinal nerve, not L5 spinal nerve

# Relationship of Disc Pathology to Spinal Nerves

## Relation of Spinal Nerve Roots to Vertebrae

### Medial Protrusion



Medial protrusion at disc level L4 - 5 rarely affects L4 spinal nerve but may affect L5 spinal nerve and sometimes S1-S4 spinal nerves

# Vertebral Ligaments – Relation to Du Channel

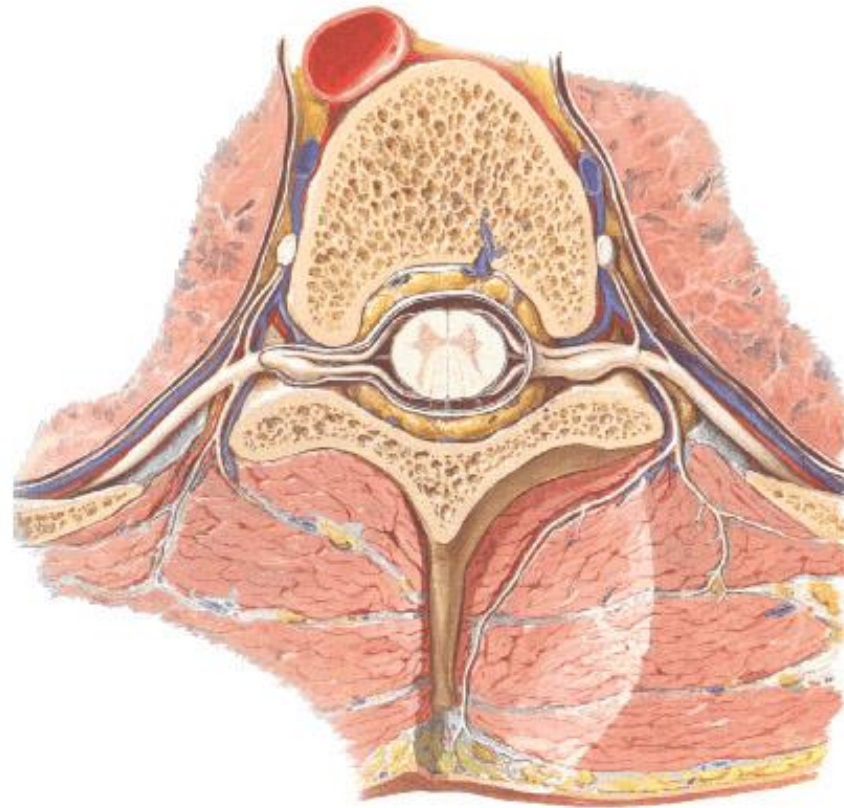
## Vertebral Ligaments of Lumbar Region

Left Lateral View - Partially Sectioned



# Lamina Groove and Huatuojaji Points

**Spinal Nerve Origin**  
Section through Thoracic Vertebra





## Thoracoabdominal Nerves

