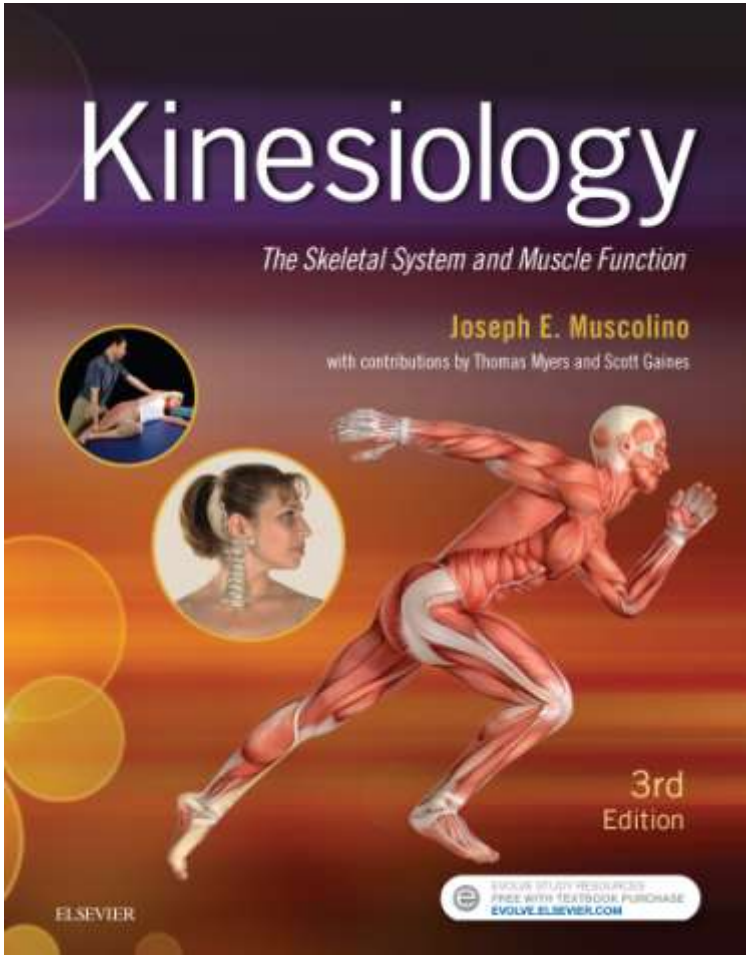
ANATOMY AND PHYSIOLOGY FOR PILATES

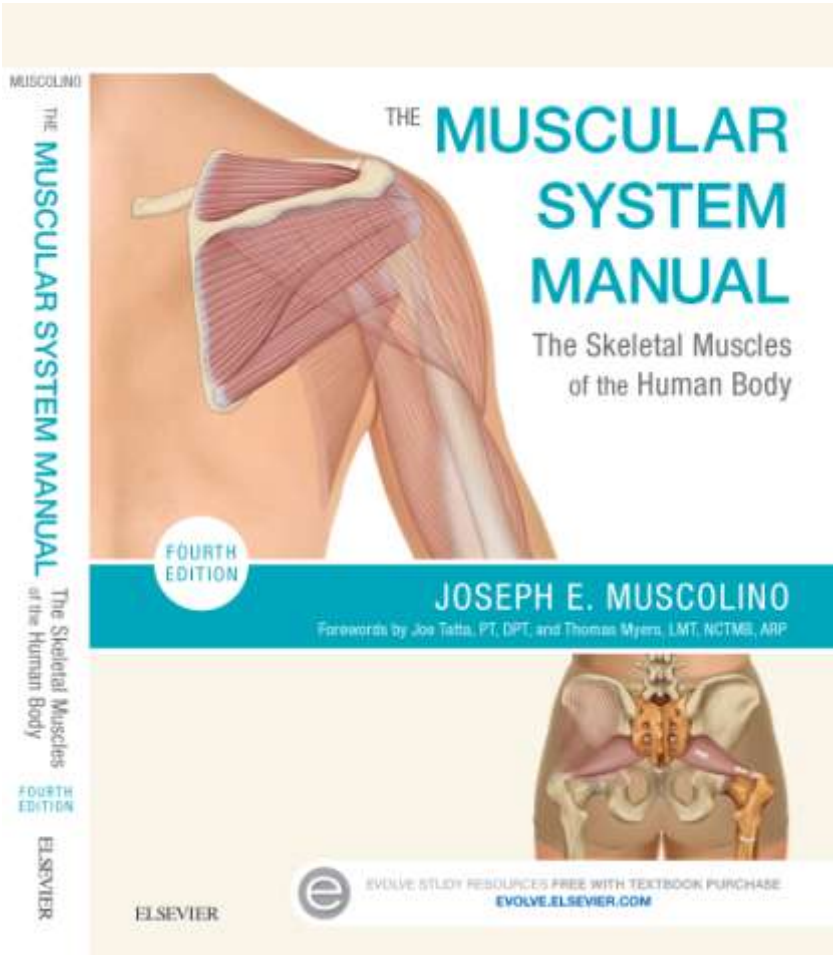
Art of Control Studio

Stamford, CT

- Dr. Joe Muscolino
- joseph.e.muscolino@gmail.com
- www.learnmuscles.com

References


Kinesiology
The Skeletal System and Muscle Function
Joseph E. Muscolino
with contributions by Thomas Myers and Scott Gaines
3rd
Edition
ELSEVIER
EVOLVE.ELSEVIER.COM


MUSCOLINO
THE MUSCULAR SYSTEM MANUAL
The Skeletal Muscles of the Human Body
FOURTH EDITION
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THE MUSCULAR SYSTEM MANUAL
The Skeletal Muscles of the Human Body
FOURTH EDITION
JOSEPH E. MUSCOLINO
Forewords by Joe Tatta, PT, DPT, and Thomas Myers, LMT, NCTMB, ARP
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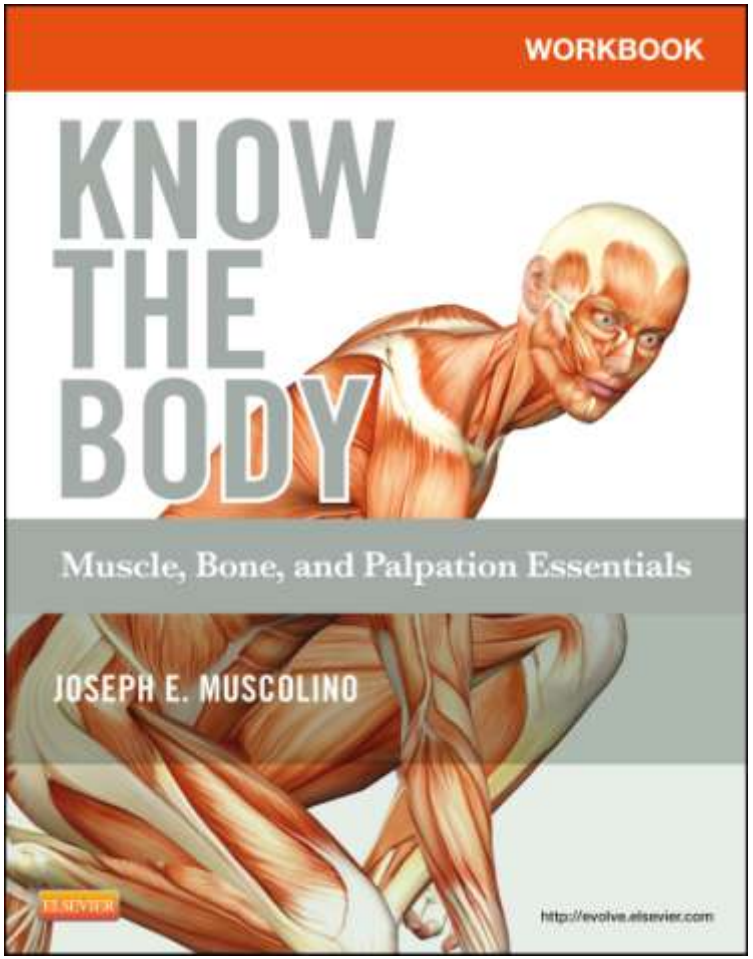

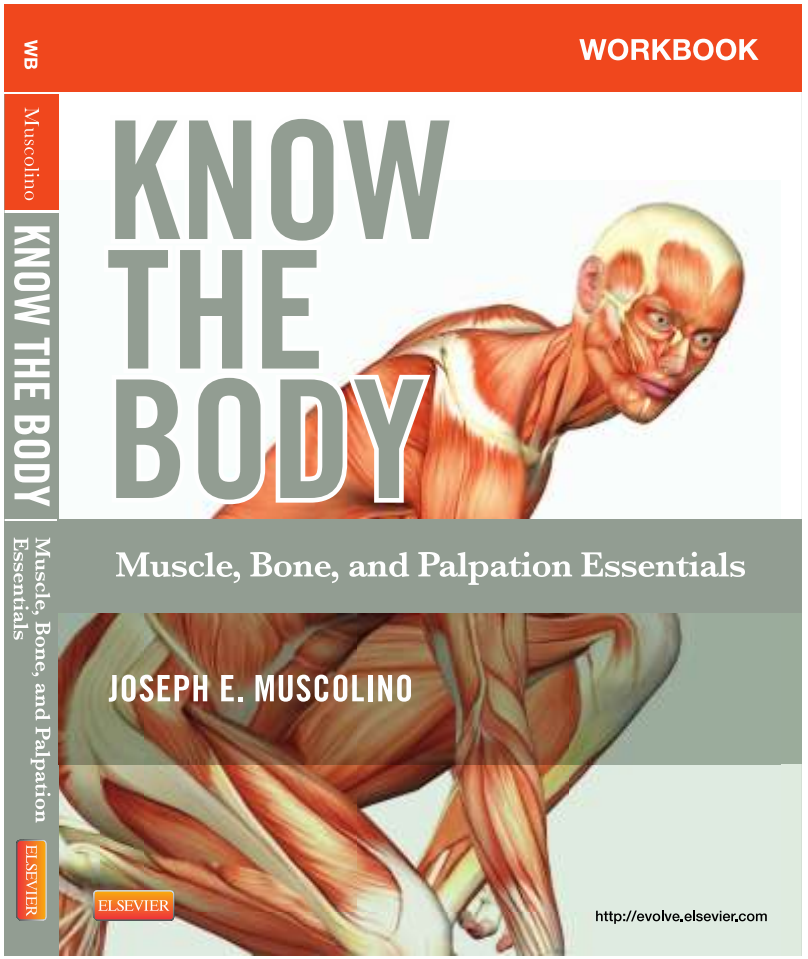

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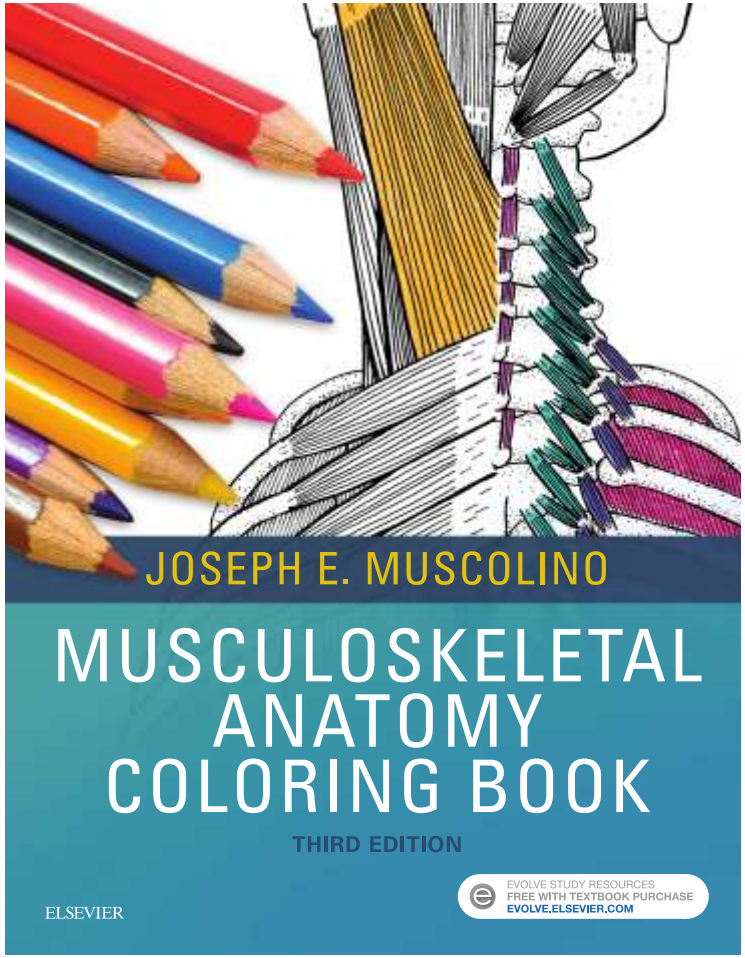

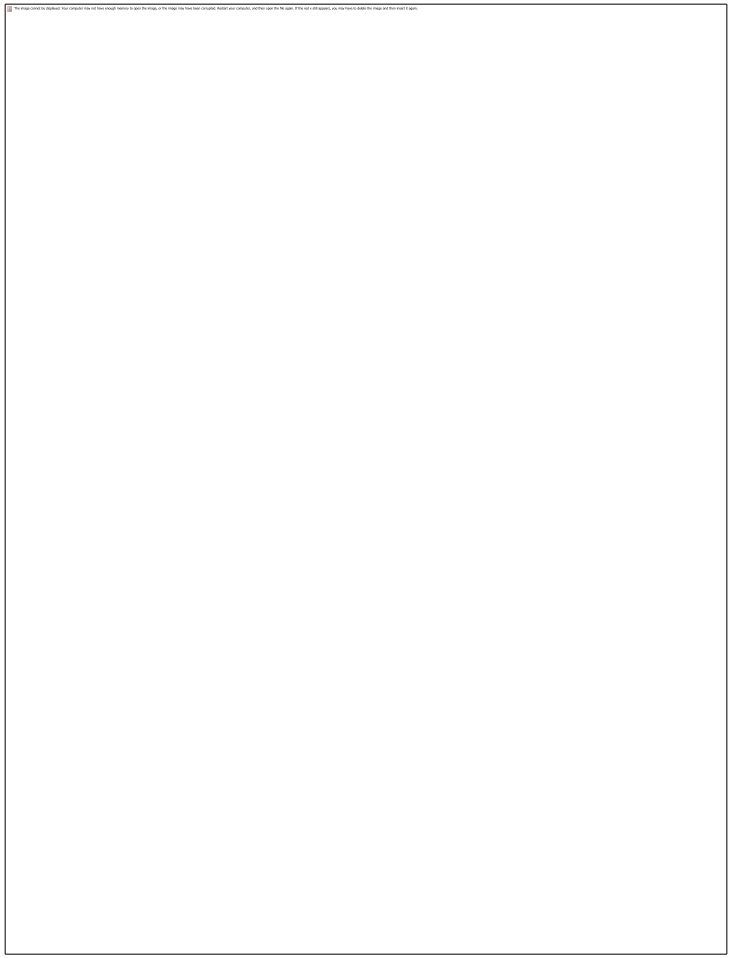

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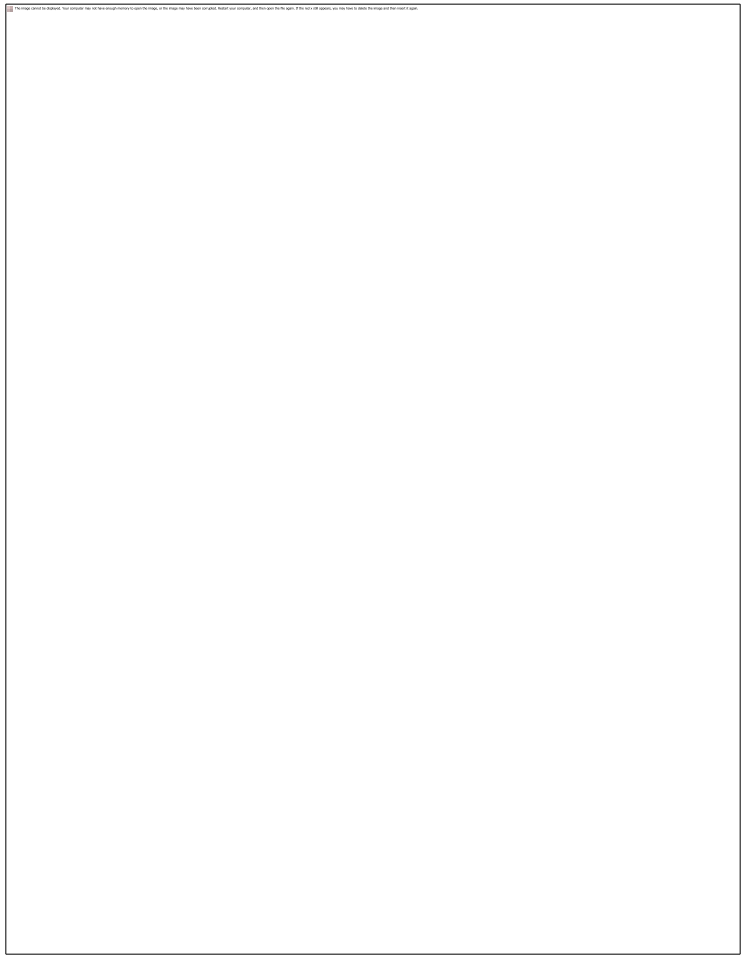
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Table of Contents

PART 1 – Kinesiology Terminology

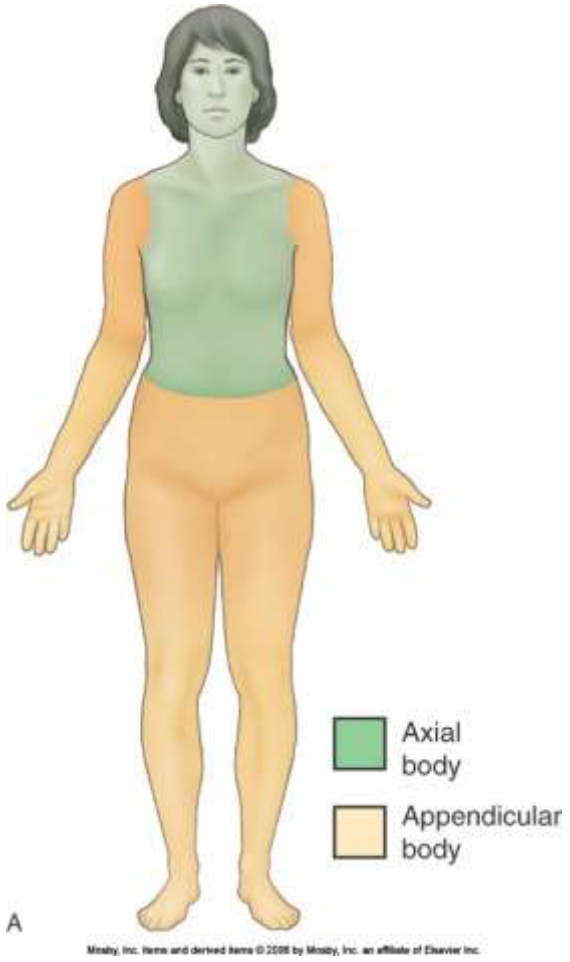
- Basic Kinesiology Terminology

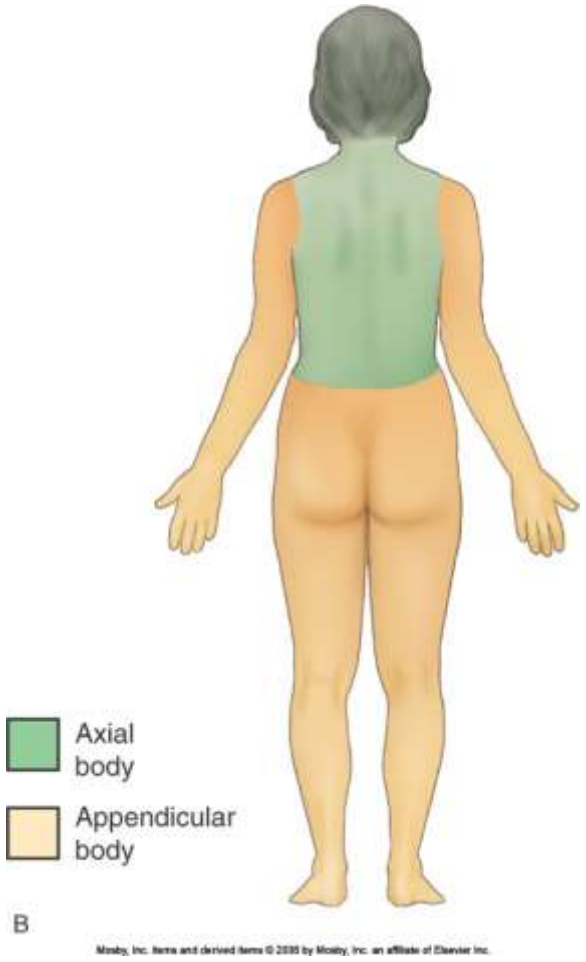
- Kinesiology
  - kine = motion
  - ology = understanding/study of

Anatomy and Physiology

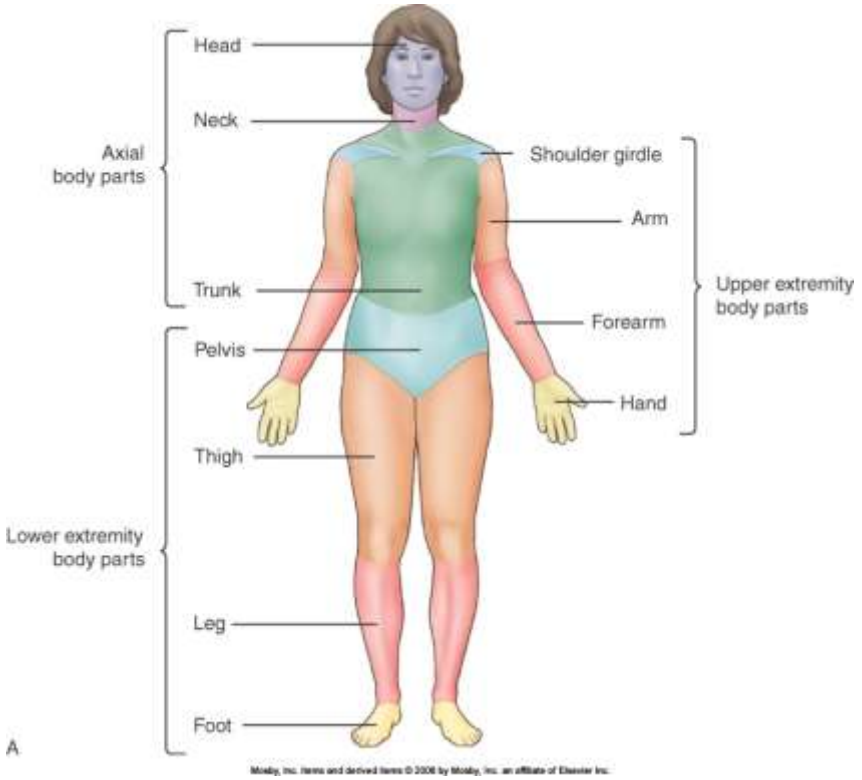
- Anatomy is Structure
  - ana =
  - tome =
- Physiology is Function
  - phys =
  - ology =

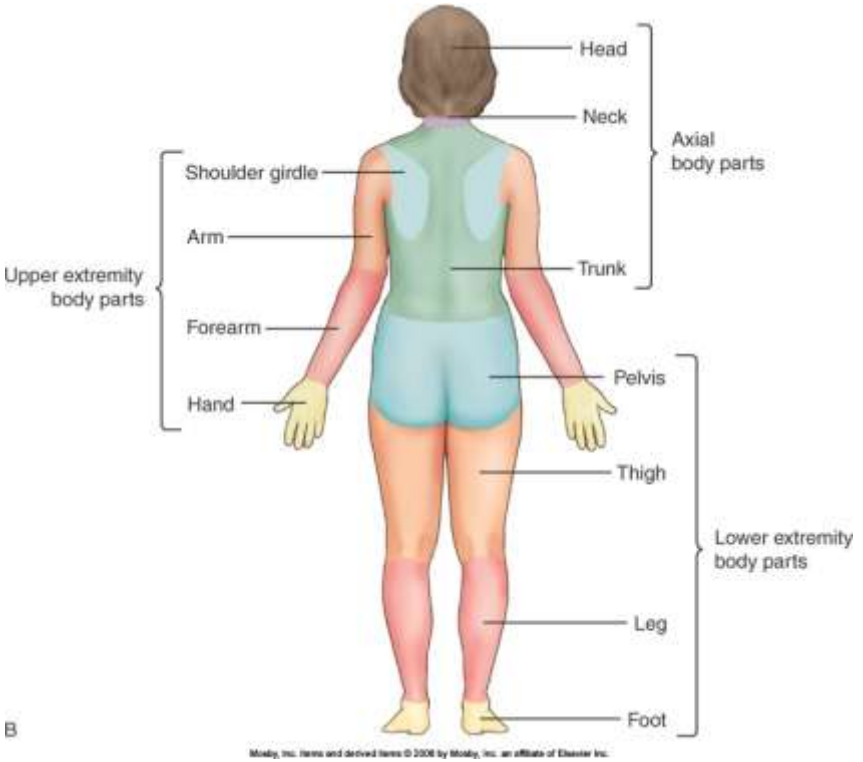
Axial / Appendicular Body





Body Parts


Head
Neck
Axial body parts
Shoulder girdle
Arm
Trunk
Forearm
Upper extremity body parts
Pelvis
Hand
Thigh
Lower extremity body parts
Leg
Foot
A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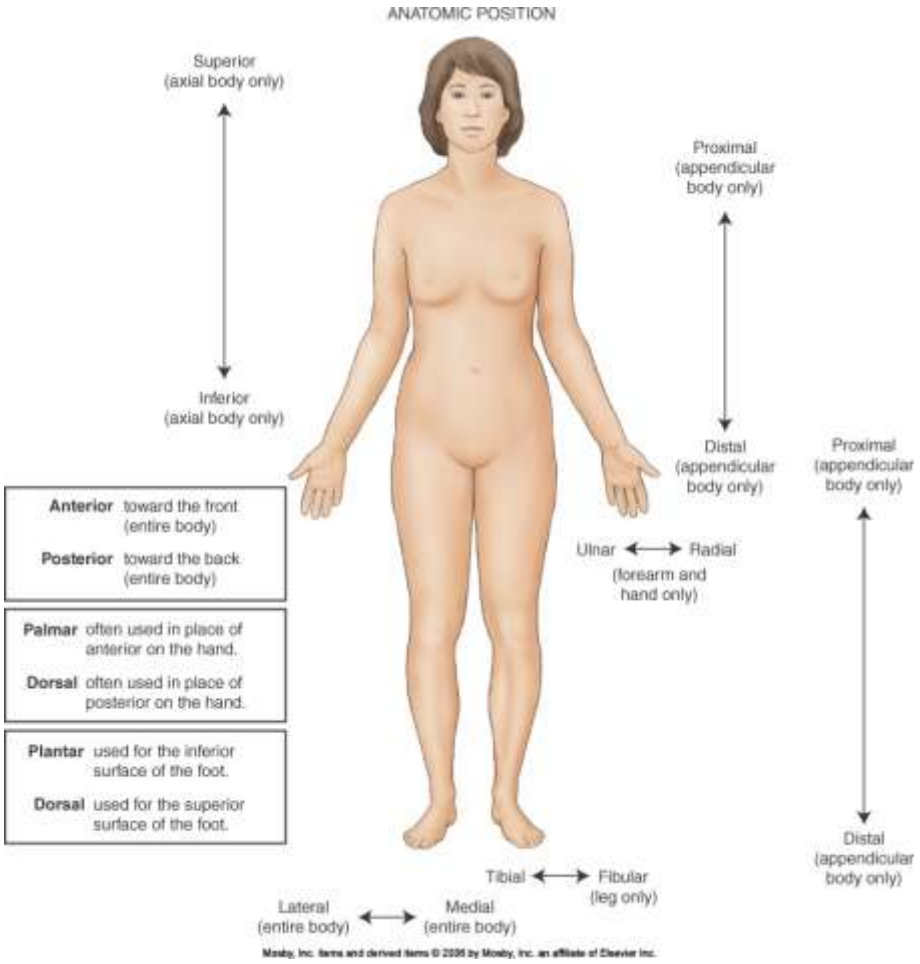
Axial body parts
Shoulder girdle
Arm
Trunk
Upper extremity body parts
Forearm
Pelvis
Hand
Thigh
Lower extremity body parts
Leg
Foot
B

Static Positional Terms



Pairs of Terms – Static Position

- Anterior / Posterior
- Medial / Lateral
- Superior / Inferior
- Proximal / Distal
- Superficial / Deep

Movement Terms - Pairs

- Flexion / Extension
- Abduction / Adduction
- Right Lateral Flexion / Left Lateral Flexion
- Medial Rotation / Lateral Rotation
- Right Rotation / Left Rotation

Movement Terms – Pairs…

- Pronation / Supination
- Dorsiflexion / Plantarflexion
- Protraction / Retraction
- Elevation / Depression
- Upward Rotation / Downward Rotation

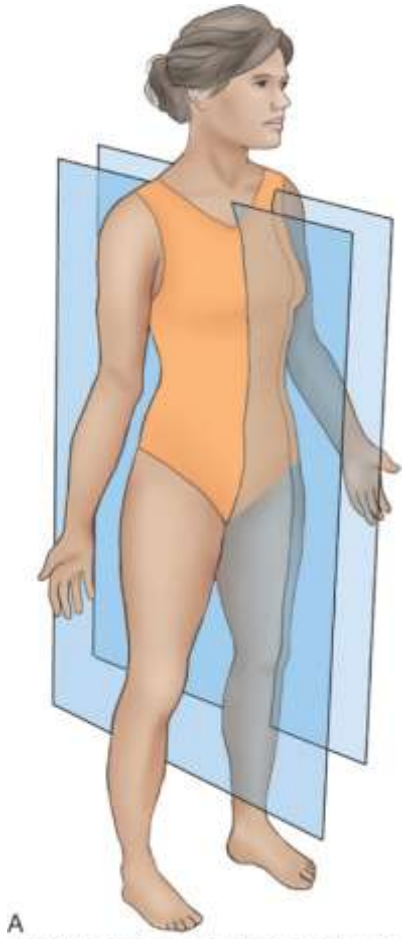
- Extension vs. Hyperextension
- Circumduction

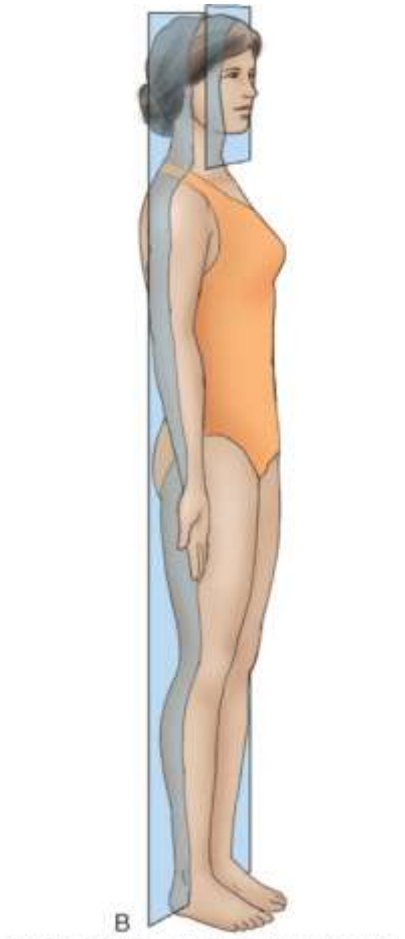
Planes

- A plane is a 2-D flat surface that divides space.
- A movements occurs within a plane.
- There are three cardinal planes:
  - Sagittal
  - Frontal (coronal)
  - Transverse (horizontal)

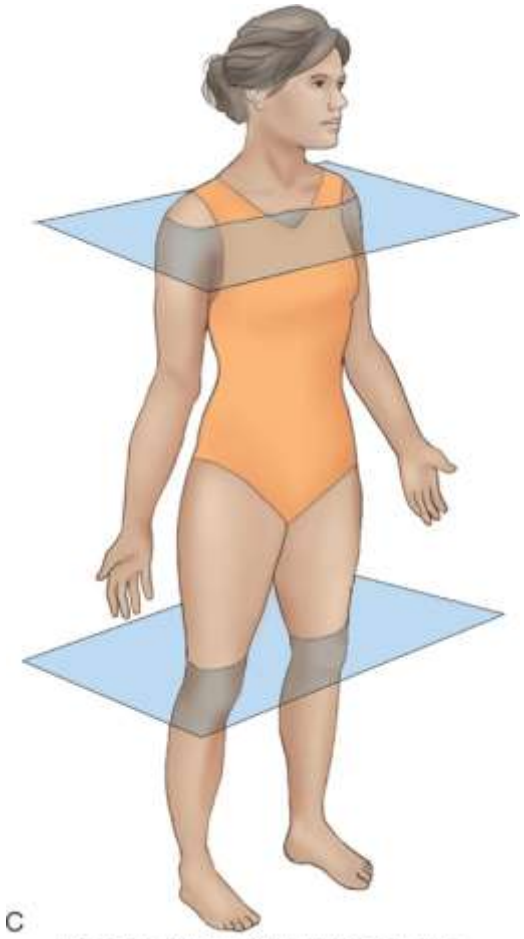
- Oblique planes…

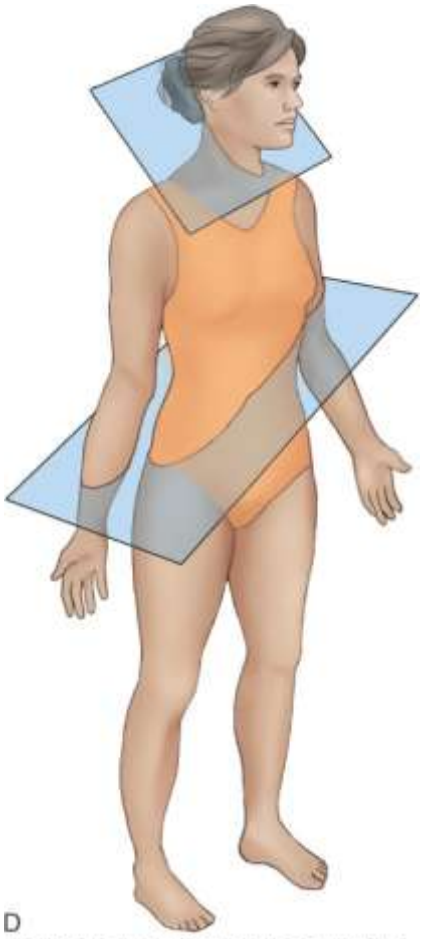
Planes – Sagittal and Frontal



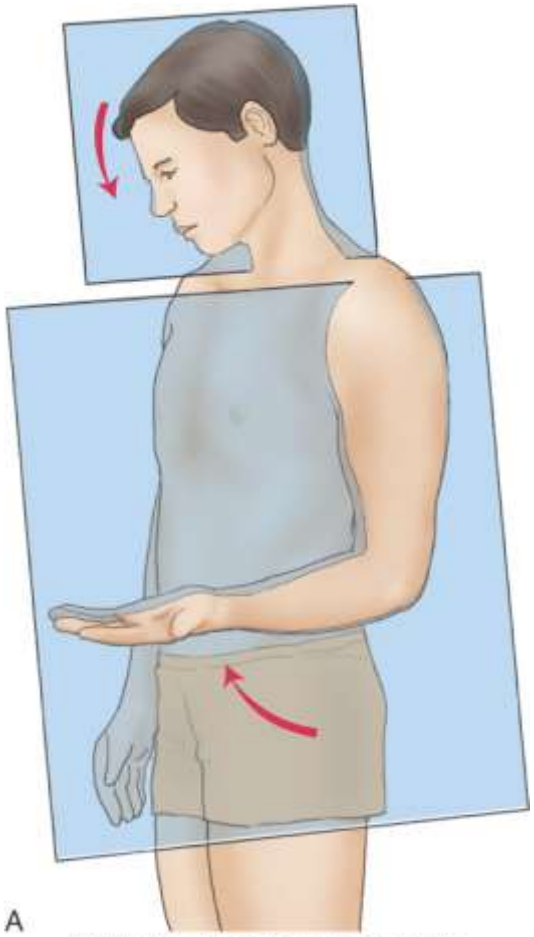


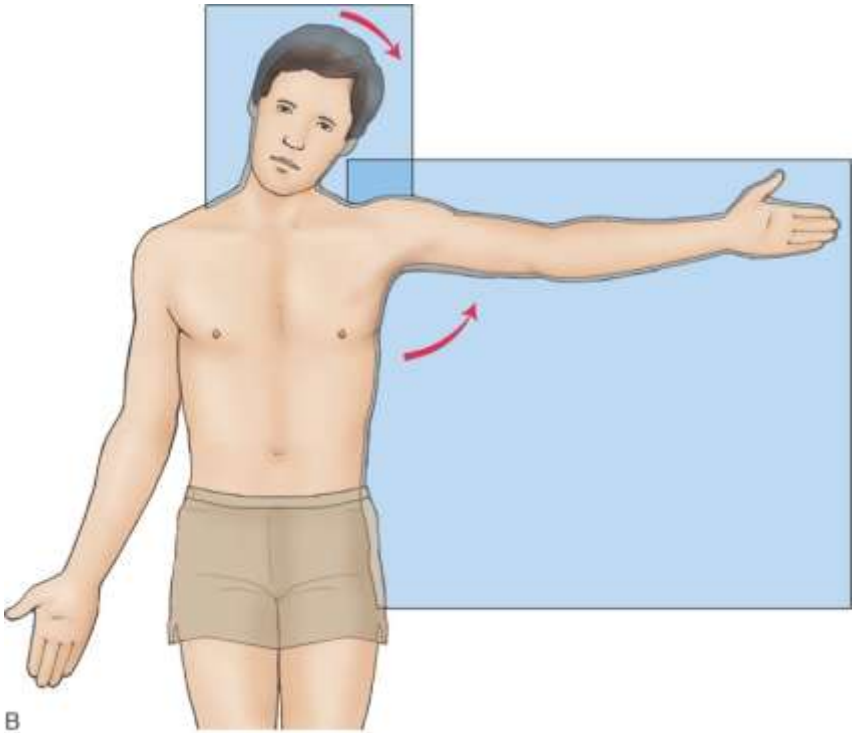
Planes – Transverse and Oblique



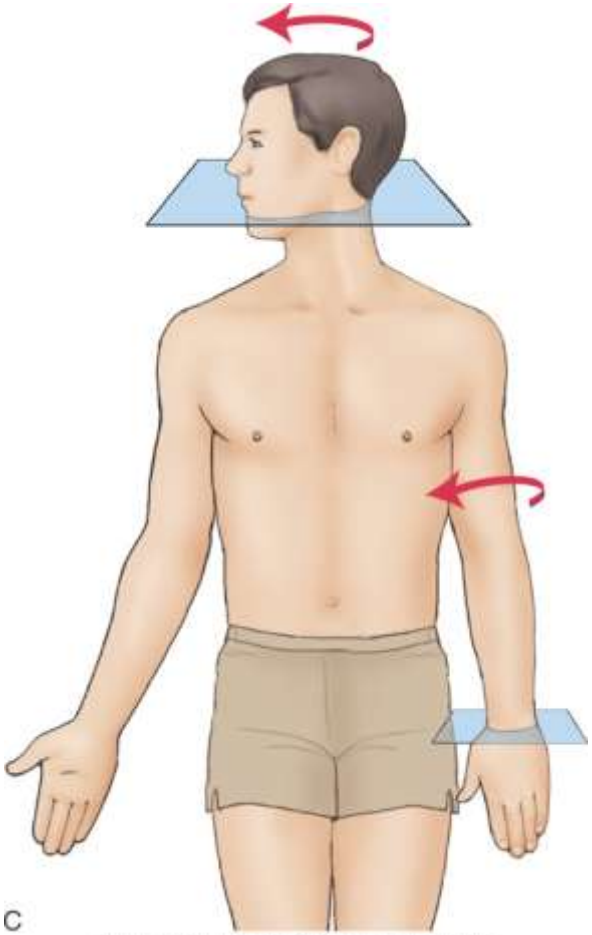


Movement in Planes – Sagittal and Frontal





Movement in Planes – Transverse and Oblique



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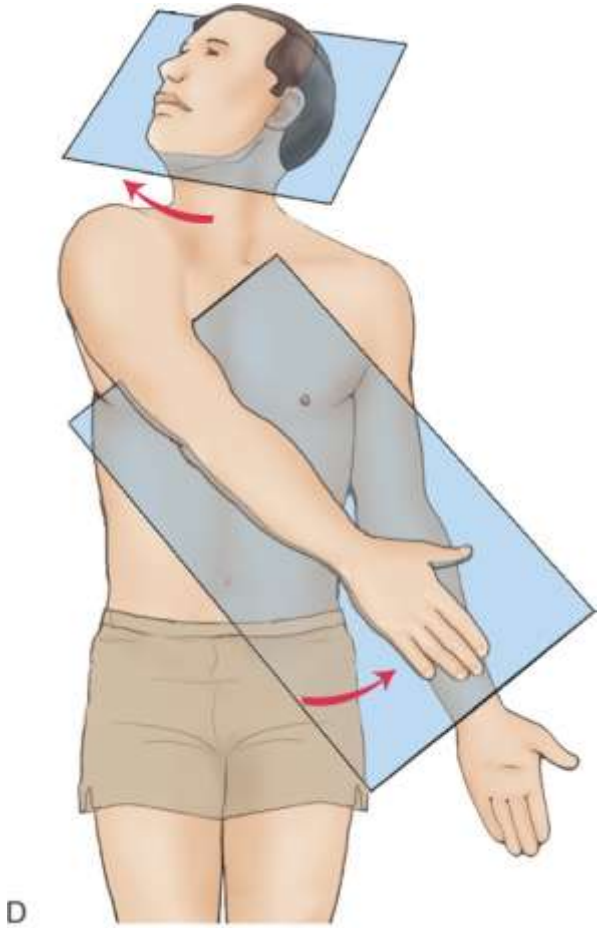

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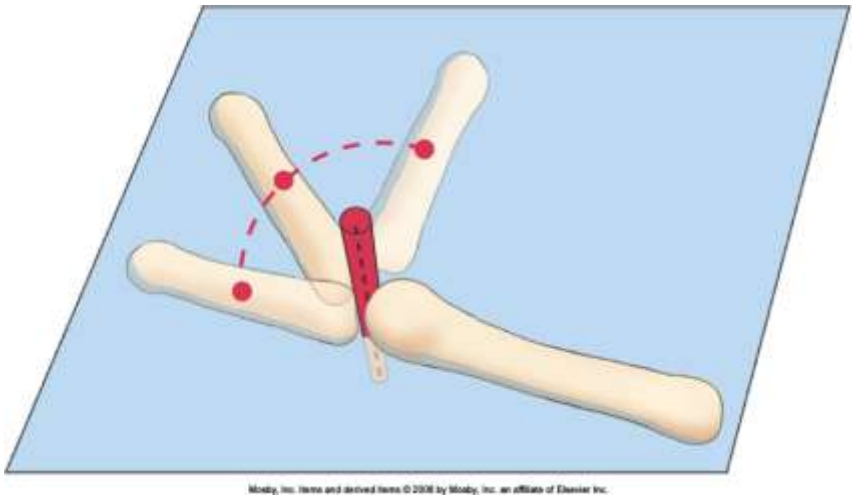
Axes



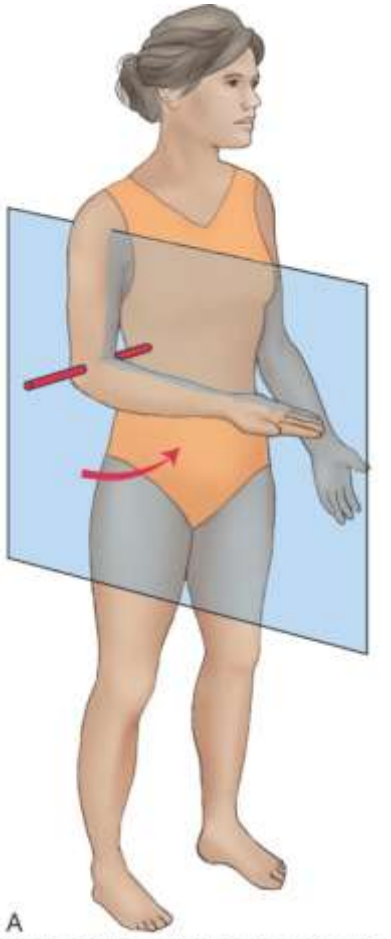
- An axis (plural: axes) is an imaginary line around which movement occurs.

Axes – cont’d

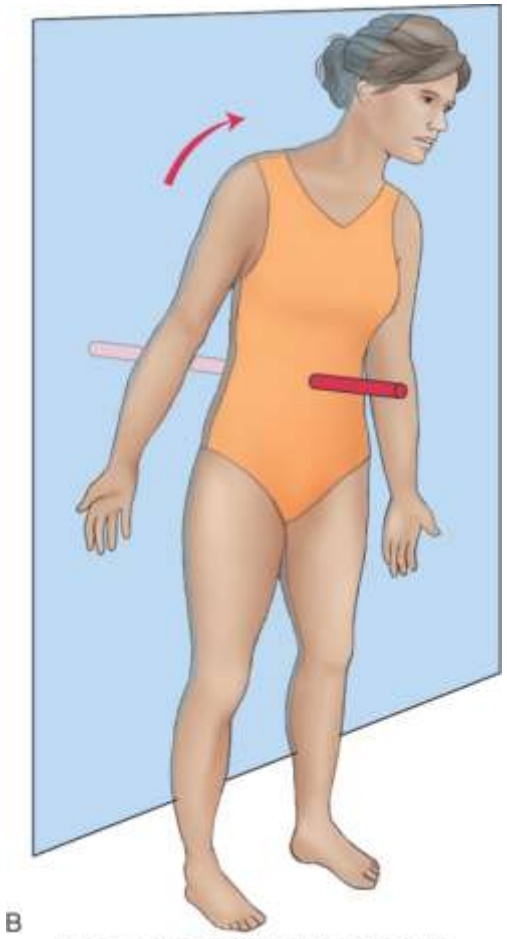
- For each plane, there is a corresponding axis
- Sagittal – mediolateral
- Frontal – anteroposterior
- Transverse – vertical (superoinferior)

- Oblique - oblique

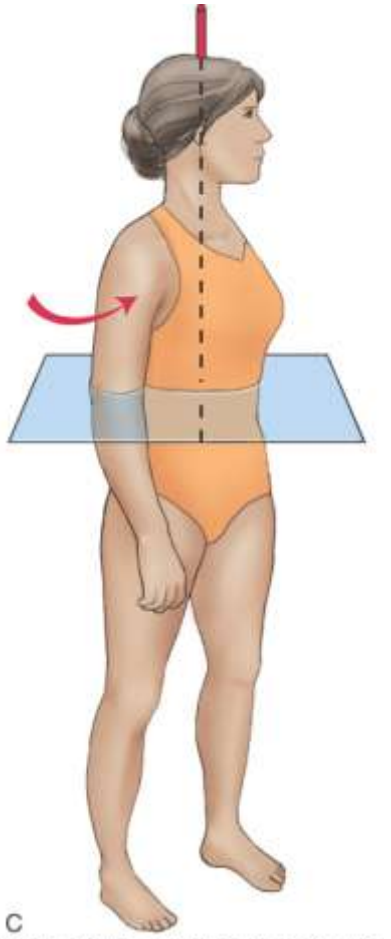
Mediolateral Axis



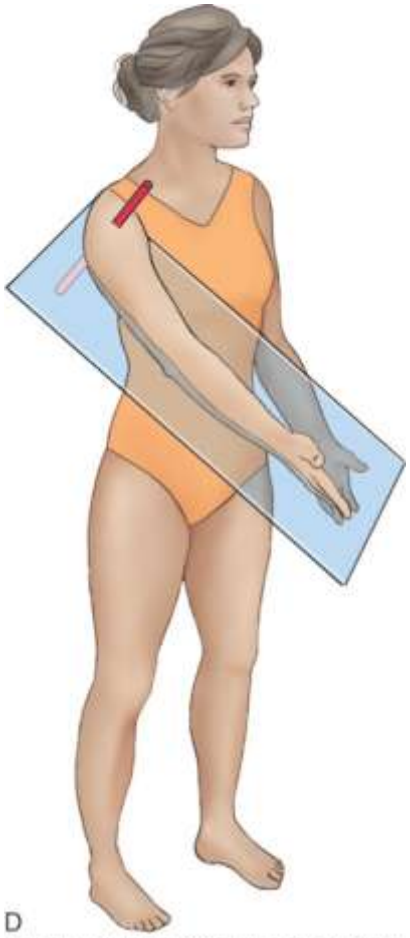
Anteroposterior Axis



Vertical Axis



Oblique Axis

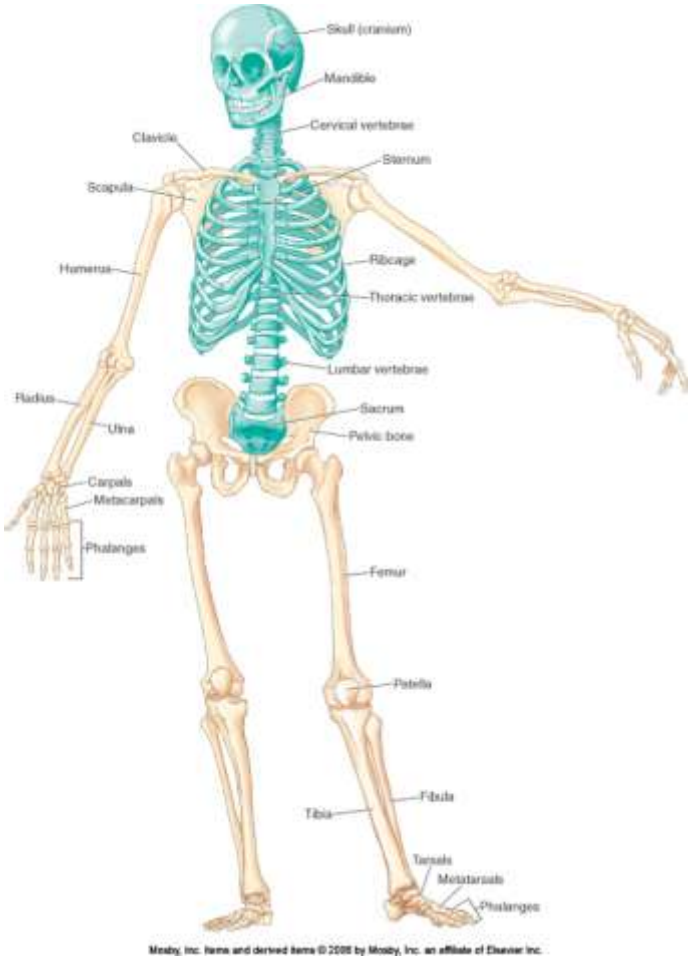


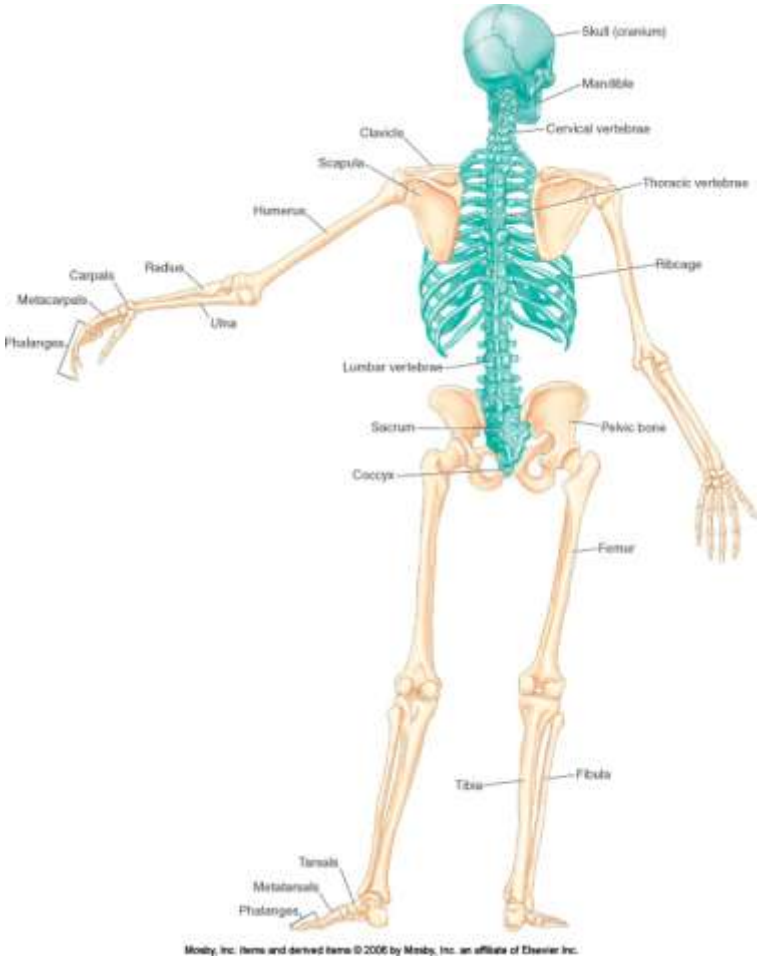
Naming Joint Actions

- A joint action is a cardinal plane joint motion.
- Three parts to fully describe a joint motion:
  - Direction of motion
  - Body part that moves
  - Joint at which motion occurs
- Example: Flexion of the arm at the shoulder joint

PART 2 – The Skeletal System

Bones of the Skeleton





Bones – Upper Extremity

- Shoulder Girdle
  - Scapula / Clavicle
- Arm
  - Humerus
- Forearm
  - Radius / Ulna
- Hand
  - Carpals
  - Metacarpals
  - Phalanges (singular: phalanx)

Bones – Lower Extremity

- Pelvis
  - Pelvic bone (ilium, ischium, pubis)
- Thigh
  - Femur
- Leg
  - Tibia / Fibula
- Foot
  - Tarsals
  - Metatarsals
  - Phalanges (singular: phalanx)

Bones – Axial Body

- Head
  - Cranium (frontal, temporal, occipital…)
  - Face
- Neck/Trunk/Pelvis
  - Vertebrae (& sacrum / coccyx)
  - Hyoid bone
  - Sternum
  - Rib cage

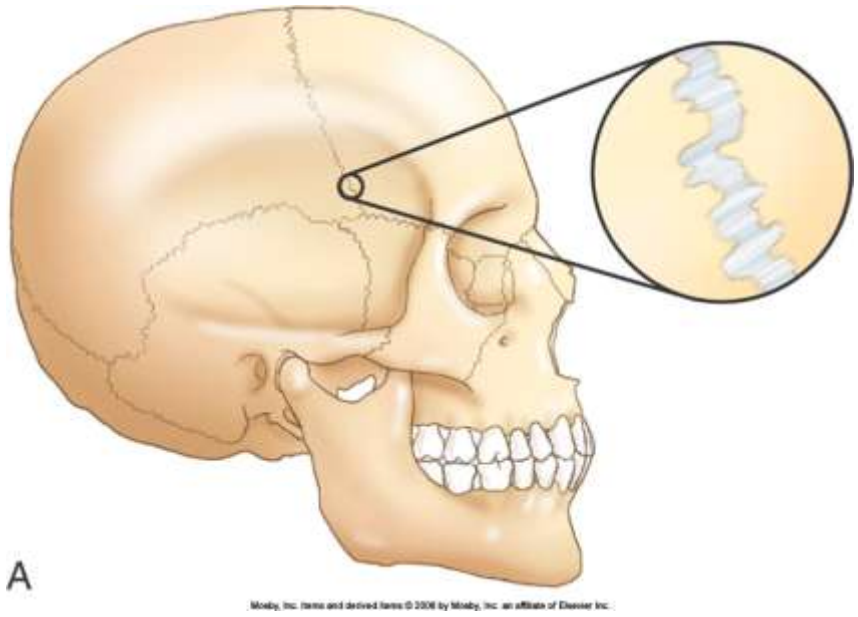
Bony Landmarks

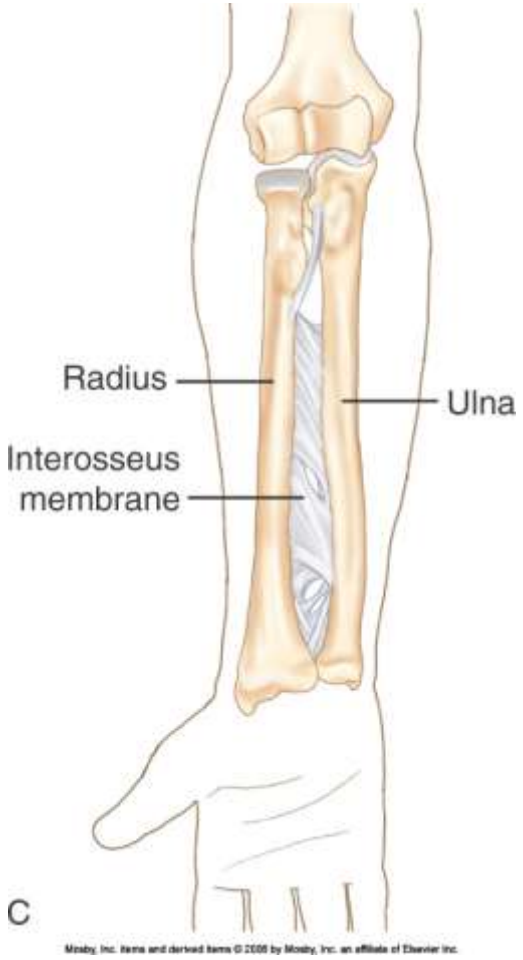
- Anterior Superior Iliac Spine (ASIS)
- Posterior Superior Iliac Spine (PSIS)
- Iliac Crest
- Medial border of scapula
- Inferior angle of scapula
- Spinous Processes (SPs)
- Transverse Processes (TPs)

Joint Classification

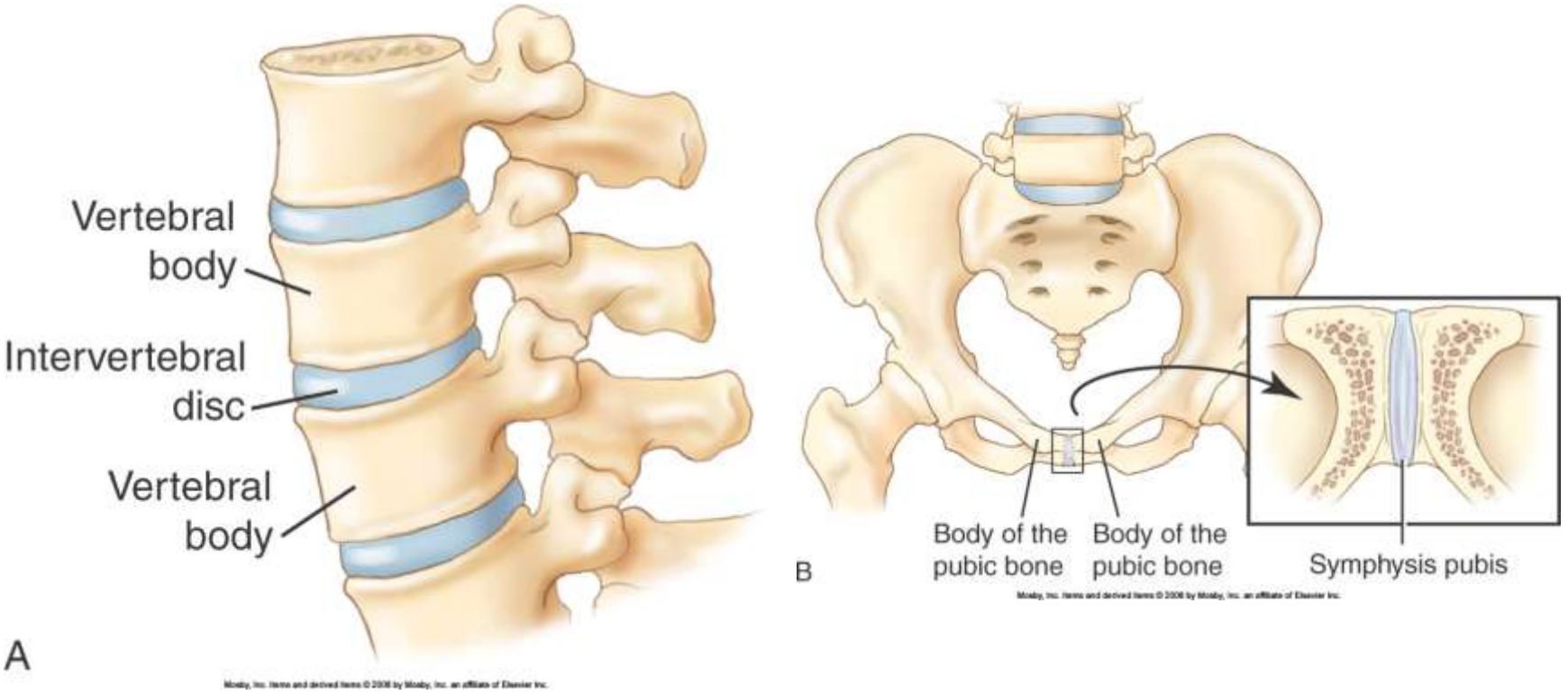
- Structural:
  - Fibrous
  - Cartilaginous
  - Synovial (joint cavity)

Fibrous Joint Examples

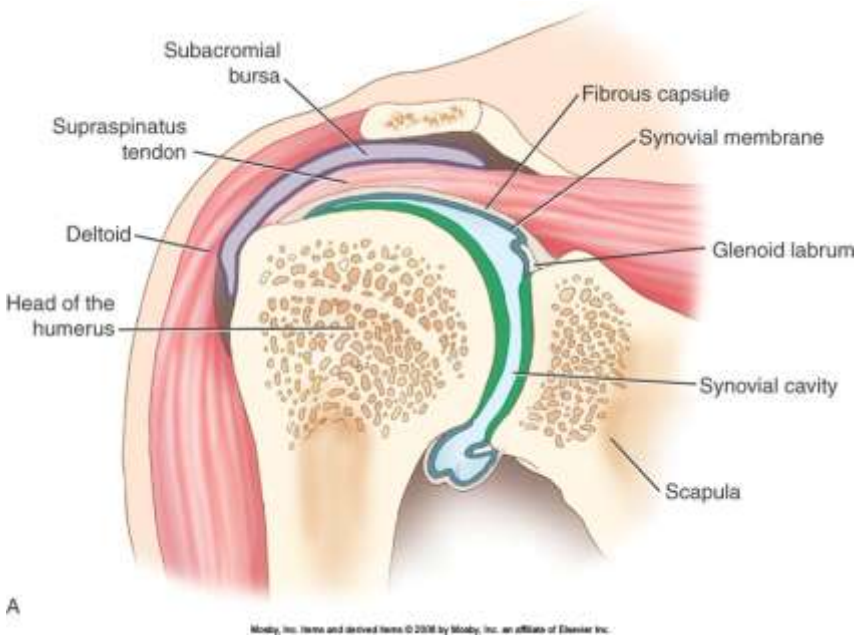


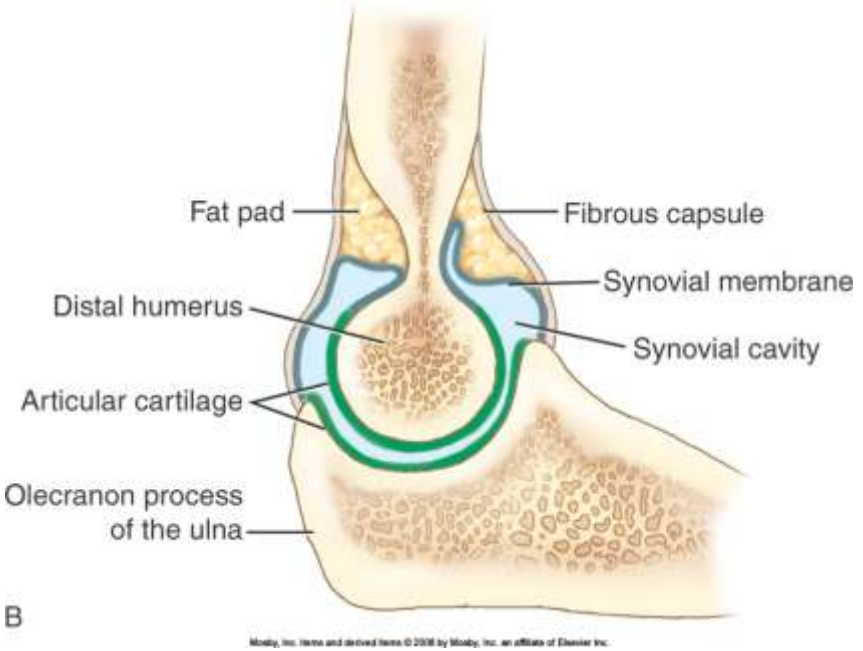


Cartilaginous Joint Examples



Synovial Joint Examples

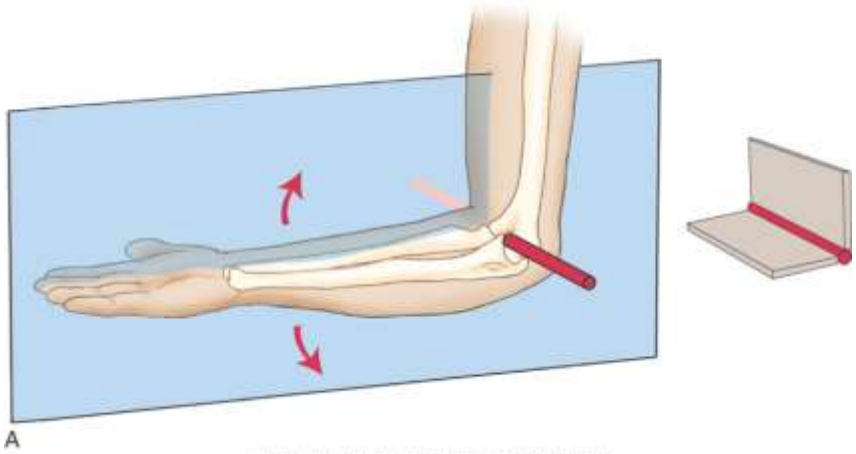


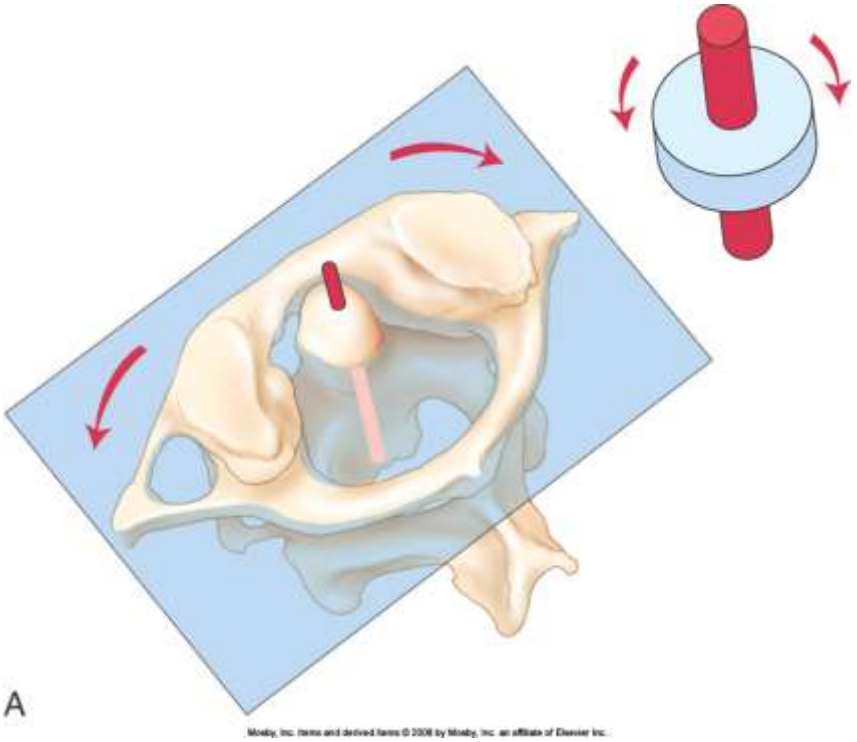


Synovial Joint Categories

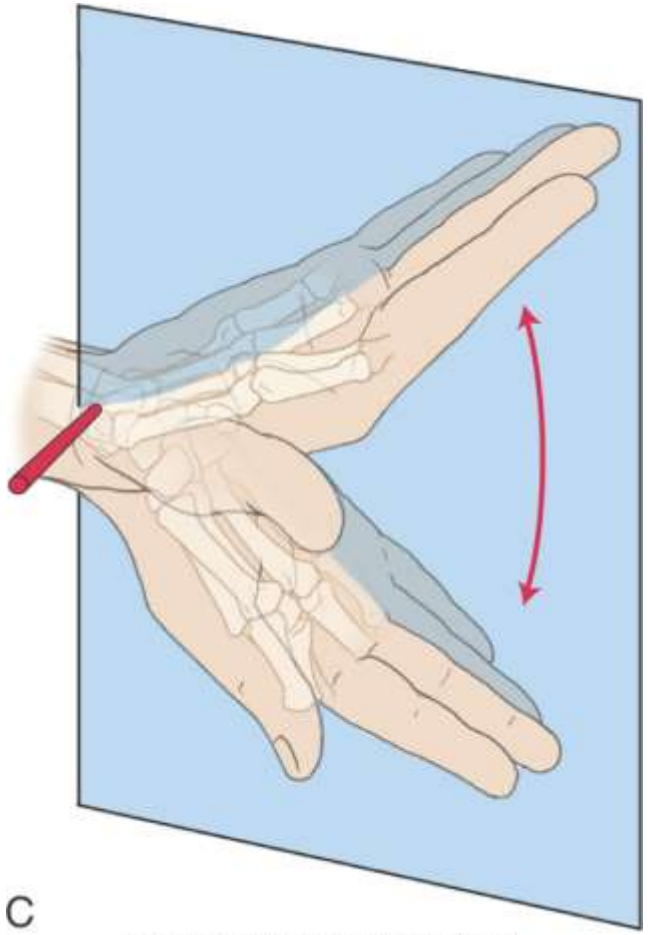
- Uniaxial (hinge and pivot)
- Biaxial (condyloid and saddle)
- Triaxial (ball and socket)
- Nonaxial

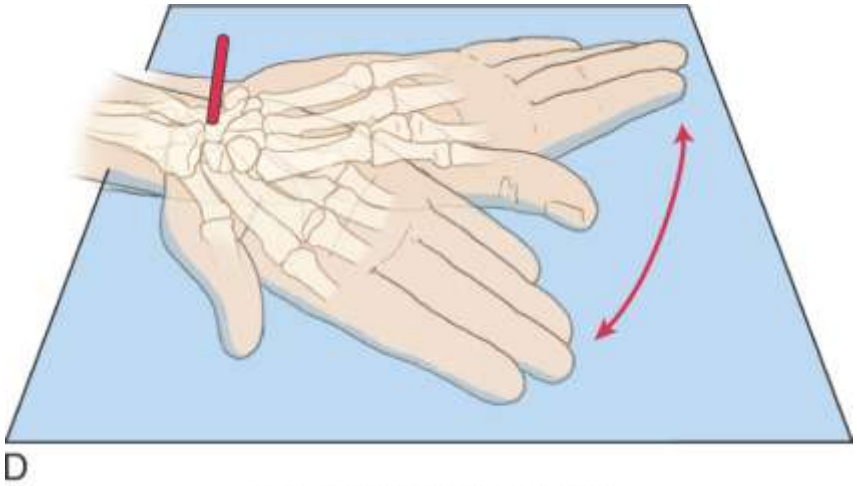
Uniaxial Joints



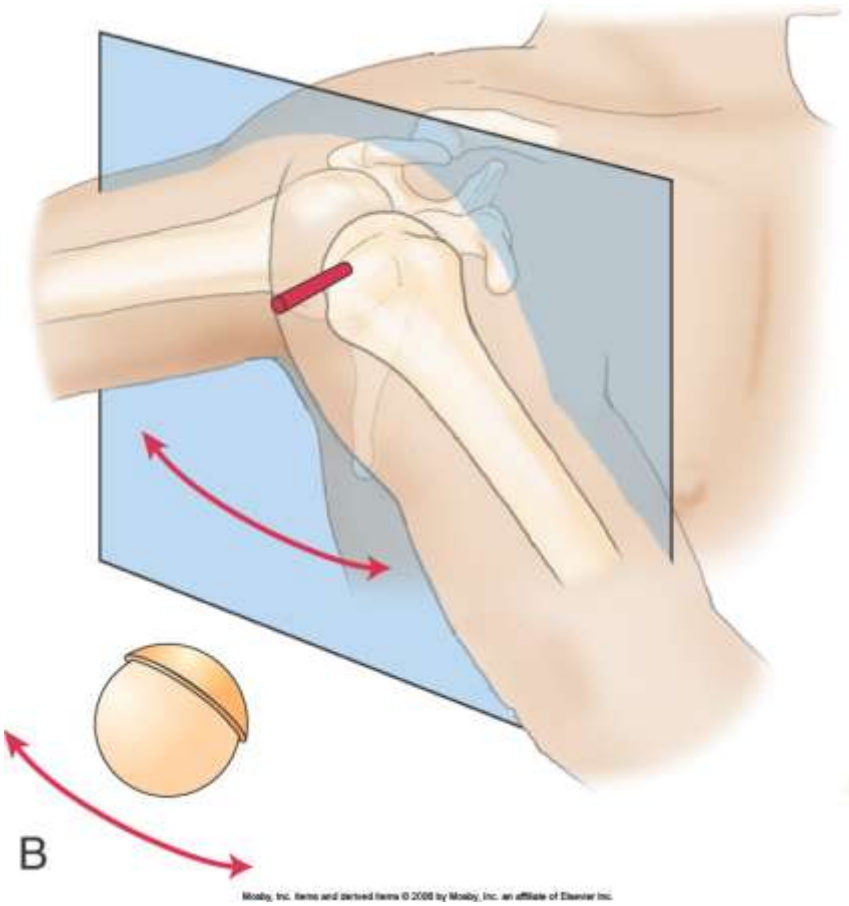


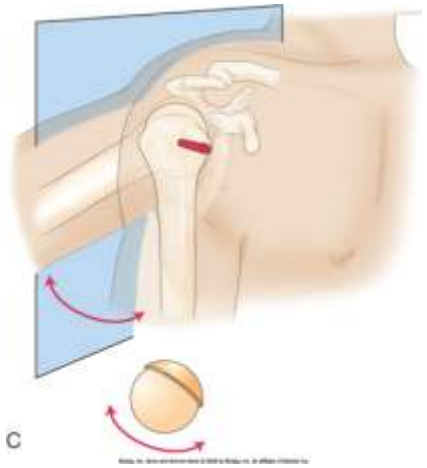
Biaxial Joints

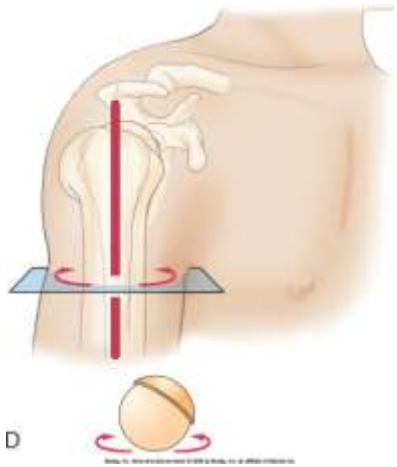




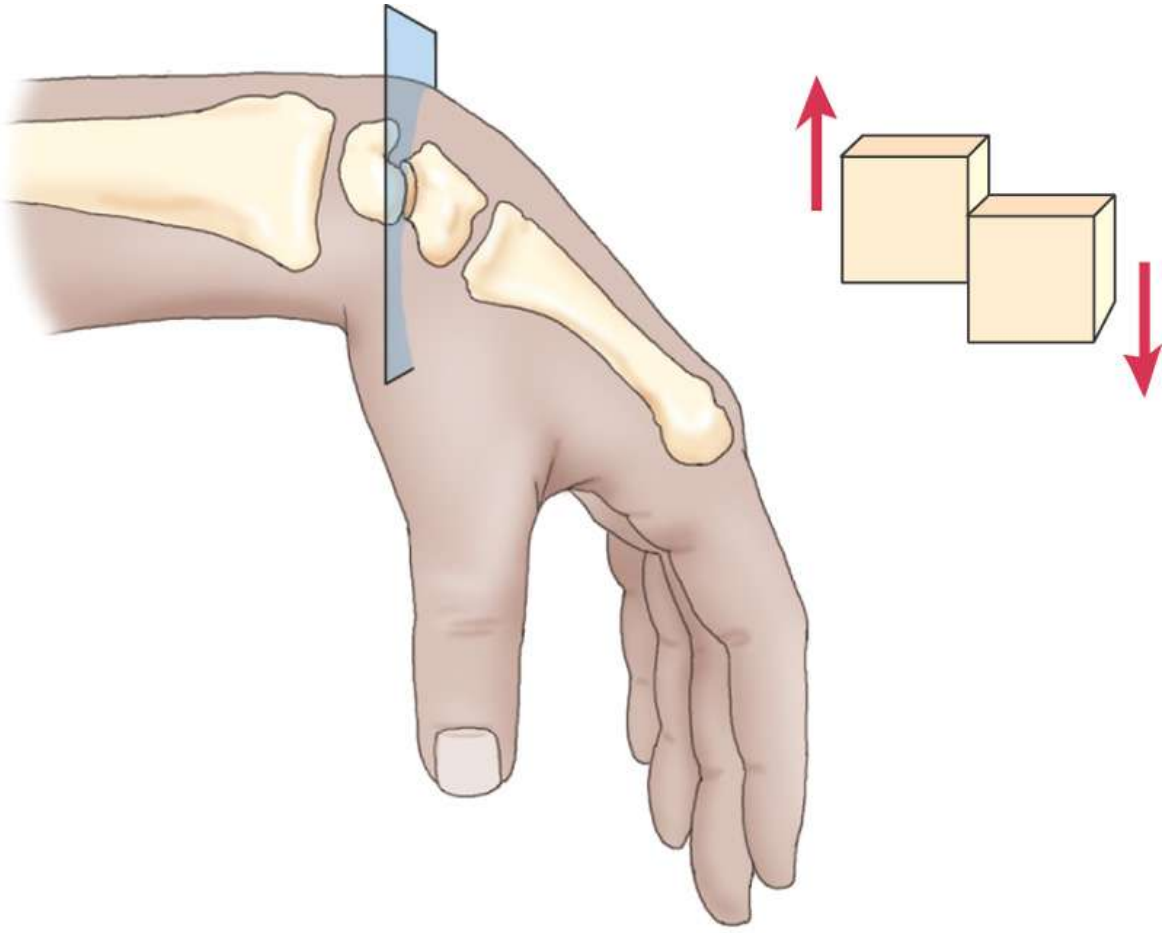
Triaxial Joints







Nonaxial Joints



Upper Extremity Joints

- Shoulder (Glenohumeral)
- Shoulder Girdle: (scapulocostal, sternoclavicular, acromioclavicular)
- Elbow
- Radioulnar
- Wrist
- Saddle of thumb
- Metacarpophalangeal
- Interphalangeal (proximal and distal)

Lower Extremity Joints

- Hip
- Knee
- Ankle
- Subtalar
- Metatarsophalangeal
- Interphalangeal (proximal and distal)

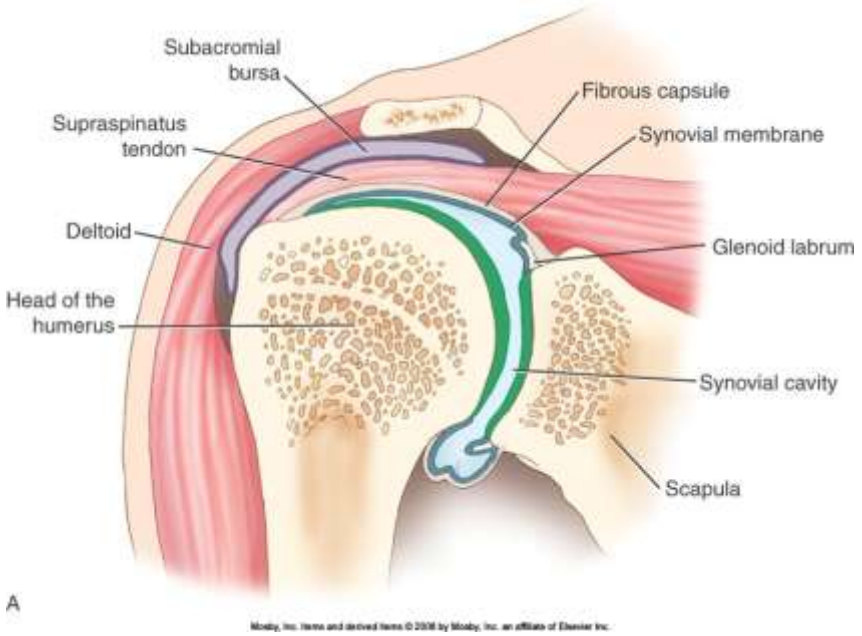
Axial Body Joints

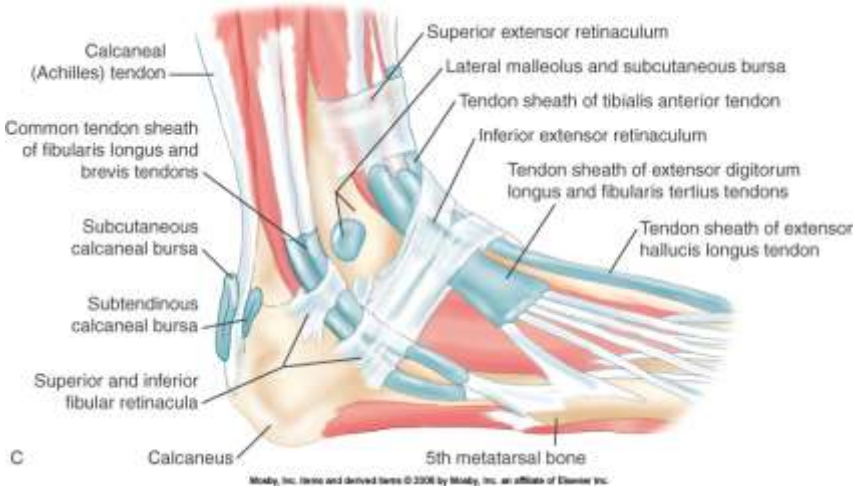
- Disc
- Facet
- Sacroiliac (“SIJ”)
- Temporomandibular (“TMJ”)

Other Skeletal Tissues

- Cartilage
- Bursa
- Tendon sheath

Other Skeletal Tissues - Figures





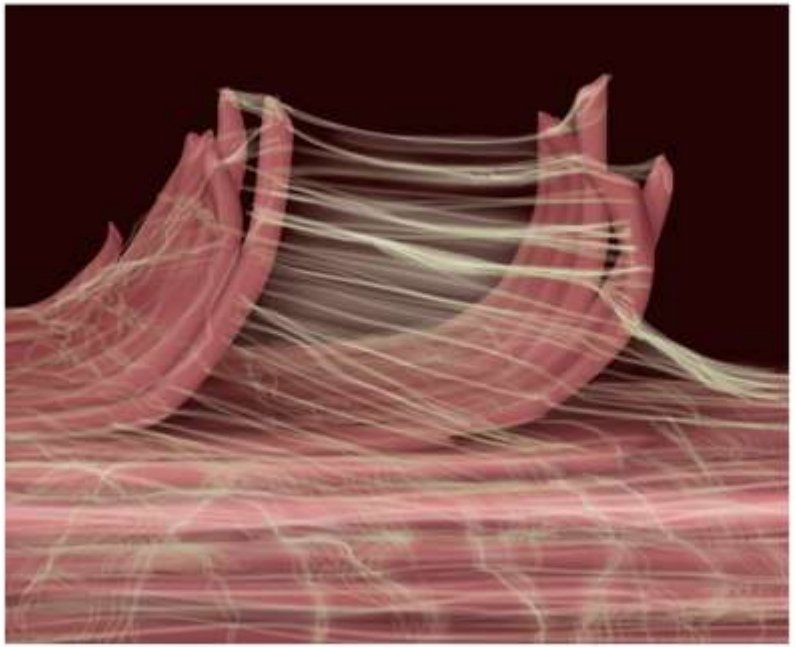
PART 3 – Myofascial Tissue & Muscle Function

- Structure & Function
  - myo =
  - fascial =

Myofascial Tissue

Fascia

From Paoletti S: The fasciae: anatomy, dysfunction and treatment, Seattle, 2006, Eastland Press.



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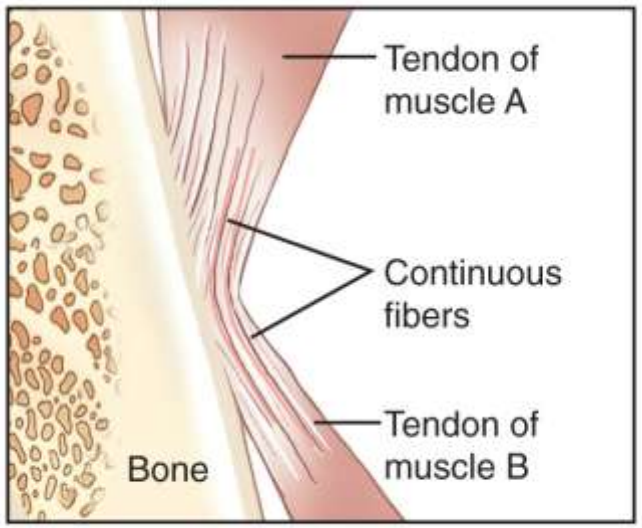
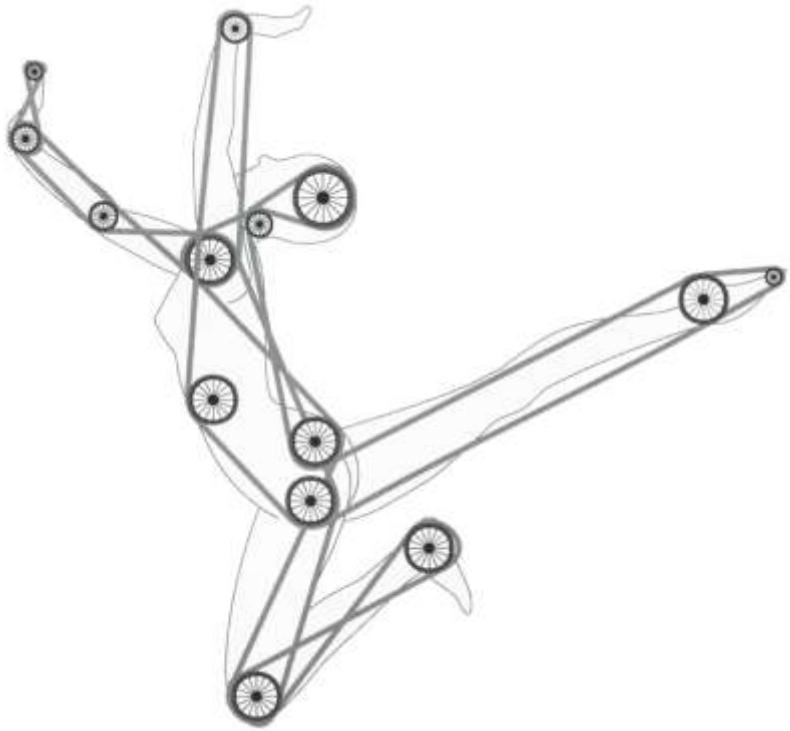
Fascia – cont'd





From Paoletti S: The fasciae: anatomy, dysfunction and treatment, Seattle, 2006, Eastland Press.

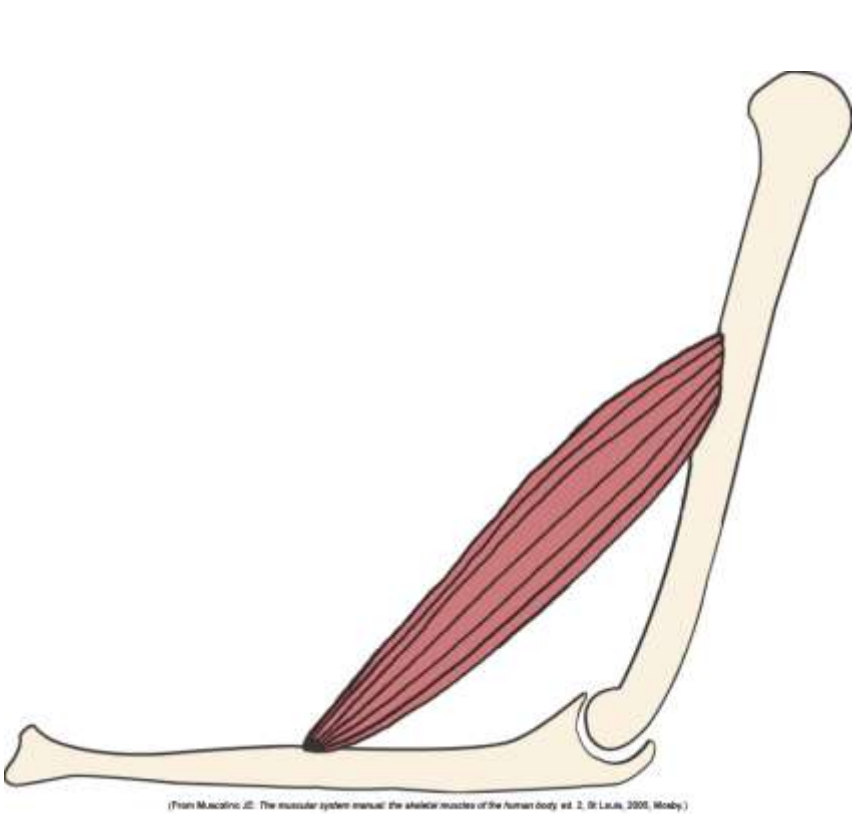
Fascia – cont'd

A

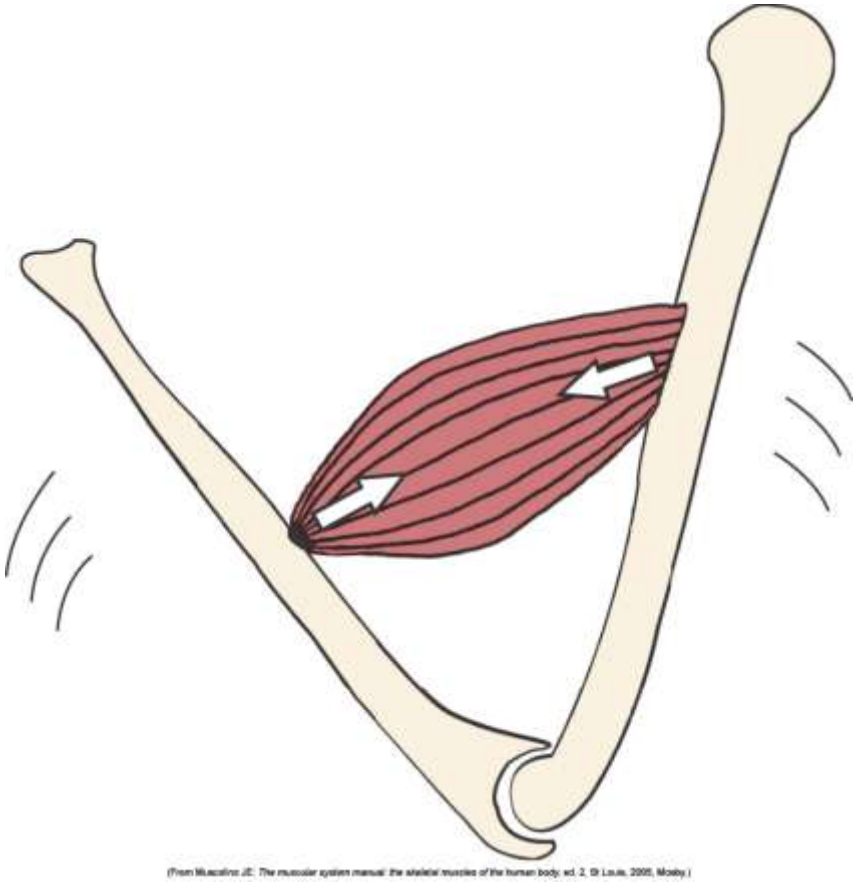
Modeled from Myers TW: Anatomy trains: myofascial meridians for manual & movement therapists, ed 3, Edinburgh, 2014, Churchill Livingstone, Elsevier.

Modified from Myers TW: Anatomy trains: myofascial meridians for manual and movement therapists, ed 3, Edinburgh, 2014, Churchill Livingstone.

Typical Muscle

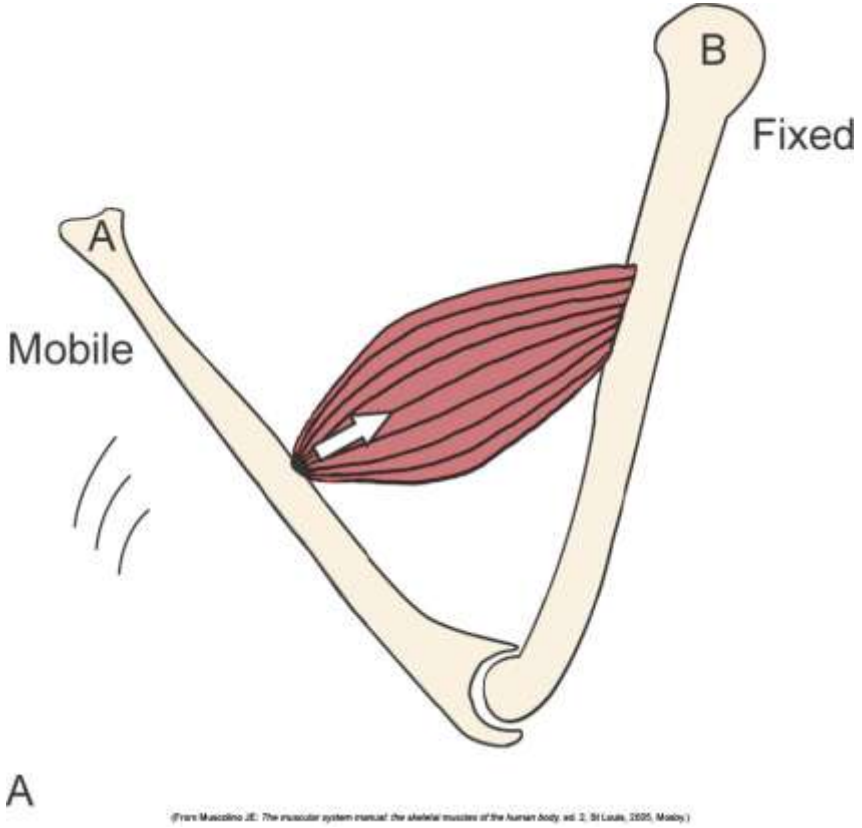


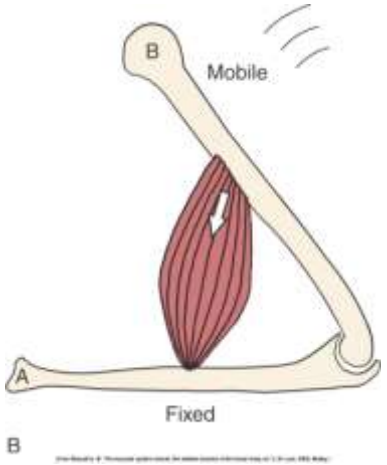
(From Muscolino JE: *The muscular system manual: the skeletal muscles of the human body* ed. 2, St Louis, 2005, Mosby.)

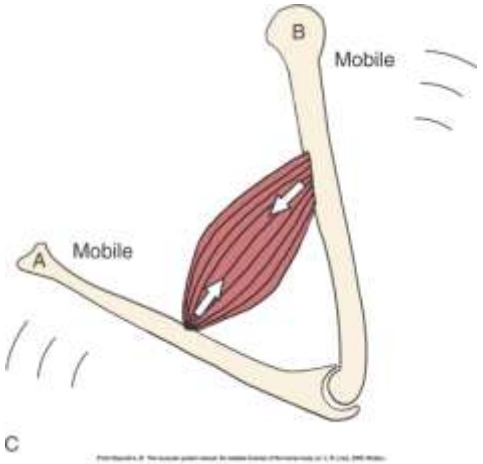


(From Muscolino JE: *The muscular system manual: the skeletal muscles of the human body* ed. 2, St Louis, 2005, Mosby.)

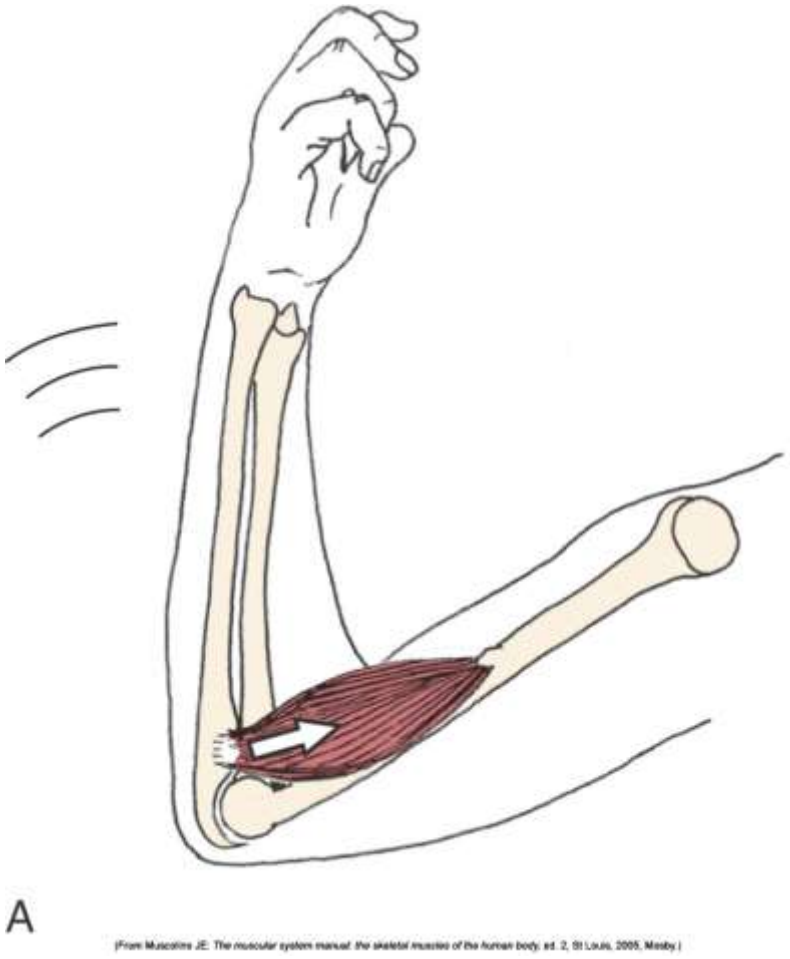
Concentric (Shortening) Contractions

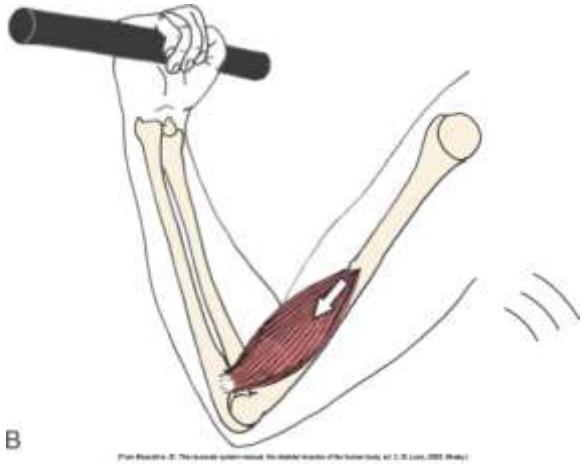




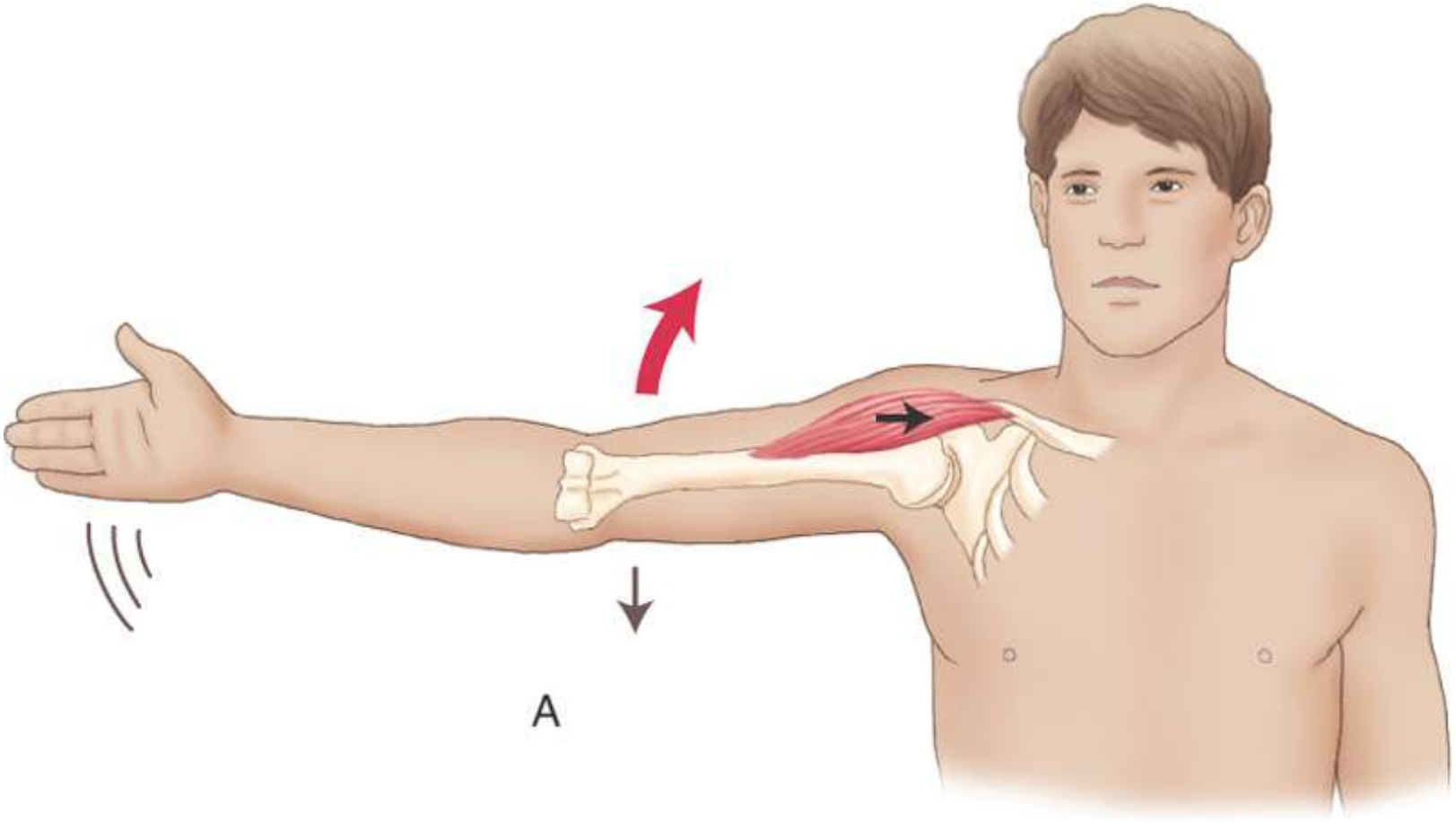


Concentric (Shortening) Contractions - Brachialis





Concentric Contraction

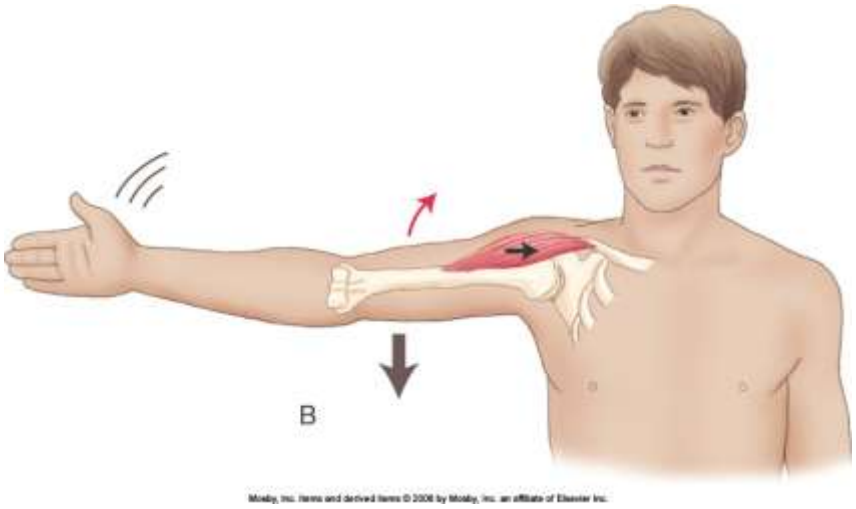


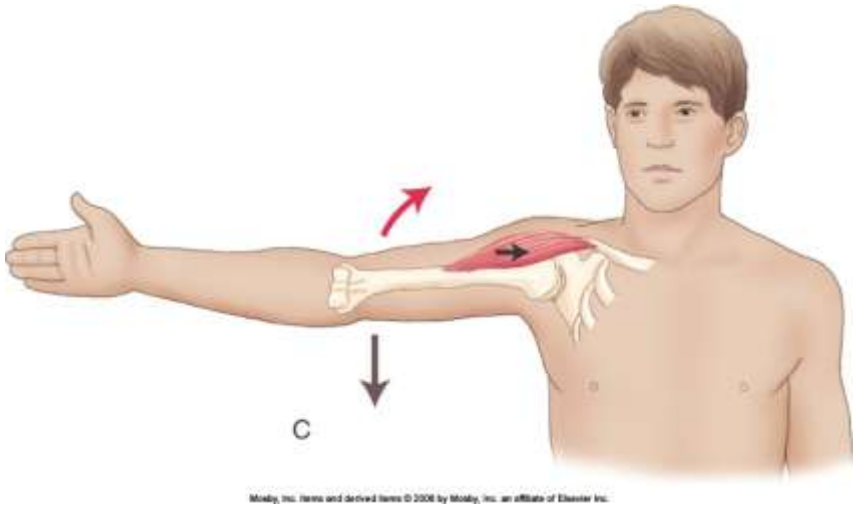
Open-Chain & Closed-Chain…

- Kinematic chain of elements
- Upper extremity
- Lower extremity

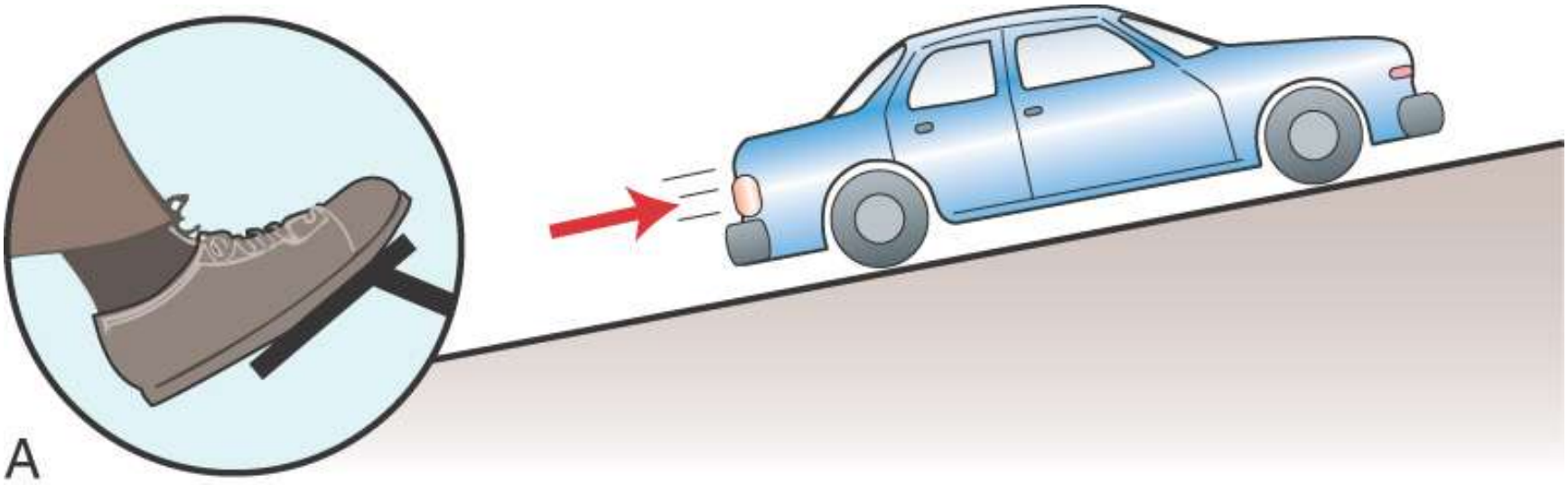
- Standard and Reverse Actions

Eccentric and Isometric Contractions

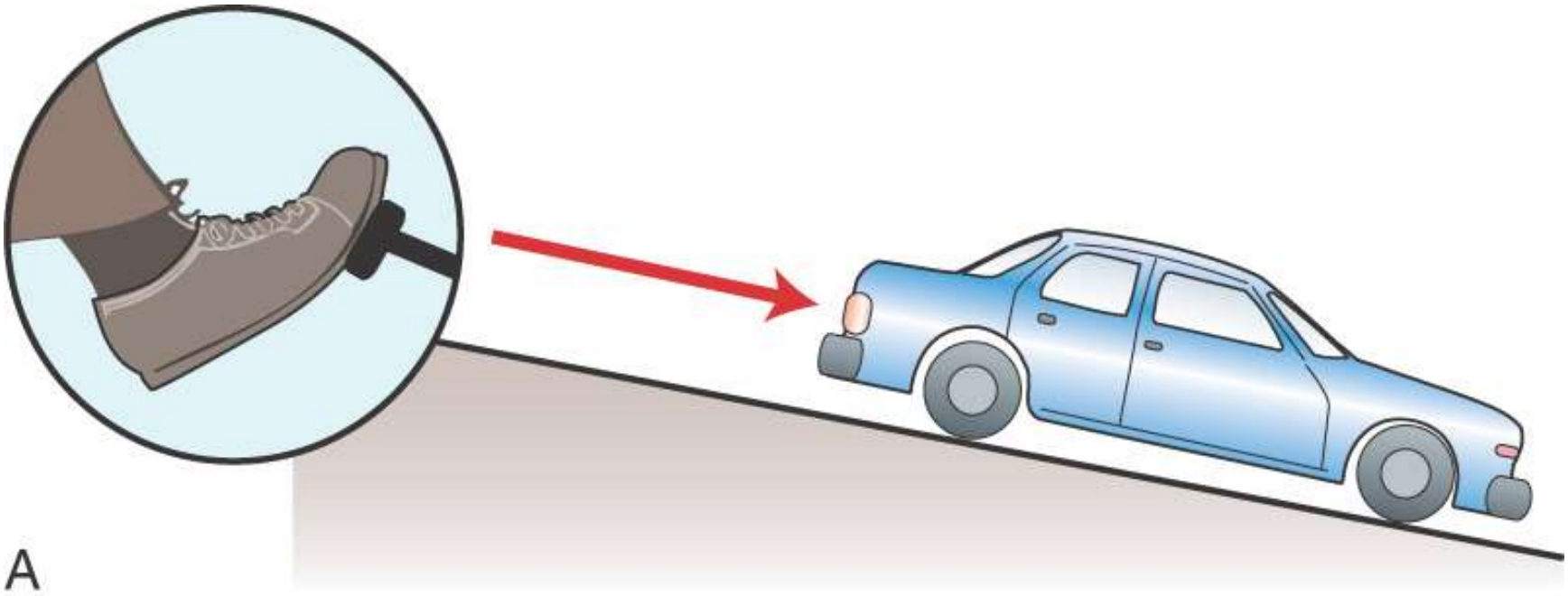




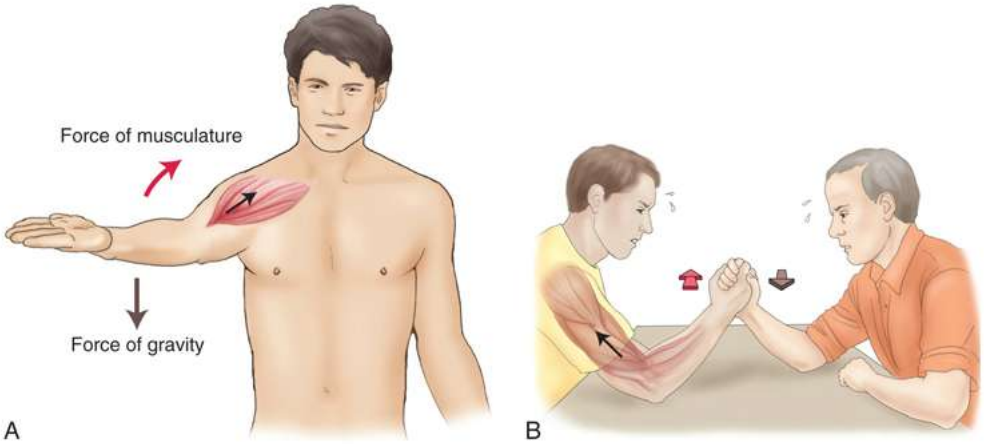
Concentric Contraction Analogy



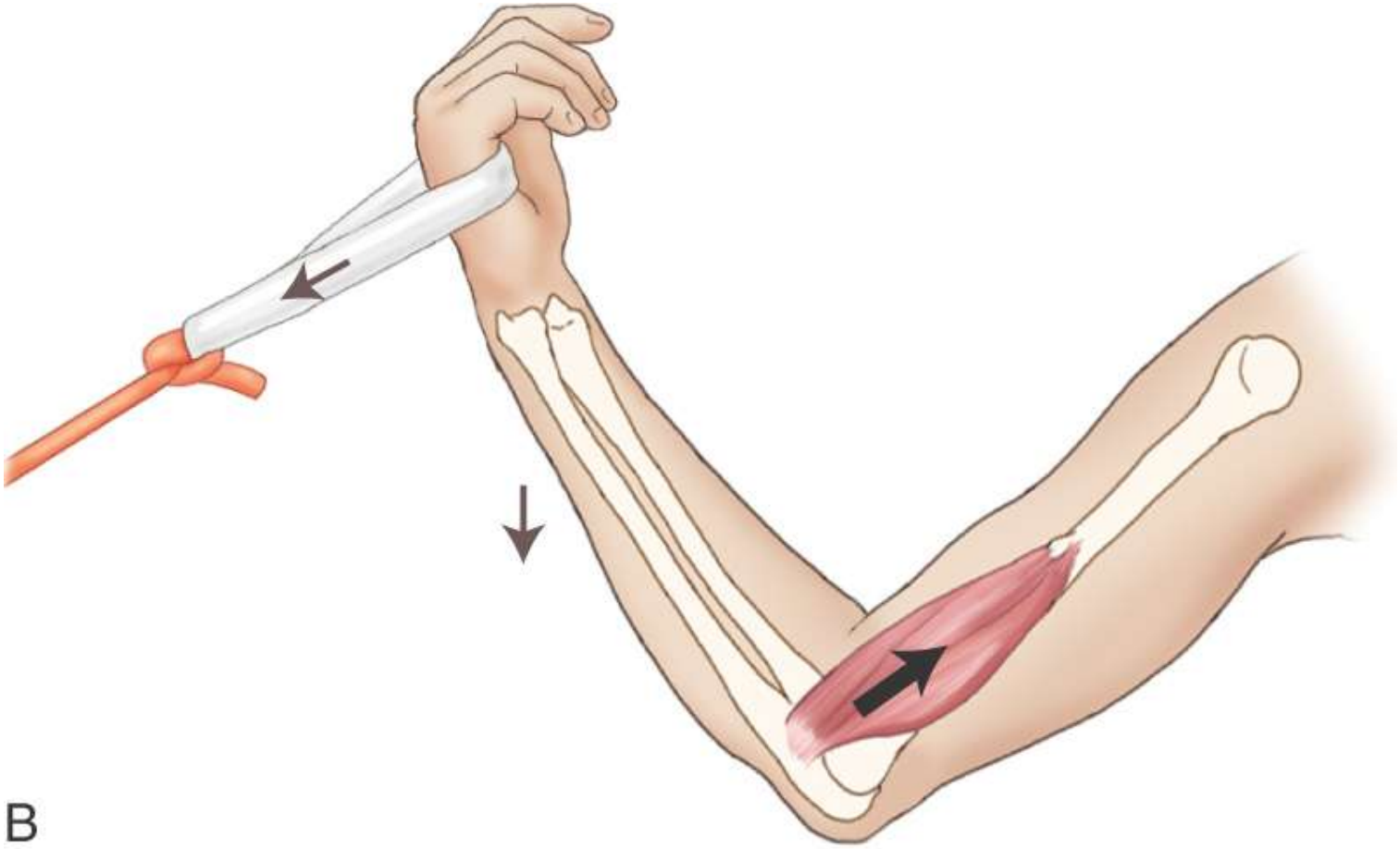
Eccentric Contraction Analogy



Isometric Contraction Example

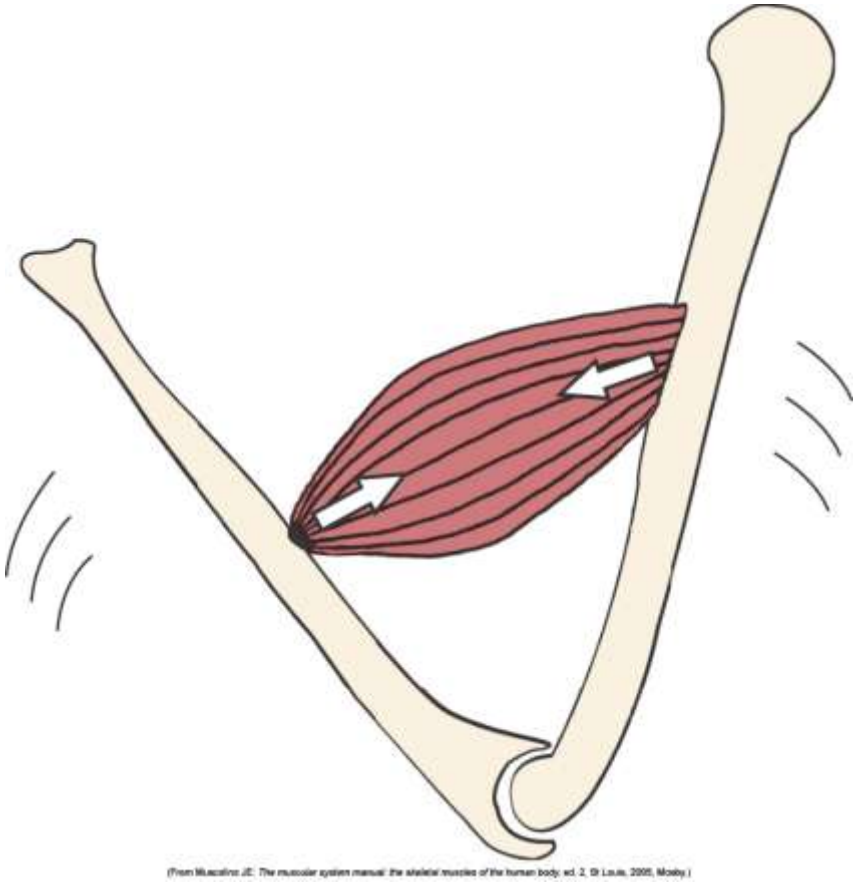


Adding Resistance

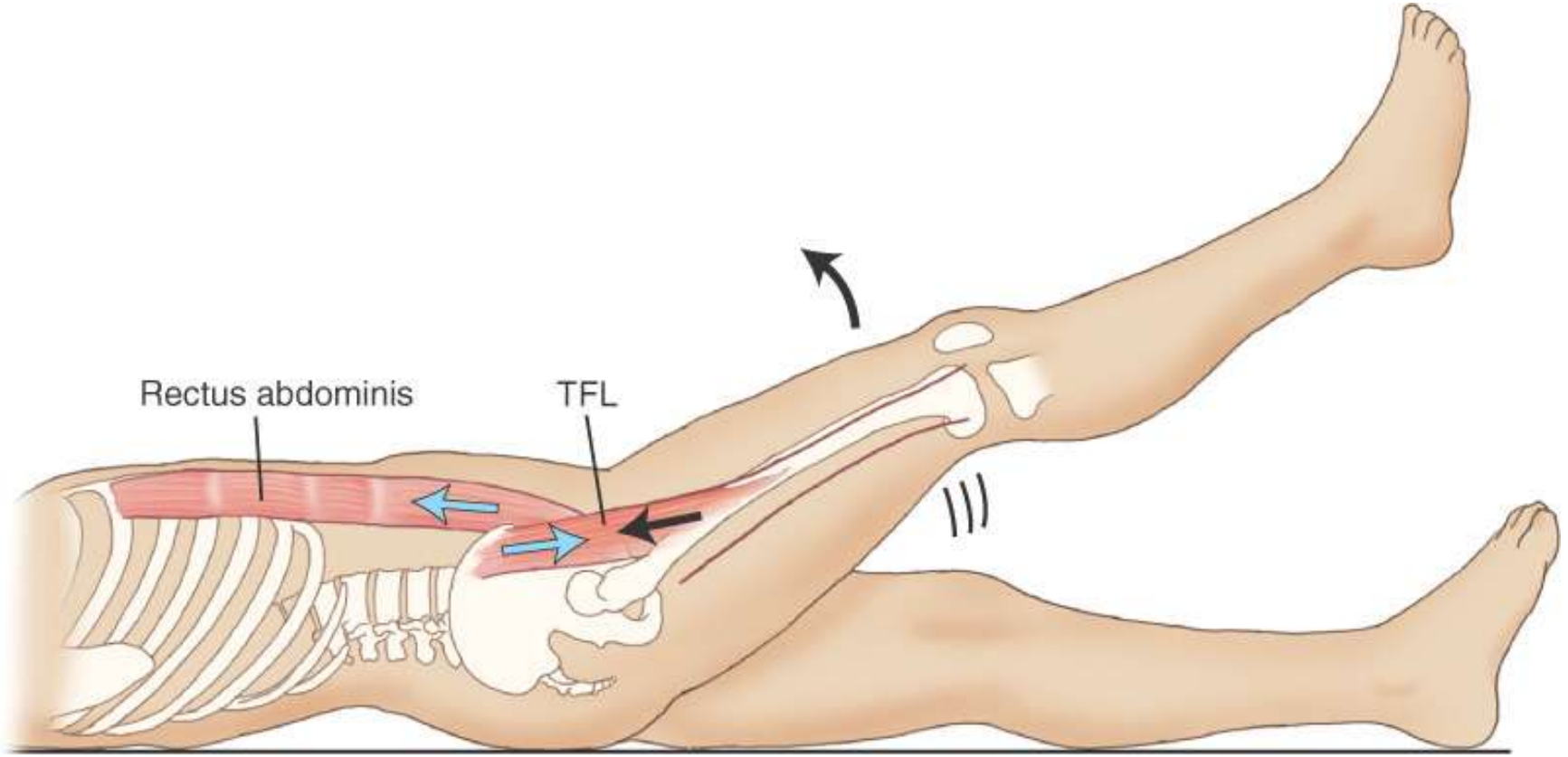


Stabilization…

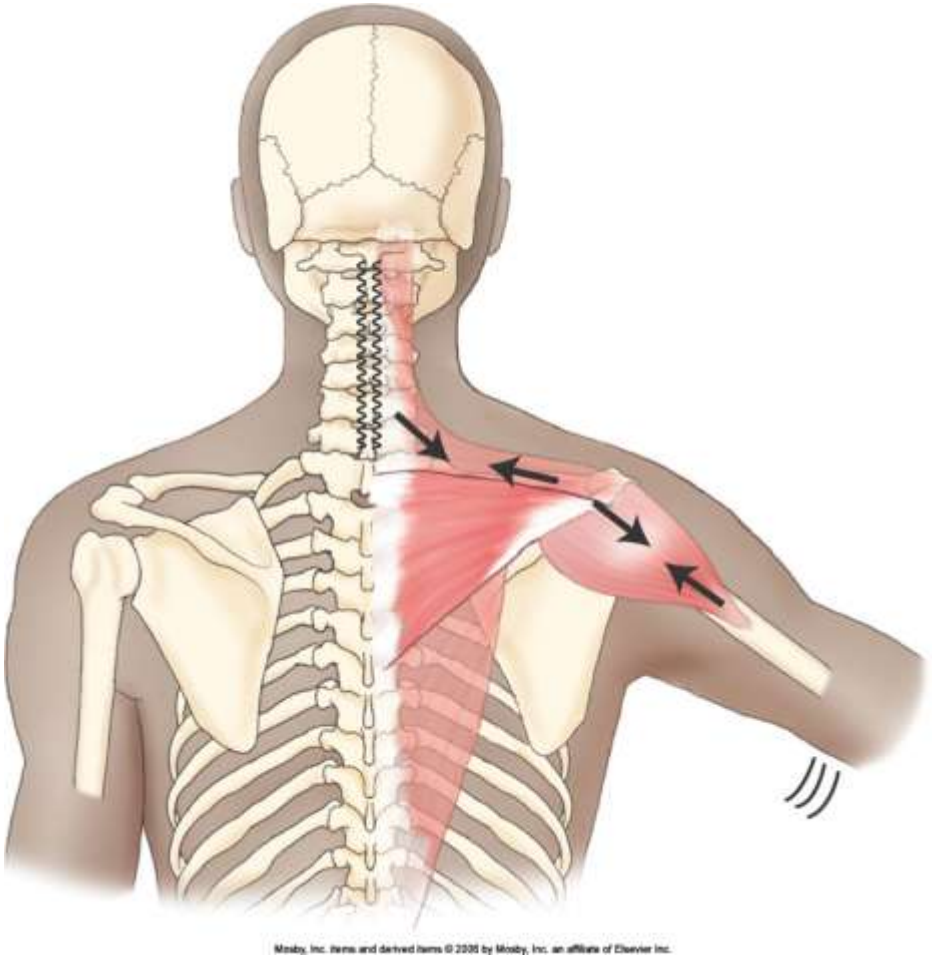
- A muscle pulls equally on both of its attachments…
- Why might only one attachment move?



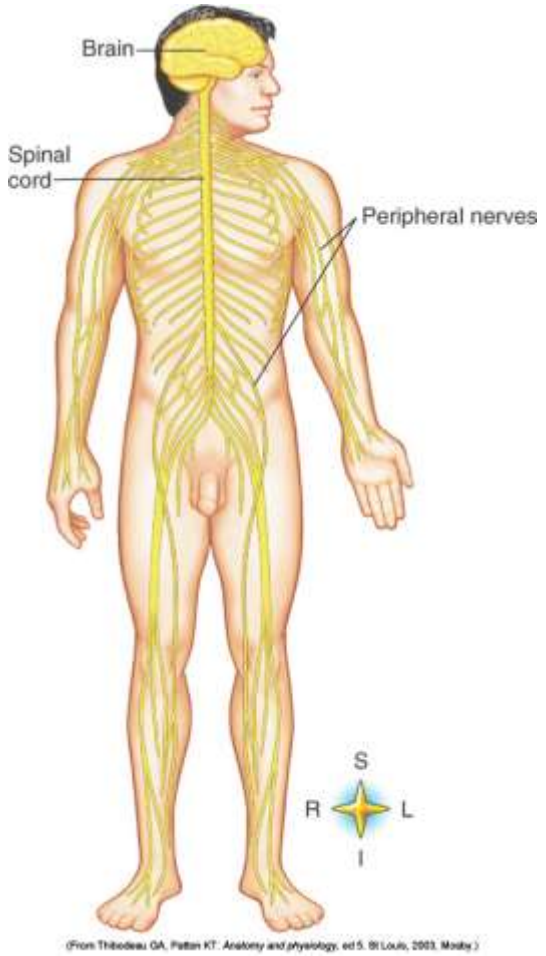
Stabilization - Pelvis



Stabilization - Scapula

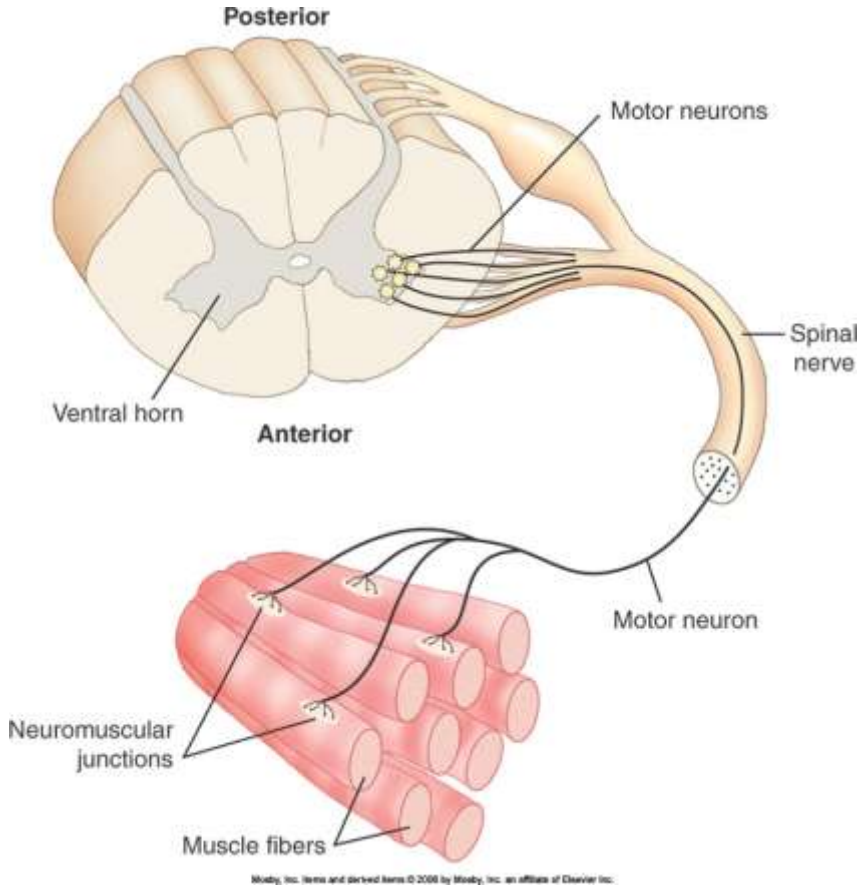


Neural Control

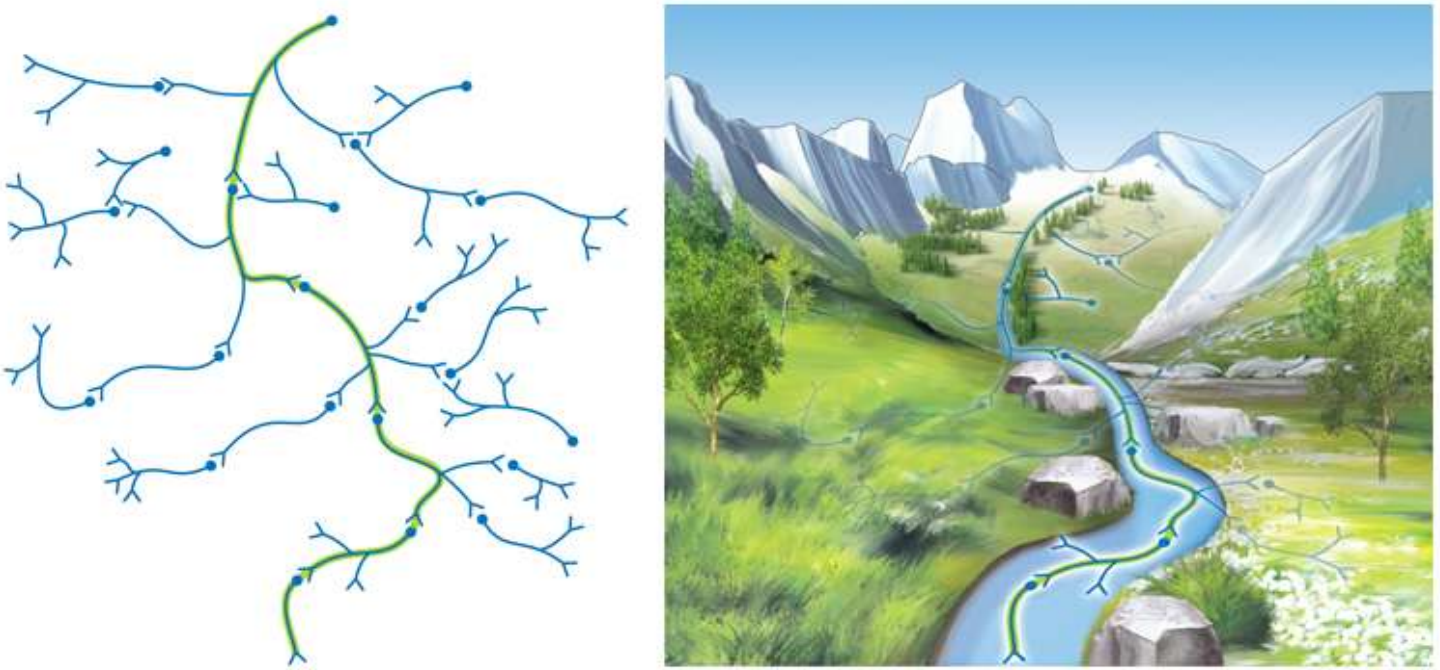


(From Thibodeau GA, Patton KT: Anatomy and physiology, ed 5, St Louis, 2003, Mosby.)

Neural Control – cont'd



Muscle Memory



Courtesy of Giovanni Rimasti

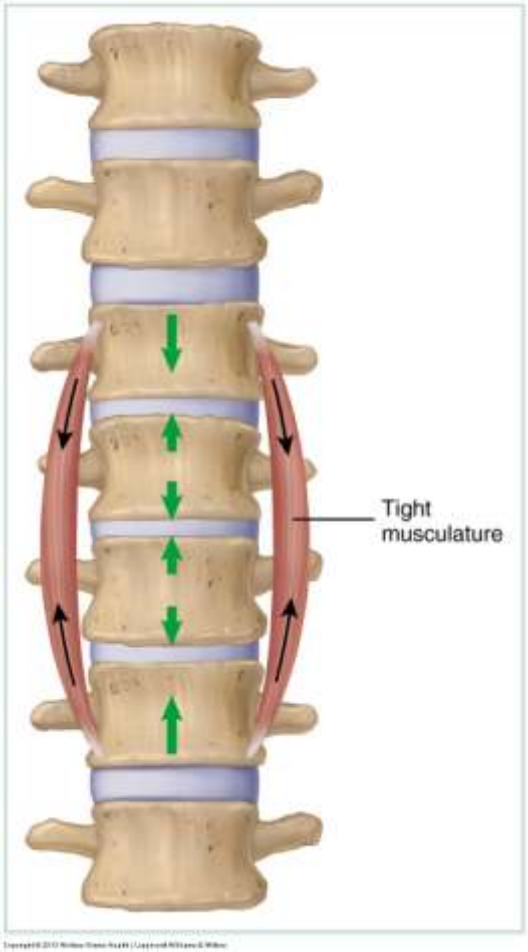
Overview of Blood Flow

- Systemic circulation:
- Heart to arteries to capillaries
  - Tissue exchange with the cells of the body
- To veins to the heart

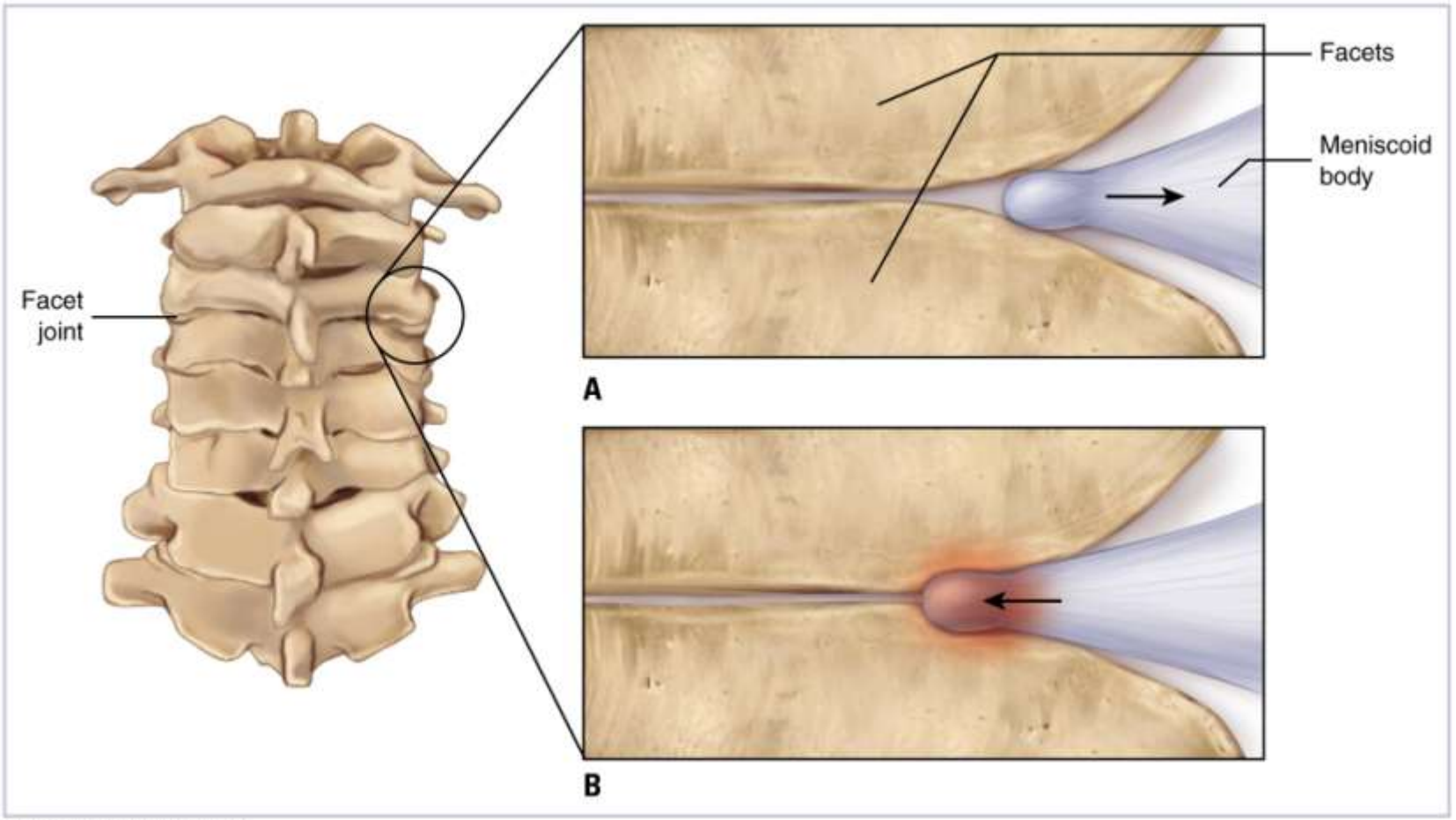
PART 4: Pathologic Conditions

- Muscle Spasm
- Joint Dysfunction
- Pathologic Disc (disc bulge / herniation)
- Sciatica
- Spinal Curves – Pelvic Tilt & Hyperlordosis / Hypolordosis
- Rounded Back & Forward-Head Posture
- Elevated Shoulder
- Scoliosis
- Spondylolisthesis
- Degenerative joint disease (DJD, osteoarthritis, OA)
- Strain / Tendinitis & Sprain & Whiplash
- Carpal tunnel syndrome
- Meniscus damage
- Foot hyperpronation
- Hip replacement

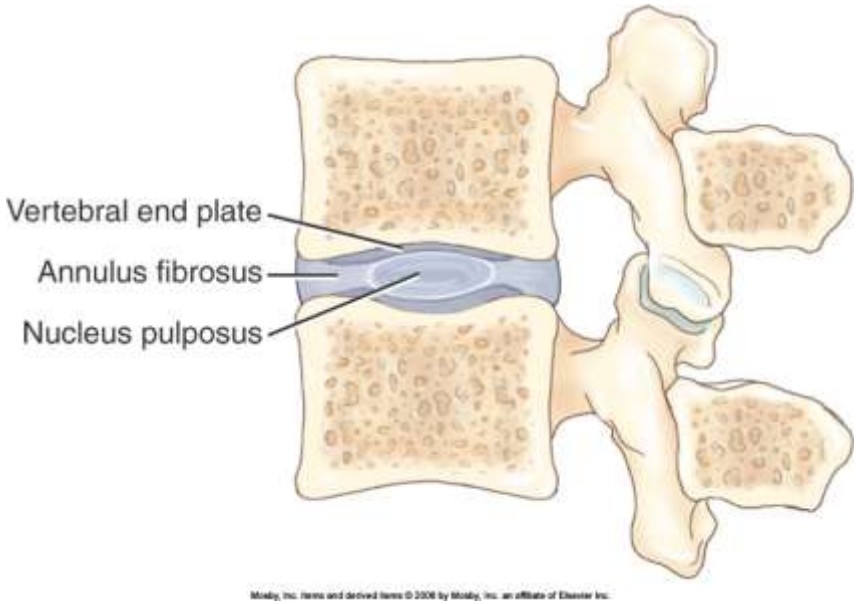
Muscle Spasm

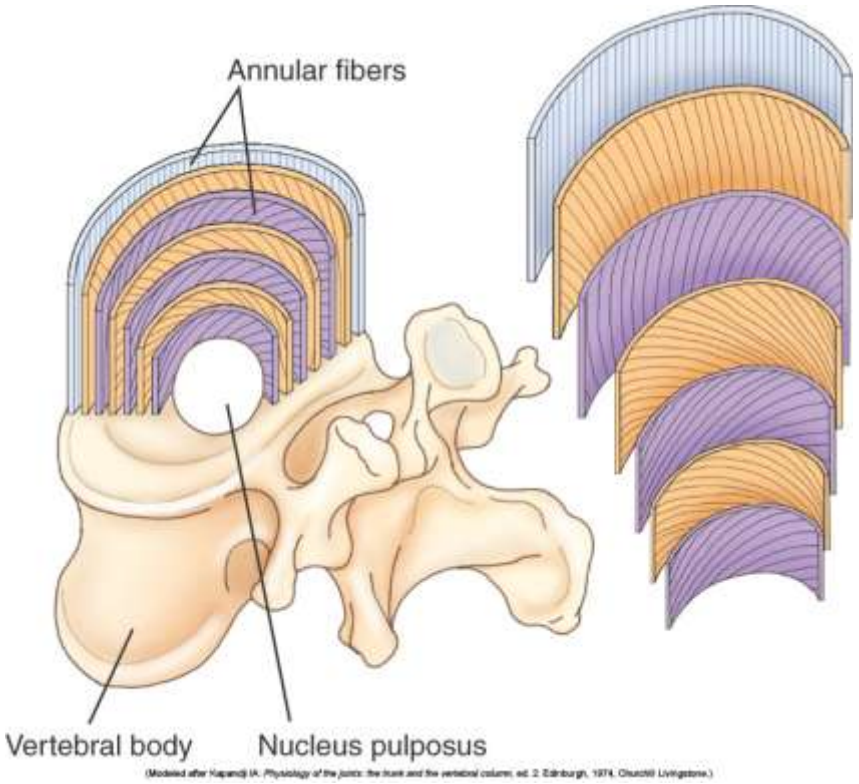


Joint Dysfunction

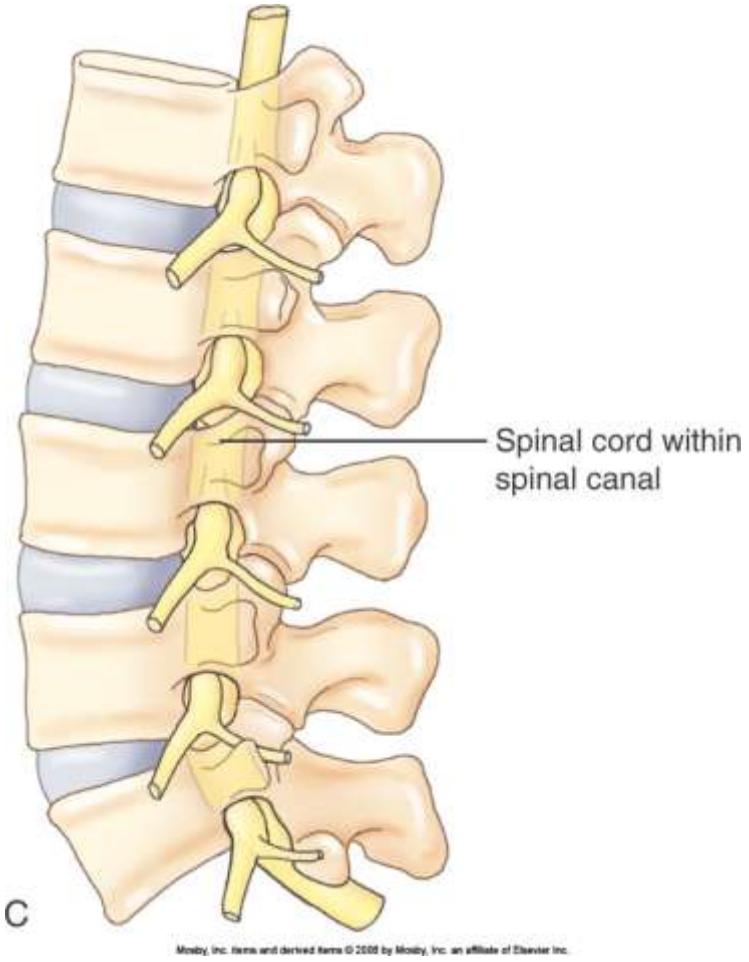


Pathologic Disc



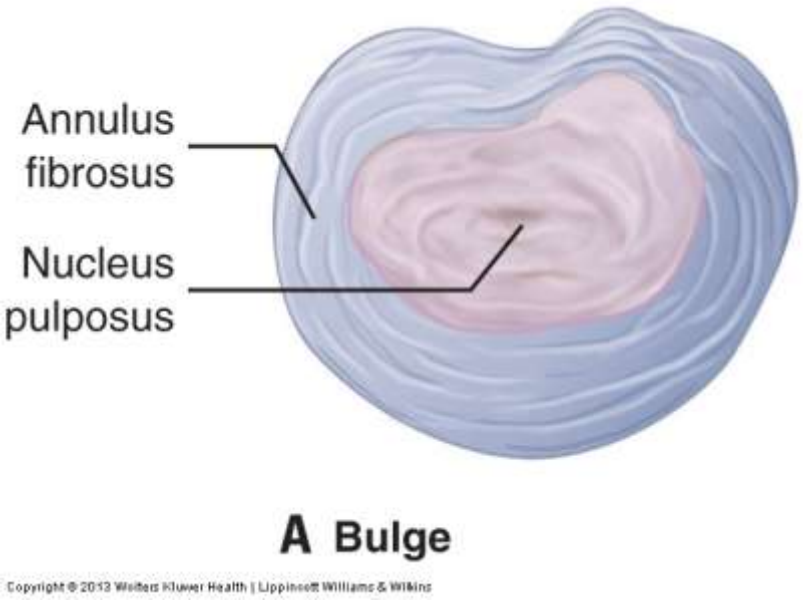


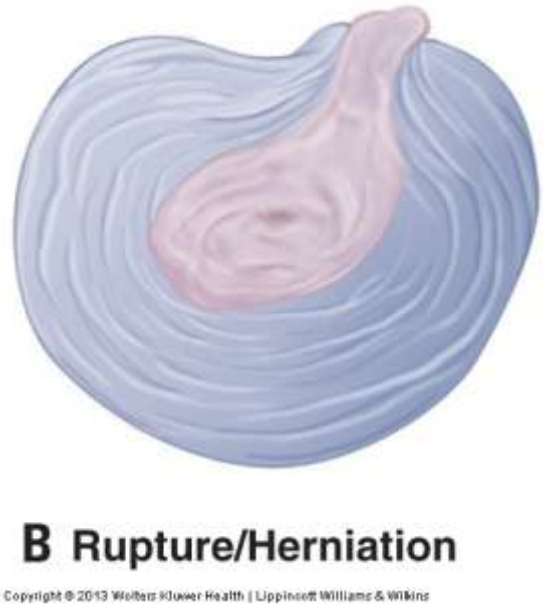
Pathologic Disc



Pathologic Disc and Flexion

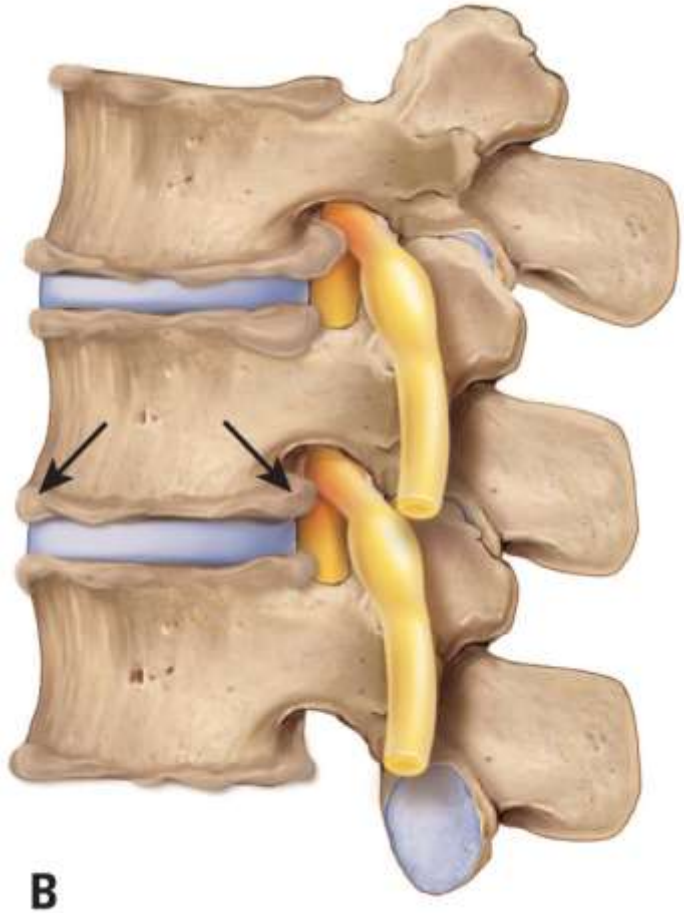
Disc Bulge & Herniation

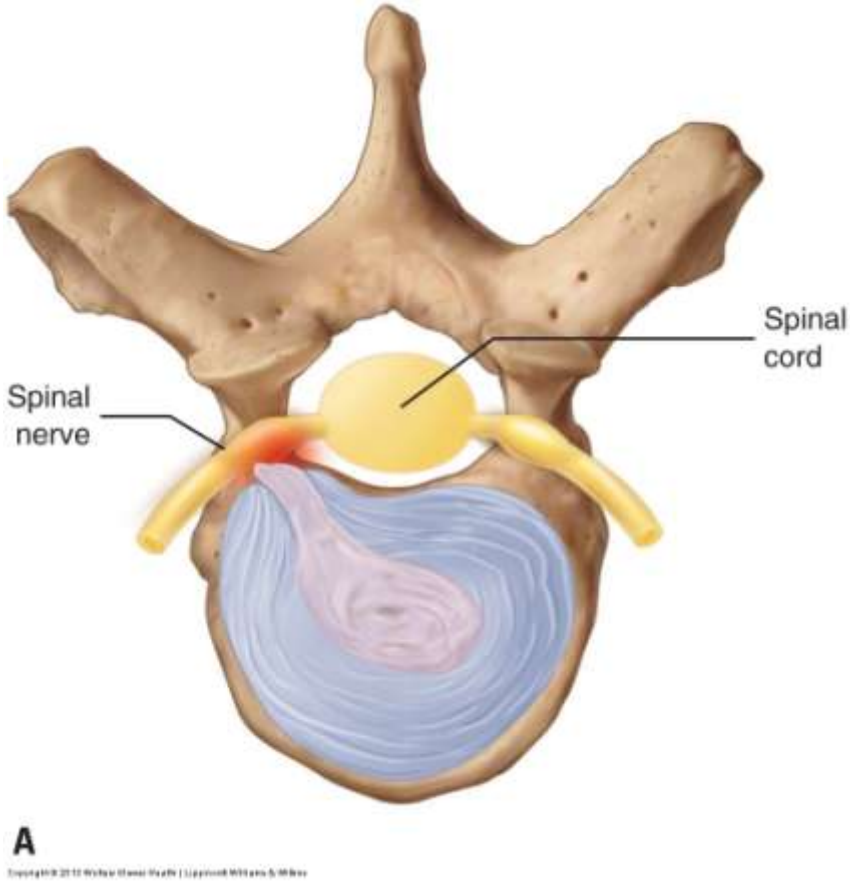




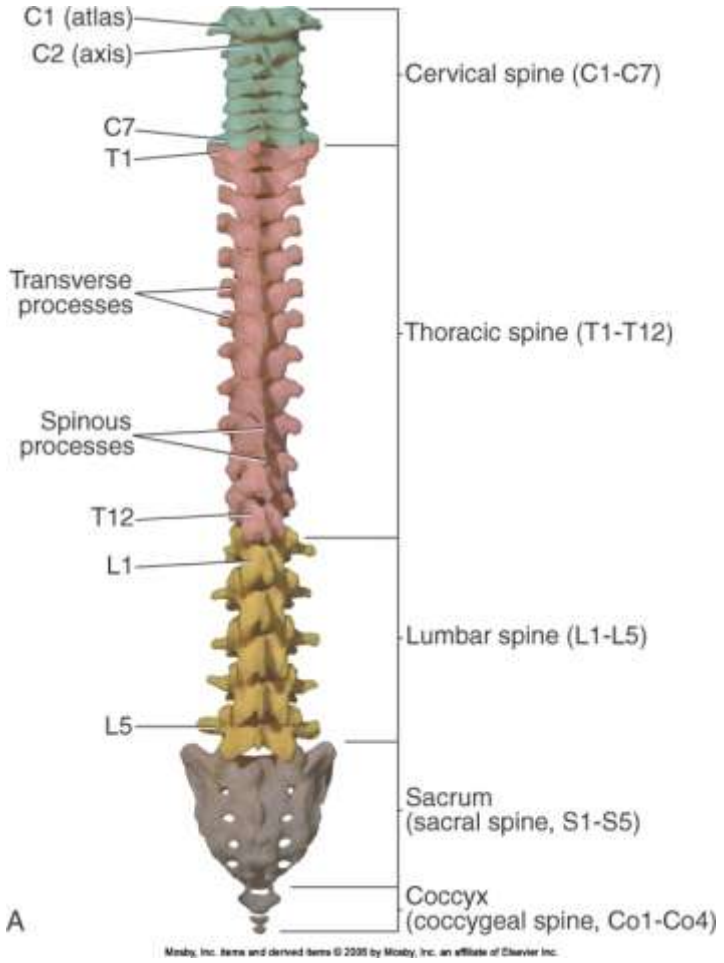
Sciatica

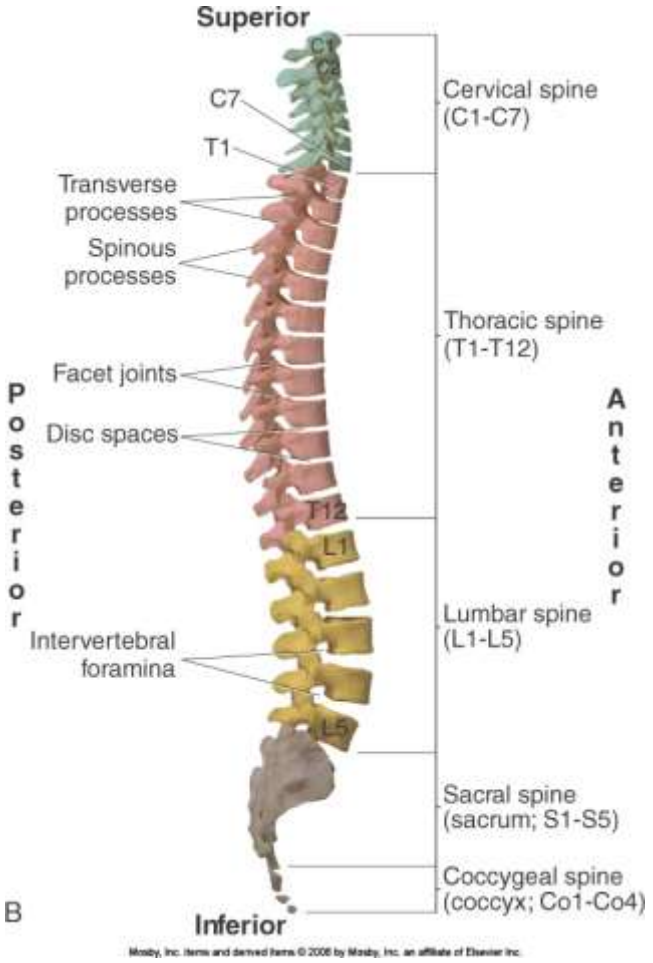
“Pinched Nerve”



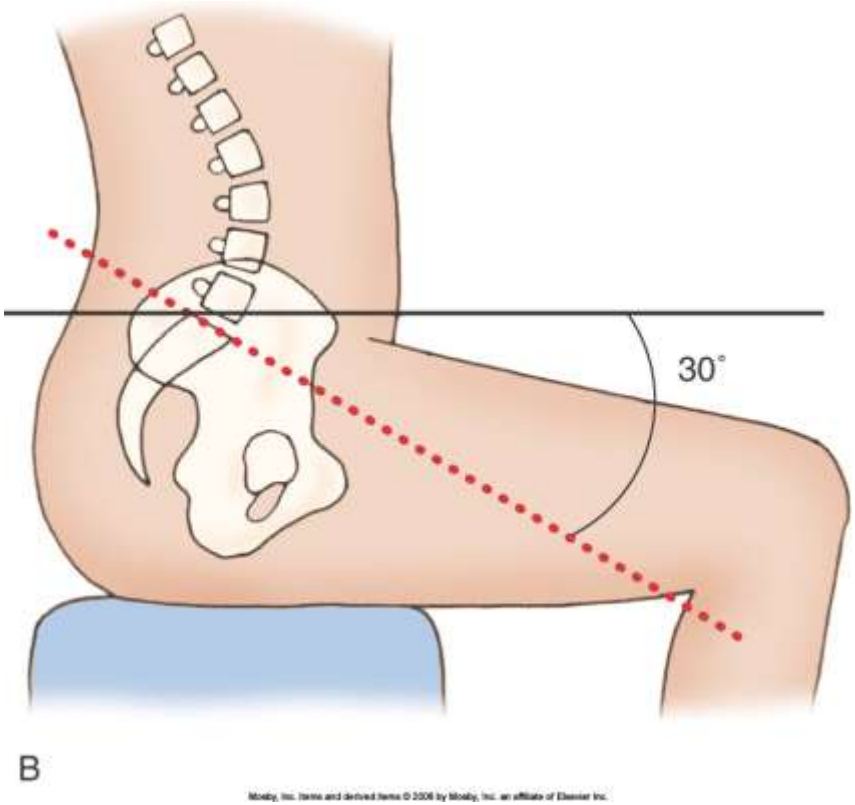


Spinal Curves



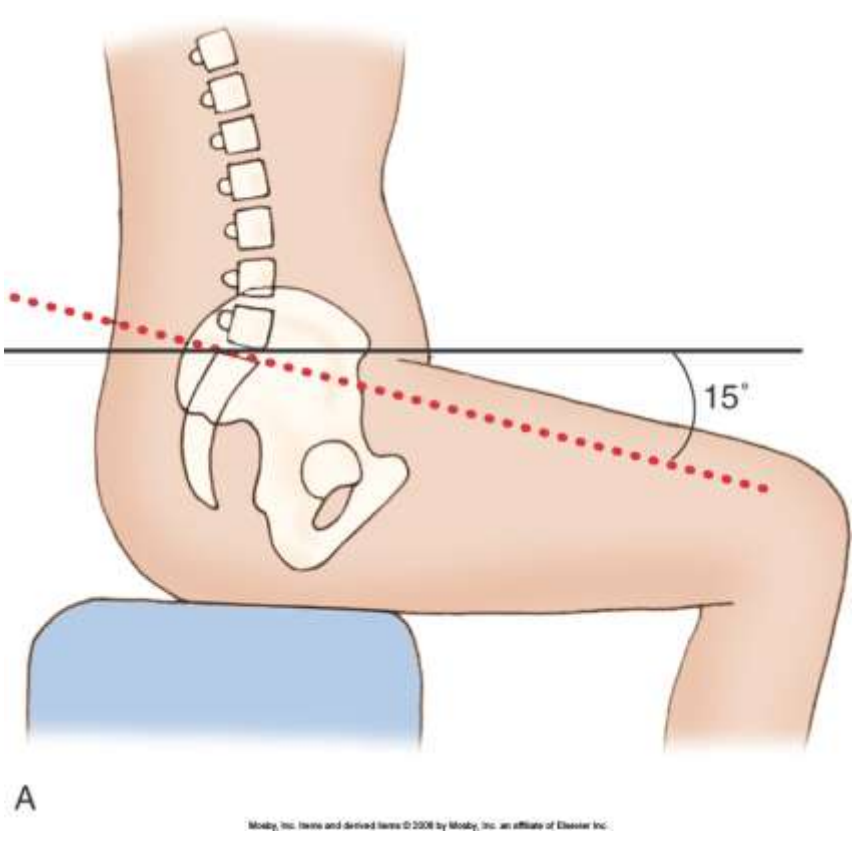


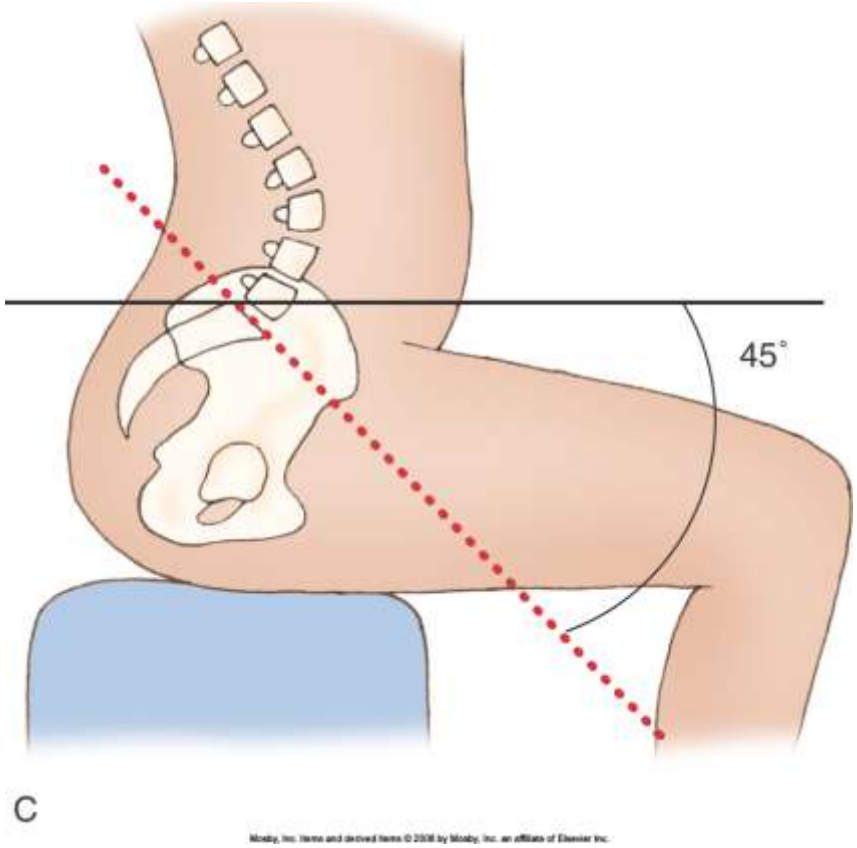
Pelvic Tilt



- Notice the relationship between the sacral base angle and the lordosis of the lumbar spine.

Hypolordosis / Hyperlordosis

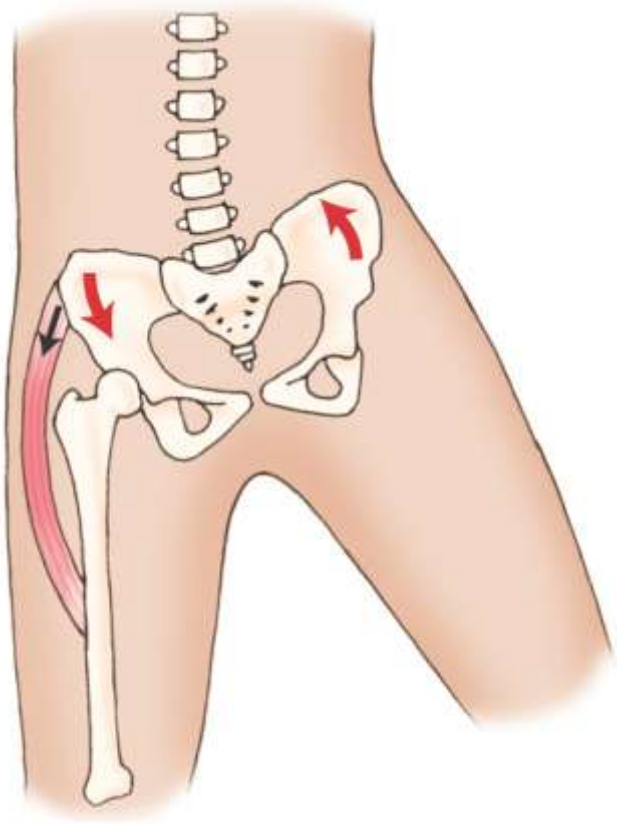




Rounded Back & Forward-Head Posture

Elevated Shoulder

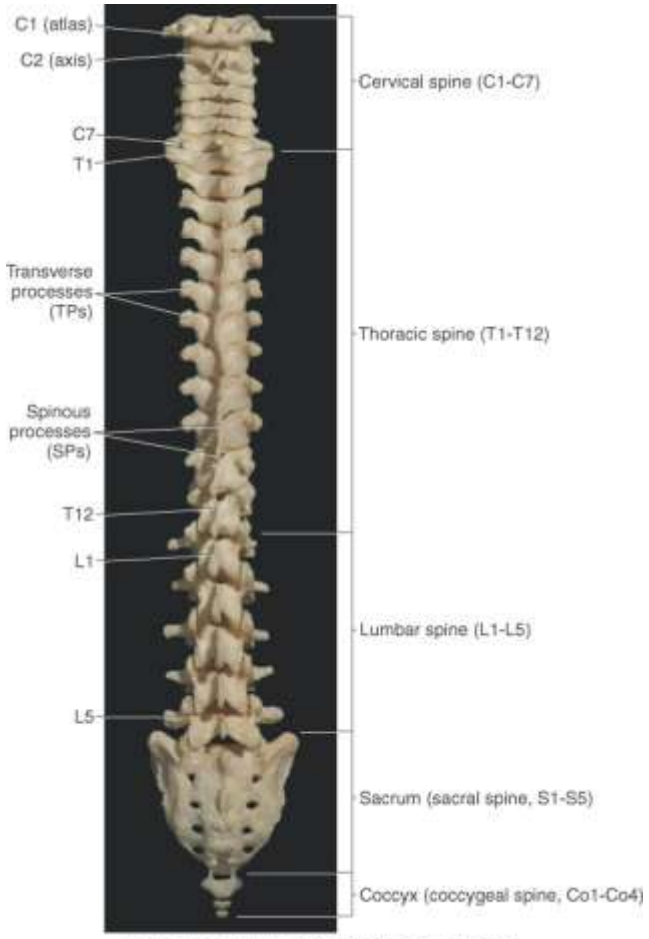
Tight ‘hip joint abductors’



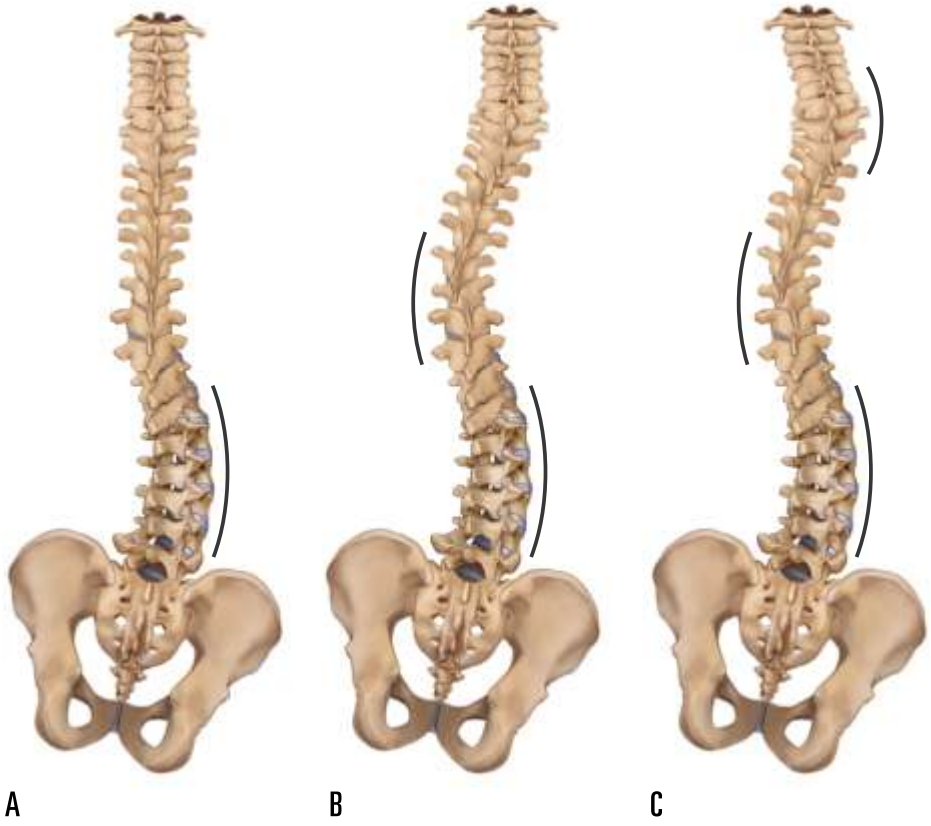
B Depression of the right pelvis (and elevation of the left pelvis)

- Notice the effect upon the spine

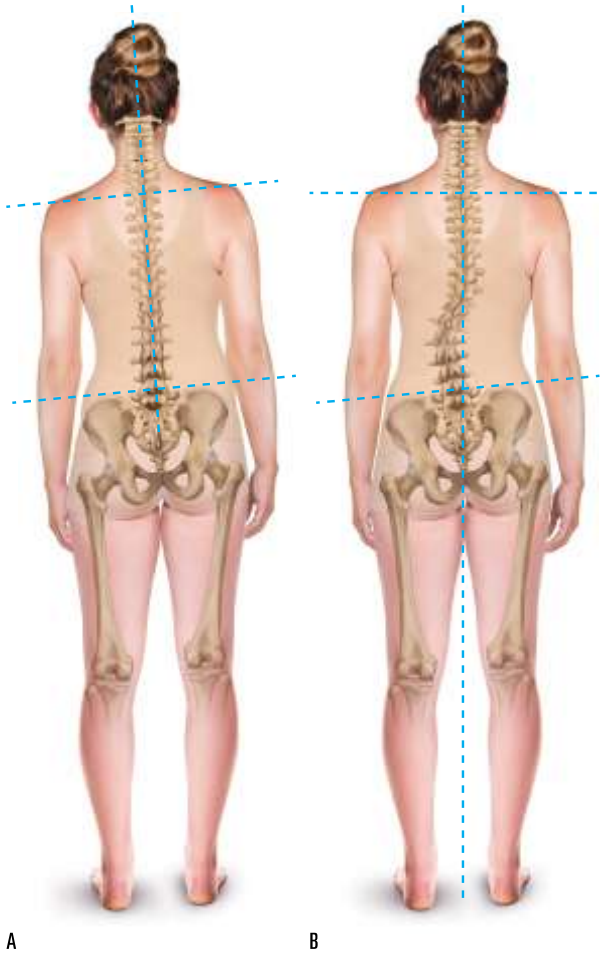
Scoliosis



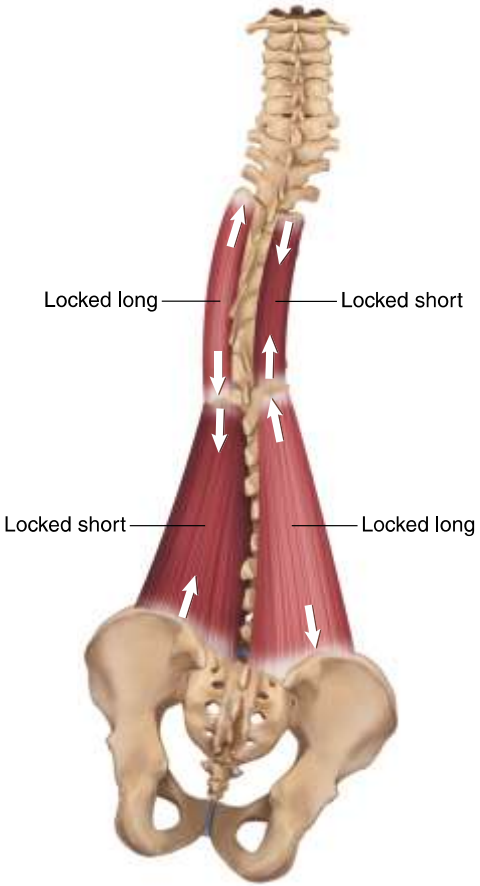
Scoliotic Curves



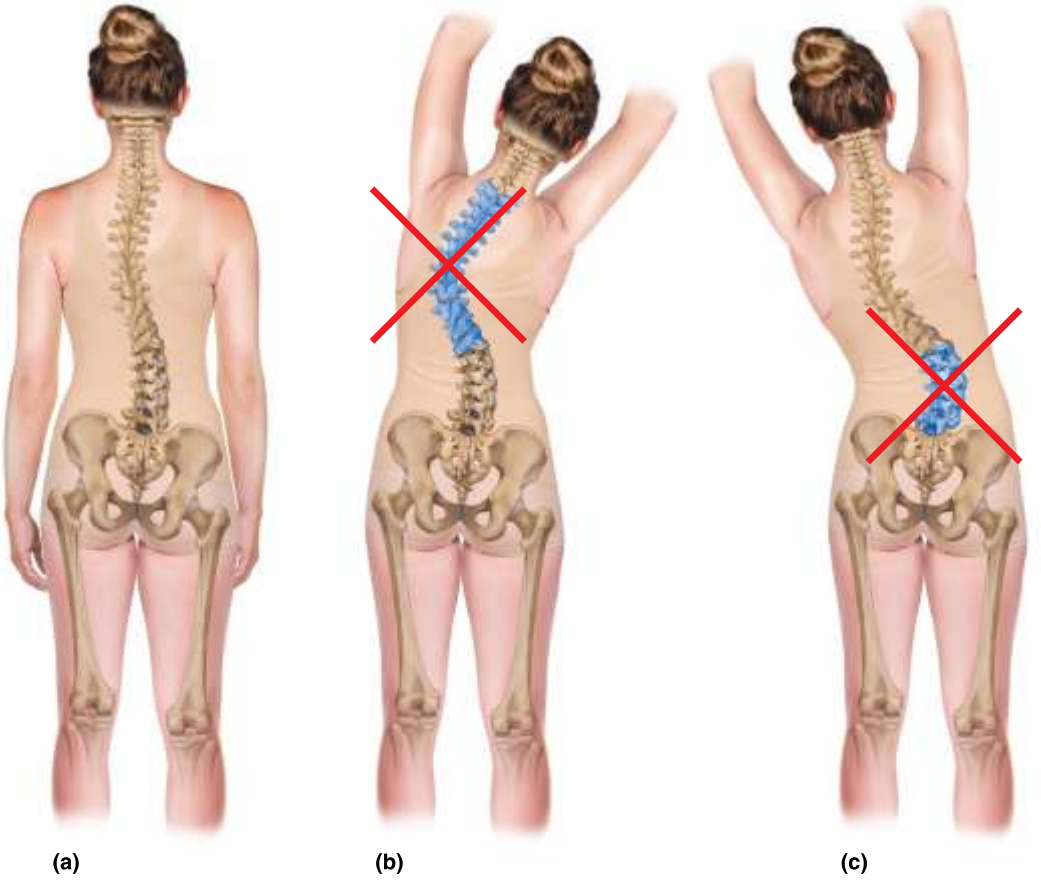
Scoliosis as a Compensation



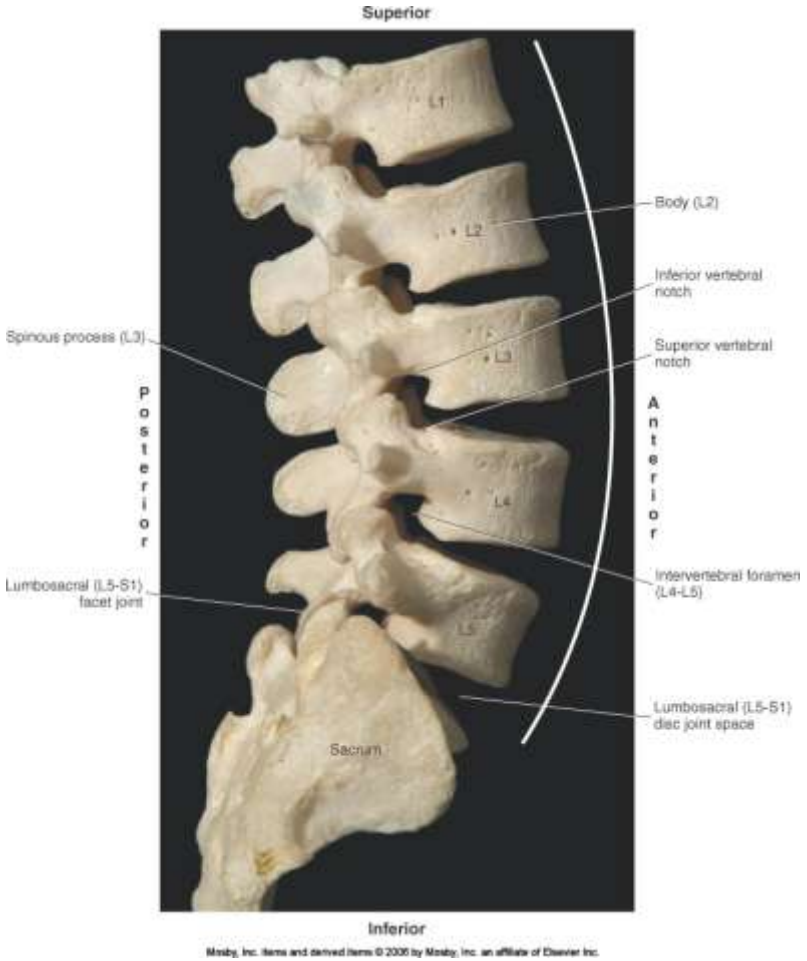
Scoliosis and Musculature



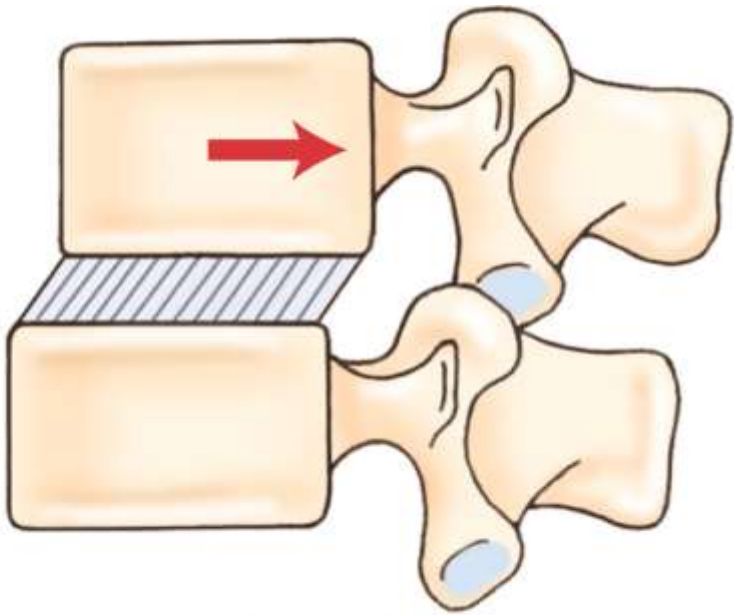
Scoliosis and Movement



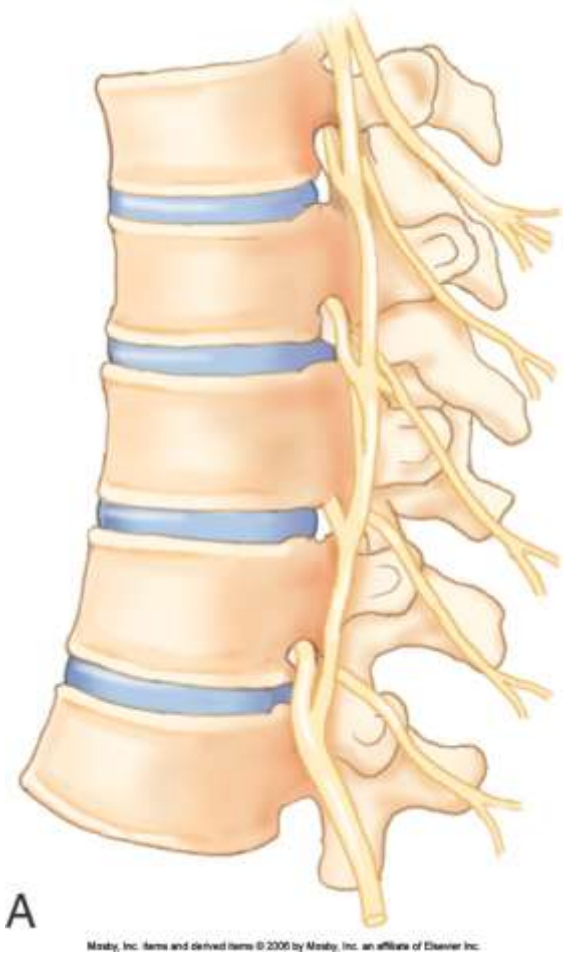
Spondylolisthesis

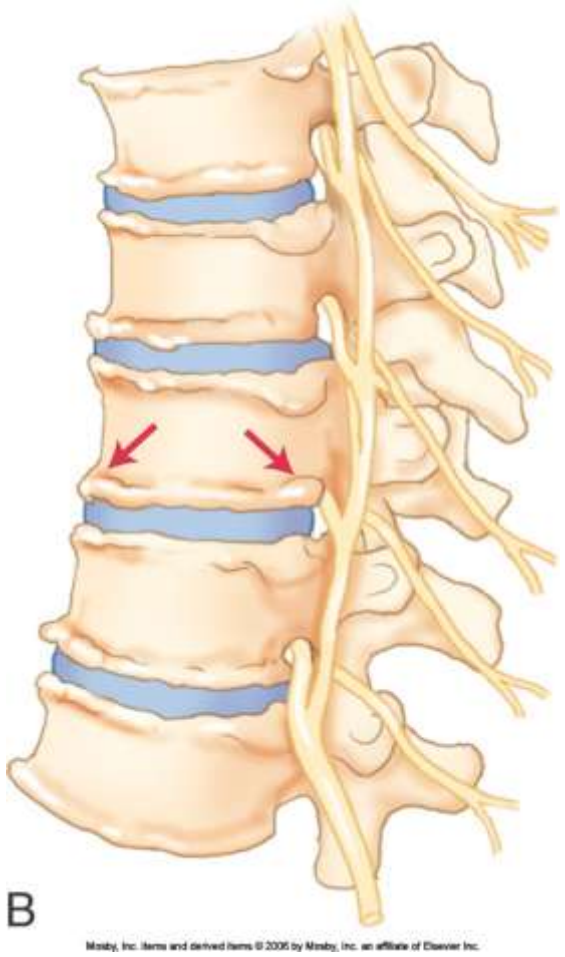


B

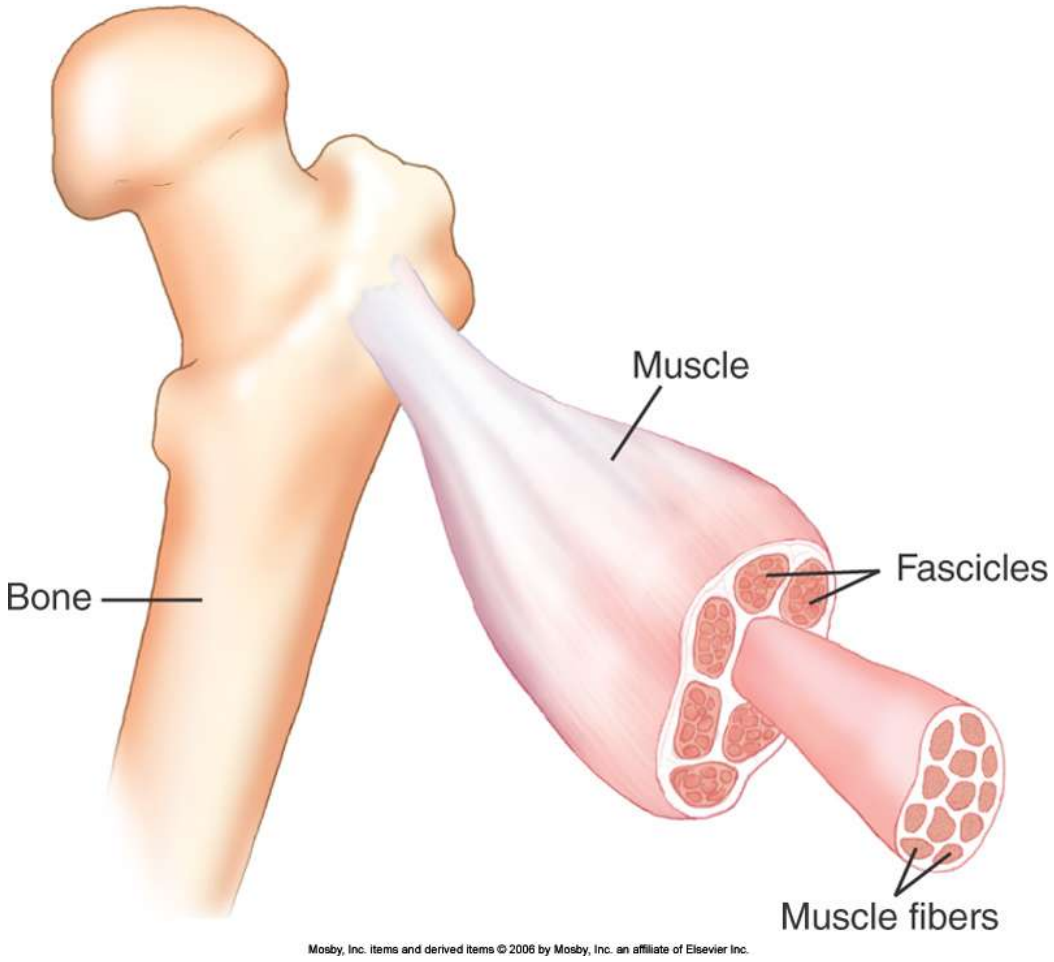


DJD/OA

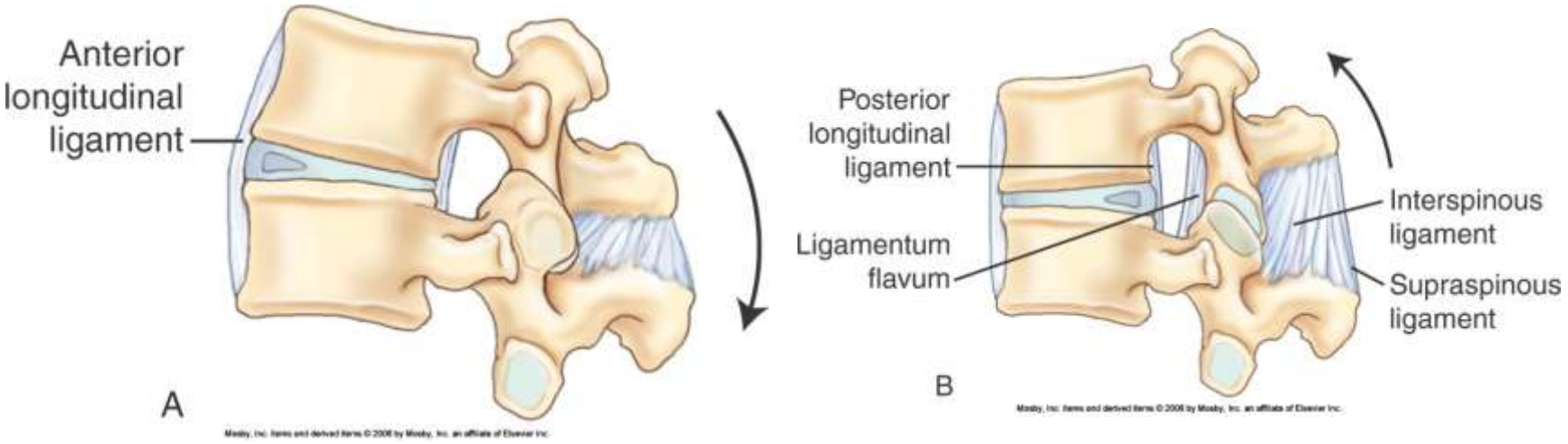




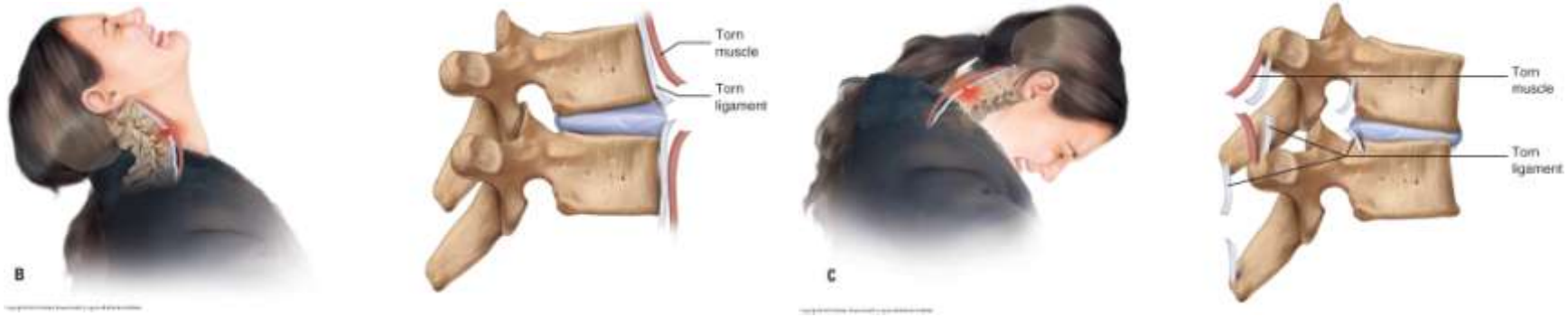
Strain / Tendinitis



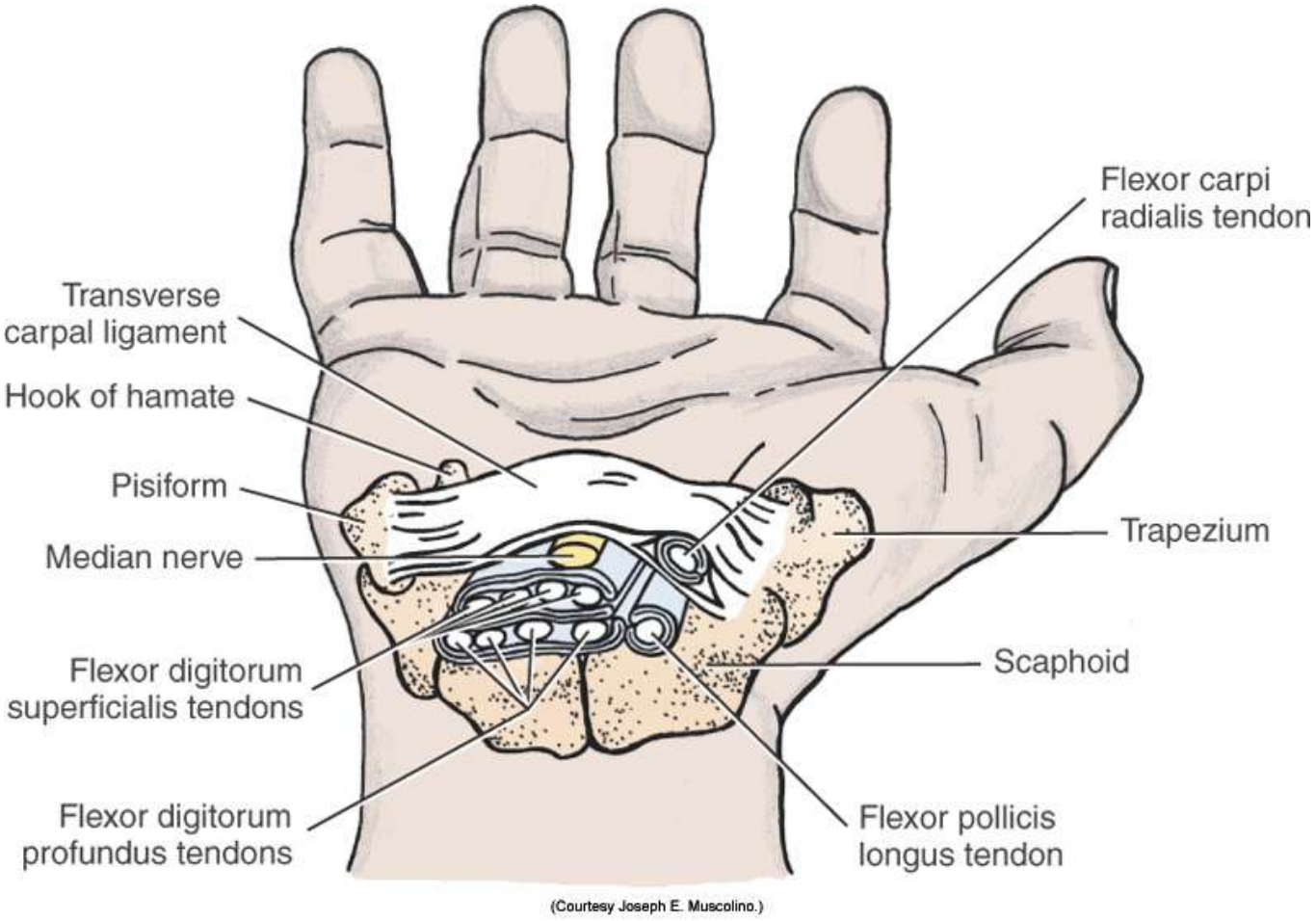
Sprain


Anterior
longitudinal
ligament
A
Posterior
longitudinal
ligament
Ligamentum
flavum
Interspinous
ligament
Supraspinous
ligament
B

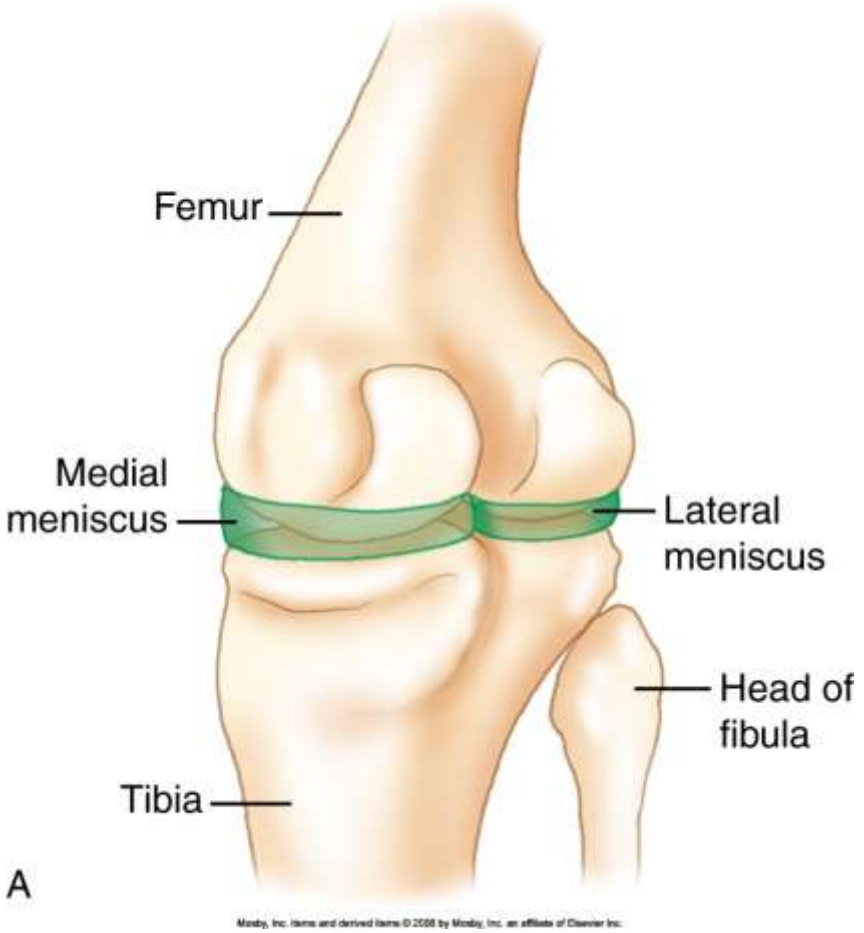
Whiplash – Strain/Sprain

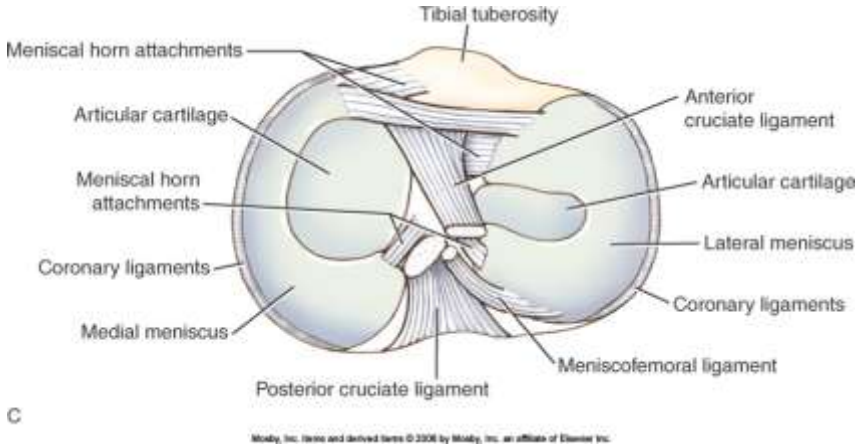


Carpal Tunnel Syndrome



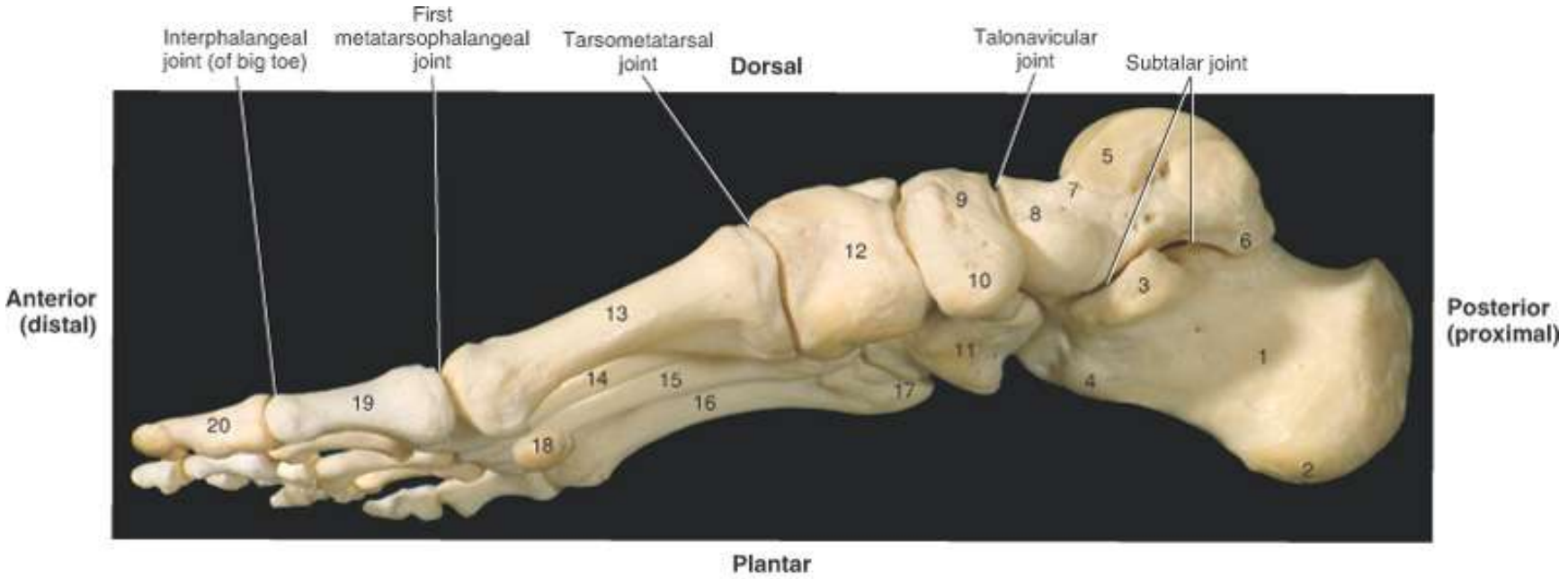
Meniscus Damage



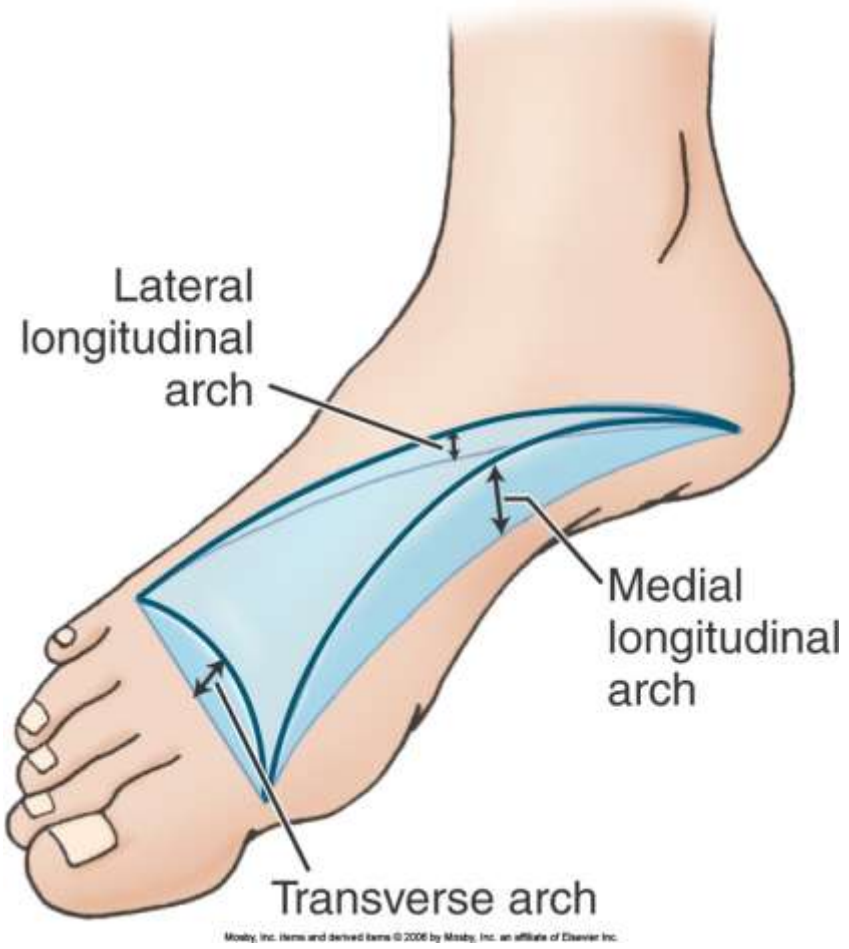


Foot Hyperpronation

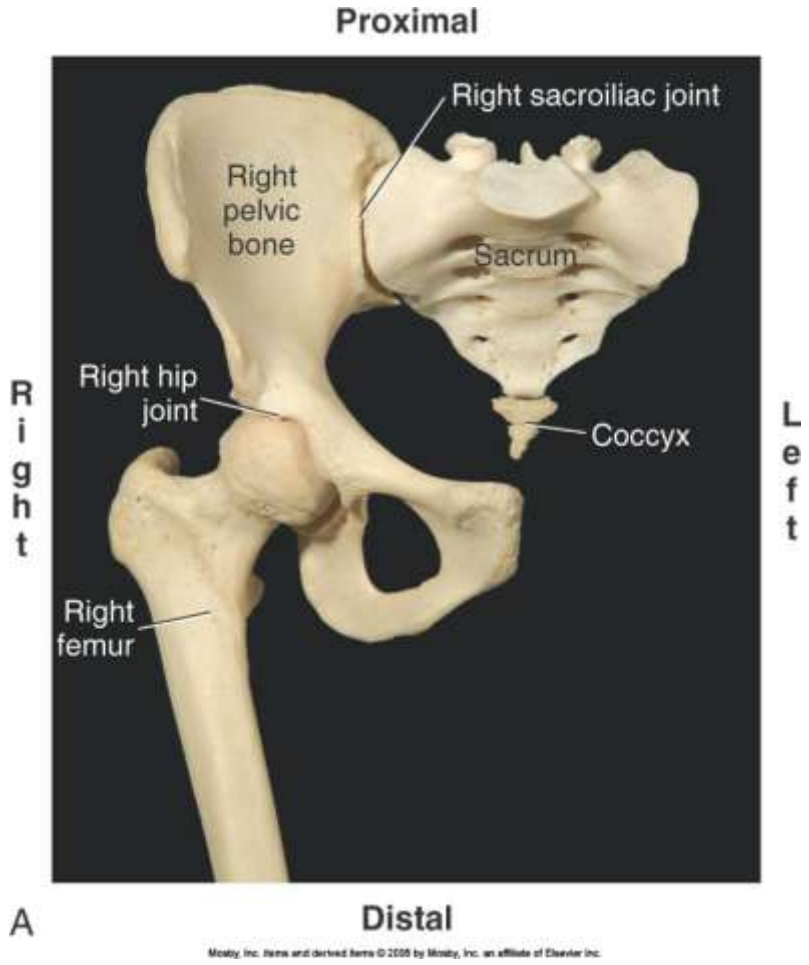
Foot Hyperpronation – cont'd

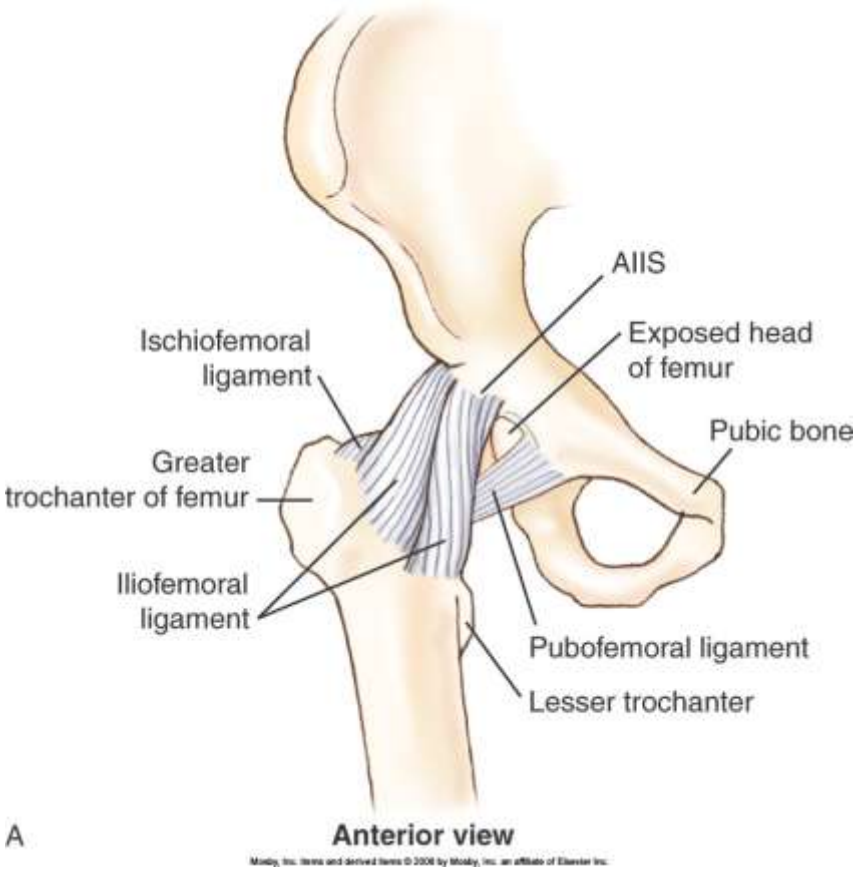


Foot Hyperpronation – cont'd

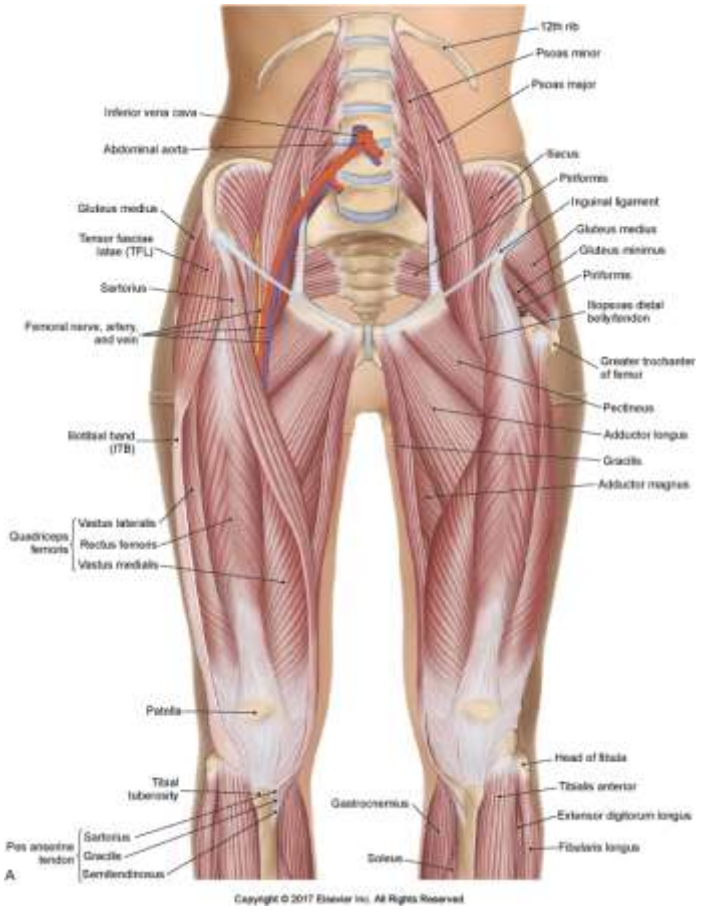


Hip Replacement





PART 5 – Muscle Functional Groups



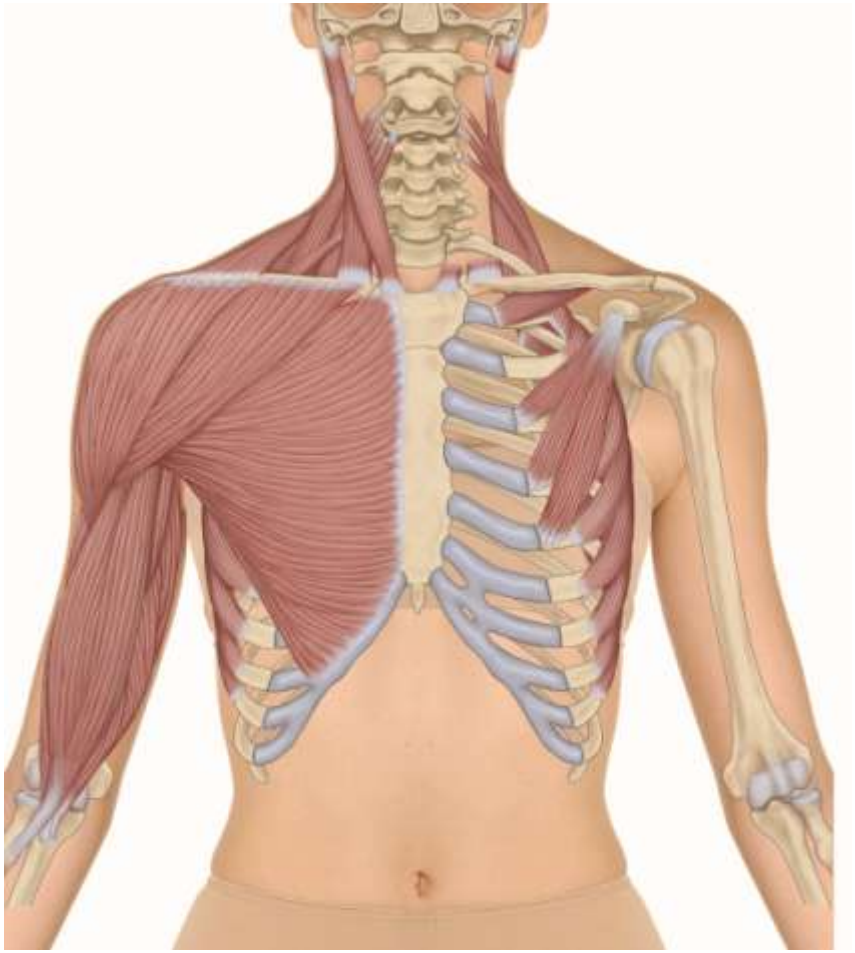
Upper Extremity

- Shoulder joint
- Shoulder girdle
- Elbow joint
- Radioulnar joints
- Wrist joint
- Finger joints

Shoulder Joint

- Flexors (anterior deltoid)
- Extensors (posterior deltoid)
- Abductors (middle deltoid)
- Adductors (pectoralis major, latissimus dorsi)
- Medial rotators (pectoralis major, latissimus dorsi)
- Lateral rotators (rotator cuff…)

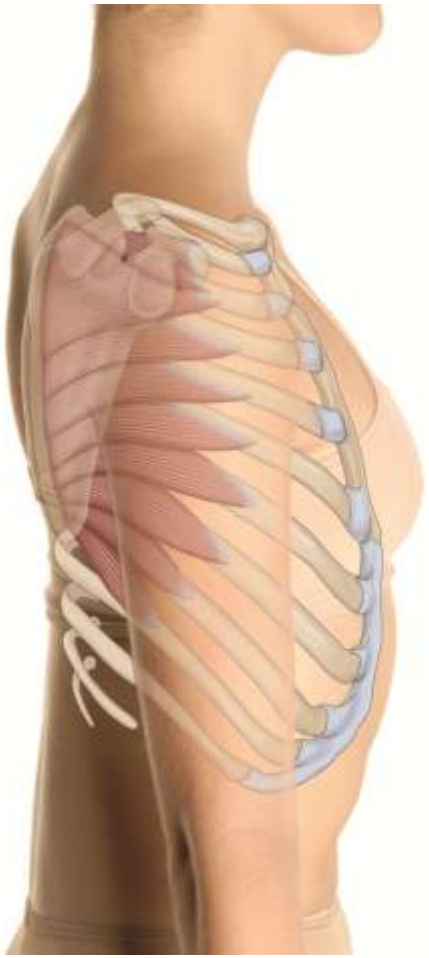
Shoulder Joint - Figures



Shoulder Girdle

- Protractors (pectoralis muscles)
- Retractors (rhomboids, middle trapezius)
- Elevators (upper trapezius, levator scapulae)
- Depressors (lower trapezius, pectoralis minor)
- Upward rotators
- Downward rotators

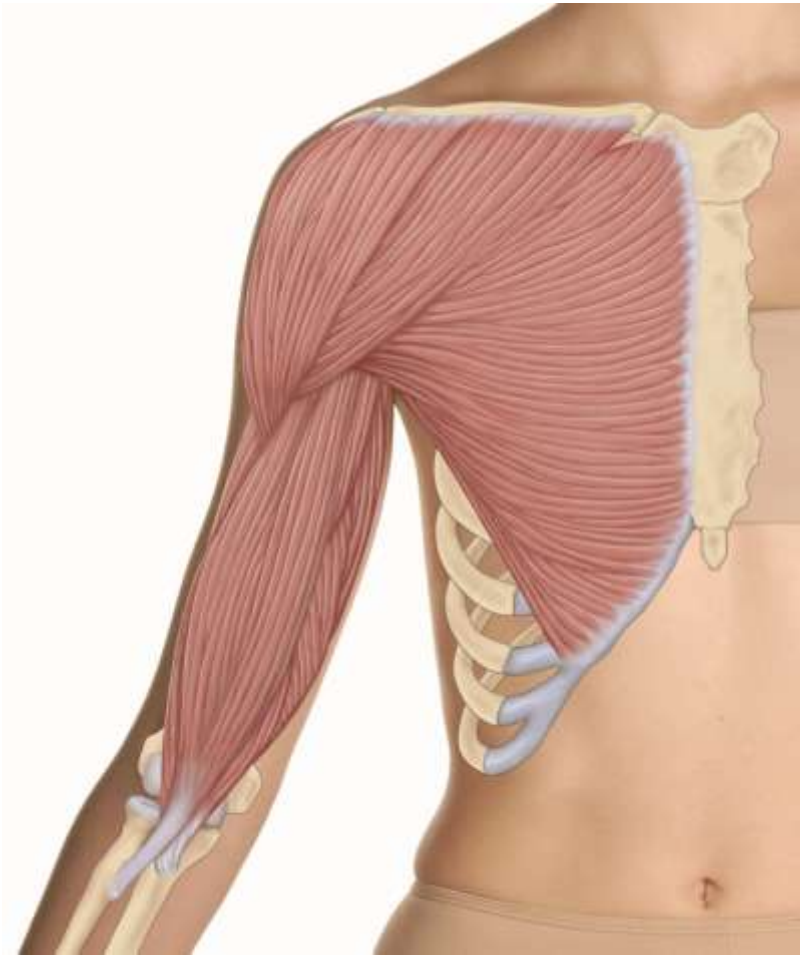
Shoulder Girdle Figures



Elbow Joint

- Flexors (biceps brachii, brachialis)
- Extensors (triceps brachii)

Elbow Joint Figures



Elbow Joint Figures – cont’d

Radioulnar Joints

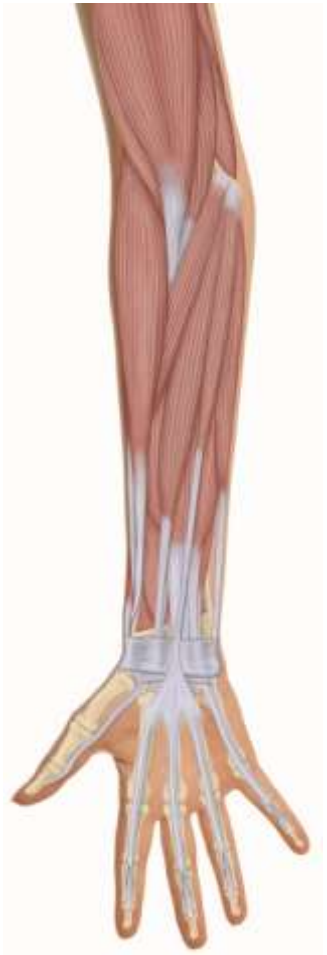
- Pronators
- Supinators

Radioulnar Joints Figures

Wrist Joint

- Flexors (wrist flexor group)
- Extensors (wrist extensor group)
- Radial deviators
- Ulnar deviators

Wrist Joint Figures



Finger Joints

- Flexors
- Extensors
- Abductors
- Adductors

Finger Joints Figures

Lower Extremity

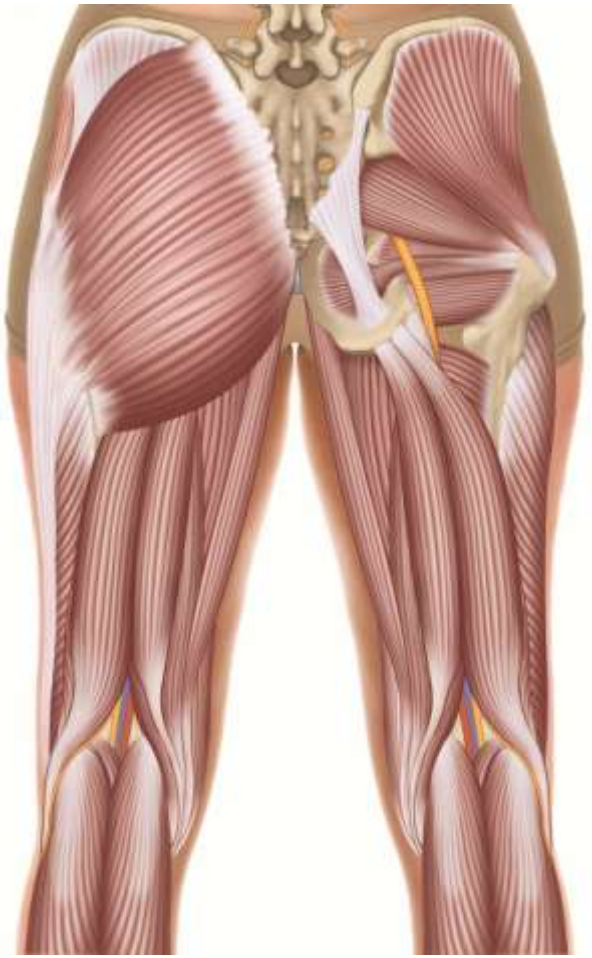
- Hip joint
- Pelvis
- Knee joint
- Ankle joint
- Subtalar joint
- Toe joints

Hip Joint

- Flexors (iliopsoas)
- Extensors (gluteal muscles, hamstrings)
- Abductors (gluteal muscles)
- Adductors (adductor group)
- Medial rotators
- Lateral rotators (gluteal muscles, deep lateral rotators)

Hip Joint Figures

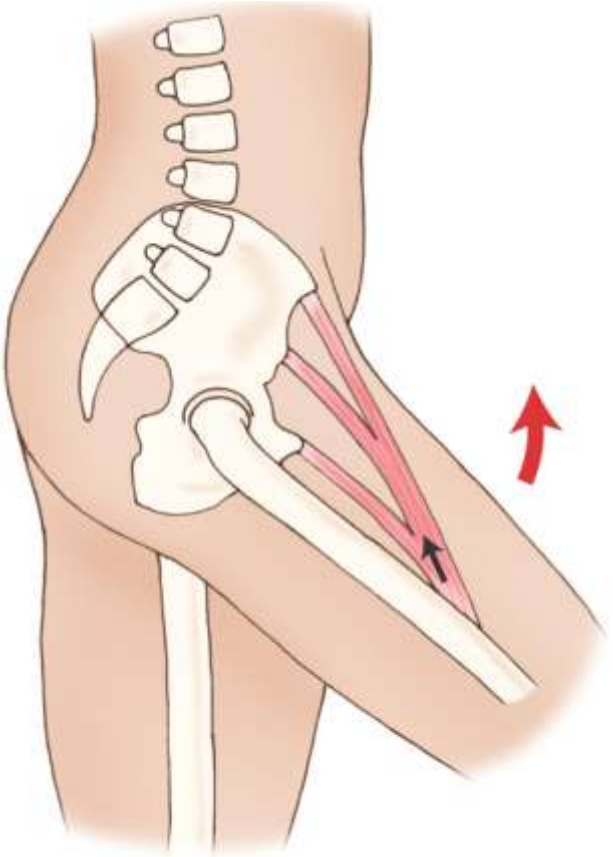
Hip Joint Figures – cont’d



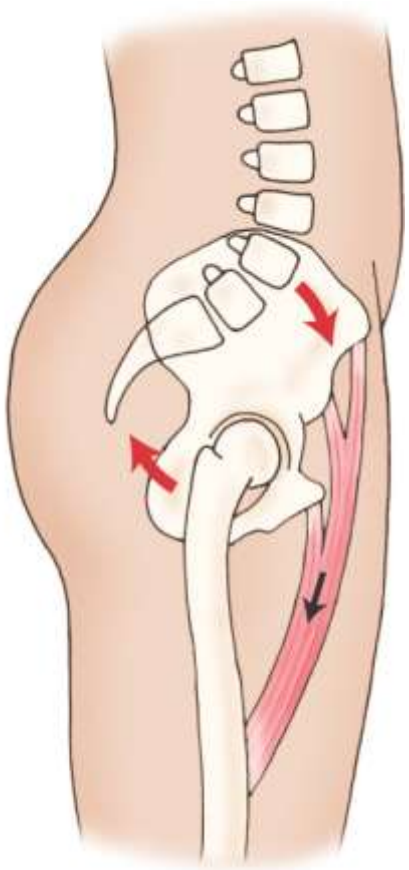
Pelvis (at the hip joint)

- Anterior tilt (hip flexors)
- Posterior tilt (hip extensors)
- Depression (hip abductors)
- Elevation
- Right rotation
- Left rotation

Pelvis Figures

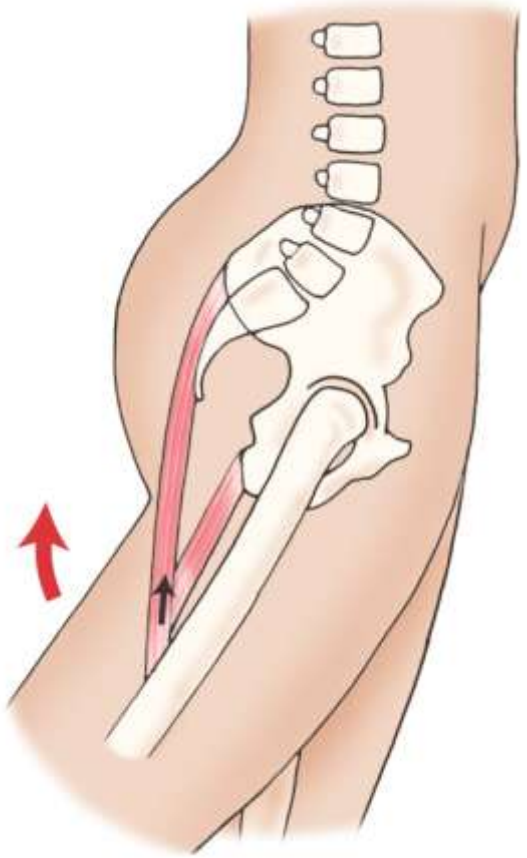


C Flexion of the thigh

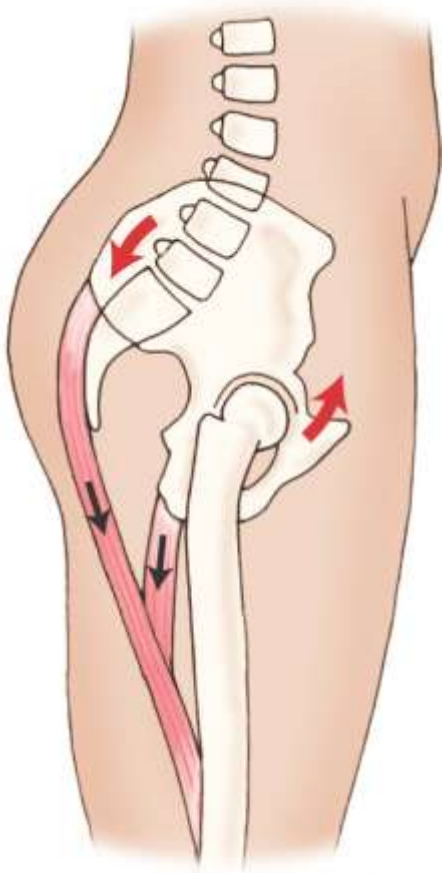


B Anterior tilt of the pelvis

Pelvis Figures – cont'd

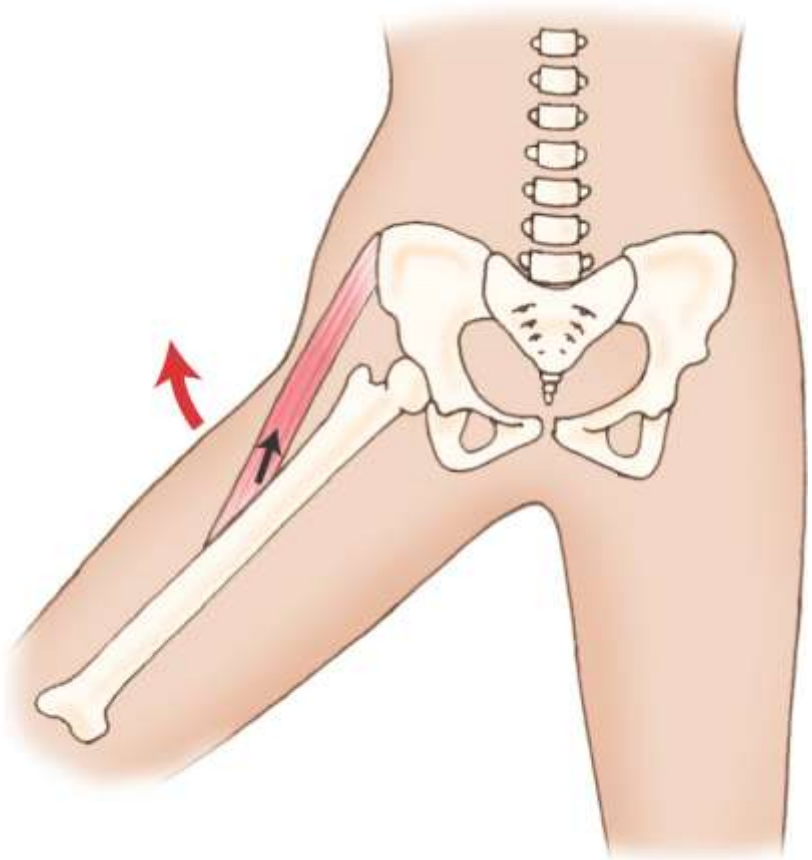


E Extension of the thigh

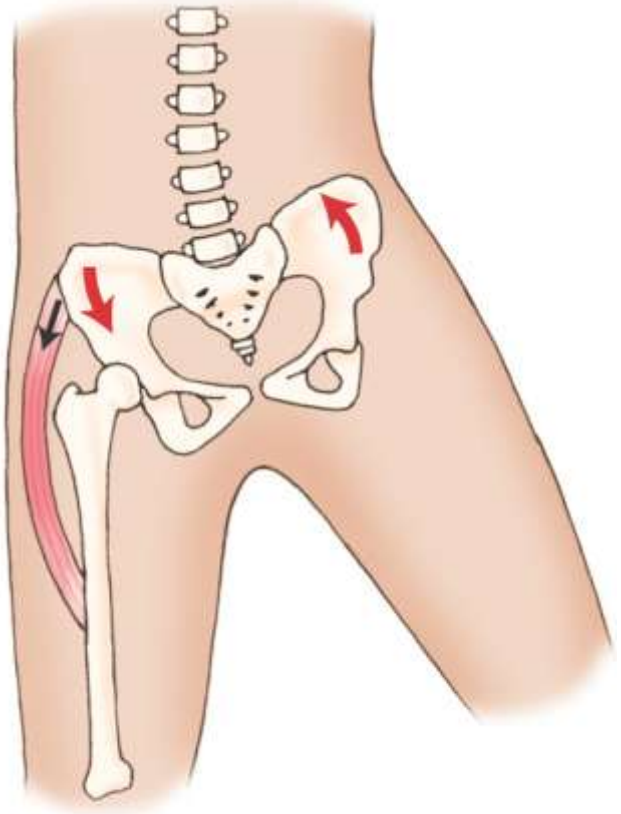


D Posterior tilt of the pelvis

Pelvis Figures – cont'd

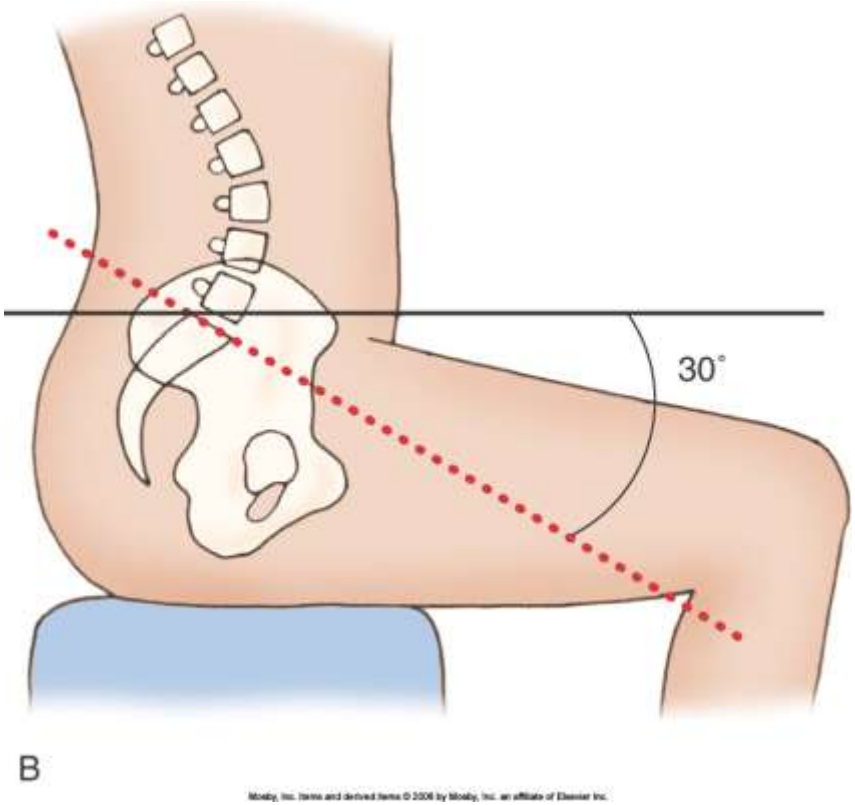


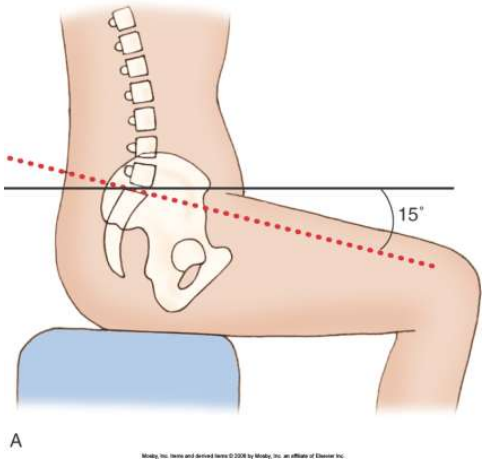
C Abduction of the right thigh

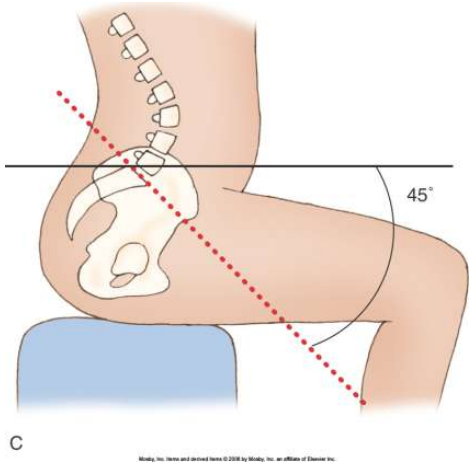


B Depression of the right pelvis (and elevation of the left pelvis)

Pelvic Posture and the Spine







Knee Joint

- Extensors (quadriceps femoris group)
- Flexors (hamstring group)

Knee Joint Figures

Ankle Joint

- Dorsiflexors
- Plantarflexors (gastrocnemius, soleus)

Ankle Joint Figures

Subtalar Joint

- Pronators / Evertors (fibularis muscles)
- Supinators / Invertors (tibialis anterior and posterior)

Subtalar Joint Figures

Toe Joints

- Extensors
- Flexors
- Abductors
- Adductors

Toe Joint Figures

Axial Body

- Spinal Joints
- Pelvis (sacroiliac and pubic symphysis)
- Temporomandibular joints (TMJs)

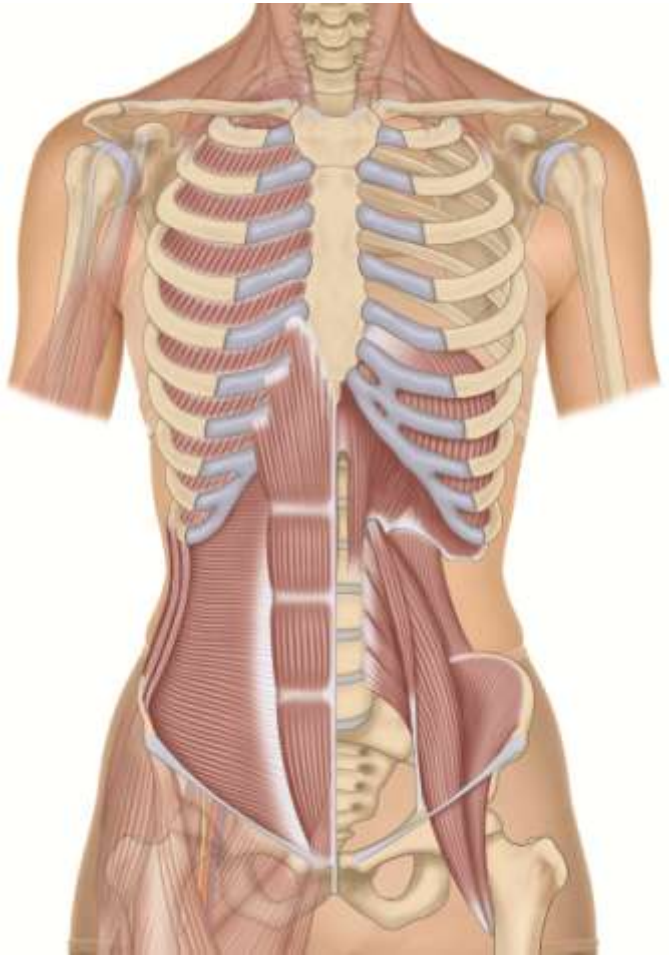
Spinal Joints - Trunk

- Flexors (abdominals: rectus abdominis, external and internal abdominal obliques)
- Extensors (erector spinae)
- Right lateral flexors
- Left lateral flexors
- Right rotators (abdominal obliques)
- Left rotators (abdominal obliques)

Spinal Joints - Neck

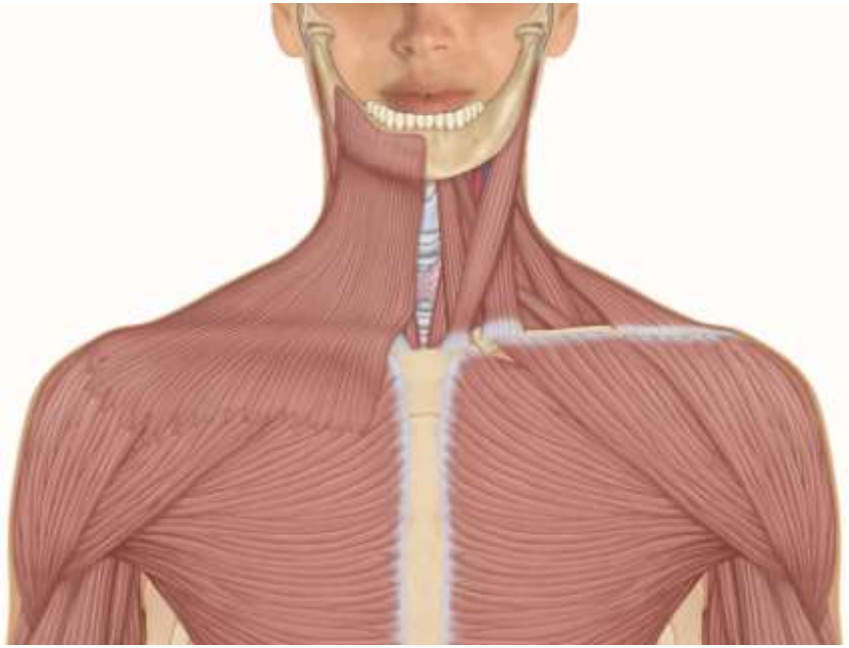
- Flexors (sternocleidomastoid [SCM], scalenes, longus muscles)
- Extensors (upper trapezius, levator scapulae, semispinalis capitis)
- Right lateral flexors
- Left lateral flexors
- Right rotators (upper trapezius, SCM)
- Left rotators (upper trapezius, SCM)

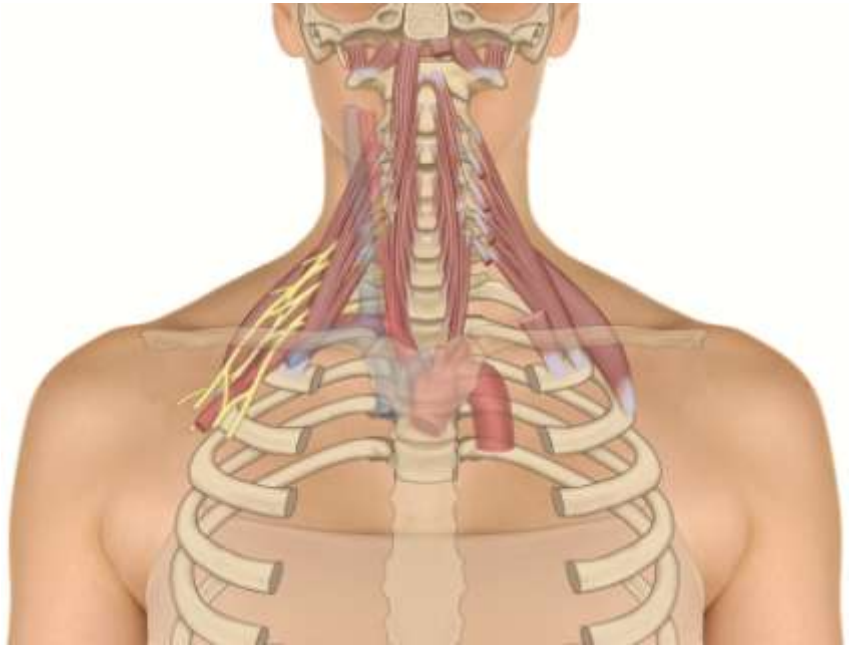
Spinal Joints Figures



Spinal Joints Figures – cont’d

Spinal Joints Figures – cont’d

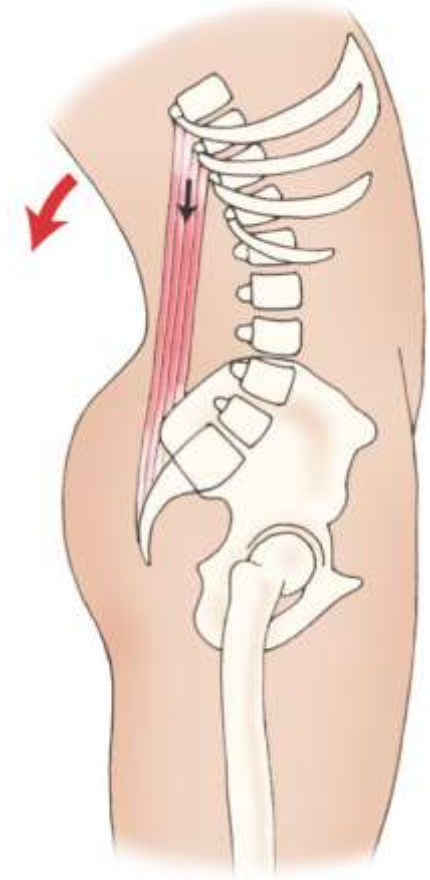




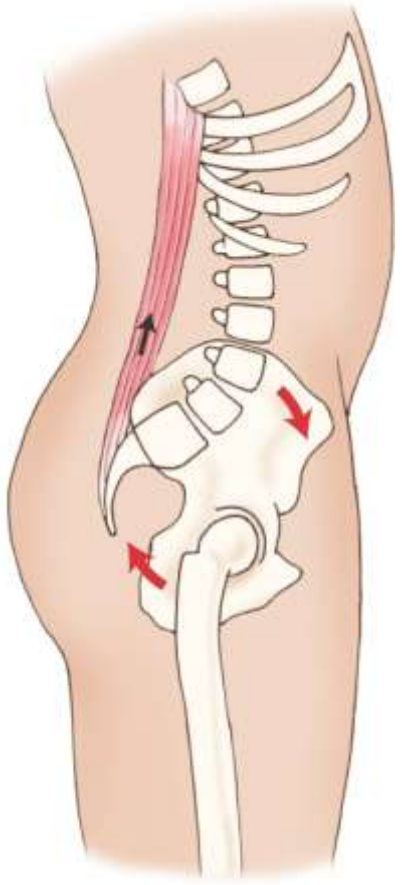
Pelvis (at the lumbosacral joint)

- Anterior tilt (back extensors)
- Posterior tilt (abdominals)
- Depression
- Elevation (lateral flexors)
- Right rotation
- Left rotation

Pelvis Figures



E Extension of the trunk



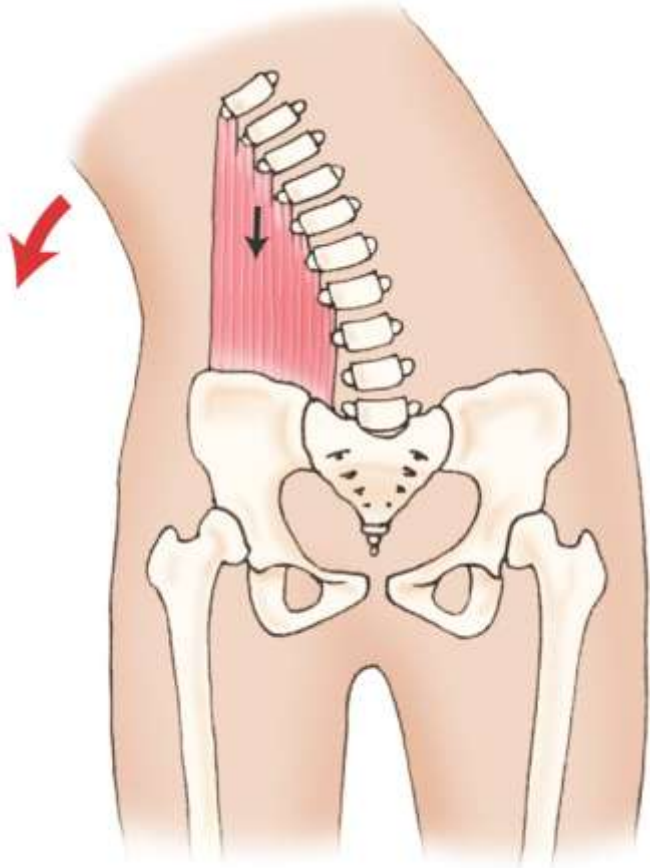
D Anterior tilt of the pelvis

Pelvis Figures – cont'd

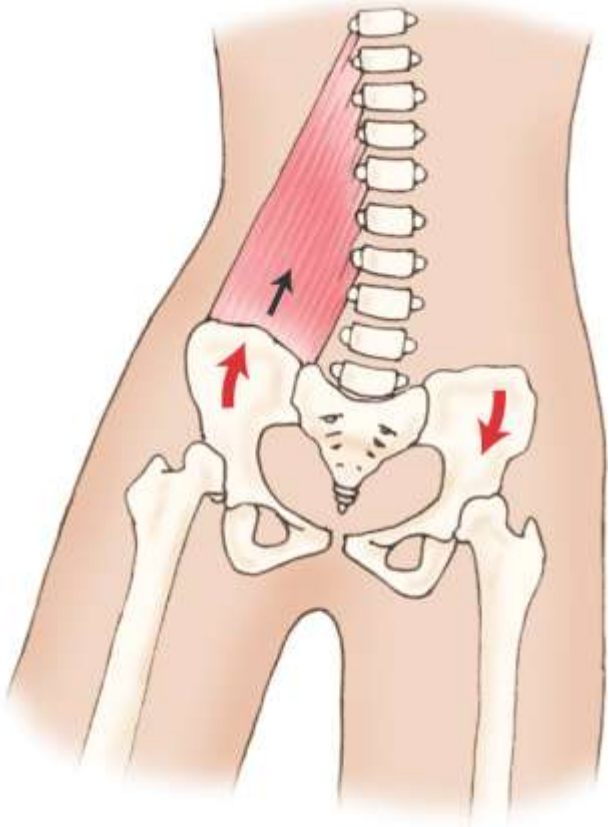
C Flexion of the trunk

B Posterior tilt of the pelvis

Pelvis Figures – cont'd

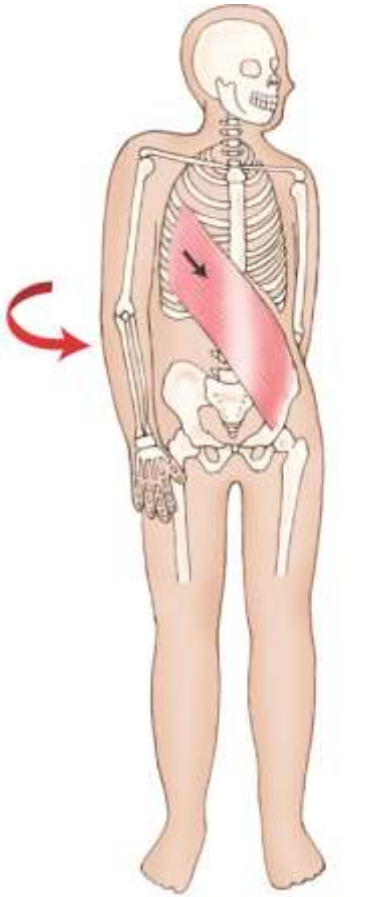


C Right lateral flexion of the trunk

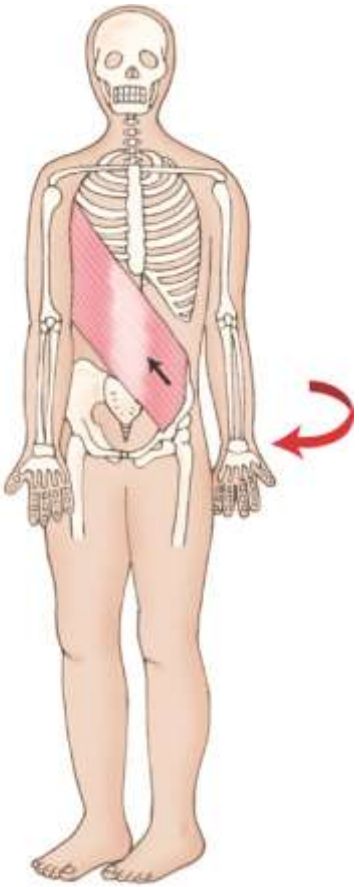


B Elevation of the right pelvis (and depression of the left pelvis)

Pelvis Figures – cont'd



B Right rotation of the trunk

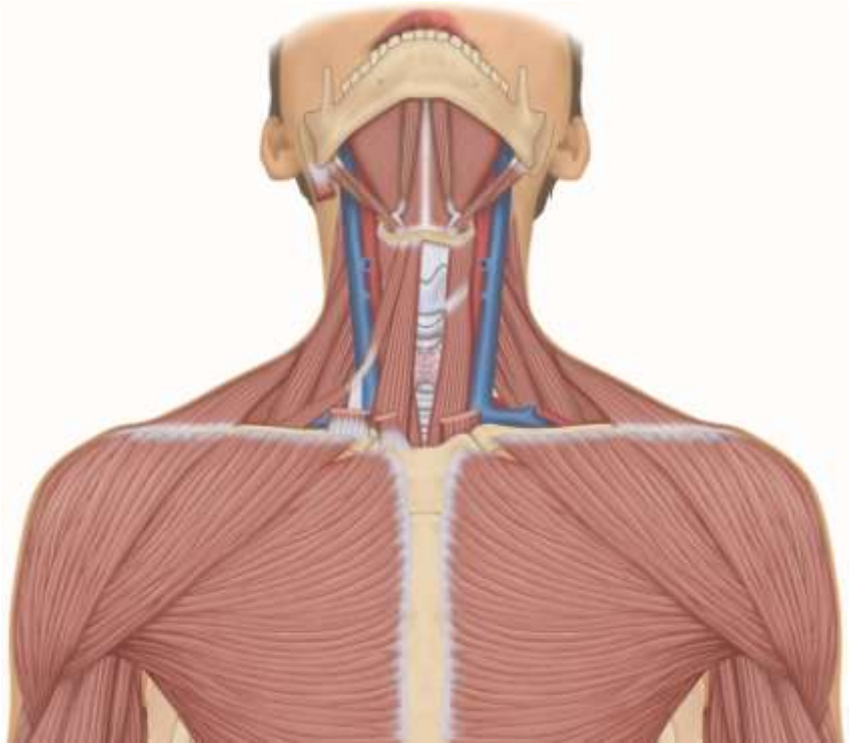


A Right rotation of the pelvis

Temporomandibular Joints (TMJs)

- Elevators
- Depressors
- Right lateral deviators
- Left lateral deviators

Temporomandibular Joints (TMJs) Figures



Fasciae

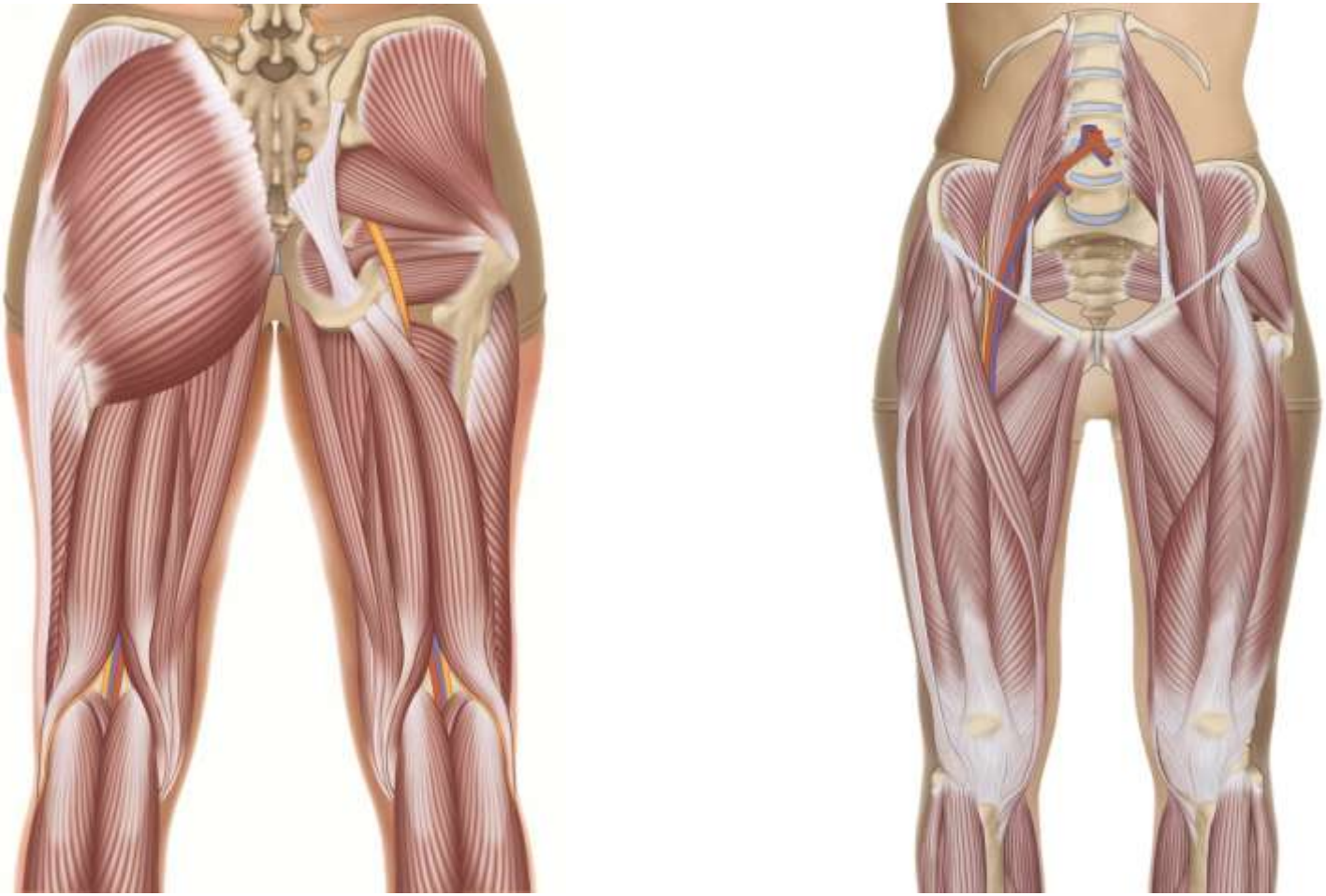
Fasciae – cont’d

Powerhouse

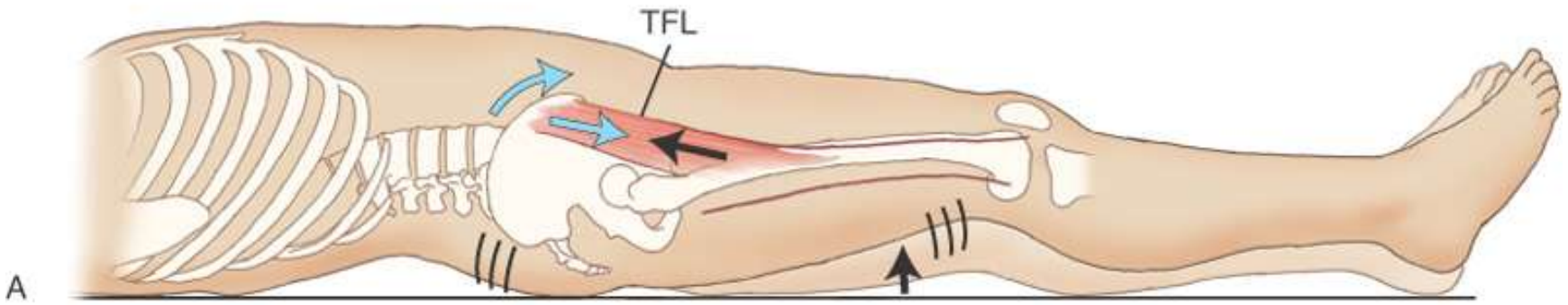
- The “core”
- Pelvis and Trunk
- Hip joints and Spinal joints

Powerhouse cont'd

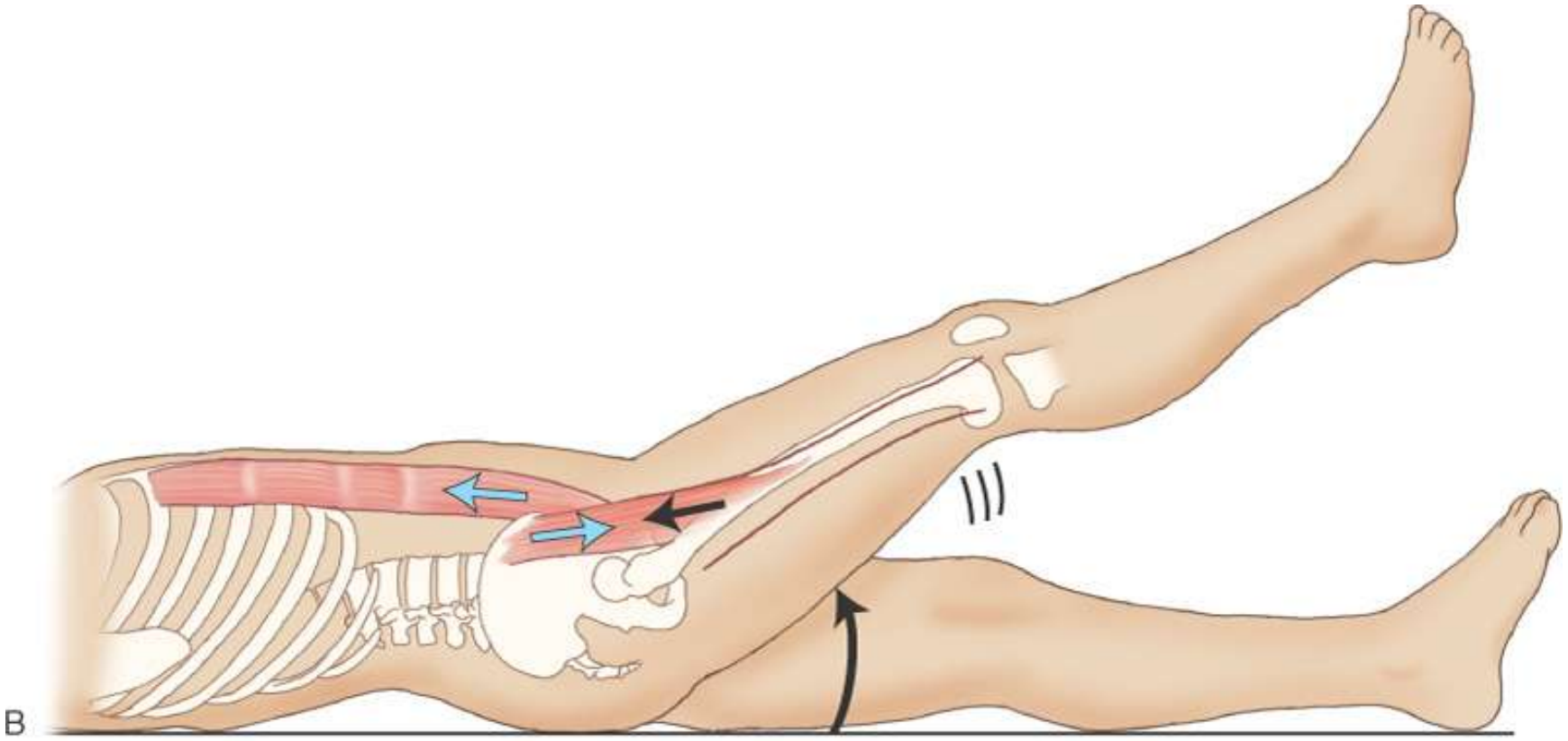
Powerhouse cont’d



Core Stabilization



Core Stabilization – cont'd



PART 6: Workshop Concepts

Where to learn more... ☺