ANATOMY AND PHYSIOLOGY FOR PILATES

Purchase College CE Class
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Week One

• Basic Kinesiology Terminology
Anatomy and Physiology

- Anatomy is Structure
- Physiology is Function
Axial / Appendicular Body
Static Positional Terms

ANATOMIC POSITION

- Superior (axial body only)
- Inferior (axial body only)
- Proximal (appendicular body only)
- Distal (appendicular body only)

- Ulnar (forearm and hand only)
- Radial (forearm and hand only)
- Tibial (leg only)
- Fibular (leg only)

- Anterior: toward the front (entire body)
- Posterior: toward the back (entire body)
- Palmar: often used in place of anterior on the hand.
- Dorsal: often used in place of posterior on the hand.
- Plantar: used for the inferior surface of the foot.
- Dorsal: used for the superior surface of the foot.

Lateral (entire body) ← Medial (entire body)
Pairs of Terms

• 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 cont’d

- 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.
• Movements occur within planes.
• There are three cardinal planes:
  – Sagittal
  – Frontal
  – Transverse

• Oblique planes…
Planes – Sagittal and Frontal
Planes – Transverse and Oblique
Movement in Planes – Sagittal and Frontal
Movement in Planes – Transverse and Oblique
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
Week Two

• The Skeletal System
Bones of the Skeleton
Bones – Upper Extremity

- Scapula / clavicle
- Humerus
- Radius / ulna
- Carpals
- Metacarpals
- Phalanges
Bones – Lower Extremity

- Pelvic bone (ilium, ischium, pubis)
- Femur
- Tibia / Fibula
- Tarsals
- Metatarsals
- Phalanges
Bones – Axial Body

- Cranium (frontal, temporal, occipital…)
- 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)
Joint Classification

• Structural:
  – Fibrous
  – Cartilaginous
  – Synovial (joint cavity)
Fibrous Joint Examples
Cartilaginous Joint Examples
Synovial Joint Categories

• Uniaxial (hinge and pivot)
• Biaxial (condyloid and saddle)
• Triaxial (ball and socket)
• Nonaxial
Uniaxial Joints
Biaxial Joints
Triaxial Joints
Upper Extremity Joints

- Shoulder
- Shoulder Girdle: (scapulocostal, sternoclavicular, acromioclavicular)
- Elbow
- Radioulnar
- Wrist
- Saddle of thumb
- Metacarpophalangeal
- Interphalangeal
Lower Extremity Joints

- Hip
- Knee
- Ankle
- Subtalar
- Metatarsophalangeal
- Interphalangeal
Axial Body Joints

- Disc
- Facet
- Sacroiliac
- Temporomandibular (TMJ)
Other Skeletal Tissues

• Cartilage
• Bursa
• Tendon sheath
Other Skeletal Tissues - Figures

A

Subacromial bursa
Supraspinatus tendon
Deltoid
Head of the humerus
Fibrous capsule
Synovial membrane
Glenoid labrum
Synovial cavity
Scapula

B

Calcaneal (Achilles) tendon
Common tendon sheath of fibularis longus and brevis tendons
Subcutaneous calcaneal bursa
Subtendinous calcaneal bursa
Superior and inferior fibular retinacula

C

Calcaneus
5th metatarsal bone
Superior extensor retinaculum
Lateral malleolus and subcutaneous bursa
Tendon sheath of tibialis anterior tendon
Tendon sheath of extensor digitorum longus and fibularis tertius tendons
Tendon sheath of extensor hallucis longus tendon
Week Three

• Pathologic Conditions
• Myofascial Tissue
Overview of Blood Flow

• Systemic circulation:
  • Heart to arteries to capillaries
    – Tissue exchange with the cells of the body
  • To veins to the heart
Pathologic Conditions

- Disc bulge / herniation
- Sciatica
- Hyper-hypo kyphosis/lordosis
- Scoliosis
- Spondylolisthesis
- Degenerative joint disease (DJD, osteoarthritis, OA)
- Sprain
- Carpal tunnel syndrome
- Meniscus damage
- Foot hyperpronation
- Hip replacement
Pathologic Disc

Vertebral end plate
Annulus fibrosus
Nucleus pulposus

Vertebral body
Nucleus pulposus
Annular fibers
Pathologic Disc

Spinal cord within spinal canal
Spinal Curves

A

C1 (atlant)  
C2 (axis)  
C7  
T1  
Transverse processes  
Spinous processes  
T12  
L1  
L5  
Cervical spine (C1-C7)  
Thoracic spine (T1-T12)  
Lumbar spine (L1-L5)  
Sacrum (sacral spine, S1-S5)  
Coccyx (coccygeal spine, Co1-Co4)

B

Superior  
Cervical spine (C1-C7)  
Spinous processes  
Transverse processes  
Facet joints  
Disc spaces  
Intervertebral foramina  
Lumbar spine (L1-L5)  
Sacral spine (sacrum; S1-S5)  
Coccyx (coccygeal spine; Co1-Co4)  
Inferior
Pelvic Tilt

- Notice the relationship between the sacral base angle and the lordosis of the lumbar spine.
Hypolordosis / Hyperlordosis
Scoliosis
Spondylolisthesis
Sprain
Meniscus Damage

- Femur
- Medial meniscus
- Lateral meniscus
- Head of fibula
- Tibia

- Meniscal horn attachments
- Articular cartilage
- Coronary ligaments
- Medial meniscus
- Posterior cruciate ligament

- Tibial tuberosity
Foot Hyperpronation
Foot Hyperpronation – cont’d
Foot Hyperpronation – cont’d
Tight ‘hip joint abductors’

• Notice the effect upon the spine

Depression of the right pelvis
(and elevation of the left pelvis)
Hip Replacement

Proximal

Right sacroiliac joint

Right pelvic bone

Sacroiliac joint

Coxyx

Right hip joint

Right femur

Left

Ischiofemoral ligament

Greater trochanter of femur

Iliofemoral ligament

AIIS

Exposed head of femur

Pubofemoral ligament

Pubic bone

Lesser trochanter

Anterior view
Typical Muscle

(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
Eccentric and Isometric Contractions

B

C
Concentric Contraction Analogy
Eccentric Contraction Analogy
Adding Resistance
Stabilization - Pelvis

- Rectus abdominis
- TFL
Stabilization - Scapula
Muscle Memory
Strain / Tendinitis
Week Four

• Muscles / Muscle Groups

• 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 scapulæ)
- 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)
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
Axial Body

- Spinal Joints
- Pelvis
- 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
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 – cont’d
Powerhouse

• The “core”
• Pelvis and Trunk
• Hip joints and Spinal joints
Powerhouse cont’d
Core Stabilization
Core Stabilization – cont’d