Anatomy and Physiology Focus: Musculoskeletal System

Anna Marie Kish, RN, BSN, ARNP, NP-C
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Session Objectives

• Review the structure and function of the musculoskeletal system
• Describe diseases and disease processes and how they affect the musculoskeletal system
The Musculoskeletal System

Two systems
- **Muscular**
  - Ability to move
  - Protects underlying structures
- **Skeletal**
  - Provides structural framework
  - Leverage for movement
Muscular System

Function of muscles:
- Motion
- Framework
- Leverage
- Maintain posture
- Thermal regulation
- Protection

Muscles and their functions:
- Sermo-mastoid
- Trapezius
- Deltoid
- Pectoralis major
- Biceps
- Triceps
- Latissimus dorsi
- External oblique
- Gluteus maximus
- Vastus externus
- Biceps femoris
- Rectus femoris
- Gastrocnemius
- Tibialis anterior
Highly Specialized Cells (fibers)

Cell functions
- Irritability: ability to respond to stimuli
- Contractility: shorten or thicken
- Extensibility: ability to stretch
- Elasticity: return to original shape

Cell types
- Smooth: spindle shaped, no striations, involuntary
- Skeletal: cylindrical, multinucleated, voluntary, striated
- Cardiac: branching fibers, striated, involuntary, synchronized contraction
Muscle Tissue

Tissue—3 types, smooth, skeletal, cardiac

• Tightly packed fibers, arranged in bundles, surrounded by connective tissue, well-supplied with blood vessels and nerves
  
  – **Smooth muscle tissue (involuntary)**
    • Visceral, form walls of hollow organs, stomach, intestines
    • Multiunit, walls of blood vessels, iris of eye, attached to hair follicles
  
  – **Skeletal muscle tissue (voluntary)**
    • Wrapped in connective tissue, arranged in bundles
    • Attached to bone by tendon (cord) or aponeurosis (sheet)
    • Heavy blood and nerve supply
  
  – **Cardiac muscle tissue (involuntary)**
    • Individual fibers
    • Intercalated discs strengthen tissue and enhance conduction from cell to cell
    • Contract and relax in rhythmic manner in response to impulses from conducting tissues in heart
Criteria for Naming Skeletal Muscles

- Nearly 700 skeletal muscles, named based on these criteria:
  - Direction of fibers: rectus, transverse, oblique
  - Location: temporalis, tibialis
  - Size: maximus, minimus, brevis, longus
  - Number of origins: biceps, triceps, quadriceps
  - Origin and insertion: brachioradialis (elbow, radius), sternocleidomastoid (sternum, clavicle, mastoid)
  - Shape: deltoid, trapezius, scalene
  - Action: flexor, extensor, abductor, adductor
Skeletal System

Functions of bones:
- Support and protection
- Leverage for movement
- Storage of minerals
- Blood cell production
Bone Cells

• Bone (osteo-)
  – Osteoblasts, (b=builders), build new bone
  – Osteocytes, mature cells, respond to stimuli to build up or break down bone
  – Osteoclasts, (c=crackers), break down and reabsorb bone matrix

• Cartilage (chondro-)
  – Chondroblasts, dividing cells that build cartilage
  – Chondrocytes, mature cells that maintain cartilage structures
  – Chondroclasts, break down and reabsorb calcified cartilage
Bone Anatomy

Two types of connective tissue, bone (osseus) and cartilage (chondrous):

**Bone**
- Mineral salts, calcium, phosphorus
- Porous, living bone cells
- Compact (dense) bone (A); hard calcified structures form Halversian canals (D) surrounding capillary and nerve cells providing strength
- Cancellous (spongy) (B) inner; irregular latticework filled with bone marrow

**Cartilage (C)**
- Dense network of elastic and collagenous fibers
- Joints between bones, rib cage, ear, nose, bronchial tubes, intervertebral discs
Bones vary in structure based on type: example, long bones

- **Epiphysis (A)**, ends; spongy bone and marrow
- **Articular cartilage (B)**: covers ends of bone
- **Diaphysis (C)**: shaft; compact, dense bone
- **Periosteum (D)**: fibrous covering; blood, nerve supply
- **Medullary cavity (E)**: spongy bone, marrow
- **Endosteum (F)**: lines medullary cavity, contains osteoblasts
Types of Bone and Cartilage

• Bones
  – Long bones: length > width, slightly curved; femur, tibia, humerus
  – Short bones: length = width, cube shaped; carpals, tarsals
  – Flat bones: thin and flat; scapula, sternum, skull, pelvis, ribs
  – Irregular bones: complex shape; vertebrae, sacrum, mandible
  – Sesamoid bones: bone imbedded in tendon; patella, 1st metatarsal

• Cartilage
  – Hyaline cartilage: most abundant; articular, costal, parts of nose, larynx, trachea, bronchi, bronchial tubes
  – Fibrocartilage: strong, rigid; symphysis pubis, intervertebral discs
  – Elastic cartilage: part of larynx, external ear, eustachian tubes
Axial Skeleton (axis)

- skull
- hyoid bone
- ossicles (inner ear)
- vertebral column
- rib cage

Appendicular Skeleton (appendages)

- shoulder girdle
- arm
- hand
- leg
- foot
Joints

Points of contact between bones or cartilage and bones

• Three types based on anatomy and degree and type of movement:
  – Fibrous joints: little or no movement, tightly joined by fibrous tissue, no joint cavity; sutures between bones in skull joined by thin layer of fibrous tissue, articulation between tibia and fibula
  – Cartilaginous joints: little or no movement, tightly joined by cartilage, no joint cavity; symphysis pubis, intervertebral discs, sternocostal joint
  – Synovial joints: movement determined by location of ligaments, muscles, tendons, and other bones, held together by ligaments, layer of hyaline cartilage covering articular surfaces; may contain bursae, sacs filled with synovial fluid, cushion between skin, tendons, bones, muscles, ligaments and bones
Diseases, Disorders, Other Conditions of Musculoskeletal System

Infectious/parasitic diseases

• Osteomyelitis, infection of bone
  – Acute, subacute, chronic
  – Bacterial, usually staph, fungal
  – Open injuries, bloodborne, soft tissue infection goes to bone

• Pyogenic or infectious arthritis (“septic” joint)
  – Pathogens enter joint via bloodstream or open wound
  – Staph, strep, gonococcus, other gram neg bacteria; fungal, viral rare
  – Immunosuppressed, IV drug users; very young, very old

• Infectious myositis, infection of muscle
  – Acute, subacute, chronic
  – Bacterial, fungal, parasitic
  – Usually in immunocompromised, associated with malignancies, diabetes, Lyme disease
Neoplasms

Malignant: May involve muscles, bones, joints, or soft tissue

- Primary

- Osteosarcoma, most common; usually teenagers and young adults; arise in osteoblasts that form new bone matrix, most common sites near end of long bones where growth occurs

- Chondrosarcoma, arise from cartilage cells; usually older adults, diverse, may be slow-growing to aggressive and highly metastatic.

- Rhabdomyosarcoma, skeletal muscle tissue, more common in children, usually arms and legs, but can be any skeletal muscle, prognosis depends on location, other tissue involvement

- Soft tissue sarcomas, muscle and surrounding tissues; liposarcoma, synovial sarcoma

- Metastatic; most commonly from breast and prostate

- Malignancies of bone marrow coded under “Blood and Blood Forming Organs”
Benign

- Chondroblastoma, rare, originate in chondroblasts, ends of long bones of arms and legs
- Giant cell tumor, bone or soft tissue, rare, grow rapidly, individual bone cells fuse to form giant cells; rarely can met to lungs, where it would be classified as malignant, distal femur, tendon sheaths of hand. May be classified as neoplasm of uncertain behavior.
- Osteochondroma, most common type, overgrowth of bone and cartilages, long bones near epiphyseal plates, occur during periods of greatest skeletal growth, 10-25.
- Uncertain origin or behavior, may not be able to determine primary lesion

BENIGN DOES NOT NECESSARILY MEAN NOT DANGEROUS!
Arthropathies: Any disease affecting a peripheral joint

- Rheumatoid arthritis: autoimmune, chronic inflammation, joint destruction; mostly hands and feet; affects lining, painful swelling
- Psoriatic arthritis: same sx as RA, accompanied by psoriasis
- Osteoarthritis, degenerative arthritis, DJD: most common form, deterioration of articular cartilage over long period of time, bone exposed and erodes > pain and damage to bone itself
- Enteropathic, associated with GI infections, inflammatory diseases of GI tract; Crohn's disease, ulcerative colitis
- Gout, caused by urate crystals in one or more joints, sudden severe inflammation and pain; overproduction or underexcretion of uric acid.
- Acquired deformities, old injuries: affect bones, joints, muscles, tendons, ligaments; bunions, torn meniscus, joint instability, dislocation; backpacks, shoulder bags
- Other joint disorders, blood in joint (hemarthrosis), joint fistula, joint instability not classified elsewhere, joint effusion, pain and stiffness, bone spurs (osteophytes)
Rheumatoid Arthritis

Healthy Joint

Joint with Rheumatoid Arthritis

Rheumatoid Arthritis:
- Bone Loss/Erosion
- Cartilage Loss
- Bone Loss (Generalized)
- Inflamed Synovium
- Swollen Joint Capsule

Osteoarthritis

Healthy Joint

Joint with Osteoarthritis

Osteoarthritis:
- Muscles
- Joint capsule
- Tendons
- Synovial membrane
- Cartilage
- Synovial fluid
- Bone
- Bone spurs
- Worn-away cartilage
- Cartilage fragments in fluid
- Synovial fluid
- Bone
Dorsopathies: Conditions affecting back or spine

- **Deforming dorsopathies**
  - Kyphosis: thoracic, congenital or acquired
  - Lordosis: lumbar, congenital or acquired
  - Scoliosis: lateral curve, twisting of ribcage

- **Spondylopathies (spondylo-)**
  - Ankylosing spondylitis, autoimmune
  - Spondylosis, spondylolysis, forward slippage
  - Spinal stenosis, sciatica
  - Stress or fatigue vertebral fractures
  - Collapsed vertebrae, compression fractures, osteoporosis

- **Other dorsopathies**
  - Intervertebral disc disorders; back pain including radiculopathy, cervicalgia, sciatica
Connective tissue disorders affect multiple organs or systems

- Sub-q tissue, fascia, tendons, ligaments, cartilage, bone, vascular

Systemic autoimmune and collagen vascular diseases

- Systemic lupus erythematosis (SLE): affects multiple organs, when in musculoskeletal system, joint and muscle pain; hands, wrists, knees
- Systemic scleroderma, systemic sclerosis: fibrosis of tissues in multiple organ systems, including musculoskeletal; limited affects mainly hands and face, systemic affects larger areas of skin and internal organs
- Polyarteritis nodosa: systemic inflammation of medium and small blood vessels primarily supplying muscles; inflammatory changes cause damage to arterial walls, blood clots, ischemia, and tissue death; skin, joints, kidneys, GI tract, heart, eyes
Soft Tissue, Bone, and Cartilage Disorders

- **Myositis**: inflammation of muscle, systemic (polymyositis) or traumatic, site of injury develops calcification, usually reabsorbs on own

- **Rhabdomyolysis**: rapid breakdown of muscle tissue; products of damaged muscle cells are released into bloodstream; may lead to kidney failure; severity of symptoms, depends on the extent of muscle damage and whether kidney failure develops; crush injury, strenuous exercise), medications, drug abuse, infections

- **Tendonitis, tenosynovitis, synovitis, bursitis**: repetitive stress injuries; result of repetitive movement, inflammation of tissue suggested by name; tennis elbow, golfer’s elbow, “Mommy’s thumb,” texter’s thumb

- **Other muscle disorders**: rupture, separation; traumatic, non-traumatic-usually in elderly; abdominal hernia (diastasis)

- **Tendon disorders**: trigger finger, narrowing of tendon sheath, locked in bent position; ganglion cyst on tendon sheath
• **Fibromyalgia**: chronic pain in muscles, ligaments, tendons; trigger points, slightest touch produces extreme pain; 18 trigger points, 9 locations bilaterally, 11/18 must be painful for diagnosis; extreme fatigue; very debilitating; increased sensitivity of brain to neurotransmitters for pain; very disabling; controversy/disagreement on cause; recognized by NIH and Am College of Rheumatology; Lyrica; [http://www.nfra.net/fibromyalgia_trigger_point.php](http://www.nfra.net/fibromyalgia_trigger_point.php)

• **Disorders of bone density and structure**: osteoporosis, osteopenia, loss of normal bone architecture; increased risk for fractures of vertebrae, wrist, hip; hyperparathyroidism; osteoporosis, cancer; bone cyst, benign but can destroy bone and surrounding tissue if untreated

• **Cartilage disorders**: tears; chondromalacia, softening of cartilage under patella, rubbing of patella against femur, more common in females; costochondritis: benign inflammation of costal cartilage; very painful, but usually self limiting, may be confused with angina
Injuries, Other Consequences of External Causes

Significant changes with much more specific documentation to capture most specific code, organized by general site, then by type of injury

**General sites of injury:**

- Head
- Neck
- Thorax
- Abdomen, lower back, lumbar spine, pelvis
- Shoulder and upper arm
- Elbow and forearm
- Wrist and hand
- Hip and thigh
- Knee and lower leg
- Ankle and foot
Fractures

Documentation related to fractures

- **Specific site of fracture:**
  - Bone involved; laterality; proximal, distal, shaft, head, neck, tuberosity

- **Fracture type**
  - Displaced, nondisplaced; open, closed

- **Specific characteristics of fracture depending on specific bone and site**

- **Additional information:**
  - Episode of care: initial, subsequent, sequela
  - Status of bone healing:
    - Routine
    - Delayed, taking longer than expected
    - Nonunion, permanent failure of healing
    - Malunion, healing in abnormal or nonanatomical position

- Closed or open, Gustilo classification if open (see next slide)
Gustilo Open Fracture Classification

• 3 main categories, type III has 3 subcategories defined by:
  – mechanism of injury
  – extent of soft tissue damage
  – degree of bone injury, involvement of other tissues (blood vessels)

**Type I**
Low energy, wound less than 1 cm

**Type II**
Wound greater than 1 cm with moderate soft tissue damage

**Type III**
High energy wound greater than 1 cm with extensive soft tissue damage

  IIIA  Adequate soft tissue cover
  IIIB  Inadequate soft tissue cover
  IIIC  Associated with arterial injury
Fracture Types

Definitions of fractures:

- Comminuted, broken in more than two pieces or fragments
- Greenstick, incomplete fracture with bending of bone
- Oblique, fracture line runs diagonal along long axis of bone
- Segmental, fracture in two different locations of same bone
- Spiral, caused by twisting or rotation
- Torus, bending or buckling of bone without complete fracture
- Transverse, fracture line straight across long axis of bone

Additional fracture types specific to certain locations: Colles’ fracture, Smith’s fracture, Boxer’s fracture
Other Injuries

Dislocations
- Complete or incomplete (subluxation); laterality
- Direction of dislocation, anterior, posterior

Sprains
- Injuries to ligaments that stabilize joint without fracture or dislocation; stretching or tear

Muscle, fascia, tendon injuries
- Strains, muscle, fascia, tendons, overstretching or over contraction. pain, weakness, and muscle spasms common symptoms; lacerations and other injuries not classified elsewhere

Crush injuries
- Body part trapped with extreme force or pressure, most often extremities; result in tissue injury and death

Traumatic amputations
- Result of accident or trauma
- Site and extent, partial or complete, affected side
References/Resources

• Advanced Anatomy and Physiology for ICD-10-CM/PCS, Contexo Media, 2010
• Comprehensive Anatomy and Physiology for ICD-10-CM Coding. Optum. 2012

Internet Resources

• Arthur’s Medical Clipart. http://www.arthursclipart.org/medical/medical.htm August 2010
• Herbaugh, Tracee. New Mommy Thumb Can Hinder the Care You Give to Baby. Jan 19, 2012
• Lupus Foundation of America, Inc. http://www.lupus.org/newsite/index.html

There is a huge amount of information available on the internet in the lay press, medical, and coding communities, all just a keystroke away!
Great Website!

• HCPro, good resource for all things HIM and more.


• Marketplace has extensive list of free newsletters on many topics.
• ICD-10 trainer is excellent. Daily email presenting cases related to specific diagnosis and coding.
Questions? Comments?
Thank You.

Contact information
Anna Marie Kish, RN, BSN, ARNP, NP-C
flamingo1951@gmail.com