Chapter 8B
The Skeletal System: Appendicular Skeleton

The Appendicular Skeleton

- 126 bones
- Pectoral (shoulder) girdle
- Pelvic (hip) girdle
- Upper limbs
- Lower limbs
- Functions primarily to facilitate movement

Pectoral (Shoulder) Girdle

The *pectoral (shoulder) girdle* attaches the bones of the upper limbs to the axial skeleton
- Consists of scapula and clavicle
- Clavicle articulates with sternum (sternoclavicular joint)
- Clavicle articulates with scapula (acromioclavicular joint)
- Upper limb attached to pectoral girdle at shoulder (glenohumeral joint)

Clavicle

- The *clavicle* or *collar bone* lies horizontally in the superior and anterior part of thorax superior to the first rib and articulates with the sternum and the scapula
- The clavicle, one of the most frequently broken bones in the body, transmits mechanical force from the upper limb to the trunk.
Clavicle (collarbone)

- S-shaped bone with two curves
- Extends from sternum to scapula above 1st rib
- Fracture site is junction of curves
- Ligaments attached to clavicle stabilize its position

Scapula

- The *scapula* or *shoulder blade* articulates with the clavicle and the humerus
- The scapulae articulate with other bones anteriorly, but are held in place posteriorly only by complex shoulder and back musculature

Anterior Surface of Scapula

- Subscapular fossa filled with muscle
- Coracoid process for muscle attachment

Posterior Surface of Scapula

- Triangular flat bone found in upper back region
- Scapular spine ends as acromion process – a sharp ridge widening to a flat process
- Glenoid cavity forms shoulder joint with head of humerus
- Supraspinous & infraspinous fossa for muscular attachments
Upper Extremity

- Each upper limb = 30 bones
  - humerus within the arm
  - ulna & radius within the forearm
  - carpal bones within the wrist
  - metacarpal bones within the palm
  - phalanges in the fingers
- Joints
  - shoulder (glenohumeral), elbow, wrist, metacarpophalangeal, interphalangeal

Humerus

- The *humerus* is the longest and largest bone of the upper limb
- It articulates proximally with the scapula and distally at the elbow with both the radius and ulna.

Humerus --- Proximal End

- Part of shoulder joint
- Head & anatomical neck
- Greater & lesser tubercles for muscle attachments
- Intertubercular sulcus or groove
- Surgical neck is fracture site
- Deltoid tuberosity
- Shaft

Humerus --- Distal End

- Forms elbow joint with ulna and radius
- Capitulum
  - articulates with head of radius
- Trochlea
  - articulation with ulna
- Olecranon fossa
  - posterior depression for olecranon process of ulna
- Medial & lateral epicondyles
  - attachment of forearm muscles
Ulna and Radius

- The **ulna** is located on the medial aspect of the forearm
- The **radius** is located on the lateral aspect of the forearm
- The radius and ulna articulate with the humerus at the elbow joint, with each other, and with three carpal bones

Elbow Joint

- Articulation of humerus with ulna and radius
- Ulna articulates with trochlea of humerus
- Radius articulates with capitulum of humerus
- Interosseous membrane between ulna & radius provides site for muscle attachment

Ulna and Radius - Distal End

- Ulna - styloid process
  - head separated from wrist joint by fibrocartilage disc
- Radius - styloid process
  - forms wrist joint with scaphoid, lunate & triquetrum
  - forms distal radioulnar joint with head of ulna

Ulna & Radius --- Proximal End

- Ulna (on little finger side)
  - trochlear notch articulates with humerus & radial notch with radius
  - olecranon process forms point of elbow
- Radius (on thumb side)
  - head articulates with capitulum of humerus & radial notch of ulna
  - radial tuberosity for muscle attachment
Carpals, Metacarpal, and Phalanges

- The eight carpal bones, bound together by ligaments, comprise the wrist
- Five metacarpal bones are contained in the palm of each hand
- Each hand contains 14 phalanges, three in each finger and two in each thumb

Metacarpals and Phalanges

- Metacarpals
  - 5 total----#1 proximal to thumb
  - knuckles (metacarpophalangeal joints)
- Phalanges
  - 14 total: each is called phalanx
  - proximal, middle, distal on each finger, except thumb

8 Carpal Bones (wrist)

- Proximal row - lateral to medial
  - scaphoid - boat shaped
  - lunate - moon shaped
  - triquetrum - 3 corners
  - pisiform - pea shaped
- Distal row - lateral to medial
  - trapezium - four sided
  - trapezoid - four sided
  - capitate - large head
  - hamate - hooked process
- Carpal tunnel - tunnel of bone & flexor retinaculum

Hand

MNEMONIC for carpal bones*:
Stop Letting Those People Touch The Cadaver’s Hand.
Scaphoid Lunate Triquetrum Pisiform
Trapezium Trapezoid Capitate Hamate

Proximal row Medial
Lateral Distal row Medial

* Edward Tanner, University of Alabama, SOM
PELVIC (HIP) GIRDLE

- The *pelvic (hip) girdle* consists of two hipbones (os coxa or coxal bones) and provides a strong and stable support for the lower extremities, on which the weight of the body is carried.
- Each *hipbone* is composed of three separate bones at birth: the *ilium*, *ischium*, and *pubis*.
- These bones eventually fuse at a depression called the *acetabulum*, which forms the socket for the hip joint.

The Ilium

- The larger of the three components of the hip bone and articulates (fuses) with the ischium and pubis.
- Bone marrow aspiration or bone marrow biopsy are frequently performed on the iliac crest in adults.
- The *ischium* is the inferior, posterior portion of the hip bone.
- The *pubis* is the anterior and inferior part of the hip bone.

Pelvic Girdle and Hip Bones

- Pelvic girdle = two hipbones united at pubic symphysis
  - articulate posteriorly with sacrum at sacroiliac joints
- Each hip bone = ilium, pubis, and ischium
  - fuse after birth at acetabulum
- Bony pelvis = 2 hip bones, sacrum and coccyx

- Ilium crest and iliac spines for muscle attachment
- Iliac fossa for muscle attachment
- Sacroiliac joint at auricular surface & iliac tuberosity
- Greater sciatic notch for sciatic nerve
Ischium and Pubis

- Ischium
  - ischial tuberosity
- Pubis
  - pubic symphysis is pad of fibrocartilage between 2 pubic bones
- Obturator foramen
- Acetabulum

Female and Male Skeletons

- Male skeleton
  - larger and heavier
  - larger articular surfaces
  - larger muscle attachments
- Female pelvis
  - wider & shallower
  - larger pelvic inlet & outlet
  - more space in true pelvis
  - pubic arch >90 degrees

Pelvis

- Pelvis = sacrum, coccyx & 2 hip bones
- Pelvic brim
  - sacral promontory to symphysis pubis
  - separates false from true pelvis
  - false pelvis holds only abdominal organs
COMPARISON OF PECTORAL AND PELVIC GIRDLES

• The pectoral girdle does not directly articulate with the vertebral column; the pelvic girdle does.
• The pectoral girdle sockets are shallow and maximize movement; those of the pelvic girdle are deeper and allow less movement.
• The structure of the pectoral girdle offers more movement than strength; the pelvic girdle, more strength than movement.

Lower Extremity

• Each lower limb = 30 bones
  – femur and patella within the thigh
  – tibia & fibula within the leg
  – tarsal bones in the foot
  – metatarsals within the forefoot
  – phalanges in the toes
• Joints
  – hip, knee, ankle
  – proximal & distal tibiofibular
  – metatarsophalangeal

Femur

• The femur or thighbone is the largest, heaviest, and strongest bone of the body
• It articulates with the hip bone and the tibia.
  – head articulates with acetabulum (attached by ligament of head of femur)
  – medial & lateral condyles articulate with tibia
• neck is common fracture site
• greater & lesser trochanters, linea aspera, & gluteal tuberosity -- muscle attachments
• patellar surface is visible anteriorly between condyles
Patella

- triangular sesamoid bone
- increases leverage of quadriceps femoris tendon

Tibia and Fibula

- medial & larger bone of leg
- weight-bearing bone
- lateral & medial condyles
- tibial tuberosity for patellar ligament
- proximal tibiofibular joint
- medial malleolus at ankle

Fibula

- not part of knee joint
- muscle attachment only
- lateral malleolus at ankle

Tarsals, Metatarsals, and Phalanges

- Seven *tarsal* bones constitute the *ankle* and share the weight associated with walking
- Five *metatarsal* bones are contained in the *foot*
- Fractures of the metatarsals are common among dancers, especially ballet dancers.
- The arrangement of *phalanges* in the *toes* is the same as that described for the fingers and thumb above - fourteen bones in each foot
Tarsus

- Proximal region of foot (contains 7 tarsal bones)
- Talus = ankle bone (articulates with tibia & fibula)
- Calcaneus - heel bone
- Cuboid, navicular & 3 cuneiforms

**MNEMONIC for tarsal bones:**
Tall Centers Never Take Shots From Corners.
Talus Calcaneus Navicular Third cuneiform Second cuneiform First cuneiform Cuboid

Arches of the Foot

- Function
  - distribute body weight over foot
  - yield & spring back when weight is lifted
- Longitudinal arches along each side of foot
- Transverse arch across midfoot region
  - navicular, cuneiforms & bases of metatarsals

Metatarsus and Phalanges

- Metatarsus
  - midregion of the foot
  - 5 metatarsals (1 is most medial)
  - each with base, shaft and head

Phalanges

- distal portion of the foot
- similar in number and arrangement to the hand
- big toe is hallux

Clinical Problems

- Flatfoot
  - weakened ligaments allow bones of medial arch to drop
- Clawfoot
  - medial arch is too elevated
- Hip fracture
  - 1/2 million/year in US
  - osteoporosis