2. The Skeletal System

2a. Introduction to Osteology

- The science concerned with the study of bones is termed **osteology.**
- The skeletal system of an adult is composed of approximately **206 bones (newborn: 270)**.
- Each bone is an organ of the skeletal system.
- For the convenience of study, the skeleton is divided into *axial* and *appendicular parts*

The axial skeleton

The **axial skeleton** consists of **80 bones** that form the axis of the body and which supports and protects the organs of the head, neck, and trunk.

- Skull
- Auditory ossicles
- Hyoid bone
- Vertebral column
- Thoracic cage

The appendicular skeleton

The *appendicular skeleton* is composed of 126 bones of the upper and lower limbs and the bony girdles, which anchor the appendages to the axial skeleton.

- **The shoulder girdle** (the scapula and clavicle)
- **The upper limb** (the humerus, ulna, radius and bones of the hand)
- **The pelvic girdle** (the hip bone)
- **The lower limb** (the femur, tibia, fibula and bones of the foot)

The periosteum

Externally bone is covered by **periosteum** (except articular surfaces). The periosteum adheres to the surface of the bones.

Functions of the skeleton

a) Haemopoiesis
b) Mineral storage
c) Support
d) Protection
e) Body movement

Classification of bones

Tubular bones

a) **Long tubular bones**

- humerus,
- radius, ulna,
- femur,
- tibia, fibula

b) **Short tubular bones**

- metacarpal,
- metatarsal bones and phalanges

Classification of bones

Spongy bones

a) **Long spongy bones**

- sternum,
- ribs, etc

b) **Short spongy bones**

- carpal and tarsal bones

c) **Sesamoid bones**

- knee-cap
- pisiform bone, etc.

Classification of bones

Flat bones

Skull bones

- Bones of the vault of the skull

Girdle bones

- The scapula
- The hip bone, etc.

Classification of bones

Mixed bones

The vertebrae are mixed, or irregular bones (their bodies are referred to spongy bones, but their arches and processes are referred to flat bones).

Introduction to Arthrology

- Arthrology = study of the joints
- Kinesiology = study of musculoskeletal movement
- Joint = articulation (lat: articulatio, art.)

CLASSIFICATION

FUNCTIONAL	MORPHOLOGICAL
Å Joints with little or no movement (synarthrosis)	→ Fibrous (articulationes fibrosae)
Å Slightly movable joints (amphyarthrosis)	→ Cartilagenous (articulationes cartilaginea)
Å Freely movable joints (diarthrosis)	→ Synovial (articulationes synoviales)

Fibrous and cartilagenous joints are also called as **nonsynovial joints**.

Flexion, Extension & Hyperextension

- Flexion decreases the angle of a joint
  - bending elbow or wrist
- Extension straightens a joint and returns a body part to the anatomical position
- Hyperextension is extension of a joint beyond 180 degrees

Abduction & Adduction

- Abduction is movement of a part away from the midsagittal line -- raising the arm to the side
- Adduction is movement towards the midsagittal line

Abduction & Adduction

- Abduction is spreading the fingers away from the midline (middle finger)
- Adduction is movement is returning the fingers to the anatomical position

Elevation and Depression

- Elevation is a movement that raises a bone vertically
  - mandibles are elevated during biting & clavicles during a shrug
- Depression is lowering the mandible or the shoulders

Protraction & Retraction

- Protraction is movement of a bone anteriorly (forward) on a horizontal plane
  - thrusting the jaw forward, shoulders or pelvis forward
- Retraction is movement of a bone posteriorly

Lateral & Medial Excursion

- Lateral excursion is sideways movement to right or left
- Medial excursion is movement back to the midline
- Side-to-side grinding movements occurring during chewing

Circumduction

- Movement in which one end of an appendage remains stationary while the other end makes a circular motion
- Sequence of flexion, abduction, extension & adduction movements
  - baseball player winding up for a pitch

Lateral and Medial Rotation

- Movement of a bone turning on its longitudinal axis
  - rotation of trunk, thigh, head or arm
- Medial rotation turns the bone inwards
- Lateral rotation turns the bone outwards

Supination & Pronation

- Occurs in the forearm and foot
- Supination
  - rotation of forearm so that the palm faces forward
  - inversion and abduction of foot (raising the medial edge of the foot)
- Pronation
  - rotation of forearm so the palm faces to the rear
  - eversion and abduction of foot (raising the lateral edge of the foot)

Opposition & Reposition

- Opposition is movement of the thumb to approach or touch the fingertips
- Reposition is movement back to the anatomical position
- Important hand function that enables the hand to grasp objects

Dorsiflexion & Plantar Flexion

- Dorsiflexion is raising of the toes as when you swing the foot forward to take a step (heel strike)
- Plantarflexion is extension of the foot so that the toes point downward as in standing on tiptoe

Inversion & Eversion

- Inversion is a movement in which the soles are turned medially
- Eversion is a turning of the soles to face laterally

Range of Motion

- Varies greatly from one type of joint to another
- Measured with goniometer
- Factors affecting ROM and joint stability
  - structure & action of the muscles
    - proprioceptors keep track of joint position & muscle tone
  - structure of the articular surfaces
  - strength and tautness of ligaments, tendons & capsule
    - gradual stretching of ligaments increases range of motion

Scapula

Crosses ribs 2 through 7 in anatomical position.

Clavicle

- Sigmoid
- Convex anteriorly
- Concave posteriorly

Radius

- Head
  - Articulates with capitulum of humerus
  - Fovea
- Neck
  - Just distal to head
- Styloid process
  - Distal, lateral process
- Articular surface for scaphoid and lunate bones

Radius

- Ulnar notch
  - At distal end of radius on medial side
- Interosseous margin
  - On medial side
  - For attachment of interosseous membrane
- Anterior margin
- Radial tuberosity (bicipital tuberosity)
  - Insertion for biceps brachii muscle

Ulna

- Interosseous margin
- Head (distal)
- Styloid process
  - Distal, medial
- Radial notch
  - At proximal end
- Trochlear notch:

Articulates with trochlea of humerus

- Coronoid process
- Tuberosity
- Anterior border
- Supinator fossa
- Supinator crest
- Posterior border
- Olecranon process:
  - For insertion of triceps

The Elbow Joint

- Single joint capsule enclosing the humeroulnar and humeroradial joints
- Humeroulnar joint is supported by collateral ligaments.
- Radioulnar joint is head of radius held in place by the annular ligament encircling the head

Carpus (Carpal Bones)

- Proximal row of bones (radial to ulnar)
  - Scaphoid
  - Lunate
  - Triquetral
  - Pisiform
- Distal row of bones (radial to ulnar):
  - Trapezium
  - Trapezoid
  - Capitate
  - Hamate

Å Metacarpal bones: I-V

Å Phalanges

Proximal:

Proximal interphalangeal joint (PIP)

Middle:

Distal interphalangeal joint (DIP)

Distal:

BONES OF THE LOWER EXTREMITY

- Function:
  - Locomotion
  - Carry weight of entire erect body
  - Support
  - Points for muscular attachments
- Components:
  - Thigh
    - Femur
  - Knee
    - Patella
  - Leg
    - Tibia (medial)
    - Fibula (lateral)
  - Foot
    - Tarsals (7)
    - Metatarsals (5)
    - Phalanges (14)

Thigh

- Femur
  - Largest, longest, strongest bone in the body!!
  - Receives a lot of stress
  - Courses medially
    - More in women!
  - Articulates with acetabulum proximally
  - Articulates with tibia and patella distally

Knee

- Patella
  - Triangular sesamoid bone
  - Protects knee joint
  - Improves leverage of thigh muscles acting across the knee
  - Contained within patellar ligament

Leg

- Tibia
  - Receives the weight of body from femur and transmits to foot
  - Second to femur in size and weight
  - Articulates with fibula proximally and distally
    - Interosseous membrane
- Fibula
  - Does NOT bear weight
  - Muscle attachment
  - Not part of knee joint
  - Stabilize ankle joint

Foot

- Function:
  - Supports the weight of the body
  - Act as a lever to propel the body forward
- Parts:
  - Tarsals
    - Talus = ankle
      - Between tibia and fibula
      - Articulates with both
    - Calcaneus = heel
      - Attachment for Calcaneal tendon
      - Carries talus
    - Navicular
    - Cuboid
    - Medial, lateral and intermediate cuneiforms
  - Metatarsals
  - Phalanges

Joints of Lower Limb

- Hip (femur + acetabulum)
  - Ball + socket
  - Multiaxial
  - Synovial
- Knee (femur + tibia)
  - Hinge (modified)
  - Biaxial
  - Synovial
  - Contains menisci, bursa, many ligaments
- Knee (femur + patella)
  - Plane
  - Gliding of patella
  - Synovial

Joints of Lower Limb

- Proximal Tibia + Fibula
  - Plane, Gliding
  - Synovial
- Distal Tibia + Fibula
  - Slight “give” (synarthrosis)
  - Fibrous (syndesmosis)
- Ankle (Tibia/Fibula + Talus)
  - Hinge, Uniaxial
  - Synovial
- Intertarsal & Tarsal-metatarsal
  - Plane, synovial
- Metatarsal-phalanges
  - Condyloid, synovial
- Interphalangeal
  - Hinge, uniaxial

The Hip Joint

- Head of femur articulates with acetabulum
- Socket deepened by acetabular labrum
  - transverse acetabular ligament completes labrum
- Blood supply to head of femur found in ligament of the head of the femur (round ligament)
- Joint capsule strengthened by ligaments

The Knee Joint

- Most complex diarthrosis of the body
  - patellofemoral = gliding joint
  - tibiofemoral = gliding with slight rotation & gliding possible in flexed position
- Joint capsule anteriorly consists of patella & extensions of quadriceps femoris tendon
- Rest of capsule strengthened by both extracapsular & intracapsular ligaments

Knee Joint

- Medial & lateral meniscus absorb shock & shape joint
- Anterior & posterior cruciate ligaments limit anterior & posterior sliding movements
- Medial and lateral collateral ligaments prevent rotation of extended knee

The Ankle Joint

- One joint capsule enclosing the joints between the talus, tibia and fibula
- Groups of ligaments
  - binding tibia to fibula both anteriorly & posteriorly
  - deltoid ligament binding the tibia to the foot on the medial side
  - lateral collateral ligament binds the fibula to the foot on the lateral side
  - achilles tendon inserting on the calcaneus
- Sprains are torn ligaments or tendons