



Musculoskeletal System I

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BONES

(osseous tissue)

- The study of bones is called osteology
- Rigid form of connective tissue forming the skeleton.
- Supporting framework of the body consists of over 200 bones.



- Bones are living structures having a blood and nerve supply
 - Perisoteum
- Living bones have some *elasticity* (results from the organic matter) and *great rigidity* (results from their lamellous structures and tubes of inorganic calcium phosphate)



Functions of the bones

- **Protection** for vital structures
- **Support**; forms a rigid framework for the body
- Forms the **mechanical basis** for movement
- **Formation of blood cells** (bone marrow)
- **Storage of salts**; calcium, phosphorus, magnesium-thus provide a mineral reservoir



General structures of bone

1. Bony substance
 - compact bone
 - spongy bone
 - Trabeculae



General structures of bone

2. Periosteum :

- **Outer or fibrous layer**
- **Inner layer** is vascular and provides the underlying bone with nutrition. It also contains osteoblasts

Endosteum is a single-cellular osteogenic layer lining the inner surface of bone that forms the medullary cavity

3. Bone marrow

- **Red marrow** : haematopoietic
- **Yellow marrow**: fatty



Types of Bones

- There are two main types
 - *Compact bone*; gives bone its strength
 - *Spongy (cancellous) bone*; filled with open spaces that has red bone marrow



Bones forming the skeleton is classified as:

– *Axial skeleton*

- skull, vertebrae, ribs, and sternum

– *Appendicular skeleton*

- bones of the upper and lower limbs and the associated bones



Bones are also classified according to their shape

- **Long bones** (humerus, bones of the fingers)
 - have a shaft and two extremities
- **Short bones** (foot and wrist bones)
 - more or less cuboidal in shape
- **Flat bones** (bones forming the calvaria, sternum, scapula)
- **Irregular bones** (facial bones and the vertebrae)
- **Pneumatic bones** (maxilla, frontal bone)
 - contains air cells or sinuses
- **Sesamoid bones**
 - round or oval nodules of bones that develop in certain tendons
- **Accessory bones**
 - develops as a result of additional ossification center or lack of fuse



BONE MARKINGS

- Surfaces of the bones are not smooth.
- Bones display elevations, depressions and holes.
- The surface features on the bones are given names to distinguish and define them.



- Linear elevation
 - superior nuchal line, iliac crest
- Round elevation
 - tubercle (small eminence), protuberance (swelling)
- Sharp elevation
 - spine, process
- Facets
 - area with a smooth surface where a bone articulates with another bone
- Rounded articular area
 - head, condyle



- **Depressions**
 - fossae (small depression), groove (sulcus, long narrow depressions)
- **Foramen**
 - hole
- **Canal**
 - a foramen having length
- **Orifice**
 - opening
- **Meatus**
 - a canal entering a structure



Changes in the Human Skeleton

- In embryos, the skeleton is primarily hyaline cartilage
- During development, much of this cartilage is replaced by bone
- Cartilage remains in isolated areas
 - Bridge of the nose
 - Parts of ribs
 - Joints



JOINTS

- **Arthrologia** is the study of joints.
- Joints are formed by the articulation between the **articular surfaces** of two or more bones.
- Articular system consists of **joints** and their **associated bones and ligaments**.



Classification of joints

- Joints are classified according to their ability of movements:
 - **Fibrous joints:** They do not have the ability to move.
 - **Cartilaginous joints:** Can make very limited amount of movement.
 - **Synovial joints:** These are freely movable joints.



Fibrous joints

- There is a fibrous connective tissue between the articular surfaces.
 - **Syndesmosis:** Articulating surfaces are connected firmly by a connective tissue e.g. distal tibiofibular joint
 - **Sutura:** Found bw the skull bones
 - **Gomphosis:** Found bw the dentures and the alveoles of the upper and lower jaw



Cartilaginous joints

- Cartilaginous tissue lies bw the articular surfaces.
- These joints can make very limited amount of movement.
 - **Synchondrosis**: The cartilaginous tissue bw the articular surfaces are **lost within time** and the joint loose the ability of movement e.g. sphenoid-occipital
 - **Symphysis**: There is a **disc made of fibrocartilaginous tissue** bw the articular surfaces. e.g. joints bw the vertebrae, symphysis pubis



Synovial joints

- This type of joints have three common features:
 - **Joint cavity**
 - **Articular cartilage:** The articular surfaces are covered by hyaline cartilage
 - **Articular capsule:** This structure surrounds the joint and formed of two layers.
 - **Fibrous membrane:** Protects and give firmness to the joint stability, continues with the periosteum
 - **Synovial membrane:** Lines the inner surface of the fibrous membrane but does not cover the articular cartilage. Secrete a fluid known as **synovial fluid**. This fluid helps to minimize the friction bw articular surfaces.
- ❖ Synovial joints have motion possible in one or more planes



Synovial joints (continued)

- *Articular capsules* are usually strengthened by **articular ligaments**
 - These are from dense connective tissue and they **connect the articulating bones** to each other.
 - Articular ligaments **limit the undesired and/or excessive** movements of the joints.
 - Articular ligaments are classified as **intrinsic and extrinsic** ligaments.
 - Intrinsic ligaments are the thickening of a portion of the articular capsule.



Synovial joints (continued)

- In addition to the main features of the synovial joints there are some additional features that are commonly seen:
 - **Articular disc:** Help to hold the bones together. In some joints it is attached to only one of the bones.
 - **Labrum:** Some synovial joints have a fibrocartilaginous ring called labrum which deepens the articular surface for one of the bones. e.g. glenoid labrum
 - **Meniscus**



Synovial joints (continued)

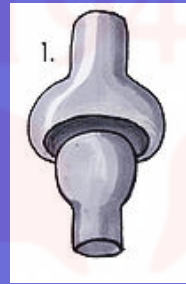
Classification of the synovial joints

- Synovial joints are classified according to the shape of articulating surfaces and/or the type of movement they can make.
- There are six major types of synovial joints



Classification of the synovial joints

1. Ball-socket joint



2. Ellipsoidal joint
(Condyloid)



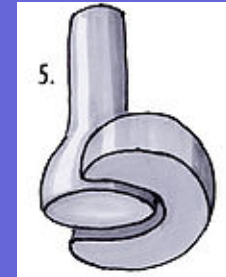
3. Saddle joint



4. Hinge joint



5. Pivot joint



6. Gliding joint



Synovial joints (continued)

- **Gliding (Plane) joints**

- They permit gliding or sliding movements.
- Articular surfaces are almost flat.
- Most plane joint move in only **one axis**, hence they are called *uniaxial* joints.
- e.g. acromioclavicular joint



Synovial joints (continued)

- **Hinge joints (ginglymus) ?**
 - This type of joints are also **uniaxial** and permits **flexion and extantion** around the transverse axis.
 - Bones are joined with strong **collateral ligaments**. e.g. elbow and knee joints



Synovial joints (continued)

- **Ellipsoidal (Condyloid) joints**
 - These are **biaxial joints** that permit movement in in two axes (trans.-sagit.)
 - e.g. radiocarpal joint



Synovial joints (continued)

- **Saddle joints**
 - The articular surfaces resemble a saddle shape and are concave and convex respectively.
 - e.g. carpometacarpal joint of the thumb



Synovial joints (continued)

- **Ball and socket joints**

- Multiaxial (movable around all three axes)
- The spheroidal surface of a bone articulates with the socket shaped articular surface of another bone.
- e.g. shoulder joint, hip joint



Synovial joints (continued)

- **Pivot joints**

- Uniaxial joints that allow rotation.
- Rounded part of a bone rotates in a sleeve or ring like osteofibrous structure
- e.g. prox-dist radioulnar joints



Features supplying the joint stability

- These features prevent the dislocation of the joint.
 - The negative pressure within the joint cavity
 - Joint capsule and the ligaments
 - Muscles and their tendons around the joint
 - Shapes of the articular surfaces



MUSCLES

- Myologia, musculus (mus-mouse)
- Muscles move the skeleton, therefore, move the body parts



There are three types of muscles

- **Striated muscle (skeletal muscles)**-voluntarily controlled, though exceptions exist
- **Non-striated muscle (smooth muscle)** - involuntary
- **Cardiac muscle**



MUSCLES

- Striated muscles are innervated by the *somatic nervous system*
- Non-striated and cardiac muscle are innervated by the *autonomic nervous system*
- Muscle cells are also referred as *muscle fibers*.



Superficial fascia and deep fascia;

Fascia is connective tissue that is woven around
each and every muscle



Parts of a muscle

- **Belly** (fleshy part)
- **Tendon** (in certain muscles termed as aponeurosis)
 - Tendons attach to the bones and cartilage, skin or to the superficial fascia.
- **Origin** and **insertion** (prox.-dist, fixed-moving)



- *Bursae*; a closed fluid-filled sac (minimize friction)
- *Tendinous sheaths*
 - Both are soft tissue pads containing synovial fluid that prevents the friction of tendons from the surrounding tissue.



Muscle terminology

- Muscles are generally given names according to their shapes, location, number of their bellies, function, and size
 - rhomboideus major
 - palmaris longus
 - biceps brachii
 - tibialis posterior
 - flexor carpi ulnaris
 - teres major-teres minor



Contraction

- When a muscle contracts its length decreases by $\frac{1}{3}$ or $\frac{1}{2}$
- **Isotonic contraction** - the length decreases
- **Isometric contraction** - the length does not decrease



Motor unit

- A motor neuron and the muscle fibers it innervates are known as a motor unit, the basic functional unit by which the nervous system controls movement
- A motor neuron and all the muscle cells (fibers) innervated by this neuron
- There are many motor units in a single muscle.
- Whole of the motor units does not necessarily contract during a muscle contraction.
- **Number of contracting units determines the force of contraction.**



During a single joint movement a number of muscles contract.

- Prime mover
- Sinergist muscles (support the movement)
- Antagonist muscles (oppose the movement)
- Fixator muscles (the muscles that prevents the undesired movements)



Innervation of the muscles

- Motor nerves (somatic or autonomic)
- Sensory nerves (for striated muscles; muscle spindle-golgi tendon organs)



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