

Osteology

Study the anatomical structures (bones, cartilages) and the skeleton which formed by these structures.

#Bones of the thoracic limb, includes:

1. Scapula.
2. Humerus.
3. Radius and ulna.
4. Carpal bones.
5. Metacarpal bones.
6. Phalanges.
7. Number of sesamoid bones.

#Bones of the pelvic limb, includes:

1. Os coxae.
2. Femur and Patella.
3. Tibia and fibula.
4. Tarsal bones.
5. Metatarsal bones.
6. Phalanges.
7. Number of sesamoid bones.

Note: A numerical variations are present in same species, like the tarsus of the hours may consist of six or seven; also carpus may be seven or eight.

Skeleton

Is applied to the frame work of hard structures which support and protects the soft tissues or organs of animals.

It consists of many bones and cartilages which articulates each others to give the form of body.

The specific studies of these parts are:

1. Osteology: (Greek ward _ osteo= bone
Logy=study) it means study of bones.
2. Chondrology: (Greek ward _ chondro= cartilage
Logy=study) it means study of cartilages.

3. Arthrology: (Greek word _ arthro= joint
Logy=study) it means study of joints.

4. Odontology: (Greek word _ odonto= tooth
Logy=study) it means study of teeth.

The skeleton may be divided into three parts:

1. Axial skeleton: comprises the vertebral column, ribs, sternum and skull.
2. Appendicular skeleton (Abaxial): includes the bones of limbs. It attached to the axial skeleton by 2 bony structures, these are:
 - Pectoral (shoulder) gridle: This is formed from six bones: Left & right scapula bones.
Left & right coracoids bones.
Left & right clavicles bones.

In the animals the pectoral gridle is incomplete because usually one or more pair of these bones are absent so the attachment of the fore limb to the body complete by means of fleshy and tendon.

- Pelvic (hip) gridle: this is consist of six bones:
Left & right Ilium bones.
Left & right ischium bones.
Left & right pubis bones.

All these bones are present in animals so the attachment is complete.

3. splanchnic or visceral skeleton: consist of certain bones developed in some soft organs or viscera like,
 - Os penis in dog, fox, raccoon, genia pig.
 - Os cardis in ox,
 - Os phrenic in camel.
 - Os nostra in the nostral of pig.

Classes of bones

Four classes

- According to their shape and function:
 1. Long bones: elongated cylindrical form with enlarged extremities or ends " expand in one direction " it present in limb, like (femur, Humerus, etc...). The cylindrical part called the shaft or body, the medullary cavity contains medulla or marrow.
 2. Flat bones: expand in two directions. It furnishes sufficient area for attachment of muscles like scapula, or protects soft organs as in skull.
 3. Short bones: such as these of the carpus and tarsus somewhat similar dimensions in the length and thickness. The chief function is diffusing concussion and allows the movement of the joint.

*sesamoid bones are also short bones which are developed in the capsules of some joints or in tendon. They diminish friction or change the direction of the tendon.

4. Irregular bones: they are irregular shapes, such as vertebrae and bones of cranial base "skull". They are median in position and unpaired or single.
- According to their structures of bone:
 1. Spongy bone (cancellous bone): it is originated from intramembranous ossification.
 2. Compact bone: it is originated from cartilaginous ossification.

Bone formation:

1. The primitive skeleton of embryo is consisting of cartilage and fibrous connective tissue.
2. Usually the bone of skeleton derived from 2 sources:
 - a) Cartilage ossification, cartilage bone (compact bone), which forming the majority of skeleton.

- b) Membrane ossification, membrane bone (spongy bone) formed flat bone + skull.
- 3. In the embryo the cartilage are formed early in develop as a skeleton.
- 4. With the bars of cartilage one or more center of ossification is developing.

Bones:

It is living structures with blood, lymph vessels and nerves, it is formed from:

- a) Network of fibrous connective tissue and cells (it is gelatin like protein called ossein).
- b) Inorganic salts mainly (tricalcium phosphate) which give Ca_3PO_4 the bone rigidity and make them opaque to X rays.

Mechanism of ossification:**1. Intramembranous ossification:**

- a) It is formed on outside of the fibrous tissue membrane covering the brain and skull.
- b) At first formed the definite center when the osteoblast surrounded themselves with deposit of bone.
- c) The center extends to the periphery of the future bone.
- d) Producing a network of bony trabeculae.
- e) The trabeculae are rapidly thickening formed bone plate.
- f) The superficial part of the original tissue (fibrous membrane) becomes the periosteum.

2. Intracartilaginous ossification:

Within the bars of cartilage there is one or more centers of ossification are appearing as following:

- a) the chondroclasts cells (Greek- chondro =cartilage
Clast = break).

These cells break down the cartilage and the cartilage cells shrink and disappear leaving gaps (spaces) (bone marrow cavity).

- b) The osteoblast cell (osteo =bone
Blast = forming).

Osteoblasts migrate from the deep face of the perichondrium to inside the cartilage and fill the gaps with primary bone (spongy bone).

- c) Later primary bone removed by osteoclasts and true bone (secondary bone) (compact bone) formed by secondary osteoblast.

Note.

1. At birth most of the cartilage bars of skeleton have been partial replaced by the bone.
2. After birth major changes of growth and secondary bone formation.

Structure of long bone:

1. The long bone consist of 3 parts:
 - d) (body) is called diaphysis.
 - e) 2 extremities (ends) are called epiphyses.
2. Between the diaphysis and epiphyses of immature bone there is a narrow band of cartilage called epiphyseal plate which is responsible for growth and increase in the length of the bone.
3. In the mature bone the epiphyseal plate undergoes of ossification and replace by bone so there is no increase in the length of bone.
4. The extremities of the long bone covered with articular cartilage (it's type hyaline cartilage) at their articular surface.
5. The reminder of the bone is covered by closely adherent fibrous membrane called periosteum.

Periosteum = (Greek ward, peri = surrounded
Osteo = bone).

Periosteum:

It is membranous layer of specialized connective tissue which covers the outer surface of the bone except the area of the epiphyses articular surface. The periosteum formed from 2 layers:

- a) Outer protective layer formed from fibrous connective tissue.
- b) Inner cellular layer formed from osteoblast.
The osteoblast cells are inactive in adult bone while in young bone are active and functional and they are responsible for increasing the diameter of the (diaphysis).
6. One or more holes (nutrient foramen) penetrate the and ends for passing blood and lymph vessels.
7. The shaft of long bone hallow in the center formed medullary cavity or marrow cavity.

Endosteum = endo—within

Osteo= bone.

The endosteum is fibrous membranes similar in structure and function to the periosteum. Endosteum line large Haversian canal and medullary cavity.

8. The medullary cavity fills with bone marrow.

Bone marrow:

It is a substance occupied the medullary cavity and space of spongy bone.

There are 4 types of marrow depend upon the age of the animal (red bone marrow – in young animal and gelatinous – in age animal).

a) red bone marrow:

1. Found in the bone of young animal.
2. It is blood forming organs.
3. It is soft, fill with vessels and cells.
4. Red bone marrow persists in the sternum, vertebrae throughout the live.

b) yellow bone marrow:

1. More fatty in nature and harder.
2. Dose not performs blood forming organs.

c) white bone marrow:

1. Hard fatty tissue.
2. Non functional as blood forming organs.

d) gelatinous bone marrow:

1. It is semifluid form.
2. Found in very aged animals.

Note.

1. In some species because of their short lifespan never have any type of bone marrow other than red bone marrow.
2. Mice, rat, hamster and other small rodents persists red bone marrow in it's long bone throughout of life.

9. The long bone is consist of:

- a) External shell of dense compact substance.
- b) Internal more loss as spongy substance.

a) The compact substance:

1. It is more thickness near the middle of the .
2. It is thin at the extremities.
3. It is composed of large calcified interstitial substance called bone matrix (ground substance) which formed from layer called lamellae.
4. The matrix have small cavities which called lacunae which filled by osteocyte.
5. There is tubular passage called canaliculi runs in different directions.
6. The lamellae of the matrix arrange around the longitudinal cannels, these structures called *Haversian system*.

b) The spongy substance:

1. Consist of delicate bony spicules and plates.
2. Bone marrow spaces between spicules and plate fill with bone marrow.
3. the spongy substance formed the bulk of:
 - a) Short bones.
 - b) Extremity of long bone.

Note.

Some long bones contain air spaces within the compact substance instead of spongy bone. This bone is called pneumatic bone.

Ossification in the long bone:

1. usually there are 3 primary centers of ossification:
 - a) One center which appears first for the diaphysis ().
 - b) One on each epiphysis (extremity).
2. Many bones have secondary ossification centers.

Some functions of the bone:

1. Give the form of the body skeleton.
2. Protect and keep the soft tissues like the brain as in the skull, spinal cord as in vertebral canal of vertebral column and the heart and lungs as in chest skeleton.
3. Act as storage for (Ca, P) salts and fat in adult animals (yellow marrow).
4. Red marrow is playing a role in blood cell forming.
5. They give places to attachment of muscles.
6. Help in locomotion and respiration.