Bones

Bone development (ossification)

Blood and nerve supply of long bone

Cartilage

Bone markings

Learning Objectives

At the end of the lecture the student should be able to:

- Explain the ossification of bone.
- Identify the centres of ossification and their significance.
- Distinguish between intramembranous and endochondral ossification.
- Enlist the sources of blood supply of long bones.
- Identify the bone markings.
- List and identify the types of cartilages.

Ossification of bone

- Ossification (or osteogenesis) is the process of laying down new bone material by cells called osteoblasts. It is synonymous with bone tissue formation.

Two types of ossification

1. Intramembranous ossification
2. Endochondral ossification

Intramembranous ossification

- Intramembranous ossification mainly occurs during formation of the flat bones of the skull but also the mandible, maxilla, and clavicles; the bone is formed from connective tissue such as mesenchyme tissue rather than from cartilage. The steps in intramembranous ossification are:
  - Development of ossification center
  - Calcification
  - Formation of trabeculae
  - Development of periosteum
Endochondral Ossification

- Endochondral ossification, on the other hand, occurs in long bones and most of the rest of the bones in the body; it involves an initial hyaline cartilage that continues to grow. The steps in endochondral ossification are:
  - Development of cartilage model
  - Growth of cartilage model
  - Development of the primary ossification center
  - Development of the secondary ossification center
  - Formation of articular cartilage and epiphyseal plate

**Endochondral Ossification**

**DEVELOPMENTAL CLASSIFICATION**

- **Long, short, and irregular** bones develop by endochondral ossification, where cartilage is replaced by bone.
- **Flat bones** develop by intramembranous ossification, where bone develops within sheets of connective tissue
Blood Supply of Long bone

- **Nutrient Artery:**
  - One or two main diaphyseal nutrient arteries enter the shaft obliquely through one or two nutrient foramina leading to nutrient canals. Their sites of entry are constant and characteristically directed away from the growing epiphysis.
  - Except for a few with double or no foramina, 90% of long bones have a single nutrient foramen in the middle third of the shaft.

Nutrient foramina

- The nutrient foramina and canal are directed obliquely away from the growing end of bone.
- Direction of nutrient foramina are indicated by a jingle, “To the elbow I go and to the knee I flee”
- The nutrient arteries divide into ascending and descending branches in the medullary cavity. These approach the epiphysis dividing into smaller rami.
- Near the epiphysis they anastamose with the metaphyseal and epiphyseal arteries.
• **Periosteal Arteries**
  Derived from the neighboring tissues and pierce periosteum, enter the cortical part of the shaft supplying outer 1/3 of cortex of diaphysis and metaphysis.

• **Epiphyseal arteries**
  Derived from nearby vessels. They enter through the numerous foramina present on the non articular part of head. Most of these foramina transferred the vein.
  • The epiphyseal arteries anastamose with metaphyseal and nutrient arteries.
• **Metaphyseal Arteries** Derived from the neighboring vessels. They pierce the metaphysis and anastamose with the metaphyseal branches of nutrient and epiphyseal arteries and supplying the metaphysis

### Blood Supply of other bones

- Short bones are supplied by the numerous periosteal arteries.
- The vertebra supplied by anterior and posterior arterial plexuses on the anterior and posterior aspect of body of vertebra.
- The ribs are supplied by nutrient arteries and periosteal arteries.
- Veins are numerous some of them accompanying nutrient artery while most of them leave the bone directly through the foramina.

### Nerve supply of Bone

- **Nerve supply:** Nerves accompanying the arteries and they are sympathetic in nature supplying the blood vessels.
- Most numerous in the articular extremities of the long bones, in the vertebrae, and in the larger flat bones.
- Usually bone do not have the lymphatic drainage but some of them may accompany the periosteal arteries.
Crest A prominent ridge.
eminence A relatively small projection or bump.
facet A small, flattened articular surface
fossa A broad, shallow depressed area.
foramen An opening through a bone.

articular process A projection that contacts an adjacent bone.
articulation The region where adjacent bones contact each other—a canal A long, tunnel-like foramen, usually a passage for notable nerves or blood vessels.
condyle A large, rounded articular process.
epicondyle A projection near to a condyle but not part of the joint.
ramus
An arm-like branch off the body of a bone.
sinus
A cavity within a cranial bone.
spine
A relatively long, thin projection or bump.
suture
Articulation between cranial bones
trochanter
One of two specific tuberosities located on the femur.
head: The proximal articular end of the bone.
neck: The region of bone between the head and the shaft.
tubercle: A projection or bump with a roughened surface, generally smaller than a tuberosity.
tuberosity: A projection or bump with a roughened surface.

diaphysis: The long, relatively straight main body of the bone; region of primary ossification. Also known as the shaft.
epiphyses: The end regions of the bone; regions of secondary ossification.
epiphyseal plate: The thin disc of hyaline cartilage between the diaphysis and epiphyses; disappears by twenty years of age. Also known as the growth plate.
TYPES OF CARTILAGES

- Cartilage is classified in three types,
- **Elastic cartilage,**
- **Hyaline cartilage,**
- **Fibrocartilage,**

which differ in the relative amounts of these three main components.

**Elastic cartilage or yellow cartilage**

- is a type of cartilage present in the outer ear, larynx, and epiglottis.
- It contains elastic fiber networks and collagen fibers.
- The principal protein is elastin.

**Hyaline cartilage (aka “Gristle”)**

- Consists of a slimy mass, pearly bluish in colour with firm consistency and considerable collagen.
- It contains no nerves or blood vessels, and its structure is relatively simple.
Fibrocartilage

- White fibrocartilage consists of a mixture of white fibrous tissue and cartilaginous tissue in various proportions.
- It owes its flexibility and toughness to the former of these constituents, and its elasticity to the latter.
- It is the only type of cartilage that contains type I collagen in addition to the normal type II.
- Fibrocartilage is found in the pubic symphysis, the annulus fibrosus of intervertebral discs, meniscus, and the TMJ.
- During labor, relaxin loosens the pubic symphysis to aid in delivery, but this can lead to later joint problems.