

OSSIFICATION

Q.What is ossification?

Ossification (or osteogenesis) in bone remodeling is the process of laying down new bone material by cells called osteoblasts. It is synonymous with bone tissue formation. There are two processes resulting in the formation of normal, healthy bone tissue: **Intramembranous ossification** is the direct laying down of bone into the primitive connective tissue (mesenchyme), while **endochondral ossification** involves cartilage as a precursor.

In both processes, the bone tissue that appears first is primary or woven. Primary bone is a temporary tissue and is soon replaced by the definitive lamellar or secondary bone. During bone growth areas of primary bone, areas of resorption and areas of secondary bone appear side by side. This combination of bone synthesis and removal (**remodeling**) occurs not only in growing bones but also throughout adult life, although its rate of change in adults is considerably slower.

Intramembranous ossification:

1. Intramembranous ossification process contributes to the growth of short bones and thickening of long bones.
2. Frontal, parietal, occipital and temporal bones of skull, epiphyseal region of long bones, maxillae and mandible of jaw are formed by intramembranous ossification process.
3. The process begins as group of cells differentiated into osteoblasts from mesenchymal or osteoprogenitor cells.
4. Osteoblasts start to synthesize and secrete collagen and ground substances that collectively form osteoid which gets mineralized.
5. Now the osteoblasts get encapsulated within this matrix to form osteocytes.
6. These islands of developing bones are called **spicules** and **loose areolar** aggregation of several spicules ultimately form the **cancellous bone**.
7. The connective tissue that remain among the bone spicules, is penetrated by growing blood vessels and additional undifferentiated mesenchymal cells give rise to bone marrow cells.
8. The mesenchymal tissue cells divide further to give rise further osteoblast cells. That are responsible for continued growth of ossification center.
9. Several ossification centers of bone grow radially and fuse to replace the original connective tissue.
10. Portion of connective tissue layer that does not undergo ossification process give rise to periosteum and endosteum.

Endochondral ossification:

1. Long bones, bones of extremities and those parts of axial skeleton that bear weight are developed by **endochondral ossification** process.
2. The process begins with formation of a hyaline cartilage that contains two swellings or epiphyses at 2 ends of a cylindrical shaft. The cartilage resembles the shape of bone to be formed.
3. At first, osteoprogenitor cells form a soft tissue or bone collar along both the sides of diaphysis (shaft) of cartilage by intramembranous ossification process.
4. Now the cartilaginous matrix of diaphysis gets calcified.
5. Next, an osteogenic bud consisting of blood vessels, osteoprogenitor cells and reserve tissue, erodes and invades the calcified cartilage.
6. Osteoprogenitor cells give rise to osteoblasts that form a continuous layer over the calcified cartilage and start to synthesize bone matrix.