

Difference Between Endochondral Ossification and Intramembranous Ossification

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Key Difference – Endochondral Ossification vs Intramembranous Ossification

Osteogenesis, more commonly referred to as ossification, is a process by which new layers of [bone](#) tissues are laid by osteoblasts. Bone ossification is not the same as bone calcification process. It is a process which involves the laying of calcium-based salts within the cells and tissues. A normal bone ossification process can be of two different types: endochondral ossification and intramembranous ossification. **During endochondral ossification, [cartilage](#) is utilized as a precursor for bone formation. In intramembranous ossification, the bone tissue is directly laid on a primitive [connective tissue](#) referred to as [mesenchyma](#) without the involvement of an intermediate cartilage.** This is the key difference between endochondral ossification and intramembranous ossification. In the context of [fractures](#), the healing process by plaster of Paris occurs through endochondral ossification whilst the fractures which are treated by open reduction and internal fixation get healed by intramembranous ossification.

What is Endochondral Ossification?

Endochondral ossification is a process which is essential for the formation of long bones (femur) and flat and irregular bones such as [ribs](#) and [vertebrae](#). Endochondral ossification is a process that involves two main functions; it is involved in the natural growth of bones and its lengthening and is also involved in the healing of bone fractures naturally. During this type of ossification process, which leads to the formation of long bones and other types of bones, the involvement of a cartilage precursor takes place. The whole ossification process takes place in two centres of ossification, primary and secondary. In the primary centre of ossification first site of ossification which leads to the formation of the mid-region of the long bone is diaphysis. Diaphysis is the region where the bone tissue first appears in long bones. In the primary ossification centre, [osteoblasts and osteoclasts](#) absorb cartilage which is produced by [chondrocytes](#) which lead to the laying down of the bone according to a cartilaginous network. It is important to mention that cartilage is not converted into bone but act as a precursor. Once the trabecular bone is formed, the cartilage is replaced by hardened bone and extend towards the ends of the long bone; epiphysis. The secondary ossification centre is found around the regions of epiphysis. Secondary ossification centre has similar functions to that of primary ossification centre. The unossified cartilage between the primary and secondary ossification centres is referred to as the cartilage plate or epiphyseal plate. The epiphyseal plate is

an important element during the formation of new cartilage which is replaced by bone.

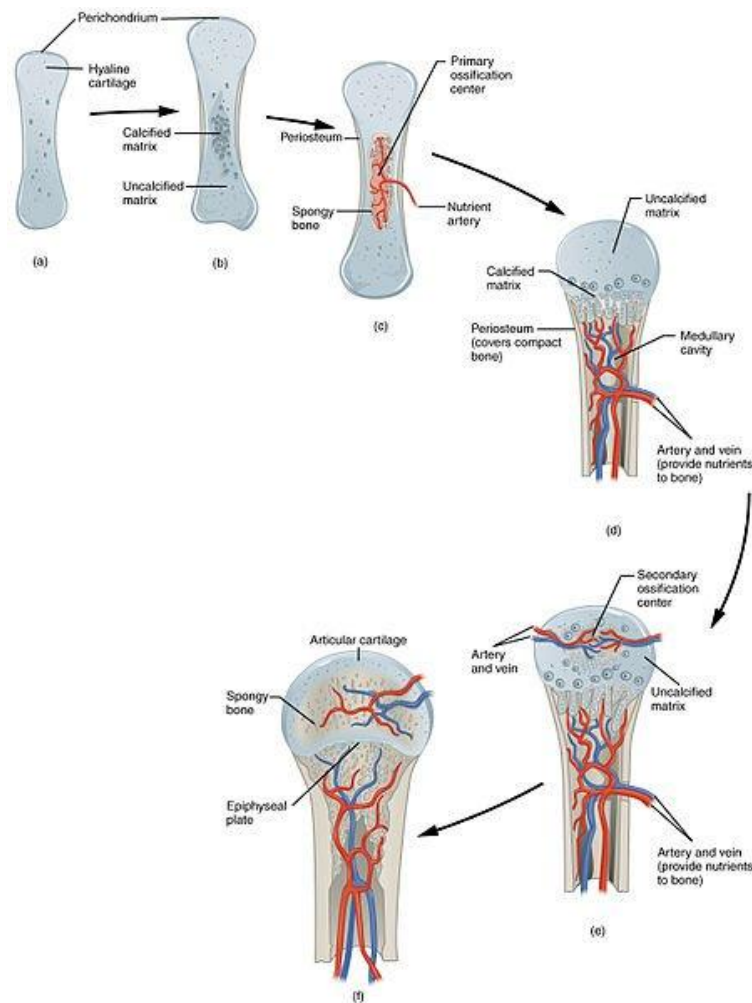


Figure 01: Endochondral Ossification

This process leads to the increment of the length of the bone. Once completed, the primary and secondary ossification centres will unite at a point referred to as an epiphyseal line. The growth of the bone is completed once the epiphyseal plate is replaced by bone.

What is Intramembranous Ossification?

Intramembranous ossification is a type of bone ossification process that doesn't involve a cartilage precursor, but the bone tissue is directly formed over the mesenchymal tissue. Intramembranous ossification is a process which leads to the formation of jaw bones, collar bones or clavicles. It is also involved in the primary formation of skull bones and occurs during the healing of bone fractures. The bone formation during intramembranous ossification is initiated by the mesenchymal cells that are present within the medullary cavity of a bone fracture. A small group of adjacent mesenchymal stem cells begin to replicate and form a small cluster of cells called a nidus. This replication process is stopped once a nidus is formed, and

development of morphological changes in the mesenchymal stem cells start to occur. The changes include the cell body becoming larger and the increment of the amount of [rough endoplasmic reticulum](#) and [Golgi apparatus](#). These developed cells are known as osteoprogenitor cells. The osteoprogenitor cells undergo different morphological changes to become osteoblasts. An extracellular matrix is formed by osteoblasts which contain osteoid, a [type 1 collagen](#). Osteocytes are formed by the incorporation of osteoblasts within the osteoid. The bone tissue and bone spicules are developed due to the mineralization process. Due to the increase in secretion of the osteoid, the size of spicules is increased, which leads to the formation of trabeculae due to the fusion of spicules with each other. As the growth continues, the trabeculae get interconnected and form woven bones. The periosteum is formed around the trabeculae; this leads to the origination of osteogenic cells which forms the bone collar. Finally, the lamellae bone replaces the woven bone.

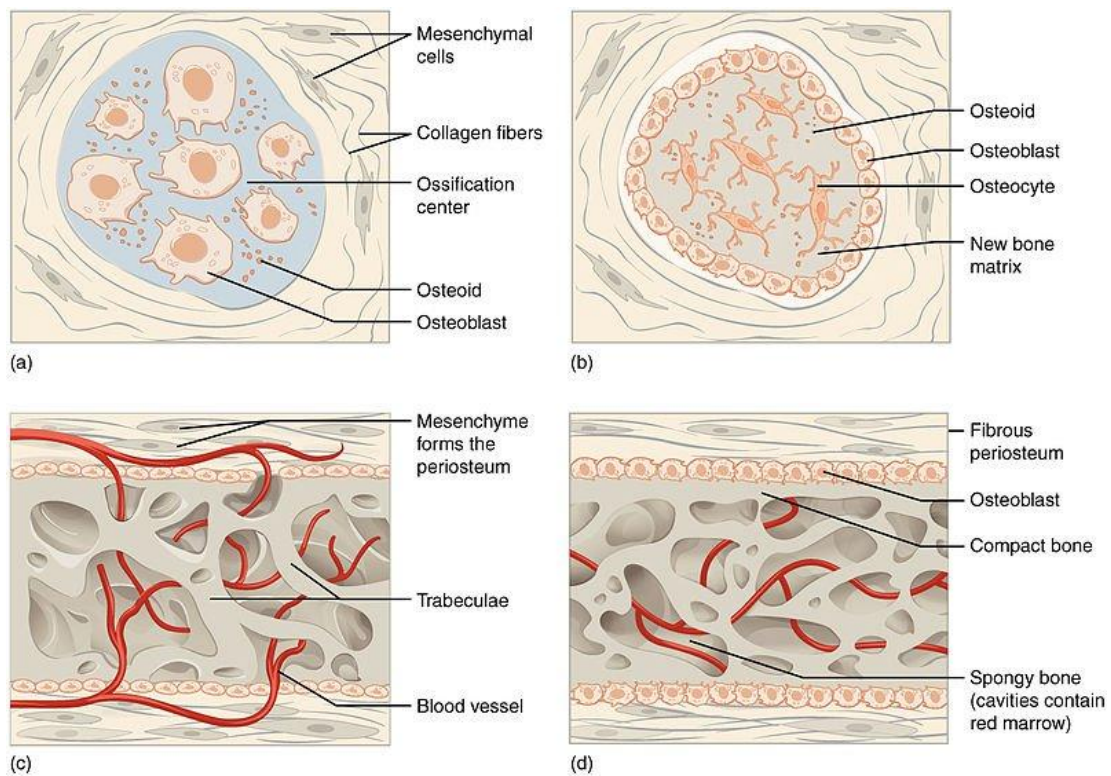


Figure 02: Intramembranous Ossification

What is the similarity between Endochondral Ossification and Intramembranous Ossification?

- Both processes are involved in the formation of bone tissue and healing of bone fractures.

What is the difference between Endochondral Ossification and Intramembranous Ossification?

Endochondral Ossification vs Intramembranous Ossification

Endochondral ossification is an essential process for the formation of long bones (femur) and flat and irregular bones such as ribs and vertebrae.

Intramembranous ossification is a process which leads to the formation of jaw bones, collar bones or clavicles without the involvement of a cartilage precursor.

Precursor

During endochondral ossification, cartilage is utilized as a precursor for bone formation.

No cartilage is used as a precursor during the formation of bone, but the bone tissue is directly formed over the mesenchymal tissue in intramembranous ossification.

Fracture Healing

In the context of fractures, the healing process with the use of plaster of Paris occurs through endochondral ossification.

The fractures which are treated by open reduction and internal fixation get healed by intramembranous ossification.

Summary – Endochondral Ossification vs Intramembranous Ossification

Osteogenesis is a process by which new layers of bone tissues are laid by osteoblasts. A normal bone ossification process can be of two different types; endochondral ossification and intramembranous ossification. During endochondral ossification, cartilage is utilized as a precursor for bone formation. In intramembranous ossification, the bone tissue is directly laid on a primitive connective tissue referred to as mesenchyma without the involvement of an intermediate cartilage. This is the difference between endochondral ossification and intramembranous ossification.

Reference:

1. Boundless. "Bone Development – Boundless Open Textbook." Boundless, Boundless, 26 May 2016, [Available here](#). Accessed 7 Sept. 2017.
2. Mackie, E J, et al. "Endochondral ossification: how cartilage is converted into bone in the developing skeleton." The international journal of biochemistry & cell biology., U.S. National Library of Medicine, [Available here](#). Accessed 7 Sept. 2017

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