



EMBRYOLOGY OF CARTILAGE

DR. DEL ROSARIO-PAJO | 09/04/2026

OUTLINE

- I. Embryology of Cartilage
 - A. Endochondral Ossification

SUMMARY OF ABBREVIATIONS

ABBREV	Meaning
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LEGENDS

Must know	Lecturer	Book	Presentation	Old Trans
!	👤	📖	💻	📝

LEARNING OBJECTIVES

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

- ✓ Identify the areas and/or cells of origin of the cartilage
- ✓ Explain the processes involved in the development of cartilage

EMBRYOLOGY OF CARTILAGE

Mesenchyme

- 🧑‍🔬 The cartilage originates from the **Mesenchyme**.
- 🧑‍🔬 It is an embryonic connective tissue meaning it can differentiate into almost any cell type.
- Condense and differentiate into **chondrocytes**.
- 🧑‍🔬 The mesenchymal cells condense and eventually differentiate into chondrocytes, then cartilage. (Describing Figure 2).

HYALINE CARTILAGE MODELS

- 6th week of development.
- 🧑‍🔬 The first sign is the formation of hyaline cartilage.
- 🧑‍🔬 This is also the future bone which serves as the scaffolding.

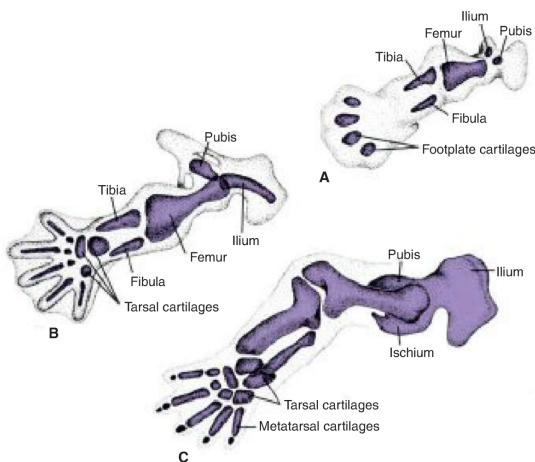


Figure 1. A. Lower extremity of an early 6—week embryo, illustrating the first hyaline cartilage models. B,C. Complete set of cartilage models at the end of the sixth week and the beginning of the eighth week, respectively.

INTERZONE

- Joints from cartilaginous condensations during arrest in chondrogenesis.
- Region between **two chondrifying bone primordia**.
- Increase in **cell number** and **density**.
- Formation of **joint cavity** by cell death (apoptosis).
- Joint capsule
 - 🧑‍🔬 Cells that did not undergo apoptosis will be the joint capsule.

ENDOCHONDRAL OSSIFICATION

Endochondral Ossification

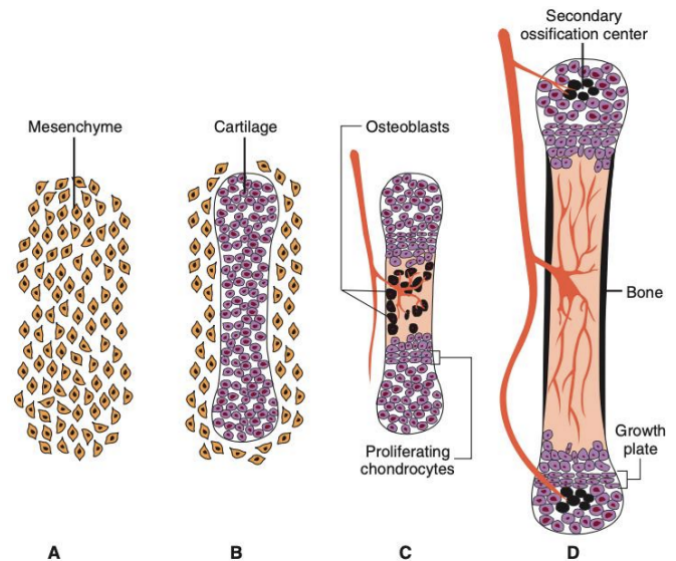


Figure 2. Stages of Endochondral Ossification.

(A) Condensation of embryonic mesenchyme at the site of future bone development. (B) Differentiation of mesenchymal cells into chondrocytes to form a hyaline cartilage model. (C) Formation of the primary ossification center within the diaphysis is marked by vascular invasion, differentiation of osteoblasts, and elongation via proliferating chondrocytes. (D) Maturation into true bone tissue following the establishment of secondary ossification centers within the epiphyses, retaining a functional growth plate (epiphyseal plate) for continued longitudinal growth.

- 🧑‍🔬 During the formation of the bones, there is ossification
- The end of the embryonic period
 - Ossification of the bones of the extremities
 - 🧑‍🔬 Ibigsabihin, tumitigas yung bone. For example, the bones of our extremities start as hyaline cartilage model, and eventually they become bones through ossification
- Primary ossification centers:
 - **12th week** of development
 - 🧑‍🔬 Where can you find the primary ossification centers? All the long bones of our body
 - **Diaphysis** – primary center (shaft)
 - **Gradual** progression towards the ends of models
 - Long bones extend on both ends
 - At birth, our bones are almost completely ossified, but at different rates. Hindi sabay-sabay. Kapag

nago-ossify, it extends outward, and you can see the shaft of the bone (center) hardened.

- Completely **ossified** at birth
- **Epiphysis**
 - Still **cartilaginous** at birth
 - 🧑 Letter D in the diagram above shows an ossified center; however, both ends remain cartilaginous at birth
 - 🧑 The area between the diaphyseal and epiphyseal ossification centers. Doon makikita yung epiphyseal plate.
 - 🧑 Ano naman significance kung cartilaginous yung epiphysis? Nagkakaron ng additional ossification centers, which can be found sa epiphyseal plate
 - 🧑 Habang may cartilaginous areas, humahaba pa yung bone. Hindi pa ossified yung bone, so humahaba pa yung bone
 - Case in point, sa long bones na'tin ossification proceeds on both sides kaya nage-elongate siya.
- **Epiphyseal Plate**
 - between the **diaphyseal and epiphyseal** ossification centers
 - **Lengthening** of bones
 - Endochondral ossification proceeds on both sides
- Full length: plates **disappear**
 - 🧑 When the bones finally reach their full length, the epiphyseal plates disappear, and growth stops
- **LONG BONES**
 - Epiphyseal plate on **each** extremity
 - 🧑 Both sides have an epiphyseal plate
- **SMALL BONES**: phalanges
 - Epiphyseal plate at **one** extremity
- **IRREGULAR BONES**: vertebrae
 - One or more **primary** center/s and several **secondary** centers

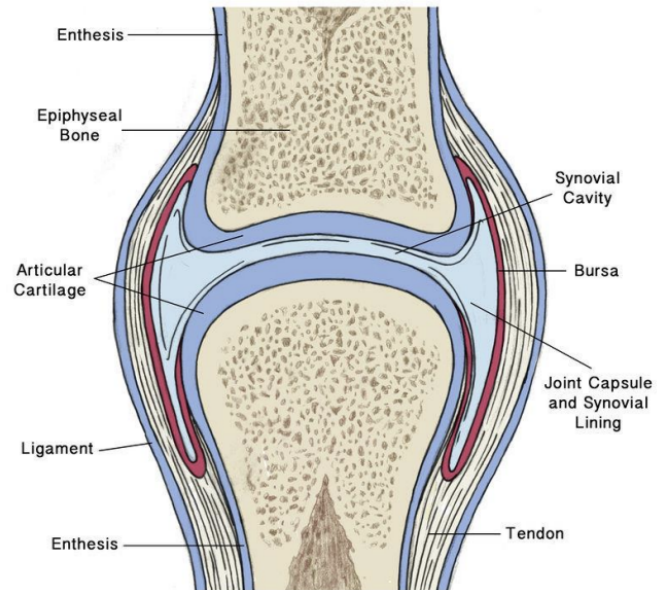


Figure 3. Structure of Synovial Joint

Synovial Joints

- These joints form at the **same time** as mesenchymal condensations to form the hyaline cartilage models
 - 🧑 Sabay nagde-develop
- Eventually, a dense fibrous tissue called the **articular cartilage** will be formed
 - Saan ba mahahanap? **Interzone**, the area between two chondrifying bone primordia
 - Covers the ends of **two adjacent articular bones**
 - Covering the **synovial membranes**
 - **Menisci and ligaments** within the joint capsule