

Cartilage

Basic characteristics

Cartilage is a type of a supporting connective tissue. It is **avascular, firm** and **elastic. White** or **yellowish** solid mass. It is characterized by a high concentration of glycosaminoglycans (GAGs) and proteoglycans. During embryonic and fetal development it becomes the basis for skeletal development. It diminishes with increasing age. It covers the articular surfaces of most joints. It forms the cartilaginous skeleton of many organs.

- It's made up of:
 1. **Chondrocytes** (unlike connective tissue, it does not contain any other cell types)
 2. **Base matter (intercellular mass)**
 1. Fibrous component - determines strength and flexibility
 2. Amorphous component - utilized in nutrition
- Cartilage is categorized into three types according to the composition of the underlying mass:
 1. Hyaline
 2. Elastic
 3. Fibrous

Cartilage growth

Cartilage develops from the mesenchyme. The cells produce ECM by which they envelope, move further apart and remain embedded in the lacunae. Cartilage growth occurs in two ways:

- **Appositional growth** = a system of regrowth of new cartilage from the inner layer of the perichondrium, which contains progenitor cells.
- **Interstitial growth** = mitotic division of cartilage cells (proliferation).

In articular cartilage, the cells and intercellular mass must be replaced from the inside because appositional growth does not occur due to the absence of perichondrium on the surface. The regenerative capacity of cartilage is low, partly due to the fact that it is avascular and therefore with little metabolic activity. Regeneration is incomplete and often a scar of dense collagenous connective tissue forms.

Cartilage growth is indirectly influenced by the growth hormone somatotropin. It promotes the production of **somatomedins**, which then directly stimulate the hyaline cartilage cells to grow.

Hyaline cartilage

- very difficult regeneration - there is no vascular system

Hyaline cartilage is the most common type of cartilage. It has a semi-transparent, glassy appearance and contains chondroitin sulfate A and C. Chondromucoprotein masks collagen fibres and fibrils.

The surface of the cartilage is covered by the **perichondrium**, which is highly vascularised and which therefore nourishes the cartilage - except for **articular cartilage**, which has no perichondrium and is nourished by synovial fluid.

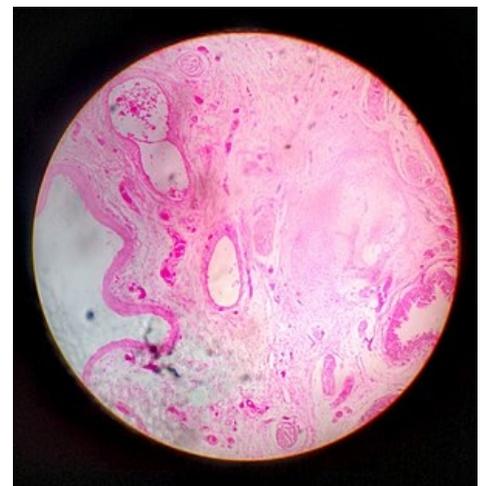
- **location:** nasal cartilages, laryngeal skelet, bronchi, trachea, suspension of ribs on sternum, **articular cartilages, growth cartilages in long bones.**

Chondrocytes

They are oval cells with a small spherical nucleus and light cytoplasm (rich in glycogen inclusions and fat droplets). Under the perichondrium are spindle-shaped which changes to a spherical shape **towards the interior** of the cartilage.

In the intercellular mass they are contained in the so-called **lacunae**, around which there is a basophilic sheath called the territorial matrix (basophilia conditioned by the increased occurrence of proteoglycans). Chondrocytes form **isogenetic groups** (in regions called territories or chondrons) or are deposited singly. Isogenetic groups are formed by mitotic division of the parental chondrocyte. **Minimal proliferative activity** is characteristic, and this cell type rarely divides. They are incapable of regeneration and proliferation.

Intercellular mass



Human hyaline cartilage tissue

The extracellular matrix of cartilage consists of **type II collagen** (collagen fibrils - not visible on the slide, masked by amorphous material), proteoglycans and multiadhesive glycoproteins. The most abundant proteoglycan is **aggrecan**, while **chondronectin** is an important glycoprotein. Most of the mass (40-60%) of cartilage consists of water bound to the GAG of proteoglycans.

Perichondrium

The connective tissue sheath forming the cartilage sheath that separates the cartilage from the surrounding tissues. It provides nourishment to the cartilage as it contains blood vessels and also small nerves. Strengthens cartilage and prevents excessive bending.

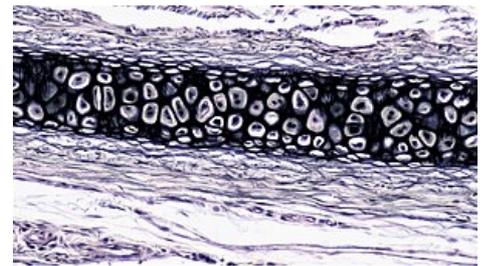
- it consists of 2 components:
 - **external** = *dense irregular collagenous connective tissue*; strengthens cartilage; prevents cracking when bending;
 - **internal** = *loose collagenous connective tissue* rich in blood vessels; contains **progenitor cells**; nourishes cartilage.

Elastic cartilage

It is composed of **collagen fibrils (type II collagen)** and a **net of elastic fibres**, which give it a yellowish colour and ensure flexibility and elasticity. It contains numerous chondrocytes, which are evenly dispersed but form **small isogenetic groups** (2 to 3 chondrocytes each).

Staining with Weigert's resorcin-fuchsin, orcein, aldehyde fuchsin - on the slide we see a fibrous component that forms networks around the chondrocytes.

- **location:** ear lobe, Eustachian tube (only partially), epiglottis - laryngeal flap, small laryngeal cartilages, nasal septum

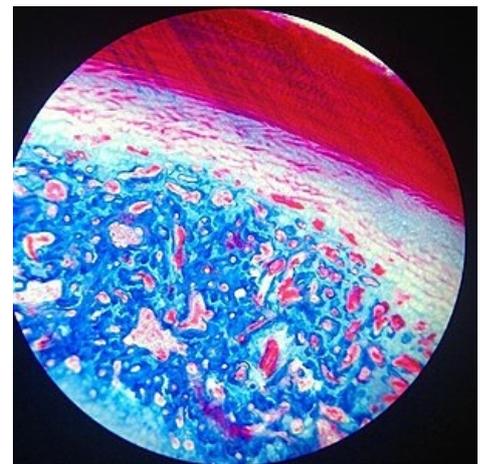


Elastic Cartilage

Fibrocartilage

It represents the transition between **dense irregular collagen connective tissue** and **cartilage**, in which the fibrous component predominates. It consists of **thick collagen fibres (type I collagen)**. It contains few chondrocytes, which are isolated, i.e. do not form isogenetic groups. There is little amorphous material around the chondrocytes, therefore, due to the lower presence of proteoglycans, fibrous cartilage is **more eosinophilic** than the previous two types of cartilage.

- **location:** intervertebral discs, symphysis pubis, some ligaments in temporomandibular joint, disci et menisci articulares.



Fibrocartilage tissue

Links

Related articles

- Bone
- Tissue
- Ossification
- Chondrocyte

External links

- Chrupavka (česká wikipedie)
- Cartilage (wikipedia)

Used literature

- KLIKA, Eduard. *Histologie pro stomatologu*. 1. edition. Avicenum, 1988. 448 pp.

Recommended literature

- JUNQUEIRA, L. Carlos - CARNEIRO, José - KELLEY, Robert O. *Základy histologie*. 1. v ČR edition. H & H, 1997. 502 pp. ISBN 80-85787-37-7.