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# CARTILAGE

Cartilage is a supportive tissue with firm ECM. The consistency of the tissue is hard, but bending.

In the adult this tissue is normally avascular, aneural and alymphatic.

It exists in the form of pieces of varied shape covered by the perichondrium. The perichondrium supplies the piece of cartilage with nutrients and oxygen via diffusion.

Tissue components: cells (chondrocytes) ECM: fibers, ground substance Types: hyaline cartilage elastic cartilage fibrocartilage

# CARTILAGE

**<u>A. Important for:</u>** 

support of soft tissues
formation and growth of long bones
durability of articular joints

**B.** Consists of an extracellular matrix (ground substance) containing,

chondroblasts and chondrocytes (cartilage cells)
collagen and in some cases elastin fibers
glycosaminoglycans
proteoglycans\*, proteoglycan agregates
water

\*Collagen provides tensile strength and durability, however, proteoglycans are also important, e.g. if you inject papain (an enzyme that digests the protein cores of proteoglycans) into the ears of a rabbit, after a few hours the ears will loose their stiffness and droop. C. The qualities of the different types of cartilage depend on,

1. Differences in the type of collagen and concentration of collagen and elastin fibers in the extracellular matrix

2. The types of proteoglycan molecules that these fibers are associated with.

- D. Hyaline and elastic cartilage are surrounded by a connective tissue capsule called the perichondrium that is composed of fibroblasts and associated fibers and ground substance.
- E. The cartilage itself is devoid of blood vessels.

Nutrition of cells within the cartilage matrix is dependent on the diffusion of nutrients from blood capillaries in perichondrium and/or adjacent tissues.

# **Cartilage**



### **Properties of Cartilage**

(collagen Type II, elastic)

#### **Ground Substance**

(hyaluronic acid, chondroitin sulfate, keritin sulfate, 60-70% H2O)

1. Avascular

2. Permeable

(conducts nutirents and water)

- **3.** Flexible but Weight-Bearing (resistance to compression)
- 4. Elasticity and Resiliency
- **5.** Resistance to Shear Forces
- 6. Slippery

(low friction at articular joints)

7. Poor Regenerative Capacity

# **Hyaline Cartilage**

## **<u>Matrix</u>** (amorphous & glassy)

hyaluronic acid chondroitin sulfate keratin sulfate H<sub>2</sub>O (60-78%)

<u>Fibers-</u> collagenous (invisible due to same refractive index as matrix)

## **Typical Locations**

intercostals (connect ribs to the sternum)

wall of trachea & bronchii

articular cartilage of bone

epiphyseal plate

fetal axial skeleton

## **Hyaline Cartilage**



## Hyaline Cartilage (SEM)



# **Fibrocartilage**

### <u>Matrix</u>

hyaluronic acid chondroitin sulfate keratin sulfate

### **Fibers**

dense collagenous bundles

### **Typical Locations**

intervertebral discs pubic symphysis meniscus of knee joint attach tendons to bone

#### **Properties**

resistance to compression and shear forces

#### **Fibrocartilage- longitudinal section**



#### **Fibrocartilage- transverse section**



#### Fibrocartilage- SEM



# **Fibrocartilage**

Occurrence:intervertebral disksmenisci of stifle jointsmeeting of tendons and ligaments with the cartilagedog: between the atrial and ventricular heart muscles



# **Elastic Cartilage**

### **Elastic Cartilage- pinnae of ear**

### **Matrix**

hyaluronic acid chondroitin sulfate kertatin sulfate

### **Fibers** elastic (elastin)

### **Typical Locations**

external ear walls of external auditory canal and eustachian tubes epiglottis & larynx bridge of nose

## **Properties**

resiliency and pliability



## **Elastic Fibers- silver stain**



# **Elastic Fibers** (resorcin-fuchsin stain)



**Comparison of the three cartilage-types:** 

**Dominating tissue component:** Physical property:

1. Hyaline cartilage: ground substance chondrons with many cells

2. Elastic cartilage: elastic fibers chondrons with single cells

**3. Fibrocartilage:** collagen fibers very few chondrocytes

tensile strength

elasticity

great tensile strength against pulling forces



# Components of Cartilage

