Hard dental tissues

Cementum

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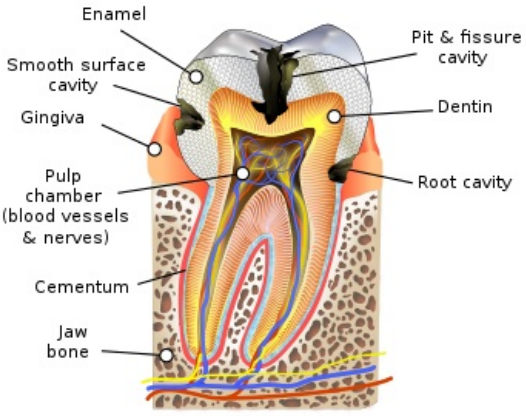
Cementum, substantia ossea , is a hard connective tissue covering the surface of the root of the tooth, which in its structure resembles fibrous-type bone. It consists of cells, cementocytes and a basic substance that contains 50% of mineral substances. The organic matter consists mainly of collagen fibers (type I and III collagen) and a small amount of interfibrillar matter.

There is a cemento-enamel border in the cervical part of the tooth. In 30% of cases, the cement adheres closely to the enamel, in 60% it slightly overlaps the enamel, and in about 10% there is a gap between the enamel and the cement where the exposed dentin is located. The cement layer thickens from the neck towards the root.

Cement has a very important property, which is the ability to respond to load. Just like bone tissue, cement can provide better mechanical resistance through resorption or tissue formation, but unlike bone tissue, it is not capable of remodeling. Another difference between cementum and bone is that cementum is an avascular tissue, nutrition takes place through the periodontium, and a non-innervated tissue.



Schematic representation of cement (blue color).

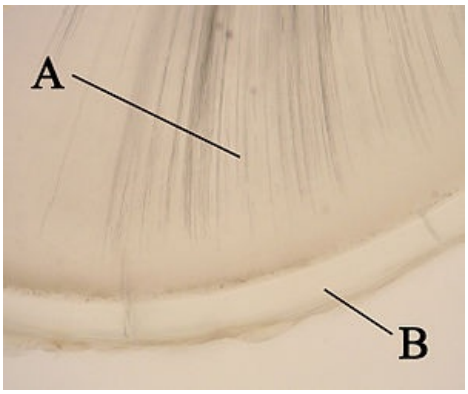
Based on the presence of cells, we distinguish **two types of cement**:

Acelular

Primary, acellular cementum forms a thin layer of mineralized matrix cementum. It is located in the upper 2/3 of the neck, during development it happened that the cementoblasts "escaped" from the extracellular matrix towards the apex, so the primary cementum is without cementocytes. So -called Sharpey fibers are embedded in it . Its thickness is around 50 µm.

Celular

Cellular, also secondary, cement consists of lamellae with cementocytes located in lacunae. Cementocytes are star-shaped cells with small, short processes. Some processes may communicate with Tomes fibers of odontoblasts. The width of the cement in the neck area is around 500 µm.



A – dentin; B – cement (acellular).

The deposition of cementum on the tooth surface is a lifelong process that occurs mainly in places of excessive load or in areas of trauma. Thus, incremental lines are created during the process, which indicate the gradual replenishment of cement.

Bundles of collagen fibers called Sharpey's fibers enter the cementum.

Sharpey's fibres

Sharpey's fibers are bundles of collagen fibers passing through the periodontal fissure.

Gingival - they attach to the free gingiva . It forms the so-called circular ligament , which we disrupt before tooth extraction. Transseptal - connect adjacent teeth in a row. When the alveolar process decreases, these fibers increase. Ridge - they come from the ridge of the alveolus to the cervical region of the cementum . It acts against tensile forces . Horizontal - support previous threads. Obliques - capture the main part of the occlusal load on the tooth. It acts against pressure forces . Apical - lead from the apex of the tooth to the bottom of the tooth bed. This arrangement is called a functional arrangement .

Dentinum

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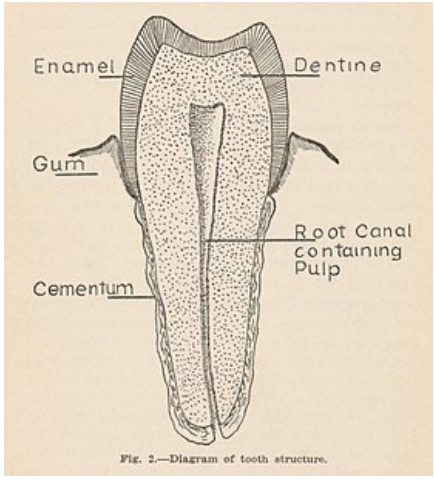
Dentin is a mineralized connective tissue similar to bone. It is the basis of the entire tooth - i.e. the crown, neck and root. Originating from the mesenchyme. It is not vascularized and contains no cells with the exception of odontoblasts, which are located at the dentin-pulp interface. However, due to the higher degree of mineralization, it is slightly harder. The basic mass consists of type I collagen fibrils, glycosaminoglycans and calcium salts such as hydroxyapatite. The basic morphological feature of dentin is **dentinal tubules arranged in parallel** across the entire thickness of dentin.



General tooth structure.

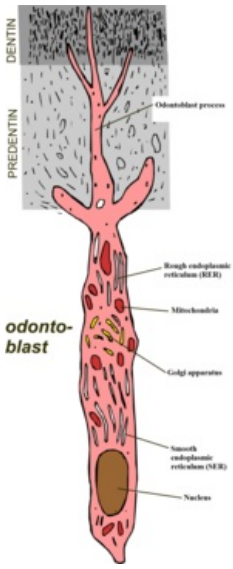
Components

Dentin consists of a cellular component and an extracellular matrix.

Cellular component

Dentin cells are so-called ***odontoblasts***. Odontoblasts are specialized cells unable to divide or renew themselves. They produce predentin = unmineralized matrix: collagen fibrils (->fibers in dentin) + amorphous mass. Predentin gradually mineralizes with the produced hydroxyapatite. In the area of occlusion or incision, the odontoblasts are tall and flatten in the apical direction. Odnotoblasts consist of a body and a process. The body of the odontoblast is richly equipped with endoplasmic reticulum, Golgi apparatus, ribosomes and mitochondria. An excess amount of these organelles contains dentin due to the formation of ECM.

One long, slender, branched ***odontoblastic process****/Tomes fibre/apical process* extends from the odontoblast towards the dentin. Tomes fibers run through the dentin to the dentino-enamel/dentino-cementum boundary in the so-called ***dentinal tubules*** together with the ***tubular fluid.*** Both the processes and the fluid ensure the perception of pain in the dentin and the metabolism.



Schematic drawing of the odontoblast.

Tomes' fibre

Tomes' fiber is a long process from the apical pole of the odontoblast. It contains microtubules, microfilaments, mitochondria, microvesicles and, conversely, lacks ribosomes and endoplasmic reticulum. At the junction between enamel and dentin, it branches into several terminal branches that can extend into the enamel. These fibers run in canals- ***canaliculi dentis***.

Extracelular matrix

The extracellular matrix contains a fibrous (fibrillar) and amorphous component. **The fibrous component** is represented in the form of collagen I. **The amorphous component** consists of organic and inorganic compounds. Inorganic compounds are mainly represented by hydroxyapatite and other minerals that are present in enamel, but to a lesser extent. Hydroxapatite crystals reach smaller dimensions than in the case of enamel, namely 20 nm in length and 3.5 nm in width (??). The crystals are not oriented and can be stacked with different densities depending on the type of dentin.

Next, the inorganic components are replaced with water.

Fibrous component	Hydroxyapatite and other minerals	Water
30%	45%	25%

Structure

Dentin is a calcified fibrous connective tissue. It is penetrated by so-called dentinal tubules. The cross-section of the tubules is circular. Their course is ace-shaped in the crown part and straight in the root part. The width of the tubules on the pulpal side reaches 4–5 µm and occupies up to 80% of the pulpal surface. In the area of the denite-enamel border, the tubules have a width of approx. 1µm. As a result of the diverging course of the tubules and the smaller cross-section in the area of the dentino-vitreous border, the tubules occupy a significantly smaller part of the area at the dentino-vitreous border than on the pulpal side. The tubules are filled with projections of odontoblasts - *Tommes fibers*. The protrusions are surrounded by intertubular fluid, the movement of which, according to Bronstrem's theory (??), causes pain. During their course, the projections anastomose with neighboring projections. The wall of the tubule is separated from the protrusion of the odontoblast and the intratubular fluid by the so-called *membrana limitans*. A nerve fiber may run between the membrana

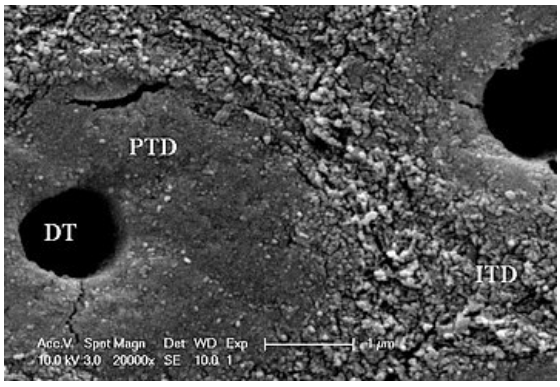


Photo from SEM. DT - dentin tubules; PTD - peritubular dentin; ITD - intertubular dentin.

limitans and the wall of the tubule. Nerve fibers enter only 20% of the dentinal tubules. A vessel never passes through the dentinal tubule. *Peritubular dentin* surrounds the dentinal tubules. This type of dentin is homogeneous and the most mineralized of all types. *Intertubular dentin* is found between the tubules. It is less mineralized and about 50% is made up of collagen fibers. *Intratubular dentin* (sclerotic dentin) is the mineralized content of the dentine tubule as a result of a pathological process. It is caused by external noxious effects - chronic caries (in the case of acute caries, there is no time for its development)(?), abrasion, unsparing preparation. As a result of external noxia, degeneration of odontoblasts and deposition of calcium compounds occurs. This dentin is more transparent due to sclerotization.

Layers (types) of dentin

Predentin

Predentin is newly formed and not yet mineralized dentin. It contains phosphate and calcium granules, which gradually give rise to crystallization centers. It consists of collagen fibers and non-calcified ECM. It reaches a width of 5–20 µm.

Circumpulpal dentin

Circumpulpal dentin is otherwise called *von Ebner's*. Collagen fibers run obliquely to perpendicular to the course of the tubules. The mineralization has a *globular character*. In this part of the dentin, the dentinal tubules do not branch.

Interglobular dentin

It is a narrow line of less mineralized dentin at the interface of circumpulpal and mantle dentin. Mineralization of the globular zones did not take place during development.

Mantle dentin

The collagen fibers contained in this layer of dentin are called *Korff's fibers*. They run ace-shaped and almost parallel to the dentinal tubules. This layer of dentin is characterized by variable mineralization, because mineralization occurs here discontinuously - odnotoblasts create vesicles that bind calcium and phosphorus. For this reason, we can observe the following lines on the mantle dentin:

- Ebner's lines – hypomineralized sections running perpendicular to the course of the dentinal tubules. They arise physiologically.
- Owen's lines – hypomineralized sections of a larger scale, arising pathologically as a result of childhood diseases.
- Neonatal line – hypomineralized line (??) separating the temporary tooth prenatally and postnatally forming dentin.

The mantle dentin reaches a width of 80-100 µm

Types of dentin

Primary

It is formed until the development of the external shape of the tooth is completed - a physiological process.

Secondary

It is formed after the end of tooth development throughout life - a physiological process. During life, it leads to a reduction of the medullary cavity.

Tertiary

It is formed as a result of external noxious action - a pathological process.

Types of dentin

The dentin canals do not point directly to the dentino-vitreous border, but in an ace shape, in such a way that the first convexity always points towards the apex of the root. Collagen fibers form a network around these dentinal tubules.

- **Peritubular dentin** is more mineralized than **intertubular dentin**. Rhe interface between them is **Neumann's sheath**, which looks like a membrane on stained histological slides.
- **Circumpulpal dentin** is otherwise called *von Ebner's*. It is formed by light **collagen fibers**, that cross the dentinal tubules at right angles. In this part of the dentin, the dentinal tubules do not branch.
- **The mantle dentin** is otherwise called *von Korff's*. It consists of coarse collagen fibers that are arranged radially. In this part of the dentin, the dentinal tubules branch.

Enamelum

__Enamelum

Odkazy

Související články

- Cementum
- Dentinum
- Enamelum
- Zuby

Použitá literatura

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Kategorie:Zubní lékařství Kategorie:Preklinické zubní lékařství