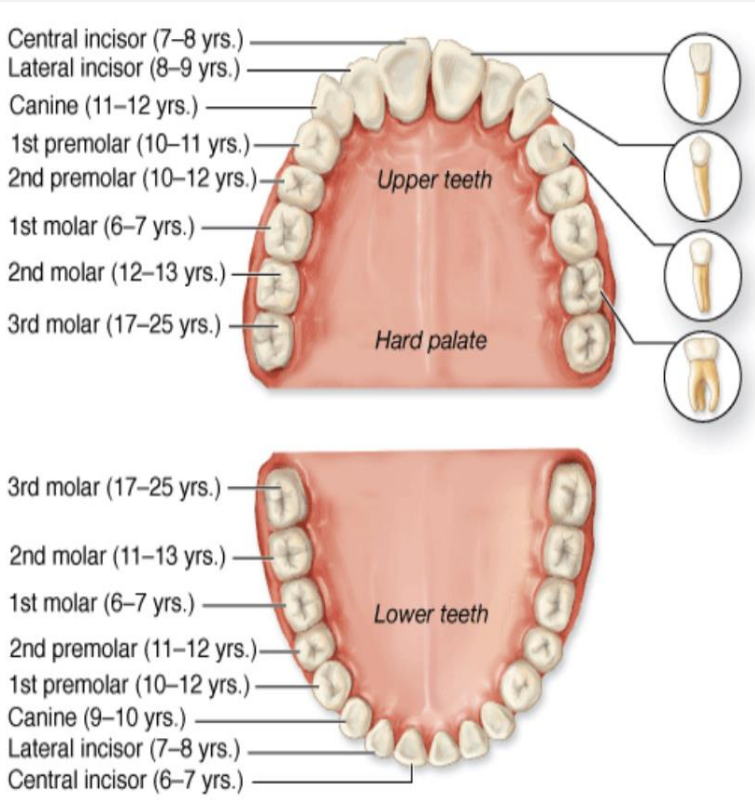
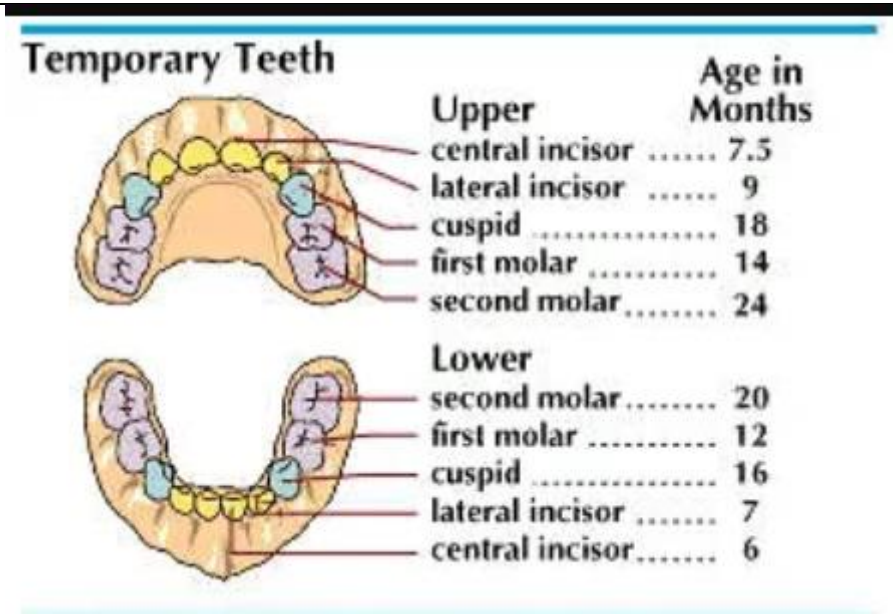
**Topic 6.** Structure of baby and permanent teeth.

<table>
<tr><th colspan="4">Permanent (secondary, adult) teeth</th></tr>
<tr><th colspan="2">Type</th><th>Number and location</th><th>Picture</th></tr>
<tr><td>1.</td><td>Incisors</td><td>1) Central and lateral of maxilla and mandibula (upper and lower jaw).<br>2) 2 central incisors and 2 lateral incisors of maxilla<br>3) 2 central incisors and 2 lateral incisors of mandibula</td><td rowspan="4"> 

Mescher.: Junqueira's Basic Histology, Text and Atlas, Fourteenth Edition, McGraw-Hill Education – Europe, 2015</td></tr>
<tr><td>2.</td><td>Canine</td><td>2 canine of maxilla and mandibula</td></tr>
<tr><td>3.</td><td>Premolars</td><td>1) two 1st premolars and two 2nd premolars of maxilla<br>2) two 1st premolars and two 2nd premolars of mandibula</td></tr>
<tr><td>4.</td><td>Permanent molars</td><td>1) two 1st molars, two 2nd molars and 3rd molars of maxilla<br>2) two 1st molars, two 2nd molars and 3rd molars of mandibula</td></tr>
</table>

| Primary (baby) teeth | | | Picture |
|---|---|---|---|
| **Type** | | **Number and location** |  |
| 1. | **Incisors** | 1) Central and lateral of maxilla and mandibula (upper and lower jaw).<br>2) 2 central **incisors** and 2 lateral **incisors** of maxilla<br>3) 2 central **incisors** and 2 lateral **incisors** of mandibula | |
| 2. | **Canine (cuspid)** | 2 **canine** of maxilla and mandibula | |
| 3. | **Molars** | 1) two 1st **molars and** two 2nd **molars** of maxilla<br>2) two 1st **molars and** two 2nd **molars** of mandibula | https://kids.britannica.com/students/assembly/view/54068 |

| Anatomical structure of the tooth | | |
|---|---|---|
| **Parts** | | **Features** |
| 1. | **Crown** | Part of tooth which is exposed above the gingiva. |
| 2. | **Neck (cervix)** | Part of tooth which is situated between the root and crown and is constricted at the gum. It is the junction between the crown and root. |
| 3. | **Roots** | Part of tooth which is situated below the gingiva and that hold the teeth in bony sockets called alveoli.<br>It has apical foramen (small opening where nerves and blood vessels enter and exit the dental pulp). |

| Histological structure of the tooth | | | |
|---|---|---|---|
| **Parts** | | **Features** | **Content of mineral and organic substances** |
| 1. | **Enamel** | 1) It is situated in the **crown** of the tooth.<br>2) The region where the enamel and cementum meet is called the cementoenamel junction (CEJ).<br>3) Structural unit **- enamel rod (prism)** | 1) **Minerals** – 96-98% calcium hydroxyapatite, fluoride.<br>2) **Organic substances** – 1% proteins, amelogenin and enamelin, but no collagen<br>3) 3% water |
| 2. | **Dentin** | 1) It is situated in the **crown and root** of the tooth.<br>2) Structural unit - **dentinal tubule** which includes odontoblastic processes.<br>3) It includes **dentinal tubule**, **odontoblastic processes** and **dentinal matrix**.<br>4) Each dentinal tubule contains an odontoblastic process about halfway toward the dentinoenamel junction; the rest of the space is filled with fluid. | 1) **Minerals** – 70% calcium hydroxyapatite<br>2) **Organic substances** – 20% type I collagen fibers and glycosaminoglycans<br>3) 10% water |
| 3. | **Pulp** | 1) It is situated in the **the central core and root canals of the tooth**.<br>2) Loose connective tissue.<br>3) It is a highly innervated and vascularized tissue (venules and capillaries).<br>4) Some nerve fibers lose their myelin sheaths and extend into the dentinal tubules. | 1) **Organic substances** – **bodies of odontoblasts** there are in the peripheral zone of the pulp, fibroblasts, macrophages, lymphocytes, ground substance, reticular fibers and other fine I, III collagen fibers, fibronectin and elastin. |
| 4. | **Cementum** | 1) It covers **root** of the tooth from the **cervix to the apex of root**.<br>2) **Cellular cementum** includes cementocytes. It is often found at the apical third of the tooth | 1) **Minerals** – 65% calcium hydroxyapatite<br>2) **Organic substances** – 23% collagen fibers, Sharpey fibers and ground |

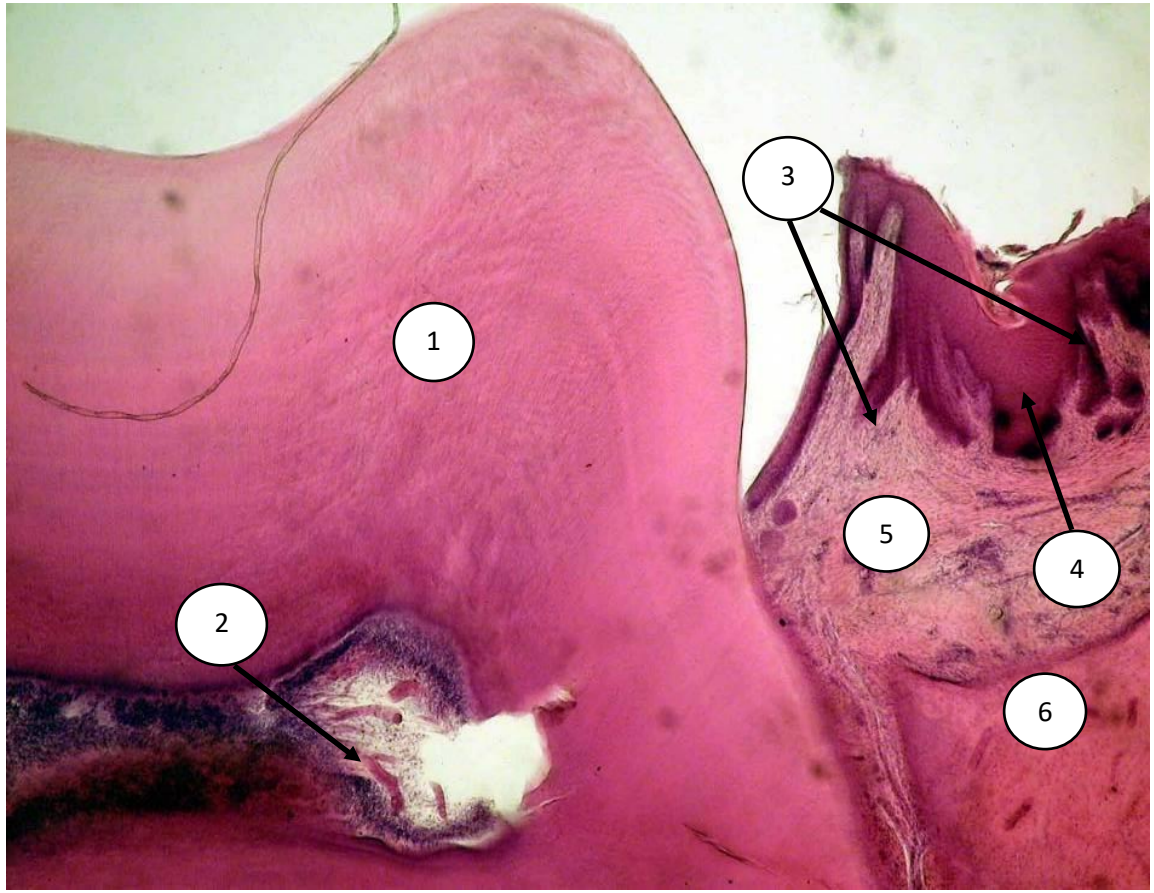
| | | | |
|---|---|---|---|
| | | root and is similar to bone with a calcified intercellular matrix.<br>3) **Acellular cementum** includes collagen fibers and does not cells. It is often found at the cervical two thirds of the root. | substance, cementocytes.<br>3) 12% water |

| **Lines and defects of enamel** | | |
|---|---|---|
| **Types** | | **Features** |
| 1. | **Striae of Retzius (incremental growth lines)** | Bands or longitudinal sections (arcs) of the mature enamel. These patterns reflect the changes in enamel secretory rhythm. |
| 2. | **Enamel tufts** | are hypomineralized areas filled with organic material from the dentinoenamel junction to the surface. |
| 3. | **Enamel lamellae** | are hypomineralized, thin, sheetlike defects that can run through the entire enamel and are commonly caused by cracks. |
| 4. | **Enamel spindles** | are thin, needlelike lines extending from the dentinoenamel junction to the enamel and includes odontoblast processes which trapped in the enamel during early amelogenesis. |

| **Classification of dentin for localizatin** | | |
|---|---|---|
| **Types** | | **Features** |
| 1. | **Peritubular dentin** | It is situated inside of dentinal tubule and is highly calcified. |
| 2. | **Intertubular dentin** | It is dentinal matrix which is situated between the dentinal tubules and is less mineralized than the peritubular dentin. |

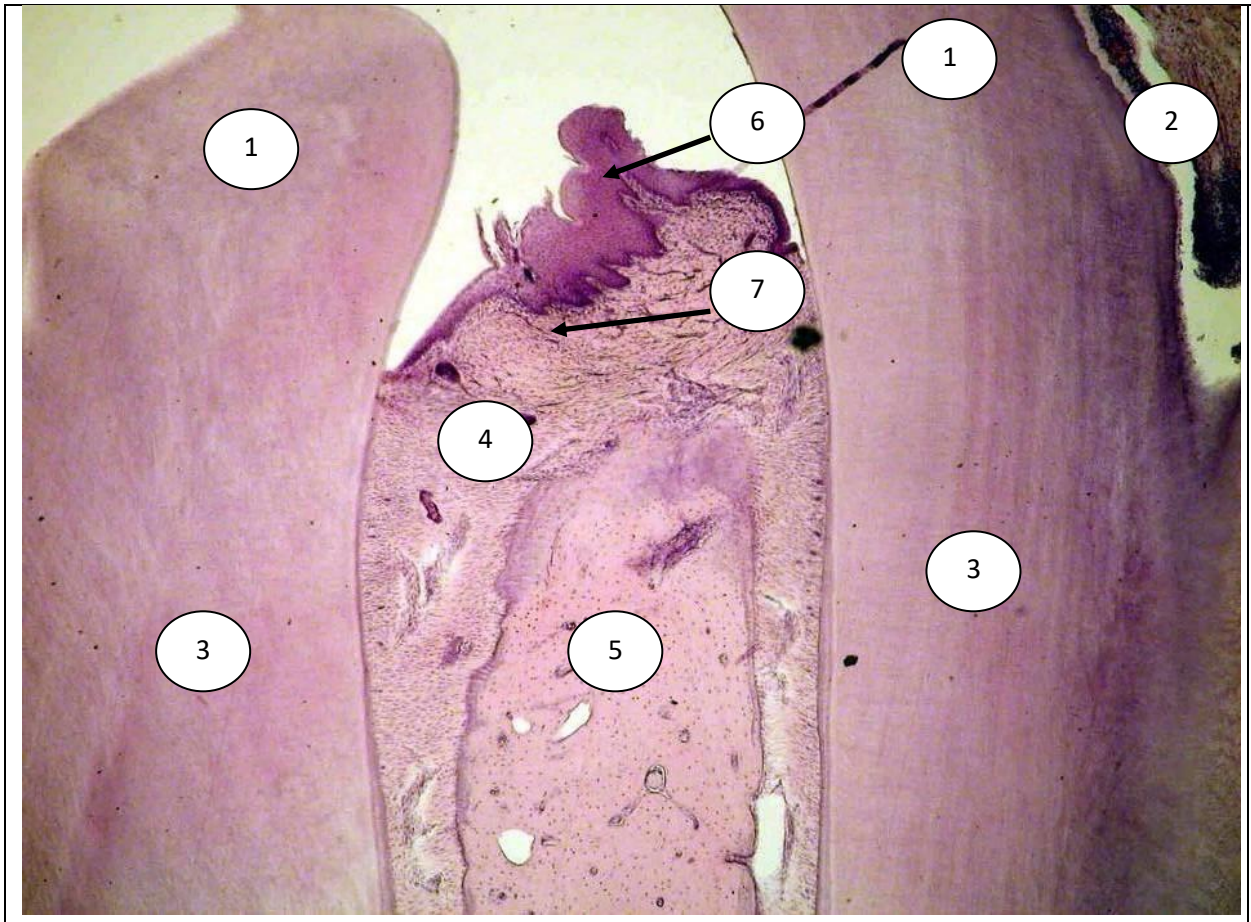
| Classification of dentin for histogenesis | | |
|---|---|---|
| **Types** | | **Features** |
| 1. | **Primary dentin** | It is deposited before the formation of the tooth root and tooth eruption have been completed, includes mantle dentin (at the dentinoenamel junction) and circumpulpal dentin. |
| 2. | **Secondary dentin** | It is produced after tooth eruption and root formation have been completed, is deposited very slowly and is located beneath the primary dentin. |
| 3. | **Tertiary (reparative) dentin** | It is produced in response to injures (caries, drilling, or attrition).<br>It is produced only by the odontoblasts that are directly stimulated when the tooth is injured. It has few, mostly irregular, dentin tubules. |

| Parts of palp | | |
|---|---|---|
| **Parts** | | **Features** |
| 1. | **Odontoblast layer** | It is peripheral layer of the pulp which includes bodies of **odontoblasts.** |
| 2. | **Cell-free zone (zone of Weil)** | It is directly under the odontoblast layer. It has fibers, cellular processes, axons, and capillaries running through it but contains no cell nuclei. |
| 3. | **Cell-rich zone** | It is beneath the cell-free zone, and has many cells and nuclei of cells densely packed in rows. It has fibroblasts, undifferentiated mesenchymal cells, neural plexuses, and capillaries.<br>Mesenchymal cells in this layer can differentiate into new odontoblasts. |
| 4. | **Pulp proper (pulp core)** | It contains blood vessels and nerves within the loose connective tissue |



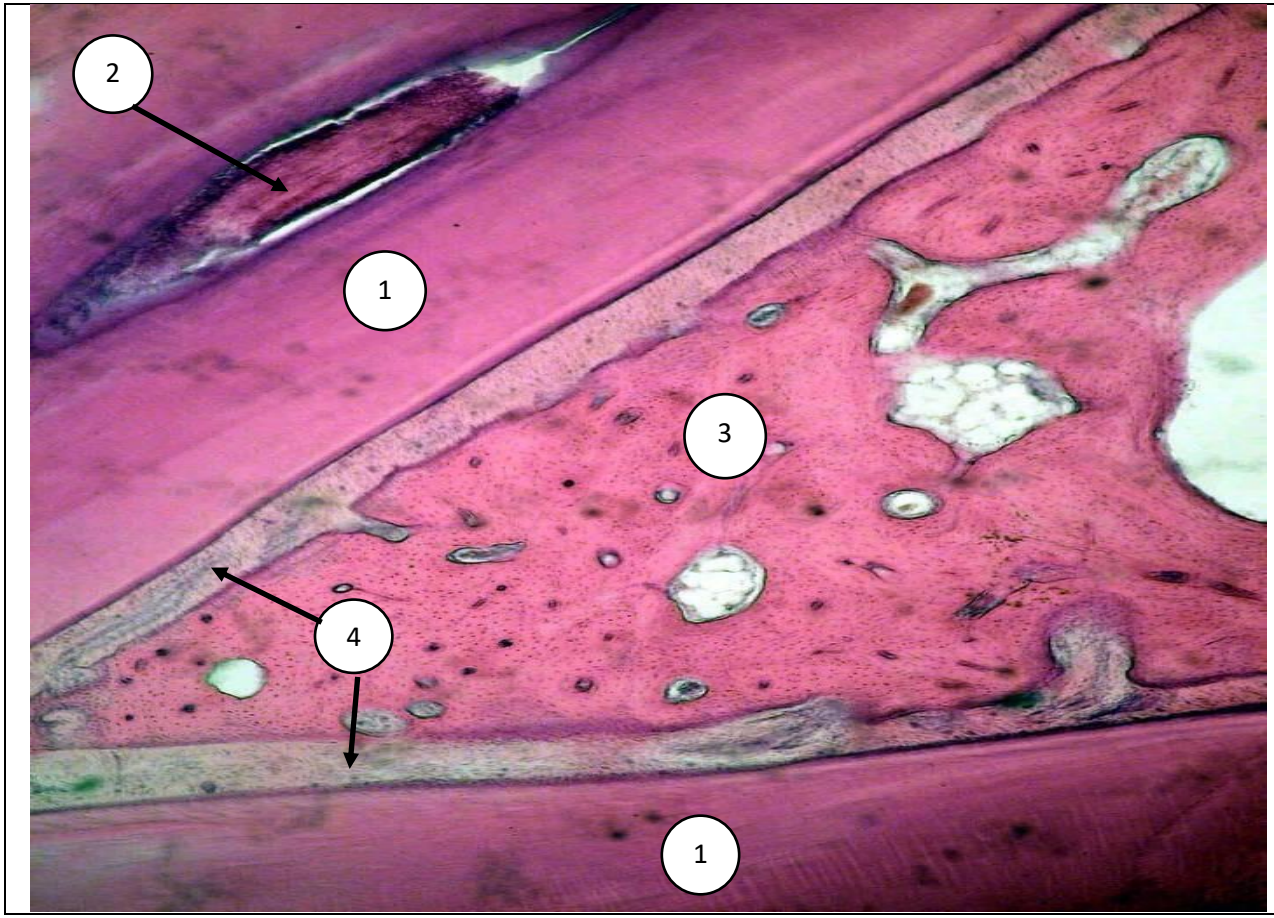

**Section of the tooth**
**Magnification X 40, hematoxylin-eosin staining.**

On the preparation of the tooth cross section you can see the crown of the tooth (1), the pulp cavity (2). Laterally from the crown there are gums (3) and alveolar process (6). The gums consist of epithelium (4) and lamina propria (5).



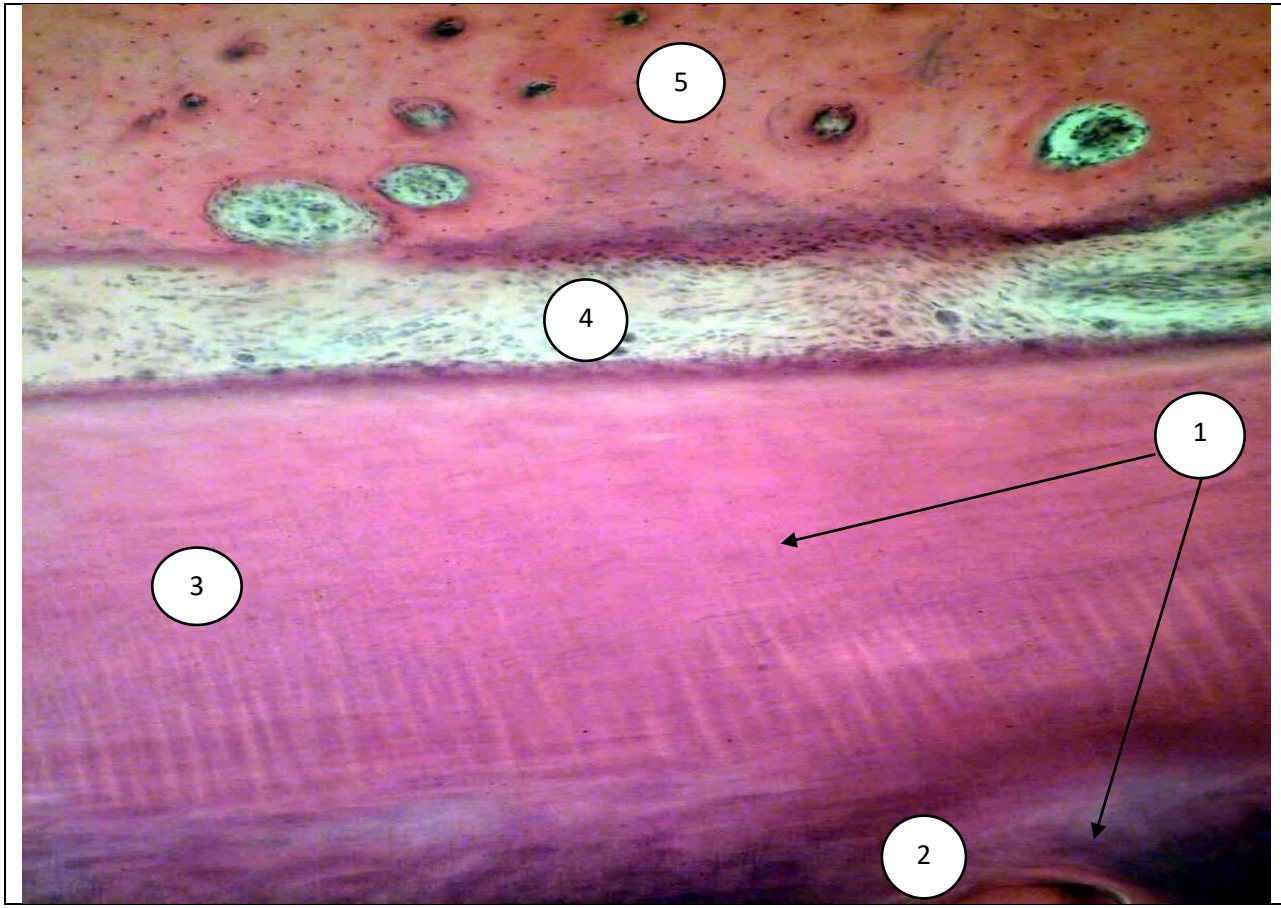

**Section of the teeth**
**Magnification X 40, hematoxylin-eosin staining.**

On the preparation of the teeth cross section you can see the crowns of the teeth (1), the pulp cavity (2) and roots of the teeth (3). Laterally from the crowns and roots there are gums (4) and alveolar process (5). The gums consist of epithelium (6) and lamina propria (7).



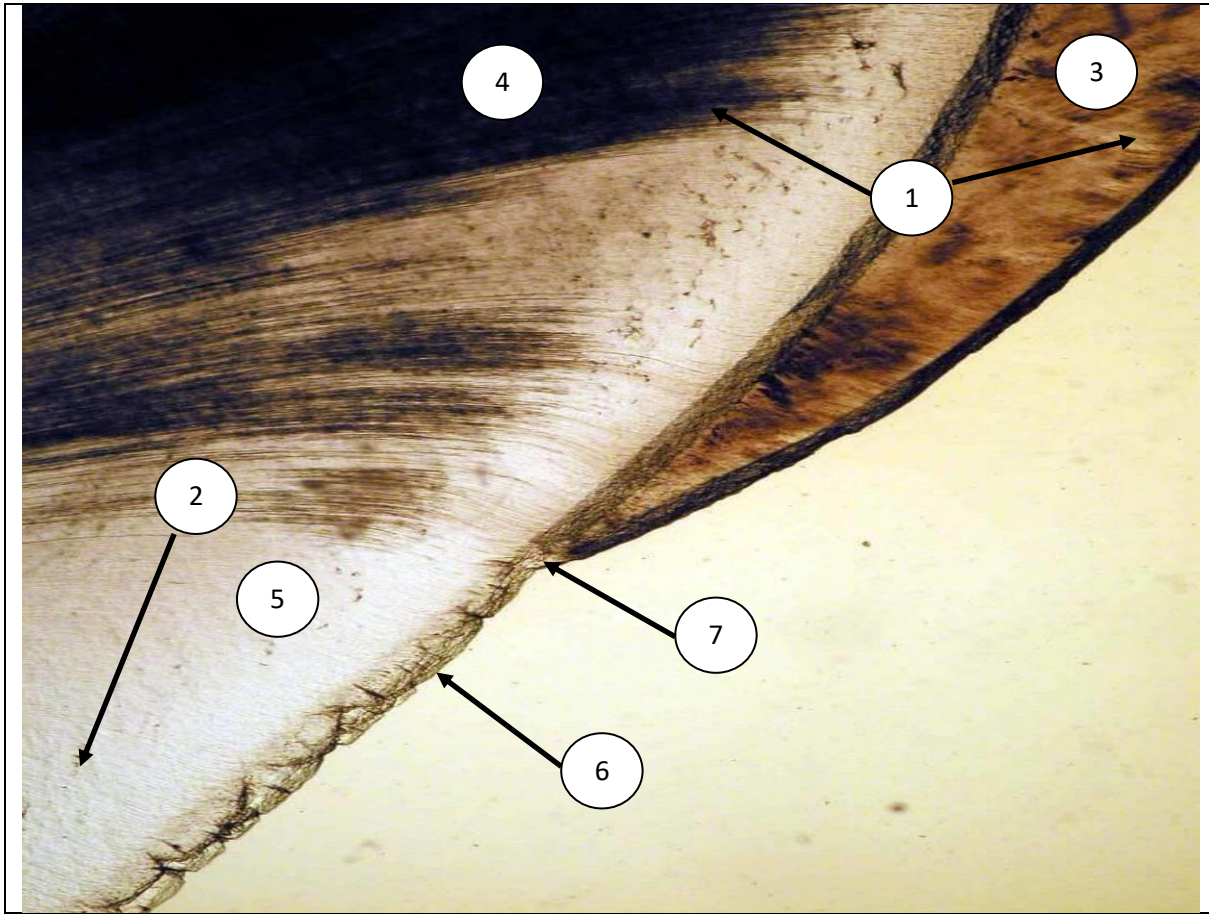

**Interradicular bone**
**Magnification X 40, hematoxylin-eosin staining.**

On the preparation of cross section interradicular bone there are roots of teeth (1), the pulp cavity (2). Laterally from roots there is interradicular bone (3). Periodontium is a ligament that supports the root of the tooth in the bone alveoli (4).



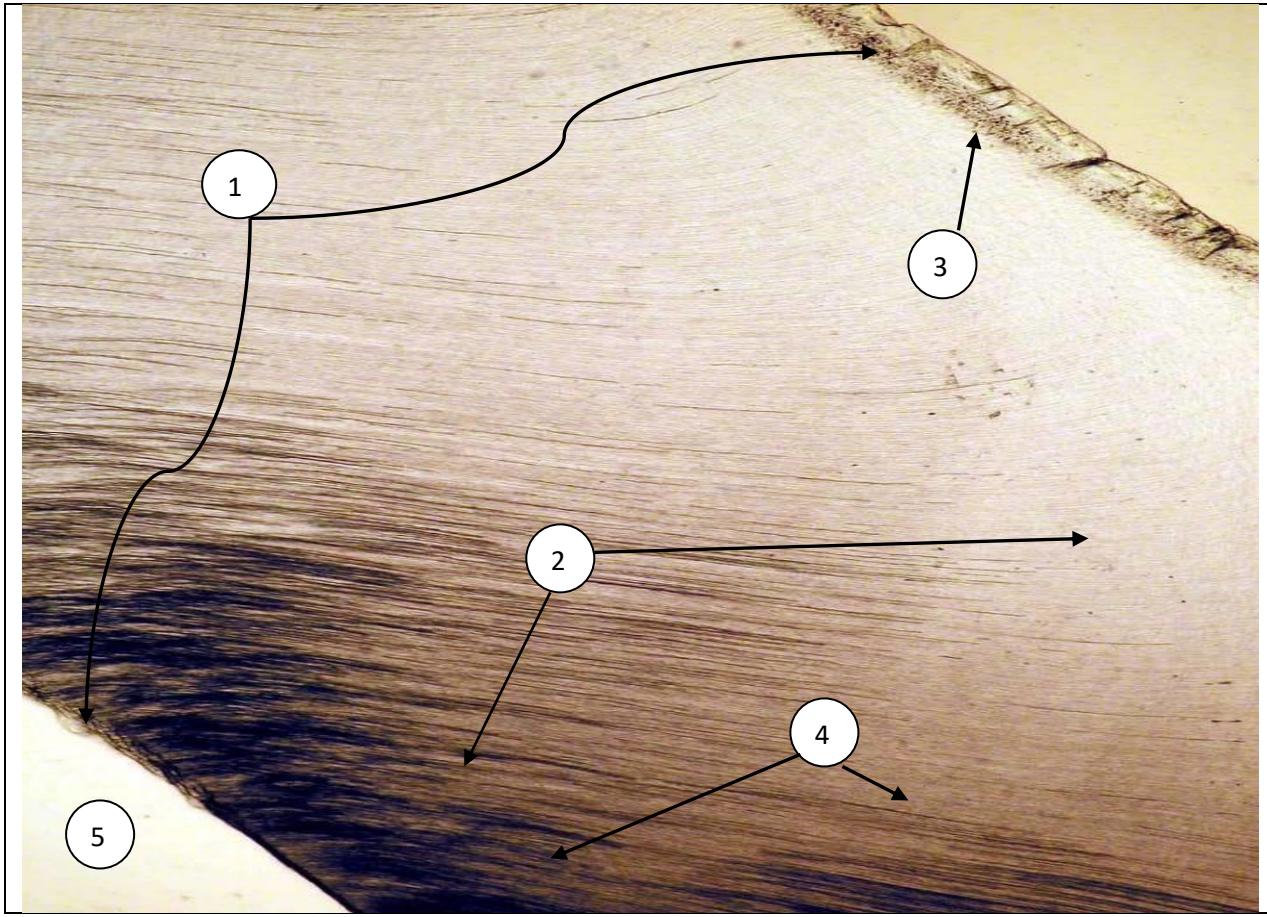

**Root of the tooth**
**Magnification X 100, hematoxylin-eosin staining.**

On the preparation of cross section root of the tooth (1) there are pulp (2), dentine (3). Laterally from the root there are periodontium (4) and interradicular bone (5).



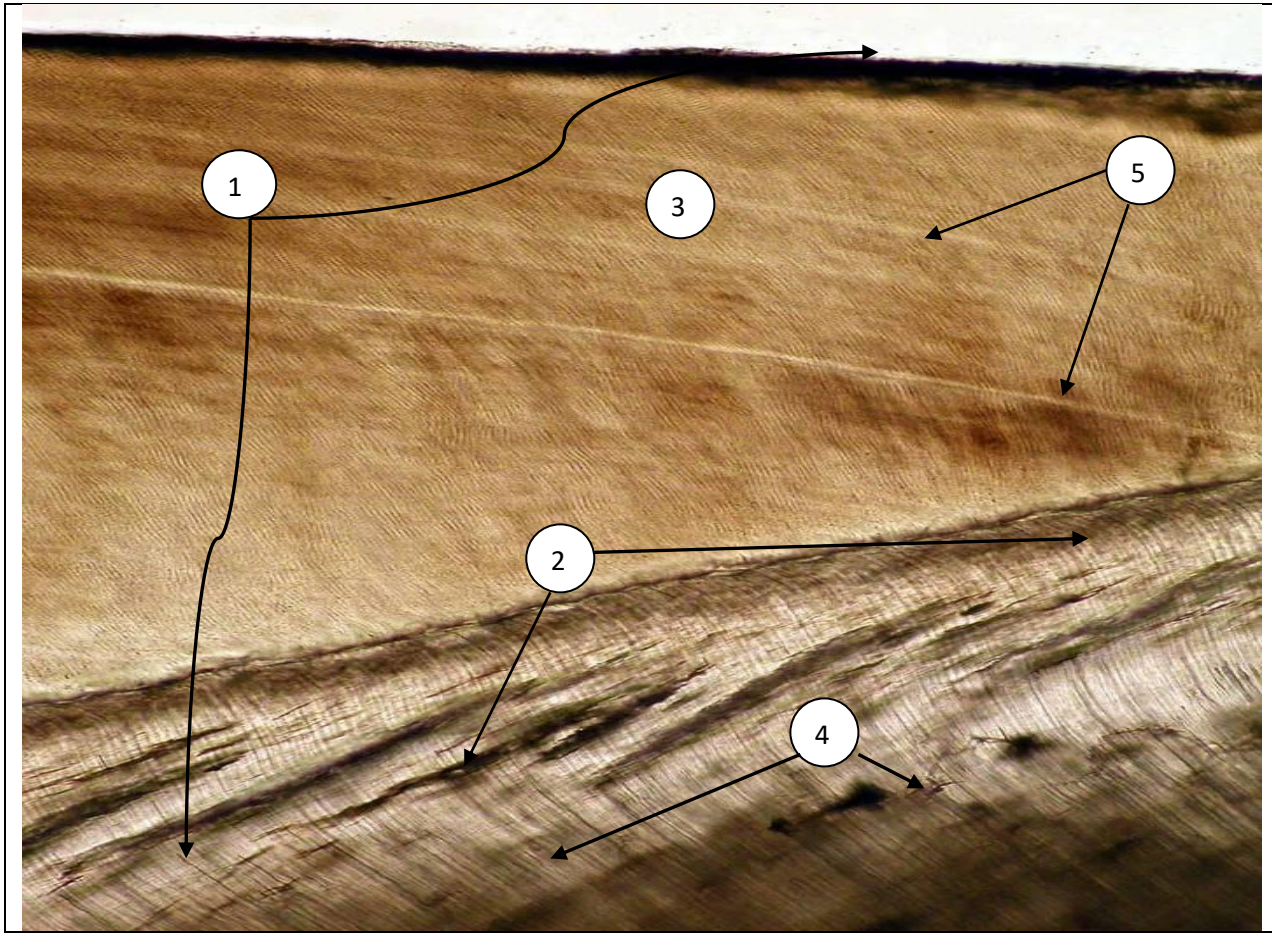

**Cervix of tooth**
**Magnification X 100. Ground specimen.**

On the preparation of the tooth there are crown (1) and root (2). Crown consists of enamel (3) and dentine (4), Root consists of dentine (5) and cementum (6). Between the crown and root there is cervix (7).



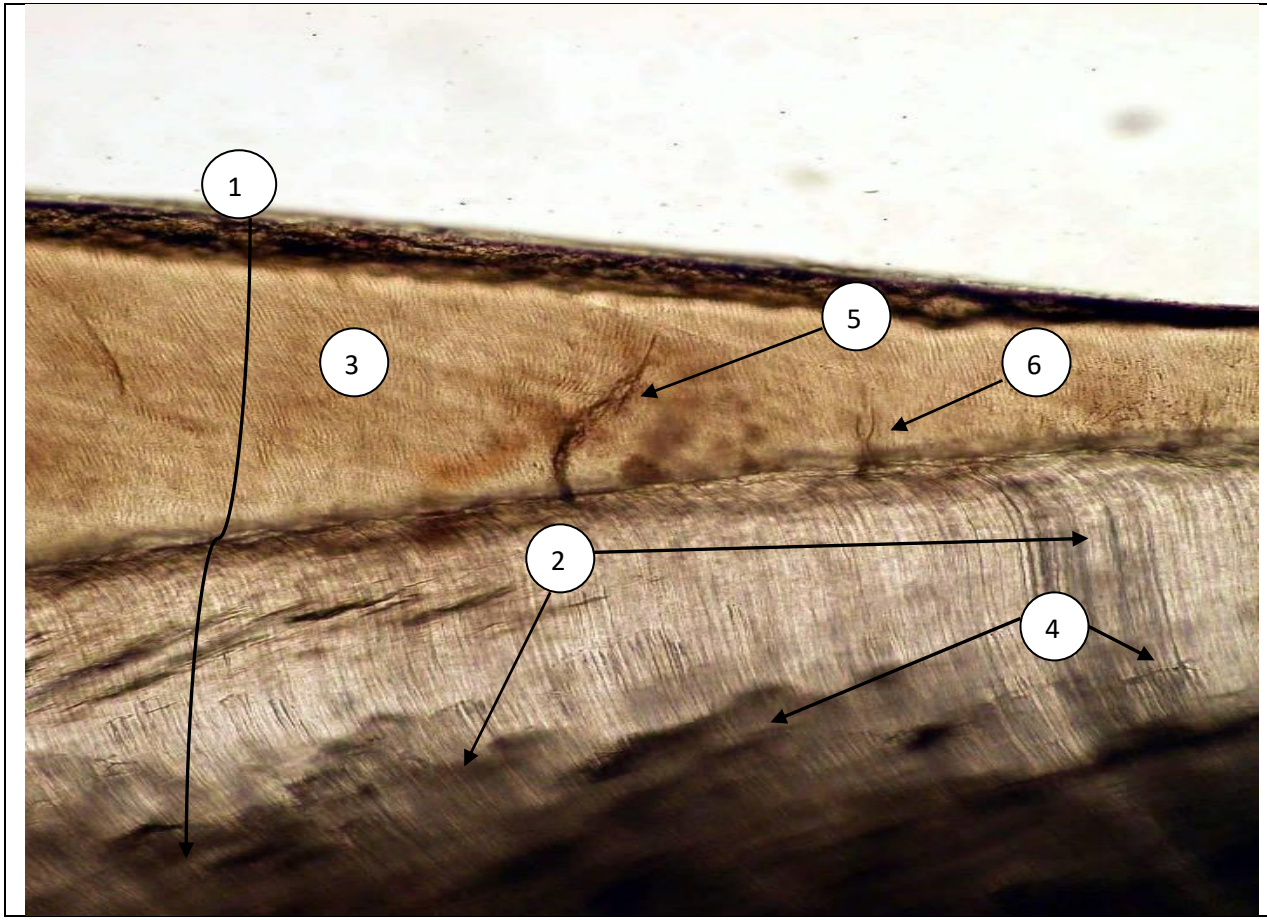

**Dentinal tubules**
**Magnification X 100. Ground specimen.**

On the preparation of the tooth there is root (1). Root consists of dentine (2) and cementum (3). Dentine consists of dentinal tubules (4). In the left corner of the preparation there is pulp cavity (5).



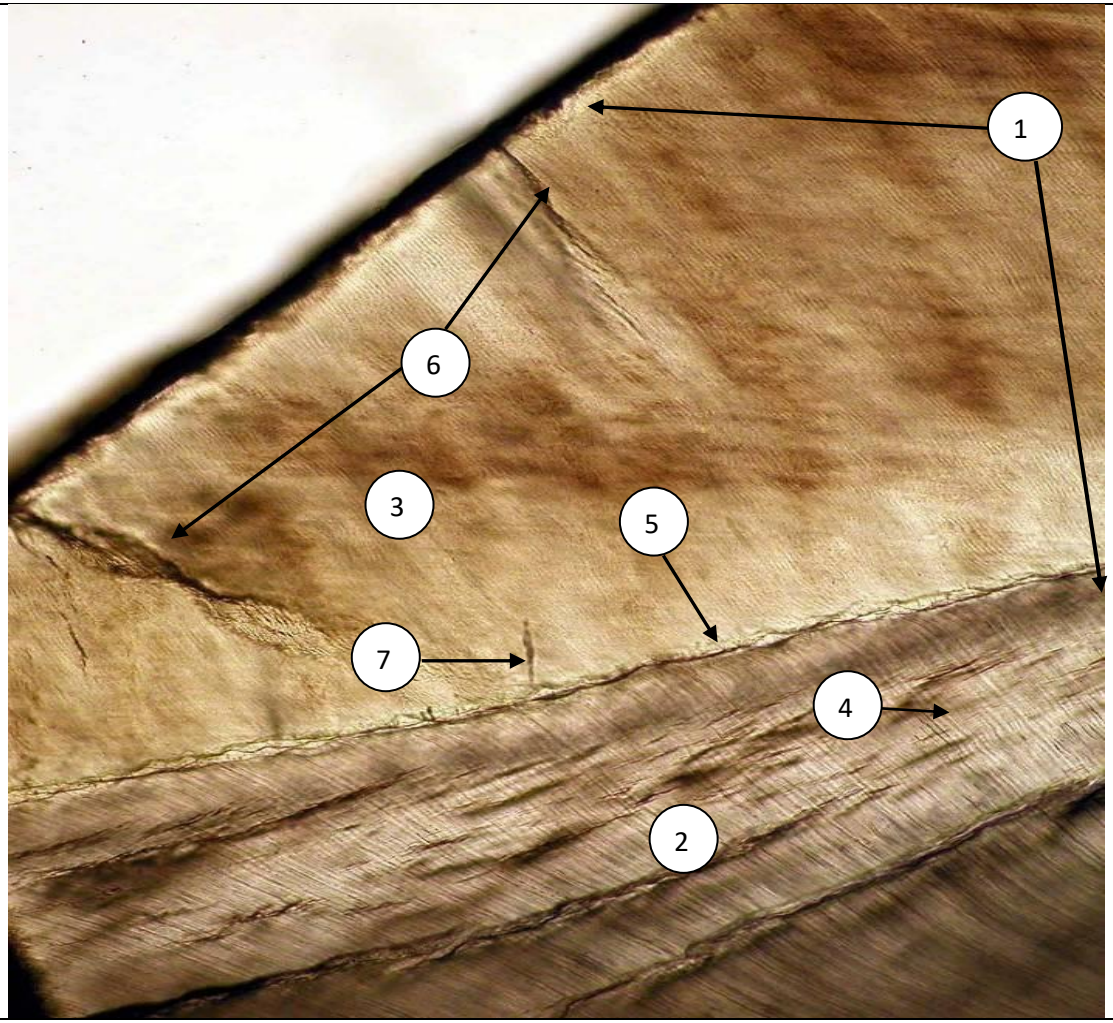

**Retzius lines in enamel Magnification X 100. Ground specimen.**

On the preparation of the tooth there is crown (1). Crown consists of dentine (2) and enamel (3). Dentine consists of dentinal tubules (4). In the enamel there are Retzius lines (5).



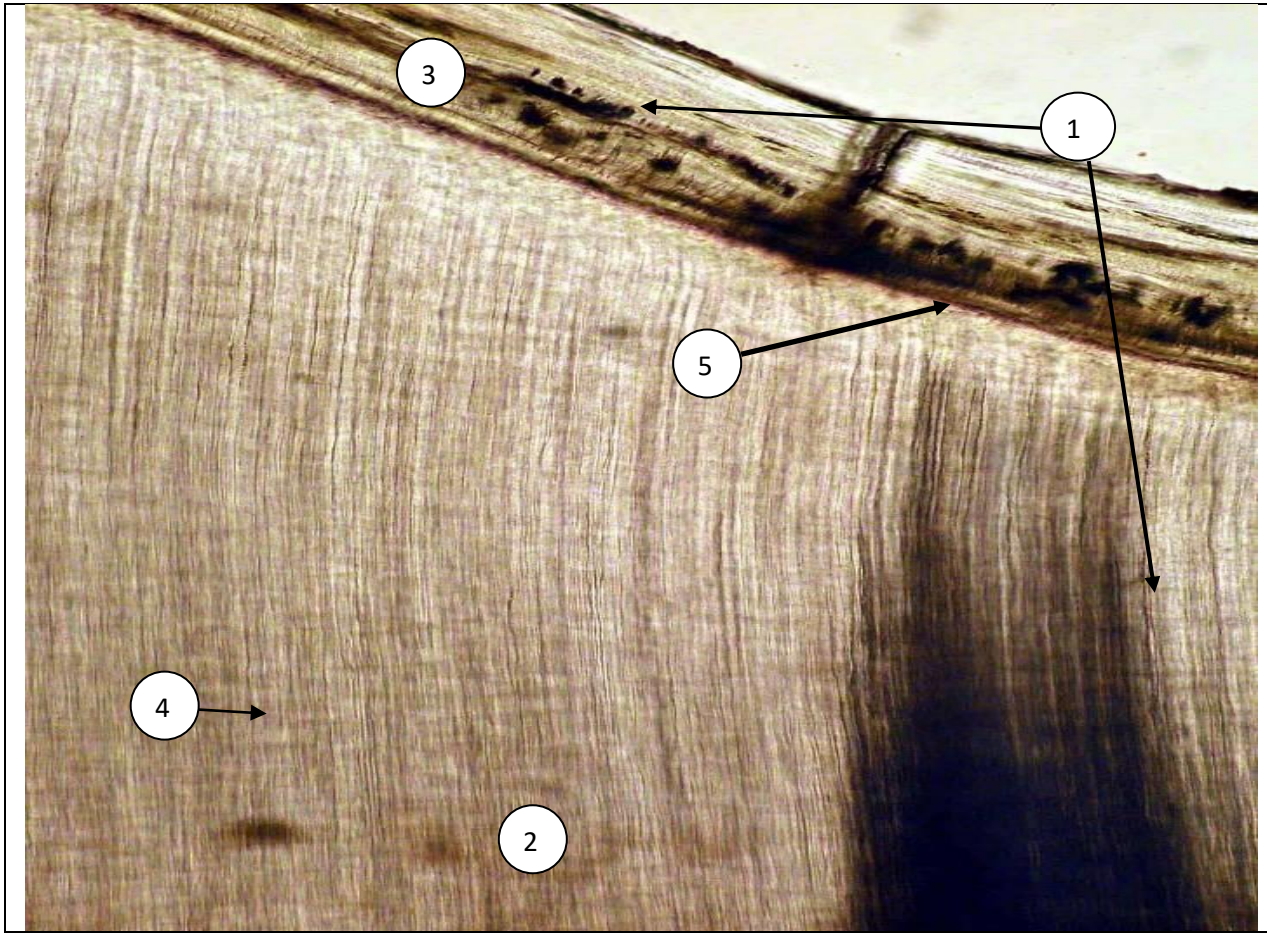

**Dentinoenamel junction Magnification X 100. Ground specimen.**

On the preparation of the tooth there is crown (1). Crown consists of dentine (2) and enamel (3). Dentine consists of dentinal tubules (4). In the enamel there are enamel tufts (5), which extend from the dentinoenamel junction and enamel spindles (6).




**Enamel plates**

**Magnification X 100. Ground specimen.**
On the preparation of the tooth there is crown (1). Crown consists of dentine (2) and enamel (3). Dentine consists of dentinal tubules (4). Between enamel and dentin there is dentinoenamel junction (5). In the enamel there are enamel plates (6) and enamel spindles (7).




**Dentinocemental border Magnification X 100. Ground specimen.**

On the preparation of the tooth there is root (1). Root consists of dentine (2) and cementum (3). Dentine consists of dentinal tubules (4). Between cementum and dentin there is dentinocemental border (5).

## VOCABULARY

**Enamel** shares some mineral characteristics with bone tissue, but it is acellular and avascular. Enamel matrix is deposited in columns called enamel rods by cells called ameloblasts. Enamel is the strongest substance in the human body, due to its high mineral content. Extra-Cellular Matrix is mostly calcium hydroxyapatite, instead of collagen fibers, enamel contains proteins including amelogenins and enamelins.

**Enamel rods** (**prisms**) – the main structural unit of tooth enamel, 4 microns wide, consisting of a densely formed and organized set of hydroxyapatite crystals, hexagonal in shape.

**Striae of Retzius –**are lines of growth visible in the enamel. As a result of the acceleration and deceleration of the enamel deposition process, bands of lighter and darker enamel (less dense and more dense) can be seen on the cross section.

**Bands of Hunter-Schreger –** are enamel that is produced by a set of ameloblasts, and are lines that extend perpendicular to the junction of dentin and enamel. The curvature of Hunter-Schrager bands makes sure that there is no single layer on which the tooth can easily become chipped.

**Enamel tufts** look like to enamel spindles, but shorter, have a bushy shape and do not possess odontoblastic processes.

**Dentin -** the yellowish tissue that constitutes the basic mass of all teeth. It is harder than bone but softer than enamel and consists mainly of apatite crystals of calcium and phosphate.

**Odontoblasts -** a cell of neural crest origination, which constitutes part of the tooth pulp outer surface, and whose function is the dentin formation.

**Dentinal tubules –**are very tiny channels that pass through dentin, starting from the pulp cavity and ending at the dentin-enamel or cemento-dentin junction.

**Interglobular dentin –** imperfectly calcified matrix of dentin situated between the calcified globules near the dentinal periphery; also called interglobular space of Owen.

**Pulp -** is an unmineralized oral tissue composed of soft connective tissue, vascular, lymphatic and nervous elements that occupies the central pulp cavity of each tooth.

**Cementum -** a layer of bonelike, mineralized tissue covering the dentin of the root and neck of a tooth that anchors the fibers of the periodontal ligament**.**

**Cellular cementum -** consists of cells and collagen fibers that attach the tooth to the alveolar bone. It is located at the root apex.

## TESTS

1. A 42-year-old patient suffering from **periodontitis** has **rounded structural formations in the crown part of the pulp**. Name these structures?

**Denticles**
interglobular dentine
Sclerotic dentine
Dead dentine
Dental stones

2. During the examination of a tooth section of a 42-year-old man, **hard linear carinated structures up to 1/3 of the enamel depth** were **found at the dentin-enamel junction**. What structures were found?

**Enamel spindles**
Denticles
Enamel fascicles
"Dead" tracts
Carious damage

3. In the histological preparation of a **multi-rooted tooth, polygonal cells with processes are found in the area of root bifurcation.** What cells and what tissues of the tooth are characterized by this morphological feature?
**Cementocytes, cementum**
Odontoblasts, enamel
Enameloblasts, enamel
Fibroblasts, pulp
Cementocytes, dentine

4. A 42-year-old patient visited a dentist with **symptoms of severe toothache**. After examination, the doctor found **inflammation of the tooth pulp**. What tissue forms the tooth pulp?
**Loose connective tissue**
Amorphous dense fibrous connective tissue
Dense fibrous connective tissue framed
Reticular connective tissue
Mesenchyme

5. The main part of the crown, the neck and the root of the tooth contains **dentin,** the length of which can increase with age, potentially as part of its **regeneration** after an injury. What structures ensure these processes?
**Odontoblasts**
Dentinal tubules
Perytubular dentin
Ameloblasts
Cementoblasts

6. In the molars, the tissue located **at the apex** and at their branching points is visible. This **tissue contains cells that lie in the gaps and numerous collagen fibers that run radially or longitudinally**. Name this tissue.
**Cell cement**
Reticular fibrous bone tissue
Dentin

Enamel
Dense connective tissue

7. **Non-calcified areas are found in the enamel at the border with dentin**, which are often the site of infection in the tooth. What are the names of such structures?
**Enamel bundles**
Enamel prisms
Enameloblasts
Dentynoblasts
Toms Fibers

8. The **child complained of a toothache**. The dentist diagnosed carious lesions of the enamel. What minerals are reduced in this pathology:
**Phosphorous, fluorine and calcium**;
Sodium, calcium, potassium,
Potassium, phosphorus, fluorine;
Magnesium fluoride, calcium
Phosphorus, magnesium, potassium

9. On a histological preparation of a **tooth slice**, light and **dark stripes 100 mm wide, directed radially, are determined in the enamel.** Give the correct name to these enamel formations.
**Bands of Gunther Shreher**
Lines of Retius
Perykimatiy
Enamel prisms
Enamel tufts

10. A histologic specimen shows **cell-free cement**. In which part of the tooth **is this type of cement localized**?
**On the lateral surface of the tooth root**

On the surface of the crown
Forms a layer of coronal pulp
At the top of the tooth root
In the pulp canal

11. The study of the chemical composition of **dentin revealed some areas with an increased mineral content**. When a tooth is damaged by caries, **this dentin is destroyed much faster, which leads to the expansion of dentin tubes and an increase in dentin permeability**. What type of dentin is it?
**Peritubular dentin**
Interglodular dentin
Predentine
Mantle dentin
Circumpulpal dentin

12. A histological section of **crown dentin reveals a small number of collagen fibers (Korf fibers)** running radially in the intercellular substance. Name this layer of dentin
**Mantle dentine**
Circumpulpal dentin.
Granular layer.
Interglobular dentin.
Predentine.

13. In a histological specimen of **tooth slice**, **cell-free tissue consisting of tubes containing cell processes is identified**. What tooth tissue is represented in the section?
**Dentine.**
Enamel.
Pulp.
Cement.
Dense connective tissue.

14. **Electron micrographs** of transverse ultrathin sections of tooth **enamel** reveal **oval, polygonal or arcuate formations consisting of compacted and organized hydroxyapatite crystals**. What are these formations?
**Enamel prisms**
Lines of Retius
Bands of Gunther - Shreher
Perykimatium.
Collagen fibers.

15. On the histological preparation of a **tooth in one of the tissues in the intercellular substance, collagen fibers are visible in radial and tangential directions.** Identify the tissue histogenesis for which this is a typical pattern?
**Dentin**
Enamel
Cementum
Pulp.
Dense connective tissue.

16. **Dentin tubules** can be seen on the longitudinal section of the tooth. What **is inside the tubules**?
**Processes of dentynoblasts.**
Processes of enameloblasts.
Body of dentynoblasts.
Fbroblasts.
Elastic fibers

17. Before the teeth erupt, a hard tissue, **similar to membranous reticular bone, appears on their roots**. What is this tissue?
**Cement**
Dentin
Enamel

Loose fibrous connective tissue
Dense fibrous connective tissue

18. A histologic specimen representing a tooth section shows that the intercellular substance of **dentin contains collagen fibers located tangentially to the dentin-enamel junction and perpendicular to the dentinal tubules (Ebner's fibers).** This layer of dentin is called:
**Parapulpar dentin**
Mantle dentin
Granular layer
Interglobular dentin
Secondary dentin

19. During the histological examination of a **transverse section of enamel, linear bands in the form of concentric circles were found, which are directed at an angle to the dentin-enamel junction**. Name these structures:
**Retsius' lines**
Hunter-Schreger's lines
Enamel plates
Enamel fascicles
Enamel spindles

20. During the histological examination of the **extirpated pulp, cylindrical cells were found in its peripheral layer**. What are the names of these cells?
**Odontoblasts**
Fibroblasts
Monocytes
Ameloblasts
Myofibroblasts

21. Histological examination revealed linear streaks in the form of **concentric circles on the transverse section of the enamel**, which are directed at an angle to the enamel-dentin junction. What are these structures?
**Lines of Retzius**
Bundles of Gunter-Shreher
Enamel lamellae
Enamel spindle
Enamel bundles

22. For some reason, the effectiveness of certain cells in the **peripheral zone of the pulp is temporarily inhibited**. What tooth structure is at risk of disruption of its physiological regeneration?
**Dentine**
Enamel
Pulp
Cellular cement formation
Acellular cement formation

23. Two tooth samples were histologically examined and found to have **cell-free cement in one** and **cellular cement in the other**. From which part of the tooth was the **second sample taken**?
**Root apex**
Cervix of tooth
The upper region of the tooth below the gumline
Crown of tooth
The bound between crown and root

24. During microscopic examination of the tooth's crown, **enamel pellicle** is diagnosed. Which structural components are part of the enamel's pellicle?
**Thin layer of glycoprotein**
Rete of collagen fibers
Accumulation of calcium salts

Residual of enaml organ cells
Gingiva

25. A medical research was conducted to study the source of **tissues that feed the tooth**. Which structural component of the tooth provides dentin **trophism**?
**Pulp**
Enamel
Cementum
Periodontum
Bone of processus maxillae

26. In the **thin regions of the crown**, we can see structures **called enamel tufts**. How they are formed?
**Processus of cuticle enamel**
Enamel prisms
Fibers with inorganic substances
Fibers with organic substances
-

27. On a histological preparation **are tooth structures that form cement**. Which cell are part of the formation of tooth cement?
**Cementoblasts**
Odontoblasts
Enameloblasts
Cementocytes
Osteoblasts

28. The many processes of **dentinoblasts are communicating** with each other through intercellular contacts. The **processes are responsible for contraction**, allowing for circulation of tissue fluid and saturation of dentin and enamel with minerals. Due to which organelles of dentinoblasts, contraction occurs?

**Microfilaments**
Golgi apparatus
Mitochondria
Lysosomes
Ribosomes

29. During the histological examination, **cylindrical cells** are found in the **peripheral layer of the pulp**. What are these cells called?
**Odontoblasts**
Fibroblasts
Monocytes
Ameloblasts
Myofibroblasts

30. A study was performed to investigate the **characteristics of the tooth structure**. In which **component of the tooth are blood vessels**?
**Pulp**
Enamel cuticle
Acellular cement formation
Dentinal tubules
Cellular cement formation

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