Methodical Instruction No. 2, 3.
For the 2\textsuperscript{d} year students’ self – preparation work
(At class and at home)
In studying Propedeutic of Therapeutic Stomatology

Topic:

Structure of a tooth: topography of tissues and formations of a tooth. Histology of enamel, dentine, cement, pulp and periodontium. And there advancing age changes.

Subtopic:

Hours: 2

1. The topic basis: the topic is very important for future doctors in their professional activity, positively influences the students in their attitude to the future profession, forms professional skills and experience as well as taking as a principle the knowledge of the subject learnt; knowledge of an anatomical and histological structure of a tooth are necessary for the student for deep comprehension of the mechanism of development of different pathological processes, which pass in its hard and soft tissues.

2. The aims of the training course:

A=1. To learn histology of a pulp of a tooth its value for normal functioning of a tooth, a periodontium. Its functional value.

A=2. 2) To understand, remember and useing the knowledge received;

A=2. 3) To know:

- Anatomical structure of tooth.
- Histological structure of enamel.
- Anatomical and histological structure of dentine.
- Histological structure of cement.
- Histological structure of pulp.
- Concept of a periodontal cleft, its topographical and anatomical structure.
- Changes in the structure of the pulp, which occurs with age.
- Differences in the structure of root crown and pulp.
- Age changes in the periodontium.

A=3. 4) To form the professional experience by reviewing, training and authorizing it;
A=3. 5) To be able to:
- To represent teeth by the anatomical and clinical formulas.
- To define the belonging of teeth to the right or left part.
- To draw a tooth schematically and to specify the anatomical and histological names of its compounds.

3. Previous materials – self class work – preparation work:

3.1 Basic knowledge, experience, skills necessary for studying the topics in connection with other subjects:

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<td>Anatomy</td>
<td>topographical anatomy of teeth.</td>
<td>Define topographic and anatomical features of different teeth.</td>
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<td>Therapeutic odontology</td>
<td>features of an anatomical structure of teeth.</td>
<td>Distinguish anatomical formations of teeth.</td>
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<tr>
<td>Histology</td>
<td>A histological structure of enamel, dentine.</td>
<td>distinguish histological formations of teeth.</td>
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2.2 The contents of the topic:

**Topic: Structure of a tooth: topography of tissues and formations of a tooth.**

**Histology of enamel, dentine, cement, pulp and periodontium. Age changes in them**

The enamel — the hardest tissue of an organism of the human (is comparable to hardness of soft steel), that allows it in a course of performance by a tooth of the function and resist to influence of the large mechanical loads. At the same time, it is
rather fragile and could crack at an appreciable load however it usually does not occur under it, there is a bolstering layer of more resilient dentine. Therefore destruction of a subject layer of a dentine inevitably results to enamel cleft.

The enamel contains 95% of mineral substances (mainly hydroxiapatite, carbonatapatite, fluorapatite etc.), 1,2 % is organic, 3,8 % are necessary in water, connected with crystals and organic components, and free. Density of enamel is reduced from a surface of a crown to dentine-enamel border and from cutting edge to neck. Maximal hardness is on the cutting edge. The enamel does not contain cells and is not capable to neogenesis at damage, however it constantly has a metabolism (mainly of ions), which act on it as the part of the subject on tooth tissues (dentine, pulp), and from saliva.

Enamel columns: main functional structure units of the enamel, which are taking place by fascicles through all its mass radially (mainly to perpendicularly to dentine-enamel border) and a little bit bent as letter S. In the neck and central part of a crown of temporary teeth the columns settle down is almost horizontal (fig. 5-1, a). Near to cutting edge and edges of chewing tubercules they go in a slanting direction, and coming nearer to cutting edge and to an apex of chewing tubercule, settle down practically upright.In constant teeth a locating of enamel columns in occlusional (chewing) 2/3 of crown the same, as in a temporary teeth. In area of neck, however, course of prisms deviates from horizontal plane in apical side. (fig. 5-1, a).

![Fig. 5-1. A course of enamel columns in a crown of temporary (a) and constant (b) teeth.]

Э-enamel; ЭП-enamel columns;

Э- enamel; ЭП- enamel columns;
The form of prisms on transversal section is oval or — most often at the man — arch (as a key chink) — (fig. 5-2); their diameter makes 3-5 microns. As the outside surface of enamel exceeds internal, border upon from dentine, enamel columns whence begin, consider, that the diameter of prisms is enlarged from dentine-enamel border to a surface of enamel approximately twice. The enamel columns consist of the densely stacked crystals, mainly hydroxiapatites $\text{Ca}_6(\text{PO}_4)_2(\text{OH})_2$ and eight-calcium phosphates $\text{Ca}_8\text{H}_2(\text{PO}_4)_6 \cdot 5\text{H}_2\text{O}$. Each crystal is covered with a hydrated environment by thickness about 1 нм. Between crystals there are microspaces filled with water (with an enamel liquid), which serves a carrier of molecules of series of substances and ions.

![Fig. 5-2. A metastructure of enamel and locating in it the crystals of hydroxiapatite.](image)

ЭП-enamel prisms; Г-head of enamel prisms; Х-tails of enamel prisms forming interprismal substance.
Locating of crystals of hydroxiapatites in enamel prisms regulated — till them length as "spruce". In the central part of each prism the crystals lay almost in parallel of its long axis; the more they are removed from this axis, the more appreciably deviate from its direction, forming with axis the increasing angle. At an arch configuration of enamel prisms crystals of a wide part ("head" or "body"), the prisms, laying in parallel to length, in its narrow part ("tail") fan-shapedly miss, deviating from its axis on 40-65 ° (see fig. 5-2).

The organic matrix connected to crystals and in a course of an enamelogenesis providing processes of their body height, in process of maturing enamel almost is completely lost. It is saved as a most thin three-dimensional albuminous network, which strings settle down between crystals.

The prisms are characterized transversal striping, formed by alternating of light and dark strips with intervals in 4 microns, that corresponds to daily periodicity of formation of enamel. Assume, that the dark and light sites of an enamel prism reflect an unequal level of a mineralization of enamel. The most peripheric part of each prism represents a narrow layer (an environment of a prism), consisting from less mineralizing substance.

The interprismal substance surrounds prisms of spherical and not regular-shaped form and differentiates them. At arch frame of prisms their parts are in immediate contact with each other, and the interprismal substance as such practically is absent — its role in area of "head" of one prisms play "tails" of others.(see fig.5-4)
The interprismal substance has smaller durability than enamel prisms, therefore at occurrence of clefts in enamel they usually pass on it, not affecting a prism. **Unprismal enamel.** The most internal layer of enamel by thickness 5-15 microns at dentine-enamel border (initial enamel) does not contain prisms, as during its formation the processes by Toms were not generated yet.

**STRIPS by Gunter-Shreger and LINE by Retzius**

Owing to changes in a direction of a course the fascicles of enamel prisms on longitudinal sections in one sites of enamel is appear cutting longitudinally (parazones), in others — transverselly (diazones). Alternating of parazones and diazones on longitudinal sections of enamel at their study in reflected light causes occurrence of light and dark strips of width about 100 microns (10-13 enamel prisms), perpendicularly to surface of enamel (fig. 5-3). These strips are named as strips by Gunter-Shreger. The light strips revealed on sections, correspond to parazones, and dark — to diazones. Simultaneously on sections of a tooth other type of striping of enamels formed by enamel strias (by strias, or lines by Retzius) is
defined. On longitudinal sections a line by Retzius look like symmetric arches going obliquely from a surface of enamel to dentine-enamel border (see a fig. 5-3, 5-4) and painted in yellow - brown colour. On transversal sections they represent concentric circles and remind rings of body height on trunks of trees. The lines by Retzius are growthal lines of enamel.

Fig. 5-3. Strips by Gunter-Shreger and lines by Retzius of enamel.

ENAMEL PLATES, FASCICLES and SPINDLES

Enamel plates and fascicles — sites of enamel containing unsufficiently calcified enamel prisms and interprismal substance, in which is taped appreciable concentration of proteins with high molecular mass, congenerous to enamelin. They arise during development of a tooth. Most clearly enamel plate and the fascicles are found out on sections of a tooth.

An enamel plate — thin foliaceous (on sections — linear) defects of a mineralization of enamel containing proteins of enamel and organic substances from an oral cavity. They are pulled from a surface deep into enamels and can reach dentine-enamel border, and sometimes proceed in a dentine. In the best way the enamel plate are visible in the neck of a tooth.
The enamel fascicles meet much more often plates. They look like small conical formations inverted by the top perpendicular to dentine-enamel border, and will penetrate into enamel on rather small distance (on 1/5-1/3 of its thickness), meeting with intervals approximately 100 microns. Externally they are similar to fascicles of a grass, whence there was their name. They the same as also of enamel plate, contain unsufficiently calcified prisms and interprismal substance.

Enamel spindles represent rather short (some micrometers) mace-shaped or spindle-shaped frames locating in an internal one third of enamel perpendicularly to dentine-enamel borders and which are not conterminous on the course to enamel prisms (see a fig. 5-5). Similarly to enamel plates and fascicles, spindles are hypomineralized sites of enamel with the rather high contents of organic components. A parentage and possible functional meaning of enamel spindles are a subject of discussion. There is an opinion, that they arise because up to a secretion of enamel the processes of separate fibrilloblasts can penetrate between enameloblasts, and further immure themself in formed enamel. The assumption is stated also, that they represent the rests of separate enameloblasts, which, as against others, did not accept participations in development of enamel and were immured in its layer.

A dentine-enamel bond. The border between enamel and dentine has a rough kind (see fig. 5-5), that promotes stronger bond of these tissues. At use of a scanning submicroscopy on a surface of a dentine in the field of dentine-enamel bond the system of communicans crests pressing in the excavation, appropriate to them, in enamel is taped.

SUPERFICIAL STRUCTURES OF ENAMEL

Pericimatiums. If to look after lines by Retzius up to their output on a surface of a tooth, they will correspond to circular grooves, that is to sites of enamel, where it has smaller thickness (see fig. 5-4). On edges of grooves and on their bottom there are numerous fine pressing on a surface of enamel 4-6 microns by a diameter and depth 0,5-3 microns. This are fossas. They occur in a course of development and correspond to a locating of processes by Toms of enameloblasts during end of a
secretion of a matrix of enamel. Between these grooves the platens of height 2-4,5 microns and width 30-160 microns termed pericimatiums settle down. The cuticle of enamel covers its surface as a thin environment and consists of two layers:

1) Of a primary cuticle (environment by Nasmith) — internal thin (about 0,5-1,5 microns) homogeneous layer of glycoproteins, being last secretory product of enameloblasts;
2) Of the secondary cuticle formed by outside to thicker (about 10 microns) layer of a reduced epithelium of an enamel body.

After eruption of teeth the cuticle is erased on their chewing surfaces, being partially saved on lateral.

Pellicula, tooth plaque, odontolith. The enamel of any cut tooth is covered outside by a layered organic film termed pellicula (from lat. pellis — a skin). The pellicula is forms, obviously, owing to a precipitation of proteins and glycoproteins of saliva and makes in thickness, on the different data, from less 1 up to 2-4 microns. After mechanical clearing of a surface of enamel it is wholly restores during several hours.

Structure of a tooth: topography of tissues and formations of a tooth. Histology of enamel and dentine.

Dentine and pulp sometimes are treated separately in textbooks on dental histology largely because dentine is a hard connective tissue and the pulp is a soft one. However, dentine and pulp are related embryologically, histologically, and functionally and therefore are described together.

BASIC STRUCTURE OF DENTINE

Dentine is the hard tissue portion of the pulp-dentine complex and forms the bulk of the tooth. Dentine is a bone like matrix characterized by multiple closely packed dentinal tubules that traverse its entire thickness and contain the cytoplasmic extensions of odontoblasts that once formed the dentine and then maintain it. The cell
bodies of the odontoblasts are aligned along the inner aspect of the dentine, against a layer of predentine, where they also form the peripheral boundary of the dental pulp. The dental pulp is the soft connective tissue that occupies the central portion of the tooth. The space it occupies is the pulp cavity, which is divided into a coronal portion (or pulp chamber) and a radicular portion (the root canal). The pulp chamber conforms to the general shape of the anatomic crown. Under the cusps the chamber extends into pulp horns, which are especially prominent under the buccal cusp of premolars and the mesiobuccal cusp of molars. Their cusps are particularly significant in dental restoration, when they must be avoided to prevent exposure of pulp tissue.

The root canal (or root canal system, as it is called in multirooted teeth) terminates at the apical foramen, where the pulp and periodontal ligament meet and the main nerves and vessels enter and leave the tooth. In the developing tooth the apical foramen is large and centrally located. As the tooth completes its development, the apical foramen becomes smaller in diameter and more eccentric in position. Sizes from 0.3 to 0.6 µm, with the large diameter occurring in the palatal root of maxillary molars and the distal root of mandibular molars, are typical of the completed foramen. The foramen may be located at the very end, or anatomic apex of the root, but usually is located slightly more occlusally from the apex. If more than one foramen is presents in a root, the largest is designated the apical foramen and the others are accessory foramina.

Connections between the pulp and the periodontal tissues also may occur along the lateral surface of the root through the lateral canals. Such canals, which may contain blood vessels, are not present in all teeth and occur with differing frequencies in different types of teeth. Occasionally, the lateral canals enter the floor of the pulp chamber of multirooted teeth. Because the apical foramen and the lateral canals are areas of communications between the pulp space and the periodontium, they can act as avenues for the extension of disease from one tissue to the other. Hence diseases of the dental pulp can produce changes in the periodontal tissues. More rarely do diseases of the periodontium involve the dental pulp.
COMPOSITION, FORMATION AND STRUCTURE OF DENTINE

Dentin is deposited as a layer of unmineralized matrix called *predentine* that varies in thickness (10 – 50 µm) and lines its innermost (pulpal) portion. Predentine consists principally of collagen and noncollagenous components. Dentine is similar to osteoid in bone and is easy to identify in hematoxylin-eosin stained sections because it stains less intensely than mineralized dentine. Predentine gradually mineralizes into dentine as various noncollagenous matrix proteins are incorporated at the *mineralization front*. Its thickness remains constant because the amount that calcifies is balanced by the addition of new unmineralized matrix.

Mature dentine is made up of approximately 70% inorganic material, 20% organic material, and 10% water by weight, and 45%, 33%, and 22% respectively by volume. Its inorganic component consists of substituted hydroxyapatite in the form of small plates. The organic phase is about 30% collagen with fractional inclusions of lipids and noncollagenous matrix proteins. The noncollagenous matrix proteins pack the space between collagen fibrils and accumulate along the periphery of dentinal tubules.

Dentine is slightly harder than bone and softer than enamel. This difference can be distinguished readily on radiographs, on which the dentine appears more radiolucent (darker) than enamel and more radiopaque (lighter) than pulp. Because light can readily pass through the thin, highly mineralized enamel and can be reflected by the underlying yellowish dentine, the crown of the tooth also assumes such colorations. The thicker enamel does not permit light to pass through as readily, and in such teeth the crown appears whiter. Teeth with pulp disease or without a dental pulp often show discoloration of the dentine, which causes a darkening of the clinical crown.

Physically, dentine has an elastic quality that is important for the proper functioning of the tooth because the elasticity provides flexibility and prevents fracture of the overlying brittle enamel. Dentine and enamel are bound firmly at the *dentinoenamel junction* that appears microscopically, as a well-defined scalloped border. In the root
of the tooth the dentine is covered by cementum, and the junction between these two tissues is less distinct since, in the human, they intermingle.

**STRUCTURES of a DENTINE.**

Dentine — is a calcified tissue of a tooth forming its basic mass and determining its form. A dentine often survey as the specialized osteal tissue. The dentine has light yellow colouring, has some elastance; he is stronger than a bone and cement, but in 4-5 times is softer than enamel. The mature dentine contains on 70 % from inorganic substances (mainly hydroxiapatites), on 20 % from organic (in the basic collagen of I type) and 10 % of water. Due to the properties the dentine interferes to clefting by harder, but fragile enamel covering it in the field of a crown. The dentine consists of calcified intercellular substance penetrated by dentinal tubules, containing processes of odontoblasts, the bodies of which lay on periphery of a pulp. Between tubules an intertubular dentine settles down. The periodicity of body height of a dentine causes presence in it of a new growthal lines posed in parallel of its surface. The zones of a hypomineralized dentine include: 1) an interglobular dentine and 2) granular layer by Toms; the dentine is separated from a pulp by a layer of a not calcified predentine.

![Fig. 6-1. Topography of a dentine and course of dentinal tubules.](image-url)
1) The interglobular dentine settles down by layers in an outside one third of crown in parallel to dentine-enamel border. He is submitted by sites of the wrong form containing not calcified collagen fibrils, which lay between not merged with each other globulas of a calcified dentine (see fig. 5-5, 6-1). In the interglobular dentine a peritubular dentine is absent (see below).

2) the granular layer by Toms settles down on periphery of a root dentine and
consists of fine weakly calcified sites (grains) laying as a stria lengthways of dentine-cement border.

**Predentine** is an internal (not calcified) part of a dentine, close to a layer of odontoblasts as oxifilly stained zone of width 10-50 microns penetrated by processes of odontoblasts. The predentine is formed mainly by collagen of an I type. The transition of a predentin in a mature dentine is carried out sharply on a boundary line, or front of a mineralization. On the part of a mature dentine in a predentine press a basephilial calcified globulas. A predentine is a zone of constant body growth of a dentine. In a dentine allocate two layers with a various course of collagen fibers (fig. 6-4, a):

**Fig. 6-4. A course of a collagen fibers (a) and dentinal tubulas (b) in a dentine.**

Э — enamel; ЭВ — enamel spindles; 
ДЭГ — dentine-enamel border; 
ОПД - a nearpupal dentine; 
ПЛД — a cloak dentine; 
ПД — a predentine; 
РВ — radial fibers (by Korf); 
ТВ — tangential fibers (by Ebner); 
ДТ — dentinal tubules; 
ОБЛ — odontoblasts (body of cells); 
П — a pulp.
1) a nearpulpal dentine — is the internal layer amounting the most part of a dentine, is characterized by prevalence of fibers going tangentially to dentine-enamel border and perpendicularly to dentinal tubules (the tangential fiber, or fiber by Ebner);

2) a cloak dentine —is outside layer, covering a nearpulpal dentine, thickness about 150 microns. He is formed by first and is characterized by prevalence of collagen fibers going in a radial direction, in parallel to dentinal tubules (radial fibers, or fiber by Korf). Close to nearpulpal dentine these fibers are going to in cone-shapedly narrowed fascicles, which from an apex of a crown to a root change the initial radial direction for one more slanting, coming nearer to a course of tangential fibers. The cloak dentine smoothly passes in nearpulpal, and to radial fibers mix the increasing quantity of tangential. A matrix of a cloak dentine is less mineralized, than the matrix of nearpulpal also contains rather less of collagen fibers.

Dentinal tubules — thin, narrowed to outside the small canales, radially penetrating a dentine from a pulp up to its periphery (dentine-enamel border in a crown and cement-dentinal border in a root) and causing its stripping. The tubules provide a trophicity of a dentine. In a nearpulpal dentine they are straight lineses, and in a cloak (near their ends) — are V-figurative branch out and contacting with each other (see fig. 6-4, 6). The terminal branching of dentinal tubules is especially clearly expressed in a root dentine. From dentinal tubules on all to their length with an interval 1-2 microns thin lateral branch depart. The tubules in a crown are slightly bent and have an S-figurative course. In the field of apexes of horns of a pulp, and also of apical one third of root they are direct (see fig. 6-1). Density of a locating of dentinal tubules is much higher on the surface of a pulp (45-76 thousand on square mm in a crown of premolars and molars), than about dentine-enamel border (15-20 thousand on square mm); relative volume, borrowed by dentinal tubules, makes about 30 % and 4 % of a dentine accordingly. In a root of a tooth near a crown density of a
locating of the tubules approximately the same, as in a crown, however in an apical direction it is reduced almost in 5 times. Dentinal tubules can in separate sites cross dentine-enamel border and superficially penetrate into enamel as so-called enamel spindles. Last, as assume, are formed in a course of development of a tooth, when processes of some odontoblasts, reaching of enamelo blasts, immure themself in formed enamel. In dentinal tubules the processes of odontoblasts surrounded with a fabric (dentinal) liquid settle down. The dentinal liquid represents transssudate of peripheric capillaries of a pulp and on albuminous structure is similar to plasma; it contains also glycoproteins and fibronectinum. This liquid fills the space between a process of an odontoblast and wall of dentinal tubules, which at pulpal edge of tubule is very narrow, and in a direction of periphery of a dentine becomes wider. This space serves the important way for carry of various substances from a pulp to dentine-enamel border. From within the wall of dentinal tubule is covered thin film of organic substance — boundary plate {membrane by Newman}, which passes on all length of dentinal tubule, contains high concentration of glycosaminoglycanes.

**Peritubular And Intertubular dentine.**

Peritubular dentine represents a layer of a dentine immediately environmental each dentinal tubule and forming its wall (see fig. 6-6). As a matter of fact the peritubular dentine is necessary to name more correctly as intratubular, as it is formed inside of tubule, reducing in due course initial diameter of its aperture. Peritubular dentine is characterized raised (on 40 %) contents of mineral substances in comparison with intertubular dentine filling spaces between tubules. The contents of organic substances in peritubular dentine are minimal — at a decalcification it almost completely disappears. This circumstance has the important clinical meaning — at a demineralization of a dentine in a course of a caries peritubular dentine is exposed to destruction much faster than intertubular, that results in expansion of tubules and augmentation of a permeability of a dentine. Intertubular dentine (see fig. 6-6) in a course of development of a tooth is formed by first both in cloak, and in a nearpulpal dentine. He is submitted basically by calcified collagen fibrils by a diameter 50-200 нм. The crystals of hydroxiapatites are posed along an axis of fibrils.
The primary dentine is formed during formation and eruption, making the basic part of this tissue (fig. 6-7). He is postponed by odontoblasts with average rate 4-8 microns on a day, and the periods of their activity alternate with the periods of rest. The secondary dentine (regular, or physiological secondary dentine) is a part of nearpulpal dentine, it is forms in the generated tooth after eruption and is continuation of a primary dentine (see fig. 6-7).

The secondary dentine is formed more slowly than primary. In comparison with primary dentine the secondary is characterized by a little less regulated locating of dentinal tubules and collagen fibrils, lower degree of a mineralization. Tubules of a secondary dentine are less numerous and narrower; crossing border of a primary and secondary dentine (demarcational line), in one sites they do not change the course, and in others — are S-figuratively bent. The adjournment of a secondary dentine occurs non-uniformly: most actively he is formed in lateral walls and in a roof of pulpal chamber, and in multirooted teeth — in its bottom. As a result of adjournment of a secondary dentine the form of the pulpal chamber changes, in particular, the horns of a pulp smooth out, and its( pulpal chamber) volume is reduced.

The tertiary dentine (irregular secondary, reparative, substitutional dentine) is formed in reply to action of the irritating factors. As against a primary and secondary dentine, which settle down along of all pulpal-dentinal borders, tertiary dentine forms more or less locally — only by cells immediately reacting to an irritation? It can be formed in any site of a wall of the pulpal chamber, most often — in the field of horns
of a pulp. Quantity and frame of a tertiary dentine depend on a nature, intensity and duration of influence. It is continuation of a primary or secondary regular dentine, usually non-uniformly and weakly mineralized and is characterized by a wrong course or even by absence of dentinal tubules and various inclusions.

**SCLEROTIC (TRANSPARENT) DENTINE and DEAD WAYS in DENTINE.**

Sclerotic (transparent) dentine is formed as a result of progressive adjournment of peritubular dentine in dentinal tubules that causes their gradual narrowing and obliteration. These changes can be connected with natural process of aging, in particular, in a root dentine ("physiological" sclerosis) or to develop under action of various pathological processes, for example, caries, deleting ("pathological" sclerosis). Two ways of a calcification of contents of dentinal tubules are described: at the first mineralization begins in periodontoblastical space and only then grasps a process of an odontoblast, at second — its beginning is a calcification of a process with the subsequent mineralization of periodontoblastical space.

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**Fig. 6-9 The dead ways in dentine.**

\[D\] — dentine; \[E\] — enamel; \[U\] — cement; \[P\] — pulp.

Fingers — dead ways in dentine.
STRUCTURE of CEMENT of a TOOTH

Fig. 7-1 Topography of the cement of a tooth (a) and its microscopic structure (b).

БКЦ — uncellular dentine; КЦ — cellular dentine; Э — enamel; Д — dentine; ДТ — dentinal tubules; 3СТ — a granular layer by Toms; П — pulp; ЦЦ — cementocytus; ЦБЛ — cementoblasts;

Cement is the calcified tissue of a tooth similar with osteal, but, as against it, is deprived of vessels and is not subject to constant reorganization. The cement covers roots and neck of a tooth (fig. 7-1, a). On the data of the majority of the researchers, it partially goes on enamel at 60-70 of %, in 10 % does not reach it (fig. 7-2, a-b). The thickness of a layer of cement is minimal in area of neck (20-50 microns) and is maximal at an apex of a root (100-1500 microns and more, it is thicker in molar teeths). The cement is sectioned on uncellular - primary and cellular - secondary (see fig. 7-1, a).

Uncellular (primary) cement — is formed by first in a course of development. It settles down on a surface of roots of a tooth as rather thin (30-230 microns) layer, which thickness is minimal in the field of cement-enamel border and is maximal at an apex of a tooth. Uncellular cement is a unique layer of cement.
covering neck of a tooth, in some teeth (for example, the bottom forward incisors) it almost wholly covers a root.

As follows from the name, uncellular cement does not contain cells and consists of calcified intercellular substance including densely posed collagen fibers and the basic substance. There are stripping, perpendicular to the surface of a root (for the bill of intertwine not calcified fibers of periodontal ligaments), and also lamination parallel to a surface of a root, owing to periodicity of its adjournment in it. The lines of body height in uncellular cement settle down closely to each other, and its border with dentine is expressed not clearly.

**Cellular (secondary) cement covers** the apical one third of root and area of a bifurcation of roots of multirooted teeth. It settles down atop of uncellular cement, however sometimes (in absence of last) is immediate closes to a dentine. The border between them is expressed clearly (tab. 7-1). The thickness of a layer of cellular cement varies over a wide range (100-1500 microns) and is most appreciable in molars. Cellular cement consists of cells (cementocytes and cementoblasts) and calcified intercellular substance (see fig. 7-1, 6). Cementocytes (from lat. cementum — cement and greek. kytos — a cell) lay in the special cavities inside of cement — lacunas — and on a structure are similar to osteocytes. They are impressed cells with the moderately advanced organellas and rather large core. Their numerous (up to 30) branching out processes by a diameter about 1 micron reach in length 12-15 microns and are connected with each other by fissured bonds (necsus). The processes settle down in small canals and are focused mainly in the party of periodontal ligament (power supply). In process of adjournment of new layers of cement on a surface of a root in its deep layers, the cementocytes, leaving from the power supply, are exposed to degenerative changes and perish, owing to what lacunas remain filled by cellular detritis or become empty. Opposite, than closer to a surface of cement, than in the greater degree cementocytes save attributes of functional activity and similarity with cementoblasts.

**Cementoblasts** (from lat. cementum — cement and greek. blastos — sprout) — active cells with the well advanced synthetic device — provide rhythmic adjournment
of new layers of cement and settle down on its surface — in peripheric sites of periodontal ligament around of a root of a tooth. At formation of uncellular cement the cementoblasts are removing to outside from the intercellular substance, produced by them, and at formation of cellular cement —immure themself in it. The most peripheric layer of not calcified justformed cement is called as cementoid (precement).

The intercellular substance of cellular cement includes fibers and basic substance. The fibers section on "own", t. i. formed by cells of cement and going mainly in parallel surfaces of a root of a tooth, and "external", by which carry fibers of periodontal ligament (are focused perpendicularly to the surfaces of a root). The parity between fibers of both types varies over a wide range in various sites of cement.

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<td>to use the material on(at) pages</td>
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<td>to learn the new material and be ready to write a summary</td>
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<td>to be ready to answer the topic</td>
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</tbody>
</table>

Literature recommended

- Main Sources:
- Additional ones:

3.4 How to work with the literature recommended:

3.5. Self-control material:

A. Questions to be answered:

B. Test tasks to be done:
4. Self-preparation at class.
   1) Listen to the information;
   2) Work with the tables, corpse, anatomical damp preparation;
   3) Ask about the problems that haven’t been found in the information given.
5. Self-preparation work at home.
   1) Review the material learnt at class;
   2) Compose the plan of your answer;
   3) Answer the questions to this topic;
   4) Do the test given above;
6. The subject of the research work.