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*Утверждено центральным координационным методическим советом
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Учебное пособие посвящено одному из важнейших разделов нормальной анатомии человека – анатомии жевательного аппарата. В нем систематизированы и обобщены современные представления о строении основных частей жевательного аппарата. Терминология приведена в соответствии с Международной анатомической и гистологической номенклатурами.

Предназначено для студентов, обучающихся в медицинских вузах на английском языке.

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GENERAL CHARACTERISTICS OF THE MASTICATORY APPARATUS

The purpose of studying the topic: the student acquires a general understanding of the structure of the masticatory apparatus.

As a result, the student should know:

- Definition of the masticatory apparatus
- Structures that form the masticatory apparatus

The masticatory apparatus is part of the digestive apparatus and consists of organs that perform mechanical and chemical processing of food products. The human masticatory apparatus is a complex interacting and interdependent system of organs that takes part not only in digestion, but also in breathing, in the formation of voice and speech.

The masticatory apparatus is formed by a solid support – the skeleton, the temporomandibular joint; masticatory muscles; organ systems for capturing food and giving it consistency for subsequent swallowing (lips, cheeks with their facial muscles, soft palate and tongue; special organs necessary for mechanical crushing of food – teeth; organs secreting mucus, secretions and enzymes (salivary glands); a specific nervous apparatus that determines the qualitative characteristics of food and a large receptor field that perceives tactile, thermal and all other external stimuli; part of the speech apparatus – the resonator (cheeks, lips, tongue, hard palate) and sound formers.

The chewing function consists of the main phases:

– opening and closing the mouth;

– moving the mandible forward and backward, right and left;

– and its combined movements – it is carried out when the state of the masticatory muscles changes (contraction and relaxation), the ratio of the elements of the temporomandibular joint and the relationship between the dentition.

ANATOMY OF THE MAXILLA

The purpose of studying the topic: the student acquires knowledge about the structure of the maxilla.

As a result, the student should know:

- Anatomy of the maxilla
- Structure of the maxillary sinus

The maxilla (fig. 1) is a paired bone with a complex structure due to its diverse functions: participation in the formation of cavities for the sensory organs – the eye socket and nose, in the formation of the septum between the cavities of the nose and mouth, as well as participation in the functioning of the masticatory apparatus. The transfer of the grasping function from the jaws (as in animals) to the hands in humans due to their work activity has led to a reduction in the maxilla. At the same time, the appearance of speech in humans made the structure of the jaw more delicate. All this determines the structure of the maxilla, which develops on the basis of connective tissue.

It is a pneumatic bone because contains a large cavity, the maxillary sinus (*sinus maxillaris; antrum Highmori*).

Maxilla has body and four processes: alveolar, frontal, palatine and zygomatic.

The body of the maxilla, *corpus maxillae* (in which the maxillary sinus is located) is irregular in shape and has four surfaces: anterior, orbital, infratemporal and nasal.

Anterior surface (*facies anterior*) is slightly concave. This surface in modern humans, due to the weakening of the chewing function caused by artificial cooking, it is concave, and in Neanderthals it was flat. It is continuous downwards with the anterior surface of the alveolar process (*processus alveolaris*). Superiorly the anterior surface of the maxilla is separated from the orbital surface by the infraorbital margin (*margo infraorbitalis*). Infraorbital foramen (*foramen infraorbitale*) opens below it. A small depression called the canine fossa (*fossa canina*) is located below infraorbital foramen. The medial border of the anterior surface is formed by the nasal notch (incisura nasalis)

whose edge extends forward to form the anterior nasal spine (spina nasalis anterior). The nasal notches of both maxillae limit the anterior bony aperture of the nose, which leads into the nasal cavity. The orbital surface (facies orbitalis) is flat, triangular in shape. It forms the inferior wall of the orbit. The anterior border of the orbital surface is smooth and forms the free infraorbital margin (*margo infraorbitalis*).

Medially the infraorbital margin curves upwards and is continuous with the frontal process, on which the lacrimal crest (*crista lacrimalis anterior*) stretches. The infraorbital groove (*sulcus infraorbitalis*) originates near the posterior border of the orbital surface. It stretches forwards, becomes deeper and continuous with the infraorbital canal (*canalis infraorbitalis*), which opens on the anterior surface of the maxilla by means of infraorbital foramen.

The alveolar canals (*canales alveolares*) arise on the inferior wall of the infraorbital canal. They transmit nerves and vessels to the upper teeth.

The infratemporal surface (*facies infratemporalis*) faces the infratemporal and pterygopalatine fossa.

It is separated from the anterior surface by the base of the zygomatic process. The infratemporal surface is often convex and forms the maxillary tuberosity (*tuber maxillae*), on which there are small openings of the dental canals, the dental foramina (*foramina alveolaria*).

Medial to the tuber maxilla there is the greater palatine groove (*sulcus palatinus major*). The nasal surface (*facies nasalis*) is continuous inferiorly with the palatine process. Wide opening of the maxillary sinus (*hiatus sinus maxillaris*) is in its superoposterior part.

The nasolacrimal groove (*sulcus lacrimalis*) stretches in front of the hiatus of the maxillary sinus. This groove meets same groove of the lacrimal bone to form the nasolacrimal canal (*canalis nasolacrimalis*). The nasal surface carries a horizontal eminence called the conchal crest (*crista conchalis*) to which the inferior nasal concha is attached.

The maxillary sinus (sinus maxillaris; antrum Highmori) is air-filled cavity. It is the most voluminous and is located in the body of

the maxilla. In newborns, the sinus has a slit-like shape and occupies a limited space between the anterior wall of the sinus, the lower wall of the orbit and the alveolar process. Its longitudinal size is 7–14 mm, its height is 5–10 mm. By the end of the 1st year of life, the sinus acquires a rounded shape, gradually increasing as the facial skull grows; by the age of 6–7 years, it acquires that multifaceted shape that is characteristic of an adult. After changing teeth, the volume of the sinus increases in accordance with the growth of the maxillofacial area and is finally formed by the age of 15–20 years. In adults, the maxillary sinus has a volume of about 15–20 cm^3. The maxillary sinus communicates with the nasal cavity by the maxillary hiatus. The anterior wall extends from the lower edge of the orbit to the alveolar process of the maxilla. Under the edge of the orbit, approximately 0.5–1 cm below it, the infraorbital canal opens, through which the neurovascular bundle emerges: the maxillary nerve, as well as the corresponding artery and vein. The upper wall is the roof of the sinus and separates it from the orbit. It contains a canal, and sometimes a semicanal, open into the lumen of the maxillary sinus, in which the maxillary nerve and vessels are located. That is why pathological processes in the sinus can affect this neurovascular bundle. The lower wall of the infraorbital canal protrudes into the lumen of the sinus in the form of a pronounced ridge, and in some cases the mucous membrane of the sinus only covers the nerve. The medial edge of the upper wall of the sinus in the anterior sections is connected to the lacrimal bone and participates in the formation of the upper opening of the nasolacrimal canal. Posteriorly, it borders on an orbital plate that separates the orbit from the cells of the ethmoidal labyrinth. The medial wall of the sinus is the outer wall of the nasal cavity. In its anterior section there is a nasolacrimal duct, which opens into the lower nasal passage. The outlet of the sinus is located almost under its very roof and opens into the middle nasal meatus. That is why the outflow from it in a vertical position of the body is difficult. The posterior wall of the sinus stands obliquely and corresponds to the tubercle of the maxilla protruding into the area of the pterygopalatine fossa. In its upper section there are

branches of the superior alveolar nerves. In the posterosuperior section, this wall comes close to the group of posterior cells of the ethmoidal labyrinth and the sphenoid sinus. The close proximity to the pterygopalatine fossa, which contains the main trunk of the second branch of the trigeminal nerve, the maxillary artery, the venous plexus associated with the orbit, and the cavernous sinus of the dura mater, may contribute to the transition of pathological processes from the maxillary cavity to this area. The lower wall of the sinus is formed by the alveolar process of the maxilla.

The frontal process (*processus frontalis*) projects upward and joins the nasal part of the frontal bone.

It has medial and lateral surfaces. The lateral surface is separated into anterior and posterior parts by the lacrimal crest (*crista lacrimalis anterior*). The medial surface carries the ethmoidal crest (*crista ethmoidalis*) for attachment of the middle nasal concha of the ethmoid bone.

The alveolar process (*processus alveolaris*) projects downwards from body of the maxilla. Its inferior border carries the alveolar arch (*arcus alveolaris*), which has a row of tooth sockets (*alveoli dentalis*) for the roots of eight teeth.

The sockets are separated from one another by interalveolar partitions (*septa interalveolaria*). Three posterior sockets are divided by interradicular partitions (*septa interraducularia*) into smaller sockets according to the number of roots which the teeth have. The anterior surface of the alveolar process has longitudinal ridges called alveolar eminences (*juga alveolaria*).

The zygomatic process (*processus zygomaticus*) begins from the laterosuperior part of the body and unites the zygomatic bone.

The palatine process (*processus palatinus*) together with the horizontal plate of the palatine bone forms the bony septum between the nasal cavity and cavity of the mouth, called hard palate. The palatine process has a sharp projection facing the nasal cavity, called the nasal crest (*crista nasalis*). Nasal crest adjoins the inferior border of the vomer and the cartilaginous nasal septum.

It is separated from the anterior surface by the base of the zygomatic process. The infratemporal surface is often convex and forms the maxillary tuberosity (*tuber maxillae*), on which there are small openings of the dental canals, the dental foramina (*foramina alveolaria*). Medial to the tuber maxilla there is the greater palatine groove (*sulcus palatinus major*). The nasal surface (*facies nasalis*) is continuous inferiorly with the palatine process.

A small opening that leads into the incisive canal (canalis incisivus) is near the anterior end of the nasal crest on the superior surface. The superior surface of the palatine process is smooth and slightly concave.

The inferior surface, facing the oral cavity, is rough and carries longitudinal palatine grooves (sulci palatini) containing the nerves and vessels.

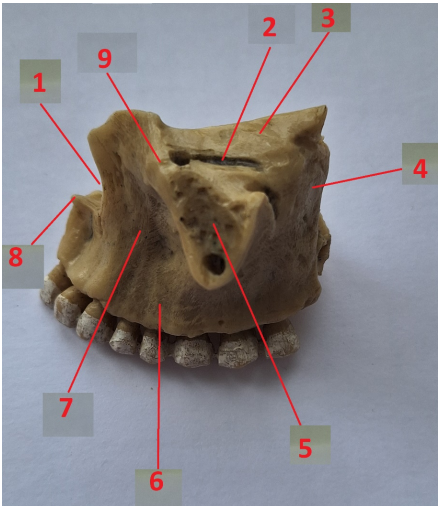

Fig. 1. Left maxilla. External aspect: *1* – incisura nasalis; *2* – sulcus infraorbitalis; *3* – facies orbitalis; *4* – tuber maxillae; *5* – processus zygomaticus; *6* – processus alveolaris; *7* – facies anterior; *8* – spina nasalis anterior; *9* – margo infraorbitalis

ANATOMY OF THE MANDIBLE

The purpose of studying the topic: the student acquires knowledge about the structure of the mandible.

As a result, the student should know:

- Anatomy of the mandible

The mandible, *mandibula* (fig. 2), is a movable bone of the skull. It has a horseshoe shape, determined both by its function and by the development of the first gill (mandibular) arch, the shape of which it retains to a certain extent. In many mammals, including lower primates, the mandible is a paired bone and in humans it is formed from two rudiments, which, gradually growing, merge in the 2nd year after birth into an unpaired bone, however, maintaining a trace of fusion along the midline both halves.

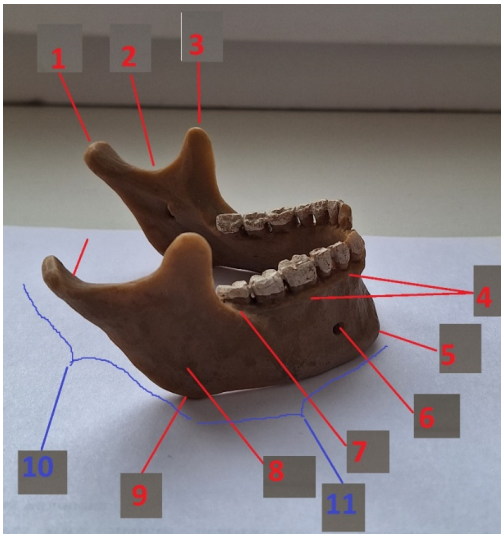

Fig. 2. Mandible. External aspect: *1* – head of the mandible; *2* – notch of the mandible; *3* – coronoid process; *4* – alveolar part; *5* – mental protuberance; *6* – mental foramen; *7* – oblique line; *8* – masseteric tuberosity; *9* – angle of the mandible; *10* – branch of the mandible; *11* – body of the mandible

Since the masticatory apparatus consists of a passive part, that is, teeth that perform the function of chewing, and an active part, that is, muscles, the mandible is divided into a horizontal part, or body, *corpus mandibulae*, which carries the teeth, and a vertical part in the form of two rami, *rami mandibulae*, serving to form the temporomandibular joint and attach the masticatory muscles. Both of these parts – horizontal and vertical – converge at an angle, *angulus mandibulae*, to which the masticatory muscle is attached on the outer surface, causing the appearance of the masseteric tuberosity, *tuberositas masseterica*. On the inner surface of the angle there is a pterygoid tuberosity, *tuberositas pterygoidea*, the place of attachment of another masticatory muscle, *m. pterygoideus medialis*, therefore the activity of the masticatory apparatus affects the magnitude of this angle. In newborns it is close to 150°, in adults it decreases to 130–110°, and in old age, with the loss of teeth and weakening of the act of chewing, it increases again.

The structure and relief of the body of the mandible are determined by the development of teeth and its participation in the formation of the mouth. Thus, the alveolar part, *pars alveolaris*, bears teeth, as a result of which on its alveolar arch, *arcus alveolaris*, there are dental alveoli, *alveoli dentales*, with interalveolar partitions, *septa alveolaria*, corresponding to the alveolar eminences, *juga alveolaria*. The rounded lower edge of the body is massive, forms the base of the mandible, *basis mandibulae*. In old age, when teeth fall out, the pars alveolaris atrophies and the whole body becomes thin and low. Along the midline of the body, the crest of the symphysis passes into the triangular mental protuberance, *protuberantia mentalis*, the presence of which characterizes modern humans. Of all mammals, the chin is expressed only in humans, and even then modern ones.

On the sides of the mental protuberance there are noticeable mental tubercles, *tuberculi mentalia*, one on each side. On the lateral surface of the body, at the level of the space between the first and second premolars, there is a mental foramen, *foramen mentale*, which is the exit of the mandibular canal, *canalis mandibulae*, which serves for

the passage of nerves and blood vessels. An oblique line, *linea obliqua*, stretches back and upward from the area of the tuberculum mentale. On the inner surface in the area of the symphysis, two mental spines, *spinae mentales*, protrude – the places of tendon attachment mm. genioglossi.

On the sides of the spina mentalis, closer to the lower edge of the mandible, the attachment points of the digastric muscle, *fossae digastricae*, are noticeable. Further backwards, the mylohyoid line, *linea mylohyoidea*, goes back and upward towards the branch, the place of attachment of the muscle of the same name.

The ramus of the mandible, *ramus mandibulae*, extends upward on each side from the posterior part of the body of the mandible. On its inner surface (fig. 3) there is a mandibular foramen, *foramen mandibulae*, leading into the mandibular canal.

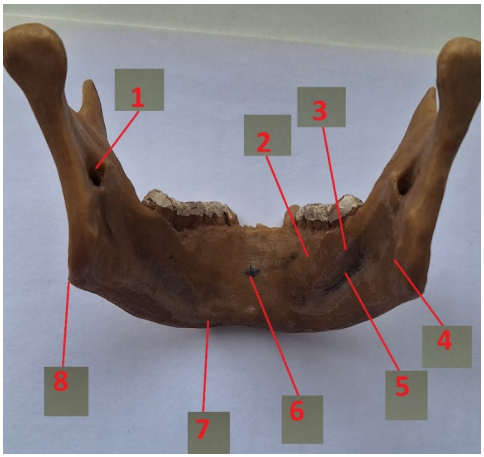

Fig. 3. Mandible. Inside aspect: *1* – foramen mandibulae; *2* – fovea sublingualis; *3* – linea mylohyoidea; *4* – tuberositas pterygoidea; *5* – fovea submandibularis; *6* – spina mentalis; *7* – fossa digastrica; *8* – angulus mandibulae

The inner edge of the hole protrudes in the form of lingula of the mandible, *lingula mandibulae*, where the lig. sphenomandibulare is attached. The lingula is more developed in humans than in mon-

keys. Posterior to the lingula, the mylohyoid groove, *sulcus mylohyoideus* (trace of the nerve and blood vessels), begins and goes down and forward. At the top, the ramus of the mandible ends in two processes: the anterior, coronoid, *processus coronoideus*, was formed under the influence of the traction of a strong temporal muscle, and the posterior, condylar, *processus condylaris*, is involved in the articulation of the mandible with the temporal bone. The mandibular notch, *incisura mandibulae*, is formed between both processes. The condylar process has a head, *caput mandibulae*, and a neck, *collum mandibulae*; in front of the neck there is pterygoid pit, *fovea pterygoidea* (place of attachment of m. pterygoideus lateralis).

ANATOMY OF THE PALATINE BONE

The palatine bone (*os palatinum*) is a paired bone situated in the back of the nasal cavity (fig. 4). It looks like a plate bent at an angle, lies in the posterior part of the nasal cavity and forms part of its bottom (hard palate) and the side wall there.

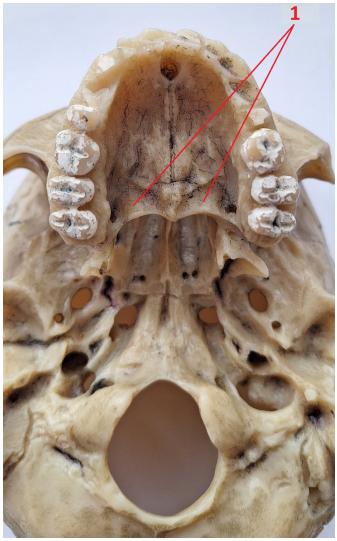

Fig. 4. External base of the skull: *1* – horizontal plate of palatine bone

It participates in the formation of a number of cavities of the skull – the nasal cavity, mouth, orbits and pterygopalatine fossa. This participation determines its unique structure in the form of a thin bone, consisting of two plates connected to each other at right angles and complementing the maxilla.

The horizontal plate (lamina horizontalis) takes part in formation of the hard palate. It has two surfaces: nasal and palatine. The nasal surface (facies nasalis) of the horizontal plate is slightly concave and smooth, the palatine surface (facies palatine) is rough.

The nasal surface of the horizontal plate carries a posterior nasal spine (spina nasalis posterior) on the posteromedial end and nasal crest (crista nasalis) on the medial border. The palatine surface carries one or two lesser palatine foramina (foramina palatine minora). The greater palatine foramen (foramen palatinum majus) is situated in front of them. These foramina are entrances of the same named canals. The palatine vessels and nerves leave the canals through them.

The perpendicular plate (lamina perpendicularis) takes part in formation of the lateral nasal wall. Maxillary surface (facies maxillaris) of the perpendicular plate has greater palatine groove (sulcus palatinus major) which together with the paltine groove of the maxilla and pterigoid process forms the greater palatine canal (canalis palatinus major). The canal opens on the hard palate by the greater palatine foramen.

The ethmoidal crest (crista ethmoidalis) extends sagittaly on the nasal surface (facies nasalis) of the perpendicular plate. It is for attachment of the middle nasal concha of the ethmoid bone. The conchal crest (crista conchalis) is below and parallel to the ethmoid crest. Conchal crest serves for attachment of the inferior nasal concha. The palatine bone has three processes.

The pyramidal process (processus pyramidalis) projects backward and laterally from the junction of the horizontal and perpendicular plates. It is wedged into the notch between the plates of the pterygoid process of the sphenoid bone and limits the pterygoid fossa from below. Nerves and vessels penetrate it vertically through the lesser palatine canals (canales palatini minores).

The superior border of the perpendicular plate terminates as two processes: orbital process (processus orbitalis) and sphenoidal process (processus sphenoidalis). The processes are separated by the sphenopalatine notch. The notch with the body of the sphenoid bone adjacent to it forms the sphenopalatine foramen.

The orbital process (processus orbitalis) adjoins the orbital surface of the maxilla. It forms the posterior part of the floor of the orbit.

The sphenoidal process (processus sphenoidalis) lies posterior to the sphenopalatine notch and approaches the sphenoid bone from below.

DEVELOPMENT OF THE MAXILLA AND MANDIBLE

The formation of the anlage of the mandible and maxilla is closely related to the first gill arch. Impaired formation of the anlage can lead to the formation of abnormally large or small maxilla and mandible. Macrogenia is an increase in the size of the mandible, and microgenyia is an abnormal decrease in the size of the mandible.

Macrognotia and micrognothia are abnormal increases and, accordingly, decreases in the size of the maxilla. The basis of the first gill arch is made up of two Meckel's cartilages, which stretch along the entire length of the mandibular processes. The distal ends of these cartilages converge near the midline, and the proximal ends take part in the formation of the auditory ossicles. At approximately 6–7 weeks of embryonic development, the anlage of the mandible bone appears outward from the Meckel's cartilages, which is formed directly from the mesenchyme. The Meckel's cartilages themselves do not take part in the formation of the bone of the mandible and subsequently disappear.

In the same way, that is, by direct osteogenesis, the bone beams of the maxilla are formed. At the beginning of the third month, the bone beams of the upper and lower jaws form a kind of groove, open towards the oral cavity. Subsequently, tooth germs descend into it, and blood vessels and nerve fibers pass at the bottom of the groove. Gradually, the number of bone beams increases, and they form the spongy substance of the body of the maxilla and mandible. The wide spaces between the beams are filled with loose connective tissue and bone marrow. As for the free edges of the bone groove (future alveolar processes), they quickly grow towards the edge of the jaws, covering the tooth buds from below and from the sides. During embryonic life, the mandible is a pair of bones, the ends of which are connected by fibrous cartilage. Shortly before birth, coarse fibrous bone is replaced by lamellar bone. The posterior end of the developing mandible comes into contact with the squama of the temporal bone and forms the temporomandibular joint. It forms an articular disc consisting of fibrous cartilage.

AGE-RELATED CHANGES IN THE MASTICATORY APPARATUS

The purpose of studying the topic: the student acquires knowledge of the age-related characteristics of the masticatory apparatus.

As a result, the student should know:

- Age-related changes in teeth
- Age-related changes in the maxilla and mandible
- Age-related changes in the masticatory muscles

The aging process of the body determines changes in all organs and tissues of the masticatory apparatus, including teeth, mucous membrane of the oral cavity, tongue, lips and facial skin, as well as in the masticatory and facial muscles, the temporomandibular joint and in the bone tissue of the jaws. Age-related morphofunctional changes affect hard (enamel, dentin, cement) and soft (pulp) dental tissues: the enamel gradually wears off over time, its color changes from white with a bluish or yellowish tint to yellow-brown, it becomes less transparent, and the appearance of cracks noticeable without magnifying instruments, which is explained by the formation of a significant amount of secondary dentin, a decrease in the enamel layer and changes in the pulp. The color of teeth also depends on the degree of penetration of the coloring elements of saliva and food into the organic substances of the enamel.

The strength of enamel changes with age; for example, the phenomenon of relative caries resistance of enamel acquired with age is known. Uniform wear of enamel and dentin during life fits into the following sequence of abrasion of tooth surfaces: by the age of 25, slight abrasion is noted on the cutting edge of the incisors; by the age of 30 – a slight exposure of the dentin of the incisors with the initial phenomena of abrasion of the cusps of molars; by the age of 35 – a sharp exposure of the dentin of the incisors, pronounced abrasion of the cusps of the molars; by the age of 40 – a decrease in the height of the incisors due to abrasion, exposure of the dentin of the molars;

sometimes such changes occur earlier in the pathological course of abrasion; by the age of 45 – severe wear of the incisors and molars; from the age of 50 – a gradual crater-shaped deepening of the central part of the molars; by the age of 60 – significant abrasion levels the surface of the molars. This diagram of the sequence of abrasion of hard dental tissues is widely used in forensic practice to determine age by dental status.

The study of the morphological structure of hard dental tissues at the micro level indicates that with age, patients develop numerous defects in the enamel in the form of chips and cracks both in the crown the tooth and in the area of the enamel-cement junction; in dentin, partial (middle age) or complete (elderly and senile age) obliteration of dentinal tubules is observed. Such morphological changes in the hard tissues of teeth are most common in the elderly and senile age and accompany non-carious lesions (wedge-shaped defects, increased tooth abrasion).

The periodontium of the tooth plays a major protective, adaptive role in relation to various chewing loads when chewing food. Endurance to the chewing loads of the periodontium depends on the age, general health of the person, the state of the immune system, the aging process, the ratio of the length of the crown and root of the tooth, as well as the condition of the gums. With age, periodontal endurance decreases significantly, the circular ligament of the tooth degenerates and its connection with the root cement is disrupted. Physiological compensation for weakening of the periodontium is the abrasion of hard tooth tissues. Age-related progression of periodontal destruction is a consequence of tooth loss and a decrease in gum level due to progressive loss of bone tissue. Age-related changes in the periodontium in a person aged 60 years are manifested by a narrowing of the periodontal fissure. The narrowing is expressed more than 10 times compared to a young organism at 13–20 years old. In people of older age groups, the surface of the alveolar bone is jagged, uneven, and the bone tissue of the jaws contains fewer fibers and cells than in young people. With age, periodontal endurance decreases significantly, the

circular ligament of the tooth degenerates and its connection with the root cement is disrupted. Physiological compensation for weakening of the periodontium is the abrasion of hard tooth tissues. Age-related progression of periodontal destruction is a consequence of tooth loss and a decrease in gum level due to progressive loss of bone tissue. Age-related changes in the periodontium in a person aged 60 years are manifested by a narrowing of the periodontal fissure. The narrowing is expressed more than 10 times compared to a young organism at 13–20 years old. In people of older age groups, the surface of the alveolar bone is jagged, uneven, and the bone tissue of the jaws contains fewer fibers and cells than in young people. With age, unevenness of the cementum of the tooth roots occurs, especially in people of older age groups. It has also been established that with age, the sensitivity of periodontal receptors decreases, especially with the development of inflammatory or dystrophic periodontal pathology due to the appearance of pathological periodontal-muscular and periodontal-muscular pathological reflexes of the masticatory apparatus.

As a person ages, involutive processes occur in the bones of the facial skeleton (with the exception of the zygomatic bone), including in the jaws. It has been established that the content of water, organic and inorganic substances in the bone tissue of the jaws is subject to age-related changes: for example, at a young age the content of the inorganic matrix is 42.4 ± 1.9 %, at middle age – 43.2 ± 1.85 %, in in old age – 47.1 ± 1.3 %, in old age – 50.3 %. Elderly and senile people have anatomically larger maxillary sinuses than young and middle-aged people, which is obviously associated with age-related atrophy of the bone tissue of the upper jaw, as well as with the loss of natural teeth. The average size of the maxillary sinuses in old and senile age is smaller in women than in men. Morphometric indicators of the maxillary sinuses in elderly and senile age do not depend on age and are determined by the loss of natural teeth, premolars and molars. The structure and optical density of bone tissue in the area of the bottom of the maxillary sinuses also depends on the degree of loss of teeth in the maxilla (partial or complete). The loss of premolars and molars leads

to a decrease in the optical density of the bone tissue of the alveolar process of the maxilla in the area of the bottom of the sinus. As the human body ages, natural teeth are lost and atrophy of the alveolar part of the lower jaw occurs (similar to the upper jaw), which occurs in a centrifugal direction. If in the upper jaw after the loss of teeth the alveolar process is subject to atrophy to a greater extent on the vestibular side, then the alveolar part of the lower jaw after the loss of teeth atrophies to a greater extent on the lingual side. The progression of age-related atrophic processes in toothless jaws leads to the emergence of "senile" progeny in humans. This ratio of the jaws with complete loss of teeth occurs due to atrophic processes of the jaws, when the angle of the lower jaw increases with atrophy of the alveolar process of the upper and alveolar parts of the lower jaw, which emphasizes the developing progenic relationship of toothless jaws. This condition is characterized by a progenic ratio of toothless jaws (the alveolar arch of the lower jaw becomes larger than the alveolar arch of the upper jaw): under such conditions, the direction of the chewing load on the lower jaw changes, which may affect its strength properties. Progeny makes a face look senile to a greater extent than its age-related changes. Sometimes there is an expansion of the mandibular canal in people of older age groups due to existing osteoporosis of the lower jaw. Age-related changes in the bone tissue of the jaws (atrophy) lead to exposure of the neck of natural teeth, which can cause hyperesthesia of hard dental tissues in clinical practice. Age-related atrophy is accompanied by a uniform decrease in the height of the alveolar part of the lower jaw throughout the entire dentition. Loss of teeth leads to accelerated loss of bone tissue in the area of the alveolar part of the lower jaw, which is accompanied by a decrease in its height, and with significant loss of teeth, an increase in the mandibular angle is observed. These processes can be most clearly observed in toothless jaws.

As the human body develops and ages, the rate of saliva secretion increases, and in old age it decreases, while in old people the secretion of saliva decreases as a result of atrophy of the gland parenchyma and atrophy of the cells of the excretory ducts. As we age,

against the background of a decrease in salivation, the content of total protein in mixed saliva increases and the viscosity of saliva increases.

In the masticatory and facial muscles, a slight atrophy of muscle fibers also occurs, sclerosis of the connective tissue and fiber located between them, which contributes to the appearance of functional disorders of their activity, therefore, inappropriate functions (parafunctions) of the chewing and facial muscles (that is, increased inappropriate activity, tension or even spasm of the chewing and facial muscles, as well as the muscles of the tongue), which can be caused by the loss of teeth or the use of removable dentures with unsatisfactory fixation, as well as occupational hazards.

With age, due to the loss of teeth or their increased wear, the heads of the mandible increasingly shift backwards and inwards, and in the "aging" temporomandibular joint the cartilaginous surface flattens, restructuring is observed in the articular disc, the heads of the mandible, ligaments up to meniscus deformation; Instead of four layers covering the surface of the heads of the lower jaw, in people of older age groups only two layers are detected, while the outer layer, consisting of collagenous connective tissue, is transformed into fibrous cartilage. Signs of the "senile temporomandibular joint" also include changes in its synovial membrane, which are expressed in the appearance of "cartilage-like" cells along with degenerative disorders of the villi (vacuolization, homogenization and calcification). Characteristic signs of an "aging" temporomandibular joint include flattening of the middle of the cartilaginous surface and degenerative changes in cells. Similar age-related changes occur in the bone elements of the articular surfaces of the temporomandibular joint. With age, partial and/or complete loss of teeth, a decrease in interalveolar height, and a distal shift of the mandible lead to a decrease in the linear dimensions of the head of the mandible, the depth of the mandibular fossa, the height of the articular tubercle, as well as a decrease in the thickness and strength of the temporomandibular joint capsule. Unilateral dental defects are characterized by asymmetric changes in the articular surfaces and capsule of the temporomandibular joint.

ANATOMY OF THE TONGUE

The purpose of studying the topic: the student acquires knowledge about the structure of tongue.

As a result, the student should know:

- Basic parts of the tongue
- Tongue papillae
- Muscles of the tongue

The tongue, lingua (glossa, for example, inflammation of the tongue – glossitis) is a muscular organ (voluntary, striated fibers) covered with a mucous membrane. The tongue is distinguished by a large part, or body, *corpus linguae*, a forward-facing apex, *apex linguae*, and a root, *radix linguae*, through which the tongue is attached to the mandible and hyoid bone. The convex upper surface of the tongue faces the palate and pharynx and is called dorsum (*dorsum linguae*). A shallow terminal groove, *sulcus terminalis*, divides the back of the tongue into two unequal parts: a large (2/3) front part, located horizontally (at the bottom of the mouth), and a smaller back part of the back, it is located almost vertically and faces the back wall pharynx. In the middle of the terminal groove there is a *foramen coecum linguae* – a blind opening. On the lateral surface the tongue is limited by the margins, *margo linguae*. The lower surface of the tongue, *facies inferior linguae*, is free only in the front part; the back part is occupied by muscles.

Both sections of the tongue (body and root) differ both in their development and in the structure of the mucous membrane. The mucous membrane of the tongue is a derivative of the I, II, III and IV gill arches, as indicated by its innervation by the nerves of these arches (V, VII, IX and X pairs of cranial nerves). From the first gill arch (mandibular) grow two lateral sections, which, fused along the midline, form the anterior section of the tongue. A trace of the fusion of the paired rudiment remains for life on the outside in the form of a groove on the back of the tongue, *sulcus medianus linguae*, and on the inside – in the form of a fibrous septum of the tongue, *septum linguae*.

The posterior section (where the lingual tonsil) develops from the II, III and IV gill arches and fuses with the anterior one along the linea terminalis. Its mucous membrane has a nodular appearance from the lymphoid follicles located here.

The collection of lymphoid formations of the posterior part of the tongue is called the lingual tonsil, *tonsilla lingualis*, which is involved in the immune function of this organ. The mucous membrane of the tongue from its posterior section to the epiglottis forms three folds: *plica glossoepiglottica mediana*, and two lateral plicae *glossoepiglotticae laterales*; between them there are two pits, *valleculae epiglotticae*.

The papillae of the tongue, *papillae linguales*, are of the following types.

1. Filiform and conical papillae, *papillae filiformes et conicae*, occupy the upper surface of the anterior part of the tongue and give the mucous membrane of this area a rough or velvety appearance. They appear to function as tactile organs.

2. Fungiform papillae, *papillae fungiformes*, are located mainly at the apex and along the edges of the tongue, equipped with taste buds, so they are believed to be involved in the perception of taste.

3. The circumvallate papillae, *papillae vallatae*, are the largest, they are located immediately anterior to the foramen caecum and sulcus terminalis in the form of a Roman numeral V, with the apex facing backwards. Their number varies from 7 to 12. They contain a large number of taste buds.

4. Foliate papillae, *papillae foliatae*, are located along the edges of the tongue. In addition to the tongue, taste buds are found on the free edge and nasal surface of the palate and on the posterior surface of the epiglottis. The taste buds contain peripheral nerve endings that make up the receptor for the taste analyzer.

The muscles of the tongue form its muscle mass, which is divided into two symmetrical halves by a longitudinal fibrous septum, *septum linguae*. The upper edge of the septum does not reach the back of the tongue. All muscles of the tongue are, to one degree or another,

connected to the bones, especially the hyoid, and when they contract, they simultaneously change both the position and shape of the tongue, since the tongue is a single muscle formation in which isolated contraction of individual muscles is impossible. Therefore, the muscles of the tongue are divided according to their structure and function into three groups. The first group is the muscles that begin on the derivatives of the first gill arch of the mandible. Genioglossus muscle, *m. genioglossus*, the largest of the muscles of the tongue, reaching its highest development only in humans in connection with the appearance of articulate speech. It starts from the *spina mentalis*, which, under the influence of this muscle, is also most pronounced in humans and therefore serves as a sign by which the development of speech in fossil hominids is judged. From the spina mentalis, the muscle fibers diverge in a fan-shaped manner, with the lower fibers attaching to the body of the hyoid bone, the middle ones to the root of the tongue, and the upper ones bending forward into its apex. The continuation of the muscle in the thickness of the tongue are vertical fibers between the lower surface and its back, *m. verticalis.* The predominant direction of muscle bundles m. genioglossus and its continuations – m. verticalis – vertical. As a result, when they contract, the tongue moves forward and flattens.

The second group is the muscles that begin on the derivatives of the second gill arch (on the processus styloideus and the lesser horns of the hyoid bone).

Styloglossus muscle, *m. styloglossus*, starts from processus styloideus and from lig. stylomandibulare, goes down and medially and ends on the lateral and lower surfaces of the tongue, crossing with the fibers of m. hyoglossus and m. palatoglossus. When both muscles contract, they pull the tongue up and back.

Superior longitudinal muscle, *m. longitudinalis superior*, begins on the lesser horns of the hyoid bone and the epiglottis and stretches under the mucous membrane of the dorsum of the tongue on both sides from the septum linguae to the apex.

Inferior longitudinal muscle, *m. longitudinalis inferior*, beginning – lesser horns of the hyoid bone; runs along the lower surface of the tongue between m. genioglossus and m. hyoglossus to the tip of the tongue.

The predominant direction of the muscle bundles of this muscle group is sagittal, due to which, when they contract, the tongue moves backward and shortens.

The third group is the muscles starting on the derivatives of the third gill arch (on the body and greater horns of the hyoid bone).

Hyoglossus muscle, *m. hyoglossus*, starts from the greater horn and the nearest part of the body of the hyoid bone, goes forward and upward and is woven into the side of the tongue along with the fibers of m. slyloglossus and m. transversus. Pulls the tongue back and down. Transverse muscle, *m. transversus linguae*, located between the upper and lower longitudinal ones in the horizontal plane from the septum linguae to the edge of the tongue. Its posterior part is attached to the hyoid bone.

The predominant direction of the muscle bundles of this muscle group is frontal, as a result of which the transverse size of the tongue decreases when these muscles contract. With unilateral action, their tongue moves in the same direction, and with bilateral action, down and back.

The origin of the tongue muscles is at three bony points located behind and above (processus styloideus), behind and below (os hyoideum) and in front of the tongue (spina mentalis mandibulae), and the arrangement of muscle fibers in three mutually perpendicular planes allows the tongue to change its shape and move in all three directions.

All muscles of the tongue have a common source of development – the occipital myotomes, therefore they have one source of innervation – the XII pair of cranial nerves, n. hypoglossus.

The tongue is supplied by a. lingualis, the branches of which form a network inside the tongue with loops elongated according to the course of the muscle bundles.

Venous blood is carried into v. lingualis, flowing into v. jugularis interna. Lymph flows from the tip of the tongue to the lnn. submentales, from the body – to lnn. submandibulares, from the root – to lnn. retropharyngeales, as well as in lnn. linguales and superior and inferior deep cervical nodes. Of these, ln is of great importance. jugulodigastricus and ln. juguloomohyoideus. Most of the lymphatic vessels from the middle and posterior thirds of the tongue intersect. This fact has practical significance: in case of a cancerous tumor on one half of the tongue, lymph nodes on both sides must be removed.

Innervation of the tongue: muscles – from n. hypoglossus; mucous membrane – in the anterior two thirds of the n. lingualis (from the third branch of n. trigeminus, V pair) and its constituent chordae tympani (n. intermedins, VII pair) – taste fibers to the fungiform papillae; in the posterior third, including papillae vallatae, from n. glossopharyngeus, IX pair; root area near the epiglottis – from n. vagus (n. laryngeus superior, X pair).

DEVELOPMENT OF THE TONGUE

The tongue (fig. 5) develops from several anlages, which look like tubercles, located at the bottom of the primary oral cavity in the region of the ventral sections of the first three gill arches. First of all, in the fourth week, an unpaired tubercle (tuberculum impar) is formed, located in the midline between the ends of the first and second gill arches. Subsequently, part of the back of the tongue develops from this tubercle, which in the formed organ is located in front of the foramen cecum. As a result of abnormal development of the unpaired lingual tubercle, a double or accessory tongue can be formed. The foramen cecum is a small hole at the root of the tongue, remaining at the site of the origin of the thyroid gland. Somewhat later, anterior to the unpaired tubercle, on the inner surface of the first gill arch, in the corner formed by the circumvallate papillae, two paired tubercles are formed: these are the so-called lateral lingual tubercles. Growing and merging together, they give rise to most of the body of the tongue and its tip. A defect in tongue development that occurs when the lateral lingual tubercles do not fully fuse is called a “cleft tongue” (splitting of the tip of the tongue).

The root of the tongue arises from a thickening of the mucous membrane located at the level of the second and third gill arches, lying behind the foramen caecum. The above-mentioned rudiments of the tongue quickly grow together, forming a single organ. The epithelial lining of the tongue initially consists of one or two rows of cells. By the end of the second month of embryogenesis, the epithelium becomes multilayered. At the same time, tongue papillae begin to form. Initially, they are only growths of the epithelium, looking like tubercles. During this period, connective tissue is not yet part of the papillae. However, soon connective tissue begins to grow into the base of the papillae. Around the same time, taste buds form in the epithelium of the papillae. The earliest papillae to form are circumvallate papillae (week 7) and the foliate papillae. In this case, the circumvallate papil-

lae are formed along the boundary line between the root and body of the tongue. This line forms an angle open anteriorly. Foramen cecum is located at the apex of the angle. Later, fungiform and filiform papillae appear (10th week).

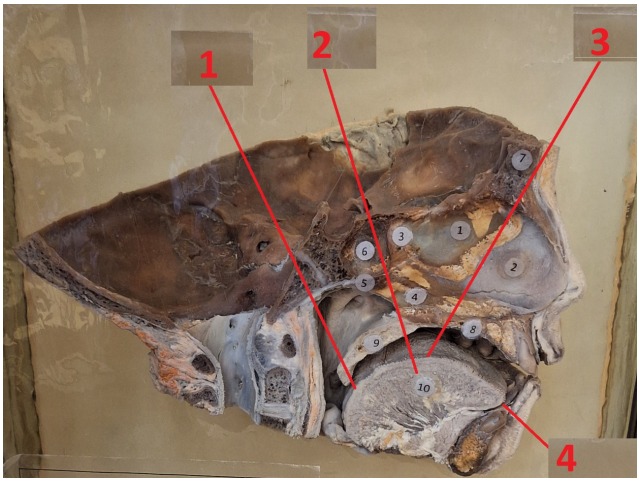

Fig. 5. Head section: *1* – root of the tongue; *2* – body of the tongue; *3* – dorsum of the tongue; *4* – apex of the tongue

The muscles of the tongue develop, as most authors believe, from myoblasts that migrate from the occipital myotomes. The lingual tonsil is formed in the area of the root of the tongue at the 5th month of embryogenesis.

The most common anomaly of tongue development is shortening of the frenulum of the tongue. It is characterized by limited mobility of the organ due to its fixation to the floor of the oral cavity as a result of incomplete degeneration of the epithelium growing into the underlying mesenchyme during the formation of the frenulum. As the tongue develops, abnormalities in its size may be observed. Macroglossia is an abnormal increase in the size of the tongue, and microglossia is an abnormal decrease in the size of the tongue. As for the size of the tongue, in newborns it is relatively large, which is associated with the act of sucking.

SALIVARY GLANDS

The purpose of studying the topic: the student acquires knowledge about the salivary glands.

As a result, the student should know:

- Anatomy of the parotid gland
- Anatomy of the sublingual gland
- Anatomy of the submandibular gland
- The structure of the minor salivary glands

The excretory ducts of three major salivary glands open into the oral cavity: parotid, submandibular and sublingual. Each of the major gland is covered with a strong connective tissue capsule.

In addition, in the oral mucosa there are numerous small glands, which, according to their location, are called; *glandulae labiales, buccales, palatinae, linguales*. They are located in the mucous membrane, submucosa and in the thickness of the buccinator.

According to the nature of the secretion, the glands can be: 1) serous, 2) mucous and 3) mixed. Three pairs of major salivary glands, *glandulae salivariae majores*, reaching significant sizes, extend beyond the mucous membrane and maintain contact with the oral cavity through their excretory ducts. These include the following glands.

Parotid gland (fig. 6), *glandula parotidea*, the largest of the salivary glands. The weight of the gland is 20–30 grams. The size of the gland varies widely. So, its length is 48–86 mm, width – 42–74 mm, thickness – 22–45 mm. The shape of the parotid glands can be semilunar, triangular, oval and trapezoidal.

This gland is lobulated, serous type. It is located on the lateral side of the face in front and slightly below the auricle and also penetrates the fossa retromandibularis. The gland is covered with fascia, *fascia parotidea*, which closes the gland into a capsule. The excretory duct of the gland, *ductus parotideus*, 5–6 cm long, extends from the

anterior edge of the gland, runs across m. masseter, passing through the fatty tissue of the cheek, pierces the m. buccinator and opens into the vestibule of the mouth with a small opening opposite the second molar of the maxilla. The course of the duct is extremely variable. The duct is bifurcated.

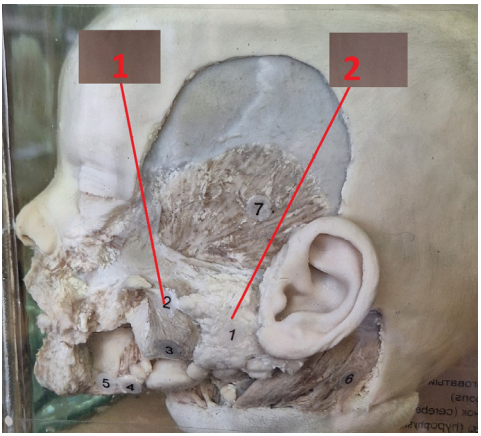

Fig. 6. Lateral region of the face: *1* – ductus parotideus; *2* – glandula parotis

The parotid salivary gland is adjacent in front to the posterior and outer surface of masseter, the branch of the mandible, the medial pterygoid muscle, the sphenomandibular ligament (lig. sphenomandibulare), the posterior pole of the submandibular salivary gland (in the lower part); behind – to the sternocleidomastoid muscle, the posterior belly of the digastric muscle and the mastoid process; medially – to the styloid process and the muscles extending from it (stylohyoid, styloglossus, stylopharyngeal), the internal jugular vein and the internal carotid artery lying inward from it with the nerves located near them (vagus, accessory, hypoglossal) and the tissue of the anterior part of the peripharyngeal space.

Laterally, the parotid gland is covered with subcutaneous fat. From above it is adjacent to the external auditory canal; from below – to the thickened sheet of the fasciae colli propriae.

The capsule of the gland is tightly fused with the tissue of the gland, it forms a bed for it. Spurs extend from the capsule deep into the gland. It is thickest on the outer surface of the gland closer to the sternocleidomastial muscle. On the side of the pharynx, the capsule is thinner and is completely absent for some extent or has several holes through which the inflammatory process can spread into the peripharyngeal space. Here the gland comes into contact with the fiber of the peripharyngeal space.

According to some authors, the capsule may be absent in the area of the external auditory canal.

Subcutaneous fatty tissue covers the outer layer of the fascia and is fused with mobile and thin skin.

The parotid salivary gland is separated by a deep layer of parotid fascia from the lateral wall of the pharynx, the posterior belly of the digastric muscle, the muscles and ligaments attached to the styloid process, and from the posterior surface of the medial pterygoid muscle. At the posterior edge of the mandible, the inner layer of this fascia merges with the outer layer, forming a strong septum at the angle of the lower jaw, which separates the lower pole of the parotid gland from the submandibular salivary gland.

Above the upper pole of the gland, both layers of the parotid fascia are attached to the lower edge of the zygomatic arch and the cartilaginous part of the external auditory canal. The upper pole of the gland is somewhat elongated and is located in the angle between the temporomandibular joint and the auditory canal.

The posterior surface of the gland is separated by the inner layer of fascia from the mastoid process and the upper part of the sternocleidomastoid muscle, the cartilaginous and bony parts of the external auditory canal, the lateral wall of the pharynx, and the styloid process.

The anterior edge of the gland often extends forward and reaches the anterior edge of the masseter muscle, which masks the beginning of the parotid duct.

Sometimes (10–20 % of observations) at the anterior edge of the gland there is an additional lobe 10–20 mm in size, which has its

own excretory duct flowing into the parotid duct. The accessory lobule is well defined in children and poorly contoured in adults.

From the capsule, processes (connective tissue septa) penetrate into the gland. They are not expressed equally everywhere. During the preparation process, the parotid gland is quite easily isolated in the area of the lower pole, external auditory canal, masticatory and digastric muscles. Isolation of the outer surface, anterior edge and upper pole of the parotid gland is difficult, since its fascia fuses with the capsule of the temporomandibular joint.

The parotid duct is often a main duct, receiving 7–18 lateral canals. Sometimes it is formed by 2 ducts almost equal in diameter. The parotid duct emerges from the gland at the border of its upper and middle thirds. Then it passes along the outer surface of the masseter parallel to the zygomatic arch and 15–20 mm below it. In this area, the excretory duct of the gland is accompanied by the transverse artery of the face (*a. transversa faciei*). The latter anastomoses with the facial artery. At the anterior edge of the masseter, the parotid duct turns 90º medially, penetrating the fatty tissue and buccinator. The diameter of the parotid duct is on average 1.5–3 mm, its length is 15–40 mm.

Above the masseter, the duct of a separate (accessory) lobe of the gland flows into the parotid duct, which is the basis for considering it an accessory lobe, and not an independent gland. The projection of the parotid duct onto the skin is determined on the line connecting the tragus of the auricle and the corner of the mouth. With age, the size of the gland and ducts and their location change.

The largest nerve passing through the parotid salivary gland is the facial nerve (n. facialis). It exits the skull through the stylomastoid foramen and, to the posterior edge of the parotid gland, is represented by a common trunk about 15 mm long (average 9–23 mm) and 0.7 to 1.4 mm thick. The nerve enters the parotid gland in the middle third of it from the posterior edge, approximately at the level of the base of the styloid process, that is, at a depth of about 2 cm from its outer surface. The main trunk of the facial nerve most often has a direction from top to bottom, from back to front, from deep to outward. To determine its

direction, you can use a line connecting the apex of the mastoid process to the angle of the mandible. The projection of the facial nerve trunk will be located 0.2–1.1 cm above this line.

In the parenchyma of the gland, the facial nerve passes through a common trunk 0.6–1.5 cm long, located outward from the external carotid artery and the retromandibular vein. Then, at a depth of 0.5–1 cm, it divides into 2 branches. One of them, continuing the course of the common trunk, goes horizontally; the other is directed downwards.

It is extremely rare that the facial nerve gives off branches before it enters the gland tissue. The horizontally located branch closer to the anterior edge of the gland is divided into the upper and middle branches. The branch that has moved downward extends as a single stem for about 2 cm, after which it also begins to divide.

In the parotid gland, branches of the facial nerve form the parotid plexus. The branches of the plexus, diverging fan-shaped forward and outward, pass behind and then laterally from the external carotid artery, as well as inside and outside the retromandibular vein.

The submandibular gland, *glandula submandibularis*, is a mixed gland, the second largest. The gland has a lobular structure. The mass of the submandibular gland is on average 9.67 g in men and 6.59 g in women. In people over 50 years of age, the mass of the gland decreases. It is located in the fossa submandibularis and extends beyond the posterior edge of m. mylohyoidei. Along the posterior edge of this muscle, the process of the gland wraps onto the upper surface of the muscle; anexcretory duct, ductus submandibularis, departs from it, which opens onto the caruncula sublingualis. Several small ducts open on the sublingual fold.

The gland is located in the submandibular triangle between the body of the mandible and the anterior and posterior bellies of the digastric muscle. The gland has three surfaces: lateral, medial and inferior. It resembles a flattened disk or polygonal prism. In the frontal section, it most often has a triangular shape.

Its size is variable: the anteroposterior size of the gland is from 2 to 4 cm, the lateral size is 0.8–2.3 cm, and the superior-inferior size is 1.3–3.7 cm.

The consistency of the gland is moderately dense. The lateral surface of the submandibular gland is adjacent to the inner surface of the body of the mandible from above, and to the fascia of the neck from below. The medial surface in the anterior section lies on the mylohyoid muscle (m. mylohyoideus), and in the posterior section it is in contact with the posterior belly of the digastric and stylohyoid muscles, in the lower section it is adjacent to the tendon of these muscles and in the middle part it borders on m. hyoglossus, separated from it by a deep layer of fasciae colli propria.

Sometimes the gland extends beyond the boundaries of the submandibular triangle. In this case, it may overlap part of the posterior belly of the digastric muscle (posteriorly) and the greater horn of the hyoid bone (anteriorly). The bed in which the gland is located is separated from fossa retromandibularis by a process of the fasciae colli propria extending deeper.

Thus, the submandibular gland is separated from the parotid gland, located in the retromandibular fossa, by the fascia indicated above. Anteriorly, the bed of the submandibular gland is not closed and communicates with the sublingual region (regio sublingualis) through the gap formed by the posterior edge of the mylohyoid muscle and the hyoglossus. Through this gap, bending around the posterior edge of the mylohyoid muscle, the submandibular duct penetrates into the sublingual region, often together with the process of the submandibular gland. Here the submandibular salivary gland is in contact with the posterior end of the sublingual salivary gland, being separated from it only by a thin fascial plate. In some diseases, their strong soldering (fusion) is possible.

The submandibular duct, bending over the posterior edge of the mylohyoid muscle, is located on the lateral surface of the mylohyoid muscle, passing between it and the medial surface of the mylohyoid muscle. Then it goes between the medial surface of the sublingual salivary gland and the more medially located genioglossus muscle to the point of its exit in the area of the sublingual papilla (caruncula sublingualis). From above it is covered with the mucous membrane of the sublingual region.

There are three options for the shape of the excretory duct of the submandibular salivary gland:

1) straight duct (occurs most often), it goes straight from top to bottom, from back to front;

2) arc-shaped duct, it forms an arc with its convexity upward;

3) s-shaped duct: the diameter of the submandibular duct is 3–3.5 mm, its length on average is 5–7 cm.

The submandibular gland is enclosed in its own capsule, which is dense on the outside and thinned on the inside. It is located between the outer and inner plates of fasciae colli propria. This fascia separates the gland from the muscles described above. There are 8–10 lymph nodes located in the fascial bed of the submandibular salivary gland. However, there are no lymph nodes in the thickness of the submandibular gland itself.

The blood supply to the submandibular salivary gland is carried out mainly by the facial (posterior half of the gland), mental and lingual arteries (inferior anterior part). The veins of the gland flow into the veins of the tongue, facial vein, mental and muscle veins, that is, venous outflow is carried out through the veins of the same name. There are 8–10 lymph nodes located in the fascial bed of the submandibular salivary gland. However, there are no lymph nodes in the thickness of the submandibular gland itself.

The blood supply to the submandibular salivary gland is carried out mainly by the facial (posterior half of the gland), mental and lingual arteries (inferior anterior part).

The veins of the gland drain into the veins of the tongue, the facial vein, and the mental vein.

The sublingual gland, *glandula sublingualis*, is of mucous type, complex alveolar-tubular in structure. It is located on top of m. mylohyoideus at the bottom of the mouth and forms a fold, plica sublingualis, between the tongue and the inner surface of the mandible. The excretory ducts of some lobules (18–20 in number) open independently into the oral cavity along the plica sublingualis (ductus sublinguales minores). The main excretory duct of the sublingual gland, ductus sub-

lingualis major, runs next to the submandibular duct and opens either with one common opening with it, or immediately nearby.

It has an ovoid or triangular shape. Its anterior end is widened, its posterior end is narrowed. Sometimes the lower process of the sublingual salivary gland (diaphragmatic) is identified, which penetrates through the mylohyoid muscle into the submandibular region. The gland is covered with a thin fascial capsule. A large number of connective tissue crossbars extend from the capsule into the gland, which separate the glandular lobules. 5–8 lobules are more common, but their number can vary from 4 to 16.

The dimensions of the gland are: longitudinal – 15–30 mm, transverse – 4–10 mm and vertical – 8–12 mm. The diameter of the duct ranges from 1–2 mm, its length is 0.9–2 cm. Short ducts ranging from 3 to 20 and 0.5 to 1 cm long open along the sublingual fold on the right and left. They are located predominantly in the posterolateral parts of the gland. In the immediate vicinity of the body of the sublingual salivary gland lie the sublingual artery and vein (branches of the lingual artery and vein) somewhat deeper than the excretory duct of the submandibular salivary gland. These vessels are located on the outer surface of the genioglossus muscle (m. genioglossus). The hypoglossal artery is often located slightly above the lower edge of the gland, less often along it and under the gland. From this artery to the gland from its medial surface there are 4–11 thin branches. In the thickness of the gland, they anastomose with each other, as well as with branches from the mental artery. Above the hypoglossal artery, also on the lateral surface of the genioglossus muscle, is the deep lingual artery (a. profunda linguae) – the largest branch of the lingual artery. The small venous vessels of the body of the gland correspond to the direction of its excretory ducts and flow into the longitudinal trunk, the anterior section of which flows into the hypoglossal vein. The veins of the sublingual salivary gland are connected to the veins of the tongue.

The parotid salivary gland is nourished from the vessels that perforate it (a. temporalis superficialis); venous blood flows into v. retromandibularis, lymph – in lnn. parotidei; innervation of the

gland: sensitive – from n. auriculotemporalis (from the third branch, V pair); sympathetic – from the plexus around a. carotis externa; parasympathetic – by postganglionic fibers in the composition of n. auriculotemporalis, extending from the ear node.

Minor salivary glands. Interest in the minor salivary glands is associated with the role they play in the body. In the total volume of oral fluid, the secretion of the minor salivary glands accounts for 31 %. The ducts of the minor salivary glands can serve as the gates of oral antigens, from which enzymes enter the oral fluid. The number of minor salivary glands on the lower lip is 1/5 times greater than on the upper lip.

The minor salivary glands are located parallel to the dentition and gums. Most of them in the lip area are projected onto the gums of the jaws, less than half of them are projected onto the teeth of the jaws. It has been established that the lower teeth are washed with the saliva of the minor salivary glands 2 times better than the upper teeth. Thus, the topography of the minor salivary glands contributes to better washing of the lower teeth with saliva, which correlates with their lower susceptibility to caries. Small minor salivary glands are located in the thickness of the mucous membrane, in the submucosal layer, between the muscle fibers. In the lip area, a group of alveolar tubular glands is located in the submucosal layer and in the thickness of the orbicularis oris muscle.

The buccal minor salivary glands are located deep in the buccinator. The palatine glands are located throughout the hard and soft palate. A greater number of them are determined in loose tissue in the posterior parts of the hard palate, as well as under the mucous membrane and between the muscles of the soft palate. A large number of minor salivary glands are also present in the tongue. They are located under the mucous membrane and between muscle fibers. In the posterior sections of the tongue, between the bundles of muscle fibers, the posterior small glands of the tongue lie. Their ducts can open in the grooves of the circumvallate papillae of the tongue.

DEVELOPMENT OF THE SALIVARY GLANDS

The salivary glands are derivatives of the epithelium of the oral cavity. Their anlages appear in the form of epithelial strands growing into the underlying mesenchyme. The earliest (in the second month of embryogenesis) large salivary glands are formed; first the parotid (at 4 weeks) and submandibular (at 6 weeks), and then the sublingual (at 8–10 weeks). At the third month of embryonic development (according to some authors at 8–10 weeks), the anlages of the minor salivary glands (labial, buccal, palatal) appear.

The anlage of the glands looks like epithelial cords, which begin to branch, giving rise to a system of excretory ducts. Secretory terminal sections are formed from the terminal outgrowths of the excretory ducts. Myoepithelial cells first appear in the terminal sections and excretory ducts at 15–16 weeks. By 25–32 weeks, cells develop processes. At the beginning of the 3rd month of embryogenesis, lumens appear in the anlage of the excretory ducts, and their epithelium becomes double-rowed in the interlobular ducts, and multilayered in large ducts. As for the terminal sections, at first they are lined with indifferent epithelium, the same in all salivary glands. In mixed salivary glands, differentiation of secretory cells begins earlier. Mucous cells appear relatively early. Then protein cells are formed. At the same time, attention is drawn to the fact that the development of the parotid salivary glands is somewhat behind the development of the other glands. The formation of epithelial anlages of glands and their further development occurs under the inducing influence of mesenchyme.

At the early stages of development, the excretory ducts lie loosely, separated from each other by very wide layers of mesenchyme. Subsequently, the amount of intralobular connective tissue decreases, and the number of branching of the excretory ducts and the

resulting terminal sections increases. In newborns, the lobulated structure of the salivary glands is clearly expressed, the crescents of Gianuzzi are clearly visible in the mixed terminal sections, and the salivary glands generally have a similar structure to that of adults. Among the malformations of the salivary glands, complete aplasia is possible – a violation of the formation and development of all salivary glands. Much more common is partial aplasia – a violation of the development of one or more glands. Sometimes dystopia occurs – a violation of the place of development of the gland compared to the norm. Among the anomalies in the development of the excretory ducts, the following are described: atresia – absence of lumen, as well as the opposite phenomenon – ectasia – significant stretching, expansion of large excretory ducts.

MUSCLES OF MASTICATION

The purpose of studying the topic: the student acquires knowledge about the anatomy of the masticatory muscles.

As a result, the student should know:

- Origin of the masticatory muscles
- Place of attachment of masticatory muscles
- Functions of the masticatory muscles

The four muscles of mastication (fig. 7) on each side are interconnected genetically (they originate from one gill arch – the mandibular), morphologically (they are all attached to the mandible, which they move during their contractions) and functionally (they perform chewing movements of the mandible, which determines their location). The following masticatory muscles are distinguished.

The masseter (*m. masseter*) consists of superficial and deep parts. The superficial part is larger; it originates on zygomatic process of maxilla and anterior part of the zygomatic arch. It stretches downward and to the back and is inserted on the masseteric tuberosity of the mandible. The deep part of this muscle is partly covered by the superficial part; it originates on the lower edge and internal surface of the zygomatic arch. Its fascicles stretch almost vertically down. Both parts are inserted on the external surface of the ramus and the angle of the mandible (to the masseteric tuberosity). Function: this muscle raises the mandible. The superficial part participates in protraction of the lower jaw.

The temporal muscle (*m. temporalis*) occupies the surface of the temporal fossa and the internal surface of the temporal fascia. Its fascicles stretch downward, continuing into a tendon, which attaches to the coronoid process of the mandible.

Function: it lifts the mandible; its posterior fascicles retract the lower jaw.

The medial pterygoid muscle (*m. pterygoideus medialis*) originates in the pterygoid fossa of the pterygoid process. Its muscle fas-

cicles stretch downwards, laterally and to the back. They are inserted on the pterygoid tuberosity of mandible. Function: lifts the mandible.

The lateral pterygoid muscle (*m. pterygoideus lateralis*) is short and thick. It has two heads of origin – the upper and lower. The upper head originates from the maxillary surface and infratemporal crest of the sphenoid bone; the lower head – from the external surface of lateral lamina of the pterygoid process. The two heads join each other, the fascicles stretch to the back and laterally and are inserted into the neck of the articular process of the mandible, articular capsule and articular disc of the temporomandibular joint. Function: during bilateral contraction the lower jaw is protracted. During unilateral contraction the muscle pulls the mandible to the opposite side.

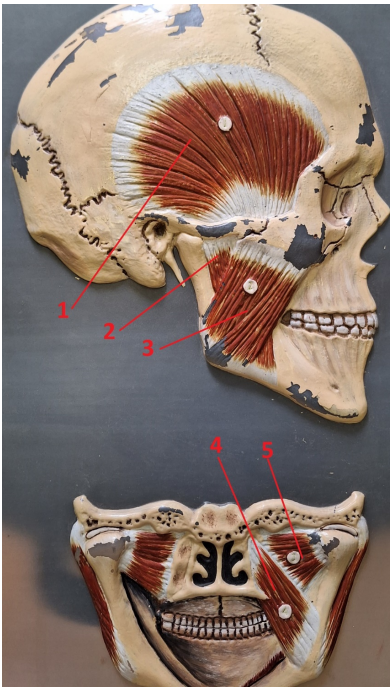

Fig. 7. Muscles of mastication: *1* – m. temporalis; *2* – m. masseter (pars profunda); *3* – m. masseter (pars superficialis); *4* – m. pterygoideus medialis; *5* – m. pterygoideus lateralis

FEATURES OF MUSCLES OF MASTICATION IN CHILDREN

The muscles of a newborn are somewhat different from those of an adult. In a newborn, the masseter muscle exceeds the temporal muscle in volume.

The surface of the physiological diameter of the temporal muscle in a newborn is 1.2 cm^2, and the physiological diameter of the masseter is 1.37 cm^2. In an adult, the cross-sectional area of the temporal muscle is 8.0 cm^2, and the diameter of the masseter is 7.5 cm^2.

Thus, the temporalis muscle, namely its posterior part, is poorly developed in a child. This is explained by the fact that the child eats milk or liquid and soft food, and therefore he has more developed muscle components associated with moving forward rather than backward. The temporal muscle reaches its sufficient development only with the appearance of teeth.

Along with the development of the dental system, the function of biting food develops and, in connection with this, the posterior bundles of the temporal muscle develop, which, by contracting, move the lower front teeth along the palatal surfaces of the upper front teeth. The temporalis muscle, pulling the coronoid process upward, presses the lower front teeth against the upper teeth, moves the mandible upward and backward, thereby increasing the biting force.

The temporalis muscle tends to tilt posteriorly as the whole body grows. As for the masseter muscle, as well as the internal pterygoid muscle, their angle is inclined anteriorly. Consequently, these two muscles tend to tilt anteriorly as they grow.

The chewing muscles in infants also differ in other features. Masseter in an adult, as is known, consists of two layers – superficial and internal, and the internal pterygoid muscle consists of only one layer. In a newborn, the internal pterygoid muscle, like the masseter, also consists of two separate layers. In addition, in a newborn, the masseter exhibits a significantly greater divergence of layers than in

an adult. It should also be noted that the direction of the "resulting" force of the external pterygoid muscles diverges more in a newborn than in an adult. The angle between the direction of the fibers of the superior head of the muscle with the median plane is 35° in a newborn, and 20° in an adult. Thus, it is clear that the masticatory muscles adapt and change depending on the function that is performed by the oral cavity before teething and during the existence of the primary and permanent dentition.

Knowledge of the functional dependence of the muscles on the activity of the dentition is very important for the orthodontist, because if the function of the dentition is impaired (open bite, mesial or distal bite), it is necessary to look for the cause of the disease in the structure and function of the muscles.

Thanks to the connection that exists between the development of muscles and dental occlusion, functional methods for the treatment of malocclusions have been widely developed and have great clinical effectiveness, among which the first place is occupied by muscular gymnastics, functional guiding equipment, etc.

TEMPOROMANDIBULAR JOINT

The purpose of studying the topic: the student acquires knowledge about the anatomy of the temporomandibular joint.

As a result, the student should know:

- Articular surfaces that form a joint
- Temporomandibular joint ligaments
- Movements possible in the joint
- Blood supply to the joint

The temporomandibular joint, *articulatio temporomandibularis*, is formed by the caput mandibulae, fossa mandibularis and tuberculum articulare of the temporal bone.

The articulating surfaces are supplemented by intraarticular fibrous cartilage, *discus articularis*, lying between them, which fuses with its edges to the joint capsule and divides the articular cavity into two separate sections.

The articular capsule is attached along the edge of the fossa mandibularis to the fissura petrotympanica, enclosing the tuberculum articulare, and below it covers the collum mandibulae.

The articular fossa is limited in front by the posterior surface of the articular tubercle, behind by the anterior wall of the external auditory foramen, above by the bottom of the middle cranial fossa, inwardly by the sphenoid process and externally by the posterior leg of the zygomatic process.

The articular disc divides the joint into two sections that do not communicate with each other, but are functionally unified. When moving in the joint, the disc moves along with the head, repeating the shape of the surfaces to which it is adjacent. When moving, the area of contact between the articular surfaces increases and the chewing pressure transmitted from the head to the articular fossa is absorbed.

Between the posterior pole of the disc and the joint capsule there is a layer of loose connective tissue, which is penetrated by elastic fibers and is rich in vessels and nerve endings extending from the

auriculotemporal nerve. The loose connective tissue of the posterior section is closely related to the synovial membrane and is directly related to the nutrition of the elements of the joint.

There are three ligaments near the temporomandibular joint, of which only lig. laterale is directly related to the joint, running on the lateral side of the joint from the zygomatic process of the temporal bone obliquely back to the neck of the condylar process of the mandible. It inhibits the posterior movement of the articular head. The remaining two ligaments (lig. sphenomandibulare and lig. stylomandibulare) lie at a distance from the joint and are not ligaments, but artificially isolated areas of fascia, forming a kind of loop that facilitates suspension of the mandible.

Ligaments regulate movement in the joint and, forming a kind of suspension for the mandible, maintain constant contact of the articular surfaces of the articulating bones.

Joint ligaments, especially extracapsular ones, prevent stretching of the joint capsule and consist of fibrous inelastic connective tissue that is not able to restore its length after overstretching.

The biomechanics of the mandible should be considered from the point of view of the functions of the dental system: chewing, swallowing, speech, etc. Movements of the mandible occur as a result of the complex interaction of the masticatory muscles, temporomandibular joints and teeth, coordinated and controlled by the central nervous system.

The temporomandibular joint is a complex (has a joint disk), combination ellipsoid joint. The right and left temporomandibular joints are capable of movements in which the mandible is elevated and depressed (opening and closing of the mouth, frontal axis); protracting the mandible forward and retracting it back; moving the mandible to the right and left (lateral movements, vertical axis).

Most movements of the mandible at the temporomandibular joint are complex and have three main components:

1) rotation (when opening and closing the mouth);

2) movement (during extension and retraction of the lower jaw);

3) grinding movements while chewing.

Rotation. The axes of rotation pass transversely through both heads of the mandible. The two axes intersect at approximately 150° (range 110–180°). During rotation, the lower jaw makes the following movements: abduction/pressure and adduction/elevation. In humans, true rotation of the temporomandibular joint usually occurs only during sleep, when the mouth is slightly open (aperture angle up to approximately 15°). When the mouth is open more than 15°, rotation is combined with sliding of the head of the mandible.

Moving. The mandible moves and slides in. The axes of this movement are parallel to the medial axis passing through the center of the head of the mandible.

Slipping in the left temporomandibular joint. Note the difference between a “resting condyle” and a “rocking condyle”. The “resting condyle” on the left working side rotates along a nearly vertical axis passing through the head of the mandible (rotational axis), while the “rocking condyle” on the right balancing side rocks back and forth in a gliding motion. Lateral movement is measured in degrees and is called Bennett's angle. During this movement, the mandible moves laterally on the working side and medially on the balancing side.

Grinding movements in the right temporomandibular joint. The right temporomandibular joint, working side, is presented. The right resting condyle rotates about a nearly vertical axis, while the left condyle on the balancing side slides back and forth.

The movements of the right and left articulation occur simultaneously. In the upper part of the joint, translational movements of the head are observed due to the sliding of the disc along the articular tubercle; in the lower part, rotational movements of the articular head around the horizontal axis predominate. When moving, the articular head normally transmits chewing pressure through the articular disc to the thick bony articular tubercle, which is ensured by the closure of the dentition and the tension of the external pterygoid muscles.

The opening of the mouth is accompanied by a synchronous movement of the head of the joint with the disc forward and down along the articular tubercle. When the jaw moves to the right or left on

the side of displacement, the movement occurs in the lower section, and on the opposite side – in the upper section. The articular capsule is a pliable connective tissue membrane that limits the movement of the lower jaw within acceptable limits. The anterior wall of the capsule is attached in front of the articular tubercle, and the posterior wall is attached to the anterior edge of the Glaser fissure of the temporal bone. On the mandible, the capsule is attached to the neck of the articular process. The capsule is long in front and outside. Many authors associate frequent anterior dislocations with this.

Depending on the type of bite, the joint has structural features. A direct bite is characterized by a flat glenoid fossa and a flat, low cusp. With a deep bite, the articular fossa is deep and narrow, the articular tubercle is high and convex. An orthognathic bite is characterized by an articular tubercle and a head of medium convexity, and the articular fossa of medium width and depth. Muscles and ligaments provide and regulate the movement of the mandible.

The temporomandibular joint has only sensory innervation. The sensory fibers innervating the joint emerge from the mandibular branch of the trigeminal nerve.

The joint is supplied with arterial blood from the external carotid artery, mainly from the superficial temporal artery. Other branches of the external carotid artery that supply blood to the joint are the deep auricular artery, anterior tympanic artery, ascending pharyngeal artery, and maxillary artery.

The lymphatic vessels of the temporomandibular joint anastomose throughout their entire length with the lymph nodes that collect lymph from the outer and middle ear. Around the joint there is a network of lymphatic vessels connecting the superficial and deep lymphatic pathways of the joint. The largest number of vessels is present in the posterior part of the capsule, where small vessels gather into large ones.

ANATOMY OF TOOTH

The purpose of studying the topic: the student acquires knowledge about the anatomy of teeth.

As a result, the student should know:

- Main parts of the tooth
- Types of teeth
- Dental formula of primary and permanent teeth
- The order and time of eruption of primary and permanent teeth

Teeth (fig. 8), *dentes*, are ossified papillae of the mucous membrane, used for mechanical processing of food. Phylogenetically, teeth come from fish scales that grow along the edge of the jaws and acquire new functions here. Due to wear and tear, they are repeatedly replaced by new ones, which is reflected in the change of teeth, which in lower vertebrates occurs many times throughout life, and in humans 2 times. In this regard, they distinguish: 1) temporary teeth (baby teeth, deciduous teeth, primary teeth), *dentes decidui*, and 2) permanent teeth (adult teeth), *dentes permanentes*.

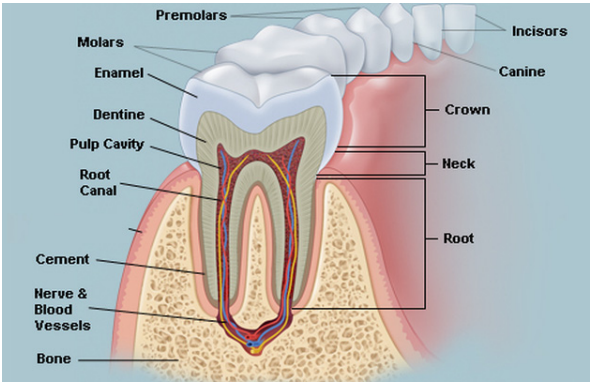

Fig. 8. Structure of tooth

The teeth are located in the cells of the alveolar processes of the maxilla and mandible, connecting by gomphosis. The tissue covering the alveolar processes is called gums (gingivae). The mucous mem-

brane here, through fibrous tissue, tightly fuses with the periosteum; Gum tissue is rich in blood vessels (so it bleeds relatively easily), but is poorly supplied with nerves. The grooved depression located between the tooth and the free edge of the gum is called a gingival pocket.

Each tooth consists of:

1) crown, *corona dentis*;

2) necks, *cervix dentis*;

3) root, *radix dentis*.

The crown protrudes above the gum, the neck (a slightly narrowed part of the tooth) is covered by the gum, and the root sits in the dental alveolus and ends at the apex, *apex radicis*, on which even the naked eye can see a small opening at the apex, *foramen apicis dentis*. Through this hole, blood vessels and nerves enter the tooth. Inside the crown of the tooth there is a cavity, *cavitas dentis*, in which a distinction is made between the coronal section, the most extensive part of the cavity, and the root section, the tapering part of the cavity, called the root canal, *canalis radicis dentis*. The canal opens at the apex with the apical opening mentioned above. The tooth cavity is filled with dental pulp, *pulpa dentis*, rich in blood vessels and nerves. The hard substance of the tooth consists of: 1) dentin, *dentinum*; 2) enamel, *enamelum*; 3) cement, *cementum*. The main mass of the tooth surrounding the tooth cavity is dentin. The enamel covers the outside of the crown, and the root is covered with cement.

Between the cement-covered tooth root, buried deep in the alveoli, and the alveolar wall lies the so-called alveolar periosteum, which lines the inner walls of the alveoli, is tightly connected to the gums and plays a significant role in strengthening the teeth. The periosteum is a dense connective tissue consisting of bundles of fibers, the ends of which directly continue in the form of so-called Sharpey's fibres, on the one hand, into the root cement, and on the other, into the bone walls of the cell. This dense connective tissue, vessels and nerves coming from the amphodont is the periodontium, or root sheath.

The fibers of the periosteum come in the form of ligaments located along the lines of force on the tooth. Some of the bundles go

from the root of the tooth to the wall of the alveoli in the radial direction. They prevent tooth movement. Other beams go in a tangential direction (tangentially), preventing rotation of the tooth along its axis.

All tissues surrounding the neck, tooth root and periodontium, including the gums, alveoli and the alveolar process of the jaw that forms it, are considered as an integral anatomical and functional system called periodontium, *parodontium*, or amphodont, *amphodontium*. The periosteum of the dental cell (periodontium) comes into contact at the bottom of the alveolus with the bone substance of the jaw: through the apical openings of the root – with the pulp; at the edges of the alveoli – with the gums and further – with the periosteum of the jaws. From these tissues and organs, the periodontium receives nerves and vessels, which represent a network rich in anastomoses, that is, connections. This anatomical proximity and the richness of the vascular network determine the ease of transition of inflammatory processes from surrounding tissues to the periodontium.

At the edges of the gums, the root membrane passes into the gum tissue, and in the area of the necks of the teeth it covers it with a strong ring, forming the so-called circular ligament of the tooth. This ligament is so strong that during various kinds of purulent processes in the periosteum of the alveolus, the pus cannot break out through it and finds its way out under the gum on the outer or inner surface of the alveolar process.

A fully developed and preserved adult human masticatory apparatus contains 32 dental organs. Each dental organ consists of the following parts:

1) tooth;

2) the alveoli and the jaw flying to it, covered with the mucous membrane of the gums, which are designated by the general term “amphodont”;

3) the ligamentous apparatus (periodontium), which holds the tooth in the alveolus;

4) blood vessels and nerves.

The teeth are enclosed in the jaws in such a way that the crowns of the teeth are on the outside and form the dentition – upper and lower. Each dentition contains 16 teeth arranged in the form of a dental arch.

In each tooth, five surfaces are distinguished: 1) facing the vestibule of the mouth, *facies vestibularis*, which in the front teeth comes into contact with the mucous membrane of the lip, and in the rear teeth – with the mucous membrane of the cheek; 2) facing the oral cavity, towards the tongue, *facies lingualis*; 3) and 4) in contact with neighboring teeth of their row, *area contingens*: the contact surfaces of the teeth directed towards the center of the dental arch are designated as *facies mesialis*. In the front teeth, this surface is medial, and in the back teeth, it is the anterior surface. The contact surfaces of the teeth, directed in the direction opposite to the center of the dentition, are called distal, *facies distalis*; in the anterior teeth this surface is lateral, and in the posterior teeth it is posterior; 5) chewing surface, or the surface of closure with the teeth of the opposite row, *facies occlusalis*. To determine the localization of pathological processes on a tooth, dentists use terms corresponding to the named surfaces: vestibular, oral, medial, mesial, distal, occlusal, apical (towards the apex radicis).

Every tooth has anatomic signs which help clinician to define it to a certain group of teeth. Foremost, they are: the shape of a crown, cutting edge or occlusal surface and amount of roots. The next ones are the signs of belonging of the tooth to the right or left side of jaw: signs of crown angle, crown curvature and deviation of root.

The sign of the crown angle is the mesial angle of the crown is more sharp than the more obtuse distal angle of the crown. This is especially pronounced for upper central and lateral incisor and for premolars.

The sign of the crown curvature is the vestibular side of the tooth is more convex than the lingual side.

The sign of the root deviation – deviation of the longitudinal axis of the root from the midline of crowns for incisors and canines – in the lateral direction, for premolars and molars – in distal direction. The roots of front group of teeth are deviated from the midline to la-

teral direction, the teeth of masticatory group are deviated – to distal direction.

The incisors, *dentes incisivi*, four on each jaw, have a crown shaped like cutting chisels that cut food of inappropriate size. The crown of the upper incisors is wide, the lower ones are twice as narrow. The root is single, compressed from the sides of the lower incisors. The root apex is deviated somewhat laterally.

The maxillary central incisor is the largest of the group of incisors. The labial surface of its crown is convex in the transverse and longitudinal directions. It has three small longitudinal ridges, each of which ends at the chewing edge with a tooth. On both sides of the median ridge there is one longitudinal depression. The lingual surface of the crown is concave in the longitudinal and transverse directions. In the cervical region it has a tubercle, *tuberculum dentale*, from which ridges extend along the distal and mesial edges of the lingual surface to the chewing edge of the tooth. Of the three signs of a tooth, the sign of crown curvature is the most pronounced. The root is conical and longer than the crown; the lateral grooves on it are weakly expressed. It has three surfaces: labial and two approximal (these are two root surfaces obliquely approaching posteriorly).

The maxillary lateral incisor is smaller than the maxillary central incisor, from which it differs in the following features: on the labial surface of the crown there is often a median longitudinal groove, on both sides of which there is one small tuberculate elevation on the cutting edge of unworn teeth. On the lingual surface, the lateral ridges are usually better defined than those of the medial incisors. Often on this surface there is a depression located occlusally (below) from the dental tubercle. The mesial surface is longer than the distal one and passes into the cutting edge almost at a right angle, while the distal one forms a significant rounding. The sign of the crown angle is well expressed. The root is shorter than that of the medial incisor, compressed in the mesiodistal direction; in most cases it is straight and has lateral grooves. Its distal surface is more convex than the mesial one.

Mandibular central incisors and mandibular lateral incisors. The lower incisors are the smallest in both jaws. In this case, the central incisor is smaller than its distal neighbor. Both teeth have characteristics of all incisors. Their crown has the most typical chisel shape. On the front surface it is slightly convex in the longitudinal direction and flattened in the transverse direction, on the rear surface it is concave in the longitudinal direction and flattened in the transverse direction. The ridges are weakly expressed and sometimes absent. The root is significantly flattened.

The central incisor has no signs of angle or root curvature. To distinguish the right central incisor from the left, a better defined lateral longitudinal groove on the root is important.

The lateral incisor has a wider crown than the central, and the root is more massive. At the same time, this tooth has quite clearly expressed signs of angle and root and weakly – curvature.

The canines, *dentes canini*, two on each jaw, have a long single root, compressed from the sides and having lateral grooves. The crown has two cutting edges that meet at an angle; there is a tubercle on its lingual surface near the neck. It is flattened in such a way that the lingual and labial surfaces converge towards the cutting edge. Its vestibular surface is convex in the transverse and longitudinal directions. There is always a well-defined longitudinal ridge on it, especially at the cutting edge, dividing the surface into smaller (mesial) and (larger) distal segments. On the lingual surface, lateral ridges are clearly visible, converging towards the neck at the tubercle of the tooth. The cutting edge of the crown consists of two halves: the smaller (mesial) and the larger (distal), converging towards the apex of the edge. The distal half of the edge descends towards the corresponding approximal surface more steeply than the mesial half. Canines are characterized by all the signs of teeth (root deviation, angle and crown curvature).

The maxillary canine. The crown is massive. The contact surfaces diverge significantly towards the cutting edge. A powerful middle ridge runs along the lingual surface of the crown, which, starting at the dental tubercle, thickens significantly and expands towards the

cutting edge. The contact surfaces are wide at their bases, but relatively short. The root is massive and is the longest of the roots of all teeth. Its approximal surfaces are wide. The labial edge is blunt and wide compared to the lingual.

The mandibular canine is smaller than the maxillary. It has less pronounced longitudinal ridges on both the vestibular and lingual surfaces of the crown. The vestibular surface of the crown is slightly convex, the lingual is slightly concave, the contact surfaces run almost parallel, and the mesial does not converge at all towards the neck, while the distal is somewhat inclined towards it. The incisal edge of the crown is shorter than that of the upper canine, and its mesial segment differs little in length from the distal one. The root is shorter than that of the upper canine, more flattened, and has better defined longitudinal grooves. There may be a bifurcation of the root at the apex, sometimes turning into a double root. The teeth sitting in front of the canines have undergone changes in one direction – they have a flat crown and a cutting edge has formed – the cusp, *cuspis dentalis*, those sitting behind them have changed in the other direction: they have acquired a well-developed crown, which serves for crushing and grinding food, and the canines appeared to be in a neutral zone and retained their original conical shape and the ancient function of the tooth – to prick and tear food. Therefore, they sit on the border between the front teeth (incisors) and the back teeth (molars).

Premolar teeth, *dentes premolares*, four on each jaw, are located immediately behind the canines. The first is located mesially, and the second distally. Characteristically, there are two tooth cusps (tuberculum molare) on the closure surface of the crown. Therefore, these teeth are called bicuspid – dentes bicuspidati. Of the tubercles, one is vestibular, the other is lingual. The root is single.

The maxillary first premolar. The vestibular surface of the crown resembles the same surface of the canine. Its chewing edge consists of mesial and distal segments, converging at the apex of the buccal tubercle. The mesial segment is most often longer and, as a rule, runs almost horizontally; the distal one descends more steeply.

A ridge bounded by longitudinal grooves descends from the tubercle onto the buccal surface. The sign of crown curvature is reversed. The lingual surface of the crown is narrower than the buccal surface, more convex and more rounded into the lingual tubercle. Its contact surfaces are almost quadrangular and slightly convex. The largest convexity is located in the buccal half of the surface at the occlusal edge and serves for contact with adjacent teeth. The closure surface has a trapezoidal shape; the buccal tubercle on it is slightly higher than the lingual one. The root is compressed in the mesiodistal direction. Its approximal surfaces have a deep longitudinal groove and pass without sharp boundaries into the lingual surface and at an angle into the vestibular surface. In more than half of the cases, a bifurcation of the root is observed in the apical area.

The maxillary second premolar is usually smaller than the first. The difference in shape between them is insignificant. The buccal cusp of the second premolar is less pronounced than that of the first. The root is cone-shaped, in most cases single. Deep grooves are visible on its contact surfaces. The root canal can be single or bifurcated. To distinguish the maxillary first premolar from the second, several signs are used: the first tooth has a buccal tubercle higher than the lingual; the root is significantly compressed and most often forked; in the second it is conical and can only split at the apex. The crown tubercles are almost at the same level. In the first tooth, the vestibular surface of the crown is triangular and resembles the corresponding surface of the canine crown more often than in the second premolar.

The mandibular first premolar. The mandibular premolars differ from the maxillar ones in that they are smaller and have a spherical crown, which has the outline of a circle in the cross section. In the first premolar, the vestibular surface of the crown is inclined towards the lingual side; the lingual surface is narrower and lower than the vestibular one; the contact surfaces are convex and weakly converge towards the neck. The largest bulges are in the area of contact with adjacent teeth. On the surface of the crown closure, the lingual tubercle is much smaller than the buccal one, and therefore this surface slopes towards

the lingual side. The root is straight, rarely curved, its circumference is even, as a result of which rotation can be used when removing a tooth. Among the signs of teeth, the sign of the root is better expressed.

The mandibular second premolar. Its crown is slightly larger than the previous one. The axis of the crown and the axis of the root form an angle open towards the floor of the mouth. The closure surface of the crown is quadrangular and slightly sloping towards the floor of the mouth. Additional grooves may extend from the groove separating the buccal and lingual cusps, and then a tricuspid tooth is formed. Thanks to this crown shape, the premolars crush food. The root has a more conical shape than the root of the first mandibular premolar. In addition, it is more massive and longer.

The molars, *dentes molares*, are located in six on each jaw, and their size decreases from front to back: the first is the largest, the third is the smallest. This latter erupts late and is called the wisdom tooth, *dens serotinus*. The shape of the crown is cuboidal, its closure surface is more or less square, approaching diamond-shaped in the upper teeth, and has three tubercles or more. This crown shape determines the function of molars – to grind food. The upper molars have three roots, two of them buccal and one lingual; lower – only two roots – anterior and posterior. Three roots of wisdom teeth can merge into one conical shape. This group of teeth is characterized by a sign of crown curvature.

The maxillary first molars. The crown is massive, its closing surface has the shape of a rhombus, the long diagonal of which goes obliquely from the anterior buccal point of the surface to the distal-lingual point. The four tubercles of this surface are separated from each other by three grooves. In this case, the mesial tubercles – buccal and lingual – are larger than the distal ones. The lingual surface of the crown is already vestibular and more convex; the contact surfaces are more convex at the chewing edge – the place of contact of the teeth. The tooth has three roots: two buccal (medial, longer, and distal) and one lingual.

The maxillary second molar is smaller than the first. Based on the appearance and nature of the crown closure surface, several variants of this tooth are distinguished.

The most common option: on the surface of the crown closure there are three tubercles – two buccal and one lingual. The closure surface has the shape of a triangle, with its apex facing the lingual side.

Second option: there are four tubercles on the closure surface, and the tooth is similar to the first molar. In this case, the maxillary second molar is distinguished from the first by the position of the roots: in the first, the lingual root is located opposite the space between the two buccal roots; in the second, the lingual root stands opposite the mesial buccal root and can even merge with it.

The third option (rare) is a three-tubercle crown, with the tubercles arranged in one row, obliquely crossing the dental arch. The entire crown is narrow and flattened. The three roots of the maxillary second molar are shorter than the roots of the previous tooth. They are often curved and may merge; the lingual root often merges with the anterior buccal root.

The maxillary third molar. It is the smallest of the molars; the shape of its crown is very variable. More often it has three chewing tubercles – two buccal and one lingual. The number of tubercles may be more or less. The tooth has three roots, but most often they all merge and form a blunt cone-shaped shaft with longitudinal grooves at the confluence. Often this tooth either does not develop at all or does not erupt.

The mandibular first molar. The crown has the shape of a cube. The closure surface is square, there are five tubercles on it: two lingual, two buccal and one distal. The buccal cusps are more massive and lower than the lingual ones, the distal one is small. The sloping surface of the closure to the distal side is well expressed. On the closure surface there are two grooves, transverse and longitudinal, forming a cross at their intersection. The transverse groove, passing between the two buccal tubercles and the two lingual ones, descends with its ends onto the lingual and vestibular surfaces of the crown.

A longitudinal groove separates the buccal cusps from the lingual ones. The distal tubercle of the crown occupies its posterior section in the buccal half. The tooth has two roots: medial (wider) and distal. Of the signs of the tooth, two are well expressed: the sign of curvature of the crown and the sign of the root.

The mandibular second molar is similar to the first. It is smaller in size, the crown has a regular cubic shape. On the surface of its closure there are four tubercles. The roots are the same as those of the first molar.

The mandibular third molar is subject to considerable variation. It is smaller than the mandibular second molar and has four or five cusps on the closure surface of the crown. There are usually two roots, but they can merge over a greater or lesser extent, forming one cone-shaped root. Significant curvature of the root is often observed, mainly towards the distal side.

On the anterior surface of the ramus of the mandible, between the ridges that serve to attach the fibers of the temporal muscle, immediately behind the lower wisdom tooth there is a triangular platform (trigonum retromolare). The so-called retromolar fossa, *fossa retromolare*, is located somewhat posteriorly. These two formations are identification points when finding the mandibular opening for the so-called mandibular anesthesia.

Baby teeth have some features: they are smaller, they have fewer tubercles, the roots are divergent, between them lie the rudiments of permanent teeth, their necks are thinner. The number of roots in primary and permanent teeth is the same.

Eruption of baby teeth. Two incisors, one canine, two molars (among the baby teeth there are molars, no premolars), that is, the thinning of the gums and the appearance of the tooth crown in the oral cavity begins in the 7th month of extrauterine life and ends by the beginning of the 3rd year. Since these teeth begin to erupt during the period of breastfeeding, they are also called milk teeth, *dentes lactei.* There are only 20 baby teeth.

The dental formula of primary teeth is as follows:

2–0–1–2|2–1–0–2

2–0–1–2|2–1–0–2

The numbers indicate the number of teeth on half of each jaw (maxilla and mandible): two incisors, one canine, two molars (there are no premolars among the milk teeth). After 6 years, the replacement of baby teeth with permanent teeth begins. It consists of erupting new additional teeth in excess of 20 milk teeth and replacing each milk tooth with a permanent one. The eruption of permanent teeth begins with the first molar (six-year-old molar); by the age of 12–13 years, the eruption of permanent teeth ends, with the exception of the third molar, which erupts between 18 and 30 years.

The dental formula of permanent teeth is as follows:

3–2–1–2|2–1–2–3

3–2–1–2|2–1–2–3

There are 32 teeth in total. In dental practice, they use a more convenient formula with the designation of teeth in numerical order, starting from the first incisor and ending with the last (third) molar: 1, 2 (incisors); 3 (canine); 4, 5 (premolars); 6, 7, 8 (molars).

The order and time of eruption of primary and permanent teeth

Milk teeth:

Central incisors – 6–8 months

Lateral incisors – 7–9 months

First molars – 12–15 months

Canines – 10–20 months

Second molars – 20–24 months

Permanent teeth:

First molar – 6–7 years

Central incisors – 8 years

Lateral incisors – 9 years

First premolars – 10 years

Canines – 11–13 years

Second premolars – 11–15 years

Second molars – 13–16 years old

Third molars – 18–30 years old

When the teeth are closed (occlusion), the maxillary incisors protrude above the corresponding teeth of the mandible and partially cover them (prognathism). This occurs because the upper dental arch is slightly larger than the lower one and, in addition, the upper teeth are directed towards the lips, and the lower ones – towards the tongue. As a result, the lingual cusps of the upper molars are placed in the groove between the lingual and buccal cusps of the lower ones. There is no complete correspondence between the upper and lower teeth: each tooth is in contact with not one, but two teeth of the other row. The teeth in contact are called antagonists (main and secondary), with the mandibular central incisor and the maxillary third molar having only one antagonist each. Due to this articulation of teeth, when one tooth falls out, the activity of the antagonist and its neighbors who participated in articulation with the missing tooth is disrupted. This must be kept in mind after removing a diseased tooth.

Variants of physiological occlusion are prognathy, progeny, in which the lower incisors are located in front of the upper ones, and orthognathia – the upper and lower incisors are closed with their tips.

Anomalies of teeth position. Adjacent teeth can change places; the tooth may be located outside the dental arch – closer to the hard palate or to the vestibule of the mouth. Sometimes teeth can erupt into the nasal cavity, on the hard palate, in the sinus maxillaris.

Anomalies in the number of teeth: the maxillary lateral incisors and second premolars may be missing. Abnormalities in the shape of the crown or root: there are elongated roots, shortened roots and roots bent at different angles. Molars have a larger number of roots than usual. The number of cusps on the closure surface can vary on the crown.

Knowledge of the structural variants of the masticatory apparatus is of decisive importance in the practical activities of a dentist. Individual differences in the external structure of the jaws and their dentofacial segments are directly related to the structure of the skull. Thus, the shape of the maxilla depends on the shape of the cerebral

part of the skull, while the shape of the mandible depends on the shape of the facial part. Extreme forms of the external structure of the jaws have been identified: the maxilla is narrow and high, wide and low; the mandible is long and narrow, short and wide.

There is also individual anatomical variability of the dentition. Malocclusions in healthy people are widespread, since only 13 % of people have normal dentition. The majority have three groups of anomalies, which leads to disruption of chewing movements and injuries to the tongue. Thus, anomalies in the number of teeth, anomalies in the dentition and malocclusions themselves are distinguished.

A connection has been discovered between the size and shape of teeth and the general type of constitution, which is important not only for dentistry, but also for other specialties, when the sex, age and racial-ethnicity of a person are determined based on dental status, even based on bone fragments (in forensic medicine, anthropology). Currently, in many countries around the world, dental identification is recognized as the most reliable.

The arteries of the teeth of the maxilla originate from a. maxillaris; the posterior teeth of the maxilla are vascularized from aa. alveolares superiores posteriores, anterior – from aa. alveolares superiores anteriores (from a. infraorbitalis). All teeth of the mandible receive blood from a. alveolaris inferior. Each alveolar artery sends:

1) branches to the teeth themselves – rami dentales;

2) branches to the periosteum of the alveoli – rami alveolares;

3) branches to adjacent areas of the gums – rami gingivales.

The outflow of blood occurs into the veins of the same name, flowing into v. facialis.

Lymph drainage occurs in the lnn. submandibulares, submentales et cervicales profundi.

Innervation of the upper teeth is carried out by nn. alveolares superiores (from the second branch of n. trigeminus – V pair). Among them there are nn. alveolares superiores anteriores, medii et posteriores, forming the plexus dentalis superior. The nerves of the lower teeth begin from the plexus dentalis inferior (from the n. alveolaris inferior from the third branch of the n. trigeminus – V pair).

TOOTH DEVELOPMENT

Dental development in humans begins around the 7th week of embryonic life. By this time, in the area of the future alveolar processes of the upper and lower jaws, a thickening of the epithelium lining the oral cavity occurs, which begins to grow in the form of an arcuate plate into the underlying mesenchyme. Soon this epithelial plate, continuing to grow in depth, is divided along its length into two secondary plates located almost at right angles to each other.

The anterior or buccal-labial plate further splits and turns into an open fold of epithelium, separating the lips and cheeks from the gums and leading, therefore, to the formation of the vestibule of the oral cavity.

The posterior dental plate takes on a more vertical position. Along its edge, epithelial growths appear, taking the form of flask-shaped protrusions and being the rudiments of milk teeth. These protrusions are called enamel organs. After the formation of the enamel organs, the dental plate continues to grow in depth in such a way that the enamel organs are located on its anterior (that is, facing the lip or cheek) side.

The developing enamel organ soon after its appearance acquires the shape of a cup or bell, and the corresponding depression is filled with mesenchyme, forming the papilla of the tooth germ.

The dental pulp develops from the dental papilla, formed by ectomesenchyme. The embryological development of the pulp is accompanied by the synthesis of a number of cytoskeletal proteins – keratin, vimentin, desmin and actin. During embryonic development, interactions between the epithelial cells of the internal enamel organ and the mesenchymal cells of the dental papilla lead to the differentiation of odontoblasts and fibroblasts, which begin to secrete collagen proteins.

X-RAY OF THE TEETH AND JAWS

On radiographs in a direct projection, the labial and oral surfaces of the teeth give a summary image, the remaining surfaces on a radiograph in a direct projection are edge-forming and are defined in the form of a clearly defined contour.

Each tooth is characterized by a shape and structure that corresponds to the function it performs, and has anatomical characteristics that make it possible to determine its group affiliation – the shape of the crown, cutting edge or chewing surface, the number of roots. The teeth of the upper jaw are larger than those of the lower jaw. There is variability in the size of the crowns and roots of the teeth. The belonging of teeth to a certain side of the jaw on radiographs is determined by the angle of the crown. The sign of the crown angle is expressed in the greater sharpness of the angle between the occlusal and medial surfaces in comparison with the angle between the occlusal and distal surfaces.

The walls of the tooth are formed by dentin, which is covered on the outside in the coronal part with a thin layer of enamel, and in the root area – with a layer of cement.

Due to their chemical composition, dentin, enamel and cementum appear homogeneous and structureless in X-ray images.

Enamel and dentin contain different amounts of inorganic substances – about 90 % in enamel, about 75 % in dentin, so on radiographs they give shadows of different densities. Due to the difference in the degree of mineralization between enamel and dentin, the enamel-dentin boundary is clearly visible on radiographs. Behind the thin, dense enamel layer, a lighter shadow of dentin is visible, in the center of which a tooth cavity filled with pulp is defined. Dense shadows of enamel narrow towards the neck of the tooth. On the cutting and chewing surfaces of teeth, the enamel layer wears off with age. Therefore, on an X-ray of a tooth in elderly people, the enamel layer in these sections is absent or weakly expressed in the form of a thin contour line. With periapical isometric radiography, the shadows of the

buccal cusps of the premolars and molars of the upper and lower jaw are projectively stretched. As a result of this, one gets the impression of less density and even absence of the enamel cover of the buccal cusps, while at the same time it is well expressed on the palatal and lingual cusps.

The X-ray image of the roots of the teeth is characterized by lower intensity and contrast, since the cement and dentin, which make up the walls of the root, differ slightly in density from each other, and their shadows are not differentiated on the X-ray image. A clear and contrasting image of the roots is also hampered by the layering of the bone structure of the buccal and lingual walls of the alveoli.

The tooth cavity is divided into the coronal part and the root canal, which ends in a narrow apical foramen in the region of the root apex. The tooth cavity is filled with pulp – loose connective tissue, vessels and nerves. The pulp provides nutrition to the tooth and protects it. The main cellular elements of the pulp are fibrocytes, histiocytes, and fibrils. The pulp is divided into coronal and root parts; vessels and nerves enter the tooth cavity through the apical foramen. The pulp is X-ray negative and only the crown cavity and root canal are visible on the radiograph.

The shape of the pulp chamber corresponds to the shape of the tooth crown. The cavities of the coronal part of premolars and molars are distinguished by the presence of horns of the pulp chamber: premolars have two horns, and molars have four (corresponding to the number of cusps on the chewing surface). On radiographs, the shadows of the buccal horns are layered on the shadows of the palatal and lingual horns and are not visible separately; only the shadows of the medial and distal horns of the molars of the lower jaw are clearly visible.

The cavities of molars and premolars in the X-ray image differ from the cavities of other teeth in that in the former they are outlined, while in the latter a fully formed bottom and a funnel-shaped narrowing of the cavity are determined, which passes into the root canal. In the incisors and canines, the cavities of the crowns, narrowing, gradually turn into canals. In molars, the pulp chamber is wide, often

located at the level of the neck and is clearly visible on radiographs. The coronal part of the cavity of premolars, flattened in the medial-distal direction, is not so clearly visible. The root canal is identified on an X-ray as a narrow strip of clearing running in the middle of the root. The root canal ends at the apical foramen, through which the neurovascular bundle of the dental pulp exits. The apical foramen in an adult, due to its small diameter and projection conditions, is not determined during X-ray examination in most cases. The root canal usually narrows sharply at the apex and is not visible on the radiograph in the area of the root apex. Radiographs do not reveal bifurcation of the canals, processes and septa in the canals.

The roots of the teeth of the lower jaw and single-rooted teeth of the upper jaw are clearly and separately identified on radiographs. The shadows of the roots of the upper molars (mainly buccal-distal and palatal) and the first premolar (buccal and palatal) overlap each other on radiography. Separate images of the roots can be obtained by deflecting the central X-ray beam in the medial or distal directions.

A normal radiological image of the alveolar ridge is characterrized by the presence of a clear, continuous cortical endplate. It looks like a thin, dense continuous line covering the interdental septa and passing into the cortical plate of the tooth socket. The cortical end plate is more pronounced in the mandible. Radiographs clearly show only the medial and distal parts of the cortical end plate, while the labial and lingual end plates overlap each other and the shadow of the neck and root of the tooth.

The cortical plate of the tooth socket wall has the same thickness throughout. Sometimes it is very thin and is clearly visible only under a magnifying glass. The compact plate may thicken (sclerosis) in any part due to increased load or a change in the nature of the function (prosthesis, tooth deviation, etc.).

The cortical plate disappears during destructive processes, but it may not be visible even when the shape of the interalveolar septa changes, when their apices are beveled and are at a large angle to the X-ray beam. In addition, such a picture is often observed with a laying defect or a significant angular displacement of the X-ray beam.

The roots of the tooth are fixed in the bone socket by a ligamentous apparatus – periodontium. Periodontal collagen fibers intertwine in different directions, but in a certain order, according to the pressure and tension experienced by the tooth in connection with the function it performs. The periodontium contains blood and lymphatic vessels, nerve fibers, and other tissue elements. The function of the periodontium is varied. Thanks to it, the tooth is suspended in the alveolus, shock-absorbed, does not move under force and can withstand heavy loads. With the help of the periodontium, nutrition and innervation of the tooth are carried out, as well as cement formation around the root and bone formation of the walls of the alveoli. The periodontium itself does not produce an X-ray shadow, but on radiographs between the root of the tooth and the cortical layer of the tooth socket, an image of the periodontal fissure is determined, in the form of a narrow strip of clearing. The radiographic periodontal fissure is formed, on the one hand, by the root of the tooth, and on the other, by the cortical plate of the socket. Under normal conditions in an adult, the width of the periodontal fissure in the X-ray image varies slightly in individual areas of the tooth. In the middle third of the root, the periodontal gap is narrowed, and in the cervical and apical third it is widened due to micromovements of the tooth in the socket. The width of the periodontal gap ranges from 0.20 to 0.25 mm; its width in the lower jaw is slightly smaller than in the upper jaw, and can change with age, the functional load of the tooth and the occurrence of the pathological process. With the loss of the antagonist, the width of the periodontal fissure decreases.

Any change in the width and outline of the periodontal fissure is associated with a change in the periodontium itself. Therefore, X-ray data make it possible to judge pathological processes in the periodontium by changes in the periodontal fissure.

In pathological processes that entail destruction of the socket wall, the contours of the periodontal fissure in the X-ray image become unclear and blurred.

The alveolar process of the maxilla has a homogeneous trabecular structure, which is the same in different parts of the bone. In the

upper alveolar process, vertically directed bone trabeculae predominate. The cellular pattern of the bone varies little in individuals of different ages.

The structure of the bone tissue of the lower jaw is formed by a looped pattern of intersecting bone beams, among which the most intense shadow is provided by horizontally directed trabeculae. The density of the bone pattern on radiographs of the lower jaw is not the same. In the central parts of the body, at the level of the incisors, there is a band of intense bone tissue density, corresponding to the zone of the symphysis and mental eminence. On both sides of it, at the base of the mental tubercle, the intensity of the shadow of the bone tissue decreases somewhat, and at the level of the molars it increases again due to the presence of tuberosities in the area of attachment of the masticatory muscles.

The multidirectionality of trabeculae in the upper and lower jaws is clearly displayed on radiographs and is one of the signs that makes it possible to determine the identity of the tooth in the image.

In the anterior section of the body of the lower jaw, on its outer surface there is a mental protuberance. The mental protuberance mainly consists of compact bone substance, and its image on the radiograph is distinguished by a greater intensity of the shadow, which stands out against the background of the spongy substance of the body of the jaw. During intraoral radiography, the massive lower edge of the lower jaw is often thrown upward, as a result of which it can overlap and overlap the apexes of the roots of the overlying teeth. The mandibular canal, which contains the inferior alveolar nerve and vessels, runs through the thickness of the lower jaw. It begins on the inner surface of the branch with the mandibular entrance foramen, goes down slightly and follows the body of the jaw parallel to its lower edge. The entrance opening of the mandibular canal, the mandibular foramen, is rarely seen on radiographs. It looks like a funnel-shaped clearing zone located in the upper part of the branch. Gradually narrowing, the funnel turns into a canal that follows along the lower edge of the jaw. The boundaries of the mandibular canal are formed by thin,

distinct cortical plates, clearly visible on radiographs. The upper wall of the canal is always traced worse than the lower one. Thin transparent lines may run from the mandibular canal to the tops of the teeth – canals in which nerves and blood vessels pass. Sometimes these canals can be oriented perpendicular to the outer surface of the body of the lower jaw and appear as rounded areas of clearing, overlaid on the images of the root apices and simulating periapical changes.

PALATUM

The purpose of studying the topic: the student acquires knowledge about the anatomy of the palate.

As a result, the student should know:

- Bones that form the hard palate
- Parts and muscles of the soft palate

The palate, *palatum*, consists of two parts. The anterior two-thirds of it have a bone base, *palatum osseum* (the palatine process of the maxilla and the horizontal plate of the palatine bone), this is the hard palate, *palatum durum*; the posterior third, the soft palate, *palatum molle*, is a muscular formation with a fibrous base. When breathing calmly through the nose, it hangs obliquely down and separates the oral cavity from the pharynx. Along the midline on the palate there is a noticeable suture, *raphe palati*. At the anterior end of the suture there is a noticeable series of transverse elevations (about six), *plicae palatinae transversae* (rudiments of palatal ridges that facilitate mechanical processing of food in some animals). The mucous membrane covering the lower surface of the hard palate is fused with the periosteum through dense fibrous tissue.

The boundary between the sections of the palate is clearly visible, since the soft palate differs in its reddish color from the paler hard palate. This is due to the significant development of blood vessels in the lamina propria of the mucous membrane of the soft palate, which are visible through a relatively thin layer of non-keratinizing epithelium. The mucous membrane of the soft palate, unlike the hard palate, is not connected to bone tissue, but to the mobile muscular basis of the organ.

The soft palate, *palatum molle*, is a duplication of the mucous membrane, which contains muscles along with a fibrous plate – the palatine aponeurosis, as well as glands. With its anterior edge it is attached to the posterior edge of the hard palate, and the posterior section of the soft palate (velum palatinum) hangs freely downwards and backwards, having a protrusion in the middle in the form of a tongue,

uvula. On the sides the soft palate passes into the arches. The anterior one, *arcus palatoglossus*, goes to the lateral side of the tongue, the posterior one, *arcus palatopharyngeus*, runs for some distance along the lateral wall of the pharynx. Between the anterior and posterior arches there is a fossa occupied by the palatine tonsil, *tonsilla palatina*. Each palatine tonsil is an oval-shaped accumulation of lymphoid tissue. The tonsil occupies the large lower part of the triangular depression between the arches, *fossa tonsillaris*. The vertical size of the tonsil is from 20 to 25 mm, the anteroposterior size is 15–20 mm and the transverse size is 12–15 mm. The medial surface of the tonsil is covered with epithelium, has an irregular, tuberous outline and contains crypts (depressions). The tonsil is surrounded by a thin fibrous capsule. The closest important blood vessel is the facial artery, a. facialis, which sometimes (with its tortuosity) comes very close to the wall of the pharynx at this level. This must be taken into account when removing tonsils. Approximately 1 cm from the tonsil passes the internal carotid artery, a. carotis interna.

The soft palate includes the following muscles.

1. Palatopharyngeus muscle, *m. palatopharyngeus*, originates from the soft palate and hamulus pterygoideus, goes down to the pharynx in the thickness of the arcus palatopharyngeus and ends at the posterior edge of the thyroid cartilage and in the wall of the pharynx. Pulls the palatine velum down and the pharynx upward, and the pharynx shortens, pressing the soft palate to the back wall of the pharynx.

2. Palatoglossus muscle, *m. palatoglossus*, begins on the lower surface of the soft palate, descends in the thickness of the arcus palatoglossus and ends on the lateral surface of the tongue, turning into *m. transversus linguae*. Lowers the velum palatine, while both arcus palatoglossus tense and the opening of the pharynx narrows.

3. Levator veli palatini, *m. levator veli palatini*, starts at the base of the skull and from the auditory tube, goes to the soft palate. Raises the palatal velum.

4. Tensor veli palatini muscle, *m. tensor veli palatini*, starts from the auditory tube, goes vertically down, goes around the hamulus

processus pterygoidei, turns from here almost at a right angle in the medial direction and is woven into the aponeurosis of the soft palate. Strains the velum palatine in the transverse direction.

5. Musculus uvulae, *m. uvulae*, starts from the spina nasalis posterior and from the aponeurosis of the soft palate and ends in the uvula. Shortens the uvula.

6. Uvula is present only in humans due to the need to create a tightness in the oral cavity that prevents the jaw from drooping when the body is upright, as well as to guide food.

The opening connecting the oral cavity with the pharynx is called fauces. It is bounded laterally by the arches, *arcus palatoglossus*, above by the soft palate, and below by the dorsum of the tongue.

The palate receives nutrition from a. facialis, a. maxillaris and from a. pharyngea ascendens (branches of a. carotis externa).

Veins carrying venous blood from the palate flow into the v. facialis. Lymph flows into the lnn. subman – dibulares et submentales.

The palate is innervated by the plexus pharyngeus, formed by the branches of the IX and X cranial nerves and the truncus sympathicus, as well as the nn. palatini et n. nasopalatinus (second branch of the trigeminal nerve), n. vagus innervates all the muscles of the soft palate, with the exception of m. tensor veli palatini, which receives innervation from the third branch of the trigeminal nerve.

Nn. palatini, n. nasopalatinus and pair IX carry out predominantly sensory innervation.

SITUATIONAL TASKS

1. When examining the child, the doctor determined that he had a scissor bite.

a. What is the relative position of the upper and lower rows of teeth in such a bite?

b. Is this bite normal?

Answer. A scissor bite (orthognathic) has the following features: the lower front teeth, with their cutting edges, contact the platform of the dental tubercle of the upper teeth, and the upper front teeth overlap the lower ones by one third of their vertical size. This type of bite is classified as physiological (does not impede the acts of swallowing, speaking, breathing).

2. The child's parents noted the beginning of the eruption of baby teeth.

a. At what age does the eruption of baby teeth usually begin and end?

b. Which teeth – incisors or canines – erupt first?

Answer. The eruption of primary teeth begins at the age of 6–8 months and ends at 20–24 months. The mandibular central incisors erupt first, followed by the maxillary ones. In the future, the sequence is as follows: mandibular lateral incisors – maxillary lateral incisors – mandibular canines – maxillary canines.

3. A patient consulted a neurologist who, upon examination, was noted to have difficulty moving his tongue forward and downward, associated with impaired function of the corresponding skeletal muscle of the tongue.

a. Which muscle function is impaired?

b. Where does this muscle begin?

Answer. The function of the geniohyoid muscle (m. genioglossus) is impaired. It begins on the mental spine and, fan-shaped, moving upward and backward, is woven into the thickness of the tongue on both sides of its septum.

4. When treating teeth, the dentist places a cotton swab in the oral cavity under the tongue to close the orifices of the excretory ducts of the submandibular and sublingual salivary glands.

a. Where exactly do the orifices of the excretory ducts of these glands open?

b. What are these glands based on the type of secretion?

Answer. Ductus submandibularis and ductus sublingualis open on the sublingual papilla. Glandula submandibularis is mixed, glandula sublingualis is predominantly mucous.

5. When treating teeth, the dentist places a cotton swab, placing it in the area of the orifice of the excretory duct of the parotid salivary gland.

a. Where exactly does the excretory duct of this gland open?

b. What is its average weight in an adult?

Answer. Ductus parotideus, emerging from under the anterior edge of the gland and surrounding the masseter, pierces the buccal muscle and opens into the vestibule of the mouth at the level of the second molar. Weight is approximately 20–30 g.

6. As a result of a chemical burn to the oral cavity, disturbances in taste sensitivity were noted.

a. Which papillae of the tongue were affected?

b. Where are these papillae primarily located?

Answer. Affected are the taste buds located in the thickness of the epithelium of the fungiform and foliate papillae, as well as in the epithelium of the vallatae papillae. Papillae fungiformes are mainly located at the apex and along the edges of the tongue, foliatae – along the edges, vallatae – in the amount of 7–12 – on the border of the body and the root of the tongue – anterior to the terminal line.

CONTROL QUESTIONS
AND STANDARD ANSWERS

1. WHICH IS NOT A POSTERIOR ATTACHMENT OF THE BUCCINATOR?

a) hamulus
b) pterygomandibular raphe
c) lateral pterygoid plate
d) mandible
e) sphenoid

2. WHICH OF THE FOLLOWING MUSCLES IS INNERVATED BY THE ANTERIOR DIVISION OF THE MANDIBULAR NERVE?

a) medial pterygoid
b) buccinator
c) anterior digastric
d) lateral pterygoid

3. WHICH OF THE FOLLOWING MUSCLES HAS AN ATTACHMENT TO THE MAXILLARY TUBEROSITY?

a) superior head of the lateral pterygoid
b) inferior head of the lateral pterygoid
c) superficial (external) head of the medial pterygoid
d) deep (internal) head of the medial pterygoid
e) levator veli palatini

4. WHERE IS THE PTERYGOID FOVEA LOCATED?

a) on the pterygoid process
b) on the angle of the mandible
c) on the neck of the mandible
d) on the maxilla

5. DAMAGE TO THE RIGHT LATERAL PTERYGOID NERVE RESULTS IN

a) mandible deviating so chin points to the right
b) mandible deviating so chin points to the left
c) inability to close the mouth
d) loss of sensation to the skin of the upper lip

6. WHICH OF THE FOLLOWING IS NOT PART OF THE MASTICATORY REGION?

a) ramus of the mandible
b) mandibular nerve
c) chorda tympani
d) sphenopalatine artery

7. NAME PARTS OF THE TOOTH

a) collum dentis
b) radix dentis
c) cementum
d) corona dentis

8. WHICH STRUCTURES ARE CONCERN TO THE TOOTH AS AN ORGAN?

a) gingiva
b) tooth
c) alveola
d) periodontium

9. WHERE DOES THE DUCT OF THE PAROTID GLAND OPEN?

a) caruncula sublingualis
b) plica sublingualis
c) vestibulum oris
d) cavitas oris propria

10. IN WHAT AGE DOES THE FIRST DECIDUOUS TEETH APPEAR?

a) 2–3 months
b) 6–7 months
c) 1–2 years
d) 2–3 years

11. IN WHAT AGE DOES THE FIRST PERMANENT TEETH APPEAR?

a) 6–7 months
b) 1–2 years
c) 2–3 years
d) 6–7 years

12. WHERE DOES THE DUCT OF THE SUBMANDIBULAR SALIVARY GLAND OPEN?

a) in the vestibulum oris
b) on palatum molle
c) on uvula
d) on caruncula sublingualis

13. THE PAROTID GLAND CONCERNS TO THE GLANDS OF

a) mucous type
b) serous type
c) alveolar structure
d) alveolar-tubular structure

14. WHICH PART OF THE TOOTH IS COVERED IN ENAMEL AND VISIBLE IN THE MOUTH (ORAL CAVITY)?

a) dentin
b) crown
c) root
d) neck

15. TEETH ARE CONSIDERED BONES

a) true

b) false

16. WHICH TISSUE COVERS THE TOOTH'S ROOT?

a) enamel

b) dentin

c) cementum

d) pulp

17. DENTIN IS THE HARDEST SUBSTANCE IN THE HUMAN BODY

a) true

b) false

18. THE PART OF THE TOOTH WHERE THE ENAMEL MEETS THE CEMENTUM IS CALLED WHAT?

a) cementoenamel junction

b) cervical line

c) the tooth's neck

d) all of the above

19. WHICH STATEMENT ABOUT DENTIN IS FALSE?

a) dentin accounts for very little of the tooth's mass

b) dentin is deep to the enamel or cementum layer

c) dentin is harder than cementum

d) dentin is softer than enamel

20. WHICH CELLS FORM AND MAINTAIN DENTIN?

a) cementoblasts

b) odontoblasts

c) enameloblasts

d) ameloblasts

21. WHICH TISSUE ANCHORS THE CEMENTUM OF THE TEETH TO THE ALVEOLAR BONE IN THE JAWS?

a) pulp
b) gingiva
c) periodontal ligament
d) nuchal ligament

22. WHICH SECTION OF THE TOOTH IS FOUND BELOW THE CEMENTOENAMEL JUNCTION AND OFTEN HIDDEN BELOW THE GUMS?

a) crown
b) neck
c) dentinoenamel junction
d) root

23. WHAT IS THE NARROW PART OF THE PULP CAVITY CALLED, WHICH RUNS ALONG THE TOOTH'S ROOT(S)?

a) pulp chamber
b) root canal
c) apical foramen
d) dentinal tubule

24. WHAT IS THE NAME OF THE TINY HOLE AT THE APEX OF THE TOOTH, WHICH ALLOWS FOR THE PASSAGE OF VESSELS AND NERVES?

a) apical foramen
b) dentinal tubule
c) enamel rods
d) none of the above

25. MUSCLE INVOLVED IN TRANSVERSAL MOVEMENTS OF THE LOWER JAW

a) geniohyoid
b) lateral pterygoid
c) temporal
d) mylohyoid

26. THE FORWARD MOVEMENT OF THE LOWER JAW IS CARRIED OUT BY MUSCLE CONTRACTION

a) lateral pterygoid
b) medial pterygoid
c) anterior part of the digastric muscle
d) mylohyoid

27. LEVATOR MANDIBULAR MUSCLE

a) mylohyoid
b) temporal
c) digastric
d) lateral pterygoid

28. LEVATOR MANDIBULAR MUSCLE

a) mylohyoid
b) digastric
c) buccinator
d) lateral pterygoid
e) geniohyoid

29. MUSCLE THAT DEPRESSES THE MANDIBLE

a) orbicularis oris muscle
b) mylohyoid
c) buccinator
d) sternocleidomastoid

30. THE TEMPOROMANDIBULAR JOINT HAS AN ARTICULAR DISC, SO IT CAN BE CALLED

a) complex
b) compound
c) simple
d) uniaxial

31. WHICH CRANIAL NERVES INNERVATE THE MASTICATORY MUSCLES?

a) vagus
b) trigeminal
c) trochlear
d) facial

ANSWERS

1	c	12	d	23	b
2	d	13	b, c	24	a
3	c	14	b	25	b
4	c	15	b	26	a
5	a	16	c	27	b
6	d	17	b	28	c
7	a, b	18	d	29	b
8	a, b, c, d	19	a	30	a
9	c	20	b	31	b
10	b	21	c		
11	d	22	d		

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